Integrated and Replicable Solutions for Co-Creation in Sustainable Cities

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Disclaimer

Executive Summary

This deliverable describes the foreseen demonstration plan for the TT#2 (Transition Track) to be deployed in Nice and its associated use cases and functionalities. It gives an update of the current status of development and a projection of the work plan, based on the current status of knowledge. To be considered is that the different actions related to the implementation of the IS under TT#2, have different levels of maturity or Technological Readiness Level (TRL) and thus, of advancement in terms of implementation plan or development.

The demonstration activity in Nice under TT#2 focuses to test different potential business cases related to the deployment of local Renewable Energy Sources (RES) and associated management system, capable of forecasting energy production and demand, optimizing under different constrains the underlying connected assets (production, storage and end-uses), in order to achieve the set objective: assessment of the economic performance of innovative smart grid technologies. It applies such demonstration activity on both electric and heating/cooling networks.

Hereby, special attention is paid on the management of self-consumption endeavours via the combination of different energy conversion and storage assets (including electric vehicles (EV) and stationary batteries energy storage systems (BESS)) and the valorisation of flexibilities under different operation strategies for relevant flexibility services for the electricity grid, to be integrated in the existing energy markets. This demonstration will close with the assessment of the feasibility and bankability of a local energy management system (LEMS).

The deliverable is intended as a direct up-date and detailing of D1.3 and D6.1 and D6.2. Given that TT#2 can only be barely isolated from other TTs of the LH Nice due to closely linked activities, some content might be repeated even though already described in previous deliverables or in the corresponding deliverable of other TT (particularly D6.3 and D6.5). As this deliverable not only describes the planning, methodologies and technologies to be implemented, but also the expected impacts, it will give an overview of the KPIs that will additionally be detailed in D9.5.

The main body of the deliverable is opened by (chapter 1) a general introduction to the demonstration activities at the TT level (TT#2), reasserting scope, objectives, impact and the overall work organisation, detailing main relations to other activities and partners. The follow-up section (chapter 2), after having outlined the overall ambition of the demonstration activity and the related demonstration area, introduces each single IS by explaining each one's scope and objectives. Chapter 3 focuses on each one's baseline and associated drivers and barriers and chapter 4 closes with by a summary of the overall work organisation. These first 4 chapters are accessible to the wider public and do need only limited notions of the IRIS project or of the energy- and smart-grid sectors.

Then, the main technical body of this D6.4 follows (chapter 5), gradually detailing the activity from the demonstrators or IS (Integrated Solution) level, to single demonstration measure, explaining for each its scope, objectives, detailed structuring and planning, and each closed by the outlining of expected impact and current achieved progress. This section is addressed to an audience who is interested to understand detailed information about the demonstrations and which should have a certain knowledge or interest in energy and smart grid technologies. Otherwise, the reader might struggle a bit to follow the text and addressed themes.

The document is closed by summarizing in chapter 8 the related monitoring activity (Key Performance Indicators) and some concluding, overall thoughts.

In the Annexes, detailed schemes and diagrams are provided (when applicable). These have been removed from the main text, as due to the provided level of detail, it might hinder the readability of the document, without having any added value for a non-specialist audience.

D6.4 will be updated through D6.8 and D6.9 delivered respectively in M48 and M60. Those will however keep a more aggregated view on the demonstration activity.

Demonstrator	In a nutshell
#1 IS 2.1 - Flexible electricity grid networks (PV // batteries // lighting network)	Brief summary: integration of local vRES (variable Renewable Energy Sources), decentralized battery storage and public/private EV charging infrastructure under a common Local Energy Management System. Objective is the testing of different operation strategies of such connected assets, towards the delivery of flexibility services to the electric grid. The demonstration is organised among different service layers, starting from the management of single assets towards the district scale and further, achieve the interfacing with energy service markets via aggregation.
	Expected impact: to be “pilots” for the industry and serve as model for further developments and replication. Provide contribution in terms of return-of-experience and results, to the complex debate concerning smart local energy management systems and thus, be integrated into the dissemination, communication and replication activities.
#2 IS 2.2 - Smart multi-sourced low temperature district heating with innovative storage solutions (excess heat from buildings equipment // heat pumps // thermal storage // decision and citizens apps)	Brief summary: The demonstration aims at assessing the potential convergence of operational strategies for integrating the management of heating, cooling and power at district scale, thanks to the supervision system to be deployed. The objective is the optimisation of the exploitation of a geothermal sourced district heating and cooling network, via the integration of different storage solutions, accompanied by an enhanced energy management system.

Demonstrator	In a nutshell
	Expected impact: As previous demonstrator, however focused not on the electric grid, but on the optimisation of thermal grids.
#3 IS 2.3 - Utilizing 2nd life batteries for smart large-scale storage schemes (PV // EVs // V2G)	Brief summary: aim is the cross-comparison of the use of 1st and 2nd life BESS (Battery Energy Storage Systems) for similar applications within the building sector. In other words, both batteries (1st life BESS in the EV, via a V2G charging pole, and the 2nd life BESS stack) will be used for providing stationary BESS based energy services within the IMREDD building. By using similar BESS capacities, performances and their temporal behaviour will be more easily made comparable.
	Expected impact: be the first of a kind implementation within the French context, which should serve as model for further developments and replication. Provide confidence to related stakeholder and decision makers and promote the further development of such solutions. Part the assessments scope is the testing of the performances of these single technologies, in providing building and grid relevant services (i.e. the optimization of self-consumption projects, PV valorisation and curtailment reduction). This should lead to a better assessment for they integration path into the energy system.

Table of Contents

List of Figures

List of Tables

List of Abbreviations and Acronyms

Abbreviation	Definition
BEMS	Building Energy Management System
BESS	Battery Energy Storage System
BOT	Build, Operate, Transpose
DA	"Day Ahead" market
DHCN	District Heating Cooling Network
DoA	Description of Action : Annexe 1 of the Grant Agreement
DSO	Distribution System Operator
EMS	Energy Management System
EPC	Energy Performance Contracting
EU	European Union
EV	Electric Vehicle
HP	Heat Pump
ID	"Intra-Day" market
IRR	Internal Rate of Return
IS	IRIS Solution
LEMS	Local Energy Management System
LV	Low voltage
NPV	Net Present Value
PDS	Public Delegation of Service
POC	Proof of Concept
RES	Renewable Energy Sources
ROI	Return of Investment
SCADA	Supervisory Control And Data Acquisition
SOC	State of Charge
SPV	Special Purpose Vehicle
TOU	Time Of Usage
TRL	Technological Readiness Level
TSO	Transmission System Operator
TT	Transition Track
UC	Use Case
V1G	Vehicle one Grid - one directional charging
V2G	Vehicle to Grid - reversible charging
vRES	Variable RES
WP	Work Package

1 Introduction

To ease the comprehension of the following document, first some key concepts are defined hereafter:

- **Flexibility:** ability of the system to maintain continuous service in the face of rapid and large swings in supply and/or demand, of network topology changes and mismatch between supply and demand. This project will focus on the flexibility that can be provided by electricity and heating/cooling production and distribution technologies and markets to the electricity sector
- **Flexibility services and products:** within electricity system, different services can be identified based on the need to ensure the offer-demand balance across all time scales within given infrastructural constraints. In power systems this leads to a need for particular services, but these can be achieved by different means, and multiple solutions might apply to the same problem. For example, active demand response measures can provide services otherwise provided by power plants. Generally, the way a service is provided, should be "technology agnostic", and could be offered by different sources. These are referred to as products, and usually the most cost effective ones are chosen first.
- **Market design:** electricity markets are regulated and individual actors enter into binding contracts, in order to produce enforceable outcomes based on the interaction among participants. Market design refers to the study of how rules affect the outcomes and more importantly, how given goals can be achieved if there is freedom is designing the rules. [1]

This deliverable describes the foreseen demonstration plan for the TT#2 to be deployed in the LH city Nice and its associated functionalities and use cases (UC). It gives an update of the current status of development and a projection of the work plan, based on the current status of knowledge. To be considered is that the different actions related to the implementation of the IS have different levels of maturity and TRL thus, of advancement in terms of implementation plan or development.

The demonstration activity in Nice under TT#2 focuses on testing different potential business cases related to the deployment of local renewable energy and other emerging technological solutions and associated management system. The latter will have to be capable of forecasting energy production and demand, to optimize under different constrains the underlying connected assets (production, storage and end-uses) in order to achieve an overall performance raise.

Hereby, special attention is paid on the management of self-consumption endeavours via the combination of different energy conversion and storage assets (including EV and stationary BESS – all resulting from IS 1.1 activity) and the valorisation of flexibilities under different operation strategies for relevant flexibility services for the electricity grid, to be integrated in the existing energy markets. An additional layer integrated into this demonstration activity, is the integration of EV charging.

TT#2 demonstration activities for Nice are managed under WP6 and more precisely under T6.4, where EDF is identified as leading partner. As explained in the previous related deliverables, TT#2 is composed by 3 main IS: IS 2.1, 2.2 and 2.3. However, it is closely tight to TT#1 via IS 1.1 and also TT#3, via IS 3.1.

[1] https://www.magnitude-project.eu/

Within TT#2 the IS2.1 – "Flexible electricity grid networks", represents the main resource intensive activity of the TT, as it's where the energy management systems development takes place in regard to the optimization of the electricity grid and mainly led by EDF and its affiliated entities (Linked Third Parties).

IS 2.2 – "Smart multi-sourced low temperature district heating with innovative storage solutions" is the parallel development in regard to the optimization of the district heating and cooling networks (DHCN) currently under construction in the Nice Meridia district and led mainly by MNCA.

IS 2.3 - "Utilizing 2nd life batteries for smart large-scale storage schemes" is a more technology focused solution, aiming at the performance assessment of 2nd life BESS and V2G charging technology integration. This differs from the previous IS which are more focused on the integration and operation of different technologies among different systems and scales. This will mostly be a joint action between IMREDD and EDF.

The current text will be structured around these 3 IS and thus, in all following chapters, all 3 points will be treated in a parallel manner so for each objective, scope, impact, implemented technologies and methods and the associated indicators will be detailed separately. If information given in the previous deliverables is yet valid, it will be indicated and referenced.

As TT#2 is generally aiming at achieving solution up to a TRL up to 8 among the theme of "smart energy management and storage for energy grid flexibility", only bankable business use cases will be retained during the process – this however is less true for IS2.3, where the technical aspects are prioritized. This does not mean that only monetary aspects will lead to the final choice of UC to retain, but that replicability and scalability are considered. This means that also technical, contractual, legal, commercial, and industrial strategy related factors will influence choices to be made. The deliverable being public, it will not be possible to the responsible lead companies to disclose all details of the work due to obvious commercial and industrial secrecy reasons however, it will be ensured that a transparent overall/generic vision of the process is given to the reader.

1.1 Scope, objectives and expected impact

Core activity of TT#2, IS 2.1 bridges local decentralized energy assets, connected via an appropriate energy management system (L/EMS), with the energy market where flexibility services might be valorised via a third-party service provider, the aggregator. Under "energy markets", spot markets are meant, so day ahead (DA) and intraday (ID) market places as TSO level.

The DSO market is not considered, as in France at the time being, no market exists nor a system foreseen in the short-term, which would enable to valorise flexibilities at the DSO level via a third-party service provider (aggregator)[2]. Therefore, the interconnection between the DSO and the L/EMS will not be considered at the time being or if so, for technical use cases only.

[2] The only option would be the Art. 199, Law n° 2015-992 of 17 August 2015, further completed by the Decree n°2016-704 of 30 May 2016 relative to the national « energy transition for green growth », regulating the possibility to offer to a DSO, local flexibility service. However, the project does not aim at applying to such legal

The manner in which the LEMS is managed and coordinated with the global energy market, is the main challenge to be addressed. Not only have local system management strategies be prioritized according to certain services, but also at the market level, flexibility portfolios have to be arranged and prioritized. This means both platforms have to be managed in a synchronized way, communicating in almost real time and ensure to manage each one's objective function correctly. Basically, for enabling this to happen following aspects have to be considered:

- Information shared: type, capacity, volume and temporal availability of flexibility considering technical constrains but also local regulatory or contractual ones (i.e. energy performance contracting and different self-consumption endeavours);
- Communication rules: identification of the type of information to be shared among local energy management systems (L/EMS) and an aggregator platform, defining the content of information to be shared, temporal gates and update frequencies and the solving of conflicts or incompatible orders, so defining order and structure of communication.

This activity advanced considerably since D1.3 and D6.2 and represents the main challenge to be addressed by the demonstration activities. Lead by EDF, the LEMS is implemented via its subsidiary EDF S&F[3] (Linked Third Party to the project), while the market aggregation in implemented via another subsidiary, AGREGIO[4] (Linked Third Party to the project).

IS 2.2 – "Smart multi-sourced low temperature district heating with innovative storage solutions" is the parallel development in regard to the optimization of the district heating and cooling networks. It's led by MNCA as district planner and organising entity of the energy supply, linking the DHCN operator IDEX, and its new subsidiary "Meridia Smart Energy" (MSE)[5], with the IRIS project. A long-term agreement has been concluded in August 2018 and the DHCN implementation and building started in October 2018. This agreement included a smart grid infrastructure and system deployment to optimize and balance thermal and electrical flexibility. Consequently, MSE district control centre will be a data and flexibility provider to the LEM operated in IRIS project. The architecture of the production site will enable to develop a smart operation strategy which will be able to optimize the synergies among heating and cooling production, leaning on innovative storage technologies as for thermal and electric energy, and make an optimal use of the geothermal source.

For IS 2.3 the scope of the work is to characterize the "2nd life" EV batteries used for stationary building related application. Moreover, this is enriched by making a direct parallel between 1st and 2nd life battery energy storage systems (BESS): more precisely, within the IMREDD case study building, a direct link can be made via the management of the recharging of EVs, so of the EV's 1st life BESS and the same type of action on the 2nd life BESS. It is foreseen that the charging station will integrate a V2G charging point, so both charge and discharge of the 1st life EV's BESS is possible. The management of the 2nd life BESS should thus, enable to foresee charge and discharge cycles similar to the EV's ones and make so performances

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framework. At the time being, no official communication is known about of any local public authority or energy stockholder having applied to the procedure.

3 https://www.edf-sf.com/en/

4 http://www.agregio-edf.com/

5 https://reseau-meridia.idex.fr/

comparable. To ease this latter aspect, it has been chosen to limit the size of the 2nd life BESS to its twin in the car.

1.2 Contributions of partners

EDF: coordination of activity related to IS 2.1 and 2.3 and assuring the compatibility with IS 3.1 and IS 1.1 by leading the definition of the use cases to be considered among the different involved actors; document the content and planning of the actions; setting up of contractual arrangements and ensure their timely implementation and compatibility with IRIS; in the upcoming implementation phase it will lead and monitor the process and ensure the advancement toward the set innovation objectives and maximize their impact; coordination of KPI definition to monitor its impact, among all cited IS; support with its know-how and expertise the implementation and achievement of all demonstration activities under TT#2.

EDF S&F: development of the EMS/LEMS in terms of specifications and functionalities towards the specificities of the buildings entailed in IS 1.1; ensure compatibility with the annex energy and communication infrastructures; definition and realization of the SCADA (Supervisory Control And Data Acquisition - in other words the machine user interface) of the EMS; deliver and operate the EMS; adapt and add EMS/LEMS functionalities during the project duration as the technology's maturity level of the system raises; support with its know-how and experience, the definition of meaningful business cases and technological solutions.

AGREGIO : operation of aggregation and market platforms; management of interface with TSO or other spot market operators, concerning the placing of market bids and interfacing with the EMS/LEMS for their activation, implementation and clearing; setting up needed arrangement with TSO to enable the identified assets to participate to the service markets; develop the existing management platform to make it compatible with EMS/LEMS; setting up communication protocols and standards; adapt and add functionalities during the project duration as the technology's maturity level of the solution raises; support with its know-how and experience, the definition of meaningful business cases and technological solutions.

MNCA: coordination and animation of the Nice related demonstrations and ensure global consistency and interfacing with the overall IRIS project, LH and follower cities; coordination of activity related to IS 2.2 and leading the definition of the related UC; document the content and planning of the actions; setting up of needed contractual arrangement to enable the implementation of the defined actions with the involved party(s); support the definition of the use cases concerning IS 3.1 and ease the interfacing with the different involved department of MNCA; support in the definition of the needed contractual arrangements to be put in place.

UNS/IMREDD : coordination of activities related to IS 1.1 (IMREDD building) and ensuring the correct interfacing with TT#2 to ensure the demonstration objectives are achievable; coordination of third parties (engineering consultants and suppliers) involved or concerned by the implementation of the EMS/LEMS; definition of use cases related to IS 2.3 together with EDF; market watch and survey for 2nd life BESS solutions and identification of relevant technologies; coordination and management of procurement and implementation of IS 2.3.

NEXITY : coordination of activities related to IS 1.1 (NEXITY building) and ensuring the correct interfacing with TT#2 to ensure the demonstration objectives are achievable; coordination of third parties (engineering consultants and suppliers) involved or concerned by the implementation of the EMS/LEMS.

CSTB: coordination of activities related to IS 1.1 and ensuring the correct interfacing with TT#2 to ensure the demonstration objectives are achievable; interface and ease exchange with involved parties.

VULOG: refer to D 6.5.

1.3 Relation to other activities

As previously evoked, TT#2 is tightly linked to TT#1 and TT#3 via the link which exists among IS 2.1 with IS 1.1 and IS 3.1. The advancement of 1.1 has to integrate the specifications and ensure the precondition to make IS 2.1 viable and ensure IRIS's objectives are respected. Additional infrastructures and technical requirements have to be planned and integrated into the works done under IS 1.1. Similarly, by developing IS 3.1, it must be ensured that the UC that will be implemented are compatible with the development under IS 2.1.

The monitoring of the systems during operation has to be coherent with IRIS' KPIs specifications, done under WP9.

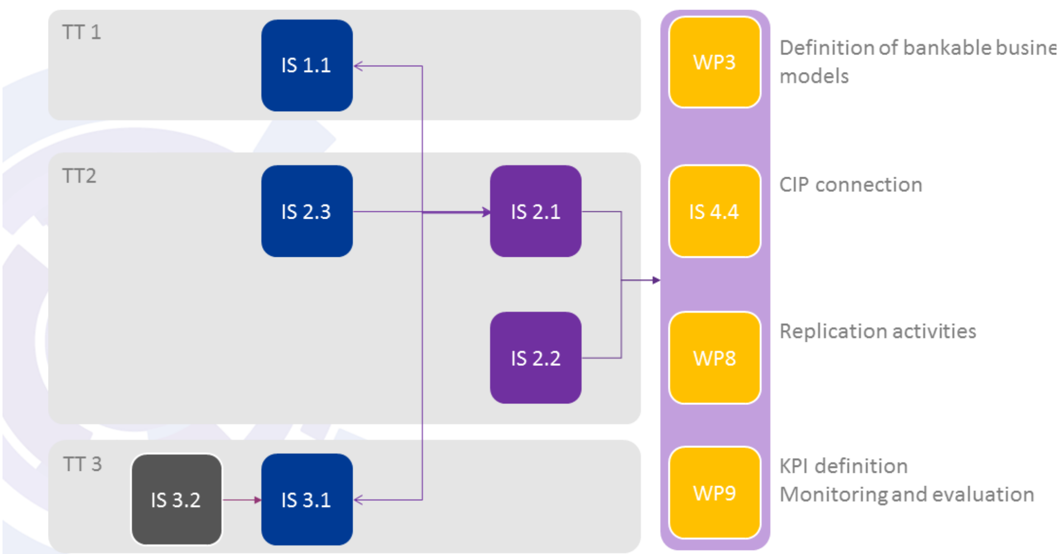

Figure 1 : Structuring among WPs, TTs and IS connected directly or indirectly to TT#2. The direction of the arrows shows the hierarchical relation among the different IS in case having only an ending arrow and a direct cooperation in case having both starting and ending arrows (source: EDF)

1.4 Structure of the deliverable

In the following paragraphs, the adopted methodology is exposed, the existing baseline discussed, the integration of demonstration activities and related implemented organization described as by current state of knowledge, the current planning of the demonstration activity detailed and explained and finally an overview is given about the adopted KPIs and their monitoring.

The document is closed by giving first conclusions evinced from the so far done work. All such themes are detailed by IS when justified. For the description of the IS and the related work, the "Use Case" methodology has been used, as usual mean to describe Smart Grid relevant activity (see SGAM – Smart Grid Architecture Model)[6]. This has been adopted at a simplified level, in order to give to a non-specialist audience the chance to follow the discourse. For coherency with the other LH cities, the "demonstration" and "measure" structures have been maintained, so IS represent Demonstrations and the underlying UC are the distinct measures that will be put in place.

[6] https://ec.europa.eu/energy/sites/ener/files/documents/xpert_group1_reference_architecture.pdf

2 Demonstration in a nutshell

2.1 Ambitions for TT#2

The main aim of the TT#2 is already outlined in D1.3, in the section concerning the demonstration section. Stated aims are yet valid while have to be updated with the details provided by chapter 2.3 below. To resume, here the citation of what stated in the Description of Action (DoA) of the Grand Agreement and which gives a glimpse of how TT#1 and TT#3 are interwoven by TT#2:

"[…] NCA's ambition is to demonstrate, how the increase in decentralised renewable energy production, resulting in a two-way energy flow, can be a paradigm shift for existing grids which hardly can effectively accommodate the integration of various energy streams. NCA pilot will demonstrate a new concept called LEM (Local Energy Management) that understands and allows the effective management of the core issues of interwoven and interdependent energy sub-networks and sub-systems of sustainable district/city smart grid environments, and introduce a system-based approach and business concept considering new requirements from DSOs on the one hand and district energy users on the other. In Nice Meridia, the LEM will leverage on smart grid technologies already existing in that area (e.g. roof-top solar PV, battery storage systems, plug-in electric vehicles, power intensive load, smart appliances and advanced metering infrastructure) to optimize at a large-scale area

a) the energy consumption and energy bill reduction, reached through customers' coaching and deployment of efficient solutions,

b) the implementation and management of self-consumption measures at building and district scales,

c) the selling of the non-self-consumed PV energy,

d) the management of electric vehicle charging ports, including peak shaving for distribution grids management,

e) the deployment of a strategy to aggregate flexibilities, up- or downwards, to be valued on energy markets or through DSOs to release grid constraints and

f) energy storage management.

The selected NCA's elements include stationary storage systems in buildings and smart multi LEMs addressing the electricity self-consumption and flexibility local management for the different Solutions of "PV to pump" or "PV to car" or "PV to smart building" and "PV to storage". […]"

2.2 Demonstration area

As by D1.3 the demonstration area was yet to be clearly defined, the choice has now been narrowed down to the Destination Meridia neighbourhood in Nice. The main demonstration will thus focus on the buildings from IS 1.1: the new Palazzo Meridia of NEXITY and the new IMREDD building of UNS/IMREDD. Below a rendered 3D overview is given about those building and of their integration with neighbouring existing and planned buildings (Figure 3 and Figure 4).

IS 2.1 also integrates IS 3.1 for the flexibility from Smart Charging and for this specific IS, the perimeter is wider, including Nice Meridia and Grand Arenas districts, and will potentially be extended over all Nice Metropolitan Area.

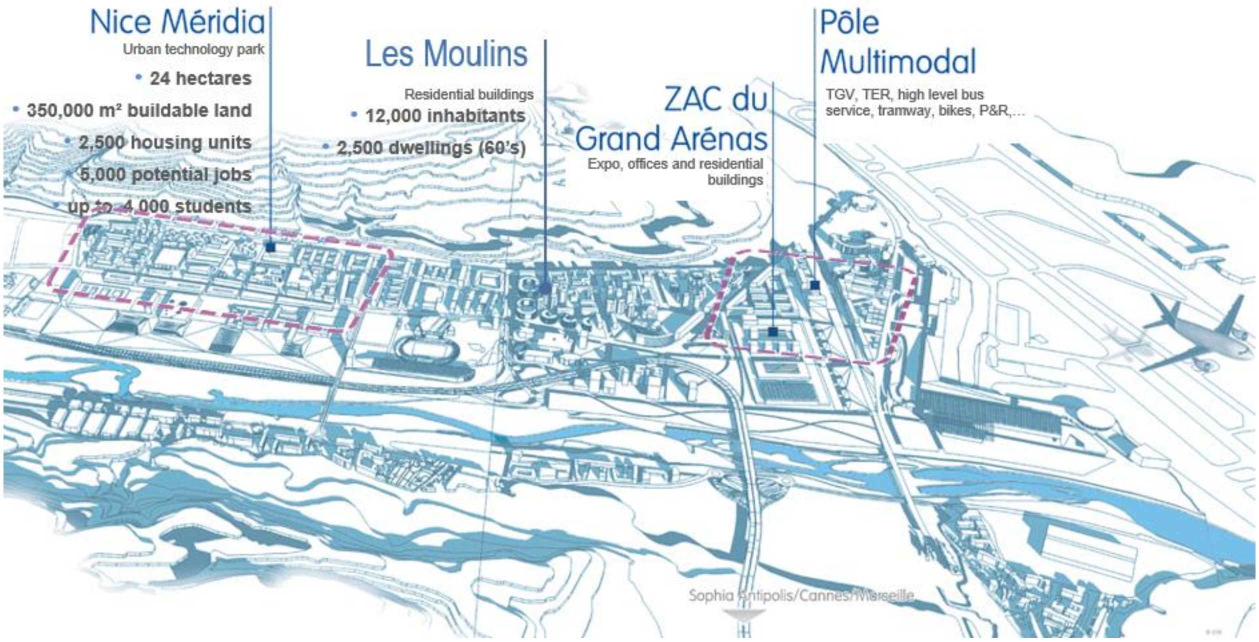

Figure 2 : Overview of the demonstration districts of Nice. IS 2.1 will concentrate on Nice Meridia District, while for integration with IS 3.1, Grand Arenas will also be considered (source: MNCA - modifications by EDF)

Figure 3 : rendering of the urban development in Nice Meridia District after 2023 – localisation and contextualisation of the IMREDD and NEXITY case study buildings (source: UNS/IMREDD - modifications by EDF)

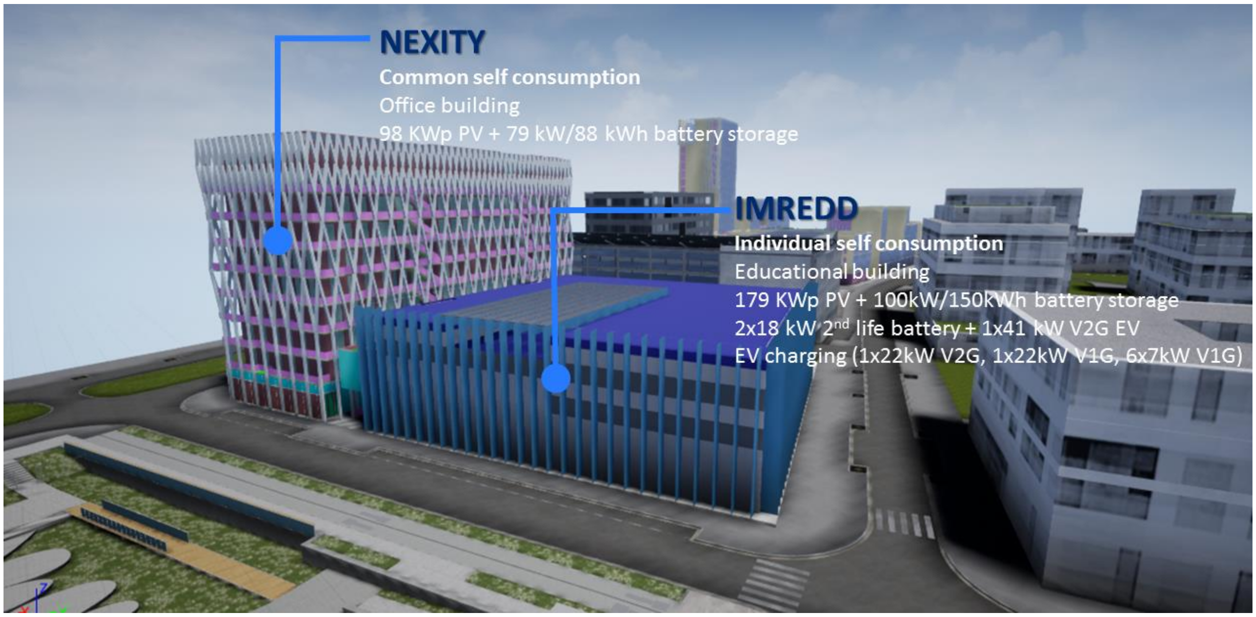

Figure 4 : rendering of the IMREDD and NEXITY case study buildings with relevant technical details (source: UNS/IMREDD - modifications by EDF)

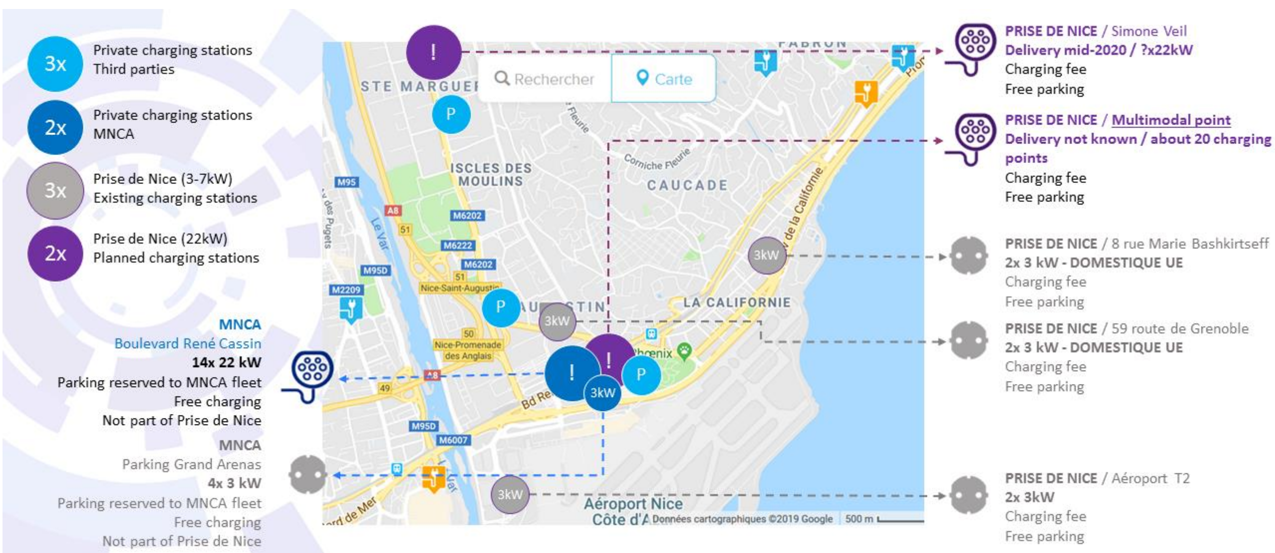

Figure 5 : IS 3.1 - localisation of existing and planned charging stations (source: https://fr.chargemap.com/map; https://www.prisedenice.fr/portal/#/ - modifications by EDF)

The perimeter for IS 2.3 is clearly the IMREDD building, which will see the first and only 2nd life BESS among Nice Metropolitan area.

Whilst the perimeter of IS 2.2 is clearly identified by the Public Delegation of Service (PDS) contract and shown below (Figure 6). Thus, a first perimeter is ensured by the connection obligation for new real estate projects or refurbishment related ones. Nevertheless, the operator can through his commercial activity enlarge the distribution perimeter towards additional neighbouring clients.

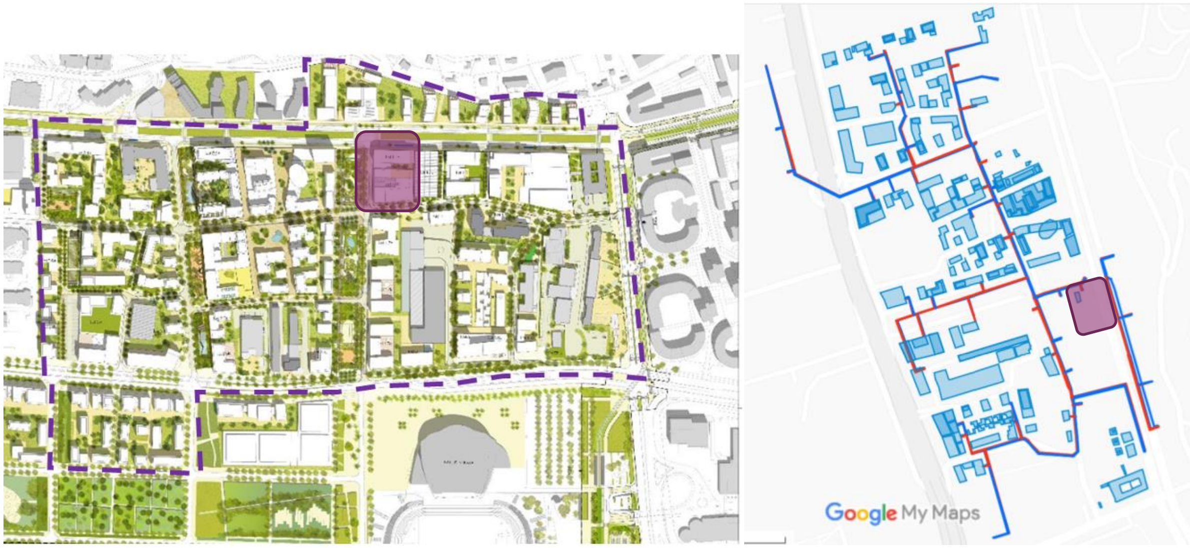

Figure 6 : left - in violet, the perimeter of the DHCN operation under the PDS contract – IMREDD and NEXITY buildings are highlighted under the red rectangle in the centre upper area (Source: EPA Plain du Var, addition by EDF); Right - planned DHCN layout and overlay of existing buildings (source: https://www.google.com/maps/d/viewer?mid=1TkVPt5Z4ZgCFmPZZu81-RcsMxyv98VwH&ll=43.680735227580634%2C7.2003187737274175&z=16)

The network construction works for the new DHCN will span all over from 2018 to 2029, according to the new district growth.

2018	2019-2020	2021-2022	2023-2024	2025-2026	2027-2028	> 2029
69 444 m²	106 097 m²	246 236 m²	304 131 m²	356 656 m²	447 284 m²	516 208 m²
	0,8	0,8	1,6	1,6	1,6	1,6
	2	3,2	3,4	4,3	5	5,7

Figure 7 : visualization and listing of Nice Meridia's mid-term planned connection phases. The extension of the constructed surface is highlighted in the coloured boxes (in square m² per period) and below the corresponding network length listed, divided in geothermal (line 2 in km per period) and hot/cold water (line 3 in km per period) pipelines (source: MN CA).

2.3 Integrated Solutions in TT#2

In brief, the demonstration activities are structured along the 3 underlying IS: IS 2.1, 2.2 and 2.3. Each is then split into "measures" or "use cases" (UC) in the follow up chapters, so to define single identifiable demonstrations activities.

2.3.1 IS 2.1 - Flexible electricity grid networks (PV // batteries // lighting network)

In the first place, the ambition to be satisfied with the deployment of the EMS under IS 2.1, is to ensure a system capable of optimising the economic benefit for self-consumption endeavours. This ensures the individual buildings and their regulated contracts as by French law and further other constrains (like Energy Performance Contracting (EPC) with subcontractors or service providers) are considered, constrains respected and revenues maximised. This EMS will then be left in place after the project duration and will ensure the long-lasting impact on the operation of the buildings (at least 10 years are the contract duration for the feed in tariffs from with the Regulator for self-consumption endeavours). This aspect is formalised by a "property transfer contract".

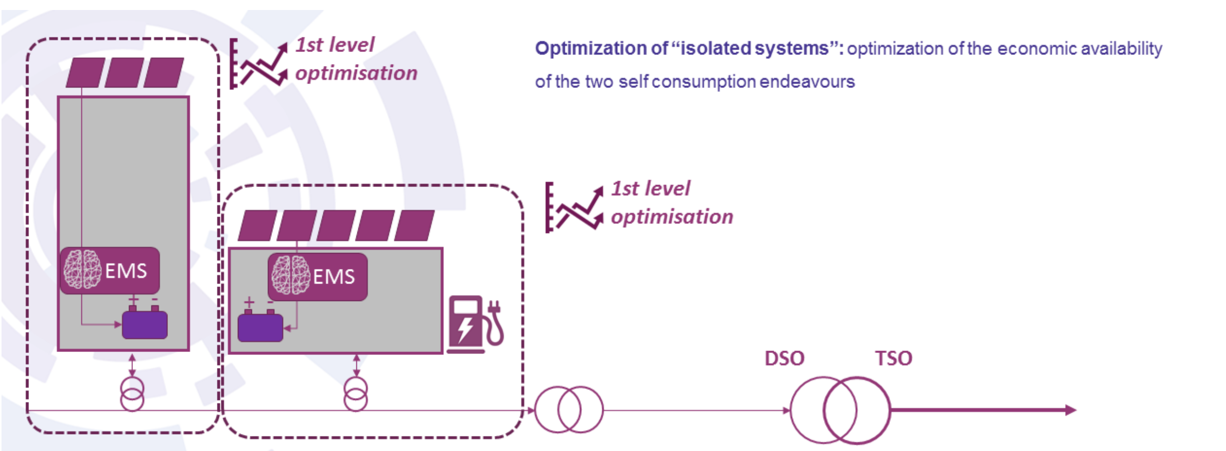

Figure 8: first level optimisation: the EMS ensures to fulfil all constrains imposed to each and every building (source: EDF).

In a second step, the EMS will be opened towards the energy markets via an aggregator and thus, enable to provide, in addition to its core functionalities, grid services to be traded on the market.

It has to be clarified here that no DSO services are foreseen to be provided under TT#2. This is due to the fact that at the time being no DSO market exists, nor is it foreseen to be created in the short-term following publicly accessible information. Thus, it is highly improbable to have any concrete business use case for DSO level flexibility activation needs in the near future, which could provide any revenue stream for the end users or just to justify a TRL 8-9 development.

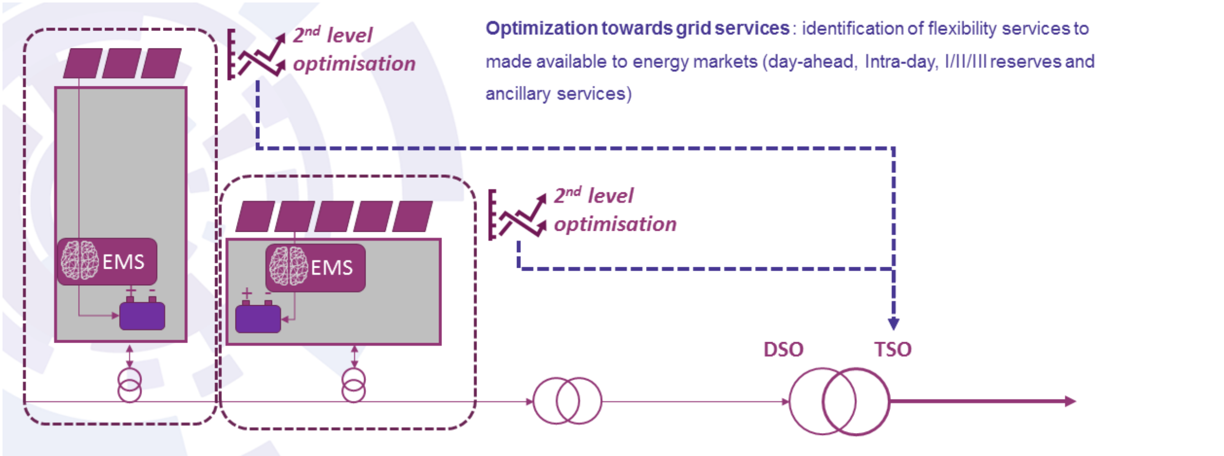

Figure 9 : second level optimisation: the EMS enables to communicate with an aggregator platform and provide flexibility services to the grid (TSO level) (source: EDF)

In a final step, the individual EMSs are enabled to communicate among them and further EMSs are emulated by using historical data. Through this exercise, it will be explored if any synergy can be found that would enable to provide any additional profitability or service quality of the local energy management system under current regulation and market conditions. So, the realization and demonstration of this latter step is dependent on the bankability of the previous UC.

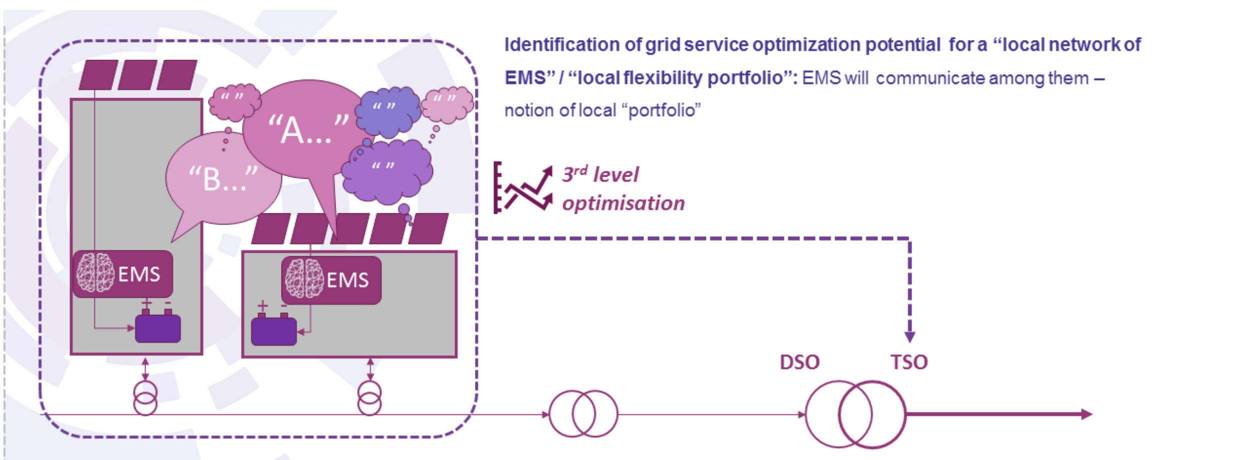

Figure 10 : third level optimisation: it is explored in how far, a local portfolio of assets could ameliorate the flexibility availability for the energy markets, as by integrating higher level optimization constrains and strategies, compared to the individual, distributed, optimization (source: EDF).

At the time being the macro UC are stabilized, so they provide more visibility on roles and responsibilities among involved parties. Their detailing in sub-UC as presented in chapter 5, are important for nourishing the contractual arrangements which have be foreseen to enable the demonstration activity. More specifically, it is foreseen to integrate those elements into an "experimentation contract" to be signed among all directly involved partners and third parties for each of the IS and related UC. This concerns IS 2.1 and 2.3 and partially IS 3.1. For the time being, an exclusivity contract has been signed with NEXITY and other involved parties for the procurement and delivery of the EMS via EDF S&F on NEXITY's buildings. All other contractual arrangements are in the starting blocks as the exact definition of their contents, objectives and each party's role is almost achieved.

What could be stated in addition to what already reported via the previous deliverables, a main ambition for IS 2.1 is also to identify if, a yet not viable business case represented by the integration of BESS for self-consumption maximisation, can be made viable via grid service provision to the grid. In other word, proof under which conditions, grid services can justify the integration of BESS in buildings by adding a revenue flow coming from the energy markets, capable of providing an acceptable IRR (Internal Rate of Return) or ROI (Return of Investment).

2.3.2 IS 2.2 - Smart multi-sourced low temperature district heating with innovative storage solutions (excess heat from buildings equipment // heat pumps // thermal storage // decision and citizens apps)

The DHCN demonstration aims at assessing the potential convergence of operational strategies for integrating the management of heating, cooling and power at district scale, thanks to the supervision system to be deployed by MSE.

In a first step, via the integration of Artificial Intelligence (AI) algorithms, the multi energy supervision algorithms can be trained on a first pool of customers, towards optimizing the thermal production and the network's hydraulic balance. Pumps and operating system (Heat Pumps – HP) are electrical grid clients and consumers. Consequently, they could provide by themselves flexibility to be integrated into the MSE supervision system.

Under the demonstration, it is aimed to further achieve the provision of energy performance service by implementing into the AI platform, energy management optimization driven strategies at building level, optimizing the control of local storage and demand/response. The MSE platform, by aggregating flexibility from DHCN operating system and flexibility from DHCN clients, could provide a pre-aggregation toward the LEMS implemented at district scale under IRIS and thus, complete the assessment of a feasibility of a LEMS.

In a second step, the complexity of the operation of MSE supervision will increase by the integration of energy storage. The site could provide 3 types of storage opportunities:

1) Centralised ice-storage: by storing cooling energy under the form of ice, the storage could be operated in a peak-shaving mode, so charging at low demand period as at nigh time and discharge the stored energy during peak hours.
2) Centralized BESS: a 86kWh BESS is planned to be installed at the production site, to provide electrical energy services to the building.
3) Distributed heat storage:
    a) SETI (Smart Thermal Energy Storage): the system is conceived as a thermal storage located at building substation level, at the interface between the primary DHCN and a building's secondary network. Heat will be stored by phase change material PCM). The system is an experimental product from CEA Liten[7].

[7] http://www.cea.fr/english;

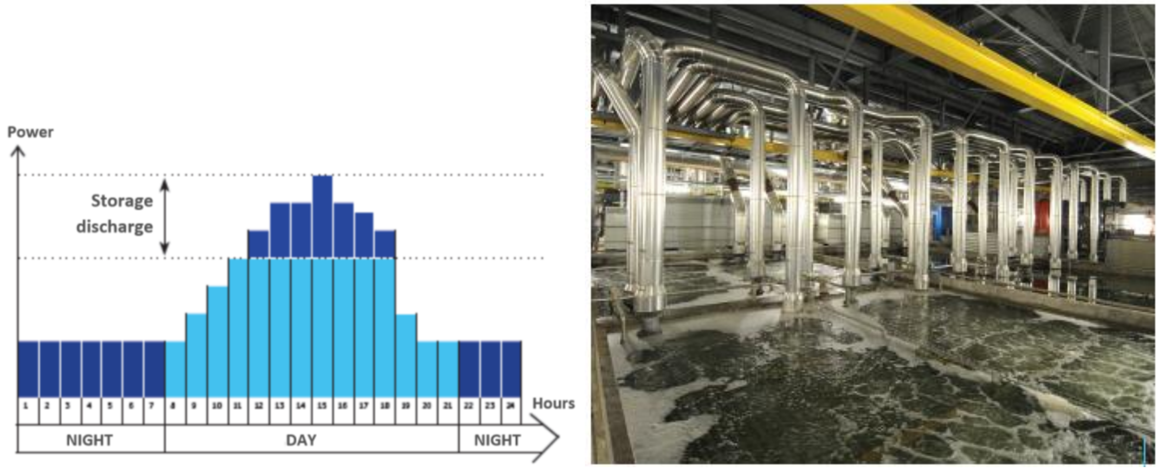

Figure 11 : left - cooling load curve at production site level. In dark blue: period of ice storage operation (charge and discharge); in light blue: cooling demand provided by the installed production means (source: MNCA); right - reference project on ice-storage – ice storage pool as in the DHCN “La Defense”, Paris, also operated by IDEX (source: MNCA)

Figure 12 : SETI prototype storage system visualisation (source: http://liten.cea.fr/cea-tech/liten/Documents/2108-9348%20LITEN%20CEA%20RA%202016%20FR.pdf)

2.3.3 IS 2.3 - Utilizing 2nd life batteries for smart large-scale storage schemes (PV // EVs // V2G)

As stated before, the aim has been enlarged from D2.3, opening to the scope towards the cross-comparison of the use of 1st and 2nd life BESS for similar applications within the building sector. It is aimed at providing additional, new knowledge to the ongoing debate about the characterisation of “the 2nd life” of BESS. In other words, both batteries (in the EV via a V2G charging pole and the 2nd life BESS stack) will be used for providing stationary BESS based energy services within the IMREDD building. By using similar BESS capacities, performances and their temporal behaviour will be more easily made comparable.

IS 2.3 will provide a new insight in how 1st life usage impacts the 2nd life performances but also, if such models are not potentially concurring one against the other: from a business perspective, if the EV integrated BESS can be used in a similar way than the 2nd life BESS and this, with similar costs and performances, the services could become redundant and thus, mutually exclusive. This might impact the way industry is looking at this market today and influence or channel decisions towards the recycling and reuse strategies of 2nd life BESS.

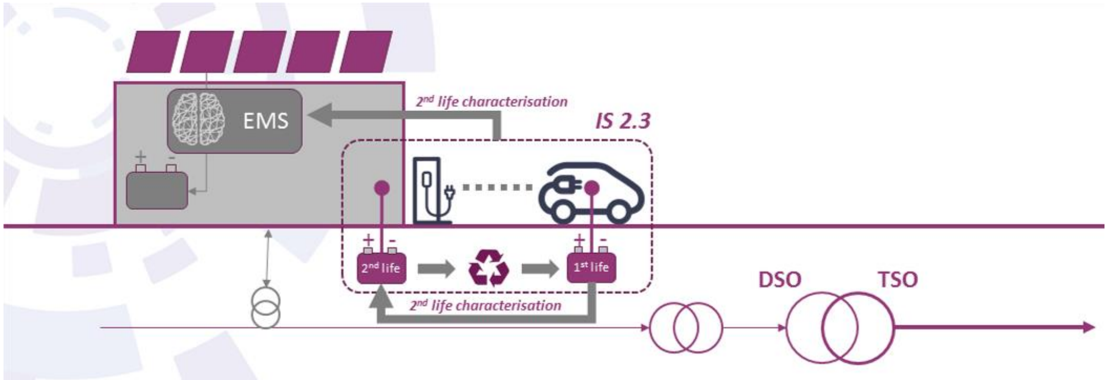

Figure 13 : schematic representation of the experimentation principle of IS 2.3 (source: EDF – UNS/ IMREDD)

2.4 Integration of Demonstrators

The coordination of the activities of TT#2 are, as explained before in chapter 1, done in a way that IS 2.1 can relate directly with IS 1.1 and 3.1.

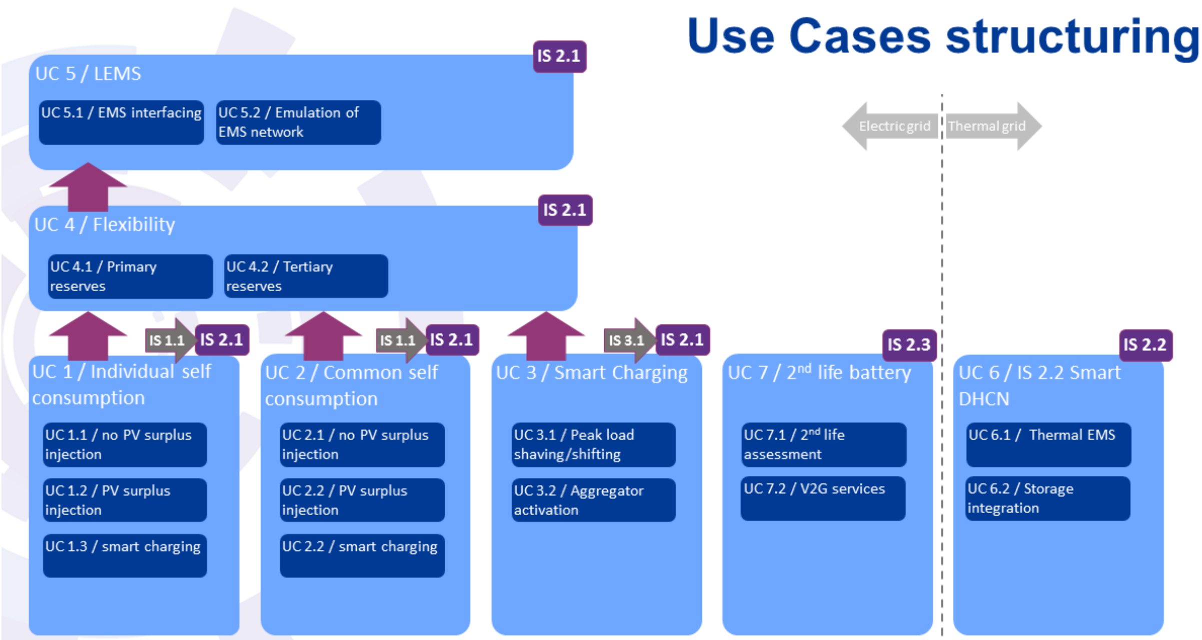

Figure 14 : schematisation of the relation and hierarchies among the chosen Use Cases and sub Use Cases. The scheme specifies also the original or relation of UC with other TTs or ISs (source: EDF)

The scheme above, gives a schematic vision of the confluence of the different single actions or measures, towards the overall objectives of TT#2. The core demonstration of IS 2.1 is so composed by a multi layered and increasingly complex (in terms of functionalities and objective functions) management system. Demonstration of IS 2.1 is so composed of UC 1/2/3/4/5. IS 2.2 is represented by the UC 6 and IS 2.3 by UC 7.

The structuring in "Use Cases", is adopted in order to reduce the overall complexity of such multi-scale and multi-actor type of action by applying hierarchies, priorities and temporal sequence, as typical within the Smart Grid sector. To describe and clarify the demonstration mostly concerning IS 2.1, the SGAM (Smart Grid Architecture Model) methodology has been applied[8]. This enables to have a coherent description of such UC which should be comparable of other private or publicly funded Smart Grid projects in the EU (but not only). It provides a common standardization framework by providing a complete toolset to ensure a complete and coherent documentation of Smart Grid related actions. Here it is used in it most aggregated terms and use, working on general "business use cases" (the UC#X as above) and one level of sub-UC (UC#X.X as above), avoiding to go to deep into the technical description and implementation of one step approach and component use cases. It is estimated that this would add a level of detail which would make it very extensive and inaccessible to non-experts of the sector. Nevertheless, by applying the documentation methodology from SGAM, the concrete actions to be implemented can be described and detailed and give also an insight in their functional and temporal articulation and integration.

To ensure a correct articulation of the different actions, during this first project period, priority has been set on assuring the coherency between IS 2.1 and its directly related IS 1.1 and 3.1. It is important to ensure infrastructure in 1.1 is made compatible with the EMS to be developed and moreover, the needed cooperation activities and related contractual arrangements are put in place. Therefore, a tight collaboration, followed by co-located meetings have been set up among TT#1 (lead by CSTB) and TT#2 (lead by EDF). This to ensure decisions and related planning are coherent among TTs as well as all involved parties aligned among the scope of the work (also third parties). EDF has thus ensured the close exchange with and between CSTB, NEXITY, IMREDD, EDF S&F, AGREGIO, MNCA and further third parties related to the work (as for e.g. DALKIA, BG21 or RENAULT to cite a few).

At present, IS 1.1 and 3.1 are developed in priority, as to ensure the consistency with the work planned in IS 2.1: EDF has taken the lead on IS 3.1, considering the established context (detailed explanation about this in D6.5). Flexibilities coming from both IS 2.1 and 3.1, should be integrated under the same aggregation platform and ensure consistency in how these flexibilities are activated and valorised. Only by doing so, consistency can be given for the assessment of the feasibility of a LEMS (Local Energy Management System). Therefore, EDF has launched recently the dialogue with and between IZIVIA (EDF subsidiary – see D6.5), AGREGIO, VULOG and MNCA (transport and sustainable mobility department; building department). The work plan is currently defined, and the contractual implications evaluated.

IS 2.2 is led by MNCA, due to its role as delegating party of the public service contract with IDEX[9] and owner of the Nice Meridia DHCN to be deployed under this IS. IDEX has locally set up a special purpose vehicle (SPV) for the contract under the name "Meridia Smart Services". MNCA has taken charge of coordinating the interfaces with IDEX and TT#2 and providing planning and reporting of the IS.

IS 2.3, principally led by IMREDD, prioritized the activity on screening the current market status by enquiring directly the related industrial players, defining so the bases to develop a consistent

[8] For more information about this well documented method, please consult the following links and provided references: https://www.cencenelec.eu/standards/Sectorsold/SustainableEnergy/SmartGrids/Pages/default.aspx; https://sgam-toolbox.org/

[9] IDEX : third largest DHCN operator and energy service company in France. IDEX has been appointed since 27/06/2018 as the winner of the public call for tender for the Public Delegation of Service of the future geothermal sourced DHCN of Destination Meridia. For this purpose an SPV has been put in place under the name: "Meridia Smart Services". In the following text, the name IDEX will be used to identify any of the two companies.

demonstration plan. Together with EDF and their R&D departments, IMREDD is currently putting their efforts on consolidating the respective return of experience, in order to present a consistent and meaningful development plan. The work done by IMREDD has actually led to significant improvements on the topic as explained in the following section.

2.5 Deviations according to the Grant Agreement

For what concerns possible impact on stated indicators and objectives related to TT#2 as installed or connected assets and KPIs, no statement can be given about possible deviations at the present date. This is due to the very early implementation stage of the demonstration activity. Surely some indicator will be challenging to be achieved nevertheless, still 3 years of developments are at hand for the LH Nice and its territory to achieve the stated aims.

The main deviation from the Grant Agreement concerning IS 2.1 are the followings:

- Integration of Linked Third Parties to EDF: EDF S&F, AGREGIO and IZIVIA. This is all related to the fact that since 2019 the company has consolidated under the brand “EDF Local Energy Management” such activities and are not anymore hosted in the R&D departments or under a direct departments or directions of EDF. This restructuration has forced to integrate these companies into the GA. This has to be seen as an enrichment to the project, as the solutions to be implemented will reach higher TRL as the business implications of the deployed UC and involved parties are nearer to market. In consequence, impact and replication should so be enriched.
- For what concerns IS 1.1 and IS 3.1, related changes are reported in D6.3 and D6.5 respectively.

The main deviation from the Grant Agreement concerning IS 2.2 are the followings:

- Attribution of the PDS for the DHCN to a third-party company IDEX (for more information please see above) and which will realize and operate the DHCN under the SPV “Meridia Smart Services”, regulated by the PDS contact among the 2 parties. So, the integrated DHCN is not operated by a partner of the consortium, yet owned by MNCA. The latter will make the coordination and interfacing of the IS related activity.

The main deviation from the Grant Agreement concerning IS 2.3 are the followings:

- The aims stated in the DoA are yet valid however, enriched by the integration of the V2G EV and related charging pole. The resulting chance to provide an assessment of the cross comparison of the 2 technologies (2^{nd} life BESS and V2G technology), is believed to provide an enrichment for the project itself and consistency with the other LH cities. In addition, it is considered as a major contribution to the ongoing debate on 2^{nd} life BESS and V2G among the scientific and industrial communities. This can be considered as enriching the impact of the IS.

3 Baseline / Drivers and Barriers

3.1 Baseline

3.1.1 Baseline IS 2.1

The baseline for TT#2 is in principle the status quo of today's French infrastructure management practice and limited by current regulation: self-consumption endeavours although representing about 40% of all new PV connection in 2018[10], are within the tertiary sector not deployed in combination with BESS. The latter is due to the fact that under current business model, the Net Present Value (NPV) of such assets is negative and ROI not ensured. The business model should so be enlarged to other service, as flexibility services for the grid, to valorise such assets and possibly provide a combined, positive NPV[11]. More detail is provided in the "problem statement" section for each UC in chapter 5.

The deployment of private and public EV Charging Infrastructure (EVCI) is usually deployed in combination with static operation systems, which do not enable to have dynamic charge plans for optimizing peak shaving and shifting. It has to be demonstrated that such technological upgrade has an economic benefit. More detail is provided in the "problem statement" section for IS 3.1 as in D6.5.

Moreover, currently, the introduction of decentralized generation means into the energy spot markets is very limited in France. The full potential of the sector is far from being targeted as the market is yet in its early stage of development. Therefore, it could be stated that the baseline is the "non-usage" of such assets for providing flexibility to energy markets. Moreover, the commercial operation of a LEMS or any comparable systems is not given in the French territory. More details are provided under chapter 5.1.4 and 5.1.5.

3.1.2 Baseline IS 2.2

The baseline for this solution is clearly the actual *status-quo* of the most common deployed energy systems among the Mediterranean region: decentralized gas boilers for space heating and SHW (Sanitary Hot Water) and decentralized electric chillers and cooling tower for space cooling. This is actually the current baseline which is used to assess the performances of such systems in the public tendering processes related to PDS for DHCN in France.

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[10] 2016: 40% of all new connection request where done under the self-consumption regulation; 33 000 self-consumption endeavours have been connected to the distribution grid, totalling 146 MW in France, by September 2018; in 2018, 90% of all new connexion request of PV systems below 36 kVA are done under the self-consumption regulation. Source: https://www.enedis.fr/sites/default/files/field/documents/CP_autoconsommation_le_mix.pdf

[11] Results from the BESS sizing assessment and EMS development work done under IRIS by EDF and in collaboration with IMREDD.

Nevertheless, it could be referenced against a next best solution, so the actual deployed DHCN in the territory: this is represented by 2nd generation networks based on high temperature water from gas boilers, CHP plants or incineration plants. However, such is rather an exceptional reference in the French DHCN service sector.

In both cases, the DHCN deployed under IS 2.2 will have to provide the proof that such systems are not only more performing in terms of environmental benefits but also economically more interesting for the end users. It is believed, that the replication of such pilot projects will further promote the acceptance of such renewable energy solutions and accelerate replication among the Mediterranean region in the mid- to long-term. More detail is provided in the "problem statement" section in chapter 5.2.1.

3.1.3 Baseline IS 2.3

The baseline for IS 2.3 is actually "new Li-Ion stationary battery storage", as deployed under IS 1.1. The experimentation has to proof to what degree, 2nd life BESS and/or V2G technology in relation to EV, are able to provide similar services in a costs competitive manner.

Seen the early development stage of their related markets, the experimentation will most probably give an insight on how much improvement has to be achieved, for making them competitive more than proving their actual competitiveness. More detail is provided in the "problem statement" section in Chapter 5.3.1

3.2 Drivers and Barriers

3.2.1 Technology

Drivers:

- Maturity level of the different hardware and software related components for the setup of the ICT infrastructure, to monitor and control the different assets related to the demonstration activity. It can be stated as being in overall, manly constituted by market "mature" technologies.

Barriers:

- The current variety (and still emerging) protocols and standards is yet, for most part, not homogenized or standardized (yet mixed among property- and open-solutions), making the interfacing of different management or supervision platforms and the related underlying infrastructure, very challenging. In such increasingly complex management systems, so multi-level and multi-actor type of automation projects, the harmonisation of the different technological bricks (being hardware or software) represents yet the biggest technological challenge.

3.2.2 Law and regulation

Drivers:

- "Clean Energy for all Europeans Package 2019/EU" and related "National Energy and Climate Plans" (NECPs) for 2021-2030 and "Renewable energy directive 2018/2001/EU" and the related

current EU driven energy market reform. For France these are implemented via the regulator (CRE – Commission for energy regulation) and the TSO (RTE – French Electric Transmission System operator) and DSO (ENEDIS) and their related markets and grid codes.
- French law n° 2015-992 of 17 august 2015, "Energy Transition Law for a Green Growth"[12] promoting decentralized and RES systems by imposing strong mid-term objectives for energy efficiency, carbon reduction and RES share.
- The related "Heating fund"[13] promoting via the ADEME (French Environment & Energy Management Agency) the deployment of RES and the decarbonisation of the DHCN sector.
- Specifically, the French Law n° 2017-227 of 24 February 2107, set the ground for the self-consumption regulation followed by different financial policies supporting the development of the model.

Barriers:

- V2G activities are not allowed when located directly on the Public Distribution Grid (PDG) – only allowed "behind the meter" (so, behind private property and as defined by French grid code). This hinders the proliferation of such technology on public space and thus, their adoption in the related French public or private driven e-mobility services.
- Regulation on BESS is yet not contemplating in a detailed manner the norms and regulations for decentralized, building integrated systems. This hinders the integration of standardized solutions and the adoption of this technology by concerned actors on the value chain (from manufacturing to operation).
- The current grid transport and distribution taxes are not very favourable in terms of fix grid connection fee (so the subscribed maximal power): the energy bill reduction that can be achieved by simple peak shaving and/or shifting for reducing fix subscription costs, have very little impact on a tertiary client's bill.
- French Law n° 2017-227 of 24 February 2107, regulating both individual and collective self-consumption projects, is yet little developed for what concerns common self-consumption. The given market design limits the connection to Low Voltage (LV) level installations and behind a 360 kVA public distribution station. Additionally, the current feed in tariff regulation is yet not very competitive. This makes them less attractive to the industry.
- Art. 199, Law n° 2015-992 of 17 August 2015, completed by the Decree n°2016-704 of 30 May 2016 relative to the national « Energy Transition Law for Green Growth », regulates the possibility to offer to a DSO, local flexibility service. However, the current regulation makes the project eligible only if it can be demonstrated that electricity grid investment can be avoided (not displaced or postponed) and the max retribution level of such service is bounded to the demonstrated avoided investments. This is yet hardly achievable among the current market conditions and related market design.
- Energy market design: current market regulation on energy reserves as regulated by CRE and operated by RTE, does only enable production-consumption sites (pro-sumers) to participate to

[12] https://www.ecologique-solidaire.gouv.fr/loi-transition-energetique-croissance-verte
[13] https://www.ademe.fr/expertises/energies-renouvelables-enr-production-reseaux-stockage/passer-a-laction/produire-chaleur/fonds-chaleur-bref

the primary and tertiary reserve markets. Those are excluded from participating to the secondary reserves, limited to production sites. Moreover, the overall minimal bid size of 1MW for those energy reserve services is yet hindering smaller players and assets to participate in the market and thus, achieve higher market liquidity.

3.2.3 Society

Drivers:

- Studies show that in principle, projects implying sharing among neighbours of RES, should face a relatively high interest in current society, with a higher bias towards younger working class generations.[14] This shows a good potential acceptance of decentralized RES and potential energy sharing mechanisms, being achieved via thermal or electric grids.

Barriers:

- Same studies show that society has different expectations towards their urban living environment: “smart” and “hyper-connected” city models are at the bottom of the ranking compared to the most accepted city models of the “green” and “renewable based” city model.[15] In other words, citizens seem to prefer to live in a “village like” green environment more that in hyper-dense and -connected city areas. This means that the technological and connectivity based aspects of solutions coming from advanced management system have a low associated value proposition for the wider public, and might thus have to be made less visible to the end users.

3.2.4 Finance

Drivers:

- Most elements related to financials tool favouring the proposed demonstrations are cited under the legal section, as related to law and regulation.
- The visibility on long term energy pricing as via EPC (Energy Performance Contracting) is believed to be a driver for the proposed energy management demonstrations as under IS 2.1.
- The potential market for decentralized flexibility assets that can be integrated into the energy market via direct contracts or aggregators, is yet barely exploited. This is surely a driver to increase investment in the sector.
- The pricing stability that DHCN can provide, have important societal and financial implications. By definition geothermal, waste heat and thalasso (sea water) based sources have no intrinsic price for the energy source and can reach up to 70% of the total energy delivered to customers. This means, only 30% of the supplied energy is sensible to pricing increase (more precisely via the electricity price, related to the operation of the auxiliaries and HP). This gives a long term stability

[14] https://lobsoco.com/lobservatoire-des-usages-emergents-de-la-ville/
[15] https://lobsoco.com/lobservatoire-des-usages-emergents-de-la-ville/

and visibility of the heating/cooling bill to end users, ensuring very low long-term pricing fluctuations.

Barriers:

- The bankability of the proposed business cases concerning IS 2.1, has yet to be proven. It is possible that environmental related aspect are yet the main driver of such pilot solutions. The development costs of management systems, of engineering, system integration and the additional costs for the needed metering and control infrastructure, are yet difficult to be counterbalanced by a direct financial benefit. The customer promise is consequently yet difficult to be clearly evaluated, and gains are not ensured for all involved parties.
- These services do also in principle multiply involved parties and thus, also the resulting contractual and financial arrangements. This is not well perceived by potential clients. Additional service provision should thus be achieved without the multiplications of interfaces and stakeholders a client has to face. Standardized offers are however not yet viable and clients have yet to face a rather disorganized market. This is yet a major barrier to the commercialization and financial viability of such services. Even more dissuasive is yet the uneven distribution of costs, as the real estate company and constructors have to bear most of the costs, before being transferred to end users.
- In the case of DHCN, the long stability and visibility of the energy retail price, is counterbalanced by higher investment costs, compared to traditional solutions. This is not only reflected in the overall project costs, but also in the fixed connection cost that end-users have to bear for the heating/cooling provision. The direct financial value proposition is so not always compatible with the perception and expectation of clients and end-users alike.

3.2.5 Environment

Drivers:

- Energy efficiency improvement, carbon footprint reduction and adoption of RES are surely the main drivers for the current regulations and reforms as cited in the “Law and regulation” section above.
- Similarly, environmental impact reduction via a more sustainable development model are a concern for the modern urban population.
- However, no direct, local environmental driver can be identified for this demonstration activity.

Barriers:

- European and national regulations have already made big improvements towards the promotion of RES and low carbon solution. However, an overall strong signal is missing: the relatively low carbon tax and other tradeable related carbon bonds are still not effective to generate any direct market impact. This does not stimulate an uptake of low carbon technological solutions and reduce the environmental footprint of the energy system at the local level.
- Nevertheless, no specific regional/local environmental barriers can be identified.

4 Organisation of work

The roles and responsibilities of each involved party has already been described in section 1.2. However is additions to this, the following third party entities have to be considered, as schematised in Figure 15.

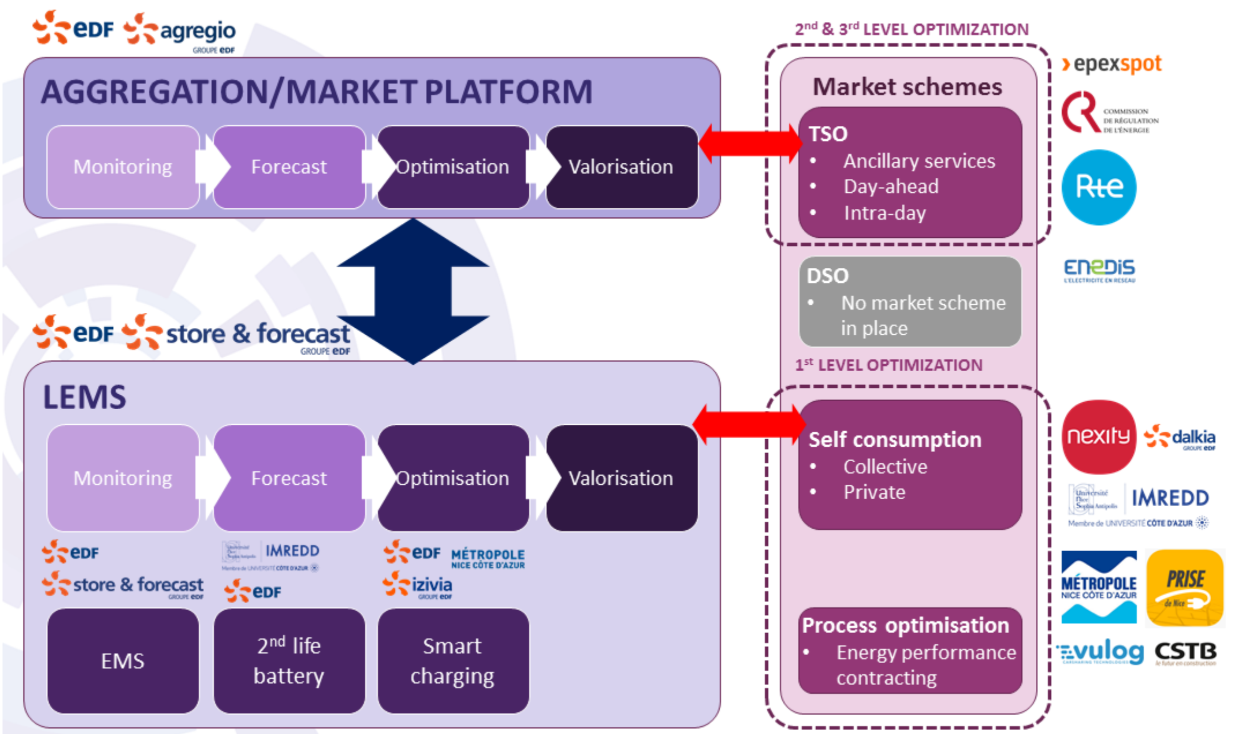

Figure 15 : Schematisation of the main actions to be demonstrated and the main involved party for TT#2. On the right hand side, the market schemes are listed and the directly involved entities mentioned, independently if being or not partner of IRIS (source: EDF)

The general relation among TTs and ISs are explained in the previous sections under section 1.3. Regarding how different demonstration actions relate to the different IS, is visualised in Figure 14.

As for reducing the complexity of the task and enable to manage in an incremental manner the different actions to be put in place, the whole actions concerning TT#2 are as said organised in separate Use Cases (UC). The method will be kept on the semantic level to enable to clarify roles and responsibilities and main structuring of the different actions entailed under each UC. Moreover, this should enable to maintain clarity on the scope and timeline of each individual action. Such UC structure will be integrated in the following chapter 5, and regrouped for clarity under the different demonstrations (at IS level) and separate measures (UC). The 2nd level UC might change as the project gains in maturity (readjusted, completed or removed) however, the 1st level UC are expected not to be changed during the project.

5 Demonstration activity TT#2

5.1 IS 2.1 - Flexible electricity grid networks

The demonstration of this activity is, as outlined in chapter 2.3.1, based on 3 sequential steps:

1) **Optimization of the self-consumption endeavours under current regulation** – UC 1 and UC2
    a. This are represented by UC 1 (individual self-consumption: UNS/MREDD Building) and UC 2 (common self-consumption: NEXITY building) – both are related to IS 1.1.
2) **Optimization towards integration of grid services under current regulation** – UC 4
    a. This represents the integration of UC 1 and UC 2 into the energy markets via UC 4.
    b. Additionally, smart charging – UC 3 - will be tested towards other services
3) **Optimization towards a local aggregation of flexibilities as under the LEMS** – UC 5
    a. This will add additional functionality layers, integrating the previous UC 1, 2, 3, 4 into a single UC 5.

In the following section, the UC are presented with the same logic, so starting from the very single building (UC 1 and UC 2) and system (UC 3), moving towards the energy market (UC 4) and closing with the LEMS (UC 5).

The final sections of each demonstration activity will provide insight into the impact assessment, the related KPIs, the main achievements until today and a short conclusion. These will further be resumed for the TT#2 level, at the end of the demonstration description and of the present document.

5.1.1 IS 2.1 - UC 1 / Individual self-consumption (related IS 1.1)

5.1.1.1 Description of the Use Case

5.1.1.1.1 Goal, Objectives and Scope and of the use case

Goal: Maximise the economic performance of the self-consumption project. Demonstrate the feasibility of controlling PV production, BESS, e-vehicle charging points and potential other further assets in an optimal way.

Objectives:

- Demonstrate the impact that an EMS has under different management strategies (optimization)
- Define the impact that an advanced EMS has on a building in term of financial performance of its exploitation (OPEX reduction)
- Reduce operational costs for building operator/owner in terms of energy expenses reduction and/or controlled injection revenues
- Minimise the impact that variable distributed RES based systems have on the grid
- Minimize not valorised PV surplus injection into the grid via the EMS
- Implement peak shaving and shifting strategies to minimize the system's impact on the grid

Scope: demonstrate that the integration via an EMS of the PV systems and BESS, has additional advantages to non-controlled systems, where monitoring, forecast and optimization functionalities are not included. Within the existing grid code boundaries and the imposed financial and technical constrains and parameters coming from related contracts, the EMS will maximise the economical objective for the building.

5.1.1.1.2 Narrative of Use Case

5.1.1.1.2.1 Short description

The EMS will forecast in a continuous manner both energy production and demand for the building in mid- and short-term and real time. The integrated optimization functionalities will enable to take real-time arbitration on the connected assets depending on the objective function imposed (or operation mode). Optimization strategies will evolve during the project, becoming increasingly complicated by integrating more variable and assets (sequence of Sub-Use Cases as below).

5.1.1.1.2.2 Complete description

Motivation and problem statement

At present, self-consumption endeavours are diffusing at an accelerating rate, making them the most common type of PV integration solution in the building sector in France among the new connection requests to the DSO. Nevertheless, except in rare cases, the integration of a BESS cannot be justified by common business models in urban areas (less in new build ones). So it could be stated that the integration of a BESS in residential and tertiary buildings is not a viable business model – except for buildings in very remote or particular situations – under the current operation modes. Environmental objectives are the predominant decision making parameter and the implementation is yet related to “early adopters”[16].

This is due to the fact that the system should, to achieve an economical optimum, self-consume at least 90% of its self-production, usually corresponding to about less than 20% of its yearly load. However, this strongly depends on the type of activity/processes within a building (this applies for businesses while in the industrial sector less than 10% are usual).

This rule of thumb is actually a consequence from the regulation in place, which through its tariff mechanism is penalising the grid injection of surplus PV. Self-consumption endeavours are thus, pushed towards reducing the PV installation sizing to a certain minimum to ensure its financial viability. For installation below 100kWp, the system in place is a feed in tariff and investment grant, inversely proportional to the system size.

For installations above this threshold, a public tendering system has been put in place, done via trimestral bidding sessions. This bids however already do not entail an investment grant but only a feed in tariff scheme, which is regulated as follows:

Compensation scheme (for 10 years) =

compensation on the self-consumed energy	$(P + 5) \times E_{\text{self-consumed}}$
+ feed in tarrif for the injected surplus into the grid	$+ P \times E_{\text{injected energy}}$
- penalties for injection peaks into the grid	$- 12 \times E_{\text{produced}} \times (P_{\text{max injected}} / P_{\text{installed capacity}})$

[16] Diffusion of Innovation (DOI) Theory, E.M. Rogers, 1962

Hereby P varies between 0-50 EUR MWh, as by the previous bidding sessions, but has no maximal threshold. As explained previously, the tendering has been put on halt at the time being by the regulator (CRE) due to its inefficiency.

This is the scheme that will probably apply to the IMREDD case study building in case its owner/operator decided to inject surplus PV into the grid. This scheme will be very harmful to the IMREDD case, which as education building will be closed during PV peak production season (August) and weekends and thus, without storage and EMS solution, be strongly penalised by the injected PV surplus due to its below baseload consumption during the same time.

Solution approach

The solutions to this penalisation of the surplus that will be generated, is given by the sizing of the BESS and the operation strategy applied by the EMS, through an integrated approach. For the storage system sizing, an extensive study has been conducted and detailed in IS 1.1. This has simulated under "near to real" operational conditions the behaviour of the EMS coupled with the emulated assets via historical and simulated data, considering forecast capabilities and different objective functions. This gave a first insight into the value the EMS can generate.

Once delivered, the EMS will be put in place with a full set of functionalities: forecast of PV production, forecast of electric load, and coupled with real time monitoring (<1 min) and the charging cycles of the BESS adjusted accordingly. As evinced from the sub-UC described below, the performances and capabilities will be increased in an additive manner.

OPF Objective Functions

The objective functions to be implemented can be as follows (to remember that 2 Phases are given by the need of regularising the installation under the self-consumption scheme):

1) Self-supply maximisation: maximise the absorption of PV during the first phase, where it is foreseen that the installation will not be allowed to inject PV surplus into the grid. PV production might probably be needed to be neutralized during certain peak production periods.

2) Peak demand shifting and shaving: generate better operational performances by shifting peak demands in less costly TOU (Time Of Usage) hours and thus, reduce energy costs. However, this will not induce a reduction of the overall energy volume, if not just the volume withdrawn from the grid. It is expected to reduce the self-supply ratio, while improving the operational economic performance (in both phases). Peak demand reduction: force the system to run under a certain threshold of peak demand and thus, reduce fixed costs for the operator. This strategy might impact the overall volume of energy used, increasing withdraw of energy from the grid: losses are more important as the BESS is used and the tariff optimisation becoming less efficient. It might be possible this option will be discarded.

General sequence of actions

The sub-UC described below will be implemented in a sequential manner. This means that the EMS will be delivered as in UC 1.1. Once the building's operator/owner has regularized the PV installation as "individual self-consumption endeavour", the EMS will be updated with the corresponding operation mode. The UC 1.3 will be integrated once EV charging infrastructure and related MMS will have been put in place and interconnections protocols been established. This will come as additional functionality of the EMS at UC 1.1 or UC 1.2 level.

The EMS is an automated system, thus the sequence of actions as detailed in 11.1.1.1.3 applies.

5.1.1.1.3 Use case conditions

5.1.1.1.3.1 Assumptions

- The PV system will not be allowed to inject power into the grid until the installation has been regularized as by current law as an “individual self-consumption endeavour” and undergone the public bidding process for the complementary remuneration definition.
- For the operation of the self-consumption endeavour as well as the operation and maintenance of the overall building installations, UNS/IMREDD will have to pass a contract with a third party. This will in the best case make reference to IRIS and the defined UC thus, exempt the future operator from performance losses due to the demonstration activities.
- Potential overconsumption, so increased withdrawal from the grid due to the demonstration activity compared to a certain baseline, will not be considered or if so, arising costs will be supported by UNS/IMREDD. Those should however be rebalanced by increased incomes from the grid injected PV due to the feed-in tariff.
- The building, being a new construction, will increase its usage rate in a progressive manner, so in the beginning of the demonstration, the EMS will have to face a changing load curve, sub-optimal for a certain period.
- 2nd life BESS will not participate directly in the demonstration related to this UC, but treated in a parallel manner in UC 7/IS 3.1.
- The EVCI is sized to 16 charging points, will be split in 2 phases. Only half will be delivered during the project and integrated into with the EMS.
- The related MMS (Mobility Management System) that will be installed will enable to modulate the power withdraw dispatched in a uniform manner among the underlying charging poles.
- The car pool accessing the building and thus, the charging poles will be operated via the VULOG platform and thus enable to access information about a foreseen parking duration of connected EV. If this will not be the case, an alternative solution has to be proposed.
- The EMS developed under this UC will be left in place and property transferred to UNS/IMREDD after the termination of the further demonstrations.

5.1.1.1.3.2 Prerequisites

- All assets to be monitored and controllable are connected to the EMS, directly or indirectly, via wires with the correct latency and compatible to “Modbus-TCP” protocol: PV inverters, BESS control, charging station (MMS) and substation-level electricity consumption meter.
- In order to allow to inject power into the grid and develop the related UC 1.3 for optimising the economic performance of the building operation, the PV installation will have to be regularized.
- To allow EDF and EDF S&F to implement its demonstration activities, a dedicated experimentation contract has to done among all involved parties.

5.1.1.2 Technical details

5.1.1.2.1 Systems and associated actors/tools

- The technical details have been extensively described in D1.3. These described systems and tools are yet valid and will be used for this UC.

- The list of technologies is entailed in D6.3 under IS 1.1 and in D1.4

The EMS will be developed based on the property software packages as listed as follows:

- Overall EMS / "PEGASE EMS": complete software and hardware solutions for the programming of an EMS. This will be hosted by two redundant industrial PCs installed in the client's premises. The real time interconnection and redundancy grants the service provision security.
- Load forecast / "CONSOSCOPE": it's is a software developed for the calculation of the electricity consumption forecasts the day ahead (D - 1) (DA) and the day D in intraday (ID) at the pace of 10 min horizon, until midnight of the day. CONSOSCOPE uses and merges the information provided by interfaced meteorological models, the intrinsic knowledge of the loads and the measurements of consumption recorded on site.
- PV forecast / "PVSCOPE": it's a PV production DA and ID forecasting service, developed in partnership with the Laboratory of Dynamic Meteorology (Ecole Polytechnique)[17].

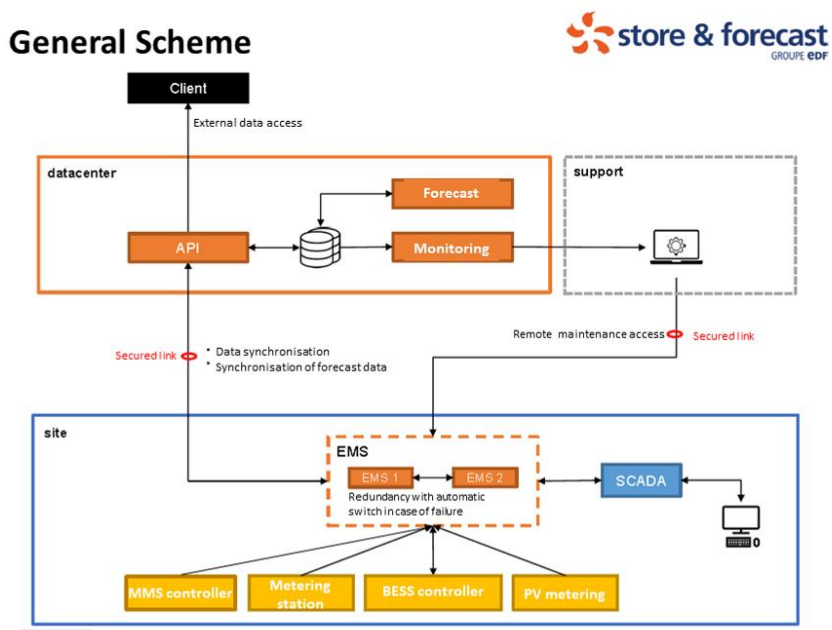

Figure 16 : overall EMS system conception. The scheme, from exception of the lower yellow boxes, represents the EMS and related ICT infrastructure. The arrows show the direction of the information flow, so if mono- of bi-directional. In has been divided the elements within the client's premises (blue rectangle) from external ones (orange rectangle) (Source: EDF – EDF S&F)

[17] https://www.edf-sf.com/en/offers/ems-offering/

5.1.1.2.2 Control variables

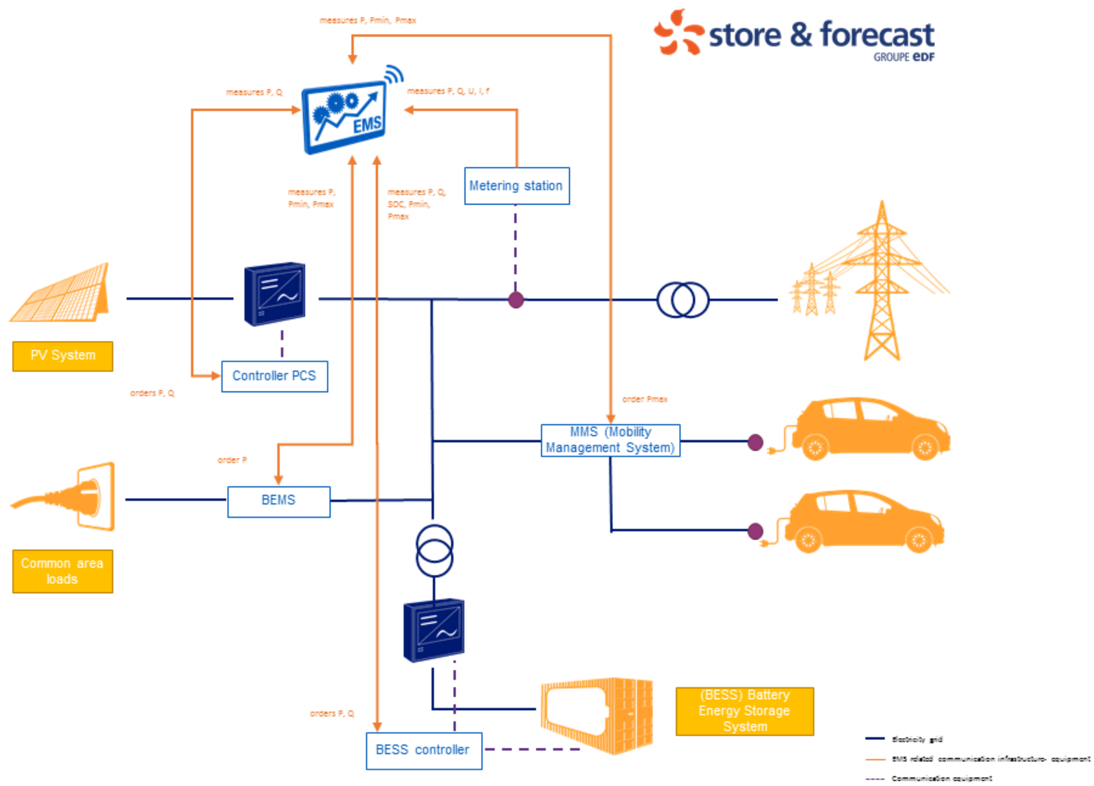

Figure 17 : overall communication and control infrastructure within the client's premises. The orange lines identify the ICT infrastructure related to the metering and control associated to the EMS (Source: EDF – EDF S&F)

From the BESS:

- Active power
- Reactive power
- Maximal power charge and discharge
- SOC – State of Charge
- BESS embedded modes and alarms

From PV system:

- Active power
- Reactive power
- Nominal power factor and setting range
- Output frequency

From MMS

- Nominal power factor and setting range
- State of charge (SOC)
- Halt/Charge timeslot - time and duration

From energy metering station:

- Active power
- Reactive power
- Frequency

5.1.1.2.3 Sub Use cases

5.1.1.2.3.1 UC 1.1 / no PV surplus injection

The objective function of the EMS is set to maximize the use of electricity produced by the PV system via the BESS and provide peak shifting with the stored energy. In case PV can't be absorbed anymore, the EMS will signal to the inverters to stop the PV injection. Once the conditions are given to restore the PV production, the EMS will activate the corresponding signal to the PV inverters.

5.1.1.2.3.2 UC 1.2 / PV surplus injection

The objective function of the EMS is set to provide peak shifting while arbitrating the injection of PV depending on the applied tariff. As imposed by current regulation, at least 50% of the yearly produced PV energy has to be self-consumed. Given the building has a high "natural self-consumption" rate, it will probably not represent a major constrain for the optimization process however, no arbitration has been done so far on this matter.

5.1.1.2.3.3 UC 1.3 / Smart charging

The EMS will have to integrate the EVCI control via the MMS (Mobility Management System) as a further input to its optimization process. The EMS will be able to retrieve the information about the state of charge (SOC) of the EV's BESS probably via the VULOG system or directly via the MMS and be able to send "max power withdrawal" order to the MMS. It is yet unclear if the MMS to be installed will allow the control of each single charging pole or just at the MMS level. So the MMS will as by standard, dispatch in an equal manner the corresponding max power order among the charging poles. The UC will enable to shift load from the EV charging to different time slots, depending on forecast data, EV charging priority, global electricity consumption, PV availability, BESS's SOC and the TOU costs of electricity.

Schemes and diagrams of the sub-UC can be found at the end of the document under: Annex 1 – technical details IS 2.1

5.1.1.3 Societal, user and business aspects:

5.1.1.3.1 Business model

The EMS is based on a "single purchase" fee for the delivery of the system and a "recurrent licensing" fee for operation & maintenance and additional forecast and optimization services. The latter ensures system updates and calibration based on operational data. Those will however not apply during the project duration.

The value proposition for the client is the optimized operation of his assets, achieving higher financial performance, as the objective function is set to the economical optimization, maximizing revenues and minimizing expenses.

5.1.1.3.2 Governance

The overall work organisation has already be explained in chapter 1.2. However here resumed:

EDF will monitor the project progress, ensure timely achievement of goal and objectives and coordinate the different involved stakeholders and support contractual arrangements needed for the implementation of the UC; support with its know-how and expertise the implementation and achievement of the demonstration activity.

EDF S&F will deliver, operate and monitor the system; ensure compatibility with the annex energy and communication infrastructures; definition and realization of the SCADA (Supervisory Control And Data Acquisition - in other words the machine user interface) of the EMS; deliver and operate the EMS; adapt and add EMS/LEMS functionalities during the project duration as the technology's maturity level of the system raises; support with its know-how and experience, the definition of meaningful business cases and technological solutions.

UNS/IMREDD directly or via the future assigned building operator, will be responsible of monitoring the correct functioning of the building and the O&M of all related assets and infrastructures. It will report any deviation for which action should be taken by EDF or EDF S&F. Furthermore, it will ensure the access to possible other 3rd parties related to the building exploitation. UNS/IMREDD, as owner of all assets and related contractual elements, he will be the only beneficiary of possible resulting financial benefits from the operation of the EMS, while he'll be also solely bearing the costs related to energy consumption or the maintenance of his assets.

5.1.1.4 Commissioning Plan

Please consider D6.3 commissioning plan of the different assets connected to the EMS. This applies to the current section.

As can be understood from the UC description, it is mainly based on software and ICT developments and their implementation plan is explained in the following section.

Here below, the specific actions which have to be considered for the commissioning of the EMS and which has been integrated into the planning of IS 1.1:

1. 1 day
    a. Receipt of the cabinet for the hosting of the 2 industrial PC for the EMS and an additional one in case UNS/IMREDD have chosen to integrate a local SCADA.
    b. Additional commissioning of the two industrial PCs with the integrated needed software components
    c. On-site test communication infrastructure – direct internet connection (cable solution) if already commissioned, otherwise a 4G modem + cable will be integrated on site as intermediate solution
2. ½ day - with BESS supplier for pilot tests of EMS interfacing
3. ½ day - with supplier / operator BEMS to ensure local access and correct software interfacing for ensuring correct data exchange.
4. 1 day - test communication equipment – all assets (PV, metering station, etc.)
5. ½ day – reception and test for interfacing MMS/charging stations (1 cluster = 1 technology)

5.1.1.5 Implementation plan

5.1.1.5.1 Planning of activities

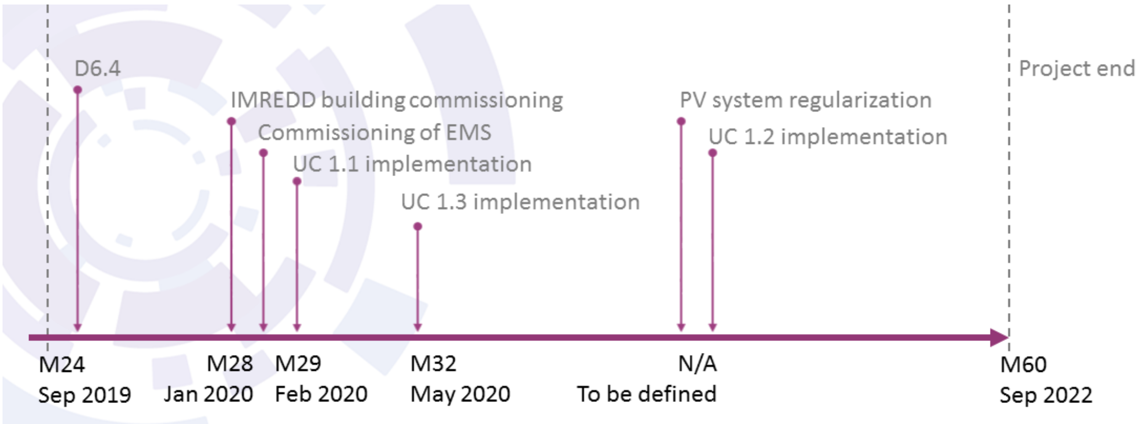

Figure 18 : provisional planning of activities – based on current knowledge state of knowledge (Source: EDF – EDF S&F – UNS/IMREDD)

5.1.1.5.2 Risk management

1. Limitations of experimentation activities due to contractual limitations with future building operator
   a. Ensure IRIS activities are integrated into the contractual specifications for the future building operator
   b. Definition of experimentation contract with all involved parties: EDF, UNS/IMREDD, EDF S&F, AGREGIO and future building operator

2. System and/or protocol incompatibility – specific products might experience wrong sourcing or commissioning specifications
   a. Exchange on product specification sheets and data/protocol exchange tables between UNS/IMREDD and related subcontractors and EDF/EDF S&F. Face to face meetings have been set up with UNS/IMREDD and related subcontractors to ensure common understanding of the requirement to be integrated in IS 1.1.

5.1.2 IS 2.1 - UC 2 / Common self-consumption (related to IS 1.1)

5.1.2.1 Description of the Use Case

5.1.2.1.1 Goal, Objectives and Scope and of the use case

Goal: same as in UC 1.1 under the changed framework of a “common self-consumption” endeavour and related regulation.

Objectives:

Same as UC 1 under the changed framework of a "common self-consumption" endeavour and related regulation. It has to be considered that today, only a handful of "common self-consumption" projects are underway in France and less than 3 are actually in operation.

In addition:

- Operate the EMS in the situation of a "common self-consumption" endeavour
- Demonstrate capability of the EMS to integrate an "Energy Performance Contracting" (EPC) for the operation of the common areas of the building
- Demonstrate optimization of the overall energy related financial flows under the common self-consumption endeavour and related current regulation.

Scope: as in UC 1 – "*demonstrate that the integration via an EMS of the PV systems and electric storage, has additional advantages to non-controlled systems, where monitoring, forecast and optimization functionalities are not included. Within the existing grid code boundaries and the imposed financial and technical constrains and parameters coming from related contracts, the EMS will maximise the economical objective for the building*". Moreover, the EMS operation will have a direct impact on the EPC in place and has to operate within the given contractual boundaries.

5.1.2.1.2 Narrative of Use Case

5.1.2.1.2.1 Short description

As in UC 1: *"The EMS will forecast in a continuous manner both energy production and demand for the building in mid-term, short term and real time. The integrated optimization functionalities will enable to take real-time arbitration on the connected assets depending on the objective function imposed. The optimization strategies will evolve during the project, becoming increasingly complicated by integrating more variable and assets (sequence of Sub-Use Cases as below)".* It will furthermore support the performances of the building operator by ameliorating its performances as stipulated in the EPC contract.

5.1.2.1.2.2 Complete description

Motivation and problem statement

Same as in UC 1, however considering the framework of regulation related to a "common self-consumption" endeavour. The same reasoning applies for the introduction section however, it has to be added that "common self-consumption" endeavours are strongly penalise for injection of PV surplus.

At the time being, the regulatory framework in place, penalises common self-consumption endeavours more than individual ones. The reasoning behind this is due to the fact that a building's internal LV distribution grid between different meters, is considered as public infrastructure and thus, grid charges apply. Therefore, specific grid charges apply to the self-consumed energy, making such endeavours less profitable than individual ones, which are exempt from such charges. The charges are nevertheless, lowered compared to common grid charges, as exempt of the local taxes (CSPE). This lowers clearly the internal rate of return (IRR) of a PV system as compared in UC1.

PV surplus is further penalised, as no specific feed in tariff is provided at the time being. The surplus energy is therefore integrated into the grid and considered as compensation of grid losses and limited to 5% of the total volume of PV energy produced, or otherwise, penalties apply.

What is allowed, is to have an “energy supply contract” with an energy producer/Balance Responsible Entity (BRE), reselling the negotiated energy volumes via the energy wholesale market. Indeed, this type of arrangements are yet in an experimental status and very few stakeholders within the French energy industry are able, or agree, to engage in such arrangements.

As within such framework, the NEXITY building will most probably be restricted in injecting PV surplus and be able to negotiate only in midterm a supply contract with an energy market player.

Solution approach

Once delivered, the EMS will be put in place with a full set of functionalities: forecast of PV production, forecast of electric load, and coupled with real time monitoring (<1 min) and the charging cycles of the BESS adjusted accordingly. As evinced from the sub-UC described below, the performances and capabilities will be increased in an additive manner.

OPF Objective Functions

The objective functions to be implemented can be as follows (to remember that 2 Phases are given by the fact that yet no “energy supply contract” has been signed):

1) Self-supply maximisation: maximise the absorption of PV during the first phase, where it is foreseen that the installation will not be allowed to inject PV surplus into the grid. PV production might thus be needed to be neutralized.

2) Peak demand shifting: generate better operational performances by shifting peak demands in less costly TOU hours and thus, reduce energy costs however without reducing the overall energy volume. It is expected to increase the self-supply ratio, while improving the operational economic performance (in both phases). Peak demand reduction: force the system to run under a certain threshold of peak demand and thus, reduce fixed costs for the operator. This strategy might impact the overall volume of energy used, increasing withdraw of energy from the grid: losses are more important as the BESS is used more and the tariff optimisation becoming less efficient. It might be possible this option will be discarded.

In both phases, the contractual boundary conditions of the EPC contract have to be taken into consideration. The performance indicators entailed in the EPC contract are not bounded to a specific threshold of energy expenses, but only to a specific threshold of annual consumed energy volume. This might conflict with an economical profitability maximisation objective. The optimization function of the EMS will have thus, to integrate the boundary conditions of the EPC contract.

General sequence of actions

The sub-UC described below will be implemented in a sequential manner. This means that the EMS will be delivered as in UC 2.1. Once the building’s operator/owner has negotiated the possibility to sell PV surplus, the EMS will be updated with the corresponding operation mode. The UC 2.3 will be integrated only once EVCI and related MMS will have been put in place and interconnections protocols have been established. This will come as additional functionality of the EMS at UC 2.1 or UC 2.2 level.

The EMS is an automated system, thus the sequence of actions as detailed in 11.1.1.1.3 applies.

5.1.2.1.3 Use case conditions

5.1.2.1.3.1 Assumptions

- The PV system will not be allowed to inject power into the grid until the installation has been regularized by an energy production contract with an energy supplier/ BRE.
- The responsible party for the operation of the self-consumption endeavour as well as the operation and maintenance of the overall building installations under an EPC contract will be DALKIA (third party to the project). Therefore, a specific experimentation contract will have to be foreseen between EDF/EDFS&F/DALKIA and NEXITY Property Management/Co-ownership entity to be created.
- The operation of the EMS will support the EPC related performance indicators and thus, not induce into any economic losses. Nevertheless, in case the latter happens, those will have to be take in charge or by NEXITY Property Management/Co-ownership or DALKIA. More precisely, potential overconsumption, so increased withdrawal from the grid due to the demonstration activity compared to a certain baseline are meant.
- The building, being a new construction, will increase its usage rate in a progressive manner, so in the beginning of the demonstration, the EMS will have to face a changing load curve, sub-optimal for a certain period.
- The EVCI, sized currently to 6 charging points, will not be operational at the delivery of the building. The system is therefore only pre-equipped with the needed arrangements in terms of space reservations for electric installations and cables, meaning no physical electric or communication infrastructure or system will be delivered.
- The EMS developed under this UC will be left in place and property transferred to NEXITY Property Management/Co-ownership entity to be created, after the termination of the further demonstrations.

5.1.2.1.3.2 Prerequisites

- All assets to be monitored and controllable are connected to the EMS, directly or indirectly, via wires with the correct latency and compatible to “Modbus-TCP” protocol: PV inverters, BESS control, charging station, electricity consumption meters (both meters for the common areas and EV charging – however the latter not be used in the starting configuration) and the potentially forthcoming MMS (Mobility Management System).
- In order to allow to inject power into the grid and develop the related use case for optimising the economic performance of the building operation (peak shifting/shaving), the PV installation will have to be integrated into a wholesale energy portfolio of an energy supplier/ BRE.
- To allow EDF and EDF S&F to implement its demonstration activities, a dedicated experimentation contract has to be foreseen with all involved parties.

5.1.2.2 Technical details

5.1.2.2.1 Systems and associated actors/tools

- The technical details have been extensively described in D1.3**.** These described systems and tools are yet valid and will be used for this UC.
- The list of technologies is entailed in D6.3 under IS 1.1 and in D1.4.
- The detailed listing of the included software components can be found in UC 1.

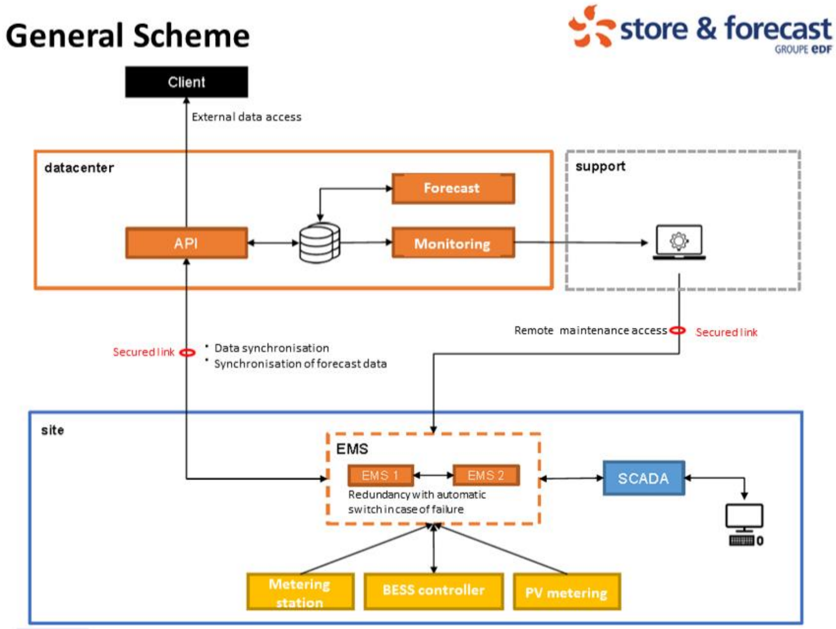

Figure 19 : overall EMS system conception. The scheme, from exception of the lower yellow boxes, represents the EMS and related ICT infrastructure. The arrows show the direction of the information flow, so if mono- of bi-directional. In has been divided between the elements within the client's premises (blue rectangle) from external ones (orange rectangle) (Source: EDF – EDF S&F)

5.1.2.3 Control variables

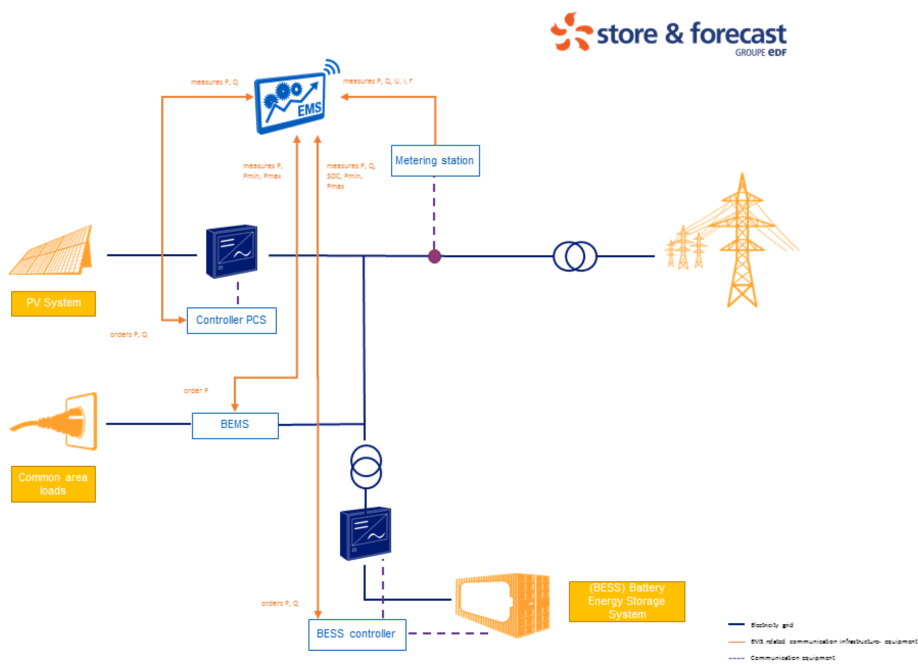

Figure 20: overall communication and control infrastructure within the client's premises. The orange lines identify the ICT infrastructure related to the metering and control associated to the EMS (Source: EDF – EDF S&F)

From the BESS:

- Active power

- Reactive power
- Maximal power charge and discharge
- SOC – State of Charge
- BESS embedded modes and alarms

From PV system:

- Active power
- Reactive power
- Nominal power factor and setting range
- Output frequency

From energy metering station:

- Active power
- Reactive power
- Frequency

5.1.2.3.1 Sub Use cases

Please see the equivalent section in UC 1.

5.1.2.4 Societal, user and business aspects:

5.1.2.4.1 Business model

The EMS is based on a “single purchase” fee for the delivery of the system and a “recurrent licensing” fee for operation & maintenance. The latter ensures system updates and calibration based on operational data. Those will however not apply during the project duration.

The value proposition for the client is the optimized operation of his assets, achieving higher financial performance, as the objective function is set to the economical optimization, maximizing revenues and minimizing expenses within the boundaries of an EPC. In case the EPC contract entails as main performance not a total energy volume consumed, but an overall economic performance from the operation of the building, the EMS would have a better valorisation.

Through this UC it will be identified in how far an EMS can contribute to the amelioration of an EPC type of contact and if a performance based on economic variables might bear advantages, compared to energy consumption based ones.

5.1.2.4.2 Governance

EDF will monitor the project progress, ensure timely achievement of goal and objectives and coordinate the different involved stakeholders and support contractual arrangements needed for the implementation of the UC; support with its know-how and expertise the implementation and achievement of the demonstration activity.

EDF S&F will deliver, operate and monitor the system; ensure compatibility with the annex energy and communication infrastructures; definition and realization of the SCADA (Supervisory Control And Data Acquisition - in other words the machine user interface) of the EMS; deliver and operate the EMS; adapt and add EMS/LEMS functionalities during the project duration as the technology’s maturity level of the system raises; support with its know-how and experience, the definition of meaningful business cases and technological solutions.

DALKIA will be responsible of monitoring the correct functioning of the building and the O&M of all related assets and infrastructures. It will report any deviation for which action should be taken by EDF or EDF S&F. Furthermore, DALKIA will be the only beneficiary of possible resulting financial benefits from the operation of the EMS in conjunction with the EPC contract.

NEXITY Property Management/Co-ownership entity to be created will be the sole entity bearing the costs related to energy consumption or the other expenses related to its assets.

5.1.2.5 Commissioning Plan

Please consider D6.3 commissioning plan of the different assets connected to the EMS. This applied to the current section.

Same plan as in UC 1 applies as exception for the related activities for the EVCI, which is not foreseen to be delivered at the same time as the building and EMS.

5.1.2.6 Implementation plan

5.1.2.6.1 Planning of activities

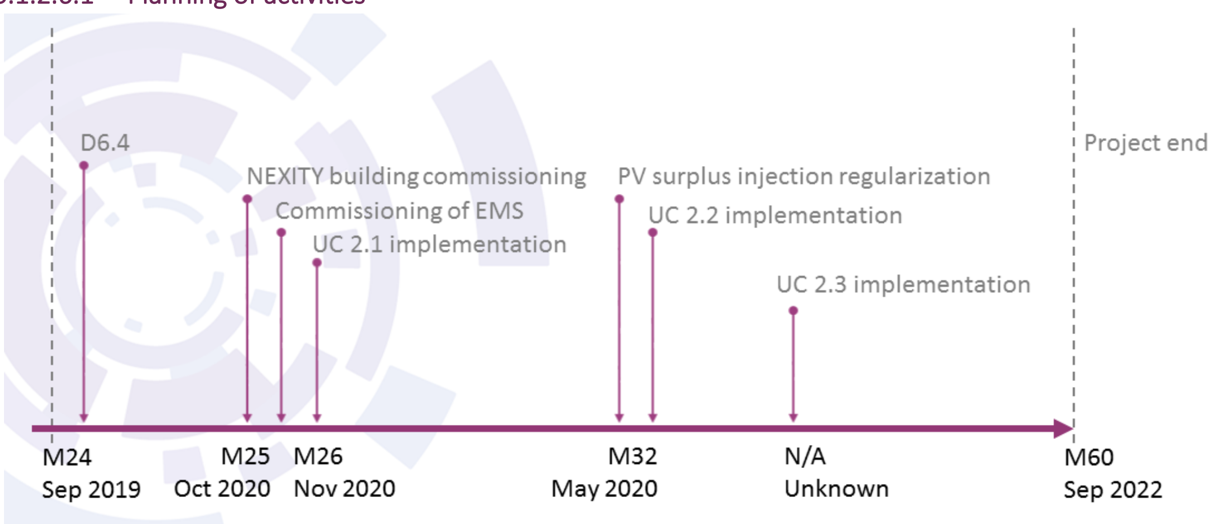

Figure 21 : provisional planning of activities – based on estimate as no dates are given for the main milestones for the UC integration (Source: EDF – EDF S&F)

5.1.2.6.2 Risk management

1. Limitations of experimentation activities due to contractual limitations or disagreement with NEXITY Property Management/Co-ownership entity
    a. Exclusivity contract has been signed between EDF, EDF S&F, NEXITY and NEXITY Property Management for the delivery of the EMS and the integration of the notion of experimentation contract as point below.
    b. Definition of experimentation contract with all involved parties: EDF, EDF S&F, AGREGIO, NEXITY Property Management/Co-ownership entity to be created and probably DALKIA.

2. System and/or protocol incompatibility of on-site products due to wrong sourcing or commissioning
    a. Exchange on product specification sheets and data/protocol exchange table between EDF/EDF S&F and NEXITY and related subcontractors.
    b. Face to face meetings have been set up with such entities to ensure common understanding of the requirement to be integrated in IS 1.1.

5.1.3 IS 2.1 - UC 3 / Smart Charging (related to 3.1)

UC detailed in D6.5 – IS 3.1

5.1.4 IS 2.1 - UC 4 / Flexibility

5.1.4.1 Description of the Use Case

5.1.4.1.1 Goal, Objectives and Scope and of the use case

Goal: Maximise the economic performance by adding to the self-consumption projects (UC 1 and UC2) and EV charging infrastructure exploitation (UC 3), revenue streams by providing energy services to be traded on energy markets.

Objectives:

- Demonstrate the capacity of the EMS to integrate energy service provision
- Demonstrate the interconnection between local EMS and an aggregator platform
- Define the impact that energy services have in terms of financial performance (income)
- Ameliorate and expand the current business model related to BESS: evaluate if energy service provision can ensure acceptable ROI and IRR for BESS in tertiary buildings with PV installations
- Reduce global operational costs for building operator/owner by adding revenue streams form energy services
- Demonstrate the participation of distributed energy systems in enhancing the flexibility of the energy grid
- Maximise the valorisation of PV energy by participating to energy services via BESS.

Scope: demonstrate that the integration via an EMS of the PV systems and BESS, can be interfaced with an aggregation platform and that energy services can be estimated in a reliable manner, be integrated into an aggregator's flexibility portfolio, be placed on the energy spot market as day ahead (DA) or intraday (ID) markets, be activated and maintained in a reliable way and cleared correctly. Moreover, identify the additional revenue stream that can be expected form such a system for the building operator/owner.

5.1.4.1.2 Narrative of Use Case

5.1.4.1.2.1 Short description

The EMS will forecast in a continuous manner the availability of defined energy service. Presumably DA services will apply (instead of ID). The aggregator will use this information for the definition of the energy service portfolios to be placed as bid on the spot market. Once the bid are set and accepted, the aggregator will inform the EMS and demand the promised service for the set time slot and foreseen capacity on day D. The EMS will be able to take real-time arbitration on the connected assets depending on the objective function imposed and accept the activation request.

The interconnection among the EMS and the aggregation platform will be defined and tested and the needed functionalities and optimization functions been integrated as an additional operation mode of the EMS. For the time being, primary services, more precisely frequency control reserves will be targeted. The experimentation of further services is not excluded, as tertiary services – positive/negative load injection (sequence of Sub-Use Cases as below).

5.1.4.1.2.2 Complete description

Motivation and problem statement

At present, energy services from distributed energy systems have a very low market penetration in France. On one side the needed systems are yet too expensive, on the other side, the related energy service not much remunerated.

The current market design imposes activation capacities in the order of the MW level for the different existing energy service. Big installations are still preferred by aggregators and only a minor part of the potential tertiary and residential based market has been reached. Distributed energy sources and storage means in building premises are not targeted in a systematic manner by aggregators (except for a very few exceptions, specializing on such distributed assets).

BESS is on the other hand, a controllable energy asset, very well fitted to provide energy services. Here again, currently mid- to high- voltage connected assets are prioritized, able as a unit, to provide sole the needed minimal capacity (bid size) to be traded on energy markets. These are in consequence directly sized and design for such purpose usually in connection with power plants as variable renewable energy sources. Clearly, on island and other specific environments the situation is not the same.

Solution approach

With this UC, the viability to integrate such assets in an energy service portfolio will be demonstrated. It is targeted to prove that decentralized BESS is a reliable mean to provide energy services which can be described in terms of activation capacity and volume, frequency and duration for specific energy services. Moreover, if this can be achieved, it is expected that these can be integrated into a business model related to BESS and hopefully, provide enough alternative revenue streams to make BESS a viable business case with acceptable ROI and IRR in the short or either mid-term.

This is a very interesting mean for valorising decentralized assets in the tertiary sector, which will need to find alternative ways for valorising PV production during PV peak production season during holiday and others critical moments as weekends.

As most promising revenue streams, primary energy reserves are targeted via Frequency Control Reserves (aFCR) – sub UC 4.1. For the integration of the smart charging (UC 3), tertiary reserves are foreseen (probably downward flexibilities) – sub UC 4.2. It is not yet clear if the buildings as from IS 1.1 will be used for the same sub-UC 4.2, as revenues from such service are lower than from primary reserves.

OPF Objective Functions

The objective function for the EMS is basically to ensure and achieve the foreseen energy service under the imposed parameters in terms of time slot availability, service duration, capacity and volume from the aggregator. It should be understood, that energy services, whatever ones, are clearly described in such terms as integral part of the current market design.

The objective of the aggregator is hereby to ensure, he provides reliable bids and manages his flexibility portfolio in an efficient and reliable manner. The overall portfolio of the aggregator that will be placed on the market will be larger than the assets provided in this UC, as a minimum threshold of 1MW has to be achieved.

The challenge for the EMS is hereby to ensure that revenues from such services are well integrated into the overall regulatory and contractual constrains it has to ensure as related to UC 1 and UC 2 respectively.

General sequence of actions

The EMS forecasts in addition to its capabilities as in UC 1 and UC 2, the available capacity that can be reserved for the service provision. This information has to be sent to the aggregator in order to manage his portfolio to be placed on the market. At clearing of the bids, the aggregator via its market platform, send the information back to the EMS of the successful (or not) placing of the bid and the needed capacity and time slot for the service. The EMS will integrate this information into his operation optimization towards the foreseen time slot. On day D, at the defined time, the market platform sends the order to the EMS to activate the service. The EMS will have to accept or withdraw the order, depending of the changed current conditions. In case the order is accepted, the aggregator's platform monitors the needed main variables related to the service in real time and in case of deviations, it sends the order to the EMS to adjust its trajectory. At the termination of the service time slot, the aggregation platform, sends the order to the EMS to stop the service. The market platform will then follow up with the clearing of the service and allocate the potential revenue streams to the defined assets. The aggregator will then, following the contractual arrangement that have been taken, provide the revenue to the related building owner/operator.

The whole chain concerning the interconnection between the EMS and the market platform will be automated via dedicated APIs and protocols.

5.1.4.1.3 Use case conditions

5.1.4.1.3.1 Assumptions

- As basis, assumptions from UC 1, 2 and 3 are directly transposed to this UC.
- The energy service provision can be operated within acceptable limits imposed by UC 1, 2 and 3. In other words, be operated within the limits of the related contractual and regulatory imposed engagement connected to such UC.
- The EMS's forecast capabilities are sufficient to be a reliable asset to be integrated into an aggregator's flexibility portfolio.
- The integration of the EVCI is directly done via the EV charging operator IZIVIA (see D6.5).
- The needed communication interfaces and protocols between the aggregator platform, the installed EMS and the Smart Charging operation platform, can be developed and be operated in a reliable manner.
- At the termination of the project, the clients will be able to choose to keep the developed services and if so, negotiate the conditions to maintain the service.

5.1.4.1.3.2 Prerequisites

- As basis, prerequisites from UC 1, 2 and 3 are directly transposed to this UC.
- The current system configurations are eligible to participate into the primary and tertiary reserve markets.
- The clients, owners of the assets, will agree to participate to the service market and thus, engage contractually with the aggregator for the demonstration period.
- In order to fully demonstrate this UC, the aggregator will be able to integrate the assets into a wider portfolio, in order to be able to meet the minimal requirements for the market product of the targeted spot energy market.
- In order to allow to inject power into the grid and provide the needed services, the aggregator will have to clear associated regulatory procedures and possible contractual arrangements as with the TSO or other market operators.
- To allow to implement its demonstration activities, a dedicated experimentation contract has to done. This will need to integrate this action in the contracts cited in UC 1, 2 and 3.

5.1.4.2 Technical details

5.1.4.2.1 Systems and associated actors/tools

In addition to UC 1 and UC 2, the market platform operated by AGREGIO has to be considered. This is however an existing operative software platform, for which technical details can’t be disclosed.

For the EMS related functionalities, those will be based on the software listed in UC 1.

In the project, the communication protocols and APIs for interfacing with such 2 platforms will be developed.

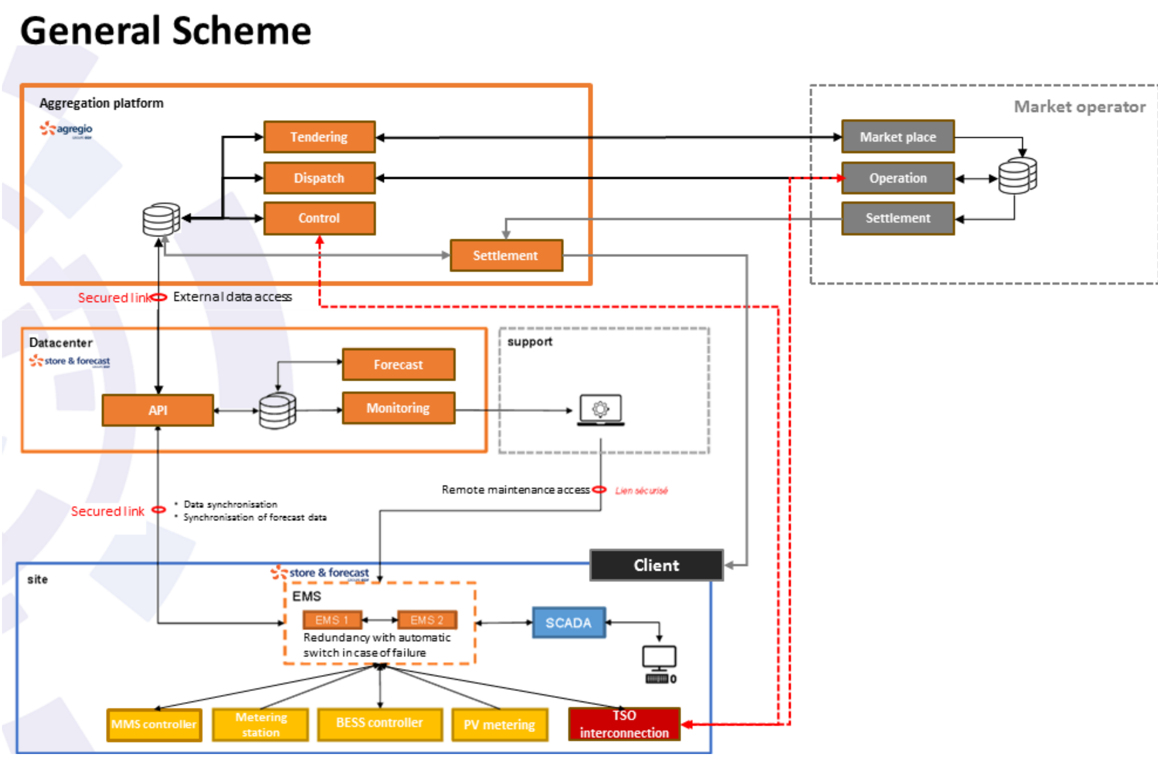

Figure 22 : overall schematic concept of platform interconnections. In variation to the previous figures, the aggregation platform has been added (orange rectangle on the top) and the relation with the market operator (upper-right dotted grey rectangle) (Source: EDF – EDF S&F - AGREGIO)

5.1.4.2.2 Control variables

Additionally to UC 1, UC 2, UC 3

Between EMS and aggregation platform:

- Activation time
- Service duration
- Power to be reserved
- Energy to be reserved
- Frequency range

5.1.4.2.3 Sub Use cases

5.1.4.2.3.1 UC 4.1 / Primary reserves

DA primary reserves market is targeted, more precisely "aFCR". This market product is clearly specified as by current market design. This means a certain power capacity has to be operated according to a certain spectrum of frequency imposed by the TSO for a time slot of 4 hours. The challenge of this UC is to integrate UC 1 and UC 2 and integrate into those the anticipation of the service from the forecast algorithms and its provision via its integration into the optimization algorithms. Moreover, the interface between the market platform and the EMS have to be build according to common communication protocols and APIs.

5.1.4.2.3.2 UC 4.2 / Tertiary reserves

For the time being, it is not foreseen to integrate UC 1 and UC 2 into this UC, so to operate them for a tertiary reserve market. This is however targeted with UC 3, so as by smart charging of IS 3.1. Therefore UC 3.1 will directly be integrated into this sub use case. It description, for consistency matters, will be left in D6.5.

Schemes and diagrams of the sub-UC can be found at the end of the document under: Annex 1 – technical details IS 2.1

5.1.4.3 Societal, user and business aspects:

5.1.4.3.1 Business model

In addition to the argumentation as from UC 1 and 2, an additional value proposition applies to the current use case: the EMS related fees should theoretically be raised, via a dedicated service licencing fee, as the revenue stream for the client should here be enhanced considerably thanks to the flexibility service related incomes.

In order to integrate the client's assets into the energy reserve markets, a dedicated contract with an aggregator will have to be negotiated, in addition to the EMS service: bonus-malus repartition between the parties should be defined, all clearly related to the "volume" of flexibility that can be achieved while special clause can apply restraining availability of the assets, related to technical or other operational constrains of the client.

5.1.4.3.2 Governance

EDF will monitor the project progress, ensure timely achievement of goal and objectives and coordinate the different involved stakeholders and support contractual arrangements needed for the implementation of the UC; support with its know-how and expertise the implementation and achievement of the demonstration activity.

EDF S&F will deliver, operate and monitor the system; ensure compatibility with the annex energy and communication infrastructures; definition and realization of the SCADA (Supervisory Control And Data Acquisition - in other words the machine user interface) of the EMS; deliver and operate the EMS; adapt and add EMS/LEMS functionalities during the project duration as the technology's maturity level of the system raises; support with its know-how and experience, the definition of meaningful business cases and technological solutions.

AGREGIO will operate the aggregation platform and develop the interfaces with the EMS and ensure correct functioning. It will take charge of all aggregation related aspects (permitting, contracting, and settlements) in interface with energy markets and related stakeholders.

IZIVIA, see D6.5, IS 3.1.

The underlying clients, UNS/IMREDD and NEXITY Property Management/future building operator will be responsible of monitoring the correct functioning of the building and the O&M of all related assets and infrastructures. They will report any deviation for which action should be taken related to the project. Furthermore, it will ensure the access to possible other 3rd parties related to the building exploitation (i.e. DALKIA). As owners of all assets and related contractual elements, they will be the only beneficiary of possible resulting financial benefits from the operation of the UC, while also being the sole responsible for bearing the costs related to energy consumption or the maintenance of his assets.

5.1.4.4 Commissioning Plan

Please consider D6.3 commissioning plan of the different assets connected to the EMS furthermore, the commissioning plan for UC 1 and UC 2 apply. The technical communication interfaces will be delivered during the first semester 2020 and start the flexibility activation during the second semester 2020.

5.1.4.5 Implementation plan

5.1.4.5.1 Planning of activities

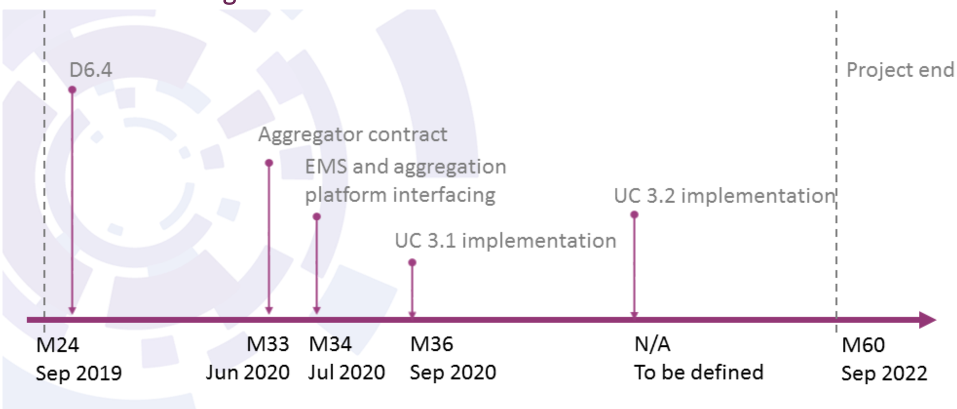

Figure 23 : provisional planning of activities – based on estimate as no dates are given for the main milestones for the UC integration (Source: EDF – EDF S&F - AGREGIO)

5.1.4.5.2 Risk management

1. Main risk is the limitations of experimentation activities due to contractual limitations with future building operators
   a. Ensure IRIS activities are integrated into the contractual specifications of the future service provider.
   b. Provide early awareness rising meetings on the issue as well as the needed support material to provide clear information
   c. Definition of experimentation contract/aggregation contract with all involved parties: EDF, UNS/IMREDD, NEXITY Property Management/ future building operator, DALKIA, EDF S&F and AGREGIO

5.1.5 IS 2.1 - UC 5 / LEMS

5.1.5.1 Description of the Use Case

5.1.5.1.1 Goal, Objectives and Scope and of the use case

Goal: Assess the bankability of a LEMS under current energy market design conditions. Identify to what degree, a local aggregation or even aggregator of flexibilities, has a competitive advantage towards the current "distributed" type of EMS and related aggregation.

Objectives:

- All objectives of the previous UC have to be respected and integrated into this UC.
- Identification of optimization levers by interfacing different EMS in terms of energy performances or higher reliability of flexibility provision.
- Assess what impact could be expected if raising the number of interconnected EMS in terms of optimization's performances and reliability of flexibility provision.
- Assess the viability of a LEMS business case

Scope: demonstrate the value that can be created by interfacing a network of EMS under a same pre/aggregator via a LEMS. The hypothesis to be validated is that the local aggregation of flexibilities has an upper value towards a national distributed portfolio of assets as commonly done. For this, at first the system as deployed UC 1 to UC 4, will be put in communication and a dedicated optimization layer be introduced to identify if better forecast variables can be achieved and thus, provide a more reliable product for the energy market players. This will be integrated into sub-UC 5.1. In a second step, further EMS will be emulated based on historical data and stochastic methods. The scale effect will be assessed toward possible optimization performance ameliorations, towards the forecast or provision reliability from such extended network. Real life demonstration will be engaged only if the assessment proves to have a bankable business model associated.

5.1.5.1.2 Narrative of Use Case

5.1.5.1.2.1 Short description

Controllable decentralized energy production systems are integrating the market although if still at a low rate. Together with the advancement and industrialization of more complex and reliable management platforms, the control of locally bounded assets seems to be a reasonable value proposition to private and public stakeholders for new urban districts as well as at wider city infrastructure projects. Although the integration of multiple services providers might sound as an appealing business case, the challenge relies on the value creation and redistribution among the involved parties. In multi-level and multi stakeholder type of systems as the electric grid is, this equation is a real challenge and its viability yet to be proved.

5.1.5.1.2.2 Complete description

Motivation and problem statement

Currently flexibility services from different decentralized energy conversion or storage systems are considered and managed as a nationwide distributed network of controllable assets. Therefore, a big gap exists between the local bounded needs of a single customer and the nationwide electricity market. So there's little channelling of a tailored value towards local communities as for new district projects, do neither to its end-users, real estate developers or public infrastructure operators. The instauration of a

DSO market might foster this type of solutions however, the energy market conditions and related regulatory framework, are not aligned yet to justify the development of such a market. Nevertheless, currently different public financed research projects are underway, which explore possible market design options. As a consequence, other, new ways of channelling the value from operation of local infrastructure and decentralized energy conversion or storage systems should be explored.

Solution approach

The demonstration aims at identifying how local interwoven energy management systems could be optimized via an additional service layer, in order to provide more value to the involved stakeholders among the related value chain. The hypothesis is that a pre-aggregation or simply "local aggregation" of assets bounded to a certain geographical area, can provide levers to better manage local energy flows, to provide more reliable flexibility to the energy markets while generating added value also to underlying assets' owners. This clearly without destabilizing the operation of such infrastructures or the local public distribution grid.

OPF Objective Functions

The objective functions to be implemented for such new layer is expected to leverage from the scale effect of the aggregation of the different load and production curves. The exact objective function is yet to be defined, as it has to leverage from the knowhow generated from the maturation of the solution among the different UC explained before. It might be argued that the optimization should be able to increase the reliability and/or availability, so the volume and/or diversity of flexibility services. It is not excluded that such hypothesis might not be achieved as geographical vicinity might not be able to create additional value to the involved stakeholders and end users alike.

General sequence of actions

During the previously described UC/measures implementation (UC 1 to UC 4), the information will be historicized (so saved under a structured database) to create enough reference cases to develop and test the additional optimisation layer. Thanks to this information base, the emulation (modelling) of further case study objects can be achieved, used in the final steps, to assess possible scale effects. First, it will be tested if forecast and optimization functions from the EMS, can be ameliorated by combining under a common forecast and optimization layer both underlying systems – UC 5.1. This work will be further enriched by adding an emulated pool of further decentralized assets – UC 5.2.

5.1.5.1.3 Use case conditions

5.1.5.1.3.1 Assumptions

- The assumptions from the underlying UCs have to be integrated into this UC.
- The before cited Art. 199, will not be considered as business case for the current UC, as no reference methodology nor related assessment request is given.
- UC 6 - IS 2.3, will not be integrated into the assessment

5.1.5.1.3.2 Prerequisites

- The prerequisites from the underlying UCs have to be integrated into this UC.
- The underlying UCs have proven to be technical feasible, accompanied by results that indicate that also their financial feasibility might be achievable in the mid-term.

- The information database from IS 3.1 / UC 3 has also to be made accessible to the current UC in order to have a complete assessment from the integration of IRIS related actions.

5.1.5.2 Technical details

5.1.5.2.1 Systems and associated actors/tools

The interfacing of EMS can be done almost in real time within the premises of EDF S&F, as the EMS are in continuous synchronisation with their in-house servers. This enables to directly test the development of the UC by using the in-house software and developed tools and algorithms.

Therefore, the assessment will not need any additional hardware implementation or API development.

5.1.5.2.2 Sub Use cases

5.1.5.2.2.1 UC 5.1 / EMS Interfacing

The forecast and optimization algorithms will be applied to the incoming monitoring data from the UC 1, 2 and possibly also UC 3, and their optimization outcomes be compared to actual forecast and optimization results. By this ex-post optimization work, a direct comparison to the previous UC performances should be achieved. The outcome will be a precondition to trigger the decision to further investigate implementation possibilities and further develop the current UC.

5.1.5.2.2.2 UC 5.2 / Emulation of EMS network

The different historical data will be used as reference data, to be enriched with stochastic models in order to simulate the behaviour of an increased number of underlying, connected, systems. The EMS optimization will thus be applied to a larger set of input case studies. The results will be evaluated towards the performance of providing more reliable and available energy services. This will put light on potential business model and associated value propositions, which can be achieved by a LEMS.

Schemes and diagrams of the sub-UC can be found at the end of the document under: Annex 1 – technical details IS 2.1

5.1.5.3 Societal, user and business aspects:

5.1.5.3.1 Business model

The LEMS is as said, believed to provide additional value for a market aggregator, as proximity might result in a meaningful predictor to ameliorate flexibility forecast as well as the scale factor ameliorate further the forecast accuracy (compared to separate, distributed optimizations as happens under UC 1, 2 and 3). This might lead to a better value proposition to the energy market stakeholders and justify the development of new offers towards new or existing districts and city areas targeting specific involved stakeholders. The LEMS could so come as a "reinforcement" of the previous UC business models.

Nevertheless, in the case of new urban areas, the deployment of an LEMS might have to be seen as a rather long-term process as it will bounded to the engineering, construction, operation processes for the different real estate developments and have to bridge the time towards a full rate of usage of a district in order to achieve a stable operation and thus, enable to run the LEMS as a rather homogenous process. This is actually the situation that can be found in the Nice demo area: a new mixed-used development district in its early expansion. Though the scalability of the business model might be rather achievable, the replicability will have to be questioned, as local conditions might vary greatly among different cities and regions. This would mean that replicability should probably have to deal with large development resources needs and thus, have to revise the overall deployment model.

5.1.5.3.2 Governance

EDF will monitor the project progress, ensure timely achievement of goal and objectives and coordinate the different involved stakeholders; it will support the assessment of the viability of the deployment of a LEMS via direct contribution and further interaction with the involved parties.

EDF S&F will developed and implement the forecast and optimization functionalities for the LEMS and the evaluation of the feasibility of the UC; it will support with its know-how, the definition of the assessment's technical specifications and support the identification of possible business models for the UC.

AGREGIO will accompany and support the LEMS related work with its know-how about current and possibly short terms developments of the market; in case the LEMS has proven to potentially provide added value compared to its underlying UC, it will participate to the arbitration of an implementation of the UC, the development of the current UC and in if needed, support the demonstration activity.

MNCA will ensure the coherence with the overall actions among the project and manage the interfaces with other LH and follower cities; potentially they could support the identification of value propositions as being a local public authority and therefore, a potential client for a LEMS.

IZIVIA will participate to the work development via the integration of UC 3.

UNS/IMRTEDD and NEXITY, in addition of being involved via the underlying UC, they could further support, as MNCA, in the identification of value proposition of an LEMS, as directly concerned from a potential implementation for demonstration.

5.1.5.4 Commissioning Plan

The current UC will in principle not need the commissioning of further infrastructure or hardware. The development of the needed software layers and potential APIs will be not outsourced.

5.1.5.5 Implementation plan

5.1.5.5.1 Planning of activities

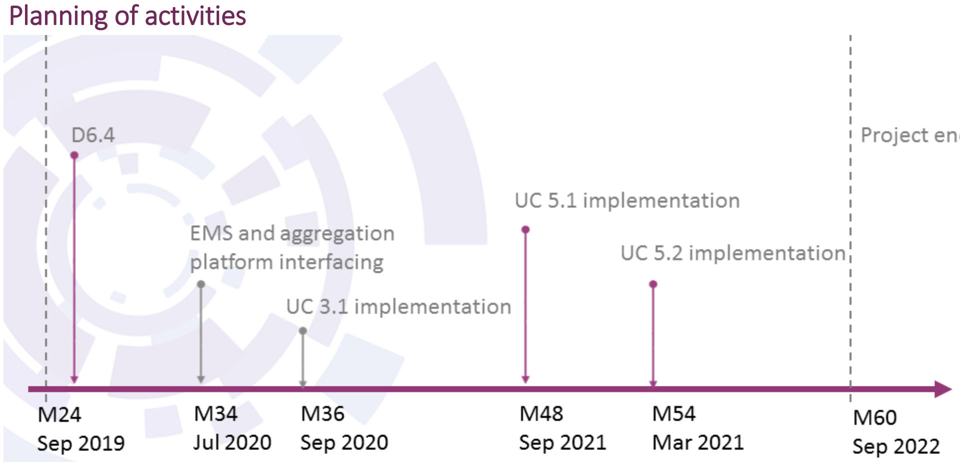

Figure 24 : provisional planning of activities – based on estimate as no dates are given for the main milestones for the UC integration (Source: EDF – EDF S&F - AGREGIO)

5.1.5.5.2 Risk management

1. The main challenge for this UC is the regulatory change. Related regulations are as seen quite recent (<5 years) and are expected to be updated or even replaced. New regulation might influence the outcome of the assessment or force a revision of both scope and objectives.
    a. Ensure that a periodic regulatory watch and inquiry is done, in order to integrate or anticipate regulatory changes within the UC specifications in a timely manner.
2. The business models from the current or underlying UC might proof of not being feasible within a reasonable time frame, so have too large ROI or low to negative IRR.
    a. The evaluation will have to be done in the early stage, in order to be able to readdress resources and reorganise the associated work planning on actions which provide more significant impact.
3. Risk coming for underlying UCs impacting the current UC feasibility or scope.
    a. No direct mitigation measure related to this UC can be applied, except a prompt reorganisation of the UC's scope to reduce the impact on the work and allocated resources.

5.1.6 Impact Assessment

5.1.6.1 Expected impact

As detailed in the DoA and GA, the following are the main targeted impacts to be achieved by IRIS for the whole demonstration under IS 2.1 (the significant impacts for IS 2.1 have been underlined):

- IMPACT 1: Put in practice a bankable solution for a challenge identified by the city
- IMPACT 2: Increase the energy efficiency on district scale
- IMPACT 3: Increase significantly the share of renewable energies, their integration into the energy system, stimulate self-consumption, reduce curtailment to the minimum
- IMPACT 4: Increase local air quality.
- IMPACT 5: Reduce the technical and financial risks in order to give confidence to investors for investing in large scale replication.
- IMPACT 6: Make the local energy system more secure, more stable and cheaper for the citizens and public authorities.
- IMPACT 8: Reduce transport-based CO2 emissions, on the basis of CO2 intensity of the European electricity grid of 443 CO2/kWh (coherent with TEST format - available on the Participant Portal)
- IMPACT 9: Create stronger links and active cooperation between cities in a large number of Member States with a large coverage of cities with different size, geography, climatic zones and economical situations

The first common impact for all UC or measured demonstrated in IS 2.1, have actually the value of being "pilots" for the industry: they represent the first of a kind implementations which should serve as model for further developments and replication. They should provide confidence to related stakeholders and decision makers and promote the further development and adoption of such solutions. This related directly to impact 1 and impact 5 via the demonstration of the measures under IS 2.1.

UC 1 and UC 2 are directly contributing to impact 2 and 3, as part of their objective function and scope is the optimization of self-consumption projects, PV valorisation and curtailment reduction and thanks to it wider upgrade toward UC 4 and 5, they integration into the energy system should be improved. This will contribute directly also to the achievement of impact 5 and 6, as the demonstration will provide financial and exploitation related results.

Thanks to UC 4 and 5, so the integration of local decentralized and RES based energy systems into the wider energy market or directly via aggregation or via the LEMS, will contribute directly to impact 2, 3, 5 and if proven feasible, also to impact 6 for such upper level energy management solutions.

Thanks to the integration of UC 3 – IS 3.1, a contribution to impact 4 and 8 are expected. However, to a lesser extent than the related TT#3 as a whole.

Additionally, through the provided results from the demonstration, it is expected to provide significant contribution in terms of return of experience and results, to such complex debate concerning smart local energy management systems and thus, be integrated into the dissemination, communication and replication activities.

If the UC proof for having potentially a feasible business model, by creating a targeted offer for specific potential client segments, a positive local (but not only) feedback loop could maybe be achieved, accelerating the adoption of the demonstrated measure and solutions. This will be an impact beyond the IRIS project, part of its replication plan.

5.1.6.2 KPIs

Table 1. Summary-list of KPIs and related parameters for Measure IS 2.1

KPI	Parameter(s)	Baseline	Target (as described in DoW or declared)	Comments
Energy savings	PV production [MWh/year] Energy injected into the grid [MWh/year] Defines the energy efficiency achieved by operating the PV+BESS+EV charging system at building level in an efficient manner and reduce thus the energy withdraw from the grid, albeit exogenous factors as grid services or economical optimization within current self-consumption regulation boundaries. This is directly proportional to the PV production which is not injected into the grid.	There is not actual measurable “baseline”. This can be achieved by the retro-calculation of the building electricity withdraw, without PV, BESS and EMS system.	The contribution of this IS to the overall achievement of the TT level KPI will be minor, compared to IS 2.2.	Smart Grids’ objective is the provision of flexibility services to the electric grid, which answers to a national or even European level efficiency objective of the electric system in terms of carbon emissions reduction. Nevertheless, this is just an energy carrier replacement (physical or temporal) via less emitting flexibility sources. This has usually no direct “energy efficiency” repercussion as not inducing a change in global energy volume produced/delivered but carbon emission reduction only.
CO2 savings	PV production [MWh/year] REF electricity CO2 [tCO2eq/MWh] PV CO2 content [tCO2eq/MWh]	The baseline is as in the previous case the retro calculation of the emission volumes which would have been achieved without the PV installation. To this, it has to be added in the same	The contribution to the TT level indicator might be consistent together with the saving achieved by IS 2.2.	In addition to the PV production valorised locally, the volume of provided flexibility can be considered, as said, above, as replacement of more CO2

	This provides Electricity CO2 savings due to PV production, as the difference between the same volume provided via the grid and via PV installation. REF electricity CO2 CHP plant [tCO2eq/MWh] Flexibility volume [MWh] **This provides Electricity CO2 savings from flexibility provision via the "replacement method" so expressed as the electricity CO2 saving between producing the same service volume with a gas CHP plant as compared to PV installations for UC 1 and 2 and from the grid as by UC 3.**	way, the volume of carbon emission that would have been produced by Gas fired CHP plants to provide the same power and volume of flexibility services as under IS 2.1		intensive gas fired CHP plants. So flexibility can be considered as replacing fuel based peak load power plants (gas CHP).
Peak load reduction	MAX elec peak [MW] REF elec peak [MW] **By diving the measured peak load by its reference electricity peak load, the % of peak load reduction can be calculated**	The baseline to be taken, is the electric substation sizing and subscribed maximal power supply as by energy retail contract from each UC. However, the indicator might be misleading in the first period of the demonstration, as far as the case studies reach full occupation and utilization ratio.	The combined effect of all UC will be used TO identify the maximal peak load reduction among IS 2.1 and will together with IS 2.3 provide the reached impact on TT level.	
RES self-supply ratio	PV production [MWh/year]	To assess the improvements from a reference scenario	The overall impact on TT level will have to account also for the	The self-supply ratio could be juxtaposed to the

	Elec consumption [MWh/year] **By dividing this two metered indicators, the ratio of RES self-supply can be estimated.**	would not be meaningful, as it would result in an always positive ratio. Interest here is to identify which proportion of the total energy load can be provided by RES.	ration of RES self-supply for thermal energy via IS 2.2	self-consumption ratio, which would express how much of the locally produced energy is also consumed onsite: produced RES energy/consumed RES energy (not injected into the grid)
Ratio of valorised PV RES	PV production injected into the grid [MWh/year] PV production [MWh/year] **Together with the totally produced PV energy, a ratio can be given on the valorised PV (and so, not curtailed).**	To assess the improvements from a reference scenario would not be meaningful, as it would result in an always positive ratio. It will simply account for the energy that is integrated into the grid via a profit for referring to "the injection of PV surplus properly remunerated".	The ratio is strictly at IS 2.1 level and it will result from the demonstration work.	
Useful storage capacity installed	Cumulative V1G BESS storage capacity activated [kWh] Cumulative 1st life BESS storage capacity [kWh] This will give the total cumulative volume of energy that has been stored, thanks to the BESS and EV management via the EMS/LEMS.	A reference case would not be meaningful as the current reference is the not existence of storage means.	The impact of the current IS, will have to be integrated with the results from IS 2.3	The objective of this KPI is to provide a more meaningful KPI than a sole “installed BESS capacity”. The latter would just give an indication of the nominal capacity in which it has been invested in. With this KPI, it is intended to show the operational impact that has been achieved with the demonstration activity to activate and combine different BESS means.

Battery degradation rate	Nominal 1st life BESS capacity [Ah] Final 1st life BESS capacity [Ah] Number of cycles of 1st life batteries [n] **This will give an assessment of the 1st life BESS degradation rate, due to the demonstration activity.**	A reference case would not be meaningful for this indicator. Actually it becomes meaningful when compared to other BESS as by IS 2.3	The KPI is not bounded to a specific objective, but serves to the knowledge creation via the comparisons with IS 2.3	It has been decide to extend the indicator among all BESS and not only 2nd life BESS, as it becomes only meaningful if it can be cross compared among other BESS technologies.
Increased system flexibility	Number of activations per year Average Power flexibility [kW] Average Energy flexibility [kWh] Average activation duration **Flexibility load ratio can be evinced by the Average Power flexibility divided by the reference Peak Load.**	A reference case would not be meaningful as the current reference is the not existence of flexibility services in the demonstration area.	The system flexibility to be achieved at TT level as to be integrated with the results form IS 2.3. This will give an overall estimation of the impact of the demonstration activity	This is actually the central KPI to be accounted for within the IS 2.1. It is less a KPI than a collection of KPIs. These provided measures are essential to the evaluation of the action and maybe most important value to be diffused among stakeholders involved in the energy value chain.
Energy costs reduction	Expenses electricity [EUR] Income PV injection [EUR] Income energy services [EUR] **Thanks to this indicators, the reduced energy costs incurred by the revenue stream of the PV injection and through energy services can be accounted for separately and by dividing it by the overall energy expenses, defined the**	The reference value is here already integrated into the calculation, to the overall energy expenses without PV injection or energy service revenue streams.	For the assessment of the impact on TT level, the indicators from IS 2.2 have to be integrated.	The overall energy expenses for a client within this IS, are mostly related to new income streams to be accounted for in the overall balance of expenses. This will be a direct indicator of the value proposition that can be achieved by this IS.

	overall cost reduction ratio for the IS.			
Investment cost	This indicator is less clear yet, as the definition of the cope and perimeter of this KPI is yet not harmonised among the LH cities.			The main matter here is that the costs entailed by the project are cumulated cost for a system development, which would result in a too high cost related to "reality". System or technology development is not an expense to be reversed into a "one shot" project, but should be part of a business' development plan and divided into a target number of replication/follow up projects and thus, reduce the costs for the first client. The KPI might thus maybe result from the replication and business modelling activity that a direct value that can be reported by the demonstration activity

5.1.6.3 Monitoring plan

The overall monitoring of the achievements of the actions will be mainly granted by the centralization of information via EDF S&F and AGREGIO and its post processing for nourishing WP9 tasks. The details about the monitoring period of the different measures, are given by the implementation plan described for each sub UC.

For the overall volumes and peak energy consumption and injection metering on the electric grid, ENEDIS will provide the aggregation of the information stored in their data centers.

For the assessment of the detailed information "behind the meter", EDF S&F and also AGREGIO, will systematically collect the information and store it on their servers (however, the agreement of the data owners will have to be provided for their exploitation). This will enable the tracing of globally all KPIs that are need for the impact and objective assessment as by WP9.

5.1.7 Progress achieved up to M24

The main achievement during this preparatory phase to the procurement and implementation phase has been the definition of the UC description and its articulation via a coordinated work under TT#2 but also a successful cooperation and information exchange work with TT#1 and TT#3.

This documentation can now be used to prepare and better articulate the contractual arrangements to be agreed on among all involved parties to ensure a successful demonstration activity. This is due to the detailed description of all main actions (UC and sub-UC) related to each and every implied case study in terms of scope and timing and the relevant roles and liabilities of each involved party. The underlying assumptions and prerequisites have also been identified as well as related risks.

At the time being, UC 1 and UC 2 seem to provide direct value to the final user however the acceptance of UC 4 and UC 5 have yet to be tested, as no contractual agreement has been achieved so far. For UC 2, an exclusivity contract among the involved parties has been signed, securing the risks related to their implementation. However, this has not been achieved yet for the overall demonstration activities among the other UC.

5.1.8 Conclusion

The return of experience so far achieved via this preparatory phase, does endorse the hypothesis that the implementation of an overall business use case as for IS 2.1 of a LEMS, might be a rather long-term process. It has been proved that a strong and tight collaboration with the overall design and engineering phases of building and other infrastructures, is unavoidable for avoiding extra costs for its realization. This is a very resource consuming process and with no direct/immediate tangible value for other involved parties (except for the EMS provider) as adaptations result mostly in increased costs: or due to additional (not foreseen) ICT infrastructure, or simply because the engineering phase planning did not include crucial working steps and thus, the work has to be readjusted.

Moreover, it has shown the complexity of such multi-stakeholder type of approach which needs much coordination and cooperation among the parties for stabilizing towards clear technical and functional requirement and the resulting contractual arrangements. These are also related to short and mid-term uncertainties toward a clear customer promise, due to the many uncertainties related to real estate development projects and other public infrastructure projects and the early development stage of the proposed solutions under IS 2.1.

What might to be specified, is that at current state of the market, all investment costs for realizing an L/EMS are beard by the real estate owner/developer. The manner to redistribute costs among future building operator, a co-ownership entity as owner and/or tenants, among the various space purchase prices, operation fixed and variable charges, has yet no clear norm or reference method. Within the demonstration activity of IRIS this does not represent an obstacle but would have to be clearly addressed for possible future industrial projects.

For reducing the complexity and possible risks of a non-viable business model for the LEMS, the action has been broken down towards single business use cases which can be integrated in a sequential manner. So, by climbing the ladder from the single EMS as in UC 1, UC 2 and UC 3, towards UC 4 and UC 5, the value proposition can be ensured at every step. While increasing the complexity of the management system, it should enable to decide when the limits for a bankability are reached and arbitrate on the follow up or not of the UC implementation and demonstration, so to avoid to implement non-added value actions towards impact and objectives of the project.

5.2 IS 2.2 – Smart district heating with innovative storage

5.2.1 IS 2.2 - UC 6 / Smart DHCN

5.2.1.1 Description of the Use Case

5.2.1.1.1 Goal, Objectives and Scope and of the use case

Goal: demonstrate the energy and environmental performance gains of a geothermal DHCN combined with thermal and electrical storage means and a smart exploitation system.

Objectives:

- Implement a district scale supervision platform for all energy flows
- Integrate AI algorithms to ameliorate the exploitation performances of the DHCN
- Further integrate the management of heat (distributed PCM storage - Phase Change Material), cold (centralized ice storage) an a centralized BESS storage solutions
- Develop flexibility offers towards energy services for end users
- Assess and test the pre-aggregation of flexibilities towards the LEMS

Scope:

The UC is driven by its long term mission under the Public Delegation of Service (PDS) in providing heating, cooling and possibly other energy services to the end users under the catchment area of the DHCN (but not only). The geothermal based DHCN is a first of its kind development for the city of Nice and will give important feedback for further, similar type of replications. The integration of an AI driven supervision platform will provide valuable experimentation for the industry on possible energy savings and further flexibility driven hybrid systems integration.

5.2.1.1.2 Narrative of Use Case

5.2.1.1.2.1 Short description

The demonstration will be conducted within the perimeter of the first DHCN customers, all new real estate developments of the Nice Meridia district. The supervision platform to be implemented, will use in a first step, AI algorithms to optimize the production station's thermal and the network's hydraulic balance. The optimization towards energy services and even flexibility offers (thermal and electrical) to end-users will further be explored.

In a second step, as the catchment area growth in terms of connected final users, thermal storage will further support the exploitation performances of the DHCN system. In total, 3 type of storage will be available on site (plan yet to be defined): cold storage via a centralized ice storage, heat storage via an innovative PCM based distributed thermal storage and a BESS at the production site.

5.2.1.1.2.2 Complete description

Motivation and problem statement

DHCN sourcing energy from waste or RES, use HP as heat and/or cooling generation mean. The sizing and operation of such systems is usually heating and cooling load driven. Exploitation systems provide usually little optimization towards a more efficient steering of the heating/cooling energy production based on energy tariffs. Within such configuration, little is leveraged from the integration of a DHCN thermal and electricity loads, nor at centralized level nor decentralized one.

Storage means are an additional option to limit overall energy source and production systems' sizing and provide energy efficiency performances to the overall system exploitation. Nevertheless, the preferred or simply most diffused form of thermal storage solutions is water storage tanks. Other storage means as ice –storage or PCM storage are yet at the piloting stage in France.

Solution approach

To ameliorate the exploitation performances of a DHCN, dedicated forecast and optimization systems are coming to market. However, less explored is the performance that an AI based system can provide under a data driven approach. This is one part of the demonstration under IS 2.2.

The geothermal based DHCN will further be equipped with centralized ice-storage, substation level distributed PCM based thermal storage and a centralized BESS. The optimal operation of the system should be able to leverage from such storage means and other connected assets, from the coupling between the thermal and electricity grids. The system could be run in a flexible mode and thus, represent a district level pre-aggregator of flexibility services.

OPF Objective Functions

The first demonstration concerning the optimization of the thermal and hydraulic systems, will leverage from AI derived method, as Deep Learning and other data driven methods, maximising the exploitation performance of the network via better forecast and optimization modules. This will be achieved by training the platform on historic data series and identify new optimization levers.

Further, the impact that decentralized, building substation level, optimization strategies can have, will be assessed. This will depend also on the commercialization that can be achieved within the district area for flexibility or energy performance related services.

Once the different storage means have been integrated into the DHCN system, the management platform should have new levers to exploit and enhance the exploitation performance. Thanks to such deployed means, thermal and electric grids can be optimized in a mutual way. The DHCN and its related control assets could thus become a pre-aggregation type of platform for local flexibilities.

General sequence of actions

The current priority of the works for the DHCN, are focusing on the deployment of the piping infrastructure and connection branches which overlay with other infrastructure projects among the district (as real estate, light rail or water lines).

Once the first customers are connected and all systems are delivered, the monitoring platform will be nourished by exploitation data. Those will be used afterwards for the training of the AI and tests new operation forecast and optimization strategies. If the assessment reveals successful, the operation system will be updated accordingly.

Thermal storage at the substation level should be rolled out next and be integrated within the overall operation strategy. Once the customer pool will reach the targeted commercialisation rate, the ice storage will be installed and run under a peak load shifting type of strategy.

5.2.1.2 Technical details

5.2.1.2.1 Systems and associated actors/tools

The DHCN related distribution network as shown in the figure below, will account for 5,7 km of pipes for hot/cold water system and 1,6 km for the geothermal water system, connecting the production unit to end-users (as tertiary, educational and housing estates). The source is composed of 2 wells (5 wells at the maximum district extension), to be drilled from the end 2019 onwards, up to early 2020 when it should then be connected to the production site. At the same time, 2 other wells (8 wells at the maximum district extension) will be drilled, serving to re-inject the geothermal water into the groundwater, after having passed the production site. The two first connected and supplied buildings will be NEXITY's "Palazzo Meridia" and UNS/IMREDD's educational buildings as delivered under IS 1.1.

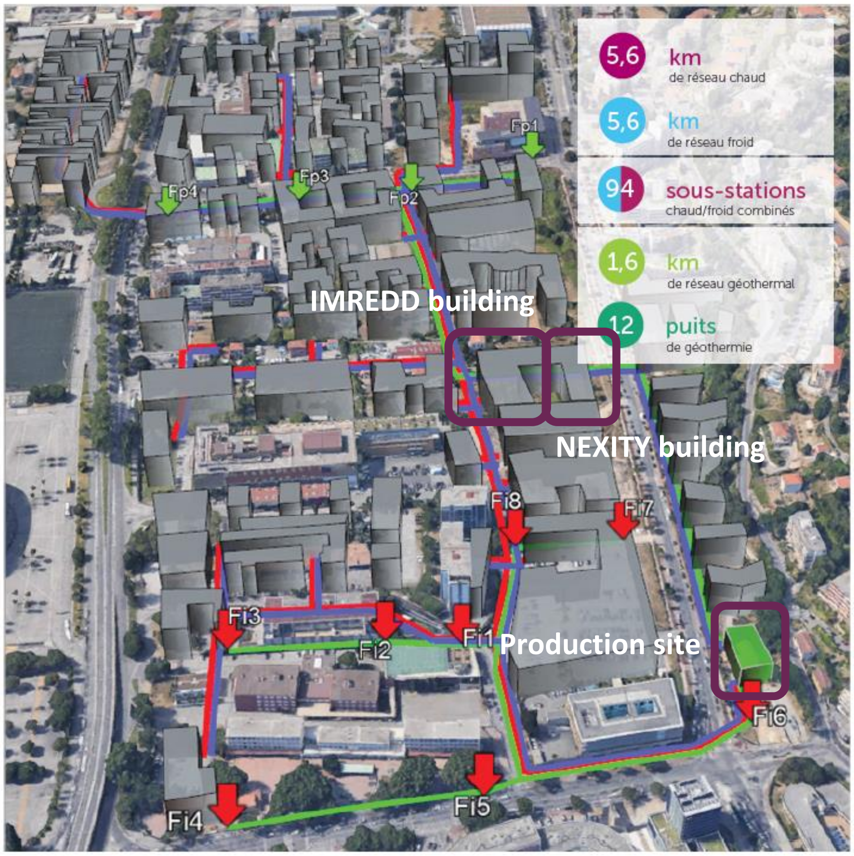

Figure 25 : bird eye view of the 3D model of the future service perimeter of the DHCN. Red and blue lines = supplying network; Green line = geothermal network; Green cube = production unit; Red downward arrows - Fi = groundwater injection well; Green upward arrows - Fp= groundwater pumping well (source: MNCA)

During the first winter period (2020), MSE will supply these building by a temporary diesel unit for heating and centralize air conditioning heat pump for cooling the building.

The geothermal network and the heating/cooling supply networks are hydraulically disconnected by exchanging calories via a heat exchanger unit located in the production site building. The production unit will be the heart of the energy supervision system of the DHCN.

Figure 26 : architectural rendering of the foreseen production site building. The building should be delivered by October 2020 (source: MNCA)

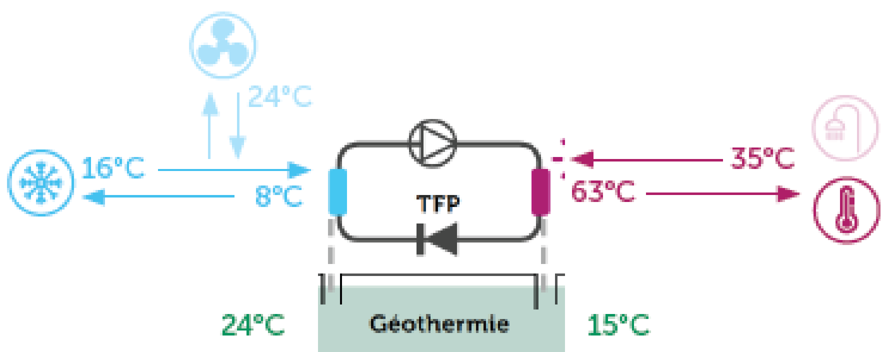

Figure 27 : Schematic representation of the temperature regimes between the geothermal and heating and cooling networks (source: MNCA)

A ring of optics fibre will connect each client with the energy station's exploitation system. Terms of agreement between a service provided by MES and the client, should permit to use such data to provide a broad panel of building supervision services. The new real estate projects on the area should be delivered as "smart-grid ready buildings", so it is expected that related BEMS (Building Energy Management System) functionalities can be integrated. Thus, the BEMS itself or by directly interfacing single building sensors, client-side metering should be made accessible to the local MSE supervision platform, passing via local intra building hubs. Data could be of various natures as for e.g. from EVCI or building BESS. All the system should be operated under IP and open services.

Via the local laid optic fibre based ICT network, heating, cooling, power and electrical consumption and production sites' metering, will be centralized under secured VPN real time data into the MSE data warehouse. This is the first level of MSE smart grid energy supervision service.

No additional information has been provided so far by the DHCN operator on other relevant assets.

5.2.1.2.2 Control variables
No further information is provided on this topic by the DHCN operator.

5.2.1.2.3 Sub Use cases
5.2.1.2.3.1 UC 7.1 / Thermal EMS
This UC focuses on the deployment of the MES supervision platform and related enhancements. It will centralize all metered DHCN related data streams in a central platform, as well as other assets operated under the MES brand. This “data-lake” will be used to develop new and/or more reliable forecast and optimization strategies for energy production and storage as well as for the distribution network pumping operation.

5.2.1.2.3.2 UC 6.2 / Storage integration
In order to downsize the overall production site and its related peak load, ice-storage and PCM based substation level storage means will be deployed. Their integration into the DHCN management system, should provide new levers for ameliorating the overall operation performances of the network. Considering the operation of the system under a flexibility pre-aggregation strategy, the DHCN system itself and further potential clients’ assets, could be operated towards flexibility provision for the electricity grid.

5.2.1.3 Diagrams of the use case
No further information is provided by the DHCN Operator, which could reach this level of detail.

5.2.1.4 Societal, user and business aspects:
5.2.1.4.1 Business model
The business model around geothermal heating and cooling networks under a PDS market, is actually regulated by the public authority to a certain extend. The pricing structure is imposed however, the overall financial optimization among investment and exploitation is left to the DHCN operator. Therefore, the end user price will be composed of a fixed fee (connection fee based on the subscribed maximal power) and a variable fee (based on metered consumption), variable among heating and cooling service provision. The operator can furthermore provide additional energy services under it PDS contract, other than heating and cooling provision. These additional revenue streams are limited to a ratio of 20% of the overall turn-over of the DHCN operation however, they are not limited in “nature” of the provided services. The principle is the provision of energy services targeting energy efficiency objectives for clients as well as other offers targeting the control of distributed vRES (variable RES), especially PV, via storage or other optimization means. The overall aim is to use the DHCN as means to leverage from both the electric and the thermal grid. The achievement of such services is however confronted with a yet not totally aware and receptive market.

5.2.1.4.2 Governance
MNCA: is the owner of the DHCN and delegating party of the PDS contract, based on a long term BOT model (Built- Operate-Transfer) with IDEX; it will monitor and coordinate the DHCN’s project progress and support the operator in the achievement of the imposed performances; as LH leader for Nice, it will ensure the realization in coherency with the other IS demonstrations and interface the other LH and follower cities.

IDEX – Meridia Smart Energy: is the operator of the DHCN of Nice Meridia, in charge of designing, constructing, delivering and operating the DHCN under the SPV; similarly, it is mandated for the design, implementation and operation of the exploitation system and performance ameliorations towards the achievement of the imposed references.

EDF – as TT leader, will ensure the coordination with the other demonstration activities under TT#2.

5.2.1.5 Commissioning Plan

Has not been disclosed by DHCN operator.

5.2.1.6 Implementation plan

5.2.1.6.1 Planning of activities

Has not been disclosed by DHCN operator.

5.2.1.6.2 Risk management

1. Construction delays – both DHCN as real estate related
    a. The DHCN needs to be operational at the delivery of the buildings. The time gap between the delivery of the new real estate developments and the termination of the construction works for the energy station and piping, is bridged by a temporary solution based on conventional production means.
    b. Delays of the overall district construction progress can impact the economic performance of the DHCN operator and delaying its business plan objectives. The conservative sizing of the system and based on a gradual phasing can hedge against such risk. Storage is here a means to such aim.

2. Limited additional value of exploitation system for overall O&M performances
    a. The DHCN exploitation system might have technological lock-inns to fully leverage from thermal and electricity network coupling. However, thanks to the foreseen storage means, it seems that the current system configuration gives the technical bases to provide flexibility services to the electric grid by an adapted dynamic operation system of the thermal grid and associated storage means.

3. Limited value proposition for energy services by end users
    a. Energy service contracts are under experimentation and have no “on the shelf” roll-out model. The commercial success of commercializing energy relevant services for end users, will be a rather mid to long terms commitment. The risk has yet to be assessed.

5.2.2 Impact Assessment

5.2.2.1 Expected impact

As detailed in the DoA and GA, the following are the main targeted impacts to be achieved by IRIS (the significant impacts for IS 2.2 have been underlined):

- IMPACT 1: Put in practice a bankable solution for a challenge identified by the city
- IMPACT 2: Increase the energy efficiency on district scale
- IMPACT 3: Increase significantly the share of renewable energies, their integration into the energy system, stimulate self-consumption, reduce curtailment to the minimum

- IMPACT 4: Increase local air quality.
- IMPACT 5: Reduce the technical and financial risks in order to give confidence to investors for investing in large scale replication.
- IMPACT 6: Make the local energy system more secure, more stable and cheaper for the citizens and public authorities.
- IMPACT 8: Reduce transport based CO2 emissions, on the basis of CO2 intensity of the European electricity grid of 443 CO2/kWh (coherent with TEST format - available on the Participant Portal)
- IMPACT 9: Create stronger links and active cooperation between cities in a large number of Member States with a large coverage of cities with different size, geography, climatic zones and economical situations

The first impact for IS 2.2 is achieved via its value as for being a “pilot” for the industry and public authority alike, within the Mediterranean context, which should serve as model for further developments and replication. They should provide confidence to related stakeholder and decision makers and promote the further development for promoting the adoption of such RES based systems. This relates directly to impact 1 and 5 via the demonstration of the measures under IS 2.2.

IS 2.2 is indirectly contributing to impact 2 and 3, as part of their scope and objectives is the assessment of the performances of a more advanced management system can achieve via a DHCN operation and other client-side connected assets. This will contribute directly also to the achievement of impact 5 and 6, as the demonstration will provide financial and exploitation related results.

Indirectly, the DHCN solution proposed, displaces in principle single or building sized gas boilers for heating and SHW provision. This implies a significant reduction of local emissions from such fuel-based energy production means and consequent amelioration of the air quality. This related to impact 4.

5.2.2.2 KPIs

Table 2. Summary-list of KPIs and related parameters for Measure X / Building Y (one table per building/installation/measure) [example of KPI (Thermal) Energy savings]

KPI	Parameter(s)	Baseline	Target (as described in DoW or declared)	Comments
Energy savings	REF heating energy [MWh/year] REF cooling energy [MWh/year] Heating energy provided [MWh/year] Cooling energy provided [MWh/year] **By adding the relative savings among cooling and heating energy, the total thermal saving can be assessed.**	The baseline is the current heating and cooling market situation: gas boilers for heating and SHW and electric chillers for cooling production respectively.	The contribution of this IS to the overall achievement of the TT level KPI will be of major importance.	
CO2 savings	REF heating coeff [tCO2eq/MWh] REF cooling coeff [tCO2eq/MWh] Heating produced coeff [tCO2eq/MWh] Cooling produced coeff [tCO2eq/MWh] **By adding the saving respectively achieved for the heating and cooling energy provided to the customer pool, the total CO2 savings from the DHCN can be assessed.**	The baseline is as in the previous case.	The contribution to the TT level indicator might be consistent together with the saving achieved by IS 2.1	
Peak load reduction	REF heating peak [MW] REF cooling peak [MW] MAX heating peak [MW] MAX cooling peak [MW]	The DHCN system is "new", so the peak load reference will have to be estimated. It is possible to compare the metered peak loads and be assessed against	The combined effect of all IS of TT#2 will be added to identify the maximal peak load reduction achieved.	

	REF elec peak prod [MW] MAX elec peak prod [MW] **By diving the measured peak load by its reference heating, cooling and electricity peak load respectively, the % of peak load reduction can be calculated**	the actual cumulated subscribed peak loads from customers.		
RES self-supply ratio	Heating provided [MWh/year] Cooling provided [MWh/year] Elec consumption aux. heating [MWh/year] Elec consumption aux. cooling [MWh/year] **By dividing these 2 metered indicators, the ratio of RES self-supply can be estimated and via a weighted average, assess the overall impact of the IS 2.2.**	To assess the improvements from a reference scenario would not be meaningful, as it would result in an always positive ratio. Interest here is to identify which proportion of the total energy load can be provided by RES.	The overall impact on TT level will have to account also for the ration of RES self-supply from IS 2.1	
Energy costs reduction	REF heating expenses REF cooling expenses Heating expenses (fixed+variable) Heating expenses (fixed+variable) Reduced heating and cooling costs can so be calculated as the cumulated savings from the current energy bill compared to a BAU reference.	The reference value is here apply as for the first two indicators.	For the assessment of the impact on TT level, the indicators from IS 2.1 have to be integrated.	
Investment cost	This indicator is less clear yet, as the definition of the cope and perimeter of this KPI is yet not harmonised among the LH cities.			As for IS 2.1, the harmonisation of the approach has to be waited for. Nevertheless, this information can be

				provided with relative ease one of the obligations resulting by the PDS contract.

5.2.2.3 Monitoring plan

As explained the section before, monitoring will be part of the DHCN operation practice. All data will be centralized by the DHCN operator at the production site. This will ensure all needed data can be queried for the assessment of the above cited KPIs.

5.2.3 Progress achieved up to M24

An insight into the current progress of the construction works of the DHCN project have been given in section 2.3.2.

Currently the works are on time and no deviation has been reported towards the wells' drilling, piping works or client connections. Below an overview is given on the connection work for the NEXITY building.

Figure 28 Photos from the pipe trenches construction work in April 2019 for the connection of NEXITY's building - A: trench digging; B: pre-insulated piping laying; C: Palazzo Meridia connection; D: trench closing (source: MNCA)

5.2.4 Conclusion

The DHCN tendering process has led to a change in the local configuration of the demo site involved parties, similarly as for TT#3. Nevertheless, it has been managed to coordinate the new parties and maintain the scope and objectives of the demonstration. The so far planned system configuration is in principle ensuring that the foreseen impact can be achieved and objectives maintained. It is expected that the real estate development will impact the performances of DHCN operator, as yet most of the catchment area is yet not constructed or under construction. This will need to wait the connection of a consistent pool of customers in order to be able to achieve noticeable performance improvements via a smart exploitation system and storage means.

5.3 IS 2.3 - Utilizing 2nd life batteries for smart large scale storage schemes

5.3.1 IS 2.3 - UC 7 / 2nd life battery

5.3.1.1 Description of the Use Case

5.3.1.1.1 Goal, Objectives and Scope and of the use case

Goal: Compare the performance of stationary 2nd life BESS and the viability of providing the same building services via V2G technology. Additionally, characterize the aging of the 2nd life BESS.

Objectives:

- Monitor and assess the aging behaviour of 2nd life BESS
- Identify the techno-economic performance of 2nd life BESS to provide building relevant service in comparison to 1st life ones
- Identify the techno-economic performance of EV BESS via V2G technology to provide building relevant service
- Provide a direct comparison of such two technologies to sustain building relevant services for PV absorption as well as peak shifting/shaving.

Scope: demonstrate the respective techno-economic performances of 2nd life BESS storage and EV BESS via V2G technology for providing building relevant services in the framework of a building individual self-consumption endeavour. Monitor, assess and evaluate the performances of such systems and clarify their relevance for the industry aiming at providing building related services. Therefore, similar BESS capacities are foreseen to be installed, simplifying such an assessment.

5.3.1.1.2 Narrative of Use Case

5.3.1.1.2.1 Short description

The UC will be a combination of BESS charge and discharge cycling procedures, in order to assess their performances in supporting an individual self-consumption endeavour by absorbing PV energy and providing consumption load's peak shifting and peak shaving.

The current UC or IS, has to be isolated from the previous UC or IS, defining temporal slots for their activation and ensure to not overlap with UCs entailed in IS 2.1. For this, an experimentation calendar will be defined, providing under a control environment (BESS capacities to be activated, cycling typology and similar PV production and load environments) an effective mean to provide such comparison.

5.3.1.1.2.2 Complete description

Motivation and problem statement

2nd life BESS aren't a mature industrial product and are in general still at the prototype stage. So the car or BESS industry, are yet not equipped by means which would enable a large scale roll out of such technology. Similarly, the characterization and definition of a "second life" of BESS in not normalized nor has a consent from the scientific and industrial community yet been achieved.

The performance in terms of energy density (per volume and weight) is less competitive compared to 1st life BESS, needing almost double the space to reach similar capacities. This is a big burden for the construction industry, aiming at maximizing the use of floorspace. Similarly, the uncertainties related to their state of health and durability make an uptake of the technology difficult. The proposed prices by the few existing manufacturers/providers are also not very competitive against 1st life BESS.

For what concerns V2G technology, is at the very early stage of diffusion and a standardization is yet not given, making real life demonstration important to raise awareness and confidence from the market to adopt such kind of technology. Yet not fully competitive in terms of costs compared to V1G technology, its upper value has yet to be validated. Industrial offers are currently developed however, bounded to the residential sector, usually for individual property owning customers. In this framework, services for the tertiary sector are far from being standardized or generalized and barely developed in the French context.

Moreover, it could be stated that these 2 technologies are in direct competition: V2G technology is strongly boosted by the car industry and its uptake is related to the diffusion of V2G capable cars. However, 2nd life BESS are as said before, having less drivers for their adoption as compared to 1st life BESS. In case V2G technology can provide services with similar or even better performances than 2nd life BESS, the latter would be a redundant investment and thus, make 2nd life BESS less competitive or even obsolete. It could be state that the second life of BESS should then be focused on the revamping, so on the complete chemical overhaul, for making them competitive in terms of costs per energy density to 1st life BESS.

Solution approach

The demonstration aims at creating a direct comparison among these 2 technologies, by providing under same storage capacities and imposed charge and discharge cycling against similar environmental conditions.

For this, an experimentation calendar will be defined so to ensure comparison can be simplified. This will have to be done in careful evaluation of the other UCs objectives and scope.

The so retrieved information will enable to have comparable indicators for either type of storages in terms of for e.g. energy performance, temporal availability or aging behaviour. The economic performances will then be assessed in consequence and enable to give a business model projection under the give case study building.

OPF Objective Functions

The objective functions to be implemented for the 2 batteries' types/UC are in principle as for the UC 1 nevertheless, the scientific approach is here the priority and thus, the objective function will be the cycling of the batteries charge/discharge for performance assessment methodology that will have been developed. By integrating the charging of the BESS in a controlled manner, their performance is storing and releasing PV produced energy can be assessed and similarly, by discharging in a controlled manner, assess their performance in providing peak shaving and shifting. The degree of optimization capacity and its exact interfacing mode with the EMS provided in UC 1 have yet to be settled.

General sequence of actions

For this use case, the priority is to set up a consistent metering and energy management methodology, in order to correctly characterize the 2 BESS behaviour. The challenge relies in comparing different BESS technologies and which might undergo different usages (mostly for the EV BESS).

Then the 2nd life EV BESS stacks have to be equipped with the required metering equipment to measure their performance and asses their aging behaviour during the project duration.

Similarly, the correct interfaces and protocols to access and steer the V2G charging pole will have to be developed. Through this, the needed information from the EV batteries' as for assessing aging behaviour and performances have to be accessible, at least during their stop, so while being connected to the charging pole. During their use as for mobility purposes, data access might be limited if not impossible.

A dedicated EMS will have to be set up as well as a related experimentation calendar (based on UC1 return of experience and/or forecasts) and thus, the assets can be tested via a series of charging/discharging cycles, enabling to achieve the set objectives of assessing their performances and aging behaviour. This means that the EMS as developed under UC 1, should or be managed under a dedicated operation mode or at least, ensure the calendar is build up in a way that it does not interfere with its performances.

5.3.1.1.3 Use case conditions

5.3.1.1.3.1 Assumptions

- For the operation of the self-consumption endeavour as well as the operation and maintenance of the overall building installations, UNS/IMREDD will have to pass a contract with a third party. This will in the best case make reference to IRIS and the defined UC thus, exempt the future operator from performance losses due to the demonstration activities.
- Potential overconsumption, so increased withdrawal from the grid due to the demonstration activity compared to a certain baseline, will not be considered or if so, arising costs will be supported by UNS/IMREDD.
- The 2 BESS under this UC, will not participate to UC 4 – Flexibility and will in principle not contribute to the injection of energy to the grid, but only be operated in a discharge mode, when the building has enough load capacity to absorb the discharged energy.
- The experimentation will need the development of an EMS specifically dedicated to the demonstration activity, capable of managing the BESS and the V2G charging pole.
- The duration of the parking time slot will be known, via declarative manner (as for e.g. conform to the demonstration calendar to be set up) or via a dedicate reservation web application.

5.3.1.1.3.2 Prerequisites

- The V2G charging pole that will be installed, will enable to retrieve via OCPP extended protocol the information about the SOC (state of charge) of the connected car and other possible variables and enable to activate-deactivate both charge and discharge functions in a controlled manner.
- The 2nd life BESS stacks will be delivered with an accessible BESS controller.

5.3.1.2 Technical details

5.3.1.2.1 Systems and associated actors/tools

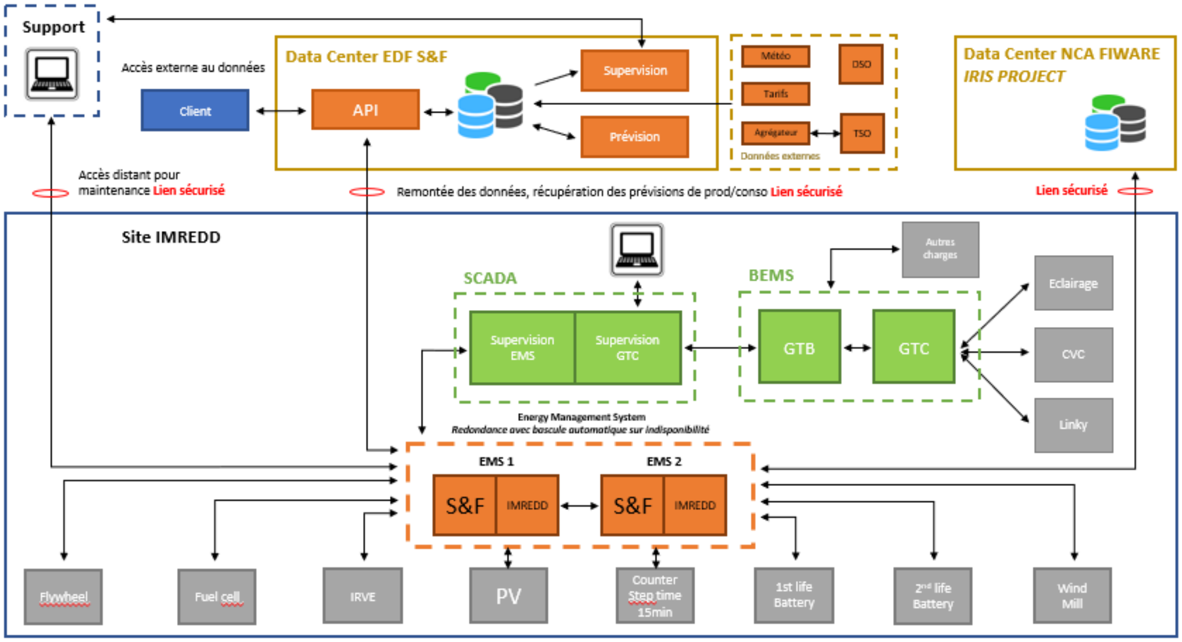

Figure 29 : overall EMS system conception, showing the wider overall system for the IMREDD building to be delivered under IS 1.1 – this should thus be considered as a general guide for the UC implementation (Source: UNS/IMREDD)

5.3.1.2.2 Control variables

List of indicators that can be probably retrieved from the 2nd life BESS:

1. CellUnderVoltage
2. AvailableEnergy
3. AvailablePower
4. CellHighestVoltage
5. CellLowestVoltage
6. CellOverVoltage
7. ChargingPower
8. ClosedCircuit_CellMaxVoltage_Threshold
9. ClosedCircuit_CellMinVoltage_Threshold
10. EndOfChargeRequest
11. GeneratedPower
12. HVB_MaxCapacity
13. HVB_TempMaxAfterChg_Threshold
14. HVB_TempMaxBegCooling_Threshold
15. HVB_TempMaxPerfLimitHot_Threshold
16. HVB_TempMaxSfty_Threshold
17. HVB_TempMaxStopCooling_Threshold
18. HVB_TempMaxStopHeating_Threshold
19. HVB_TempMinBegHeating_Threshold
20. HVB_TempMinPerfLimitCold_Threshold

21. HVB_TempMinStopCooling_Threshold
22. HVBatHealth
23. HVBatInstantCurrent
24. HVBatInternalError
25. HVBatLevel1Failure
26. HVBatLevel2Failure
27. HVBatOverCurrent
28. HVBatOverTemp
29. HVBatOverVoltage
30. HVBatSerialNumber
31. HVBatState
32. HVBatteryMaxTemp
33. HVBatteryMinTemp
34. HVBatteryTemp
35. HVBatUnderVoltage
36. HVIsolationImpedance
37. HVNetworkVoltage
38. HVPowerConnection
39. InterlockBatt
40. IsolDiagAuthorisation
41. LBC_RefusetoSleep
42. LBCPRUNAnswer
43. SafetyMode1Flag
44. UserSOC

List of probably accessible information from V2G charging pole:

1. Active power
2. Reactive Power
3. Energy
4. EnergyMax
5. EnergyMin
6. Maximal power charge and discharge
7. Discharge power charge and discharge
8. battery CapacityCharge and discharge control
9. Selected Payment
10. Selected Charge Type
11. Max Supporting Points
12. Charge Current Max
13. Discharge Current Max
14. Charge Current Min
15. Discharge Current Min
16. Voltage Max
17. Voltage Min
18. Timestamp

19. Set Working Point
20. Set Tariff Schedule

5.3.1.2.3 Sub Use cases

5.3.1.2.3.1 UC 7.1 / 2nd life assessment

The EMS to be developed for the 2nd life BESS control, will integrate as basic function, the control of the BESS in order to enable to implement the methodology developed to assess the aging behaviour and performances of the BESS. Therefore, the EMS will activate a certain cycling mode for charging/discharging the BESS without consideration of optimization factors. In a second step, the EMS might be extended to similar optimization functions as for UC 1 nevertheless, this will need the creation of coherent interfaces to enable the two EMS to work properly and not interfere with their respective optimization functions and performances.

5.3.1.2.3.2 UC 7.2 / V2G services

The EMS to be developed for the 2nd life BESS control, will have to be further expanded to the control of the V2G charging pole and be able to access the information from the EV's BESS. As for sub UC 7.1, the primary objective is to control the charging pole for implementing the methodology developed to assess the aging behaviour and performances of the BESS. Therefore, the EMS will activate a certain cycling mode for charging/discharging the BESS without consideration of optimization factors, except the time slot duration limitations and ensure a correct charging of the BESS for the EV use at the end of the available time slot. In a second step, the EMS might be extended to similar optimization functions as for UC 1 nevertheless, this will need the creation of coherent interfaces to enable the two EMS to work properly and not interfere with their respective optimization functions and performances.

The creation of efficient protocols and interfaces between EMS, V2G charging pole and the EV are here the main scope, as well as to assess and test the potential services to be delivered by such technology to sustain PV absorption maximisation and peak shaving and shifting optimization.

Schemes and diagrams of the sub-UC can be found at the end of the document under: Annex 2 – technical details IS 2.

5.3.1.3 Societal, user and business aspects:

5.3.1.3.1 Business model

The business model concerning second 2nd life batteries and V2G have each separately their own value proposition. The reuse of 2nd life BESS, provide an important value proposition for the whole BESS and automobile industry, displacing BESS recycling by enlarging their useful life-time. Nevertheless, as said before, the little standardisation of the product makes entry investment less attractive and the lack in performance assessment reliability hinders the wider adoption of the technology. Therefore, to be able to better characterize their aging process and related performances for specific building application might be a way to provide more awareness about the technology and possibly rise acceptance among the related sectors.

Concerning the V2G charging pole, the service provision capacity within a tertiary buildings case study is of major importance. The integration of V2G capable EV might be able to offset higher investments by assuring better performances of a self-consumption endeavour. It might be argued that if scaled up, the V2G technology might also participate to the energy market flexibility provision. However, this is here less the focus. As argued before, the proposed business case around V2G should provide meaningful insight into possible ways this technology might impact the 2nd life BESS' business case. If the performances of the latter are comparable in terms of cost and service availability, the 2nd life BESS business UC might have to be revised from its current form, as they would be redundant and probably the first one the less attractive to the tertiary sector. However, this is a hypothesis which will have to be proven.

5.3.1.3.2 Governance

UNS/IMREDD is the main leader on the definition and implementation of the action; it is owner and user of the 2 assets and will integrate them into their educational work program; it will manage the interface with the asset supplier and the related contractual interfaces; it will lead the development and deployment of the demonstration work and related assessment work.

EDF will actively support the demonstration activity through its research & innovation direction; support the elaboration of the experimentation calendar, the metering requirement sand methods and integrate its industrial knowhow; develop partial services to be integrated to the energy management systems for the V2G charging pole management and/or 2nd life BESS; coordinate and support the exchange with EDF S&F for ensuring a coordinated deployment of the UC under TT#2.

5.3.1.4 Commissioning Plan

Table 3 : provisional commissioning plan as by current best estimate (source: IMREDD)

Phase		Activity	Parties involved	Responsibility
1	**Design**	Set up list of requirements	• EDF/IMREDD	• Initiation and coordination of works
		Set up preliminary design	• IMREDD/EDF • IMREDD • IMREDD/Renault/GreenVision	• Coordination and input • Draw the design • Assess the design
2	**Engineering**	Elaboration of the design	• IMREDD/Renault/GreenVision • IMREDD • Renault/GreenVision	• Input for design • Draw the design • Assess the design
		Revenue calculations	• IMREDD	• Set up calculation
		Construction costs calculations	• IMREDD	• Construction costs calculations
3	**Contracting**	Contracting works	• Renault/IMREDD	• Set up and sign contract
4	**Realization**	Preparation of the 2nd life BESS	• Green Vision	• Prepare the hardware
		Preparation of the V2G	• Renault	• Prepare the hardware
		Installation of the 2nd life BESS	• IMREDD	• Installation in the parking lot
		Installation of the V2G	• IMREDD	• Connect all items
5	**Testing**	Test of the system	• IMREDD/Renault • EDF	• Test and report • Assess the report
6	**Completion**	Accept the executed works	• IMREDD	• Handover the installation • Assess the executed works and as-built documents • Accept the installation

5.3.1.5 *Implementation plan*

5.3.1.5.1 Planning of activities

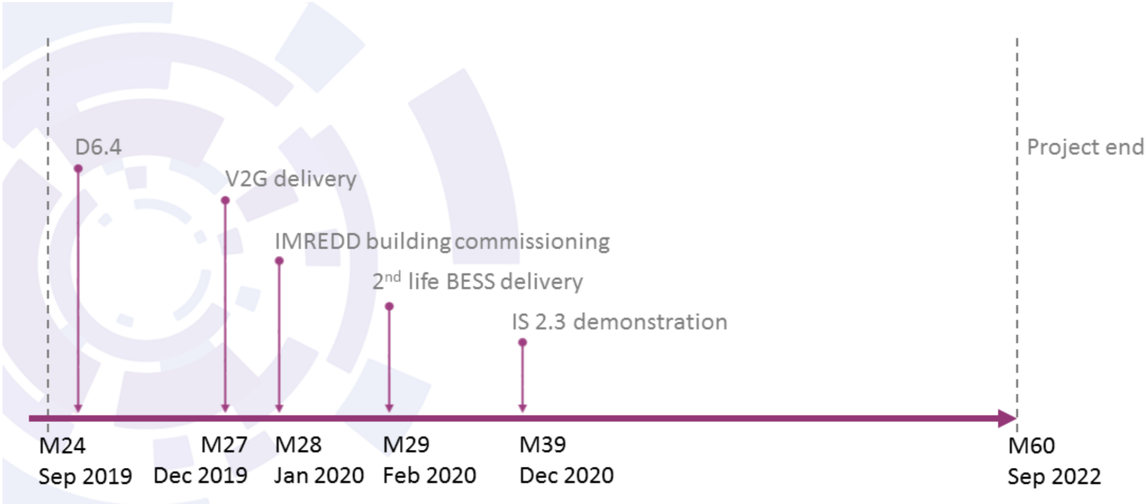

Figure 30 : provisional planning of activities – estimate based on current state of knowledge (Source: EDF – UNS/IMREDD)

5.3.1.5.2 Risk management

1. Limitations of experimentation activities due to contractual limitations with other third parties:
    a. *Future building operator:* UNS has to ensure IRIS activities are integrated into the contractual specifications of the future service provider.
    b. *2nd life BESS, V2G EV and charging pole supplier*: clearly identify the limitations that have to be considered to be included into the implementation plan of IS 2.3.

2. Overlap of demonstration activities or conflict of energy usage among IS 2.1 and IS 2.3
    a. The technical solution so far identified is to integrate a separated mode into the EMS as by UC 1, enabling the current UC to be prioritized in precise time-slots.
    b. A transparent interaction among the different parties involved in IS 2.1 and 2.3 has to be ensured. Possible arbitrations on actions will as far as possible be done in a collaborative manner.

3. Technical limitations in developing comparable experimentation methodologies and calendars among sub-UC 7.1 and UC 7.2
    a. An early assessment on the type of accessible information from both charging pole and BESS control has to be planned.
    b. The definition of a common and compatible experimentation calendar has to be fixed in order to enable the assessment of the impact on other measures tested under IS 2.1

4. Procurement limitations:

a. Power electronic inverter solutions regarding the 2nd life BESS are provided by third party suppliers (foreign). Quality, time schedule and delivery are not guaranteed at the time being.

5.3.2 Impact Assessment

5.3.2.1 Expected impact

As detailed in the DoA and GA, the following are the main targeted impacts to be achieved by IRIS (the significant impacts for IS 2.3 have been underlined):

- IMPACT 1: Put in practice a bankable solution for a challenge identified by the city
- IMPACT 2: Increase the energy efficiency on district scale
- IMPACT 3: Increase significantly the share of renewable energies, their integration into the energy system, stimulate self-consumption, reduce curtailment to the minimum
- IMPACT 4: Increase local air quality.
- IMPACT 5: Reduce the technical and financial risks in order to give confidence to investors for investing in large scale replication.
- IMPACT 6: Make the local energy system more secure, more stable and cheaper for the citizens and public authorities.
- IMPACT 8: Reduce transport based CO2 emissions, on the basis of CO2 intensity of the European electricity grid of 443 CO2/kWh (coherent with TEST format - available on the Participant Portal)
- IMPACT 9: Create stronger links and active cooperation between cities in a large number of Member States with a large coverage of cities with different size, geography, climatic zones and economical situations

The first common impact for all UC or measured demonstrated in IS 2.3, have actually the value of being “pilots” for the industry: they represent the first of a kind implementations within the French context, which should serve as model for further developments and replication (this is valid for the UC as a whole and also for both sub-UC). They should provide confidence to related stakeholder and decision makers and promote the further development for promoting the adoption of such solutions. This related directly to impact 5 via the demonstration of the measures under IS 2.3.

IS 2.3 is indirectly contributing to impact 2 and 3, as part of their scope and objectives is the assessment of the performances of these technologies to provide relevant services as the optimization of self-consumption projects, PV valorisation and curtailment reduction and assess also they integration potential into the energy system. This will contribute directly also to the achievement of impact 5 and 6, as the demonstration will provide financial and exploitation related results.

Via the testing of the V2G technology, a better knowledge about the single contribution that such solutions and the proposed services might have towards the transportation sector and thus, impact 8, but more generally also towards impact 3, 5 and 6.

5.3.2.2 KPIs

Table 4. Summary-list of KPIs and related parameters for Measure X / Building Y (one table per building/installation/measure) [example of KPI (Thermal) Energy savings]

KPI	Parameter(s)	Baseline	Target (as described in DoW or declared)	Comments
Useful storage capacity installed	Cumulative V2G BESS activated capacity [kWh] Cumulative 2nd life BESS activated capacity [kWh] **This will give the total cumulative volume of energy that has been stored, thanks to the BESS and EV management via the EMS.**	A reference case would not be meaningful as the current reference is the not existence of storage means. Instead a cross comparison with other BESS technologies within TT#2 is of interest.	The impact of the current IS, will have to be integrated with the results from IS 2.1	The objective of this KPI is to provide a more meaningful KPI than a sole "installed BESS capacity". The latter would just give an indication of the nominal capacity in which it has been invested in. With this KPI, it is intended to show the operational impact that has been achieved with the demonstration activity to activate and combine different BESS means.
Battery degradation rate	Nominal 2nd life BESS capacity [Ah] Nominal V2G BESS capacity [Ah] Final 2nd life BESS capacity [Ah] Final V2G BESS capacity [Ah] Number of cycles of 2nd life BESS Number of cycles of V2G BESS	A reference case would not be meaningful for this indicator. Actually it becomes meaningful when compared to other BESS as by IS 2.1	The KPI is not bounded to a specific objective, but serves to the knowledge creation via the comparisons with IS 2.1	It has been decide to extend the indicator among all BESS and not only 2^{nd} life BESS, as it becomes only meaningful if it can be cross compared among other BESS technologies.

	This will give an assessment of the respective BESS degradation rate due to the demonstration activity for both 2nd life and V2G.			
Increased system flexibility	**2nd life - Number of activations per year** **2nd life -Average Power Flexibility [kW]** **2nd life -Average Energy Flexibility [kWh]** **2nd life -Average activation duration** **V2G - Number of activations per year** **V2G -Average Power Flexibility [kW]** **V2G -Average Energy Flexibility [kWh]** **V2G -Average activation duration** **Flexibility load ratio can be evinced by the Average Power flexibility divided by the reference Peak Load for both technologies.**	A reference case would not be meaningful as the current reference is the not existence of flexibility services in the demonstration area.	The system flexibility to be achieved at TT level as to be integrated with the results from IS 2.1. This will give an overall estimation of the impact of the demonstration activity.	This is actually the central KPI to be accounted for within TT#2. It is less a KPI than a collection of KPIs. These provided measures are essential to the evaluation of the action and maybe most important value to be diffused among stakeholders involved in the energy value chain.
Investment cost	This indicator is less clear yet, as the definition of the cope and perimeter of this KPI is yet not harmonised among the LH cities.			The main matter here is that the costs entailed by the project are cumulated cost for a system development, which would result in a too

				high cost related to "reality". System or technology development is not an expense to be reversed into a "one shot" project, but should be part of a business' development plan and divided into a target number of replication/follow up projects and thus, reduce the costs for the first client. The KPI might thus maybe result from the replication and business modelling activity that a direct value that can be reported by the demonstration activity

5.3.2.3 Monitoring plan

The BESS is foreseen to be instrumented in case the BESS control won't give access to all needed measurement points, as for the methodology for the characterization of 2nd life of the BESS that yet has to be settled. This will be defined once the 2nd BESS stacks will be delivered and connection test can be done.

The same applies for the V2G charging pole. It is yet not completely clear what information can be retrieved via the charging pole about the EV integrated BESS. So possible complementary metering equipment or development of dedicated APIs can be assessed once the assets are delivered.

The current IS 2.3, is based on the development of locally hosted control and metering equipment. Therefore, the data streams will be stored locally in UNS/IMREDD and ensure the consistency of a historical database for the post evaluation of the implemented control strategies.

5.3.3 Progress achieved up to M24

Thanks to the market watch and direct inquiry of relevant e-car industrial players and 2nd life BESS providers, a comprehensive overview has been achieved on the available products and service provision in the French context, and not only. This has led to the current UC definition, which is actual mirroring the current state of innovation of the sector and can be defined as being on the edge of current industrial knowhow and foreseen developments. The vision of a possible competition among 2nd life batteries and V2G EV associated services, is the result of the acquisition of a comprehensive vision of the sector and the adaptation to the chosen case study building, so a representative mean for the tertiary sector. The interest for such type of UC is validated by the achieved cooperation with the assets provider and the involved partner companies.

5.3.4 Conclusion

The market watch performed by UNS/IMREDD has put light on the current availability of 2nd life BESS solutions among the French industry. It has come to light that the maturity of the technology is yet at is very early stage with very limited providers. The available technological solutions are yet not a standardized or "on the shelf" product. The commercialized products are very specific for each provider and price competitiveness compared to 1st life BESS is not achieved. The lower energy density of such BESS, make them less appealing as the volume of the installation and it corresponding weight (almost doubling at same capacity), can be a major burden for building integrated solutions as in the UNS/IMREDD building and favour the adoption of 1st life BESS instead. The challenge that will have to be addressed in further work is to identify if the efficiency and performance of such system can counterbalance the value proposition towards such negative aspects of the technology.

Similar as for the 2nd life BESS, the market watch for V2G technologies and related providers show the yet little standardization among the sector and the diversity of charging technologies and little development of services. The relation among EV and charging pole is yet a couple that can be hardly discerned one from the other: the choice of a EV will force to use certain charging pole technology and vice versa, choosing certain charging pole technologies will narrow down sharply the EV that are compatible. In the case of the experimentation chosen by UNS/IMREDD, the couple can't be discerned at all. This clearly shows the early market development, in a stage where companies' own property solutions have yet the hegemony, above common standardization.

What could be argued, is that there is yet little development from the car industry of standardized offers which provided a real added value proposition for V2G technologies for the tertiary sector. Although the offer towards the private individual sector, have reached an almost packaged solutions selling them under a "plug and play" type of approach, the services for tertiary customers is far less developed. The V2G service layer for a tertiary customer has yet little, if no appeal at all, and the challenge to integrate it in the wider context of a building is the major challenge. The missing brick is an EMS that can provide the control of all such technologies under a common strategy for a building. The definition of potential added value services, and their associated performances assessment, will be the major challenge to be addressed in the further work development.

6 Summary on monitoring of KPIs

6.1 Expected impact

As detailed in the DoA and GA, the following are the main targeted impacts to be achieved by IRIS (the significant impacts for TT#2 have been underlined):

- IMPACT 1: Put in practice a bankable solution for a challenge identified by the city
- IMPACT 2: Increase the energy efficiency on district scale
- IMPACT 3: Increase significantly the share of renewable energies, their integration into the energy system, stimulate self-consumption, reduce curtailment to the minimum
- IMPACT 4: Increase local air quality.
- IMPACT 5: Reduce the technical and financial risks in order to give confidence to investors for investing in large scale replication.
- IMPACT 6: Make the local energy system more secure, more stable and cheaper for the citizens and public authorities.
- IMPACT 8: Reduce transport-based CO2 emissions, on the basis of CO2 intensity of the European electricity grid of 443 CO2/kWh (coherent with TEST format - available on the Participant Portal)
- IMPACT 9: Create stronger links and active cooperation between cities in a large number of Member States with a large coverage of cities with different size, geography, climatic zones and economical situations

TT#2 has great potential to showcase and put into practice, bankable solution tailored to the chose case study area. In a context of ever-growing share of local decentralized and RES solutions, the emerging adoption of storage technologies and the ever more open and decentralized energy market, seem to give the right premises for more large scale, district scale, management systems which can provide a coherent and harmonized use of energy among a certain geographic area.

More integrate management systems bear the promise of increasing the overall efficiency through better exploitation of the various connected energy assets and infrastructures. This is accompanied by the expectation in terms of technology adoption and better environmental performances as energy efficiency and carbon emission reduction. Nevertheless, the business models implication in such multi-scale and multi-stakeholder type of environment, are a major challenge towards achieving the foreseen impact.

Therefore, TT#2 and its 3 related IS demonstrations have been broken down into single meaningful business UC in order to ensure that while climbing up the ladder toward more complex management systems and business models, the value proposition is ensured at every step and thus, ensure to be able to provide the thought impact and avoid as possible, the set-up of technically feasible but not in the mid-term bankable demonstration cases.

Thanks to the implementation of IS concerning both the electric and thermal networks, a global, multi energy assessment can be achieved and lead to an overall impact assessment at the LH level. The achievement of the impacts from 1 to 8 as above, will influence in how far impact 9 can be achieved.

6.2 Aggregation of KPIs for each LH city

Each LH city has its own set of KPIs that can be related to the IRIS KPI house; the top level of the house containing the IRIS level KPIs (IL) is however the same for all cities. On solution level (STT#1-5), the KPIs may vary between the cities since different solutions are implemented in each city and the cities have different objectives, but in many cases the same KPIs can be found in all cities, thus allowing comparison between the Transition Tracks of the cities. For some Transition Tracks the evaluation of integrated solutions cannot be separated and the KPIs are hence calculated at Transition Track level (TT#1-5). The KPIs for each transition track and possibilities to aggregate them are presented in Table 5.

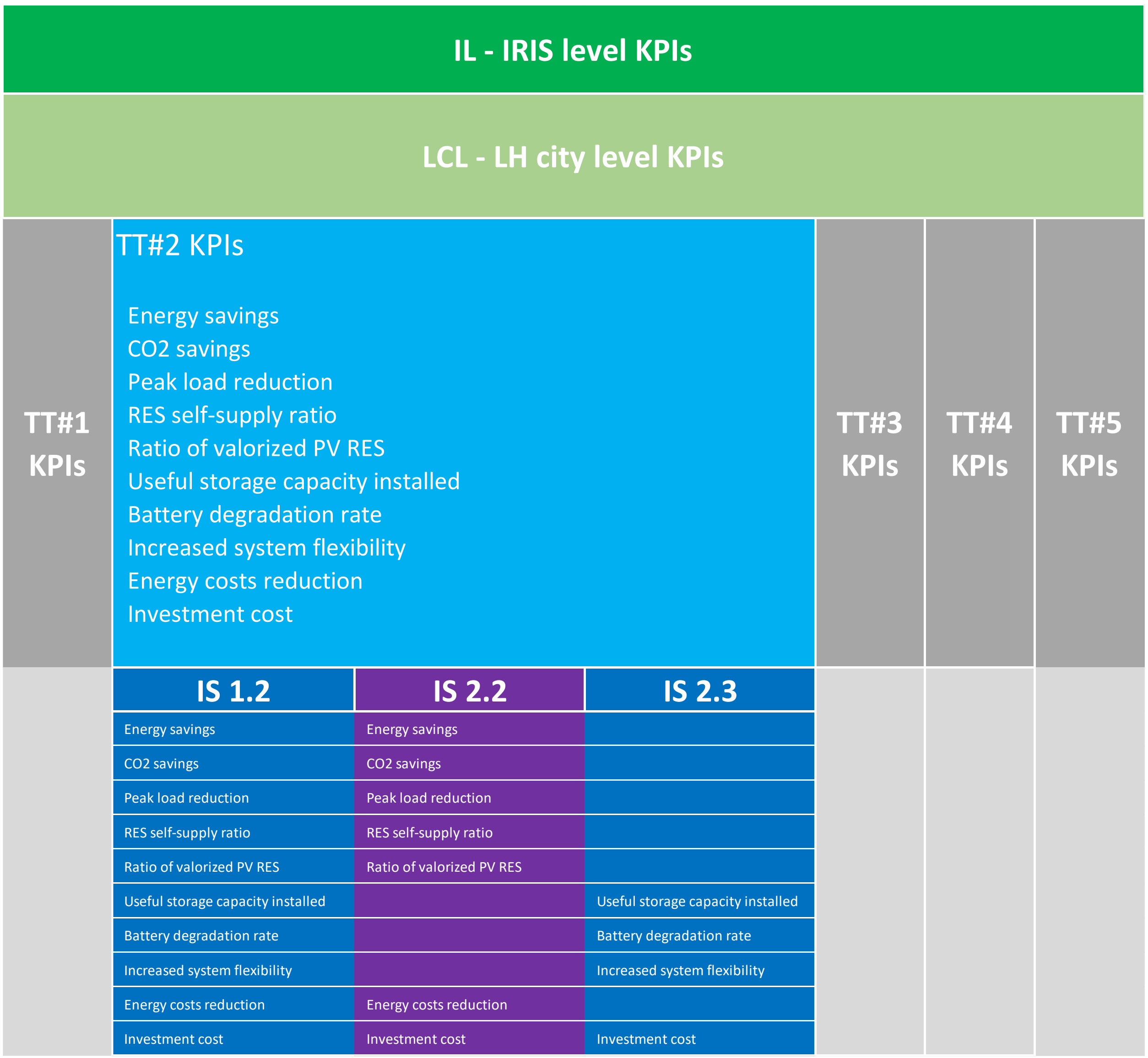

Figure 31: IRIS KPI-house representation and integration of KPIs at TT and IS level. The aggregation towards higher level – LCL/IL KPIs - is done within the framework of WP9 (source: EDF)

6.2.1 Nice

Table 5. Relation and possible aggregation of KPIs to solutions and the IRIS KPI-house in the figure above.

KPIs	Solution	Proposed position in IRIS KPI-house
Energy savings	IS 2.1 IS 2.2	All levels
CO2 savings	IS 2.1 IS 2.2	All levels
Peak load reduction	IS 2.1 IS 2.2	All levels
RES self-supply ratio	IS 2.1 IS 2.2	All levels
Ratio of valorized PV RES	IS 2.1 IS 2.2	All levels
Useful storage capacity installed	IS 2.1 IS 2.3	All levels
Battery degradation rate	IS 2.1 IS 2.3	All levels
Increased system flexibility	IS 2.1 IS 2.3	All levels
Energy costs reduction	IS 2.1 IS 2.2	All levels
Investment cost	IS 2.1 IS 2.2 IS 2.3	All levels

7 Ethics requirements

No specific ethical requirements are identified for this TT.

7.1 GDPR compliance

GDPR does not apply for the demonstration activity of IS 2.1 and 2.3, as in no case, personal information is collected.

In case of IS 2.2, the heating and cooling provision is regulated under public contract and the related use of personal information by the DHCN operator regulated accordingly. It is estimated that the bilateral contract between DHCN operator and clients, entailing whatever complementary service beyond the heating and cooling provision, will comply with the GDPR requirements.

7.2 Ethical aspects

No specific ethical aspects apply to this TT.

8 Links to other work packages

The relation among the TT#2 activities and the other work packages and TTs or ISs, has been fully outlined in chapters 1 and 2.

9 Conclusions and next steps

In the work progress so far, the complexity of the implementation of such multi actor and multi scale type of developments has come to light. The related commercial and contractual coordination requirements are very resource intensive and generally, ad-hoc arrangement with no reference towards previous work, have to be put in place. The openness of the involved parties to participate to such pilot solutions, is the main driver for the so far achieved progress, more than a clear value proposition.

This is on one side a very good indicator of the innovation degree of the proposed demonstrations, nevertheless, they are a big challenge for the whole value chain among technical, legal and financial aspects, and this for all involved parties, not only IRIS relevant partners. The capitalization of the learnings from each of the stages towards a standardized approach, has to be considered towards the scalability and replicability of the proposed demonstrations.

To put the different proposed IS demonstration and underlying measures on an innovation scale, IS 2.3 is surely the most innovative one in terms of technological innovation with very little development of any service layer; IS 2.1 has to address all complexities listed however, service layers are more mature than in the previous case and their integration and coordination towards new value propositions represents the biggest challenge; for IS 2.2 the technological challenge is the main challenge addressed, while the contractual and financial arrangements are regulated by the public authority via the PDS model.

What influences specifically the planning and settling of the demonstration activity in the Nice demonstration for TT#2, is the fact that all involved assets are yet not realized nor delivered. Therefore, the project has to cope with all known risks entailed in the value chain from design to operation and interact with all involved parties. Nevertheless, this represents an enrichment of the project as the whole value chain is experienced.

The follow up work will be mostly focus on two axes: settling of the contractual arrangements and clear definition of the experimentation scope with the various involved parties, as the formal agreement for all involved parties has yet not been secured. This is very important to secure the feasibility of the proposed demonstration activity. Secondly, the technical specifications of all IS proposed under this TT have to be detailed but that only at the pace that the technical endowment of the underlying assets progresses. Once these engineering and procurement related uncertainties are solved, the involved partners can focus on the developments and implementation of the proposed solutions.

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11 Annex 1 – technical details IS 2.1

11.1.1.1 Diagrams of UC 1

11.1.1.1.1 Context diagram per sub use case

11.1.1.1.1.1 UC 1.1 / no PV surplus injection

This process will be completely automatized within the EMS.

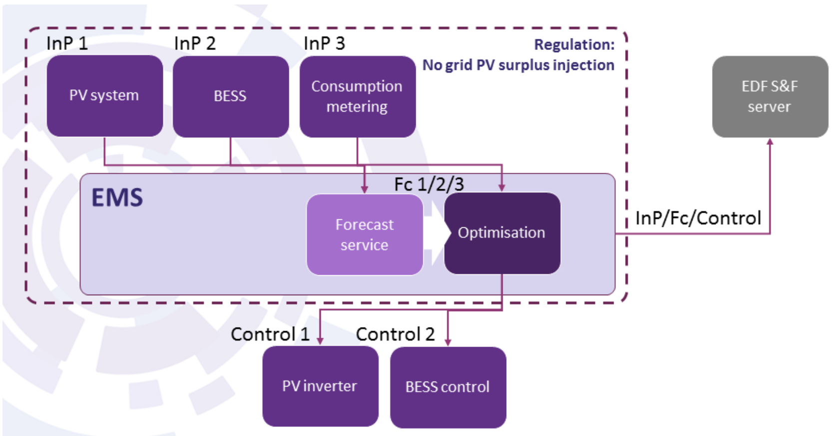

Figure 32: context diagram UC 1.1 – the system will use InP 1/2/3 for both forecast and optimization functions, resulting is a control output OuP 1 and/or OuP 2. All information will be synchronised with the EDF S&F servers. The non-injection of surplus PV will represent the main boundary condition (Source: EDF – EDF S&F)

11.1.1.1.1.2 UC 1.2 / PV surplus injection

This process will be completely automatized within the EMS.

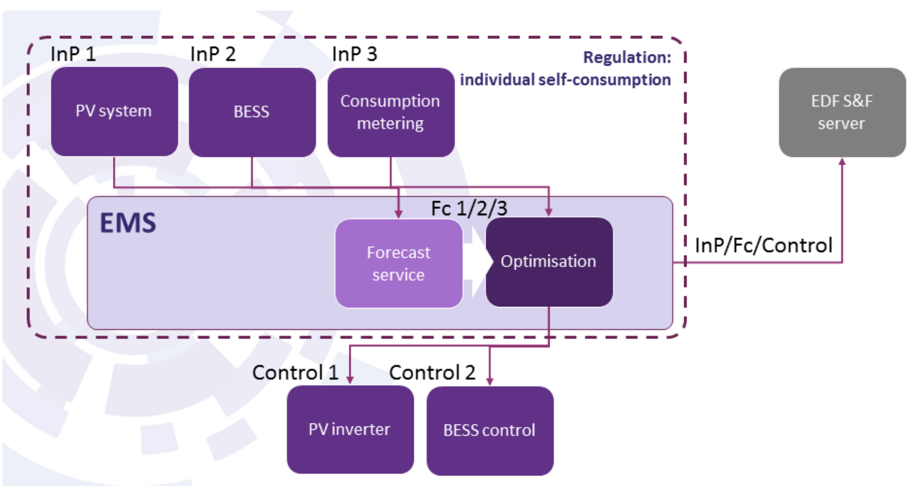

Figure 33: context diagram UC 1.2 – changing from the previous diagram, is the changed regulatory framework to be considered by the EMS (Source: EDF – EDF S&F)

11.1.1.1.1.3 UC 1.3 / smart charging

This process will be completely automatized within the EMS.

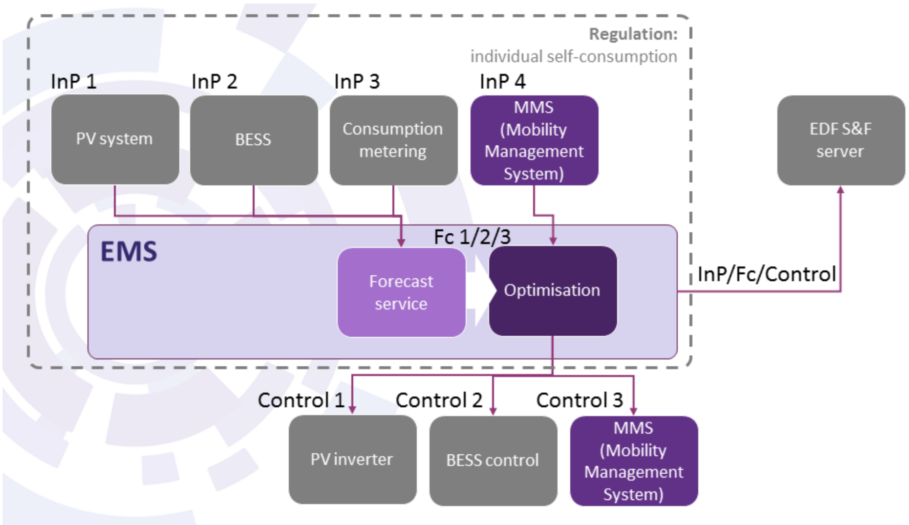

Figure 34 : context diagram UC 1.3 – the main change to the previous UC is the integration of the information flow with the MMS (Source: EDF – EDF S&F)

11.1.1.1.2 Sequence diagram per sub use case

11.1.1.1.2.1 UC 1.1 / no PV surplus injection

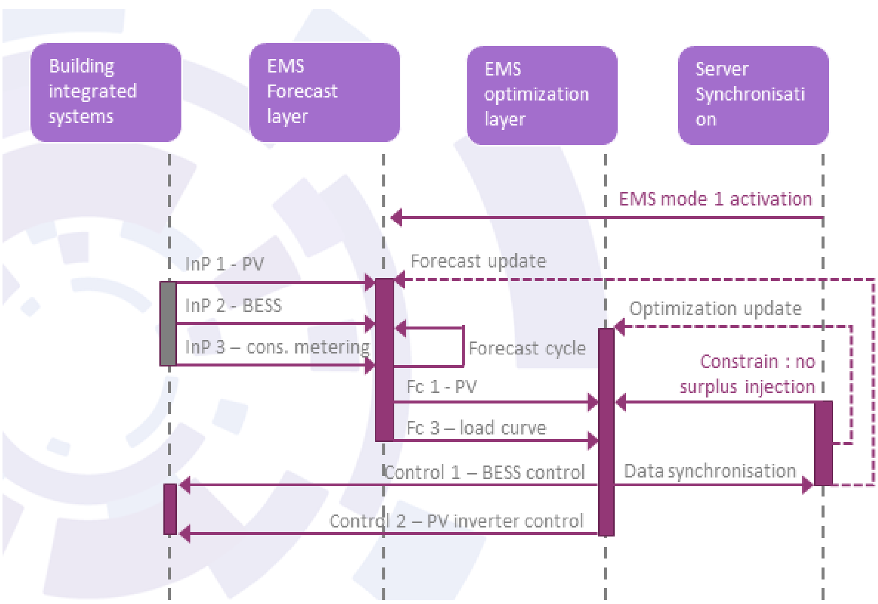

Figure 35: sequence diagram UC 1.1 (Source: EDF – EDF S&F)

11.1.1.1.2.2 UC 1.2 / PV surplus injection

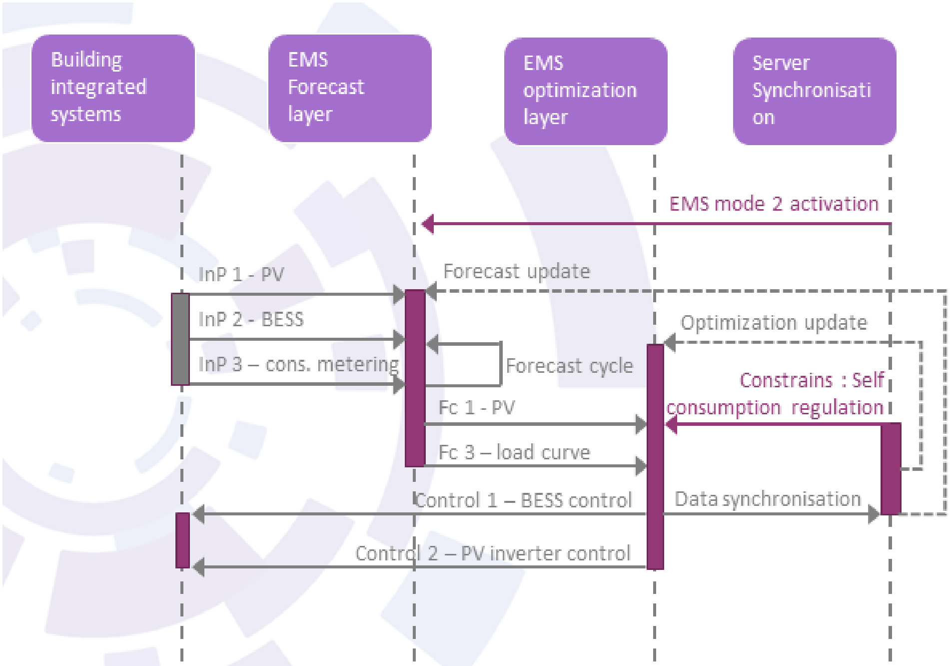

Figure 36 sequence diagram UC 1.2 – changes from previous UC is colour coded (Source: EDF – EDF S&F)

11.1.1.1.2.3 UC 1.3 / smart charging

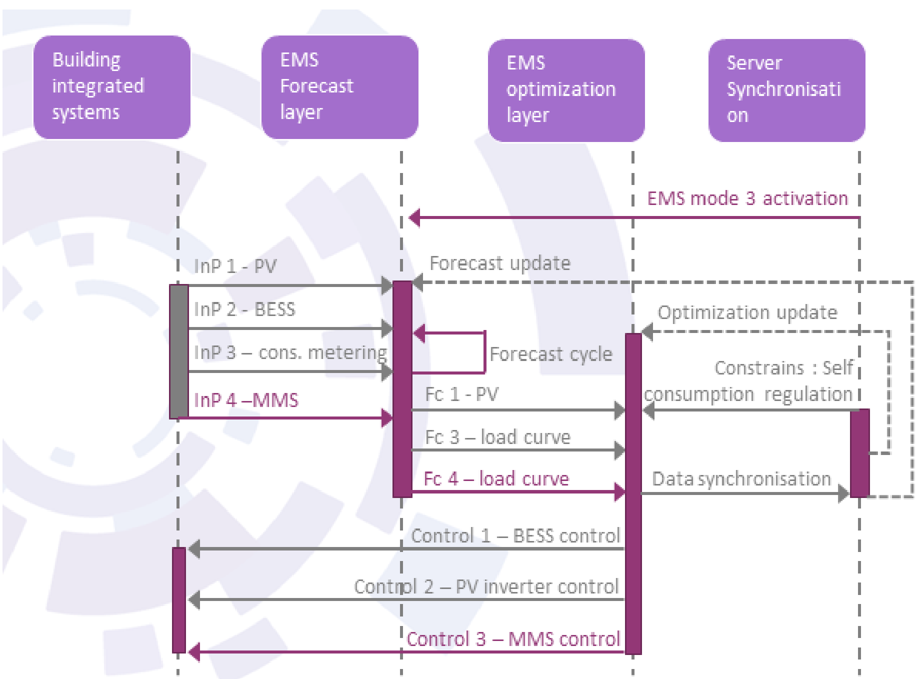

Figure 37 sequence diagram UC 1.3– changes from previous UC is colour coded (Source: EDF – EDF S&F)

11.1.1.1.3 Timing diagram per sub use case

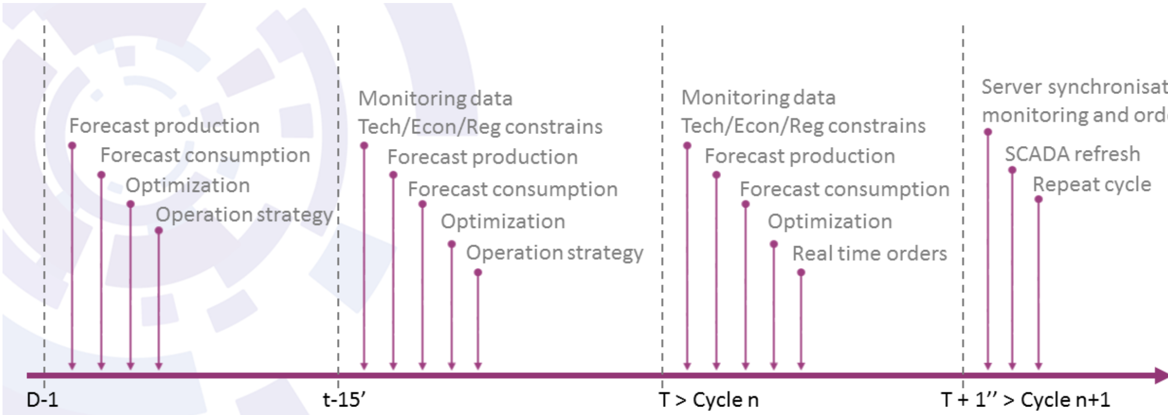

Figure 38: overall timing diagram of UC 1 and related sub-UC (Source: EDF – EDF S&F)

11.1.1.2 Diagrams of UC 4

11.1.1.2.1 Context diagram per sub use case

11.1.1.2.1.1 UC 4.1 / Primary reserves

This process will be completely automatized among market platform and the local EMS. The service provision will be a separate operation mode which will be activated at a given time.

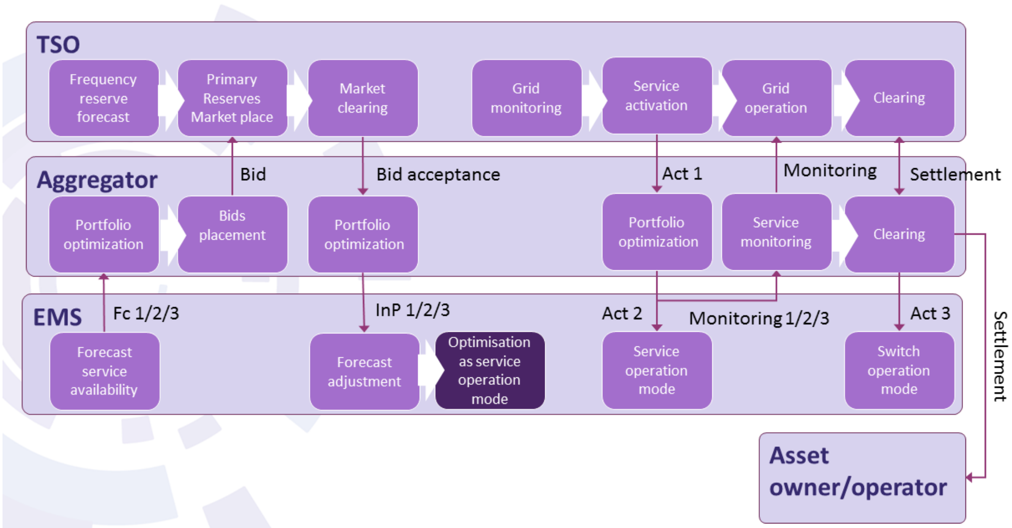

Figure 39 context diagram UC 4.1 (Source: EDF - EDF S&F - AGRGIO)

11.1.1.2.1.2 UC 4.2 / Tertiary reserves

UC detailed in D6.5 – IS 3.1

11.1.1.2.2 Sequence diagram per sub use case

11.1.1.2.2.1 UC 4.1 / Primary reserves

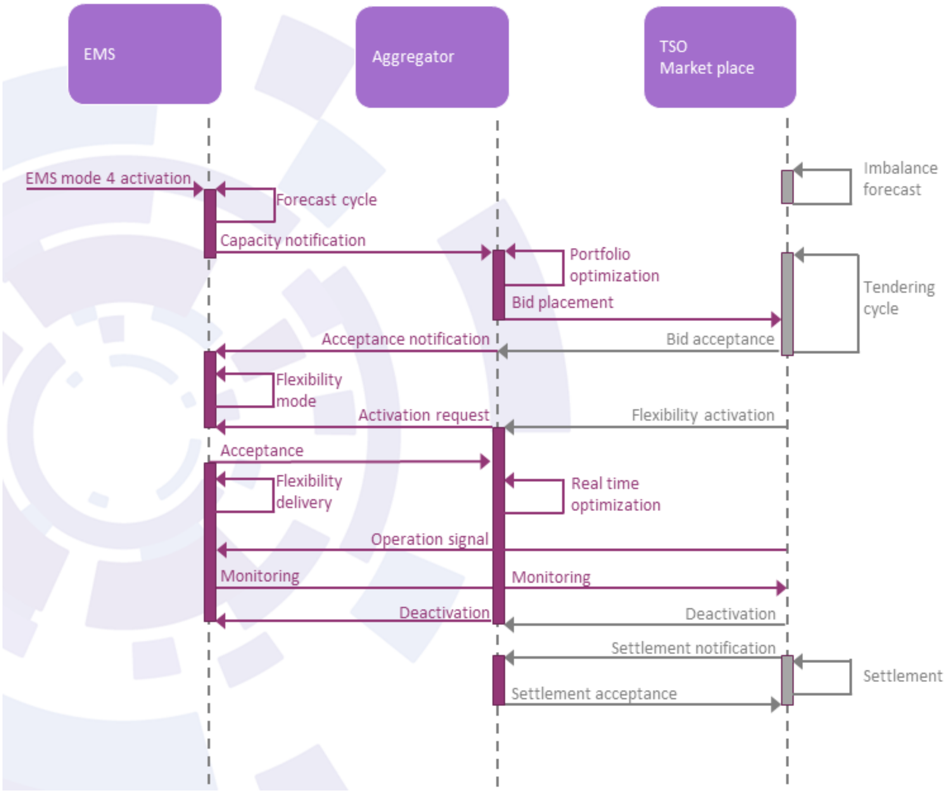

Figure 40: sequence diagram UC 4.1 (Source: EDF - EDF S&F - AGREGIO)

11.1.1.2.2.2 UC 4.2 / Tertiary reserves

UC detailed in D6.5 – IS 3.1 – UC 4.1

11.1.1.2.3 Timing diagram per sub use case

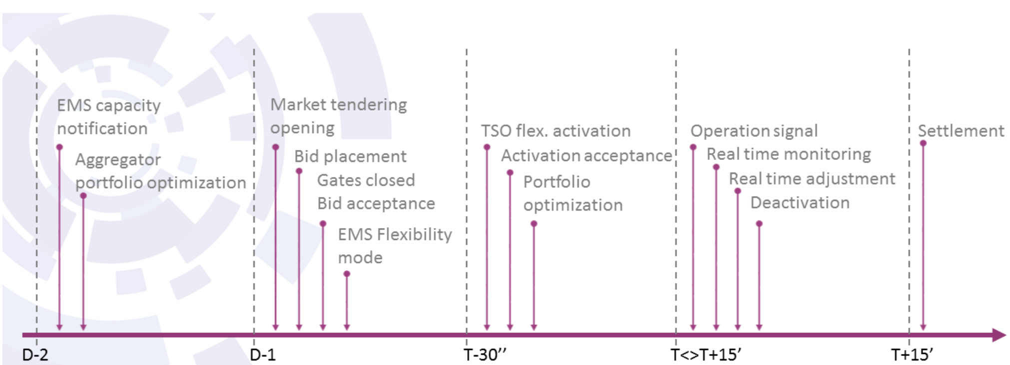

Figure 41: overall timing diagram of UC 4.1 (Source: EDF)

11.1.1.3 Diagrams of UC 5

11.1.1.3.1 Context diagram per sub use case

11.1.1.3.1.1 UC 5.1 / EMS interfacing

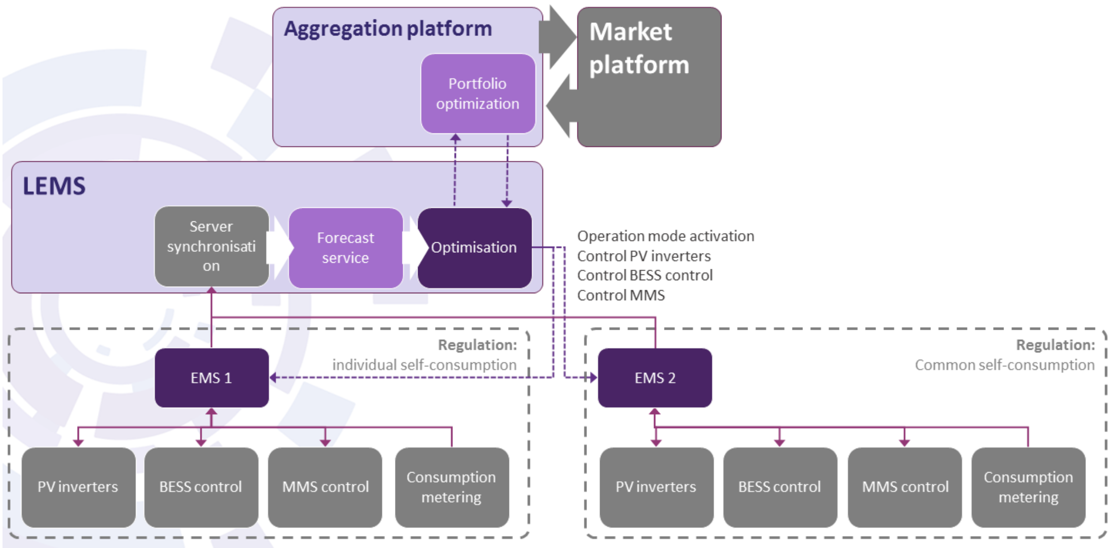

Figure 42 : context diagram UC 5.1 (Source: EDF – EDF S&F - AGREGIO)

11.1.1.3.1.2 UC 5.2 / Emulation of EMS network

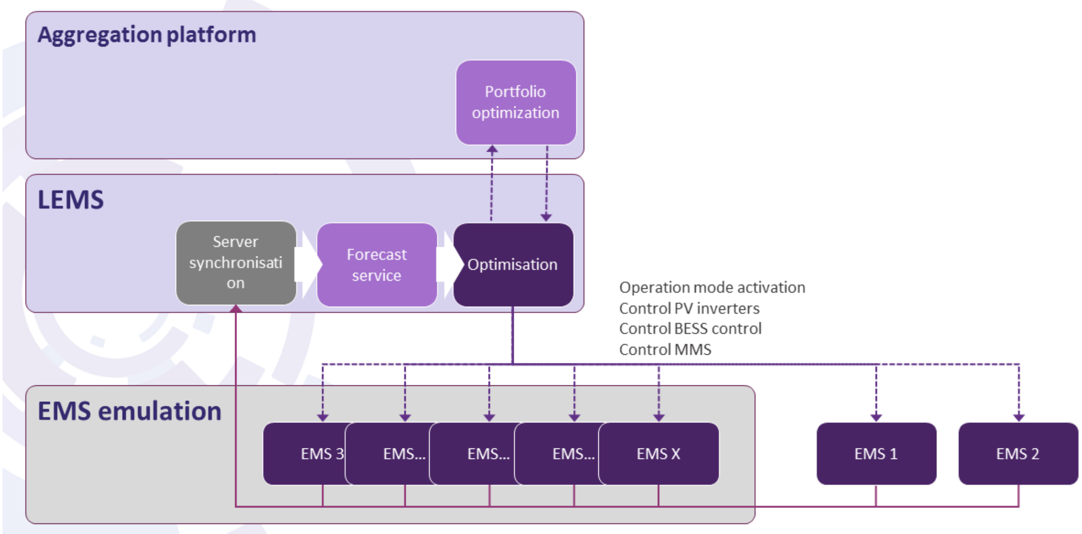

Figure 43 : context diagram UC 5.2 (Source: EDF – EDF S&F - AGREGIO)

11.1.1.3.2 Sequence diagram per sub use case

11.1.1.3.2.1 UC 5.1 / EMS interfacing

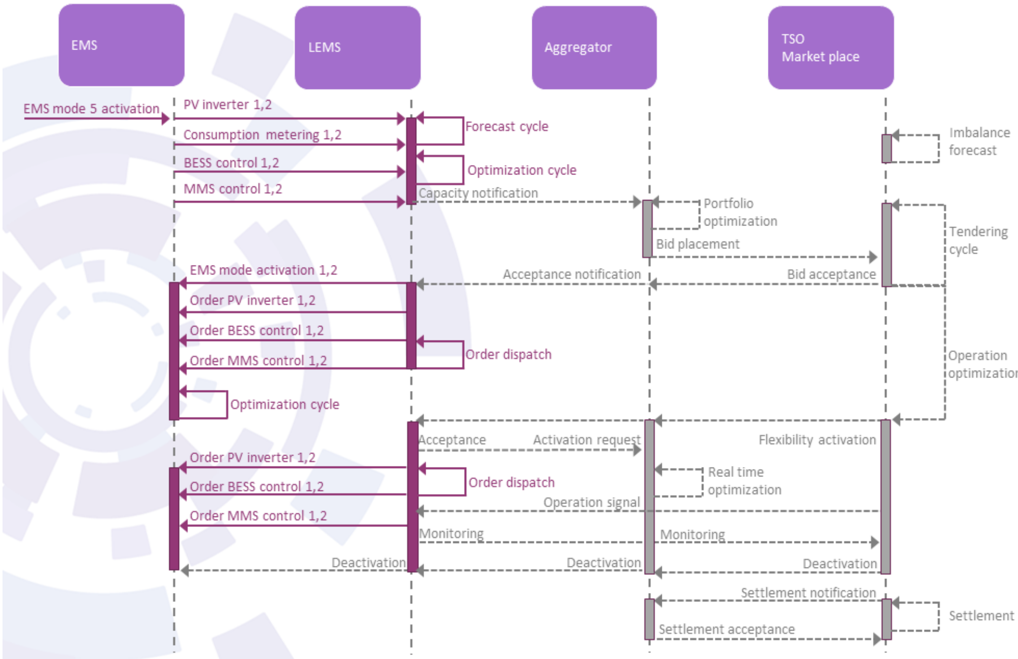

Figure 44: sequence diagram UC 5.1 (Source: EDF – EDF S&F - AGREGIO)

11.1.1.3.2.2 UC 5.2 / Emulation of EMS network

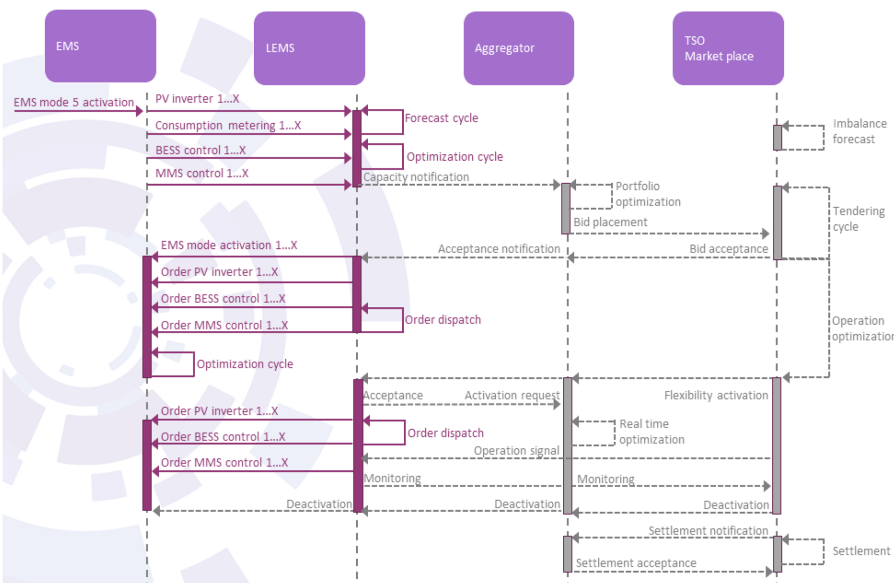

Figure 45 : sequence diagram UC 5.2 (Source: EDF – EDF S&F - AGREGIO)

12 Annex 2 – technical details IS 2.3

12.1.1.1 Diagrams of UC 7

12.1.1.1.1 Context diagram per sub use case

12.1.1.1.1.1 UC 7.1 / 2nd life assessment

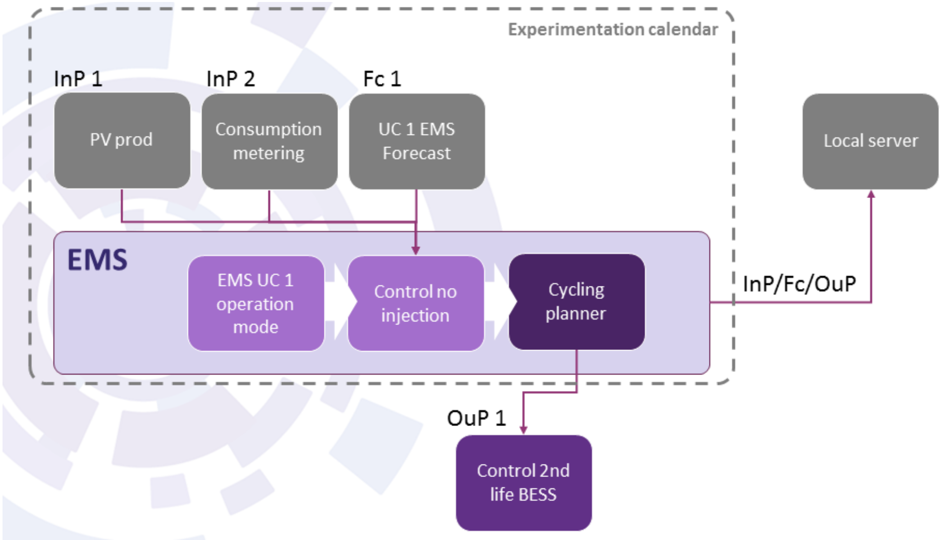

Figure 46 : context diagram UC 7.1 (Source: EDF, UNS/IMREDD)

12.1.1.1.1.2 UC 7.2 / V2G services

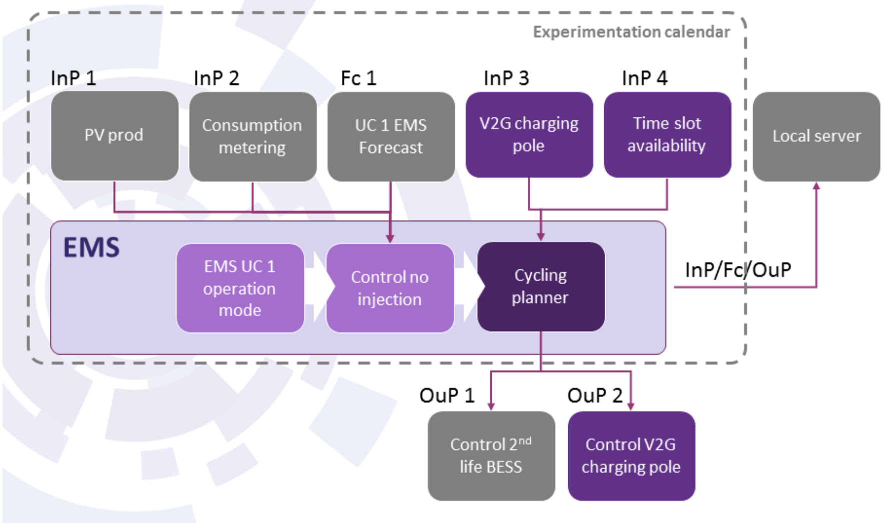

Figure 47 : context diagram UC 7.2 (Source: EDF, UNS/IMREDD)

12.1.1.1.2 Sequence diagram per sub use case

12.1.1.1.2.1 UC 7.1 / 2nd life assessment

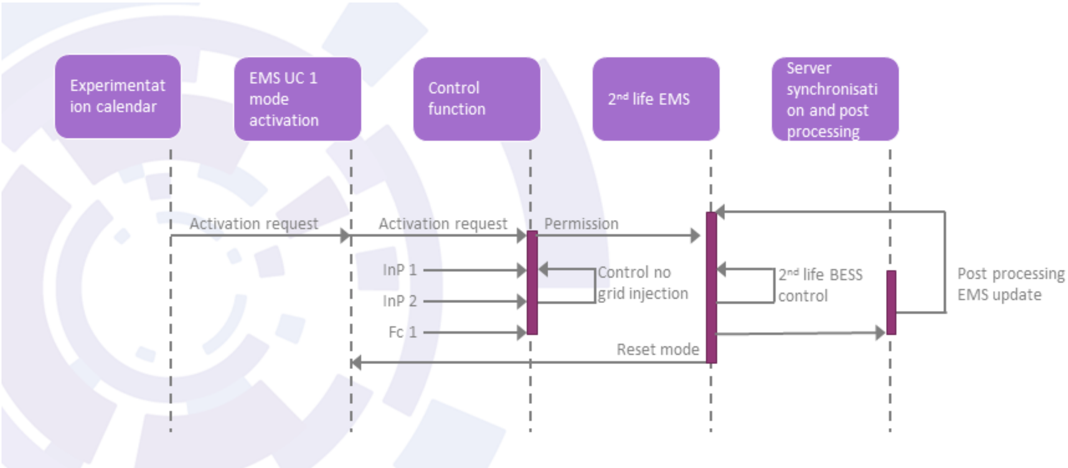

Figure 48: sequence diagram UC 7.1 – InP 1: BESS metering; InP 2: building consumption metering; Fc1: PV production/Load forecast (Source: EDF, UNS/IMREDD)

12.1.1.1.2.2 UC 7.2 / V2G services

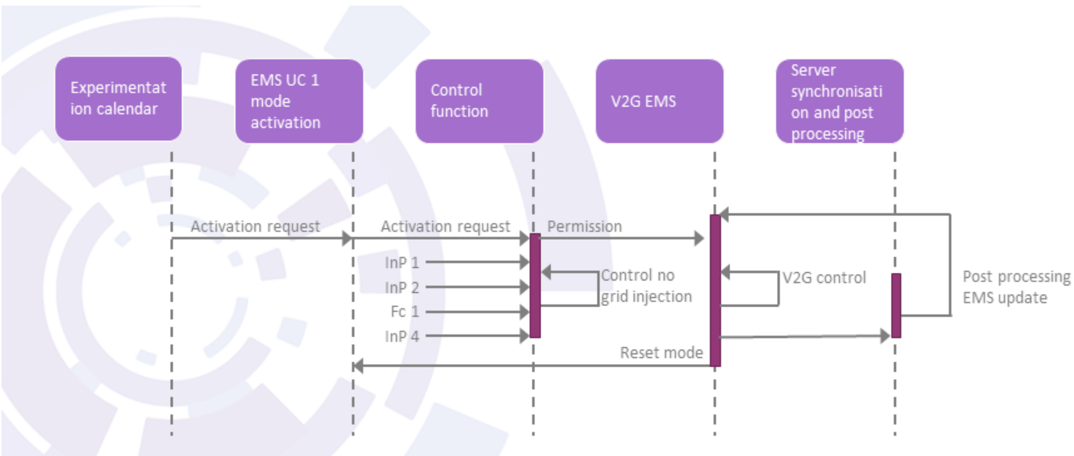

Figure 49 : sequence diagram UC 7.2 - InP 1: BESS metering; InP 2: building consumption metering; InP 4: available time slot; Fc 1: PV production/Load forecast (Source: EDF, UNS/IMREDD)

13 Annex 3 – KPIs – detailed listing

Detailed description of parameter/variable per measure.

Table 6 Description of parameter X for measure/building Y – resumes all variables needed to account for the KPIS as in the closing section

Parameter	Value	PV production	Energy injected into the grid	Flexibility volume	Heating energy provided	Cooling energy provided	MAX elec peak	MAX heating peak	MAX cooling peak	Elec consumption	PV production injected into the grid
Data Variable Name	i.e. Thermal energy consumption, locally produced electrical energy, etc.	Volume of PV energy produced	Volume of energy injected into the grid	Total activated flexiiblity volume	DHCN supply - heat	DHCN supply - cold	Maximal electricity peak			Annual energy consumption	PV injected into the grid with retribution
Measure Number As it is stated in the measure tracker	As described in the measure tracker, https://docs.google.com/spreadsheets/d/1XxZERkvuO5l-	IS 2.1	IS 2.1	IS 2.1	IS 2.2	IS 2.2	IS 2.1, IS 2.2	IS 2.2	IS 2.2	IS 2.1, IS 2.2	IS 2.1
KPI Number	KPI('s) that are related to the data As described	13, 5, 53, 54	13	5, 21	13, 5, 53, 34	13, 5, 53, 34	31, 21	31	31	53	54 (Ratio of valorised PV RES)
Units of measurement	i.e. kWh, Euro, etc.	[MWh]	[MWh]	[MWh]	[MWh]	[MWh]	[MW]	[MW]	[MW]	[MWh]	[KWh]
Baseline (of data variable)	e.g. relating to BaU or previous performance data	N/A	N/A	N/A	N/A	N/A	Calculated	Calculated	Calculated	N/A	N/A
Meter	i.e. smart meter, survey, energy bill,	Inverter	Smart Meter	Server	Smart Meter	Smart Meter	Smart Meter	Smart Meter	Smart Meter	Smart Meter	Smart meter
Location of measurement	Where the measurements take place	Inverter [IMREDD/NEXITY buildings]	Substation [IMREDD/NEXITY buildings]	Substation [IMREDD/NEXITY buildings]	MSE Energy station	MSE Energy station	Substation [IMREDD/NEXITY buildings]	MSE Energy station	MSE Energy station	Substation [IMREDD/NEXITY buildings]; MSE Energy station	Substation [IMREDD/NEXITY buildings]
Data accuracy	How accurate is the measurement	N/A	Watt	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
Collection interval	How often the data is recorded	Yearly	Yearly	Yearly	Yearly	Yearly	Yearly	Yearly	Yearly	Yearly	Yearly
Start of measurements	i.e. 1-1-2019, 0:00CET	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
End of measurements	i.e. 31-12-2020, 24:00CET	End of project	End of project	End of project	End of project	End of project	End of project	End of project	End of project	End of project	End of project
Expected availability	i.e. open data, public, confidential,	Public	Public	Public	Public	Public	Public	Public	Public	Public	Public
Expected accessibility	i.e. 1) online without access	Offline	Offline	Offline	Offline	Offline	Offline	Offline	Offline	Offline	Offline
Data format	i.e. csv file, json…	.csv	.csv	.csv	.csv	.csv	.csv	.csv	.csv	.csv	.csv
Data owner	i.e. the name of the company that owns the data	UNS/IMREDD, NEXITY/NEXITY PM	UNS/IMREDD, NEXITY; others	UNS/IMREDD, NEXITY; MNCA	IDEX; MNCA	IDEX; MNCA	UNS/IMREDD, NEXITY/NEXITY PM; IDEX; MNCA	IDEX; MNCA	IDEX; MNCA	UNS/IMREDD, NEXITY/NEXITY PM; IDEX; MNCA	UNS/IMREDD, NEXITY/NEXITY PM; IDEX; MNCA
Data provider	i.e. the name of the company that will give access to data	UNS/IMREDD, NEXITY; EDF S&F; DALKIA	UNS/IMREDD, NEXITY; EDF S&F ENEDIS	EDF S&F	MNCA	MNCA	ENEDIS; MNCA	MNCA	MNCA	ENEDIS	EDF / EDF S&F
Comments	Further info										

No	Parameter	Value	Activated 1st life BESS capacity	Activated V1G BESS capacity (public and private)	Activated 2nd life BESS capacity	Activated V2G BESS capacity	Nominal 1st life battery storage	Final 1st life battery storage capacity	Number of cycles of 1st life BESS	Nominal 2nd life BESScapacity	Nominal V2G BESS capacity	Final 2nd life battery storage capacity
1	Data Variable Name	i.e. Thermal energy consumption, locally produced electrical energy, etc.	Storage capacity mobilized by the demonstration	Storage capacity mobilized by the demonstration	Storage capacity mobilized by the demonstration	Storage capacity mobilized by the demonstration	Battery capacity as by constructor	Battery capacity as by test	Charge/discharge cycles for the BESS	Battery capacity as by constructor	Battery capacity as by constructor	Battery capacity as by test
2	Measure Number As it is stated in the measure tracker	As described in the measure tracker, https://docs.google.com/spreadsheets/d/1XxZERkvuO5l-	2.1	2.1	2.3	2.3	2.3	2.3	2.3	2.2	2.3	2.3
3	KPI Number	KPI('s) that are related to the data As described	55 (Usefull storage capacity)	55	55	55	4	4	4	3	4	4
4	Units of measurement	i.e. kWh, Euro, etc.	[kWh]	[kWh]	[kWh]	[kWh]	[Ah]	[Ah]	[n]	[Ah]	[Ah]	[Ah]
	Baseline (of data variable)	e.g. relating to BaU or previous performance data	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
6	Meter	i.e. smart meter, survey, energy bill,	Server	Server	Server	Server	Server	Server	Server	Server	Server	Server
7	Location of measurement	Where the measurements take place	BESS/Server	BESS/Server	BESS/Server	BESS/Server	BESS/Server	BESS/Server	BESS/Server	BESS/Server	BESS/Server	BESS/Server
8	Data accuracy	How accurate is the measurement	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
9	Collection interval	How often the data is recorded	Yearly	Yearly	Yearly	Yearly	Yearly	Yearly	Yearly	Yearly	Yearly	Yearly
10	Start of measurements	i.e. 1-1-2019, 0:00CET	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
11	End of measurements	i.e. 31-12-2020, 24:00CET	End of project	End of project	End of project	End of project	End of project	End of project	End of project	End of project	End of project	End of project
12	Expected availability	i.e. open data, public, confidential,	Public	Public	Public	Public	Public	Public	Public	Public	Public	Public
13	Expected accessibility	i.e. 1) online without access	Offline	Offline	Offline	Offline	Offline	Offline	Offline	Offline	Offline	Offline
14	Data format	i.e. csv file, json…	.csv	.csv	.csv	.csv	.csv	.csv	.csv	.csv	.csv	.csv
15	Data owner	i.e. the name of the company that owns the data	UNS/IMREDD, NEXITY/NEXITY PM	IMREDD; MNCA	IMREDD	IMREDD	UNS/IMREDD, NEXITY/NEXITY PM	UNS/IMREDD, NEXITY/NEXITY PM	UNS/IMREDD, NEXITY/NEXITY PM	UNS/IMREDD	UNS/IMREDD	UNS/IMREDD
15	Data provider	i.e. the name of the company that will give access to data	EDF / EDF S&F	EDF / EDF S&F	IMREDD	IMREDD	EDF/ EDF S&F	EDF/ EDF S&F	EDF/ EDF S&F	UNS/IMREDD	UNS/IMREDD	UNS/IMREDD
16	Comments	Further info										

Parameter	Value	Final V2G battery storage capacity	Number of cycles of 2nd life battery	Number of cycles of V2G battery	Number of activations per year	Average Power flexibility	Average Energy flexibility	Average activation duration	Expenses electricity	Income PV injection	Income energy services
Data Variable Name	i.e. Thermal energy consumption, locally produced electrical energy, etc.	Battery capacity as by test	Charge/discharge cycles for the BESS	Charge/discharge cycles for the BESS	Number of flexibility activations	Average capacity of flexibility activations	Average volume of the capacity provided during activation	Average duration of activation	Electricity bill	Income generated by PV resell	Income generated by flexiiblity activations
Measure Number As it is stated in the measure tracker	As described in the measure tracker, https://docs.google.com/spreadsheets/d/1XxZERkvuO5l-	2.3	2.3	2.3	2.1, 2.3	2.1, 2.3	2.1, 2.3	2.1, 2.3	2.1	2.1	2.1
KPI Number	KPI('s) that are related to the data As described	4	4	4	21	21	21	21	34	34	34
Units of measurement	i.e. kWh, Euro, etc.	[Ah]	[n]	[n]	[n]	[kW]	[kWh]	[hours]	[EUR]	[EUR]	[EUR]
Baseline (of data variable)	e.g. relating to BaU or previous performance data	N/A	N/A	N/A	N/A	N/A	N/A	N/A	Calculated	N/A	N/A
Meter	i.e. smart meter, survey, energy bill,	Server	Server	Server	Server	Server	Server	Server	Energy bill	Energy bill	Energy bill
Location of measurement	Where the measurements take place	BESS/Server	Server	Server	Server	Server	Server	Server	N/A	N/A	N/A
Data accuracy	How accurate is the measurement	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
Collection interval	How often the data is recorded	Yearly	Yearly	Yearly	Yearly	Yearly	Yearly	Yearly	Yearly	Yearly	Yearly
Start of measurements	i.e. 1-1-2019, 0:00CET	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
End of measurements	i.e. 31-12-2020, 24:00CET	End of project	End of project	End of project	End of project	End of project	End of project	End of project	End of project	End of project	End of project
Expected availability	i.e. open data, public, confidential,	Public	Public	Public	Public	Public	Public	Public	Public	Public	Public
Expected accessibility	i.e. 1) online without access	Offline	Offline	Offline	Offline	Offline	Offline	Offline	Offline	Offline	Offline
Data format	i.e. csv file, json…	.csv	.csv	.csv	.csv	.csv	.csv	.csv	.csv	.csv	.csv
Data owner	i.e. the name of the company that owns the data	UNS/IMREDD	UNS/IMREDD	UNS/IMREDD	UNS/IMREDD, NEXITY/NEXITY PM; MNCA	UNS/IMREDD, NEXITY/NEXITY PM; MNCA	UNS/IMREDD, NEXITY/NEXITY PM; MNCA	UNS/IMREDD, NEXITY/NEXITY PM; MNCA	UNS/IMREDD, NEXITY/NEXITY PM; MNCA	UNS/IMREDD, NEXITY/NEXITY PM; MNCA	UNS/IMREDD, NEXITY/NEXITY PM; MNCA
Data provider	i.e. the name of the company that will give access to data	UNS/IMREDD	UNS/IMREDD	UNS/IMREDD	EDF / EDF S&F	EDF / EDF S&F	EDF / EDF S&F	EDF / EDF S&F	UNS/IMREDD, NEXITY/NEXITY PM; MNCA	UNS/IMREDD, NEXITY/NEXITY PM; MNCA; EDF / EDF S&F	UNS/IMREDD, NEXITY/NEXITY PM; MNCA; AGREGIO
Comments	Further info										

No	Parameter	Value	Heating expenses (fixed+variable)	Cooling expenses (fixed+variable)	2nd life - Number of activations per year	2nd life -Average Power Flexibility	2nd life -Average Energy Flexibility	2nd life -Average activation duration	V2G - Number of activations per year	V2G -Average Power Flexibility	V2G -Average Energy Flexibility	V2G -Average activation duration
1	Data Variable Name	i.e. Thermal energy consumption, locally produced electrical energy, etc.	Heating bill	Heating bill	Number of flexibility activations	Average capacity of flexibility activations	Average volume of the capacity provided during activation	Average duration of activation	Number of flexibility activations	Average capacity of flexibility activations	Average volume of the capacity provided during activation	Average duration of activation
2	Measure Number As it is stated in the measure tracker	As described in the measure tracker, https://docs.google.com/spreadsheets/d/1XxZERkvuO5l-	2.2	2.2	2.3	2.3	2.3	2.3	2.3	2.3	2.3	2.3
3	KPI Number	KPI('s) that are related to the data As described	34	34	21	21	21	21	21	21	21	21
4	Units of measurement	i.e. kWh, Euro, etc.	[EUR]	[EUR]	[n]	[kW]	[kWh]	[hours]	[n]	[kW]	[kWh]	[hours]
	Baseline (of data variable)	e.g. relating to BaU or previous performance data	Calculated	Calculated	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
6	Meter	i.e. smart meter, survey, energy bill,	Energy bill	Energy bill	Server	Server	Server	Server	Server	Server	Server	Server
7	Location of measurement	Where the measurements take place	N/A	N/A	Server	Server	Server	Server	Server	Server	Server	Server
8	Data accuracy	How accurate is the measurement	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
9	Collection interval	How often the data is recorded	Yearly	Yearly	Yearly	Yearly	Yearly	Yearly	Yearly	Yearly	Yearly	Yearly
10	Start of measurements	i.e. 1-1-2019, 0:00CET	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
11	End of measurements	i.e. 31-12-2020, 24:00CET	End of project	End of project	End of project	End of project	End of project	End of project	End of project	End of project	End of project	End of project
12	Expected availability	i.e. open data, public, confidential,	Public	Public	Public	Public	Public	Public	Public	Public	Public	Public
13	Expected accessibility	i.e. 1) online without access	Offline	Offline	Offline	Offline	Offline	Offline	Offline	Offline	Offline	Offline
14	Data format	i.e. csv file, json…	.csv	.csv	.csv	.csv	.csv	.csv	.csv	.csv	.csv	.csv
15	Data owner	i.e. the name of the company that owns the data	UNS/IMREDD, NEXITY/NEXITY PM; MNCA; DALKIA	UNS/IMREDD, NEXITY/NEXITY PM; MNCA; DALKIA	UNS/IMREDD	UNS/IMREDD	UNS/IMREDD	UNS/IMREDD	UNS/IMREDD	UNS/IMREDD	UNS/IMREDD	UNS/IMREDD
15	Data provider	i.e. the name of the company that will give access to data	IDEX; MNCA	IDEX; MNCA	UNS/IMREDD; EDF	UNS/IMREDD; EDF	UNS/IMREDD; EDF	UNS/IMREDD; EDF	UNS/IMREDD; EDF	UNS/IMREDD; EDF	UNS/IMREDD; EDF	UNS/IMREDD; EDF
16	Comments	Further info										