General Pilot Management Plan

D9.2

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Deliverable

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General Pilot Management Plan

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DISSEMINATION LEVEL

✔	**P**	**Public**
	C	Confidential, only for members of the consortium and the Commission Services

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Statement of Originality

This deliverable contains original unpublished work except where clearly indicated otherwise. Acknowledgement of previously published material and of the work of others has been made through appropriate citation, quotation or both.

Legal Disclaimer

Executive Summary

The present document is the Deliverable D9.2 "General Pilot Management Plan" of the TwinERGY project, funded by the European Commission's Innovation and Networks Executive Agency (CINEA) under its Horizon 2020 Research and Innovation programme (H2020).

The main objective of this deliverable is to be a guide in the pilot management at the different pilot sites. Each pilot faces similar tasks but will need to develop different approaches to fulfil these tasks. This is due to different local requirements and regulations. In relation to this, "local project manuals" have been prepared for each pilot to be used as a manual to fulfil the tasks and document the way it was accomplished. These "local project manuals" are designed as living documents, because local regulation could change, the approach to engage participants can be redesigned or even new experiments due to the development of the TwinERGY System may become necessary.

While the D1.5 "Project Management Handbook" relates to the overall project management, this deliverable focuses on the pilot's management. With the D9.1 "Pilot quality assurance guide", which marks the quality assurance procedures at the pilot sites, it delivers guidance throughout the pilot test phase.

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1 Introduction

1.1 Scope of the deliverable

This document is aimed at planning and documenting the pilot phase during the whole project time. It consists of a description of the pilot sites and demonstration activities, the objectives, expectations and processes of each experiment at the pilot sites, the pilot monitoring and reporting process, the communication needs and processes, the experiments and their technical management (hardware selection and integration), and the risk management process. Every planned experiment shall be defined within the Pilot Management Plan. Each pilot will be supported by local project manuals.

This deliverable has several overlapping contents with other related documents. First, there is D1.5, the "Project Management Plan", which is aimed to the PM of the whole project. Since the pilot sites cover a large part of the project, it is helpful, to define pilot specific processes in this separate deliverable. Deliverable D9.1 "Pilot Quality Assurance Guide" is also very close to D9.2. The execution of experiments and the correct installation of hardware, for example, are important topics for both the PM and the QA processes. Hence, these two deliverables complement each other. Deliverable 11.2 contains the public project communication strategy for the project. An efficient communication inside the communities is crucial for a successful pilot phase, since the participants have to be kept engaged over the duration of this phase. As a result, an overlap regarding communication with this deliverable is unavoidable and will tailor the strategies to each specific pilot site.

1.2 Structure of the deliverable

Since every pilot utilizes different equipment and has different needs, this deliverable takes this into account and keeps the parts that are expected to change over the course of the project in the "local project manuals" that are found in the annex of this document.

Chapter 2 describes the pilot sites, their main objectives, KPIs and expected outcomes. These are described for each pilot site in its own section. In chapter 3, the pilot monitoring and reporting process is addressed. The general communication needs with the pilot participants are described in chapter 4. The overall technical management of the pilot sites follows in chapter 5. In chapter 6, the planned experiments for the pilot sites are roughly described. Chapter 7 provides a description of the pilot risk management plan. Chapter 8 outlines the "local project manuals", which can be found in more details in the annex of the deliverable.

1.3 Reference documents

This document is based on the following reference documents:

- TwinERGY Grant Agreement No.957736
- Horizon 2020 AGA – Annotated Model Grant Agreement
- Horizon 2020 Online Manual: https://ec.europa.eu/research/participants/docs/h2020-funding-guide/index_en.htm
- D1.1 - "Project Management Handbook"
- D1.5 - "Project Management Plan"
- D2.1 - "Best practice guidelines for engaging citizens in the pilot and metrics for diversity and inclusion"
- D9.1 - "Pilot Quality Assurance Guide"
- D13.1 - "H - Requirement No. 1"
- D13.2 - "POPD - Requirement No. 2"

1.4 Abbreviation list

The main abbreviations that are used in this document are shown in Table 1.

Table 1: Abbreviation list

Acronym	Full Name
ARERA	Authority for Energy, Networks and Environment
EV	Electric Vehicle
GDPR	General Data Protection Regulation
H2020	Horizon 2020 programme
HEDNO	Hellenic Electricity Distribution Network Operator
HEMS	Home Energy Management System

IT	Information Technology
IoT	Internet of Things
KPI	Key Performance Indicator
PM	Project Management
SM	Smart Meter
OB	Objective
QA	Quality Assurance
RES	Renewable Energy Source
UK	United Kingdom
Wi-Fi	Wireless Fidelity
WP	Work Package

2 Description of the Pilot Sites

2.1 Pilot demonstration in Greece (Athens)

2.1.1 Location and main regulations

The Greek Pilot will involve a group of residential buildings belonging to the clientele of Mytilineos (counting over 280,000 consumers), used for experimental testing of new solutions and located in Athens, Greece. Apart from that charging stations located in the broader area of Athens' municipality will also be part of the Greek Pilot Site.

The distribution of electricity is operated by HEDNO (Hellenic Electricity Distribution Network Operator). The energy supply contract is negotiated between the customer and Protergia, the energy unit of Mytilineos. There is no option to create a real TwinERGY tariff system in the pilot phase. None of the houses that will be participating in the project has installed a photovoltaic system.

2.1.2 Main objectives, outcomes and KPIs

The main objectives of Mytilineos' participation in the TwinERGY project include profound benefits for both the participants and the energy retailer. More specifically, via the TwinERGY project the behaviour profiling of each individual consumer will be enabled, along with the extraction of highly accurate forecasts for the short- and mid-term. In addition, advanced analytics will be executed upon the collected information to enable the delivery of each individual consumer's flexibility profile (against varying electricity prices) and their capability to shed or shift the operation of specific loads to satisfy emerging needs of the electricity retailer. Such profiles will be jointly analysed and processed.

Furthermore, a main objective of the project aims towards enabling the realization of consumer-centric demand response programs. Detailed comfort profiles will be advanced to context-aware demand flexibility profiles to enable the realization of novel and engaging feedback mechanisms and semi-automated home management services, towards shedding or shifting demand away from high electricity price hours and, thus, satisfying in real-time emerging requirements for improving the energy performance of

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buildings according to the business needs of the electricity retailer, without compromising comfort of consumers or significantly affecting their daily schedules.

In conclusion, apart from the profound benefits for the consumers involved (regarding energy savings, energy cost reduction, comfort preservation, smart home services), the retailer is expected to enjoy significant optimization of its business processes and operations in terms of: (i) significantly reducing imbalances caused by forecasting errors, thus avoiding extremely high imbalance charges; (ii) examining advanced billing concepts (e.g. dynamic energy pricing) by segmenting, clustering and analysing consumption behaviours, inferring the elasticity of specific clusters against varying energy pricing levels and deploying highly effective implicit demand response strategies, towards optimizing the performance of the portfolio while hedging against non-anticipated imbalances; (iii) monitoring the compliance to Energy Efficiency obligations imposed by the European Commission and adopted by the Member States and designing appropriate demand response strategies and campaigns to achieve the anticipated targets; and (iv) analysing spatio-temporal patterns of the portfolio, identifying trends and outliers and receiving valuable knowledge for the design and delivery of added value services per individual customer or clusters of them to satisfy their needs for energy cost reduction through targeted innovative energy service bundles.

In summary the objectives, KPIS and expected outcomes are presented below:

Objectives

OB1. Deployment of home energy management devices to work with energy flexibility services, linking to the TwinERGY platform range of services support, including transactive energy functionality as and where applicable, and engagement of households in up to 20 homes

OB2. Flexibility modelling using digital twinning to understand buildings' potential to participate in flexibility services in up to 20 homes

OB3. Better understanding and responding to citizens needs in participating in energy flexibility programmes and deploying energy technologies through co-design methodologies and engagement

Outcomes

The outcomes from the pilot are listed below:

- Households have a better understanding and engagement around their home energy management
- Participants comfort health is preserved while energy efficiency is achieved
- Participants feel confident in how the project is using their data and for what purpose
- Residents participate in demand response programs to minimize energy costs and support grid balancing
- Data are retrieved from homes and analysed as part of evaluation activities
- Changed energy behaviour to more sustainable patterns
- Digital Twin produced for each building engaged in pilot to inform flexibility modules

KPI's

KPI 1

Description: Demand flexibility including EV loads

Metric 1. Reduction of peak load at point of common coupling per household / per EV charger.

Metric 2. Identifying number and rate of home appliances whose operation is adapted according to the demand response signals.

Metric 3. Average Energy Demand Reduction quantifying the average Energy Demand Reduction achieved through the deployment of various interventions. Interventions are associated to the several services deployed during the roll-out activities, therefore we need to link this KPI to each of those interventions.

Metric 4. Annual CO_2 Emissions Reduction, quantifying the Annual CO_2 Emissions Reduction per pilot, achieved once the roll out activities have finished.

KPI 2

Description: Penetration of dynamic energy tariffs.

Metric 1. Identifying how many households are willing to invest in dynamic energy tariffs.

Metric 2. Identifying performance of dynamic energy tariffs regarding how much money households can save and how flexible these tariffs would have to be to provide actual benefits. Cost reduction is to be measured.

KPI 3

Description: Participant's responsiveness.

Metric 1. Documenting the active participation rate and acceptance through user engagement activities.

Metric 2. Identifying participants' satisfaction through periodic surveys and feedback channels.

Metric 3. Pilot's dropout rate: Number of participants who decided to leave the experiment / Original sample size at the beginning of the pilot's rollout.

KPI 4

Description: Participant's Comfort Health

Metric 1. Operative Temperature: Temperature/ Humidity sensors available in pilot's residences, will help calculate Indoor Operative Temperature per Humidity level and Outdoor Temperature Conditions.

Metric 2. Operative illuminance: Luminance sensors available in pilot's residences, will help calculate indoor illuminance level. Considering that outdoor conditions affect the perceived level of luminance, we distinguish the analysis at daytime and night hours.

2.2 Pilot demonstration in UK (Bristol)

2.2.1 Location and main regulations

The Bristol pilot activities are concentrated primary in the south Bristol area Knowle West, however, other activities are taking place beyond this locality due to the non-geographic ties of the use cases. The focus of the pilot is on households with a range of levels of energy awareness from those who might not even have any understanding of a smart meter to those who are energy savvy and have a range of expertise and existing on site equipment.

The main regulations to consider are covered in WP2. In short, in the UK peer to peer trading is not currently possible on the open market place. Demand side response is active to some extent through providers who manage battery storage on a customers' behalf. Time of Use tariffs are emerging but there are currently limited options with only one dynamic tariff available through Octopus Energy on the market.

2.2.2 Main objectives, outcomes and KPIs

The pilot objectives were reviewed by pilot partners and updated in July 2021 to reflect more precisely the Bristol pilot goals. Objectives 1-3 received some updated wording. An additional objective was added to capture the pilots' community engagement intentions.

The focus of activity in the Bristol Pilot is to identify 12 households that have existing Solar PV installed and to increase the onsite usage of the generated energy. This will be achieved through adding in devices and hardware that will include both storage energy devices (batteries) and time appliances to work when grid intensity is lower through smart plugs. Energy usage optimisation will take place in each home to manage the batteries and smart plugs in a way that saves money for households and reduces carbon by ensuring they are charged and discharged at optimal times. The trial will involve a business case assessment to ascertain if these optimising technologies could be scaled up in a cost-effective programme across the city council's social housing portfolio.

Each of the homes will have a digital twin undertaken alongside a local community building and a University of Bristol building.

Objectives

OB1. Instalment or making use of existing home energy generation/storage assets to maximise self-consumption and self-sufficiency in up to 12 homes

OB2. Deployment of home energy management devices to work with energy flexibility services, linking to the TwinERGY platform range of services support, including transactive energy functionality as and where applicable, and engaging households in up to 12 homes

OB3. Flexibility modelling using digital twinning to understand buildings' potential to participate in flexibility services in up to 12 homes and up to 2 other large scale buildings

OB4. Better understanding and responding to citizens needs in participating in energy flexibility programmes and deploying energy technologies through co-design methodologies and engagement

Outcomes

The outcomes from the pilot are listed below:

- Residents maximize self-consumption and self sufficiency
- Households have a better understanding and engagement around their home energy management
- Participants feel confident in how the project is using their data and for what purpose
- Residents participate in demand response programs / smart energy tariffs to minimize energy costs and support grid balancing
- City Council has a better understanding of the potential value streams and benefits to residents in domestic dwellings
- Data retrieved from homes and analysed as part of evaluation activities
- Changed energy behaviour to more sustainable patterns
- Digital Twin produced for each building engaged in pilot to inform flexibility modules
- Instituting scenario-boarding to understand micro-generation/peer-to-peer market landscapes

KPI's

Note that the KPIs have been updated from the project bid to better reflect the local emerging delivery plan following the objectives review process.

- Households achieve a self-consumption ratio 42-60%
- The largest daily power consumption value is reduced by 25%
- The number of households receiving analysis about the impact of a dynamic price tariff on their household bills and carbon footprint at 12
- % of households agree or strongly agree that they would consider switching to a dynamic price tariff if it was shown to be beneficial
- Active participation rate through user engagement and acceptance; it measures the number of users actively participating in the pilots among those that initially accepted their participation (11 of 12 homes)
- Customer responsiveness; it measures the number of customers that have

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responded to a DR program following a DR signal sent to them, like a change in price (11 of 12 homes of participants to have responded)

- Demand Flexibility at 10%; it measures the increase of the amount of load capacity participating in demand side management
- Number of households who have self-reported a greater understanding of energy management in their home (12 homes)
- Number of households who have self-reported to have changed their behaviours around energy usage in their household (12 homes)
- Customer satisfaction of the project overall (9 of 10)

2.3 Pilot demonstration in Italy (Benetutti)

2.3.1 Location and main regulations

The Italian pilot is located in Benetutti, a municipality in the province of Sassari in the Sardinia region. The distribution of electricity on medium and low voltage power grid is granted by the Municipality itself, following a concession of the Italian Ministry of Productive Activities. The Energy contracts for the supply of the final customers still follow the so-called "servizio a maggior tutela" in which the Italian Regulatory Authority for Energy, Networks and Environment (ARERA) fixes the standard offer price at the beginning of each quarter. Table 2 shows an example of the main cost components in the energy bill while Table 3 indicates the time periods in which the different prices are in effect.

Table 2: Energy tariff example for Benetutti

1 January- 31 March 2021	**Matter energy**			**Transport and management of the meter**	**System charges**
Energy share (€/kWh)	*zone f1*	*zone f2*	*zone f3*		
January 2021	0,08702	0,07705	0,06194	0,00951	0,051823
February 2021	0,08691	0,07779	0,06337		
March 2021	0,07654	0,07256	0,05892		

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Fixed quote (€/year)	123,4376			25,4105	25,0860
Power share (€/kW/year)	-			31,2327	30,8340

Table 3: Tariff timezones for Benetutti

f1	*f2*	*f3*
8:00 - 19:00	7:00-8:00 19:00-23:00	00:00-7:00 23:00-24:00
from Monday to Friday	from Monday to Friday	from Monday to Friday
	7:00-23:00	Every hour
	On Saturday	On Sunday and on holydays

There is no option to create a real TwinERGY tariff system in the pilot phase; however, a test-case can be achieved involving a few existing structures and simulating the system for the other facilities involved. All 20 facilities participating in the TwinERGY project have a photovoltaic system installed, one of them has its private storage system.

2.3.2 Main objectives, outcomes and KPIs

The main objective of Benetutti's participation in the TwinERGY project is related to driving the municipality into its process of constitution of local energy communities. In order to do that, the population needs to get used to energy flexibility strategies such as the user-centric demand response programs of the TwinERGY platform. At the same time, the system operator needs to understand the possible critical issues and the countermeasures, also increasing the observability of the households and upgrading their monitoring and communication systems. These DR programs need to focus on the customers' energy profile and their forecast, but also on the user's comfort and on the dynamic variation of the energy price following the power grid necessities.

The project represents a good opportunity for the transposition of the European Directive - DIR (UE) 2018/2001[1] in promoting the use of energy from renewable sources. Moreover, Italy, and especially the Sardinia region, is inside the decarbonisation process of the thermal energy plants and the information and exploitation of the advantages of the distributed power generation and the energy sharing in the community to the population are some main results that need to be tackled.

[1] https://eur-lex.europa.eu/legal-content/IT/ALL/?uri=CELEX:32018L2001

Moreover, during the TwinERGY project, the municipal distribution system operator wants acquire an updated knowledge about the prosumers and the participants' availability into Demand Response programs. This information allows the municipality to understand where to invest in energy flexibility programs or build/reinforce grid power lines.

Objectives

OB1. Instalment or making use of existing home energy generation/storage assets to maximise self-sufficiency in up to 20 facilities

OB2. Deployment of home energy management devices to work with energy flexibility services, linking to the transactive energy platform and engaging households in up to 20 facilities

OB3. Flexibility modelling using digital twinning to understand buildings' potential to participate in flexibility services in up to 12 homes and up to 2 other large scale buildings

OB4. Better understanding and responding to citizens needs in participating in energy flexibility programmes and deploying energy technologies through co-design methodologies and engagement

Outcomes

- Residents maximize self-consumption and self sufficiency
- The Benetutti municipality acquires a better understanding of the potential value streams and benefits to the prosumers
- Participants feel confident in how the project is using their data and for what purpose
- Residents participate in demand response programs / smart energy tariffs to minimize energy costs and support grid balancing
- Data are retrieved from homes and analysed as part of evaluation activities
- Informed decisions are made about supplier and tariff choices
- Change behaviour is triggered to more sustainable patterns
- Decisions about taking a more active role (e.g. prosumer) and investing in energy systems are encouraged

- People become aware they can change their energy pattern without significant loss in comfort
- Digital Twin modules inform flexibility modules
- Households have a better understanding and engagement around their home energy management
- Households understand their energy issues/needs and feed this into the design of the system and pilot study generation and contribution to community schemes
- Scenario-boarding is instituted to understand micro-generation/peer-to-peer market landscapes

KPI's

- The RES share achieves a ratio of 85%
- Households achieve a self-consumption ratio of 85%
- The largest daily power consumption value is reduced by 20%
- The percentage of households agree or strongly agree that they would consider switching to a dynamic price tariff if it was shown to be beneficial
- Active participation rate through user engagement and acceptance at 95%; it measures the number of users actively participating in the pilots among those that initially accepted their participation
- Customer responsiveness at 90%; it measures the percent of customers that have responded to a DR program following a DR signal sent to them, like a change in price
- Demand Flexibility at 10%; it measures the increase of the amount of load capacity participating in demand side management
- Number of customers who self-reported a greater understanding of energy management in their home at 90%
- Number of customers who have self-reported to have changed their behaviours around energy usage in their household at 90%
- Customer satisfaction of the project overall at 9 out of 10

2.4 Pilot demonstration in Germany (Steinheim)

2.4.1 Location and main regulations

The German Pilot is located in the small village Hagedorn, which is part of the City of Steinheim in Westphalia. The grid is operated by the Westfalen Weser Netz GmbH. The

Energy supply contract is negotiated between the customer and the electricity supplier. There is no option to create a real TwinERGY tariff system in the pilot phase. Some of the houses have an own photovoltaic system, which size is only limited by the available place, power capabilities of the grid and the money to be spent. The self-produced energy can be used for self-consumption, while excess energy is fed into the grid. It is also possible to feed in all produced energy. During the pilot phase, a battery storage at the power station will be implemented and tested. The feed-in tariff will be around 3-6 ct/kWh, while the electricity from the grid will cost around 25ct/kWh.

2.4.2 Main objectives, outcomes and KPIs

The main objective of the German pilot is the demonstration of demand response in grids with high local renewable energy penetration. The developed technologies shall rise the local self-consumption ratio and the share of renewable energy used. The objectives shall be fulfilled by two different approaches, first the automated grid optimisation by technology and second the enabling of demand response by participants.

On technology level, a district based electric storage will be implemented and tested in relation to utilisation, impact on power patterns and self-consumption at the community level. Secondly, the integration of a local car sharing with bidirectional charging capabilities will be deployed. All technologies are controlled by a DER-Management, which includes real time grid state/penetration calculation, demand response actions, and a signal calculation for demand response by the habitants.

On community level, the education of the habitants in energy related topics is the main objective. The main content is the renewable energy production and consumption, not simply on an overall level but rather on local energy sources and already installed RES-Capacities. The consumers not only shall know their total energy consumption, but the knowledge of energy consumption patterns of themselves and of the community as a whole shall enable demand response actions by choice. Part of it is the environmentally friendly energy use and the benefits of using technologies such as smart metering and smart plugs.

Objectives

OB1. Utilising quarter-based storage

OB2. Employment of home energy monitoring/management and smart appliances to educate the end user

OB3. Utilising shared e-mobility to support the fuel switch

OB4. Utilising bidirectional smart charging to reduce the energy peak load and improve self-consumption

OB5. Utilising active participation in demand response initiatives to reduce the peak load and increase the self-consumption

Outcomes

The outcomes from the pilot are listed below:

- Maximize resident self-consumption and self sufficiency
- Let residents understand their energy issues/needs, feed this knowledge into the design of the system and pilot study generation and contribute to community schemes
- Let residents make informed decisions about supplier and tariff choices
- Change residents' behaviour to more sustainable energy demand patterns
- Encourage residents' decisions about taking a more active role (e.g. prosumer) and invest in energy systems
- Institute scenario-boarding to understand micro-generation/peer-to-peer market landscapes

KPI's

The KPIs presented below have been updated in the project bid to better reflect the local emerging delivery plan, following the objectives review process.

- The RES share achieves a ratio of 60%
- Households achieve a self-consumption ratio 42-60%
- The largest daily power consumption value is reduced by 20%
- The percentage of households agree or strongly agree that they would consider switching to a dynamic price tariff if it was shown to be beneficial
- Active participation rate through user engagement and acceptance at 95%; it measures the number of users actively participating in the pilots among those that initially accepted their participation

- Customer responsiveness at 90%; it measures the percent of customers that have responded to a DR program following a DR signal sent to them, like a change in price
- Demand Flexibility at 10%; it measures the increase of the amount of load capacity participating in demand side management
- Number of customers who self-reported a greater understanding of energy management in their home at 90%
- Number of customers who have self-reported to have changed their behaviours around energy usage in their household at 90%
- Customer satisfaction of the project overall at 9 out of 10

2.4.3 Options for participation

To meet the individual needs of all the participants, four different levels of participation are introduced. The inhabitants of the pilot are free to choose from these levels, which determine the amount of household data that are used and the pieces of hardware that are integrated.

The lowest level of participation is level 0. This level does not change anything in the household, no extra data is collected, and no hardware is installed. However, because the project uses publicly available grid data to which the level 0 user contributes, this very low-level tier is also defined. Information like the house orientation and the estimated energy consumption extracted from the grid data are collected. Since this information is collected from public information sources, no privacy violations occur.

The next tier, level 1, is the first level in which the participants actively contribute to the project. The first step is to fill a form with information about the house characteristics, the used appliances and the general behaviour regarding energy consumption. It is planned to install an energy information system, like a dashboard, which can be accessed via PC or mobile devices to monitor the community's energy consumption and provide a deeper insight into the behaviour over a day. Participants of level 1 are also eligible to use the car-sharing programme, which includes an electric car and a bidirectional charging station. They are free to use it as long as it is not occupied. Its usage is logged but no person-related information, such as the destination or driven routes, is collected. Instead, only the total driven distance and time is recorded. Furthermore, it is planned to organize additional information events and feedback meetings, where the participants get informed about the progress of the project and have the chance to ask questions on a face-to-face basis, since this is the most convenient way to discuss any issues. Any feedback from the households is appreciable in pilot development.

The participation level 2 builds upon level 1, thus the previous description also applies to the higher levels. This is the first level that integrates additional hardware in the households as part of the TwinERGY project. It is planned to provide the inhabitants with switchable smart plugs that can be used to optimize the energy consumption in terms of environmental friendliness. They can be used to switch on devices that are not time-critical at times when there is a high amount of regenerative energy available to make more use of these phases. To further incentivise this behaviour, an energy-traffic-light is installed in the level 2 households, which indicates the share of RES in the energy mix in real-time (red=low/bad, yellow= medium, green=high/good). The actual usage of this information remains with the end-user and is not controlled remotely.

The highest participation level is level 3. Additional to all the features of levels 0, 1 and 2, a smart metering device is installed in the house. With this device, it is possible to monitor the household's energy consumption over a day, providing the necessary tools to optimize the personal energy usage and to locate potential energy consuming devices that are not required to be running. For this, a personal dashboard for the household is accessible, where the energy related data is visualized.

During the project phase, it is possible for a household to transfer, at any time, to a higher or lower level of participation. A level 3 participant is not obliged to keep this status over the whole project period, if this does not fit to his/her needs and a level 1 participant can always switch to a higher level, if he/she is interested to explore and make use of the advanced capabilities of the TwinERGY project. In any case, all kinds of data collection are done in compliance with the GDPR.

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3 Pilot Monitoring and Reporting

3.1 Internal and external reporting

The internal and external reporting guidelines are described in Deliverable D1.5 and will be adapted for the pilot reporting as well. Changes in the local project manuals will be submitted with the periodic reporting cycles described in subsection 6.2.2 of D1.5.

3.2 Economic management

Budget allocation for the pilot sites is also described in the TwinERGY Grant Agreement, as well as in section 4.2 of D1.5. Additionally, all financial actions have to comply with local budget law of the corresponding country. These details are further described in the local project manuals.

4 Communication (participants)

This chapter describes the pilot related communication needs between humans. An effective communication strategy is important to both keeping the participants up to date with the progress of the pilot phase as well as being able to encounter problems fast and effectively. These two factors are very important to keep the participants engaged in the project and avoid the feeling of being left alone. Since all pilots have different demographic and geographic structures, there have to be individual solutions for the different communication needs. These are further described in the local project manuals. This section describes the general classes of communication.

4.1 Organisational communication

The organisational communication is the centrepiece of providing the participants with the latest information regarding the pilot progress and keeping them informed about upcoming events. These actions shall happen on a regular basis, so the participants feel informed about the project, which is an important factor to keep them engaged. Further, such regular information activities give the participants the opportunity to ask questions and discuss topics regarding the project.

4.2 Technical communication

The technical communication is another important aspect. It shall provide the participants with the ability to work with the technical appliances and understand how they work, to maximise the benefits gained by them. It will also make the work of the pilot partners easier, if the participants are able to deal with smaller technical issues themselves and are not dependent on the technical support for minor problems.

4.3 Feedback channel

A feedback channel is the possibility for the participants to be able to contact the pilot partners rapidly and effectively. Based on the age and technical skills of the participants, there can be different kinds of common channels, such as telephone or email. It is important that any requests are answered quickly, since requests may refer to technical problems, which should be resolved as promptly as possible.

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4.4 Pilot meeting and workshop organisation

During the lifecycle of the project, it is necessary that the partners involved in the respective pilot meet on a regular basis to discuss the performance of the pilot-site and consider possible changes to improve the outcomes. For more complex tasks and in order to better disseminate the current work status and the future developments, it may be advantageous to organise workshops to elaborate these further. The responsibility for the event (meeting or workshop) organisation lies with the pilot leaders. They should decide about the event type (meeting or workshop), its scheduling and advertising, the proper documentation and dissemination of its outcomes.

5 Technical Management

Each pilot needs a technical management to fulfil TwinERGY's needs. Due to the fact that, at each pilot site, the already installed hardware and the Use Cases differ, the technical management needs to resolve problems in different ways. This chapter describes technical management issues for the different pilots. First, each pilot needs to establish a stable communication with the IoT devices. Secondly, the hardware selection process and the installation of the hardware can be performed in different ways. The overall requirements are described in the sections below.

5.1 Communication (IoT)

In the TwinERGY project, a digital twin for consumers is developed. The digital twin needs reliable data sources, therefore each pilot needs solid communication among the sensing devices (Smart Meter, Smart Sensor) and the TwinERGY data management platform. The participants can use different technologies for their home network, therefore the solutions may need some sort of adaption whether to connect via Ethernet, Wi-Fi or other communication standards.

5.2 Hardware selection process

The hardware selection process needs to appoint sufficient hardware for the pilots. The three main points, which need to be complied with, are the technical requirements from the regulations, the TwinERGY system needs, and the participants needs (Figure 1). In addition, some favourable hardware may not be available, therefore an alterantive solution need to be considered in the selection process. Moreover, the seleced solution must be a GDPR compliant one.

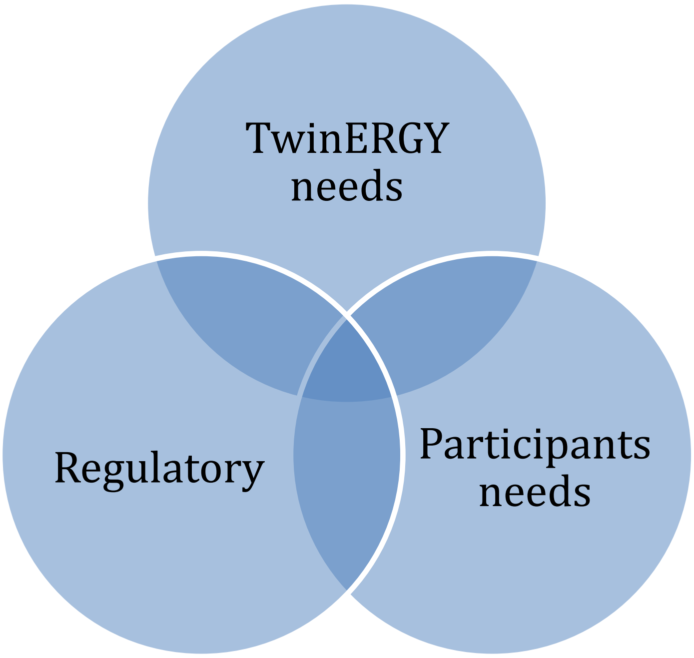

Figure 1: The three main attributes of the hardware selection process

5.3 Hardware installation

In relation to the selected hardware, the installation process can vary from pilot to pilot. The installation of some sensors and actors may be directly implemented by the users. Instead, other equipment, such as a smart meter, will need the involvement of a technician (electrician). During the installation process, the communication between the installer, the pilot team members, and the participant is very important and special care should be given to that by the pilot leaders and teams. Another issue of interest is the hardware retrenchment or, if possible, the retention of the hardware at the participants after project completion.

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6 Pilot Experiments

Over the lifecycle of the project, there are several experiments to be rolled out at the pilot sites to test the robustness of the installations, as well as the performance of the components. In the following sections, the expected experiments for the pilot sites are described. Since every community incorporates different technologies and has different goals, not all experiments might be feasible at every pilot site. The more specific experiments will be described in the local project manuals (see Annex of this document).

6.1 Communication (IoT) test

Efficient communication with the pilot sites' devices is key for a successful pilot operation throughout the project. Therefore, it is necessary to make sure the communicating devices work properly at all times. To test the robustness of the devices, the pilot leaders will create individual test scenarios depending on the used hardware.

Appliances under observation: Smart meters, smart plugs, any communicating devices

Objectives: Test the correct communication between appliances

Affected modules: M1, M4, M5, M7

Affected Pilot sites: All

6.2 Demand Response (DR) test

The application and evaluation of DR techniques is an important part of the TwinERGY project. As a result, it is important to measure the impact and reliability of demand response applications at the participating households. Since there are different approaches to reach that goal, the best suitable test procedures for each pilot site are to be chosen.

Appliances under observation: Smart meters, smart plugs

Objectives: Test the implementation and effectiveness of DR-strategies

Affected modules: M4, M5

Affected Pilot sites: All

6.3 Anomalies test

The intention of the anomalies tests is to find anomalies in the running system. The consumption pattern of a household might not be perfectly predicted, thus the measured values can deviate from the predicted ones. This could be induced by temporary unusual situations, such as a birthday party with many guests or the users' absence on a vacation. To check the system and its actions, anomalies like very low energy consumption or the cut-off of PV systems are provoked, and the system response will be analysed.

Appliances under observation: PV-Systems, large energy consumer, battery storage
Objectives: Checking the anomalies detection and countermeasure-procedures
Affected modules: M4, M5
Affected Pilot sites: All

6.4 Storage test

A battery storage is a powerful tool to increase the rate of used RES energy. To maximise the efficiency in communities, where batteries are installed, different loading strategies and the behaviour of the battery have to be tested and monitored. Depending on the size and the purpose of the storage (e.g. community-level or household-level), the outcome can be different in terms of optimal solutions for battery operation.

Appliances under observation: Battery storage units
Objectives: Checking the behaviour and performance of battery storage units
Affected modules: M5
Affected Pilot sites: Benetutti, Bristol, Steinheim

6.5 Digital Twin (DT) test

The implementation of the digital twins is the centrepiece of the TwinERGY project, as the name suggests. Therefore, it is of great importance to check the correct operation of the DT. To do that, the results provided by the DT platform have to be compared with real life measurements to evaluate its precision.

Appliances under observation: Digital twin platform
Objectives: Test the correct implementation and reliability of the digital twin
Affected modules: M2, M3
Affected Pilot sites: All

6.6 Transactive Energy Module test

The correct operation of energy transactions has to be monitored and assessed throughout the pilot-phase. Therefore, suitable test scenarios have to be implemented in this regard.

Appliances under observation: Battery storage units, smart meters

Objectives: Test the correct operation of energy transactions

Affected modules: M9

Affected Pilot sites: Benetutti, Bristol, Steinheim

7 Pilot Risk Management

7.1 Strategy

The pilot risk management is embedded in the overall project risk management described in in *D1.1 "Project Management Handbook"*. In this document, the general management strategy and its steps are described in detail and hold to a large degree for the project pilots too. The first risk management phase is the risk identification process, followed by the assessment, the elaboration of risk responses, and their continuous monitoring. A risk reporting plan is developed following the internal reporting process described in *D1.5 "Project Management Plan"*. This strategy is applied to the pilots risk management and focusses on technical/implementation risks, participation risks, and pilot management risk. Each pilot may face similar risks to other pilots, however the countermeasures may vary because of different regulations. Therefore, each pilot develops its own Pilot Risk Management Plan. All actions have to comply with the ethical principles stated in *D13.1 "H- Requirement No. 1"* and the GDPR stated in *D13.2 "POPD – Requirement No. 2"*.

7.1.1 Technical/Implementation risks

The pilots face several risks on the technical side. The data collecting process needs sufficient and reliable internet connection since most of the TwinERGY system will be delivered by online services. The risk responses may vary due to different available technologies at the pilot sites, such as Wi-Fi, Ethernet or mobile connections. Equipment that is already installed at the participants or the local grid needs to be integrated into the TwinERGY system. A local gateway could collect the data and set the connection to the TwinERGY system.

7.1.2 Participation risks

One of the main objectives of the TwinERGY project is the integration of consumers in demand response programs letting them be proactive energy users. This, in fact, requires participants that are willing to be part of the project. All pilots will face risks on the recruitment and engagement of participants during the project runtime. Participants may raise concerns about data protection and security, possibly resulting in reluctance or denial to participate in the pilots. Therefore, each pilot shall communicate the ideas and foreseen outcomes of the project, as well as clarify the roles of the participants in an appropriate way to gain the highest possible participation. Another point of interest is the participant engagement during the project runtime. With local workshops, the integration of ideas of the participants, and additional services, the pilot leaders may prosper in engaging participants in the long term. For further information on citizen engagement, see *D2.1 "Best practice guidelines for engaging citizens in the pilot and metrics for diversity and inclusion"*.

7.1.3 Management risks

The pilot management is a key ingredient for the whole project success. The project needs a testbed to run and optimise the TwinERGY approach, which is to be provided by the pilots. Pilot management risks, especially regarding the modules integration and the time requirements for the pilot execution, need to be continuously monitored and mitigated. Additionally, COVID-19 has various influences on the pilot management. First, local events need to comply with changing regulations and restrictions. Secondly, COVID-19 has an effect on the electronics production and transport, thus some of the required pieces of hardware may not be delivered in time. This whole process needs to be monitored by the pilots' management.

7.2 Pilot-specific risk management plans

The pilot-specific risk management plan represents the central repository for all identified pilot risk and is used as the main tool to support the risk management process. The risk management plan is maintained by the Pilot Leader with inputs mainly from the pilots' team members and is constantly updated as the pilot evolves. In practice, the pilot risk management plans consist of an Excel spreadsheet, which is based on the template for the project risk management described in *D1.1 "Project Management Handbook"*. As some pilot risks have already been identified in the project proposal phase by the consortium members (see DoA) and in the assessment of project risks in WP1, the emphasis here is on pilot-specific risks that the pilot team may face. These risks that have been identified in the pilot management plan development phase are classified, based on the risk category, and are presented in the Annexes of the present deliverable D9.2 "General Pilot Management Plan".

8 Local Project Manuals

The uniqueness of the pilot sites in the project requires different approaches to fulfil the TwinERGY mission. Therefore, creating a local project manual for each pilot site is useful. In this chapter, the scope of the local project manual is described and a structured template is presented.

8.1 Scope of the local project manuals

The local project manuals scope is to be built as a handbook to provide guidance in all pilot related tasks. The local project manuals are different to the deliverables submitted, because they focus on local issues. While D1.1 "Project Management Handbook" describes the project and risk management related to the whole project, the local project manuals shall describe the local pilot management, the local partners and the local lifecycle management. Additionally, some of the pilot risks foreseen in D1.1 need different approaches to minimise the effects in the different pilot sites. Deliverable D1.5 "Project Management Plan" handles the project management structure, resource planning and quality assurance for the project, but not in detail for the pilots. Therefore, a local management structure, resource planning and work plan shall be integrated in the local project manuals. Lastly, Deliverable D11.2 "Communication and Dissemination Plan" handles the overall project communication and dissemination strategy of the project, but every pilot needs a communication strategy with the participants at the pilot site, which fulfil the ethical requirements stated in D13.1 and D13.2.

Every pilot has its own regulatory and different technical equipment and different combination of Use Cases in the project, therefore each pilot needs different approaches and equipment to provide the functionality that the modules need. The local project manuals are living documents, as the circumstances can change. Every local project manual shall be updated (if necessary) by the pilot leader during the project lifecycle with addition and revisions, as appropriate and effective.

8.2 Structure of the local project manual

A template with the following index is provided to the pilot leaders. As a living document that may be revised in time, the structure can be adapted to the pilot leading partner's needs. The current structure has been developed based on discussions among pilot partners in the framework of WP9.

Table 4: Structure of the local project manuals

No.	Name	Content
1	Introduction	
1.1	Scope of the document	
1.2	Structure of the document	
1.3	Abbreviation list	
2	Management structure	The management structure of the pilot shall help the user to get local project partners, such as electricians or even colleagues of pilot leading partners.
2.1	Pilot Leader	Contact details of the pilot leaders
2.2	Pilot Team	Contact details of the pilot team members
2.3	Data protection officer	Contact details of the Data protection officer
2.n		Any local partner, such as the DSO contact or electrician can be added to the management structure
3	Work plan	Local work plan for the project planning, with hardware implementation times, local events (if applicable) to schedule the work which needs to be done.
4	Communication with participants	Any pilot needs sufficient communication with the participants, therefore all ways to communicate with the participants shall be mentioned in this chapter.
4.1	Organisational communication	The organisational communication section is for organising pilot related meetings with pilot partners, local partners and participants.
4.2	Technical communication	During the pilot test, different technologies, such as smart plugs, will be integrated in the participant's home. Despite a tutorial by the pilot team, some kind of support may be necessary and this shall be well organised.
4.3	Feedback channel	The pilot participants need a channel for feedback to the pilots partners. Therefore, a sufficient way in relation to the participant's efforts shall be mentioned here.
5	Technical Management	One of the biggest parts in the pilot phase is the integration of hardware to establish demand response possibilities. Therefore, a technical management is necessary. All technical related information, like how to select hardware, how to communicate with the IoT

		devices, how the hardware is installed and other technical topics shall be mentioned in this chapter
5.1	Communication (IoT)	The data collection process needs sufficient communication to the TwinERGY backend. This section describes the solutions, which enable this communication in the pilot.
5.2	Hardware selection process	Every pilot has a different approach on selecting hardware. This section describes this process.
5.3	Installing Hardware	This section describes the hardware installing process.
6	Experiments	This chapter is dedicated to the description of the experiments at the pilot site.
6.n	Experiment n	Description of experiment n.
7	Risk management	Each pilot can have different risks and countermeasures against them.
7.1	Social/Communication risks	
7.2	Technical risks	
7.3	Risk table	

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9 Conclusions

The General Pilot Management Plan provides a guide for the pilot management at the different pilot sites. While there are general management needs that are similar in all pilots, there are also pilot specific needs that are due to different pilot activities, participants involved, local requirements and regulations. For this reason, "local" pilot project manuals are developed for each pilot to be used as a manual to assist the pilot work the documentation.

The report provides description of the pilot sites and the demonstration activities, referring to the locations and main regulations as well as the main objectives of each pilot. It further refers to the pilot monitoring and reporting process as well to the communication among participants including the organizational communication, the technical communication, the feedback channel, and the organization of pilot meetings and workshops. Other important aspects of the pilot demonstrations that are described in this management report concern technical issues (e.g., communication via IoT, hardware selection and installation) and issues regarding the experiments to be executed. Finally, the important issue of risk management is analysed in terms of pilot risk identification/assessment and response management plans. The main risks associated with the pilots fall within the categories of technical/implementation risks, participation risks and management risks.

The report is accompanied by risk management plans for each individual pilot site. The aim is to incorporate the special characteristics and the management needs of each site. Because of the dynamic nature of the pilot implementation and the potential need for amendments that make the pilot objectives and work realizable (e.g., regulations, participant engagement, experiment redesign, etc), this report is considered as a living document, indicating that updated versions of it may be developed later on, if and whenever it is deemed necessary.

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Annexes

Annex 1 - Local Project Manual: Athens

TWIN ERGY

Local project manual

Pilot Athens

August 2021

Document

PROJECT ACRONYM	GRANT AGREEMENT #	PROJECT TITLE
TWINERGY	**957736**	**Intelligent interconnection of prosumers in positive energy communities with twins of things for digital energy markets**

Local project manual – Pilot Athens

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1 Introduction Local Project Manual

1.1 Scope of the document

The intention of the "Local Project Manual" is to function as an assistant in pilot related questions. While the D9.2 "General Pilot Management Plan" contains all general pilot management requirements, the "Local Project Manual" describes the ways these requirements were met at the pilot site. Additionally, all risk, which were foreseen by the pilot's leading partners, are analysed and countermeasures elaborated.

This document is a living document, so by the time and progress of the pilot implementation, new chapters about hardware support, technical support partners (electrician for implementation or such) can be added.

1.2 Structure of the document

This document is structured in six chapters. Chapter 1 describes the scope, structure and contains the abbreviation list. All functional persons, such as the pilot leader and data protection officer, are mentioned in Chapter 2. Chapter 3 contains the work plan of the pilot's activities. Chapter 4 describes the communication with the participants at the pilot's site and chapter 5 the technical issues (technical communication, hardware selection, etc.). The last chapter contains the risks at the pilot site.

1.3 Abbreviation List

Table 5: Abbreviation list

Acronym	Full Name
ADSL	Asymmetric Digital Subscriber Line
ARERA	Authority for Energy, Networks and Environment
ESS	Energy Storage System

EV	Electric Vehicle
GDPR	General Data Protection Regulation
H2020	Horizon 2020 programme
HEDNO	Hellenic Electricity Distribution Network Operator
HEMS	Home Energy Management System
ICC	Incentive Curve
IT	Information Technology
IoT	Internet of Things
ITM	Internet Terminal
KPI	Key Performance Indicator
PM	Project Management
SFTP	Secure File Transfer Protocol
SM	Smart Meter
SP	Smart Plug
SS	Smart Sensor
OB	Objective
QA	Quality Assurance
QEMS	Quarter Energy Management System
RES	Renewable Energy Source
UK	United Kingdom
USB	Universal Serial Bus

Wi-Fi	Wireless Fidelity
WP	Work Package

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2 Management structure

2.1 Pilot Leader

Yet to be defined.

2.2 Pilot Team

Yet to be defined.

2.3 Data protection officer

Yet to be defined.

3 Work plan

3.1 Pilots Gantt chart

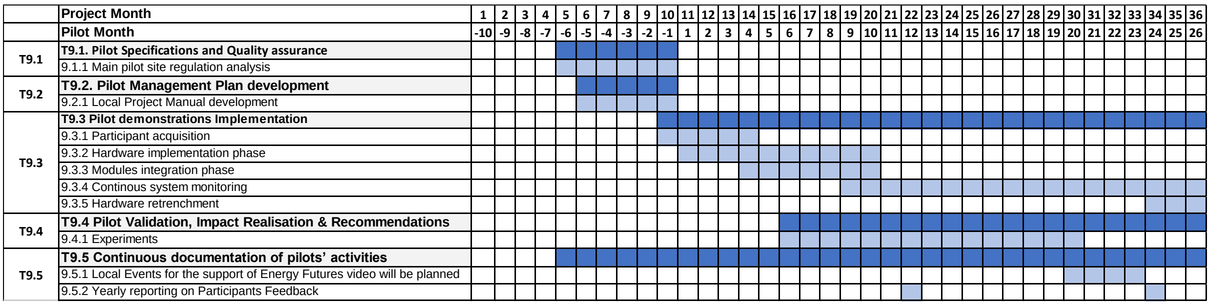

Figure 2: Pilots gantt chart

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4 Communication with participants

4.1 Organisational communication

Information meetings are planned for all participants on a regular basis.

These events are meant to take place digitally, as there seems to be an open communication already established within the selected pool of pilot users.

A regular newsletter, maximum on a bimonthly basis, will inform the participants about the progress of the project. This includes energy statistics, changes on the platform and other noteworthy information.

For needs that concern a single person or household, e.g. the installation of a smart meter, personal email conversations will of course also be possible, to ensure the individual needs of every participant are also met at every time.

4.2 Technical communication

The technical communication will be provided via the same channels as the organisational communication.

Additional to that, both the equipment and the solutions that will be tested, will be thoroughly explained to the pilot users, to ensure maximum engagement and smooth operation.

4.3 Feedback channel

As a feedback channel, the email address alexandros.vavouris@mytilineos.gr will be used to ensure an easy and fast way to reach out to the TwinERGY team. Any email sent to this address reaches the project partners at Mytilineos. Every request, that is made shall be answered in no less than three working days.

This provides a fast and focussed communication with individual inhabitants.

If topic occurs that affect not only the individual requester, but the whole community, they will be communicated via the usual communication channels like the meetings or the newsletter.

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5 Technical Management

5.1 Communication (IoT)

The different devices such as smart plugs or smart meters are connected over the local area network via Wi-Fi or cable network depending on the most convenient solution.
The HEMS is also connected to the internet, as features like the demand response devices need information from the TwinERGY server to work correctly.
Also, data like energy consumption has to be communicated outside to allow the digital twins to work properly and react to dynamic changes as fast as possible.

5.2 Hardware selection process

For every household the used hardware will be tailored to the inhabitants needs and wishes.
EV Charging Stations are planned to be installed and the energy metering and ambient data control devices already installed within the premises of the participants will also be involved in the project.

5.3 Installing Hardware

The installation process of the hardware at the pilot site includes the following steps. Presentation of selected hardware and explanation of its capabilities, usage, benefits.

On site visit, via selected partner of Mytilineos, for survey and installation of the equipment along with a thorough explanation of its use, once again, to ensure that the pilot participant's questions are all answered.

Workshop and newsletter to enable a smoother transition of the participants into their involvement in the Project.

6 Experiments

6.1 Communication (IoT) Test

To ensure the communication with installed equipment in the premises of the pilot users constant communication with the users will be maintained.

6.2 DR Response Test

Yet to be defined.

6.3 Anomalies test

Based on the base-data a forecast for the household (for consumption) is provided via the digital twin. These predictions are continuously compared with the current measured values for this test. As soon as significant deviations occur, the algorithm detects an anomaly and issues a warning signal. For the experiment, anomalies are actively produced.

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7 Risk management

7.1 Social/Communication risks

The biggest risk in the Greek pilot site lies in the recruitment process. Most of the participants that are contacted maintain a certain lack in trust regarding the equipment and the solutions that will be tested in their premises.

Regular workshops and informational meetings shall help mitigate any concerns that are held by inhabitants by addressing them directly so that uncertainties and worries among the participants regarding project activities are minimized.

7.2 Technical risks

Three main technical risks are foreseen. First of all, communication errors, such as unstable internet services or non-reachable online services. This is the main risk for the TwinERGY pilot phase. The implemented smart meters have a separate backup-strategy, therefore no data loss is foreseen during communication errors. But the TwinERGY services and real-time control will be set in safe operation modes if the connection to the equipment is lost. The connection will be tested during the installation process and will be monitored during the pilot phase. Secondly, an operating error could occur. This will be minimized by good instructions. Additionally, the participant can get annoyed by the project and could want to end his participation. The pilot leading partners will encourage the participants during the whole pilot phase by a steady flow of information during the pilot phase on energy topics, the process and results of the experiments, and public events.

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7.3 Risk table

No. Risk	Risk category	Risk type	Description	WPs affected	Likelihood	Severity	Risk Level	Proposed mitigation measures	Respnsible partner(s) for mitigaiting risk
1	Management risk	Integration delay	Delay in the integration and deployment of the solution may happen due to diverse factors.	WP9, WP8	Low	Medium	Low	contionous monitoring of the implementation progress to find delays as soon as possible.	
2		Hardware shortage or Delivery Delays	Shortage of selected hardware or delivery delays, as COVID has an impact on the availability of electronics.	WP9	High	High	High	As soon as possible, the hardware will be orderd to have knowlege of the delivering time. If the selected hardware is not available in time, other hardware, which suits the requirements, will be selected.	
3	Technical risks	Integration testing failures with devices and smart grid assets	Failures happening in the process of integration of field devices and distributed smart grid assets.	WP9, WP8	Medium	High	High	Establishment of a clear plan with responsibilities distribution related to the correct implementation of the described assets/devices.	
4	Participation risks	Participant shortage	Shortage of participants at the pilot site	WP9	Medium	High	High	Starting with online workshops, we encrage the possible participants to interact with the pilot team before pilot start, so most of them know the pilot team. Secondly, all concerns against the pilot approach can be reduced or solved before the pilot start is terminated.	
5		Availability of Results needed for evaluation	Unforeseen cirmustances cause limited outputs for evaluation against KPIs and considering impact of exploitation as planned.	WP9, WP10	Medium	Low	Low	Focus on "quick wins" through prioritisation of Ucs to ensure tangible outcomes for some KPIs	
6		Communication issues	We do not find the right channels to communicate and engage the consumers to the project	All	Low	Medium	Low	There is a good practices share among all pilots. We ensure that open communication and transparency is supported.	

Figure 3: Pilot Risk Table

Annex 2 - Local Project Manual: Benetutti

Local project manual

Pilot Benetutti

August 2021

Document

PROJECT ACRONYM	GRANT AGREEMENT #	PROJECT TITLE
TWINERGY	**957736**	**Intelligent interconnection of prosumers in positive energy communities with twins of things for digital energy markets**

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v1.0	31.08.2021	Fynn Christian Bollhöfer	TH OWL	Template

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1 Introduction Local Project Manual

1.1 Scope of the document

The intention of the "Local Project Manual" is to function as an assistant in pilot related questions. While the D9.2 "General Pilot Management Plan" contains all general pilot management requirements, the "Local Project Manual" describes the ways these requirements were met at the pilot site. Additionally, all risk, which were foreseen by the pilot's leading partners, are analysed and countermeasures elaborated.
This document is a living document, so by the time and progress of the pilot implementation, new chapters about hardware support, technical support partners (electrician for implementation or such) can be added.

1.2 Structure of the document

This document is structured in six chapters. Chapter 1 describes the scope, structure and contains the abbreviation list. All functional persons, such as the pilot leader and data protection officer, are mentioned in Chapter 2. Chapter 3 contains the work plan of the pilot's activities. Chapter 4 describes the communication with the participants at the pilot's site and chapter 5 the technical issues (technical communication, hardware selection, etc.). The last chapter contains the risks at the pilot site.

1.3 Abbreviation List

Table 6: Abbreviation list

Acronym	Full Name
ADSL	Asymmetric Digital Subscriber Line
ARERA	Authority for Energy, Networks and Environment
ESS	Energy Storage System

EV	Electric Vehicle
GDPR	General Data Protection Regulation
H2020	Horizon 2020 programme
HEDNO	Hellenic Electricity Distribution Network Operator
HEMS	Home Energy Management System
ICC	Incentive Curve
IT	Information Technology
IoT	Internet of Things
ITM	Internet Terminal
KPI	Key Performance Indicator
PM	Project Management
SFTP	Secure File Transfer Protocol
SM	Smart Meter
SP	Smart Plug
SS	Smart Sensor
OB	Objective
QA	Quality Assurance
QEMS	Quarter Energy Management System
RES	Renewable Energy Source
UK	United Kingdom
USB	Universal Serial Bus

Wi-Fi	Wireless Fidelity
WP	Work Package

2 Management structure

2.1 Pilot Leader

Yet to be defined.

2.2 Pilot Team

Yet to be defined.

2.3 Data protection officer

Yet to be defined.

3 Work plan

3.1 Pilot Gantt chart

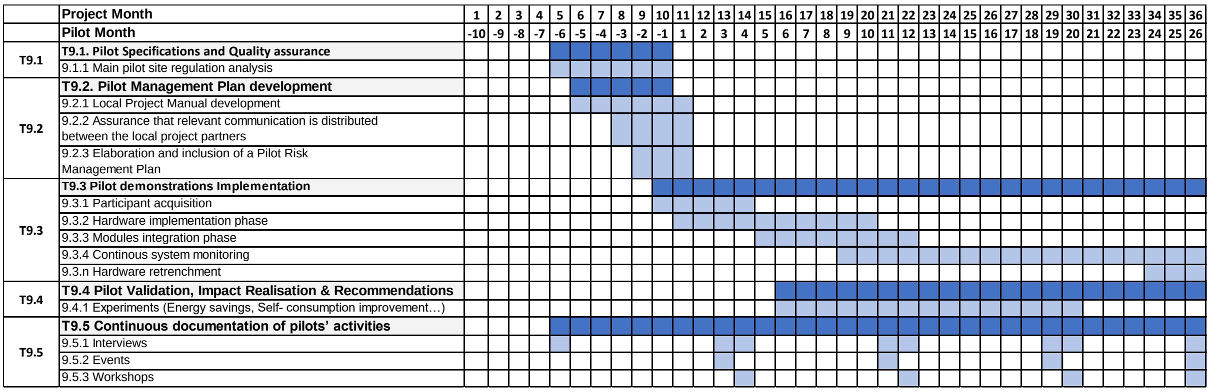

Figure 4: Pilots gantt chart

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4 Communication with participants

4.1 Organisational communication

It is planned to organize information meetings for all participants on a regular basis.
These events are meant to take place in person and not digital, because it makes the communication easier and allows the inhabitants to share their experiences during the project phase.
A regular newsletter will inform the participants about the progress of the project. This includes energy statistics, changes on the platform and other noteworthy information.
All information events and presentations will be recorded and uploaded to a public webserver. In this way, the participants can rewatch any past events if they couldn't attend to the live-meeting or if they are looking for some information provided at these events.
For needs that concern a single person or household, e.g. the installation of a smart meter, personal email conversations will of course also be possible, to ensure the individual needs of every participant are also met at every time.

4.2 Technical communication

The technical communication will be provided via the same channels as the organisational communication.
Additional to that, several tutorial videos will be made in which the different pieces of hardware are explained in detail. These videos will also be available on a web server for easy access. Additional to that, the equipment and the solutions that will be tested will be thoroughly explained to the pilot users during a live meeting to allow a questions and answers session.

4.3 Feedback channel

As a feedback channel, the email address lillino.sini@gmail.com and Twinergy@stamtech.com have been currently selected to ensure an easy and fast way to reach out to the STAM TwinERGY team. Every request, that is made shall be answered in no less than three working days.
This provides a fast and focussed communication with individual inhabitants.

If topics occur that affect not only the individual requester, but the whole community, they will be communicated via the usual communication channels like the meetings or the newsletter.

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5 Technical Management

5.1 Communication (IoT)

The different devices such as smart plugs or smart meters are connected over the local area network via Wi-Fi or cable network depending on the most convenient solution.
The HEMS is also connected to the internet, as features like the demand response devices need information from the TwinERGY server to work correctly. Also, data like energy consumption or production has to be communicated outside to allow the digital twins to work properly and react to dynamic changes as fast as possible.

5.2 Hardware selection process

For every household, the used hardware will be tailored to the inhabitants needs and wishes.
The central baseline for the optimal selection of the hardware will be the level of participation. For example, the use of smart metering devices is only planned for level 3 participants.
Based on their level and the appliances in the household, the team will look into the houses profile, provided by the questioning form from level 1 on, to judge, which devices could be used effective in this specific household. If it is planned to implement a smart energy production-based control of a washing machine, not every model has the capability to work easily with a smart plug. Things like this have to be considered in the hardware selection process as well.

5.3 Installing Hardware

The installation process of the hardware at the pilot site will be set in 7 steps. First of all, the pilot leading partners will present the selected hardware in public meetings and will talk about their functionality, what they can do with it and where it can help to reduce their energy bill or provide flexibility. For all who are not able to visit the meeting or have questions during the installation and use phase, a tutorial for each hardware will be produced in an appropriate way (video, document, etc.). The following steps (3-6) will be necessary for the participation level 3, because an electrician is needed for the installation of the smart meter. The third step is to identify the state of the electrical installation at the participants to integrate the smart meter. This could either be done by a structural survey or via photos by the participant. The next step is the selection of a technical local to integrate the hardware. It is followed by the process to arrange the appointments between the participants and technicians for the installation of the hardware, which will be supervised by the pilot leading partners. After the installation (Step 6), a first briefing will be held with the participants (Step 7).

6 Experiments

6.1 Communication (IoT) Test

Yet to be defined.

6.2 DR Response Test

Yet to be defined.

6.3 Anomalies test

Yet to be defined.

7 Risk management

7.1 Social/Communication risks

The biggest social risk in the Italian pilot site lies in the active participation of the people in the project. Some participants are elderly people, who have little knowledge about the technology and could easily lose patience and interest in the project.

Regular workshop and physical information events shall help mitigate any concerns that are held by inhabitants by addressing them directly so that uncertainties and worries among the participants regarding project activities are minimized.

7.2 Technical risks

Four main technical risks are foreseen. First of all, communication errors, such as unstable internet services or non-reachable online services. This is the main risk for the TwinERGY pilot phase. The implemented smart meters have a separate backup-strategy, therefore no data loss is foreseen during communication errors. But the TwinERGY services and real-time control will be set in safe operation modes if the connection to the equipment is lost. The connection will be tested during the installation process and will be monitored during the pilot phase. Secondly, an operating error could occur. This will be minimized by good instructions. Third, if the project installations and implementation phase take too long, the time for test will be lower. Additionally, the participant can get annoyed by the project and wants to end his participation. The pilot leading partners will encourage the participants for the whole pilot phase by a steady flow of information during the pilot phase on energy topics, the process and results of the experiments, and public events.

7.3 Risk table

No.	Risk category	Risk type	Description	WPs affected	Likelihood	Severity	Risk level	Proposed mitigation measures	Responsible partner(s) for mitigaiting risk
1	**Management risk**	implementation time issues		no	Low	Medium	**Low**	contionous monitoring of the implementation progress to find delays as soon as possible.	pilot leaders
2	**Technical risks**	hardware shortage	Shortage of selected hardware, as COVID has an impact on the availability of electronics	no	High	Medium	**High**	As soon as possible, the hardware will be orderd to have knowlege of the delivering time. If the selected hardware is not available in time, other hardware, which suits the requirements, will be selected.	pilot leaders
		Poor internet connection	Benetutti is a small and remote municipality which can suffer of poor internet connection	no	Medium	High	**High**	Speedtests will be performed and whenever is necessary Wi-Fi extender and/or stand-alone router with SIM will be installed to fulfill all the project communication requirements. Moreover, a local buffer of memory or a cloud based features in the monitoring system will backup the data related to additional communication issues.	pilot leaders
3	**participation risks**	participant shortage	Shortage of participants at the pilot site	no	Medium	High	**High**	Starting with online workshops, we encurage the possible participants to interact with the pilot team before pilot start, so most of them know the pilot team. Secondly, all concerns against the pilot approach can be reduced or solved before the pilot start is terminated.	pilot leaders

Figure 5: Pilot Risk Table

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Annex 3 - Local Project Manual: Bristol

TWINERGY

Local project manual

Pilot Bristol

August 2021

Twinergy has received funding from the European Union's Horizon 2020 research and innovation programme under grant agreement No. 957736

Document

PROJECT ACRONYM	GRANT AGREEMENT #	PROJECT TITLE
TWINERGY	**957736**	**Intelligent interconnection of prosumers in positive energy communities with twins of things for digital energy markets**

Local project manual – Pilot Bristol

Revision: <v1.0>

AUTHORS

Funded by the Horizon 2020 programme of the European Union
Grant Agreement No 957736

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H2020	Horizon 2020 programme
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HEMS	Home Energy Management System
ICC	Incentive Curve
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IoT	Internet of Things
ITM	Internet Terminal
KPI	Key Performance Indicator
KWMC	Knowle West Media Centre
PM	Project Management
SFTP	Secure File Transfer Protocol
SM	Smart Meter
SP	Smart Plug
SS	Smart Sensor
OB	Objective
QA	Quality Assurance
QEMS	Quarter Energy Management System
RES	Renewable Energy Source

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UNIVBRIS	University of Bristol
UK	United Kingdom
USB	Universal Serial Bus
Wi-Fi	Wireless Fidelity
WP	Work Package

2 Management structure

2.1 Pilot Leader

Professor Theo Tryfonas – University of Bristol
Matthew Jones – Bristol City Council

2.2 Pilot Team

The Bristol pilot is a collaboration between the University of Bristol, Bristol City Council and Knowle West Media Centre. Roles are shared across organisations. They key members of the pilot team are set out below.

2.2.1 University of Bristol

Professor Theo Tryfonas	Pilot Leader
Patrick Tully	Project Manager
Sam Gunner	Technical Lead Residential UoB
Ulas Baloglu	Technical Lead Commercial UoB

2.2.2 Bristol City Council

Matthew Jones	Pilot Leader
Sarah Lee	Smart City and Innovation Manager
David Gray	Energy Supply Programme Manager
Emily Lloyd	Project Officer

2.2.3 Knowle West Media Centre

Zoe Banks Gross	Pilot co-leader
Josephine Gyasi	Community engagement and recruitment
Lorraine Hudson	Community engagement and recruitment
Sue Mackinnon	Community engagement and recruitment
Lucas Sweeney	Technical Lead Residential KWMC

2.3 Data protection officer

Professor Theo Tryfonas – Univbris

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2.4 Electrician (if applicable)

Electrician role will be subcontracted, it is likely to be fulfilled by:

Solarsense UK Limited
Helios House
Brockley Lane
Backwell
BS48 4AH

3 Work plan

A Gantt chart has been developed which outlines the planned approach to the pilot delivery. This is under constant review and forms a working document.

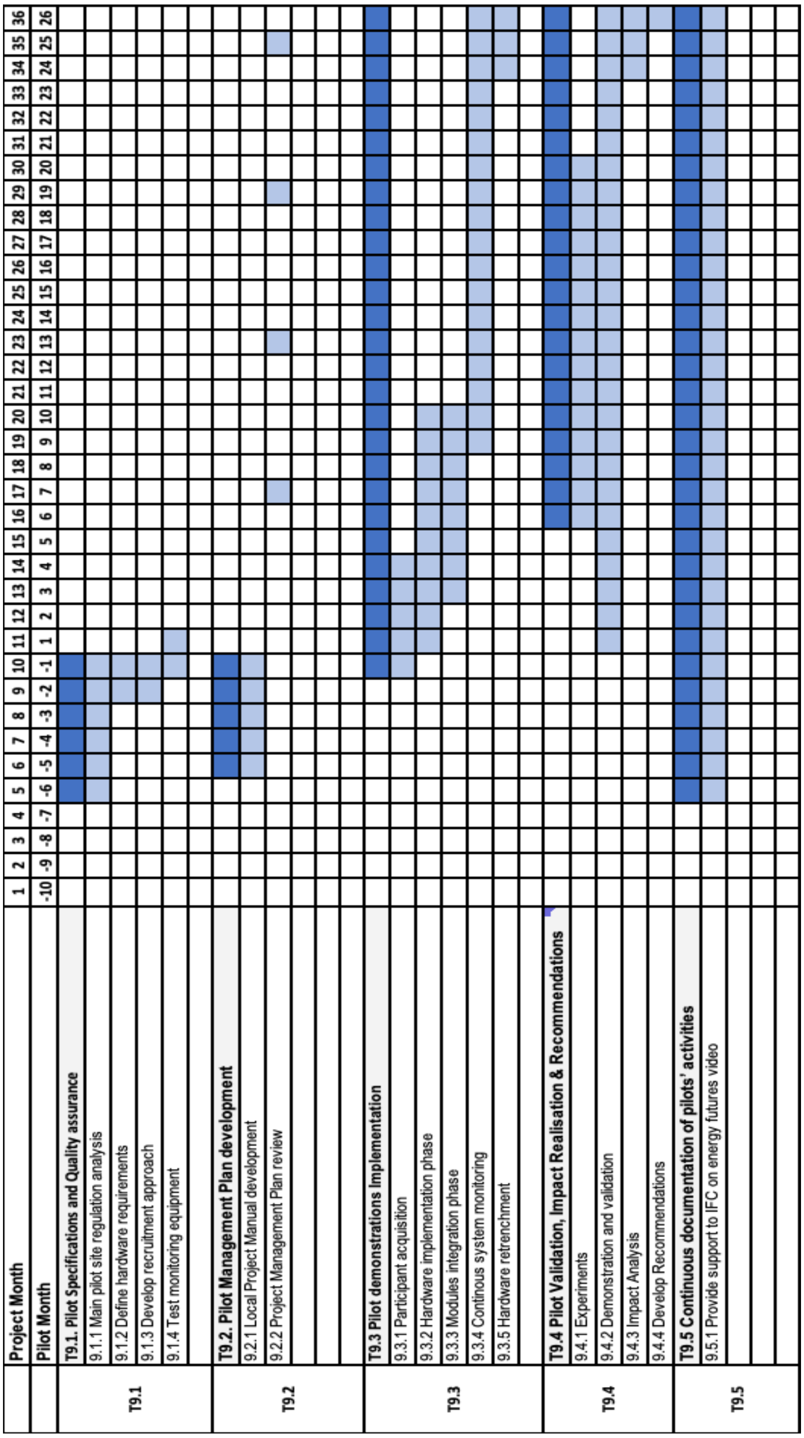

Figure 6: Pilot Gantt Chart

4 Communication with participants

4.1 Organisational communication

Regular partner project meetings are held to review actions and progress towards deliverables. Ad hoc meetings also take place amongst a technology subgroup and communications subgroup as required.

Shared project management documents are utilized amongst partners including a contacts database tracking participant engagement alongside a project Gantt chart.

Communication with third parties such as potential subcontractors happen in a joint up way between pilot partners (e.g. by including a representative of every partner into emails or meetings), so that the current status of such liaisons is transparent to all.

4.2 Technical communication

Our objective is to minimise the need for technical communication with pilot participants through the installation of a resilient and low maintenance, commercial grade local testbed. Some elementary installation and first line support will be provided as part of a subcontracting deal with local providers (e.g. apparent connectivity issues). Significant instances of technical issues that cannot be addressed at that level (e.g. observed data loss) will be examined by technical experts from the local pilot partners, in collaboration with TwinERGY platform or module development partners where needed (e.g. software bugs or platform functionality failures). We will keep communications clear and via single/dedicated contact points known to participants so that when such issues are resolved they are not overwhelmed if they need to take any action.

4.3 Feedback channel

The email address twinergy@kwmc.org.uk has been set up as a feedback channel so that participants and interested stakeholders can communicate with the Bristol TwinERGY pilot partners. Emails come directly to the KWMC TwinERGY team who check the account regularly and then forward to the relevant person/organization in the Bristol pilot. The email address will be included on project publicity materials (including a leaflet for recruitment) along with KWMC main phone number (manned by reception staff during working hours and it has an answer phone). KWMC have also established a TwinERGY page on their website https://kwmc.org.uk/projects/twinergy/ (which includes the contact email) and links with TwinERGY main project website and are using their social media accounts (e.g. twitter, Instagram) channels as a further mechanism for project communication.

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5 Technical Management

To fulfil the requirement of the project, the Bristol pilots will deploy a number of different energy monitoring and demand-side management systems. These different systems will have different communications and installation requirements. Systems include:

1) The Equiwatt 'Power Capsule' energy monitoring hub and smart plugs, able to perform energy monitoring and some demand side management.
2) The PassivEnergy Platform, able to perform optimisation of home energy infrastructure.
3) House batteries, from a range of suppliers including Tesla and Alpha ESS.
4) Gridkey MCU520, monitoring the grid condition and energy use of one of the University of Bristol campus buildings.

A high-level illustration of the home energy monitoring and demand side management system is presented in Figure 1.

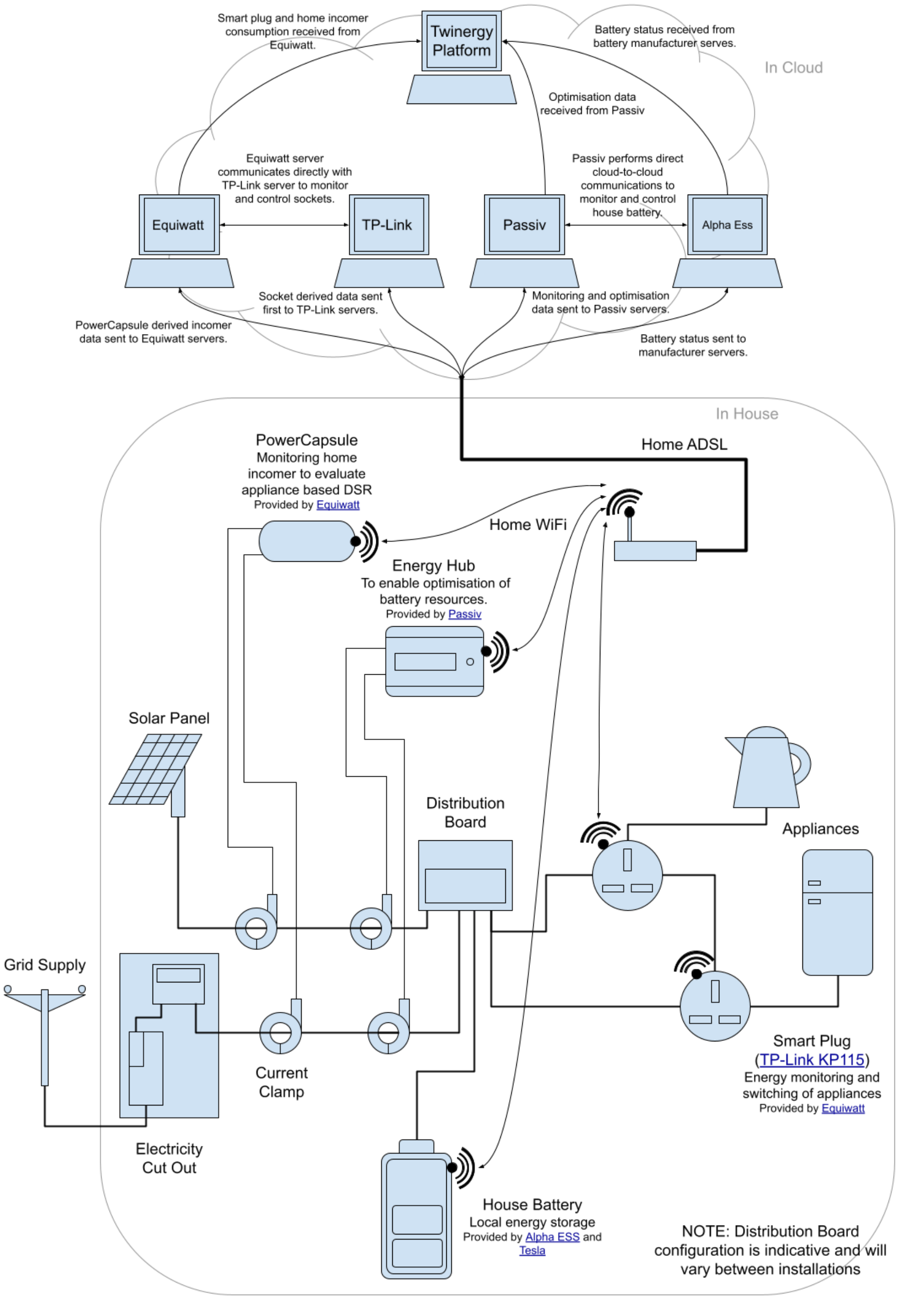

Figure 7: Bristol TwinERGY Pilot household energy monitoring and demand side management high level system diagram.

5.1 Communication (IoT)

The different systems mostly rely on Wi-Fi connectivity to transmit data. Since each is operated by a different provider, each system sends data to a different location, from where it can be accessed.

1) Both the Equiwatt Power Capsule Energy Hub and the Equiwatt Smart Plugs connect to a home's Wi-Fi access point. Data is then forwarded to cloud based servers hosted by either Equiwatt or the smart plug manufacturer. This data is then accessible by the TwinERGY Project through APIs.
2) The Passiv hardware is also connected to a home's Wi-Fi, and data sent to Passiv's servers. The Passiv system is able to optimise a home's battery usage by controlling the times when the battery is charged and discharged, based on a home's energy usage profiles and weather forecasting. Battery control is done 'cloud-to-cloud' with the Passiv servers communicating with the battery providers' servers to receive charge data and send control signals.
3) To ensure scalability, batteries from a number of different suppliers will be integrated into the TwinERGY project. These include the Tesla Powerwalls and the Alpha ESS Smile 5. These will communicate over Wi-Fi or wired Ethernet with their respective providers' servers, through which state information can be gathered and control signals sent.
4) An IEC optical probe and a Windows installed computing device are required for the configuration of the MCU520 devices. A static IP configuration is necessary when using the network interface modules of these devices. Since the University of Bristol network has security restrictions on communication, these devices aren't directly connected to the University network. Instead, they are connected to a single board computer (Raspberry Pi 3) by using a USB Ethernet dongle. The single board computer is used as a bridge between the MCU520 and the University network and is also used for decrypting the raw data payloads. In Figure 2, IoT communication for the MCU520 is depicted with the other forms of data collection at a University building.

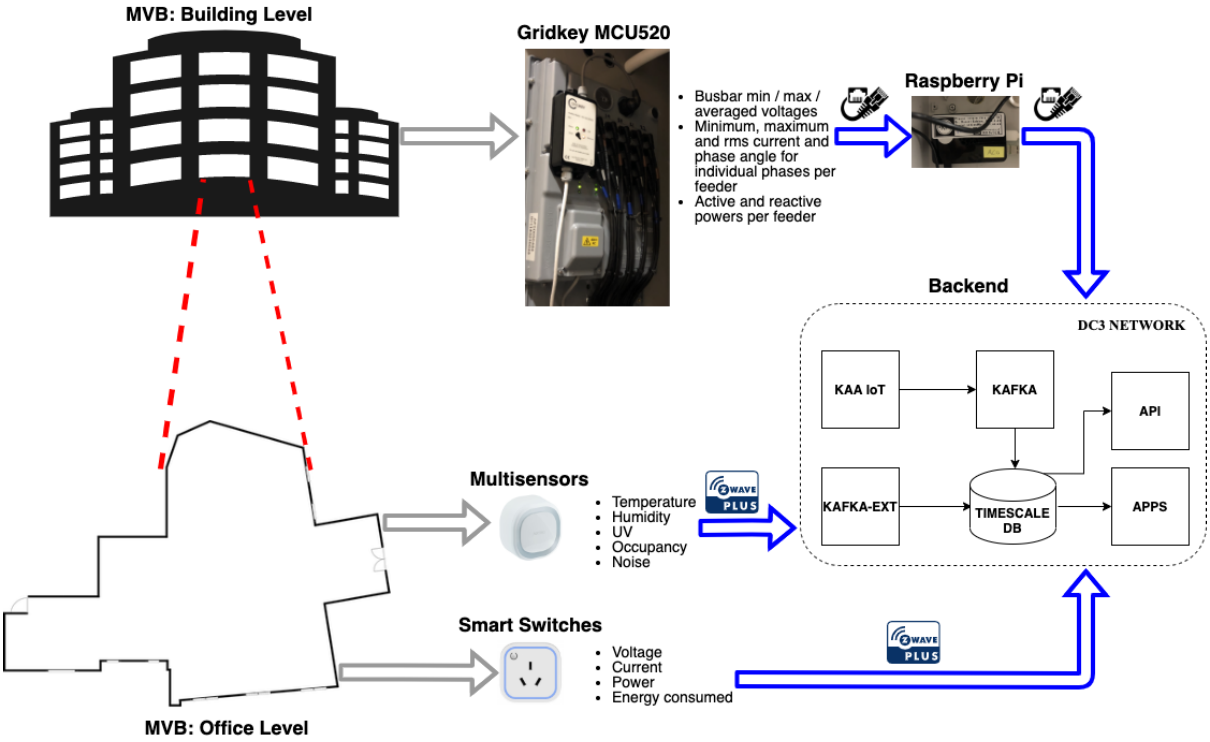

Figure 8: IoT communication for the MCU520, along with other forms of data collection installed at a University building for the TwinERGY Project.

5.2 Hardware selection process

To enhance the applicability of the TwinERGY pilots, suppliers have been selected that are able to demonstrate a good level of product maturity, although in a number of cases some extra development work is required to tailor an existing product to deliver the needs of the TwinERGY Project. The aim has been to use suppliers that are able to deliver a good user experience for the households involved in the pilot and deliver long-term benefits to participants even beyond the end of the project deployment.

Households with a range of pre-installed hardware have been selected. Each house will be surveyed to understand what an appropriate level of technology invention for that property is. Baseline data will be gathered to understand each household energy consumption habits before any demand side management is implemented.

5.3 Installing, maintaining and removing Hardware

In total 12 households will be selected from the Bristol area. The appropriate level of extra technology will be selected independently for each household based on the results of the site survey and discussions with the residents of that property to understand their wishes.

The different systems have different installation requirements. Equiwatt equipment is designed to be installed by a resident, although residents will be supported by the TwinERGY Project to ensure that the installation conforms with the project requirements. The Passiv system and house batteries will require a registered electrician to perform the installation, and the cost of this is included in the TwinERGY Bristol Pilots costs.

Decommission has also been considered, and residents will be given the offer to continue with Equiwatt, albeit at their own expense. Should they choose not to continue the hardware will be removed.

6 Experiments

6.1.1 Communication (IoT) Test

The Bristol Pilot's use of relatively mature commercial systems means that much of the devices communication testing is covered by the commissioning processes carried out by the systems' providers. Although details will vary depending on the system in question, the connection to each device will be checked as part of the installation and commissioning process. Confirmation of data exchange between the home-based device and the provider's server will be carried out at this commissioning stage.

Data exchange between the TwinERGY Platform and the various provider servers will be carried out separately. Each provider will be worked with separately to ensure that the TwinERGY Platform is able to receive the necessary monitoring data.

6.1.2 DR Response Test

DR is performed in different ways by the different systems. The Equiwatt system enables DR by switching off devices within the home. The ability of the system to do this will be confirmed during the commissioning process.

The Passiv system is able to monitor and manage the charging and discharging of the house battery, as well as managing any heat pumps that are installed in the residence. Again, the system's ability to actuate these controls will be tested by the system supplier during the commissioning process.

6.1.3 Storage test (Impact)

The Equiwatt system will be installed before much of the other energy management infrastructure. The data generated by this system will then provide a baseline for the home's energy use, before any battery storage or demand side management is fitted. This will allow comparison of before and after the storage was fitted, allowing a demonstration of the effect of the extra energy management infrastructure. Effects such as seasonality, however, mean that a direct and detailed comparison might not be possible, as no two days are exactly the same.

6.1.4 Anomalies test

The highest probability anomaly is estimated as being dropouts in connection between the installed hardware and the cloud-based server that manages its operation. The impact of this will be tested during the commissioning process. Dependence on residential internet connections means that dropouts cannot be completely avoided, and so instead processes are being put in place to monitor the connectivity, with any dropout being investigated by the Bristol Pilot team with the aim of resolving the issue in a timely manner. Smart plug and home incomer consumption received from Equiwatt. Smart plug and home incomer consumption received from Equiwatt.

7 Risk management

7.1 Social/Communication risks

For the Bristol pilot there are risks in the recruitment process. A fine balance needs to be struck between understanding the technical requirements of the project (e.g. what technology will be installed in people's homes and the data that will be collected and who it will be shared with) and engagement with potential participants and providing them with sufficient information so they can make an informed choice on whether they wish to participate. To do effective engagement there needs to be as much information as possible on the technical/data side, but as TwinERGY is a large and complex project it is taking time for partners to be clear on this. This means that if KWMC/BCC start engagement too early, there is a risk we will lose potential participants if we can't answer their questions quickly and they lose interest.

The Bristol pilot also faces constraints from navigating the challenges of COVID-19, as due to national and local lockdowns we have had to initially focus on using online engagement and outside events (e.g. Filwood market). To address these issues, KWMC are working closely with the pilot technical partners to develop easy to understand project recruitment materials (e.g. banner, leaflet, frequently asked questions document) to use in events and communication with potential participants. KWMC has an organizational risk assessment in place to deal with managing COVID risks and is applying this when organising events and activities for TwinERGY but the Bristol pilot will need to continue to adapt to the ever-changing situation around COVID-19 in the UK.

7.2 Technical risks

The selection of relatively mature technologies lowers the technical risks that face the Bristol TwinERGY Pilots. The use of registered electricians where appropriate, and installation and commissioning supported by TwinERGY project partners also lowers the risks of a failed or aborted commissioning, or one that does not fulfil the requirements of the project. The biggest technical risk predicted to be the technology's dependence on residential Wi-Fi and broadband connectivity, which can be unreliable. Where appropriate technologies solutions to this have been sought, such as the backing up of data locally to overcome temporary drops in connectivity. Processes are also being put in place to overcome connectivity issues, with TwinERGY pilot partners monitoring the status of the remote hardware and providing technical support to households in the situations where outages do occur.

7.3 Risk table

No. Risk	Risk category	Risk type	Description	WPs affected	Likelihood	Severity	Risk level	Proposed mitigation measures	Respnsible partner(s) for mitigaiting risk
1	Management risk	GDPR	GDPR procedures delay start of implementation	WP9	Medium	Medium	Medium	Regular meetings with Pilot partners. Use previously agreed templates where possible.	
2		Equipment supply timescales	Delays to equipment supply timescales	WP9	Medium	High	High	Ensure timescales are committed to before agreeing contracts	
3		Personal safety installers	COVID and other risks at point of any install	WP9	Low	High	Medium	Suppliers to provide appropriate risk assessments. Bristol Pilot team likewise.	
4	Technical risks	Compatibility of equipment	Battery storage/ PV systems not compatible to send data to Suite5	WP9/7	Low	High	Medium	Consult Suite5 and other partners re technology choice and API specifications	
5		Data quality	Variability of data quality		Medium	Medium	Medium		
6	Participation risks	Recruitment	Difficulties recruiting the target numbers	WP9	Low	High	Medium	Use existing project participants from previous projects where possible. Target more reliable known households	
7		Participant drop out	Participants leave project	WP9	Low	High	Medium	Some drop outs might be expected but will include questions about likelihood of staying in same location in questionnaire	
8		Participant damages equipment	Damage to equipment	WP9	Low	Medium	Low	Terms and conditions outline procedures in this situation	

Figure 9: Pilot Risk Table

Annex 4 - Local Project Manual: Steinheim

Local project manual

Pilot Steinheim

August 2021

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Document

PROJECT ACRONYM	GRANT AGREEMENT #	PROJECT TITLE
TWINERGY	**957736**	**Intelligent interconnection of prosumers in positive energy communities with twins of things for digital energy markets**

Local project manual – Pilot Steinheim

Revision: <v1.0>

AUTHORS

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1 Introduction Local Project Manual

Scope of the document

The intention of the "Local Project Manual" is to function as an assistant in pilot related questions. While the D9.2 "General Pilot Management Plan" contains all general pilot management requirements, the "Local Project Manual" describes the ways these requirements were met at the pilot site. Additionally, all risk, which were foreseen by the pilot's leading partners, are analysed and countermeasures elaborated.

Structure of the document

This document is structured in six chapters. Chapter 1 describes the scope, structure and contains the abbreviation list. All functional persons, such as the pilot leader and data protection officer, are mentioned in Chapter 2. Chapter 3 contains the work plan of the pilot's activities. Chapter 4 describes the communication with the participants at the pilot's site and chapter 5 the technical issues (technical communication, hardware selection, etc.). The last chapter contains the risks at the pilot site.

Abbreviation List

Table 8: Abbreviation list

Acronym	Full Name
ADSL	Asymmetric Digital Subscriber Line
ARERA	Authority for Energy, Networks and Environment
ESS	Energy Storage System
EV	Electric Vehicle
GDPR	General Data Protection Regulation

H2020	Horizon 2020 programme
HEDNO	Hellenic Electricity Distribution Network Operator
HEMS	Home Energy Management System
ICC	Incentive Curve
IT	Information Technology
IoT	Internet of Things
ITM	Internet Terminal
KPI	Key Performance Indicator
PM	Project Management
SFTP	Secure File Transfer Protocol
SM	Smart Meter
SP	Smart Plug
SS	Smart Sensor
OB	Objective
QA	Quality Assurance
QEMS	Quarter Energy Management System
RES	Renewable Energy Source
UK	United Kingdom
USB	Universal Serial Bus
Wi-Fi	Wireless Fidelity
WP	Work Package

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2 Management structure

Pilot Leader

Fynn Christian Bollhöfer – TH OWL
Alexander Rauer – Stadt Steinheim

Pilot Team

The German pilot is a collaboration between the TH OWL and the Steinheim City Council. The key members of the pilot team are set out below.

TH OWL

1.	Professor Johannes Üpping
2.	Fynn Christian Bollhöfer
3.	Axel Balke
4.	Dr. Lukasz Wisniewski
5.	Maxim Friesen

Steinheim City Council

Alexander Rauer	Pilot Leader

Data protection officer

The Data protection officer of the Steinheim City Council is the DPO of the pilot.

3 Work plan

3.1 Pilot Gantt Chart

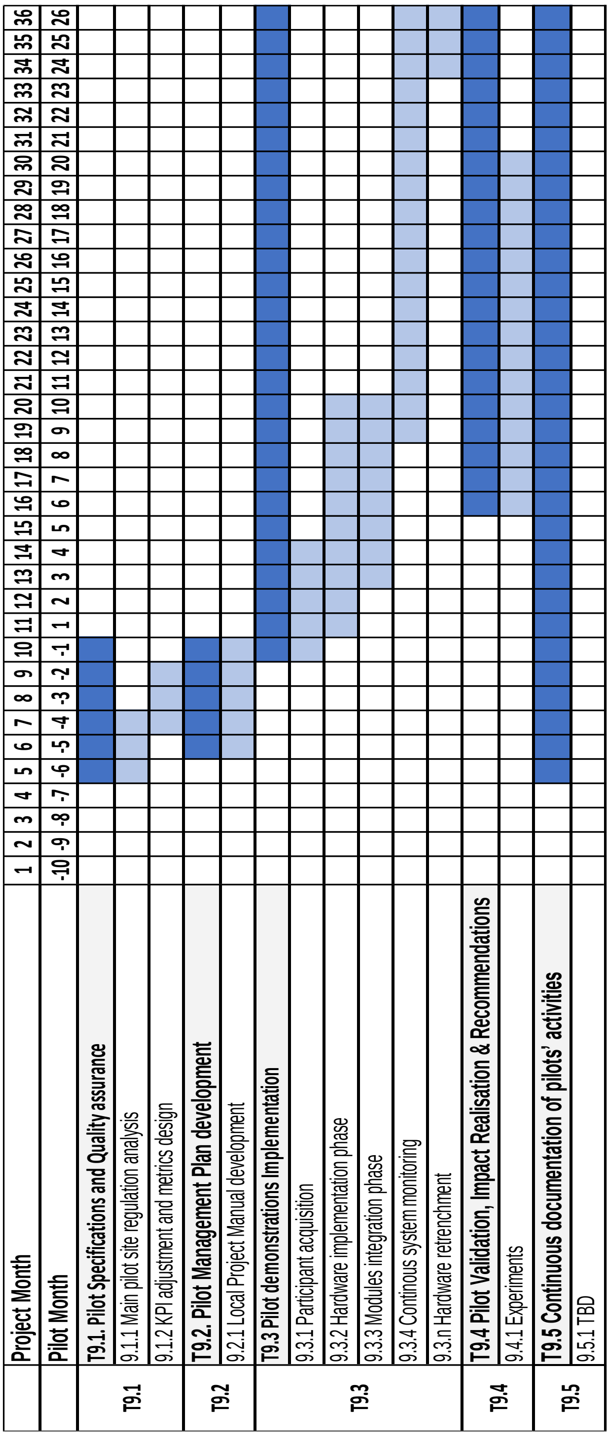

Figure 10: Pilot Gantt Chart

4 Communication with participants

Organizational communication

It is planned to organize information meetings for all participants on a regular basis. These events are meant to take place in person and not digital, because it makes the communication easier and allows the inhabitants to share their experiences during the project phase.

A regular newsletter will inform the participants about the progress of the project every month. This includes energy statistics, changes on the platform and other noteworthy information.

All information events and presentations will be recorded and uploaded to a public webserver. In this way, the participants can rewatch any past events if they couldn't attend to the live-meeting or if they are looking for some information provided at these events.

For needs that concern a single person or household, e.g. the installation of a smart meter, personal email conversations will of course also be possible, to ensure the individual needs of every participant are also met at every time.

Technical communication

The technical communication will be provided via the same channels as the organizational communication. Additional to that, several tutorial videos will be made in which the different pieces of hardware are explained in detail. These videos will also be available on a web server for easy access. This will enable the participants to operate the devices by themselves and will not need any support for the installation or if they want to make changes in the configuration. All tutorials will also be provided in text form as a manual.

Feedback channel

As a feedback channel, the email address steinheim@twinergy.eu has been created to ensure an easy and fast way to reach out to the TwinERGY team. Any email sent to this

address reaches the project partners at TH OWL. Every request, that is made shall be answered in no less than three working days.
This provides a fast and focussed communication with individual inhabitants.
If topic occur that affect not only the individual requester, but the whole community, they will be communicated via the usual communication channels like the meetings or the newsletter.

Interpilot communication

For communication between the different pilot teams across Europe, there will be online meetings with the WP9 teams on a regular basis. There, the teams will share their progresses and address issues regarding the pilot sites. This way, particular problems, that affect multiple pilot sites can be addressed early to prevent problems from reoccurring.

5 Technical Management

Communication (IoT)

The communication of IoT equipment is shown in *Figure 11*. The grid equipment for control purpose (Measuring equipment at the Transformer station, bidirectional charging station and the quarter storage) are connected in a local area network (red dotted line) with the quarter energy management system (QEMS). It also serves as a gateway to the TwinERGY Services via internet (blue dotted line). The communication at the participants differs in relation to the level of participation. A level 0 participant does not communicate any data to the TwinERGY system. Starting with level 1, a filled questionnaire and a Internet Device (ID) is necessary. They are used to show the dashboard of the TwinERGY system and are necessary to book the car sharing. The questionnaire is transferred to the TwinERGY services to build the digital twin and to run the services. A level 2 participant will be equipped with Smart Plugs (SP) and Smart Sensors (SS), which must be integrated in the participants' local home network. It needs to provide internet access. On top, a level 3 participant needs to connect the smart meter (SM), home energy management system (HEMS) and possible controllable loads (heat pumps, charging station, etc.) to his local network and needs to provide access to the internet as well. All controllable devices and sensors are sending data to the TwinERGY services, the HEMS or a separate gateway will be installed to gather the local data and send it to the services.

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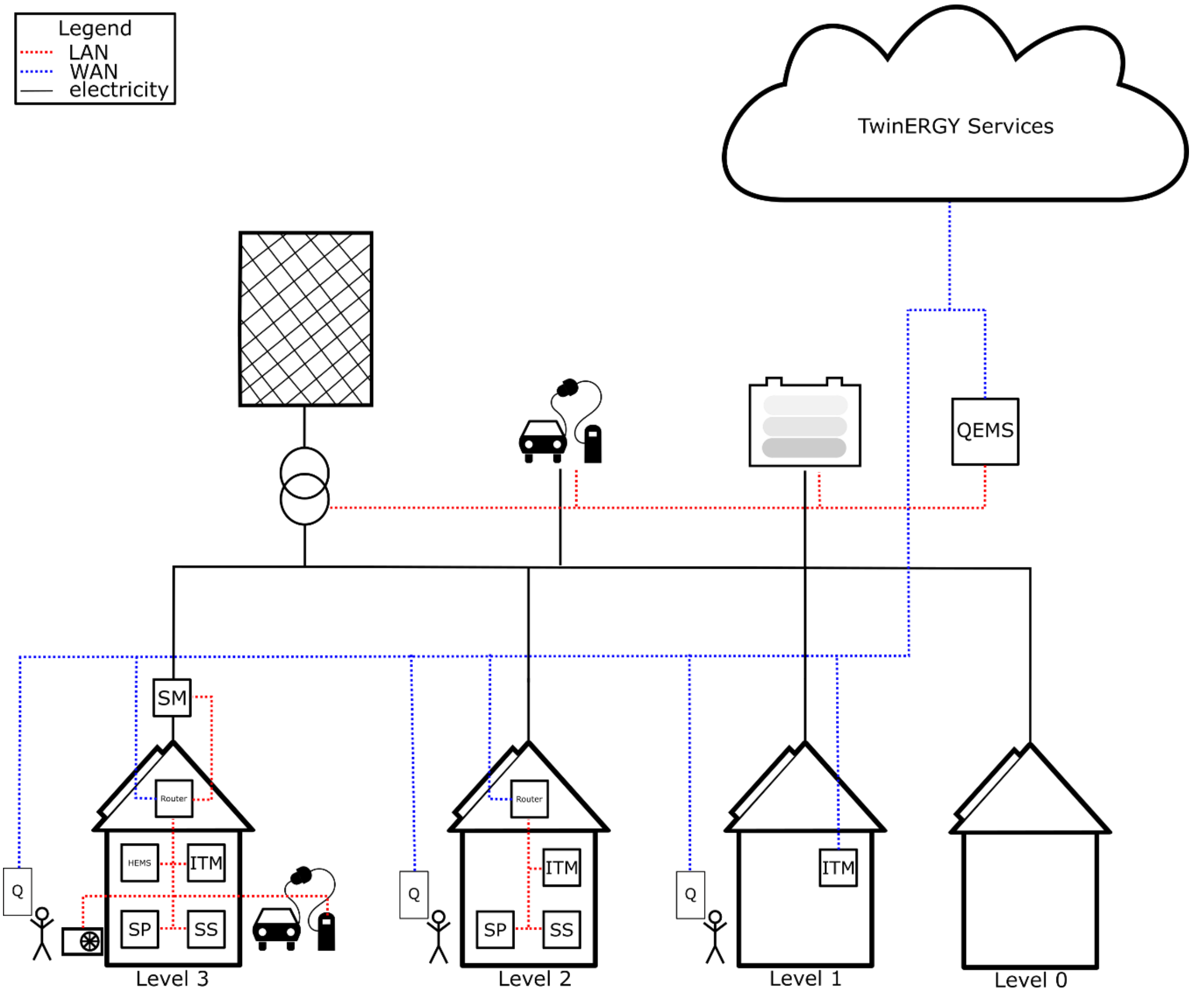

Figure 11: IoT-Communication in the Steinheim Pilot

Hardware selection process

For every household the used hardware will be tailored to the inhabitants needs and wishes.

The central baseline for the optimal selection of the hardware will be the level of participation. For example, the use of smart metering devices is only planned for level 3 participants.

Based on their level and the appliances in the household, the team will look into the houses profile, provided by the questioning form from level 1 on, to judge, which devices could be used effective in this specific household. If it is planned to implement a smart energy production-based control of a washing machine, not every model has the capability to work easily with a smart plug. Things like this have to be considered in the hardware selection process as well.

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Installing Hardware

The installation process of the hardware at the pilot site will be set in 7 steps. First of all, the pilot leading partners will present the selected hardware in public meetings and will tell about their functionality, what they can do with it and where it can help to reduce their energy bill or provide flexibility. For all who are not able to visit the meeting or have questions during the installation and use phase, a tutorial for each hardware will be produced in an appropriate way (video, document, etc.). The following steps (3-6) will be necessary for the participation level 3, because an electrician is needed for the installation of the smart meter. The third step is to identify the state of the electrical installation at the participants to integrate the smart meter. This could either be done by a structural survey or via photos by the participant. The next step is the selection of a local electrician to integrate the hardware. It is followed by the process to arrange the appointments between the participants and electrician for the installation of the hardware, which will be supervised by the pilot leading partners. After the installation (Step 6), a first briefing will be held with the participants (Step 7).

6 Experiments

Communication (IoT) Test

The communication of the IoT-Devices at the participants and in the grid will be monitored during the whole pilot phase. The communication will be tested at the installation process.

DR Response Test

For this test, specially manipulated ICC's (power curves) are sent to all participants (level 1-3, storage, charging station). The ICC's are adjusted so that a phase with very little available renewable energy follows a phase with very much available renewable energy. The overall response of the neighbourhood is observed. Different ICC's are generated to represent different situations for better classification. Multiple runs of these tests are intended to give an overall picture of the DR's performance.

Storage test (Impact)

For this test, type days with similar characteristics are defined. Within the type days, a similar energetic behaviour of the neighbourhood is expected. Specifically, this means similar PV generation, similar temperature and same general situation. Such days are grouped into pairs. On one day each, the storage is used with optimized operation and is used for storage. On the other day, the storage is not used. By comparing the overall performance of the quartier, a conclusion can be drawn about the influence of the storage. However, since it is never possible to find identical pair days, the complementary use of the storage is simulated on the computer with the measured values afterwards. This provides a further comparison between the pair days. All in all, the measurements together with the simulations on several pair days' lead to reliable statements about the real influence of the storage with optimized operation in the quarter.

Anomalies test

The anomaly test is performed in stages and is only for participants in level 3. Based on the base-data a forecast for the household (for consumption and generation) is provided via the digital twin. These predictions are continuously compared with the current measured values for this test. As soon as significant deviations occur, the algorithm detects an anomaly and issues a warning signal. For the experiment, anomalies are actively produced. In the neighbourhood, inverters are taken off the grid when there is a lot of sunshine in order to simulate an outage. In addition, large consumers are manually put into operation to simulate an unknown load. Both states are to be recognized by the algorithm.

7 Risk management

Social/communication risks

The biggest risk in the German pilot site lies in the recruitment process. Although every inhabitant is contacted via mail, electronic or the village's caretaker, it is possible that the overall resonance will fall behind the expectations. On one side this happens due to the COVID-19 pandemic, leading people to reduce their contacts to reduce the infection risk. However, there are still many elderly people in the village, who have little knowledge about the technology and thus no interest in participating in the project.

Regular physical information events shall help mitigate any concerns that are held by inhabitants by addressing them directly so that uncertainties and worries among the participants regarding project activities are minimized.

Technical risks

Four main technical risks are foreseen. First of all, communication errors, such as unstable internet services or non-reachable online services. This is the main risk for the TwinERGY pilot phase. The implemented smart meters have a separate backup-strategy, therefore no data miss is foreseen during communication errors. But the TwinERGY services and real-time control will be set in safe operation modes if the connection to the equipment is lost. The connection will be tested during the installation process and will be monitored during the pilot phase. Secondly, an operating error could occur. This will be minimized by good instructions. Third, if the project installations and implementation phase takes too long, the time for test will be lower. Additionally, the participant can get annoyed by the project and wants to end his participation. The pilot leading partners will encourage the participants for the whole pilot phase by a steady flow of information during the pilot phase on energy topics, the process and results of the experiments, and public events.

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Risk table

No. Risk	Risk category	Risk type	Description	WPs affected	Likelihood	Severity	Risk level	Proposed mitigation measures	Respnsible partner(s) for mitigaiting risk
1	Management risk	implementation time issues	Implementation takes to long to fulfil the data collection time	no	Low	Medium	Low	contionous monitoring of the implementation progress to find delays as soon as possible.	
2		financial risk	The battery storage needs to comply with local regulations, therefore the energy to store will cost arround 25ct/kWh, while the energy supplied will earn about 5ct/kWh. A gap arround 20ct/kWh needs to be payed for each kWh saved and feed back.	no	High	High	High	The energy values ot the battery storage will be monitored and the cost directly calculated. Some of the aid money for services will be reserved for the test with the battery storage. If there is a change in regulation or tarif, which suits our approach better, we will change the tarif as soon as possible to lower the cost.	
3	Technical risks	hardware shortage	Shortage of selected hardware, as COVID has an impact on the availability of electronics	no	High	Medium	High	As soon as possible, the hardware will be orderd to have knowlege of the delivering time. If the selected hardware is not available in time, other hardware, which suits the requirements, will be selected.	
4	participation risks	participant shortage	Shortage of participants at the pilot site	no	Medium	High	High	Starting with online workshops, we encurage the possible participants to interact with the pilot team before pilot start, so most of them know the pilot team. Secondly, all concerns against the pilot approach can be reduced or solved before the pilot start is terminated.	

Figure 12: Pilot Risk Table

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Annex 5 - Risk Management Plan Athens

No. Risk	Risk category	Risk type	Description	WPs affected	Likelihood	Severity	Risk Level	Proposed mitigation measures	Respnsible partner(s) for mitigaiting risk
1	Management risk	Integration delay	Delay in the integration and deployment of the solution may happen due to diverse factors.	WP9, WP8	Low	Medium	Low	contionous monitoring of the implementation progress to find delays as soon as possible.	
2		Hardware shortage or Delivery Delays	Shortage of selected hardware or delivery delays, as COVID has an impact on the availability of electronics.	WP9	High	High	High	As soon as possible, the hardware will be orderd to have knowlege of the delivering time. If the selected hardware is not available in time, other hardware, which suits the requirements, will be selected.	
3	Technical risks	Integration testing failures with devices and smart grid assets	Failures happening in the process of integration of field devices and distributed smart grid assets.	WP9, WP8	Medium	High	High	Establishment of a clear plan with responsibilities distribution related to the correct implementation of the described assets/devices.	
4	Participation risks	Participant shortage	Shortage of participants at the pilot site	WP9	Medium	High	High	Starting with online workshops, we encurage the possible participants to interact with the pilot team before pilot start, so most of them know the pilot team. Secondly, all concerns against the pilot approach can be reduced or solved before the pilot start is terminated.	
5		Availability of Results needed for evaluation	Unforeseen cirmustances cause limited outputs for evaluation against KPIs and considering impact of exploitation as planned.	WP9, WP10	Medium	Low	Low	Focus on "quick wins" through prioritisation of Ucs to ensure tangible outcomes for some KPIs	
6		Communication issues	We do not find the right channels to communicate and engage the consumers to the project	All	Low	Medium	Low	There is a good practices share among all pilots. We ensure that open communication and transparency is supported.	

Figure 2: Pilot Risk Management Table Athens

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Annex 6 - Risk Management Plan Benetutti

No.	Risk category	Risk type	Description	WPs affected	Likelihood	Severity	Risk level	Proposed mitigation measures	Responsible partner(s) for mitigaiting risk
1	**Management risk**	implementation time issues		no	Low	Medium	**Low**	contionous monitoring of the implementation progress to find delays as soon as possible.	pilot leaders
2	**Technical risks**	hardware shortage	Shortage of selected hardware, as COVID has an impact on the availability of electronics	no	High	Medium	**High**	As soon as possible, the hardware will be orderd to have knowlege of the delivering time. If the selected hardware is not available in time, other hardware, which suits the requirements, will be selected.	pilot leaders
		Poor internet connection	Benetutti is a small and remote municipality which can suffer of poor internet connection	no	Medium	High	**High**	Speedtests will be performed and whenever is necessary Wi-Fi extender and/or stand-alone router with SIM will be installed to fulfill all the project communication requirements. Moreover, a local buffer of memory or a cloud based features in the monitoring system will backup the data related to additional communication issues.	pilot leaders
3	**participation risks**	participant shortage	Shortage of participants at the pilot site	no	Medium	High	**High**	Starting with online workshops, we encurage the possible participants to interact with the pilot team before pilot start, so most of them know the pilot team. Secondly, all concerns against the pilot approach can be reduced or solved before the pilot start is terminated.	pilot leaders

Figure 3: Pilot Risk Management Table Benetutti

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Annex 7 - Risk Management Plan Bristol

No. Risk	Risk category	Risk type	Description	WPs affected	Likelihood	Severity	Risk level	Proposed mitigation measures	Respnsible partner(s) for mitigaiting risk
1	Management risk	GDPR	GDPR procedures delay start of implementation	WP9	Medium	Medium	Medium	Regular meetings with Pilot partners. Use previously agreed templates where possible.	
2		Equipment supply timescales	Delays to equipment supply timescales	WP9	Medium	High	High	Ensure timescales are committed to before agreeing contracts	
3		Personal safety installers	COVID and other risks at point of any install	WP9	Low	High	Medium	Suppliers to provide appropriate risk assessments. Bristol Pilot team likewise.	
4	Technical risks	Compatibility of equipment	Battery storage/ PV systems not compatible to send data to Suite5	WP9/7	Low	High	Medium	Consult Suite5 and other partners re technology choice and API specifications	
5		Data quality	Variability of data quality		Medium	Medium	Medium		
6	Participation risks	Recruitment	Difficulties recruiting the target numbers	WP9	Low	High	Medium	Use existing project participants from previous projects where possible. Target more reliable known households	
7		Participant drop out	Participants leave project	WP9	Low	High	Medium	Some drop outs might be expected but will include questions about likelihood of staying in same location in questionnaire	
8		Participant damages equipment	Damage to equipment	WP9	Low	Medium	Low	Terms and conditions outline procedures in this situation	

Figure 4: Pilot Risk Management Table Bristol

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Annex 8 - Risk Management Plan Steinheim

No. Risk	Risk category	Risk type	Description	WPs affected	Likelihood	Severity	Risk level	Proposed mitigation measures	Respsnible partner(s) for mitigaiting risk
1	Management risk	implementation time issues	Implementation takes to long to fulfil the data collection time	no	Low	Medium	Low	contionous monitoring of the implementation progress to find delays as soon as possible.	
2		financial risk	The battery storage needs to comply with local regulations, therefore the energy to store will cost arround 25ct/kWh, while the energy supplied will earn about 5ct/kWh. A gap arround 20ct/kWh needs to be payed for each kWh saved and feed back.	no	High	High	High	The energy values ot the battery storage will be monitored and the cost directly calculated. Some of the aid money for services will be reserved for the test with the battery storage. If there is a change in regulation or tarif, which suits our approach better, we will change the tarif as soon as possible to lower the cost.	
3	Technical risks	hardware shortage	Shortage of selected hardware, as COVID has an impact on the availability of electronics	no	High	Medium	High	As soon as possible, the hardware will be orderd to have knowlege of the delivering time. If the selected hardware is not available in time, other hardware, which suits the requirements, will be selected.	
4	participation risks	participant shortage	Shortage of participants at the pilot site	no	Medium	High	High	Starting with online workshops, we encurage the possible participants to interact with the pilot team before pilot start, so most of them know the pilot team. Secondly, all concerns against the pilot approach can be reduced or solved before the pilot start is terminated.	

Figure 5: Pilot Risk Management Table Steinheim