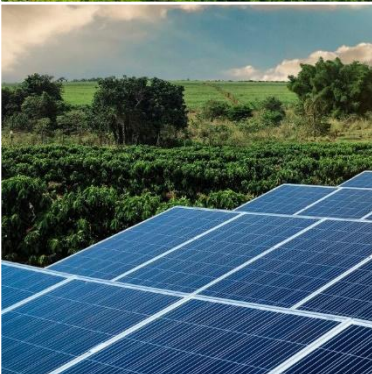




MERUCOUNTY ENERGY PLAN

2023 - 2033



COUNTY ENERGY PLAN

2023 - 2027



**Funded by
the European Union**

Partners



MINISTRY OF ENERGY AND
PETROLEUM



Technical Support



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Table of Contents

<u>LIST OF TABLES</u>	ix
<u>LIST OF FIGURES</u>	xiii
<u>FOREWORD</u>	xv
<u>PREFACE</u>	xvi
<u>ACKNOWLEDGEMENTS</u>	xvi
<u>ABBREVIATIONS</u>	xviii
<u>EXECUTIVE SUMMARY</u>	xxiv
<u>CHAPTER ONE: INTRODUCTION</u>	27
<u>1.1 Background</u>	27
1.1.1 Rationale	27
1.1.2 County Energy Plan objectives	28
<u>1.2 Process of developing the County Energy Plan</u>	29
1.2.1 Methodology - The Energy Delivery Models (EDM) approach	29
<u>1.3 Integration of County Energy Planning into the CIDP process</u>	34
<u>1.4 County overview</u>	34
1.4.1 Location and size	35
1.4.2 Physical and Topographic Features	35
1.4.3 Climatic Conditions	36
1.4.4 Ecological Conditions	36
1.4.5 Socio-economic Characteristics	36
1.4.6 Administrative and Political Units.....	40
1.4.7 Demographic features	42
<u>1.5 Policy and Regulatory Framework for the Energy Sector</u>	47
<u>1.6 Applicable Energy Legislation</u>	47
1.6.1 International Frameworks	47
1.6.2 National Frameworks	48
1.6.3 County Frameworks	50
1.6.4 Other Relevant Policy Frameworks and Approaches for County Energy Planning	51
<u>CHAPTER TWO: MERU COUNTY ENERGY RESOURCES ASSESSMENT</u>	70
<u>2.1 Biomass Energy Resources</u>	70
<u>2.1.1 Woody Biomass Energy Sources, Proximity and Access in Meru County</u>	70
<u>2.1.2 Consumption of Wood-Based Bioenergy Resources In Meru County</u>	72
2.1.3 Alternative Bioenergy from Crop Residuals.....	76

2.2	<u>Waste Resources</u>	77
2.3	<u>Geothermal Resources</u>	77
2.4	<u>Hydropower Resources</u>	77
2.5	<u>Solar Resources</u>	78
2.5.1	<u>Solar Potential for Thermal Applications</u>	80
2.6	<u>Wind Power</u>	83
2.7	<u>Fossil Fuels</u>	86
2.8	<u>Nuclear Resources</u>	86
2.9	<u>Other Energy Resources</u>	86
<u>CHAPTER THREE: ENERGY ACCESS</u>		88
3.1	<u>Electricity Access</u>	88
I.	<u>Policies And Regulations that Relate to Electricity Access</u>	88
II.	<u>Key Stakeholders Involved in Electricity Access, Their Roles And Capacities</u>	90
III.	<u>Past and Current Initiatives On Electricity Access</u>	92
IV.	<u>Proposed Training and Capacity Building</u>	92
3.1.1	<u>Progression to Universal Access to Electricity</u>	93
3.1.2	<u>Development of Electricity Goals and Strategies to Promote Electricity Access</u>	98
3.1.3	<u>Productive Use Of Energy</u>	208
b.	<u>Livestock Farming</u>	249
i.	<u>Livestock Sector Goals and Strategies to Promote Electricity Access</u>	249
c.	<u>County Access to Clean Cooking</u>	281
i.	<u>Demand For Cooking Services in The County</u>	286
ii.	<u>Supply Of Cooking Technologies and Fuels</u>	289
iii.	<u>Clean cooking plans for the County</u>	290
<u>4.0 County Energy Efficiency and Conservation Measures Assessment</u>		318
4.1	<u>Elements of Energy Efficiency Assessment</u>	320
i)	<u>Level of energy efficiency awareness in key sectors</u>	320
ii)	<u>Development of benchmarking standards for Government buildings and transport</u>	321
iii)	<u>Identification of energy efficiency gaps and potential solutions</u>	321
iv)	<u>Availability of capacity building opportunities in tertiary institutions</u>	323
v)	<u>Analysis of implementation barriers and constraints</u>	323
4.2	<u>Energy Efficiency in households</u>	326
4.3	<u>Energy efficiency in industries</u>	328
i)	<u>Energy use by type of industry</u>	328

ii) <u>Number of audited industries</u>	328
<u>4.4 Energy efficiency in transport sector</u>	328
i) <u>Estimated number of vehicles operating in the County</u>	328
ii) <u>Estimated number of vehicles owned by residents and used within the County</u>	329
iii) <u>Proportion of the people using non-motorised transport (NMT)</u>	329
iv) <u>Proportion of vehicles inspected per annum (obtained from the motor vehicle inspection agencies)</u>	329
v) <u>Number of motorbikes registered in the County (obtained from the licensing office)</u>	329
vi) <u>Number of electric two, three and four wheelers in the County</u>	329
vii) <u>Availability of electric mobility charging infrastructure</u>	329
<u>5.0 Bioenergy</u>	330
<u>5.1 Laws and Regulations Governing Production and Consumption of Bioenergy</u>.....	330
5.1.1 <u>The Forest Conservation and Management Act, 2016</u>	330
5.1.2 <u>The Environmental Management and Coordination Act (EMCA), 1999</u>	330
5.1.3 <u>The Water Act, 2016</u>	330
5.1.4 <u>The Energy Act, 2019</u>	331
5.1.5 <u>The Land Act, 2012</u>	331
5.1.6 <u>The Community Land Act, 2016</u>	331
5.1.7 <u>The Land Registration Act, 2012</u>	331
5.1.8 <u>The Land Control Act</u>	331
5.1.9 <u>The National Environment Management Authority (NEMA) Act, 1999</u>	331
5.1.10 <u>The Bioenergy Strategy, 2020</u>	332
<u>5.2 Stakeholders</u>.....	332
<u>5.3 Specific Objectives of the Bioenergy Sub-Sector</u>.....	333
<u>5.4 Baseline Supply of Bioenergy</u>.....	333
5.4.1 <u>Bioenergy potential from forest products</u>	334
5.4.2 <u>Balance between fuelwood consumption and sustainable supply</u>	336
5.4.3 <u>Bioenergy potential from agricultural residues</u>	336
5.4.4 <u>Bioenergy from animal wastes</u>	338
<u>5.5 Bioenergy Trade</u>.....	340
<u>5.6 Current Bioenergy market and demand situation</u>	341
i. <u>Power generation</u>	341
ii. <u>Industrial sector</u>	342
iii. <u>Households and institutions</u>	343
<u>5.7 Challenges affecting the Bioenergy Sector</u>.....	344

<u>5.8 Cross-Cutting Issues in Bioenergy</u>	345
<u>5.9 Selection of Interventions</u>	346
<u>6.0 Programmes and Projects</u>	347
<u>6.1 National Government Projects</u>	347
<u>6.2 County Government Projects</u>	347
6.2.1 Improving access to household and street lighting	347
6.2.2 Access to clean, safe and affordable cooking solutions	348
6.2.3 Improving access to clean water.....	349
6.2.4 Improving access to basic health services	350
6.2.5 Improving income from crop farming	351
6.2.6 Improving income from poultry farming.....	352
<u>6.3 Non-Governmental and Private Sector Projects</u>	353
<u>6.4 Development Partners</u>	354
<u>6.5 Any Other Organisations or Person/s</u>	Error! Bookmark not defined.
<u>6.6 Summary of Programme/Project Interventions in the County</u>	355
<u>Implementation,Coordination,Monitoring and Evaluation</u>	377
<u>.1 Implementation</u>	377
<u>.2 Coordination</u>	378
<u>.3 Monitoring and Evaluation</u>	379
.3.1 Monitoring and evaluation frameworks.....	379
.3.2 Challenges and success factors for monitoring and evaluation.....	380
.3.3 The CEP Monitoring and Evaluation Guide	381
.3.4 Outcomes and outputs framework and indicators	382
.3.5 Summary of indicators by project.....	384

LIST OF TABLES

<u>Table 1 Summary of CEP activities</u>	33
<u>Table 2: Area (Km2) by Sub County.....</u>	41
<u>Table 3: County Government administrative wards</u>	42
<u>Table 4 Population projections (by Sub-County and sex)</u>	43
<u>Table 5: Population projections by age cohort</u>	44
<u>Table 8: Population distribution and density by Sub-County</u>	46
<u>Table 9: Demographic dividend potential</u>	47
<u>Table 10: Gazetted forests and sizes in Meru County</u>	72
<u>Table 11: : Base year (2019) estimate of wood fuel (firewood and charcoal) consumption by residential households in Meru County</u>	75
<u>Table 12: Estimated area and production of major food and cash crops in 2017.....</u>	76
<u>Table 13: Livestock population.....</u>	77
<u>Table 14: Hot water and energy demand from education institutions in Meru County.....</u>	82
<u>Table 15: Prospective Sources</u>	87
<u>Table 16: Mapping of key stakeholders in electricity access in Meru County.....</u>	92
<u>Table 17: Summary of electricity generation and consumption in the County</u>	94
<u>Table 18: Summary of electricity generation and consumption in the County</u>	95
<u>Table 19: Percentage distribution of conventional households by main type of lighting fuel.....</u>	97
<u>Table 20: Energy consumption scenarios explored for Meru least-cost electrification planning.....</u>	100
<u>Table 21: Investment by scenario and supply option.....</u>	102
<u>Table 22: Number of new connections by supply option and scenario.....</u>	104
<u>Table 23: Summary of connection cost to supply a single household in a grid-covered area</u>	105
<u>Table 24: Levelized cost of electricity (USD/kWh) according to electrification options and scenarios</u>	105
<u>Table 25: Lighting priority needs and value propositions</u>	111
<u>Table 26: Lighting solutions and alignment with CIDP</u>	114
<u>Table 27: Sunking home 200x costs.....</u>	115
<u>Table 28: Pros and cons of the recommended lease schemes</u>	116
<u>Table 29: Price comparison between the supplier PAYGO and recommended lease models</u>	117
<u>Table 30: Budget commitment Tier 1 lighting systems</u>	118
<u>Table 31: Budget commitment training solution</u>	119
<u>Table 32: Budget commitment end-user sensitisation</u>	119
<u>Table 33: Budget commitment streetlights and floodlights</u>	119

<u>Table 34: Expected outputs Tier 1 solution</u>	120
<u>Table 35: Expected outputs streetlights and floodlights solution</u>	120
<u>Table 36: Stakeholders and roles</u>	122
<u>Table 37: Risks and challenges</u>	123
<u>Table 38: Climate resilience building measures in the lighting sector</u>	131
<u>Table 39: Lighting outcomes indicators</u>	133
<u>Table 40: Lighting outputs indicators</u>	137
<u>Table 41: Categories of challenges for level two facilities in Meru County</u>	143
<u>Table 42: Health solution business model</u>	145
<u>Table 43: Capex and opex assumptions for costing the electricity components</u>	146
<u>Table 44: Summary of costs of each solution type (US dollars)</u>	146
<u>Table 45: Number of dispensaries per technology option</u>	147
<u>Table 46: List of appliances and equipment health required to deliver “good enough” level two health services</u>	148
<u>Table 47: Aligning CEP solutions with CIDP priorities</u>	151
<u>Table 48: Target level two facilities per sub County</u>	152
<u>Table 49: Total CAPEX per system type</u>	152
<u>Table 50: Cumulative 10-year per system type (including cost estimates for annual maintenance and repair)</u>	153
<u>Table 51: Solution costs</u>	155
<u>Table 52: Health solution costs - Demonstration Phase (1-2 years)</u>	156
<u>Table 53: Health solution costs – Scale-Up Phase 1 (3-5 years)</u>	157
<u>Table 54: Health solution costs – Scale-Up Phase 2 (6-10 years)</u>	158
<u>Table 55: Implementation of electricity solutions by phase</u>	161
<u>Table 56: Stakeholder roles during the demonstration and scale-up phases</u>	163
<u>Table 57: Risks and mitigation measures</u>	165
<u>Table 58: Climate resilience building measures</u>	169
<u>Table 59: Outcome and Output indicators for health solution</u>	173
<u>Table 60: Population in the underserved regions without access to water</u>	178
<u>Table 61: Boreholes running on diesel fuel</u>	182
<u>Table 62: Estimated number of optimal boreholes taking into account demand, yield, geographical area, pumping hours and distance travelled</u>	187
<u>Table 63: Estimated costs for Phase 1</u>	188
<u>Table 64: Estimated costs for Phase 2 – Scale-up</u>	190
<u>Table 65: Stakeholders mapping and roles</u>	195

<u>Table 66: Risks and mitigation measures</u>	196
<u>Table 67: Climate resilience building measures</u>	200
<u>Table 68: Water solutions outcomes indicators</u>	202
<u>Table 69: Water solutions outputs indicators</u>	207
<u>Table 70: Cost-benefit analysis</u>	223
<u>Table 71: Estimated costs for the demonstration phase</u>	225
<u>Table 72: Estimated costs for Phase 2 – Scale-up</u>	226
<u>Table 73: Expected outputs agriculture solutions</u>	227
<u>Table 74: Risks and mitigation measures</u>	234
<u>Table 75: Climate mainstreaming approaches</u>	240
<u>Table 76: Energy Access Outcome</u>	241
<u>Table 77: Outputs and indicators</u>	247
<u>Table 78: Challenges to increasing income from poultry farming</u>	251
<u>Table 79: Overview of solution components</u>	257
<u>Table 80: Aligning CEP solutions with CIDP priorities</u>	258
<u>Table 81: Financing model for individual farmers</u>	259
<u>Table 82: Cost and revenue model</u>	260
<u>Table 83: Projected cashflows for the MV member farmers (per farmer)</u>	261
<u>Table 84: Projected cashflows for the individual farmers with own 96-egg incubator</u>	261
<u>Table 85: Farmer finance requirements before revenues begin to flow</u>	262
<u>Table 86: Target farmers for the poultry solutions</u>	263
<u>Table 87: Investment model for the Demonstration Phase</u>	265
<u>Table 88: Investment model for the Scale-up phase</u>	266
<u>Table 89: MV farmer and individual farmer membership during Demonstration and Scale-up</u>	267
<u>Table 90: Stakeholder roles during the demonstration and scale-up phases</u>	271
<u>Table 91: Risks and mitigation measures</u>	273
<u>Table 92: Climate resilience building measures</u>	277
<u>Table 93: Output and outcome indicators for the poultry solution</u>	280
<u>Table 94a: Percentage of households using different fuels in the County</u>	287
<u>Table 95b: Percentage of households using different cooking technologies in the County</u>	287
<u>Table 96c: Percentage of institutions using different fuels in the County</u>	288
<u>Table 97d: Institutional stoves in the County</u>	288
<u>Table 98e: Percentage of SMEs using different fuels in the County</u>	288

<u>Table 99f: Percentage distribution of conventional households by main type of cooking fuel, area of residence, County and sub-County</u>	289
<u>Table 100: Overview of solutions components</u>	294
<u>Table 101: Alignment of Clean Cooking Solution with CIDP</u>	297
<u>Table 102: Capex and working assumptions for Transition Pathway 1</u>	298
<u>Table 103: Capex and working assumptions for Transition Pathway 2</u>	299
<u>Table 104: Capex and working assumptions for Transition Pathway 3</u>	300
<u>2. Table 105:.....</u>	300
<u>Table 106: Capex for training and sensitisation activities</u>	301
<u>Table 107: Sub-counties with highest number of households using firewood</u>	302
<u>Table 108: Annualised budget estimates for Transition Pathway 1</u>	303
<u>Table 109: Annualised budget estimates for Transition Pathway 2</u>	304
<u>Table 110: Annualised budget estimates for Transition Pathway 3</u>	304
<u>Table 111: Potential sources of funding for the different Pathways</u>	306
<u>Table 112: Roll out plan for the three transition pathways</u>	306
<u>Table 113: Stakeholder roles during the demonstration and scale-up phases</u>	310
<u>Table 114: Risks and mitigation measures</u>	311
<u>Table 115: Climate adaptation and resilience building measures</u>	313
<u>Table 116: Overall outcome areas for clean cooking solutions</u>	315
<u>Table 117: Output indicators for the clean cooking solutions.....</u>	316
<u>Table 116: Priorities and strategies for EE in Meru County</u>	320
<u>Table 117: Type of transport modes operating in Meru County</u>	329
<u>Table 118: Means of transport to workplace in Meru County</u>	329
<u>Table 119: stakeholders, mandates and resources</u>	333
<u>Table 120: Estimates of potential sustainable woody-based bioenergy in Meru County.....</u>	335
<u>Table 121: Key crops producing residues with high potential for manufacture of briquettes/pellets.....</u>	337
<u>Table 122: Key crops producing residues with high potential for production of biogas.....</u>	337
<u>Table 123: Calorific value of crop-specific available residual biomass.....</u>	338
<u>Table 124: Potential biogas production from relevant crop residues</u>	338
<u>Table 125: Calorific value (in MJ/U) specific to fuel type</u>	339
<u>Table 126: Biogas production from livestock in Meru County</u>	340
<u>Table 127: Summary of programme/project interventions in Meru County</u>	376
<u>Table 128: Summary of programme/project interventions in Meru County</u>	394

LIST OF FIGURES

<u>Figure 1: Energy Delivery Model (EDM) six step Government and sector-level process for County energy planning</u>	29
<u>Figure 2: Delivery model canvas</u>	32
<u>Figure 3: Location of Meru County in Kenya</u>	35
<u>Figure 4: County administrative and political units</u>	40
<u>Figure 5: Enabling legal and institutional framework for climate change planning in Meru County</u> ..	56
<u>Figure 6: CCCF Mechanism</u>	57
<u>Figure 7: The five dimensions or domains of GESI</u>	61
<u>Figure 8: Meru land use map</u>	71
<u>Figure 9: Top 10 County hydro potentials</u>	78
<u>Figure 10: Long-term yearly average of global horizontal irradiation (GHI) in kWh/m2 in Meru County</u>	79
<u>Figure 11: Monthly production averages for 1kWp installed in Meru (GSA)</u>	80
<u>Figure 12: Long-term yearly average of potential photovoltaic electricity production in kWh/kW-peak in Meru County</u>	80
<u>Figure 13: Mean annual wind speed at 100 metre heights for Meru County</u>	83
<u>Figure 14: Wind power capacity factor for Meru County</u>	84
<u>Figure 15: Wind power capacity factor values (%) in Meru County</u>	85
<u>Figure 16: Electrification status of population clusters in relation to transformers</u>	99
<u>Figure 17: Summary of investments by scenario for universal access in Meru County</u>	101
<u>Figure 18: Electrification planning of Meru County - Scenario 6</u>	103
<u>Figure 19: Primary lighting source by sub-County</u>	107
<u>Figure 20: MTF – Appliances powered by T1, T2 and T3 systems</u>	109
<u>Figure 21: MTF – Appliances powered by T1, T2 and T3 systems</u>	110
<u>Figure 22: Timeline Tier 1 solution</u>	121
<u>Figure 23: Five steps to implement the initial phase</u>	125
<u>Figure 24: Electrification status of target L2 facilities</u>	141
<u>Figure 25: Distribution of electricity solution component types</u>	147
<u>Figure 26: Capex investment per sub County</u>	153
<u>Figure 27: Ten-year Opex costs per sub County</u>	154
<u>Figure 28: Phases and timelines for implementation</u>	160
<u>Figure 29: Five steps of the Demonstration Phase implementation</u>	167
<u>Figure 30: Past and future impacts of climate hazards in Meru</u>	176
<u>Figure 31: Population in lower regions underserved with water access</u>	177

<u>Figure 32: Health facilities beyond 1km from access to borehole and rivers</u>	178
<u>Figure 33: Water quality level in Lower regions of Meru based on TDS</u>	180
<u>Figure 34: Configured borehole water management for sustainability. Creating horizontal linkages for interactive learning and vertical integration for national Government synergies.....</u>	184
<u>Figure 35: Water solutions timeline</u>	192
<u>Figure 36: General borehole design for application in lower Meru region. (a) Maximum depth of 150m and 200m and (b) maximum depth of 106m.....</u>	193
<u>Figure 37: Five steps of the initial Phase implementation.....</u>	198
<u>Figure 38: Meru County Agroecological Zones.....</u>	210
<u>Figure 39: Distance from rivers in Upper and Lower Midland Zones of Meru</u>	211
<u>Figure 40: Agriculture solutions timeline.....</u>	229
<u>Figure 41: Stakeholders and roles agriculture solutions.....</u>	232
<u>Figure 42: Five steps of the initial Phase implementation.....</u>	235
<u>Figure 44: Location of Poultry Model Villages in Meru County.....</u>	249
<u>Figure 45: Implementation timeline.....</u>	267
<u>Figure 46: The five steps of the Demonstration Phase</u>	275
<u>Figure 47: Households distribution in Meru County based on fuel use.....</u>	283
<u>Figure 48: Percentage distribution of households based on cooking fuels per Sub-Counties in Meru</u>	284
<u>Figure 49: Distribution of households per cooking technology used</u>	285
<u>Figure 50: Distribution of households per cooking technology used</u>	285
<u>Figure 51: Distribution of households based on secondary fuels</u>	286
<u>Figure 52: Pathway 1: Transitioning households using firewood and three stone open fires</u>	294
<u>Figure 53: Pathway 2: Transitioning households using charcoal in traditional metallic stoves</u>	295
<u>Figure 54: Pathway 3: Transitioning households using kerosene.....</u>	296
<u>Figure 55: Roll out plan for Transition Pathway 1: Households using firewood.....</u>	307
<u>Figure 56: Roll out plan for Transition Pathway 2: Households using charcoal.....</u>	307
<u>Figure 57: Roll out plan for Transition Pathway 3 Households using kerosene</u>	308
<u>Figure 58: Implementation steps.....</u>	312
<u>Figure 55: Key pillars for EE&C</u>	325
<u>Figure 56: Household lighting energy sources by type</u>	327
<u>Figure 57: Households cooking fuel source by type</u>	327
<u>Figure 58: Deficit of woody biomass in sustainably meeting bioenergy needs in Meru Count.....</u>	336

FOREWORD



H.E. Hon. Rev. Mutuma M'Ethigia
GOVERNOR - MERU COUNTY

Energy is a key enabler for transformative and sustainable development and subsequently the realisation of Kenya's Vision 2030. Furthermore, the County's development blueprint Meru Vision 2040 which highlights renewable energy resources development, ensuring energy security and universal access to modern energy services. Indeed, the energy sector's contribution to poverty reduction and wealth creation is unmatched.

In line with the Paris Agreement and Sustainable Energy for All Agenda (SE4ALL), my government is committed to fully contributing to the international, regional and national targets set on energy access as well as transitioning the population to clean cooking. The implementation of the Meru County Energy Plan (CEP) is the first step towards promoting the sustainable production, distribution and utilisation of renewable energy for both productive and domestic usage particularly in the County's peri-urban and rural areas. County Energy Plan is crucial in integration of energy planning with economic development strategies.

In cognisance to the Constitution of Kenya, 2010 on governance, the development of the Meru County Energy Plan involved extensive consultations within the County

Government, stakeholder engagement, insightful review on national and international best practices, and most importantly the involvement of the citizenry through the community needs assessment exercises. Additionally, the County Energy Plan has taken into account the economic, policy, climatic and legal changes and dynamics experienced over the recent past.

My government has commenced several initiatives to unlock the County's renewable energy generation potential such as the Meru Energy Park geared towards solar and wind energy in Tigania region in collaboration with our partners Hewani Energy.

The County Energy Plan is expected to provide a concise roadmap to ensure that the County competitively and sustainably exploits development opportunities within the energy sector while addressing the existing gaps and unforeseen challenges. In this regard, I offer my full commitment the implementation of Meru County's first Energy Plan.

The goal of 'Meru Building Together' is a concerted effort of all actors. In this respect, I call upon the National, Development Partners, Faith Based Organisations (FBOs), Civil Society Organisations (CSOs) and the private sector to work together in ensuring the implementation of the County Energy Plan. I call upon all stakeholders in the energy and nexus sectors to work together to ensure that the strategies contained in the County Energy Plan are timely implemented.

H.E HON. Rev. Mutuma M'Ethigia
Governor, County Government of Meru

PREFACE



The preparation of the County Energy Plan (CEP) stems from the recognition of the fundamental role that energy plays in shaping the County's socio-economic landscape. As we navigate the challenges and opportunities of the 21st century, it is essential to align our energy resources, policies, and actions with the broader aspirations of sustainable development and inclusive growth. This County Energy Plan is underpinned by a comprehensive analysis of the County's energy landscape, considering its unique socio-economic context, resource endowments, and developmental priorities.

For more than a decade, Sessional Paper No. 4 of 2004 on Energy has governed the energy landscape and policy direction. However, now the Energy Act 2019 serves as the primary legislation governing the energy sector and complimented by the Integrated National Energy Policy (INEP). The INEP policy framework provides the strategic direction and guidance for the energy sector as well as promote a cohesive and integrated approach to energy planning and development at both national and County levels.

Ultimately, the development of the County Energy Plans is guided within a legal framework that empowers County

Governments to manage and promote energy development within their jurisdictions. The Constitution of Kenya, Energy Act 2019, County Government Act 2012, Energy Policy, and Public Participation Guidelines provide the legal foundation for County Governments to develop and implement their energy plans. By leveraging this framework, County Governments can address local energy challenges, enhance energy access, promote renewable energy, and contribute to the overall sustainable development of the energy sector in Kenya.

Overall, discoveries on Meru County's potential in generating renewable energy presents immense untapped potential for the sector development. Concerted efforts have been made in exploration of these resources to address the energy needs in the County including revenue generation. Capital investments for exploration, energy efficiency and conservation, bioenergy and sensitisation on clean energy usage for cooking and lighting remains a pivotal agenda for the sector in Meru.

The County Energy Plan highlight key strategies to address access to reliable and quality supply of productive uses, clean cooking and lighting energy, resource mobilisation, capacity building and overall development of energy infrastructure for access to affordable quality energy. The energy docket will provide overall leadership, oversight, guidance and direction to ensure full implementation.

David Baariu Mwirabua

CECM Roads, Transport and Energy

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George Kimathi Kobia

Chief Officer Roads, Transport & Energy

ABBREVIATIONS

ADPs	Annual Development Plans
AEP	Annual Energy Production
AfDB	African Development Bank
APVC	Agricultural Produce Value Chains
ASAL	Arid and Semi-arid Areas
BAU	Business as Usual
BoQs	Bill of Quantities
CAFOD	Catholic Agency for Overseas Development
CAPEX	High Capital Expenditure
CBA	Cost Benefit Analysis
CBOs	Community-Based Organisations
CCAK	Certificate of Cloud Auditing Knowledge
CCAK	Clean Cooking Association of Kenya
CCAPs	County Climate Action Plans
CCCCF	County Climate Change Fund
CCMAP	Climate Change Mitigation Action Plan
CCRI	County Climate Resilience Investment
CCU	County Climate Unit
CECM	County Executive Committee Member
CEKEB	Central Kenya Economic Bloc
CEO	Chief Executive Officer
CEP	County Energy Plan
CEPC	County Energy Planning Committee
CEPTC	County Energy Plan Technical Committee
CER	Certified Emission Reduction
CG	County Governments
CGM	County Government of Meru
CIDP	County Integrated Development Plan
CIFs	Climate Investment Funds
CIMES	County Integrated Monitoring and Evaluation System

CO	Chief Officer
CO ₂	Carbon Dioxide
CSOs	Civil Society Organisations
CSOs	Civil Society Organisations
DRR	Disaster Risk Reduction
E.A.	East Africa
EAT	Expected Areas under Trees
EDM	Energy Delivery Model
EE	Energy Efficient
EEC	Energy Efficiency and Conservation
EMCA	Environmental Management and Coordination Act
EO	Extension Officer
EPRA	Energy and Petroleum Regulatory Authority
EPRA	Energy and Petroleum Regulatory Authority
EU	European Union
FBOs	Faith Based Organisations
FDG	Focus Group Discussion
FLLoCA	Financing Locally Led Climate Action Programme
FPO	Focal Point Officer
GAP	Good Agricultural Practice
GDC	Geothermal Development Company Limited
GESI	Promoting Gender and Social Inclusion
GhG	Greenhouse Gases
GHI	Global Horizontal Irradiation
GIS	Geographical Information System
GIZ	Gesellschaft für Internationale Zusammenarbeit
GoK	Government of Kenya
GSLs	General Service Lamps
Ha	Hectare
HHs	Households
HIV	Human Immunodeficiency Virus
ICS	Improved Cook stoves

ICT	Information Communications Technology
IIED	International Institute for Environment and Development
INEP	Integrated National Energy Plan
IPF	Investment Project Financing
IPM	integrated pest management
IPPS	Independent Power Producers
KALRO	Kenya Agricultural and Livestock Research Organisation
KAPs	Knowledge, Attitude and Practices
KEBS	Kenya Bureau Of Standards
KEFRI	Kenya Forestry Research Institute
KEREA	Kenya Renewable Energy Association
KES	Kenyan shilling(s)
KETRACO	Kenya Electricity Transmission Company Limited
KFS	Kenya Forest Service
Kg	kilograms
KNBS	Kenya National Bureau of Statistics
KNEECS	Kenya National Energy Efficiency and Conservation Strategy
KNME	Kenya National Monitoring and Evaluation
KOPIA	Korea Programme on International Agriculture
KPHC	Kenya Population and Housing Census
KPLC	Power and Lighting Company
KWFT	Kenya Women Finance Trust
kWh	Kilowatt-hour:
L1	Level 1
L2	Level 2
L3	Level 3
LAPSSET	Lamu Port and Lamu-Southern Sudan-Ethiopia Transport
LCOE	Levelized Cost of Electricity
LED	Light-Emitting Diode
LMCP	Last Mile Connectivity Project
LPG	Liquefied Petroleum Gas
M& E	Monitoring and Evaluation

m ³	Cubic Meter
MCCA	Meru County Climate Change Act
MCCF	Meru Climate Change Fund Regulations
MCCP	Meru Climate Change Policy
MCIDC	Meru County Development and Investment Corporation
MCMC	Meru County Microfinance Corporation
MEPS	Minimum Energy Performance Standards
MFIs	Microfinance financial Institutions
MoALF	Ministry of Agriculture and Livestock Development
MoE	Ministry of Education
MoEP	Ministry of Energy and Petroleum
MT	Metric Tonnes
MTF	Multi-tier Framework
MTP	Medium-Term Plan
MTPs	Medium Term Plans
MV	Model Village
MVs	Model Villages
MWa	MegaWatts
NCC	National Climate Change Act
NCCAP	National Climate Change Action Plan
NCCRS	National Climate Change Response Strategy
NCFP	National Climate Finance Policy
NDC	Nationally Determined Contribution
NEMA	National Environment Management Authority
NGOs	Non-Governmental Organisations
NHIF	National healthcare Insurance Fund
NIMES	National Integrated Monitoring and Evaluation System
NMT	Non-Motorised Transport
NPV	Net Present Value
NuPEA	Nuclear Power and Energy Agency
OpEx	Operating expenditure
OPEX	Organization of Petroleum Exporting

PAYGO	Pay as You Go
PforR	Performance-for-Results
PHL	Post-Harvest Loss
PIG	Project Implementation Group
PV	Photovoltaics
PVOUT	Photovoltaic Electricity
PWDs	People With Disabilities
RBW	Rural Borehole Water
RCDA	Rural Community Development Agency
REA	Rural Electrification Authority
REREC	Rural Electrification and Renewable Energy Corporation
RO	Responsible Officer
SACCOs	Savings and Credit Cooperative Organizations.
SDG	Sustainable development goal
SETA	Sustainable Energy Technical Assistance
SHG	Self-Help Groups
SHS	Shillings
SMEs	Small and medium-sized enterprises
SNV	Schweitzerisch Normen Vereinigung
SoE	State of the Environment
SWP.	Solar Water Pumps
TBD	To Be Determined
TV	Television
TVET	Technical and Vocational Education and Training
UHC	Universal Health Cover
UNFCCC	United Nations Framework Convention on Climate Change
USAID's	United States Agency for International Development
USD	United States Dollar
VCT	Voluntary Counselling and Testing
VTCs	Vocational Training Centres
WEEK	Women in Energy Enterprises in Kenya
WHO	World Health Organization

WRA	Water Resources association
Y	Year
MtCO ₂ e	Million Tonnes of carbon dioxide equivalent
ESCOs	Energy service companies
CO ₂ e/year	amount of carbon dioxide that would have the same climate impact over a year

EXECUTIVE SUMMARY

Energy is a vital resource crucial for enhancing living standards, driving economic progress, and safeguarding national security. The rate of energy consumption stands as a key indicator of economic development and growth. In Kenya, energy is recognized as a fundamental component of infrastructure supporting the social and economic aspects outlined in the Kenya Vision 2030.

Under Section 5 and the fifth schedule of the Energy Act 2019, all County Governments are mandated to develop and submit a County Energy Plan (CEP) to the Cabinet Secretary. This underscores the collaborative effort between National and County Governments in ensuring the provision of sustainable, affordable, and demand-driven energy services to all citizens, consolidated into an Integrated National Energy Plan (INEP) for triennial (3 years) review. Furthermore, the National Energy Policy, 2018 requires annual reporting on the implementation of the INEP.

The primary objectives of the CEP include providing a medium to long-term planning framework for advancing access to affordable, sustainable, and reliable energy for various purposes within the County. It also aims to enforce compliance with constitutional and statutory provisions regarding energy administration and planning while addressing challenges and capitalizing on opportunities in the energy sector at the County level. However, it is essential to note that simply providing access to energy does not automatically catalyze energy consumption; rather, energy services must align with the development needs of citizens and be integrated with other forms of support to generate impactful development outcomes.

Meru County serves as the ‘demonstration’ County for the Ministry of Energy’s flagship programme, Sustainable Energy Technical Assistance (SETA), also funded by the European Union. Aligned with the INEP vision, Meru County pioneers an innovative approach to CEP development using the Energy Delivery Model (EDM), treating energy as an enabler of broader development objectives.

The EDM planning approach follows a systematic six-step process, beginning with the identification of priority needs and barriers faced by different County citizen groups, culminating in the development of fully costed, contextually appropriate solutions in collaboration with stakeholders, promoting gender equality, energy efficiency, and climate change resilience. While the CEP focuses on prioritizing development needs, it delineates six priority sectors for intervention over the next decade, including improving access to lighting, clean cooking, clean water, basic health services, and enhancing income from crop and poultry farming. To ensure sustainability and efficiency, the EDM CEP development process identifies priority investments and delivery partners, aligning interventions with the County Integrated Development Plan (CIDP). Challenges persist, including limited granular data and insufficient data disaggregation, necessitating enhanced data collection, analysis, and capacity building among County actors.

The CEP is organized into several chapters to provide a comprehensive framework for energy planning and implementation as follows:

Chapter One: Introduction

The introduction provides background information on the rationale behind the CEP, outlining its objectives and the process followed in its development. The Energy Delivery Models (EDM) approach was adopted, ensuring a participatory process that involved stakeholders and considered the broader socio-economic context.

Chapter Two: Meru County Energy Resources Assessment

This chapter assesses the various energy resources available within Meru County, including biomass, waste, geothermal, hydropower, solar, wind, fossil fuels, and nuclear resources. It provides insights into the potential of each energy source and its contribution to the County's energy landscape.

Chapter Three: Energy Access

The chapter focuses on electricity access, examining policies, regulations, stakeholders, past initiatives, and proposed strategies to achieve universal access. Additionally, it delves into the County's initiatives to promote productive use of energy, improve livestock farming, horticulture production, access to clean drinking water, access to basic health services through electricity access, and enhance access to clean cooking and household lighting solutions.

Chapter Four: County Energy Efficiency and Conservation Measures Assessment

This section evaluates energy efficiency and conservation measures in Meru County across households, industries, and the transport sector. It identifies gaps, potential solutions, and barriers to implementation, aiming to enhance energy efficiency and reduce energy consumption.

Chapter Five: Bioenergy

The chapter explores laws, regulations, stakeholders, and objectives governing the bioenergy sub-sector in Meru County. It assesses the baseline supply of bioenergy, market demand, challenges, and interventions required to promote sustainable bioenergy production and utilization.

Chapter Six: Programmes and Projects

This chapter outlines National Government projects, County Government projects, initiatives by non-Governmental and private sectors, and contributions from development partners. It provides a summary of interventions aimed at improving access to energy services and fostering socio-economic development.

Chapter Seven: Implementation, Coordination, Monitoring, and Evaluation

The final section focuses on the implementation, coordination, monitoring, and evaluation of the CEP. It highlights the frameworks, challenges, success factors, and indicators used to assess the plan's progress and impact, ensuring accountability and effectiveness in achieving its objectives.

In conclusion, the Meru County CEP, developed within the framework of the draft INEP, represents a pivotal step towards addressing energy needs while fostering sustainable development. It is imperative to address existing challenges and gaps to ensure the efficacy and inclusivity of future iterations of the CEP. The total expected investment for the implementation of the CEP is Kes. 3,960.041million.

CHAPTER ONE: INTRODUCTION

This chapter presents the background, process of development of the CEP including its link to the County Integrated Development Plan (CIDP). It also provides an overview of the County's physical and socio-economic profile, policy and regulatory frameworks.

1.1 Background

Energy is a crucial resource and a critical component for economic development, improved living standards and overall national security. The rate of energy utilisation is a key indicator of economic growth and development. The Kenya Vision 2030 identifies energy as one of the infrastructure enablers of its socio and economic pillars. Sustainable, affordable and reliable energy for all citizens is a key factor in realisation of Kenya Vision 2030 and ultimately the Sustainable Development Goals (SDGs). Energy planning at the highest and most aggregate level, should provide an analysis of all energy issues within the unified policy framework with the goal of arriving at optimal energy solutions over the long term.

1.1.1 Rationale

The Constitution of Kenya, 2010 established devolved units (47 counties) and implemented a framework that decentralizes certain energy planning and administrative functions to the County level. The distribution of functions was targeted at promoting equitable sharing of resources, enhance participation in County energy planning and facilitate targeted investments, especially in historically marginalised areas.

Chapter Eleven and the Fourth Schedule of the Constitution of Kenya, 2010 outlines the functions of the two levels of Governments in the Country. Section 5 and fifth schedule of the Energy Act, 2019 specifies the functions of Counties as far as energy planning is considered. All County Governments are required to develop and submit a County Energy Plan to the Cabinet Secretary in respect of their energy requirements. Additionally, the National Government, in close cooperation with the County Governments, is required to ensure the provision of sustainable, affordable, reliable, and demand-driven energy services for all citizens. The Cabinet Secretary consequently is required to consolidate the submitted energy plans from Counties into an Integrated National Energy Plan (INEP) to be reviewed every three years. In tandem with this, the National Energy Policy, 2018 requires the Cabinet Secretary under Section 6 of the Act to prepare and publish a report on the implementation of the integrated national plan within three months after the end of each financial year. Thus, legislative and policy instruments are clear in terms of timelines for executing energy planning functions.

In addition to formulating the County Energy Plan, County Governments play a vital role in overseeing the utilisation of renewable energy resources through strategic planning and effective delivery of energy services to domestic, institutional, commercial, and industrial users. Their responsibilities encompass guiding the exploitation and sustainable use of renewable energy resources, ensuring optimal strategies are in place for efficient energy delivery. The development of the Meru County Energy Plan is in line with the legislative and institutional provisions. The process is steered through the County's Department of Roads, Transport and Energy with support from the Sustainable Energy Technical Assistance

(SETA) Project, a collaborative initiative between the Ministry of Energy and Petroleum (MoEP) and the European Union (EU).

With a strategic location and abundant resources, Meru County is well-positioned to leverage its potential for economic advancement and environmental conservation. The County serves as a hub for agricultural production, fostering innovation and growth in the sector. It also attracts tourists with its breath-taking natural attractions, providing opportunities for the hospitality and tourism industry to flourish. Additionally, Meru County nurtures a vibrant business environment, offering avenues for trade and industry to thrive. Education and healthcare are key priorities for the County, ensuring access to quality educational institutions and healthcare services for its residents. By nurturing a well-rounded ecosystem of trade, industry, agriculture, tourism, education, and healthcare, Meru County aims to create a conducive environment for its people to prosper and contribute to the overall development of Kenya.

As Meru County positions itself on the path of progress, the rising energy demands will play a crucial role in shaping its future. The County envisions sustainable energy planning and development as vital components of its growth strategy, aiming to ensure reliable, affordable and eco-friendly energy services for all sectors and communities within its borders. The County Energy Plan (CEP) serves as a guiding framework, positioning the County within the National energy planning landscape. It outlines the County's aspirations and strategic goals in the energy sector while highlighting potential investment opportunities. By focusing on sustainable energy planning and development, Meru County aims to provide reliable, affordable, and environmentally friendly energy services to meet the needs of its communities and contribute to the County's overall progress.

1.1.2 County Energy Plan Objectives

The overall goal of this CEP is to ensure the provision of affordable, sustainable, and reliable energy in line with Sustainable Development Goal (SDG) 7. This goal targets universal access to modern energy services and is essential in achieving sustainable development goals in nexus sectors such as health, education, agriculture, livestock, industrialisation and realisation of Paris Agreement and other global commitments. In this context, the definition of energy encompasses electric, mechanical and thermal applications covering social service and productive sectors provisions for residential, institutional and commercial users.

The key objectives of the CEP include:

- Providing a medium-long term planning framework for advancing access to affordable, sustainable, and reliable energy for cooking, lighting and productive usage within the County.
- Enforcing proactive compliance with the provisions of both the Kenya Constitution, 2010 and the Energy Act 2019 on energy administration and planning.
- Addressing the challenges and accessing opportunities in the energy sector at the County level.

1.2 Process of Developing the County Energy Plan

The CEP development process was an inclusive and extensive endeavor. The process involved assessing and mapping the energy resource potential in Meru; the analysis of the current and projected energy demand; evaluating the existing energy efficiency and conservation measures; and the development of an implementation and financing plan, as envisioned in the INEP framework.

1.2.1 Methodology - The Energy Delivery Models (EDM) approach

Meru County was identified as the Demonstration County for the SETA project with eleven other Counties mirroring the development process from it. The methodology used was the Energy Delivery Model (EDM) planning approach. EDM is an inclusive and integrated energy planning approach first developed by the Catholic Agency for Overseas Development (CAFOD) and the International Institute for Environment and Development (IIED) and subsequently refined by IIED and the STEER Centre, Loughborough University, where it is currently housed (see www.edm-hub.org).

The EDM approaches energy as an enabler of wider development needs. Through a systematic, six step process (see Figure 1), it identifies the varied needs and contexts of end users (in this case, County citizens) and the gaps or barriers preventing these priority needs being met. These gaps could be energy-related (e.g., access to irrigation systems) or, non-energy factors (e.g., cost of inputs or access to markets for farmers). EDM then works with end users and other stakeholders to develop context-appropriate, fully costed solutions for inclusion in the CEP, and to inform Least Cost Electrification (LCE) and energy efficiency (EE) investments.



Figure 1: Energy Delivery Model (EDM) six step Government and sector-level process for County energy planning

Source: Garside and Perera (2021)

The EDM approach was first used at the project/community level in Indonesia and subsequently in different Countries in developing Asia and sub-Saharan Africa to design new services and review existing projects by NGOs, businesses, and social enterprises. More recently, it was adapted for use at the macro-level of County energy planning in Kenya, notably to develop the Kitui County Energy Plan (CEP), validated in November 2021, and for the Meru CEP. It was also intended for use under the SETA Project as a training approach for eleven other Counties “mirroring” the Meru CEP process.

The EDM approach recognizes that coordination and collaboration between different stakeholders along the planning cycle, including at National and County level, and across sectors is vital throughout its six steps to build understanding and buy-in for needs-and evidence-based solutions that are financially, environmentally, and socially sustainable.

For this reason, its inclusive methodology engages stakeholders across sectors to build understanding and buy-in to the priority needs identified and the solutions developed to address them. This increases the likelihood that CEPs will be taken forward to implementation through the County Integrated Development Plans (CIDP) and Annual Development Plans (ADPs).

In Steps One (Identify starting point) and Two (Be inclusive), the EDM process engaged Meru stakeholders by:

Establishing buy-in and forming a partnership with the County Government. This formalised the planning mandate across County Government, identified key contact points between County and national level planners and other relevant ministries, and sensitised relevant stakeholders on the planning process and activities. It also helped identify initial priority focus sectors for the CEP process.

1. A cross-sectoral Technical Committee was established for regular review and input to the CEP process, including validation of the solutions developed. While the CEP process was managed by the Department of Energy, a Focal Point was responsible for overseeing the whole process. The Focal Point’s role is to coordinate and progress actions among all actors involved in the CEP development. In Meru the focal point was the Director of Economic Planning, which enabled effective CIDP integration but the Focal Point could also be an independent actor.
2. Inclusive stakeholder mapping was carried out to support initial needs identification, build buy-in and assist further data gathering during the baselining, and in later stages of planning, such as the needs assessment (Step Three) and solutions design, testing and optimisation, and preparing for implementation (Steps Four to Six).

In these latter steps, ongoing engagement with national entities – Government, private sector, NGOs and development partners - is critical for optimising the solutions through additional data collection/analysis and building understanding of relevant policies and sectoral programmes and projects (public and private sector) that could support solutions development, implementation and priority investments, including through technical assistance and co-financing.

Step 2 of EDM carries out baseline research and analysis using a range of tools including secondary (literature review) and primary data gathering (through household surveys, Key Informant Interviews (KIIs), Ward Administrator surveys and Focus Group Discussions (FGDs)), and in Step 3 (Build understanding) through community and sectoral needs assessment workshops. Data collection and analysis in the EDM process is iterative along the six steps.

It should be noted that there were significant gaps in the availability, accessibility and quality of data (both in energy and other sectors) (see Garside, Onsare, Ngewyo and Wykes, 2022). This presented challenges to the CEP process, particularly the lack of granular data to the ward level and data disaggregated by gender, age, income levels and other forms of marginalisation, given that EDM aims to disaggregate the needs of different end user groups. The latter is critical to develop interventions that can promote Gender Equality and Social Inclusion (GESI) outcomes.

Six priority areas were identified during the baselining and needs assessment which helped come up with the six sectors for the County's development. *They are; increased income from crop and from poultry farming (Agriculture & Livestock sectors), access to clean water for HH and general use (Water sector), improved access to basic health services (Health sector), improved access to household lighting (Lighting sector) and access to clean, safe and affordable cooking solutions (cooking sector).* Subsequently, the energy and non-energy gaps preventing these needs being met were identified, and initial value propositions developed through the needs assessment workshop that could form the basis for solutions development.

Further intensive research and analysis was then carried out to develop detailed solutions in Steps Four (Design and test) and optimise them in Step Five (Review and Optimise) using a range of methods. One innovative tool used was the Delivery Model Canvas (Figure 2). This is adapted from Osterwalder's Business Canvas to support the process of identifying the different solution components. These are categorised into the delivery infrastructure (the key activities, outputs, resources and partners/stakeholders), the end users (including how they will be involved and how they expect to participate) and accounting (financial but also social and environmental costs and benefits). EDM pays particular attention to the socio-cultural factors (practices, norms and beliefs) that can be critical success or failure factors for solutions. Equally, it is critical that the costs and revenue streams for every component are clearly identified.

The Delivery Model Canvas

Delivery infrastructure		Value proposition	End users	
Key activities What are the activities we need to carry out to deliver our value proposition, and to make sure that we are reaching our end-users and generating sufficient revenue? Which of these activities are the most important to fulfil our value proposition and which would be 'nice to have' but not essential? Would any of these activities disrupt existing businesses or upset power relationships? Is there the potential for conflict? Example: Firstly, there are problem-solving activities e.g. how to connect and build different ways of distributing the energy services & products, how to build trust with end-users. Then there are activities related to the 'nuts and bolts' of running the energy service: for example, acquiring SHS and appliances & physically selling them; assembling & customising them; and training and managing the technicians who will maintain & repair them. There could potentially be issues with existing energy providers such as kerosene sellers.	Key stakeholders Who are our key stakeholders? Eg partners, suppliers, repair & maintenance, local authorities, end-users etc. Which key resources are we acquiring from them? Which key activities do they perform? What do they expect from us? What do we expect from them? How do we add value with all the other stakeholders, including with the end-users? How does the value proposition fit with government strategies and public policies? Example: International suppliers provide products (SHS and appliances). Retailers of appliances and gadgets (TVs, radios, phones) sell devices that enable end-users to use energy services, and retailers provide repair & maintenance. National and local authorities give import permits, tax and other incentives etc and provide other subsidies and establish policies. Local bank manages micro-loans. International organisation provides funding for loans to farmers and supports training, as does the farmers' association, which is a trusted source of information.	What value are we adding to the end-user's life? What problem are we helping the end-user to solve? What needs of the end-user are we helping to meet? What collection of products and services are we using to add value or solve a problem or satisfy the end-user's needs? What are the social and/or environmental problems we are solving? Are we creating any risks? How is the wider community beyond the specific end-users going to benefit? By doing *** activities with *** people/organisations, we will deliver *** impacts and/or meet *** needs and/or solve *** problems. Example: The additional value delivered by the proposition is the following: the ability of the farmers and their families to access electric lighting for the first time, along with (improved) access to modern communications (TV, radio); the improvement of livelihoods by using appliances such as processors, refrigerators and water pumps; more educational opportunities for children and adults due to the availability of light at night for studying. There are also other benefits from actual and potential use of electric appliances (eg labour-saving for women, health benefits from reduced kerosene use etc). Another co-benefit is the decreased use of diesel generators, leading to lower fuel costs for the farmers and also more environmentally sustainable fuel use. The SHSs and some appliances are imported but the rest of the value chain is local.	Target groups Which individuals or groups is the service creating value for? (e.g. services/ products for all users or targeted by gender/age/ income etc.) Who are our most important end-users? Why? Are there local behaviours/attitudes towards innovation and risk that could affect the value proposition? Are there preferences and customs that could affect the value proposition? How do gender relationships affect the value proposition? Example: The target group is subsistence farmers. This group can be further divided up by income. The farmers with lower incomes are most concerned about the affordability and durability of the appliances and they are likely to be interested in solar lamps with a phone charger. Farmers with higher incomes could be looking at SHSs and water pumps and potentially some kind of processing equipment. Crops are currently sold directly after harvest, and people are not used to processing them. Women are generally the ones who grow crops, but men are more likely to visit town and sell crops.	Ways of doing outreach & delivery Do the end-users have preferred ways of being reached when it comes to: awareness-raising, purchase, delivery of the energy service? How can we make sure our ways of reaching end-users fit with their preferences/routines? How much do people use informal channels to build their understanding of services & products? Example: Most farmers visit stores in the market town to buy products directly but they also swap information through informal channels such as the farmers' association and they do not often make big purchases or try new products. Women trust information they get from their women's group & feel comfortable asking questions in this environment.
Key resources What resources do we need to deliver our value proposition, reach our end-users, generate revenues and build our partnerships? Can we easily obtain all the resources (natural, financial, human, physical, institutional etc) that we need? Do we need any extra supporting services? How will we obtain these? Example: The following resources are available. Physical resources: the business has its shop premises in the town & storage for imported goods. Human: the business employees, and other actors involved in awareness-raising. Financial: funding from the international organisation to start revolving loans, and micro-credit & subsidies from the government to buy bigger SHSs and appliances, plus a reduction in import taxes for solar products. Constraints: replacement parts for the SHSs and appliances need to be imported from abroad. Also, there is no electric grid connection and no plans to expand in the local region. There is poor transport infrastructure and the solar business will need to build a local distribution channel. Supporting services: Funder to provide revolving fund start-up capital and to build relationships with local banks so that they will manage fund and eventually be willing to provide micro finance loans themselves. Awareness-raising for the farmers on SHSs and appliances; training on using appliances and also on improving agricultural techniques and enterprise development; training for technicians to do installation and maintenance of systems; lobbying government to improve transport infrastructure to improve access to markets.			Relationship with the end-users What type of relationship does each of our groups of end-users expect us to establish and maintain with them? (e.g. individual service, people expect to be involved in creating the service etc.) Do end-users expect services to be delivered by the private or public sector (e.g. private business, governmental agency, cooperative, intermediary such as international NGO, local NGO, church etc.)? Example: Solar business with a shop in county capital does customised outreach to the farmers with the support of government incentives and working with the farmers' association. Micro-finance loans are made available from a fund supported by the international organisation but managed by the local banks. The farmers' association also acts as a trusted intermediary. Maintenance services are offered by the business through local technicians.	In this case, the farmers and the village as a whole are given demonstrations of products (appliances and SHSs) by local business (supplier) during awareness-raising and promotional campaigns. These are carried out with local associations (farmers' association, women's groups) with the support of trusted development partners. Examples of other similar products being used in neighbouring communities are also used for demonstration and, because evening radio soap operas are popular and used to transmit information, the government pays for awareness-raising through this channel. SHSs are customised according to the farmer's needs, then delivered & installed by the business and maintained by locally trained agents.
Accounting				
Revenue streams Where will the revenues come from to pay for the service? What are the different sources? Eg from selling products or assets, fees, lending/ renting/ leasing, etc. Can the end-users pay for the service? In full or in part? How much does each source/ stream of revenue contribute to total revenue? Do donors or the government offer any subsidies or incentives that could be used? Can civil society offer any 'in-kind' resources (physical eg equipment or financial)? Can the end-users offer any 'in-kind' resources that could be used? Example: Revenue stream comes from end-users selling crops. In addition, there are subsidies for the appliances from the government and funding from the international organisation for the payment schemes.	Other costs/ benefits What are the most important social & environmental costs that this particular service will have? What are the benefits? Types of costs/ benefits: Social – Increasing conflict or cohesion among social or ethnic groups. Impacts of the EDM on gender relationships, job creation, health and well-being and empowerment. Environmental – Increased pollution or energy sustainability. Restoration/degradation/exhaustion of the natural resource base. Impact on eco-systems services and contribution to resource management (positive/negative). Example: Increased information/educational opportunities & increased income for farmers. Strengthened resilience through more sustainable energy use, enhanced energy security. Also improved resilience to increasing drought due to the possibility of pumping water. Job creation. Substitution of kerosene lamps & diesel generators mean possibly decreased CO₂ emissions & improved health outcomes.	Cost structure What are the biggest costs of delivering the energy service? Eg Fixed costs (salaries, rents and utilities); variable costs (depending on the amount of goods produced); economies of scale; economies of scope (incorporating other businesses) Which resources required are the most expensive? Which activities are the most expensive? Example: The most important costs are supplying the SHSs and appliances, and ongoing repair and maintenance.		

Figure 2: Delivery model canvas

Source: Garside and Wykes (2017)

A range of other tools/approaches are used to collect and analyse data for solutions development, including KIIs, mini-surveys, value chain analysis, market mapping, GIS mapping, and energy modelling to develop detailed business and investment models. The aim is to develop fully financially, environmentally and socially sustainable solutions.

It is also important to identify where there may be dependencies between solutions (for instance, in the Meru CEP, the solution to increase income from horticulture cannot be delivered without a water management component) and co-benefits from delivering one or more solutions (e.g., by placing a borehole for underserved populations in proximity to a health clinic, the needs for both household and health facility access can be met). Any financial, social or environmental risks related to the solution must also be identified and mitigation strategies ahead of implementation. **Error! Reference source not found.** shows the EDM steps and key activities in each step:

EDM Step	CEP Activities
Step 1 – Identify starting point	Establishment of County Energy Technical Committee Inception meeting (stakeholders, County departments and the executive) Building buy-in (executive)
Step 2 – Be inclusive	Stakeholder mapping Baselining activities to identify initial list of needs (Literature review, Household Survey, Focus Group Discussion (FDG), Ward Administrators Survey, Key Informant Interviews)
Step 3 - Build understanding	Selection of representative wards across the County (six wards) for needs assessment. Community and sectoral needs assessment workshops (indicatively one per ward/sector for 3 days) Identification of priority needs for disaggregated end users and sector and energy and non-energy gaps. Development of initial value propositions.
Step 4 - Design and test	Development of solutions to meet the priority needs. Additional research including finance and business modelling; mapping delivery partners and co-financing opportunities. Mapping of renewable energy potential for CEP LCoE planning for HH and street lighting Identification of dependencies and co-benefits Identification of risks and development of mitigation strategy
Step 5 - Optimise and review	Review and optimise solutions to develop sustainable business models Agreeing delivery partnerships and co-finance Investment modelling and priority investments for Demo and Scale up phases Integration of solutions into CIDP programmes and projects
Step 6 - Prepare to implement	Implementation planning (Demo Phase) M&E Framework

Table 1 Summary of CEP activities

1.3 Integration of County Energy Planning into the CIDP Process

The CEP considered the priority sectors and activities outlined in the County Integrated Development Plan (CIDP) 2023-2027 and the development priorities identified by community members and sectoral stakeholders during an in-depth and inclusive needs assessment process. The CEP development process highlighted the existing cross-sectoral synergies through the proposed solutions. The CEP forms the basis for and/or contributes to some of the new programmes/projects captured in the CIDP 2023-2027.

Meru County has an established County Energy Planning Committee as well as an all-inclusive cross-sectoral technical committee to lead solution development and eventually the CEP implementation process. The initial implementation phase is expected to involve carrying out demonstration projects for the proposed solution and detailed implementation planning for the scale up phases.

The Kenya Constitution, 2010, states that no funds should be appropriated in the budget unless planned for. To ensure seamless budgetary allocation and sustained funding for the CEP solutions, it was essential to integrate the solutions into the County Integrated Development Plan (CIDP) 2023-2027. The implementation of the solutions will be operationalized through Annual Development Plans (ADPs) and departmental work plans as outlined in Section 126 of the Public Finance Management Act. The ADP is an annual plan derived from the CIDP, allowing for more comprehensive planning and necessary adjustments in response to emerging County issues. The ADPs will incorporate CEP solutions to be tabled to the County Assembly. This facilitates the allocation of appropriate budget lines for the proposed solutions within each sector and enables the aggregation of solutions or solution components (such as maintenance of solar home systems).

During this phase, the County Energy Planning Technical Committee will take a leading role by engaging with sectoral departments to ensure integration of different components of the solutions and prioritisation of investments into the new County development planning process. The Directorate of Energy will conduct awareness raising around the activities targeting various sectors and internal and external stakeholders, including the County Executive and the public. Additionally, the Directorate will establish a Cross-Sectoral Implementation Committee to ensure coordinated action and cost-effective implementation. These activities aim to enhance implementing departments and wider stakeholder understanding of the CEP's content and build understanding on the need for an integrated approach to its implementation.

1.4 County Overview

This section offers a general profile and baseline of the County, including size and location, political and administrative units, demographic features, geographical and climatic features, endowment of natural resources, and socio-economic characteristics (including infrastructure development, land and land use and industry and trade), health access and nutrition, education and skills and social protection.

1.4.1 Location and size

Meru County (code 012) is one of the 47 counties of Kenya. It spans the equator lying 0o6' North and 0o1' South and between latitudes 37o West and 38o East. Meru County is located approximately 225 kilometres Northeast from Kenya's Capital City, Nairobi, and east of Mount Kenya, whose peak cuts through the outskirt of its southern boundary. The County borders five counties. To the North, it borders Isiolo County, to the East Tharaka Nithi County, to the Southwest Nyeri County and to the West Laikipia County. The County has a total surface area of 6,936.2Km², of which 972.3Km² is gazetted forest.



Figure 3: Location of Meru County in Kenya

Source: KNBS (2019)

1.4.2 Physical and Topographic Features

The topography of Meru County is influenced by its position in the Eastern Highlands at an elevation of approximately 5,300 feet. The altitude in Meru County ranges from 300m to

5,199m above sea level, which influences the atmospheric conditions and leads to a wide variety of microclimates and agro-ecological zones. The drainage pattern in the County is characterised by rivers and streams originating from catchment areas such as Mt. Kenya and Nyambene ranges in the North of the County. The rivers cut through the hilly terrain on the upper zones to the lower zones and drain into the Tana and Ewaso Nyiro Rivers. The rivers form the main source of water for both domestic and agricultural use.

1.4.3 Climatic Conditions

The natural conditions of the County are significantly influenced by its position in the Eastern Highlands. The distribution of rainfall ranges from 300mm per annum in the lower midlands in the North to 2500mm per annum in the Southeast. Other areas receive on average 1250mm of rainfall annually. There are two seasons with the long rains occurring from mid-March to May and short rains from October to December. Temperatures range from a low of 8oC to a high of 32oC during the cold and hot seasons respectively.

1.4.4 Ecological Conditions

The County has varied ecological zones ranging from Upper to Lower Highlands, Upper Midlands and Lower Midlands. The Upper Highlands zones cover majority of the County's area ranging from Imenti South, Imenti Central, Imenti North, Part of Tigania East, Part of Tigania West, Igembe Central and Igembe South constituencies. The lower midland zones are only found in lower parts of Buuri, Igembe North and Tigania East and West which borders Laikipia and Isiolo Counties.

1.4.5 Socio-economic Characteristics

In terms of transport infrastructure, Meru has a 5,968 km road network, with 10% paved, 11% graveled, and 79% earth roads. Meru Vision 2040 outlines short-term goals of achieving all-weather accessibility and maintaining the current road network, with medium and long-term goals focusing on tourism, sustainable road infrastructure, and a comprehensive Transport Master Plan.

Meru is the sixth-largest contributor to national GDP. The County's geography and diverse agro-ecological zones determine the major economic activities. The most significant sector is the Agriculture, Livestock, and Fisheries sector, from which 89% of households in the County gain their livelihoods (Meru County Socio-Economic Indicators Baseline Survey, 2016). Most residents of the County participate in the subsistence crop farming of maize, beans, sorghum, millet and a variety of fruits. Commercial farming is also widely practiced as evidenced by sizable plantations of tea, coffee, macadamia, wheat, and barley although the sector is dominated by the miraa (khat) trade. There is a reliance on owned land (89%) for farming, with only 24% of farms adopting irrigation practices. Access to agricultural extension services stands at 22%, with low use of inputs such as subsidized fertilizer (12%) and seedlings (3%), and low uptake of supporting services including training and extension services (5%) and artificial insemination (4%) (ibid). Vision 2040 aims to promote

macadamia, potatoes, avocado, miraa, green grams, and banana crops, aligning with the national food security agenda.

In the livestock sector, cattle, sheep, goats, pigs, rabbits, poultry, donkeys, and beekeeping constitute the primary focus. Poultry farming represents 50% of the total livestock sector while dairy farming is also significant. The County aims to increase processed milk from 40% to 75% of the County's annual 180 million-litre yield. Fish production, comprising aquaculture and limited riverine fisheries, is earmarked for growth from 60 tons to 2250 tons by 2040, tapping into the County's aquaculture potential of 10,000 hectares.

The forest cover, encompassing 14.02% of the County, plays a vital role in environmental sustainability, contributing to water regulation, soil fertility, and carbon sequestration. Vision 2040 prioritizes forest protection and sustainable resource exploitation, recognizing the challenges posed by climate change.

Challenges facing the agricultural sector include small farm sizes, traditional farming practices, uneconomic plot sizes, low agro-industrial development, and issues related to lack of use and knowledge on farm inputs, GAP, marketing, and irrigation.

Meru County is also ideally situated midway between Mount Kenya to the west and the Meru National Park. This has led to the County hosting several national parks and conservancies which are tourist attractions receiving international and local visits. This has led to enhanced contributions to the local economy with tourism hotspots including the Meru National Park and the renowned Lewa conservancy and the Mount Kenya climbing circuit.

Meru County's industrial landscape, primarily fueled by tea, coffee, and dairy cooperatives, holds significant untapped potential to elevate the economic status of its population. However, existing challenges, such as dependence on rain-fed agriculture, unreliable power supply, limited land, and insufficient data on production patterns, hinder its full exploitation. Development of the MSME sector in Meru faces challenges due to lengthy business registration processes, property registration issues, contract enforcement difficulties, and high corruption levels.

Meru Vision 2040, the County's strategic roadmap, outlines a robust industrialization strategy, emphasizing policy development, capacity building, infrastructure enhancement, and the creation of reliable raw material supply chains. The overarching goal is job creation, focusing on key sectors like tea, coffee, miraa, horticulture, livestock, and technology. Key strategies include promoting value addition along agricultural produce value chains (APVC), supporting SMEs, attracting FDI, enhancing the business environment, and building a strong Government delivery capability.

The industrialisation flagship projects encompass the development of an industrialization/manufacturing policy, exploration, and exploitation of mineral resources (iron), establishment of industrial and incubation centres/parks, and the development of cottage industrial clusters. These clusters target industries such as meat, dairy, leather, agro-

processing, textiles, assembly plants, ceramics, tools, equipment, and inputs, as well as furniture production.

Additionally, Meru County aims to address energy needs by focusing on renewable energy sources like solar, wind, small hydro plants, biogas, and solid waste. The proposed manufacturing plant in Igembe Central will produce equipment and accessories for renewable energy generation, aligning with efforts to transition to low-carbon energy sources.

Meru County is part of the Central Kenya Economic Bloc (CEKEB) that was previously known as the Mount Kenya and Aberdare Economic Bloc composed of 10 counties of Meru, Tharaka-Nithi, Embu, Nyandarua, Laikipia, Nakuru, Nyeri, Muranga, Kiambu and Kirinyaga. The regional economic bloc mostly aims at leveraging on member Counties competitive and comparative advantage through economies of scale, sharing of natural resources and specializations in access to local and regional markets, enhanced food security and economic growth through private sector investments. The County's active role in the bloc is mostly focused on the revamping of collapsed regional industries as well as the horticulture sector and the rehabilitation of poor roads towards the promotion of trade and business travel. The County is also participating in the LAPSSSET project connecting Lamu, Tana River, Isiolo, Meru, Laikipia, Samburu and Marsabit as illustrated in the Kenya Vision 2030.

Meru's educational infrastructure includes 773 early childhood development and education (ECDE) centres, 753 primary schools and 379 secondary schools. Staffing ratios are a concern, with ECDE centres having a 1:50 teacher-student ratio against the recommended 1:25. One major challenge is pupil dropout rates at all levels. Multifaceted approaches are being adopted to address this. Inter-sectoral programs, partnerships, and advocacy for parental education can enhance early childhood development, along with incentives such as cash transfers to encourage enrolment.

The County also has focus on rebranding Technical and Vocational Education and Training (TVET) to promote greater uptake of technical courses as opposed to more academic courses. This involves ensuring competency-based, market-driven courses through surveys and integrating ICT to improve quality and outreach. 40% of households have internet access but broadband penetration is at only 18.2%. The County aims to use the National Fiber Optic Backbone Infrastructure to enhance ICT accessibility.

Meru County citizens have a life expectancy of 63.5 years, an infant mortality rate of 39 (per 1,000 births), and an adult mortality rate of 375 (per 1,000 population).

Prevalent diseases include upper respiratory tract infections, joint pains, and intestinal worms. The stunting rate is 25%, and the rate of underweight children is 8.15%, with a wasting rate is 2.9%.

The health sector in Meru County encompasses preventative, curative, and palliative interventions. Meru County hosts 549 health facilities, 56% of which are privately owned, 32% supported by the Department of Health (MOH), 11% by faith-based organizations, and

1% by NGOs. This includes one Level 5 Hospital, 15 Sub-County Hospitals, 122 Dispensaries, and 34 Health Centres.

Staff recruitment and retention is a significant challenge, with a doctor/patient ratio of 1:14,285; a nurse/patient ratio of 1:1,652; and a clinical officer/population ratio of 1:7,142.

Other challenges include the distribution of health facilities, which varies across sub-counties, with Imenti South having the highest percentage (20%) and Igembe North the lowest (7%). Cultural practices can also prevent patients accessing treatment.

Despite these challenges, there are several positive trends, including hospital births increasing from 42.5% in 2012 to 81.8% in 2014, surpassing the national average of 61.2%. Immunisation coverage stands at 70%.

The Constitution of Kenya 2010 underscores the inclusion of all citizens in development. However, challenges persist, with difficulties in economic engagement and accessing public amenities for persons with disabilities. The sector aims to elevate the status of persons with disabilities by promoting inclusion. A particular issue for social inclusion in Meru County is the rise in street children and families. The Social Protection sector plans to investigate the reasons behind children running away from home and implement protective measures for various categories of children in need.

Gender mainstreaming is also crucial to address challenges faced by both genders, such as school dropouts, substance abuse, and harmful cultural practices leading to early marriages and teenage pregnancies among girls. Tackling gender-based violence is a priority, given the reported increase in cases.

Finally, Meru has a rich and diverse cultural heritage, exemplified by the Njuri Ncheke formal governance system and the Kimeru language. Despite these cultural assets, challenges include the under-celebration of the Great Njuri Ncheke Elders, the endangered status of the Kimeru language, and the existence of retrogressive cultural practices such as child marriage and female genital mutilation (FGM).

1.4.6 Administrative and Political Units

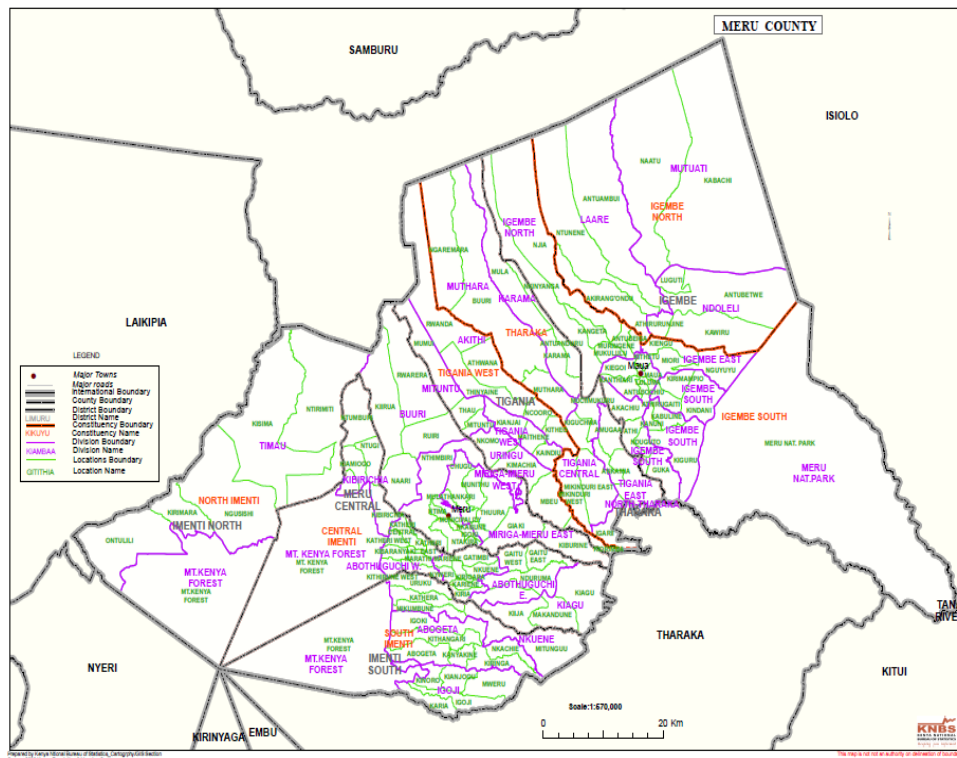


Figure 4: County administrative and political units

Source: KNBS (2019)

Meru County has increased its sub counties from the previous 10 to 16. These administrative parameters and logistical considerations inform service delivery within County development planning, in terms of resource mobilisations and spatial planning. There is a need to develop an inclusive plan with coverage of all geographical areas in the County to promote equality.

Sub County	No. of Divisions	No. of Locations	No. of sub-Locations	Area (Km2)
Igoji	2	12	25	393.87
Abogeta	3	10	37	
Nkuene/Mitunguu	2	8	14	
Imenti North	3	7	22	293.01
Imenti East	3	15	31	
Imenti Central	4	22	57	333.10
Buuri East	2	11	27	1,068.67
Buuri West	2	9	21	
Igembe South	4	16	36	263.31
Igembe Central	3	7	15	511.62
Kiengu	2	5	12	
Igembe North	1	2	4	
Mutuati	2	4	11	1,172.83
Tigania West	7	15	63	
Tigania East	3	9	21	
Tigania Central	2	12	29	647.10
	45	164	425	
				5,137.50

Table 2: Area (Km2) by Sub County

Source: KNBS (2019)

1.4.6.1 County Government Administrative Wards by Sub County

The County has sixteen (16) gazetted sub-counties, namely Igoji, Abogeta, Nkuene/Mitunguu, Imenti North, Imenti East, Imenti Central, Buuri East, Buuri West, Igembe, South, Igembe Central, Igembe North, Mutuati, Tigania West, Tigania East, Kiengu, and Tigania Central. There are 45 wards and 425 villages which are also used as administrative units.

Sub County	No. of Wards	No. of Villages
Igoji	2	25
Abogeta	2	37
Nkuene/Mitunguu	2	14
Imenti North	3	22
Imenti East	2	31
Imenti Central	4	57
Buuri East	3	27
Buuri West	2	21
Igembe South	5	36
Igembe Central	3	15
Kiengu	2	12
Igembe North	2	4
Mutuati	3	11
Tigania West	5	63
Tigania East	3	21
Tigania Central	3	29

Table 3: County Government administrative wards

Source: County Government of Meru

1.4.7 Demographic features

The County population as per the 2019 Kenya Population and Housing Census (KPHC) is 1,545,714 consisting of 767,698 males, 777,975 females and 41 intersexes.

The County's population growth rate is estimated at 2.1 per cent per annum. The population was expected to rise to 1,643,096 in 2022, 1,746,609 in 2025 and 1,819,966 in 2027. The growth in population will be a strain on available resources such as land, water and natural resources but on the other hand provides opportunity for growth.

The County Population Age Structure is as provided in Table 4 below, taken from the Kenya Population and Housing Census (KPHC) 2019 disaggregated by sub-County and sex. It indicates that Igembe Central is the most populated sub-County with 221,412 persons followed by Imenti South with 206,506 persons. Tigania East is the least populated Sub-County with 72,549 persons. It further indicates the distribution of the 41 intersex in Meru County by Sub-Counties with Igembe South leading with 8 cases

Sub County	Census (2019)				Projection (2025)				Projection (2027)			
	M	F	Inter-sex 2019)	T	M	F	Inter-sex	T	M	F	Inter-sex	T
Buuri East	38,101	38,497	0	76,598	43,053	43,500	0	86,553	44,861	45,327	0	90,189
Buuri West	40,496	40,264	2	80,762	45,759	45,497	2	91,259	47,681	47,408	2	95,091
Igembe Central	111,208	110,200	4	221,412	125,662	124,523	4	250,189	130,939	129,753	4	260,697
Igembe North	83,364	85,949	4	169,317	94,199	97,120	4	191,323	98,155	101,199	4	199,359
Igembe South	80,192	81,446	8	161,646	90,614	92,031	8	182,655	94,420	95,897	8	190,326
Imenti North	88,506	89,056	5	177,567	100,009	100,631	5	200,645	104,209	104,857	5	209,072
Imenti South	103,338	103,162	6	206,506	116,769	116,570	6	233,345	121,673	121,466	6	243,146
Meru Central	66,920	66,894	4	133,818	75,618	75,588	4	151,210	78,793	78,763	4	157,561
Tigania Centra	51,814	52,916	-	104,730	58,548	59,793	-	118,342	61,007	62,305	-	123,312
Tigania East	35,352	37,194	3	72,549	39,947	42,028	3	81,978	41,624	43,793	3	85,421
Tigania West	67,715	72,241	5	139,961	76,516	81,630	5	158,152	79,730	85,059	5	164,794
Meru National Park*	283	102	-	385	320	115	-	435	333	120	-	453
Mt. Kenya Forest*	409	54	-	463	462	61	-	523	482	64	-	545
TOTAL	767,698	777,975	41	1,545,714	867,476	879,087	41	1,746,609	903,907	916,011	41	1,819,966

Table 4 Population projections (by Sub-County and sex)

Source: KNBS (2019)

Table 5 indicates specific age cohorts and their projected population sizes, with an inter-censal growth rate of 2.1%. It further indicates that the male population from most age cohorts 0-4, 5-9, 10-14, 35-39, 40-44, 45- 49 and 50-54 are slightly higher than those of females. For the cohorts 15-19 to 30-34 years, and from 55-59 to 100+, the female population remains higher. This is because of higher morbidity among male children.

Age Cohort	2019				2025				2027			
	M	F	Inter- sex	T	M	F	Inter- sex	T	M	F	Inter- sex	T
0-4	85,384	84,878	-	170,262	96,481	95,910	-	192,391	100,533	99,938	-	200,471
5-9	87,982	87,068	-	175,050	99,378	98,346	-	197,724	103,552	102,477	-	206,028
10-14	97,842	97,080	-	194,922	110,515	109,655	-	220,170	115,157	114,261	-	229,417
15-19	81,866	83,385	-	165,251	92,470	94,186	-	186,656	96,354	98,142	-	194,496

Age Cohort	2019				2025				2027			
	M	F	Inter- sex	T	M	F	Inter- sex	T	M	F	Inter- sex	T
20-24	64,934	67,176	-	132,110	73,345	75,877	-	149,222	76,425	79,064	-	155,489
25-29	56,368	56,462	-	112,830	63,669	63,775	-	127,445	66,343	66,454	-	132,798
30-34	57,082	60,428	-	117,510	64,476	68,255	-	132,731	67,184	71,122	-	138,306
35-39	53,003	50,953	-	103,956	59,868	57,553	-	117,421	62,382	59,970	-	122,353
40-44	44,922	41,124	-	86,046	50,741	46,451	-	97,191	52,872	48,402	-	101,273
45-49	35,815	35,146	-	70,961	40,454	39,698	-	80,152	42,153	41,365	-	83,518
50-54	24,760	23,349	-	48,109	27,967	26,373	-	54,340	29,142	27,481	-	56,622
55-59	22,436	23,555	-	45,991	25,342	26,606	-	51,948	26,406	27,723	-	54,130
60-64	17,297	18,641	-	35,938	19,537	21,056	-	40,593	20,358	21,940	-	42,298
65-69	14,021	15,419	-	29,440	15,837	17,416	-	33,253	16,502	18,147	-	34,650
70-74	10,957	13,682	-	24,639	12,376	15,454	-	27,830	12,896	16,103	-	28,999
75-79	5,294	6,713	-	12,007	5,980	7,583	-	13,562	6,231	7,901	-	14,132
80-84	3,909	6,074	-	9,983	4,415	6,861	-	11,276	4,600	7,149	-	11,750
85-89	2,071	3,217	-	5,288	2,339	3,634	-	5,973	2,437	3,787	-	6,224
90-94	926	1,901	-	2,827	1,046	2,147	-	3,193	1,090	2,237	-	3,327
95-99	518	926	-	1,444	585	1,046	-	1,631	610	1,090	-	1,700
100+	295	784	-	1,079	333	886	-	1,219	347	923	-	1,270
Age NS	16	14	-	30	18	16	-	34	19	17	-	35
Total	767,698	777,975	-	1,545,673	867,172	878,784	-	1,745,955	903,594	915,692	-	1,819,285

Table 5: Population projections by age cohort

Source: KNBS (2019)

* Intersex population is excluded from the table since it is too small to be distributed by age

1.4.7.1 Population by urban centres

Table 6 shows that the urban population is projected at 64,471 males and 66,891 females as per the 2019 Census with approximately 61 per cent of the total urban population residing in Meru Town. The rise of urban population from 115,033 in 2009 to 131,362 by 2019 and the projected figure of 154,669 in 2027 is expected to provide an expanding urban market but will also strain the available urban resources.

This calls for prior planning of available resources and expansion of social and economic facilities in the urban areas to accommodate the expanding population. The growth in population within the urban centres will expand central markets for agricultural and industrial products within these centres that call for investment in the agricultural value chain to meet this demand. Creation of income generating opportunities, sensitising the population against drug and substance abuse will also help check the crime rate which is usually high in urban areas

	2019 (Census)				2025 (Projection)				2027 (Projection)			
	M	F	Intersex	T	M	F	Intersex	T	M	F	Intersex	T
Meru Town	39,865	40,322	-	80,187	45,046	45,563	0	90,609	46,938	47,476	0	94,414
Maua Town	10,695	11,426	0	22,121	12,085	12,911	0	24,996	12,593	13,453	0	26,046
Timau	5,144	5,427	0	10,571	5,813	6,132	0	11,945	6,057	6,390	0	12,447
Nkubu	3,528	4,146	0	7,674	3,987	4,685	0	8,671	4,154	4,882	0	9,036
Laare	2,656	2,702	0	5,358	3,001	3,053	0	6,054	3,127	3,181	0	6,309
Mitunguu	1,596	1,697	0	3,293	1,803	1,918	0	3,721	1,879	1,998	0	3,877
Kiirua	987	1,171	0	2,158	1,115	1,323	0	2,438	1,162	1,379	0	2,541
Total	64,471	66,891	0	131,362	72,850	75,585	0	148,435	75,910	78,759	0	154,669

Table 6: Population projections by urban area

Source: KNBS (2019)

1.4.7.2 Population Density and Distribution

Table 8 shows that population density is widely distributed among the nine sub-counties, with the average density in the County estimated at 329 persons per Km² in 2019 KPHC. Population density ranges from 126 persons per Km² in Buuri West to 769 persons per Km² in Imenti North constituencies. The high density in Imenti North is attributed to urbanisation and fertile land whereas most areas of Buuri constituency are sparsely populated due to the semi-arid conditions and existence of large-scale farms.

Constituency	2019 (Census)			2022(Projections)		2025 (Projections)		2027 (Projections)	
	Area (Km ²)	Pop	Density (Km ²)	Pop	Density (Km ²)	Pop	Density (Km ²)	Pop	Density (Km ²)
Imenti South	413.9	206,506	499	219,516	530	233,345	564	243,146	588
Central Imenti	381.6	133,818	350	142,249	372	151,210	395	157,561	412
Tigania East	507.9	72,549	143	77,120	152	81,978	162	85,421	168
Tigania central	237.4	104,730	441	111,328	469	118,342	498	123,312	519
Imenti North	230.8	177,567	769	188,754	817	200,645	869	209,072	905
Igembe North	1,076.90	169,317	157	179,984	167	191,323	177	199,359	185
Igembe Central	604.1	221,412	366	235,361	389	250,189	414	260,697	431
Igembe South	255.2	161,646	633	171,830	673	182,655	715	190,326	745
Buuri East	332.9	76,598	230	81,424	244	86,553	260	90,189	271
Buuri West	638.7	80,762	126	85,850	134	91,259	142	95,091	148
Tigania West	507.9	139,961	351	148,779	373	158,152	397	164,794	413
Meru National Park	868.1	385	0	409	0	435	0	453	0
Mt. Kenya Forest	1,059.90	463	0	492	0	523	0	545	0
	6,877.90	1,545,714	3,624	1,643,094	3,852	1,746,609	4,095	1,819,966	4,267

Table 6: Population distribution and density by Sub-County

Source: KNBS (2019)

1.4.7.3 Demographic dividend

The term “demographic dividend” refers to the accelerated economic development that a country can attain by slowing the pace of population growth while making strategic investments in the health, education, economic, and governance sectors. A bigger proportion of working people in the total population coupled with decreasing dependent sections of the population is a prerequisite for opening of this window of opportunity. Kenya will attain this window of opportunity by 2038. Evidence however shows that Counties in Kenya are at different stages of demographic transition. The demographic window of opportunity for Meru County is estimated to open by the year 2025 if the current fertility and mortality levels persist. To take advantage of this window, the County is making specific and strategic investments in four focus areas of the demographic dividend, namely, health and wellbeing, education and skills development, employment and entrepreneurship and rights, governance and youth empowerment as guided by the County Adolescent and Youth Survey reports of 2015 and the Kenya’s Demographic Dividend Roadmap. See Table 9 below.

Category	2019	2023	2024	2025	2026	2027
Population Size	1,545,714	1,675,554	1,710,741	1,746,666	1,783,346	1,820,796
Population below 15 (%)	34.95%	37.89%	38.68%	39.49%	40.32%	41.17%
Population 15-64 (%)	59.44%	64.43%	65.78%	67.16%	68.57%	70.02%
Population above 65 (%)	4.40%	4.77%	4.87%	4.97 %	5.08%	5.13%
Dependency ratio	68.82	63.04	61.72	60.42	59.15	57.91
Fertility rate	2.90	2.66	2.60	2.55	2.49	2.44

Table 7: Demographic dividend potential

Source: KNBS (2019)

1.5 Policy and Regulatory Framework for the Energy Sector

The INEPC will provide a standardised brief on policies and strategies, to be adopted by counties for purposes of this section.

1.6 Applicable Energy Legislation

1.6.1 International Frameworks

Kenya remains committed to several established global and regional frameworks. The principal frameworks include the following:

- The UN Agenda 2030. The agenda, to which Kenya remains part of, identifies energy as a key variable in promoting economies, fighting poverty and improving livelihoods. Goal 7 of the Sustainable Development Goals (SDGs) point to access to affordable, reliable, sustainable and modern energy for all as the way to transform lives.

- The African Agenda 2063. The agenda aims to promote environmentally sustainable and climate resilient economies and communities through the development of renewable energy sources. The agenda promotes the basic necessities of life such as, water, food, sanitation, energy, public transport and ICT. Energy poverty remains a serious obstacle to economic and human development in most parts of the African Continent. The continent's energy sector continues to face critical challenges, among them lack of access to modern energy services (especially in rural areas), poor infrastructure, low purchasing power, low investments and overdependence on traditional biomass to meet basic energy needs. Kenya remains not only committed, but also a key player in the implementation of the agenda.

1.6.2 National Frameworks

The relevant national frameworks for the energy sector include the following;

1.6.2.1 The Constitution of Kenya (2010)

The Kenyan Constitution of 2010 devolved the roles of County planning and development in energy regulation. The Constitution provides for a two-tier structure of Government, i.e. the National and the County Governments. It distributes the functions and powers between the two levels as detailed in Chapter Eleven and the Fourth Schedule.

Specifically, in relation to the energy sector, Part 1 of the Fourth Schedule provides that the National Government shall be responsible for protection of the environment and natural resources with a view to establishing a durable and sustainable system of development including water protection, securing sufficient residual water, hydraulic engineering and the safety of dams. Energy policy including electricity and gas reticulation and energy regulation.

In relation to the County Governments, Part 2 of the Fourth Schedule provides that they shall be responsible for County planning and development including electricity and gas reticulation and energy regulation. It is necessary to review and align the energy sector policy, legal and regulatory framework with the provisions, spirit and aspirations of the Constitution.

1.6.2.2 National Energy Policy (2018)

Kenya's National Energy Policy identifies major challenges facing energy exploitation and utilization. They include improving the competitiveness, quantity, quality and reliability of energy supply; high initial capital outlay; mobilising adequate financial resources to undertake massive investments; the high cost of energy; low per capita incomes, and low levels of income. Apart from wood fuel, which is overexploited, Kenya has abundant renewable energy resources which are yet to be fully exploited.

1.6.2.3 Energy Act (2019)

The Act provides for the development and publishing of the Integrated National Energy Plan (INEP) which will guide the country in the provision of clean and affordable energy. To this end the cabinet Secretary Ministry of Energy and Petroleum is required to work with County Governments in developing the Integrated National Energy Plan (INEP). In addition, County

Governments are mandated with regulating and licensing of biomass production, transport and distribution, biogas systems, as well as charcoal production, transportation and distribution. The Act further provides for the promotion, development and use of renewable energy technologies including, but not limited to, biodiesel, bioethanol, charcoal and fuelwood, among other sources.

1.6.2.4 National Energy Efficiency and Conservation Strategy (2020)

The strategy refocuses all the players in the energy sector to efficiency and conservation in the development and utilisation of energy resources.

1.6.2.5 Gender Policy in Energy, 2019

See Chapter 5.

1.6.2.6 Bio Energy Strategy (2020)

Chapter 5 outlines the enabling environment for bio-energy in Meru County, the challenges, key stakeholder and current initiatives, and the future bio-energy outlook, and proposed interventions.

1.6.2.7 Kenya Vision 2030

Kenya Vision 2030, Kenya's national development blueprint, contains an energy sub-sector mandate (Executive Order No. 1 of January 2023). This covers the following sub-sectors:

- National Energy Policy Development and Management.
- Thermal Power Development.
- Rural Electrification Programme.
- Energy Regulation, Security and Conservation.
- Hydropower Development.
- Geothermal Exploration and Development.
- Promotion of Renewable Energy.

1.6.2.8 National Energy Sub-Sector Institutional Framework

The institutional structure of the energy sub sector comprises of State Department for Energy, seven Semi-Autonomous Government Agencies (SAGAs), and the Energy and Petroleum Tribunal.

The State Department for Energy is responsible for policy formulation, resource mobilisation, oversight to all energy sector entities and energy planning. It comprises of three technical Directorates namely, Geo-Exploration, Electrical Power and Renewable Energy. In addition, the State Department has eight Administration and support services departments/units.

The Semi-Autonomous Government Agencies (SAGAs) under the State Department for Energy and their roles in implementation of the Ministry's mandate are as outlined below:

- Energy and Petroleum Regulatory Authority (EPRA). EPRA is established under the Energy Act, 2019. The Authority is responsible for the economic and technical regulation of the electric power, renewable and petroleum sub sectors.
- Kenya Power & Lighting Company PLC (KPLC). KPLC was established in 1922 as East Africa Power & Lighting Company and renamed to Kenya Power and Lighting Company in line with the Electric Power Act Cap 314 (Revised 1986). Its core mandate is purchasing electrical energy in bulk from KenGen and other power producers and carrying out transmission, distribution, supply and retail of electric power.
- Kenya Electricity Generating Company PLC (KenGen). KenGen was established by the Companies Act CAP 486 of 1954 (Revised 1997). It is mandated to generate electric power and currently produces the bulk of electricity consumed in the country. The company utilizes various sources of energy to generate electricity. This includes hydro, geothermal, thermal, wind among others.
- Rural Electrification and Renewable Energy Corporation (REREC). REREC is established under the Energy Act, 2019. It is mandated to oversee the implementation of rural electrification programmes and projects; develop, promote and manage, in collaboration with other agencies, the use of renewable energy and technologies.
- Geothermal Development Company Limited (GDC). GDC was formed as a result of the enactment of the Energy Act No. 12 of 2006, after the adoption of Sessional Paper No. 4 on Energy in 2004. This is a 100% state-owned company established by the Government of Kenya as a Special Purpose Vehicle for the development of geothermal resources in Kenya.
- Kenya Electricity Transmission Company Limited (KETRACO). KETRACO was incorporated on 2nd December 2008 and registered under the Companies Act, Cap 486 pursuant to Sessional Paper No. 4 of 2004 on Energy. This is a GoK wholly owned company established to be responsible for the development, maintenance and operation of the national high voltage transmission grid network in addition to facilitating regional power trade through its transmission network. Its currently designated as the System Operator.
- Nuclear Power and Energy Agency (NuPEA). NuPEA was established under the Energy Act, 2019. It is charged with the responsibility of promoting and implementing Kenya's Nuclear Power Programme as well as carrying out research and development for the energy sector.

1.6.3 County Frameworks

In terms of institutional arrangements, in Meru County, the Energy directorate is domiciled in the Ministry of Roads, Transport and Energy. The key policy frameworks are as follows.

1.6.3.1 Meru County Vision 2040

In Meru County Vision 2040, Energy is one of the enabling pillars of County development. The main goal in this sector is to improve access to clean and sustainable energy in Meru County and to have private-sector-friendly legislation to encourage both generation and distribution of energy, especially renewable energy projects, and support development of an Energy Master Plan for the County.

Some of the flagship projects under Meru Vision 2040 include:

- Domestic solar lighting to replace use of firewood and tin lamps for lighting in households by 2040.
- Development of a recycling and solid waste management plant in the short term
- Development of wind and solar power parks and development and setting up a County power grid by 2040.

The long-term blueprint of Meru Vision 2040 will be implemented through medium term plans contained in the County Integrated Development Plans (CIDPs) and the short-term plans within the Annual Development Plans (ADPs).

1.6.4 Other Relevant Policy Frameworks and Approaches for County Energy Planning

1.6.4.1 Climate Change Integration in CEPs

The draft INEP Framework (February 2023) recognises that climate change and environmental sustainability are cross-cutting issues that must be addressed in CEPs and requires County Governments to refer to national policies and targets on climate change, including promoting “actions to enhance energy efficiency and conservation in order to improve energy security and mitigate the impacts of climate change by lowering GHG emissions” (INEP, Section 6.1.5).

Kenya has a comprehensive enabling framework for climate change action at the national level, based on Kenya Vision 2030, which itself draws on international agreements and laws such as the Paris Agreement, the Kyoto Protocol, and the Nationally Defined Contributions (NDCs) that Kenya has committed to. In turn, Meru County has already or is in the process of translating this enabling environment to County level planning, as outlined in the following sections.

The CEP solutions themselves contain measures aimed at increasing the resilience to climate risks of the proposed interventions (see Chapter 3), but also recognise the need for further research and analysis, including climate risk and vulnerability assessments during the inception, and the need for more rigorous systems of data collection and analysis during solutions implementation in order to ensure that the solutions clearly identify and manage climate risks and ensure effective adaptation and mitigation. This will require additional time and resource on the part of County Government to be factored into implementation planning.

1.6.4.2 National climate change policies

1.6.4.2.1 Environmental Management and Coordination Act (EMCA)

The EMCA creates the County Environment Committee comprising representatives of pastoralists within the County in question. The Act is the principal instrument of Government for the management of the environment. The Act addresses the environmental concerns and safeguards against environmental degradation within and outside protected areas. The Act provides the legal framework for the implementation of National Environment Action Plan (NEAP), which gives due regard to ensuring that people live in a healthy environment. It also emphasises maximum participation by stakeholders in the development and implementation of policies, plans and processes for the management of the environment and provides for the relevant institutional framework for the coordination of environmental management.

1.6.4.2.2 National Climate Change Response Strategy (NCCRS)

The NCCRS is a comprehensive suite of strategies to respond to the challenges that climate change is posing to Kenya's socio-economic development. The vision of the NCCRS is "a prosperous and climate change resilient Kenya" and the Mission of the Strategy is "to strengthen nationwide focused actions by ensuring commitment and engagement of all stakeholders towards adapting to and mitigating against climate change." Its primary focus is ensuring adaptation and mitigation measures are integrated in all Government planning, budgeting and development objectives and proposes a concerted programme of activities and actions to combat these impacts and an enabling implementation framework. The NCCRS also calls for collaborative and joint action with all stakeholders (private sector, civil society, NGOs, faith-based organisations, etc) in tackling the impacts of climate change.

1.6.4.2.3 National Adaptation Plan (NAP)

The NAP aims to integrate climate change into national and County level development planning and budgeting, as well as enhance the resilience of vulnerable populations to climate shocks through adaptation and Disaster Risk Reduction (DRR). The NAP presents adaptation actions that cover the timeframe 2015-2030. NAP is aligned to Kenya's Medium-Term Plan (MTP) II in which climate change adaptation is represented in the drought risk management and ending drought emergencies, environment, water, energy, agriculture, livestock, and fisheries sectors. NAP proposes macro level adaptation actions and sub-actions in 20 planning sectors, categorising them into short-, medium- and long-term time frames. The objectives of the NAP include:

- Highlight the importance of adaptation and resilience building actions in development.
- Integrate climate change adaptation into national and County level development planning and budgeting processes.
- Enhance the resilience of public and private sector investment in the national transformation, economic and social pillars of Vision 2030 to climate shocks.
- Enhance synergies between adaptation and mitigation actions to attain a low carbon climate resilient economy; and

- Enhance resilience of vulnerable populations to climate shocks through adaptation and disaster risk reduction strategies.

1.6.4.2.4 National Climate Change Action Plan (NCCAP)

The NCCAP furthers the achievement of Kenya's development goals by providing mechanisms to realise low carbon climate resilient development. It emphasises sustainability, while prioritising adaptation and enhanced climate resilience for vulnerable groups.

NCAAP aligns with the Government's Big Four Agenda, and the Sustainable Development Goals. (SDGs) The NCCAP has identified seven priority areas, including: disaster risk management, food and nutrition security, water and the blue economy, forestry and wildlife, and tourism, health, sanitation, and human settlements, manufacturing, energy, and transport. For further information on the NCCAP and other national policies, [see Annex X](#).

1.6.4.2.5 National Climate Change Act (NCC)

The NCC Act is forward looking, comprehensive and clearly sets out the purposes and focus of climate mainstreaming at both national and County levels sector and programmes. The main objective of the Act is to enhance climate change resilience and low carbon development for sustainable development of Kenya. The Act establishes the strategic office of the Climate Change Directorate which is replicated at the County level.

The Act also establishes the mechanisms for the formulation of a National Climate Change Action Plan, and outlines duties of counties regarding climate change planning, mainstreaming, and action, as well as integration with CIDPs, considering national and County priorities, and enactment of legislation that further defines implementation of its obligations, and annual reporting on the progress of implementation of climate change actions to the County Assembly for review and debate.

1.6.4.2.6 National Climate Finance Policy (NCFP)

The 2018 NCFP establishes the legal, institutional, and reporting frameworks to access and manage climate finance, consistent with the institutional structures and framework set out in the Climate Change Act, 2016. The goal of the policy is to further Kenya's national development goals through enhanced mobilisation of climate finance that contributes to low carbon climate resilient development goals.

The objectives of the policy are the following:

- I. Enhance the implementation of public finance management in relation to climate financing,
- II. Establish mechanisms to mobilize internal and external climate finance,
- III. Track, monitor, evaluate and report on sources, applications and impacts of climate finance,
- IV. Enhance the capacity of the country to mobilise climate change finance to support sustainable development; and
- V. Encourage private sector participation in climate relevant financing opportunities.

1.6.4.3 Meru County Climate Change Policies and Initiatives

Based on the national policies outlined above, Meru County has developed the following climate change-related policies and regulations:

- Meru County Climate Change Act (2020)
- Meru Climate Change Policy
- Meru County Climate Change Mitigation and Adaptation Plan
- Meru Climate Change Finance Regulations (2021)
- Financing Locally Led Climate Action (FLoCCA) programme brief.
- County Climate Action Plans (CCAPs) - not reviewed as it has not been approved by the County Assembly

In addition, the following policies are in process of development or approval by the relevant authority:

- County climate finance framework
- Meru County climate change fund report or strategy
- Meru climate risk assessment report and action plan
- Annual state of the environment reports or reporting framework.

The next section outlines these policies in further detail.

1.6.4.3.1 Meru County Climate Change Act (MCCA)

The purpose of the MCCA is to enhance climate resilience through development, management, implementation, regulation and monitoring of adaptation and mitigation measures and actions in Meru County, in alignment with the NCCRS.

It establishes the necessary governance and administrative structures to mainstream climate into the County development plans. The Act stipulates the establishment of the relevant governance and administrative units, composition, and roles in climate action, namely:

- Climate Change Unit to support coordination of climate change matters in the County as envisaged by section 19(3) of the Climate Change Act, 2016.
- Directorate on Climate Change
- County Climate Change Fund
- Administrator of the County Climate Change Fund
- Climate Change Planning Committee
- Steering Committee
- Ward Planning Committee.

1.6.4.3.2 Meru Climate Change Policy (MCCP)

The MCCP is well-grounded in the principles of mainstreaming including climate resilience, adaptive capacity enhancement which goes further than climate mitigation, public participation that fosters the co-creation of bottom-up approaches, ownership, and behaviour change.

The Act incorporates the use of ‘climate lens’ to assess the climate threats, risks, magnitude, and impact to plan adequately for mitigation and adaptation. It aims at integrating environmental concerns into development planning. Furthermore, the policy addresses environmental issues on climate change from various sectors in an integrated manner at the County level and their significance in developing planning, “toward a low carbon, resilient economy.”

The priority areas of the MCCP are as follows:

- Low carbon resilient development - mainstreaming climate change
- Climate change governance
- Public awareness and civic education
- Research and technology
- Knowledge management and access to information.

Despite having a Climate Change Policy, the County will conduct a climate risk and vulnerability assessment across sectors and populations. This will provide important information to enable cross sectoral planning, which will address system interdependencies to avoid increased risk to other systems that are sensitive to climate change and for social wellbeing. A comprehensive risk and vulnerability assessment will also provide room identifying maladaptation that may result from misalignment of climate programmes which may result in short-term gains or economic benefits but lead to exacerbated vulnerability in the medium to long term.

1.6.4.3.3 Climate Change Governance Framework

The climate change governance framework clearly outlines the structure of the composition, roles, and management of the varied committees, in accordance with the requisites of the National Climate Change Policy. The structure is based on the architecture of devolution and uses the public financial management systems to channel funds to counties and wards for climate risk mitigation and adaptation efforts. Figure 5 illustrates the legal and institutional framework of the County Climate Change Governance.

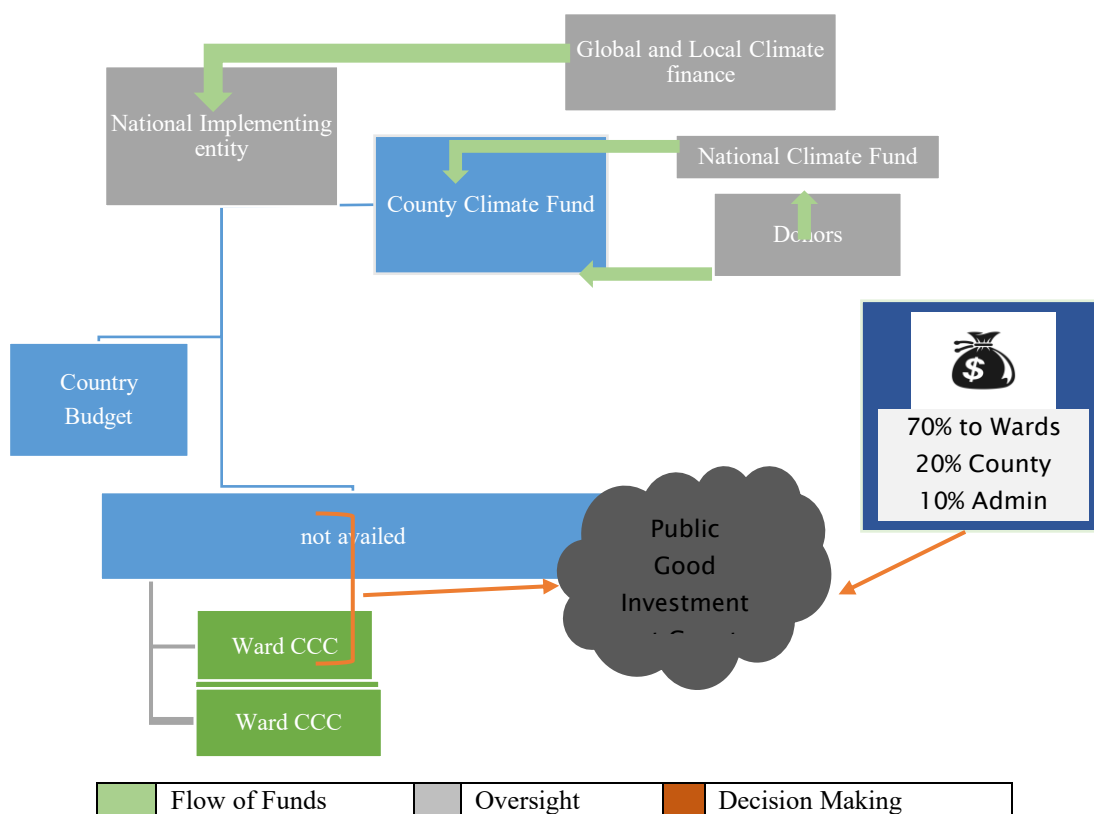


Figure 5: Enabling legal and institutional framework for climate change planning in Meru County

Source: FSD Kenya (2022)

1.6.4.3.4 Climate Change Financing

Due to the critical nature of the dangers and risks posed by climate change, Meru County has committed to take deliberate steps to mobilise resources from its budget, the national Government, international partners, civil society, communities, and individuals with an interest in matters climate change. The policy calls for the adoption of a climate finance strategy and establishment of an appropriate funding mechanism that enables implementation of priority actions for climate resilience and adaptive capacity and low carbon growth (County Climate Change Fund or CCF.). See Figure 6. More information on the CCF can be found in Annex X.

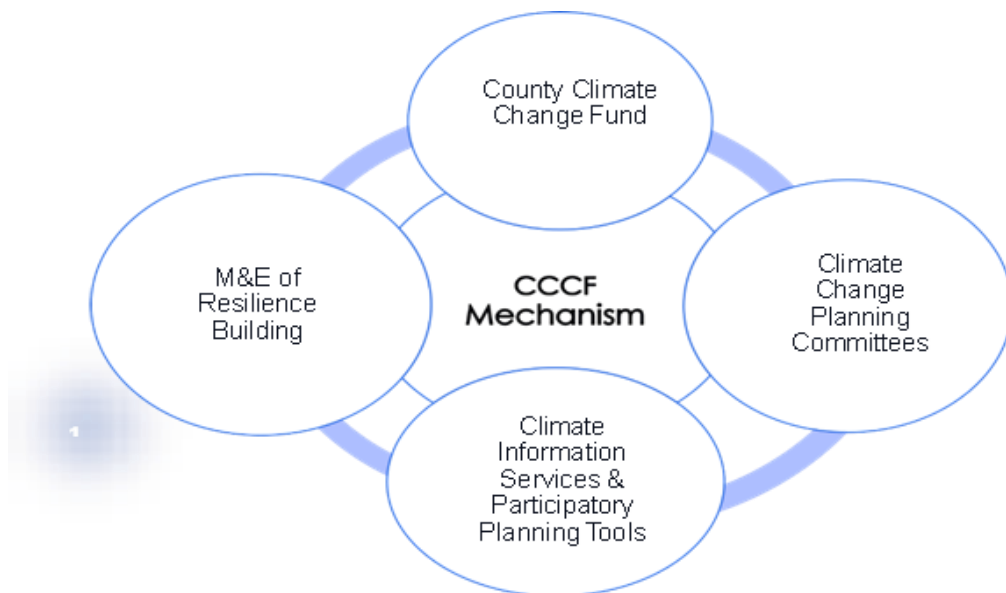


Figure 6: CCCF Mechanism

Source: Except, FSD Kenya Green Finance in Kenya

The CCCF aims to strengthen the County capacity in five key areas:

- I. Finance: strengthening existing frameworks by establishing specialised climate accounts in counties
- II. Public participation: ensure greater social inclusion and public accountability, primarily through participatory risk assessment approaches.
- III. Climate information: creating awareness in communities about the impacts of climate change and needed actions.
- IV. Demand-driven capacity building: enhance County structures' ability to manage resources, plan their use in consultation with communities, integrate climate plans into CIDPs, and implement actions using innovations and indigenous knowledge on adaptation; and
- V. M&E: by strengthening existing M&E systems to allow for assessment and reporting on resources and resilience building.

1.6.4.3.5 The County Climate Change Action Plan (CCCAP)

The national climate change action plan requires that each County shall develop a CCCAP. Meru County has developed its CCCAP and will be soon published and publicly available.

1.6.4.3.6 Financing Locally Led Climate Action (FLLoCA) Programme

FLLoCA is a climate change adaptation-focused programme funded by the World Bank. It aims to deliver locally led climate resilience actions and strengthen County and national Governments' capacity to manage climate risks. Specific intervention areas include strengthening local resilience to the impacts of climate change, natural hazards, and other shocks/stressors and building counties' capacity to plan, implement and monitor resilience investments in partnership with communities.

FLLoCA adopts the CCCF as an innovative financing instrument for locally led climate actions to capitalise on the national climate change fund and subsequently County climate change funds to build County-level capacity for planning and implementation of local climate actions and strengthen national-level capacity for coordination, monitoring, and reporting on climate action.

The programme is implemented by the County Government in partnership with local communities at ward levels, with support from the national Government. The programme is implemented as a hybrid programme, with an investment project financing (IPF) component for the activities or funded by the national level agencies on a performance-for-results (PforR) component that represents 90% of the FLLoCA budget.

The CCIS grant is intended to put in place institutional arrangements to be able to visualise County budgets and expenditures for climate action and prepare, in a participatory manner and guided by climate risk assessments and County climate action plans. The grant allows the County to implement, equally in a participatory manner, the action plans whilst providing incentives for the County to increase resources into the CCCF and mainstream climate action into the regular operations of the County departments.

FLoCCA calls for the establishment of ward climate change committees, which is imperative for cascading adaptative capacity building and creating ‘bottom up’ climate response strategies. It also calls for conduct of a baseline survey of climate change indicators, and capacity building for the climate change unit and ward climate change committees.

Care must be taken to ensure cross sectoral programming is applied and synergies and collaboration brought to bear to avoid short gains at the expense of mid and long term climate gains.

Therefore, Meru County has developed a monitoring and evaluation (M&E) policy to prevent a risk of maladaptation in new FLoCCA projects in case these are designed and implemented without consideration for interdependent systems, misalign climate action plans and resource utilisation, or inadvertently increase risks to other systems and programmes.

The M&E policy which will be anchored in the GoK’s new climate MRV+ system. The reports will include information on ongoing and completed climate resilience actions, the participatory process at the community and ward levels, environmental and social measures taken, disbursement, grievances, citizen feedback, and other programme aspects as needed. It is expected that the system will be linked to the national climate finance tracking system, national integrated monitoring and evaluation system (NIMES), and County integrated monitoring and evaluation system (CIMES) to allow aggregation of data beyond the programme. All the programme’s indicators are climate-tagged since they measure results that contribute to climate adaptation or mitigation; and sex-disaggregated. Citizen engagement indicators are included in the results framework and will be monitored continuously during implementation.

1.6.4.3.7 Climate Change Mitigation Action Plan (CCMAP)

The CCMAP integrates environmental concerns into the County's policies, plans, programmes, and projects in line with the provisions of the EMCA, and other environmental frameworks. The CCMAP addresses environmental issues from various sectors in an integrated manner at the County level and their significance in developing planning. It proposes strategies for achieving sustainable development in line with the County's quest to meet the Sustainable Development Goals, Kenya Vision 2030, Meru Vision 2040 and the CIDP. The plan has identified actions to be taken by Government agencies, civil society, and individuals for incorporation into sectoral development plans and programmes. Its implementation will be monitored through the Annual State of the Environment (SoE) reporting.

The goal of the plan is to enhance mitigation, and adaptive capacity and resilience to climate change and promote low carbon development for the sustainable development of Meru County by reducing vulnerability to the impacts of climate change resilience and strengthening capacities for disaster risk reduction.

The plan posits several implementation priorities:

- Just transition and low carbon resilient development
- Mainstreaming climate change
- Climate change governance
- Climate finance
- Implementation framework
- Public awareness and civic education
- Research and technology
- Knowledge management and access to information.

The CCMAP highlights action plans for these eight strategic priorities and allocate budgets, responsibilities, and timelines for the establishment of the operational structure.

1.6.4.3.8 Meru Climate Change Fund (MCCF) Regulations

The MCCF is comprehensive in addressing climate change mainstreaming activities and governance and management structures. The aim of the MCCF regulations is to define the procedures for management, operations and winding up of the Fund, and for planning of climate change response interventions to be funded by the Fund. The Fund specifically addresses core climate mainstreaming principles of community participation, development of bottom-up approaches and leveraging community structures and indigenous knowledge to building adaptive capacities. The main objective and purpose of the Fund is to provide funding for climate change activities identified in the County climate change action plan and County climate finance framework and for connected purposes including:

- Climate resilience assessments
- Implementation of climate change response projects proposed by ward climate change committees and communities, recommended by the County climate change technical committee, and approved by the steering committee.
- Priority County level climate change response projects recommended by the County climate change technical committee and approved by the steering committee.
- Research and knowledge management in the County.
- Public education, sensitisation and awareness creation on climate change and its impacts.
- Capacity building for staff of the County and other stakeholders to effectively respond to climate change.
- Monitoring, evaluation, reporting and learning on climate change response in the County.

The Fund requires that the climate change steering committee provides oversight over the fund and specifically, put in place financial controls to ensure fiduciary standards are maintained in all fund operations and to achieve the desired transparency and accountability with a view to ensuring that project implementers and oversight providers have the necessary capacity and putting in place effective structures. **More information can be found in Annex X.**

1.6.4.4 Policies & Approaches to Promote Gender Equality & Social Inclusion (GESI)

1.6.4.4.1 Introduction

Gender equality and social inclusion are two different, but interdependent, terminologies and forms of analysis and practice aimed at addressing the root causes of inequality and marginalisation of groups and individuals and promoting their economic social and cultural rights. Besides GESI being a fundamental human right, it is also essential to achieve inclusive sustainable development (UN, 2022).

According to World Vision (2020), “gender equality is the state or condition that affords women and girls, men and boys, equal enjoyment of human rights, socially valued goods, opportunities, and resources. It includes expanding freedoms and voice, improving power dynamics and relations, transforming gender roles, and enhancing overall quality of life so that males and females achieve their full potential”. Social inclusion “seeks to address inequality and/or exclusion of vulnerable populations by improving terms of participation in society and enhancing opportunities, access to resources, voice and respect for human rights. It seeks to promote empowerment and advance peaceful and inclusive societies and institutions.”

World Vision defines GESI as “a multi-faceted process of transformation” that:

- Promotes equal and inclusive access, decision-making, participation, and well-being of the most vulnerable.
- Transforms systems, social norms, and relations to enable the most vulnerable to participate in and benefit equally from development interventions.

- Builds individual and collective agency (or empowerment), resilience, and action.
- Promotes the empowerment and well-being of vulnerable children, their families and communities. (World Vision, 2020).

There are five dimensions of GESI (see Figure 7) which require implementation across multiple levels of action: individual, household, community, and societal levels.

FIGURE 4 | World Vision's five GESI domains



Figure 7: The five dimensions or domains of GESI

Source: World Vision, 2020

1.6.4.4.2 Approaches and Challenges to GESI Integration in Development and Energy Planning

Mainstreaming GESI into the design, implementation and monitoring and evaluation (M&E) – in this case, into the interventions developed under the County Energy Plan for Meru – begins with applying a “GESI lens” to identify who are the most vulnerable groups and individuals in the project context, including those groups or individuals who are experiencing multiple factors of vulnerability or “intersectionality”.

According to World Vision (2020):

“Evidence suggests that gender, inequality and social exclusion disproportionately affects children—girls and boys, women, persons with disabilities (PWDs), youth, and people living

in poverty (PLP). Other factors of vulnerability or exclusion include refugee or migrant status, ethnicity, religion, age, language and health status. Individuals have overlapping and inter-related vulnerabilities (known as intersectionality). For example, women with disabilities may face double marginalization because of gender norms, stereotypes and stigma towards persons with disabilities; Adolescent boys living in extreme poverty may be exposed to higher risks of community violence (due to age and socio-economic status).”

The barriers or gaps facing these groups and individuals and what processes, institutions, attitudes etc. are the root causes of these barriers across the five GESI domains and at household, community, societal levels must be understood to identify key actions or interventions that can address these barriers, plus indicators to evidence the process of transformative change (ibid).

Integrating GESI into project design, implementation and M&E requires collection and analysis of GESI-disaggregated data. In the case of County energy planning within Kenya, this is one of a number of critical data gaps have been identified and are recognised by both County and national energy planners working in the context of INEP. According to the data on the gender and energy nexus by Energia, gender-disaggregated data on the energy sector in Kenya is very limited. Analysis based on the experience of developing the CEP in Meru also highlighted several data gaps for County planning, including limited disaggregated data (both in relation to GESI and more broadly in relation to sub-County and ward level data)

GESI focuses on increasing the access to development, participation in society and the decision-making power and wellbeing of vulnerable groups and individuals excluded from societal processes and practices on the grounds of social class, income, gender, age, ethnicity, disability, religious beliefs and practices, and work and life experiences. It seeks to achieve gender equality as a fundamental value where women are active agents of development, not just passive recipients. The overall objective is a society in which women, men and all people enjoy the same opportunities, rights and obligations in all spheres of life.

GESI aims to remove the **systemic** barriers of discrimination. This often requires specific, targeted interventions and policies to address existing inequalities. It is therefore important for public institutions and private bodies to have in place systems and processes to constantly assess the status of GESI integration within their policy, planning, and operations. This includes, in the Kenyan context, the operations of County Governments. Approaches to GESI in planning can be summarised as follows:

GESI blind: ignores gender and other forms of inequality.

GESI sensitive: considers gender and other forms of inequality but takes no remedial action to address it.

Box 1: GESI aims and approaches

Source: World Vision 2023

1.6.4.4.3 National Policies for Integrating GESI In Development Planning

Kenya's national development blueprint, Kenya Vision 2030, recognises energy as a core enabler to alleviate poverty and a catalyst for the Sustainable Development Goals (SDGs). Kenya has national targets to achieve universal access to electricity by 2022 and to clean cooking by 2028. Many policies and programmes have been developed aimed at achieving SDG 7, as has been discussed. Globally, it is recognised that there are critical GESI gaps in energy access, with women and people from marginalised groups having unequal access to energy and energy services, as well as use of, control over and benefits from, energy resources and services (Buchy and Shakya, 2023).

The Kenya Constitution (2010) recognises the importance of GESI by requiring representation by women on public decision-making bodies to be at least 33% and enabling access to Government opportunities for “special interest groups” including women, PWDs and youth (national and County Government). Thirty percent of public procurement opportunities must legally go to these marginalised groups.

However, as in other sectors, there is no specific policy promoting gender and social inclusion (GESI) in the Kenya energy sector. According to one recent analysis, this goes hand in hand with there being little understanding of GESI among policy and decision makers and investment planners, and a conflation of GESI with gender equality (Onyango et al, 2022).

On the other hand, there is a focus on GESI integration in the National Climate Change Action Plan 2018-2022, which recommends enhancing GESI in climate change action by adapting a gender and youth mainstreaming to climate change adaptation. It recommends the County Governments to mirror it within their climate change development initiatives.

The NCCAP outlines the following strategies to support mainstreaming of GESI within climate change interventions: adopting intergenerational, special needs and gender mainstreaming approaches across all aspects of Country’s climate change response; promoting and encouraging effective partnerships in production and utilization of green energy options in the County as well as mitigation and building resilience to climate change and related disasters; and ensuring that its climate change response is equally beneficial to women, youth, persons living with disability, and men while enhancing gender equality.

The NCCAP also recommends using systematic vulnerability analysis of its climate change response, which will require the collection and analysis of data disaggregated by gender, age and special needs. Finally, it recommends the following priority actions:

- Adopt a GESI mainstreaming approach at all stages of the climate change policy cycle from research to analysis, to the design and implementation of actions to monitoring and evaluation.
- Development of responsive actions, to ensure that marginalization and vulnerability arising from age and gender disparities as well as disabilities are addressed at all stages of climate change response project cycle.

- Measures to ensure and enhance the participation of the youth, women, and people with disabilities in climate change governance and to position them to take advantage of emerging opportunities through awareness creation community sessions. This can include opportunities such as considerations in tendering processes and employment during project implementation processes.
- Undertake a systemic analysis of the various special needs and ensure that planning and climate change responses mainstream participation and protection to persons with special needs in collaboration with other stakeholders.
- Enhance gender equality in land ownership, decision making, planning and management of rangeland resources and together with relevant stakeholders while considering the “Do No Harm” policy.
- Avoid any backlash from the custodians of culture (predominantly senior male members of the society) by conducting GESI responsive awareness campaigns.
- Progressively deal with retrogressive and harmful cultural practices that perpetuate GESI discrimination, in line with the provisions of the constitution and other enabling statutes.

These strategic provisions are comprehensive and, if implemented, could provide a potential roadmap to support development of an over-arching GESI framework for development planning.

1.6.4.4.4 GESI Versus Gender Equality in Energy Policy

Over the last three decades, in Kenya as well as globally, there has been greater focus on gender mainstreaming in development policy, planning, and implementation. Gender mainstreaming is now a national mandate in Kenya, as per the National Policy on Gender and Development Policy. This details the overarching principles, to be adopted and integrated into the National and County Government sectoral policies, practices and programmes (GoK, 2019a).

Gender equality has been increasingly recognized as a key strategy for accelerating progress on the SDGs, including SDG 7. For instance, the African Development Bank (AfDB), the Climate Investment Funds (CIFs) and ENERGIA collaborated on four country briefs, including for Kenya, highlighting the need to “increase data availability on gender and energy and provide insights for future gender sensitive interventions to ensure men and women reap the benefits of energy interventions.” (AfDB et al., 2020).

In the Kenyan energy sector, the key policy framework is the MoE’s Gender Policy in Energy (GoK, 2019b). This policy provides a framework for mainstreaming gender and highlights five areas of priority action that are intended to form a framework for action across national and County Governments, and in state agencies (see below). Each of these priorities, which constitute a mixture of internal, institutional-facing, and external, programmatic-facing action areas, has within it a number of strategies or deliverables:

- Strengthen institutional frameworks for gender equality, including by appointing gender champions, and ensuring equitable recruitment, placement, deployment of qualified women and men and promotion to positions of decision making.
- Ensure compliance with the Constitution on Gender, including by reviewing all existing policies in the energy sector to make them gender responsive and monitoring compliance with the two thirds Gender rule in employment (i.e., there must be at least one third women), promotion and placement of women and men in leadership/boards and committees.
- Increasing awareness on gender in the Energy Sector, including by conducting gender sensitisation campaigns and trainings.
- Integrating gender in programmes, monitoring & evaluation, including by carrying out gender assessment of existing programmes, developing gender sensitive monitoring and evaluation tools and strengthening the capacity of all units and sections to collect gender-disaggregated data
- Promoting clean cooking solutions and environmental sustainability, including by assessing the percentage uptake of clean cooking solutions and the level of adoption to renewable solutions by households in rural and hard to reach areas, and promoting activities for environmental sustainability (awareness creation, tree planting, forest conservation, among others, energy efficiency and conservation).

The draft INEP Framework (February 2023 version) further identifies gender equality as a cross-cutting issue for energy planning and calls for “gender aware planning” including for CEPs. The MoEP 2019 Gender Policy is highlighted as a key reference document for planners.

Energy interventions impact men and women differently, as they have distinct roles, responsibilities and voice within their households, markets, and communities. This leads to differences in their access, control, use of energy and the impact of energy services on their lives. Policies and plans provide the framework for distribution of access to and control over public resources to address an identified problem as per Government values and principles. Policies determine choice and priorities, whether to improve fossil fuel distribution through public and/or private sector investment, or to promote the use of small-scale renewable energy systems through financial instruments, such as subsidies (INEP, Section 4.1, p. 48).

The draft Framework outlines the following guiding questions for CEP planners:

- Which gender is likely to participate in and benefit from the energy intervention?
- Which gender is going to be involved in the management and maintenance of the system?
- Is women’s knowledge, e.g., on ecosystems and biodiversity, considered?
- How far have individuals and non-Governmental organizations with experience in gender mainstreaming participated in project identification, formulation and appraisal?
- Are project personnel able to mainstream gender issues?

- Are there appropriate opportunities for women to participate in project management positions? Among others.
- During monitoring, evaluation and feedback, the following questions may be considered.
- What is the impact of the energy interventions on women's workload and time use, access and control of income and resources, decision making, reproductive roles and expressed aspiration of men and women?
- Does the project's monitoring and evaluation system explicitly measure the impacts on men and women?
- What are the types and courses of data needed?
- Are monitoring and evaluation results used for decision making?
- Are women involved in the collection and interpretation of this data? (Ibid, pp. 48-49).

At the national level, the existence of such a gender equality-enabling framework within the energy sector could serve as building blocks or bridge to developing a more in-depth GESI mainstreaming policy, where the existing gender policy is further deepened and extended to promote other forms of social inclusion as well as gender equality. For instance, the MoE's Gender Policy already makes reference to the need to promote inclusion of some other vulnerable and marginalised groups by "monitoring compliance with 30% AGPO rule for women, youths and PWD in the energy sector" as well as to assessing "the involvement of women, men, PWDs and youth in energy exploration, generation, transmission and distribution" and by "identify[ing] projects that facilitate easier access of energy by vulnerable groups and the marginalised" (GoK, 2019(b)).

1.6.4.4.5 County Policy Frameworks for integrating GESI into CEPs

Baseline research on the enabling context for the development of Meru County CEP using the EDM approach highlighted that, as at the national level, Meru County has some expertise on gender issues and nascent enabling policies on gender equality but little explicit capacity or enabling environment on social inclusion in development planning and project implementation more widely, in terms of GESI.

The County has a Department of Youth Affairs, Sports, Gender and Social Development and the County Government references the need for gender equality in the design and implementation of development projects, namely in the previous CIDP (2018-22), with references to building County officials' capacity on climate change and gender-related issues and, in terms of public finance management, the need for inclusivity and non-discrimination is highlighted, including application of the constitutional requirement for 30% participation of women and for GESI in procurement.

However, there are few specific interventions designed at promoting gender equality and social inclusion in sectoral programmes and projects, and across all sectors, including in the energy sector, little disaggregation of project indicators based on GESI or even gender. The next step would be to operationalize such provisions through concrete CIDP/ADP

programmes and projects, including implementation of the CEP solutions, and use this experience to inform design of future interventions within the energy sector.

In terms of policies, in 2019, the County Government launched a policy on sexual and gender-based violence. The ADP for FY2022-2023 states that a Meru County Gender Mainstreaming Policy was under development, in partnership with Ripples international.

As per the recommendations from the NCCAP, Meru's Climate Change Policy should promote GESI integration into any climate change action legislation, policies or programmes. Meru's Climate Change Act (2020) refers to the need for community driven and bottom-up planning of the County responses to climate change; and commits to informed participation of communities in planning and implementation of climate change response interventions. Meru's Climate Change Policy also refers to the need to mainstream climate change action across all County development programming, applying a climate risk lens. However, there is no reference to integrating GESI or that marginalised and vulnerable groups may also run higher risks from climate change impacts and require GESI-sensitive or transformative interventions.

There is equally a lack of reference to promoting GESI in the County's nascent climate change financing regulations, developed in response to the Financing Locally Led Climate Change Action (FLLOCA) initiative. This gap will make it difficult to allocate financing for any proposed GESI-related climate change actions and interventions.

The lack of a specific national umbrella policy on GESI mainstreaming in development planning does not necessarily have to be a barrier to developing such an approach in Meru or other counties. As at the level of the national energy sector policies, if Meru or other counties have some experience of gender mainstreaming or adopts gender mainstreaming or other relevant policies and begin to apply a gender lens to their County development planning and programme implementation, this could be a stepping stone to developing a more comprehensive social inclusion approach.

1.6.4.4.6 Further steps to support GESI integration in County Energy Planning.

After consideration of the current enabling environment, the following suggestions are proposed to support mainstreaming of GESI in County energy programmes.

A first step would be to develop a plan for mainstreaming GESI, ideally moving to a "gender transformative approach" over a defined timeline, and to determine the level of investment required in terms of both resource and staff time. The second step would be to identify the internal (e.g. Gender Directorate) and external GESI expertise that can support the process of developing the plan. Ideally, this process should be led by a high-level official (CECM) with sufficient staff time allocated to undertake the requisite research and analysis to inform development of the plan.

On the governance side, the following actions are suggested to support mainstreaming of GESI in County energy planning:

- Appoint a “GESI Champion” at top level of County Government (CECM/CO).
- Ensure the technical officers from the Department of Gender and Social Development are included in the planning process.
- Employ at least one GESI expert housed in the Directorate of Economic Planning and/or develop an ongoing partnership to source expertise from an external organisation, ideally with good local presence.
- Develop a GESI policy for County Government (build on gender equality policy if available and relevant).
- Raise awareness/train key officers leading County development, climate change and CEP.
- Create a standing, cross-sectoral GESI integration planning committee.
- Adopt GESI policies in recruitment and retention within the Energy Directorate and other Ministries, with the support of the Department of Gender and Social Development.

In terms of the project planning cycle, the following steps are recommended:

- Develop/adopt processes and tools for collection and analysis of energy (and other) sector data disaggregated by gender, age, ethnicity, and other potential factors of vulnerability. This includes data to assess the participation of women and marginalised groups in activities along the energy value chain.
- Undertake GESI assessments of existing (or flagship) projects and programmes to identify any retrofitting needed to promote GESI.
- Undertake vulnerability assessments for all new energy projects and programmes to identify most vulnerable end users/people.
- Develop M&E frameworks to target and enhance GESI impacts of specific project (components).
- Ensure sufficient budget allocation in CEPs/ CIDPs/ADPs for GESI-related project activities.

One particularly critical step is to invest in improved collection and analysis of energy (and other key development) sector data disaggregated by gender, age, ethnicity, and other potential factors of vulnerability that can be analysed to support the design of CEP and CIDP interventions to promote GESI. This includes data to assess the participation of women and marginalised groups in activities along the energy value chain from resource ownership and extraction through, generation, transmission, distribution and energy access/consumption to inform project design and implementation.

KNBS has unpublished disaggregated data sets related to the national census and other statistical updates to ward level (e.g., on electricity and cooking technology and fuel access) that could be made available for County energy planning. Additionally, there could be further collection of data points useful for County energy planning - for example, through collaboration with KNBS as part of the periodic national census or sectoral statistical updates or other partners.

Potential support could also be sought through INEP to develop standardised data sets to facilitate CEP development, with standardised tools for data collection and management, given that INEP recognises the current challenges in data for County energy planning and has introduced a new section in the draft Framework on Data Management (Part Nine).

CHAPTER TWO: MERU COUNTY ENERGY RESOURCES ASSESSMENT

2.1 Biomass Energy Resources

Biomass energy resources are derived from forests - closed forests, woodlands, bush lands, grasslands, farmlands, and plantations. According to County Government of Meru (2018), the main source of energy for cooking by household is wood fuel and charcoal which accounts for 86.1 per cent and 6.6 per cent respectively. The County, however, has other potential biomass feedstock that can be harnessed for bioenergy, including crop residues (for processing of pellets, briquettes) or animal dung which provide energy needs for cooking, heating, drying or electricity production depending on available quantity. Municipal solid and sewer wastes and industrial residues can also be for electricity production.

2.1.1 Woody Biomass Energy Sources, Proximity and Access in Meru County

Biomass energy resources are derived from forests - closed forests, woodlands, bush lands, grasslands, farmlands, and plantations. According to County Government of Meru (2018), forests provide crucial direct and indirect goods and services to Meru people and make a significant contribution to the County's economy. The distribution of these resources is depicted in the land use map in Figure 8.

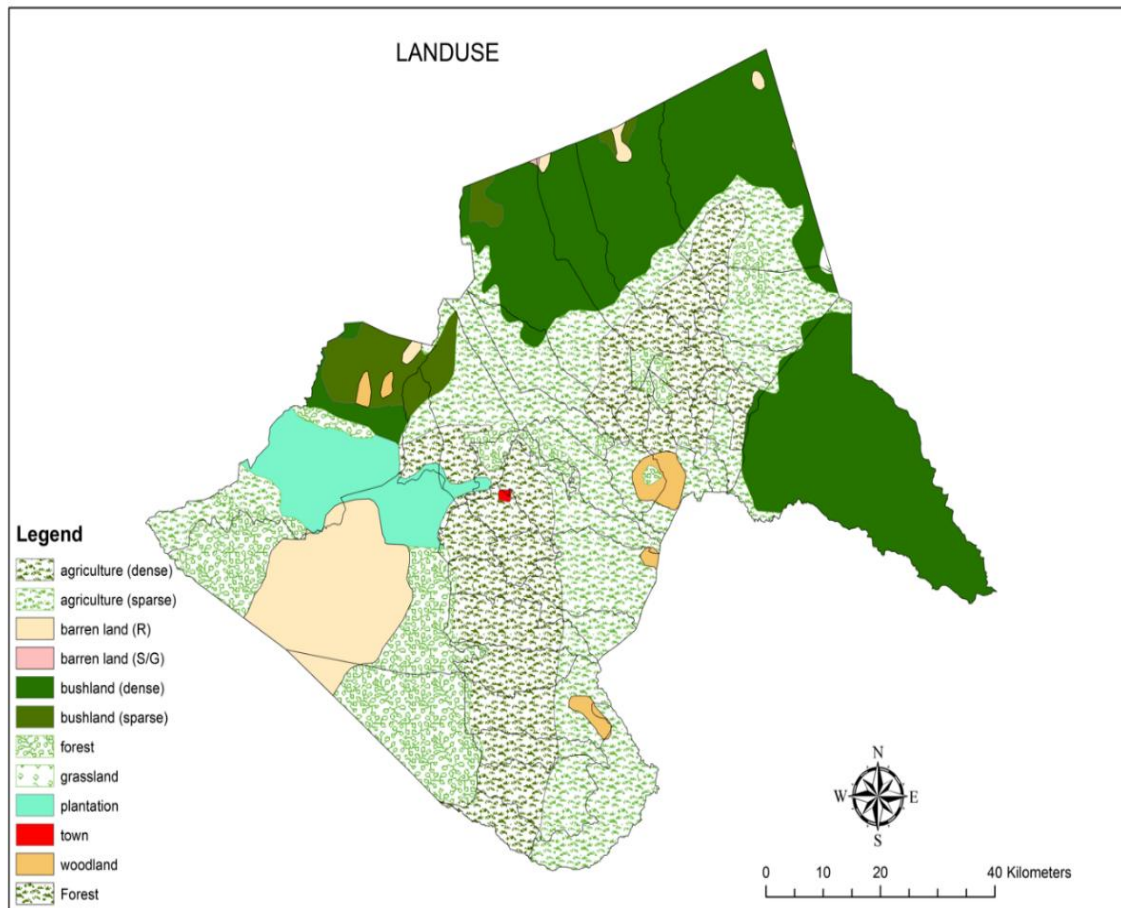


Figure 8: Meru land use map

Source: <https://meru.go.ke/assets/image/maps/landuse.png>

As shown in the map, forest cover dominates the Meru National park, Mt. Kenya National park, Lewa Downs Conservancy, Nyambene Conservancy and Ngare Ndare Forest Trust. However, these are mainly tourist attraction sites in Upper Eastern-Kenya and extractives use is largely prohibited. Besides the conservation areas, Meru County also have public forestlands that are gazetted and managed by Kenya Forest Service (KFS). The Forest Management and Conservation Act 2016 has provisions for extractive utilisation of gazetted forests by the forest adjacent communities based on participatory forest management plan required to be developed for each gazetted forest. The gazetted forests recorded in Table 9 are assumed to be legally accessible to market segments for fuel wood. This assumption exempts other protected areas (for example National Parks and Game Reserves) that are in Meru County. Most of the accessible forests have been vulnerable to degradation as reported by the Global Forest Watch (Global Forest Watch, n.d.). However, the size of the forestlands is expected to remain unchanged as the existing law governing forest conservation has sealed loopholes for deforestation.

#	Forest	km2	Ha	Assumed Annual productivity in m3/ha/year (MoE, 2002)
1	Upper Imenti	148.35	14,835	0.64

2	Lower Imenti	24.62	2,462	0.64
3	Ruthumbi	1.26	126	0.64
4	Nyambene	68.78	6,878	0.64
5	Muchene	102	10,200	0.64
6	Marania	72.8	7,280	0.64
7	Ontulili	332.27	33,227	0.64
8	Ngare Ndare	55.54	5,554	0.64
9	Ngaya	41.89	4,189	0.64
	Total		84,751	

Table 8: Gazetted forests and sizes in Meru County

Source: Meru CIDP, 2018-2022

Besides the public forestlands, agro-forestry is widespread in Meru County especially among the smallholders whose average land holding size per household is 1.8 ha for smallholders that dominate Meru County (County Government of Meru, 2018). There is no data on the average size of land under natural forest or woodlot (naturally growing on-farm) across the County. However, Meru County is well covered with trees on-farm, similar to many Counties in central Kenya and therefore, the average value of one tenth (i.e., 0.1) of their small farms being under trees is assumed. This matches with the middle scenario envisaged by Githiomi et al. (2012) for Counties in central Kenya. Based on those assumption, the expected areas under trees within farmlands (EAT) in Meru County, was computed using the following formulae: $EAT = \mu * p * PNH$, where EAT is the expected area under trees, μ is the mean area in hectares under trees per given household (0.18 ha or a tenth of the average land holding by smallholders); p is the proportion percentage expected to be under trees on the basis of individual household land size, and PNH is the projected number of households. The p was assumed 10 %, calculated as: $\frac{0.18}{1.8} * 100$. The areas under trees on-farm is projected to increase proportional to growth of households.

2.1.2 Consumption of Wood-Based Bioenergy Resources In Meru County

Wood-based bioenergy is the main source of energy for cooking by households. Wood is also used as a fuel by other end-users in Meru County, such as households for heating, cottage or small and medium enterprises (SMEs) (for example informal eateries, small hotels/restaurants, brick-making, local tobacco curing), health facilities, learning and correction institutions. The quantity consumed annually by households is substantial and was therefore estimated using the KNBS (2019) population data and the MoE (2019) data on the national average household firewood and charcoal consumption. Urban and rural households differ on their average annual consumption but this study has used the general or total average.

In order to estimate the balance between annual wood fuel consumption (mainly firewood and charcoal) against annual sustainable supply from forests and on-farm woody biomass, the charcoal consumption (kg) was converted to the amount of raw wood (kg) that was used to

produce the corresponding mass of charcoal. The amount of wood equivalent Qty_{wd} to carbonized charcoal was calculated as follows (Giothiomi et al., 2012):

$Qty_{wd} = \frac{AMTC}{r}$, where Qty_{wd} is the quantity of wood used for making charcoal, $AMTC$ is the amount of charcoal carbonised, and r is the rate of recovery (in this case the r for the earth kiln is 20 %).

The estimates of wood-based bioenergy consumption (both for the base year (2019) and projected years up to 2028, are summarised in Table 10. It is notable that the quantities consumed by the other market segments was not estimated as the data on the number of establishments of the respective segments and their corresponding average annual consumption was not available. As a recommendation, data on wood fuel consumption by all market segments in Meru County should be collected and updated regularly.

Firewood											
Year	Units	2019	2020	2021	2022	2023	2024	2025	2026	2027	2028
Household annual growth rate for Meru	%	1.67%	1.67%	1.67%	1.67%	1.67%	1.67%	1.67%	1.67%	1.67%	1.67%
Convention household number	#	426,360	433,480	440,719	448,079	455,562	463,170	470,905	478,769	486,765	494,894
Percentage number of HHs the specified fuel-type	%	86.10%	86.10%	86.10%	86.10%	86.10%	86.10%	86.10%	86.10%	86.10%	86.10%
Average consumption of firewood per household	Kg	1,349	1,349	1,349	1,349	1,349	1,349	1,349	1,349	1,349	1,349
Projected consumption of firewood in kg	Kg	495,212,450	503,482,498	511,890,656	520,439,230	529,130,565	537,967,045	546,951,095	556,085,178	565,371,801	574,813,510
Projected consumption of firewood in tonnes	Ton	495,212	503,482	511,891	520,439	529,131	537,967	546,951	556,085	565,372	574,814
Charcoal											
Year		2019	2020	2021	2022	2023	2024	2025	2026	2027	2028
Household annual growth rate for Meru	%	1.67%	1.67%	1.67%	1.67%	1.67%	1.67%	1.67%	1.67%	1.67%	1.67%
Convention household number	#	426,360	433,480	440,719	448,079	455,562	463,170	470,905	478,769	486,765	494,894
Percentage number of HHs the specified fuel-type	%	6.60%	6.60%	6.60%	6.60%	6.60%	6.60%	6.60%	6.60%	6.60%	6.60%
Average consumption of charcoal per household	kg	395	395	395	395	395	395	395	395	395	395
Projected consumption of charcoal in kg	kg	11,115,205	11,300,829	11,489,553	11,681,429	11,876,508	12,074,846	12,276,496	12,481,513	12,689,955	12,901,877
Projected consumption of charcoal in tonnes	ton	11,115	11,301	11,490	11,681	11,877	12,075	12,276	12,482	12,690	12,902
Overall annual wood used to make	kg	55,576,026	56,504,146	57,447,765	58,407,143	59,382,542	60,374,230	61,382,480	62,407,567	63,449,774	64,509,385

consumed charcoal (kg)- Households											

Table 9: : Base year (2019) estimate of wood fuel (firewood and charcoal) consumption by residential households in Meru County

2.1.3 Alternative Bioenergy from Crop Residuals

According to County Government of Meru (2018), the major land use in the County is mainly for agricultural activities for both crop farming and livestock keeping. Crop farming is common in all the Sub Counties and is particularly intense in the Imenti and Buuri Sub-Counties. Major food crops in the County include bananas, maize, beans, sorghum, millet, green grams, potatoes, cabbages, carrots and kales among others. Coffee, tea and macadamia are also major crops produced in Imenti Central and Imenti South sub counties respectively. Zero volume of macadamia, avocado and mango is processed in Meru County. Table 11 lists the major crops grown in Meru County, summarising the respective areal coverage (Ha) and annual production (tons).

Crop	Area (Ha)	Annual production (Tons)
Maize	128,634	64,740
Beans	93,100	35,855
Potato	17,534	196,434
Sorghum	16,314	260
Pigeon peas	16,589	12,334
Wheat	14,000	46,450
Cow peas	7,976	4,479
Green grams	7,108	5,576
Rice	336	267
Coffee	5,659	1,643
Tea	14,942	107,773
Macadamia	2,730	2,731
Banana	3,200	210,450
Avocado	670	5,404
Grapes	14	
Mango	4,133	29,192
Miraa	11,000	

Table 10: Estimated area and production of major food and cash crops in 2017

Source: Meru CIDP, 2018-2022

2.1.4 Alternative Bioenergy from Animal Wastes

According to County Government of Meru (2018), livestock is common in the Tigania and North Igembe Sub Counties. Table 12 lists the major livestock types in Meru County and estimated population of each type. The waste generated from these livestock populations is ideal feedstock for biogas production which could be harnessed to meet household energy needs. Assessment for biogas production was only conducted for dairy and the small ruminants (sheep and goats). Beef cattle were considered to be under open grazing system and data was not available regarding the number of days in a year the beef cattle spend in a home boma (i.e., shed). Similarly, the chickens were considered to be under open grazing system and therefore difficult to recover the waste.

Livestock type	Number
Diary	185,000
Beef	250,000
Sheep	190,000
Goat	280,000
Chicken	1,300,000

Table 11: Livestock population

Source: County Government of Meru, 2018

2.2 Waste Resources

Refer to sections 2.1.3 and 2.1.4 for details about the crop residual and animal waste resources in Meru County. In order to comprehensively assess bioenergy resource potential, data is required on municipal solid waste, sewer waste and records of animals slaughtered in the individual abattoirs in the County. The County had limited resources to conduct a primary data study and it is therefore proposed that for the future the County Government should carry out feasibility studies on waste-to-energy potential in the County (both solid and liquid waste).

2.3 Geothermal Resources

There is no evidence of existing geothermal resources in the County and the Government is prioritising the development of other energy sources.

2.4 Hydropower Resources

Hydropower was one of the earliest recognised national resources dating back to the early 1920s. Besides large hydropower plants, several isolated micro-hydro schemes were established by the private sector largely tea estates and sawmills and missionaries. For example, Mujwa Catholic Mission near Nkubu in Meru County established a 60kW micro-hydro in 1927 which worked successfully until the late 1990s (MoE&P, 2023).

The available potential assessed in Meru County (run-of-the-river) is about 281 MWa (megawatts) or 308 MWa as optimised potential. In the top 10 of counties with hydro potentials (see Figure 9), Meru County is sixth, after Tana River, Kitui, Tharaka, Embu and Muranga. Geologically speaking, the area on the northeast of Mt Kenya (known as the Nyambene volcanics) provides a very important form of natural water tower supplying Meru and Isiolo counties.

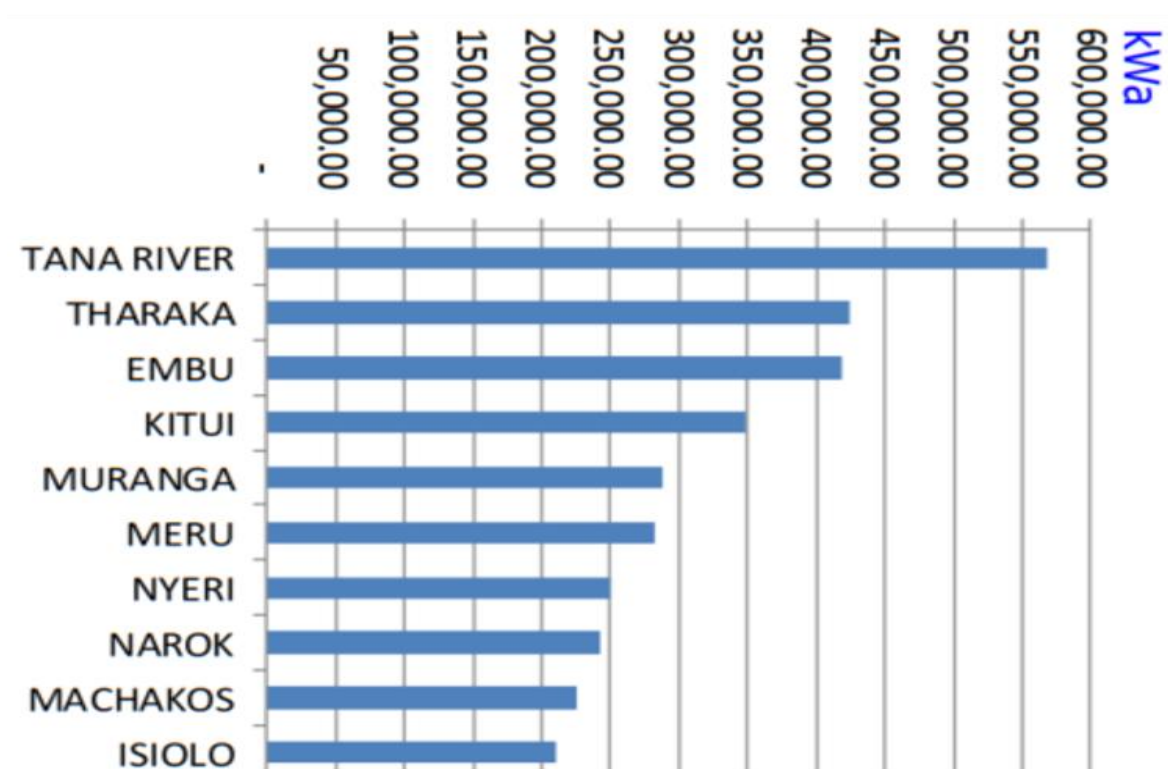


Figure 9: Top 10 County hydro potentials

Resources, Ministry of Energy and Petroleum (2015). Hydropower Resources Atlas of Kenya with Emphasis on Small Hydropower Resources

2.5 Solar Resources

According to the Global Solar Atlas Global Solar Atlas (n.d.), the solar potential in Meru is significant, particularly in the northern parts of the County. Figure 10 below shows the long-term yearly average Global Horizontal Irradiation (GHI) in Meru County with the average GHI being about 2,139 kWh/m². This implies a high potential for photovoltaic electricity production (see Figure 11).

The average potential photovoltaic power output is about 4.67 kWh/kW-peak per day. In other words, a small residential PV system could supply on average more than 1,700 kWh per year.

This small residential PV system could vary in terms of its capacity in kW and how it will be used, however a typical system of 3kW solar system will generate about 12 kWh of electricity each day. This is enough to power a few home appliances, including a fridge, TV, light bulbs, microwave and air conditioner (depending on how much energy the units use)

(EcoWatch, 2023). This can be enough to power a 2-3-bedroom residential house (The Eco Experts, 2023).

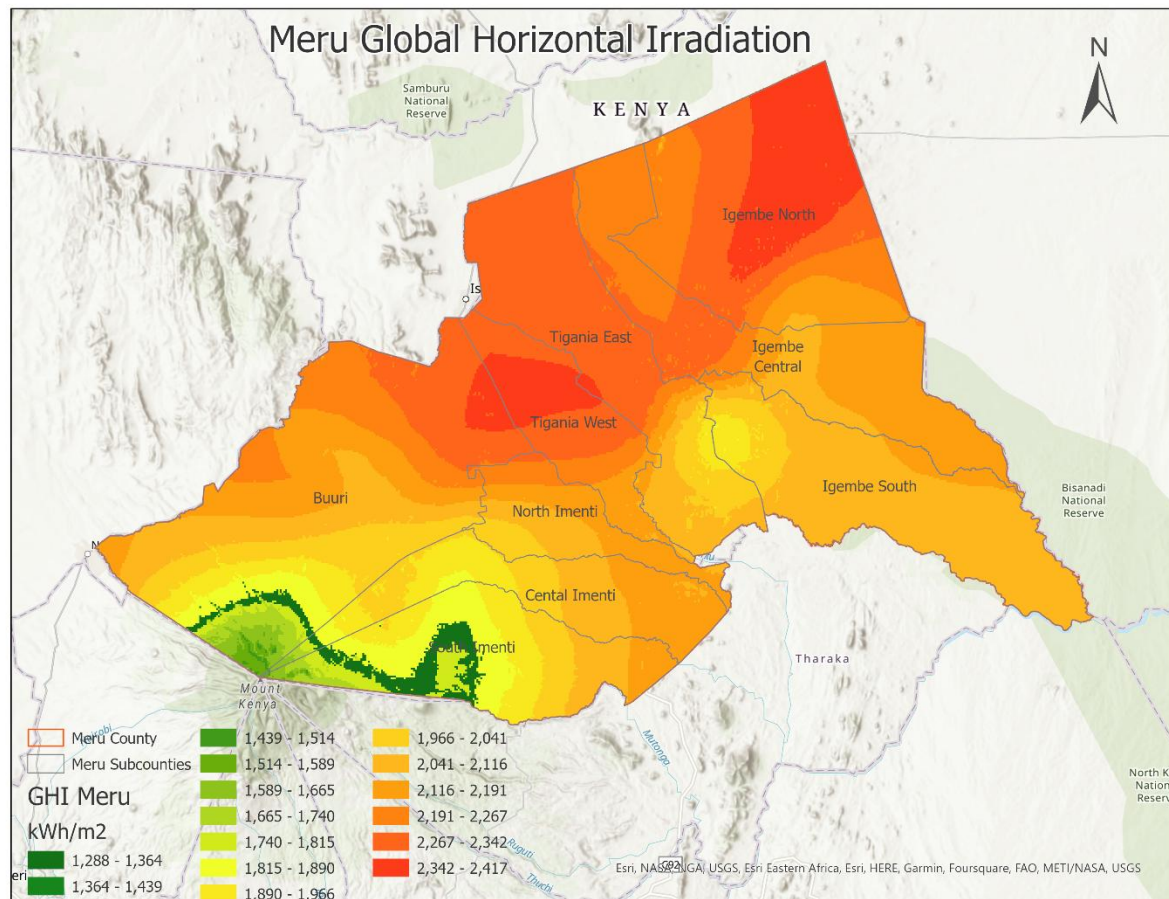


Figure 10: Long-term yearly average of global horizontal irradiation (GHI) in kWh/m2 in Meru County¹

The Northern sub-counties of Igembe North, Igembe Central, Tigania East, Tigania West, and the north-western part of Buuri are endowed with the highest GHI ($> 2,150$ kWh/m²). However, depending on the location on the map, the production in the months of June and July can be 1/3 smaller than the production during January to March and September/October. For a small residential PV system installed in Meru, the average power output is on average 1,580 kWh/kWp corresponding to a Global tilted irradiance of 2,028 kWh/m² per year.

¹ Datasets are on long-term yearly average of global horizontal irradiation (GHI) in kWh/m² and potential photovoltaic electricity production (PVOU^T) in kWh/kWp, covering the period 1994-2018.

Month	Consumption [kWh]
Jan	150
Feb	148
Mar	155
Apr	130
May	125
Jun	105
Jul	98
Aug	112
Sep	142
Oct	145
Nov	120
Dec	132

Meru Photovoltaic Power Potential

The map displays the Meru County area, divided into subcounties: Samburu National Reserve, Igembe North, Tigania East, Tigania West, Buuri, North Imenti, Central Imenti, South Imenti, and Igembe South. The map uses a color scale to represent photovoltaic power potential in kWh/kWp.

Legend:

- Meru County (Red outline)
- Meru Subcounties (Black outline)

Photovoltaic Power Potential kWh/kWp

1,293 - 1,328	1,328 - 1,364	1,541 - 1,577	1,755 - 1,790
	1,364 - 1,399	1,577 - 1,612	1,790 - 1,826
	1,399 - 1,435	1,612 - 1,648	1,826 - 1,861
	1,435 - 1,470	1,648 - 1,683	1,861 - 1,897
	1,470 - 1,506	1,683 - 1,719	1,897 - 1,932
	1,506 - 1,541	1,719 - 1,755	

Data Source: Esri, DigitalGlobe, GeoEye, IGN, AerGRID, AIR, USGS, Esri Eastern Africa, Esri, HERE, Garmin, Foursquare, FAO, METI/NASA, USGS

2.5.1 Solar Potential for Thermal Applications

80

The Solar Water Heating Regulations (2012) were developed by the then Energy Regulatory Commission under the Energy Act No. 12 of 2006. The objective was to promote the uptake of solar water heating solutions (SWH) in industrial, commercial and residential buildings. The expected benefits of this regulation were, (i) enhanced national energy security through diversification, (ii) reduced demand during peaking hours which results in avoiding expensive fossil fuel powered plants, (iii) increased environmental protection through reduction of greenhouse gases (GHG) and (iv) increased employment, technical capacity and income from an expanded SWH industry (EED Advisory, 2017). These regulations make it mandatory for all premises (within the jurisdiction of a local authority) with hot water requirements exceeding one hundred litres per day to install and use solar water heating systems.

Using the methodology developed by EED Advisory in their report the Study of the Solar Water Heating Industry in Kenya (2017), the demand for SWH was estimated for schools and healthcare facilities in Meru.

b) Healthcare facilities

The number of beds per 1,000 people in Kenya is reported to be 1.4 (World Bank, n.d.) In 2022, the projected population of Meru was at 1,775,511. Thus, the total number of hospital beds in Meru based on this amount to about 2,486 beds. The SWH regulations estimate that each bed has a daily hot water requirement of 50L.

Thus, the total requirement comes to 124,286L of hot water daily. If SWH systems of 20m²/1,000L are installed across the medical facilities. Then an average of 124 units will be installed with a total collector area of 2,486m².

Assuming each unit consumes 4kWh per every 100L of water heated, (Solar Thermal World, 2016) this translates to a daily requirement of 40kW for each SWH or a total of 4,960kW for all the SWHs in the healthcare facilities in Meru. Given the average annual GHI for Meru is given as 2,139 kWh/ m², the daily GHI received will be about 5.86kWh/m² resulting in about 117kWh available for each SWH system of 20m²/1000L. Thus, the solar potential in Meru is enough to power the SWH for the health facilities there comfortably.

c) Education facilities

All schools at pre-school, primary and secondary level are considered as well as public universities, Vocational Training Centres, Technical and Vocational Education and Training (TVET) Centres and teacher training colleges. The number of students enrolled was multiplied by the 5L hot water requirement outlined in the SWH regulations to determine the litre requirements at the educational institutions. The numbers of students are outlined in the table below based on data from the 2018-2022 Meru County Integrated Development Plan (The County Government of Meru, n.d.) and the required litres of hot water daily per student plus the total SWHs needed to meet this demand calculated.

Education Institution	Enrolled Students	Litres of Hot Water Required (5L daily/student)	SWHs Units Required (20m ² /1000L)
Pre-School	65,396	326980	327
Primary School	263,892	1319460	1320
Secondary School	93,217	466085	467
Vocational Training Centres (VTCs)	3,333	16665	17
Technical, Vocational Education and Training Centres (TVETs)	6,395	31975	32
Totals	432,233	2,161,165	2,163

Table 12: Hot water and energy demand from education institutions in Meru County

Source: Meru County Integrated Development Plan (2018-2022)

Using the same concept as in the healthcare facilities, there will be a demand of 40kW for each SWH to heat 1,000L of water which translates to a total of 86,520kW for all the SWHs in the education facilities in Meru. Given the average annual GHI for Meru is given as 2,139 kWh/ m², the daily GHI received will be about 5.86kWh/m² resulting in about 117kWh available for each SWH system of 20m²/1000L against a demand of 40kW. This means that once again, the solar potential in Meru is good enough to power this demand in water heating for education facilities.

d) Solar drying

Drying of agricultural produce using solar has been tested historically in Meru to improve value-addition of products and act as a preservation technique for both plants and animal products like meat.

The 2018-2022 Meru County Integrated Development Plan illustrates the pros and cons of using a solar dryer to dry pyrethrum in some parts of Kenya including Meru with some of the highlighted challenges including high procurement costs, inability to work during rainy seasons. However positive sides on it are that it can be used to accelerate the drying process during the hot seasons reducing waste and improving yield value due to longer shelf life hence meeting the needs for export markets. In addition, inclusion of auxiliary sources of power is possible which can make it able to work in rainy seasons.

Another more recent example is this solar tunnel drier that can dry and preserve meat for a year which has been tested in Isiolo (The Standard Media, n.d.). It can enable livestock farmers to dry their meat produce faster than traditional techniques like sun drying to make high-value meat products hence increased value addition and reduced losses. Besides meat, it can also be used to dry vegetables, fruits, herbs and cereals like maize.

With the high solar potential in Meru, these solutions can be explored and tested.

2.6 Wind Power

The Global Wind Atlas provides data that was used to visualise the mean annual wind speed and the wind power capacity factor of Meru County (see below). The capacity factor is defined as the average power generated, divided by the rated peak power (the amount of energy actually produced by a wind turbine compared to the energy produced if the machine ran at its rated power over a given period of time). It is used as a performance parameter for comparing the potential for wind power generation at different sites.

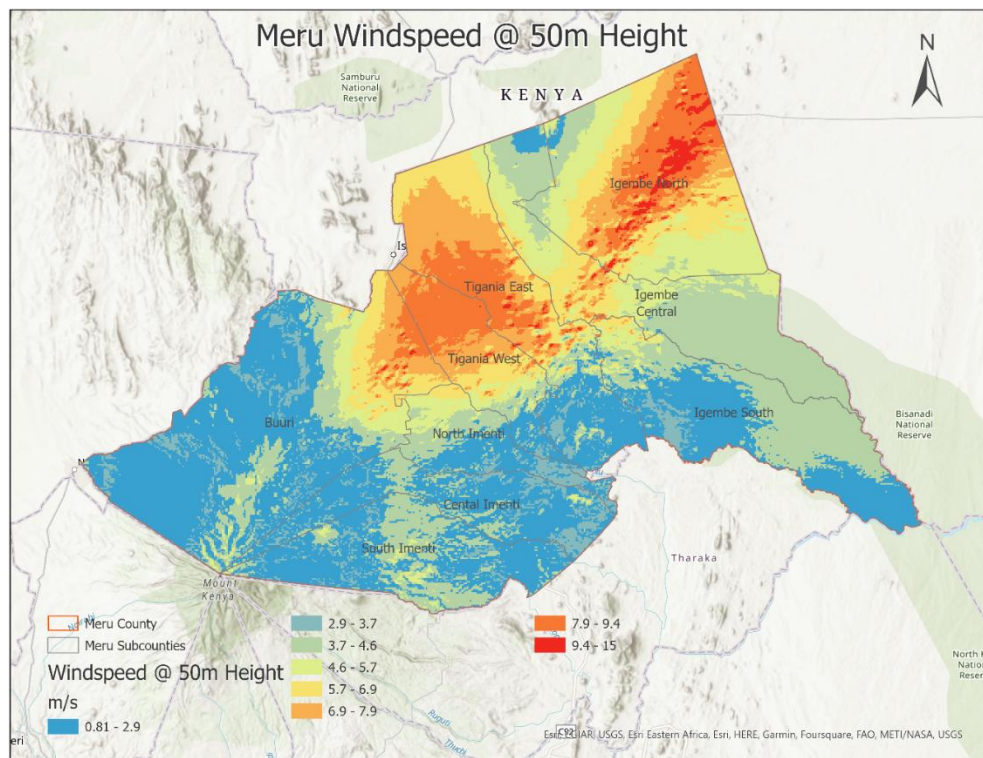


Figure 13: Mean annual wind speed at 100 metre heights for Meru County

Source: The Global Wind Atlas

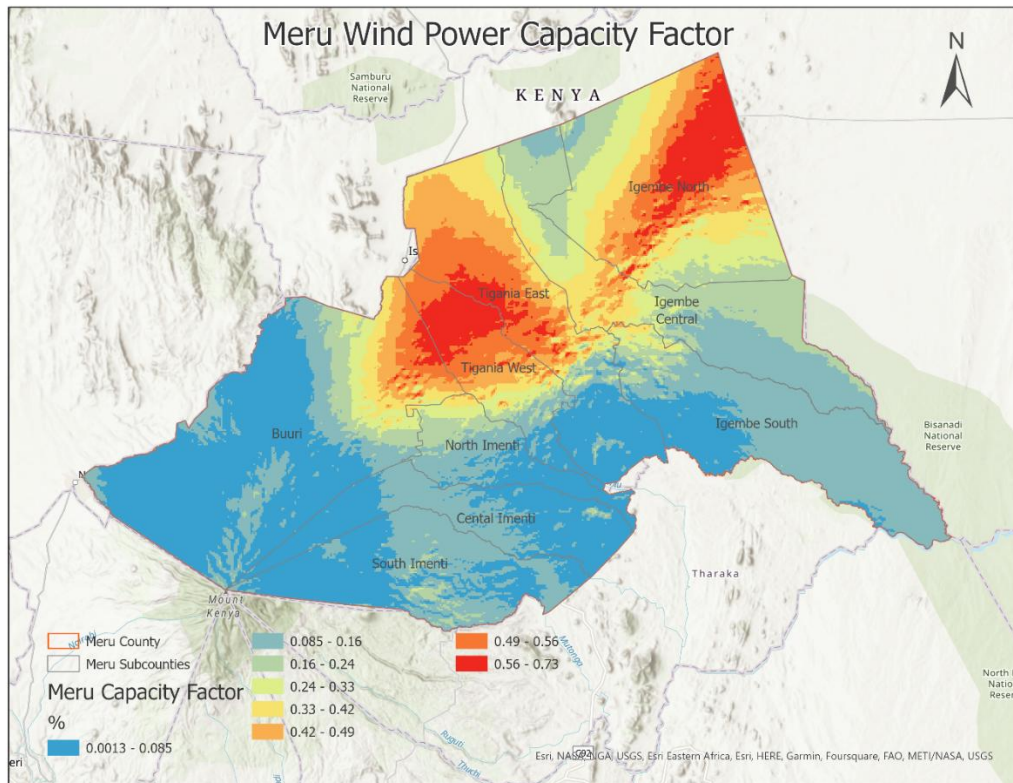


Figure 14: Wind power capacity factor for Meru County

Source: The Global Wind Atlas

According to the wind speed map of Meru County, higher wind speeds of above 6m/s at a height of 50m are located towards the northern parts of the County within Igembe North, Tigania East and Tigania West as well as in some parts of Buuri and Igembe Central sub counties.

This translates to an equally higher percentage of wind power capacity factor² in the same areas as is evident in **Error! Reference source not found.** comparing the average wind power capacity factors across the sub-counties of Meru.

Igembe North, Tigania East and Tigania West sub-counties have wind power capacity factors of 30% and above, an initial indication of potentially suitable sites for wind power installations.

The Global Wind Atlas provides a very rough indication of wind potential to start a more professional prospecting of the resources. High-level wind data based on numerical weather prediction mesoscale model and reanalysis data can be provided by dedicated platforms³. At this stage, the annual energy production (AEP) is low +/- 50%. At least one year of on-site

² Ratio of the average annual production divided by the installed capacity and by 8,760 hours. 1MW wind turbine with an average annual production of 3,000 MWh shows a power capacity factor of 0,34 (potentially a high-capacity factor).

³ E.g., 3tier.com or ul.com.

wind measurement from one or more met-towers or remote instruments is required in the project area. Based on these site data and depending on the local site conditions (slopes, roughness), different models can assess a more accurate AEP. Before securing a bankable wind energy assessment, losses and uncertainty require a specific assessment (estimation of risks).

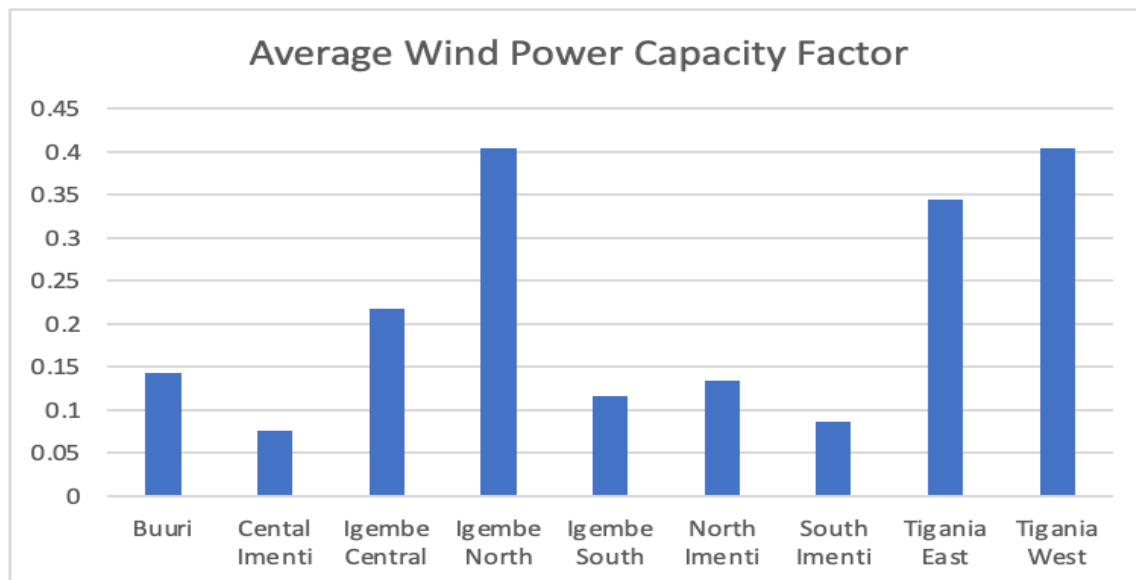


Figure 15: Wind power capacity factor values (%) in Meru County

Source: Global Wind Atlas

The due diligence for starting a prospecting activity may involve conducting a basic desktop analysis, which uses the following data:

- Wind speed or wind energy density for each region of interest from the wind resource maps.
- Proximity to power transmission lines and road network. Regions that are close to infrastructure should be preferred.
- Terrain features and environmental and/or cultural value of regions under consideration. A wind-rich region may be eliminated if it is in high mountain ranges, a national forest, or environmentally or culturally sensitive areas.

Site visits will be organised with the purpose of:

- Triangulate map data with observations on the site (flagging of local vegetation and discussions with the locals)
- Availability of land (size and type of ownership)
- Terrain, elevation, and vegetation

- Soil type and condition
- Availability and quality of roads
- Micrositing of wind measurement locations in the region

2.7 Fossil Fuels

The County is prioritising the deployment of alternative energy resources.

2.8 Nuclear Resources

The County is prioritising the deployment of alternative energy resources.

2.9 Other Energy Resources

There are no other energy resources developments in the County besides the ones described in the previous sections. The previous sections present a detailed analysis of Meru County resource potential with all available data at the time of writing. The table below from the INEP framework is left here for reference but it is not possible to fill it in this format.

PROSPECTIVE SOURCES					
Sector	General description	Potential energy capacity	Unit of Measure	Status of Exploitation	Location4
Biomass					
Wood fuel					
Agricultural residues					
Animal Waste					
Waste					
solid					
Liquid waste					
Geothermal					
potential for different sites					
Hydro					
Potential for different sites					
Solar					
Solar radiation by area					
Wind					
Potential by area.					
Fossil resources-including coal					
Nuclear					
Other energy resources					

Table 13: Prospective Sources

CHAPTER THREE: ENERGY ACCESS

3.1 Electricity Access

This section provides an overview of electricity access in the County. It will cover electricity access trends over time, key stakeholders, strategies, goals and barriers to access.

3.1.1 Policies And Regulations that Relate to Electricity Access

In Kenya, a comprehensive framework of policies and regulations governing the energy sector has bolstered the quest for universal and equitable electricity access. These strategic guidelines have been established by the Government to promote sustainable electricity generation, distribution, and consumption while addressing environmental concerns and economic development. The Energy Policy outlines a strategic roadmap for the sector, while the Energy Act and associated regulations set the legal foundation for licensing, pricing, and quality of service. Moreover, the introduction of the Meru County Energy Plan aligns with these policies and regulations, acknowledging their significance in shaping the future of electricity access at both the national and local levels. By adhering to these policies and regulations, Meru County endeavours to create a resilient and inclusive energy landscape, empowering communities across the country with reliable and affordable electricity.

a. National Energy Policy, 2018

Energy Policy of Kenya serves as a comprehensive and strategic roadmap for the energy sector in the country. It is designed to guide the development, regulation, and management of energy resources, with a particular focus on electricity generation, transmission, distribution, and access. The policy addresses various key aspects to achieve a sustainable and efficient energy sector that can cater to the needs of the growing population and economy of Kenya. In general, its main goals include increasing electricity access, promoting renewable energy sources, and ensuring sustainable development. The policy emphasises private sector participation, energy efficiency, and conservation efforts. It encourages research and development, while fostering public-private partnerships to expedite energy projects. By prioritising environmental considerations and strong governance, the policy aims to achieve a reliable, affordable, and environmentally conscious energy supply to support Kenya's socio-economic growth.

b. Energy Act, 2019

A predecessor of the Energy Act, 2006 this legislative act plays a crucial role in governing Kenya's energy sector, including electricity access. The Act establishes the legal framework for various aspects of the energy industry, encompassing licensing procedures, electricity generation, transmission, distribution, and sale. They provide the necessary guidelines and regulations to ensure the efficient and sustainable management of the energy resources in the country, promoting transparency, accountability, and fair competition among energy companies. With these acts in place, the Government can effectively oversee the development and operation of the energy sector, fostering a conducive environment for private investment, technological advancement, and overall progress in meeting Kenya's energy needs.

c. The Rural Electrification and Renewable Energy Corporation (REREC) Act, 2019

The Rural Electrification and Renewable Energy Corporation (REREC) Act is a significant piece of legislation that created the Rural Electrification and Renewable Energy Corporation in Kenya. This corporation is entrusted with the responsibility of executing rural electrification projects, specifically aimed at enhancing electricity access in remote and underserved regions of the country as well as promoting renewable energy techniques. By focusing on these areas, the act aims to bridge the energy gap between urban and rural areas, promoting socio-economic development and improving the quality of life for the people in those communities. Through the REREC Act, the Government aims to accelerate electrification efforts, stimulate the use of renewable energy sources, and foster sustainable energy practices for a more inclusive and equitable energy landscape in Kenya.

d. The Energy (Electricity Licensing) Regulations, 2012

The Feed-in Tariff Policy is a strategic initiative adopted by the Kenyan Government to promote the growth of renewable energy projects, including wind, solar, and geothermal. Under this policy, renewable energy producers are offered predetermined prices for the electricity they generate, guaranteeing a stable and attractive return on their investments. By providing this financial incentive, the Government aims to attract more private investments in renewable energy, accelerate the deployment of clean energy technologies, and reduce the country's dependence on fossil fuels. The Feed-in Tariff Policy plays a pivotal role in diversifying Kenya's energy mix, increasing energy security, and contributing to the nation's efforts in mitigating climate change and achieving a sustainable energy future.

The revisions to the Feed-in Tariff Policy in 2021 introduced substantial changes to the development of renewable energy projects in Kenya, aligning with the Energy Act, 2019, and recent developments in the energy sector. Notably, the policy now excludes medium to large-scale projects, limiting it to small-scale biomass, biogas, and small hydro projects up to 20 MW. Larger renewable energy projects, including solar and wind, will be procured under the Auctions Policy, using a competitive bidding process for awarding generation licenses. The revisions aim to enhance competitiveness, optimise renewable energy integration, and ensure the economic viability of the sector.

e. The Energy (Electricity Licensing) Regulations, 2012

The Electricity Licensing Regulations are governed by the Energy and Petroleum Regulatory Authority (EPRA), responsible for issuing licenses to electricity companies. These regulations dictate the operations of these companies, encompassing pricing, quality of service, and consumer protection. EPRA plays a vital role in ensuring that electricity providers comply with established standards, deliver reliable services, and safeguard consumer interests, fostering a well-regulated and efficient electricity sector in Kenya.

f. The Energy (Net-Metering) Regulations, 2022

The Net Metering Regulations were introduced to incentivize the adoption of solar PV systems for electricity generation. These regulations facilitate net metering, allowing consumers with solar panels to sell any surplus electricity they produce back to the grid. By enabling consumers to be compensated for their excess generation, net metering encourages

the uptake of renewable energy technologies, such as solar power, promoting sustainable energy practices and reducing the overall demand for non-renewable energy sources in Kenya.

g. The Energy Efficiency Regulations, 2012

The Energy Efficiency Regulations aim to promote the responsible and efficient use of electricity while minimizing wastage. These regulations encourage individuals, businesses, and industries to adopt energy-saving practices and technologies, ultimately leading to reduced energy consumption losses and costs. By improving energy efficiency, Kenya can optimize its electricity resources, enhance energy security, and extend access to electricity to a larger portion of the population, supporting sustainable economic and social development across the country.

h. The Energy (Appliances, Energy Performance and Labelling) Regulations, 2016

The regulations are designed to promote energy efficiency in household appliances. These regulations mandate the labelling of certain appliances, such as refrigerators, air conditioners, washing machines, and lighting products, with energy efficiency information. The labelling includes energy consumption ratings, allowing consumers to make informed choices when purchasing appliances. The labelling system usually uses energy efficiency labels with specific ratings, ranging from highly efficient (e.g., A+++ or 5-star rating) to less efficient (e.g., D or 1-star rating). This allows consumers to identify and choose appliances that consume less energy, resulting in reduced electricity bills and environmental benefits.

3.1.2 Key Stakeholders Involved in Electricity Access

The pursuit of reliable and affordable electricity access for a broader population in Meru relies on a diverse array of stakeholders, each playing a specific role in the energy sector. These stakeholders, ranging from Government institutions and electricity providers to consumers and development partners, hold unique capacities and interests that are essential for achieving this shared goal (see Table 14 below). In this stakeholder analysis, we explore the roles and level of interest of key actors involved in Meru's electricity access landscape, emphasising the significance of collaboration and coordination among them. Understanding the dynamics and contributions of these stakeholders is critical in formulating effective strategies that pave the way for a sustainable and inclusive energy future in the County.

Stakeholder	Type of Stakeholder	Role/ Responsibility	Level of Interest/Influence
Government Institutions	Ministry of Energy and Petroleum (MoEP)	Setting energy policies, strategies, and overseeing the energy sector's development, including electricity access initiatives.	High
	Energy and Petroleum Regulatory Authority (EPRA)	Regulates the electricity industry, issues licenses, sets tariffs, and ensures compliance with regulations.	

Stakeholder	Type of Stakeholder	Role/ Responsibility	Level of Interest/Influence
	Rural Electrification and Renewable Energy Corporation (REREC)	Implements rural electrification projects to increase electricity access in underserved areas and promote renewable energy technologies.	
	County Governments (CG)	Collaborate with national agencies to enhance electricity access in their respective regions and promote rural electrification projects.	
Electricity Generation Companies	Public and Private Power Producers	Generate electricity through various sources, such as thermal, hydro, geothermal, solar, and wind power plants, to supply the national grid.	High
	Independent Power Producers (IPPs)	Contribute to electricity generation through privately owned and operated power plants.	
Electricity Transmission and Distribution Companies	Kenya Power and Lighting Company (KPLC)	The national utility responsible for electricity transmission and distribution, ensuring electricity is efficiently delivered to consumers across the country.	High
Renewable Energy Developers and Investors	Companies and investors	Involved in developing and financing renewable energy projects like solar, wind, and geothermal power plants, which contribute to electricity access and sustainability.	High
Consumers and End-Users	Individuals, households, businesses, and industries	Consumers of electricity for various purposes, driving the demand for electricity access.	High
Development Partners and Donor Organisations	International organisations, NGOs, and bilateral/multilateral donors	Provide financial and technical support for electricity access projects, especially in rural and underserved areas.	Medium to High
Academic and Research Institutions	Universities and research organisations	They conduct studies, gather and analyse data, and provide insights to support electricity access planning, policy formulation, and technological advancements.	Medium
Civil Society Organisations (CSOs) and Community-Based	CSOs and CBOs	Play advocacy roles, representing the interests of communities and advocating for improved electricity access,	High

Stakeholder	Type of Stakeholder	Role/ Responsibility	Level of Interest/Influence
Organisations (CBOs)		especially in marginalised areas.	

Table 14: Mapping of key stakeholders in electricity access in Meru County

3.1.3 Past and Current Initiatives on Electricity Access

a. Meru County Energy Park (Athwana Ward, Tigania West)

In collaboration with Hewani, a global renewable energy developer, Meru County (through Meru County Development and Investment Corporation (MCIDC)) aims to establish Africa's first utility-scale hybrid renewable energy facility, integrating wind, solar, and battery technologies. With a capacity of approximately 80MW, the Meru County Energy Park will feature up to 20 wind turbines and over 40,000 solar panels. This cutting-edge facility is projected to attract over USD 150 million in investments to the County and deliver reliable, predictable renewable energy to power more than 200,000 Kenyan homes. A flagship project of the Meru County Investment and Development Corporation (MCIDC), the Energy Park is a testament to successful Public-Private Partnership (PPP), with the County holding a stake in the project's operations.

b. Rural Electrification Projects (Last Mile Connectivity)

The Rural Electrification and Renewable Energy Corporation (REREC) has been implementing projects to extend the electricity grid to rural and underserved areas in Meru County. These initiatives aim to bring electricity connectivity to remote communities, improving living conditions and enabling economic development.

c. Proposed 300 MW Solar PV/Wind Hybrid Power Plant with Storage

Spearheaded by the Meru County Investment and Development Corporation (MCIDC), and Renewable Energy Corporation (REREC), this Public Private Partnership (PPP) innovative initiative aims to create Africa's largest utility-scale hybrid renewable energy facility, merging solar, wind, and storage technologies. The Solar PV/Wind Hybrid Power Plant with Storage is a Greenfield project, planned to span approximately 5,000 acres of land, ideally situated around 50KM from Isiolo-KETRA 132kV substation. Its strategic location allows it to tap into the region's ample solar and wind resources to generate electricity efficiently. Through a Public-Private Partnership model, the project leverages private capital and expertise to complement the Government's commitment to universal energy access. With the integration of solar photovoltaic and wind technologies, the initiative ensures a consistent and dependable energy supply. Additionally, energy storage systems enhance grid stability, guaranteeing seamless electricity delivery even during periods of low renewable energy generation. The 200 MW Solar PV, 80MW Wind and 20MW Storage Hybrid Power Plant holds the potential to inject over USD 150 million in investments, driving economic growth and creating job opportunities for local communities.

d. Proposed Training and Capacity Building

Programmes that focus on training and capacity building in the energy sector i.e. training of solar technicians and Women in Energy Enterprises in Kenya (WEEK project) are expected to be implemented within the current span of the CEP. These initiatives aim to enhance local skills in energy management, renewable energy technologies, and maintenance.

e. Proposed Energy Efficiency Programmes

Energy efficiency initiatives will be introduced to promote responsible energy consumption and reduce wastage. These programmes target both households and businesses, encouraging the adoption of energy-saving appliances and practices.

f. Proposed Public Awareness Campaigns

Public awareness campaigns will be carried out to educate the population about the benefits of sustainable energy practices, renewable energy technologies, and the importance of electricity access.

3.1.4 Progression to Universal Access to Electricity

This section covers the planned on-grid connectivity rate together with the off-grid alternatives to enable achievement of 100% access to electricity by the year 2026. The County is to target minimum levels of access to allow for “empowerment” for people in underserved communities with minimum energy targets necessary to improve education, accelerate the transfer of knowledge, facilitate communication, and promote entrepreneurship, with reference to the Multi-tier Framework (MTF) for energy access (ESMAP, n.d.).

The targets for on-grid and off-grid connectivity progression are to be summarised in **Error! Reference source not found.**, and the trend of levels and electricity generation and consumption commercially, on-grid, off-grid and standalone in Table 16.

It has not been possible to complete these tables due to a lack of data and the limitations of time and budget for comprehensive data collection through the CEP process.

As advised in the draft INEP Framework (2023), this CEP has used KNBS 2019 to provide baseline data on types of technologies and fuels used for access to household lighting in 2019 (see Table 17: *Percentage distribution of conventional households by main type of lighting fuel* below) In addition, the next section discusses the provision of minimum levels of electricity access to enable households (lighting and different tiers of access), community services (water, health and street lighting) and productive activities (crop and poultry farming) as part of holistic solutions, with targets for different years across the next CIDP cycle.

Year	2019	2020	2021	2022	2023	2024	2025	2026

Total connectivity of the HHs in %								
Total connectivity of the SMEs in %								
Total connectivity of the industries in %								
Total connectivity of the institutions in %								
HH connected to solar home systems								
HH connected to mini grids								

Table 15: Summary of electricity generation and consumption in the County

Year	2019	2020	2021	2022	2023	2024	2025	2026
Households (kWh)								
Public Institutions/Facilities (kWh)								
Commercial and Industrial Customers (kWh)								
Water and street lighting (kWh)								
Total units sold (kWh)								

Table 16: Summary of electricity generation and consumption in the County

Volume IV of the Kenya Population Households Census (KNBS, 2019) shows the use of different energy sources in the County for access to household lighting. Across the County's 423,931 households, most use electricity as the main energy source for lighting at 40.2%. The use of solar was also reported to be a preferred energy source for lighting at 18.8% followed by Lamps at 13.9% and Paraffin Lanterns at 11.0%. Least preferred sources of energy for lighting were reported as Biogas (0.0%), Generator (0.0%), Gas Lamp (0.2%), Paraffin Pressure Lamp (0.5%), Battery/car charger (0.6%) and wood (1.5%).

County/ Sub-County	Type of Lighting Fuel (%)														
	Conventional HH	Mains	Paraffin Pressure lamp	Paraffin Lantern	Paraffin Tin lamp	Gas Lamp	Wood	Solar	Torch/ Spotlight / Solar Charged	Torch/ Spotlight - Dry cells	Candle	Battery (Car/ Charged)	Generator (Diesel/ Petrol)	Biogas	Not Stated
Meru	423,931	40.2	0.5	11.0	13.9	0.2	1.5	18.8	3.6	8.3	1.5	0.5	0.0	0.0	0.0
Buuri East	23,737	41.5	0.6	14.9	10.0	0.2	0.6	23.0	4.5	3.2	1.1	0.5	0.0	-	0.0
Buuri West	27,905	53.5	0.4	8.6	7.9	0.1	0.4	17.8	4.6	3.7	1.6	1.1	0.2	-	0.0
Igembe Central	51,848	22.3	0.6	12.1	16.1	0.3	2.5	24.3	4.0	14.9	1.9	1.0	0.0	0.0	0.0
Igembe North	38,716	19.6	0.6	9.3	16.4	0.2	4.2	29.1	4.6	13.7	1.8	0.4	0.0	0.0	0.0
Igembe South	43,222	36.2	0.3	9.6	12.0	0.2	1.5	15.8	3.4	18.1	2.2	0.6	0.0	0.0	0.1
Imenti North	57,556	73.1	0.2	6.3	7.5	0.1	0.2	8.2	1.3	1.6	1.2	0.1	-	-	0.0
Imenti South	63,954	54.4	0.6	10.7	10.9	0.1	0.4	13.5	2.9	4.6	1.5	0.2	0.0	0.0	0.0
Meru Central	39,498	44.3	0.4	11.3	11.6	0.1	0.8	18.8	3.5	7.4	1.3	0.4	0.0	0.0	0.0
Tigania Central	24,983	19.5	0.8	14.8	23.2	0.2	2.6	19.2	3.4	14.5	1.4	0.5	-	0.0	0.0
Tigania East	16,791	19.2	0.2	14.5	17.5	0.4	5.1	28.2	9.7	4.3	0.6	0.2	0.0	0.0	0.1
Tigania West	35,402	23.9	0.6	15.9	28.1	0.3	0.9	23.0	3.4	2.9	0.7	0.4	0.0	0.0	0.0
Meru National Park	46	93.5	-	-	-	-	-	-	-	2.2	-	-	4.3	-	-

Mt. Kenya Forest	273	8.8	-	9.5	7.7	0.4	12.8	1.8	8.1	50.2	0.7	-	-	-	-

Table 17: Percentage distribution of conventional households by main type of lighting fuel

Source: KNBS (2019)

3.2 Development of Electricity Goals and Strategies to Promote Electricity Access

This section includes the areas of the energy access outlook, goals, specific objectives and strategies to promote electricity access in Meru County, as mandated under the INEP Framework (2023). The structure has been amended after discussion with the County Government team and national MoEP to take account of the methodology used to develop the CEP and the available data.

The section on Future energy access outlook provides an in-depth analysis of six electrification scenarios based on different levels of supply-demand, drawing on the MTF tiered approach as mandated, and the least (or levelized) cost of delivering electricity for each. It concludes with potential pathways for Meru that have informed the projects and investments proposed, including access to household lighting for those households currently using kerosene or with very low electricity consumption.

Sections on Priority goals, strategies, and interventions, given the EDM planning approach of energy as an enabler of development priorities in Meru, the INEP sub-sections on “goals for electricity access”, “strategies to promote access”, and “intervention options” have been used to discuss the six priority need sectors and the solutions developed for each (comprising energy and non-energy components). These are clustered into household and community services; followed by productive uses of energy. The solution areas are as follows: access to improved household lighting, access to improved basic health services, and access to clean and affordable water provision. In the section on productive uses of energy, increased income from crop agriculture and livestock farming are covered. Finally, access to cleaner, safer and affordable cooking fuels and technologies is covered also.

It should be noted that the discussion highlights how the needs for specific priority target groups were identified, analyses the energy and non-energy gaps or barriers preventing these needs being currently met. The gaps or barriers are addressed holistically as different components of a single solution under “Strategies to promote access” and turned into scalable projects or programmes under the “Intervention options” section. These projects are fully costed and identify expected outputs for each phase (Demonstration and Scale up), stakeholders' roles and sources of funding, and risks and mitigation strategies. For each solution, an initial implementation plan with suggestions for monitoring and evaluation indicators is included. These project interventions are also summarised in Chapter 6.

The solutions also integrate aspects of the cross-cutting themes mandated in the INEP Framework of promoting gender and social inclusion (GESI), climate change action, energy efficiency and conservation, with an emphasis on operationalising these during project implementation. Colour coding has been used to highlight these aspects as follows: orange text for GESI aspects; green text for climate change aspects and blue text for energy efficiency and conservation aspects.

3.2.1 Future Energy Access Outlook

3.2.2 Least-Cost Electrification for Meru County

a. Overview and Background

As part of the Integrated National Energy Planning (INEP), the County Energy Planning (CEP) aims to explore the least-cost electrification options to reach universal access in Meru County by 2030. By 2023, 58.5 % of the households living in the County were not connected to the national grid¹ and 23% relied on kerosene as their primary lighting source². At the same time analysis conducted as part of developing the Meru County Energy Plan (CEP) shows 87,3% are within connection distance of an existing transformer (600 metres radius as the accepted Government definition) - see Figure 16. Reasons for this are likely to include affordability, challenges in getting connected, relatively low electricity consumption and associated demand from many lower income households.

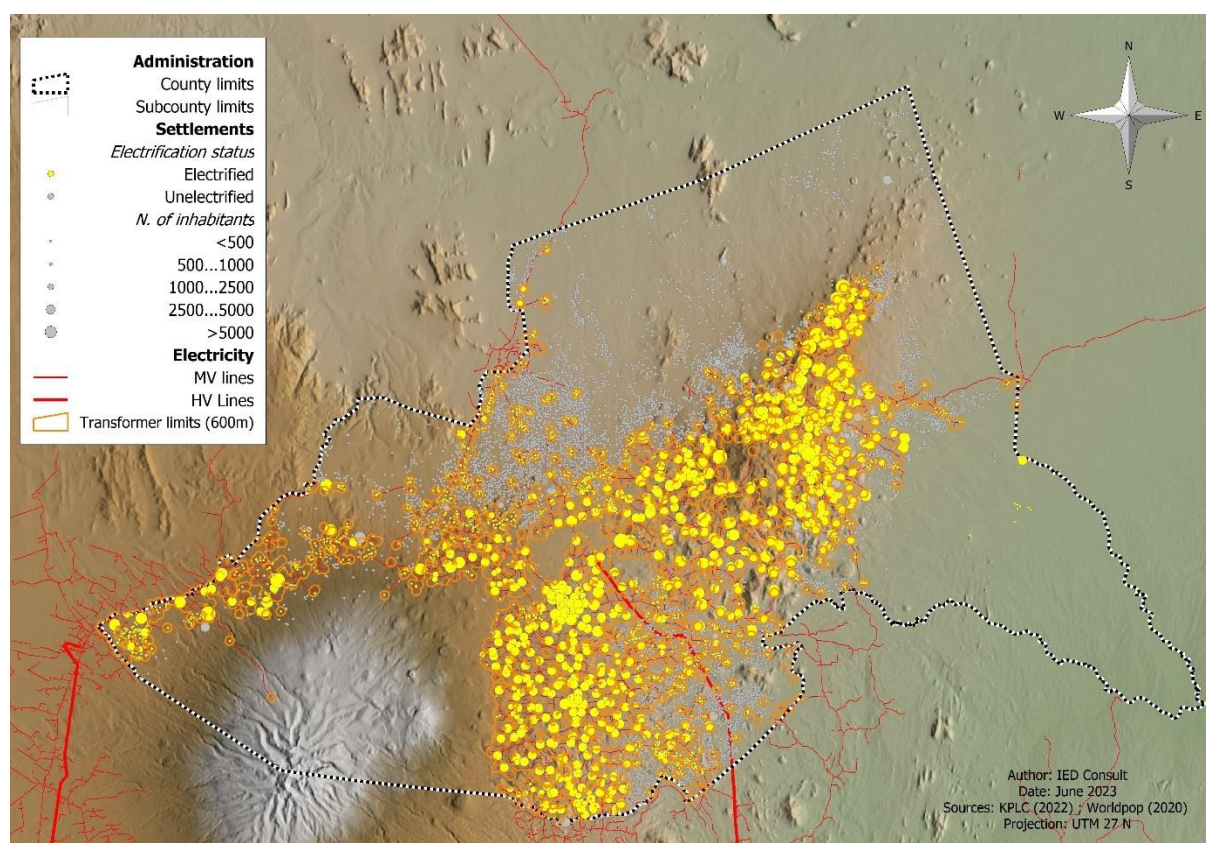


Figure 16: Electrification status of population clusters in relation to transformers

Taking into account the range of electricity demand, six scenarios corresponding to different levels of consumption - or tiers of access, according to the Multi-Tier Framework or MTF approach developed by the Energy Sector Management Program of the World Bank⁵ - were

⁵ <https://mtfenergyaccess.esmap.org/>.

tested for rural and urban areas to identify the best electrification option and quantify the investment required to give access to electricity to every community across the geography of Meru. As indicated in Table 18 below, levels of consumption ranged from Tier 1 (a level of service sufficient to power task lighting and phone charging or a radio) to Tier 4 (allowing the use of medium and high-load appliances such as laptop, fridge, rice cooker, washing machine, iron, hair dryer, toaster or microwave) as well as small business operation – so called productive use of energy.

The geographically dispersed population is divided into small units of analysis referred to as population ‘clusters’ of which 92% have less than 1,000 inhabitants and 8% from 1,000 to 9,000 inhabitants.

Scenario	Urban	Rural	Annual Energy (kWh)	Capacity (W)
	Tier	Tier		
1	Tier 4	Tier 1	9.125	11
2		Tier 1	40.15	40
3		Tier 2	51.465	50
4		Tier 2	104.39	120
5		Tier 3	200.75	200
6		Tier 3	1095	750

Table 18: Energy consumption scenarios explored for Meru least-cost electrification planning

b. Methodology

All the analysis was conducted using a GIS model developed specifically for the Meru County electrification plan.

First, in order to obtain the greatest accuracy, a set of 6,993 population clusters were defined using a continuous raster surface representing the population density of the County. Population estimates for both rural and urban clusters were then cross checked with the population data of the national census 2019.

The electrification status of the clusters was defined based on the location of step-down transformers through a GIS data layer provided by KPLC. Clusters that are located fully or partially within a 600m buffer around transformers (maximum distance at which households are generally located from transformers) were considered ‘electrified’. It should be noted that this is not synonymous with every household being connected to the grid. As discussed above, Meru has a relatively low connection rate for current grid-penetration. Clusters that did not overlap with the buffer were considered unelectrified.

Using these population clusters as a starting point, the geospatial electrification tool GEOSIM was then used to calculate the investments and operating costs related to the development of electrification projects. Different supply options were proposed to reach universal access:

- Grid densification – to connect unelectrified households in already electrified cluster.

- Grid intensification – to electrify housing clusters within a perimeter between 601 to 1,500 meters from an existing transformer.
- Grid extension – consisting in extending the interconnected grid to the clusters in unserved areas.
- Mini-grids (both PV and hybrid) – deployed in small and medium sized clusters located far from the interconnected network.
- Solar home systems (SHS) – standalone systems to reach households in very sparsely areas OR in densification or intensification areas when the price of a SHS becomes lower than a grid connection for an equivalent level of consumption. This tends to be the case with lower levels of consumption.

The choice of the best electrification option was based on the lowest levelized cost of electricity (LCOE): the ratio between the lifetime costs divided by the electricity production of a project. For conventional electrification solutions like grid or mini-grid connections, as the size of the localities and the level of consumption increase (from Tier 1 to Tier 4), the LCOE decreases. The LCOE of SHS does not change insofar as these solutions are individual. The investment for each electrification project, as well as the OPEX costs were calculated from the current costs of equipment in Kenya.

c. Least Cost of Electrification Results For Meru County

Considering the 187,000 households already electrified, 307,000 households will need to be electrified to achieve universal access. As shown in Figure 17, the total investment for achieving this objective varies greatly from one scenario, and therefore from one level of expected consumption to another.

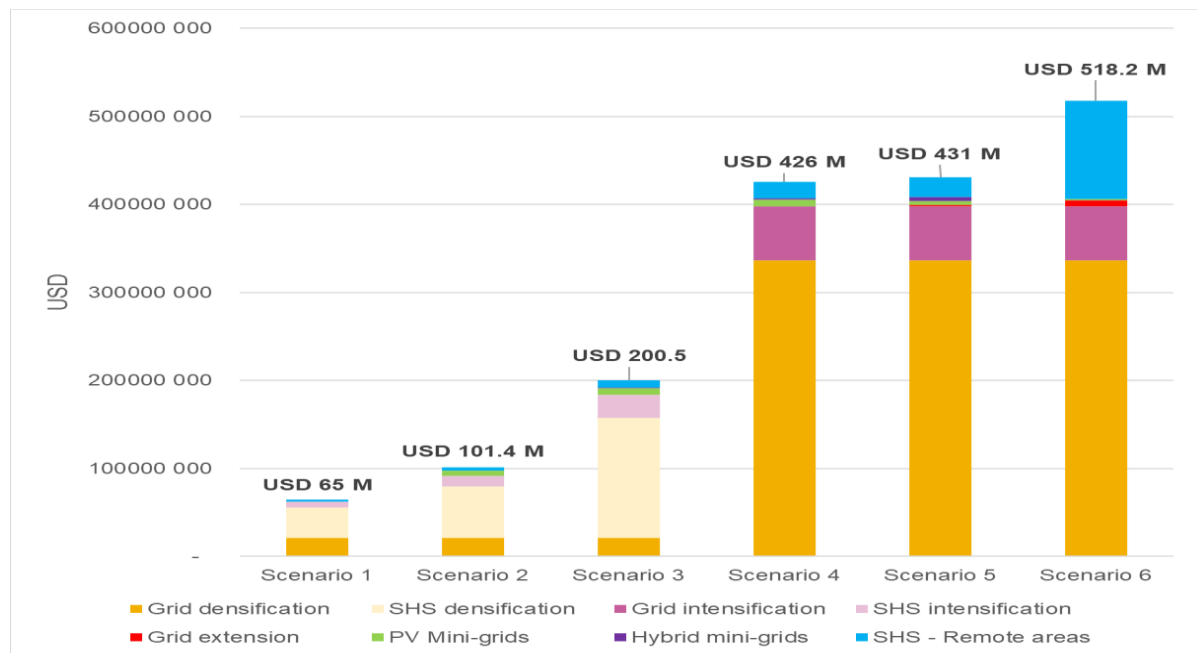


Figure 17: Summary of investments by scenario for universal access in Meru County.

In Scenario 6, with a high level of consumption (equivalent to Tier 4), electrification will mainly take place through the development of the existing network in order to obtain the lowest LCOE (from USD 0.22 to USD 0.275 per kWh). In this scenario, 95% of the households would be electrified by grid connection (80% via grid densification, 14% via grid intensification, 1% by grid extension) and 5% would be electrified via SHS. Only 3 PV mini grids would be considered across Meru County. This would imply an investment of USD 518.2 million. See Table 19 and Figure 17 below.

Supply option	Scenario 1	Scenario 2	Scenario 3	Scenario 4	Scenario 5	Scenario 6
Grid densification	23 972	23 972	23 972	246 744	246 744	246 744
Share (%)	8	8	8	80	80	80
SHS densification	222 772	222 772	222 772			
Share (%)	73	73	73			
Grid intensification				43 191	43 191	43 191
Share (%)				14	14	14
SHS intensification	43 191	43 191	43 191			
Share (%)	14	14	14			
Grid extension					259	2 988
Share (%)					0	1
PV Mini-grids		2 655	2 882	2 548	1 353	
Share (%)		0	1	1	0	
Hybrid mini-grids			393	727	1 663	287
Share (%)			0	0	1	0
SHS - Remote areas	17 287	14 632	14 012	14 012	14 012	14 012
Share (%)	5	5	4	5	5	5
Total	307 222	307 222	307 222	307 222	307 222	307 222

Table 19: Investment by scenario and supply option

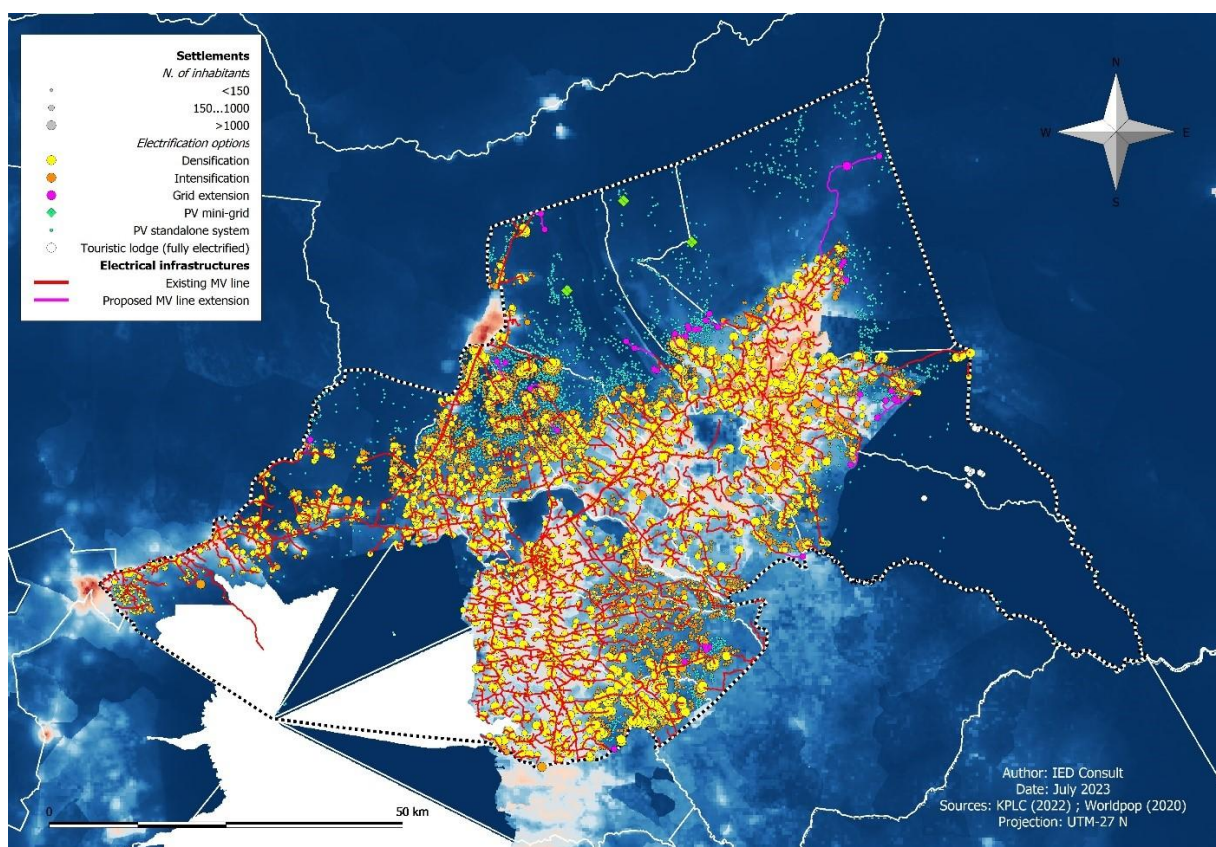


Figure 18: Electrification planning of Meru County - Scenario 6

Scenarios 5 and 4 are quite similar to scenario 6. Of the 307,000 electrified households, approximately 94% will be through grid densification and intensification. The two notable changes come from (i) the electrification of certain large clusters located in rural areas by the installation of PV/diesel and PV mini-grids instead of the interconnected grid (ii) a reduction in costs related to the deployment of SHS with lower capacities than those of scenario 6. For rural access to medium-load appliances, between USD 426 and USD 431 million will be needed.

The structure of the County's electrification plan changes drastically for scenarios 1,2,3 compared to the three upper scenarios. In these scenarios, only urban households located in the densification area would be electrified via the national grid due to their expected high level of consumption. All the others (92% of all households to be electrified) would be by SHS, and to a lesser extent by PV mini-grids for scenarios 2 and 3. SHS capacity make the investment change from USD 65 million to USD 200 million depending on whether households simply have access to lighting or are able to equip themselves with small appliances (television, fan or computer for example). See Table 20.

Supply option	Scenario 1	Scenario 2	Scenario 3	Scenario 4	Scenario 5	Scenario 6
Grid densification	23 972	23 972	23 972	246 744	246 744	246 744
Share (%)	8	8	8	80	80	80

SHS densification	222 772	222 772	222 772			
Share (%)	73	73	73			
Grid intensification				43 191	43 191	43 191
Share (%)				14	14	14
SHS intensification	43 191	43 191	43 191			
Share (%)	14	14	14			
Grid extension					259	2 988
Share (%)					0	1
PV Mini-grids		2 655	2 882	2 548	1 353	
Share (%)		0	1	1	0	
Hybrid mini-grids			393	727	1 663	287
Share (%)			0	0	1	0
SHS - Remote areas	17 287	14 632	14 012	14 012	14 012	14 012
Share (%)	5	5	4	5	5	5
Total	307 222	307 222	307 222	307 222	307 222	307 222

Table 20: Number of new connections by supply option and scenario

Since 2007, Kenya's Rural Electrification Authority (REA) has rapidly expanded the national grid, installing electricity distribution lines and transformers across many of the country's rural areas. In Meru County, the national grid is also already very dense. Even if electrified clusters represent only a third of all the localities, 80% of the population clusters are located less than 1.6 km (one mile) from the interconnected network and 87.3% of the total population already lives in an electrified settlement. Therefore, Meru County has a solid base for the electrification of the remaining clusters, which could be connected with a moderate level of effort.

Even if the population coverage rate is good, universal access to electricity in Meru County is still a major challenge. Indeed, despite the density of the national network, too many "under grid" households are not connected, which reflects real problems around connectivity. Beyond the many technical and social factors that can impact access and quality of service, low connectivity access can mainly be explained by the connection cost that is out of reach for most of the poor and rural households.

Since 2004, the electricity connection price for a household within 600 meters of an electric transformer has been set at USD398 (35,000 KES). This usually includes two poles, the meter and the service line but the full cost for supplying a single connection in a grid-covered area was estimated by KPLC at USD 1,435. Since 2015 and the launch of the Last Mile Connectivity Project (LMCP) the price has been lowered to USD171 (15,000 KES) thanks to the support of the World Bank and the African Development Bank. However, in 2019, a study conducted by Lee & all3 showed that only 23.7 percent of rural households would take-up even at a similar connection price. Results of this energy planning work for Meru show that the connection costs in the densification areas (with 100% access) will be similar to those estimated by KPLC but will naturally be much higher as the localities are further from the interconnected network (see Table 21 below). A high level of subsidy for connections to households, especially the most isolated, will therefore remain important – and as shown in

Table 5 below, use of lower-cost alternatives like PV SHS where consumption remains low. Access to specific credits could also help rural households to pay the up-front cost associated with electrification.

	Scenario 1	Scenario 2	Scenario 3	Scenario 4	Scenario 5	Scenario 6
Densification (urban / rural)	564 / 154	564 / 263	564 / 610	564 / 1450	564 / 1450	564 / 1450
Intensification	154	263	610	1450	1450	1450
Extension					1737	2241
PV Mini-grids		2571	2858	2975	3624	5368
Hybrid mini-grids			1577	2022	2883	
PV SHS	154	263	610	1450	1588	7973

Table 21: Summary of connection cost to supply a single household in a grid-covered area

The unit cost of electricity could also be another important obstacle to some households' willingness to connect. The cost of the electricity unit could also be another obstacle to some households' desire to connect. For now, the base power prices are USD 0.086 and USD 0.11 per unit for those who consume less than 30 and 100 units but the simulations made for this plan result in prices above USD 0.22 on-grid and above USD 0.4 off-grid for the most optimistic scenarios and options. See Table 22.

	Scenario 1	Scenario 2	Scenario 3	Scenario 4	Scenario 5	Scenario 6
Densification				> 0,8	> 0,43	> 0,22
Intensification				> 0,8	> 0,43	> 0,22
Extension					0,923	0,275
PV Mini-grids		1,801	1,589	0,841	0,486	0,526
Hybrid mini-grids			1,097	0,860	0,743	
PV SHS	2,5	2,3	2,2	1,9	1,8	1,3

Table 22: Levelized cost of electricity (USD/kWh) according to electrification options and scenarios

d. Conclusions

The LCoE modelling has identified different opportunities to achieve universal access by 2030 in Meru County, both on-grid and off-grid. The investment required for each scenario is therefore calculated with a household connection rate equal to 100%. However, we must keep in mind that this objective is very ambitious, particularly in relation to the ability of rural households to finance their connection, and that the connectivity rate envisaged in the medium term is always overestimated by decision-makers.

The decision on where the national grid is extended further and where efforts are made on intensification to actually connect the many unconnected households that already sit within access to the grid is a political decision. From a commercial perspective it would be prudent to prioritise the connection of unconnected households in urban areas and to target localities in rural areas offering the best economic potential to generate incomes and to support the demand. However, this will exclude households with lower incomes and not deliver on the 100% access goal.

The evidence from this report clearly shows that if household demand levels remain low within tier 1&2 that the most cost-effective approach would be to deploy standalone PV Solar Home Systems. These systems have the added advantage of rapid deployment and many come packaged with PAYGO loans, requiring significantly less Government investment. As levels of demand build, it makes sense from a cost perspective to connect households to the grid, but as noted above household affordability will remain a challenge.

Solar home systems are still an affordability challenge for those on lowest income households. Targeting households currently using kerosene with affordable Standalone Solar Systems is a priority for Meru County Government, and a fully costed project targeting these households is detailed in Chapter 3 and summarised in Chapter 6.

3.2.2.1 Lighting Sector Goals and Strategies to Promote Electricity Access

I. Overview of The Sector and Background

By 2019, the level of grid electrification (mains electricity) across Meru was 40.2% of total households in the County (KNBS, 2019). Yet, there is a significant disparity across the County, and sub-counties such as the Tiganias, Igembe North and Central have less than a quarter of their households connected to the grid. And although many households in these sub-counties are close to the existing transformers, many still remain unconnected. Reasons for this are varied and often interlinked, one significant reason being high costs of connection and ongoing usage. The limited grid connectivity in these regions, and for those unelectrified in general, creates an opportunity to identify and compare off-grid energy solutions with standard grid roll-out. In addition, a large number of households in these sub-counties still rely on non-modern form of energy, mainly kerosene, as their primary lighting fuel. See Figure 19 summarising the main energy sources used across the County.

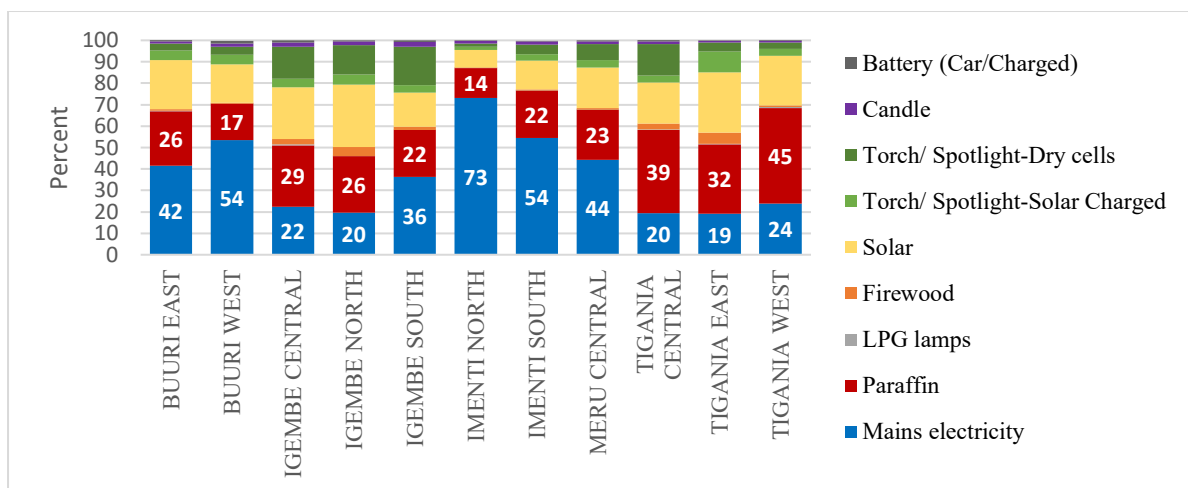


Figure 19: Primary lighting source by sub-County

Meru Vision 2040 envisages that the County will achieve universal access to electricity by 2030. And different programmes have been implemented to hit this target, including the dissemination of solar lanterns and standalone solar systems to replace traditional means such as kerosene and firewood for lighting (County Government of Meru, 2019). The private sector is also actively contributing to bridging the energy access gap and the sale of off-grid solar products has rapidly increased over the last years. This success is largely attributed to the adoption of business models such as pay as you go (PAYGO) which attracted a number of players over the years – e.g. Sunking, D.Light, M-Kopa, Solar Panda, Azuri, Bboxx, Engie, Bright, Spark Possibilities, and Azuri, among others. The PAYGO model offers a more affordable financial scheme to low-income households – mainly targeting entry to mid-level off-grid quality packaged solar systems. However, many households still lack access to a modern source of energy as the existing business models are failing to address some of the most common barriers such as, affordability, lack of awareness on the benefits of alternative energy sources and limited access to pre and after-sale services in remote areas.

Meru County Government aims to work ambitiously in the off-grid space to create new affordable opportunities for electrification through household solar, and to deliver on the universal electrification targets in Meru Vision 2040 and under Sustainable Development Goal 7.

In addition, County Government of Meru aims to improve safety and security in small towns by expanding the street and floodlighting infrastructure in public spaces. To address this need, the County Energy Directorate will require more technical staff – and capabilities - in the Directorate dealing with the recurrent maintenance of the street and floodlighting network.

II. Challenges, Priorities and Needs

There are various -and different- challenges preventing households in Meru from transitioning to modern, reliable, and affordable sources of energy. From a GESI perspective, low-income and rural households – particularly women, people with disabilities, and other

marginalised groups, face bigger challenges to have access to reliable, affordable, and clean sources of energy.

The most typical challenges can be broadly split into two main dimensions, those related to accessibility, meaning access to a modern, reliable, and affordable source of energy, and those related to supporting services, meaning enabling access to pre and after-sale services). Among these various challenges the most common ones are:

Accessibility

- Grid - and expansion plans - remains limited to main towns: Households living in remote areas are beyond the coverage of the existing grid infrastructure and the grid expansion plans. As result, most of these family use traditional sources of energy such as paraffin lamps as their primary source of lighting.
- High grid connectivity costs: even where the grid distribution network is present the connection fees remain still high and unaffordable for many households. And also, households have to install all the internal wiring which adds an additional burden to their budget. These connection costs are preventing households from connecting to the grid even when the grid arrives.
- Lack of affordable off-grid products: most low-income households rely on small-scale agriculture as their main source of income which typically generates minimal and seasonal incomes. This often limits their ability to afford the good-quality lighting systems currently available in the market. And although suppliers sell on credit - mainly through PAYGO- low-income households cannot maintain regular payments, and afford high up-front deposits requested in most PAYGO schemes. Also, women-headed households tend to experience higher level of poverty due to competing family financial needs like (i.e. food, school fees, clothing, healthcare) or lack of job opportunities, and are less likely to either apply or be the targeted end-users of the payment schemes developed by suppliers.
- Lack of community awareness about the benefits of good quality, safe lighting: there is not sufficient awareness on how better-quality lighting systems can improve quality of life for households and on the risks posed to health from burning fuels like paraffin. Also, there is not sufficient knowledge on the quality of the different systems available in the market, which has led to low-quality products purchase with low lighting quality and lifetimes. There are also counterfeit products in informal markets which can add to perceptions that solar is of bad quality. This challenge is more prevalent among women and other marginalized groups. For instance, women are over burden with daily home chores and are unable to follow up and reach out to the right information.
- Lack of regulation/certification of SHS in the local market: Low quality products are easily and cheaply available in the local markets. Without proper regulations or certification standards people continue to purchase low quality generic systems, and lose investments and trust due to fast breakdown or poor quality lighting they produce. Measures should be put in place to ensure solar dealerships are operated by Artisans/ technicians licenced by EPRA and products Certified by KEBS.

- Theft/vandalism of solar panels and batteries: issues around security also affect decision making to purchase a high-cost product e.g. SHSs, panels and batteries which are easily portable.

Supporting Services

- Breakdown of off-grid systems and lack of local technicians for repair: Lack of know-how on maintenance and operation, and lack of access to local technicians to undertake maintenance and repair, or useable system warranties, has resulted in some shifting back to old low-quality types of fuel when SHS breakdown or unable to provide lighting as expected. Also, there is a gender disparity in the sector and most technicians are men and service providers run by men. Having more women workers in the sector can not only provide more job opportunities for women, but also to help better understand the specific challenges affecting women.

These various challenges affect households to different extents generating specific needs for certain type of end-users. These different needs can be examined through the lens of the World Bank ESMAP Multi-Tier Framework (MTF)⁶ as this approach goes beyond the traditional binary definition of energy access: ‘connected versus not connected’. Instead, the MTF examines the specific type of electricity access within the broad spectrum of service level – including definitions of supply available (amount) – while it also investigates the reliability of the electricity service. This approach facilitates understanding what type of energy system can better meet the priority needs of different group of end users. For instance, Figure 20 shows the type of appliances than can be run by T1, T2 and T3 systems and for how many hours per day.

APPLIANCE POWERED	POWER CONSUMPTION	TIER 1		TIER 2		TIER 3	
		Lower Tier 1	Upper Tier 1	Lower Tier 2	Upper Tier 2	Lower Tier 3	Upper Tier 3
Basic Lighting <2W	3W-14W	TRUE	TRUE	TRUE	TRUE	TRUE	TRUE
Bright Lighting (2-4W)	15W-49W	TRUE	TRUE	TRUE	TRUE	TRUE	TRUE
Phone charging	Less than 1W	TRUE	TRUE	TRUE	TRUE	TRUE	TRUE
Torch	Less than 1W	TRUE	TRUE	TRUE	TRUE	TRUE	TRUE
Radio	Less than 1W	TRUE	TRUE	TRUE	TRUE	TRUE	TRUE
Small TV: 19"-24"	Less than 8W	✗	TRUE	TRUE	TRUE	TRUE	TRUE
Medium size TV: 32"-40"	8-12W	✗	✗	✗	TRUE	TRUE	TRUE
Pedestal Fan DC	7-12W	✗	✗	✗	TRUE	TRUE	TRUE
Small Fridge-100L	20-40W	✗	✗	✗	TRUE	TRUE	TRUE
Medium size Fridge-150L	40-75W	✗	✗	✗	✗	TRUE	TRUE
Large TV: >40"	12-20W	✗	✗	✗	✗	TRUE	TRUE
Small Water pump	500-750W	✗	✗	✗	✗	✗	TRUE
Electric pressure cooker	1000W	✗	✗	✗	✗	✗	✗

Figure 20: 1. MTF – Appliances powered by T1, T2 and T3 systems

⁶ For more information on the Multi-Tier Framework (MTF) refer to this link: https://www.esmap.org/mtf_multi-tier_framework_for_energy_access.

Figure 21: MTF – Appliances powered by T1, T2 and T3 systems

Applying the MFT to Meru, it is possible to distinguish three main groups of households:

- 1) **Kerosene end-users:** As explained these are mainly marginalised groups such as low-income households, households living in remote areas who lack access to affordable, reliable, and clean energy. The needs of those households having no access to modern forms of electricity – as explain earlier, in Meru County these group of people mainly use kerosene as their primary lighting fuel - would be significantly addressed with the lowest powered MTF tier – tier 1. These ‘low-income’ households have a priority for good quality (of sufficient brightness) and safe lighting that will cover the rooms of their home, as well as phone charging. These households are a top priority for County Government, given they currently have no access to modern energy services and rely on harmful fuels such as kerosene to meet their lightings needs. Enabling access to a modern energy source represents a significant improvement in the quality of life for these households.

This group of end-users typically live-in smaller towns or remote areas and therefore, are less likely to receive on-site after sale services as these are usually provided by suppliers in the main towns. Thus, another key priority for this group is to ensure local access to maintenance and repair services.

- 1) **Unreliable energy end-users:** Other non-grid connected households fall on a spectrum of the MTF for their current usage/access i.e., they already use some form of electricity, ranging between Tier 1 and Tier 3. The needs for these households tend to be oriented around increasing quality and reliability⁷ of what they have, and in increasing the types of appliances that their systems support for additional functionality – for example improved entertainment and news through a TV, and cooling through a refrigerator. what standalone energy solutions are available in Kenya as these can provide an alternative solution to the low-quality energy system currently used.
- 2) **High-quality energy end-users:** these households have larger systems (categorised under higher power tiers). They have or are moving up to tier 3+. Yet, these households commonly encounter difficulties to procure technical services such as maintenance of bespoke off-grid systems, warranties, and other type of after-sale support. These barriers can be tackled by increasing the network of qualified technicians across the County and also by attracting reliable providers who can widespread their after-sale services across Meru.

⁷ We referred to the ESMAP definition of quality and reliability for our analysis. See more on this link: https://www.seforall.org/sites/default/files/MTFpresentation_SE4ALL_April5.PDF.

Based on the analysis of the above-mentioned challenges, Meru County aims to address the following priority needs through the following value propositions:

Target group	Priority needs	Value Proposition
Kerosene end-users	Access to modern, reliable and affordable off grid lighting systems	Provide access to Tier 1 systems to kerosene end-users, allowing people to carry out various domestic activities at night, such as cooking, working, and studying. Among the targeted end-users, this programme will target women-headed households, people with disability and other vulnerable groups using kerosene as their primary lighting source.
	Access to after-sale services in local towns	Ensure that suppliers provide different type of after-sale services in local towns. And also, that providers provide equal job opportunities for women to work in the sector.
Unreliable energy end-users And high-quality energy end-users	Access to qualified technicians who can provide technical support in small towns, such as installation and maintenance	• Training youths, women, people with disabilities and others, as electricians and supporting them to acquire licenses to ensure that households have access to pre and after-sale services in their local towns. • Ensure that there are sufficient technical staff – and capacities in the relevant department – to guarantee the proper functioning of the street lighting network. • Vigorous capacity building (training, coaching and mentorship) for women businesses operating in this sector to increase knowledge, build business capacity and abilities.
All	More information and sensitisation on alternative off-grid systems	Raise awareness on the benefits of alternative energy sources and inform households what are the existing high-quality off-grid systems available in the market. Ensuring that this programme is targeting marginalised groups, including women, people with disability, youth.
	Improve safety and security through better street lighting services	Expand the street lighting infrastructure in public spaces, primarily in small towns

Table 23: Lighting priority needs and value propositions

a. Promoting Gender and Social Inclusion (GESI)

The previous sections present opportunities for integrating GESI into the off-grid space recognising that marginalised groups face multiple and different types of challenges. Income level, race, gender, disabilities, among others, produce greater and specific disadvantages to different marginalised groups, and the recommended solutions aim to address these specific barriers. Meru County will continue carrying out further GESI analysis to develop a

comprehensive approach as part of the inception phase of implementation. And also, will routinely collect gender disaggregate data through specific programme indications to inform subsequent phases of the recommended solutions as well as future programmes and policies.

b. Climate resilience mainstreaming

Applying climate lens to the design and implementation of sectoral policies and programmes is essential. One of the first requisites to achieve this, is to ensure that climate risks assessments are conducted in the formulation of national and sectoral strategies and policies, as well as at the project level (Olhoff & Schaer 2010). If the policy, programme, or project is assessed to be at risk, further work is required to identify the extent of the risk, assess climate change impacts and adaptation responses in more detail, and identify recommendations/actions.

Equally important, all key stakeholders involved in the project design and implementation should have a deep understanding of the linkages between climate variability, climate change, vulnerability, and development needs. Otherwise, awareness on climate mainstreaming should be raised among all relevant stakeholders.

The climate lens screening tools assess the vulnerability of policies, programmes, and projects to climate risks at the planning, implementation, M&E, and feedback levels, as well as at cross sectoral levels. More specifically, climate lens screening includes:

- Identifying climate risks in the solution and the vulnerability of target groups.
- Assessing whether the solution could lead to increased vulnerability to the target groups through maladaptation.
- Analysing whether there are further opportunities to address climate risks by optimising the solution.
- Making recommendations on changes to the solution.

These aspects are further elaborated in the implementation, Coordination, Monitoring and Evaluation section included further below.

c. Promoting Energy Efficiency and Conservation

The recommended solutions have been assessed from an energy efficiency perspective and the technologies to be deployed meet the highest energy efficiency standards. This assessment will be repeated over the different phases of the programmes to ensure that new technological development are considered in sub-sequent phases of the programmes and replace current technologies that may become obsolete in upcoming years.

- Some of the energy efficient technologies considered in the recommended solutions include:
- Use of efficient LEDs. LED Lighting consumes less energy for same light output as compared to conventional lighting. For instance, LED bulbs use less than 75 percent energy than incandescent bulbs and LED flood lamps use only 10 watts while creating

a light output comparable to a 50-watt incandescent bulb. In addition, LED lights typically last much longer than other lighting types. e.g. LED bulbs can last 3 to 5 times longer than a Compact Fluorescent lamp and 30 times longer than an incandescent bulb lights. Given these benefits, LED lights have lower operating costs and have short paybacks, sometimes just a few months.

- Use of LED floodlights and streetlights (with over 100 lumens/watt). Compared to traditional floodlights, an LED floodlight only loses about 5% while converting 95% of the consumed power to light. Usually, an LED floodlight can reduce energy consumption by over 60% compared to traditional lighting. Low energy LED energy consumption reduces electricity bills and respective carbon footprint thus mitigating climate change. LED Lights also last longer with some lasting over 30,000 hours which implies lower maintenance cost.
- Adoption of solar LED lighting for streetlights/public spaces. Standalone solar streetlights harvest solar energy during the day and automatically power the streetlights poles at night saving energy costs and reducing the infrastructure cost of the conventional systems that require cabling and accessories. This technology is also modular so that a fault in one does not impact on the.
- Lights as per the new Kenyan Standards. In order to address the proliferation of inefficient lights, a new standard has been developed and approved by Kenya Bureau Of Standards (KEBS). The standard for General Service Lamps (GSLs) covers the minimum energy performance requirements and functional performance of general lighting, directional and non-directional lamps, of all shapes and finishes, using various light source technologies. Moreover, the above standard now effectively bans the use of incandescent lamps.

III. Strategies to promote access to lighting services

a. Solution Components

The following section – Alignment with CIDP priorities - presents the recommended lighting solutions and how these are links to the CIDP.

Alignment with CIDP priorities

As result of the extensive needs assessment conducted in Meru County, the following solutions will be implemented:

CIDP priorities	Solution	What	Why (aim)	How
Provision of clean energy Development of energy policies	Targeted support for off-grid households	1) Promote Tier 1 lighting systems among low-income households to enable access to an	Achieve universal access to clean and affordable energy	Develop an investment and business proposal for Tier 1 solar systems that help address affordability and accessibility gaps faced by low-income households. This solution component initially targets sub-counties with a high percentage of households using

CIDP priorities	Solution	What	Why (aim)	How
		affordable and modern source of energy - replacing harmful fuels such as Kerosene		kerosene for lighting as there is a high potential of replacement (further details in bullet point 1). Work closely with supplier of Tier 1 system to ensure that these companies provide local services to households living in remote areas.
		2) Train and incentivise technicians to capacitate and acquire licenses on pre and after-sale technical services for off-grid systems (mainly Tier 1 and Tier3 systems)	Ensure that end-users living in remote areas have access to high-quality technical support on off-grid solar systems.	Create a network of qualified technicians who are trained in T1,T2 and T3 levels who can provide technical support to T1 and T3 end-users. This programme will target women, youth and people with disabilities among the targeted trainees.
		3) Raise awareness of quality off-grid systems among households.	Better inform households on the benefits of different off-grid solutions	End- User sensitisation programmes to by widespread information on off-grid systems through different channels, e.g., social media, local radio, and barazas among others.
Installation of floodlights and streetlights	Public street lighting – including solar street lighting	4) Installation of streetlights and floodlights in various towns and markets centres	Create a 24-hour working economy, and improve security during the night working hours	Deploy an extensive network of street lighting services across the County.

Table 24: Lighting solutions and alignment with CIDP

1) Promote Tier 1 lighting systems among low-income households.

A review of available quality lighting systems in the market was conducted and these were categorised according to the MTF tier. Given the range of functionality possible in each tier, the tier was subdivided in to ‘upper’ and ‘lower’ power provision e.g., Upper Tier 1’ and

‘Lower Tier 1’⁸. Each system was assessed according to different technical, financial, and operational attributes of the product and the supplier business model. The two most appropriate systems in preferential order for lower Tier 1 delivery, and most suited for kerosene households, were the Sunking Home 200X system and the D.light X850 (without TV).

The above-mentioned analysis investigated the following (SunKing 200X system used as an illustration):

- a. Light intensity: The Sunking Home 200X system can light three small rooms, with improved brightness, equivalent of a 2 wat LED bulb, each 20 times brighter than a kerosene lam.
- b. Type of appliances powered by the off-grid system: the recommended system provides sufficient electricity to power a list of essential appliances, which besides lighting includes mobile charging and radio.
- Expected lifespan of the system: The recommended Tier 1 system has a 2.55Ah Li-ion NMC battery which ensure 5 to 7 years of lifespan.
- Product support: the system includes a 2-year warranty and the supplier have a toll-free call centre in Nairobi and faulty products can be serviced through regional offices in Meru or sent back to Nairobi.
- Business model and market access: Sun King sells through individual commission agents based in villages or town centres, partner reseller organisations and retail outlets based in Imenti North- Meru town, Igembe south-Maua. The commission agent strategy ensures that products are available to- and can reach- last-mile end-users.
- System costs: Although there are cheaper lighting products in the market, the Sunking home 200X system has a proven reputation in the market due to it has high-quality components. Also, Sun King offers a PAYGO scheme which consist of a 1,600KES up-front deposit and daily payments of 50KES over 384 days (see Table 25).

Although this scheme makes the system more accessible to low-income users who cannot cover the entire cost upfront, it increases the product price to nearly 90% -as compared to the cash price. Thus, the solution recommends two different financial models which keep the product prices lower and make it more affordable to the targeted low-income households. For further details see section financing models.

MTF LEVEL	Lighting system	Price (in KES)	Payment method (in KES)
Tier 1	Sunking Home 200X	Cash price: 11,000 PAYGO price: 20,800 Price increase: 89%	PAYGO • Deposit: 1,600 • Daily payments: 50 • Days: 384 days

Table 25: Sunking home 200x costs

⁸ Analysis conducted by SETA and held on file by Meru County Government.

Financing models

1) Promote Tier 1 lighting systems among low-income households.

As commented earlier, two different customer finance and associated ownership models will be rolled out to make the lighting system more affordable for low-income households. Each has pros and cons, and customers will be allowed to choose between the two in Phase 1 – see Table 26 below. The model(s) to take forward to scaler-up will be evaluated based on learning from phase 1.

Model	Description	Pros	Cons
Lease-only	Energy as a service – the customer continues paying for as long as they have the system	Lower monthly cost (more affordable) More sustainable - responsibility of maintenance and replacing systems always lies with the supplier	Not used widely in Kenya Possible risk of customer default after long period of payments (familiarity with other products that are based on repayment)
Lease-to-own	Ownership after repaying capital costs	Customer familiarity with credit and repayment model; many existing PAYGO models work this way No ongoing payment needed after loan term	More expensive monthly payments Maintenance and repair customer responsibility after initial warranty period

Table 26: Pros and cons of the recommended lease schemes

In both models, the Meru County Investment and Development Corporation (MCIDC) will bulk purchase the recommended Tier 1 system to the suppliers keeping its price as low as the cash price. Households will sign a contract with the MCIDC, can either choose to purchase or lease the Tier 1 system, and in both cases will make daily or monthly payments over a set period of time. In case of non-payment/default the PAYGO system managed by the provider would shut-off the system.

The following presents the main attributes of the models, including a comparison with the PAYGO scheme offered by the Sun King.

System	Sunking home 200X		
Model terms	Current scenario (supplier PAYGO)	Lease to own model	Lease model
Cash price	11,000 KES	10,000 KES (Landed cost - bulk pricing with direct importation)	
Deposit	1,600 KES	1,000 KES (connection fees)	
Daily payment	50 KES (1,5000 monthly)	10 KES (300 monthly)	20 KES (600 monthly)
No. of days for full repayment	384 days	1,100 days. Full payback in 3 years. From year 4, start to raise cash for replacement products	600 days. Full payback in 20 months

Total Price	20,800 KES (daily payments 50 KES over 384 days + 1,500 deposit)	12,000 KES (daily payments 10 KES over 1,100 days + 1,000 deposit)	13,000 KES (1,000 deposit+20 KES daily payment)
Price difference (lease vs PAYGO)		73% (cheaper than the PAYGO scheme)	60 % (cheaper than the PAYGO scheme)

Table 27: Price comparison between the supplier PAYGO and recommended lease models

Cost-benefit analysis

An average household expenditure on kerosene for lighting⁹ of about KES 1,350 per month was estimated. While in the recommended lease models for the Tier 1 solar product, households will spend from KES 300 to 600 per month (daily payments of KES 10 to 30 over 30 days) which drastically reduces the domestic expenditure on lighting fuels. Also, the smaller daily instalments of the lease model should allow households to use their own income to cover this expenditure. More details of the two lease models recommended are presented in the previous section.

b. Intervention options

Target beneficiaries

- 1) Promote Tier 1 lighting systems among low-income households.

As explained before, the Tier 1 lighting solution targets kerosene users from the lower-income areas in Meru as the use of more harmful fuels- such as kerosene- increases among lower income families. Four different socio-economic indicators (kerosene consumption, poverty line, cooking fuel and asset ownership) were used to assess which are these areas and as result six sub-counties were shortlisted¹⁰: Tigania West, Tigania Central, Tigania East, Igembe North, Igembe Central and Buuri East. The different phases of the Tier1 solutions targets different sub-counties as explained below:

- 1st cohort: includes Tiganias West and Central - as these are two sub-counties which scored lower in the four socio-economic indicators examined – and Igembe north – fourth sub-County in the matrix but included in the 1st cohort to include one sub-County which is not from the Tiganias.
- 2nd cohort: includes all six sub-counties.

- 2) Train and incentivise youth and technicians to capacitate and acquire licenses on pre and after-sale technical services.

⁹ To calculate the average expenditure on Kerosene we assumed that: (1) a typical household uses three kerosene lamps four hours a day, (2) A kerosene lamp producing 37 lumens for four hours per day, consumes about three litres of kerosene per month, and (3) a litre of kerosene costs nearly 150 KES.

¹⁰ For more details on this analysis refer to the methodology guidelines.

Approximately 10 technicians are likely to be employed by Meru County for the recurrent installation and maintenance from year 2 onwards. Additionally, 10 other technicians will be hired for Tier 3 household and other installations.

The private sector, including companies like Davis & Shirtliff will provide internship for technicians enrolled in the training programme. It is estimated that about 20 internships per year will be provided.

3) Raise awareness of quality off-grid systems

This solution will target households across the entire County as the main objective is to raise awareness on off-grid solutions for different tiers of electricity access. Also, awareness raising campaigns will be gender sensitive and gender inclusive targeting GESI groups.

4) Installation streetlights in various towns and markets centres

The off-grid public lighting solutions will be rolled out in areas that are least likely to access the grid in the near future. These areas are informed by the Levelised Cost of Electricity (LCoE) analysis. This analysis specifies the areas less likely to be connected to the grid based on criteria such as population density and market centre locations.

Budget commitment and funding sources

1) Promote Tier 1 lighting systems among low-income households.

Description	Budget line	Budget (in millions of KES)		
		Phase 1	Phase 2	Phase 3
Bulk purchase T1 systems [Debt finance MCIDC)	Total (revolving fund)	43,2	86,4	150
Supporting public finance (energy docket)	Project management	2,1	5,6	7
	M&E cost	2,3	4,6	7,2
	Total	4,4	10,2	14,2

Table 28: Budget commitment Tier 1 lighting systems

2) Train and incentivise youth and technicians to capacitate and acquire licenses on pre and after-sale technical services.

Local Polytechnics and Universities-Technician training are likely to lowering the fees and, possibly, offer affordable accommodation to the candidates of the training programme.

Course level	Tuition (in KES)	Upkeep and accommodation (in KES)	Total cost (in KES)	Proposed subsidy (in KES)
Training 1	35,000	35,000	70,000	50%=35,000
Training 2	30,000	35,000	65,000	50%=32,500

Training 3	60,000	50,000	110,000	50%=55,000
TOTAL SUBSIDY PER ONE STUDENT				122,500

Table 29: Budget commitment training solution

3) Raise awareness of quality off-grid systems

Budget allocations for sensitisation activities crosscut across the three solutions. Most sensitisation activities will be launched in phase 2 and 3.

Description	Budget (in millions of KES)	
	Phase 1	Phases 2 and 3
Mainstream media	0	2
- Ads on local radio stations - Video on local TV stations		
Social media:	0	1
Sensitisation messages and videos on the County's official website and social media channels		
Community engagement:	0	5
- Energy staff training - Door to door engagement		
Roadshows, public barazas and other forums	0	2
- Transportation - Sensitisation material - Other facilitation for forums		
Total Sensitisation	0	10

Table 30: Budget commitment end-user sensitisation

4) Installation streetlights and floodlights in various towns and markets centres

The following table presents the budget commitment from County Energy department for each year of the street lighting programme:

Sub Programme	Description	Budget (in millions of KES)					
		Year 1	Year 2	Year 3	Year 4	Year 5	Total
Floodlight	Low mast floodlights	46	46	46	46	46	230
	Off-grid	13	19.5	19.5	19.5	19.5	91
	High mast lights	52.5	52.5	52.5	52.5	52.5	262.5
	Off-grid	5	15	15	15	15	65
Streetlighting	Townships lit	40	40	40	40	40	200
	Off-grid	24	24	24	24	24	120
Total per year (in million KES)		138.5	138.5	138.5	138.5	138.5	692.5

Table 31: Budget commitment streetlights and floodlights

Expected outputs in each phase

1) Promote Tier 1 lighting systems among low-income households.

Sub-County	Phase 1: 10% of HHs in year 1	Phase 2: 20% of HHs in year 2	Phase 3: 20% of HHs from all sub-counties annually
Tigania Central	1,000	2,000	2,000
Tigania West	1,600	3,200	3,200
Igembe North	1,000	2,000	2,000
Tigania East	0	0	1,100
Igembe Central	0	0	3,000
Buuri East	0	0	1,200
Total second group of sub-counties	3,600	7,200	12,500

Table 32: Expected outputs Tier 1 solution

2) Train and incentivise youth and technicians to capacitate and acquire licenses on pre and after-sale technical services.

- 10 technicians to be employed by Meru County to work on the installation and maintenance of the streetlight infrastructure from year 2 onwards.
- Additionally, 10 technicians will be trained to provide technical services to Tier 3 household and other installations.
- Internships in the private sector: 20 technicians.

3) Raise households' awareness on quality off-grid systems: the end-user sensitisation will target households from different socio and economic backgrounds across Meru.

4) Installation streetlights in various towns and markets centres

Sub Programme	Description	Total number of masts to be installed					
		Year 1	Year 2	Year 3	Year 4	Year 5	Total
Floodlight	Low mast floodlights	92	92	92	92	92	460
	Off-grid	20	30	30	30	30	140
	High mast lights	15	15	15	15	15	75
	Off-grid	1	3	3	3	3	13
Streetlighting	Townships lights	5	5	5	5	5	25
	Off-grid	2	2	2	2	2	10
Total per year		112	112	112	112	112	560

Table 33: Expected outputs streetlights and floodlights solution

Timeline

1) Promote Tier 1 lighting systems among low-income households.

The Tier 1 solution will be implemented in three phases (see figure presented below). Phase 1 and 2 will target 10% and an additional 20% - respectively- of kerosene users from sub-counties included in the first cohort while Phase 3 will target 20% of kerosene users from all targeted sub-counties:

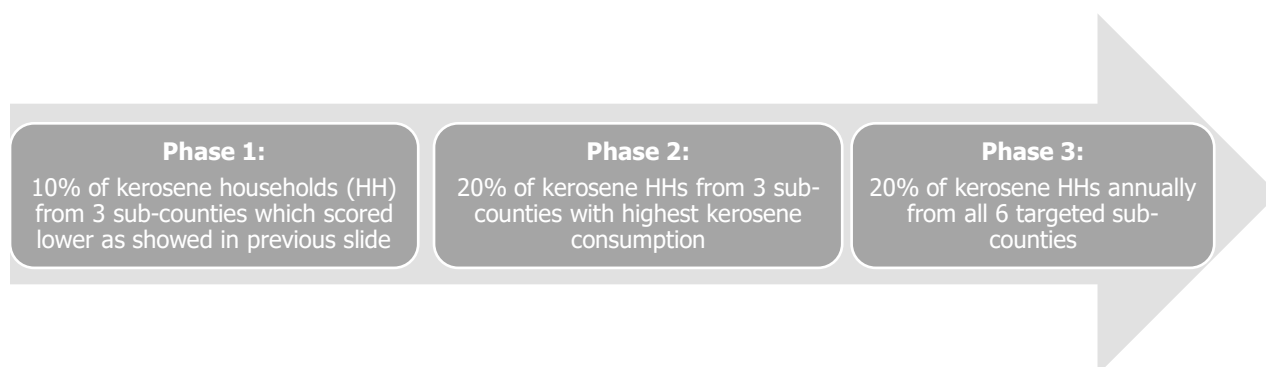


Figure 22: Timeline Tier 1 solution

- 2) Train and incentivise youth and technicians to capacitate and acquire licenses on pre and after-sale technical services: Most training activities will be conducted in year 2.
- 3) Raise households' awareness on quality off-grid systems: Most sensitisation activities will be launched in phase 2 and 3 of the Tier 1 lighting solution.
- 4) Installation streetlights in various towns and markets centres: refer to Table 34: Expected outputs streetlights and floodlights solution.

IV. Stakeholders and Roles

Stakeholder	Activity	Role
Steering Group/Project Governance	General/Management	- To be formed at start of project and will include participants from Energy Department and MCIDC and delivery partners (as they are brought onboard). - Finalise distribution and financing models. - Agree on partnerships. - Project coordination body throughout
Meru Energy Department	General/Management	- Overall project implementation and management - Chair and provide secretary for Steering Group
	Access to lighting	- Work with delivery partners to identify target end-users for tier 1 - Monitoring and evaluation. - Develop and disseminate sensitisation materials to households
	Streetlighting	Employ about 10 technicians to take care of the installation and maintenance of the streetlight infrastructure
Meru County Investment and Development Corporation (MCIDC)	Access to Tier 1 lighting	- Negotiate bulk discounts available on system with supplier and establish contractual relationship. - Bulk purchase Tier 1 system

Stakeholder	Activity	Role
		- Develop lease scheme in consultation with Energy Department and working with delivery partner. - Establish a revolving fund for the lease scheme - Collect money from households - Manage repayments and defaults
Gender Department	All	- Ensure GESI lens being included across all strata of activities - Initiate and help track gender disaggregated data - GESI focal point of contact - Access to donor funding linkages and grants for GESI activities
Partner system suppliers	Access to Tier 1 & broader market penetration in target sub-counties	- Marketing campaign to sensitise farmers of its products - Establish points of presence to service customers in target sub-counties - Manage repayments and defaults - Provide equipment and agreed years of after-sales service and warranty (depending on each package). - Provide agreed monitoring data to County Government for assessing targets/progress
Local and national Polytechnics and Universities	Training	- Train 10 technicians who will provide technical services to tier 3 household and other installations. - Offer reduced fees and discounts on accommodation to participants
Private sector. E.g., Davis & Shirtliff.	Training	Provide internships to participants enrolled in the training programme

Table 34: Stakeholders and roles

V. Risks and Challenges

Solution	Risk / Challenge	Mitigation measure
Tier 1 systems	Lack of clarity on project management and responsibilities results in inefficient project implementation.	Clear project management and delineation of responsibilities between the Meru Energy Department and Water Department and MCIDC
	Limited demand from end-users as there is limited knowledge on the recommended system.	Sensitisation campaign will be run to communicate benefits of the recommended lighting systems and ensure end-users buy in
	The recommended lighting system do not meet households' expectations	Expectations will be set and informed consent sought as part of selling the system. The Government sensitisation campaign will also

Solution	Risk / Challenge	Mitigation measure
		assist with this. The demonstration phase will also provide strong monitoring of any issues.
	Higher income households sign up in the programme	Work with suppliers to establish approaches better target households. Monitor strongly in the demonstration phase. Noting that also the small sized systems may to some extent be self-selective for low-income households
	Same households buying more than one lighting system	Systems will be registered to a specific address, with a one household per scheme allowance. Options for assessing system location is correct (geo-fencing) will also be discussed with the supplier
	Lack of technical knowledge among local technicians, and maintenance of lighting systems can result in break-down or under-performance of the T1 solar systems	After-sales support and training is included in the proposal
	Spare parts are not readily available to households	The technology suppliers will provide a 2-year warranty and spare parts for the lighting systems. Beyond the 2 years it is expected that the market will be large enough that the distributors will be based in Meru.
	The lease model can create market distortion (e.g., set non-sustainably low prices in the market; reduce incentives to control cost base;)	The lease scheme will be granted to low-income families and will be phased out gradually as end-users become more aware of the savings on expenditure for lighting fuels (expenditure on kerosene vs daily instalments on T1 systems)
	Lack of distribution and logistics support in smaller towns	The supplier will provide distribution and after sales support in all targeted wards.
Training	Technicians enrolled in the training programme move to another County after completing the training	Meru County will employ 10 technicians to ensure that qualified personnel stay in the County. Partnership with private companies will provide job opportunities in the County to participants enrolled in the training programme.
Streetlighting	Political interference: funds controlled by political actors e.g., the ward development fund may not have a huge effect since the project implementation will be politically inclined.	This can be mitigated by ensuring adequate information is made available to the actors and proper guidance is given so as to have projects in areas that will create a huge impact
	Budget re-allocation to other County's priorities.	Lobby to relevant actors to emphasize the importance of this projects. And also, engaging other actors in the space – such as REREC – who can also provide funding

Table 35: Risks and challenges

VI. Implementation and Coordination, Monitoring and Evaluation

a. Implementation and coordination

The process to implement the initial phase has five steps, as shown in the following figure. This includes the final project design and implementation plan for the Scale-Up Phase(s).



Figure 23: Five steps to implement the initial phase

VII. Summary of Approaches and Steps to Promote GESI in Lighting Solutions

Building a GESI-disaggregated evidence base

Collect data on usage, purchase, access, affordability among other dynamics to constantly get right numbers and performance among women, men and marginalised groups both in rural, urban and per-urban settings.

Awareness raising and sensitisation

Provide training on GESI approaches and strategies to Government officers involved in project implementation.

Conduct vigorous training, coaching and mentorship for women entrepreneurs and women-led businesses operating in this sector to increase knowledge, build business capacity and abilities.

Carry out comprehensive consumer education awareness among women end users to improve their knowledge and technical know-how.

Sensitise all key stakeholders involved in lighting sector (municipal agencies, electricity utility, private sector, etc.) and raise their awareness of GESI and from the project's onset.

Mainstreaming GESI issues into the lighting sector

Energy Docket and Gender Directorate will work collaboratively and closely to mainstreaming GESI in County lighting programmes and projects.

Recruit and train women technicians and people with disabilities to provide technical support.

Recruit a local gender expert as part of the team to train team members on basic concepts about gender and EE, street lighting international and local norms, gender-responsive street lighting and how to use gender mainstreaming tools and guidelines.

Integrate GESI in the project budget as a specific component or as part of the existing budget items from the start.

Partnerships to promote GESI

Map out interested partners and key gender advocacy groups for gender impact awareness of investors about the importance of gender informed business practices among women operating in this space.

Climate resilience building measures.

Solution	Risk	Climate mainstreaming approaches
Tier 1 lighting Solution	Level of knowledge of climate change among the members of the implementing team is not assessed	- Assessment of adequacy of adaptive capacity and availability of technical support within the County to support project. The implementing teams need to be aware of climate change impacts on development, the effect to using non-modern and 'polluting' energy sources for lighting, environmental and health impacts on the users to effectively deliver Sensitisation and capacity development to influence perceptions and change behaviour resulting in increased adoption and uptake of clean lighting fuels. - Assessment of internal capacity to design Sensitisation campaigns and training curriculum, and manage the process is key to identifying knowledge and skills gaps, and resource gaps. The gap assessment, staff training, and deployment of staff need to be deliberate and adequately resourced. - Identify cross sectoral climate change opportunities
Tier 1 lighting solution: MCIDC will engage with solar lighting suppliers, negotiate bulk prices for solar lighting technologies, pay upfront and distribute to selected households and collect payments back into the revolving fund	- Lack of policies to guide on Supplier engagement-mapping, vetting, pricing, and contracting. - Risk assessment for maladaptation leading to unintended consequences and/or increased vulnerability of the County and end users	- Develop policy for mapping selection, vetting and contracting suppliers. - Develop regulations/ certification policy to guide on quality of technologies, distribution and after sales support. - Develop formal warranty management system- this can be a simple digital data base maintained at the County level which contains details of all equipment sold, supplier, buyer, date, warranty period, and a system to collect and collate complaints and claims from the ward level and follow up with the supplier for resolution and feedback. The system should also track how long it takes to settle an issue satisfactorily and the number and frequency of warranty claims and complaints by supplier and type of equipment to track poor quality equipment and rogue suppliers - Conduct risk assessment of the policy and potential for maladaptation
All solutions: Roles actors and responsibilities outlined but need for segregation of duties to avoid duplication within	- Adaptive capacity and availability of technical support of the MCIDC/ Energy ministry not assessed - Lack of evidence in cross sectoral planning for capacity	- Conduct capacity assessment of the implementing agents - Segregate roles to ensure proper human resource placement and responsibility

Solution	Risk	Climate mainstreaming approaches
programmes and across sector programmes and projects	building and responsibilities TBD	
Tier 1 lighting Solution: Pilot project regions identified for implementation in Phase 1 and 2 and project reaching 12,500 households in Phase 3 in all 6 sub-counties	No Climate risk assessment and screening to understand the magnitude of risk and impacts on health, productivity, income, and safety	○ Conduct climate risk screening and vulnerability assessment to identify the prevalence of risk and impact and identify households most at risk of adverse impacts. Questions; ○ What are the risks arising from use of firewood, charcoal and kerosene, and improved cooking stoves, LPG? Impact on health and safety, environment, development- time use, illness causing lost man hours, education. ○ What value does cooking with firewood, charcoal and kerosene provide for the Users? ○ Using the high priority areas and pathways identified collect baseline information on the above- health impacts, development impacts, livelihoods impact e.g.- increased expenditure incurred purchasing improved technologies ○ Strategy needs to incorporate creating awareness around changing perceptions towards climate risk, gains made from changing behaviours and then the available options, prioritise gender and climate risks and impacts in different spheres of their lives/ the benefits of the new solution must outweigh those of the old. ○ The awareness raising strategy needs to expand to incorporate ‘why change behaviour’ then presentation of the available solutions. - questions asked need to be expanded; ○ Which lighting source is used? Where is the fuel accessed, how much is bought, how long is it used, how frequently, how many rooms is it used in, what activities is it used for? ○ Who pays for the fuel, who buys it? gender, age, education level, economic activity ○ How much does it cost per week/ month/ how is it accessed? ○ Why use that fuel/s and not any other? ○ Any negative effects of using that fuel? Magnitude/ frequency/ who it affects in the household ○ How the negative impact is coped with

Solution	Risk	Climate mainstreaming approaches
		○ How that affects the individual, the household/ cost of coping mechanisms (money, time, lost opportunity cost) ○ Knowledge of other technologies and perception towards ○ Benefits of other technologies ○ Why not used/ Likelihood of using if available ○ How much can afford to purchase the technology/ terms? ○ How to pay- savings, loan and which loan sources ○ If used improved technology and stopped, why? When? What would need to happen for them to again? ○ Other energy appliances used/not used/ other technology needs in lighting, water, agri, livestock/ barriers to access Vulnerability assessment will help in developing a criterion for selection of households to benefit first from the intervention Provides baseline climate information to inform level and mix of support required and enable development and measurement of performance indicators.
Tier 1 lighting Solution: Access and distribution of lighting technologies	Proposed strategy may lead to maladaptation and increase vulnerabilities	○ Selection, registration, and access to equipment and support for end-users in a way that does not create new barriers e.g., increased expenses, lost opportunities/ or create new accessibility problems due to the barriers
End-users sensitisation: Awareness raising among the public on the benefits of solar lighting and access	○ Lack of strategy and approach for creating awareness among the public on the risks of using kerosene and firewood, benefits and cost benefit analysis of using clean lighting, and quality solutions available in the market	○ Using the climate screening findings above, develop training curriculum for implementers to equip them with the right knowledge and perceptions for project design, implementation, and monitoring and ○ Design awareness raising implementation strategy to present the value proposition, project design and expected outcomes. ○ Design training approaches and training plans for awareness creation

Solution	Risk	Climate mainstreaming approaches
Tier 1 lighting Solution: Product Pricing / bundling	Low and seasonal income could lead to no payment/default and low uptake of technologies. Affordability is key to implementing sustainable interventions in lighting.	○ Conduct a product acceptability survey among potential users to understand Product refinement/ repackaging. ● Develop different customer value propositions in access and use of SHS. ● Use a Cross sectoral approach to bundle technology financing for households
Tier 1 lighting Solution : MICDC will bulk purchase the recommended solutions Households will purchase the Tier 1 systems and make daily or monthly payments as agreed in the TCs.	Limited capacity of the MICDC to implement this in ways that close the proximity gap, deploy the solutions effectively and efficiently, and do not add to the costs for the solution. Risk assessment for maladaptation leading to unintended consequences/ increased vulnerability of the County and end users	○ Partnership engagement is crucial in climate mainstreaming. There is need to map, identify, and engage partners to support the route to market (RTM) in building awareness, behaviour change, registration and asset distribution, support and payments/ credit management training, uptake and use of SHS. Suggested partnerships include co-operatives, registered Self-Help Groups, Community-Based Organisations, religious institutions etc.
Street lighting: Improved Technical capacity to implement and manage the street lighting project and serve Tier 1 and 3 Users by training and incentivising youth and technicians to capacitate and acquire licenses on pre and after-sale technical services.	Adequacy of the number of technical supports to cover the proposed regions- 20 technicians will be trained	○ Need for localised training of technician assistants? E.g., using local Technical and Vocational Education and Training institutions TVETs) apprenticeships with suppliers/ manufacturers? ○ Employ strategies such as ‘fee for service’ for technicians to enhance sustainability of model ○ Develop a platform for listing and linking trained technicians to Users. This will ensure that there is no service gap that could lead to lack of use or suboptimal use of equipment, foster negative perceptions, or increase vulnerability
Tier 1 lighting Solution: Partners System suppliers will establish Solar Home Systems touch points, manage repayments and defaults,	Lack of defined and evaluated route to market strategy that is efficient, effective and does not burden the consumer or the supplier with high operational costs. (see above recommendation)	○ Selection, training, and management of sales agents who double as local technicians. This could be achieved by training sales agents in installation, User training, and basic trouble shooting of appliances, and act as a liaison between the User and technician when there are more complex issues to manage.

Solution	Risk	Climate mainstreaming approaches
aftersales support, and agreed monitoring data to the County		Design sustainable RTM to ensure investment gains and climate adaptation acceptance and practice among the target population
Tier 1 lighting Solution: Aftersales service and consumer protection	- Lack of policies on partnership management and warranty management systems - Lack of consumer awareness and protection policy to ensure engagement terms are adhered to and provide data on quality of SHS, frequent repair and maintenance issues for solution to provide the end user with value for money.	- Design warranty management systems to ensure end user gets value for money/ the solution does 'no harm' and increase vulnerability and enforcement in the event of noncompliance - Develop consumer protection policies that ensure efficient an effective communication and feedback, Users rights are protected to drive climate adaption practices. - Develop M&E plan to manage and track climate action deliverables between the MICDC and partners, and end users. This will include dash boards such as customer satisfaction, feedback and action.

1. Table 36: Climate resilience building measures in the lighting sector

a. Monitoring and evaluation

INEP Energy access outcomes for Lighting The County will target to have minimum electricity access levels to allow for the empowerment for people in underserved communities with minimum energy targets necessary to improve education, accelerate the transfer of knowledge, facilitate communication, and promote entrepreneurship. The planned on-grid connectivity rate together with the off-grid alternatives will enable achievement of 100% access to electricity by the year 2026.			
CEP Energy access outcomes for Lighting Impact: The primary impact outcome is increased access to clean and affordable energy for lighting by end-users living in remote areas Secondary aims are: Increased knowledge on the benefits of different off-grid solutions Increased access to, and use of, affordable clean energy off grid solar lighting solutions Access to high-quality technical support for pre and after-sale technical services for off-grid systems (mainly Tier 1 and Tier 3 systems). Creation of a 24-hour working economy and improve security during the night working hours.			
	Outcome focus area	Outcome	Indicator
1.	Climate change adaptation and resilience	Improved climate change resilience of targeted communities and end users through reduction of harmful fuels like kerosene	% growth in access to, and use of, Tier 1 systems
2.	Environmental conservation and climate change action	Decreased environmental degradation caused by kerosene use environmental impact.	% reduction in GhG emissions from transitioning to clean lighting systems
3.	Enhanced health benefits	Reduced harmful fuel-based diseases including eye and respiratory diseases / reduced financial burden for Level 2 medical facilities	% reduction kerosene related illnesses
4.	Gender and social empowerment	Benefits for women, People With Disabilities (PWDs) and children – increased time availability for productive use, access dynamics and positive changes in household roles	% growth in women reporting productive use of energy
5.	Socio economic livelihood benefits from capacity development, local job creation, and increased working hours	Enhanced security in public spaces	% decrease in reported criminal incidences
		Creation of a 24-hour working economy	No. of markets adopting longer working hours
			% increase in business income
		Enhanced gender inclusion in the working economy	% improvement in below parameters - gender dynamics in lighting access,

			- impact of energy access on gender roles, safety, and economic empowerment, - reduced discrepancies in access to lighting products and technical services between male and female-headed households
6.	Productive use of energy	Target users reporting increased incomes from access to adequate and quality lighting services	No. and Kshs increase in income by HHs, technicians, marketplaces by type on income- generating activity
		Creation of local job opportunities related to energy and water services.	No. of new jobs created by gender, age and PWDs
		Assess quality of pre and post sales service	% customer satisfaction with pre and post sales service No. of non-functioning appliances No. of warranty claims by type of energy source and supplier No. and value of warranty claims settled
7.	Stakeholder buy-in	Participation in decision-making processes and community ownership of energy systems	Participation in management of public utilities Increased attendance at community forums especially by women, PWDs and other marginalised groups

Table 37: Lighting outcomes indicators

Output Indicators

Outputs result from project activities and utilization of resources including human capital, labour, funds, technology, equipment etc.

CEP Energy access indicators			
1.	Increased access of Tier 1 lighting systems among low-income households to enable access to affordable and modern source of energy - replacing harmful fuels such as Kerosene	Identify sub-counties with a high percentage of households using kerosene for lighting as there is a high potential of transitioning to clean lighting systems	- No. of sub counties selected for project participation using the (LCoE) analysis baseline report -
		Collect data on lighting usage – source of fuel, cost of fuel, accessibility, User preferences	- Lighting usage data across households and public spaces
		Identify and partner with tier 1 systems suppliers	- No. of suppliers mapped

CEP Energy access indicators			
			- No. of supplier partnerships developed
		Work closely with suppliers of tier 1 system to ensure that these companies provide local services to households living in remote areas.	- No of end user – Households (HHs) - accessing quality localised services - No. of suppliers providing localised services to HHs
		HHs transitioning to use of solar lighting	% decrease in use of kerosene for lighting
		Assess User preferences for different technologies; efficiency, quality and durability, affordability, maintenance costs etc.	% HHs using each type of lighting technology
2.	Technicians trained and incentivised to acquire practicing licenses and pre and after-sale technical services for off-grid systems (mainly T1 and T3 systems)	Map training and licensing partners	No. of active training and licensing partners
		Map of potential end-users for training opportunity pre and after-sale technical services for off-grid systems	No. of participants selected for training, disaggregated by age, gender, and people from other marginalised groups e. g., PWDs)
		Conduct training needs assessment and develop training curriculum in partnership with training and licensing partners	No. of curriculums
		Train youth in pre and after-sale technical services for off-grid systems	No. of trained youth technicians disaggregated by age, gender, and people from other marginalised groups (.e.g PWDs)
		License technicians to practice	No. of licensed technicians disaggregated by age, gender, and people from other marginalised groups (.e.g PWDs)
3.	Enhanced market access for local technicians	Create a network of qualified technicians who can provide technical support to t1 and t3 end-users- profiling and registering local technicians and linking them to suppliers and users.	Platform developed to map out local technicians No / %. of practicing technicians versus trained technicians
		collect data on technicians accessing green jobs through the network	No. by type of jobs disaggregating data by age, gender, and people from other marginalised groups (.e.g PWDs)
			Kshs. Income generated
4.	HHs knowledge and on the benefits of different off-grid solutions strengthened	Raise awareness of quality off-grid systems among households through Sensitisation campaigns, e.g., social media, local radio, and barazas among others	- No. of campaigns launched.

CEP Energy access indicators			
			- No. of participants reached disaggregated by age, gender, and people from other marginalised groups (.e.g PWDs). - No. of suppliers showcasing off grid solutions
5.	Street lighting	Map towns and market centres without public lighting and high insecurity for implementation	No. of towns and markets identified
		install high mast, low mast, off grid floodlights and streetlights in various towns and markets centres.	No. by type of street lighting
6.	System Efficiency	measure the energy efficiency of off grid solution	- Energy consumed per unit. - No. of hours of available power especially during rainy and cold seasons
		Measure the energy efficiency of solar street lighting	Energy consumed per unit
		Assess energy reliability.	Access and consistency of energy production by source in terms of; - availability, - duration, - stability
		Measure quality of lighting for HHs and public spaces inside households	- % brightness, - coverage, - reliability of lighting options= lighting hours.
7.	Affordability and cost-effectiveness	Assess the affordability of different lighting energy projects, particularly for underserved communities.	Cost comparison - Unit cost of kerosene, lamps, solar, kWh - energy cost per unit of energy produced for different types of energy source
		Assess energy expenditure on lighting- financial burden of energy access and its impact on household and County budgets.	- Kshs. household income spent on lighting disaggregated by type of energy source (kerosene, solar, grid etc).

CEP Energy access indicators			
			- Kshs energy costs for access to street and market lighting. - Kshs maintenance costs by type of lighting solution
8.	Access to finance	Promote affordable and inclusive access to finance for the purchase of lighting solutions	- Kshs credit advanced to target population by type of financier and payment method, e.g., lease to own and lease only. - % loan default
GESI Indicators			
9.	Energy Docket and Gender Directorate collaborate to integrate GESI into energy solutions design, planning and implementation	Recruit a local gender champion expert at the subCounty and ward level as part of the team to train team members on gender concepts in access to economic opportunities (increased security and working hours, productive use of energy) local norms, gender-responsive street lighting and how to use gender mainstreaming tools and guidelines.	No of gender experts appointed
		Integrate GESI activities in the project budget as a specific component at the start.	% of budget allocated to GESI activities % of budget used for GESI activities.
10.	Enhanced partnerships to promote GESI.	Map interested partners and key gender advocacy groups for gender impact awareness and planning and implementation.	No. of active partnerships managed
		Ensure female and disadvantaged groups are targeted in the technician training programme.	% of female and disadvantaged groups train disaggregated by age, education, rural vs. urban
11.	Awareness raising and Sensitisation.	Conduct capacity needs and KAPS assessment on project implementers and partners	Report
		Develop training curriculums and coaching and mentoring approaches that embed GESI mainstreaming in programming	Number of curriculums developed
		Conduct training on GESI	No. of mentorship and coaching programmes designed No. of project staff and supporting organization trained disaggregated by gender, rural vs urban and disadvantaged groups

CEP Energy access indicators			
		Implement coaching and mentorship programmes for women entrepreneurs, and women-led businesses as well as placement/ internship opportunities for technicians	No of female and disadvantaged entrepreneurs and women led business participating in programme disaggregated by age, income level, rural vs. urban
		Sensitise key stakeholders involved in lighting sector (municipal agencies, electricity utility, private sector, etc.) and raise their awareness of GESI and from the project's onset.	No. of participating stakeholders disaggregated by rural vs. urban/ peri urban
12.	Building a GESI-disaggregated evidence base	Collect data on access, purchase, usage, affordability of lighting solutions.	No of users disaggregated by gender, vulnerability indexes, income, in rural, urban and peri-urban settings

Table 38: Lighting outputs indicators

Conclusions

The strategies suggested in this document have identified viable pathways to improve access to clean, affordable, and modern sources of energy for different households across Meru. The overall aim of the approaches laid out in these strategies is to build sustainable programmes which ensure that these solutions can be effectively implemented by Meru County, and later replicated to other areas across the County through a multi-stakeholder collaboration. For that end, collaborative effort between the relevant Government department, technology suppliers, and local organisations will be essential. Furthermore, it is envisaged that the interventions previously outlined will contribute to achieving the SDGs, the Meru Vision 2040 and the National Vision 2030.

Health sector goals and strategies to promote electricity access

3.1.2.3.1 Goals for electricity access in the health sector

1. Overview of the sector and background

Health is a devolved sector in Kenya, but national policies and strategies govern the provision of health services by County Governments. The most important is the Kenya UHC Policy, 2020-2030, based upon the Constitution of Kenya (2010) and aligned with global development agendas. The policy aims at ensuring all Kenyans have access to essential quality health services without suffering financial hardship. County Governments provide medical services including inter-alia expansion of health facilities, ambulance services and promotion of primary health care (Department of Health, 2020). The vertical linkages between national policies and the County implementation of health policies and strategies are operationalised through the CIDP and ADPs.

According to Meru Vision 2040, there are 435 primary community health units (level two dispensaries), 39 level three facilities (clinic), 23 level four hospitals and one level 5 hospital (County Government of Meru, 2018) offering services to about 1.5 million people (Meru County Government, 2019). The vast majority (87%) of medical facilities in Meru are thus level two facilities (dispensaries) providing outpatient services, including Voluntary Counselling and Testing (VCT) services for HIV, maternity clinics, antenatal and postnatal services, vaccinations, pharmacy services, and general consultations. Dispensaries also issue referral letters to higher level facilities.

The baseline identified various health sector flagship projects in the CIDP (2018-2022) which include increased investment in public health education, improving the working environment for health workers, ensuring adequate and proper usage of drugs for all health facilities, door-to-door campaigns on hygiene and sanitation and other preventive health strategies; support for community health services with targets of 30% increase in immunisation rate and 80% of community members signed up to the NHIF; increasing the number of specialists and nurses to attain global standards for the patient: practitioner ratio, and embracing e-health and innovation.

Challenges, priorities and needs

Given that level two (L2) facilities are the main point of access to basic health services for Meru's citizens, improving service delivery via level two facilities was identified as a priority need through the CEP baseline and subsequent needs assessment process. Various infrastructure challenges were identified as common across level two facilities, including lack of access to reliable and affordable electricity and lack of clean water access. In addition to these infrastructure challenges, staff recruitment and retention, and lack of adequate medicine supplies, and lack of or poor functioning of medical equipment and appliances were also identified.

According to the baseline and additional research, less than half (46.3%) of level two facilities had a functioning electricity connection and most of these facilities experience frequent grid blackouts (approximately once a week, lasting 30 minutes) and required back-up generators to power the facilities, at high cost.

Access to sufficient clean water to run outpatient services was also a challenge. The County Directorate of Medical Services stated that, in the Highlands, facilities have sufficient water supply whereas in the lowland (ASAL) regions, acute water scarcity leads to some facilities purchasing water. Investment in water storage and boreholes are required in these regions (namely, Igembe North and Central, Tigania East, Central and West and Buuri East and West). Other non-energy challenges identified for level two facilities included the following:

Inadequate budget for the sector overall, including low budgetary allocation from the National Government level.

Lack of financial management including inadequate record keeping at the facility level, in part due to the inability of clients to pay for services due to high poverty levels, and inadequate implementation/poor coverage of universal healthcare insurance (NHIF), lack of charging for services via NHIF due to no or inadequate digitalisation of records, in turn linked to unreliable power, lack of internet access and lack of equipment such as laptops.

This was linked to the lack of a County-wide charging policy for services.

High cost of utilities and equipment.

High cost of medicines and lack of proper storage systems for medicines, leading to stock wastage.

High cost of recruiting well-trained staff (exacerbated due to COVID pandemic). Delays in payment of health workers' salaries and lack of good housing and working conditions especially at remote facilities was also highlighted as disincentives to recruitment and retention.

Poor community health strategy and inadequate stipend for Community Health Volunteers (CHV) leading to lack of basic disease prevention and health promotion in communities.

Lack of information and misperceptions among communities of what services they could expect from level two facilities.

Socio-cultural beliefs and practices restricting individual or groups' willingness to access services.

After the needs assessment, additional research was carried out to understand the challenges to provision of “good enough” outpatient service via level two facilities. This included further secondary research with the support of Directorate of Medical Services Staff on mandated appliances and staffing levels at these facilities, and a survey of functioning L2s to identify minimal appliances/equipment/supplies for “good enough” service delivery. There was also mapping of current and past health projects/initiatives in Meru County supported by National and County Government and other service providers, with analysis of lessons learned, and any best practice initiatives identified from other Counties.

Primary research was also undertaken with Sub-County Health Officials, through a questionnaire and workshop on access to, and costs of, energy and water infrastructure, staffing levels, availability and functioning of appliances and equipment, and access to medicines.

This led to subsequent GIS mapping of the locations of level two facilities which reported a lack of reliable electricity (whether from grid or off-grid sources), which ranged from those which reported an existing electricity supply but with sub-optimal reliability, to those which reported as not having any functioning electricity access. One challenge was that facilities lacked GIS coordinates. One hundred and sixty (160) L2 facilities were located while seven (7) were not included in the analysis since they could not be geolocated.

From the 160 L2 facilities mapped, 112 L2 facilities were identified as already grid-connected, while 48 were not (see Table 23 below).

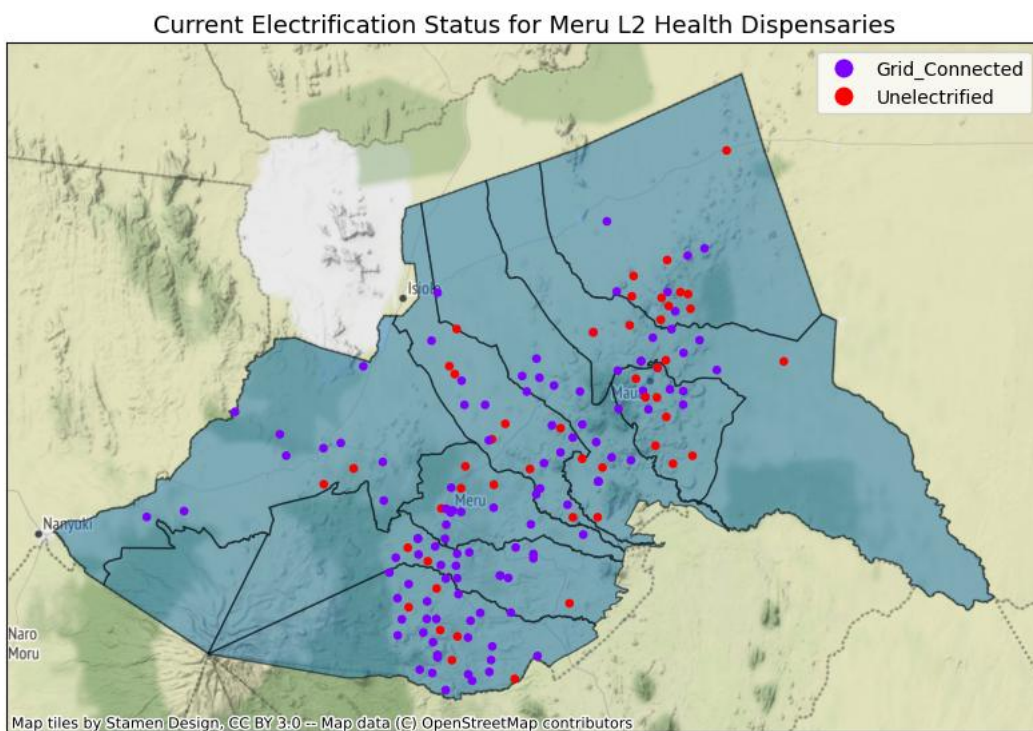


Figure 24: Electrification status of target L2 facilities

Using Qgis geospatial analysis tool, the distances between each L2 facilities and the nearest KPLC transformers were calculated. Facilities were mapped according to whether they were within and beyond 600m from grid. Facilities within and beyond 3km from population clusters, and within and beyond 1km of permanent rivers and boreholes were also identified. 32 facilities were located more than 1km from permanent rivers/boreholes, while 26 were identified as possible targets for new dual-use boreholes under the CEP water solution, given their proximity to population clusters.

Table 39 summarises the broad categories of challenges for the target L2 facilities, grouped according to three types of potential energy access solutions.

	Group 1 Patients of grid connected L2 facilities with unreliable supply	Group 2 Patients of unelectrified/L2s or with unreliable supply within grid connection distance (< 600m)	Group 3 Patients of unelectrified L2s with unreliable supply beyond connection distance (> 600m)
Type of challenge	L2 facilities without a reliable, affordable electricity and water supply & other non-infrastructure challenges (staff retention/recruitment, lack of medical supplies & equipment) hampering delivery of “good enough” outpatient services		
Energy access	○ Grid connected” but experience frequent power outages. ○ No back up system or BUS non-functioning	○ Not connected to grid with off-grid system (SHS) that is non-functioning. ○ No back up system or BUS non-functioning	○ Not connected to grid with off-grid system (SHS) that is non-functioning
Water access	○ No or insufficient access to clean water (synergies with water solution)	○ No or insufficient access to clean water	○ No or insufficient access to clean water
Appliances	○ Lack of appliances/equipment to deliver “good enough” services	○ Lack of appliances to deliver “good enough” services	○ Lack of appliances to deliver “good enough” services
Medical supplies	○ Issues with supply	○ Issues with supply	○ Issues with supply
Staffing	○ Inadequate staffing due to either recruitment and/or retention issues	○ Inadequate staffing due to either recruitment	○ Inadequate staffing due to either recruitment and/or retention issues

Locations			and/or retention issues	
	L2 facilities across Meru County			
		○ Cross County ○ Priority targets defined through GIS mapping.		

Table 39: Categories of challenges for level two facilities in Meru County

a. Promoting Gender and Social Inclusion (GESI)

GESI-sensitive health services are informed by knowledge and understanding of end user inequalities, and the specific challenges faced by women and other marginalised groups - in this case in accessing L2 facility services - and their health service needs. Evidence shows such groups can be disadvantaged due to vulnerabilities relating to social class and income (poverty), and a range of inequalities including age, ethnicity, physical or mental disabilities, and gender. Some people suffer from more than one of these vulnerabilities, so understanding this “intersectionality” in relation to specific groups of end users is also important to address existing imbalances. Achieving GESI in solution development and implementation will require further analysis to disaggregate the different groups of target end users (in this case L2 facility users), concrete implementation measures including in relation to staff training and recruitment, including resource allocation and development of GESI indicators for monitoring and evaluation, with collection and analysis of disaggregated data. The County Government will need to carry out further GESI analysis to develop this approach as part of the inception phase of implementing the solutions.

c. Climate resilience mainstreaming

It is important that climate risks are recognised, and mitigation strategies developed in the formulation of County health strategies and policies, as well as at the project level. The first step is to raise the awareness of key health sector stakeholders on the linkages between climate variability, climate change, vulnerability, and health interventions and outcomes. The ambitious national goal for Universal Health Cover (UHC) primarily focuses on vulnerable populations, who are more at risk of experiencing the effects of climate change, rendering them unable to cope with and bounce back from adverse events. These populations are likely to be one of the main outpatient groups served by L2 facilities.

In terms of their locations, half of the targeted L2 facilities are also located in the arid or semi-arid sub counties of Tigania East, Tigania West, Imenti North, Imenti Central and Imenti South, areas which experience severe and prolonged droughts which are likely to be exacerbated by climate change. This means that the infrastructure components, particularly the water solutions, designed for facilities in locations experiencing such impacts must address these risks and build in resilience.

However, this requires good evidence and data to identify the specific risks and impacts in these locations.

If resource is available, the health solution implementation planning should apply an additional climate vulnerability assessment to the Demonstration solution. This would:

- Identify climate risks to the solution and the vulnerability of target groups.
- Assess whether the solution could lead to increased vulnerability to the target groups through maladaptation.
- Analyse whether there are further opportunities to address climate risks by optimizing the solution.
- Make recommendations on changes to the solution.

Given the data gaps, data collection systems should be designed to collect data on the magnitude, frequency, and impact of climate-related health impacts which can then be analysed (which will require additional resource) to inform future implementation planning. This should also inform resource allocation, including the costs of mitigating or managing the identified risks through optimisation of the solutions.

d. Promoting Energy Efficiency and Conservation

The approach to promoting EEC in the health sector solution should be based on collection of data or a baseline audit of the target facilities, including infrastructure, equipment and appliances and staff practices etc., if resource is available, to identify which EEC interventions would be the most effective, and to quantify the resources needed to implement these. As discussed below, the solution focuses specifically on promoting the procurement the most energy efficient equipment and appliances over the longer-term, including development of a Green Procurement Policy for L2s, and staff training to promote EEC. This could also be a model for the health sector in Meru overall. If additional resource is available, measures to improve EEC in the physical infrastructure of L2 facilities could also be piloted.

3.1.2.3.2 Strategies to promote access to basic health services

The basic value proposition is to provide a reliable, affordable, and adequate electricity and clean water supply plus the minimum appliances, equipment, medicines and trained staff to ensure “good enough” basic health (outpatient) services in target level two facilities (dispensaries).

The business model for the solution is summarised in Table 40 below.

	Group 1 Grid connected plus back up	Group 2 (a) New grid connection plus back up - □ 50 m from transformer	Group 2 (b) New grid connection plus back up – 50 to 600 m from transformer	Group 3 Off grid – □ 600m from transformer
Electricity access	Energy System: Add 6kVA Petrol Generator. Maintenance and repair function.	Energy System: Single Phase Grid+6kVA Generator.	Energy System: Single Phase Grid+ low voltage extension line +6kVA	Energy System: 3kW Solar, with 2.4kWh Battery Bank

	Maintenance and repair function.	Generator. Maintenance and repair function	(Backup). Maintenance and repair function.
Clean water access	System: New dual use solar borehole or piped water. 26 facilities with new solar borehole, 6 piped water and remaining facilities have customised solutions. Governance: Water Committee with level two facility staff representation.		
Appliances & Equipment	- Repaired or replaced basic appliances/equipment. - Supplier mapping for EE appliances - Provision of maintenance/repair & staff training - Feasibility on bulk purchase of equipment - Development of “green procurement” policy		
Medical supplies & storage	- Identification of essential medicines list for all levels - Quantification to ensure optimal stocks. - Procurement arrangements - Construction of 50 stores in level II - Purchase of shelves and pallets		
Financial management & customer outreach	- Develop and implement policy on service charging - Training - digital stock taking & charging. - Community sensitisation on levels of service & charging policy		
Staff retention & recruitment	- Feasibility studies to benchmark best staff recruitment and retention practices. - Training needs assessment. - Annual training and refresher courses for level two staff.		

Table 40: Health solution business model

II. Solution Components

Table 40 (above) gives a summary of the different solution components.

Three main types of solution were identified as least cost options for electricity access (see also Target beneficiaries). For Group 1, those facilities which are grid connected, the aim is to provide a functioning grid connection and affordable back-up system. However, it is important to caveat that during the set-up phase, further field research will be needed to ascertain whether each facility does have a functioning grid connection, as anecdotal evidence suggests that some in this Group may not have a complete or functioning connection to a transformer.

For Group 2, new grid connection plus back-up, this has been divided into two further sub-categories to make costings as accurate as possible. According to KPLC distribution standards, the typical span length for low-voltage lines is 50m. This explains the use of the 50m threshold for Group 2 (a). Group 2 (b) is those L2s located between 50 to 600m from an existing transformer, where the costs of connection will be higher than for Group 2 (a). The County Government will request KPLC/REREC to connect these facilities to the grid and an affordable back-up system will be provided. For Group 3, those located more than 600m from an existing transformer, they will be provided with an off-grid energy solution (SHS).

The costs for each electricity solution were modelled using the assumptions outlined in Table 41. In terms of capex, the grid with generator solution has the cheapest capex followed by the grid with battery option, and finally the solar PV with battery option. In terms of opex, the solar PV with battery solution is the cheapest followed by grid with battery and finally grid with generator. In terms of total costs, this means the options of grid with battery and solar PV with battery are the cheapest solutions for Groups 2 and 3 (see Table 29). It is important to note that as both back-up components use lead acid batteries which need replacement every five years, these must be disposed of safely to avoid negative environmental impacts. Lithium-ion phosphate batteries could as well be used. However, these are currently expensive (approx. USD 400/kWh) and would therefore not be suitable for a large scale-up programme.

Assumption	Unit cost	Source
USD Rate	139.8706	Central Bank of Kenya (Jan 2023) ¹¹
Medium Voltage Line Cost	53000 USD/km	KPLC
Low Voltage Line Cost	15 USD/m	
Threshold for Grid Connection Only	50m	
Grid Connection Cost (Service Line + meter)	643.45 USD	
Service transformer Capex	2000 USD for a 50kVa transformer	
Grid+ Generator Capex	1378.77 USD	Meru CEP Modelling
Grid + Battery Capex	2740.83 USD	
Battery Backup Only Capex	2095.44 USD	
Generator Capex	735.32 USD	
Standalone Solar PV Capex	8342.28 USD	
Grid+ Generator 10-year Opex	17615.49 USD	
Grid + Battery 10-year Opex	17402.32 USD	
Standalone Solar PV 10-year Opex	8584.72 USD	

Table 41: Capex and opex assumptions for costing the electricity components

Solution	System CAPEX	Cumulative 10-yr OPEX
Group 1: Backup Only	735.32	8,708.14
Group 2 (a) Grid Connection with Generator	1,378.77	9,062.85
Group 2 (b) Grid Connection with Generator and Low Voltage Extension	5,259.39	8,708.14
Group 3: Solar with Battery Storage	8,342.28	6,433.93

Table 42: Summary of costs of each solution type (US dollars)

L2 facilities already electrified (whether or not the service was reported as reliable) were directly assigned costs for backup only. Group 2 (a) - L2 facilities less than the threshold (50m) from the nearest

¹¹ Central Bank of Kenya exchange rate on 16 January 2023 of 1 USD = 123.8912 KES.

service transformer - were assigned new grid connection plus generator capex costs. Group 2 (b) - L2 facilities with distance from the transformer more than 50m and less than 600m from the nearest service transformer) were assigned costs for new grid connection plus generator plus low voltage line extension. Group 3 - L2 facilities more than 600m for the nearest service transformer - were directly assigned the solar plus battery capex as per the assumptions. Opex costs were then assigned. Table 43 below shows electricity solution type by number of facilities.

Option	Number of L2s
Group 1: Backup only	112
Group 2 (b) Grid connection with generator and low voltage extension line	37
Group 3: Solar with battery storage	7
Group: 2 (a) Grid connection with generator	4
Total	160

Table 43: Number of dispensaries per technology option

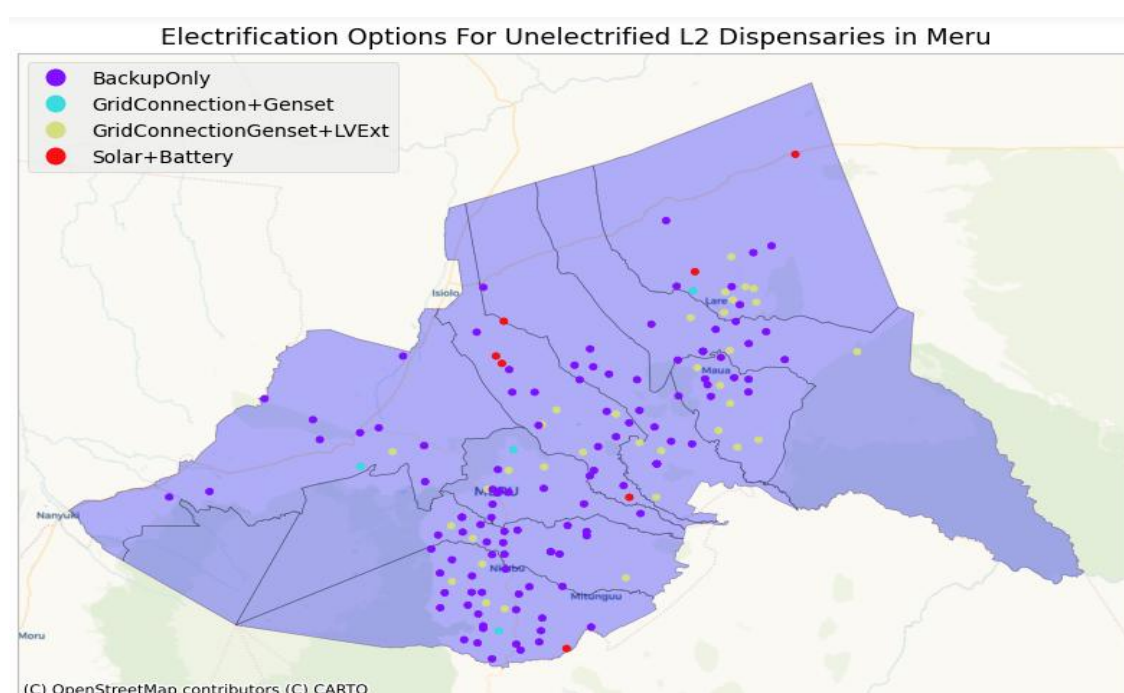


Figure 25: Distribution of electricity solution component types

The solution also provides for the estimated cost of annual maintenance and repair for the energy system and appliances (see Tables 37 & 38). In the case of maintenance for the off-grid, SHS-powered facilities, the Directorate of Energy is exploring whether the technicians trained as part of the lighting solution to install and/or maintain and repair SHS and solar street lighting could be deployed to support SHS components included in other CEP solutions (namely the crop farming, poultry, water and health solutions). An estimate of the aggregate technician days and costs has been developed which will allow the County Government to negotiate supplier contracts either with the new technicians or potentially SHS equipment suppliers. Level two facility staff will also be trained on basic operation and maintenance of the on-grid and off-grid back-up and SHS-powered energy systems, as well as of the medical appliances and equipment.

The solution has identified a list of minimal number and type of appliances and equipment needed to provide the basic services of a level two facility (see Table 44). The power required to run these appliances and equipment to deliver the mandated services has been used to model the energy solutions.

Again, further field work will be needed to assess the supply and functionality of appliances and equipment in each of the target facilities. The Department of Health will operate a “repair or replace” approach and, where new appliances or equipment is required, develop a “green procurement” policy to ensure purchase of the most energy efficient (EE) appliances, which will also help reduce opex. It will also explore with the Meru County Investment Development Corporation (MCIDC) and suppliers the opportunities for future bulk purchase of EE appliances to drive down costs.

No	Equipment	Power (W)	Quantity	Usage/day	Link
1	Refrigerator	120	1	18	Ramtoms
2	Vaccine Fridge	325	1	18	Vaccine
3	Centrifuge Machine	75	1	2	800D
4	Desktop Computer	240	1	8	DELL
5	Personal Computer	70	1	4	Laptop
6	Microscope	20	1	2	Labomed
7	Suction Machine	120	1	2	2 bottle
8	Examination Lamp	12	2	4	Lamps
9	Nebuliser Machine	50	1	1.5	Nebuliser

Table 44: List of appliances and equipment health required to deliver “good enough” level two health services

The water access component has been developed in discussion with the Directorate of Water and Irrigation and Irrigation, aiming to build co-benefits with the water solutions. GIS mapping identified 26 level two facilities that are in the vicinity of underserved populations in terms of access to clean water (up to 1KM radius). These facilities will be given priority for delivery of dual-use (community and health facility) boreholes in the Demonstration Phase of implementing the solution (see below). The water use by the level two facilities will be metered, and they will pay for usage. In terms of governance of the boreholes, best practice arrangements will be put in place building on aspects of the Ngushishi Water Resource Users Association (see water solution). Health facility personnel should participate in the governance committee and under the training component, will receive specific training to carry out this role. The governance committee should also ensure inclusion of women and other marginalised groups.

The Directorate will also carry out a feasibility assessment for piped water supply in six level two facilities in the Imenti region that have reported having no functioning water supply. Over the course of the CIDP, the Directorate of Medical Services will work with the Directorate of Water to assess the status of water access in the remaining targeted facilities and develop appropriate solutions (e.g., boreholes, piped water, water harvesting etc.). The suggested target is 54 additional feasibility studies in

the Demonstration Phase to enable the solution to reach half of the targeted facilities (80) in the first Scale-Up Phase (to Year 5).

It should be noted that it is not possible to calculate accurately the costs of implementing the water component of the solution in the Scale-Up Phases because the water access solutions will need to be customised to the specific sites (facilities), as above. However, for illustration purposes, the same unit cost as for solar-powered boreholes plus meters has been used as in the Demonstration Phase. It should be further noted that the cost of deploying the water component to 50% of the target facilities in Scale-Up Phase 1 will need to be calculated during the Demonstration Phase and for Scale-Up Phase 2 during Phase 1.

In terms of the non-energy and non-infrastructure components, one of the key components is improving staff retention and recruitment (including addressing skewed staff redistribution). During the Demonstration Phase, further research will be carried out to benchmark best practices in this area, including for promoting GESI in recruitment and retention, and an assessment of capacity building needs of level two staff will be undertaken to identify training needs and areas for career development which could incentivise staff. This should include assessment of GESI-related gaps and needs. During the Scale-Up Phase, annual training and refresher courses staff will be introduced. Training approaches must promote participation of women and marginalised groups. In relation to the critical challenge of delays in paying health worker salaries, the Department Finance, Economic Planning & ICT will explore whether there are innovative ways to address this, for instance, through access to credit .

To improve timely access to, and storage of, medical supplies, the County Government aims to introduce quantification to ensure optimal stock levels, new procurement systems and digitalisation of stock taking, as well as construction of 50 medicine storage rooms in level two facilities. If these storage rooms are required to be temperature controlled, the sizing of the energy component may need to be optimised to ensure there is adequate power supply. Staff will be trained on operation of these stores and on digital stock taking.

Finally, there is a need to improve the financial management and record keeping of L2 facilities, including through training and introduction of digital book and record keeping. Many L2 facilities incur high operational costs, including for utilities. These could be reduced by ensuring that staff are able to process bills in a timely manner through the national insurance system and by charging for services in a consistent and transparent manner. To this end, the Department of Health will develop a standard charging policy.

Alignment with CIDP (2023-2027) priorities

The solution is aligned with the Health Department's priority outcome in the CIDP 2023-27 of "enhanced access to basic health services" (see Table 45 below). However, further discussion with the Department of Health has been ongoing led by the Directorate of Economic Planning to ensure that there will be sufficient multi-year budgetary allocation, starting with the ADP 2023-24, for all the solution components, and that a specific financing plan is developed as part of the implementation planning, agreed by the Implementation Committee. This could include any co-financing that can be identified to deliver some of the solution components.

Sector & Outcome	CEP Solution Components	CIDP Priority (Reference Chapter 4: Development Priorities, Strategies and Programmes under Section 4.2.1 Sector Programmes)	Activities (Reference: Annex I: Projects Derived from Programmes)	Implementing Agency
Health: Enhanced access to basic health services	Sufficient appliances/equipment (Health solution energy component)	Programme: Administration, Planning and Support Services. Sub-programme/project: Health Infrastructure	- Renovations and upgrading of health facilities. - Provision of reliable electricity supply in health facilities. - Provision/replacement of basic appliances/equipment - Supplier mapping for energy efficient appliances - Equip laboratories. - Upgrade laboratories - Laboratory supplies and consumables - Construction, equipping and operationalising wellness centres - Provision of maintenance/repair for electricity systems & appliances	Health Services
Ref: Annex 1.9				
Sector & Outcome	CEP Solution Components	CIDP Priority (Chapter 4: Section 4.2.1)	Activities (Reference: Annex I)	Implementing Agency
Health: Enhanced access to basic health services	Adequate medicines & medical supplies (Health solution non-energy solution components)	Programme: Curative and Rehabilitative Health Sub-programme/project: Pharmaceutical and Non-pharmaceutical commodities	- Identification of essential medicines list for all levels - Quantification to ensure optimal stocks. - Procurement arrangements - Construction of 50 stores in level II - Purchase of shelves and pallets for all level II and III	Health Services

			○ Policy on service charging ○ Staff training on digital stock taking and charging. ○ Community Sensitisation	

Table 45: Aligning CEP solutions with CIDP priorities

Financing models

The financing model is that the County Government of Meru will make the investments using public finance. The Directorate of Medical Services would provide the bulk of financing for the solution components of electricity, appliances and equipment, training and digitalization of records keeping and charging. It is also assumed that their opex for energy and water access, costs of medicines etc would come from the health sector budget, paid directly by the target facilities.

There may be health sector donors that could be approached to co-finance aspects of the solution implementation, for instance, some of the training functions, in the set-up phase, as well as support further scale up in the next CIDP cycle/final five years of the CEP. This would require further mapping and engagement with potential donors by the Directorate of Health.

The Directorate will finance installation of 26 dual-use boreholes and undertake feasibility studies for 24 facilities during the Demonstration Phase of implementation and then further scaling of both feasibility and implementation of water solutions. Further discussion between the two Directorates will be necessary to allocate budget through the ADPs for this CIDP cycle to 2027 and through the next CIDP cycle (2028-2033).

Cost-benefit analysis

Coupled with the potential for reducing costs through bulk purchase of appliances/equipment by the Department of Health and lower energy opex due to higher energy efficiency of appliances/equipment (along with the potential reduce maintenance costs for the small number of facilities using SHS power through use of the planned Directorate of Energy SHS maintenance service contracts), the targeted L2 facilities should be transformed into functioning cost centres.

In this first five-year CEP- CIDP cycle, about 50% of targeted level two facilities in Meru will be reached. If there is subsequent scale-up from 2028-33 to reach 100% of the targets, this will represent over one third (37%) of all L2 facilities in Meru (if that number is 435, as reported in Meru Vision 2040). As the target facilities are located across all Sub-counties in Meru, citizens in all locations should benefit from improved provision of basic outpatient services.

3.1.2.3.2 Intervention options

l. Target beneficiaries

Figure 33 shows the distribution of the total target facilities, which covers all Sub-counties in Meru. The distribution of the L2 facilities mapped per sub County is outlined in Table 46 below:

SubCounty	Count of Dispensaries
Imenti South Sub County	32
Tigania West Sub County	21
Imenti Central Sub County	20
Tigania East Sub County	17
Igembe North Sub County	16
Igembe South Sub County	15
Imenti North Sub County	14
Igembe Central Sub County	13
Buuri Sub County	12
Grand Total	160

Table 46: Target level two facilities per sub County

Budget commitment and funding sources

If all the target L2 facilities were targeted for electricity access, the total investment capex is approximately KES 47.7 million (see Table 47 for distribution by solution type).

Solution	Total CAPEX (KES)
Group 1: Backup Only	11,519,160.76
Group: 2 (a) Grid Connection with Generator	771,397.55
Group 2 (b) Grid Connection with Generator and Low Voltage Extension	27,218,455.01
Group 3: Solar with Battery Storage	8,167,877.96
Total	47,676,891.28

Table 47: Total CAPEX per system type

The total estimated five-year Opex is approximately KES 385.4 million (see Table 48).

Solution	Cumulative 10-yr Opex
Group 1: Backup Only	275,955,585.47
Group: 2 (a)Grid Connection with Generator	9,855,556.62
Group 2 (b) Grid Connection with Generator and Low Voltage Extension	91,163,898.77
Group 3: Solar with Battery Storage	8,405,249.56
Total	385,380,290.43

Table 48: Cumulative 10-year per system type (including cost estimates for annual maintenance and repair)

In terms of distribution of investment for the energy component of the solutions across the Sub counties (capex and opex without maintenance and repair), Tigania West sub County and Igembe North would receive the highest and second-highest investment (KES 9.4million and KES 8.2 million respectively), while Buuri SubCounty has the lowest aggregate investment (KES 2.2 million) (see Figure 3).

It is worth noting that the cost distribution correlates with that of the targeted L2 facilities across these Sub-counties (see Table 33). Figure 26 shows the estimated opex costs over 10 years per Sub County for implementation of the electricity solution components.

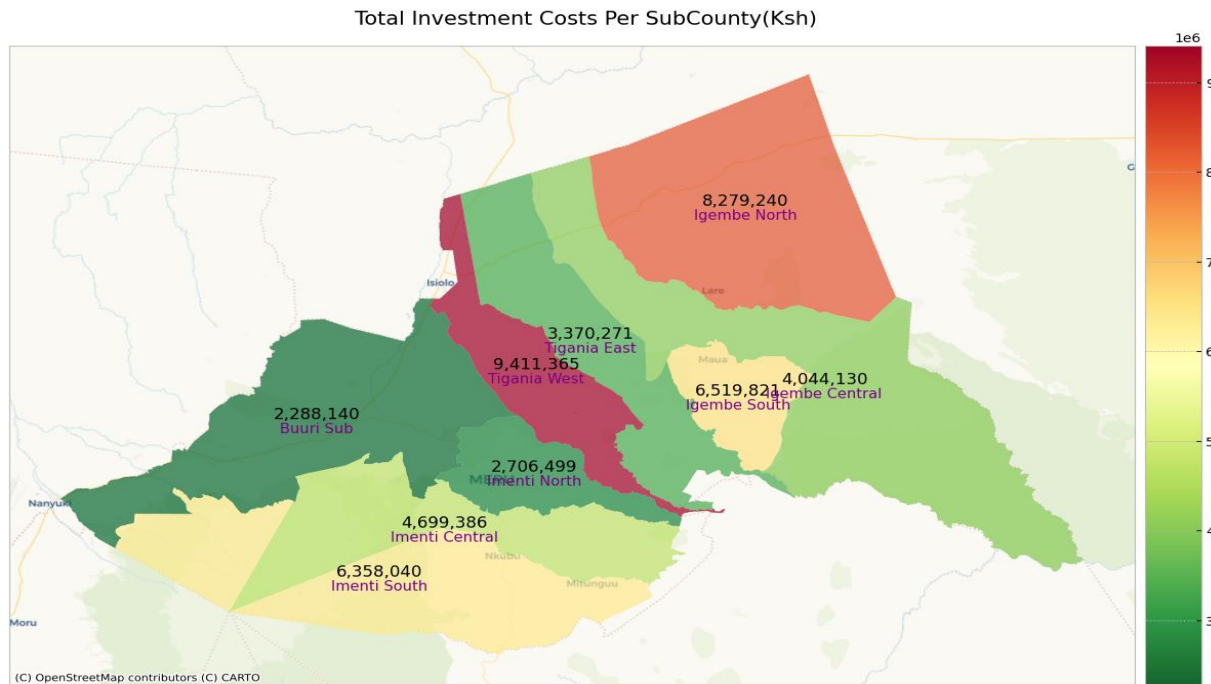


Figure 26: Capex investment per sub County

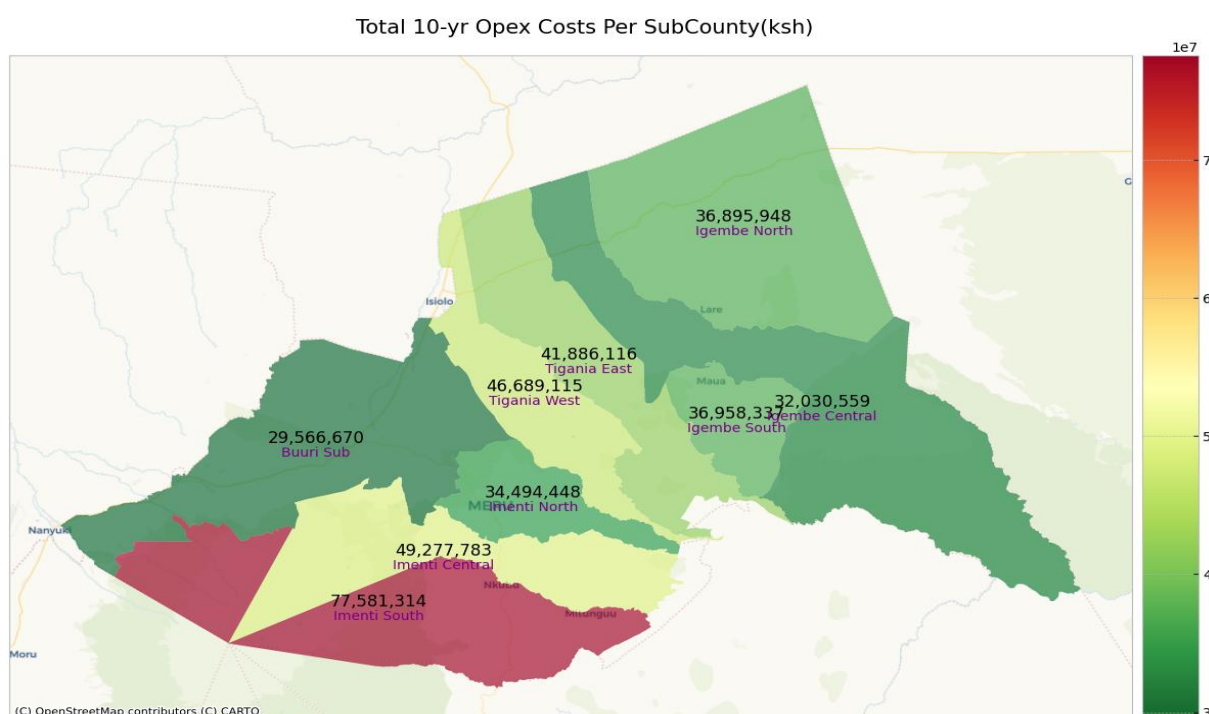


Figure 27: Ten-year Opex costs per sub County

Table 36 summarises the projected investment costs (CAPEX + OPEX) in the solution for the Demonstration and Scale-Up Phases (see Tables 49-53 below). The financing source is assumed to be County Government budget allocation unless co-financing is identified for some components.

It should be noted that the water infrastructure costs for the Scale-Up Phases are modelled according to the cost of solar boreholes as it is not possible to identify in advance of carrying out site-specific feasibility studies what specific water solutions will be required for the remaining target facilities and model the costs. The KES costs will require updating during implementation planning and before each phase is undertaken to take account of cost increases. The USD figures are included for illustration only.

Phase	Total Investment Cost (KES)	Total Investment Cost (USD) ¹²
Demo Phase	156,726,715	1,034,396
Phase 1: Scale-Up(Y3-Y5)	413,930,468	2,731,941
Phase 2: Scale-Up(Y6-Y10)	550,320,839	3,632,118
Total public investment	1,120,978,022	7,398,455

¹² Based on an exchange rate of 0.0066 KES=1 USD (25 Oct 2023, Xe.com. The same exchange rate is used for the USD figures in Tables 12-14. Again, this is for illustration only.

Table 49: Solution costs

Solution Component		Unit cost (KES)	No. of facilities	Total cost (KES)
Water	Establishing water committees	200,000	26	5,200,000
	Solar borehole/installation – 26 @200m depth and 12 cubic meter/hour yield	3,680,540	26	95,694,036
	Installation of meters	3,000	26	78,000
	Feasibility studies water solutions	200,000	54	10,800,000
	Subtotal - water			111,772,036
Electricity	Group 1: Generator Backup Only	102,849.65	12	1,234,195.80
	Group: 2 (a) Grid Connection with Generator	192,849.39	0	-
	Group 2 (b) Grid Connection with Generator and Low Voltage Extension	735,633.92	0	-
	Group 3: Solar with Battery Storage	1,166,839.71	0	-
	Group 1: Generator Backup only 10yr opex	1,218,012.77	12	14,616,153.20
	Group: 2 (a)Grid Connection with Generator 10yr opex	1,267,626.27	0	-
	Group 2 (b) Grid Connection with Generator and Low Voltage Extension 10yr opex	1,218,012.77	0	-
	Group 3: Solar with Battery Storage 10yr opex	899,917.65	0	
	Subtotal Electricity			15,850,349.00
Appliances & equipment	New appliances	406,824	12	4,881,888.00
	Repair of appliances	203,410	12	2,440,920.00
	Annual Maintenance	40,682	12	488,184.00
	Total Appliances & Equipment			7,810,992
Staff recruitment & retention	Training in appliance operation/maintenance, digital stock taking & charging			4,500,000.00
Benchmarking	Benchmarking of staff R & R best practice & capacity gaps			500,000.00
Subtotal - all components				140,433,377
Project management & monitoring and evaluation	Project management (@ 10% of CAPEX)			14,043,337.68
	M&E			2,300,000.00
	Subtotal - PM/M&E			16,343,337.68
Total costs	Total (KES)			156,776,715
	Total (USD)			1,034,726

Table 50: Health solution costs - Demonstration Phase (1-2 years)

Solution Component		Unit cost (KES)	No. of facilities	Total cost (KES)
Water	Establishing water committees	200,000	54	10,800,000.00
	Solar borehole/installation @200m depth and 12cubic meter/hour yield	3,680,540	54	198,749,151.36
	Installation of meters	3,000	54	162,000.00
	Feasibility studies water solutions	200,000	80	16,000,000.00
	Subtotal - water			225,711,151.36
Electricity	Group 1: Generator Backup Only	102,849.65	50	5,142,482.48
	Group: 2 (a)Grid Connection with Generator	192,849.39	4	771,397.55
	Group 2 (b) Grid Connection with Generator and Low Voltage Extension	735,633.92	14	10,298,874.87
	Group 3: Solar with Battery Storage	1,166,839.71	0	0.00
	Group 1: Generator Backup Only 10yrOpex	1,218,012.77	50	60,900,638.33
	Group: 2 (a)Grid Connection with Generator 10yr opex	1,267,626.27	4	5,070,505.07
	Group 2 (b) Grid Connection with Generator and Low Voltage Extension 10yr opex	1,218,012.77	14	17,052,178.73
	Group 3: Solar with Battery Storage 10yr opex	899,917.65	0	0.00
	Subtotal Electricity			99,236,077.03
Appliances & equipment	New appliances	406,824	68	27,664,032.00
	Repair of appliances	203,410	68	13,831,880.00
	Annual Maintenance	40,682	68	2,766,376.00
	Subtotal Appliances & Equipment			44,262,288.00
Staff recruitment & retention	Training appliance operation/maintenance, digital stock taking & charging, staff development		Lump sum for all training	5,000,000.00
Subtotal - all components				374,209,516
Project management & monitoring and evaluation	Project management (@ 10% of CAPEX)			37,420,951.64
	M&E			2,300,000.00
	Subtotal - PM/M&E			39,720,951.64
Total Costs	Total (KES)			413,930,468.04
	Total (USD)			2,731,941.09

Table 51: Health solution costs – Scale-Up Phase 1 (3-5 years)

Solution Component		Unit cost (KES)	No. of facilities	Total cost (KES)
Water	Establishing water committees	200,000	80	16,000,000
	Solar borehole/installation – @200m depth and 12cubic meter/hour yield	3,680,540	80	294,443,187
	Installation of meters	3,000	80	240,000
	Feasibility studies water solutions	200,000	0	0
	Subtotal - water			310,683,187
Electricity	Group 1: Generator Backup Only	102,849.65	50	5,142,482.48
	Group: 2 (a)Grid Connection with Generator	192,849.39	0	-
	Group 2 (b) Grid Connection with Generator and Low Voltage Extension	735,633.92	23	16,919,580.14
	Group 3: Solar with Battery Storage	1,166,839.71	7	8,167,877.96
	Group 1: Generator Backup Only 10yrOpex	1,218,012.77	50	60,900,638.33
	Group: 2 (a)Grid Connection with Generator 10yr opex	1,267,626.27	0	-
	Group 2 (b) Grid Connection with Generator and Low Voltage Extension 10yr opex	1,218,012.77	23	28,014,293.63
	Group 3: Solar with Battery Storage 10yr opex	899,917.65	7	6,299,423.55
	Subtotal - Electricity			119,144,872.54
Appliances & equipment	New appliances	406,824	80	32,545,920.00
	Repair of appliances	203,410	80	16,272,800.00
	Annual Maintenance	40,682	80	3,254,560.00
	Subtotal - Appliances			52,073,280.00
Staff recruitment & retention	Training - appliance operation and maintenance, digital stock taking & charging, staff development	Lump sum		10,000,000
Subtotal - all components				498,200,763
Project management & monitoring and evaluation	Project management (@ 10% of CAPEX)			49,820,076.33
	M&E			2,300,000.00
	Subtotal PM/M & E			52,120,076.33
Total Costs	Total (KES)			550,320,840
	Total (USD)			3,632,118

Table 52: Health solution costs – Scale-Up Phase 2 (6-10 years)

The key assumptions are as follows:

The Directorate of Medical Services and Energy will need to manage the delivery of the solution across two CIDP cycles and budgetary allocation across multi-year ADPs, including liaising with the Directorate of Water regarding sufficient and timely budget allocation for the water infrastructure component.

A “repair or replace” approach to the list of essential appliances and equipment is assumed. For this reason, both options are included in the costs for the Scale-Up Phases.

The successful implementation of the water infrastructure component will require ongoing joint financing and project management by the Medical Services and Water Directorates (see below). The costs of this implementation have been estimated based on the costs of solar boreholes but will need to be revised once site-specific solutions have been identified.

The criteria for prioritising the target facilities for feasibility studies and implementation of water solutions will have to be agreed between the Directorates of Medical Services and Water.

The Directorates of Medical Services and Energy will need to agree on how the maintenance and repair function will be delivered and managed.

Expected outputs in each phase

The aim is to reach 50% of the target 160 level two facilities for the first five period of the CEP to review, aligned with the current CIDP cycle (2023-27) (see Figure One). These facilities were identified by additional research, including primary data gathering with Sub-County Health Officers, as having no reliable, affordable, and sufficient access to electricity, along with most (if not all) the non-energy challenges discussed above. If the solution is successfully implemented over this CIDP cycle, the aim during the subsequent five years of the CEP and next CIDP cycle (2028-33) would be to scale up to reach all 160 level two facilities.

During the set-up phase, the Directorate of Medical Services will need to identify which of the facilities in the target group will receive priority for implementation in this CIDP cycles. The suggested target facilities in the Demo Phase investment model (see Table 9) are those are nominally grid connected but require a back-up system to ensure a reliable electricity supply. In the first Scale-Up Phase it would make sense to prioritise the electrification of 26 facilities that have been identified as candidates for dual-use borehole provision.

However, the County Government may decide that, for instance, as there are only a small number of facilities in Group 3 (off-grid solar PV electricity solutions) and as these are in remote areas, mostly ASAL areas with higher levels of socio-economic deprivation, these facilities should be prioritised. This would frontload the higher costs of this solution type. However, whatever the prioritisation process, the Directorates of Medical Services, Water and Energy should develop transparent criteria for identifying which facilities will be prioritised for solution implementation.

Timeline

The solutions will be tested during a demonstration phase before scaling up to reach the target 160 facilities (see Figure 27).

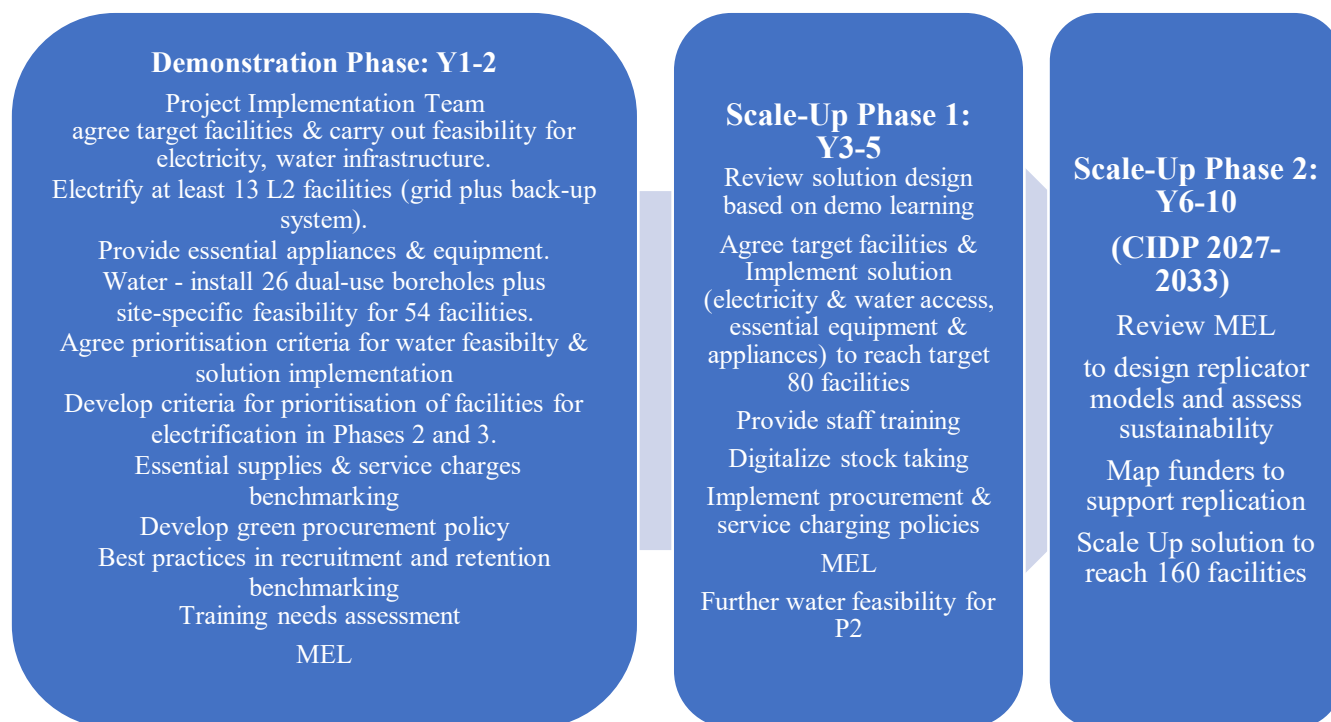


Figure 28: Phases and timelines for implementation

With regard to the electricity solutions, the implementation plan is summarised in Table 43 below:

Solution	Demo	Phase 2 Scale-Up (Y3-5)	Phase 3 Scale-Up (Y6-10)
Group 1: Backup Only	12	50	50
Group 2 (a) Grid Connection with Generator	0	4	0
Group 2 (b) Grid Connection with Generator and Low Voltage Extension	0	14	23
Group 3: Solar with Battery Storage	0	0	7

Table 53: Implementation of electricity solutions by phase

Stakeholders and roles

Table 54 outlines the roles of each of the stakeholders during the demonstration phase.

Stakeholder	Activity	Role
Steering/Implementation Group	Governance	- To be formed at start of project and will include participants from Directorates of Energy, Economic Planning, Medical Services and Water - Decision making body for the project. - Decisions on financing & supplier partnerships
Directorates of Energy, Water & Medical Services	Oversight/Project management	- Overall project implementation and management, including MEL. - Support for target facilities for implementation and stakeholder outreach - Contractual arrangements with suppliers of energy and water equipment & maintenance service providers
Directorate of Medical Services	Fund/source training functions	- Carry out training capacity assessment. - Training - digital stock taking & service charging. - Other staff training as identified in capacity needs assessment.
	Policy development	- Essential supplies & service charges benchmarking. - Best practices in recruitment and retention benchmarking. - Green procurement policy.
	Procurement	Contractual arrangements with equipment, appliances, medicines suppliers, and training providers
	Finance	- Provide finance for investment model (except for water infrastructure, see below) - Map potential co-funders/donors for future scale-up of the solutions

Stakeholder	Activity	Role
Directorate of Energy	Training	Source/advise on suppliers of maintenance and repair for energy equipment
Directorate of Water	Finance	• 26 dual use boreholes and feasibility studies for X facilities • Additional water infrastructure including purification equipment as identified in feasibility studies
	Procurement	• Installation of boreholes and other water infrastructure as agreed with Directorate of Health
	Training	• Source suppliers of maintenance and repair for pumping, piping and purification equipment (with Directorate of Energy for solar-powered boreholes)
	Water infrastructure governance	• Set up water committees for new dual-use boreholes
Directorate of Health & Gender with external experts	Mainstream GESI	• Support creation of GESI focal points within each sub County with appropriate resourcing. • Input to GESI analysis of solution implementation during inception and any design optimisation. • Advise on GESI sensitive practices among L2 service providers.
	Building a GESI-disaggregated evidence base	• Advise on GESI policy development. • Advise on best practices for disaggregated data collection. • Input to research and analysis on GESI.
	Sensitisation	• Support training of Department of Health officials on GESI issues • Input to design of County campaigns etc. • Support engagement with health providers
	Recruitment & Retention	• Advise on GESI-related best practices
	Training	b. Support development of GESI aspects of capacity gaps assessment and analysis of findings c. Support development of measures to address GESI-related training gaps. d. Support development and delivery of gender-sensitive training for L2 staff.
	M&E	e. Advise on GESI-related project indicators.

Stakeholder	Activity	Role
		f. Support design of measures to ensure inclusive participation of women and people from marginalised groups in M&E. g. Support analysis of reporting.
	Financing and partnerships	- Advise on partners for promotion of gender equality. - Finance GESI training where feasible.
Training providers	Train L2 staff	h. Deliver training to L2 staff in target facilities, including GESI specific training
L2 facility staff	Equipment operation and maintenance	Ensure staff members having responsibility for equipment receive training in appropriate handling and basic maintenance of equipment
	Rationalise opex	Opex is included in the investment model, but target facilities are expected to contribute to reducing costs by adopting EE practices in equipment use and implementing any new service charging policies transparently and efficiently.
	Management of medicines and other supplies	Participate in, and implement, training on digitalised stock taking and record keeping
	Skills training	- Participate fully in the training needs assessment. - Participate in, and implement, any training provided because of the training needs assessment.
	Recruitment & retention	- Participate in the recruitment and retention benchmarking. - Participate in any pilots established as part of the benchmarking.
	Water governance	Participate in the Water Committees for dual use boreholes

Table 54: Stakeholder roles during the demonstration and scale-up phases

Risks and challenges

Some of the key risks, and suggested mitigation measures, to the solution are included in Table 55. This list is not exhaustive and will need to be reviewed by the County Energy Plan Implementation Committee. By taking a phased approach it will be possible to learn whether this risk management strategy works and identify any additional emerging risks during the Demonstration Phase, and then enhance existing, or develop new, risk mitigation measures to inform the final design of the subsequent phases, reducing risk further.

	Risk / Challenge	Mitigation measure
Project finance	Budget allocated in CIDP is not allocated via ADP or insufficient allocation to some solution components	○ Ensure buy-in and build understanding of solution among relevant Directorates & target end users to solutions in CIDP through socialisation activities. ○ Directorates of Energy & Economic Planning do ongoing engagement with Directorates of Medical Services & Water/ Plan Implementation Committee (CEPIC) to emphasise the importance of this project. ○ Build high-level political buy-in through CEP launch events and communications strategy.
	Lack of clarity on project management and roles/responsibilities for implementation	○ County Energy Plan Implementation Committee (CEPIC) set up with clear terms of reference, roles & responsibilities between the County Government Directorate of Medical Services, Water, Energy and any other partners.
	Delays in project implementation	○ Ensure sufficient time for set-up phase (including for MEL Framework) including identification of any process bottlenecks & challenges.
Project governance	Inadequate inclusivity/promotion of GESI and community participation	○ End user and stakeholder participation in CEPIC, including GESI measures. ○ Participatory monitoring & evaluation, including GESI indicators. ○ Ongoing socialisation activities
Data and information management	Lack of current data and appropriate management technology to collect and analyse project information	○ Set up robust data and information management technology systems during Start-up Phase, including for collection and analysis of GESI-disaggregated data.
Infrastructure & equipment	The new/additional energy systems are implemented without supporting energy (maintenance/repair), water and non-energy components	○ Commitment to implementing the water, non-energy components of the investment by CEPIC
	Lack of or high cost of EE appliances from suppliers	○ Repair before replace policy within solution. ○ Directorate of Medical Services negotiates equipment suppliers on bulk purchase of EE appliances to reduce costs
Staff skills	L2 staff lack technical knowledge and skills in maintenance of equipment & appliances	○ Commitment to fund basic training for health staff, in addition to external maintenance from service provider (potentially County-trained technicians).
	Lack of financial management and/or IT skills among L2 staff to implement service charging and digitalization of records	○ The proposal includes provision for a capacity needs assessment for the targeted facilities followed by training to address gaps.

	Risk / Challenge	Mitigation measure
		○ Potential to have a performance element linked to training
Staff motivation	Training and other initiatives do not result in improved recruitment/retention	○ Rigorous benchmarking & research in Demo phase on recruitment & retention best practices including for GESI ○ Participation of target facility staff in benchmarking and capacity needs assessment ○ Participatory approach to MEL (see above) in Demo Phase.
Policy changes	Resistance by L2 target facility patients to new charging policy	○ Inclusion of end users in project governance ○ Ensure robust and inclusive testing/piloting of any new policy prior to roll-out. ○ Socialisation activities prior to roll-out.
	Community members avoiding the targeted L2 facilities based on past experience of poor services.	○ Socialisation with targeted community members to appreciate the enhanced services of L2 facilities and consider them the 1st stop point for health services
	Internal or political resistance to green procurement policy	○ Ensure robust cost-benefit analysis and supplier mapping. ○ Socialisation with relevant stakeholders to build buy-in. ○ Collaboration with Directorates for Environment and Climate Change. ○ Piloting of new policy prior to roll-out.

Table 55: Risks and mitigation measures

Implementation and coordination, monitoring and evaluation

b. Implementation and coordination

The process to implement the Demonstration Phase has five steps, as shown in Figure 28. This includes the final project design and implementation plan for the Scale-Up Phase(s).

Step 1

• **Budget Allocation and Implementation Group**

- County Government of Meru (Directorate of Medical Services, Water and Energy) allocate CIDP/ADP budget for infrastructure or feasibility studies, medical appliances or equipment purchase/repair and the other solution component costs (training etc.) and set up an Implementation/PM Committee.

Step 2

• **Partner identification**

- The County needs to identify the partners it will work with in terms of technology, equipment and medicines suppliers, and training as well as target facilities and staff. The process may need to follow a public procurement approach to ensure transparency, fairness and open competition. In particular the following need to be identified:
 - Confirmation of Demo Phase target facilities and staff through further feasibility.
 - Finalise locations of 26 dual-use boreholes and identify additional 54 target facilities for water feasibility studies.
 - Technology partners: suppliers or distributors that can supply energy, medical and other equipment/appliances, including EE appliances. This includes maintenance & repair, which could include support from Directorate of Energy trained SHS technicians.
 - Consultant/organisation to carry out the supplies & service charges benchmarking, retention & recruitment benchmarking and green procurement policy
 - Training providers – for needs assessment and training content and delivery.

Step 3

• **Negotiate and agree contractual relationships**

- The partners identified in Step 2 will be brought together with other relevant stakeholders (Government, NGOs, health staff and patient user groups) in the Project Steering Committee to agree details on the solution roll-out, roles, ways of working, and contractual relationships.

Step 4

• **Implementation – Demonstration**

- Agree target facilities & carry out feasibility for electricity, water infrastructure
- Priority facilities/staff sensitised on the project and support available. Provide electricity and water to a minimum of 12 facilities, including provision of water via 26 dual-use boreholes plus feasibility for water for further 24 facilities
- Assess staff training needs and develop and deliver training to meet needs. including for GESI
- Benchmark good practice in retention and recruitment, pilot and introduce changes
- Digitalize stock, record keeping and billing
- Develop, pilot and introduce Green procurement policy.
- Develop, pilot and introduce new charging policy

• **Training developed and delivered**

Step 5

• **End of demonstration review**

- Carry out an audit of resources used and evaluate :
 - Number of facilities reached with electricity and water access vs target.
 - Increase in number of patients treated.
 - Increase in number of staff recruited and retained and increase in skills
- Reduction of opex for utilities
- Decrease in stock spoilage
- Increase in amount billed for services
- Compile and review lessons learned and plan for Phase 2

Figure 29: Five steps of the Demonstration Phase implementation

- Summary of approaches and steps to promote GESI in health solutions

Building a GESI-disaggregated evidence base

- Develop a policy for promoting GESI through County health information monitoring and reporting systems.
- Collect data on health users disaggregated by gender, age, ethnicity, disability, religious affiliation, income level etc.
- Undertake research and analysis on GESI, including documenting best practice models and learning on GESI promotion in the health sector.

Awareness raising and Sensitisation

- Working with the Directorate of Gender, and other experts promote GESI through training of Department of Health officials, in this case those involved in project implementation.
- Raise awareness of GESI issues in health among service users and the wider public through social media, vernacular media stations, County campaigns etc.
- Sensitise suppliers to L2s about GESI.

Mainstreaming GESI issues into health service delivery

- Appoint a GESI champion in the Department of Health with responsibility for mainstreaming GESI in County health programmes and projects.
- Establish GESI focal points within each Sub County with appropriate resourcing.
- Mandate GESI analysis in design of programmes and projects, including in the inception phase of delivering the L2 solutions.
- For targeted L2s, Identify the priority needs and services in terms of maximum impact on the health outcomes of women and marginalised groups and any gaps that may be exacerbating or failing to address inequalities and vulnerabilities.
- Where required, make appropriate changes to the design of the demonstration and Scale-Up Phases to promote better health outcomes, with appropriate M&E.
- Promote GESI sensitive practices among L2 suppliers.

Staff training

- For all health staff, integrate GESI issues in curricula for early age, ECDE teacher training and vocational training, as well as for community health workers.

- Use a GESI lens in the capacity needs assessment of L2 staff.
- In the feasibility studies to benchmark best staff recruitment and retention practices, identify any GESI-related gaps or barriers and benchmark best practice in promoting GESI in recruitment and retention.
- Ensure inclusive participation of women and people from marginalised groups in the training and refresher courses for L2 staff.
- Specific GESI training for L2 staff.

Partnerships to promote GESI

- Map potential partners at the international, national and local level who are “thought leaders” or exponents of best practices on promoting GESI-related health outcomes to support different solution components, including through co-financing, research and knowledge exchange.

■ Climate resilience building measures

Activity	Gap	Recommendation
Data collection	Granular data on climate change impacts in target L2 locations is not currently available. Resilience building activities could include staff training on observed risks, impacts, and measures to adapt or build resilience of staff or patients to them. It could also include measures to improve the resilience of physical infrastructure or access to basic services (water and electricity). climate risk and related impacts on health outcomes	Design data collection tools and undertake data gathering activities in the Demonstration Phase, if resource and expert capacity is available, to inform the design of the Scale-Up Phase 1. Further data gathering could be carried out during Scale Up 1 to inform optimization of the solution in future phases with ongoing monitoring and evaluation of climate risks.
Optimise resilience of infrastructure component	There is a need to assess the climate risk of the water and electricity components and ensure that they resilient to climate change impacts. This is dependent on having good quality data on short and long-term climate risks (see above).	Assess the resilience of physical infrastructure and components to provide reliable supply of water and electricity. For instance, if additional resource is available, either from the County Governments own budget or from co-financing, the option to use SHS to provide electricity for more facilities, rather than grid connection, could be explored. Additional water conservation and management interventions might also attract co-financing.
Staff awareness of climate risks to service delivery and climate-related health impacts on service end users.	Understanding of staff on climate-related impacts on local population’s health and need for adaptation of service change or behaviour change at the household level.	Staff training on observed climate risks, impacts, and adaptation and resilience building measures.
M&E	Lack of monitoring and evaluation indicators and framework to measure ability of solution to manage climate risks and data to identify specific measures to adapt or mitigate these and build resilience of L2 service delivery.	○ Develop criteria and systems for robust data collection and analysis of climate-related risks and impacts on delivery of

		L2 services, including identifying vulnerable patient groups. ○ Measure impact of climate related risks on target L2 service delivery, and the ability of L2s to manage these risks through appropriate mitigation and adaptation measures over the lifetime of project.

Table 56: Climate resilience building measures

▪ Energy Efficiency and Conversation measures

In terms of environmental impacts, the solution aims to promote more energy efficient equipment and staff training to promote EEC measures (e.g., training staff on correct operation of appliances and turning off power when equipment not in use, which would also save on operating costs). The use of voltage stabilisers could also be explored to promote energy efficiency by reducing voltage variations. The solution includes development of a Green Procurement Policy in the health sector to promote purchase of the most sustainably produced and energy efficient equipment. There could be negative environmental impacts from the energy solutions which use lead acid batteries for back-up. As both back-up components use lead acid batteries which need replacement every five years, it will be important to ensure that they are disposed safely to avoid negative environmental impact.

e. Monitoring and evaluation

	Overall solution impact	Outcome	Indicator
INEP energy access outcomes for health The County will target to have minimum electricity access levels to allow for the empowerment for people in underserved communities with minimum energy targets necessary to improve education, accelerate the transfer of knowledge, facilitate communication, and promote entrepreneurship. The planned on-grid connectivity rate together with the off-grid alternatives will enable achievement of 100% access to electricity by the year 2026.			
CEP energy access outcomes for health Impact: access to reliable, affordable, and adequate electricity and clean water, and the minimum appliances, equipment, medicines, and trained staff to ensure “good enough” health (outpatient) services in target level two facilities (dispensaries)			
	Enhanced health outcomes for target L2 clients	Improved service delivery quality and patient outcomes, and overall healthcare quality through provision of reliable electricity and water for lighting, and to power appliances, repair or replacement of essential appliances and equipment, sustainable maintenance of equipment, improved retention and recruitment of staff (improved job satisfaction), improved training of staff, improved (digitalised) records keeping and	% target L2s reporting improved health outcomes. These would need to be further specified in relation to the indicators for measuring outpatient services at L2 facilities. Qualitative: patient and staff satisfaction surveys and independent evaluations.

	Overall solution impact	Outcome	Indicator
		improved stock taking to ensure reliable supply of medicines.	A patient advisory group could also be set up for the implementation to give ongoing feedback.
	Improved understanding of climate change risks to infrastructure and service delivery and most vulnerable end user groups at targeted L2 health centres with targeted measures to contribute to building resilience to these risks	Climate vulnerability assessment of infrastructure and service delivery carried out in Demo Phase and mitigation measures developed (if needed/resource dependent)	Assessment designed and implemented in Demo Phase
			Mitigation measures identified.
		Improved collection and analysis of climate risk-related data	Data collection tools and systems developed
			Data collected and analysed in Demo Phase
			M & E framework developed for implementation
		Improved staff awareness of climate risks and most vulnerable populations	% of staff trained on risks, vulnerability and mitigation/resilience building measures
			Staff survey
	Increase awareness of GESI among staff and target populations and build in measures to improve service to most vulnerable groups at target L2s	Political buy-in and understanding of GESI in the Department of Health	Policy for promoting GESI through County health information monitoring and reporting systems developed.
			GESI Champion appointed in the Department of Health
			Number of partnerships to supply GESI expertise/carry out GESI initiatives
		Improved collection and analysis of GESI data	Data collection tools and systems developed to disaggregate L2 service users by gender, age, ethnicity, disability, etc.
			Database of disaggregated data
			Analysis of GESI-related issues
		Improved understanding of priority needs/gaps to improve health outcomes of women and marginalised groups accessing L2s	Measures identified to maximise GESI outcomes in implementation
			M&E framework for implementation
		Build awareness of GESI in L2 suppliers	GESI sensitive policies/practices among L2 suppliers.

	Overall solution impact	Outcome	Indicator
		Improved staff awareness and GESI practices	% of women and people from marginalised groups in the training and refresher courses for L2 staff.
			% of staff undergoing GESI training
		Improved GESI outcomes in recruitment and retention	GESI-related gaps or barriers and best practice in recruitment and retention benchmarked
			% of women and people from marginalised groups recruited
			% of women and people from marginalised groups at different levels of seniority
Specific outcome and output indicators			
	Impact	Outcome/output	Indicators
1.	Target L2s have a reliable supply of electricity	Group 1 have reliable electricity	% of target group with back-up system + maintenance
			Decrease in frequency and duration of power outages (number of hours of electricity supply)
		Group 2(a) have reliable electricity	% with new grid connection, back-up and maintenance
			Decrease in frequency and duration of power outages
		Group 2(b) have reliable electricity	% with new grid connection, back-up and maintenance
			Decrease in frequency and duration of power outages
		Group 3 have reliable electricity	% with SHS, batteries and maintenance
			Decrease in frequency and duration of power outages
		All target L2s have reliable maintenance and repair	% of facilities receiving annual maintenance and repair
			% of staff at Group 1 & 2 facilities trained on maintenance of back-up systems
			% of staff at Group 3 facilities trained on SHS maintenance
2.	Target L2s have operational essential equipment and appliances	Repair or replacement of essential equipment and appliances	% of target facilities with essential equipment fully operational

	Overall solution impact	Outcome	Indicator
		Improved operation and maintenance of equipment and appliances	% of staff receiving training Reduced breakdown of equipment due to incorrect operation/lack of maintenance % of redundant appliances due to outages
3.	Increase in EEC at Target L2s	Green Procurement Policy	Development and piloting of policy
		Reduction in electricity consumption due to use of more EE appliances/equipment	% reduction in electricity bills after introduction of new EE appliances.
		Reduction in electricity consumption due to correct use and maintenance of appliances/equipment	% reduction in electricity bills after repair and maintenance function introduced plus staff training.
4.	Target L2s have a reliable water supply	Increase in solar boreholes and other water solutions at target facilities	Number of target facilities with new dual-use solar boreholes Number of additional facilities with functioning water solutions Number of feasibility studies carried out
		Improved operation and maintenance of water solutions	% of staff receiving training in operation/basic maintenance % of facilities receiving annual water maintenance Reduction of breakdown of equipment due to incorrect operation/lack of maintenance
			Number of new community water committees set up with health staff representation
5.	More sustainable water management at target L2s	More efficient water usage and increased conservation at target L2s	Number of water meters installed Number of staff trained on sustainable water management Number of water-harvesting measures implemented % reduction in water usage through conservation measures % reduction in water bills Qualitative: staff and target community awareness and use of water management and conservation strategies
6.	Target L2s become operational cost centres	Target L2s improve financial and records management systems	Development & introduction of standard charging policy

	Overall solution impact	Outcome	Indicator
			% of staff trained to process bills in national insurance system
			% of facilities with digitalised records
			Number of staff trained and % of facilities in financial management & records keeping
		Target L2s reduce operating costs through bulk purchase of appliances/equipment (see EEC above)	Development of bulk purchase agreements with suppliers
			% of expenditures by target L2s on opex of appliances and equipment
		Target L2s reduce costs and improve services through more effective stock management.	Development of procurement policy to optimize stock levels
			% of staff trained on digital stock taking.
			% of facilities with digitalised inventory management
			At least 50 medicine storage rooms constructed at L2s
			% of staff trained to operate storage rooms
		L2s decrease their burden on health budget	Number of facilities with balanced books
			Number of facilities reporting increased revenue
7.	Target L2s show improved staff retention and recruitment	Understanding of best practices	Benchmarking report
		Explore innovations to address issue of late payment of salaries	Report with recommendations for CG
		Improved staff training	Identification of capacity needs/ assessment report
			Number of training sessions developed and implemented per year
			% of staff trained/ % per facility
			Qualitative: staff feedback
		Improved staff job satisfaction	Qualitative: periodic staff surveys
			A staff advisory group could also be set up for the implementation to give ongoing feedback

Table 57: Outcome and Output indicators for health solution

Conclusions

The health solution aims to ensure that a good enough level of outpatient service provision is supplied through a critical number of Level 2 facilities across Meru County, including in remote locations and locations with vulnerable patient groups. Critical success factors for the solutions include the following:

- f. Effective and ongoing collaboration with the Directorate of Water to ensure delivery of feasibility studies and implementation of water solutions customised to the needs of the target facilities, including adoption of clear criteria for target facilities.
- g. Agreement between the Directorates of Medical Services and Energy on how the maintenance and repair function will be delivered and managed.
- h. Development of effective green procurement and standard charging policies and their effective implementation, with appropriate piloting and patient and wider stakeholder awareness raising on the latter to ensure buy-in.
- i. Effective operation and maintenance of equipment and appliances by L2 staff and effective record keeping and billing to reduce costs and maximise sustainability.

The following next steps should be undertaken to move forward from proposal stage to implementation:

- Government demonstrating leadership – the County Government of Meru (Department of Health) should adopt all the components of the solution and pathway to implementation into the new CIDP 2023-27 and develop a multi-year financing plan across the next five ADP cycles, including allocating budget in the 2023-2024 ADP for inception and development of the implementation plan moving into to demonstration phase.
- Establish a Project Implementation Group to oversee implementation as part of the CEP Technical Implementation Committee including the CO/Director for Health, CO/Director for Water and representatives of the Directorates of Energy and of Economic Planning. This could also include County Government or external representatives with GESI and climate mainstreaming expertise.
- Ongoing engagement between Government, target facility staff representatives and patient groups, NGOs, and private sector technology suppliers etc. will also be important in this process and regular meetings should be set up with these various stakeholders. Representatives of the target facility staff and patient representatives could also be included in the CEPIC.
- Commit funding and map opportunities for co-financing, in-kind support – it is envisaged that the public finance aspects of this solution are supported by County Government of Meru, and Government commitment through budgetary allocation will also be critical for attracting co-financing. Other opportunities for public financing - for example, through national and donor health programmes could be a way to scale more quickly.

3.1.2.4 Water Sector Goals and Strategies to Promote Electricity Access

Meru County has big water requirement disparity between those in the leeward side of Mount Kenya and in the windward side. The lower region of Meru suffers prolonged drought with limited or no surface water supply. The burden is high on children and women who have greater responsibilities in

fetching water for the family. Often, they walk long distances posing both risk of abuse and conflict over water resource. Moreover, children losing time for education and women time for productive engagement. The investment proposal recognises these challenges and the underlying causes, some social and some technical, such as inadequate local technicians to maintain existing boreholes, insufficient number of boreholes, community willingness to pay for water services, lack of knowledge on water demand, poor governance, etcetera. As such, the solution proposal seeks to address these challenges by reducing operation cost of boreholes through solarisation of existing boreholes, expansion of boreholes, awareness creation on need for payment for service and water conservation, and proposing new governance structures – community led with Government overciting. Issues of water quality that would make other boreholes water to be abandoned would be addressed through water purification, promoting both community scale purification and residential scale portable purifiers. These solutions would be achieved through multi-agency collaboration and involvement of private sectors and micro-finance organisations.

3.1.2.4.1 Goals for electricity access in the water sector

I. Overview of the Sector and Background

Meru County has a big disparity in altitude and rainfall across the different regions which impacts on in the availability of reliable water sources. The Highlands have several river sources, heavier rainfalls (>1500 mm precipitation) as well as cooler temperatures (<15°C) (Gitonga & Eshton, 2020). In these zones, such as Imenti sub-counties, water is mainly supplied through intakes from rivers and distributed to farms (Gitonga & Eshton, 2020). However, there are some areas in the Highlands with bad terrains where the County Government has supplied borehole water (K. D. Mugambi, personal communication, February 15, 2022).

The lower regions have insufficient water due to low rainfall and lack – or limited number - of – rivers. These regions have arid climates, with temperatures above 23°C, and average precipitations of around 750 mm. As a result, households are affected by insufficient water supply, which is aggravated during the dry season when households travel long distances in search of water.

Meru County is affected by climate hazards such as flooding, dry spells, and heat stress which have a significant impact on the agriculture and livestock sector. These climate hazards vary across the different seasons. During the first wet season (March to May) the County experienced approximately 45 consecutive days of moisture stress - ranging from 30-60 in any given year. These dry spells are longer in the second wet season (Oct to Dec), ranging between 60 and 80 of consecutive days of moisture stress in any given year. Extreme precipitation and flood risks can be frequently during the rainy season. The first rainy season experiences a high single day of precipitation when in most years, the County experience more than 20 mm of precipitation in a single day. The second wet season varies from year to year, and it can have very high precipitation events when rainfall is greater than 50 mm in a single day. The following figure illustrates the precipitation and weather patterns in Meru County:

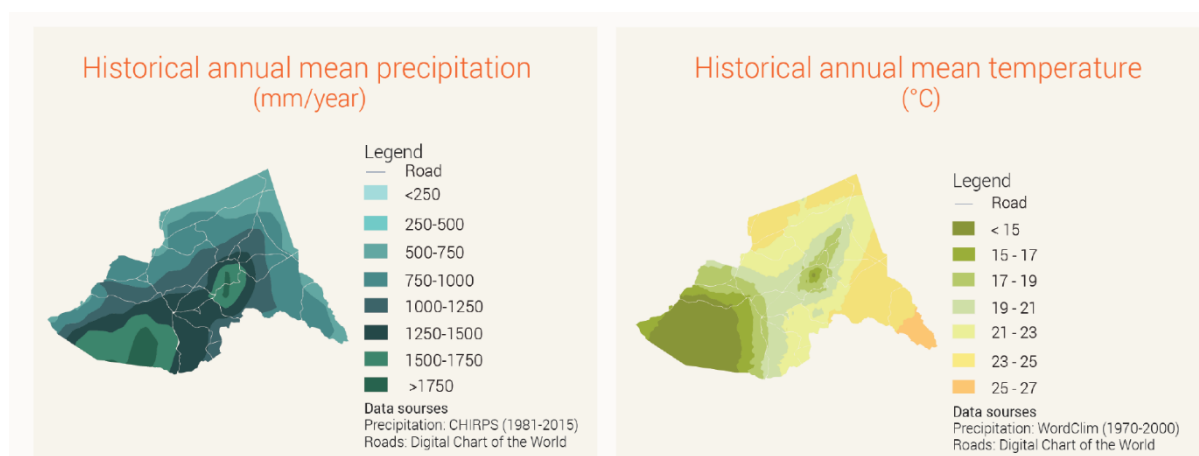


Figure 30: Past and future impacts of climate hazards in Meru

Source: CCAFS. Climate Risk Profile Meru County¹³

Meru County has placed increasing focus on improving access to clean and potable water, especially in the Buuri, Igembe and the lower areas of Tigania East and West. The County recognises that people walk long distances to fetch water, there is inadequate supply for irrigation and inadequate potable water for communities. Because of these reasons, the CIDP spells out the following policy measures as key interventions (Meru County Government, 2018):

- Rainwater harvesting.
- Ground water exploration, extraction and recharge strategies.
- Metering water points.
- Conservation and protection of water catchment areas.
- Demarcation of catchments and wetlands.
- Introduction of modern efficient irrigation technologies.
- Development of climate proof irrigation infrastructure.

II. Challenges, Priorities and Needs

Challenges in water demand and supply in Meru are numerous, however the lower regions of Meru are intensely challenged. General water challenges in Meru include, irregular climate patterns and limited water resources restricting access, additional budget requirements for water developments, insufficient information on water demand and competing demand for water services. Other challenges relate to water management include unmanaged supply, illegal water intakes and abstraction, and lack of metering and tariffing.

¹³ See: <https://ccafs.cgiar.org/resources/publications/climate-risk-profile-meru-County-kenya-County-climate-risk-profile>.

The lower regions (Tigania East and West, Igembe regions and part of Buuri) of Meru identified to have acute water shortage for drinking and domestic use. Specific challenges on water access in lower regions of Meru is further outlined below:

Long distances walked by women and children in search of water

Water supply in the lower regions of Meru is highly dependent on borehole water supply. The County Government is committed to improve water supply for domestic use across Meru. The lower regions of Igembe and Tigania have insufficient water and is often dry. In the lower region, the County Government is seeking for a provision of 10 boreholes per 45 wards as was target of the CIDP (2018-2022) (Meru County Government, 2022). About 220 boreholes were completed by December 2021. In Igembe, 73 boreholes have been installed, 63 in Tigania, 30 in Buuri and 20 in Imenti even-so there is still a huge gap in water access. By 2022, the status of water access within 1km radius is presented in the table presented below. In our further analysis total of 3,678 population settlement clusters representing a total population of 1,355,102 people were found to live within 1km to the nearest borehole and a total of 5,811 population settlement clusters with a total population of 1,311,088 people were found to be both underserved by boreholes and rivers.

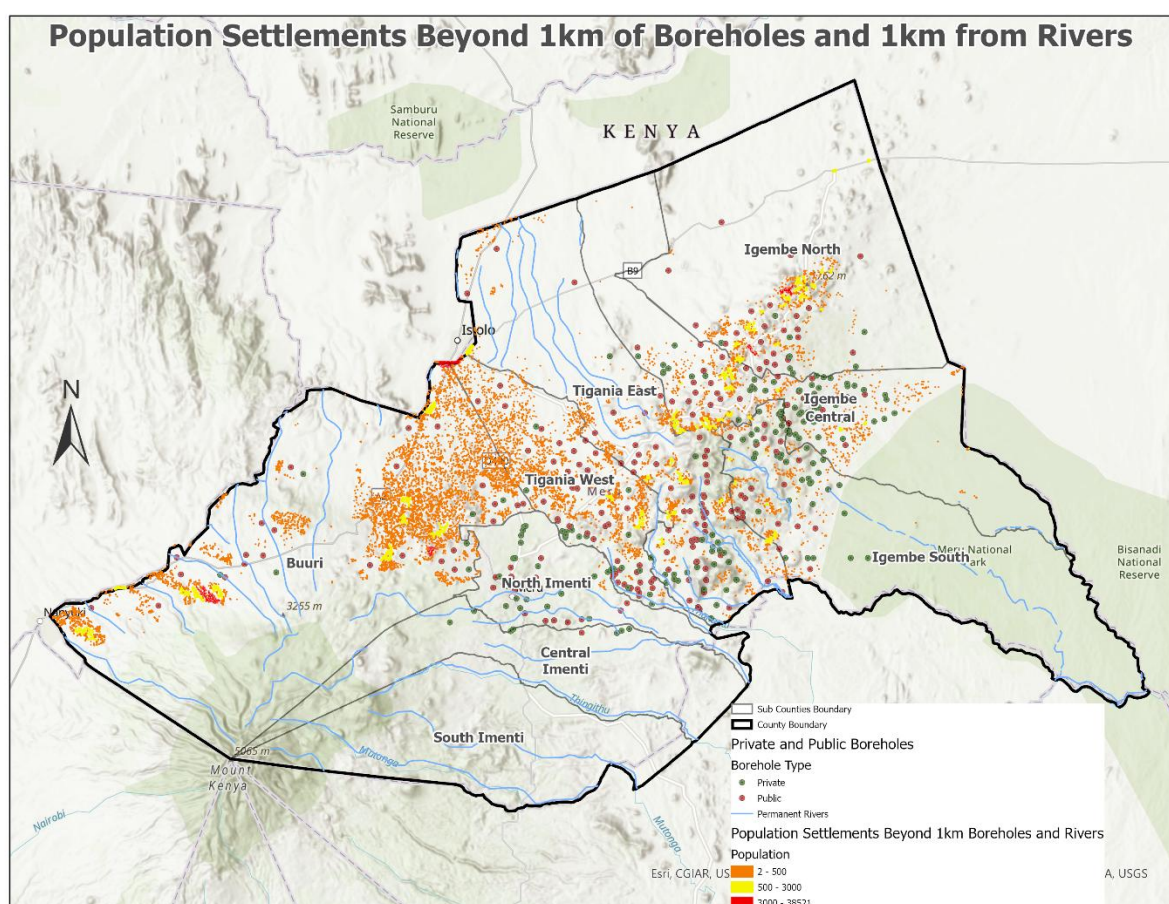


Figure 31: Population in lower regions underserved with water access

Sub-County	Total population	No. of people/ HHs within 1km radius from nearest borehole	Population/households within one kilometre from other water sources (rivers)	Population beyond 1km radius from nearest borehole and river	Percent population underserved
Igembe North	289,865	148,342	0	141,521	49%
Igembe Central	415,623	259,591	0	156,032	38%
Igembe South	399,694	306,710	89,298	51,202	13%
Tigania East	305,066	171,846	136,214	88,634	29%
Tigania West	615,174	264,739	27,674	339,620	55%
Buuri	552,790	88,492	90,266	401,613	73%

Table 58: Population in the underserved regions without access to water

In a water health nexus, there were also established that about 32 Level 2 health facilities in the lower regions of Meru do not have access to any water source within one kilometre radius. Most of them are in the Igembe regions as illustrated in the following.

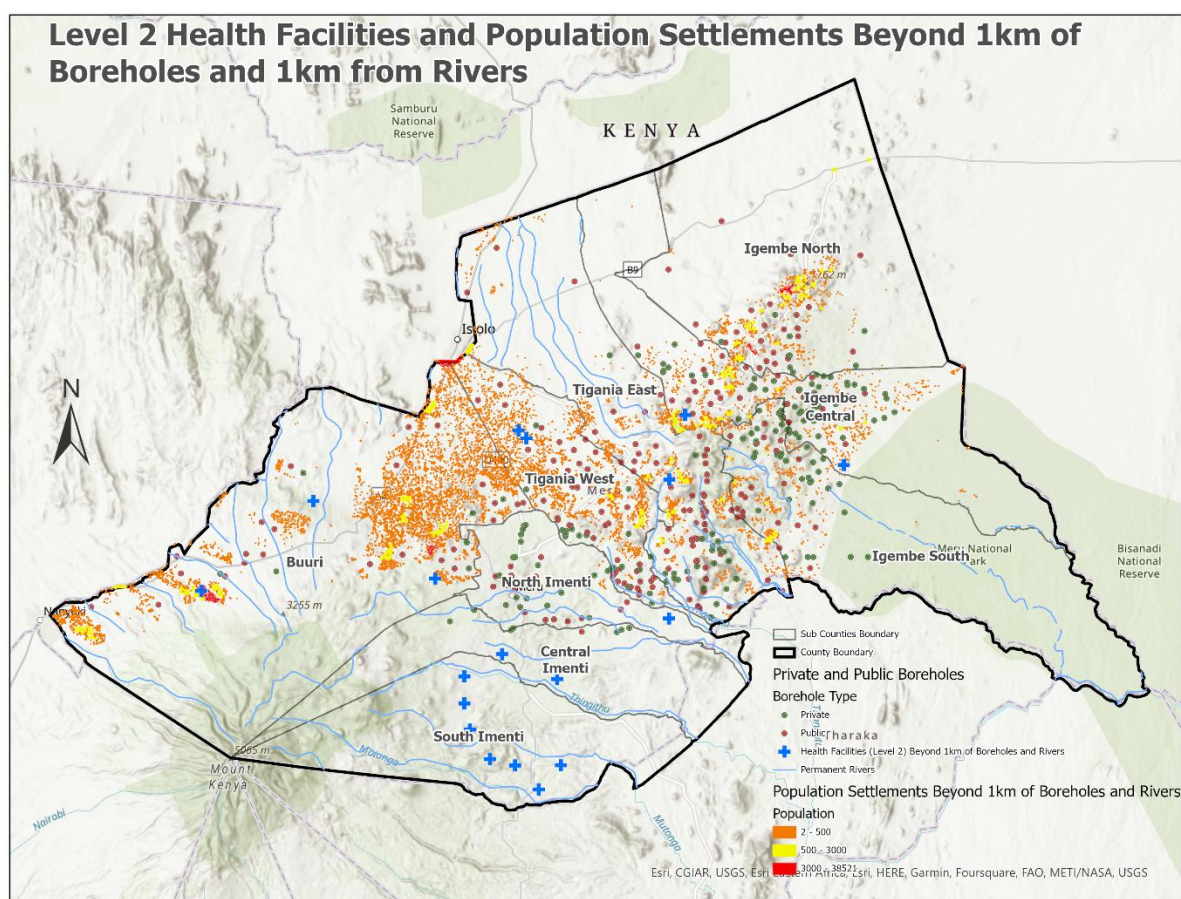


Figure 32: Health facilities beyond 1km from access to borehole and rivers

Poor quality water for drinking and cooking

Access to water is only effective to the extent to which water is suitable for use. In the lower regions some communities encountered that borehole water is not suitable for drinking or cooking. And these communities abandon their boreholes in the dry season and seek for other sources of water because of salt levels. To exemplify, in commissioned research targeting lower regions of Meru (Igembe, Tigania and Buuri) through a simple online survey form, 30% perceived their water to be salty, while about 29% perceived the water to be clean (pure, clear and clean). Majority of the salty water was reported for groundwater sources, and of the respondents who indicated that their water is salty, 71% said it is a little salty, 25% medium/moderately salty and 4% very salty.

To quantitatively examine the water quality, available laboratory groundwater quality data of the study area was collated and analysed. Data from 80 boreholes could be found containing information on Chloride, Iron, Total Dissolved Solids and Fluoride. Further analysis on the levels of water quality in lower region were based on existing database at WRA for the lower region of Meru. Water quality analysis in respect to total dissolved solid is presented in the sub-section below.

- Total Dissolved Solids

Total dissolved solids (TDS). is an indication of the level of salts in water. In Kenya, the Kenya Bureau of Standards (KEBS) has set a maximum standard of 1000 mg L⁻¹ TDS for treated potable water and 1500 mg L⁻¹ for natural potable water (KEBS EAS 12:18). **Error! Reference source not found.** shows the distribution of TDS in lower Meru regions. The available data indicates that TDS concentration varies from 54 mg L⁻¹ to 3,768 mg L⁻¹ with an average of 441 mg L⁻¹. From the data, 9% of the boreholes recorded TDS concentration above 1,000 mg L⁻¹ maximum limit for treated potable water. This reduces to 4% when 1,500 mg L⁻¹ maximum limit for natural potable water is considered. Although this data may not be very comprehensive for the study area, it suggests that TDS for most boreholes in the area will fall within the standard limits. However, in some areas, in Buuri and Igembe it can rise to significantly high level. This could explain the water quality perception reported by the survey respondents regarding saltiness in which some of them indicated that their water is “salty”.

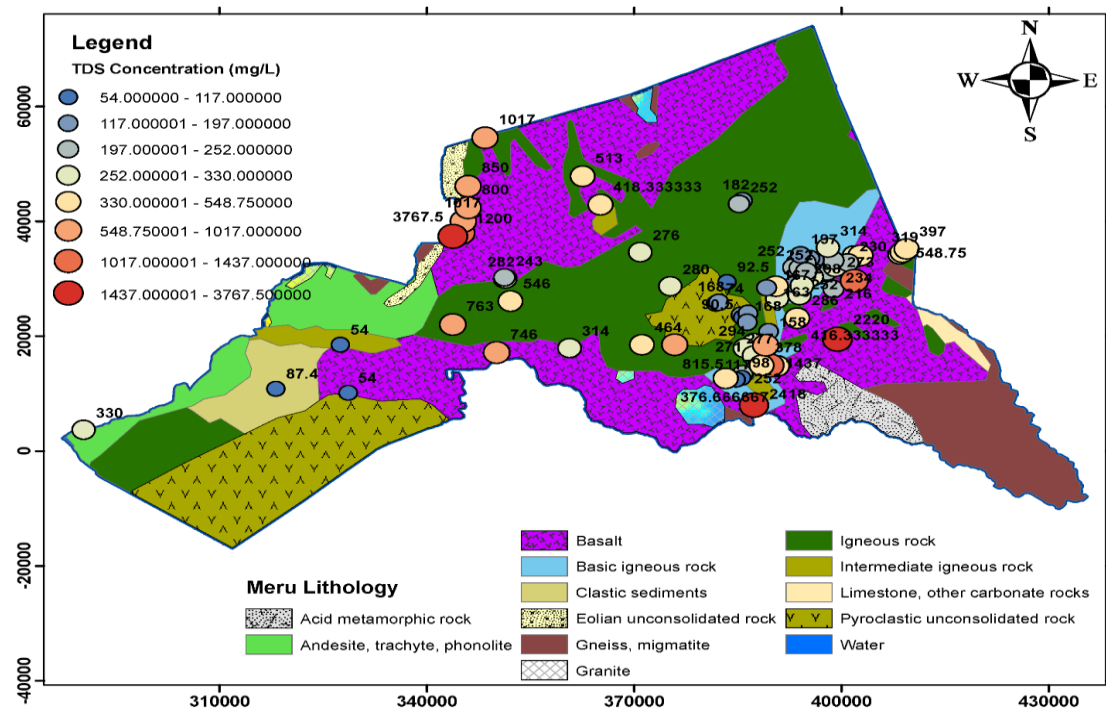


Figure 33: Water quality level in Lower regions of Meru based on TDS

Poor water governance and resource management knowledge

Water governance and management is not only a challenge in the lower regions of Meru.

There are borehole water management committees¹⁴ in all community setups however with different governance challenges. The most typical challenges span from political interference to inadequate management capacity of the selected committee members. Moreover, women and marginalised groups lack representation in these management committee's and therefore, the specific challenges suffered by these groups are not well understood and addressed.

Availability of public finance for new infrastructure and technical support

Public boreholes are mainly financed by the Government so typically, the deployment of new boreholes in the lower regions depend on the availability of public funds. And the competing demand on national budget among different priority sectors, creates delays in meeting the planned targets. Funding restrictions also affect Government's plans to build capacities on water management, to complete solarisation of some of the existing boreholes and to conduct further analysis on water qualities of boreholes.

A. Promoting Gender and Social Inclusion (GESI)

¹⁴ In the current governance system, committee members include the ward administrator, local chief, community members representing chair of the committee, treasurer and secretary. Other members would be incorporated representing social organisations such as church representatives or community-based organisation.

The Gender Equality and Social Inclusion (GESI) approach followed in the recommended solutions seeks to embrace and embedded an understanding of differences and inequalities in roles, relations and contributions of different marginalised groups. It calls for the integration of a GESI perspective and the inclusion of all social groups regardless of their disadvantages and challenges with the goal of achieving gender equality and justice.

As stated in the previous section, marginalised groups, mainly women and low-income people living in remote areas, face greater challenges in accessing clean and reliable water sources for domestic and livelihood purposes. To better understand and address these specific challenges in the recommended solutions, the County has followed a GESI and intersectionality approach. This also included a cross-departmental collaboration between the Department of water, irrigation, Environment and Climate Change and the Department of Gender, as well as consultations with an external GESI expert who also brought an intersectional and GESI lens to the recommended water solutions.

Meru County will continue unpacking the specific challenges experienced by different marginalised groups during the project implementation. GESI disaggregated data will be collected during the inception phase of the recommended solutions which will inform the sub-sequent implementation phases. Also, the GESI indicators will monitor and evaluate to what extend the solutions are effectively addressing the challenges of marginalised groups, and this will also inform the design of future and new phases of the recommended solutions.

b. Climate Resilience Mainstreaming

The 2023-2027 CIDP recognises that key water ecosystem sites and catchment areas have been degraded and there is riparian land encroachment and deforestation, resulting in inadequate water supply. Water has become a scarce resource as pressure increases on the hydrological systems due to various human caused (anthropogenic) factors. The vulnerability of water resources can be classified into several vulnerability factors, such as water-shortage, water pollution, and water-related natural disaster, i.e., flood or drought. In the risk management chapter, the 2023-2027 CIDP notes that borehole and river water volumes are decreasing over time due to natural resource depletion and degradation, poor environment management, illegal abstraction, toxic and hazardous pollutants, climate change, and human activity. Additionally, there is an inadequate number of dams and water pans to harvest water during rainy season, poor water connectivity lack of distribution lines to supply most of the towns with water for domestic use, inadequate storage water facilities, and inadequate water treatment facilities to provide safe water.

To address these challenges, the CIDP specifically targets key interventions in environment, water, natural resource management, and climate change. The proposed water solutions are closely aligned with the CIDP at policy and planning entry points, and recognises a cross sectoral approach in health, agriculture, livestock, and environment management. The following sections present the proposed water solutions and the implementation, Coordination, Monitoring and Evaluation section summarises different approaches and steps to mainstream climate into the recommended solutions.

c. Promoting Energy Efficiency and Conservation

The water solutions presented in the following section have been assessed from an energy efficiency perspective and the recommended technologies meet the highest energy efficiency standards, e.g. use of smart water meters, energy efficient solar panels for boreholes and solar water pumps. Though, the County will conduct energy efficiency studies during the project implementation and new technologies may replace the ones recommended in the solutions presented below.

3.1.2.4.2 Strategies To Promote Access To Water Services.

I. Solution Components

The following solutions aim to improve the livelihoods of the Meru community living in the lower zones by enhancing water supply and accessibility in right quantity and quality while conserving water resource consumption. The proposal aims to improve borehole water access for improved livelihoods in a sustainable manner. It will do this by addressing the key challenges outlined above, with a focus on expansion of boreholes, water purification and enhancing the capacity of water management committees.

The key areas for intervention are outlined below:

- Solarisation of diesel-powered boreholes. Meru County is seeking to change all diesel-powered boreholes to solar PV powered boreholes. This was advised due to the high operational cost of diesel-powered boreholes, frequent stalling because of the lack of finance to purchase fuel, and its environmental impacts. Meru's Department of Water and irrigation has identified about 20 boreholes still running on diesel that require to be solarised – see the following table.

Name of the borehole	Sub County	Ward
Ntunene Community Borehole	Igembe North	Ntunene
Ndurumu Community	Igembe North	Antuambui
Kandebene Community	Tigania West	Athwana
Malaene	Igembe central	Athiru Rujine
Ndoleli 1	Igembe central	Athiru Rujine
Ndoleli 2	Igembe central	Athiru Rujine
Mwomwere	Igembe central	Athiru Rujine
Baibariu	Igembe central	Athiru Rujine
Baithubuku	Igembe central	Athiru Rujine
Materine	Igembe central	Athiru Rujine
Githongo community borehole	Igembe central	Athiru Rujine
Karichu Primary school borehole	Igembe North	A/Kiongo
Kamiruru	Igembe central	Igembe east
Kiambanjua	Igembe Central	Igembe east
Thuru Community	Igembe central	Igembe east
Njia Secondary School	Igembe central	Njia
Mariara Community	Igembe central	Njia
Kaelo Community Borehole	Igembe North	Antuambui
Kiani Primary School	Igembe central	Njia
Barubaru borehole	Igembe North	A/Kiongo

Table 59: Boreholes running on diesel fuel

- Expansion of boreholes to the underserved regions of Meru. The Meru community in the low land regions are facing water crisis, not only for agriculture but also for general livelihoods and domestic uses. This has brought conflict, drudgery to women and loss of lives and animals. The solutions seek to address issues of proximity to access. Mapping out underserved areas and proposing new boreholes based on population and water demand for residential use would enhance access.
- Piloting community scale water treatment plant. Water access is only effective if it is available in right quantity and quality. Some boreholes are extremely saline that are un-usable. Mapping out water quality across the lower regions of Meru and proposing pilot community scale treatment plant will enhance targeted solutions to regions of poor water quality. Owing to the cost and technical aspects of water purification and purification facilities, the pilot facilities will demonstrate adoptability, sustainability, and effectiveness of community water purification systems.
- Promotion of small-scale bench top water purifiers. Benchtop water purifiers is an alternative to community level water purifiers. Whereas community scale water purifier is riding on the economy of scale and coordinated systems operation for a large group of people, the benchtop purifier is targeting sparsely populated population relying on other water sources but also individual customers. The County Government would stimulate the market as the financing, ownership and operation the purifier relies on the user. It is a form of small household scale system. The solution is proposed to be financed through PAYGo system.
- Establish/strengthen community water management groups and capacity building of community members on water resource conservation will form the basis for all the support included in this proposal. The solution proposes new borehole water management structure as presented in the figure and detailed in Annex 1: Borehole water management. New water committees/associations will be established, or existing ones strengthened and training will be provided to the members on water conservation and on managing communal resources. Also, this solution will ensure that women, youth and people from other marginalised groups are included in this committees.

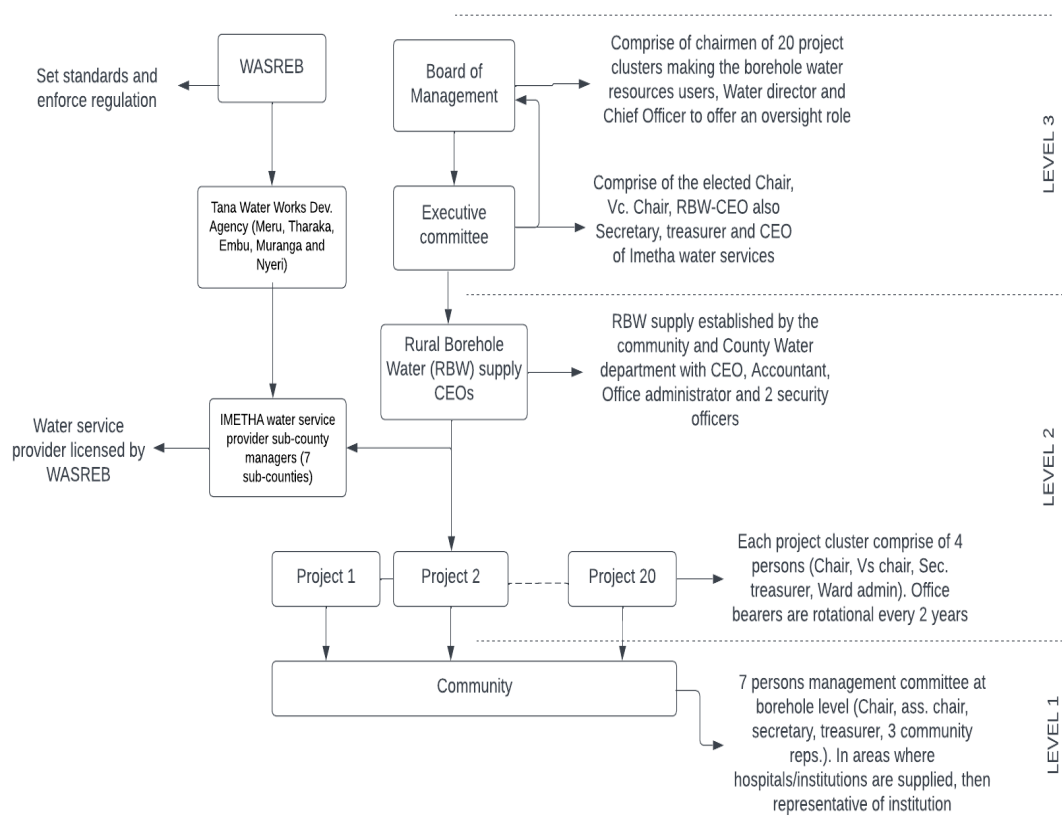


Figure 34: Configured borehole water management for sustainability. Creating horizontal linkages for interactive learning and vertical integration for national Government synergies

- Water metering and tariffing. Water meters will be installed in all borehole bulk water pumped in daily basis and water dispensed in the water kiosks. This will enhance data capture for supply and demand for effective management and growth projection. Metter will also help collect GESI disaggregated data on number of people from marginalised accessing the boreholes, water usage, etc.
- Promoting distributed water storage solutions to far flanged communities targets the population of households with population density of below 100 persons per km radius or about 30 homes per 3-4km². This is a small population that is not economically viable to sink a borehole rather will be supplied with a water storage solution.

II. Alignment with CIDP Priorities

- Solarisation and expansion of boreholes. This fall within the broader CIDP programme of drilling and solarisation of borehole equipment.
- Piloting community scale water treatment plant. CIDP programme number 1 is to provide portable water services, not only for the river communities but also for the communities relying on boreholes as main water source. It is further captured in the CIDP sub-programme on Water Quality monitoring and control in Timau, Mikinduri and Tigania Water Treatment Plants.

- Promotion of small-scale bench top water purifiers. As above, in the spirit of ensuring portable water within the CIDP program, benchtop purifiers would support meet the portable water for communities in the lower regions of Meru.
- Establish/strengthen community water management groups and capacity building of community members on water resource conservation. The CIDP activities under sub-program rural water supply seek to carry out capacity building on operations and management, feasibility study, survey and mapping, Design Bill of Quantities(BoQs), Distribution of pipes.
- Water metering and tariffing. The CIDP under the sub-program installation of water meters seek to ensure water use in a sustainable way.
- Promoting distributed water storage solutions to far flanged communities. This falls within the CIDP program on domestic water supply and irrigation and sub-program rainwater harvesting and storage. Also, under sub activity on rural water supply, it seeks to construct storage tanks.

III. Financing Models

The following paragraphs presents the main assumptions about the financing models recommended for the various water solutions:

- Solarisation and expansion of boreholes and community scale water treatment plant Meru's Ministry of Water and irrigation will make the investments using public finance.
- Promotion of small-scale bench top water purifiers Residential scale purifiers are presented in two scenarios, portable benchtop and small scale under sink purifiers for people with piped borehole water. The financing for these products will adopt a PAYGO system. The 6-month pre-solution design phase is assumed to bring the private sector, financiers, and digital platform developers. The County Government will finance the pre-investment phase and partnership creation as users pay for the products and services.
- Establish/strengthen community water management groups and capacity building of community members on water resource conservation: public funding from Meru's Ministry of Water and Irrigation will finance all relevant activities of this solution component.
- Water metering and tariffing: The water supply will be metered and billed. From the technical committee a recommendation of KES 1/20liter jerrican, equivalent to KES50/cubic meter was proposed. However, treated water will be sold at a premium. Revenues generated by water fees will cover all project costs of this solution component.
- Promoting distributed water storage solutions to far flanged communities: Rainwater collection roof and tanks in public facilities (schools, police camps etc.) will be financed with public funding from Meru's Ministry of Water and Irrigation.

IV. Cost-Benefit Analysis.

Targeted households will have access to funding through PAYGO schemes provided by the suppliers of the portable benchtop and small-scale under-sink purifiers. In addition, high quality purifiers will reduce maintenance costs. The PAYGO scheme coupled with low maintenance costs will help address affordability gaps making the residential scale purifiers more affordable for households.

Intervention Options

I. Target beneficiaries

Meru County's geography varies significantly across the whole County, from high altitude on the slopes of Mount Kenya, which is served by rivers, to the leeward side of Mount Kenya in the north and east of Meru which is semi-arid/ASAL and experiences extreme water stress. Here, the population is affected by drought, acute water shortage and unequitable water distribution. Women and Children walk long distances in search of water due to inadequate water in boreholes, few numbers of boreholes and poor-quality water exposing them to numerous health and social behavioural risks inter alia lower backaches, attack by wild animals, assault, and rape.

- Lower region of Meru County

The lower region of Meru County covers the following six sub-counties: Buuri, Tigania East, Tigania West, Igembe South, Igembe Central and Igembe North which has been divided into several administrative sub-locations.

- Water demand estimation in the target regions

Estimating expansion boreholes is a factor of demand, borehole yield and population density. Assuming that a borehole serves a radius of 1 km (which is approximately 3-4 km²) without extensive reticulation and a uniform distribution, optimally, Buuri would have approximately 240 boreholes, 150 (Igembe Central), 270 (Igembe North), 65 (Igembe South), 60 (Tigania Central), 130 (Tigania East), and 100 (Tigania West) based on their geographical area. However, the estimates are oversimplified. Using an average per capita water demand of 61 L/person/day, the water demand within a 1 km radius in Igembe South is approximately 154 m³/day. For a single borehole to satisfy this demand, a yield of at least 22 m³/hour would be needed for 10 hours per day.

In areas where the average yield is about 6 m³/hour, at least 3 boreholes would be necessary to satisfy the demand within the same pumping duration. Using this argument, the following table shows the estimated number of boreholes necessary to provide safe water within a 1 km travelling radius to the source. We did not adjust the number of boreholes to serve both the health facility and the community assuming that, the change in demand will not significantly vary the slightly overrated design yield. Although the required numbers of boreholes have been identified and a generic design provided, it is recommended to carry out site specific feasibility studies during implementation.

Sub-County	Demand within 1 km radius (m ³ /day)	Average yield (m ³ /h)	Design Yield (m ³ /h)	Number of B/H within 1 km radius	Total optimal Boreholes	Existing boreholes
Buuri East	56	6.7	5.0	1.1	93	24*
Buuri West	31	6.7	5.0	0.6	98	-
Igembe Central	90	10.7	8.0	1.1	169	25
Igembe North	37	11.6	8.7	0.4	115	24
Igembe South	154	9.4	7.0	2.2	141	16
Tigania Central	108	8.1	6.1	1.8	105	1
Tigania East	35	8.1	6.1	0.6	72	25
Tigania West	86	17.1	12.8	0.7	67	40

Table 60: Estimated number of optimal boreholes taking into account demand, yield, geographical area, pumping hours and distance travelled

The solutions will target two groups of communities in lower regions of Meru, being:

1. These are population above 100 persons within a kilometre radius. From water supply modelling, this group of people can benefit from a single borehole with a minimum capacity of 30cubic meter per day.
2. The second group of people are those who are in far flanged areas, they are sparsely populated and it would be costly to sink a borehole to this group of people compared to demand. These community thus would be supplied by water harvesting and storage systems.

II. Budget Commitment and Funding Sources

The total costs for Phase 1 are exhibited in Table 62.

Activities description	Specification	Unit cost (KES)	No.	Total (Million KES)	Meru/public funding (Million KES)	End users (Million KES)	Private finance (Million KES)
Solarisation of boreholes	5m3/hr @200m	3.7	5	18.5	18.5		
	8m3/hr @200m	4.4	10	44.3	44.3		
	12m3/hr @200m	6.6	5	32.9	32.9		
	Sub-total		20	95.8	95.8	0	0
Borehole expansion	5m3/hr @200m	3.7	33	122.4	122.4		
	8m3/hr @200m	4.4	87	385.5	385.5		
	12m3/hr @200m	6.6	18	118.4	118.4		
	Sub-total		138	626.3	626.3	0	0
Community scale water purification	16% of daily output (9.6m3/day)	4.8	4	19.1	19.1		
	16% of daily output (14.4m3/day)	4.8	16	77.0	77.0		
	Water qiality tests	0.005	20	19.1	19.1		
	Sub-total		20	77.0	77.0	0	0
Water meters	Bulk water meters - public borehole	0.075	231	17.3	1.3		
	Bulk water meters - new boreholes	0.075	138	10.3	10.3		
	Domestic water meters	0.003	0	0	0		
	Health facility	0.003	27	0.081	0.081		
	Kiosk	0.003	369	1.107	1.107		
	Sensitisation / awareness	0.2	32	6.4	6.4		
	1 year - Water fees (clean water)	0.215	50	-10.7		10.7	
	1 year - Water fees (potable water)	0.021	1000	-21.0		21.0	
	Sub-total			35.3	35.3	31.7	0
Domestic water purifiers	Formation of actor network for	0.5	1	0.5	0.5		

	distribution system (Cash/PAYGO)						
	Establishment of collaboration agreements	0.5	1	0.5	0.5		
	Market activation activity 1: Roadshows in Igembe, Tigania and Buuri	1	3	3.0	1.5		1.5
	Product exhibition in the three regions (annually)	1	3	3.0	1.5		1.5
	Purification systems (large, piped)	0.05	50	2.5		0.25	2.3
	Purification systems (table top)	0.005	200	1.0		0.1	0.9
	Sub-total			10.5	4.0	0.35	6.2
Water management committees and training	Establishment of water management committees	0.2	25	5.0	5.0		
	Training of water committees	0.2	25	5.0	5.0		
	Training technical staff	0.02	300	6.0	6.0		
	Sub-total training and water committees			16.0	16.0	0	0
Rainwater harvesting	Rainwater collection tanks in public facilities (schools, police camps etc.)	0.0042	20	0.084	0.084		
	Rainwater collection roofs	0.015	20	0.3	0.3		
	Farm ponds	0.1	20	2.0		2.0	
	Sub-total			2.4	0.38	2.0	0
Project management and M&E	Project management			20.0	20.0		
	M&E			6.0	6.0		
	Sub-total			26.0	26.0		
Total (KES)				907.5	899.98	2.3	5.3

Table 61: Estimated costs for Phase 1

The following table provides an overview of the estimated water access costs for Phase 2 in lower Meru regions:

Activities description	Specification	Unit cost (Million Kshs)	No.	Total (Million Kshs)	Meru public funding (Million Kshs)	End users (Million Kshs)	Private sector (Million Kshs)
	5m3/hr @200m	3.7	57	211.5	211.5		

Borehole expansion	8m3/hr @200m	4.4	100	443.0	443.0		
	12m3/hr @200m	6.6	56	368.5	368.5		
	Sub-total		213	1023.0	1023.0	0	0
Community scale water purification	16% of daily output (9.6m3/day)	4.8		0	0		
	16% of daily output (14.4m3/day)	4.8		0	0		
	Water quality tests	0.005	582	2.9	2.9		
	Sub-total		0	2.9	2.9	0	0
Water meters	Bulk water meters - public borehole	0.075		0			
	Bulk water meters - new boreholes	0.075	213	15.98	15.98		
	Domestic water meters	0.003	5000	15.0		15.0	
	Health facility	0.003	0	0			
	Kiosk	0.003	213	0.64	0.64		
	Sensitisation / awareness	0.2	32	6.4	6.4		
	Water fees (clean water)		50	0	0	0	
	Water fees (potable water)		1000	0	0	0	
	Sub-total		5426	38.0	23.0	15.0	0
Solar water purification	Market activation activities: Roadshows in Igembe, Tigania and Buuri	0.5	1	0.5			0.5
	Product exhibition in the three regions (annually)	0.5	1	0.5			0.5
	Purification systems (large, piped)	0.05	1000	50.0		5.0	45.0
	Purification systems (table top)	0.005	5000	25.0		2.5	22.5
	Sub-total			76.0	0	7.5	68.5
Water management committees and Training technical staff	Establishment of water management committees	0.2	35	7.0	7.0		
	Training of water committees	0.2	35	7.0	7.0		
	Training technical staff	0.02	300	6.0	6.0		
	Sub-total training and water committees			20.0	20.0	0	0
Rainwater harvesting	Rainwater collection tanks	0.0042	500	2.1	2.1	2.1	
	Rainwater collection roofs	0.015	500	7.5	7.5	7.5	
	Dew harvesting			0	0	0	
	Farm ponds	0.1	500	25.0	25.0	25.0	

	Sub-total			34.6	29.8	29.8	0
Project management and M&E	Project management			20.0	20.0		
	M&E			6.0	6.0		
	Sub-total						
Total (KES)				1220.6	1124.8	52.3	68.5

Table 62: Estimated costs for Phase 2 – Scale-up

III. Expected Outputs in Each Phase

The following outputs are envisaged from the phase 1 of the water sector solutions implementation:

Component 1 – Solarisation of diesel driven boreholes

- A total of 20 boreholes identified as running on diesel, assessed and re-designed for solar PV equipment installation.
- 20 diesel powered boreholes converted to solar powered borehole.

Component 2 – Expansion of boreholes in lower regions of Meru

- In Phase I a total of 138 new boreholes installed and operational. The expansion of boreholes will be as follows 63 Number of boreholes in Igembe south, central and North; 33 Number of boreholes in lower regions of Buuri; 42 number of boreholes in Tigania regions; Prioritizing 16 level 2 health facilities without access to water at 1km radius.
- Assessment report of the 32 level 2 health facilities without access to water in Meru detailing the course and impacts
- Established 138 new community water management committees and trained on community water management and conservation.

Component 3 – Community scale water purification

- 20 pilot functional community scale reverse osmosis water purification in 20 wards in Tigania West and East bordering Isiolo and Igembe central and Igembe South regions that were mapped with boreholes with high TDS levels (>1000mg/l)

Component 4 – Water metering and tariffing

- 369 digital meters installed in existing and new boreholes.
- A data capture protocol for water demand including metering and transmission to centralized data management centre
- Successful implementation of residential water tariff KES50/cubic meter and KES1000/cubic meter

Component 5 – Residential scale water purification

- At least 3 roadshows and exhibition of small-scale water purifiers
- PAYGO instrument established for sale and distribution of small-scale water purifiers
- 50 households adopting undersink type residential water purifiers and another 200 household adopting benchtop small scale

Component 6 – Water management committee capacity building

- 25 sessions of water management committee training held
- 300 local technical staff trained on basic equipment operations and maintenance

Component 7 – Distributed solution such as rainwater harvesting and storage

- 10,000 households supported to acquire water storage tanks
- 20 units farm ponds
- 20 units of rainwater storage tanks from institutional roofs

The outputs from Phase 2 will be:

Component 2 – Expansion of boreholes in lower regions of Meru

- A total of 213 new boreholes installed and operational. The expansion of boreholes will be as follows 135 Number of boreholes in Igembe south, central and North; 57 Number of boreholes in lower regions of Buuri; 32 number of boreholes in Tigania regions.
- Established 213 new community water management committees and trained on community water management and conservation.

Component 4 – Water metering and tariffing

- 213 bulk digital meters and water meters for water kiosks installed in new boreholes.
- 5,000 domestic water meters installed for number of households seeking water piping to own residences.

Component 5 – Residential scale water purification

- At least 3 roadshows and exhibition of small-scale water purifiers.
- 1,000 households adopting under sink type residential water purifiers and another 5,000 households adopting benchtop small scale.
- 35 training sessions for water management committee planned and successfully implemented.

Component 7 – Distributed solution such as rainwater harvesting and storage

- 10,000 households supported to acquire water storage tanks.

IV. Timeline

It is proposed to implement the proposal in two phases as it will allow the intervention model to be tested. The first phase targets all wards in the lower region and aims to achieve an equitable water access of 30%. The expansion phase seeks to expand access to 60% share of population in the lower regions with access to borehole and portable drinking water in proximity of 1km radius. These two phases will be preceded by a six-month inception period dedicated to pre-project implementation detailed planning.

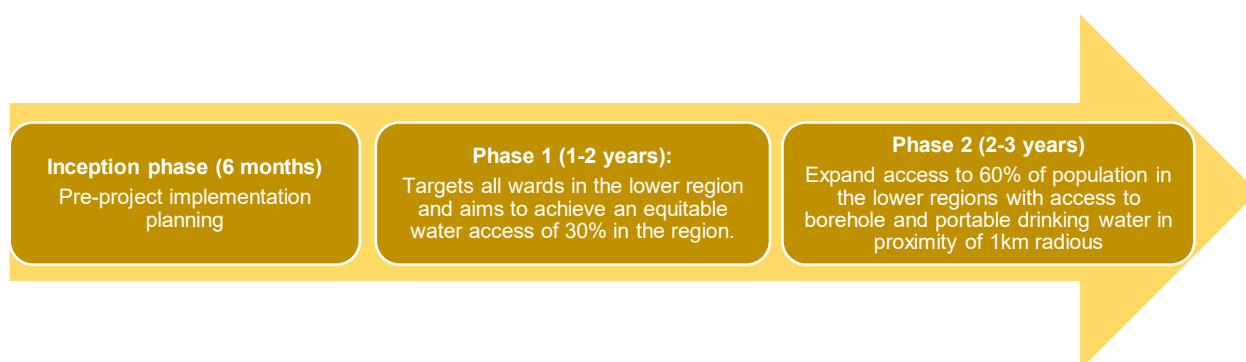


Figure 35: Water solutions timeline

The key assumptions for phase 1 are:

- Priority goes to transformation of diesel driven boreholes to solarised boreholes.
- Also a feasibility study is commissioned to assess water requirement for level 2 hospitals without water supply in the lower regions.
- GESI assessment as part of the feasibility study to understand GESI related dynamics for interventions
- The expansion boreholes have assumed three yield scenarios (5m³, 8m³ and 12m³) characteristics to the borehole yield mapping that was done across different areas in lower regions of Meru. On average, the yield is estimated to be 9 m³/hour and ranging between 1 – 36 m³/hour.
- The borehole depth varies from 19 m to 400 m with an average of 104 m (median 93 m) based on the County borehole mapping. The expansion boreholes also assumed three scenarios (110m, 150m and 200m) based on the sampled boreholes depths in Meru lower region and technical pump specifications in Kenya.

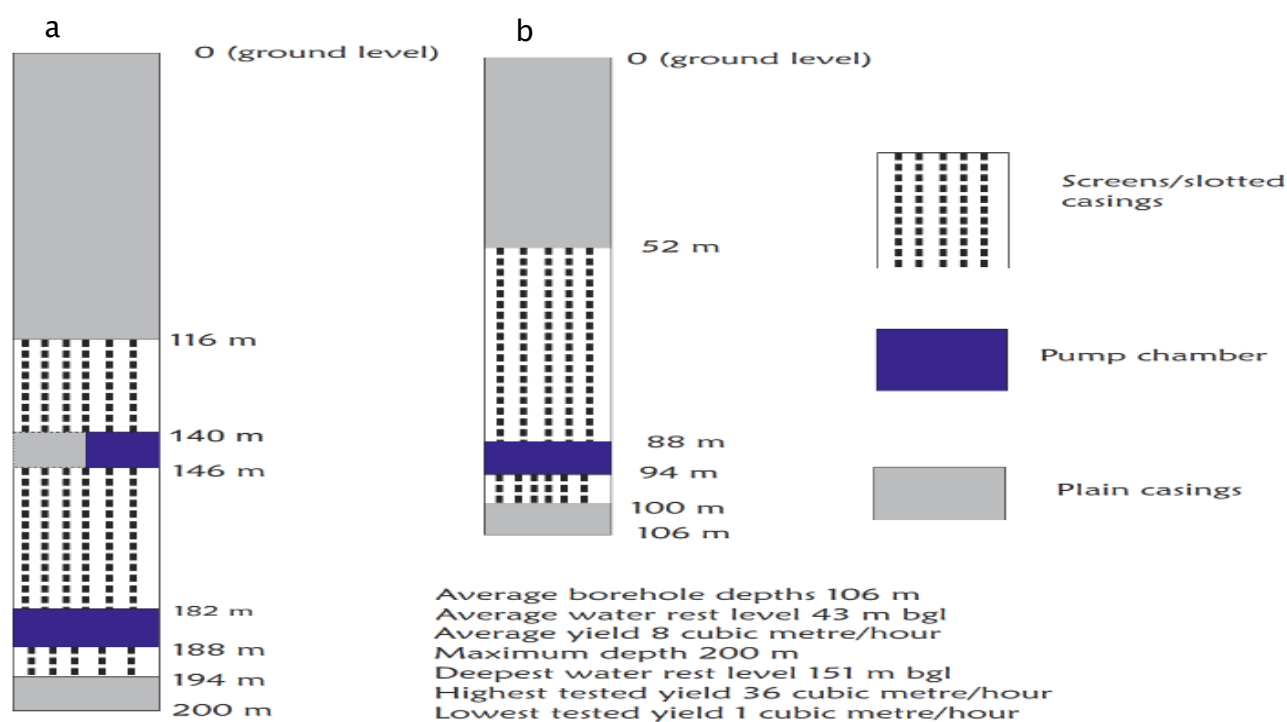


Figure 36: General borehole design for application in lower Meru region. (a) Maximum depth of 150m and 200m and (b) maximum depth of 106m

The key assumptions for phase 2 are:

- In phase II the expansion targets will be 126 Number of boreholes in Igembe south, central and North; 32 Number of boreholes in Tigania East and West; 57 Number of boreholes in lower regions of Buuri; Establishing 214 community water management committees; Training 214 community water management committees.

V. Stakeholders and Roles

All relevant stakeholders have been classified according to the proposed community water management structure. The following table illustrates stakeholder categories and their roles:

Stakeholder	Intervention	Role
New stakeholders		
Meru borehole water board	All	• To be formed as an association in the first phase of CEP implementation with the existing borehole committees. • Comprises Chair of 20 project clusters comprising borehole water resource users' association and representatives from WRA and County ministry of water and irrigation • Is top decision-making body for the project. • Offer oversight in borehole water development
Rural Borehole water (RBW) supply	Management and operation	• A limited liability company managed by the borehole board to run daily operations and management of County boreholes

Stakeholder	Intervention	Role
Borehole project clusters	Operations	- This is the community level governance mediating between the single community borehole projects management and the RBW supply. - A cluster constitute number of boreholes within geographical location (in this case wards) - Besides the office bearers ward admin represent the County's interest
Existing stakeholders		
Community borehole water committees	Operations	- It is a replica of community level management in existing committees. - They enforce conservation practices, self-policing and tariffing and bill collections
Department of Water and Irrigation	Policy, Resource mobilisation, capacity building and technical expertise	- Mobilise service providers, develop training curricula and harmonise training delivery - Seek for investors and donors to invest in water infrastructure - Provide technical experts in major repair and installation works - Provide training on water management - Carry out site specific feasibility surveys for expansion boreholes
Ministry of Gender	GESI related activities resource mobilization, GESI M&E tracking and impact measurement	- Mobilize funds and grants for GESI specific activities - Support GESI specific training and consumer education campaigns
Imetha Water	Water supply management, water distribution management	- Provide technical backstopping in areas where water is to be piped to the households in rural areas - Collaborate by providing technical support to RBW - Install water meters and develop tariffs for water users - Develop water management strategy handbook, including community sensitisation process
Farmers SACCO and other MFIs (See Annex 2)	Finance	Develop financial solutions for water supply (borehole water equipment or purification solutions) Create farmer profiles and database for those supplied with borehole water Capacity building and awareness creation of financial solutions and products
Equipment suppliers including solar	Technology	Create awareness of new technological products in the market (e.g. efficient pumps, integrated solutions, solar PV products etc.) Training of newly identified technicians for new boreholes and Refresher training for existing technicians Repair and maintenance services as per the contracts Identify new financiers and financial products

Stakeholder	Intervention	Role
WRA	Water resource assessment	• Carry out underground water resources assessment and produce ageo-map for underground water availability and yield across Meru • Carry out water quality assessment for all public boreholes • Create awareness on water conservation and promote efficient water usage • Create awareness on demand side water regulations and relevant legislation governing water resource use • Encourage water tariffing from the perspective of conservation and management
Borehole drillers (see annex 3)	Inputs	• Provide drilling services for new boreholes • Bid for Meru County tenders for borehole works • Carry out site specific survey and provide site specific estimated cost of drilling.
Training providers	Training	• In coordination with Government, develop training curricula and harmonise training delivery • In coordination with Government, develop training materials and dissemination material for extension officers and farmers • Deliver refresher courses for extension officers • Deliver training
NGOs/FBOs	Water service providers	• Trusted 3rd party supporting in water services provision • Providing County Government with pipeline of areas of critical need based on their experience in the ground and evidence • Provide grants to subsidise community led water projects in the marginalised areas of Meru • Capacity building and awareness on synergy of water and other sectors e.g. health, agriculture etc.
Solar PV installers	Service provision	• Solar PV system design and installation for borehole • Participate in competitive bidding of service provision in an open and transparent process

Table 63: Stakeholders mapping and roles

VI. Risks And Challenges

There are several risks and challenges identified that could hinder the effective implementation of the investment proposal. Some of the key risks, and their mitigation measures, are included in the following table. In addition, by taking a phased approach it will be possible to learn from the implementation experience during the first phase to inform the scale up, thereby reducing further risks.

Risk / Challenge	Mitigation measure
Uncertainties on the level of knowledge of community leaders who will be nominated to the board of management in the new management structure may risk effective implementation	The Ministry of water and irrigation will chair the board in the interim period of capacity building for strategic leadership. Moreover, the board will employ expert managers supported with expert technical staffs who will be doing daily operations.
Water supply and governance is a politically sensitive topic and buy in by the County executive is a pre-requisite to its implementation.	The Minister in charge of water in Meru County in collaboration with Minister in charge of energy will popularise the investment proposals to the County executives
Inadequate technical knowledge and skills in RO water purification technology, installation and maintenance of pumps and solar PV management can result in break-down or under-performance of the pumps	After-sales support and training is included in the proposal
Culture of free public services would make it hard for farmers to adopt payment for water hence leading to vandalism of equipment	Awareness creation is budgeted for in the investment proposal
Permits/licences to use water resource are dependent on the County and country regulations	WRA will formulate a working relationship with community water management
Farmers not wanting to have water meters installed in their farms / not wanting to pay water fees	Building farmer buy-in is an important part of sensitisation and formation of the water associations, which will include full transparency of costs and how they will be paid for. County Government is putting a lot of effort into the sensitisation and training approach.
Women farmers and people with disabilities inability to attend committee meetings and training sessions	Build buy in from the GESI group and develop implantation plans around their work schedules and challenges

Table 64: Risks and mitigation measures

VII. Implementation and Coordination, Monitoring and Evaluation

a. Implementation and coordination

The process to implement the initial Phase has five steps, as shown in the following Figure. This includes the final project design and implementation plan for the Scale-Up Phase(s).

Step 1**• Budget Allocation**

- Meru County Government (Water and irrigation) will need to set aside budget for the grant, subsidy and concessional loan allocation for irrigated agriculture and seek budget approval.

Step 2**• Partner identification**

- The ministry of water and irrigation will need to identify the partners it will work with in terms of technology suppliers, credit suppliers, fund managers and training partners. For some of the partners the process may need to follow a public procurement or tendered approach to ensure transparency, fairness and competition. In particular the following need to be identified:
 - Technology partners: Technology suppliers or distributors that can supply the equipments and technologies such as RO equipments, water pumping system
 - Financing partners – That can offer financing packages to for water access
 - Training providers – can develop and deliver required training

Step 3**• Netotiate and agree contractual on need basis**

- The partners identified in Step 2 will be engaged on need basis through contractual relationships, patnership and investor.

Step 4**• Implementation**

- This includes the following steps:
 - Review of the identified diesel powered borehole yields and seek for site specific solar PV design and costing. (*N.B: the investment proposal present estimated cost based on estimated yield*)
 - Establish County Government approval of proposed management structure for public sector boreholes
 - Create a database of exisiting and active borehole committees and plan for the first capacity building and awareness raising on proposed structure
 - Get community buy in to the new structure and establish an intereme community led borehole board
 - The County Government ministry of water and irrigation will chair the intereme board for the first year while planning exit strategy
 - Make clear plan for implementation of borehole expansion and community scale water purification as per the available budget and role out site specific feasibility studies
 - Onboard strategic patners such as MFIs, equipment suppliers, CSOs and drillers to leverage on external resources in feasibilities, equipment promotions adn awareness creations

Step 5**• End of phase I review**

- Carry out an audit of resources used at the end of the demonstration period and assess, inter alia, the following output and outcome metrics: Number of diesel powered boreholes solarised; number of boreholes board sittings, resolutions and implemented resolutions; borehole water demand and supply inventory; number of community water purifiers deployed; annual revenue received from water purchase.
- Compile and review lessons learned
- Make recommendations for Phase 2

Figure 37: Five steps of the initial Phase implementation

- Summary of approaches and steps to promote GESI in water solutions

Awareness Raising and GESI Sensitisation

- Meru County will continue applying GESI and intersectionality lens to awareness raising initiatives about water resource management and conservation, water access and storage opportunities. This includes targeted messaging and communication strategies addressing the specific needs and challenges faced by different marginalised groups.
- Women and members of different marginalised groups will be actively involved to create awareness at the community level about safe water practices.

Women's Participation and Empowerment

- The recommended solutions will promote meaningful participation of women and people from marginalised groups in decision-making processes of the existing and new water management committees. Also, marginalised communities will be actively engaged in consultations, training programmes, and capacity-building activities to ensure their voices are heard and their knowledge and skills are valued and heard.

Capacity Building and Training

- The recommended water solutions will also focus on strengthening local communities' capacities, especially women and marginalized groups, to actively participate in local water projects. This includes providing training on operation and maintenance of facilities, and creating opportunities for income generation related to water and sanitation services.

Building A GESI-Disaggregated Evidence Base

- Meru County will continue collecting disaggregated GESI data on water access, usage, among other dynamics to constantly get right numbers and performance among women, men and marginalized groups both in rural, urban and per-urban settings.

▪ Climate resilience building measures

Intervention area	Gap	Recommendation
Expansion and solarisation of boreholes to the underserved regions of Meru, water purification, pilot water treatment plants	Marginalised households are not prioritised/targeted for enhanced water access and purification	Conduct climate risk screenings to identify high priority regions and communities in identified underserved areas for targeted interventions- where it would result in the highest gains at optimal resource deployment. And also, assess how does this manifest among households e.g. declining health status from drinking unsafe water and poor nutrition lost production and education, low productivity in agriculture? Using data from the risk screening identify which interventions to deploy first in which underserved area as a priority. Working with cross sector programmes identify which intervention and early target areas to address first to mitigate climate risk and enhance adaptive capacity in water, health, agriculture, and livestock for priority budgeting and financing. Conduct CBA of implementing proposed solution vs. BAU
Establish/strengthen community water management groups	Limited -or lack of capacity of Water Management Committees and County staff on climate mainstreaming.	Conduct a climate change perception study and capacity needs assessment among Water Management Committee members, County staff and other key stakeholders. And, assess what are the specific training needs of these different stakeholders.
Establish/strengthen community water management groups	Lack of approved curriculum and training material	Identify stakeholders to partner with Department of Water and Irrigation in developing relevant curriculum. Assess all involved stakeholders' capacities to offer the training programme, identify gaps, and make recommendations. Assess and develop appropriate training finance model – subsidies, scholarships, apprenticeships etc. Lobby educational institutions to enhance capacity to offer climate change curriculum and develop curriculums
Residential scale water purification	Lack of customer acceptability of the recommended water purification technologies such as the benchtop water purifiers.	Conduct study to assess households' perception of the suggested water purifiers to assess potential adoption and uptake of residential home purifiers. Care must be taken to ensure that this model does not disenfranchise already climate vulnerable households by brokering affordability, considering seasonality of incomes etc, especially rural women and People With Disabilities (PWDs)
All technology procurement and offers	Lack of quality standards to ensure affordability, usability, sustainability of all proposed technology- solar, borehole systems, water treatment,	Develop quality standards for suppliers of equipment to adhere to, to ensure communities are safeguarded from abuse. Develop Warranty management systems to ensure sustained access and use of equipment, repair, maintenance, and compliance.

Intervention area	Gap	Recommendation
	water purifiers, water meters, water tanks	
All water solutions – link to health and agriculture and livestock solutions	Cross sectoral programming with livestock, agriculture, and health	Assess vulnerability of households to water stress and effect/ outcomes in other spheres incl. health, agriculture, and livestock. Collect baseline data on health, nutrition/ food security, agricultural productivity, lost income, access to education, increased gender inequalities, abuse, and conflict as a result of poor water access
All solutions	Lack of climate change perception and awareness study at the community level to inform interventions uptake and use, political good will and ownership. Do communities understand the link between CC, food security, Agri productivity, health, and development, and what needs to change?	Conduct perception study to understand perceptions towards climate change and water stress, proposed solutions, and cost benefit analysis of interventions versus Business as Usual (BAU) scenario. Using findings from the study above, develop an awareness creation strategy and training curriculum on mainstreaming systems, processes, and capacities
All solutions	Lack of climate risk indicators	Develop strategies to measure climate gains, impacts, assess change in vulnerability and level of maladaptation of strategies and impacts if any

Table 65: Climate resilience building measures

b. Monitoring and Evaluation

Water solution outcome and output indicators

Area of focus	Outcome	Indicator
INEP Energy access outcomes for water The County will target to have minimum electricity access levels to allow for the empowerment for people in underserved communities with minimum energy targets necessary to improve education, accelerate the transfer of knowledge, facilitate communication, and promote entrepreneurship. The planned on-grid connectivity rate together with the off-grid alternatives will enable achievement of 100% access to electricity by the year 2026.		
CEP Energy access outcomes for water Impact: improved livelihoods of the Meru communities living in the lower zones by enhancing water supply and accessibility in right quantity and quality while conserving water resource consumption.		

	Area of focus	Outcome	Indicator
1.	Climate change adaptation and resilience	improved climate change resilience of targeted communities and end users, namely to risk of water shortages through more sustainable water use, management, and increased conservation	% reduction in households (HHs) reporting water stress
2.	Economic benefits	livelihood benefits from increased production and incomes through more sustainable irrigation practices co-benefits reported from crop farming solution	No. of farmers with irrigation access
3.	Environmental conservation	enhanced use and sustainability of public water infrastructure and use- water management and conservation	% growth in volume of water harvested and distributed
		reduce environmental impact caused by diesel use	% reduction in Gasemissions for solarised boreholes
		extent to which renewable energy sources are utilized to minimize environmental harm because of solarizing boreholes	% growth in clean energy access in water
4.	Health outcomes	increased access to safe potable water leads to reduction in water borne diseases/ enhanced health outcomes at level 2 medical facilities	No. of health centres reporting reduction in water borne diseases
5.	Gender and social empowerment	Benefits for women and children	No. of women reporting increase in time available for productive use/ reduction in risk of abuse and resource conflicts
		Embedded local ownership – co-created with farmers and local stakeholders. Embedded in Meru County Government planning and budgeting	No. of women participating in water management committees
6.	Socio economic benefits	reduce incidences of water related conflict, loss of life, level of drudgery especially for women and children.	% reduction in reported parameters
		improvements in water quality and sanitation	% increase in water quality use
		increased access to clean water for households and communities	% reduction in number of waters stressed communities

	Area of focus	Outcome	Indicator
7.	Long-term water management sustainability	improved sustainability of water resource management programmes	% profitability gained by metering and tariffing
		adherence to programme budgets- tracker over or underspend and underlying reasons	% variance actual vs. plan
		Viability of investment model (water supply and demand metrics current and future projections on revenue from water tariffing)	Kshs. Revenue collected by subCounty
8.	Stakeholders buy in	participation in decision-making processes and community ownership of energy systems	% increase in attendance at community forums disaggregating data based on gender, age, income-level, rural vs urban

Table 66: Water solutions outcomes indicators

Output indicators

Outputs result from project activities and utilisation of resources including human capital, labour, funds, technology, equipment etc.

	Activity	Output	Indicator
	INEP Energy Access Data Sets		
	Critical Non-Energy Development Sectors		
1.	Water sector	Boreholes dataset (flow, depth of the water table, GIS reference, water quality data)	GIS map with attributes
	CEP Energy access indicators		
2.	Solarization of diesel-powered boreholes	20 boreholes identified as running on diesel, assessed, and re-designed for solar PV equipment installation	No. of diesel boreholes identified and GIS maps
		20 diesel-powered boreholes converted to solar PV powered boreholes	No. of boreholes solarised
		reduce operating costs of diesel-powered boreholes	% reduction in operating costs against baseline
		improve the borehole operating downtime due to frequent stalling	% reduction in operating downtime
3.	Phase 1: Expansion of boreholes to the underserved regions of Meru	mapping out underserved areas	GIS maps- number of areas identified.
		138 new boreholes installed and operational. (63 in Igembe south, central and North, 33 in lower regions of Buuri; 42 in Tigania	No. of boreholes constructed per region
			Volume of water yield per boreholes

Activity		Output	Indicator
		regions; Prioritizing 16 level 2 health facilities without access to water at 1km radius. about 32 level 2 health facilities in the lower regions of Meru don't have access	No. of women and people from marginalised groups served by new boreholes.
		Assessment report of the 32 level 2 health facilities without access to any water source within one kilometre radius detailing the causes and impacts	No. of assessments done
4.	Phase 2: Expansion of boreholes to the underserved regions of Meru	213 new boreholes constructed in selected lower regions	No. of new boreholes constructed.
			No. of new operational boreholes
			Volume of water yield per boreholes
			No. of women and people from marginalised groups served by new boreholes.
		increased proximity to water access	% of households in water stressed regions within 1 km of a functional borehole. % of level 2 health centres within 1 km of a functional borehole
5.	Piloting community scale reverse osmosis water purification	mapping out water quality across the lower regions of Meru and will enhance targeted solutions to regions of poor water quality	Water quality analysis reports per region disaggregating access data based on gender, age, income-level, urban vs rural.
		20 pilot functional community scale treatment plants in 20 wards in Tigania West and East bordering Isiolo and Igembe central and Igembe South regions that were mapped with boreholes with high TDS levels (>1000mg/l)	No. of community scale water treatment plants implemented
		assess adoptability, sustainability, and effectiveness of community water purification systems	Evaluation report
6.	Phase 1: Distributed solution such as rainwater harvesting and storage	Map and support 10,000 households to acquire water storage tanks	No. of households with rainwater harvesting tanks by sub County disaggregating data based on gender, age, income-level, rural vs urban.
			Volume of water harvested per season disaggregating data based on gender, age, income-level, rural vs urban.
			Volume of water harvested per season
		Map and support 20 institutions to acquire water storage tanks from institutional roofs	No. of institutions with rainwater harvesting tanks by subCounty

Activity		Output	Indicator
			Volume of water harvested per season
		Map and support construction of 20 units of farm ponds	No. by sub County
			Volume of water harvested per season
		Through supplier/ financier partnership, provide access to credit for purchase of water tanks	- No. of active partnerships and payment systems developed. - Number of target users accessing credit for rain harvesting by type and sub County - Kshs loan accessed by type and sub County - Kshs loan defaulted by type and sub County
7.	System maintenance	Assess County capacity to disseminate training, partnership with stakeholders for training, and apprenticeship.	No of partnership established. No. of training courses offered.
		Train 300 local technical staff trained on basic equipment operations and maintenance	No. of staff trained disaggregated per gender.
8.	Phase 1: Promotion of residential scale water purification using small-scale bench top water and small scale under sink purifiers for people with piped borehole water	identify sparsely populated households and individuals targeted.	No. of HHs and individuals targeted disaggregating data based on gender, age, income-level, rural vs urban.
		develop partnerships for procurement of, and payment of benchtop water purifiers and small scale under sink purifiers – suppliers and financers.	No. of partnerships signed off and active.
		50 households adopting under sink type residential water purifiers and another. 50 benchtop and small scale under sink water purifiers sourced and distributed to target groups and individuals	No. of small-scale bench top water purifiers distributed by region and target population disaggregating data based on gender, age, income-level, rural vs urban
		200 household adopting benchtop small scale water purifiers	
9.	Phase 2: Promotion of residential scale water purification using small-scale bench top water and small scale under sink purifiers for people with piped borehole water	5,000 Households adopting and using bench top small-scale purifiers and under sink type residential water purifiers.	No. of households using bench top small-scale purifiers disaggregating data based on gender, age, income-level, rural vs urban
			No. of HHs using under sink type residential water purifiers disaggregating data based on gender, age, income-level, rural vs urban
10.	Access to finance	Promote affordable and inclusive access to finance for the purchase of small-scale bench top water and small scale under sink purifiers	Kshs credit advanced to target population by type of financier and payment method, e.g., PAYGO.

Activity		Output	Indicator
			% loan in default
11.	Phase 1: Strengthen community water governance and management structures	Establish 138 new community water management committees and	No. of new water committees established
			% of women and people from different marginalised groups as members of the water management committees
		Conduct capacity needs assessment for selected water management groups and community members	No. of assessments
		Develop training curriculum in water resource conservation and managing communal resources	No. of curriculums developed
12.	Phase 2: Strengthen community water governance and management structures.	conduct training in community water management and conservation	No of committees trained
		Establish/strengthen 213 community water management groups	No. of functional water committees
			% of women and people from different marginalised groups as members of the water management committees
			No. of functional water committees
13.	Increase capacity of community water management groups and community members on water resource conservation	Conduct capacity needs assessment for selected water management groups and community members	Stakeholders buy in- farmers- accept to uptake and pay for metered water
		Develop training curriculum in water resource conservation and managing communal resources	No. of training curriculum developed.
		Train 213 community water management groups and community members in water resource conservation	No. of community water management groups trained disaggregating data based on gender, age, income-level, rural vs urban
14.	Phase 1: Water metering and tariffing	369 digital meters installed in existing and new boreholes Especially relevant for the conservation of water and monitoring	No. of water meters installed
		Develop a data capture protocol for water demand including metering and transmission to centralized data management centre	No. of data capture protocols produced.
		Successful implementation of residential water tariff KES50/cubic meter and KES1000/cubic meter	KES revenue collected by category
15.	Phase 2: Water metering and tariffing	213 bulk digital meters and water meters for water kiosks installed in new boreholes	No. of meters installed for boreholes and water kiosks by subCounty
		5000 domestic water meters installed for number of households seeking water piping to own residences	No. of water meters installed

Activity		Output	Indicator
		analysis of current and future water and energy demand, supply, and costs by sub County	No. of studies conducted
		analysis of effectiveness of water meters	% of installed functional water meters
16.	System Efficiency	Measure the energy efficiency of water pumping, treatment, and distribution systems.	- Energy consumed per unit of water delivered. - Energy losses during distribution - Use of energy-saving technologies and practices. - Water losses during distribution
17.	Productive use of energy	target users reporting increased incomes from access to adequate and quality water	No. and average Kshs increase in HH income by type on income generating activity, disaggregated by rural vs. urban HHs
		health centres reporting improved delivery of health services	No. health centres
		current and future projections on revenue from water tariffing	KES. by subCounty
		remote rural populations access and use water storage facilities for irrigation	No. of rural HHs using harvested water for irrigation
		creation of local job opportunities related to energy and water services.	No. of new jobs created by gender and age and PWDs by rural vs, urban populations
18.	Affordability and cost-effectiveness:	Assess the affordability of energy for water projects, particularly for underserved communities.	energy cost per unit of water produced or distributed.
		Conduct survey to map number of connected NON-Users (not using water services) for different income groups rural vs urban	No. of connected non-users
		Asses a) willingness to pay, and b) ability to pay among connected users NOT using water services for different income groups rural vs urban	% of connected non-users willing to pay
			% of connected Non-Users UNABLE to pay for water services
		Assess cost-effectiveness of the energy-water- health nexus	% Cost burden on the health centre budgets for access and maintenance of water services
GESI Indicators			
19.	Awareness raising and GESI Sensitisation.	Develop targeted messaging and communication strategies addressing the specific needs and challenges faced by women and disadvantaged groups.	No. of GESI specific communication approached used

	Activity	Output	Indicator
20.	Women's participation and empowerment	Develop policies for the inclusion of women and disadvantaged groups in water management committees.	No. of women and disadvantaged groups on management committees by subCounty and ward level
		Develop policy for minimum number of women to participate in training and awareness raising,	No. of women and disadvantaged groups trained.
		Develop policy for minimum number of women and disadvantaged groups accessing domestic water solutions	No. of women accessing domestic water solutions y type- water purifiers, water tanks, farm ponds
21.	Capacity building and training	Develop policy in minimum number of women to be trained as technicians.	No of female and disadvantaged groups' technicians by subCounty and ward
22.	Building a GESI disaggregated evidence base	Collect disaggregated GESI data on water access and usage, credit access and usage, access to water solution, access to training among other dynamics in rural, urban, and per-urban settings	Database and analytics showing gendered growth in performance trends

Table 67: Water solutions outputs indicators

VIII. Conclusions

This investment proposal has identified a viable pathway for Meru County Government to increase water access for domestic use in lower regions of Meru. A participatory approach seeks to onboard multi-stakeholders to leverage on both financial and technical expertise in various aspects and stages of implementation. The proposal addresses key social concerns of water inadequacy in lower Meru and the approach is non-profit nature. Even-so the proposal sets strategy for what has been critically lacking in the past water metering and tariffing. This will ensure sustainability of the boreholes ensuring effective management of the systems, repair, maintenance, continuous and reliable water supply to the community. The funds raised from water sales will be managed by the boreholes board on behalf of the community to sustain the system, pay the technicians and managers and promote community social well fare.

The following next steps should be undertaken to move forward from proposal stage to implementation:

Government buy-in – Meru County Government to adopt the proposal and allocate funds to implement some of the activities. It will provide a road map for the Department of Water and irrigation on water sector needs and areas of synergies with department of Energy. The ministry of water and irrigation and department of energy leveraging on allocated County budgets for specific activities e.g. department of energy supporting the design and solarization of all diesel powered boreholes.

Further map and explore funding support – the public finance aspects of this proposal could be supported by Meru County Government, and indeed in terms of attracting other finance Government commitments through budgetary allocation is important. Exploring other opportunities for public financing - through for example grants identified and other programs that are supporting Meru such as the GoK Women, Youth & Innovation Funds - could be a way to scale more quickly. As important is to continue to map and explore the commercial finance components, including identifying which of the Option PAYGO versus MFI financiers are most viable for some solutions such as increasing adoption of small-scale water purifiers.

3.1.3 Productive Use Of Energy

Meru County conducted an extensive baseline analysis and as result, six priority sectors for which energy is a key enabler were identified. These six priority sectors are: lighting, cooking, agriculture, livestock, water, and health. Section 3.1.3. Productive Use of Energy covers two of these priority sectors, agriculture (see section 3.1.3.6) and livestock farming section 3.1.3.7.

3.1.3.1 Energy and micro and small-scale enterprises (MSEs).

Refer to section 3.1.3 for more details on the priority sectors targeted by Meru County in the INEP.

3.1.3.2 Industrial application

Refer to section 3.1.3 for more details on the priority sectors targeted by Meru County in the INEP.

3.1.3.3 Transport

Refer to section 3.1.3 for more details on the priority sectors targeted by Meru County in the INEP.

3.1.3.4 Geothermal direct use

Refer to section 3.1.3 for more details on the priority sectors targeted by Meru County in the INEP.

3.1.3.5 Agro processing

Refer to section 3.1.3 for more details on the priority sectors targeted by Meru County in the INEP.

3.1.3.6 Water supply and irrigation

3.1.3.6.1 Agriculture sector goals and strategies to promote electricity access

Refer to section 3.1.3 for more details on the priority sectors targeted by Meru County in the INEP.

3.1.3.6.2 Goals For Electricity Access In The Crop Farming Sector

I. Overview of the sector and background

Agriculture is the major economic activity and source of livelihoods in Meru County. The County has 161,907 hectares of land under food production and a further 15,773 ha for cash crops (MoALF, 2016). Nearly 60% of all Meru households are involved in crop production, and of these, 89% grow food for subsistence and 11% for commercial sales (KNBS, 2019). The County has a diverse range of agro-ecological zones from humid tropical in the south to semi-arid to the north and east (as shown in the following figure).

As a result, crop cultivation and average farm size varies across Sub-counties. Yet, most households own small parcels of land, varying from 0.2 ha in the more fertile (tea/dairy) zones to over 2 ha in the lower midlands (Meru CIDP 2018-22, 2018), while a minority of large-scale farmers own most of the land (MoALF, 2016). There are significant gender disparities in term of land ownership in the County, and it is estimated that men own about 80% of the land compared to women owning 20%.¹⁵ Women make up 70% of the agricultural labour force in Meru County, yet their roles in production and sales goes mostly unrecognised (Transform Trade, n.d.).

¹⁵ These estimates are based on a survey completed by all Ward Administrators from Meru.

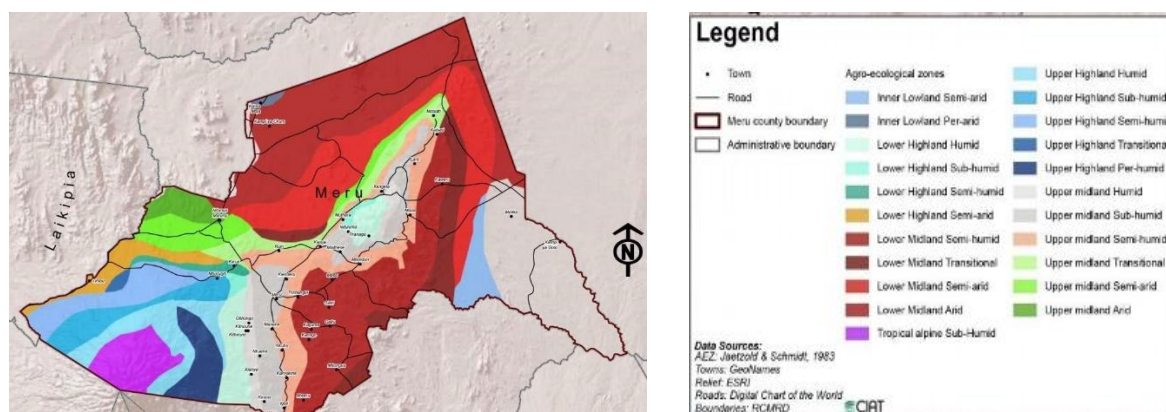


Figure 38: Meru County Agroecological Zones

Source: Meru County spatial map (<https://meru.go.ke/County-maps/>)

There are two rainy seasons (March to May and Oct to Dec) when crops are rainfed. In 2014 about 14% of households used irrigation water as an input with the area under irrigation estimated at 15,000 ha. Yet, the potential for land under irrigation is much higher and is estimated at 80,000ha (MoALF, 2016). The County Government of Meru has prioritised irrigation with more than 275 Government irrigation projects covering areas from 2 hectares up to 1,500 hectares and supplying thousands of farmers. The irrigation projects use pumped water and transport it more than 2km from water sources. The County Government is also building some very large tanks with a capacity of about 225,000 litres to store water to cover times of water stress. Farmers close to rivers are also abstracting water individually for irrigation, normally using gravity. The main areas for irrigated horticulture in Meru are in the Upper and Lower Midlands, specifically Imenti South (41% of crop farmers), followed by Buuri West (35%), and Imenti Central (33%) (KNBS 2019). The potential for irrigation in the Upper and Lower Midlands is estimated at 52,500¹⁶ ha, including irrigation projects and farms close to permanent rivers – this was classified as within 300 metres of a river (shown in the following figure).

¹⁶ Estimates according to result of GIS mapping.

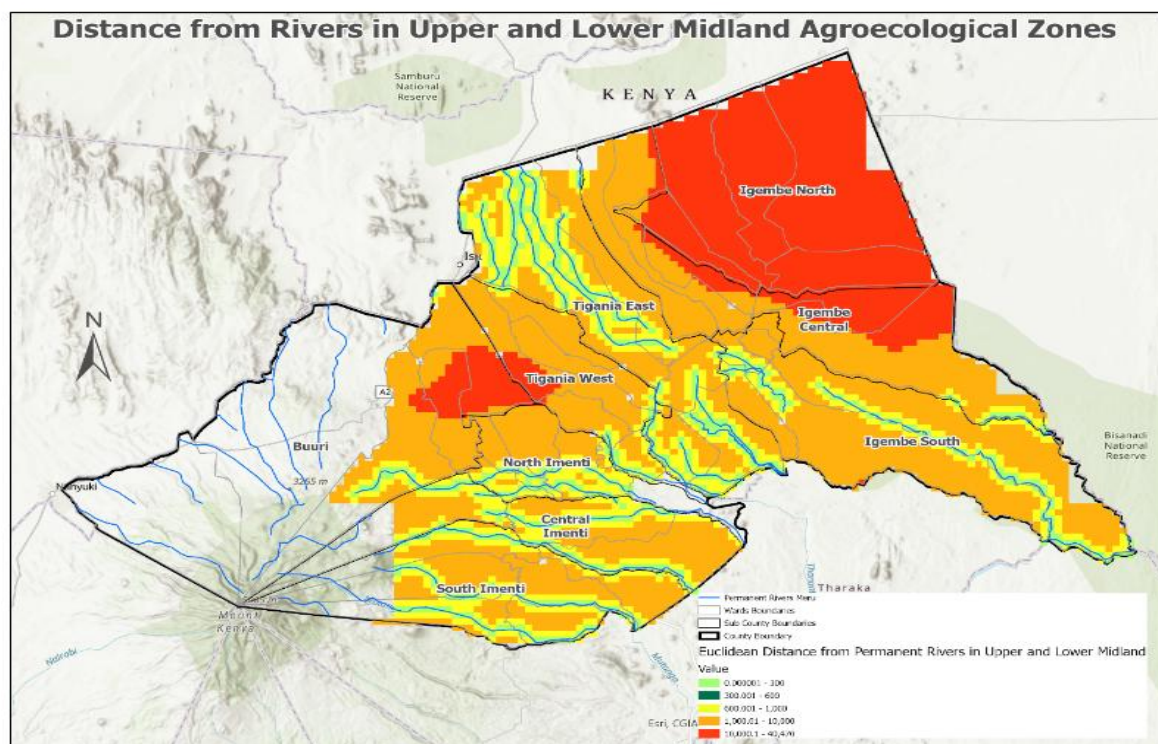


Figure 39: Distance from rivers in Upper and Lower Midland Zones of Meru

Major crops of importance include: maize and beans (widespread across all areas of the County); bananas (Imenti South, Imenti North, Meru Central, Tigania Central), potatoes (Buuri East & Buuri West), onions (Imenti South & Buuri West), and tomatoes (Imenti South & Imenti North) [KNBS 2019). In addition, Meru grows tea, coffee and miraa as cash crops. Men tend to focus on the higher value crops such as miraa, bananas and potatoes with women growing more maize. Women constitute a bigger number of small holder farmers practising mostly subsistence farming and crop selling for household income.

There is potential for horticultural farmers to improve their incomes by growing out of season as prices vary by up to 150% in local markets between the dry and rainy seasons¹⁷. The most lucrative crops in the County are sweet potatoes and tomatoes followed by onions and cabbages. Sweet potatoes present a good opportunity for sale in the dry period, June to August, when prices are higher. Tomatoes can get good prices in October/November and farmers can also better prices for kale in February time, indicating a good fit with sweet potato and tomato cycle.

II. Challenges, Priorities, And Needs

The challenges to horticulture smallholders fall all along the value chain and pose different risks to developing or improving their livelihoods if not addressed. Women small holder farmers are more disadvantaged experiencing more challenges that includes gendered

¹⁷ Research was conducted on mapping high value horticultural products currently farmed in Meru with demand in local markets.

behaviour patterns that constrain them to a certain level of nodes of the value chains that require unskilled labour, affecting their upward mobility. Specific challenges are further outlined below:

a) Access to quality inputs

Using good quality inputs under expected conditions can increase yield and overall profit margins. However, farmers experience constraints in buying inputs due to various reasons such as: high prices, lack of access to credits, long distances to markets, lack of access to inputs at the right time (MoALF, 2016). High costs are also due to limited availability of certified seed and because stockists sometimes sell low quality seed that is not certified.

Changing weather patterns and high levels of humidity during the rainy seasons have led to an increase in pests and diseases (eg. BXW a bacterial disease that affects apples and bananas, and blight which affects tomatoes) whilst some are also developing resistance to the commonly used pesticides. Furthermore, farmers lack knowledge of, and capacity to use, quality inputs and do not always know of all the benefits associated with them. Often, the farmers lack the capacity to identify specific crop pests and diseases resulting in insufficient crop pest and disease management with farmers using the wrong control measures, or poor timing of spraying leading to low- and poor-quality yields.

Women farmers are often more vulnerable to the effects of climate change and they lack access to the right information on right types of inputs, fertilisers and pesticides to use and where to buy them to be able to mitigate climate change effects. They lack enough capital to buy the farm inputs and are unable to access financing for the same.

b) Irrigation and drought management

Water stress has serious and varied effects on crop production, it reduces yields, dries out crops and delays crop maturity, among others. Water is scarcer in Meru during the dry season. Farmers who are part of communal irrigation schemes face water rationing during this period, especially between August and October, while those with individual or no irrigation systems experience water shortages and potential conflicts on the use of the limited existing water sources. As result many farmers do not farm in the dry season because they cannot afford pumping and rely on rains for their irrigation. This challenge is exacerbated in the Midlands regions, such as Imenti, Tigania and some parts of Igembe and Buuri. To address the issue, more boreholes, water pans and dams are being constructed.¹⁸

Also, water volumes in rivers are declining for different reasons:

- Increasing numbers of intakes and farms practising irrigation including the construction of many illegal intakes. The cost of permits has disincentivised some

¹⁸ However, DOMWASS has recently been engaged in installing boreholes in the upper regions (mostly supplied by rivers) because numerous rivers are drying up and rationing of supplies is becoming more frequent and for longer periods.

water users from getting permits and levels of abstraction of river water cannot be controlled. Where individual farmers abstract the water, there are no water management committees to manage the water at a community level resulting in disputes and less water further downstream.

- Inefficient irrigation systems (e.g., furrow systems) mean that water is wasted or more water than necessary is being used to irrigate.
- Vandalism of pipes – people break pipes to access water, especially during dry seasons for livestock and miraa farming.
- Water catchment management. There is considerable encroachment into forest and wetland zones that has led to the destruction of important water systems
- Inappropriate planting of eucalyptus trees at the riverbanks.

c) Climate change

Climate change presents enormous challenges to smallholder farmers due to extended and more frequent droughts, floods, reductions in rainfall and the consequent reduced recharge rates of rivers, shifting seasons and changes in temperature. Climate has already been observed to change in the County. Since 1981, the first wet season has experienced a moderate (1°C) increase in mean temperature and associated reduction in crop cycle, a significant increase in heat stress days, and no detectable change in precipitation. The second wet season experienced a mild (~0.5°C) increase in temperature, and no change in precipitation. Looking to the future in the years of 2021-2065, both extreme precipitation and prolonged moisture stress are projected to occur (MoALF, 2016).

Horticultural crops are especially sensitive to climate change because of their high demand for water and their strict temperature requirements. Rain and flooding affect land preparation, crop establishment, and pests and diseases are more prevalent. Similarly, long dry spells and droughts affect land preparation, reduce quality and crop yields, and contribute to increases in pest and disease prevalence. These fluctuations of rainfall and rise in temperatures and their impacts can affect the suitability of areas for growing horticultural crops.

For potatoes, heat stress leads to drying of the seed materials and also causes the plants to produce smaller low-quality tubers that fetch very low prices. Harvesting of the potato tubers becomes very difficult due to the hardening of the soils increasing the costs of labour (MoALF, 2016).

Smallholder farmers are particularly vulnerable due to other systemic factors that increase their sensitivity and exposure while undermining their adaptive capacity, for example economic, social and infrastructure and market factors. The poor are less able to access irrigation facilities and disease management inputs due to the high prices. Lowland farmers suffer worse as they are even more exposed to the floods and droughts as well as to moisture and heat stress due to the hot and dry conditions plus the topography and soil characteristics.

Women smallholder farmers have been widely affected by the effects of climate change due to inability to understand how to mitigate the impact and low literacy levels. UN figures

indicate that 80% of people displaced by climate change are women. Roles as primary caregivers and providers of food and fuel make them more vulnerable when flooding and drought occur. Their livelihoods have been negatively affected by climate-related changes because of loss of income, food insecurity and low crop productivity (Dibakoane et al., 2022). More so, women farmers are less equipped to confront climate change for example during extreme weather such as droughts and floods, women tend to work more to secure household livelihoods, and this will leave less time for women to access training and education to develop skills on mitigation measures. This also exacerbates aspects of sexual harassment, mental health, and physical abuse. Value chain climate smart financing opportunities, training of better farming practices, joining cooperatives to help the deal with climate change challenges is one of the way women farmers in Meru County are adapting.

Farmers in Meru are adapting by increased use of mulching, reducing the acreage under irrigation and shifting to short-maturity varieties or to less water intensive crops (e.g. horticulture to beans, sorghum or sweet potato). A study from 2014 stated that about 47% of the total households in Meru County had changed crops as an adaptation strategy to climate change with youth-headed households having the highest adoption rate (56%) followed by female-headed households (49%) then male-headed households (45%.) (MoALF, 2016).

- Affordability and limited access to finance

In addition, farmers, who would like to expand the growing season into the dry season, find the lack of powered irrigation, and lack of access to credit to start irrigation, key barriers to expansion. The cost of irrigation pumps is beyond the affordability of farmers with low income, and solar irrigation is more expensive; the lack of finance makes them unaffordable to most smallholder farmers. Even diesel-powered irrigation pumps are too expensive for many farmers. Exacerbating the problem, lack of land ownership negatively affects investment decisions; in Meru about 35% of the farmers lack title deeds (Meru County, 2018). Further, it is very common for farmers to rent land for horticultural farming from land owners who either have no interest or do not have the means to farm the land themselves. The most common leases are for one year which means the farmers are not interested in investing in permanent infrastructure, such as drip irrigation.

A key challenge identified is the lack of access to credit which hinders farmers' ability to grow their business or afford the high-quality inputs and irrigation systems. There is also limited information on the available financial products or services for crop farmers. Farming groups do practice merry-go-round banking which allows members to purchase assets, e.g. water harvesting tanks, but higher value products are still difficult to finance.

Access to finance is an important gender gap affecting women small holder famers in the County more than men. Most women farmers own very small sizes of land that do not pass for use as collateral when trying to access lines of credit from financial institutions to grow their farming businesses. A lack of financial products that support women financial access exacerbates the situation even further. Inadequate financial literacy levels and lack of right information on available access to finance options and opportunities among women farmers

also impedes on their ability to access capital to invest in their farming business. Support of gender-inclusive interventions will help address this gap.

d) GAP, training, and access to knowledge

Good agricultural practice (GAP) improves soil fertility, increases infiltration of rainfall, reduces runoff, reduces evaporation of moisture from the soil and interrupts the life cycle of pests and diseases that build up. All these are aimed at reducing the chances of crop failure and higher yields. However, small scale farmers lack this knowledge leading to poor crop performance and low crop yields.

Also, there is not sufficient knowledge, information and awareness of the opportunities from alternative efficient irrigation technologies, such as drip irrigation and SWP. There is also a lack of skills in irrigation water management, and in installation and maintenance, which can result in break-down or under-performance of the pumps. Extension services, along with technology suppliers, can help address these gaps but due to the remoteness of many farmers the information does not reach them.

The historical disparity in educational opportunities based on gender, which was widespread in the past, still has repercussions for female farmers today. Acquiring knowledge and training in farming practices remains crucial for individuals of both genders. However, even though women play a vital role in agriculture, they are frequently overlooked as farmers, resulting in reduced access to agricultural information, particularly information tailored to their specific requirements. There is lack of robust and comprehensive training for both women and men farmers on how to mitigate climate change impacts by adopting the right types of farming practices and mitigation measures. Inability to carry out a gap analysis frequently leads to these challenges not being addressed and eventually impact women farmers (AfDB, 2015).

e) Marketing

- Low Prices - Smallholder farmers face several inter-related market constraints which impact on their incomes, profitability, and ability to expand. There are high market price fluctuations with low prices offered to farmers during peak production periods. The farmers have limited ability to mitigate this due to lack of market access, the perishability of produce, lack of access to storage facilities and limited ability to farm in other seasons due to limited irrigation options, water stress or finance for irrigation. Women farmers face lack of access to markets opportunities for their products due to inability to access viable markets as a result of male dominance and harassment. They also lack necessary skills to market their products and negotiate for better prices for their products.
- Lack of value-addition - Most of the commodities produced in the County are sold in raw form. Non-efficient post-harvest handling of the farm products and lack of value

addition through processing leads to high losses and lower prices. Meru potatoes primarily go to Nairobi to fast food outlets selling chips. Small-scale processors/consumers in the County consist of hotels and fast-food outlets. These factors plus poor transport networks to the larger markets drive farmers to sell immediately after harvest at often low prices in local markets. This can disproportionately affect women farmers where the need for quick sales, hurry to dispose of stock and households' money demands leads to lack of value addition for products harvested.

- Poor market access - Farmers have limited access to market and lack marketing options when they are reliant on individual marketing to middlemen/brokers or selling in the local market¹⁹ due to the high transport costs and poor roads. Middlemen bulk products for traders who take the products to Nairobi, or to markets further away. In addition, impassable roads, especially during the rainy season discourage buyers and lead to post-harvest losses for the perishable products. Farmers therefore lack bargaining power and receive lower prices (Sigei et al., 2014). Women farmers are not able to take their produce quickly and easily to market at the right time and during the right price season due to bad roads, high transport costs other household activities, and inability to get into workable transportation contracts with main transporters who are predominantly men.

There is widespread use of aggregation in Meru through cooperatives and farmers' groups who carry out both production and marketing. However, most of the existing cooperatives that collectively aggregate products grow coffee dairy and tobacco. Potato and horticulture as perishable products have limited aggregation with a few notable exceptions, such as the Meru Potato cooperative society buying potatoes from farmers for aggregation. Lack of up-to-date market information impedes farmers' ability to make informed decisions. Across Meru, there is very limited understanding of different markets; prices vary significantly across Counties, and within local markets at different times of the year. Most farmers rely on informal channels to access market information.

a. Promoting Gender and Social Inclusion (GESI)

According to the Agriculture sector Gender Policy, gender inequalities in agriculture still exist in all areas of value chains, from production to processing and consumption / disposal. Gendered patterns of behaviour condition men's and women's roles, the distribution of resources and benefits derived from income generating activities in the chain, and the efficiency and competitiveness of value chains in the global market. These gender inequalities impact negatively on families and the larger economy. Gender as one of the major factors holding back agricultural productivity and perpetuating poverty and hunger in many regions, particularly in Sub-Saharan Africa. Lower access to productive inputs such as

¹⁹ Only a small portion of the potatoes in Meru is sold in local markets, mostly by women traders (MoALF, 2016).

land and capital for women is one of the root causes of the productivity gap between men and women, both in the farm and non-farm sectors.

It is demonstrated that even the slightest reduction in the gender gap in agriculture results in huge economic benefits that elevate millions of people out of poverty.

Therefore, involvement of women and excluded groups in agriculture in Meru County is important for more equitable access to agricultural service and benefits.

The previous sections present opportunities for integrating GESI into the agriculture, recognising that marginalised groups face multiple and different types of challenges. Income level, race, gender, disabilities, among others, produce greater and specific disadvantages to different marginalised groups, and the recommended solutions aim to address these specific barriers. Meru County will continue carrying out further GESI analysis to develop a comprehensive approach as part of the inception phase of implementation. And also, will routinely collect gender disaggregate data through specific programme indications to inform subsequent phases of the recommended solutions as well as future programmes and policies.

b. Climate Resilience Mainstreaming

Adverse climate change deeply impacts the agricultural sector. Increase in temperature (0.5°C-1°C increases) have been noted since 1981, with decreased precipitation in the main wet seasons. These events have produced different impacts on farmers such as crop yields and income generation, increased pest and disease incidence, and, in some cases, affected food security.

Smallholder farmers are more vulnerable to climate risks due to other systemic factors – economic, social and cultural - that increase their sensitivity and exposure while undermining their adaptive capacity. Also, smallholder farmers typically lack access to adequate information, knowledge, and awareness of the opportunities for alternative efficient irrigation technologies and water management governance structures, which add to these challenges.

There is need to deepen knowledge and attitude change in agriculture in the adverse climate environment. This requires a shift to agriculture that is resilient to the realities of climate change i.e., build adaptive capacities to reduce, absorb, and overcome climate effects and variabilities. And also, a shift to low-carbon agriculture i.e., agriculture that reduces and avoids carbon emissions. The Implementation, Coordination, Monitoring and Evaluation section presented further below outlines a series of actions aimed at mainstreaming climate into the recommended solutions.

c. Promoting Energy Efficiency and Conservation

The recommended solutions have been assessed from an energy efficiency perspective and the technologies to be deployed meet the highest energy efficiency standards. This assessment will be repeated over the different phases of the programmes to ensure that new technological developments are considered in subsequent phases and replace current technologies that may become obsolete in upcoming years.

Some of the energy efficient technologies considered in the recommended solutions include:

- Use of solar water pumps (SWPs) for irrigation, based on a review of the market to determine quality and price point. Noting that different SWP systems have been selected to target particular farmer needs and farm sizes.
- Continued use of gravity irrigation where water pressure remains high. Water pressure from the river supply has reduced significantly with climate change and farmer use. There is a significant need for powered pumping as well as less water use. However, the proposed solution does not switch out gravity-fed systems where water pressure is more than sufficient to carry out drip irrigation.

Water conservation and associated pumping requirements – a non-energy related efficiency that is important to note is water conservation through switching to drip irrigation, and a focus on the supply-side of water through the water management committees and use of water metering. The reduced use of water has spillover benefits for the sizing of pumps required to irrigate farmer land, and associated energy savings.

3.1.3.6.3 Strategies To Promote Access To Agriculture Services

I. Solution Components

The following solutions aim to improve the livelihoods of small-scale potato and horticulture farmers in the midland areas of Meru who are beginning to experience water scarcity. The proposal aims to support them to become more resilient to climate change related water stresses while increasing and improving their agricultural productivity and incomes. It will do this by addressing the key challenges outlined above, with a focus on less water-consuming irrigation technologies and water management i.e., reducing and better managing demand for water whilst improving efficiency of water use and farm productivity.

For horticultural farmers, there is potential to meet the significant demand for sweet potatoes, tomatoes, and kale in local markets and to get better prices out of season. This proposal will promote solar powered irrigation and water efficient drip systems by supporting farmers to access and purchase the technology, in parallel with introducing improved water management with self-policing farmer water management committees.

Irrigation and water management need to be seen within broader farm production and therefore to maximise yield improvements, the proposal is to also support farmers with access to quality farm inputs and address the lack of integrated pest management (IPM) and

GAP techniques. It is also proposed to improve access to finance and credit to enable farmers to purchase the higher quality farm inputs.

Although water efficient irrigation has the potential to mitigate water stresses and unlock high value horticulture production, it comes with inherent market related risks including low prices, little access to market information, market saturation and lack of reliable buyers. The associated crop perishability issues may make market access for potato, and horticultural crops even worse than for dry produce like cereals and pulses, especially for more distant markets. Therefore, the recommended solutions will not only improve farm-side practices, it will also address marketing challenges by training in marketing. As the initiative scales, the aim is to diversify to markets outside Meru by aggregating in quality storage centres being proposed by the County and identifying opportunities for processing for further value addition.

The key areas for intervention are outlined below:

- Establish/strengthen community water management groups and capacity building of community members on water resource conservation will form the basis for all the support included in this proposal. New water committees/associations will be established, or existing ones strengthened and training will be provided to the members on water conservation and on managing communal resources. Lower-income farmers with smaller plots will be included as part of the target groups, and County Government will ensure a significant mix of women and other disadvantaged farmers are part of this water committee and groups Training will also be tailored and given to women farmers and people of disadvantaged groups on water resource management and conservation.
- Installation of water metering –water meters will be installed on all irrigation in-takes for all the members of the water committees. This will create an incentive for farmers within these committees to invest in water efficient irrigation. In addition, modern water meters provide accurate and timely information on water and energy use. For water service providers, meters will produce various benefits such as: i) reduce water losses due to accurate water balance, ii) lower operational costs due to elimination of field meter readers, and iii) improve revenue collection due to reduction in unaccounted water and billing errors. Equally, smart energy meters provide insights into energy usage in pumping and anomalous power usage, which would prompt for interventions to address and quantify the changes from baseline energy usage. Furthermore, use of smart meters increases compliance with water abstraction and use permit conditions. This will enhance monitoring and enforcing water extraction limits by MEWASS/IMETHA. This has added benefits of reducing water resources depletion and regulating water reserves especially in the dry season to the benefits of the farmers.
- Support for the purchase of irrigation systems to be more efficient and use less water. Addressing the key barriers to access to water efficient irrigation, it is necessary to address the lack of knowledge of solar and drip irrigation and the lack of access to

credit to enable farmers to purchase irrigation systems. Therefore, it is proposed to work with technology providers to carry out marketing with horticulture farmers at the same time as making financing packages available to the farmers, either through the technology supplier or a financing organisation, and also offering an end-user subsidy. Farmers will be asked to pay a deposit and would pay the balance in monthly instalments.

The recommended irrigation systems will help farmers improve revenues and reduce costs. For instance:

- With improved solar panels' technology, the average energy conversion efficiency has increased from 15 percent to over 22 percent in recent times. This change in efficiency has resulted in the power rating of a standard-size panel increasing from 250W to over 500W. Higher efficiency implies shorter payback period and improved performance.
- Drip irrigation systems deliver water in a controlled, timely, and accurate manner directly to the root zone of the plant. As result, farms save water and money – due to lower water costs.
- Support for local water storage (farm ponds) will be provided where there are particular water constraints in the form of grants and loans for the pond liners. Farmers will be expected to carry out the civil works.
- Improving access to quality/certified inputs– To address the challenges in access to quality, certified seeds and fertilisers, sensitisation/training on the benefits of certified seeds will be carried out as well as providing introductions to quality agro-dealers or a one stop shop. To incentivise farmers to procure and use the quality inputs, support will be provided to set up systems to purchase seeds in bulk, which can improve the availability to farmers and reduce the cost, in addition to the provision of a subsidy for the first season inputs. Improving access to pesticides to target infestations brought on by the high level of moisture retained in the soil is also important.
- GAP training – Good quality extension services are important to improving incomes. Training and Sensitisation will be provided on integrated pest management, GAP farming techniques, crop cycle design, irrigation and water management to support the uptake of solar-powered irrigation and to increase crop yields and improve soil fertility, with minimum labour requirements. A demonstration farm will be used as part of the training. Emphasis must be put on any need to tailor training of women farmers and disadvantaged groups.
- Improving farmers market literacy and access to markets - To ensure farmers can sell their produce at a fair price, farmers will be trained in market literacy, market mapping, contracts and negotiation skills, and improving access to market information as well as encouraging the formation of organised marketing groups (associations) for easy market linkages and aggregation and promoting linkages to strategic market platforms. This could be done by carrying out a very brief Training

Needs Assessment along these lines for both men and women and a gendered training content developed that would address both stakeholders needs.

- Improving access to finance and credit - Improving horticulture farmers' access to appropriate and affordable finance that is tailored to business cycles will enable them to purchase high-cost inputs (seed, disease, and pest control) and equipment to improve yields and incomes. Therefore, it is proposed to work with marginalised farmers and Self-Help Groups (SHG) to extend services to the marginalised farmers as well as linking horticultural farmers with financing institutions and platforms.

II. Alignment With CIDP (2023-2027) Priorities

- Establish/strengthen community water management groups and capacity building of community members on water resource conservation, installation of water metering, and support for local water storage. These three solutions fall within CIDP Programmes 3: Soil Conservation, Fertility management and Water Harvesting, and Programme 6: Capacity building.
- Solutions Support for the purchase of irrigation systems to be more efficient and use less water and Improving access to finance and credit: fall within CIDP Programme 1: Crop Development.
- Improving access to quality/certified inputs is aligned with Programme 4: Inputs Supply Support.
- GAP training and improving farmers market literacy and access to markets: these two solutions fall within CIDP Programme 6: Capacity building and Programme 1: Agriculture education and extension of the Agricultural Training Centre Programme.

III. Financing Models

Financing packages will be made available to farmers to purchase highly efficient irrigation systems. Farmers will be asked to pay a deposit for the main technology plus the cost of the installation and ancillaries. They would pay the balance in monthly instalments. The terms of the financing will be finalised in the project inception phase and will depend on the technology solution selected. There are two options for financing, depending on the technology supplier selected:

- Option A – The technology supplier offers PAYGO financing direct to the farmer. The supplier has pre-defined financing packages, for both its solar pump and drip irrigation systems, which take into account the farmers' ability to pay monthly instalments.
- Option B - The technology supplier provides the pump system and a local MFI offers the finance to the farmer. The MFI would work through the existing local Self-Help Groups (SHG). Group based lending allows farmers to serve as guarantors to each other. The MFI lends to farmers via the SHG. The SHG also ensures that the money is spent on the correct selected irrigation system. An MoU would be signed between the farmer and the technology supplier to provide the pumps, associated training and

after-sales support. Farmers would pay their deposits and monthly instalments to the SHG who would, in turn, pay back the MFI.

The terms of finance under Options A and B are likely to be similar but different. Pump suppliers will offer a standard finance package but are more risk averse than MFIs so not all farmers may pass the threshold for finance and the interest rates may be higher. Pump suppliers will only contract direct with a farmer. On the other hand, MFIs are in the business of lending but do not understand the technology, and therefore lend on the basis of potential farming incomes and assets. Furthermore, MFIs are likely to only deal with their own customers who have records/accounts with them. However, MFIs do have experience working with SHGs which reduces some risks.

In addition to the financing models above, there is still a need to further support farmers in a demonstration phase since they are likely to be reluctant to take out a loan when they cannot be certain of the benefits afforded by a new technology and irrigation technique. Therefore, financial support has been found to be a key intervention to unlock market potential for solar water irrigation because they directly address the affordability challenges and help reduce the perceived risks (Lighting Global, 2021). This strategy will not only incentivize farmers, but it will also reduce risks for the finance provider who will only be loaning about 40% of the value of the product.

The financial support will be used to reduce the deposit (farmers will pay 50% of the deposit) and the instalment payments. For Option B, the financial support would be paid to the technology supplier via a trusted party on proof of paid deposit and installation of the correct pump from the SHG. The subsequent SHG farmer loan from the MFI would be negotiated based on the lower sum.

For Option A, a farmer finance package will be negotiated with the technology supplier that takes into account the Government financial support (e.g., a reduction in monthly instalments and tenure). The farmer pays a reduced deposit (50%) to the technology supplier and the technology supplier claims the 50% cost of the pump/irrigation system from the Government (on a quarterly basis) on receipt of the deposit and with proof of pump installation. Local SHGs could provide proof of installation of the correct pump.

The impact of this financial support would be assessed during the demonstration phase and it would be reduced subsequently during Phase 2 of the project. As the benefits of water efficient irrigation are proven, farmers will find it easier to take out a loan, removing the need for the Government support.

IV. Cost-Benefit Analysis

The following table presents a cost-benefit analysis from a farmer perspective:

All in KES		0.25 acre with SWP		0.25 acre no pumping		1 acre with SWP		1 acre no pumping	
Description		SWP, drip irrigation and tank (0.25 acre)		Drip irrigation and tank (0.25 acre)		SWP, drip irrigation and tank (1 acre)		Drip irrigation and tank (1 acre)	
Financial support		Without	With	Without	With	Without	With	Without	With
Payment method		PAYGO / MFI		MFI		Cash or MFI		MFI	
Sweet potatoes	Inputs & equipment (deposit, 4 months instalments)	157,585	62,622	105,268	52,957	474,008	180,869	329,869	108,742
	Sales of sweet potato 1st harvest	450,000		450,000		1,800,000		1,800,000	
	1st season profit (KES)	292,415	387,378	344,732	397,043	1,325,992	1,619,131	1,470,131	1,691,258
Break-even point		Month 5		Month 5		Month 5		Month 5	
Year 1 Profit – following 3-crop cycle (KES)		580,817	692,505	667,454	748,160	2,607,578	2,994,325	2,808,706	3,131,243
Annual Profit (after loan repayment)		After 2 years	After 1 year	After 18 months	After 18 months	After 3 years	After 2 years	After 2.5 years	After 2 years
		758,888		758,888		3,056,550		3,056,550	

Table 68: Cost-benefit analysis

c. Intervention Options

I. Target beneficiaries

All farms targeted have access to permanent water supplies. Solutions with groups only work if good cohesion, trust, management, and leadership are inculcated and maintained. The solutions will target three large groups of horticulture farmers, being:

- Group 1: Established individual farmers currently using fossil fuel pump or gravity-fed irrigation with furrows or sprinklers who are located close to a water source but experience water stress during the dry season. Irrigated plots are over 1 acre. The farmers will either: (1) share a collective in-take from the river; or (2) have an individual in-take.
- Group 2: Individual farmers having small plots – typically farming not more than a quarter of an acre – who are not currently irrigating but are close to a permanent water source.
- Group 3: Established potato and horticultural farmers already using communal mostly Government organised irrigation systems with furrow or sprinkler irrigation systems.

County Government will ensure a percentage of those engaged from each group are women farmers and people from marginalised groups as part of project inception and reviewed in each project phase.

II. Budget Commitment and Funding Sources

The total costs for the demonstration phase are exhibited in the following table. The key assumptions are:

- All farmers (150) receive financial support: 142 farmers a subsidy covering 50% of the solar water pump (SWP) and drip irrigation systems costs are and 8 demonstration plot farmers covering 70% of the solar pump and drip irrigation systems.
- Targeted farms: 1) 36 farmers select the 0.25 acre system with pump and drip, 2) 35 farmers the 0.25 acre with drip only, 3) 35 farmers the 1 acre drip only system and 4) 36 farmers for the solar pump and drip system for the 1 acre plots.
- Financing of the balance is provided by the technology supplier or MFI.
- 50% input subsidy provided for all farmers for the first season.
- The cost of installing water meters is met by the Water department or other public funding.
- Farmers pay for their own training but must commit to 12 months as part of the demonstration project.
- An external provider is identified to train the extension officers who then deliver the training.
- The County Government will build best practice training handbooks on aspects such water management, irrigation, GAP, and farmer business skills.
- Development of the training is funded by the Government (or other donors).

Solution Component	Description	Unit cost (KES)	No. of farmers/ acres	Total cost (KES)	Amount and Source of finance (KES)			
					Farmers	Government/ Other public funding	SACCOs /MFIs	Suppliers
Water management	Establishing water committees			517,500		517,500		
	Installation of meters (KES per meter)	17,250	142	2,449,500		2,449,500		
	Training and enforcement (KES per farmer)	11,500	142	1,633,000		1,633,000		
Inputs	Sensitisation and introductions to agro-dealers			345,000		345,000		
	Farmer inputs (1st sweet potato season) KES per acre	83,300	89	7,392,875	3,696,438	3,696,438		
Irrigation	Cost of filter (those with pump only)	3,000	71	213,000	213,000			
	Deposit for irrigation system	61,231	142	8,694,808	8,694,808			
	Financing for irrigation equipment (supplier)	60,001	36	2,130,044				2,130,044
	Financing for irrigation equipment (MFI)	113,415	142	16,104,947			16,104,947	
	End-user subsidy for irrigation equipment (50%)	178,771	142	25,385,549		25,385,549		
	Farm ponds	100,000	45	4,500,000	2,250,000	2,250,000		
Training	Training the extension officers/other	920,000	1	920,000		920,000		
	Farmer Group Training by Extension officers/suppliers	12,000	142	1,704,000	1,704,000			
	Demo farms (1 acre system)	772,780	3	2,318,340	695,502	1,622,838		
	Demo farm (0.25 acre system)	174,761	5	873,807	262,142	611,665		
Implementation and M&E	Project management			4,000,000		4,000,000		
	M&E			2,300,000		2,300,000		
Total (KES)				81,482,371	17,515,890	45,731,490	16,104,947	2,130,044
Total (USD)	USD exchange	115		708,542	152,312	397,665	140,043	18,522
Total investment per farmer (KES)				573,820	123,351	322,053	113,415	15,000
Total investment per farmer (USD)				4,990	1,073	2,800	986	130

Table 69: Estimated costs for the demonstration phase

The following table provides an overview of the likely costs of supporting 3,000 farmers to take up water efficient irrigation in Phase 2. The key assumptions are:

- Deploy a mix of the four irrigation solutions offered during the demonstration, although this will be reviewed based on the uptake in the demonstration phase.
- 20% of the irrigation systems is covered by an end-user subsidy for the first 1,500 farmers.
- Targeted farms: 2,000 0.25-acre plots and 1,000 1-acre plots.
- The next 1,500 farmers do not receive a subsidy but purchase the systems on finance.
- Financing of the balance is provided by the technology supplier or MFI.
- Farmers pay for their own training.
- An external provider is identified to train the extension officers who then deliver the training.
- Development of the training is funded by the Government.
- The first season input subsidy provided in the demonstration phase is discontinued in the Scale-up phase.
- Marginalised farmers will be supported to form or join informal savings groups such as SHGs, through training for marginalised farmers in the benefits and establishment of saving groups and by working with SHG to extend their membership.

- Support will be provided to farmers to link to existing financial institutions, such as Equity Bank, or platforms such as the Digifarm platform (from Safaricom (www.safaricom.co.ke) and MercyCorps Kenya (www.mercycorpsagrifin.org) which offers micro loans for inputs, crop insurance, and marketing platforms to registered small holder farmers. Care must be taken to support women farmers and other marginalised group of farmers.

Component	Description	Unit cost	No. of farmers /acres	Total cost (KES)	Amount and Source of finance (KES)			
					Farmers	Government/ Other public funding	SACCOs /MFIs	Suppliers
Water management	Establishing water committees			1,035,000		1,035,000		
	Installation of meters	17,250	3,000	51,750,000		51,750,000		
	Training and enforcement			11,500,000		11,500,000		
	Farmers payment/Revenue from water metering (1 yr)	71,531	1,500	64,378,125	64,378,125	(64,378,125)		
Inputs	Sensitisation and introductions to reliable agro-dealers			690,000		690,000		
	Farmer inputs (1st sweet pot season)	83,300	1,500	124,950,000	124,950,000			
Irrigation	Cost of filter	3,000	3,000	9,000,000	9,000,000			
	Deposit for irrigation without subsidy	99,612	1,500	149,417,410	149,417,410			
	Deposit for irrigation with subsidy (20%)	74,980	1,500	112,470,456	112,470,456			
	End-user subsidy for irrigation equipment (20%)	54,475	1,500	81,712,258		81,712,258		
	Financing for irrigation equipment (supplier - 80%)	118,829	500	59,414,472				59,414,472
	Financing for irrigation equipment (MFI - 80%)	267,435	1,000	267,434,560			267,434,560	
	Financing for irrigation equipment (supplier - 100%)	120,003	500	60,001,250				60,001,250
	Financing for irrigation equipment (MFI - 100% of balance)	234,005	1,000	234,005,240			234,005,240	
Training	Farm ponds	100,000	900	90,000,000	45,000,000	45,000,000		
	Training the extension officers (govt and out-source)	13,800,000	1	13,800,000		13,800,000		
	Farmers training	12,000	3,000	36,000,000	36,000,000			
Access to finance	Improving access to finance	3,500,000	1	3,500,000		3,500,000		
Implementation and M&E	Project management			10,000,000		10,000,000		
	M&E			6,000,000		6,000,000		
Total investment (KES)				1,387,058,771	541,215,991	160,609,133	501,439,800	119,415,722
Total investment (USD)		115		12,061,381	4,706,226	1,396,601	4,360,346	1,038,398
Total investment per farmer (KES)				462,353	180,405	53,536	167,147	39,805
Total investment per farmer (USD)				4,020	1,569	466	1,453	346

Table 70: Estimated costs for Phase 2 – Scale-up

III. Expected Outputs in Each Phase

The following outputs are envisaged:

Solution component	Demonstration phase	Scale-up phase
Water management	5-8 new water associations. – 150 water meters installed. 150 farmers trained on water management & irrigation –	80-100 new water associations 3,000 water meters installed 3,000 farmers trained

Financing for solar pumping and water efficient irrigation equipment	• 150 new irrigation systems (SWP, drip and tank) deployed. 50% with SWP (40% are women) • 10 farmers swap fossil fuel pumping to solar • 150 loans taken out by smallholder farmers on SWP and/or drip systems • 45 farm ponds (100,000 litres each) in strategic locations	• 3,000 new irrigation systems deployed. • MFIs provide finance to self-help groups (SHP) which allow 3,000 farmers to purchase irrigation systems • Suppliers provide finance (PAYGO) to 1,000 farmers to purchase solar pumps (0.25 acre) • 900 farm ponds
Better access to quality farm inputs	• 150 farmers receive sensitisation on the use of certified seeds and other high quality inputs. • 150 farmers buy approved certified seeds and other high-quality inputs • 150 farmers receive subsidised inputs for the first season	• 3,000 farmers linked to reliable agro-dealers and buy approved certified seeds and other high-quality inputs
GAP training and marketing support	• 150 farmers trained on GAP, IPM, irrigation, production, business, value addition and marketing • 8 demonstration farms demonstrating SWP and drip irrigation • 6-10 agricultural extension officers receive training on GAP, irrigation, production and marketing • 2/3 pump and drip irrigation suppliers target rural areas of Meru County	• 3,000 farmers trained on GAP, IPM, irrigation, production, business, value addition and marketing (40% women)

Table 71: Expected outputs agriculture solutions

Gender and social inclusion will be integrated through the implementation planning and deployment. County Government will define and ensure a percentage of women and marginalised groups during each phase. Data will be disaggregated by gender and other disadvantaged group categories. Where possible for farmers organised around water usage areas, existing structures like women's farmers groups and SHP groups for finance will be used and expanded on. Training materials will also be tailored, and close monitoring will be undertaken to ensure finance products and other barriers such as market access are adjusted to be appropriate for these groups.

The delivery of these outputs will result in the following demonstration project outcomes:

- Improved climate resilience as farmers move away from inefficient water intensive irrigation and rain fed farming to more efficient irrigation, allowing the same water supply to produce higher yields

- Livelihood benefits - Increased production and incomes for 3,150 horticulture farmers and smallholders (13,545 people²⁰) from access to water efficient irrigation solutions.
- Reduced water usage – Improved sustainable water management and reduced water usage for same outputs.
- Emissions reduction – There is potential for carbon emission savings of about 250 kgCO₂e/year during the demonstration phase and 5 tonnesCO₂e/year from the scale-up phase if SWP drip irrigation replaces petrol pumping with furrow irrigation.
- Benefits for women and disadvantaged groups – from livelihood benefits from irrigation as well as reduced hardship hand watering, and increased quality and quantity of crop production, increase knowledge and awareness and better prices for inputs and outputs.

IV. Timeline

It is proposed to implement the proposal in three phases as it will allow the intervention model to be tested during a demonstration phase before scaling it up to more farmers, adding additional support in access to credit and aggregation and new markets as it moves towards a fully commercial model. The phases will be preceded by a six-month inception period dedicated to pre-project implementation detailed planning.

- Phase 1 Demonstration will be a testing and learning phase for the model, supporting 150 Meru midland farmers and will demonstrate how addressing the above issues will result in improved resilience, farmer production yields and profit as well as building the confidence of MFIs and technology suppliers in servicing this market.
- Phase 2 Scale-Up will target 3,000 farmers, whilst reducing the percentage of public finance. Phase 2 will multiply up the demonstration model to the whole County in two to three years. This will be undertaken in two stages. The first stage will expand to 1,500 horticulture farmers (equivalent to 4.4% of sweet potato farmers or 11% of existing tomato farmers) before scaling up further. By the end of the second stage, Phase 2 aims to support more than 3,000 farmers and achieve more than 600 hectares under irrigated horticulture with a total annual production of 97,500 tonnes of sweet potato, tomato, and kale by the end of the three-year period.
- Phase 3 Aggregation and new markets will build on Phase 2 and provide additional support services to all farmers in aggregation, processing, and market access with the aim that with benefits proven and commercial finance in place, the model is fully commercial. 6,000 farmers are expected to benefit by the end of Phase 3.

²⁰ Based on average household size of 4.3.

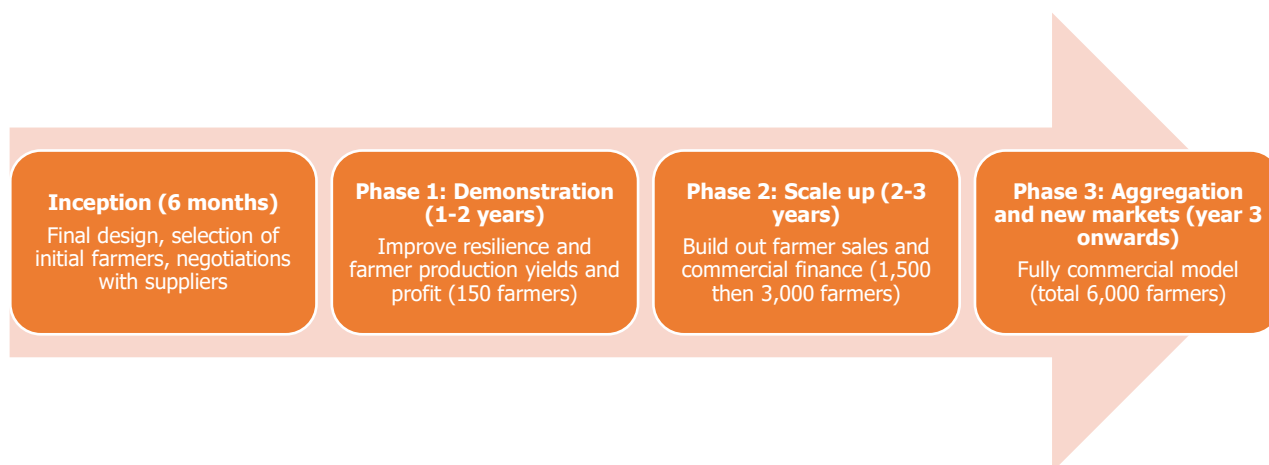


Figure 40: Agriculture solutions timeline

V. Stakeholders And Roles

Stakeholder	Intervention	Role
Steering Committee/Project Governance	All	- To be formed at start of project and will include participants from Agriculture and Water departments. - Decision making body for the project. - Finalise distribution and financing models. - Agree on partnerships
Meru Directorates of Agriculture and Water	General/ Management / M&E	- Overall project implementation and management - Chair and provide secretary for Steering Group - Sensitisation meeting for farmers and stakeholders - Conduct situation analysis on irrigation farming and select potential participating farmer groups and farmers - Profile farmers by farm size, crops grown - Monitoring and evaluation
Directorate of Agriculture	Training	- Mobilise service providers²¹, develop training curricula and harmonise training delivery - Develop training materials and dissemination material for extension officers and farmers - Facilitate refresher courses for extension officers - Manage training delivery - Select farmers as demo farmers - Support demonstration farmers / establishment of demonstration farms

²¹ GAP training can be offered by several actors already in the agri space including Government projects (NAGRIPG, ASDSP) and agricultural officers, NGOs including CARITAS, MESPT, agro dealers and equipment suppliers – private or public delivery.

	Access to quality farm inputs	• Profile agro-dealers / one stop shop and negotiate bulk pricing. • Agree input packages with agro-dealers • Sensitise farmers on quality inputs and provide introductions to agro-dealers • Sensitise farmers on viable models for access to inputs and providing support to establish table banking and seed pooling. • Provide 50% subsidy on inputs for the first season for all demonstration farmers
Meru Directorate of Water	Water management	• Identify water groups/sub-committees to work with • Support establishment of/strengthening of water groups/sub-committees • Provide training on water management • Install water meters and develop tariffs for water users • Read meters, collect and enforce water payments • Develop water management strategy handbook, including community sensitisation process
	Water efficient irrigation and financing	• Profile equipment providers and negotiate bulk pricing and distribution models, after sales services as well as warranty management systems • Profile potential financiers and products and negotiate management of financing and pricing • Sensitise farmers on offers and terms, their options and roles • Link providers to farmers • Provide end-user subsidies to enable farmers access to irrigation equipment via Caritas Meru/ (Option A) or SHGs (Option B). • Purchase farm pond material and sell at half price (as 50% subsidy) to farmers where there are water constraints. • Get feedback from suppliers on loan repayments and defaults • Oversee delivery and monitor implementation
Directorate of Gender and Social Inclusion	Gender and socially inclusive approaches	• Support inclusion and selection of women and other disadvantaged farmers to be involved • Work with trainers to develop gender and socially inclusive specific content after carrying out a training needs analysis • Work with the project team to ensure the finance models and products are suitable to deployment location specific needs • Overall monitoring and GESI technical support
Irrigation equipment suppliers	Irrigation	• Develop farmer profiles / review profiles of Government • Develop equipment profiles • Develop distribution models • Develop financing models (Option A PAYGO or Option B MFI)

		• Marketing campaign to sensitise farmers of its products • Option A – vet the prospective customer (screening) offer finance to farmers. It approves the consumer financing • Notify trusted third party on receipt of deposit to trigger equipment and input subsidy • Make a claim for the subsidy finance to the Government in pre-determined cycles, eg. quarterly • Option B – Make referrals to the MFI for consumer financing and articulate clearly the ideal technology for the farmer • Provide training on equipment use • Manage repayments and defaults • Provide equipment and 2 years after-sales service and warranty (depending on each package)
Certified agro-dealers / one-stop-shops	Inputs	• Negotiate with Government/SHGs on bulk discounts available on inputs
MFIs	Irrigation	• Option B – Develop SHGs and farmer profiles • Option A - For financing for tank only – develop farmer profiles • Develop financing packages in consultation with technology providers for pumps, drip irrigation and tanks • Vet the prospective customer (SHG/farmer) including credit screening. It approves the consumer financing portion via an internal credit committee process
	Inputs	• Where farmers negotiate individually or in groups, MFI can offer financing packages on inputs. • Provision of advice on structure and initial training / awareness raising for table banking/financing.
SHGs	Inputs	• Support farmers in development of seed pooling and table banking • Manage e-vouchers for inputs
	Irrigation	• Option B – Work with/as MFI in developing financing packages for members. • Vet the prospective customer (farmer) including credit screening. It approves the consumer financing portion • Support farmers in purchasing pumps – manage deposits and instalment payments
	Training	• SHGs collect money from farmers to cover the cost of their training • SHGs pay training providers and extension worker stipends
Training providers	Training	• In coordination with Government, develop training curricula and harmonise training delivery

		• In coordination with Government, develop training materials and dissemination material for extension officers and farmers • Deliver refresher courses for extension officers • Deliver training
NGOs	Inputs	• Trusted 3rd party issuing e-vouchers for subsidy inputs
	Irrigation	• Trusted 3rd party holding subsidy funds for the irrigation equipment, dispersing funds to technology providers against proof of purchase of pumps
	Training	• Potential provider of training to trainers and to farmers

Figure 41: Stakeholders and roles agriculture solutions

VI. Risks And Challenges

There are a number of challenges and risks to the investment proposal. These include those that are intrinsic to solar irrigation technology and those related to project implementation. Some of the key risks, and their mitigation measures, are included in the following table. In addition, by taking a phased approach it will be possible to learn from the implementation experience during the demonstration to inform the final design of the subsequent phases, thereby reducing risk further.

Risk / Challenge	Mitigation measure
Lack of clarity on project management and responsibilities results in inefficient project implementation	Clear project management and delineation of responsibilities between the Meru Water Department and Agriculture Department will be agreed during the inception phase
The new irrigation systems do not increase productivity and improve livelihoods if the other factors are not also addressed. Without GAP or inputs and without buyers for the produce, pumps will not be maintained well and will break down or be abandoned	Support is being provided to ensure quality inputs, GAP training and improved market literacy
Lack of technical knowledge and skills in irrigation water management, installation and maintenance of pumps can result in break-down or under-performance of the pumps	After-sales support and training are included in the proposal
SWP irrigation can lead to over-extraction of groundwater at zero marginal cost, reducing water tables	Farmer training in irrigation water management is included to minimise this risk
Drip irrigation systems are easy to damage	Farmer training in irrigation water management is included to minimise this risk
Theft of installed system may occur	Mobile units are included for small plots and security fencing for permanent infrastructure
Meru's sandy water leads to silt blocking the pumps and they stop working and leads to clogging of drip irrigation	Filters will be included within the design and a budget for their maintenance and/or replacement has been included. The drip systems include a filter.
Spare parts are not readily available to the smallholder farmers	The technology suppliers will provide 3-year warranties and spare parts for the pumps. Beyond the 3 years it is

	expected that the market will be large enough that the distributors will be based in Meru.
A lack of awareness of irrigation benefits, the long-term benefits of solar pumps, agronomic education and financial literacy is a key implementation challenges to ensure uptake	The proposal includes for Sensitisation for the farmers, training and demonstration farms.
A short-term subsidy can create market distortion (e.g., set non-sustainably low prices in the market; reduce incentives to control cost base;)	The subsidy will be applied for the deposit and over a loan repayment period which can be less distortive. The subsidy will also be phased.
Fraudulent use of subsidy, or incorrect application of subsidy (eg multiple applications for the same pump)	Local SHGs will be involved in the monitoring of the end-user subsidy and the installation of the pumps.
There can also be a lack of awareness on the distributors side about the subsidy and the appraisal processes	Time for discussions, negotiations and agreement on the basis for subsidies and financing packages with the technology suppliers and MFIs is part of the inception phase of the demonstration.
If quality standards are not upheld as part of the subsidy, and there is a proliferation of varying standards, consumer perceptions could be affected	Pump suppliers will be pre-selected to be part of the project with certified products, warranties and after-sales support. Information will be provided to farmers to allow them to compare the different options.
Existing land tenure systems may present a challenge, particularly in terms of long-term decisions and investment for the smallholder²²	Mobile units are proposed targeted at smallholder farmers.
Lack of distribution and in-County logistics support	The partner technology suppliers will provide distribution and after sales support in Meru.
Lack of exit strategy for subsidies results in uncertainty and market distortion	It is expected that the subsidy will be phased out over Phase 2 as the benefits of the irrigation system are demonstrated and the perceived risk associated with a loan is reduced.
Drop of horticultural market prices affects the return on investment	The return on investment for the irrigation package is very good. Prices will need to reduce significant to affect the overall profitability of the irrigated farmers.
All suppliers offer products only on cash basis	Pump suppliers will be pre-selected to be part of the project and discussions held regarding financing packages.
Permits/licences to use water resource are dependent on the County and country regulations	The demonstration phase will work with existing farmers in established locations with reliable water supply. The County Government of Meru can play a role in verification of water resource use during scale-up
Farmers not wanting to have water meters installed in their farms / not wanting to pay water fees	Building farmer buy-in is an important part of sensitisation and formation of the water associations, which will include full transparency of costs and how they will be paid for. County Government is putting a lot of effort in to the sensitisation and training approach.
Farmers not wanting to buy the irrigation systems after the Scale-Up Phase or when subsidies are discontinued	It is important to frame any use of subsidy in a way that does not distort the market for drip irrigation systems that is being built. For example, an 'introductory offer' by suppliers. This messaging needs to be part of sensitisation across County Government. It is also anticipated demand will be there for systems as more farmers see others benefiting (during demo and scale-up). Finally, the overall

²² 40% of farmers in the survey did not own the land they farmed.

	cost of the non-subsidised system is manageable in the farmer business model i.e. they will make good profit. This again needs to be communicated to farmers as part of sensitisation
Lack of certainty on whether there is enough demand for the targeted crops and whether farmers will be able to sell all their produce to markets	We lack data on the volume of crops local markets can absorb. However, it is likely that the number of farmers in phase 1 and 2 will not significantly distort local markets. The mitigation for larger numbers of farmers relies on establishing market potential outside of Meru. Individual farmer skills will be built on marketing during the training. Aggregation in phase 3 is the County intervention that can support this in a more organised way for larger scale.
Women farmers and marginalised farmers constraints – inability to attend training sessions etc	Critical to closely work with trainers to schedule sessions around women's availability and make arrangements to help them overcome constraints at home to able to attend sessions. Also, liase with suppliers to take their knowledge awareness sessions close to the stakeholders

Table 72: Risks and mitigation measures

VII. Implementation and Coordination, Monitoring and Evaluation

a. Implementation And Coordination

The Process To Implement The Initial Phase has five steps, as shown in the following Figure. This includes the final project design and implementation plan for the Scale-Up Phase(s):



Figure 42: Five steps of the initial Phase implementation

- Summary of approaches and steps to promote GESI in lighting solutions

Within the context of the agriculture solutions proposed in the CEP, the Agriculture Docket and Gender Directorate will work collaboratively and closely to mainstreaming GESI as the solution is implemented. This includes:

Building a GESI-disaggregated evidence base

- Collect data on usage, purchase, access, affordability among other dynamics to constantly get right numbers and performance among women, men and marginalised groups both in rural, urban and per-urban settings.

Awareness raising and Sensitisation.

- Provide training on GESI approaches and strategies to Government officers involved in project implementation – including a GESI expert as part of the team
- Sensitise all key stakeholders involved in the agriculture sector solution (municipal agencies, electricity utility, private sector, etc.) and raise their awareness of GESI and from the project's onset.

Active targeting and support

- Actively targeting women farmers and other disadvantaged groups as the programme is developed and rolled out – ensuring a balanced mix
- Further differentiating differing GESI needs and ability to engage in the proposed solution during the inception and demonstration phases – for example: (i) barriers to market access such as ability to travel to market – identifying associated strategies and support mechanisms (ii) loan repayment challenges (iii) specific training needs. Tailor the solution to these local groups.
- Integration of GESI in the project budget as a specific component or as part of the existing budget items from the start – including budget for GESI disaggregated monitoring and evaluation (as noted above).

Climate Resilience Building Measures

Solution	Risk	Climate mainstreaming approaches
Establish/ strengthen community water management groups and capacity building of community members on water resource conservation	Small-farm holders, including women, and other marginalised groups are not members or represented in the water management groups.	Assess climate change awareness and action among implementing staff level (County) using Knowledge, Attitudes, Practices (KAP) surveys, collect training needs. Assess capacity of implementing teams to offer climate change Sensitisation and water management strategies. Assess climate change awareness and action at community level using KAPs surveys, collect training needs. Develop appropriate capacity strengthening training programmes and approaches for both implementing teams and communities/ small holder farmers. Mobilise farmers to form new water management groups or strengthen existing ones, based on an agreed criteria with communities, e.g., proximity to water source or access point. Use community assets survey to identify suitable candidates for the water management groups and committees, and ensure a diverse representation of women, PWDs and people from other marginalised groups. Develop training curriculum and approaches for capacity strengthening for the community members and management groups. Leverage cross sectoral collaboration by tapping into the training curriculum/ joint training for water management committees, and community Sensitisation in the Water Project.
Installation of water meters	Farmers are not able to afford the cost of water.	Conduct vulnerability assessment on households to identify which are most vulnerable to water stress and water pricing due to social factors including age, gender, economic status, and proximity to the water source. Access to repair and maintenance function is critical for the sustained use of metered water. Leverage water programmes to access trained technicians.

Support for the purchase of irrigation equipment.	Lack of knowledge of solar and drip irrigation systems is acknowledged.	Conduct a KAPs survey to assess small-farm holders perceptions, knowledge, adoption, and use of solar and drip technologies, identify barriers to access and adoptions. Conduct a survey to profile the financial service providers offering green finance for irrigation equipment, the terms and conditions offered and assess suitability for small farmers. Working with the financial service providers refine/ repackage the products and delivery channels to align to small farmers business cycles e.g., seasonality of incomes. Conduct vulnerability assessment on households to identify which are most vulnerable to water stress and water pricing due to social factors including age, gender, and economic status, and proximity to the water source. The proposed end-user subsidies would target these households. Develop a quality standards policy that every product must meet to avoid a proliferation of low-quality technologies. Develop warranty management systems to ensure that suppliers provide spare parts and settle warranty claims appropriately in a timely manner. Train local technicians in solar and drip irrigation technologies repair and maintenance- leverage the water solution on training technicians. The technology providers can collaborate in training local technicians. Train farmers in the operation and routine maintenance of the pumps, and drip systems. E.g., sandy water leads to blocking the pumps/drip system and farmers should be able to take perform basic maintenance an only engage technicians for more complex repair and maintenance
Support for local water storage (farm ponds).	Farmers may not the adopt farm ponds and/or purchase dam liners	Conduct a KAPs survey to assess SHF perceptions, knowledge, adoption, and use of farm ponds, identify barriers to access and adoption. Conduct vulnerability assessment on households to identify which are most vulnerable to water stress and pricing due to social factors including age, gender, and economic status, and proximity to the provider. The proposed end-user grants would target these households. Conduct a survey to profile the financial service providers offering green finance for irrigation equipment, the terms and conditions offered and assess suitability for small-farm holder access. Working with the financial service providers refine/ repackage the products and delivery channels to align to SHF business cycles e.g., seasonality of incomes. To avoid a proliferation of low-quality technologies, develop a quality standards policy that every product must meet. Develop warranty management systems to ensure that warranty claims are settled appropriately in a timely manner. Train local technicians in dam construction and dam liner installation, repair, and maintenance- leverage the water solution on training technicians. The technology providers can collaborate in training local technicians.
Improving access to quality/certified inputs	Lack/limited awareness and perception to using certifies inputs including seeds, fertilisers,	Conduct a KAPs survey to assess small-farm holder perceptions, knowledge, adoption, and use of certified seeds and other chemical inputs identify barriers to access and adoption. Conduct vulnerability assessment on households to identify which are most vulnerable to access due to social factors including age, gender, and economic status, and proximity to providers. The proposed end-user subsidies would target these households to access quality inputs, soil testing services, and training.

		Develop a Sensitisation curriculum that incorporates climate friendly inputs as well including use of perennial seeds, bio fertilisers and bio pesticides. This training should be offered in a practical, ‘see-do’ experiential learning set up on a demonstration farm. Farmers should be encouraged to set up mini demo farms in their localities to disseminate learning. Assess capacity of implementing teams to train farmers in GAP and integrated pest management. Refresher training for extension officers may be required. Establish partnerships with soil testing providers and provide subsidized soil testing for vulnerable households.
Improving access to quality/certified inputs	Limited or lack of awareness and perception to green agroecological practices using certified inputs including seeds, fertilisers,	Conduct a KAPs survey to assess small-farm holder perceptions, knowledge, adoption, and use of green agroecological practices, identify barriers to access and adoption. - Indigenous, drought tolerant, perennial, and orphan crops seeds - Bio fertilisers- green manure/ vermi-composting, bio slurry/ tea, nitrogen fixing plants, manure management to biogas for lighting, heating, powering farm machinery. - Bio pesticides- aloe vera, chilli, neem, ash, maize cob ash/ juice, etc. - Use of contour terracing, Zai pits, cover cropping to reduce soil erosion and prevent and moisture loss, weed infestation. - Use of Silvopasture system - Mulching, green manure - Composting, vermiculture - Push and pull disease management and control - Alley cropping + ecological and economic benefits. - Indigenous medicines and pest repellents
	Limited knowledge of agroecology practices among farmers and agriculture extension officers.	Assess capacity needs among extension staff and develop curriculum and train Extension staff. Train farmers in a learn- do- check approach, utilizing Trainer of trainers approaches and demonstration farms
Improving farmers market literacy and access to markets	Inadequate knowledge and skills in post-harvest loss (PHL) management, including handling,	Develop a curriculum and provide training in PHL management, preservation techniques e.g., locally constructed potato and vegetable charcoal coolers, drying, canning etc. This ensures that more money remains with the farmer enabling them to make farm improvements that enable adaptation.

	packing, transport, storage and preservation, and value addition to produce, to reduce perishability and improve sale prices	
Improving access to finance and credit	Lack of suitable green finance for small-farm holders	Sensitisation of climate change risk and these solutions to financial service providers and their role is necessary to collaborate to remove and reduce access to finance barriers.
Link agri solution to water, health, and livestock solutions	Lack of cross sectoral programming with water, livestock, and health	Assess vulnerability of households to water stress, heat stress on agri productivity, and effects/ outcomes in other spheres incl. health, and livestock. Collect baseline data on health, nutrition/ food security, agricultural productivity, lost income, access to education, increased gender inequalities, abuse, and conflict as a result of poor agri production and productivity, PHL, access to markets and pricing. Leverage cross sectoral resources to conduct studies, develop curriculum and train communities, technicians and suppliers engagements, procurement, and warranty management systems.
All solutions	Lack of climate risk indicators	Develop strategies to measure climate gains, impacts, assess change in vulnerability and level of maladaptation of strategies and impacts if any

Table 73: Climate mainstreaming approaches

b. Monitoring and Evaluation

INEP Energy Access Outcome

Citizens have access to minimum levels of electricity access to allow for empowerment for people in underserved communities with minimum energy targets necessary to improve education, accelerate the transfer of knowledge, facilitate communication, and promote entrepreneurship. The planned on-grid connectivity rate together with the off-grid alternatives will enable achievement of 100% access to electricity by the year 2026.

CEP Outcome

Energy access for improved livelihoods

Crop Farming

Impact: improved livelihoods of small-scale potato and horticulture farmers in the midland areas of Meru who are beginning to experience water scarcity by supporting them to become more resilient to climate change related water stresses and increasing agricultural productivity and incomes through improved water management, GAP training, and access to quality farm inputs			
	Outcome Area	Outcomes	Indicators
1.	Improved climate resilience	farmers move away from inefficient water intensive irrigation and rain fed farming to more efficient irrigation, with production of higher yields for the same water supply.	600 hectares of land under irrigation
2.	Economic benefits	increased production and incomes from access to efficient irrigation solutions. 3,150 horticulture farmers and total 13,545 people will benefit, with potential to scale with integrated, phased transition to more commercial finance	% increase in crop farming productivity by MT
3.	Sustainability	Revenue generation from water tariffing enhances sustainability of project	% of framers paying for metered water
4.	Gender and social empowerment	benefits for women from reduced labour on hand watering and access to economic opportunities	No. of women and disadvantaged persons reporting reduced labor demands from farming after transitioning to irrigation
5.	Environmental conservation	reduced water usage due to more sustainable water management for same outputs.	% reduction in water misuse
		emissions reduction. potential carbon emission savings of approximately 250 kgco2e/year during the demonstration phase and 5 tonnesco2e/year in scale-up phase if solar-powered drip irrigation replaces petrol pumping with furrow irrigation.	% reduction in GhG
6.	Increased water conservation	Farmers access water ponds for water harvesting	No. of water ponds supported
		Volume of water harvested in cubic meters	CM3 by subCounty
		Reduction in water use for irrigation (baseline data on furrow irrigation	No. of framers using furrow irrigation
		Conduct water access and use audits conducted	No. of audits conducted
7.	Stakeholder engagement	Stake holders buy in as farmers accept the use of water meters and pay for services	
8.	Productive use of energy	New households engaging in income generating activities because of transitioning to clean energy use	No. of HH reporting new income lines
		% increase in household income	

Table 74: Energy Access Outcome

Output Indicators

Outputs result from project activities and utilisation of resources including human capital, labour, funds, technology, equipment etc.

Activity		Output	Indicator
1.	Capacity building of community members on water resource conservation and management of communal resources including water metering	Training material e.g., best practice training handbooks on water management, irrigation developed.	No. of training material developed
		Awareness training events conducted per target sub County e.g., roadshows, community forums	No. of training events conducted
		Farmers trained, disaggregated by gender and age	No. of farmers trained disaggregated by farm size, gender, PWDs, and age
		Groups e.g., farmers groups mobilised and reached	No. of farmers groups reached out disaggregating composition by gender, PWDs and age.
2.	Installation of water metering	Water meters installed on all irrigation in-takes for all the members of the water committees.	No. of meters installed per target group
3.	Water resource conservation strengthened	Community water management groups established/strengthened per target sub County	No. of water management groups established disaggregating data of members by gender, PWDs, and age. No. of water management groups strengthened disaggregating data of members by gender, PWDs, and age.
		Active water management groups	No. of active water management groups
		Stakeholders buy in- farmers- accept to uptake and pay for metered water	No. of farmers paying water fees
4.	Increase capacity of farmers in productivity improvement	Training material e.g., best practice training handbooks on water management, irrigation, GAP, and farmer business skills developed	No. of training materials produced.
		GAP Training on integrated pest management, GAP farming techniques, crop cycle design, irrigation, and water management to support the uptake of solar-powered irrigation and to increase crop yields and improve soil fertility	Number of farmers trained in GAP. No. of farmers practicing GAP

		Establish demonstration farms for farmer training	No. of demonstration farms established
5.	Support for the purchase of drip irrigation, solar water pumps and tanks	Partnerships with technology suppliers signed and active	No. of partnerships agreements signed.
		Farmers use drip irrigation	No. of farmers using drip irrigation, solar pumps and/or tanks by size of farm, gender, and age
		Farmers access finance for purchase of irrigation systems	No of farmers accessing finance disaggregated by farm size, gender, PWDs, and age
6.	Reduce reliance on rain fed agriculture	Farms use alternative water sources by type of water source	No. of farmers shifting from rain fed to other water sources disaggregated by farm size, gender, PWDs, and age.
7.	Water Harvesting	Farmers access finance for water harvesting and conservation technologies e.g., farm ponds	No. of farm ponds built
			Kshs finance mobilised
			No. of women and disadvantaged people accessing finance
			Kshs. Amount of finance accessed by women and disadvantaged people
8.	Improving access to quality/certified inputs	Partnerships with quality agro dealers for bulk purchase agreements	No. of active partnerships
		Farmers trained on the benefits of using certified seeds and fertilisers	Number of farmers trained by sub County disaggregated by farm size, gender and age
		Subsidised fertilizer purchased by farmers per year by type of input	No. of farmers trained accessing fertilizer disaggregated by farm size, gender, PWDs, and age
			MT inputs distributed by target region
		Subsidised certified seeds purchased by farmers per year by type of input	No. of trained farmers using certified seeds disaggregated by farm size, gender, PWDs, and age

			MT inputs distributed by target region
		Increase in crop productivity	% increase in yields per farmer using inputs disaggregated by farm size,, gender, and age
		Partnerships with irrigation suppliers	No. of active partnerships
9.	Improve farmers market literacy access to markets	Farmers trained in market literacy, market mapping, contracts, and negotiation skills	No. of curriculums developed
			No. of farmers trained by subCounty disaggregated by farm size, gender, PWDs, and age
		Formation of organized marketing groups (associations)	No. of active associations
		Promoting linkages to strategic market platforms.	Number of platforms linked to farmers
			No. of farmers engaging with market platforms
			Volume of produce sold on platforms by type of produce
		Farmers aggregate produce for sale	No. of farmers/ groups aggregating produce
			Volume of produce aggregated for sale by type
10.	Improving access to external finance and credit (disaggregated by technology, gender, age, and type of farmer)	Number of partnerships with financial service providers MFI, bank, SHGs	No. of active partnerships
		Products and services tailored to agricultural business cycles	No. of business models (products and/or services) tailored to small farmers farmers business cycles
		Farmers access appropriate and affordable credit	No. of farmers accessing finance disaggregated by purpose, farm size, gender, PWDs and age.
		Loans for water conservation technologies granted	No. of loans granted for water conservation technologies
		Volume of external loans granted for water conservation	Kshs of loans granted for water conservation technologies

		Volume of external loans for water conservation technology defaulted	Kshs of loans granted for water conservation technologies defaulted
		Growth in loans per annum	% of yearly growth in loan granted
11.	Improved access to internal finance and credit- Group loans	SHGs mobilised	No. of SHG mobilised
		SHGs members receiving internal loans for irrigation system purchase	No of members from SHGs receiving internal loans for irrigation systems purchase disaggregated by farm size, gender, PWDs and age.
		Volume of internal loans granted for water conservation technology by type of technology loans at group level	Kshs of internal loans granted to farmers for irrigation systems purchase disaggregated by farm size, gender, PWDs and age.
		Volume of loans defaulted	Ksh of internal loans defaulted
		Growth in loans per annum	% of growth in loans granted per annum
12.	Access to Government financial support for purchase of solar pumps and irrigation kits (disaggregated by technology, gender, age, and type of farmer)	Active farmers apply for Government financial support by type of farmer and purpose.	No. of farmers applying to financial support to purchase irrigation equipment disaggregated by purpose, farm size, gender, PWDs and age. No. of farmers receiving financial support to purchase irrigation equipment disaggregated by purpose, farm size, gender, PWDs and age.
		Volume of financial support granted by type of farmer and purpose of subsidy	Kshs of financial support granted to purchase irrigation equipment disaggregated by purpose, farm size, gender, PWDs and age.
		Farmers willing to pay for training by sub County	No. and Kshs paid
		Farmers participating in training by sub County	No of farmers participating in training workshops by sub-

			County, farm size gender, PWDs and age,
		Volume of funds disbursed by type	Kshs of financial support granted
		Number of active farmers after 12 months	No. of active farmers after 12 months
13.	Improved management, maintenance and servicing of installed drip, water ponds technologies (add rows for each technology deployed)	Technology not functioning as expected by type of technology	No. failures reported by type of technologies
		Warranty claims by type of technology and supplier	No. of farmers exercising warranties by type of technology and supplier.
		Warranty claims settled satisfactorily by type of technology and supplier	No. warranty claims settled satisfactorily by type of technology and supplier
		Value of warranty claims settled satisfactorily by type of technology and supplier	Kshs of warranty claims settled satisfactorily by type of technology and supplier
GESI Indicators			
14.	Building a GESI disaggregated evidence base	Collect data on usage, purchase, access, affordability among other dynamics to constantly get right numbers and performance among women, men, and marginalised groups both in rural, urban and per-urban settings.	Data base and analytics disaggregated by gender health, education, and income
15.	Awareness raising and Sensitisation. Provide training on GESI approaches and strategies to Government officers involved in project implementation – including a GESI expert as part of the team	- Assess KAP and capacity needs in GESI for implementers - Appoint GESI champions at subCounty and ward levels - Develop training curriculum - Train implementing staff	Number of women farmers and farmers from marginalised groups attending training and knowledge awareness sessions
			Value of financing advanced to women and farmers from marginalised groups
			Number of women farmers and people from marginalised groups accessing/purchasing right inputs etc
16.	Increased awareness on gendered programming	Map key stakeholders for awareness raising on GESI in agriculture.	No. of stakeholders identified

		Sensitise all key stakeholders involved in the agriculture sector solution (municipal agencies, electricity utility, private sector, etc.) and raise their awareness of GESI and from the project's onset.	No. of stakeholders trained
		Actively targeting women farmers and other disadvantaged groups as the programme is developed and rolled out – ensuring a balanced mix	No. of women and disadvantaged groups of farmers reached disaggregated by age, income levels, activity
		Conduct further differentiation of GESI needs and ability to engage in the proposed solution during the inception and demonstration phases – for example: (i) barriers to market access such as ability to travel to market – identifying associated strategies and support mechanisms (ii) loan repayment challenges (iii) specific training needs. Tailor the solution to these local groups.	In-depth data analysis and redesign of project solutions to serve highly vulnerable groups
		Integrating GESI in the project budget as a specific component or as part of the existing budget items from the start – including budget for GESI disaggregated monitoring and evaluation (as noted above). Allocate project budget for GESI activities	% of budget allocated for GESI programming

Table 75: Outputs and indicators

VIII. Conclusions

This investment proposal has identified a viable pathway for the County Government of Meru to improve the climate resilience and incomes for small-scale horticultural farmers in Meru. Working with commercial technology suppliers and financiers, as well as established local organisations such as locally trusted NGOs and SACCOs, the approach laid out in the proposal aims to build new and sustainable markets which use public finance to leverage commercial finance. The three detailed and costed phases are a roadmap of how to achieve this, with increasing benefits to farmer lives and livelihoods across the County through collective learning in the demonstration phase, followed by scale-up.

The following next steps should be undertaken to move forward from proposal stage to implementation:

- Government demonstrating leadership - County Government of Meru (Directorates of Agriculture and Water) as the lead in this process to adopt the roadmap outlined in this proposal into the new CIDP process starting in 2023. This, along with allocating budget in the 2023 ADP, will help to provide confidence with the other stakeholders needed to implement the 3-phase approach.
- Establish a steering committee – to build understanding and consensus and to continue to drive the initiative forward to implementation. This should include chief officer and director level from County Government departments of water & irrigation, agriculture, and energy, plus the director of County microfinance corporation and representative from County planning. Continuing discussions on the details in this investment proposal will be important to refine it further and get all relevant stakeholder commitment to move forward to implementation. Bi-lateral meetings between Government, NGOs, and private sector technology suppliers and financiers will also be important in this process. These should be onboarded in the steering group when relationships are established.
- Further map and explore funding support – the public finance aspects of this proposal could be supported by Meru County Government, and indeed in terms of attracting other finance Government commitment through budgetary allocation is important. Exploring other opportunities for public financing - through for example the carbon savings identified and other programmes that are supporting Meru such as the GoK Women, Youth & Innovation Funds - could be a way to scale more quickly. As important is to continue to map and explore the commercial finance components, including identifying which of the Option A/B PAYGO versus MFI financiers are most viable for these solutions in Meru.

b. Livestock Farming

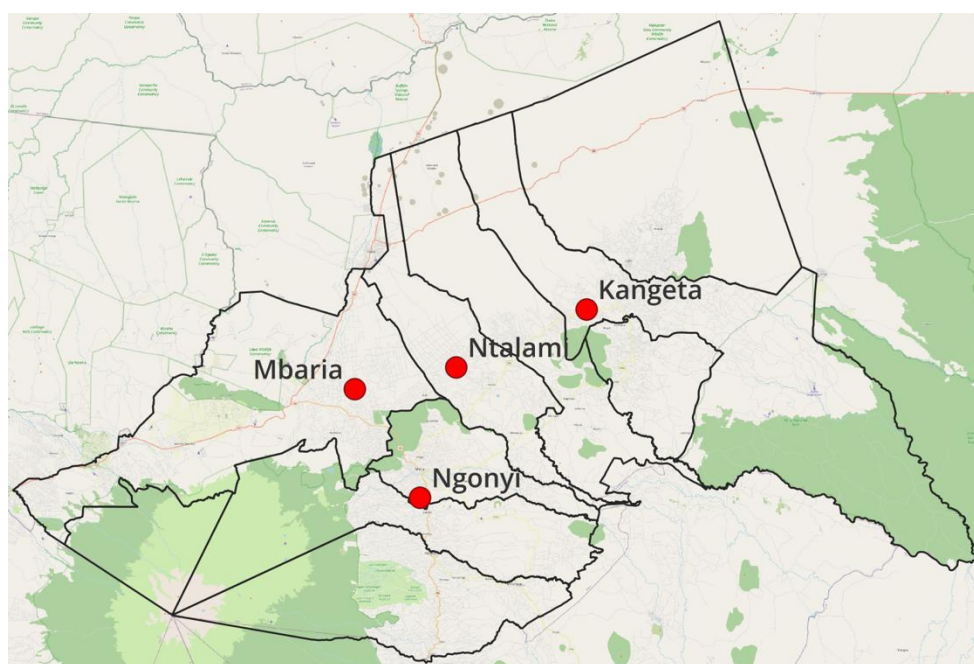
i. Livestock Sector Goals and Strategies to Promote Electricity Access

1. Goals For Electricity Access in The Poultry Farming Sector

I. Overview Of the Sector And Background

Meru County Vision 2040 highlights that 67% of households in Meru live in semi-arid areas and that 89% of these rely on indigenous chicken value chains for their income. Poultry farming is mostly small-scale subsistence farming for domestic consumption. The flagship Meru KOPIA Model Village (MV) Project was implemented from 2020-2022, with support from the South Korean Development Agency, in four locations in Meru County (Ntalami in Tigania West sub County, Kangeta in Igembe Central sub County, Ng'onyi in Imenti North sub County and Mbaria in Buuri sub-County). Research had identified that there was significant latent demand for indigenous chicken products in the County and nationally, particularly for white meat. One of KOPIA's aims was to improve and increase the production of indigenous chicken through aggregation for incubation, and its commercialisation through improving market linkages and access.

The baseline and needs assessment carried out for the EDM CEP process identified the initial need for improved income from poultry farming, and additional research showed that the existing MV farmer groups were largely non-functioning. There was an opportunity to build on the sunk capital (infrastructure investment and farmer training) in the KOPIA Project while addressing the gaps in the current business model. In addition, a further opportunity was identified to improve additional farmer income through individual production, linked to the MV hubs to take advantage of aggregation for production support and marketing.



1. Figure 43: Location of Poultry Model Villages in Meru County

After the needs assessment, additional primary and secondary research was carried out to understand the poultry value chain. This included extensive value chain analysis and market surveys on the price of poultry products and costs of inputs (feed, fertilized eggs, chicks, vaccinations and veterinary services) and access to financial services. Key informant interviews (KIIs) and workshops were carried out with KOPIA farmers, small-scale commercial poultry farming businesses, agro-dealers, veterinary services providers, egg suppliers, extension officers, and poultry buyers (including a business contracted by the County Government to run a white meat processing plant near Ng'onyi) and finance providers (MFIs and banks).

II. Challenges, Priorities and Needs

A range of challenges for poultry farming result in high losses to farmers. Indigenous chicken often has stunted growth and matures slowly. On average, Mugambi reports a mortality of 50%-70% associated with poor health management and predators (Mugambi, 2020). Vaccination efforts are hampered by reinfection due to lack of quarantine and isolation of sick birds. The cultural perception that chicken is for subsistence is another key challenge to the development of commercial scale poultry farming in Meru County (Mugambi, 2020). The EDM process also identified similar and further significant challenges to increasing farmer income along the value chain for both group and individual poultry farming. These are summarized in Table 78 below.

	Existing MV farmers	Individual farmers
Characteristics	4 X 100 active farmers organised in MVs (KOPIA Project). Ntalami, Kangeta, Ng'onyi & Mbaaria	Existing self-help groups or co-operatives with functioning organisation, linked to MV locations
Existing infrastructure & challenges	- Hatcheries, incubators (1,050 egg), infrared lights, lighting - Grid connection - Social halls with AV. 5.5m solar powered boreholes - High cost of electricity & frequent outages - Lack of maintenance & repair (non-functioning equipment)	Simple poultry houses, feeder troughs and drinkers and laying boxes.
Production challenges – inputs & training	- Some training in poultry management: and some inputs (DOCs); vaccination services - Weak adoption of best practices in poultry management (no production planning) - Average HH flock 17; 40% mortality rate - High cost of quality inputs (feed/stock/fertilised eggs/vaccinations etc) - Under-utilisation of incubation equipment - Weak group cohesion/management - Lack of technical skills (equipment operation, maintenance) including business planning	- Weak adoption of best practices in poultry management (no production planning) - High cost of quality inputs (feed/stock/vaccinations etc) - High mortality - Limited stock - Limited access to livestock extension officers - Lack of technical skills (equipment operation, maintenance) including business planning
Access to finance	Some table banking	Some table banking
Access to markets	- Limited market channels (community, farmgate, middlemen) - Lack of marketing skills	- Limited market channels (community, farmgate, MM) - Lack of marketing skills

Table 76: Challenges to increasing income from poultry farming

Overall, research showed that the viability of poultry farming as is very sensitive to the following factors:

- Cost of feeds
- Cost of fertilised eggs
- Mortality and hatch rate
- % of mature chickens sold and sale price
- Sales prices for chicks
- If selling mature birds for meat, income is only available from month five of the production cycle.

Thus, any business model for poultry farming (individual farmer or aggregation) must ensure these factors are optimized. This requires:

- Consistent supply of high quality fertilised eggs
- Optimisation of use of equipment
- Stable access to markets and consistent sales cycles
- Negotiations with breeders and agro dealers for cheaper (bulk) purchase of inputs
- In addition to bulk feed purchase, establishment of own feed production
- Training, quality feed and vaccinations to minimise mortality and stunted growth.
- Maintenance and uninterrupted electricity supply to maximize hatch rates.
- Financing for startup costs.

c. Promoting Gender and Social Inclusion (GESI)

Gender and other forms of inequality can be a hindrance to economic growth and poverty reduction. Sometimes people experience various types of vulnerability or marginalization (“intersectionality”) which can result in increased marginalisation (e.g., due to social class, age and gender). When women and men are relatively equal, economies including livestock production grow faster, poverty levels reduced and livelihoods for both and women and men enhanced. There is a gender gap in agricultural productivity in Kenya not because women are less efficient farmers, but due to inequitable access to agricultural inputs including family labour, production inputs, training and knowledge about poultry production and marketing, and unequal access to markets. These barriers need to be addressed if interventions to increase income are promote GESI.

GESI outcomes can be potentially achieved through the increased investment in this sector, as poultry keepers are primarily women, but this also requires proactive interventions designed with a GESI lens, starting with the targeting of MV and individual farmers.

Financial inclusion is critical since a certain level of savings/capital is required from farmers to participate and women and marginalised groups can be particularly disadvantaged.

In both this specific intervention under the CEP and wider interventions in the Livestock Sector, training programs should be designed through a GESI lens, considering the specific needs, roles, and constraints faced by women and men in the livestock sector. The County Government should advocate for equitable access to productive resources, such as land, livestock, inputs, credit, and technology for women and marginalised groups and any policy barriers that limit women's access to resources and to promote their ownership and control over productive assets be addressed. Specific financial inclusion initiatives may be needed to enhance access to credit for women farmers and farmers from other marginalised groups, as well as understand and address barriers to market access for such farmers.

GESI-responsive livestock extension services are needed to consider the specific needs and constraints faced by women and other marginalised groups in livestock farming. Extension officers should be trained to address GESI dynamics, provide tailored advice and support and promote participation in decision-making processes related to livestock management.

Gender-sensitive data collection and analysis as part of the solutions implementation, from inception through demonstration to scale up, is also essential for ensuring GESI promotion. Disaggregated data from interventions in different stages of planning and implementation, and GESI-specific monitoring and evaluation is required to better understand the different needs and challenges of different targeted groups, including men and women. This data helps inform decision-making, helps identify gender disparities and gaps including during the different phases of project implementation, and to design and further optimize interventions to address GESI inequalities in the livestock sector.

a. Climate Resilience Mainstreaming

Poultry and other livestock farmers in Kenya are currently experiencing the adverse effects of climate change. Studies in impact of climate change (Missouri State University, 2015) have shown that livestock producers across Africa are experiencing changes in temperature and rainfall patterns resulting in reduced feed resources, greater animal mortality rates, smaller herd sizes, fewer water sources during the dry season, decreased animal performance and productivity, and emergence of new animal diseases.

Poultry production decreases at temperatures higher than 30°C. Heat stress on poultry reduces feed intake, weight gain, carcass weight, and protein/muscle calorie content. Furthermore, heat stress on hens reduces reproductive efficiency and, consequently, egg production because of reduced feed intake and interrupted ovulation. Egg weight and shell thickness may also be negatively affected by increasing temperatures. (Missouri State University, 2015)

Climate change can impact poultry production by stressing the birds' ability to maintain homeostasis, the tendency to resist change in order to maintain a stable internal environment suitable for sustaining life. In poultry management, homeostasis is a dynamic state of

equilibrium adjusted and maintained by an integrated system of physiological processes. Changes in humidity compound the effects of high environmental temperature. A study on the impact of increasing temperature on the survival and performance of poultry birds indicated that an ambient temperature of $< 34^{\circ}\text{C}$ induced heat stress on poultry birds, limiting their ability to efficiently reach the productivity peak (Ravichandran and Mohamed, 2015). Additionally, heat stress, feed loss or inadequacy, and water contamination lead to recurrent outbreaks of diseases, failing vaccinations, and increased rearing mortality, which result in increased cost of veterinary services. (Missouri State University, 2015)

This empirical evidence indicates the vulnerability of the poultry industry to climate change, particularly to increased temperature levels.

African poultry production is also at risk of indirect climate change aspects that will impact feed ingredient availability and quality for poultry, particularly for the commercial poultry industry. Arid and semi-arid regions experiencing increasing temperatures, low rainfall, and irregular rainfall patterns cannot produce the level of feed production needed to stave off rising feed prices. Climate change is predicted to decrease crop productivity and increase market prices of feed inputs.

The effects of adverse climate change result in a production, fixed and operational cost disequilibrium leading to unprofitable and unsustainable business models.

The research and analysis carried out to develop the poultry solution highlighted that the target farmers in the MVs were struggling with significantly increased feed costs and lacked flock health management skills. These are key risks to the solution that are likely to be exacerbated by climate change impacts. The poultry farming solution has suggested ways to address these gaps and develop a sustainable business model but, if resource is available, the poultry solution implementation planning should apply an additional climate vulnerability assessment to the Demonstration solution. This would:

1. Identify climate risks to the solution and the vulnerability of target groups.
2. Assess whether the solution could lead to increased vulnerability to the target groups through maladaptation.
3. Assess further opportunities to address climate risks by optimizing the solution.
4. Make recommendations on changes to the solution.

Given the data gaps, data collection systems should be designed to collect data on the magnitude, frequency, and impact of climate-related impacts on the target poultry farmers, which can then be analysed (which will require additional resource) to inform future implementation planning. This should also inform resource allocation, including the costs of mitigating or managing the identified risks through optimisation of the solutions.

b. Promoting Energy Efficiency And Conservation

The approach to EEC for the poultry farming solution should start with collection of data or a baseline audit of the target facilities, including the physical and other infrastructure (water), equipment and appliances and poultry production practices. If resource is available, to identify which EEC interventions would be the most effective, and to quantify the resources needed to implement these. As discussed below, the solution envisages for the individual farmer solution the use of solar technology for incubation and lighting, and the use of the most energy efficient appliances and equipment for all aspects of production for the individual farming model, for new MVs and to retrofit existing MVs could also be explored, if additional resource is available. This could include measures to ensure existing and new physical infrastructure (poultry housing, aggregation hall etc.) had the most energy efficient heating and cooling systems in place, as well as exploring the use of RE technologies for all aspects of production and the most EE forms of water supply equipment.

Strategies To Promote Sustainable Poultry Farming

The basic value proposition is to provide poultry farmers with reliable, affordable electricity and infrastructure for incubation & brooding plus reduced cost inputs, access to finance and stable markets.

Two solution types are proposed: the first involves aggregation of poultry production and marketing by re-invigorating the existing MVs, addressing the current gaps in the business model. The second proposal targets individual farmers who currently keep fewer than 50 birds and are already in self-help groups or co-operatives. Both solutions raise the social inclusion question in both models, as farmers must contribute a reasonable level of their own savings/capital as well as receiving targeted subsidies. The solution components (activities and outputs) are outlined in Table 79.

a. Solution Components

Solution Component	Rationale	What and how?	
		Existing Model Village (MV)	Individual farmer
Membership activities/group governance	Ensure effective group functioning/ planning and growth – support for governance	Reinvigorating existing MVs with sensitisation/starting with demo farmers >200 active members	Identifying target areas and poultry farmers to work with
Equipment	Optimise use of incubation equipment to near 100% utilisation to maximise hatch rate and reduce losses for collective incubation and	- Training on use and management of incubator, ordering and payments. - Repair/replace any broken equipment.	96 solar egg incubator (90% hatch rate) - Chick brooder - paraffin lamp - Solar lighting system - 3 power LEDs with

	brooding. Will include full time MV staff employed	• Install new 1056 incubator (85% hatch rate) with subsidy and finance. • Automated candling equipment • After base year, the MV invests in more incubators	300 lumens total flux (100 lumens per lamp). Five-year lifetime, 6000 mAh Lithium Ferro-Phosphate (LFP) battery • All with subsidy and finance.
	Provision of reliable and affordable energy to minimise spoiling	• Install diesel back-up generators and maintenance. • All with subsidy and finance	• Solar system and plan savings for battery replacements. • All with subsidy and finance
	Reduce feed costs	• Feed mill and mixer at MV • All with subsidy and finance	n/a
	Aggregation and feed hall to provide additional space	• New aggregation hall with subsidy	n/a
Inputs	Consistent supply of quality fertilised eggs	• Contracting with suppliers with capacity to meet cyclical demand. Subsidies for first 5 months until mature birds ready for sale. • Feasibility study to start a breeding farm	
	Reduce cost and assured supply to quality feed and meds to reduce mortality	• Negotiate with agro dealers/vets for bulk purchase by MVs and farmers. • Subsidies for first 5 months until mature birds ready for sale.	
	Reduce feed costs	• Develop a feed mill and mixer at MV	• Purchase feed from MV mill
		• Assess feasibility of own feed production	
Training	Improving poultry management practice, productivity & marketing	• Provision of more extension officer (EO) support & specialist training of extension officers to support MV production on ongoing basis. Provide transport costs for EOs. (Re)train farmers on: • Equipment operation/basic maintenance. • Flock health & disease surveillance and control • Improved poultry breeds, production and management practices for layers, chicks, housing.	

		• Feed and nutrition requirements of livestock, knowledge on suppliers of various inputs and appliances that can improve production. • Business skills and planning including production planning, risk measurement and financial management, as well as record keeping. ○ Market knowledge and marketing skills. There may need to be additional or tailored training specifically for women farmers or farmers with particular vulnerabilities.
Market access	Improving access to markets and good prices	• Market mapping of new market channels/buyers with a GESI lens for access issues of marginalised farmers and gender sensitive sourcing. • Reactivate/identify new self-help groups or cooperatives at village level, including for women farmers, and join Apex Cooperative. • Provide support for sales contracting, particularly for white meat.

Table 77: Overview of solution components

b. Alignment with CIDP Priorities

The solution is aligned with the Livestock Departments priority for “local poultry improvement” in the CIDP 2023-28 (see Table 80 below). However, only some the non-energy components (provision of inputs, training and (re)activation of farmer groups) were initially included. Further discussion with the Ministry of Agriculture has been ongoing, led by the Directorate of Economic Planning, to ensure sufficient multi-year budgetary allocation, starting with the ADP 2023-24. A specific financing plan must be developed as part of the implementation planning, agreed by the Implementation Committee. This could include further identification of co-financing to deliver some of the solution components.

Sector & Outcome	CEP Solution Components	CIDP Priority (Reference Chapter 4: Development Priorities, Strategies and Programmes under Section 4.2.1 Sector Programmes)	Activities (Reference: Annex I: Projects Derived from Programmes)	Implementing Agency
Increased income from livestock farming (poultry)	Farmer group reactivation /formation	Programme: Livestock Production Sub-programme/project: Local poultry improvement	○ Capacity building poultry farmers ○ Procuring and distribution of chicken	Livestock Development

	(Non-energy solution component)		○ Extension services	
			Ref: Annex 1.10	

Table 78: Aligning CEP solutions with CIDP priorities

c. Financing Models

Model Villages

In both phases of the project, microfinance will be provided to the MVs to support the purchase of back-up generators (sized for expansion and feed mills and mixers), feed mill and mixer, and new 1056 incubator plus new buildings for aggregation of mature chickens and expansion of operations. In addition to a 50% Government subsidy on these costs, MFI or bank finance will be required to enable the MV cooperatives to cover the remaining financing gap of 30% (MV's are expected to pay a 20% deposit on new equipment).

Individual farmers

MFI finance will be offered to the farmers for the individual incubator package (96 egg incubator, solar lighting, and brooder heater) through farmer groups. Farmers will be asked to pay a 10% deposit. The MFI would work through the existing local Self-Help Groups (SHG). Group-based lending allows farmers to serve as co-guarantors. The MFI lends to farmers via the SHG. The SHG also ensures that the money is spent on the correct incubator. Farmers would pay their deposits and monthly instalments to the SHG who would, in turn, pay back the MFI. The terms of the financing will be finalised in the project start-up phase.

In addition to the financing models above, there is still a need to support the demonstration farmers further since they are likely to be reluctant to take out a loan when they cannot be certain of the benefits afforded by the incubators. Adoption of new technology and management practices for many Meru poultry farmers in nascent market conditions requires confidence building. End user subsidies have been found to be a key intervention to unlock market potential because they directly address the farmer affordability challenges and help reduce the perceived risks. It is recommended to offer an end-user subsidy of 50% of the full cost of the incubation package (incubator, lighting and brooder). Not only will this incentivise the farmers, it will also reduce the risk for the finance provider who will only be loaning about 40% of the value of the product.

To avoid market distortion and manage farmer expectations of ongoing discounted/free products, the framing of this subsidy to the end-user is very important. It is proposed that the subsidy be framed as an introductory discount for a limited period. The subsidy would be paid to the technology supplier via a trusted party on proof of paid deposit and delivery of the incubators.²³ The subsequent SHG farmer loan from the MFI would be negotiated based on

²³ Timely release of payments is very important. A third party such as a trusted local CSO could be used for verification and release, or the MFI may wish to take on this function.

the lower sum. From the farmers' point of view, the subsidy would be reflected in their repayment terms (e.g., a reduction in monthly instalments and tenure), as shown in Table 7 below.

The impact of the subsidy would be assessed during the Demonstration Phase and reduced subsequently. As the benefits of incubators are proven, farmers will find it easier to take out a loan, removing the need for a subsidy.

Table 81 provides an overview of the financing model available to the farmers (with and without subsidy) indicating the deposit payable and monthly instalment payments. The cost of finance has been assumed at 10%.

	With subsidy	Without subsidy
Cost of incubator	28,100	28,100
Cost of brooding and lighting equipment	13,604	13,604
Total capex	41,704	41,704
Deposit paid by farmer	4,170	4,170
Monthly repayments in Y1	400	901
Monthly repayments in Y2	1,201	2,703
Total repayments	19,224	43,253
Total cost to farmer	23,394	47,423

Table 79: Financing model for individual farmers

d. Cost Benefit Analysis

Costs have been estimated for the new equipment and assets and for the likely inputs (eggs, feed, vaccinations, electricity, fuel for back-up generators, loan repayments, maintenance, and staffing). It is assumed that the MV feeds and vaccinates 50% of the chicks hatched until they are three-week-old, and feed is bought in bulk and milled and mixed by the Model Village. Revenues for the MV come from the sale of day-old chicks and 3-week-old chicks plus aggregation fees for the sale of mature birds from the member farmers.

Costs for the individual farmer include the new equipment and inputs (eggs, feed, vaccinations, kerosene, maintenance, loan repayments and battery replacement fund). Revenues for the individual farmers come from the sale of the mature birds and the sale of three old chicks.

Table 82 provides an overview of total costs for the two options – MV and individual incubator - with and without subsidy. It also shows the net present value (NPV) after one year and after five years. The revenues in the first year are lower because there are lower mature bird sales. The first mature birds will only be sold in month five.

All in KES		KOPIA				Individual incubators	
Description		KOPIA (existing model villages)				Individuals, members of self-help/cooperatives	
		With commercial feed		With own feed mixer & miller		Purchase feed from MV	
In base year - With or without 50% subsidy on equipment, training paid for, eggs for first 5 cycles and 50% of feed for 5 cycles		Without subsidy	With subsidy	Without subsidy	With subsidy	Without subsidy	With subsidy
Total costs for base year		5,436,855		5,668,754		905,666	
Subsidy level in base year (5 cycles)		-	1,375,254	0	1,524,108	-	135,055
Subsidy at 12 months			150,000		150,000		-
Loan for 30% of equipment		80% capex	30% capex	80% capex	30% capex		
16 cycles (1 year)	Costs per cycle	335,528	257,283	342,024	264,039	37,497	32,319
	Revenue per cycle	353,708	353,708	353,708	353,708	27,667	27,667
	Net income per cycle	18,180	96,425	11,684	89,669	-9,829	-4,652
Year 1 Profit – 16 cycles (KES)		222,469	1,474,391	-9,430	1,238,324	-241,649	-115,984
NPV (5 years) KES		8,239,314	9,576,633	10,005,835	11,501,742	181,816	310,951
NPV (5 years) USD		66,504	77,299	80,763	92,837	1,468	2,510

Table 80: Cost and revenue model

The following tables outline the costings and revenues per farmer. First, for farmers who are members of the MV (Table 83) and, second, for individual farmers who purchase their own incubator (Table 84). They show the likely operational costs for the initial base year without the capex/deposit and for a future year (without subsidy). Incomes are considerably lower in the first year because mature chickens can only be sold from month five. The Tables show that the individual farmers have the potential to make greater net income. They have a positive cashflow from the fifth cycle, but they make a significant loss in the base year and break even in Year 1, whereas Model Village members can break even in the first year.

Farmer Cashflows-	Base Year (100 farmers/ 2 incubators)	Year 4 (200 farmers/5inc ubators)
Expenses	KES	
Membership fee	500	500
Purchase of chicks (DOC and 3 week)	44,292	58,662
Vaccinations	1,547	2,049
Feed	161,980	214,532
Aggregation fee	7,701	15,300
Government subsidy	- 35,433	-
Sub-total (expenses)	180,587	291,042
Revenue		
Sale of mature chickens	169,428	336,594
Shared profit from MV	11,393	23,633
Sub-total (income)	180,820	360,227
Net annual income (KES)	233	69,185
Net annual income (USD)	2	558

Table 81: Projected cashflows for the MV member farmers (per farmer)

Farmer Cashflows-	Base Year	Year 1
Expenses	KES	
Membership fee	500	500
Purchase of eggs	48,960	48,960
Vaccinations	12,147	12,147
Feed	729,994	729,994
Aggregation fee	10,987	16,480
Operational costs (labour, battery r	76,095	79,294
Training - travel costs	12,000	12,600
Loan repayments	4,806	14,418
Subsidy on inputs	- 118,253	-
Sub-total (expenses)	777,235	914,393
Revenue		
Sale of mature chickens	604,264	994,524
Sale of 3 week old chicks	59,752	59,752
Sub-total (income)	664,017	1,054,277
Net annual income (KES)	- 113,219	139,884
Net annual income (USD)	- 914	1,129

Table 82: Projected cashflows for the individual farmers with own 96-egg incubator

Even with the proposed Government subsidy, the MV member farmers will need access to savings or finance to be able to invest in the MV and in their own flock until revenues start in month five. This has been estimated at 40,000 KES (327 USD). The individual farmers with incubators will need significantly greater access to savings or finance to be able to finance the

costs for the first five months, estimated at 146,000 KES (1179 USD), as shown in Table 84 below. This raises a question over social inclusion of poorer farmers. To address this, increased amounts of subsidy would be required.

Costs required by farmers	KOPIA +	Individual
Costs required for set up and 5 cycles (KES)	1,105,173	
Per farmer (KES)	11,052	
Per farmer (USD)	89	
Farmer costs for 5 cycles to maturity (KES)	29,510	146,089
Farm costs 5 cycles (USD)	238	146,089
Total needed per farmer for first 5 cycles and investment in MV	327	1,179

Table 83: Farmer finance requirements before revenues begin to flow

The expected benefits are as follows:

- 800+ active members of Model Villages with expanded poultry production (each with income of >500 USD/year). Gender disaggregated data will be gathered to show the % of women and people from marginalised groups.
- Strengthened and sustainable governance structures of 4 MVs including strengthened inclusion and participation of women and marginalised groups in decision-making structures.
- 100 individual farmers with expanded poultry production (with income of 900 USD/year). Gender disaggregated data to show % of women and people from marginalised groups.
- Strengthening of existing or creation of sustainable self-help groups (4 X 25 farmers), including strengthened inclusion and participation of women and marginalised groups.
- MV operating incubators at capacity and feed mill and mixers. They operate sustainably and aggregate mature chickens for sale (up to 57,759 birds per village per year)
- 900+ farmers buy improved feed and fertilised eggs and chicks. Gender disaggregated to show % of women and people from marginalised groups.
- 900+ farmers receive training on livestock management, incubator use, production, marketing. Gender disaggregated to show % of women and people from marginalised groups.
- 20 Livestock extension officers (EOs) receive additional training on livestock management, incubator use, production, marketing. Consider GESI promotion in recruitment of new EOs.
- 16 full time jobs and four part-time jobs created at MVs. Gender disaggregated to show % of women and people from marginalised groups.

The expected outcomes are livelihood benefits for 900+ households (4,500 people) because of:

- increased income derived from increased productivity.
- access to profitable and reliable markets.
- access to affordable inputs.
- access to timely and effective disease control and surveillance due to collective purchase of medicines and vaccination of flocks.
- effective record keeping and access to affordable finance, lower production costs.

Intervention Options

e. Target Beneficiaries

The aim is to target approximately 800+ farmers (200 per MV) and 100 farmers (25 per MV) for individual production by the end of the Scale-up Phase (five years, in alignment with the CIDP). Farmers who are in the vicinity of the MVs so that they can benefit from access to cheaper feed, farmer training and potentially aggregation for marketing will be prioritised. The solution will aim to promote Gender Equity and Social Inclusion (GESI) by including women farmers and farmers from marginalised groups in its implementation. Targeting criteria will need to be further developed by the County Government. Further details of the target groups are provided in Table 86 below.

KOPIA PLUS		INDIVIDUAL FARMERS
	Existing Model Village farmers	
Characteristics	• X 100 farmers. The aim is to have at least one third women farmers and additionally farmers from other marginalised groups. • Locations: Ntarami, Kangeta, Ng'onyi and Mbaaria	• Identification of target groups: existing self-help groups or co-operatives with functioning organisation • Start with 25 farmers, increasing to 100. The aim is to have at least one third women farmers and additionally farmers from marginalised groups. • Produce table and fertilised eggs, practice natural hatching/ or/ and buy commercial day-old chicks. • Keeps <50 birds of both indigenous/improved breeds.

Table 84: Target farmers for the poultry solutions

f. Budget Commitments and Funding Sources

The tables below show the projected investment costs for both the MV and individual farmer solutions for the Demonstration and Scale-up Phases.

The key assumptions for the Model Villages in both phases are as follows:

- 50% of the cost of a new 1056 incubator, back-up diesel generator, a feed mill and mixer and new aggregation hall is covered by a subsidy.
- 20% deposit paid by MV.
- Financing of the balance is provided by MFI.
- 100% of fertilised eggs are provided to the MV for five cycles.
- 50% subsidy on commercial feed purchase for five cycles, so chicks grow to three weeks.
- 70% subsidy provided to the MV member farmers for the first five cycles to grow chicks to mature birds (100 farmers)
- Training provided by extension officers who have been trained. Farmer training is funded by the Government (or another donor).
- The costs for operation for the first five months have been included to show commitment from MVs before first income from the sale of mature birds.

For individual farmers, the model has the following assumptions:

- 50% subsidy on the individual 96 egg incubator (25 farmers)
- 10% deposit paid by farmer.
- Financing of the balance is provided by MFI.
- 100% of fertilised eggs are provided to the individual farmers for five cycles (25 famers).
- 50% subsidy on commercial feed purchase is provided for five cycles, to chick maturity.
- Farmers pay for their own training but must commit for a 12-month period as part of the demonstration project.

Solution Component	Description	Cost per model village (KES)	No. of MV / farmers	Total cost (KES)	Amount and Source of finance (KES)		
					Model Village	Government/Other public funding	MFIs
KOPIA Model Villages							
Reinvigorating existing model village	Reinvigorating existing model village	185,837	1	185,837		185,837	
Inputs	Negotiation/ arrangements with agro-dealers/ breeders			371,674		371,674	
	Fertilised eggs for 5 cycles	316,800	1	316,800		316,800	
	Commercial feed (for 3 week chicks)	360,701	1	360,701	180,350	180,350	
	Vaccinations	55,427	1	55,427	55,427		
	MV active farmer members - support for feed for 5 cycles	10,124	100	1,012,376	303,713	708,663	
	Diesel genset backup	237,188	1	237,188	47,438	118,594	71,156
	Incubator (deposit, subsidy and finance)	104,853	1	104,853	20,971	52,426	31,456
Equipment	Deposit for mill and mixer	102,375	1	102,375	102,375		
	Financing for mill and mixer equipment (MFI/bank)	153,563	1	153,563			153,563
	Subsidy for mill and mixer equipment	255,938	1	255,938		255,938	
Other assets	Aggregation and feed hall/extra buildings	300,000	1	300,000	150,000	150,000	
Training	More extension officer support & specialist training plus transport costs	300,000	1	300,000		300,000	
	Member training and business supervision	600,000	1	600,000		600,000	
Operation and Maintenance of MV for first 5 cycles (before mature chickens sold)	Utilities (grid and genset diesel)	321,112	1	321,112	321,112		
	Personnel	180,000	1	180,000	180,000		
	Maintenance of equipment	17,525	1	17,525	17,525		
	Administration and Governance	135,000	1	135,000	135,000		
	Marketing	62,500	1	62,500	62,500		
	Other	6,250	1	6,250	6,250		
Feasibility studies	Feasibility study/demo plot on own production of feed			1,982,259		1,982,259	
	Feasibility study - brooder farm			2,000,000		2,000,000	
Market access	Market mapping			557,510		557,510	
Total MV expenses (capex and opex for 5 cycles)				9,618,885	1,582,659	7,780,051	256,175
Individual farmers							
Identifying groups	Identifying target areas and poultry groups/SACCOs to work with			111,502		111,502	
Inputs (for 5 cycles)	Fertilised eggs for 5 cycles	14,400	25	360,000		360,000	
	Feed from MV (for 5 cycles worth to maturity for 65%)	214,704	25	5,367,600	2,683,800	2,683,800	
	Listing/research with vet-dealers/ negotiating and what is in the package for poultry farmers	incl.above					
	Support to establish bulk buying and access to finance	345,000	1	345,000		345,000	
Equipment	Deposit for incubator/lighting and brooder (individual farmer)	4,170	25	104,260	104,260		
	Susbidy / Financing for incubator equipment (MFI)	37,534	25	938,340		521,300	417,040
Training	Training the extension officers/other	incl. above	1				
	Farmer Group Training by Extension officers/other suppliers (for 1st year)	12,000	25	300,000	300,000		
Total individual farmers for 5 cycles				7,526,702	3,088,060	4,021,602	417,040
Total demo costs				17,145,587	4,670,719	11,801,653	673,215
Implementation, monitoring and	Project management			4,000,000		4,000,000	
	M&E			2,477,824		2,477,824	
Total (KES)				23,623,411	4,670,719	18,279,477	673,215
Total (USD)		123.8912		190,679	37,700	147,545	5,434

Table 85: Investment model for the Demonstration Phase

Solution Component	Description	Cost per model village (KES)	No. of MV / farmers	Total cost (KES)	Amount and Source of finance (KES)		
					Model Village	Government/Other public funding	MFIs
KOPIA Model Villages							
Reinvigorating existing model village	Reinvigorating existing model village	185,837	1	185,837		185,837	
Inputs	Negotiation/ arrangements with agro-dealers/ breeders			371,674		371,674	
	Fertilised eggs for 5 cycles	316,800	1	316,800		316,800	
	Commercial feed (for 3 week chicks)	360,701	1	360,701	180,350	180,350	
	Vaccinations	55,427	1	55,427	55,427		
	MV active farmer members - support for feed for 5 cycles	10,124	100	1,012,376	303,713	708,663	
Equipment	Diesel genset backup	237,188	1	237,188	47,438	118,594	71,156
	Incubator (deposit, subsidy and finance)	104,853	1	104,853	20,971	52,426	31,456
	Deposit for mill and mixer	102,375	1	102,375	102,375		
	Financing for mill and mixer equipment (MFI/bank)	153,563	1	153,563			153,563
	Subsidy for mill and mixer equipment	255,938	1	255,938		255,938	
Other assets	Aggregation and feed hall/extra buildings	300,000	1	300,000	150,000	150,000	
Training	More extension officer support & specialist training plus transport costs	300,000	1	300,000		300,000	
	Member training and business supervision	600,000	1	600,000		600,000	

Operation and Maintenance of MV for first 5 cycles (before mature chickens sold)	Utilities (grid and genset diesel)	321,112	1	321,112	321,112		
	Personnel	180,000	1	180,000	180,000		
	Maintenance of equipment	17,525	1	17,525	17,525		
	Administration and Governance	135,000	1	135,000	135,000		
	Marketing	62,500	1	62,500	62,500		
	Other	6,250	1	6,250	6,250		
Feasibility studies	Feasibility study/demo plot on own production of feed			1,982,259		1,982,259	
	Feasibility study - brooder farm			2,000,000		2,000,000	
Market access	Market mapping			557,510		557,510	
Total MV expenses (capex and opex for 5 cycles)				9,618,885	1,582,659	7,780,051	256,175

Individual farmers							
Identifying groups	Identifying target areas and poultry groups/SACCOs to work with		1	111,502		111,502	
Inputs	Fertilised eggs for 5 cycles	14,400	75	1,080,000		1,080,000	
	Feed from MV (for 5 cycles worth to maturity for 65%)	214,704	75	16,102,800	16,102,800		
	Listing/research with vet-dealers/ negotiating and what is in the package for poultry farmers	incl.above					
	Support to establish bulk buying and access to finance	345,000	1	345,000		345,000	
Equipment	Deposit for incubator/lighting and brooder (individual farmer)	4,170	75	312,780	312,780		
	Financing for incubator equipment (MFI)	37,534	75	2,815,020		-	2,815,020
Training	Training the extension officers/other	incl. above	1				
	Farmer Group Training by Extension officers/other suppliers (for 1st year)	12,000	75	900,000	900,000		
Total individual farmers		Sub-total		21,667,102	17,315,580	1,536,502	2,815,020
Implementation, monitoring and	Project management			10,000,000		10,000,000	
	M&E			6,000,000		6,000,000	
Total (KES)				50,053,156	21,152,419	25,317,193	3,583,544
Total (USD)		USD exchange	123.8912	404,009	170,734	204,350	28,925

Table 86: Investment model for the Scale-up phase

g. Expected Outputs In Each Phase

Table 89 shows the number of farmers that will be targeted in each year of the Demonstration and Scale-Up Phases.

Membership/Target farmers		Demo	Scale	Y2	Y3	Y4	Y5	Y6
Number of KOPIA MVs reinvigorated		1	3	3	3	3	3	3
Active growth p.a.			30%	20%	10%	10%	10%	-
No. farmers per MV		200	260	312	343	378	415	415
No of active farmers per MV	50%	100	130	156	172	189	208	208
No. of farmers per MV			200	260	312	343	378	415
No. of active farmers per MV	50%	-	100	130	156	172	189	208
No. of active MV farmers in project		100	430	546	640	704	774	831
No. of individual farmers with incubators		25	100	100	100	100	100	100
Total targeted farmers		125	530	646	740	804	874	931

Table 87: MV farmer and individual farmer membership during Demonstration and Scale-up

h. Timeline

The solutions will be tested during a demonstration phase before scaling up to more farmers, adding additional support in terms of access to credit and aggregation and new markets as it moves towards a fully commercial model (see Figure 45). Phases one and two are integrated into the CIDP. If successful, a further Phase 3 for replication could be envisaged.

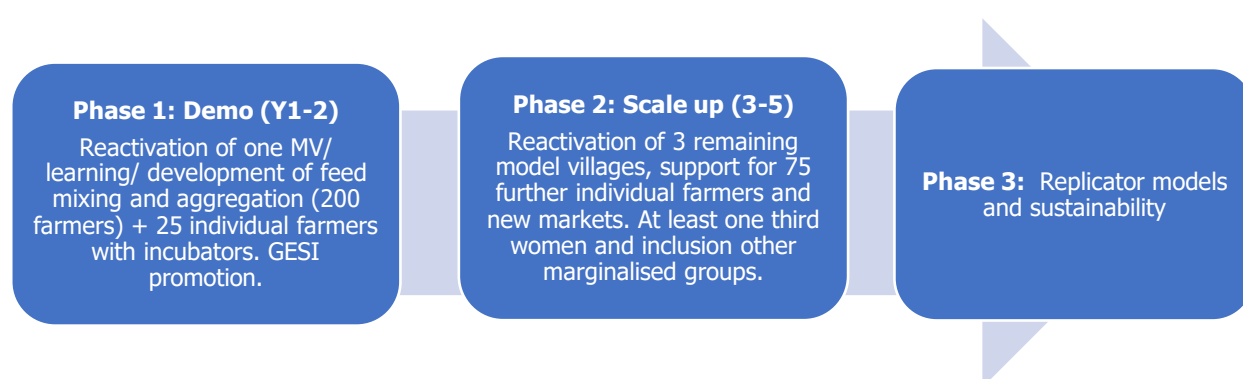


Figure 44: Implementation timeline

i. Stakeholders And Roles

Table 89 outlines the roles of each of the stakeholders during the demonstration phase.

Stakeholder	Activity	Role
Steering/Implementation Group	Governance	- To be formed at start of project and will include participants from Directorates of Energy, Economic Planning, Livestock, MFI. - Decision making body for the project. - Financing & supplier partnerships and procurement
Directorates of Energy & Livestock	Oversight/Project management	- Overall project implementation and management, including MEL - Partnerships with end users (MVs and farmers) and stakeholder outreach - Contractual relationships with project suppliers and trainers - Set up Apex Cooperative - Support reinvigoration of MV farmer groups/new self-help groups for individual farmers
	Fund training/mentoring costs	- Farmer training for the first year. - Additional Poultry Extension Officers (Eos). - Transport costs - Specialist training for Poultry Eos.
	Deliver training through EOs & source external providers	- Eos provide ongoing mentoring to farmers once trained. - Source training provider for: - Flock health and disease surveillance and control - Improved poultry breeds, production and management practices for layers, chicks, housing. - Training on feed and nutrition requirements of livestock, knowledge on suppliers of various inputs and appliances that can improve production. - Business skills and planning including production planning, risk measurement and financial management, as well as record keeping. - Market knowledge and marketing skills
	Targeted subsidy provision	MVs: provide 50% subsidy on back-up generators provided to MVs, incubator and feed mill and mixer and on new buildings.

		• Individual farmers: provide 50% subsidy on incubator, brooder and lighting. • Subsidise each MV for 50% of MV egg and feed inputs for DOC/3-week chicks during the first 5 cycles. • Subsidise 70% of feed requirements for MV farmer members for first 5 cycles.
	Feasibility studies & market research	• Carry out or commission research on the following: ▪ Input suppliers who could do bulk purchase discounts (including fertilised eggs) & support contracting. ▪ Feasibility studies for a brooder plant and own feed production. ▪ Feasibility/demo plot for own feed production ▪ Market mapping of new channels/buyers for white meat.
	Support for contracting by farmers	• Bulk purchase agreements for inputs • Purchase agreements with buyers • Potential bulk purchase of incubation etc. equipment by MCDIC
Directorate of Gender	Targeting of end users	• Support in mapping of women farmers into the pilots
	Finance	• Support GESI related activities
	Training	• Technical input to development of either specific training for women farmers or for mainstreaming gender in training
	Data collection and results measurement (M & E)	• Provide technical support on solution implementation indicators and disaggregated data collection. • Support monitoring and reporting of gender related results
Meru County Microfinance Corporation (MFI)	Finance	• Provide finance to MVs via cooperatives to cover the remaining financing gap after 50% Government subsidy & 10% deposit for equipment. • Provide finance to individual farmers via self-help groups to cover 40% of cost of

		equipment after govt subsidy & farmer deposit.
	Training	• Train existing MV groups on financial literacy • Support formation of self-help groups for individual farmers and train on financial literacy
Incubation & brooding equipment suppliers	Supply equipment to farmers	
Training providers	Deliver specialist training	i. Deliver specialist training fo Eo j. Deliver training through MVs for MV members & individual farmers. k. Mentor champion farmers
MVs	Governance/	Reinvigorate MV farmer groups including setting membership fees/criterai & select champion farmers
	Training	• Pay for training after Y1.
	Production support	• Provide 50% of cost of inputs for first 5 cycles of production. • Set up bulk purchase arrangements with suppliers. •
	Equipment costs	• Pay 20% deposit on new incubation etc. equipment.
	Opex	• Pay for opex, maintenance and repair of equipment (including salaries for staff)
MV member farmers	Production support	• Provide 30% of cost of inputs for first 5 cycles of production & subsequently 100% (bulk purchase discount via MVs) • Pay membership fee. • Pay aggregation fee.
	Equipment costs	• Pay for 30% of equipment cost via loan from MFI.
Individual farmers	Equipment costs	• Pay 10% deposit • Farmer pays for 40% of cost via loan from MFI via self-help group.
	Opex	• Pay for opex including repair/maintenance of SHS (private provider or MV technicians)
	Form self-help groups	• Pay membership fee

		• Pay aggregation fee
	Training	• Pay for training after Y1

Table 88: Stakeholder roles during the demonstration and scale-up phases

j. Risks and Challenges

Some of the key risks, and suggested mitigation measures, to the solution are included in Table 91. This list is not exhaustive and will need to be reviewed by the Project Implementation Group. By taking a phased approach it will be possible to learn whether this risk management strategy works and identify any additional emerging risks during the Demonstration Phase, and then enhance existing, or develop new, risk mitigation measures to inform the final design of the subsequent phases, reducing risk further.

	Risk / Challenge	Mitigation measure
Project finance	Budget allocated in CIDP is not allocated via ADP or insufficient allocation to some solution components	Ensure buy-in and build understanding of solution among relevant Directorates & target end users to solutions in CIDP through socialisation activities. Directorates of Energy & Economic Planning ongoing engagement with Livestock/Project Implementation Group (PIG) to emphasize the importance of this projects. Build high-level political buy-in through CEP launch events and communications strategy.
	Lack of clarity on project management and roles/responsibilities for implementation	Project Implementation Group (PIG) set up with clear terms of reference, roles & responsibilities between the County Government Livestock Department, MFI, MVs and other partners.
	Delays in project implementation	Ensure sufficient time for set-up phase (including for MEL Framework) including identification of any process bottlenecks & challenges.
Project governance	Inadequate inclusivity and community participation	End user and stakeholder participation in PIG Participatory monitoring & evaluation Ongoing socialisation activities
Incubation & energy infrastructure – MVs & individual	The new/additional energy systems and incubation/brooding equipment will not increase productivity if other components are not implemented	Attention paid in the investment model to provision of non-infrastructure components such as quality inputs, flock management training, business skills & improved market literacy etc
	Lack of technical knowledge and skills in equipment management, installation and maintenance of pumps can result in break-down or under-performance of the pumps	After-sales support, funding of maintenance position & training included in the solution for MVs. For individual farmers, after sales plus option to source maintenance from County-trained technicians or MV technicians
	Spare parts are not readily available to the farmers	The technology suppliers will provide three-year warranties and spare parts for the pumps.

		The CG & MFI will support negotiations with equipment suppliers.
	Lack of skills including business planning, flock management and financial literacy etc.	The proposal includes provision for ongoing training and mentoring of farmers, demo farms and champion farmers.
Equipment & inputs financing model – MVs & individual	Provision of subsidies for equipment & start-up costs can create market distortion (e.g., set non-sustainably low prices in the market; reduce incentives to control cost base;)	The subsidy will be applied for initial equipment purchase & for first cycle of production only. The subsidy be framed as an introductory discount for a limited period.
	Fraudulent use of subsidy, or incorrect application of subsidy (e.g., multiple applications for the same equipment)	Subsidy for equipment will be directly to the equipment supplier (potential also for County to bulk purchase). For start-up costs, administered by MVs and Farmer SH Groups. All to receive financial literacy training.
	Lack of awareness of distributors of how to administer subsidy etc.	Time for discussions, negotiations and agreement on subsidies and financing packages with the technology suppliers and MFI included in the start-up phase.
	Lack of quality equipment and low standards leads to breakdown	Technology suppliers will be pre-selected to be part of the project with certified products, warranties and after-sales support.
Financing model – individual farmers	Default by individual farmers on MF loan	Individual farmers will be selected for their viability based on criteria established in the Start-up Phase. The MFI lends to farmers via the SHG. Group-based lending allows farmers to serve as co-guarantors. The SHG also ensures that the money is spent on the correct incubator. Farmers would pay their deposits and monthly instalments to the SHG who would, in turn, pay back the MFI.
Cost of inputs	Inputs including feed, vet supplies & fertilised chicks and eggs increase significantly	The solution will reduce the costs of feed inputs, starting with subsidised inputs for the first cycle, own feed milling, bulk purchase of ingredients by MVs and exploration of feasibility of own feed production. It will also reduce the cost of vet services, eggs and fertilised chicks through negotiating better/bulk supplier agreements and, longer term, feasibility for a brooder farm.
Low profit margin	Drop of market prices or hike in inputs affects the return on investment and makes the solution unviable.	The return on investment for the poultry solutions is not high but it is assumed that there is high demand for poultry products, particularly white meat and it will be possible to reduce the cost of inputs, as above. Current productivity is also very low. Through better and ongoing training and production support, productivity should increase significantly.

		Market mapping and other support will identify new market channels and there will be support for negotiating contracts with buyers.
Market demand/access	Lack of demand for the targeted produce and lack of farmer knowledge to market their products	There is a lack of data on market demand, but research indicated potential high demand, especially for white meat, in Meru and other counties. The CG has built wholesale and retail infrastructure. Individual farmer skills on marketing will be built as well as aggregation for marketing via the MVs. A mapping of different market channels will be carried out and support offered for negotiation with buyers.
Data and information management	Lack of current data and appropriate management technology to collect and analyse project information	Set up robust data and information management technology systems during Start up Phase.

Table 89: Risks and mitigation measures

k. Implementation and Coordination, Monitoring and Evaluation

l. Implementation and Coordination

The process to implement the demonstration phase follows the following five steps which includes the final project design and implementation:

Step 1

• **Budget Allocation and Implementation Group**

- Meru County Government (Directorate of Livestock) allocate CIDP/ADP budget for the subsidy for equipment and start up costs; and for the other solution component costs (training etc.) and set up an Implementation/PM Group led by Directorate of Energy and MFI.

Step 2

• **Partner identification**

- The County needs to identify the partners it will work with in terms of technology suppliers, MF provision, input suppliers and training partners, as well as the Demo Phase MV and farmer representatives (see below). For some of the partners the process may need to follow a public procurement or tendered approach to ensure transparency, fairness and open competition. In particular the following need to be identified:
 - MV and 25 individual farmers organised in SHG.
 - Technology partners: Technology suppliers or distributors that can supply the target farmers with incubation, brooding & lighting equipment. This includes maintenance & repair, which could include support from Directorate of Energy trained SHS technicians.
 - Input suppliers - for eggs and chicks, feed, vet suppliers etc.
 - Financing partners – in particular Meru MFI or other microfinance provider for equipment loans through the SHGs for individual farmers
 - Training providers – to develop and deliver the required training , including selected extension officers who will receive specialist training.

Step 3

• **Negotiate and agree contractual relationships**

- The partners identified in Step 2 will be brought together with other relevant stakeholders (Government, NGOs, farmers representatives) in the project Steering Group to agree details on the solution roll-out, roles, ways of working, and contractual relationships.

• **Implementation**

- Champion farmers & demo farms in MV plus individual farmers identified and sensitised on the project and support available.
- MV governance reactivated and individual farmers form SHG, supported by MFI with financial literacy and record keeping training
- Technology partner(s) do marketing campaign for farmer groups and farmers
- Agro-dealer introductions and bulk purchasing of inputs
- Feasibility for brooder farm & own feed production undertaken
- Equipment & start up costs subsidy dispersed via MVs and SHGs
- Technology partner(s) make referrals to the MFI for consumer financing
- On proof of purchase from MVs/SHGs, 50% of equipment cost to technology supplier. After-sales package supplied.

- Training developed and delivered

• **End of demonstration review**

- Audit resources used and evaluate output and outcome metrics
- Number of (female) farmers reached vs target
- Level of farmers' productivity realised vs. target
- Number of technology products deployed
- Proportion of defaults as a percentage of loan portfolio
- Percentage increase in target farmer incomes.
- Compile and review lessons learned and make recommendations for Phase 2

Step 5

Figure 45: The five steps of the Demonstration Phase

Summary of steps and approaches to promoting Gender Equality and Social Inclusion (GESI) in poultry solutions

As highlighted in the outputs above, the aim is to promote GESI outcomes through proactive interventions starting with the targeting of both MV and individual farmers to include women and marginalised people. If resource permits, representatives of such groups should be identified through a vulnerability analysis and apart from being beneficiaries, the interventions should ensure their participation in decision-making structures (at MV and individual farmer self-help group levels), and that they benefit equally from any employment opportunities. Issues of financial inclusion are critical since a certain level of savings/capital is also required from farmers to participate in the solutions, and marginalised groups often suffer disproportionately from financial exclusion. This may require social protection measures - further Government financial support (or grant) co-financing) – to ensure farmers from these groups can participate in the solution. Training approaches will need to take account of gender inequality and social exclusion issues in the delivery and content of training (for instance, developing women-only training, if appropriate). GESI should also be considered in the recruitment and training of specialist poultry Extension Officers.

Climate Resilience Building Measures

In terms of the energy infrastructure component of the MV solution, diesel-powered generators have been selected as the most cost-effective option to provide back-up power, which are intended to increase the MV's resilience to grid unreliability, which could also increase with climate change – but this would need to be determined through a climate vulnerability assessment. Back-up generators are the least-cost option as the existing MVs are already grid-connected, while solar incubators are proposed for the new, individual farmer solution on a least-cost basis. Grid or solar power cooling equipment for poultry housing to adapt to climate change impacts could also be explored.

For water infrastructure, a climate vulnerability assessment of the existing water sources used by the MVs during inception would be beneficial to identify any changes required to ensure sustainable management and use of the resource. Cross sectoral planning with the Directorate of water for scaling up of new MVs will be critical to ensure that water sources and solutions used are “climate proofed” in terms of sustainable management and use of water. Sustainable water management and conservation could also be included in farmer training.

Climate-aware poultry management is crucial to maintaining peak production and productivity levels. Poultry farmer training under the solution implementation could include adaptation strategies in response to poultry heat stress, feed, and disease management and control due to climate change impacts.

The solution envisages bulk purchase of feed inputs and own milling and mixing to keep down costs. Longer-term, the solution envisages own feed production as the most effective

strategy to bring down input costs, and this could also be part of climate adaptation strategy that explores production of the most-climate change resilient feed ingredients. These and additional activities are included in Table 92.

Activity	Gap	Recommendation
Data collection and analysis	Granular data on the specific climate change risks and impacts on the poultry flocks in the MV and other locations in Meru is not currently available.	Design data collection tools and undertake data gathering activities in the Demonstration Phase, if resource and expert capacity is available, to inform the design of the Scale-Up Phase 1. Further data gathering could be carried out during Scale Up 1 to inform optimization of the solution in future phases, with ongoing data collection and monitoring and evaluation of climate risks.
Optimise resilience of infrastructure components	There is a need to assess the climate risk to the current water, electricity and physical infrastructure and ensure that the solution components proposed for both MVs and the individual farmers will contribute to building the resilience of their businesses to climate change impacts. This is dependent on having good quality data on short and long-term climate risks (see above).	Assess the resilience of physical infrastructure and components to provide reliable supply of water and electricity. For instance, retrofitting or ensuring new chicken huts built are more heat resistant, with better natural ventilation systems, planting fast growing trees to provide shade for buildings, and installing cooling equipment could be integrated as adaptation responses aimed at combating high temperature levels, using either indigenous techniques or new appliances. ²⁴ This would require additional (co) funding. On the mitigation side, there could be the option to use SHS to provide electricity for replication/scaling to new MVs rather than grid connection plus diesel, if justified by least cost modelling or if additional financing is available (e.g., climate finance) Additional water conservation and management interventions might also attract co-financing.
Farmer management of climate risks and climate-related impacts on flock health and productivity	Farmer knowledge on climate risks and impacts, and capacity to adapt poultry management practices.	Farmer training on observed climate risks and impacts to flock health, and appropriate adaptation and resilience building measures in terms of managing flock health and productivity.

²⁴ Indigenous practices for cooling rooms involved placing water-filled clay pots in a room, building high roofs and using reeds for roofing.

Farmer adaptation to increasing costs of feeds due to climate change (as well as other factors)	Farmer knowledge of climate risks to feed sources, and capacity to diversify feed stocks and manage costs.	Feasibility on own feed production pilot and, if funding is available, implementation and moving to scale over the lifetime of the project, including production of more climate-resilient feed sources. Training of farmers on production and use of these inputs.
M&E	Lack of monitoring and evaluation indicators and framework to measure ability of solution to manage climate risks and gather data to identify specific measures to adapt or mitigate these and build resilience of poultry production (through adaptation of infrastructure, different feed inputs etc.)	○ Develop criteria and systems for robust data collection, and analysis of climate-related risks and impacts on poultry production, including identifying particularly vulnerable farmer groups. ○ Measure impact of climate-related risks on poultry production and ability to manage these risks through mitigation and adaptation measures over the lifetime of project.

Table 90: Climate resilience building measures

a. Energy Efficiency and Conservation

The solution envisages for the individual farmer solution the use of solar technology for incubation and lighting, but for the existing MVs to use the existing appliances and equipment in place and diesel-powered backup systems for the existing grid electricity supply, as the least cost options. The solution aims to ensure optimisation of the existing grid-connected incubation systems, which should improve the efficient use of electricity.

If additional resource is available, some components of the MV solution could be optimised for EEC, for instance, retrofitting of poultry housing to ensure they have the most efficient heating and cooling systems. For replacement equipment or new equipment for milling and mixing, there is an option to procure the most EE models available, as well as to ensure new physical infrastructure such as the aggregation hall promotes EEC. Transition to and optimization of infrared brooding equipment to replace paraffin brooders could be explored for the individual farmer model. There could also be the option to procure EE appliances and equipment and ensure the physical, electricity and water infrastructure for all aspects of production for new MVs are the most energy efficient, if additional resource is available.

b. Monitoring and Evaluation

The County will target to have minimum electricity access levels to allow for the empowerment for people in underserved communities with minimum energy targets necessary to improve education, accelerate the transfer of knowledge, facilitate communication, and promote entrepreneurship.

CEP energy access outcomes for livestock – Poultry

Impact: provide poultry farmers with reliable, affordable electricity & infrastructure for incubation & brooding plus reduced cost inputs, access to finance and stable markets.

Overall solution impact	Outcome	Indicator
Enhanced livelihood outcomes for target poultry farmers	Improved income through increased and planned poultry production, more affordable and reliable electricity, better flock management through improved training and mentoring, decreased costs of inputs (fertilised eggs, chicks, feed, vaccinations etc.) and improved market channels.	% of target farmers reporting increased incomes.
		% of farmers meeting loan repayments
		% increase in productivity
		% increase in sales of poultry products
Improved farmer and County Government understanding of climate change risks to poultry production and adoption of adaptation strategies	Climate vulnerability assessment of production carried out in Demo Phase and adaptive measures adopted	No. of assessments designed and implemented in Demo Phase
		No. of adaptive measures identified, including for infrastructure (cooling for chicken housing, use of climate-resilient feed ingredients etc.)
	Improved collection and analysis of climate risk-related data	No. of data collection tools and systems developed
		Data collected and analysed in Demo Phase
	Improved farmer and County Government awareness of climate risks and most vulnerable populations	M & E framework developed for implementation
		% of extension officers and farmers trained on climate risks and vulnerability and adaptation/resilience building measures
Increase awareness of GESI among CG staff and target farmers and ensure vulnerable and marginalised groups benefit	Political buy-in and understanding of GESI in Livestock Directorate	A standing farmer-CG project advisory group including external experts is established
		Policy for promoting GESI through County livestock programmes
		GESI Champion appointed in Ministry of Agriculture
	Improved collection and analysis of GESI data	No. of partnerships to supply GESI expertise/carry out GESI initiatives
		No. of data collection tools and systems developed to disaggregate farmers by gender, age, ethnicity, disability, etc.
		GESI disaggregated database
	Increased participation of women and marginalised groups in the poultry solutions	Analysis of GESI-related issues during Demo Phase
		No. of measures identified to maximise GESI outcomes in implementation.
		M & E framework for implementation
		% of farmers that are women and people from marginalised groups.
		% women and people from marginalised groups in MVs Governance Committees

			% of women and people from marginalised groups trained.
			% of women and people from marginalised groups accessing microfinance.
		Build awareness of GESI among input suppliers and sales partners	GESI sensitive policies/practices
		Improved CG staff and farmer awareness and GESI practices	% of extension officers trained in GESI approaches
			% of farmers trained in GESI approaches
		Improved GESI outcomes in recruitment and retention	No. of GESI-related gaps or barriers and best practice in recruitment and retention of EOs identified
			% of women Extension Officers and people from marginalised groups
			% of women and people from marginalised groups recruited
Specific outcome and output indicators			
	Impact	Outcome/output	Indicators
1.	Target farmers have a reliable supply of electricity	MVs have reliable electricity for incubation, lighting etc.	% of target MVs with back-up system
			Decrease in frequency and duration of power outages (% of time MV has electricity)
		Individual farmers have reliable incubation & lighting systems	% of farmers with SHS + batteries
		MVs and individual farmers have reliable maintenance and repair	% of MVs and individual farmers receiving annual maintenance and repair
			Number of people at MVs trained on maintenance of back-up systems
			Number of farmers trained on SHS maintenance
2.	MVs have operational equipment and appliances (incubators, infrared lighting, mixers, and millers etc.	Equipment operating at full capacity	% of MVs with essential equipment fully operational
		Improved operation of maintenance of equipment and appliances	Number of staff employed to operate/maintain equipment
			Reduced breakdown of equipment due to incorrect operation/lack of maintenance
			% of losses due to equipment malfunction/breakdown
3.	More sustainable water management at target MVs	More efficient water usage and increased conservation	Number of water meters installed
			Number of staff trained on sustainable water management
			Number of water-harvesting measures implemented
			% reduction in water usage through conservation measures
			% reduction in water costs
			% increased awareness and use of water management and conservation strategies amongst staff and target community
4.	Sustainable poultry production	Reduction in costs of inputs	% reduction in costs of feed materials
			% reduction in cost of chicks

			Number of MV/individual farmers doing own feed milling and mixing
			Number of bulk purchase agreements with input suppliers
			Feasibility for own feed production completed
			Number of operational own feed production plots
		Reduction in flock mortality	% of stock lost to disease
			% of flock vaccinated
			% of farmers trained in disease prevention and management
		Improved productivity	% of MVs/farmers with production plans and record keeping
			% increase in flocks
			% of F1 grade eggs supplied
			% hatch rate (% of incubator operating capacity used)
			% of birds sold for white meat
			Numbers of farmers trained on improved poultry breeds, production and management practices for layers, chicks, housing, feed and nutrition requirements of poultry etc.
			% of expenditure by target farmers on OPEX for appliances and equipment
		Improved business and financial management	% of MVs/farmers trained on production planning and record keeping
			% of farmers paying membership fees for MVs/self-help groups
			% of farmers
			% of farmers accessing MIFI loans
			% of farmers trained on financial management
5.	Increase in sales	Understanding of markets & increased market channels	Completion of market mapping survey.
			% of farmers trained on how to access markets
			Operational Apex Cooperative established
		Improved marketing practices	% of farmers trained on marketing & contract negotiation.
			Number of farmer sales contracts
		Overall	% increase in sales of different products

Table 91: Output and outcome indicators for the poultry solution

Conclusions

The poultry solution seeks to build on the sunk capital and capacities in the four existing MVs and to reinvigorate these and build a viable business model for the farmers. Once successful, this model could be scaled to new model villages, although this would require additional finance for capex. It also aims to build a viable individual farmer business model

for farmers organised into self-help groups that can piggy-back on the MVs in terms of access to affordable inputs, training and marketing. Critical success factors for the solutions include the following:

- Member recruitment drives and ongoing active membership (including payment of membership fees) by a critical mass of MV farmers with identified champion/lead farmers, including carrying out demonstration activities on own feed production and breeder farm.
- (Re)training and recruitment of specialist extension officers in poultry management to provide ongoing support, along with expert training and mentoring on production planning, and business skills such as marketing, financial management and records keeping, in a 'learn-do-check' approach to ensure widespread knowledge and skills transfer. Expert training and mentoring approaches will also be needed to embed GESI approaches and climate adaptive poultry management.
- Effective operation and maintenance of equipment and poultry housing to prevent business downtime.
- Access to affordable finance to meet first cycle operating costs and equipment investment.
- Access to a diversity of market channels and sales to reliable markets.

The following next steps should be undertaken to move forward from proposal stage to implementation:

c. County Access to Clean Cooking

This section provides an overview of access to clean cooking in the County. It should be noted that it has not been possible to provide data on all the areas envisaged in the INEP Framework for CEPs given the significant data gaps related to cooking access, availability of fuels and technologies, County policies, end user practices and preferences, and current and past initiatives promoting clean cooking. In summary, there is no comprehensive historical data on the cooking sub-sector in Meru County.

Review of County Integrated Development Plans (CIDPs) 2013/2017 and 2018/2023 and the related Annual Development Plans (ADPs) did not capture any mention of cooking solutions. Similarly, the County's development blueprint, Meru Vision 2040 mentions energy as a key development pillar but does not refer to cooking solutions as a development priority.

Furthermore, there is lack of disaggregated data on the use of cooking fuels and technologies by women, youth, persons with disabilities, low-income end-users, disadvantaged groups and communities, and people living in remote regions. This is critical given the gendered nature of household and community cooking practices and the socio-cultural and economic drivers of cooking demand, practices and preferences, including affordability. Energy poverty tends to be very high among women, girls and socially excluded groups. These groups of people still use firewood, charcoal, energy inefficient cook stoves, plant residues and animal dung as

fuels for cooking and heating. They also spend their time and labour collecting and managing these fuels and are the most impacted by negative health impacts of smoke inhalation from inefficient stoves in poorly ventilated houses. This exposure affects children and other family members hence health deterioration and even loss of lives.

a. Policies, Laws And Regulations That Relate To Clean Cooking

Globally, access to clean cooking falls under Sustainable Development Goal No. 7 on ensuring “access to affordable, reliable, sustainable and modern energy for all” by 2030. At national level, Kenya has set a target of achieving 100 per cent access to clean cooking by 2028 and clean energy by 2030, contributing to the Nationally Determined Contribution (NDC) target to abate emissions by 2.8 MtCO₂eq in 2030 (MECS, n.d)

The promotion of clean cooking solutions in Kenya is also guided by various policies that involve different stakeholders from the public, private, and civil society sectors, as well as producer groups. These policies are relevant for both the national and County Governments and aim to facilitate the transition to cleaner and more efficient cooking technologies and fuels. Some of the key policies that inform the promotion of clean cooking solutions in Kenya are:

- The SEforALL Action Agenda and Investment Prospectus (2016). This brings to the fore the investments required to improve access to modern cooking solutions.
- The Energy Act of 2019 articulates the Mandates of both national and County Governments on energy planning.
- The Energy policy of 2018 expands the mandate of REREC to promote renewable energy including alternative cooking solutions and take charge of energy centres across the nation.
- The Bio-energy Strategy 2020-2027 promotes the sustainable production, distribution, and utilization of bioenergy as a clean source of energy (which gives an overview of national data on bioenergy in Kenya).
- The Kenya National Energy Efficiency and Conservation Strategy (KNEECS) 2020; discusses cooking solutions at the household level using data from the 2019 Census.
- The Kenya Clean Cooking Compact 2021, targets a transition of institutional stoves from firewood to alternative cleaner energy sources
- The Forest Conservation and Management Act of 2016
- The Forest (Charcoal) Rules 2012
- The Masterplan for Development of Bioethanol fuel in Kenya, 2019
- Other strategies under development include The National Clean Cooking Strategy and the National E-cooking Strategy.

The cooking sector relies on various fuels and technologies that must meet quality standards. One of the most important standards is the ISO standard for biomass cook stoves (KS 1814 2019), which defines technical requirements and performance indicators for different types of biomass stoves. Other relevant standards are the ones for ethanol-fuelled cooking appliances (KS 2759 – 2018), domestic biogas stoves (KS 2520 – 2014), the technology-neutral standards and labelling program, and the standard for solid biofuel–sustainable charcoal and carbonised briquettes for household and commercial use (DKS 2912 – 2020).

b. Access Trends In The County

Using 2019 as the base year for understanding the cooking status in the County, Meru County had 423, 931 conventional households (KNBS, 2019) out of which 74.3 percent relied on firewood, 12.6 percent on LPG, and 9.8 percent on charcoal to meet their cooking. The remaining households relied on other sources of fuels as shown in Figure 44 below.

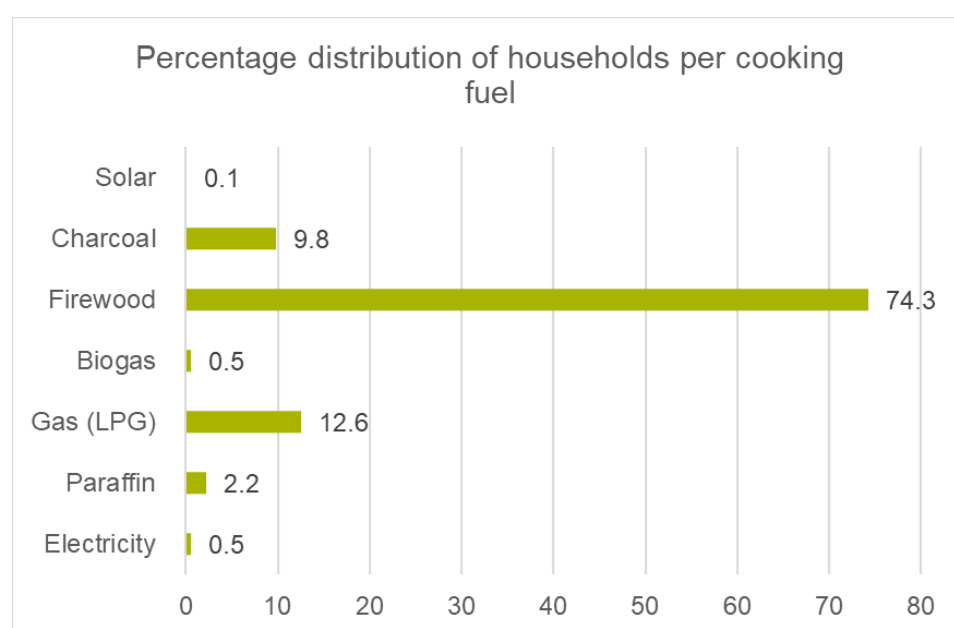


Figure 46: Households distribution in Meru County based on fuel use

Based on these statistics, together with WHO (2014) definition of clean fuels and technologies, 13.7 percent of all households in Meru County were using clean fuels in 2019, namely, electricity, LPG, Biogas and solar energy. This illustrates the high dependence on biomass fuels in the County, which have negative impacts on health, environment, economy, and gender equality.

c. Overview Of Cooking Fuels And Technologies In The Sub-Counties

At sub-County level, Tigania Central had the highest percentage (90.9%) of households using firewood, while Imenti North had the highest percentage (34.4%) of households using LPG. Buuri West had the highest number (23.7%) of households using charcoal (see Figure 45).

Overall, nine out of the eleven sub-counties in Meru County have over 70 percent of

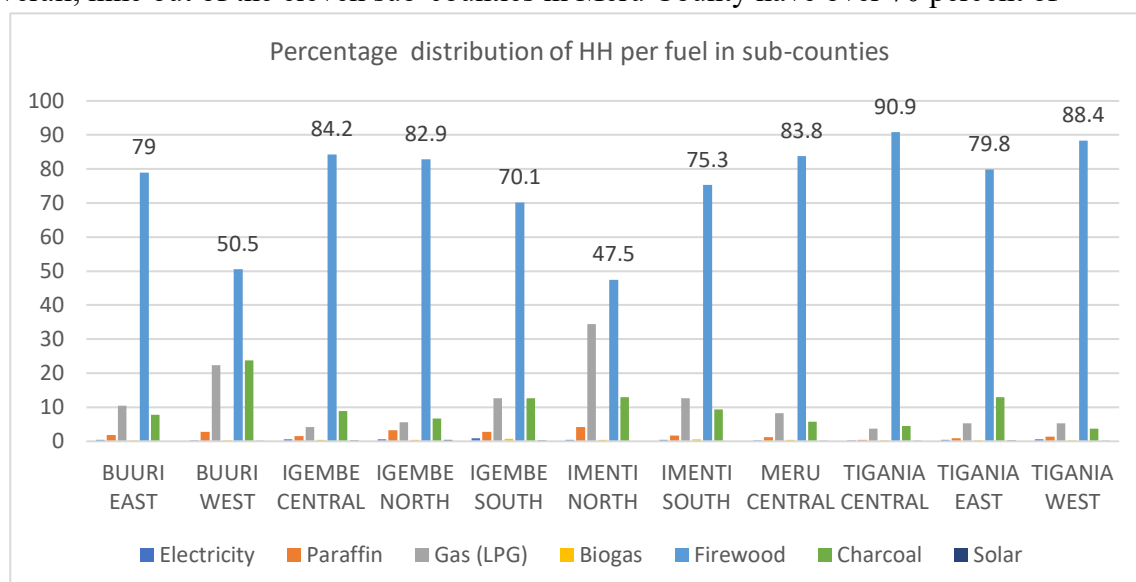


Figure 47: Percentage distribution of households based on cooking fuels per Sub-Counties in Meru

households using firewood, implying that firewood is the most dominant fuel in the County.

The analysis of the household survey done by the SETA project in the County in 2022 targeting 3 sub-counties and 131 households in six wards showed that about 82.4 percent of the households were using traditional, three stone open fires, while 37.4 percent were using a form of improved cookstove as primary cooking technology. Note that the summation of the two percentages in Figure 46 exceeds 100 percent. This is an indicator that, there are households that use both three stone open fires and an improved form of cookstoves to meet their primary and secondary cooking needs, what is normally referred to as fuel and technology stacking.

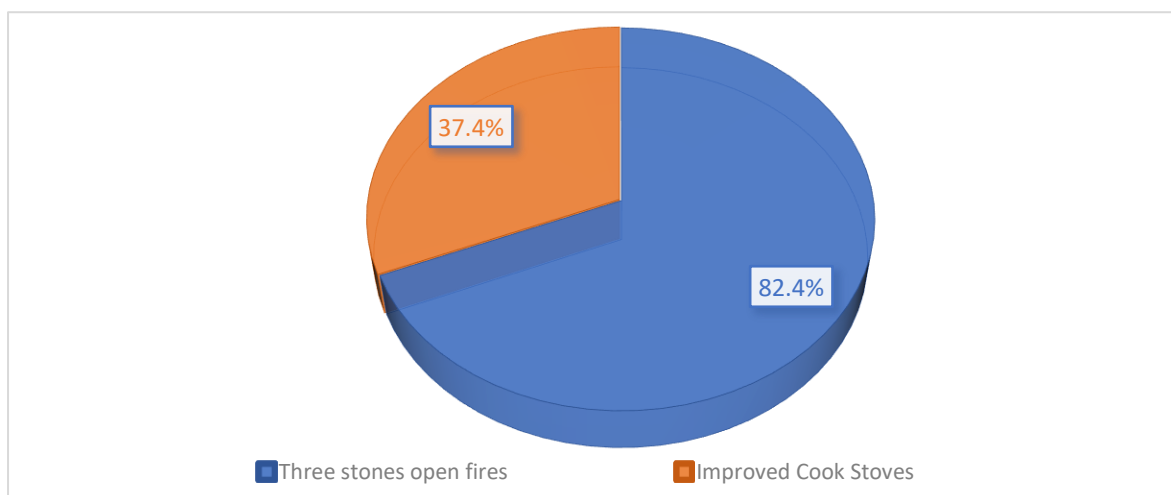


Figure 48: Distribution of households per cooking technology used

From the surveys carried out as part of the baseline activities in three sub-counties in Meru, (Kenya Ceramic Jiko KCJ), Maendeleo Jiko, and Environfit Jiko were the most dominant stoves at 25.2, 8.4, and 7.6 percent respectively among the households using improved cookstoves as their primary cooking technology. There were other types of improved cookstoves as shown in Figure 26 below. It can also be deduced that of all households using charcoal in the County, only 35.1% were using improved cookstoves i.e. KCJ, Environfit, and Jiko Koa (see Figure 47 below) Note that the use of KGas denotes use of LPG & the associated technology.

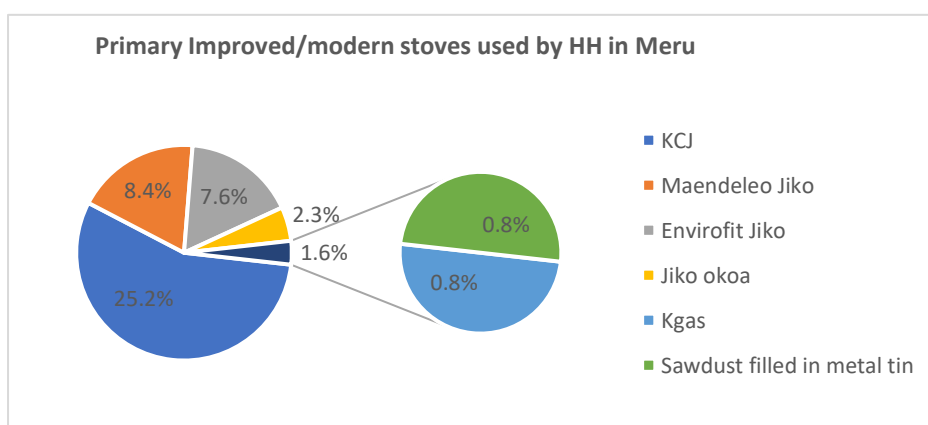


Figure 49: Distribution of households per cooking technology used

LPG had the highest usage at 51.9 percent as secondary fuels used by households (Figure 48), while electric cookers are used by 1.5 percent and biogas are used by 0.8 percent of the households as secondary cooking solutions.

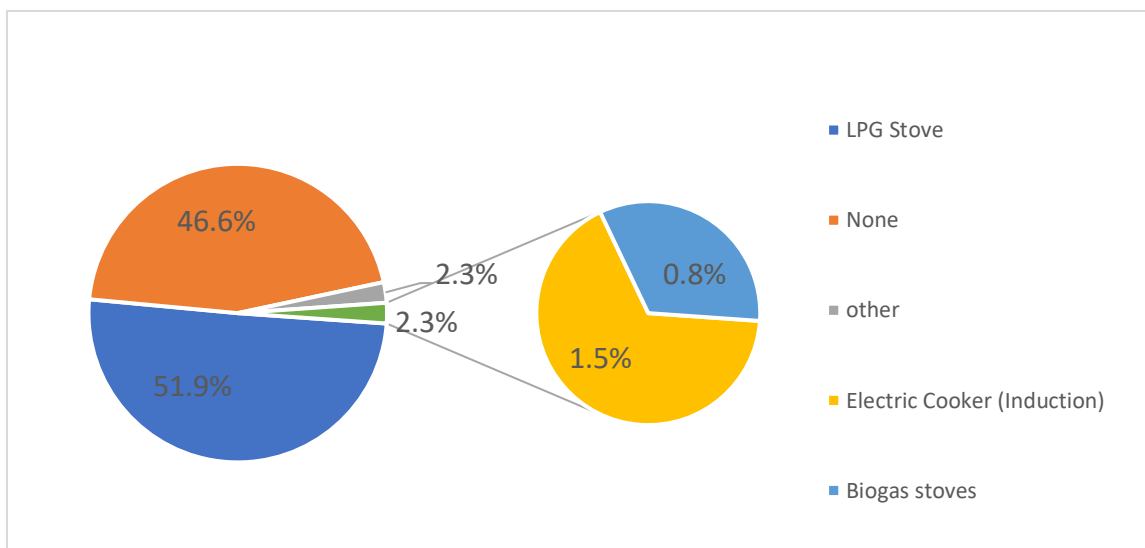


Figure 50: Distribution of households based on secondary fuels

d. Key Stakeholders Involved in the Clean Cooking Sector

While cooking solutions were not mentioned or prioritised in previous planning cycles, stakeholders (both state and non-state) were actively promoting them, including the Ministry of Energy through Mitunguu Energy Centre, Caritas Meru, GIZ (central region), Rural Community Development Agency (RCDA), Mwangaza Light (Jiko Koa; national), as well as local artisans who manufacture various types of improved cook stoves. New entrants to promote cooking space in Meru County include Practical Action (promoting cook stoves) and SNV which are promoting biogas technology. However, the initiatives of these two organisations are still at the formative stage.

i. Demand For Cooking Services in The County

This section is supposed to cover the status of cooking technology and fuels use in the County. It shall address both traditional, transitional and modern cooking technologies and fuels.

It has not been possible to complete Tables 80 (a), 81 (b) 82 (c) 83 (d), and 84 (e) showing access to cooking fuels and technologies progression up-to 2028 due to a lack of data on which to base forecasting. Data for 2019 is available from KNBS (2019), see Table 98 (f) below.

Apart from a lack of quantitative data, there is little qualitative data on the drivers of consumption of traditional, transitional and modern cooking technologies and fuels. A literature review carried out as part of the CEP development aimed to analyse the available secondary data, and further primary data was collected through household surveys, KIIs, community engagement, and sectoral workshops. This identified several barriers to the adoption of modern cooking solutions in Meru County (see Section 3.2.3 below).

Year	2019	2020	2021	2022	2023	2024	2025	2026	2027	2028
Firewood %	74.3									
Charcoal %	9.8									
Briquettes %										
Pellets %										
Kerosene %	2.2									
Bioethanol %										
LPG %	12.6									
-6 Kg Cylinder										
-13 kg Cylinder										
Others eg Agric waste %										

Table 92a: Percentage of households using different fuels in the County

Year	2019	2020	2021	2022	2023	2024	2025	2026	2027	2028
Three Stones Open Fire										
Traditional Metallic Charcoal Stoves										
Improved Charcoal Stoves										
Advanced biomass stoves (gasifier and other Tier 3+ stoves)										
Bioethanol stoves										
LPG stoves										
Electric hot plate/coil										
Electric pressure cookers										
Microwave ovens										
Induction stoves										

Table 93b: Percentage of households using different cooking technologies in the County

Year	2019	2020	2021	2022	2023	2024	2025	2026	2027	2028
Firewood										
Charcoal										
Briquettes										
Pellets										

Kerosene										
Bioethanol										
LPG										
Electricity										

Table 94c: Percentage of institutions using different fuels in the County

Year	2019	2020	2021	2022	2023	2024	2025	2026	2027	2028
3- Stones										
Inst Rocket stoves										
LPG										
Electric stoves										

Table 95d: Institutional stoves in the County

Year	2019	2020	2021	2022	2023	2024	2025	2026	2027	2028
Firewood										
Charcoal										
Briquettes										
Pellets										
Kerosene										
Bioethanol										
LPG										
Electricity										

Table 96e: Percentage of SMEs using different fuels in the County

Volume IV of the Kenya Population Households Census (KNBS, 2019) highlights the County's energy use in terms of cooking and lighting. In detailing distribution of conventional households by main type of cooking, the report's findings identified the use of firewood most prevalent with 74.3% of the County's 423,931 households using firewood for cooking. The use of LPG followed with 12.6% of the County's households using gas as main type source of cooking energy. The lowest recorded energy source for cooking was reported to be 0.1%, electricity (0.5%) and Biogas (0.5%). See Table 98f below.

County/Sub-County	Type of Cooking Fuel (%)								
	Conventional Households	Electricity	Paraffin	Gas (LPG)	Biogas	Firewood	Charcoal	Solar	Not Stated
Meru	423,931	0.5	2.2	12.6	0.5	74.3	9.8	0.1	423,931

Buuri East	23,737	0.5	1.8	10.5	0.3	79.0	7.8	0.0	0.0
Buuri West	27,905	0.3	2.8	22.3	0.3	50.5	23.7	0.1	0.0
Igembe Central	51,848	0.6	1.5	4.2	0.4	84.2	8.9	0.2	0.0
Igembe North	38,716	0.6	3.2	5.6	0.5	82.9	6.7	0.4	0.0
Igembe South	43,222	0.9	2.8	12.6	0.7	70.1	12.7	0.2	0.1
Imenti North	57,556	0.4	4.2	34.4	0.5	47.5	12.9	0.0	0.0
Imenti South	63,954	0.4	1.7	12.6	0.6	75.3	9.4	0.0	0.0
Meru Central	39,498	0.2	1.2	8.3	0.5	83.8	5.8	0.1	0.0
Tigania Central	24,983	0.2	0.4	3.7	0.2	90.9	4.5	0.1	0.0
Tigania East	16,791	0.5	0.9	5.3	0.3	79.8	12.9	0.3	0.1
Tigania West	35,402	0.6	1.4	5.3	0.3	88.4	3.7	0.1	0.0
Meru National Park	46	-	-	87.0	2.2	-	10.9	-	-
Mt. Kenya Forest	273	-	0.4	4.4	-	94.1	1.1	-	-

Table 97f: Percentage distribution of conventional households by main type of cooking fuel, area of residence, County and sub-County

Source: KNBS (2019)

ii. Supply Of Cooking Technologies and Fuels

There is no database of suppliers of clean fuels and technologies at the County level, and it was not possible in the scope of the CEP to undertake this data collection exercise.

LPG – there is no comprehensive data on this.

Depots for LPG in the County

Type and sizes of cylinders within the County

Distributors and service providers for LPG appliances

Bioethanol – there is no comprehensive data on this.

Sources of bioethanol fuel

Distributors/vendors of ethanol and ethanol gel and their coverage

Electric Cooking

Manufacturers, distributors and vendors of electric cooking stoves.

There is no comprehensive data on this.

The LCE modelling can be used as a guide to the location of populations with Tier 3 access that are “electric-cooking ready”. Electric cooking is discussed as a Transition Pathway in Sections 3.2.3 and 3.2.4 below.

Biogas – there is no comprehensive data on this.

- Availability of installers for biogas systems
- Types, sizes and materials for biogas systems
- Manufacturers and distributors of appliances and accessories

Wood fuel technologies – there is no comprehensive data on this.

- Transitional cooking technologies such as types and sizes of improved firewood and charcoal stoves,
- Production centres and the capacity,
- The sub section will include other emerging technologies that may be in the County.

Clean Cooking Market Ecosystem – there is no comprehensive data on this.

Sections 3.2.3 and 3.2.4 below contain information on stakeholders involved in clean cooking access, past and current initiatives on clean cooking and barriers increasing access to clean cooking solutions in rural and urban settings.

iii. Clean cooking plans for the County

Barriers to adoption of clean cooking fuels and technologies

Below is a summary of energy and non-energy challenges that were identified as the underlying causes leading to the low uptake of cleaner and more efficient cooking fuels and technologies in the County from primary and secondary baseline research and additional research and analysis carried out using the EDM process for the CEP development.

1. Energy barriers and challenges

- Low/limited availability of alternative and affordable clean cooking appliances in the local markets
- High capital expenditure (capex) and/or operating expenditure (opex) for some of cooking solutions e.g., LPG costs about KES 4880/- to acquire a 6kg LPG cylinder, burner, and the grill as the initial capital investment and the operating cost of about KES1600/- for every refill (Total Energies September 2023). Also, the opex for installation of 8 M3 biogas plant is about KES 82,000/- (Sistema Bio, n.d)

- Sale/installation of sub-standard cooking appliances and fuels e.g., non-functioning biogas systems, LPG stoves and gas cylinders-not filled with gas but unknown liquid that does not burn/combust, biogas plants that do not produce gas due to poor masonry work or feeding of the plants.
- Local fabricators opting to produce and sell low quality ICS (use of light gauge -32 metal clads plus unfired clay liners) with the justification that liners will be fired during cooking and more importantly, that the stoves won't last long, therefore the end-users will be forced to re-buy new stoves after every few months (1-3 months)
- Low number of local suppliers of modern cooking solutions especially as you move towards the rural parts of the County due to limited demand/ under-developed market.

2. Non-energy barriers and challenges

- Cultural beliefs e.g., a belief that certain foods are better cooked by traditional/rudimentary cooking solutions e.g., three stone open fires or un-improved charcoal stoves to make local delicacies such as ugali, Nyama choma
- Low awareness by men, women, persons living with disabilities and marginalised people in rural areas about time saving, health, and environmental benefits of using clean cooking solutions.
- Lack of essential amenities for setting up clean, cheaper, and easy to use cooking systems e.g., land, water, animals (feedstock)
- Fear of accidents that comes from using modern cooking solutions especially LPG where leaking gas could explode when used indoors. Similarly, some of the women participants during community engagement workshops expressed fear of letting their younger family members to use LPG because of likely burns as compared to using three stone open fires.
- Preference based on age disparity. During the community engagement workshops, older persons preferred traditional methods of cooking-justifying that these are the solutions they have known and accustomed to, their entire life, while younger participants were more open to adopt different modern cooking solutions.
- Gendered nature of energy poverty and cooking practices. Along with the other barriers related to socially marginalised groups above, the issue of promoting GESI in cooking solutions is discussed below.

Strategies To Promote Access to Clean Cooking Solutions By Households

The value proposition is to improve access to clean, affordable, faster, reliable, adequate, and safer cooking solutions by households currently using rudimentary cooking solutions in Meru County.

The proposed interventions are aimed at addressing the challenges identified above and to support specific transition pathways for different groups of households to cleaner fuels and

efficient technologies. The solutions target three groups of households, namely, households using firewood in three-stone open fires, households using purchased charcoal in traditional charcoal stoves, households using Kerosene. These solutions are also meant to create demand for the different modern cooking solutions available in Kenya and within Meru County. It is assumed that the suppliers of different clean cooking solutions will supply the products to Meru as long as the demand is there. The transition of households to clean cooking solutions will follow different pathways as described in Figures 49, 50, and 51. Table 99 provides an overview of solution components.

I. Solution components

Intervention Area	Description of the intervention
a. Carry out awareness raising campaigns	This intervention is aimed at addressing the non-energy challenges of (i) cultural norms & believes (ii) low awareness by households on benefits of using modern cooking solutions (iii) fear of burns. The outcome of this intervention is increased demand for different types of cleaner fuels and efficient cooking technologies as more households opt to transition following different pathways. A proposal is made for the awareness raising campaigns to be carried out in all the sub-counties in Meru County, with more emphasis being laid to sub-counties that have more than 70% of households using firewood and three stone open fires. The campaigns will prioritize end-user cooking needs and behaviours and it put women and girls at the center because they bear greater responsibility of meeting household cooking-energy needs and are mostly affected by the lack of it. The proposed awareness raising activities include • Developing easy to digest information nuggets for women and socially excluded groups especially in rural areas such as easily readable and understandable materials through pictorial or local language • Holding demonstrations events i.e. (a) live cooking (b) field demonstration using different clean cooking solutions which are broadcast on mass media. • Holding clean cooking roadshows timed to coincide with recurrent events such as market days, farmer's days • Targeted campaigns for groups such as women groups, Self-help groups, farmer groups, youth groups, and marginalised persons etc., through trainings and consumer education campaigns sessions on the use, availability, affordability and safety of the clean cooking solutions including the health, financial, environmental, social and psychological benefits that come with the adoption of clean cooking solutions In designing these activities and developing the campaign materials, the following questions will act as a guide Who cooks? What is cooked? How is it cooked? With what fuel? At which time? in which vessel? for how long? and how frequently? this in realization that acquisition of clean cooking solutions (fuels and stoves) is just one element of the services performed by the household

	cooking solutions, thus more needs to be done beyond supply of the cooking fuels and technologies. To avoid picking winners especially where public resources are used for the campaigns, the activities implemented under this intervention are designed to increase awareness and promote a clean cooking environment and technology without giving any brand prominence over the others in the market. The campaigns will be a concerted effort bringing on board different stakeholders, namely, the Meru County Government (collaboration between different directorates i.e. energy, climate change, environment, gender, health, and trade), National Government through Mitunguu Energy Centre, Civil Society Organizations such as Caritas Meru, Development partners such as GIZ, SNV, Private Sector actors such as Sistema bio, financial institutions offering cooking solution products e.g., Equity, KWFT etc., CCAK.
b. Training of local ICS fabricators and cooking solution installers	This intervention is aimed at addressing the energy challenge (i) low quality ICS being produced and sold to end-user in Meru County (ii) lack of repairs and maintenance for cooking solutions (iii) installation of sub-standard cooking solutions such as biogas (poor masonry work). Local artisans (including women and other marginalised persons) will be trained and sensitized on the importance of producing quality cooking solutions and provision of repairs and maintenance for cookstoves and biogas systems. Mitunguu Energy Centre has well established facilities to provide quality training to artisans on production of different varieties of cooking solutions such as construction of biogas systems, and improved cookstoves. Similarly, private sector players such as Sistema Bio have capacity to train local artisans on installation and maintenance of the biogas system. Further, the current fabricators of stoves have potential to provide hands-on training to interested artisans at a fee.
Improving access to finance and credit	This intervention is aimed at addressing the challenge of (i) high capex for acquiring clean cooking solutions (ii) low availability of alternative modern cooking solutions. The intervention considers the following alternatives for accessing financing (see section 3.3 on source of financing for detailed description) • Groups (self-help groups, farmer groups, church groups etc.) riding on their existing practices of weekly/monthly contributions for bulk purchase of ICS. • Riding on revolving fund set up by Meru County for Micro, Small & medium size enterprises (see Meru CIDP 2023-27 under department of trade, Industrialization, Tourism and cooperative) for cookstove entrepreneurs to access affordable credit to stock different varieties of fuels and efficient cooking technologies. The County has set aside KES 600 million for 5 years • Directorate of Energy in Meru County purchasing different cookstoves in bulk for • Distribution/sell under subsidy (25% or 50%). This is to reach double or 4 times the number of targeted end-users and inculcate the sense of ownership as compared to if it is given free

	• Distribution to households under affirmative action (poor households that cannot afford to acquire the stoves under subsidy) • Accessing loan from financial institutions and SACCOS; either specific loans for cooking solutions or general loans. The County to work with these financial institutions to develop financing models that support women and other marginalised groups access to clean cooking products and easy and affordable process.

Table 98: Overview of solutions components

Based on the understanding that households have context specific cooking needs, preferences, and believes and that stakeholders play critical role in spurring adoption of clean cooking solutions, discussions were held with the technical committee of Meru County on the most viable transition pathways for:

- i. Households using firewood and three stone open fires
- ii. Households using charcoal or Kerosene with inefficient technologies.

Therefore, the following transition pathways (Fig 34, Fig 35, and Fig 36) for each of the household categories were considered viable. The pathways were also ranked in terms of options i.e., Option A being the most viable path (first Priority), Option B, the second most viable path (second priority), and Option C the third most viable path (third priority).

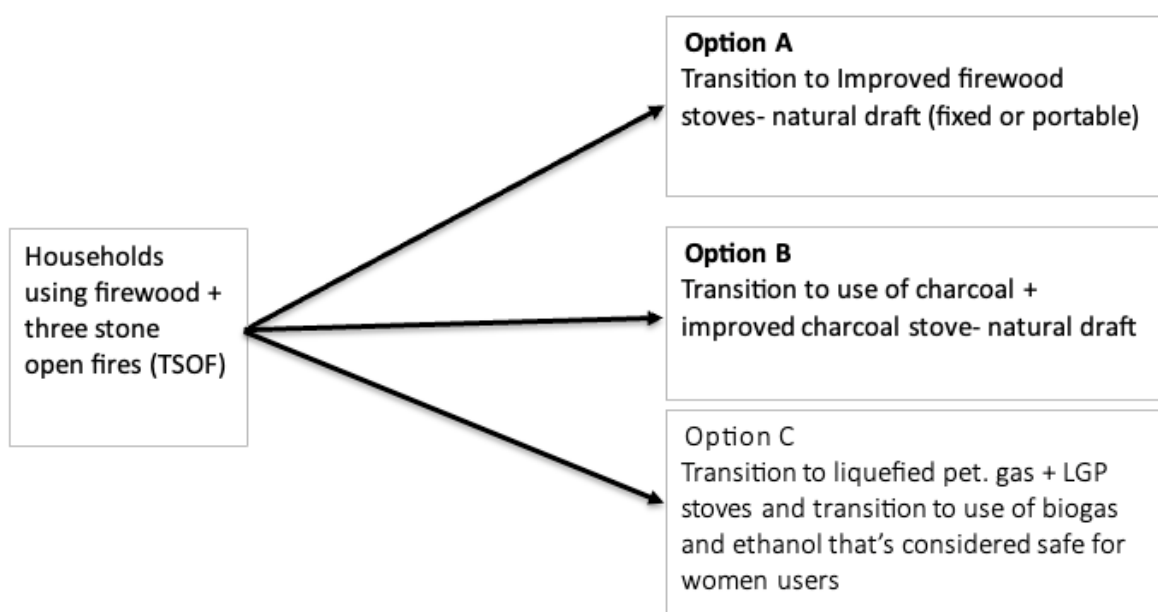


Figure 51: Pathway 1: Transitioning households using firewood and three stone open fires

Option B and C were confirmed as 2nd and 3rd priority of transitioning for households currently using firewood. Worth to note that these options introduce the element of operating cost in addition to capital expenditure. For example, option B requires households to purchase improved charcoal stoves and either produce charcoal for own consumption or purchase from nearby vendors while option C requires households to purchase LPG (has another challenge in terms of adequacy and reliability of supply in remote areas, which could make cost of refilling LPG higher compared to households using the same fuel in urban areas).

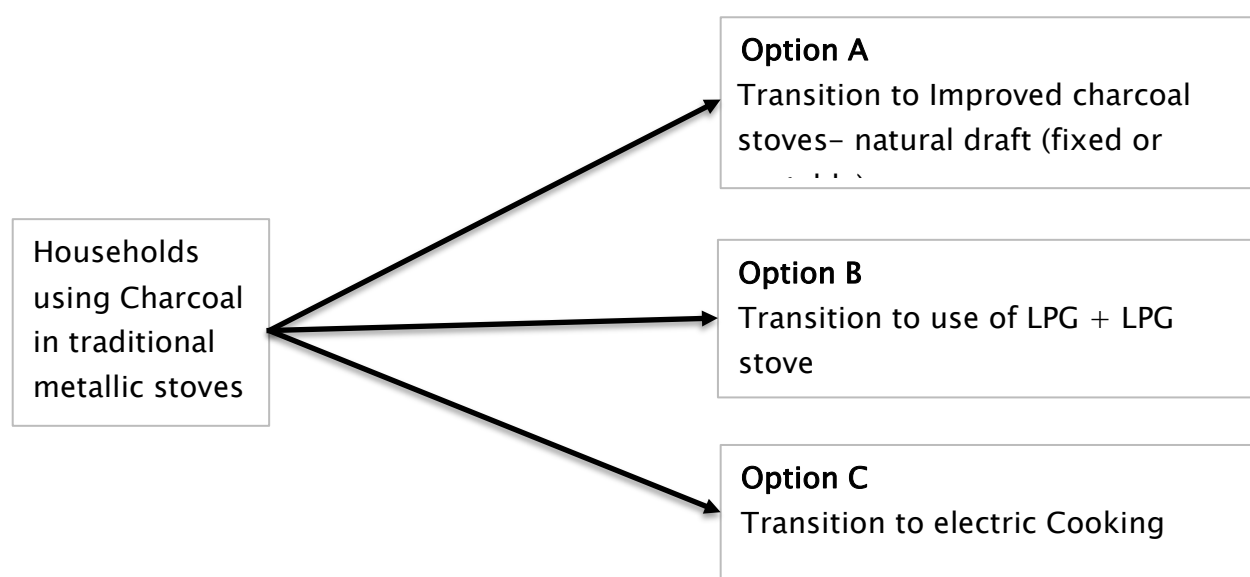


Figure 52: Pathway 2: Transitioning households using charcoal in traditional metallic stoves

As for Pathway 2, the transition to improved charcoal stoves was considered as the most viable path for households currently using traditional charcoal stoves (first priority). It was assumed that these households were already incurring cost of purchasing charcoal and few were producing the fuel for own consumption, therefore, supporting them to adopt ICS with its inherent benefits was considered a quick win for end-users in terms of accrued financial benefits following reduced fuel consumption due to improved efficiency of the stoves.

Transition options B and C were given second and third priority respectively. Unlike in Option A, where the targeted end-users are already using the fuel of choice and only capital expenditure of acquiring the ICS is envisaged, Options B and C require the end-users to acquire new cooking solutions where capital expenditure and new operating costs come into play. Further, issues of affordability, safety, & reliability of supply for LPG, & connectivity, safety, affordability, reliability, and adequacy of electricity supply.

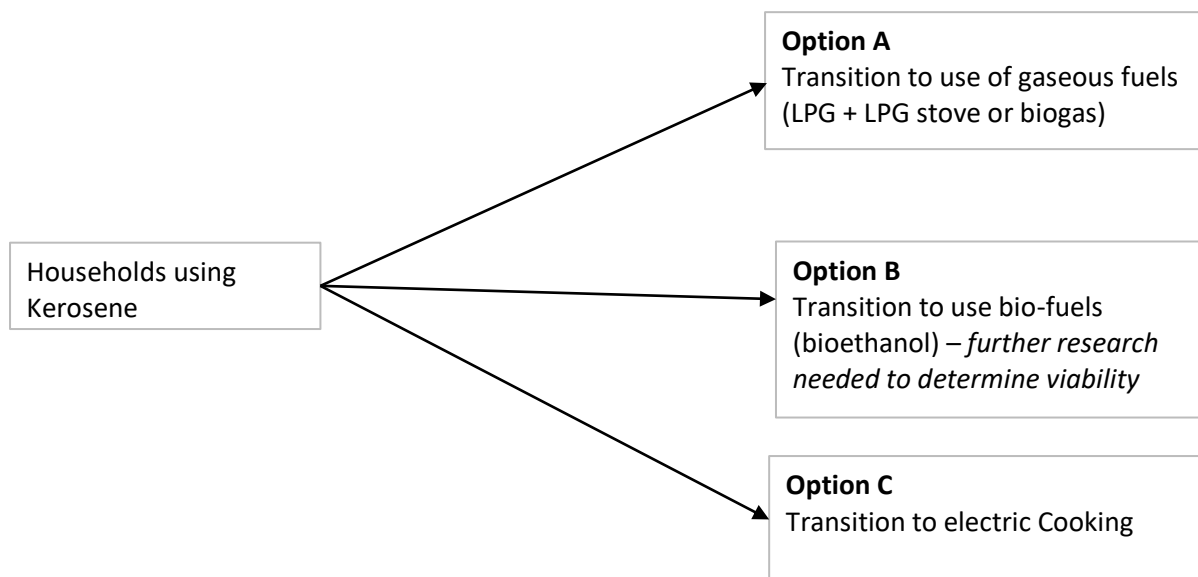


Figure 53: Pathway 3: Transitioning households using kerosene

This pathway is premised on the reality that the targeted households are already incurring consumption cost for Kerosene. Option A, transitioning to either use of LPG or biogas was given 1st priority. LPG was considered an option especially for those households in areas that have access to reliable supply of the fuel. Issues flagged out by the technical committee that have bearing on adoption of LPG included, quantities/packaging of LPG, affordability, cooking practices of the households.

Biogas was also considered a first option for the targeted households. It was considered viable to households that have the requisite infrastructure and feedstock for biogas generation i.e., sufficient space for setting up/installation of the bio-digester, reliable supply of water, and animal waste among others.

Option B was considered the 2nd transition priority for the targeted households. Currently, Bioenergy appears to be supplied in limited places in Meru County especially within Meru town. Therefore, the target end-users for this solution will be mainly those within the urban setting where they can easily access the refilling shops. However, empirical studies are needed to ascertain the actual cost savings of switching to bioethanol. This will help determine the viability of such transition. Electric cooking (3rd priority) was considered conditional to households that have access to reliable and affordable electricity (grid or off-grid).

II. Alignment With CIDP Priorities

The clean cooking solution aligns with priorities and strategies of the Department of Roads, Transport and Energy, of Meru County. Its CIDP 2023-2027 prioritizes “promotion of clean cooking strategies” and outlines the following strategies, construction of demonstration hubs, provision of Clean cooking solutions e.g., Meko jikos, Sensitisation on clean cooking, and demonstration of clean cooking technologies. Under Programme 2 of new projects of the Department, the following projects align with cooking solutions; clean energy provision and capacity building and training (aimed to Sensitise households on clean cooking). Table 100 below highlights alignment between CIDP and CEP solution components.

Whereas energy solution components are all included in terms of activities, other non-energy activities of the solution are left out, namely, trainings of local artisans on production/installation of quality cooking technologies and access to finances for end-users and suppliers of cooking solutions.

SECTOR	CEP Solution Components	CIDP Priority	Activities	Implementing Agency
Clean Cooking – Access to affordable, cleaner, safer, efficient & reliable cooking fuels/ technologies	Development of a roadmap for transition to clean cooking solutions in Meru	Programme: County Energy Sub-programme (s)/Project: Promotion of clean cooking energy strategies, policy development; renewable energy generation	• Sensitisation, • Feasibility Studies, • Policy development • Database, • Purchase and distribution of clean cooking appliances	• Directorate of Energy

Table 99: Alignment of Clean Cooking Solution with CIDP

III. Financing Models

The total cost in terms of purchasing the different technologies for Transition Pathway 1 and the working assumptions are presented in Table 88 below. It should be noted that the use of different brands in determining the costs was informed by availability of these products in Meru County and also on online platforms. It is not meant to lock out any potential investor or entrepreneur who would like to introduce new solutions to the County. Note that the budgets exclude components that support GESI interventions like training, consumer awareness, information access and management and access to finance models to be implemented which are captured in Table 91.

Pathway 1

	Number of households using firewood	314,980	Data from KNBS (2019) census report)		
	Number of households using TSOF	259,543.52	Data extrapolated from SETA (2022) HH survey in Meru where 82.4% of HH relied on TSOF		
				Option A	
	Improved woodstoves names/brands	Retail Prices (KES)	Number of HH	Overall CAPEX (KES)	Assumptions
	Maendeleo Jiko fixed	3500	181,680.46	635,881,624.00	70% of HH take this option
	Maendeleo Jiko portable	1500	25,954.35	38,931,528.00	10% of HH take this option
	Jiko Smart	4800	25,954.35	124,580,889.60	10% of HH take this option
	Kuni Okoa	3990		103,557,864.48	
	Jiko Dura	3800		98,626,537.60	
	Supersaver	4500		116,794,584.00	
	Fireless cookers	1800	28852.17	46,717,833.60	
				Option B	
	Improved Charcoal stoves names/brands	Retail Prices (KES)	Number of HH	Overall CAPEX (KES)	Assumptions
	KCJ	1200	15,572.61	18,687,133.44	6% of HH take this option
	Jiko Okoa	4500	5,190.87	23,358,916.80	2 % of HH take this option
	Jiko Bora	5200		26,992,526.08	
	Supersaver charcoal	5500		28,549,787.20	
				Option C	
	LPG + Accessories names/brands	Retail Prices (KES)	Number of HH	Overall CAPEX (KES)	Assumptions
	Total Energies -6Kg + Accessories	4880	5,190.87	25,331,447.55	2% of HH will take this option
	Pro-gas- 6Kg+ accessories	3558		18,469,116.88	
	K-gas- 6Kg + accessories	6168		32,017,288.63	
	Afrigas-6kg + accessories	5010		26,006,260.70	

Table 100: Capex and working assumptions for Transition Pathway 1

For Option A: it assumed that 90% of the HH targeted will take the option with 80% going for locally fabricated ICS and 10% going for imported ICS. For option B, only 8% will take the option with 6% going for locally fabricated while 2% go for imports. For Option C, only 2% of the households will go for this transition option.

Pathway 2					
Number of households using charcoal	41,545		Data from KNBS (2019) census report		
Number of households using charcoal + traditional stove	31006		Data extrapolated from SETA (2022) HH survey in Meru where 35.1 HH used charcoal ICS		
				Option A	
Improved Charcoal stoves names/brands	Retail Prices (KES)		Number of HH	Overall CAPEX (KES)	Assumptions
KCJ	1200		16,177.62	19,413,147.60	45 % of HH take this option
Jiko Okoa	4500		9,436.95	42,466,260.38	35 % of HH take this option
Jiko Bora	5200			49,072,123.10	
Supersaver charcoal	5500			51,903,207.13	
				Option B	
Gaseous fuels + Accessories	Retail Prices (KES)		Number of HH	Overall CAPEX (KES)	Assumptions
Total Energies -6Kg + Accessories	4880		4,044.41	19,736,700.06	15% of HH will take this option
Pro-gas- 6Kg+ accessories	3558			14,389,995.66	
K-gas- 6Kg + accessories	6168			24,945,894.67	
Afrigas-6kg + accessories	5010			20,262,472.81	
Biogas- 8M3	82000		1,348.14	110,547,090.50	5% of HH will take this option
				Option C	
E Cooking (Electric Pressure cookers)	Retail Prices (KES)		Number of HH	Overall CAPEX (KES)	Assumptions
Sayona SPC-100 Electric pressure cooker-6l	7800		1,348.14	10,515,454.95	5% of HH will take this option
Von VSCP60MMX Pressure Cooker 100W-6l	11995			16,170,882.32	
Ecoa Electric Pressure Cooker	9990			13,467,871.15	
Nutricook Eko - Ncspek6-6L Smart Pot	15995			21,563,423.32	

Table 101: Capex and working assumptions for Transition Pathway 2

This pathway envisages that 80% of the targeted households will opt for ICS with 45% going for locally fabricated ICS while 35% opting for imports under option A. Only 15% of HH will opt for new solutions that rely on gaseous fuels with 10% going for LPG and 5% going

for biogas under option B. 5 % of the HH using charcoal would consider transition to using electricity Option C as shown in Table 89 above.

Table 90 below shows the budget estimates for purchasing cooking solutions for Pathway 3.

Pathway 3					
	Number of households using Kerosene	9,326	Data from KNBS (2019) census report		
				Option A	
	Gaseous fuels (LPG & biogas)	Retail Prices (KES)	Number of HH	Overall CAPEX (KES)	Assumptions
	Total Energies -6Kg + Accessories	4880	7,927.10	38,684,248.00	85% of HH will take this option
	Pro-gas- 6Kg+ accessories	3558		28,204,621.80	
	K-gas- 6Kg + accessories	6168		48,894,352.80	
	Afrigas-6kg + accessories	5010		39,714,771.00	
	Biogas Plant - 8M3	82000	466.30	38,236,600.00	5% of HH will take this option
				Option B	
	Biofuels	Retail Prices (KES)	Number of HH	Overall CAPEX (KES)	Assumptions
	KOKO cooker + canister	1715	466.30	799,704.50	5% of HH will take this option
				Option C	
	E Cooking (Electric Pressure cookers)	Retail Prices (KES)	Number of HH	Overall CAPEX (KES)	Assumptions
	Sayona SPC-100 Electric pressure cooker-6l	7800	466.30	3,637,140.00	5% of HH will take this option
	Von VSCP60MMX Pressure Cooker 100W-6l	11995		5,593,268.50	
	Ecoa Electric Pressure Cooker	9990		4,658,337.00	
	Nutricook Eko -Ncspek6-6L Smart Pot	15995		7,458,468.50	

Table 102: Capex and working assumptions for Transition Pathway 3

2. Table 103:

In Option A, 90% of the targeted households are assumed to opt for gaseous fuels with 85% of HH opting for LPG while 5 % opting for biogas systems. 5% of households are assumed to opt for biofuels (Option B), while electric cooking will be adopted by another 5% of the households (Option C).

Table 91 provides capital expenditure for undertaking activities that support GESI interventions like training, consumer awareness, information access and management and access to finance models to be implemented.

Key Activity	Number of units	Cost per Activity (KES)	Total Cost (KES)
Training of Artisans	225 artisan	35000	7,875,000/-
Sensitisation activities	45 sessions	500000/-	22,500,000/-

Table 104: Capex for training and sensitisation activities

Notes that informed the above costing include:

- Five artisans are targeted for training per ward in Meru County
- Training costs estimated from materials required and HR time for training artisans. Note this cost will vary based on the service provider
- One Sensitisation session is envisaged per ward.

IV. Cost Benefit Analysis

The three transition pathways to clean cooking entails costs and benefits. The cost attributed to the transitions include but are not limited to capital investment in acquiring the new cooking devices or installation of ventilation system, training plus sensitisation expenses, supply, distribution and marketing expenses, expenses for operations (cooking solution may require use of commercial fuels like LPG and bioethanol) and maintenance. Other unquantified costs include the inconvenience that may be caused by the need to alter cooking practices to be able use a new cooking technology. Further, some of the improved stoves may be difficult to adapt to local cooking needs and may result in dissatisfaction with food preparation by the end users.

The benefits of transition to clean cooking solutions will only be accrued when the end users continuously use the cleaner technologies and fuels. These benefits include improvement in health of end users stemming from better quality of indoor air, time saved from cooking and routine collection of fuelwoods, improvement in aesthetics and social standing from the use of cleaner cooking solutions. Environmental benefits realised from reduction in Greenhouse Gases (GHGs) and deforestation. According to Hutton et al., (2007) and Larsen (2014), the deterministic cost-benefit analyses of transitioning to clean cooking solutions accrues benefits to household, however, because of resource limitation, the current solution did not model different transition pathway to determine the benefits.

3. Intervention Options

The transition to improved firewood stoves (Option A) was given the first priority as the County aims to eliminate use of three stone open fires. This ambition is in line with the national Government Bioenergy strategy Action plan (2023) target of eliminating three stone

open fires in Kenya by 2028. Household survey studies done by SETA in Meru County in 2022 showed that about 82.2% of households using firewood use three stone open fires. It is therefore envisioned that promotion of improved firewood stoves (natural draft) will be accepted by households, especially those who are not purchasing firewood. Additionally, improved firewood stoves design e.g., the fixed natural draft stoves such as Maendeleo Jiko have some similarities with three stone open fires, thus, minimal end-user training will be required to use these stoves.

I. Target beneficiaries

The targeted households are those using rudimentary cooking technologies to meet their cooking needs. Households in Meru County could be clustered into four broad categories based on fuels used for cooking as per KNBS (2019) census report (also refer to section 1.1):

- Category I: HH using firewood - 74.3% of all HH
- Category II: Charcoal - 9.8%
- Category III: Kerosene - 2.2 %
- Category IV: Cleaner fuels (electricity, biogas, LPG, solar) - 13.7%
- Similarly, a further classification into two broad categories based on cooking technologies (SETA Meru HH survey, 2022 done in six wards)
- Category A: HH using three stone open fires - 82.4% of all HH
- Category B: HH using improved stoves -37.4 % of all HH

Therefore, the targeted categories of households for transitioning to cleaner cooking solutions are:

- Category I & A, i.e., those using firewood and three stone open fires
- Category II & III, i.e., using charcoal and Kerosene (with inefficient cooking technologies), assuming the majority of these HH purchase their fuels.

In addition to the target categories of households, a proposal is made to give priority to sub-counties with over 75% of the households relying on biomass fuels as indicated in Table 92.

Sub-County	Conventional Households	Percentage using firewood
Igembe Central	51,848	84.2
Igembe North	38,716	82.9
Meru Central	39,498	83.8
Tigania Central	24,983	90.9
Tigania West	35,402	88.4
Tigania East	16,791	79.8

Table 105: Sub-counties with highest number of households using firewood

II. Budget Commitments and Funding Sources

The annualised budget estimates for all three Transition Pathways (Pathways 1, 2 and 3) are shown in Tables 93, 94 and 95 respectively. The budget for training of artisans is to be utilized during the 1st year of implementation while the Sensitisation budgets are spread over the transition period following the roll out plan targets.

	Yr1: 10% of HH (KES,000)	Yr2: 20% of HH (KES,000)	Yr3: 30% of HH (KES,000)	Yr4: 20% of HH (KES,000)	Yr5: 10% of HH (KES,000)	Yr6: 10% of HH (KES,000)
Improved woodstoves names/brands	Option A					
Maendeleo Jiko fixed total costs	63,588	127,176	190,764	127,176	63,588	63,588
Maendeleo Jiko portable total costs	3,893	7,786	11,679	7,786	3,893	3,893
Highest retail total costs for imported ICS	12,458	24,916	37,374	24,916	12,458	12,458
Lowest retail total costs for Imported ICS	9,863	19,725	29,588	19,725	9,863	9,863
Improved Charcoal stoves names/brands	Option B					
KCJ	1,869	3,737	5,606	3,737	1,869	1,869
Lowest retail total costs for ICS imports	2,336	4,672	7,008	4,672	2,336	2,336
Highest retail total costs for ICS imports	2,855	5,710	8,565	5,710	2,855	2,855
LPG + Accessories names/brands	Option C					
Lowest retail total costs	1,847	3,694	5,541	3,694	1,847	1,847
Highest retail total costs	3,202	6,403	9,605	6,403	3,202	3,202

Table 106: Annualised budget estimates for Transition Pathway 1

	Yr1: 10% of HH (KES,000)	Yr2: 20% of HH (KES,000)	Yr3: 30% of HH (KES,000)	Yr4: 20% of HH (KES,000)	Yr5: 10% of HH (KES,000)	Yr6: 10% of HH (KES)

(KES, 000)						
Improved Charcoal stoves names/brands						
KCJ	1,941	3,882	5,824	3,884	1,941	1,941
Lowest retail total cost for imported ICS	4,247	8,493	12,740	8,493	4,247	4,247
Highest retail total cost for imported ICS	5,190	10,381	15,571	10,381	5,190	5,190
Gaseous fuels + Accessories						
Lowest Retail total costs	1,439	2,878	4,317	2,878	1,439	1,439
Highest retail total costs	2,495	4,990	7,484	4,990	2,495	2,495
Biogas- 8M3 retail total cost	11,055	22,109	33,164	22,109	11,055	22,109
E Cooking (Electric Pressure cookers)						
Lowest retail total cost (6l)	1,052	2,103	3,155	2,103	1,052	1,052
Highest retail total cost (6l)	2,156	4,313	6,469	4,313	2,156	2,156

Table 107: Annualised budget estimates for Transition Pathway 2

Cooking solutions	Yr1: 10% of HH (KES, 000)	Yr2: 20% of HH (KES, 000)	Yr3: 30% of HH (KES,000)	Yr4: 20% of HH (KES,000)	Yr5: 10% of HH (KES,000)	Yr6: 10% of HH (KES,000)
Gaseous fuels (IPG & biogas)						
Lowest retail Price	2,820	5,640	8,461	5,640	2,820	2,820
Highest Retail price	4,889	9,778	14,668	9,778	4,889	4,889
Biogas Plant -8M3	65,002	130,004	195,006	130,004	65,002	65,002
Biofuels						
KOKO cooker + canister retail total costs	80	160	234	160	80	80
E Cooking (Electric Pressure cookers)						
Lowest retail total costs for EPC (6l)	364	727	1,091	727	364	364
Highest retail total costs for EPC (6l)	746	1,492	2,238	1,492	746	746

Table 108: Annualised budget estimates for Transition Pathway 3

A number of funding sources are considered to operationalise the solution interventions and the different roll-out plans as elaborated in Table 96.

Solution Intervention	Potential Source of Funding
Awareness Raising Campaigns	i. The Meru County has allocated KES 25 million for a period of 5 years under the current CIDP 2023-2027 for “promotion of clean cooking energy strategies” which include Sensitisation on clean cooking solutions. ii. REREC through Mitunguu Energy Centre. The centre carries out targeted demonstration activities for different cooking solutions. iii. Civil Society organisations such as Caritas Meru which promote different cooking solutions under different projects/programmes iv. Private sector actors such as Sistema bio which promotes biogas technology v. Development partners: GIZ, SNV vi. Develop gender business case in the use of clean cooking solutions among women and approach donors for funding opportunities
Training of artisans for cooking solutions	i. Artisans paying for own training ii. REREC through Mitunguu Energy centre providing subsidized training to cookstove artisans and biogas masons iii. Meru County under its Sensitisation budget in the CIDP 2023-2027 budget. iv. Civil Society Organisations through their programmes of promoting adoption of clean cooking solution. v. Development partners such as GIZ and SNV vi. Women and people from marginalised groups be considered for funding to attend free training sessions
Purchase of cooking solutions	ii. Direct purchase by end-users: Some households can easily afford some of the cooking solutions such as Maendeleo Jiko which averagely cost KES 3500 (including installation) or Kenya ceramic Jiko which costs an average of KES 1200/- iii. Meru County Government has allocated resources for the purchase of clean cooking technologies under CIDP 2023-2037 of KES 100 million. It has also allocated budget for the installation of biogas digester over the same period of time of KES 230 million. It is proposed that the County uses these allocations to subsidise different cooking technologies to reach more targeted end-users. For example, a 50% subsidy will enable the County reach double the number of end-users, while a subsidy of 25% will enable the County to reach 4 times the number of targeted end-users. This approach has the advantage of inculcating the sense of ownership for the end-users and will help sieve out those who will have gone for the cooking solutions by the virtue of being free and not being driven by the need to transition to cleaner cooking solution. To address the issue of limited supply of clean cooking technologies and fuels-

	the KES 600 million allocated by the County for MSMEs could be considered seed capital for entrepreneurs selling cooking solutions. iv. Loans from financial institutions such as KWFT, Family Bank, Centenary Sacco, Yetu Sacco. The table below provide details of the loan products v. Private sector actors such as Sistema bio which has repayment plan for its biogas systems that include - Upfront payment (cash sale) - Payment in two equal instalments (30 days after first payment) - Payments spread over 12 months with monthly contributions depending on the size of the plant - Payment spread over 24 months with monthly contribution depending on the size of the biogas plant - Negotiate to have a separate and favourable plan for women and people with disabilities

Table 109: Potential sources of funding for the different Pathways

III. Expected Outputs in Each Transition Pathways

All the three transition pathways have a similar rollout plan of six (6) years. Since resource allocation from the County Government follows the CIDP/ADP processes and that political economy issues play a significant role in how these resources are allocated on annual basis, it is then envisaged that the peak transition target is to be reached on the third year of implementation if its implementation commences the 1st year of the new Government. This transition plan is illustrated in Table 97. below.

Years of transition	Year 1	Year 2	Year 3	Year 4	Year 5	Year 6
No. of HH transitioning to cleaner cooking solutions	10%	20%	30%	20%	10%	10%

Table 110: Roll out plan for the three transition pathways

Roll Out Plan for Transition Pathway 1: Households Using Firewood

Figure 37 shows the rollout of Pathway 1 which captures the highest number of conventional households to be transitioned to higher-tier cooking solutions i.e., moving from three-stone open fires to different forms of improved cookstoves.

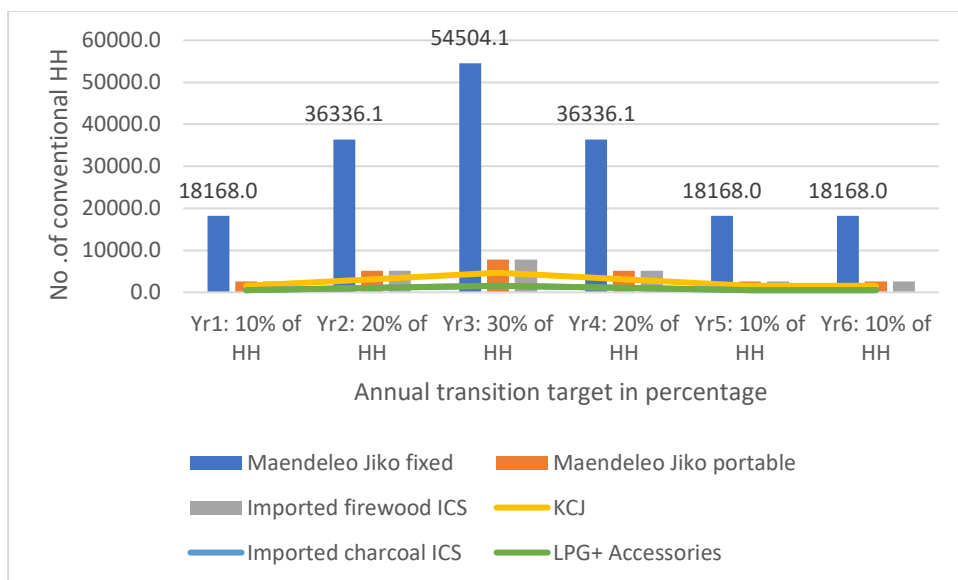


Figure 54: Roll out plan for Transition Pathway 1: Households using firewood

Figure 38 shows the rollout for Pathway 2 Beyond adoption of more efficient cook stoves (KCJ and imported ICS), This pathway has the highest number of conventional households making transitions that require new cooking technologies and fuels, i.e., from charcoal to LPG, Biogas, or electric cookers.

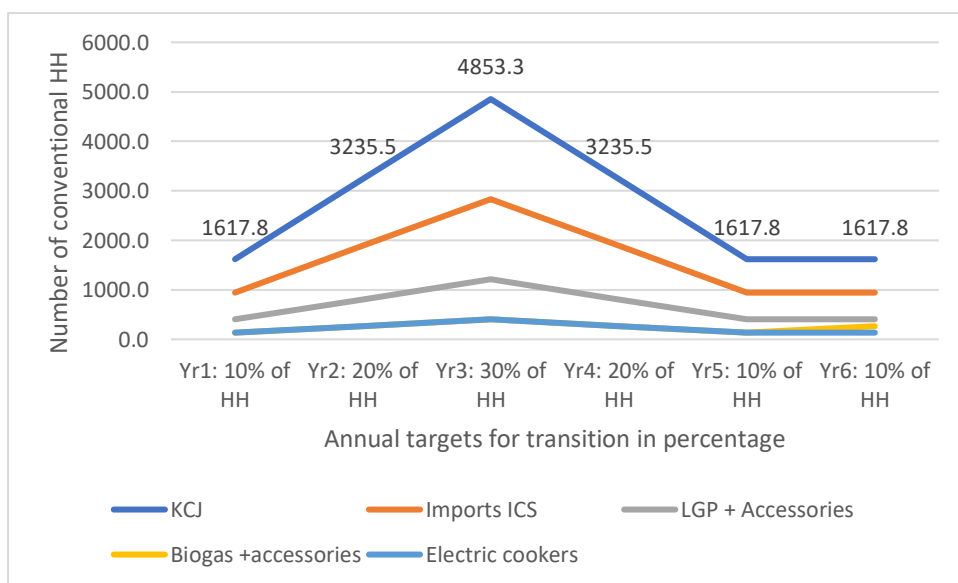


Figure 55: Roll out plan for Transition Pathway 2: Households using charcoal

The rollout plan for Pathway 3 is shown in Figure 39 below. This pathway envisages complete elimination of solid biomass fuels. It also introduces bioethanol as an alternative/replacement for kerosene since the mode of dispensing of both fuels in urban areas are similar.

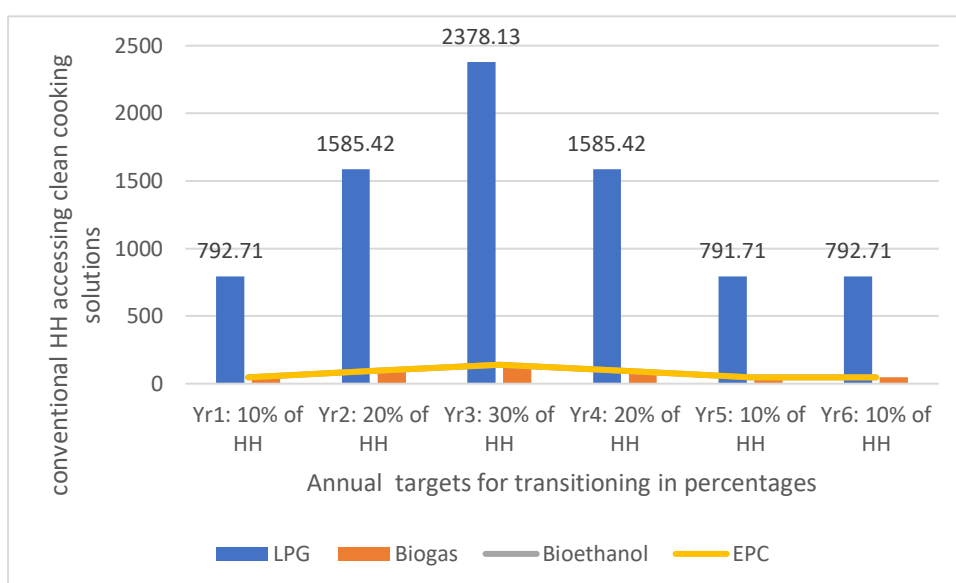


Figure 56: Roll out plan for Transition Pathway 3 Households using kerosene

IV. Timeline

The transition to clean cooking solutions is to be realized within six years of full implementation following the roll-out plan outlined in Table 97 and the annualized targets for each transition pathway, illustrated in Figures 37, 38, and 39. This timeline was developed based on consultations with the CEP Technical Committee.

V. Stakeholders And Roles

Table 98 below provide a list of stakeholders and the critical role they play critical in the implementation of the cooking solution. This list is not exhaustive as more stakeholders will emerge during preparation for the implementation period of the cooking solutions. Furthermore, the role of the stakeholders may change with context.

Stakeholder	Activity	Role
Implementation Group	Governance	- To be formed at the start of implementing the roll-out plan and will include participants from Directorates of Energy, Economic Planning, Trade and Industry, climate change and gender + REREC-Mitunguu Energy Centre - Decision making body for the project. - Financing & supplier partnerships and procurement

Directorates of Energy	Oversight/Project management	• Overall solution implementation and management • Partnerships with end-user groups (self-help groups, women groups, church groups, farmer groups etc) and stakeholder outreach
	Fund awareness campaign activities	• Development of campaign materials • Hosting demonstration activities jointly with Mitunguu Energy Centre and other stakeholders • Facilitating clean cooking roadshows • Facilitating targeted awareness raising activities to farmer groups, self-help groups, church groups etc.,
	Targeted subsidy provision	• Provide 25% or 50% subsidy to end-users for different cooking solutions.
	Feasibility studies & market research	• Carry out or commission research on the following: • Input suppliers who could do bulk purchase discounts (including fertilised eggs) & support contracting. • Feasibility studies for a brooder plant and own feed production. • Feasibility/demo plot for own feed production • Market mapping of new channels/buyers for white meat.
	Training of local artisans	• Work jointly with directorate of trade to train local stove artisans under the capacity building program MSMEs
Cooking solution suppliers	Supply different cooking solutions to the end-users	• Ensure reliable supply of different cooking solutions that are on demand in Meru
Mitunguu Energy Center	Provide training to cookstove fabricators and biogas masons	• Ensure quality stoves are produced for end-users through specialised training of fabricators • Ensure biogas systems constructed are functional through specialised training of mason

Financial Institutions	Provide loan facilities to end-users of cooking solutions	• Offer of general loan products that could be used to purchase cooking solutions (Family Bank, Yetu SACCO, Centenary SACCO) • Offer of cooking solutions on loan (KWFT, Equity Bank)
Individual households & artisans	Financing	• Purchase of cooking solution on choice through own financing in full or take advantage of subsidy • Pay for own training • Pay for own stocking on different cooking solutions
CSOs	Training	• Pay for training of cooking solutions artisan
	Financing awareness raising campaigns	• Contribute to different awareness raising campaign activities.
Ministry/directorate of Gender	• Training • Access to finance and markets Linkages • Consumer education campaigns	• Support funding of these activities • Monitor and evaluate impact • Set GESI priorities

Table 111: Stakeholder roles during the demonstration and scale-up phases

VI. Risks And Challenges

The risks listed in Table 99 are not exhaustive. New risks will emerge during the implementation of the cooking solutions. Therefore, it is recommended that the implementation team continually monitor the changing context to capture any emerging risks and develop mitigation measures to address them.

	Risk	Mitigation measure
Project finance	Budget allocated in CIDP is not allocated via ADP or insufficient allocation to some solution components	o Ensure buy-in and build understanding of solution among relevant decision markers & target end users to solutions in CIDP through socialisation activities.

		o Build high-level political buy-in through CEP launch events and communications strategy.
	Lack of clarity on project management and roles/responsibilities for implementation	o Project Implementation Group (PIG) set up with clear terms of reference, roles & responsibilities between Directorate of Energy, Trade and Industry, Climate Change, and Gender
	Delays in project implementation	o Ensure sufficient time for set-up phase (including for MEL Framework) including identification of any process bottlenecks & challenges.
Project governance	Inadequate inclusivity and end-user participation	- o End user and stakeholder participation in PIG - o Participatory monitoring & evaluation - o Ongoing socialisation activities
Availability of cooking solutions	Suppliers of clean cooking solutions may not find sufficient market to warrant supplying/retailing products in the County	- o Ongoing socialisation activities to create demand for the different cooking solutions - o Provision of subsidy to encourage uptake by the end-users
Quality of products	Dealers taking advantage to retail sub-standard cooking solutions	- o End-user education on benefits on acquiring quality products - o Training on cookstove artisans to produce quality products
Demand for clean cooking solution	Low demand among the marginalised groups of modern cooking solutions	o Consumer education to elicit demand

Table 112: Risks and mitigation measures

VII. Implementation And Coordination, Monitoring And Evaluation

m. Implementation And Coordination

The process to implement the cooking solutions follows the three steps highlighted in Figure 40 below.

STEP 1

Meru County allocates resources captured in the 2023/27 CIDP to ADP for awareness raising, purchase of the cooking technologies and for installation of biogas systems.

STEP 2

- Directorate of Energy identify partners that will support in the implementation of the

a. Promoting Gender and Social Inclusion (GESI)

Figure 57: Implementation steps

include the following:

- Access to Finance and Investment Gaps for upfront purchase of the products for use at home or invest in the re-distribution and supply of clean cooking solutions businesses due to inadequate or lack of control over collateral.
- Lack of knowledge of clean cooking products know how makes it hard to understand how to technically operate the products. This makes them shy away from accessing and buying these solutions.
- Lack of clear County enabling policies to promote access to clean cooking solutions, especially with a focus on GESI.

Meru County should begin by carrying out a GESI and vulnerability analysis to develop a comprehensive policy approach as part of the implementation of clean cooking solutions. Systems to collect and analyse GESI-disaggregated data to inform development of appropriate monitoring and evaluation frameworks and indications during the inception phase and to inform any additional interventions required to promote GESI in subsequent phases of the recommended solutions as well as future programmes and policies, are also needed.

b. Climate Resilience Building Measures

	Entry point	Intervention Area	Recommendations
Project	Planning and implementation	Carry out awareness raising campaigns addressing the non-energy challenges of cultural norms & beliefs, low awareness by households on benefits of using modern cooking solutions, safety concerns, etc., The outcome of this intervention is increased demand for different types of cleaner fuels and efficient cooking technologies as more households opt to transition following different pathways.	Risk Screening – conduct surveys on the target population to understand perceived benefits and risks of technologies used currently, perceptions on the magnitude of impact on household health and safety, environment, economic losses e.g., loss of productive time due to illness causing lost hours or looking for fuel. Identify who is most at risk of these impacts. Collect data using household surveys to understand the following; ○ Perceived value provided by using firewood, charcoal, and kerosene for cooking. To counter these perceived benefits, gendered risk and climate impact analysis needs to be presented to foster reflection that may lead to adoption and transition to clean energy technologies. The benefits of the new solution must outweigh those of the old. ○ Awareness and perception of clean technologies, access, use and pricing, as well as perceived or real barriers and constraints to adoption. Using the developed technologies and transition pathways assess the critical success factors including on building climate resilience that would drive adoption and use. The entry strategy would incorporate creating awareness around changing perceptions towards climate risk, potential gains to be made by changing behaviours, and then present the available options and technology stacking as a pathway to transition. This will ensure that the solution is value driven towards adaptation and resilience, not technology driven. The capacity building strategy would change from technology based to ‘why change behaviour’.

Table 113: Climate adaptation and resilience building measures

c. Energy Efficiency And Conservation

The recommended solutions for the different transition pathways were assessed from an energy efficiency perspective and the proposed cooking solutions are more efficient than the rudimentary solutions that the interventions seek to address.

Improved Cook stoves (ICS) – Efficient cook stoves reduce the use of biomass fuel like charcoal or briquettes compared to the traditional three-stoned open fires or the traditional metallic charcoal stoves. They also have low emissions and are therefore safer to use. Use of ICS can result in about 10 percent energy savings and can reduce fuel used in cooking by about 50 percent, while reducing toxic emissions by up to 70 percent. [6]

- Use of biogas for cooking. Biogas is a renewable, eco-friendly and affordable source of energy for households and institutions. Generation of biogas has multiple benefits: revenue generation from waste management, creating renewable energy source reducing dependence on biomass, reducing greenhouse gas emissions, improved environmental quality, and increased employment opportunities. Biogas systems are also a source of organic fertilizers that can increase agricultural productivity.
- Use of efficient kilns for charcoal production. There is widespread use of traditional kilns to convert wood into charcoal. The kilns have efficiency of about 10 percent resulting in substantial losses. According to KEFRI, improved earth kilns have a higher recovery rate of 26-30 percent compared to traditional earth kilns of 10-20 percent [7]. Use of efficient kilns can contribute to more sustainable charcoal value chains
- Adoption of E-cooking. E-cooking provides great opportunity to reduce reliance on biomass for cooking. For example, cooking with electric pressure cookers at the household level is 60 percent cheaper than firewood (Jon et al., 2023) 70 percent cheaper than gas and 82 percent cheaper than charcoal (KERE, 2022). Kenya is currently developing an e-cooking strategy.
- Transition to Liquefied Petroleum Gas (LPG). LPG is a cleaner cooking fuel and a rapidly scalable option that is key to achieving Kenya's ambitious target of 100 percent clean household energy access by 2028 (UCL 2022). Use of LPG is increasing widely due to its availability, clean air quality and cost compared to biomass.

d. Monitoring and Evaluation

Table 101 below provides outcome indicators of the cooking solution.

INEP Energy access outcomes for clean Cooking
The County will target to have all households in Meru County transition from using three-stone open fires to cleaner cooking options. The planned transition pathways will enable achievement of 100% access to cleaner cooking solutions 6 years after the roll out plan.
CEP Energy access outcomes for clean cooking

Impact: The primary outcome is increased adoption of cleaner cooking solutions by households in Meru County.

Secondary aims are;

- **increased knowledge on the benefits of adopting cleaner cooking solutions**
- **increased access to, and use of, cleaner cooking solution**
- **Increased access to end-user finances for clean cooking solutions and credit to dealers/suppliers of clean cooking solutions**

	Outcome focus area	Outcome	Indicator
1.	Conservation of the environment and climate change mitigation	decreased environmental degradation caused by inefficient use of firewood and charcoal	% reduction in GhG emissions from transitioning to clean cooking solutions
2.	Improved health benefits	Reduction in cases of diseases attributed to indoor air pollution resulting from use of rudimentary cooking solutions	% Reduction indoor air pollution related ailments
3.	Gender and social empowerment	benefits for women, People with Disabilities (PWDs) and children – increased time availability for productive use, access dynamics and positive changes in household roles	% Growth of women, PWDs, and children reporting increased time for productive activities

Table 114: Overall outcome areas for clean cooking solutions

Table 102 below shows output indicators for the cooking solution.

Clean cooking output indicators				
1.		Increased access of cleaner cooking solutions by rural households replacing three-stone open fires	identify sub-counties with a high percentage of households using firewood in three-stone open fires	- No. of sub counties prioritised for clean cooking interventions.
			Collect data on use of different cooking solutions	- Data on usage of different cooking solution across households in Meru County
			identify and partner with clean cooking solutions suppliers	- No. of suppliers mapped - No. of partnerships signed/entered with suppliers
			work closely with suppliers of clean cooking solutions to avail affordable cooking solutions for households using three-stone open fires	- No of households - accessing clean cooking solutions

			Households transitioning to use of clean cooking solutions	No. households adopting clean cooking solutions
2.		Local artisans trained and incentivised to produce quality cooking technologies (stoves and biogas installations)	map training and licensing partners	No. of active training and licensing partners
			map of potential end-users for training opportunity pre and after-sale technical services for off-grid systems	No. of participants selected for training, disaggregated by age, gender, and people from other marginalised groups e. g., PWDs)
			conduct training needs assessment and develop training curriculum in partnership with Mitiguu Energy centre	No. of curriculums developed
			train local artisan on production of quality stoves in pre and after-sale technical services for off-grid systems	No. of trained cookstove artisans disaggregated by age, gender, and people from other marginalised groups (.e.g PWDs)
3.		Households knowledge on benefits of using clean cooking solutions strengthened	raise awareness of quality cooking solutions among households through sensitisation campaigns, e.g., social media, local radio, and barazas among others	○ No. of campaigns launched. ○ No. of participants reached disaggregated by age, gender, and people from other marginalised groups (.e.g PWDs). ○ No. of suppliers showcasing clean cooking solutions.
4.		Access to finance	promote affordable and inclusive access to finance for the purchase of cooking solutions	○ Kshs credit advanced to target population by type of financier and payment method, e.g., lease to own and lease only. ○ % loan default

Table 115: Output indicators for the clean cooking solutions

VIII. Conclusions

The cooking solution seeks to transition the majority of households currently using rudimentary cooking solutions in Meru County to cleaner cooking options. This solution is in line with the County's development activities as outlined in the CIDP 2023-2027 with national Government objectives and target of universal access to clean cooking solutions by 2028. Since it is the first time that Meru County is planning and budgeting for clean cooking initiatives, three transition pathways targeting households using firewood and charcoal in traditional cooking technologies such as three stone open fires and metallic charcoal, and

households using kerosene re considered realistic. Critical success factors for the solutions include the following:

- Access to a wide variety of clean cooking solutions by end user within closer proximity to their households.
- Access to affordable finance for both end users and suppliers of different clean cooking solutions.
- Training of local artisans to produce quality cooking appliances.
- Rollout of end user Sensitisation campaigns, including demonstrations on the use of different clean cooking solutions.

The following next steps should be undertaken to move forward from planning to implementation:

- Commit funding and map opportunities for co-financing (Practical Action and SNV are just starting work in Meru). It is assumed that public finance aspects of the solution will come from Meru County (already allocated in CIDP) and from national Government under REREC through Mitunguu Energy Center.
- Establish a Project Implementation Group to oversee implementation as part of the CEP Technical Implementation Committee including the CO and Director of Energy, Director of Economic planning, Director of Gender, and Director of Climate Change.
- Ongoing engagement between Government, clean cooking solution suppliers, end user groups (e.g., women groups, farmer groups, religious groups), NGOs, and financiers.

4.0 COUNTY ENERGY EFFICIENCY AND CONSERVATION MEASURES ASSESSMENT

County Governments are strategically positioned to collaborate with local businesses, non-Government actors, and private sector in addition to other levels of Government to ensure progress towards a sustainable energy-efficient future, improve energy security and mitigate the impacts of climate change by lowering Greenhouse Gas (GHG) emissions. Energy Efficiency at the County level is important to the County Government for the following reasons.

- I. Rising energy costs – this has direct impact on the level of livelihood of the people in the counties. Higher energy bills imply that investment in other priority areas is foregone. By adopting energy-efficient appliances, consumers can lower their electricity bills while reducing their carbon footprint (IEA, 2022)
- II. Adverse environmental and health impacts – Inefficient use of energy especially for biomass leads to environmental degradation which has negative impacts on the local, national and global level accelerating climate change as a result of GHG emissions. Indoor pollution leads to increased hospitalisation thus reduced useful economic time.
- III. The current policy and legal framework allows for increased role of the County Government in the Energy Efficiency and Conservation arena.
- IV. Adoption of energy efficiency accelerate the uptake and a transition to cleaner energy. Main drivers of such uptake include the reduction of traditional and inefficient use of biomass in rural areas thereby resulting in savings that can be spent of biofuels or other cleaner sources of energy.

Policies and regulatory frameworks that mandate the County Governments to promote energy efficiency and conservation measures include the following:

- a) **The Constitution of Kenya, (2010)**, under the Fourth Schedule, provides for functions of the County and National Governments’. The constitution establishes energy as a shared mandate between National and County Governments. Counties are mandate to reticulate electricity and gas.
- b) **The National Energy Policy (2018)** is the primary document that guides the development, legislation and implementation within the energy sector in Kenya. It provides for County Governments to prepare County energy plans, undertake County energy regulation and implement County energy operations. The Policy recommends Integrated Energy Planning since energy is a critical input in the social economic progress of the economy.
- c) **The Energy Act (2019)**, allows County Governments, with approval from Energy and Petroleum Regulatory Authority’s (EPRA’s) to amend the energy conservation building codes to suit the local climatic conditions and may, provide the suitable

applicable codes; enforce codes set for purposes of efficient use of energy and conservation; create awareness programmes; train personnel and specialists in the relevant techniques; encourage preferential use of energy; and what to be considered during inspection. In addition, it empowers the County Government to give directions on regulations or norms for process and energy consumption standards in any industry or building or building complex; or the energy consumption standards for equipment and appliances. To ensure provision of financing towards EE, the Act allows the County Government to develop a fund for the promotion of efficient use of energy and its conservation within the County.

- d) **The Kenya National Energy Efficiency and Conservation Strategy (KNEECS)** launched in 2022 provides a roadmap for the Government of Kenya toward achieving energy efficiency goals that have a positive impact on Kenya's economy. It aims to reduce the National energy intensity by -2.8 per cent per year to enable the country to achieve a 30 percent emission reduction by 2030 relative to Business as Usual of 143 MtCO₂e as contained in the updated Nationally Determined Contribution (NDC). The KNEECS Implementation Plan identifies measurable targets across the Household sector; Building sector; Industry and Agriculture sector; and Transport and Power Utility sectors at national and County level.
- e) **Energy Management Regulation (2012)** made under section 110 of the Energy Act, 2006, provide with respect to an energy management policy and energy management and saving issues, such as energy audits. Due to the enactment of the Energy Act 2019, EPRA is currently developing a revised version of energy management regulations. A formal framework to govern Energy Service Companies (ESCOs) will provide them with further regulatory backing to conduct their businesses and would provide confidence to their clients.
- f) **The Energy (Appliances' Energy Performance and Labelling) Regulations, 2016.** These regulations implemented by EPRA provides for testing and labelling of selected appliances for Minimum Energy Performance Standards (MEPS). Minimum Energy Performance Standards are used to guide the testing and the labelling of the appliances. The standards developed in Kenya provides for testing the energy performance of the appliances as per acceptable international standards. The labelling uses a five-star labelling scheme where the highest performing appliance has five stars, while the lowest has one star.
- g) **The Energy (Solar Water Heating) Regulations, 2012** required all premises within the jurisdiction of local authorities that have hot water requirements of a capacity exceeding 100 litres per day to install and use solar water heating systems. With enactment of the Energy Act 2019, new Energy (Solar Water Heating) Regulations, 2022 have been developed and are yet to be gazetted (Proposed Renewable Energy Regulations). The regulation gives the County Government the leeway to develop legislation under the County Government Act, 2012 on inclusion and exemption from this regulation.

- h) **The Energy (Net-Metering) Regulations, 2022.** The proposed net metering concept allows an individual generating electricity to sell excess capacity back to the grid and offsetting the cost of the electricity they consume from the national grid. Eligibility for net metering is restricted to residential, industrial or commercial consumers with renewable energy generators of a capacity not exceeding 1MW primarily intended for self-consumption (Prosumers) and to a distribution or retail licensee in the consumer's area of supply (Licensee)(Proposed Renewable Energy Regulations).
- i) **The Draft Energy (Improved Biomass Cookstoves) Regulations, 2015.** These Regulations imposes a variety of requirements related to licensing, installing Improved Cookstoves (ICS), and record keeping, upon a wide range of cookstove industry stakeholders and consumers(Proposed Renewable Energy Regulations). They apply to manufacturers, importers, distributors, technicians, and contractors of Improved Biomass Cookstoves; and institutions using biomass fuels for cooking and heating purposes. The Clean Cooking Association of Kenya (CCAK) has developed voluntary biomass performance label based on the existing Kenya Bureau of Standards (KEBS) performance standard for improved biomass cookstoves (KS 1814-1).

4.1 Elements of Energy Efficiency Assessment

i) Level of energy efficiency awareness in key sectors

Meru County CIDP 2023-2027, outlines the initiatives that the County intends to implement during the target period. Table 1 presents priority areas towards EE as highlighted in the CIDP.

#	Sector Priorities	Strategies
1	Provide adequate, safe and quality source of sustainable energy	Promotion and adoption of alternative energy e.g. Biogas, solar and wind energy
2	Promotion of clean cooking strategies	Construction of Demonstration hubs Provision of Clean cooking solutions e.g. Meko, jikos Sensitization on clean cooking Demonstration of clean cooking technologies
3	Energy policies development	Development of CEP and energy policies
4	Provision of safe and standard public works facilities	Promotion and adoption of alternative modern building Technologies
5	Housing and infrastructure	Improve waste management methods to promote circular economy. Develop effective storm water drainage and rainwater harvesting. Promote use of solar energy in street and household lighting

Table 116: Priorities and strategies for EE in Meru County

Source: Meru County Integrated Development Plan 2023-2027, 2023

Many of the strategies in the above table focus on Renewable Energy in the County. Thus, it is clear that although there is an understanding of EE in the County, there are only a few concrete strategies identified.

ii) **Development of benchmarking standards for Government buildings and transport**

Energy benchmarking and disclosure is a market-based policy tool used to increase product energy performance awareness and transparency among key stakeholders and create demand for energy efficiency improvements. Energy benchmarking allows stakeholders to establish energy performance baselines, monitor performance, identify investments and verify the benefits of energy efficiency. Energy benchmarking is widely used in transport, building and food sectors. In buildings, the energy performance is measured and compared to the performance of other buildings as well as national and County targets. Energy benchmarking seeks to ensure that stakeholders (including members of the public) are informed. For example, once a building is benchmarked, there are opportunities for market transformation. Additionally, the County Government can develop programs to improve the energy use/efficiency of lesser performing buildings. Such benchmarking data can be used to facilitate the development of more effective policies. For example, information on energy performance of buildings can lead to more targeted and effective building codes and policy. However, Meru County is yet to develop any benchmarking standards for buildings and transport.

iii) **Identification of energy efficiency gaps and potential solutions**

As per the overview of the regulatory framework, the following energy efficiency gaps were identified:

- **High operation cost:** Energy costs represent a substantial expense in the annual operating budget of the County Government.
- **Inadequate green procurement in the County:** the procurement criteria needs to integrated energy efficiency requirements.
- **Lack of MEPS for appliances:** Even though Minimum Energy Performance Standards (MEPS) for appliance exist at the national level, Meru County has not adopted and operationalized these standards for appliances procured or sold in the County.
- **Lack of Energy Fund:** The County has not established the energy fund as outlined in the Energy Act (2019).
- **Lack of market priming and financing:** There are few programs to promote enhanced the adoption and use of energy efficient products in the County.
- **Lack of data;** There is lack of comprehensive data on energy potential and efficiency gaps in Meru County.
- **There is limited information-** there is limited information on benefits of energy efficiency, its positive impacts on cost savings, environmental sustainability, and enhanced comfort and well-being.

These broad gaps provide opportunities for the County Government of Meru to enhance energy efficiency initiatives both for its own operations and for the local communities.

- i. **Reduction of Operation Cost** - By investing in energy efficiency, this budget can be reduced by realizing substantial savings in energy expenses for the entire County owned facilities. This will also demonstrate commitment to energy and environmental stewardship. One of the schemes to achieve this is to mandate energy efficient equipment purchases and replacements.
- ii. **Green Procurement** – The County Government can improve the efficiency of their facilities by incorporating energy efficiency criteria into their product procurement decisions for both existing and new structures.
- iii. **Adoption of MEPS for Appliances** - The County Government can effectively promote energy efficiency by implementing MEPS Regulations to ensure compliant products are on sale in the retail outlets in the locality. Adoption of the energy efficient appliances would enable residents reduce their energy bills. Standards and labelling measures represent some of the most direct and impactful actions that can be implemented with clear and measurable benefits.
- iv. **Incentive Scheme** – By actualizing the Energy Fund as proposed in the Energy Act, the County could develop policies that support institutional/industrial domestic energy usage improvements for residents.
- v. **Developing Partnerships** - By working with key stakeholders and other organisations dedicated to improving energy efficiency, the County Government can leverage resources and capitalise on the expertise and unique abilities of these organisations to improve energy efficiency among end users in their jurisdictions. Collaboration and complementarity play a vital role in ensuring coordination among the various agencies in the County, which enhances support for the successful implementation of County energy efficiency action plan.
- vi. **Market Priming and Financing** - Market priming involves developing programs to enhance the adoption and use of energy efficient products. These programs incentivise the adoption of energy efficient products by consumers, encouraging manufacturers to increase production and marketing and ultimately leading to economies of scale, which have the effect of lowering prices. For example, a consumer might receive a rebate after purchasing a high-efficiency refrigerator that has a higher upfront cost than less efficient appliances on the market.
- vii. **Energy Planning** – This involves analysing energy sector scenarios and using models to derive County targets, policies, and investment strategies. It will guide decisions on investments in the energy efficiency in terms of timing, location, and approach.

- viii. **Data Collection and Knowledge Management** –One of the key attributes of INEP is the use of up-to-date and reliable data in developing strategic plans. This involves the County Government assessing the current situation, the reasons for lack of action or change, possible solutions, and what policy or intervention can make an impact to achieve the desired goals. One of the major task will be primary data collection at the County level which is currently missing. Collaboration with statistical agencies is central to the successful implementation of the County Action Plan. Data from statistical agencies need to be used in the policy planning and implementation process. It is vital for researchers, statistician and energy modellers to be involved in the planning process and the monitoring process to be established.
- ix. **Political Goodwill** – Stakeholder buy in, transparency, governance and accountability are key to ensure that the EE action plan is stakeholders at all levels of influence. Political alignment ensures that policies are adopted and promoted at the County level and not viewed as a National Government push.
- x. **Communication** - To effectively convey the benefits of energy efficiency it is essential to emphasise its positive impacts on cost savings, environmental sustainability, and enhanced comfort and well-being. In most cases, stakeholders (e.g., consumers and political leaders) may not identify energy efficiency as crucial to the County Government’s broader missions as lower energy bills, reduced operation costs, and climate change and mitigation. Good communication motivates stakeholders to get on board and do their part. Additionally, good communication ensures information on energy efficiency benefits are well spelt out and can attract support from different stakeholders. Raising consumer awareness and driving market-based demand for energy-efficient products spurs new business opportunities and job creation for individuals and companies.

iv) Availability of capacity building opportunities in tertiary institutions.

Implementation of Kenya National Energy Efficiency and Conservation Strategy provide opportunity for County Government in collaboration with the private sector and development partners to strengthen institutions responsible for energy efficiency; Establish long-term mechanisms for higher public awareness of the importance of energy efficiency by integrating energy efficiency curricula into the education system; Enable the increase of financing opportunities for energy efficiency and enhance gender mainstreaming in energy efficiency activities.

v) Analysis of implementation barriers and constraints.

The following are the identified key barriers to energy efficiency and conservation.

Energy Efficiency awareness and Information Barriers: There is low level on energy efficiency for both the distributors and the consumers about the benefits of energy efficiency even on domestic level. Consumer’s make purchasing decisions based on initial product cost only. There are no public awareness campaigns conducted for the general population. In addition, there is a general lack of comprehensive, reliable

energy consumption data and information covering various economic sectors. This reduces timely interventions and data driven solutions on energy efficiency.

Regulatory and Policy Barriers: While a sound regulatory framework exist at the national level, this has not been replicated at the County level. Meru County is still yet to localize energy efficiency policies and regulations as expected in the Energy Act 2019. In addition, although the County has the overall mandate to approve any new building codes, there is still no clear criteria developed for energy efficiency in building regulations.

Human Capacity – The County like many others still has no adequate human capacity to address EE issues. EE is lumped together with other energy and environmental issues at the County level. Availability of staff dedicated to energy efficiency is low, which makes enforcement of existing regulations a challenge.

County Priorities: Due to the competing priorities in the County, energy efficiency is not regarded as a top priority in the County matters. There is no specific budget line for energy efficiency activities despite the potential therein.

Market barriers: Efficient technologies may slightly cost more as compared to traditional technologies. Under the existing public sector procurement rules, the guiding procurement principle is to consider the lowest price and not the best cost/benefit ratio. In most cases, the investment criteria are dictated by the lowest cost when purchasing equipment rather than life-cycle cost.

Technical Barriers: The end users lack the knowledge and capacity to identify, develop, and implement energy efficiency projects. There are few if any energy efficiency service providers with the necessary experience and ability to develop and implement energy efficiency projects domiciled in the County. Most of the energy efficiency professionals are based in Nairobi.

Financial Barrier: There are Inadequate financial incentives/loans to promote adoption of these technologies as they are very expensive compared to the inefficient ones. No existing energy fund as proposed in the Energy Act has been actualised.

Recommendations on priority sectors or areas of interventions, investment needs and sequence of actions.

Error! Reference source not found. illustrates the key pillars of energy efficiency and conservation.

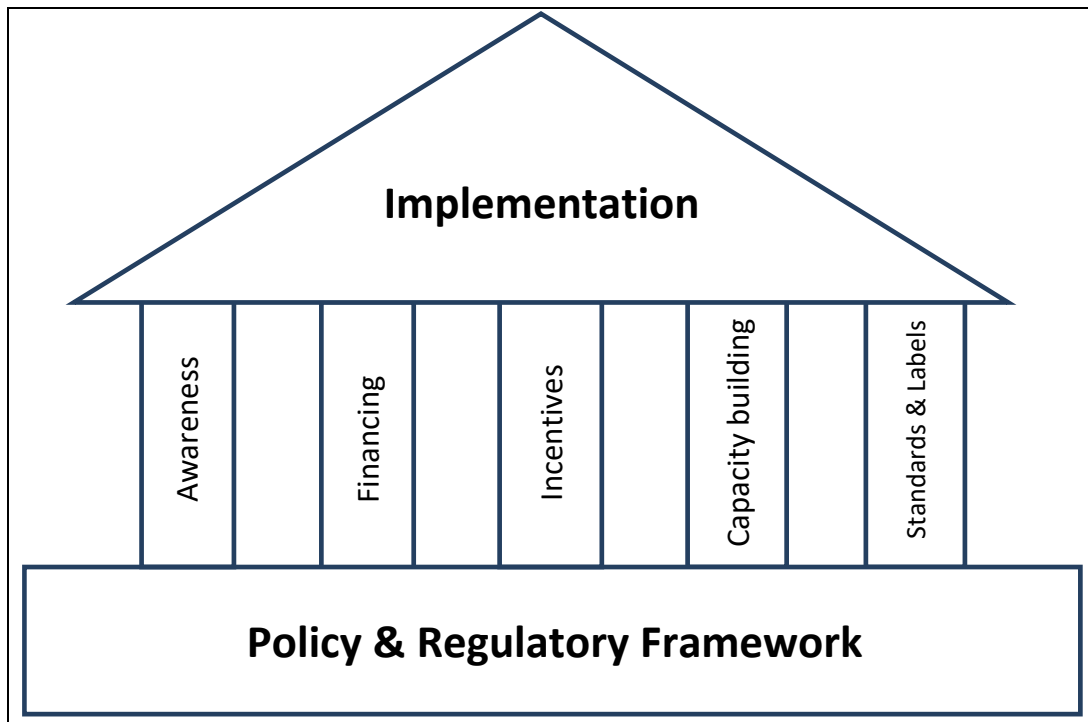


Figure 55: Key pillars for EE&C

At the bottom of the illustration, is the need for sound policy and regulatory framework foundation. The National Energy Policy and Energy Act provides the basis and empowers the County Government to pursue effective policy and EE regulatory framework that will spur Energy Efficiency Action plan. Upon the pillars identified above, the County Government of Meru can develop viable strategies to enhance EE&C in the County.

a) Awareness

Develop and implement sustainable, awareness and sensitisation programmes on energy efficiency and conservation.

b) Financing and incentives

Establish a County Energy Efficiency Fund for appropriate fiscal and incentives to adopt EE

Establishment of energy centres for promotion of renewable energy technologies, energy efficiency and conservation.

Develop fiscal legislation to encourage efficient technologies and discourage inefficient technologies.

c) Capacity Building

Build capacity and empower the energy efficiency and conservation directorate to champion and spearhead energy efficiency and conservation activities

Enforce building codes to enhance the concept of green design in buildings

Develop and enforce standards for fuel economy of motor vehicle operations and maintenance practices.

d) Standards and Labels

Develop and enforce Minimum Energy Performance Standards and rating labels for energy efficiency and conservation equipment.

Customise national codes for energy efficiency and conservation in buildings to local conditions

Regulation and licensing of biomass and charcoal producers, transporters and distributors.

Promote safe and fuel-efficient transportation for passengers and cargo through energy optimisation technologies.

e) Partnership and Collaboration

Collaborate with the private sector in energy efficiency and conservation.

Adopt ESCO Models for County owned facilities like buildings and hospitals.

f) Implementation

Implement energy efficiency and conservation initiatives in all sectors.

The particular EE solutions covering agriculture, livestock, lighting, water, health, and cooking are highlighted in the specific sections of Chapter 3 in this CEP.

4.2 Energy Efficiency in households

According to the current Meru County Integrated Development Plan (CIDP) (2023), there is low access to clean and sustainable energy sources in the County. The percentage distribution of lighting energy source by households in the County is 40.2 percent for electricity, 13.9 per cent for tin lamp, 11 per cent lantern, 18.8 per cent solar, 1.5 per cent fuel wood, 0.2 per cent gas lamp, 0.5 per cent pressure lamp and 13.9 per cent of other lighting energy sources (Kenya National Bureau of Statistics, 2019). The distribution of lighting energy source is presented on Figure 56.

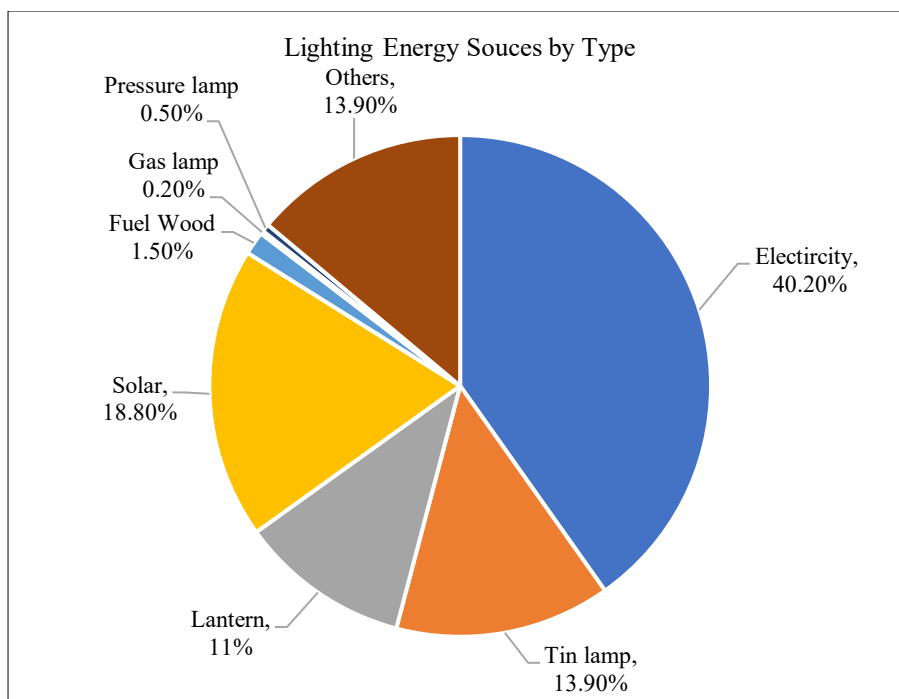


Figure 56: Household lighting energy sources by type

Source: 2019 Kenya Population and Housing Census: Volume IV, 2019

The percentage of cooking fuel source by household is 74.3 per cent firewood, 9.8 per cent charcoal, 2.2 percent paraffin, 12.6 per cent Liquefied Petroleum Gas (LPG), 0.5 per cent biogas, 0.5 per cent electricity and 0.1 per cent solar (2019 Kenya Population and Housing Census: Volume IV). A distribution of cooking fuel sources is shown on Figure 57.

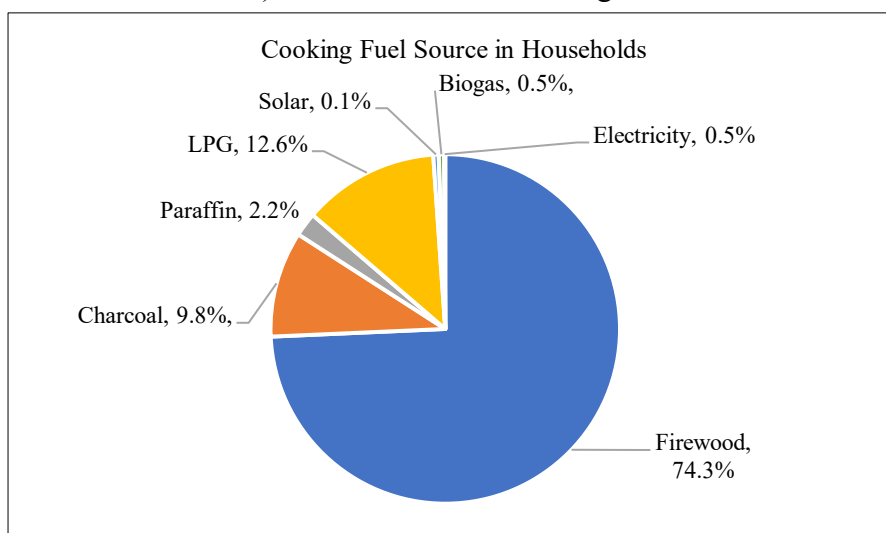


Figure 57: Households cooking fuel source by type

Source: 2019 Kenya Population and Housing Census: Volume IV, 2019

Thus, the majority of households use firewood for cooking, while only 0.5 per cent use electricity. With increased electrification, the figures are expected to change in future.

It worth noting that we lack comprehensive data on efficiency of appliances used for lighting in Meru County and the conservation measure put in place by the end –users. For efficiency of different cooking appliance, refer to Chapter 3.2 of the CEP. Similar to lighting, we lack data on energy conservation measures on cooking.

4.3 Energy efficiency in industries

There are less than 100 designated facilities in Meru County as per the 2012 Energy Management Regulations. The facilities in Meru County include industries, hotels, schools, public and commercial buildings, hospitals water facilities among others. Some of the facilities are managed by the Meru County Government. Such designated facilities consume over 180,000kWh of energy annually (The Energy (Energy Management) Regulations, 2012).

i) Energy use by type of industry

The County's economy is largely driven by the processing of agricultural and livestock products. The main actors in this sector are the tea and coffee cooperative societies, which own factories that add value to their crops and enhance their marketability. The County also has a vibrant dairy industry, with farmer-owned cooperatives running milk processing plants. In addition, there are small-scale manufacturing enterprises that produce bread and animal feeds, mostly located in Meru town. The County also has some potential for mining, especially of building stones and ballast, but this is not fully exploited and only done in small quantities in some parts of Imenti Central and Imenti South. However, the exact number of industries in Meru County is not specified in the available data.

ii) Number of audited industries

No data is available on number of industries audited in the County.

4.4 Energy efficiency in transport sector

i) Estimated number of vehicles operating in the County

Estimated number of vehicles operating in the County

According to the Transport Department in the County, there are over 600 three-wheeled and above vehicles operating the County plus over 300 motorbikes used for public transport.

Error! Reference source not found. The table below represents the different type of transport modes used within the County as of 2023.

#	Transport Mode	Total Number
1	Small cars – Saloon cars	200
2	Station Wagons	40
3	Passenger vehicles – Mini Buses / Matatus ²⁵	100
5	Passenger vehicles – Buses and Coaches	20
6	Tuk tuks ²⁶	10
7	Boda Bodas ²⁷	300
8	Panel Vans/ Pick Ups	50
9	Lorries /Trucks	100
10	Trailers	50
11	Wheeled Tractors	Not Available
12	Bicycles	Not Available

²⁵Local reference to minibuses

²⁶Local reference to three wheeled vehicles

²⁷Local reference to public transport motorcycles

13	Other Vehicles	30

Table 117: Type of transport modes operating in Meru County

Source: Transport Department Meru County, 2023

ii) Estimated number of vehicles owned by residents and used within the County

It is assumed that all of the vehicles highlighted in Table 1 above are owned by residents of Meru County and are all used within the County. Worth noting that the Meru County could not obtain the data from the relevant national Government agency.

iii) Proportion of the people using non-motorised transport (NMT)

Whereas, there is no data highlighting means of transport for all residents in Meru County, **Error! Reference source not found.** 119 below shows the common means of transport used by those who go to work places within Meru County.

#	Means of Transport to Work	Approximate percentage
1	Drive to work (own car, own bodabodas)	2%
2	Walk to work	5%
3	Cycle to work (only non-motorised/bicycle)	-
4	Use public transport (matatus, bus, tuktuks, bodabodas)	93%

Table 118: Means of transport to workplace in Meru County

Source: Transport Department Meru County

The majority of the people (93 per cent) use public transport to work while only 2 per cent drive/ride to work. 5 percent of working residents walk to work. Unlike many towns in Kenya, there are no record showing the percentage of persons using bicycles to work in Meru County. This may be due to unfavorable terrain, which discourages the use of bicycles.

iv) Proportion of vehicles inspected per annum (obtained from the motor vehicle inspection agencies)

The County has not managed to acquire the required data from the relevant national Government agency.

v) Number of motorbikes registered in the County (obtained from the licensing office)

The County of Meru has not managed to acquire the data from the relevant national Government agency. However, from the County Government records, there are over 300 registered motorbikes currently operating in public transport. Data on motorbikes not under public transport is not available.

vi) Number of electric two, three and four wheelers in the County

There are no official records of electric two, three and four wheelers vehicles operating in Meru County.

vii) Availability of electric mobility charging infrastructure

Currently, there are no electric mobility charging stations Meru County that can be used by residents or drivers going through the County.

5.0 BIOENERGY

The chapter provides an overview of Bioenergy initiatives, the challenges, key stakeholders, future Bioenergy outlook, and proposed interventions. The following shall be put into consideration:

5.1 Laws and Regulations Governing Production and Consumption of Bioenergy

Laws and regulations that relate to the production and use of biomass and land tenure.

5.1.1 The Forest Conservation and Management Act, 2016

The act aims to preserve and sustainably manage the country's diverse forests and related resources. By regulating the use of biomass from forests, the law promotes responsible practices to combat deforestation and degradation. It empowers local communities as stewards of the land, encouraging their involvement in conservation efforts. Through effective enforcement and environmental considerations, the Act seeks to strike a balance between human needs and the preservation of valuable forest ecosystems for future generations.

5.1.2 The Environmental Management and Coordination Act (EMCA), 1999

Amended in 2015, the act establishes a comprehensive legal framework for managing Kenya's environment. It addresses the sustainable use of natural resources like biomass and land, mandates environmental impact assessments for development projects, and enforces strict environmental standards. EMCA plays a vital role in promoting responsible practices and protecting the country's natural heritage. The amendments introduced in 2015 strengthened the Act, making it more effective in preserving the country's natural resources and promoting sustainable practices.

The revised Article 49 now places greater emphasis on the use of renewable energy and encourages tree planting initiatives as essential steps to combat deforestation and address climate change challenges effectively. Furthermore, Article 50's amendment established a legal framework to ensure the conservation of biological diversity, empowering the relevant agency to assess the value of unexploited natural resources based on factors like watershed protection, climate influence, cultural and aesthetic value, as well as their genetic significance. The revised Article 57 grants the relevant ministry the authority to offer fiscal incentives in the form of tax rebates to private entities investing in pollution control equipment, waste recycling, water harvesting, flood prevention measures, and other eco-friendly energy resources, thereby promoting sustainable practices and environmental responsibility.

5.1.3 The Water Act, 2016

The Water Act, 2016 prioritises the protection, conservation, and effective management of water resources in Kenya. Given the indispensable role of water in various agricultural and forestry practices, this act holds great relevance to the production and use of biomass, as it ensures sustainable water usage and safeguarding these essential natural assets. Additionally, the act fosters responsible water stewardship, supporting the conservation of aquatic ecosystems vital to the well-being of both human populations and biodiversity.

5.1.4 The Energy Act, 2019

The act governs Kenya's energy sector and includes provisions specifically related to renewable energy sources, such as biomass energy production and utilisation. By addressing renewable energy, the act encourages sustainable practices and supports the development and utilisation of biomass as an eco-friendly energy source. The inclusion of biomass as a viable renewable energy option promotes diversified and cleaner energy solutions, contributing to the reduction of greenhouse gas emissions and enhancing the Country's commitment to combating climate change.

5.1.5 The Land Act, 2012

The Land Act, 2012 establishes the legal framework for the administration, management, and registration of land in Kenya. Its provisions on land tenure, land rights, and land use planning are of significant importance in the context of biomass production and land use, as they provide a solid foundation for responsible and sustainable land practices. By ensuring secure land tenure and equitable access to land resources, the act empowers individuals and communities engaged in biomass production to invest in long-term and environmentally sound land-use practices.

5.1.6 The Community Land Act, 2016

The Act specifically addresses matters concerning the management, administration, and registration of community land, which is particularly relevant for communities involved in biomass production or dealing with land tenure issues. By recognising community land rights, this law empowers communities to play an active role in the sustainable management of biomass resources. It fosters local ownership and involvement in decision-making, promoting a collaborative and inclusive approach to biomass production and land use planning.

5.1.7 The Land Registration Act, 2012

This Act is responsible for governing the registration of land titles in Kenya and outlines the various land registration procedures. Proper land registration is essential in ensuring secure land tenure for biomass producers and users, fostering an environment conducive to sustainable land practices. The act streamlines land registration processes, reducing bureaucratic hurdles and enhancing land tenure security for those engaged in biomass-related activities.

5.1.8 The Land Control Act

It regulates the transfer and ownership of agricultural land, which holds relevance to the production of biomass from agricultural activities. By providing a legal framework for land control, this act contributes to responsible land use and management, positively impacting biomass production in the agricultural sector. It aims to prevent land fragmentation and speculative land transactions, ensuring that agricultural land is utilised efficiently and sustainably for biomass production and other essential agricultural purposes.

5.19 The National Environment Management Authority (NEMA) Act, 1999

The NEMA Act is instrumental in Kenya's environmental governance, establishing the National Environment Management Authority responsible for overseeing environmental

matters in the country. NEMA plays a crucial role in regulating the production and use of biomass, ensuring compliance with environmental regulations and promoting environmentally sustainable practices. The act empowers NEMA to monitor and enforce environmental standards, facilitating the adoption of environmentally friendly technologies and practices in biomass production, minimizing negative environmental impacts and fostering a more sustainable bioenergy sector.

5.1.10 The Bioenergy Strategy, 2020

The Bioenergy Strategy (2020-2027) focuses on universal access to modern bioenergy services by 2030, with a specific commitment to achieving clean cooking targets by 2028. Emphasising sustainability, the strategy promotes the production and consumption of bioenergy for economic growth and environmental well-being.

Key goals include informing investors, accelerating the transition to clean cooking technologies, and serving as a regional framework for bioenergy cooperation. The strategy's timely launch aligns with the nation's dependence on biomass energy (68% of total supply) and addresses health concerns associated with traditional cooking practices, especially relevant in the context of the Covid-19 pandemic.

Crucial features involve private sector involvement, adaptive planning, and multi-stakeholder consultations, highlighting the strategy's role in Kenya's path towards Sustainable Development Goal 7. The strategy stands as a pivotal instrument for sustainable development, recognising the urgency in the final decade to meet access to modern energy targets.

5.2 Stakeholders

The stakeholders responsible for specific aspects of biomass energy, their mandates, resources, and capacities within the County are provided in Table 120 below.

Stakeholder	Role/Interest	Resources/Capacities
National Ministry of Energy and Petroleum	Energy policy formulation and promotion of national biomass energy initiatives	Expertise, budget allocation, national energy plans
National Environmental Management Authority (NEMA)	Ensures compliance with national environmental regulations for biomass projects	Environmental expertise, monitoring capabilities, regulatory authority
National Ministry of Agriculture	National-level support for biomass feedstock production and utilisation	Agricultural expertise, agricultural land at the national level
State Department for Physical Planning	National-level land-use planning and permitting for biomass projects	Land-use planning expertise, national-level permits
Energy and Petroleum Regulatory Authority (EPRA)	Regulation and oversight of energy projects, including biomass energy initiatives	Regulatory authority, technical expertise
County Energy Directorate	Policy development, implementation, and promotion of biomass energy projects	Expertise, budget allocation, regulatory authority

Stakeholder	Role/Interest	Resources/Capacities
County Environmental Management Authority	Ensure environmental compliance of biomass projects	Environmental expertise, monitoring capabilities
County Agriculture, Livestock and Fisheries Department	Promotion of biomass feedstock production and utilisation	Agricultural expertise, agricultural land
County Physical Planning Directorate	Land-use planning and permitting for biomass projects	Land-use planning expertise, permits
County Investment Corporations	Promote, develop, invest and operate biomass energy projects	Investor sourcing, Capital Investment and Research
Private Sector Entities	Develop, invest in, and operate biomass energy projects	Capital investment, technical expertise
Research Institutions and Universities	Provide technical expertise, research, and innovation	Research facilities, technical knowledge
Non-Governmental Organisations (NGOs)	Advocate for sustainable biomass energy initiatives	Advocacy, community engagement
Community-Based Organisations	Community involvement and participation in biomass projects	Local knowledge, community support
Local Energy Cooperatives	Collective investment and management of local biomass projects	Community support, financial contributions
Financial Institutions	Provide funding and support through loans or grants for projects	Financial resources
Donor Organisations and Development Agencies	Financial and technical assistance for projects	Funding, technical expertise

Table 119: stakeholders, mandates and resources

5.3 Specific Objectives of the Bioenergy Sub-Sector

Section 5.3 requires a workshop setting, bringing those stakeholder departments and Directorates to brainstorm on the objectives of bioenergy sector. Example:

1. To promote the development of alternative bioenergy resources, for example briquettes and pellets potential from crop residues, biogas from livestock wastes, among others.
2. To promote production of bioenergy crops or biomass (for example, fast-growing trees *Gliricidia Sepium*, castor, sunflower, among others) to provide material for briquette fuels for modern bioenergy applications.

However, the County Government of Meru has limited resources to carry this out in time for this CEP and will look to conduct this workshop in the future.

5.4 Baseline Supply of Bioenergy

This section presents the quantities of bioenergy obtained from the feedstock available in Meru County. Bioenergy crops such as castor, jatropha, croton, among others, are being promoted by Government agencies like Kenya Forestry Research Institute (KEFRI), Kenya Agricultural and Livestock Research Organisation (KALRO) as well as by the private sector.

However, assessment of the bioenergy sub-sector is yet to be done as the County Government of Meru has inadequate data and resource to carry out full primary data collection on production of these bioenergy crops. Similarly, bioenergy potential from municipal solid, sewer wastes and slaughterhouses is yet to be assessed. County Government of Meru also lack resource to carry out full primary data collection on daily or weekly volumes of municipal solid and sewer wastes across Meru County. Therefore, going forward the County Government is recommended to carry out full data collection on these sub-sectors.

The assessment of bioenergy potential from forest biomass, residuals from crop production, and wastes from livestock were largely constrained by data availability. Going forward the County Government is recommended to carry out primary data collection on the average size of land under natural forest or woodlot (naturally growing on-farm) as well as data on dominant tree species in the gazetted forests across Meru County. In view of these challenges, assumptions were used to derive estimates presented in sub-sections below. It is notable that the assessment of demand for woody biomass considered only the household segment, as the County lacked resource for a full primary data study on wood fuel consumption by other market segments. Yet, woody biomass remains the dominant bioenergy feedstock meeting fuelwood demand to households, cottage industries, health facilities, and learning and correctional institutions in Meru County. Going forward the County Government is recommended to carry out full data collection on consumption by all market segments in Meru County. Similarly, although the calculated supply-demand balance of woody biomass energy is showing bioenergy deficit, the County Government should update the balance once the data on consumption by the other market segments is obtained.

5.4.1 Bioenergy potential from forest products

Sustainable supply of wood fuel (firewood and charcoal) from the forests and farmlands is calculated based on the following formulae (Githiomi et al., 2012): $SS = AAP \times H$, where AAP is the average annual productivity of forest stand (AAP) which varies; and the land area in hectares under trees (H). Data on dominant tree species in the gazetted forests of Meru is not available. Moreover, because of the degradation, the accessible have been assumed to be categorised as woodlands whose annual productivity is 0.64 m³/ha/year while trees on-farm has a productivity of 1.44 m³/ha/year (MoE, 2002).

The sustainable supply for woody biomass from both the forestlands and trees on-farms was first calculated with units as m³/year. In order to compare the woody biomass resource with annual consumption, the total sub-County values for sub-County supplies were converted from m³ to kg. Wood density is species and age specific (Githiomi & Kariuki, 2010). For example, Mango tree, one of the densest wood species found in Kenya, has a density of 675 kg/m³_{solid_bone-dry} (The Wood Database, 2017) while *Pinus patula*, a common pine planted in Kenya and one of the lighter wood found in Kenya averaging 450 kg/m³_{solid_bone-dry} (Adlard, Godwin Baily, & Austin, 1979). For the case of woody biomass resource assessment of Meru County, an average value of 562.5 kg/m³_{solid_bone-dry}. Estimates of sustainable supply for woody biomass (m³/year and kg/year), both in from both the forestlands and trees on-farms, is summarised in Table 121.

	Units	2019	2020	2021	2022	2023	2024	2025	2026	2027	2028
On-farm											
Expected areas under trees (EAT) (Ha) on-farm	Ha	17,651	17,946	18,246	18,550	18,860	19,175	19,495	19,821	20,152	20,489
Projected annual sustainable supply from farmlands (m ³ /year)	m ³ /year	25,418	25,842	26,274	26,713	27,159	27,612	28,073	28,542	29,019	29,504
Projected annual sustainable supply from farmlands (kg/year)	Kg/year	14,297,556	14,536,325	14,779,082	15,025,893	15,276,825	15,531,948	15,791,332	16,055,047	16,323,166	16,595,763
Outside farm (gazetted forestlands)											
Projected annual sustainable supply from outside farmlands (m ³ /year)	m ³ /year	54,241	54,241	54,241	54,241	54,241	54,241	54,241	54,241	54,241	54,241
Projected annual sustainable supply from outside farmlands (kg/year)	kg/year	30,510,360	30,510,360	30,510,360	30,510,360	30,510,360	30,510,360	30,510,360	30,510,360	30,510,360	30,510,360
Total annual projected sustainable supply											
Projected annual sustainable supply from farmlands + Projected annual sustainable supply from outside farmlands											
	m ³ /year	79,659	80,083	80,515	80,953	81,399	81,853	82,314	82,783	83,260	83,744
	kg/year	44,807,916	45,046,685	45,289,442	45,536,253	45,787,185	46,042,308	46,301,692	46,565,407	46,833,526	47,106,123

Table 120: Estimates of potential sustainable woody-based bioenergy in Meru County

5.4.2 Balance between fuelwood consumption and sustainable supply

The summary of wood fuel balance for Meru County is shown in Figure 59. It is calculated by differencing total consumption from total potential sustainable production.

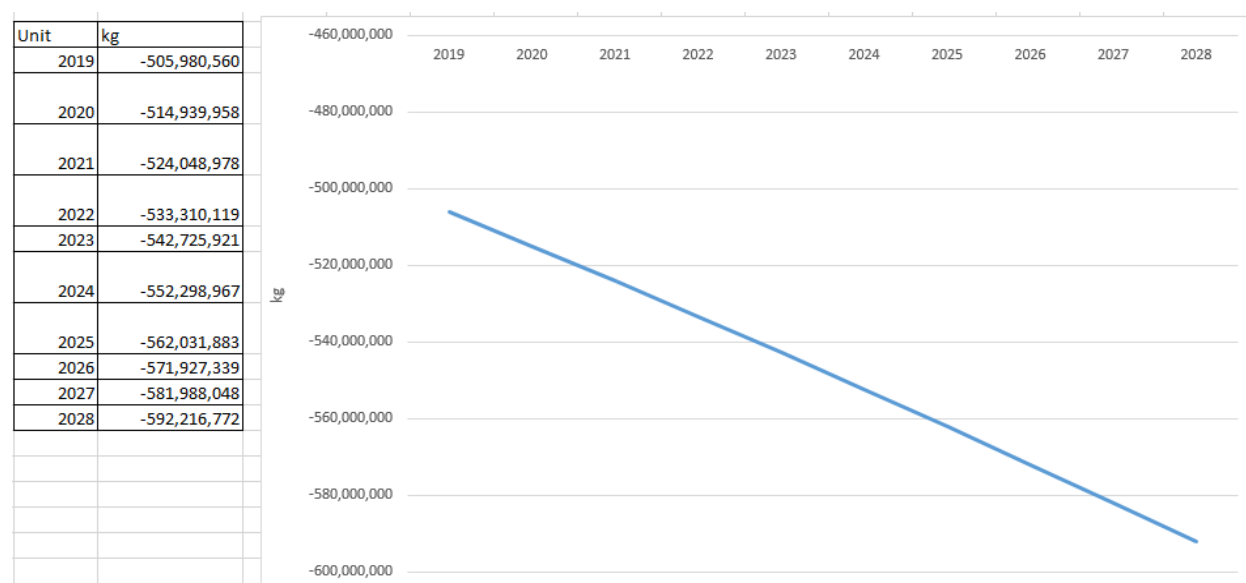


Figure 58: Deficit of woody biomass in sustainably meeting bioenergy needs in Meru County

It is notable that woody biomass consumption surpasses the sustainable supply from both the public forests and on-farm woody biomass. The County is already suffering deficit of wood-based fuel consumption. This implies that the harvesting is already beyond sustainable yield, and eating into the standing stock. The deficit is likely to be huge, given that consumption by other market segments (for example cottage or small and medium enterprises, health facilities, learning and correctional institutions) was not accounted for in this study due to lack of data.

In meeting the wood fuel balance, over-exploitation of standing biomass causes degradation of resources. Continuation of such business-as-usual scenario continue will decimate potential future supplies of these resources. Going forward the County Government is recommended to enhance control and enforcement of rules Government utilisation of woody biomass resource as well as promote expansion of woody biomass production especially by the private sector.

5.4.3 Bioenergy potential from agricultural residues

Table 6 shows the key residues producing crops with potential for briquettes or pellet manufacturing while Table 7 shows residues producing crops having potential for biogas production. Assumptions for calculating Meru County's agricultural crop residue availability is derived from Welfle et al. (2020), NIRAS-LTS (2021), Maj et al. (2019), Mai-Moulin et al. (2016) and Wekesa (2013). For manufacturing of briquettes or pellets from relevant crop residues, the following formulae is used:

$$ARB = Cp * RPR * RF * OF$$

Where: ARB = available residual biomass in tons per year

Cp = crop production in tons per year

RPR = residue-to-product ratio in tons of residues per tons of product

RF = recoverable fraction per tons of product

OF = biomass fraction available after considering other uses per ton of product

+ Assumed that 65 % of maize husks and cobs are already put into use in Meru County

Key residues producing crops		Residue to product ratio	Residue recovery factor	Competition for residues	Moisture content as received (wt %)	HHV or LHV (MJ/kg)
Maize	Stalk	1.60	80 %	65%		15 *LHV
	Husk	0.20	100 %	+65%		18.02 *LHV
	Cobs	0.29	100 %	+65%		9.69 *LHV
Bananas	Residue	4.30	50 %	40%		16.0 *LHV
Coffee	Husks	0.24		0		12.69 * LHV
Macadamia	Nutshells	0.7	60 %		10	21*HHV
Wheat	Straw	1.0	80 %			17.98 * LHV
Sorghum	Stalk	4.20	80 %	40 %		12.38 *LHV
Beans	Stalk	1.10	*50 %	*40 %		16.0 * LHV
Pigeon peas & cow peas	Stalk	1.10	*50 %	*40 %		15.0 LHV
Rice	Husks	0.28				16.01 * LHV

Table 121: Key crops producing residues with high potential for manufacture of briquettes/pellets

Key residues producing crops	Residue component	Residue to product ratio	Residue recovery factor	Moisture content as received (wt %)	Biogas potential (Nm ³ /t fresh weight)	Volatile matter (weight %)
Mangoes	peels, fibre, stone	0.452	50%	70	60	75
Potatoes	Stems	0.36	50%	85%	60	77
Avocadoes	peels, stone	0.9	100%	83%	90	95

Table 122: Key crops producing residues with high potential for production of biogas

The theoretical bioenergy potential from the crop residues relevant for briquettes or pellets (listed in Table 123) manufacturing was then calculated considering the available residual biomass and its energy content, using the expression below. The results are presented in Table 124.

$$BEP = ARB \cdot (1 - MC) \cdot HHV$$

Where: BEP = bioenergy potential in GJ

ARB = available residual biomass in tons per year

MC = moisture content

HHV = higher heating value in GJ per ton

	Calorific value in GJ	Calorific value in MWh
$BMP_{\text{Maize stalks}}$	435,053	120,945
$BMP_{\text{Maize husks}}$	81,663	22,702
$BMP_{\text{Maize cobs}}$	63,674	17,701
$BMP_{\text{Wheat stalks}}$	656,778	182,584
Coffee	3,002	835

Banana	4,343,688	1,207,545
Macadamia	21,679	6,027
Sorghum	6,489	1,804
Beans	189,314	52,629
Pigeon peas	61,053	16,973
Cow peas	22,171	6,164
Rice	718	200
Total	5,885,283	1,636,109

Table 123: Calorific value of crop-specific available residual biomass

The theoretical bioenergy potential for biogas production from relevant crop residues (listed in Table 125) was then calculated considering the available residual biomass and its energy content, using the expression below. The results are presented in Table 9.

$$Q_{\text{biogas from crop-residuals}} = TB_{\text{Fresh-residues-collected-per-year}} * RF * VS_{\text{content}} * BP_{\text{Biogas potential}}$$

Where:

$Q_{\text{biogas from crop-residuals}}$ = Amount of biogas that can potentially be produced annually from relevant crop residues

$TB_{\text{Fresh-residues-collected-per-year}}$ = Amount of residue (tons per year)

RF = Recoverable fraction of the total available residue biomass

VS_{content} = Volatile solids (VS) content (% RF)

$BP_{\text{Biogas potential}}$ = Biogas potential for the substrate ($\text{m}^3/\text{t VS}$)

VARIABLE	Units	Mangoes	Potatoes	Avocado	TOTAL
TOTAL ANNUAL BIOGAS PRODUCTION FROM RELEVANT CROP RESIDUES	'1000 m^3/year	296,883	883,953	415,838	1,597
TOTAL ENERGY FOR COOKING (THERMAL) FROM BIOGAS PRODUCED BY RELEVANT CROP RESIDUES	GJ/year	3,711	11,049	5,198	19,958
TOTAL ENERGY (ELECTRICITY) FROM BIOGAS PRODUCED BY RELEVANT CROP RESIDUES	MWh/year	588	1,750	823	3,161

Table 124: Potential biogas production from relevant crop residues

The available crop-based feedstock to produce briquettes or pellets can be harnessed by small and medium enterprises, as they can economically develop local supply chain to aggregate the feedstock from small-scale farmers. Potential biogas production from mangoes, potatoes and avocados can also be developed by small and medium enterprises and used to produce mini-grid electricity for use as productive use of energy (PUE) and can also be fed to the national grid.

5.4.4 Bioenergy from animal wastes

The potential biogas production from livestock population is estimated using the following expression, for each livestock category considered:

$$\text{Annual biogas production from cattle} = \text{Cattle No.} * TDM_{\text{cattle}} * DHB_{\text{cattle}} * AFCD_{\text{cattle}} * RW_{\text{cattle}} * VS_{\text{cattle}} * BY_{\text{cattle}},$$

$$\text{Annual biogas production from SHEEP/GOATS} = \text{Sheep/goats No.} * TDM_{\text{sheep/goats}} * DHB_{\text{sheep/goats}} * AFCD_{\text{sheep/goats}} * RW_{\text{sheep/goats}} * VS_{\text{sheep/goats}} * BY_{\text{sheep/goats}},$$

where:

Cattle No. is the total number of cattle,

Sheep/goats No. is the total number of small ruminants (sheep and goats),

TDM_{cattle} is the total daily manure production per unit cattle,

TDM_{sheep/goats} is the total daily manure production per unit sheep/goats,

DHB_{cattle} is the mean # of days spent by cattle in home boma,

DHB_{sheep/goats} is the mean # of days spent by small ruminants in home boma,

AFCD_{cattle} is the available fraction of cattle dung not collected for some other uses,

AFCD_{sheep/goats} is the available fraction of small ruminants not collected for some other uses,

RW_{cattle} is the percentage waste from cattle that can be recovered for biogas production,

RW_{sheep/goats} is the percentage waste from cattle that can be recovered for biogas production,

VS_{cattle} is the Volatile solids (VS) as % fresh manure,

VS_{sheep/goats} is the Volatile solids (VS) as % fresh manure,

BY_{cattle} is the Biogas yield,

BY_{sheep/goats} is the Biogas yield.

The biogas that can potentially be produced is recommended for household residential use, for example cooking, water heating, and PUE such as space heating for poultry brooding. Since biogas from livestock would mainly be promoted to contribute thermal demand for cooking purposes, it is necessary to estimate the calorific value that would be recovered from potential biogas production in Meru County. Methane is the valuable component under the aspect of using biogas as a fuel (Itodo et al., 2007). Energy from fuels is calculated using the following formula.

Energy = Heat Value of Fuel x Fuel Amount x Efficiency

For the unit of energy, Mega-joule (MJ) is generally used. However, other units (such as kWh) are used, but for the assessment of biogas potential and benefit, it is necessary to convert values into the same unit. Heat value is specific to each fuel type, as shown in Tables 126 and 127 below.

Fuel type	Calorific unit	Calorific value
LPG	MJ/kg	45-51
LPG	MJ/L	26
Natural gas	MJ/kg	37.3
Kerosene	MJ/L	36.7
Diesel oil	MJ/L	37.7
Coal	MJ/kg	22-26
Biogas	MJ/m ³	20-30 (average=25)
Dry firewood (non-resinous wood, stem-wood, bark, branches, needles)	MJ/kg	10-20

Table 125: Calorific value (in MJ/U) specific to fuel type

Source: Ashton, 2007

The calculated biogas potential (both in m³/year and in GJ/year) from dairy, sheep and goats are summarised in Table 127.

VARIABLE	Units	Totals
Estimate total annual biogas production from both cattle and small ruminants	m ³ /year	3,958,432,148.16
Estimate total energy for Cooking (Thermal) from biogas produced by both cattle and small ruminants	GJ/year	49,480,402
Estimate total energy (electrification) from biogas produced by both cattle and small ruminants	MWh/year	7,837,696

Table 126: Biogas production from livestock in Meru County

5.5 Bioenergy Trade

Meru County in Kenya, like many other regions, has been exploring and promoting Bioenergy solutions to address energy needs sustainably and promote economic development. While Meru County is known for its agricultural activities, including coffee and tea farming, and has significant biomass resources, the Bioenergy trade in the region might not be as advanced or well-established as in some other areas. However, the potential and opportunities related to Bioenergy trade in Meru is huge:

1. **Biomass Feedstock Production:** Meru County has the potential to produce ample biomass feedstock, including agricultural residues, coffee husks, tea waste, and other organic materials. This can serve as a valuable resource for Bioenergy production.
2. **Biofuel and Biogas Production:** Opportunities exist for producing biofuels, such as biodiesel or bioethanol, from locally available vegetable oils or sugarcane. Biogas production from agricultural waste and organic matter can also be an attractive Bioenergy option for the region.
3. **Household and Institutional Use:** Bioenergy solutions, such as improved cookstoves that use biomass pellets or briquettes, can find applications in households and institutions across the County, especially in rural and off-grid areas.
4. **Renewable Energy Policies:** National and County-level renewable energy policies and incentives can play a significant role in promoting Bioenergy trade in Meru. Supportive policies can encourage investments and create a conducive environment for Bioenergy businesses to thrive.
5. **Entrepreneurship and Innovation:** Local entrepreneurs and businesses can explore opportunities in the Bioenergy sector, such as biomass briquette production, biogas plants, or biofuel retailing.
6. **Sustainable Development:** Bioenergy trade in Meru should prioritize sustainability, ensuring responsible sourcing of biomass feedstock and minimizing environmental impacts.
7. **Capacity Building:** Building local capacities and technical expertise in Bioenergy production and utilization can enhance the region's ability to harness its Bioenergy potential.

8. **Partnerships and Collaboration:** Collaboration between the County Government, private sector, NGOs, and research institutions can accelerate the development and uptake of Bioenergy solutions.

5.6 Current Bioenergy market and demand situation

i. Power generation

The Bioenergy market for power generation has been steadily growing, driven by increasing global awareness of the need to transition to renewable energy sources and reduce greenhouse gas emissions. Bioenergy plays a significant role in the power sector, providing electricity through various biomass-based technologies. The current Bioenergy market and demand situation in power generation are as follows:

1. **Bioenergy Sources:** Biomass-based power generation primarily relies on various sources, including solid biomass, biogas, and biofuels. Solid biomass, such as wood pellets, agricultural residues, and forestry waste, is used in biomass power plants to produce electricity. Biogas, produced from organic waste, is utilized in biogas power plants. Biofuels, such as biodiesel and bioethanol, can be used in conventional power plants with some modifications.
2. **Renewable Energy Targets:** Many countries and regions have set renewable energy targets and policies to increase the share of renewables, including Bioenergy, in their power generation mix. These targets drive the demand for Bioenergy projects and investments in the sector.
3. **Decentralized and Off-Grid Power Generation:** Bioenergy is particularly relevant for decentralized and off-grid power generation, especially in rural and remote areas. Biomass and biogas plants can provide reliable electricity to communities not connected to the main power grid.
4. **Sustainable Development Goals (SDGs):** Bioenergy aligns with several Sustainable Development Goals, including affordable and clean energy (SDG 7) and climate action (SDG 13), further bolstering its demand in the power generation sector.
5. **Waste-to-Energy:** Biogas plants and biomass power plants that use agricultural residues and organic waste offer a sustainable waste-to-energy solution, addressing waste management challenges while producing electricity.
6. **Intermittency and Baseload Power:** One challenge for Bioenergy in power generation is its intermittency, as certain sources like solar and wind are dependent on weather conditions. However, some biomass-based power plants can provide baseload power, offering a consistent and reliable electricity supply.
7. **Sustainability and Environmental Concerns:** The sustainability of biomass sourcing is a crucial consideration. Ensuring responsible and sustainable biomass supply chains is vital to avoid negative environmental impacts and land-use conflicts.
8. **Technology Advancements:** Advancements in Bioenergy technologies, such as improved biomass conversion efficiency and biogas purification techniques, are enhancing the competitiveness of Bioenergy in the power sector.

9. **Investment and Financing:** Access to finance and investment is essential for the expansion of Bioenergy projects. Supportive policies and financial incentives can attract private and public investments in the Bioenergy sector.
10. **Grid Integration:** Integrating Bioenergy into existing power grids requires planning and grid infrastructure upgrades to accommodate variable power generation.

ii. Industrial sector

The Bioenergy market in the industrial sector has been witnessing significant growth and increasing demand. Industries are increasingly adopting Bioenergy solutions to meet their energy needs sustainably and reduce their environmental footprint. The current Bioenergy market and demand situation in the industrial sector are as follows:

1. **Biomass-Based Heat and Power Generation:** Industries are utilizing biomass-based systems, such as biomass boilers and cogeneration plants, to generate heat and electricity. Biomass offers a renewable and carbon-neutral energy source for industrial processes.
2. **Waste-to-Energy:** Industrial facilities are exploring waste-to-energy solutions, converting various types of organic waste and residues into biogas, biofuels, or other forms of energy to power their operations.
3. **Biofuels for Process Heat and Steam:** Some industries are adopting biofuels, such as biodiesel or bioethanol, for process heat and steam generation, reducing their reliance on fossil fuels.
4. **Cement and Lime Kilns:** Biomass is increasingly being used as an alternative fuel in cement and lime kilns, replacing traditional fossil fuels and lowering carbon emissions.
5. **Sustainable Manufacturing:** Bioenergy aligns with sustainable manufacturing practices, contributing to corporate social responsibility and environmental sustainability goals.
6. **Energy Efficiency and Cost Savings:** Industries are integrating Bioenergy solutions to improve energy efficiency and reduce energy costs over the long term.
7. **Regulatory Drivers:** Environmental regulations and carbon pricing mechanisms are pushing industries to adopt cleaner energy sources like Bioenergy to reduce greenhouse gas emissions.
8. **Co-Generation and Combined Heat and Power (CHP):** Industries are adopting co-generation and CHP systems, where waste heat from industrial processes is utilised to generate additional electricity or heat, making the overall process more energy-efficient.
9. **Sustainable Supply Chain:** Some industries are incorporating sustainable biomass sourcing and supply chain practices to ensure the environmental integrity of their Bioenergy solutions.

10. **Technology Advancements:** Advancements in Bioenergy technologies, such as gasification and anaerobic digestion, are expanding the range of options available to industrial users.
11. **Investment and Partnerships:** Investments in Bioenergy projects by industries and collaborations with renewable energy developers and suppliers are contributing to market growth.
12. **Wider Bio-Economy:** The growing Bioenergy market in the industrial sector is part of a broader bio-economy trend that emphasizes the sustainable use of biomass for various applications.

iii. Households and institutions

The bioenergy market for households and institutions has been steadily growing, driven by increasing awareness of renewable energy sources and the need to transition away from fossil fuels. Overall, the current Bioenergy market for households and institutions is characterized by a growing demand for cleaner and more sustainable energy options. As technology advances, costs decrease, and supportive policies continue to be implemented, the adoption of Bioenergy solutions is expected to further increase, contributing to a more sustainable energy landscape. Biomass, which includes biofuels, biogas, and biomass pellets, is a significant component of the Bioenergy market for residential and institutional use. The demand situation varies depending on the region and country, but some general trends can be observed:

1. **Biomass Pellets and Briquettes:** Biomass pellets and briquettes are increasingly used as a cleaner alternative to traditional solid fuels like firewood and charcoal. They are more energy-dense, produce less smoke and pollutants, and are easier to handle and store. The demand for biomass pellets has been on the rise, especially in countries with policies supporting renewable energy and those facing deforestation challenges.
2. **Biogas:** Biogas, produced from the anaerobic digestion of organic materials such as agricultural residues, animal waste, and food scraps, is gaining popularity in households and institutions. Biogas can be used for cooking, heating, and lighting, providing a sustainable energy source while also managing organic waste.
3. **Biofuels:** In some regions, biofuels, such as biodiesel and bioethanol, are used in stoves, cookers, and heating systems. They are produced from various biomass sources, including vegetable oils and sugarcane.
4. **Institutional Demand:** Institutions, such as schools, hospitals, and community centers, are increasingly adopting Bioenergy solutions to meet their energy needs sustainably. Biomass-based systems are often integrated into cooking, heating, and electricity generation in such settings.
5. **Renewable Energy Policies:** Government policies promoting renewable energy, incentives, and subsidies have positively influenced the demand for Bioenergy in households and institutions. Supportive policies encourage investments in Bioenergy technologies and make them more accessible to consumers.

6. **Rural and Off-Grid Areas:** Bioenergy solutions are particularly attractive in rural and off-grid areas, where access to traditional energy sources may be limited. In such regions, Bioenergy offers a reliable and locally available energy option.
7. **Awareness and Education:** Increased awareness about climate change, environmental degradation, and the benefits of clean energy has led to a growing interest in Bioenergy as a sustainable energy solution.

5.7 Challenges affecting the Bioenergy Sector

1. **Feedstock Availability and Cost:** Securing a reliable and sustainable supply of biomass feedstock can be challenging. Competition for feedstock resources with other industries, such as agriculture and forestry, may drive up costs and limit availability.
2. **Land Use Competition:** The production of biomass feedstock for Bioenergy may compete with other land uses, such as food production and conservation. Balancing land use priorities and avoiding potential conflicts is essential.
3. **Technological Limitations:** Some Bioenergy conversion technologies may still be in the early stages of development, limiting their efficiency and cost-effectiveness compared to traditional energy sources.
4. **Infrastructure and Logistics:** Establishing and maintaining efficient biomass supply chains, including collection, transportation, and storage, can be costly and challenging, especially in rural areas.
5. **Intermittency and Seasonality:** Certain Bioenergy sources, such as solar, wind, or hydrothermal energy, are intermittent and dependent on weather conditions. This can make their integration into the energy grid more complex.
6. **Environmental Impact and Land Use Change:** Poorly managed Bioenergy projects can lead to negative environmental impacts, such as deforestation, soil degradation, and habitat loss. Ensuring sustainability and minimizing adverse effects is crucial.
7. **Policy and Regulatory Frameworks:** The absence of supportive policies and regulations can impede Bioenergy development and investment. Clear and consistent policies are needed to provide incentives and ensure a level playing field for Bioenergy technologies.
8. **Financial and Investment Challenges:** High upfront costs and perceived risks may deter investors from funding Bioenergy projects, especially in emerging markets or regions with uncertain policy environments.
9. **Public Acceptance and Awareness:** Public perception and understanding of Bioenergy may impact its acceptance. Engaging communities and raising awareness about the benefits and potential of Bioenergy is essential.
10. **Competing Energy Sources:** Conventional energy sources, such as fossil fuels, may still dominate the energy market due to their historical reliance and established infrastructure.

11. **Technological Scale-up:** Scaling up Bioenergy technologies from small-scale to commercial levels can be challenging, requiring significant investment and technological advancements.
12. **Energy Density:** Some Bioenergy sources have lower energy densities than fossil fuels, requiring larger volumes for the same energy output, which can pose logistical challenges

5.8 Cross-Cutting Issues in Bioenergy

This section covers a number of cross-cutting issues in Bioenergy including: gender and social inclusion; environmental and climate issues; stakeholder participation and communication; and technology and innovation.

1. **Sustainability:** Ensuring that Bioenergy production and utilization are sustainable, economically, socially, and environmentally. This includes responsible biomass sourcing, avoiding negative impacts on biodiversity, and promoting long-term viability.
2. **Land Use and Food Security:** Balancing the use of land for Bioenergy feedstock production with the need for food production and conservation of natural ecosystems. Avoiding competition for land resources is critical to maintain food security and preserve natural habitats.
3. **Social and Economic Inclusion:** Ensuring that Bioenergy projects benefit local communities, promote equitable access (including by gender), and provide opportunities for income generation and employment, particularly in rural areas where Bioenergy projects are often situated.
4. **Climate Change Mitigation:** Evaluating the actual greenhouse gas emissions reduction potential of Bioenergy projects and considering indirect land-use change impacts to ensure that they contribute to climate change mitigation effectively.
5. **Technology and Innovation:** Promoting research and development in Bioenergy technologies to improve efficiency, reduce costs, and enhance performance. Innovation is essential for maximizing the potential of Bioenergy as a renewable energy source.
6. **Policy and Regulation:** Developing clear and supportive policy frameworks and regulations that encourage the sustainable development and use of Bioenergy while safeguarding environmental and social interests.
7. **Capacity Building:** Building human and institutional capacities to implement and manage Bioenergy projects effectively. This includes technical skills, knowledge transfer, and awareness-raising activities.
8. **Supply Chain and Infrastructure:** Establishing efficient and reliable biomass supply chains, including collection, transportation, and storage, as well as the necessary infrastructure for biomass processing and energy conversion.

9. **Waste Management and Circular Economy:** Exploring opportunities to utilize agricultural and forestry residues, organic waste, and by-products for Bioenergy production to contribute to a circular economy and reduce waste.
10. **Stakeholder Engagement and Participation:** Ensuring the active involvement and consultation of relevant stakeholders, including local communities, in the planning, decision-making, and implementation of Bioenergy projects.

5.9 Selection of Interventions

This requires preparation and a workshop setting, bringing the stakeholder departments and Directorates to brainstorm on the interventions and prioritisation. County Government has limited resource to carry this out in time for this CEP and will look to conduct this workshop in the future. Areas to cover are:

- i. List and prioritize potential intervention options,
- ii. Specify the selected interventions,
- iii. Develop a governance structure for implementation.

CHAPTER SIX: PROGRAMMES AND PROJECTS

6.1 National Government Projects

In the pursuit of sustainable and inclusive development, the synergy between national and County Governments plays a pivotal role, especially in addressing crucial aspects such as energy infrastructure. Meru County is set to witness a transformative phase with several National Government projects underway.

One of these key partnerships shaping the energy landscape in Meru County is the collaboration between the County Government and the Rural Electrification and Renewable Energy Corporation (REREC). Through the Matching Fund Project, Meru County aims to install high mast and low mast floodlights. These strategic installations are poised to bring about a significant positive impact on public safety, security, and overall accessibility within the County.

Additionally, Kenya Power and Lighting Company (KPLC) has an ambitious streetlight installation project for urban centres, enhancing visibility, and fostering a sense of community well-being.

Kenya Electricity Transmission Company Limited (KETRACO) is actively engaged in conducting a feasibility study for a high-voltage transmission line (132kV/33kV) culminating in the establishment of a proposed substation at Maua.

The Ministry of Energy and Petroleum has also begun a Clean Cooking Project in Meru County focussed on the installation of bio digesters, particularly targeting women's groups. By providing clean cooking solutions, this initiative not only addresses environmental concerns but also empowers local communities, especially women.

These initiatives reflect a holistic approach, encompassing not only the provision of energy but also supporting safety of public spaces, empowerment of local communities, and the promotion of environmental sustainability.

6.2 County Government Projects

6.2.1 Improving access to household and street lighting

This programme has the following components. First, providing access to Tier 1 of affordable, reliable, sustainable, and modern energy to all households across Meru County using kerosene as their primary lighting fuel. The programme will be implemented in three initial phases:

- **Inception Phase** targeting three sub-counties facing bigger social and economic challenges and having many kerosene end-users. This testing and learning phase will allow to pilot the programme and refine it in sub-sequent phases as it is scale up to a larger number of households.
- **Implementation Phases** (phase 2 and 3): these two implementation phases will gradually increase the number of targeted households, from 7,200 in phase 2 to 12,500 in phase 3. In **Phase 3**, the targeted sub-counties will be expanded to six.

Subsequent phases of this programme will be launched in year 4, and it will continue until reaching to all households using kerosene as their primary lighting fuel. The programme will launch two innovative financial models – a lease and lease to own scheme – with the support of Meru County Investment and Development Corporation (MCIDC). These two lease schemes will significantly reduce the cost of the Tier 1 solar system by bulk purchasing the

product to the providers and granting a user-friendly repayment scheme to the targeted households.

Second, training technicians to provide pre and after-sale technical services to end-users of off-grid systems. The aim of this programme is to create a network of qualified technicians to ensure that end-users living in remote areas have access to high-quality technical support on off-grid solar systems. The County will train and hire ten technicians who will provide technical support to end-users of off-grid systems, and other Government facilities across the County. Additionally, ten technicians will be employed by the Energy Docket for the recurrent installation and maintenance of the streetlighting infrastructure. Furthermore, Meru County will work closely with off-grid system providers to create internship programmes and early career opportunities for technicians enrolled in off-grid energy programmes provided by local Polytechnics and Universities across the County.

Third, raising awareness of quality off-grid systems among households. The objective of this programme is to sensitise and better inform households on the benefits of different off-grid solutions by disseminating information through different channels, such as social media, local radio, barazas and other forums. Most sensitisation activities will be launched in years 2 and 3 of the Tier 1 lighting systems described above, as the information campaigns will raise end-users' awareness and will simultaneously provide information about the existing opportunities to purchase off-grid systems and how end-users can seek technical support. This programme will target households across the entire County, but some campaigns will specifically target certain marginalised groups, such as women, people with disability, low-income households or groups living in remote areas.

Four, installing streetlights and floodlights in towns and markets centres. The aim of this programme is to deploy an extensive network of street lighting services across the County to create a 24-hour working economy and improve security during the night working hours. Funded by the County Energy Docket, the programme will be implemented over the course of five years, and the poles to be installed includes both, grid-tied infrastructure as well as off-grid floodlights and street lighting poles.

6.2.2 Access to clean, safe and affordable cooking solutions

To promote the adoption and use of cleaner and modern cooking solutions in Meru County, the proposed interventions target specific transition pathways for different groups of households based on their current cooking practices. The three groups of households are (i) those using firewood in three-stone open fires, (ii) those using purchased charcoal in traditional metallic charcoal stoves, and (iii) those using Kerosene. These groups accounted for 299,875 households in 2019. The details of the transition pathways are provided in section 3.2.3.2 (i) of this CEP.

The main interventions include: (a) conducting awareness-raising campaigns, (b) training local ICS fabricators and cooking solution technicians, and (c) improving access to finance and credit. These interventions address both energy and non-energy barriers and stimulate demand and adoption of cleaner cooking solutions by households in the County according to their context. The interventions will be implemented over 6 years with annual targets of households to be reached/transitioned. Refer to section 3.2 of the CEP for the fully worked out solution.

6.2.3 Improving access to clean water

Replace diesel pumping for solar technologies in boreholes. The programme will reduce emissions and operational costs in existing boreholes powered by diesel. The programme will be implemented in 1 year targeting 20 diesel-powered boreholes spread across Igembe North, Central, Tigania West which will be converted to solar.

Expand the borehole network to underserved regions of Meru. This programme will provide a proximate source of water to the lower areas of the County where people have to walk long distances to have access to water for domestic and livelihood purposes. Also, 16 level 2 health facilities currently more than 1 km away from a water source, will be benefited by the new borehole network. The programme will target Igembe South, Central and North, the lower areas of Burri and the Tiganias and will be implemented in two phases. In phase 1, 138 boreholes will be constructed while in phase 2 the number will be expanded to 213 boreholes. In parallel, new water management committees will be established and member will receive training on water management and conservation.

Pilot community scale water treatment plant. The programme aims to address low-quality water challenges experienced in the lower regions of Meru served by boreholes where water is extremely saline by deploying new water treatment plants across. 20 pilot community scale power purification facilities will be constructed across 20 wards in Tigania West and East.

Water metering and tariff. The programme seeks to promote a sustainable use of water in boreholes, dwellings, water kiosks and health facilities. Water meters will also help collect data to better estimate water demand, manage water effective, and estimate future demand. Data collected by water meters will be transmitted to a centralised data management center.

Over the two phases of the programme, more than 500 digital meter will be installed in existing and new boreholes, 27 in health facilities, 582 in kiosks and 5,000 in dwellings.

Promote residential scale water purification. This programme will provide access to drinking water to people living in remote areas who relies on low-quality water. Two types of residential scale technologies will be deployed: undersink water purifiers and small-scale benchtop water purifiers. In total, 6,250 households will be targeted over the two phases of the programme. A PAYGo system will be launched to address affordability barriers.

Establish and strengthen community water management groups. This programme has a twofold objective: 1) to establish a new water management structure across the targeted committees and 2) to strengthen knowledge of member of water committees on operations and management, feasibility study, survey and mapping, Design BoQs, Distribution of pipes. Over the duration of the programme, 25 sessions of water management committee training held 300 technical staff will be trained on basic equipment operations and maintenance.

Promote distributed water storage solutions to remote communities. The programme will address water shortage challenges faced by communities with low population density - below 100 persons per km radius or about 30 homes per 3-4k. The programme will be implemented in two phases. Phase 1 will support 10,000 households to acquire water storage tanks, build 20 farm ponds and, and install 20 rainwater collection roofs and storage tanks in public facilities. Phase 2 will provide support to additional 10,000 households to purchase water storage tanks.

6.2.4 Improving access to basic health services

The programme aims to ensure “good enough” basic health (outpatient) services provision in through 160 target level 2 facilities (dispensaries) across Meru County. The programme has the following components.

First, provision of reliable, affordable, and adequate electricity. The target facilities will be provided with reliable energy systems according to their location and connectivity. For those already grid connected, this will be a backup system (6kVA petrol generator); for those located up to 600m from an existing transformer, grid connection (single phase) plus backup system. For the few facilities 600m beyond the grid, a solar home system with 2.4kWh battery bank for backup. All the facilities will have a maintenance and repair function, including staff training on operation of the generator and solar home system, and annual maintenance check.

Second, provision of reliable clean water supply. This will be implemented by the Directorate of Water and customised for each facility (depending on whether they have existing boreholes or piped water systems). 26 facilities in the first phase will have a new solar borehole for dual facility and community use and feasibility studies will be carried out to identify the best solution for the remaining facilities. A maintenance and repair function will be provided. For dual use boreholes, there will be a Water Committee with level two facility staff representation.

Third, ensuring the target facilities have the minimum appliances, equipment, and medicines required to deliver “good enough” outpatient services. A repair or replace policy will be implemented for the list of minimum and staff will be trained on proper operation and basis maintenance of equipment. Bulk purchase of equipment will be explored with supplier mapping for the most energy efficient appliances (for both cost reduction and sustainability). The County Government will develop a green procurement policy to promote EE appliance purchase. A list of essential medicines will also be developed with quantification to ensure optimal stock management and new procurement systems. 50 stores will be constructed in L2 facilities and staff will be trained on digital stock taking.

Fourth, improving staff retention and recruitment. Benchmarking of best staff recruitment and retention practices will be carried out and a capacity and training needs assessment carried out with target facility staff. This will inform development of a training programme with annual and refresher courses for staff. To address the systemic challenge of delays in paying health worker salaries, the Department of Health will explore whether there are innovative ways to address this.

Finally, financial management and record keeping of facilities will be improved through staff training and introduction of digital book and record keeping, including to process bills in a timely manner through the national insurance system. So that services can be charged for in consistent and transparent manner, the Department of Health will develop a standard charging policy for outpatient services.

The programme will be implemented in three phases, with 50% of the target 160 level two facilities reached under the current CIDP cycle (2023-28) and the remaining 50% in the next CIDP cycle. In the Demonstration Phase (years one and two), at least 13 facilities will be electrified and provided with the minimal appliances and equipment and medicines and staff trained in maintenance and operation of appliances, and 26 dual-use solar powered boreholes

will be installed, with feasibility studies on a further 54 facilities. The benchmarking of best recruitment and retention practices, green procurement and charging policies and digital stock taking in the target facilities will also be completed. In Scale up Phase 1 (years three to five), the whole solution will be delivered to 80 facilities, and in Scale up Phase 2 (years five to ten, second CIDP cycle), to the remaining 80 facilities.

6.2.5 Improving income from crop farming

All programmes mentioned in the following points will target farms in the upper and lower midland zones of Meru and will be implemented over three phases. This allows the intervention models to be tested during a demonstration phase before scaling it up to more farmers, adding additional support in access to credit, aggregation, and new markets as it moves towards a fully commercial model. These phases will be preceded by a six-month inception period dedicated to pre-project implementation detailed planning. The demonstration phase will target 150 horticulture farmers, while the scale-up phase will reach to 3,000 farmers. Finally, as the model is fully commercial in phase 3, 6,000 farmers are expected to benefit by the end of this phase. The following summarises the overall features of the agriculture programmes:

Establish and strengthen community water management groups. This programme will strengthen water committee's members capacities on water conservation and management of communal resources for both, existing water committees and new ones to be established in the upper and lower midland zones of Meru. In phase 1, five to eight new water committees will be established, and 150 farmers will be trained on water management & irrigation while in phase 2, the targeted end-users will be increased to 80-100 new water associations to be established and 3,000 farmers who will received the before-mentioned trained. One of the key components of the training package focuses on strengthening capacities on water efficient irrigation equipment, such as drip systems, and water harvesting as most farmers in the targeted areas use gravity irrigation.

Water metering for irrigation. This programme aims to sensitise farmers on their water consumption for irrigation, and it is expected that water meters will create an incentive for farmers to invest in water efficient irrigation equipment. The water meter model will be piloted in the demonstration phase with 150 farms, while the tested model will be scaled up to 3,000 in phase 2 introducing the water fees.

Support for the purchase of water-efficient irrigation equipment. This programme will support small-farm holders for the purchase of solar water pumps, drip systems and storage tanks. The model includes making financing packages available to farmers, through both, technology suppliers or financing organisations. In addition, financial support will be provided in the demonstration phase to reduce the cost of the irrigation equipment, as more farmers become aware of the recommended irrigation kit and the model is scaled up to 3,000 farmers in phase 2.

Support for local water storage (farm ponds). This programme aims to address water constraints in strategic areas facing significant challenges in accessing water for irrigation. Public financing will be allocated in the form of grants and loans for the pond liners while it is expected that farmers will carry out the civil work. It is estimated that 45 farm ponds will be built in phase 1 and 900 in phase 2.

Improved access to quality/certified farming inputs. This programme will support farmers in accessing high-quality farming inputs, such as certified seeds, fertilisers, and pesticides. Sensitisation and training campaigns will be run to increase farmers knowledge on the benefits of the recommended farming inputs, and also, farmers in the targeted areas will be connected to reliable agro-dealers or one stop shops. To incentivise farmers, financial support will be provided in the demonstration phase so that the targeted end-users can purchase all farming inputs needed for the first harvesting season.

Train farmers on Good Agriculture Practices (GAP) and market literacy. This programme will strengthen both, agriculture extension officers and farmers, knowledge of GAP covering aspects such integrated pest management, farming techniques, crop cycle design, water efficient irrigation equipment. Demonstration farms will be used in phase 1 as part of the training. In addition, all targeted farmers in Phases 1 and 2 will receive training on different marketing skills such as contract farming, negotiation strategies, market mapping and aggregation strategies (formation and management of marketing groups).

6.2.6 Improving income from poultry farming

The programme aims to provide target poultry farmers with reliable, affordable electricity & infrastructure for incubation & brooding plus reduced cost inputs, access to finance and stable markets. There are two sub-programmes. The first targets four model villages (MVs) established by the County Government under a previous programme for aggregation of poultry production and marketing. The current programme aims to leverage the sunk capital in the MVs and build a sustainable business model. The second sub-programme targets individual farmers who currently keep fewer than 50 birds and are already in self-help groups or co-operatives located near the MVs to benefit from their economies of scale. The programmes have the following components.

First, reinvigoration of existing MVs by reactivating membership and improving governance through training, beginning with one MV (100 active farmers) in the Demonstration Phase, and scaling up to reach all four MVs (800+ farmers). For the individual farmer programme, 25 farmers will be targeted in the Demonstration Phase, scaling up to 100 farmers (one self-help group per MV).

Second, ensuring a reliable supply of electricity for the MV incubation, brooding and lighting equipment. The MVs are grid connected (three phase) so a backup system will be provided (diesel generator) and a maintenance and repair function, including training on basic maintenance of both generator and equipment and paid staff to operate the appliances. Broken equipment will be repaired or replaced, and a new 1056 incubator installed (with additional incubators as production expands). Automated candling equipment will be provided, along with a new aggregation and feed hall. For the individual farmer programme, 96-egg solar powered incubators will be used, and solar lighting. Paraffin lamps are used for brooding, to reduce costs. The component in both sub-programmes will require public subsidy on new equipment, framed as an “introductory discount” for the farmers, and micro finance loans.

Third, access to reliable, high quality and affordable inputs. Feed costs for the MV farmers will be reduced by providing new mixing and milling equipment (with subsidy and microfinance) and support to negotiate bulk purchase of feed inputs. Given that the sustainable solution to reduce feed costs is own feed production, a feasibility study on own

feed production will be carried out. Individual incubation programme farmers can also purchase feed through the MVs. A reliable supply of high-grade fertilised eggs will be identified with support for contracting and a feasibility study and demonstration project will be undertaken for a brooder farm. Public subsidy for inputs until the mature birds can be taken to market will be provided to farmers.

Fourth, a wide range of skills development will be provided through different methods including use of specially trained extension officers, external training providers, mentoring and use of “champion farmers” to improve poultry management practice, productivity & marketing. Farmer learning will be on the following: equipment operation and basic maintenance of equipment; flock health & disease surveillance and control; improved poultry breeds, production and management practices for layer and chicks; chicken housing including cooling; feed and nutrition requirements; business skills including production planning, risk measurement, management and record keeping; and market knowledge and marketing skills. Farmers should also be trained on adaptive management of climate risks to poultry production.

Both business models (aggregated and individual production) are only viable with a component of public subsidy and with microfinance. A 50% Government subsidy will be provided to the MVs to support the purchase of backup generators (sized for expansion and feed mills and mixers), feed mill and mixer, and new 1056 incubator plus new buildings. The MV will pay a 20% deposit and microfinance organised to cover the remaining financing gap of 30%. For the first five cycles of production until the mature birds go to market, a full subsidy (100%) will also be provided for fertilised eggs, 50% subsidy on commercial feed purchase to grow chicks to three weeks and a 70% subsidy to grow chicks to mature birds (100 farmers). Farmer training is funded by the Government (or another donor).

For individual farmers, the financing model is the same but with the farmer paying a 10% deposit on new equipment. Farmers will pay the remaining costs including for their own training and must commit for a 12-month period as part of the demonstration project. All other operating costs, group membership fees, vaccinations etc are covered by the farmers themselves.

6.3 Non-Governmental and Private Sector Projects

Practical Action is currently implementing a Women in Energy Enterprises (WEEK III) Project. This initiative is designed to empower women across the County, recognising the pivotal role they play in both household and community-level energy management. By fostering entrepreneurship and providing training opportunities, Practical Action aims to not only enhance energy access but also catalyse economic empowerment for women in Meru County.

Meru County Investment and Development Corporation (MCIDC) is partnering with Hewani Energy (PYT) LTD, formerly known as Windlab, to establish the Meru Energy Park, a pioneering venture targeted at harnessing wind power for the benefit of the County. These projects extend beyond mere energy provision. They embody a shared commitment to community development, gender inclusivity, and the adoption of clean and sustainable energy practices.

6.4 Development Partners

The European Union and the Ministry of Energy and Petroleum (MoEP) are pivotal contributors to Meru County's development through their support for the Sustainable Energy Technical Assistance (SETA) Project under which Meru's CEP development was supported.

6.6 Summary of Programme/Project Interventions in the County

S/No	Objective	Project/ Programme	Timelines	Specific Activities	Implementin g Agency	Project Cost (KES)* = million	Source of funds	Targeted Beneficiarie s	Status (New/Ongoing)
a)	National Government Projects/Programmes								
	To enhance rural electrification by pooling resources from both the national and county levels	REREC/CGM matching fund	Ongoing	Installation of high mast and low mast floodlights	CGM REREC	TBD	CGM REREC	Meru County residents	Ongoing
	To evaluate the technical, economic, and environmental viability of constructing a high-voltage transmission line	Feasibility study on high voltage line 132kV/33kV	TBD	Feasibility study on high voltage line (132kV/33kV) to feed the proposed Maua sub station	KETRACO CGM	TBD	KETRACO	20,000 residents per feeder line	New
	To promote sustainable, affordable, and healthier cooking alternatives	Clean cooking/ Installation of bio digesters	Ongoing	Installation of bio digesters	MoEP	TBD	MoEP		Ongoing
County Government Projects/Programmes									
Improving access to lighting for HH and street lighting									
b)	Provide access to affordable, reliable,	Promote access to Tier 1 lighting systems	Three initial phases: inception	Launch a lease and lease to own model which will offer an	Energy Docket working	279.6	Debt finance through MCIDC and other	The programme will initially	New

S/No .	Objective	Project/ Programme	Timelines	Specific Activities	Implementin g Agency	Project Cost (KES)* = million	Source of funds	Targeted Beneficiarie s	Status (New/Ongoing)
	sustainable, and modern energy to all households using kerosene as their primary lighting fuel		phase and two implementation phases. Subsequent phases of the programme will target additional households until reaching to all kerosene end-users across the County	affordable scheme to purchase Tier 1 lighting systems. Support incentives and subsidies to mainstream solarization to vulnerable and institutions.	together with the MCIDC and private suppliers of off-grid lighting systems.	28.8	development partners CGM funding to cover project management costs and monitoring and evaluation activities. Development Partner	target 23,300 HH from 6 sub-counties using kerosene as their primary lighting fuel	
c)	Create a network of qualified technicians to ensure that end-users living in remote areas have access to high-quality technical support on off-grid solar systems	Train technicians to widespread pre and after-sale technical services for off-grid systems as well as EPRA licencing	Y 2-3	The County Energy Docket will employ: 1) 10 technicians to provide technical support to end-users of off-grid systems, and 2) 10 technicians for the recurrent installation & maintenance of the streetlighting infrastructure. Promote off-grid training in TVETs, Internship programmes and early	Energy Docket	5	CGM Development Partner	Registration is open for people with or without previous expertise in the sector as training will be provided. The programme will ensure a gender quota among the trainees.	New

S/No .	Objective	Project/ Programme	Timelines	Specific Activities	Implementin g Agency	Project Cost (KES)* = million	Source of funds	Targeted Beneficiarie s	Status (New/Ongoing)
				career opportunities for technicians enrolled in local Polytechnics and Universities.					
d)	Sensitise and better inform households on the benefits of different off-grid solutions	Raise awareness of quality off-grid systems among households	The programme will be run over two years which will coincide with phase 2 and 3 of the Tier 1 lighting programme).	Widespread information through different channels, such as social media, local radio, roadshows, exhibitions, barazas and other forums.	Energy Docket	10	CGM Development Partner	All households across the County. Specific sensitisation campaigns will target marginalised groups such low-income women, people with disability, low-income/rural households.	New
e)	Expand the street lighting infrastructure to create a 24-hour working economy and improve security during	Installation and solarization of streetlights and floodlights in towns and markets centres	The programme will be implemented over the course of five years.	Installation of 460 low mast floodlights (140 off-grid), 75 high mast floodlights (13 off-grid), 25 townships lights (10 off-grid)	Energy Docket	692.5	CGM Development Partners	Towns and markets centres across the County	Ongoing

S/No .	Objective	Project/ Programme	Timelines	Specific Activities	Implementin g Agency	Project Cost (KES)* = million	Source of funds	Targeted Beneficiaries	Status (New/Ongoing)
	the night working hours								
Sub-total						1,015.9			
Provide access to affordable, cleaner, safer, efficient & reliable cooking fuels/ technologies									
2.	Provide Access to affordable, cleaner, safer, efficient & reliable cooking fuels/ technologies	Promotion of clean cooking energy strategies, policy development; renewable energy generation	Annual targets for transition households is provided based on the pathways.	Sensitization, Feasibility Studies, Policy development Database, Purchase and distribution of clean cooking appliances.	Directorate of Energy. Development partners Civil society organisations	a) 100m for purchase of cook stoves b) 240m for biogas installatio n c) End-user funds/DFI s	- Costs (a) & (b) - County Government- CIDP - Cost (c) - households purchasing from own source or through loans. - Cost (d) - development partners/CSOs	Households using Firewood and charcoal in traditional stoves and those using kerosene	(a) & (b) are new © & (d) new & on-going
Sub-total						340			
Improving access to clean water									
3.a	Reduce emissions and operational costs in existing diesel-powered boreholes	Solarisation of boreholes	20 existing diesel-powered boreholes will switch to solar in the first year of the programme	Installation of solar-pumping technologies in the targeted diesel-powered boreholes	Department of Water and Irrigation	95.8	Public funding	20 boreholds in Igembe Central and North, Tigania West	Ongoing

S/No .	Objective	Project/ Programme	Timelines	Specific Activities	Implementin g Agency	Project Cost (KES)* = million	Source of funds	Targeted Beneficiarie s	Status (New/Ongoing)
3.b	Provide a proximate source of water to communities distant to a reliable water source.	Borehole expansion	The programme will be implemented in two phases. Phase 1 will allow test the intervention and phase 2 will scale up to a larger number of communities across the targeted areas.	Build 351 new boreholes and establish new water committees	Department of Water and Irrigation	1,649	Public funding	Households and 16 level 2 health facilities in Igembe South, Central and North, the lower areas of Burri and the Tiganias	Ongoing
3.c	Improve water quality in areas served by boreholes having water with high level of salinity	Community scale water treatment plant	All water treatment facilities will be built in the first year of the programme	Build 20 community scale water treatment plants	Department of Water and Irrigation	77	Public funding	20 wards in Tigania West and East	Ongoing
3.d	Promote a sustainable use of water in boreholes, dwellings, water kiosks and health facilities	Water metering and tariff	The programme will be implemented in two phases. Phase 1 will serve as a demonstration	Install more than 500 meters in existing and new boreholds, 5,000 residential water meters, 27 health facilities and 582 kiosk.	Department of Water and Irrigation	72.3 46.8	Public funding to purchase and install water meters in boreholes, health facilities and kiosks.	Households	New

S/No .	Objective	Project/ Programme	Timelines	Specific Activities	Implementin g Agency	Project Cost (KES)* = million	Source of funds	Targeted Beneficiaries	Status (New/Ongoing)
			to test the model.				End-users (repayment of residential water meters)		
3.e	Provide access to drinking water to people living in remote areas who relies on low-quality water	Residential scale water purification	The programme will be implemented in two phases. Phase 1 will pilot the model and it will scale up in phase 2.	Promote households to purchase undersink water purifiers and small-scale benchtop water purifiers Launch a PAYGo system	Department of Water and Irrigation	4 7.85 74.7	Public funding End-users Private sector	New	New
3.f	Strengthen knowledge of member of water committees on operations and water management.	Establish and strengthen community water management groups	The programme will be implemented in two phases.	Train members of water management committees. Establish a new management structure in the targeted water committees.	Department of Water and Irrigation	4	Public funding	300 members of water committees	Ongoing
3.g	Address water shortage experienced in remote communities with low	Distributed water storage solutions in remote communities	The programme will be implemented in two phases.	Support households to purchase water storage tanks. Build 20 farm ponds. Install 20 collection roofs and rainwater	End-users Department of Water and Irrigation.	31.8 TBC	End-users' repayment Public funding to finance the installation of	20,000 households will receive support to acquire water storage	Ongoing

S/No .	Objective	Project/ Programme	Timelines	Specific Activities	Implementin g Agency	Project Cost (KES)* = million	Source of funds	Targeted Beneficiarie s	Status (New/Ongoing)
	population density			storage tank in public facilities.			collection roofs and storage tanks in public facilities	tanks. Also, households in the proximity of the targeted areas will benefit from 20 new farm pond. And, 20 public facilities will benefit from rainwater storage tanks.	
3.h	Strengthen water committee’s members capacities on water conservation and management of communal resources	Establish and strengthen community water management groups	The programme will be implemented in three phases, demonstration phase, scale up, and aggregation and new markets	Establish new water committees in the targeted areas. Strengthen water committees’ members knowledge on water conservation and management.	Department of Water and Irrigation	14.69	Public funding	Between 85 to 108 new water associations to be established and 9,150 farmers to be trained	New
Sub-total						2,077.94			
Improved access to basic health services									

S/No .	Objective	Project/ Programme	Timelines	Specific Activities	Implementin g Agency	Project Cost (KES)* = million	Source of funds	Targeted Beneficiaries	Status (New/Ongoing)
4.a	Provide reliable clean water access for target L2 facilities.	Improving water governance for dual-use boreholes	Y 1-2	Establishing water committees for dual-use boreholes (where required)	Department of Water and Irrigation & Department of Health	Demo Phase - 26 committees 5.2m <i>Scale up Phase (if needed) 10.8m</i>	Department of Water and Irrigation	Outpatients across sub-counties at 80 L2 facilities	New
		Provision of dual-use boreholes at 26 facilities	Y1-2	Solar borehole installation – 26 @200m depth and 12 cubic meter/hour yield Installation of meters	Department of Water and Irrigation & Department of Health	9.7 0.078	Department of Water and Irrigation	Outpatients at 80 L2 facilities across Meru	New
		Customised solutions for 54 target L2 facilities	Y1-2	54 Feasibility studies	Department of Water and Irrigation & Department of Health	10.8m	Department of Water and Irrigation	Outpatients at 80 L2 facilities across Meru	New
		Customised solutions for 54 target L2 solutions	Y3-5	Installation of water systems in 54 solutions	Department of Water and Irrigation & Department of Health	3.61m* Based on solar borehole plus meter costs	Department of Water and Irrigation	Outpatients at 80 L2 facilities across Meru	New
4.b	Provision of reliable electricity	Reliable electricity supply Programme: Administration,	Y1-5	Provision of backup system (petrol generator) + 10-year opex + annual	Department of Health and Directorate of Energy	Demo Phase 15,85 Scale up Phase 99.2	Department of Health	Staff and outpatients at 80 L2 facilities across Meru	Ongoing/ new

S/No .	Objective	Project/ Programme	Timelines	Specific Activities	Implementin g Agency	Project Cost (KES)* = million	Source of funds	Targeted Beneficiarie s	Status (New/Ongoing)
		Planning and Support Services. Sub-programme/project : Health Infrastructure		maintenance/ repair for 80 facilities					
4.c	Essential appliances needed to deliver L2 services	Repair or replacement of appliances Programme: Administration, Planning and Support Services. Sub-programme/project : Health Infrastructure	Y1-5	Repair of essential appliances or procurement of new appliances	Department of Health and Directorate of Energy	Demo Phase 7.3 Scale up Phase 41.5	Department of Health	Staff and outpatients at 80 L2 facilities across Meru	New
4.d	Reduced operational costs and improved EE	Maintenance of appliances	Y1-5	Annual maintenance of appliances	Department of Health and Directorate of Energy	3.25	Department of Health	Staff and outpatients at 80 L2 facilities across Meru	New
		Improved procurement & promotion of EE in procurement	Y1-2	Development of Green Procurement policy	Department of Health	TBD	Department of Health	Staff and outpatients at 80 L2	New/ ongoing

S/No .	Objective	Project/ Programme	Timelines	Specific Activities	Implementin g Agency	Project Cost (KES)* = million	Source of funds	Targeted Beneficiarie s	Status (New/Ongoing)
		Programme: Curative and Rehabilitative Health Sub- programme/project : Pharmaceutical and Non- pharmaceutical commodities	Y1-2 Y1-5	Bulk purchase of appliances				facilities across Meru	
		Improved stock management Programme: Curative and Rehabilitative Health Sub- programme/project : Pharmaceutical and Non- pharmaceutical commodities	Y 1-5	Digitalisation of stock taking Construction of stores in level II Purchase of shelves and pallets for all level II	Department of Health	TBD	Department of Health	Staff and outpatients at 80 L2 facilities across Meru	New/ ongoing
		Improved financial management.	Y1-2	Development & piloting of standard charging policy	Department of Health/ independent expert	TBD	Department of Health	Staff and outpatients at 80 L2	New

S/No .	Objective	Project/ Programme	Timelines	Specific Activities	Implementin g Agency	Project Cost (KES)* = million	Source of funds	Targeted Beneficiarie s	Status (New/Ongoing)
			Y2-5	Digitalisation of records & billing				facilities across Meru	
4.e	Improved staff retention and recruitment	Benchmarking of staff R & R best practice & capacity gaps	Y1-2	Benchmarking study Capacity gaps analysis	Department of Health/ Independent expert	0.5	Department of Health	Staff and outpatients at 80 L2 facilities across Meru	New
		Staff training	Y1-5	Training in appliance operation/maintenance , digital stock taking & charging; skills-based training.	Department of Health/ External providers	9.5	Department of Health	Staff at 80 L2 facilities across Meru	New
4.f	Effective project implementation & learning	Project management	Y1-5	Project management	Department of Health/ independent expert	51.46	Department of Health	Staff and outpatients at 80 L2 facilities across Meru	New
		M & E		Monitoring & Evaluation Framework development and implementation	Department of Health/ independent expert	4.6	Department of Health	Staff and outpatients at 80 L2 facilities across Meru	New
Sub-total						121.84			
Improved income from crop farming									
5.a	Sensitise farmers on water conservation and incentivise farmers to	Water metering for irrigation	The programme will be implemented in three phases,	Design a water metering scheme for irrigation. Installation of meters.	Department of Water and Irrigation	--	Revenues are expected to be generated by water fees in phase 2	9,150 farmers from the upper and lower midland	New

S/No .	Objective	Project/ Programme	Timelines	Specific Activities	Implementin g Agency	Project Cost (KES)* = million	Source of funds	Targeted Beneficiaries	Status (New/Ongoing)
	switch to water efficient irrigation equipment		demonstration phase, scale up, and aggregation and new markets					zones of Meru	
5.b	Reduce water consumption for irrigation by incentivising farmers to use water efficient irrigation equipment	Support for the purchase of water-efficient irrigation equipment	The programme will be implemented in three phases, demonstration phase, scale up, and aggregation and new markets	Financing packages will be available to farmers, through both, technology suppliers or financing organisations to purchase the recommended irrigation equipment. Also, financial support will be provided in the demonstration phase to reduce the cost of the irrigation equipment.	Department of Water and Irrigation	232.05 279.80 517.5 517.5	Public funding End-users SACCOs/ MFI Private sector.	150 farmers to be targeted in phase 1, 3,000 in phase 2 and 6,000 in phase 3.	New
5.c	Address water constraints in strategic areas facing greater challenges in accessing water for irrigation	Support for local water storage (farm ponds).	The programme will be implemented in two phases, demonstration phase and scale up.	Construction of farm ponds through a Government and end-users collaboration.	Department of Water and Irrigation	47.25 47.25	Public funding End-users	45 farms ponds will be built in phase 1 and 900 in phase 2 in strategic areas in the upper and	New

S/No .	Objective	Project/ Programme	Timelines	Specific Activities	Implementin g Agency	Project Cost (KES)* = million	Source of funds	Targeted Beneficiaries	Status (New/Ongoing)
								low midlands zones of Meru.	
5.d	Support farmers in accessing high-quality farming inputs	Improve access to quality/certified farming inputs	The programme will be implemented in three phases, demonstration phase, scale up, and aggregation and new markets	Training campaigns to increase farmers knowledge on the benefits of the quality agricultural inputs. Sensitisation and introductions to agro-dealers	Department of Water and Irrigation	4.73 128.65	Public funding End-users	150 farmers to be targeted in phase 1, 3,000 in phase 2 and 6,000 in phase 3.	New
5.e	Strengthen agriculture extension officers and farmers’ knowledge of GAP and marketing strategies	Train farmers on Good Agriculture Practices (GAP) and market literacy	The programme will be implemented in three phases, demonstration phase, scale up, and aggregation and new markets	Training courses targeting both, small-farm holders and agriculture extension officers	Department of Water and Irrigation	16.95 38.66	Public funding End-users	150 farmers to be targeted in phase 1, 3,000 in phase 2 and 6,000 in phase 3.	New
Sub-total						300.98			
Increased income from poultry farming									

S/No .	Objective	Project/ Programme	Timelines	Specific Activities		Implementin g Agency	Project Cost (KES)* = million	Source of funds	Targeted Beneficiarie s	Status (New/Ongoing)
6.a	Reactivation of MV farmers	Building a sustainable MV business model Programme: Livestock Production Sub-programme/ project: Local poultry improvement	Y1-5	Reinvigorating governance through training and mentoring Identifying champion farmers and core members	Meru County Government Directorate of Livestock/external providers		0.743	Meru County Government Directorate of Livestock	800+ poultry farmers in 4 MVs in Ntarami, Kangeta, Ng'onyi and Mbaaria	New
				Administration and governance support	Farmers		0.565	Farmers – 141,250 per MV	800+ poultry farmers in 4 MVs in Ntarami, Kangeta, Ng'onyi and Mbaaria	New
6.b	More affordable production inputs	Building a sustainable MV business model	Y1-5	Negotiations with agro dealers/breeders for bulk purchase	Meru County Government Directorate of Livestock/external providers/farmers		1.48	Meru County Government Directorate of Livestock	800+ poultry farmers in 4 MVs in Ntarami, Kangeta, Ng'onyi and Mbaaria	New/ ongoing
		Programme: Livestock		Supply of fertilised eggs for 5 cycles	Meru CG Directorate of		1.26	Meru County Government	800+ poultry farmers in 4 MVs in	New/ ongoing

S/No .	Objective	Project/ Programme	Timelines	Specific Activities		Implementin g Agency	Project Cost (KES)* = million	Source of funds	Targeted Beneficiarie s	Status (New/Ongoing)
		Production Sub-programme/ project: Local poultry improvement			Livestock External suppliers			Directorate of Livestock	Ntarami, Kangeta, Ng’onyi and Mbaaria	
				Supply of commercial feed for 3-week chicks	Meru CG Directorate of Livestock /External suppliers	1.44	50% Meru CG Directorate of Livestock 50% farmers	800+ poultry farmers in 4 MVs in Ntarami, Kangeta, Ng’onyi and Mbaaria	New	
				Support for feed for 5-cycles		4.05	70% Meru CG Directorate of Livestock 30% Farmers	800+ poultry farmers in 4 MVs in Ntarami, Kangeta, Ng’onyi and Mbaaria	New	
				Feed milling & mixing equipment		2.05	50% subsidy (total 1.24m) County Government 20% deposit (total 409,950) Farmers 30% credit (total 614,252) MFI	800+ poultry farmers in 4 MVs in Ntarami, Kangeta, Ng’onyi and Mbaaria	New	

S/No .	Objective	Project/ Programme	Timelines	Specific Activities	Implementin g Agency	Project Cost (KES)* = million	Source of funds	Targeted Beneficiarie s	Status (New/Ongoing)
				Feasibility study /demo for own feed production		7.92	County Government	800+ poultry farmers in 4 MVs in Ntarami, Kangeta, Ng'onyi and Mbaaria	New
6.c	Improving productivity & production planning	Building a sustainable MV business model		Providing reliable electricity supply for incubation etc – backup generator		0.949	Meru County Government Directorate of Livestock	800+ poultry farmers in 4 MVs in Ntarami, Kangeta, Ng'onyi and Mbaaria	New
				Additional incubation equipment	Meru CG Directorate of Livestock Meru MFI Farmers	0.419	50% subsidy (total 209,704) County Government 20% deposit = (total 83,844) Farmers 30% credit (total 125,82) MFI	800+ poultry farmers in 4 MVs in Ntarami, Kangeta, Ng'onyi and Mbaaria	New
				Opex for equipment first 5 cycles	Farmers	1.28	Farmers – 321,112 per MV	800+ poultry farmers in 4 MVs in Ntarami,	New

S/No	Objective	Project/ Programme	Timelines	Specific Activities	Implementin g Agency	Project Cost (KES)* = million	Source of funds	Targeted Beneficiary s	Status (New/Ongoing)
								Kangeta, Ng'onyi and Mbaaria	
				Maintenance of equipment	Farmers/ external providers.	0.070	Farmers – 17,525 per MV	800+ poultry farmers in 4 MVs in Ntarami, Kangeta, Ng'onyi and Mbaaria	New
				16 full-time personnel to run incubation and appliances	Farmers	0.720	Farmers – 180,000 per MV	800+ poultry farmers in 4 MVs in Ntarami, Kangeta, Ng'onyi and Mbaaria	New
				Business supervision and training	Meru CG Directorate of Livestock /External suppliers/	2.4	Meru County Government Directorate of Livestock	800+ poultry farmers in 4 MVs in Ntarami, Kangeta, Ng'onyi and Mbaaria	New
				Aggregation & feed hall	Meru CG Directorate of Livestock/ Farmers	1.2	Farmers – 50% (600,000) County Government – 50% (600,000)	800+ poultry farmers in 4 MVs in Ntarami, Kangeta,	New

S/No .	Objective	Project/ Programme	Timelines	Specific Activities	Implementin g Agency	Project Cost (KES)* = million	Source of funds	Targeted Beneficiary s	Status (New/Ongoing)
								Ng'onyi and Mbaaria	
				Feasibility study for brooder farm	Meru CG Directorate of Livestock/External suppliers/Farmers	8	Meru County Government Directorate of Livestock	800+ poultry farmers in 4 MVs in Ntarami, Kangeta, Ng'onyi and Mbaaria	New
6.d	Improved flock management	Building a sustainable MV business model	Y1-5	Vaccinations	Meru CG Directorate of Livestock /External suppliers/ Farmers	0.222	Farmers	800+ poultry farmers in 4 MVs in Ntarami, Kangeta, Ng'onyi and Mbaaria	Ongoing
		Programme: Livestock Production Sub-programme/ project: Local poultry improvement		Training of 20 specialist extension officers, EO support to farmers + transport costs	Meru CG Directorate of Livestock /External suppliers/ Farmers	1.2	Meru CG Livestock Directorate	800+ poultry farmers in 4 MVs in Ntarami, Kangeta, Ng'onyi and Mbaaria	New
6.e	Diversification of marketing channels/ building markets		Y1-5	Market mapping	Meru CG Directorate of Livestock /External suppliers/	2.23	Meru CG Livestock Directorate	800+ poultry farmers in 4 MVs in Ntarami, Kangeta,	New

S/No .	Objective	Project/ Programme	Timelines	Specific Activities		Implementin g Agency	Project Cost (KES)* = million	Source of funds	Targeted Beneficiarie s	Status (New/Ongoing)
									Ng’onyi and Mbaaria	
				Support for marketing	Farmers/ external providers	0.25	MV farmers – 62,500 per MV	800+ poultry farmers in 4 MVs in Ntarami, Kangeta, Ng’onyi and Mbaaria	New	
6.f	Identification of farmers & organisation into viable self-help groups	Building a sustainable individual farmer business model	Y1-5	Identifying target locations and mapping existing groups Formation of new groups Training in governance	Meru CG Livestock Directorate/ farmers	0.446	Meru CG Livestock Directorate	100 farmers organised into self-help groups near MVs in Ntarami, Kangeta, Ng’onyi and Mbaaria	New	
6.g	More affordable production inputs	Programme: Livestock Production Sub-programme/ project: Local poultry improvement	Y1-5	Supply of fertilised eggs for 5 cycles	Meru CG Directorate of Livestock External suppliers	1.44	Meru County Government Directorate of Livestock	100 farmers organised into self-help groups near MVs in Ntarami, Kangeta, Ng’onyi and Mbaaria	New/ ongoing	

S/No .	Objective	Project/ Programme	Timelines	Specific Activities	Implementin g Agency	Project Cost (KES)* = million	Source of funds	Targeted Beneficiaries	Status (New/Ongoing)
				Feed from MVs first 5 cycles @65%	Meru CG Directorate of Livestock /Farmers	37.57	50% Meru CG Directorate of Livestock (18,786,600) 50% farmers (18,786,600)	100 farmers organised into self-help groups near MVs in Ntarami, Kangeta, Ng'onyi and Mbaaria	New
				Support to establish bulk purchase agreements & access to finance	Meru CG Directorate of Livestock Farmers External suppliers	1.38	Meru CG Directorate of Livestock	100 farmers organised into self-help groups near MVs in Ntarami, Kangeta, Ng'onyi and Mbaaria	New
6.h	Improving productivity & production planning	Building a sustainable MV business model		100 Solar powered 96 egg incubators	Meru CG Directorate of Livestock Meru MFI Farmers	0.419	50% subsidy/introducor y discount for first 25 farmers (total 521,300) County Government 10% deposit = (total 417,040) Farmers	100 farmers organised into self-help groups near MVs in Ntarami, Kangeta, Ng'onyi and Mbaaria	New

S/No .	Objective	Project/ Programme	Timelines	Specific Activities		Implementin g Agency	Project Cost (KES)* = million	Source of funds	Targeted Beneficiarie s	Status (New/Ongoing)
							40% credit (total 3.23m) MFI			
		Programme: Livestock Production Sub-programme/ project: Local poultry improvement		Training by extension officers/external providers through MV	Meru CG Directorate of Livestock /Farmers/ external suppliers	1.2	Farmers	100 farmers organised into self-help groups near MVs in Ntarami, Kangeta, Ng’onyi and Mbaaria	New	
	Effective project implementatio n & learning	Project management	Y1-5	Project management		14		100 farmers organised into self-help groups near MVs in Ntarami, Kangeta, Ng’onyi and Mbaaria	New	
		M & E		Monitoring & Evaluation Framework development and implementation		8.47			New	
Sub-total							103.373			
f)	Non-Governmental and Private Sector Projects/Programmes, etc									

S/No .	Objective	Project/ Programme	Timelines	Specific Activities	Implementin g Agency	Project Cost (KES)* = million	Source of funds	Targeted Beneficiarie s	Status (New/Ongoing)
		Women in Energy Enterprises in Kenya (WEEK III)		Trainings	Practical Action CGM		Practical Action	80 women entrepreneur s	New
		Meru Energy Park		Solar and wind power generation	MCIDC Hewani Energy Limited		MCIDC Hewani Energy Limited		Ongoing
Grand Total						3,960.041			

Table 127: Summary of programme/project interventions in Meru County

7.0 IMPLEMENTATION, COORDINATION, MONITORING AND EVALUATION

Chapter 7 outlines the implementation and coordination structures and monitoring and evaluation (M&E) activities for the Meru CEP projects outlined in Chapters 3 and 6.

7.1 Implementation

The successful implementation of the County Energy Plan (CEP) requires strong partnerships with a spectrum of stakeholders, spanning Governmental departments, private sector entities, and non-Governmental entities, local and international development organisations, the national Government, bilateral and multilateral energy agencies.

To establish an effective implementation framework for the CEP, a coordinating secretariat, responsible for the day-to-day management of the CEP's operations will be established. The Secretariat will be led by a Focal Point Officer (FPO), supported by a core team. It will ensure there is dedicated support for CEP implementation within the County. Aligned with the recommendations of the draft Integrated National Energy Plan (INEP) framework (GoK 2023), this new institutional structure will require a legal basis in County legislation.

Furthermore, County Energy Planning Committee (CEPC) will be established to provide policy and strategic guidance to the CEP Secretariat in accordance with energy regulations. The CEPC will comprise members including the Chief Officer for Energy as the Secretary of the Committee, a Representative of the County Commissioner, relevant County Executive Committee Members, and representatives from various key energy-related entities.

In addition to the CEPC, the establishment of a County Energy Plan Technical Committee (CEPTC) is envisaged. The CEPTC will play a crucial role in overseeing the implementation of the CEP, ensuring that the strategies and actions outlined in the plan are effectively put into operation, as well as coordination with other development sectors, given the cross-sectoral nature of the CEP solutions. The CEPTC will consist of representatives from diverse technical stakeholders, including Governmental bodies, such as sectoral departments, non-Governmental organisations, and relevant energy agencies.

The chair of the CEPTC will be the Chief Officer for Energy, and the CEPTC will convene at regular intervals to review progress, address challenges, and ensure that CEP implementation is progressing as per the defined timelines and goals. The combined efforts of the CEPC and CEPTC will significantly contribute to the efficient implementation of the CEP, ultimately driving the County towards achieving sustainable energy access to deliver key development priorities in Meru County.

Feeding in to the CEPTC, there will be project-specific implementation teams for the solutions outlined in Chapters 3 and 6. These teams will be responsible for delivery of the project, and tracking project specific outcome and output indicators (see 7.3).

7.2 Coordination

A multi-tiered approach will be used to ensure the successful coordination of CEP implementation. This encompasses horizontal coordination at the County level, focusing on close collaboration with various County departments and other local actors involved in project delivery, as well as vertical coordination with the National Government, national energy service providers and any other national sectoral ministries and actors as required.

Horizontal Coordination (County Level): At the County level, horizontal coordination is crucial to harness the collective expertise and resources of various County departments and agencies as well as external delivery partners. This collaboration will include regular meetings, information sharing, and joint decision-making processes to align the efforts of different departments. Key aspects of horizontal coordination include:

1. **Interdepartmental Collaboration:** Departments responsible for energy, agriculture, livestock and fisheries, health, water, environment, finance, and economic planning will work together to ensure that the CEP implementation is integrated into and aligns with broader County development goals.
2. **Data and Resource Sharing:** Sharing data, resources, and best practices to enhance the efficiency of energy-related projects and initiatives.
3. **Stakeholder Engagement:** Engaging project end users, local communities, businesses, and other stakeholders to ensure the CEP implementation delivers the intended impacts in terms of the needs and priorities of the intended beneficiaries and to build understanding more widely among County residents.

Vertical Coordination (National Level): Vertical coordination involves establishing a seamless connection with the National Government, national energy service providers and any other national ministries or development partners whose support is required for successful implementation of CEP solutions. This ensures both that the CEP is aligned with national energy and other sectoral policies and leverages resources and expertise from the higher administrative levels and from other national actors. Key elements of vertical coordination include:

1. **Policy Alignment:** Regularly assessing and aligning the CEP with the national energy and other sectoral policies and objectives, ensuring a unified approach towards sustainable energy development.
2. **Regulatory Compliance:** Collaborating with relevant national agencies to ensure that the County's initiatives adhere to national regulations and standards.
3. **Resource Access:** Leveraging national-level resources and funding opportunities for CEP projects within the County, such as grants, subsidies, and technical support.
4. **Information Exchange:** Establishing channels for sharing critical information and updates between the County and national energy and other sectoral bodies to maintain a proactive and informed approach.

7.3 Monitoring and Evaluation

7.3.1 Monitoring and Evaluation Frameworks

The monitoring and evaluation (M&E) component of the County Energy Plan (CEP) is based on the guidance provided in the Integrated Energy plan (INEP), the Kenya National M&E Policy, as well as the Meru County Integrated Monitoring and Evaluation System (CIMES). These frameworks are complemented by specific output and outcome indicators developed for each of the sectoral solutions or interventions in the CEP.

The INEP's overall outcome is to ensure that Kenya has the *“minimum levels of electricity access to allow for empowerment for people in underserved communities with minimum energy targets necessary to improve education, accelerate the transfer of knowledge, facilitate communication, and promote entrepreneurship”*. The country's target is universal access to electricity by the year 2028.

The EDM planning approach used to develop the Meru CEP plans energy services as enablers of wider development need and builds demand for the energy service proactively through holistic solutions with supporting services to address both energy and non-energy gaps. This aims to ensure financial, social and environmental sustainability and development impact, in line with the INEPs goal of energy access enabling wider development and Kenya's 'approach to development planning based on informed, participation.

The INEP framework under *Step 10: Plan to Monitor and Evaluate* requires the County to “establish a plan for performance measurement and reporting” (INEP Section 3.2.). Chapter Seven of the INEP focusses on “Implementation, Coordination, Monitoring and Evaluation”, including the timeline for major activities and those responsible for their delivery.

The Kenya National M&E Policy recognises results-based management, transparency, accountability, and efficiency as fundamental to managing public policies, programmes, and projects in line with the Constitution of Kenya. It aims to strengthen Government's capacity to assess the extent of implementation of development initiatives and their success in delivering services to its citizenry, and to improve the execution of public interventions at both national and County levels (National Treasury and Planning, 2022).

The INEP states that implementation of CEPs will require legal and institutional frameworks and provides for the County Government to establish a legislative and regulatory framework for the energy sector, with a centralised department with an overarching supervisory role to ensure coordination and implementation. Coordination will be done at two levels: horizontal coordination at the County level with County departments and vertical coordination with the national Government and the national energy service providers. The INEP also requires that identified energy projects should consider existing CIDP projects and private sector and other actor (e.g., NGOs') engagement in the energy sector.

The monitoring and evaluation framework used to track progress on implementation of Meru County development projects is the Meru County Integrated Monitoring and Evaluation System (CIMES). In the case of the County Integrated Development Plan (CIDP) and the Annual Development Plans (ADPs), Meru County develops a Performance Management Plan so that all commitments are translated into performance contracts with public officers in the County. This M&E framework will be used for the monitoring and evaluation of the six CEP sectoral interventions or projects. The M&E framework provides specific outcome and output indicators for the CEP that will be monitored and evaluated, means of identifying deviations from the plan and achievable systematic deliverables according to the programme design, financial budget, quality, and time schedule.

In addition to the considerable background research on M&E frameworks carried out to inform the CEP M&E, specific indicators have been developed for each of the sectoral interventions or projects detailed in Chapter 3. For readability, the background research carried out is summarised below and described in more detail in a separate guide developed by the CEP team (*The CEP Monitoring and Evaluation Guide*). This section focusses in more detail on the project indicators, concluding with the summary table of output and outcome indicators, as required by the INEP framework.

7.3.2 Challenges and Success Factors for Monitoring and Evaluation

The background research highlighted several challenges to effective M&E for the CEP. First, it identified a weak M&E culture at the County Government level, and use of different strategies, making it difficult to determine whether M&E is used to inform planning and decision making at all levels of implementation. There is fragmented and uncoordinated M&E reporting resulting in a lack of comprehensive data from the implementing units. These challenges may emanate from a range of gaps in institutional, managerial, and technical capacities to carry out effective M&E of projects. Second and related to this, there are inadequate data management systems for collection and analysis of data to inform decision making. There is a need to invest in this further and foster an overall culture of M&E as an integral part of planning to drive achievement of the desired development outcomes, including implementation of the CEP.

To address the weak M&E culture, one potential approach that captures programme planning and implementation in a context of a range of risks to project implementation, including potential resource constraints and changing climate trends and impacts, is an adaptive project management cycle, based on USAID's 'Adaptive Management' theory of change. This has three components:

- i. Capacity development or improved knowledge through intentional learning, (human capital such as skills and knowledge, social capital, organisational capital)
- ii. Motivation, including incentives for learning and managing adaptively and disincentives
- iii. Opportunity, including identifying and removing barriers that prevent programme modification such as bureaucracy, resource allocation, distracting competing priorities. (USAID, 2018).

Adaptive project management calls for a 'plan-do-check' (or evaluate-learn-adjust), iterative approach. This is in line with CIMES, which calls for periodic reviews through monthly,

quarterly, and annual implementation checks, and midterm and project/programme end reviews. This approach assumes that there is need to continually monitor and evaluate programme or project designs and activities in terms of their cost, relevance, effectiveness and efficiency, outputs and outcomes, as well as to assess new risks and mitigation actions, and new trends in the operating environment.

Critical factors effective implementation of M&E in Meru includes the following:

1. Adequate budgeting
2. Operationalisation of the CIMES and NIMES
3. Capacity assessment and development of staff and County Assembly officers around M&E approaches and reporting standards
4. Embedding M&E at the start of the project/programme design cycle
5. Developing an adaptive, agile, management culture that is driven by effective M&E (see above).

As above, frequent monitoring is critical to identify deviations from planned activities, changes in the operating environment, emerging opportunities and threats for early corrective action and timely decision making. Monitoring should be both inward-facing, assessing County structures (people, processes, systems, budgets, capacities, programmes, partners) and outward-facing, assessing the deployment of the products and services (outputs) as well as end-user impacts (outcomes).

The importance of adequate and accurate data for effective M&E cannot be underestimated. Data- and evidence-driven decision making, and performance management is critical to achieving the different sectoral solution outcomes.

7.3.3 The CEP Monitoring and Evaluation Guide

The *CEP Monitoring and Evaluation Guide* Chapter 2 provides the background and context to monitoring and evaluation of the CEP, introduces the Meru County Integrated Monitoring and Evaluation System (CIMES) and National Integrated Monitoring and Evaluation Systems (NIMES), the Government M&E systems used to capture and analyse data at County levels and consolidate it into national monitoring and evaluation data for centralised development planning.

The *CEP Monitoring and Evaluation Guide* Chapter 3 shows the alignment of the Meru CEP M&E framework to national policies and frameworks, principally the Kenya National Monitoring and Evaluation (KNME) policy, CIMES systems and structure, the INEP requirements for CEP development, the Meru County M&E policy and M&E framework, and formats for data collection and reporting.

The *CEP Monitoring and Evaluation Guide* Chapter 4 provides practical guidance for the implementation of the M&E function and presents the framework that will be used to track progress. It calls for the development of robust performance management plans that will ensure that there is a clear way of measuring performance.

Monitoring entails continuous collection, collation, and analysis of data for reporting, decision making and to inform evaluations. Chapter 4 provides practical guidance on four aspects of this process:

- a. Process Monitoring (Real Time Monitoring)

- b. Progress Tracking
- c. Progress Validation
- d. Performance Monitoring.

The *CEP Monitoring and Evaluation Guide* Chapter X provides guidance and describes global best practice in M&E design and implementation. Monitoring and evaluation are closely interrelated. Therefore, ongoing monitoring processes should form an integral part of any evaluation system. CIMES provides a checklist of the most important aspects to be considered in developing an effective M&E system and provides a standard M&E Plan complete with responsibilities for all County projects and programmes and outlines responsibilities for coordination and joint reporting for each County department to the County Executive, Council of Governors (CoG) national Government level and the Senate (GoK, 2019).

A well-designed M&E system will ensure that good quality data is regularly collected during and after implementation of every project/programme defined in the CIDP and the CEP. The data will help guide County project/ programme implementation teams in monitoring and evaluation and inform strategic policy decisions to be taken by the County Executive, County Commissioners, and other management teams in the County.

The *CEP Monitoring and Evaluation Guide* Chapter Y outlines the institutional arrangements for implementation and co-ordination of M&E and reporting within Meru County. The proposed structure takes into consideration the proposed institutional arrangements outlined in the CIMES guidelines as well as the local context. The monitoring process should be undertaken by various units at different levels within the County Government function.

Internal and external stakeholders also play a pivotal role in M&E by providing policy direction, financial resources, and technical support in the various sectors, capacity building and enactment of laws that safeguard the interests of the County. Citizens should also be included to foster transparency and accountability. The County Assembly and all its structures play an important oversight role and lead on the M&E agenda, through enactment of enabling regulations and approval of policies, mobilizing political goodwill, and addressing challenges that may arise in the implementation of public projects, as well as disseminating monitoring information within the County Assembly, local communities, and other stakeholders. This Chapter provides guidance on the levels of monitoring, evaluation, and reporting including County, Sector, Ward, and Village monitoring and evaluation levels.

7.3.4 Outcomes And Outputs Framework And Indicators

An indicator is a measure that can be used to monitor or evaluate an intervention. Indicators can be quantitative (derived from measurements associated with the intervention) or qualitative (entailing direct feedback from beneficiaries). Indicator types are:

- Process indicators
- Efficiency indicators
- Output indicators

- Outcome/ Impact indicators.

Process indicators can be developed in the inception phase leading to solution implementation. Process evaluations evaluate how well the project is being implemented and whether the end users are receiving the intended benefits. They should be conducted during the early and mid-cycle phases of implementation for all project solutions individually. All challenges and barriers experienced during implementation should be analysed to understand the underlying causes to inform future planning and identify any modifications in implementation needed to address them.

Cost-effectiveness analysis and cost-benefit analysis) measure the use of financial resources to deliver the project outcomes. As much as possible, a participatory process should be employed to create knowledge and understanding of the project's financial management and create ownership. Such analysis should take place at the planning stage, and early, mid and end term of the project cycle to assess whether resources are being utilised effectively and take corrective action if needed.

Cross-cutting indicators are used to track the projects' impact in relation to issues such as GESI, environmental sustainability climate adaptation and resilience building. INEP highlights the need for CEP planning and implementation to take account of such issues, as discussed in Chapter 1. Outcome and impact indicators should be designed to assess these impacts for each solution.

Output and outcome indicators for each of the six proposed solutions including indicators for GESI, climate adaptation and resilience building and energy efficiency and conservation (EEC) impacts M&E, have been developed. These are discussed in detail in Chapter 3 and are summarised in the tables below. As noted above, process and financial management indicators will be in the inception phase as projects move towards implementation. They are discussed in more detail in the CEP M&E Guide.

7.4 Summary of Indicators By Project

S/N	Programme	Output Indicators	Baseline		Phase 1 Target	Phase 2 Target	Phase 3 Target (if applicable)	Source of Data	Frequency	Responsibility	Reporting Entity
			Value	Year							
Improving access to household and street lighting											
1	Promote Tier 1 lighting systems among low-income kerosene end-users	No of Tier 1 solar systems sold in the targeted areas	No of households using kerosene for lighting as main fuel: 107,678	2019 (KPHC)	3,600	7,200	12,500	System provider	Annually	System Provider & MCIDC	Directorate of Energy
2	Installation of streetlights and floodlights in various towns and markets centres	No. of new off-grid streetlights installed in towns and market	% of people stating that streetlight will help them feel safer	---	24	24	24	Energy Docket	Annually	Energy Docket	Directorate of Energy
Access to clean, safe and affordable cooking solutions											
3	Carry out awareness raising campaigns for adoption of cleaner cooking solutions	Number of awareness raising campaigns done per ward targeting household using firewood and three stone open fires	0	2023	8 (yr. 1)	8 (yr. 2)	8 (yr.3)	Directorate of Energy	Annually	Directorate of Energy	Directorate of Energy

S/N	Programme	Output Indicators	Baseline		Phase 1 Target	Phase 2 Target	Phase 3 Target (if applicable)	Source of Data	Frequency	Responsibility	Reporting Entity
			Value	Year							
4	Training of local ICS fabricators and cooking solution installers	Number of ICS fabricators and cooking solution installers trained per wards	0	2023	225 (Yr. 1)	0	0	Directorate Energy	1 st year	Directorate of Energy	Directorate of Energy
5	Enhance access to finance and credit for acquisition of cleaner cooking solutions	Number of end-users accessing finance to purchase cooking solution Number of cooking solution suppliers/dealers accessing affordable credit	0	2023	10 Groups	10 Group	10 Groups	Directorate of Energy	Annually	Groups (farmer/women) /Financial service providers/Directorate of Energy	Directorate of Energy
Improving access to clean water											
6	Expansion of boreholes to the underserved regions of Meru	No. of new boreholes	% Of population underserved in the targeted areas. Igembe North: 49% Igembe Central: 38%	2023	138	213	--	Community borehole water committees	Annually	Community borehole water committees	Department of Water and Irrigation

S/N	Programme	Output Indicators	Baseline		Phase 1 Target	Phase 2 Target	Phase 3 Target (if applicable)	Source of Data	Frequency	Responsibility	Reporting Entity
			Value	Year							
			Igembe South: 13% Tigania East: 29% Tigania West: 55% Buuri: 73%								
7	Promotion of small-scale bench top water purifiers	No of small-scale bench top water purifiers sold`	30% of sampled households in Igembe, Tigania and Buuri stated that water quality is bad in their towns	2023	250	6,000	-	System provider	Annually	System Provider & MCIDC	Department of Water and Irrigation
Improving access to basic health services											
8	Target L2s have a reliable supply of electricity	No. of target Group 1 facilities with backup system (genset)	0	2023	12	50	50	System provider/ Directorate of Energy	Annually	System provider/ Directorate of Energy	Department of Health
9		No. of target Group 2 facilities with grid connection and backup system	0	2023	0	18	23	System provider/ Directorate of Energy	Annually	System provider/ Directorate of Energy	Department of Health

S/N	Programme	Output Indicators	Baseline		Phase 1 Target	Phase 2 Target	Phase 3 Target (if applicable)	Source of Data	Frequency	Responsibility	Reporting Entity
			Value	Year							
10		No. of target Group 3 facilities with SHS and backup	0	2023	0	0	7	System provider/ Directorate of Energy	Annually	System provider/ Directorate of Energy	Department of Health
11		No. of L2 target facilities with annual maintenance and repair	0	2023	12	80	160	Supplier/ Directorate of Energy	Annually	Supplier/ Directorate of Energy	Department of Health
12	Target L2s have essential appliances & equipment	No. of L2 facilities with functioning appliances & equipment	0	2023	12	80	160	Annually	Department of Health	Department of Health	Department of Health
13	Target L2s have a reliable clean water supply	Number of L2s with dual-use solar boreholes	0	2023	26			Annually	System provider/ Directorate of Water	Directorate of Water	Department of Health
14		No. of water feasibility studies carried out	0	2023	54	80		Annually	System provider/ Directorate of Water	Directorate of Water	Department of Health
15		No. of facilities with functioning water supply	0	2023	26	80	160	Annually	System provider/ Directorate of Water	Directorate of Water	Department of Health
16		Number of facilities with staff trained on sustainable water management	0	2023	26	80	160	Annually	Supplier/ Directorate of Water	Directorate of Water	Department of Health

S/N	Programme	Output Indicators	Baseline		Phase 1 Target	Phase 2 Target	Phase 3 Target (if applicable)	Source of Data	Frequency	Responsibility	Reporting Entity
			Value	Year							
17	Target L2s reduce costs & improve financial management	Introduction of standard charging policy	0	2023	1			Annually	Department of Health	Department of Health	Department of Health
18		No. of facilities with digitalised records	0	2023	12	80	160	Annually	Department of Health	Department of Health	Department of Health
19		No of facilities with staff trained in financial management (including bill processing)	0	2023	12	80	160	Annually	Department of Health	Department of Health	Department of Health
20		Effective Procurement Policy	0	2023	1			Annually	Department of Health	Department of Health	Department of Health
21		No. of facilities with digitalised inventory management	0	2023	12	80	160	Annually	Department of Health	Department of Health	Department of Health
22		At least 50 medicine storage rooms constructed at L2s	0	2023	12	38		Annually	Supplier/ Department of Health	Department of Health	Department of Health
23		Number of facilities reporting increased revenues	0	2023	12	80	160	Annually	Department of Health	Department of Health	Department of Health
24	Improved staff retention and recruitment	Benchmarking report on best practices	0	2023	1			Annually	Supplier/ Department of Health	Department of Health	Department of Health

S/N	Programme	Output Indicators	Baseline		Phase 1 Target	Phase 2 Target	Phase 3 Target (if applicable)	Source of Data	Frequency	Responsibility	Reporting Entity
			Value	Year							
25		Capacity needs assessment	0	2023	1			Annually	Supplier/ Department of Health	Department of Health	Department of Health
26		Number of facilities with staff undergoing annual training	0	2023	12	80	160	Annually	Supplier/ Department of Health	Department of Health	Department of Health
Improving income from crop farming											
27	Support for the purchase of irrigation systems	No. of irrigation equipment sold	No. of farmers using inefficient irrigation techniques (Data will be collected through survey to be administered in the project inception phase)	-	150	3,000	-	System provider and MFI	Annually	System Provider & MFI	Ministry of Agriculture
28	Improving access to quality/certified inputs	No. of farmers receiving support to purchase farming inputs	No. of farmers using low quality farming	-	150	3,000	-	Agro dealers and Ministry of Agriculture	Annually	Agro dealers and Ministry of Agriculture	Ministry of Agriculture

S/N	Programme	Output Indicators	Baseline		Phase 1 Target	Phase 2 Target	Phase 3 Target (if applicable)	Source of Data	Frequency	Responsibility	Reporting Entity
			Value	Year							
			inputs (data will be collected through survey to be administered in the project inception phase)								
Improving income from poultry farming											
29	Building a sustainable MV business model: Reactivating	No. of active, champion farmers per MV	Current number of active MV farmers	2023	100	400	800+	MV farmers & Directorate of Livestock	Annually	Directorate of Livestock, Meru MFI	Directorate of Livestock
30	MVs	% of MV farmers paying membership fees per MV	Current number paying fees	2023	25%	50%	100%	MV farmers	Annually	MV farmers	Directorate of Livestock
31	Building a sustainable MV business model:	No. of target MVs with back-up electricity system	0	2023	1	4		Service provider/ Directorates of Energy	Annually	Service provider/ Directorates of Energy	Directorate of Livestock
32	improved productivity	Number of people trained to maintain back-up system	0	2023	2	8		Service provider/ Directorates of Energy	Annually	Service provider/ Directorates of Energy	Directorate of Livestock
33		No., of MVs with additional 1096 egg	0	2023	1	4		Service provider/ MFI	Annually	Directorate of Livestock/MFI	Directorate of Livestock/MFI

S/N	Programme	Output Indicators	Baseline		Phase 1 Target	Phase 2 Target	Phase 3 Target (if applicable)	Source of Data	Frequency	Responsibility	Reporting Entity
			Value	Year							
		incubator, feed mixing and milling machines									
34		% hatch rate (% of incubator operating capacity used)	15%	2023	85%	85%	85%	MV farmers/ Directorate of Livestock	Annually	MV farmers/ Directorate of Livestock	Directorate of Livestock
35		Number of people employed full-time to operate equipment per MV	0	2023	4	16		MV farmers	Annually	MV farmers/ Directorate of Livestock	Directorate of Livestock
36		No. of MVs with aggregation & feed halls	0	2023	1	4		MV farmers/ Directorate of Livestock	Annually	MV farmers/ Directorate of Livestock	Directorate of Livestock
37		No. of feasibility studies on own feed production	0	2023	1	4		Supplier/ Directorate of Livestock	Annually	Directorate of Livestock	Directorate of Livestock
38		No of feasibility studies on brooder farm	0	2023	1	4		Supplier/ Directorate of Livestock	Annually	Directorate of Livestock	Directorate of Livestock
39		% of farmers with production plans and records per MV	0	2023	25	50	100	MV farmers/ Directorate of Livestock	Annually	MV farmers/ Directorate of Livestock	Directorate of Livestock
40	Building a sustainable MV business	Number of water meters installed	0	2023	TBD	TBD		Directorate of water	Annually	Directorates of Water & Livestock	Directorate of Water

S/N	Programme	Output Indicators	Baseline		Phase 1 Target	Phase 2 Target	Phase 3 Target (if applicable)	Source of Data	Frequency	Responsibility	Reporting Entity
			Value	Year							
41	model: sustainable water management	Number of staff trained on sustainable water management per MV	0	2023	4	16		Supplier/ Directorate of water	Annually	MVs/Directorates of Water & Livestock	Supplier/ Directorate of water
42		Number of water-harvesting measures implemented	0	2023	TBD	TBD		Directorate of water	Annually	MVs/Directorates of Water & Livestock	Directorate of Water
43	Building a sustainable MV business model: More affordable production inputs	Number of bulk purchase agreements with input suppliers	0	2023	TBD	TBD		MV farmers/ Directorate of Livestock	Annually	MV farmers/ Directorate of Livestock	Directorate of Livestock
44		Number of own feed production demo plots	0	2023	2	8		MV farmers/ Directorate of Livestock	Annually	Supplier/MV farmers/ Directorate of Livestock	Directorate of Livestock
45		% of F1 grade eggs supplied	0	2023	100%	100%		Supplier/ Directorate of Livestock	Annually	Supplier/MV farmers/ Directorate of Livestock	Directorate of Livestock
46	Building a sustainable MV business model: Diversification of marketing channels/	Number of market mapping surveys	0	2023	1	4		Supplier/ Directorate of Livestock	Annually	Supplier/ Directorate of Livestock	Directorate of Livestock
47		No. of sales contracts	0	2023	TBD	TBD		MV farmers/Suppliers Directorate of Livestock	Annually	MV farmers/ Directorate of Livestock	Directorate of Livestock

S/N	Programme	Output Indicators	Baseline		Phase 1 Target	Phase 2 Target	Phase 3 Target (if applicable)	Source of Data	Frequency	Responsibility	Reporting Entity
			Value	Year							
48	building markets	Apex Cooperative established	0	2023	1			Farmers/ Directorate of Livestock	Annually	Directorate of Livestock	Directorate of Livestock
49	Building a sustainable business model for MV farmers: improved flock management	No. of farmers trained in flock management (including health & disease surveillance & control; improved breeds, production & management practices; housing; feed and nutrition)	0	2023	100	400	800+	Supplier/ Directorate of Livestock	Annually	Supplier/ Directorate of Livestock	Directorate of Livestock
50		No of climate vulnerability and risk analyses and carried out and adaptation/resilience building strategy developed per MV	0	2023	1	4		Supplier/ Directorate of Livestock	Annually	Supplier/ MV famers/ Directorate of Livestock	Directorate of Livestock
51		Number of specialist extension officers trained	0	2023	4	20		Supplier/ Directorate of Livestock	Annually	Supplier/ Directorate of Livestock	Directorate of Livestock
52	Building a sustainable individual farmer model:	No. of individual farmers with Solar powered 96 egg incubators i	0	2023	25	100		Supplier/ Meru MFI	Annually	Directorate of Livestock, Meru MFI	Supplier/ Meru MFI

S/N	Programme	Output Indicators	Baseline		Phase 1 Target	Phase 2 Target	Phase 3 Target (if applicable)	Source of Data	Frequency	Responsibility	Reporting Entity
			Value	Year							
53	access to finance	No. of target farmers with MF loans	0	2023	25	100		Meru MFI	Annually	Directorate of Livestock, Meru MFI	MFI
54	Building a sustainable business model for individual farmers: improved flock management	No. of farmers trained in flock management (including health & disease surveillance & control; improved breeds, production & management practices, including climate risk adaptation; housing; feed and nutrition)	0	2023	25	100		Supplier/ Directorate of Livestock	Annually	Supplier/ Farmers Directorate of Livestock	Directorate of Livestock
55	Building a sustainable business model for individual farmers: improved productivity	Incubator hatch rate	0	2023	90%	90%		Farmers/ Directorate of Livestock	Annually	Farmers/ Directorate of Livestock	Directorate of Livestock

Table 128: Summary of programme/project interventions in Meru County

Source: INEP framework – adapted to align with Meru solution project phases

S/ N o.	Programme	Outcome Indicators	Baseline		Phase 1 Target	Phase 2 Target	Phase 3 Target (if applicable)	Source Of Data	Frequency	Responsibilit y	Reportin g Entity
			Value	Year							
Improving access to household and street lighting											
1	Promote Tier 1 lighting systems among low-income kerosene end-users	No of households actively using the Tier 1 systems (tracked through continued repayments)	No of households using kerosene for lighting as main fuel: 107,678	2019 (KPHC)	3,600	7,200	12,500	System provider	Annually	System Provider & MCIDC	Energy Docket
2	Installation of streetlights and floodlights in towns and markets centres	% of people stating they feel safer due to the new streetlight infrastructure (through survey administered in targeted towns)	People stating that streetlight infrastructure will help them feel safer in their communities. Data will be collected through survey to be administered in the project inception phase	To be collected in 2024	At least 50% of people feel safer	At least 50% of people feel safer	At least 50% of people feel safer	Energy Docket	Annually	Energy Docket	Energy Docket
Access to clean, safe and affordable cooking solutions											
3	Carry out awareness raising campaigns for adoption of cleaner cooking solutions	Number/percentage of household acquiring and using cleaner cooking solutions in Meru County	Number of households (HH) using firewood in Meru County was 314,980 (KNBS 2019)	2019 (KNBS)	25954 or 10% of HH using TSOF adopt different cleaner cooking	51909 or 20% of HH using TSOF adopt different cleaner cooking solutions in yr.2	77863 or 30% of HH using TSOF adopt different cleaner cooking solutions in yr.3	Directorate of Energy	Annually	Directorate of Energy, Civil Society and private sector, Mitunguu	Directorate of Energy

S/ N o.	Programme	Outcome Indicators	Baseline		Phase 1 Target	Phase 2 Target	Phase 3 Target (if applicable)	Source Of Data	Frequency	Responsibilit y	Reportin g Entity
			Value	Year							
			of these 259543 use TSOF (SETA 2022)		solutions in yr.1		For yr.4 (20%), yr.5 (10%) and yr. 6 (10%)			Energy Center	
4	Training of local ICS fabricators and cooking solution installers	Percentage of artisans with skills fabricating and installing cooking solutions that are of high quality	0	24	225 artisans (yr.1)	-	-	Director ate of Energy	Yr.1	Mitunguu Energy Center, CSOs, private sector Directorate of Energy	Directora te of Energy
5	Enhance access to finance and credit for acquisition of cleaner cooking solutions	Percentage of groups (farmers, women) and cooking solution suppliers accessing financing and credit for cleaner cooking solutions	0	To be collected in 2024	At least 10 groups (farmer/wome n)	At least 10 groups (farmer/women)	At least 10 Groups	Director ate of Energy, Table banking groups & FIs	Annually	Table banking groups, financial institutions, Directorate of Energy	Directora te of Energy
Improving access to clean water											
6	Expansion of boreholes to the underserved regions of Meru	% of people stating that new boreholes made drinking water more accessible (to be collected through surveys in inception phase)	% of people stating that access to drinking water is a main problem in their community. Data will be collected through surveys	To be collected in 2024	At least 70% of people in the targeted areas believe that boreholes improved their access to drinking water	At least 70% of people in the targeted areas believe that boreholes improved their access to drinking water	At least 70% of people in the targeted areas believe that boreholes improved their access to drinking water	Communi ty borehol e water committ ees	Annually	Department of Water and Irrigation	Departm ent of Water and Irrigation

S/ N o.	Programme	Outcome Indicators	Baseline		Phase 1 Target	Phase 2 Target	Phase 3 Target (if applicable)	Source Of Data	Frequency	Responsibilit y	Reportin g Entity
			Value	Year							
			in inception phase								
7	Promotion of small-scale bench top water purifiers	No. of people with access to high-quality drinking water in the targeted areas (tracked through continued repayments of purifiers)	% of people stating that water quality is bad in the targeted areas: 30% of sampled households in Igembe, Tigania and Buuri	2023	250	6,000	-	System provider	Annually	System Provider & MCIDC	Departm ent of Water and Irrigation
Improving access to basic health services											
8	Enhanced access to outpatient services for target L2 clients	No. of patients reporting improved satisfaction in surveys	0 – or establish baseline through sampling survey	2023	TBD depending on baseline	75%	90%	Depart ment of Health	Annually	System provider/ Directorate of Energy	Departm ent of Health
9		Independent evaluations	0	2023	1	1	1	Evaluat or	Annually	Evaluator/ Department of Health	Evaluato r/ Departm ent of Health
10	Improved target L2 staff satisfaction	No of staff reporting improved satisfaction in surveys	0	2023	TBD depending on baseline	75%	90%	Evaluat or	Annually	Evaluator/ Department of Health	Evaluato r/ Departm ent of Health

S/ N o.	Programme	Outcome Indicators	Baseline		Phase 1 Target	Phase 2 Target	Phase 3 Target (if applicable)	Source Of Data	Frequency	Responsibilit y	Reportin g Entity
			Value	Year							
		Staff retention and recruitment trends	Establish baseline	2023	% Improvement TBD depending on baseline	TBD	TBD	Evaluat or	Annually	Evaluator/ Department of Health	Evaluato r/ Departm ent of Health
11	More sustainable procurement at target L2s	Green procurement policy	0	2023	1			Depart ment of Health	Annually	Department of Health	Departm ent of Health
		Bulk purchase agreement with EE equipment suppliers	0	2023	TBD	TBD		Depart ment of Health	Annually	Department of Health	Departm ent of Health
12	Improved awareness of climate risks and most vulnerable populations	No. of facilities with staff trained on risks, vulnerability and mitigation/resilience building measures	0	2023	50%	75%	90%	Evaluat or	Annually	Evaluator/ Department of Health	Evaluato r/ Departm ent of Health
13	Improved GESI outcomes in target L2s	% of women and people from marginalised groups recruited as staff	Baseline to be established	2023	TBD	TBD	TBD	Evaluat or	Annually	Department of Health	Evaluato r/ Departm ent of Health
14	Improved understanding of priority needs/gaps to improve health outcomes of women and marginalised	GESI vulnerability assessment per facility (sub-County)	0	2023	12 (TBD)	80 (TBD)	160 (TBD)	Supplier	Annually	Supplier/ Department of Health	Supplier/ Departm ent of Health

S/ N o.	Programme	Outcome Indicators	Baseline		Phase 1 Target	Phase 2 Target	Phase 3 Target (if applicable)	Source Of Data	Frequency	Responsibilit y	Reportin g Entity
			Value	Year							
	groups accessing L2s										
Improving income from crop farming											
15	Support for the purchase of irrigation systems	No of small farm holders using water efficient irrigation equipment	No. of farmers using inefficient irrigation techniques (Data will be collected through survey to be administered in the project inception phase)	-	150	3,000	-	System provider and MFI	Annually	System Provider & MFI	Ministry of Agriculture
16	Improving access to quality/certified inputs	No of farmers purchasing quality/certified inputs (tracked through sells made by partners agro dealers)	No. of farmers using low quality farming inputs (data will be collected through survey to be administered in the project inception phase)	-	150	3,000	-	Agro dealers and Ministry of Agriculture	Annually	Agro dealers and Ministry of Agriculture	Ministry of Agriculture

S/ N o.	Programme	Outcome Indicators	Baseline		Phase 1 Target	Phase 2 Target	Phase 3 Target (if applicable)	Source Of Data	Frequency	Responsibilit y	Reportin g Entity
			Value	Year							
Improving income from poultry farming											
17	Building a sustainable MV farmer model	Number of MV farmers with improved income from poultry farming	0	2023	125	740	931	MFI/M V farmers	Annually	MFI/ Directorate of Livestock/ MV farmers	MFI/ Directora te of Livestoc k
18	Building a sustainable individual farmer model	Number of farmers with sustainable poultry business	0	2023	25	100		MFI/ farmers	Annually	MFI/ Directorate of Livestock/ farmers	MFI/ Directora te of Livestoc k
19	Farmer management of climate risks and climate-related impacts on flock health and productivity	Number of farmers trained on observed climate risks and impacts to flock health, adaptation and resilience building measures	0	2023	125	256+	800+	Supplier / Director ate of Livesto ck	Annually	Supplier/ Directorate of Livestock/ farmers	Supplier/ Directora te of Livestoc k
20	Improved GESI outcomes for target farmers	% of MV & Individual farmers that are women and people from marginalised groups.	0 or baseline to be established	2023	TBD (33% minimum)	TBD (33% minimum)	TBD (33% minimum)	MFI/Dir ectorate of Livesto ck	Annually	MFI/ Directorate of Livestock	MFI/ Directora te of Livestoc k
21		% women and people from marginalised groups in MV or SH	0 or baseline to be established	2023	TBD (33% minimum)	TBD (33% minimum)	TBD (33% minimum)	Director ate of Livesto	Annually	Farmers/ Directorate of Livestock	Directora te of Livestoc k

S/ N o.	Programme	Outcome Indicators	Baseline		Phase 1 Target	Phase 2 Target	Phase 3 Target (if applicable)	Source Of Data	Frequency	Responsibilit y	Reportin g Entity
			Value	Year							
		groups Governance Committees						ck/farm ers			
22		% of women and people from marginalised groups trained.	Baseline to be established	2023	TBD (33% minimum)	TBD (33% minimum)	TBD (33% minimum)	Supplier / Director ate of Livesto ck	Annually	Directorate of Livestock	Supplier/ Directora te of Livestoc k

Table 130: M&E results matrix (outcome) for CEP

Source: INEP framework – adapted to align with Meru solution project phases