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Report about the outcome on scientific collaboration including Sociology and organization analysis

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Summary

In a culmination of 36 months of dedicated effort, the EURICA project (WP15) has reached its final milestone with the completion and delivery of this last project deliverable. This achievement marks the end of a journey, aimed at designing, developing, and testing two approaches to enhance the electrification and contribute to meeting the SDG7 objectives. This report provides the key messages derived from the lessons learned during the project, its accomplishments and challenges which were all thoroughly documented in previous WP?s deliverables. Involving a total of six partners, this project enabled to successfully demonstrate the technologies in two demonstration sites serving as real-world testbeds in Burkina Faso and Madagascar. By providing tangible example of technology deployment, they allowed to assess their viability and effectiveness. A SWOT analysis has been conducted in order to take a step back and gain insights into the consortium's dynamics and potential for further development. The lessons learned from these sites have laid the groundwork for future sustainable energy initiatives in Africa. Finally, a specific focus is given to the fruitful scientific collaboration between European and African partners and the actions performed over the complete project?s period to enrich it. This synthetic note on the outcomes underscores its significance. It showcases the integration of diverse expertise and the advancement of knowledge in consortium?s area of expertise. From the consortium perspective, the LEAP-RE experience has provided a strong foundation upon which future activities can rely. This deliverable serves as a resource for stakeholders and decision-makers interested in the utilization of similar solutions in the African context.

Approval

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Report about the outcome on scientific collaboration including sociology and organization analysis

EURICA

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Abstract

In this report the WP leader analyse the consortium from a SWOT analysis perspective and the highlighted elements will be useful for the valorisation of the LEAP-RE experience into WP5 and WP6.

Keyword list

SWOT analysis, key message, scientific collaboration, communication, capacity building

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Abbreviations and Acronyms

Acronym	Description
AC	Alternating Current
CAPEX	Capital Expenditure
DC	Direct Current
DER	Distributed Energy Resources
DSO	Distribution System Operator
EMS	Energy Management System
GIS	Geographical Information System
IFDD	L'Institut de la Francophonie pour le Développement Durable (The Francophonie Institute for Sustainable Development)
IoT	Internet of Things
JAE	Jeunes Acteurs de l'Energie (Young Energy Actors)
MAR	Multi-Annual Roadmaps
OIF	Organisation Internationale de la Francophonie (International Organisation of the Francophonie)
OPEX	Operational Expenditure
PV	Photovoltaic
ROI	Return On Investment
SDG	Sustainable Development Goal
SHS	Solar Home System
SWOT	Strengths, Weaknesses, Opportunities and Threats
TRIAE	Table Ronde Internationale des Acteurs de l'Energie (International Energy Players Round Table)

Executive summary

In a culmination of 36 months of dedicated effort, the EURICA project (WP15) has reached its final milestone with the completion and delivery of this last project deliverable. This achievement marks the end of a journey, aimed at designing, developing, and testing two approaches to enhance the electrification and contribute to meeting the SDG7 objectives.

This report provides the key messages derived from the lessons learned during the project, its accomplishments and challenges which were all thoroughly documented in previous WP's deliverables. Involving a total of six partners, this project enabled to successfully demonstrate the technologies in two demonstration sites serving as real-world testbeds in Burkina Faso and Madagascar. By providing tangible example of technology deployment, they allowed to assess their viability and effectiveness.

A SWOT analysis has been conducted in order to take a step back and gain insights into the consortium's dynamics and potential for further development. The lessons learned from these sites have laid the groundwork for future sustainable energy initiatives in Africa.

Finally, a specific focus is given to the fruitful scientific collaboration between European and African partners and the actions performed over the complete project's period to enrich it. This synthetic note on the outcomes underscores its significance. It showcases the integration of diverse expertise and the advancement of knowledge in consortium's area of expertise.

From the consortium perspective, the LEAP-RE experience has provided a strong foundation upon which future activities can rely. This deliverable serves as a resource for stakeholders and decision-makers interested in the utilization of similar solutions in the African context.

1 Introduction

1.1 About the LEAP-RE programme

The LEAP-RE programme seeks to create a long-term partnership of African and European stakeholders in a quadruple helix approach: government (programme owners and funding agencies), research and academia, private sector, and civil society. LEAP-RE establishes and jointly implements research, innovation, and capacity-building activities that respond to the Multi-Annual Roadmaps (MARs) developed in PRE-LEAP-RE. LEAP-RE draws on the experience and partnership developed in PRE-LEAP-RE. LEAP-RE is further strengthened by previous collaboration between partners in other projects supporting the EU-Africa HLPD on STI, such as LEAP-Agri, ERAfrica, LEAP4FNSSA, RINEA, and CAAST-Net Plus.

It is organised in three pillars, the External Research Funding and Capacity Building Activities (Pillar 1), 8 key projects (Pillar 2) and Management, Coordination, Monitoring and Evaluation and development of the future long-term partnership (Pillar 3). More information is available on the programme website [1].

1.2 About the EURICA project

1.2.1 Objective and approach

The EURICA project is one of the key projects of the Pillar 2. It is about green electrification in Africa enabling productive usage of electricity and facing both short-term and long-term African electrification requirements: a fast development of the access of the entire African population to an electrical service and the construction of a reliable, decarbonised, decentralized, and intelligent, electrical infrastructure able to accompany the sustainable development of the continent. The two classical methods answer separately those requirements through individual electrification and the deployment of a massive electrification for all through capital-intensive transport and distribution networks. The proposed scheme in EURICA combines a top down and a bottom-up approach to bring together those two classical methods and to address both the short-term and long-term challenges.

The bottom-up approach consists in the interconnection of existing small microgrids called "Nanogrids" in order to improve the quality of the service and reach higher tier in the electricity access. The top down consists in improving the service in on-grid places and make the area more resilient through the promotion of DER, the provision of digital tools to ease their insertion in the network and the creation of a local flexibility market which aims the reductions of congestion issues with limited impact on the population.

The main focus of the projects are:

- The use of data driven methodology rather than a long and costly physical grid modelling
- Engage local energy community & build local marketplaces to manage flexibilities and support mini grid stability and reliability of supply
- Maximize local, sustainable, and cost-effective energy resources.

1.2.2 The involved partners

The WP15 – EURICA involve 6 partners of the LEAP-RE programme:

- Odit-e, a French SME based in Meylan which develops software to digitize the maintenance, supervision and planning of the low voltage network, based on the analysis of smart meters data
- INEA, a Slovenian company based in Ljubljana which designs, integrates, and delivers cutting-edge industrial automation and energy management solutions, based on continued R&D efforts balanced with leading global HW and SW technologies.
- Nanoé, a French/Malagasy SME develops, manufactures, and deploys innovative IT and smart energy management solutions at the service of a new electrification path for rural Africa named "Lateral Electrification"
- Institut Supérieur Dale Kietzman, a teaching and research centre based in Douala, Cameroun
- La Société nationale d'électricité du Burkina Faso, SONABEL, its main activities include electricity generation, transmission, distribution, and sale to customers connected to the national grid
- Next Energy Consumer, a policy consultancy based in Turin, Italy and specialised in the social aspects of the energy transition. Next Energy Consumer in a service provider mainly involved in the task 15.2 and 15.6.

1.3 Scope of the document

The scope of this document is to provide an overview of the outcomes obtained during EURICA's project in order to facilitate the valorization of the LEAP-RE experience. Thus, it serves as a synthetic note which incorporates key aspects of the project as partners have taken a step back from its implementation phase.

First, it encapsulates the essential key messages derived from the lessons learned throughout the project's duration, shedding light on both its accomplishments and the challenges encountered along the way.

Secondly, it includes a strategic SWOT analysis that aims to delve into both approaches' characteristics, highlighting strengths, weaknesses, opportunities, and threats. This analysis offers insights into the technologies' potential for further development and growth.

Lastly, the document places a particular emphasis on the fruitful scientific collaboration between partners, showcasing the activities performed to promote communications and exchange among the energy community.

2 Key message

After this 36-months project, the EURICA's consortium has synthetized its activities, findings and lesson learnt into one key message which has been shaped throughout time and the different activities under the sociology, organisation, and capacity building task. This key message is available hereafter.

Table 1: EURICA's key message

In Madagascar, the emphasis on lateral electrification in rural settings stands out as a beacon for sustainable energy transition and the achievement of SDG7. This approach, which combines hardware solutions with a clear pathway towards electrification, underscores the importance of a bottom-up approach in energy initiatives. Central to this is the principle of lateral electrification, which champions decentralized, community-driven energy solutions. However, to truly scale these efforts and ensure their sustainability, digitalization is paramount. It not only aids in improving the quality of distributed electricity but also optimizes resources and enhances overall human satisfaction. This is particularly crucial in combating energy poverty, a challenge that disproportionately affects women and marginalized groups. *In contrast, the narrative in Burkina Faso, particularly in urban settings in Ouagadougou, revolves around the potential of digitalization combined with flexibility and residential photovoltaic systems. Although the area is connected to the SONABEL's national distribution network, power supply difficulties remain significant. By introducing digital tools and solutions, there's potential to optimize assets, manage distributed production resources, and prioritize essential energy uses. This approach not only ensures efficient energy distribution but also paves the way for a more resilient and adaptable energy infrastructure.* *Across both regions, and indeed the broader energy industry, there's an overarching message emerging from the sociological and organizational analysis: the need for gender equity. The energy sector, historically male-dominated, requires a paradigm shift. Women must be at the forefront of decision-making, innovation, and implementation. This is not just a matter of equity but also of efficiency and innovation. By ensuring gender equity, the industry can tap into a broader pool of ideas, solutions, and perspectives, driving the energy transition forward and ensuring it benefits all segments of society.*

3 SWOT analysis of the consortium

A SWOT analysis is a strategic planning tool which facilitate comparative analysis and is used to assess a project, organization, or technology by examining its internal strengths and weaknesses, along with external opportunities and threats. In the framework of EURICA, two SWOT analysis have been performed, in order to gather and consolidate insights upon the technologies deployed in both demonstration sites.

Conducting such analysis enabled to depict the perception of EURICA's stakeholder upon the status and ambition of their respective technologies together with the perspective and challenges ahead of them. In the process, each stakeholder provided information upon its technologies and examined the specific contexts in which these technologies are deployed, considering local economic, social, and regulatory conditions.

Synthetic and detailed results of both analysis are provided in the two following paragraphs, they are intended for decision-makers in governments, international financing institutions, regulatory bodies and energy industry stakeholders to guide them in their choice. There is no one-for-all solution when it comes to the electrification challenges and this analysis position EURICA's technologies in the landscape of available solutions.

3.1 Bottom-up technologies

INTERNAL

EXTERNAL ANALYSIS

STRENGTHS (S)

- Lowest CAPEX/user rural electrification solution
- More flexible solution compared to conventional minigrid
- Less financially risky to deploy compared to conventional minigrid
- Easier solution to deploy (no preliminary studies needed)
- Safer solution to deploy (low voltage)
- More inclusive solution (more affordable)
- Digitization allows cost optimization for equivalent quality of service

OPPORTUNITIES (O)

- The solutions is deployable in rural villages of all sizes
- International Financial Institution looking for new electrification solutions to overcome the shortcomings of SHS and conventional minigrid
- Cost decrease of solar panels and batteries helping to reach economically even poorer users
- Many young locals willing to be trained to this solution to empower their community
- Rural settings are natively digital for remote operation

WEAKNESSES (W)

- Requires more maintenance than conventional minigrid
- Less extended electricity service (Tier 3) compared to conventional minigrid
- Largely unknown solutions by main sector decision-makers
- Less added value proposition on grid digitization because of DC lower complexity to operate

THREATS (T)

- Competition with AC minigrid developers on biggest and denser village
- Inadequate regulatory context for the deployment of this kind of electrification solution
- Political stability that harms long term business activities

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3.1.1 *Strengths*

Rural electrification solution with the lowest CAPEX/User:

In the Malagasy demonstration site, the implemented solution is the rural electrification solution with the lowest CAPEX/per user. Traditional rural electrification projects often involve significant upfront investments, making them economically challenging in remote and underserved areas. By gradually merging affordable nanogrids, Nanoé's solution reduce capital requirements. Digital practices to optimize system design participate to reduce such cost.

More flexible solution compared to conventional minigrid:

The approach provides a more flexible solution when compared to conventional minigrid systems which are mostly designed in preliminary studies relying on energy demand hypothesis and limited adaptability later on. In contrast, the modular approach consisting in interfacing nanogrids components, allows for scalability and easy adjustments to meet the evolving energy needs of rural areas. This adaptability ensures that the system can grow and evolve as the demand for electricity increases.

Less financially risky to deploy compared to conventional minigrid:

Deploying conventional minigrid can entail significant financial risks, given the substantial upfront investments and uncertainties related to energy demand assessment. In EURICA's approach, reducing the upfront CAPEX and offering a more flexible system, the financial risks associated with rural electrification is significantly lowered. This could make the solution more attractive to investors and funders.

Easier solution to deploy (no preliminary studies needed):

The absence of need for extensive preliminary studies is a strength itself. Indeed, projects typically require extensive assessments, feasibility studies, and surveys to determine energy needs and associated infrastructure sizing. In contrast, Nanoé's solution is easier to deploy, with a simplified planning and implementation process. This streamlining of the deployment phase can result in faster project execution and lower barrier to entry.

Safer solution to deploy (Low Voltage):

The operation of DC systems under low voltage reduces safety concerns associated with electricity distribution. Conventional minigrid often operates at higher voltage levels, which can pose significant safety risks during operation.

More inclusive solution (more affordable):

Accessibility and affordability are critical factors in rural electrification. By offering a more cost-effective option with reduced CAPEX and lower operating costs, the solution makes electricity access more affordable for rural residents. This inclusivity is essential in addressing energy poverty and improving the overall quality of life in underserved areas.

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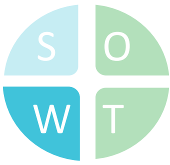
Digitization allows cost optimization for equivalent quality of service:

Digitization enables cost optimization while delivering equivalent electrical service. Through simulation and operational data analysis, the hardware solution is enhanced with decision support tools to optimize and efficiently allocate resources. This optimization ensures that the deployed PV and storage capacity are used most efficiently, maximizing their use and life expectancy. Digitization also provides the potential for remote monitoring and targeted maintenance in hardly accessible location, further reducing operational costs and improving system reliability.

3.1.2 Weaknesses



Requires more maintenance than conventional minigrid:

While Nanoé's rural electrification solution displays significant strengths, it does come with the drawback of requiring more maintenance compared to conventional minigrid systems. This increased maintenance demand is due to the use of modular components and lower voltage systems, which require more frequent check-ups and servicing to ensure the system's reliability and longevity. It does represent an operational cost that needs to be considered when implementing this solution.

Less extended electricity service (Tier 3) compared to conventional minigrid:

The principle of the Nanogrid's interconnection is to improve the electricity service, through this interconnection, the solution achieves Tier 3 access. However, conventional minigrids often have the infrastructure and capacity to deliver higher tiers of service, such as 24/7 access, higher power capacity, enabling the use of a broader range of electrical appliances.

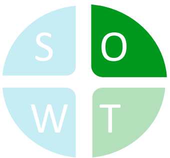
Largely unknown solutions by main sector decision-makers:

Traditional minigrids have a longer history and established recognition among policymakers, investors, and energy sector stakeholders. The adoption of new and unfamiliar solutions can face resistance or scepticism due to a lack of awareness and track record. Efforts to educate and inform decision-makers about the benefits and feasibility of the bottom-up approach are essential to drive its acceptance and enable its implementation.

Less added value proposition on grid digitization because of DC lower complexity to operate:

Regarding the grid digitization component, the provided technology offers a reduced added value proposition compared to its application to conventional minigrids. This is because the use of direct current (DC) systems, which are simpler to operate, may require fewer digital control and monitoring features. Conventional minigrids often rely on alternating current (AC) systems, which benefit more from advanced digitization and smart grid capabilities for optimal operation and efficiency.

3.1.3 Opportunities



The solution is deployable in rural villages of all sizes:

One of the notable opportunities of the solution is its versatility and scalability, making it deployable in rural villages of all sizes. Whether it's a small, remote hamlet or a larger rural community, the infrastructure can be adapted to meet the specific energy needs and demands. This flexibility ensures that no rural area is excluded from the benefits of electrification, regardless of its size, helping to bridge the energy access gap more effectively.

International financial institution looking for new electrification solutions to overcome the shortcomings of SHS and conventional minigrid:

International financial institutions are looking for innovative solutions with the potential to address the limitations of existing electrification approaches, such as Solar Home Systems (SHS) and conventional minigrids. The bottom-up approach offers an alternative to provide reliable and sustainable electricity access to underserved regions. It aligns with their goals and can drive substantial interest.

Cost decrease of solar panels and batteries helping to reach economically even poorer users:

The decreasing costs of solar panels and batteries enables to make the bottom-up approach more accessible to economically disadvantaged users. As the prices of these key components continue to decline, the overall system's cost structure is reduced. This is especially beneficial for the poorer users in rural areas who may have previously found electrification solutions prohibitively expensive. The decreasing cost barrier enables a more inclusive approach to rural electrification, empowering these users with affordable access to electricity.

Many young locals willing to be trained to this solution to empower their community:

The willingness of many young locals to be trained in the implementation and maintenance of Nanogrids is a promising aspect for the technology's deployment. By involving and training young members of rural communities, the approach not only create job opportunities but also foster a sense of ownership and self-sufficiency in managing their energy infrastructure. This localized approach takes root in the community in the long term which enhances sustainability and strengthens the community's capacity to manage and maintain its electrification system.

Rural settings are natively digital for remote operation:

Rural communities are difficult to access due to the lack or bad quality transportation infrastructure. Therefore, rural settings are increasingly becoming natively digital environments which enable remote operation and management to reduce on-site intervention and therefore costs. The infrastructure needed for grid digitization practices is readily available, enabling simpler and less capital-intensive deployment to make rural electrification more efficient, sustainable, and resilient to disruptions.

3.1.4 Threats

Competition with AC minigrid developers on biggest and denser villages:

While the bottom-up approach offers several advantages for rural electrification, it faces competition with AC minigrid developers in the largest and densest villages. AC minigrids are well-established solutions and can provide higher power capacities and more extensive services, making them appear more suitable for now in densely populated areas with higher energy demands.

Inadequate regulatory context for the deployment of this kind of electrification solution:

The deployment of innovative electrification solutions can be hindered by an inadequate regulatory framework. Many countries have established regulations and policies that primarily cater to traditional electrification approaches and may not have provisions for newer, more decentralized, and service-based systems. This regulatory mismatch can create obstacles, making it difficult to gain the necessary approvals and permits for deployment. Additionally, uncertainties related to tariffs and energy market regulations may pose challenges to the long-term viability of the bottom-up approach, further emphasizing the need for regulatory reforms to support alternative approaches.

Political stability that harms long-term business activities:

The political stability of the regions where the bottom-up approach could be implemented can significantly impact long-term business activities. Political instability can lead to changes in government policies, sudden regulatory shifts, and a general sense of uncertainty that negatively affect investments and long-term planning.

3.2 Top-down technologies

INTERNAL	EXTERNAL ANALYSIS

STRENGTHS (S)

- Open for collaboration with third-party providers
- Digital model of the grid robust to poor GIS information
- Powerful Energy Management System compatible with various industrial devices and domestic appliances utilizing standardized FlexOffer protocol
- Solutions is ready for small energy communities and large DSOs

OPPORTUNITIES (O)

- International Financial Institution looking for new electrification solutions to meet SDG7 targets
- Tremendous infrastructure improvement needs linked to the unprecedented population growth in African cities
- Projects of smart metering infrastructure deployment for revenue protection will provide valuable data
- Young and increasingly qualified workforce
- Cost decrease of DER and flexibility assets helping to reach faster ROI

WEAKNESSES (W)

- Not yet widely recognized as an alternative to traditional solutions.
- Challenges in defining a clear and effective business model
- Solution require to be adapted for various types and communication-less devices or appliances
- Relies on an operating smart meter infrastructure
- Sensitive to data quality and completeness
- No industrial and commercial footprint in Africa

THREATS (T)

- Strong regulatory influence on flexibility markets
- Political stability that harms long term investments
- Uncertainties regarding the future inclusion of flexibility market
- Involved IoT technology which is sometimes hard to implement
- Asian competitors with cheaper technologies

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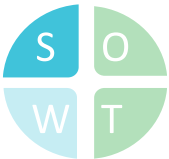
3.2.1 *Strengths*



Open for collaboration with third-party providers:

The top-down approach is designed to enable the collaboration with third-party providers. This openness facilitates partnerships with external organizations and stakeholders, fostering innovation and adaptability. By enabling collaborations, the approach can tap into the expertise, technologies, and resources of other entities, potentially expanding the scope and capabilities of the solution.

Digital model of the grid robust to poor GIS information:

A key advantage of the grid digitization solution deployed in the top-down demonstration site is its ability to effectively handle and adapt to poor GIS data. In many contexts, obtaining accurate and up-to-date GIS information can be challenging. The solution, based on smart meters' data, is designed to overcome this limitation. This robustness ensures that electrification efforts can be prioritized and optimized in any context through digitization practices.

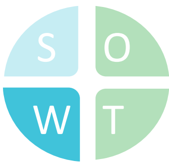
Powerful energy management system compatible with various industrial devices and domestic appliances utilizing standardized FlexOffer protocol:

The top-down approach incorporates an EMS that is versatile and compatible with a wide range of industrial devices and domestic appliances. This versatility is achieved through the use of the standardized FlexOffer protocol [2], which facilitates communication and control of energy resources. The FlexOffer protocol allows for straightforward integration with a variety of energy-consuming and producing devices, to foster the flexibility and adaptability of the electrical infrastructure. This compatibility ensures that the solution can cater to the diverse energy needs of different users, from small households to industrial facilities.

Solution is ready for small energy communities and large Distribution System Operators (DSOs):

As it is adaptable, the top-down solution can be deployed in both small energy communities and large DSOs. In small energy communities, it provides cost-effective and reliable remote monitoring and control, and its scalability allows it to grow as the energy community expands. Simultaneously, the solution is suitable for integration into the operations of large DSOs and aligns with the needs to efficiently manage electrical distribution networks.

3.2.2 *Weaknesses*



Not yet widely recognized as an alternative to traditional solutions:

The technology deployed in the Burkina Faso demonstration site is not as established as traditional solutions and therefore not yet widely recognized as a possible alternative. Against conventional electrification approaches it is challenging for new technologies to gain such recognition and acceptance. The lack of awareness and familiarity with this solution could hinder its adoption and efforts are required to showcase its potential.

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Challenges in defining a clear and effective business model:

The sustainability and scalability of the solution is conditioned by a clear and effective business model. However, in the current technological and regulatory framework's maturity, crafting one that aligns with the context and the demand of the solution is a difficult exercise which require adaptation to local economic conditions. Such adaptation consists in particular to the identification of stream of revenue generation and distribution of the created value among stakeholders.

Solution requires adaptation for various types of communication-less devices or appliances:

The adaptability of the solution for various types of communication-less devices or appliances is a technical challenge as many still lack communication capabilities and therefore require the use of additional equipment to enable monitoring and control. Adapting the technology to work with these legacy devices while ensuring compatibility is necessary to make the technology accessible for a broader range of users.

Relies on an operating smart meter infrastructure:

The implementation of the grid digitization solution is conditioned to the presence of an operating smart meter infrastructure. Smart meters enable data collection and management of the one required to compute the model and perform the grid digitization thus facilitating network analysis and system optimization. In areas where smart meter infrastructure is absent, deploying this technology require additional investments which may affect the economic viability of the deployment.

Sensitive to data quality and completeness:

The technology's effectiveness is sensitive to data quality and completeness. It is essential to compute an accurate and reliable model of the grid which then design and size the necessary flexibilities. If data quality is compromised due to technical issues, inaccuracies, or other factors, it can affect the efficiency and reliability of complete top-down approach.

No industrial and commercial footprint in Africa:

Another notable challenge is the absence for EURICA's partners of an industrial and commercial footprint in Africa while more established technologies may have already established their presence in the market. The absence of local industry partnerships and commercial networks can hinder the technology's growth and will require strategic collaboration with local entities to address this issue to scale and operate effectively.

3.2.3 Opportunities

International financial institution looking for new electrification solutions to meet SDG7 targets:

Similarly to the opportunities detailed in the bottom-up SWOT, the search for new electrification solutions by international financial institutions in pursuit of the SDG7 targets is an opportunity for the top-down approach. These institutions play an important role in mobilizing funding and resources to support electrification in Africa and are currently facing the limitation of existing electrification approaches.

Tremendous infrastructure improvement needs linked to unprecedented population growth in African cities:

The unprecedented population growth in African cities foresees tremendous infrastructure improvement needs, particularly regarding the energy assets and the electrical network. As urban areas experience rapid expansion, the demand for reliable and sustainable energy services increases therefore requiring upgrading and expanding energy infrastructure to meet such needs. The demonstrated top-down approach in Burkina Faso can be part of the solution to address this urbanization challenge.

Projects of smart metering infrastructure deployment for revenue protection will provide valuable data:

Revenue protection policies are an important driver for the deployment of smart metering infrastructure. They justify their deployment and associated CAPEX thanks to the additional revenue they enable. Such infrastructure being a prerequisite to find economic balance in the EURICA's top-down approach, the existence of these policies is a chance. The data generated from these projects can enable the solution's deployment at low cost.

Young and increasingly qualified workforce:

As previously depicted in the bottom-up SWOT, the presence of a young and increasingly qualified workforce is a promising asset for electrification initiatives in Africa. As the continent's youth population grows, there is a growing pool of talent and expertise. The willingness and capacity of the young workforce to be actively involved in electrification projects can be a driving force for the demonstrated solution. This has particularly been visible in the framework of LEAP-RE initiative such as the RESchool.

Cost decrease of DER and flexibility assets helping to reach faster ROI:

The decreasing costs of DER and flexibility assets will enable faster ROI for future technology's deployment. Accelerating the ROI timeline makes the top-down approach more attractive to final users, investors, and funders. The higher affordability of these assets will contribute to the scalability of the flexibility market, reaching more users in less time and making it more impactful in the management of grid issues. This could trigger a virtuous circle has the value of platform businesses is correlated to platform size and user's market share.

3.2.4 Threats

Strong regulatory influence on flexibility markets:

Flexibility markets for the management of low voltage grid issues as demonstrated in Burkina Faso is yet to be regulated in most geographies. As its revenue generation will be defined by the regulation, the influence of the last will have a significant impact on the emergence of such technologies. Regulations will shape the rules and dynamics of this market affecting among others the market entry, the pricing or the participation of various stakeholders. On one hand, well-designed and supportive regulations can stimulate the growth of flexibility markets by providing clear frameworks and incentives. On the other hand, overly complex or restrictive regulations may stifle innovation and limit the ability of market participants to adapt and provide flexible offers.

Political stability that harms long-term investments:

Similarly to the bottom-up analysis, political stability is a critical factor for attracting long-term investments for such solutions. It provides the necessary security to investors about capital protection and reasonable expectation for return on investments. On the opposite, changing government policies, unexpected regulatory shifts, and an overall sense of uncertainty, can deter long-term investors and hinder the development of flexibility markets.

Uncertainties regarding the future inclusion of flexibility markets:

The uncertainties regarding the future inclusion of flexibility markets in the energy landscape is a challenge as it requires important efforts to educate and inform decision-makers about its potential. Flexibility markets are still evolving and finding their place in the broader energy ecosystem therefore clarity and assurance about their future role are essential to encourage commitment from both investors and technology providers.

Involved IoT technology which is sometimes hard to implement:

The implementation of Internet of Things (IoT) technology in the context of flexibility markets in Africa is a double-edged sword. IoT offers valuable capabilities for data collection, monitoring, and control, enabling more efficient and responsive energy systems. However, the deployment of IoT can be technically challenging and resource intensive. It requires skilled personnel for maintenance and operation. The difficulty of implementing IoT technology can be a barrier for final users and DSOs.

Asian competitors with cheaper technologies:

Competition from Asian providers with cheaper technologies is to be considered in the global flexibility market landscape. These providers often excel in manufacturing cost-effective equipment for similar use as in EURICA's top-down approach. EURICA's solutions may focus on other decision-making factors such as added value services, after-sales support, reliability which are also critical considerations when choosing technology providers.

4 Outcome on scientific collaboration

The EURICA project which is one of the LEAP-RE program's Pillar 2 initiatives, has been an opportunity to foster scientific collaboration. Within the scope of the two project’s approaches analysed from a socio-economic and organization perspective, developed, and then demonstrated, a stimulating international cooperation and interdisciplinary teamwork took place. Over its course, this project has not only been technology oriented but has also fostered emulation and exchanges among energy stakeholders through communication activities which peaked with the organisation of two key events: the Energy actors round table and the IFDD webinar. This paragraph gathers the main identified outcome of EURICA’s project in this field, from capacity building activities to dissemination activities.

4.1 Capacity building activities

As extensively underscored in D15.6, one of EURICA’s capacity building strategy has been to empower users through documentation package to effectively adopt and use the solution. The following set of documentation plays a significant role in empowering users:

- Deployment guides
- User guides
- Implementation plans
- Support and training documentation
- Solution description and use cases.

The following Table 2 derived from D15.6 consist of the repository of documentation edited in the framework of the EURICA project to enable the users’ onboarding and rapid increase in skills on project’s technologies.

Table 2: List of documentation

Document Type	Burkina Faso (top-down)	Madagascar (bottom-up)
Solution description and use cases	• D15.2: Capacity building plan and local flexibility market specification WP15 • D15.3: Grid digitization tool specification and mock-up WP15 • D15.4: Report of bottom-up pilot as deliverable of task 15.4 • D15.5: Report of top-down pilot as deliverable of task 15.5	
Implementation plans	• WP15.5 Deployment plan for Burkina Faso (part of D15.5)	• Lateral electrification deployment plan (Annex in D15.6)
Deployment Guides	• User guide for equipment deployment (part of D15.5)	• “Plan de passation Micro-réseau 2022“ (Confidential)
User Guides	• User guide for system administrators • User manual for mobile application • (part of D15.5)	• “Module d’interconnexion - Mode d’emploi” (Confidential) • “Module d’interconnexion – Montage” (Confidential) • “Module d’interconnexion - Software à installer” (Confidential) • “Module d’interconnexion - Charges communales” (Confidential)
Support and Training material	• LoRa description document • User manual for LoRa Field tester (part of D15.5)	• Eurica presentation (Annex in D15.6)
Dissemination material	• Commercial flyer for Ouagadougou, Azimmo 2000 residents (Annex in D15.6)	

4.2 Associated dissemination activities

4.2.1 Target audiences

The EURICA project, set against the broad context of energy in developing countries, spans three African nations with two distinct demonstration sites: a bottom-up approach in Madagascar and a top-down strategy in Ouagadougou. At its core, the project is steered by a multidisciplinary team, ensuring a balanced representation in terms of geography and gender. The essence of our message is that electricity is not just a utility; it "brightens life", serving as a potent tool for empowerment, especially for women. When harnessed to fulfil both professional and personal aspirations, such as preserving food or charging phones, electricity becomes a catalyst for development, aligning with the goals of SDG7 and poverty reduction. This message resonates deeply with international donors and NGOs.

As individuals transition from mere energy users to discerning consumers, their expectations evolve. They seek reliability, affordability, and transparency in their electricity service. The allure of solar energy, for instance, lies in its perceived simplicity: once installed, it promises consistent electricity. This consumer-centric perspective is vital for project leaders, regulators, and policymakers.

EURICA's solution emphasizes the transformative role of digitalization. By leveraging digital tools, electricity services can be optimized, whether from the national grid in Ouagadougou or nano-grids in Ambanja, without escalating costs. This proposition, rooted in principles of demand-side response, energy efficiency, and sufficiency, is particularly relevant for energy companies, project leaders, regulators, and policymakers.

As we look ahead, our focus is on testing the efficacy of these digital tools in real-world scenarios. We aim to foster discussions around the societal impacts of electricity, exploring ways to safeguard energy consumers from escalating costs and ensuring they are protected from underperforming energy companies. This forward-looking perspective is especially pertinent for project leaders and donors.

4.2.2 Communication channel and activities

4.2.2.1 Energy actors round table

The first International Energy Players Round Table (TRIAE) was a landmark event held in Ouagadougou and simultaneously online on 18 March 2023. Organized by EURICA in close collaboration with the local youth association, Les Jeunes Acteurs de l'Energie (JAE), the primary objective was to foster a platform where diverse energy stakeholders could converge, share their unique visions, and facilitate enhanced coordination in the energy sector. The meticulous planning for this event spanned over six months, leveraging the expertise and collaborative efforts of teams from Odit-E, Next Energy Consumer, and JAE.

On the day of the event, the agenda was thoughtfully curated to address pressing topics in the energy sector. The opening session, led by Dimitri TIENTEGA of JAE and Luc RICHAUD of Odit-e, set the tone with an introduction to the LEAP-RE programme and the objectives of the NGO JAE. This was followed by a series of debates on pivotal themes: the potential of solar energy in Africa, the gender dynamics in the energy sector, and the transformative role of digitalization in energy deployment. These debates featured insights from prominent figures like Ange SEBEGO, Ahmadou DIALLO, Cheick FOFANA, Inès NANEMA, Sara BAGRE, Fatoumata DIALLO, Romuald OUEDRAOGO, Charles BAZIE, and Malik LINGANI, among others. Interspersed with these discussions were video screenings that provided deeper insights into specific LEAP-RE projects and initiatives.

Communication and outreach for TRIAE were primarily driven through professional social channels, leveraging the influential profiles of Dimitri TIENTEGA (JAE) and Marine Cornels (Next Energy Consumer). The event's success was evident in its impressive engagement metrics, with posts garnering over 19,000 impressions, nearly 400 reactions, and 84 reposts, predominantly on LinkedIn.

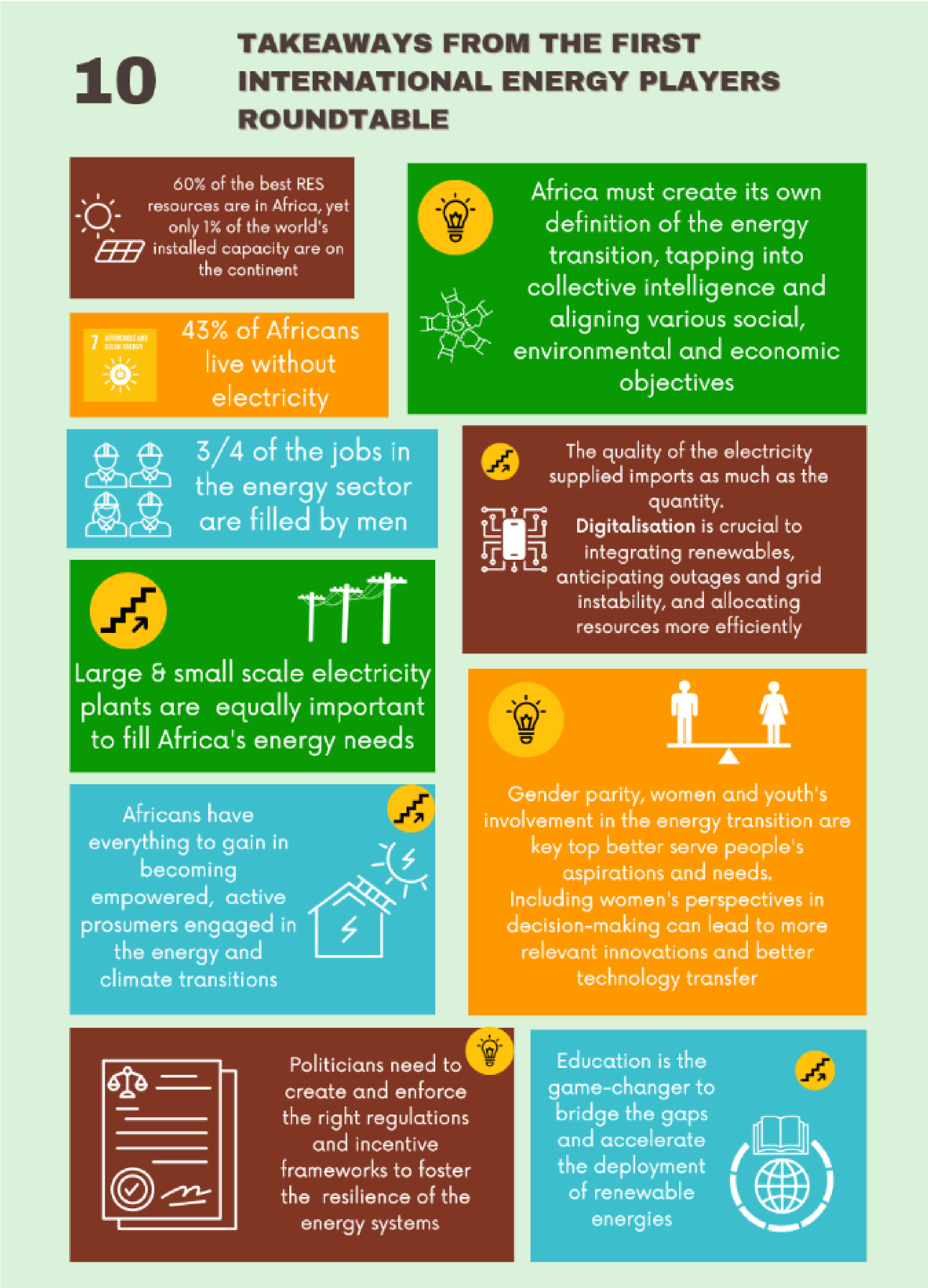

Figure 1: Key takeaways from the TRIAE - Extract from the TRIAE report available in D15.6

4.2.2.2 IFDD event

L'Institut de la Francophonie pour le développement durable (IFDD) stands as a testament to the collaborative spirit of the Francophonie. As a subsidiary of the Organisation Internationale de la Francophonie (OIF), which brings together 88 states and governments, the IFDD is dedicated to fostering cooperation that propels the transition towards sustainable energy, environmental conservation, and overall sustainable development. Its actions resonate with the objectives outlined in the Cadre Stratégique de la Francophonie (2015-2022), particularly under the mission "Développement durable, économie et solidarité" and the strategic objective 7, which aims to contribute to the post-2015 development programme and the Sustainable Development Goals.

The significance of the Francophonie, especially in the context of Africa, cannot be overstated. A staggering 60% of the world's French-speaking population resides in Africa, according to the OIF. This majority is concentrated mainly in West and Central Africa. Given this linguistic landscape, there's an evident under availability of resources in French, including among LEAP-RE and EURICA, despite the language's widespread use across the continent.

Addressing this gap, the SELF IFDD event titled "Innovation digitale pour un avenir électrique à Madagascar et au Burkina Faso" (Digital innovation for an electric future in Madagascar and Burkina Faso) was organized on 13 July 2023. Supported by the IFDD, this online seminar delved deep into the transformative potential of digitalization in the energy sector. Drawing from the EURICA case studies, the seminar shed light on both interconnection of rural nano-grid in Madagascar and the implementation of flexibilities in the urban setting in Burkina Faso. By conducting this seminar in French, it not only catered to the linguistic preferences of a significant portion of the African population but also ensured that the insights and innovations discussed were accessible to those who stand to benefit the most.

4.2.2.3 Publications

The energy transition and consumer empowerment landscape has been enriched by a series of publications that investigate its mmultidimensional complexities:

- A significant contribution is the book chapter *"Demand-side flexibility to address household energy poverty in Sub-Saharan Africa: The Case of Burkina Faso and Madagascar"*, penned by Cornelis, Mballa Elanga, E., and Richaud, L. featured in the Routledge publication "Living with Energy Poverty: Perspectives from the Global North and South" in 2023, it offers a deep dive into the challenges of energy poverty and the tailored solutions for the Sub-Saharan context.
- Further, the case study "From Blackouts to Flexibility" presented at CIRED by Ursic S., Cornelis, M., and Richaud, L. provides a focused exploration of Burkina Faso's energy landscape and potential of digitalisation.
- Additionally, the publication "Boosting prosumerism: State of play of the best practice to inform and boost individuals, communities and other relevant stakeholders" by Cornelis, M., presented at EUSEW 2022, underscores the transformative potential of prosumerism in the energy sector.
- Complementing these is a book chapter titled "Energy digitisation as a consumer empowerment tool: opportunities and risks" in ESCOP4GREEN, coordinated by the University of Camerino and authored by M. Cornelis in 2023, which offers insights into the dual-edged nature of digital advancements in the energy sector.
- A set of technical publications depicting the bottom-up approach has been published:
    - "Specifications and Design of a DC-DC Converter for Decentralized DC Microgrids in Rural Africa", SGE 2023, Lille, France. L. Richard et al.
    - "Development of a DC Microgrid with Decentralized Production and Storage: From the Lab to Field deployment in Rural Africa" MDPI Energies 2022, L. Richard et al.

- "A New Electrification Model to End Energy Poverty: An example from a novel rural electrification approach in Madagascar" IEEE Electrification Magazine, 2023, L. Richard et al.
- "Planning methods for DC lateral electrification in rural Africa" CIRED, 27th International Conference on Electricity Distribution, June 2023, L. Richard et al.
- "A Decentralized and Communication-free Control Algorithm of DC Microgrids for the Electrification of Rural Africa" EPE ECCE 2022; September 2022, L. Richard et al.
- "Experimental Design of Solar DC Microgrid for the Rural Electrification of Africa" PCIM 2022, L. Richard et al.

4.2.2.4 leap-re.eu

EURICA is showcase on the LEAP-RE platform [3] through its dedicated page. This page offers visitors an in-depth look into EURICA's mission, objectives, and stakeholders involved in its journey towards fostering sustainable energy solutions.

In addition to the dedicated page, EURICA's activities and insights have been featured in the LEAP-RE newsletters. These newsletters, circulated to a wide audience of energy professionals, policymakers, and enthusiasts, have highlighted EURICA's achievements and upcoming events. By sharing news and updates through this channel, EURICA has ensured that its voice and vision resonate within the broader energy community, fostering collaboration, knowledge exchange, and collective progress towards a sustainable energy future.

4.2.2.5 Industry events

EURICA's commitment to fostering dialogue and sharing insights on energy transition and consumer empowerment has been evident through its active participation in a series of events and conferences. A significant accolade was achieved when the interconnection module solution of Nanoé was honoured with the Grand Prize at the 2023 IEEE Empower a Billion Lives Global Final [4], underscoring the innovation's potential to revolutionize energy access.

In June 2023, EURICA marked its presence at the European Sustainable Energy Week (EUSEW), a platform for discussions on Europe's energy future. Further, in May 2023, Marine Cornelis (Next Energy Consumer) brought EURICA to the stage at the CEER - Energy Regulators conference, shedding light on the intersections of digitalization and consumer rights. The beginning of the year saw a keynote address at the Foro Espanol de Energia Limpia in January 2023, emphasizing the importance of clean energy serving consumer needs at the global level. Later in 2022, EURICA representative chaired the Democratisation Hub at ENLIT Europe and delivered a keynote at the MEDREG Consumer Protection Working Group in October. The University of Groningen hosted a webinar in June 2022 where EURICA spoke on "Facilitating Sustainability via Consumers: The Perspective of Energy Law". This was closely followed by a leadership role at the ECEEE Summer Study's Panel 3, focusing on policy, finance, and governance. The year also witnessed two significant engagements with Ombudsman Energia Mexico, where EURICA shared insights on the energy consumer experience in Madagascar and delved into the energy landscape of Burkina Faso.

5 Conclusion

In conclusion, the EURICA project has reached the culmination of a 36-month journey. With the completion and delivery of this final project deliverable, we take a moment to reflect on the achievements and the lessons learned throughout its activities. The project's primary aim was to design, develop, and test two approaches that enhance electrification, aligning with the goal of contributing to SDG7.

By involving six partners and establishing real-world testbeds in Burkina Faso and Madagascar, we demonstrated these technologies in two diverse settings. These demonstration sites have not only provided tangible examples of technology deployment but also allowed us to assess their viability and effectiveness in different contexts.

Such aspects have been analysed in the SWOT analysis of this deliverable and will guide further developments. The lessons learned from the demonstration sites have indeed laid the groundwork for future improvements of both approaches.

A particular focus in this report has been given to the fruitful scientific collaboration between partners. Over the course of the project, numerous actions were undertaken to enrich this collaboration, resulting in two key events: the TRIAE and the IFDD webinar. The communication activities incorporated as well publications, online presence, and participation in industry events.

From the consortium's perspective, the LEAP-RE experience has provided a strong foundation upon which future activities can rely. The outcomes presented in this document serve as resource for stakeholders and decision-makers interested in utilizing similar solutions in the African context. It is our hope that the knowledge, experiences, and achievements shared in this report will contribute to further innovation in the pursuit SDG7 in Africa. As we close this chapter, we look forward to a future enriched by the experiences and insights gained through the EURICA project.

6 References

[1] https://www.leap-re.eu/
[2] https://flex-community.eu/
[3] https://www.leap-re.eu/eurica/
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