SESA
Smart Energy Solutions for Africa

DELIVERABLE 2.6
COLLECTION OF GOOD PRACTICES FROM THE SESA CAPACITY BUILDING ACTIVITIES

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Summary Sheet

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Abstract	The Collection of good practices from the SESA capacity building activities report (D2.6) provides an overview of the best cases and good practices learned via or directly created by the project in its capacity building activities. This document aims to serve as an inspiration for demonstration countries/cities and other organization or projects working with the knowledge transfer, stakeholders' engagement.

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List of Abbreviations

CO_2	Carbon-di-oxide
CoM	Covenant of Mayor
CoP	Communities of Practice
EV	Electric Vehicle
GHG	Greenhouse gases
ICE	Internal Combustion Engine
LiFePO4	lithium iron phosphate
MIG	Make in Green
Motos	Motorcycle taxis
NDC	Nationally Determined Contribution
NGO	Non-governmental organisation
NOx	Nitrogen oxides
PM	particulate matter (PM)
PPP	Public-Private Partnership
PV	Photovoltaic
SESA	Smart Energy Solutions for Africa
SLB	Second-life battery
SME	Small and Medium-sized Enterprises

Executive Summary

The report provides an overview of the best cases and good practices learned via or directly created by the Smart Energy Solutions for Africa (SESA) project in its capacity building activities. These good practices showcase the outcomes of capacity-building efforts, including online tools (webinars, e-learning modules, Sustainable Energy Solutions Catalogue and manuals), and Peer-to –peer exchanges and in-country capacity building sessions in various regions of Africa and Europe, including site visits.

The collection is based on three key criteria: **innovation**, **impact**, and **replication potential**. These examples highlight the creative application of existing and new technologies, their measurable positive outcomes for communities, and their ability to be scale it up to the neighborhoods, city and the region given the local context. The capacity-building activities were designed to transfer knowledge, build skills, and promote innovation. Examples include:

- E-mobility initiatives in Rwanda, Nigeria and Portugal
- Second-life battery solutions in Rwanda
- Waste-to-energy projects in Ghana
- Off-grid solar systems in South Africa and Ghana

These good practices serve as valuable models for other regions, demonstrating the potential for innovative energy solutions to address Africa's energy challenges. By emphasizing replicability, the report encourages the adoption of these approaches in future sustainable energy development projects.

1. Introduction

1.1. The SESA project

Smart Energy Solutions for Africa (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 facilitating the co-development of scalable and replicable energy access innovations, to be tested, validated, and later replicated throughout the African continent. These solutions include decentralised renewables (solar photovoltaics), innovative energy storage systems including the use of second-life electric vehicle batteries, smart microgrids, waste-to-energy systems (biomass to biogas), climate-proofing, resilience and adaptation, and rural internet access.
SESA is the result of a strong partnership between leading European and African universities, research centres, industry actors, local governments, knowledge and implementation organisations and networks. These are strengthened via peer-to-peer exchange, policy dialogues, regional and international events among others.

SESA's objective is to mitigate climate change and avoid lock-in situations while improving access to sustainable energy under affordable and reliable conditions. The project aims to achieve a high level of replicability of actions. As part of an effort to go beyond the state of the art and maximise the project's impact, the project co-develops innovations with local partners and cooperates closely with sister projects to exploit synergies.

Solutions that are tested in this project have been selected based on their replication potential. Demonstration concepts aim to integrate several solutions to provide essential energy services to rural and urban communities and create easily replicable business opportunities for local entrepreneurs.

1.2. Objectives and scope of the document

This report provides an overview of the best cases and good practices that emerged through the SESA projects capacity building activities. Many of the featured cases and practises in this document include strategies and approached applied across various technologies, such as second life Electric Vehicle (EV) batteries, solar irrigation systems, off grid energy systems, and e-mobility initiatives. While most examples are based in Africa, European references are also included to showcase the peer-to-peer learning process facilitated by the project where peers from both Africa and Europe had the opportunity to exchange insights and experiences. This document aims to serve as a source of inspiration for countries, cities, businesses, organizations and projects working on knowledge transfer, stakeholder engagement and innovation creation in the renewable energy sector.

2. Overview of SESA Capacity Building Programme and Materials

The SESA project's Capacity Building Programme and Materials are designed to meet the needs of the SESA project Living Labs in Kenya, Ghana, Malawi, Morocco and South Africa as well as a wider audience that includes students, professionals, non-governmental organizations (NGOs) and small and medium-sized enterprises (SMEs), and other interested stakeholders. Various participants both within and beyond these Living Labs have benefited from the capacity building materials and activities, delivered through a diverse range of formats including interactive online tools, on-site presentations, and peer-to-peer exchanges, which are outlined below.

2.1 Online tools

The SESA online capacity building materials are designed to reach a broader range of stakeholders. This includes the **SESA e-learning courses**, which are freely available on the NUA Campus1 platform, the SESA Toolbox and SESA YouTube channel (video recordings only):

Additional resources are currently under development and will be finalized by September 2025, the end of SESA project. These include **guides on maintenance and installation** of selected technologies, **webinars** organized in collaboration with sister projects, and content being developed under the three Communities of Practice (CoPs): i) Waste to Energy and cookstoves, ii) Solar PV and iii) E-mobility and Batteries.

The content to be developed under the SESA CoPs include:

- **Webinar**: Agricultural waste for pellet production (December 2024)
- **Podcast episodes (3)**: Circular economy, Biogas technology, Biogas facilities in Africa (November 2024 - March 2025)
- **Webinar:** Sustainable waste to energy / sharing of case studies from UN-Habitat's Harare Sustainable Cities Initiative (January – March 2025)
- **Webinar:** Africa's readiness for the roll-out of microgrids (February 2025)
- Collection and dissemination of existing knowledge, resources and tools on solar irrigation (May 2025)
- **Knowledge product:** Energy efficiency and cost-effective Photovoltaic (PV) design (December 2024)
- **Knowledge product:** Tripling of renewables for transitioning of cities using solar PV (Date to be confirmed to be confirmed)

The final version of all the capacity building materials and activities will be available on the SESA Toolbox and widely disseminated through SESA newsletter and social media channels.

2.1.3 Webinars

Several webinars were conducted (and recorded) as part of the capacity building programme, complementing the above-mentioned e-learning courses. The six webinars included and are available here:

- Webinar I: Unlocking the potential of solar energy in Africa
- Webinar II: Enhancing adoption of Waste-to-Energy solutions for Clean Cooking in Africa
- Webinar III: Increasing access to financing for e-mobility deployment
- Webinar IV: Rural Internet Access - Solving the Challenge
- Webinar V: Exploring the potential of 2nd life batteries in the Africa countries
- Webinar VI: Harnessing the potential of Smart Microgrid Systems in African countries

2.1.1 E-learning courses

The SESA project's e-learning course cover of specific technical aspects related to the various technologies implemented within the project. Each e-learning course consists of 5 to 9 modules and addresses the following topics, which are available here:

- Solar energy
- Clean cooking and waste to energy
- Electric mobility
- Rural internet access
- Second life electric vehicle batteries
- Smart microgrids

2.1.2 Sustainable energy solutions catalogues and manuals

The Sustainable Energy Solutions Catalogue contains ten factsheets, each dedicated to a specific sustainable energy solution or cross-cutting aspect. It is designed for energy practitioners, policy makers and civil society, offering key insights into technologies, business models, impact areas related to sustainable energy. The

[1] https://nuacampus.org/llcu/sesa-smart-energy-solutions-for-africa/

catalogue also explores innovative approaches and concepts that contribute to the long-term viability and success of sustainable energy, particularly in the African context. Below is the list of topics covered in the factsheets, which are accessible here:

- Sustainable e-mobility
- Productive use of solar energy
- Second-life lithium-ion batteries
- Climate proofing sustainable energy solutions
- Solar mini grids
- Solar power and the water-energy-food nexus
- Circularity and sustainable energy
- Clean cooking solutions
- Energy efficiency
- E-Waste from off-grid solar solutions

2.2 Peer-to-peer exchanges and in-country capacity building sessions

The SESA project's peer-to-peer exchanges, site visit knowledge exchanges and in-country capacity building sessions are tailored to address the capacity building needs around smart energy solutions on the ground. These activities are multidirectional, facilitating south-south, north-south, and south-north exchanges among African and European actors.

The following section outlines the peer-to-peer exchanges and capacity building sessions conducted, grouped into two SESA regions: 1) **Northern and Western Africa**; and 2) **Eastern Africa**. Additional activities will take place in the coming months and outcomes incorporated in relevant document and news article, such as in Morocco (October 2024) and in South Africa (February 2025).

2.2.1 Northern and Western Africa region (Ghana and Morocco)

Peer-to-peer exchange: waste to energy site visit at Safisana, Ashaiman (Accra, Ghana)

A peer-to-peer exchange at Safisana, West Africa's first waste-to-energy plant in Ashaiman, Accra, brought together 20 participants, including officials from Accra, Alba Iulia (Romania), and Pune (India). Safisana, West Africa's pioneer waste-to-energy plant, is a notable Public-Private Partnership located in Ashaiman, a municipality with over 250,000 residents, 90% of whom live below the poverty line. See more information here.

"Climate finance and project development: taking the first step" workshop featuring waste-to-energy project (Accra, Ghana)

A total of 28 participants, including government officials, private sector representatives, SESA partners, and SMEs from Kenya, South Africa, Malawi, and Ghana, attended this capacity building workshop in Accra. Among other discussions, during the workshop, officials from Ga North and Ashaiman Municipal Assemblies began co-developing a waste-to-energy project, while SESA partner ICLEI Africa explored synergies with the Covenant of Mayors in Sub-Saharan Africa's (CoM SSA's) waste/finance initiatives.

Site visit and launch of biofuel cooker (Accra)

A total of 75 participants, including 50 scholars from the school, attended a site visit featuring the launch of a biofuel cooker by the SESA selected SMEs Econexus and a demonstration of the InfoSpot by the SESA partner Basic Internet Foundation. St John's Grammar School, a SESA Living Lab site, has installed four clean cooking stoves using locally produced bioethanol to test their viability. These stoves create no smoke, offer higher efficiency than gas and firewood, and provide clear health benefits and time savings. Data on firewood savings will be collected over the next two years. The visit provided insights into local clean cooking solutions. See more information here.

Site visits and launch of at biofuel cooker (at Nkawie school, Toase school) and Micro-grid system (at Bedabour community)

A total of 40 participants attended the site visits, including SESA partners and local government representatives from Kumasi (Ghana), Alba Iulia (Romania), and Pune (India). Nkawie and Toase schools saw demonstrations of

biofuel cookers, showcasing their benefits over traditional methods like firewood and coal, followed by a Question-and-Answer session with students. At Bedabour, the event featured the solar PV micro-grid system and was attended by local community members, the local chief, and media.

Figure 1. Site visits and launch of at biofuel cooker (at Nkawie school, Toase school) and Micro-grid system (at Bedabour community)

Site visit and launch of solar PV mini-grid (Kumasi, Ghana)

The site visit to Bedabour in Kumasi featured the formal launch of the solar PV micro-grid system under the SESA selected SME Nastech. The event aimed to educate community members about the system and gather feedback on its benefits. Key benefits shared were on 1) electricity, i.e. improved lighting for homes and schools, enhancing evening study and activities for children, and 2) refrigeration, i.e. enabled the sale of small items such as cold drinks and fresh foods, supporting local businesses.

Figure 2. Site visit and launch of solar PV mini-grid (Kumasi, Ghana)

2.2.2 Eastern Africa region (Kenya and Rwanda)

Site visit and launch on sustainable energy solutions (Katito Living lab, Kisumu, Kenya)

In October 2023, Kisumu hosted the first SESA regional event, featuring the Katito living lab's site visit and launch on sustainable energy solutions. Attendees, including SESA partners, local officials, and community members, toured the living lab (see images below), which provides energy access, e-bikes, and clean drinking water. The visit offered valuable insights into sustainable energy solutions and facilitated knowledge exchange among participants.

Figure 3. Site visit and launch on sustainable energy solutions (Katito Living lab, Kisumu, Kenya)

Site visit at Eco green solutions Ltd facilities (Kigali, Rwanda)

At the SESA regional event in Kigali in April 2024, 22 participants, including SESA partners and SMEs from Côte d'Ivoire, Nigeria, Tanzania, Namibia, Ghana, and Rwanda, visited one of the SESA selected SMEs EcoGreen Solutions Ltd. They toured the facility and observed demonstrations of EcoGreen's biofuel and cookers (see images below). The discussion on customer engagement, sustaining product demand and competition strategies to address market competition were held. This visit facilitated valuable knowledge exchange on clean cooking solutions and business models, with a particular focusing being placed on the importance of customer relations in ensuring successful business in the clean cooking industry as well as the value role carbon crediting can play in the clean cooking industry. For example, PowerStove representatives from Nigeria gave some insightful tips to EcoGreen and other participants on how carbon financing mechanisms have been implemented in PowerStoves business model.

Figure 4. Site visit to EcoGreen Solutions Ltd facilities in Kigali (Rwanda)

Peer-to-peer exchange: City-business cooperation (Kigali, Rwanda)

In Kigali, 18 participants attended the peer-to-peer exchange, including selected SESA project partners, SESA SMEs representatives and city representatives from Larissa (Greece) and Kigali (Rwanda). The focus was on city-business cooperation, with discussions on collaboration examples, challenges, and solutions. The session highlighted the importance of shared vision, strong policies, adequate financing, mutual trust, and open communication for successful partnerships in climate action and energy accessibility.

Figure 5. Peer-to-peer exchange: City-business cooperation (Kigali, Rwanda)

"Building capacity on solar PV minigrid systems, second life EV batteries and carbon credits" (Kigali, Rwanda)
During the SESA project's regional event in Kigali (Rwanda), 30 participants, including renewable energy master's students and Kigali-based energy developers, attended a capacity building session at the University of Rwanda. The event discussed on: 1) Energy Storage Solutions: SLS Energy, one of the SESA selected SMEs, presented on using retired EV batteries for energy storage; 2) Solar Installation and Maintenance: Nastech Power Solutions, another of the SESA selected SMEs presented solar PV systems and their application in Ghana, including potential uses in Rwanda; and 3) Carbon Credit Markets: Powerstove covered the setup, benefits, and challenges of carbon credit markets with case studies, and addressed questions on carbon standards.

2.2.3 Europe (Portugal, Spain and Sweden)

The SESA project hosted the European Study Programme in three cities across Europe – Cascais (Portugal), Barcelona (Spain), and Gothenburg (Sweden). This peer-to-peer exchange brought representatives from Living Labs in eight of the SESA project countries to Europe. The programme enabled the delegation to visit these three cities with the objective of learning about smart energy solution technologies and their deployment in different contexts. It also provided an opportunity for participants to engage with European cities and businesses, exploring potential collaborations within a broader ecosystem of stakeholders, including private sector, public sector, academia and the local communities. The ultimate goal of the study programme was to expose participants to a diverse range of experiences that could inspire the development of the Living Labs and support their further growth.

Figure 6. Site visit at Johanneberg Science Park (JSP) in Gothenburg (Sweden)

3. Good practices in capacity-building activities

3.1 Defining good practices

At the core of all SESA project capacity building activities, the engagements and materials - either delivered online, in person, or through hybrid format, are focused on capacity building needs identified at the local level ensuring contextual relevance and maximum impact. This chapter aims at showcasing the best cases identified throughout the various capacity building activities summarized in the previous chapter.

The following cases were selected for their strong balance between innovation, impact and replication potential.

- **Innovation**, refers to the overall novelty of proposed solution, preferably developed and implemented in the African region. It is not just about new technology unrelated to Technology Readiness Level (TRL) but also the creative application of existing technology applied in unique ways to enhance system efficiency.
- **Impact**, considers the indicative number and types of stakeholders that are affected by the initiative, along with the cost effectiveness and economic savings
- **Replication potential** looks at the possibility of technology transfer in the neighborhoods, city and the region given the local context. These technologies may originate from Africa or other regions. Replication can also highlight the other potential initiatives that can make use of these cases to implement a similar experience.

3.2. Collection of good practices

This section provides a list and brief descriptions of the good practice examples for the technologies implemented through the SESA project Living Labs, categorized according to the three criteria outlined in section 3.1.

The best cases proposed are organized according to four technological categories which are E-mobility, second life batteries, E-waste treatment and e-waste recycling, and off-grid solar energy provision. These are not exhaustive of the full scope of examples and best cases encountered in the SESA journey but are a frame to capture the most significant ones.

3.2.1 E-mobility

Good practice 1: E- Motos in Kigali (Rwanda)

Innovation element: Motorcycle taxis (or Motos) have been used in Kigali (Rwanda) to provide last-mile connectivity. The electric motorcycles (e-Motos) in the Kigali were the part of the demonstration action in the EU Research & Innovation project SOLUTIONSplus aimed at supporting the transition from fossil-fuel to electric motorcycles.

The project places a strong focus on gender inclusivity. After recruiting women drivers and providing them with targeted driving training 24 e-Motos were handed over to local women in November 2022. Monitoring of their operation and the challenges faced by the users was conducted to improve conditions for women drivers.

The e-Motos batteries are lithium-ion, which is expensive compared to lead acid batteries. However, to keep the upfront costs low for drivers, these batteriesare owned and charged by the local operator Ampersand. The drivers would pay 1.84 USD per charge to get the charged batteries. This innovation not only reduces costs but also mitigates risk for the e-Moto drivers. The demonstration project involved existing transport operators, service providers and associations, including motorcycle taxi associations, in Kigali to ensurelearnings are shared with all relevant stakeholders.

Ampersand led the development of e-Motos in-house so that, to the extent possible, value chains for e-Motos would be within the country. Project technical support as well as seed capital was provided by SOLUTIONSplus.

Impact: On a well-to-wheels basis (including CO_2 emissions in electricity generation), when the e-Motos (Kigali) replace the old internal combustion engine (ICE) vehicles, they result in 73% lower Greenhouse Gases (GHGs). Since these vehicles have no tailpipe emissions, e-motos significantly reduce air pollution. Therefore, particulate matter (PM) and nitrogen oxides (NOx) emissions will be 100% lower than the ICE-motos.
The demonstration also showed positive financial impact with Internal Return Rate (IRR) of 17.7%, based on a daily mileage of 157 km/day, a 3 kWh li-ion battery, a typical 2.23 battery swaps per day on average. This represents an ITT improvement by 5.3 percentage points, compared to ICE motorcycles.

Replication potential: Electric mobility is positioned as one of the crucial components of the ongoing efforts to reduce carbon and air pollution. In its updated Nationally Determined Contribution (NDC), the Government of Rwanda identified that the usage of electric vehicles can help cut energy-related carbon emissions by 9% by 2030. Consequently, the government set ambitious electrification targets, aiming for 25% of vehicles introduced in 2022/23 to be electric, 30% in 2023/2024, and 70% in 2034/3035 (National Strategy and Policy for Rwanda, 2021). Ampersand has benefited from this improved policy environment and, as of January 2024, leads the transition to electric motorcycles in East Africa with 1,350 motorcycle taxis and more than 10 swapping stations in Kigali (Rwanda) and Nairobi (Kenya).

In Kigali, supporting the first cohort of female drivers enabled the identification of 5 principles to implement gender-inclusive e-mobility projects, and facilitated the replication work across four other sub-Saharan African countries (Kenya, Uganda, Sierra Leon, Togo)

How SESA learned about it? This case example was showcased in the SESA project's E-learning course: E-mobility Planning and Implementations.

Where to find more information: NUAcampus; e-Mobility Tools 1.2.1 (emobility.tools)

Figure 7. E-moto with women drivers in Kigali (Rwanda)

Good Practice 2: Electric 2-and 3 wheelers for last mile transportation in Ibadan, Nigeria

Innovation element: ThinkBikes is a micro-mobility company that providing last mile transportation using electric cargo bikes made available for ride sharing and lease to individuals and businesses in urban and rural communities in Inadan (Nigeria), such as for farmers, for affordable transport. It uses two lithium-ion battery packs, using recycled materials (1.68-kWh power packs are assembled locally using recycled 18650 cells). In an innovative approach to affordability, ThinkBikes's business model allows customers to purchase their vehicles without the battery packs, which are often the most-costly component. Instead, users can lease or rent the battery packs directly from ThinkBikes, making electric mobility more accessible and cost-effective for a wide range of consumers. It has a leasing service/subscription business in which its customers can rent a bike on a daily, weekly or monthly basis.

Impact: The local production of ThinkBikes along with the use of recycled batteries allow to reduce the cost of vehicles by 40%, compared to the imported counterparts of similar use case, additionally building up local capacity and local economy (source). This service promotes circular economy approach, i.e. the recycling of battery cells recovered from old laptops and other technical devices. It also supports job creation through local design and manufacture.

Replication potential: There is potential for scaling up the recycled batteries in electric 2-and 3 wheelers, that reduces the upfront cost of the vehicles. The expected rise in the demand for EV batteries will also lead to a significant increase in second-life batteries (SLBs) availability. Battery manufacturers, second-life battery companies and automotive manufacturers can contribute significantly to the scale up of SLBs.

How SESA learned about it? SESA became aware of the company during research for the development of the Sustainable Energy Solutions Catalog and more specifically during research on the "e-mobility" factsheet.

Where to find more information: ThinkBikes website, Electronic Design web-article , CleanTechnica web-article

Figure 8. ThinkBikes for cargo service

Good Practice 3: Charging and bike sharing solutions in Cascais, Portugal

Innovation element: Since 2017 the city of Cascais (Portugal) made public transport free for residents, students and workers integrated the bus fleet with charging and bike sharing solutions. The initiative, called MobiCascais, is substantially covered by parking fees and it also includes an app that incentivizes citizens engagement through gamification. This is the first Mobility as a Service (MaaS) experience in Portugal.

Impact: The cost of the MobiCascais System is around €15 million and is entirely supported by the City Council of Cascais through two main sources of revenue: the operation of on-street parking and municipal car parks, and the income from the Vehicle circulation tax (IUC). Therefore, the sustainability of the model, in economic and financial terms, is totally supported by individual transport. In terms of users, the initiative is estimated to have a positive impact on 215.000 residents, 16.200 students and 87.500 workers daily commuting to the city.

Replication potential: Whilst the model adopted seems to be difficult to be transferred to the African context due to the great differences, some components of the project such as the gamification approach use to incentivize and raise awareness could be considered to promote the use of public transports among citizens.

How SESA learned about it? Representatives of Cascais presented the initiative, among many others, over the European study visit which took place in May 2023. The SESA experts delegation saw the buses and the bike sharing stations around the city.

Where to find more information: SESA Study Visit and Url: https://utmc.app/resource-129

Figure 9. MobiCascais in Cascais (Portugal)

3.2.2 Second-life batteries

Good Practice: SLS Energy, Kigali, Rwanda

Innovation element: SLS Energy is addressing battery waste and power supply quality problems. From understanding battery operation and aging patterns, the company is safely leveraging the value of retired batteries by repurposing them until they have reached their true end of life. The company is building the missing link for the sustainable adoption of renewable energy and electric mobility. They tailor battery packs for diverse market segments, offering power backup and cost savings through peak shaving and load-shifting applications. SLS Energy stands out through offering innovative pricing models and flexibility in two categories: The Battery-as-a-Service (BaaS) model, which leverages retired electric vehicle batteries or batteries salvaged from electronic waste to create sustainable energy storage solutions. SLS Energy´s batteries are customized to meet specific energy and power requirements, with the flexibility to adapt as those needs evolve over time. The Purchase to Own model, which is a system that is customizable and sold with a down payment, provides clients with ownership and tailored solutions.

A key innovation is the integration of real-time, remote monitoring, enabling real-time auditing on the sites and proactive management without the need for physical inspections. Intelligent battery management system algorithms optimize battery state estimation, protection, and lifetime. The assembly into battery packs employs a solderless method with locally designed modular components.

SLS Energy further enhances its offering by bundling its battery solutions into affordable service packages, therefore also delivering operational cost savings. This comprehensive approach ensures that customers receive a seamless, efficient, and cost-effective energy storage solution.

Impact: SLS Energy´s batteries have a positive impact on environmental sustainability as well as on the access to clean energy in Rwanda. By salvaging retired batteries from electronic waste or from electric vehicles, the impacts of improper disposal of Li-ion batteries from electric vehicles such as leaks of heavy metals (cobalt, nickel, manganese) can be avoided. Also, the improper disposal of electronic waste that leads to significant contamination of soil and groundwater and raises the risk of fires and release of toxic gases can be avoided. In addition, the adoption of circular economy approaches with efficient SLB collection, recycling and repurposing processes can create new employment opportunities. The creation of local value chains for second life batteries can also reduce the dependence on battery imports.

Replication potential: There is significant potential for scaling up the use of SLBs in the solar off-grid sector. The expected rise in the demand for EV batteries will also lead to a significant increase in SLBs availability. Battery manufacturers, second-life battery companies and automotive manufacturers can contribute significantly to the scale up of SLBs. Policies play an important role in the uptake of SLBs as well, due to the fact that standards and regulations need to be established for the reduction of barriers to a widespread use of SLBs in Africa

How SESA learned about it? SSL Energy company presented at the SESA regional event on: Solar PV minigrid systems, second life EV batteries and carbon credits in Kigali, Rwanda

Where to find more information: For more information on SLS Energy´s battery-as-a-service innovation visit: https://www.slsenergy.io/index.html#home

3.2.3 E-Waste treatment and e-waste recycling

Good Practice: E-waste treatment and recycling in Kumasi, Ghana

Innovation element: Nastech Power Solutions' innovation lies in its creative and environmentally responsible use of e-waste to address two major challenges: managing e-waste and providing affordable, renewable energy solutions. The company focuses on repurposing lithium-ion batteries sourced from discarded laptops, power tools, electric vehicles, and other electronic devices to develop second-life battery storage systems.
This process involves collecting and recycling e-waste, refurbishing batteries, and integrating them into solar energy systems. These systems, including solar generators, inverters, and battery banks, are deployed in off-grid communities across Ghana to provide clean, reliable electricity. By giving a "second life" to discarded batteries, Nastech reduces the environmental impact of e-waste while making solar energy more accessible and affordable.
The circular economy model employed by Nastech, where waste is reprocessed into valuable resources, exemplifies a sustainable and innovative approach to renewable energy. This solution is not only novel but also highly effective in tackling the dual issues of energy poverty and e-waste management in an African context.

Impact: Nastech's e-waste treatment and recycling initiative has had a profound impact on both environmental sustainability and energy access in Ghana. By recycling over 425,000 lithium-ion battery packs, the company has processed more than 255 tons of e-waste into usable energy storage solutions. This recycling process prevents toxic materials from entering landfills or being incinerated, which reduces greenhouse gas emissions, and the environmental hazards associated with improper e-waste disposal.
Furthermore, the initiative has created new economic opportunities by training young people in solar installation and e-waste recycling, which contributes to local job creation and builds technical expertise within the community.

Replication potential: Nastech's e-waste recycling model has significant potential for replication across other African countries and regions facing similar challenges with e-waste management and energy access. The technology and processes involved—collecting, refurbishing, and repurposing lithium-ion batteries—are not highly capital-intensive and can be adapted to local contexts with available resources.
By partnering with local e-waste collection centers and recycling initiatives, other regions can replicate Nastech's model to develop affordable solar energy solutions. This approach not only addresses the growing e-waste problem but also supports the development of decentralized renewable energy systems, helping to reduce dependency on traditional grid power.
The scalability of the pay-as-you-go financing model, which lowers the financial burden on low-income households, also enhances the potential for widespread adoption. The success of this initiative demonstrates that e-waste can be an asset rather than a liability, providing a sustainable solution for both energy generation and environmental protection.

How SESA learned about it? This initiative taught around 225 individuals in e-waste recycling, contributing to Nastech's efforts to enhance its workforce and promote local employment creation. This program equipped participants with the technical competencies necessary for engaging with solar energy systems, emphasising the use of second-life lithium-ion batteries to develop cost-effective solar solutions.

Where to find more information: For more information on Nastech's e-waste treatment and recycling activities, you can visit:
Nastech Power Solutions: https://nastechpowersolution.com/
Project Reports and Case Studies: Available upon request from info@nastech-solar.com

3.2.4 Off-grid solar energy provision

Good Practice 1: Off-grid solar containerised energy system in South Africa

Innovation element: The South Africa living lab uses the existing concept of an isolated microgrid powered by solar energy, ideal for remote and rural areas where utility-supplied electricity is unreliable, unavailable, or unaffordable or carbon-intensive. It uses second-life lithium iron phosphate batteries for energy storage, supporting a 100% renewable facility. The lab provides energyr for micro electric vehicles, community services, and solar PV installation training, promoting energy efficiency and the circular economy.

The off-grid solar system has progressed from technology readiness level (TRL) (the system/process prototype demonstration is in an operational environment and has been integrated into a pilot system level) to technology readiness level 8 (the system has been incorporated into a commercial design and the actual system/process is completed and qualified through test and demonstration and pre-commercial demonstration) and is expected to reach TRL 9 (the system has been proven through successful operations in the operating environment and is ready for full commercial deployment) by 2025. It repurposes second-life electric vehicle batteries, an emerging concept in sub-Saharan Africa, to make the system cost-effective for broader use. Multiple pilots are needed to assess feasibility across the continent.

Additionally, the lab supports rural transportation with road-approved 3- and 4-wheeler electric vehicles that can carry more passengers than 2-wheeler electric scooters, improving transport efficiency during peak periods like school runs and social grant days.

Impact: Electrifying public transport is a key goal in South Africa's Just Energy Transition Investment Plan (2023-2027), aimed at benefiting low- and middle-income households. In Alicedale – where off-grid containerised solar system was installed, the introduction of micro electric vehicles reduced the average trip cost from R50 (2.53 EUR) to R10 (0.51 EUR). This affordability is due to lower maintenance costs of electric vehicles and solar-powered charging from off-grid system, avoiding electricity tariffs.

Under South Africa's Just Energy Transition Investment Plan (JET-IP) framework, public-private partnerships (PPPs) can be established for the off-grid containerised energy hub. These partnerships play a crucial role in supporting the country's transition to a low-carbon economy, ensuring that marginalised and vulnerable communities are not left behind. The JET-IP includes two critical strategic priorities and focus areas that complement the off-grid containerised energy hub in Alicedale: electrifying and decarbonising the transport sector with a key focus on public transport, and decarbonisation of the electricity sector which includes electric vehicle charging infrastructure linked to off-grid or microgrid systems and strategic off-grid renewable energy generation.

The population of Alicedale is approximately 3868, with 1060 households. Thus, 3868 people and 1060 households have access to the off-grid containerised solar system. These stakeholders include community members and local government. This has improved their daily life activities.

Replication potential: The concept of the off-grid solar containerised system of the South Africa Living Lab can be replicated locally, nationally and in other countries across the African continent. The concept is being validated by collecting and analysing qualitative and quantitative data, which will also be used to recommend how the system can be optimised for future replication. Government and industry stakeholders are already interested in replicating the off-grid solar containerised system within other areas of the Eastern Cape province and in additional provinces around South Africa. In South Africa, the replication potential lies both in remote and rural villages and towns and also within more prominent cities like Nelson Mandela Bay in the Eastern Cape, which is currently struggling with ageing electricity infrastructure, which can cause power outages of between 7-14 days some areas in the city. There is also replication potential with countries across the African continent, mainly due to the high availability of energy from the sun in Africa.

How SESA learned about it? The South Africa Living Lab information is available on the South Africa section of the SESA website within the South Africa Living Lab's Web Page.

SESA Webinar: A SESA webinar was held on 24 January 2024, during which SESA partners learned more about the South Africa Living Lab and its off-grid containerised energy hub. The title of the webinar was

"Exploring the potential of second-life batteries in African countries." uYilo also presented the off-grid solar containerised system for the South Africa Living Lab to SESA partners at this webinar.

Where to find more information
SESA Project Website: www.sesa-africa.org

Figure 10. Off-grid solar containerised energy system with electric vehicles in Alicedale (South Africa)

Good Practice 2: Solar Microgrid in Rural Community in Ghana

Innovation element: The innovation in this off-grid solar energy provision project, executed by Nastech Power Solutions, lies in the novel use of second-life lithium-ion batteries sourced from e-waste. This approach creatively applies existing solar energy technologies to develop micro-grids and solar generators tailored to the needs of marginalized, off-grid communities in Ghana. By repurposing e-waste materials such as laptop batteries, Nastech enhances energy system efficiency while promoting sustainability through recycling and circular economy principles. The project stands out for its integration of affordable solar inverters and battery storage systems capable of handling both residential and business energy needs.

The focus on using locally sourced, recycled materials allows the solution to be both cost-effective and environmentally friendly, supporting local job creation through skills training in solar technology installation. The innovation also extends to the financial model employed, with pay-as-you-go and subscription-based services, making it accessible to low-income users. This is a groundbreaking step in improving access to renewable energy in the region, without relying on new technologies outside the community's reach.

Impact: This project has significantly improved energy access in rural Ghanaian communities, impacting over 3,000 individuals. Through the installation of three solar micro-grids, Nastech Power Solutions has provided 54 homes with uninterrupted power, increasing economic activities and improving living conditions. The community-focused approach, including school electrification, supports educational development while allowing local businesses to thrive. The project has reduced dependency on traditional, polluting energy sources like kerosene and diesel generators, thereby decreasing energy costs by an estimated 30-40%.

The recycling initiative has repurposed over 253 tons of waste batteries, contributing to environmental conservation and reducing e-waste in Ghana. By creating 52 jobs—22 direct and 30 indirect—this project is stimulating the local economy and building the technical capacity of young people through solar energy training programs. Cost-effective solar energy solutions have also been provided through a pay-as-you-go model, promoting economic inclusivity and long-term sustainability

Replication potential: This project presents strong replication potential across other African regions and globally, especially in areas facing similar energy access and e-waste challenges. The technical

approach of using second-life lithium-ion batteries, combined with solar technology, can be easily transferred to other rural and peri-urban areas that lack reliable grid access.
The business model, which integrates local labour, upcycling of materials, and flexible financial options, is adaptable to different socio-economic contexts. Given the affordability of Nastech's energy systems, other off-grid regions can implement similar solutions to meet local electrification needs. The project's partnership with local government agencies and international organizations ensures a scalable and replicable framework for policy-driven adoption across Africa.

How SESA learned about it? The capacity-building activity where Nastech's innovation was showcased involved training young Ghanaian youth in solar energy technologies. Through this initiative, over 225 individuals were trained in solar system installation and maintenance, as part of Nastech's efforts to expand its workforce and support local job creation. This activity provided participants with the technical skills required to work with solar energy systems.

The training program, conducted in partnership with local organizations such as National vocational training Institute (NVTI), Ghana and Dream Renewables, equipped participants with practical knowledge, enabling them to support the deployment of solar micro-grids and standalone solar systems in off-grid communities across Ghana.
During the SESA regional event, about 110 participants were trained on installation and maintenance of PV systems.

Where to find more information
SESA Project Website: www.sesa-africa.org
Nastech Power Solutions: www.nastech-solar.com

These resources provide additional insights, technical specifications, and case studies on solar energy solutions in rural African communities.

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