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SMILE

Smart Island Energy Systems

Deliverable D6.1

Report on selected evaluation indicators

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<u>Disclaimer</u>

This deliverable is a living document and the KPI panel could be updated during the project lifetime considering new demonstration targets, deployment plans etc.

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1 Introduction

1.1 Scope and objectives of the deliverable

The general idea of SMILE project is to test and optimize the operation of smart grids, mainly islandic ones, whose outcome could also be extrapolated to the case of non-islandic conditions when operating with a high degree of RES. Technologies for energy storage such as Battery Energy Storage System (BESS), including electric vehicles and electric storage on boats, and thermal energy storage systems are to be integrated; thus allowing to set current grids more sustainable in terms of efficiency, especially when compared with their current status of operation. Towards this aim, many solutions are proposed in order to make smart grids fed primarily by clean energy more promising for investors, more efficiently sustainable for TSOs and DSOs, and more practical and cheap for consumers, who might as well be RES producers (i.e. prosumers).

In this light, the assessment of new proposed technology solutions is a very important step for the further development of smart grids, as the approach on this should be as holistic as possible. Taking this into account and attempting to address the needs of each individual stakeholder, who can take benefit of smart grid operation on a EU level, this assessment is proposed to be conducted by domain[1], i.e. in technical, environmental, economic and social terms individually, taking into consideration that every energy system is operating in a synergetic environment and in this sense should be in position to meet as much as possible the various requirements imposed by the market operators and/or its potential customers. Towards this objective, the use of Key Performance Indicators (KPIs) is determined, which are used to evaluate certain technical characteristics of a technology, its impact on the social and environmental surroundings, and its feasibility from an economic point of view.

As a result, the present deliverable aims to present the results of the work undertaken in Task 6.1 entitled as "Gathering of the reference data and identification of the indicators", having considered the feedback of various stakeholders for each of the foreseen demonstrated solutions in the three (3) demo areas of Orkneys, Samsø and Madeira islands.

Scope of this deliverable, is to determine the appropriate list of KPIs for the technology solutions proposed in SMILE by either gathering existing ones in the open literature that fit well to the requirements of the specific project, and/or proposing new ones, <u>in order to assess more accurately the success level of each technology or methodology tested by the demonstrators, during and afterwards the monitoring and data collection phases of the project</u>.

The main objective is to set the ground allowing to be in position to conduct a holistic evaluation of the proposed solutions, by various and sometimes competing interests of the relevant stakeholders (e.g. profit for the market operator vs cheap services for the consumer). The scalar quantification of solutions through the assessment criteria, being defined by the selected repository of KPIs, enables the comparison on a fair basis among the Business as Usual (BaU) technologies and the application of innovative ones.

1.2 Structure of the deliverable

At first, in section 2, a general overview of the KPIs concept is presented, along with a literature survey of the available methodologies followed by similar to SMILE projects and/or other types of EU initiatives. A critical review on these existing methodologies is also made, so as to filter the assets that could be adopted by the SMILE KPI repository, as well as to identify any missing characteristics that should as well be considered.

[1] a term used along the whole Deliverable, which will be explained in more detail in the following paragraphs

Section 3 describes SMILE approach on KPIs as well as the methodology for their gathering and definition. A list of SMILE KPIs is presented at the end of the section.
In section 4, all the three demonstrators are thoroughly reviewed on the basis of SMILE approach on KPIs. The section finishes with a connection between close and far focus of the SMILE assessment: the relationship between local and "global" evaluation.
Section 5 - "Data Control" - provides a description of the various necessary pieces of data, along with some of their most important requirements that should be met during their collection. No specific thresholds are for the moment determined for the KPIs, since the Deliverable is written in a very early stage of the project, and there is no equipment available to take any actual measurements.
Conclusions are reported at the end of this Deliverable (section 6), followed by a detailed list of the KPIs having been decided (Annex), for the moment at least, to serve the various needs and specifications evaluation of the solutions demonstrated.
The Annex consists of all the KPI cards. Each KPI card contains the objectives of the specific KPI along with a description, the formula used for its calculation, directions for the acquisition of data and guidelines for the calculation of the baseline value. Moreover, it defines whether it concerns the whole grid or just the pilot, whether it is a result of simulation or not, and the frequency of the KPI calculation. As mentioned, it is a living document, so much of the information given will be changed throughout the 4 years of the project.

1.3 Relation to other tasks and deliverables

The deliverable is related to several other tasks of SMILE project. The WPs that are dedicated to the demonstration activities in the three regions (WPs 2, 3 and 4) are expected to give a continuous feedback for any necessary SMILE KPI repository update. In this sense, this Deliverable should be treated as a living document for at least 6 months more, in order to fit better to the needs of the solutions to be demonstrated in the three demo sites.

- As concerns WP2, it is mainly linked to Task 2.7 because of the need to collect the necessary data from Orkneys.
- As concerns WP3, Tasks 3.1, 3.6 and 3.7 along with their corresponding deliverables (D3.1, D3.5 and D3.6) are responsible for the data acquisition in Samsø that is needed for the respective KPI calculation.
- In WP4, Tasks 4.1 and 4.3 are respectively responsible for the data acquisition for Madeira. Moreover, Tasks 4.5 and 4.8, along with deliverables D4.5 and D4.6 are dedicated to the evaluation of the proposed technologies in Madeira, and in that respect the present deliverable is closely related to them, since it provides the basis on which every evaluation will be made in future WPs. In addition to these, D4.4 is connected to the present deliverable, as its output will include the theoretical expectations for the pilot, to be used in the evaluation phase. Finally, deliverables D4.4 and D4.9 are responsible for the evaluation of the solutions' social acceptance, so they are certainly related to D6.1.

The resulting KPIs will in turn feed the following WPs 5, 6, 7 and 9 to support the holistic assessment of the demonstrated solutions. More specifically:

- WP5 performs the technical analysis needed to develop the architecture and special characteristics of the solutions demonstrated in the three pilots. Therefore, it will be fed by the output of the present assessment guidelines.
- In WP6, Tasks 6.2, 6.4 and 6.5, along with deliverables D6.3, D6.4 and D6.6 undertake LCA, CBA and market analysis which require the gathering of a significant amount of data. The collection of much of this data is already routed by the present deliverable. In this sense, the aforementioned Tasks are dependent on the KPIs of this deliverable, since mainly economic, environmental and social assessment will be done on the basis of the identified List of KPIs/domain.

- WP7 is responsible for the legal and regulatory assessment concerning the development of SMILE solutions. The present list of KPIs contains a special category of legal KPIs, therefore it will deliver the first key conclusions needed by WP7 to proceed to a thorough legal assessment among with the corresponding proposals.
- In WP9, along with deliverable D9.4, a Newsletter relevant to KPIs is going to be published, since the selection of most representative KPIs/domain are highly important for EU not only for the framework of this type of Projects but also more citizens-oriented ones, as that of Smart Cities and Communities.

2 KPI's role and methodological background

The evaluation of any new proposed technological solution is a very important step during the procedure of its development and improvement. The use of indicators is valuable not only to describe accurately a specific characteristic, but also to evaluate this in a simple and on a fair basis way, facilitating its comparison (in many aspects, as it will be evident later from the text document) to similar ones. Key Performance Indicators (KPIs), in general, are methods/systems that measure the effectiveness of a project towards the achievement of its specific key objectives [1]. The process of selecting KPIs also assist to clarify project objectives measures of success [2]. These indicators should contain the following characteristics, i.e. being:

- **Meaningful**: this means that a KPI relates with one or several expected innovation impacts, and therefore makes sense since contributing to reach the program overarching goals,
- **Understandable**: this means that the KPI definition relates clearly with the expected impacts of the studied innovation and,
- **Quantifiable**: this means that experimental values coming from field testing at an appropriate scale are used to develop ad-hoc simulation tools able to estimate the expected innovation impacts.

The KPIs are performance indicators that can assess a) characteristics of a technology solution, b) its impact on its environmental surrounding, c) its economic feasibility and d) its social approval either by the policy-making bodies or by the local society. Especially, the latter one is not taken into much consideration when referring to these type of projects, and this is something that should be kept in mind and the project aims as well to address, compared to the most of the rest. The KPIs value in R&D is very important as they can form the basis for an analytic evaluation of it (technology solution) by being in position to valorise the various proposed solutions according to their performance and the specific needs of each situation they serve.

The goal of SMILE project is not only to present the performance of new technological solutions, but also to optimize their integration in a grid in an efficient, cost-effective, user-friendly and environmentally friendly way, respecting as much as possible the social needs of the local communities, where each system is expected to be demonstrated. Thus, various aspects need to be taken into consideration, when a technology solution is assessed as those of a) each stakeholders' opinion about that (i.e. each stakeholder has a different perspective), b) the technical performance of each solution, c) its contribution to system security and sustainability, d) the worth feasibility of a necessary investment, e) the environmental burden compared to addressing similar technologies, f) the legislative burdens for the application of the proposed technologies and g) last but not least, the consequences on the local residents quality of life and their opinion of them, since citizens engagement on the examination and the use of a solution is a prerequisite for the solution further development and application on a bigger level.

The work on the definition of the most appropriate repository of KPIs is undertaken in the framework of SMILE project, where different system and market operators, policy bodies and governance across European Union gather, exchanging opinions and conducting both theoretical and real-life examination of RES-based systems. The scope is the development and EU fostering of smart grid support by cross-functional solutions for an optimized, synergetic power distribution in the LV/MV grid. In the following paragraph, a summarized literature review is presented, in order to identify and evaluate the most meaningful conclusions relevant to Smart Grid performance measurement. The expected outcome, augmented with contributions from the consortium members, supports the documentation of SMILE performance framework and the selection of the KPIs.

2.1 Literature survey on Smart Grid evaluation frameworks

In order to determine the optimal approach for the KPI gathering and their definition in the SMILE project, a literature survey about the already available KPI framework of smart-grid-oriented projects is performed. Ongoing projects of similar general objectives that are taken into account are "Distributed Renewable resources Exploitation in electric grids through Advanced hierarchical Management – **DREAM**" [1], "Definition and Calculation Methodology of Project KPIs – the **DISCERN** approach" [2], "Integrating Active, Flexible and Responsive Tertiary Prosumers into a Smart Distribution Grid – **INERTIA**" [3], "Energy Positive Neighbourhoods Infrastructure – **EPIC-HUB**" [4] and "integrated Smart GRID Cross-Functional Solutions for Optimized Synergetic Energy Distribution, Utilization & Storage Technologies – **inteGRIDy**" [5]. All these projects are characterized for their destination to integrate state-of-the-art technologies in small grids, with similar goals to SMILE. Additional literature resources have been identified after being reviewed and the most relevant have been taken into consideration, providing an inclusive summary of the background knowledge on Smart Grid Evaluation Frameworks [6-8].

The **DREAM** project demonstrated an industry-quality reference solution for DER aggregation-level control and coordination, based on commonly available ICT components, standards, and platforms for all actors (DER owners, grid operators, etc.) of the Smart Grids. The KPIs in DREAM had a supporting role on the achievement of objectives that were set for the proposed solutions and on the measurement of their success. In order to get exportable, comparable and industry relevant results, DREAM introduced KPIs which were mapping and enriching goals and metrics, according to the EEGI (European Electricity Grid Initiative) roadmap[9]. The experience by the DREAM approach of evaluation is mostly related to the organizational approach of the KPI determination, i.e. the proposal for a methodology capable of achieving a holistic evaluation of solutions on the grid level.

In the beginning of the **DREAM** project [1] [10], two were the possible approaches for the KPI development, i.e. a) either a procedure for the KPI selection and definition starting from the use case goals and then moving to the trial sites/demo site goals or b) starting from the pilot goals, developing KPIs and use case solutions accordingly. In its end, a combination of the two approaches was decided to be adopted.

Moreover, as the project was at its early stage when the corresponding deliverable was being prepared, not all information about the final use cases was available (tested in trials). Therefore, the discussion of goals and KPIs in one-to-one sessions per demo site (moderated by KPI development leaders) has been postponed for a later stage in the project and the outcomes have been set to be checked across the use cases. However, the demo site leaders encountered again difficulties in specifying their goals at the early stage of the project, and to resolve this problem an adequate set of KPIs existing from other similar projects has been proposed as a starting point.

In the organizational level, the challenge was to engage stakeholders to contribute to the KPI definition process. The task and consortium leaders emphasized on the importance of KPI definition and collection not only for the partners themselves, but also for the advertisement of the entire project towards EC (European Commission), in order to motivate beyond its end as a project the relevant stakeholders of the demonstrated solutions.

The "**DISCERN**" project examined cost effective network solutions for future network development. The starting point for DISCERN was the EEGI framework[9] which was adopted for practical purposes and operational use by the DSOs. **DISCERN** used organized structured and detailed workshops aimed at refining the list of KPIs from EEGI, developing the KPI framework and their detailed definitions. These workshops included the maximum possible DSOs to present a consolidated partners' point of view within the respective countries and regulatory frameworks represented in the project.

The **INERTIA** project addressed the "structural inertia" of existing Distribution Grids by introducing more active elements combined with the necessary control and distributed coordination mechanisms. It adopted the Internet of Things/Services principles to the Distribution Grid Control Operations.

INERTIA provided an overlay network for coordination and active grid control, running on top of the existing grid and consisting of distributed and autonomous intelligent Commercial Prosumer Hubs.
A list of thoroughly defined indicators had to be delivered to evaluate the performance of the Local Hubs, as single entities and as active components of a holistic Demand Response framework. The Performance Indicators were used to measure the success of the different energy management strategies implemented within the project and to support the development of strongly focused corrective and preventative actions. The control approach proposed by **INERTIA** comprised a holistic framework that examined all aspects stemming both from the Aggregators and the local citizen's view.
According to the aforementioned information, (mainly in the Demand Response field, which was the core interest of **INERTIA**) the project established an Integrated Energy Performance Model that extended existing Energy Performance Models, by incorporating and integrating multiple dimensions, i.e. a) the physical sub-system (buildings and their energy-consuming equipment), b) the human sub-system (occupants, with their occupancy and usage behaviour), c) the Enterprise sub-system (enterprise processes and business goals, and the way they impact human behaviour and the cost/benefit analysis of energy usage) and d) the general surrounding environment. Through direct incorporation of the Enterprise as a specific actor, this performance model was better adjusted to specific business domains and provided the basis for the optimal balance between Demand Side Management, Energy Performance and Enterprise Performance.
In addition, the recently EU funded **inteGRIDy** project[5] aims to integrate cutting-edge technologies, solutions and mechanisms, in a scalable Cross-Functional Platform (CFP) of replicable solutions towards connecting existing energy networks with a diverse group of stakeholders consisting of both generation and consumption profiles. The establishment of the **inteGRIDy** framework would further facilitate the optimal and dynamic operation of the Distribution Grid, fostering grid stability and coordinating of Distributed Energy Resources (DERs), Virtual Power Plants (VPPs) and collaborative Storage schemes within a continuously increased share of Renewable Energy (RES).
The KPI determination in **inteGRIDy** was based in a 4-axis principles:

- the different focus between global and local level, concerning whether the evaluation of technologies is made on a single pilot or not,
- the stakeholder's point of view,
- the thematic pillars (demand response, energy storage, smartening of the distribution grid and smart integration of grid users through transport), which represent the science and technology areas where the main innovative activities are tested and
- the domain that an indicator tries to address, that is whether it is technical, economic, environmental etc.

Last but not least, the project goal of **EPIC-HUB** was to develop new methodology, architecture and services able to provide improved Energy Performances to Neighbourhoods (NBH), combining Energy-Hub-based Energy Optimization capabilities with a Seamless Integration of pre-existing energy ICT systems and other ICT system deployed. **EPIC-HUB** focused on efficient Management, Control and Decision-Support Energy Policies at neighbourhood-level, defining an interoperable Middleware solution and a structured vision for the communities to use and share renewable energy sources, energy storage, and micro-generation, to consistently realise energy savings, reduce CO2 emissions and optimize energy usage.
The focus of the project performance measurement was energy consumption. The "Energy" KPIs of the project[4] provided to the end users (i.e. buildings in general, airports, enterprises, etc.) the most important energy performance information, to enable them to understand their energy performance level. Therefore, the main role of KPIs, in this project, lies on helping the monitoring of the execution of the different planned energy strategies with the purpose of achieving a global decrease in energy consumption.

What is gained from the specific project is a distinction of the performance measures in three types: Key Results Indicators (KRI), Performance Indicators (PI) and Key Performance Indicators (KPI) and the concomitant use of them according with different aspects and dimensions of the project, such as the time. The specific distinction provides a useful and functional taxonomy that can be used in the establishment of a complete and multi-dimensional performance framework. It is worth noted that the data collection methodology adopted by the project is mainly non-residential and aims to enable the gathering of consistent and complete Energy Efficiency reports that could be easily compared to the results of other EU projects.

The definition of an assessment framework for projects of common interest in the field of smart grids is the topic of the manual published by the Smart Grids Task Force Expert Group 4, on Infrastructure Development[7]. The goal of the report was to define an assessment framework for the evaluation of Smart Grid projects against a set of criteria in line with the requirements put forward by the European Commission (EC) in the Proposal for a regulation on guidelines for Trans-European energy infrastructure (COM(2011)658)[11]. The report suggested the use of KPIs for the measurement against six different criteria (level of sustainability, capacity of transmission and distribution grids, network connectivity and access, security and quality of supply, efficiency and service quality in electricity supply and grid operation, contribution to cross-border electricity markets and increase in interconnection capacities), which were reflecting the contribution of the project to six functions/services (enabling the network to integrate users with new requirements, improving market functioning, enhancing efficiency in day-to-day grid operation, ensuring network security, system control and quality of supply, better planning of future network investment, and enabling and encouraging stronger and more direct involvement of consumers in their energy usage and improving customer service)[12] of the "ideal" Smart Grid.

Beyond the relevant projects, there are various other worth mentioning scientific studies. Among of them is the study of Mia Ala-Juusela et al. [6]. In this paper, the concept of an energy positive neighbourhood and the metrics and tools to measure the energy positivity level of an area is presented for first time. In addition, it presents an energy positivity label to enable the visualisation of the progress of an area towards becoming energy positive. In doing so, it extends the systems limits of current approaches to energy analysis for urban sustainability. The energy positivity level of an area is estimated with calculating energy matching indicators: on-site energy ratio, annual mismatch ratio and other mismatch indicators.

Due to the remarkable variation in demand response systems, it becomes a challenge to evaluate and compare the effectiveness of different DR programs holistically. In the scientific work of Thanos et al. [8], a number of different performance metrics are defined, that could be used to evaluate DR programs based on peak reduction, demand variation and reshaping, and economic benefits.

To sum up, each project consortium developed a methodology based on the same main structure in order to reach compact conclusions, but also applied advanced differences concerning the special needs of the project.

2.1.1 The EEGI roadmap

The EEGI (European Electricity Grid Initiative) is one of the European Industrial Initiatives under the Strategic Energy Technology Plan (SET-Plan). The EEGI mission is to create an adequate European grid (both transmission and distribution systems), to achieve the European energy policy goals. The EEGI strategic objectives are:

- To transmit and distribute up to 35% of electricity from dispersed and concentrated RES by 2020, and a completely decarbonized electricity production by 2050,

➢ To integrate national networks into a market-based, truly pan-European network, to guarantee a high-quality of electricity supply to all customers and to engage them as active participants in energy efficiency,
➢ To anticipate new developments such as the electrification of transport,
➢ To substantially reduce capital and operational expenditure for the operation of the networks while fulfilling the objectives of a high-quality, low-carbon, pan-European, market-based electricity system.

The SMILE objectives coincide with the EEGI so it is reasonable to evaluate the EEGI methodology of assessment thoroughly. The selected KPIs for the EEGI Research and Innovation Roadmap have three main roles:

- to support effective communication processes to depict overarching goals of the Research and Innovation activities performed at EEGI level, and embedded within the larger SET Plan activities;
- to support the monitoring process of the R&I activities, thus showing that each project is effective at delivering the pieces of expected new knowledge needed at national and/or EU level to meet the overarching goals;
- to support the R&I management process which links the expected impacts of each R&I project performed at national and/or EU level with the deployment conditions of the resulting most promising parameters, provided that this knowledge can prove to be scalable and replicable by network operators at affordable costs.

Therefore, R&I KPIs aim to show and estimate the contribution of R&I to achieve the EEGI targets. They should guide policy makers, regulators and network operators towards using the results of R&I activities to prepare the decisions for large scale deployment of innovative network solutions that have been demonstrated through the activities of the EEGI Research and Innovation Roadmap, providing appropriate scalability and replication studies of project results that have been performed.

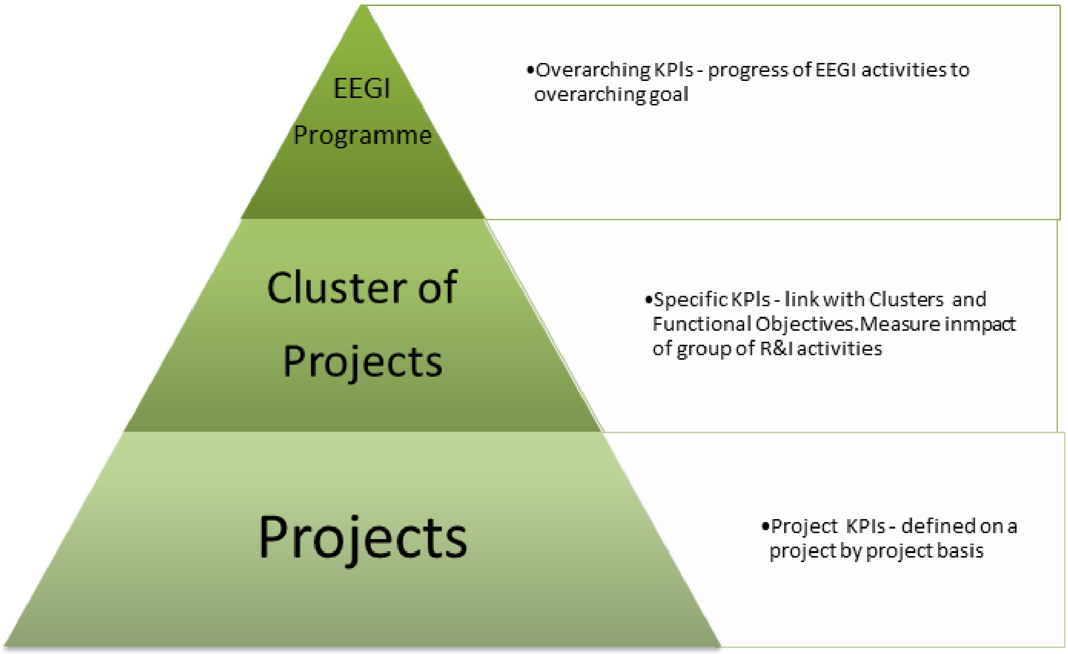


Figure 2.1: EEGI KPI levels [13]

As depicted in Figure 2.1, the KPIs are listed, according to their point of view, in the three following levels:

- **Level 1: “Overarching KPIs”** consist of a set of indicators which trace clear progress brought by EEGI activities towards its overarching goal,
- **Level 2: “Specific KPIs”** include those indicators oriented to quantify the expected impacts of a group of R&I activities in view of meeting the R&I roadmap overarching goal,
- **Level 3: “Project KPIs”** are a set of indicators proposed by each R&I project in view of detailing further the contribution of each R&I project to level 2 KPIs.

The EEGI Roadmap has identified **an overarching goal** (EEGI Level 1) of allowing European electricity networks continuously deliver effective flexible capacities to integrate actions of grid users at affordable costs, keeping the system reliability at levels compatible with societal needs. In order to evaluate the approach of R&I activities to this goal, two KPIs are defined to be applied to clusters of projects, however mostly oriented to technical aspects and less to environmental impact and/or business modelling aspects:

- The *increased network capacity at affordable cost*, which is the variation of the amount of network capacity per euro of cost, and
- The *increased system flexibility at affordable cost*, which evaluates the increase/decrease of system flexibility (evasion of potential instability and blackouts), keeping an affordable cost.

The overarching aforementioned goals (increasing network capacity and system flexibility) can be further quantified and monitored through seven **specific KPIs** (EEGI Level 2); six of them are common for DSOs and TSOs, and the last one is specific for DSOs only (Table 2.1).

Table 2.1: KPIs concerning TSOs and DSOs

Common TSO and DSO Specific KPIs	B.1 Increased RES and DER hosting capacity. B.2 Reduced energy curtailment of RES and DER. B.3 Power quality and quality of supply. B.4 Extended asset lifetime. B.5 Increased flexibility from energy players. B.6 Improved competitiveness of the electricity market
DSO Specific KPI	B.7 Increased hosting capacity for electric vehicles (EVs) and other new loads.

Furthermore, each project can propose its own KPI list in order to evaluate in a next level the different technology solutions presented according to different points of view. These are the **Project KPIs** (EEGI Level 3), which are determined in order to consolidate all different approaches that might be followed by each project to the higher level KPIs as being proposed by EEGI.

Once the list of solutions (for which the appropriate calculations have been made) is defined, EEGI also proposes a step-by-step methodology to measure the KPIs. This is a six-step process, defined as it follows:

- **STEP 1:** Determination of the reference scenario or initial situation, the problems to solve, needs to satisfy, and the drivers that trigger a network/system improvement
- **STEP 2:** Analysis of the future situation when the conventional evolution of the network happens (BaU situation)
- **STEP 3:** Calculation of the correspondent KPI to evaluate the BaU situation
- **STEP 4:** Analysis of the future situation when smart grid solutions are deployed in the network (R&I situation)
- **STEP 5:** Calculation of the correspondent KPI to evaluate the R&I situation

➢ **STEP 6:** Comparison of both scenarios, and calculation of the final indicator applying the proposed formula

2.2 SMILE's critical approach to the existing KPI literature

The determination of the methodology to create the appropriate list of KPIs about both the general purpose (e.g. the operation of the grid) and special issues (e.g. the performance of a technology application) is a matter of each project. EEGI provides a generally acceptable roadmap to direct the method of evaluation of each project, since it begins from the overarching goal to improve the electricity services at low cost, focusing a little to the System Operator's point of view who are in charge to draw the basic line and, finally, focusing to the evaluation of each proposal in each demo.

Such an approach is very sensible and helpful for the evaluation of the proposed solutions, especially when addressing the System Operator's point of view. Indeed, most similar projects, as well as SMILE can gain from this, since the solutions investigated and demonstrated (Technology Readiness Level 7→8) concern mainly the feasibility of the application of state-of-the-art innovative technologies in real-conditions grid.

On the other hand, the EEGI lacks the approach of the various stakeholder points of view, as concerns both the planning of the appropriate list of KPIs towards a holistic evaluation of solutions and its presentation. The stakeholders are not few, and some points of view lie unavoidably sometimes on opposite sides (for example the relationship between cost and quality of a service).

Moreover, the focus distinction made by most approaches (different levels of evaluation), can cause a misunderstanding instead of a flexibility that would allow the same KPIs being evaluated with different levels of focus, upon the requirements imposed by each interested in such technologies party.

SMILE proposes a methodology which is quite close to the inteGRIDy[5] project approach being followed and was described above, and its main differentiation compared to the EEGI's widely referenced, is that the proposed approach attempts to make a complete evaluation of a solution and/or of each component of the evaluation, which will be addressed from each and every stakeholder point of view. The next chapter provides a full description of this train of thought, as well as the actual proposed SMILE KPI list**.**

3 SMILE approach on KPIs

In this chapter, SMILE is fragmented into a 3-axis framework in order to include all the existing aspects that should be taken into account in order to construct and materialise a solid methodology of evaluation that will reach to the most appropriate KPI repository. The 3-axis are:

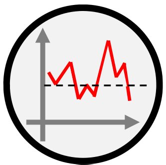
- the technology **pillars**, which categorise the main solutions tested in the SMILE pilots
- the **stakeholders**, who represent the various viewpoints of grid exploitation
- the **domains** of interest, which define the approach in the evaluation of a solution

The next subchapters describe the 3-aforementioned axis, and conclude to the proposed methodology.
In the following sections, a short description of the thematic pillars, stakeholders' perspectives and the performance domains is made, aiming to highlight the relationship and interaction among them within SMILE.

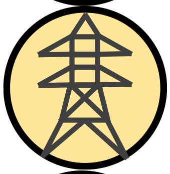
3.1 SMILE thematic pillars

The Smile innovations can be categorized in five main thematic pillars. Some of these pillars are examined in all three pilots, while some other only in one. These five thematic pillars are listed below:

Demand Response (DR) services with the use of predictive algorithms are proposed and tested in the most appropriate scheme for each pilot



Smartening the Distribution Grid through advanced monitoring and predictive models



Energy storage provided with the use of BESS or heating storage, and storage management through models and algorithms

Smart Integration of grid users from Transportation, using the flexible capacity of electric vehicles and boats

Domestic heating/cooling systems, using renewable technologies coupled with energy/heat storage options

This high-level segmentation of SMILE framework sets the first methodological layer for KPI analysis. The listed thematic pillars above should be kept in mind when evaluating any of the pilots. These pillars represent the main categorization of the solutions tested, so that the evaluation of a pilot/demonstrator can be done according to them.

3.2 SMILE stakeholder's perspective

The selected SMILE KPI repository establishes the grounds or the basis one could say of a mechanism for continuous monitoring and evaluation of the SMILE pilot demonstrators (when it comes to solutions), providing useful information to the stakeholders involved in the different business models envisaged to be examined in the course of this project, apart from the technical and/or the legal ones, specially examined in WP7.

To further understand the SMILE KPIs performance framework, individual categories of KPIs (<u>named as Domains</u>) are introduced, i.e. those <u>being the technical, environmental, social, economic and legal</u> ones. This approach is followed to make SMILE proposed list of demonstrated solutions, strongly one-to-one business linked for each of the various business stakeholders' groups, through the development and application of specific oriented for each solution innovative business models, as a follow-up of this Deliverable in WP6, with the rest ones to be conducted under the same WP. Nevertheless, a short description of the SMILE key groups of identified stakeholders and their goals is useful for the identification and definition of their interest and of the main strategy, expected to be followed for the overall SMILE project evaluation in terms of advancements and new know-how gained during its course, for the EU and its citizens. The 4 stakeholders referred, represent all the stakeholder point of views concerning the development of smart grids. Since the SMILE consortium consists of partners by all 4 enlisted stakeholders, the various goals could be identified in detail.

A. <u>Distribution System Operator (DSO)</u>

A DSO is responsible for the management and operation of the distribution network of electricity. To this end, the DSO is responsible for control rooms and various ICT systems for power distribution management and automation in the LV/MV grid electricity network. Also, depending on the legislation of each country, a DSO might be responsible for energy consumption reduction requests; in the competitive electricity market, the distribution of electricity is usually a monopoly controlled by the regulating authorities.

While DSOs are actively involved in SMILE pilots with their main interest to optimally operate their local grid, it is of high interest for the project to evaluate SMILE system performance from the Distribution System Operators point of view. The main aim of a DSO is the sustainability, reliability and flexibility of the system, the ability of the Distribution grid to reciprocate to the consumer needs every single moment, or the ability to modify the load curve via peak shaving techniques. In that respect, the role of contact with the respective DSOs of Orkney and Samsø (Madeira DSO is a consortium member) is planned throughout the SMILE project duration, and will be asked to express their point of view in the evaluation methodology, and if possible propose new KPIs. Again, in that respect, the present Deliverable should be handled as a living document.

B. <u>Consumers (End Users)</u>

The role of the customer in the energy system can change from a passive user, simply using energy from the energy system, to an active participant in the energy system, reacting to signals in the market and delivering energy services to the grid and market participants. Actually, one of the main objective of SMILE project is to ensure and promote the active participation of end users in market and grid operations; thus special focus is delivered to the evaluation of End Users performance within the context of the project. The consumers can be sorted as *residential* and *non-residential,* if someone wants to examine end-users role in the grid level in a more detail:

- *Residential consumers*: Their main interest is the low price, with a probable environmental care about the electricity mixture. Several questionnaires will be made, in order to deal with the acquisition of local residents' point of view.
- *Non-residential consumers*: Their main interests are grid security and sustainability, as well as the provision of energy (electricity, thermal) for a low price. They include facilities, offices and generally non-residential buildings.

C. Market Operator (MO)

In this category, the traditional utility operators and their expected new business roles is considered. ESCOs and DR Aggregators are the responsible parties to manage the technology to perform DR and negotiate on behalf of their customers with the operator for the provided services. ESCOs, Aggregators and retailers are interested to monitor and analyse the behaviour of the end – users, to validate the operational credibility of the technological installations supporting alternative DR schemes, to identify potential profile deviations, and to evaluate the impact of the benefits generated by the applied policies. Towards this direction, it is essential for the project to evaluate the impact of the different strategies (Demand Response, Storage and EV management) to the different market stakeholders. Furthermore, the term '*prosumers'* refers to agents that both consume and produce energy at local level. The growth of small and medium-sized agents using solar photovoltaic panels, smart meters, vehicle-to-grid electric vehicles, home batteries and other 'smart' devices, induces the increase in flexibility in the electricity networks. As the number of prosumers increases, the electricity sector is likely to undergo significant changes over the coming years, offering possibilities for greening of the system. However, demand reduction implications on the grid have not been implemented yet; managing a grid is mainly a fixed cost and as the use of the grid reduces, so the percentage cost of the grid maintenance increases and is undertaken by the remaining users of the grid. The main interest of a Market Operator is the profits in an energy venture, a fast payback period of the initial capital cost and a large investment lifetime. Various market operators will be asked for their opinion, beginning from the ones that own the largest share in the electricity mixture in each island, to small prosumers.	

D. Policy-Making Bodies and Governance

The current regulators represent an important stakeholder group for which to consider, too. They are responsible for a normal and steady operation of the energy market, its gradual privatization, and they provide all the regulatory framework which is responsible for the determination of the quality standards and the basic rules. A clear and consistent vision for the smart grid has not been adopted by legislators or regulators. Even though there is a great discussion about individual technologies such as renewables or about specific energy issues (e.g. environmental impact), little progress about the overall vision for a modernized grid is detected. That strategy will integrate the appropriate technologies, solve the grid related issues, and provide the desired benefits to stakeholders and society [14]. Consequently, all the respective current regulators will be asked to provide their vision and their opinion.	

Figure 3.1 presents the four categories of stakeholders with their main features.

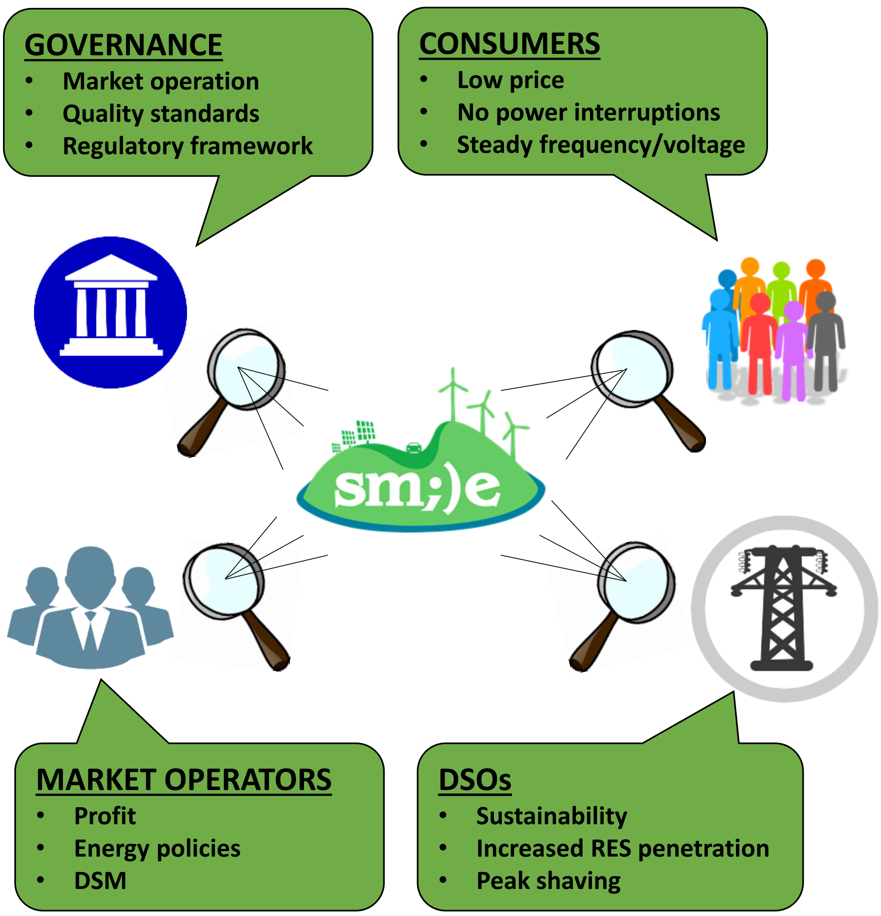


Figure 3.1. SMILE four main categories of the stakeholders

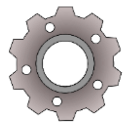
3.3 SMILE KPI domains

The other basic axis of SMILE KPI framework lies on the definition of SMILE domains, namely technical, economic, environmental, social and legal. These domains (or dimensions) are complementing each other to set the holistic performance framework.

The SMILE KPI domains are defined as:

- **KPIs measuring Technical Performance**, such as the energy consumption, the RES generation ratio, the peak load reduction etc.
- **KPIs measuring Economic Performance**, such as the average cost of energy consumption, the average estimation of cost savings etc.
- **KPIs of Environmental Performance**, such as CO2 emissions reduction
- **KPIs of Social Performance** such as the degree of users' satisfaction from DR services.
- **KPIs of Legal Performance**, such as the level of adaptation of electricity/heat integration in the legal framework

- ***Technical Performance Domain***

KPIs in Technical Domain measure the effectiveness of a given use case with respect to the operating parameters and technical constraints acting on the MV/LV grid and active/passive users. They identify and quantify the benefits that SMILE architecture offers to existing assets and on the quality of service provided to customers.	

Technical KPIs are obtained by gathering the electrical metrics on the network (e.g. voltages/currents collected along feeders and active/reactive powers measured at the interface with the transmission system) and on customers and producers (e.g. active/reactive energy/power exchanged with the network). In some cases, the KPIs need to be supported by numerical simulations on the basis of a grid model and the actual measurements collected on the grid (KPIs aiming at evaluating the technical performance of a particular asset e.g. batteries or the model based evaluation of DER capacity in a local network), as foreseen in WP8.
The interest in these KPIs changes depending on the perspective of the various stakeholders, such as system operators (DSOs) that are mainly concerned about KPIs related to the MV/LV network operation, while customers are focused on KPIs assessing the performance of a new approach/strategy at their premises. However, other factors exist that could affect the relevance of the KPIs considered in the different situations, for example the regulatory framework in force which could promote an improvement of the quality of service with reference to specific technical indexes (SAIDI/SAIFI), or business cases applying in each particular scenario, also in relationship with the target performances defined in the economic domain.

- ***Economic Performance Domain***

The economic performance evaluation takes into account the business efficiency of each application and usage scenario from the market stakeholder perspective. The three pilots offer different value propositions to SMILE stakeholders and thus, special focus should be delivered to the definition of KPIs that reflect this specific viewpoint. Among the objectives of the project is to provide market viable solutions, defining business oriented KPIs to evaluate the day to day performance of the SMILE tools and applications. For example, the residents of apartments would like to have a view of the economic benefit produced by their flexible consumption behaviour. They may be willing to sacrifice part of their comfort to achieve lower energy bills and they would like to know what the cost/benefit ratio is. Likewise, the business stakeholder (DR Aggregator) will like to know the actual benefit from the implementation of DR strategies in a portfolio of customers.
Once again, the overall business and economic analysis is closely related to the definition of business stakeholders in the project, along with the selection of business models and associated scenarios to be examined at the demonstration sites of the project.

- ***Environmental Performance Domain***

KPIs in the Environmental Domain are important for understanding and evaluating the environmental impact of energy/storage, smart grid distribution related solutions and are important for a smart system planning and operation.
In SMILE project, the environmental KPIs will be used to evaluate the efficiency of the energy systems demonstrated in the pilots in environmental terms. For example, there are KPIs that refer to the operational phase (Noise Pollution Exposure), as well as to the end-of-life phase (EROI). The main focus is on operational phase evaluation through the definition of KPIs that set the framework for day to day evaluation while the Life Cycle Analysis (LCA) methodology will be applied for the determination of environmental aspects and potential impacts of a product or system from raw material extraction through production, use and disposal, while evaluating possible recycling routes following a Cradle-to-Cradle approach.

- ***Social Performance Domain***

The social aspects of energy projects were found to be the less popular among the employed KPIs in previous similar studies. The chosen indicators reveal that attitudes towards energy are interrelated with demand response mechanisms [15] and such KPIs can be used to evaluate the extent up to which the end-users (citizens in most cases) are willing to participate and be self-motivated for further demonstration and application of the demonstrated

solutions. This is a core aspect of the SMILE as the project aims at investigating the potential of end customers to actively participate in demand response schemes, for example. Generally, the social performance domain visualizes the impact of a technology, scheme or policy to social factors like local wealth, unemployment, satisfaction, or even more specific like the effect on the use of public transport, the health care system etc. A popular approach used in literature for expressing the social KPIs is the Likert scale, since it is a sensible way for quantifying a qualitative value. Partners responsible for such KPIs will determine target groups among the various stakeholders and pose them a question that need a Likert answer.	

- ***Legal Performance Domain***

KPIs in the Legal Domain, which mainly monitors the legislative background concerning the application of the proposed solutions. The specific domain is not commonly used, but it is of great importance in the R&I, since law-making bodies are often not flexible enough to follow the progress of technology. This is a serious problem, especially in EU, since most of the already mature technologies cannot be actually implemented and operate in real-life conditions, because there is not the necessary legal background, allowing their actual life operation. Even more important are the economic results. An immediate legislative support of a new technology can give a serious handicap for its developer and end-user in a world-wide market, where the exploitation of innovations is one of the most serious sources of profit. Generally, market operators (including DSOs and prosumers) need a steady legislation concerning their invested capital, and fast response concerning the legislative background of innovations. The Legal KPIs evaluate mainly the governance in terms of legislative flexibility. This flexibility is difficult to be objectively quantified, so the subjective point of view of several stakeholders is needed, usually in the form a percentage scale.	

	DSOs	Market Operators	Consumers	Policy Bodies and Governance
Technical domain	DSOs are mostly interested in ensuring an adequate level of quality of supply to the grid connected customers, taking into consideration each of the specific grid characteristics. Critical peaks of demand should be avoided, constantly monitoring users' consumption to avoid grid breakdowns and efficiently addressing fraud challenges. In other words, DSOs are interested in the operational impact of any scenario to the grid conditions.	With reference to the technical domain, Market Operators (MOs) are interested in the various technologies available for power generation and storage, as well as to the proposed DR strategies. Technology performance is crucial for any investment decision. Moreover, a better exploitation of assets devoted to improving the regulating capabilities of Virtual Power Plant (e.g. energy storage systems) would reduce the required investment costs and increase the incomes.	The quality of the power delivered is a matter of interest mainly to non-residential consumers. Especially factories and large workplaces can withstand neither power interruptions, nor large voltage variations or harmonics. Residential consumers are not as dependent to quality of service as the above, but certainly demand it.	Policy Bodies are interested in monitoring the contribution of the projects (pilots) to the smart grid functions, which are directly related to Smart Grid policy objectives. These are among others, the Security and quality of supply, the connectivity and access to all categories of network users, the capacity of transmission and distribution grids to connect and bring electricity from and to users.
Economic domain	The aforementioned concerns of the DSOs in the technical domain are also having an economic aspect, as any potential inefficiencies in the quality of supply to the grid customers, may cause significant charges from the side of the regulation authorities. Moreover, DSOs are responsible for proposing an energy strategy, giving directions about the future of the energy mixture, bearing in mind the overall cost.	Main goal of the Market operators is to maximize profit concerning the cost of the investment. This means that they care for all the economic aspects of any possible technology on which they could invest. They compete to sell DR services to the utility operator and provide compensation to consumers, in order to modify their preferable consumption pattern. In this respect, they will make use of economic indicators to identify operational needs, market opportunities or critical situations and deploy appropriate DSM strategies. Any available RES promotion paying policies (feed-in tariff, etc.) are under close observation as they play a decisive role in the overall feasibility of an investment. Real-time views for revenue protection, unexpected EV and solar loads identification are some of the metrics that would make sense for utilities in such case.	The main expectation of the residential consumers is a direct economic benefit either in the form of cost reduction or in terms of at hand compensation, depending on the DR schema category they participate. Non-residential consumers also demand the lowest possible final cost, as the energy cost is one of the main factors that are included in the final cost of any kind of business, and thus is very important to the international competition.	From the perspective of policy makers, economic domain indicators should reflect the efficiency and quality of service achieved in electricity supply and grid operation. Measures of interest indicatively include: Demand side participation in electricity markets and in energy efficiency measures, societal CBA, which goes beyond the costs and the benefits incurred by the project promoter, as well as the monetary value of reduced CO_2 emissions, whereas the KPI analysis might just refer to the amount of CO_2 reduction expressed in tons.

Environmental domain	DSOs are highly interested in knowing about the effect new smart technologies will have on environment when applied and replace conventional systems, since their electric grid, under supervision, influences the cities and citizens' quality of life much. Moreover, they need to confront with the current EU legislation policies promoting the low CO_2 technologies.	Market Operators are expected to apply schemes contributing in making grid distribution smarter and more efficient (e.g. DR programs by LSEs or third-party energy aggregators). Environmental KPIs related to demand determine the quality of response from the customers. Moreover, the environmental indicators are necessary for the Market Operators to provide the environmental profile asked by both governance and end-users (market).	Both residential and commercial end-users are highly interested in knowing more about the environmental impact of any incentive. Environmental parameters are linked and to a certain extent reflect the, demographical, physical and contextual characteristics such as types of premises and profile of users, weather conditions, national/local characteristics, idiosyncrasies and legislation etc.	Governance is interested in the levels of sustainability and would like to monitor it in a quantified manner (including the reduction of greenhouse emissions and the environmental impact of electricity grid infrastructure). International agreements are directing the local energy policies which include the increase in RES penetration and the reduction of the CO_2 emissions.
Social domain	The social approach is necessary for the definition of the quality standards of the delivered services, as comfort and satisfaction are seriously taken into consideration.	Even more than the social approach of the DSOs, Market Operators (especially the utility-scale) depend on the social comfort and satisfaction by the delivered services, as it plays a crucial role in the determination of the marketing strategy to prevail the competition.	All kinds of consumers can be motivated to change their energy behaviour through different social approach techniques, especially if there is direct monetary benefit. It further allows them to understand and feel comfortable with the energy infrastructures at home (RES, batteries, smart-meters, etc.) and improve their energy attitude.	Governance is interested to the social approach in the filter of the general evaluation of its general policy that has to be acceptable to the highest possible percentage.
Legal domain	Being responsible for the optimization of the grid, the DSOs have to be free to apply the most suitable mix of technologies according to the needs. The legislative background sets the barriers of the DSO freedom to apply any new changes. On the other hand, laws are seriously based on the proposals of the DSO, although there are other additional perspectives that need to be taken into account.	Market operators are probably the most affected stakeholders by the legal domain. The various-size companies and enterprises, purchase technologies that have to cope with specific standards. The permission to use a technology, and sometimes the terms under which the market operates is pre-set by the legislative framework. A very serious point is the profitability of an investment. Generally, in the multinational market, the sooner an innovative technology is applied, the bigger market share it will acquire. That is why law-making bodies are pressed often by companies to adjust (or make it fit) the legislative framework according to the technology progress as soon as possible.	Consumers are the least involved in the legal domain. End-users want the legal framework to help the market operation in such a way so as to provide the best possible relationship between price and quality.	Governance is the mostly related stakeholder with the legal domain. It could be said that the legal domain evaluates the governance, and specifically its ability to set up the rules of the market under which all the stakeholders can take benefit of.

3.4 SMILE KPI methodology

3.4.1 The concept of KPI determination

As mentioned in the previous chapter, the main concept of SMILE evaluation model is to emphasize on the stakeholder perspective. Each stakeholder can observe a proposed solution through different viewpoints. The purpose is to assist each stakeholder produce the most interesting questions from his/her point of view, as well as the most sensible presentation of the answer. Therefore, the determination of the KPI list should be a result of the questions made by each stakeholder in order to evaluate each technological solution according to all the possible domains of interest. This is schematically depicted in Figure 3.2:

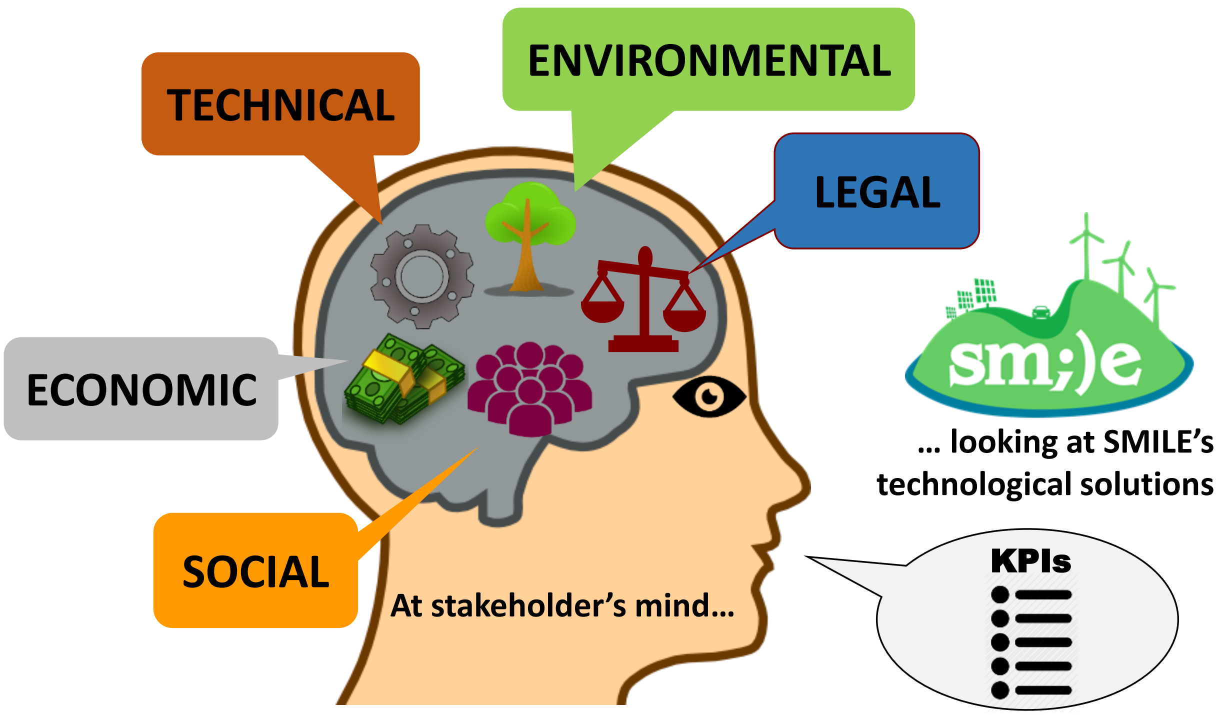


Figure 3.2: KPI determination depiction

The methodology described can prove to be the most reasonable way to include every kind of evaluation of any possible reader (who will represent in reality a different stakeholder) of the study.

3.4.2 The concept on KPI presentation

On the other hand, the presentation of the KPIs is more efficient to be understood through a domain categorization. A separate list for each stakeholder would not be helpful, since most of the KPIs interest more than one stakeholder. Domain categorization is the most usual even though the list of domains is not always the same.

Thus, after the provision of the various stakeholders' point of view about the proposed solutions through the 5 domains, a final list is derived after the interaction between the demonstrators. **Figure 3.3** depicts schematically the overall methodology that is followed in SMILE project for the project's assessment. The procedure of KPI identification and assessment is separated into three phases. In Phase 1, the various stakeholders of each island demonstrator propose the KPIs that interest them for the evaluation of the various technology pillars. In the meantime, the three demonstrators are in touch giving feedback to each other and interacting in order to make an optimized integration of the KPIs proposed. In Phase 2, the KPIs are grouped in a final list, which is presented divided in the 5 domains aforementioned. Finally, the KPIs are returned to the demonstrators for calculation during the project (and even further) in order to be given to publicity.

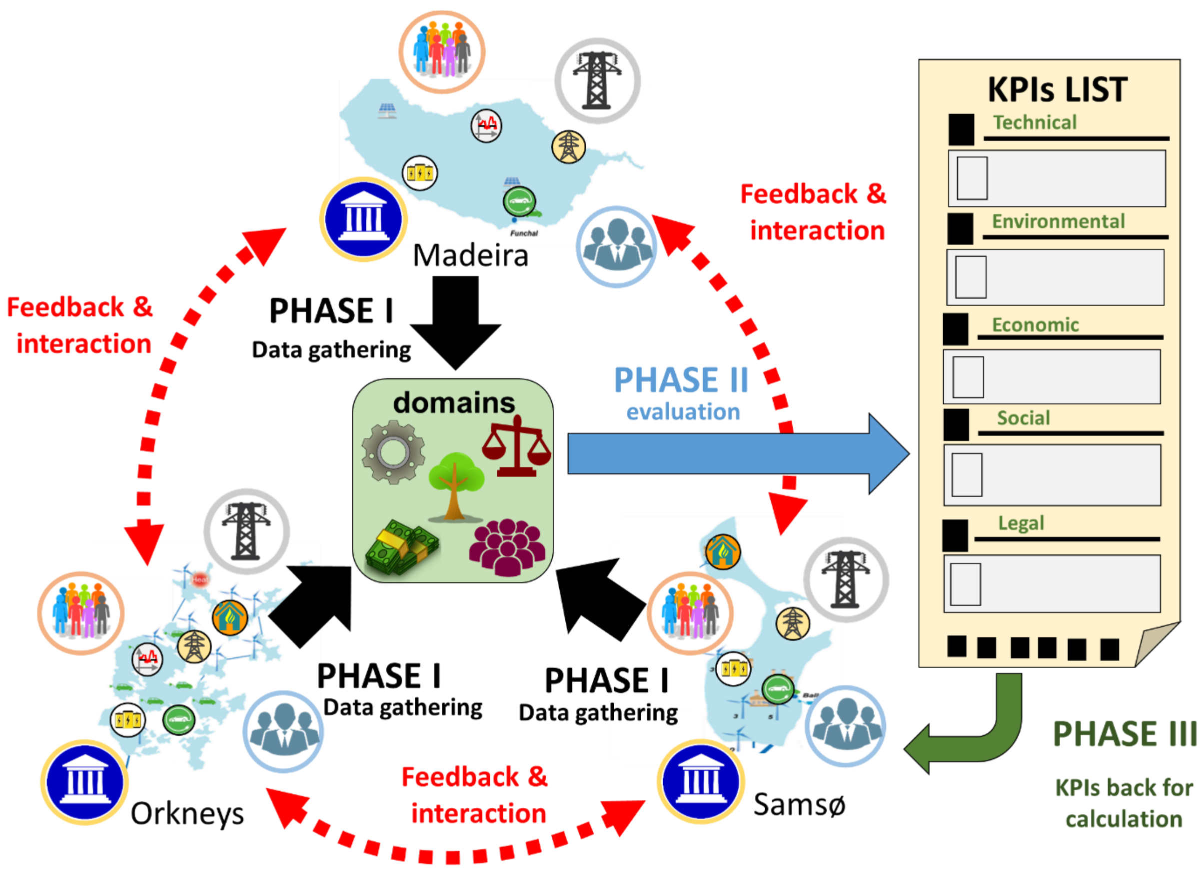


Figure 3.3: SMILE's methodology for KPIs gathering, definition and presentation

3.5 SMILE KPI List

3.5.1 Technical KPIs

Name of KPI	Definition or Source if not clear	Unit	If specifically for one system (otherwise mention all)
Share of RES: a) electricity, b) heating/cooling and domestic hot water (DHW)	RES penetration for covering a) electrical and b) thermal needs	%	RES
Share of DER (decentralized/distributed energy resources)	Share of DER in the energy mix	%	All
Peak shaving from the side of consumption	Reduction of the power peaks	% of peak power reduction	RES, DSM, energy storage
Generation Forecasting Accuracy	Confidence or fuzziness (risk) in RES generation forecasting?	RMSE (root mean square error)	Forecasting tool
Energy Losses	Yearly amount of energy lost on grid's conductors, transformers, etc.	kWh/year	MV/LV distribution networks
Voltage variations	Difference between the actual voltage supplied to MV/LV users and the nominal value	%	MV/LV distribution networks
On-site Energy Ratio	Relation between the annual energy supply from local renewable sources and the annual energy demand	%	Pilot or local grid
Maximun Hourly Surplus-Deficit (MHS-Dx)	The maximum value on how much bigger the hourly local renewable supply is than the demand during that hour (per year)	KWh	All (electricity separately from heating-cooling)
Reduced Energy Curtailment of RES/DES	The difference between the energy curtailments before and after the integration of a/all the SMILE solutions.	%	RES
Grid Congestion	Grid sustainability to peaks	%	Each network
Battery degradation rate	The rate at which the battery performance is reducing over a year/cycle	%	BESS
System Average Interruption Frequency Index (SAIFI).	Measures the average frequency of power-supply interruptions in the system	$\frac{interruptions}{customer \cdot year}$	MV/LV grid
System Average Interruption Duration Index (SAIDI).	Measures the average cumulative duration of power-supply interruptions in the system	$\frac{minutes}{customer \cdot year}$	MV/LV grid
Unbalance of the three-phase voltage system	Difference in the voltage of the three phases	%	LV/MV grid. Defined under

			European norm EN 50160: 2010
Harmonic distortion	THDU ≤ 5%, each harmonic/U1 ≤ 3% THDU=Total Harmonic Distortion Unit	%	LV/MV grid. Defined under European norm EN 50160: 2010
Storage Energy Losses	Losses because of energy storage solutions	%	Energy storage systems
Degree of self-supply	Measures the percentage of PV generation which is used for self-supply, and not sold to the grid.	%	All
Frequency Control	This KPI calculates the number of times that the average value of the fundamental frequency measured over periods of 10 seconds goes out of the stated ranges.	%	All

3.5.2 Environmental KPIs

Name of KPI	**Definition or Source if not clear**	**Unit**	**If specifically for one system (otherwise mention all)**
EROI	Energy return on (energy) investment taking into consideration the component's whole lifetime.	MWh (usable energy) / MWh (energy used to obtain that energy resource)	any RES, storage system
CO_2 tonnes saved	Tonnes saved per annum as compared with gas and grid electricity	tonnes CO_2	each component
Noise Pollution Exposure	Noise pollution in residential areas	%	each pilot
Reduced Fossil Fuel Consumption	Reduction in the fossil fuels consumption for heating, transportation and power generation	TOE/yr	Each pilot
Carbon Footprint of Heating House	Examines the carbon footprint for heating a house with(out) the project's proposed solutions	Kg CO2/year	Pilot heating houses

3.5.3 Economic KPIs

Name of KPI	**Definition or Source if not clear**	**Unit**	**If specifically for one system (otherwise mention all)**
Life-cycle cost of energy generation	The sum of all the costs throughout the lifetime of the energy investment, normalized to the energy generated.	(€/Mwhel or €/MWhth)	any RES, storage system

(€/MWhel or €/MWhth)			
Internal Rate of Return (IRR)	Profitability of an investment	%	All tools RES, energy storage solutions
ROI	Return on investment	%	All tools RES, energy storage solutions
Investment Payback Period	The length of time that it takes for the cumulative gains from an investment to equal the cumulative cost.	Years	All tools RES, energy storage solutions
Annuity Gain	Measures the annual profits of an investment throughout its lifetime.	€/y	Any RES, storage system
Total capital cost per kWt installed	Examines the initial cost of an investment depending on the size of the capacity being installed	€/kW	All
Feed in Tariff	Energy policy which provides guaranteed price to RES energy investors	€	All
Heating Prices		€/kWh	All
Load purchasing from mainland	The amount of power that has to be purchased by the mainland	€	All
Fossil Fuel purchasing from mainland	The amount of fossil fuels that have to be purchased by the mainland for heating, transportation and power generation	€	All
Transportation Cost	Calculation of the fuel cost for electric transportation	€/100km	Each Pilot

3.5.4 Social KPIs

Name of KPI	Definition or Source if not clear	Unit	If specifically for one system (otherwise mention all)
Improved access to online services	The extent to which access to online services was improved	Likert scale	primarily developed ICT platforms
Increased environmental/sustainability education	The extent to which the project has used opportunities for increasing environmental awareness and educating about sustainability and the environment	Likert scale	Dissemination and communication activities of the systems deployment and testing/monitoring
City's uneployment rate	Residents unemployed as a share of all economically active residents	%	Each pilot
DR scheme sensibility	Are consumers satisfied with the DR policy?	Likert scale	Each pilot

EV scheme sensibility	Are consumers going to be using EVs within the next 15 years	Likert scale	Each pilot
Thermal Comfort	Evaluation of the performance of the heating solutions proposed	Likert scale	Each pilot
Degree of Landscape Impact	Refers to the possible opposition from citizens. A wind turbine or battery may look ugly or obstruct the view to the horizon. An aesthetical measure.	Likert scale	Each pilot

3.5.5 Legal KPIs

Name of KPI	**Definition or Source if not clear**	**Unit**	**If specifically for one system (otherwise mention all)**
Local grid balancing legal framework development	The extent to which local grid balancing technologies' regulation is suitable at EU level and at the partners' islands level	%	Each pilot island, EU
Micro-grids legal framework	The extent to which micro-grids regulation is suitable at EU level and at the partners' islands level	%	Each pilot island, EU
Suitable Energy Storage Regulation	The extent to which energy storage regulation is suitable at EU level and at the partners' islands level	%	Each pilot island, EU
Monitoring and Evaluation	The extent to which the progress of policies/strategies/projects is evaluated and is adapted according to the findings	Likert scale	any RES, storage system, ICT platform

4 Specialized and general evaluation

4.1 Orkney site

4.1.1 Application of the SMILE pillars in Orkney

The aim of RES and smart grid operation solutions tested in the Orkney demonstrator is to enhance the current electricity generation system by implementing more generators (wind turbines) supporting the operation of the grid, turning it from semi-smart to fully smart, so as to maximize its existing assets. Basic characteristic of the pilot is the attempt to support the rollout of electric vehicles. The Orkney pilot is going to demonstrate all 5 SMILE pillars.
More specifically, DSO and demand aggregators will participate to setup and deliver DR services, testing them in 50 premises, before being rolled out in the market. These services will be evaluated concerning their sensibility to the customer, and their support to the grid sustainability. Several DR methodologies will be examined in conjunction with the various energy storage solutions. These technologies will be evaluated according to a) their technical performance, b) their support to the RES penetration and c) their feasibility as an energy services alternative. The target is to reduce curtailment by 1000 MWh/year.
Green transportation is, as already mentioned, one of the main pillars tested during SMILE project, since the rollout of EVs demands various types of existing infrastructure. Many EV charging points need to be efficiently electrically supported and completely integrated in the smart controllers of the grid, receiving and sending away information about the demand. SMILE will evaluate this solution by a) grading their comfort to the locals, b) measuring the difference in the environmental impact compared to fossil fuels based transportation means, and c) the economic feasibility for both the consumer and the DSO.
The last pillar that is investigated in Orkney case is the domestic heating. The 50 households mentioned above will be equipped with 3 new heating technology solutions with the help of heating storage. The goal is to reduce the effective heat cost by 10%, while maintaining the temperature comfort level of the customers to a high level.

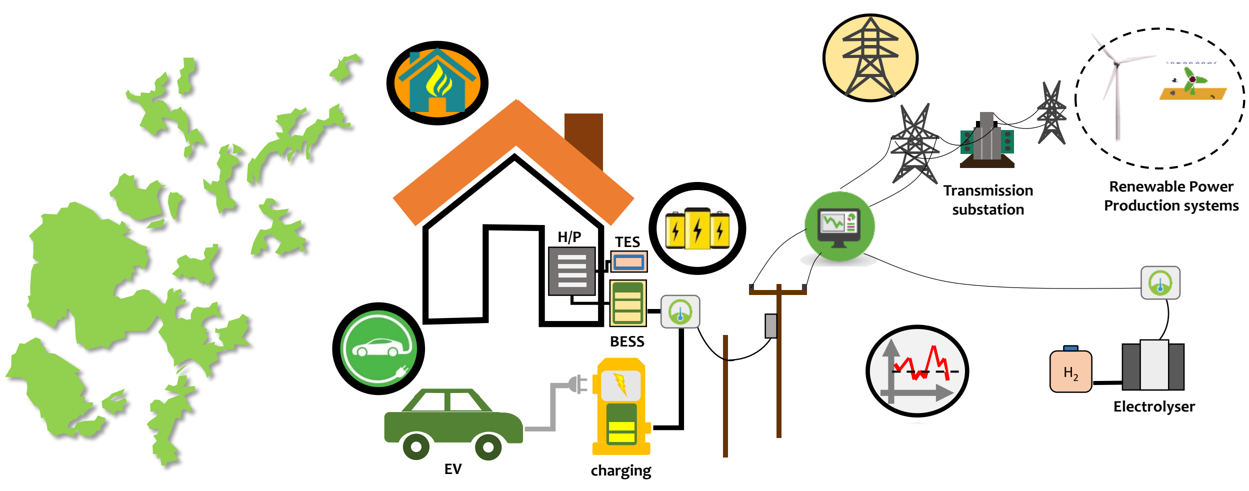


Figure 4.1: Technology solutions to be investigated and relevant pillars for the Orkney demo site

4.1.2 Stakeholder interest in Orkney

The solutions tested in the Orkney demonstrator are of high interest for all participating stakeholders. They are not only technological oriented, but also include DR policies, and can be viewed either as a stand-alone technology with a performance, or as a key element of an integrated solution for the overall grid performance.

DSO has a difficult task to conduct, as many changes are proposed and, thus several aspects have to be taken into consideration and to be evaluated. Higher RES penetration with more wind turbines as well as energy storage solutions change the power generation characteristics, while DR, electric transportation and electric heating solutions change dramatically the load curve. DSO evaluates all of the above more as an add-on to the grid and less independently compared to the rest of each solution stakeholders, where the main interests are investigated whether smartening the grid makes it both secure and feasible.

Market operators, prosumers and aggregators are certainly interested in the DSM policies, connected to the law infrastructure considering the energy market, the feed-in tariffs etc. Each technology proposed (RES generators, heating solutions) has a different profitability degree, which is the main care of a possible investor.

Consumers mainly care about the electricity price. Non-residential consumers will certainly check the quality of the power provided and the grid sustainability in order to stay away from loss-making power interruptions. Residential consumers will take special interest in the EV proposition concerning the flexibility and generally the comfort of this method of transportation, as well as its environmental impact compared to fossil fuel transportation. All consumers will certainly show much interest in the new heating solutions, evaluating the quality of service that is the distance from comfortable temperatures, and the overall price of heating.

Finally, governance will assess the solutions keeping a distanced focus. Its interest is to create the optimum legal infrastructure in order to provide on the one hand cheap electricity to all consumers, and on the other incentives for market operators, triggering them to invest further on new technologies and services for covering the needs of the end-users.

4.1.3 Domain evaluation in Orkney

As mentioned, the domains tested in each pilot are the technical, the environmental, the economic, the social and the legal. Orkney demonstrator will test several new technologies including heating and energy storage, as well as DR policies, EV transportation and energy storage solutions that affect the grid performance, the RES penetration and maybe the quality of the power provided.

So, concerning the technical domain Orkney demonstrator will be tested about the technical performance of each and every new technology proposed, on the curtailment reduction via the smartening of the grid, on the grid sustainability (SAIFI, SAIDI), on the quality of power concerning the increased RES penetration (Voltage variations, harmonic distortions) and on the technical consequences of DSM policies and EV transportation to the load curve, mainly to the peaks.

The environmental domain includes a variety of KPIs that will evaluate the solutions at Orkney demonstrator, primarily concentrating on the impact to the environment compared to BaU conditions. Increased RES penetration solutions with the use of energy storage, individually and in synergy with each other, certainly reduce CO_2 emissions by a percentage that has to be measured. Moreover, the use of wind turbines may have an effect on the noise pollution that has to be checked too.

The economic point of view to the Orkney demonstrator solutions is the feasibility of each solution individually and all-together as a grid upgrading step. The overall effect on the energy price to consumer is very important, the potential need to build more utilities to support the grid are some of the aspects that will be evaluated. The price of EV transportation compared to fossil fuel is to be evaluated too. The feed-in tariff to the market operators also interests the economic domain.

The social domain can indicate the (dis)advantages of the heating proposed to the local community thermal comfort, as well as to their satisfaction with EV prospect. Moreover, it can give an impression on the success of the DR policies proposed depending on their sensibility to the eyes of the customers. Other conclusions can be provided too, like the effect of the model on the unemployment of the community tested.

Finally, the legal domain will evaluate the adaptation of the legislative background to the evolving needs of the island to increase the RES penetration in its electricity mixture, including the adjustments to the market operation.

4.2 Samsø site

4.2.1 Application of the SMILE pillars in Samsø

The main goal in Samsø demonstrator is to increase RES penetration so as to become fossil-fuel free until 2030. The Samsø pilot is going to demonstrate all five SMILE pillars, too.

The main characteristic of the pilot is its marina area that demands a big variation of load, which is very high in July-August. A solar power generator and maybe also a wind turbine will be placed in one of the marinas, as well as a smart controller, which will be responsible for the majority of the local power generation. The smart operation of the grid will be reinforced with a central BESS and other distributed energy storage solutions.

The energy supply of boats and EVs will be driven by a new DR market model. While the current situation is that owners pay a fixed daily amount, the new prices will be dynamic and depend on the local energy production.

The demonstrator will be evaluated for the sustainability of the grid concerning the fuzziness in both RES energy generation and marine energy demand. Storage is certainly necessary in such an attempt, but being an expensive solution, it will be evaluated both technically and economically.

As in Orkney, the transportation by EVs is proposed and will be tested for its economic, environmental and social impact, considering the cost for transportation (€/km), the easiness of transportation and the CO_2 emission reduction.

Heating solutions are also included in the pilot of Samsø, including a booster heat pump to support the local district heating system storage facilities. These solutions will be evaluated individually, but also in the scale of heating energy consumption of the community.

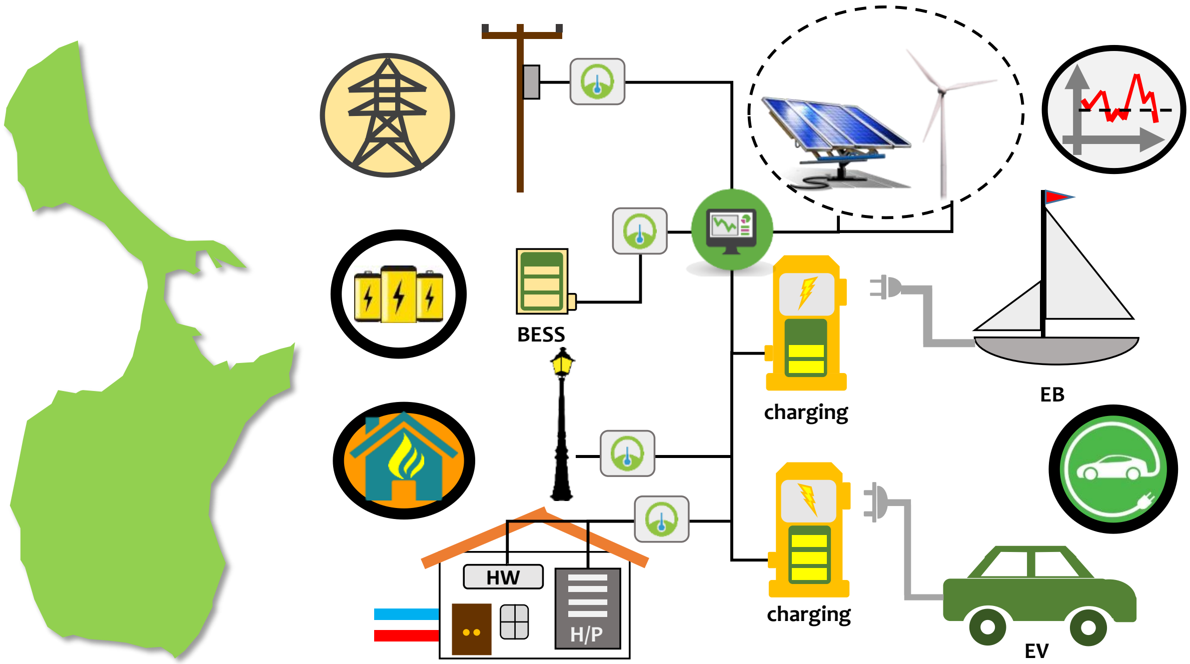


Figure 4.2: Technology solutions to be investigated and relevant pillars for the Samsø demo site

4.2.2 Stakeholder interest in Samsø

The solutions tested in Samsø could catch the interest of all the possible stakeholders, as new technologies, higher RES energy mixtures, grid operational solutions and policies are tried.
The DSO, being responsible for the security and sustainability of the grid, cares for the evaluation of the application of energy storage solutions, as well as the DR policies in order to smarten and manipulate in the best way to allow them both fit in the most efficient way, both the generation and the demand curves. Reaching the level of using a 100% fossil-free grid is certainly not easy and the optimization of the mixture requires for an accurate and well-controlled simulation/prediction.
The market operators, including the prosumers are interested in the Samsø proposals, as the model proposed demands a high level of participation by the market operators. Moreover, the market model that will be constructed is closely attached to the feasibility of their investment; so an optimized solution, taking into consideration also financial aspects, both matter on their final decision. SMILE KPIs, especially the economic ones, will help them make the best possible conclusions.
The consumers need to compare the 100% fossil free model to the BaU mainly on the final price. Especially residential consumers will most probably care about the cleaner environmental impact of this model, but the final price will probably be their first interest. Non-residential consumers certainly demand a high quality of power without interruptions, so technical KPIs concerning the quality of service in a grid depended on PVs and wind turbines will be attractive, indeed. However, placing PVs and a wind turbine on a small idyllic marina brings many thoughts and considerations in mind. The sizes of PVs and wind turbine matching the load will not necessarily be the optimum sizes at the harbour because of the local interests from sailors and other tourists as well as local residents that may prefer the PVs and turbine to be small and less visible in the marina or placed somewhere else such as at the ferry harbour close by.
Finally, governance will assess the solutions keeping a distanced focus. Its interest is to create the optimum legal infrastructure in order to provide on the one hand cheap electricity to all consumers, and

on the other incentives to market operators to invest. Especially the proposal of a market model for EVs and boats is a potential income that will not let the governance future decisions-making related to that unaffected. Last but not least, such an energy system, with an envisioned small operational cost supported by the developed innovative business models, is expected to affect the governance decisions-making, especially when related to social aspects (e.g. unemployment rate).

4.2.3 Domain evaluation in Samsø

The solutions examined in Samsø case will again be evaluated by five (5) KPI domains; the technical, the environmental, the economic, the social and the legal. The demonstration and monitoring in Samsø includes the operation of a 100% fossil free energy system containing energy storage systems, heating systems operating with green power by PVs and wind turbines, as well as a new market model for the supply of boats and EVs.
Observing the pilot by the technical point of view, each technology needs to be evaluated concerning its performance compared to others or to BaU, respect to grid operation, paying most of the focus on its curtailments, the quality of power delivered (voltage variations, harmonic distortion), the amount of interruptions (SAIFI, SAIDI) and the impact of the market policy to the sustainability of the grid.
The KPIs of the environmental domain can enlighten the reader about the amount of CO_2 that has not been released to the atmosphere because of a 100% fossil free energy system, the difference in the noise pollution, and the energy performance of each technology compared to its energy cost to be manufactured and while operating (EROI).
The KPIs of the economic domain can provide some conclusions about the feasibility of a totally green energy community, supposing that it is the main burden that keeps it from prevailing. Although a multi-dimensional cost-benefit analysis will give more accurate results, the economic KPIs can provide a more-than-faint idea of, not only the feasibility, but also more specifically the main sources of the financial burdens. More obvious is the service of the domain in the evaluation of the market model proposed.
The social domain can observe the pilot focusing in aspects like unemployment, as mentioned, the satisfaction level of the locals about the heating system proposed, the transportation via EVs, the impact on tourist attraction, and the amount of local companies and local individuals participating in the energy service of the island.
Finally, the legal KPIs will evaluate the advanced local legislation that allows/promotes RES penetration in the highest possible share, supporting the attempt to sustain a fossil-fuel free electricity power system. A legislative flexibility is crucial in order to adapt to the technology progress that increases performance and ensures feasibility.

4.3 Madeira site

4.3.1 Application of the SMILE pillars in Madeira

The island of Madeira is the only one of SMILE demonstrators that is not connected to a mainland grid of electricity and operates totally autonomous. This means that it is completely electrically independent, which is a very difficult business case for the local DSO, especially with the increase of solar energy penetration, which is the most unpredictable for the moment, when compared to rest of RES available sources. Moreover, the legislation framework, promotes self-consuming of PV prosumers instead of grid injection, mainly due to the unstable nature of the grid. The demonstrator works on 4/5 of the SMILE pillars, except that of the heating.

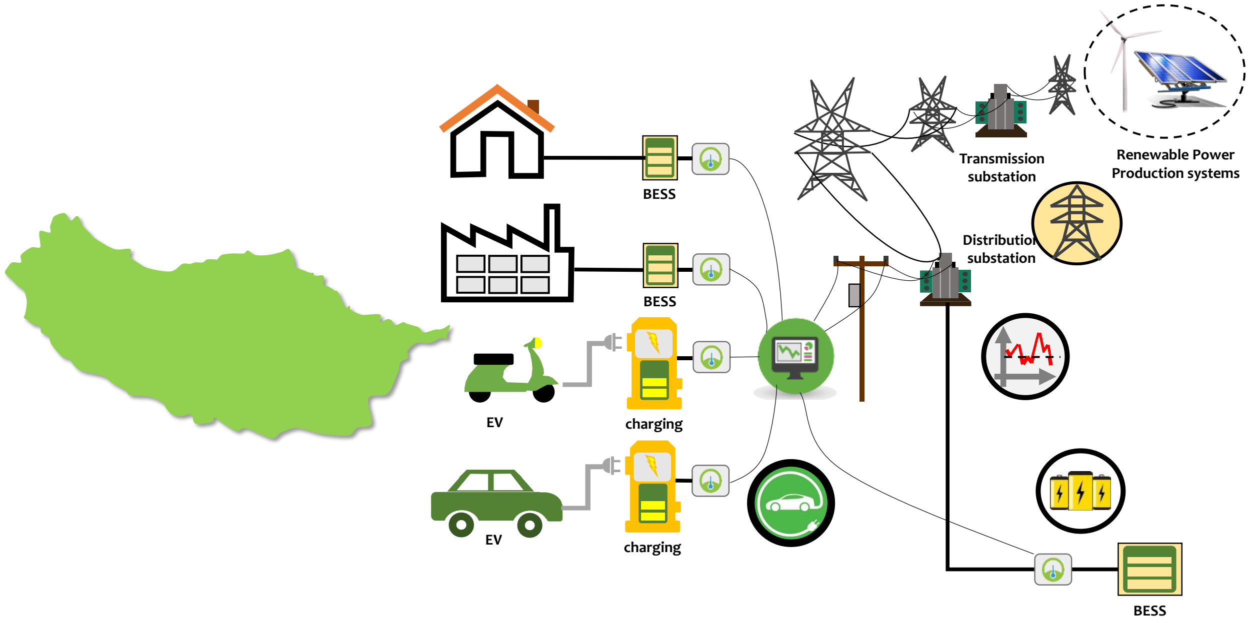


Figure 4.3: Technology solutions to be investigated and relevant pillars for the Madeira demo site

The main objective of the Madeira demonstrator is to smarten the system so as to reduce curtailment, to become secure and sustainable even though it is independent from the mainland grid. Both load demand and generation can be smartly scheduled so that the existing generation assets perform better. BESS and DSM methods are going to be used in order to reach this goal. Specifically, small BESS solutions will be tested in order to support self-consumption of PV prosumers, while big BESS solutions will be tested in order to provide voltage and frequency control of the distribution grid. Moreover, smart metering will be promoted for micro-production sites. The DR techniques will support the matching between demand and generation, which is even more difficult due to the fuzziness of the generation of PVs.
Finally, a new smart EV charging methodology will be tested considering its support to the grid and its sensibility approval by the locals, aiming at the expansion of the measurement to the rest of the island.

4.3.2 Stakeholder interest in Madeira

The demonstrator of Madeira is a characteristic situation of a grid that needs to be smart and requires the use of BESS due to its independency and currently high RES penetration (almost 30% nowadays). That is why it would attract the eyes of all the possible stakeholders, either the ones of Madeira specifically, or others interested in similar case studies.
The Madeira DSO has a really difficult job, as it has to make a “small” grid both secure and sustainable. Other grids have the surplus/lack backup of a highland cable connection. This is why an independent grid as that of Madeira’s focuses on BESS. Taking into account that BESS is a quite expensive solution, the DSO has to optimize its use so that the whole grid operation is feasible. Thus, a DSO would certainly be interested in indicators like the curtailment reduction, the BESS performance indicators, the quality of services delivered, the capacity/sustainability of the grid, the share of RES in the electricity mixture and the final price.
The market operators in Madeira vary, since the existing energy mixture consists of a utility-scale amount of thermal generators (mainly diesel and secondarily natural gas), and a considerable number of PV

prosumers, who are directed to self-consumption by the existing legislative framework, which due to the currently experienced grid instability does not allow for any additional RES penetration. Thus, market operators are certainly interested in the technical and financial performance of each technology individually, as well as to the success rate of the DR policies proposed.

Consumers have serious reasons to be anxious and opt for the optimization of such a grid, as its difficulty to match generation and load demand leads to interruptions and bad power quality on the one hand, and on the other a high final price because of the use of BESS. Thus, all the consumers would care for the final price. The non-residential consumers certainly care about power interruption indicators (SAIFI, SAIDI) and power quality (voltage variations, harmonic distortion, frequency control).

Finally, governance already has an important role, as it has applied a legislative framework considering the various stakeholders in the energy market of the island. The performance of the DR policies and the various technologies, including the smartening of the grid, can lead to different conclusions about the best possible legislative framework. Thus, governance will be probably interested in social KPIs showing the approval of the locals on the solutions tested, as well as the profitability indicators of the various technologies in order to direct its policies with the corresponding incentives.

4.3.3 Domain evaluation in Madeira

The Madeira demonstrator could again be evaluated by the 5 KPI domains that were used in the other demonstrators, too; the technical, the environmental, the economic, the social and the legal. The demonstration and monitoring in Madeira includes the operation of an independent, by other mainland grids, energy system containing BESS and a rising amount of RES generators, EV charging stations, as well as DR policies for a better matching between generation and load demand.

The technical domain contains KPIs that can evaluate the main purposes of the Madeira demonstrator, mainly focusing on the sustainability of the grid, with their view towards the expansion of RES penetration, evaluating BESS technologies, the grid capacity, the curtailment reduction and the quality of the delivered power voltage. The study on the load curve and its characteristics (Maximum hourly surplus, peak shaving from the side of consumption) can provide partial but necessary conclusions about the DR policies.

Madeira's first priority is to optimize the operation of its independent grid, with the purpose to gradually increase the RES share in the mixture. Thus, the environmental point of view is not as strong as in the other two demonstrators, but still, the goal to gain maximum energy profit by existing RES (clean and cheap in operational cost) can be evaluated by the SMILE environmental KPI pool.

On the other hand, the economic feasibility of such a grid is as important as its technical aspect. BESS is one of the main characteristics of the demonstrator, but also one of its most expensive (either considering in prosumer-scale or in utility-scale). Many of the more specific KPIs in the economic domain (Payback KPIs for BESS, feed-in tariff, current energy prices) can give information about the grid feasibility and the level of optimization it has reached.

The social domain will mainly have to check the DR sensibility by the consumer's point of view. In addition, the access to EVs will also be particularly useful because of the smart EV charging demonstrated.

Finally, the legal domain will evaluate the existing legislation. For the time being, only self-consumption is allowed for the owners of PVs. Legislative standards in used technology, as well as the rules of the market operation play a crucial role in the sustainability and the feasibility of the grid.

4.4 From Local to Global evaluation

The process of evaluation through the use of KPIs is of great importance, as it indicates the degree of success of the research. All interested stakeholders can just take a look at the KPI values and acquire a good impression of the progress that is made. In that respect and to improve and strengthen the impact of solutions demonstrated, starting from the SMILE limited boundaries and expanding to EU level, the evaluation has to be done inductively (the part to whole approach). Such a route approach can also achieve the successful passage from the specific case studies to a more generalized scheme. That is the reason why the evaluations of each case study need to be generalized taking benefit of smaller-scale experience gained by similar to SMILE case studies towards a greater than SMILE scale (i.e. from pilot grid level up to whole island level, see Figure 4.4).

The pool of SMILE KPIs varies a lot regarding their expected role. For instance, some indicators evaluate a specific technology application or methodology on the level of the solution itself (e.g. a BESS or a PCM as a thermal storage solution), while others evaluate the effect of the previous to something wider than the solution itself, as for example a grid, and others something even wider as for the example the community level, where this solution is applied. This telescopic focus variation is closely related to each stakeholder's point of view. To be more specific:

- Each community consumers have the closest look/focus on the results of the proposed solutions, since they are interested much in what benefits they individually will have after the appliance of a solution (e.g. a battery in their homes);
- Market operators have the second closest look, as they are primarily considering the market needs, i.e. for example the needs of the community consumers.
- DSOs have a clearly more distant approach than the Market Operators as they have an overview of the grid operation. Being responsible for the sustainability of the grid, they propose best available technology directions to the market operators, while
- Governance has the most distant approach of all, since they are obliged to bear stick to the DSO's directions and build the legislative framework that will bear in mind all the above. Governance is responsible for the local SEAP in the scale of an island, a city or even a country. In that respect, this telescopic approach can enhance the further development of any island SEAP, setting goals and measures, currently not being considered, owed to limited know-how of the advancements each of the solution demonstrated can achieve.

Such an approach may not apply to every KPI but indeed for most of them is quite reasonable. For example, a KPI evaluating a DSM policy concerns both consumers and governance, but still, the focus of each is different; the consumer can just express the degree of satisfaction, while governance has to consider many more aspects.

In this light, someone should to have in mind to foresee an expanding character in the selected KPIs, so that the most important of them or appropriate consolidations of them into fewer can operate as a general framework for policy and business investment making, on a larger than each community level. A globalized evaluation of solutions, considering the needs primarily of the Governance from the side of stakeholders' perspective along with the inclusion of consolidated globalized KPIs in terms of the five (5) already defined KPI Domains, should form the basis for a holistic globalized evaluation platform.

Although it is not among the objectives of the present Deliverable, the technology evaluation should be able to acquire more global characteristics. For example, the use of EVs and electric boats as a method of storage and DSM in order to help the increase in RES penetration, is firstly used in the specific pilots of each island. The collective experience by all the pilots could give the directions for the integration in a larger scale, which could be that of a whole island. This could give additional experience according to its evaluation and show the way to a wider integration on larger islandic grids, or even to the interconnected system. The final level of generalization is that of the EU who is close to a market grid unification according to the Target Model[16].

This generalised evaluation cannot be done in the close barriers of a single project. SMILE and similar other projects are under observation by EC since the conclusions can guide to tomorrow's European policies concerning the state-of-the-art application and the market rules.

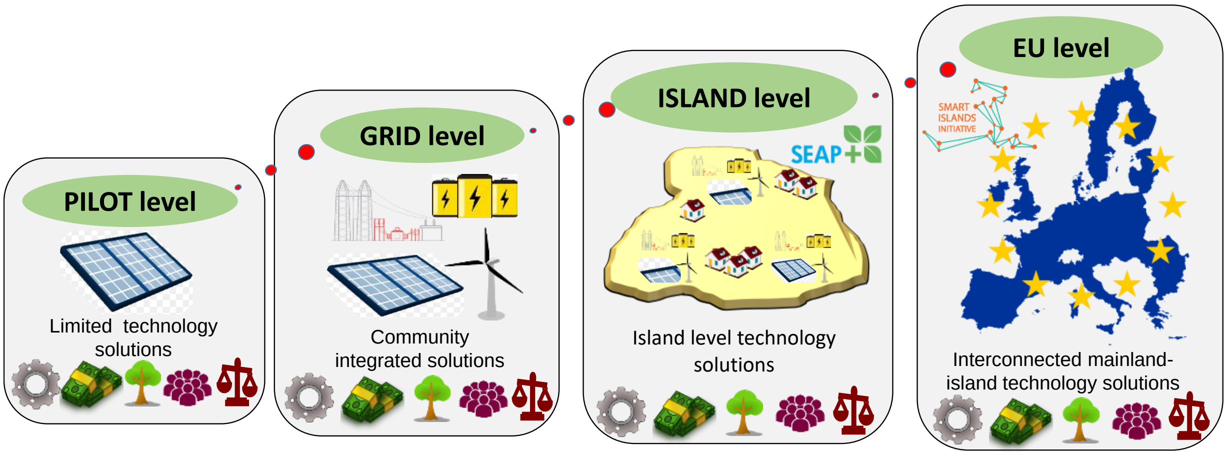


Figure 4.4 Schematic Depiction of the Local-to-Global strategy

5 Data Control

The determination of the evaluation method for the calculation of the list of KPIs is not a difficult task. On the other hand, the main difficulty appears in the collection and proper management/sorting of data, as it requires accuracy in the kind and format of data needed. Moreover, the data may need complex adjustments in order to be used for the KPI value estimation. The data may be real-time data collected on-site, or determined by bibliography parameters.

The first category is the ***measurement-based data*** (*primary data*), for which it is of utmost importance to know the history of the system examined, based on real data. The information should be very detailed (i.e. divided into different end-users and time intervals), so that it is as useful as it can be during the management programme. Such specific oriented monitoring activities are foreseen in WPs 2, 3 and 4 for each demo site.

The second category is the ***model-based data*** (*secondary data*), where mathematical modelling of the grid systems is applied in order to identify energy saving potentials and operational capabilities of the grid. Therefore, they can be used for the analysis of grid/aggregator level conditions and for the optimization procedure. Such activities are foreseen in WPs 5 and 8 for the selected demonstrated solutions.

SMILE, as well as many other projects, uses a mixture of both categories. The following paragraphs give a more analytical idea of the methodology used for the determination and collection of data of both categories.

5.1 Primary (measurement-based) data

The collection of data by the different pilots is crucial for the calculation of the SMILE KPIs, as well as its overall evaluation in terms of the different pilots and its replication ability. In most cases, the data is described by its units and the time point/period it refers to. The data source directs to the methodology used for the data collection. The most usual cases are described below:

Existing web services

Online data, both real time and historical can be collected from online services via web-service API. One of the more common examples is environmental data such as temperature that is often needed for energy efficiency or demand calculations. Services such as http://www.wunderground.com or https://rda.ucar.edu, can provide easy access to such data either manually via a website, or automatically via connecting software using a web service API. Moreover, existing web-services will provide RUG with all the information needed in order to evaluate the legislative background concerning the quality standards of the three grids, as well as the market operation rules.

Web services will be also used by RUG for the collection of all the data about the legislative background concerning the energy standards and the market operation. Though they are not measurements, they are supposed to be primary data since they are not the output of a simulation.

Smart meters

Some sites may already have meters or data loggers installed that are already connected or provisioned to connect and send data to the network via a dedicated network interface. These meters can be easily connected and configured to send data files into a pre-defined web address that can then be accessed online by users or automatic web services. In some cases, such meters cannot be accessed directly, but need to be accessed via a web service that is included as part of the solution. In such case, data can be accessed online manually from a website and exporting the data, or using some type of API. Some of the

more advanced utilities have also deployed smart meters at the utility input, and are enabling user access to the meter data.
In other generation sites, smart meters will have to be applied and, along with existing equipment of the premises, in order to provide exact information about the electricity generation, especially in RES power plants.
On the other hand, there is the alternative of simple *energy meters*. These meters/analysers are used for metering but not necessarily for billing. They are often coupled with analytical tools to help users/operators analyse the consumption profiles.
The determination between smart meters and simple energy meters is depending on several criteria like connectivity, sampling frequency and accuracy.
The data acquired either way will be mostly in a compatible form.

Plug-level meters

They will be used in pilots to measure the current signal in EVs. The aspects taken into consideration are mainly the need for a remote access, an open API, as well as the necessity to use a smart plug which will allow a larger maximum current than that needed for charging.

Utility bills

Historical and highly delayed data is provided by utility bills. This data is, of course, interval data for very long intervals (months). However, collecting this historical data can provide good benchmarks for initial calibration. This data is provided in different formats by different utilities and in most cases, needs to be manually collected and organized in files, or even better to be gathered by the local electricity utility in computer files.

Battery Management Systems (BMS), EV and boat charging platforms

BESS and charging platforms for EVs and boats are some of the main technology solutions tested. Data needed for their evaluation will be gathered by smart metering in place, and connected with the management platform.

Grid power quality analyser

A grid power quality analyser shares the basic functions of a smart meter, in terms of measuring the consumption of energy with information such as active, reactive and apparent power, power factor, network frequency, harmonic distortions, voltage and current, allowing, at the same time, bidirectional communication of the data obtained using cellular networks (i.e., 3G, GSM and GPRS) or Wi-Fi.
One difference between smart-meters and grid power quality analysers is the sample frequency. Typically, smart meters sample data every few seconds or minutes. However, the control of voltage and frequency levels in distribution points need real time information about these quantities, thus the need for such equipment.

Supervisory control and data acquisition (SCADA)

A very important source of data is SCADA as will provide all the relative data for the DSO. The values provided are various including plenty of the electricity qualitative and quantitative characteristics like voltage, active/reactive/apparent power, frequency etc. Moreover, the data is separated by very short time intervals (from 1 to 15 minutes; the latter is required by most of the current standards and EU based national legislation rules), so a quite exact impression can be given in order to evaluate accurately.

5.2 Secondary (model-based) data

Except for the raw measurements associated with the real-time operation of the SMILE platform, many additional parameters, not easy to be measured, will need to be determined for the calculation of SMILE Key Performance Indicators. These data consist of the configuration parameters and normalization factors that will enable the model- based KPIs calculation. These values are of high importance and their actual use within our calculations is:

- To reflect factors that can be considered constant throughout the overall SMILE approach without introducing bias to our evaluation results.
- To represent values, selected taking into account the conditions/parameters of the EU market or the pilot countries (retailer energy prices).
- To derive factors, which allow someone to normalize KPI values so as to support further comparative analysis (installed capacity).
- To be factors and configuration parameters associated with different business models and contractual agreements; of high interest within the SMILE framework (feed-in tariffs).

The configuration data values are to be extracted from the audit process at pilot infrastructures of the SMILE project. In some cases (e.g. retailer or market prices), dynamically updated values will be considered and thus interfaces with external service providers (e.g. energy markets) will be defined.

In summary, the SMILE performance framework can form, with the introduction of such data, a holistic approach for the estimation of indicators based on a priori estimations and a posteriori measurement values. This separation of work mandates for the adoption of both Measurement-based and Model-based metrics and therefore, both types of KPIs have been selected for the performance evaluation of the project. The KPIs will be fed with raw data originated from a variety of devices, systems or web sources, coupled with or validated against technical references, where appropriate, for calibration and/or testing purposes.

6 Conclusions

6.1 Summary

SMILE aims to present cross-cutting solutions about the smartening of the grids, working on-site at 3 islandic environments, one of which is completely independent from any mainland grid. In general terms, the main goal of SMILE project is to increase the RES penetration in the energy mixture, insisting on the sustainability of the system.
This deliverable defines the evaluation methodology of the solutions tested, both independently and as a whole. Performance measures will be used to assess the success of the energy management strategies developed in SMILE pilots and to create corrective and preventative action processes. These indicators will receive inputs, for instance, from smart meters and wireless sensors, demand and energy limiters, energy devices as well as past data and validated characteristics of the pilots.

The evaluation framework proposed here is based on three-axis - technology pillars, stakeholders, and domains of interest -, which are briefly described below (for a detailed description please refer to chapter 3).
First of all, SMILE innovations can be categorized in five main **pillars**, corresponding to the different technology solutions tested: smartening of the distribution grid; energy storage; smartening through electric transport; domestic heating/cooling systems; and demand response services.
Secondly, the representation of the different points of view of the grid exploitation, are presented as **stakeholders**. Each stakeholder is concerned about the various technology solutions according to its owns interests. The stakeholders are: the DSOs; market operators, end-users (or consumers), and governance.
Lastly, in order to emphasize on the stakeholders' perspective, the KPIs list is divided in 5 categories corresponding to the stakeholders' different **domains** of interest which are: Technical domain; Environmental domain; Economic domain; Social domain; and Legal domain.
It should be pointed out that the last (legal) domain is a novelty of the SMILE KPI methodology since it is not used in other similar works. The legal infrastructure is supposed to be one of the main burdens of the R&I application as, in order to adapt to the latest needs, the governance flexibility is more and more crucial, both technically and financially.
For the determination of the KPI list, all stakeholder points of view needed to be represented. Fortunately, the consortium consists of all 4 kinds of stakeholders. In addition, there will be need for contact with the rest DSOs to acquire data, so it is possible that more feedback about the Smart Grid assessment will be provided.

The final list consists of:

- 18 Technical KPIs
- 5 Environmental KPIs
- 11 Economic KPIs
- 7 Social KPIs
- 4 Legal KPIs

The preparation of this deliverable takes place in the first months of SMILE project, when the conditions and solutions presented by each demonstrator are not yet completely defined. Thus, all the contacts with the various stakeholders already done during almost the first year of the project and the current list of

KPI pool are expected to be updated in order to provide a more holistic evaluation to all the possible interests. In this sense, the current deliverable should be considered as a living one.

6.2 Progress

The SMILE assessment methodology had to be defined in the beginning of the project, based on its main objectives and the technologies proposed. Although it began in the third month of the project and was completed in the ninth, it was supported by feedback which was acquired in parallel for Tasks 2.7, 3.1 and 4.1, since they are the Tasks describing thoroughly the demonstrators. Main tasks, advanced objectives and possible burdens are some of the aspects that had to be taken into consideration for the undergoing of the present deliverable, and the aforementioned Tasks were responsible for the clarification of these aspects.
In the meantime, the present Deliverable was responsible to provide directions to the demonstrators on the assessment of SMILE solutions. This means that the demonstrators will try to find the means to acquire the necessary data for the KPI calculations throughout and after the end of the project.

6.3 Next deliverables

The WP6 deliverables following in month 18 (November 2018) are:

- D6.3: Methodological framework for conducting socio-economic studies (Confidential report). Document describing the MAMCA (Multi-Actor Multi-Criteria Analysis) that will be used for the feasibility analysis and the social acceptance of the SMILE solutions application.
- D6.5: Extended market report on SMILE solutions (First edition, Confidential report). This first edition of the document will contain a market survey that will later lead to complete business plans.

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8 Abbreviations

API	Application Programming Interface
BaU	Business as Usual (estimation of a situation concerning that the same technology route continues)
BESS	Battery Energy Storage System
CBA	Cost-Benefit Analysis
DER	Distributed Energy Resources
DR	Demand Response
DSM	Demand-Side Management
DSO	Distribution System Operator
EC	European Commission
EEGI	European Electricity Grid Initiative
ESCO	Energy Service Company
EV	Electric Vehicle
GPRS	General Packet Radio Service
GSM	Global System for Mobile communication
ICT	Information and Communication Technologies
KPI	Key Performance Indicator
LSE	Large-Sized Enterprise
LV/MV	Low/Medium Voltage
PCM	Phase Change Material
PV	Photovoltaic
R&D	Research and Development
R&I	Research and Innovation
RES	Renewable Energy Sources
SME	Small/Medium Enterprise
THDU	Total Harmonics Distortion Unit
TOE	Tonne of Oil Equivalent
TSO	Transmission System Operator
VPP	Virtual Power Plant
NBH	Energy Performance to Neighbourhoods
TRL	Technology Readiness Level
SEAP	Sustainable Energy Action Plan
SCADA	Supervisory Control and Data Acquisition
TES	Thermal Energy Storage

ANNEX

The ANNEX includes the descriptions of all the KPIs used for the evaluation of SMILE solutions distributed in the five domain categories, as mentioned in the previous chapters of the Deliverable. Following, there is a table which contains useful definitions and instructions in order to clarify the content of the KPI cards.

Project sites to be calculated	It shows the conditions of assessment and mostly depends on the TRL of the proposed technology solution. *Simulation Platform*: Modelling software used as a tool to check viability and optimize a solution under various circumstances *Demonstration Laboratory*: Testing of a technology solution in lab circumstances and maybe extreme occasions. Generally the lab performance is a little higher than the real. *Field demonstrator*: The technology solutions is tested in the actual life, in real conditions, and is assessed according to this.
KPI Calculation Methodology	It divides the KPI calculation into several steps. In most cases these steps are the data collection and the actual KPI calculation. Each step is given a responsible partner.
Scenarios to be measured	*Baseline*: It is an actual number, an existing measured value, usually a measurement in the beginning of the project. *Business as Usual (BaU)*: It is an estimation of a KPI value in the (near) future, depending that the specific technology used is kept the same. It shows the development in the performance, if we continued using an existing technology, and it is compared to the estimated performance should we applied the one tested. *Smart Grid*: Calculation with data after the implementation of the SMILE solutions.
KPI Data Collection	*Data*: A name of a separate piece of data. *Data ID*: An abbreviation of the mentioned data name. *Methodology for data collection*: It describes whether the data will be requested by another organization or if it will be acquired with the use of special equipment etc. *Location of data collection*: It defines the focus of the mentioned piece of data. It can vary between pilot, local grid and whole country. *Frequency of Data Collection*: It defines whether the data used will be real-time or they will be gathered annually etc. *Minimum monitoring period*: It defines how many times/years will the KPI be counted. In some cases, the monitoring period is suggested to last longer than the 4 years of SMILE, so as for the impact to deliver visible results. *Data collection responsible*: Each piece of data is given a partner who is responsible for its acquisition.
Source of Baseline	*Secondary Data*: It is ticked when the baseline measured by data taken by other literature, or it is a simulation result *Company History Values*: When the baseline is measured by recent history data of the responsible organization. *Values Measured at Start of the Project*: The most usual selection which shows the recent level of technology.

BASIC KPI INFORMATION			
KPI NAME	System Average Interruption Frequency Index	KPI ID	SAIFI
Main Objective	Observes how often each customer encounters a power interruption.		
KPI Description	This KPI calculates the annual average number of power interruptions encountered by each end-user.		
KPI Formula	$$SAIFI = \frac{ST}{CUS}$$ ST= number of power interruptions annually in the grid to all end-users CUS= number of end-users		
Unit of measurement	Interruptions/customer/year		
Connection/Link with other relevant defined KPIS and Use Cases	System Average Interruption Duration Index		
Project sites to be calculated	Simulation platform: ☐	Demonstration Laboratory: ☐	Field Demonstrator: √

KPI CALCULATION METHODOLOGY		
KPI STEP METHODOLOGY ID [KPI ID #]	Step	Responsible
SAIFI_1	Collection of data (SAIFI)	CES, SE, EEM/PRSMA/M-iTi

KPI SCENARIOS			
Scenarios to be measured	BASELINE	BUSINESS AS USUAL (BaU)	SMART GRID
	√	√	√

KPI DATA COLLECTION							
DATA	DATA ID	Methodology for data collection	Source/Tools/instruments for Data Collection	Location of Data Collection	Frequency of Data Collection	Minimum monitoring period	Data collection responsible
SAIFI	SAIFI	Data request by the local DSOs or power suppliers.	Internal software possessed by the local DSOs or power suppliers.	Each pilot, each local grid	Annually	6 years	CES, SE, EEM

KPI BASELINE

Source of Baseline	**SECONDARY DATA (literature, databases, simulation)** ☐	**COMPANY HISTORICAL VALUES** √	**VALUES MEASURED AT START OF PROJECT** √
Details of Baseline	The baseline can be calculated either using the data of the last year, or with the average value of the last 5 years.		
Responsible (Name, Company) for Baseline	CES, SE, EEM/PRSMA/M-iTi		
GENERAL COMMENTS			

BASIC KPI INFORMATION			
KPI NAME	System Average Interruption Duration Index	KPI ID	SAIDI
Main Objective	Observe the time duration of the power interruptions the end-users encounter.		
KPI Description	This KPI calculates the average time duration of the power interruptions encountered by the end-users each year.		
KPI Formula	$SAIDI = \frac{\sum_{i=1}^{CUS}\sum_{j=1}^{n(i)} STt_{ij}}{ST}$ CUS= number of end-users n(i)= number of annual interruption of the end user *i* ST= number of power interruptions to all end-users in the grid annually STt=the time duration of a power interruption		
Unit of measurement	minutes/customer/year		
Connection/Link with other relevant defined KPIS and Use Cases	System Average Interruption Frequency Index		
Project sites to be calculated	Simulation platform ☐	Demonstration Laboratory ☐	Field Demonstrator √

KPI CALCULATION METHODOLOGY		
KPI STEP METHODOLOGY ID [KPI ID #]	**Step**	**Responsible**
SAIDI_1	Collection of data	CES, SE, EEM/PRSMA/M-iTi

KPI SCENARIOS			
Scenarios to be measured	**BASELINE**	**BUSINESS AS USUAL (BaU)**	**SMART GRID**
	√	√	√

KPI DATA COLLECTION							
DATA	**DATA ID**	**Methodology for data collection**	**Source/Tools/instruments for Data Collection**	**Location of Data Collection**	**Frequency of Data Collection**	**Minimum monitoring period**	**Data collection responsible**
SAIDI	SAIDI	Data request by the local DSOs or power suppliers.	Internal software possessed by the local DSOs or power suppliers.	Each pilot, each local grid	Annually	6 years	CES, SE, EEM

KPI BASELINE

Source of Baseline	**SECONDARY DATA (literature, databases, simulation)** ☐	**COMPANY HISTORICAL VALUES** √	**VALUES MEASURED AT START OF PROJECT** √
Details of Baseline	The baseline can be calculated either using the data of the last year, or with the average value of the last 5 years.		
Responsible (Name, Company) for Baseline	CES, SE, EEM/PRSMA/M-iTi		
GENERAL COMMENTS			

BASIC KPI INFORMATION			
KPI NAME	Share of RES: a) electricity, b) heating/cooling and domestic hot water (DHW)	KPI ID	SRES
Main Objective	To monitor the increase in the RES penetration to the overall electricity mixture		
KPI Description	This KPI counts the amount of energy generated by RES and present its share to the overall electricity mixture and the energy used for heating/cooling and domestic hot water		
KPI Formula	$$SRES_{el} = \frac{E_{RES}}{E_{ALL}} \cdot 100$$ $$SRES_{H} = \frac{H_{RES}}{H_{ALL}} \cdot 100$$ $SRES_{el}$= Share of RES to the overall electricity mixture $SRES_{H}$= Share of RES to the overall heating energy demand		
Unit of measurement	%		
Connection/Link with other relevant defined KPIS and Use Cases	Share of DER		
Project sites to be calculated	Simulation platform ☐	Demonstration Laboratory ☐	Field Demonstrator √

KPI CALCULATION METHODOLOGY		
KPI STEP METHODOLOGY ID [KPI ID #]	**Step**	**Responsible**
SRES_1	Calculation of the amount of electricity energy generated by RES	CES, SE, EEM/PRSMA/M-iTi
SRES_2	Calculation of the amount of energy generated by RES for heating/cooling purposes	CES, SE, EEM
SRES_3	Calculation of the percentage share by dividing the calculated values of the previous steps with the respective overall energies	CES, SE, EEM/PRSMA/M-iTi
SRES_4	Repetition of the steps above in an annual base.	CES, SE, EEM/PRSMA/M-iTi

KPI SCENARIOS			
Scenarios to be measured	**BASELINE** √	**BUSINESS AS USUAL (BaU)** ☐	**SMART GRID** √

KPI DATA COLLECTION

DATA	DATA ID	Methodology for data collection	Source/Tools/instruments for Data Collection	Location of Data Collection	Frequency of Data Collection	Minimum monitoring period	Data collection responsible
Electriciy share	SRES_1	Data request by the local DSOs	Local DSO	Local grid	Annual	10 years	CES, SE, EEM/PRSMA/M-iTi
Heating share	SRES_2	Data request by Statistic Organizations	Statistic Organizations	Pilot or/and local grid	Annual	10 years	CES, SE, EEM/PRSMA/M-iTi

KPI BASELINE			
Source of Baseline	SECONDARY DATA (literature, databases, simulation) √	COMPANY HISTORICAL VALUES √	VALUES MEASURED AT START OF PROJECT √
Details of Baseline	The baseline can be calculated either using the data of the last year, or with the average value of the last 5 years.		
Responsible (Name, Company) for Baseline	CES, SE, EEM/PRSMA/M-iTi		
GENERAL COMMENTS			

BASIC KPI INFORMATION			
KPI NAME	Share of DER (decentralized/distributed energy resources)	KPI ID	SDER
Main Objective	To monitor the increase in the DER penetration to the overall electricity mixture		
KPI Description	This KPI counts the amount of energy generated by DER and present its share to the overall electricity mixture and the energy used for heating/cooling and domestic hot water		
KPI Formula	$SDER_{el} = \frac{E_{DER}}{E_{ALL}} \cdot 100$ $SDER_{H} = \frac{H_{DER}}{H_{ALL}} \cdot 100$ $SDER_{el}$= Share of DER to the overall electricity mixture $SDER_{H}$= Share of DER to the overall heating energy demand		
Unit of measurement	%		
Connection/Link with other relevant defined KPIS and Use Cases	Share of RES		
Project sites to be calculated	Simulation platform ☐	Demonstration Laboratory ☐	Field Demonstrator √

KPI CALCULATION METHODOLOGY		
KPI STEP METHODOLOGY ID [KPI ID #]	**Step**	**Responsible**
SDER_1	Calculation of the amount of electricity energy generated by DER	CES, SE, EEM/PRSMA/M-iTi
SDER_2	Calculation of the amount of energy generated by DER for heating/cooling purposes	CES, SE, EEM
SDER_3	Calculation of the percentage share by dividing the calculated values of the previous steps with the respective overall energies	CES, SE, EEM/PRSMA/M-iTi
SDER_4	Repetition of the steps above in an annual base.	CES, SE, EEM/PRSMA/M-iTi

KPI SCENARIOS			
Scenarios to be measured	**BASELINE**	**BUSINESS AS USUAL (BaU)**	**SMART GRID**
	√		√

KPI DATA COLLECTION

DATA	DATA ID	Methodology for data collection	Source/Tools/ instruments for Data Collection	Location of Data Collection	Frequency of Data Collection	Minimum monitoring period	Data collection responsible
Electricity share	SDER_1	Data request by the local DSOs	Local DSO	Local grid	Annual	10 years	CES, SE, EEM/PRSMA/M-iTi
Heating share	SDER_2	Data request by Statistic Organizations	Statistic Organizations	Pilot or/and local grid	Annual	10 years	CES, SE, EEM/PRSMA/M-iTi
KPI BASELINE							
Source of Baseline		**SECONDARY DATA (literature, databases, simulation)** √		**COMPANY HISTORICAL VALUES** √		**VALUES MEASURED AT START OF PROJECT** √	
Details of Baseline		The baseline can be calculated either using the data of the last year, or with the average value of the last 5 years.					
Responsible (Name, Company) for Baseline		CES, SE, EEM/PRSMA/M-iTi					
GENERAL COMMENTS							

BASIC KPI INFORMATION			
KPI NAME	Maximum Hourly Surplus - Deficit	KPI ID	MHS - Dx
Main Objective	To define the highest level of disagreement between RES supply and demand.		
KPI Description	The maximum value of the difference between the hourly local RES supply and the demand during that hour (per year).		
KPI Formula	$$MHSDx = \frac{S - D}{D} \cdot 100$$ S= supply (kWh) D= demand (kWh)		
Unit of measurement	%		
Connection/Link with other relevant defined KPIS and Use Cases			
Project sites to be calculated	Simulation platform ☐	Demonstration Laboratory ☐	Field Demonstrator √

KPI CALCULATION METHODOLOGY		
KPI STEP METHODOLOGY ID [KPI ID #]	**Step**	**Responsible**
MHSDx_1	Create an automatic route for the collection of demand and RES supply, or gather yearly supply and demand hourly data.	CES, SE, EEM/PRSMA/M-iTi
MHSDx_2	Calculation of the KPI value	CES, SE, EEM/PRSMA/M-iTi

KPI SCENARIOS			
Scenarios to be measured	**BASELINE**	**BUSINESS AS USUAL (BaU)**	**SMART GRID**
	√	☐	√

KPI DATA COLLECTION							
DATA	**DATA ID**	**Methodology for data collection**	**Source/Tools/instruments for Data Collection**	**Location of Data Collection**	**Frequency of Data Collection**	**Minimum monitoring period**	**Data collection responsible**
Supply	S	Data request by the local DSOs	Local DSO	Pilot or local grid	Hourly	6 years	CES, SE, EEM/PRSMA/M-iTi
Demand	D	Data request by the local DSOs	Local DSO	Pilot or local grid	Hourly	6 years	CES, SE, EEM/PRSMA/M-iTi

KPI BASELINE			
Source of Baseline	SECONDARY DATA (literature, databases, simulation) ☐	COMPANY HISTORICAL VALUES √	VALUES MEASURED AT START OF PROJECT √
Details of Baseline	The baseline can be calculated either using the data of each year, or with the average value of the last 5 years.		
Responsible (Name, Company) for Baseline	CES, SE, EEM/PRSMA/M-iTi		
GENERAL COMMENTS			

BASIC KPI INFORMATION			
KPI NAME	Voltage Variations	KPI ID	V±
Main Objective	This KPI examines the quality of the power supplied (in accordance with NP EN 50160:2010)		
KPI Description	Difference between the actual voltage supplied to MV/LV users and the nominal value. Under normal operating conditions, during each one-week period analysed, 95% of the 10-minute average RMS values of the supply voltage should be in the range: Un +/- 10% and all 10-minute RMS values of the voltage must be within the range of + 10% / -15%.		
KPI Formula	$$V \pm = \frac{A_{RMS}}{230} \cdot 100$$ A_{RMS} = Average Voltage supplied in a 10-min period		
Unit of measurement	%		
Connection/Link with other relevant defined KPIS and Use Cases	Frequency Control, Harmonic Distortion, Unbalance of the 3-phase Voltage System		
Project sites to be calculated	Simulation platform ☐	Demonstration Laboratory ☐	Field Demonstrator √

KPI CALCULATION METHODOLOGY		
KPI STEP METHODOLOGY ID [KPI ID #]	**Step**	**Responsible**
V±_1	Data gathering	CES, SE, EEM/PRSMA/M-iTi

KPI SCENARIOS			
Scenarios to be measured	**BASELINE**	**BUSINESS AS USUAL (BaU)**	**SMART GRID**
	√	√	√

KPI DATA COLLECTION							
DATA	**DATA ID**	**Methodology for data collection**	**Source/Tools/instruments for Data Collection**	**Location of Data Collection**	**Frequency of Data Collection**	**Minimum monitoring period**	**Data collection responsible**
Voltage Variations	V±	Data request by the local DSOs	Local DSO	Local grid	Hourly in annual packages	6 years	CES, SE, EEM/PRSMA/M-iTi

KPI BASELINE

Source of Baseline	**SECONDARY DATA (literature, databases, simulation)** ☐	**COMPANY HISTORICAL VALUES** √	**VALUES MEASURED AT START OF PROJECT** √
Details of Baseline	The baseline can be calculated either using the data of each year, or with the average value of the last 5 years.		
Responsible (Name, Company) for Baseline	CES, SE, EEM/PRSMA/M-iTi		
GENERAL COMMENTS			

BASIC KPI INFORMATION			
KPI NAME	On-site Energy Ratio	KPI ID	OER
Main Objective	The objective of OER is to examine the amount of RES penetration to the grid, concerning mainly difficulties the have to do with mismatching of RES generation and demand.		
KPI Description	Relation between the annual energy supply from local renewable sources and the annual energy demand		
KPI Formula	$$OER = \frac{RES - OUT}{LOAD} \cdot 100$$ RES= the annual energy generated by RES in the island OUT= the amount of the annual RES energy generated in the island that is exported LOAD= the annual load in the island		
Unit of measurement	%		
Connection/Link with other relevant defined KPIS and Use Cases			
Project sites to be calculated	Simulation platform ☐	Demonstration Laboratory ☐	Field Demonstrator √

KPI CALCULATION METHODOLOGY		
KPI STEP METHODOLOGY ID [KPI ID #]	**Step**	**Responsible**
OER_1	Data collection	CES, SE
OER_2	OER calculation	CES, SE

KPI SCENARIOS			
Scenarios to be measured	**BASELINE**	**BUSINESS AS USUAL (BaU)**	**SMART GRID**
	√		√

KPI DATA COLLECTION							
DATA	**DATA ID**	**Methodology for data collection**	**Source/Tools/instruments for Data Collection**	**Location of Data Collection**	**Frequency of Data Collection**	**Minimum monitoring period**	**Data collection responsible**
Annual RES generation	RES	Data request by the local DSOs	Local DSO	Pilot or local grid	Hourly in annual packages	6 years	CES, SE
Electricity export	OUT	Data request by the local DSOs	Local DSO	Pilot or local grid	Hourly in annual packages	6 years	CES, SE
Annual Load	LOAD	Data request by the local DSOs	Local DSO	Pilot or local grid	Hourly in annual packages	6 years	CES, SE

KPI BASELINE

Source of Baseline	**SECONDARY DATA (literature, databases, simulation)** √	**COMPANY HISTORICAL VALUES** √	**VALUES MEASURED AT START OF PROJECT** ☐
Details of Baseline	The baseline will require historical data by either the local DSO or by other local databases.		
Responsible (Name, Company) for Baseline	CES, SE		
GENERAL COMMENTS			

BASIC KPI INFORMATION			
KPI NAME	Reduced Energy Curtailment	KPI ID	REC
Main Objective	Energy curtailment is an existing problem in all three islands due to RES integration, so its reduction is one of the main goals,		
KPI Description	The difference between the energy curtailments before and after the integration of a/all the SMILE solutions.		
KPI Formula	$REC = \frac{EC_{SMILE} - EC_{BASE}}{EC_{BASE}} \cdot 100$ EC_{BASE} = Energy curtailment before the implementation of SMILE solutions EC_{SMILE} = Energy curtailment after the implementation of SMILE solutions		
Unit of measurement	%		
Connection/Link with other relevant defined KPIS and Use Cases			
Project sites to be calculated	Simulation platform ☐	Demonstration Laboratory ☐	Field Demonstrator √

KPI CALCULATION METHODOLOGY		
KPI STEP METHODOLOGY ID [KPI ID #]	**Step**	**Responsible**
REC_1	Collection of data	CES, SE, EEM/PRSMA/M-iTi
REC_2	Calculation of the KPI	CES, SE, EEM/PRSMA/M-iTi

KPI SCENARIOS			
Scenarios to be measured	**BASELINE**	**BUSINESS AS USUAL (BaU)**	**SMART GRID**
	√	☐	√

KPI DATA COLLECTION							
DATA	**DATA ID**	**Methodology for data collection**	**Source/Tools/ instruments for Data Collection**	**Location of Data Collection**	**Frequency of Data Collection**	**Minimum monitoring period**	**Data collection responsible**
Energy Curtailment before the implementation of SMILE solutions	EC_{BASE}	Data request by the local DSOs	Local DSO	Pilot and/or local grid	Real time data for each month. The REC value is annual.	5 years	CES, SE, EEM
Energy Curtailment after the	EC_{SMILE}	Data request by the local DSOs	Local DSO	Pilot and/or local grid	Real time data for each month. The	5 years	CES, SE, EEM/PRSMA/ M-iTi

implementation of SMILE solutions					REC value is annual.		

KPI BASELINE			
Source of Baseline	**SECONDARY DATA (literature, databases, simulation)** ☐	**COMPANY HISTORICAL VALUES** √	**VALUES MEASURED AT START OF PROJECT** √
Details of Baseline	The baseline can be calculated either using the data of each year, or with the average value of the last 5 years.		
Responsible (Name, Company) for Baseline	CES, SE, EEM/PRSMA/M-iTi		
GENERAL COMMENTS			

BASIC KPI INFORMATION			
KPI NAME	Peak shaving from the side of consumption	KPI ID	PSC
Main Objective	Evaluation of DSM policies.		
KPI Description	It practically is the annual standard deviation of the instantaneous loads throughout the year. The lower it is compared to the average, the higher the peak shaving		
KPI Formula	$$PSC = \frac{\sqrt{\frac{\sum_{j=1}^{D}\sum_{i=1}^{N}\left(L_{ij}-\bar{L}_j\right)^2}{D\cdot N}} - PSC_{BASE}}{PSC_{BASE}}\cdot 100$$ D= the number of days of the year N= the number of load calculations throughout a day L= load measurement $\bar{L}$= average load of day		
Unit of measurement	%		
Connection/Link with other relevant defined KPIS and Use Cases			
Project sites to be calculated	Simulation platform ☐	Demonstration Laboratory ☐	Field Demonstrator √

KPI CALCULATION METHODOLOGY		
KPI STEP METHODOLOGY ID [KPI ID #]	**Step**	**Responsible**
PSC_1	Data collection	CES, SE, EEM/PRSMA/M-iTi
PSC_2	KPI calculation	CES, SE, EEM/PRSMA/M-iTi

KPI SCENARIOS			
Scenarios to be measured	**BASELINE** √	**BUSINESS AS USUAL (BaU)** ☐	**SMART GRID** √

KPI DATA COLLECTION							
DATA	**DATA ID**	**Methodology for data collection**	**Source/Tools/instruments for Data Collection**	**Location of Data Collection**	**Frequency of Data Collection**	**Minimum monitoring period**	**Data collection responsible**
Peak shaving	PSC	Data request by the local DSOs	Local DSO	Local grid	Daily peak hours consumption data collection with yearly analyses (aggregated for the	4 years	CES, SE, EEM/PRSMA/M-iTi

					average load for comparisons).		

KPI BASELINE			
Source of Baseline	**SECONDARY DATA (literature, databases, simulation)** ☐	**COMPANY HISTORICAL VALUES** √	**VALUES MEASURED AT START OF PROJECT** √
Details of Baseline	The baseline can be calculated either using the data of the last year, or with the average value of the last 5 years.		
Responsible (Name, Company) for Baseline	CES, SE, EEM/PRSMA/M-iTi		
GENERAL COMMENTS			

BASIC KPI INFORMATION			
KPI NAME	Battery Degradation Rate	KPI ID	BDR
Main Objective	The assessment of a BESS technology		
KPI Description	Illustrates the capacity losses through use/time.		
KPI Formula	$$BDR_c = \frac{BC_n - BC_0}{n \cdot BC_0} \cdot 100$$ $$BDR_Y = \frac{BC_Y - BC_0}{Y \cdot BC_0} \cdot 100$$ BDR_C= BDR per cycle BDR_Y= BDR per year BC_0= initial battery capacity BC_n= battery capacity after n cycles n= number of cycles Y= number of years		
Unit of measurement	%		
Connection/Link with other relevant defined KPIS and Use Cases			
Project sites to be calculated	Simulation platform ☐	Demonstration Laboratory √	Field Demonstrator √

KPI CALCULATION METHODOLOGY		
KPI STEP METHODOLOGY ID [KPI ID #]	**Step**	**Responsible**
BDR_1	Data Collection	CES, SE, EEM/PRSMA/M-iTi
BDR_2	KPI calculation	CES, SE, EEM/PRSMA/M-iTi

KPI SCENARIOS			
Scenarios to be measured	**BASELINE**	**BUSINESS AS USUAL (BaU)**	**SMART GRID**
	√	☐	√

KPI DATA COLLECTION							
DATA	DATA ID	Methodology for data collection	Source/Tools/instruments for Data Collection	Location of Data Collection	Frequency of Data Collection	Minimum monitoring period	Data collection responsible
BDR	BDR_1	The capacity losses through use/time	Equipment to be purchased with BESS and suitable for this particular data collection	Pilot	One collection every month.	Six months.	CES, SE, EEM/PRSMA/ M-iTi

KPI BASELINE			
Source of Baseline	SECONDARY DATA (literature, databases, simulation) √	COMPANY HISTORICAL VALUES	VALUES MEASURED AT START OF PROJECT √
Details of Baseline	The baseline can be calculated either using the batteries manufacturers reference data for battery degradation or considering the first year of battery usage in SMILE as baseline		
Responsible (Name, Company) for Baseline	CES, SE, PRSMA/M-iTi		
GENERAL COMMENTS			

BASIC KPI INFORMATION			
KPI NAME	Grid Congestion	KPI ID	GC
Main Objective	Examines the effect of SMILE solutions to the grid's durability		
KPI Description	Estimates the percentage of power passing through a "hot" spot of the grid to the overall capacity of the grid in that spot.		
KPI Formula	$GC = \frac{P_{max}}{C_{max}} \cdot 100$ P_{max}= Maximum instantaneous Power load of the month for a specific grid spot C_{max}= Grid capacity in a specific grid spot		
Unit of measurement	%		
Connection/Link with other relevant defined KPIS and Use Cases			
Project sites to be calculated	Simulation platform ☐	Demonstration Laboratory ☐	Field Demonstrator √

KPI CALCULATION METHODOLOGY		
KPI STEP METHODOLOGY ID [KPI ID #]	**Step**	**Responsible**
GC_1	Locate the grid's "hot" spots	CES, SE, EEM
GC_2	Automatically collect monthly data for this spot	CES, SE, EEM
GC_3	KPI calculation	CES, SE, EEM/PRSMA/M-iTi

KPI SCENARIOS			
Scenarios to be measured	**BASELINE**	**BUSINESS AS USUAL (BaU)**	**SMART GRID**
	√	☐	√

KPI DATA COLLECTION							
DATA	**DATA ID**	**Methodology for data collection**	**Source/Tools/instruments for Data Collection**	**Location of Data Collection**	**Frequency of Data Collection**	**Minimum monitoring period**	**Data collection responsible**
Hot spot tracing	GC	Data request by the local DSOs	Software: Geographic based integrated analysis and optimization system for electrical distribution networks	Pilot	Annually	6 years	CES, SE, EEM

KPI BASELINE

Source of Baseline	**SECONDARY DATA (literature, databases, simulation)** ☐	**COMPANY HISTORICAL VALUES** √	**VALUES MEASURED AT START OF PROJECT** √
Details of Baseline	The baseline can be calculated either using the data of the last year, or with the average value of the last 5 years.		
Responsible (Name, Company) for Baseline	CES, SE, EEM		
GENERAL COMMENTS			

BASIC KPI INFORMATION			
KPI NAME	Generation Forecasting Accuracy	KPI ID	GFA
Main Objective	The accuracy of the forecasting models can determine the share of the various power generators. Moreover, it makes possible the signing of contracts of longer durations, which are better-priced		
KPI Description	The calculation of Root Mean Square Error of a forecasting tool.		
KPI Formula	$$MAPE = \frac{100}{n} \cdot \sum_{i=1}^{n} \left| \frac{\widehat{L_i} - L_i}{L_i} \right| \sqrt{\frac{\sum_{i=1}^{n} (\widehat{L_i} - L_i)^2}{n}}$$ i= time points of RES generation measurements and their respective predictions $\hat{L}$ = predicted value of RES generation L= actual RES generation n= the sum of the time points examined4		
Unit of measurement	%		
Connection/Link with other relevant defined KPIS and Use Cases			
Project sites to be calculated	Simulation platform ☐	Demonstration Laboratory ☐	Field Demonstrator √

KPI CALCULATION METHODOLOGY

KPI STEP METHODOLOGY ID [KPI ID #]	Step	Responsible
GFA_1	Collection of data	CES, SE, EEM/PRSMA/M-iTi, Route Monkey
GFA_2	Calculation of GFA	Route Monkey

KPI SCENARIOS

Scenarios to be measured	BASELINE	BUSINESS AS USUAL (BaU)	SMART GRID
	√		√

KPI DATA COLLECTION

DATA	DATA ID	Methodology for data collection	Source/Tools/instruments for Data Collection	Location of Data Collection	Frequency of Data Collection	Minimum monitoring period	Data collection responsible
GFA	GFA_1	Predicted value of RES generation and actual RES generation	Forecasting models	Pilot	One prediction point every 30 minutes, and one production point every 15 minutes	4 years	CES, SE, EEM/PRSMA/M-iTi, Route Monkey

KPI BASELINE

Source of Baseline	**SECONDARY DATA (literature, databases, simulation)** √	**COMPANY HISTORICAL VALUES** ☐	**VALUES MEASURED AT START OF PROJECT** ☐
Details of Baseline	The baseline can be calculated either using the data of the last year, or with the average value of the last 5 years.		
Responsible (Name, Company) for Baseline	Route Monkey		
GENERAL COMMENTS			

BASIC KPI INFORMATION			
KPI NAME	Energy Losses	KPI ID	ELSS
Main Objective	Observation of the impact of the various solutions like DR and BESS on the power losses of the grid's transformers, conductors etc.		
KPI Description	The sum of the energy losses because of the equipment of the grid		
KPI Formula	$$ELSS = \frac{EG - ES}{EG} \cdot 100$$ EG=Energy Generated ES= Energy sold		
Unit of measurement	%		
Connection/Link with other relevant defined KPIS and Use Cases			
Project sites to be calculated	Simulation platform ☐	Demonstration Laboratory ☐	Field Demonstrator √

KPI CALCULATION METHODOLOGY		
KPI STEP METHODOLOGY ID [KPI ID #]	**Step**	**Responsible**
ELSS_1	Collection of data	CES, SE, EEM/PRSMA/M-iTi
ELSS_2	Calculation of ELSS	CES, SE, EEM/PRSMA/M-iTi

KPI SCENARIOS			
Scenarios to be measured	**BASELINE** √	**BUSINESS AS USUAL (BaU)** √	**SMART GRID** √

KPI DATA COLLECTION							
DATA	**DATA ID**	**Methodology for data collection**	**Source/Tools/instruments for Data Collection**	**Location of Data Collection**	**Frequency of Data Collection**	**Minimum monitoring period**	**Data collection responsible**
Energy Generated	EG	Data request by the local DSOs	Local DSO	LV Electrical Microgrid and other (if applicable)	Every six months.	5 years	CES, SE, EEM/PRSMA/M-iTi
Energy sold	ES	Data request by the local DSOs	Local DSO	LV Electrical Microgrid and other (if applicable)	Every six months.	5 years	CES, SE, EEM/PRSMA/M-iTi

KPI BASELINE

Source of Baseline	**SECONDARY DATA (literature, databases, simulation)** ☐	**COMPANY HISTORICAL VALUES** √	**VALUES MEASURED AT START OF PROJECT** √
Details of Baseline	Bears into mind the absolute and percentage losses of the last years		
Responsible (Name, Company) for Baseline	CES, SE, EEM/PRSMA/M-iTi		
GENERAL COMMENTS			

BASIC KPI INFORMATION			
KPI NAME	Storage Energy Losses	KPI ID	SEL
Main Objective	The assessment of the performance of the energy storage solutions.		
KPI Description	Compares the amount of energy before and after the storage, including the added transformations.		
KPI Formula	$$SEL = \frac{E_{before} - E_{after}}{E_{before}} \cdot 100$$ E_{before} = the energy input in a piece of energy storage equipment E_{after} = the energy output of a piece of energy storage equipment		
Unit of measurement	%		
Connection/Link with other relevant defined KPIS and Use Cases			
Project sites to be calculated	Simulation platform [ ]	Demonstration Laboratory [ ]	Field Demonstrator [√]

KPI CALCULATION METHODOLOGY		
KPI STEP METHODOLOGY ID [KPI ID #]	Step	Responsible
SEL_1	Collection of data	DTI
SEL_2	Calculation of KPI	DTI

KPI SCENARIOS			
Scenarios to be measured	BASELINE [√]	BUSINESS AS USUAL (BaU) [ ]	SMART GRID [√]

KPI DATA COLLECTION							
DATA	DATA ID	Methodology for data collection	Source/Tools/instruments for Data Collection	Location of Data Collection	Frequency of Data Collection	Minimum monitoring period	Data collection responsible
Storage Energy Losses	SEL	Use of equipment out of the BESS-transformer system	Special meters	BESS-transformer system of pilot	Monthly	Six months	DTI

KPI BASELINE			
Source of Baseline	SECONDARY DATA (literature, databases, simulation) [√]	COMPANY HISTORICAL VALUES [ ]	VALUES MEASURED AT START OF PROJECT [ ]

Details of Baseline	The baseline can be calculated using recent (of the past 15 years) databases for BESS performance.
Responsible (Name, Company) for Baseline	DTI
GENERAL COMMENTS	

BASIC KPI INFORMATION			
KPI NAME	Degree of Self-Supply	KPI ID	DSS
Main Objective	Self-consumption is preferable in PV generation, so its percentage to the overall PV generation has to be measured.		
KPI Description	Measures the percentage of PV generation which is used for self-supply, and not sold to the grid.		
KPI Formula	$DSS = \frac{PV_{self}}{PV} \cdot 100$		
Unit of measurement	%		
Connection/Link with other relevant defined KPIS and Use Cases			
Project sites to be calculated	Simulation platform √	Demonstration Laboratory	Field Demonstrator √

KPI CALCULATION METHODOLOGY		
KPI STEP METHODOLOGY ID [KPI ID #]	Step	Responsible
DSS_1	Data collection	CES, SE, EEM/PRSMA/M-iTi
DSS_2	KPI calculation	CES, SE, EEM/PRSMA/M-iTi

KPI SCENARIOS			
Scenarios to be measured	BASELINE	BUSINESS AS USUAL (BaU)	SMART GRID
	√		√

KPI DATA COLLECTION							
DATA	DATA ID	Methodology for data collection	Source/Tools/instruments for Data Collection	Location of Data Collection	Frequency of Data Collection	Minimum monitoring period	Data collection responsible
Degree of self-supply	DSS	Data request by private RES owners	Meters in privately owned RES. or Simulation programs and estimative calculations about PV generation which is used for self-consumption.	Pilot	Annually	4 years	CES, SE, EEM/PRSMA/M-iTi

KPI BASELINE

Source of Baseline	**SECONDARY DATA (literature, databases, simulation)** √	**COMPANY HISTORICAL VALUES** √	**VALUES MEASURED AT START OF PROJECT** √
Details of Baseline	The baseline can be calculated for each month or per year or with the average value of the last 5 years.		
Responsible (Name, Company) for Baseline	CES, SE, EEM/PRSMA/M-iTi		
GENERAL COMMENTS			

BASIC KPI INFORMATION

KPI NAME	Frequency Control	KPI ID	FRC
Main Objective	Measures how often the nominal frequency of the supply voltage goes out of the range: 50 Hz ±2% in a 95% weekly analysis or 50 Hz ±15% all the measured time.		
KPI Description	This KPI calculates the number of times that the average value of the fundamental frequency measured over periods of 10 seconds goes out of the stated ranges.		
KPI Formula	KPI FRC_1= (Number of times out of considered range / 1008 (*10 minutes intervals* in a week)) x 100 (%) and KPI FRC_2 = (Number of times out of considered range / XXXX (*10 minutes intervals* of all the measured time)) x 100 (%)		
Unit of measurement	% of time (weekly basis or all the time basis)		
Connection/Link with other relevant defined KPIS and Use Cases	Harmonic Distortion, Unbalance of the 3-phase Voltage System, Voltage Variations		
Project sites to be calculated	Simulation platform ☐	Demonstration Laboratory ☐	Field Demonstrator √

KPI CALCULATION METHODOLOGY

KPI STEP METHODOLOGY ID [KPI ID #]	Step	Responsible
FRC_1	Collection of data (weekly analysis of the nominal frequency of the supply voltage)	CES, SE, EEM/PRSMA/M-iTi

KPI SCENARIOS

Scenarios to be measured	BASELINE	BUSINESS AS USUAL (BaU)	SMART GRID
	√	☐	√

KPI DATA COLLECTION

DATA	DATA ID	Methodology for data collection	Source/Tools/instruments for Data Collection	Location of Data Collection	Frequency of Data Collection	Minimum monitoring period	Data collection responsible
Supply Frequency	FRC_1 FRC_2	Real time data request by local DSOs	Local DSOs	Pilot or local grid	Real time	4 years	CES, SE, EEM/PRSMA/ M-iTi

KPI BASELINE

Source of Baseline	SECONDARY DATA (literature, databases, simulation)	COMPANY HISTORICAL VALUES	VALUES MEASURED AT START OF PROJECT
	☐	√	√

Details of Baseline	Local DSO history data of the last years will be probably needed. If there is no such database, measurement will be taken on site.		
Responsible (Name, Company) for Baseline	CES, SE, EEM/PRSMA/M-iTi		
GENERAL COMMENTS			

BASIC KPI INFORMATION			
KPI NAME	Harmonic Distortion (THD)	KPI ID	THD
Main Objective	Measure the Harmonic Distortion (THD).		
KPI Description	Under normal operating conditions, during each one-week measurement period, 95% of the 10-minute average values of each individual harmonic voltage shall be less than or equal to the values given in the Table below. In addition, the THD of the supply voltage (including the harmonics up to the order 40) must be less than or equal to 8%.		

Harmónicas ímpares				Harmónicas pares	
Não múltiplas de 3		Múltiplas de 3			
Ordem h	Amplitude relativa U_h	Ordem h	Amplitude relativa U_h	Ordem h	Amplitude relativa U_h
5	6,0 %	3	5,0 %	2	2,0 %
7	5,0 %	9	1,5 %	4	1,0 %
11	3,5 %	15	0,5 %	6 ... 24	0,5 %
13	3,0 %	21	0,5 %		
17	2,0 %				
19	1,5 %				
23	1,5 %				
25	1,5 %				

The values for higher order harmonics than 25 are not showed, being generally of low amplitude, but quite unpredictable due to resonance effects.

KPI Formula

For each harmonic h, mean U_h / U_1 in each cycle for 10 min (weekly basis):

$$U_h(\%) = 100\ x\ \frac{U_h}{U_1}$$

and

$$THD\ (\%) = 100\ x\ \frac{\sqrt{\sum_2^{40} U_h^2}}{U_1}$$

U_h= harmonic voltage (RMS) of order h (values: 2 to 40);

U_1= fundamental.

***The** number of orders was limited until 40 (conventional).*

Unit of measurement	%		
Connection/Link with other relevant defined KPIS and Use Cases	Frequency Control, Unbalance of the 3-phase Voltage System, Voltage Variations		
Project sites to be calculated	Simulation platform √	Demonstration Laboratory	Field Demonstrator √

KPI CALCULATION METHODOLOGY		
KPI STEP METHODOLOGY ID [KPI ID #]	**Step**	**Responsible**
THD	Collection of data	CES, DTI, EEM/PRSMA/M-iTi

KPI SCENARIOS			
Scenarios to be measured	BASELINE ☐	BUSINESS AS USUAL (BaU) √	SMART GRID √

KPI DATA COLLECTION							
DATA	DATA ID	Methodology for data collection	Source/Tools/instruments for Data Collection	Location of Data Collection	Frequency of Data Collection	Minimum monitoring period	Data collection responsible
Harmonic voltage	U	Real time data request by local DSOs	Local DSO	Pilot	10-minute average values (weekly basis)	Each one-week period of measurement for 1 month	CES, DTI, EEM/PRSMA/M-iTi

KPI BASELINE			
Source of Baseline	SECONDARY DATA (literature, databases, simulation) ☐	COMPANY HISTORICAL VALUES √	VALUES MEASURED AT START OF PROJECT √
Details of Baseline	Local DSO history data of the last years will be probably needed. If there is no such database, measurement will be taken on site.		
Responsible (Name, Company) for Baseline	CES, DTI, EEM/PRSMA/M-iTi		

GENERAL COMMENTS

BASIC KPI INFORMATION			
KPI NAME	Unbalance of the 3-phase Voltage System	KPI ID	Unb3-Ph
Main Objective	Examines the quality of the power supplied according to the guidelines of EN50160:2010		
KPI Description	Measures the supply voltage gap between L1, L2 and L3 which should be 120º Under normal operating conditions, during each one-week period, 95% of the 10-minute average (RMS) values of the inverse component of the supply voltage shall be within the range of 0% to 2% of the corresponding direct component.		
KPI Formula			
Unit of measurement	%		
Connection/Link with other relevant defined KPIS and Use Cases	Frequency Control, Harmonic Distortion, Voltage Variations		
Project sites to be calculated	Simulation platform ☐	Demonstration Laboratory ☐	Field Demonstrator √

KPI CALCULATION METHODOLOGY		
KPI STEP METHODOLOGY ID [KPI ID #]	**Step**	**Responsible**
Unb3-Ph		CES, SE, EEM/PRSMA/M-iTi

KPI SCENARIOS			
Scenarios to be measured	**BASELINE** ☐	**BUSINESS AS USUAL (BaU)** √	**SMART GRID** √

KPI DATA COLLECTION							
DATA	**DATA ID**	**Methodology for data collection**	**Source/Tools/instruments for Data Collection**	**Location of Data Collection**	**Frequency of Data Collection**	**Minimum monitoring period**	**Data collection responsible**
Phase Unbalnce	Unb3-Ph	Real time data collection with appropriate equipment	Equipment to be purchased and suitable for the particular data collection	Pilot	10-minute average values (weekly basis)	Week period for a month	CES, SE, EEM/PRSMA /M-iTi

KPI BASELINE			
Source of Baseline	**SECONDARY DATA (literature, databases, simulation)** √	**COMPANY HISTORICAL VALUES** ☐	**VALUES MEASURED AT START OF PROJECT** ☐

Details of Baseline	Local DSO history data of the last years will be probably needed. If there is no such database, measurement will be taken on site.
Responsible (Name, Company) for Baseline	CES, SE, EMM/PRSMA/M-iTi
GENERAL COMMENTS	

BASIC KPI INFORMATION				
KPI NAME	Energy Return On energy Investment		KPI ID	EROI
Main Objective	It is a distinct measure from energy efficiency as it does not measure the primary energy inputs to the system, only usable energy.			
KPI Description	The ratio of the amount of usable energy (the exergy) delivered from a particular energy resource to the amount of exergy used to obtain that energy resource during its lifetime.			
KPI Formula	$EROI=\frac{E_{out}}{E_{in}}$ E_{out}= Energy delivered (kWh) E_{in}= Primary energy required for the delivery of the energy above (kWh)			
Unit of measurement				
Connection/Link with other relevant defined KPIS and Use Cases				
Project sites to be calculated	Simulation platform √	Demonstration Laboratory	Field Demonstrator √	

KPI CALCULATION METHODOLOGY		
KPI STEP METHODOLOGY ID [KPI ID #]	**Step**	**Responsible**
EROI_1	Data collection	CES, SE, PRSMA/M-iTi
EROI_2	Simulation	CERTH
EROI_3	KPI calculation	CERTH

KPI SCENARIOS			
Scenarios to be measured	**BASELINE**	**BUSINESS AS USUAL (BaU)**	**SMART GRID**
	√		√

KPI DATA COLLECTION							
DATA	**DATA ID**	**Methodology for data collection**	**Source/Tools/instruments for Data Collection**	**Location of Data Collection**	**Frequency of Data Collection**	**Minimum monitoring period**	**Data collection responsible**
Energy delivered	E_{out}	Use of equipment and software	Meters	Pilot	Real time	4 years	CES, SE, PRSMA/M-iTi

Primary energy	E_{in}	Simulation, use of available literature	Software	Pilot	2 years	4 years	CERTH

KPI BASELINE			
Source of Baseline	**SECONDARY DATA (literature, databases, simulation)** √	**COMPANY HISTORICAL VALUES** ☐	**VALUES MEASURED AT START OF PROJECT** ☐
Details of Baseline			
Responsible (Name, Company) for Baseline	CERTH		
GENERAL COMMENTS			

BASIC KPI INFORMATION			
KPI NAME	CO_2 Tonnes Saved	KPI ID	CO_2TS
Main Objective	CO2TS calculates the amount of CO2 saved by the RES during its entire lifetime starting from its manufacture.		
KPI Description	It calculates the equivalent CO_2 emissions that would be emitted if the same amount of energy was generated with conventional fossil fuels. This indicator is in relation with the capacity factor and the load of the RES and both of them are functions of the operation time.		
KPI Formula	$CO_2TS = (h - r) \cdot E$ h= the amount of CO_2 (tonnes CO2eq/kWh) emitted per unit of energy produced with conventional fossil fuels r= the amount of CO_2 emitted per unit of energy produced with the method tested (tonnes CO2eq/kWh) E= the amount of energy produced in the presented way (kWh)		
Unit of measurement	tonnes CO2eq		
Connection/Link with other relevant defined KPIS and Use Cases			
Project sites to be calculated	Simulation platform √	Demonstration Laboratory ☐	Field Demonstrator √

KPI CALCULATION METHODOLOGY		
KPI STEP METHODOLOGY ID [KPI ID #]	Step	Responsible
CO_2TS_1	Calculation / simulation of conventional CO_2 emissions	CERTH
CO_2TS_2	Simulation of tested method emissions	CERTH
CO_2TS_3	Delivered energy of the tested method	CERTH
CO_2TS_4	Calculation of the KPI	CERTH

KPI SCENARIOS			
Scenarios to be measured	BASELINE	BUSINESS AS USUAL (BaU)	SMART GRID
	√	☐	√

KPI DATA COLLECTION							
DATA	DATA ID	Methodology for data collection	Source/Tools/instruments for Data Collection	Location of Data Collection	Frequency of Data Collection	Minimum monitoring period	Data collection responsible
Electricity mix		Data request by the	Supplier official databases	Island	Once	Once	CES, SE, EEM

		electricity suppliers					
Properties of fuel mix and tech specs of the relevant power plants		Data request by the electricity suppliers	Supplier official databases and relevant published studies	Island	Once	Once	CES, SE, EEM
Properties and tech spec of tested technology		Data request by the technology manufacturers	Technology manufacturer official databases and relevant published studies	Island	Once	Once	CES, SE, EEM

KPI BASELINE			
Source of Baseline	**SECONDARY DATA (literature, databases, simulation)** √	**COMPANY HISTORICAL VALUES** ☐	**VALUES MEASURED AT START OF PROJECT** ☐
Details of Baseline	Baseline is the emission level in the current electricity mix		
Responsible (Name, Company) for Baseline	CERTH		
GENERAL COMMENTS			

BASIC KPI INFORMATION			
KPI NAME	Noise Pollution Exposure	KPI ID	NPE
Main Objective	Examines the amount of noise affecting the local population		
KPI Description	Measures the amount of noise in the closest point of a residential area to a "noisy" RES		
KPI Formula			
Unit of measurement	dB		
Connection/Link with other relevant defined KPIS and Use Cases			
Project sites to be calculated	Simulation platform ☐	Demonstration Laboratory ☐	Field Demonstrator √

KPI CALCULATION METHODOLOGY		
KPI STEP METHODOLOGY ID [KPI ID #]	Step	Responsible
NPE	Data collection	CES, SK, ACIF-CCIM

KPI SCENARIOS			
Scenarios to be measured	BASELINE √	BUSINESS AS USUAL (BaU) ☐	SMART GRID √

KPI DATA COLLECTION							
DATA	DATA ID	Methodology for data collection	Source/Tools/instruments for Data Collection	Location of Data Collection	Frequency of Data Collection	Minimum monitoring period	Data collection responsible
Noise level	NPE	Measuring the sound in the closest point of a district to a SMILE solution (e.g. wind turbine, heat pump etc.)	Sound meter	Closest district point to the noise source	One measurement at the beginning and one at the end of SMILE	One measurement at the beginning and one at the end of SMILE	CES, SK, ACIF-CCIM

KPI BASELINE			
Source of Baseline	SECONDARY DATA (literature, databases, simulation) ☐	COMPANY HISTORICAL VALUES ☐	VALUES MEASURED AT START OF PROJECT √

Details of Baseline	
Responsible (Name, Company) for Baseline	CES, SK, ACIF-CCIM
GENERAL COMMENTS	

BASIC KPI INFORMATION			
KPI NAME	Reduced Fossil Fuel Consumption	KPI ID	RFFC
Main Objective	Measurement of the effect of solutions like EVs that will greatly decrease the fossil fuel consumption.		
KPI Description	Measures the amount of fossil fuels which is now not consumed because of EVs and higher RES penetration.		
KPI Formula	$$RFFC = \frac{FFC_{base} - FFC_{SMILE}}{FFC_{base}} \cdot 100$$ FFC_{BASE} (MJ) is the primary energy corresponding to fossils fuels consumed per 100km before the implementation of SMILE solutions FFC_{SMILE} (MJ) is the primary energy corresponding to fossil fuels consumed per 100km concerning EVs after the implementation of SMILE solutions		
Unit of measurement	%		
Connection/Link with other relevant defined KPIS and Use Cases			
Project sites to be calculated	Simulation platform ☐	Demonstration Laboratory ☐	Field Demonstrator √

KPI CALCULATION METHODOLOGY		
KPI STEP METHODOLOGY ID [KPI ID #]	**Step**	**Responsible**
RFFC_1	Data collection	CES, SK, ACIF-CCIM
RFFC_2	KPI calculation	CES, SK, ACIF-CCIM

KPI SCENARIOS			
Scenarios to be measured	**BASELINE**	**BUSINESS AS USUAL (BaU)**	**SMART GRID**
	√		√

KPI DATA COLLECTION							
DATA	**DATA ID**	**Methodology for data collection**	**Source/Tools/instruments for Data Collection**	**Location of Data Collection**	**Frequency of Data Collection**	**Minimum monitoring period**	**Data collection responsible**
Fossils fuels consumed per 100km in conventional fuel based vehicles	FFC_{BASE}	Searching for official car consumption	Car manufacturers	Pilot	One measurement at the beginning and one at the end of SMILE	One measurement at the beginning and one at the end of SMILE	CES, SK, ACIF-CCIM

Fossils fuels consumed per 100km in EVs used in SMILE pilots	FFCSMILE	Searching for official car consumption	Car manufacturers	Pilot	One measurement at the beginning and one at the end of SMILE	One measurement at the beginning and one at the end of SMILE	CES, SK, ACIF-CCIM
KPI BASELINE							
Source of Baseline	**SECONDARY DATA (literature, databases, simulation)** √		**COMPANY HISTORICAL VALUES** √		**VALUES MEASURED AT START OF PROJECT** √		
Details of Baseline	The baseline can be calculated for each month or per year or with the average value of the last 5 years.						
Responsible (Name, Company) for Baseline	CES, SK, ACIF-CCIM						
GENERAL COMMENTS							

BASIC KPI INFORMATION			
KPI NAME	Carbon Footprint of Heating House	KPI ID	CFHH
Main Objective	Examines the carbon footprint of heating a house with(out) the project's proposed solutions.		
KPI Description	Calculates the operational CO_2 proposed domestic heating technology compared to the previous technologies		
KPI Formula	$CFHH = F_i \cdot FE_i$ F_i= the amount of the fuel *i* (tonnes) needed annually for the heating of a domestic house FE_i= the CO_2 impact factor per unit of fuel *i (tn CO2/ tn fuel)*		
Unit of measurement	Tonnes CO2/year		
Connection/Link with other relevant defined KPIS and Use Cases			
Project sites to be calculated	Simulation platform √	Demonstration Laboratory	Field Demonstrator √

KPI CALCULATION METHODOLOGY		
KPI STEP METHODOLOGY ID [KPI ID #]	Step	Responsible
CFHH_1	Data collection	CERTH
CFHH_2	KPI calculation	CERTH

KPI SCENARIOS			
Scenarios to be measured	BASELINE	BUSINESS AS USUAL (BaU)	SMART GRID
	√		√

KPI DATA COLLECTION							
DATA	DATA ID	Methodology for data collection	Source/Tools/instruments for Data Collection	Location of Data Collection	Frequency of Data Collection	Minimum monitoring period	Data collection responsible
Fuel consumption	F	Measurements by literature review	On site and literature measurements	Pilot	Once in the beginning and once in the end of SMILE	4 years	CERTH
CO_2 impact factor per unit of fuel	FE	Simulation	Software platform	Pilot	Once	Once	CERTH

Calculation of CO_2 emissions	CFHH	Estimation based on data provided by published databases	Simulation tool	Pilot	Once in the beginning and once in the end of SMILE	4 years	CERTH

KPI BASELINE			
Source of Baseline	**SECONDARY DATA (literature, databases, simulation)** √	**COMPANY HISTORICAL VALUES** ☐	**VALUES MEASURED AT START OF PROJECT** √
Details of Baseline			
Responsible (Name, Company) for Baseline	CERTH		
GENERAL COMMENTS			

ANNEX III (ECONOMIC KPIs)

BASIC KPI INFORMATION			
KPI NAME	Life-cycle cost of energy generation	KPI ID	LCC
Main Objective	LCC is defined as a technique which enables comparative cost assessments to be made over a specified period of time, taking into account all relevant economic factors, both in terms of initial costs and future operational costs.		
KPI Description	LCC of energy generation includes the private cost (investment, operational, maintenance and end of life), as well as the external cost corresponding to the environmental impact, when it is applied. The costs are taken into consideration for the whole life time of product /process.		
KPI Formula	$LCC=\frac{CC+O\&M+EoL+RhC+EC-RV}{E}$ CC= Capital Cost of investment O&M= Operation and Maintenance cost EoL= End of Life, disposal cost RhC= Rehabilitation Cost EC= other External Cost RV= Residual Value E= Total energy generated during lifetime of investment		
Unit of measurement	€/MWh_{el} or €/MW_{th}		
Connection/Link with other relevant defined KPIS and Use Cases	Total Capital Cost per kW installed		
Project sites to be calculated	Simulation platform √	Demonstration Laboratory ☐	Field Demonstrator √

KPI CALCULATION METHODOLOGY		
KPI STEP METHODOLOGY ID [KPI ID #]	Step	Responsible
LCC_1	Data collection	CERTH
LCC_2	KPI calculation	CERTH

KPI SCENARIOS			
Scenarios to be measured	BASELINE	BUSINESS AS USUAL (BaU)	SMART GRID
	√	☐	√

KPI DATA COLLECTION							
DATA	DATA ID	Methodology for data collection	Source/Tools/instruments for Data Collection	Location of Data Collection	Frequency of Data Collection	Minimum monitoring period	Data collection responsible

Capital Cost	CC	Request for official data by manufacturers	Technology manufacturers	Pilot	Once	Once	CERTH
Operation & Maintenance Cost	O&M	Request for official data by manufacturers and demo operators	Technology manufacturers and demo operators	Pilot	Once	Once	CERTH
End of Life cost	EoL	Request for official data by manufacturers	Technology manufacturers	Pilot	Once	Once	CERTH
Rehabilitation Cost	RhC	Request for official data by manufacturers and demo operators	Technology manufacturers and demo operators	Pilot	Once	Once	CERTH
External Cost (may have to do with emission fees etc)	EC	Legislation search and other estimations	Official legislative sources	Pilot	Once	Once	RUG, CERTH
Residual Value	RV	Request for official data by manufacturers and demo operators	Technology manufacturers and demo operators	Pilot	Once	Once	CERTH
Total energy generated during lifetime	E	Simulation / Estimation based on tech specs	Databases, measurements, values given by manufacturers	Pilot	Once	Once	CERTH

KPI BASELINE			
Source of Baseline	**SECONDARY DATA (literature, databases, simulation)** √	**COMPANY HISTORICAL VALUES** √	**VALUES MEASURED AT START OF PROJECT** ☐
Details of Baseline			
Responsible (Name, Company) for Baseline	CERTH		
GENERAL COMMENTS			

BASIC KPI INFORMATION			
KPI NAME	Annuity Gain	KPI ID	AG
Main Objective	It shows the profit or the cost for the operator when implementing energy efficiency or renewable energy measures.		
KPI Description	It gives an impression of how much money can be saved or must be paid annually when implementing energy efficiency or renewable energy measures.		
KPI Formula	$$AG = \frac{EC_{SG} - EC_{Bl}}{EC_{Bl}} \cdot 100$$ AG=Annual Gain EC_{SG}=Annual Cost of the Energy to the Operator in a Smart Grid case study EC_{Bl}=Current Annual Cost of the Energy to the Operator		
Unit of measurement	€/y		
Connection/Link with other relevant defined KPIS and Use Cases			
Project sites to be calculated	Simulation platform √	Demonstration Laboratory	Field Demonstrator √

KPI CALCULATION METHODOLOGY		
KPI STEP METHODOLOGY ID [KPI ID #]	Step	Responsible
AG_1	Data collection	CERTH
AG_2	KPI calculation	CERTH

KPI SCENARIOS			
Scenarios to be measured	BASELINE	BUSINESS AS USUAL (BaU)	SMART GRID
	√	√	√

KPI DATA COLLECTION							
DATA	DATA ID	Methodology for data collection	Source/Tools/instruments for Data Collection	Location of Data Collection	Frequency of Data Collection	Minimum monitoring period	Data collection responsible
Energy generation		Measurements and calculation methods based on tech specs	Simulation tool and measurements	Pilot	Once	Once	CERTH
Economic indicators (such		Data collected by the legislative framework	Legislative framework	Pilot	Once	Once	CERTH

as tariff, green certificate etc)							

KPI BASELINE			
Source of Baseline	**SECONDARY DATA (literature, databases, simulation)** √	**COMPANY HISTORICAL VALUES** ☐	**VALUES MEASURED AT START OF PROJECT** √
Details of Baseline			
Responsible (Name, Company) for Baseline	CERTH		
GENERAL COMMENTS			

BASIC KPI INFORMATION			
KPI NAME	Internal Rate of Return	KPI ID	IRR
Main Objective	Examines the profitability of an investment		
KPI Description	The reverse idea of the discount rate. It is the value of the discount rate at which the Net Present Value (NPV) of an investment becomes *zero*.		
KPI Formula	The starting point is the NPV formula: $$NPV = C0 + \sum_{t=1}^{\tau} Ct/(1+r)^{\tau}$$ Where: C0= net cash flow in year 0 t=generic year included in the calculation period Ct=net cash flow at the year t of the calculation period τ= calculation period r=discount rate		
Unit of measurement	%		
Connection/Link with other relevant defined KPIS and Use Cases	Investment Payback Period		
Project sites to be calculated	Simulation platform √	Demonstration Laboratory ☐	Field Demonstrator ☐

KPI CALCULATION METHODOLOGY

KPI STEP METHODOLOGY ID [KPI ID #]	Step	Responsible
IRR_1	Data collection	RINA-C
IRR_2	KPI calculation	RINA-C

KPI SCENARIOS

Scenarios to be measured	BASELINE	BUSINESS AS USUAL (BaU)	SMART GRID
	√	☐	√

KPI DATA COLLECTION

DATA	DATA ID	Methodology for data collection	Source/Tools/instruments for Data Collection	Location of Data Collection	Frequency of Data Collection	Minimum monitoring period	Data collection responsible
Economic cash flows		Data request by suppliers and operators	Suppliers and Operators	Pilot	Once	Once	RINA-C

KPI BASELINE

Source of Baseline	SECONDARY DATA (literature, databases, simulation) √	COMPANY HISTORICAL VALUES ☐	VALUES MEASURED AT START OF PROJECT ☐
Details of Baseline			
Responsible (Name, Company) for Baseline	RINA-C		
GENERAL COMMENTS			

BASIC KPI INFORMATION			
KPI NAME	Total Capital Cost per kW installed	KPI ID	TCC
Main Objective	Examines the initial cost of an investment depending on the size of the capacity being installed		
KPI Description	Measures the total capital cost of an energy investment per kW installed (per kWh when we examine storage)		
KPI Formula	$TCC = \frac{\sum_{i=1}^{n} CAPEX}{IC}$ i= pointer of CAPEX sources CAPEX= Capital cost IC= Installed capacity		
Unit of measurement	€/kW		
Connection/Link with other relevant defined KPIS and Use Cases	Life Cycle Cost		
Project sites to be calculated	Simulation platform √	Demonstration Laboratory ☐	Field Demonstrator √

KPI CALCULATION METHODOLOGY		
KPI STEP METHODOLOGY ID [KPI ID #]	Step	Responsible
TCC_1	Data collection	RINA-C
TCC_2	KPI calculation	RINA-C

KPI SCENARIOS			
Scenarios to be measured	BASELINE	BUSINESS AS USUAL (BaU)	SMART GRID
	√	☐	√

KPI DATA COLLECTION							
DATA	DATA ID	Methodology for data collection	Source/Tools/instruments for Data Collection	Location of Data Collection	Frequency of Data Collection	Minimum monitoring period	Data collection responsible
Capital Cost	CAPEX	Data request by suppliers and operators	Power suppliers and operators	Pilot	Once	Once	RINA-C
Installed Capacity	IC	Data request by operators	Network operator	Pilot	Once	Once	RINA-C

KPI BASELINE

Source of Baseline	SECONDARY DATA (literature, databases, simulation) √	COMPANY HISTORICAL VALUES	VALUES MEASURED AT START OF PROJECT
Details of Baseline			
Responsible (Name, Company) for Baseline	RINA-C		
GENERAL COMMENTS			

BASIC KPI INFORMATION			
KPI NAME	Return on Investment	KPI ID	ROI
Main Objective	Examines the increase in the value of an investment		
KPI Description	Measures the value of an investment (sell value) compared to its initial cost (buying cost)		
KPI Formula	$ROI = \frac{SV-CV}{CV}$ SV= selling value of the investment in a precise moment CV= initial cost of the investment		
Unit of measurement			
Connection/Link with other relevant defined KPIS and Use Cases			
Project sites to be calculated	Simulation platform √	Demonstration Laboratory ☐	Field Demonstrator ☐

KPI CALCULATION METHODOLOGY		
KPI STEP METHODOLOGY ID [KPI ID #]	Step	Responsible
ROI_1	Data simulation	RINA-C
ROI_2	KPI calculation	RINA-C

KPI SCENARIOS			
Scenarios to be measured	BASELINE	BUSINESS AS USUAL (BaU)	SMART GRID
	√	☐	√

KPI DATA COLLECTION							
DATA	DATA ID	Methodology for data collection	Source/Tools/instruments for Data Collection	Location of Data Collection	Frequency of Data Collection	Minimum monitoring period	Data collection responsible
Initial investment cost	CV	Data request by technology manufacturer	Technology manufacturer	Pilot	Once	Once	LIBAL, SUNAMP, V-CHARGE
Selling value in a precise moment	SV	Data request by technology manufacturer	Technology manufacturer	Pilot	Annually	4 years	LIBAL, SUNAMP, V-CHARGE

KPI BASELINE

Source of Baseline	**SECONDARY DATA** (literature, databases, simulation) √	**COMPANY HISTORICAL VALUES** ☐	**VALUES MEASURED AT START OF PROJECT** ☐
Details of Baseline			
Responsible (Name, Company) for Baseline	RINA-C		
GENERAL COMMENTS			

BASIC KPI INFORMATION			
KPI NAME	Investment Payback Period	KPI ID	IPP
Main Objective	Examines the duration needed for an investment to start being profitable		
KPI Description	Searches for the year when the Net Present Value becomes zero.		
KPI Formula	$0=\sum_{t=1}^{T}\frac{C_t}{(1+r)^t}-C_0$ t= pointer of years (equals to IPP when the equation is satisfied) T= lifetime of investment C= annual net cash inflow C_0= initial cost		
Unit of measurement	years		
Connection/Link with other relevant defined KPIS and Use Cases			
Project sites to be calculated	Simulation platform √	Demonstration Laboratory ☐	Field Demonstrator √

KPI CALCULATION METHODOLOGY		
KPI STEP METHODOLOGY ID [KPI ID #]	Step	Responsible
IPP_1	Data simulation	RINA-C
IPP_2	KPI calculation	RINA-C

KPI SCENARIOS			
Scenarios to be measured	BASELINE √	BUSINESS AS USUAL (BaU) ☐	SMART GRID √

KPI DATA COLLECTION							
DATA	DATA ID	Methodology for data collection	Source/Tools/instruments for Data Collection	Location of Data Collection	Frequency of Data Collection	Minimum monitoring period	Data collection responsible
Investment lifetime	T	Data request by manufacturer	Manufacturer	Pilot	Once	Once	RINA-C
Initial cost	C_0	Data request by supplier and manufacturer	Supplier and manufacturer	Pilot	Once	Once	RINA-C
Annual cash inflow	C	Data request by supplier	Supplier	Pilot	Once	Once	RINA-C

KPI BASELINE

Source of Baseline	SECONDARY DATA (literature, databases, simulation) √	COMPANY HISTORICAL VALUES ☐	VALUES MEASURED AT START OF PROJECT ☐
Details of Baseline			
Responsible (Name, Company) for Baseline	RINA-C		
GENERAL COMMENTS			

BASIC KPI INFORMATION			
KPI NAME	Feed-In Tariff	KPI ID	FIT
Main Objective	The monitoring of the feed-in tariff policy and the effect of the project on them		
KPI Description	A recording of the progress of the feed-in tariffs in the beginning, throughout and for some years after the project.		
KPI Formula			
Unit of measurement	€		
Connection/Link with other relevant defined KPIS and Use Cases			
Project sites to be calculated	Simulation platform √	Demonstration Laboratory	Field Demonstrator √

KPI CALCULATION METHODOLOGY		
KPI STEP METHODOLOGY ID [KPI ID #]	Step	Responsible
FIT_1	Data collection	CES, SE, EEM
FIT_2	Data simulation	CES, SE, EEM
FIT_3	KPI calculation	CES, SE, EEM

KPI SCENARIOS			
Scenarios to be measured	BASELINE √	BUSINESS AS USUAL (BaU) √	SMART GRID √

KPI DATA COLLECTION							
DATA	DATA ID	Methodology for data collection	Source/Tools/instruments for Data Collection	Location of Data Collection	Frequency of Data Collection	Minimum monitoring period	Data collection responsible
FIT	FIT_1	Data request by the local DSOs	Local DSO	Each Island	Annually	10 years	CES, SE, EEM

KPI BASELINE

Source of Baseline	**SECONDARY DATA (literature, databases, simulation)** ☐	**COMPANY HISTORICAL VALUES** √	**VALUES MEASURED AT START OF PROJECT** √
Details of Baseline			
Responsible (Name, Company) for Baseline	CES, SE, EEM		
GENERAL COMMENTS			

BASIC KPI INFORMATION			
KPI NAME	Heating Prices	KPI ID	HeatP
Main Objective	Comparing of the various heating alternatives, concerning the final price.		
KPI Description	Measures the final price of the useful energy, simulating to the performance of each heating alternative.		
KPI Formula	$$HeatP = \frac{FP \cdot r}{CV}$$ FP= price of fuel used r= performance of the tested technology CV= calorific value of the fuel unit		
Unit of measurement	€/kJ		
Connection/Link with other relevant defined KPIS and Use Cases			
Project sites to be calculated	Simulation platform √	Demonstration Laboratory ☐	Field Demonstrator ☐

KPI CALCULATION METHODOLOGY		
KPI STEP METHODOLOGY ID [KPI ID #]	**Step**	**Responsible**
HeatP_1	Data collection	DTI
HeatP_2	Data simulation	DTI
HeatP_3	KPI calculation	DTI

KPI SCENARIOS			
Scenarios to be measured	**BASELINE** √	**BUSINESS AS USUAL (BaU)** √	**SMART GRID** √

KPI DATA COLLECTION							
DATA	**DATA ID**	**Methodology for data collection**	**Source/Tools/instruments for Data Collection**	**Location of Data Collection**	**Frequency of Data Collection**	**Minimum monitoring period**	**Data collection responsible**
Fuel Price	FP	Data request by statistic organizations	Statistic Organizations	National	In the beginning and in the end of SMILE	4 years	DTI
Performance	r	Available data in various literature	Available literature	National	In the beginning and in the	4 years	DTI

					end of SMILE		
Calorific value	CV	Available data in various literature	Available literature	National	In the beginning and in the end of SMILE	4 years	DTI

KPI BASELINE			
Source of Baseline	SECONDARY DATA (literature, databases, simulation) ☐	COMPANY HISTORICAL VALUES √	VALUES MEASURED AT START OF PROJECT √
Details of Baseline			
Responsible (Name, Company) for Baseline	DTI		
GENERAL COMMENTS			

BASIC KPI INFORMATION			
KPI NAME	Load Purchasing from Mainland	KPI ID	LPM
Main Objective	Examines the sufficiency of the electricity generation in each island, since the electricity transactions are usually not preferred.		
KPI Description	Measures the electricity purchasing from mainland.		
KPI Formula			
Unit of measurement	€/year		
Connection/Link with other relevant defined KPIS and Use Cases			
Project sites to be calculated	Simulation platform ☐	Demonstration Laboratory ☐	Field Demonstrator √

KPI CALCULATION METHODOLOGY		
KPI STEP METHODOLOGY ID [KPI ID #]	Step	Responsible
LPM_1	Data collection	CES, SE

KPI SCENARIOS			
Scenarios to be measured	BASELINE	BUSINESS AS USUAL (BaU)	SMART GRID
	√	☐	√

KPI DATA COLLECTION							
DATA	DATA ID	Methodology for data collection	Source/Tools/instruments for Data Collection	Location of Data Collection	Frequency of Data Collection	Minimum monitoring period	Data collection responsible
Load Purchasing from Mainland Cost	LPM	Data request by the local DSOs	Local DSO	Each Island	Annually	6 years	CES, SE,

KPI BASELINE			
Source of Baseline	SECONDARY DATA (literature, databases, simulation) ☐	COMPANY HISTORICAL VALUES √	VALUES MEASURED AT START OF PROJECT ☐
Details of Baseline			

Responsible (Name, Company) for Baseline	CES, SE
GENERAL COMMENTS	

BASIC KPI INFORMATION			
KPI NAME	Fossil Fuel Purchasing from Mainland	KPI ID	FFP
Main Objective	Examines the economic result of the application of fossil-free solutions like EVs.		
KPI Description	The amount of fossil fuels that have to be purchased by the mainland for heating, transportation and power generation.		
KPI Formula			
Unit of measurement	€/year		
Connection/Link with other relevant defined KPIS and Use Cases			
Project sites to be calculated	Simulation platform ☐	Demonstration Laboratory ☐	Field Demonstrator √

KPI CALCULATION METHODOLOGY		
KPI STEP METHODOLOGY ID [KPI ID #]	Step	Responsible
FFP_1	Data collection	CES, SE, ACIF-CCIM

KPI SCENARIOS			
Scenarios to be measured	BASELINE	BUSINESS AS USUAL (BaU)	SMART GRID
	√	☐	√

KPI DATA COLLECTION							
DATA	DATA ID	Methodology for data collection	Source/Tools/instruments for Data Collection	Location of Data Collection	Frequency of Data Collection	Minimum monitoring period	Data collection responsible
Fossil fuel purchasing	FFP	Data request by statistic organizations	Statistic Organizations	Island	Annually	10 years	CES, SE, ACIF-CCIM

KPI BASELINE			
Source of Baseline	SECONDARY DATA (literature, databases, simulation) ☐	COMPANY HISTORICAL VALUES √	VALUES MEASURED AT START OF PROJECT ☐
Details of Baseline	The baseline can be calculated per each year or with the average value of the last 5 years.		

Responsible (Name, Company) for Baseline	CES, SE, EEM/ACIF-CCIM
GENERAL COMMENTS	

BASIC KPI INFORMATION			
KPI NAME	Transportation Cost	KPI ID	TC
Main Objective	Examines the cost of electric transportation compared to the previous technology.		
KPI Description	Calculation of the fuel (electricity) cost when moving with EVs, compared to other technologies using fossil fuels.		
KPI Formula	$TC = F_i \cdot p_i$ F_i= the price of the fuel *i* unit p_i= the performance of the technology *i*, that is the amount of fuel *i* needed for 100km		
Unit of measurement	€/100km		
Connection/Link with other relevant defined KPIS and Use Cases			
Project sites to be calculated	Simulation platform: ☐	Demonstration Laboratory: ☐	Field Demonstrator: √

KPI CALCULATION METHODOLOGY		
KPI STEP METHODOLOGY ID [KPI ID #]	Step	Responsible
TC_1	Data collection	CERTH
TC_2	KPI calculation	CERTH

KPI SCENARIOS			
Scenarios to be measured	BASELINE	BUSINESS AS USUAL (BaU)	SMART GRID
	√	☐	√

KPI DATA COLLECTION							
DATA	DATA ID	Methodology for data collection	Source/Tools/instruments for Data Collection	Location of Data Collection	Frequency of Data Collection	Minimum monitoring period	Data collection responsible
Fuel price	F_i	Monitoring the official fuel prices	Statistic Organizations	Pilot	Annually	4 years	CERTH
Performance	p_i	Request for official data by technology manufacturers	Available data online, technology manufacturers	Pilot	Annually	4 years	CERTH

KPI BASELINE

Source of Baseline	**SECONDARY DATA (literature, databases, simulation)** √	**COMPANY HISTORICAL VALUES**	**VALUES MEASURED AT START OF PROJECT**
Details of Baseline			
Responsible (Name, Company) for Baseline	CERTH		
GENERAL COMMENTS			

BASIC KPI INFORMATION				
KPI NAME	Improved access to online services		KPI ID	ITAcc
Main Objective	Examines to what extent the energy services are publicly monitored easily and massively by the community.			
KPI Description	Survey on local residents and enterprises whether the accessibility to online services concerning the energy applications is easy and helpful.			
KPI Formula	Likert scale			
Unit of measurement				
Connection/Link with other relevant defined KPIS and Use Cases				
Project sites to be calculated	Simulation platform ☐	Demonstration Laboratory ☐	Field Demonstrator √	

KPI CALCULATION METHODOLOGY		
KPI STEP METHODOLOGY ID [KPI ID #]	Step	Responsible
ITAcc_1	Determination of survey's target group	CES, SK, ACIF-CCIM
ITAcc_2	Preparation of the survey questionnaire	CES, SK, ACIF-CCIM
ITAcc_3	Survey processing	CES, SK, ACIF-CCIM
ITAcc_4	Survey report	CES, SK, ACIF-CCIM

KPI SCENARIOS			
Scenarios to be measured	BASELINE	BUSINESS AS USUAL (BaU)	SMART GRID
	√	☐	√

KPI DATA COLLECTION							
DATA	DATA ID	Methodology for data collection	Source/Tools/instruments for Data Collection	Location of Data Collection	Frequency of Data Collection	Minimum monitoring period	Data collection responsible
Level of online services	ITAcc	Survey processing	Online forms	Pilot	In the beginning and in the end of SMILE	4 years	CES, SK, ACIF-CCIM

KPI BASELINE			
Source of Baseline	**SECONDARY DATA (literature, databases, simulation)** ☐	**COMPANY HISTORICAL VALUES** ☐	**VALUES MEASURED AT START OF PROJECT** √
Details of Baseline			
Responsible (Name, Company) for Baseline	CES, SK, ACIF-CCIM		
GENERAL COMMENTS			

BASIC KPI INFORMATION			
KPI NAME	Increased environmental sustainability education	KPI ID	EnvEdu
Main Objective	Examines the extent at which locals learn to live caring for the environment by an early age.		
KPI Description	Survey about the environmental care of children of different ages. Involves a report on the actions taken by the local governance (involving educational schedule, organizing interactive activities for teenagers etc.).		
KPI Formula	Likert scale		
Unit of measurement			
Connection/Link with other relevant defined KPIS and Use Cases			
Project sites to be calculated	Simulation platform ☐	Demonstration Laboratory ☐	Field Demonstrator √

KPI CALCULATION METHODOLOGY		
KPI STEP METHODOLOGY ID [KPI ID #]	Step	Responsible
EnvEdu_1	Preparation of the survey questionnaire	SEV
EnvEdu_2	Survey processing	SEV
EnvEdu_3	Report	SEV

KPI SCENARIOS			
Scenarios to be measured	BASELINE	BUSINESS AS USUAL (BaU)	SMART GRID
	√	☐	√

KPI DATA COLLECTION							
DATA	DATA ID	Methodology for data collection	Source/Tools/instruments for Data Collection	Location of Data Collection	Frequency of Data Collection	Minimum monitoring period	Data collection responsible
Level of environmental care	EnvEdu	Survey	Mail or hardcopy questionnaire	Pilot	4 years	12 years	SEV

KPI BASELINE

Source of Baseline	SECONDARY DATA (literature, databases, simulation) √	COMPANY HISTORICAL VALUES ☐	VALUES MEASURED AT START OF PROJECT √
Details of Baseline			
Responsible (Name, Company) for Baseline	SEV		
GENERAL COMMENTS			

BASIC KPI INFORMATION			
KPI NAME	City's Unemployment Rate	KPI ID	CUR
Main Objective	(Un)employment level of the pilot islands give a useful background of the local economy.		
KPI Description	Residents unemployed as a share of all economically active residents. The KPI will take an annual value for the time period of the project and some years afterwards.		
KPI Formula	$$CUR = \frac{UR}{EAR} \cdot 100$$ UR= Unemployed residents of the pilot island EAR= Economically active residents of the pilot island		
Unit of measurement	%		
Connection/Link with other relevant defined KPIS and Use Cases			
Project sites to be calculated	Simulation platform ☐	Demonstration Laboratory ☐	Field Demonstrator √

KPI CALCULATION METHODOLOGY		
KPI STEP METHODOLOGY ID [KPI ID #]	Step	Responsible
CUR_1	Data collection	CES, SK, ACIF-CCIM
CUR_2	KPI calculation	CES, SK, ACIF-CCIM

KPI SCENARIOS			
Scenarios to be measured	BASELINE	BUSINESS AS USUAL (BaU)	SMART GRID
	√	☐	√

KPI DATA COLLECTION							
DATA	DATA ID	Methodology for data collection	Source/Tools/instruments for Data Collection	Location of Data Collection	Frequency of Data Collection	Minimum monitoring period	Data collection responsible
(Un)employment level	CUR	Data request by statistic organizations	Statistic Organizations	Island	Annually	6 years	CES, SK, ACIF-CCIM

KPI BASELINE

Source of Baseline	**SECONDARY DATA (literature, databases, simulation)** √	**COMPANY HISTORICAL VALUES** ☐	**VALUES MEASURED AT START OF PROJECT** ☐
Details of Baseline	The baseline can be calculated per each year or with the average value of the last 5 years.		
Responsible (Name, Company) for Baseline	CES, SK, ACIF-CCIM		
GENERAL COMMENTS			

BASIC KPI INFORMATION			
KPI NAME	Thermal Comfort	KPI ID	TC
Main Objective	Evaluation of the performance of the heating technics proposed.		
KPI Description	Locals living/working in residences/offices with the proposed heating technics will be asked about the thermal result of the introduced technology.		
KPI Formula	Likert scale		
Unit of measurement			
Connection/Link with other relevant defined KPIS and Use Cases			
Project sites to be calculated	Simulation platform ☐	Demonstration Laboratory ☐	Field Demonstrator √

KPI CALCULATION METHODOLOGY		
KPI STEP METHODOLOGY ID [KPI ID #]	**Step**	**Responsible**
TC_1	Undertaking the survey	CES, SK
TC_2	Calculation of the average for each pilot	CES, SK

KPI SCENARIOS			
Scenarios to be measured	**BASELINE**	**BUSINESS AS USUAL (BaU)**	**SMART GRID**
	√	☐	√

KPI DATA COLLECTION							
DATA	**DATA ID**	**Methodology for data collection**	**Source/Tools/instruments for Data Collection**	**Location of Data Collection**	**Frequency of Data Collection**	**Minimum monitoring period**	**Data collection responsible**
Thermal comfort level	TC	Survey or/and heat monitoring	Questionnaire or/and special heat monitoring equipment	Pilot	Every 2 years	4 years	CES, SK

KPI BASELINE			
Source of Baseline	**SECONDARY DATA (literature, databases, simulation)** ☐	**COMPANY HISTORICAL VALUES** ☐	**VALUES MEASURED AT START OF PROJECT** √

Details of Baseline	
Responsible (Name, Company) for Baseline	CES, SK
GENERAL COMMENTS	

BASIC KPI INFORMATION			
KPI NAME	DR Scheme Sensibility	KPI ID	DRSS
Main Objective	Examines the performance of the DR schemes to the eyes of the customers.		
KPI Description	Specific customers including residential and large-scale are asked about the sensibility of the proposed/used DR schemes.		
KPI Formula	Likert Scale		
Unit of measurement			
Connection/Link with other relevant defined KPIS and Use Cases	EV Scheme Sensibility		
Project sites to be calculated	Simulation platform ☐	Demonstration Laboratory ☐	Field Demonstrator √

KPI CALCULATION METHODOLOGY		
KPI STEP METHODOLOGY ID [KPI ID #]	**Step**	**Responsible**
DRSS_1	Determination of the target group	CES, SK, ACIF-CCIM
DRSS_2	Undertaking of the survey	CES, SK, ACIF-CCIM
DRSS_3	Calculation of the average	CES, SK, ACIF-CCIM

KPI SCENARIOS			
Scenarios to be measured	**BASELINE**	**BUSINESS AS USUAL (BaU)**	**SMART GRID**
	☐	√	√

KPI DATA COLLECTION							
DATA	**DATA ID**	**Methodology for data collection**	**Source/Tools/instruments for Data Collection**	**Location of Data Collection**	**Frequency of Data Collection**	**Minimum monitoring period**	**Data collection responsible**
Demand Response Scheme Sensibility	DRSS	Survey processing	Online forms	Pilot	4 years	4 years	CES, SK, ACIF-CCIM

KPI BASELINE

Source of Baseline	SECONDARY DATA (literature, databases, simulation) ☐	COMPANY HISTORICAL VALUES ☐	VALUES MEASURED AT START OF PROJECT √
Details of Baseline	BaU estimation		
Responsible (Name, Company) for Baseline	CES, SK, ACIF-CCIM		
GENERAL COMMENTS			

BASIC KPI INFORMATION			
KPI NAME	EV Scheme Sensibility	KPI ID	EVSS
Main Objective	Examines the performance of the EV schemes to the eyes of the locals.		
KPI Description	Locals are asked about the sensibility of the proposed/used EV schemes.		
KPI Formula	Likert Scale		
Unit of measurement			
Connection/Link with other relevant defined KPIS and Use Cases	DR Scheme Sensibility		
Project sites to be calculated	Simulation platform ☐	Demonstration Laboratory ☐	Field Demonstrator √

KPI CALCULATION METHODOLOGY		
KPI STEP METHODOLOGY ID [KPI ID #]	Step	Responsible
EVSS_1	Determination of the target group	CES, SK, ACIF-CCIM
EVSS_2	Undertaking of the survey	CES, SK, ACIF-CCIM
EVSS_3	Calculation of the average	CES, SK, ACIF-CCIM

KPI SCENARIOS			
Scenarios to be measured	BASELINE	BUSINESS AS USUAL (BaU)	SMART GRID
	☐	√	√

KPI DATA COLLECTION							
DATA	DATA ID	Methodology for data collection	Source/Tools/instruments for Data Collection	Location of Data Collection	Frequency of Data Collection	Minimum monitoring period	Data collection responsible
EV Scheme Sensibility	EVSS	Undertaking of the survey	Online forms	Pilot	4 years	4 years	CES, SK, ACIF-CCIM

KPI BASELINE			
Source of Baseline	SECONDARY DATA (literature, databases, simulation) ☐	COMPANY HISTORICAL VALUES ☐	VALUES MEASURED AT START OF PROJECT √

Details of Baseline	BaU estimation
Responsible (Name, Company) for Baseline	CES, SK, ACIF-CCIM
GENERAL COMMENTS	

BASIC KPI INFORMATION			
KPI NAME	Degree of Landscape Impact	KPI ID	DLI
Main Objective	Measures the possible/existing opposition by the locals to RES like wind turbines due to aesthetic reasons. (A wind turbine or battery may look ugly or obstruct the view to the horizon. An aesthetical measure.)		
KPI Description	Locals will be asked for their opinion on the aesthetic point of view of the RES solutions.		
KPI Formula	Likert Scale		
Unit of measurement			
Connection/Link with other relevant defined KPIS and Use Cases			
Project sites to be calculated	Simulation platform ☐	Demonstration Laboratory ☐	Field Demonstrator √

KPI CALCULATION METHODOLOGY		
KPI STEP METHODOLOGY ID [KPI ID #]	**Step**	**Responsible**
DLI_1	Undertaking of the survey	CES, SK, ACIF-CCIM
DLI_2	Calculation of the average	CES, SK, ACIF-CCIM

KPI SCENARIOS			
Scenarios to be measured	**BASELINE** √	**BUSINESS AS USUAL (BaU)** ☐	**SMART GRID** √

KPI DATA COLLECTION							
DATA	**DATA ID**	**Methodology for data collection**	**Source/Tools/instruments for Data Collection**	**Location of Data Collection**	**Frequency of Data Collection**	**Minimum monitoring period**	**Data collection responsible**
DLI	DLI_1	Undertaking of the survey	Online forms	Pilot	4 years	4 years	CES, SK, ACIF-CCIM

KPI BASELINE			
Source of Baseline	**SECONDARY DATA (literature, databases, simulation)** ☐	**COMPANY HISTORICAL VALUES** ☐	**VALUES MEASURED AT START OF PROJECT** √

Details of Baseline	The results are given in the form of an average in the Likert Scale
Responsible (Name, Company) for Baseline	CES, SK, ACIF-CCIM
GENERAL COMMENTS	

ANNEX V (LEGAL KPIs)

BASIC KPI INFORMATION				
KPI NAME	Local grid balancing legal framework development		KPI ID	LGB
Main Objective	Assessment of the suitability of the current legal framework in the EU and its members providing pilots to the SMILE project, to ensure local grid balancing.			
KPI Description	The extent to which local grid balancing technologies' regulation is suitable at EU level and at the partners' islands level.			
KPI Formula	Colour code or 5-level adjective rating scale of the suitability of the existing legal framework at the different levels (EU + member states concerned)			
Unit of measurement				
Connection/Link with other relevant defined KPIS and Use Cases	Monitoring and Evaluation, Microgrids legal framework, Suitable Energy Storage Regulation			
Project sites to be assessed	Simulation platform ☐	Demonstration Laboratory ☐	Field Demonstrator √	

KPI CALCULATION METHODOLOGY		
KPI STEP METHODOLOGY ID [KPI ID #]	Step	Responsible
LGB _1	Data collection	RUG
LGB _2	KPI calculation	RUG

KPI SCENARIOS			
Scenarios to be assessed	BASELINE	BUSINESS AS USUAL (BAU)	SMART GRID
	√	☐	√

KPI DATA COLLECTION							
DATA	DATA ID	Methodology for data collection	Source/Tools/instruments for Data Collection	Location of Data Collection	Frequency of Data Collection	Minimum monitoring period	Data collection responsible
Directives		Desk study	http://eur-lex.europa.eu/homepage.html?locale=en	Island/ country	Continued	10 years	RUG
National Laws		Desk study	National lawmakers websites	Island/ country	Continued	10 years	RUG

KPI BASELINE			
Source of Baseline	SECONDARY DATA (literature, databases, simulation) √	COMPANY HISTORICAL VALUES ☐	VALUES MEASURED AT START OF PROJECT ☐
Details of Baseline			
Responsible (Name, Company) for Baseline	RUG		
GENERAL COMMENTS			

BASIC KPI INFORMATION			
KPI NAME	Microgrids legal framework	KPI ID	MLF
Main Objective	Assessment of the suitability of the current legal framework in the EU and its members providing pilots to the SMILE project, to develop microgrids.		
KPI Description	The extent to which microgrids regulation is suitable at EU level and at the partners' islands level.		
KPI Formula	Colour code or 5-level adjective rating scale of the suitability of the existing legal framework at the different levels (EU + member states concerned)		
Unit of measurement			
Connection/Link with other relevant defined KPIS and Use Cases	Local grid balancing legal framework development, Monitoring and Evaluation, Suitable Energy Storage Regulation		
Project sites to be assessed	Simulation platform ☐	Demonstration Laboratory ☐	Field Demonstrator √

KPI CALCULATION METHODOLOGY		
KPI STEP METHODOLOGY ID [KPI ID #]	Step	Responsible
MLF_1	Data collection	RUG
MLF_2	KPI calculation	RUG

KPI SCENARIOS			
Scenarios to be assessed	BASELINE	BUSINESS AS USUAL (BAU)	SMART GRID
	√	☐	√

KPI DATA COLLECTION							
DATA	DATA ID	Methodology for data collection	Source/Tools/instruments for Data Collection	Location of Data Collection	Frequency of Data Collection	Minimum monitoring period	Data collection responsible
Directives		Desk study	http://eur-lex.europa.eu/homepage.html?locale=en	Island/ country	Continued	10 years	RUG
National Laws		Desk study	National lawmakers websites		Continued	10 years	RUG

KPI BASELINE			
Source of Baseline	SECONDARY DATA (literature, databases, simulation) √	COMPANY HISTORICAL VALUES ☐	VALUES MEASURED AT START OF PROJECT ☐
Details of Baseline			
Responsible (Name, Company) for Baseline	RUG		

GENERAL COMMENTS

BASIC KPI INFORMATION			
KPI NAME	Suitable Energy Storage Regulation	KPI ID	ESR
Main Objective	Assessment of the suitability of the current legal framework in the EU and its members providing pilots to the SMILE project, to develop the installed energy storage technologies.		
KPI Description	The extent to which energy storage regulation is suitable at EU level and at the partners' islands level.		
KPI Formula	Colour code or 5-level adjective rating scale of the suitability of the existing legal framework at the different levels (EU + member states concerned)		
Unit of measurement			
Connection/Link with other relevant defined KPIS and Use Cases	Local grid balancing legal framework development, Monitoring and Evaluation, Microgrids legal framework		
Project sites to be assessed	Simulation platform ☐	Demonstration Laboratory ☐	Field Demonstrator √

KPI CALCULATION METHODOLOGY		
KPI STEP METHODOLOGY ID [KPI ID #]	**Step**	**Responsible**
ESR _1	Data collection	RUG
ESR _2	KPI calculation	RUG

KPI SCENARIOS			
Scenarios to be assessed	**BASELINE**	**BUSINESS AS USUAL (BAU)**	**SMART GRID**
	√	☐	√

KPI DATA COLLECTION							
DATA	DATA ID	Methodology for data collection	Source/Tools/instruments for Data Collection	Location of Data Collection	Frequency of Data Collection	Minimum monitoring period	Data collection responsible
Directives		Desk study	http://eur-lex.europa.eu/homepage.html?locale=en	Island/ country	Continued	10 years	RUG
National Laws		Desk study	National lawmakers websites	Island/ country	Continued	10 years	RUG

KPI BASELINE			
Source of Baseline	**SECONDARY DATA (literature, databases, simulation)** √	**COMPANY HISTORICAL VALUES** ☐	**VALUES MEASURED AT START OF PROJECT** ☐
Details of Baseline			
Responsible (Name, Company) for Baseline	RUG		

GENERAL COMMENTS

BASIC KPI INFORMATION			
KPI NAME	Monitoring and Evaluation	KPI ID	ME
Main Objective	The extent to which the progress of policies/strategies/projects is evaluated and is adapted according to the findings.		
KPI Description	Market operators, DSOs and governance will be asked to evaluate the degree of adoption of policies/strategies/projects		
KPI Formula	Likert scale		
Unit of measurement			
Connection/Link with other relevant defined KPIS and Use Cases	Local grid balancing legal framework development, Microgrids legal framework, Suitable Energy Storage Regulation		
Project sites to be calculated	Simulation platform ☐	Demonstration Laboratory ☐	Field Demonstrator √

KPI CALCULATION METHODOLOGY		
KPI STEP METHODOLOGY ID [KPI ID #]	Step	Responsible
ME_1	Determination of the target group	RUG
ME_2	Implementation of the survey	RUG
ME_3	Presentation of the results in the form of an average value	RUG

KPI SCENARIOS			
Scenarios to be measured	BASELINE	BUSINESS AS USUAL (BaU)	SMART GRID
	√	☐	√

KPI DATA COLLECTION							
DATA	DATA ID	Methodology for data collection	Source/Tools/instruments for Data Collection	Location of Data Collection	Frequency of Data Collection	Minimum monitoring period	Data collection responsible
Level of policy adoption	ME	Survey	Online form, questionnaire	Pilot / island	4 years	8 years	RUG

KPI BASELINE

Source of Baseline	SECONDARY DATA (literature, databases, simulation) √	COMPANY HISTORICAL VALUES ☐	VALUES MEASURED AT START OF PROJECT ☐
Details of Baseline			
Responsible (Name, Company) for Baseline	RUG		
GENERAL COMMENTS			