IANOS
SUSTAINABLE SOLUTIONS
for islands' decarbonisation

# D6.7 Terceira system commissioning report

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| | | | |
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# Executive Summary

One of the key objectives of IANOS is to demonstrate specific technology-driven interventions envisioned through 3 Transition Tracks and 9 Use Cases, towards energy system de-carbonization in two #LH Islands, validating IANOS solutions up to TRL 8. Based on this, many cost-effective system technologies were developed in this project to decarbonise the power system and electric mobility in Islands.

These technologies are planned to be deployed in LH Islands i.e. Terceira, and Ameland. This deliverable presents the commissioning of the developed key technologies in Terceira to meet the project objectives. These system technologies are aiming to facilitate the seamless adoption of extremely high-(Renewable Energy Sources) RES penetration, by encompassing synergetic operation of energy resources and carriers through a VPP framework, for pro and re-active orchestration of energy flows.

The system technologies are planned to be managed and controlled to maximum provision and utilisation of flexibility and self-sufficiency through the use of distributed renewable energy and storage technologies.

Most of the key technologies were shipped and installed in Terceira. This includes the Heat Battery from SUNAMP, HEMS from Cleanwatts, the PV panels from BeON, the Smart Energy Routers and the Intelligent Water Heaters from UniNova. A delay was expected for some technologies developed by EFAEM, EFACEC, and TERALOOP, which includes the V2X charger, transformer, and flywheel.

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# Table of Contents



This project has received funding from the European Union's Horizon 2020 research and innovation programme under grant agreement N° 957810

# List of Figures



This project has received funding from the European Union's Horizon 2020 research and innovation programme under grant agreement N° 957810

# List of Tables

# Abbreviations and acronyms

| Abbreviations | Full Description |
| --- | --- |
| ANN | Artificial Neural Networks |
| CD | Centralised Dispatcher |
| CFRP | Carbon Fibre Reinforced Polymer |
| CHP | Combined Heat and Power |
| DER | Distributed Energy Resources |
| DLT | Distributed-Ledger based energy Transactions |
| ESS | Energy Storage Systems |
| EV | Electric Vehicle |
| FEID-Plus | Fog-Enabled Intelligent Devices |
| UC | Use Cases |
| HEMS | Home Energy Management System |
| iVPP | Intelligent Virtual Power Plant |
| LHI | Lighthouse Island |
| NWP | Numerical Weather Prediction |
| PCM | Phase Change Material |
| PEBB | Power Electronics Building Blocks |
| RES | Renewable Energy Sources |
| TRL | Technology Readiness Level |
| V2G | Vehicle-to-Grid |

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# 1 Introduction

This deliverable is part of WP6. The Work Package 6 (WP6) relates solely to the lighthouse island of Terceira and aims to prepare the demonstration of the several Use Cases (UCs) and technologies defined for this island and detailed in T2.1 –Islands Requirements engineering and use case definitions.

In T6.1, the specifications of all systems were defined besides the identification of the pilot site requirements and constraints, by assessing existing infrastructures and feasibility of installing the different systems and equipment.

In T6.2, the Terceira's deployment plan (D6.4) was managed, which includes the reference timelines; transportation, site deployment and commissioning requirements, according to the demo physical ecosystems and solutions' specifications; relevant stakeholders' engagement, including end-users; and risk management strategy.

In T6.3, the System Integration, Implementation & Commissioning were identified and planned.

## 1.1 Objectives and Scope

The initial scope in the Grant Agreement (GA) for this deliverable foresee the commissioning procedures to be conducted locally. This deliverable aims to provide a commissioning of the technologies that were developed in WP4. The technologies were deployed in Terceira Island. After this step, the Use Cases (UCs) realization should be done to achieve the environmental and the economic objectives of the IANOS.

## 1.2 Relation to other activities

This deliverable presents the commissioning of all the technologies in Terceira. It based on the outcomes of T2.4 and T6.2. The present deliverable is included in WP6 - "Deployment, Use Cases Realization and Monitoring at LH#2 (Terceira)". This deliverable part of T6.3 - "System Integration, Implementation & Commissioning". This deliverable is detailing the commissioning of all systems and technologies in Terceira. It will also feed other Work Package's tasks with relevant information.

## 1.3 Structure of the deliverable

This deliverable is structured as follows:

- Section 2: This section presents the technologies' commissioning in the Terceira pilot and details the interface of each technology with other ones.
- Section 3: The conclusion based on the commissioning section presented in this section.

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# 2 Technologies

This is section presents the initial TRL before the project and implemented and deployed TRL of the developed technologies as listed in the Table 1.

*Table 1: TRL development of the deployed key technologies in Terceira.*

| Technology | TRL before IANOS | Developed TRL |
|---|---|---|
| PV panels and microinverter (BeOn) | 6 | 8 |
| Heat Battery (Sunamp) | 9 | 9 |
| Electric water heaters (UniNova) | | |
| HEMS (Cleanwatts) | 9<br>New features: TRL 6 | 9 |
| Smart energy router (UniNova) | | |
| Flywheel (Teraloop) | 7 | 8 |
| V2G EV charger (EFAEM) | | |
| Hybrid transformer (EFACEC) | 5 | 7 |
| Fog-Enabled Intelligent Devices – FEID-Plus (CERTH) | 7 | 9 |

## 2.1 Solutions Commission

### 2.1.1 PV panels and microinverter (BeOn)

The BeON Solar Kits are a house complete and easy to install solution composed by:

- One photovoltaic panel.
- BeON plug-in microinverter (pluginverter);
- Aluminium structure support structure;
- Steel ground/roof fixations structure;
- Wiring and all the accessories;
- Communication interface.

The kits has been packed and shipped to Terceira. The installation was performed (Figure 1) by local installers with all the manuals and procedures being provided by BeON.

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Although the system is fully plug and play, with a unique system that uses a plug-in inverter that can be connected to any household power outlet, the installer as to be certified/verified perform the installation of a PV system.

The integration and commissioning procedures are followed upon the system installation finalisation. The local installers guaranteed that the system is communicating and BeON staff will locally and remotely test the system connectivity and if it is sending the collected data to the Enterprise Service Bus (ESB). After this check, the system is fully integrated and can be controlled by the IANOS iVPP.

*Figure 1: PV panels installation and commissioning in Terceira.*

*Table 2: PV kit vertification.*

| # | Test | Means of verification |
|---|---|---|
| 1 | Integration of the equipment connected to the gateway with the ESB BeON system | Verifying if the BeON systems are receiving commands from the ESB, and if replies are arriving to the ESB |
| 2 | Power output control of the BeON kits locally | Local Control of the Output Power of the system's power level (0 1 2 3 4 5) |

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| | | |
|---|---|---|
| 3 | Remote power output control of the BeON kits by the ESB | Remote control of the Output Power of the system's power level (0 1 2 3 4 5) |

## *INSTALLATION - Configuration*

Next figure (Figure 2) shows the main components of the system, the main connections and PV panel mounting possibilities.

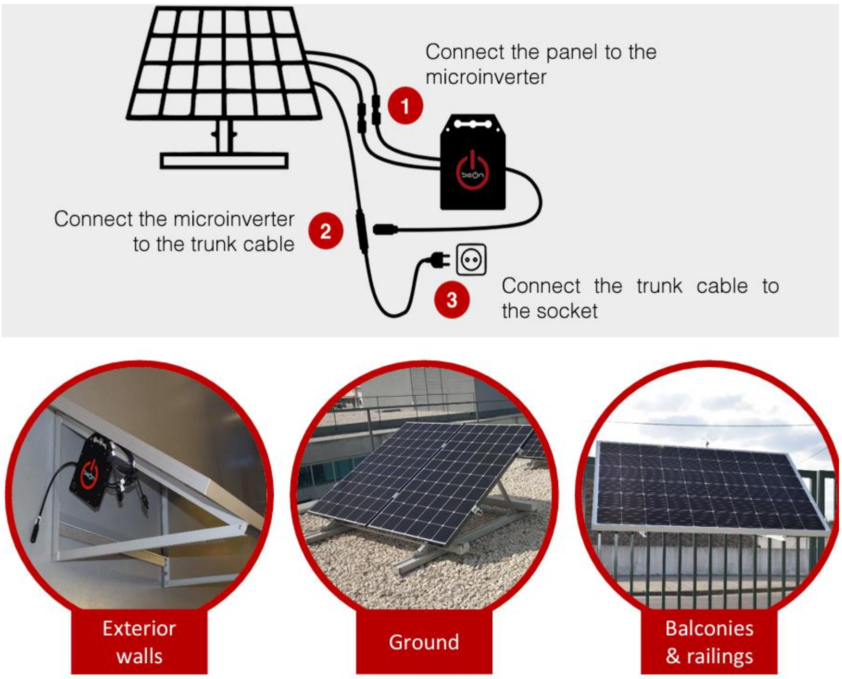


Figure 2: The main PV system components.

## *INSTALLATION - Interface with other technologies*

The Local installer guaranteed that the system is communicating and BeON staff has locally and remotely test the system connectivity and check if it is sending the collected data to the Enterprise Service Bus (ESB). After this check, the system is fully integrated (Figure 3) and can be controlled by the IANOS iVPP.

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*Figure 3: PV kit commissioning.*

## *INSTALLATION - Final check*

The operations that are necessary for the installation, integration and commissioning are summarized on the next table (Table 3).

Table 3: Installation, integration, and commissioning procedures check list table for BeON energy PV system (Bemicro LDA).

| ID | Procedure | Insert comment / Data | Check box |
|---|---|---|---|
| 1 | Install support structure | N.A. | ☐ |
| 2 | Fix PV panels on the structure | N.A. | |
| 3 | Install Pluginverters | N.A. | ☐ |
| 4 | Install cabling and connect to the closest wall socket | N.A. | |
| 5 | Inspection and verification | N.A. | ☐ |
| 6 | Install communication interface | N.A. | |
| 7 | Install BeON application on a mobile device (APP store) | N.A. | ☐ |
| 8 | Communication setup and interface verification | N.A. | |

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| | | | |
|---|---|---|---|
| 9 | Commissioning Report | N.A. | ☐ |

## *INSTALLATION - Site*

The installation sites are located in Bairro da Terra Chã – Ilha Terceira. Below is the map (Figure 4) of the installation sites, identifying local houses to be performed with BeON system.

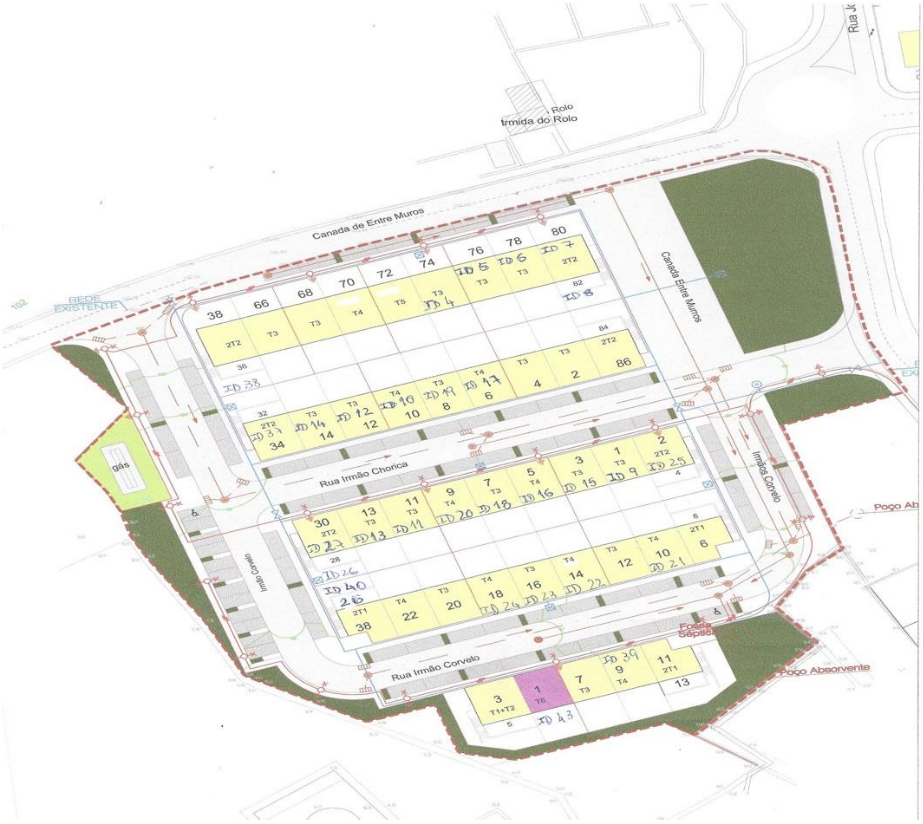


Figure 4: installation sites.

## *Heat battery (Sunamp)*

Sunamp develops, manufactures and distributes heat batteries for different markets around the globe. One of the main applications Sunamp is active is in providing hot water for existing buildings, and this is also what Sunamp is providing to the IANOS project.

## *INSTALLATION - Configuration*

A total of 24 Thermino 70 e were installed, Figure 5: heat-battery, Thermino 70 e.. While the products were as standard as possible to maintain manufacturing prices low, an add on, an Industrial RS232/485 to Ethernet Converter, which allowed to connect Thermino through a MODBUS RTU connection to the developed devices of Cleanwatts also for this project. More information about the converter can be found in the next section.

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Regarding the Therminos installed, Thermino 70 e offers the customer instant heat for hot water application. It represents an equivalent hot water tank of 70 litres and is able to be charged with electricity coming from the grid. The main advantages of Thermino are space saving, lower energy consumption due to 2 to 4 times better insulation compared to hot water tanks and no maintenance needed, since Thermino doesn't has water in its system and ergo no danger of legionella. As just mentioned, Thermino doesn't use water to provide sanitary hot water, instead it uses phase change material (PCM) that changes the phase from solid to liquid at 58 °C. This fact allows Thermino to use the latent energy of the material increasing the energy density up to 4 times and therefore reducing the needed space (with water) to achieve the same amount of energy stored. The better insulation is achieved with vacuumized insulation panels and the lack of water can be done with heat exchangers submerged in the PCM that allow the flowing water to heat up instantly and therefore not having to have the water itself stored in a vessel.

Figure 5: heat-battery, Thermino 70 e.

### *INSTALLATION – Interface with other technologies*

After the brief explanation of the technology in the section before the detailed installation two interfaces are described in this section.

The first one is not a technology interface but how Thermino is connected to the house and how the customer is in contact with Thermino in an indirect way. The heat exchanger is connect on one side to the cold mains that bring sanitary water from the system connected to the house and the  other side is connected to the existing pipes providing

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hot water to the building/house. The cold water is heated up instantely and the customer receives this hot water.

The second one is in more relation to the project. To foresee when it would be better to charge Thermino, Thermino is connected to the system of Cleanwatts through an additional device that manages to change the signal given by Thermino to MODBUS RTU. The device is called Waveshare (Figure 6) and can be seen in all figures in the chapter "INSTALLATION - Site".


*Figure 6:* Waveshare device which connects the heatbattery with HEMS (Source: *https://www.waveshare.com/wiki/Modbus_rtu_relay)*.

## *INSTALLATION - Final check*

1. The details for the commissioning of the units will be described in this chapter. Nevertheless, two topics should be understood by the reader at this point:
2. The reference for installation and commissioning is the installation manual.
3. Sunamp was not involved in the installation of Thermino and the communication with the installer was limited due to the language barrier. Sunamp therefore is not taking any responsibility for the installation and commissioning of the Therminos installed in relation with the project IANOS.

Commissioning procedure:

4. Ensure that the temperature sensor of the Heat Battery is fully inserted into its pocket. The white marker should be sitting on top of the blue cable gland.
5. Turn on the water supply and ensure that there are no leaks.
6. Fully open any hot water taps in the dwelling and allow to run for a minimum of two minutes. This is for any air to leave the system. This may vary depending on the Heat Battery model size.

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7. Switch ON the power supply of the Heat Battery, via the Double Pole Isolating Switch, min. 16 A.
8. If applicable, ensure the peak-off times are set correctly to the desired tariff, on the time switch.
9. If available press the BOOST button on the time switch
10. Continue to run the tap for a further two minutes, then close.
11. Check the front of the Heat Battery to ensure the “power” and “heating element” LED’s are lit
12. Allow the Heat Battery to charge for approximately 30 minutes with the hot water tap closed.
13. Please note that on first charge or when the Heat Battery has been deep discharged, the heating element will cycle ON and OFF for up to one hour, depending on the Heat Battery size. This is normal operation.
14. After 30 minutes open the hot water tap and check for hot water.
15. Adjust the Hot Water Tempering Valve, so that the output temperature is 45°C to 55°C.
16. Check hot water temperature at all hot water outlets in the dwelling with the customer and advise on temperature settings.
17. Ensure that the Heat Battery charges to half charge and that there are no lights flashing (which may otherwise indicate an error).
18. Leave all product information and literature with the customer/ end user.
19. Fill in and return the Sunamp Ltd commissioning certificate, provided with the product. These documents must be compiled and returned to Sunamp after installation.

## *INSTALLATION - Site*

The Figure 7 shows three different Thermino 70 e installed in three different demonstrations sites.

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Figure 7: Heat-battery installations in Terceira.

### *2.1.2 Electric water heaters (UniNova)*

Non-intrusive characterization and use of energy flexibility provided by electric water heaters.

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The Innovative Element "Non-intrusive characterization and use of energy flexibility provided by electric water heaters" allows the non-intrusive characterization and use of energy flexibility provided by electric water heaters, which can be considered to achieve objectives at both individual and aggregated levels. The information presented in this section describes the hardware required to collect data and control the electric water heaters providing the referred energy flexibility and the respective installation and commissioning at Terceira Island.

The main hardware component refers to the Smart Electric Water Heater Controller, which is an electronic device made of a network of sensors to i) monitor water flows and thermal energy stored in domestic electric water heaters; and ii) optimize the management of the electricity consumption. This hardware component consists of analogic sensors to acquire the temperature of the electric water heater, an analogic sensor for ambient temperature, a digital water flow meter, and a circuit to control the power supply of the electric water heater. The Smart Electric Water Heater Controller is dimensioned to operate with electric water heaters of up to 2.5 kW. Figure 8 (A and B) presents the outside and inside view of the Smart Electric Water Heater Controller, respectively.

The Smart Electric Water Heater Controller will allow the remote control of available energy flexibility, using the forecasting and optimization algorithms running at UNINOVA servers or the control signals sent by the iVPP, to improve PV self-consumption and reduce energy costs. Additionally, it can assume the local control of the respective electrical water heater in case the user prefers this option (or in case of Wi-Fi connection failure) or it can set the operation to factory thermostat mode.


*A (outside view).*

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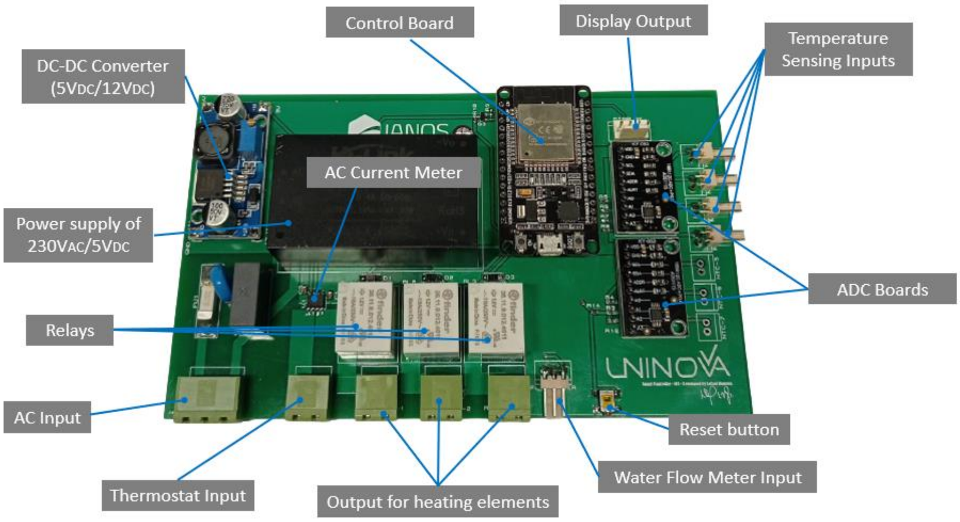


*B (inside view).*

*Figure 8: Smart Electric Water Heater Controller.*

During IANOS, the models needed to implement the non-intrusive solution will be validated using real data collected from five electric water heaters. Therefore, installation and commissioning work also considered the installation of five electric water heaters, which also contributed to increase the electrification of energy demand by replacing gas boilers. Figure 9 presents a 150 L electric water heater temporarily installed at UNINOVA facilities to conduct the preliminary tests described in deliverable D6.2.

Figure 9: Electric water heater temporarily installed at UNINOVA facilities to conduct the preliminary tests.

A total of four 150 L electric water heaters, and one of 100 L, have been shipped to Terceira Island. Figure 10 shows the equipment being picked-up at UNINOVA facilities, while Figure 11 presents an example of the Smart Electric Water Heater Controller already installed at one household in Terceira Island, from the five shipped (Figure 12). In this example, one can see the display offered by this solution, which shows the following information in real-time:

- Wi-Fi status (ON or OFF);
- Type of control, namely: TST (factory thermostat mode); AUT (automatic – when it operates locally, without orders from the UNINOVA server or from the iVPP); and EXT (External - when it operates according to the orders sent by the UNINOVA server or by the iVPP);
- Volume of water consumed since the beginning of the day; and
- Water temperature.


*Figure 10: Equipment pick-up at UNINOVA facilities.*


Figure 11: A Smart Electric Water Heater Controller already installed at one household in Terceira Island.


*Figure 12: Five Electric Water Heater Controllers.*

## *INSTALLATION - Configuration*

The respective electrical water heaters replaced gas boilers, contributing, therefore, to the electrification of energy demand. The remaining two buildings still require additional work to accumulate the replacement of existing water heating solutions.

In the referred three households, installation works started by the extraction of the existing gas boilers. Then, hydraulic installations, both, for cold and hot water, were

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adapted to receive the new electric water heaters. The final step in terms of hardware modifications concerned the addition of electricity meters given the need to measure total consumption and generation in real-time to conduct PV self-consumption improvement (i.e., store thermal energy by heating-up the water when PV surplus is available) and the integration of protective devices for IANOS solutions. Due to the lack of space on the existing electrical switchboards, additional switchboards, dedicated to IANOS solutions' protective devices and meters, had to be installed. Figure 13 presents the additional switchboards installed in one of the households (highlighted in blue). These replacement efforts, together with the adaption of hydraulic and electrical installations, were conducted by a local installer, under the supervision of UNINOVA team, which then configured the Smart Electric Water Heater Controller by 1) stablishing the required Wi-Fi connection; ii) calibrating sensors and converters; and iii) certifying the good operation of all components.

Figure 13: One of the installed switchboards for IANOS solutions' protective devices and meters (highlighted in blue).

### *INSTALLATION – Interface with other technologies*

The meter installed to collect each building's total demand and generation data refers to the Shelly 3EM, which interfaces with UNINOVA's servers using a local ESP32 powered microcontroller with integrated Wi-Fi capabilities so all power related data can be synchronized with Smart Electric Water Heater Controller data. Figure 14 presents the high-level representation of the Smart Electric Water Heater Controller interaction with external entities, where the forecasting and optimization algorithms are deployed at UNINOVA's servers or by the IANOS iVPP using ESB as interface.

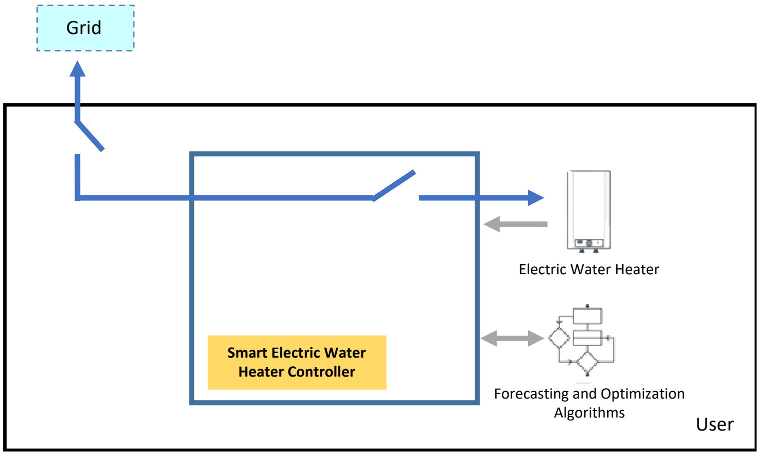


Figure 14: High-level representation of the Smart Electric Water Heater Controller interaction with the external entities.

Figure 15 and Figure 16 illustrate the data collected at one household. These data refer to a period short after the installation of the respective hardware. The presented data are being used to train the forecasting models and as baseline to assess the performance of the PV self-consumption improvement strategies. All data are synchronized thanks to the utilization of the referred local ESP32 powered microcontroller, with integrated Wi-Fi capabilities, as local gateway.

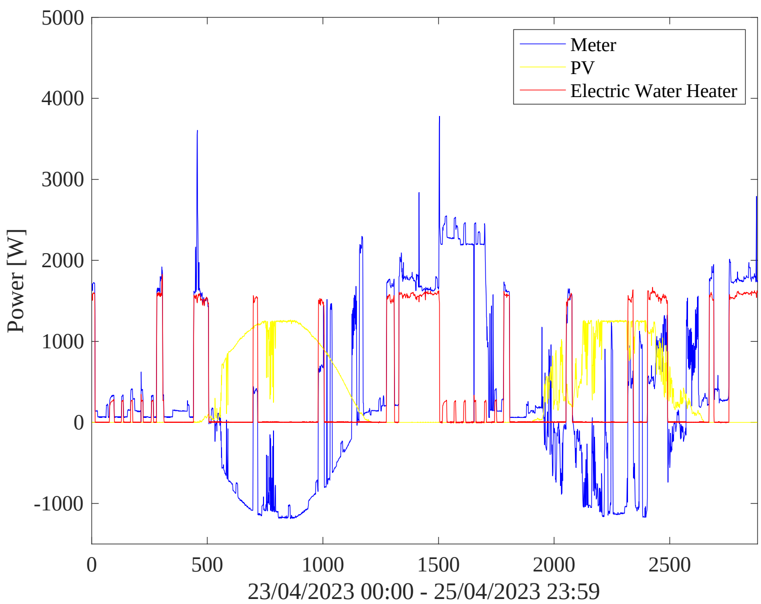


Figure 15: Illustrative power related data collected at a specific household.

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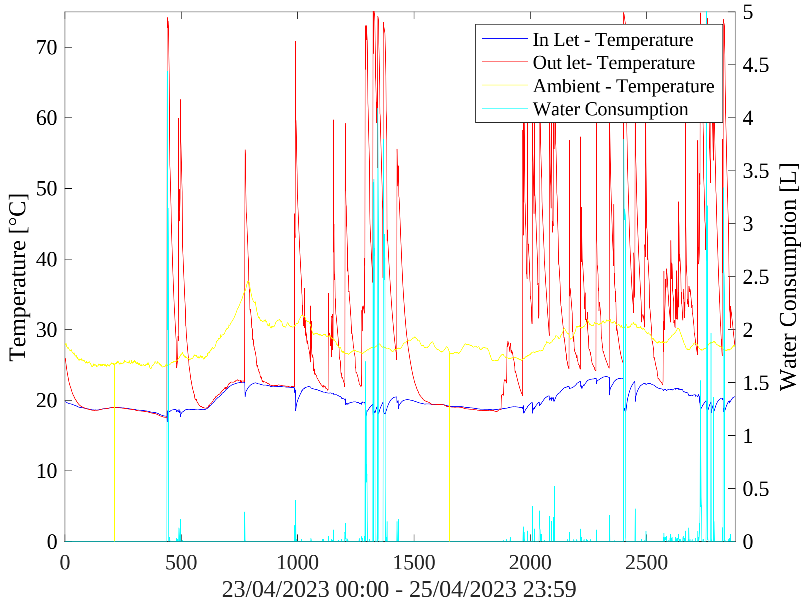


Figure 16: Illustrative water and temperature related data collected at a specific household.

### *INSTALLATION - Site*

Figure 17 presents the three systems already installed in Terceira Island. These refer to 150 L water heaters and their respective Smart Electric Water Heater Controllers. The remaining two systems are expected to be installed soon.

Figure 17: Systems already installed.

### *2.1.3 HEMS (Cleanwatts)*

To achieve the decarbonization objectives in islands as the IANOS project aims for. There are many key technologies that should be installed locally. These technologies were developed and improved as part of the IANOS project. To help and support homes in the Terceira Island to achieve the individual self-consumption and the self-consumption at community level, CWD developed some smart devices to be installed i.e. Kiome, and smart plugs. The devices were installed in 20 homes in Terceira Island are as follow (Table 4):

Table 4: The installed HEMAS kit and its accessories.

| Device | Qnt. |
|---|---|
| Kiome HUB (HEMS) | 20 |
| Kiome POWERPLUG V2 (HEMS plugs) | 40 |
| Shelly WiFi-operated Energy Meter+ContactorControl | 20 |
| Shelly Split Core Current Transformer 50A | 20 |
| Kiome- Ethernet Cable / Cabo de rede | 20 |
| Kiome- M4 Power adaptor | 20 |

In Terceira, there are two storage systems were adopted. One is the electrochemical battery, which is adopted in 8 homes. The corresponding architect of these homes is shown in Figure below (Figure 18):

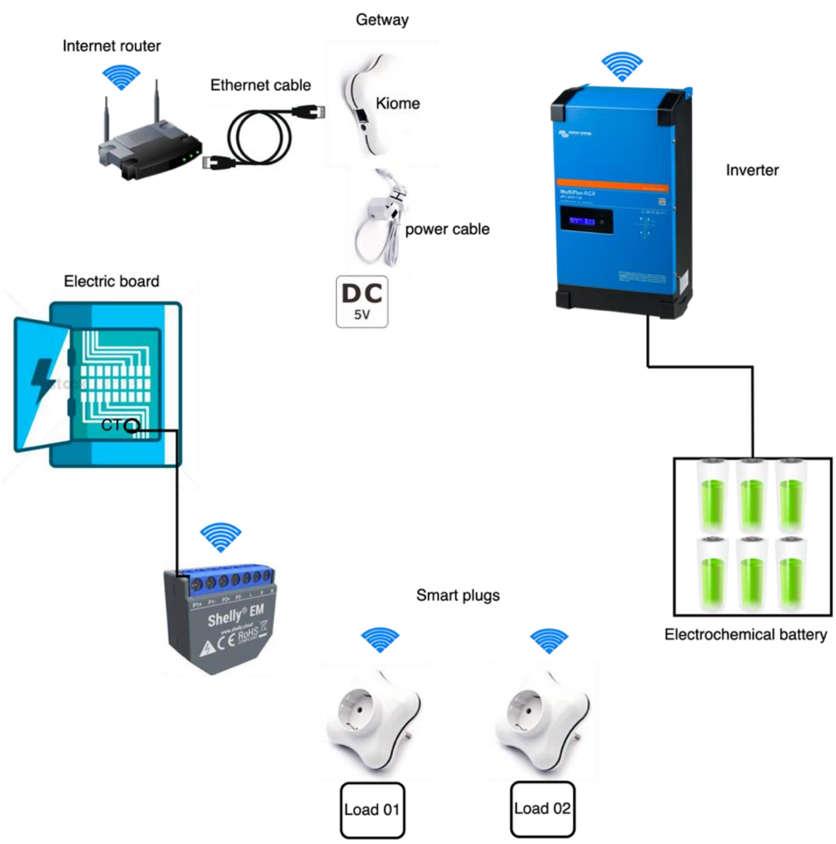


Figure 18: The system architect at the homes with electrochemical batteries.

As shown in the Figure above (Figure 18), the getaway needs to be connected via ethernet cable to the internet and it collects data from the local devices using the local IP address. Another storage system that was adopted in Terceira homes is the heat battery technology, which were installed in 12 homes. The corresponding architect of these homes is shown in Figure below (Figure 19):

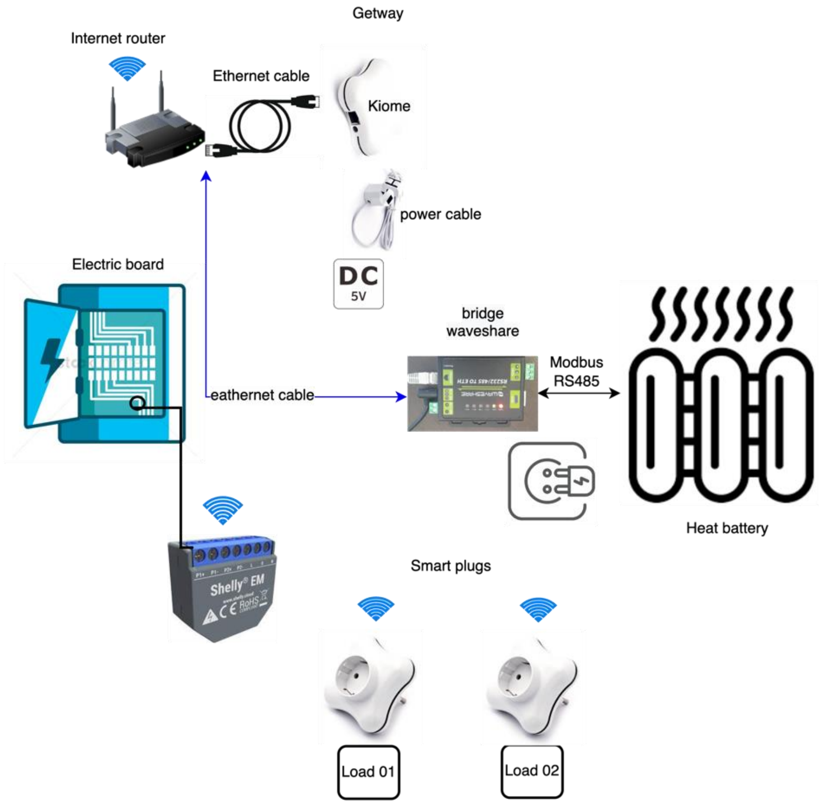


Figure 19: The system architect at the homes with heat batteries.

## *Kiome HUB V2 (HEMS)*

In the depicted figures below (Figure 20) is Kiome getway that has been installed and commissioned. The Kiome connected to the internet through Cloogy - Ethernet Cable and connected to the power source through Cloogy - M4 Power adaptor.


Figure 20: Kiome getway that has been installed and commissioned.

Through the getway the measurements from the local devices are obtained and transferred to the Kiplo platform to be visualised and processed by the Kiplo engine to send the optimum setpoints to the controllable assets.

### *Cloogy POWERPLUG V2 (smart plugs)*

The Smart plugs were configured to be connected to the internet via WiFi. The figures below (Figure 21) show some Smart plugs installations and commissioning.

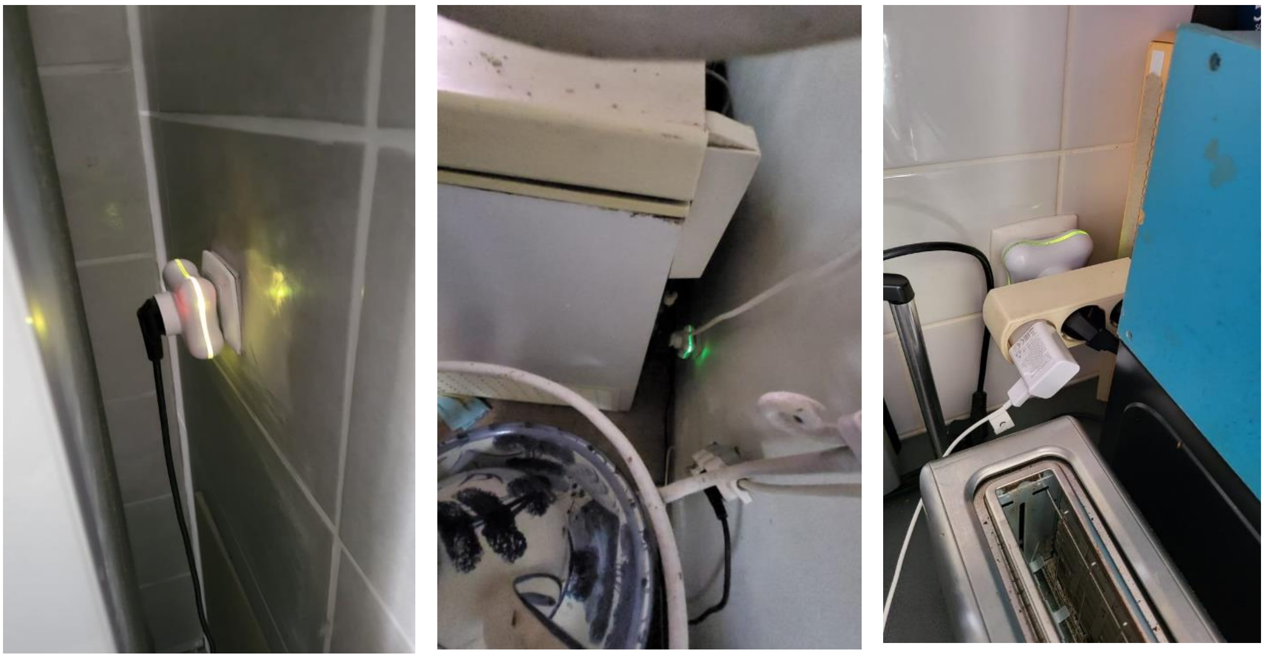

Figure 21: Smart plugs installations and commissioning.

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The smart plugs are connected to the controllable assets, which are managed by the Kiplo. The smart plugs are controlled to be ON/OFF. The smart plugs are collecting many measurements from the connected loads, such as voltage, current, power, etc.

### *Shelly WiFi-operated Energy Meter+ContactorControl*

To control and manage the local assets, it is important to get some grid measurements, such as voltage, current, and power. These measurements besides many other parameters are measured by the Shelly EM at the switchboard. Thee Shely EM is connected to the internet via WiFi. The collected measurements by the Shelly EM are transferred to the Getway. The figure below (Figure 22) shows some installations for the Shelly EM at the switchboard.

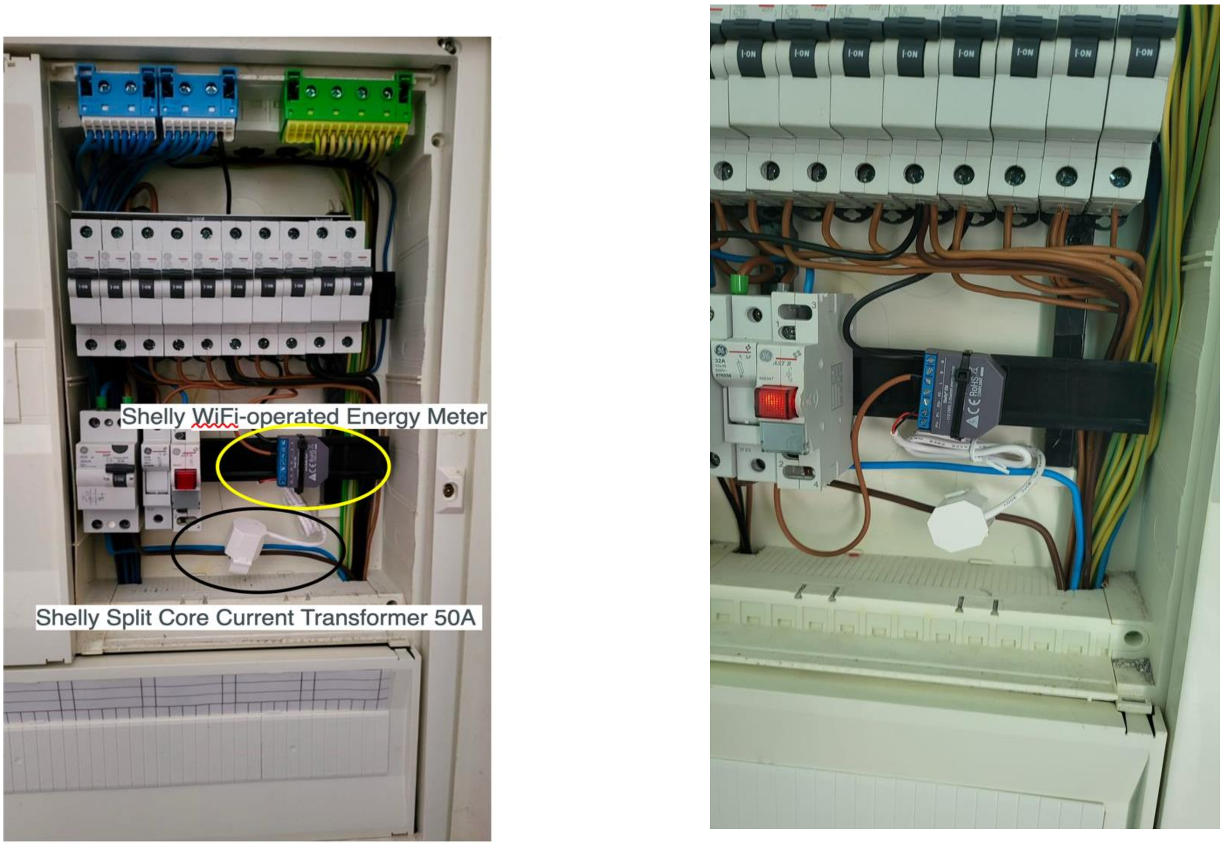


Figure 22: The Shelly EM installations at the switchboard and commissioning.

### *Victron inverter and electrochemical battery*

Victron/Gerbo Gx connected to the internet through WiFi (it is possible also through ethernet). The Victron measurements transferred to the Shelly EM through the WiFi internet connection and then to the Kiome hub (HEMS). The installation of the Victron

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inverter and its interface with the electrochemical battery is shown below. The DC terminals of the Electrochemical battery connected to the Victron inverter.

Figure 23: Installation and commissioning of the Victron inverter.

### 2.1.4 Smart energy router (UniNova)

### 2.1.5 Flywheel (Teraloop)

At time of this deliverable submission, the flywheel did not installed and commissioned yet but the Teraloop will install and commission its 100kW flywheel device during the course of the project, see Figure 24.

The Teraloop 100kW solution of a flywheel differs from conventional flywheel solutions by using a patented and prototyped hubless outer-rotor design. The typical limiting factor for conventional flywheels is radial stress. When radial stress is very low, this allows full utilization of the material tensile stress properties, and all carbon fibres can be wound in the circumferential direction. The Teraloop rotor is made from filament wound Carbon Fiber Reinforced Polymer (CFRP) as it has very high tensile strength in longitudinal direction [long axis of the fibres] ($\sigma t$) and very low density. Unlike conventional flywheels,

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the manufacturing process are ongoing and scalable up to several meters of rotor diameter. This permits significant reductions in the cost per unit energy stored. Within IANOS, the flywheel would be operated as a black box solution, performing the required adaptations so that its internal control systems are compatible with the externally developed dispatch algorithms of the iVPP, alongside its physical point of contact. The end customer is PRONICOL- PRODUTOS LÁCTEOS, S.A., part of the Dairy Product Manufacturing Industry. Located in Angra Do Heroismo, Portugal, Terceira an island in the Atlantic Ocean, Pronicol employs 248 employees at this location and generates $82.69 million in sales (USD). PRONICOL SA experiences interruption of the production lines, caused by the voltage dips events that reduces their production capacity and increases their cost of production. Responding to these challenges, Teraloop is proposing to Pronicol a solution that can answer and solves the above-mentioned problems, by integrating Teraloop flywheel achieving economic and technological benefits allowing Pronicol to overcome the shutdown events, sustain, lower the cost, and increase the volume of their production, adding to enabling them the possibility for participating in the frequency containment market with EDA in Terceira Island.

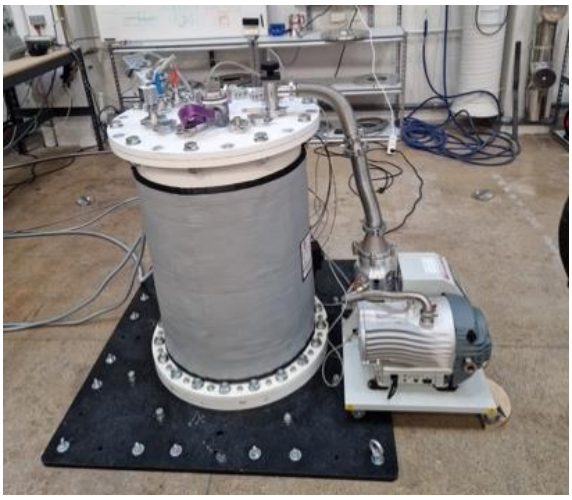

Figure 24: The Teraloop is shown in the picture below.

## *INSTALLATION - Configuration*

Teraloop's flywheel is providing as a black box solution, interfacing with the local energy infrastructure through its power electronics, which were originally planned to be provided by Siemens. Unfortunately, Siemens has provided lead times for this component which were not acceptable in order to complete the project in due time. Alternative solutions were sought from alternative providers (for motor inverter and grid side inverter). Those alternative providers are KEBA (DE), Danfoss (FI), VEO acting as system integrator and tailoring a specific solution for Teraloop (FI). Through this process, Teraloop will be able to provide the flywheel during the summer of 2023, mitigating the significant delays caused by the situation with Siemens.

### *INSTALLATION – interface with other technologies*

The containerised flywheel solution will be integrated on site, interfacing with the tailor made ESB of IANOS.

Before the installation, a reinforced concrete bed will be cast on site according to Teraloop's specifications. The electrical integration allows Teraloop to tune its response to the high level power fluctuations, thus avoiding the voltage sags that are damaging to Pronicol.

### *INSTALLATION -Final check*

The electrical integration allows Teraloop to tune its response to the high-level power fluctuations, thus avoiding the voltage sags that are damaging to Pronicol. Functionalities that need to be tested on site are: start-up and shut down procedures, safety functions including power outage events and emergency shut down, remote access to the control functionalities, guidance to local personnel on access policy and safety.

### *INSTALLATION - Site*

The installation site is Pronicol's premise, as shown in the picture below (Figure 25).

Figure 25: installation site is Pronicol's premises.

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### 2.1.6 V2G EV charger (EFAEM)

At time of this deliverable submission, the V2G charger did not installed and commissioned yet.

### 2.1.7 Hybrid transformer (EFACEC)

At time of this deliverable submission, the hybrid transformer did not installed and commissioned yet. Due to the nature and complexity of the work involved, Efacec EN will not delegate the integration and commissioning of the Hybrid Transformer to third parties. All the procedures and actions regarding the equipment deployment will be performed by specialised personal from the transformer manufacturer Efacec EN and from the distribution system operator EDA, according to the following Efacec EN internal guidelines that will include all the necessary installation and commissioning procedures:

- EDTE 64084 - Distribution Transformers Hermetically Sealed - Instructions
- AS23000738 – DVR Operation Manual
- AS23000739 – DVR Installation & Commissioning Manual
- Diagnosis DT v1 Technical Guidelines

In any case, the manufacturing of the hybrid transformer is behind schedule, so commissioning has not been possible as of June 2023.

### 2.1.8 Fog-Enabled Intelligent Devices – FEID-Plus (CERTH)

A 20 FEID-Plus devices were installed and commissioned in Terra-Cha neighbourhood in Terceira, at 20 respective households, according to D6.5. Before deploying the devices in the field, a FEID-Plus unit was sent to EDP's laboratory on July 29$^{th}$/2022 for testing the connection and controlling of the SUNAMP heat battery. The test was conducted to ensure the proper connection and control of the SUNAMP heat battery. The second test was conducted at the Laboratory of CWD at the end of October to verify the connection and control of the electrochemical battery. Both tests were successfully completed, and the testing results were stored directly in the Enterprise Service Bus (ESB). Specifically, the FEID-Plus device was able to effectively to monitor the measurements of both batteries, including the State of Charge (SoC), the temperature, the current and the voltage. Moreover, a series of tests were carried out to validate the control of the batteries by configuring predetermined setpoint values to their respective addresses by employing the Modbus-TCP protocol. The performance of the batteries was assessed through the continuous monitoring of the measurements, and the results were analysed to confirm if the batteries behaved according to the specific setpoint. The comprehensive details of the test and the outcomes are elaborated in document D6.2.

The commissioning process for the FEID-Plus is completed. In February 2023, 12 devices were sent to Terceira Island to be installed in residential properties along with required supplementary equipment i.e., smart energy meters and smart plugs. CERTH completed the development and dispatched another 8 devices (20 FEID-PLUS in total), on 24th April (arrived in Terceira on 5th May). For the installation of the FEID-Plus devices, a professional installer was needed (see detailed installation instructions in D6.5 ANNEX 2. Remote assistance is to be provided by CERTH if required.

Regarding the deviations encountered during the project's implementation, the original timeline had targeted completion of the commissioning phase during October 2022. The main setbacks for such delay had to do with: I) the prolonged process of identifying and engaging a local installer; ii) the development of supplementary technologies like the PV panels.

Furthermore, as part of the shipment of the FEID-Plus devices, an additional package has been included containing 20 Ethernet cables, 20 power adaptors, 20 shelly smart plugs, 20 shelly WiFi –operated energy meters, and 32 shelly split core current transformers (50A) that have been integrated with the FEID-Plus devices.

### *INSTALLATION - Configuration*

In order to configure the FEID-Plus, it is only required to establish a connection to the internet using an ethernet cable and to supply power through a power cable. No additional steps are necessary for the setup process. A more detailed description of the installation of FEID-Plus device is included in D6.5 Annex 2.

### *INSTALLATION – Interface with other technologies*

The FEID-Plus devices are to be integrated within the premises of 20 households in Terra Cha and communicate with the local infrastructure: i) two household batteries: the electrochemical battery and the heat battery; This connection is established using the MQTT TCP/IP protocol; ii) the shelly plugs, enabling FEID PLUS to manage local resources. The shelly smart plugs are connected to the internet, and the FEID-Plus device interacts with them through the REST endpoints provided by shelly. This allows the device to send ON/OFF commands. Similarly, the FEID-Plus device is connected to the shelly meter, which monitors household measurements, using the meter's API; iii) Additionally, the FEID-Plus device will be able to monitor BEON's solar panels power output through the Enterprise Service Bus (ESB).

## *INSTALLATION - Final check*

After the successful installation of the FEID-Plus device, CERTH has the capability to remotely access and monitor its functionalities via the Remote website. This online platform provides an interface that simplifies the process of remotely monitoring and controlling the FEID-Plus device from any location with internet connectivity. Consequently, it becomes possible to make adjustments to configurations and oversee different aspects of the device's operation. A visual representation in the form of a snapshot showcases (Figure 26) the monitoring of the already installed FEID-Plus devices within households.

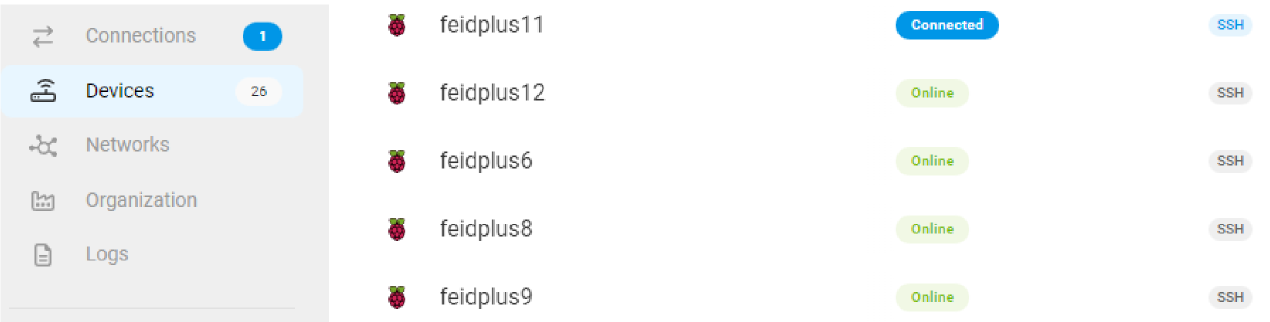


Figure 26: Remote monitoring of the installed FEID-Plus devices.

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# Conclusion

The "Terceira system commissioning report" successfully achieved the installation and commissioning of various technologies aimed at decarbonizing the island and accomplishing the respective use cases. As per the original plan, the majority of the technologies were installed and commissioned following rigorous testing at the EDP labs and the facilities/labs of the respective technology providers.

However, there were delays encountered with the V2G charger from EFAEM, the transformer from EFACEC, and the flywheel from TERALOOP. Efforts are currently underway to address these delays and resolve any interface/communication challenges that have arisen between certain technologies. We are systematically addressing these issues one by one.

Significant progress has been made in controlling some of the technologies to work towards achieving the project's objective. For more detailed information about the monitoring of technology operations, D6.8 report will provide comprehensive insights.

Overall, the "Terceira system commissioning report" highlights the successful installation and commissioning of most technologies while acknowledging the challenges faced and ongoing efforts to overcome them.