D4.5

BUSINESS MODELS FOR GENTE SOLUTIONS WITH REPLICABILITY AND SCALABILITY EVALUATION

SUMMARY

This document contains a detailed description of the business models and scalability and replicability potential of the key exploitable results identified in the GENTE project. It includes a detailed analysis of each key exploitable result's market viability, stakeholder engagement potential, and an evaluation framework developed to identify and enhance the replicability and scalability of GENTE's solutions.

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Impressum

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Document sensitivity

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Disclaimer

This deliverable has been developed using a standard methodology already developed by R2M in previous EU-funded projects, and featured in the deliverable D7.6 of the LIGHTNESS H2020 project (GA n. 953020). Ad hoc modifications have been added to comply with the Grant Agreement conditions for the GENTE project (GA n. 883973).

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Abstract

This report represents Deliverable D4.5, *Business models for GENTE solutions with replicability and scalability evaluation*, presenting the results from *Task 4.5: Verified Business Models, Scalability, and Replicability of GENTE Solutions (M12–M30)*. All project partners who are developers of KERs have participated in this task.

Deliverable 4.5 provides an in-depth analysis of the business models and scalability and replicability potential of four key exploitable results (KERs) within the GENTE Project: the GENTE toolkit, the DLT-based prosumer platform, the DLT-based community manager platform, and the efficient energy service for heat pump and district heating. The report employs the Lean Business Model Canvas to construct customer-centric, market-driven business models for each KER, focusing on core customer needs, value propositions, and revenue opportunities to facilitate effective market entry and growth strategies.

Additionally, a Scalability and Replicability Analysis (SRA) was conducted to assess the potential of each KER for expansion across different European markets. This analysis evaluated technical, economic, regulatory, and stakeholder-related factors, identifying key enablers and challenges to broader adoption. The findings reveal high scalability and replicability for each KER, though some challenges, including regulatory variances and the need for stakeholder acceptance, require targeted strategies for effective adaptation.

Overall, this deliverable provides GENTE partners with essential insights and strategic recommendations for the exploitation, scaling, and replication of these solutions. By addressing identified barriers, GENTE's solutions are positioned to contribute significantly to the establishment of local energy communities (LECs) across Europe, aiding the transition towards sustainable, decentralized energy systems.

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List of Abbreviations

AI	Artificial Intelligence
DLT	Distributed Ledger Technology
DSO	Distribution System Operator
EC	Energy Community
ER	Exploitable Results
EU	European Union
IoT	Internet of Things
IP	Intellectual Property
KER	Key Exploitable Result
LEC	Local Energy Community
MVP	Minimum Viable Product
RES	Renewable Energy Sources
SRA	Scalability and Replicability Analysis
SWOT	Strengths, Weaknesses, Opportunities, and Threats

1. Introduction

This deliverable, D4.5 "Business models for GENTE solutions with replicability and scalability evaluation," is a crucial component of Task 4.5 within the GENTE project, aimed at developing robust business models for key exploitable results (KERs) and assessing their potential for market uptake across diverse contexts. The GENTE project focuses on advancing distributed governance for local energy communities (LECs) through the integration of cutting-edge digital technologies such as internet of things (IoT), distributed ledger technology (DLT), and artificial intelligence (AI). These innovations aim to enhance energy management, flexibility, and sustainability within energy networks.

Task 4.5 leverages the results of Task 4.3, which involved analyzing and identifying the project's KERs. The detailed market and stakeholder analysis, as well as the evaluation of exploitation pathways, were presented in D4.3, which serves as a foundational reference for this report. The findings from D4.3 have informed the selection of the KERs that are the focus of this deliverable, providing insights into their market potential and barriers to deployment.

The purpose of D4.5 is to develop business models that address market requirements and facilitate the replicability and scalability of the GENTE solutions. By using methodologies such as the Lean Business Model Canvas and Scalability and Replicability Analysis (SRA), this deliverable aims to ensure the long-term viability and broader adoption of the project's innovations across varying regulatory, social, and technical environments.

1.1. Introduction to Lean Business model Canvas

The Lean Business Model Canvas[1] is a strategic tool used for mapping out business models in a quick, concise, and flexible manner. It was developed by Ash Maurya as an adaptation of Alexander Osterwalder's original Business Model Canvas, designed specifically for the lean startup methodology. The Lean Canvas emphasizes rapid iteration and real-world validation, focusing on creating value for customers while reducing risks associated with traditional business planning.

Unlike conventional business plans, which can be lengthy and complex, the Lean Canvas simplifies the process into a one-page format. This layout covers nine essential components: problem, customer segments, unique value proposition, solution, channels, revenue streams, cost structure, key metrics, and unfair advantage. Starting with understanding customer problems, the Lean Canvas ensures that solutions are grounded in real market needs and allows for continuous refinement based on feedback.

The primary goal of the Lean Canvas is to help businesses test assumptions quickly, adapt to changes, and make data-driven decisions. It supports a learning-based approach, where the focus is on iterating the business model based on actual customer and market insights rather than following a rigid, predefined plan. This makes the Lean Canvas an ideal choice for innovative projects like GENTE, where

[1] https://businessmodelanalyst.com/lean-canvas/ lastly accessed in October 2024

the aim is to develop scalable and replicable solutions for rapidly changing sectors such as local energy communities.

By using the Lean Canvas, the GENTE project can communicate its business strategies effectively, engage stakeholders in meaningful discussions, and align efforts towards achieving sustainable and market-ready solutions. This approach lays a solid foundation for exploring the potential of the project's KERs, ensuring their successful adoption and impact.

1.2. Introduction to Scalability and Replicability Analysis

The SRA is a systematic approach used to evaluate the potential of a solution to expand and adapt across different markets, regions, or use cases. In the context of innovative projects like GENTE, this analysis is critical for ensuring that the developed solutions can be effectively scaled up and replicated in diverse environments, thereby maximizing their impact and market reach.

Scalability refers to a solution's ability to grow or expand its operations while maintaining or improving efficiency. This involves assessing whether the solution can handle increased demand, larger user bases, or broader deployment without significant changes to its core functionalities. Factors such as modularity, design flexibility, and economic viability are typically considered when evaluating scalability.

Replicability, on the other hand, examines whether a solution can be adapted or duplicated in different contexts, taking into account variations in regulatory frameworks, cultural conditions, and technological infrastructures. It focuses on understanding the barriers and enablers that might affect the solution’s adoption in new settings, such as legal requirements, market dynamics, and social acceptance.

The SRA in this deliverable follows a structured methodology inspired by frameworks used in previous Horizon Europe projects. It considers both quantitative and qualitative factors, including:

- **Technical flexibility**: Assessing the modularity of the solution and its ability to integrate with different systems.
- **Regulatory and legal constraints**: Evaluating how varying regulations may impact the adoption of the solution across different regions.
- **Economic factors**: Understanding the cost structures and potential economies of scale that could facilitate or hinder scaling efforts.
- **Stakeholder acceptance**: Considering the social and market readiness for the solution, including user engagement and support from relevant stakeholders.

The Scalability and Replicability Analysis helps identify the conditions under which the GENTE solutions can be successfully deployed and expanded. It ensures that potential challenges are addressed early on, providing a pathway for the sustainable growth of the project’s KERs.

2. Methodology

This section outlines the approach taken to develop business models for the GENTE solutions, as well as the methods used to evaluate their scalability and replicability. The methodology builds on the findings from Deliverable 4.3 and integrates best practices from previous projects to ensure a comprehensive assessment of the GENTE project's KERs.

2.1. Approach for Business Model Development

The process for developing business models in this deliverable follows the Lean Business Model Canvas methodology. This approach provides a structured framework to identify and validate the core components of the business models for each KER. The Lean Canvas, an adaptation of Alexander Osterwalder's traditional Business Model Canvas created by Ash Maurya, is optimized for the "lean startup methodology". It focuses on deconstructing traditional business plans into key assumptions and values to maximize user value and deliver a streamlined business model.

The Lean Canvas replaces elaborate business plans with a one-page template that quickly formulates business models and communicates them in a visually appealing and easily understandable format. It consists of nine building blocks, which include customer segments, value propositions, revenue streams, cost structures, and channels. The structure of the Lean Canvas starts with identifying customer problems and proposing solutions, ensuring that the business models are tailored to market needs while being adaptable to different Local Energy Community (LEC) scenarios.

To strengthen the business model development, qualitative inputs were gathered from stakeholders through surveys and workshops conducted during Task 4.3. These activities provided insights into market requirements and user expectations, complementing the structured approach of the Lean Canvas. Additionally, a SWOT analysis was performed as part of Deliverable 4.3, allowing partners to understand the strengths, weaknesses, opportunities, and threats associated with each KER before proceeding with the business modeling process.

Figure 1 shows the Lean business model canvas that was finally selected to perform the analysis for the GENTE's KERs.

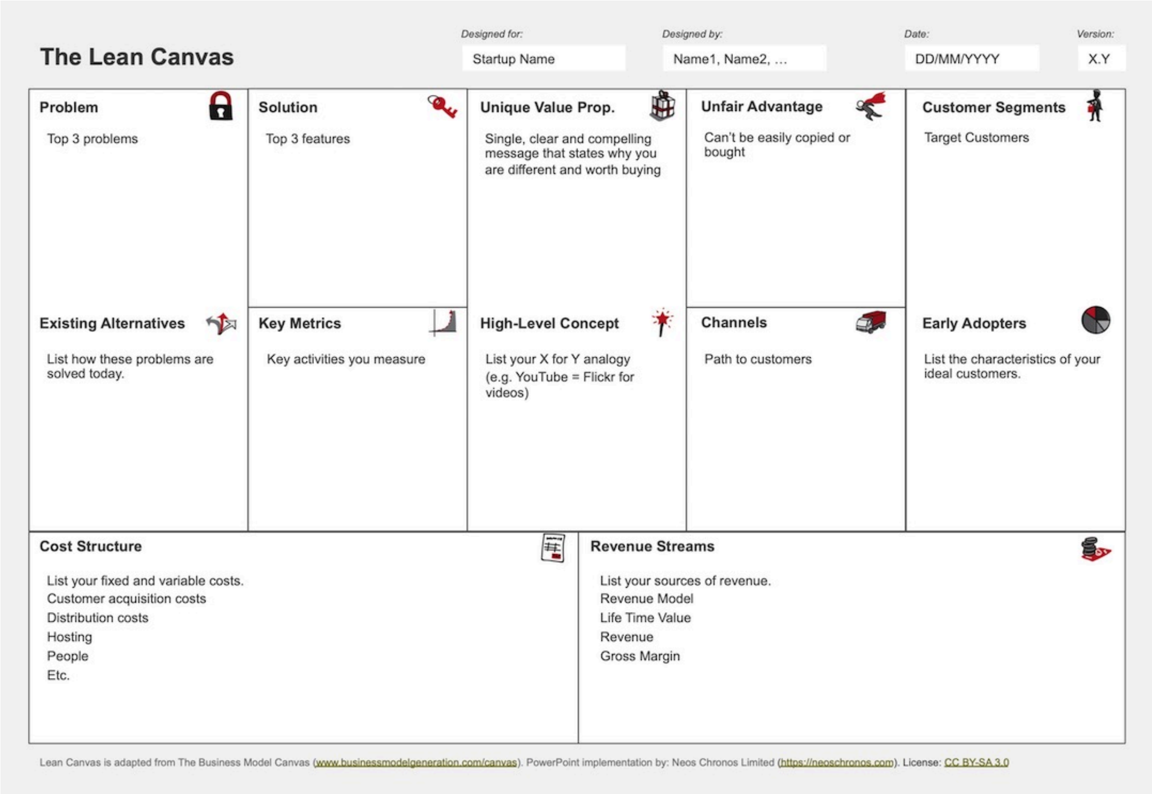

Figure 1 - Lean Business Model Canvas

To effectively utilize the Lean Business Model Canvas, it is essential to understand each of its nine building blocks and follow a logical order when filling out the canvas:

1. **Problem**: Each customer segment experiences specific problems that need to be addressed. This section lists one to three high-priority problems faced by the customer segment. Identifying these problems is the starting point for the business model, as the proposed solution must directly address them.
2. **Customer segments**: Customer segments and problems are interconnected; defining one helps clarify the other. If there are multiple customer segments, a separate Lean Canvas should be developed for each to accurately capture their unique needs.
3. **Unique value proposition**: The unique value proposition defines the primary reason why a customer should choose the product or service. It highlights the specific benefits that differentiate the business from competitors and describes what makes the offering stand out in the market.
4. **Solution**: The solution addresses the identified problems with a minimum viable product (MVP) that delivers the unique value proposition. It includes the essential features and functionalities needed to meet customer expectations.
5. **Channels**: Channels represent the methods used to reach customer segments. This can include both traditional and digital marketing, communication, and distribution strategies. The goal is to identify the most effective ways to engage customers and deliver the product or service.

6. **Revenue streams**: This block addresses how the business will generate income. It includes pricing strategies, payment models, and considerations for maximizing revenue while potentially offering lower initial costs to attract customers.
7. **Cost structure**: Here, all operational costs required to bring the business to market are listed, including research and development, production, salaries, and overhead expenses. Understanding the cost structure helps in determining the financial viability of the business model.
8. **Key metrics**: Key metrics are used to track the performance of the business. Identifying the right metrics is crucial for monitoring progress, making data-driven decisions, and ensuring that the business remains on the path to success.
9. **Unfair advantage**: This section defines any unique factors that give the business a competitive edge that cannot be easily replicated or acquired by competitors. It answers the question, "What does this business have that no one else does?" This advantage must be truly unique and difficult for others to mimic.

2.1.1. Characterization of benefits for a strong value proposition

It is part of task 4.3 to articulate in the exploitable result (ER) analysis all the benefits that will be derived from the GENTE project and the exploitable results. For this reason, partners were asked to fill in a questionnaire (Appendix B and Appendix C) to understand and be able to integrate all the benefits and risks related to their results, considering:

The innovation risk and the expected impact of the ER in terms of:

- Scientific impact,
- Economic benefits,
- Environmental benefits,
- Societal benefits

2.2. Approach for the Scalability and Replicability Analysis

The SRA aims to evaluate each KER's potential for scaling up and being replicated in different contexts. The SRA framework draws from established methodologies used in other EU projects, providing a robust foundation for assessing both quantitative and qualitative factors that influence scalability and replicability. To inform the SRA approach for this deliverable, a review has been conducted of several relevant documents, including:

- D2.9 - Scalability, replicability and modularity (REUSEHEAT project, 2020)[2]

[2] https://www.reuseheat.eu/

- D3.8 - Scalability and replicability analysis (SRA) for all use cases (INTERFLEX, 2019)[3]
- D8.2 - The scalability and replicability analysis of local energy community solutions (CLUE, ERA-Net Smart Energy Systems)[4]
- D7.2 - Methodology for SRA (PLATONE)[5]
- D7.3 - Innovative business models and D7.6 - Scalability and replicability (LIGHTNESS)[6]

Following the literature review, it was decided to use a methodology similar to previous projects, adjusting it to suit energy communities, the LIGHTNESS project, and the specific ER of the GENTE project. The chosen approach involves conducting both quantitative and qualitative analyses. The methodology consists of identifying factors that affect the scalability and replicability of the GENTE KERs, drafting questions, and collecting information from the KER owners.

The evaluation of these factors is based on a scoring system, allowing for quantification of the current and potential scalability and replicability of the solutions. The methodology includes the following steps:

Quantitative analysis:

- **Step 1**: Select the key factors that affect the scalability and replicability of the KERs.
- **Step 2**: Identify question sets for each factor and assign scores to different answers. Dedicated questionnaires were prepared and sent to KER owners, with the aim of assessing their perceptions.
- **Step 3**: Score the individual factors for each KER based on the analysis of the responses.
- **Step 4**: Estimate the effectiveness ratio using the scoring procedure, which will be detailed in subsection 2.1.3. The effectiveness ratio measures the degree to which a condition contributes to scalability.
- **Step 5**: Estimate the scalability and replicability indexes.
- **Step 6**: Analyze the results.

Qualitative analysis:

- **Step 1**: Prepare a set of qualitative questions related to scalability and replicability.
- **Step 2**: Send the questionnaire to KER owners.
- **Step 3**: Analyze the answers and compare them with the quantitative analysis outcomes.
- **Step 4**: Draft the final conclusions for scalability and replicability, identifying any barriers.

This combined approach ensures a comprehensive assessment, allowing for both numerical quantification and contextual understanding of the scalability and replicability potential of the GENTE solutions. By using this multi-dimensional framework, the SRA aims to provide a thorough evaluation of each KER's ability to grow and adapt across different environments, ensuring the project's solutions are

[3] INTERFLEX
[4] The scalability and replicability analysis of Local Energy Community solutions
[5] https://platone-h2020.eu/data/deliverables/864300_M24_D7.2.pdf
[6] https://www.lightness-project.eu/resources/lightness-materials/innovative-business-models/

not only technically robust but also economically viable and socially accepted for broader implementation.

2.2.1. Identification of scalability and replicability factors

To assess the scalability and replicability of the GENTE project's KERs, it is essential to conduct a multidimensional analysis. This is necessary because various factors can significantly influence the outcomes of such assessments. The identified factors have been grouped into four categories: technical, economic, regulatory, and social factors. To facilitate the SRA, a questionnaire (Appendix A) has been sent to KER owners, allowing them to provide insights into each factor's impact. The selected factors are detailed in table 1.

Table 1 - Examples of weak and strong evidence.

Category	Factors for scalability	Factors for replicability
Technical	Modularity Technology evolution Interface Design Software integration Hardware integration Existing Infrastructure External Constraints	Standarisation Interoperability Interface Design External Constraints Technology adaptation
Economic	Economy of Scale Profitability	Business model Economy of Scale Market design
Regulatory	Regulatory issues	Regulatory issues
Stakeholder/Social	Level of Acceptance	Level of Acceptance

Factors for scalability:

- **Technical factors**:
  - **Modularity**: Refers to the design and implementation of systems in a modular manner, allowing for flexible and efficient scaling by adding or modifying individual components without disrupting the entire system.
  - **Technology evolution**: Ensures that scalability aligns with the trajectory of technological advancements, maintaining ongoing relevance and optimizing performance.
  - **Interface design**: Plays a crucial role in accommodating increased user interaction and data exchange, facilitating scalability while preserving user experience.
  - **Integration of software and hardware components**: A well-coordinated fusion of these elements ensures smooth expansion while maintaining overall system stability.
  - **Existing infrastructure**: Assesses how well current infrastructure can support increased demands and whether it can be adapted easily or requires substantial upgrades.
  - **External constraints**: Considers factors related to the location to ensure compliance during the scaling process.

- **Economic factors**:
  - **Economy of scale**: Evaluates the economies of scale, cost-effectiveness, potential growth, and potential barriers to scaling.
  - **Profitability**: Considers whether, based on previous experiences, the business model is financially viable enough for scaling.
- **Regulatory factors**:
  - **Regulatory barriers**: Examines the presence and significance of regulatory barriers that may affect the scalability of the solution.
- **Stakeholder/Social factors**:
  - **Stakeholder acceptance**: Measures the importance of stakeholder acceptance for scalability and whether comprehensive outreach strategies exist to attract new participants.

Factors for replicability:

- **Technical factors**:
  - **Standardization**: Assesses compliance with industry or international standards to ensure compatibility for replication across different locations.
  - **Interoperability**: Evaluates the ability to share and exchange information through software and hardware, which is crucial for effective communication between components for replication.
  - **Interface design**: Examines the organization of control components and how it impacts replication in diverse settings.
  - **External constraints**: Considers whether replicability is influenced by the specific infrastructure of the demonstration location and to what extent adjustments are needed for new environments.
  - **Technology adaptation**: Evaluates how easily existing technology can be modified to accommodate new energy sources, user types, contracts, or other changes.
- **Economic factors**:
  - **Business model**: Determines if the solution can be deployed in another environment without significant additional investment (in terms of time or money) for adaptation and whether economic indicators from other demonstration cases show that the business model is viable.
  - **Economy of scale**: Assesses economies of scale and cost-effectiveness, as well as potential replicability in other locations and associated barriers.
  - **Market design**: Evaluates if the solution can comply economically and technically with a different set of standards for replicability.
- **Regulatory factors**:
  - **Regulatory barriers**: Considers the presence and importance of regulatory barriers that may affect the replicability of the solution.
- **Stakeholder/Social factors**:
  - **Stakeholder acceptance**: Measures the significance of stakeholder acceptance for replicability.

2.2.2. Evaluation of scalability and replicability potential

The evaluation of scalability and replicability potential is divided into quantitative and qualitative assessments. The quantitative evaluation, following the methodology described above, is carried out in the following steps:

1. Each question is designed to measure scalability and replicability potential from different perspectives, assigning an indicator for each response.
2. Each respondent selects one answer per question, which corresponds to a specific score. The answer options are structured on a Likert scale, allowing scores to capture respondents' attitudes and opinions regarding how these factors impact the exploitation potential of the result.
3. The "maximum potential score" represents the highest possible score for each question, while the "actual score" reflects the score assigned based on the respondent's answer. A higher score indicates that a particular factor is better addressed and developed, thus enhancing scalability and replicability.
4. The "effectiveness" score is calculated as the actual score divided by the maximum potential score. This ratio measures the degree to which a factor contributes to scalability and replicability potential, standardizing the scores.
5. The "importance" score is a ranking assigned by respondents to each factor or question. A higher rank suggests that the respondent considers that factor more critical for successful upscaling or replication.
6. Importance weights are calculated to normalize the scores further, facilitating a more accurate comparison across factors.

The following table presents the calculation formulas:

Table 2 - Calculation formulas for SRA.

Question	Maximum score	Actual score	Effectiveness (%)	Importance	Importance of weights	Calculated index
#	(a)	(b)	(c) = (b)/(a)	(d)	(e)=(d)/maximum score of importance	(f)= ROUND (c)* (e)
	Pre-defined in the template	Given score by partners	Calculated with the formula	Given by R2M (presented in tables 3 and 4)	Calculated with the formula	Calculated with the formula

While the "importance" of factors may vary depending on the nature of each ER, a standardized ranking order has been established by R2M to enable consistent analysis across all KERs. The common ranking order is provided in the tables 3 and 4:

Table 3 - Assigned importance of scalability factors.

Scalability factors	Importance (Higher to lower impact)	Scoring
Modularity	3	4.5
Technology evolution	2	3
Interface Design	4	6
Software integration	5	8
Hardware integration	1	2
Existing Infrastructure	6	9
External Constraints	7	10.5
Economy of Scale	9	13.5
Profitability	11	16.5
Regulatory issues	8	12
Level of Acceptance	10	15
		100

Table 4 - Assigned importance of replicability factors.

Replicability factors	Importance (Higher to lower impact)	Scoring
Standardisation	3	6
Interoperability	4	7
Interface Design	2	4
External Constraints	5	9
Technology adaptation	1	2
Business model	8	15
Economy of Scale	6	11
Market design	7	12
Regulatory issues	10	18
Level of Acceptance	9	16
		100

3. Key exploitable results analysis

On the prior steps in the Exploitation Journey, as part of the work performed in Task 4.3, 17 ERs were identified, characterised and analysed. These 17 results were of different nature such as, products, applications, methodologies, services, and knowledge. After conducting the analysis, a list of KERs were identified for developing in Task 4.5 the business modelling and SRA. The complete analysis of ERs is described in D4.3. The list of KERs are stated in table 5.

Table 5 - Examples of weak and strong evidence.

Final list of Exploitable Results for Business Modelling	
KER5 - GENTE toolkit	All partners
KER10 - DLT-based prosumer platform	PROSUME
KER11 - DLT-based community manager platform	PROSUME
KER16 - Efficient energy service for heat pump and district heating	Energy Save

3.1. Business modelling analysis

As outlined in the methodology, the selected approach for business modelling is the Lean Business Model Canvas tool. This section compiles all responses provided by the partners, offering a deeper understanding of the KERs. This step is crucial in the exploitation journey, as completing the template encourages each partner to focus not only on the KER itself but also to consider market conditions, customer needs, target segments, channels, key metrics, cost structures, and revenue streams.

Table 6 - R2M - KER5 GENTE toolkit

KER5 - GENTE toolkit				
1) Problem: Top 3 problems • Lack of an integrated governance tool for effective management and sustainability within LECs. • Need for autonomous and optimized energy resource management to support grid flexibility and efficiency. • Difficulties in adopting and implementing advanced digital technologies due to regulatory, infrastructural, and operational challenges in LECs.	**4) Solutions: Top 3 features** • Distributed governance and autonomous energy resource management using IoT and AI. • Flexibility provision for energy networks enabled by DLT and edge processing. • Comprehensive adoption guidelines with best practices and integration steps for easy onboarding within LECs.	**3) Unique value proposition** • A fully integrated, distributed governance toolkit tailored for LECs that combines IoT, DLT, edge processing, and AI for autonomous energy management and flexibility provision to networks. • Comprehensive support for adoption through a set of best practices, guidelines, and integration recommendations specifically for LEC environments. • The toolkit directly enables the green energy transition within communities, aligning with sustainability goals and future energy	**7) Unfair advantage** • Unique integration of IoT, DLT, edge processing, and AI technologies specifically tailored to LECs, making it a one-of-a-kind solution. • Developed and validated through pilot testing, ensuring a tested and effective solution for real-world community energy management. • Includes an extensive set of guidelines and best practices, addressing regulatory and infrastructural diversity across regions.	**2) Customer segment** • LECs aiming to implement sustainable energy practices. • Energy network operators interested in integrating flexible, community-based energy resources. • Municipalities and community organizations focused on promoting renewable energy and energy independence. **Early adopters** • Pilot LECs engaged in green energy transition projects. • Innovative municipalities with active renewable energy and sustainability initiatives. • Community organizations prioritizing energy autonomy and environmental sustainability.
The main problem is: The lack of a comprehensive toolkit for LECs that integrates IoT, DLT, and AI for autonomous resource management and network flexibility, essential for sustainable community energy governance. **The existing alternatives to address the same problems**: Current solutions are fragmented,	**8) Key Metrics** • Number of LECs adopting the toolkit and fully integrating it into their operations. • Measurable energy efficiency improvements and flexibility contributions to energy networks.		**5) Channels** • Direct sales and licenses to LECs, energy networks, and municipalities. • Partnerships with community energy initiatives and governmental programs. • Case studies and pilot testing to showcase benefits and drive broader adoption.	

with separate tools for different aspects of LEC management, lacking a coordinated, holistic approach tailored to LEC needs.	• Positive feedback and satisfaction levels from pilot users, indicating ease of integration and functionality.	infrastructure needs.		
9) Cost structure • Development and integration costs for IoT, DLT, edge processing, and AI components. • IP protection and legal expenses related to the ownership and usage of various modules. • Marketing, training, and partnership-building costs for reaching target customers such as LECs, municipalities, and energy operators.			**6) Revenue Streams** • Licensing fees for toolkit usage, providing access to core and advanced functionalities. • Operation fees covering integration, support, and maintenance services. • Potential revenue from offering individual modular components as stand-alone services for specific applications.	

Table 7 - PROSUME- KER10 - DLT-based Prosumer Platform

KER10 - DLT-based Prosumer Platform				
1) Problem: Top 3 problems • Limited access for prosumers to actively participate in energy communities. • Complexity in accessing energy services autonomously. • Lack of incentives to maximize renewable energy use within communities. **The main problem is**: Difficulty for prosumers to participate in energy communities and access renewable	**4) Solutions: Top 3 features** • Intuitive interface for prosumers to engage in energy communities. • Wallet application for secure identity management, payments, and service aggregation. • Integration with incentives to encourage renewable energy use.	**3) Unique value proposition:** A secure, user-friendly platform that allows prosumers to interact with energy communities, maximize renewables use, and leverage incentives autonomously.	**7) Unfair advantage** • Tested in real-world LEC pilot programs, validating ease of use and functionality. • Proprietary integration of identity, payment, and service aggregation in one application. • Exclusive IP protection managed by PROSUME, leveraging the Hyperledger Fabric DLT.	**2) Customer segment** • Individual prosumers within LECs. • Environmentally conscious individuals seeking autonomous access to renewable energy services. **Early adopters** • Prosumers in Italian LEC pilot programs. • Early adopters of blockchain-enabled

energy services efficiently. **The existing alternatives to address the same problems**: Stand-alone applications that facilitate some aspects of prosumer interaction, but lack integration with community-wide platforms.	**8) Key Metrics** • Number of prosumers using the platform. • Increased renewable energy use within LECs. • User satisfaction ratings and feedback on interface usability.		**5) Channels** • Pilot deployments in LECs for demonstration and feedback. • Collaboration with local government programs promoting renewable energy adoption. • Direct engagement with renewable energy platforms and prosumer networks.	energy solutions and renewable energy services.
9) Cost structure • Development and maintenance costs for the DLT and wallet functionalities. • IP protection and legal expenses. • Marketing and partnership costs for outreach to prosumers and renewable energy advocates.			**6) Revenue Streams** • Licensing fees for the prosumer platform. • Subscription fees for wallet services (identity, payments, service aggregation). • Transaction fees for secure service aggregation.	

Table 8 - PROSUME- KER11 - DLT-based Community manager platform

KER11 - DLT-based Community Manager Platform				
1)Problem: Top 3 problems • Complexity in onboarding prosumers and managing interactions within energy communities. • Challenges in maximizing renewable energy use and engagement across stakeholders. • Lack of a unified tool for	**4) Solutions: Top 3 features** • Onboarding and identity management for prosumers. • Governance tools to manage community interactions and incentivize renewable energy use. • Wallet application for	**3) Unique value proposition:** A secure, integrated platform for community managers to onboard prosumers, maximize renewable energy use, and manage community interactions effectively.	**7) Unfair advantage** • Proven in pilot testing with real-world LECs, validating the platform's functionality • Comprehensive governance and onboarding features designed specifically for community managers. • Proprietary technology owned by PROSUME, ensuring a unique offering	**2)Customer segment** • Community managers responsible for overseeing and governing LECs. • Municipalities and organizations promoting community-based renewable energy projects. **Early adopters** • Community managers in Italian LEC pilot programs.

community governance that supports incentives and flexible energy management. **The main problem is**: Absence of a streamlined tool for community managers to onboard prosumers and govern interactions effectively within energy communities. **The existing alternatives to address the same problems**: Independent tools for community management, which lack comprehensive governance features tailored to LECs.	secure transactions and service aggregation.		within the market.	● Municipalities involved in renewable energy transition initiatives.
	8) Key Metrics ● Number of prosumers onboarded and managed through the platform. ● Renewable energy utilization rates within the community. ● Satisfaction and usability feedback from community managers.		**5) Channels** ● Deployment in LECs to showcase platform benefits and obtain user feedback. ● Partnerships with municipal energy initiatives to drive community adoption. ● Demonstration in case studies to illustrate benefits for community governance.	
9) Cost structure ● Development and operational costs for DLT, governance, and wallet functionalities. ● Legal and IP protection costs for proprietary technology. ● Marketing and outreach expenses for targeting community managers and municipal stakeholders.			**6) Revenue Streams** ● Licensing fees for community manager platform usage. ● Service fees for identity management and governance features. ● Consulting or training fees for integration with new communities.	

Table 9 - Energy Save - KER16 - Efficient energy service for heat pump and district heating

KER16 - Efficient energy service for heat pump and district heating				
1)Problem: Top 3 problems • Difficulty in optimizing heating sources for district heating in response to real-time market data. • High energy costs and inefficiencies in current heating systems, especially where district heating is involved. • Limited interoperability and scalability of existing heat pump solutions for diverse regulatory environments. **The main problem is**: Lack of a flexible, real-time platform that enables DSOs with district heating to optimize heating source selection based on market dynamics. **The existing alternatives to address the same problems**: Conventional heat pump systems that operate without real-time market	**4) Solutions: Top 3 features** • Real-time market-responsive control platform for optimizing heat pump operations in district heating. • Modular design for enhanced interoperability and flexibility across different countries and regulatory environments. • Energy management algorithms developed in collaboration with Chalmers, integrated by Energy Save.	**3) Unique value proposition** • A real-time control and management platform for DSOs that optimizes heating source selection for district heating based on live market data, improving efficiency and reducing costs. • Modular and interoperable design, adaptable to diverse regulatory environments and market conditions.	**7) Unfair advantage** • Proven IP protection and established product base owned by Energy Save, with interoperability enhancements developed through collaboration with Chalmers. • Unique real-time optimization based on market data, allowing DSOs to dynamically adjust heating source choices for cost savings and efficiency • High relevance in the growing heat pump market, with scalability and adaptability for various international markets.	**2)Customer segment** • District heating operators (DSOs) aiming to improve energy efficiency and reduce operational costs. • Municipalities and energy utilities seeking to optimize district heating networks. • Industrial users and large-scale buildings utilizing heat pumps and district heating. **Early adopters** • DSOs in Sweden, where regulatory conditions and infrastructure support district heating optimization. • Municipalities or utilities in regions focused on energy efficiency and sustainable heating solutions.

responsiveness and lack modular, interoperable designs for district heating.	**8) Key Metrics** • Number of DSOs and municipalities adopting the platform. • Reduction in energy costs and operational efficiency improvements reported by users. • User satisfaction and ease of integration in diverse regulatory environments.		**5) Channels** • Direct sales to DSOs and large-scale industrial users. • Turn-key solutions and integration partnerships with municipalities and energy utilities. • Strategic partnerships with other technology providers seeking to integrate the heat pump platform a	
9) Cost structure • Development costs for platform interoperability and market-responsive algorithms. • IP protection and collaboration expenses with Chalmers. • Marketing and sales expenses focused on reaching DSOs and key industrial users in target regions.			**6) Revenue Streams** • Direct sales revenue from platform deployment. • Service fees for custom integration and ongoing support. • Licensing fees for specific interoperable functionalities tailored to various regulatory contexts.	

3.2. SRA of the GENTE's KERs

This section provides a detailed assessment of the scalability and replicability potential for each KER within the GENTE project. Using a structured questionnaire across key factors—including technical, economic, regulatory, and social dimensions—this analysis evaluates each KER's adaptability to larger scales and new environments. The resulting scores reflect the strengths and challenges for each KER in scaling up and replicating in diverse contexts, identifying both opportunities for impact expansion and areas requiring additional support.

3.2.1. GENTE toolkit (KER05)

This section examines the scalability and replicability of KER5 - the GENTE Toolkit. As detailed in previous deliverables, this KER provides a comprehensive toolkit designed to support LECs by integrating advanced digital technologies—such as IoT, DLT, and AI—into autonomous energy management systems. The toolkit enables LECs to optimize resource use, enhance sustainability, and support flexibility in energy networks. As part of its business model, the GENTE Toolkit also includes guidelines and best practices for adoption, which are tailored to various socio-economic and policy contexts, enhancing its adaptability and relevance across diverse regions and community settings.

Scalability analysis for GENTE toolkit

Table 10 - Scalability analysis for KER05

Scalability factors	Score (b)	Maximum potential score (a)	Effectiveness (c) = (b)/(a)	Scoring (e)	Calculated index (f) = ROUND ((c)*(e))
Modularity	6	6	100%	4.5	5
Technology evolution	6	6	100%	3	3
Interface Design	4	6	67%	6	4
Software integration	5	5	100%	8	8
Hardware integration	3	3	100%	2	2
Existing Infrastructure	5	6	83%	9	8
External Constraints	3	4	75%	10.5	8
Economy of Scale	9	13	69%	13.5	9
Profitability	3	3	100%	16.5	17
Regulatory issues	3	4	75%	12	9
Level of Acceptance	5	6	83%	15	13
					86

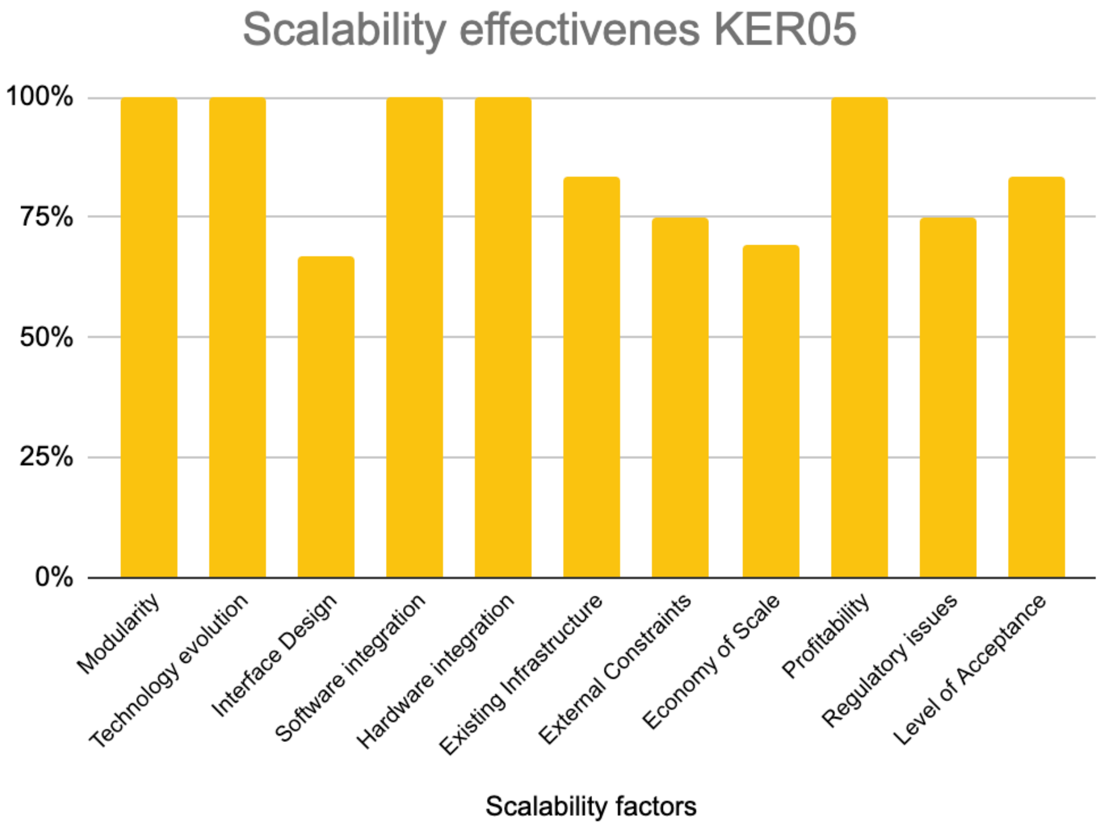

Figure 2 - Scalability effectiveness by factor for KER05

Based on insights from both quantitative and qualitative analyses, several key points highlight the scalability potential of KER05. The scalability index for the GENTE Toolkit is 86, indicating a reasonable level of scalability.

From a technical perspective, the GENTE Toolkit is designed to be adaptable regardless of the size of the energy community it serves, with minimal technical limitations or physical constraints. Key functions, such as managing energy resources and optimizing flexibility, remain effective across varying community scales, with larger communities potentially benefiting from enhanced accuracy in resource management. Thus, the toolkit is scalable in terms of both community size and operational density.

Economically, the GENTE Toolkit's business model has demonstrated viability and adaptability to different stages of energy community development. This flexibility supports the evolving needs of energy communities, ensuring it remains valuable as community energy demands grow over time.

The analysis also identifies certain challenges and barriers to scalability:

1. **Regulatory environment**: The effectiveness and scalability of the GENTE Toolkit are influenced by the regulatory landscape. Limited incentives or gaps in policy may reduce financing options for energy community projects.
2. **External constraints**: Location-dependent factors, closely tied to regulatory conditions, play a significant role in affecting scalability outcomes.

3. **Size-dependent incentives**: Some available incentives may vary based on the community's size, such as installed capacity or proximity of energy generation to consumption points, and should be factored in when scaling the toolkit's application to different projects.

Replicability analysis for GENTE toolkit

Table 11 - Replicability analysis for KER05

Replicability factors	Score (b)	Maximum potential score (a)	Effectiveness (c) = (b)/(a)	Scoring (e)	Calculated index (f) = ROUND ((c)*(e))
Standardisation	3	3	100.00%	6	6
Interoperability	2	2	100.00%	7	7
Interface Design	2	3	66.67%	4	3
External Constraints	3	4	75.00%	9	7
Technology adaptation	3	3	100.00%	2	2
Business model	6	7	85.71%	15	13
Economy of Scale	16	17	94.12%	11	10
Market design	3	4	75.00%	12	9
Regulatory issues	5	6	83.33%	18	15
Level of Acceptance	3	4	75.00%	16	12
					84

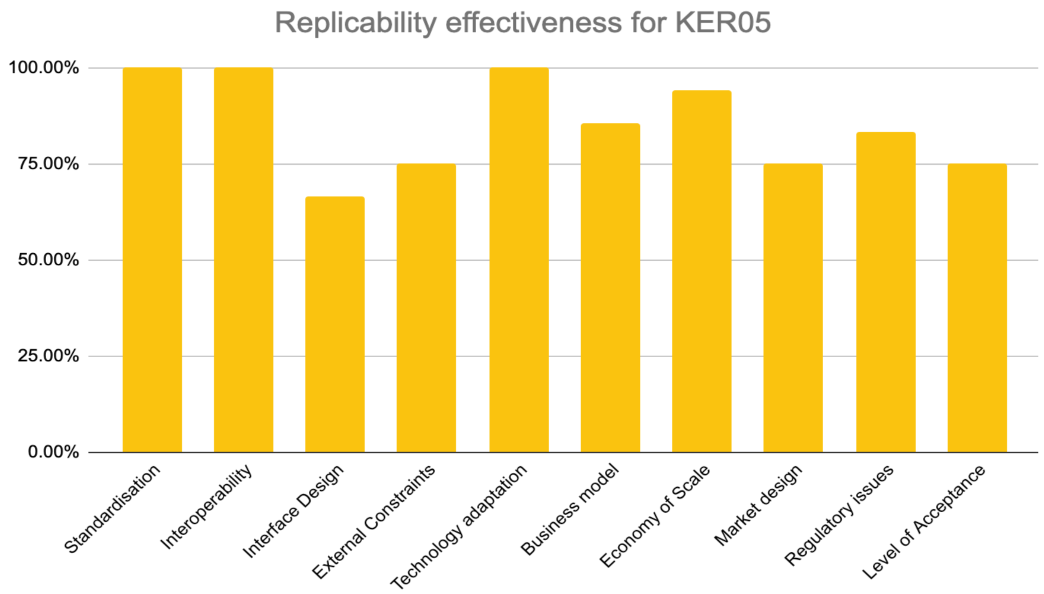

Figure 3 - Replicability effectiveness by factor for KER05

Based on insights from both quantitative and qualitative analyses, several key points highlight the replicability potential of KER05. The replicability index for the GENTE Toolkit is 84, indicating moderate replicability.

Replicability within the same country is reasonably high, as regulations, economic incentives, and social behaviors tend to be consistent. However, regional variations in incentives may require adjustments for optimal deployment. Beyond providing tools to support energy management in LECs, the GENTE Toolkit aims to facilitate integration into a platform for broader community engagement, combining multiple financing options, including crowdfunding, to support deployment.

The GENTE Toolkit has shown profitability when implemented in diverse locations, as demonstrated by ongoing projects in Spain, Italy, and Tanzania. However, certain barriers to replicability have been identified:

1. **Location and Regulatory Dependency**: Although designed for versatile application, the financial analysis is highly dependent on specific regulatory and locational contexts. This dependency requires additional time, effort, and financial resources for adaptation, making intra-national replication easier than international replication.
2. **Standardization**: Standardization across different regions and countries is limited, necessitating significant adaptation efforts to align with varying local contexts.
3. **Stakeholder Acceptance**: Gaining stakeholder acceptance is crucial for new implementations. Therefore, engaging stakeholders early is essential when replicating in new markets to ensure successful deployment and adoption.

3.2.2. DLT-based prosumer platform (KER10)

This section examines the scalability and replicability of KER10, a customizable platform designed for the management of LEC projects. The platform can be tailored to meet specific needs within LECs and integrates seamlessly with planning tools to enhance project coordination and community energy management. A data acquisition system is embedded within the platform, gathering real-time data from smart meters and converting it into accessible, analyzable formats for effective processing directly within the platform.

Scalability analysis for DLT-based prosumer platform

Table 12 - Scalability analysis for KER10

Scalability factors	Score (b)	Maximum potential score (a)	Effectiveness (c) = (b)/(a)	Scoring (e)	Calculated index (f) = ROUND ((c)*(e))
Modularity	5	6	83%	4.5	4
Technology evolution	6	6	100%	3	3
Interface Design	3	6	50%	6	3
Software integration	5	5	100%	8	8
Hardware integration	3	3	100%	2	2
Existing Infrastructure	6	6	100%	9	9
External Constraints	4	4	100%	10.5	11

Economy of Scale	9	13	69%	13.5	9
Profitability	3	3	100%	16.5	17
Regulatory issues	4	4	100%	12	12
Level of Acceptance	4	6	67%	15	10
					88

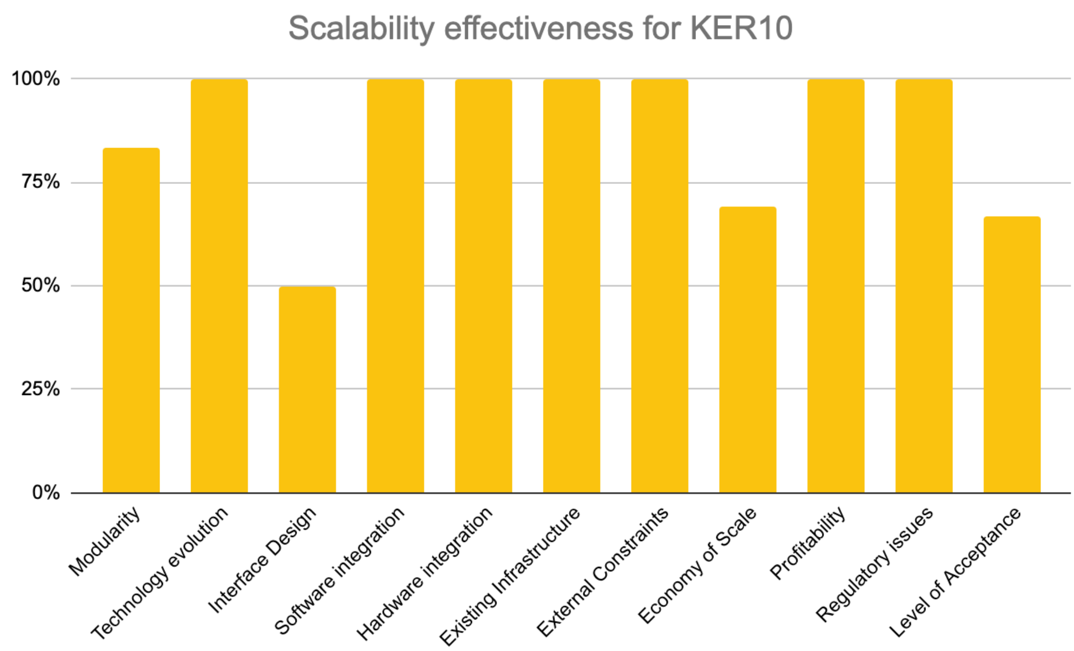

Figure 3 - Scalability effectiveness by factor for KER10

Based on insights from both quantitative and qualitative analyses, several key points highlight the scalability potential of KER10. The scalability index for this platform is 88, indicating a high degree of scalability.

The DLT-based Prosumer Platform is designed to support a wide range of projects, provided that relevant data is accessible. The platform easily incorporates additional data elements—whether related to more users, increased energy exchange, or added assets—making it highly adaptable. In fact, as the volume of data increases (e.g., from energy consumption, generation, or trading), the platform's analytic accuracy and efficiency improve. For energy trading within the platform, better economic outcomes were observed with a larger member base, up to a threshold beyond which further member growth had no additional impact on economic results.

From an economic standpoint, the platform's current business model has demonstrated viability across multiple projects, showing that it is financially sustainable and ready for scaling. However, the analysis has identified a few key challenges:

1. **Regulatory environment**: The platform's usage is heavily influenced by regional regulations. For instance, in many EU countries, energy trading among community members is restricted, limiting the platform's applicability for peer-to-peer or community energy trading services.
2. **Stakeholder acceptance**: Scalability depends significantly on stakeholder consent, particularly as users must be comfortable with data monitoring within the platform.
3. **Data availability**: Given the platform's reliance on data, scaling a project requires the ability to collect and integrate data from all relevant components.

Replicability analysis for DLT-based prosumer platform

Table 13 - Replicability analysis for KER10

Replicability factors	Score (b)	Maximum potential score (a)	Effectiveness (c) = (b)/(a)	Scoring (e)	Calculated index (f) = ROUND ((c)*(e))
Standardisation	3	3	100.00%	6	6
Interoperability	2	2	100.00%	7	7
Interface Design	1	3	33.33%	4	1
External Constraints	4	4	100.00%	9	9
Technology adaptation	3	3	100.00%	2	2
Business model	7	7	100.00%	15	15
Economy of Scale	16	17	94.12%	11	10
Market design	4	4	100.00%	12	12
Regulatory issues	6	6	100.00%	18	18
Level of Acceptance	3	4	75.00%	16	12
					92

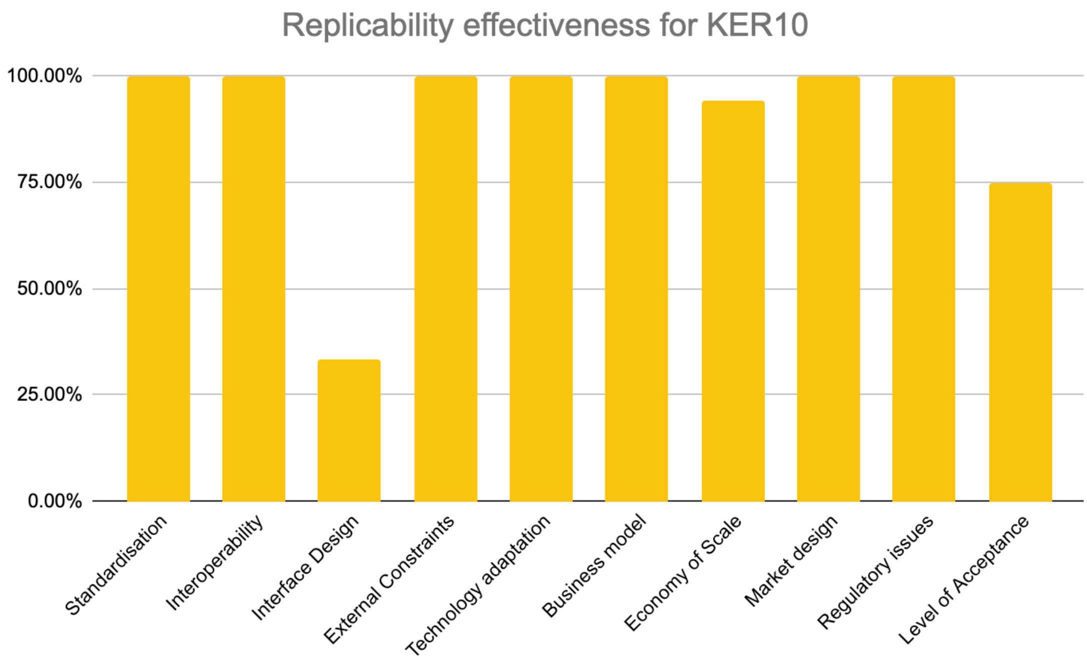

Figure 4 - Replicability effectiveness by factor for KER10

Based on both quantitative and qualitative analyses, several key insights illustrate the replicability potential of KER10. The replicability index for this platform is 92, indicating a high level of replicability.

The DLT-based Prosumer Platform is designed with commercial scalability in mind, emphasizing ease of replication through standardization and interoperability. As part of the company's growth strategy, the platform's architecture allows for data acquisition across different regions, thanks to standard data exchange protocols that facilitate data collection in various locations and countries. Intra-national replication is more feasible, as the solution can generally be deployed with minimal investment in regions with similar regulatory environments.

Key barriers to replicability include:

1. **Regulatory Environment**: The platform's functionality, such as peer-to-peer or peer-to-pool trading, is significantly impacted by local regulations. These limitations may restrict the platform's full capabilities in certain regions.
2. **Community Leadership Requirement**: For the platform to effectively support different communities, each community requires a designated leader. This individual acts as the main point of contact, making decisions based on the platform's insights and defining the necessary features. Thus, a community leader is essential for successful replication.
3. **User Support Challenges**: The main challenge identified is user support. Feedback indicates a steady volume of user inquiries that need resolution. Expanding to new countries would require multilingual support aligned with the platform's growth to ensure that each new project has access to adequate customer support.

3.2.3. DLT-based community manager platform (KER11)

This section examines the scalability and replicability of KER11, a customizable platform designed for the management of LEC projects. The platform can be tailored to meet the specific administrative and operational needs of LECs and integrates seamlessly with planning tools to streamline project coordination and facilitate effective community energy management. It includes a data acquisition system that gathers real-time data from smart meters, converting it into accessible, analyzable formats for efficient processing directly within the platform.

Scalability analysis for DLT-based community manager platform

Table 14 - Scalability analysis for KER11

Scalability factors	Score (b)	Maximum potential score (a)	Effectiveness (c) = (b)/(a)	Scoring (e)	Calculated index (f) = ROUND ((c)*(e))
Modularity	5	6	83%	4.5	4
Technology evolution	6	6	100%	3	3
Interface Design	4	6	67%	6	4
Software integration	5	5	100%	8	8
Hardware integration	3	3	100%	2	2
Existing Infrastructure	5	6	83%	9	8
External Constraints	2	4	50%	10.5	5
Economy of Scale	8	13	62%	13.5	8
Profitability	3	3	100%	16.5	17
Regulatory issues	2	4	50%	12	6
Level of Acceptance	4	6	67%	15	10
					75

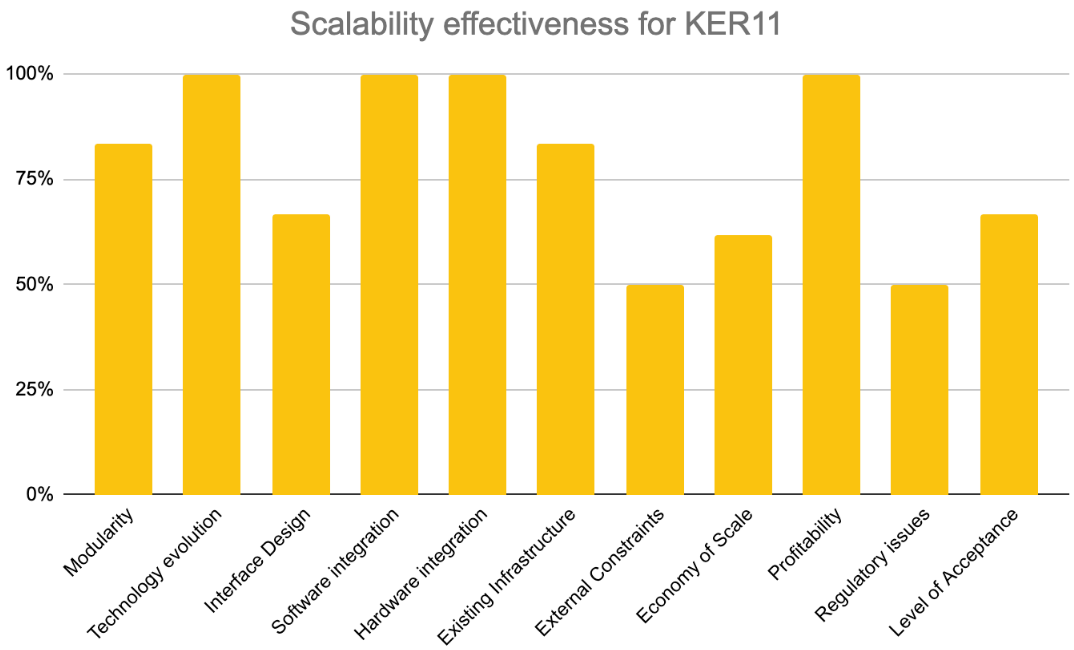

Figure 5 - Scalability effectiveness by factor for KER11

Based on insights from both quantitative and qualitative analyses, several key points highlight the scalability potential of KER11. The scalability index for this platform is 75, indicating a high level of scalability.

The DLT-based Community Manager Platform is designed to be modular and highly adaptable, supporting a range of community energy projects with minimal interaction and additional costs. Once a project is established within the platform, it can be easily scaled to accommodate larger projects, integrating additional community members, new energy assets, and expanded infrastructure as needed. This adaptability makes the platform highly scalable in terms of both density and project size.

The platform's cloud-based infrastructure, hosted on a scalable service, allows it to automatically adjust to increased computational demands, further enhancing its scalability potential. No significant barriers to scalability have been identified within the platform's current design and infrastructure.

Replicability analysis for DLT-based community manager platform

Table 15 - Replicability analysis for KER11

Replicability factors	Score (b)	Maximum potential score (a)	Effectiveness (c) = (b)/(a)	Scoring (e)	Calculated index (f) = ROUND ((c)*(e))
Standardisation	1	3	33.33%	6	2
Interoperability	2	2	100.00%	7	7
Interface Design	2	3	66.67%	4	3
External Constraints	4	4	100.00%	9	9
Technology adaptation	3	3	100.00%	2	2

Business model	6	7	85.71%	15	13
Economy of Scale	15	17	88.24%	11	10
Market design	3	4	75.00%	12	9
Regulatory issues	3	6	50.00%	18	9
Level of Acceptance	3	4	75.00%	16	12
					76

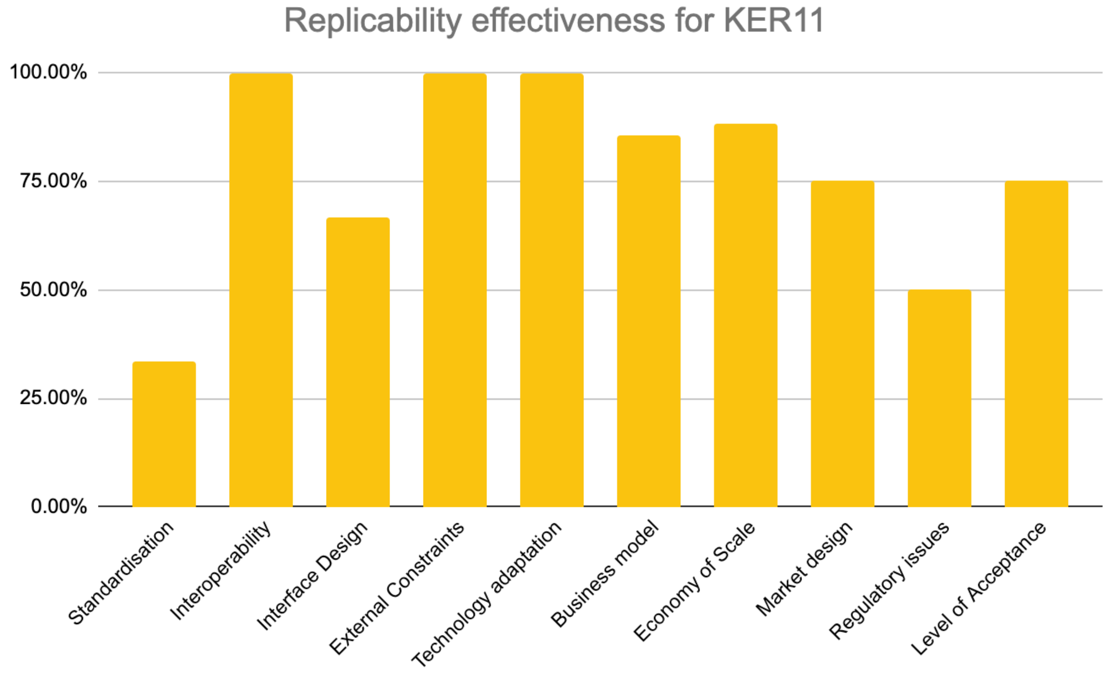

Figure 6 - Replicability effectiveness by factor for KER11

Based on both quantitative and qualitative analyses, several key insights illustrate the replicability potential of KER11. The replicability index for this platform is 76, indicating moderate to high replicability.

The DLT-based Community Manager Platform is designed to be location-agnostic, enabling deployment across multiple regions without being limited by geographical constraints. Although certain countries impose regulatory limitations on aspects like energy community formation and energy sharing back to the grid, the platform itself can incorporate these considerations without difficulty, even if full implementation depends on local regulations. Data acquisition is also streamlined, as standard data exchange protocols facilitate data collection across different locations and countries. Additionally, the platform includes various climate standards, allowing it to adjust to and reflect climate differences worldwide, further supporting its replicability.

However, a significant barrier to replicability is the variation in energy community adoption and regulatory support across countries. The platform will primarily be relevant in regions where energy communities are legally supported. Furthermore, creating accurate community models requires active participation and data sharing from community members, making stakeholder acceptance crucial. Thus, stakeholder engagement remains one of the most important factors influencing replicability.

3.2.4. Efficient energy service for heat pump and district heating (KER16)

This section presents the results of the SRA for KER16, an efficient energy service designed to optimize heat pump and district heating operations. This service provides a practical framework for integrating real-time data and market dynamics to support decision-making by energy operators. It includes a set of management tools tested in various settings, allowing partners to enhance energy efficiency and sustainability in diverse district heating contexts.

Scalability analysis for Efficient energy service for heat pump and district heating

Table 16 - Scalability analysis for KER16

Scalability factors	Score (b)	Maximum potential score (a)	Effectiveness (c) = (b)/(a)	Scoring (e)	Calculated index (f) = ROUND ((c)*(e))
Modularity	5	6	83%	4.5	4
Technology evolution	6	6	100%	3	3
Interface Design	4	6	67%	6	4
Software integration	6	5	120%	8	10
Hardware integration	3	3	100%	2	2
Existing Infrastructure	5	6	83%	9	8
External Constraints	2	4	50%	10.5	5
Economy of Scale	9	13	69%	13.5	9
Profitability	3	3	100%	16.5	17
Regulatory issues	2	4	50%	12	6
Level of Acceptance	4	6	67%	15	10
					78

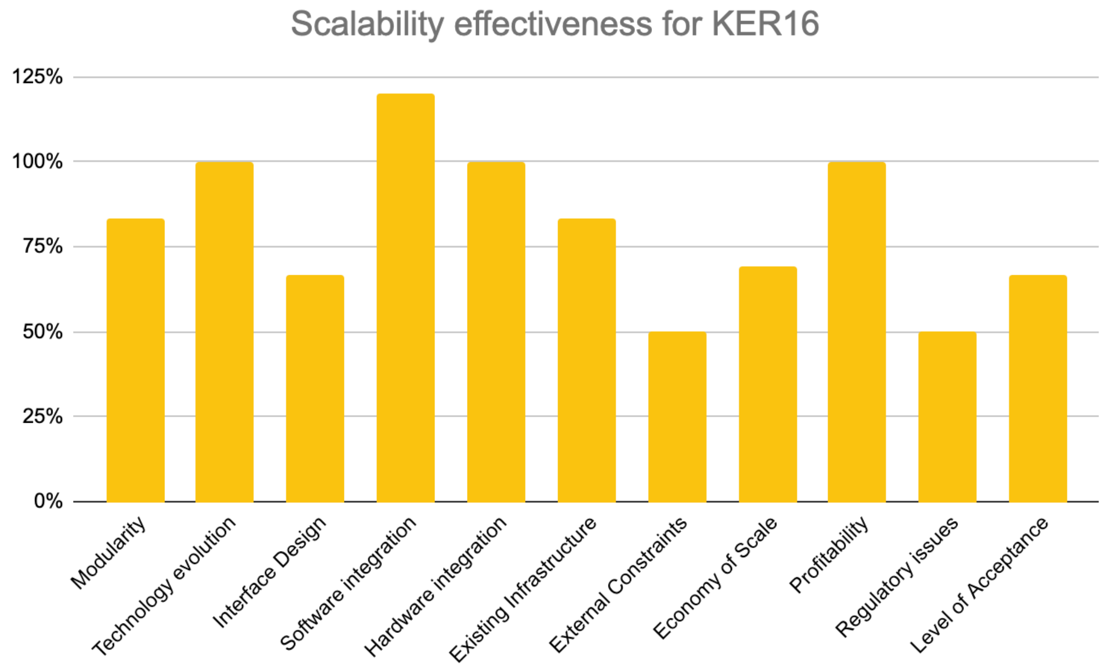

Figure 7 - Scalability effectiveness by factor for KER16

Based on insights from both quantitative and qualitative analyses, several key points highlight the scalability potential of KER16. The scalability index for this service is 78, indicating a high level of scalability.

The efficient energy service for heat pump and district heating is designed to adapt flexibly to diverse operational contexts, provided that a preliminary analysis of local conditions has been conducted. This modular solution can be easily scaled and adjusted to meet various needs, whether by adding new tools or applying the same tools to larger district heating networks. The service benefits from demand-driven growth, with increased usage and community needs further enhancing its functionality.

The platform operates independently of most regulatory or physical constraints, requiring only slight adjustments to align with specific user requirements. Nonetheless, the analysis identified several key challenges:

1. **Regulatory variation across regions**: Different regulations related to energy management, data use, and district heating infrastructure may affect scalability, particularly in regions with strict regulatory requirements.
2. **Integration with existing infrastructure**: Scaling the service to function within established district heating systems may require technical adjustments, especially for legacy systems not originally designed for real-time data integration and optimization.
3. **Stakeholder and user engagement**: Successful adoption requires buy-in from district heating operators and end users, as their active involvement is critical to optimizing heat pump operations. Customizing the service to align with operator practices and user expectations is essential for broader scalability.

Replicability analysis for Efficient energy service for heat pump and district heating

Table 17 - Replicability analysis for KER16

Replicability factors	Score (b)	Maximum potential score (a)	Effectiveness (c) = (b)/(a)	Scoring (e)	Calculated index (f) = ROUND ((c)*(e))
Standardisation	3	3	100.00%	6	6
Interoperability	2	2	100.00%	7	7
Interface Design	2	3	66.67%	4	3
External Constraints	2	4	50.00%	9	5
Technology adaptation	3	3	100.00%	2	2
Business model	5	7	71.43%	15	11
Economy of Scale	13	17	76.47%	11	8
Market design	2	4	50.00%	12	6
Regulatory issues	4	6	66.67%	18	12
Level of Acceptance	2	4	50.00%	16	8
					68

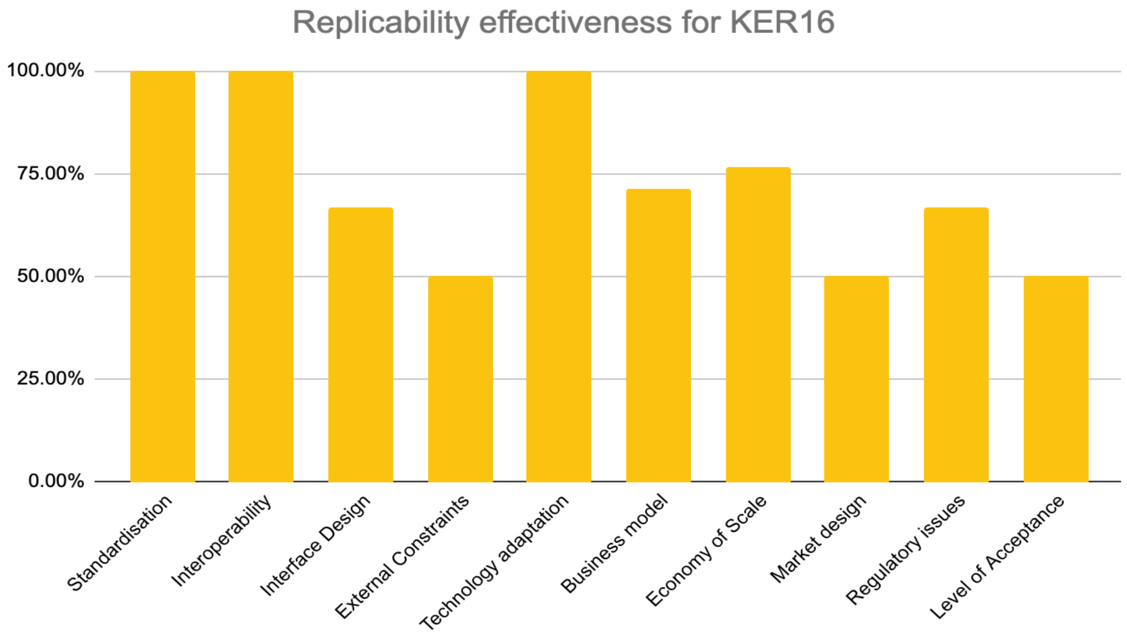

Figure 8 - Replicability effectiveness by factor for KER16

Based on both quantitative and qualitative analyses, several key points highlight the replicability potential of KER16. The replicability index for this service is 66, indicating a moderate level of replicability.

The energy service for heat pump and district heating can be replicated across different locations, provided that adjustments are made to accommodate local energy needs and regulatory requirements.

While the core functionalities of the service remain applicable across diverse regions, certain adaptations are necessary to align with local market dynamics and infrastructure requirements. Due to the modular design, the service can be tailored to specific energy systems in various locations, as long as local data is available and relevant adjustments are made.

The analysis also identifies some barriers to replicability:

1. **Local context understanding**: It is essential to understand the specific context in which the service will be applied, as different regions may have unique operational, climate, and regulatory requirements. This contextual knowledge is crucial for effective adaptation.
2. **Regulatory and infrastructure alignment**: Although the core service is designed to be versatile, adapting to different regulatory environments and district heating infrastructures may require additional adjustments and effort.
3. **Translation and localization of user interfaces**: The service interface and any supporting materials may need translation and localization to meet the language and cultural needs of end users, which could require additional resources.
4. **User-specific requirements**: Each deployment will have unique client needs related to economic factors, demographic factors, and user expectations, which vary from project to project. Customizing the service to these requirements is essential for successful replication.

4. Wider replication potential of GENTE

This section provides an analysis of the broader replication potential of the GENTE project's KERs across diverse European markets, assessing how GENTE's innovative solutions for LECs can be adapted and scaled in various regional contexts. As Europe moves toward decentralizing and diversifying its energy systems, GENTE's solutions are well-positioned to support this transition, aligning with both regulatory initiatives and community-driven energy goals.

Each KER within GENTE offers unique advantages for replication, depending on the regulatory environment, market infrastructure, and community needs in different regions:

- **GENTE Toolkit (KER5)**: Developed by all partners, this toolkit is a resource designed to enhance LEC management and stakeholder engagement, adaptable to markets with a strong focus on community energy and citizen involvement.
- **DLT-Based prosumer platform (KER10) and Community manager platform (KER11)**: Developed by PROSUME, these platforms offer secure, blockchain-enabled solutions for energy prosumers and community managers, particularly suited to regions with high smart meter penetration and supportive frameworks for decentralized energy transactions.
- **Efficient energy service for heat pump and district heating (KER16)**: Managed by Energy Save, this service optimizes district heating and heat pump management and has high replication potential in markets with established heating infrastructure and favorable regulations for efficient energy use.

The evaluation of these KERs across different European contexts, different key opportunities have been identified for wider replication and scaling of GENTE solutions . Challenges, such as regulatory variations and the need for localized stakeholder engagement, are also considered, with strategic recommendations for overcoming these barriers to ensure successful deployment and long-term impact in new markets.

5. Conclusion

This deliverable presents the journey of developing business models and evaluating the scalability and replicability potential of GENTE's KERs. Through a focused analysis, four KERs were identified as the core outputs with potential for wide impact across European markets. Each KER was assessed with the Lean Business Model Canvas approach, enabling an in-depth understanding of value propositions, customer needs, and the paths to economic viability for market entry and growth. The Lean Business Model Canvas provided a practical framework that focused on clear client needs and value alignment, ensuring each KER's readiness for market adoption.

Alongside business model development, the scalability and replicability analysis (SRA) offers insights into each KER's potential for market expansion and adaptability across different regulatory and geographic contexts. Using a multi-dimensional SRA methodology, GENTE partners assessed technical, economic, regulatory, and stakeholder-related factors for each KER, identifying both enablers and challenges to broader adoption. For example, while solutions like the DLT-based prosumer and community manager platforms demonstrated high scalability potential, they face regulatory challenges in certain regions that limit full functionality. Similarly, the GENTE toolkit and efficient energy service for heat pumps and district heating revealed opportunities for regional scaling but also highlighted the importance of stakeholder acceptance and local adaptation.

The combined insights from the business model and SRA evaluations provide a comprehensive foundation for the next steps in GENTE's exploitation journey. Moving forward, partners can focus on further refining exploitation strategies, securing IP protections, and addressing the identified barriers through tailored commercialization and replication plans. With these steps, GENTE's solutions can be successfully integrated into diverse energy markets, supporting Europe's transition to sustainable, decentralized energy systems.

FUNDING

Smart Energy Systems ERA-Net

This project has received funding in the framework of the joint programming initiative ERA-Net Smart Energy Systems' focus initiative Digital Transformation for the Energy Transition, with support from the European Union's Horizon 2020 research and innovation programme under grant agreement No 883973.

Appendix A - Quantitative analysis

Scalability questions

Factor	Question	Score
TECHNICAL FACTOR		
1. Modularity	Can the solution be divided into interdependent components/independent functional units?	3 - Independent functional units clearly defined 2 - Component division, somewhat clear 1 - Not clear if the solution could be divided
	How easily can the tools and services handle increased demand and usage as the energy community project grows?	3 - Easily 2 - With some difficulties 1 - Difficult
2. Technology evolution	Is the underlying technology and infrastructure designed to support scaling without major disruptions or bottlenecks?	3 - Fully/adequately 2 - Partially 1 - Will have disruptions and bottlenecks
	How well do the tools and services perform when subjected to increased workloads or data volumes as the community size increases?	3 - well 2 - Decent 1 - With difficulties
3. Interface Design	How is the control of components in your solution organised: Centrally, Decentralised or both?	3 - Centralised 2 - Both 1 - Decentralized
	Is the interface designed so that new systems related to scalability can be added?	3 - Fully/adequately addressed 2 - Partially addressed 1 - Not addressed at all
4. Software integration	The design of software permits the integration of more elements	2 - Yes 1 - No
	Is the size of the community (in terms of number of users, assets, or data) relevant for the exploitable result?	3 - Independent of size 2 - Slightly dependent on size 1 - Strongly dependent on

		size
5. Hardware integration	Is it possible to add more hardware components to the current solution?	3 - Easily 2 - Yes with some difficulties 1 - Difficult
6. Existing infrastructure	Are there physical size limitations to use your exploitable result in an EC?	3 - No 2 - Not of importance 1 - Yes
	Presence of weak elements (network configuration, specific parts of network or specific required infrastructure, size limitation)	3 - No 2 - Not of importance 1 - Yes
7. External Constraints	Is the scalability of the solution influenced by the specific location of your demo?	4 - No influence 3 - Yes, minor influence 2 - Yes, certain influence 1 - Yes, major influence
ECONOMIC		
8. Economy of Scale	If the size of your solution increases, how do you think the cost and benefit of your solution would increase (economies of scale and cost-effectiveness)?	3 - Yes, cost and benefit would increase 2 - No, cost and benefit would not increase 1 - Not yet considered
	Do you foresee evolutions in the short to medium term which will have a positive influence on the cost-benefit ratio of your solution from scalability point of view?	3 - Yes, evolutions with major influence 2 - Yes, evolutions with minor influence 1 - No
	Are there any economic barriers with respect to scalability that could affect the solution?	1 - No 2 - Yes, minor 3 - Yes, some 4 - Yes, Major
	Can the current business model be scaled up to a bigger project?	1 - Yes 2 - No 3 - Not yet considered
9. Profitability	The economic indicators of previously performed projects show that the business model is viable enough to scale up	3 - Yes 2 - No 1 - Not yet considered

REGULATORY		
10. Regulatory issues	Are there any regulatory barriers with respect to Scalability that could affect the solution?	4 - No barriers 3 - Yes, minor barriers 2 - Yes, some barriers 1 - Yes, major barriers
STAKEHOLDER		
11. Level of Acceptance	Is the stakeholder acceptance important regarding Scalability potential for your solution?	4 - Yes, of major importance 3 - Yes, of some importance 2 - Yes, of minor importance 1 - No importance
	Does the project have a comprehensive outreach strategy to attract new participants?	2- Yes 1 - No

Replicability questions

Factor	Question	Scoring guide
TECHNICAL		
1. Standardisation	Is the solution standard compliant to be replicated in other places?	3 - Yes, can be replicated in other countries 2 - Yes, can be replicated within the same country (main market of KER partner) 1 - Have to be adjusted to different locations
2. Interoperability	There is the ability to share data via software and hardware	2 - Yes 1 - No
3. Interface Design	Readiness for replicability: How will the control of components in your solution be organised: Centrally, Decentralised or both?	3 - Centralised 2 - Both 1 - Decentralised
4. External Constraints	Is the replicability of the solution influenced by the specific infrastructure of the location of your demo?	4 - No influence 3 - Yes, minor influence 2 - Yes, some influence 1 - Yes, major influence

5. Technology adaptation	How easily can the existing technology be adapted or upgraded to match the energy sources available in the new location?	3 - Easily 2 - With some effort 1 - With major effort
ECONOMICAL		
6. Business model	Based on the own experience, do you think that solution could easily be deployed in another environment without additional investment on adjusting the solution to the new location (time/money)?	4 - Yes, with minor investment 3 - Yes, with some investment 2 - Yes, with major investment 1 - No
	The economic indicators of other demo cases demonstrate that the business model is viable enough to replicate	3 - Yes 2 - No 1 - Not yet considered
7. Economy of Scale	Have you evaluated different options (locations, network topology...) before the implementation?	3 - Yes, with good results 2 - No 1 - Yes, with bad results
	Do you foresee evolutions in the short to medium term which will have a positive influence on the cost benefit ratio of your solution from a replicability point of view?	4 - Yes, evolutions with major influence 3 - Yes, evolutions with some influence 2 - Yes, evolutions with minor influence 1 - No
	From replicability point of view do you think the solution would be profitable if implemented in other countries?	3 - Yes 2 - It depends on the location 1 - No
	From replicability point of view do you think the solution would be profitable if implemented in other locations within the same country?	3 - Yes 2 - It depends on the location 1 - No
	Are there any economic barriers with respect to Replicability that could affect the solution?	4 - No barriers 3 - Yes, minor barriers 2 - Yes, some barriers 1 - Yes, major barriers

8. Market design	Do you think that you could make the study case solution easily (economically and technically) compliant with a defined different set of standards?	4 - Yes, with minor change 3 - Yes, with some change 2 - Yes, with major change 1 - No
REGULATORY		
9. Regulatory issues	Are there any regulatory barriers that could affect the replicability of the solution in different countries?	4 - No 3 - Yes, minor barriers 2 - Yes, some barriers 1 - Yes, major barriers
	Does your solution depend on elements of current national or regional regulation that are necessary for your solution to be feasible and viable?	2 - No 1 - Yes
ACCEPTANCE		
10. Level of Acceptance	Is the stakeholder acceptance important regarding Replicability potential for your solution?	4 - No 3 - Yes, of minor importance 2 - Yes, of some importance 1 - Yes, of major importance

Qualitative analysis

Scalability

- Is the use of the result dependent on the community size?
- Can the result adapt to changing increasing community energy needs over time?
- How does the technology/service handle increased demand or usage
- Describe replicability challenges and barriers identified for the use of your result

Replicability

- Is the technology or service designed for easy replication in other projects?
- Is it relevant the location of the new project (same country or different one?)
- Can it be adapted to fit different regulatory environments and community structures?
- Describe replicability challenges and barriers identified for the use of your result

Appendix B - KER Assessment questionnaire

This appendix contains the template elaborated to assess the KER. This template was completed for each of the ER of the project, so that the innovation level and risk degree of each ER could be addressed, and the ER could be classified based on these aspects, as shown in Figure 4. The data gathered through this template was also used to elaborate section 4.

Exploitable result assessment

ERs will be considered as KERs if they reach a high score with the below questionnaire. Evidence is used to support the underlying hypothesis of the ER indicator. The strength of a piece of evidence determines how reliably the evidence helps support or refute a hypothesis.

Weak evidence	Strong(er) evidence
Opinions (beliefs)	Facts (events)
What people say	What people do
Lab setting	Real world setting
Small investments: signing up by email to show interest in an upcoming product or service is a small investment	Large investments: Pre-purchasing a product or service or putting one's professional reputation on the line is an important investment

A brief explanation for each of the indicators is provided in Appendix C.

Expected impact of your ER

Indicator	Value (Please adjust)	Evidence (Please precise)
Scientific impact		
Creation of high quality knowledge	None - Major	
Strengthening human capital in R&D	None - Major	
Fostering diffusion of open science	None - Major	
Economic impact		
Area of deployment (internal / external)	Within the organization - On the market	
If external (market) deployment:		

Size of the untapped market	Small - Large	
Type of addressable market	Existing - New	
Market need	Not clear - Clear	
Market grow	Low - High	
Scalability of the business model	Poor - Very good	
Environmental impact		
Fossil fuel consumption	Decrease - increase	
Carbon footprint	Small - Large	
Local air pollution	Small - Large	
Societal impact		
Energy poverty	None - Reduced	
Energy Citizenship	Low - High	
Social exclusion	None - Reduced	
Job creation	None - Many	

Innovation risk of your ER

Indicator	Value	Evidence
ER ownership	None - Clear	
Type of innovation	Incremental - Adjacent - Transformational	
Completeness of technology	TRL1 - TRL9	
Additional development needed	Major - None	
IP protection	Weak - Strong	
Management support	None - Committed	
Alternative solutions	Better alternatives - No alternatives	
Regulatory hurdles	Yes - No	

Innovation Radar[7]: Actions and needs for support

Only for ERs with commercialization perspectives

Indicate the step(s) in order to bring the innovation to (or closer to) the market:

	Done or ongoing	Planned	Not planned but desirable	Not planned & not needed
Market study				
Feasibility study				
Business Plan				
A partner's research team and business units are both engaged in activities relating to this innovation				
Raise funding from public sources				
Raise capital				
Pilot, Demonstration or Testing activities				
Prototyping in laboratory environment				
Prototyping in real world environment				
Complying with existing standards				
Contribution to standards				
Technology transfer[8]				
Licensing the innovation to a 3rd party				
Launch a start-up or spin-off				
Other (please specify)				

Indicate your needs to fulfil the market potential.

[7] https://ec.europa.eu/digital-single-market/en/innovation-radar
[8] Technology transfer (TT) refers to the process of conveying results stemming from scientific and technological research to the market place and to wider society, along with associated skills and procedures.

	Your needs ('X' when needed)
Executive Training	
Mentoring or Coaching	
Business plan development	
Partnership with other SME(s)	
Partnership with large corporates	
Legal advice (IPR or other)	
Investor readiness training[9]	
Expanding to more markets	
Incubation/Startup accelerator	
Introduction to investors	
Other	

[9] Investor Readiness means understanding the criteria that the investors are using to assess your business opportunity so that they can decide whether they want to make an investment. This training aims to acquire knowledge to prepare for a round of funding.

Appendix C - KER assessment indicators for GENTE

Indicator name	Indicator description	Value description
EXPECTED IMPACT OF THE ER		
Scientific impact indicators (Horizon Europe Key Impact Pathways)		
Creation of high quality knowledge	Indicator showing how influential publications are in their field and world-wide	Publications: Number of peer reviewed scientific publications; citations: Field-weighted Citation Index of peer reviewed publications; Number and share of peer-reviewed publications that are core contributions to scientific fields
Strengthening human capital in R&D	Indicator showing the improvement in skills, reputation and working condition of participants	Number of researchers having benefited from upskilling activities; Number and share of upskilled researchers with more influence in their R&I field; number and share of upskilled researchers with improved working conditions
Fostering diffusion of open science	Indicator showing research outputs shared openly, re-used and stimulating new transdisciplinary/trans-sectoral collaborations.	Share of research outputs (open data/publication/software etc) shared through open knowledge infrastructures; share of open access research outputs actively used/cited; share of beneficiaries having developed new transdisciplinary/tans-sectoral collaborations with users of their open R&I outputs

Indicator name	Indicator description	Value description
Economic impact indicators		
Size of the untapped market	Indicator of the size of the market in terms of number of customers or value. To estimate the total market size, you can use this 4-step approach: (1) Define your target customer, e.g hospitals, steel factories, households etc (2) Estimate the total number of target customers. If possible, use public databases to get more precise numbers (3) Determine penetration rate of your solution. Assume a high penetration rate if your solution is mandated or mission critical. Low for a specialized purpose. (4) Calculate potential volume and value. Market volume is Number of target customers x penetration rate.	The ranking goes from small to large. This is in the context of the industry you are targeting. A market can be low in number of customers but high in value, e.g. in the case of solar power plants. In general, a market should have a minimum value of 1 billion euro to be attractive enough to target.
Type of addressable market	Indicator of the type and maturity of the target market. If the market is non-existent, the potential impact is considered large, but this needs to be taken in consideration together with the market growth rate and expected size of the market once mature.	The ranking goes from existing to new. The product life cycles stages are used as value indicator. The four stages are: · Decline: The market is contracting; alternative solutions are becoming available. · Maturity: The market is large, competition is high. · Growth: The market is growing, and the ER is becoming mainstream. Competition is moderate. · Introduction: New market, size is still small. Early adopters are interested in the ER and competition is still low.
Market need	Indicator of the level of demand from the market and the fit of the ER with the market. To score high, the target customer segment has the jobs, pains and gains relevant for the ER.	The ranking goes from “Not clear” to “Clear”. In the case of technology push, the technology is available but has not yet been turned in a value proposition addressing a specific market need. Market need is “Clear” when the market has a clear need for the ER and a market pull situation is created.

Indicator name	Indicator description	Value description
Market growth	Indicator of the growth rate of the market showing the increase in size or sales within a given customer group. Market growth rate is calculated as follows: Growth rate = ((Current market size) - (Original market size) / (Original market size)) *100	Growth rates can range from negative in declining markets to over 1000% in fast growing markets and are industry specific. An example that can be used for scoring is: <0%; between 0 – 15%; between15% – 50%; between 50% – 200%; or >200%.
Scalability of the business model	Indicator of how scalable and replicable the business model behind the ER is. Scalability in business allows for expansion and revenue growth while minimizing increases in operational costs. Two factors that influence scalability are: 1 How much capital does the business model need to generate incremental growth? growth' requires 'investment' – be it in the form of marketing or building infrastructure (putting up retail stores and warehouses, building a power plant, developing a website). 2. What kind of human resource does the business require to generate incremental growth? Distinct between low cost, high productivity labour force completing commodity tasks against high cost, low productivity labour force completing complex tasks.	Scalability range from "Poor" to "Very good" and can be interpreted in the following way: · Scaling up requires investing in marketing, infrastructure and high-cost expert labour staff for executing complex tasks. · Scaling up requires investing in marketing and high-cost expert labour staff for executing complex tasks · Scaling up requires investing in marketing, infrastructure and low-cost labour staff for executing common tasks. · Scaling up requires investing in marketing and low-cost labour staff for executing common tasks. · Scaling up requires only investing in marketing. Little or no investment in manpower or infrastructure.
Environmental impact indicators		
Fossil fuel consumption	The absolute consumption of fossil fuel consumption, including coal, lignite, oil and natural gas. The consumption of fossil fuels (such as crude oil, oil products, hard coal, lignite and natural and derived gas) provides a proxy indicator of resource depletion, CO_2 and other greenhouse gas emissions and air pollution levels (e.g. SO2 and NOX). The degree of environmental impact depends on the relative share of different fossil fuels and the extent to which pollution abatement measures are used. Natural gas, for instance, has approximately 40 % less carbon than coal per unit of energy content, and 25 % less carbon content than oil, and contains only marginal quantities of sulphur. (source: European Environment Agency)	Range from increased to decreased

Indicator name	Indicator description	Value description
Carbon footprint	A carbon footprint is the total greenhouse gas (GHG) emissions caused by an individual, event, organization, service, or product, expressed as carbon dioxide equivalent. Greenhouse gases, including the carbon-containing gases carbon dioxide and methane, can be emitted through the burning of fossil fuels, land clearance and the production and consumption of food, manufactured goods, materials, wood, roads, buildings, transportation and other services. (Wikipedia)	Range from small to large. Scores show percentage reduction of carbon footprint of subject targeted by ER, e.g. a building, household or process. Example answers are: <5%; between 5 – 15%; between 15 – 50%; between 50 – 80%; or >80%
local pollution	Indicator of the impact of the ER (production, distribution and consumption) on pollutant emissions to air, water and land that are harmful to human and environmental health. The generation of waste is also included in this indicator. Harmful emissions for pollutant releases to air, are in particular CO_2, Sox, Nox, PM10, NMVOCs or heavy metals. For water, nutrients like nitrogen and phosphorous and heavy metals. For soil, heavy metals, mineral oils or hydrocarbons. More information on indicators on environment can be found at the European Environment Agency (EEA) website https://www.eea.europa.eu/	Range from small to large. Possible options are: · The ER does not result in reduction of local pollution. · The ER slightly reduces the emissions of harmful elements to water, air and/or land but increases less harmful emissions and/or waste streams. · The ER slightly reduces the emissions of harmful elements to water, air and/or land. · The ER significantly reduces the emissions of harmful elements to water, air and/or land but increases less harmful emissions and/or waste streams. · The ER significantly reduces the emissions of harmful elements to water, air and/or land without introducing new waste streams.

Indicator name	Indicator description	Value description
Societal impact indicators		
Social exclusion	Social exclusion is a complex and multi-dimensional process. It involves the lack or denial of resources, rights, goods and services, and the inability to participate in the normal relationships and activities, available to the majority of people in a society, whether in economic, social, cultural or political arenas. Three conditions can be determined that impact poverty-social inclusion[10]: 1. Risk of poverty after social transfer (income poverty) 2. Severe material deprivation 3. Low working intensity households	Range from negative to reduced. Possible options are: · The ER results in significantly higher unemployment rates, brings advantages only to specific income classes, gender, or race, or excludes geographical areas from access to common rights, goods and services. · The ER results in slightly higher unemployment rates or brings advantages only to specific income classes, gender, or race. · The ER has no impact on the social exclusion of involved target user groups. · The ER has a slightly positive effect on unemployment rates or access to goods and services allowing people to participate in society. · The ER creates new jobs and/or lowers the gap between social classes, different races or gender.
Energy poverty	Energy poverty is a lack of access to modern energy services. The ability for households to pay their energy bills and the share of household income are examples of indicators for energy poverty. From a new technology perspective, impact of the ER on energy poverty can be determined on the following indicators[11]: · Impact on absolute energy expenditure · Impact on energy prices	Range from negative to reduced. Possible options are: · The ER results in higher energy prices and higher costs for energy and has a negative impact on energy poverty. · The ER has a slightly negative impact on energy poverty caused by increasing energy prices or increased energy costs. · The overall impact of the ER on energy poverty is neutral. Share of household spending on energy remains unchanged. · The ER has a slightly positive effect on energy poverty through reduced energy prices or lower costs for energy. · The ER results in lower energy prices and lower costs for energy reducing energy poverty.

[10] https://ec.europa.eu/social/main.jsp?catId=751&langId=en

[11] https://www.energypoverty.eu/

Indicator name	Indicator description	Value description
Energy citizenship	Citizen participation is a process which provides private individuals an opportunity to influence public decisions. This can be on local, national, or European level. ERs often impact existing policies and require the development of new policies. Effective citizen involvement programs realise tangible benefits like having a richer set of ideas on public issues, public support for planning decisions or a spirit of cooperation and trust between the agency and the public.	Range from low to high. Possible options are: · Citizens are not getting any further involvement in the policy making process · Citizens are invited to provide information to policy makers · Citizens are informed and consulted by having them respond to plans or proposals · Joint setting of the agenda and agreement of the process. Participatory decision-making · Citizens have dominant decision-making power.
Job creation	Gross direct jobs created, full time equivalents (FTE): A new working position created (did not exist before) as a direct result of project completion (workers employed to implement the project are not counted). The position needs to be filled (vacant posts are not counted) and increase the total number of jobs in the organisation. Full-time equivalent: Jobs can be full time, part time or seasonal. Seasonal and part time jobs are to be converted to FTE using ILO/statistical/other standards. Durability: Jobs are expected to be permanent, i.e. last for a reasonably long period depending on industrial-technological characteristics; seasonal jobs should be recurring. Gross: Not counting the origin of the jobholder as long as it directly contributes to the increase of total jobs in the organisation. Source: Indicative Guidelines on Evaluation Methods: Reporting on Core Indicators for the European Regional Development Fund and the Cohesion Fund (2007-2013)	Absolute number. Example answers are: 0 <100 200 at project end 100-500 in 2030 500-1000 in 2030

Indicators to assess the innovation risk of each Exploitable Result		
Indicator name	**Indicator description**	**Value description**
ER ownership	Every ER needs an owner who is committed to successfully exploit the ER after project end. In the case of multiple owners (joint exploitation) agreements need to be made about the terms and conditions for the use of the ER by each of the owners.	Range from none to clear
Type of innovation	Three main types of innovation can be distinguished: Incremental innovation: Involves making smaller upgrades to existing products and services Adjacent innovation: Entering a new market and connecting with a new audience by leveraging something a partner already does well Transformational innovation: Completely transform, create, or eliminate entire industries. High risk, high reward.	Rang from low risk (incremental) to high risk (transformational)
Completeness of technology	The maturity of technology types ER. For measuring maturity, the Technology Readiness Level (TRL) scale is used[12].	Range from TRL1 to TRL9
Additional development needed	In order to prepare an ER for commercial exploitation or make it ready for further use in follow-up research, additional effort need to be put in the ER. Often not only further technical development is necessary, but also activities like certification, business case development, packaging, legal, marketing or sales activities need to be carried before (commercial) launch of the ER.	Range from major to none
IP protection	Intellectual property (IP) refers to creations of the mind, such as inventions; literary and artistic works; designs; and symbols, names and images used in commerce. IP is protected in law by, for example, patents, copyright and trademarks, which enable people to earn recognition or financial benefit from what they invent or create.	Range from weak to strong. Typical options are: · IP has not yet been reviewed · IP has been identified · IP protection measures have been defined · IP protection measures have been implemented

12 https://ec.europa.eu/research/participants/data/ref/h2020/wp/2014_2015/annexes/h2020-wp1415-annex-g-trl_en.pdf

Indicator name	Indicator description	Value description
Management support	Executive leadership support and buy-in is needed to ensure alignment plans with corporate strategies and support for exploitation plans and activities. Executive buy-in or commitment manifests itself in the form of support for resources, budgetary approvals or making key business decisions. It is even better when executives are fully engaged in the process of making sure initiatives are successful, not only sayin g that they will do something but actually doing something to support exploitation of the ER.	Range from none to committed
Alternative solutions	Are substitute products or services available or do competitors offer better price or value.	Range from no alternatives to better alternatives available
Regulatory hurdles	Legislation or regulation can prevent exploitation of the ER. Examples are competition policies, price regulation, market entry regulations and the regulation of natural monopolies and public utilities.	Range from no legal or regulatory barriers to major legal barriers