



D 3.2 Capacity building strategy and implementation plan

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Nature of the deliverable		
R	Report	x

DEC	Websites, patents, filing, etc.	
DEM	Demonstrator	
O	Other	

Dissemination level		
PU	Public	x
CO	Confidential, only for members of the consortium (including the Commission Services)	

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SWARM-E is a trans- and multi-disciplinary approach for sustainable, affordable and modern energy access and well-being for Sub-Saharan Africa, aligned with the AU-EU Agenda 2063.

SWARM-E consists of several layers: 1) an innovative renewable electricity infrastructure, the SWARM grid, a circular and cyber-smart network where end-users exchange electricity of their solar home systems and form the nodes of a smart grid which can dynamically grow to meet demand; 2) unlocking unutilised renewable energy for productive uses in the water energy food nexus – cold storage, water purification, water pumping and irrigation, carpentry; 3) transfer and decentralisation of Global North energy transformation innovations – decentralised hydrogen production for cleaner cooking, bi-directional charging of light electric vehicles (two- and three-wheelers) to transport goods and people. SWARM-E builds on network effects generated through the inclusion of localised economies with strong producer-consumer linkages embedded within larger systems of trade and exchange for the creation of bottom-up energy communities.

SWARM-E will operate and replicate 5 pilots in Rwanda and Tanzania, under which 5 SWARM grids are installed, delivering 6.9 GWh of renewable electricity while generating income through the trading of electricity and avoiding the discard of 3,200 batteries; 5 water purification applications deliver 101.M L of clean water; 15 light electric vehicles deliver farmers' produce, power mobile productive uses and cold storage, increasing the yields of 1,000 farmers and reducing the food losses of more than 5,000; 700 kg of H2 blended with LPG for cleaner cooking, and more than 500 jobs for women and youth to be created. The balanced participation of EU and AU private, public and civil society organisations in the consortium will ensure the knowledge transfer North-South and South-South, and the sustainability of value chains based on local value creation and entrepreneurship.

More information on the project can be found at: www.swarm-e.eu

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Summary of the deliverable

This deliverable outlines a strategy for implementing capacity building activities within the SWARM-E project, a vital component of its success. After highlighting the objectives and the methodology used, the report provides a thorough baseline needs assessment detailing partners' experience of training activities in Bangladesh, Rwanda and Tanzania, as well as the local capacity building needs identified in the SWARM-E pilot sites in Rwanda and Tanzania through the earlier site surveys and focus group discussions with local communities. The strategy then outlines the targeted recipients of the training activities, the intended formats, and the implementation process. This capacity building strategy will be further detailed and adjusted in accordance with feedback from partners and communities during project implementation.

This deliverable has eight chapters:

- **Chapter I:** This introduction to the document presents the strategy scope and objectives.
- **Chapter II:** This chapter details the methodology used.
- **Chapter III:** In this chapter, a detailed baseline capacity building assessment is provided, including the analysis of pre-existing experience of some of the partners in Bangladesh, Rwanda and Tanzania, as well as the needs of local communities and their expectations.
- **Chapter IV:** This chapter is dedicated to a description of the training recipients targeted for capacity building in the SWARM-E project.
- **Chapter V:** This chapter provides an outline of the different training formats considered for the various capacity building activities.
- **Chapter VI:** The chapter outlines the implementation plan, the approach to change management and how the impact of the training process will be monitored.
- **Chapter VII:** This chapter describes training activities for scaling and replication disseminating learnings of the pilot's implementation, to ensure impact and long-term sustainability.
- **Chapter VIII:** This part provides a conclusion on the document.

List of Acronyms and Abbreviations

Abbreviation	Definition
AM	Area Manager
CBO	Community based organization
COSTECH	Tanzania Commission for Science and Technology
EAC	East African Community
EV	Electric vehicle
EWURA	Electricity and Water Utilities Regulatory Authority
FGD	Focus group discussion
GS	Grameen Shakti
INKO	INKOMOKO ENTREPRENEUR DEVELOPMENT LIMITED
KPI	Key Performance Indicator
LPG	Liquified petroleum gas
M&E	Monitoring and Evaluation
MEI	MICROENERGY INTERNATIONAL GMBH
MINEMA	Ministry of Emergency Management
MININFRA	Ministry of Infrastructure
MOF	Ministry of Finance
NGO	Non-governmental organization
NEMC	National Environment Management Council
OGB	OFFGRIDBOX RWANDA LTD
PPE	Personal Protective equipment
P2P	Peer-to-peer
PUEs	Productive use of energy
Q&A	Questions and Answers
RALGA	Regional Administration and Local Government Authorities

REA	Rural Energy Agency
REG	Rwanda Energy Group
REMA	Rwanda Environment Management Authority
RURA	Rwanda Utilities Authority
RSB	Rwanda Standards Board
R4A	RES4AFRICA Foundation
SHS	Solar home system
SMART	Specific, measurable, achievable, relevant, and time-bound
SNA	Social network analysis
SOP	Standard operating procedure
TAREA	Tanzania Renewable Energy Association
ToC	Theory of Change
TOT	Training of trainers
TRA	Tanzania Revenue Authority
TVET	Technical and Vocational Education and Training
UNHCR	United Nations High Commissioner for Refugees
VETA	Vocational Education and Training Authority
WP	Work package
WUP	Wuppertal Institute

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1. CHAPTER 1: INTRODUCTION

1.1 Scope of the report

Objectives. The SWARM-E project aims to support innovative and decentralised forms of bottom-up electrification, that rely on components of peer-to-peer grids (P2P) interconnected with a mini grid in Tanzania and the OffGridBox Pioneer (OffGridBox's Energy and Water Purification Technologies) in Rwanda, that both electrify households and introduce productive uses of energy (PUEs). SWARM-E operates in 5 pilot sites in Rwanda and Tanzania. Capacity building activities targeting households, SWARM operators, local technicians and entrepreneurs are essential for the project's success; these will be complemented by know-how exchange among SWARM-E partners. This report outlines both the strategy for these capacity building activities, as well as the implementation plan, including a list of possible training activities, types of stakeholders to be trained, training formats, and timeline for implementation. The document shall serve as a general guideline that will be adjusted during the project, based on the evolution of the project's needs and feedback from end-users.

Linkages with other deliverables. This deliverable builds upon Deliverables D2.2 "Report including data gathering results, interpretation, application of selection methodology and conclusions" and D3.1 "Local Context Report". Deliverable 2.2 provided a detailed demand analysis and socio-technical profiling of the target communities in Tanzania and Rwanda, revealing both the heterogeneity of energy needs and user readiness for engaging with the SWARM-E electricity infrastructure. D3.1 provided detailed insights into the local site profiles, key stakeholders, communities' needs and preferences for improvement of economic activities and access to basic services. Deliverable D3.2 integrates the findings of these two deliverables into the design of a locally suitable capacity-building implementation plan by proposing a structured programme of training, community engagement, policy support, and institutional learning that directly targets the identified gaps, enabling the transition from analysis to implementation. In addition, the activities described in this deliverable are designed in a way that directly supports the KPIs on capacity building that are illustrated in D2.4 Demonstration Sites and their M&E Framework.

Expected outcomes. This deliverable is expected to give an outline of the capacity building strategy for the SWARM-E project, providing a mechanism for its implementation and change management if required during implementation.

1.2 Importance of the capacity building strategy

Capacity building is a fundamental component of SWARM-E, as all stakeholders involved in the project must become familiar with the several layers of innovation that characterise the project. A first layer of innovation lies in the implementation of the P2P grid, between households and entrepreneurs, a new approach in Rwanda and Tanzania. While this type of renewable energy infrastructure leans on the density of already deployed solar home systems (SHSs) over the past few years, interconnecting them is a novel infrastructure and requires end-user onboarding, awareness raising and technical training. On top of the P2P grids, the SWARM-E project adds an extra layer of interconnection with a mini grid in Tanzania and the OffGridBox Pioneer systems in Rwanda. Lastly, enabling PUEs is the key target to enable socio-economic development and welfare of local communities. Various types of training (technical, behavioural, business skills) need to accompany the introduction of multiple PUE solutions that will be

tested. Some PUEs exhibit a particularly strong level of site or technological innovation, such as LPG and hydrogen blended fuel for clean cooking, seaweed grinding or light electric vehicles.

In particular, the capacity building activities aim to:

- **Train a wide variety of stakeholders**, including households and entrepreneurs connected to the P2P grid, households and entrepreneurs connected to the mini grid in Tanzania or the OffGridBox Pioneer in Rwanda, technicians, operators of the SWARM grids, businesses or households involved in PUEs and SWARM-E partners.
- **Provide a sustainable embedding of skills** required to continue to operate and maintain the SWARM grid among citizens and technology operators, after the project's end.
- **Undertake relevant knowledge transfer activities** at each stage of the system value chains. Knowledge transfer and alignment of interests across actors ensure diffusion of the technology and business models, maintenance and long-term sustainability of the approach.
- **Strengthen the collaboration of SWARM-E partners** through multiple internal peer training and knowledge exchange activities.
- **Support the scaling and replication of the SWARM-E approach** by training external stakeholders.

To achieve the objectives of the project and in alignment with recommendations on the local needs (D3.1), the capacity building activities will need to be tailored according to the very different contexts, **applying the following principles**:

- **Customised**: the training activities will match the specific pilot characteristics, for instance, on the specific PUE considered, mirror the diversity in the project sites, rely on the experience of local training providers, and be conducted in the local languages, when done on site.
- **Practical**: preference should be given to applied and simple training.
- **Inclusive**: input and feedback from the local communities should be sought after, and the training activities should be designed to ensure safe spaces for women, allowing full participation, e.g., through women-only training activities.
- **Incremental**: training should leave room for adjustment and flexibility, based on the evolution of the pilot and feedback from the local communities.
- **Paving the way to scale**: scaling and replication will be supported through internal peer learning within the consortium, and linked with dissemination and communication activities (WP8), as well as the open-source knowledge hub on PUE.

2. CHAPTER 2: METHODOLOGY

The Capacity Building Baseline Assessment is based on insights from the deliverables D2.2 and D3.1:

- The inputs from the surveys conducted under WP2 and WP3 were extracted to inform on the existence of any preliminary training in the pilot sites.
- Data collected during the Focus Group Discussions (FGDs) in the pilot sites in February and March 2025 provide essential insights into the training needs on the specific PUEs in each site. In addition, semi-structured interviews with SWARM-E partners were conducted and constitute the base that allows for understanding the experience with P2P grids in Bangladesh, expectations for the implementation of SWARM-E in Rwanda and Tanzania, and experience in conducting capacity-building activities by SWARM-E partners outside of the SWARM-E project. Two rounds of interviews were conducted, in October 2024 and May 2025.

3. CHAPTER 3: CAPACITY BUILDING BASELINE NEEDS ASSESSMENT

3.1 Capacity building experience with P2P grids in Bangladesh.

The P2P grid is the first component of the SWARM grid to be implemented. **Within the consortium, we can draw on the experience of SOLshare from the successful deployment of more than 100 P2P grids in Bangladesh.** For instance, SOLshare has already developed training materials that can be used as a baseline to adjust to the local context and languages.

SOLshare reports a certain level of simplicity of the system. Although P2P grids are a relatively new approach¹SOLshare indicates that the technology, tested and proven, is a simple plug-and-play. The SOLbox or the SWARM controller acts as a bi-directional charge controller that allows for the sharing of energy between nodes or SHS. SOLshare stressed that the technology poses no significant safety risks, as it operates on a low-voltage 12V DC system, making it safe for use and requiring only minimum personal protective equipment.

For the 100 P2P grids, SOLshare conducted ToT for Grameen Shakti (GS) and other operators to provide training for the following two target groups:

End users. This training consisted of the following components:

- How to operate the SHS and the SWARM controller
- How to sell and buy electricity
- How to check the balance of the SOLbox and how to recharge
- How to correctly charge and discharge the battery
- Regular maintenance tasks: SWARM controller verification, PV panel cleaning

The P2P grid local operator, also called AM GS Area Manager. This training consisted of the following:

- Technical training on basic troubleshooting tasks
- Training on mobile money transfers.

The technical training for the local operators follows a training of the trainers approach. Field engineers of SOLshare will train the upcoming GS area managers on the ground. This training focuses on practical training including demonstrations, rather than intensive classroom training. The GS area manager will be responsible to support the end-users in case of questions or troubleshooting. Available supporting documents include (1) a Standard Operation Procedure (SOP) of SOLgrid installation, (2) the SOLbox user manual, (3) a SOP for troubleshooting, (4) a training of trainers slide deck, (5) the Solar PV Program for Rural Areas report. In addition to the technical training, GS provided training on skills development to end users.

¹ Sheridan et al. (2023) "Swarm electrification: A comprehensive literature review", Renewable and Sustainable Energy Reviews, Vol. 175, 113157

3.2 Capacity building experience of the East African Community (EAC) countries

ELICO Foundation

ELICO Foundation has extensive experience in the provision of technical training in Swahili to technicians working with SHSs and mini grids. The training is mainly conducted on the job and includes topics such as basic maintenance and troubleshooting. The training that is conducted is very “hands on” and doesn’t include any predefined structured modules but is based on the installation process stages and regular direct exchange of feedback between a trainer and a trainee.

Training recipients are selected by identifying the most active and reliable members of the local community, the “champions”, able and willing to carry on the knowledge sharing within the community. The initial level of knowledge of training recipients is usually checked by means of a basic Q&A prior to the start of training. ELICO Foundation endeavours to ensure gender diversity and incorporate women in the training. ELICO’s experience indicates that the most efficient way of conducting such training is in person and that also supporting visual materials such as leaflets or flyers are important and facilitate the learning process.

OffGridBox (OGB)

In some ways, the experience of OGB in technical training is similar to that of ELICO: the training is usually provided on the job and to those with pre-existing knowledge or at least basic literacy. The selection process is organised through a basic questionnaire and sometimes a check by phone call.

OGB has experience in providing practical training, including hands-on installation, commissioning, and operation of its solar and water purification technologies, basic troubleshooting, preventive and routine maintenance activities, and interpretation of online monitoring system performance reports. Training is done together with the installation process, and this also gives an opportunity for continuous feedback, adjustment and reviewing topics that were not clear right away. Using a WhatsApp group to support the technicians and/or system operators after the training can be an effective way of ensuring follow-up and maintaining contact with the training recipients.

The training is normally divided into stages such as a safety brief, theoretical part, and the installation part itself. Depending on the installed system ownership and operational model, OGB also provides some very basic business induction, specific to the product (inventory sheets, basic sales training).

The target groups for OGB training, and the respective technologies they are trained on, are listed below.

Local technicians’ training covers the below content:

- Safety brief which highlights the importance of Personal Protective equipment (PPEs), and availability of right installation tools and accessories;

- How to install and commission OffGridBox solar and water systems: Fixation of different components by following proper design and measurements, wiring, piping, interconnection of the system and testing before commissioning.
- Basic troubleshooting when the system is malfunctioning or once there is any alert, which component to check first, how to restart the system, etc.
- Different types of maintenance (routine, preventive, and curative), when and how to do them.

Operators or boxkeepers are trained on the following aspects:

- Working principle of installed systems.
- Safety brief which highlights the importance of Personal Protective equipment (PPEs) and cleanness of the working space.
- How to clean external parts of the system; replacement of water filters, backwashing of filters and water tanks, etc.
- Basic business skills including bookkeeping and accounting of their daily transactions, basic inventory; customer management, and reporting.

Franchisees or staff of institutions (case of donor-funded projects where beneficiaries such as health facilities or schools are entrusted with the project):

- Working principle of installed systems;
- Safety brief and necessary precautions measures if it happens to interact with the system;
- How to clean external parts of the system; replacement of water filters, backwashing of filters and water tanks, etc.
- Basic business skills and possible business model to generate income by leveraging excess water and /or power with other PUE business;

INKOMOKO

With over 12 years of experience, INKOMOKO provides business advisory, direct financing, market linkages and advocacy services to help refugee and local entrepreneurs improve their families' economic standing, create jobs, and provide crucial goods for their communities. INKOMOKO's services are anchored on three pillars. First, INKOMOKO trains and advises local entrepreneurs in business basics, and offers below market rate financing. Second, it connects isolated communities and displaced entrepreneurs to larger markets and supply chains. Third, INKOMOKO advocates for inclusion in policies and practices, leveraging our data and impact, so that whole communities can benefit.

Participants are selected through several channels with the main criteria being commitment to grow their business and that INKOMOKO's offer fits their needs. Having worked in the same communities for several years, many come through word of mouth, other channels are through local authorities and advertisement.

The methodology used by INKOMOKO combines classical training with extensive one-on-one coaching to ensure customization and that business practices are implemented at each business, combining Business Development Support with affordable financing has proven to be one of the factors that ensure success. Additionally, INKOMOKO provides both manual and digital bookkeeping tools.

The standard length of the program is about six months, with one training module and one consultancy session per month. Training is done for groups of 50 persons, each followed by one-on-one consulting sessions that are focused on setting individual business goals relating to the training and then working together to achieve them. Based on the sessions, entrepreneurs are recommended for investment and due diligence can start at any time of the program when an entrepreneur is ready. Investments are provided based on set criteria and approval of the internal investment committee.

INKOMOKO aims to have gender-inclusive training, currently with over half of the client-facing team being women.

WeTu

WeTu has important experience in providing technical training on some of the PUEs to the end users. WeTu also offers business training and focus group discussions to create and co-develop training content.

The company uses external experts extensively, as well as conducting training with its own resources, which allows for greater flexibility and a larger variety of topics. The structure and duration of training depend heavily on each specific case and the intended PUE. The mode of delivery can be entirely practical or hybrid, including both practical and theoretical components. The training is always offline and conducted in an accessible manner, using familiar vocabulary and avoiding complicated concepts. Cell phones are used during the training sessions, as well as for follow-ups.

WeTu experienced the challenge of achieving a balanced gender share in the training because of limited availability of women due to the need to combine it with childcare and other duties.

Ekoglobe

Ekoglobe usually trains two types of training recipients: the end users of electric vehicles as well as mechanics that would provide basic maintenance. Selection of mechanics to be trained is done by choosing from the existing pool of persons already working in the field.

End users are trained to be able to do basic record keeping, use the vehicle efficiently and to be able to do very basic fault finding for which the assistance of a qualified mechanic might not be necessary. Mechanics instead are trained for performing a more complex maintenance. Before the training, the training needs are collected by means of a simple questionnaire to check the existing knowledge.

Training for both categories is done exclusively offline with the support of manuals originally available in English, which have been translated into the local language by Ekoglobe. The training for mechanics is structured as a three-day practical course. Ekoglobe personnel offer follow up support by WhatsApp and phone if needed. There is no time limit on this support.

TAREA

Tanzania Renewable Energy Association (TAREA) has been conducting solar artisan training since its founding. Trainees are recruited in two models. Trainees connected to the solar installation projects and youth from the village for general self-employment. TAREA has already trained more than 2,000 solar artisans. To ensure that trainees utilise the skills, TAREA has incorporated an employment enabler component. TAREA has been providing working tools and personal protective equipment to the trainees. These practices have been very successful and more than 90% of trainees have remained in their respective villages.

3.3 Initial partner expectations on training needs in Rwanda and Tanzania.

Interviews with Rwanda- and Tanzania-based partners enabled WP3 partners to identify expectations regarding the implementation of SWARM grids and capacity-building activities in the two countries.

SWARM-E partners pointed to **the absence of pre-existing knowledge on P2P grids in both countries**. This should be decisively addressed during capacity-building activities and constitute a core element of the training activities to both operators and users of the P2P grid as well as the entire interconnected infrastructure, i.e., mini grid in Tanzania and the OffGridBox Pioneer in Rwanda. This technical challenge was expected to be complex in the case of heterogeneous SHS brands, SHS not compatible with SOLbox integration, or if the SHS had not been repaid yet, which could create trust issues with users or interconnection challenges.

In addition, **partners identified the need for training on SHSs as base components of the P2P grids**. A set of common challenges and limitations was found with SHS, including rapid battery aging due to a lack of user knowledge on charging, with frequent practices of over-discharge, under-sizing, or substandard products, especially smaller SHSs. Partners in both countries pointed out key challenges pertaining to insufficient user training on SHS, such as lack of training on basic maintenance skills (e.g., for PV panel cleaning or regular inspection of wires), a lack of maintenance practices even after training, and a lack of knowledge of correct placement of solar panels. In addition to issues found with users of SHSs, a barrier often lies in the absence of formally trained local technicians - specifically stressed for Tanzania -, or challenges to retain local technicians due to rural exodus. This confirms previous findings of academic research conducted in refugee camps in Rwanda, as highlighted in deliverable D3.1. In Tanzania, partners added the challenges of the absence of a certification framework for renewable energy installers, creating trust issues with users. As a result, a clear recommendation is to provide user training on SHS basics as part of the SWARM-E capacity building activities (use, maintenance, service), especially as SHS providers are not involved in the project. In addition, it will be essential to monitor that SHS maintenance activities are properly conducted.

Moreover, **partners mentioned the need for training on the selected PUEs**. They emphasised the lack of knowledge on some of the applications envisaged for the project, especially on hydrogen or electric mobility, which are either new as a technology approach, or new in the specific environment. This can be addressed through the body of complementary knowledge and experience that is present within the SWARM-E consortium, gathering partners with a wide range of knowledge in the different PUEs considered (cf. D3.1). Some training material or practice already exists on some PUEs, while new training guidance will need to be developed for the more innovative ones. The training on PUEs should ideally cover topics of technology; behavioural change if it includes a shift in the energy source, for instance fossil-fuel to electric vehicles; operation and maintenance; and looking at specific requests shared by communities during the FGDs (cf. Section 2.5).

Lastly, **two cross-cutting topics should be integrated during the SWARM-E training: gender inclusion, and skills or business training**. Training programs on decentralised renewable energy systems such as SHSs and mini grids often do not, or not sufficiently, address the specific needs of women. A strength of the SWARM-E project lies in the involvement of partners with gender-inclusive programmes or training modules (e.g. INKOMOKO, TAREA, WeTu, etc.) as well as their fine knowledge of the local contexts, in order to implement the gender-inclusive focus detailed in deliverable D3.1. With regards to skills or business training, these are considered essential to support small businesses leveraging PUE opportunities created through the increased access to electricity. Overall, it is essential to seek community input in the identification of needs and training materials, and to design business models in WP7 that incentivise technicians to remain in their communities in the long run and apply their training effectively.

3.4 Pre-existing knowledge in the local sites

The surveys, conducted under WP2 in October and November 2024 in the local sites² with a wide range of stakeholders (village leaders, households, businesses, NGOs, cooperatives, mobile money agents, health, education, religious institutions, and suppliers), provided a first understanding of the local situation with regards to pre-existing training and knowledge levels around technical and financial aspects. Details can be found in D3.2. The social aspects displayed in the following tables were obtained through interviews with local partners and only present hypotheses because the data were not collected directly from end users. Details can be found in D3.1. The following tables summarize the pre-existing knowledge per type of user and per type of knowledge for each site.

Kwale, Tanzania

Type of end user	Technical	Financial	Social
Households	Little 19% of surveyed households received basic use training by SHS suppliers	Little 20% of surveyed households have attended a financial training course	No perceived risk around acceptance of the technology Hypothesis of possible issues

² Local pilot sites of Gakoma, Mahama, Kanombe, Kwale; replication or control site: Koma

	35% think that electricity usage is too complicated to manage		around the trading of electricity because the concept of energy sharing is difficult to understand, especially since existing SHSs don't provide surplus energy to trade
Businesses	Very little None of the surveyed businesses received training on SHSs	Good 75% of surveyed businesses attended a business training	
Public institutions	Very little As there is no electricity in the school and clinic, existing knowledge around technical aspects is assumed to be very little		

Table 1. Pre-existing knowledge analysis in Kwale, Tanzania

Gakoma, Rwanda

Type of end user	Technical	Financial	Social
Households	Little 22% of surveyed households received basic use training by SHS suppliers 41% think that electricity usage is too complicated to manage	Very little 2% of surveyed households have attended a financial training course	Uncertainty on acceptance risks Hypothesis of possible issues of trust in the SWARM grid
Businesses	Little 17% of the surveyed businesses received training on SHSs	Very little 4% of surveyed businesses attended a business training	

Table 2. Pre-existing knowledge analysis in Gakoma, Rwanda

Kanombe, Rwanda

Type of end user	Technical	Financial	Social
Households	Little 26% of surveyed households received basic use training by SHS suppliers 42% think that electricity usage is too complicated to manage	Very little 3% of surveyed households attended a financial training course	Uncertainty on acceptance risks Hypothesis of possible issues of trust in the SWARM grid
Businesses	Little 25% of the surveyed businesses received training on SHSs	Little 18% of surveyed businesses attended a business training	

Table 3. Pre-existing knowledge analysis in Kanombe, Rwanda

Mahama, Rwanda

Type of end user	Technical	Financial	Social
Households	Very little 11% of surveyed households received basic use training by SHS suppliers	Very little 12% of surveyed households attended a financial training course	Uncertainty on acceptance risks Hypothesis of possible issues of trust in the SWARM grid
Businesses	Very little 11% of the surveyed businesses received training on SHSs	Little 30% of surveyed businesses attended a business training	Possible tensions between different groups, or due to decreasing funding levels of international aid

Table 4. Pre-existing knowledge analysis in Mahama, Rwanda

3.5 Clusters to consider within local communities

The demand assessment conducted in deliverable D2.2 provides an overall understanding of the communities of the selected sites. This exercise lays the foundations to structure tailored capacity building activities, in particular to assess the level of depth of capacity building expected and needed. Further details can be found in D2.2. Three main clusters were identified in Tanzania and Rwanda, as presented below.

Stable agro-fishery villagers: a group of SHS users identified by a moderate engagement level, not having a grid connection, marked with highest income and education level.

Electricity demand outlook: Likely to increase steadily, especially with agricultural productivity improvements or the adoption of electrical appliances for farming.

Key leverage points to maximize SWARM grid deployment success:

- Early adopters for SWARM-E pilots, leveraging their relatively high literacy and stability.
- Potential to initiate peer-to-peer energy trading pilots within the SWARM grid.
- Provide training on decentralized grid operations = local electricity “stewards”, whenever possible including women.

Challenged agro-fishery villagers: a group characterized by a lower engagement level and complexity perception, not owning a SHS, with a lower income and education level.

Electricity demand outlook: Likely latent potential for demand growth if reliability improves.

Key leverage points to maximize mini grid deployment success:

- Need for awareness campaigns to build trust and basic energy knowledge.
- Demonstration projects showcasing benefits of SHS at nearby peers.
- Offer low-barrier entry points to SWARM grid (e.g., starter kits or similar).

Small enterprises: a group characterized by a certain financial literacy, often owning a SHS and finding electricity very useful.

Electricity demand outlook: High potential growth, especially if SWARM grid enables longer operating hours, refrigeration, or productivity tools.

Key leverage points to maximize mini grid deployment success:

- Prioritize connection to mini grid to support further development of local economic activity - possibly the first group to be addressed.
- Micro-loans or energy-as-a-service models to help finance energy-efficient equipment.
- Also benefit from awareness campaigns on how to use and maintain electricity assets.

3.6 Local requests for training on PUEs

This section presents a summary of the key findings on the PUEs, as initially recommended in the previous deliverables D2.2 and D3.1 on the local context and demands and refined in D4.1 SWARM Grid Topology and Technical Feasibility Per Site.

Need for business and finance training. D3.1 revealed the importance for training on both PUEs and business skills to enable sustainable and scalable use of productive loads, for the following reasons:

- **Entrepreneurs lack familiarity with productive energy uses and viable business models.** Survey data showed that fewer than 25 % of businesses interviewed could name an appliance that would transform their value-addition potential (e.g., refrigeration, milling, welding). This signals a need for opportunity mapping and business-development training linked to real market demand.
- **Inadequate financial literacy on tariffs, cost recovery and value creation:** households expressed uncertainty about how buying and selling energy would affect monthly expenses. Similarly, micro-enterprises lacked cost-benefit analysis tools. Embedding financial literacy in all modules will help participants make informed decisions on the business case for SWARM grids.
- **Gender barriers restrict women's access to training and finance.** Women-owned enterprises often operate in the informal sector without collateral, making it harder to secure loans for PUE equipment. In Kwale (Tanzania), women expressed their desire to gain more financial knowledge and business management skills, to be able to manage their businesses more effectively.
- **Training as a segmentation factor.** Analysis revealed that financial training is a key differentiator among household types. Households with higher levels of financial literacy are more likely to initiate or grow local businesses, underlining its importance not only for individual livelihoods but also for broader local economic development.

PUE-specific training requested by the communities

In February and March 2025, the local communities expressed their wishes for training on a wide range of PUEs, as indicated in the table below. This overview can also serve as a basis to make final decisions on which PUE training to implement as indicated in D4.1 and D7.1 (narrower list).

Rwanda	
Gakoma	<ul style="list-style-type: none"> • Water purification: Operators have to be trained on how to manage the machine (servicing and recognising faults). • Electric mobility: Participants to the FGDs wish to receive training for basic knowledge on the working principles of EVs, and practical training with tests to get familiar with the electric vehicles. Users have to be instructed on how to service the EVs. • Agricultural appliances: The end users will have to be trained on how to service and maintain agricultural appliances, such as a maize milling machine.
Mahama	<ul style="list-style-type: none"> • Clean cooking: For a new cooking solution such as the LPG-hydrogen blend, FGD participants strongly emphasized the need for training on operation and safety procedures for users. Operators need specific operational and technical training for the electrolyser and compressor. • Electric mobility: FGD participants stated their interest in testing electric vehicles and receiving training, even before the test. While they have heard of electric vehicles through “friends”, they feel a need to receive proper training. They suggest training to provide an overview of electric vehicles and address key operational and financial questions such as range per charge, costs, and differences between conventional vehicles and electric ones. • Commercial appliances: The users should be instructed on how to use them properly and conduct service.
Kanombe	<ul style="list-style-type: none"> • Water purification: FGD participants emphasized the need for training on the equipment and maintenance for system operators. • Agricultural appliances: The end users will have to be trained on how to service and maintain agricultural appliances, such as a maize shelling machine.
Tanzania	
Kwale	<ul style="list-style-type: none"> • Water purification: Operators have to be trained on how to manage the machine (servicing and recognizing faults). Additionally, FGD participants raised the need for training the community on sustainable and useful use of the desalinated water to reduce waste and use it in the most efficient way. • Transportation: If any pilot of light electric vehicles is deployed, FGD participants would like to receive training on the working principles of EVs, and practical training with tests to get familiar with the electric vehicles. Users have to be instructed on how to service the EVs. • Fishing activities & cold storage: End-users have to be instructed on the best practices of cooling fish, such as the maximum loading of the freezer and preparation of the products before storing. • Women group: Despite participating in Village Community Banks, many women indicated that they still lack financial knowledge and business management skills, which limits their ability to improve their economic standing and manage their businesses more effectively.

Table 5. PUE specific training by community.

4. CHAPTER 4: TRAINING RECIPIENTS

The following chapter gives a detailed description of the stakeholders to a different degree involved in the project, both by participating directly or being target groups for project deployment and involved partially as external actors. All these stakeholders are however recipients of the capacity building activities of some kind. Trainees in the SWARM-E project can be divided into two large groups with a subsequent split into minor subgroups, the larger groups being external and internal training recipients. By internal training recipients we refer to members of the consortium directly involved in the project and with an active role in the project implementation.

4.1 Capacity building to internal training recipients within the consortium

Knowledge sharing among the consortium members involves sharing of know-how and expertise among the partners for the benefit of the project and consortium as a whole. Knowledge sharing is a powerful tool fostering collaboration, innovation, and collective learning. In particular, at this stage, several opportunities in terms of internal knowledge sharing have been identified and some already implemented. Four low-hanging fruits in terms of knowledge sharing have been identified:

- **Knowledge sharing from SOLShare towards OGB and ELICO Foundation** on the use of the SOLshare technology and sharing the experience in capacity building in Bangladesh that consisted in technical training to SWARM grid users and training of the trainers.
- **Internal capacity building and training on relevant PUEs**, based on the site-specific PUEs selected and the experience of SWARM-E consortium partners on these PUEs, e.g. WeTu, MEI, Wuppertal Institute, etc. This will be discussed on an ad-hoc basis.
- **Knowledge sharing on the conduction of efficient Focus Group Discussions (FGDs)** for the involvement of local communities, which is crucial throughout the implementation of the project, to ensure local ownership, co-design of solutions, and evaluation of outcomes. This will lean on the experience of FGDs conducted by WUP supported by INKOMOKO and WUP. The experience could be valuable to other partners such as the University of Rwanda, ELICO, Ekoglobe, OffGridBox. Initial online and on-site training sessions on FGDs were conducted in 2024 and 2025 by INKOMOKO, as well as on innovative system mapping with local communities (Fuzzy Cognitive Mapping) by VITO.
- **Knowledge sharing between INKOMOKO and ELICO based on the complementarity of their training capacity**: it has been already identified as a potential synergy and their “knowledge sharing” is going to take place during the training activities in Tanzania and Rwanda. The main objective is to transfer INKOMOKO’s knowledge of training entrepreneurs and basic finance training, having already supported thousands of emerging businesses. On the other hand, ELICO would share with INKOMOKO its on-the-job approach for some of the technical training.
- **Potential knowledge sharing based on the same synergy between INKOMOKO and OffGridBox**, similar to knowledge sharing between INKOMOKO and ELICO cited above, also facilitated by their geographical overlap, both being based in Rwanda. In this case as well INKOMOKO would provide their financial and entrepreneurial training skills in exchange for experience of OffGridBox in technical training.

- **Knowledge sharing on the operation and management of solar mini grids** by ELICO, including monitoring, energy demand patterns and customer management/relations through experience. This option might be valuable at a theoretical stage of replication, if this will include further mini grids.

Other opportunities will be explored during the rollout of the training activities.

4.2 Capacity building to external recipients

Capacity building to external training recipients includes several categories of end-users as well as technicians that are in charge of maintenance and troubleshooting. The external recipients of the training are direct beneficiaries of the project.

4.2.1. Layer 1: P2P households and entrepreneurs

The peer-to-peer electricity trading model empowers households to trade surplus solar energy, reducing losses and enhancing energy efficiency. This approach fosters localised energy resilience and incentivizes renewable energy adoption towards the creation of an energy community where people own, maintain and operate their SHS. Data on energy production, generation, consumption, and pricing will guide the design and scalability of the trading system. Users included in P2P model can be divided in the following categories with specific capacity building needs:

Prosumers: households or businesses with a SHS both *producing* and *consuming* electricity:

- Training on exchanging energy: how to use the technology to sell the excess energy, how to buy in case of need.
- Training on maintaining SHS: basic technical training on how to use and maintain a SHS, providing user manual and very easy to read instructions.
- Specific to businesses with a SHS both producing and consuming electricity: training on business and economics: basic training on key business management aspects and business model to integrate the benefits of energy sharing within existing activities or to expand existing business.

Pure consumers: households and possibly businesses, without a SHS, only *consuming* electricity:

- General overview of the P2P concept and practical understanding of how they can buy electricity from their neighbours owning a SHS.

4.2.2. Layer 2: Mini grid (Tanzania) / OffGridBox Pioneer users (Rwanda)

Households with previous access to electricity or that get access to electricity for the first time:

- Mini grid users in Tanzania: training on basic energy usage and energy efficiency and safety.
- OffGridBoxPioneer users in Rwanda: training on the correct use of the asset in terms of energy access and water purification benefits.

Businesses with previous access to electricity or that can use electricity for the first time:

- Technical training on energy use and safety.
- Training on business models to unlock new business avenues.

Institutional consumers including schools and health centres:



- Technical training on energy use and safety.

4.2.3. *Layer 3: SWARM Grid, when the P2P grid is connected to the mini grid (Tanzania) or to the OffGridBox Pioneer (Rwanda)*

Local technicians and operators: this includes those who will operate and maintain the revitalised mini grid in Tanzania and those who will operate and maintain the OffGridBox Pioneers (solar container) in Rwanda. Ideally, these are the same people that will be trained to troubleshoot problems with SHSs of the P2P grid. They will be selected from among known members of the community, who are preferably already performing activities relating to electronics and mechanics. The scope of the training will be:

In Rwanda:

- Operators (also called boxkeepers) assigned to the OffGridBox Pioneers: training on safe and correct use of OffGridBox Pioneer respecting procedures established by the manufacturer shall be provided: basic troubleshooting, understanding of operational parameters of the machine etc., water maintenance, inventory keeping, and the daily use of their reporting application.
- Technicians shall be trained on UV lamp replacement, PV Basics, OGB installation, maintenance, and troubleshooting, and use of their application during routine or emergency maintenance.

In Tanzania:

- Technicians assigned to the mini grid: training on troubleshooting of the mini grid infrastructure.

4.2.4. *Crosscutting across the three layers: training on PUEs*

Businesses, individual entrepreneurs, and any other interested parties interested in PUEs: training including all phases of business set up and development depending on the needs of the target audience (business maturity), including topics as fostering entrepreneurial mindset, sales and marketing, bookkeeping, fundamentals of accounting, financial statements as well as business plan development, strategic planning, business registration and legal basics.

4.2.5. *Training matrix by stakeholder type*

The table below provides a schematic overview of the training activities per stakeholder type, which will be modulated in each site following the three and crosscutting layers presented above, and integrating the local specificities (mini grid or container, identity of stakeholders involved in the PUEs, etc.).

Training recipient	Energy exchange training	Training on electricity use, safety and maintenance	Training on business and economics of energy	Technical and business training on PUEs
P2P prosumers	x	x		
P2P consumers	x	x		
P2P businesses	x	x	x	x

Mini grid households (Tanzania)		x		
Mini grid businesses (Tanzania)		x	x	x
Solar container households (Rwanda)		x*		x
Solar container businesses (Rwanda)		x*	x	x
Technicians	x	x		x
Public institutions (Clinic, school and local government office in Tanzania)	x	x	x	x

Table 6. Training matrix by stakeholder type.

**In this case training is to be provided only on electricity use and safety, not maintenance.*

5. CHAPTER 5: FORMATS OF TRAINING

5.1 Training formats for internal recipients

Training exchanges between consortium partners is thought of as a process where individuals from different organizations within a consortium participate in learning activities of other partners in order to enhance their skills, knowledge and competences and adopt best practices. These exchanges can involve various formats like in-person or online workshops, job shadowing, as well as training knowledge products. The following formats can be implemented within the consortium:

Workshops (in-person and online):

Workshops can be organized to facilitate the process of training exchange between technical and other interested partners, in a virtual format (webinar) or in-person. Encouraging participants to share their knowledge and experiences with each other through dedicated discussions. This could lean on site visits.

Job shadowing:

Job shadowing can allow individuals to observe and learn from colleagues in other organizations within the consortium during the training, such as technical on the job training. This would require linguistic compatibility and will likely be implemented within the same country.

Exchange of knowledge products:

Training materials and knowledge products exchange can be done by using the project's shared repository folder. This can also support the development of a public PUE Knowledge Hub.

5.2 Training formats for external recipients

On the job training

In this training format, trainees learn by doing. The format is highly practical and involves direct, hands-on experience under the supervision of a trainer during the implementation of technical activities related to the installation process. Project partners within SWARM-E who implement this type of training are TAREA, ELICO, OGB, Ekoglobe, WeTu. On the job training has the advantage of enabling direct contact with the trainee, assessment of their abilities during the training, as well as answering practical questions that might arise regarding equipment maintenance. It also allows for continuous feedback during the training. The contact that is established between the trainer and trainee during the training can be maintained after the training is completed, for example via a WhatsApp group or phone calls, in case any follow ups are needed in the future.

Training of trainers:

This format is recommended based on the capacity building experience of SOLshare in Bangladesh, where technical training of trainers was provided to SOLshare area managers (i.e. local operators) to support the local community with their SHSs for the P2P grid. Available supporting documents include (1) a Standard Operation Procedure (SOP) of SOLgrid installation, (2) the SOLbox user manual, (3) a SOP for

troubleshooting, (4) a training of trainers slide deck, (5) the Solar PV Program for Rural Areas report. The programme aims to prepare a group of local trainers who, once equipped with the right technical skills and teaching tools, will be able to deliver training independently and support their communities well beyond the duration of the project.

The ToT participants can be selected among (e.g.):

- Local technicians and maintenance personnel (e.g. from mini grid or container sites)
- Community champions or SHS prosumers with high energy literacy
- Entrepreneurial youth or women from existing CBOs or cooperatives
- Trainers and instructors affiliated with local TVETs or NGOs

Business consulting

This training format is mostly used by INKOMOKO as a part of their comprehensive engagement programme with entrepreneurs and emerging businesses. It provides an opportunity of establishing a direct one on one connection with a trainee and setting individual goals related to a particular business, particular environment and circumstances. The format is partly mentoring and partly advisory sessions. Between sessions, trainees are expected to work on the goals they have defined with their business advisor. In the context of the SWARM-E project this format will be applied to ToT training as well as to working with entrepreneurs.

Training workshops

The preferred format of training in the SWARM-E project remains on the job training. In some cases, training workshops may be used as a training method, including both theoretical and practical training components. In particular, when training entrepreneurs who are already operating in the field or are about to start their business, the basics of business and economics are most efficiently transferred through group lectures accompanied by practical tasks.

Digital support

While the preferred format of training in the SWARM-E project is in-person training activities, online format can provide a useful method to complement, reinforce or spread knowledge generated:

- Online support is a valuable way to ensure the lasting connection between trainers and trainees and potentially creating some sort of community among the trainees themselves. Materials placed online and rendered available to the trainees have a benefit of being accessible after the training and remaining a solid source of reference over the time. Online support will be provided in the way of setting up WhatsApp groups including trainers and trainees in order to ensure that the simple doubts are resolved quickly. During the training some videos can be made that will be rendered accessible to the trainees via a dedicated YouTube channel.
- Online activities can help to spread knowledge generated during the project, which can help its scaling and replication in other areas. This could take various forms to be identified during the project, such as online self-paced courses available to external recipients of the projects (e.g. students present in other East-African or Sub-Saharan African countries); webinars, especially for sister projects. This should be done in alignment with the communication and dissemination strategies and the development of the public PUE Open Knowledge Hub.

Printed materials



Printed materials, such as handouts for calculations used for business training, and some of the basic user manuals, maintenance manuals simplified to several pages will be used during the training as a visual aid and as something that the students might consult later after the training. Flyers and brochures, in the local languages, can also be used to recap the key learnings of the training, and for general awareness and outreach.

6. CHAPTER 6: IMPLEMENTATION PLAN

6.1 Implementation phase

The implementation of the capacity building strategy follows three main phases: preparation, roll-out, monitoring and evaluation.

The preparation phase includes the set-up of a capacity building team (WP3 members), co-creation of the strategy, exchange of previous training materials and interviews with partners on their expectations, experience and recommendations on training activities. The initial preparation phase has been completed with the submission of this deliverable.

The roll-out phase includes

- **Development of the capacity building schedule**, which will operationalise the content of Chapter 4 (recipients and activities) and 5 (formats). For this matter, WP3 meetings will be used to develop an initial schedule that will be continuously adjusted based on the pace of the procurement and installation of equipment.
- **Preparation of the training materials**, based on the schedule: gathering them from the partners, checking if they are fit for purpose, if they need translating etc.
- **Implementation of the training activities**. Partners implementing the activities should provide a brief reporting, following the template to be developed by R4A (see section 6.3, KPIs and impact measurement), WUP, MEI, and VITO, to be reviewed by all partners.

The monitoring and evaluation phase starts simultaneously with the implementation of the training activities and is ongoing over the length of the project. Learnings on the capacity building activities should be disseminated to country education and Technical and Vocational Education Training (TVET) authorities, identified as relevant by SWARM-E country partners, in order to ensure an adequate handover. In the case of Tanzania, country partners identify the need to inform local competent authorities such as VETA.

6.2 Change management

In addition to monthly discussions and regular technical and financial reporting allowing for adjustments, especially of the schedule, a yearly assessment of the capacity building activities will be conducted at mid-term of the implementation of the capacity building strategy (M30). In the case of significant changes of the project (e.g. schedule of the procurement or installation, change of scope, etc.), a strategy adjustment plan might be developed.

6.3 Impact measurement

The impact of the capacity building strategy will be monitored through a three-pronged approach as also suggested in D 2.1.

First, the impact of each training activity will be assessed using a template developed by R4A (e.g. number of beneficiaries, formats, dissemination, feedback, etc.) and reviewed by all partners. At mid-term of the

implementation of the capacity building strategy (M30), the progress of the programme will be assessed through data collection with the capacity building strategy team, with the possibility to adjust the programme. Finally, a social impact survey that will be conducted as part of the social impact assessment under Task 6.2 will provide an overall assessment of the skills developed.

Tools that could be considered to evaluate the impact of the capacity building activities include:

- Theory of Change (ToC): developing specific, measurable, achievable, relevant, and time-bound (SMART) indicators.
- Pre and post capacity-building assessment surveys: comparing results pre and post training.
- Identification of case studies.
- Kirkpatrick's model of training evaluation that foresees a multilayer evaluation on i) how participants perceive the activities (reaction), ii) what participants learned (learning), iii) what changes happened in participant behaviour (behaviour) and iv) organizational and societal impact (results).
- Social Network Analysis (SNA) which assesses the relationship changes among participants and stakeholders and the impact of knowledge sharing and collaboration.

D 2.4 includes detailed descriptions on training and capacity building KPIs and methodologies and will serve as a guide for monitoring and evaluation of capacity building activities throughout the project.

7. CHAPTER 7: PROJECT SCALING AND REPLICATION PHASE

In the scaling and replication phase, the project will aim to reach a greater audience and achieve greater impact, ideally enabling scaling of tested innovations (SWARM grid, PUE tested, etc.), and replication in other geographical locations. Peer training on learning and outcomes, especially to sister projects can be a powerful tool to this aim.

7.1 Policy linkage via training, communication and dissemination in the public sector

The long-term success of the project in Rwanda and Tanzania also depends on establishing relationships with public sector stakeholders, raising their awareness of the project and ensuring efficient communication. This could include training on the project outcomes and lessons learned. For instance, online activities could disseminate the project's findings and train the staff of diverse public entities on the characteristics of SWARM grids, as well as of the PUEs that were implemented in the project.

Such training could be offered to relevant Technical and Vocational Education and Training (TVET) schools active in the field of energy, who are likely to be interested in such a training. Academic partners, such as the University of Rwanda, and partners with connections to TVET institutions, such as TAREA, will play a key role in liaising with educational institutions and students.

In addition, online training webinars could be considered to be offered to staff of relevant public ministries and agencies. The key and primary public institutions listed in D3.1 (Annex) for both Rwanda and Tanzania can be used as a basis to identify relevant staff members to involve.

In addition to these online activities, the communication and dissemination events planned throughout the SWARM-E project, in line with the communication plan, could also provide an opportunity for targeted training sessions.

7.2 Peer learning for stakeholders who may want to replicate the SWARM-E approach

Peer learning is also crucial at the more mature stages of the project, to disseminate findings and train on the SWARM-E approach, to stakeholders that may be incentivised to replicate the approach in another geographical location. In particular, this should be done in strong alignment with the sister projects identified as per the SWARM-E Synergy Action plan (T8.4), including other projects funded under Horizon Europe, other EU programmes, or other international programmes. This should however not be limited to project stakeholders, but also to energy entrepreneurs in Rwanda, Tanzania, but also other EAC and sub-Saharan African countries.

These training activities will likely be developed through webinars, joint events, or participation at conferences, that are crucial for dissemination of the project results but also for attracting interested stakeholders with a potential for replication.

8. CHAPTER 8: CONCLUSION

The development of the capacity building strategy is an essential part of SWARM-E WP3, based on a co-development process between its members of the consortium. It is worth emphasizing that this deliverable is not a static plan to be followed but rather an outline of the context, needs and tools for capacity building that will be adjusted during the project to closely align with the needs of local communities, as well as use the abilities of each partner in the optimal way. The capacity building schedule will be detailed and enriched during the monthly discussions and will benefit from the continuous feedback and inputs received from the recipients of capacity building activities.