*local **E**lectricity retail **M**arkets for **P**rosumer smart grid p**OWER** services*

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Table of contents

Abbreviations and Acronyms

Acronym	Description
CA	Consortium Agreement
DoA	Description of Action (annex I of the Grant Agreement)
EC	European Commission
GA	Grant Agreement
PC-A	Project Coordinator-Administrative
PC-T	Project Coordinator-Technical
PMC	Project Management Committee
PO	Project Officer
QM	Quality Management
TMT	Technical Management Team
ToC	Table of Contents
WP	Work Package
WPL	Work Package Leader

Executive summary

This report describes the commonalities and idiosyncrasies of the different test sites. Reference to both type of appliances, technical infrastructure (AMS, control equipment, etc.) and local grid topology will be made. Focus on local production, existing demand-response programs, new loads will be addressed. This will be fed into task T7.2 A thorough analysis of geographical, demographical and sociographical aspects will be made in order to characterize the end-user group. The report will also treat business aspects related to retail pricing, tariffs, consumption levels, load profiles, services available and other things that represent standards of local day-to-day operations prior to EMPOWER deployment.

1 Introduction

As the project has progressed, it has been concluded that the architecture based on SGAM model will be the best for way of working, since it has been documented in deliverables belonging to other work packages as the WP3 or WP4.

According to the below diagram, there are a few factors involved in the process both physical devices, systems and programs that are in direct contact with the customer or the DSO.

Figure 1 shows the SGAM generic component layer, independent of the pilot sites. The components it includes and their description are listed in the Annex (see Section 6). This diagram is a generic model of the SGAM architecture for the project. Not all the elements from the model appear or are involved in all the pilots.

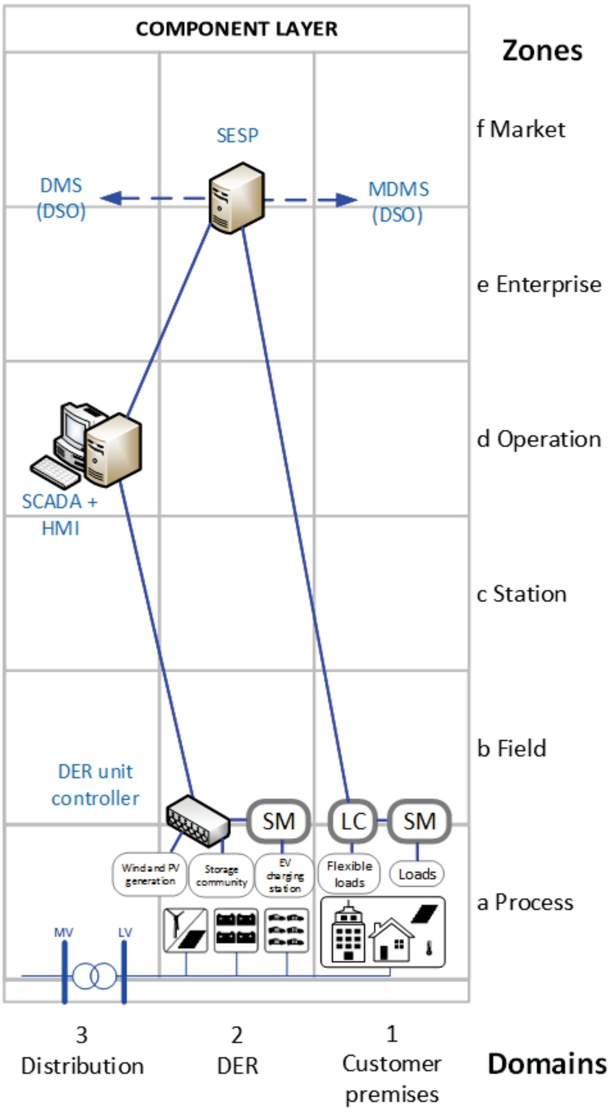


Figure 1: SGAM generic EMPOWER component layer

They have been represented in identifying the zone and domain to which they belong and taking into account their interconnections. The type of information exchanged and the way it is exchanged (that is to say, the communication protocols used) are detailed in the information and communication layer, respectively. To know more regarding the SGAM diagram representation, please consult deliverable D3.1.

In Section 4, the component layer of each pilot site is presented. It corresponds to an adaptation of the generic component layer detailed in Figure 1 to the specific characteristics of each pilot.

According to the different layers and performing, we do a, “bottom up” analysis. We start in the process layer, with the different devices that are in direct contact with the low voltage network.

On one hand, it appears prosumers (SESP members), which refer to those households which are both consumers and producers, and communicate with the Control Cloud directly.

On the other hand, Distributed Energy Resources (DER), refer to those devices and technologies related to Generation (Wind, solar), Storage and EV chargers. Due to their capabilities they need another system between them and Control Cloud, called SCADA in order to communicate with Control Cloud.

In addition to these physical elements, Local Controllers (LC) will be needed in order to send the information to the business (enterprise) layer, and to operate loads (switches).

Local controllers report information upstream either to the Control Cloud or to the SCADA where such information is treated and sent periodically to Control Cloud on the business layer.

Once the data reaches the Control Cloud, they are treated and reported to the Market layer, which is in contact with the DSO and different customers and business systems. Services offered by the SESP (Smart Energy Service Provider)

As it has been shown with this architecture proposed, it includes from small residential consumers, which can be both consumers and small producers, within the microgrid (with photovoltaic generation etc.) and distributed generation (DER) which includes storage systems, wind turbines, photovoltaic panels, and chargers for electric vehicles connected to the microgrid power.

2 Pilot Sites definition

For the Empower project, 3 geographically pilot areas have been chosen. These pilots are reflecting deployment of technologies, and will be used for testing the identified use cases in the project.

Each pilot is different from the others, in terms of types of technologies, functionalities and markets / regulatory assumptions.

These pilots are located in Germany, Malta and Norway, and established through contractual agreements. All contractual agreements overall, in the Ethics report, deliverables 10.

2.1 Norway

In case of the Norwegian pilot, there are different “sub” locations and it includes all the complete SGAM model architecture from the first section.

Pilot 1

The first pilot region for the deployment, include residential homes, with distributed generation, as photovoltaic panels. These prosumers, will be connected directly to the Control Cloud using a smart gateway installed at these households. These prosumers will also be a part of the battery storage at “street level”

Pilot 2.

The second pilot will be at Municipality recycle station area. The area is a combination of small buildings for different purposes at the Municipality and the recycling facility.

This pilot includes Wind and Solar Generation, Storage and chargers for EV. This in addition to a “residential” LC installation in between the 5 smaller buildings at this location.

Wish list Equipment in Norwegian pilots:

- AMS- smart meters
- Local Controllers / Gateways
- Switches for flexible loads
- PM-instruments (power-monitoring)
- PLC-communication
- GPRS-communication

Equipment on the Minicipality Pilot in addition:

- IDPR (intelligent Dritribution Power Router)
- PVs 1200m2 & Inverters
- Storage (240kWh)
- Wind-turbine (3kW)
- EV-charging (3 x 2 x 12kW)
- Scada System & RTUs

2.2 Germany

Pilot 1

In the case of Germany, smart devices will be installed in some residential households, and will be communicating directly with the Control Cloud

Pilot 2.

Local Controller LC, and smart devices to be installed in some public buildings, and will be communicating directly with the Control Cloud.

Wish list Equipment in German pilots:

- AMS- smart meters
- Local Controllers / Gateways
- Switches for flexible loads
- PM-instruments (power-monitoring)
- PLC-communication
- GPRS-communication

2.3 Malta

Malta Pilot has the same architecture as in Germany, but the consumption and the market is different. In Malta, some of the consumers / prosumers possess photovoltaic generation at home (prosumers). Some do not. The need of floor heating is not relevant in Malta, but the need of Air-Conditioning (cooling is high).

Pilot 1

In the case of Malta, smart devices will be installed in 5 residential households, and will be communicating directly with the Control Cloud

Pilot 2.

Local Controller LC, and smart devices to be installed in 5 Ministry/public/municipal buildings, and will be communicating directly with the Control Cloud. These 5 buildings are partly supplied by 4 different PV-installations installed on different rooftops.

Wish list Equipment in Maltese pilots:

- AMS- smart meters / Optical readers
- Local Controllers / Gateways
- Switches for flexible loads
- PM-instruments (power-monitoring)
- PLC-communication
- GPRS-communication

3 Pilot Use cases

3.1 PUC-1: Consumption and generation monitoring

Actors: SESP, Prosumers, Producers, Consumers

Preconditions:

1. SESP enters into a contract with prosumers and producers for managing energy produced from solar PV installations, wind generators or other renewable generators.
2. SESP enters into a contract with community members for providing energy and managing their flexible loads at certain time periods.
3. SESP possesses the required technology to monitor energy consumption at the appliance level for flexible loads.

Assumptions:

1. Smart meters are installed at prosumer and consumer sites for either measuring net energy consumption or energy production and consumption separately.
2. Local Controllers are installed at prosumer and consumer site for controlling appliances through the Control Cloud platform.

Steps:

1. SESP collects high-resolution energy production and consumption profiles from all members.
2. SESP uses collected information to predict consumption and production patterns in order to optimally place its bids in the day ahead market and to schedule flexibility.
3. SESP monitors high resolution real-time energy consumption and production profiles to manage local deviations and to cater to DSO requests.
4. SESP builds a flexibility reserve for each time period based on continuous monitoring of energy production, consumption and the state of the flexible loads.
5. Local deviations and DSO requests are managed by utilizing the flexibility reserve and by monitoring appliance level performance of flexible loads in real-time.

Variations:

1. SESP can enter into different contracts with consumers for monitoring their flexible loads for extended periods of time, say two hours before the activation period begins. This will help the SESP to accurately estimate the flexibility reserve and plan its operations in the most optimal manner.
2. SESP can offer multiple services to members based on continuous monitoring of production and consumption profiles, for example, helping members to understand consumption patterns, to minimize their consumption costs and in general to increase their active participation in the community.

3.2 PUC-2: Production Management

Actors: SESP, Prosumers, Producers

Preconditions:

1. SESP enters into a contract with prosumers and producers for managing energy produced from solar PV installations, wind generators or other renewable generators.
2. Smart meters are installed at prosumer site for measuring net energy consumption/production.

Assumptions:

1. The contract template is finalized and price for energy production from PV panels is set. However, prices are subject to revision during contract renewal phase.
2. There are only two modes of operation of solar panels (On/Off).

Steps:

1. SESP installs controllers at the prosumer site for remotely switching the panels on or off.
2. SESP acquires time series data on production and together with weather forecast information, predicts solar PV output one day in advance at an aggregated level.
3. SESP places bids in the day ahead market accordingly.
4. SESP operation is decided based on optimization algorithms of Local/Cross Energy and Flexibility Markets after taking into account the costs associated with each option.
5. SESP sends a control signal to the PV panels through the local controller.
6. The results of the optimization process sets the energy price that will be finalized in the contract between SESP and prosumer during contract renewal.

Variations:

1. PV installations could have the option to regulate power output from panels and hence three different models of operations can be identified (On/Off/continuous) and controlled using a local controller.
2. SESP could offer production ramping/curtailment service to the DSO if production capacity is high enough to interest the DSO.
3. New types of contracts or business models to manage PV production could be derived from existing models.

3.3 PUC-3: Flexibility Management

Actors: SESP, Prosumers, Consumers

Preconditions:

1. SESP enters into a contract with the DSO for regulating load.
2. SESP enters into a contract with community members for providing energy and managing their flexible loads at certain time periods.

3. Smart meters and local controllers are installed at prosumer and consumer site for measuring energy consumption and controlling appliances respectively through the control cloud platform.

Assumptions:

1. The contract template is finalized and the price for flexibility is set. However, prices are subject to revision during contract renewal phase.
2. Members are willing to actively participate in flexibility markets by providing useful information about their appliance usage preferences and other information that helps the SESP with its planning and operations.

Steps:

1. SESP collects resource technical and commercial characteristics and status (UC5.1.1 and UC5.1.2).
2. SESP estimates flexibility capacity in both directions at the individual appliance level and household level for each member along with a certain margin for tolerance (UC5.1.2).
3. SESP installs the necessary equipment for monitoring and controlling flexible assets (residential gateway, local controllers, etc.)
4. SESP studies household energy consumption patterns and appliance usage behavior/characteristics during the trial period.
5. SESP predicts household energy consumption based on available time series data and weather information.
6. SESP bids in the Local/Cross Energy and Flexibility Markets.
7. SESP schedules flexibility assets, creates a flexibility plan (including batteries) and gets it approved by the DSO both on a daily and hourly basis based on its optimization algorithms.
8. SESP allocates parts of the flexibility reserve for catering to different modes of DSO request and for managing energy imbalances/deviations along with a certain margin for tolerance.
9. During operations, SESP schedules its flexibility assets with the aim of both minimizing cost and maximizing reliability.
10. SESP sends control signals to flexible appliances in various households through the local controller.
11. Local/Cross Flexibility Market operations determine the flexibility price for members.
12. SESP evaluates the performance of both its members and flexibility assets in order to create a ranking and rewarding system.

Variations:

1. When the combined flexibility capacity of the community is high enough for participating in balancing markets, SESP can include the TSO as well in its daily operations and schedule its resources accordingly.
2. SESP or any third party could develop an intelligent trading agent that automates the entire process on behalf of members.

3.4 PUC-4: EV Charging Station Management

Actors: SESP, DSO, EV charging stations

Preconditions:

1. SESP enters into a contract with EV charging stations for providing energy and managing flexibility.
2. SESP enters into a contract with EV owners for managing their EV charges.
3. EV charging stations have inbuilt meters for measuring energy used for charging EVs.
4. EV charging stations have local controllers capable to receive and send messages from/to SESP

Assumptions:

1. EVs are treated as stochastic and flexible consumer loads.
2. The contract template is finalized and the prices for providing energy and managing flexibility for EVs are set. However, prices are subject to revision during contract renewal phase.
3. EV charging stations have three different models of operations: On/Off/continuous.
4. EV charging stations do not have EV discharging capability (Vehicle-2-Grid)

Steps:

1. SESP installs the necessary equipment at the EV charging station for monitoring and controlling EV charging and billing.
2. SESP studies EV connection and charging patterns and EV user behavior during the trial period.
3. SESP predicts EV charging station consumption based on data collected and other parameters such as weather and traffic information.
4. SESP estimates flexibility capacity of EV charging stations in both directions with a certain margin for tolerance.
5. SESP bids in the Local/Cross Energy and Flexibility Markets.
6. SESP schedules EV charging, creates a flexibility plan and gets it approved by the DSO both on a daily and hourly basis based on its optimization algorithms.
7. SESP allocates parts of the EV flexibility reserve for catering to different modes of DSO request and for managing energy deviations.
8. During operations, SESP sends control signals to EVs through the EV charging station's local controller.
9. Local/Cross Flexibility Market operations determine the flexibility price for EV charging stations and eventually for EV users.

Variations:

1. SESP may be able to better plan its operations if there exists a mechanism for greater level of EV user participation by indicating their preferences for EV charging in terms of connection time, level of charging required, etc.
2. New business models can be developed by directly combining renewable energy output with EV charging.

3.5 PUC-5: Battery Management

Actors: SESP, DSO, Prosumers, Consumers, Batteries

Preconditions:

1. SESP enters into a contract with community members for managing their household batteries during all time periods and the price is set.
2. SESP enters into a contract with battery owners at substation or street level for managing their batteries during all time periods and the price is set.
3. SESP has installed a communication system like a gateway, local controller or battery unit interface capable of communicating with the cloud.
4. Smart meters are installed at battery site for measuring energy flow through batteries.

Assumptions:

1. If the DSO owns the battery, the SESP cannot use the battery for any market operations.
2. Contract prices are subject to revision during the contract renewal phase.

Steps:

1. SESP estimates the cost of charging and discharging batteries based on various parameters such as battery price, operational parameters, charging cycles, battery life time, degradation, etc.
2. Depending upon the battery operation costs, SESP makes use of batteries either for catering to different modes of DSO request or commands and/or for managing energy deviations.
3. Cross/Local market operations determine the need for using batteries.
4. SESP uses a battery management algorithm to decide when to charge and discharge batteries taking into consideration the costs and profits of battery operation.
5. SESP sends control signals to the battery through the communication platform.

Variations:

1. SESP may have to reserve a part or total battery capacity exclusively for catering to an emergency request from the DSO.
2. SESP may enter into a different type of contract with the DSO for offering exclusive battery-based services such as reactive power management, power quality, etc.
3. SESP may prioritize storing energy produced from renewable sources over using the battery for market operations depending upon the business model.

3.6 PUC-6: DSO Interactions Management

Actors: SESP, DSO, Prosumers, Consumers, Batteries

Preconditions:

1. SESP enters into a contract with the DSO for load regulation.
2. The different types of DSO load regulation requests such as scheduled regulation, hour-ahead regulation and emergency regulation are clearly differentiated and the prices for catering to every type of request is agreed.

Assumptions:

1. DSO is not willing to share the entire distribution grid topology with SESP but is ready to share information that is pertinent to SESP location and operation.

2. Communication between the DSO and SESP takes place through a web-based communication system.
3. Contract prices are subject to revision during the contract renewal phase.

Steps:

1. Based on its optimization algorithm, SESP schedules flexibility and non-flexibility assets, creates an energy plan and gets it approved by the DSO.
2. Based on its optimization algorithm, SESP schedules flexibility assets, creates a flexibility plan (including batteries) and gets it approved by the DSO both on a daily and hourly basis.
3. The daily energy and flexibility plan together with the hourly flexibility plan constitutes the baseline that serves as a reference for DSO load regulation requests.
4. DSO makes a scheduled request for load regulation when it knows well ahead of time the magnitude and direction of regulation required.
5. DSO makes an hour-ahead request for load regulation when it predicts distribution grid overloading or congestion issues within the next hour.
6. DSO makes an emergency command when it encounters unforeseen criticalities in the grid that endangers the distribution system.
7. When SESP accepts a request from DSO, it responds with an acceptance message if it is able to cater to the requests (except for the emergency command that must be complied with immediately).
8. Based on the magnitude, direction and type of load regulation requested by DSO, SESP runs the local flexibility market algorithm to mobilize the least expensive and most reliable flexibility resources including batteries.
9. SESP flexibility and battery management use cases are described in PUC-3&4.

Variations:

1. SESP may enter into a different type of contract with the DSO for offering exclusive battery-based services such as reactive power management, power quality, etc.
2. SESP may be a penalized by DSO for deviations from contracted flexibility delivery.

3.7 PUC-7: Island Operation Management

Actors: SESP, DSO, Prosumers, Consumers, Batteries, IDPR

Preconditions:

1. Unforeseen contingent circumstances have necessitated the distribution grid to be operated in island mode.
2. SESP enters into a contract with the DSO for operations in island mode.
3. SESP enters into contract with consumers for managing priority loads.
4. SESP owns and operates an intelligent distribution power router (IDPR) in the distribution grid.

Assumptions:

1. DSO communicates to the SESP immediately when the grid goes into island mode of operation.

2. SESP has rough knowledge about the estimated time duration for which the grid will be operated in island mode.
3. There is sufficient production from distributed/renewable energy sources and adequate battery reserve during this time for the grid to be operated in island mode.
4. Contract prices are subject to revision during the contract renewal phase.
5. Communications between SESP and IDPR remain under operation

Steps:

1. SESP communicates to the DSO immediately when the main switch is disconnected and the island mode is running.
2. SESP predicts total energy production from distributed/renewable energy sources during the island mode operation time.
3. SESP identifies loads that need to be run in fail-safe mode and creates a priority list of loads that need to be served.
4. SESP schedules loads according to the total energy production from renewable/distributed sources (together with battery reserve) and consumption for priority loads.
5. SESP creates an island mode operation plan based on the scheduling and sends this information to the DSO for confirmation.
6. Once the DSO confirms the plan, SESP sends necessary control signals to the power router.

Variations:

1. If the SESP cloud cannot communicate with the IDPR, the IDPR local management system sends the control signals to loads and generators.

4 Pilot sites characteristics

4.1 Norway

4.1.1.1 Legal Issues

There have been no legal issues in definition of the Norwegian pilot. The work with the Ethical delivery (10.1-10.9) was underestimated and caused some delay.

4.1.1.2 Actual situation

The recruitment of 10+ participants/customers for Empower demonstration is on-going in the Norderhaug area and will be completed within this year. Local controllers, sensors and controlling equipment's are also under installation

The three pilot sites in Norway are located in the municipality of Hvaler. They are located on two different island, where one is located on the island of Vesterøy and two are located on Kirkeøy.

Figure 2: Norwegian pilot location.

4.1.2 Norderhaugveien

4.1.2.1 Location

The pilot site is located at the island of Vesterøy. The island is the second largest of the islands in Hvaler. The pilot consists of households, some with connected PV panels, and a storage unit.

4.1.2.2 Grid topology

The pilot site has one substation with 315kVA capacity and 230V supply to the end users. There will be a storage unit connected directly to the substation. There are 50 end-users connected to the substation, in which 4 have PV-panels installed and connected.

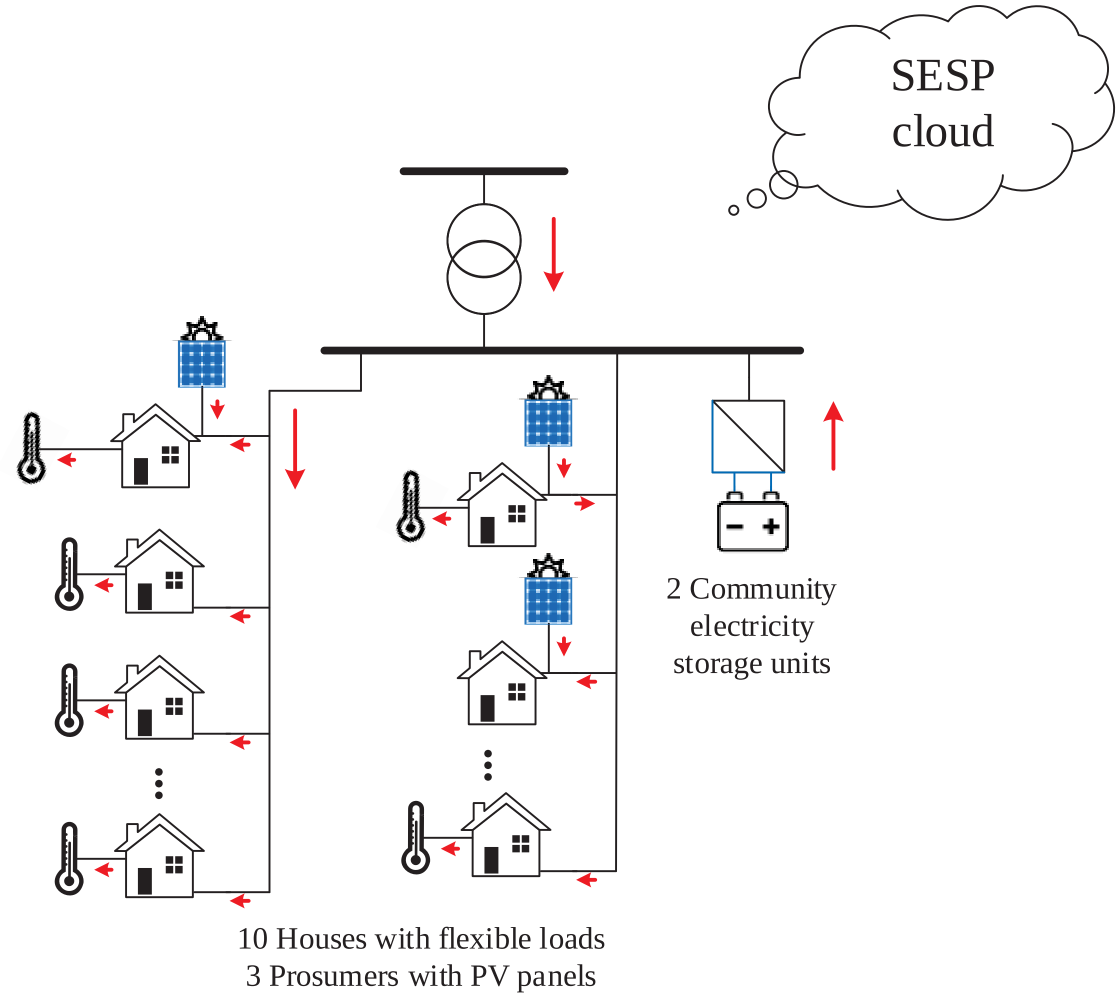


Figure 3: Norderhaugveien pilot diagram.

4.1.2.3 Consumption and generation

The annual energy consumption at the transformer is approximately 920 000 kWh, with a peak load of 280kW. The main part of the consumption occurs at winter, due to relatively high use of electricity for heating purposes.

The PV-panels range from 2 – 4 kWp. Calculated production from the panels estimate a energy production between 2000 and 4500 kWh from each panel. The main production is at summer, with little or nothing produced at winter.

4.1.2.4 SGAM architecture

The SGAM component layer corresponding to Norderhaugveien pilot site is presented below.

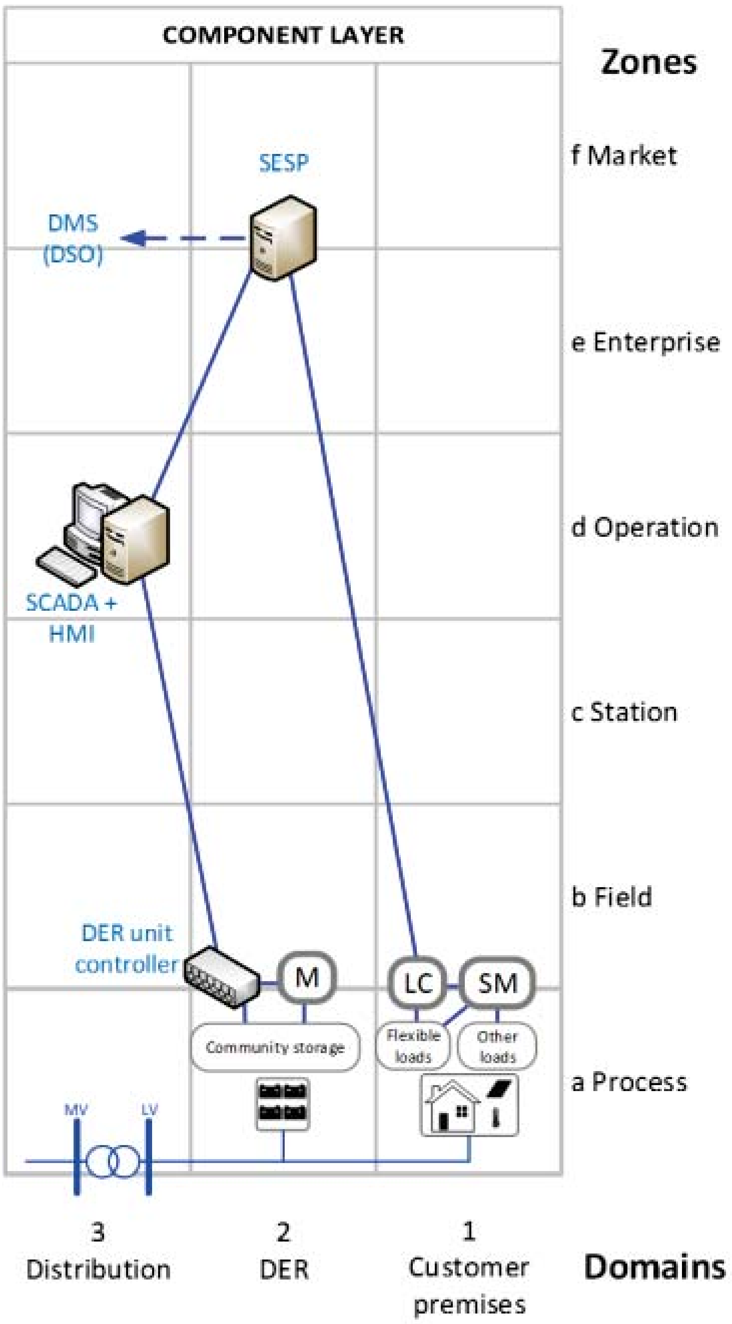


Figure 4: SGAM Norderhaugveien pilot component layer.

4.1.2.5 Equipment

The entire municipality of Hvaler has been equipped with smart meters since 2012. Additionally, the project will need to install smart house equipment at selected end users and a storage unit.

- Local Controllers / Gateways QTY - 10
- Optical readers or HAN-interface QTY - 10
- Switches for flexible loads

- PM-instruments (power-monitoring)
- PQ-Instruments (Power Quality)
- Storage unit – QTY 1

4.1.2.6 Pilot use cases

This pilot will test PUC-1,2,4,5

4.1.3 Sandbakken microgrid

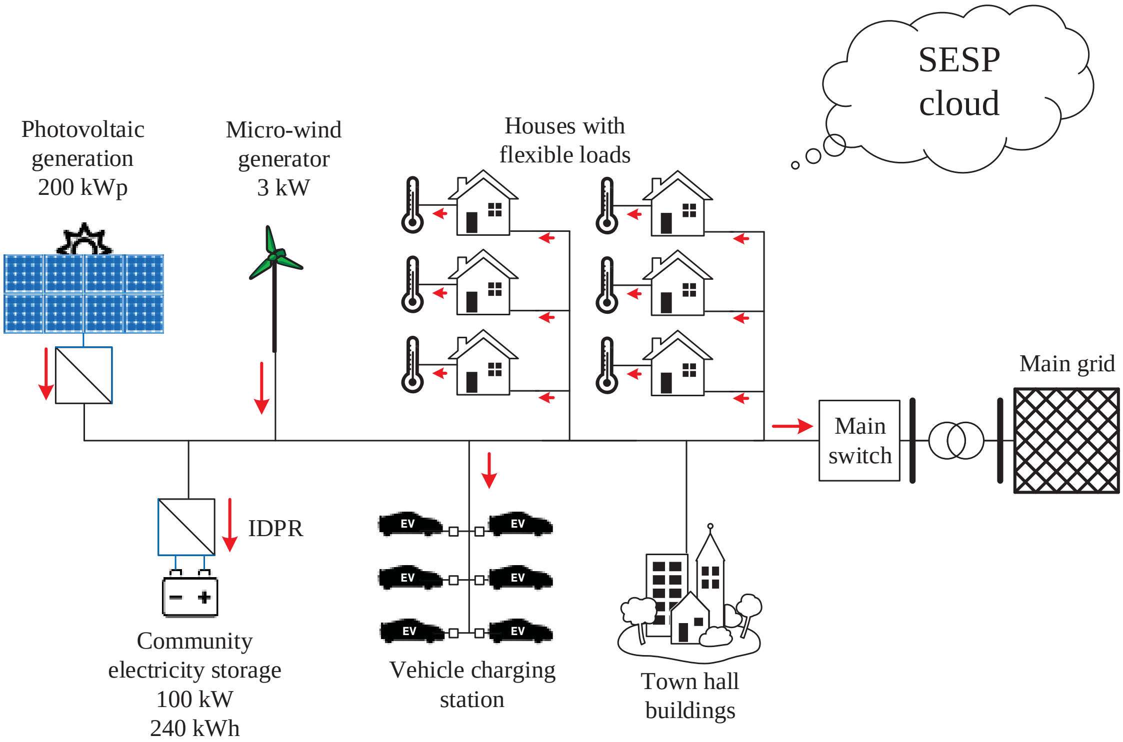


Figure 5: Sandbakken pilot diagram.

4.1.3.1 Location

The Sandbakken recycling station is located at the island of Kirkeøy. Kirkøy largest island in the municipality and the administration center is located on the island. The pilot consists of a municipal recycling station, a firehouse and some utility buildings.

4.1.3.2 Grid topology

The pilot-site has one substation with a capacity of 800kVA, and supply voltage of 400V. The recycling station is currently the only connected end user. The municipality is installing 1200m2 of PV-panels, and a storage-unit. One windmill will be installed initially, with three more planned.

4.1.3.3 Consumption and generation

Due to the complete remodeling of the site, there are only estimations of consumption and production available. The estimated consumption is 200 000kWh with a peak load of 300kW. The estimated production is 200kWp.

4.1.3.4 SGAM architecture

The SGAM component layer corresponding to Sandbakken pilot site is presented below:

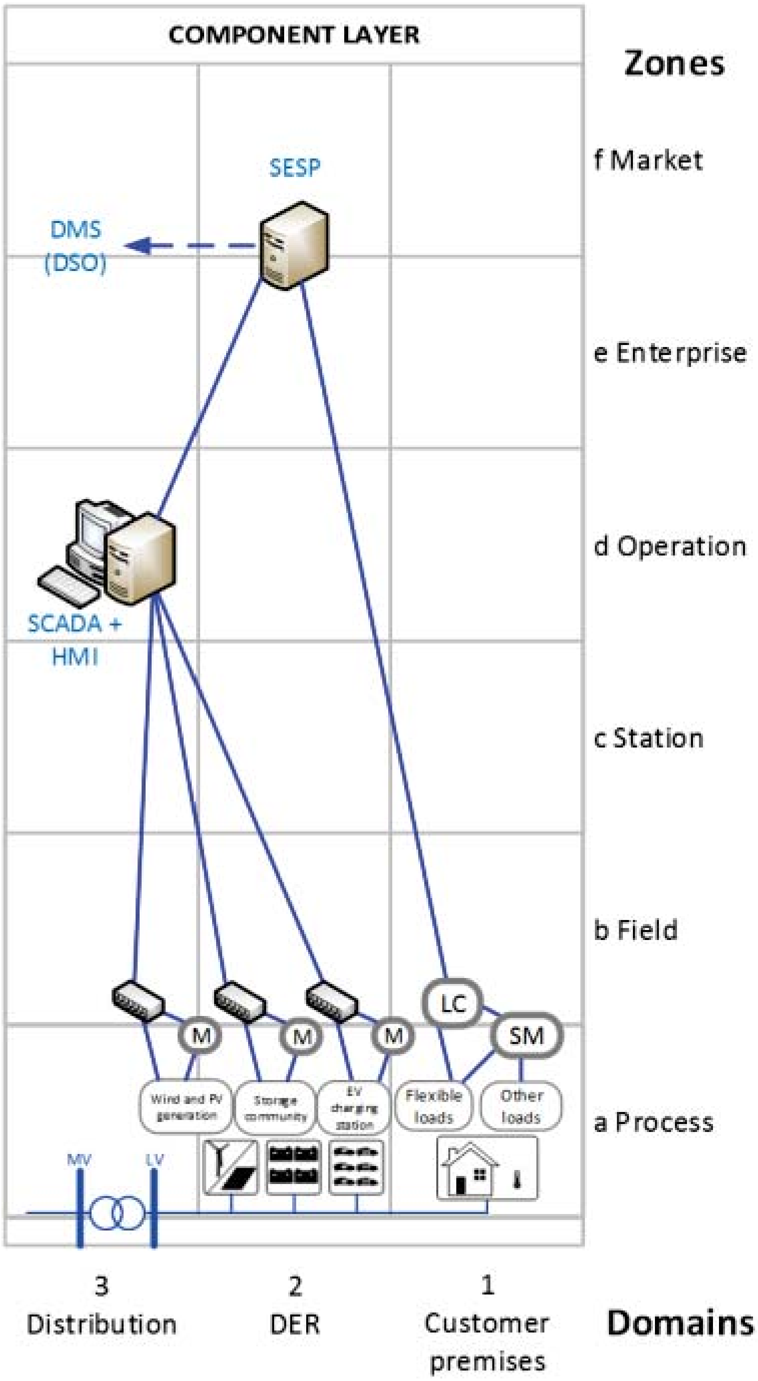


Figure 6: SGAM Sandbakken pilot component layer.

4.1.3.5 Equipment

- Scada
- IDPR
- PQ Instruments (Power Quality)

4.1.3.6 Pilot use cases

This pilot will test PUC-1,2,3,4,5,6,7

4.1.4 Hvaler municipality

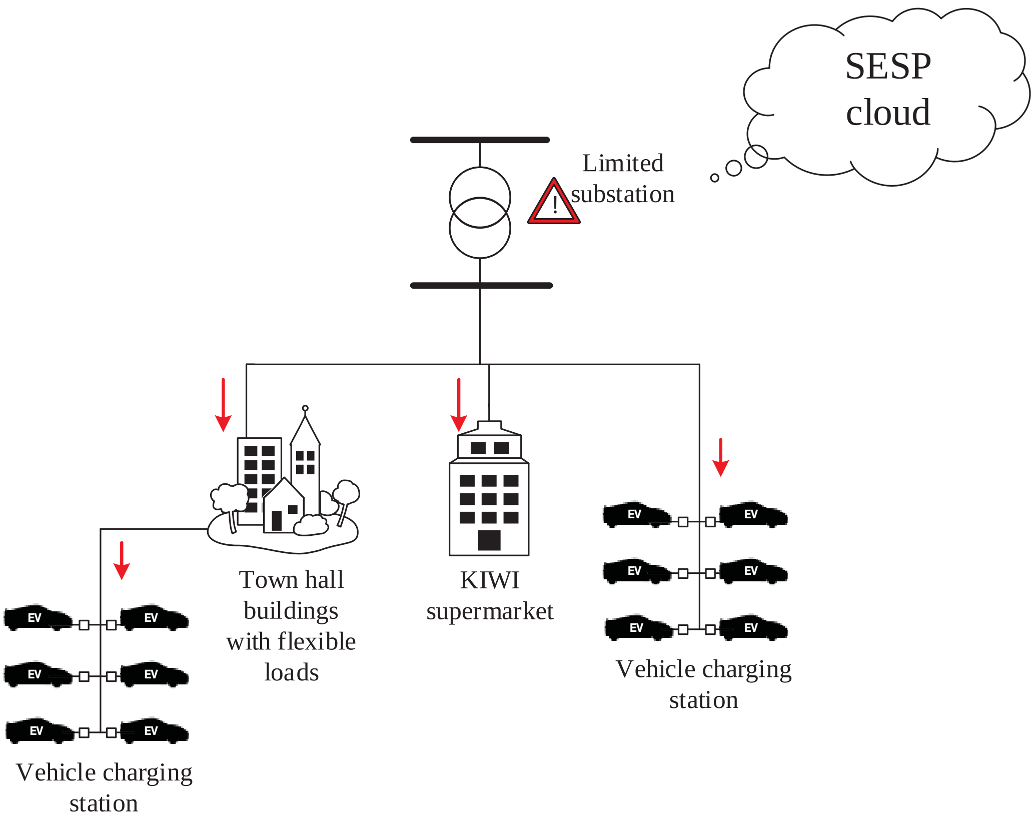


Figure 7: Hvaler pilot diagram.

4.1.4.1 Location

The Hvaler municipality pilot site is located at the island of Kirkeøy, the largest island in the municipality. The pilot consists of the town hall, with charging station. There is also a separate charging station, and a commercial building.

4.1.4.2 Grid topology

The pilot site has one substation with a capacity of 630kVA, and a supply voltage of 400V. There are 15 end users connected to the substation. All of the end users has smart meters.

4.1.4.3 Consumption and generation

The annual energy consumption at the transformer is 955 000 kWh, with a peak load of 170kW. There is no production at this site. There are no data yet available on the energy consumption of the charging sites.

4.1.4.4 SGAM architecture

The SGAM component layer corresponding to Sandbakken pilot site is presented below.

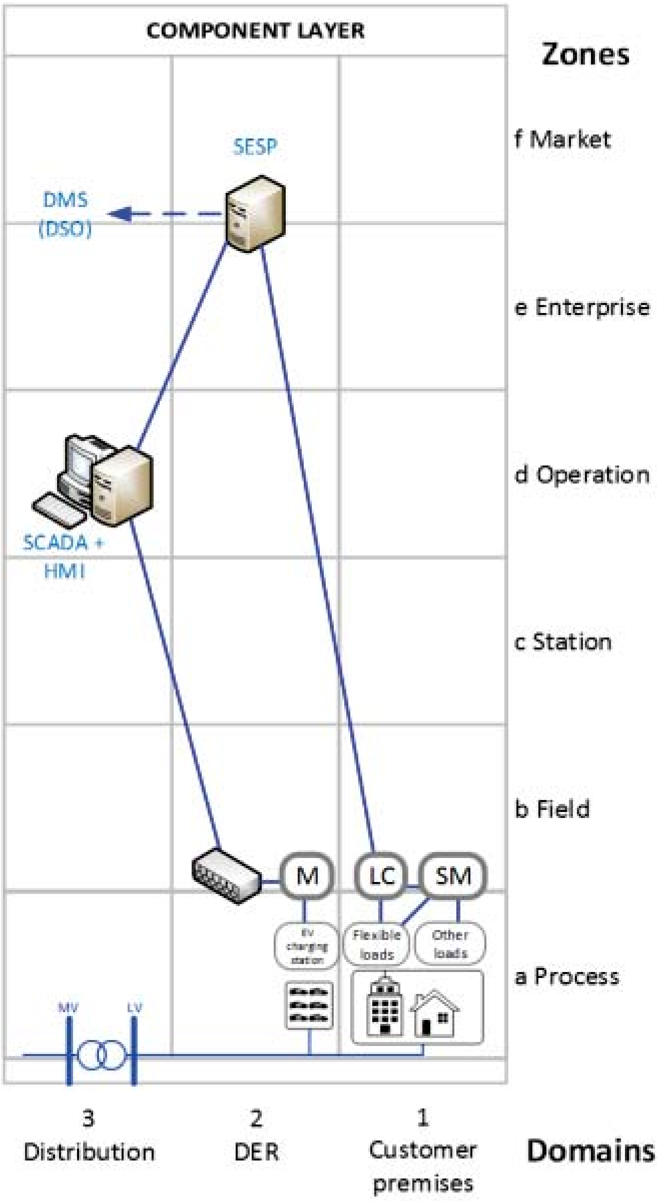


Figure 8: SGAM Hvaler pilot component layer.

4.1.4.5 Equipment

- PQ-instruments
- PM-intruments

4.1.4.6 Pilot use cases

This pilot will test PUC-1,3,4,6.

4.2 Germany

4.2.1.1 Legal Issues

There are legal issues regarding the pilot site Wolpertshausen (smart meter roll-out and pre-qualification for balance energy market)

4.2.1.2 Migration Action Plan

It has been managed to get Wolpertshausen participated in the roll-out test programme of the DSO in 2017. This is the first date of the stepwise roll-out in Germany.

However, smaller consumers, as the public buildings on-site, are NOT obliged to participate in the official roll-out yet. The DSO incorporated the municipality into its test programme, although its building are small consumers. The DSO is also willing to incorporate private households. This all happened on our request. They therefore need more calibrated smart meters (They now just have enough for the public buildings).The calibration process will not be finished up to spring next year. We so have found the earliest possibility to install calibrated smart meters in Wolpertshausen.

Moreover, we are planning to found a cooperation on-site in order to enable a local trade platform in the future. We will just show the potentials of a micro-flexibility market on-site during the project.

4.2.1.3 Actual situation

All the public households in Wolpertshausen do not consume as much energy as to fulfill the obligation to have smart meters installed. Private households are likely to do so as well.

Furthermore, the given EMPOWER structure does probably not fulfill the pre-qualification requirements of the German balancing energy market.

The two demo-sites are located within the municipality of Wolpertshausen, close to Schwäbisch Hall. It is part of the region Baden-Württemberg in the southwest of Germany.

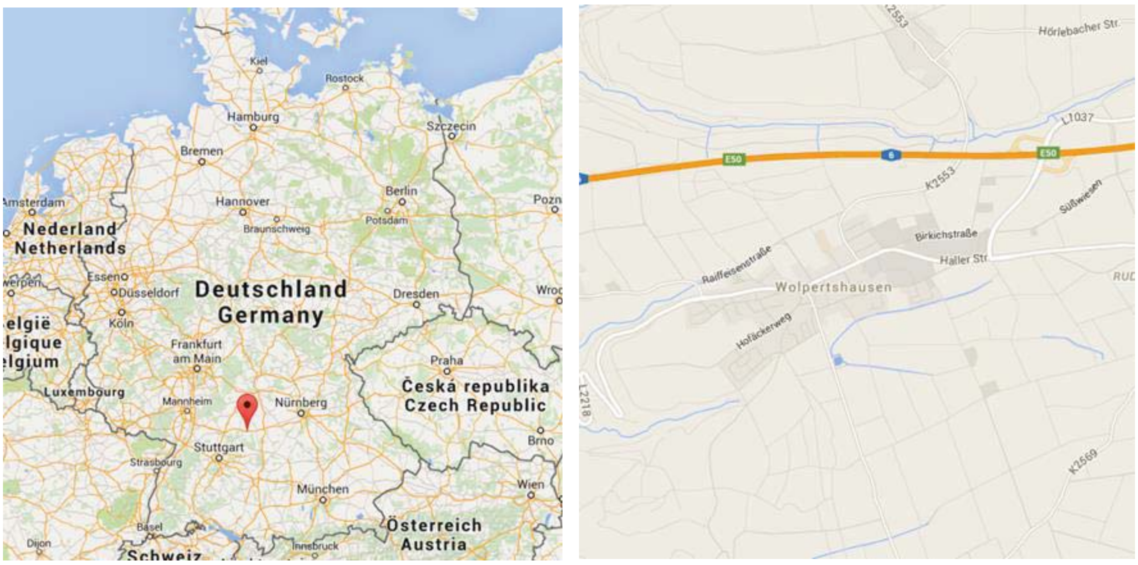


Figure 9: German pilots location.

4.2.2 School area

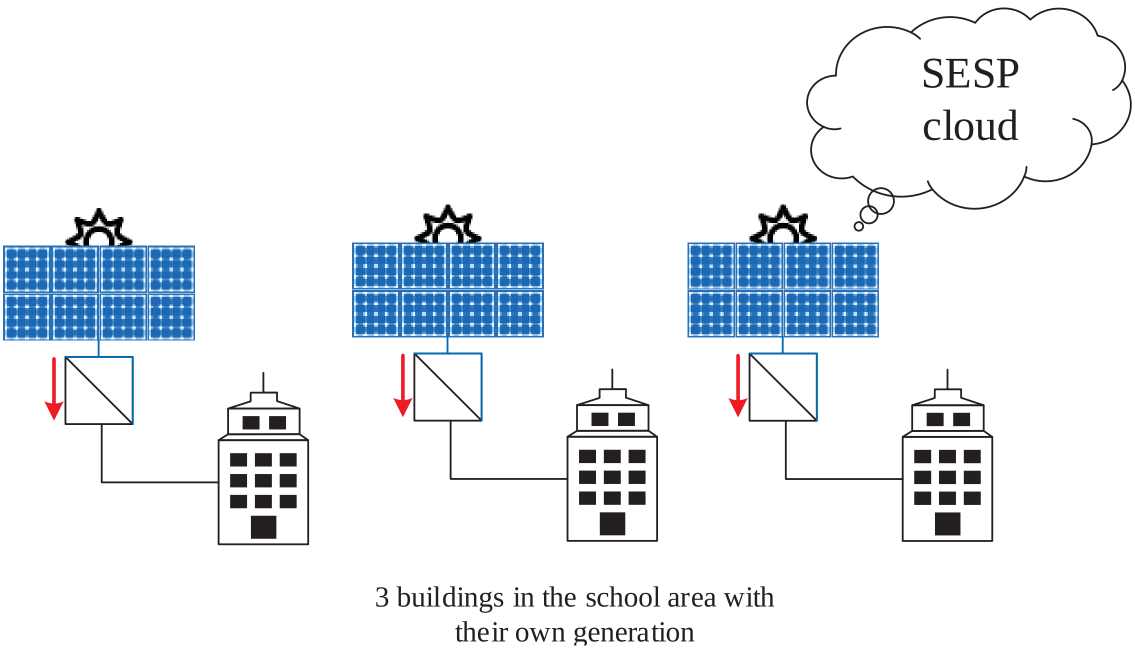


Figure 10: School area German pilot diagram.

4.2.2.1 Location

3 of 9 public buildings available. will be included into the pilot-site architecture of Wolpertshausen. The buildings are used in a different way, enabling a wide field of electricity data. They a located in a radius about 250 meters. There may be more public

buildings incorporated if it becomes more difficult to find private households joining EMPOWER.

4.2.2.2 Grid topology

Currently there are analogue electricity meters installed in all the public buildings yet, but they will be replaced by digital meters gradually. There are PV systems rented to private people installed on the public buildings. The aim is to incorporate the generation capacity to the project. The buildings are connected to low voltage distribution substation and thus to the national grid. See structure below:

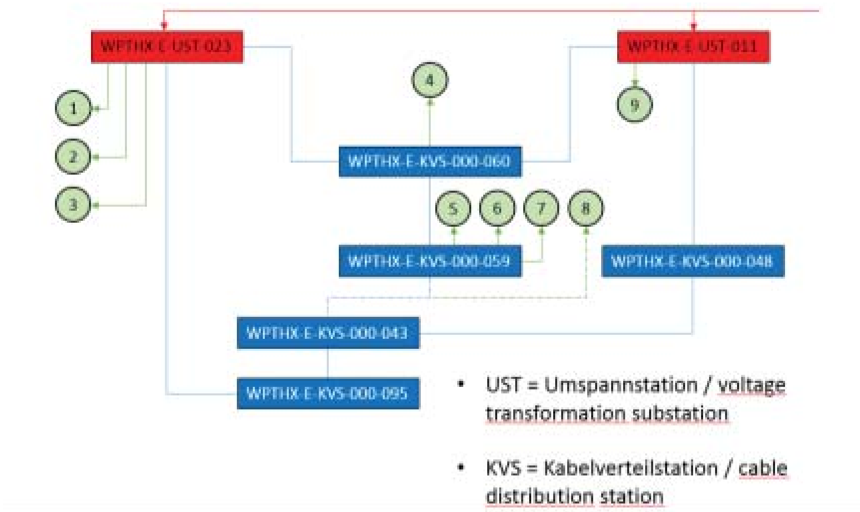


Figure 11: Schematic grid plan Wolpertshausen.

4.2.2.3 Consumption and generation

See below the table of the consumption of the 9 public buildings available to EMPOWER in 2015:

Object:	**Consumption:**
Building yard	3.832 kWh
Fire brigade Wolpertshausen	6.237 kWh
House of the citizens	2.012 kWh
Elementary School	9.277 kWh
Playschool / daycare	6.435 kWh
Herolthalle (Gym)	15.232 kWh

Mehrzweckhalle (Gym)	31.030 kWh
Europasaal (Gym, Union Hall)	7.008 kWh

Table 1: Consumptions in Wolpertshausen pilot.

4.2.2.4 SGAM architecture

The SGAM component layer corresponding to Germany school area pilot site is presented below.

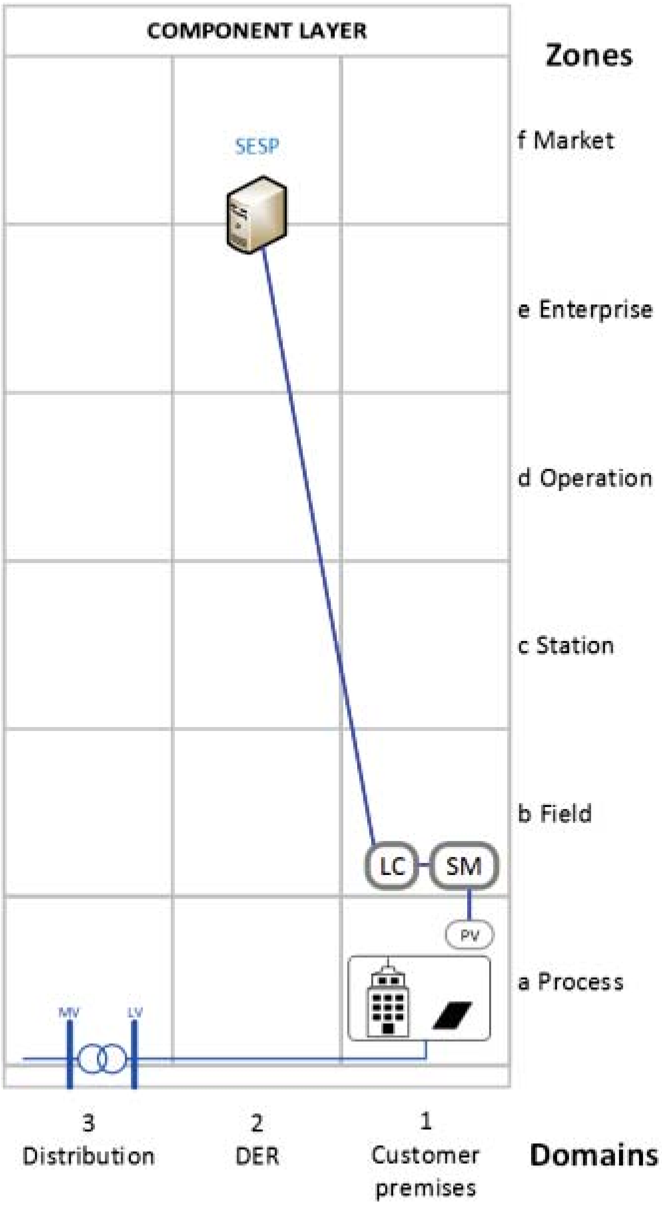


Figure 12: SGAM School area German pilot component layer.

4.2.2.5 Equipment

- Digital E-Meter ehz-n or ebzd (installed by DSO)

    - Optional: Optical Reader (if Smart Meter cannot be installed)

- External Meter Interface LED (e2u)
- Gateway MGW101-DP3 (e2u)
- TP-Link GSM-Modem (mandatory for public buildings)

4.2.2.6 Pilot use cases

This pilot will test PUC-1, and additionally PUC-3, if possible due to flexible loads.

4.2.3 Residential area

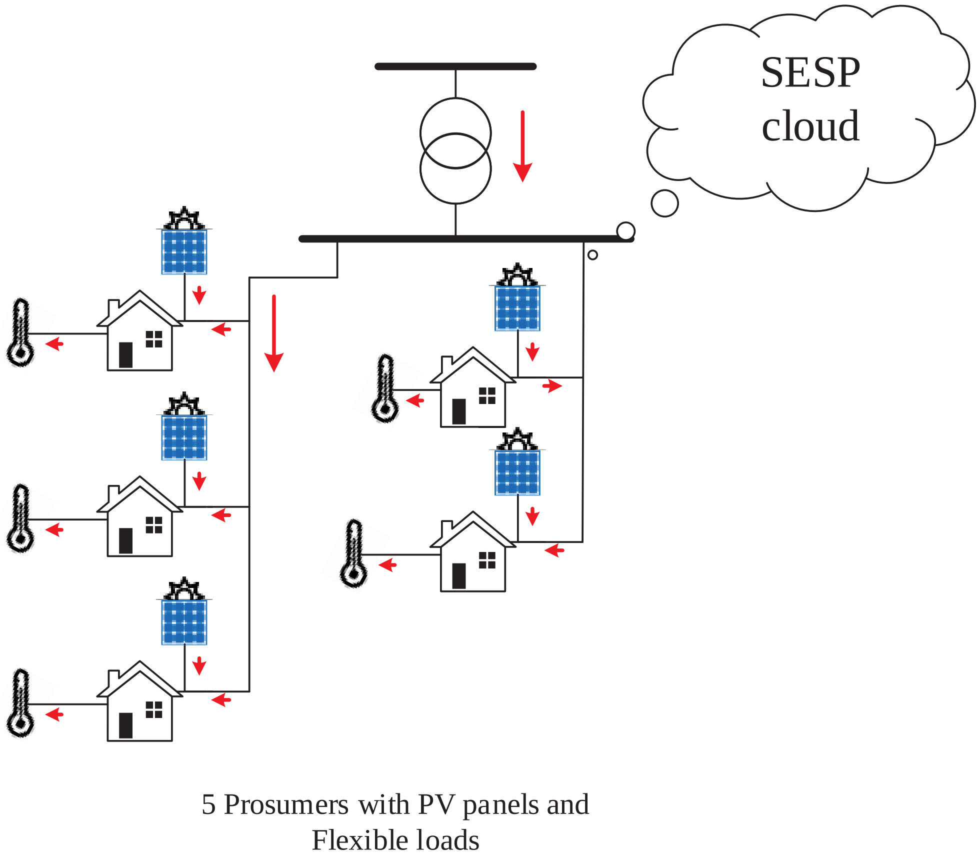


Figure 13: Residential area German pilot diagram.

4.2.3.1 Location

The households are selected, so that they are in a spatial context, preferably prosumers, producing their own energy. We aim to find households having flexible loads available.

4.2.3.2 Grid topology

There is no data to the private households available up to now. Due to its close location to the public buildings the private households will be connected to the same local grid circle, having several transformers to the upper voltage level.

4.2.3.3 Consumption and generation

There is no data available yet. We assume that they have analogue meters installed, that may be substituted by smart meters of the DSO. The consumption is assumed to be around 4.000 kWh per year.

4.2.3.4 SGAM architecture

The SGAM component layer corresponding to Germany residential area pilot site is presented below.

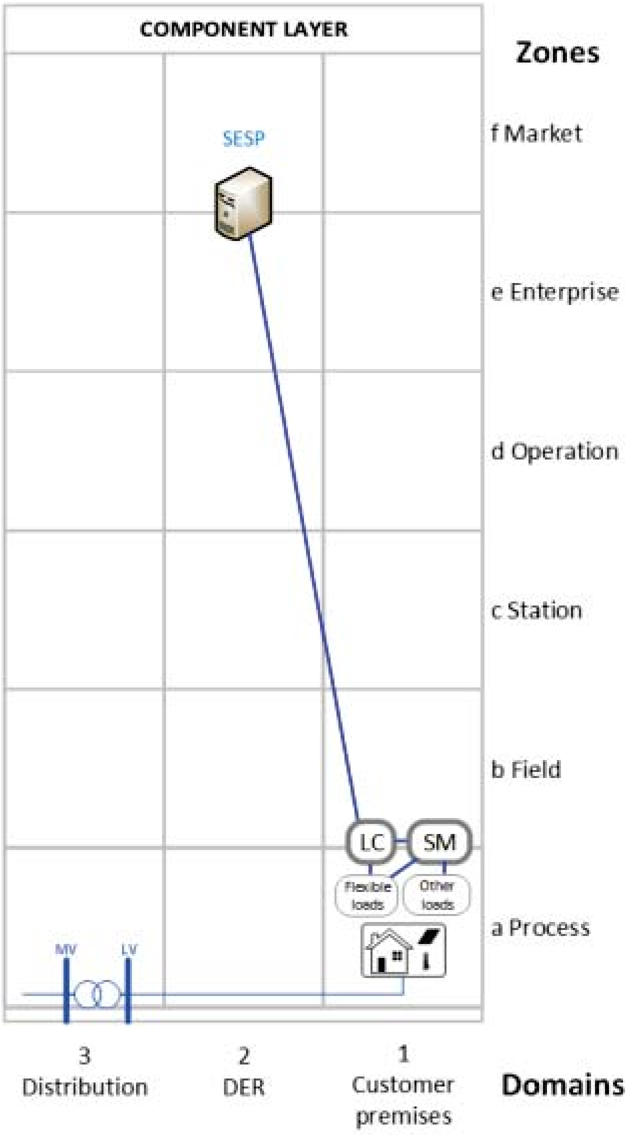


Figure 14: SGAM Residential area German pilot component layer.

4.2.3.5 Equipment

- Digital E-Meter ehz-n or ebzd (installed by DSO)
- Optional: Optical Reader (if Smart Meter cannot be installed)

- External Meter Interface LED (e2u)
- Gateway MGW101-DP3 (e2u)
- TP-Link GSM-Modem (if internet not available)

4.2.3.6 Pilot use cases

This pilot will test PUC-1, and additionally PUC-3, if possible due to flexible loads.

4.3 Malta

4.3.1.1 Legal Issues

No outstanding legal issues are present in the Malta pilot site. Clearance has been obtained from the data protection commissioner and agreements with participants and Enemalta have been signed.

4.3.1.2 Migration Action Plan

Delays were caused in the initial phase of the implementation of the Malta pilot action due to the political and administrative situation in the energy sector, and the necessity to obtain clearance from Enemalta, which enjoys a practically monopolistic situation in the electricity supply and distribution system in Malta.

The institutional situation required an intervention by the ministry responsible for energy with Enemalta, but the Minister for Energy and the CEO of the responsible unit (SEWCU) both resigned unexpectedly, for different reasons and on separate occasions. Besides, Enemalta was in the meantime partially privatised, with foreign interests taking up 30% of the shareholding in the company. This resulted in a period of inaction from the ministry, which is no longer in a position to exert control over Enemalta.

The inability of the ministry to make arrangements with Enemalta on behalf of MIEMA, and inaction from Enemalta's side to supply the information required, caused delays to the initial phase of the Malta pilot. Mitigation action was taken and a solution was found through the introduction of the optical readers to get real time data, bypassing the need for Enemalta's regular contribution to the project.

4.3.1.3 Actual situation

The Malta pilot action has been defined and potential participants were selected. Practically all households have now been supplied with smart meters.

Site visits were organized to all the identified participants and details of each site were taken. Data protection obligations have been fulfiilled and consent forms, as well as agreements with the public entities involved, have been signed.

Smart devices (gateway and EMI with optical readers) for trial purposes have been installed in two households, one being a prosumer. Experimentation with data transmission has been ongoing for the past few weeks.

A local stakeholder group has been set up and regular meetings are held from time to time.

Pilot 1: Residential area – Households

The pilot, which is being implemented in the residential area, consists of 5 households. At least one of these households shall have a photovoltaic system installation. All 5 households have controllable loads (water heaters or air-conditioning).

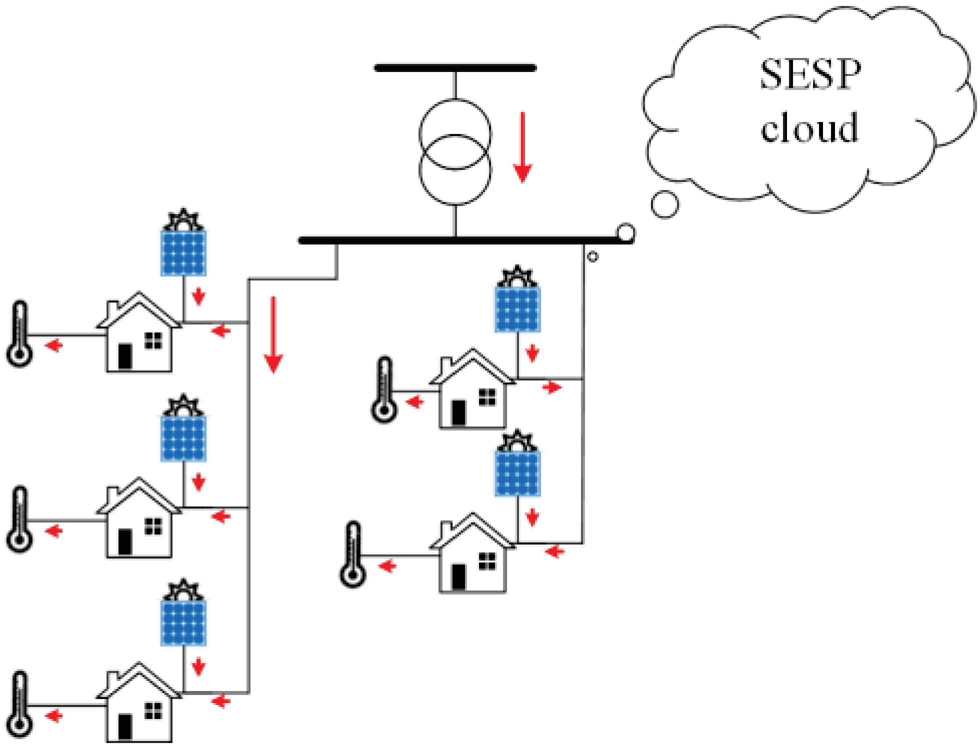


Figure 15: Residential area and Households Maltese pilot diagram.

Pilot 2: Public Buildings

The second part of the pilot is being implemented in public buildings. This consists mainly in ministry and local council's buildings. Public buildings also have controllable loads (water heaters or air-conditioning).

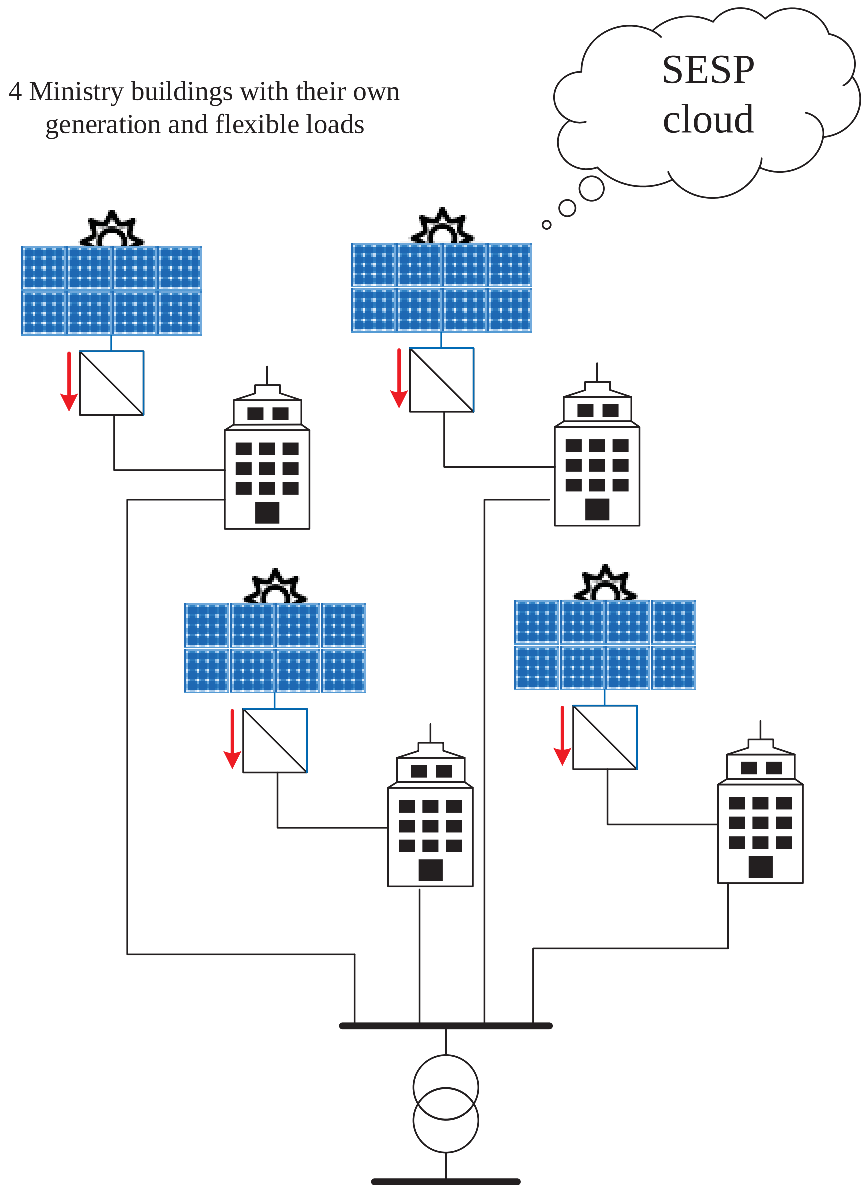


Figure 16: Public buildings Maltese pilot diagram.

4.3.1.4 Location

The pilot is mainly being implemented at the Ministry for Gozo (MGOZ) which is located in Victoria, Gozo. Satellite imagery of the location is shown in the following images.

Figure 17: Maltese pilot location.

4.3.1.5 <u>Grid topology</u>

Each residential building participating in the pilot has at least one consumption smart meter. In the case of prosumers there is an additional smart meter (PV Import/Export).

The ministry buildings have 2 consumption meters and 4 generation meters, all of which are connected to the same substation.

4.3.1.6 Consumption and generation

The ministry buildings are supplied by two smart metering systems, which are both connected to the same Enemalta substation, located in the MGOZ car park. There are 4 photovoltaic systems on the buildings (10kWp, 40.32kWp, 42.09kWp and 15.6kWp).

All the 4 PV systems installed are connected to a PV and Import/Export meter. The meters are all connected to the same substation to which the consumption meters are connected.

4.3.1.7 SGAM architecture

The SGAM component layer corresponding to Malta residential area pilot site is presented below.

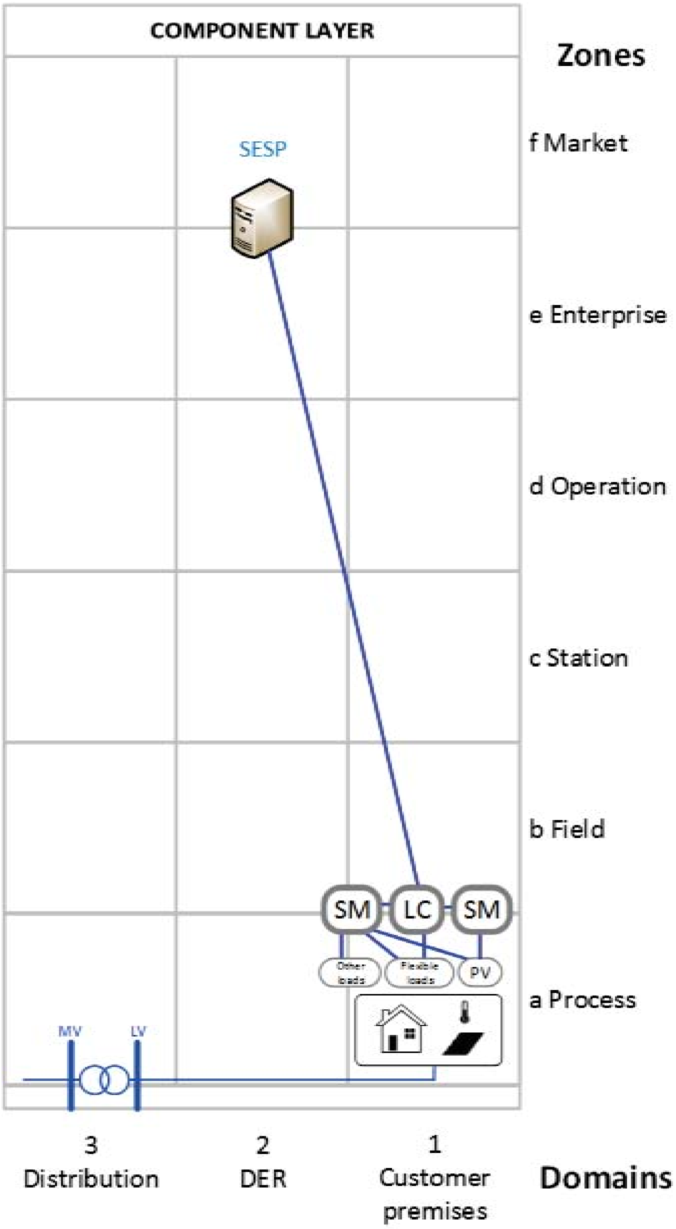


Figure 18: SGAM residential area and Households Maltese pilot component layer.

The SGAM component layer corresponding to Malta public buildings pilot site is presented below.

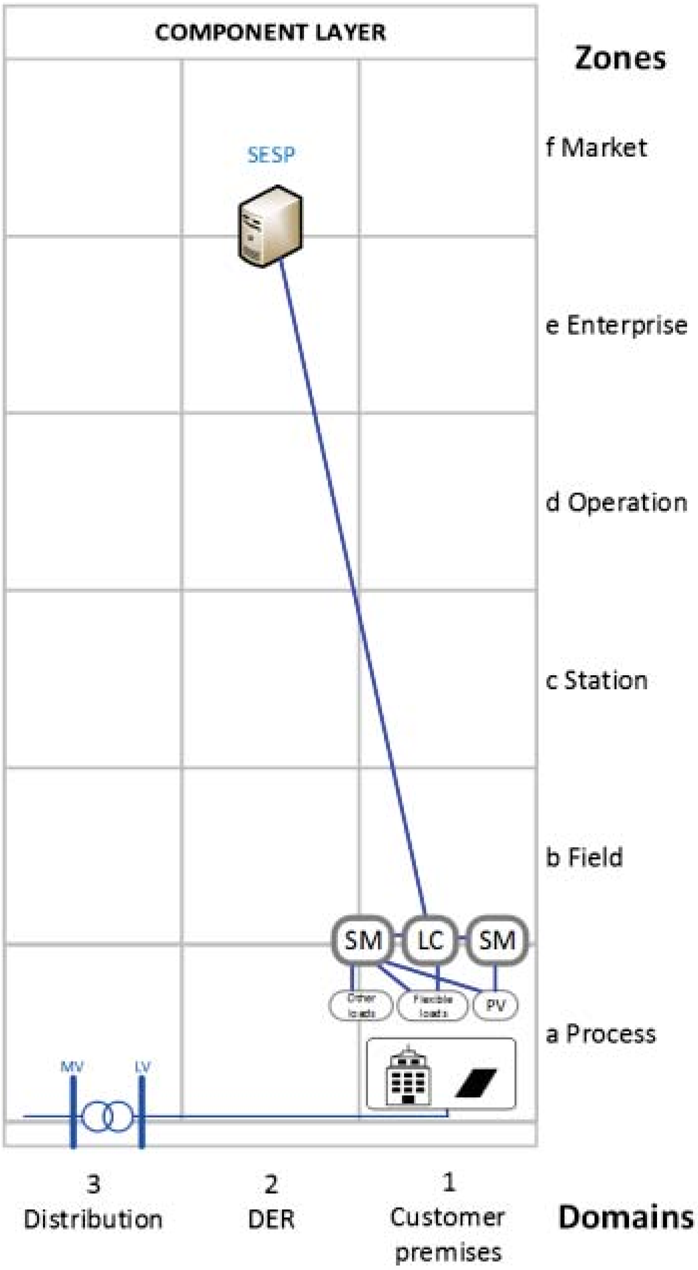


Figure 19: SGAM public buildings Maltese pilot component layer.

4.3.1.8 Equipment

It is foreseen that the following equipment is required for the implementation of the pilot (residential and public):

- AMS- smart meters / Optical readers – QTY: 15
- Local Controllers / Gateways – QTY: 10
- Switches for flexible loads – QTY: 10

- PM-instruments (power-monitoring)
- PLC-communication
- GPRS-communication

4.3.1.9 Pilot use cases

This pilot will test PUC-1,2,3

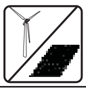
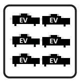
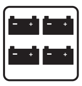
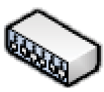
5 Conclusions

The main goal achieved in this document is the definition of the specifications for the architecture and types of factors involved in each pilot. These specifications are the base for the actual process of development and deployment, always depending on the existing devices, products on the market and the requirements of each one of the institutions involved in the project.

It is very important to define as accurate as possible pilot specifications in order to have less probabilities to have deviations when the deployment starts.

6 Annex

This section identifies and describes all the devices that might be needed for the component layer.

Symbol	Group	Name	Description
	Home & building infrastructure	Local controller (LC)	Control the energy consumption of a load according to a received set point. The system can consist of several decentralized controllers and a centralized management system to monitor and control the heating, ventilation, air conditioning, light and other facilities within a building. It can also interact with a Building management system, a Customer energy management system or a Demand response management System. It can include a customer portal or a HAN gateway to establish the communication between external systems and the local controller.
		Customer appliances	It includes loads and customer appliances that provide an interface to influence their consumption behaviour. It can also include generation, storage and electric vehicles.
	Distributed energy	DER unit controller	Controller of a DER that allows the adjustment of its active or reactive power output according to a received set point.
		Distributed energy resource (DER)	A small unit which generates energy and which is connected to the distribution grid.
		EV charging station	Single or multiple power outlets specially designed to charge the battery of cars. Typically including also facilities meter the energy consumption and to authenticate the owner of the car to be charged for settlement reasons.
		Energy storage	An electrical energy storage which is installed within the distribution grid or DER site and operated either by a utility or energy producer.
	Metering infrastructure	Metering cloud	The metering cloud is in charge of monitoring specific clients' generation and consumption. It also provides Accounting with periodic statements on the energy flowing across boundaries within the community and beyond.
		Meter data management system (MDMS)	MDMS is a system or an application which maintains all information to be able to calculate the energy bill for a customer based on the meter data retrieved from AMI head end(s). The energy bill information is typically forwarded to consumer relationship and billing systems
		AMI head end (AHE)	A system which acts as back-end for the metering communication and controls and monitors the communication to the meter devices. The collected meter information is provided for other system like meter data management
		Meter data concentrator (MDC)	Device or application typically in a substation which establishes the communication to smart meters to collect the metered information and send it in concentrated form to an AMI head end.

M		Meter (M)	Device which measures the energy consumption within predefined cycles. The metered energy consumption is used to determine the energy bill. It is not used by the DSO.
SM		Smart meter (SM)	Electronic device that measures and records consumption of electric energy in intervals of an hour or less and communicates that information at least daily back to the utility for monitoring and billing.
	Electric system	Distribution management system (DMS)	Application server of a Distribution Management System which hosts applications to monitor and control a distribution grid from a centralized location, typically the control center. A DMS typically has interfaces to other systems, like a GIS or an OMS.
 + 		Supervisory control and data acquisition (SCADA) + Human-Machine Interface (HMI)	SCADA and HMI systems provides the basic functionality for implementing EMS or DMS, especially provides the communication with the substations to monitor and control the grid. SCADA will receive data from DER meter-local controllers in order to have a real time vision of the network.
		Control cloud	The control cloud is in charge of managing the orders and schedules that the market cloud defines. It is also equipped with prediction and big data analytics in order to monitor and manage the local market operation.
	Market and trading system	Market cloud	The market cloud manages all transactions and workflows necessary to implement a local energy market. It includes energy scheduling, flexibility, settlement, billing and accounting applications.

Table 2: Components description