MASTERPIECE -
Multidisciplinary Approaches and Software Technologies for Engagement, Recruitment and Participation in Innovative Energy Communities in Europe

Deliverable 2.3

FUNCTIONALITIES' NEEDS AND PERFORMANCE MEASUREMENT PLANNING (FIRST VERSION)

Title	Functionalities' needs and performance measurement planning
Document description	Deliverable 2.3 describes the outcomes of T2.3 and T2.4 until month 6, focus on the application scenarios, initial use cases and analysis as well as the current definition of the evaluation planning and KPIs definition.
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Disclaimer:

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EXECUTIVE SUMMARY

This document provides a comprehensive analysis of the conduced out in Task 2.3 "Pilot surveys, validation scenarios analysis and deployment definition" and Task 2.4 "Evaluation planning and KPIs definition" of Masterpiece project, which primarily focus on defining the functionalities' needs and the Performance Measurement Planning including preliminary functional studies, performance measurement plans, and key considerations.

The **Introduction** section establishes the document's context, highlights its relationship to other tasks in the project, and outlines its structure.

In **Section 2**, a preliminary functional research section will focus on scenarios, initial use cases, and compiling components. These studies will serve as the basis for further stages of the project, ensuring a robust and effective implementation.

Section 3 is devoted to the Masterpiece Performance Measurement Planning. detailed definition of Key Performance Indicators (KPIs) and their measurement methods are defined to contribute to a framework for evaluating project progress and outcomes. The Evaluation Planning section describes a systematic approach to evaluating project results, including identifying different aspect such as data sources, evaluating test cases, and using end-user surveys.

The document concludes with **Section 4**, with a summary of the most important findings and conclusions from the research and performance measurement plan until month 6 of the project. It emphasizes the importance of aligning project activities with Masterpiece Key Objectives, addressing identified Topic Challenges, and facilitating collaboration with stakeholders and end-users.

Finally, the **Section 5 References** section contains a list of relevant sources and literature used in the preparation of this deliverable.

This document will serve as a comprehensive guide for preliminary functional studies and performance measurement plans, that will be defined in detail during Work Package 5 of the Masterpiece project, providing a solid foundation for project implementation and evaluation, ensuring a systematic and evidence-based approach to achieving defined objectives.

1 INTRODUCTION

This document provides a comprehensive analysis of the work carried out in Task 2.3 "Pilot surveys, validation scenarios analysis and deployment definition" and Task 2.4 "Evaluation planning and KPIs definition" of MASTERPIECE project focus on defining the functionalities' needs and the Performance Measurement Planning including preliminary functional studies, performance measurement plans, and key considerations.

1.1 Relation to other tasks

The main objective of this document is to describe the outcomes of Task 2.3 and Task 2.4, including data sourcing, pilot mapping, use case needs, performance assessment planning.

Task 2.3 -"Pilot surveys, validation scenarios analysis and deployment definition" focuses on establishing the application scenarios of the project through the study work and analysis of the pilots in terms of energy consumption, user comfort, energy sources and available infrastructures, collaborating with the work done in the Task 2.2. For this, work has been done in three main areas, i.e., 1) the compilation of Scenarios, 2) Initial Use Cases and Components, and 3) Surveying Final Users, the results of which are included in section 2 of this document.

In addition, *Task 2.4 - Evaluation planning and KPIs definition* aims to analyse and define the KPIs and the Evaluation Planning to establish the performance of the solution that is being designed within the MASTERPIECE project. The current outcome of this work is described in Section 3.

On the other hand, this document is published in parallel with the deliverables D2.1 "Business requirements, barriers and regulatory analysis for energy communities" and D2.5 – "Assessment of energy communities' maturity and aspirations in the pilot cases", with the rest of the results of the WP2, in particular the outcomes of the tasks T2.1 and T2.2. *Task 2.1 - Multilevel regulatory frameworks, administrative/operational barriers, market and financial requirements* is focused on analysing regulations and standards at the local, national, and European level, the maturity of the market and the financial barriers related to energy communities. *Task 2.2 - Pilot surveys, validation scenarios analysis and deployment definition* is oriented towards investigating user needs, behaviour patterns, drivers and deployment barriers of energy communities. These three documents (D2.1, D2.3 and D2.5) must be therefore considered together, since they complement each other and collect together the different facets of the analysis and study work of the energy communities, as well as the bases that the platform that will be designed within WP2 must establish and follow in the context of the Task 2.5. and later integrate (Task 5.1), deploy (Tasks 5.2-5.5, and evaluate (Task 5.6) in *WP5 - Integration, demonstration & evaluation*.

1.2 Structure of the document

Below is a brief description of the content dealt with in each of the sections of the document, starting by Section 1 – Introduction, it establishes the context of the document, highlighting its relationship to other tasks in the project, and outlines its structure.

Section 2 offers a preliminary functional research section focus on scenarios, initial use cases, and compiling components. These studies will serve as the basis for further stages of the project, ensuring a robust and effective implementation.

Section 3 is devoted to the MASTERPIECE Performance Measurement Planning. Detailed definition of Key Performance Indicators (KPIs) and their measurement methods are defined to contribute to a framework for evaluating project progress and outcomes. The Evaluation Planning subsection describes a systematic approach to evaluating project results, including identifying and the analysis of different aspect such as data sources, evaluating test cases, and using end-user surveys.

The document continues with Section 4 - Conclusions, with a summary of the most important findings and conclusions from the research and performance measurement plan until month 6 of the project. It emphasizes the importance of aligning project activities with MASTERPIECE Key Objectives, addressing identified Topic Challenges, and facilitating collaboration with stakeholders and end-users.

Finally, Section 5 - References contains a list of relevant sources and literature used in the preparation of this deliverable, which may be relevant for future work and research.

2 PRELIMINARY FUNCTIONALITY INVESTIGATIONS FOR PILOT SURVEYS, VALIDATION SCENARIOS AND INTERVENTIONS DESIGN

This section provides an overview of three key subsections: Compilation of Scenarios, Initial Use Cases and Components, and Surveying Final Users. The Compilation of Scenarios section highlights the importance of understanding energy community scenarios and presents diverse examples from different European countries. These scenarios serve as valuable tools for evaluating and improving pilot plans for energy communities. The Initial Use Cases and Components section maps the key objectives, associated components, and stakeholders for each objective. Lastly, the Surveying Final Users section emphasizes the significance of surveys in gathering feedback from end-users to tailor the project to their needs and preferences.

2.1 Compilation of scenarios

Understanding scenarios within the context of energy communities is essential because these scenarios vary substantially depending on each energy community. It is also important to clarify the concept of a "scenario." According to the literature and previous experiences, in the realm of energy communities (ECs), a scenario refers to a detailed description of possible states and developments specific to an energy community. These scenarios consider factors such as energy resources, technologies, community needs, and emerging opportunities.

For this reason, a preliminary investigation has been conducted to gain an overview of the diverse scenarios within energy communities across Europe. This will facilitate the validation of scenarios for project's pilot interventions. Moreover, these scenarios serve as valuable tools for understanding and evaluating the different paths that energy communities can pursue to achieve their objectives.

While there are many more energy communities within the European framework (which can be found in the EC repository [1]), the selected scenarios showcase their diversity and shared goal of achieving a sustainable future with renewable energies. By learning from these scenarios, we can improve our pilot plans for energy communities and gain insights from the experiences of others.

For instance, the KARDITSA (ESEK) [2] community in Greece aims to promote access to solar energy for every Greek citizen while combating climate change and fostering a fair solar economy. Their

scenario focuses on biomass generation, utilizing bioenergy technologies and local biomass resources to create job opportunities, address waste management challenges, and drive economic growth in the region through renewable energy. Similarly, the Energy Community of Mayenne Bois Énergie [3] in France focuses on the promotion of local collaboration, enhancing the biomass supply chain, and fostering a socially responsible energy community.

In Greece, the energy community of Chalki [4] aims to promote a sustainable energy transition by utilizing virtual net metering and providing free access to renewable energy solutions for all residents, including energy-disadvantaged households. This initiative contributes to the digitalization and decarbonization of Greek islands, fostering collective efforts towards a sustainable energy future.

BürgerEnergieGenossenschaft Wolfhagen [5] in Germany empowers citizen involvement in the ownership and governance of the local utility. This is a wind-powered energy community. Also, there is the initiative focused on the concept of renewable energy investment in the Netherlands. The energy community Buurtmolen Herbaijum [6] adopts a collective investment approach, where residents jointly invested in a wind power. This provides local citizens with sustainable and cost-effective electricity while promoting the benefits of renewable energy within the community.

The SonnenCommunity [7] in Germany connects prosumers through cloud-based software, facilitating the sharing of clean energy resources and promoting active participation in the renewable energy network. In Belgium, Mouscron City [8] established a self-consumption installation and created a convenient one-stop-shop for individuals and businesses seeking to invest in solar technology. By embracing a joint ownership model, Mouscron City encourages collaboration among residents, making solar energy installations more accessible for households and businesses. This cooperative approach not only promotes the widespread adoption of solar energy but also enhances its affordability, fostering a spirit of cooperation within the community.

Crevillent [9], one if the first energy communities in Spain, boosted its energy independence and strengthens social bonds by utilizing rooftop solar panels and electric vehicle charging stations. This initiative encourages the community to consume renewable energy locally and fosters stronger connections among its members.

In Italy, the pioneering Italian Renewable Energy Community of Magliano Alpi [10] has taken a significant step towards sustainability by installing photovoltaic (PV) panels on the roof of the town hall. This PV system not only supports the energy needs of the building but also provides free electric vehicle charging facilities. The community's primary objectives are to reduce reliance on the grid, lower energy costs, and foster collaboration among citizens and stakeholders to promote greater self-consumption of renewable energy.

Furthermore, in Italy, the Solidarity & Energy Social Housing (SO_EN) [11] initiative introduces self-consumption and storage systems, complemented by an innovative cost distribution and accounting system. Their implementation is a social tool that considers the residents' health and socioeconomic conditions, ensuring fair pricing and billing. Moreover, it fosters the sharing of solar energy in a manner that promotes equity and inclusivity. Dalby Solby [12], in Sweden, actively promotes sustainable living through renewable energy initiatives. They employ wind turbines, solar thermal systems, and solar PV panels to generate heat and power. Additionally, their dedication to sustainability extends to using LED lighting and planning future projects to expand solar capacity and to enhance EV charging infrastructure. These diverse energy community scenarios demonstrate the wide range of strategies and initiatives being undertaken to accelerate the transition to renewable energy. From self-consumption and virtual net metering to renewable energy

investments and collective ownership models, each community is striving to maximize the utilization of clean energy sources while actively involving citizens in the process.

These scenarios hold significant value for the current project as they serve as valuable benchmarks for validating the pilot energy community scenarios. Each community is focused on reducing carbon emissions, promoting energy independence, fostering social cohesion, and driving economic growth through renewable energy technologies. These scenarios highlight the common objective shared by all energy communities: to create a sustainable and environmentally conscious future empowering citizens.

2.2 Initial use cases and components

MASTERPICE is an Innovation Action to be implemented over ICT platforms and interactive tools. Some members of the consortium have contributed components that will be used as a starting point to build the platform and that will be presented in the project agreement document. We have conducted an initial mapping to connect the proposed components with the main project Key Objectives (KO). Additionally, we have identified the stakeholders who will be involved with these key components. The purpose of this mapping is to uncover the relationships among them and to provide a foundation for defining specific use cases. By understanding how the components and stakeholders interact, we can develop targeted and effective use cases for the project.

It is important to highlight that all software components must comply with specific security requirements and standards. This ensures that the software is designed and implemented with a strong focus on security measures. Adhering to these requirements helps to mitigate risks, protect sensitive data, and maintain user privacy. Below is a description of the Key Objectives (KOs) of the project. In Table 1, it is provided an initial outline of the preliminary components that satisfy the different KOs. Following that table, the component descriptions outline their usefulness and main target audience.

Key Objectives description
- **KO1.** To develop technical and social innovations to empower traditional energy consumers and to make them active agents of collaborative energy communities, paving the way towards a new energy market paradigm.
- **KO2.** To create user-centric solutions that based on participatory approaches such as co-creation and naturally accelerate citizens' involvement.
- **KO3.** To propose new business strategies and incentive mechanisms that activate the reactions of market participants craving for business opportunities that imply energy use and cost reduction.
- **KO4.** To configure a standardised and sound cyber-security infrastructure so the active citizens are protected against cyber-attacks, while privacy is defended in accordance with the revised EPBD and the GDPR law.
- **KO5.** To demonstrate the applicability and replicability of methodological, technical, and business innovations in a variety of real-life pilots in different geographical locations, with heterogeneous social and economic environments and different regulatory/administrative frameworks.

Components	KO1	KO2	KO3	KO4	KO5
Policy frameworks guide	✖				✖
Financial and social plan / Business model canvas for ECs	✖		✖		✖
Financing mechanisms for ECs / barriers guide			✖		✖
Informative and participatory tools	✖				✖
Nudging Mechanisms and Boosting Mechanisms			✖		✖
Artificial Intelligence mechanisms to support community management	✖				✖
Community members profiling	✖	✖			✖
Simulation & DSS toolkit	✖	✖	✖		✖
REC mgmt platform	✖	✖	✖		✖
Automated feature extraction		✖			✖
Plug-N-Harvest based evaluation platform		✖			✖
Decision-making toolkit EC modelling		✖			✖
Real-time policy optimization tool			✖		✖
Micro-grid load control			✖		✖
Community competition and incentives			✖		✖
Innovative market mechanisms for incentivising green and resilient energy use			✖		✖
Development of new demand response mechanism for energy communities maximised turnover			✖		✖
FIWARE IoT platform				✖	✖
Blockchain-based energy flows monitoring and measuring platform				✖	✖
Meet Personalised APP				✖	✖
GDPR-compliant and ISO:27001-inspired Information Security Management System for RECs				✖	✖
Data filtering				✖	✖

Regarding the first and second components, for EC promoters (i.e., municipalities, households, associations, foundations and small and medium-sized enterprises (SMEs)) and end-users (citizens and EC members), value is created by simplifying and streamlining the process of setting up ECs, enabling informed decision-making and fostering community collaboration. For SMEs and

companies looking to join, business and growth opportunities are offered by access to clear information on the policy frameworks of ECs.

- **Policy frameworks guide:** This component aims to expedite the setup of ECs by reducing the time and effort required by promoters/members. It provides a comprehensive guide on policy frameworks, enabling users to access all relevant information in a centralized digital platform. Users can customize their experience by selecting their level of interest, facilitating efficient navigation, and understanding of the policies.

  Additionally, investors and participants in the energy market benefit from identifying investment opportunities and engaging in the growing energy market. This involvement enhances transparency and helps mitigate risks.

- **Financial Plan / Business Model Canvas for ECs:** This component focuses on co-designing and streamlining financial mechanisms to support the setup and management of energy communities (ECs). Its objectives include assisting in the development of the business model (BM), reinforcing collaboration and a sense of community, assessing the feasibility of EC initiatives, attracting investments, mitigating risks for investors through clear cost and revenue definitions, ensuring transparency among EC members and shareholders, and enabling the scaling-up of EC initiatives.

- **Financing mechanisms for ECs / barriers guide:** This component supports the setup and long-term management of energy communities (ECs), enhancing feasibility and scalability. It identifies and addresses barriers, provides decision-making support, and increases awareness.

Participation and encouragement tools facilitate informed strategies and decisions for all the stakeholders mentioned above. As well as the promotion of energy efficient behaviours and an attractive experience in the ECs.

- **Informative and participatory tools:** Understanding the traditional energy consumer involves delving into their comfort preferences and behavioural patterns related to energy consumption. These tools facilitate a comprehensive understanding of the drivers and barriers that shape consumer behaviour, as well as the influencers and motivations behind their energy choices. By leveraging these insights, the aim is to create an attractive EC experience, starting from the onboarding process and extending throughout the entire engagement.

- **Nudging Mechanisms and Boosting Mechanisms:** These components focus on encouraging members to proactively engage in energy production. They aim to positively change the behavior of citizens and community members, shifting them from passive energy users to prosumers, and from passive prosumers to active participants.

The following components create value by enhancing the management, participation, and sustainable development of the ECs for all stakeholders involved. EC promoters discover more effective community management tools, while EC operators/managers enhance their management capabilities through the utilization of artificial intelligence tools. Municipalities gain transparency and citizen participation, while EC members experience greater personalisation and participation in decisions. In addition, energy market players find new business opportunities within ECs.

- **Artificial Intelligence mechanisms to support community management:** These mechanisms offer support to EC management and governance, especially in the handling of complex multi-

sectoral data, offering valuable insights and decision support. They also enhance communication within the community governance structure, promoting transparency and enabling the identification of opportunities for improvement.

- **Community members profiling:** This component involves the creation of identification and profiling systems for citizens within the EC. It emphasizes the importance of various member features and seeks to characterize the behaviour patterns and preferences of individuals. By comparing and analysing these profiles, appropriate rewards or penalties can be assigned. Compliance with GDPR regulation will be pursued to allow leveraging the value of collected/processed data in respect of EC members' rights and privacy, building on top of dedicated components (see below).
- **Simulation & DSS toolkit:** This toolkit includes a simulation and Decision Support System (DSS) tool for conducting economic evaluations of energy communities. It supports the preliminary assessment of renewable energy community projects, providing analyses of energy, economic, and financial aspects. The tool calculates key performance indicators (KPIs) for investment appraisal, considering financing options, tax deductions, and incentives.
- **REC mgmt platform:** A web application that supports various community forms such as renewable energy communities (REC), collective self-consumption (CSC) or citizen energy community (CEC). It facilitates community management and local governance responsibilities for associations, cooperatives, and living labs. The platform enables communication with members through interactive reports and graphics, showcasing energy, economic, and environmental performance. It manages community finances, allocates profits according to internal regulations, and integrates data from IoT metering devices and distributed energy resources. The platform optimizes controllable DERs, maximizing community performance.
- **Automated feature extraction:** It involves training data-driven models specific to different types of energy communities and user profiles. By mapping user data and extracting relevant features, valuable insights can be obtained to enhance participation in the activities of the energy community (EC). The platform will offer customized suggestions and solutions based on users' needs and interests. This includes the creation of identification (IDs) and profiles for citizens, emphasizing the importance of different features. The component also facilitates the characterization of community members, allowing for a comparison of behaviours and appropriate implementation of rewards or punishments accordingly. This component is closely linked with the Community members profiling one.
- **Plug-N-Harvest based evaluation platform:** This platform will be leveraged and used for MASTERPIECE purposes. It will help with the interpretation and presentation of the data to the users.
- **Decision-making toolkit / EC modelling:** The toolkit is specifically designed to assist citizens in making informed decisions when onboarding into energy communities. It will utilize behavioural mechanisms to actively encourage citizens to participate in the EC.

The real-time policy optimisation tool and microgrid load control components focuses on citizens (as consumers or prosumers), energy suppliers and partner companies. These components enable citizens to control energy consumption, optimise the operations of energy suppliers and foster innovation of partner companies, driving efficiency and sustainability in the energy sector.

- **Real-time policy optimization tool:** This tool optimizes policies in real-time, leveraging dynamic data and advanced algorithms for continuous improvement and better decision-making.

- **Micro-grid load control:** This component implements an adaptive approach to adjust local building and micro-grid adaptive controllers on-the-fly. AI based control: reduction of costs, energy management, active engagement with the energy market.
- **Community competition and incentives:** This component utilizes profile matching to engage similar prosumers, extracting average profiles and identifying outliers for comparison.

That previous component is related with both next innovative market mechanisms and the development of new demand response mechanisms. They create value for consumers, prosumers, service providers, and energy market players. They incentivize green energy adoption, optimize energy consumption, drive innovation in the energy sector, and enhance market dynamics for improved efficiency and reliability.

- **Innovative market mechanisms for incentivising green and resilient energy use:** require operational testing to understand their potential and limitations in different marketplaces and policy frameworks. Practical implementation of specific schemes, such as crowdfunding solutions or awards for virtual energy communities, is currently limited, despite extensive research in the field. It is important to align incentives and market mechanisms with the specific technical, political, and social needs of each context.
- **Development of new demand response mechanism for energy communities maximised turnover:** This component introduces new demand response mechanisms for energy communities, aiming to maximize turnover, reduce energy costs, and promote sustainable energy practices. It includes a demand response program to optimize energy consumption by shifting usage to low-cost periods. Additionally, incentives are provided to encourage and enhance energy practices within the community.

All the following components, aimed at fulfilling KO4 of the project. They are based on security and privacy aspects, primarily targeting consumers, prosumers, innovators, and service providers.

- **FIWARE IoT platform:** The FIWARE IoT Platform provides essential features for data protection, privacy preservation, secure financial transactions, and efficient energy operations. It ensures the security of sensitive data, incorporates privacy-preserving mechanisms, enables secure financial transactions through DLT contracts, and optimizes energy consumption.
- **Blockchain-based energy flows monitoring and measuring platform:** The blockchain technology ensures secure and transparent energy and flexibility exchange, enabling automated demand response (DR) settlement. It utilizes innovative meters to accurately measure and track energy usage and exchanges, allowing monitoring and measuring energy flows within the community.
- **Meet Personalised APP:** It allows identifying and joining ECs, visualizing energy consumption and costs. Additionally, this component includes social peer-to-peer interactions, enabling community members to engage with each other and foster a sense of belonging and collaboration within the energy community.
- **GDPR-compliant and ISO:27001-inspired Information Security Management System for RECs:** his component establishes a secure Information Security Management System for Renewable Energy Communities (RECs). It ensures compliance with GDPR regulations and follows ISO 27001 standards, protecting sensitive data and ensuring privacy for REC members.

- **Data filtering:** This tool detects anomalies and preserves data, ensuring accurate and high-quality information for tasks such as feature extraction, citizen clustering and metric representation.

All the components described above are aligned with the last key objective (KO5). Consumers and prosumers benefit from enhanced security, privacy, and personalized services in energy communities. Aggregators gain access to advanced technologies for efficient energy management, grid issues and needs. The Administration EU Commission, national governments, academia, and organizations driving change can utilize these components to strengthen energy policies, gain valuable insights, and advocate for better decisions in the energy sector. Overall, these components demonstrate the applicability and replicability of innovations in real-life pilots across diverse locations and regulatory frameworks.

2.3 Surveying final users

Surveys in the context of the ongoing project will be targeting on one side stakeholders and on the other side final users. In this case, the term "final user" or "end-user" extends beyond citizens who consume and/or produce energy within the energy community and includes all stakeholders who benefit from EC services and tools, support them, or contribute to their growth.

The first survey carried out was specifically aimed at pilot managers, but some aspects could inform us at least of the end-users that we may find in each pilot. This version was designed to gather comprehensive information about the pilots and their potential / existing energy communities. Accompanying this survey was a guide intended to provide support to the pilot managers in understanding the survey questions. The survey covered social, economic, technological, policy and regulatory aspects. As well as the exploration of answers regarding first identified barriers, strategies, stakeholders involved and related information provided by the pilots. This initial survey established an initial connection with the pilots.

Conducting surveys with end-users is crucial for the proper development and evolution of the ongoing project. Gathering direct feedback from the users plays a vital role in making informed decisions when developing the project platform, ensuring it is tailored to the specific needs and preferences of their energy communities.

The end-user's surveys that will be planned for the whole duration of the project will not only focus on needs and preferences but they will also look into experiences and expectations related to the energy communities. Aspects such as beneficial outcomes, satisfaction, and achievement of objectives will be explored, considering both the end-users and the overall project goals. The surveys aim to provide a comprehensive useful information, incorporating both qualitative and quantitative data, aligned with the desired outcomes. The variety and format of the surveys will be determined at the time of the survey. Note that, if available, usable, and useful, surveys previously conducted by other entities with end-users will be considered as a valuable resource for this project.

To ensure a comprehensive assessment, the surveys will address various aspects including expectations, needs, level of knowledge, concerns, suggestions, and opinions related to technological, social, economic, and regulatory dimensions. User feedback will be highly valued and considered to drive continuous improvement and alignment with the objectives of the project and the Masterpiece platform, ultimately delivering a satisfactory user experience.

Specifically, users will be invited to provide feedback on customizable features and functionalities that could enhance their experience on the Masterpiece platform. Additional information regarding this type of survey will be detailed in Section 4.5.

3 MASTERPIECE PERFORMANCE MEASUREMENT PLANNING

A comprehensive performance measurement planning is essential to be able to assess the effectiveness and impact of the MASTERPIECE project. This section provides a detailed definition of the Key Performance Indicators (KPIs) and the measurement and evaluation methodologies required for each KPI, detailed evaluation planning focused on the MASTERPIECE Intervention Program to be implemented in Work Package 5, data collection considerations, and initial proposals of several measurement methods such as test case evaluation methodology and first version of end-user questionnaires.

These elements work together to create a solid and organized framework for monitoring and analysing project results and consequences. The definition of the Evaluation Planning makes sure that accurate and trustworthy data is gathered and evaluated to guide decision-making, project performance optimization, and ongoing improvement by defining clear targets and employing suitable measuring tools.

The Performance Measurement Planning (PMP) considers the KO defined in the MASTERPIECE project's Grant Agreement[13]. These KO must be sought to achieve and serve as the basis for defining relevant KPIs aligned with the project's areas of interest. These KOs have already been presented and discussed in section 3.2 in relation to the platform components, and in this section, they serve as the basis for defining relevant KPIs and specific evaluation methodology and baselines, to align them with project's areas of interest, working on increasing the adherence of traditional users, creating an user-centric platform, demonstrating applicability and proposing new business strategies, configuring a cybersecurity, and ensuring wide-reaching impact.

In addition, the PMP considers the Topic Challenges identified in the Grant Agreement. Topic Challenges highlight specific areas of interest and innovation for MASTERPIECE project. By incorporating these challenges into the Evaluation Framework, PMP ensures that the project's impact will be aligned with them, providing a comprehensive understanding of the project's contribution to solving key problems and challenges. The following is the list of Topic Challenges of the MASTERPIECE project:

1. Demonstrate in real life interactive communication and support tools to engage citizens in the energy transition and to support them throughout the process of creating, constituting and developing an energy community, that are developed and fine-tuned based on field tests.
2. Improve the engagement of distributed active consumers and energy communities at broad scale, including through innovative incentive mechanisms.
3. Enabled new market roles and market participants.
4. Enabled automated participation.
5. Residential and SME related Demand Response contributing to increased level of flexibility and to the development of new flexibility products.
6. Identified drivers and rules beyond marginal pricing which can steer the transactions within the energy communities.

7. Developing mechanisms to support the creation, growth and capacity building of energy communities.

Each subsection below contributes to the comprehensive Evaluation Planning that enables project teams to effectively monitor progress, assess the impact of project activities, and glean valuable insights from stakeholders and end users.

3.1 Key Performance Indicators (KPIs) and measurement methods

This subsection formulates the methodology to be employed for the evaluation, and the definition of expected results as Key Performance Indicators (KPIs). KPIs are directly addressing the degree of achievement of Project Objective (PO) and Topic Challenges (TC) as included in the MASTERPIECE Grant Agreement. Moreover, the plan indicates the measuring method and data unit that will be needed to monitor and assess the usability and performance of the MASTERPIECE solution. The next table provides a summary of every KPI identified and its relationship with a Project Objective (PO) and Topic Challenges (TC). To explain the KPIs in more detail, below a table for each KPI is provided including the definition, calculation methodology, boundaries, and baseline calculation.

1. **Name**: Short KPI name.
2. **Acronym:** Acronym description.
3. **ID:** Identification number.
4. **MASTERPIECE Project Objective**: MASTERPIECE PO that the KPI addresses.
5. **MASTERPIECE Topic Challenge**: MASTERPIECE Topic Challenge that the KPI address.
6. **Main objective**: Main objective of the KPI.
7. **Description**: Short description of the KPI.
8. **Formula**: If applicable, formula or formulas to calculate the KPI.
9. **Target Value**: Target value (if applicable) defined for the KPI.
10. **Unit of Measurement**: Unit of Measurement (if applicable) defined for the KPI.
11. **Responsible Partner**: Partner responsible for the definition of the KPI.
12. **In accordance with**: Source of the agreement (document, WP or Task involved in the definition of the KPI).
13. **Lower and Upper boundaries**: Lower and Upper boundaries of the KPI, being those set by the definition of the KPI itself, normative or other casuistic.
14. **Source of boundaries**. Please select from the drop-down list. If further explanation is required, please use the blank cell at right-hand side of the list.
15. **Methodology description**: Description of the methodology used to calculate the initial baseline.
16. **Initial baseline**: Initial baseline value of the KP**I.**
17. **Source of Baseline**: Source of initial KPI baseline value (surveys, calculation, measurement, …).
18. **Methodology Description**: Description of the methodology used to calculate the pilot phase value.
19. **Target Pilot Value**: MASTERPIECE Pilot phase value of the KPI.
20. **Source of Pilot Phase Value**: Source of pilot KPI baseline value (surveys, calculation, measurement, …).

3.1.1 KPI1 - Adherence to the ECs after the Intervention Program

KPI BASIC INFORMATION					
Name [1]	Adherence to the ECs after the Intervention Program	Acronym [2]	AIP	ID [3]	K1
MASTERPIECE Project Objective identifier and description[4]	PO-1	To develop technical and social innovations to empower traditional energy consumers and to make them active agents of collaborative energy communities, paving the way towards a new energy market paradigm. [addressed by WP3, WP5]			
MASTERPIECE Topic Challenge [5]	TC-1, TC-2, TC.3, TC-4, TC-5, TC-6, TC-7				
Main Objective [6]	30% increase of adherence to the ECs after the Intervention Program				
Description [7]	The assessment of the 4 hubs of energy communities will produce new evidence on how to nudge on-boarding of more citizens in energy communities and how to boost adherence to the vision and mission of the communities. Qualitative insights will frame the modelling of energy communities' resources and tools to foster participation, agency, literacy and social entrepreneurship. The tools will be launched in the Pilot sites through a dedicated Intervention Program.				
Formula (if applicable) [8]	KPI1 = ((AAIP - AEC) / AEC) * 100 where, AEC is the initial Adherence to the ECs during the pilot monitoring phase and AAIP is the Adherence alter the Intervention Program in the pilot scenarios.				
Target Value [9]	30	Unit of Measurement [10]	%		
Responsible partner [11]	WP3, WP5	In accordance with… [12]	DoW		
KPI BOUNDARIES SETTING					
Lower and Upper Boundaries [13]	Lower boundary		Upper boundary		
	0	%	100	%	
Source of Boundaries [14]	Normatives / Standards		Normatives / Standards		
INITIAL KPI BASELINE					
Methodology description [15]	AEC is the initial Adherence to the ECs at the beginning of the Pilot Monitoring Phase. This value will be calculated by extrapolating the data from the initial surveys by asking the current level of adherence to the existing platforms in the areas where they are deployed. Another option is to measure the level of platform adherence at an early stage (e.g., the first two months) and then compare it with the data at the end of the Intervention Program to see the effect of the incentive measures.				
Initial baseline [16]	To be calculated		%		
Source of Baseline [17]	Survey identifier / Platform				
KPI MASTERIECE PILOT PHASE VALUE					

Methodology description [18]	AAIP is the Adherence alter the Intervention Programa in the pilot scenario. This value will be calculated by extrapolating the data from the final surveys by asking the final level of adherence to the MASTERPIECE platforms in the pilots where it is deployed. Another option is to measure the level of platform adherence at the final stage (e.g. the last two months) and then compare it with the data at the beginning of the Intervention Program to see the effect of the incentive measures.	
Target Pilot Value [19]	30	%
Source of Pilot Phase Value [20]	Survey identifier / Platform	

Table 2: Detailed description of KPI1

3.1.2 KPI2 - Master Plan of services and Services Blueprints

KPI BASIC INFORMATION				
Name [1]	Master Plan of services and Services Blueprints	Acronym [2]	MPS	ID [3]
MASTERPIECE Project Objective identifier and description[4]	PO-2	To create user-centric solutions that based on participatory approaches such as co-creation and naturally accelerate citizens' involvement [addressed by WP3, WP5]		
MASTERPIECE Topic Challenge [5]	TC-1, TC-3, TC-7			
Main Objective [6]	Master Plan of services and Services Blueprints			
Description [7]	The publication of MASTERPIECE Master Plan and Service Blueprints will contribute to spark genuine collaboration among federated services of community members. The early assessment of community maturity and aspirations will pave the way to participatory sessions of service design and innovative concepts. Service Blueprint will collect personalized services for community members that will be designed, localized and launched at each Pilot site, improving participatory approaches for EC co-creation and the acceleration of citizen involvement.			
Formula (if applicable) [8]	Publication of D2.7 – "Architecture design and functional blueprint" at M09 and D2.8 – "Architecture design and functional blueprint - update" M27			
Target Value [9]	N/A	Unit of Measurement [10]		Unitless
Responsible partner [11]	WP2, WP3, WP4, WP5	In accordance with… [12]		DoW
KPI BOUNDARIES SETTING				
Lower and Upper Boundaries [13]	Lower boundary		Upper boundary	
	N/A	Unitless	N/A	Unitless
Source of Boundaries [14]	Other (explain)		Other (explain)	
INITIAL KPI BASELINE				
Methodology description [15]	N/A			
Initial baseline [16]	N/A		Unitless	
Source of Baseline [17]	N/A			

KPI MASTERIECE PILOT PHASE VALUE		
Methodology description [18]	Publication of D2.7 – "Architecture design and functional blueprint" at M09 and D2.8 – "Architecture design and functional blueprint - update" M27	
Target Pilot Value [19]	N/A	Unitless
Source of Pilot Phase Value [20]	Project deliverables	

Table 3: Detailed description of KPI2

3.1.3 KPI3 - Increase of federated services

KPI BASIC INFORMATION					
Name [1]	Increase of federated services	**Acronym [2]**	IFS	**ID [3]**	K3
MASTERPIECE Project Objective identifier and description[4]	PO-3	To propose new business strategies and incentive mechanisms that activate the reactions of market participants craving for business opportunities that imply energy use and cost reduction [addressed by WP2, WP4]			
MASTERPIECE Topic Challenge [5]	TC-1, TC-2, TC-3, TC-5, TC-6, TC-7				
Main Objective [6]	Spillover effect: 20% increase of federated services in each EC				
Description [7]	Multi-dimensional incentive models will give consumers access to tools that will encourage them to make the investments and lifestyle adjustments required to become members of an energy community and prosumers. Only if new services and business models can rely on income streams that, in the ideal scenario, come from new consumer goods or from cost savings from the elimination of inefficiencies will they be self-sustaining. The development of new business models that will enable the establishment of businesses that contribute to the reduction of energy use and to better management of the energy infrastructure. Clear membership mechanisms will be designed to ensure that new citizens can enter in the energy communities and acquire membership rights, ownership rights and benefits. The objective is to increase a 20% the number of federated services, with special interest in new services to simplify the purchase and sharing of clean energy, thanks to enabling automated onboarding mechanisms and including economic incentives, loyalty mechanisms and other benefits				
Formula (if applicable) [8]	KPI3 = ((FFSN - IFSN) / IFSN) * 100 where, IFSN is the Initial Number of Federated Services measured at the beginning of the pilot monitoring phase and FFSN is the Final Number of Federated Services at the End of the Intervention Program.				
Target Value [9]	30	**Unit of Measurement [10]**	%		
Responsible partner [11]	WP2, WP4	**In accordance with… [12]**	DoW		
KPI BOUNDARIES SETTING					
	Lower boundary		**Upper boundary**		

Lower and Upper Boundaries [13]	0	%	100	%
Source of Boundaries [14]	Normative / Standards		Normative / Standards	

INITIAL KPI BASELINE	
Methodology description [15]	IFSN is the Initial Number of Federated Services measured at the beginning of the Pilot Monitoring Phase. This value can be calculated by extrapolating the data from the initial surveys by asking the current level of services federated into the existing platforms in the pilots. Another option is to measure the level of federated services at an early stage (e.g., the first two months) and then compare it with the data at the end of the Intervention Program to see the effect of the incentive measures.
Initial baseline [16]	To be calculated	%
Source of Baseline [17]	Survey identifier / Platform	

KPI MASTERIECE PILOT PHASE VALUE	
Methodology description [18]	FFSN is the Final Number of Federated Services measured at the end of the Pilot Monitoring Phase. This value can be calculated by extrapolating the data from the final surveys by asking the final level of services federated in MASTERPIECE platform pilots. Another option is to measure the level of federated services at the final stage (e.g., last two months) and then compare it with the data at the beginning of the Intervention Program to see the effect of the incentive measures. The objective is to achieve at least a 20% increase in the number of federated services.
Target Pilot Value [19]	20	%
Source of Pilot Phase Value [20]	Survey identifier / Platform	

Table 4: Detailed description of KPI3

3.1.4 KPI4 - Secure data management

KPI BASIC INFORMATION				
Name [1]	Secure data management	Acronym [2]	SDM	ID [3]	K4
MASTERPIECE Project Objective identifier and description[4]	PO-4	To configure a standardised and sound cyber-security infrastructure so the active citizens are protected against cyber-attacks, at the same time that privacy is defended in accordance with the revised EPBD and the GDPR law [addressed by WP2, WP4]		
MASTERPIECE Topic Challenge [5]	TC-1, TC-3, TC-7			
Main Objective [6]	Secure data management of stakeholder private information = 100%			
Description [7]	New digital tools that collect information about citizen behavior and the real world may serve as a bypass for threats like cyberattacks. For that reason, Privacy-Preserving Identity Management mechanisms will be integrated and extended in tandem with an advanced access control system that enables policy-based authentication and authorisation evaluation for data sharing and access while preserving privacy. These mechanisms will increase the trust of all stakeholders for using the MASTERPIECE technological innovations that require sharing private information or personal data. The project has to ensure at 100% the secure data management of stakeholder			

	private information, thanks to the inclusion in the project of experts in the field and the most robust technologies to increase the strength of the solution.
Formula (if applicable) [8]	KPI4 = (IDC - FNSD) / IDC) * 100 where, IDC is the Initial number of (kind of) Data Collected at the beginning of the pilot monitoring phase and FNSDC is the Final Number of No Secured Data collected at the end of the Intervention Program.

Target Value [9]	100	**Unit of Measurement [10]**	%
Responsible partner [11]	WP1, WP3, WP4	**In accordance with… [12]**	DoW

KPI BOUNDARIES SETTING				
Lower and Upper Boundaries [13]	**Lower boundary**		**Upper boundary**	
	0	%	100	%
Source of Boundaries [14]	Normative / Standards		Normative / Standards	

INITIAL KPI BASELINE		
Methodology description [15]	This value must be measured as a result of the detailed definition of the platform and the services that will participate in the pilot phase, collecting the data that will be stored and processed in order to verify that they have been correctly secured in a later phase. D1.2 - Multi-Aspect Technical, Quality, Ethics & Data Management Plan D1.3 - Multi-Aspect Technical, Quality, Ethics & Data Management Plan - update D4.1 - Requirements of the digital platform, conceptual design and definition of the tools for flexibility D4.2 - Requirements of the digital platform, conceptual design and definition of the tools for flexibility - update	
Initial baseline [16]	To be measured at the beginning of the pilot monitoring phase	%
Source of Baseline [17]	Platform database	

KPI MASTERIECE PILOT PHASE VALUE	
Methodology description [18]	CERTH, D1.3 - Multi-Aspect Technical, Quality, Ethics & Data Management Plan - update D4.2 - Requirements of the digital platform, conceptual design and definition of the tools for flexibility - update D5.5 - Intervention Program: All pilots implementation - final update This value should be calculated as a result of the detailed definition of the platform and the services that will participate in the pilot phase, collecting the data that will be stored and processed and verifying that they have been correctly secured following the relevant European regulations and the

	guidelines established in the project to guarantee the protection of the information.			
Target Pilot Value [19]	To be measured at the end of the pilot monitoring phase			%
Source of Pilot Phase Value [20]	Project deliverables			

Table 5: Detailed description of KPI4

3.1.5 KPI5 - Validation of large-scale acceleration programs

KPI BASIC INFORMATION					
Name [1]	Validation of large-scale acceleration programs	**Acronym** [2]	**VAP**	**ID** [3]	K5
MASTERPIECE Project Objective identifier and description [4]	PO-5		To demonstrate the applicability and replicability of methodological, technical, and business innovations in a variety of real-life pilots in different geographical locations, with heterogeneous social and economic environments and different regulatory/administrative frameworks [addressed by WP2, WP4]		
MASTERPIECE Topic Challenge [5]	TC-1, TC-7				
Main Objective [6]	Validation of guidelines for large scale acceleration programs				
Description [7]	The goal of making energy communities grow like wildfire to reach the target of more than 250 million clean energy producers in 2050 can be achieved with a methodological and experimental approach on a large scale, such as the one configured and tested by MASTERPIECE. The Intervention Program, designed with the participants of the energy communities of the pilot sites, constitutes a project asset laying the foundations for the validation of intervention and acceleration models on a very large scale (up to 1000 and more energy communities). In this sense, it is necessary to define the guidelines to be follow by the project during its development and the application of the Intervention Program, as well as to define the validation methodology and the results of this validation to evaluate its possible effect over other large scale acceleration programs.				
Formula (if applicable) [8]	N/A				
Target Value [9]	N/A		**Unit of Measurement** [10]	Unitless	
Responsible partner [11]	WP2, WP4. WP5		**In accordance with…** [12]	DoW	
KPI BOUNDARIES SETTING					
Lower and Upper Boundaries [13]	Lower boundary		Upper boundary		
	N/A	N/A	N/A	Unitless	
Source of Boundaries [14]	Other (explain)		Calculation		

INITIAL KPI BASELINE		
Methodology description [15]	The definition of the initial list of guidelines that have to be validated, have to be developed in the context of the guidelines and roadmaps that will be defined in Deliverable D5.1 and D5.2 focused on defining the "Holistic proof-of-concept and pilot implementation roadmaps" as well as in the Intervention Program defined in deliverables D5.3-5 "Intervention Program: All pilots implementation".	
Initial baseline [16]	To be defined.	Unitless
Source of Baseline [17]	Defined in Deliverables D5.1-2 and D5.3-5	
KPI MASTERIECE PILOT PHASE VALUE		
Methodology description [18]	The validation work of the guidelines is divided on two parts. On the one hand, the definition of the validation guidelines and the detailed definition of the KPIs to be met, which will be included in Deliverables D2.3 and D2.4 "Functionalities' needs and performance measurement planning". On the other hand, their subsequent application will be carried out during work package 5 and 6, in documents D5.6-D5.8 "Evaluation of social, environmental, technical and economic impact (initial, interim update and final update)" in charge of validating the results of the project and the intervention plan at different levels and Deliverable "D6.9 - Replicability study of methodological and technological innovations", in charge of analyse the replicability of the project's methodologies and technical innovations.	
Target Pilot Value [19]	To be evaluated	Unitless
Source of Pilot Phase Value [20]	To be evaluated in D5.6 - D5.8	

Table 6: Detailed description of KPI5

3.1.6 KPI6 - Dissemination of Scientific publications

KPI BASIC INFORMATION					
Name [1]	Dissemination of Scientific publications	Acronym [2]	DSP	ID [3]	K6
MASTERPIECE Project Objective identifier and description[4]	PO-6	To ensure wide reaching impact and use of project methodological, business, and technological outcomes among different stakeholders' categories			
MASTERPIECE Topic Challenge [5]	TC-1, TC-5, TC-6, TC-7				
Main Objective [6]	Dissemination of Scientific publications				
Description [7]	Scientific publications in journals in gold access with Impact Factor or in self-archiving green access with repositories listed in https://zenodo.org/, or used by the consortium members. Potential journals have been identified, considering the most appropriate ones according to the consortium's previous experience. N° of Gold Open Access publications: 3 scientific and 3 industrial publications				
Formula (if applicable) [8]	DSP = GOAP + IP where, GOAP is the number of Gold Open Access Publications and IP is the number of Industrial Publications				
Target Value [9]	6	Unit of Measurement [10]	Publications		

Responsible partner [11]	WP6	In accordance with… [12]	DoW

KPI BOUNDARIES SETTING			
Lower and Upper Boundaries [13]	Lower boundary		Upper boundary	
	0	Publications	∞	Publications
Source of Boundaries [14]	Other (explain)		Other (explain)	

INITIAL KPI BASELINE	
Methodology description [15]	N/A
Initial baseline [16]	0	Publications
Source of Baseline [17]	Start of the counter at zero.

KPI MASTERIECE PILOT PHASE VALUE	
Methodology description [18]	To be evaluated during the project in WP6 following the methodology defined in D6.1 "Communication, Dissemination and Engagement Plan". The results will be published in D6.2 - D6.5 "Iterative Report of Communication, Dissemination, Engagement, Ecosystem (initial, interim update, final)".
Target Pilot Value [19]	6	Publications
Source of Pilot Phase Value [20]	Deliverables D6.2 - D6.5

Table 7: Detailed description of KPI6

3.1.7 KPI7 - Dissemination of mainstream media publication

KPI BASIC INFORMATION					
Name [1]	Dissemination of mainstream media publication	Acronym [2]	DMMP	ID [3]	K7
MASTERPIECE Project Objective identifier and description[4]	PO-6	To ensure wide reaching impact and use of project methodological, business, and technological outcomes among different stakeholders' categories			
MASTERPIECE Topic Challenge [5]	TC-1, TC-5, TC-6, TC-7				
Main Objective [6]	Dissemination of mainstream media publication				
Description [7]	MASTERPIECE partners will through media packages and targeted messages and pieces create an interest on the platform and its role on supporting and scaling new and existing LECs				
Formula (if applicable) [8]	N/A				
Target Value [9]	3	Unit of Measurement [10]	Publications		
Responsible partner [11]	WP6	In accordance with… [12]	DoW		

KPI BOUNDARIES SETTING				
Lower and Upper Boundaries [13]	Lower boundary		Upper boundary	
	0	Publications	∞	Publications
Source of Boundaries [14]	Other (explain)		Other (explain)	

INITIAL KPI BASELINE	

Methodology description [15]	N/A	
Initial baseline [16]	0	Publications
Source of Baseline [17]	Start of the counter at zero.	

KPI MASTERIECE PILOT PHASE VALUE		
Methodology description [18]	The number of mainstream media have to be greater or equal than 3 publications	
Target Pilot Value [19]	3 Publications	Publications
Source of Pilot Phase Value [20]	Deliverables D6.2 - D6.5	

Table 8: Detailed description of KPI7

3.1.8 KPI8 - MASTERPIECE dedicated workshops

KPI BASIC INFORMATION					
Name [1]	MASTERPIECE dedicated workshops	Acronym [2]	MDW	ID [3]	K8
MASTERPIECE Project Objective identifier and description[4]	PO-6	To ensure wide reaching impact and use of project methodological, business, and technological outcomes among different stakeholders' categories			
MASTERPIECE Topic Challenge [5]	TC-1, TC-5, TC-6, TC-7				
Main Objective [6]	MASTERPIECE dedicated workshops				
Description [7]	The recommended method for engaging the groups who have been recognized as particularly important stakeholders for the project would, whenever possible, be experiencing it first-hand. The organization of the MASTERPIECE's own workshops, as well as participation in workshops and events, will also guarantee a two-way exchange of information between the project consortium and the local community. In the nations serving as the pilot site, there will be at least 4 workshops organized with local and national stakeholders. The objectives of these workshops are: (i) Share with different stakeholders the project objectives and results achieved, collect feedback and ask for validation; (ii) Further validate and refine the assumptions underpinning the engagement strategy and the selection of incentives; (iii) Develop business models applicable to the further exploitation of the results; (iv) Define potential supporting measures to ensure sustainability and extend the use of the project results.				
Formula (if applicable) [8]	N/A				
Target Value [9]	4	Unit of Measurement [10]		Workshops	
Responsible partner [11]	WP6	In accordance with… [12]		DoW	

KPI BOUNDARIES SETTING				
Lower and Upper Boundaries [13]	Lower boundary		Upper boundary	
	0	Workshops	∞	Workshops
Source of Boundaries [14]	Other (explain)		Other (explain)	

INITIAL KPI BASELINE		
Methodology description [15]	N/A	
Initial baseline [16]	0	Workshops
Source of Baseline [17]	Start of the counter at zero.	

KPI MASTERIECE PILOT PHASE VALUE		
Methodology description [18]	A workshop must be held for each pilot and each workshop must be attended by at least 20 people.	
Target Pilot Value [19]	4	Workshops
Source of Pilot Phase Value [20]	Deliverables D6.2 - D6.5	

Table 9: Detailed description of KPI8

3.1.9 KPI9 - Dissemination through conferences and events

KPI BASIC INFORMATION				
Name [1]	Dissemination through conferences and events	Acronym [2] DCE	ID [3]	K9
MASTERPIECE Project Objective identifier and description[4]	PO-6	To ensure wide reaching impact and use of project methodological, business, and technological outcomes among different stakeholders' categories		
MASTERPIECE Topic Challenge [5]	TC-1, TC-5, TC-6, TC-7			
Main Objective [6]	Dissemination through conferences and events			
Description [7]	Presentations on European conferences, workshops, fairs and events.			
Formula (if applicable) [8]	N/A			
Target Value [9]	6	Unit of Measurement [10]		Events
Responsible partner [11]	WP6	In accordance with… [12]		DoW

KPI BOUNDARIES SETTING				
Lower and Upper Boundaries [13]	Lower boundary		Upper boundary	
	0	Events	∞	Events
Source of Boundaries [14]	Other (explain)		Other (explain)	

INITIAL KPI BASELINE		
Methodology description [15]	N/A	
Initial baseline [16]	0	Events
Source of Baseline [17]	Start of the counter at zero.	

KPI MASTERIECE PILOT PHASE VALUE		
Methodology description [18]	Number of presentations at European conferences, fairs and events	
Target Pilot Value [19]	6	Events
Source of Pilot Phase Value [20]	Deliverables D6.2 - D6.5	

Table 10: Detailed description of KPI9

3.1.10 KPI10 - Dissemination through cooperation and joint research with EU research projects and clustering initiatives

KPI BASIC INFORMATION					
Name [1]	Dissemination through cooperation and joint research with EU research projects and clustering initiatives	Acronym [2]	DEU	ID [3]	K10
MASTERPIECE Project Objective identifier and description[4]	PO-6	To ensure wide reaching impact and use of project methodological, business, and technological outcomes among different stakeholders' categories			
MASTERPIECE Topic Challenge [5]	TC-1, TC-5, TC-6, TC-7				
Main Objective [6]	Dissemination through cooperation and joint research with EU research projects and clustering initiatives				
Description [7]	KPI focus on the cooperation with projects funded under H2020 (HESTIA, LocalRES, NEON, Lightess, SmartBuilt4EU, Reinassance) and in the same call of MASTERPIECE; cooperation with BRIDGE initiative and specific working groups (e.g.: WG on Consumers and Citizen engagement).				
Formula (if applicable) [8]	N/A				
Target Value [9]	3	Unit of Measurement [10]		Initiatives	
Responsible partner [11]	WP6	In accordance with… [12]		DoW	

KPI BOUNDARIES SETTING				
Lower and Upper Boundaries [13]	Lower boundary		Upper boundary	
	0	Initiatives	∞	Initiatives
Source of Boundaries [14]	Other (explain)		Other (explain)	

INITIAL KPI BASELINE		
Methodology description [15]	N/A	
Initial baseline [16]	0	Initiatives
Source of Baseline [17]	Start of the counter at zero.	

KPI MASTERIECE PILOT PHASE VALUE		
Methodology description [18]	Number of participations in cooperative workshops and other initiatives must be equal to or greater than *Target Pilot Value.*	
Target Pilot Value [19]	3	Initiatives
Source of Pilot Phase Value [20]	Deliverables D6.2 - D6.5	

Table 11: Detailed description of KPI10

3.1.11 KPI11 - Development of inspiring case studies

KPI BASIC INFORMATION					
Name [1]	Development of inspiring case studies	Acronym [2]	DIC	ID [3]	K11
MASTERPIECE Project Objective identifier and description[4]	PO-6	To ensure wide reaching impact and use of project methodological, business, and technological outcomes among different stakeholders' categories			
MASTERPIECE Topic Challenge [5]	TC-1, TC-3, TC-5, TC-6, TC-7				
Main Objective [6]	Development of inspiring case studies				
Description [7]	This KPI is based on measuring the development of inspiring case studies based on local implementations, including interviews and videos. At least one case study per country will be developed, targeting both homeowners and other stakeholders.				
Formula (if applicable) [8]	N/A				
Target Value [9]	3	Unit of Measurement [10]	Case studies		
Responsible partner [11]	WP6, WP2	In accordance with... [12]	DoW		
KPI BOUNDARIES SETTING					
Lower and Upper Boundaries [13]	Lower boundary		Upper boundary		
	0	Case studies	∞	Case studies	
Source of Boundaries [14]	Other (explain)		Other (explain)		
INITIAL KPI BASELINE					
Methodology description [15]	N/A				
Initial baseline [16]	0		Case studies		
Source of Baseline [17]	Start of the counter at zero.				
KPI MASTERIECE PILOT PHASE VALUE					
Methodology description [18]	Number of inspiring case studies have to be equal to or greater than target pilot value, with the aim of developing at least one case studied per country.				
Target Pilot Value [19]	3		Case studies		
Source of Pilot Phase Value [20]	Deliverables D6.2 - D6.5				

Table 12: Detailed description of KPI11

3.2 Evaluation planning

The design of an evaluation plan is of utmost importance due to the multiple benefits it offers to the project. Through a comprehensive evaluation plan, project stakeholders can gain valuable information on the progress and achievements to date, giving them a clear understanding of whether the project is meeting its intended objectives and goals. This allows them to determine the overall effectiveness of the project and identify areas that may require improvement or adjustment,

especially interesting in a project like MASTERPIECE that is designed with two refinement intervals, with the first release of the architecture in month M9 and the final version in month M27. Moreover, subjecting the project to an objective evaluation allows stakeholders to have confidence in the process and results, as well as to monitor whether project resources are being used appropriately and, in a manner, aligned with the project.

Evaluation planning plays a vital role in validating the assumptions and hypotheses made during the project's design and implementation phases. Through rigorous data collection and analysis, evaluation activities provide concrete evidence that serves to bolster the project's credibility and the validity of its results. This validation process helps project stakeholders gain a deeper understanding of the project's impact and effectiveness, enabling them to make informed decisions between iterations and regarding future directions and strategies.

Another crucial benefit of evaluation planning is its role in facilitating learning and knowledge sharing. By examining the project's outcomes, challenges faced, and lessons learned, evaluation activities generate valuable insights that can be disseminated within the project team and shared with others in the field. This exchange of knowledge fosters a culture of continuous improvement, enabling project stakeholders to enhance their practices, avoid potential pitfalls, and capitalize on best practices.

In addition, evaluation planning contributes to the sustainability and replicability of the MASTERPIECE project and its Intervention Program. By assessing factors that contribute to success and identifying best strategies for long-term viability, evaluation activities help project members to develop a solid foundation for ongoing implementation and scalability. This ensures that the project's benefits can be sustained beyond the project's lifespan and replicated in other contexts, maximizing its impact and aligning it with Key Objective 5, focused on validating MASTERPICE guidelines for large-scale energy community acceleration programs.

In summary, evaluation planning plays a vital role in project success by providing a systematic and comprehensive approach to assess progress, identify areas for improvement, and make informed decisions. It promotes accountability, transparency, and credibility while facilitating learning and knowledge sharing. Moreover, it supports the project's sustainability and replicability, ensuring that its benefits extend far beyond its initial implementation.

This section offers an initial version, based on the work done on work package 2 during the first months of the project, that will need to be refined during Task 5.1 of Work package 5. T5.1 will use the technical knowledge from WP3 and WP4 to define a systematic roadmap for the correct integration, installation, configuration and performance monitoring of the planned technology elements, as well as of the architectural design of T2.5, to define a systematic roadmap on how to integrate, install, configure and monitor correctly the performance of the envisioned technology elements to increase business and end-users acceptance on MASTERPIECE services on energy community programs. Once this roadmap has been defined, the evaluation plan proposed below must be refined and adapted to several points: a) to the requirements that have been defined within the project, b) to the architecture of the defined platform, as well as to c) the defined Intervention Program adapted to the real state of the energy communities of each pilot at the time of application.

Based on this, the Evaluation Planning consists of the following items:

1. **Define evaluation goals and objectives:** Review the project objectives and identify specific evaluation goals and objectives that align with each PO. This work has been developed within work package 2, analysing the current state of the art at different social, economic

and technological levels, to refine those objectives based on the work done in the different Tasks of the package.

2. **Identify Key Performance Indicators (KPIs):** Specific KPIs will need to be defined that will be used to measure the progress and success of each PO. The starting point for this section is the objective list defined in the project's Grant Agreement. Based on these objectives, a series of KPIs have already been defined, which have been worked on in Section 4.3, in order to be defined in detail. In addition to these KPIs, this list should be expanded with the KPIs defined together with the project requirements in the next version. The complete list will be used to later evaluate the achievement of the objectives and the alignment of the MASTERPIECE platform and the Intervention program with them.

3. **Analyse possible evaluation methods:** To evaluate the platform alignment with the Key Objectives, together with the adherence of end users and the increase of federated services on the advanced and innovative platform proposed in the MASTERPIECE Project, here are some platform evaluation methods which can provide interesting results:

    -   **User adoption metrics:** Track and analyse user adoption metrics such as the number of registered users, active users, and frequency of platform usage. This can provide insights into the level of user engagement and adherence to the platform, especially interesting for KPI 1. These metrics should be collected both at the beginning and at the end of the Intervention Program in order to adequately assess the effect of the Program.

    -   **User feedback and satisfaction surveys:** Develop surveys to collect feedback from end users regarding their experience with the platform, collecting success stories from end users who have benefited from the platform. Assess their satisfaction levels, ease of use, perceived value, and suggestions for improvement. This feedback can help gauge the platform's effectiveness in meeting user needs and expectations.

    -   **Service usage analytics:** Utilize analytics tools to gather data on user behaviour within the platform services, such as the features utilized, duration of sessions, and patterns of interaction. Analysing this data can provide insights into user preferences, usage patterns, and identify areas for optimization or enhancement.

    -   **Test cases evaluation:** this method enables systematic and structured assessment of the functionality, performance, and reliability of a system or software. These test cases will be developed around MASTERPIECE use cases to validate whether the system and the defined use cases meet the specified requirements and performs as expected in various scenarios. A draft version of the format that the test cases have to follow is described in Section 3.4.

    -   **Platform performance and stability testing:** Conduct performance and stability testing of the platform to assess its responsiveness, scalability, and reliability. This evaluation helps ensure that the platform can handle increased user loads and provide a seamless experience to users accessing federated services.

    -   **Comparative analysis between pilots:** Compare the platform's features, capabilities, and performance between the four pilots. This evaluation can provide insights into the platform's uniqueness, competitive advantages, and areas for improvement.

    -   **Service Providers interviews and surveys:** Engage with service providers involved in the provision of federated services through the platform. Conduct interviews or

surveys to gather their perspectives on the platform's effectiveness, its impact on service provision, and the increased interaction with stakeholders.

- **Compliance and security audits:** Perform compliance and security audits to ensure that the platform adheres to relevant standards and regulations of each pilot. Assess the platform's data privacy, confidentiality, and protection against cyber threats to instil trust among users and foster adherence.

Some of these methods are analysed and developed in the following subsections of Section 4, in order to set the guidelines for Work Package 5 work.

4. **Selection, refinement and development of evaluation instruments:** Design evaluation instruments based on previous methods tailored to each PO and corresponding KPIs and adapted to Pilot contexts. This work will be developed in the context of T5.1, placing the emphasis on the selection and preparation of the necessary mechanisms during the first 4 months of the task, to measure and establish the starting points that must be carried out at the beginning of the Intervention Program. During the rest of the task, task T5.6 focused on the Intervention Program will be carried out in parallel with the integration and coordination work of the pilots, the development and refinement of the evaluation tools in collaboration. The following diagram shows the Gantt chart with the schedule of the main work packages and tasks as well as the milestones that mark the relevant milestones for the evaluation plan.

5. **Continuous monitoring and iterative evaluation:** in the context of T5.6 "Intervention Program: evaluation of social, environmental, technical and economic impacts", the objective is to assess and evaluate the integrated MASTERPIECE solution from T5.1 applied in real world pilots of energy communities. This task will leverage the requirement analysis performed in WP2 and the KPIs defined in T2.4 to perform the multi-dimensional evaluation of MASTERPIECE solution considering social, environmental, technical and economic impacts based on continuous monitoring and iterative evaluation over the pilots. The evaluation process will include the instruments defined in the previous point (Task 5.1 outputs. The lessons learned in T5.6 will serve to improve the development in WP3 and WP4 for the second phase of pilot demonstrations. The KPI outcomes will be used for measuring and benchmarking the key performance factors to contribute to the regulatory innovation strategies in T6.4 and the replicability study in T6.5. Based on these evaluation tools, WP5 teams will establish a system for continuous monitoring of the pilots and the intervention program as a whole, continuously collecting and analysing data to track progress, identifying emerging issues, and adapting strategies for improvement. This work can be split into three points.

- Collect baseline data for each pilot to establish a reference point for evaluation, including energy consumption, user behaviour, market dynamics, and cybersecurity vulnerabilities at the beginning of Task 5.6 (first 3 months).
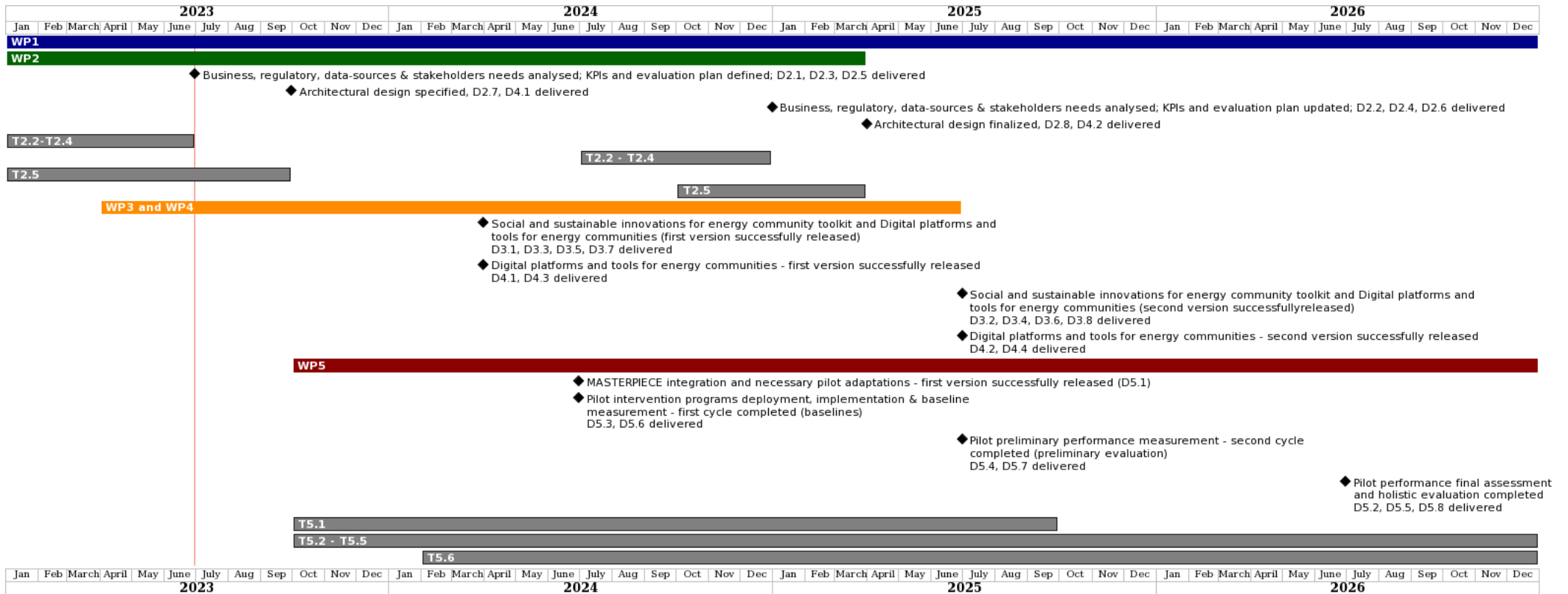
Figure 1: Gantt diagram for MASTERPIECE projec

- Analyse the collected data using appropriate statistical techniques, qualitative analysis, and comparative assessments against the defined KPIs.

- Prepare comprehensive evaluation reports summarizing the findings, highlighting successes, challenges, and areas for improvement. Provide recommendations to enhance the effectiveness and impact of the intervention program.

6. **Dissemination and knowledge sharing:** the objective of this point is to share the evaluation results generated during the Intervention Program over the Pilots as well as project outcomes with stakeholders, partners, and the wider community. Lessons learned from the evaluation process can be used to inform future projects and initiatives, sharing insights and best practices to contribute to the advancement of energy communities. Disseminate findings through reports, presentations, workshops, and publications to promote knowledge transfer and utilization in collaboration with WP6. Lessons learned from the evaluation process and use them to inform future projects and initiatives. Share insights and best practices to contribute to the advancement of energy communities.

3.3 Data sourcing

As seen in the Description and Methodology Description forms of the KPIs, MASTERPIECE will utilize data from various sources. These sources include, but are not limited to:

- Surveys and questionnaires for the pilot managers and end users
- Past historical data of the users
- Existing data platforms (through available APIs)
- Existing IoT devices

For the integration and interoperability of data collected from various heterogeneous devices, sensors and platforms, appropriate Data Models will be considered within the Energy-Communities' context. Originally, these models are typically used in the context of smart cities, Internet of Things (IoT) systems and other domains where large amounts of data are generated and analyzed. These models can encompass a wide range of data domains, such as energy, transportation, environmental monitoring, healthcare, and more. They can include entities like sensors, devices, locations, measurements, events, and other relevant aspects of the domain being modelled. The most prominent, open-source and community-supported EU initiative is FIWARE foundation. FIWARE aims at IoT interoperability of devices, data, applications and services in several Smart sectors — e.g., Smart Cities, Smart Building, Smart Energy. FIWARE foundation[14] is strongly supporting the Smart Data Models initiative. Other relevant organizations like TM Forum[15], OASC[16] or IUDX[17] are also joining forces with the FIWARE Foundation bringing support to this model. The FIWARE Data Models are aligned with the principles of linked data and are based on widely accepted standards and ontologies such as NGSI-LD (Next Generation Service Interface for Linked Data) [18]. They provide a common language for data representation, enabling developers to build applications that can consume and process data from different sources without requiring extensive integration efforts.

The motivation to employ these data models is that they are widely accepted and open source. So, the developed tools will be compatible with other applications that use FIWARE's Smart Data Models and the payment of royalties is not required.

The Smart Data model to be eventually adopted in the technical implementation of MASTERPIECE will be performed within Task 4.5 context (and the related D4.1 report expected in M9), aligning to NGSI-LD scheme which is already aligned to SAREF (ETSI) [19] standardized ontological representations.

3.4 Test Cases evaluation methodology

With the objective of advancing in the proposals of evaluation mechanisms, one of the proposed methods is based on the development of Test Cases. These test cases must be defined based on the MASTERPIECE use cases to evaluate the alignment and validity of the implementations with the proposed use cases, mainly evaluating the functional aspects of the developments.

The following table offers a first view of the format that these test cases must follow, as well as the description and examples, where appropriate, of the content and format that each of the proposed fields must follow.

1. Test Case	Test Case identifier
Actor & MASTERPIECE tools involved	1. Actor example 1: Pilot user / Building Manager / District Manager 2. Actor example 2: Social collaboration platform 3. Actor example 3: Security and Privacy Layer
Goal	Goal Description
Brief description	Description of the test case goal. E.g.: The user provides …
Precondition	The user has previously provided ….
Postcondition	The user account is successfully …
Involved Work Packages	WP3 and WP4
Execution	1. Step 1 2. Step 2 3. ….
Expected results	- Short description of the results
Successful criteria	- Successful criteria description. - Example: "Correct user login by verifying the email/password on the security platform."

Fail criteria	- Fail criteria description
	- Examples:
	   o No valid email and/or password.
	   o No completed the messages exchanged between social platform and security platform.

3.5 End user questionnaires

For the evaluation plan, it is necessary collect information regarding the status of some of the aspect that need to be improved during the Intervention Program to measure the degree to which the project's KPIs are being achieved. To set the initial project status (initial baseline) and to be able to compare the effect on different indicators of deployments, measures and actions throughout the project, each KPI defines it own methodologies adapted to the context of the specific data to be collected. In the case of collecting information on users and stakeholders, the method that usually offers the best results is the use of questionnaires, since they are a common, well-known and accessible mechanism for interacting with people.

The purpose in this initial phase of the project is to prepare an initial version of user questionnaires to collect on one hand the information necessary to stablish the baseline for some specific KPIs and on the other hand, to collect useful feedback regarding other relevant aspect around MASTERPIECE platform.

To evaluate the topics and questions included in the questionnaire, there are two types of questions. The first one is rated in accordance with a Likert scale:

1. = **Very Low** – **fully disagree**,
2. = **Low** – **partially disagree**,
3. = **Medium** – neutral,
4. = **High** – **partially agree**,
5. = **Very High** – **fully agree**.

The second group are formulated as Yes/No questions, in order to be able to count the whole number of people involved in this kind of questions.

1. = **No**
2. = **Yes**

The following table includes the initial list of questions that, based on the KPIs, project objectives and the work done during the beginning of the project, have been considered as most relevant for collect user information. The main objective of these questions is to establish an initial baseline for user adherence to Energy Communities and their level of use, satisfaction and motivation between the end users and the Energy Communities.

Number	User Questions	Answer
1	Are you affiliated with any energy community?	(No/Yes)
2	You have found it easy to join the Energy Community	(1-5)
3	Your current platform covers all the services you need	(1-5)
4	It is necessary to add new services to the EC	(1-5)
5	The information I receive is of good quality	(1-5)

6	You belong to an energy community because it is good economically	(1-5)
7	You belong to an energetic community because it's good for it's good for the environment.	(1-5)
8	You belong to an energy community because my installation/building was already registered initially.	(1-5)
9	How often do you use the EC platform (5 - every day, 3 - one per month, 1 - never)?	(1-5)
10	How well do you rate the data security and privacy provided by your current EC solution (5- very good, 1 - very bad)?	(1-5)

The following table includes the initial list of questions that have been considered as most relevant for collect service providers' information, based on the KPIs, project objectives and the work done during the beginning of the project. In this case, the objective of these questions is to establish the initial number of services federated to Energy Community platforms and their motivation and plans of federation, in order to compare with the future effect on the improvement of these numbers after the MASTERPIECE Intervention Program.

Number	User Questions	Answer (1-5)
1	Does your company offer services to energy communities?	(No/Yes)
2	Are the services offered by your company federated within the energy community platform?	(No/Yes)
3	Do you think the federation of your services is beneficial?	(1-5)
4	Has the adherence to your services increased after being federated within the platform?	(1-5)
5	Do you plan to include new services?	(1-5)
6	Do you think it is easy to include new services within the Energy communities?	(1-5)

4 CONCLUSIONS

This document presents a comprehensive analysis of the preliminary functionality investigations and performance measurement planning conducted in the MASTERPIECE project in the first phase of WP2 (M1-M6), with the aim of offering a strong foundation for the project's implementation and evaluation that will be carried out in WP5, addressing key aspects related to functionalities, user surveys, performance measurement, and evaluation planning.

The preliminary functional investigations presented in Section 2, includes the compilation of a wide range of scenarios and the identification of initial use cases and components, including preliminary

investigation conducted to gain an overview of the diverse scenarios within energy communities across Europe. These investigations hold significant value for the current project as valuable starting point for further development and refinement of the project's functionalities and interventions and as benchmarks for validating the pilot energy community scenarios.

The MASTERPIECE Performance Measurement Planning, discussed in Section 3, will play a vital role in ensuring the project's progress and outcomes were effectively measured and evaluated. The definition of Key Performance Indicators (KPIs) and the selection of appropriate measurement methods enabled the project team to establish a framework for assessing project performance and impact. The evaluation planning, data sourcing, test cases evaluation methodology, and end-user questionnaires were carefully designed to serve as starting point for WP5 work, setting the tools and mechanisms to gather relevant data, assess project outcomes, and capture user experiences and feedback. By aligning the evaluation planning with the project's objectives and challenges, the project aims to achieve its intended impact and address the expected outcomes. The evaluation results will provide valuable insights into the effectiveness and efficiency of the project's Intervention Program, offering the possibility of making the necessary adjustments and improvements between the two interactions proposed in the project.

Summarizing, this document will serve as crucial reference for the preliminary functionality investigations and performance measurement planning conducted in the MASTERPIECE project, offering the possibility of making the necessary adjustments and improvements between the two interactions proposed in the project. In addition, the work done will be very useful along the project, since it will be refined in a second version on the M24, and also will be used as a guide during the development of work package 5 to contribute to the successful implementation, evaluation, and further development of the project. By continuously monitoring and evaluating the project's progress against the defined KPIs and using the feedback obtained through various evaluation methods, the project team will be able of ensuring its alignment with the project's objectives, address the identified challenges, and ultimately deliver innovative and impactful solutions to the energy community sector.

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