



Productive Use of Energy: Moving to scalable business cases

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Reading guide:

Illustrative examples

Blue boxes provide illustrative cases from the countries

Recommendations

Turquoise boxes highlight general recommendations or critical success factors

List of Abbreviations

BMZ	German Federal Ministry for Economic Cooperation and Development
A2EI	Access to Energy Institute
AEI	Africa Electrification Initiative
AVSI	Association of Volunteers in International Service
CLASP	Collaborative Labeling and Appliance Standards Program
DC	Direct Current
EnDev	Energising Development
ESMAP	Energy Sector Management Assistance Programme
GIZ	German Corporation for International Cooperation
GOGLA	Global Off-Grid Lighting Association
HIVOS	Humanist Institute for Social Change
IFC	International Finance Corporation
LEIA	Low Energy Inclusive Appliances
MSME	Micro, Small and Medium-sized enterprises
PAYGO	Pay-As-You-Go
PRODUSE	Joint initiative by ESMAP, AEI, EUEI PDF and GIZ
PUE	Productive Use of Energy
PULSE	Productive Use Leveraging Solar Energy
R&D	Research and development
RBF	Result-based financing
SHS	Solar Home System
SNV	Netherlands Development Organisation
SWP	Solar Water Pump
TA	Technical Assistance
WE4F	Water and Energy for Food



EnDev at a glance

Approximately 3,6 billion people have no access to electricity or modern cooking technologies. This has a dramatic impact on quality of life, environment, health, education and income opportunities. EnDev's involvement focuses on providing access to modern, renewable energy. This is a pivotal factor in strengthening socio-economic development and combatting climate change.

EnDev's drive is to improve the lives of the most vulnerable people; ensuring no one is left behind. Economic opportunities and green jobs are created by building markets for modern, renewable energy. EnDev contributes to reducing greenhouse gas emissions to protect our planet's climate. Its approach is to empower structural, self-sustaining change; kickstarting market and sector development that evolves further without support from EnDev.

EnDev is a strategic partnership. Dedicated donors, partners and individuals work together to support social development and economic development by providing access to modern, renewable energy in more than 20 countries around the globe.

The driving force behind EnDev is the partnership comprised of Germany, the Netherlands, Norway, Switzerland, and the United Kingdom; donors who are committed to accelerating energy access and socio-economic development. The Deutsche Gesellschaft für Internationale Zusammenarbeit (GIZ) GmbH and the Netherlands Enterprise Agency (RVO.nl) act as the principal agencies for programme coordination.



Learning & Innovation Agenda

Energising Development (EnDev) is one of the largest on-the-ground technical assistance programmes for energy access in the world. At present, EnDev is striving to further develop and structure its learning and innovation agenda with the intention of sharing its outcomes with the wider SDG7 community. The aim is that this shared knowledge can lead to both a higher pace of implementation and increased impact of the EnDev programme. The results shared can also inform similar initiatives in the field.

Through the EnDev Learning & Innovation Agenda, EnDev supports EnDev implementers in the collection, analysis and sharing of findings and experiences of the implementation of energy access activities. In addition, it aims to provide learnings to a wider audience of energy access practitioners. This report focuses on lessons learned from the EnDev programme managed by GIZ and RVO, and from EnDev implementers such as SNV, GIZ, HIVOS, Practical Action, AVSI and CLASP.

SNV is leading the EnDev Learning & Innovation Agenda on Productive Use of Energy (PUE) within EnDev, which entails the development of this

knowledge product and the coordination of a Community of Practice (CoP) (Annex 5.5). The CoP aims to bring together EnDev implementers and other organisations to share and exchange successful approaches used to promote PUE.

This knowledge product aims to:

- Contribute to a higher pace of implementation and increased impact of the EnDev programme and other interventions in the field of productive use of energy
- Expand the knowledge and understanding of innovative and successful approaches
- Actively strengthen EnDev's new programming (2021 to 2024) and pilots, as well as other interventions.

This report first introduces the concept of PUE through an overview of the PUE market, technologies and programmes in Chapter 3. Chapter 4 provides results from the analysis. Discussion & Recommendations are finally presented in Chapter 5.



Executive summary

Productive Use of Energy (PUE) is not a new topic but is receiving an increasing amount of attention. It is considered the main priority for energy access in emerging countries, specifically in rural settings. Multiple factors support the use of energy for productive uses, such as increased energy access, payment models like Pay-As-You-Go (PAYGO), technological innovation and lower costs for solar technologies and appliances.

Productive use of energy also contributes to making (mini)grid development in rural areas commercially viable. While a variety of initiatives have identified the market opportunity of PUE applications for farmers and other micro, small and medium-sized businesses (MSMEs), key barriers have prevented PUE from reaching scale.

This report, as part of the EnDev Learning & Innovation Agenda, seeks to facilitate learning and exchange on successful PUE promotion approaches. Also, it aims to contribute to accelerated implementation and impact of PUE interventions in EnDev and other programmes, provide input to future programming and expand the wider knowledge

and understanding of successful PUE promotion approaches among practitioners.

The report provides background on PUE, technologies and programmes through desk research. The mapping of PUE initiatives by EnDev implementing organisations provides a categorisation of projects, success factors and challenges in PUE promotion projects. Specific PUE promotion projects are thoroughly analysed through in-depth interviews on project design, implementation and evaluation, following the methodological approach of the PRODUSE manual. This provides a basis for practical recommendations for improving sector learning, collaboration and design of future PUE projects.

Mapping & Analysis

Practitioners often use different definitions for PUE, which can lead to a different judgment of what to prioritise, implement and measure while carrying out PUE promotion projects. The PUE definitions can thus influence what we consider to be successful PUE approaches and need to be considered in learning and exchange about PUE.

PUE promotion projects include a variety of products and technologies, target groups, activities and support measures. To create a better understanding of PUE promotion approaches and compare and analyse similar approaches, this report proposes the following categorisation:

Such categorisation can support practitioners in creating a better understanding and alignment of PUE promotion projects. Though the proposed categorisation is based on a limited number of projects and does cover all PUE promotion projects in the sector, it can be used as a basis for a more comprehensive categorisation based on extensive sectoral mapping.

Targeting specific groups	Value chain approach	PUE as one element in broader approach	Focus on supply side & technology
<ul style="list-style-type: none"> • (Woman-led) MSMEs • Communities/villages • Smallholder farmers 	<ul style="list-style-type: none"> • Agriculture • Aquaculture • Other 	<ul style="list-style-type: none"> • Energy access projects • RBF programs 	<ul style="list-style-type: none"> • R&D grants • Quality assurance • Product catalogues

Figure 1: PUE project categorisation

Ecosystem approach

Key challenges identified in the analysis are lack of availability of appropriate products and business cases, and lack of an enabling market environment to facilitate the scaling of PUE. Key success factors are a detailed analysis of demand, an integrated market development approach, continued support to businesses adopting PUE and detailed monitoring using tailored PUE indicators.

The analysis shows that PUE promotion requires a more holistic or ‘ecosystem’ approach to PUE promotion, addressing the key barriers and integrating the key success factors. Different projects, support activities and stakeholders are strongly interlinked, and therefore increased coordination and collaboration between stakeholders and projects are required to enhance effectiveness and efficiency in PUE promotion. Specific support measures are needed to enable market growth, stimulate demand and increase supply.

Following the ecosystem approach, specific fields of increased coordination between stakeholders can be identified:

- Linking R&D and market development projects can ensure staged market building from the product development to market scaling phase.
- Research institutions and other initiatives must work together with development organisations to translate research findings into concrete development projects and scalable business cases.
- Local financial institutions working together with impacts funds and banks can play an important role in developing tailored financial products to enhance end-user affordability.

Figure 2: PUE ecosystem approach



Additional knowledge products

The development of additional knowledge products can further enhance learning and exchange on successful PUE promotion approaches. A new iteration of the PRODUSE manual including a wider scope of technologies, sectors and types of project designs can help practitioners in designing tailored projects. Additional desk research on current PUE initiatives, linking to the findings in this report can enhance the applicability of learnings and recommendations. Development of approaches for specific PUE project categories can increase understanding of success factors for specific technologies, sectors and/or value chains. In addition, investigations into specific PUE aspects, such as after-sales services, consumer protection and operation & maintenance practices and the impact of PUE on gender equality and social inclusion will be valuable.

General Recommendations



- Increase effectiveness and efficiency in PUE promotion by applying an **'ecosystem approach'** for PUE interventions: a coordinated effort with a wide variety of stakeholders and across sectors, providing support measures to enable market growth, stimulate demand and increase supply.
- Intensify **collaboration** between complementary, targeted PUE promotion projects and engage with different stakeholders across PUE and adjacent sectors.
- Adopt **multi-disciplinary** project teams with experts from different sectors and backgrounds to increase cross-sectoral understanding and effectiveness of interventions.
- **Sensitise stakeholders** in funders, governments and development organisations on specific characteristics of PUE needs and interventions to provoke an integrated, flexible approach in PUE promotion and to ensure inclusion of PUE in project designs for energy access programmes from the start.
- Tailor PUE project designs towards **scalability**, aiming at replicable models and scalable business cases.



Introduction



1.1 Methodology

Informed by discussions with the EnDev advisory team and partners, several research questions were identified, aimed at the EnDev Learning & Innovation Agenda objectives:

- Which different approaches are being applied to stimulate PUE within EnDev and beyond¹, and how can they be categorised?
- Analysing these (categories of) approaches, what are the key success factors and the main challenges?
- What are the most promising innovative approaches in this area of work?
- What are the lessons learned and recommendations of activities related to PUE?

The EnDev implementing organisations, part of the PUE core group, contributed to this document by providing input and being the subject of analysis. This was done through regular meetings, interviews with project managers and review of drafts (terms of reference, report).

1.1.1 Tool for analysis: PRODUSE Manual

The PRODUSE initiative, a joint initiative from ESMAP, AEI and GIZ on the interaction of energy access and productive activities², developed a toolkit and manual that provides energy practitioners with step-by-step guidance for designing and implementing productive use of energy activities in electrification programmes. The PRODUSE manual is used as the basis for the qualitative analysis in this report. See Annex 5.2 for more details.

1 Other PUE projects implemented by EnDev implementing partners

2 www.produce.org



Copyright: Russell Watkins/DFID

1.1.2 Methods of data collection

The methodological approach is divided in three components:

- **Desk research** to analyse the state of the market and the methodologies and research toolkits currently present in the PUE sector. This was done through research of online sources and documentation provided by the EnDev implementing organisations.
- **Project mapping** to analyse the scope and variety of PUE projects implemented by the EnDev implementing organisations as well as their vision on PUE definition and general success factors and challenges in PUE promotion projects. The mapping was conducted through a questionnaire filled in by the EnDev implementing organisations. The results were analysed and discussed. This informed the selection of projects that were further analysed through interviews.
- **Interviews:** 11 projects were selected from the project mapping for deeper analysis, based on these criteria:
 - Variety in PUE project categories (as defined in 4.1.2)
 - Variety of PUE technologies
 - Variety of countries and continents
 - Variety of finalised projects and projects in the implementation stage

The project selection was endorsed by the EnDev implementing organisations, and interviews were held with project managers and/or project PUE advisors/experts. The interview questions were based on the PRODUSE manual. For each set of project modules, related to project phases, an evaluation section was included to deepen the understanding of the success factors and challenges identified by the interviewee. The interviews were recorded and transcribed. An overview of all responses was fed into a matrix, which was used to label similarities and noteworthy responses for each project. A summary/conclusion was added to each interview question. The analysis in chapter 4 highlights the findings from this exercise for each module.



Background



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2.1 Productive Use of Energy

In recent years, business models for rural energy access, especially through solar home systems (SHS), have become more standardised. Adoption of these products has become widespread and many country electrification strategies consider decentralised renewable energy as a key component in achieving nation-wide energy access.

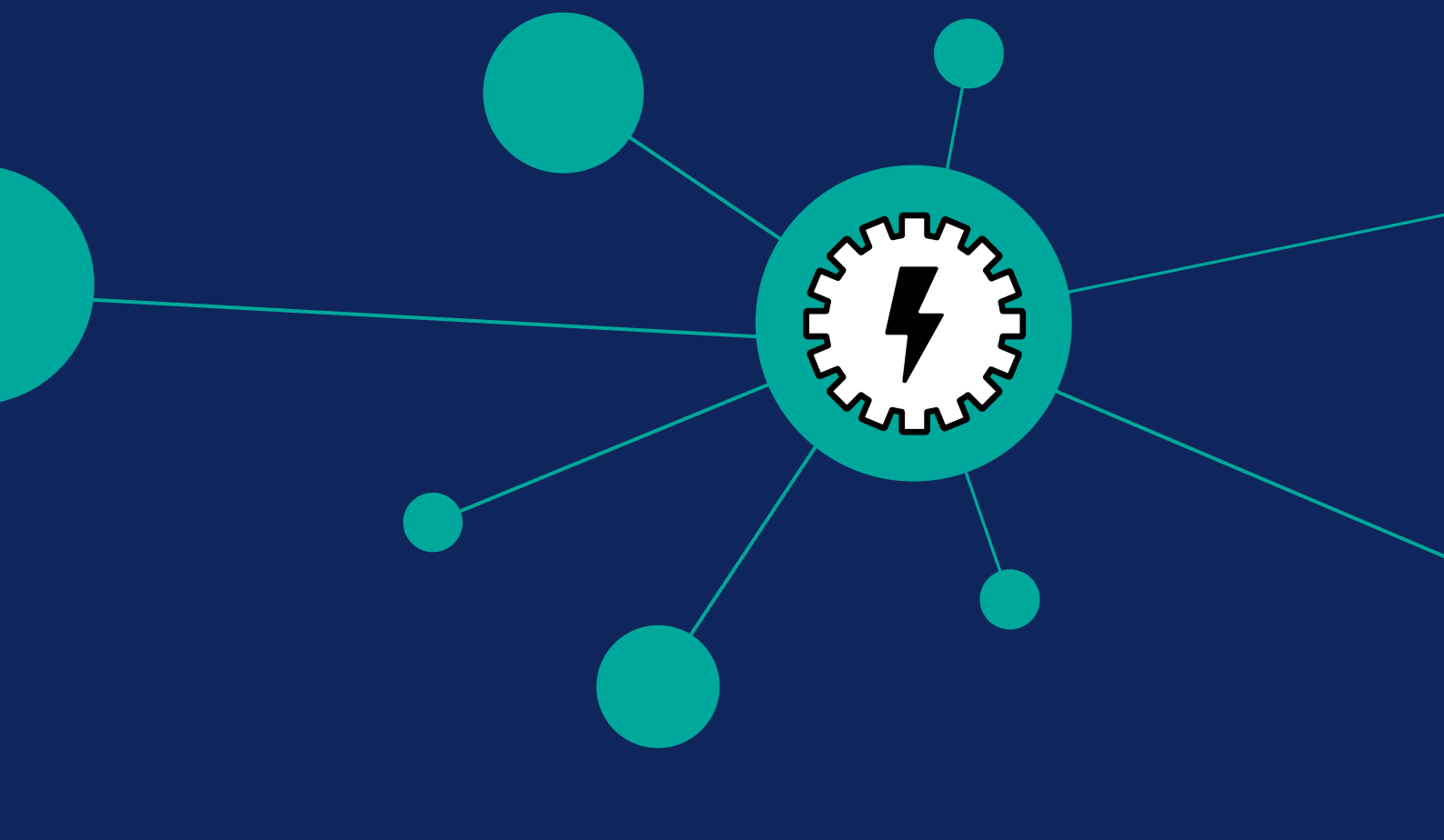
The EnDev programme defines productive use of energy as those uses of energy that increase income and/or productivity. PUE is not a new concept and has been researched and promoted in on-grid development long before the growth of decentralised renewable energy and rural electrification. For PUE applications in the rural context, a vast amount of knowledge has been collected on applications in solar, cooking, hydro power and biogas³. However, several recent developments/trends have led to increased interest and emphasis of sector stakeholders on researching and promoting PUE:

- The increasing amount of people with access to Tier-2 levels of electricity⁴ and above has led to stakeholders in the sector putting more emphasis on translating energy access into new opportunities for income-generation and sustainable socio-economic development in rural contexts.
- The emergence of Pay-As-You-GO (PAYGO) models and the growth of mobile-money services have contributed to energy products becoming affordable for low-income consumers.
- The increased deployment of (mini-)grids in rural areas has created opportunities for productive use applications with higher energy needs.
- Technological innovation and decreasing costs of solar panels and batteries lead to viable alternatives for diesel-based motors. These technologies specifically provide opportunities to increase efficiency and output. For instance, solar water pumps powered by brushless DC motors have demonstrated their impact on small-scale farming⁵.

3 https://energypedia.info/wiki/Portal:Productive_Use

4 ESMAP MTF for measuring energy access: <https://www.esmap.org/node/55526>

5 FAO, 2019, The benefits and risks of solar-powered irrigation – a global overview: <http://www.fao.org/3/I9047EN/I9047en.pdf>



While there is a large market potential for productive use solutions, the market is still in a nascent stage. Research shows a solid market opportunity and identifies key barriers that limit the possibility to scale.

- GOGLA's Powering Opportunity report shows that SHS ownership has translated in an average additional income generated per month of \$46 in East Africa, \$31 in West Africa and \$65 in South Asia. SHS appears to stimulate entrepreneurship, though this potential is not realised to its full extent.
- IFC estimates the total Sub-Saharan Africa market for agricultural PUE products (or micro-PULSE) to be \$734M factoring in affordability and ability to pay and up to \$11.3B without. Solar-powered irrigation is the most mature technology followed by cooling & refrigeration and solar agro-processing.
- The Efficiency for Access Coalition Solar Water Pump Outlook 2019 report estimates that solar water pumps have the potential to reach up to 1.6 million households in sub-Saharan Africa by 2025 and as many as 2.8 million households by 2030 — a value of approximately \$1.6B by 2030.

The previously mentioned developments and market trends show the potential and importance of PUE promotion approaches and business cases to be developed, aiming to move from the nascent market stage towards scale. To realise this, there is a need for knowledge sharing in terms of successful and less successful approaches.



2.2 PUE technologies

Productive use of energy is not limited to specific technologies but can be categorised by types of energy. Based on the categorisation at Energypedia⁶, this report considers productive use of electricity for MSMEs and mechanical processes as well as productive use of thermal energy.

Productive use of electricity

Productive use of electricity projects can be divided in electricity used for micro, small and medium-sized businesses (MSMEs) in rural settings as well as mechanical processes. For MSMEs electricity sources can be plug-and-play Solar Home Systems (SHS), component-based solar systems, mini-grids and the national grid. These electricity sources power specific productive appliances that can help a business to generate additional income. Examples of common products/appliances available in the market are: Phone-chargers, fridges, barber-kits and entertainment systems.

Productive use of electricity for mechanical processes is focused on sectors like agriculture, agro-processing, water supply, natural resource extraction and small-scale manufacturing⁷. The focus of most PUE projects, as well as product development by manufacturers, is on applications in agriculture, agro-processing and water supply. This is because solar and other renewable technologies can help to optimise farming practices in areas without electricity access and/or offer an alternative to costly and environmentally harmful diesel-powered equipment. Examples of common applications in the market are:

- Irrigation: Solar water pumps and hydroponic production
- Cooling/drying: Ice-making, solar drying, cold storage
- Agro-processing: Solar-powered milling, husking, threshing, hulling, grating and pressing
- Livestock: Poultry lighting, egg incubators and milking machines
- Small-scale manufacturing: Sewing, weaving, pottery

6 Energypedia 2020:
[https://energypedia.info/wiki/
Portal:Productive_Use](https://energypedia.info/wiki/Portal:Productive_Use)

7 Energypedia, 2020:
https://energypedia.info/wiki/Mechanical_Energy



Copyright: Dawit Dagnew



Copyright: Ute Grabowsky

Productive use of thermal energy

Productive use of thermal energy can involve a range of activities including cooking, drying, heating, smoking, baking, cooling and manufacturing, mostly applied by MSMEs in rural settings⁸. PUE research and promotion often focuses on cooking in commercial settings such as cafés, restaurants, hotels and institutions. Thermal energy can also be used for production processes like fish smoking, beer brewing, shea butter production and soil sterilisation. Examples of common products in the market are improved cookstoves and ovens fuelled by biomass, LPG or ethanol.

8 Energypedia, 2020:
[https://energypedia.info/wiki/
Productive_Use_of_Thermal_Energy](https://energypedia.info/wiki/Productive_Use_of_Thermal_Energy)

2.3 PUE initiatives

Existing and new sector stakeholders have set up programmes to research and promote PUE. Focus is on market research, R&D, early-stage grant financing and piloting business cases. In terms of technologies, there is a focus in recent literature on solar water pumping and cooling as those are considered the most market ready. An increasing amount of initiatives look at integrating the nexus of energy, agriculture and water to promote PUE.

Some initiatives worth highlighting are:

- **Efficiency for Access Coalition**⁹ is a multi-stakeholder coalition focusing on harnessing energy efficiency to accelerate access to modern energy services. PUE projects are the Global LEAP award and Low-energy-inclusive-appliances (LEIA) programme.
- **Powering Agriculture**¹⁰ was a multi-donor partnership that utilised a cross-sectoral approach, providing technology and business model innovation grants, increasing financing through an investment alliance, awareness raising and knowledge management.
- **Water and Energy for Food (WE4F)**¹¹ is a new programme that builds on the learnings from Powering Agriculture and focuses on scaling water-energy-food innovations.
- **Productive Use Leveraging Solar Energy (ESMAP)**¹² is a research report exploring opportunities to catalyse growth in the market for PULSE micro-applications, which can be powered by small standalone solar systems.
- **Access 2 Energy Institute**¹³ is a R&D institute focusing on productive use appliances that allow small businesses and smallholder farmers to generate a stable income, generate jobs and create robust local economic networks. A recent A2EI report uses a systematic methodology for successful adoption and scaling of agricultural technologies.
- **PRODUCE**¹⁴ is a joint initiative from ESMAP, AEI and GIZ aiming to gain insights into the interaction of energy access and productive activities. PRODUCE has developed a manual, study and methodology. The manual provides practical guidance for energy projects with a focus on promoting PUE and is also used in this report.

This report builds on the lessons learned from these initiatives and adds knowledge and recommendations based on practical lessons learned and gaps from the implementation of PUE promotion projects.

9 <https://efficiencyforaccess.org/>

10 <https://www.usaid.gov/energy/powering-agriculture>

11 <https://we4f.org/>

12 <https://www.esmap.org/market-research-on-productive-use-leveraging-solar-energy>

13 <https://a2ei.org/>

14 <https://www.produce.org/>



Project Mapping & Analysis



3.1 Project mapping

The project mapping provided insight into the general perspective and experiences of the EnDev implementers with regards to PUE. The mapping collected information on the adopted PUE definition within the implementers and their projects, an overview of PUE projects within their portfolio's and the general successes and challenges experienced with implementing these projects.

3.1.1 PUE definition

Productive Use of Energy does not have one standardised definition and numerous varieties are used by practitioners. Several researchers and institutes have tried to come up with standardised definitions¹⁵. Annex 5.1 summarises the various definitions adopted in literature and by the EnDev implementing organisations. Some of these definitions are derived directly from existing literature, others were drafted by the organisations or their donors. The variety of definitions adopted by practitioners can lead to a different judgment of what to prioritise, implement and measure while carrying out PUE promotion projects.

All PUE definitions used by the EnDev implementing organisations include facilitating, enhancing, or stimulating income generation and/or income-generating activities. Next to this economic definition, more socio-economic components are added: Improving overall business climate, supporting livelihoods, use of energy that contributes to education, health and gender equity.

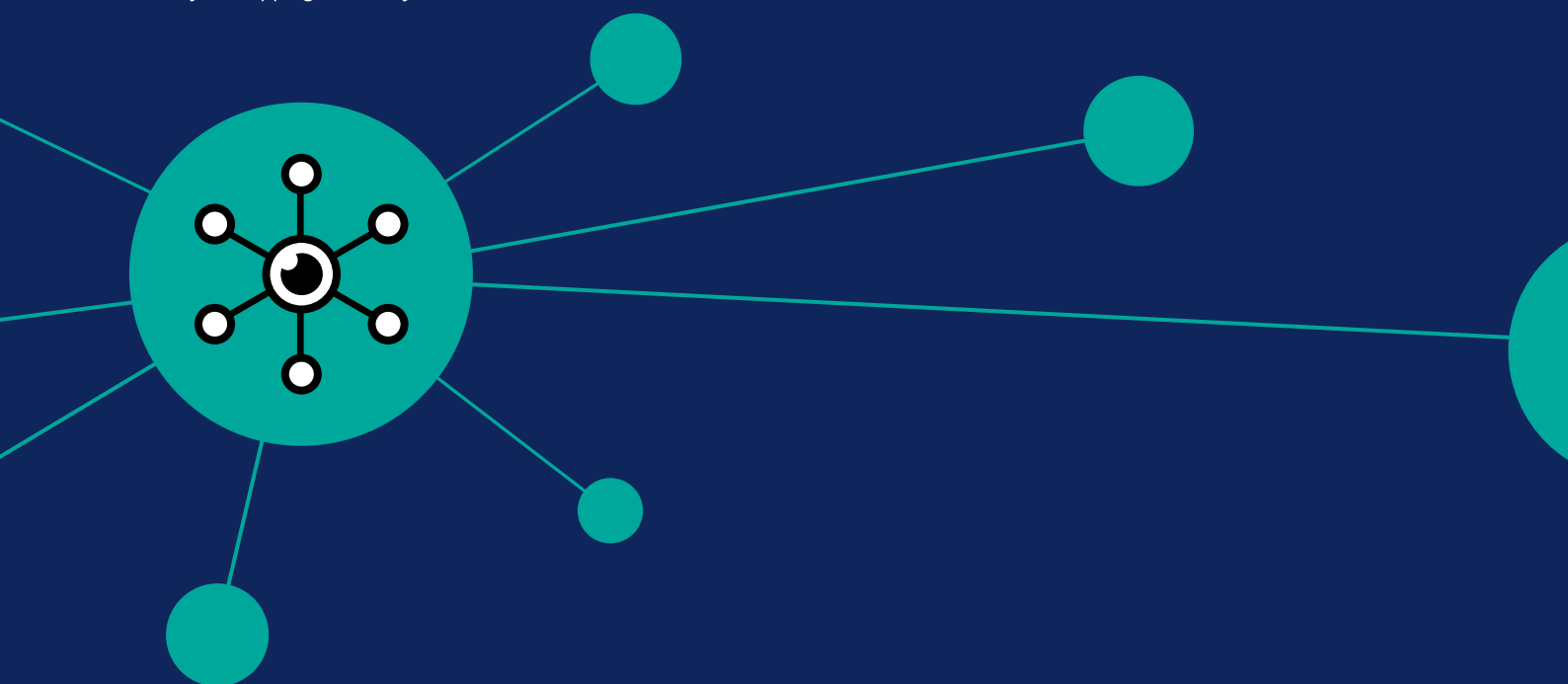
Some definitions specifically describe a selection or all types of energy (electrical, thermal, mechanical energy) and sectors (agriculture, rural enterprise, health and education).

The question is if standardisation of the definition could benefit PUE promotion projects. Standardising the definition might improve mutual understanding of what PUE is, while project interventions can still focus on specific components of PUE. On the other hand, when communicated clearly, the use of distinct definitions can also serve to clarify the specific focus of the PUE promotion projects.

It is important to consider how the definition can impact the design of the project approaches, activities implemented, and indicators used in the monitoring and evaluation phase. A project with a narrow definition might have a limited view in the design phase while a project with a broader definition is likely to consider all relevant aspects when deciding on necessary interventions. Within the monitoring and evaluation phase, a project with a narrow definition might restrict indicators to only measure e.g. job creation or income, while a project with a broader definition would probably measure wider aspects of the PUE impact, e.g. socio-economic changes for specific groups like smallholder farmers or woman entrepreneurs and the communities and geographic areas they live in.

The PUE definitions can thus influence what we consider to be successful PUE approaches and need to be considered in learning and exchange about PUE approaches.

¹⁵ https://energypedia.info/wiki/Productive_Use_of_Electricity



3.1.2 PUE categorisation

Like the variety of definitions, PUE promotion projects include a variety of products and technologies, target groups, activities and support measures. This can cause unclarity and a lack of common understanding among stakeholders about what we consider to be (successful) PUE promotion. Creating categories of approaches and projects can create a better understanding of the varieties in PUE promotion and provides a basis for further analysis of success factors in the project design.

An inventory of PUE promotion projects implemented by the EnDev implementing organisations was used to create a categorisation of PUE projects (Figure 1). From the inventory of projects, eleven projects were selected for deeper analysis, covering the different categories. The categorisation provides structure to the analysis by identifying similarities and differences in success factors and challenges in the different project categories.

Though the proposed categorisation is based on a limited number of projects and does not cover all PUE promotion projects in the sector, it can be used as a basis for a more comprehensive categorisation based on extensive sectoral mapping. This can support practitioners in creating a better understanding and alignment of PUE promotion projects.

Targeting specific groups	Value chain approach	PUE as one element in broader approach	Focus on supply side & technology
<ul style="list-style-type: none"> • (Woman-led) MSMEs • Communities/villages • Smallholder farmers 	<ul style="list-style-type: none"> • Agriculture • Aquaculture • Other 	<ul style="list-style-type: none"> • Energy access projects • RBF programs 	<ul style="list-style-type: none"> • R&D grants • Quality assurance • Product catalogues

Figure 1: PUE project categorisation





3.2 Interview analysis

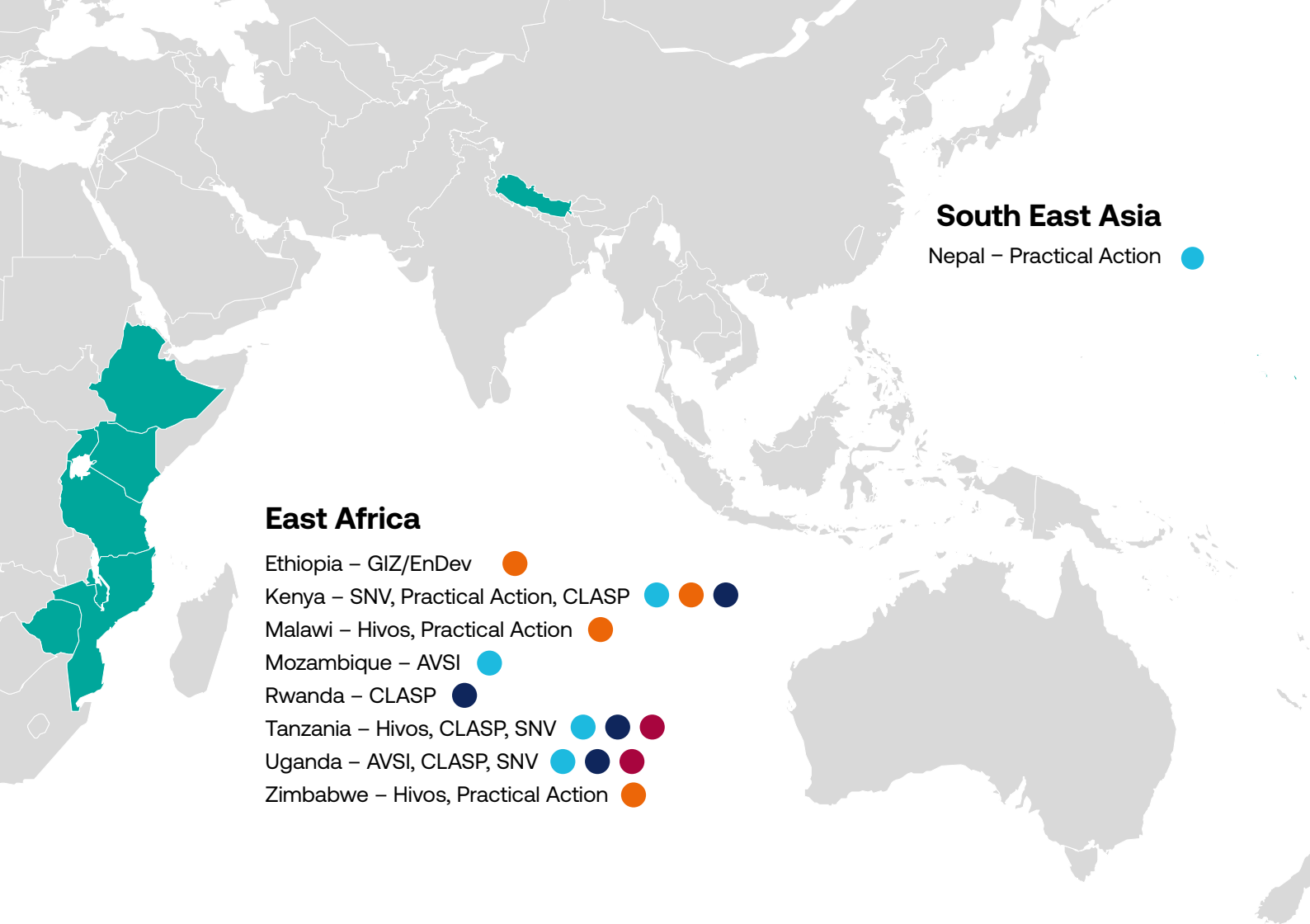
Eleven projects were analysed involving eleven countries across South America, Africa and Asia, as shown in Figure 3. The project details can be found in Annex 5.4. The interview questions (Annex 5.3) are linked to the PRODUSE modules (Figure 1). The sections below describe observations based on the interview analysis and conclusions & recommendations for each project phase.

3.2.1 Feasibility & initial planning

Observations

The reasons to engage in PUE promotion vary widely among implementing organisations. A few examples to demonstrate this variety:

- An existing mini-grid project realised that adding a PUE component could create socio-economic impact as well as improving commercial viability for mini-grid providers.
- A project focused on the promotion of improved cooking technologies realised that existing businesses selling food could generate additional income by using more efficient improved cooking technology.



- Targeting specific groups
- Value chain approach
- Focus on supply side & technology
- PUE as one element in a broader approach

Figure 3: Project overview

- A project focused on enhancing climate resilience for farmers identified productive use technologies as an important vehicle for farmers to become less dependent on rainfed agriculture as well as increasing the efficiency of production.
- A project focused on promoting productive uses for local communities while improving commercial viability for local electricity suppliers.
- Research on efficient appliances among several companies showed certain mature productive use technologies. Based on this research, financial incentives were designed to kick-start markets by supporting distributors to sell to end-consumers.

For each project category, similar reasons were found to engage in PUE promotion:

Projects targeting specific groups engage in PUE promotion for the potential socio-economic impacts that PUE can bring to those groups in combination with the improved commercial viability of business models from energy suppliers.

Projects with a value chain approach engage in PUE promotion as this can contribute to increasing outputs, energy efficiency and/or the overall goal to enhance farmers' climate resilience.

Projects focused on R&D and technology engage in PUE promotion from a more holistic perspective, where the introduction of energy-efficient appliances can benefit both households, businesses and farmers to increase outputs as well as welfare.

Projects with PUE as one element in a broader approach in most cases did not include PUE components initially but realised the opportunity at a later stage.

The evidence collected as a basis for the interventions is linked to the specific type of project. Projects targeting specific target groups and focusing on value chain approach included a feasibility study, rapid market assessment, or value-chains analysis. Projects with PUE as an element in a broader approach that realised the opportunity for PUE promotion at a later stage did not include a market study or added a study at a later stage. Projects focused on supply side & technology were mainly informed by existing research and experience from earlier projects.

The PUE objectives defined within the projects are linked to the main focus of the project and target beneficiary. The most common objectives are energy-related (number of beneficiaries with access to PUE products, generated capacity, improved energy efficiency), socio-economic (jobs created, enhanced income, gender equity), agriculture-related (increased yield, amount of farmland created, small-holder farmers supported to adopt PUE), enabling environment (ecosystem developed, policy briefs created) and/or related to access to finance (loans provided, financial institutions supported).

»The current objectives are too linear to measure PUE.«

CASE: EnDev Bolivia

EnDev Bolivia, implemented by GIZ, started in the year 2006 and initially focused efforts on meeting basic energy needs for domestic use. Later, the Productive Use Energy Component (PUEC) was added, focusing on PUE applications in primary production and post-harvest processing of agricultural value chains. The aim is to strengthen the local production, processing and value addition of agricultural products and local production of goods and services. To realise that, EnDev Bolivia targets peasant communities, agricultural cooperatives, SMEs, public sector and NGOs.

Between 2007-2019, 2.238 PUE technologies were introduced to rural areas of Bolivia. Key success factors were the user-centred support, a widespread network of public and private actors and flexible and tailored support measures to promote PUE technologies.

As EnDev Bolivia focused on facilitating access to modern energy, its priority was not the promotion and linkage of food to market systems. Over time, it became evident that the user access and adoption of technologies is pulled by market opportunities and the consumers' will to pay. Alliances were established with NGOs and private sector, who incorporated effective actions into their projects to link food produced through PUE with market systems.



Project focus

In the Feasibility & Initial planning phase:

- the number of different productive uses focused on (or 'horizontal scope of interventions' in the PRODUSE manual) was broad and not limited to specific technologies in most projects. The PUE products promoted within projects were based on the demand analysis. Only in the case of R&D and Results-Based Financing (RBF) projects, specific technologies and products were selected to be eligible for funding and/or incentives.
- The projects also adopted a broad focus in the number of different activities where productive use is promoted (or 'vertical scope of interventions' in the PRODUSE manual), with a variety of activities for technical assistance, awareness-raising, access to finance and enabling environment.

Given the nascent stage of the market and PUE product development, a broad focus allows projects to respond to market demand and provides flexibility in emphasising specific support measures during the project. At the same time, a broad focus can reduce the effectiveness of the projects due to resources being spread too thin and the focus being less on developing specific PUE business cases.



Copyright: GIZ/Raabe

Feasibility & initial planning



- Include PUE at the beginning of project designs for energy access programmes (electricity and clean cooking), to allow for the integration of PUE promotion targets, indicators and activities based on evidence collected in feasibility studies and market assessments.
- Include both assessing demand for PUE products and mapping of suppliers in the market in evidence collection at the start of a project, through studies and assessments for any type of PUE. Additionally, linking with existing R&D and research projects can help to assess the availability and viability of PUE products in the market.

» We should focus more on scalability«

» Market development takes a long time«

Interviews with PUE practitioners July-Aug 2020

- For more transformative impact, reduce the number of activities per project and increase collaboration between more specialised projects, executed by expert organisations in that area, e.g. focusing on R&D, business support, financial incentives and/or enabling environment.
- Sensitise donors to the need for adopting less linear objectives to measure PUE as well as more flexible project designs and longer project periods that allow for adaption to a changing environment.

Copyright: Shrestha



CASE: Strengthening the Capacity of the Energy Sector to Deliver Gender Equality and Social Inclusion Results project

This TA-9334 NEP project started from 2018, is led by ENERGIA/Hivos and implemented by Practical Action Consulting, Centre for Rural Technology Nepal, National Association of Electricity Users Nepal and Ricardo Energy. It is funded by the Asian Development Bank (ADB) and co-funded by the Swedish International Development Cooperation Agency (SIDA). One of the objectives of the project is to promote Gender Equality and Social Inclusion in accessing and supporting productive use of clean energy technologies and services by women, the poor and vulnerable households of Electricity Users' Cooperatives.

The key success factors in the project are a robust selection mechanism of women entrepreneurs, engagement with family members for committed supports, comprehensive training packages integrating agency-based empowerment, energy management (including adoption of efficient, safe appliances), and post-training support including business counselling and facilitation for business support services. Lessons learned are that the project did not allocate enough budget for capacity building of local institutions and fostering partnerships among entrepreneurial ecosystem stakeholders.



3.2.2 Analysis and programme design

Observations

In planning PUE promotion activities, key bottlenecks defined by the EnDev implementing organisations are described below.

Availability of products and suppliers in the market

In the inception phase of the projects, it is often realised that there are very few suppliers of suitable PUE products in the market. Due to the limited availability, projects work with any supplier of products in the local or international market. This also leads to the promotion of sub-standard products and a lack of developed after-sales service or warranty.

Appropriateness of technologies

Even when suppliers are identified through market assessment or a feasibility study, there is often a challenge in finding products that are appropriate for the specific need from the MSME and/or small-holder farmer that is targeted within the project. System sizing and design do not always fit the needs of the customer.

End-user affordability

Most projects experience a challenge in the affordability of products for end-users when promoting PUE products. The high upfront cost of purchasing PUE products, a lack of clarity on the potential savings and a lack of suitable payment models reduce the uptake of products and lead to mainly higher-income customers purchasing products.

Distribution channels

Specialised PUE distributors and sales agents are lacking, and distribution networks are often not well developed. Reasons for this are the lack of availability of mature PUE products, the technical know-how needed to sell and install PUE products and the lack of business opportunity that existing distributors see in expanding their portfolio with PUE products.

Private-sector funding

There is a lack of targeted PUE grant, equity and debt funding to support companies from the R&D phase to market introduction. Grant funding is often earmarked for R&D projects or for activities supporting market development, leaving a gap between R&D and market introduction. Investors are hesitant to provide equity or debt funding due to the lack of proven business cases and the complexity of the market for PUE products.

Lack of end-user awareness

Target customers are often not aware of the available technologies or not convinced of the benefits of the products in relation to the high cost.



CASE: Climate Resilient Agriculture for Tomorrow (CRAFT)

CRAFT, implemented by SNV Netherlands Development Organisation, is stimulating the application of renewable energy and energy efficiency solutions in prioritized agricultural value chains (oil seeds, pulses, potatoes and cereals) in Uganda, Tanzania and Kenya since 2018 as part of the overall resilience building and mitigation strategies in climate smarting agriculture. CRAFT aims to increase income for smallholder farmers and SMEs, increase business performance for agribusiness SMEs and cooperatives through facilitating climate-smart investments in selected agricultural value chains and improving the enabling environment favourable for large scale roll out of climate-smart agriculture. This is achieved through: Increased adoption of climate smart practices and technologies among smallholder farmers, SMEs and Cooperatives – increased investments and business growth in climate smart value chains; and increased involvement of women and youth agribusiness development as well as increased collaboration and exchange among public-private actors on large scale roll out of Climate Smart Agriculture.

Key success factors are the inclusive agribusiness approach that uses a wider perspective and integrates more opportunities for all actors within one value chain through the development of business cases in partnership with the private sector. A challenge is finding appropriate and commercially viable solutions and business cases in the market suited for the targeted value chains. Also, end-user affordability continues to be a main barrier, and this could be addressed in the project design and adaptive implementation.



Analysis and programme design

- Address availability and appropriateness of PUE products by better linkages with existing R&D programmes, more thorough market assessments at the start of projects and/or budget allocated for R&D and product development within the project design.
- Focus on developing and promoting proven business cases and supplier and/or end-users to increase the effectiveness of market development projects, while R&D and research programmes can support the development of these business cases.
- To address end-user affordability, support manufacturers and distributors to design and adopt suitable payment models through the support of financial institutions, specialised funds or lease-to-own and PAYGO models.

» Because of the cost, we are only addressing the need of wealthier customers. We are a long way from reaching the poor.«

Interviews with PUE practitioners July-Aug 2020

- Develop distribution models by motivating existing last-mile entrepreneurs to adopt PUE products, for example through training on PUE technologies, financial incentives to cover operational expenditures like stock financing, and marketing and awareness-raising.
- Unlock private sector funding through the provision of staged grant funding to support early-stage PUE products and companies from the R&D phase to market introduction and scale-up. This will allow for commercial investment to be leveraged once the product and business model is proven.
- Promote PUE by awareness-raising through supporting above-the-line national campaigns (to a wider audience) as well as below-the-line grassroots marketing campaigns (to specific target groups) conducted by last-mile entrepreneurs.



CASE: Sustainable Energy Services in Kitobo Island

The project Sustainable Energy Services in Kitobo Island, Kalangala District has been implemented between 2015 and 2016 by AVSI Foundation and was funded by Energy & Environment partnership (EEP). The aim of the project was to provide electrification from a renewable energy source, support the sustainable economic growth of the villages and reduce the population's vulnerability to climate change. The project realised the installation of 235 kWp solar mini grid, with 500 household connections and 40 SME connections. Among the businesses, three high energy consuming and 15 low energy consuming ventures were initiated thanks to PUE activities such as business skills training, coaching and access to finance.

Key success factors in the project were working with a private sector partner, that facilitated combining business sustainability and socio-economic impacts. Also, the inclusion of a financial component to provide loans through a local cooperative bank for the purchase of PUE products is important.

Lessons learned are that to stimulate credit institutions to provide affordable loans, the use of credit guarantees would be more effective than providing cheap loans to the credit institutions, as it can allow some of the requirements for receiving a loan to be removed (such as presentation of a collateral).



3.2.3 Implementation phase

Observations

In the implementation phase, most projects include a broad variety of productive uses and supporting activities (as mentioned in chapter 4.2.1). The project activities most adopted in the project implementation phase are described below.

Technical assistance

Most projects include a technical assistance (TA) component. For projects focusing on specific target groups, TA is targeted to suppliers, distributors and MSMEs adopting PUE products. Some examples of support are market intelligence, linkages with distributors and business and technical skills training. For projects with a value chain approach, TA is focused on supporting farmers and agribusinesses to adopt PUE technologies in their farming/business practice to increase yields/production, and business support to distributors, agronomists and other suppliers of agriculture related PUE technologies.

Key in providing technical assistance is a customer/business-centred approach that focuses on identifying the needs of the users and business opportunities. Adopting PUE products to increase productivity is not a straightforward process and requires tailored TA depending on the type of business, business maturity and sector. Furthermore, continued support

after the purchase and installation of PUE products increases the likelihood of long-term productivity growth and allows the impact of the adoption of PUE products to be monitored.

Awareness-raising

Awareness-raising activities are included in all projects targeting specific groups as well as some projects centred on specific value chains and projects with PUE as one element in a broader approach. Common activities implemented are marketing events focused on promoting PUE products, training to sales entrepreneurs, training on the inclusion of women and vulnerable groups and the development of toolkits on how to adopt PUE in daily business practice. Although the benefits of PUE promotion might be clear on paper, often customers are not convinced of the benefit in relation to the high upfront cost.

Access to finance

Access to finance is a key component of the implementation phase in all projects focused on market development. A variety of financial facilitation and incentives activities are designed, both for suppliers and end-users, often in partnership with financial institutions like banks and micro-finance institutions. Activities implemented in end-user financing include

developing tailored loan products with savings groups, using a specialised de-risking fund to lower interest rates from micro-finance institutions, and working with local banks to provide a guarantee for customers to allow collateral-free loans for people without land ownership.

Activities related to supply-side financial support include de-risking grants of a certain percentage of the product value and/or activity costs, tailored RBF designs for specific PUE technologies, and financial facilitation up to a certain percentage of the cost for marketing activities. These grant-based support mechanisms to suppliers are aimed to incentivise companies to engage in challenging markets, de-risking and leveraging commercial investment in these initiatives.

Gender equality & social inclusion

Most projects have included a component specifically focusing on gender equality and social inclusion in the provision of PUE technologies. This is done by specifically targeting women-led businesses in the adoption of PUE technologies, targeting women and vulnerable groups in awareness-raising activities as well as designing tailored financial products. Women are considered not only as beneficiaries, but women entrepreneurs are key drivers of change in energy access.

Implementation phase



- For TA interventions, focus on the needs of MSMEs and smallholder farmers adopting PUE, provide them with tailored TA and continued support and monitoring after the adoption of PUE products.
- Combine awareness-raising activities with a product offering that is accessible through financing.
- Develop attractive financial products and loans tailored to PUE and use guarantee funds to reduce interest rates and collateral requirements.
- Tailor financial facilitation and incentives to specific PUE products/technologies to increase effectiveness.
- Integrate an assessment of PUE for woman-led businesses and vulnerable groups in the project inception and implementation phase to understand which productive uses can benefit these groups most and by conducting targeted awareness raising.
- Sensitise public stakeholders on benefits and need for policy framework to stimulate PUE.
- Adapt activities addressing the enabling environment to country contexts and coordinate efforts with local and international sector associations.



Enabling environment

The enabling environment is identified within most of the projects as a key element of the implementation phase. Activities related to the enabling environment include training of government officials on PUE technologies and benefits, advising on tariff setting for mini-grids, advising local government on how to adopt policies for PUE promotion, supporting the development of quality standards, advising on tax regulations and/or setting up an industry association.

» Energy is a prerequisite for economic development but just one of the inputs. Families need income generating processes. It is important to tie PUE technology access to market systems development.«



CASE: ENERGIA

ENERGIA is the International Network on Gender and Sustainable Energy, hosted by Hivos. ENERGIA runs several programmes, including the Empowering Women Engendering Energy programme (EWEE). This programme, supporting women's entrepreneurship in PUE, is being implemented in Senegal, Nepal, Kenya, Nigeria and Tanzania and funded by SIDA and ADB. The enterprises run by these women range from those that use standalone solutions such as solar fridges and solar water pumps, to businesses enabled by grid extension, such as livestock, agriculture and production.

A key success factor is the holistic approach of the programme, which includes an exit strategy and looks at both supporting entrepreneurs and creating an enabling environment. The programme aims at creating an ecosystem for women entrepreneurs to adopt PUE technologies by including technical assistance and looking at broader value chains, reverse logistics, after-sales service and E-waste.

Lessons learned are a need to focus more on scalability, standardising learnings, develop financing schemes to support micro-enterprises to scale up and better integrate PUE in the project design.



3.2.4 Monitoring & Evaluation

Observations

The most common **approach for project monitoring** is a quarterly reporting cycle. Most projects report on generic indicators demanded by donors as in energy access projects related to number of units sold, jobs created and generated capacity. There is not a standardised set of indicators to measure PUE (see 5.2.1). Some projects realised at a later stage that the Monitoring & Evaluation (M&E) did not sufficiently capture measurement of PUE. Others have integrated a component on data collection on socio-economic indicators through baseline and mid-term surveys.

Defining (measurable) objectives for PUE is often considered to be challenging as there is not one standard indicator for measuring productivity. Also, data collection processes for measuring increased income or additional jobs can be costly and time intensive. At the same time common indicators used by donors (quantity of products sold; people reached) are not designed to measure productive uses.

» Good data is essential for developing the market, the more robust the data sets the better it can help build the ecosystem«

Data collection on socio-economic indicators requires a structured process over a longer period. Collecting customer data with mobile-based tools next to standard sales verification processes allows for insights on socio-economic impacts to be collected on a rolling basis. This can provide opportunities for more detailed analysis and contribute to the development of the PUE ecosystem. Possible indicators to measure PUE can be:

- Income: income or revenue change from the end-user related to the PUE application over a period
- Product usage: remote monitoring of energy use of the PUE product
- Efficiency increase: time spent on certain (end-user) business activities
- Output: increase of specific (agricultural) outputs over a period
- Sustained use: verifying product use over a longer period
- Reduction of workload: work hours spent on production from adopting PUE

When assessing **project performance** against targets, specifically projects targeting specific groups and adopting a value chain approach struggle to perform. Supply side & technology projects (such as R&D and RBF projects) are the exception and are performing well against targets as there is a lot of interest in these funds and even over-subscription. The low performance of projects can be explained by too high expectations from a nascent market and/or targets that are based on the dynamics of the energy access market. Additionally, the COVID-19 pandemic makes it more challenging to work with private sector companies and has reduced customers' ability to pay. The over-subscription in R&D and RBF projects shows that the PUE market has a need for funding support to develop and test new innovations and test them in the market.

» Productive use of energy
is a learning journey.
We must learn from failures.«

Monitoring & Evaluation

- More sharing of knowledge and best practices among implementing organisations on how to measure PUE.
- Work with research organisations or working groups to help define tailored indicators for measurement of PUE and share with a wider audience to stimulate standardisation.
- Conduct a comprehensive baseline and impact survey to keep track of socio-economic development.
- Collect customer data with mobile- and cloud-based tools (e.g. customer-anonymous product usage data through product embedded sensors) next to standard sales verification processes for a more detailed analysis of PUE impact.

CASE: Global LEAP Results-based Financing

The Global LEAP+RBF is implemented by CLASP and aims to catalyse the uptake of high quality super-efficient appliances by 1) lowering the cost to procure large volumes of best-in-class off-grid appliances for early mover off-grid solar companies, and 2) facilitating new business partnerships for appliance suppliers that have invested in the production of high-quality off-grid appliances.

The M&E process in this project creates a dynamic platform for consumer, market, and impacts research. Through a series of telephone, in-person and SMS interviews, Global LEAP+RBF leverages the verification process conducted by an independent 3rd party verification agent to not only verify that consumers have purchased an eligible appliance, but collect additional information on how these appliances are being used and their impact on end-consumers lives. To date, the programme has completed more than 4,000 robust consumer surveys with end-users of off-grid appropriate TVs, fans, refrigerators and solar water pumps in East Africa, Zambia, Senegal and Bangladesh.

In Africa, this work has primarily been implemented in partnership with 60 Decibels. The process typically involves baseline phone interviews – conducted within 4 weeks of purchase and follow up interviews with the same customers 3-4 months later. Data collected through this process helps deepen the understanding of these nascent technologies and can be used by a variety of stakeholders: manufacturers to improve R&D, distributors to better target and serve customers, financiers to create better suited end-user financing packages, impact investors in gaining confidence with their investments. Longitudinal insights from customers who have owned their products for over a year, will soon be available on the programme website.

Learn more: efficiencyforaccess.org



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3.3 PUE success factors and challenges

Within the project mapping, the EnDev implementing organisations were asked what they consider to be general success factors and challenges for the PUE promotion projects in their portfolio. Challenges mentioned by some were addressed by others and mentioned as key success factors. The key challenges and success factors mentioned have been mapped and categorised in four themes, as visualised in Figure 4.

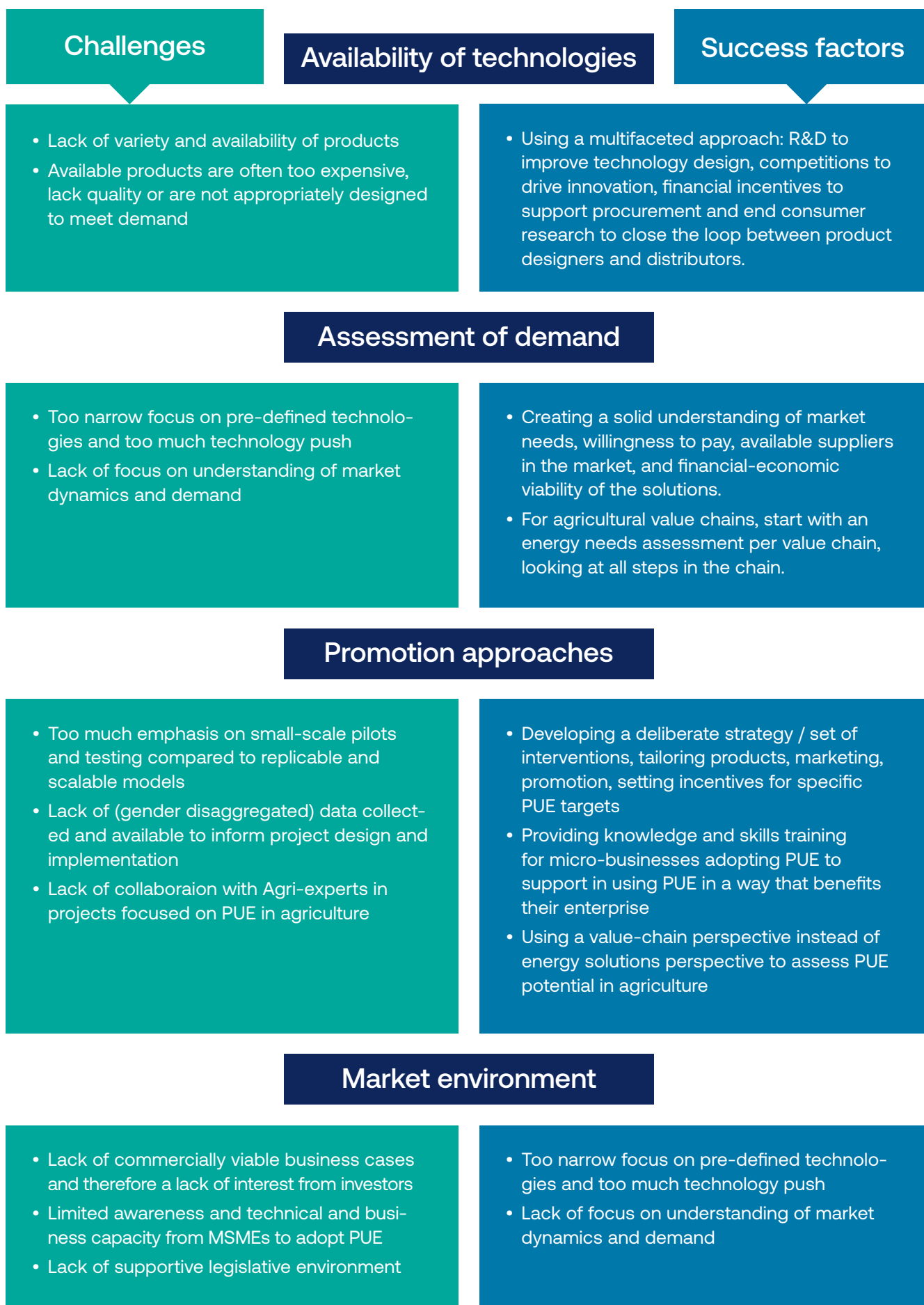
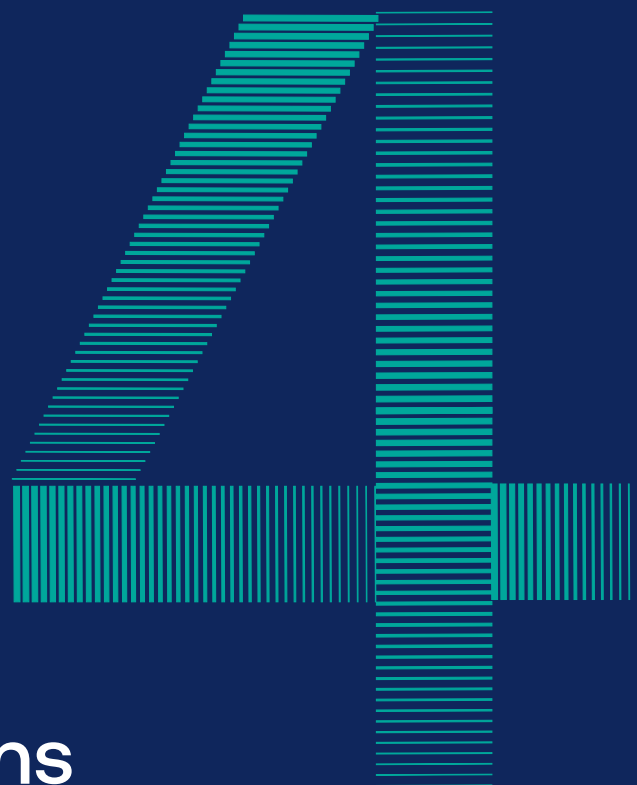


Figure 4: Key challenges & success factors



Discussion & Recommendations

4.1 PUE ecosystem approach

The project mapping and interviews identify several key challenges and success factors experienced in PUE promotion projects. The key challenges experienced in projects that focus on specific groups, value chains or PUE as one element are: lack of availability of appropriate products and business cases, and lack of an enabling market environment to facilitate the scaling of PUE. Some of the key success factors identified are a detailed analysis of demand, an integrated market development approach, continued support to MSMEs and farmers adopting PUE and detailed monitoring through adoption of tailored PUE indicators.

Enabling market growth	Stimulating demand			Increasing supply
Focus on policies, regulations and monitoring	Targeting specific groups	Value chain approach	PUE as one element in broader approach	Focus on supply side & technology
<ul style="list-style-type: none"> • Quality standards • Enabling environment • Impact measurement 	<ul style="list-style-type: none"> • (Woman-led) MSMEs • Communities/villages • Smallholder farmers 	<ul style="list-style-type: none"> • Agriculture • Aquaculture 	<ul style="list-style-type: none"> • Energy access projects • RBF programs 	<ul style="list-style-type: none"> • R&D grants • BD support • Consumer research

Figure 5: Extended PUE project categorisation

The analysis shows that from a broader perspective, PUE promotion requires support to enable market growth, stimulate demand and increase supply. Building on the project categorisation from 4.1.2, Figure 5 shows how different project categories are linked to the different intervention levels. This analysis did not include projects in the category ‘enabling market growth’, but this element is key to supporting PUE scaling. Examples of activities that fall into this category are: Initiatives to develop standards for specific PUE technologies (e.g. Global LEAP awards)¹⁶, projects specifically focused on improving the enabling environment for PUE products and working groups to develop indicators to measure impacts of PUE products (e.g. GOGLA impact metrics)¹⁷.

This categorisation reflects a need for a more holistic or ‘ecosystem’ approach towards PUE promotion, as visualised in Figure 2. This model addresses key barriers from the analysis and has integrated the key success factors. It illustrates how different projects, support activities and stakeholders are strongly interlinked. Increased coordination and collaboration between stakeholders and projects are required in order to enhance and increase effectiveness and efficiency in PUE promotion.

¹⁶ <https://globalleapawards.org/>

¹⁷ <https://www.gogla.org/impact/gogla-impact-metrics>

4.1.1 Description of the PUE ecosystem approach

Through awareness of the PUE ecosystem amongst PUE stakeholders, in combination with more coordination, collaboration and learning among stakeholders, the PUE Ecosystem approach provides a basis for scaling PUE products and business cases.

To **enable market growth**, specialised organisations, initiatives and institutions can focus on quality assurance through the introduction of quality standards, testing procedures and consumer protection codes. Sector associations, NGO's and lobby groups can sensitise governments to adopt favourable policies for PUE market development. Specialised research institutions, workgroups and universities can contribute to the development of standardised M&E frameworks that allow for better measurement of productive uses. Access to finance is key to supporting early-stage PUE products and companies from the R&D phase to market introduction and scale-up. Early stage grants and RBF can be useful instruments to de-risk and unlock commercial investments.

Demand stimulation can be addressed through PUE promotion and market development projects focused on specific target groups, value chains and/or as part of broader projects. This is done through a detailed analysis of the market and by focusing on mature technologies and business cases that have the potential to scale. It is necessary to intervene on multiple levels to tackle key barriers for PUE adoption, by focusing on core capabilities and partnering with other organisations and experts.

Sustainable adoption of PUE is realised by capacity building and financial incentives that result in long-term income increase. Detailed monitoring through the adoption of tailored indicators and the use of mobile-based longitudinal data collection will facilitate the measurement of long-term socio-economic impacts of PUE adoption.

To **increase supply**, initiatives and funding focusing on research and development to improve technology and design are key. Tailored incentives, business development support and product competitions drive innovation among the private sector. Research on consumers, products and business models provides valuable information on the viability of business cases and the gaps that need to be addressed.

Figure 2: PUE ecosystem approach



4.1.2 The Ecosystem approach in practice

Increased stakeholder coordination

Increasing collaboration between more targeted projects (e.g. focusing on R&D, business support, financial incentives and/or enabling environment) can lead to more transformative impact. Following the ecosystem approach, specific fields of increased coordination between the stakeholders can be identified:

- **Linking R&D and market development:** R&D programmes mainly focus on innovation and product development and stop at the level of market entry. Market development programmes start from assessing the market for available products and suppliers. Better linking R&D and market development programmes through partnerships can bridge the gap between product development and market introduction.
- **Research and NGOs:** Specialised research institutions on PUE, like A2EI¹⁸, provide tangible data and information on viable products and business cases that can be further developed in market development programmes. Organisations like 60 Decibels¹⁹ and universities, as well as targeted programmes²⁰, work on consumer data collection and indicator development. Collaboration between market development programmes implemented by NGOs and these specialised institutions/initiatives allows expertise gaps to be filled and can improve market development programmes.
- **Local financial institutions – impact funds – banks:** While PAYGO has revolutionised the solar market, including appliances like phone chargers, TVs, barber kits and small-scale irrigation systems, a similar effect for PUE more broadly is unlikely, due to the high upfront cost of many appliances, and the variety of technologies and targeted customers. High interest rates and collateral requirements are key barriers for access to finance provided by local financial institutions. This can be solved through guarantees provided by national banks and/or specifically designed instruments to allow local financial institutions to offer tailored and more attractive loans for PUE products and appliances.



Copyright: Russell Watkins/DFID

¹⁸ <https://a2ei.org/>

¹⁹ <https://www.60decibels.com/>

²⁰ Such as <https://efficiencyforaccess.org/leia>

Multi-disciplinary project teams

Even though PUE strongly links to other sectors like agriculture, commerce and industry, often PUE promotion projects only include experts with an energy background. To increase effectiveness, PUE promotion projects must adopt multi-disciplinary teams with experts on entrepreneurship, engineers, marketing & sales, agronomy and others depending on the specific target group. This allows for better understanding of the needs of specific sectors and users, and targeted support to MSMEs, beyond the adoption of technologies only. Inclusion of experts on gender equality & social inclusion in the project design is essential to understanding the benefits of productive uses for specific groups and assess their role in scaling PUE.

Sensitisation on PUE in the development sector

Many stakeholders in government, donor and development organisations lack a thorough understanding of PUE and/or adopt a very specific definition in project development. To provoke an integrated, flexible approach in PUE promotion, these stakeholders need to be sensitised to the specifics of PUE needs and interventions.

- **Development organisations:** With more NGOs engaging in PUE promotion projects, often projects are designed and implemented as part of energy access portfolios, and later it is realised that PUE requires different approaches and teams. It is recommended for practitioners to exchange with and learn from other organisations engaged in PUE and include PUE from the start in project designs for energy access programmes.
- **Funders** are recommended to increase insights in the complexity of PUE compared to other energy access projects. Project designs need to allow for longer project periods, more flexible funding to adapt to changing market circumstances and the development of tailored PUE indicators and monitoring. Also, the success of PUE business models and products, even more than in energy access in general, can depend heavily on country contexts and each context requires a targeted approach.
- **Governments** are recommended to look at the role they play in promoting PUE, not only for rural economic development but as a general effort to improve quality of life, enhance income-generating activities and improve the commercial viability of on-grid and off-grid energy supply.



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Project designs aimed at scaling

Most PUE projects and initiatives focus on R&D, innovation and pilots. To move to more replicable models and scalable business cases, project designs should be adapted. Some recommendations for new project designs are:

- R&D + Catalytic Grants + RBF:** A project design that combines R&D grants for a specific PUE product category. Once the technology is proven, early-stage grants and RBF can be used to cover the risk for testing the product in the market, and to scale up the business. The project will include TA to support companies in market entry and scale-up.
- PUE promotion consortium:** A consortium with a research institution, data analysis partner and market development expert can test specific business cases for PUE products, testing assumptions and adapting the business case based on end-user data. New iterations of the business model can be designed during the *project until a viable model is established. The market development expert manages partnerships and supports marketing, sales and customer engagement through TA and financial incentives.
- Guarantee fund** for PUE product loans: The design of tailored financial products is key to addressing end-user affordability. High interest rates and collateral requirements are key barriers to access to finance provided by local financial institutions. A guarantee fund can be set up to allow local financial institutions to design loans without collateral requirements and reasonable interest rates tailored to a selection of PUE products and appliances.

Additional knowledge products

The increased attention for PUE has brought new insights, business cases and project approaches for which this report provides examples and learnings. Based on the consultations with the PUE community of practice, the following areas might be considered for future knowledge development:

- A new iteration of the PRODUSE manual, expanding the scope to more technologies and sectors, providing practical guidance for other types of project designs and including updated M&E frameworks & data collection procedures and investment pathways.
- More extensive desk research on the findings of publications from the various PUE initiatives as described in chapter 3.3 and linking them with the findings in this report.
- Further development of PUE promotion approaches tailored per project category, technology and/or sector/value chain, based on the lessons learned. Specifically, given the considerable potential impact in increasing productivity in agriculture, additional research should focus on analysing value chain approaches.
- Investigation into the impacts of PUE/PUE projects on gender equality and social inclusion.
- Investigation into after-sales services, quality assurance/consumer protection and operation & maintenance practices as part of PUE support projects.

4.2 Recommendations



- Increase effectiveness and efficiency in PUE promotion by applying an **'ecosystem approach'** for PUE interventions: a coordinated effort with a wide variety of stakeholders and across sectors, providing support measures to enable market growth, stimulate demand and increase supply.
- Intensify **collaboration** between complementary, targeted PUE promotion projects and engage with different stakeholders across PUE and adjacent sectors.
- Adopt **multi-disciplinary** project teams with experts from different sectors and backgrounds to increase cross-sectoral understanding and effectiveness of interventions.
- **Sensitise stakeholders** in funders, governments and development organisations on specific characteristics of PUE needs and interventions to provoke an integrated, flexible approach in PUE promotion and to ensure inclusion of PUE in project designs for energy access programmes from the start.
- Tailor PUE project designs towards **scalability**, aiming at replicable models and scalable business cases.
- Further enhance **learning** on successful PUE promotion approaches by developing targeted knowledge products and facilitate exchange in a Community of Practice of PUE practitioners.



Annex

5.1 PUE definitions

Standardised definitions from several researchers and institutes on Productive Use of Energy²¹:

- The World Bank paper on Productive Uses of Renewable Energy (2004) defines productive uses of energy as activities »that involve the utilization of energy – both electric and non-electric energy in the forms of heat, or mechanical energy – for activities that enhance the income and welfare in rural contexts. These activities are typically in the sectors of agriculture, rural enterprise and education«²².
- Jose Etcheverry defines productive use promotion projects as projects that »aim at enhancing income generation opportunities and productivity in rural areas [...] to improve quality of life and increase local resilience and self-reliance«²³.
- Ron White suggests a different and more narrow definition: »Activities that involve the application of energy [...] to create goods and/or services either directly or indirectly for the production of income or value. The production of income or value is understood to be achieved by selling products or services at greater than their cost of production, resulting in an increase in the net income of the enterprise or the entrepreneur«²⁴.
- The PRODUSE manual (2011) defines productive uses of electricity as »agricultural, commercial and industrial activities involving electricity services as a direct input to the production of goods or provision of services«²⁵.
- More recently IFC's PULSE report adopts a narrower definition for PULSE (Productive Use Leveraging Solar Energy): »any agricultural, commercial, or industrial activity that uses solar energy as a direct input to the production of goods or provision of services«²⁶.

Definitions derived from the project mapping and used by EnDev implementing organisations:

- PUE is: Agricultural, commercial and industrial activities involving energy services as a direct input to the production of goods or provision of services.
- Productive uses of energy are those uses of energy that increase income or productivity.
- A productive use of energy facilitates income generating activities and improves overall business climate.
- Initiatives to promote sustainable energy access through the promotion of technology that can support livelihoods.
- PUE is defined as any income generating activity involving electricity or thermal energy as a direct input in the production of goods or provision of services.
- Energy that facilitates income generating activities and improves overall business climate. Any use of energy that contributes toward education, health, and gender equity should also be considered a productive use of energy.
- Productive uses of energy: Use of energy for income generation (in formal and informal enterprise).

21 https://energypedia.info/wiki/Productive_Use_of_Electricity

22 KAPADIA, K. (2004): Productive Uses of Renewable Energy: A Review of Four Bank-GEF Projects. January 2004 draft version. Washington, D.C.

23 ETCHEVERRY, J. (2003): Renewable Energy for Productive Uses: Strategies to Enhance Environmental Protection and the Quality of Rural Life. Toronto.

24 WHITE, R. (2003): GEF-FAO Workshop on Productive Uses of Renewable Energy –Synthesis and Report. Washington, D.C.

25 RÜDERLE, A./ATTIGAH, B./BODENBENDER, M. (2011): Productive Use of Energy (PRODUSE) – A Manual for Electrification Practitioners, GIZ and EUEI PDF, Eschborn.

26 IFC PULSE report, 2019. <https://www.lightingglobal.org/wp-content/uploads/2019/09/PULSE-Report.pdf>

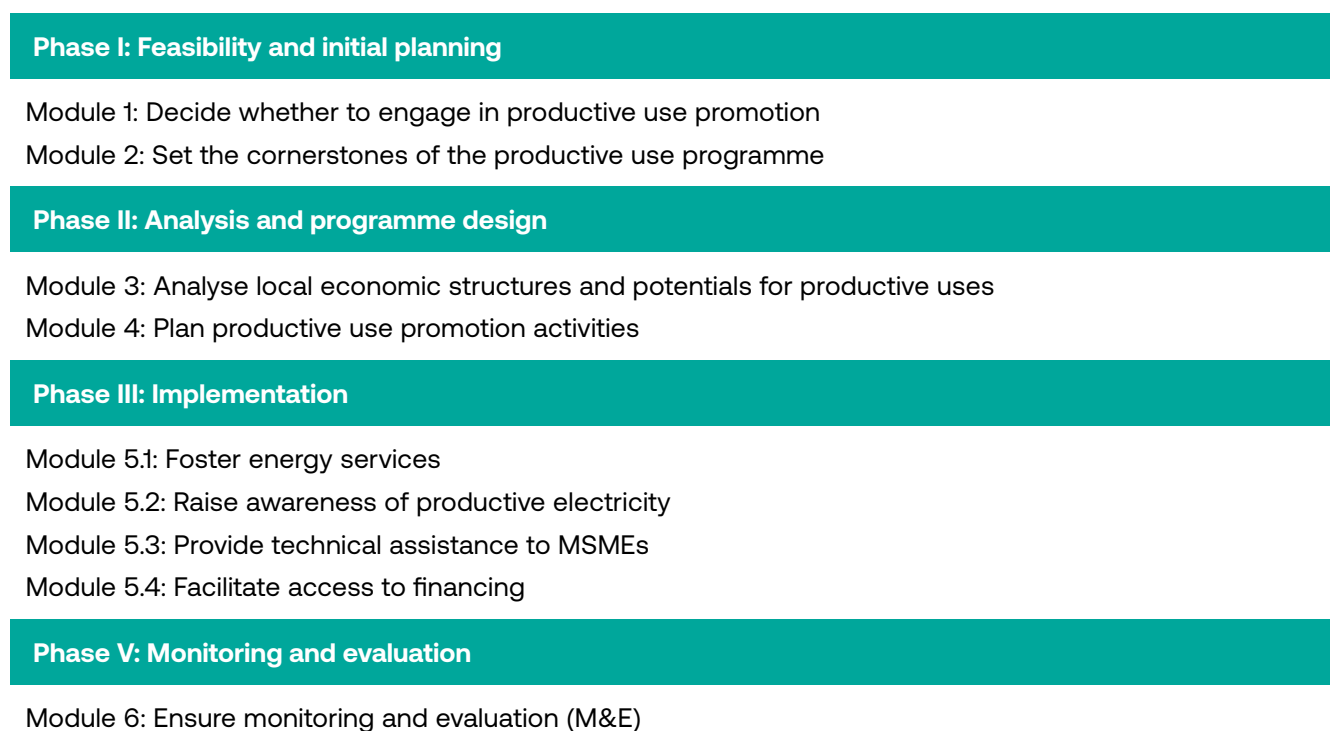
5.2 PRODUSE Manual

- Activities that involve the utilization of renewable energy – both electric, and non-electric energy in the forms of heat, or mechanical energy – for activities that enhance income and welfare. [In rural contexts] these activities are typically in the sectors of agriculture, rural enterprise, health and education.
- Activities “that involve the utilization of energy – both electric, and non-electric energy in the forms of heat, or mechanical energy – for activities that enhance income and welfare. [In rural contexts] these activities are typically in the sectors of agriculture, rural enterprise, health and education.

The PRODUSE initiative, a joint initiative from ESMAP, AEI and GIZ on the interaction of energy access and productive activities²⁷, developed a toolkit and manual that provides energy practitioners with step-by-step guidance for designing and implementing productive use of energy activities in electrification programmes. The PRODUSE manual is used as the basis for the qualitative analysis in this report.

The manual is structured according to a generic project cycle, with six modules that describe practical tasks (Figure 6). The modules in the PRODUSE manual are translated into qualitative questions that inform how various approaches are designed, which components are considered key success factors and where challenges and/or gaps lie.

Figure 6: PRODUSE PUE project modules



²⁷ <https://www.produce.org/>

5.3 Interview questions

Intro

- Quick check on project name, duration, geographical scope
- What is your role within this project and how long have you been part of it?
- How many people are part of the project team?
- How does the project define productive use of energy?

Feasibility and initial planning

Decision to engage in PUE promotion

- What was the process of determining the case for developing a PUE promotion project, or including PUE as an intervention area in the project?
- How did the project collect evidence on the need for PUE promotion?
- What did the project do to avoid duplication? (mapping of existing initiatives and stakeholders, stakeholder consultation)

Setting the cornerstones of the project

- What objectives did the project define within the project design? (economic, social development, special focus on specific groups, agriculture-related targets, gender)
- What types of productive uses were identified that help achieve the defined objectives?
- How did the project define the scope of interventions and why? (horizontal vs. vertical scope, narrow vs. wide scope)
- If applicable, how and when was the mapping conducted of existing PUE support programmes?

Evaluation

- What do you consider to be success factors in the planning phase?
- In retrospect, what components have been missing in the planning phase which could have improved the project design and/or outcomes of the project?

Analysis and programme design

Analyse local economic structures and potential for PUE

- If applicable, what steps were taken by the project to analyse existing economic activities in the target area?
- If applicable, what steps were taken by the project to generate new business ideas for productive use of energy?

Plan productive use promotion activities

- What are the key bottlenecks identified for promoting PUE?
- Which activities were planned in the initial stage?
- What partnerships with other implementers or stakeholders were identified for implementing the project?
- How replicable are the PUE opportunities identified?

Evaluation

- What were the success factors in the analysis and programme design?
- In retrospect, what components have been missing in the analysis and design phase which could have benefitted the implementation phase and outcomes?

Implementation

Energy service providers

- Were energy service providers (SHS companies, mini-grid, grid utility) involved in the project to promote PUE? (as technology facilitator, awareness raisers, financiers, recipient of project support)

Technical Assistance

- If applicable, how is the TA component designed and implemented? (assessment of training needs, training strategy, designing training course)

Awareness-raising

- If applicable, how is the awareness-raising component designed? (defining target group, defining messaging, selecting communication channels)

Access to finance

- If applicable, how is the Access to Finance component designed and implemented? (Assessing hurdles for loan applications, identifying existing lending programmes, advising how to improve access to loans, monitoring loan performance. In the case of RBF, RBF design, incentive size and conditions, disbursement cycle)?

Co-financing

- If applicable, how is the co-financing component designed and implemented?

Gender

- If applicable, how is the gender component designed and implemented?

Enabling environment

- If applicable, how is the enabling environment component designed and implemented?

Evaluation

- What were the success factors in the analysis and programme design?
- In retrospect, what components have been missing in the analysis and design phase which could have led to better reaching the objectives?

Monitoring and evaluation

- How was the monitoring and evaluation cycle designed and which objectives and measurable indicators were identified? (Socio-economic indicators like income change, employment increase, consumption of goods, an increase of existing business, increased yields for farmers)
- What data collection was done? (Baseline data, monitoring of capacity building achievements, changes in the regulatory framework. Quantitative, qualitative, how many reporting cycles?)
- How has the project been performing compared to targets?
- Is there a mid-term or end evaluation report that you could share, or monitoring data?

Evaluation

- What were the success factors in the monitoring and evaluation design?
- In retrospect, what impact indicators and/or process components have been missing in the monitoring & evaluation phase which could have led to better measurement of the objectives reached?

Enabling environment

- If applicable, how is the enabling environment component designed and implemented?

Evaluation

- What were the success factors in the analysis and programme design?
- In retrospect, what components have been missing in the analysis and design phase which could have led to better reaching the objectives?

Closing

- What would you advise your organization to focus on more in future PUE projects?
- How has COVID19 impacted the project?
- Anything else you want to share?

5.4 Project list

Organization	Project name	Location	Primary Category	Interview details
GIZ	Energising Development – Clean cooking in Ethiopia	Ethiopia	Value chain approach	27/8/2020 – David Ochieng Otieno, Samson Tolessa, Florent Eveille
GIZ	Energising Development-Productive Use of Energy Component (PUEC)	Bolivia	PUE as one element in broader approach	25/8/2020 – Juan Arevalo, Florent Eveille, Philipp Waigel
AVSI	Productive use of energy in Kitobo Island, Uganda	Uganda	Targeting specific groups	11/8/2020 – Anna Benetello, Francesca Oliva
AVSI	ILUMINA – E2COM Cabo Delgado – Energia para o Empoderamento Comunitário das Mulheres	Mozambique	Targeting specific groups	11/8/2020 – Anna Benetello, Francesca Oliva
Practical Action	Green Mini-Grid facility	Kenya	PUE as one element in broader approach	10/8/2020 – Gerard Hendriksen, Jechoniah Kitala
Practical Action	Strengthening the Capacity of the Energy Sector to deliver gender equality and social inclusion results	Nepal	Targeting specific groups	4/8/2020 – Pooja Sharma, Bibek Shreshta, Judith Sanchez
SNV	Climate Resilient Agriculture for Tomorrow (CRAFT)	Kenya, Uganda, Tanzania	Value chain approach	6/2/2020 – Jacob Etunganan
SNV	EnDev phase III – Productive use of solar sub-project	Kenya	PUE as one element in broader approach	5/8/2020 – John Ngigi
CLASP	Global LEAP RBF	Bangladesh, Kenya, Tanzania, Rwanda, Uganda, Zambia, Senegal	Focus on supply side & technology	12/8/2020 – Nyamolo Abagi
HIVOS	ENERGIA programme	Senegal, Nepal, Kenya, Tanzania	Targeting specific groups	17/8/2020 – Remco van Stappershoef

5.5 EnDev Learning & Innovation Agenda – PUE Community of Practice

Name	Organisation	Name	Organisation
Rita Bachmann	ADES	Chih-Jung Eva Lee	GIZ
Francesca Oliva	AVSI	Samo Teddy Miller	GIZ
Jacopo Guerini	AVSI	Samuel Alemu	GIZ
Jeff Stottlemeyer	CLASP	Fred Marree	HIVOS
Nyamolo Nabagi	CLASP	Remco van Stappershoef	HIVOS
Makena Ireri	CLASP	Cecilia Ragazzi	Mercy Corps
Chris Beland	EST	William Brent	Power for All
Richa Goyal	EST	Judith Sanchez	Practical Action
Catoer Wibowo	GIZ	John Chettleborough	Practical Action
Walter Kipruto	GIZ	Pooja Sharma	Practical Action
Pia Hopfenwieser	GIZ	Bianca van der Kroon	RVO
Tolessa Samson	GIZ	Charlotte Panhuyzen	RVO
Razvan Dimutru Sandru	GIZ	Merijn Havinga	SNV
Maria Fischer	GIZ	Constanze Windberg	SNV
Gift Chunda	GIZ	Jacob Etunganan	SNV
Afoudji Ehemba Mireille	GIZ	Theo Sand	SNV
Mariana Butron Oporto	GIZ	Rianne Teule	SNV
Daniel Fuchs	GIZ	Susanne Hounsell	SNV
Andrea Reikat	GIZ	Inga Brill	SNV
Alexander Haack	GIZ	John Ngigi	SNV
Raya Kuehne	GIZ	Vandana Thottoli	SNV
Juan Arévalo	GIZ	Victor Gathogo	SNV
Ratan Kumar Gosh	GIZ	David Wanyoike	SNV
Florent Eveille	GIZ	Sascha Flesch	SNV
Selen Costa Kesrelioglu	GIZ	Peace Kansime	SNV
Mansour Sow	GIZ	Martin van Dam	SNV
Birane Kebe	GIZ	Javier Ayala Arnez	SNV
Khadim Bakhoun	GIZ	Pedro Moleirinho	SNV
Ahmadou Diop	GIZ	John Mlay	SNV
Johanna Banken	GIZ	Martijn Veen	SNV
Flora Tuyizere	GIZ	Subash Dhakal	SNV
Erik Iwan-Rescheleit	GIZ	Brian Bonsuk Koo	WB/ESMAP
Clarisse Akoua Kangnivi	GIZ	Juliette Besnard	WB/ESMAP
Johannes Hertlein	GIZ	Raluca Georgiana	WB/ESMMAP
Kedir Adem	GIZ	Maarten Kleijn	WFP
Philipp Waigel	GIZ		

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