SESA
Smart Energy Solutions for Africa

D5.3 POLICY ROADMAPS AND POLICY BRIEFS TO REMOVE BARRIERS TO SPECIFIC TECHNOLOGIES

WP 5.2

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Abstract	This report seeks to provide guidance for creating enabling policy frameworks for selected smart energy technologies in African countries. It presents nine case studies from various contexts, each focusing on a different technology. Based on findings of the barrier analysis developed as part of the SESA project, this report supports the development

	of policy roadmaps and identifies good practice policies for each case study, proposing specific policy solutions to address the identified challenges. Thus, the report encourages national governments to initiate their own policy road mapping processes, while the case studies presented in this report can be seen as starting points for in-depth discussions and policy implementation.

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Executive Summary

As a collaboration project between the European Union and nine Africa countries, SESA, which stands for Smart Energy Solutions for Africa, aims at providing energy access technologies and business models that are easily replicable and generate local opportunities for economic development and social cohesion in Africa. For nine country cases, this report provides policy guidance to support the market penetration of selected technologies. These case studies are:

- Solar Productive Use in Kenya
- E-mobility in Kenya
- Clean Cooking in Malawi
- Second-Life Use of EV Batteries in South Africa
- PVs for Household in Morocco
- E-mobility in Morocco
- Second-life battery use as energy storage for solar photovoltaic systems in Ghana
- Bio-ethanol Technology for Cooking in Ghana
- Solar Irrigation in Rwanda

A policy roadmap is often seen as an official document containing fixed targets and target years as well as the corresponding steps or activities to realise these targets to which national governments have committed themselves. However, given the scope and constraints (e. g. limited resources) in the SESA project, the added value of D5.3 was considered to feed a potential road mapping process for certain technologies to be implemented in respective countries. Hence, D5.3 provides support or guidance to a similar but more granular government-backed process.

This document builds on the barrier analysis developed as part of the SESA project deliverable D5.2 (Jyoti & Rocha Romero, 2023). In fact, a barrier analysis had been conducted for each of the above cases. These analyses were based on the PESTELA-framework, which, basically, groups barriers in seven overall categories: **p**olitical, **e**conomic, **s**ocial, **t**echnological and infrastructural, **e**nvironmental, **l**egal as well as **a**wareness and information.

As part of this Task, barriers identified in D5.2 and grouped according to PESTELA were prioritised by partners on a case-by-case basis in order to find the most pressing concerns for policy interventions. Based on desk research, complemented by expert interviews, country-specific policies were identified that are needed for an enabling policy framework – to, ultimately, contribute to technology diffusion. The enabling framework serves in this case as a "toolkit" for possible policies and can serves as inspiration for policy changes. Moreover, the relevant steps to implement identified policies were identified and grouped into short-, medium- and long-term activities.

While it is difficult to draw conclusions for all case studies given the different country contexts and technologies analysed, some of the more general findings show that policy action is needed

in several areas. While in all cases, economic aspects remain a key challenge (e. g. high prices for end-users), capacity building / training, awareness raising or regulatory changes almost always need to be part of a policy package, as well. In some case studies, ecological challenges of smart energy technologies remain a concern, too.

Some country-specific findings are:

- **Solar Productive Use in Kenya:** The case study highlights the importance of a clear strategy, communication, and monitoring to ensure successful implementation of solar productive use in Kenya. It also proposes incorporating community-based approaches and addressing the issue of e-waste through extended producer responsibility. Additionally, the roadmap highlights the need for education and capacity building to support the growth of the recycling industry and mitigate water stress, that could exacerbate if, for instance, solar PV systems are used for water pumping.
- **E-mobility in Kenya:** The role of a steering committee is emphasised to coordinate e-mobility activities. Several economic instruments may help to make EVs more affordable, but also to build a domestic manufacturing base in the long run. Grid reliability (and the increasing need for capacities to facilitate e-mobility) as well as the end-of-life handling need to be covered as the market expands.
- **Clean Cooking in Malawi:** can be based on a Multi-Level Governance Coordination Initiative. The policy roadmap provides a contributing strategy to enhancing clean cooking diffusion in Malawi. It ties together the critical elements of policy, stakeholder engagement, activities, and resources, creating a cohesive plan for the sustainable development of the sector
- **Second-Life Use of EV Batteries in South Africa:** is critical for South Africa's transition to a renewable-based electricity grid, but faces barriers like inadequate supply, lack of awareness, and safety risks due to insufficient regulatory frameworks. A proposed policy framework emphasizes safety standards, improved waste management, and collaboration among government, industry, and educational institutions to develop a robust ecosystem for battery recycling and repurposing, requiring stakeholder engagement, skilled workforce development, and funding for research and pilot projects.
- **PVs for Household in Morocco:** A key challenge besides the high upfront costs identified is providing a legal framework for grid connectivity and infrastructure in order to connect solar PV. The analysis suggests that learning from international examples and formulating suitable feed-in tariffs or net metering policies will contribute to accelerating rooftop solar PV deployment.
- **E-mobility in Morocco:** Morocco's existing policy framework for transitioning to a net-zero emissions transport system is insufficient, requiring short, medium, and long-term actions to achieve its 2030 targets. Recommendations for addressing key barriers include promoting financial incentives, improving regulations for EV infrastructure and electricity sales, and raising public awareness, with the Ministry of Energy Transition, Ministry of Transport, and other stakeholders playing crucial roles in implementing these policies and encouraging sustainable electric mobility.
- **Second-life Battery Use as Energy Storage for Solar Photovoltaic Systems in Ghana:** Measures to drive technology diffusion include creating a supportive regulatory environment, providing incentives, promoting local content, raising awareness, establishing standards, supporting research, and promoting sustainable

lithium mining. The successful implementation of these measures requires government involvement, resources, and a coordinated approach.

- **Bio-ethanol Technology for Cooking in Ghana:** The analysis proposes strategic measures to overcome obstacles through financial incentives, infrastructure development, regulatory frameworks, public awareness campaigns, and research and development grants. The roadmap aims to create a supportive environment for the widespread adoption of bioethanol. Coordinated efforts from government institutions, private sector stakeholders, NGOs, and the general public are needed to achieve significant progress in promoting clean cooking technologies and contributing to sustainable development.
- **Solar Irrigation in Rwanda:** As relevant policies, this analysis suggests, for instance, the promotion of water harvesting for irrigation, in combination with financial support and training to develop sound business models. If all proposed policy measures are well implemented, this may lead to the adoption of solar-powered irrigation systems in Rwanda and, hence, may change the harvest yields of farmers and positively affect the climate and the economy of the country.

1. Introduction

1.1. About the SESA Project

SESA is a collaborative project between the European Union and nine African countries (Kenya, Ghana, South Africa, Malawi, Morocco, Namibia, Tanzania, Rwanda, and Nigeria) that aims at providing energy access technologies and business models that are easily replicable and generate local opportunities for economic development and social cohesion in Africa. Through several local living labs, it is expected to facilitate the co-development of scalable and replicable energy access innovations, to be tested, validated, and later replicated throughout the African continent.

The SESA project covers innovative energy access solutions for a range of applications in both urban and rural areas across the African continent. The innovations are designed to be initially co-developed by partners in Kenya as a demonstration case (also referred to as the living lab). The living lab aims at addressing three focus areas related to innovation in energy transitions, namely: (1) access, (2) productive use, and (3) a circular economy. The demonstration case is subsequently followed by the validation cases in living labs in Morocco, South Africa, Malawi, and Ghana.

The SESA solutions include decentralised renewables (i.e., solar photovoltaics), innovative energy storage systems including second-life electric vehicle batteries, smart microgrids, waste-to-energy systems (i.e., biomass to biogas), climate-proofing, resilience and adaptation, and rural internet access. The project's overall objective is to provide innovative energy access technologies and business models that are easily replicable and generate local opportunities for economic development and social cohesion. Therefore, the SESA projects outcomes are aligned with the sustainable development goals (SDG) of the United Nation. However, depending on the case study, the focus may shift to one or several SDGs.

To achieve its objectives, activities to be carried out in SESA have been divided into nine work packages (WP) with specific objectives, and sub-divided into various tasks with work

packages, leading to various project deliverables. The tasks are carried out by project partners in collaboration with each other.

1.2. About this report

This report entitled "**Policy roadmaps and policy briefs to remove barriers to specific technologies**" is one of the deliverables (D5.3) under the **package WP5- Task 5.2.** The ultimate objective of this report is to provide guidance to the creation of an enabling policy framework for specific smart energy technologies in different country contexts in Africa. In total, partners covered nine case studies:

Table 1 Case studies covered in the SESA project and responsibilities

Country	Technology	Responsibility
Kenya	Solar Productive Use	Wuppertal Institute for Climate, Environment and Energy (WI)
Kenya	E-mobility	UNEP Copenhagen Climate Centre (UNEP-CCC)
Malawi	Clean Cooking	ICLEI Africa
South Africa	Second-Life Use of EV Batteries	ICLEI World Secretariat
Morocco	PVs for Household	Technical University Berlin/SEI
Morocco	E-mobility	ICLEI Europe
Ghana	Second-life battery use as energy storage for solar photovoltaic systems	Urban Electric Mobility Initiative (UEMI)
Ghana	Bio-ethanol Technology for Cooking	Akenten Appiah-Menka University of Skills Training and Entrepreneurial Development (AAMUSTED)
Rwanda	Solar Irrigation	University of Rwanda

This report addresses and seeks to inspire decision makers of the respective countries to facilitate market diffusion of low-carbon technologies and, in so doing, reduce greenhouse gas (GHG) emissions. In order to support the formation of an enabling policy framework, for each of the country- and technology-specific case studies, partners gathered information to support the design of a policy roadmap in each of the countries. Hence, if national governments addressed in this report wish to start an official policy road mapping process, that will have to rely on commitments by the government itself, ministries and other actors, case studies in this report may serve as a starting point for discussing the actual realization of the roadmap.

This report includes the methodology developed for providing guidance for policy roadmap development and policy briefs. As the case studies were delivered by different partners of the consortium, the methodology helped to provide a common understanding of this task and in facilitating a consistent approach to delivering all of the nine case studies. The methodology to this case-study-based approach and the actual implementation of the case studies by all partners rests upon the findings of the barrier analysis (D5.2) of this Task 5.2.

Basically, the barrier analysis (Jyoti & Rocha Romero, 2023) provides an overview of barriers in each of the aforementioned case studies. For categorising barriers, the PESTELA framework was applied. PESTELA stands for political and institutional, economic, socio-cultural, technological and infrastructural, legal and awareness and information and aims to provide a holistic view of a particular barrier. Henceforth, partners assigned identified barriers to one of these categories. For D5.3 and, thus, for this report, relevant barriers largely unaddressed or insufficiently addressed so far were selected and it was reflected how such barriers can be overcome through policies.

The consortium worked between January 2024 and September 2024 on D5.3. After a preparation phase, a familiarisation meeting was held in January 2024 with all of the task partners. The partners then met digitally twice a month to discuss the progress made, clarify questions and ask for further advice.

In this section 1, a brief account of how D5.3 is linked with other work packages of the SESA project is described below. Section 2 of this report describes the methodological approach in more detail. Then, Section 3 dives directly into the case studies in the same sequence as depicted in Table 1 above. The case studies all have the following order. First, a short introduction to the country context is followed by, second, a more concrete account of how data was gathered in each of the specific cases. It should be noted that while the overall methodology was supposed to pave the way for a consistent approach across all case studies, partners were given some flexibility in data collection. This has been necessary, amongst others, because of the diverse countries and technologies covered. Third, an overview of policies addressing relevant barriers initially focusses on design details and relevant actors before more attention is drawn to the implementation timeline for each of the policies. Fourth, a sub-section on good practice policies provides two in-depth examples on how certain country- and technology-specific barriers can be addressed. Section 4 concentrates on summarising the most important results.

1.3. Linkages with other work packages

The Task has clear linkages with other work packages of the project, as well as with other tasks within the same work package (WP 5), as shown in Figure 1. The linkages are further described in the following sections.

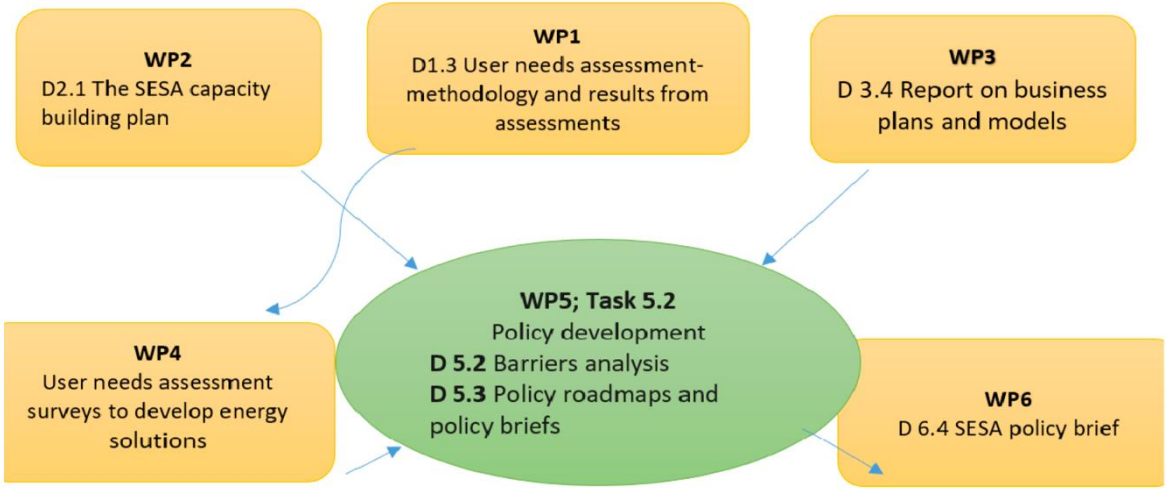

Figure 1 Linkages between Task 5.2 and other work packages

Work Package 1 and 4 (WP1 and WP4): The framework for user needs assessment developed in WP1 is also used in WP4 to carry out a user needs survey. User surveys provide inputs for innovative energy solutions for WP4 and provide inputs on barriers and policies needed to address the barriers to the technologies uptake from the users' perspective. As such, the user needs assessment reports are the responsibility of WP1 (Deliverable 1.3), which can also provide inputs on barriers as well as policies needed to remove barriers from users' perspectives.

Work Package 2 (WP2): One of the deliverables of WP2 is the SESA capacity building plan for various demonstration and validation sites. Capacity-building needs have been brought out in the plans based on the barriers identified and policy actions have been recommended to implement the plans. This provides inputs on capacity-building policies for Deliverable 5.3 on policy roadmaps.

Work Package 3 (WP3): Various business models for solution providers for technologies to be employed at various sites are explored in WP3. Deliverable D 3.4 brings out various models and policy requirements to address various issues (barriers) in implementing the models. It thus provides inputs for policy roadmap from solution providers' perspective for the models they plan to employ for penetration and dissemination of selected technologies at various sites.

Work Package 6 (WP6): The policy roadmaps and policy briefs produced in WP5 will serve as starting points for the policy dialogues (Task 6.4). The policy dialogues are to be organized in the framework of Regional Events in Task 6.2. The results of the discussion will be summarised in a final SESA policy brief (D 6.4) to amplify the outcomes and widen the impact of the SESA project. The policy briefs will be disseminated among local governments to enable them to scale up their climate action.

2. Methodology

The overall objective of Deliverable 5.3 is to deliver guidance for nine policy roadmaps for each of the case studies. This document combines these case studies into a single report; this chapter describes the overall approach to plan, implement and assess the individual country analysis. As mentioned above, the starting point of D 5.3 was the barrier analysis (D5.2) (Jyoti & Rocha Romero, 2023). Hence, the key assumptions of this report are:

- barriers hinder the deployment of technologies or innovation,
- policies can overcome respective barriers and, thus, facilitate technology deployment,
- given the existence of multiple barriers hindering technology deployment, a set of policies – the enabling policy framework – needs to be implemented to address multiple barriers,
- a plan – the policy roadmap – is necessary, that orchestrates the implementation of the enabling policy framework, including timeline, resources needed, institutional mechanism and responsibilities for implementation.

The barrier analysis was based on the PESTELA-framework, which, basically, groups barriers in seven overall categories: **p**olitical, **e**conomic, **s**ocial, **t**echnological and infrastructural, **e**nvironmental, **l**egal as well as **a**wareness and information. Barriers identified in D5.2 and grouped according to PESTELA were to be prioritised by partners on a case-by-case basis. Due to the sometimes very long list of barriers identified, it was necessary that responsible partners selected the most relevant barriers for their respective case studies. As the same partners carried out both the barrier analysis (D5.2) as well as the policy analysis (D5.3), it was seen as a pragmatic approach that precisely these partners were to select the relevant obstacles to be addressed by new policies.

A policy roadmap is often seen as an official document containing fixed targets and target years as well as the corresponding steps or activities to realise these targets to which national governments have committed themselves. However, given the scope and constraints (e. g. limited resources) in the SESA project, the added value of D5.3 was considered to feed a potential roadmapping process for certain technologies to be implemented in respective countries. Hence, D5.3 provides support or guidance to a similar but more granular government-backed process.

With this in mind, three key research questions for D5.3 evolved as follows:

1. What additional priority policies need to be implemented to overcome deployment barriers and to create an enabling policy framework in the respective case study?
2. How do activities of additional priority policies need to be organised in the short-, medium- and long-term?
3. What good practice policies implemented in other countries may contribute to add value to the situation of the respective case study?

2.1. Three-step approach

2.1.1. Policies forming an enabling policy framework

The enabling policy framework is the result of policy measures identified to overcome relevant barriers so far not addressed. In this report, individual and national level policies were to be identified and described in line with the following information categories as shown in Table 2:

Table 2 Relevant information and data to be collected for research question 1

Research question	**Relevant information / data to be collected**
1. What additional priority policies need to be implemented to overcome deployment barriers and to create an enabling policy framework in the respective case study?	**Name of the Policy Measure / Type**: Identify a generic name or title of the policy measure; examples can be found in Table 3 of this document. **Barrier addressed**: Identify what barrier the policy measure addresses and how the policy addresses the barrier. **Policy design details**: Identify how the policy may be designed concretely (e. g. financial incentives in % differentiated per target group, phase out of fossil-based applications for certain end uses). **Responsible Institutions**: Identify relevant governmental institutions relevant for realizing the policy.

The following Table 3 represents a non-exclusive list of examples of policy measures. This list was only to provide an impression on policy measures; for the specific case studies in the SESA project, other or slightly different policy measures might be applicable.

Table 3 Non-exclusive list of policy measures

Name of the Policy Measure	**Description of the Policy Measure and rationale**
International co-operation	Countries can co-operate in many ways to learn from each other's experience in policy-making and policy success. The opportunities for international co-operation are diverse. For example, countries can jointly develop test procedures, create harmonised labels and co-operate in professional training.
Energy agencies	For greater effectiveness of their energy policy, both national but also local governments are likely to need an energy agency. The tasks of energy agencies typically include the co-ordination of policies and implementing parts of the policy package, such as the provision of information and initial advice, promotional activities, education, training, dissemination, demonstration activities, network-building between market actors, awareness raising, and the organising of campaigns.
Funds	Funds are special entities founded and funded by the state for organisation and funding of certain programmes. These programmes typically combine information, motivation, financial incentives and or

	financing, capacity building, and RD&D/BAT promotion. Funds or trusts may be given greater flexibility in implementing programmes than government agencies
Government agencies and budget	The traditional way is that, for instance, integrated energy efficiency programmes with financial incentives, information and individual advice are managed by existing government agencies and funded from the public budget. The advantage over other mechanisms is the direct implementation and budget control by government and parliament. Experience shows, however, that appropriations for programmes in the government's budget are more subject to cuts and fluctuations or even "stop and go" effects than energy efficiency funds created via special levies.
Removal/reform of subsidies to end-user energy prices and on energy supply	Energy prices should 'tell the economic and ecological truth' through full-cost pricing or the internalisation of external effects in order to discourage wasteful consumption of environmental resources. Therefore, existing inefficient subsidies for non-renewable energy production or on energy prices should gradually be removed - legislators and governments should rather use the budget saved to fund low carbon energy technology schemes (e. g. for low-income households).
Removal of legal barriers	Sometimes, law prohibits low-carbon technology solutions. Examples could be the prescription of low maximum air temperatures e.g. 20 °C, during hot days in offices or schools, or of minimum ventilation rates even if nobody or just a few people are in the room, or the prohibition of solar water heaters on the roofs of historic buildings. Such legal barriers to solutions that can save a lot of energy should be re-examined and if possible removed.
Minimum energy performance standards (MEPS)	By setting an upper limit for the allowed energy consumption (e. g. of a building, appliances), minimum energy performance standards are used to exclude at least the most inefficient technologies concepts and technologies from the market.
Provision of information	Informing investors and end-users (e. g. about energy saving) opportunities and the achievable cost savings and other benefits, as well as about assistance available through other policies and services, will enable decision-makers to make more informed choices and improve uptake of energy efficiency options. Important instruments for providing information are, for instance, information centres, demonstration buildings, information campaigns, websites, and calculation tools.
Financial Incentives	Investors will evaluate costs and benefits of an investment. Financial incentives may be powerful instruments as they can make an important contribution to accelerating the market penetration of low-carbon energy technologies. Examples of financial incentives include direct grants or tax incentives.
Financing	Financing instruments target the barrier of insufficient availability of, or access to, capital for financing the incremental up-front costs. Among the vast variety of different financing schemes, preferential loans, revolving energy efficiency funds or government-facilitated third-party financing schemes (e.g. on-the-bill or property tax financing) are

	exemplary and suitable public policy responses to address the existing financing gap and to foster private investment.
Education & training	Capacity building measures for workforce in the respective value chains provides specific knowledge to facilitate the diffusion of low carbon technologies. Capacity building can be for public administrations or for cratsmen, amongst others.
Certification of qualified actors	Certification of the qualification level of supply chain actors (e. g. installation contractors) increases their incentives to undergo training (because they will benefit from improved credibility among potential customers) and helps investors in their search for properly skilled and trustworthy service providers.
clusters / networks	Networks can link relevant actors and promote exchange of experiences and good practices including SMEs, local authorities or civil society organisations. They are also instrumental for coordinating marketing, information and motivation, and professional training activities at the local or regional level.
Funding for research, development and demonstration (RD&D) projects	Through promotion of research and development activities as well as demonstration projects (RD&D), innovations in terms of technologies and design concepts are fostered. Research, development and demonstration (RD&D) is critical to drive the development of innovative technology concepts. RD&D funding is a key driver for innovative ideas, assists the accelerated market introduction, and reduces the incremental costs of energy-efficient solutions. However, market breakthrough is often hindered by a plethora of market barriers and is thus likely to need further policy support. Through a coherent RD&D policy, governments can further capacity building of comprehensive national scientific and technological research institutions on energy efficiency.
Public sector programmes	'Lead by example' programmes in the public sector to may create a (initial) demand for certain innovative solutions. Public procurement requiring the uptake of innovative technologies may result in increased market penetration and reduce market prices for these technologies.
Competitions & awards	Competitions and awards rewards frontrunners in facilitating / uptaking innovative solutions. The publicity gained means value added in terms of profit and prestige.

2.1.2. Guidance for a Policy Road mapping Process

Given that the policy roadmap is a plan for orchestrating the implementation of policies identified, relevant information on roadmaps – differentiated in short-term (by 2025), medium-term (between 2026 to 2030) and long-term perspectives (beyond 2030) – need to include perspectives for time and resources:

Table 4 Research question 2 and respective information / data to be collected including activities, timeline and resource needs

Research question	**Relevant information / data to be collected**
How do activities and resource needs of	**Activities**: Identify important activities to realise the policy (e. g. ex-ante assessments, creation of an agency, monitoring and

additional priority policies need to be organised in the short-, medium- and long-term to form a policy roadmap facilitating the enabling policy framework?	enforcement, capacity development of an authority); see Textbox 1 of this document for illustrative information. **Timeline**: Identify information on how to sequence important activities in order to realise the policy. **Resource needs**: Identify information on financial aspects in terms of overall policy implementation or on resource needs for the individual activities.

In order to identify activities relevant for policy measures, the "policy cycle" described in Textbox 1 may serve as a generic framework to identify relevant activities and resource needs. Note that the steps of the policy cycle should not be analysed for each and every policy measure in detail. Instead, it was to help partners search for relevant information and data for their respective case studies and, thus, to increase their information content.

Textbox 1 The "policy cycle" as a framework to identify relevant activities to realise policy measures (taken from European Geosciences Union, n.d.)

Agenda setting: This step scopes "new issues that may require government action".
Example: A study may expect an increasing energy consumption per capita. Meeting this demand while reducing emissions, may require an expansion of renewables.

Formulation: This step asks what *goals* need to be realized, what are the costs, what are stakeholders' reactions?
Example: Should governments facilitate start-ups for low carbon innovation by offering funding or rather support for end-users? What might be the effects of these actions?

Adoption: Policies need formal approval before becoming effective.
Example: Policies to increase wind power capacity will require a vote in Parliament.

Implementation (incl. monitoring and enforcement): The relevant actors to implement the policy need to have human and financial resources for their activities.
Example: Administrative processes to apply subsidies need to be created, funding needs to be secured.

Evaluation: The effectiveness and success (or failure) of the policy needs to be assessed in this step. This includes an analysis whether unpredicted effects have occurred.
Example: Several countries introduced highly popular solar energy policies. Occasionally more energy is being produced than is needed, which leads to further questions about how to handle the 'excess' energy.

Support / maintenance: This step scrutinizes how instruments can be advanced to become more successful.
Example: Shall support for certain low carbon innovations, an awareness raising program or training activities be continued?

2.1.3. Good practice for Inspiring the Enabling Policy Framework

In addition to providing a broader picture of the overall enabling policy landscape and how to realise it, this reports also includes two policy briefs for each case study. These policy briefs include good practice policies already implemented in other countries to overcome relevant technology-specific barriers identified in the case study. Ideally, the situation of the country where the good practice policy was implemented should resemble the situation of the case study. No particular limitation for the good practice policies were defined. Never the less, whenever good practice policies of countries facing similar barriers was difficult to realise, the search for good practices was opened to other countries. In so doing, the presentation of good practices will serve as illustrative examples to policy makers and as a starting point to discuss policies and policy implementation. For a description of these good policy practices, the following information categories of Table 5 were established supporting information and data gathering.

Table 5 Information categories for describing good policy practices implemented in other countries

Name of the policy	*Name of the policy.*
Policy type	*Name of the policy type / category.*
Location of implementation	*Please mention where the policy is implemented.*
Background / state at the outset	*Provide the context for the policy implementation (before the policy was implemented).*
Policy description	*Outline the policy aims, including the specific barriers addressed, who initiated the policy, and when it was implemented.*
Outcomes	*Highlight the results or impacts of the policy (e. g. GHG emission reduction, socio-economic impacts like jobs / employment, air quality).*
Success factors	*Identify key factors that contributed to the success of the policy, particularly focusing on design features that were effective in achieving the desired outcomes.*

2.2. Data collection

Information and data for Deliverable 5.3 on guidance for policy roadmap development were collected by **desk research** combined with **semi-structured and qualitative-oriented interviews** with relevant stakeholders. The most relevant information needs have been given in Table 2, Table 4 and Table 5. In order to identify relevant policies to overcome existing barriers and add value to the existing policy framework, desk research was considered to provide a good starting point factoring in latest policy analysis or assessments. With the help of such preliminary screening, interviews with relevant stakeholders complemented the search for information. The following stakeholder groups were considered to be relevant:

- Policymakers (relevant government authorities)
- (Institutional representatives of) end users of the technology (e. g. citizen organisations)
- Suppliers of the technology
- Experts from academia and other institutions
- NGOs

- Funding agencies

A list of each stakeholder group interviewed is included in each case study. Even though partners were given flexibility in developing their interview guides and adjusting them for specific target groups, research questions 1 and 2 were to frame the individual set of interview questions. For data gathering via interviews, partners were, in general, called to carry out a minimum of three interviews and strive for engaging with a maximum of ten interview partners. As the networks of responsible partners vary from country to country, it was considered important to allow for a certain range in the number of people to be interviewed. When data was collected and compiled into a first draft for the case studies by responsible authors, a peer review process was set up to have a critical reflection of the content.

3. Case studies

3.1. Solar Productive Use in Kenya

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3.1.1. Introduction

The Constitution of the Republic of Kenya, established in 2010, grants each Kenyan citizen the entitlement to a clean and healthy environment as stipulated in Article 42. Also, under Article 69, the government is mandated to undertake measures aimed at eradicating any activities or practices that contribute to the deterioration of the environmental quality. To comply with the constitution, the productive use of energy (PUE) entails a critical role for Kenya. Numerous use cases of PUE technologies in Kenya exist. Over 40 different types of PUE such as in agricultural production, agricultural post-harvest processing and storage, dairy, poultry and livestock, fisheries, light industry, small commerce and restaurants, hospitality, and a variety of off grid power applications have been identified. As Kenya has a high solar irradiance of approximately 15,000 MW/year, the PUE holds a particular importance (KIPPRA, 2022).

While many advances in the PUE in Kenya have been achieved, many barriers remain in place. This policy roadmap aims to address the most pressing barriers identified in the previously conducted barrier analysis where political and institutional, economic and financial, social and cultural, technical and infrastructural, legal and regulatory, and awareness and informational

barriers have been identified. The most pressing barriers for PUE in Kenya are as follows. First of all, in Kenya an overall strategy for PUE is lacking, in particular clear targets and timelines are lacking. Secondly, high upfront costs and insufficient funding of solar equipment and its installation is a key barrier to scale PUE. Thirdly, the improper disposal and insufficient waste management of solar modules, solar power devices and used batteries increases the risks of environmental damage. Lastly, the over-exploitation of groundwater using solar water pumps, as one of the productive use types, can lead to future water stress. For more detailed information about the specific barriers, please consult the barriers analysis report, which is the deliverable D 5.2 of the SESA project.

3.1.2. Data Collection

The data collection for this policy roadmap is based on desk research and expert interviews. Generally, desk research has turned out to be helpful in providing an initial overview of policies to address barriers that are hindering deployment of the PUE in Kenya. In parallel, four interviews of experts from academia and policy makers have been conducted in January 2024. A list of the organisations interviewed is given in Table 6.

Table 6 Interviewees for the case study on the productive use of solar energy in Kenya

Institution	Stakeholder group represented
GIZ (German Society for International Cooperation)	Expert from Academia
Ministry of Energy and Petroleum	Policy Maker
University of Nairobi	Expert from Academia
Durham University	Expert from Academia

3.1.3. Enabling Policy Framework

Based on the identified barriers in the barrier analyses as well as desk research and expert interviews conducted as part of this analysis, the following policies are advisable and should be examined by policy makers for implementation. The enabling policy framework has been summarised in Table 6.

Overall strategy for PUE

With the National Energy Efficiency and Conservation Strategy (NEECS) of the Ministry of Energy, PUE is generally supported. However, an overall strategy for PUE is lacking. In particular clear targets and timelines are lacking. This remains true even for Implementation Plan of Kenya's National Energy Efficiency Conservation Strategy of 2022. The determination of an overall strategy for PUE and clear targets has multiple benefits such as efficient resource allocation, stakeholder alignment, enhanced communication and accountability.

Incentives addressing high upfront cost of solar equipment and its installation

Although Kenya has made significant progress in expanding electricity grid connectivity, many rural areas remain unconnected to the grid. According to the World Bank (2021) 31,8% of the rural population does not have access to electricity. While off grid PV-systems offer an opportunity, the high upfront cost of solar equipment and its installation remain a major barrier.

Extended producer responsibility (EPR)
Unregulated e-waste disposal is a major environmental and health issue. PV panels, batteries and regenerators contain toxins and valuable resources which ideally need to be integrated into a circular economy. Consequently, Kenya has taken important steps in the direction of circular management of e-waste. For instance, an extended producer responsibility has been introduced. The national regulation on e-waste management does include solar panels and solar-powered appliances but solar companies are not incentivized to integrate e-waste management into their business models, which would include a process to deliberately dispose e-waste. Therefore, adjustments in the current regulations regarding e-waste are essential. A Closed life cycle regulation on e-waste and **extended producer responsibility** shall address the inappropriate disposal of solar panels, solar-power appliances, and end-of-life batteries leading to environmental threats.

Regulation restricting ground water extraction using solar pumps
According to the Aqua Stat Database of Food and Agriculture Organization (FAO) of the United Nations 33.24% (2020) of the renewable freshwater resources is being withdrawn in Kenya which classifies the country as low water stress. However, the water availability can change in different regions and over-exploitation of groundwater should be avoided. Solar water pumps are one PUE use case for the extraction of groundwater. Besides the domestic demand for water, solar pumps are primarily used for irrigation purposes. According to the Kenyan National Irrigation Authority and based on the Kenyan Vision 2030 an expansion of the irrigation capacity is in place. Observable unreliable rainfall patterns demand, besides other measures, solar pumps to satisfy the water demand. The irrigation potential is estimated at 1,350,000 acres while currently 500,000 acres have been developed. Along with improved water harvesting and storage facilities, the irrigation potential is estimated to go up to 1.9 Mio. Acres (National Irrigation Authority, 2023). Currently regulations restricting the extraction of water apply mostly to wells and according to our research no policies limiting the use of solar pumps are being enforced. **The regulation of restricting ground water extraction using solar pumps** aims to address the over-exploitation of groundwater while including capacity development as a means of education and increased acceptance of the regulation.

Table 7 presents suggestions for the elaboration of possible policies of PUE in Kenya. Hereby the potential policies address the previously identified barriers, name the policy measure, list potential responsible institutions for the implementation and showcase additional remarks.

Table 7 Enabling Policy Framework for PUE in Kenya

Name of the Policy Measure	Barrier addressed	Policy design details	Responsible Institutions	Remarks
Strategy for PUE	Solar energy strategy with clear targets and timelines accelerates solar energy deployment. Barrier addressed: 3.1 Lack of clear strategy for PUE	Solar energy strategy defines the solar energy targets and introduces mandates and/or initiatives to reach them. This strategy should be based on an ex-ante assessment, in which technological & economic potentials are estimated.	Ministry of Environment and Forestry, KEPSA, Treasury, KAM, KIPPRA, KEREA, The Kenya Association of Technical	With the help of its Solar Energy Strategy, the EU seeks to “bring online over 320 GW of solar photovoltaic by 2025 (more than doubling compared to 2020) and almost 600 GW by 2030” (COM 2022).

		Additionally, each PUE use case individual targets should be established. The overall strategy should be aligned with other targets of the Kenyan government (e. g. growth plans).	Training Institutions (KATTI), lead TVET institutions	
Community-shared solar PV	Solar community PV makes possible for individual subscribers to benefit from a solar installation or other PUE use case located within their community Barrier addressed: 3.2 financial barriers and physical barriers such as ownership of house or business, lack of roof space or roofs unable to host solar system for static reasons and financial barriers	Community shared solar PV is an innovative solar energy program design that allows multiple consumers to share the costs and benefits of ownership in an off-site solar PV facility or other PUE use case, opening market access to a wider variety of individuals. It could be structured as an incentive program aimed at providing funding for projects serving low-income customers. Alternatively, it could adopt a low-income-specific mandate, necessitating a certain percentage of the program to be allocated for low-income subscribers	Ministry of Environment and Forestry, KEPSA, local authorities, MoE	Best practice examples for the promotion/ implementation of "Community Shared Solar PV" policy: Solar community energy project in the City of Recklinghausen (Germany). Here public roof surfaces are being utilized for electricity and heat generation. The city supports the initiative by leasing roof surfaces for the PV installations. The project is entirely financed by the local community, with investments starting at €50 and an average invest of €3,300. An alternative approach can be observed in Spain with a community owned solar PV project. *The members of a cooperative provide zero-interest loans, and in return they get access to clean electricity at cost price. Each member of the collective scheme can buy shares corresponding to its household consumption. The cooperative then supplies KWh to the members at cost prices, following the model of collective auto-consumption. Generation KWh*

				reached members across the whole of Spain, providing them access to electricity.
Extended Producer Responsibility (EPR)	EPR take back scheme mandates producers and distributors of PV systems to finance the collection and environmentally sound recycling of the PV-equipment that have reached their end-of-life. Barrier addressed: 3.3 regulatory barriers	EPR is a policy instrument, which applies the 'polluter pays principle' by placing the responsibility of a product's entire life cycle – from designing environment friendly and low-impact products to managing their EoL – onto the producers. In principle, the EPR fees cover the real EoL costs, i.e. the costs for collection, transport and treatment of the EoL products including costs for awareness raising and administrative issues. (EEB, 2023) The part of EPR fees can be used to finance awareness and skill development programs, R&D and infrastructure development.	Ministry of Environment and Forestry, KEPSA, Treasury, KAM, MoE	As an optional and or complementary instrument of an ERP system a bonus/ penalty system could be implemented: It can be implemented as a part of EPR system. The modulation criteria could broadly be categorized in general terms, such as regarding the products' recyclability, recycling rate, reusability, recycled content, durability and reparability. (Sachdeva et al., 2021) Complementary policies: Eco-design incentives, can reduce e-waste by encouraging firms and distributors to produce or distribute easy-to-repair, disassemble and recyclable products. Additionally, it can effect low-quality non-certified products (with shorter lifespan) are penalised. (Evidence on Demand, 2017) Eco-modulation: e-waste prevention through differentiated recycling fees which incentivize upstream design changes. The modulation criteria could broadly be categorized in general terms, such as regarding the products' recyclability, recycling rate, reusability, recycled content,

				durability and reparability. (Sachdeva et al., 2021)
Skills development training programs for recycling workforce	Skill development programs support formal and informal workforce to properly handle the modules. Barrier addressed: 3.3 Information and capacity barrier	Various groups involved in the informal sector can benefit from the training, including collectors, transportation workers, dismantlers, shop owners, repair shops, and production workers (Lenz et. al., 2019). Formal sector players will also be trained to enable them to effectively handle the PV modules and components. The part of EPR fees can be used to finance the skills development programs.	Ministry of Environment, NEMA, KAM, KEPSA, The Kenya Association of Technical Training Institutions (KATTI), lead TVET institutions	
Sustainability labelling requirements for PV modules	Mandating manufacturers to provide PV module labels help consumers to make informed decisions and increase transparency and information exchange between PV manufacturers and EoL PV management stakeholders. Barrier addressed: 3.3 Information barrier	Sustainability labels are a tool to inform consumers that not all PV modules are equal and empower them to actively support better alternatives (Curtis et. al., 2021). Labeling requirements could enable information exchange between manufacturers and EoL PV management stakeholders. PV module labels can provide information regarding the concentrations of hazardous material (such as lead) to eliminate the need for expensive and variable hazardous waste characteristic testing. (Gervais et al., 2021)	Ministry of Environment, NEMA, KAM, KEPSA. MoE	The EU currently works on a Ecodesign Regulation and Energy Labelling Regulation for solar PV modules (COM 2022). In particular, energy labelling can be seen as an important tool to raise consumers' awareness on the energy performance of certain products. As labelling may help ranking modules regarding their sustainability, financial support programmes can be interlinked with a labelling instrument. For instance, for purchasing better performing products, consumers receive a (higher) premium.
Stakeholder capacity building and awareness raising	Conducting stakeholder capacity building and awareness raising programs help to make solar industry	Capacity building and awareness raising for solar industry stakeholders: It is important that the industry understands	Ministry of Environment, NEMA, KAM, KEPSA, Ministry of	

	stakeholders aware of the concept of EPR and their responsibilities to comply with the requirements. Barrier addressed: 3.3 awareness and information barriers	their role, responsibilities, and compliance requirements. As yet, the industry is not familiar or aware of the regulations and the concept of EPR itself. (Evidence on Demand, 2017). The part of EPR fees can be used to finance the awareness raising activities.	ICT, Media, MoE	
Industry-Led Initiatives	Development of industry standards encourage compliance to environmentally sustainable EoL management/business practices and ensure effective services. Barrier addressed: 3.3 technical	The national voluntary industry standards can encourage environmentally sustainable EoL management decisions for PV, including design for recycle as well as recycling and resource recovery of EoL PV modules (Tura et al. 2018; Bai et al. 2015; Dong et al. 2016). Voluntary standards can include a certification program to reward compliance with a given standard. Certifications are typically awarded after confirmation of compliance by third-party authorities through testing and audits. (Curtis et. al., 2021)	Ministry of Environment KEPSA, KAM, KEREA	Best practice example: A national program to encourage PV recycling among SEIA membership in the US: In 2016, SEIA launched a member-based National PV Recycling Program (PV Recycling Program) that aggregates the services offered by recycling vendors and PV manufacturers. The PV Recycling Program establishes a network of cost-effective recyclers that can responsibly manage EoL PV modules and system components. SEIA's PV Recycling Working Group identifies preferred recycling partners through an evaluation process that may include a site visit to ensure practices meet SEIA's standards. The PV Recycling Program lists U.S. firms capable of recycling PV modules, inverters, and other related equipment. (Curtis et. al., 2021)
Government investment for upgrading	Government investment for waste collection	Government can finance establishment of the collection and	Ministry of Environment,	In most developed countries with EPR-regulation, the

transport, waste collection infrastructure and recycling facilities	infrastructure and recycling facilities can incentivize producers to collect PV waste. Barrier addressed: 3.3 Technical (infrastructural)	take-back points as much as possible embedded into existing channels and logistics networks (Evidence on Demand, 2017) Public waste collection infrastructure can be made available (Kariuki, 2024). Recycling facilities can be upgraded and new once can be developed The part of EPR fees can be dedicated to infrastructure upgrade. Additionally international cooperation contribute to upgrading existing recycling structures	Ministry of Transport, Infrastructure, Housing and Urban development, Treasury, National construction authority (NCA)	producers can rely on an already well-functioning public waste collection infrastructure. For example, a dense network of public "recycling stations" where households and certain small enterprises can hand in all sorts of e-waste. (Kariuki, 2024).
Groundwater metering and allocation or charging for PUE in the agriculture sector	Groundwater metering contributes to efficient water management by tracking groundwater use. Barriers addressed: 3.4 over-exploitation of groundwater	Groundwater metering measures groundwater abstractions and provides information on the location and volume of groundwater used. Groundwater metering facilitates the limitation of groundwater usage to the allocated quota.	Ministry of Water, Sanitation and Irrigation, National Irrigation Authority, Water Services Regulatory Board (WASREB), Water Resources Authority, Ministry of Environment and Forestry, NEMA	Jordan installed meters on all wells including those used for irrigation, to measure the abstracted volume of water and to limit abstracted quantities according to the license. Remote sensing is used as a method that could be used to verify metering data and to estimate total water abstraction. (Al-Karablieh & Salman, 2016)
Training / capacity building and awareness raising of water consumption for the use of solar PUE for agricultural production	Over consumption of water Barrier addressed: 3.4 Information and capacity barrier	Food production should ideally be decoupled from water use. The appropriate communication is a central element of the capacity development and should be addressing communities and not individuals, additionally the private sector should be involved. Suppliers of solar pump technologies should be	National Irrigation Authority, Ministry of Agriculture and Livestock Development	

		required to couple the sale of their product with training to mitigate environmental impacts. Furthermore, drip irrigation should be emphasised instead of flooding to reduce the overall water demand.		

3.1.4. Guidance for Policy Roadmap Development

In this section, we address the implementation of the policies enumerated in Table 7, incorporating a temporal framework categorized into short-term, medium-term, and long-term activities. For clarity, short-term encompasses the period from the present up to three years, medium-term spans from three to ten years, and long-term refers to policies that should be realized or maintained from ten years onward. The suggested timelines for each policy are detailed in Table 8.

Table 8 Policy-specific timelines for PUE in Kenya

Name of the Policy Measure	**Short-term**	**Medium-term**	**Long-term**	**Remarks**
Strategy for PUE	Based on the National Energy Efficiency and Conservation Strategy (NEECS) and the implementation plan a updated strategy with clear targets for PUE have to be elaborated and communicated publicly. Besides a final target several sub-targets should be integrated to make the progress tracking easier.	Public communication and implantation of the PUE strategy	Continuous Evaluation of the status of probability of target achievement. A bi-annual evaluation can provide the opportunity for potential adjustments	
Community PV	Grant access to public rooftops or surface areas to install PV systems. Provide low interest credits in order to enable investment opportunities for low-income households.	Created a legal framework which allows flexibility in investment volume. This increases the accessibility for households with lower income	Partly subsidies investment in PV community project	
Extended Producer Responsibility	Development of EPR scheme Development of an incentive framework and financing	Enactment and enforcement of EPR Operationalization of an incentive	Adjustment of EPR in line with eco/modulation	Additionally, a bonus/penalty system could be established.

	mechanism for the sustainability of the EPR take back scheme (National waste management strategy 2019)	framework and financing mechanism (National waste management strategy 2019)		Eco-design incentives and Eco-modulation can be implemented to increase the effectiveness s of EPR
Skills development training programs for recycling workforce	Conducting need assessment to evaluate the gap in formal and informal sector players' knowledge and skills Designing and developing a skills development plan and materials addressing the needs of informal and formal sector players Conducting skill development programs	Evaluating the program and adjusting it for further needs of the formal and informal sector players Engagement of informal sector workers to the formal sector	Provision of training programs for more workers from formal and informal sector and engagement of more informal sector workers to the formal sector	
Sustainability labelling requirements for PV modules	Development of a sustainability labelling criteria Development of labelling program and certification scheme for PV modules	Regular audits and compliance check	Setting more strict labelling criteria (based on technological improvements etc.)	As inspiration the EU Energy Labelling regulation for solar PC modules can be used
Stakeholder capacity building and awareness raising	Conducting capacity building and awareness raising program to increase stakeholder's awareness on the EPR requirements and compliance	Evaluating the program and adjusting it for further capacity building and awareness needs of the industry	Engagement of sector representatives to policy discussions and forums Conducting consultations with PV industry	
Industry-Led Initiatives	Development of national voluntary industry standards for the sustainable EoL management of PV modules and components	Development of a certification program to reward compliance with the standard Conducting audits by third party to certify PV recyclers Identification of recyclers complying with the standard and rewarding them with a certificate	Regular audits to check the compliance of recyclers with the standard Establishment and management of a network of certified recyclers and PV manufacturers	A national program to encourage PV recycling among SEIA membership in the US: In 2016, SEIA launched a member-based National PV Recycling Program (PV Recycling Program) that aggregates the services offered by recycling

				vendors and PV manufacturers. The PV Recycling Program establishes a network of cost-effective recyclers that can responsibly manage EoL PV modules and system components. SEIA's PV Recycling Working Group identifies preferred recycling partners through an evaluation process that may include a site visit to ensure practices meet SEIA's standards. The PV Recycling Program lists U.S. firms capable of recycling PV modules, inverters, and other related equipment. (Curtis et. al., 2021)
Government investment for upgrading transport, devolpment of dismantling and recovery facilities (Waste management strategy) and waste collection infrastructure	Conducting e-waste collection infrastructure analysis and identify the needs of the existing infrastructure Developing a plan for infrastructure improvements	Investment for the improvement of existing infrastructure (logistic networks and collection points etc.) Investment for the improvement of existing dismantling and recovery facilities	Investment for the establishment of new collection and take-back points and the establishment of new dismantling and recovery facilities	In most developed countries with EPR-regulation, the producers can rely on an already well-functioning public waste collection infrastructure. For example, a dense network of public "recycling stations" where households and certain small enterprises can hand in all sorts of e-waste.

				(Kariuki, 2024).
Groundwater metering	Due to the high regional difference in water availability and water stress, critical region should be identified and water extraction limits should be established for region with high water stress.	Water meter should be installed on wells to 1. Monitor the water arability based on the water arability and reginal water stress 2. the abstracted quantities for communities shall be limited including those used for irrigation. Drop irrigation systems shall be party subsides to promote effect use of water.	N/A	
Training / capacity building and awareness raising of water consumption	Establishment on regulation of use of solar water pumps. Free of charge training/capacity building need to be established. Community based learning workshops need to be emphasised.	Obligation of suppliers of solar pump technologies to couple the sale of their product with training to mitigate environmental impacts. Teach the Training programme for capacity building	N/A	

3.1.5. Policy briefs on Good Practices

To promote the Productive use of Energy (PUE) in Kenya, existing barriers can be overcome by implementing corresponding policies. The Barrier analysis has identified the lack of an overall strategy for PUE, the high upfront cost of solar equipment and its installation, unregulated e-waste disposal, and the over-exploitation of groundwater using solar pumps as the main barrier for PUE in Kenya. The policy roadmap addresses these main barriers by providing tailored suggestions for potential policies, their design, the responsible institutions and a proposed implementation timeline. This two-stage approach of firstly conducting a barrier analysis and secondly the development of a policy roadmap leads to the following policy recommendations. To develop an overall strategy for PUE, the elaboration of a "Solar energy strategy" that defines solar energy productive usage targets and introduces mandates (based on an ex-ante assessment, in which technological & economic potentials are estimated), is required. High upfront costs can be addressed by the establishment of "community shared solar PV" which allows multiple consumers of energy to share the costs and benefits of a PV-system and supplies electricity. By applying the "polluter pays principle", the extended producer responsibility can reduce unregulated e-waste disposal. This policy can be accompanied by eco-design incentives and eco-modulation, which aim to reduce the overall amount of e-waste. The over-exploitation of groundwater can be limited by metering, allocation or charging of groundwater. This should be coupled with appropriate training/capacity building for efficient water use and awareness raising of water consumption

Good practice policies

In order to provide guidance for the policy design of PUE in Kenya good practice examples have been identified. These examples of existing policies consider the country and use-case-specific circumstances, where these have been implemented. Consequently, they should not be regarded as definitive blueprints for the policy formulation in the Kenyan PUE context. Instead, these examples serve as a source of inspiration and a potential foundation for the development of policies tailored to the unique requirements of PUE in Kenya.

Best practice example: National PV Recycling Program

Table 9 shows the "National PV Recycling Program" of the United States of America as a possible policy to address the unregulated e-waste disposal and as a mean to reduce the overall amount of e-waste from PV-Systems.

Table 9 National PV Recycling Program

Policy type	Industry-led initiatives and standards
Location of implementation	USA
Background / state at the outset	In the US, there were no specific federal laws or regulations addressing the recycling of PV modules prior to the introduction of the National PV Recycling Program (Curtis, Buchanan, Heath, et al., 2021). In 2017, Washington put the first law into force that mandates PV manufacturers to take back, reuse or recycle end of life (EoL) PV modules (Curtis, Buchanan, Heath, et al., 2021).
Policy description	The National PV Recycling Program was a member-based scheme initiated in 2016 and implemented by the Solar Energy Industries Association (SEIA) (SEIA, n.d.). The National PV Recycling Program sought to create a network of recycling partners for PV modules, inverters and other solar equipment based on the SEIA standards (SEIA, n.d.). SEIA's PV Recycling Working Group specifies the preferred recyclers through the assessment process including site visits (Sharma et al., 2019). Recyclers extend their services to installers, project and system owners, developers, distributors, and various other involved parties (SEIA, n.d.). Establishing such standards and initiatives mitigates environmental risks linked to improper disposal of solar modules, power devices, and used batteries. These standards and initiatives promote environmentally sustainable end-of-life practices, such as designing for recycling, in addition to recycling and resource recovery of PV modules (Curtis, Buchanan, Heath, et al., 2021).
Outcomes	The industry-led initiatives such as National PV Recycling Program encourage compliance to environmentally sustainable EoL management practices and mitigates the negative impacts of business operations on the environment and human health (Curtis, Buchanan, Smith, et al., 2021). These initiatives enhance companies' competitiveness by showcasing their dedications to quality and environmentally responsible management (Curtis, Buchanan, Heath, et al., 2021).
Success factors	• The National PV Recycling Program and SEIA's standards establish criteria and guidelines for environmentally sustainable disposal of PV modules within the industry (Curtis, Buchanan, Heath, et al., 2021). • The National PV Recycling Program facilitates the recycling of PV modules by helping customers in identifying companies that offer cost-effective and environmentally friendly end-of-life management solutions for their PV modules (Sharma et al., 2019). • The National PV Recycling Program streamlines the process for both established and emerging market players to recycle EoL PV modules, inverters, and other system components (Curtis, Buchanan, Heath, et al., 2021).

Best practice example: PV Cycle

Table 10 shows the "PV Cycle" as an alternative policy to address the unregulated e-waste disposal and as a mean to reduce the overall amount of e-waste of PV-Systems.

Table 10 PV Cycle

Policy type	A Voluntary Take-Back and Recycling Scheme for PV modules
Location of implementation	Founded in Europe; operating around the world
Background / state at the outset	PV Cycle was introduced as a voluntary industry initiative to ensure the proper collection and recycling of PV modules in 2007 (Yu et al., 2022). When PV Cycle started its operations, PV modules were not included in the scope of the Waste from Electrical and Electronic Equipment (WEEE) Directive (Magalini et al., 2016). PV Cycle filled a crucial gap for collection and recycling of PV modules until PV modules started to be covered by the WEEE Directive in 2012 (Magalini et al., 2016).
Policy description	The members of PV Cycle Association initiated the voluntary take-back and recycling scheme for PV modules in 2007 (Yu et al., 2022). The PV Cycle aims to mitigate the environmental risks associated with improper disposal practices by mapping the EoL PV modules and ensuring the management of materials within them through recycling and recovery processes (Malandrino et al., 2017).
Outcomes	The PV Cycle initiative contributed to the sustainable management of PV modules. From 2010 to 2022, PV Cycle processed a total of 77.514 tons of waste generated from PV systems, which is equivalent to 1.3 GW (PV Cycle, 2023). PV Cycle also facilitates collaboration among PV manufacturers by providing a convenient platform for them to realise their Extended Producer Responsibility (EPR) obligations (Yu et al., 2022).
Success factors	• PV Cycle provides collective and customized waste management services to waste holders within the European Union, with a specific focus on solar energy equipment and photovoltaic production scrap (PV Cycle, n.d.). • By streamlining take-back, handling, financing, and product registration and declaration, the initiative enables companies to meet their legal obligations in a simple and cost-effective manner (PV Cycle, n.d.). • Operating on a membership model, the voluntary take-back initiative requires participants to fund the collection and recycling of PV modules (Malandrino, 2017). This is achieved through annual financing and a variable fee, determined by the number of modules introduced to the market in the preceding year (Malandrino et al., 2017). • PV Cycle facilitates the proper collection, transportation, and recycling of PV modules by managing the collection and transportation of crystalline silicon and thin film modules, while outsourcing other operational steps to third parties (Malandrino et al., 2017).

	• The scheme ensures that all collected products undergo treatment using only the best available technology (PV Cycle, n.d.).

3.1.6. Summarising Remarks

This policy roadmap suggests policy instruments to address the most significant barriers to the PUE in Kenya, including the absence of a comprehensive strategy for PUE, limited affordability of solar equipment due to high upfront costs, regulations concerning the closed lifecycle of e-waste and extended producer responsibility, and the regulation of groundwater extraction using solar pumps. First of all, the emphasis lies on creating a clear strategy and the definition of missing targets. Communication and monitoring are essential to increase the likelihood of target achievement. Secondly, the policy design aims to incorporate the community aspect embedded in Kenyan culture to increase adoption of the new policies. Thirdly, the growing issue of e-waste is addressed by several individual policies. At the core of the suggested policies is the consideration of the whole lifecycle and the extended responsibility of the producer of PV equipment. In particular PV equipment should be designed and assembled in a way that facilitates recycling after its useful life ends.

Another focus is on education and capacity building. A workforce needs to be educated and trained to satisfy the further work demand in the recycling industry. These measures should include the informal sector as Kenya possesses a substantial informal economy that significantly contributes to employment generation (Federation of Kenya Employers, 2021). This increases the integration of existing structure and increases local value creation. Furthermore, capacity building is identified as an effective way to mitigate potential water stress due to overuse of solar water pumps. Nevertheless, this capacity building needs to be coupled with regulation in order to increase effectiveness. Furthermore, the policy brief entails concert examples which show possible policies of PUE in other countries which may serve as guidance of the implementation in Kenya. Lastly, incentives for the private sector should be provided to manage e-waste and solar products sustainability.

The NEECS shows that Kenya has made significant advances in the diffusion of PUE. As the PUE increases in significance in Kenya the policies need to adapt and address the emerging gaps. As these gaps in many cases address cross-cutting economic and cultural barriers we suggest an elaboration process of policies that includes all relevant ministries. The Ministry of Energy plays a central role and can therefore act as a coordinator to ensure the smooth integration of the policies and avoid contractionary policies.

3.2. E-mobility in Kenya

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3.2.1. Introduction

Kenya submitted an ambitious Nationally Determined Contribution (NDC) to the United Nations Framework Convention on Climate Change Secretariat (UNFCCC) that committed to

reducing GHG emissions by 32% by 2030. As one of the main contributors to emissions in the country, the transport sector is at the heart of the realization of this target. The National Climate Change Action Plan (NCCAP) 2018- 2022 and its successor 2023-2027 identify the uptake of electric vehicles (EVs) as one of the climate actions in the transport and energy sectors. Also, the Integrated Transport Policy (2024) promotes the adoption of e-mobility for transport services including supporting investments in modern vehicle technologies to reduce GHG emissions and noise, while also promoting the use of renewable fuels including promotion of green mobility. Equally, the National Energy Efficiency and Conservation Strategy (2020) envisions that by 2025, 5% of all registered vehicles in Kenya will be electric-powered. Similarly, the Long-Term Strategy (LTS) for GHG emissions reduction aims that the country should achieve net zero neutrality by 2050 and it targets Kenya's transition to e-mobility. The use of electric power to power transport locomotives, e-mobility, significantly reduces the emission of GHGs and hence addresses their attendant health and environmental consequences. The Kenyan grid capacity is sufficient to support e-mobility with its expanded generation capacity of a well-diversified mix with nearly 90% of the energy generated from renewable sources (i.e., geothermal, hydro and wind).

Under the SESA project, a barrier analysis for e-mobility in Kenya was conducted in 2023 under the first phase of the project. The barrier analysis report indicated various barriers within the PESTELA[1] framework used to classify the most predominant barriers that hinder development in the e-mobility segment. Such barriers were identified in close consultation with stakeholders as well as via literature review. From the barrier analysis (Painuly and Romero, 2023), it became evident that important barriers to e-mobility in Kenya included the following:

a) Lack of institutional capacity and governmental strategy to raise funds to scale up e-mobility,
b) High price of EVs, including high up-front costs and a lack of access to finance,
c) Affordability issue for a large part of the current fossil-fuel vehicle users,
d) Lack of charging infrastructure and EV-related technical skills,
e) Lack of EV-friendly regulations, and lastly,
f) A lack of awareness of EV benefits among potential users.

In the meantime, the Kenyan Government appointed an e-mobility Taskforce in March 2023 to drive the work on e-mobility policymaking for Kenya, and the Taskforce released an interim report (Taskforce, 2023) in November 2023 with its initial findings and recommendations. The focus of the interim report was on development of an enabling policy framework to promote EVs including promotion of local manufacturing and assembly. The stakeholder consultations carried out by the Taskforce also indicated various barriers to e-mobility in Kenya and proposed several suggestions on how to address them. More recently, in March 2024, the Taskforce came out with a Draft National e-mobility policy (Taskforce, 2024). The Taskforce had several private sector experts and Taskforce consulted a wide range of stakeholders from various government, private sector, academics, NGOs, experts etc. in formulating the draft e-mobility policy. Proposal for Steering Committee is one of the recommendations to ensure coordination between government and partners.

[1] As per the Barrier Analysis report done under SESA, PESTELA here refers to **Political and Institutional, Economic and Financial, Social and Cultural, Technical, and Infrastructural, Legal and Regulatory, and Awareness and Information barriers**.

Both reports were used to validate the findings of the barrier analysis and were also used in the development of policy framework for Kenya. Indeed, the original plan to develop an e-mobility policy framework to address the identified barriers by UNEP-CCC through a second round of stakeholder consultation was modified considering that the draft e-mobility policy had already been brought out by the government of Kenya. The objective itself was modified to pick up the draft e-mobility policy and examine its sufficiency to address the barriers from the stakeholders' perspective. The next section therefore describes the methodology used and data collected to examine the enabling framework embedded in the draft e-mobility policy and provides recommendations to strengthen the policies, where needed.

3.2.2. Data Collection

The methodology used for data collection, review and analysis included the following steps:
(i) Mapping of barriers with policies recommended by Taskforce: The barriers identified by UNEP-CCC in the first phase of the SESA project were mapped against the policies recommended by the Taskforce in the Draft e-mobility Policy, which had a broad mandate to create an enabling environment for the growth and adoption of electric vehicles in Kenya.

The policy mapping can be seen in Table 12 (columns 1 and 2), which also includes additional policies/ actions needed as per stakeholders that were consulted by UNEP-CCC, and institutional responsibilities to design and implement the policies.

(ii) Consultation with key stakeholders: From the mapping of recommended policies in the Draft e-mobility Policy it became evident that not all barriers may get addressed in the foreseeable future, and in many cases, the policies recommended were inadequate to address the previously identified barriers (this is indicated in the comment column of Table 11). Therefore, it was decided to conduct stakeholder interviews with experts and members of the Taskforce to get their input on adequacy of policies and further recommendations to strengthen the policies where the same were found inadequate. Stakeholders from various categories were identified which included policy makers, e-mobility solution providers, experts from academia and others, and consultations were done virtually via Microsoft Teams. The interviews were carried out during third and fourth week in May (21-27 May). A list of stakeholders with whom virtual meetings were held for consultations is given in Table 11.

Table 11: List of stakeholders consulted

Sl. No.	Organisation /Institution	Category of the stakeholder	Remarks
1.	State Department of Transport, Kenya	Government-Policymaker	n/a
2.	Ministry of Energy, Kenya	Government-Policymaker	Member Taskforce
3	BasiGo, Kenya	Service provider – Electric Buses	Private sector/Solution provider

4	WeTu, Kenya	Solution provider- e-two wheelers, solar-energy hubs providing power for other sectors incl. E-mobility, irrigation etc.	Social Enterprise (Private sector)
5	SEI, Kenya	Expert / research	Member Taskforce
6	GIZ, Kenya	Expert	International Organisation

The stakeholders were asked questions on policies suggested by the Taskforce in terms of their adequacy to address various barriers that were identified in SESA Phase 1 using the PESTELA framework - the same are attached as Annex 1. The questions were open-ended, and respondents were encouraged to provide their input freely. All interviews were recorded with their permission and findings from the same were integrated with the Draft Policies covered in Table 12 to come out with an Enabling Policy Framework for e-mobility in Kenya.

3.2.3. Enabling Policy Framework

An enabling policy framework was developed based on inputs provided by stakeholders for each type of barrier. It should be noted that the framework does not substitute but complements the Draft Policy framework developed by the Taskforce in Kenya. It indicates wherever policies need to be strengthened and/ or include more details. A summary of stakeholders' discussions on policies recommended by Taskforce, challenges and additional policies / steps needed is given below.

Policies to address political and institutional barriers: The Taskforce recommended establishing an e-mobility Steering Committee for overall coordination of Electric Mobility initiatives. According to a stakeholder, a dedicated secretariat or commission may be required to coordinate e-mobility efforts across various sectors, including rural, urban, public and private transport, two wheelers, three wheelers, cars, buses etc. Moreover, the Taskforce also recommended setting target timelines when all new vehicles registered will be required to be zero-emission vehicles (ZEVs) with different timelines for distinct categories of vehicles. Though this would indicate governmental commitment, stakeholders interviewed were of the view that quantified targets along with timeline need to be specified. One of the stakeholders was of the view that Kenya does not have the economic capacity to import new vehicles at the scale this commitment may require. Yet another stakeholder opined that the target for net zero emission vehicles (by 2050, assuming that it is coordinated with Kenya's commitment to net zero) is ambitious and requires significant financing and infrastructure. The Kenyan President also announced a duty-free window for 100,000 electric vehicles within three years, with 3,000 for government use (Musalia, 2024). Stakeholders pointed out that if implemented, this will require eliminating the import of second-hand vehicles that Kenya currently imports. Financing and infrastructure requirements for that also need to be considered and appropriate provisions made. A green fund for example could be established to support green financing for e-mobility. It would also require alignment with industrial policy on manufacturing and imports of EVs. Another barrier that falls under the "policy and institutional" barriers, as well as "legal and regulatory" barriers is the lack of capacity of the enforcing institutions towards EV deployment in the public transport sector, which needs to be addressed through their capacity building,

regulations and legal backing but that is first and foremost contingent on suitable policy backing from a top-down level in Kenya.
Lastly, the Taskforce also suggested prioritizing addition of EVs in government vehicle fleets with a minimum local content requirement. This is considered a good step to promote EVs.

Policies to address economic and financial barriers: High up-front cost is one of the major barriers for which regulatory framework for EV Asset financing has been recommended by Taskforce in addition to tax rebates and other incentives. The Taskforce has primarily recommended fiscal and non-fiscal incentives to manufacturers and assemblers to promote local manufacturing/ assembly, to promote charging infrastructure development, and to consumers to accelerate EV adoption. However, these activities may not address the issue of risk that financing institutions perceive in lending for e-mobility. Low interest loan programme to invest in EVs has been suggested by the Taskforce for businesses investing in EVs but in this case also cost will need to be borne by the government. A few of the solution providers are using innovative models such as Pay as you Go (BasiGo for buses), and leasing e-motorcycles (WeTU). However, the sustainability of these models may not be feasible at large scale due to their high capital requirements from solution providers.

The involvement of international finance institutions such as African Development Bank and World Bank could be considered for de-risking financing. Furthermore, Government support in the form of a green fund for mobility was suggested. Green financing available from international financing institutions/mechanisms, along with domestic financing, can also be helpful in reducing cost of loan, provide longer repayment terms, and thereby reduce perceived risks for banks. Exploring carbon market financing was also suggested by a stakeholder. One of the stakeholders also suggested public-private partnerships to meet high capital requirements of the EV adoption.

Lastly, a stakeholder also pointed out that the proposed taxes on batteries and eco-taxes in the finance bill in 2024 could negate the benefits of incentives.

Policies to address social and cultural barriers: The Taskforce has recommended targeted programmes for gender, youth, and others. It also includes incentives and e-mobility financing programmes for them.

Some suggestions by stakeholders included the need to raise awareness and behavioural changes to include women, youth, and people with disabilities into e-mobility. Education in science, technology, engineering, and maths (STEM) fields can also help include more women, and youth, and development partners can play a crucial role in building capacity and providing resources. Focus should be on involving these groups in the entire value chain, from training to business opportunities. On the user side, buses may also need to be designed to be inclusive for persons with disabilities.

It is relevant to flag that none of the stakeholders consulted spoke about the need of a structural and national-wide approach to removing social, cultural and gender barriers with regards to EVs, pointing to a lack of prioritization and top-down guidance on the subject.

Policies to address technical and infrastructure barriers: Skill development and the encouragement of local manufacturing and assembly has been prioritized by the Taskforce,

which provided several recommendations including e-mobility curriculum in TVETs/ universities to certificate programmes for technicians, and local content requirements in phased manner.

In the consultations, some stakeholders suggested partnerships with international organisations to support the capacity building efforts. Existing mechanics, often trained through apprenticeships, will need retraining. They may need to be supported through special programmes. Establishing a centre of excellence for e-mobility can support sustainable training and research.

To enhance feasibility of local assembly and manufacturing, explicit targets are needed along with phased approaches. Almost all stakeholders opined that competition from global players is the biggest challenge in this area. It was suggested that research and development institutions such as Strathmore University can play a key role in supporting local assembly and ensuring that capacity is retained in the country.

Charging Infrastructure: is one of the most important requirements for rolling out e-mobility and the Taskforce recommended measures such as setting targets for EV charging infrastructure, governmental facilitation for charging infrastructure in public spaces, and encouraging interoperability of EV charging systems and public charging stations. Building codes to facilitate charging was also suggested.

The stakeholders emphasised the need for a strong private sector and government partnership for development of charging infrastructure and clear policies on governmental land concessions for charging stations. All stakeholders mentioned that a clear policy on provision of land is crucial for development of charging infrastructure. Grants or results-based financing was also suggested to channelise investment in charging infrastructure. Standardization of charging system and infrastructure was also considered important.

Grid reliability and electricity tariff: These were considered as two other key areas for charging infrastructure development and the Taskforce recommended review and development of electricity tariff for EV charging. For grid reliability, the Taskforce recommended the development of a coordination framework between major players in the electricity sector (Generation, Transmission and Distribution).

The stakeholders also indicated the need for special (lower) electricity tariffs for EVs. Designing specific (low) tariffs for EV charging during off-peak hours was suggested as a potential solution. One of the stakeholders pointed out that recommendations for subsidizing electricity tariffs for EVs have already been there but no progress has been made on implementation so far.

Grid reliability was considered a significant challenge by stakeholders, particularly outside Nairobi and in rural areas. Grid connectivity in rural areas is an issue due to low level of electrification in Kenya, and other issues include distribution and frequent outages. Power production is not an issue, but transmission lines are not able to support the amount of power, which is passing through them according to a stakeholder, leading to power cuts. And when a transformer breaks down, it can take weeks to get it repaired. Thus, though off-peak power may work out as a solution in cities, it is not a solution for other areas. Increasing grid capacity

to manage power load is therefore important. Additionally, decentralized renewable energy solutions, such as mini grids, have been proposed as alternatives.

Policies to address environmental barriers: Disposal of battery and other environmentally polluting substances from EV operations requires appropriate regulations. The Taskforce recommended establishing of end-of-life disposal methods for EVs in compliance with other existing policies.

In addition to above, the stakeholders suggested repurposing batteries for solar home systems and mini grids, as well as other usages such as in fisheries. This could be done via two possible ways: 1. EV batteries could be repurposed and combined with solar-powered fishing lamps. During the day the solar panels charge the batteries and at night the stored energy powers LED fishing lamps; 2. Portable battery-powered lamps could be developed that fishermen can carry for work. These lamps could use repurposed EV batteries and provide illumination during nighttime fishing trips).

Returning used batteries to manufacturers for discounts was also suggested to ensure safe disposal. One of the challenges includes managing batteries with different efficiency levels. Setting up recycling plants for batteries was suggested with incentives for companies managing battery waste. One of the stakeholders pointed out that informal recycling of batteries is common but lacks regulation. Taskforce recommendations primarily included support for local battery manufacturing, recycling and repurposing, and R&D initiative in this area.

Policies to address legal and regulatory barriers: The need for development of a comprehensive legal and regulatory framework, including standards, is implicit in various policy recommendations discussed above. The Taskforce reiterated the need for regulation in areas such as EV asset financing, incentives, minimum local content requirement for EVs, certification programmes, building codes for charging, safety regulations, end-of-life disposal methods for batteries, vehicle emission standards and so on. The stakeholders also confirmed this.

An area of interest where regulation can help adopt e-mobility is ***public transport.*** The Taskforce recommended developing a framework for adoption of EVs for mass transport and grants or subsidies to public service transport players who acquire high capacity EVs for passenger transportation. A phased approach with defined timelines was suggested. A financing and insurance mechanism could also be developed to incentivize the transition of current public transport vehicles from ICEVs to EVs.

EV adoption for mass transit is capital intensive and requires clear roles for government and private sector, as pointed out by a stakeholder. Public-private partnerships were suggested as a viable solution. One of the stakeholders pointed out a lack of capacity of the enforcing institutions, which needs to be addressed through their capacity building.

Policies to address awareness and information barriers: The Taskforce recommended developing targeted programs for creation of public awareness on e-mobility's benefits, cost savings, and environmental advantages. Low awareness about electric vehicles and their benefits was also considered a challenge by the stakeholders, who supported the proposal of targeted awareness programmes.

A summary of Taskforce recommendations and stakeholders' suggestion on additional policies /actions is presented in Table 12.

Table 12: Enabling Policy Framework for e-mobility in Kenya

Name of the Policy Measure	Barrier	Policy measures/ actions proposed by Taskforce	Responsible Institution[2]	Additional policies/ actions needed as per discussions with stakeholders
Policies to overcome institutional and political barriers.	**Political and Institutional** • Political commitment in terms of targets, timelines, and resource allocation • Institutional mechanism (including coordination) and capacity, allocation of responsibilities,	• Establish an Electric Mobility Steering Committee with relevant ministries and agencies. • Set target with timelines when all new vehicles registered will be required to be zero-emission vehicles. • Integrate charging infrastructure with transport planning	Ministry of Roads and Transport Ministry of Energy	• In addition to Steering Committee, set-up a dedicated secretariat or commission to coordinate e-mobility efforts across various sectors. • Set quantified targets along with timeline for each category of vehicles need to be specified for net zero.
Policies to overcome high upfront costs of EVs, sub-optimal market development, sub-optimal business models around EVs, high import duties, lack of financial and incentives.	**Economic and Financial** • High price of EVs resulting in high PBP (for end user) and IRR (for business) • Uncompetitive with existing mobility solution • A lack of market development • A lack of appropriate	• Conduct demand assessment for EVs. • Develop a regulatory framework for EV Asset Financing • A financing and insurance mechanism to incentivise public transport switch to EVs. • Provide tax incentives for EV parts (import duty,	Ministry of Roads and Transport The National Treasury and Economic Planning	• Involve international development finance institutions to de-risk financing. • Establish a green fund to support e-mobility. • Access green financing available from international financing institutions / mechanisms to reduce cost of loan and

[2] Suggested, primarily at the ministry level. Some directly relevant agencies have been added. More can be added by the ministries.

	business models • High upfront cost, a lack of access to credit, excessive cost of credit • A lack of adequate incentives. • High import and excise duties	excise duty and VAT reductions), on built EVs (initially), and on locally built EVs. • Provide incentives for developing charging infrastructure to businesses and property owners. • Misc: Provide stamp duty waiver for charging infrastructure, registration tax waiver-on EVs. • Develop low interest loan programme for businesses investing in EVs		reduce risk for domestic financing. • Explore carbon market financing
Policies to overcome social inclusion and equality barriers	**Social and Cultural** • Affordability for minorities • Gender equality and inclusion • Social biases	• Develop targeted programme for gender, youth, and handicapped for inclusion in EV related economic activities. • Develop incentive mechanisms to employ women, youth, and handicapped. • Develop affordable e-mobility financing programmes for women, youth, and handicapped	Ministry of Public Service, Gender and Affirmative Action Ministry of Roads and Transport National Gender and Equality Commission	• Conduct awareness programmes for behavioural change. • Facilitate entry of women and disabled in the STEM education area.
Policies to overcome limited	**Technology and Infrastructure**	• Certification programmes for technicians	Ministry of Trade,	• Partner with international organisations

technological infrastructure development barriers	• A lack of skills to operate and maintain e-mobility technology. • A lack of local supply chain and spare parts • Driving range • A lack of charging infrastructure and related regulations • Grid reliability and connectivity (in rural areas) issues.	• EV codes and standards • Building codes to accommodate EV charging. • Local content requirements in phased manner • Support for local manufacturing batteries and EV parts. • E-mobility curriculum / modules for TVETs/ Universities • User training mandatory for suppliers • ZEV sales targets for automakers for incentives • EVs in Government vehicle fleet with a minimum local content requirement • Targets for EV charging infrastructure and government facilitation. • Encourage interoperability of EV charging systems and interoperability of public charging stations • National government and County governments will facilitate installation of charging	Investments and Industry Ministry of Co-operatives and Micro, Small and Medium Enterprises (MSME) Development Kenya Bureau of Standards Technical and Vocational Education and Training Authority Energy and Petroleum Regulatory Authority (EPRA)	to support the capacity building efforts. • Organise re-training of the existing mechanics. • Establish a centre of excellence for e-mobility to conduct training and research. • Establish targets for increased local content in manufacturing and localization of assembly of EVs in a phased manner. • Involve research and development institutions to support localization. • Establish public-private partnerships to meet high capital requirements of the EV adoption. • Bring out clear policies on governmental land concessions for charging stations. • Explore grants or results-based financing was also suggested to channelise investment in

		infrastructure in public spaces. Develop coordination framework between major players in the electricity sector (Generation, Transmission and Distribution) to improve electrification and reliability		charging infrastructure. • Strengthen grid capacity to manage current and projected power load. • Promote decentralized renewable energy solutions. • Explore and establish low tariffs for EV charging during off-peak hours • Short, medium terms
Policies to address toxic and pollutant waste hazard	**Environmental** • Disposal of hazardous waste (batteries)	• Residual battery life requirement for imported EVs. • End of life disposal methods	National Environmental Management Authority	• Explore and repurpose batteries for solar home systems, mini-grids, and other uses-fisheries etc. • Promote returning used batteries to manufacturers for discounts. • Explore and set up recycling plants for batteries.
Policies to address non-existing/sub-optimal laws and regulations on EVs	**Legal and Regulatory** • A lack of adequate policy • E-mobility unfriendly laws • A lack of building codes for charging • A lack of electricity tariff regulation for EVs	• Develop a countrywide framework for adoption of electric mass transport system. • Vehicle emission standards • Safety regulations • Review, develop and implement electricity tariff for EVs	Ministry of Roads Transport Kenya Bureau of Standards National Transport and Safety Authority Ministry of Energy	• Develop a plan with phased approach and defined timelines to transition public transport to EVs • Develop a financing and insurance mechanism to incentivize transition of public transport

				vehicles from ICEVs to EVs.
Policies to address a better understanding toward EVs among users, funders, and the wide community.	**Awareness and Information** • A lack of awareness about e-mobility and its benefits • A lack of information on government programmes among users • A lack of demonstration pilots	• Targeted public awareness programme on EVs involving mixture of government and civil society.	Ministry of Roads and Transport Ministry of Information, Communications and The Digital Economy	China's rapid economic growth over the past few decades has resulted in a substantial expansion of the country's middle class. This demographic is becoming increasingly aware of the environmental impact of their consumption habits and is seeking out eco-friendly and sustainable products for everyday use. This trend is now extending to EVs, which are increasingly viewed not only as a status symbol but also as an expression of environmental responsibility. Following the 20th National Congress's call for green consumption and the inclusion of EV charging infrastructure in the latest Five-Year Plan, sustainability is becoming a key factor in consumer choices, with many willing to pay a premium for green products.

3.2.4. Guidance for Policy Roadmap Development

In this section, we turn our focus to the implementation of the policies listed under Table 12 and add a timeframe for their activities under the short, medium and long term. For reference, short term is understood as immediate (from now until the next 3 years), medium term is understood to cover a 3–10-year period, while long-term refers to policies that should be ensured/implemented 10 years from now and beyond. The policy-specific suggested timelines are given in Table 13.

Table 13: Policy-specific activities and timelines

Policy Measure	Short-term policies / measures	Medium-term policies/ measures	Long-term policies/ measures
Political and institutional policies / measures • Set –up institutional coordination mechanisms. • Set-up targets with timelines, resource allocations and institutional responsibility to show political commitment. • Develop a framework for transition of public transportation to EVs. • Integrate charging infrastructure with transport planning	**Coordination mechanism for policy formulation and implementation** • Establish an Electric Mobility Steering Committee with relevant ministries and agencies. • In addition to Steering Committee, set-up a dedicated Secretariat or Commission to coordinate e-mobility efforts across various sectors	Review coordination mechanisms and strengthen, if needed	n/a
	Set up target along with timelines, resource allocation and institutional responsibilities for introduction of all type of EVs (Note that EVs may not be fully zero emission as of now but need to be introduced considering future potential)	Review and update the target for EVs and set targets for all new vehicles to be zero emission. Review resource allocations and institutional responsibilities, and strengthen, if needed.	n/a
	Public transport transition to EVs • Develop a framework for transition of public transportation to EVs and implement. • Develop a financing and insurance mechanism to incentivise public transport switch to EVs	Review implementation and take corrective action, if needed	n/a
	Develop charging infrastructure plan and targets	Integrate charging infrastructure with transport planning	n/a

Economic and financial policies / measures	Develop a Regulatory framework for EV Asset Financing to address the issue of access to finance, and implement	Review performance of the EV Asset Financing regulation and take corrective measures	n/a
	Promote and roll out tax incentives for EV parts (import duty, excise duty and vat reductions, registration tax waiver. etc.), on built EVs, and on locally built EVs (to address the issue of excessive cost of EVs)	Review tax incentive policy; modify if required, and continue	Incentives could be reduced or eliminated for imports based on review, but continued for local manufacturing as per need.
	Establish mechanism for low interest loan programme for customers as well as businesses investing in EVs (to address issue of excessive cost of finance)	Review and modify loan programmes, if needed	n/a
	Develop incentive mechanisms for businesses and property owners) to establish charging infrastructure (including stamp duty waiver and others to address issue of excessive cost of infrastructure)	Review and modify incentive mechanisms for charging infrastructure, if needed	n/a
	Develop and implement low electricity tariffs for EV charging during off-peak hours	Review and implement low off-peak electricity tariff for EVs	n/a
	Involve international development finance institutions to de-risk financing EVs by financial institutions	Establish a green fund to support e-mobility.	n/a
	Explore accessing green financing available from international financing institutions / mechanisms. to reduce cost of loan and reduce risk for domestic financing	Access green financing and explore carbon market financing	n/a
Policies/ measures to address affordability, gender equality and inclusion issues	Develop affordable e-mobility financing programmes for women, youth, and handicapped	Review and implement nation-wide affordable e-mobility financing programmes for women, youth, and handicapped	Review and implement nation-wide affordable e-mobility financing programmes for women, youth, and handicapped
	Develop incentive mechanisms to employ women, youth, and persons with disabilities in the EV related sectors Develop incentive mechanism for woman, youth, and	Review and implement incentive mechanisms to employ women, youth, and handicapped Review and implement incentive mechanism	Review and implement incentive mechanisms to employ women, youth, and handicapped

	persons with disabilities – founded startups in the e-mobility sector		Review and implement incentive mechanisms with modifications, if needed.
	Develop targeted programme for gender, youth, and handicapped for inclusion in other EV related economic activities	Review and implement the targeted programme for gender, youth, and handicapped for inclusion in EV related economic activities	Review and implement the targeted programme for gender, youth, and handicapped for inclusion in EV related economic activities
	Conduct awareness programmes to inspire behavioural change for support to gender and inclusiveness programmes	• Continue awareness programmes. • Facilitate entry of women and disabled in the STEM education area	Review and implement entry facilitation of women and disabled in the STEM education area
	Codes and standards • Develop EV codes and standards. • Develop framework for the interoperability of EV charging systems and public charging stations through development of appropriate standards. • Develop Building codes to accommodate EV charging	Ensure the implementation EV codes and standards.	n/a
	Skill development • Institutionalize the implementation of e-mobility curriculum / modules in TVETs/ Universities • Partner with international organisations to support the skill building efforts. • Develop certification programmes for technicians. • Mandate user training by suppliers of EV equipment. • Organise re-training of the existing mechanics to suit EV	Review skill development programmes and take corrective action, if required	n/a

	technology requirements. • Establish a centre of excellence for e-mobility to conduct training and research		
	Promotion of local manufacturing • Bring regulation for local content requirements and localization of assembly in a phased manner. • Mandate EVs in Government vehicle fleet with a minimum local content requirement. • Provide support for local manufacturing of batteries and EV parts. • Involve research and development institutions to support localization. (Note: These measures are in addition to financial incentives already covered)	Review the progress of localization policies and take corrective action, if needed	n/a
	Charging infrastructure facilitation • Bring out clear policies on governmental land concessions for charging stations. • National government and County governments to facilitate installation of charging infrastructure in public spaces. • Explore grants or results-based financing was also suggested to channelise investment in charging infrastructure. • Establish public-private partnerships to meet high capital requirements of the charging stations /EV adoption	Review development of charging infrastructure vis-à-vis target (plan) and take corrective action, if needed	n/a
	Grid reliability.	Review progress and strengthen grid, if needed.	n/a

	• Develop coordination framework between major players in the electricity sector (Generation, Transmission and Distribution) to improve electrification and reliability. • Strengthen grid capacity to manage current and projected power load. • Promote decentralized renewable energy solutions		
Policies to address environmental barriers	Develop regulations for residual battery life requirement for imported EVs		n/a
	Develop regulations for end-of-life disposal methods and implement	Review progress, and resolve issues, if any	n/a
	Recycling batteries • Explore and repurpose batteries for solar home systems, mini-grids, and other uses-fisheries. • Promote returning used batteries to manufacturers for discounts. • Explore and set up recycling plants for batteries	Review progress and provide support to repurpose batteries, if needed	n/a
Legal and regulatory policies/ measures (Various other policies in this column also require regulatory measures. This row covers those not included elsewhere).	Develop a countrywide framework for adoption of electric mass transport system	Implement a countrywide framework for adoption of electric mass transport system	Implement a countrywide framework for adoption of electric mass transport system
	Develop Vehicle emission standards and implement	Review and implement vehicle emission standards	n/a
	Develop Safety regulations and implement	Review and implement safety regulations	n/a
Awareness and information policy / measure	Develop targeted public awareness programme on EVs	Implement and periodically review targeted public awareness programme on EVs	Implement and periodically review targeted public awareness programme on EVs

3.2.5. Policy Briefs on Good Practices

Country Context:

Kenya's transport sector is key in the context of the country's decarbonization and ambition under the Paris Agreement. Kenya's NDC makes provision for a reduction of GHG emissions of 32% by 2030, and while efforts to electrify the country's transport sector can be a solution to decrease emissions, it offers a series of co-benefits (e.g., decreased air and noise pollution, job creation and income generation via the e-mobility sector, particularly to SMEs and other e-solution providers, among others) to a growing and rapidly urbanizing country (UN Habitat, 2023).

To promote the further scaling of E-mobility Kenya, it is important that existing barriers are overcome by implementing corresponding policies. In the Barrier Analysis, predominant barriers to E-mobility were identified and categorized. The Policy Roadmap further addresses the previously identified barriers and provided concrete policy suggestions to overcome each of the main barriers. Suggestions were made after a second round of stakeholder consultation with key stakeholders in Kenya and in the context of recent policy developments in Kenya's E-mobility policy arena (i.e., the developments related to the creation of a government mandated Taskforce for E-mobility, which seeks to address, lift barriers, and positively influence the policy landscape on EVs in the country). The policy suggested under the Policy Roadmap included suggestions for policy design, incumbent institution(s) and a proposed implementation timeline (i.e., short, medium and long-term).

The policies presented in this brief constitute of examples from other countries that can further inspire the ongoing discussions in Kenya related to key policies barriers that need to be fully overcome in order to support a consistent and efficient shift to EVs.

Good practice policies

To supplement the analytical work related to the policy roadmap for E-mobility in Kenya, good practice examples on existing E-mobility policies have been identified. The examples provide details on two policies, one on "Incentivization of Local Assembly Lines of EVs in Brazil" and the other on "Accelerating the Construction of Electric Vehicle Charging Infrastructure in China". While the selected examples can be useful in providing context for viable ways to scale e-mobility elsewhere in the world, it is important to consider that policies applied to the Kenyan context must be uniquely designed to accommodate Kenya's current policy context, stakeholders in the sector as well as existing barriers. As such, the best practices identified in this policy brief, are merely examples that can inspire policy work in the Kenyan context.

Best practice example 1: Table 14 shows the Mover Programme, incentivizing, among other things, local assembly lines in Brazil as a policy option to address barriers to local production of EVs.

Table 14: Mover Programme, incentivizing, among other things, local assembly lines in Brazil.

Policy type	Mover Programme, incentivizing, among other things, local assembly lines in Brazil. (Law Nº 14.902).
Location of implementation	Brazil

Background / state at the outset	While Brazil has a well-established and continuously growing bio-fuels sector, the country focus on scaling EV adoption has been slow and hindered by several barriers over the last decade (Climate Transparency, 2020). Many of the EV barriers faced by Brazil and akin to those faced by Kenya, particularly related to policies to incentivize local assembly and make the industry attractive for local stakeholders.
Policy description	The policy under Mover, (which stands for "Programa Mobilidade Verde e Inovação"in Portuguese and translates to "Green Mobility and Innovation Programm" in English), was put forward by Brazil's Ministry of Development, Industry, Trade and Services (MDIC) and was signed by Presidential decree in 2023. This policy aims to promote the expansion of investments in energy efficiency, include minimum recycling limits in the manufacture of vehicles and charge less tax to those who pollute less, creating the Industrialized Products Tax (IPI), also known as "Green IPI" (IPI Verde, in Portuguese). The tax incentive for companies to invest in decarbonization and meet the program's mandatory requirements will be BRL 3.5 billion in 2024, BRL 3.8 billion in 2025, BRL 3.9 billion in 2026 BRL 4 billion in 2027 and BRL 4.1 billion in 2028, which will have to be converted into financial credits. In the end, it is expected that the program will grant more than BRL 19 billion in credits (G1, 2024) The Provisional Measure under Mover particularly encourages the relocation of EV industrial plants from other countries to Brazil. These companies will receive a financial credit equivalent to the import tax levied on the transfer of production cells and equipment. In addition, they will also receive rebates on Corporate Income Tax and Social Contribution on Net Profits, relating to the export of products and systems produced in Brazil (Government of Brazil, 2024).
Outcomes	So far, 89 companies from nine states of Brazil have been qualified for the program. Of these, 70 are for plants that already produce auto parts; 10 for light vehicles; six for heavy vehicles in Brazil; two are for R&D services; and one is for a project to relocate an FCA Fiat Chrysler engine plant from another country, with an expected investment of R$ 454 million and the creation of 600 direct jobs (Government of Brazil, 2024).
Success factors	The policy is relatively new but bears the promise of addressing significant barriers of EVs in the Brazilian context, especially with regards to incentivizing large international vehicle companies to shift production to Brazil. Moreover, the policy provides a solid political backdrop to support the green and just transition in Brazil's transport sector. While the policy is new, it is expected to continue to yield positive results Indeed, to avoid the hefty import taxes, some Chinese car companies began to shift some production capacity to Brazil, thus mobilizing and creating the infrastructure for local assembly and capacity development in the country. BYD, a major Chinese EV manufacturer, has started construction of a large production base in northeast of Brazil, with the new factory expected to start operating by the end of 2024 or early 2025. Great Wall Motors, another private Chinese EV manufacturer, announced last year that its factory in São Paulo state, is scheduled to begin operations in the second half of 2024.

Best practice example 2: Table 15 shows the Guidance on Accelerating the Construction of Electric Vehicle Charging Infrastructure in China as the policy option to address the barriers creation of charging infrastructure for EVs.

Table 15: Guidance on Accelerating the Construction of Electric Vehicle Charging Infrastructure in China

Policy type	Political (target setting) and technical (standards) policies
Location of implementation	China
Background / state at the outset	The development of the electric vehicle charging infrastructure is crucial for the large-scale deployment of the EVs. In 2015, when policy was announced, it was found that the charging infrastructure was unable to meet the demand. According to the New Energy Vehicle Industry Development Plan (2021–2035), by 2025, the number of new energy vehicles sold in China will account for a quarter of the overall number of vehicles sold. By 2030, EVs will be mainly sold. The development of charging infrastructure was therefore important for which policy support was needed. The State Council of China therefore brought the guideline to systematically improve the charging infrastructure of electric vehicles (EV) and to promote the healthy and rapid development of the EV industry.
Policy description	Construction of more than 12000 new centralised charging and battery replacement stations. More than 4.8 million decentralised charging stations to be added by 2020, effectively meeting the charging demands of 5 million new energy vehicles. The target was to ensure a balanced vehicle-to-charger ratio of 1:1.
Outcomes	Though the vehicle-to-charger ratio did not reach 1:1, at the end of 2022, the total number of charging infrastructure in China reached 5.21 million units, reflecting a significant year-on-year increase of nearly 100 percent. This includes 650,000 units of public charging infrastructure, resulting in a cumulative total of 1.8 million units, as well as around 1.9 million units of private charging infrastructure, reaching a cumulative total of over 3.4 million units. By 2023, the projected number of EV chargers is expected to reach 9.58 million units, representing an impressive growth rate of approximately 84 percent. This significant upward trend underscores the immense potential and opportunities within the EV charger industry.
Success factors	Government support and a robust policy framework led to the development of EV charging infrastructure. The policies, besides setting the targets included; Promote the strategic planning and rapid construction of charging stations, with financial support for public station development. Coordinate the installation and upgrading of charging stations in residential communities. Optimize the overall infrastructure layout, ensuring the synchronized development of vehicles and charging stations. Implement pilot projects for innovative charging and battery swapping stations that integrate solar power, energy storage, and charging. Enhance the development of supporting facilities, including parking lots, charging stations, battery swapping stations, and hydrogen refuelling stations.

Source: IEA50; Taskforce (2023); China Briefing (2023)

3.2.6. Summarising Remarks

The Taskforce appointed by the Kenya Government released a Draft National E-mobility Policy Report in March 2024. This document addressed a number of barriers to e-mobility in Kenya, many of them previously highlighted by the SESA project. However, some of the barriers identified in the Phase 1 under SESA, had not been fully addressed in the Draft Policy

prepared by the Taskforce. Stakeholder consultations were carried out to elicit their views on additional policy measures needed to address the identified barriers fully, as well as indicate challenges and support requirements in implementation of policies. The policy roadmap in Table 3 was prepared based on the policy recommendations by the Taskforce and inputs provided by the stakeholders.

A holistic strategy is needed to ensure a sustainable transition to electric mobility, encompassing several key measures across different areas. Politically, a Steering Committee should be established for high-level coordination, supported by a Secretariat to manage multiple stakeholders. Clear EV adoption targets must be set, frameworks for public transport EVs initiated, and charging infrastructure planning integrated.
On the economic front, regulations for EV asset financing need to be implemented, along with tax incentives and low-interest loans for businesses and customers. Incentives for charging infrastructure should be introduced, with schemes refined over time and access to international green financing. In the long term, import incentives can be phased out while supporting local manufacturing and developing charging infrastructure.
Socially, affordable financing options should be created for marginalized groups, along with promoting their employment in the EV sector and conducting awareness campaigns on inclusivity. Technical advancements require skill development through TVETs and universities, the establishment of EV standards, interoperability frameworks, and promotion of local assembly and manufacturing. Grid capacity needs to be strengthened, and decentralized solutions explored to support e-mobility.
Environmentally, battery disposal regulations must be set up, alongside promoting recycling and repurposing EV batteries for other uses, such as solar home systems. Legally, regulatory frameworks will be necessary for various policies, including low off-peak electricity tariffs and transitioning public transport to EVs.
Finally, awareness campaigns are crucial to educate the public on the benefits of electric vehicles. Together, these measures will provide the foundation for a sustainable transition to electric mobility.

3.3. Clean Cooking in Malawi

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3.3.1. Introduction

The barrier analysis undertaken in respect to deployment and adoption of clean cooking technologies and fuels in Malawi provided a comprehensive perspective on the key issues limiting broader diffusion and uptake of clean cooking technologies and fuels in the country. This analysis placed a strong but non-exclusive focus on the deployment of improved cookstoves (ICS) in rural geographies in Malawi.
This policy roadmap builds on the barrier analysis and derives its structure and specific recommendations from the PESTELA (Political, Economic, Social, Technological, Environmental, Legal and Awareness and capacity) framework utilised and explored in the barrier analysis. The following barriers were identified as focus areas for the policy roadmap.

- Insufficient finance for manufacturers, distributers and other actors in the clean cooking value chain;

- Large proportion of the potential cookstove market is un-bankable with limited alternative consumer financing available;
- Weaknesses in minimum standards and quality testing leading to lack of market stability and confidence;
- Inconsistent local production capabilities required to overcome unfavourable unit economics for hard-to-reach rural markets;
- Limited maintenance services for clean cooking technology;
- Sub-optimal institutional coordination and awareness, horizontally and vertically across government;
- Insufficient public facing awareness raising campaigns, including those considering the integration of early adopters as clean cooking transition champions.

The approach to the development of this policy roadmap builds on this barrier analysis and addresses two critical questions in developing a policy framework and roadmap to overcome deployment barriers for clean cooking in Malawi. Firstly, the chapter identifies priority policies essential for overcoming barriers and fostering an enabling environment. This involves naming each policy measure, specifying the addressed barrier, detailing the proposed policy design elements, and identifying appropriate governmental bodies responsible for implementation. Secondly, the chapter presents a strategy for the organisation of activities across short-, medium-, and long-term horizons to construct a coherent policy roadmap. This structured approach ensures that policies are not only targeted and actionable but also adaptable to evolving needs and challenges, fostering effective implementation and long-term success.
In order to adequately and compellingly address the wide scope of clean cooking technology and fuel options applicable to the Malawi context (both urban and rural), the approach to the development of this policy roadmap included a consideration of terms currently used in clean cooking discourse. The following International Energy Agency (2023) definition encompasses the scope of clean cooking technologies and fuels addressed by this policy roadmap.

"Cooking solutions that release less harmful pollutants, are more efficient and environmentally sustainable than traditional cooking options that make use of solid biomass (such as a three-stone fire), coal or kerosene. This refers to improved cook stoves, biogas/biodigester systems, electric stoves, liquefied petroleum gas, natural gas or ethanol stoves." (International Energy Agency, 2023)
In addition to the above definition, in line the ICS focus of the barrier analysis, and in respect to the Government of Malawi's strategy to phase out open fires through universal access to transitional, efficient wood stoves (Government of Malawi, 2021c), this policy roadmap necessarily extends the definition of clean cooking to include cookstove technologies which may not meet established ICS definitions (International Energy Agency, 2023) but which represent a demand side management (DSM) energy efficiency intervention.

Key Information on Current State of Clean Cooking Access in Malawi
Malawi's National Energy Policy 2018 addresses the unsustainable production and use of biomass as an energy source that accounts for 80% of the country's energy balance. (Government of Malawi, 2018) Malawi's National Energy Policy 2018 also address the issue of cleaner cooking through the prioritisation of liquified petroleum gas (LPG) as a domestic energy source, as well as from the perspective of DSM. (Government of Malawi, 2018).
In respect to household and institutional clean cooking services specifically, biomass was estimated to account for 90% of the fuel mix in urban settings, and 98% in rural settings. (World Bank, 2023c) Despite close to half of urban households having a grid connection, only 2% are estimated to use electricity as a primary means of cooking. (Republic of Malawi, 2024) The

country is nevertheless a leader among lessor developed countries (LDCs) in actively championing SDG-7 and has established public and private institutional arrangements aiming to coordinate actions promoting clean cooking. (Coley & Galloway, n.d.) An example is Malawi's National Clean Cooking Steering Committee (NCCSC), chaired by the Ministry of Energy (MoE) and reporting to the National Planning Commission (NPC).

Malawi has a low level of urban population relative to regional neighbours (18%) - Tanzania (37%), Zambia (46%) Zimbabwe (33%) – its annual urban population growth (4.2%) remains higher than average for least developed countries. (World Bank, 2023) The country's rural population currently makes up an estimated 82% of its total population, but the country is noted for exhibiting one of the highest annual urban population growth rates in the world at 4.2%. (World Bank, 2023a; World Bank, 2023b) Given current annual growth rates the proportion of the country's population residing in urban areas is expected to be in the region of 30% by 2023 and 50% by 2050. (Republic of Malawi, 2019) This presents a long-term challenge in simultaneously addressing the significant use of unsustainable biomass in both rural hard to reach markets and urban areas.

Notable in Malawi's clean cooking policy space is the Ministry of Energy's Cleaner Cooking Energy Compact (2021). This document builds on the National Energy Policy (2018), and addresses cleaner cooking ambitions from the perspective of Sustainable Development Goal 7 (SDG7) ambitions. (Government of Malawi, 2023c) Ambitions contained within the Cleaner Cooking Energy Compact differentiate between rural and urban contexts. In the case of the rural context the ambition is the phasing out of open fires through universal access to transitional, efficient wood stoves. This level of widespread adoption of energy efficient improved cookstoves is associated with its potential to reduce rates of deforestation and greenhouse gas (GHG) emissions, as well as its ability to deliver associated economic, and timesaving impacts at household and institutional level. For the urban context the Compact aims to reduce the share of unsustainably produced charcoal, and support the transition to other sustainably produced fuels. (Government of Malawi, 2021c)

Malawi's Nationally Determined Contributions (NDCs) submitted in 2021 state that "up-scaled adoption of alternatives energy to biomass for cooking and heating" is a national need with respect to actions for climate change adaptation. (Republic of Malawi, 2021a) Documented measures in the country's 2021 updated NDCs include reducing the emissions of GHG originating from the production and consumption of cooking fuels. This includes the promotion of efficient charcoal production making use of improved kilns, as well as continued support towards the usage and increased uptake of improved charcoal and firewood cookstoves. The countries NDC targets in respect to clean cooking are therefore, and by design, in alignment with the Malawi SDG 7 Cleaner Cooking Energy Compact. The approach taken by Malawi's NDCs assumes efficiency related GHG emissions reductions and resultant preservation of carbon sinks through the adoption of DSM measures in the form of largescale adoption of improved efficient cookstoves. (Republic of Malawi, 2021a)

The stabilisation of the Malawian national electricity grid, predominantly supplied by renewable generation (75%) (IRENA, 2023); the countries ambitious national electrification targets contained within the Malawi 2063 First 10-Year Implementation Plan (MIP-1) (Republic of Malawi, 2021b); as well as the recent launch of Malawi's eCooking Roadmap (Republic of Malawi, 2024), signal that the country will focus on additional actions increasing the use of eCooking as the least-cost technology and fuel mix for clean cooking in the long term. Assessments modelling the positive relationship between increased electricity demand and enhanced revenue streams to the national utility likely contribute to this focus. Similar to the urban focused approach taken by government in respect to enabling the market to adopt liquified petroleum gas (LPG), the promotion on eCooking is likely to focus on urban households and institutions.

3.3.2. Data Collection

This policy roadmap is informed by desktop research and stakeholder and expert interviews conducted during March and April 2024. These semi-structured interviews were conducted following similar work undertaken for the preceding barrier analysis which in and of itself directed the investigation of this roadmap. The relation of the interviewed stakeholders can be found in the table below. A variety of primary and secondary written sources were reviewed including national level policies, strategic documents, as well as scholarly articles.

Table 16: Interviewees

Name	Institution	Stakeholder group represented
Confidential	Ministry of Energy	Policy Maker
Confidential	Ministry of Natural Resources and Climate Change	Policy Maker
Confidential	Ministry of Natural Resources and Climate Change	Policy Maker
Confidential	Mzuzu University	Expert from Academia
Confidential	Leading commercial business involved in the sale and distribution of improved cookstoves.	Private Sector
Confidential	Leading commercial business involved in the development, sale and distribution of biogas.	Private Sector
Confidential	Centre for Community Organisation and Development (CCODEMalawi)	Civil Society

3.3.3. Enabling Policy Framework

Based on the identified barriers in the barrier analyses as well as desk research and expert interviews conducted as part of this analysis, the following policies are advisable and should be examined by policymakers for implementation.

Table 17: Policies to overcome Political and Institutional barriers to market deployment of Clean Cookstoves in Malawi

Name of the Policy Measure	Barrier addressed	Policy design details	Responsible Institutions	Remarks
Multi-Level Governance Coordination Initiative[3]	Sub-optimal institutional coordination and awareness, horizontally and vertically across government. A clean cooking focal points initiative would address the critical barrier of low capacity within the public sector regarding clean cooking solutions. By nominating focal points within key ministries and agencies	Nominate clean cooking focal points within key ministries and agencies, including Energy, Natural Resources and Climate Change, Health, Finance, Gender Community Development and Social Welfare, as well as relevant stakeholders like MERA, MBS, ESCOM, and other government departments.	Ministry of Energy (MoE), Ministry of Natural Resources and Climate Change (MNRCC) , National Cookstove Steering Committee (NCSC)	n/a

[3] Note that this recommendation mirrors the Clean Cooking Focal Points imitative noted in the Malawi eCooking Roadmap (2024)

	and providing them with specialised training, the initiative aims to build institutional capacity and foster cross-sectoral collaboration to promote clean cooking.	Provide specialised training to enhance knowledge and skills on clean cooking technologies, including eCooking. Build capacity of focal points and their respective ministries/agencies to understand and address clean cooking issues comprehensively. Embed clean cooking in the agendas of various ministries to promote cross-sectoral collaboration.		

Table 18: Policies to overcome Economic and Financial barriers to market deployment of Clean Cookstoves in Malawi

Name of the Policy Measure	**Barrier addressed**	**Policy design details**	**Responsible Institutions**	**Remarks**
Access to Finance for Limited access to finance for Small and Medium Enterprises (SMEs)in Clean Cooking Sector	Insufficient finance for manufacturers, distributers and other actors in the clean cooking value chain. Inconsistent local production capabilities required to overcome unfavourable unit economics for distant rural markets; SMEs involved in the provision of clean cooking technology and fuels, constraining their scale-up potential. The policy measure aims to address the limited access to finance for SMEs in the clean cooking sector by facilitating partnerships between development finance institutions and commercial banks to offer credit guarantees.	Development finance institutions partner with commercial banks in Malawi to offer credit guarantees of 50-70% collateral for SMEs, reducing the risk for banks and increasing access to finance for clean cooking businesses. Tailoring financial products and services to meet the specific needs of SMEs in the clean cooking sector, including flexible repayment terms, lower interest rates, and targeted support for capital expenditure and working capital requirements. Monitoring and evaluation mechanisms to assess	Ministry of Energy (MoE) Development finance institutions (e.g., Malawi Development Bank, Small and Medium Enterprises Development Institute) Commercial banks	n/a

	Monitoring and evaluation mechanisms will enable the assessment of the impact of financial support initiatives on SMEs' access to finance and their contribution to the development of the clean cooking sector.	the impact of financial support programs on SMEs' access to finance, business growth, and contribution to the clean cooking sector's development.		
Consumer Financial Support for Clean Cooking Technology	Large proportion of the potential cookstove market is un-bankable with limited alternative consumer financing available. Consumer affordability gap for clean cooking technology due to relative high cost in comparison to household income and expenditure patterns, interest rates and un-bankable markets. Government collaboration with financial institutions to offer soft loans for clean cooking technology and fuels, reducing the affordability gap for rural and unbankable populations.	Establishment of a low-interest, government-guaranteed revolving fund. Development of appropriate financial instruments and mechanisms by development finance institutions (DFIs) hosted by the Government of Malawi (GoMW), to facilitate access to finance for clean cooking projects. Inclusion of clean cookstoves financing in existing soft loan schemes for formally employed individuals, such as government employees who benefit from soft loans for selected consumer goods. Promotion of access to finance for clean cooking through Savings and Credit Cooperative Organisations (SACCOS), particularly in rural areas, where they cater to members including civil servants and women's groups.	Ministry of Energy (MoE) Ministry of Finance Development finance institutions (DFIs) Commercial banks and financial institutions (GoMW) Savings and Credit Cooperative Organizations (SACCOS) Civil service organizations	Monitoring and evaluation mechanisms will be necessary to assess the effectiveness and impact of financial support programs on increasing access to clean cooking technology and fuels, particularly in rural areas.
Permanent Removal of Duty/ Institution of	Fuel and technology costs not cost-competitive with traditional	Implementation of tax exemptions or incentives for clean cooking fuels such as	MoE, Ministry of Finance, Malawi	The current regulatory framework regarding fiscal

Tax Waivers/Subsidy on Clean Cooking Fuels and Technologies	(charcoal/wood) fuels due to taxation. Permanent removal of tax on clean cooking fuels and technologies to reduce the cost barrier and increase affordability for consumers.	efficient cookstoves, eCookstoves, (LPG), biogas, and to promote their adoption and usage. Collaboration with relevant government departments, including the Ministry of Finance, to enact legislation or amendments to tax laws to ensure the permanent removal of taxes on clean cooking fuels and technologies. Monitoring and evaluation mechanisms to assess the impact of tax removal on the affordability and adoption of clean cooking solutions, particularly among low-income households and rural communities.	Revenue Authority (MRA), NCSC	incentives for clean cooking in Malawi exhibits gaps. While there are policies in place for aspects like eCooking, VAT, and duty, specific regulations for their implementation are lacking. To address this deficiency, it is necessary to develop detailed and actionable secondary regulations through a collaborative process involving multiple stakeholders.

Table 19: Policies to overcome Technological barriers to market deployment of Clean Cookstoves in Malawi.

Name of the Policy Measure	**Barrier addressed**	**Policy design details**	**Responsible Institutions**	**Remarks**
Feasibility and R&D Support for Biofuel Production and Utilisation	Limited availability and utilisation of bio-ethanol and bio-diesel fuels due to production capacity constraints, lack of appropriate incentives, and limited distribution infrastructure. Government support, encouragement, and promotion of bio-ethanol ensuring that such production does not jeopardise food security.	Implementation of fiscal incentives to promote domestic bio-ethanol production, encouraging investment and development in the biofuel sector. Adoption of appropriate pricing incentives to encourage the use of biofuels, making them more competitive and attractive compared to conventional fuels. Examination of feasibility and implementation of	Ministry of Energy (MoE), Ministry of Agriculture, Ministry of Trade and Industry, Malawi Energy Regulatory Authority (MERA), National Cookstove Steering Committee (NCSC), Farmers' cooperatives and associations, Research institutions and universities	Building capacity and skills for sustainable biofuel production, with a focus on inclusive development through collaboration with farmers' cooperatives, women farmers' coalitions, and other marginalized groups. Promoting socially responsive research and

		socially and environmentally responsible large-scale bio-ethanol production projects, ensuring sustainable production practices and minimising environmental impacts. Increasing the supply of domestically produced bio-ethanol through expansion of production capacity and distribution infrastructure.		development in the biofuels sector to address specific challenges and opportunities.

Table 20: Policies to overcome Environmental barriers to market deployment of Clean Cookstoves in Malawi

Name of the Policy Measure	**Barrier addressed**	**Policy design details**	**Responsible Institutions**	**Remarks**
Regulation and Enforcement of Sustainable Charcoal Value Chain	Weak enforcement of fuelwood harvesting, charcoal production, and sale regulations leading to illegal charcoal production and hindering the uptake of clean cooking. Implementation of legislation to overcome illegal collection and harvesting of biomass and charcoal, with a focus on regulating the charcoal value chain to promote sustainable and efficient production.	Develop and implement training programs for stakeholders involved in fuelwood harvesting and charcoal production including workshops and seminars to educate local communities, charcoal producers, and enforcement agencies on sustainable harvesting techniques, legal requirements, and environmental impacts. Introduce incentives for producers who comply with sustainable harvesting and production practices. (e.g. tax incentives, subsidies for equipment, or preferential access to markets for certified sustainable charcoal producers.) Create certification schemes that	Ministry of Natural Resources and Climate Change, Malawi Energy Regulatory Authority (MERA), District Government, Development Committees, Law enforcement agencies Community-based organizations (CBOs) Non-governmental organizations (NGOs) working in conservation and sustainable development	Illegal charcoal production and marketing pose significant barriers to the uptake of clean cooking technologies, highlighting the need for stronger regulation and enforcement in the charcoal value chain. Legislation and regulations aimed at regulating fuelwood harvesting and charcoal production are essential for promoting sustainable practices and ensuring compliance with clean cooking standards.

		recognize and reward compliance with environmental and legal standards. Strengthen enforcement mechanisms and monitoring systems for charcoal production and sales including increase patrols and inspections in charcoal production and areas, transport routes, and markets to deter illegal activities. Equip enforcement agencies with adequate resources and training to conduct effective monitoring across the value chain and manage political economic considerations. Establish a reporting system for citizens to report illegal activities anonymously.		

Table 21: Policies to overcome Legal barriers to market deployment of Clean Cookstoves in Malawi

Name of the Policy Measure	Barrier addressed	Policy design details	Responsible Institutions	Remarks
Establishment of Government-Supported Technical Standards for Clean and Improved Cookstoves (ICS)	Weaknesses in minimum standards and quality testing leading to lack of market stability and confidence Lack of government-supported technical standards for clean cooking technology, leading to low confidence in the durability and performance of clean cooking technologies due to variability in quality and tier performance. Development and implementation of legislation that	The legislation will aim to promote the production of good and reliable clean cooking technology by setting quality benchmarks and ensuring adherence to safety and performance standards. Collaboration with relevant stakeholders, including manufacturers, industry associations, research institutions, and consumer advocacy groups, to develop	Ministry of Energy (MoE), Ministry of Trade and Industry, Malawi Bureau of Standards (MBS), District Government, National Cookstove Steering Committee (NCSC), Private Sector, Testing Centres	Register of approved stoves and fuels to be held at national / District level. Links to National ISO standards and enforcement of imports / exports / retail sales / sustainable charcoal. Link to reduction of illegal charcoal activities by tacitly disincentivising purchase. Links to awareness

	establishes minimum standards, protocols, and testing procedures for clean cooking technology and fuel production.	comprehensive standards that reflect best practices and technological advancements in clean cooking. Implementation of measures to address counterfeit products and copyright infringement through strengthened enforcement of laws governing the production and distribution of ICS.		campaigns (local / national) relating to environmental degradation.
Regulation and Standardisation of Clean Cooking Installation and Maintenance	Limited maintenance services for clean cooking technology Low confidence in the market due to poor standards of installation and maintenance by some providers, as well as the absence of ISO standards for equipment. Development and implementation of regulations and licensing requirements for installation and maintenance companies to ensure adherence to quality standards and practices.	Establishment of government-supported technical standards for equipment, including the adoption of ISO standards where applicable, to improve confidence in the sector and promote the use of reliable and safe technology. Collaboration with industry stakeholders, including manufacturers, installers, and maintenance providers, to develop comprehensive standards and regulations that reflect best practices and industry advancements. Promotion of relevant curriculum embedding in Technical and Vocational Education and Training (TVET) institutions to address the lack of skilled labour in the market and reduce the high cost of training unskilled labour from scratch.	Ministry of Energy (MoE), Ministry of Trade and Industry, Malawi Bureau of Standards (MBS), Minerals and Energy Regulatory Authority (MERA), TVET institutions, Regulatory bodies overseeing installation and maintenance services	Recommendation relating to the introduction of a biogas specific curriculum into technical education institutions should be seen as complimentary to higher level regulation and of the sector including standards. It should be noted that these recommendations are also relevant to barriers associated with awareness and information.

		Support for the development and dissemination of training programs and materials to enhance the skills and knowledge of installers and maintenance technicians, ensuring competency and professionalism in the sector.		

Table 22: Policies to overcome Awareness and Information barriers to market deployment of Clean Cookstoves in Malawi

Name of the Policy Measure	**Barrier addressed**	**Policy design details**	**Responsible Institutions**	**Remarks**
Mass Communication Campaign - Promotion of Clean Cooking technologies and fuels	Insufficient public facing awareness raising campaigns, including those considering the integration of early adopters as clean cooking transition champions. Awareness, information, and socio-cultural barriers contributing to low rates of adoption of clean cooking technologies and fuels beyond traditional fuels such as wood and charcoal, the use of which leads to deforestation, indoor air pollution, and health hazards. Lack of awareness and information regarding alternative sustainable fuels for clean cooking, including but not limited to sustainable harvesting of wood, production of charcoal using efficient kilns, production of briquettes from biomass waste, and utilisation of biogas. Limited awareness and technical capacity hindering the uptake of alternative clean	Implementation of awareness campaigns and educational programs to inform communities about the benefits of using alternative sustainable fuels and the importance of preserving forests and mitigating indoor air pollution. Support for the adoption and utilisation of clean cooking technologies and equipment compatible with alternative sustainable fuels, such as improved cookstoves and biogas digesters. Implementation of sustainable harvesting practices to ensure the long-term availability of wood resources and reduce environmental degradation. Collaboration with local development committees, and relevant government extension workers to promote the transition to alternative	Ministry of Energy (MoE), Ministry of Natural Resources and Climate Change (MNRCC), Ministry of Health (MoHealth), Ministry of Gender, Community Development and Social Welfare (MGCDSW), Ministry of Agriculture (MoA), Ministry of Education, National Cookstove Steering Committee (NCSC) Non-governmental organizations (NGOs)	Components of mass communications campaigns focused on clean cooking technologies and / or fuels should be tailored to context (urban / rural), technology agnostic, and grounded in a realistic clean cooking energy transition. Gender considerations are critical in the design of clean cooking awareness and information initiatives. Women's disproportionate burden in traditional fuel collection and cooking responsibilities must be addressed. Efforts should ensure women's equal participation,

	cooking fuels such as Liquefied Petroleum Gas (LPG), Biogas, eCooking Implementation of awareness campaigns to educate the public about the availability, benefits, and usage of alternative clean cooking fuels, including LPG and Biogas.	sustainable fuels and ensure their sustainable use. Design and deliver public awareness programs to provide training on the effective use and maintenance of clean cooking technologies, addressing users' hesitation and lack of technical expertise. Collaboration with local communities, NGOs, and relevant stakeholders to disseminate information and raise awareness about clean cooking technologies, overcoming cultural barriers and increasing acceptance. Implementation of a multi-platform mass communication campaign. The campaign will target individuals who cook, as well as other influential stakeholders such as heads of households, business/institution managers/owners, and community leaders.		access to clean cooking technologies, and safety in fuel collection. Collaboration with women's organisations is vital for effective gender integration.

3.3.4. Guidance for Policy Roadmap Development

The policy roadmap outlined here addresses the comprehensive array of policy measures aimed at overcoming barriers to the deployment and adoption of clean cooking technologies and fuels in Malawi. The policies addressing identified barriers are structured across short-term, medium-term, and long-term time horizons to ensure a coordinated and phased approach to implementation. Short-term initiatives focus on immediate actions. These efforts are geared towards achieving lasting impact, promoting innovation, and ensuring environmental sustainability. Each policy measure is aligned with specific timelines and responsibilities, ensuring accountability and adaptability to evolving challenges and opportunities in the clean cooking sector in Malawi.

Table 23: Timeline of individual policy measures to overcome barriers to market deployment of clean cookstoves in Malawi

Name of the Policy Measure	**Short-term**	**Medium-term**	**Long-term**	**Remarks**
Multi-Level Governance Coordination Initiative	Nominate key focal points in ministries and agencies, conduct capacity needs assessment and training. Conduct cross sectoral collaboration.	**Set up organisational inter-ministerial / agency structure** to embed practices of regular cross-sectoral collaboration.	Provide continuous evaluation of effectiveness and capacity needs assessments in line with developments in the field, clean cooking gains, changes in personnel.	Note that this recommendation mirrors the Clean Cooking Focal Points imitative noted in the Malawi eCooking Roadmap (2024)
Mass Communication Campaign - Promotion of Clean Cooking Technologies and Fuels for Clean Cooking	**Development of government stamped multi-channel communication campaigns** and associated media assets. Capacity building of local level officials championing campaigns.	**Delivery of campaign** in line with relevant policy reviews and revisioning. Ongoing evaluation of campaign effectiveness with local level monitoring of clean cooking uptake / negative environmental impacts avoided as a proxy.	Ongoing evaluation of campaign effectiveness. Continuous improvement / updating of campaign in line with national and local priorities, market and technology advancements, clean cooking uptakes patterns.	As existing communications campaigns exist (e.g. from previous gov / dev agency initiatives), consider leveraging existing assets where appropriate.
Establishment of Government-Supported Technical Standards for Improved Cookstoves (ICS)	**Establishment / adoption of standards by national body.** (e.g. Malawi Bureau of Standards) **Establishment / reestablishment of stove testing centres with relevant accreditation**	Monitoring and enforcement	Monitoring and enforcement Revisions to standards	n/a
Regulation and Standardisation of Installation and Maintenance	Identification of ministry / agency points of contact championing adoption. Development of standards by relevant national body (e.g. MERA)	**Development / adoption of standards by relevant national body (e.g. MERA)** Enactment of regulations by relevant national body (e.g. MERA)	Enforcement Monitoring and Evaluation	n/a

	Development of regulations by relevant national body (e.g. MERA)	Development and adoption of accredited training curriculum for trades people		
Development and Enforcement of Standards for eCooking Appliances	**Establishment / adoption of standards by national body. (e.g. Malawi Bureau of Standards)** **Establishment / reestablishment of stove testing centres with relevant accreditation**	Monitoring and enforcement	Monitoring and enforcement Revisions to standards	Note that this is recommendation is contained as an action point within the Malawi 2024 eCooking Roadmap (MECS, Ministry of Natural Resources and Climate Change)
Access to Finance for SMEs in Clean Cooking Sector	Engage with DFIs and donors to secure funding and technical support. Identify host ministry / agency and **set up institutional arrangements.** **Draft policy guidelines** outlining the objectives, scope, and operational mechanisms of the credit guarantee scheme. **Pilot the credit guarantee mechanism** on a small scale, involving selected financial institutions and clean cooking enterprises.	**Launch the credit guarantee scheme based on lessons learned during the pilot phase.** Monitor and evaluate to track the performance of the scheme, including uptake rates, default rates, and overall impact on the clean cooking sector. Continuous, evidence-based refinement of the policy framework to address any identified gaps or challenges.	Institutionalise the scheme within national financial and environmental policies to ensure its sustainability and long-term impact. **Establish a Dedicated Agency** Consider integrating the credit guarantee scheme with broader clean energy and climate policies to maximise its impact on reducing emissions and promoting sustainable development. Regular review and iteration.	n/a
Consumer Financial Support for Clean Cooking Technology	Implement direct subsidies to lower the upfront cost of clean cooking technologies Provide grants to low-income households to	Partner with microfinance institutions with the intention of offering context appropriate solutions including low-interest micro-	Collaborate with private sector to develop appropriate public private partnerships to leverage private sector investment	n/a

	fully cover the cost of transitioning to clean cooking solutions. Bulk purchase agreements with manufacturers Strengthen distribution networks to reduce the per unit cost of improved / clean cooking technologies and fuels for households in rural / hard to reach markets.	loans, credit programmes Through government stamped awareness campaigns, promote pay-as-you-go (PAYG) technology, as well as community-based savings and credit organisations	Establish dedicated clean cooking funds to provide ongoing financial support and subsidies to consumers Corporate Social Responsibility (CSR) Initiatives	
Permanent Removal of Duty/ Institution of Tax Waivers/Subsidy on Clean Cooking Fuels and Technologies	Undertake economic cost / benefit analysis for removal of duty / implementation of subsidy.	Based on economic cost / benefit analysis and assuming favourable outcomes, develop and implement taxation mechanisms including (e.g.) reductions, exemptions, consumer tax credits Set up and deliver impact tracking mechanisms, adjusting policy as and when necessary.	Based on performance sustained financial support for permanent tax policies. Encouragement of local production and innovation. Establish feedback mechanisms for public / private sectors Continuous review of policy	n/a
Feasibility and R&D Support for Biofuel Production and Utilisation	**Conduct feasibility studies and baseline assessments** Develop policy frameworks and formulate policies that support biofuel production. Engage Stakeholders. Provide seed funding for R&D projects,	Research and development (R&D) expansion including pilot projects. Infrastructure development including production and distribution facilities Market development and incentives created and promoted	Established R&D support should be reconfigured to focus more on commercialisation and scale-up.	n/a

	potentially partnering with local research institutions.			
Regulation and Enforcement of Sustainable Charcoal Value Chain	Strengthen law enforcement of current regulations. Develop and pilot monitoring systems to track production and trade, including the use of digital technologies like GPS and remote sensing.	Strengthen enforcement mechanisms and monitoring systems for charcoal production and sales including increase patrols and inspections in charcoal production and areas, transport routes, and markets to deter illegal activities. Equip enforcement agencies with adequate resources and training to conduct effective monitoring across the value chain and manage political economic considerations. **Develop and implement training programs** for stakeholders involved in fuelwood harvesting and charcoal production including workshops and seminars to educate local communities, charcoal producers, and enforcement agencies on sustainable harvesting techniques, legal requirements, and environmental impacts.	Strengthen law enforcement including establishing a reporting system for citizens to report illegal activities anonymously Integrate with national policies including continuous Improvement. Introduce incentives for producers who comply with sustainable harvesting and production practices. (e.g. tax incentives, subsidies for equipment, or preferential access to markets for certified sustainable charcoal producers.) Create certification schemes that recognize and reward compliance with environmental and legal standards.	Existing regulations strategies exist in relation to the regulation of the charcoal industry, however enforcement of regulations requires ongoing monitoring and oversight in addition to the implementation of incentive strategies suggested here. Invest in R&D to explore new methods and technologies for sustainable charcoal production, including alternative biomass sources and production processes as complimentary measures.

3.3.5. Policy Briefs on Good Practices

Country Context

This policy brief aims to provide policy design guidance through best practice examples, to address key barriers to scaling clean cooking initiatives in Malawi; consumer financial challenges and the high cost of clean cooking fuels and technologies. One of the primary barriers identified is the significant affordability gap for consumers due to the relatively high costs of clean cooking technologies and fuels compared to household incomes and the un-bankable status of a large part of the market. Additionally, the cost-competitiveness of clean cooking technologies and fuels remains a challenge, with taxation contributing to the price gap between clean alternatives and traditional fuels such as charcoal and wood.

To address these barriers, additional policy measures are needed that focus on enhancing consumer financial support and reducing the cost of clean cooking fuels and technologies. This is particularly important for overcoming clean cooking access barriers that are experienced by lower income market segments as the market for clean cooking technologies among higher income market segment is becoming increasingly well served and, in some cases, saturated.

Financial support can be achieved through government collaboration with financial institutions to facilitate the provision of end user subsidies through the use of results-based financing. The inclusion of clean cookstove financing in existing finance schemes offered by Savings and Credit Cooperative Organisations (SACCOS), and micro-finance institutes can also help to reduce the affordability gap, particularly in rural areas.

On the cost side, implementing permanent tax exemptions or incentives for clean cooking fuels and technologies can reduce the price barrier and increase affordability for consumers. Collaboration with the Ministry of Finance to amend tax laws and implement these fiscal incentives is crucial to ensure their long-term impact on the market.

These policy measures serve as essential steps toward overcoming economic and financial barriers to clean cooking adoption.

Good practice policies

Consumer Financial Support for Energy Access[4] [5]

[4] This good practice policy relates to the support to the private sector led solar home system market and not clean cooking specifically. There is however significant enough overlap in the financial and economic barriers faced by consumers in both sectors to justify the inclusion of this example. It should also be noted that the leverage of carbon markets in service of improved and clean cooking adoption is relatively widespread a developing practice Malawi.

[5] Note that the Government of Malawi (GoMW), through the Ministry of Energy (MoE) is responsible of establishing and operating the World Bank funded Off-Grid Market Development Fund (OGMDF) or the Ngwee Ngwee Ngwee Fund launched in 2023. Similar to the objectives of the Rwandan REF, the Ngwee Ngwee Ngwee fund aims to contribute towards national electrification targets including through the subsidisation of solar home systems via a private sector RBF scheme. This policy brief has elected to focus on the Rwandan REF example, as it holds significant similarities, has been active for slightly longer, and therefore provides clearer outcomes and indications of success factors.

Table 24: Consumer Financial Support for Energy Access

Policy type	Financing (Pro-Poor Results Based Financing)
Location of implementation	Rwanda
Background / state at the outset	The World Bank funded Rwanda Renewable Energy Fund (REF) project was launched in 2017 (World Bank, 2017). The REF was initially set up with the primary objective of the Development Bank of Rwanda (BRD) providing lines of credit to Rwandan financial intermediaries with the intention of incentivising their investment in businesses in the off-grid electrification sector. The intermediaries included Savings and Credit Cooperatives (SACCOs), commercial banks, and micro finance institutions (MFIs). The outcome of this was envisaged to be increased electricity access through off-grid technologies and the facilitation of private-sector participation in renewable off-grid electrification. A number of challenges including those relating to the insufficient and slow uptake of on lending to the off-grid sector by private sector financial institutions, and saturation of higher income market segments, led to the REF being restructured to include a pro-poor results-based finance (RBF). (World Bank, 2022). The decision by the Government of Rwanda (GoR) to make this adjustment to the scope of the project was based on the success of Energising Development's (EnDev's) pro-poor results-based financing pilot initiative taking place in the country at the time The EnDev project (ESMAP, 2022) aligned with evolving national guidelines on standards for solar home systems (SHS), and worked closely with the Rwanda Energy Group (REG), and the GoR during the design phase of the project.
Policy description	Under the pro-poor RBF mechanism, companies are provided with a subsidy for every verified household accessing a SHS sold by the company. This subsidy is provided based on the income level of the household as well as the cost of the product selected by the household. The segmentation of households based on income is linked to the GoR's Ubudehe system of household socio-economic categorisation. Companies receive increasing levels of subsidies for providing access to households with lower income levels under the Ubudehe system. Under the scheme companies are compelled to pass on the full subsidy to households. The policy includes the requirement that technology sold by qualifying companies eligible for the subsidy, must meet GoR agreed quality standards and performance criteria. As the majority shareholder in BRD, GoRs role in this policy is to link strategic level policy targets to the strategy of the BRD, as well as to the relevant inter-ministerial strategic and operational actions.
Outcomes	The EnDev Results-Based Financing (RBF) initiative significantly improved access to off-grid electrification technologies for low-income households in Rwanda. By engaging the private sector to tackle energy poverty, the initiative helped provide solutions to many households that had previously faced barriers to access.

	In 2022, the EnDev pro-poor RBF pilot had provided access to over 22,000 low-income households, with 71% categorized in Ubudehe 1, the lowest poverty bracket. Companies using pay-as-you-go technology saw increased device utilization and reduced default rates, indicating healthier customer portfolios (Gogla, 2022). Building on the successes of the World Bank Renewable Energy Fund (REF) and EnDev projects, the Government of Rwanda (GoR), supported by the World Bank, broadened the REF by adding USD 15 million for a new Pro-Poor RBF window. This new window aimed to enhance household affordability for renewable energy. After initial success of the pilot, this project has been scaled up to cover all 30 districts across the country. An additional USD 15 million was allocated under the World Bank-funded Energy Access and Quality Improvement Project in September 2020. By October 2021, over 28,000 connections had been established since the new window's launch in February 2021, which has a goal of reaching 5.2 million household connections under the REF window.
Success factors	Several factors contributed to the success of the initiative, including the alignment with national energy access goals, the provision of targeted financial incentives, the involvement of experienced implementing partners, and the focus on capacity building for local companies. The use of a results-based approach ensured that funds were disbursed based on actual outcomes, which increased accountability and encouraged companies to meet their targets.

Permanent Removal of Duty/ Tax Waivers/ Provision of Subsidy on Clean Cooking Fuels and Technologies

Table 25: Permanent Removal of Duty

Policy type	Removal/reform of subsidies to end-user energy prices and on energy supply
Location of implementation	Kenya
Background / state at the outset	Value Added Tax (VAT) and import duties on cooking fuels typically results in higher costs for consumers, as the tax is added to the base price of the fuel. This can significantly impact low-income households, who spend a large part of their income on cooking fuel. Increased fuel prices can strain their budgets, due t to higher costs for cooking and potentially lead to energy poverty. Conversely, the removal or reduction of VAT on cooking fuel can lower costs and make it more affordable, easing financial pressure on households and increasing the uptake of clean fuel. Increased affordability can also facilitate the transition to cleaner cooking technologies by making alternative fuels or technologies more financially accessible, thus supporting efforts to reduce reliance on traditional, more polluting fuels. In 2012 Kenya first announced its ‘Kerosene Free Kenya’ plan to phase out the use of Kerosene for lighting. At that time 68% of the Kenyan population was reported to use the kerosene for lighting, with total annual expenditure on importing Kerosene being more than six hundred million US dollars. This plan was initiated with the backdrop of a need for climate change mitigation actions and the adoption of solar lighting (Lighting Global, 2012). Solar equipment and accessories are VAT exempt in Kenya (PWC, 2023), and have been since the introduction of the VAT (Amendment) Act,

	2014 (IEA, 2016). The introduction of this exemption was responsible for a reduction in the cost to consumer for household solar products. (Meza, 2014) In 2016 Kenya zero rated LPG (made VAT exempt) to promote its adoption and use. This action was taken in the context of LPG being viewed as key for meeting national clean cooking targets of 100% access by 2028. Between 2017 and 2019 the demand for LPG in Kenya nearly doubled from ~124,000 tonnes to ~217,000 tonnes. (Douglas, 2021) In 2018, in an important report, bioethanol was classified as a subsector of the clean cooking industry, which (bioethanol) was expected to have a significant potential for impact across environmental, health, and economic / opportunity cost domains. Using a triple bottom line approach[6] the report demonstrated the potential of bioethanol as a cooking fuel source and advocated for VAT and import tariff exemption as a strategy for enhancing its price competitiveness. (Dalberg, 2018) In 2021 the 16% VAT on LPG was reintroduced leading to price hike and a reduction in reported frequency of use by existing consumers. In a community where the stacking (i.e. making use of more than one technology and fuel mix) is common, this led to a reversion to the use of dirty fuels at household level, affecting low-income households disproportionately. (Schupler et al, 2022).
Policy description	In Kenya at present the following items relating to energy access are VAT exempt; prefabricated biogas digesters, biogas, supply of denatured ethanol, and sustainable fuel briquettes for household and commercial use. (PWC, 2023) The policy aims to remove or reduce VAT and import duties on clean cooking fuels and technologies to improve household affordability and increase uptake. It addresses barriers related to the high cost of clean fuels and the prevalence of energy poverty. The policy was initiated by the Kenyan government in various phases implemented over the years in line with clean cooking policy and the private sector market development. This included the 2016 zero-rating of LPG and the current VAT exemptions for biogas, ethanol, and sustainable fuel briquettes.
Outcomes	The zero-rating of LPG led to a significant increase in its adoption, with demand nearly doubling between 2017 and 2019. The removal of VAT on clean cooking fuels and technologies has contributed to the clean cooking transition and consequently is expected to have contributed to the reduction of GHG emissions, reduced negative health outcomes, and decreased barriers to affordability by encouraging the shift from traditional polluting fuels to cleaner alternatives. Expected socio-economic impacts include potential job creation in the clean cooking sector, improved household health due to reduced indoor air pollution, and financial relief for low-income households. However, the reintroduction of VAT in 2021 negatively impacted LPG usage, highlighting the importance of consistent policy support if particular fuels are seen as long-term energy transition options.
Success factors	Key success factors include the government's commitment to climate change mitigation, evidenced by the "Kerosene Free Kenya" initiative and the support for solar and LPG adoption. The policy design effectively addressed affordability barriers by removing VAT, making clean cooking fuels more accessible. Additionally, advocacy and research, such as the Dalberg report on bioethanol (Dalberg, 2018), play a significant role in shaping policy decisions. Continued government support and clear policy communication are crucial in achieving the desired outcomes. The

[6] The triple bottom line (TBL) approach is a framework that incorporates three dimensions of performance: social, environmental and financial. (Slaper et al, 2011)

	challenge remains to ensure long-term consistency in policy implementation to avoid negative impacts like those seen with the reintroduction of VAT on LPG.

3.3.6. Summarising Remarks

This policy roadmap for clean cooking in Malawi has presented recommendation for overcoming the significant barriers identified in the initial barrier analysis. The policy roadmap emphasises the importance of a harmonised and cross-sectoral enabling policy framework, notes complimentary roles of key public and private stakeholders, and suggests actionable and time-bound activities presenting opportunities to consider resource needs.

The Enabling Policy Framework outlined in Chapter 3.3.3 directly addresses the barriers identified in the barrier analysis, as well as further barriers noted during data collection activities. These policies focus on overcoming political and institutional, economic and financial, social, environmental, legal, as well as awareness and informational barriers by proposing the establishment of measures including robust standards, enhancement of coordination across government levels, and promoting financial mechanisms that support clean cooking initiatives.

The roadmap reinforces suggestions for the role of the most critical and relevant actors, including government ministries, agencies, and private sector stakeholders. Their cross-sectoral and multi-level coordination and involvement is essential for implementing the enabling policy framework. Government of Malawi Ministries such as the Ministry of Energy, Ministry of Natural Resources and Climate Change, and Ministry of Finance are crucial for policy development, coordination, enforcement and resource allocation. Private sector entities, including manufacturers and distributors, play a vital role in developing and deploying distributed clean cooking technologies. As such the roadmap seeks to address barriers experienced by the private sector via Government's role in creating an enabling environment.

The roadmap presented in Chapter 3.3.4 develops policy components into activities and recommend actions to taken in the short, medium, and long term to enhance the adoption of clean cooking technologies and fuels. Short-term activities notably focus on establishing standards and raising awareness, while medium-term activities involve scaling up production and distribution. Long-term activities aim at ensuring sustainability through continuous policy improvement and capacity building. The Roadmap provides the opportunity to map resource requirements to activities with the intention of practical implementation. Resource requirements may include financial investments, technical expertise, and institutional support. Bridging the implementation gap will require coordinated efforts to mobilise these resources, ensuring that all stakeholders are adequately supported.

In conclusion, this policy roadmap provides a contributing strategy to enhancing clean cooking diffusion in Malawi. It ties together the critical elements of policy, stakeholder engagement, activities, and resources, creating a cohesive plan for the sustainable development of the sector.

3.4. Second-Life Use of EV Batteries in South Africa

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3.4.1. Introduction

The shift away from fossil fuels towards a renewables-based energy system will require a number of supporting technologies to ensure a sustainable and reliable energy system. Energy storage is one such key enabler. As more energy end uses are electrified, battery storage technologies will become increasingly important—not just to support the integration of a higher share of renewables in the grid, but to enable decentralized renewable technologies as well.

Lithium-ion chemistries already account for a significant share of batteries and are only projected to grow. However, this rapid expansion, driven largely by electric vehicle (EV) batteries (IEA, 2023), creates the impending challenge of handling significant quantities of used batteries as they near the end of their lifespan. While all used batteries must ultimately be disposed of (by recycling and recovering materials), some, such as EV batteries, can be re-used in different applications, giving them a 'second life'. Second-life batteries (in most cases) offer a significant cost advantage over new batteries, making them attractive and accessible while simultaneously contributing to the use of fewer resources and raw materials, reduced waste generation, improved overall resource use efficiency, and reduced energy use and associated emissions.

In South Africa, there is a significant potential for the use of battery storage in solar home systems and other decentralised generation options, as well as for grid storage. Based on previous interviews conducted as part of the barrier analysis, it is clear that there is a high demand for such systems to balance out the unreliability of grid-connected electricity. Yet, a number of barriers were identified that can hinder the widespread adoption of used EV batteries for this purpose (a full list of barriers is available in Section 3.4.3). At its core, the management or repurposing of used EV batteries is not a priority in South Africa at the moment owing to the low penetration of EVs in general in the South African market. A number of challenges follow from this, such as ensuring an **adequate supply** of such batteries to help develop a cost-effective domestic value chain. These factors contribute to the general **lack of awareness** of the potential and risks of second-life batteries, the development of adequate skills to process such batteries (further complicated due to informal waste management), as well as legislation and regulations regarding **safe operation and handling** of such batteries. Until a significant value chain develops as more used batteries come onto the market, such barriers may hamper the business case for second-life batteries—without the necessary skills and infrastructure, the costs associated with safely collecting and repurposing these batteries might eat into their cost advantage. This is not to suggest that there are no efforts to manage this waste stream—many interviewees pointed to the fact that a conversation around storage and e-waste management (including batteries) is present and evolving, as is the case in many other countries in the world.

However, this does not mean that this waste stream will not grow in the future, and it is important that policymakers in South Africa get ahead of the issue before it becomes more pressing. Given the nature of this use case, i.e. essentially extracting further value (second life) from a potentially dangerous waste product (used batteries) before its ultimate disposal, it would not be useful for the policy framework to encourage the use of this technology in a standalone manner. The development of this waste stream will likely depend heavily on policies outside the scope of this analysis, namely the expansion of e-mobility in South Africa. Rather, the focus of this policy roadmap and the recommendations therein is to ensure that 1) there exists a policy framework that allows for second-life uses (in the interest of resource use efficiency and lower costs), and 2) that such a framework prioritizes ***safety***, in that any such use is undertaken so in a safe manner that minimizes harm to the people involved in the process as well as the environment.

3.4.2. Data Collection

Similar to the barrier analysis, this policy roadmap and associated recommendations were developed through a mix of desk research and stakeholder interviews. This research was guided by the question of how to ensure safe practices along the value chain of battery repurposing and recycling.

The desk research involved mapping existing policies related to second-life batteries in South Africa, as well as the key ministries/institutions responsible. The Department of Forestry, Fisheries, and the Environment (DFFE) is one of the main actors in the e-waste management space in South Africa, with the National Environmental Management Waste Act (NEMA) providing the legislative basis for a lot of waste-management processes, such as extended producer responsibility (EPR). The desk research also looked into policies related primarily to e-waste management, the opportunities and hazards posed by second-life batteries, and to a lesser extent the use of storage in South Africa's electricity system (household or utility scale).

The picture painted by this research suggests that the management of used EV batteries is a looming problem, particularly for countries where EV use has grown rapidly. The batteries still have the potential for reuse in certain applications, but there is a higher risk of serious accidents—primarily fires—due to defective cells or unsafe handling. South Africa is also in dire need of upgrades to its electricity system, with many consumers opting for solar-plus-storage systems. Storage also has a high potential for use in the electricity grid to provide much-needed backup power and flexibility (Halsey, Bridle, and Geddes, 2023). However, in this case, the demand is primarily for new batteries as the supply of used batteries is relatively low. Regardless, proper second-life and eventually end-of-life management will be essential for all used batteries in South Africa, and many of the same principles apply.

In addition, a literature review of global best-practice cases for the use of second-life batteries was conducted. While the number of national-level policies governing this specific use case are limited, there were a number of policies at a different scale (e.g. local or regional government, technology companies, etc.) that were used as reference. In some cases, recommendations from leading experts in the field were used (e.g. academic studies, policy papers, etc.) in the absence of real-world examples in order to strengthen the case for such measures. Some of these 'best practices' are further detailed in Table 3 along with the policy brief.

While a number of interviews were sought, a total of 5 interviews were conducted with a number of stakeholders familiar with the energy storage and e-waste management sectors primarily in South Africa and also globally. Stakeholders interviewed included researchers/academics, non-governmental organisation (NGO) representatives, technical experts (who have also been involved in policy and technical advisory groups for the national government), and funding agencies. Further details of the interviewees are given in Table 26.

Table 26: Interview partners

Institution	**Stakeholder group represented**
International Institute for Sustainable Development (South Africa)	Academia/research [R1]

EPR Waste Association of South Africa (eWASA)	Technology/policymaker [T1]
Two representatives from the Deutsch Gesellschaft für Internationale Zusammenarbeit (GIZ) South Africa	Funding agency [F1; F2]
ICLEI	Non-governmental organization/technology [N1]

3.4.3. Enabling Policy Framework

As mentioned above, repurposing used batteries is a potential option to handle batteries that have reached the end of their 'first life'—in the case of EV batteries, when their capacity has dropped to 70–80% of the potential when they were new (EnelX, n.d.). Such repurposing can create an alternate supply of batteries and typically at costs much lower than that of new batteries. Some reports indicate this cost advantage can range from 30–70% over new EV batteries, but with EV battery prices projected to fall, this advantage is expected to drop to 25% by 2040 (Engel and Hertzke, 2019). Their lower cost offers a major advantage for consumers, while for producers, the economics of a battery become more favourable with repurposing. The magnitude of this difference will be the make-or-break factor for the success of this use case. However, a number of barriers stand in the way. Table 27 provides an overview of the main barriers identified in the earlier barrier analysis.

Table 27: Overview of barriers for the adoption of second-life EV batteries in South Africa

Level 1	**Level 2**	**Level 3**
1. Political and institutional	1.1 Ambitions, strategies, and plans	Sustainable mobility priorities
		Priorities for energy policy
	1.2 Governance	Vertical and horizontal integration of governance
2. Economic and financial	2.1 Market development issues	Insufficient supply of EV batteries to build value chain (including demand for energy technologies using batteries e.g., solar home systems)
	2.2 Cost competitiveness of second-life batteries	Costs and expertise required to handle EV batteries and viable business case for recycling/repurposing
3. Social	3.1 Socio-economic systems	Informal waste management sector
	3.2 Health and safety	Toxic materials in batteries, and safety hazards from operations
4. Technology and infrastructure	4.1 Technical standards	Lack of standardization in battery design
	4.2 Battery production	Resistance from existing battery manufacturers/OEMs
		Availability of skills to handle battery waste safely
5. Environmental	5.1 Local pollution	Leaching of toxic materials into the environment during handling
		Unmanaged solid waste
6. Legal and regulatory	6.1 Regulation of the services sector	Lack of standards in supporting measures e.g., warranties, certification of installers etc.
	6.2 Standards and enforcement	Enforcement of policies, standards, regulations etc.

		Operating standards for second-life batteries
7. Awareness and capacity	7.1 Lack of awareness	Lack of awareness of various stakeholders regarding battery technology, especially second-life uses
		Lack of compelling research in specific contexts about second-life uses

Given the barriers detailed above, making it possible to use this technology in the first place is an important purpose of an enabling policy environment. This can allow countries—South Africa in this case—to take advantage of increased efficiencies (resource use, revenues) and other benefits. The second, and perhaps more critical, purpose is to ensure that these batteries—which must ultimately be disposed of—are handled safely and securely to avoid risks to people and the environment. Table 28 summarises various policy measures to address the identified barriers.

Table 28: Policies to overcome barriers to market deployment of second-life EV batteries in South Africa

Name of the Policy Measure	**Barrier addressed**	**Policy design details**	**Responsible Institutions**	**Remarks**
Extended producer responsibility	Unsafe operation and handling of used batteries Purpose of the policy: Identifying responsible and accountable parties for any waste generated	Extended producer responsibility (EPR) functions as a policy tool embodying the 'polluter pays principle', whereby the producer is held accountable for the environmental and social costs and awareness-raising efforts across every stage of a product's life cycle, from eco-friendly design to end-of-life management. EPR can thus lead to reduced or better managed waste, and can help increase material repurposing by providing the right incentives to producers. However, consumers may face additional costs if manufacturers transfer the expenses of EPR compliance onto them (McNamara, 2023).	Department of Forestry, Fisheries and the Environment Producers and producer responsibility organizations (PROs)	Extended producer responsibility (EPR) regulations have been a critical step for waste management globally. South Africa implemented EPR regulations in 2008, initially focusing on plastics and packaging, but more recently expanding to include portable batteries (National Environmental Management: Waste Act of 2008; DoFFE, 2023). South African regulations align with global norms by holding producers accountable for any waste generated. Nevertheless, the amendment specifically excludes automotive batteries, and it remains ambiguous whether this exclusion

				pertains solely to electric vehicle (EV) batteries. In addition, a proliferation of single-purpose PROs was cited as a challenge in ensuring policy and standards alignment as well as a regulatory burden, as producers active across multiple sectors must be registered with a PRO responsible for a specific waste stream [T1].
Regulations for liability across the recycling value chain	Unsafe operation and handling of used batteries Purpose of the policy: Clarifying unclear liability for and responsibility for second-life batteries in the recycling process	While EPR regulations may account for end-of-life products, additional regulations may be required for repurposed products, such as second-life batteries. One of the interviewees [N1] suggested including multiple check in points in which liabilities shift from mobility company to the recycler and back. Regulations can clearly establish this liability—whether it remains with the manufacturer, or with the recycler, and at what stage of the process—through strict monitoring and tracing of the battery. Unclear regulations may lead the 'owners' of the battery to simply recycle them rather than risk further accidents after they are repurposed.	Department of Forestry, Fisheries and the Environment Battery recyclers, transportation companies, battery producers	
Battery 'passports'	Unsafe operation and handling of used batteries Purpose of the policy: Providing sufficient information on battery components and traceability	Battery passports can provide unique and traceable information for each battery pack. They can improve supply chain traceability as they track digitally a battery's production and use throughout its lifecycle, which can help track defects and recalls. By providing information about chemical composition, they can also make recycling and repurposing efforts easier. Such a framework can play a crucial role in improving transparency and management	Department of Forestry, Fisheries and the Environment Department of Trade Industry and Competition (for imported/exported components)	The EU recently adopted a regulation that makes it mandatory for certain batteries to have a 'passport'. This includes EV batteries, light means of transport (LMT) batteries and rechargeable industrial batteries with a capacity above 2kWh (European Parliament, 2022

		of the used-battery waste stream (Global Battery Alliance, 2024).	*Battery importers/exporters*	[2023]). The regulations also provide guidelines on the readability and format of the information to be provided (DNV, 2024).
Mandated capacity building and training, including collaborations with industry actors to identify gaps and conduct the training	Unsafe operation and handling of used batteries Purpose of the policy: Developing adequate skills and protections for workers for handling and processing	Used EV batteries can be quite dangerous if mishandled, proving to be a significant fire risk [N1], which can further create a risk of toxic pollutants contaminating the environment. Collaboration with the extended stakeholder environment—including existing producer responsibility organisations that work directly with industry, waste- pickers associations, battery recyclers, battery manufacturers, etc.—to provide relevant information on handling used batteries and repurposing them (including safe storage, monitoring, dismantling, and handling practices) is essential. Such training can be supplemented by official certifications.	Department of Employment and Labour Department of Higher Education and Training Department of Trade, Industry and Competition South African Safety and Security Sector Education and Training Authority (SASSETA) Industrial Development Corporation *Battery producers, recyclers, transport companies, waste collectors and associated organizations*	Even if legislation such as the *Second-Hand Goods Act* (2009) set enabling frameworks, local communities and waste-pickers are not always aware of its implication, which underlines the necessity of an education-driven approach [T1]. Moreover, our interview partner described a lack of trust of the government by waste pickers and flagged the urgent need for a new and more representative waste-pickers association [N1].
Safety regulations specifically targeted at battery recycling facilities	Unsafe operation and handling of used batteries: Purpose of the policy: Ensuring safety in transport, handling, and storage of batteries	Ensuring that facilities and transport that handle used batteries deploy adequate safety measures and precautions, e.g. proper storage, fireproof containers, sensors, regular safety inspections, etc. will be critical to minimise workplace accidents owing to the risk of battery recycling and repurposing. Existing occupational health and safety requirements can be supplemented with regulations specific to battery facilities,	Department of Employment and Labour Department of Health South African Safety and Security Sector Education and Training Authority (SASSETA)	In Germany, the technical inspection association (TÜV) carries out safety inspections that are prescribed by state regulations and laws [N1]. A similar occupational safety organization in South Africa can be made in charge of battery recycling/manufactu

		including regular inspections. Documentation and reporting requirements can help trace incidents and prevent future accidents [N1]. Battery recyclers and handlers can also be incentivized to develop their own standards in the absence of regulation, in a collaborative manner with regulators, to ensure the safety of everyone involved. In addition, specific certifications should be issued for installers of systems that use second-life batteries, such as fire safety, temperature control, etc. One of the barriers highlighted was the lack of oversight regarding unsafe installations for solar home systems and a lack of recourse; such a certification system can be developed along with industry actors as is being done in the solar space (e.g. PV Greencard by SAPVIA).		ring facilities, if their mandate allows.
Develop official regulations and standards to ensure safe second-life uses	Unsafe operation and handling of used batteries: Purpose of the policy: Ensuring proper operational safety standards for second-life batteries	To allow for repurposing, safety standards must also be brought out that define safe operating parameters for repurposed batteries, such as state-of-health. Battery cells and packs that do not meet these criteria may be deemed safer for direct end-of-life treatment. To ensure compliance and buy-in, such standards and regulations can be carried out in collaboration with industry stakeholders.	Department of Forestry, Fisheries and the Environment Department of Small Business Development Battery manufacturers, recyclers	This will require collaboration with battery manufacturers and the transparent sharing of information. Such information disclosure can be mandated, and efforts should be made to standardize this information.
Proper safety labelling	Unsafe operation and handling of used batteries: Purpose of the policy: Ensuring user safety	For batteries in general and especially second-life batteries, proper information regarding safe operating temperatures, d how to react in case of an accident, or how to identify potential problems, should be adequately displayed on packaging or on the battery so the user is aware. Other information such as where to find drop-off points for disposal can also be displayed to ease collection and safe handling practices.	Department of Forestry, Fisheries and the Environment National Consumer Commission Batter recyclers/resellers	Once familiarized with the possibilities of second-life batteries for domestic uses, when communities start to use second-life batteries for energy storage or micromobility, knowledge on how to handle them is key for user safety. This education on environmental waste management and safety standards is supported by the non-profit sector but

				can be boosted by public policy frameworks [T1]. Open-house days can be a supportive measure to explain battery recycling to communities and raise awareness for battery collection [N1].
Establishing designated collection points for used EV batteries	Unsafe operation and handling of used batteries: Purpose of the policy: Safe collection of used batteries	Electric vehicle batteries that have reached the end of their first life must be disposed of adequately. Ensuring that there are sufficient collection points with safe storage options is critical [N1]. For example, at automotive workshops or designated locations at the municipality level, or through official recyclers or other designated actors. Collection points must be accompanied with appropriate safety guidelines, linked with general safety procedures for battery handling, such as signs and ensuring separate storage. A similar practice was indicated by an interviewee [N1].	Department of Forestry, Fisheries and the Environment Municipal waste management departments Commercial stores, waste management companies, automobile value chain (manufacturers, workshops, etc.)	
Define appropriate penalties or incentives	Weak enforcement framework Purpose of the policy: Ensuring proper enforcement of policies, safety standards, and any associated penalties to provide sufficient incentives/disincentives for actors across the value chain	In line with ensuring the safety of facilities and transport, South Africa must ensure that adequate enforcement follows any regulations. Numerous interviews have highlighted the fact that while policies in South Africa may be in line with global best-practices, enforcement is the challenge [T1, R1]. Interviewees listed significant fines, and even imprisonment as possible enforcement mechanisms [T1]. While penalties can be punitive, other interviewees also suggested a more collaborative approach between industry and regulators, including multiple rounds of warning, with time to implement changes [N1].	Department of Forestry, Fisheries and the Environment	Defining a high standard for all actors as soon as possible can help avoid situations where leading industry actors are effectively penalized for high safety standards [indicated by N1]. Positive incentives such as collection targets can be supplemented by negative incentives such as landfill fees (see Nurdiawati and Agrawal, 2022) and other punitive payments if required. Here, as well as for the entire chain of treatment and recycling of the batteries, a

				transparent methodology for identifying misbehaviour and assigning remediation or penalties accordingly is key (RMI India and RMI, 2022).
Ensure vertical and horizontal policy alignment and integration	Lack of awareness Purpose of the policy: Aligning jurisdictions across local, provincial, and national governments	Allowing for the safe use of second-life batteries requires alignment in policy across the national, provincial, and local governments in South Africa. The National government can set certain standards to be met, such as safe operating standards or information disclosure requirements, but local governments can define specifics e.g. local collection points, engage with local stakeholders, etc. to enforce these and also to feed back into national policy to address any gaps (Moyo et al., 2022).	Department of Forestry, Fisheries and the Environment Municipalities/ cities Provincial governments	
Eco-design	Lack of awareness Purpose of the policy: Limit the proliferation of different battery designs and move towards standardization and cross-compatibility of software, etc.	Eco-design of EV batteries can be promoted by regulatory requirements or by economic instruments, such as fiscal incentives. Both mechanisms help to reduce low-quality, harmful to the environment and non-standardized products to facilitate remanufacturing and to enhance the lifespan and the safety of batteries (Dong et al., 2023). These standards in design will impact the monitoring of the state of health (SOH) of batteries, which is important for their recycling and reuse.	Department of Forestry, Fisheries and the Environment Battery manufacturers	Studies on the optimization of eco-design of EV batteries show a significant decrease in the environmental impact of the battery's life cycle, taking into consideration indicators such as global warming, fossil fuel use, and freshwater ecotoxicity potentials (Zhang et al., 2020).
Capacity building on sustainable procurement processes	Lack of awareness Purpose of the policy: Ensuring the sustainable use of second-life batteries in the electricity system, for small- and large-scale projects alike	Despite the growing interest in electricity storage in South Africa, there is insufficient awareness around end-of-life management of batteries [R1]. One potential tool to ensure that ethical, social and environmental standards are included in the deployment of this technology is sustainable procurement. End-of-life management can be clearly defined in a procurement process in the absence of other accountability measures.	Department of Education and Training Department of Employment and Labour Eskom and other publicly-owned utilities Other project implementers,	

		This training can include a wide range of actors, including development organizations. Some interviewees pointed to the fact that such considerations were not present in past pilot projects involving battery systems [F1, F2]. It is important that all actors dealing with battery systems are aware of end-of-life management practices and account for them in their work.	private sector entities	
Financial support for research and pilot projects	Lack of awareness Purpose of the policy: Providing hands-on use cases and experience to identify obstacles and improve capabilities	By financially supporting and promoting research and development activities as well as demonstration projects (RD&D) that seek to demonstrate the technical and financial viabilities of first-life uses as well as second-life battery solutions (Global Sustainable Electricity Partnership, 2021; Nurdiawati and Agrawal, 2022; interview R1), the feasibility of the use case as well as the required safety measures can be explored. RD&D plays a pivotal role in driving the evolution of innovative technological ideas and can catalyse their integration into the market. Such projects can also help with 'soft' skills, such as sustainable procurement, that can be used to build the idea of end-of-life management of battery systems into the project design and execution itself [R1, F1, F2].	Department of Science and Innovation Various government departments through grants Development finance institutions	A government study on the safety of second-life batteries from the UK shows that safety is linked to knowledge of the first life applications of batteries (Christensen, Mrozik and Wise, 2023).
Recycling and reuse targets for manufacturers	Improper waste management Purpose of the policy: Promoting recycling and repurposing over landfilling	Respecting the waste hierarchy results in diverting waste from landfilling towards other waste management options. Shifting towards reuse and recycling technologies supports the development and growth of a secondary resource economy and is based on e-waste collection. One can currently observe an absence of economic drivers to recycle, meaning that policy intervention to incentivise recycling is required to enable technology shift (Nurdiawati	Department of Forestry, Fisheries and the Environment Battery manufacturers, recyclers, producer responsibility organizations	In 2017, in South Africa only 9.7% of e-waste was recycled and 90.3% landfilled (Moyo et al., 2022). To raise the share of recycling, legislative action is needed. For instance, South Korea made it mandatory for battery makers to use certain portions of minerals (such as nickel, cobalt, and

		and Agrawal, 2022). Regulatory requirements for manufacturers to meet recycling quotas and targets, which are integrated into long-term goals, strategies, and roadmaps can be critical incentives. Encouraging recycling and alternative uses can incentivize manufacturers to design with recyclability in mind, and to consider second life uses to improve the economics of batteries.		copper) from waste batteries, (Lee and Kim, 2022).
Mandate collection targets for battery waste	Improper waste management Purpose of the policy: Improving collection rates of used batteries	Clear and achievable targets for the collection of battery waste are important. South Africa has done something similar under its existing EPR regulation, but this does not yet apply to EV batteries. Moreover, establishing mechanisms for monitoring and evaluating progress towards waste collection targets is key to track the effectiveness and progress.	Department of Forestry, Fisheries and the Environment Municipalities Battery recyclers, waste collectors' organizations	Meeting waste collection targets ensures compliance with environmental regulations and international standards, demonstrating a commitment to responsible and sustainable waste management. For instance, the EU's battery regulation establishes targets for collection for portable batteries (45% by 2023, 63% by 2027 and 73% by 2030) and for LMTs batteries (51% by 2028, 61% by 2031) (European Parliament, 2022 [2023])
Clarify and expand the existing regulatory framework to allow for repurposed uses (definitions, approvals, classification, etc.)	Improper waste management Purpose of the policy: Developing clear guidelines allowing for the use of second-life batteries	In the absence of clear regulations, the transport and storage of used batteries can fall, from a legal perspective, under the category of hazardous materials and hazardous waste, which can cause delays in securing approvals and increases the costs of their transportation, storage, and recycling. Revising waste classifications and import guidelines can reduce regulatory barriers for "healthy" batteries (McNamara, 2023),but must be accompanied by having more information on the status of the battery. This can be done in the interest of resource-use efficiency and reducing the	Department of Forestry, Fisheries and the Environment Department of Mineral Resources and Energy	Some interviewees pointed to the fact that there are unclear or unavailable definitions of certain terms, such as 'energy storage', which can hamper the use of these technologies. If their role in the energy system is unclear, their roll-out is affected due to a lack of clarity about the associated responsibilities and liabilities of the owners of these technologies [R1].

		cost of batteries for legitimate uses. Import restrictions can be clarified to allow the reuse of batteries if they adhere to certain standards in line with international practices, or other information disclosure standards.		Additionally, not assigning the status of waste to batteries after the end of their first life use can foster their reuse and unlock economic potential. Therefore, they can keep their status as a product or as a resource for minerals (Moyo et al., 2022) and do not need to be treated under (hazardous) waste requirements. Only when manufacturers evaluate that a battery cannot be used, reused or recycled, it is defined as waste. This can help foster legal development towards circularity (U.S. Environmental Protection Agency).
Global advocacy and partnerships	Lack of awareness: Need for international coordination	Global advocacy and strategic partnerships can be crucial for the reuse of batteries in a second-life application. For instance, the idea for a regional hub for battery recycling was discussed among African decision-makers as part of the *African Continental Master Plan* [R1], which can be a good solution to adopt a more regional approach and can also tackle the issue of an inadequate EV battery supply. Furthermore, a uniform EPR policy across Africa can support the development of an intra-African responsible e-waste economy and trade, which can be supported by organisations such as the *EPR Africa Forum* [T1].	Department of International Relations and Cooperation Department of Trade, Industry and Competition Department of Forestry, Fisheries and the Environment	South Africa is a member of the Basel Convention, an international treaty to regulate the transboundary movement of hazardous waste. Such international mechanisms can be useful for coordinated dialogues on issues such as second-life uses of used batteries.

3.4.4. Guidance for Policy Roadmap Development

Table 29: Policy-specific timelines and a long-term vision for second-life battery use in South Africa

Name of the Policy Measure	Short-term (0–3 years)	Medium-term (4–10 years)	Long-term (10+ years)	Remarks

Ensuring the development and enforcement of safety standards (across the value chain, and for consumers)	Begin consultations with relevant stakeholders (automotive industry, battery recyclers, waste pickers, producer responsibility organizations, NGOs, etc.) about the looming challenge of waste batteries Follow developments globally to find policy alignments e.g. common standards, information disclosure, etc. Identify how to localize policies as much as possible to suit SA's unique circumstances. Conduct studies of the various ecosystems existing for installation and maintenance, and battery recycling—what facilities, safety standards, etc. Engage in international partnerships or processes to learn and contribute to global best practices, particularly with neighbouring countries for a more coordinated regional approach, or with leading countries such as China, USA, and European countries *Resources: Experts, research and development funding*	Integrate EV batteries into existing legislation regarding EPR Develop a system of monitoring and inspection, as well as incident reporting guidelines, to ensure clear accountability and liability Develop associated workplace safety guidelines for batteries and integrate them into existing legislation Certify trusted certification programs for installers Collaborate with waste pickers organizations, keeping in mind existing challenges with these associations [T1] Explore synergies with other countries in Africa, for example to examine regional approaches to battery waste Develop clear communication and information disclosure standards regarding repurposed batteries for consumer awareness Have in place a robust monitoring and verification system to ensure safe handling of batteries and operation of recycling facilities Designate a one-stop-shop for lithium-ion battery recycling and repurposing	Have in place strong safety guidelines for battery recycling and repurposing with strong compliance and buy-in from various stakeholders	Interview T1 indicated consultations are already underway in South Africa, as are capacity building activities for waste pickers

		(information management, complaints, etc.) *Resources: Human resources (inspectors, social experts, industry associations)*		
Waste management (allowing for second-life uses, and encouraging recycling and collection of waste)	Clarify existing regulations regarding the reuse of used EV batteries (or other comparable batteries) in South Africa Expand recycling targets to include EV batteries and other batteries used for energy storage Expand waste collection targets to include batteries EV batteries and other batteries used for energy storage *Resources: Human resources (inspectors, social experts, industry associations)*	Work with local recyclers and battery manufacturers/owners to sensitise them about circular business practices Clarify and enforce recycling and collection targets through a robust system of penalties or incentives Adapt the approach as needed in response to the growth of EVs or other battery storage systems in SA (e.g. updated targets, standards, etc.) *Resources: Human resources (inspectors, social experts, industry associations)*	A large percentage of materials from batteries are recovered, creating a strong base for circular practices including 'urban mining'	Given that there are many informal actors active in South Africa's waste-management sector, efforts will be needed to ensure that there is improved trust and transparency between them and the government, which goes beyond second-life battery handling [indicated by T1].
Increasing awareness and capabilities (of the possibility of second-life uses, and challenges associated with battery recycling)	Consult with local governments about the scale of the battery recycling issue Work with expert organizations to understand the potential of second-life batteries as well as the challenge posed by proliferating battery waste *Resources: Experts, research and development funding, improved multilevel government communication*	Streamline policies across national, provincial and local governments regarding used batteries Implement pilot projects to understand local impacts, as well as the procurement process, end-of-life management, safety concerns, etc. [R1] *Resources: Experts, research and development funding, improved multilevel government communication*	A robust waste management ecosystem is in place International collaboration and agreement regarding cross-border movements of batteries	Improve coordination on this topic across multiple levels of government (national, provincial, local) for a more dynamic policy-making process that allows for robust feedback and the scaling-up of successful approaches

3.4.5. Policy Briefs on Good Practices

Country Context

Following a detailed barrier analysis, desk research, and several interviews with relevant stakeholders, a policy roadmap was developed that provided recommendations aimed at facilitating the use of second-life electric vehicle (EV) batteries in South Africa.

The initial findings indicated that the management of EV batteries is not a policy priority, given their low market penetration in South Africa. When it comes to increasing the utilization of second-life batteries, the limited supply of batteries is a barrier in itself. This supply constraint spawns several other challenges, beginning with a limited awareness of the issue. This lack of awareness results in policy uncertainty regarding its use. This lack of policy focus further contributes to a skills and resource gap in the battery recycling and processing sector, thus increasing the risks associated with handling this waste stream, both for people and the environment. This lack of a robust value chain can lead to higher costs for battery repurposing (at least initially), which further hampers the business case. This is critical as the cost advantage of second-life batteries (estimated to be 30—70% by 2025) is often highly dependent on the cost-effectiveness of the repurposing process (Engel and Hertzke, 2019).

There are, however, forward-looking discussions in South Africa about the management of this waste stream. Key policy frameworks, such as extended producer responsibility, are already in place for other technologies (such as plastics, or portable batteries. The policy roadmap emphasized the need to expand the scope of these policies to include electric vehicle (and other similar) batteries while placing safety concerns at the core of any policy efforts. Such measures could include more robust enforcement mechanisms, improved safety standards and training, greater information disclosure about battery sourcing and components, collaboration with industry players, clear allocation of liability for various stages of repurposing, improving collection rates and associated safety practices, among others. This policy brief draws on the experiences of other countries and describes two such policy measures or approaches that could be adapted to South Africa's context.

Good practice policies

Table 30: Regulatory frameworks for circular approaches

Policy type	Regulatory frameworks encouraging circularity in batteries (European Union's Batteries Regulation of July 2023)
Location of implementation	European Union
Background / state at the outset	Typically, batteries have been disposed of at the end of their life and treated as hazardous waste. The older European Union (EU) 'Batteries Directive', adopted in 2006, had set several environmental standards for batteries (such as maximum permissible levels of certain chemicals and metals) and required proper waste handling (collection, recycling, final disposal). It set certain minimum (or maximum) standards, which member states were free to adopt or even exceed (European Parliament, 2006). Until 2023, electric vehicle (EV) batteries were covered under this Directive (which would have been concretized in each member state through national legislation, which may have been updated in the meantime). While useful for end-of-life management and disposal, the specific

	considerations of EV batteries, lifecycle considerations, as well as technological development since 2006, had not necessarily been taken into account at an EU-level. When a revision of this Directive was announced in 2020, battery demand globally was projected to increase up to 14-times by 2030, with the EU accounting for almost a fifth of this demand. Moreover, the number of lithium batteries ready for recycling are expected to increase 700 times between 2020 and 2040 (European Commission, 2020a). This required the adoption of stronger rules to improve the overall sustainability of the battery sector and sustainability of the value chain. Given the rise in battery demand since 2006, a revision of the Directive was proposed, leading to the adoption of the Batteries Regulation in July 2023 (DG-ENV, 2023).
Policy description	The EU Batteries Regulation (Regulation (EU) 2023/1542) adopted in July 2023 replaced the previous European Battery Directive. As a Regulation, it does not need specific legislation in each member state to come into force (as was the case with the Directive) and has the status of a law when adopted. Its implementation follows a staggered approach, with some requirements slated to go into effect in 2024 and others in 2025 or later (European Parliament, 2023). The EU Batteries Regulation is a holistic regulation, accounting for sustainability metrics across the lifecycle of a battery (including the carbon footprint, ethical sourcing of raw materials, possibility of re-use and repurposing, etc.), establishing guidelines and requirements at each step from manufacturing, operations, to end-of-life disposal. It also aims to increase the rates of recycling and the use of recycled materials in new batteries by setting targets, which can incentivize manufacturers or importers to invest their resources accordingly. It clearly defined the scope of batteries that fall under the regulation, which is essentially all batteries being brought into the European market, and expanded the definition of batteries to include those used in vehicles. It specifically allows for repurposed batteries, which will also be covered by the regulations that apply to all batteries entering the EU market, including imported used batteries. It also defines the need to develop easily removable or replaceable batteries, such as portable or light motorized transport (LMT) batteries, which can indirectly contribute to their use in second-life applications. In addition, it provides performance and durability requirements for portable batteries. The main barriers addressed include awareness about the potential of sustainable practices in batteries, as well as the absence of supporting legislative and regulatory frameworks (or, rather, outdated ones). In the EU, in comparison to South Africa, battery waste management is a much more pressing concern, and so some of the barriers to second-life battery adoption that are present in South Africa are absent in the European Union.
Outcomes	The intended outcome was to create a more sustainable battery ecosystem. This includes improving overall resource use through the adoption of circular practices, as well as batteries that are less detrimental to the environment and human health across the entire value chain. New enforceable regulations, such as design parameters, information disclosure requirements, collection targets, etc., were defined. Penalty mechanisms were left to be determined by individual member states, provided they are “effective, proportionate and dissuasive” (European Parliament, 2023).
Success factors	• Clear provisions for enforcement mechanisms and penalties, as well as strong state capacity for monitoring and enforcement across most member states. • Given the structure of the EU, a coordinated regional approach was adopted. Individual member states still have some autonomy in defining higher standards or appropriate penalties, but the overall approach was coordinated across the EU. This can be something to consider for other countries, such as southern Africa (a similar point was discussed in the policy roadmap). • Thorough policy development process that engaged a wide range of stakeholders, soliciting feedback across multiple rounds (European Parliament, 2021; European Commission, 2020b).

	• Phased implementation, providing sufficient advance notice for manufacturers, importers, etc., to align their operations to comply with upcoming new regulations • Built-in review process to understand the successes/shortcomings of the Regulation by 2031 (European Parliament, 2023)

Table 31: Battery information disclosure

Policy type	Battery information disclosure/transparency and labelling
Location of implementation	European Union
Background/state at the outset	Battery safety labelling was already put in place in the European Union under the Batteries Directive (2006). These were mostly limited to hazardous chemicals or metals and basic instructions regarding appropriate disposal. However, as newer categories of batteries and digital technologies have entered the market, they have not necessarily been incorporated into policy and regulatory frameworks. With the rapid growth of electric vehicle (EV) batteries and battery management systems, new forms of information are available to be disclosed, including the state-of-health (SoH) of the battery, composition, ESG criteria to better track supply-chain sustainability, etc. This has become increasingly important as the demand for batteries is set to grow very rapidly, requiring an increasing demand for raw materials as well greater consideration of the environmental impacts of their extraction, as well as the operation and final disposal of these batteries as they often contain toxic or hazardous materials. The scale of the waste management issue is likely to grow in lockstep with the demand for batteries, necessitating approaches that bring greater efficiency in the use of batteries (including second-life uses), incentivize the reuse of materials from old batteries, and make recycling of materials a viable and lucrative end-of-life management strategy. All this necessitates increased information disclosure to better track batteries across the supply chain, determine their recyclable components, potential for re-use, etc.
Policy description	The European Union addressed this need for greater transparency and awareness regarding battery components and operating parameters through the introduction of a ‘battery passport’ under its recent Batteries Regulation (European Parliament, 2023; Rizos and Urban, 2024; EPBA 2023). This ‘passport’ would feature different kinds of information for different categories of batteries (European Parliament, 2023).

	A battery 'passport' is a digital document or 'twin' of the battery that provides information about its materials, value chain and manufacturing history, ESG criteria, etc. (Global Battery Alliance, n.d.) The 'passport' can overcome informational and awareness barriers regarding battery components and its health, helping determine its suitability for reuse as well as its potential for providing recyclable materials, which can allow recyclers to better sort and recover materials. It is also digital, meaning the information is easily accessible via a QR code on the battery. This can also help address the cross-border trade of batteries. Consumers can also access information about proper disposal, which can contribute to improved collection rates. Moreover, each battery has a unique identifier that can help track it from the time of production to final disposal and improve general tracking and collection processes.
Outcomes	Improved tracking across the battery lifecycle can help improve accountability across several parameters (such as materials contained, ESG criteria, the value chain and manufacturing history, carbon footprint, battery lifetime, etc.). Such tracking forms the basis for identifying shortcomings and improving sustainability across the value chain, including material sourcing, battery operations, recycling, and end-of-life disposal.
Success factors	• Given the cross-border flows involved in any supply chain, setting international standards for information disclosure on battery passports would enhance their utility and ensure consistency • Deploying technologies such as blockchain that can help secure data and prevent manipulation, which can increase the reliability of these 'passports' • Ensuring these passports can be integrated into existing supply chain management systems will help with uptake • Defining transparency requirements, e.g. a list of criteria that must be included, ensuring a reliance on open-source standards, interoperability, etc. • Engage with stakeholders across the battery value chain to determine common guidelines and best practices regarding data disclosure

3.4.6. Summarising Remarks

Energy storage—small- and large-scale—will play a key role in enabling South Africa's transition to a more stable, reliable, and renewables-based electricity grid. All options are on the table, including new batteries as well as used EV batteries that provide a potentially significant cost advantage. However, the use of second-life EV batteries is a newly emerging area that faces several barriers. These include an inadequate supply of used EV-batteries and an associated lack of awareness and capabilities to handle this waste stream and its eventual

repurposing and recycling. This can lead to unsafe practices which can pose serious risks to health and safety, as well as the environment. In addition, given these challenges, the regulatory framework is also currently insufficient to enable the widespread and safe use of second-life batteries.

The proposed policy framework provides a holistic approach to address these barriers. It has three main pillars: ensuring the development and enforcement of safety standards (across the value chain, and for consumers), improved waste management (allowing for second-life uses, and encouraging recycling and collection of waste), and increased awareness and capacities (of the possibility of second-life uses, and the challenges associated with battery recycling).

The most important institutions are national ministries, primarily the Department of Forestry, Fisheries and the Environment (DFFE), but it is clear that inter-departmental collaboration will be needed for the truly safe use of second-life batteries. The importance of partnerships with industry actors, educational institutions, battery manufacturers, recyclers, waste collectors, municipalities, and so on, cannot be overstated.

The most relevant activities to start as soon as possible would be to consult relevant stakeholders, experts, global frontrunners, and citizens to help develop an enabling framework for this use case. Frontline actors such as municipalities, waste collectors, etc. can be engaged relatively quickly to be able to handle increasing volumes of e-waste, including EV batteries. Long-term steps include developing streamlined policies across government levels in order to create a robust waste- management ecosystem. Such an ecosystem would enable greater circularity—ensuring that the most value is extracted from existing batteries, and that a robust recycling infrastructure is in place to recover materials and improve resource use—while putting in place high safety standards.

To realize this vision, soft-skills and human resources, such as a skilled workforce and improved administrative capacities, are crucial. Finance for research and development on the safe operation of second-life batteries and associated pilot projects will also be important.

To summarize, some of the key takeaways that are relevant for policymakers are:

- **Safety first:** While used batteries have many similarities with waste products, their technical specifications create an added safety risk, including fires, toxicity, etc. The priority of any policy environment should be to promote the safe use of second-life batteries, and prioritize such measures when it comes to collection, dismantling, repurposing, transporting, and finally disposing of such batteries.
- **Multistakeholder partnerships:** Policies must be developed with the input of various stakeholders, both from the formal and informal sectors. Industry actors, such as recycling firms and producer responsibility organizations (PROs) can help national authorities to define safety standards and practices. Organizations working with waste-pickers and other informal workers should ideally also be consulted, as they may encounter such waste and need to know how to handle it appropriately.
- **Context-specific development of policies:** While many of the policy best practices have already been implemented in European countries, the USA, etc., South Africa's context is unique, and so efforts should be taken to localize such policies according to the needs of various actors involved in the recycling process.
- **Act with foresight:** Regulations and procedures to handle this waste stream are best developed soon to put in place at least some initial measures/competencies. Depending on how South Africa's electric vehicle market grows, it is better to establish safe

practices sooner rather than later, and to not wait until used EV batteries become a significant waste stream in the future.

- **International cooperation:** Learning from other countries about their experiences instituting relevant measures can help bridge the capacity and awareness gap. In addition, cooperating with neighbouring countries in southern Africa can help develop a more coordinated regional approach that can take advantage of economies of scale, etc. Invest in capacity building and awareness raising: This is particularly important for regulators, utilities, and other actors that may be involved in renewable energy or storage projects. Raising awareness about the technical specifications of used batteries can help improve the chances of their safe operation. Moreover, increasing awareness of the necessity of end-of-life management can help establish good practices, such as accounting for such measures in public procurement processes.
- **Implementation can start small:** Pilot or demonstration projects can be worthwhile to showcase the use case of these batteries, raise awareness among consumers and producers alike, as well as to test the functioning of administrative processes such as those related to procurement.
- **Work with subnational governments:** As it often falls on local governments to handle waste-related issues, the national government should engage them in the development of standards, targets, etc., as well as invest in capacity building to enable them to handle this waste stream.

3.5. PVs for Household in Morocco

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3.5.1. Introduction

Morocco is one of the countries on the African continent that has made plausible steps towards low carbon growth in the energy sector by making decisive efforts to diversify its energy mix by including renewable energy sources. The renewable energy share in the country was at 37.08% in 2021, solar energy contributing 7.08% (Rabab, 2023). The country's renewable energy targets stand at 52% of the energy mix, of which 20% is solar by 2030. The solar PV systems in Morocco were introduced on large scale through the rural electrification programme-RERG which has been instrumental in meeting the electrification targets for the population (GEGLOBAL, 2022). The programme installed more than 50,000 off grid system that covered around 100,000 homes and totals to 20 MW (ibid)
However, the solar PV barrier analysis study for Morocco done through the SESA project identified several barriers to the deployment of this technology in the country, which are outlined using the PESTELA framework:

1. Political barriers

There are several barriers identified under this category from the Barrier analysis report, however, for this report, two major ones are considered. While the mainstreaming of PV solutions was driven by the government's commitment to provide electricity to 100% of households (or population), the private sector/association representative pointed out the lack of a dedicated policy for PVs for household use, another political/regulatory barrier is the cost of electricity. The country's approach on private producers is to offer the electricity under a fixed grid feed in tariff which is not necessarily a reflection of market prices.

2. Economic and financial barriers

One of the biggest challenges that solar PV users are facing is the upfront investment cost. In Morocco, it is currently affordable for only relatively affluent customers with direct access to rooftop spaces where PV installations can be placed. The possibility of households having a dedicated energy storage facility was considered unrealistic for most users. In 2018 some sources reported that 100% of solar PV systems were imported mainly from China (REGLOBAL,2022), rendering higher upfront costs.

Related to the barrier mentioned above are the many legislative hurdles and additional financial costs encountered in the importation of new products linked to taxation and certification.

Household-level solar PV users would like to be able to sell back the excess electricity to the grid. Currently, this is not possible due to technology constraints, as it may cause grid instability, but there are no regulations in place to facilitate this. Selling back electricity to the grid is considered as one of the ways to manage the related costs of PV installations.

The existing taxing system is not supportive of self-generated electricity as it was pointed out that products offered via the grid were taxed at a level of 14% VAT while self-generated energy was at 20% VAT. Added to this is the absence of government and donor support on solar PV-related importation taxes and certification as opposed to private sector and large-scale investment by government programs that received support from donors.

Lastly, financing facilities for private individuals are still dependent on conventional loans as opposed to concessional loans where the latter will offer low interest rates. Other financial incentives target predominantly large-scale installations and new companies entering the PV market but exclude private individuals.

3. Technology and infrastructure barriers

One key factor on solar PV sustainability is considered to be the ability for individuals to sell the excess power back to the grid, however this is still technologically challenging and the feasibility of the same needs to be assessed.

Another technology-related barrier is the absence of proper oversight of the PV installations; each company varies in how they approach the installation process. Over time, with a lack of attention to maintenance, other technical issues may appear. Additionally, one of the experts pointed out that most companies specialize in installations and the maintenance skills are not yet truly tested or prioritized.

4. Environmental barriers

The recycling of PV-linked materials is still not thought through. As widespread use of PV accelerates in the country, it becomes crucial to have recycling measures in place.

5. Legal and regulatory barriers

The most recently passed regulation in 2022 allows households to sell 20% of the power back to the grid, however, the details on the procedures and in what manner are not in place. There needs to be a regulation in place that stipulates more precisely how this is meant to happen.

6. Awareness and information barriers

The main area identified as needing attention on awareness raising is the issue of maintenance requirements to enhance safety and sustainability, also to avoid technological hazards that can be experienced at household level. There is also a gap in awareness raising in educating children and youth and on the benefits of solar energy.

Other barriers identified in literature include low flexibility in the existing power system structure which applies not only to roof top solar PV technology but generally to all other technologies identified to support the energy transition strategy of the country.

3.5.2. Data Collection

The overall objective is to create an understanding among partners on the relevant steps that are necessary to address barriers from a policy roadmap. The following questions guided the data collection:

- What additional priority policies need to be implemented to overcome deployment barriers and to create an enabling policy framework in the respective case study?
- How do activities and resource needs of additional priority policies need to be organised in the short-, medium- and long-term?

This study was mainly conducted through a literature review of policies and practices elsewhere around the globe and more specifically in Africa that are implemented to address the identified barriers to deployment of solar PV in Morocco.

One interview was conducted at the beginning of the study to orient the author on institutions, regulations, and energy and solar PV policies programmes in Morocco and links shared for further research. Further interviews were not carried out due to challenges faced in reaching out to experts. Table 32 below summarizes a list of policies/regulations in the country and the barriers they address.

Table 32: Morocco energy-related policies and their relationship to barriers identified

Policy/regulation/strategy/Programmes/ instruments	Addressed barriers	Comment (from literature search)
Renewable Energy bill	No	-
Moroccan Solar Energy Plan	No	Mostly based on large-scale production, does not necessarily address solar PV barriers
Renewable Energy Development law	No	
Net metering legislation (Law No. 58-15)	Yes	Ambiguous as it is still mentioned as a barrier
National Energy Strategy	No	-
Law of self-generation	Yes	-Allows self-entities to produce electricity for their own needs. -All grid users pay service charge, this may be further hindrance to solar PV -Purchase price of power by the grid from self-producers will be fixed by the National Electricity Regulation Agency (ANRE)(Chance, 2023).
Green bonds	No	Offered financing for large scale solar production
Energy Strategy? **Law 13-09**	Yes	Allowed access to production and marketing of RE by private sector (Rim, 2021) [7].
Law 40-19	No	Under consideration to endure market liberalization for Independent Power Producers (IPPs) to access high and medium voltage markets

Law 16-08 and its amendment 54-14	Yes	Allows public, private sector and individuals to produce their own electricity (Chance, 2023).
Energy and Energy efficiency plan	Yes	Adoption of pay as you go for rural areas far from the grid

3.5.3. Enabling Policy Framework

Challenges mentioned in the Morocco barrier analysis are not new to other countries in the region that are pursuing renewable energy solutions. One of the pertinent ones is non cost reflective electricity tariffs caused by institutional and political pressure to maintain low tariffs (IEA, 2019). The existing electricity tariff is regarded as a social tariff, which is a cross-subsidization measure by the government and weighs heavily on the national budget (Rim, 2022). However, the country has been going through a number of reforms in the last three decades, notably the ones for roof top solar PV include grid access fees (also named as grid code), grid management and surplus energy sale. One of the new reforms that could support upscaling of solar PV at household level but specifically low income ones, is the green bonds that have so far supported large scale solar projects in the country.
A list and description of priority policies overcoming barriers unaddressed so far, ultimately, creating an enabling policy framework are collected in Table 33 below.

Table 33: Policies suggestions to address barriers to deployment of Solar PV technology in Morocco

Name of Policy measure	Barrier addressed	Policy design details	Responsible institution	Remarks
Feed in tariff scheme needs to be in place or competitive auctions.	Lack of Solar PV Policy/ lack of regulation for low-voltage connection	Feed in tariffs will guarantee grid access, offer long-term contracts that guarantee cost based purchase prices for the energy produced. The regulator describes principles for tariff structure and responsibility for reviews where necessary.	National Energy Regulatory Authority (ANRE)	Mexico has a policy that buys excess electricity from small PV on a monthly basis and store on a virtual bank then paid to the customer after a year (RES4Africa Foundation and AFRY, 2022).
Adoption of a net metering system that pays the PV owner the excess power that is supplied in the system for an agreed price	Absence of a net metering system for small PV including household PV owners.	A prosumer that produces larger amounts/excess electricity from their solar PV to be able to sell it to the grid under a specified legal and regulatory framework	National Energy Regulatory Authority (ANRE)	A number of nations in the region and outside the region have adopted a net metering system with varying tariff model e.g. Bangladesh (IEA, 2018),
Establishing clear rules of the game in establishing	Grid connection rules for self-producers not	Standardized power purchase agreements	The Ministry of Energy Transition and Sustainable	Tanzania has adopted a PPA regulation for solar

prices for energy sold to the grid from small PV systems.	clearly defining tariff for supplying and selling of energy surplus (rely on private negotiation with National Office of Electricity and Drinking Water (ONEE)) Household selling electricity to the grid	(SPPA) with standardized power purchase tariffs (SPPT) for small household producers selling electricity to the grid.	Development has the responsibility to set up the energy strategy and the general framework, while the Ministry of Interior is in charge of the supervision of the autonomous utilities of distribution.	power producers which defines schedule for delivery of electricity and payment terms, however, the PPA have not been adopted at solar PVs at household level, but model can be adopted to household level (EWURA, 2015).
Adopting a cost reflective tariff	Regulated electricity tariff- not reflecting market price	An establishment of a regulation that is cost reflective tariff that is reviewed from time to time	ONEE and MASEN	Tanzania has adopted a cost reflective tariff based on all conceivable costs necessary to install, operate and maintain the assets and provide reasonable return to the licensee for rendering regulated services (EWURA,2017);
Preparing a multi annual grid investment plan to allow feed in from small voltage sources	Infrastructure to accommodate low voltage input into the grid is not in place.	A distribution company may be vested with the responsibility of connecting small PVs, supplying metering system and incorporating the cost in a power purchase agreement	ANRE	
Public financing reaching local microfinance institutes which administer funds to rural households. **Adoption of a pay as you go business model[8].** **Subsidy to solar PV technology**	High upfront cost	Taxes paid through fossil fuels are shared to rural energy agency to finance the upfront cost and make solar technology available to low-income households or small-scale investors.	IRISEN/MASEN SIE Sustainable Energy Financing Facility (MorSEEF)	Policy implemented in India through Infrastructure Development Company Limited, (IDCOL) company and recommended for Africa (Roy, 2022) Tanzania implements a levy on fossil fuel that contributes to the Rural Energy Fund.

		Pay as you go model is adopted by the implementing /re sponsible institution Subsidies should be designed in a manner that it will not bring market distortion by bringing competition between subsidies and commercial market (Global Off-Grid Lighting Association, 2021). Morocco has adopted a pay as you go business model for solar PV in rural areas that are far from the grid (Hteit,2023)		Universal access funds employed by Rwanda The pay as you go model is commonly employed in the eastern Africa region by solar off grid companies
Adoption of solar PV quality standards and testing method to slow down e-waste generated from solar PV	The recycling of PV-linked materials is still not thought through	Strict measures on standards for imported solar goods	ANRE	Applied by Kenya, Tanzania, Ethiopia, Rwanda and Uganda
Incorporating tailored solar PV courses in tertiary education systems and R&D programs	Awareness raising on the issue of maintenance requirements to enhance safety and sustainability	Regulations should stipulate a legal obligation for every company supplying solar PV to carry out after service customer support, sensitization on solar repairs to customers, private sector working tertiary education institutions in training and support of solar PVs installation and repairs.	ONEE and MASEN	Some solar projects implemented by NGOs like SNV included rural youth solar training on solar technology and business skills, this could be an interesting model for awareness raising.

There have been reforms in the energy sector's legal framework that aimed at addressing some of the burning challenges which included revision of laws related to production and

sale of electricity. However, most of these reforms addressed issues of mid to large-scale renewable energy producers and not necessarily the solar PV home systems. Some of the challenges that were addressed in these reforms included:

- The national grid was experiencing grid overload, the reform introduced grid carrying capacity that is published every 31st of January each year and guides application from private investors (Clifford Chance,2023).
- The reform introduced the grid service fee- system services fees where energy producers using the grid will be required to pay a fee, for low voltage generation like solar PV this may be a further hindrance to the already existing challenge of selling their power to the grid.

3.5.4. Guidance for Policy Roadmap Development

Table 34: Policy Roadmap

Name of the Policy Measure	Short-term	Medium-term	Long-term	Remarks
Adoption of solar PV quality standards and testing methods to slow down e-waste generated from solar PV	Development of national voluntary industry standards for the sustainable management of PV modules and components	Development of a certification program to reward compliance with the standard Conducting audits by third parties to certify PV recyclers Identification of recyclers complying with the standard and rewarding them with a certificate	A national program to encourage PV recycling in the Morrocco. Preparing regulations and policies that necessitate recycling plans at the beginning of projects	Linking project recycling plans in the environmental Impact assessments to national regulations on solar PVs
Providing grid infrastructure to connect solar PV	Provide small stand-alone networks in remote areas to connect the solar PV systems	Development of a grid network to connect to isolated aggregated grids	Development of standardized authorization procedures for power grid connection	Minigrids can be operated by private sector who bare the cost of infrastructure and are paid by customers who use their services
Adoption of PV solar subsidies	To scale up adoption, subsidies that will not distort market prices may be useful	N.A.	Subsidies should be removed	Important that subsidies do not distort markets and applied to certain value chain segments
Development of power purchase agreements (PPA) for IPPS	N.A	Develop a policy that ensures solar PV producers can sell excess power at market price	Prepare a regulation that institutes a review system on tariffs on to make the PPA financially viable over time.	

Formation of energy producer unions/companies to manage solar PVs network	Develop simple mechanisms to manage solar PVs in the same geographical locations	Fiscal and technical support for small producers to operate mini grids	Network management rules in place	N. A
Unbundling of the distribution and supplying services, connecting to main grid	N.A	Publishing technical requirements for grid access for roof top PV	Develop regulations on market shares between owners of the grid and producers	N.A
Promoting domestic manufacturing of solar PV	Providing grants to domestic-based manufacturing ventures to stimulate local production of solar PV and associated parts	Encouraging joint venture programmes that support knowledge transfer between Morocco and nations that are technically more advanced in solar PV fabrication	Scaling up technologies for high-value and low-cost PV manufacturing	

3.5.5. Policy Briefs on Good Practices

Morocco has made considerable efforts in diversifying its energy mix through increasing the share of renewables. Morocco is regarded as one of the three African countries with the highest solar potential with Egypt and South Africa head of her. One of the programmes that contributed to this success is the solar PV system that installed more than 50,000 off grid systems covering about 100,00 homes. With this accomplishment comes several barriers identified in the Morocco barrier analysis and the ensuing policy road map that provide suggestions to addressing the respective barriers. Two main barriers discussed in this policy brief is high upfront cost facing installations of solar PV and the inability of individuals to sell back the excess power to the grid; the former barrier can be addressed through a number of policy designs that have proven to be successful in other countries apart from the pay as you go business model that is already adopted by Morocco, others include careful designing of subsidy schemes, encouraging local manufacturing of solar major solar PV components and or public financing programmes to rural households through local microfinances. The second barrier could be addressed through two facets; designing some suitable policies and regulations that guide the selling back of power into the grid and secondly by providing the necessary infrastructure to allow the feeding ack of power without destabilising the gid. The suggestions in this policy brief underscores the sustainability of solar PV from technical, social and policy and legal frameworks.

Good practice policies

The examples provided under this section acknowledges that there are many good examples around the globe and or the region, however examples cited are meant to serve as inspirations and expected to be tailored to the country's specific context if deemed appropriate. Further learning of cited policies is encouraged, and appropriateness tested before applications (design and use) of the policies.

Table 35: Public financing to rual areas

Policy type	Public financing provided to rural areas by the Rural Electrification Agency through levy collected from fossil fuels
Location of implementation	Tanzania
Background / state at the outset	Rural energy projects were coordinated by the Ministry of energy and minerals and received funding from the general budget support through the Ministry of finance. Before formation of the rural energy board that lead to formation of rural energy fund and the rural energy agency there was no structured way of ensuring rural energy is made affordable, financing for rural project is made consistently available from domestic sources and investors in the rural areas receive financial and technical support.
Policy description	The energy policy of 2003 resulted into establishment of the Rural energy Act of 2005 which established the rural energy board, rural energy fund and the rural energy agency with the role of promoting and facilitating access to modern energy services to rural areas of Tanzania mainland through grid extension in rural areas, support private sector in small scale rural projects and offer technical assistance, training and capacity building to private developers and offer financial support to the same . The 2003 energy policy was revised to 2015 energy policy with one of its specific objectives to accelerate rural electrification to foster socioeconomic transformation (GoT, 2015). One of the most important barriers addressed is technical and financial support needed by private developers to invest in less attractive areas where demand for productive use of energy is not high and business is not lucrative.
Outcomes	Increased electrification rate in the rural areas through public and private sector investment, the latter being supported by the Rural Energy Agency through the rural electrification funds. The most significant impact being the socio-economic benefits that come with electrification in rural communities; rural electrification doubled in a span of 10yrs to 48.7% (REA, 2020). Most rural electrification is done through solar mini grids and PV, small hydro and hybrid of solar and wind, there is emission reduction from these power sources, however avoided emissions have not been calculated. With renewable energy come in social economic benefits such as offering support to business activities, offer more learning hours to students, and support access to social services such as health services brought closer (Diyammi and Mkude, 2022).
Success factors	Apart from funding received from donors, the rural energy fund (REF) has been receiving government support from fossil fuel levies and contributions from the electricity Levy. Though not in adequate amounts to meet the electrification goals, the funding provided is consistent and allows for rural electrification subsidies and private sector investment in rural energy.

Table 36: Net metering policy

Policy type	Net metering policy
Location of implementation	Israel

Background / state at the outset	Israel had most of its energy needs met by available abundant natural gas and imported coal and fossil fuels. The country took a long time to develop its renewable energy resource because of the bureaucratic red tape, onerous regulations and difficulty in acquiring land for renewable energy farms (Ashwarya, 2022). The government enacted a mandate in 2011 demanding renewable energy optimisation. A series of policies were then adopted, including the feed in tariff, net metering and subsidies on solar home systems. In its ambition to meet climate change mitigation targets, Israel has committed to phase out coal by 2025 which contributes to about 30% of the country's electricity.
Policy description	The energy policy in Israel generally aimed at diversifying the country's energy sources, reduce reliance on expensive fossil fuel imports and reduce polluting emissions (Ashwarya, 2022) In 2013 Net metering regulations for renewable energy systems were adopted. The policy allowed for prosumers to save their electricity retail tariff and charged for grid balancing cost (State of Israel utilities, 2018). Surplus electricity is exported to the grid and compensated by credit. The prosumer is charged for a grid integration cost. Amendments on the new regulations in 2020 provides for PV projects not exceeding 15kW to access net metering or apply for 25 years feed in tariff (Tsagas, 2023). All excess power will be bought by Israel power utility. Several revisions of the net metering have been adopted from 2017 to support all PV facilities: ground mounted units, large and small roofs.
Outcomes	The amended regulations have allowed prosumers to store their power and sell it at peak times when prices are more lucrative (pv-Magazine, 2023). Reduce greenhouse gas emission by increasing renewable energy share into the energy mix which is predominantly natural gas and coal. Since the introduction of net metering in 2013 to 2020 generation capacity from solar PV has risen by 856.7 MW (Ashwarya, 2022)
Success factors	-Adoption of a series of favourable regulatory decisions -PV tariffs have dropped significantly, making it competitive to gas -Country's ambition to meet her climate mitigation goals. -Authorities supported a market-driven renewable energy development.

3.5.6. Summarising Remarks

Management of roof top solar PVs maybe cumbersome and unattractive due the numerous numbers of producers, forming companies or unions that manage a conglomeration of rooftop solar PV producer may ease the management load and economically make sense for regulators. Morocco has been working assiduously on achieving renewable energy targets and reducing its carbon footprint through the ambitious renewable energy targets. However, there still needs to be some legal and regulatory framework improvement in order to achieve some of its rural social targets through solar PV programs in order to accelerate deployment. One policy measure that appeared in a number of facets as a challenge is providing grid infrastructure to connect solar PV. This was mentioned by stakeholders in terms of physical infrastructure that will allow grid stability when feeding in low voltage and soft infrastructure in terms of legal and regulatory infrastructure where regulations on feed in tariff, net metering or the like need to be in place in order to operationalise the selling of excess energy to the grid. In other parts of the world, associated measures such as net metering seemed to accelerate deployment of

roof solar PVs. Morocco has many examples around the world to learn from and formulate a suitable feed in tariff or net metering (may be a combination of both) for effective solar PV deployment, this could be one of the first steps to implement and make solar PV attractive for the prosumers

3.6. E-mobility in Morocco

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3.6.1. Introduction

Morocco has undergone significant reforms in recent years, encompassing administrative restructuring and the implementation of national initiatives such as the New Development Plan and Generation Green 2020-2030 (Special Commission on the Development Model, 2021). Government's primary focus on decarbonisation revolves around achieving its renewable energy targets, as outlined in its Nationally Determined Contribution (Government of Morocco, 2021). While the country led advancements in renewable energy during the 2010s, progress has decelerated in recent years, particularly with solar capacity growth stagnating in 2019 and 2020 (Climate Action Tracker, 2023). Given that renewable energy constituted 42% of electricity capacity in 2024, Morocco must significantly accelerate the implementation of new renewable projects to achieve its 2030 goal of reducing greenhouse gas emissions by 45.5% (International Energy Agency, 2023).

According to the Ministry of Energy Transition and Sustainable Development, Morocco's electricity production in 2022 consisted of 7.03% fuel oil, 7.82% solar, 13.48% wind, 16.70% hydroelectricity, 17.72% natural gas, and 37.25% coal (International Trade Administration, 2024). Moreover, the transport sector remains heavily reliant on fossil fuels, comprising 99% of its energy consumption. This dependency not only makes transport the primary consumer of final energy, at 38%, but also the second-largest emitter of CO2, contributing to 31% of the nation's total emissions (International Energy Agency, 2019).

The country faces an urgent need to decarbonize all energy sectors to support an effective e-mobility strategy. One of the key measures is the expansion of renewable electricity generation from a share of 17.6% in 2020 to of 52% by 2030 (IEA, 2023). Achieving this involves transitioning from coal to cleaner energy sources across various sectors, including transportation, industry, and residential energy use. By reducing coal dependency, Morocco can not only improve air quality and public health but also enhance energy security and economic resilience. Additionally, integrating more renewable energy into the grid will provide the necessary clean power for electric vehicles, promoting sustainable transportation and helping the country meet its climate goals. Comprehensive policies and investments in renewable energy infrastructure, along with incentives for adopting e-mobility, are crucial steps towards achieving these objectives.

This policy roadmap addresses barriers identified in previous Barrier Analysis, which encompasses policy, economic, social, technical, legal, and awareness aspects. Foremost among these obstacles is the evident absence of proactive governmental advocacy for e-mobility nationwide. Furthermore, the combination of elevated electric vehicle costs, regulatory deficiencies such as the prohibition on selling electricity at low voltage according to Moroccan law, and infrastructural challenges such as the small number of charging stations and insufficient access to electricity grid connections, collectively dissuade a significant portion of the Moroccan population from adopting electric mobility solutions. The electricity network's inadequate capacity to support the increased demand from e-mobility is a significant concern. The Moroccan transmission network experiences losses of nearly 13-14%, underscoring the urgent need for infrastructure upgrades and efficiency improvements. For a comprehensive understanding of each specific barrier, reference to the detailed barrier analysis of D 5.2 of the SESA project is recommended.

3.6.2. Data Collection

Like the barrier analysis, the policy roadmap was developed through desk research and expert interviews. Desk research entailed mapping existing policies related to E-Mobility in Morocco, as well as the key ministries responsible. These involved policies related primarily to EVs, charging infrastructure, public-private partnership and financial incentives.
While academic literature on E-mobility in Morocco is limited, posing a challenge to contextualizing its use, various policies at different scales (e.g., local and regional government) served as reference points.
Additionally, although efforts were made to conduct several interviews, a total of seven were successfully completed with experts from academia, private sector and policymakers between March and June 2024. Each interview lasted around 60 minutes and was conducted online. Further details of the interviews are given in Table 37.

Table 37: Interview partners

Name	Position	Institution	Stakeholder group represented
Expert 1	Service Studies Municipality of Marrakech	Municipality of Marrakech	Policy Maker
Expert 2	National Project Coordinator	United Nations Development Program	Policy Maker
Expert 3	Former VP of the program Berkan Smart City	Majal Berkane SA	Private sector
Expert 4	Chief of Staff	Ministry of energy transition and sustainable development	Policy Maker
Expert 5	Advisor to the Minister of Energy Transition and Sustainable Development	Ministry of energy transition and sustainable development	Policy Maker
Expert 6	Co-founder and CEO	POGO	Private sector
Expert 7	Head of Smart Grids Group	Green Energy Park	Academia

3.6.3. Enabling Policy Framework

Considering the barriers identified in the barrier analyses, as well as insights gleaned from desk research and expert interviews conducted for this analysis, the following table includes existing policies before the next table introduces new policies suggested for examination and potential implementation by policymakers.

Table 38: Existing policies to overcome barriers to market deployment of e-mobility in Morocco

Name of the Policy Measure	Barrier addressed	Policy design details	Responsible Institutions	Remarks
National Energy Efficiency Strategy 2023 (Ministry of Energy, Mines and Environment, 2020).	The National Energy Efficiency strategy for 2030 has set the goal of reducing energy consumption in the transportation sector by 24% between 2017 and 2030 Barrier addressed: economic and financial barriers; environmental barrier	This entails the adoption of multimodal transport modes that consist of reducing the energy bill and carbon footprint through the adoption of new technologies.	Ministry of Energy Transition and Sustainable Development Ministry of Transport, and Logistics	
The National Strategy of Sustainable Development 2030 (Royaume du Maroc, 2017):	Barrier addressed: economic and financial barriers; environmental barrier	The National Strategy of Sustainable Development 2030 identifies seven challenges: - Achieving the transition towards a green economy - Strengthening the governance of sustainable development - Improving the management and promotion of natural resources, and enhancing the conservation of biodiversity - Promoting the implementation of national policies against climate change; - Giving special attention to sensitive areas - Promoting human development and reducing territorial and social inequalities; and, - Promoting education to sustainable development.	Ministry of Energy Transition and Sustainable Development	

National Plan for Electric Mobility	Barrier addressed: political and institutional; technology and infrastructure;	Launched in 2021 and completed in 2023, the plan outlines the major directions for developing this mobility at the national level with a budget of 22 billion dirhams over five years. This plan has 5 mayor objectives: - to develop a network of 2500 charging stations in the largest urban centres (Rabat, Casablanca, Marrakech, Tangier, Agadir) - to promote local manufacturing of electric vehicles, as well as battery production. - to promote renewable energies and to develop all necessary infrastructure. - to create up to 4500 direct green jobs related to electric mobility. - to meet Morocco's objectives in terms of reducing and combating climate change, particularly reducing greenhouse gas emissions.	The National Office of Electricity and Drinking Water (ONEE)	
Nationally Determined Contribution (NDC) (Government of Marocco, 2021).	Barrier addressed: political institutional, environmental, technology and infrastructure;	- It was published in 2021. Regarding transport, it has established the target of reducing energy consumption in transportation sector by 24% between 2017 and 2030. Other measures include - Urban Public Transport Improvement Program: Equip major urban areas with high-capacity public transportation using renewable energy; - Plan for the Exemplarity of the Administration: Increase the share of eco-friendly cars (hybrid or electric) in the state's fleet by 30%; has only started to take effect since 2020. The Moroccan Post Office agreed to electrify its fleet (225 vehicles in total, specially	Ministry of Equipment, Transport, Logistics and Water, Ministry of Economy and Finance Ministry of Energy Transition and Sustainable Development	

		dedicated to mail and package distribution) with the support of the Ministry of Industry, Trade and Digital Economy.		
The National Strategic Adoptation Plan/Le Plan National Stratégique d'Adaptation (PNSA) (Ministry of Energy Transition and Sustainable Development, 2024).	Barrier addressed: economic and financial barriers; social and cultural barriers; environmental barrier	5 new major actions are planned: 1. Improvement of the environmental standards of vehicles: Limitation of emissions of certain polluting gases from vehicle emissions. From 2023, the standard requires manufacturers to produce cleaner cars, with compliance, notably, with emission rates of fine particles and nitrogen oxides complying Euro 6 standards. Will allow Morocco to converge with a 10-year time lag by 2030 with the European regulation. 2. Bonus-Malus system: Subsidies would be offered to individuals choosing hybrid or electric vehicles, while additional taxes would be levied on polluting car 3. Renewal and scrapping programme: it aims to grant renewal bonuses and scrapping bonuses 4. Eco-driving: This training includes education on eco-friendly driving practices, such as minimizing braking and acceleration, adhering to speed limits, and promoting overall road safety. Additionally, it emphasizes the importance of regular maintenance, including checking axle conditions, avoiding overloads, routinely inspecting tires, and optimizing the truck's aerodynamic features. 5. Application of CO2 emissions and fuel economy standards for	Ministry of Equipment, Transport, Logistics and Water, Ministry of Economy and Finance Ministry of Energy Transition and Sustainable Development Moroccan Agency for Energy Efficiency	Good practice example from Moroccan Agency for Energy Efficiency: in 2017, it started operationalizing eco driving strategy by: - Providing support to both public and private sectors, - Offering comprehensive training programs, - Assisting in the implementation of mandatory energy audits, - Disseminating information, conducting tests, and publishing practical guides

		new passenger cars and light commercial vehicles		
Renewable Energy Developmental Law	Barrier addressed: political and institutional barriers	This law was introduced in 2010 to fill the gaps in the area of renewable energy, encourage investment and address several challenges. It has several fixed objectives: promoting renewable energy production, facilitating its marketing and export by public or private entities, subjecting renewable energy production facilities to a regime of authorization or declaration, and ensuring the right of operators to produce electricity from renewable sources on behalf of individual consumers or consumer groups	Ministry of Energy Transition and sustainable development	
Net Metering Legislation (Law N°58-15)	Barrier addressed: technology and infrastructure barriers	The government of Morocco adopted the Nez-Metering Law in the end of 2015. The new Law enhances the existing Renewable Energy Development Law by introducing a net-metering scheme for wind and solar PV plants, initially connected to the high-voltage grid and subsequently extending to those connected at the medium and low-voltage levels (Policy Centre for the New South, 2021).	Ministry of Energy Transition and sustainable development	
National Energy Strategy	Barrier addressed: technology and infrastructure barriers	The Morocco government implemented the national strategy in 2009. It has the following goals: increasing the share of renewables in total power capacity to 52% by 2030, reducing energy consumption in buildings, industry, and transport by 2030, and installing an additional 3,900 MW of combined-cycle technology powered by imported natural gas by 2030.	Ministry of Energy Transition and Sustainable Development	
Law of self-generation, Law 16-08	Barrier addressed: legal and regulatory barriers	Law 16-08 on self-generation was voted in 2008 allows any natural or legal person or entity to produce electricity for their own needs, subject to authorization and specific conditions. It raised the self-generation limit for industrial sites from 10 MW to 50 MW. While primarily designed to support wind power, the law also applies to other technologies.	Ministry of Energy Transition and Sustainable Development	

		However, the Draft Bill provides for the possibility of selling the surplus production to the network operator (transmission or distribution) within the limit of 10% of the annual production of the self-consumption installation (Policy Centre for the New South, 2021).		
Green Bonds	Barrier addressed: economic and financial barriers	In 2016 to achieve its renewable energy targets and fund the Noor projects, the Moroccan Agency for Solar Energy (MASEN) issued the country's first Green Bond. These bonds, with a significant total value, were issued through a private placement authorized by the Moroccan Authority of Capital Market (AMMC) to the following investors: Al Barid Bank, Attijariwafa Bank, La Caisse Marocaine des Retraites, and La Société Centrale de Réassurance (Policy Centre for the New South, 2021).	Moroccan Authority of Capital Market	
Law n°. 13-0910 on renewable energy	Barrier addressed: legal and regulatory barriers	It enabled the private sector to produce and market electricity from renewable sources. In 2023, it was introduced an amendment for law no. 13-09 (law 40-19), aiming to allow industries to produce their own energy for their operating needs. These independent power producers ("IPPs") can also sell their surplus to other consumers. However, only electrical energy produced from renewable energy sources can be marketed (Policy Centre for the New South, 2021).	Ministry of Energy Transition and Sustainable Development	
Act n° 37-1615, amending and supplementing Act 57-09 that created the Moroccan Agency for Sustainable Energy (MASEN)	Barrier addressed: legal and regulatory barriers	The aim was to extend the Agency's responsibilities to include all current and future renewable energy projects that ensure grid stability, as well as projects developed under Act 13-09 (Policy Centre for the New South, 2021).	Ministry of Energy Transition and Sustainable Development	
Morocco Sustainable Energy	Barrier addressed: economic and financial	It is a credit line facility of up to €110 million to participating financing institutions in Morocco to on-lend to businesses and	Ministry of Economy and Finance	

Financing Facility		Energy Service Companies (ESCOs) investing in energy efficiency and renewable energy projects.		
Financial incentives	Barrier addressed: economic and financial barriers	Morocco has introduced a VAT reduction for importers and distributors of ecological cars. Exercise duties have been reduced to 2.5% for hybrid and electric vehicles instead of 17.5% for "traditional cars". Exemption from the special annual tax on the vehicles Exemption from the tax on luxury vehicles	Ministry of Economy and Finance	The reduction of import taxes on EVs tries to reduce the high price of these vehicles and promote their purchase. As part of the pilot project in city of Marrakech the rental of e-scooters will be affordable, as the municipality will cover the electricity bill, making charging stations available for free for EVs and e-scooters
Development of a CO2-based bonus-malus system for low carbon transport	Barrier addressed: economic and financial barriers	The bonus-malus system, also referred to as a feebate scheme, imposes a fee on high-carbon vehicles and gives a rebate to low-carbon cars so that consumers can be induced to purchase vehicles with low CO2 emissions. This policy encourages the choice of low emission vehicles and will penalize the purchase of the most polluting models.	Ministry of Economy and Finance	

Table 39: New policies to overcome barriers to market deployment of e-mobility in Morocco

Name of the Policy Measure	**Barrier addressed**	**Policy design details**	**Responsible Institutions**	**Remarks**
Regulation of the sale of electricity through charging stations	In Morocco sale of electricity through charging stations is not yet regulated. It is illegal to resell electricity, as energy is sold by the Government. This gap hinders the full utility and operational efficiency of the charging stations.	The sale of electricity through charging stations in Morocco could be regulated by implementing a comprehensive legal and regulatory framework that addresses key aspects of the operation, pricing, and distribution of electricity for electric vehicle (EV) charging. This would involve amending existing energy laws to include provisions for EV charging infrastructure that specifically allow the resale of electricity	Ministry of Energy Transition and sustainable development Ministry of Economy and Finance	To charge EV or e-moped users charge their batteries at home or at the parking spots provided by gas stations like Afriquia, Kilowatt.ma and Total. It is possible to charge a vehicle for free. Charging

	Barrier addressed: legal and regulatory barriers	through charging stations as well as designating a regulatory authority to oversee the EV charging sector and to ensure compliance with regulations, setting standards, and monitoring the market.		stations are not allowed to earn money by selling electricity, sometimes users pay for parking usage.
Financial incentives direct	The promotion of direct financial incentives on EVs would reduce the high price of these vehicles and promote their purchase. Barrier addressed: economic and financial	1. Direct financial incentives to reduce the higher upfront investment costs of EVs and stimulate private sector purchases 2. Subsidies on CAPEX/Tax exemptions in the form of reduced VAT and corporate income tax or exemption from annual vehicle tax and registration fees. Import duties exemptions to be adopted until a domestic market has been developed 3. Continued subsidies on the CAPEX with reduced values as the cost of the technology decreases and continued exemptions from import duties if a domestic market has not developed will have to continue. Circulation privileges for EVs post 2045 like: special driving lanes, preferential or free parking, and waiving of toll fees)	Ministry of Economy and Finance	In the long-term direct incentives for EVs can be replaced by indirect incentives, as the initial cost of EVs is expected to decrease due to lower technology costs.
Financial incentives Indirect (end user)	Barrier addressed: economic and financial	Setting up emission and life-cycle caps for polluting vehicles (diesel vehicles). Such an approach involves emission regulation produced by vehicles and the duration of their operational life. 1. Government can establish legal limits of pollutants that a vehicle can emit. 2. Emission standards that define	Ministry of Economy and Finance	**n/a**

		permissible emission levels for different classes of vehicles should be established 3. Vehicles should undergo emissions testing during production and their operational life 4. Government may impose higher taxes or registration fees on high-polluting cars 5. For fleet operators cap and trade system can be implemented, where the cap is placed on total emissions and companies can trade emission allowances.		
Financial incentives Indirect (value chain)	Barrier addressed: economic and financial	1. Support the development of public charging infrastructure for EVS and H2 vehicles 2. Charging infrastructure development should be supported on an ongoing basis and extended to hydrogen charging stations 3. Specific policy measures must be put in place to stimulate the development of a domestic hydrogen industry	Ministry of Economy and Finance	**n/a**
Financial incentives Indirect (value chain)	Barrier addressed: economic and financial	1. Support the development of domestic EV industry to mitigate technological barrier and speeding up technology maturity 2. Creation of a domestic market through a foreign manufacturer, e.g., through in-kind incentives, as well as R&D subsidies to foster technological improvement and identify the best technical standards and	Ministry of Economy and Finance	**n/a**

		business models (e.g., smart charging). 3. In the long-term the development of national industry could foster the adoption of e-mobility by facilitating the monitoring of technological maturity and accelerating the improvement of costs and skills.		
Revision of awareness raising campaigns	Even though there are some social awareness campaigns, there is a lack of proactive governmental advocacy for nationwide e-mobility. Barrier addressed: awareness	The government should lead an awareness-raising campaign that highlights the environmental, economic, and health benefits of EVs. Providing clear information on available incentives, subsidies, and charging infrastructure would also address common concerns and misconceptions. Collaborating with local communities, and educational institutions could engage the public directly, fostering a hands-on understanding of the advantages of electric mobility.	Automotive Industry Ministry of Energy Transition and Sustainable Development Ministry of Transport, and Logistics	**n/a**
Procurement rules	Barrier addressed: legal and regulatory barriers	1. Adapt procurement from upfront cost approach to models considering the whole structure and benefits solutions 2. Procurement models should be adapted to consider the full cost and benefit structure of the assets and assign responsibilities for the new tasks that arise from e-mobility business models, namely: • BESS (Battery Energy Storage System) maintenance and replacement for public e-buses; • Development and operation of the network infrastructure (e.g., public or private development and operation)	Automotive Industry Ministry of Energy Transition and Sustainable Development Ministry of Transport, and Logistics Ministry of Economy and Finance	**n/a**

Skills and training	Eco-driving Barrier addressed: social	Eco-driving training includes education on eco-friendly driving practices, such as minimizing braking and acceleration, adhering to speed limits, and promoting overall road safety. Additionally, it emphasizes the importance of regular maintenance, including checking axle conditions, avoiding overloads, routinely inspecting tires, and optimizing the truck's aerodynamic features. (Confederation General des Enterprise du Maroc)	Moroccan Agency for Energy Efficiency (MEAE) MEAE's transportation energy efficiency program	**n/a**

3.6.4. Guidance for Policy Roadmap Development

Table 40: Requirements for the policy implementation

Name of the Policy Measure	**Short-term by 2025**	**Medium-term by 2030**	**Long-term from 2035 onwards**	**Remarks**
Regulation of the sale of electricity through charging stations	The absence of regulation that organises the EV charging activity is also perceived as a barrier to the development of infrastructure. In Morocco sale of electricity through charging stations is not yet regulated. It is illegal to resell electricity, as energy is sold by the Government. This gap hinders the full utility and operational efficiency of the charging stations. Law 82-21 concerning self-generation should be revised. Particularly the definition of "self-consumption" to include the charge of electrical vehicles as an eligible activity for self-consumption.	In the medium-term such a regulation should be in place with prices adjusted allowing the private sector to deploy the needed infrastructure and allow users to purchase electricity No permit is required to install a charger on private ground, there is currently no permitting schemes to enable the installation of chargers on public ground. Permitting law needs to be designed, so such public chargers. can be installed.	In the long-term prices of electricity should be affordable and even lower than the fossil fuel electricity to attract a bigger number of users.	To charge EV or e-moped users charge their batteries at home or at the parking spots provided by gas stations like Afriquia, Kilowatt.ma and Total. It is possible to charge a vehicle for free. Charging stations are not allowed to earn money by selling electricity, sometimes users pay for parking usage.
Financial incentives direct	Direct financial incentives to reduce the higher upfront investment costs of	Subsidies on CAPEX/Tax exemptions in the form of	Continued subsidies on the CAPEX with reduced values as the cost of the	In the long-term direct incentives for EVs can be replaced by indirect

	EVs and stimulate private sector purchases should be introduced by the Ministry of Economy and Finance	reduced VAT and corporate income tax or exemption from annual vehicle tax and registration fees. Import duties exemptions to be adopted until a domestic market has been developed.	technology decreases and continued exemptions from import duties if a domestic market has not developed will have to continue. Circulation privileges for EVs post 2045 like: special driving lanes, preferential or free parking, and waiving of toll fees)	incentives, as the initial cost of EVs is expected to decrease due to lower technology costs.
Financial incentives Indirect (end user)	Setting up emission and life-cycle caps for polluting vehicles (diesel vehicles) should be introduced by the Ministry of the Economy and Finance by 2025	Scrapping and recycling programs for old vehicles should be designed as a part of the national program. Whereby owners of taxis, buses, microbuses, and trailer trucks voluntarily surrender their vehicles for managed scrapping and recycling in exchange for financial incentives that may be used toward the purchase of new vehicles.	While in the long term the new vehicles reduce emissions of other airborne pollutants (e.g., carbon monoxide, nitrogen oxides) and contributes to increased traffic safety, the Government can review the instrument.	In Egypt a total of 40,689 new taxi vehicles have replaced aging taxis in Cairo alone, some of which were over 50 years old.
Financial incentives Indirect (value chain)	Support the development of public charging infrastructure for EVs and H2 vehicles should be prepared at the national level by the Ministry of Economy and Finance. Establishing robust charging infrastructure is a cornerstone of Morocco's EV adoption strategy, it should be based on the following steps: a) fast charging network b) semi-public and private charging infrastructure c) public charging infrastructure	Charging infrastructure development should be supported on an ongoing basis and extended to hydrogen charging stations. Specific policy measures must be put in place to stimulate the development of a domestic hydrogen industry. Charging infrastructure should be deployed in the major cities of Morocco. In parallel, developing a National Battery Plan that supports local manufacturing, maintenance, second-	Charging infrastructure should be equally distributed along the Morocco surface, so it´s easy to reach any destination between North and South. Charging infrastructure should be installed in all cities.	Establishment of charging stations for electric vehicles (2 and 4 wheels) through pilot sites in certain cities. So far, the Moroccan charging network currently consists of 600 e-chargers, a large part is located along the Tangier-Agadir highway.

	d) charging infrastructure for buses	life applications, and battery recycling is essential.		
Financial incentives Indirect (value chain)	Support the development of domestic EV industry to mitigate technological barrier and speeding up technology maturity. The national authorities should envisage that the local production of EVs should serve Moroccan population and allow for the transport decarbonisation of the country.	Creation of a domestic market through a foreign manufacturer, e.g., through in-kind incentives, as well as R&D subsidies to foster technological improvement and identify the best technical standards and business models (e.g., smart charging). The public authority aims to increase the share of hybrid and electric vehicles in the government fleet to 30%	In the long-term the development of national industry could foster the adoption of e-mobility by facilitating the monitoring of technological maturity and accelerating the improvement of costs and skills. Public authorities could serve as an example of usage of hybrid and electric vehicles as part of social awareness raising.	
Eco-driving promotion	Promote eco-driving for professional drivers and also for all categories of drivers, during the initial training for the driving license	Eco-driving training should be mandatory for all the drivers as of year X (remains to be decided at the national level).		
Application of CO2 emissions and fuel economy standards for new passenger cars and light commercial vehicles Decrease of EV purchasing cost	The specific standards should be defined, assessed, analysed (in the short-term) to become implemented (in the mid-term). n/a	In the mid-term the improvement of the environmental standards of vehicles will allow Morocco to align with the European standards of vehicles (Euro 6). Cars, taxis and buses still need financial incentives to facilitate and accelerate EV adoption.	In the long-term it will be complemented by the application of CO2 emissions and fuel economy standards for new passenger vehicles and new light duty commercial vehicles, which will allow Morocco to converge with a 10-year time lag by 2030 with the European regulation	2 and 3 wheelers are already financially more attractive.
Procurement rules	Adapt procurement from up-front cost approach to models considering the whole structure and benefits solutions	Procurement models should be adapted to consider the full cost and benefit structure of the assets and assign	N/A	

		responsibilities for the new tasks that arise from e-mobility business models, namely: • BESS (Battery Energy Storage System) maintenance and replacement for public e-buses; • Development and operation of the network infrastructure (e.g., public or private development and operation)		
Awareness raising and capacity building campaigns	Citizens do not have technical information on EVs which may cause apprehension of EV adoption. Therefore, information assessment needs should take place, where targets groups and information channels for an awareness campaign could be identified. Such an awareness campaign could take place in the specific target groups like youth obtaining their driver´s license, public employees driving public vehicles etc. Creating awareness campaign presents an opportunity for the public and private sectors to join efforts in awareness raising Barrier addressed: social and cultural barriers	Raise awareness and educate users about electric vehicles through public campaigns, addressing concerns like health, safety, and environmental impact. Utilize existing car dealerships to offer test drives and experiences with EVs.	Automotive Industry Ministry of Energy Transition and Sustainable Development Ministry of Transport, and Logistics	Good practice example: a pilot project by the UNDP and the Ministry of Energy Transition and Sustainable Development will promote awareness campaigns, communication tools, workshops, training sessions.
Encourage public-private partnership	n/a	Even though most projects are driven by the private sector rather than the government. The goal of law n° 86-1212 related to Public-Private Partnership contracts is to establish a unified and incentivizing	Automotive Industry Ministry of Energy Transition and Sustainable Development Ministry of Transport, and Logistics Ministry of Economy and Finance	Good practice example from Berkane Municipality. Expert 3 mentioned a good practice example from Berkane, where municipality led a startup initiative together with private

		framework that supports the development of infrastructure in Morocco while enhancing the visibility of infrastructure opportunities for both foreign and local investors.		universities to set up a network of electric vehicle stations with wheels.

3.6.5. Policy Briefs on Good Practices

Country Context:

The barrier analysis has identified that the current policy framework is insufficient for transitioning to a net-zero emissions transport system in Morocco. To address these key barriers, the policy roadmap offers several recommendations for potential policies, including their design, the responsible institutions, and a suggested implementation timeline. This two-stage approach, starting with a barrier analysis and followed by the development of a policy roadmap, leads to the following policy recommendations presented in this brief.

It is necessary to regulate electricity sales for both the deployment of charging stations and the purchase of EVs facilitate the uptake of the EV market. Direct financial incentives are needed to reduce the high upfront costs of EVs and stimulate private sector purchases. Indirect incentives should support the development of charging infrastructure. Permitting processes should be streamlined to enable the installation of chargers on public grounds. Additionally, self-consumption laws should be revised to allow EV owners to charge their vehicles as an eligible activity for self-consumption.

Moreover, public awareness, support, and information campaigns are crucial for the successful formulation and implementation of sustainable transport policies in developing cities. Sustainable urban transport measures cannot be implemented without the support of key local stakeholders. Public awareness is vital in order to generate a vision of an alternative future, and pressure for action. Finally, these policies should be supported by professional training programs for technicians, electricians, and emergency responders, equipping them with the skills needed to service and maintain EVs and charging stations. These comprehensive policy recommendations aim to overcome the current barriers and pave the way for a sustainable, net-zero emissions transport system in Morocco.

Good practice policies:

In order to provide guidance for the policy design of transport decarbonisation good practice examples have been identified. These existing policies take into account the specific circumstances in Europe (France) and North Africa (Egypt) where they have been implemented. They can serve as a source of inspiration and a valuable foundation for the development of policies tailored to the unique needs of car scrapping and ecological bonus introduction in Morocco.

1. Best practice example: The Egypt Vehicle Scrapping and Recycling Program of Activities

Table 41 shows the “Egypt Vehicle Scrapping and Recycling Program” as a possible policy to address passenger vehicles decarbonisation

Table 41: Egypt Vehicle Scrapping and Recycling Program

Policy type	The Egypt Vehicle Scrapping and Recycling Program
Location of implementation	Egypt
Background / state at the outset	Egypt's population is about 77 million, with around 20 million residing in the Greater Cairo Region (GCR), which includes Cairo, Giza, and Shubra El-Kheima, forming one of the world's largest urban agglomerations (World Bank, 2015). The GCR has experienced a significant increase in vehicle registrations, doubling from 2.1 million in 1993 to 4.3 million in 2008. The aging mass transport fleet, with the average taxi previously on the road for 32 years, often suffers from breakdowns and high emissions due to lack of modern catalytic converters (World Bank, 2015). A program was launched to enforce Traffic Law 121, effective June 9, 2008, aiming to improve air quality and reduce greenhouse gases by prohibiting operating licenses for vehicles older than 20 years (World Bank, 2015).
Policy description	To promote low-carbon transportation in Egypt, Traffic Law 121 was enacted on June 9, 2008, prohibiting license renewal for public transport vehicles older than 20 years. While this law aimed to accelerate fleet replacement and improve air quality, it did not mandate replacement or disposal of old vehicles. To address this, in April 2009, the Egyptian Ministry of Finance, with support from the Prime Minister, initiated the Vehicle Scrapping and Recycling Program for the Greater Cairo Region. This national program has been established where vehicle owners can voluntarily surrender their vehicle for managed scrapping and recycling, or for retrofit, in exchange for the tax break that can be used to purchase a new vehicle. Initially limited to taxis, the program was expected to expand to include microbuses, trucks, and buses, and to other regions such as Alexandria (World Bank, 2015), however no formal national rollout or significant expansion had been implemented.
Outcomes	Focusing initially on taxi replacement in the Greater Cairo Region (GCR), a collaborative effort between the government and private sector offers a financial package to encourage participation. This package includes a 25-30% discount on new replacement vehicles, €2,500 in subsidies and tax waivers, favourable loan terms, and insurance discounts (Energy Efficient Cities Initiative, 2010). The program was set to run for 28 years, aiming to replace 45,000-50,000 taxis in the GCR during the first phase. Subsequent phases will expand to other regions and include additional mass transport vehicles, pending approval. The first phase was expected to reduce GHG emissions by 1.3-2.3 million tons of CO2e over 10 years from 2010. Carbon financing will support the development of a recycling facility for scrapped vehicles (Energy Efficient Cities Initiative, 2010).
Success factors	• From April to August 2009, 18.5% of older taxis in the Greater Cairo Region (GCR) were replaced with newer, fuel-efficient models, resulting in a 6.5% reduction in accidents and a 4% decrease in traffic citations among affected taxis (Energy Efficient Cities Initiative, 2010). • The Vehicle Scrapping and Recycling Program, the first of its kind in Egypt, promotes fuel-efficient vehicles through outreach, incentives, and market organization. (Energy Efficient Cities Initiative, 2010) As of 2023, Egypt’s Vehicle Scrapping and Recycling Program, had replaced over 24,000 old taxis, private cars, and minibuses with new natural gas-powered vehicles. • The program's "one-stop-shop" approach allows taxi drivers to handle vehicle inspections, scrapping, purchasing new vehicles, insurance, licensing, and auto loans all in one place, contributing to high participation rates (Energy Efficient Cities Initiative, 2010). • Addressing environmental issues from aging vehicle fleets, especially in developing countries, is challenging due to financial, logistical, and technological barriers Energy Efficient Cities Initiative, 2010)

2. **Best practice example:** Ecological bonus

Table 42 shows the ecological bonus scheme in France that addresses the EV uptake and clean transport supply chain.

Table 42: Ecological bonus

Policy type	Ecological bonus
Location of implementation	France
Background / state at the outset	The French government announced an €8 billion aid package to support the auto industry in recovering from the coronavirus crisis. This package included increased incentives for purchasing new electric vehicles and enhancing a scrapping program to remove higher-polluting older models from the roads. France aims to install over 100,000 public charging points and produce 1 million EVs annually by 2025.
Policy description	Since January 1, 2023, individuals can benefit from the ecological bonus for a new or used private car once every three years. A decree issued on October 7, 2023, introduced a new eligibility criterion for new electric cars, considering the environmental and climatic impact of their production and transport. To qualify, vehicles must achieve a minimum environmental score and be listed by the Ecological Transition Agency (Ademe), (JORF, 2024). An order dated December 14, 2023, and amended on April 15, 2024, details the eligible electric passenger cars, including their make, model, and variant version type (TVV). The ecological bonus is available to individuals and professionals as aid for purchasing or leasing new or used electric or hydrogen vehicles with low carbon footprints. (JORF, 2024) The bonus can reach up to €7,000 for new passenger cars (subject to income conditions) and €1,000 for used passenger cars. The amount depends on the vehicle's price, the applicant's nature (individual or legal entity), and the reference tax income for individuals. Residents overseas receive an additional €1,000 for new cars. The bonus is only applicable if the vehicle's purchase price is under €47,000. (JORF, 2024)
Outcomes	The ecological bonus, which was previously a flat cash incentive of €5,000 applicable to all EVs regardless of their production cycle or environmental attributes, will now be subject to stricter criteria. The assessment will consider the vehicle's entire lifecycle and components, including the electric battery. Under the new regulations, each EV will receive a 'green score' as part of a broader initiative aimed at relocating EV production lines to France and the EU. (Euroactiv, 2023)
Success factors	• This initiative offers numerous advantages and could serve as a model for other European countries. • The French green bonus aims to minimize the environmental impact of vehicles while promoting the use of clean materials and energy in car production; its objectives extend beyond just environmental concerns. • It serves as a strategic approach to encourage the production of vehicles in France and Europe, allocating subsidies specifically for these models. • The electric vehicles imported from countries with high carbon emissions, such as China, will be ineligible for financial incentives, diminishing their competitive edge. • By implementing this environmental criterion, France is effectively adopting a new industrial policy tool to safeguard the competitiveness of the European automotive industry, which faces challenges from the influx of cheaper Chinese electric vehicles. • Such a policy has the potential to redefine the landscape of national and European vehicle regulations.

3.6.6. Summarising Remarks

Barriers Addressed by the Policy Framework

Existing policy framework is not sufficient to successfully transition to net-zero emissions transport system in Morocco. More needs to be done in the short, medium and long term to achieve the 52% target by 2030. Through various experts' interviews, we come to the following conclusions:

- Policy, Economic, and Social Barriers: The existing policy framework tackles these barriers by promoting financial incentives, tax reductions, multimodal transport adoption, and public-private partnerships. Notable initiatives include the Bonus-Malus System, VAT Reduction for Importers and Distributors of EVs, Adoption of Multimodal Transport Modes, and Public-Private Partnerships (PPP). Direct Incentives also include subsidies on CAPEX, reduced VAT, corporate income tax exemptions, and exemption from annual vehicle tax and registration fees.
- Technical and Legal Barriers: It also addresses regulatory deficiencies and infrastructural challenges, aiming to increase EV adoption despite high costs, regulatory gaps, and limited infrastructure. Public-Private Partnerships (PPP) are highlighted in this context.
    - Regulation of Electricity Sale through Charging Stations: In Morocco, the sale of electricity through charging stations is not regulated, making it illegal to resell electricity since the government controls energy sales. This regulatory gap limits the efficiency and utility of charging stations. EV users typically charge at home or at parking spots provided by gas stations such as Afriquia, Kilowatt.ma, and often for free since charging stations can't profit from selling electricity. Sometimes, users pay for parking instead.
- Awareness and Advocacy: The existing roadmap includes awareness campaigns and training to overcome social barriers. However, a lack of proactive governmental advocacy for nationwide E-mobility remains a significant obstacle. More concrete actions and campaigns need to be designed and implemented at the national level to raise the social awareness of citizens.

The most relevant activities to be carried out in the short term

- Regulation of electricity sales is needed to allow EV market uptake for both charging stations deployment and EV purchase.
- Permitting should be designed to enable the installation of chargers on the public ground and self-consumption laws should be carefully revised to allow end-users of electrical vehicles to charge their cars as an eligible activity for self-consumption.
- Financial incentives both direct to reduce the higher upfront investment costs of EVs and stimulate private sector purchases and indirect to support the development of charging infrastructure help to overcome central bottlenecks on e-mobility in Morocco.
- It is common that electric vehicles, especially battery EVs, are eco-friendly and correspond to zero direct emissions. However, when they are charged with a non-decarbonized grid, GHG emissions and air pollution they are only shifted from cities to power plants.
- Sensitizing EV users to eco-driving practices can save energy and emissions as well. More public awareness campaigns are needed, where the government and civil society like NGOs and community form a team and implement a campaign.

- Professional training programs for technicians, electricians, and emergency forces with the skills is needed to service and maintain EVs and charging stations.

Role of most relevant actors implementing enabling policy framework

- **Ministry of Energy Transition and Sustainable Development:** This ministry is responsible for formulating and implementing laws and regulations related to renewable energy development in Morocco. The Renewable Energy Developmental Law provides the legal framework and incentives for promoting renewable energy sources such as solar, wind, and hydroelectric power. Therefore, the Ministry of ETSD will play an essential role in regulating the decarbonisation of the energy sector, which will make e-mobility in Morocco more climate-friendly
- **Ministry of Transport and Logistics:** it oversees the development and implementation of the National Transport Strategy. This strategy aims to improve transportation infrastructure, promote sustainable transport options, and reduce emissions from the transport sector through policies on public transport, logistics, and road infrastructure.
- **Ministry of Economy and Finance:** it plays a crucial role in the financial aspects of energy efficiency initiatives. The National Energy Efficiency Strategy 2023 focuses on improving energy efficiency across various sectors to reduce energy consumption and enhance economic competitiveness. The Ministry of Economy and Finance also coordinates Morocco's NDC under the Paris Agreement. This involves setting targets for reducing greenhouse gas emissions, implementing mitigation actions, and securing financial resources for climate adaptation and mitigation projects.
- **The National Office of Electricity and Drinking Water (ONEE)**: it is a key actor in the energy sector, is involved in implementing the National Plan for Electric Mobility. This plan aims to promote the adoption of electric vehicles (EVs) and develop the necessary infrastructure such as charging stations to support electric mobility in Morocco.
- **Confederation General des Entreprises du Maroc (CGEM)**: As a representative body of Moroccan enterprises, CGEM contributes to the formulation and implementation of the National Sustainable Development Strategy. This strategy outlines the country's overarching goals and action plans for achieving sustainable development across economic, social, and environmental dimensions

3.7. Second-life battery use as energy storage for solar photovoltaic systems in Ghana

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3.7.1. Introduction

Second-life batteries are estimated to cost 60 to 75% of the price of new batteries. Their potential uses include energy storage for microgrid installations, storing energy for charging EVs, for use in low-powered electric vehicles such as forklifts, and supporting off-grid as well as grid-connected renewable energy systems. Renewable systems are noted for power fluctuations due to time variability and the intermittent nature of renewable sources. Second-

life batteries could be used in these instances to store the energy and later supplied to the grid, when needed. In the case of off-grid applications, the stored energy could be directly connected to the applications. Second-life batteries have however several barriers in their application which include difficulty in determining, safety concerns, and other technical issues.

In Ghana, despite past efforts to boost renewable energy uptake, there is still a seeming lack of adoption on a wide scale with the emphasis on conventional energy sources which are fossil based. The subject of second-life batteries to be used as energy storage for off-grid solar photovoltaic systems is also not addressed in any of the past interventions for renewable energy use in Ghana. To understand the barriers hindering the use of second-life batteries as energy storage for off-grid solar photo-voltaic systems in Ghana, four interviews were conducted to understand key stakeholders' perspectives. The stakeholders included three policymakers (from governmental agencies) and three solution providers. Findings from the interviews were compiled into a previous SESA report on barrier analysis. The summary of barriers to second-life battery use as energy storage for solar photovoltaic systems in Ghana is given below.

- **Policy and institutional barriers**: Some work on standards for electric vehicles and batteries has been initiated but currently there are no plans and regulations regarding the use of second-life batteries in Ghana. Also, there are no initiatives for local manufacturing in the near future, leading to full dependence on imports even after plans and policies are formulated. Besides a lack of policy to promote second-life batteries, barriers to renewable energy adoption also impact the adoption of second-life batteries as storage for PV systems.

- **Economic and Financial barriers:** Though solar PV technology is now considered viable, high up-front cost, a lack of access to and high cost of finance are barriers to its adoption in Ghana. It requires financial incentives to address these barriers and achieve the renewable energy target. The use of second-life batteries, which could reduce costs, is however faced with several barriers inhibiting the growth of the sector.

- **Social barriers**: Competing demand for water for other activities such as agriculture and tourism and resulting forced migration, condition of workers in Lithium mines and safety concerns have been brought out as social issues in some studies.

- **Technological barriers**: Despite experience with PV systems, skilled labour and access to solar technologies remain challenges for many companies in Ghana. In the case of second-life batteries, there is a lack of technical staff to test second-life batteries, and there is also uncertainty around cost reduction in the use of second-life batteries.

- **Environmental barriers**: According to a study, the second- life processing of batteries delays the recycling process for end-of-life batteries as in some cases, these batteries could be reused for between 6 to 10 years in second-life applications. In such instances, the materials needed for producing new batteries need to be mined, which can have environmental consequences.

- **Legal barriers**: As already used batteries can also be imported from elsewhere, providing a second life to those batteries in Ghana may not be allowed and face legal barriers in Ghana according to a policy maker. Also, standards for testing second-life batteries have not been framed yet and there is no laboratory to test or capacity for this in the country.

- **Awareness and capacity building barriers**: A lack of education and awareness of the existing legal regulations on e-waste handling is a major hindrance to the adoption of this technology. As a result of this, solution providers are under the impression that there is a ban on the importation of second-life EV batteries for use but according to the Environmental Protection Agency (EPA), there are specific protocols to be followed that would allow for the importation of same. Banks also do not offer to finance this product due to a lack of awareness.

It must be mentioned that the identified barriers were presented to local and national stakeholders working in the energy field in Ghana through a validation workshop organized during the SESA' Policy Dialogue event in October 2023. During the validation workshop, participants were asked through an online platform to express their views on the barriers as summarized below. Options varied from Disagree, strongly disagree, Agree, and Strongly agree. Live results were generated and formed the basis for discussion among the stakeholders. Stakeholders indicated that all the barriers existed and needed to be addressed to ensure that the technology of using second-life batteries for energy storage in PV solar systems is sustainably developed in Ghana.

The barriers validated by the stakeholders during the Policy Dialogue event are summarized below.

Political and Institutional

- P1 - There are no current policy actions specifically targeted at the productive use of second-life batteries in Ghana.
- P2 - Private companies are willing to invest in the technology, but there are no concerted national or local policies and plans to promote such investments.
- P3 - There are no indications on specific measures to promote local manufacturing of solar components and batteries, despite the measure being mentioned in the RE Master Plan.
- P4 - There is inadequate prioritization measures for renewable energy development by key stakeholders, though current policy documents acknowledge the potentials thereof.

Economic and Financial

- E1 - High initial costs of renewables/solar systems/batteries due to material costs and taxes associated with importing renewable energy technologies.
- E2 - The banking sector is not fully positioned to accelerate the uptake of renewable/solar technology due to scepticism about resource availability and revenue generation
- E3 - High interest rates from banks. Only a few banks offer lower interest rates for renewable energy projects. This slows down private investments.
- E4 - Lack of a local supply chain for renewable technologies/solar components/batteries is a challenge, with most components being imported.
- E5 - Government financial incentives for individuals and local innovators to use/develop battery/solar energy solutions are insufficient.
- Social and Cultural
- S1 - Sustainability of green energy storage is questioned due to the human cost of mining lithium, which is a key component in Lithium-ion batteries - violations of labour laws, child and forced labour, and indigenous rights, etc.

- S2 - High costs of renewable energy solutions raise affordability concerns for low-income households/users.
- S3 - Safety concerns arise from the explosive potential of second-life lithium-ion batteries if not handled properly.

Technical and Infrastructural

- T1 - The process of disassembling a used battery pack to inspect cells one by one could be very laborious, time consuming and an expensive exercise.
- T2 - There is inadequate skilled labour and knowledge on solar technologies including battery technologies, though licensed companies that install and maintain solar systems exist in Ghana.
- T3 - Key National and Local Institutions mandated for regulations and standards lack technical staff or capacity to test second-life batteries.

Environmental

- EN1 - Second-life processing of batteries delays recycling of end-of-life batteries, as such materials like lithium and other metals needed for new batteries are not timely recovered and made available.
- EN2 – Mining of lithium and other metals needed for new batteries results in negative impact on the environment - land degradation, biodiversity loss, creation of hazardous waste, or contamination of water, soil, and air.
- EN3 - Improper disposal of residual components after second-life battery processing poses environmental risks - severe toxic pollution.

Legal and Regulatory

- L1 - Used batteries from electric vehicles and appliances are classified as used electrical items, making it difficult for companies to import them for recycling and second-life use.
- L2 - Standards for testing second-life batteries were recently introduced but not widely disseminated yet. - Renewable Energy (Renewable Energy Batteries) Regulations, 2022 (LI 2452)
-

Awareness and Information

- A1 - There is inadequate awareness about existing policies and regulations on renewable energy/e-waste.
- A2 – There is limited skilled labour and inadequate training on renewables/second-life lithium-ion batteries technology.

Following up on the identification and validation of the barriers, this current document presents a set of policy measures in form of Policy Roadmaps that can be taken up by relevant stakeholders to address the identified barriers. The following sections of this documents outline the process followed to come up with the Policy Roadmaps touching on the data collection processes followed, the enabling policy framework, and policy specific timelines, activities and resource needs.

3.7.2. Data Collection

In order to develop the Policy Roadmaps, an initial desk research was conducted to identify existing policy measures put in place at the local and national levels that deal directly or indirectly with the technology of *Second-life Battery Use as Energy Storage for Solar Photovoltaic Systems* in Ghana. This task aims to: 1. understand the policy gaps and identify additional priority policies that need to be implemented to overcome deployment barriers and

to create an enabling policy framework; and 2. propose activities for the additional priority policies, organizing them in the short-, medium- and long-term to form a policy roadmap that can facilitate the roll out of an enabling policy framework.

In addition to the desk research, a total number of four interviews were carried out in May, 2024 with relevant key stakeholders to further deepen understandings of the current policy environment and seek perspectives on proposed policy measures that can address the previously identified barriers. The key stakeholders include a senior lecturer from Kwame Nkrumah University of Science and Technology (KNUST) representing academia, an industry representative from Nastech Power Solutions, personnel from Ghana Standards Authority, government agency and personnel from Environmental Protection Agency, an agency of government under the Ministry of Environment, Science, Technology and Innovation.

3.7.3. Enabling Policy Framework

In the course of the desk research, it was revealed that government of Ghana has launched the National Electric Vehicle Policy (Ministry of Transport, 2023). In the policy document, some provisions were made regarding Electric Vehicle batteries but no specific details were provided on second life battery technology. Also, it was found out that, there exist some legislative instruments (LIs) on importation of electrical appliances and renewable energy products but there is a need to review these legislative instruments to include second life battery use.

During the stakeholder interviews, it was revealed that second life battery use as energy storage for solar photovoltaic systems is a grey area in Ghana. It was mentioned that, although there exist some second life battery applications in Ghana, the use of second life batteries for energy storage has not been tapped. Further, it was revealed that there are some existing policies regarding batteries, specifically, lead acid batteries, and also on re-use of the end-of-life Lithium-ion batteries coming from e-waste, such as handheld power tools, mobile phones, laptops, power banks, etc yet there are currently no regulations on Lithium-ion batteries from electric vehicles.

The outcome of the exercises (review of existing policies, and stakeholder interviews), enabled the identification of the policy gaps. Table 43 presents new sets of policies that could be taken to complement current efforts and facilitate the uptake of second-life battery technologies for energy storage in solar PV systems in Ghana.

Table 43 Policies to overcome barriers to market deployment of Second-life Battery Use as Energy Storage for Solar Photovoltaic Systems in Ghana

Name of the Policy Measure	Barrier addressed	Policy design details	Responsible Institutions	Remarks
I. Regulatory Framework for Promotion of Second-life battery (SLB) technology	P1 - There are no current policy actions specifically targeted at the productive use of second-life batteries in Ghana.	The policy will establish specific regulations on importation/exportation, collection, processing and disposal of second-life batteries, incentives for local value addition, and guidelines to encourage the integration of second-life batteries into energy storage systems.	Ministry of Energy, Ministry of Tade and Industry Energy Commission, Environmental Protection Agency (EPA), Ministry of Environment,	

		The policy will also cover directives on building the needed capacity to support the sector and promote research and development activities.	Science, Technology and Innovation	
II. Policy on Investment Promotion into second-life battery technology development.	P2 Private companies are willing to invest in the technology, but there are no concerted national or local policies and plans to promote such investments. E7 - High interest rates from banks. Only a few banks offer lower interest rates for renewable energy projects. This slows down private investments. E9 - Government financial incentives for individuals and local innovators to use/develop battery/solar energy solutions are insufficient.	The policy will institute tax holidays, subsidies, and support for research and development to attract private companies to invest in second-life battery technology. The policy will establish low-interest loan programs to provide financial assistance to businesses and organizations investing in EV battery repurposing/ second-life battery technology. The policy will create room for government to collaborate with financial institutions to develop affordable E-mobility financing products that support local uptake. Also, the policy will include measures to put in place incentive mechanisms to support businesses involved in EV Battery repurposing / second-life batteries (Energy Commission, 2022).	Ministry of Energy Energy Commission Ministry of Trade and Industry Ministry of Environment, Science, Technology and Innovation Ministry of Finance Bank of Ghana (BoG) Ghana Revenue Authority Ghana Investment Promotion Commission	Expand scope of funding by actively engaging international agencies and private sector and developing international collaboration with local innovators and R&D centres (Energy Commission, 2019). Local start-ups like NASTECH POWER SOLUTIONS should be identified and scaled-up
III. Targeted Financial Incentives to promote productive use of second-life batteries	E5 - High initial costs of renewables/solar systems/batteries due to material costs and taxes associated with importing renewable energy technologies. S11 - High costs of renewable energy solutions raise affordability concerns for low-income households/users	The policy will include government-led financial incentives targeted at reducing the initial costs of renewables, solar systems, and batteries by revising import taxes, tariffs, and duties on renewable energy technologies. Supportive programs and social interventions tailored to renewable energy solutions affordability needs for low-income	Energy Commission Ministry of Trade and Industry Ghana Revenue Authority Ministry of Finance Ministry of Energy	

		households would be made available.	International Donors	
IV. Regulation on Local Content Development and Local Participation	P3 - There are no indications on specific measures to promote local manufacturing of solar components and batteries, despite the measure being mentioned in the RE Master Plan. E8 - Lack of a local supply chain for renewable technologies/solar components/batteries is a challenge, with most components being imported.	The policy will provide subsidies, grants, and technical assistance to local manufacturers, as well as fostering partnerships between local businesses and international companies, and support for scaling up their operations. The policy will support the existence of a robust supply chain system enabled by ready availability of raw materials, processing equipment and resources, and facilitate market exposure for the end products.	Ministry of Trade and Industry Ministry of Transport Energy Commission	In order to reduce the over reliance on imported RETs, government shall support local manufacturing / assembly initiatives by providing incentives such as tax breaks, capital subsidies, loan guarantees, etc (Energy Commission, 2019)
V. National Framework for awareness raising on productive use of second-life batteries.	P4 - There is inadequate prioritization measures for renewable energy development by key stakeholders, though current policy documents acknowledge the potentials thereof. A21 - There is inadequate awareness about existing policies and regulations on renewable energy/e-waste. E6 - The banking sector is not fully positioned to accelerate the uptake of renewable/solar technology due to scepticism about resource availability and revenue generation	The policy will include government-led interventions and efforts that create awareness on the benefits of renewable energy and encourage investment in the sector. The policy will stipulate specific activities that can be taken up by both public and private institutions to create visibility for end-products developed from second-life batteries. The policy will task relevant public institutions in the energy sector to produce easy-to-read leaflets, handouts, and brochures, and media campaigns to improve knowledge of policy and regulatory framework on renewable energy/e-waste. The policy will also encourage media publicity on socio-economic and environmental benefits of processing second-life batteries for productive use highlighting the job	Energy Commission Ministry of Information Media Ghana Standards Authority (GSA) Ministry of Energy Ministry of Transport Ministry of Environment, Science, Technology and Innovation	

		creation, the waste management benefits, and the greater impact on climate change. Awareness campaigns could include radio programmes, road shows, advertisements, social media visibility, exhibitions, sponsoring renewable energy events, and partnering with local businesses to showcase innovative applications of second-life batteries. Again, the policy will cover measures to increase awareness and dissemination of standards for testing second-life batteries among relevant stakeholders. This can be achieved through training sessions, workshops, and outreach programs to educate industry professionals, regulators, and consumers about battery testing standards and requirements. This policy will also establish platforms to engage with the banking sector to increase the sector's awareness and understanding of renewable energy technologies and their potential for revenue generation. This would involve providing training and education to banking professionals and offering incentives for banks to finance renewable energy projects.		
VI. Standards and Regulations for productive use and management of second-life batteries.	L20 - Standards for testing second-life batteries were recently introduced but not widely disseminated yet. - Renewable Energy (Renewable Energy Batteries) Regulations, 2022 (LI 2452) S12 - Safety concerns arise from the explosive potential of	This policy will establish standards for second-life batteries / repurposing EV batteries in order to streamline the sector. It includes the need to formalize EV battery repurposing standards in agreement with international standards, and adapt local electrical installation norms to safely incorporate batteries second-life requirements	Ghana Standards Authority Environmental Protection Agency (EPA) Energy Commission Ministry of Environment, Science,	Standards and technical codes are needed to ensure that optimal benefits are derived from the utilisation of RETs. The Ghana Standards Authority (GSA) has adopted

	second-life lithium-ion batteries if not handled properly. EN18 - Improper disposal of residual components after second-life battery processing poses environmental risks - severe toxic pollution. EN16 - Second-life processing of batteries delays recycling of end-of-life batteries, as such materials like lithium and other metals needed for new batteries are not timely recovered and made available.	(Energy Commission, 2022). The policy will also promote training and education to industry professionals and implementing strict safety protocols. The policy will develop guidelines and regulations for proper disposal and recycling of residual components after second-life battery processing to prevent environmental pollution. This would involve implementing waste management standards, establishing recycling and reuse infrastructure, and enforcing compliance with environmental standards. In addition, the policy will establish recycling incentives such as pay-as-you throw (PAYT) schemes, standards, and requirements for battery manufacturers and recyclers. The policy will develop a national battery plan to address EV battery pack fates, support second-life battery market, and ensure battery recycling	Technology and Innovation Ministry of Transport	standards for solar modules, batteries, inverter, etc (Energy Commission, 2019).
VII. National Support Mechanism for Research and Development into productive use of second-life batteries	T13 - The process of disassembling a used battery pack to inspect cells one by one could be very laborious, time consuming and an expensive exercise.	The policy will establish measures to invest in advanced testing equipment and technologies that make the processing of second-life batteries more efficient and effective. This will include funding for tertiary and TVET institutions to procure such technologies, dedicated funding to support technology adoption among local SMEs in the sector. The policy will also ensure the establishment of centres of excellence for second-life battery technology/ EV	Ministry of Energy Ministry of Finance Ministry of Education Research and Development Institutions	In South Africa, government provide a tax incentive to companies that incur expenditure related to research and development. There is also an accelerated depreciation deduction on a 50:30:20 basis over three years for capital expenditure incurred on

		battery repurposing. The centres would undertake research into the optimization of the processing process and battery process parameters.		machinery or plant and equipment used for research and development (Department of Trade, 2023).
VIII. National Policy on Education, Training, Technical and Capacity Development on second-life battery development	T14 - There is inadequate skilled labour and knowledge on solar technologies including battery technologies, though licensed companies that install and maintain solar systems exist in Ghana. T15 - Key National and Local Institutions mandated for regulations and standards lack technical staff or capacity to test second-life batteries. A22 – There is limited skilled labour and inadequate training on renewables/second-life lithium-ion batteries technology.	The policy will ensure the expansion of TVET and tertiary institutional programs to include renewable energy technologies and battery technology. Also, offer scholarships and apprenticeships, and partnering with educational institutions to develop curricula and training materials. The policy will promote training and capacity building programs on renewables and second-life lithium-ion battery technology. This would include specialized training programs, workshops, certifications, and knowledge-sharing initiatives to enhance technical expertise and capabilities.	Ministry of Education Commission for Technical and Vocational Education and Training (CTVET) Ghana Tertiary Education Commission (GTEC) Scholarship Secretariat Energy Commission Ghana Standards Authority Environmental Protection Agency	The skills development must start immediately to avoid having to import all the new skills when the country has high unemployment levels (Department of Trade, 2023). Deliberate efforts to improve local expertise through capacity building will help reduce over-reliance on foreign expertise for execution of renewable energy projects (Energy Commission, 2019).
IX. Policy on lithium mining and processing in Ghana	S10 - Sustainability of green energy storage is questioned due to the human cost of mining lithium, which is a key component in Lithium-ion batteries - violations of labour laws, child and forced labour, and indigenous rights, etc. EN17 – Mining of lithium and other metals needed for new batteries results in negative impact on the environment - land degradation,	The policy will develop regulations and standards to ensure ethical sourcing of lithium. Also, the policy will strengthen environmental regulations and enforcement measures to mitigate the negative impacts of lithium mining on the environment. This would include conducting environmental impact assessments, imposing stricter regulations on illegal mining practices, and promoting sustainable mining techniques.	Minerals Commission Ministry of Gender, Children and Social Protection Environmental Protection Agency	

	biodiversity loss, creation of hazardous waste, or contamination of water, soil, and air.			

As presented in Table 43, nine policy measures were proposed. The policy measures include the establishment of a regulatory framework and investment promotion policies to attract investment into the technology, provision of targeted incentives to help reduce financial barriers, policy measure on local content development and participation. Additional measures are national awareness campaigns and educational initiatives to enhance stakeholder knowledge and technical capacity, standards and regulations on safe use and disposal of second-life batteries, support for research and development to help streamline and improve the technology uptake, making it more efficient. Key institutions responsible for the implementation of the policy measures include Ghana Standards Authority, Environmental Protection Agency (EPA), Energy Commission, Ministry of Environment, Science, Technology and Innovation. Collectively, the policy measures proposed will help create a comprehensive and sustainable framework for advancing second-life battery use as energy storage for solar photovoltaic systems in Ghana.

3.7.4. Guidance for Policy Roadmap Development

Policy timelines are necessary to have a choice of priority in connection with the implementation and realization of the enabling policy framework since not all the policy measures could be implemented within same frame of time. Activities to be implemented in short, medium and long term for various policy measures are indicated in Table 44.

Table 44 Relevant activities for instruments of an enabling policy framework

Name of the Policy Measure	Short-term	Medium-term	Long-term	Remarks
I. Regulatory Framework for Promotion of Second-life battery (SLB) technology	Government together with stakeholders should develop regulations for the importation and exportation of second-life batteries. Establish guidelines for the collection and initial processing of second-life batteries. Begin providing incentives to encourage companies to invest in local value addition and promote SLB utilization.	Implement comprehensive policies for the disposal and recycling of second-life batteries to ensure environmental compliance. Establish collaborations with research institutions to encourage R&D activities focused on second-life battery technology.	Integrate second-life batteries into national energy storage systems to enhance grid stability and energy resilience.	
II. Policy on Investment Promotion into second-life battery	Provide tax holidays and subsidies for companies investing in second-life battery technology to encourage early-stage investment.	Work with banks and other financial institutions to create affordable financing products for businesses and individuals involved in	Encourage direct government investment in second-life battery infrastructure to bolster growth and	

technology development.	Launch awareness campaigns highlighting the benefits and potential of second-life battery technology to attract investors and industry stakeholders. Initiate funding and grants for research into innovative uses of second-life batteries, encouraging universities and private research institutions to explore new applications.	second-life battery technology.	stability of the sector. Foster innovation to create new products and services derived from second-life batteries, positioning Ghana as a leader in second-life battery technology in sub-Saharan Africa with export opportunities. Implement a continuous monitoring and evaluation systems to assess the effectiveness of policies and adjust them as needed to ensure long-term success and sustainability of second-life battery technology development.	
III. Targeted Financial Incentives to promote productive use of second-life batteries	The government to reduce import taxes, tariffs, and duties on renewable energy technologies to lower the initial costs of renewables and batteries. For example, eliminating import duties on lithium-ion battery cells and solar panels can reduce costs for businesses and consumers.	Develop programs that provide financial assistance for low-income households to make renewable energy solutions more affordable. For instance, a government grant program could offer financial assistance to cover a portion of the cost of installing solar systems with second-life battery storage in low-income communities. Establish social programs designed to help low-income households access renewable energy solutions, ensuring equitable energy transitions. A specific program could provide free or subsidized solar systems with second-life battery storage to low-income families.	Encourage the growth of local industries around second-life batteries and renewable energy by reducing dependence on imports and creating more sustainable and affordable solutions in the long term. An example could be supporting the establishment of local battery recycling plants to create a sustainable supply chain for second-life batteries.	

IV. Regulation on Local Content Development and Local Participation	Make available direct funding for startups and small businesses to invest in manufacturing equipment and infrastructure. Implement training programs to build skills and expertise among local manufacturers. This would include workshops on advanced manufacturing processes.	Facilitate market exposure for locally made products by providing platforms such as trade fairs and exhibitions for showcasing and promoting locally made second life batteries.	Encourage the growth of local manufacturing industries for export potential, helping Ghana become a regional hub for renewable technology manufacturing by establishing government-backed initiatives to promote Ghanaian-made solar components and batteries in international markets.	
V. National Framework for awareness raising on productive use of second-life batteries.	Launch initial awareness campaigns focusing on the benefits of renewable energy and second-life batteries. Use platforms like radio, social media, and community events.	Expand campaigns to a wider audience and geographic regions. Increase outreach to schools and local businesses for broader engagement.	Establish ongoing partnerships for long-term campaigns, including integration of second-life battery technology into existing academic curricula and regular community events.	
VI. Standards and Regulations for productive use and management of second-life batteries.	Establish basic safety standards for repurposing and reusing EV batteries, ensuring compliance with international standards. Develop basic guidelines for proper disposal and recycling of residual components after second-life battery processing to prevent environmental pollution. Government to establish a pay-as-you-throw (PAYT) scheme, charging a fee for improper disposal of batteries. At the same time, tax credits are provided to companies that implement battery recycling programs. This incentive structure encourages businesses to invest in recycling rather than landfill disposal.	Build infrastructure for recycling and reuse, including facilities and logistical support for processing residual battery components. A national recycling program be established to handle the influx of second-life batteries. This program includes new recycling facilities, waste collection centres, and logistical support for transporting battery components. It also provides training to staff to ensure proper recycling practices.	Establish a framework for continuous updates to safety standards and compliance requirements, adapting to new technologies and evolving industry practices. A national plan is developed to guide the lifecycle management of EV battery packs. This plan includes a roadmap for supporting the second-life battery market, recycling strategies, and goals for reducing environmental impact. The plan is periodically updated to reflect new technologies and market trends.	

VII. National Support Mechanism for Research and Development into productive use of second-life batteries	Provide dedicated funding to support technology adoption among local SMEs involved in second-life battery processing. Government to provide grants to universities and TVET institutions to acquire advanced battery testing equipment for research and training.	Create centres of excellence focused on second-life battery technology and EV battery repurposing. These centres will conduct research, promote innovation, and offer training programs to support the development of the sector.		
VIII. National Policy on Education, Training, Technical and Capacity Development on second-life battery development	Partner with educational institutions to develop curricula and training materials focused on renewable energy technologies and battery technology. Introduction of new courses on renewable energy and battery technology. Make scholarship programs available to attract students into renewable energy and battery technology programs. At the same time, encourage partnerships with local businesses to offer apprenticeship opportunities. Conduct initial training programs, workshops, and knowledge-sharing initiatives to enhance technical expertise in second-life battery technology. These initiatives aim to support industry professionals and students.	Technical universities can introduce certification programs for second-life battery technology, with a curriculum designed to meet industry needs. Promote collaborative research projects and industry-led training programs. Promote knowledge-sharing initiatives to facilitate the exchange of expertise and best practices among industry professionals and educators. This can include conferences, seminars, and industry networking events.	Develop long-term scholarship and apprenticeship programs to continuously attract talent into the renewable energy and battery technology sectors. This approach ensures a sustained pipeline of skilled professionals.	
IX. Policy on lithium mining and processing in Ghana	Establish initial regulations to ensure ethical sourcing of lithium. This includes setting minimum requirements for labour standards, safety, and environmental practices for companies involved in lithium sourcing. Require environmental impact assessments for all lithium mining	Strengthen compliance checks and enforcement measures to ensure companies adhere to ethical sourcing and environmental regulations. A dedicated compliance team is established to conduct regular audits of lithium mining	Encourage long-term adoption of sustainable mining practices, focusing on reducing environmental impact and supporting local communities. This approach includes continuous investment in sustainable	

	projects to evaluate potential environmental risks and mitigate negative impacts.	companies, ensuring they adhere to labour and environmental standards. Companies found in violation face fines and mandatory corrective actions.	technologies and community engagement.	

3.7.5. Policy Briefs on Good Practices

The energy sector in Ghana is characterized by high fossil fuels power plants. The share of Renewable Energy Sources (RES) should be increased, despite the challenge of their intermittent and non-dispatchable nature. According to the National Electric Vehicle Policy, Ghana aims to phase out ICEs by the year 2045, having all government fleets been electric by the year 2040 (Ministry of Transport, 2023). As the market for Electric Vehicle in the country grows, it is established that the number of available used EV batteries will increase. There will become environmental issues regarding end-of-life batteries from EVs. Currently, battery recycling is an economic, logistic and technical challenge. Secondary utilization of EV batteries for storing electricity from RES may simultaneously help to address the challenges in the energy, transport and e-waste management sectors. Storing energy from renewable sources is the most common second-life use of Lithium-ion batteries (Kotak et al., 2021). To promote the adoption of Second-life Battery use as Energy Storage for Photovoltaic systems in Ghana, there is the need to develop a policy roadmap. The roadmap identifies barriers faced by the adoption of the technology and develops a growth path for the technology through some policy proposals based on some best practices identified through desk research and was supplemented by consultations from stakeholders comprising of academia, industry, and government agencies. The stakeholder consultations were aimed to further understand the policy environment and to seek expert knowledge on the identified barriers and a validation of the proposed policy measures. The inputs of the stakeholders were curated and consolidated into the policy roadmap. The barrier analysis has identified the lack of a regulatory policy framework for second-life battery application, lack of awareness and education on the technology, limited technical experts and capacity needs, standardization and safety risks, among others. The policy roadmap addresses these main barriers by providing tailored policy measures, identified responsible stakeholders, and a proposed implementation timeline. The policy measures include: a regulatory framework and investment promotion policies to attracts investment into the technology, provision of targeted incentives to help reduce financial barriers, local content development and participation to foster domestic manufacturing and supply chains, national awareness campaigns and educational initiatives, standards and regulations to ensure safe use and disposal of second-life batteries, support for research and development, among others. These policy measures would lead toward sustainable practice while promoting the wider acceptance of Photovoltaic energy storage and advancement of e-mobility in Ghana and reduction in battery wastes. This will significantly contribute to reducing greenhouse gas emissions and mitigating climate change.

Good practice policies

The policy brief intends to outline policy best practices and priority issues associated with the use of the technology in order to provide guidance and to strengthen the need for policy framework for the adoption of second-life battery use as energy storage for solar PV systems in Ghana. The policy brief contains findings from a literature review. Notwithstanding, the presentation of the good practices are only to serve as illustrative examples and inspiration and

a potential basis for the development and implementation of enabling policies for the uptake of the technology. Hence, the good practice examples should not be regarded as a definitive blueprint for the policy formulation in the context of Ghana. Table 45 presents the Inflation Reduction Act (IRA) of the United States of America as a policy to address climate crises and to accelerate the deployment of clean energy.

Table 45: Best practice example: Inflation Reduction Act (IRA) of the United States of America

Policy type	Inflation Reduction Act (IRA) of 2022
Location of implementation	USA
Background / state at the outset	In August 2022, the U.S. Congress approved the Inflation Reduction Act (IRA) of 2022, combining the objectives of reducing domestic inflation - notably brought by the global energy crisis - while tackling climate change. A key stated goal of the act is to reduce carbon emissions by around 40 percent by 2030.
Policy description	The IRA includes a combination of grants, loans, tax provisions and other incentives to accelerate the deployment of clean energy, clean vehicles, clean buildings and clean manufacturing. This includes investments in deploying clean energy, expanding the electricity grid, developing domestic clean technology manufacturing, incentivizing uptake of electric vehicles, reducing methane emissions, increasing the efficiency of buildings, improving the climate resilience of communities, and other areas. In total, around 370 billion USD will be disbursed for measures dedicated to improving energy security and accelerating clean energy transitions (The White House, 2023). It also sets a minimum threshold for the raw materials in a battery that need to come from countries with which the US has a free trade agreement, with the threshold set to increase over time. In total, the various subsidies on offer for domestic battery manufacturers are estimated to be able to cover up to a third of the total battery manufacturing price (Morris, 2023).
Outcomes	Between August 2022 and March 2023, major EV and battery makers announced cumulative post-IRA investments of at least USD 52 billion in North American EV supply chains – of which 50% is for battery manufacturing, and about 20% each for battery components and EV (International Energy Agency, 2023)Some battery manufacturers have announced their intent to move manufacturing sites to the US to take advantage of the incentives offered (International Energy Agency, 2023)
Success factors	Clean energy projects creating 170,606 new jobs in 44 states were announced or advanced between August 16, 2022, and July 20, 2023. There are 272 new clean energy projects in small towns and big cities nationwide, totalling $278 billion in new investments(Climate Power, 2023).

Table 46 shows the Production Linked Incentives (PLI) on Advanced Chemistry Cell (ACC) Battery Storage policy of India to provide incentives to domestic industries to boost local production

Table 46: Best practice example: Production Linked Incentives (PLI)

Policy type	Production Linked Incentives (PLI) on Advanced Chemistry Cell (ACC) Battery Storage

Location of implementation	India
Background / state at the outset	The development of a domestic battery manufacturing ecosystem is crucial to India's ambitious push towards renewable energy and electric vehicles (EVs) (Randheer Singh & , Jagabanta Ningthoujam, Arjun Gupta, 2022). The Indian PLI on Advanced Chemistry Cell (ACC) Battery Storage was announced in late 2021 with the aim of boosting domestic battery manufacturing with a budget of INR 181 billion (Indian rupees) (USD 2.2 billion) (International Energy Agency, 2023). The Production Linked Incentive (PLI) Scheme is a government initiative designed to enhance the competitiveness of India's manufacturing sector by providing financial incentives to eligible companies. Launched by the Government of India, the scheme aims to attract investments, boost domestic production, create employment opportunities, and promote exports in specific sectors. This will be favourable to EV ecosystem and energy storage market as it will support the demand for EVs and renewable and attract investment in this sector.
Policy description	The recent rollout of the solar photovoltaic (PV) and advanced chemistry cell (ACC) Production Linked Incentive (PLI) schemes worth $3.2 billion and $2.5 billion, respectively, will kick-start the domestic manufacturing of solar panels and advanced batteries that can drive India towards achieving the ambitious target of installing 500 GW of non-fossil fuel electricity capacity by 2030 (Raj, 2021) Specifically, the government aimed to reach a cumulative 50 GWh in domestic manufacturing capacity by allocating funding to companies based on the sales of batteries manufactured in India, disbursed over five years, and dependent on meeting a domestic value-add of at least 25% in year 1, increasing to 60% in year 5. This is particularly ambitious given that there is currently no significant domestic battery cell manufacturing in India, and the 50 GWh figure is 50% greater than anticipated domestic demand as projected in the IEA Stated Policies Scenario (STEPS) in 2025 (International Energy Agency, 2023)
Outcomes	India had approved bids in late March for four companies to avail incentives under the PLI Scheme for ACC Battery Storage Manufacturing. In July, three of the selected bidders signed the Program Agreement under Production Linked Incentive (PLI) Scheme for Advanced Chemistry Cell (ACC) Battery Storage – Reliance New Energy Solar Limited, Ola Electric Mobility Private Limited, and Rajesh Exports Limited (Bhardwaj, 2022). These companies received incentives under India's INR 181 billion program to boost local battery cell production. Under the battery scheme, selected ACC battery storage manufacturers must set up a production facility within two years.
Success factors	The scheme attracted 10 bids with cumulative capacity of 128 GWh in early 2022, and by July 2022, the government had assigned funding to 3 companies

3.7.6. Summarising Remarks

Second-life battery technology has been recognized as one of the promising technological solutions for advancing environmental sustainability as the technology contributes to reduction in waste and demand for new raw materials, thus minimizing the ecological footprint associated with battery production and disposal. Second-life batteries offer an alternative for energy storage solutions, contributing to the viability and expansion of renewable energy systems by providing affordable, reliable storage capacity. In Ghana, despite past efforts to boost renewable energy uptake, there is still a seeming lack of adoption on a wide scale. The subject of second-life batteries to be used as energy storage for off-grid solar photo-voltaic systems is also not addressed in any of these interventions for renewable energy use in Ghana. The present

study, through desk research and interviews, has summarised the barriers hindering the adoption and use of second-life batteries as energy storage for off-grid solar photovoltaic systems in Ghana. There were 22 barriers identified. The barriers were classified as: Policy and institutional barriers; Economic and Financial barriers; Social barriers; Technological barriers; Environmental barriers; Legal barriers; Awareness and capacity building barriers.

Following up on the identification and validation of the barriers, policy measures in the form of policy roadmap to be taken up to address the barriers were identified. To develop guidance for a policy roadmap, an initial desk research was conducted, and a number of key stakeholder interviews were carried out to further understand the current policy environment and to seek perspectives on proposed policy measures. In all, nine policy measures were proposed as a basis for the enabling policy framework. These policy measures seek to address the identified barriers to the adoption and development of second-life battery technology in Ghana by creating a supportive regulatory and investment environment. The establishment of a regulatory framework and investment promotion policies attracts investment into the technology. Provision of targeted incentives will help reduce financial barriers, thereby making the technology more affordable. Policy measure on local content development and participation will foster domestic manufacturing and supply chains. Furthermore, national awareness campaigns and educational initiatives enhance stakeholder knowledge and technical capacity. These efforts ensure that both the private sector and the public are well-informed and capable of contributing to the adoption and growth of second-life battery technology in Ghana. Additionally, the introduction of standards and regulations will ensure the safe use and disposal of second-life batteries, mitigating environmental risks and improving battery repurposing efficiency. Support for research and development will help streamline and improve the technology uptake, making it more efficient. Furthermore, sustainable lithium mining policies address ethical and environmental concerns. This will promote responsible sourcing of materials.

An enabling policy framework for use of second-life batteries as energy storage for off-grid solar photovoltaic systems in Ghana has the potential to have an important economic impact on Ghana. Support for domestic manufacturing of second life battery storage has the potential to create decent jobs and support the local value chain. There are jobs associated with making second-life energy storage: managing fleet of batteries, discharge and disassembling of batteries, and safely storing and grading them for use in energy storage. Additional potential jobs include training and skills development for local communities for employment in battery storage systems, awareness raising, and marketing of energy storage products. There are some existing startups in Ghana that are involved in battery repurposing and some others in solar photovoltaic installations. When given the needed support and collaborations backed by an enabling policy framework, the uptake of second-life battery for solar photovoltaic energy storage in Ghana can achieved. In Rwanda, for instance, a collaboration between Carnegie Mellon University Africa (CMU-Africa) and its Pittsburgh counterpart has led to the creation of a startup called Second Life Storage (SLS) that markets energy storage-as-a-service using repurposed batteries (Reveche, 2023). In Kenya, a local company BBOXX worked together with Aceleron (battery manufacturer) and support from the Shell foundation on testing the second use of lithium-ion batteries for energy storage. BBOXX is working on a business model to commercialize the second-life energy storage approach and to expand it to other countries (Largue, 2019).

For the successful implementation of this policy framework, several institutions and agencies of government are responsible for the uptake. Most of these institutions are ministries of

government. The ministries of government stated here are responsible for the formulation, implementation, monitoring and evaluation as well as supervision and coordination of the sector agencies.

Policy timelines are necessary to have a choice of priority in connection with the implementation and realization of the enabling policy framework. In the short term, relevant activities such as stakeholder engagements is required in order to develop a regulatory framework and policies for the uptake of the technology. Medium term action plan should be to encourage and promote private investment into the technology, making available funding opportunities for continuous research and development of the technology, and support for local innovators to enhance the uptake of the technology. Some long-term activities to be considered include direct government investment into second life battery infrastructure, continuous review and upgrade of policies and standards in conformity with global trends. Also, integration of second life battery energy storage into the national grid to enhance grid stability and energy resilience.

For successful implementation of a policy framework, resources are needed. The situation is the same with the enabling policy framework for the productive use of second life battery as energy storage for solar photovoltaic systems in Ghana. Some resource needs include funding to support the policy implementation, technical experts in related fields to provide technical guidance and support, a coordinating agency or committee made up of key stakeholders to ensure coordination efforts across the relevant stakeholders of the policy framework.

3.8. Bio-ethanol Technology for Cooking in Ghana

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3.8.1. Introduction

Ghana has been exploring various renewable energy sources to improve energy access and reduce environmental degradation. The primary source of cooking fuel for most households in Ghana is traditional biomass, such as wood and charcoal. These traditional fuels contribute significantly to deforestation, indoor air pollution, and associated health problems.
Bioethanol, derived from biomass such as agricultural waste and other organic materials, presents a promising alternative for clean cooking (Tulashie et al., 2023). However, the deployment of bioethanol as a cooking fuel in Ghana is still at an early stage. As previously identified in the barrier analysis study, there is limited infrastructure for the production, distribution, and retail of bioethanol, coupled with economic and regulatory challenges, which has hindered its widespread adoption.
The barrier analysis for the adoption of bioethanol for cooking in Ghana identified several barriers using the PESTELA framework that hinder the widespread adoption of bioethanol for cooking in Ghana, including:

1. **Political and Institutional:** The lack of specific targets, inadequate institutional capacity, and insufficient coordination among stakeholders hinder progress in bio-ethanol implementation, necessitating increased investment in research, development, and capacity-building
2. **Economic and Financial Barriers**: The high initial cost of bioethanol stoves and the inconsistent pricing of bioethanol fuel make it less accessible for many households.

Financial incentives and subsidies are needed to make bioethanol a viable alternative to traditional biomass.

3. **Social and Cultural Barriers:** Limited awareness and acceptance among the population, along with entrenched preferences for traditional cooking fuels, pose significant challenges. Public awareness campaigns and educational programs are necessary to shift consumer behavior towards bioethanol.
4. **Technical and Infrastructure Barriers**: There is limited infrastructure for the production, distribution, and retail of bioethanol. Developing a robust supply chain is crucial to ensure consistent availability and affordability of bioethanol fuel.
5. **Legal and Regulatory Barriers:** The absence of comprehensive policies and regulations to support bioethanol adoption creates an uncertain environment for investors and consumers. Clear policies and regulations are needed to promote the use of bioethanol for cooking.

Awareness and Information Barriers: There is a need for comprehensive awareness campaigns, demonstrations, pilot projects, and training programs to promote bio-ethanol as a cooking fuel, as the general population lacks knowledge about its advantages and practical applications.

Despite these barriers, there are ongoing initiatives to promote the use of bioethanol for cooking in Ghana. Several pilot projects have been launched to demonstrate the feasibility and benefits of bioethanol stoves. For instance, the Ghana Alliance for Clean Cookstoves (GHACCO, n.d.) and other NGOs are working on programs to introduce bioethanol stoves in rural and urban areas. These initiatives aim to create awareness, build local capacity, and establish initial distribution networks.

Additionally, there have been efforts to produce bioethanol locally from agricultural waste, which not only provides a sustainable fuel source but also supports local economies and value creation (Takase et al., 2023; Adu et al., 2022). These projects are still in their infancy and require significant support to scale up and achieve broader impact.

3.8.2. Data Collection

To address these challenges and formulate an effective policy roadmap, a mixed-methods approach was employed, involving both desk research and stakeholder interviews.

The desk research involved a review of existing literature on bioethanol adoption, policy frameworks from other countries, and reports on energy access and cooking fuels in Ghana. Key sources included academic journals, government publications, and reports from international organizations.

Interviews were conducted with a diverse group of stakeholders to gather insights and validate findings from the desk research. The stakeholders included (see Table 47):

Table 47: List of stakeholders consulted

SL Number	Institution	Stakeholder Group
1	Ministry of Energy	Policy maker
2	Energy Commission	Policy maker
3	Local assembly	Policy maker
4	AAMUSTED	Academia
5	KNUST	Academia
6	UNER	Academia
7	Econexus	Solution provider
8	Clean cooking Alliance 0	NGO

9	SNV Netherlands	NGO

i. **Policy Makers:** Representatives from the Ministry of Energy and the Environmental Protection Agency (EPA).
ii. **Non-Governmental Organizations (NGOs)**: Organizations focused on sustainable energy and public health, such as the Clean Cooking Alliance and the Netherlands Development Organization.
iii. **Solution Providers** Entrepreneurs and companies involved in the bioethanol supply chain, including producers and distributors.
iv. **Academia:** Researchers from local universities (AAMUSTED, University of Energy and natural resources, UNER and Kwame Nkrumah University of Science and Technology, KNUST) with expertise in renewable energy and environmental health.

In total, 9 stakeholders were interviewed via phone and face to face between the first and second weeks of May 2024. The interviews provided valuable qualitative data on the barriers to bioethanol adoption and potential policy measures.

3.8.3. Enabling Policy Framework

Table 48: Policies to overcome barriers to market deployment of bioethanol for cooking in Ghana.

Name of the Policy Measure	Barrier addressed	Policy design details	Responsible Institutions	Remarks
Financial Incentives for Stoves	Economic and Financial Barrier: High initial costs of bioethanol stoves	Subsidies or tax incentives for the purchase of bioethanol stoves. A potential subsidy could cover up to 50% of the stove cost for low-income households.	Ministry of Energy, Ministry of Finance	
Limited access to finance for Small and Medium Enterprises (SMEs) in the Clean Cooking Sector.	Economic and Financial barriers: The lack of consistent local production capabilities and constraints on scale-up potential of SMEs involved in clean cooking technology and fuels are hindering their growth in rural markets. The policy measures aim to improve finance access for clean cooking SMEs by fostering collaborations between development finance institutions	Establishment of a dedicated fund to support the development of bioethanol production facilities. Customizing financial products for clean cooking sector SMEs, including flexible repayment terms and lower interest rates, and monitoring their impact on business growth and sector development. Establish dedicated funds to help investors to reduce upfront costs for investments in bioethanol production facilities"	Ministry of Energy (MoE), Ministry of Finance, Local commercial banks, Regional and international Development finance institutions	

	and commercial banks to provide credit guarantees.			
Infrastructure Development Fund	Technical and infrastructure barriers: The lack of adequate infrastructure, including storage facilities and transportation networks	Establishment of a dedicated fund for investors/operators of the distribution network Funds to help investors to set up storage facilities at key locations, including production centers and major consumption areas, ensuring a stable supply chain.	Ministry of Energy (MoE), Ministry of Finance, Local commercial banks, Regional and international Development finance institutions	
Comprehensive Regulatory Framework	Legal and Regulatory Barriers: Lack of supportive policies	Implement training programs for stakeholders in fuelwood harvesting and charcoal production, including workshops and seminars, to educate on sustainable techniques, legal requirements, and environmental impacts, and introduce incentives for compliance Legislation is needed to combat illegal fuelwood harvesting, charcoal production, and sale, promoting sustainable and efficient production, and addressing the value chain of charcoal	Environmental Protection Agency, Ministry of Energy, Ghana energy Commission, Non-governmental organizations (NGOs) working in conservation and sustainable development	Illegal felling of trees for fire wood and charcoal production hinders clean cooking technologies adoption, necessitating stronger regulation in the charcoal value chain to promote sustainable practices and ensure compliance with clean cooking standards.
Establishment of technical standards for clean and improved cookstoves (ICS).	Legal and Regulatory Barriers: Regulation of feedstock and standards of biofuel. Legislation can play a role in ensuring the availability and sustainability of feedstock for bio-ethanol production	Development and enforcement of regulations for bioethanol standards, safety. Inclusion of bioethanol in national energy policies.		
Public Awareness Campaigns	Awareness and capacity building barriers: Limited awareness and acceptance.	The benefits of using bioethanol for cooking can be effectively communicated through various platforms like television, radio, social media, and community-based initiatives.	Ministry of energy, Ministry of Information, NGOs,	Mass communicati on campaigns regarding sustainable

	The initiative aims to increase awareness and encourage the adoption of bio-ethanol technology in Ghana.	Demonstrations and pilot projects can be used to test new ideas and technologies. Training and capacity-building initiatives can improve the local ecosystem and promote bio-ethanol production, stove maintenance, and marketing, providing necessary skills to community leaders and entrepreneurs		cooking technologies should be customized to the specific contexts of urban and rural areas, and they should be realistic in terms of energy transitions and technology agnostic. Gender consideratio ns are essential in order to address the disproportio nate burden of women in traditional fuel collection and to ensure equal participation and safety.
Research and Development Grants	Cross-cutting: Innovation and local adaptation. The will support feasibility studies, developing policy frameworks, engaging stakeholders, and providing seed funding for R&D projects, potentially partnering with local research institutions.	Grants for R&D to improve bioethanol production technologies and develop cost-effective stove designs suited to local conditions. Establishment of a pilot to establish a supply chain (incl. agricultural waste, bioethanol production and a distribution and retail network) supported by international partners. The will lead to R&D expansion, infrastructure development, market development, and creation of incentives to promote growth and innovation.	Ministry of energy, Ministry of Science and Technology, Universities	

3.8.4. Guidance for Policy Roadmap Development

The policy roadmap outlines measures to overcome barriers to clean cooking technologies and fuels in Ghana. These measures are structured into short-term, medium-term, and long-term time horizons, aiming to achieve lasting impact, promote innovation, and ensure environmental

sustainability. Each policy measure is aligned with specific timelines and responsibilities, ensuring accountability and adaptability to evolving challenges.

Table 49: Timeline of individual policy measure address the barriers for clean cooking in Ghana

Name of the Policy Measure	Short-term	Medium-term	Long-term	Remarks
Financial Incentives for Stoves	Implement subsidies or tax incentives for the purchase of bioethanol stoves.	Evaluate the impact and adjust subsidy levels; Expand program to more regions.	Maintain and adjust incentives based on market changes and penetration rates.	Tailored to the country's context and market conditions, results-based financing is a successful approach to motivating the market through the use of public resources. (World Bank, 20)
Access to Finance for SMEs	Establish dedicated funds and financial products for SMEs in the clean cooking sector; Initiate collaborations with development finance institutions.	Monitor and evaluate the impact on SME growth; Expand credit guarantee schemes.	Sustain and scale up successful financial products; Integrate learnings into broader financial sector policies.	Rwanda's SME Access to Finance program has facilitated significant growth and scale-up of Micro small and medium enterprises (AFR, 2020)
Infrastructure Development Fund	Set up initial infrastructure funds; Identify key locations for storage and distribution facilities.	Expand infrastructure networks based on demand; Ensure stable supply chains.	Maintain and upgrade infrastructure; Expand to cover emerging areas and needs.	Tanzania's Rural Energy Fund has successfully improved energy access by developing local infrastructure (Rugaimukamu, Shauri & Mazigwa, 2023).
Comprehensive Regulatory Framework	Develop and implement legislation to support sustainable charcoal production and bioethanol standards.	Train stakeholders and enforce regulations; Monitor compliance.	Continuously update regulations to adapt to new challenges and technologies.	
Public Awareness Campaigns	Launch initial awareness campaigns using various media platforms; Conduct pilot projects.	Expand campaigns; Introduce training and capacity-building initiatives.	Maintain ongoing awareness efforts; Integrate feedback to improve campaigns.	Ghana's LPG promotion campaigns significantly increased adoption of cleaner cooking technologies in urban areas Bawakyillenuo et al. (2021)
Research and Development Grants	Provide initial grants for R&D in bioethanol technologies and stoves; Partner with	Expand R&D projects; Develop cost-effective stove designs; Pilot supply chain initiatives.	Scale up successful R&D projects; Integrate new technologies and practices into the market.	South Africa's R&D initiatives in bioenergy have led to innovative technologies that are now being

	local research institutions.			commercialized (Razwinani, Tshikovhi, & Motaung, (2024).

3.8.5. Policy Briefs on Good Practices

Country Context:

Ghana's reliance on conventional biomass sources, including wood and charcoal, for cooking has resulted in substantial environmental and health issues, including indoor air pollution, deforestation, and associated health risks. The exploration of bioethanol, which is produced from agricultural residue and other organic materials, offers a promising alternative for clean cooking (Tulashie et al., 2023). However, the adoption of bioethanol as a cooking fuel in Ghana faces several barriers that need to be addressed through targeted policy interventions.

Agricultural policies in Ghana could be adapted to support bioethanol production as a complementary income source for farmers. For example, policies promoting sustainable farming practices could include provisions that encourage farmers to grow crops specifically for bioethanol production, or policies could promote the use of agricultural by-products in bioenergy initiatives. This integration would help ensure that the promotion of bioethanol aligns with broader agricultural goals such as food security, poverty reduction, and environmental sustainability. For instance, crop rotation strategies can be employed to maintain food production while also providing biomass for bioethanol.

The Political and Institutional barriers include a lack of specific governmental targets for bioethanol adoption and inadequate coordination among stakeholders. Economic and Financial barriers are marked by the high initial costs of bioethanol stoves and the inconsistent pricing of bioethanol fuel, making it less accessible to many households. On the Social and Cultural front, entrenched preferences for traditional cooking fuels and limited public awareness about the benefits of bioethanol pose significant challenges. Technical and Infrastructure barriers are characterized by inadequate infrastructure for the production, distribution, and retail of bioethanol, while Legal and Regulatory barriers stem from the absence of a comprehensive policy framework to support the bioethanol market. Finally, Awareness and Information barriers highlight the need for widespread public education and capacity-building initiatives to promote the adoption of bioethanol

A variety of policy measures, such as financial incentives, infrastructure development, capacity building, and regulatory reforms, are necessary to overcome these obstacles. These policies will not only establish an enabling environment for the adoption of bioethanol, but they will also contribute to the broader objectives of public health development and environmental sustainability. Implementing best practices from other countries that have successfully integrated bioethanol into their energy mix will be crucial in ensuring the success of these initiatives in Ghana.

Good practice policies

Table 50: Legal and regulatory framework

Policy type	Ethanol Cooking Fuel Masterplan
Location of implementation	Kenya

Background / state at the outset	Before the implementation of the Ethanol Cooking Fuel (ECF) Masterplan Ministry of Energy, 2021), Kenya's cooking fuel market was dominated by charcoal, firewood, and kerosene, leading to significant health, environmental, and socio-economic costs. Despite the availability of cleaner alternatives like LPG, their adoption remained limited due to cost and accessibility issues. The ECF sector was at a nascent stage, with local ethanol production being minimal and supply chains underdeveloped
Policy description	The ECF Masterplan was introduced by the Kenyan government to establish a sustainable domestic ethanol industry. It aims to increase the adoption of bioethanol as a cooking fuel by addressing barriers such as awareness, affordability, and accessibility. The policy includes the expansion of ethanol production using feedstocks like molasses, sugarcane juice, and cassava. It also promotes investments in infrastructure, such as ethanol plants and distribution networks, and introduces financial incentives to make ECF more affordable for consumers
Outcomes	The implementation of this policy has led to a significant increase in ethanol production and consumption. There has been a notable shift in consumer behaviour, particularly in urban areas, where bioethanol has become a more popular cooking fuel. The policy has also contributed to job creation in the ethanol production sector and has helped reduce Kenya's greenhouse gas emissions
Success factors	The provision of subsidies and tax incentives has made bioethanol more affordable for consumers and more profitable for producers. Public Awareness Campaigns have successfully informed the public about the benefits of bioethanol, driving demand. Effective partnerships with financial institutions and the private sector have ensured the availability of affordable credit and the efficient implementation of the policy

Table 51: Financial incentives

Policy type	Financial Incentives for Bioethanol Production and Use
Location of implementation	South Africa
Background / state at the outset	South Africa faces challenges in scaling bioethanol production due to high production costs and limited market incentives. The high cost of first-generation biofuels relative to conventional fuels has discouraged investment, and there is no natural financial incentive for petroleum companies to integrate bioethanol into the fuel supply chain. Furthermore, the lack of an established market for bioethanol necessitates government intervention to ensure industry viability and environmental benefit
Policy description	South Africa's biofuels policy includes several financial incentives designed to support bioethanol production. Key measures include (Department of Energy, 2020): i. Subsidies for First-Generation Biofuels: The government introduced subsidies for first-generation bioethanol producers, which are critical to offset the higher costs of production compared to conventional fuels. The subsidies are tied to the socio-economic benefits, such as job creation in rural areas and the support of black farmers. ii. Mandatory Blending Regulations: Regulations enforce a minimum blending requirement of 2% bioethanol into petrol. This regulation ensures a captive market for bioethanol producers, supporting the industry's growth. iii. Cost Recovery Mechanisms: The policy provides for cost recovery mechanisms for petroleum companies that incur additional costs due to bioethanol blending, ensuring these companies remain financially neutral

Outcomes	The implementation of these financial incentives has led to increased bioethanol production capacity, a more stable market for biofuels, and reduced carbon emissions from the transport sector. Additionally, the policies have driven socio-economic development, particularly in rural areas where biofuel feedstock is grown, thereby supporting job creation and economic growth
Success factors	Key factors contributing to the success of this policy include: • The subsidies are specifically designed to support socio-economic goals, such as rural job creation and support for black farmers. • The mandatory blending regulations create a guaranteed market for bioethanol, which has been crucial for encouraging investment in the sector. • The success of the policy is bolstered by collaboration between various government departments, including the Department of Agriculture, Land Reform and Rural Development, and the Department of Mineral Resources and Energy, ensuring the policy's effective implementation and monitoring.

3.8.6. Summarising Remarks

The adoption of bioethanol as a cooking fuel in Ghana presents a significant opportunity to improve energy access, reduce environmental degradation, and enhance public health. Despite the numerous barriers identified, including economic, technical, regulatory, and social challenges, there is a clear pathway to overcome these obstacles through a comprehensive and well-structured policy roadmap.

This policy roadmap outlines strategic measures across short-term, medium-term, and long-term timeframes to address these barriers. Financial incentives, access to finance for SMEs, infrastructure development, comprehensive regulatory frameworks, public awareness campaigns, and research and development grants are key components of this roadmap. Each measure is designed to create a supportive environment for the widespread adoption of bioethanol, ensuring sustainability and scalability.

Learning from similar initiatives in other African countries, such as Kenya, Rwanda and South Africa, provides valuable insights into effective implementation strategies and potential pitfalls. The successes and lessons from these countries can guide Ghana in developing robust policies that are contextually relevant and impactful.

Overall, the transition to bioethanol for cooking requires coordinated efforts from government institutions, private sector stakeholders, non-governmental organizations, and the general public. With committed implementation and continuous evaluation, Ghana can achieve significant progress in promoting clean cooking technologies, thereby contributing to environmental conservation, public health improvement, and sustainable development.

Key Policy Takeaway

- **Infrastructure Development:** Investments in bioethanol production, storage, and distribution networks are critical to ensure a reliable and affordable bioethanol supply, especially in rural areas.
- **Financial Incentives:** Offering subsidies for bioethanol stoves and facilitating access to finance for small and SMEs involved in the bioethanol supply chain will help make clean cooking accessible to low-income households and boost local production.
- **Public Awareness and Capacity Building:** Effective communication campaigns and training programs are essential to shift consumer behavior toward bioethanol cooking and build local capacity for stove maintenance and production.
- **Integration with Agriculture and Rural Development**: Linking bioethanol production to agricultural policies by utilizing agricultural waste as feedstock can create

new income streams for farmers, support rural economies, and promote sustainable farming practices.

3.9. Solar Irrigation in Rwanda

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3.9.1. Introduction

The Government of Rwanda's 7-year National Strategy for Transformation (NST1) (2017 - 2024), has a target to increase agriculture under irrigation from 48,508 hectares in 2017 to 102,284 hectares by 2024. To reach this target, there is an increasing need for the private sector to be involved. As the country is densely populated and farmers own small pieces of land, a land consolidation policy was developed to increase consolidated land from 635,603 hectares (in 2017) to 980,000 hectares (in 2024). Rwanda developed its first Irrigation Master Plan in 2010. The Rwanda Irrigation Master Plan (IMP) is a ten-year national sectoral plan that provided planning tools for rational exploitation of soil and water resources by promoting irrigation in its various forms (The Government of Rwanda, 2010). Currently, the plan is being reviewed and updated to incorporate the changing trends in irrigation technologies (The Government of Rwanda, 2020; JICA, 2022). An initial review of data on solar energy versus energy from diesel for pumping water for irrigation indicates that solar energy has lower total costs and lower overall energy consumption despite the higher initial investment cost and higher depreciation of machinery and equipment ((Jean Baptiste, 2018). This makes a case for promoting solar irrigation in Rwanda. In Rwanda, the promotion of solar-powered irrigation technology started in 2019. It is among the technologies that benefit from the provision of government subsidies to individual farmers, or to a group of farmers, or cooperatives under the national program for small-scale irrigation technology. The area of irrigation in these cases varies mostly from 0.5 hectares to 10 hectares. Solar-powered irrigation systems are composed of solar arrays without batteries, pumping units, water storage units, and distribution pipes. The most used storage units are elevated tanks and surface tanks. Also, drip irrigation and tap irrigation are the two types of irrigation practiced.

In this report, we build on a previously carried out activity where we identified barriers hindering the adoption of solar irrigation in Rwanda. These barriers included a lack of reliable water sources, lack of technical expertise, economic and financial, social barriers (gender issues), awareness (limited social networks and knowledge sharing), environmental, technical, and regulatory barriers. Barriers are arranged starting with the most relevant one. Respectively in this current report, we propose policy measures that could be taken up to address the identified barriers. The following section describes the methodology that was deployed.

3.9.2. Data Collection

The methodology employed was a mixed approach consisting of a desktop review, a policy dialogue meeting, and structured questionnaires that were used to carry out stakeholder

interviews. The structured interviews were used as a tool to collect information from experts in academia, solution providers, and funding agencies while the desktop review highlights some policies, programs, and initiatives that are supportive of solar-powered irrigation, in policy dialogue meeting all stakeholders were invited and results from desktop review and interviews were presented and their inputs were added. During the barrier analysis stage as mentioned earlier, two solution providers, four experts from academia, and one expert from a funding agency were interviewed represented in Table 52. For the policy roadmap engagement during the Policy Dialogue in Kigali, government agencies and solution providers in solar-powered irrigation systems were present represented in Table 53.

Table 52: List of Experts from Academia, Solution Providers, and Funding Agency

s/n	Respondent	Type of institution
1	four experts from academia from the Irrigation and Drainage Department and Agricultural Mechanization Department from the College of Agriculture, Animal Science and Veterinary Medicine-University of Rwanda	Public University
2	The expert from Nikki Production LTD	Private Solution Developer.
3	Expert from INNOVATECH	Private Solution Developer.
4	Expert from the Development Bank of Rwanda	Funding Agency

Table 53: List of Government and Private Developers who attended policy dialogue meeting.

S/n	Attended Institutions	Type of Institution
1	Rwanda Agriculture and Animal Resources Development Board (RAB).	Government Institution responsible for all types of irrigation systems.
2	Rwanda institute of conservation in Agriculture (RICA)	Government Institution
3	Rwanda Utilities Regulatory Authority (RURA).	Government Institution
4	Rwanda Energy Group (REG)	Government Institution
5	Rwanda National Council for Science and Technology (NCST)	Government institution
6	Rwanda Standards Board (RSB)	Government Institution
7	City of Kigali	Government Institution
8	Rwanda Green Fund (FONERWA)	Environment and Climate Change Fund
9	Ministry of Infrastructure	Government Ministry
10	Rwanda Environment Management Authority (REMA)	Government Institution
11	University of Rwanda	Government Institution
12	Bright Future Contracting Company Ltd	Private Developer
13	Ecogreen Solution ltd	Private Developer
14	SLS Energy Rwanda	Private Developer
15	ETC Construction Mixed	Private Developer
16	African Energy Services Group Ltd	Private Developer
17	African Energy Developers (EPD)	Association of Energy Developers
18	Genius Environmental ltd	Private Developer
19	Right Lump Shine Group	Private Developer

3.9.3. Enabling Policy Framework

Table 54 provides an overview of possible policy measures that could be taken to address barriers to the adoption of solar irrigation in Rwanda. The table shows the name of the policy

and the challenge(s) it addresses, a short description of the policy, and also the responsible institutions relevant to policy design, planning, and implementation. Remarks are made where necessary.

Table 54: policy measures, barriers being addressed, policy design details, responsible institutions, and remarks.

Name of the Policy Measure	Barrier addressed	Policy design details	Responsible Institutions	Remarks
I. Promote Water harvesting for irrigation.	The barrier being addressed is a lack of reliable water sources.	Promoting water harvesting systems for irrigation from rainfall in areas without access to water sources would increase the land surface area access to reliable water sources. This can be done by introducing water storage systems with shades made of iron sheets that will collect and direct harvested water in the water storage tank. This will serve mainly as a solution to rainfall interruption (due to climate change), which causes many losses in agricultural harvest (in season A (which is from September 2022 to February 2023) & B (which started from March to June.)). This will increase the agricultural productivity of the land as a result of the availability of more water for irrigation.	Rwanda Water Resources Board (RWB), Rwanda Agriculture and Animal Resources Development Board (RAB), Private Sector Federation, Rwanda ministry of agriculture, Rwanda institute of conservation in Agriculture (RICA) and Rwanda Meteorology Agency (METEO RWANDA)	Rwandans own small pieces of land and many places are hilly. Introducing water harvesting systems from rainfall in areas without access to water sources would increase the surface area access to reliable water sources. Thus, it will increase the area with access to irrigation and promote agricultural mechanization. The barrier being addressed is a lack of reliable water sources. Working with the private sector and introducing a water harvesting system can help increase the area of land with access to irrigation and promote agricultural mechanization.
II. Promote efficient water use management practices.	The barrier being addressed is a lack of reliable water sources.	Promote good water conservation practices such as covering cultivated land with grass or any other biomass materials, adding organic fertilizers, and preventing soil erosion.	Rwanda Water Resources Board (RWB), Rwanda Agriculture and Animal Resources Development Board (RAB), Private Sector Federation, Rwanda Ministry of Agriculture, and RICA.	Many farmers especially small farmers do not apply good water conservation practices such as Covering cultivated land with grass or any other biomass materials, adding organic fertilizers, and preventing soil erosion. and as a result, water evaporates faster and more water is needed for irrigation.

III.	Develop specialized capacity in solar-powered irrigation systems.	The barrier being addressed is a lack of technical expertise.	Develop a short-term curriculum program on solar-powered irrigations which can build capacity for individuals and or the companies involved in solar-powered irrigation systems. This can be done by first conducting a skills gap survey and developing a short-term curriculum that responds to the identified skill gap.	universities and technical institutions in collaboration with the Rwanda Agriculture and Animal Resources Development Board (RAB), Rwanda Institute of Conservation in Agriculture (RICA), the Ministry of Agriculture, and the Ministry of Education.	Farmers will be encouraged to form cooperatives, which will serve as platforms for organizing workshops on best farming practices. Through these cooperatives, a skills audit will be conducted to identify gaps in knowledge and competencies. Based on the audit, training manuals will be developed, with a focus on addressing prioritized skill areas in collaboration with the cooperatives. Additionally, through public-private partnerships, farmers will gain access to a broader pool of expertise, funding sources, and advocacy networks. These partnerships will expand the range of training programs offered, covering areas such as technology use, financial management, and market access, to ensure farmers are well-equipped for sustainable growth and success.
IV.	Developing solar-powered irrigation system sizing guidelines that consider terrain differences.	The barrier being addressed is a lack of technical expertise.	Develop system sizing guidelines on Solar powered irrigations which provide detailed guidelines on system sizing at different terrains and are used as user manual reference during system sizing. This can be done by first a group of experts conducting country terrain mapping with all technical coordinates and developing a sizing guideline manual for different terrains.	Rwanda Water Resources Board (RWB), Rwanda Agriculture and Animal Resources Development Board (RAB), Private Sector Federation, Rwanda Ministry of Agriculture, and RICA. universities and technical institutions in collaboration with the Rwanda Agriculture and Animal Resources Development Board (RAB), Rwanda Institute of Conservation in Agriculture (RICA), the Ministry of Agriculture,	

				and the Ministry of Education.	
V. Develop new innovative business models that are cost-effective in farming using solar-powered irrigation systems.		The barriers being addressed are Economic and Financial.	Introduce seed funds for incubates to fund the development of new innovative business models that are cost-effective in farming using solar-powered irrigation systems.	Rwanda Agriculture and Animal Resources Development Board (RAB) in collaboration with universities, Rwanda Cooperative Agency (RCA), Rwanda Institute of Conservation in Agriculture (RICA), and Ministry of Agriculture and Animal Resources (MINAGRI).	
VI.	Special subsidies and training for women involved in Solar Powered irrigation	The barrier being addressed is Gender issues (Social barriers.)	Include setting targets for women's participation in project leadership roles, providing training and capacity-building programs specifically for women, and ensuring that women have access to resources and benefits from solar irrigation technology by providing them some special subsidies.	Rwanda Water Resources Board (RWB), Rwanda Agriculture and Animal Resources Development Board (RAB), Private Sector Federation, Rwanda ministry of agriculture, and RICA.	Gender issues can be considered a social barrier to solar-powered irrigation in Rwanda. In many Rwanda rural communities, women play a significant role in agricultural activities. However, they often have limited access to resources, information, and decision-making power.
VII.	Public Awareness Campaigns on benefits of solar irrigation	The barrier being addressed is Awareness barriers	The government must Launch public awareness campaigns to educate communities about the benefits of solar irrigation. These campaigns should use culturally appropriate messaging and channels, such as national radio, TV, and Umuganda gatherings, to reach a wide audience.	Rwanda Agriculture and Animal Resources Development Board (RAB), Private Sector Federation, Rwanda ministry of agriculture, and RICA.	Limited social networks and knowledge sharing on irrigation in Rwanda can be categorized as awareness barriers to the promotion of solar-powered irrigation in Rwanda.
VIII.	Develop a special Waste Management plan for water sources that are used for solar-powered irrigation	Environmental barriers.	Promote proper disposal practices for chemical containers and unused chemicals. Encourage farmers to follow guidelines for disposing of chemicals safely, such as rinsing containers thoroughly and disposing of them at designated collection points.	Rwanda Water Resources Board (RWB), Rwanda Agriculture and Animal Resources Development Board (RAB), Private Sector Federation, Rwanda ministry of agriculture, and RICA.	

IX.	Technical standards and certification requirements for solar-powered irrigation equipment setup.	Technical and regulatory barriers.	Set up technical standards and certification requirements for solar-powered irrigation equipment to ensure quality, safety, and performance standards are met. This can enhance consumer confidence in the technology and facilitate widespread adoption.	Rwanda Water Resources Board (RWB), Rwanda Agriculture and Animal Resources Development Board (RAB), Private Sector Federation, Rwanda ministry of agriculture, and RICA.	

3.9.4. Guidance for Policy Roadmap Development

In the table below, the proposed policy measures are further detailed into short-, medium- and long-term interventions, highlighting activities that are possible within the respective time horizons for implementation

Table 55: Policy Roadmap

Name of the Policy Measure	Short-term	Medium-term	Long-term	Remarks
I. Promote Water harvesting for irrigation.	Install demonstrative water harvesting water storage in every district. Also, encourage banks especially micro-finance to introduce loan schemes for water harvesting and storage.	Scaleup water harvesting storage to many farmers	Promote the use of locally fabricated water harvesting storage systems and train farmers on repairing skills and installation of water harvesting systems.	Introducing the use of locally fabricated promotes the use of locally fabricated water harvesting storage systems and trains farmers on repairing skills and installation of water harvesting systems. This will reduce prices and bring sustainability.
II. Promote efficient water use management practices.	Develop efficient water use management practices guidelines and implement them.	Regular audits and compliance checks	Keep Regular audits and compliance checks on a Bi-yearly	
III. Develop specialized capacity in solar-powered irrigation systems.	Conducting a need assessment to evaluate the gap in formal and informal sector players' knowledge and skills in solar-	Evaluating the program and adjusting it for further needs of the formal and informal sector players	N/A	

	powered irrigation systems Designing and developing a skills development plan and materials addressing the needs of informal and formal sector players Conducting skill development programs			
IV. Developing solar-powered irrigation system sizing guidelines that consider terrain differences.	Development of a system sizing guidelines program and certification scheme for PV modules	Regular audits and compliance checks	N/A	
V. Develop new innovative business models that are cost-effective in farming using solar-powered irrigation systems.	Through existing incubation hubs add seed funds for innovation in business models for solar-powered irrigation systems. Test the models (pilots)	The Rwanda Agriculture and Animal Resource Board provides grants for scaling up innovation pilot prototypes.		
VI. Special subsidies and training for women involved in Solar Powered irrigation	Develop subsidies and training programs. Implement the subsidy program and conduct training. Also, Develop awareness and selection criteria.	Scale up		
VII. Public Awareness Campaigns on the benefits of solar irrigation	Develop awareness raising program to increase farmers' awareness of the use of solar-powered irrigation systems and its benefits.	Disseminate the awareness-raising program through radio, TV, newspapers, community participation activities (for example Umuganda), farmers associations, and social media as well	Engagement of districts, churches, and schools in awareness-raising program companies.	
Develop a special Waste Management plan for water sources that are used for solar-powered irrigation	Develop a waste management plan. Set-up pilots	Evaluate pilots and implement the program for improvement	Implement the program	Evaluate pilots will lead to the success of implementation

IX. Standards and monitoring set up.	Develop guidelines for standards and monitoring.	Implement the guidelines.	Evaluate and improve the guidelines.	
Technical standards and certification requirements for solar-powered irrigation equipment setup.	Develop Technical standards and certification requirements for solar-powered irrigation equipment and develop guidelines for monitoring.	Implement technical standards and certification requirements for solar-powered irrigation equipment (This could also be in the short-term as well)		

3.9.5. Policy Briefs on Good Practices

To promote solar-powered irrigation in Rwanda, the existing barriers can be overcome by implementing corresponding policies. The barrier analysis has identified the lack of reliable water sources for agriculture, lack of technical expertise, economic and financial, social barriers (gender issues), awareness (limited social networks and knowledge sharing), environmental, technical, and regulatory as the key barriers in implementing the solar-powered irrigation in Rwanda.

The policy roadmap addresses these main barriers by providing tailored suggestions for potential policies, their design, the responsible institutions and a proposed implementation timeline. This two-stage approach of firstly conducting a barrier analysis and secondly the development of a policy roadmap leads to the development of policies related to the following key points:

i. Promote water harvesting for irrigation.
ii. Promote efficient water use management practices.
iii. Develop specialized capacity in solar-powered irrigation systems.
iv. Developing solar-powered irrigation system sizing guidelines that consider terrain differences.
v. Special subsidies and training for women involved in Solar Powered irrigation
vi. Develop new innovative business models that are cost-effective in farming using solar-powered irrigation systems
vii. Public awareness campaigns on the benefits of solar irrigation
viii. Develop a special waste management plan for water sources that are used for solar-powered irrigation
ix. Standards and monitoring set up.
x. Technical standards and certification requirements for solar-powered irrigation equipment setup.

Good Practices policies

To provide guidance for the policy design of solar-powered irrigation in Rwanda, two good practice examples have been identified. These examples of existing policies take into account the country and use-case-specific circumstances where they have been implemented. However, they should not be regarded as definitive blueprints for policy formulation in the context of solar-powered irrigation in Rwanda. Instead, these examples serve as a source of inspiration

and a potential foundation for developing policies tailored to the unique requirements of solar irrigation in Rwanda.

Best practice example 1: Solar Irrigation for Agricultural Resilience (SIRA) Program
The SIRA program in Kenya exemplifies best practices by integrating renewable energy with sustainable agriculture, fostering economic empowerment, ensuring environmental sustainability, and building resilience to climate change. Its success demonstrates the potential of innovative, community-driven solutions to address complex development challenges and provides a valuable model for similar initiatives worldwide. Table 56 summarizes the background, the outcomes, and the success factors of the solar irrigation for Agriculture resilience program in Kenya.

Table 56: Solar Irrigation for Agricultural Resilience (SIRA) Program in Kenya (Republic of Kenya Ministry of Water, Sanitation and Irrigation, 2017)

Policy type	Industrial (Agriculture)-led initiatives
Location of implementation	*K*enya
Background / state at the outset	Kenya has been facing the problem of arid areas where growing crops was very hard. Arid and semi-arid regions in Kenya receive very low and unpredictable rainfall. The lack of consistent water supply makes it difficult to sustain traditional farming practices and grow crops. For this reason, Kenya has implemented several programs to promote solar-powered irrigation, particularly in arid and semi-arid regions. To attain increased and sustained food production, the country will need to reduce reliance on rain-fed agriculture and increase irrigation-based systems that allow production throughout the year, thus better responding to market demand fluctuations.
Policy description	The policy has been designed to reinforce the following key areas. 1. **Public-Private Partnerships:** • Collaborates with private companies to provide solar irrigation systems. • Engages with NGOs to provide technical assistance and training. 2. **Innovative Financing:** • Implements pay-as-you-go models and microfinancing to help smallholder farmers afford solar pumps. • Provides grants and matching funds to incentivize adoption. 3. **Research and Development:** • Invests in R&D to develop efficient and affordable solar irrigation technologies suitable for local conditions. • Partners with universities and research institutions to pilot and test new solutions. 4. **Environmental Sustainability:** • Ensures that solar irrigation projects include measures for sustainable water management. • Promotes the use of drip irrigation systems to maximize water use efficiency.
Outcomes	• To attain increased and sustained food production • To reduce reliance on rain-fed agriculture and increase irrigation-based systems. • To reduce GHG emissions.

Success factors	• Active stakeholder participation including the private sector • Strengthened by institutional and legal frameworks

Best practice example 2: PM-KUSUM initiative: Solar Pumping Program for Irrigation in India (PM-KUSUM initiative, 2019)

The Solar Pumping Program for Irrigation in India offers a comprehensive and effective model that addresses key challenges in agriculture through the integration of renewable energy, economic benefits, environmental sustainability, scalability, government support, and community engagement. Adopting and adapting this best practice policy can help Rwanda develop a robust and sustainable solar irrigation program, contributing to increased agricultural productivity, improved livelihoods, and environmental conservation. Table 57 summarizes the background, the outcomes, and the success factors of Solar Pumping Program for Irrigation in India.

Table 57: Solar Pumping Program for Irrigation in India

Policy type	Industry-led initiatives
Location of implementation	India
Background / state at the outset	Government of India has taken various policy measures to fulfil its commitment made in Paris Climate Agreement in 2015 to have 40% of installed power generation capacity from non- fossil fuel sources by 2030. To provide energy and water security to farmers and enhance their income, de-dieselise the farm sector, and reduce environmental pollution. .
Policy description	**For an Installation of Standalone Solar Powered Agriculture Pumps:** Central Financial Assistance (CFA) up to 30% of the Benchmark cost (fixed by Ministry of New & Renewable Energy (MNRE) every year) of the standalone solar pump will be provided. The State Government will give a subsidy of 30%; and the remaining 40% will be provided by the farmer. Bank finance up to 30% out of 40% share can be availed by the farmer, so that farmer has to initially pay only 10% of the total cost of the pump. However, in North Eastern States, Sikkim, Himachal Pradesh, Uttarakhand, Jammu & Kashmir, Ladakh, Lakshadweep and A&N Islands, higher CFA up to 50% of the benchmark cost of the standalone solar pump will be provided by the
Outcomes	• **Day-time reliable power for irrigation** Farmers typically get power for irrigation at night. This not only causes them a great deal of inconvenience but also results in wastage of water as pumps are left running once switched on. Providing solar panels for irrigation under PM-KUSUM would result in day-time reliable power to farmers making irrigation easier for them and also avoiding over-use of water and power. • **De-Dieselization of Farm Sector By Replacing Diesel Pumps With Solar Pumps** Farmers have been demanding the replacement of diesel pumps by electric pumps as the former one is costly to run. By replacing diesel pumps. with solar pumps and panels, the farmers will get cheaper and more reliable power for irrigation resulting in savings in diesel cost

	• Enhancing Farmers' Income Reducing the Agriculture Electricity Subsidy Burden on States and Improving the Financial Health of DISCOMS (Electricity distribution companies) • Reduce the GHG emissions
Success factors	•Access to loans for both farmers and Public or private solar power developers/EPC •Applicable rules and regulations. • available central Government incentive

3.9.6. Summarising Remarks

This document outlines identified barriers and provides an overview of possible policy measures that could be taken to address barriers to the adoption of solar irrigation in Rwanda. Also, the proposed policy measures are further detailed into short-, medium- and long-term interventions, highlighting activities that are possible within the respective time horizons for implementation.

The identified barriers are lack of reliable water sources, lack of technical expertise, Economic and Financial, Social barriers (gender issues), Awareness (limited social networks and knowledge sharing), Environmental, Technical, and regulatory. The barriers are arranged starting with the most affecting ones. Drawing insights from similar policy initiatives in other countries such as Solar Irrigation for Agricultural Resilience (SIRA) program in Kenya and Solar Pumping Program for Irrigation in India (PM-KUSUM initiative, 2019), and if all proposed policy measures are well implemented would lead to the adoption of solar-powered irrigation systems in Rwanda hence changing the lives of farmers and positively impacting the climate and economy of the country.

4. Concluding remarks

As a collaboration project between the European Union and nine Africa countries, SESA, which stands for Smart Energy Solutions for Africa, aims at providing energy access technologies and business models that are easily replicable and generate local opportunities for economic development and social cohesion in Africa. For nine country cases, this report provides guidance to support the diffusion of selected technologies.

A policy roadmap is often seen as an official document containing fixed targets and target years as well as the corresponding steps or activities to realise these targets to which national governments have committed themselves. However, given the scope and constraints (e. g. limited resources) in the SESA project, the added value of D5.3 was considered to feed a potential roadmapping process for certain technologies to be implemented in respective countries. Hence, D5.3 provides support or guidance to a similar but more granular government-backed process.

This document builds on the barrier analysis developed as part of the SESA project (Jyoti & Rocha Romero, 2023). In fact, a barrier analysis had been conducted for each of the above cases. These analyses were based on the PESTELA-framework, which, basically, groups barriers in seven overall categories: **p**olitical, **e**conomic, **s**ocial, **t**echnological and infrastructural, **e**nvironmental, **l**egal as well as **a**wareness and information.

As part of this Task, barriers identified in D5.2 and grouped according to PESTELA were prioritised by partners on a case-by-case basis in order to find the most pressing concerns for policy interventions. Based on desk research and complemented by expert interviews, country-specific policies were identified that are needed for an enabling policy framework – to, ultimately, contribute to technology diffusion. Moreover, the relevant steps to implement identified policies were identified and grouped into short-, medium- and long-term activities.

While it is difficult to draw conclusions for all case studies given the different country contexts and technologies analysed, some of the more general findings show that policy action is needed in several areas. While is all cases, economic aspects remain a key challenge (e. g. high prices for end-users), capacity building / training, awareness raising or regulatory changes almost always need to be part of a policy package, as well. In some case studies, ecologic challenges of smart energy technologies remain a concern, too.
The policy recommendation in this report are tailored to the specific needs and contexts of different African countries, ensuring that the policy recommendations are not one-size-fits-all. Never the less cross-learnings between the case studies and the resulting policy recommendation can be observed. Policy makers should in particular focus in providing financial incentives for environmentally friendly behavior. This needs to be coupled with programs that focus and capacity building in urban and rural areas while taking into consideration the cultural specifics of the region.

Some country-specific findings are:

- Solar Productive Use in Kenya: The case study highlights the importance of a clear strategy, communication, and monitoring to ensure successful implementation of solar productive use in Kenya. It also proposes incorporating community-based approaches and addressing the issue of e-waste through extended producer responsibility. Additionally, the roadmap highlights the need for education and capacity building to support the growth of the recycling industry and mitigate water stress, that could exacerbate if, for instance, solar PV systems are used for water pumps.

- E-mobility in Kenya: The role of a steering committee is reinstated to coordinate e-mobility activities. Several economic instruments may help to make EVs more affordable, but also to build a domestic manufacturing base in the long-run. Grid reliability (and the increasing need for capacities to facilitate e-mobility) as well as the end-of-life handling need to be covered as the market expands.
- Clean Cooking in Malawi can be based on a Multi-Level Governance Coordination Initiative. The policy roadmap provides a contributing strategy to enhancing clean cooking diffusion in Malawi. It ties together the critical elements of policy, stakeholder engagement, activities, and resources, creating a cohesive plan for the sustainable development of the sector
- Second-Life Use of EV Batteries in South Africa is critical for South Africa's transition to a renewable-based electricity grid, but faces barriers like inadequate supply, lack of awareness, and safety risks due to insufficient regulatory frameworks. A proposed policy framework emphasizes safety standards, improved waste management, and collaboration among government, industry, and educational institutions to develop a robust ecosystem for battery recycling and repurposing, requiring stakeholder engagement, skilled workforce development, and funding for research and pilot projects.
- PVs for Household in Morocco: A key challenge besides the high upfront costs identified is providing a legal framework for grid connectivity and infrastructure in order to connect solar PV. The analysis suggests that learning from international examples and formulating suitable feed-in tariffs or net metering policies will contribute to accelerating rooftop solar PV deployment.
- E-mobility in Morocco: Morocco's existing policy framework for transitioning to a net-zero emissions transport system is insufficient, requiring short, medium, and long-term actions to achieve its 2030 targets. Key barriers addressed include promoting financial incentives, improving regulations for EV infrastructure and electricity sales, and raising public awareness, with the Ministry of Energy Transition, Ministry of Transport, and other stakeholders playing crucial roles in implementing these policies and encouraging sustainable electric mobility.
- Second-life battery use as energy storage for solar photovoltaic systems in Ghana: Measures to drive technology diffusion include creating a supportive regulatory environment, providing incentives, promoting local content, raising awareness, establishing standards, supporting research, and promoting sustainable lithium mining. The successful implementation of these measures requires government involvement, resources, and a coordinated approach.
- Bio-ethanol Technology for Cooking in Ghana: The analysis proposes strategic measures to overcome obstacles through financial incentives, infrastructure development, regulatory frameworks, public awareness campaigns, and research and development grants. The roadmap aims to create a supportive environment for the widespread adoption of bioethanol. Coordinated efforts from government institutions, private sector stakeholders, NGOs, and the general public are needed to achieve significant progress in promoting clean cooking technologies and contributing to sustainable development.
- Solar Irrigation in Rwanda: As relevant policies this analysis suggests, for instance, the promotion of water harvesting for irrigation, in combination with financial support and training to develop sound business models. If all proposed policy measures are well implemented, this may lead to the adoption of solar-powered irrigation systems in Rwanda and, hence, may change the lives of farmers and positively affect the climate and the economy of the country.

This report has shown that policy mixes are truly relevant to facilitate low carbon technologies and need take into account the country-specific situations. Negative effects of certain innovations have to be factored in as well if, for instance, new technologies increase the risk to deplete groundwater resources. Given the severity of the climate crisis and its effects seen worldwide, it is key that Governments throughout the world commit themselves to facilitate low-carbon energy technologies and innovation. The European Union and its Member States can support emerging and developing countries willing and interested in facilitating the market for such technologies.

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Annex

Kenya E-mobility Stakeholders´ Consultation

Interview Steps:
1. Brief Introduction to the project was given to the stakeholder being consulted / interviewed
2. The information about "Barrier Analysis" done in the first phase was provided. The barriers were classified into the following categories.

- **P**olitical and institutional
- **E**conomic and Financial
- **S**ocial and Cultural
- **T**echnology and Infrastructure
- **E**nvironmental
- **L**egal and Regulatory
- **A**wareness and information

2. By and large, barriers identified by stakeholders during the survey last year are similar to what are implicit from the draft policy framework developed by the Task Force.
The draft policy report (submitted by the Taskforce to the government is in tabular form; a table consisting of various policies in the framework that was decided at the time of preparation of the interim report last year. It does not contain an explanation of the policies, challenges that

may be encountered in their implementation, support requirements, etc. Therefore, the discussions with stakeholders focused on these aspects of the policies.

Questions

Question 1: Recommendations have been made by the Taskforce to constitute a steering committee. Setting a target for zero-emissions vehicles and integrating charging infrastructure with transport planning have also been suggested. All good suggestions, which indicate political commitment.

However, the target year for zero-emission vehicles is not specified. What challenges do you see in terms of financing, infrastructure, and other requirements?

Question 2: A regulatory framework for EV Asset Financing has been suggested and tax incentives for EV Parts and on built EVs (import, excise duty, and VAT) has also suggested in the draft policy. Exemption from stamp duty (charging infrastructure) and registration tax exemption are also suggested.

Again, good recommendations- and these follow from some of the best practices. What challenges do you see? For example, will it be able to address the issue of high upfront cost?

Question 2A: Will financial institutions be able to take risks that Asset Financing regulation may bring? Will it not push up the cost of finance?

Question 3: What challenges do you see in terms of financing all these incentives and what support requirements do you foresee? (and from where and by whom?)

Question 4: Several policy recommendations have been given for skill development, including e-mobility curriculum in TVET/ University, Certification requirements, mandated user training, etc. These are good recommendations. What challenges do you see in the implementation of these recommendations? What kind of support, if any you think would be needed (and from where/ by whom)

Question 5: There is a good recommendation to support local assembly and manufacturing including local content requirements in a phased manner, EVs in government fleets with min local content, and support for the manufacturing of batteries and EV Parts.

What challenges do you see because of the emerging players in this area globally, economies of scale, etc, and how do you think this will pan out? What unique advantage do you see Kenya has in this area?

Question 6: For charging infrastructure suggestions have been made for appropriate building codes, and targets for infrastructure with government facilitation.

Again, a good step in line with best practices. What challenges do you see- for example, in terms of a lack of clarity on how the infrastructure development is foreseen institutionally- government will play a major role, or private sector? Or it will be PPP? Policies may need to be moulded accordingly. Maybe all three? How private sector will be motivated?

Do you see any support requirements for this?

Question 7: The grid reliability issue is suggested to be addressed through a coordination framework among actors (Generation, Transmission, and Distribution). What challenges do you see, and do you think this alone is enough or do you need additional policies/regulations to address this issue? What support would be needed (and from where/ by whom)?

Question 8: There are good recommendations for the adoption of EVs for mass transit, emission standards, and safety regulations - all will promote EVs. Do you see any challenges in the implementation of these, and support requirements (if any)?

Question 9: Electricity tariff also set to be reviewed for EVs- good step in line with best practices. What challenges do you see? What about rural areas where the grid does not reach?

Question 10: The Taskforce made recommendations for targeted programmes for gender, youth, and incentives to employ women, financing programs for youth, women, and others, which are good recommendations. What challenges do you see?

Question 11: End of life disposal method is a very good policy initiative recommended by the Taskforce. Also, residual battery requirements for EV imports, awareness programs are also recommended. What challenges do you see in implementation?

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