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Renewable Energy for Self-Sustainable Island Communities

WP3 – RES/storage enabled infrastructure deployment

D.3.2 Early deployment at pilot sites

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DISCLAIMER

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Executive Summary

This deliverable describes the installation and commissioning process that was followed at each of the three demonstrations sites, it includes the main objectives of each pilot related to the STOs identified in the REACT Project Grant Agreement.

This report documents a structured description of the different materials deployed and systems described un the deliverable D3.2 (REACT D3.1, 2020). This document includes research on different innovative storage technologies including the Power-to-hydrogen technology which will substitute the Power-to- Gas technology. See Chapter 3.2.1.1.

Different reasons have led to several delays on the deployment activities, the one that affected most is the actual situation caused by the pandemic. The mobility restriction has not allowed us to perform activities on the field. It has caused a shortage of raw materials worldwide which was aggravated by the incident that blocked the maritime traffic in Suez channel.

Nevertheless, these barriers have not undermined the development of installation activities within the pilot sites. Contingent activities have been adopted to minimize the negative impact to the projects.

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1 INTRODUCTION

1.1 Scope

This deliverable presents the deployment activities based on the plan specification on the D3.1 in each island and respective demonstration areas. It describes the installation and commissioning process.

1.2 Audience

The intended audience of the deliverable 3.1 consists of members of REACT Consortium, the Project Officer and all interested people. This document is public.

1.3 Definitions / Glossary

Demand Response (DR) provides an opportunity for consumers to play a significant role in the operation of the electric grid by reducing or shifting their electricity usage during peak periods in response to time-based tariffs or other forms of financial incentives.

Demand Side Management (DSM) is commonly used to refer to demand side electrical load management. It involves actions that influence how much energy is used or when energy is used. The goal of DSM is to encourage users to use less energy during peak hours or to move the time of energy use to off-peak times such as night-time and weekends.

Demonstration scenario refers to the operational scenario (or use case), describing the key elements and actions (e.g., control strategy, target indicators, actors and equipment involved…), that will be carried out for **demonstration**/validation project purposes once the REACT technology (both HW and SW) is deployed.

Deployment plan refers to the specific energy system installation plan, comprised of the specific technical system details (e.g., topology, technology, sizing…), according to which the deployment of the mentioned energy system will be carried out at project demo sites.

Distribution Network Operators (DNOs) are often also referred to as Distribution System Operators (DSO). They are responsible for the transport of electricity at a regional level and as such they transport electricity at gradually reducing voltages from national grid supply points to final customers, both residential and non-residential. Throughout the EU, electricity distribution is a regulated monopoly business.

Dwellings (also known as a residence or abode) are self-contained units of accommodation used by one or more households as a home - such as a house or an apartment. A dwelling may or may not contain a garage, which may or may not be adjacent to the unit of accommodation.

Dynamic electricity tariffs often referred to as real-time pricing. Prices change usually on an hourly basis reflecting the cost of generating and/or purchasing electricity at the wholesale level at the time of delivery.

Early adopters are the second fastest category of individuals who adopt an innovation. "These individuals have the highest degree of opinion leadership among the other adopter categories. Early adopters are typically younger in age, have a higher social status, have more financial lucidity, advanced education, and are more socially forward than late adopters" (Rogers, 2003, p. 267).

Electrical Load management, often referred to as simply load management, is achieved through controlling the power flow in the electric system at the generating end (supply side management) or the customer end (demand-side management).

Electricity self-consumption is when all of the power generated is used on-site and no surplus is injected into the grid. This means blocking surplus energy at certain times or storing it in a battery system.

Electricity Supply is the process of buying electricity in bulk and selling it on to the final customer. Electricity supply in most EU counties is a competitive market.

Energy autonomy or energy self-sufficiency refers to the ability to generate, distribute and store renewable energy so as to service the energy demand in real time of the energy autonomous area.

Energy performance contract (EPC) is a contractual arrangement between the beneficiary and the provider of an energy efficiency improvement measure, verified and monitored during the whole term of the contract, where investments (work, supply or service) in that measure are paid for in relation to a contractually agreed level of energy efficiency improvement or other agreed energy performance criterion, such as financial savings.

Energy Service Company (ESCO) is a company that offers energy services which may include implementing energy-efficiency projects (and other sustainable energy projects). The energy services supplied by ESCOs can include a wide range of activities such as energy analysis and audits, energy management, project design and implementation, maintenance and operation, monitoring and evaluation of savings, property/facility management, energy and/or equipment supply, provision of service (space heating/cooling, lighting, etc.) advice and training.

Energy Suppliers buy electricity and /or gas in bulk and sells it to final consumers.

Energy Supply Contract, the key element in this type of contract is the efficient supply of energy. The contracting partner provides products/services such as supplying electricity, gas, or heat. Financing, engineering design, planning, constructing, operation and maintenance of energy production plants, as well as management of energy distribution, are often all included in the complete service package. For example, district heating providers are the most widely implemented example of energy supply contracting in the residential sector.

Follower island is a term used in the REACT project to refer to the five islands for which plans for the large-scale replication of the implementation of the REACT solution will be developed as part of the project. These plans will be based on the findings from the pilots ran on the three islands on which the solution is being tested or piloted as part of the project. The REACT follower islands are Gotland (Sweden), Lesbos (Greece), Isle of Wight (UK), Majorca (Spain) and Reunion (France).

Island territories are defined in the REACT project as geographical islands that have: a minimum surface of 1 km^2; a minimum distance between the island and the mainland of 1 km; a resident population of more than 50 inhabitants; no fixed link (for example, a bridge, a tunnel, or a dyke) between the island(s) and the mainland.

Mainland is the main part of a country or continent, not including the islands around it

Pilot island is a term used in the REACT project to refer to the three islands on which the REACT solution will be piloted/demonstrated during the lifetime of the project. These are; La Graciosa (Spain), San Pietro (Italy) and Aran Islands (Ireland).

Pilots are experiments or tests conducted prior to the technology or system being introduced more widely.

Pilot focus areas are the areas that have been defined on the REACT pilot islands for the implementation of the REACT solution during the lifetime of the project. These are, Caleta del Sebo in La Graciosa (Spain), Carloforte in San Pietro (Italy), Kilronan, on Inis Mór one of the Aran Islands (Ireland).

Renewable energy is energy from a source that is not depleted when used, such as wind or PV power.

Renewable Energy Systems are energy systems that rely on renewable forms of energy generation.

Smart devices or appliances can connect to a network via wi-fi so you can control them when you are away from home using a smart phone or tablet (e.g., iPad).

Smart grid technologies include but are not limited to, Home Energy Displays, Home Energy Management Systems (HEMS), Smart Meters, Micro CHP, PV, Electric Vehicles, batteries, hot water storage and Smart household appliances.

Smart Grids are "electricity network[s] that can cost efficiently integrate the behaviour and actions of all users connected to it – generators, consumers and those that do both – in order to ensure economically efficient, sustainable power system with low losses and high levels of quality and security of supply" (EC – Directorate General for Energy, 2011).

Social media feeds are software that provide notifications when new items have been posted to a social medium, it includes Facebook twitter LinkedIn, WhatsApp etc.

Supply Side Management (SSM) is commonly used to refer to supply-side electrical load management. It refers to actions taken to ensure that energy generation, transmission distribution and storage are conducted efficiently, on the supplier's side of the energy supply chain.

Surveys (sometimes called questionnaires) is used to collect data from subjects (often called respondents) who respond to a series of questions about behaviours and opinions.

Technology Acceptance Models are models used to understand technology acceptance based on two primary factors (perceived ease of use and perceived usefulness) that influence an individual's intention to use new technology.

Time-based pricing is a pricing strategy where the provider of a service or supplier of a commodity, may vary the price depending on the time-of-day when the service is provided, or the commodity is delivered.

Transmission Network Operators (TNOs) are responsible for the bulk transport of electricity by high voltage power lines from power stations to grid supply points. The transmission system is generally referred to as the national grid. Throughout the EU Transmission is a regulated monopoly business.

Usability as defined by ISO 9241: extent to which a system, product or service can be used by specified users to achieve specified goals with effectiveness, efficiency and satisfaction in a specified context of use.

User centred design: based on ISO 13407 User Centred Design calls for a collaborative design process where users deliver continual feedback based on their reactions to a product's prototype.

Utilities industry in its broad sense refers to electricity, gas and water supply companies and integrated energy service providers. The term is most often used to refer to the companies involved in the generation, transmission and distribution of energy.

Network Time Protocol (NTP) is an Internet protocol for synchronizing computer system clocks through packet routing in networks with variable latency.

1.4 Abbreviations

DSO: Distribution system operators

PV: Photovoltaic

RES: Renewable energy sources

kW / MW / GW: kilowatt / megawatt / gigawatt

Wh / KWh / MWh / GWh: kilowatt hour / megawatt hour / gigawatt hour

GHG: Greenhouse gas

LV: low-voltage

MV: medium-voltage

TOU: Time-of use

REC: Renewable Energy Community

CDM: Canonical Data Model

M.E.: Mitsubishi Europe

CT: Current Transformer

ATA: Air-To-Air

VRF: refrigerant flow

ATW: water heat)

DHW: domestic hot water

1.5 Structure

- **Section 1:** contains an overview of this document, providing its Scope, Audience, Definitions, Glossary and Structure.
- **Section 2**: implementation strategy, overall strategy, communication strategy with the REACT platform
- **Section 3**: Deployment activities, recruitment process, technical configuration, technical and legalization process, material installation and commissioning, training strategy, testing strategy and constraints
- **Section 4**: Conclusion
- **Appendix I**: New heat pump system components for San Pietro public buildings and private buildings
- **Appendix II:** New heat pump system components for Aran Islands community buildings

1.6 AIMS AND OBJECTIVES

Task 3.2 performs early deployment activities according to the deployment plan (D3.1) for all demo sites in parallel. The idea behind such early deployment is to enable the acquisition of baseline data on time, which will be later used for the validation of the REACT solution in the last year of the project. Activities of this task will include deployment of energy generation, storage, demand-side systems and monitoring equipment already provided by the consortium partners and integration with existing infrastructure. This will provide technical assets and infrastructure for monitoring and performing the control actions necessary to conduct optimal energy dispatching under the identified control strategy. A corresponding data acquisition system will be used to collect all data necessary for REACT platform to devise and perform the optimal control actions. To achieve integration of deployed energy assets in the existing energy infrastructure and to ensure a cost-effective solution, REACT will be enhanced by supporting control units (such as dedicated PLCs, circuit switcher and breaker units, battery control modules) that will provide the possibility to act upon the deployed energy assets remotely by the REACT platform. This task will also deal with early configuration of existing energy assets and a monitoring framework. In this way, it will enable the early set up of the overall REACT system at all demo sites. All monitoring data acquired in this phase will be integrated and further processed under the REACT platform to support DR control strategy identified for each pilot.

1.6.1 CONTRIBUTION OF THE PROJECT PARTNERS

The following is a description of the partners' contributions to this report:

Partner	Contribution	PM
VEO	Early deployment support for pilots	3
NUIG	Early deployment support for Aran	2
UNG	Support at local side for Aran pilot deployment	2
MERCE	Support ASHP system (and associated DAQ) deployment at pilot sites	6
FEN	Supervision of the deployment in La Graciosa	3
AIE	Subcontracting of electricians for the deployment in La Graciosa	6
R2M	Early deployment support and management for Carloforte	3
MID	Early deployment in Carloforte	5
CCF	Early deployment in Carloforte	1
ORD	Material acquisition and electrical integration deployment (Aran)	9

1.6.2 RELATIONS TO OTHER ACTIVITIES IN THE PROJECT

In this task we have executed the deployment activities according to the task description stated for deliverable D3.2. The scope of the action developed in each pilot site, the scenarios described and the strategy of action according to the STOs identified in the REACT project are the basis of the actions. This are part of implementation of technology for the development of actions framed in the tasks T3.4 Energy Storages Management and Integration, T3.5 REACT Platform Integration with RES Enabled Infrastructure and the implementation of DR strategy of WP5 tasks.

On the other hand, the implementation of the systems themselves in the pilot sites will allow the definition of action for the generation of business models, generation of exploitable results and replicability in the follower islands, which will be addressed in WP7 and WP8.

2 IMPLEMENTATION STRATEGY

2.1 OVERALL STRATEGY

SCIENTIFIC AND TECHNICAL OBJECTIVES (STOs)

To achieve the objectives of the REACT project, we have identified several STOs to accomplish and track the progress. The deployment activities on each pilot are related with 3 of these STOs and their main indicators which are the Action and project outcomes, Keys Performance Indicators (KPIs) and the Target Metrics.

STO 1: Increased RES hosting capacity coupled to large scale energy storage deployment.

REACT is deploying different RES technologies and storage solutions under identified effective operation scenarios and ensuring synergy with different energy networks. To achieve this, REACT is integrating with the underlying energy infrastructure and deploying designated predictive and optimisation services that will deliver automated optimal control actions under designated DR strategy. System interoperability will be ensured via adaptable and scalable interfaces which will provide a seamless integration with different RES and storage technologies and legacy energy systems. REACT will be envisioned as a cloud-based, service-oriented platform providing a way for reuse of internal as well as external services. It is deploying different open software concepts and will be leveraged by contemporary interoperability standards in the smart-grid domain.

Project outcomes:

- Deploy different RES enabled systems under effective operation
- Integrate with underlying energy infrastructure (deployed and legacy)
- Perform automated optimal control and DR to maximise RES exploitation

Keys Performance Indicators:

- System deployments
- Standardisation and interoperability
- Validation of the integration
- Replication potential

STO3: Lifecycle assessment and long-term plan of RES and storage enabled infrastructure

RES infrastructure planning will be leveraged by the state-of-the-art renewable energy resource assessment tools combined with multi-criteria decision analysis methods for integrated regional energy development to deliver an optimal selection and dimensioning of RES technologies. As part of such holistic life-cycle assessment, REACT considered a variety of technologies, including wind, solar, biomass and tidal, in terms of RES, and both, conventional and innovative energy storage such as power-to-gas, desalination plants, pumped hydro, etc.

Project outcomes:

- Platform for RES based infrastructure design including storage and DR assessment

Keys Performance indicators:

- Level of energy autonomy
- Energy cost reduction due to RES and reduction of hydrocarbon fuels

STO5: Demonstrators as case studies and early adopters.

REACT is demonstrating the capacity to implement innovative and complex renewable energy systems for self-sustainable island communities via cost-effective technologies in 3 real demo Islands. REACT is validating and integrating different technologies into the integrated design process, bringing its services up to TRL 7-8 in average. Real-life deployment will be feasible owing to the efforts made to adapt and realize developments necessary prior to actual integration with complex systems, considering simulation, modelling, prototyping and testing in controlled environments (e.g., hardware in the loop testing). REACT will then demonstrate (monitor, evaluate, document, assess) the viability and performance of the integrated solution on demo islands. Finally, acquired knowledge and feedback will support large-scale replication and business models for the deployment in the "follower" islands and beyond.

Project outcomes:

- 3 islands as demonstrators case study and champions
- Replication potential at 5 "follower" islands

IMPLEMENTATION STRATEGY

The REACT Project's strategy for technology implementation is based on social, business model and technology aspects. The objectives in these different aspects of the implementation (Deployment) context are as follows:

Social objectives

Test the "engagement" of the population from action in the public sphere (action at the public level with citizens participation).

- Implementation of systems in public buildings with collective use by the citizens
- Generation of events with the citizens at the project presentation, implementation, generation of results, exploitation, ...
- Generation of activities for environmental awareness and participation in the REACT project

Test the "engagement" of the population from action in the private sphere (action on dwellings and private buildings).

- Implementation of systems in dwellings with DR strategies, peak shaving and load shifting
- Promote the creation of local energy communities
- Promote the generation of self-consumption in condominiums

Business model objectives

Test the feasibility of ESCO business model acting in public and private industrial and commercial buildings.

Implementation of systems in public and private industrial buildings and future manageability as ESCO of CFAT or Udaras with SEAI support, FENIE, VEO, R2M, etc.

Test a Virtual Power Plant (VPP)

- implementation of a smart grid operating in distributed RES.
- Implementing the energy hub to the centralized RES production
- Test different business models with VPPs

Test the feasibility of selling energy management services with REACT platform to DSOs or ESCOs generated for this purpose.

- Implementation of the REACT platform and definition of added services. Presentation to DSOs and ESCOs.

Technology objectives

Technology	
Test	**Actions**
Test renewable penetration capacity and grid management from decentralized generation systems.	Implementation of systems in public and private industrial buildings with and without energy storage.
	Installation of intelligent grid monitoring systems in transformation centres.
Test different storage technologies in identified scenarios (Salt, lithium, Lead Acid)	Implementation of systems in dwellings and public buildings
Test energy generation with hydrogen storage systems (P2H).	Implementation of system in public buildings.
Test energy generation and storage systems at the public building level with reduction grid needs and grid balance (load shifting and peak shaving).	Implementation of lithium battery system in a dwelling and community buildings.
Test energy generation and storage systems at a residential level with minimization of contracted power and discriminate tariff. (Load shifting and peak shaving)	Implementation of lithium battery system in a dwelling and community buildings.

Test the implementation of intelligent management systems in HVAC with PV production at residential level.	Implementation of Melcloud system in existing residential (RESPOND housing projects).
Test the design and integration of PV system in existing aerothermal at commercial and industrial level.	Implementation of PV system + reengineering of existing aerothermal existing public building.
Test the design and integration of PV system HVAC system integration of new installation at commercial and industrial level.	Implementation of PV with HVAC system in public building.
Test the design and implementation of PV system with load management in industrial process to maximize the use of renewables in the process.	Implementation of PV system without storage in industrial building.
Design and test REACT energy management platform for the management of the implemented systems and the grid.	Design and implementation of REACT platform.
Test and integrate RES production with V2G chargers	Implementation of system in public buildings.

Table 1 REACT technology objectives

2.2 SPECIFIC OBJECTIVES PER PILOT

2.2.1 LA GRACIOSA

The overall implementation strategy in La Graciosa is subject to the legal possibilities that the Spanish Laws allow, regarding self-consumption. Table 2 shows a brief overview of such possibilities, according to the Royal Decree 244/2019, of April 5th.

Self-consumption for individual or shared Self-Consumption	
Installation through INTERNAL GRID Internal grid connection	**Installation connected** to GRID Connection to LV grid under the same transformer station. Distance between

			generation and consumption counters <500m, both connected to LV. Same cadastral register reference (14 digits).
Without surplus (individual) No possibility to inject to the grid. **Without surplus with repayment possibility (shared)** No possibility to inject to the grid.	**With surplus with compensation possibility** Renewable energy source. Generation power ≤100kW. Repayment contract.	**With surplus without compensation possibility** Rest of installations with surplus.	**With surplus without compensation possibility** Installations with surplus.

Table 2. Possibilities regarding self-consumption in Spain

Among the 20 installations that will be deployed in La Graciosa, 19 follow the scheme of "individual self-consumption with energy storage. There is a possibility of compensation of the surplus energy feed to the grid", as they fulfil the conditions to do so (i.e., renewable sources installed of a power ≤100kW) and it is the most favourable option for individual self-consumption in terms of monetary savings. All these 19 installations include the use of the energy storage.

The last installation will consist of a shared self-consumption, as it is a group of tourist apartments that fits the requirements for this scenario (i.e., connection to LV grid under the same transformer station, distance between generation and consumption counters <500m, both connected to LV, and same cadastral register reference). This installation will not include accumulation in batteries.

Nowadays, shared self-consumption in Spain is only possible with "constant coefficients", meaning that the percentage of energy distributed to each dwelling connected to the installation is fixed, and revised once a year. However, a draft order to modify the Royal Decree 244/2019, of April 5th, is being written. Although it will not include the possibility of real time adjustments in the energy distribution, it will modify the coefficients into a "more dynamic" manner: they will be fixed throughout the year, but it will be possible to set different values for them along all the hours of the year.

About the different tariff schemes that participants have, in terms of considering the different possibilities of demand response actions, ten of them are 2.0A-2.1A (domestic users without ToU tariffs), eight are 2.0DHA (domestic users with ToU tariffs), and one is 3.0A (similar to 2.0A, but for higher consumptions). However, in Spain, a new legislation has just entered into force that modifies the whole model of electricity tariffs, making them all ToU tariffs.

Thus, it is expected that these schemes will be possible in all cases, bringing additional savings to the users.

Customers with the old 2.0A-2.1A tariffs who have changed to the new 2.0TD tariff, will have different periods for power and energy. These are shown in **Error! Reference source not found.**[1].

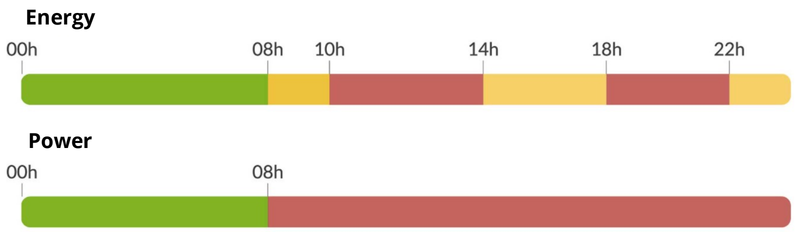


Figure 1. New electricity tariff-hours for 2.0TD users in the Canary Islands Green = cheapest, red = most expensive (Energía, s.f.)

Figure 2 shows the different hourly tariffs, according to the seasons, for customers with 3.0TD (old 3.0A) in the Canary Islands. These periods differ within the Peninsula, the Balearic and Canary Islands, Ceuta, and Melilla.

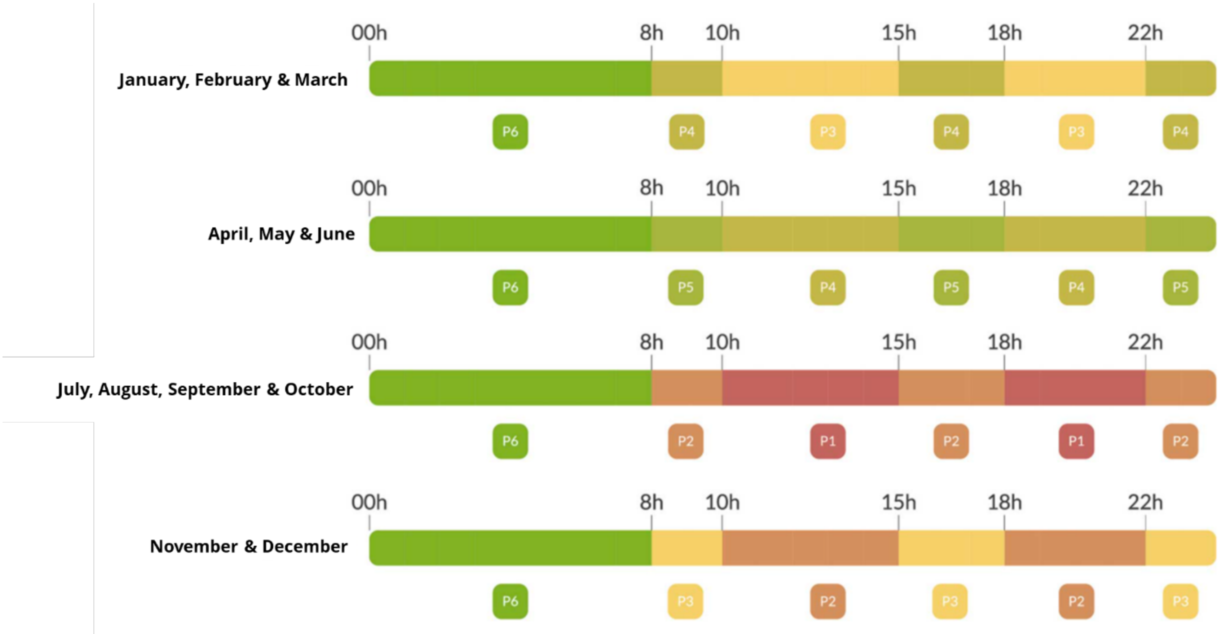


Figure 2. New electricity tariff-hours for 3.0TD in the Canary Islands, per season (Energía, s.f.)

[1] Green = cheapest, red = most expensive

As it can be deemed from the figures above, strong efforts by the Spanish Government are being made, in order to incentivize and enable flexibility mechanisms among the Spanish population.

2.2.2 SAN PIETRO

The objectives for San Pietro, as part of the project REACT are:

- To investigate the adequacy of the REACT platform for use as the software with which to operate a Virtual Power Plant (VPP).
- On the supply side of the VPP, to optimise the energy self-production and self-consumption of renewable energy sources (heat pumps and PV) treated as distributed energy resources (DER – e.g., integrated into the existing grid scenario and not in a microgrid context).
- On the demand side of the VPP, to stimulate both electrical and thermal flexibility via the scheduling of household appliances, household heating and cooling and domestic hot water.
- To deploy batteries as electrical storage to make possible load shifting and peak shaving with renewable energy (optimizing RES and stimulating flexibility)
- To deploy smart meters which are fiscally certified and blockchain enabled giving the end users immediate access to their data and more options related to the use and optimisation of renewable energy sources.
- To develop building level services to remunerate optimization of single user buildings (individual self-consumption) or multi-user dwellings (collective self-consumption where shared walls are present).
- To assess the possibility for grid ancillary services or the participation in Italy's demand response program (UVAM) if the scale of the VPP can eventually aggregate 1MW of flexible assets.

These objectives have a limited potential impact in that community-level or collective actions are largely not possible. For this reason, the San Pietro pilot has the additional objectives:

- To stimulate the formation of a Renewable Energy Community (REC) providing the regulatory framework to enable the buying and selling of energy between community members and to qualify for a state incentive on energy collectively self-consumed within a REC.
- Via the REC to lower the cost of electricity to community members (coupling more self-consumption of renewable energy / less energy sold back to the grid at non-interesting prices) and via potential future savings associated with renegotiated energy contracts
- To develop community-level services

Combining these together, the San Pietro pilot has a viable way to meet the project's main objective/aim which can also be considered the final objective for the San Pietro pilot.

- To stimulate the installation of renewable energy technologies and flexible assets

Currently, San Pietro is operating in a traditional scenario, with no "smart" elements present. Citizens that installed PV on their buildings use them for instantaneous self-consumption and share (remuneration through state incentive) the surplus electricity produced back to the grid. The new scenario (within the REC), will be characterized by increased RES production, increased self-consumption of that renewable energy, increased flexibility via the use of load-shifting and peak-shaving made possible by digitalisation (REACT platform coupled to smart meters), and end-users that are stimulated to use energy more efficiently, by shifting part of the consumption during the PV production times or when the batteries are charged/able to provide energy. Additionally, there is a potential that increasing a household's awareness of their own energy consumption through real-time measures will translate into more energy aware behaviour, which could further reduce energy consumption.

2.2.3 ARAN ISLAND

The overall objective for the Aran Islands pilot is to optimize the PV self-consumption, using a battery storage system and intelligent control of the Mitsubishi Electric Ecodan heat pumps, as elements to achieve flexibility, thus enabling demand response capabilities. The majority of the buildings will have the set of equipment presented in Figure 3. It is composed of a PV system connected to a Storage system, which gives flexibility as energy from PV can be used at the moment of production or stored to be used, for instance, when the cost of electricity is higher or the energy peak in the neighbourhood is high. Furthermore, additional flexibility is achieved with a Mitsubishi Ecodan Heat Pump that can be configured remotely (automated DR). In this regard, the heat pump can be set to heat the building when the cost of energy is low, or PV production is high. Finally, the smart meter helps to improve monitoring of a building's energy consumption, which allows the verification of energy reduction or load shifting. For instance, messages can be sent from the REACT platform asking users to reduce their energy consumption through manual actions at a specific time of the day. This efficacy and engagement can be analysed by comparing the data from the smart meter and the baseline (expected values without DR).

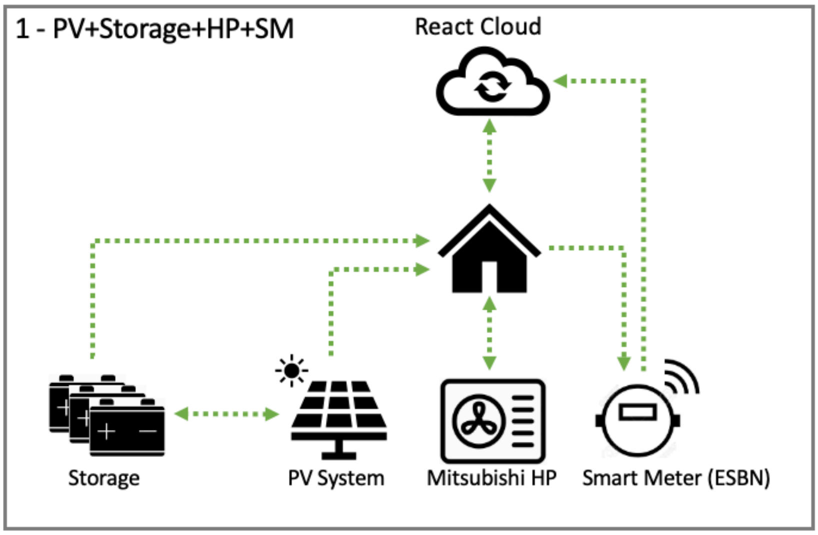


Figure 3 - Full equipment set composed of PV+ ESS + HP + SM (Source: NUIG)

Technology implementation is based on social, business model and technology aspects. The objectives in these different aspects of the implementation (Deployment) context are as follows:

Social Objectives

Test the "engagement" of the population from action in the public sphere (action at the public level with citizen participation).

- Implementation of systems in public buildings with collective use by the citizens (community hall, school, childcare,).
- Generation of projects events with the citizenship, such as project presentation, project implementation, generation of results, exploitation, ...

Business model objectives

Test feasibility of ESCO business model acting in public and private industrial/commercial buildings.

- Implementation of systems in public and private industrial buildings and future manageability as ESCO of CFAT or Udaras with SEAI support (community hall, school, childcare, recycling plant, Blath Na Mara).

Test feasibility of selling energy management services with REACT platform to ESBN or ESCO generated for this purpose.

- Implementation of REACT platform and definition of added services. Presentation to ESBN and ESCO of CFAT o Udaras....

Technology

Technology	
Test	**Actions**
The renewable penetration capacity and grid management from decentralized generation systems.	Implementation of systems in public and private industrial buildings with and without energy storage (offices, school, childcare, recycling plant).
	Installation of intelligent grid monitoring systems in transformation centres
The energy generation with hydrogen storage systems.	Implementation of system in public buildings (Community Office).
The energy generation and storage systems at the public building level with reduction of contracted power and discriminate tariff (load shifting and peak shaving).	Implementation of lithium battery system in a dwelling and community buildings.
The energy generation/accumulation systems at a residential level with minimization of contracted power and discriminate tariff. (Load shifting and peak shaving)	Implementation of salt-ion battery system in homes (4 single-phase homes).
The implementation of intelligent management systems in aerothermal with PV production at residential level.	Implementation of Melcloud system in existing residential (RESPOND housing projects).
The design and integration of PV system in existing aerothermal at commercial/industrial level.	Implementation of PV system + reengineering of existing aerothermal existing public building (childcare facility).
The design and integration of PV system + aerothermal system integration of new installation at commercial/industrial level.	Implementation of PV + x system in public building (offices).
The design and implementation of PV system with load management in industrial process to maximize the use of renewables in the process.	Implementation of PV system without storage in industrial building (recycling plant).
The design and test REACT energy management platform for the management of the implemented systems and the grid.	Design and implementation of REACT platform.

Table 3 Aran technology objectives

2.3 COMMUNICATION STRATEGY WITH REACT PLATFORM

Communication and monitoring activities are a key factor to allow acquisition of baseline data, and to be able to execute automatic control actions. Baseline data is the main input for the analytical services to provide optimal energy dispatching under the identified control strategy.

For this reason, is a crucial point to ensure that the installation has internet connection and in case of network failure, the recovery process for this internet connection must be done as quick as possible, to allow continuous data monitoring and the execution of automatic control actions in any time required.

Deliverable D6.1 (REACT D6.1, s.f.) defines two approaches for the integration of field level equipment with the REACT platform, one is implemented by the "Energy Gateway" for Victron and SMA equipment, installed in La Graciosa and Aran Island pilots. The second approach is implemented by the specific cloud-to-cloud integration for MIDAC batteries, Nesosnet smart meters, and Mitsubishi Heat Pumps without the need of an additional "Energy Gateway" deployed in the field. MIDAC batteries and Nesosnet smart meters are deployed in San Pietro. Mitsubishi Heat Pump are deployed in San Pietro and in the Aran Islands.

Deliverable D6.2 (REACT D6.2, 2021) defines the Canonical Data Model (CDM) format for the data publication between field level and cloud, and the relevant key parameters to be sent such as the "gateway id" and "device id", these parameters must be defined accordingly in every installation performed in the field level.

Cloud-to-cloud integration does not require an additional "Energy Gateway" deployed in the field, and the management of the specific configuration in every installation is defined at cloud level, for example the device id of the equipment of every installation is managed in the cloud, and no specific configuration must be done in the field level.

The next chapter summarizes the main constraints related to the communication and monitoring strategy for the installations with the REACT "Energy Gateway". Victron and SMA equipment requires the deployment of the "Energy Gateway", powered by an OpenMUC application. OpenMUC configuration files are required to be defined in every installation in the field level.

Gateway Configuration

"Energy Gateway" provides an application based on OpenMUC framework in charge of the following main activities, the first one is the data acquisition by Modbus communication protocol, the second one is the translation to the payload format defined in D6.2 and the third one is the publication to the cloud by MQTT communication protocol. Additionally, for data acquisition the control actions are managed and executed also by the "Energy Gateway".

There are two main configuration files in which parameters are defined. The Mqttlogger configuration file "org.openmuc.framework.datalogger.mqtt.MqttLogger.cfg", located in folder "framework\load" defines the connection parameters with REACT mqtt broker. This file does not require changes, it is the same content for all installations.

The main OpenMUC configuration file is "channels.xml", located in folder "framework\conf". This file must be configured for every installation. The channels configuration file defines a specific driver of type "mqtt" for the management of the subscriptions with the REACT platform MQTT broker.

The channels configuration file defines one driver of type "modbus" and one or many devices and channels, where devices are the set of equipment to connect by Modbus TCP connection, and the channels are the Modbus address to be monitored for data acquisition and simple control actions for every device.

The OpenMUC configuration file requires the definition of some identifiers related to the management of the data between the platform and the "Energy Gateway". These identifiers are "gateway id" and "device id" and the definition of the names of both must follow the specification defined in deliverable D6.2.

Gateway Id

The "gateway id" is the identifier where the "Energy Gateway" is deployed, and it is linked to the MQTT topic in which the data is published. In this case the gateway id value contains the serial number of the Raspberry Pi. The steps required for the definition of the gateway id value are the following ones:

1- Obtain the serial number of Raspberry Pi, by executing in the command console the command:

```
cat /proc/cpuinfo
```

the output is the following, and the relevant value is the one identified as "Serial"

```
Hardware: BCM2711
Revision: c03112
Serial: 10000000637ac4c4
Model: Raspberry Pi 4 Model B Rev 1.2
```

2- Compose the name for the gateway id with the prefix for the specific manufacturer provider (VIC for Victron or SMA for SMA) and the Serial Number.

```
VIC-10000000637ac4c4
```

3- Define this gateway id in the sections:
channelAddress of the subscriptions to the MQTT broker. Two subscriptions are created one to receive the request (of the control actions) and another one to send the response of the request.

```
<device id="REACT_CLOUD">
<channel id="mqtt_subscription_request_from_cloud">
    <channelAddress>VIC-10000000637ac4c4/request</channelAddress>
    <listening>true</listening>
    <valueType length="2000">BYTE_ARRAY</valueType>
</channel>

<channel id="mqtt_publication_response_to_cloud">
    <channelAddress>VIC-10000000637ac4c4/response</channelAddress>
    <valueType length="2000">BYTE_ARRAY</valueType>
    <listening>true</listening>
</channel>
```

loggingSettings of the channel publication to the MQTT Broker, in which publish the value of the specific channel (Modbus address).

```
<driver id="modbus">
       <device id="VIC-GXHQ2030WHP27">
       <channel id="eAcGridInL1">
       <loggingSettings>mqttlogger:topic=VIC-
10000000637ac4c4/data</loggingSettings>


</driver>
```

Channels

The channels definition requires the analysis of the Modbus specification of the manufacturers, Victron (Victron, s.f.) and SMA (SMA, s.f.), to select the relevant information to be gathered from the installation.

The channel has a set of parameters, the description of these parameters is defined in deliverable D6.2. One relevant parameter to be defined in every installation is the device id

Device Id

Define the unique ID of a particular sensor, smart meter, or equipment in charge of data acquisition and control action management.

The definition of the name must include a prefix for the specific manufacturer provider (VIC for Victron or SMA for SMA) and the prefix for the specific device (in Victron the GX) and the Serial Number of the specific Device that provide Data for example HQ2030WHP27. This serial number is defined in the equipment itself and this information must be collected from the installer.

```
VIC-GXHQ2030WHP27
```

Define this value in the corresponding id name in the section for the driver Modbus

```
<driver id="modbus">
        <device id="VIC-GXHQ2030WHP27">
                <settings>TCP</settings>
                <deviceAddress>IP:502</deviceAddress>
```

The IP address of the device is a relevant parameter to be defined in the configuration file. This IP value must be configured with a static address, in order to ensure that OpenMUC can always connect to it.

With Victron equipment usually only one driver for Modbus is defined in the OpenMUC configuration file, due to the fact that the Cerbo GX is the only one that provides the Modbus communication. Other devices are involved in the data management, such as Energy Meter, Cerbo GX, Multiplus and Battery BMS. Every of this equipment has assigned a UNIT_ID value, that is usually defined in the configuration process of the Modbus communication. UNIT_ID value is a Modbus parameter required to be defined in the channel address.

By default, Victron devices has the Modbus connectivity disabled, so it is needed enable this Modbus communication. In the Remote Console select the option menu “Settings → Services → Modbus/TCP” and clicking on “Enable Modbus TCP”

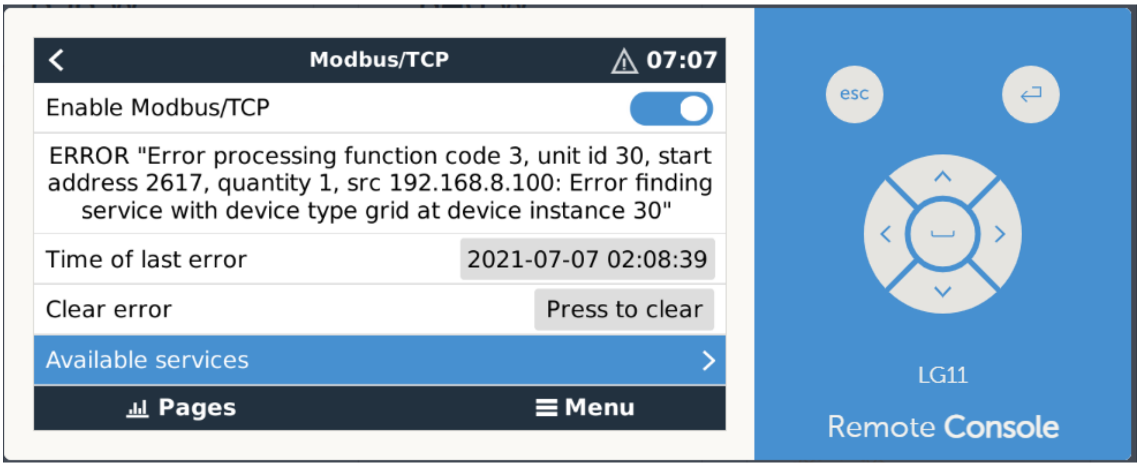


Figure 4 Victron Modbus enable

To obtain the list of Modbus parameter of the UNIT_ID of the devices, in the Remote Console go to the section "Modbus/TCP"- "Available services"- "Modbus TCP services".

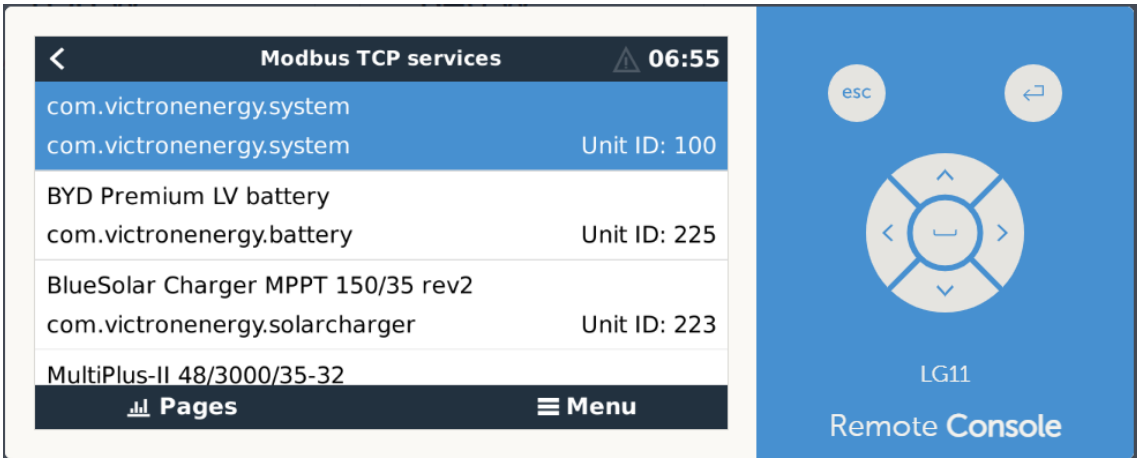


Figure 5 Victron Modbus UNIT_ID

The following table summarizes the default values. In any case in every facility, it is required to verify the corresponding ones.

VICTRON Device	Model	UNIT_ID = deviceIdSuffix
Control Unit	Cerbo GX	100
EnergyMeter	ET 112	30
SolarCharge	SolarCharge MPPT	223
BatteryInverter	Multiplus II	227
Battery	BYD BMS	225

Table 4 La Graciosa Victron device Id suffix

To publish the data acquired from the equipment with the specific information of the device in charge of the acquisition of the measurement, a new functionality has been implemented in the REACT OpenMUC application to include this information in the mqtt payload. The new attribute inside the settings parameter is the “deviceIdSuffix”, that is added to the device Id in the mqtt payload.

```
<device id="VIC-GXHQ2030WHP27">
   <channel id="pAcHomeL1">
       <settings>measurementIndex=1;measurementId=pAcHome;deviceIdSuffix=-100</settings>
       <channelAddress>100:HOLDING_REGISTERS:817:UINT16</channelAddress>
       <valueType>FLOAT</valueType>
       <samplingInterval>10s</samplingInterval>
       <loggingInterval>60s</loggingInterval>
       <logSettings>mqttlogger:topic=VIC-10000000637ac4c4/data</logSettings>
    </channel>

</device>
```

The corresponding mqtt payload for the channel defined below is the following:

```
{
"measurementIndex": 1,
"timestamp": 1625550555919,
"measurementId": "pAcHome",
"deviceId": " VIC-GXHQ2030WHP27-100",
"value": 234.23}
```

MIDAC cloud-to-cloud integration also defines their own device id suffix values for the equipment that are managed by the installation.

For MIDAC the implemented device Id Suffix are the following ones.

MIDAC Device	Model	deviceIdSuffix
Energy Meter	Gavazzi AC Meter	GAV
Battery Inverter	Leonardo PROX 3000/48 Li (inverter)	LEO
Battery	MIDAC Battery	RES

Table 5 MIDAC device Id suffix

Control Actions

Deliverable D6.2 defines the protocol and format for the message to be interchanged between platform and equipment.

The first version of REACT OpenMUC application implements the simple write functionality for control actions that only requires a simple Modbus write.

For this control actions, it is required to identify which are the Modbus address that allows write access and identify the available values for each parameter.

The actuation channels identified for the Victron are the ones in the table below

Channel	Description	Available values
relay1State	Victron Venus GX relay1 Normally Open	0=Open;1=Closed
relay2State	Victron Venus GX relay2 Normally Closed	0=Open;1=Closed
acPowerSetPoint	ESS Control Loop setpoint	Calculated value

Table 6 La Graciosa Victron Control Actions

For control actions that requires a more complex management than a simple Modbus write, Task 3.4 is in charge of the definition and implementation of specific Controllers for the specific control actions identified.

In summary the approaches implemented in the data acquisition to the REACT platform in each pilot is presented below:

- **LA GRACIOSA**

In La Graciosa only the "Energy Gateway" approach has been implemented. "Energy Gateway" has been installed to perform data acquisition and control actions for the PV installation and potential loads to be controlled by relay.

- **ARAN ISLAND**

In the Aran Islands two approaches have been implemented. "Energy Gateway" has been installed to perform data acquisition and control actions for the PV installation and the "MEL cloud" cloud-to-cloud integration is in charge of the management of the Mitsubishi Heat Pump installed.

- **SAN PIETRO**

In San Pietro only the approach of cloud-to-cloud integration has been implemented, but for three types of equipment, MIDAC batteries, Nesosnet smart meters, and the Mitsubishi Heat Pump.

La Graciosa	Aran Island	San Pietro
"Energy Gateway" for PV installation	"Energy Gateway" for PV installation	"MIDAC cloud" for MIDAC batteries
	"MEL cloud" for Mitsubishi Heat Pump	"MEL cloud" for Mitsubishi Heat Pump
		"Nesosnet cloud" for smart meters

Table 7 Summary Data Acquisition

3 DEPLOYMENT ACTIVITIES

3.1 Recruitment process

3.1.1 LA GRACIOSA

The recruitment process in La Graciosa started with a meeting, held on 25/01/2020, in which REACT was presented to the islanders. It was headed by AIELPA, Fenie Energía, Suministros Orduña and Comet Technology with support of the Ayuntamiento de Teguise.

Around 25 island residents attended, including people that finally participated, and people that did not. They filled out an initial User Assessment Survey to evaluate the demographic and contact data for each dwelling and their energy consumption habits and appliances. A Q&A session was organized to clear their doubts about the project's approach, technology, DR and Energy Communities.

Figure 6. First meeting in La Graciosa, January 2020

After this first contact, several participants were selected according to a defined criterion, which includes the following points:

- Continuous inhabiting: the dwelling has a constant use throughout the year.
- connection that allows connecting and sending the necessary data to the REACT platform
- Space availability: there is enough space available, both inside the dwelling and outside (roof and patios) to install the necessary equipment
- Benefits for the community: the dwelling has a secure and robust electricity supply, the economical means to maintain it, it fulfils environmental restrictions, etc.
- Exemplarity: the user appears to have a strong engagement with the project and will cooperate to its dissemination
- Operability: the dwelling includes electrical elements that are operable from the REACT platform

Due to the COVID-19 pandemic, meetings in 2020 were cancelled, but the recruitment process continued as we had not recruited enough participants. New interested islanders were identified by AIELPA and Feníe Energía, thanks to direct contact with some committed participants who have spread the word.

Following the previous criterion, a total of 41 participants were contacted as part of the recruitment process. Of them, 21+1[2] dwellings were finally included in the project, and are the ones located in the map (Figure 7). Six of them are touristic apartments, eleven are residential dwellings, one is a diving centre, one is a Restaurant, and another, a laundry service. The yellow marks correspond to two public buildings (the school and the Council's building) that already count with PV panels and will be included in the project as for monitoring and control. A total power of 60,28Wp, corresponding to 181 PV panels will be installed, while the total accumulation capacity will be 153kWh. Each installation's characteristics are defined in the section **Error! Reference source not found.**.

Nº	REACT Reference	State	Nº	REACT Reference	State
1	LG 1	incorporated	5	LG 5	Retired
2,1	LG 2.1		6	LG 6	
2,2	LG 2.2		12	LG 12	
3	LG 3		14	LG 14	
4	LG 4		20	LG 20	
11	LG 11		8	LG 8	
13	LG 13		26	LG 26	
15	LG 15		28	LG 28	
16	LG 16		29	LG 29	
17	LG 17		31	LG 31	
18	LG 18		32	LG 32	
19	LG 19		33	LG 33	
7	LG 7		34	LG 34	
9	LG 9		36	LG 36	
24	LG 24		37	LG 37	
25	LG 25		38	LG 38	
27	LG 27		39	LG 39	
30	LG 30		40	LG 40	
35	LG 35		42	LG 42	

[2] One participant includes two installations in the same dwelling, connected to different CUPS.

41	LG 41		43	LG 43	
44	LG 44				
45	LG 45				

Table 8 Total number of participants contacted in La Graciosa

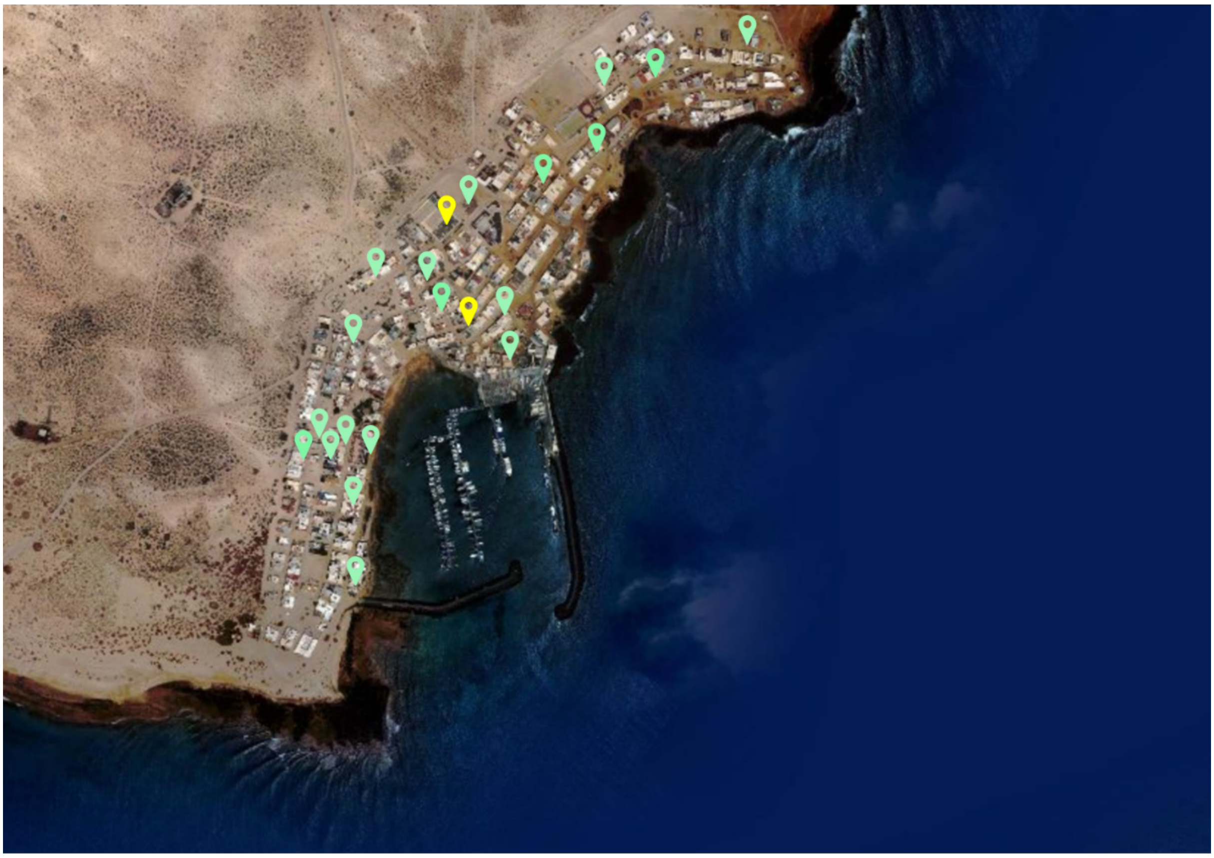


Figure 7 – Final participants' location in La Graciosa

3.1.2 SAN PIETRO

The recruitment process in San Pietro started in late 2019 through a series of meetings with the residents organized by R2M and Comune di Carloforte. The aim of the meetings was to explain the purpose of the project and attract building owners that might be willing to take part in the demonstration activities.

Figure 8: Citizen engagement meeting November 2019

Due to the pandemic, meetings in person during 2020 were almost all cancelled however the recruitment process continued. New participants were identified both by direct contact from the PCC in collaboration with the Municipality through word of mouth between citizens, or directly from the islanders through the Facebook page promoting the activities carried out in San Pietro (https://www.facebook.com/SanPietroREACT/), as shown in Figure 9.

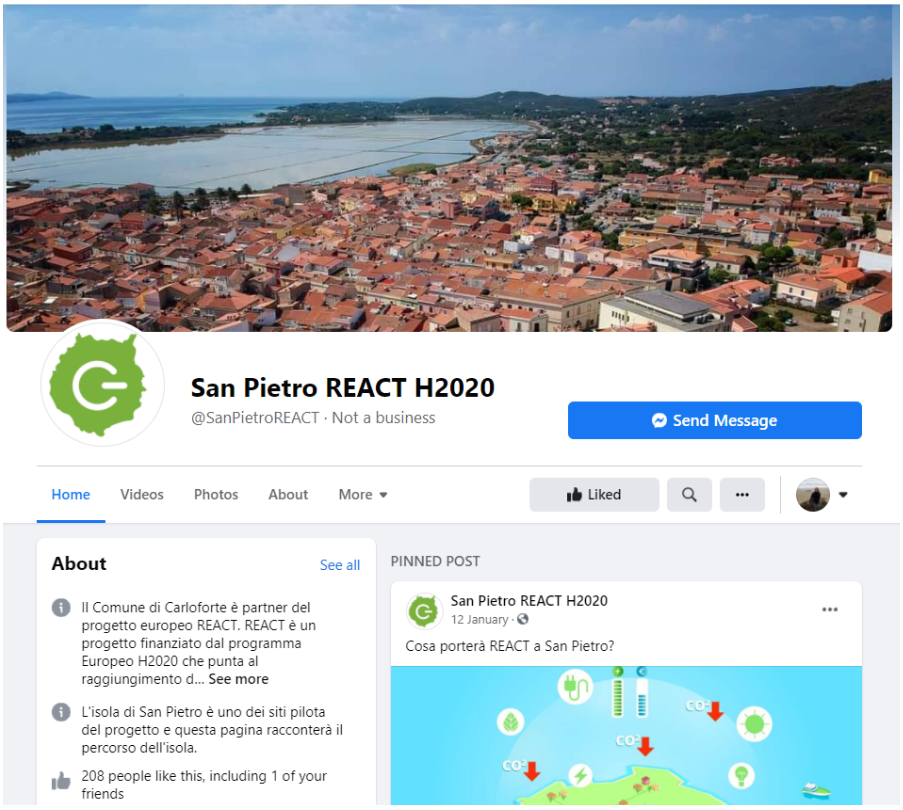


Figure 9: San Pietro Facebook page

As of June 2021 53, buildings were considered and surveyed to be included in the demonstration activities of the pilot. Out of these, few were no longer interested after the initial survey and others were not considered due to technical issues (e.g., unavailability of space for installation or building not up to code). The exceeding buildings that will not be included in the installations covered by the project due to budget limitations will be considered for scaling-up the demo site financed by external funds.

Nº	REACT Reference	Status	Nº	REACT Reference	Status
1	04_Public	Wave 1 (installation in June 2021)	31	16_Home	Scale up
2	01_Public		32	17_Home	
3	02_Public		33	18a_Home	
4	05_Public		34	18b_Home	
5	08_Public		35	07_Public	
6	04_Hotel		36	05_Home	
7	09_Home		37	23_Home	
8	13_Home		38	06_Public	
9	33_Home		39	09_Public	
10	35_Home		40	24_Home	

11	36_Home		41	25_Home	
12	37_Home		42	26_Home	
13	38_Home		43	27_Home	
14	39_Home		44	28_Home	
15	10_Home	July 2021	45	03_Public	Retired
16	32_Home	WAVE 2 (installation in September 2021)	46	01_Home	
17	34_Home		47	02_Home	
18	41_Home		48	03_Home	
19	42_Home		49	06_Home	
20	43_Home		50	08_Home	
21	44_Home		51	11_Home	
22	45_Home		52	12_Home	
23	46_Home		53	14_Home	
24	40_Home		54	15_Home	
25	47_Home		55	19_Home	
26	48_Home		56	20_Home	
27	50_Home		57	21_Home	
28	51_Home		58	22_Home	
29	52_Home		59	29_Home	
30	49_Home		60	30_Home	
			61	31_Home	

Table 9 Total number of participants contacted in San Pietro

3.1.3 ARAN ISLAND

The following is a list of criteria considered during the recruitment process that the buildings, dwellings, or constructions that are candidates had to meet to take part in the REACT project. This list served to homogenize the selection criteria among all the pilots and to recruit those candidates that can provide the greatest benefit to the interests of the project.

<u>Continuous room criteria:</u>

The first and fundamental filter is that the building has a continuous and constant use. This criterion seeks to select those candidates that present a constant consumption throughout the year, in order to implement the desired "demand response" measures.

<u>Connectivity criterion:</u>

The second filter is that the building has a stable internet connection. This criterion is necessary to ensure that the actions designated from the REACT platform can be communicated and carried out by the systems provided for this purpose, and also to ensure constant data collection.

Space availability criterion:

The third filter, also fundamental, consists of the building having available surface or space, both on the roof and inside, to locate the elements to be installed.

Community benefit criterion:

The fourth filter is that the candidate's participation will be of benefit to the community where the pilot takes place. This criterion seeks to give the opportunity to participate to those buildings that as community meeting places, places of community use or any other justifiable reason by having the installation can provide security of supply, economic, environmental or any other type of benefits to all the residents of the island.

Criterion of exemplarity:

The fifth filter consists of the candidate's participation making the project and the objectives it pursues visible. The objective of this criterion is to promote those candidates whose participation helps to disseminate and raise awareness among neighbours and serves as an act of community engagement.

Operability criterion:

The last filter evaluates the existence of electrical elements that can be operated remotely from the REACT platform to perform optimal demand management. This criterion aims to evaluate those candidates with electrical elements that allow the development of the demand-side management objectives defined in the project.

All these criteria must be weighted on a scale of 0 to 10 for each of the potential candidates, and those with the highest score will be selected to participate in the project.

After the evaluation, a total of 24 buildings were selected in the Aran Islands across different categories: 5 community buildings, 1 commercial building and 18 dwellings, considering 5 legacy dwellings from a previous project (RESPOND project).

Nº	REACT reference	Status
1	AI1	Incorporated
2	AI2	
3	AI4	
4	AI6	
5	AI7	
6	AI8	
7	AI9	
8	AI10	
9	AI11	
10	AI12	
11	AI13	
12	AI14	
13	AI15	
14	AI16	
15	AI17	
16	AI18	
17	AI20	
18	AI21	
19	RESPOND ID: ARAN_02	
20	RESPOND ID: ARAN_03	
21	RESPOND ID: ARAN_04	
22	RESPOND ID: ARAN_05	
23	RESPOND ID: ARAN_12	
24	AI3	Retired
25	AI5	
26	AI19	

Table 10 total number of participants contacted in Aran Island

This mix of groups will give REACT a wide range of DR possibilities due to the different type of energy usage of these users. Moreover, the list of beneficiaries includes building owners, local cooperative, staff and occupants of the community and commercial buildings (teachers, nurses and administrative employees), public (students, children, elderly people, occupants in general) and the electricity supply company. The complete assessment that shows the list of stakeholders impacted by the REACT solution can be found in deliverable D1.3, which also includes some profiles of the selected buildings.

3.2 TECHNICAL CONFIGURATION

3.2.1 LA GRACIOSA

The characterization and the technical requirement have been defined in the deliverable D3.1. There is a total of 20 participants where has been installed 60,6kWp power generation and 163,26 kWh of energy storage capacity.

As was stated on the DoA of the REACT proposal different battery technologies will be deployed and tested in terms of chemistry, performance, cost and safety characteristics.

3.2.1.1 Alternative ESS technology solutions

As the REACT project planned to incorporate aluminium-ion batteries, one of the several innovative storage technologies that have been identified with a great potential by many studies, our consortium has made the effort to look for and evaluate solutions that include more traditional, mature (lead-acid or lithium-ion), as well as more innovative (sodium-ion, vanadium redox-flow) technologies.

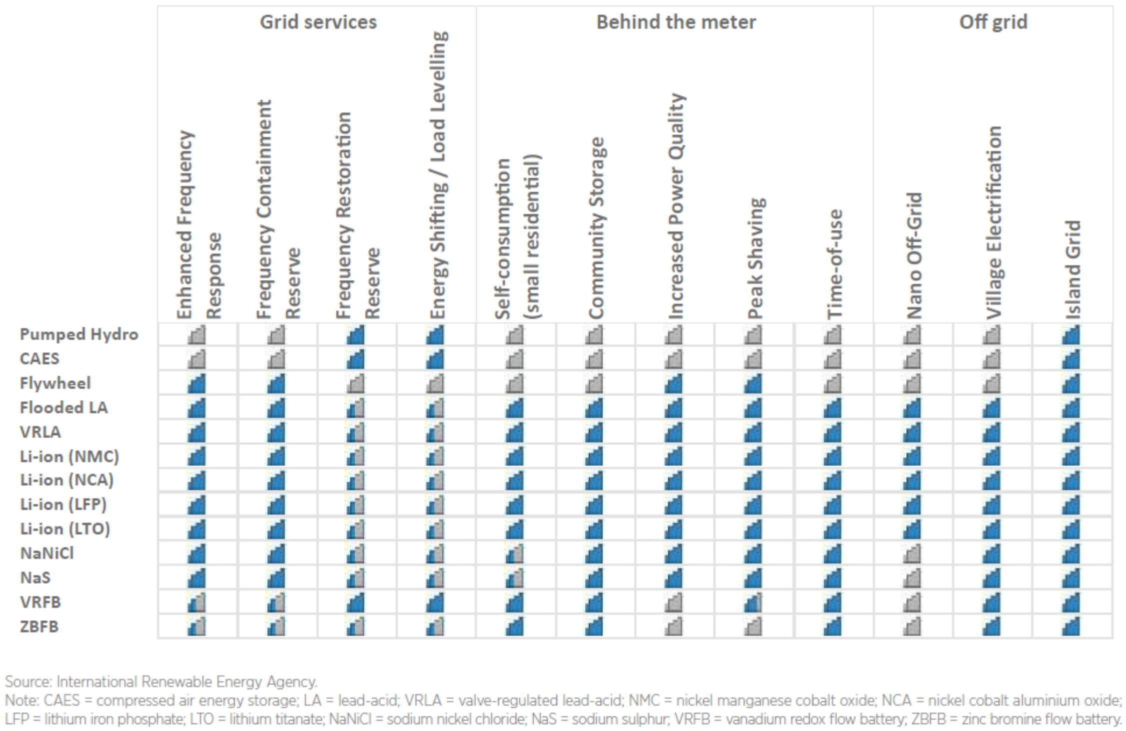


Figure 10 Suitability of storage technologies for different applications (International Renewable Energy Agency (IRENA), 2017)

A listing is included below, with a short description of the main advantages and drawbacks of each option, as well as a brief description of concrete products from each technology that could be deployed, as Albufera energy Storage (AES) will not be providing aluminium-ion batteries to the REACT project.

Lead-carbon (Pb-C) batteries

Lead-carbon batteries are a further development of the well-established lead-acid technology, therefore no disruptive variations regarding costs or energy density shall be expected. They offer the main advantage of a higher tolerance to wider battery cycles (higher depth-of-discharge, higher ratio between useful and installed capacity), better resistance to being stored in low state-of-charge (required in self-consumption applications), and higher power density as compared to lead-acid.

Lead-carbon batteries could be purchased from the established lead-acid battery manufacturer LEOCH, from their product series PLH+C (pure lead carbon) or LRC (lead reinforced carbon), which come in 12V blocks and are compatible with all inverters that can also handle lead-acid batteries.

Vanadium Redox Flow Batteries

Being the most established chemistries vanadium (VRFB) or zinc-bromine (ZBRFB), flow batteries are the technologies that offer a longest lifetime (which offers lower life-cycle costs in some applications, as compared to other technologies), and also a lower ecological footprint and higher recyclability[3], added to the advantage of non-flammability and no risks of thermal runaway. Pilot projects with VRFB have been undergone for many years in Europe, and only few years ago a series of industrial products have appeared from European manufacturers for residential and industrial self-consumption products in the market.

Forecast for vanadium redox flow batteries (VRFB) to reach the turning point of 120 €/ kWh in 2030 overcoming the cost-performance potential of Li-ion batteries (which are foreseen to lay at ca. 200 €/ kWh by 2030)[4], and is hence a technology with great prospects in the stationary storage applications segment.

Pre-selected potential energy storage systems solutions from VRF are the systems from:

[3] M.C. Díaz-Ramírez, V.J. Ferreira, T. García-Armingol, A.M. López-Sabirón, G. Ferreira, *Environmental Assessment of Electrochemical Energy Storage Device Manufacturing to Identify Drivers for Attaining Goals of Sustainable Materials 4.0*, sustainability, MDPI, 2019.

[4] *European COMMISSION STAFF WORKING PAPER: Materials Roadmap Enabling Low Carbon Energy Technologies*

- VisBlue, ESS system with units of 25kWh / 2.5kW, with open Modbus/TCP communication and basic EMS functionalities
- VoltStorage SMART, scalable ESS system with units of 6.2kWh / 1.5kW, integrated EMS

Sodium-ion Batteries (Salt-water batteries)

Sodium is present in the earth's crust at 2.6 percent and Na_2CO_3 costs less than one-tenth the price of Li_2CO_3 (carbonates). Thus, sodium-ion batteries (Na-IB) have a great potential to become on the mid-term a cost-effective alternative to lithium-ion batteries[5]. This technology also shows a better life-cycle footprint, especially if high cycle life is achieved through a proper design of the active materials[6]. Due to the lower intrinsic density of sodium-based compounds resulting from the ion size, the overall energy density is lower compared to lithium-ion, but this is not regarded in general as a highly relevant criteria in stationary applications. Although maturity of this technology has not reached lead-acid or lithium-ion yet, commercial systems for residential applications are available since several years at the market at competitive prices.

Pre-selected potential battery system solutions for Sodium-ion technology are:

- Bluesky Energy GREENROCK Home, scalable system with battery blocks of 5kWh / 1.25kW, with Modbus/TCP communication
- Innov.energy Salidomo, ESS system with one or two battery blocks of 9kWh / 2.25kW, Victron inverter

Alternative lithium-ion chemistries

In the actual deployment plan, all planned lithium-ion batteries are based in lithium iron phosphate (LFP) cells. Alternative SoA lithium-ion cells and systems could also be adopted in the REACT pilot sites, including nickel manganese cobalt (NMC), with higher power density, or lithium-titanate oxide (LTO), with better performance under cold temperatures and higher cycle life.

---

[5] Fraunhofer ISI, *Energiespeicher-Roadmap (Update 2017): Hochenergie-Batterien 2030+ und Perspektiven zukünftiger Batterietechnologien*, 2017.

[6] J. Peters, D. Buchholz, S. Passerini, M. Weil, *Life cycle assessment of sodium-ion batteries*, Energy Environ. Sci., 2016, 9, 1744.

Other chemistries from lithium-ion batteries could be introduced to the REACT pilots, like lithium-titanate oxide (LTO).

Potential alternatives include, among others, BMZ ESS 7.0 / 9.0 (NMC), or LG Chem RESU 7H / 10H / 13H (NMC), both with good compatibility to SMA Sunny Island (as foreseen in the deployment plan) and therefore attached to seamless integration efforts.

Benchmarking

According to the defined criteria, a benchmarking procedure has been applied to try to quantify the suitability of each of the presented options.

	Lead-carbon	Lithium LTO	Lithium NMC	Vanadium Redox-Flow	Natium-ion	Hydrogen Storage
Communication, integration and interoperability	+++	+++	+++	+	++	+
Technical innovation degree	+	++	+	+++	+++	+++
Technology and market readiness	+++	++	+++	++	++	++
Environmental impact (LCA) and footprint	+	++	++	+++	+++	++
Technical performance	++	+++	+++	++	++	++
Costs	+++	+	++	++	++	++

Table 11 Comparison between different ESS according to the criteria proposed

Giving descending weight values to each of the criteria, the suitability of each of the pre-selected technology options can be quantified (see Figure below).

	Weight	Lead-carbon	Lithium LTO	Lithium NMC	Vanadium Redox-Flow	Natium-ion	Hydrogen Storage
Communication, integration and interoperability	3	3	3	3	1	2	1
Technical innovation degree	3	1	2	1	3	3	3
Technology and market readiness	2	3	2	3	2	2	2
Environmental impact (LCA) and footprint	2	1	2	2	3	3	2
Technical performance	1	2	3	3	2	2	2
Costs	1	3	1	2	2	2	2
	SUM	25	27	27	26	29	24

Figure 11 Results of the benchmarking between different ESS according to the criteria proposed

Taking into account all information provided, the preferred technology option to substitute aluminium-ion batteries from AES is found to be sodium-ion, with potential system providers Bluesky Energy or innov.energy. As a second option, lithium nickel manganese cobalt (NMC) technologies have been selected, for their high technical characteristics and high punctuation overall.

Based on the technology and components' selection, the concrete sizing and specification of the systems to be deployed will be adapted to maintain, as close as possible, the system design proposed in the deployment plan.

3.2.1.2 Technical Configuration

The buildings recruited for the REACT project in La Graciosa can be classified in seven scenarios, according to their energy consumption profile.

Scenario	Type 1	Type 2	Type 3	Type 4	Type T1	Type T2	Type A1
Profile consumption [kWh/day]	4 – 6	6 - 10	10 - 15	15 - 25	25 - 40	More than 40	-

Table 12 Installation type scenarios of la Graciosa

3.2.1.3 Self-consumption with storage

In La Graciosa the predominant Energy Storage System (ESS) deployed is in a DC coupling mode with a Victron devices, connected in parallel with the grid, which can be both in single-phase or three-phase buildings. That integrates a power grid connection, allows for time shifting power, charging from solar, providing grid support, and exporting power back to the grid.

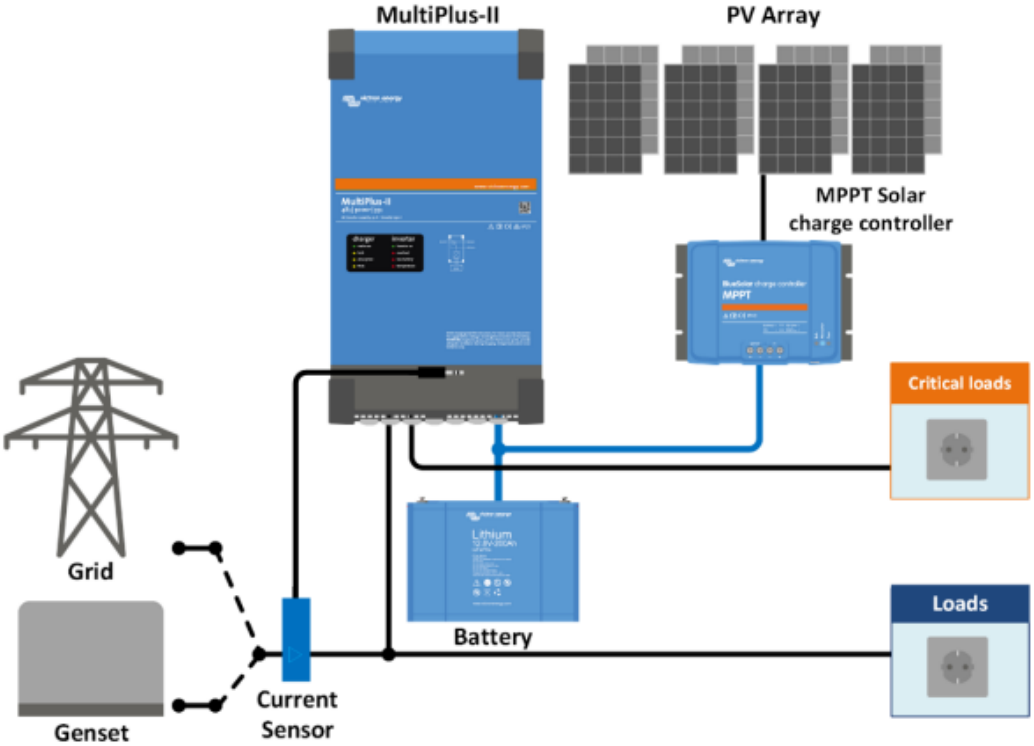


Figure 12: DC-Coupling configuration single-phase system

The **Solar Charger** is connected to the PV panels and the battery, and this communicates with the Cerbo GX through the VE. Direct or VE-Can cables, allowing PV production information and the SOC of the battery (Energy, 2021).

The **Battery Inverter Multiplus II** is connected to the battery and to the grid and it is communicated to the Cerbo Gx through the VE-Bus cable. In three-Phase systems it is deployed as one inverter per phase, each inverter feeds one phase (L1, L2 and L3 or R, S and T) and to achieve the correct operation, the inverters communicate with each other via VE-Bus cable and each are set and assigned to each phase in regard to the synchronization to the local grid, and the L1 inverter is also set as a master which will communicate with the Cerbo GX. See Figure 13 and Figure 14.

The batteries with BMS are controlled and monitored by the Cerbo GX which is communicated with via VE-Can. The batteries without built-in BMS are controlled and monitored by the inverter.

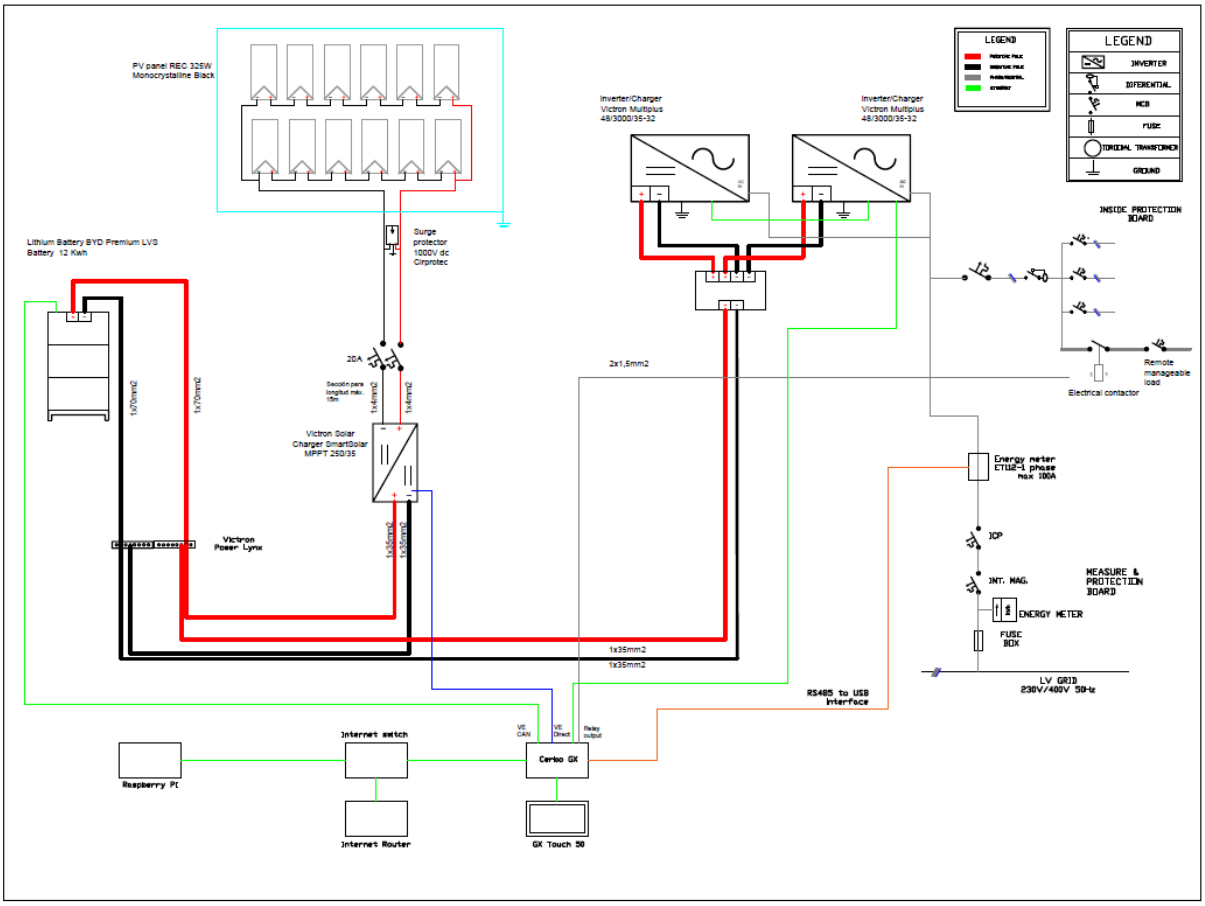


Figure 13 Single-phase electrical diagram

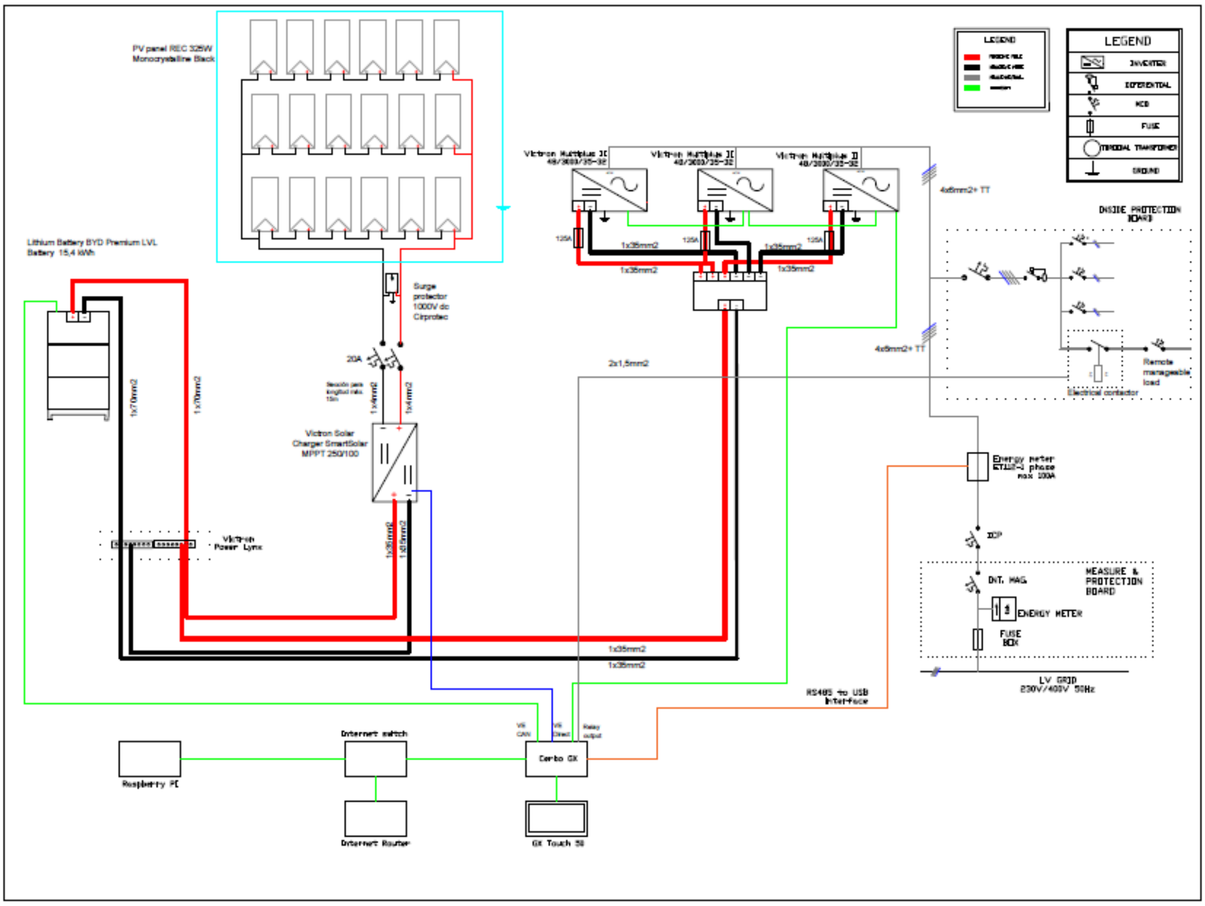


Figure 14 Three-phase electrical diagram

An SMA device AC coupling has been deployed in one building with shared self-consumption, whereby the PV energy production is directly consumed and the surplus energy is directly fed to the public grid. For this configuration, there will be no energy storage. This system is feeding 7 different apartments.

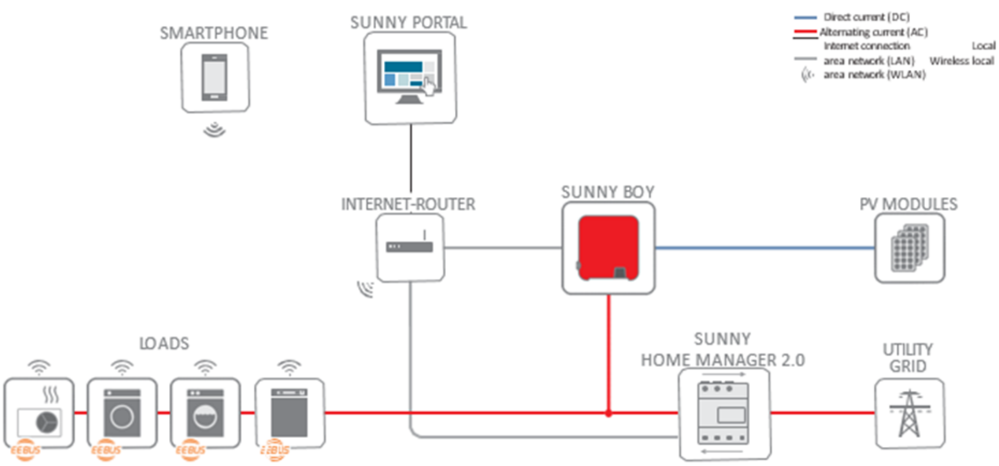


Figure 15 AC-Coupling configuration in self-consumption without energy storage.

3.2.1.4 Shared Self-Consumption without Storage

A three-phase SMA Tripower PV inverter has been deployed in a building consisting of seven apartments. This inverter is connected to the centralized point which feeds each apartment. The DSO have installed an Energy meter on the PV generation side and the distribution is managed with the coefficients assigned for each apartment.

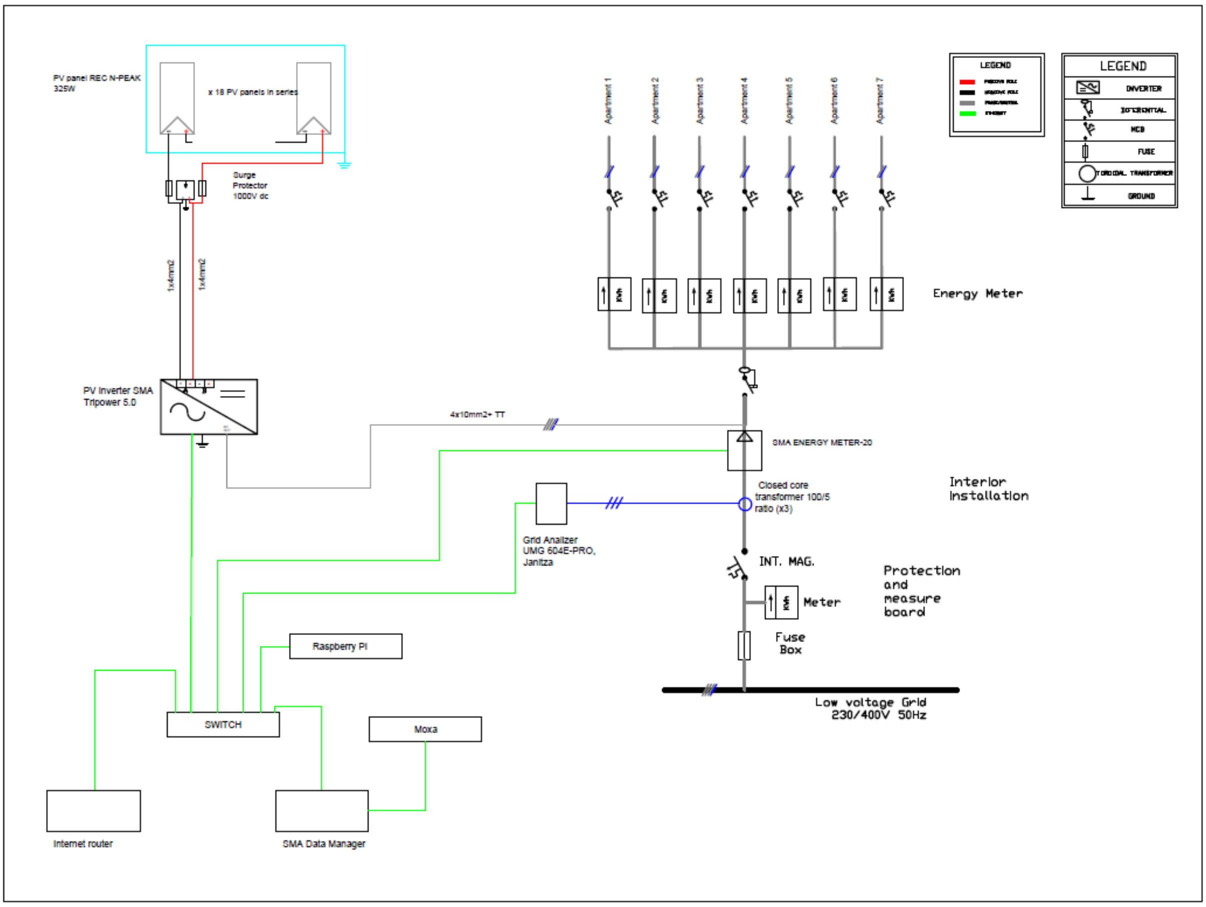


Figure 16 Shared self-consumption electrical diagram

Table 13 below presents a summary of the equipment installed per scenario and how the different storage technologies are distributed.

	REACT Reference	Total PV panels	Power peak (kWp)	Battery Capacity (kWh)	Battery technology	Scenario Type	Material
Single-phase	LG 2.1	4	1,3	4,90	Pure Lead Carbon High Endurance (PLH+C)	1	● Raspberry PI ● Victron Solar Charger BlueSolar MPPT 150/35 ● Victron Inverter Multiplus II 48/3000/35-32 ● Gateway Victron Cerbo GX ● Victron Touch GX Display
	LG 44	4	1,46	4,90	Pure Lead Carbon High Endurance (PLH+C)		
	LG 2.2	4	1,3	4,00	Lithium Iron Phosphate (LFP)		
	LG 11	4	1,3	4,00	Lithium Iron Phosphate (LFP)		
	LG 13	6	1,95	4,90	Pure Lead Carbon High Endurance (PLH+C)	2	● Raspberry PI ● Victron Solar Charger BlueSolar MPPT 150/45 ● Victron Inverter Multiplus II 48/3000/35-32 ● Gateway Victron Cerbo GX ● Victron Touch GX Display
	LG 17	6	1,95	4,00	Lithium Iron Phosphate (LFP)		
	LG 27	6	1,95	4,00	Lithium Iron Phosphate (LFP)		
	LG 30	6	2,19	4,90	Lead-Acid (Pb)		
	LG 15	8	2,6	8,16	Pure Lead Carbon High Endurance (PLH+C)	3	● Raspberry PI ● Victron Solar Charger BlueSolar MPPT 150/60 ● Victron Inverter Multiplus II 48/3000/35-32 ● Gateway Victron Cerbo GX ● Victron Touch GX Display Note: For LG25 comes with battery a Victron Multiplus II 48/300/35-32 GX
	LG 18	8	2,6	8,00	Lithium Iron Phosphate (LFP)		
	LG 19	8	2,6	8,00	lithium titanate (LTO)		
	LG 41	8	2,6	9	Lead-Acid (Pb)		
	LG 25	8	2,6	7,70	Sodium Nickel Chloride (NaNiCl2)		
	LG 16	12	3,9	12,00	Lithium Iron Phosphate (LFP)	4	● Raspberry PI ● Victron Solar Charger BlueSolar MPPT 250/85 ● 2x Victron Inverter Multiplus II48/3000/35-32 ● Gateway Victron Cerbo GX ● Victron Touch GX Display
	LG 24	6	2,16	12,00			
Three-phase	LG 45	12	4,32	15,40	Lithium Iron Phosphate (LFP)	T1	● Raspberry PI ● Victron Solar Charger BlueSolar MPPT 250/100

	LG 4	18	5,85	15,40			● 3x Victron Inverter Multiplus II 48/3000/35-32 ● Gateway Victron Cerbo GX ● Victron Touch GX Display
	LG 3	12	4,32	16	Lithium Iron Phosphate (LFP)	T2	● Raspberry PI ● 2x Victron Solar Charger BlueSolar MPPT 250/85 ● 3x Victron Inverter Multiplus II 48/3000/35-32 ● Gateway Victron Cerbo GX ● Victron Touch GX Display
	LG 35	24	7,8	16			
	LG 1	18	5,85	-	Shared self-consumption without storage	A1	● Raspberry PI ● SMA Tripower 5.0 PV inverter ● SMA Data manager EDMM Gateway

Table 13 La Graciosa table of participants and technology distribution

3.2.1.5 Data acquisition and communication with the REACT platform

Several devices have been deployed to ensure the data acquisition, the communication with the REACT Platform and the control and monitoring of each installation, such as the Raspberry PI and the Victron Cerbo GX.

The Raspberry PI is a low power computer capable of running OpenMuc applications and ensures the interoperability of the system with the REACT cloud.

The Cerbo GX provides monitoring, and operates as the communication centre of the installation, the system components such as Battery inverter, solar chargers, batteries and the Energy Meters are connected to it. This device has also a built-in relay which allows us to activate and deactivate loads (explicit demand response) remotely. For external control and monitoring, the Cerbo GX is connected to the internet.

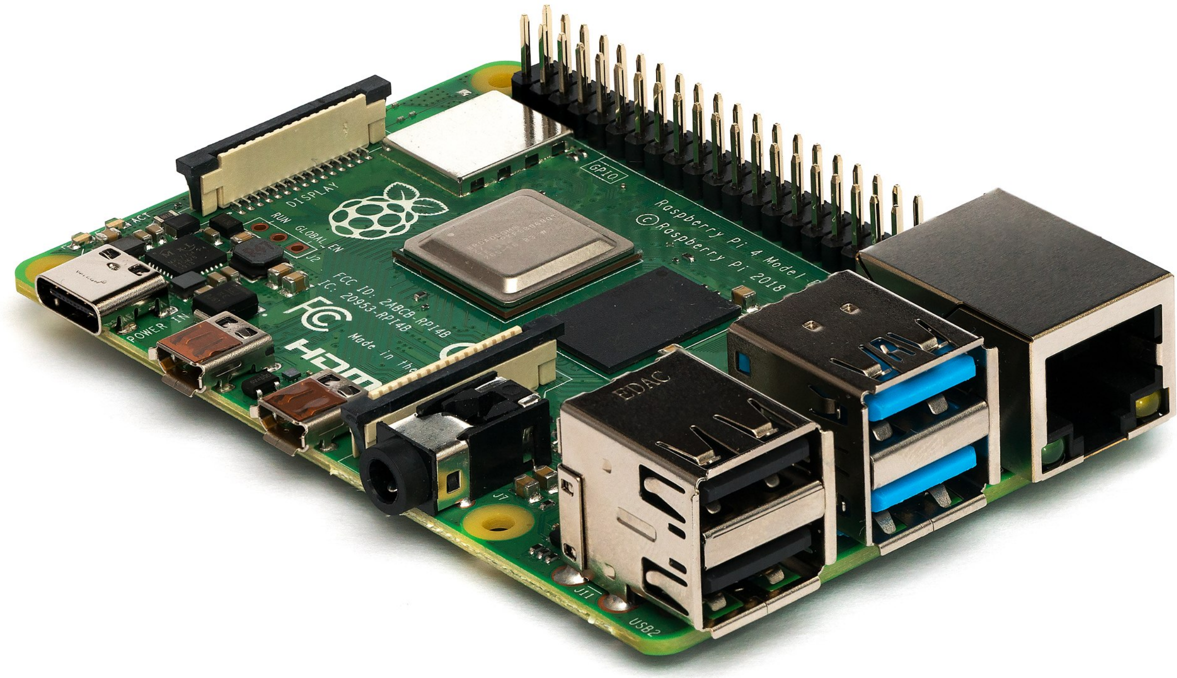


Figure 17 Raspberry PI

Figure 18 Cerbo GX

For better integration and interoperability, a pre-wired cabinet in which to place the devices has been designed. This will also ease the work of the installers. For the local control and monitoring, a Victron Touch GX display is placed on the external side of the door cabinet so that real time installation data can be visible.

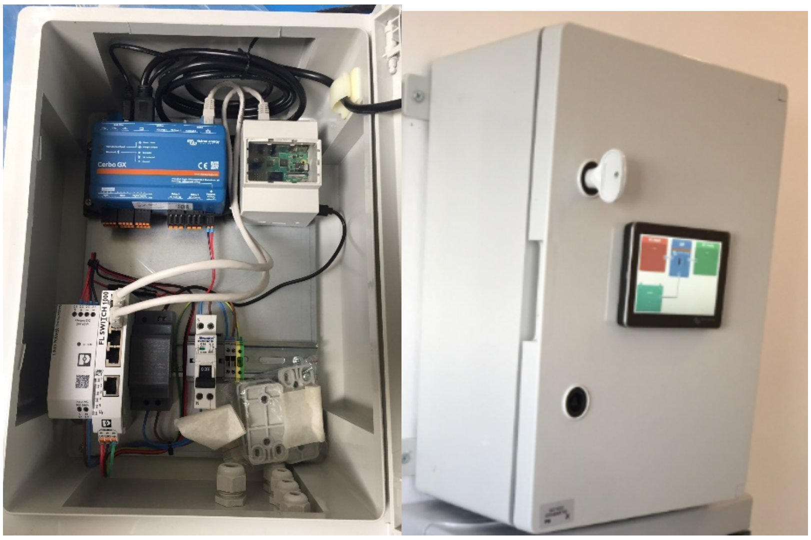


Figure 19 Monitorization cabinet

The Energy meter is connected to the building's main distribution board, between the grid and the installation. This communicates with the Cerbo GX through the RS485-USB interface. This device reads the energy coming from the grid (buy) and the energy that is injected to the grid (sell).

Figure 20 Victron Energy Meter ET112, ET340 and RS485-USB Interface

3.2.1.6 Explicit Demand Response (Load Control)

For the direct load control, the remote direct on/off or incremental control over significant consumption devices (e.g., heating or cooling systems) is a key driver of explicit demand response programs as it facilitates effective quick and on-demand load curve modifications (D5.2). For this we take advantage of the built-in relays of the Cerbo GX or inverters which can be automatically activated or remote direct activated when needed. This relay opens and closes a contact which activates a contactor connected to the load that we want to control.

A box has been designed to place an Energy Meter, a Contactor, a Timer and an activation Button. The operation mode is that the REACT platform sends an order to activate a certain load (ex. Boiler), it will close or open the relay to activate the contactor. If we want to revert this order manually, because for example the final user wants to use a hot water but the boiler is off, they can press the Activator Button and it will revert the actual state of the contactor and will run a timer which is pre-adjusted for a time to run. The boiler will work during this time and when it finishes, it will turn the contactor to the initial position. When the timer is running the orders from the REACT platform will not make any effect.

Figure 21 Energy Meter and load Activation Box

3.2.1.7 System configuration

Once the installation is finished and all devices are connected as was described in section 3.2.1.1, it must be set according to the characteristics of the installation. Victron has made available the VE Configuration tools for VE-Bus devices and the MK3-USB interface to connect to a computer for configuration and firmware updates.

First of all, before configuration we have to update the firmware of all the devices to the last version, and then we start with the inverter using VE Configure tool.

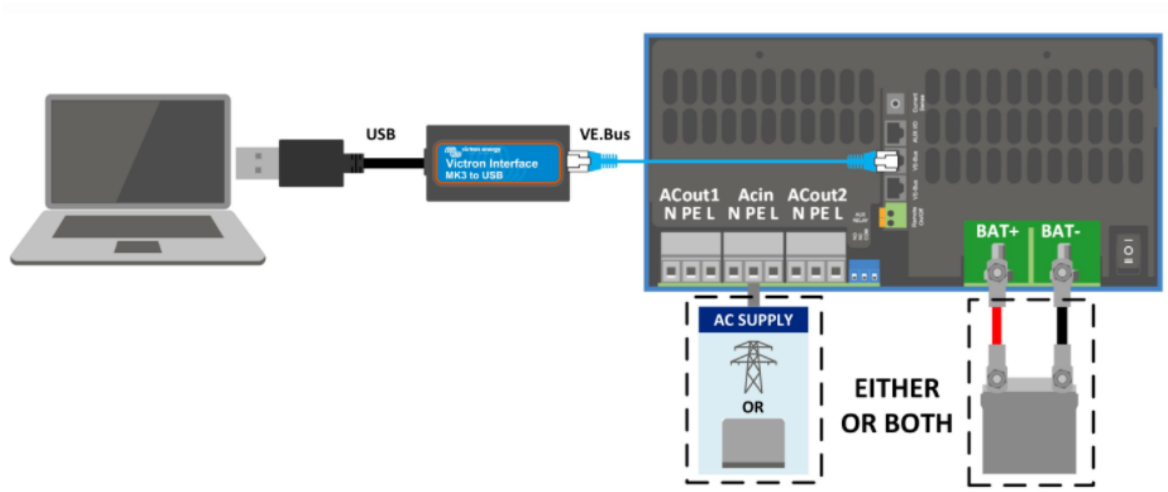
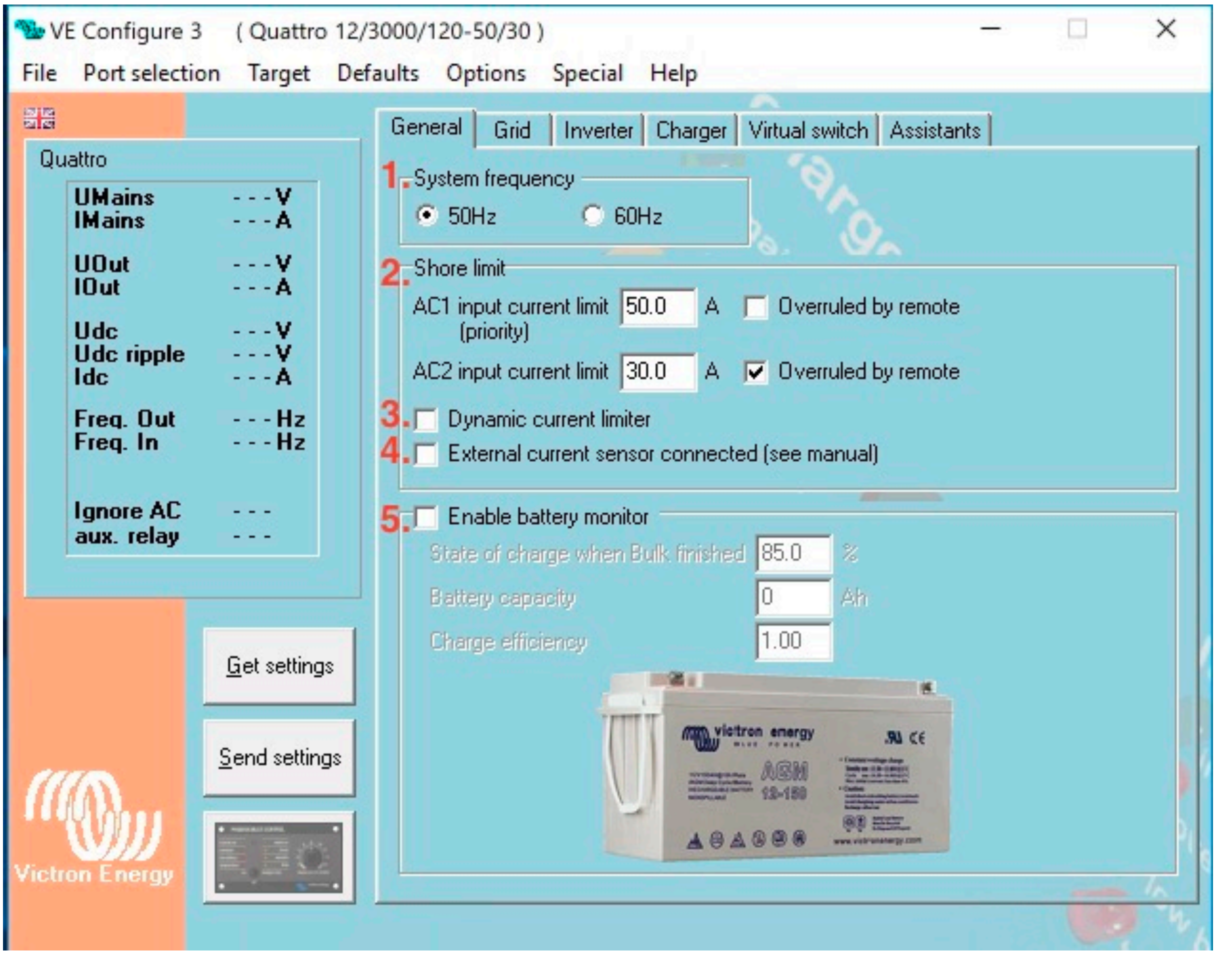


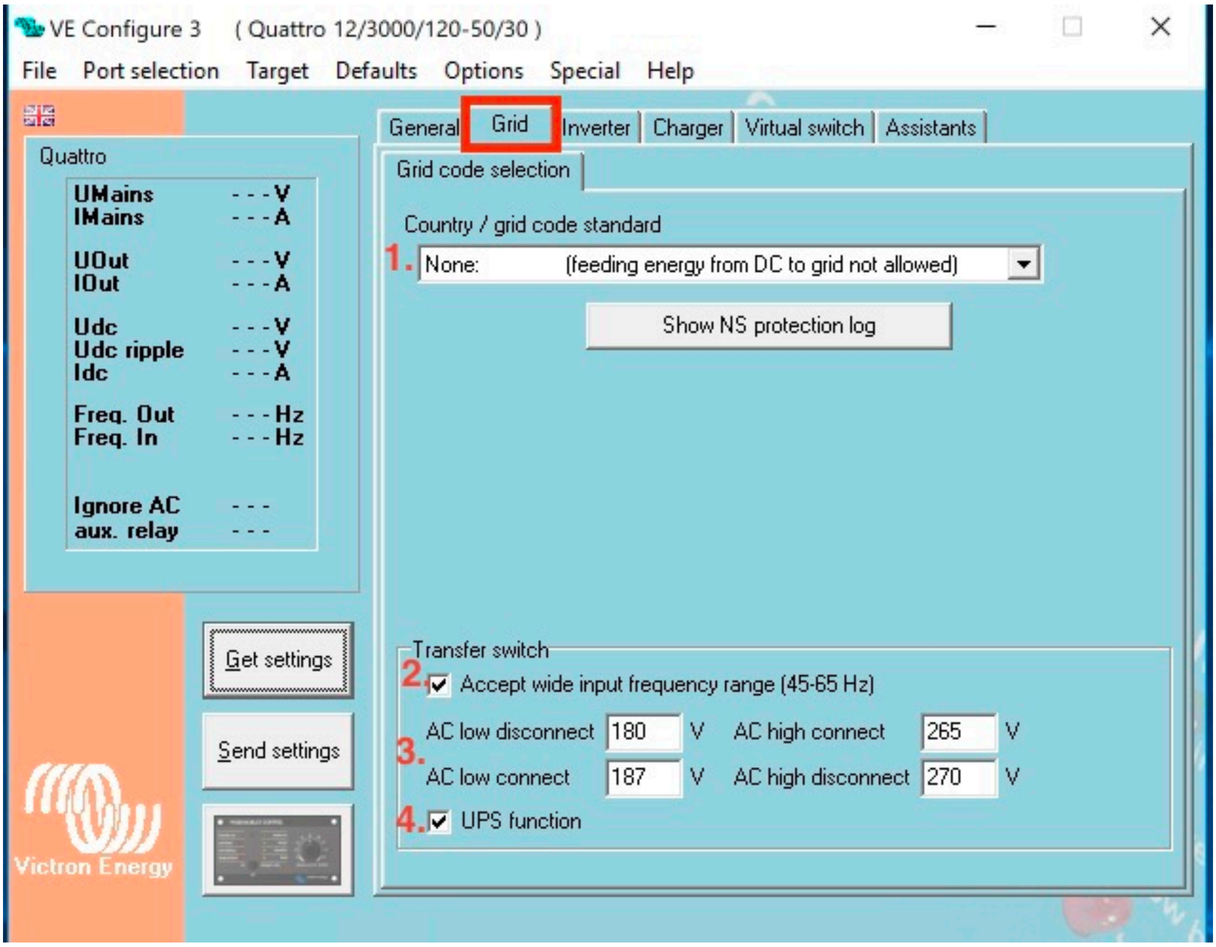
Figure 22 Victron configuration with MK3 interface

General Settings



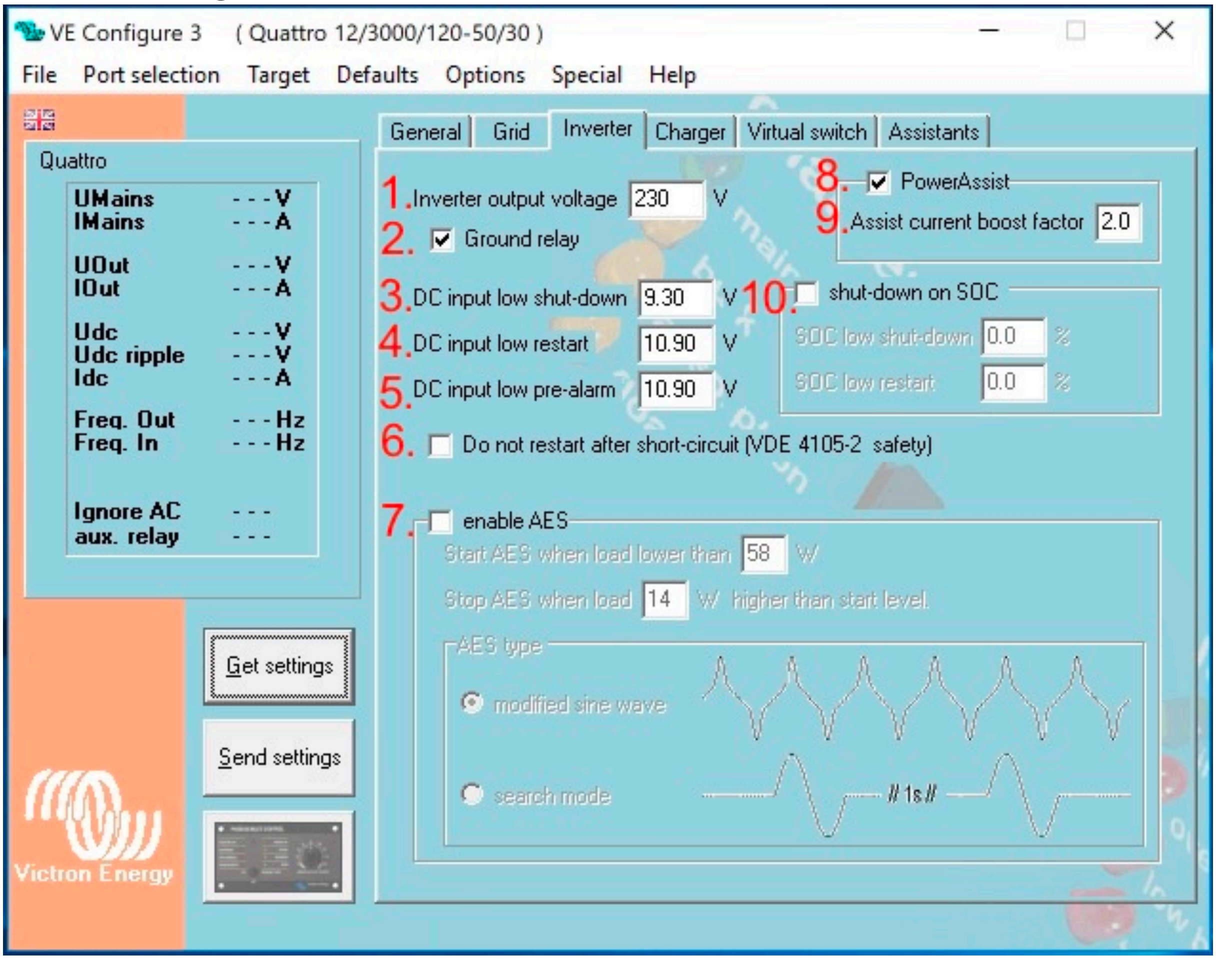
- **System frequency setting**
- **Maximum shore current setting (is overruled by the remote panel if connected)** - This setting is only active if no system panel is installed.
- **Dynamic current limiter - Setting for use with 'small' generator** - If an inverter-generator is used, such as the HONDA EU series, the shore current setting will be dynamically reduced (following a period of low current consumption) to compensate for the engine reaction time when higher loads are activated.
- **External Current Sensor** - This is for use with the Multiplus-II external current sensor.**Battery Monitor** - Enabling the VE.Bus battery monitor, this also enables many features that can use a State of Charge (SOC) such as generator start/stop.

Grid Setting



- **Country Grid Code** - This setting is used to indicate whether it is necessary for the input frequency to be exactly 50 or 60 Hz. This is a setting that is primarily used in conjunction with generators (speed may not always be stable) to prevent the Multi from rejecting the input supply
- **Set the sensitivity of frequency measurement.** These are the limits at which the unit will accept or reject the supply. If the input voltage drops below the set value of the lower limit, the charger output will be reduced to the minimum to prevent further reduction of the voltage.
- **Voltage limits at which feedback relay opens/closes. Also, charger stops at lower limit.** - If UPS Function is deselected, this automatically activates the function preventing the lower voltage limit from being exceeded with heavy start-up loads! (Previously labelled “Allow inrush current”)
- **UPS Function determines whether the Multi should be critical of the distortion in the supply waveform.**

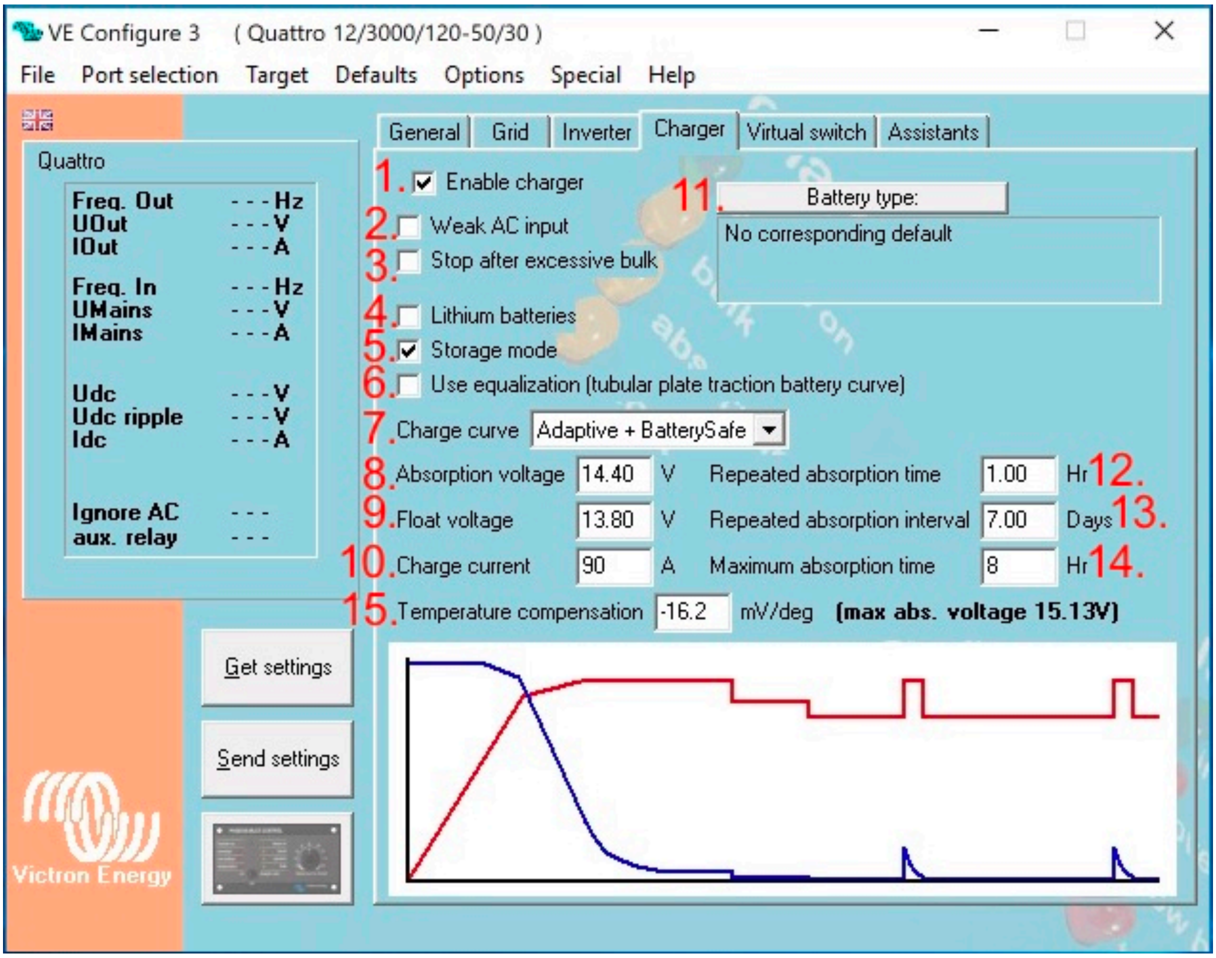
Inverter settings



- **To set output voltage of inverter** - This is normally 230 Vac. Possible values 210V ~ 245V.
- **Used to enable/disable the internal ground relay functionality. Connection between N and PE during inverter operation.** - The ground relay is useful when an earth-leakage circuit-breaker is part of the installation. When the internal transfer switch is open (inverter mode) the Neutral of the inverter is connected to PE. When the transfer switch closes (AC input is transferred to the output) the Neutral is first disconnected from PE. Warning: Disabling the ground relay on "120/240V" models (split phase models) will disconnect the L2 output from the inverter.
- **To set the low battery voltage level at which the inverter shuts off** - To ensure long battery life, this value should be set according to your battery manufacturer specification.
- **To set the voltage at which the inverter restarts after low voltage shut-down.** - To prevent rapid fluctuation between shut-down and start up, it is recommended that this value be set at least one volt higher than the low battery shut-down voltage.

- **To set the voltage at which the inverter triggers a warning light and signal before shutdown.** - DC input low pre-alarm with this setting one can determine the level at which the Low batter pre-alarm indication starts. Note that in fact the parameter which is changed is an offset voltage relative to the DC input low restart level which in its turn is relative to the DC input low shut-down level. The result of this is that, when changing either one of DC input low restart and DC input low shut-down, this "DC input low pre-alarm" level changes also!
- **Safety Feature** - If a short circuit is detected, the unit will not automatically restart unlike other overload conditions.
- **Energy saving setting to conserve power if there is no significant load drawn from the inverter.** - If the system has consumers with high inrush characteristics (such as microwave ovens and air-conditioning) deactivate Automatic Energy Saving (AES) to prevent them from switching on too slowly and causing overload.
- **Activates Power Assist function.** - Use Power Assist to prevent an external AC input circuit breaker to trip due to excessive load. If the load exceeds the AC input current limit the Multi will start inverting in parallel with the external AC supply and will provide the extra current needed. Note: When Power Assist is enabled there is a minimum AC input current limit depending on the device type. Setting a lower limit than this minimum will result in the minimum limit. Note that in a parallel system this limit is per device!
- **The boost factor is the peak power provided by the inverter when the shore current limit is exceeded at start-up of heavy loads.** - This value is normally set to 2. This is a safe value because any small peak will be compensated by the inverter and the excessive power will not overload the input circuit protection. Be very careful with this setting and change it only once you have carefully considered the possible negative aspects of doing so! 10. If the Multi is set to have State of Charge enabled, you can use this feature to shut it down when it reaches the set level. This can be useful on systems where battery voltage does not give a good indication of battery level.
- **Shut down on State of Charge (SOC)**

The charger tab contains all the settings which are related to the charger. For convenience a charge curve is also on this tab. This curve changes when the storage mode is changed or when another charge curve is chosen.



- **To set the charger function on/off** - The inverter and assist functions of the Multi will continue to operate, but it will no longer charge; the charging current is therefore zero.
- **Weak AC input option** - If the quality of the supply waveform is less than the charger expects, it will reduce its output to ensure that the COS phi (difference between current/voltage phases) remains acceptable. This protection can be deactivated for low capacity or poorly regulated power supplies.
- **Stop after excessive bulk (Overcharge protection)** - If the absorption voltage has not been reached after 10 hours, the battery may be faulty and the charger will switch off for safety reasons.
- **Lithium Battery (will trigger battery wizard)** - This setting will trigger the lithium battery options and wizard, depending on the configuration of your lithium battery and manufacturers advice you may need to adjust additional settings as well.
- **To set storage mode on/off** - With this feature active, after 24 hours in float charge, the charging voltage will be reduced below the float voltage to provide optimum protection of the battery against overcharging; charging current will continue to be applied regularly to compensate for self-discharge. This is the rest voltage if the battery is fully charged.

- **Special charge curve for traction batteries** - For optimum charging, special traction batteries require a fixed charging current phase in addition to a voltage curve. Beware that this often results in a higher charging voltage that can be damaging to regular on-board consumers!
- **Select charge curve behaviour** - Under normal circumstances always select the adaptive mode. If the balance between the charger and battery is not ideal it may be better to choose fixed mode, otherwise the voltage will rise too quickly or too slowly and the battery may be over or under charged as a result.
- **Manual settings for battery charging** - Use this setting to specify the Absorption voltage. Absorption is the charge phase where the battery is held at continuous target voltage with variable current.
- **Float Voltage** - Use this setting to specify the Float voltage. Float stage is reduced voltage from absorption, used to trickle in current to finish battery charge without creating excess heat or gassing.
- **Charge current limit in DC Amps** - Charge current. Use this setting to specify the current with which the battery is charged during the bulk phase. Note that the actual charge current depends on other conditions also. Therefore, it is possible that the actual charge current is lower than this setting. This can, among others, be due to a low AC input current limit in combination with a high load; high environmental temperature; too high ripple voltage due to improper cabling. For lead batteries, the charging current should be approximately 10 to 20% of the battery capacity. Also keep in mind the DC consumption that is expected in the system.
- **To set pre-programmed battery type** - VEConfigure is pre-programmed with prescribed charge profiles for different battery types that can be easily selected from the menu.
- **Absorption time** - With this setting, one can specify the duration of the repeated absorption "pulses".
- **Use this setting to specify the interval between repeated absorptions.** - Use this setting to specify the interval between repeated absorptions.
- **If the charge curve is fixed then this setting is used to determine the absorption time.** - Maximum Absorption time. If the charge curve is fixed, then this setting is used to determine the absorption time. In all other cases this setting determines the maximum absorption time. See also Charger settings.
- **The variable for adjusting the battery charging voltage based on temperature compensation algorithm.** - Battery voltage and temperature compensation adjustment. Output voltages for Float and Absorption are at 25 °C. A temperature sensor serves to reduce charging voltage when battery temperature rises. In most circumstances, this value should be left as default. In some situations, e.g., unusual temperatures and battery chemistries, the battery manufacturer may specify a different variable for temperature compensation. This adjustment is ONLY for trained technicians under specific advice from a battery supplier with knowledge of Victron equipment, incorrectly adjusting (e.g.,

inputting figure based on a spec sheet and not compensating for bank size) will result in batteries being destroyed

In three-Phase installation, we will use VE-bus quick Configure tool that will allow to set the inverters to each phase lines and that they work as a single three-phase inverter.

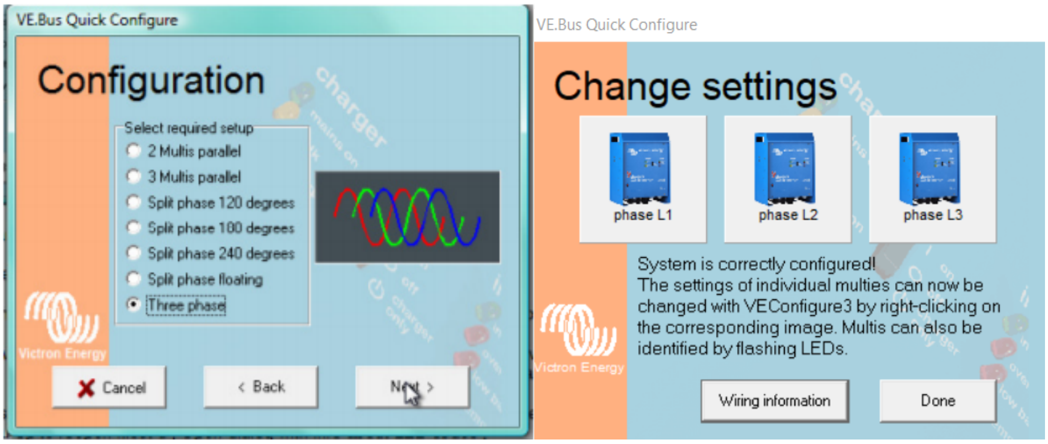


Figure 23 VE. Bus Quick Configure dialogue board

3.2.2 SAN PIETRO

The Italian regulations set three important constraints for the San Pietro pilot development:

- Italy has only "partially adopted" Directive 2018/2001 on the promotion of the use of energy from renewable sources and energy communities can only be created by "proximity".
- The Municipality of Carloforte has no direct management of the grid and uses the electricity distribution grid of a DnstaliSO
- Red II communities are implemented as "virtual energy communities":
    - The PV is connected to the network, not directly to the households in the community
    - Users and source exchange energy through the public electricity distribution network
    - Users can benefit from economic incentives aiming at aligning moments of energy consumption with moments of PV production-U

To be able us to pursue the aims of the REACT project and adopt smart grid technologies that otherwise would be blocked under the current regulation, the San Pietro Energy community was transformed into a Virtual Power Plant (VPP), enabling different functionalities of the energy systems (e.g., prosumer, grid balancing, congestion). The VPP enables Smart Grid compatible solutions while still operating in an existing energy infrastructure context.

In order to satisfy the heating load and DHW needs of islanders Mitsubishi Electric is providing air-source heat-pumps for the demo buildings whilst MIDAC Li-Ion battery systems will provide flexibility to the grid with an energy storage system which will act as a load (during charging) or as a generator (during discharge).

3.2.2.1 MIDAC Batteries – Technical Configuration

MIDAC battery solution is composed of a single 4,2 kWh battery type that can be configured to be put in parallel with up to 4 batteries to achieve the maximum storage capacity of 16,8 kWh. A summarized battery specification is reported in the table below:

MIDAC RES		
	Chemistry	LFP
	Dimension (LxWxH)	506 x 443 x 143 mm
	Weight	40 kg
	Nominal Voltage	51,2V
	Capacity	80 Ah
	Energy	4200 Wh
	Operating Temperature	-20°C/55°C
	Comunication Protocol	CAN Open

Table 14 Midac battery

The connection with the grid is provided by a 3000VA inverter that can be use as standalone, for the single-phase grid connection, or in a three-phase configuration with a Master and two slaves (one inverter for each phase).

The inverter shares data with the REACT Cloud by a MQTT connection and the battery can be charged or discharged by the commands sent by the REACT cloud.

In the figure below the three-phase installation drawing is shown. The parallel of the four batteries is marked with the orange colour, the three-phase inverter configuration is marked with the green colour. The PV energy production is read by a Carlo Gavazzi meter installed on the PV system (red colour) and the energy shared with the grid is read by three current transformers (CT) shown on the blue box.

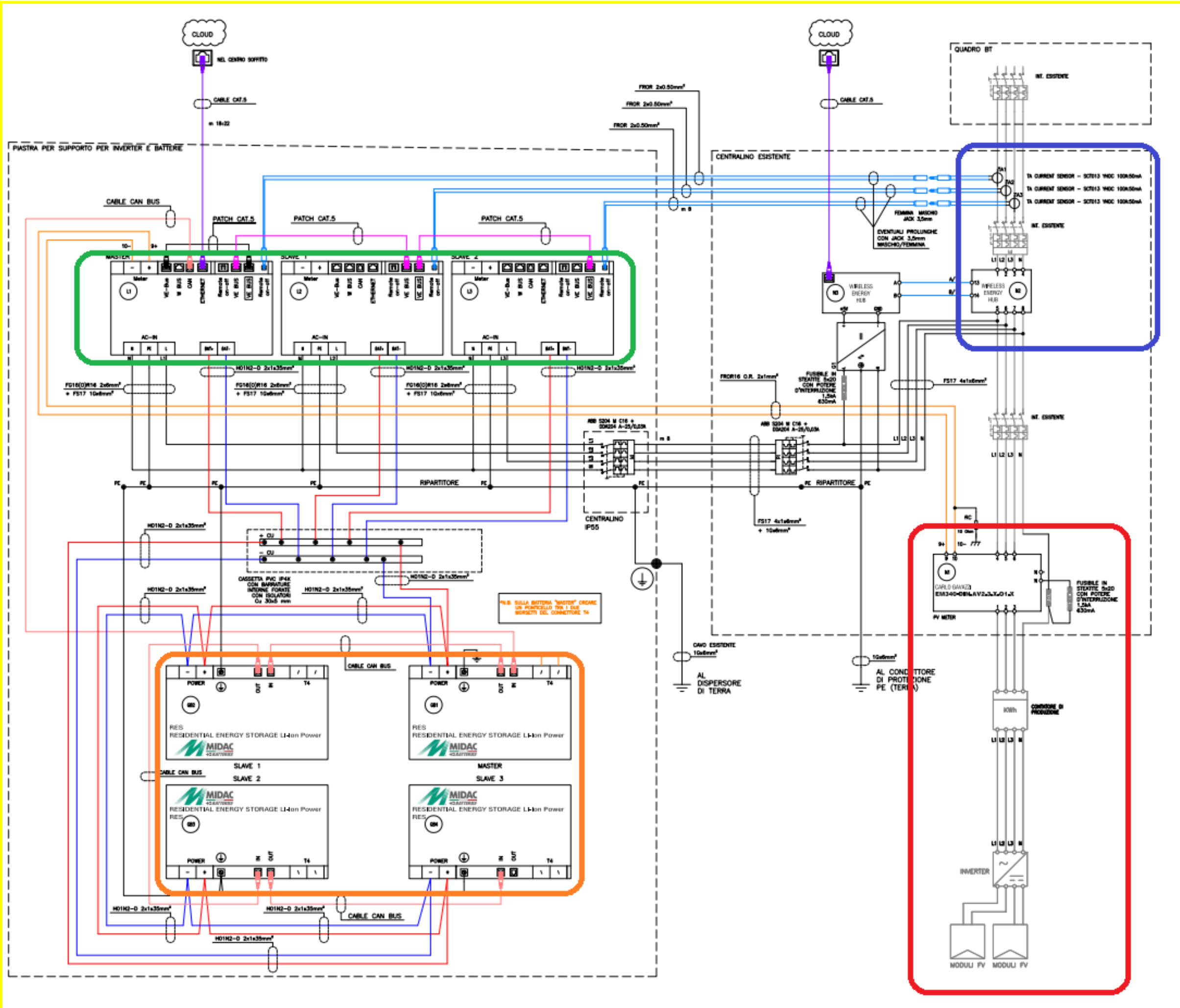


Figure 24 Three-phase electrical scheme

In the figure below the single-phase installation drawing is shown. The Energy Storage System (ESS) can be configured with a parallel with up to three batteries (marked with the orange colour), the inverter is marked with the green colour. The PV energy production is read by a Carlo Gavazzi meter installed on the PV system (red colour) and the energy shared with the grid is read by a CT shown on the blue box.

In both solutions, the ESS can share data by the REACT cloud using a wireless or a wired internet connection.

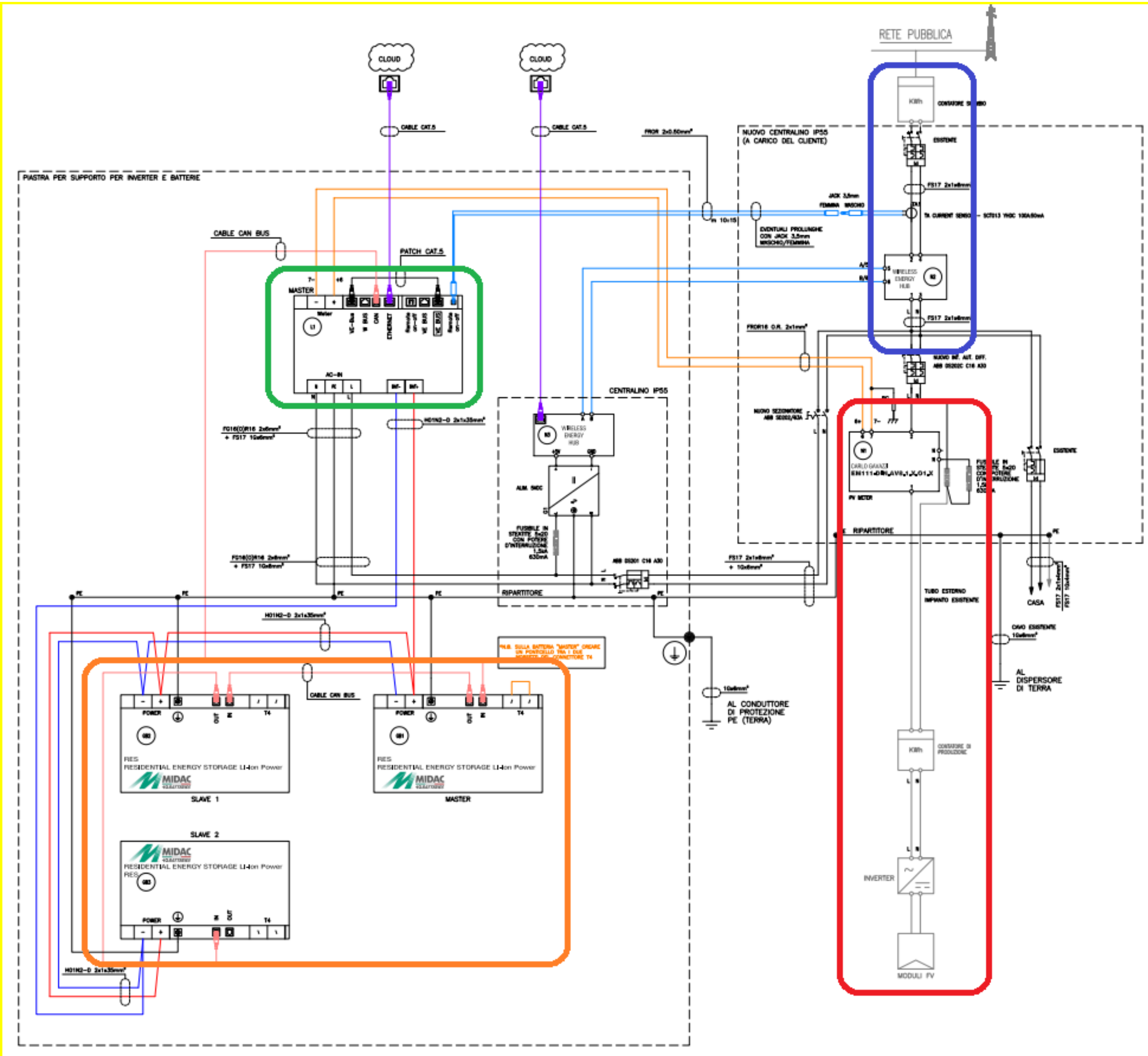
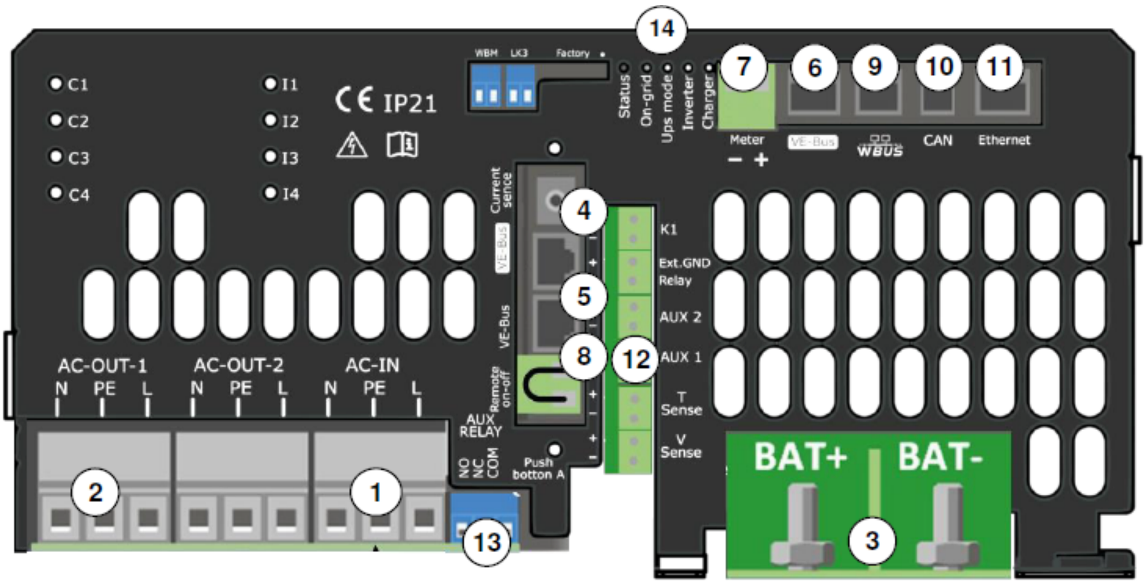


Figure 25 Single-phase electrical scheme

In both solutions, the Energy storage system can share data by the REACT cloud using a wireless internet connection or a wired one.

This is the inverter connection scheme:



1. AC-IN: AC mains input connection, $3x13mm^2$
2. AC-OUT-1 (EPS OUT): Privileged load connection (EPS), $3x13mm^2$
3. BAT+/- : Battery connections, M8 screws
4. Current Sense: TA sensor, 3.5mm jack
5. VE-Bus: Internal bus connection, RJ45 (Leonardo PRO X is supplied already connected to the VE-Bus port
6. VE-Bus: Internal control bus connection, RJ45
7. Meter: Connection of the production meter bus P1, $2x2.5mm^2$ (in case of AC configuration) or connection for maximum self-consumption (in case of DC installation with external regulators)
8. VE-Bus: Control Bus Connection for connecting a Leonardo PRO X Slave, RJ45
9. WBUS: Port for connecting WESTERN CO devices. (WRM, WBM), RJ11
10. CAN: CANBUS battery connection, RJ10
11. Ethernet: Internet connection, RJ45
12. Terminal block for internal connection of the maximum self-consumption contact
13. Contact output for activating auxiliary loads (in case of DC installation with external regulators)
14. Warning LED

Figure 26 inverter connection scheme

And the connection to the batteries is made with power connection cables:

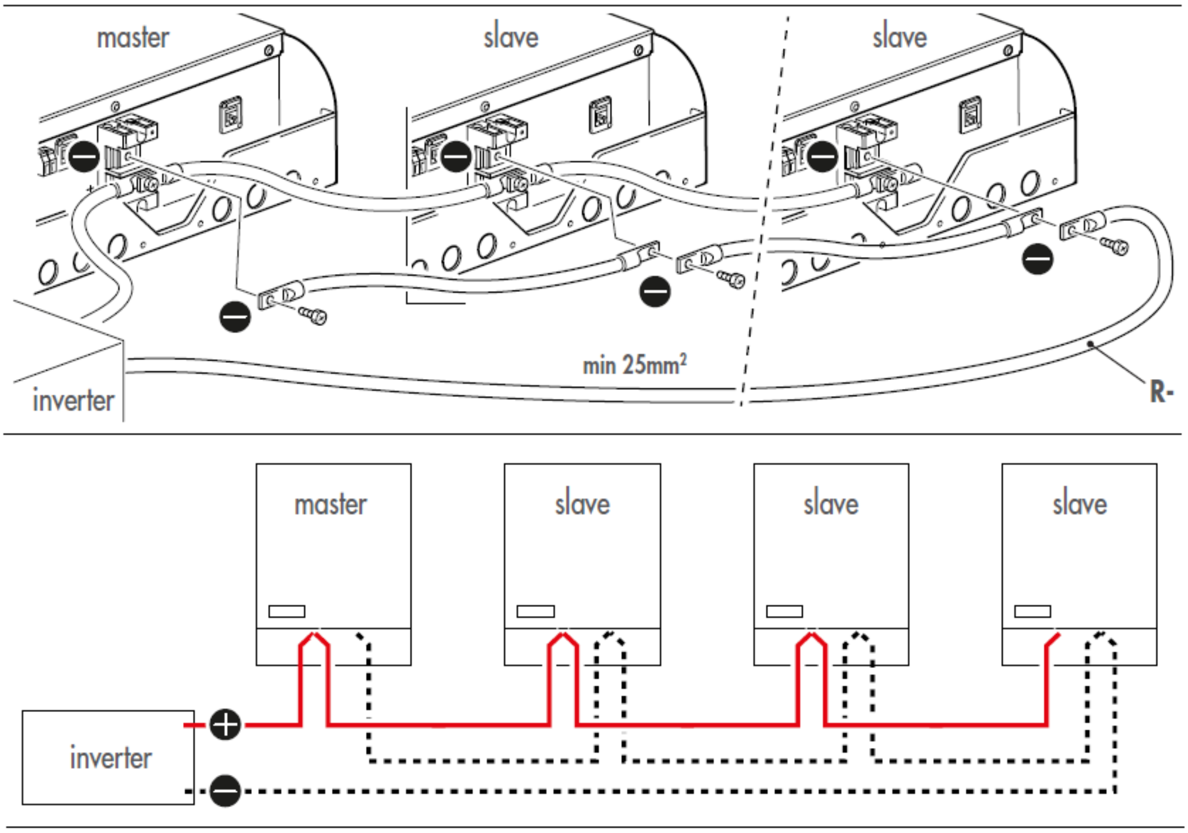


Figure 27 Connection to the batteries

The Controller Area Network (CAN) communication cables are in daisy chained configuration, from the Master battery to the last Slave battery:

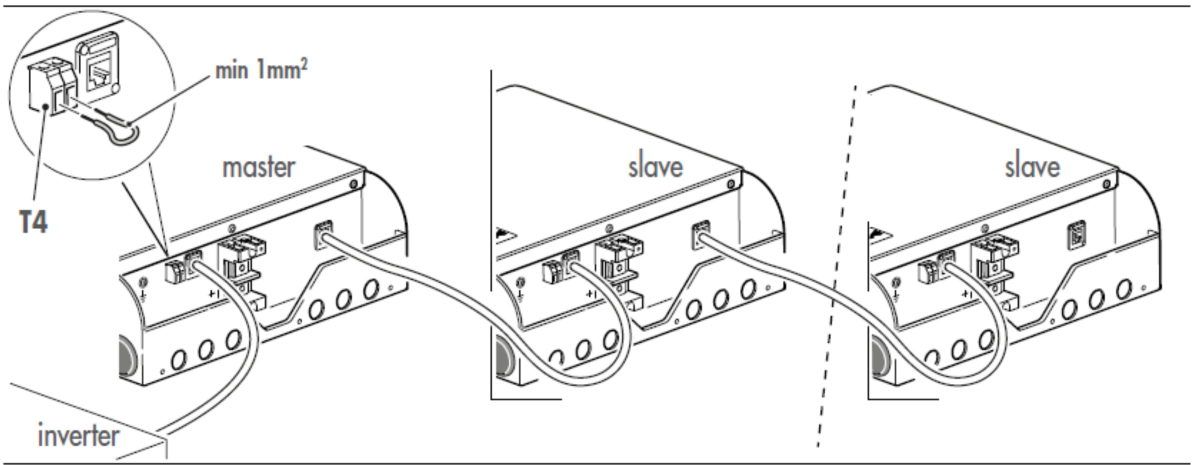


Figure 28 CAN communication cables

The information on the battery State of Charge is available on the front LEDs display panel:

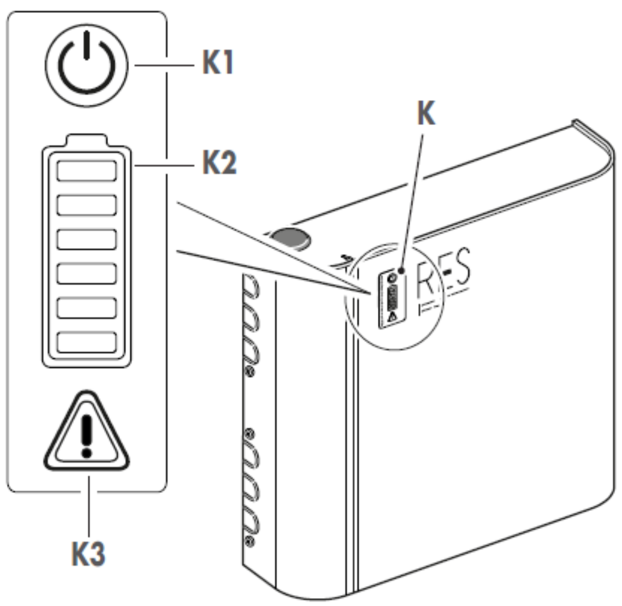
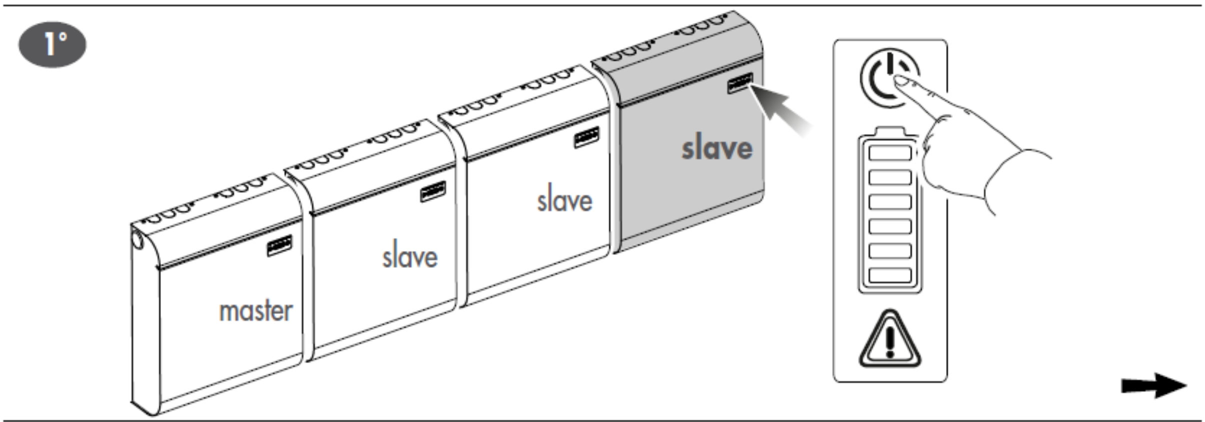


Figure 29 State of Charge panel

The activation sequence is carried out from the last Slave and ends with the Master:



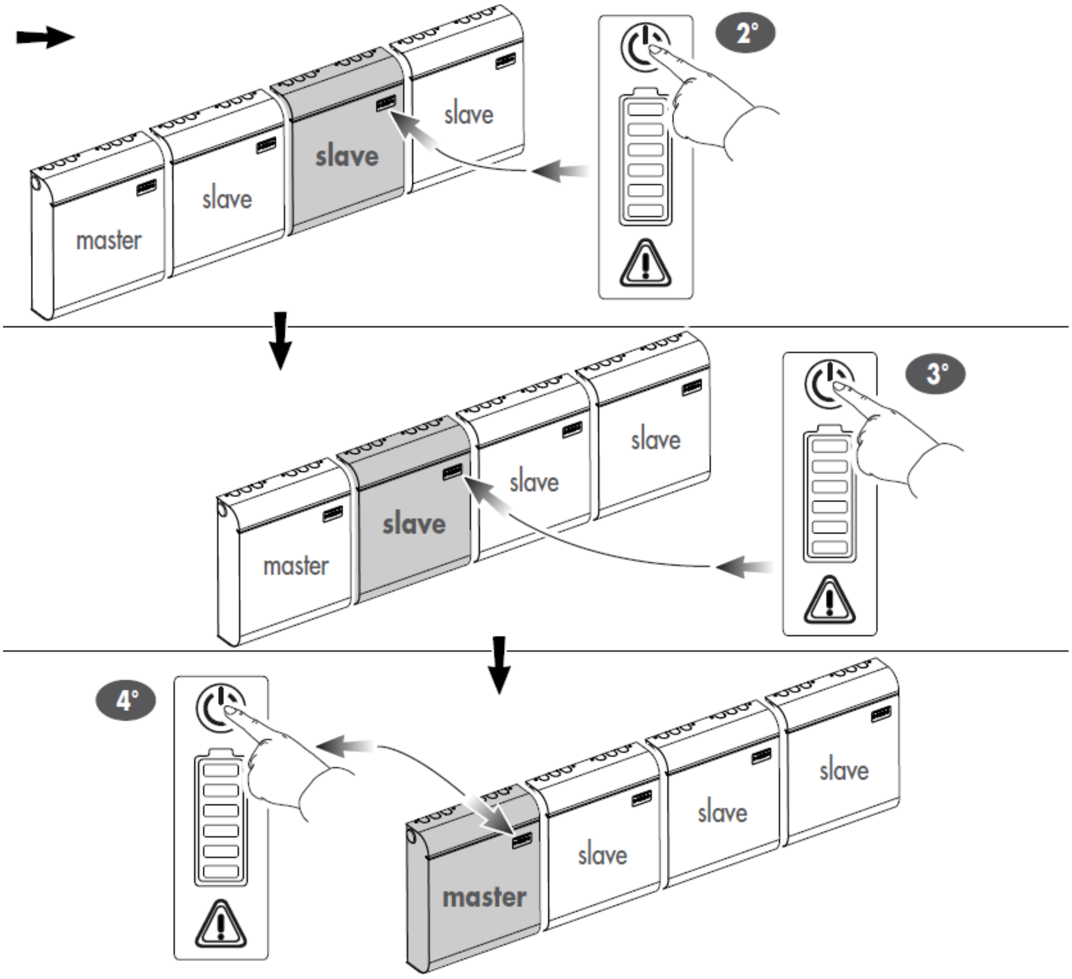
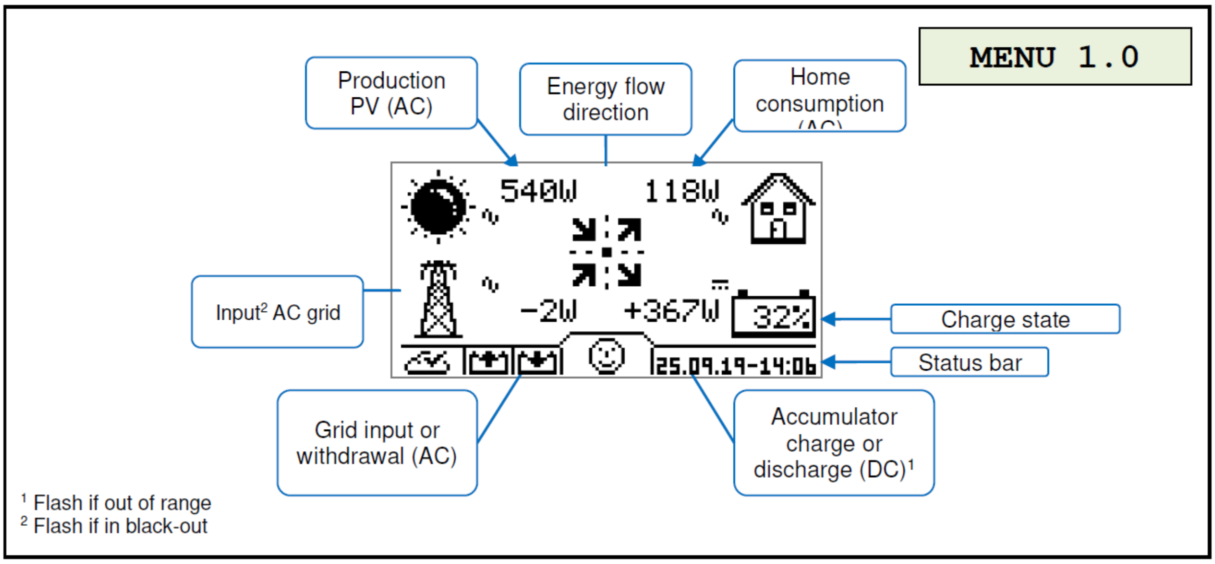


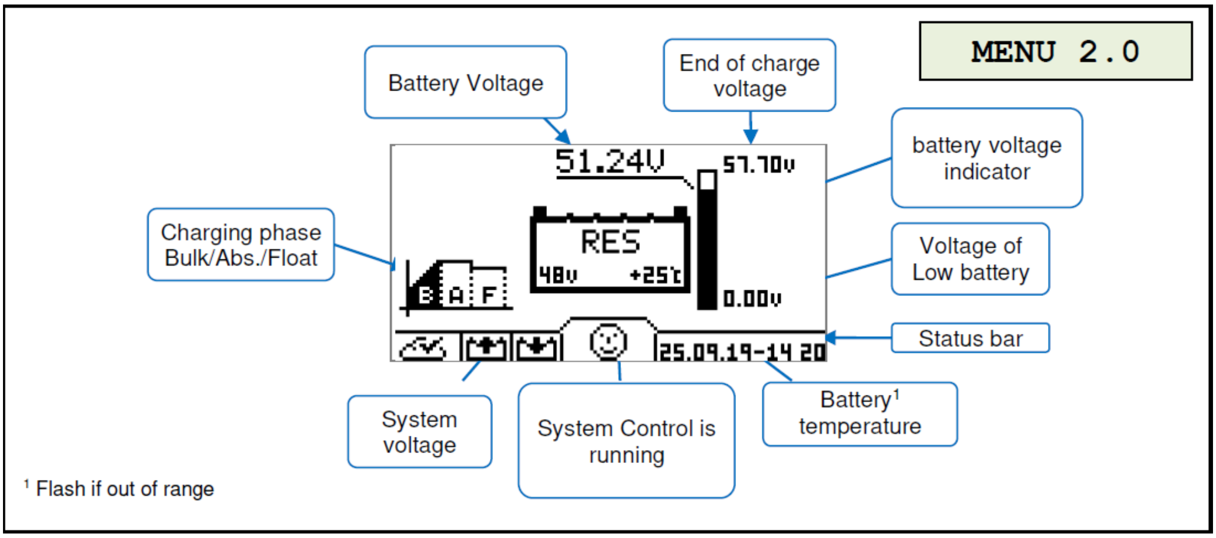
Figure 30 Activation sequence

The Inverter display provides the following information:

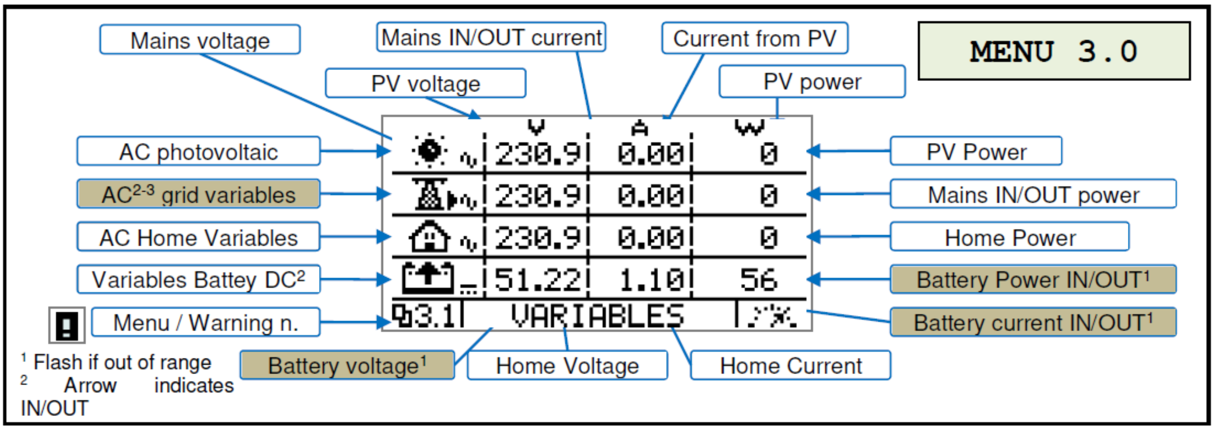
- Real-time system power exchange information



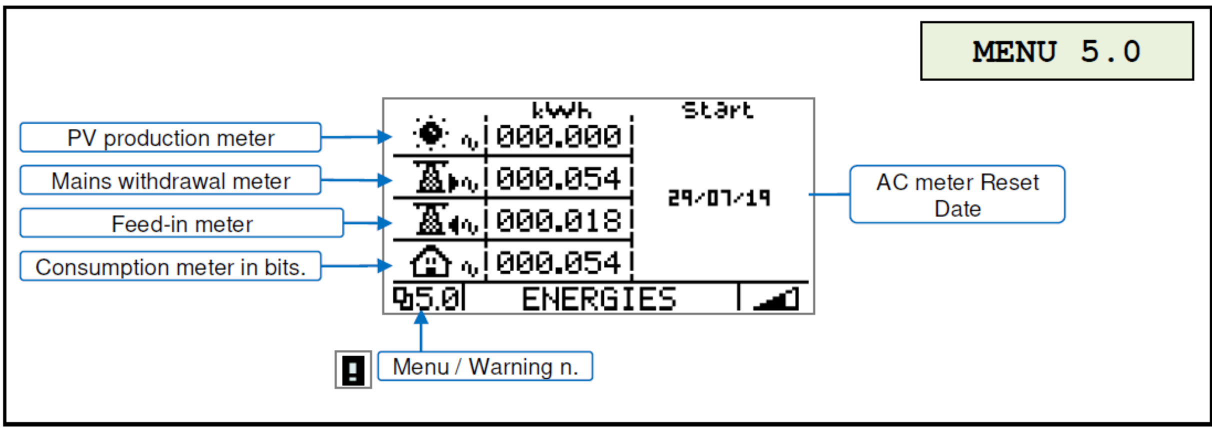
- Information regarding battery



- Voltage and current measurements



- Cumulative energy data



The Midac ESS is specially designed to work with an internet connection, for monitoring, remote assistance and updates. For this reason, it is essential to configure the system connection settings, through the display, in order to have correct operation.

If local internet network supports the DHCP function, no further configuration is required. Otherwise, it is possible to configure a static IP address through the following menu:

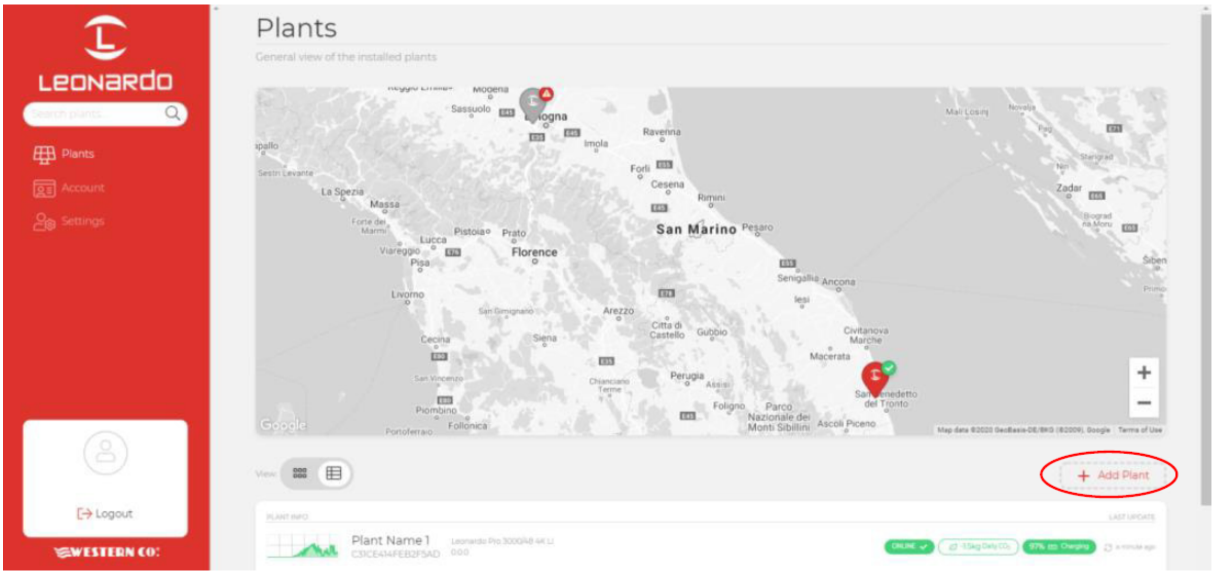
MENU 7.3

List displayed: Item:	Value:	Settable values and descriptions:
CONNECTION	OFF	OFF; ON : Disable/Enable cloud connection for data transfer to the server.
Enable DHCP	ON	OFF; ON : Disable/enable the DHCP function.
1-IP Address	192	< 0..255> : sets the IP address of the device.
2-IP Address	168	<0..255> : "
3-IP Address	100	<0..255> : "
4-IP Address	100	<1..255> : "
1-subNetMask	255	< 0..255> : sets the network sub-mask.
2-subNetMask	255	<0..255> : "
3-subNetMask	255	<0..255> : "
4-subNetMask	000	<0..255> : "
1-Gateway	255	< 0..255> : sets the IP address of the Gateway.
2-Gateway	255	<0..255> : "
3-Gateway	255	<0..255> : "
4-Gateway	255	<0..255> : "
1-prim.DNS	008	< 0..255> : sets the IP address of the primary DNS.
2-prim.DNS	008	<0..255> : "
3-prim.DNS	008	<0..255> : "
4-prim.DNS	008	<0..255> : "
1-secon.DNS	255	< 0..255> : sets the IP address of the secondary DNS.
2-secon.DNS	255	<0..255> : "
3-secon.DNS	255	<0..255> : "
4-secon.DNS	255	<0..255> : "
7.3 NETWORK		

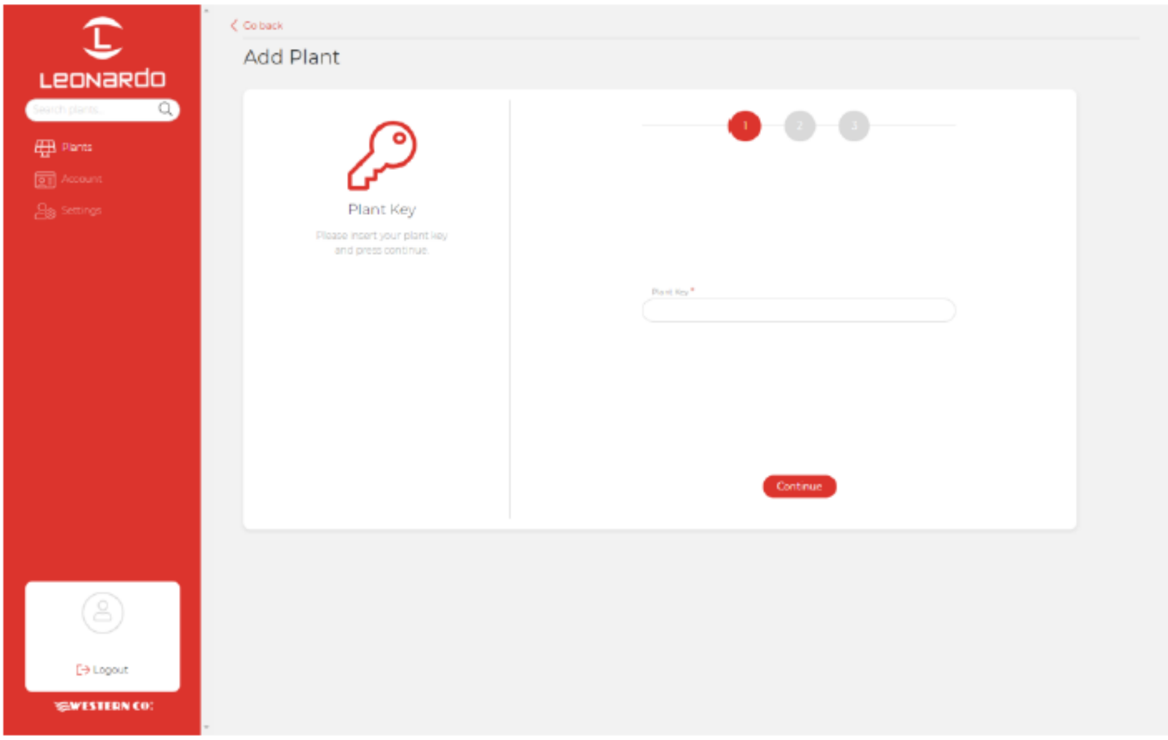
Table 15 Static IP address configuration

This configuration must be performed before a system can be monitored, following the installer must record it on the system and associate it with the end customer. The installer must to be authenticated and in possession of the MIDAC SpA credentials.

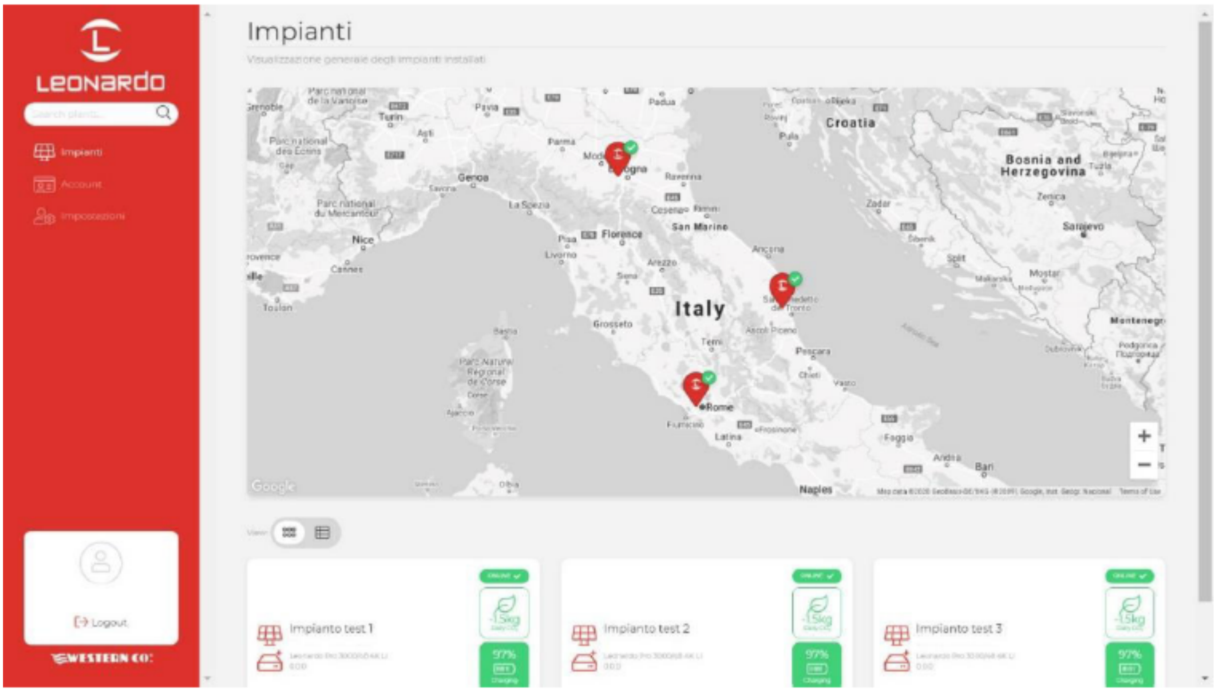
Once have accessed the portal, enter the list of systems and click on "Add System". It is mandatory to register the system only after it has been successfully started.



At this point, the PLANT KEY, which is shown on the label on the left side of the product, must be entered in the appropriate box.



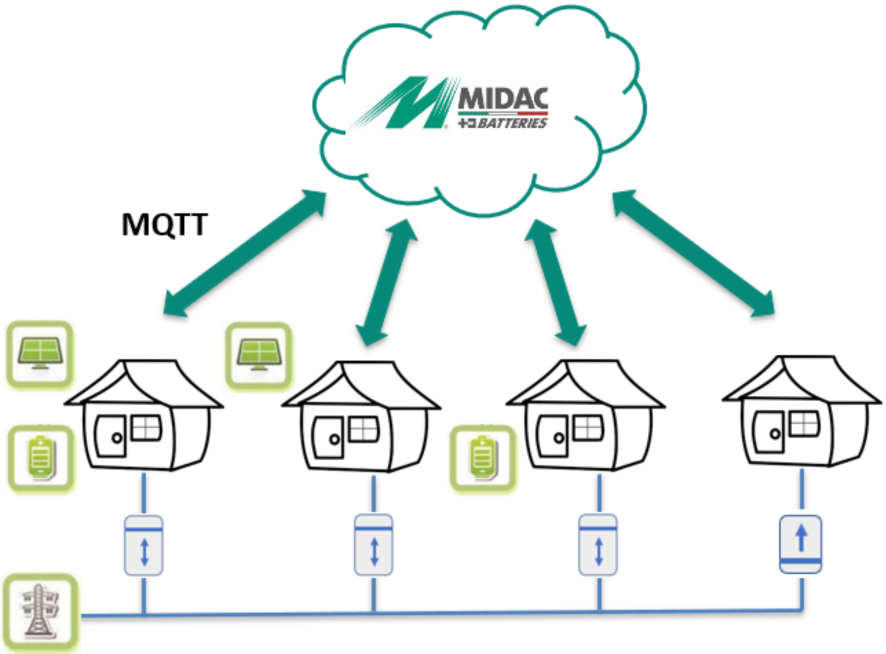
In order to monitor a system, the installer must first register the system, after logging in, there will be a list of your systems, available in map, grid and list version:



In addition, from this screen you can access your account settings and some portal preferences. In the settings section you can activate notifications.
By clicking on a system, you can access the dashboard where three different sections are available:

1. **Realtime**: real-time monitoring of system settings;
2. **Energy**: energy statistics and log;
3. **Advanced**: graphs that represent the operation of your system in detail.

After connection to internet of remote device, systems can be controlled from MIDAC web services:



And Cloud-To-Cloud integration is realized with REACT Platform:

3.2.2.2 Heat Pump systems

Due to the hot summer conditions in San Pietro, many of the public and residential buildings have a requirement for air conditioning. The majority of heat pumps installed at the San Pietro demo site are air-to-air (ATA) heat pumps that provide space heating or cooling by directly treating the air in the space. ATA heat pumps can be useful for enhancing self-consumption of electricity generated from local PV, due to the time-alignment of diurnal cooling demand and solar irradiance profiles. This alignment can be further enhanced through the use of electrical battery storage. ATA heat pumps include smaller "mono-split" and "multi-split" room air conditioners in the residential buildings and larger variable refrigerant flow (VRF) systems for public buildings (specifically, the Library, Hotel Paola and Bed & Breakfast).

Air to water heat (ATW) pumps are deployed for buildings with significant domestic hot water demands, which includes 8 residential buildings (second wave of deployment) and the Sports Centre (first wave), The key contribution provided by ATW heat pumps for demand response is thermal storage for electrical load shifting using the domestic hot water (DHW) cylinder. Residential systems are specified with 200 L DHW cylinders as standard, while the Sports Centre heat pump will be integrated with a 1500 L DHW storage tank (See CAHV diagram in Figure 31). Assuming typical temperatures for DHW storage of 50-60 ˚C, this provides an approximate total thermal storage capacity of ~150 kWh.

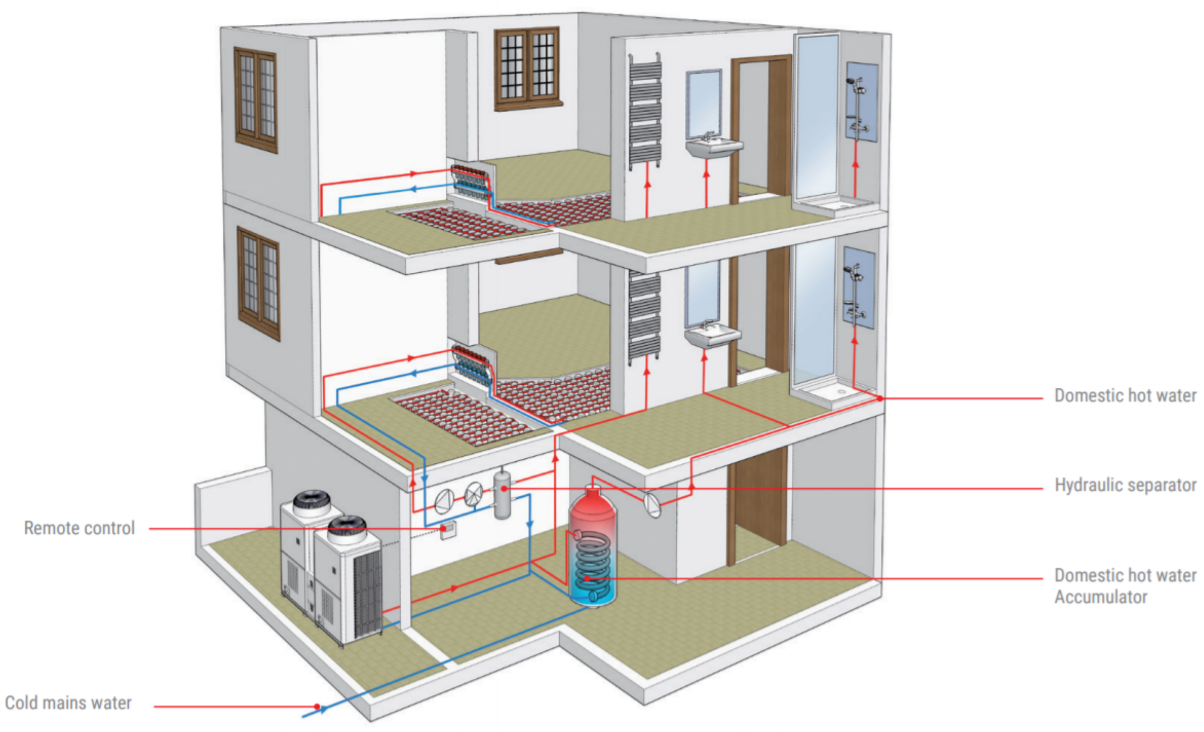


Figure 31: Mitsubishi Electric CAHV Hot Water Heat Pump (For illustration only) [Source, Mitsubishi Electric Italy]

Heat pump systems deployed in the Hotel Paola and Bed & Breakfast will make use of recovered heat from air-conditioned spaces to heat water for domestic use, by way of a hot water generation module integrated into the central VRF system. The PWFY-P100VM[7] hot water generation module uses a separate smaller heat pump circuit to upgrade the temperature of rejected heat from the cooled spaces, which is used to heat water in a DHW cylinder via a separate heat exchanger. Further details of ATA and ATW heat pump system components installed the public buildings are included in Appendix I.

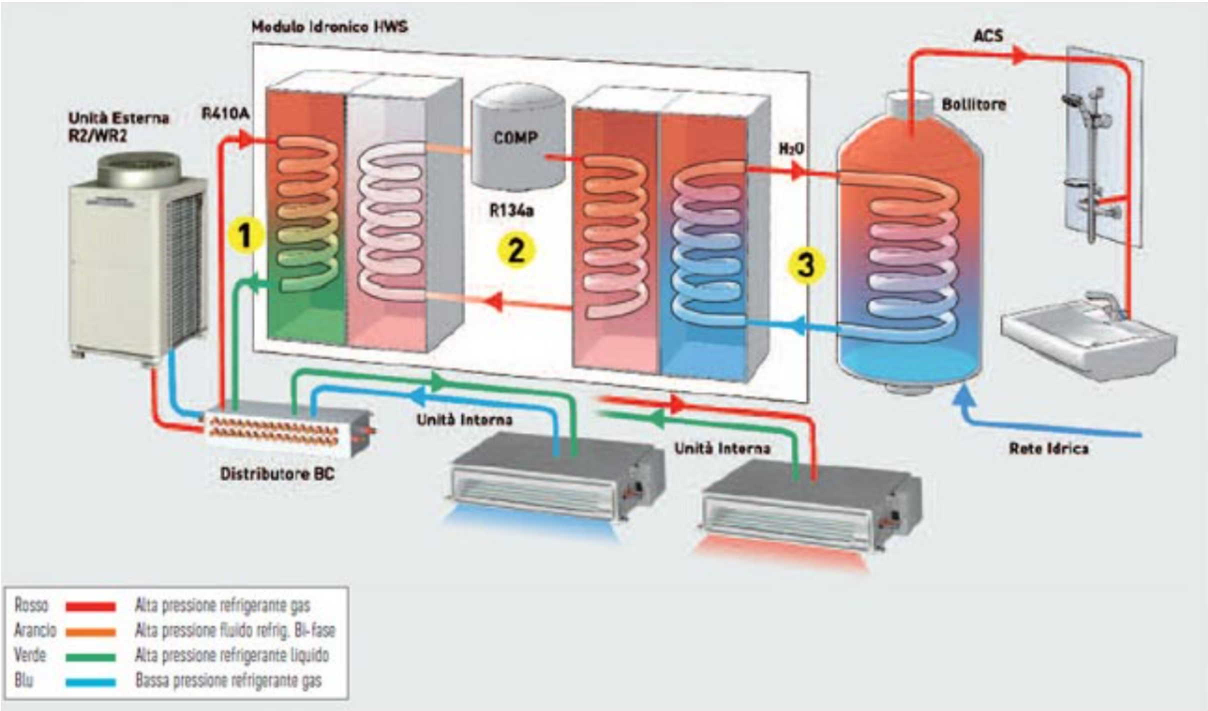


Figure 32: Mitsubishi Electric VRF system with Hot Water Heat Recovery (for illustration purpose only) [Source: Climastore.it]

All residential heat pump systems will communicate with the REACT platform via the MELCloud API. Each of the indoor units will be fitted with MELCloud Wi-Fi adapters to allow connection to the internet via a local wireless router (this also includes indoor units on the VRF systems in the library, hotel and Bed & Breakfast buildings). For public building HVAC systems, including the VRF system outdoor units and the Sports Centre DHW heat pump, the Mitsubishi Electric Remote Monitoring Interface (RMI) system will

[7] https://library.mitsubishielectric.co.uk/pdf/book/PWFY-P100VM-E-U_Product_Information_Sheet#page-1-2

also be used to collect detailed performance data during the baseline data collection period.

To be able to feed information on load and peak profiles of the buildings directly to the REACT platform, all buildings will be provided with a smart energy hub from NesosNET. The smart energy hubs have been installed in 7 public buildings in June 2019 and they have been deployed in 13 additional buildings during the batteries installation. An additional smart energy hub will also be installed in the 1MWp PV plant present on the island (NASCA), to be able to include it into the VPP and provide the production load profile that will be matched with the energy demand from the buildings.

Figure 33 NASCA PV Plant of 1MWp

The San Pietro pilot currently includes 30 buildings: 6 public buildings and 24 private dwellings (condominium, hotel, B&B and single homes). These buildings were clustered into four different use cases:

Use cases	Buildings	#
Monophasic domestic	Home, 9, 10, 13, 32, 34, 35, 36, 37, 38, 39,40, 47, 48, 49,	17

	50, 51, 52	
Monophasic multi-users	B&B Borgo Santa Barbara (Home 41, 42, 43, 44, 45, 46)	7 (2 groups)
Triphasic public	4 Kindergarten 1 Police station 2 Secondary school 5 Sport facility Exhibition Centre (Ex Macello)	5
Triphasic commercial	Hotel	1

Table 16 San Pietro table of participants

Based on the REACT technology that is at each site and what is already available, buildings have three different technology configurations:

Technology configurations	**Buildings**	**#**
PV + Battery + HP (New systems, Mitsubishi-Electric) + Smart meter	Sport facility Hotel Home 9, 13, 33, 34, 38, 48	8 buildings (1 public + 7 private)
PV + Battery + HP (Existing systems, not Mitsubishi-Electric) + Smart meter	Kindergarten Police station Exhibition Centre Home 10, 32, 35, 36, 37, 39, 40, 47, 49, 50, 51, 52 Residence Borgo Santa Barbara (41, 42, 43, 44, 45, 46)	21 buildings (3 public + 18 private)
PV + Battery + Smart meter	Secondary school	1 public building

Table 17 San Pietro technology configuration

3.2.3 ARAN ISLANDS

3.2.3.1 PV and Energy Storage Systems

In the Aran Islands, the REACT proposal has mentioned the existence of on-site Hybrid power generation, PV/solar thermal arrays and community-owned wind turbines.

In the description of action (DoA) of the REACT project, High-capacity battery system of 200kWh would be deployed by AES (Al-C 20 x 10KWh) and a small-scale pilot unit of power-to-gas (P2G) system, delivered by Eletrochaea GmbH (ELE).

After a technical survey on the island, it has been acknowledged a lack of CO_2 source for the methanation process, an inability to have an automatized operational prototype (both at lab scale and on-site), and a lack of gas grid, storage capacity and demand. For this reason, as the proposed alternatives did not accomplished with the aims of the REACT project, the consortium opted to introduce a Power-to-Hydrogen (P2H) storage technology delivered by CTS.

Due to the lack of the Aluminium Carbon batteries, the REACT consortium conducted research on a battery energy storage system (BESS) to implement innovative storage technologies. In this way, three different storage technologies will be deployed, which are Iron Phosphate (LPF), Sodium Nickel Chloride (NaNiCl2) and Hydrogen (H2).

For the private dwellings, the same Victron system referred in the 3.2.1 will be deployed, it used same configuration.

For the 5 community buildings, SMA systems will be deployed with energy storage that will allow short-term grid support as part of explicit DR. These include:

- emergency load shedding (temporary turning off heat pumps),
- emergency load boost (temporary turning on heat pumps),
- power factor corrections using storage controllers,
- voltage-based setpoint active/reactive power control,
- frequency-based active power control.

3.2.3.2 Data acquisition and communication with the REACT platform

Regarding the SMA system the data acquisition, for the communication with the REACT platform and for the control and monitoring of each installation, a small computer (Raspberry PI) has been deployed to allow the communication with the REACT platform and the SMA Data manager device that provides monitoring, and operates as the communication centre of the installation. These control and monitoring devices are enclosed in the same cabinet mentioned in the Section 3.2.1.5

Regarding the SMA Data Manager, unlike the Victron system, the components of the system such as battery inverter, solar chargers, batteries and the energy meters are not connected directly to it. All the devices of the installation are connected at the same local network with the Data Manager, each of them with assigned same range IP direction to allow communication between them.

Figure 34 The SMA Data Manager

The SMA Energy meter is connected to building main distribution board, between the grid and the Installation, this is connected to the local network and sends data to the Data Manager.

Figure 35 SMA Energy Meter

For the control and monitoring of the active and reactive energy of the installation and provide grid support services, a grid analyser Janitza UMG 604-Pro was deployed.

Figure 36 Grid analyser Janitza UMG 604-Pro

The SMA PV system works in AC coupling mode. In three-phase buildings, a SMA Tripower PV inverter was deployed, which is connected in parallel to the grid. The solar energy flows directly to the grid feeding the loads.

To charge and discharge the batteries, a SMA Sunny Island battery inverter was deployed. One Sunny Island for single-phase and three Sunny Islands for the three-phase systems.

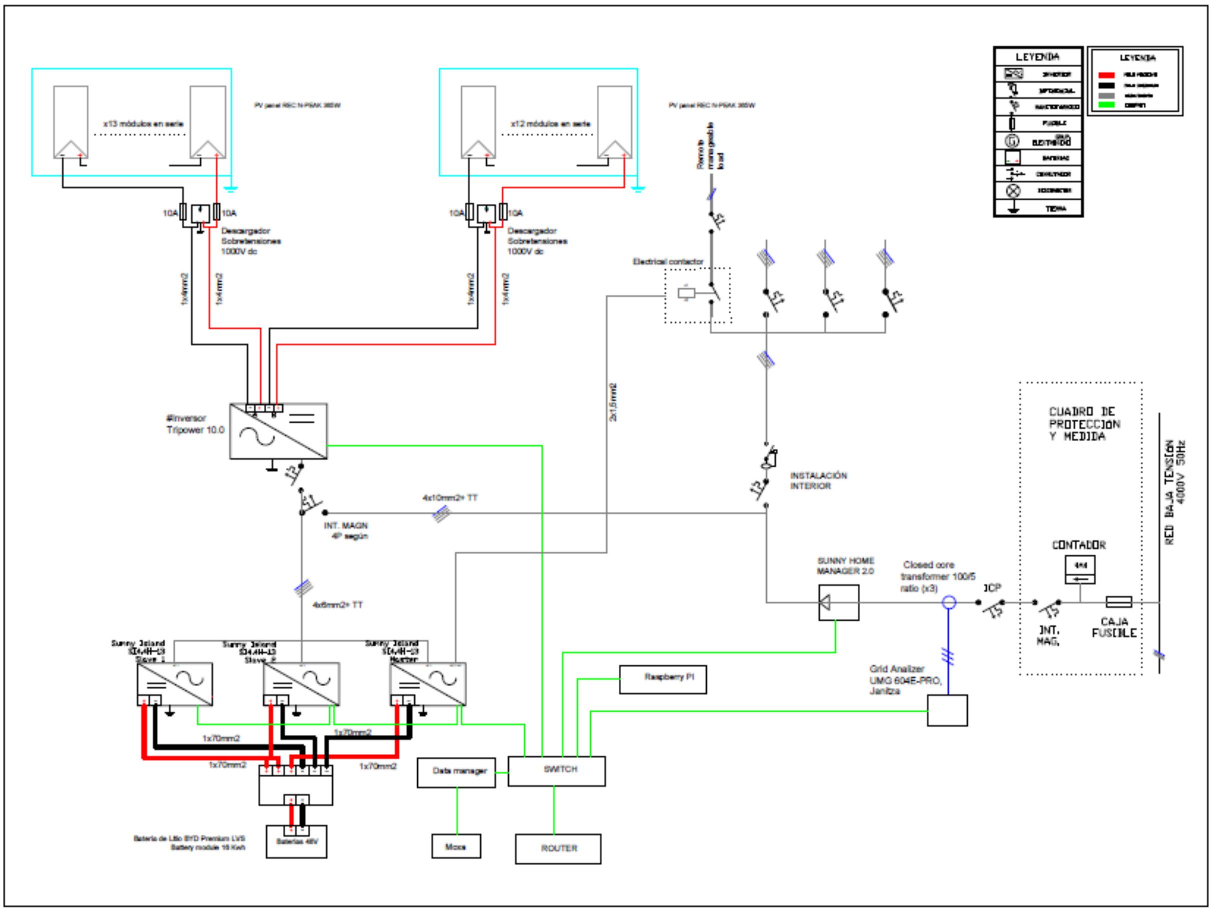


Figure 37 Victron three-phase electrical diagram

3.2.3.3 SMA system Configuration

All the SMA products are equipped as standard with an integrated webserver, which provides a user interface for configuring and monitoring the product. By tapping twice on the equipment, a Wi-Fi access point is activated and is used to connect the equipment to an end device (e.g., computer or tablet PC). Once stablished this connection opens the web browser of the end device and enters the standard IP address 192.168.12.3 in the address line of the web browser, which starts the installation assistant.

SMA Sunny Island Battery Inverter

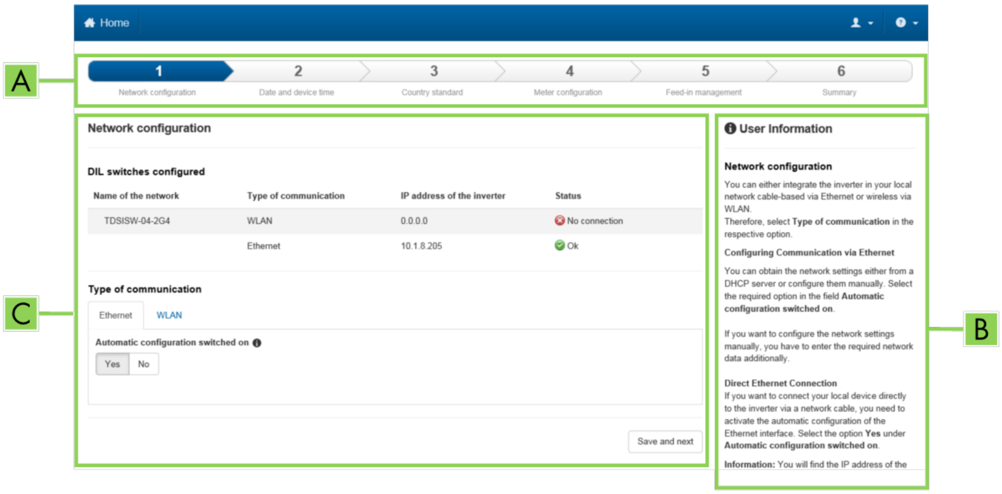


Figure 38 Layout of the installation assistant

Select the **Configuration with Installation Assistant** and follow the installation steps and make the settings appropriate to the system.

The Energy meter will be automatically detected and added to the PV system

The country data set must be set correctly.

Select and set country data so it cannot cause a disturbance in the PV system and lead to problems with the grid operator. When selecting the country data set, you must always observe the locally applicable standards and directives as well as the properties of the PV system (e.g., PV system size, grid-connection point).

Charge Battery Configuration

Set the parameter Maximum charging current to the maximum battery charging current recommended by the battery manufacturer.

Set the parameters for boost charge.

- Set the parameter Battery boost charge time to the boost charge absorption time recommended by the battery manufacturer.
- Set the parameter Cell charge nominal voltage for boost charge to the cell voltage setpoint recommended by the battery manufacturer for boost charge.

Set the parameters for full charge.

- Set the parameter Battery full charge time to the full charge absorption time recommended by the battery manufacturer.

- Set the parameter Cycle time full charge to the full charge cycle time recommended by the battery manufacturer.
- Set the parameter Cell charge nominal voltage for full charging to the cell voltage setpoint recommended by the battery manufacturer for full charge.

Set the parameters for equalization charge.

- Set the parameter Battery equalization charge time to the equalization charge absorption time recommended by the battery manufacturer.
- Set the parameter Cycle time equalization charge to the equalization charge cycle time recommended by the battery manufacturer.
- Set the parameter Cell charge nominal voltage for equalization charge to the cell voltage setpoint recommended by the battery manufacturer for equalization charge.

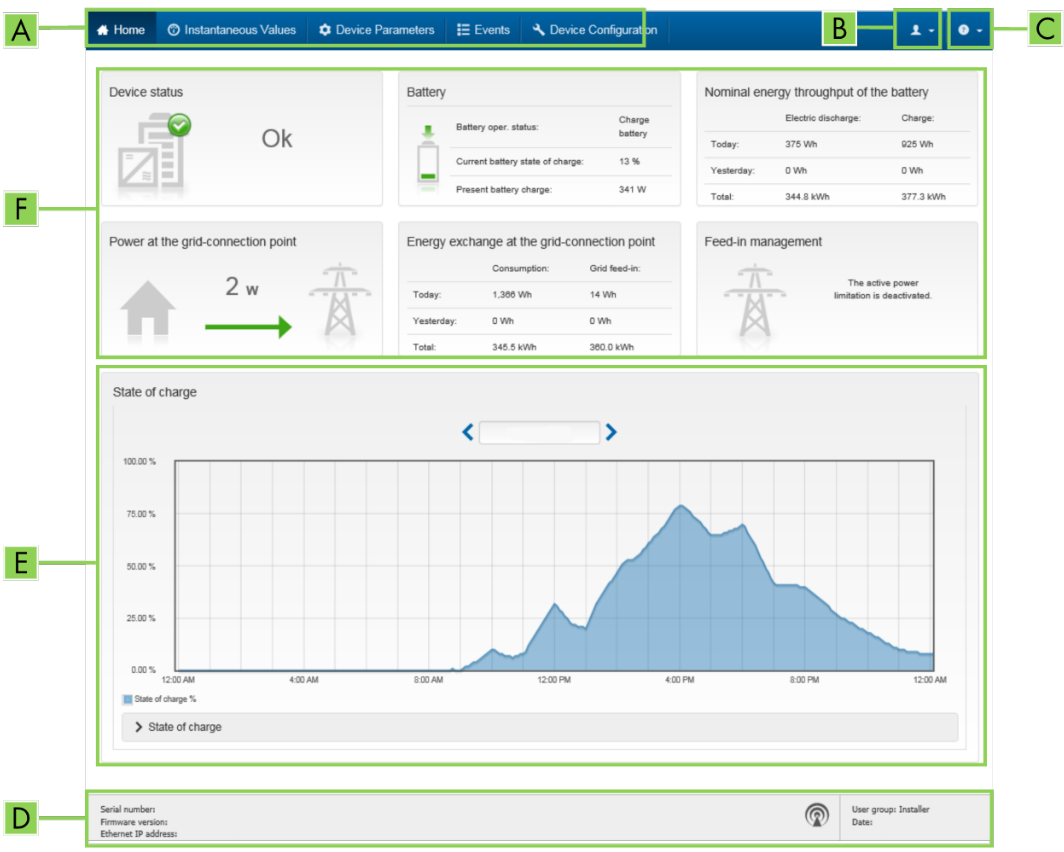


Figure 39 Start Page Design of the User Interface

Data Manager configuration

Once you have connected the product to the local network, the user interface login page opens.

- All devices in the local network must be in operation and connected to the product via an Internet router.
- There must be an active Internet connection.
- A Network Time protocol (NTP) server must be available in the local network or via the Internet. If there is no NTP server available, the time set in the web browser can be used as system time

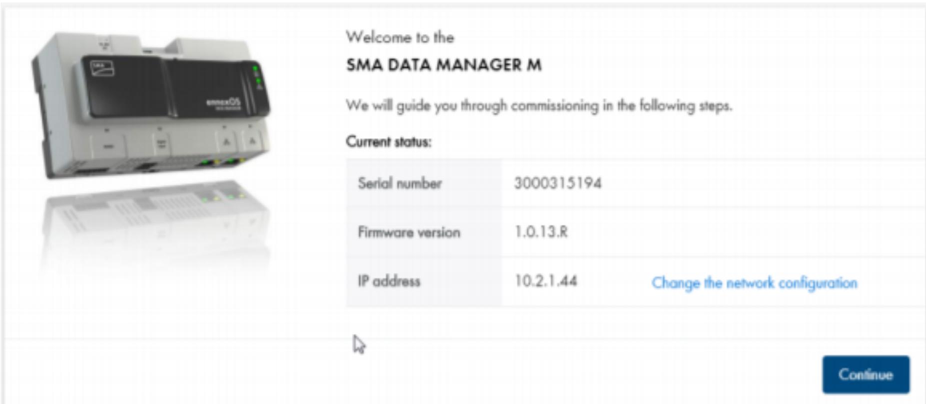
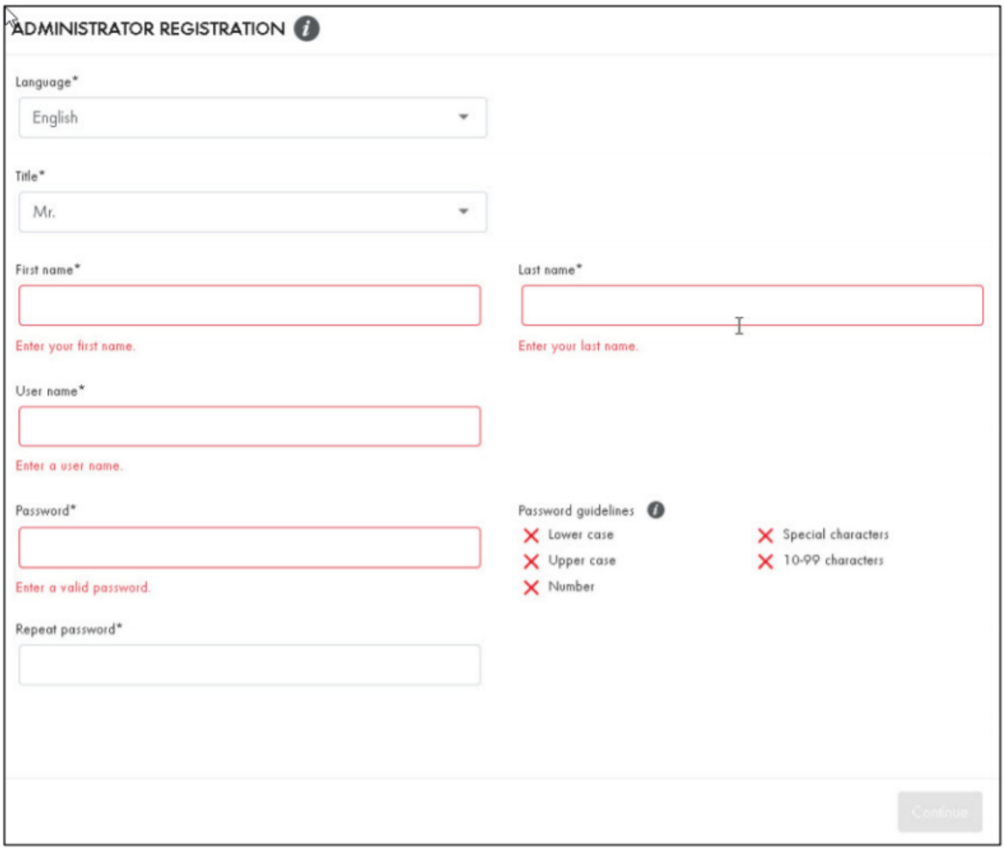
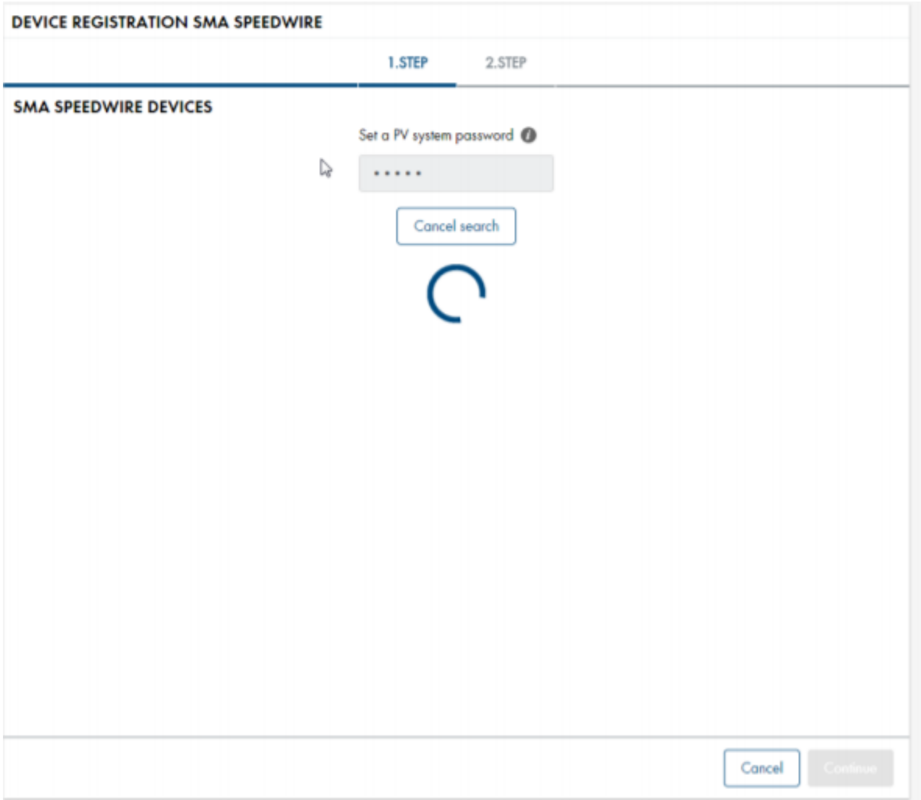


Figure 40 Password for the system



The **Administrator Registration** page. All fields marked with an asterisk are required to configure the Administrator account and password that will be used to access the User Interface (UI) of the Data Manager



The following screen is the "**Device Registration**" page, here select the communication protocol and add Speedwire, Modbus and SMA FLX/TLX devices. Those are selected when applicable.

- The system password becomes the "Installer" password for all devices that will be associated to the EDMM.
- If a password has already been entered into each of the SMA Speedwire devices connected to the network, enter that password. The password must be the same in all devices that you intend to connect to this EDMM for simplicity.
- Click on "Search devices" to start the detection.
- Once devices have been detected, select all the devices that will be associated to this Data Manager.

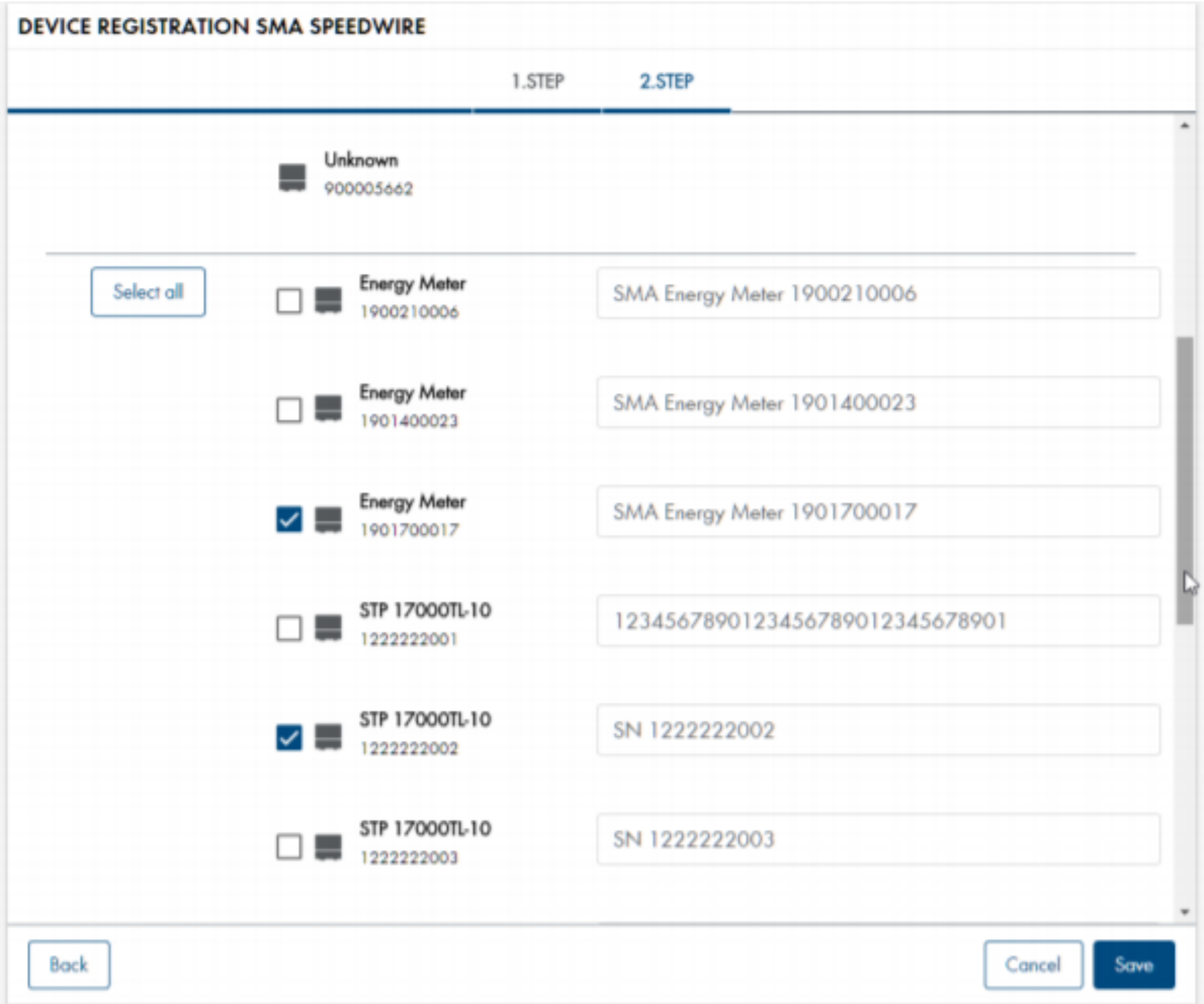


Figure 41 The data Manager detects all SMA devices connected to the same LAN

The next screen is for configuring the “National Standard” (grid type) of the inverters

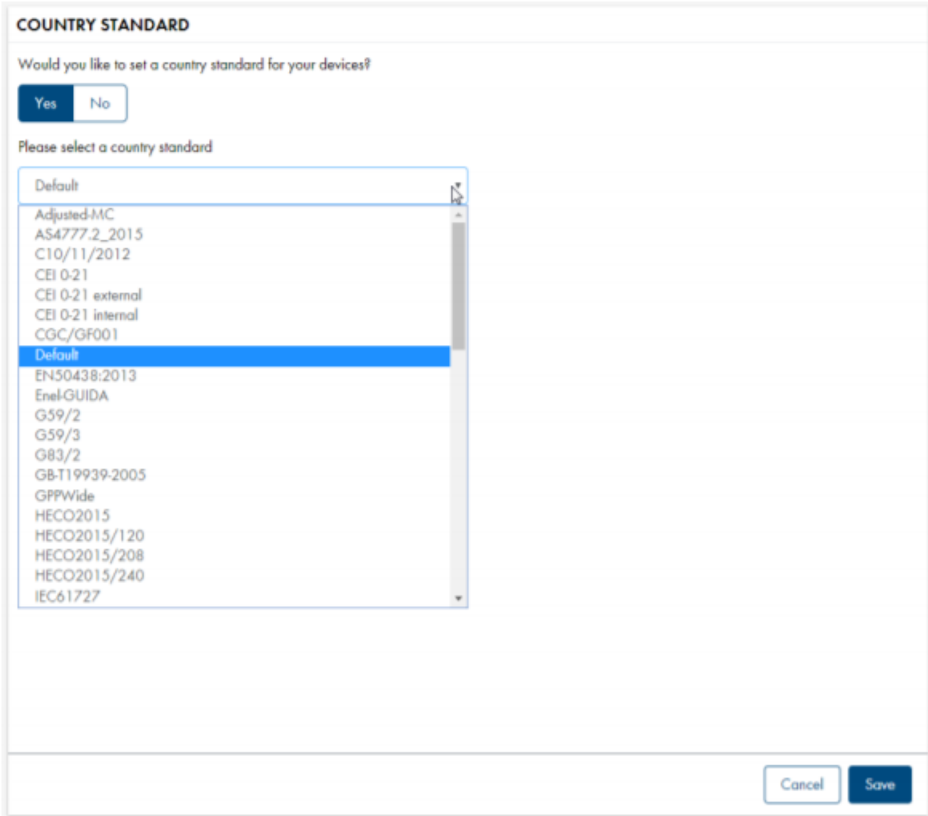


Figure 42 Select country grid code

The next screen is the “**Meter at the grid feed-in point**” page, which displays energy meter details.

The next page is “**External Communication**.” Here you can enable Modbus for the EDMM to communicate with other third- party data loggers that would poll data from the plant. You can also specify the modbus port to be used. Port 502 is the default port that is typically used.

The following screen is “**Type of control**” for configuring setpoints of any external device that will control **Active Power or Reactive Power**.

- **Active Power control**. With the Data Manager, you can implement grid operator specifications for the limitation of the active power feed-in from 0% to 100%. The setpoint for limitation of active power feed-in is specified in percentage. The total system power is taken as the reference value. If the grid operator requires the system not to feed in any active power, it must limit the active power feed-in to a fixed value of 0% and additionally adjust the pre-set value for the active power gradient. Thus, it is possible to limit the active power feed-in to 0% within a few seconds. To compensate for load step changes and to establish a safety distance to the active power limitation, a negative value can be set. This achieves a timely limitation of the active power feed-in. The value for the limitation of the active power feed-in should be adjusted to the load step changes accordingly.

- **Reactive Power control**. With the data manager, is possible to implement reactive power as a function of grid voltage (Q(V)) into the system.

3.2.3.4 Power to Hydrogen (P2H)

The REACT project's Consortium, led by VEO, has conducted exhaustive research on P2H technologies in recent months, contacting several companies that provide different P2H systems and solutions: some of them providing only parts of the overall hydrogen conversion system (mainly electrolyser and/or fuel cell) and some of them offering stand-alone and/or plug-and-play systems.

After reviewing all different proposals from many P2H system manufacturers and/or providers, it was deemed that the CTS H2 product "H2 Home" aligns with the aims and objectives of the REACT project, being able to take over the role of ELE's originally envisaged P2G small-scale unit.

Based on the technology and components' selection, the concrete sizing and specification of the systems to be deployed will be adapted to maintain, as close as possible, the system design originally proposed in the deployment plan. The P2H system is meant to be deployed at the Community Development Offices (CDO) building.

Technical information from that building was collected so that both CTS and the REACT Consortium can perform an optimal design and sizing of the system, coupling it with the envisaged PV system deployment and considering the different criteria that have been mentioned in aforementioned sections. An inside-the-building system proposal has been provided by CTS, as well as another one considering placing all related equipment in a dedicated container.

- Hydrogen generator (electrolyser): 2 x AES providing 1 Nm^3/h at 35 bar with STD power supply of 100 – 240 V_{AC} with 4,8 kW of nominal power consumption (6 kW_p)
- Hydrogen storage tank: 700 L (24,5 Nm^3 of H_2 at 35 bar, approximately 31 kWh)
- Fuel cell unit: 2 x module providing 5kW output power (43,2 – 57,6 V and 0 – 94 A @54V), 24 V of input voltage and external temperature between 5 and 45 °C
- AC/DC inverter: 4,8 kW output power supply at 25 °C (10 kVA peak) with STD power output of 230 V_{AC} ± 2%, 50 or 60 Hz ± 0,1%

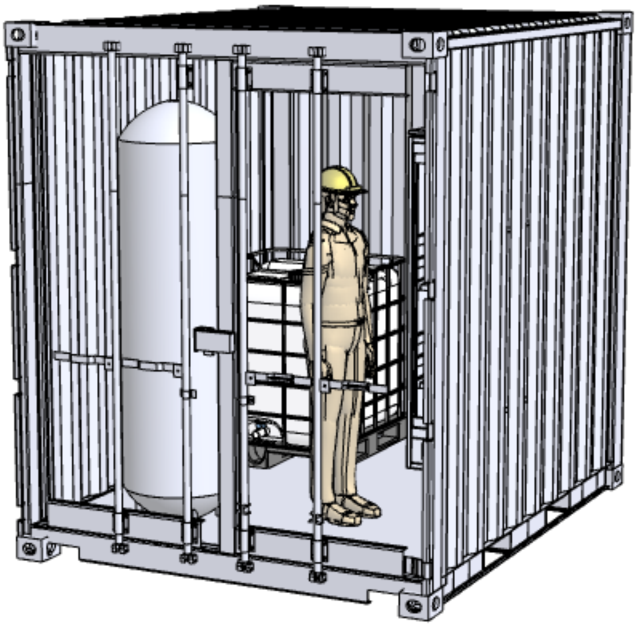


Figure 43 Assembly Container to be deployed on the Community Office

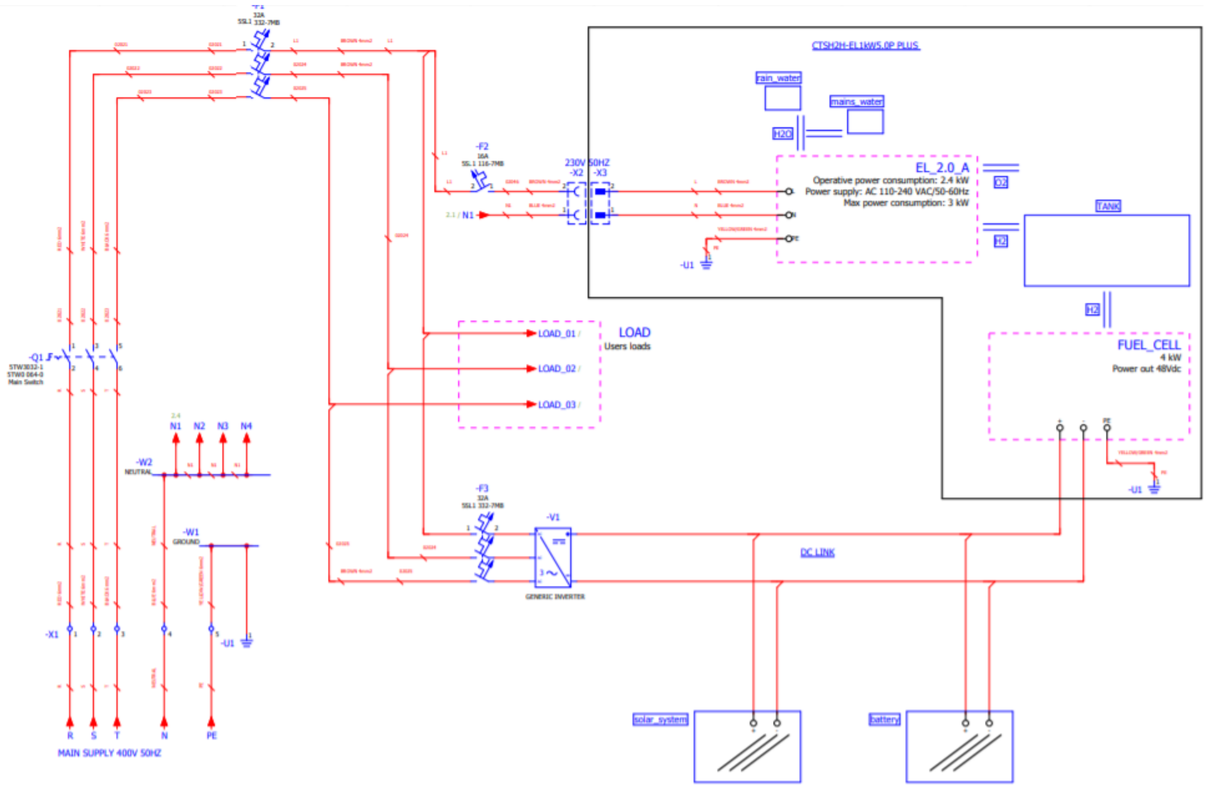


Figure 44 General Schematic of H2 Home PLUS system

3.2.3.5 Electrical vehicle Charger (V2G)

An innovative bi-directional electric charger was developed for homes. It uses unique power electronics and high frequency switching technology to optimize the energy relationship between vehicle, power grid, home energy generation and storage. It allows to charge and discharge the vehicle acting as a storage unit.

The EV Charger (Wallbox, s.f.) will be installed in building AI6 one of the community buildings.

General Specifications

Model	DC Charger
Connector type	CCS or CHAdeMO[1]
Dimensions	350x350x150mm (1P)[2]
Operating temperature	-25ºC to 40ºC
Storage temperature	-40ºC to 70ºC
CE Mark	IEC61851-1 - IEC61851-23

Electrical Specifications

Maximum Power	7,4 kW (1P)[1]
AC Voltage	230V AC ± 10% / 115V AC ± 10%[1,3]
DC Voltage Range	150V - 600V[1]
Maximum current	32 A, 3x6 mm² cable
	Charging current configurable from 6 A to 32 A
Rated frequency	50 Hz / 60 Hz
Protection rating	IP54 / IK08
Surge category	CAT III

Figure 45 Wallbox V2G Charger

	REACT reference	Total PV Panels	Power Peak (kWp)	Battery capacity (kWh)	Battery Technology	Material
Three-Phase	AI2	34	11,05	18	H2	●Raspberry PI ●SMA Data Manager EDMM-10 ●SMA Tripower 10.0 PV inverter ●Hydrogen energy storage
	AI4	20	6,5	16	Lithium Iron Phosphate (LFP)	●Raspberry PI ●SMA Data Manager EDMM-10 ●SMA Tripower 10.0 PV inverter ●3x Sunny Island 4.4
	AI6	34	11,05	16	Lithium Iron Phosphate (LFP)	●Raspberry PI ●SMA Data Manager EDMM-10 ●SMA Tripower 10.0 PV inverter ●3x Sunny Island 4.4 ●V2G Charger
	AI7	25	9	16	Lithium Iron Phosphate (LFP)	●Raspberry PI ●SMA Data Manager EDMM-10 ●SMA Tripower 10.0 PV inverter ●3x Sunny Island
	AI8	25	9	16	Lithium Iron Phosphate (LFP)	●Raspberry PI ●SMA Data Manager EDMM-10 ●SMA Tripower 10.0 PV inverter ●3x Sunny Island
Sigle-Phase	AI1	20	6,5	16	Lithium Iron Phosphate (LFP)	●Raspberry PI ●SMA Data Manager EDMM-10 ●SMA Tripower 6.0 PV inverter ●1x Sunny Island
	AI9	6	2,16	6	Sodium Nickel Chloride (NaNiCl2)	●Raspberry PI ●1x Unit of Salidomo ECO (Victron Solar Charger BlueSolar MPPT 250/85 Victron Inverter Multiplus 48/3000/35-32 GX)
	AI10	6	2,16	6		
	AI11	6	2,16	6		
	AI12	6	2,16	6		
	AI13	6	2,16	6	Lithium Iron Phosphate (LFP)	●Raspberry PI ●Victron Solar Charger BlueSolar MPPT 150/35 ●Victron Inverter Multiplus 48/3000/35-32 II ●Gateway Victron Cerbo GX ●Victron Touch GX Display
	AI14	6	2,16	6		
	AI15	6	2,16	6		
	AI16	6	2,16	6		
	AI17	6	2,16	6		
	AI18	6	2,16	6		
	AI19	6	2,16	6		
	AI20	6	2,16	6		
	AI21	6	2,16	6		

Table 18 Table of participants and technology configuration

3.2.3.6 Heat Pump systems

Residential buildings at the Aran Islands pilot site have a substantial requirement for winter-time heating, and air-to-water (ATW) heat pumps that have previously been installed as replacements for oil-fired central-heating boilers. Five residential dwellings have existing Mitsubishi Electric ATW heat pumps that will be integrated with the REACT platform by retrofitting MELCloud Wi-Fi adapters for internet communication via the local Wi-Fi network. This will allow the REACT platform to remotely monitor heat pump operation and provide basic control of temperature set points and heating schedules (see REACT Deliverable 1.4 for further details). Where possible, the Mitusbishi Electric Metering and Monitoring Service Pack (MMSP)[8] will also be fitted to allow further detailed data on heat pump energy use to be exported to the REACT platform via MELCloud.

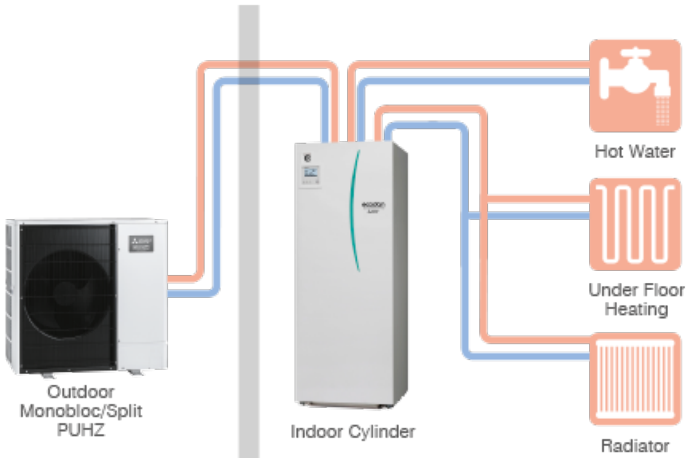


Figure 46: Typical Ecodan ATW Residential Installation (Underfloor Heating / Radiators shown as space heating option)

[8] https://library.mitsubishielectric.co.uk/pdf/book/Ecodan_MMSP_Application_Guide#page-1

Figure 47: MELcloud adapter for Wireless control, and integration to REACT platform

New ATW heat pump systems are deployed in two of the community buildings on Inis Mór: The Community Development Offices building and the Naíolann Árann Childcare Facility building. These buildings are of similar size and age, and as such, have similar design heating loads. The solution implemented for both buildings is a cascade system of 2x 12 kW Zubadan ATW heat pumps providing space heating and domestic hot water Figure 48. Both solutions have been developed to maximise thermal storage capacity for electrical load shifting. For the Community Development Office, this includes the installation of a new 200 L domestic hot water cylinder and a central heating circuit consisting of new radiators and a 300 L fluid buffer tank. For the Childcare facility, the new heat pump is interfaced with an existing 310 L DHW cylinder, buffer tank and underfloor heating system (see photographs below). Both new systems will be fitted as standard with MELCloud Wi-Fi adapter devices and include the latest FTC6 control system to allow minute-resolution energy data to be exported to the REACT platform via the MELCloud API. The full list of Mitsubishi Electric heat pump system components for both community buildings is listed in Appendix II.

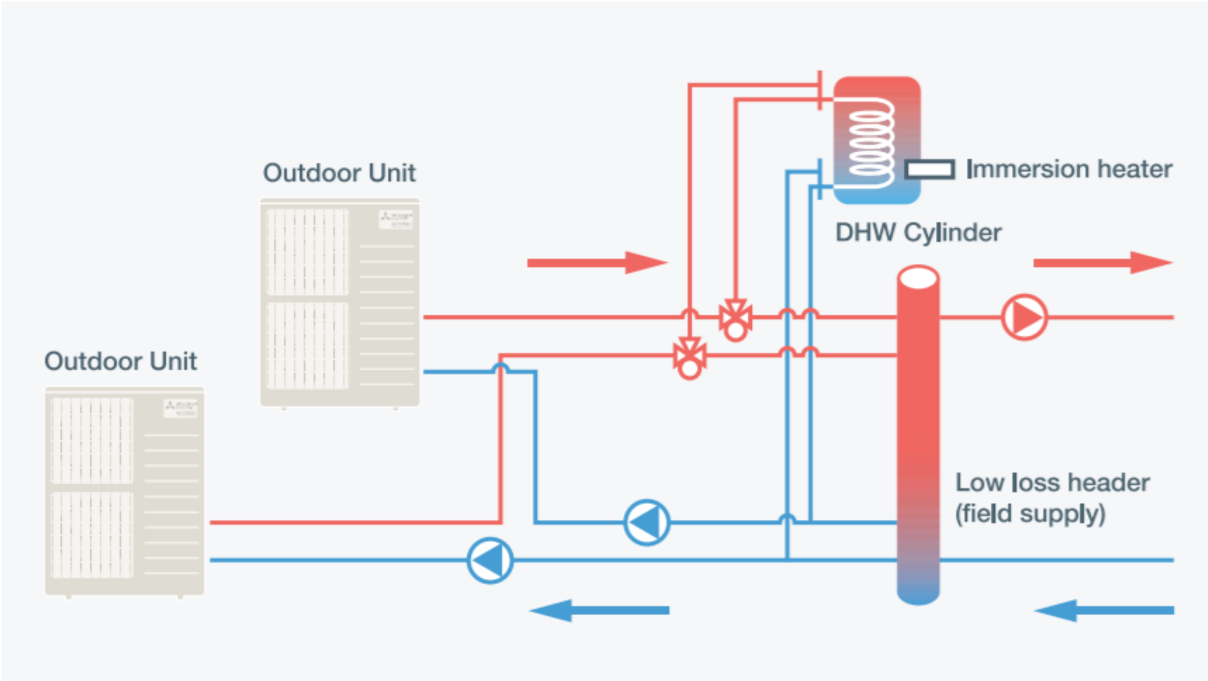


Figure 48: Typical ATW 'Cascade' installation

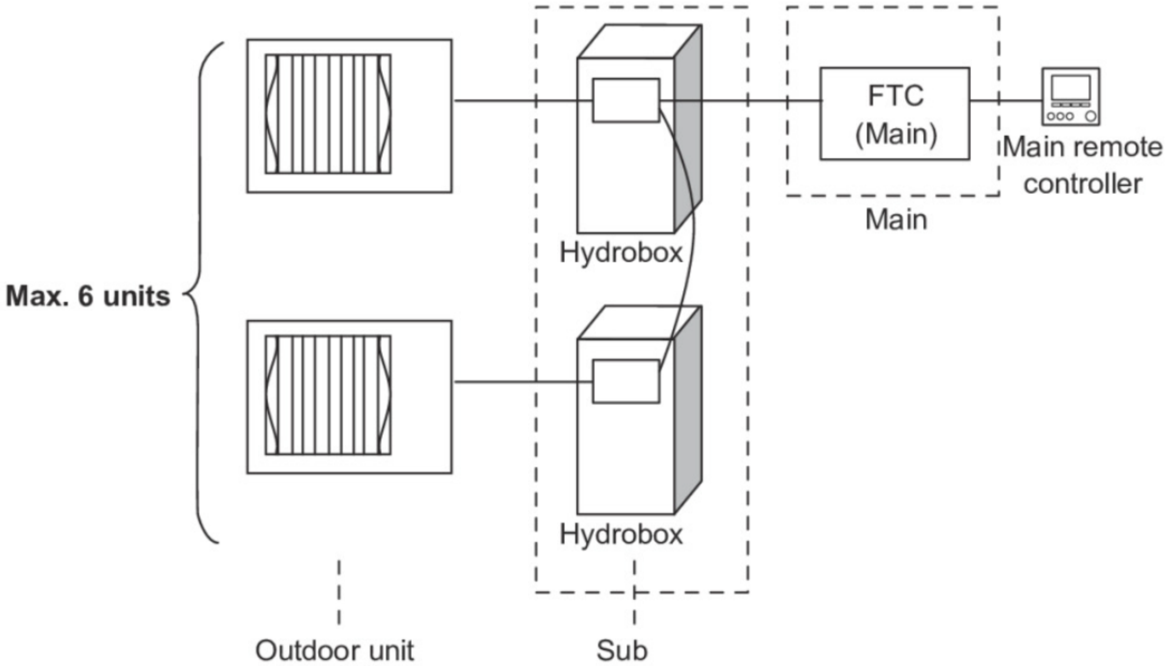
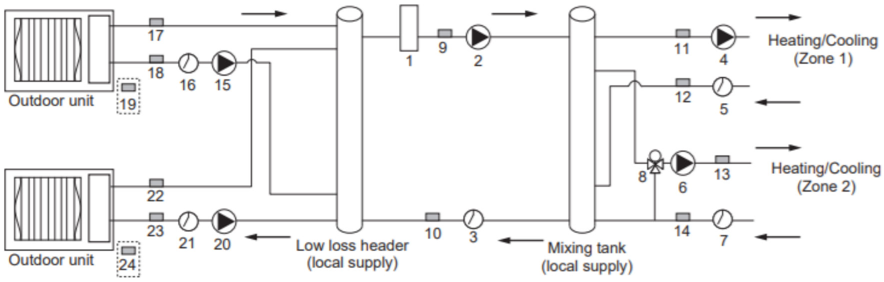


Figure 49: Cascade configuration for Ecodan Outdoor units and Hydroboxes

System 3: 2-zone temperature control
• Install a mixing tank (local supply) for 2-zone temperature control.
• Install a low loss header (local supply).
• Install booster heater toward the local system, relative to the low loss header.
• For details on 2-zone installation, refer to '2-zone temperature control' in "3.5 Local system".



<Fig. 9.2.5>

No.	Component	Wiring Main	Wiring Sub 1	Wiring Sub 2
1	Booster heater (local supply)	✓		
2	Circulation pump1 (local supply)	✓		
3	Flow switch1 (local supply) *2	✓		
4	Circulation pump2 (local supply)	✓		
5	Flow switch2 (local supply) *2	✓		
6	Circulation pump3 (local supply)	✓		
7	Flow switch3 (local supply) *2	✓		
8	Motorized mixing valve (local supply)	✓		
9	Flow temp. thermistor (THW1)	✓		
10	Return temp. thermistor (THW2)	✓		
11	Zone1 flow temp. thermistor (THW6) (option)	✓		
12	Zone1 return temp. thermistor (THW7) (option)	✓		

No.	Component	Wiring Main	Wiring Sub 1	Wiring Sub 2
13	Zone2 flow temp. thermistor (THW8) (option)	✓		
14	Zone2 return temp. thermistor (THW9) (option)	✓		
15	Sub1 circulation pump1 (local supply)		✓	
16	Sub1 flow switch (local supply) *2		✓	
17	Sub1 flow temp. thermistor (THW1)		✓	
18	Sub1 return temp. thermistor (THW2)		✓	
19	Sub1 ref. liquid temp. thermistor (TH2) *1		✓	
20	Sub2 circulation pump1 (local supply)			✓
21	Sub2 flow switch (local supply) *2			✓
22	Sub2 flow temp. thermistor (THW1)			✓
23	Sub2 return temp. thermistor (THW2)			✓
24	Sub2 ref. liquid temp. thermistor (TH2) *1			✓

*1 When the outdoor unit is split type, TH2 needs to be installed. <Fig. 9.2.1>

*Figure 50: Wiring and component configuration with mixing (buffer) tank**

Figure 51 Naíolann Árann Childcare Facility plant room. Left: existing buffer storage tank (300 L approx.), and right: existing 310 L DHW cylinder with internal heat exchanger coils.

3.3 Technical and Legalization process

3.3.1 LA GRACIOSA

The whole process for the legalization of the installations in La Graciosa was carefully presented in section 3.4 “Regulatory Framework” of Deliverable 1.1. The main points described were the different possibilities, requirements and motivation in renewable energy installations and self-consumption installations, with and without surplus, shared or not. Moreover, the main lines that affect these kinds of installations, as presented in the Spanish Technical Building Code for new and existing dwellings (“CTE” or “Código Técnico de la Edificación”) were summarized, as well as the current legislation regarding flexibility and energy communities. For detailed information about any of these points, please refer to Deliverable 1.1.

Hereafter, a brief summary about the restrictions and requirements encountered when legalizing the installations is presented.

In the first place, two cases when legalizing the installations can be differentiated:

- Installations that can be legalized with a prior reporting to the Council. In such a report, the characteristics of the installations are described, including the equipment to be deployed, the technicians’ data, the overall budget, etc. Legally, 15 days after submitting this report, and if no requirements are made by the Council, the installations can be started.
- Installations that need a building permit/license (public buildings and the ones located in DPMT, i.e., very close to the sea). To apply for the license, a project signed by an engineer is needed, which consists of a complete document of more than 100 pages and includes a plan for work risks and waste treatment, among other things.

In both cases, it is necessary to pay the license fees and present the property records of the land and the owner's permission to carry out the construction. In addition, the execution is subject to construction laws (quite complex).

Initially, it was believed, due to information gathered from the Council, that all installations would need a building permit. Thus, engineering projects were developed for all of them.

The requirements all installations need to fulfil, according to Canary Laws (some of them particular for the protected Chinijo Archipelago, in which La Graciosa is located), are:

- The dwellings and plots should fulfil the following (if they do not, the installations cannot be developed, or subject to additional authorizations):
    - Maximum total height of the dwelling, including the solar panels, limited to 6,30m.

  - Minimum characteristics of the plot: area of 150m², front of 7.50m
  - Characteristics of the dwelling:
    - Minimum front of 5m,
    - Maximum length of 20m,
    - Maximum occupancy (m² built/ m² of the plot) of 1.70 m²/ m² (a 100% on the ground floor, and a 30% on the second floor). No third floors are allowed.
    - Minimum living space of 50 m²
- Maximum area of PV installation limited to the 10% of the roof (this restriction limited the design in many cases, and caused the drop out of a few participants)
- Request for a permit from the Lanzarote's Council for environmental impact
- Request for a permit from the Canary Islands' Vice-Ministry of Territorial Planning and Ecological Transition, who must check that the constructions are in accordance with the urban planning
- In the areas affected by the demarcation of the DPMT assets (those located very close to the coastline), a prior authorization is required from the Canary Islands' Vice-Ministry of Territorial Planning and Ecological Transition

All in all, the legalization process was very complex, and many problems were encountered. The installations needed to be adapted multiple times, as a law-change did also happen during the process. The Vice-Ministry and Council took up to a year to answer the requests in many cases, though many letters were sent and even phone calls were made.

By July 2021, we had 14 legalized installations, and still do not have the authorization for carrying out the installations in the dwellings that require building licenses, nor for the monitoring of the two dwellings that already have PV panels.

3.3.2 SAN PIETRO

San Pietro island has to comply with several specific strict urban and landscape regulations as it is a nature reserve.

In Italy, whenever a building undergoes work involving construction or intervention on the envelope-plant system that affects the consumption of the building, an energy technical report called "Ex Legge 10/91" that disclose that all requirements are verified, has to be filed (all. 1 art. 5.3.2 DM 26/06/2015 "minimum requirements"). The "Ex Legge 10" can be drawn up only after building an energy model of the building that is also needed to determine the thermal loads of the heat pumps to satisfy the building's energy demand. For the installation or substitution of heat pumps, air conditioner or air with power (or sums of power) greater than 12 kW, which is the case for most of San Pietro's dwellings, the "Ex Legge 10" is mandatory.

Moreover, the installation of heat pumps in the city centre of Carloforte (main city on San Pietro Island) have to follow specific constraints listed in the urban and landscape plan "Piano Particolareggiato del Centro Storico" and a module containing the technical specification and executive details of the system has to be reported and filed with the municipality. The need for this authorisation will need to be evaluated on a case-by-case basis for the selected buildings; only 6 dwellings among the 30 selected for the pilot are located in the city centre. The authorization's process can last up to 60 days maximum for installation of heat pumps from scratch and up to 30 days for substitution of heat pumps.

For batteries there is no necessary permission required prior to installation. However, the installation scheme has to be shared with "Enel Distribuzione", the DSO as part of the request to connect to the grid during the testing phase. According to Italian regulations, the installation of batteries in residences equipped with a PV system (e.g., the buildings included in the pilot site) requires an amendment to the connection request to ENEL (Ente Nazionale Energia Elettrica) drawn up when the PV system was connected to the national grid. The modification consists of a technical addendum with the technical specifications of the installed storage battery and the attached inverter. In addition, Enel also requires a modification of the plant data on Terna (Transmission System Operator) portal, in the section called "Gestione Anagrafica Unica degli Impianti", with the addition of the technical features of the storage material installed. Finally, an official declaration on storage installations must be sent to GSE (Gestore Servizi Energetici). The connection requests for the batteries already installed is currently in progress, together with the modification on Terna portal and will continue as the installation proceeds.

3.3.3 ARAN ISLAND

As stated in deliverable D1.1, there are planning exceptions and restrictions for small scale renewable technologies in Ireland. The "Housing, Planning and Local Government" in the public document "Planning and Development Act 2000" states the restrictions and procedures that should be followed in the planning of small-scale RES technologies installations. In case that the installation characteristics are covered under the conditions of exemptions, it is advised to obtain a written declaration from the local authority assuring the exemption condition.

Within REACT, the exemptions that apply are the following:

Equipment/energy asset	Description of restriction/procedure

Heat pump in a light industrial or business setting (Exemptions apply to ground source or air source heat pumps)	The level of the ground must not be altered by more than 1m above or below the level of the adjoining ground. The total area of any air source HP must not exceed 10 sq. m. An air source heat pump must be a minimum of 50cm from the edge of the wall or roof on which it is mounted. Noise levels at the nearest party boundary must not exceed 43 dB (A). No structure must be placed to the front of a building.
Heat pump in a domestic setting (Exemptions apply to ground source or air source heat pumps)	The level of the ground must not be altered by more than 1m above or below the level of the adjoining ground. The total area of any air source HP or combination of two heat pumps must not exceed 2.5 sq. m. The heat pump must be a minimum of 50cm from the edge of the wall or roof on which it is mounted. Noise levels at the nearest party boundary must not exceed 43 db(A). No structure must be placed to the front of a building.
Solar Thermal or PV panel in a domestic setting	Total panel area must not exceed 12 sq. m or 50% of the total roof area including existing panels. The distance between the plane of the wall or pitched roof and the panel must not be more than 15cm. The distance between the plane of a flat roof and the panel must not exceed 50cm. The panel must be a minimum of 50cm from the edge of the wall or roof on which it is mounted. A free-standing array's height must not exceed 2m above ground level. The erection of a free-standing array must not reduce the area of private space to the rear or side of the house to less than 25 sq. m.
Solar Thermal within a light industrial or business setting	Cannot be erected on a wall. Total panel area must not exceed 50 sq. m or 50% of the total roof area including existing panels. The distance between the plane of the pitched roof and the panel must not exceed 50cm in a light industrial building and 15cm in a business premises.

	The distance between the plane of a flat roof and a panel must not exceed 2m in a light industrial setting and 1m in a business premises. The panel must be a minimum of 50cm from the edge of the roof on which it is mounted or 2m on a flat roof. Any associated equipment or storage must be within the roof space of the building. A free-standing array's height must not exceed 2m above ground level. The total aperture area of a free-standing array must not exceed 25 sq. m. No advertising can be placed on the panel and a free-standing panel must not be placed to the front of the premises.
PV within a light industrial or business setting	Total panel area must not exceed 50 sq. m or 50% of the total roof area including existing panels. The distance between the plane of the wall and the panel must not exceed 15cm. The distance between the plane of a pitched roof and the panel must not exceed 50cm in the case of a light industrial building and 15cm in a business setting. The distance between the plane of a flat roof and the panel must not exceed 2m in the case of a light industrial building and 1m in the case of a business premises. The panel must be a minimum of 50cm from the edge of the roof or pitched roof on which it is mounted or 2m on a flat roof. Any associated equipment or storage must be within the roof space of the building. A free-standing array's height must not exceed 2m above ground level. The total aperture area of a free-standing array must not exceed 25 sq. m. No advertising can be placed on the panel and a free-standing panel must not be placed to the front of the premises.

Table 19 - Restrictions and procedures related to the deployment of RES technologies.

The revised Renewable Energy Directive (REDII), as part of the EU Clean Energy Package, now provides the right for citizens and communities to produce, store, consume (including self-consuming) and sell renewable energy. Energy communities now also have the right to share energy. For this to be effective, EU Member States need to ensure that grid operators cooperate with energy communities.

The new REDII states that home production of renewable electricity can be sold with some charges applied, but these network charges should only reflect the cost of injecting electricity to the grid. Community energy advocates have argued that charges and fees should not apply for electricity that is self-produced and consumed at home. The REDII endorses that principle.

The new EU rules required that governments ensure that from 2021, renewable self-consumers receive a fair payment for the electricity they sell into the grid. This payment must correspond to at least the market value of that electricity.

These new EU rules must be adopted by each EU Member State. Each state must develop enabling frameworks including support for self-consumption and payments for injecting renewable energy to the grid. They must also develop and submit National Energy & Climate Plans to the European Commission by the end of 2019, and adopt these rules/plans into national policy and law by 2021[9].

Ireland has made a lot of progress in this area, with the Commission for the Regulation of Utilities (CRU) developing a Roadmap for Ireland in relation to the EU Clean Energy Package and Renewable Directives, which details Ireland's current regulatory framework and plans for workstreams required to meet the requirements of the recast RED. This was launched in March 2020. This roadmap[10]. The CRU also then published 2 calls for evidence, relating to Active Consumers and Energy Communities. These documents[11] were published in August 2020 to seek industry feedback on the current thinking in regards to the implementation of regulatory frameworks in Ireland on active consumers and energy communities as required by the EU legislation under the Clean Energy Package.

A Microgeneration Support Scheme Bill 2017 is currently at committee stage (not approved yet) within the Irish Parliament, to provide for the growth of electricity

[9] Ireland's National Energy & Climate Plan 2021-2030 can be found here https://www.gov.ie/en/publication/0015c-irelands-national-energy-climate-plan-2021-2030/

[10] https://www.cru.ie/document_group/roadmap-to-clean-energy-package-implementation/

[11] https://www.cru.ie/document_group/energy-communities-and-active-consumers/

production from micro-generators through a supplier obligation to provide a tariff for electricity exported to the grid.

Electricity suppliers having above 10% market share have to provide a payment for kWh of electricity exported to the grid from domestic micro-generators. A minimum price-tariff will be applied across all suppliers from micro-generators.

Micro-generation includes small scale wind power, PV, CHP using renewable sources, small scale hydroelectric, and combined renewable Micro Generator and storage systems.

According to the information published by ESB Network, micro-generators operate in parallel with the DSO low voltage system and their connection is rated up to:

- 25 amperes (6kW) at low voltage [230 volts] when the connection is single phase
- 16 amperes(11kW) at low voltage [230/400 volts] when the connection is three phases

The CRU has, as of May 2020, published a Microgeneration Information Paper[12], which provides an outline of the relevant legislation and areas of work being progressed by the CRU in order to support microgeneration in Ireland.

The Irish Government has, also in 2020, set up a Microgeneration Working Group to progress activity in line with the REDII and Ireland's Climate Action Plan requirements.

3.4 MATERIAL INSTALLATION AND COMMISSIONING

3.4.1 LA GRACIOSA

In order to select the installation technicians for the material deployment and commissioning in La Graciosa, a tender for its execution was developed. A circular was sent to all AIELPA associated companies (180 in total), on November 5th, 2020. There was a part of the tender allocated for companies in Fuerteventura, another one for companies of Lanzarote, and another for companies of Gran Canarias.

Five responses were received in total. Four of them were from companies of Lanzarote and one from a company of Fuerteventura. There were none from companies of Gran Canarias.

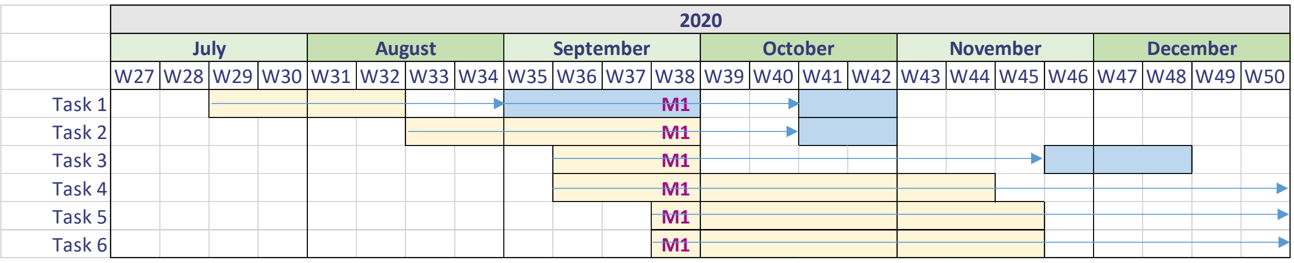
[12] https://www.cru.ie/wp-content/uploads/2020/05/CRU20059-Microgeneration-Information-Paper.pdf

Of the four technicians from Lanzarote, one of them exceeded the reference budget and was, therefore, automatically discarded (the entrepreneur was notified to give him the option to change it, but he did not modify it or send a new budget). The company INSTALACIONES ELECTRICAS ROLUZ, SL was the one that obtained the highest evaluation and was given the package of installations for companies located in Lanzarote.

The part of the tender reserved for companies from Fuerteventura was allocated easily and directly, as only one company from this island responded with an offer. The company is JOSE MANUEL PEREZ ZARZA.

The execution of the installations allocated for the companies of Gran Canarias, given that there were no offers from companies of this island, was decided to be given to the second classified company of the island of Lanzarote: INSTALACIONES ELECTRICAS CONEJERAS, SL (INELCON).

The company ACUÑA TECNICOS ELECTRICOS, S.L.U., the third classified one from Lanzarote remained as a reserve in the event that some of the aforementioned companies cancelled their contracts.



Similarly, but with regard to the civil works, after evaluating the different estimated offers given by several construction companies, the company ACUÑA TECNICOS ELECTRICOS, S.L.U. was awarded the contract.

Having explained the tenders' process, the legal and installation phase for the projects is hereafter summarized. This necessary process to deploy the solution in La Graciosa, can be better understood with a Gantt Chart see Figure 52.

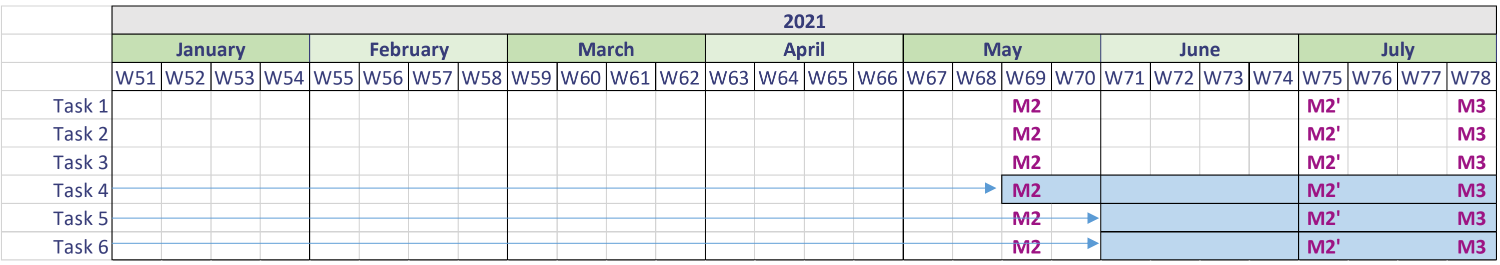


Figure 52. Legal Process and Installation Gantt Chart

As it can be seen, some of the tasks had to be delayed with reference to what was initially planned (blue boxes vs. yellow boxes), due to legal complications, and COVID-19 circumstances that prevented the visits to the island and caused discomfort among participants.

The main tasks developed are the ones drafted in the Gantt Chart, and explained hereafter:

- **Task 1**: Collection of building information in order to start the engineering projects, and making a tender for local installers to perform the installations
- **Task 2**: Finding the local installers to which present the tender and choosing the best offers
- **Task 3**: First smart meters installation and DATADIS platform registrations (to allow data collection before PV installation)
- **Task 4**: PV systems, storage and remaining Smart meters installation
- **Task 5**: System commissioning
- **Task 6:** REACT Platform communication commissioning

On other side, the main Milestones set, as they can be seen in the Gantt Chart are:

- **MILESTONE 1**: Travel to La Graciosa, organization of a meeting with participants and collection of buildings' information.
- **MILESTONE 2**: Approval of the legal process. It is split in two phases (M2 + M2'), depending on the legal approval of the installations. Building permits are not considered in this Milestone, as there is not enough information regarding time scopes.
- **MILESTONE 3**: All systems fully installed (again, the ones for which building permits are needed not considered).

3.4.1.1 Installation overview

Actual State of the Installations	
Installation finished	LG 4
	LG11
	LG13
	LG15
	LG16
	LG17
	LG18
	LG19
	LG24
	LG27
	LG30
	LG41
Installation to be finished on the second week of August	LG1
	LG2.1
	LG2.2
	LG3
	LG25
	LG35
	LG44
	LG45

Table 20 Installation actual state

Figure 53 installations in buildings with scenario type 1

Figure 54 installations in buildings with scenario type 2

Figure 55 installations in buildings with scenario type 3

Figure 56 installations in buildings with scenario type 4

Figure 57 installations in buildings with scenario type T1

3.4.2 SAN PIETRO

Following a planning phase and different site visits by both MIDAC and Mitsubishi Electric Italia, which helped define the systems to be installed in the demo buildings, installation in San Pietro started in June 2021.

Buildings were divided into two different waves of installation:

Wave	id	Type	Sub-Type	PV [kWp]	Battery [kWh]	HP system description
1st WAVE	1	04_Public	Kindergarten	19.32	16.80	existing system, not M.E.*
	2	01_Public	Police station	19.90	16.80	2x VRF PUHY-P400YSNW.
	3	02_Public	Secondary school	19.32	16.80	-
	4	05_Public	Sport facility	19.90	16.80	3x MUZ Mono-split + CAHV ATW
	5	08_Public	Exhibition Centre	11.66	16.80	existing system, not M.E
	6	04_Hotel	Hotel	19.80	16.80	design phase
	7	09_Home	Single house	3.00	8.40	2 x MXZ Multi-split 1 x Ecodan Idrotank 170L
	8	13_Home	Single house	3.00	4.20	1x PUMY-SP112
	9	33_Home	Single house	6.00	4.20	
	10	35_Home	Single house	6.00	4.20	existing system, not M.E
	11	36_Home	Single house	4.50	4.20	existing system, not M.E
	12	37_Home	Single house	3.00	4.20	existing system, not M.E
	13	38_Home	Single house	4.50	4.20	1 x MUZ Mono-split
	14	39_Home	Single house	4.50	4.20	no heating/cooling system
2nd WAVE	15	10_Home	Single house	1.00	4.20	existing system, not M.E
	16	32_Home	Single house	4.50	4.20	existing system, not M.E design phase
	17	34_Home	Single house	4.50	4.20	2x MXZ Multi Split
	18	40_Home	Single house	4.50	4.20	existing system, not M.E
	19	41_Home	Residence	1.50	4.20	existing system, not M.E
	20	42_Home	Residence	1.50	4.20	existing system, not M.E
	21	43_Home	Residence	1.50	4.20	existing system, not M.E
	22	44_Home	Residence	1.50	4.20	existing system, not M.E
	23	45_Home	Residence	1.50	4.20	existing system, not M.E
	24	46_Home	Residence	1.50	4.20	existing system, not M.E
	25	47_Home	Single house	5.00	4.20	existing system, not M.E
	26	48_Home	Single house	4.6	4.20	
	27	49_Home	Single house	6.00	4.20	existing system, not M.E
	28	50_Home	Single house	4.90	4.20	existing system, not M.E
	29	51_Home	Single house	-	4.2	existing system, not M.E

	30	52_Home	Single house	6.00	4.20	existing system, not M.E
		07_Public	Library	19.90	16.80	1x VRF PUHY-P400YNW
		23_Home	Single house	4.50	4.20	1x MXZ Multi-split 1x Ecodan ATW
		16_Home	Condominium	4.50	12.60	1x MXZ Multi-Split 1x MUZ Mono Split
		17_Home	Condominium			1x MUZ Mono Split
		18a_Home	Condominium			2x MXZ Multi-Split
		18b_Home	Condominium		4.20	1x MXZ Multi Split

At the time of writing, MIDAC successfully completed the installation of batteries on the 13 sites included in wave 1. Batteries on the remaining sites will be installed between July and the end of September 2021.

Building	**Storage size installed**
01_Public	16.80 kWh
02_Public	16.80 kWh
05_Public	16.80 kWh
08_Public	16.80 kWh
04_Hotel	16.80 kWh
09_Home	8.40 kWh
13_Home	4.20 kWh
33_Home	8.40 kWh
35_Home	4.20 kW
36_Home	4.20 kWh

37_Home	4.20 kWh
38_Home	4.20 kWh
39_Home	4.20 kWh

Figure 58 San Pietro completed installation

Figure 59: 09_Home battery installed

Figure 60: 33_Home battery installed

Figure 61: 04_Hotel battery installed

Figure 62: 38_Home battery installed

3.4.2.1 MIDAC Battery commissioning

At the time of writing MIDAC put into service 13 sites and the commissioning activities took place in parallel with the installation phase. The table below summarizes the commissioned phases that took place during the first wave of the battery deployment;

a plant key is dedicated for each site and it is the key to how the battery shares data with the REACT cloud. The kind of grid connection is reported in the below table, a single-phase connection is indicated with “M”, with “T” indicating a Three-phase connection.

N.	Rif.	Grid	Battery Capacity	Plant KEY	Photo	Final Check
1	**09_Home**	M	8,4kWh	**0002618C245BC6A6**		ok
2	**01_Public**	T	16,8kWh	**000269F98EED3916**		ok
3	**38_Home**	M	4,2kWh	**000256C3768BD3FE**		ok
4	**33_Home**	M	8,4kWh	**00023910A44195ED**		ok

5	**08_Public**	M	16,8kWh	**000262F667E57CFE**		ok
6	**05_Public**	T	16,8kWh	**00027194C533C6DD**		ok
7	**36_Home**	M	4,2kWh	**000252528CC8A65A**		ok
8	**02_Public**	T	16,8kWh	**000276AAE6A44C94**		ok

9	**39_Home**	M	4,2kWh	**000260B717A55279**		ok
10	**35_Home**	M	4,2kWh	**000265E235D8D25C**		ok
11	**04_Hotel**	T	16,8kWh	**000278b9765acf6e**		ok
12	**37_Home**	M	4,2kwh	**000253853547EBAA**		Rem.

13	**13_Home**	M	4,2kwh			Rem.

Table 21 Images of the completed installations

Following the site visit by Mitsubishi Electric Italia and the installers in June 2021, the first wave of HP installation will begin in July 2021. The systems identified are summarized in the following table:

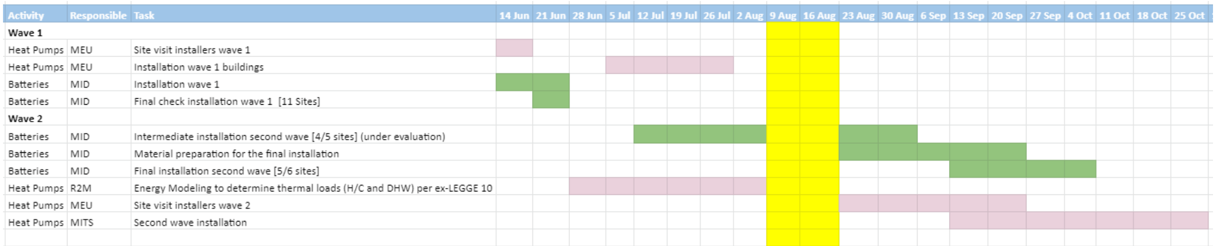
Building	**Air to air (Split system)**	**Air to air (VRF)**	**Air to water**
Home9	4xMUZ Multi Split		
Home13	2xMXZ Multi Split		
Home23	1xMXZ Multi Split 1xMUZ Mono Split		
Home33		PUHZ-SW200YKA	Hydrobox
Home34	1xMXZ Multi Split		
Home38	1xMUZ Mono Split		
Home48	2xMUZ Mono Split		
Condominium 16/17/18a/18b	1xMXZ Multi Split 1xMUZ Mono Split		
Hotel	1x MXZ Multi-split	1x PURY-P300YNW. 1x PURY-P250YNW 1x PUMY-SP112YKMR2	
Library		PUHY-P400YNW	
Sport Facility	3xMXZ Multi Split		CAHV

Table 22 San Pietro HP participants configuration

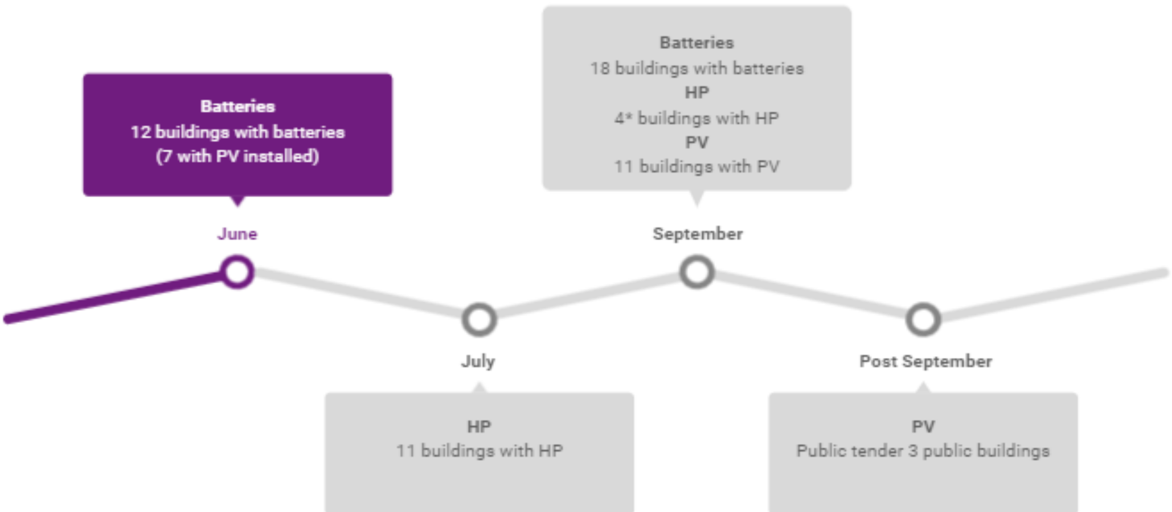
3.4.2.2 Commissioning of heat pump systems

Commissioning of heat pump systems will be performed on site directly following installation as indicated in the Gantt chart below. Commissioning procedures are to be followed according to the Mitsubishi Electric product documentation for all systems and components listed in Appendix I[13].

At the end of the installation of the first wave, the Italian cluster decided to change the approach for Wave 2 in order to simplify the installation process. Rather than focus all the installation on a limited amount of time (e.g., two weeks), the installation will be scheduled ad hoc based on owners/installers/systems availability. The following Gantt summarises the period of times when the final installations (wave 2) will take place.



The following installation timelines provide an overview of when the different technologies will be installed.



[13] For further product documentation including installation and service manuals for all models, refer to the Mitsubishi Electric Document Library: https://library.mitsubishielectric.co.uk/home

It should be noted that the project did not foresee the installation of PV on the island of San Pietro. However, the installation of batteries for managing the load without PV is not possible nor financially viable, hence the cluster prioritised buildings which already had PV installed. For the private buildings where PV is currently not available, the installation will take place in September, utilising funds external to the project, whilst for the three public buildings with no PV, the Municipality is organising tenders and the installation should be completed by the end of 2021.

3.4.3 ARAN ISLAND

3.4.3.1 Installation of PV on Inis Mór

Installation of the materials was in two phases. Phase 1 related to 4 community buildings which were chosen based on a scoring chart. Because Inis Mór is designated a special area of conservation, we had to apply for planning permission to the local authority to place PV panels on the roof of these buildings.

Scaffold access was required at all four locations and this was erected on the 5th of May 2021. Installation of the panels commenced on the 24th May 2021 and was completed for the 31st May 2021. At the time of writing, commissioning of 3 buildings was complete. The commissioning of the secondary school was delayed due to the Leaving Certificate Exams, which was a request of the school principal, as the school did not want to risk any interruption to the electrical system when commissioning the PV and battery system.

Figure 63 Installation at school and at Community Hall

Figure 64 : Installation at the Community Offices

	REACT reference	Total PV Panels	Power Peak (kWp)	Battery capacity (kWh)	Battery Technology	Installation state
Three-Phase	AI2	34	11,05	18	H2	Installation finished waiting for the commissioning and H2 storage
	AI3	20	6,5	16	Lithium Iron Phosphate (LFP)	Installation finished waiting for the commissioning
	AI4	34	11,05	16	Lithium Iron Phosphate (LFP)	
Single-phase	AI1	20	6,5	16	Lithium Iron Phosphate (LFP)	

Table 23 Table Installation finished and waiting for commissioning

Figure 65 Battery installs at Community Hall and at the Community Offices

Phase 2 of the installation is due for completion at the end of July 2021. An additional 15 sites were chosen, on a scoring system, for the installation of PV panels and batteries, as shown in the table below.

	REACT reference	Total PV Panels	Power Peak (kWp)	Battery capacity (kWh)	Battery Technology	Installation State

Three-Phase	AI2	34	11,05	18	H2	PV installation finished H2 storage installation prevision for September
	AI5	25	9	16	Lithium Iron Phosphate (LFP)	Installation prevision to finish on the first week of August
	AI6	25	9	16	Lithium Iron Phosphate (LFP)	
Single-phase	AI7	6	2,16	6	Sodium Nickel Chloride (NaNiCl2)	Installation prevision to finish on the second week of August
	AI8	6	2,16	6		
	AI9	6	2,16	6		
	AI10	6	2,16	6		
	AI11	6	2,16	6	Lithium Iron Phosphate (LFP)	
	AI12	6	2,16	6		
	AI13	6	2,16	6		
	AI14	6	2,16	6		
	AI15	6	2,16	6		
	AI16	6	2,16	6		
	AI17	6	2,16	6		
	AI18	6	2,16	6		
	AI19	6	2,16	6		

Table 24 List of additional participants

3.4.3.2 Commissioning of heat pump systems

Commissioning of heat pump systems will be performed on site directly following installation as indicated in the Gantt chart for Aran Islands deployment. Commissioning procedures are to be followed according to Mitsubishi Electric product documentation for all systems and components listed in Appendix II.

Heat pump system installations for community buildings are expected to commence during August 2021, based on installer availability, while residential installations will be completed in parallel. All Heat pump installation and commissioning works on Inis Mor are expected to be complete by end of August 2021.

3.5 TRAINING STRATEGY

3.5.1 LA GRACIOSA

After several interviews were carried out in La Graciosa, and with the information gathered in the periodical phone calls, a lack of knowledge was detected among the participants, regarding several concepts of the project (i.e., PV panels and the equipment necessary for its correct functioning, energy communities, demand response, etc.).

Several actions have been and are being developed so that users can better interact with their installations.

In the first place, a maintenance manual was developed by Feníe Energía as PCC, in which the necessary actions to be taken by the users to keep their PV installation in good condition are explained. They are very simple guidelines, in Spanish, as it can be seen in Figure 66.


MANUAL DE MANTENIMIENTO DE AUTOCONSUMO FOTOVOLTAICO DOMESTICO

LA GRACIOSA

fenie energía

MANUAL DE MANTENIMIENTO DE AUTOCONSUMO FOTOVOLTAICO DOMESTICO

Este documento trata de recoger las acciones necesarias que debe realizar un usuario para mantener su instalación fotovoltaica en correctas condiciones. Son unas directrices muy simples, resumidas a continuación, que optimizarán su funcionamiento.

PANELES SOLARES

- **Mantenimiento del sistema de paneles solares**

Se debe retirar periódicamente cualquier tipo de objeto, particula o suciedad que pueda afectar a la producción energética de los paneles fotovoltaicos (excrementos de aves, polvo acumulado, etc.).

IMPORTANTE: no se deben emplear métodos que puedan rayar o estropear los paneles (estropajos, productos abrasivos…). Lo más recomendable es, simplemente, un trapo con agua.

- **Inspección visual de posibles degradaciones**

Se controlará, al menos 1 vez al año, que:

- Ninguna célula del panel se encuentre en mal estado (cristal de protección roto, por ejemplo)
- El marco del módulo se encuentre en correctas condiciones, es decir, que no presente deformaciones o roturas.

En caso de observar imperfecciones, contactar con su técnico.

LA GRACIOSA

MANUAL DE MANTENIMIENTO DE AUTOCONSUMO FOTOVOLTAICO DOMESTICO

ESTRUCTURA SOPORTE DE LOS PANELES SOLARES

La estructura que soporta los paneles fotovoltaicos instalados en La Graciosa está fabricada prioritariamente por perfiles de aluminio y acero inoxidable, por lo que no requiere mantenimiento anticorrosivo.

Su adherencia se consigue gracias a elementos pesados (por ejemplo, bloques de hormigón), de una masa especificada, situados sobre sus railes. Con ello se evita taladrar las azoteas, y aguanta vientos de hasta 150km/h.

Su mantenimiento se reduce a comprobar que:

- Los elementos pesados no hayan sido retirados, pues podría desplazarse la estructura.
- No existan degradaciones, como deformaciones o grietas.

LA GRACIOSA

MANUAL DE MANTENIMIENTO DE AUTOCONSUMO FOTOVOLTAICO DOMESTICO

INVERSORES

Los inversores solares transforman la energía producida por los paneles solares en energía útil para el consumo diario.

Están situados en el interior de la vivienda, y su mantenimiento se realiza de forma remota.

Sin embargo, el usuario sí debe comprobar periódicamente que no haya ningún mensaje de error en su pantalla, por si la comunicación con los servidores hubiese fallado.

CONEXIÓN A INTERNET - PLATAFORMA DE DATOS

Es imprescindible una conexión a internet estable durante todo el proyecto, para el envío de los datos de generación y consumo a la plataforma.

Si la instalacion deja de enviar datos durante un tiempo prolongado, nos pondremos en contacto con ustedes para que:

1. Apaguen y vuelvan a encender el router de internet
2. Apaguen y vuelvan a encender el automático (palanca/interruptor diferencial) que controla el dispositivo de monitorización

LA GRACIOSA

Figure 66. La Graciosa Maintenance Manual

Secondly, and in order to address the questions users might have and inform them about the progress of the project and next steps, an informative meeting was organized and held on July 5th 2021. It took place in La Graciosa and was broadcasted online, for those participants and partners that could not attend.

Though it is in Spanish, the meeting agenda is the one shown in Figure 67. The partners involved were Feníe Energía as PCC, Orduña, AIELPA, VEOLIA, Tekniker and COMET, with 12 representatives attending the meeting. 10 participants attended the meeting in the islands, while 6 participants attended it online.

REACT Renewable Energy for Self-Sustainable Island Communities

LA GRACIOSA

REUNIÓN INFORMATIVA PARA PARTICIPANTES

Fecha: lunes 5 de JULIO de 2021, a las 17:30h canarias

Ubicación:

- MODALIDAD PRESENCIAL: Salón Parroquial C/ García Escámez, 21 (Local al lado de la Iglesia de Nuestra Señora del Carmen) – Caleta del Sebo, La Graciosa
- MODALIDAD TELEMÁTICA: Microsoft Teams *[se enviará enlace por email]*

Socios involucrados:

ORDEN DEL DÍA

(Horas conforme a las Islas Canarias)

- 17:30h – 17:40h

Acceso a la reunión, solución de posibles problemas de conexión para los participantes que se conecten en remoto.

[Ver detalles de conexión en la siguiente página]

- 17:40h – 18:00h

[FENÍE ENERGÍA, AIELPA y VEOLIA] Bienvenida. Breve introducción al proyecto y estado actual de las instalaciones del piloto de La Graciosa. Futuros pasos.

- 18:00h – 18:15h

[ORDUÑA y AIELPA] Equipos instalados: características, funcionamiento, mantenimiento.

- 18:15h – 18:30h

[TEKNIKER] Presentación de la plataforma de gestión energética y aplicación móvil que se está desarrollando.

- 18:30h – 18:40h

[COMET] Presentación del grupo de Facebook y canales de comunicación.

- 18:40h – 18:55h

Preguntas y respuestas.

- 18:55h – 19:00h

[FENÍE ENERGÍA] Despedida y cierre de la reunión.

Figure 67. La Graciosa July 5th Informative Meeting's Agenda

Many aspects were presented in this meeting, from an introduction to the project for those participants that joined in the past months, to the next planned steps, including a demo of the Mobile App and REACT Platform, in order to show them how they will be able to interact with their installations and adapt their consumption habits to more efficient ways.

A detailed explanation of the installed equipment and its functioning was presented too. All the content was printed and given to each participant in a folder, including the estimated savings each of them would achieve, the datasheets of all the installed equipment, their signed contracts, the presentation shown during the meeting, etc.

By the end of the meeting, souvenir bottles depicting the island, its name, the project URL and the react logo specifically designed for this purpose were distributed among the participants. They are shown in Figure 68. All in all, the meeting was a total success, and the participants were very satisfied.

Figure 68. Bottles for La Graciosa Participants

Apart from the meeting, a periodic follow up via phone calls and emails will be conducted to address any questions they might have. Additionally, a Facebook page was created in March see Figure 69, in order to post any updates regarding the installations or the projects, and to easily interact with the users.

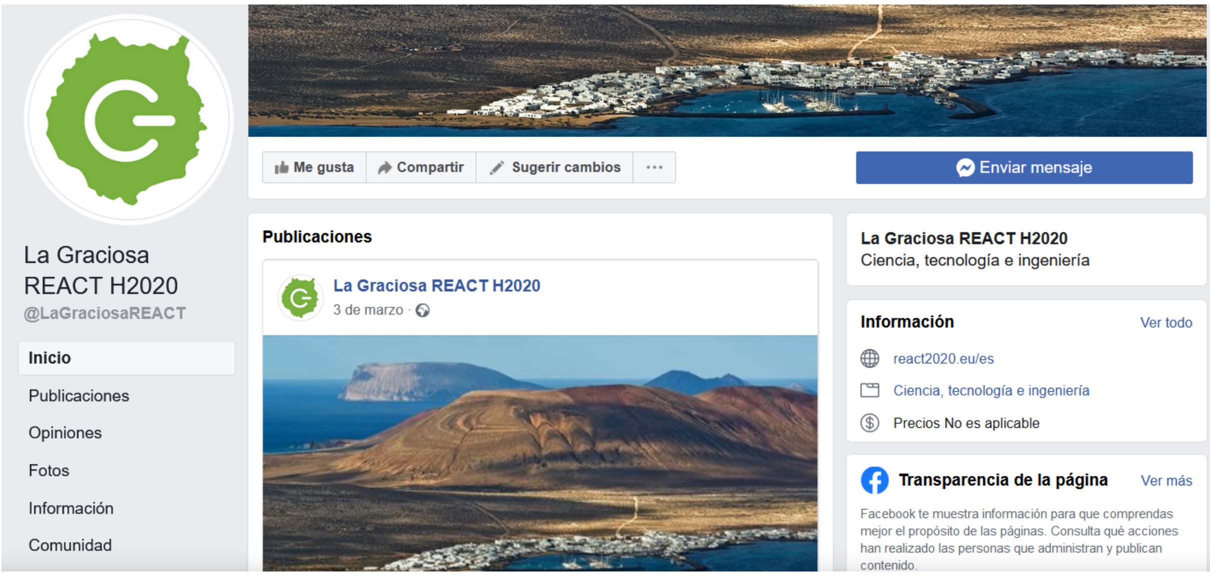


Figure 69. La Graciosa Facebook Page

Regarding their data and accessibility, all users can access to a platform developed by the Spanish DSOs, named datadis, where they can see and download their historical electricity consumption see Figure 70.

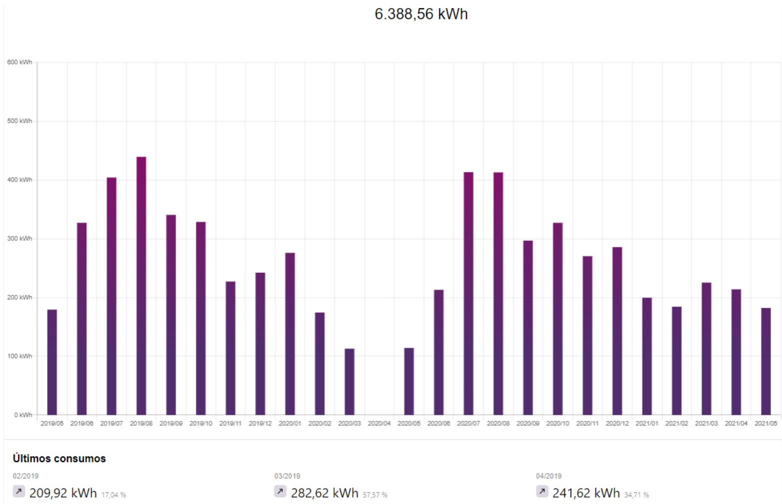


Figure 70. Datadis platform user interface

3.5.2 SAN PIETRO

The PCC team works in close contact with all the participants, taking care not only of the logistical matters linked with the installations but also guiding them through the process and answering questions.

Those participants that did not take part in the meeting with the general public in 2019 (where the project was presented) have received detailed information about REACT and what their participation in the project entails.

Following the completion of the first wave of installations of HP, the Italian cluster will organise a meeting on the island (end of August) where all participants will receive information about the system installed, how to maintain them and the next steps. The meeting will be an opportunity to address any additional questions following the installation and begin the discussion on how to reduce electricity consumption during their daily life. Participants will also be encouraged to use the Facebook page as a platform for discussion and share their experiences.

3.5.3 ARAN ISLAND

The Irish PCC team are working closely with the participants, and at an early stage a WhatsApp group was formed to keep participants up to date on delivery dates etc. We have also set up a Facebook page to offer advice, take questions and any general comments on the project.

A one-to-one consultation will be provided by the PV installation company to all participants, giving a demonstration of the system, the demand response actions of the participant, maintenance of the system and to answer any questions the participant may have. Later in the year, we intend to have a meeting with all participants to discuss the progress made on the project and other deliverables.

3.6 TESTING STRATEGY

Testing of the systems that are deployed in the field was conducted in Task 3.3 and is described in detail in D3.3. Here a short overview of the conducted tests and their impact on the further deployment of systems is given.

Three different types of tests were conducted in the laboratory to validate the proposed control scheme. At first there were tests to gather information on how to optimally control the systems that are deployed in the field. In this evaluation appropriate settings to achieve specific control actions were identified.

The second part of the tests included a simulation of a demonstration site distribution grid as well as several simulated systems that were combined with the distribution grid in a co-simulation. This simulation environment was used to evaluate different types of optimization strategies and their potential impacts. The results achieved through these simulations were indicative and will provide valuable input for further development of optimization algorithms.

At last hardware-in-the-loop experiments were conducted, combining real laboratory hardware with the co-simulation environment. Three different systems that will also be deployed in the field were evaluated. The results show that the proposed coordinated control scheme in the REACT project achieves what it aims for, and that the control from optimization algorithms through the REACT platform is performing well.

4 CONSTRAINTS

The process of implementing technology in the pilots has been marked by mobility restrictions resulting from the COVID-19 crisis that is still affecting the world as a whole. These restrictions have had a greater impact on the islands, as any mobility has been more limited during the last 18 months.

On the other hand, at the Project level, in each of the pilots there have been restrictions and limitations of a technical nature, legalization processes and recruitment of participants.

4.1 Technical constraints

It should be noted that access limitations of Aluminium-Carbon battery technologies, exposed in the amendment dated November 2020, as well as economically viable alternative solutions to P2G, which have finally been solved but with delays in the final implementation process.

4.2 Legalization constraints

The legalization processes of PV systems are influenced by land type and land protection restrictions. The islands are mostly protected habitats that limits the implementation of any work to be carried out. As an example, it should be noted that in July 2021 no license has been granted for the execution of works in the installations of La Graciosa, whose legalization depends on the coasts. It is expected that the works can be executed in August.

The choice of public buildings in the three pilots as a strategy to work both in the private and public sphere for the engagement of the population, has caused delays in the building permits, since the management of licenses is different between public and private buildings.

It is also important to highlight current limitations in the legalization process of energy communities in Europe, which limits the development of virtual power plants and shared energy management.

4.3 Participant constraints

The COVID-19 pandemic has very negatively affected the engagement of the participants. The lack of continuous and direct contact during the last months has caused some participants to drop out of the project. Engagement actions in the coming months of the REACT Project will be very important to reverse this situation.

5 CONCLUSIONS

The implementation of innovative technology in different pilot installations with the need in this case to manage processes of legalization of installations and with more than 25 public and private participants per pilot, is a challenge for this project.

During the last few months, we have been experiencing a situation worldwide that had never been experienced before. This situation has caused and continues to cause delays in the final implementation of technology. This is a fact. For this reason, the activities planned in the three pilots, the subject of this report, are expected to be completed in September, as described in each of the pilots.

The execution and installation of smart meters in La Graciosa and San Pietro in 2020, together with the information mostly disaggregated of electricity consumption in Aran, allows us, together with the implementation of the technology in 2021, to have a baseline to work on the planned actions depending on T3.2 in the coming months.

On the other hand, it is important to highlight that we have managed to implement innovative technology such as the implementation and future testing of up to 5 types of batteries, a P2H solution at residential level, installation of V2G charger pilot unit; implementation of a VPP in the pilot of San Pietro as well as implementation of innovative solutions in DR strategies that we will visualize in WP5.

Therefore, it is important to highlight that despite the very limiting conditions we are experiencing, it has been possible to continue with the project, in the three defined pilots and with a considerable degree of success in this phase of technology implementation.

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Appendix I

New heat pump system components for San Pietro public buildings and private buildings (first wave)

Home_9 via Albenga 36/a

Qty	Model	Description
1	MUZ-EF42VG	R32 MUSU Serie Unità Esterna
3	MUZ-EF25VG	R32 MUSU Serie Unità Esterna
+ .0		

1	MSZ-EF42VGWK(Wireless)	Unità a parete Unità Interna
3	MSZ-EF25VGWK(Wireless)	Unità a parete Unità Interna

Home_13 ZONA PESCETTI

Qty	Model	Description
2	MXZ-3F68VF3-E1	R32 MXZ Serie Unità Esterna
2	MSZ-EF50VGKW(Wireless)	Unità a parete Unità Interna
1	MSZ-EF22VGWK(Wireless)	Unità a parete Unità Interna
1	MSZ-EF50VGWK(Wireless)	Unità a parete Unità Interna

Home_23_via XX Settembre 179

Qty	Model	Description
2	MXZ-3F68VF3-E1	R32 MXZ Serie Unità Esterna
2	MSZ-EF50VGKW(Wireless)	Unità a parete Unità Interna
1	MSZ-EF22VGWK(Wireless)	Unità a parete Unità Interna
1	MSZ-EF50VGWK(Wireless)	Unità a parete Unità Interna

Home 16_17_18a_18b (CONDOMINIO VIA GARIBALDI)

Qty	Model	Description
1	MUZ-EF35VG	R32 MUSU Serie Unità Esterna
2	MXZ-2F42VF3-E1	R32 MXZ Serie Unità Esterna
1	MUZ-EF25VG	R32 MUSU Serie Unità Esterna
1	MXZ-2F53VF3-E1	R32 MXZ Serie Unità Esterna
1	MXZ-2F33VF3-E1	R32 MXZ Serie Unità Esterna
1	MSZ-EF35VGWK(Wireless)	Unità a parete Unità Interna
2	MSZ-EF18VGWK(Wireless)	Unità a parete Unità Interna
1	MSZ-EF25VGWK(Wireless)	Unità a parete Unità Interna
4	MSZ-EF18VGKWK(Wireless)	Unità a parete Unità Interna
1	MSZ-EF35VGKWK(Wireless)	Unità a parete Unità Interna
1	MSZ-EF22VGKWK(Wireless)	Unità a parete Unità Interna

Home_34

Qty	Model	Description
1	MXZ-3F54VF3-E1	R32 MXZ Serie Unità Esterna
2	MSZ-EF42VGKW(Wireless)	Unità a parete Unità Interna
2	MSZ-EF22VGKW(Wireless)	Unità a parete Unità Interna

2	MSZ-EF25VGKW(Wireless)	Unità a parete Unità Interna

Public_04 (Sports Centre)

Qty	Model	Description
10	PAR-40MAA	MA remote controller
1	PAR-33MAA	MA remote controller
11	MAC-334IF-E	Interfaccia MA
1	MXZ-5F102VF-E1	R32 MXZ Serie Unità Esterna
1	MXZ-4F72VF3-E1	R32 MXZ Serie Unità Esterna
1	MXZ-2F42VF3-E1	R32 MXZ Serie Unità Esterna
5	MSZ-EF18VGKW(Wired)	Unità a parete Unità Interna
4	MSZ-EF22VGKW(Wired)	Unità a parete Unità Interna
1	MSZ-EF25VGKW(Wired)	Unità a parete Unità Interna
1	MSZ-EF18VGW(Wired)	Unità a parete Unità Interna
1	CAHV-P500YB-HPB	
1	PAR-W21MAA	
1	RMI-3G-BOX-WL-PG	Remote Monitoring Interface
12	PRO-RMI-UI	Remote Monitoring Interface

Public_06 (Library)

Qty	Model	Description
1	AE-200E	Central controller
9	PAR-40MAA	MA remote controller
1	PZ-61DR-E	LOSSNAY remote controller
1	PUHY-P400YNW-A1	R410A Y Serie Unità Esterna
6	PFFY-P50VLEM-E	Unità a pavimento in vista Unità Interna
1	PKFY-P20VLM-E	Unità a parete Unità Interna
2	PKFY-P50VLM-E	Unità a parete Unità Interna
3	CMY-Y102LS-G2	Joint
5	CMY-Y102SS-G2	Joint
1	LGH-100RVX-E	Lossnay
1	RMI-3G-BOX-WL-PG	Remote Monitoring Interface
10	PRO-RMI-UI	Remote Monitoring Interface

Home_33 (Bed & Breakfast)

Qty	Model	Description
1	AE-200E	Central controller
1	PAR-W21MAA	MA remote controller
7	PAR-CT01MAA-SB	MA Touch Remote controller

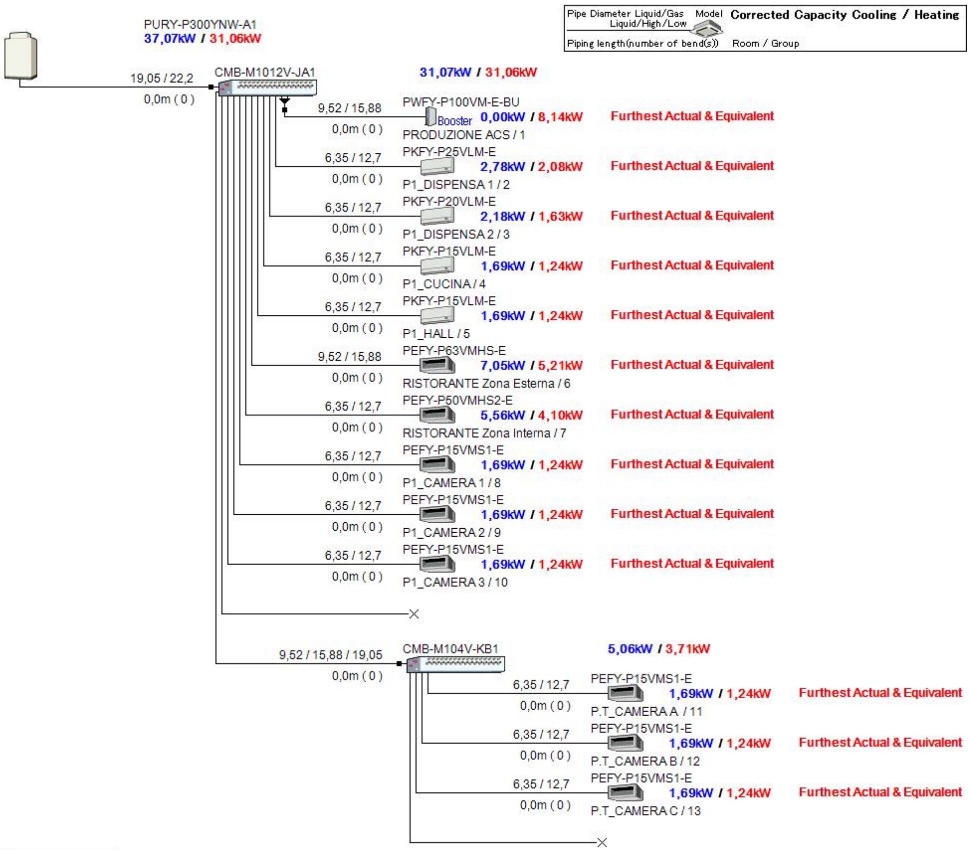
1	PURY-P250YNW-A1	R410A R2 Serie Unità Esterna, 28 kW
1	CMB-M1012V-J1	BC controller single
1	CMY-R301S-G	Reducer
1	PWFY-P100VM-E-BU	HWS Unità Interna
2	PEFY-P25VMS1-E	Incasso in controsoffitto Unità Interna
3	PKFY-P25VLM-E	Unità a parete Unità Interna
1	PEFY-P50VMS1-E	Incasso in controsoffitto Unità Interna
1	PKFY-P10VLM-E	Unità a parete Unità Interna
1	PKFY-P32VLM-E	Unità a parete Unità Interna
1	CMY-R160-J1	Giunto
1	ROUTER-RMI-3G	Remote Monitoring Interface
9	PRO-RMI-UI	Remote Monitoring Interface

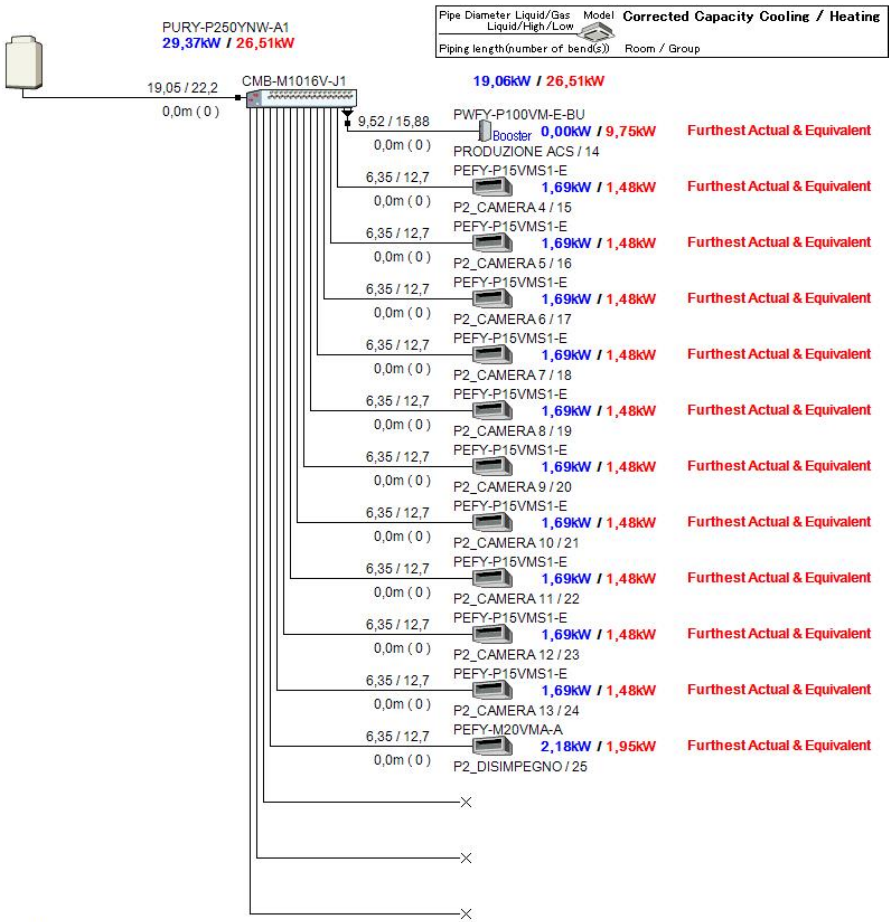
Hotel_04

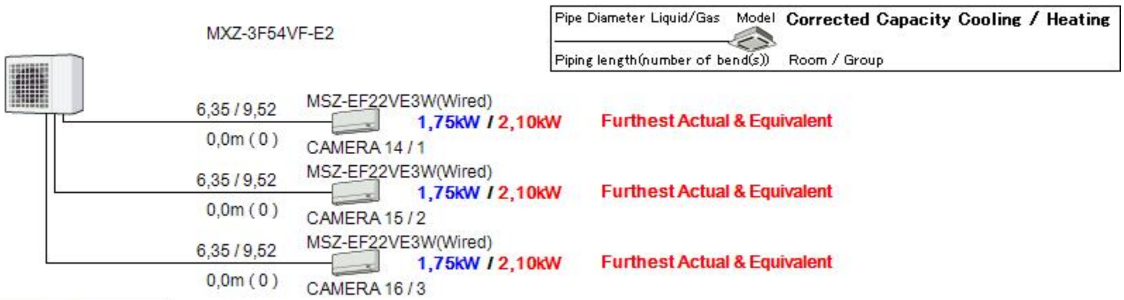
MATERIALI :

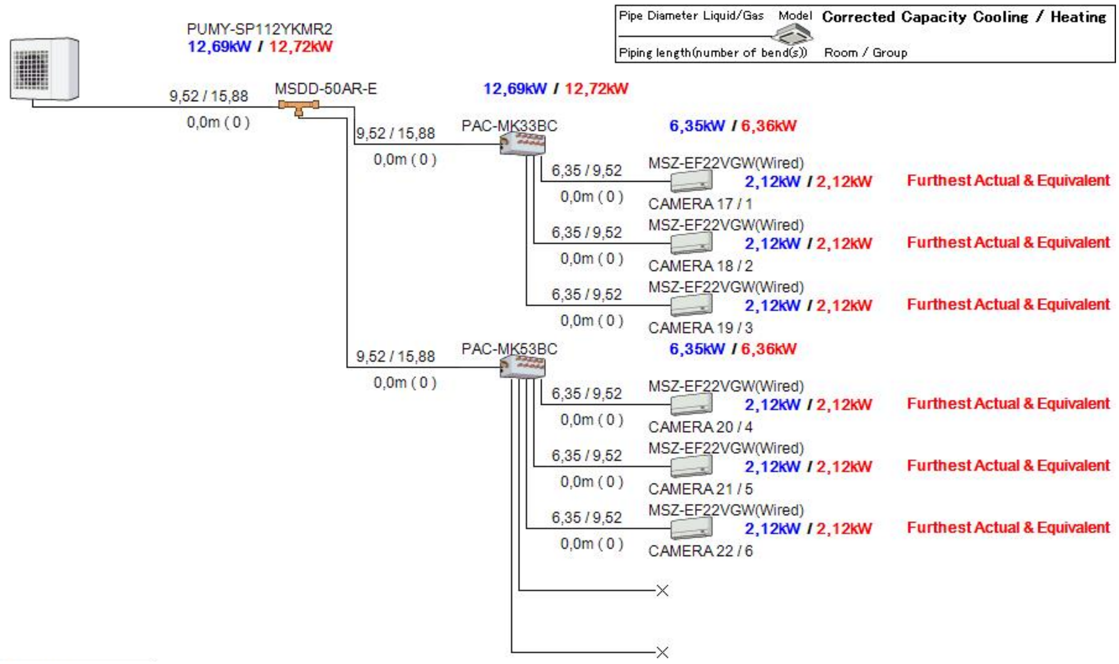
Codice	Descrizione	Quantità
276612	AE-200E CNTRL WEB SERVER DT	1
283551	EW-50E COMANDO CENTRALIZZATO	2
217248	PAR-W21MAA-J COM.REM. WU/BU TIPO A TIMER	2
315706	PAR-CT01MAA-SB COMANDO REMOTO BIAN E BLU	32
279329	PZ-61DR-E COMANDO LOSSNAY LGH-RVX	4
404755	MAC-334IF-E INTERFACCIA M/NET	9
492586	PURY-P300YNW-A1 UE STD R2 R410A 33,5KW	1
492585	PURY-P250YNW-A1 UE STD R2 R410A 28,0KW	1
486802	MXZ-3F54VF3-E1 MULTISPLIT 3 ATT. R32	1
503780	PUMY-SP112YKMR2 UE SMY CPCT R410 12,5 KW	1
486525	CMB-M1012V-JA1 BC R2 12 ATTACCHI R410A	1
486531	CMB-M104V-KB1 BC R2 4 ATTACCHI R410A	1
486742	CMB-M1016V-J1 BC R2 16 ATTACCHI R410A	1
217041	PWFY-P100VM-E-BU HWS UNIT 12,5KW	2

404750	PKFY-P25VLM-E.TH UI PARETE 2,8kW	1
404747	PKFY-P20VLM-E.TH UI PARETE 2,2kW	1
404745	PKFY-P15VLM-E.TH UI PARETE 1,7kW	2
317811	PEFY-P63VMHS-E.TH UI CANALIZ.A/P.7,1KW	1
317810	PEFY-P50VMHS-E.TH UI CANALIZ.A/P.5,6KW	1
495907	PEFY-P15VMS1-ER3.TH UI CANALIZ.MBP 1,7KW	16
485621	PEFY-M20VMA-A UI CANAL MP 2,2kW	1
486944	MSZ-EF22VGKW-E1 UN.INT.PARETE 2,2KW	9
231872	CMY-R160-J1 GIUNTO DI CONG.R2	2
498511	PAC-MK34BC DISTR 3 ATT. PUMY-SP/P-V/YKM	1
498517	PAC-MK54BC DISTR 5 ATT. PUMY-SP/P-V/YKM	1
291409	LGH-150RVXT-E LOSSNAY 1500 MCH	1
278853	LGH-80RVX-E LOSSNAY 800 MCH	1
278849	LGH-25RVX-E LOSSNAY 250 MCH	1
278851	LGH-50RVX-E LOSSNAY 500 MCH	1
339520	ME-AC-MBS-100 V2 INTER MBS CM FINO 100UI	1
272760	ROUTER 3G MOBILE PRE-CONFIGURATO	1
272630	PRO-RMI-UI CONFIG./AVV.RMI MOLTIPLI.X UI	40
163315	MSDD-50AR-E GIUNTO A CARTELLA MXZ-8A140	1


PURY-P300YNW-A1
37,07kW / 31,06kW
Pipe Diameter Liquid/Gas
Liquid/High/Low
Model
Corrected Capacity Cooling / Heating
Piping length(number of bend(s))
Room / Group
19,05 / 22,2
0,0m (0)
CMB-M1012V-JA1
31,07kW / 31,06kW
9,52 / 15,88
0,0m (0)
PWFY-P100VM-E-BU
Booster
0,00kW / 8,14kW
Furthest Actual & Equivalent
PRODUZIONE ACS / 1
6,35 / 12,7
0,0m (0)
PKFY-P25VLM-E
2,78kW / 2,08kW
Furthest Actual & Equivalent
P1_DISPENSA 1 / 2
6,35 / 12,7
0,0m (0)
PKFY-P20VLM-E
2,18kW / 1,63kW
Furthest Actual & Equivalent
P1_DISPENSA 2 / 3
6,35 / 12,7
0,0m (0)
PKFY-P15VLM-E
1,69kW / 1,24kW
Furthest Actual & Equivalent
P1_CUCINA / 4
6,35 / 12,7
0,0m (0)
PKFY-P15VLM-E
1,69kW / 1,24kW
Furthest Actual & Equivalent
P1_HALL / 5
9,52 / 15,88
0,0m (0)
PEFY-P63VMHS-E
7,05kW / 5,21kW
Furthest Actual & Equivalent
RISTORANTE Zona Esterna / 6
6,35 / 12,7
0,0m (0)
PEFY-P50VMHS2-E
5,56kW / 4,10kW
Furthest Actual & Equivalent
RISTORANTE Zona Interna / 7
6,35 / 12,7
0,0m (0)
PEFY-P15VMS1-E
1,69kW / 1,24kW
Furthest Actual & Equivalent
P1_CAMERA 1 / 8
6,35 / 12,7
0,0m (0)
PEFY-P15VMS1-E
1,69kW / 1,24kW
Furthest Actual & Equivalent
P1_CAMERA 2 / 9
6,35 / 12,7
0,0m (0)
PEFY-P15VMS1-E
1,69kW / 1,24kW
Furthest Actual & Equivalent
P1_CAMERA 3 / 10
9,52 / 15,88 / 19,05
0,0m (0)
CMB-M104V-KB1
5,06kW / 3,71kW
6,35 / 12,7
0,0m (0)
PEFY-P15VMS1-E
1,69kW / 1,24kW
Furthest Actual & Equivalent
P.T_CAMERA A / 11
6,35 / 12,7
0,0m (0)
PEFY-P15VMS1-E
1,69kW / 1,24kW
Furthest Actual & Equivalent
P.T_CAMERA B / 12
6,35 / 12,7
0,0m (0)
PEFY-P15VMS1-E
1,69kW / 1,24kW
Furthest Actual & Equivalent
P.T_CAMERA C / 13


Pipe Diameter Liquid/Gas Liquid/High/Low
Model
Corrected Capacity Cooling / Heating
Piping length(number of bend(s))
Room / Group
PURY-P250YNW-A1
29,37kW / 26,51kW
19,05 / 22,2
0,0m (0)
CMB-M1016V-J1
19,06kW / 26,51kW
9,52 / 15,88
0,0m (0)
PWFY-P100VM-E-BU
Booster
0,00kW / 9,75kW
PRODUZIONE ACS / 14
Furthest Actual & Equivalent
6,35 / 12,7
0,0m (0)
PEFY-P15VMS1-E
1,69kW / 1,48kW
P2_CAMERA 4 / 15
Furthest Actual & Equivalent
6,35 / 12,7
0,0m (0)
PEFY-P15VMS1-E
1,69kW / 1,48kW
P2_CAMERA 5 / 16
Furthest Actual & Equivalent
6,35 / 12,7
0,0m (0)
PEFY-P15VMS1-E
1,69kW / 1,48kW
P2_CAMERA 6 / 17
Furthest Actual & Equivalent
6,35 / 12,7
0,0m (0)
PEFY-P15VMS1-E
1,69kW / 1,48kW
P2_CAMERA 7 / 18
Furthest Actual & Equivalent
6,35 / 12,7
0,0m (0)
PEFY-P15VMS1-E
1,69kW / 1,48kW
P2_CAMERA 8 / 19
Furthest Actual & Equivalent
6,35 / 12,7
0,0m (0)
PEFY-P15VMS1-E
1,69kW / 1,48kW
P2_CAMERA 9 / 20
Furthest Actual & Equivalent
6,35 / 12,7
0,0m (0)
PEFY-P15VMS1-E
1,69kW / 1,48kW
P2_CAMERA 10 / 21
Furthest Actual & Equivalent
6,35 / 12,7
0,0m (0)
PEFY-P15VMS1-E
1,69kW / 1,48kW
P2_CAMERA 11 / 22
Furthest Actual & Equivalent
6,35 / 12,7
0,0m (0)
PEFY-P15VMS1-E
1,69kW / 1,48kW
P2_CAMERA 12 / 23
Furthest Actual & Equivalent
6,35 / 12,7
0,0m (0)
PEFY-P15VMS1-E
1,69kW / 1,48kW
P2_CAMERA 13 / 24
Furthest Actual & Equivalent
6,35 / 12,7
0,0m (0)
PEFY-M20VMA-A
2,18kW / 1,95kW
P2_DISIMPEGNO / 25
Furthest Actual & Equivalent


MXZ-3F54VF-E2
Pipe Diameter Liquid/Gas
Model
Corrected Capacity Cooling / Heating
Piping length(number of bend(s))
Room / Group
6,35 / 9,52
0,0m (0)
MSZ-EF22VE3W(Wired)
1,75kW / 2,10kW
CAMERA 14 / 1
Furthest Actual & Equivalent
6,35 / 9,52
0,0m (0)
MSZ-EF22VE3W(Wired)
1,75kW / 2,10kW
CAMERA 15 / 2
Furthest Actual & Equivalent
6,35 / 9,52
0,0m (0)
MSZ-EF22VE3W(Wired)
1,75kW / 2,10kW
CAMERA 16 / 3
Furthest Actual & Equivalent



Appendix II:

New heat pump system components for Aran Islands community buildings

Community Development Office

Qty	Model	Description*
2	PUD-SHWM120VAA	12kW Split outdoor unit (ZUBADAN) (R32)
2	EHSD-VM2D	Hydrobox FTC6
2	ACC-MFI-028	28mm TF1 Magnetic Filter (8.5kW to 14kW)
1	PAC-IF072B-E	FTC6 Master Controller for 3rd party cylinders (only for use with R32 outdoor units)
1	PAC-TH011TK2-E	FTC6 Cylinder DHW Temp Sensor 5m Cable
2	ACC-AVM-001	Ecodan Anti Vibration Fix-it-Foot 600mm - Pair
2	PAC-SG61DS-E	Drain socket kit recommended for 5kW/8.5kW/11.2kW/14kw monobloc 7.5kw/1SHW112 Split
2	PAC-FS01-E	FTC6 Third Party Indoor Unit Flow Sensor
2	PAR-WT50R-E	Wireless transmitter Stat
1	PAR-WR51R-E	Wireless remote Receiver
2	MAC-567IF-E1	WI-FI Interface for MELCloud

* Note: only components supplied by Mitsubishi Electric listed. Radiators, DHW cylinder and buffer storage tank all from third party suppliers.

Childcare Facility

Qty	Model	Description
2	PUD-SHWM120VAA	12kW Split outdoor unit (ZUBADAN) (R32)
2	EHSD-VM2D	Hydrobox FTC6
2	ACC-MFI-028	28mm TF1 Magnetic Filter (8.5kW to 14kW)
1	PAC-IF072B-E	FTC6 Master Controller for 3rd party cylinders (only for use with R32 outdoor units)
1	PAC-TH011TK2-E	FTC6 Cylinder DHW Temp Sensor 5m Cable
2	ACC-AVM-001	Ecodan Anti Vibration Fix-it-Foot 600mm - Pair
2	PAC-SG61DS-E	Drain socket kit recommended for 5kW/8.5kW/11.2kW/14kw monobloc 7.5kw/1SHW112 Split
2	PAC-FS01-E	FTC6 Third Party Indoor Unit Flow Sensor
2	PAR-WT50R-E	Wireless transmitter Stat
1	PAR-WR51R-E	Wireless remote Receiver
2	MAC-567IF-E1	WI-FI Interface for MELCloud