Horizon 2020 Programme

LEAP-RE

Research and Innovation Action (RIA)

This project has received funding from the European Union's Horizon 2020 research and innovation programme under grant agreement No 963530

Start date : 2020-10-01 Duration : 72 Months
http://www.leap-re.eu/

LEAP-RE
Long-Term Joint EU-AU Research and Innovation Partnership on Renewable Energy

Guidelines of the methodology for defining business and delivery models of mini grid

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LEAP-RE - Contract Number: 963530

Project officer: Maria-Laura TRIFILETTI

Document title	Guidelines of the methodology for defining business and delivery models of mini grid
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Number of pages	16
Document type	Deliverable
Work Package	WP13
Document number	D13.7
Issued by	LUT
Date of completion	2025-11-05 11:18:19
Dissemination level	Public

Summary

The report was developed as part of the research activities of the Sustainable Energy Transition and Digitalization of Smart Mini-Grids for Africa (SETaDiSMA) work package of the LEAP-RE project. SETaDiSMA aims to tackle the African mini-grid sector, addressing technological and energy planning challenges, digitalization research and development and related capacity building. The work focuses on case studies in Kenya and Rwanda. This report is part of SETaDiSMA's Task 13.3 - Business Models and Socio-Economic Contexts, constitutes deliverable D13.7 - Guidelines of the methodology for defining business and delivery models of mini-grid. Building on the theoretical foundation presented in Deliverable D13.6 - Evaluation methodology and selection of Best Practices for business and delivery models of mini-grid, this report offers practical guidelines for addressing the key themes of the methodology for defining business and delivery models of mini-grid. These guidelines focus on considerations for designing business and delivery models, tariff-setting strategies, and approaches to integrating inclusive actions within the mini-grid ecosystem.

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LEAP-RE

Long-Term Joint EU-AU Research
and Innovation Partnership on Renewable Energy

Research & Innovation Action

D13.7 - Guidelines of the methodology for defining business and delivery models of mini-grid

This deliverable will report the D13.7 - Guidelines of the methodology for defining business and delivery models of mini-grid. This is the second report of Task 13.3.

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Disclaimer

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Document information

Grant Agreement	963530
Project Title	Long-Term Joint EU-AU Research and Innovation Partnership on Renewable Energy
Project Acronym	LEAP-RE
Project Coordinator	Vincent Chauvet – LGI
Project Duration	1st October 2020 – 30 September 2026 (72 Months)
Related Work Package	WP13 - SETADISMA
Related Task(s)	T13.3
Lead Organisation	LUT
Contributing Partner(s)	Polimi
Due Date	31/10/2024
Submission Date	02/10/2024
Dissemination level	Public

History

Date	Version	Submitted by	Reviewed by	Comments
02/10/2024	1	Anti Pinomaa	Riccardo Mereu	
19/11/2025	2	Anti Pinomaa	Mathilde Videlo	Upon PO request

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Abbreviations and Acronyms

Acronym	Description
ABC	Anchor-business-community
ATP	Ability to pay
BOO	Build-own-operate

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CAPEX	Capital expenditure
DBOM	Design-build-operate-maintain
DRP	Demand-response program
DSM	Demand-side management
EPC	Engineer-procure-construct
ESCO	Energy service company
F&O	Financing and ownership
GOVT	Government
LCOE	Levelized cost of energy
NGO	Non-governmental organisations
O&M	Operation and maintenance
OPEX	Operating expenditure
PPP	Public-private-partnership
PUE	Productive use of energy
SDG	Sustainable development goals
UM	Utility model
WTP	Willingness to pay

1. Introduction

The business model concept is critical in determining the success and sustainability of ventures, offering a strategic structure that helps organizations create, deliver, and capture value [1], [2]. This is especially important in rural electrification projects, where the primary value lies in energy services such as generating and distributing electricity to under-served communities [3]. These services are vital for economic growth, providing significant benefits to project developers, facilitators, and residents.

For off-grid, self-sustaining energy systems, financial viability depends on a well-crafted business model that ensures energy access is both affordable and reliable for local communities [4]. Success in such projects hinges on both technical and

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commercial factors. On the technical side, the system must be efficient, reliable, and high-performing, while commercial success relies on revenue generation, cost control, and profitability. Customized approaches to mini-grid solutions must address the specific socio-economic and technological needs of each region. This includes considering ownership models, financial strategies, and promoting the productive use of energy (PUE) to foster local economic activities and community development [5].

Inclusive business models play a crucial role in rural electrification, particularly within mini-grid systems [6], [7]. These models aim to involve economically disadvantaged groups by addressing unmet needs and integrating them into the energy value chain. By fostering local ownership, encouraging demand-side management (DSM), and supporting entrepreneurship through value-added services, inclusive business models ensure that rural electrification not only powers communities but also boosts local economic development. These models help resolve the inherent challenges between financial profitability, technological efficiency, and socio-economic impact, allowing energy providers to generate revenue while improving the quality of life for local populations.

Additionally, the delivery model in mini-grid development outlines how the system is set up and operated, addressing essential questions such as who owns the assets, who is responsible for installation, and who manages ongoing investments [3], [8]. These aspects can be handled by private entities or through partnerships, with ownership and operational models playing a significant role in the long-term viability of the projects.

Building on the theoretical foundation presented in Deliverable D13.6 - *Evaluation methodology and selection of Best Practices for business and delivery models of mini-grid*, this report offers practical guidelines for addressing the key themes of the methodology for defining business and delivery models of mini-grid. These guidelines focus on considerations for designing business and delivery models, tariff-setting strategies, and approaches to integrating inclusive actions within the mini-grid ecosystem.

2. Business model design overview

To design an effective business model, developers must first understand their customers, their types, and their specific needs. They should tailor services according to these needs, considering customers' willingness to pay (WTP) and ability to pay (ATP). As illustrated in Figure 1, it is crucial to balance the cost of providing energy services with the revenue generated from various streams, such as electricity sales, additional energy services, and productive use of energy activities. Additionally, developers should seek partnerships to gain access to technical, financial, and operational support, while also collaborating with local governments (GOVT) and non-governmental organisations (NGOs) to enhance their business activities and foster growth.

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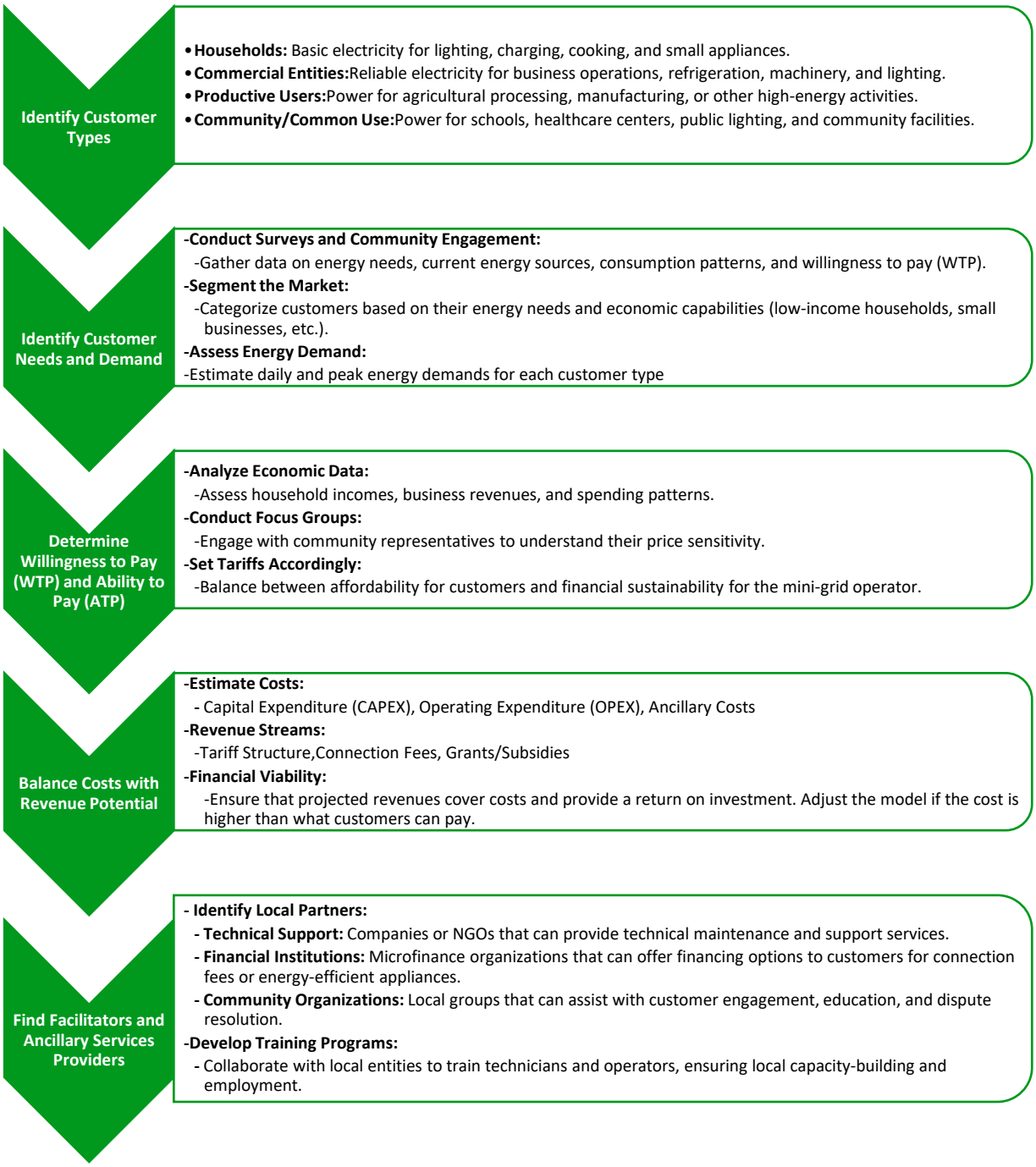

Figure 1. Mini-grid business model design process.

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3. Delivery models

A delivery model outlines how mini-grids are installed and operated, answering key questions like who owns, delivers, and installs the assets, as well as who is responsible for their replacement or expansion [8]. Ownership and operation can be managed by the private sector or through partnerships with other entities. Since there is no one-size-fits-all approach to selecting a delivery model, various factors and options must be considered. Table 1 provides a matrix of appropriate models based on different criteria to assist in the decision-making process.

Table 1. Criteria for delivery models.

Criteria	Utility Model (UM) / EPC	DBOM / ESCO	PPP - Split Asset Model	PPP - Management Model	BOO / Private with CAPEX Grant	Cooperative Model
Best Used When	GOVT wants full control and operation	GOVT owns assets but private sector manages operations	GOVT wishes to share responsibility with private sector	GOVT builds, private sector operates	Private sector-led with GOVT support	Community-driven projects with local ownership
Ownership of Assets	GOVT / National Utility	Government (GOVT)	GOVT (Distribution) Private (Generation)	GOVT	Private	Community Cooperative
Operation Responsibility	Utility	Private / Cooperative	Private	Private	Private	Community / Third Party
Financing Responsibility	GOVT	GOVT finances, Private operates	GOVT finances distribution, Private finances generation	GOVT	Private with GOVT CAPEX grant	Community or External Financing
Tariff Setting	Utility / GOVT controlled	Operator with GOVT OPEX support	Operator with mix of GOVT and private inputs	Operator collects revenue, may involve leasing	Operator (with subsidies)	Cooperative sets tariffs
Government Control Level	High	Medium	Medium	Medium	Low	Varies (depends on out-sourcing)
Subsidy Type	CAPEX by GOVT	OPEX grants and tariffs	Mix of CAPEX and OPEX grants	Primarily OPEX or contractual payments	CAPEX grant	Varies (may include external grants)

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Examples of implementation	National utilities in developing countries	Rural electrification in partnership with private firms	Hybrid setups where the government focuses on distribution	Private sector manages rural grids built by GOVT	Off-grid solutions with private investment	Community micro-grids in remote areas

4. Incorporating PUE in mini-grid projects

Productive use of energy (PUE) plays an essential role in enhancing the sustainability of mini-grids and fostering economic development in rural areas [9]-[11]. By supporting energy-driven economic activities, PUE helps communities generate additional income while reducing dependence on less efficient energy sources such as diesel generators. It also tackles the challenge of low electricity demand, reduces the levelized cost of electricity (LCOE), and balances load distribution. As outlined in Deliverable 13.6, the business model for PUE has evolved beyond basic electricity supply to include financing options for PUE equipment and the creation of value chains, positioning mini-grid operators as key contributors to local economies.

- *ABC Strategy (Anchor—Business—Consumers):*
  - Start by securing a reliable anchor client (e.g. telecom towers) to create a stable and predictable demand for electricity.
  - Foster and support local businesses to establish a steady demand for electricity, encouraging economic development within the community.
  - Expand services to residential customers, though these customers alone may not ensure financial viability.
  - Integrating essential services like health centers or cold storage facilities can improve the mini-grid's financial and environmental performance by reducing unit costs and emissions.
- *Transition to a Diversified Customer Base:*
  - Shift away from dependence on a single anchor client, as their strong bargaining power can erode profit margins.
  - Focus on identifying customers who account for majority of energy consumption and revenue.
  - Tailor services to meet the specific needs of these high-value customers to ensure sustainable growth and profitability.
- *Business Acceleration Model:*
  - Offer financing solutions, such as lease-to-own schemes, to enable rural customers to acquire PUE appliances, thereby boosting energy consumption and economic activity.
- *Supplier-Off-taker Model:*
  - Mini-grid operators can actively create or support local industrial activities based on regional resources, such as ice production for fishermen or agricultural processing.

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5. Exploring strategic approaches

5.1 Promoting inclusivity

To ensure that the electrification of marginalized communities through mini-grid development is beneficial, an inclusive business strategy should focus on promoting economic opportunities, local ownership, and sustainability [7]. Inclusivity must be embedded in the mini-grid business model, involving community participation in both value-creation and value-capture systems [6]. Below are some key inclusive actions that can be integrated into the mini-grid ecosystem:

1. *Value Creation System*: In mini-grid development, the value creation system involves the processes developers use to deliver sustainable energy and related services. Community involvement can enhance inclusivity and ensure long-term project success. Here are examples of inclusive actions to support mini-grid value creation.
    - *Power Generation and Energy Storage as a Service*: Community members can contribute to power generation and energy storage capacity through service agreements, enhancing system flexibility and providing income opportunities.
    - *Demand Response Programs (DRPs)*: Engaging users in demand-side management (DSM) helps reduce electricity consumption during peak times, offering financial benefits and stabilizing the grid.
    - *Operation and Maintenance (O&M)*: Training residents to manage and maintain the mini-grid fosters job creation and ensures the sustainability of the system.
    - *Financing and Ownership (F&O)*: Encouraging community involvement in financing and ownership, such as through cooperatives or local businesses, promotes shared responsibility and reduces risks for investors.
2. *Value Capture System:* The value capturing system of mini-grid projects focuses on the economic benefits generated by the business model, where stakeholders engage in productive activities. To maximize value capture, community involvement is key, achieved through local entrepreneurship, revenue-sharing, productive use of energy, and value-added processing.
    - *Local Entrepreneurship*: Supporting local entrepreneurs through tailored training programs helps to build a self-sustaining business ecosystem around the mini-grid, promoting long-term economic development.
    - *Revenue-Sharing Mechanisms*: Establishing revenue-sharing agreements with communities ensures equitable distribution of economic benefits, fostering local investment in the project.

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- *Productive Use of Energy (business acceleration model)*: Encouraging the productive use of energy, such as for agriculture or small-scale industries, enhances local economic activity and development.
- *Value-Added Processing (supplier-off-taker)*: By supporting local entrepreneurs in value-added activities, such as processing agricultural products, mini-grid projects can significantly boost economic opportunities and social development.

These actions aim to integrate inclusivity into the mini-grid framework, ensuring that the electrification process benefits all stakeholders and promotes long-term sustainability.

5.2 Assessing cost reduction strategies

Mini-grid developers may explore various approaches that could potentially reduce project costs by addressing specific cost drivers. Each approach provides distinct means to optimize operational efficiency and support long-term financial sustainability. This section highlights four promising approaches to cost reduction: The clustering approach; the franchise model; the containerized solution; and the under-the-grid model. Ultimately, the most suitable approach depends on the specific operational context. The four approaches with considerations on potential cost reduction, description, and needs are presented in Table 2.

Table 2. Approaches with potential for cost reduction [12]-[14].

Approach	Potential cost reduction	Description	Needs
Clustering approach	Transaction costs and capital overhead	Mini-grids from neighboring villages are grouped into a single operational unit, managed by designated cluster managers.	Advanced technical expertise and strong management skills to effectively manage the mini-grids as a consolidated operational unit.
Franchise approach	Management costs and economy of scale	The franchiser bears most of the management costs. This model leverages economies of scale and improves market efficiency.	Franchiser must provide training to local entrepreneurs enabling them to own and operate the mini-grid effectively.
Container model	Project development and construction costs	Reduces logistics, manufacturing and developing costs by delivering a mini-grid system solution integrated into containers, which also offer flexibility to expand when demand grow.	Careful planning of logistics as well as scalable technical expertise to ensure the system can expand.
Under-the-grid model	Distribution costs	The mini-grid provides electricity to a community that is within the reach of an existing utility distribution grid but remains underserved.	It requires a regulatory framework in place that permits the interconnection, or operation under the main distribution grid territory.

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6. Tariff setting

Setting tariffs in the mini-grid ecosystem requires careful consideration of economic, social, and environmental factors from both the developer's and consumer's perspectives. The design of tariffs must consider the local population's financial capacity, their willingness to pay and the expected costs of the electricity service. Higher tariffs improve the financial viability of microgrid projects but limit electricity access for vulnerable populations, hence creating a need to balance both objectives. One effective method for tariff setting is the use of a customer-class tariff structure, where different tariffs are assigned to distinct consumer groups such as households, institutions, and businesses [15]-[18]. This approach allows for more precise and suitable pricing, catering to the unique needs and characteristics of each group. The chart illustrated in Figure 2 provides guidelines for selecting appropriate tariff structures for mini-grids.

In addition to the above considerations and guidelines, tariff design should include the following criteria:

- *Cost-reflectivity*: Tariffs should reflect the distribution operator's cost structure and generate sufficient revenue, ensuring fairness and neutrality for all customers.
- *Neutrality for third parties*: Tariff structures should not restrict third-party operations, such as energy retailers, and should focus on maintaining the system without creating new business opportunities.
- *Incentives for efficient electricity use*: Tariffs should encourage customers to use electricity efficiently, helping to lower overall system costs through better capacity utilization.
- *Feasibility of implementation*: The tariff system must be practical, cost-effective, and compatible with current or future technologies, such as advanced metering systems.
- *Compliance*: Tariffs must not conflict with existing or future retailer tariffs and should align with third-party pricing trends.
- *Intelligibility*: The tariff structure should be clear and simple, allowing customers to easily understand how their fees are determined.

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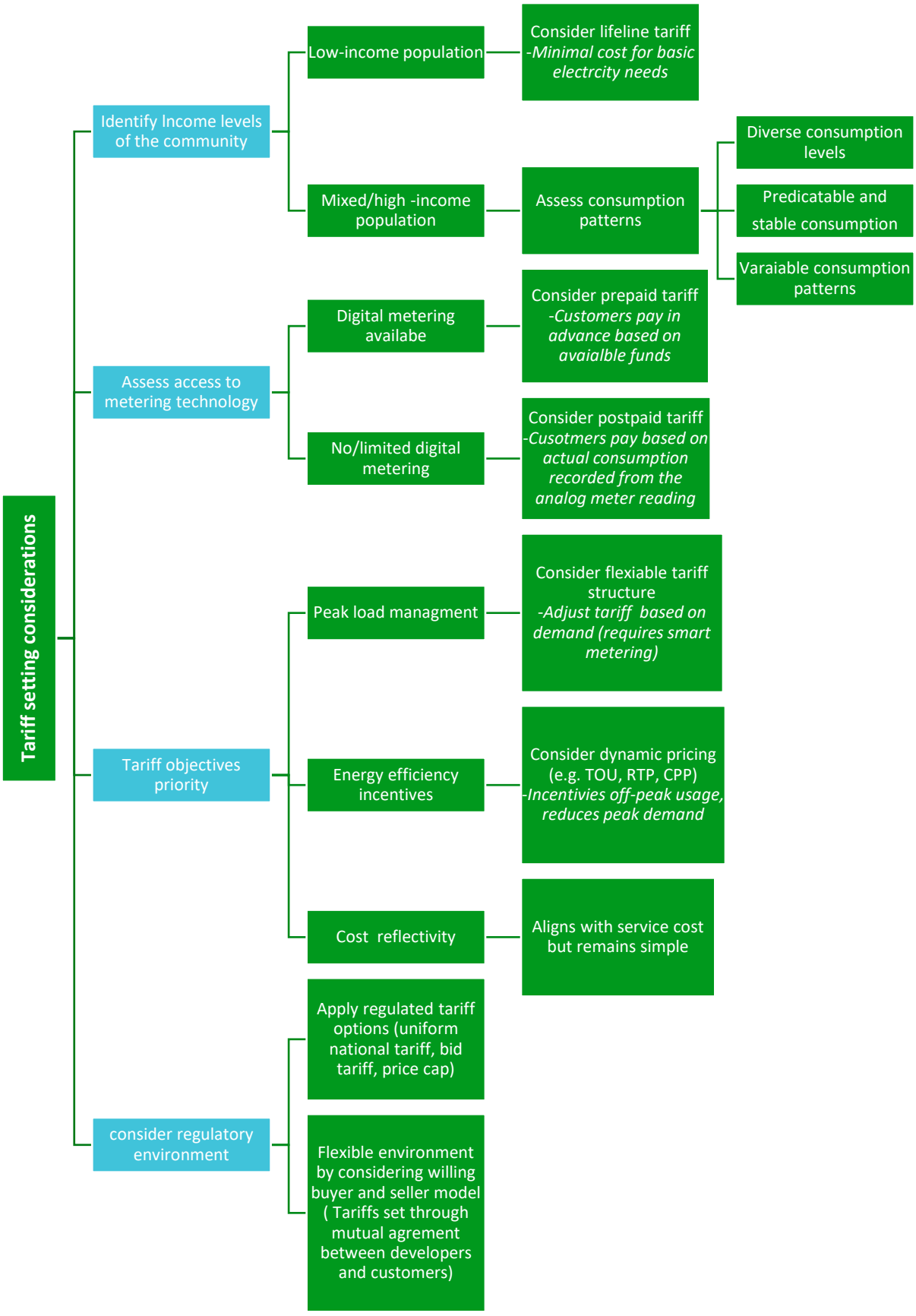

Figure 2. Mini-grid tariff design considerations.

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7. Tools for business model development

There are various business model tools that can be used to outline and reconfigure business models for the mini-grid ecosystem. For example:

- *Business Model Canvas*[1]: Consists of nine elements:
  - Key partners;
  - Key activities;
  - Value proposition;
  - Customer relationships;
  - Customer segments;
  - Key resources;
  - Distribution channels;
  - Cost structure; and
  - Revenue streams.

  It provides a comprehensive platform for analyzing and refining business models, helping entrepreneurs sketch and test their ideas quickly.

- *Value Proposition Canvas*[1]: Helps marketing experts and product owners craft value propositions that align with customer needs. Integrated with the Business Model Canvas, it is widely used by leading organizations and startups.

- *Lean Startup Canvas*[2]: An adaptation of the Business Model Canvas that focuses on breaking down ideas into key assumptions. It replaces traditional business plans with a concise model, specifically designed for Lean Startups.

- *Business Model Navigator*[3]: Explores the "who, what, how, and why" of the business. By examining business models from multiple angles and identifying key drivers, this tool supports innovation and enhances business model understanding.

[1] https://www.strategyzer.com.

[2] https://www.leanfoundry.com.

[3] https://businessmodelnavigator.com

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8. Conclusion

The aim of this deliverable is to provide comprehensive guidelines of the methodology for developing effective business models for mini-grids. It addresses practical aspects of business model design, productive-use-of-energy-focused approaches, delivery models, tariff design, and inclusiveness. These guidelines are intended to help ensure that future mini-grid projects are both technically viable and financially sustainable, while also promoting economic development in under-served communities.

The deliverable emphasizes that a robust business model is essential for the success of rural electrification projects. It should balance the technical requirements of efficient and reliable energy provision with the commercial needs of revenue generation and cost control. Additionally, effective delivery models must clarify ownership and operational responsibilities to support long-term project viability. Tariff structures must be designed to reflect the true cost of distribution while remaining fair and understandable for users.

Incorporating inclusive business practices is crucial for integrating economically disadvantaged groups into the energy value chain, promoting local ownership, and encouraging entrepreneurial activities. The use of business model tools such as the Business Model Canvas, Value Proposition Canvas, Lean Startup Canvas, and Business Model Navigator can further enhance the development and optimization of these models. These tools provide valuable frameworks for analyzing, designing, and refining business models to ensure they meet the unique needs of rural mini-grid systems and contribute to sustainable community development.

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