RESPOND
DEMAND RESPONSE FOR ALL

Integrated Demand REsponse SOlution Towards Energy POsitive NeighbourhooDs

WP 2: Use case deployment and follow-up

T 2.3: Design of the initial deployment plan

D2.3 Initial deployment plan

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EXECUTIVE SUMMARY

With the goal of stablishing the route map for the early deployment of the RESPOND solution, this document presents the plan to be implemented in each of the three Pilot Sites within the project: namely, in Aarhus (Denmark), in the Aran Islands (Ireland) and in Madrid (Spain).

Task *T2.3 Design of the initial deployment plan*, started in January 2018 and finishes at the end of June 2018. Precisely the month of June 2018 overlaps with the task *T2.4 Early deployment at pilot sites*, which ends at the end of September 2018. This month in common has been designed this way purposely, in order to leverage the valuable inputs acquired from working on the field. These inputs can adjust the initial idea of the designed plan, while sticking it to working on real world casuistic.

Therefore, this document explains task by task, the actions to be undertaken in each pilot site to satisfy its specific requirements and ensuring the complete early deployment ahead of the scheduled deadline of September 2018.

These actions are derived from agreeing on the following:

- The final list of devices to be deployed,
- The shipment of these devices to the pilot sites,
- Where and how install these devices,
- The adequate configurations for a proper operation.

Furthermore, this document details the required steps for deploying an initial basic version of some cloud platform components to start acquiring and storing data for a baseline measurement.

During the design of this preliminary deployment plan, it has been taken into account that working on the field may involve dealing with real world problems and difficulties and are not been considered in ideal theoretical designs. Therefore, in order to handle this unforeseen issues, the elaborated plan needed to be flexible enough to adapt the deployment for each specific situation while meeting the previously specified requirements.

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ABBREVIATIONS AND ACRONYMS

AAU	Aalborg Universitet
ALBOA	Almen Boligorganisation Aarhus
ARAN	Comharchumann Fuinnimh Oileain Arann Teoranta
AURA	Aura Radgivning AS
DEV	Develco Products A/S
DR	Demand Response
FEN	Fenie Energía
ICT	Information and communication technology
IMP	Institute Mihajlo Pupin
MQTT	MQ Telemetry Transport
NUIG	National University of Ireland, Galway
OGEMA	Open Gateway Energy Management
PC	Personal Computer
PV	Photo Voltaic
TEK	Fundación Tekniker

1. INTRODUCTION

The purpose of this document is to define the different activities and milestones to be undertaken for the early deployment plan. It is of utmost importance that, once the test are selected, all the equipment and devices are installed according to the deployment plan.

This document aims the global goal of defining the initial RESPOND deployment plan adapted for each pilot site according to their specific requirements, taking into account the functional, technical, sociological and topological point of view. It is also necessary to meet the DR requirements identified in task *T1.4 Demand response actions discovery for each pilot* while matching the system architecture model agreed in task *T2.1 System architecture design*.

This deployment plan will be the base for the early deployment of the hardware part of the project allowing a quick start of data collecting activities in order to set up as soon as possible the baseline where contrast RESPOND's platform developments and activities. This deployment plan will be updated during next year with the integration and deployment activities.

In addition, this document identifies the monitoring needs in the necessary measurements points for each pilot to monitor both, energy related parameters and contort variables. Moreover, *D2.3* also analyses how RESPOND store system (databases) should be organised and where and how data will be stored, processed and transmitted. The document shows a plan for ICT system integration with energy assets and home automation systems (both legacy and new ones) fulfilling the requirements of each Pilot Site.

This deliverable has a section for each Pilot where the initial deployment plan is presented along with a detailed explanation of each task, the responsible to carry it out, the expected initial and final dates and the necessary resources always trying to be concise and clear to ease the correct becoming of the next activities of the project.

2. DEVICE CATALOGUES

In order to monitor and implement adequate DR actions the test houses, it is necessary the installation of devices of different types. As regards for monitoring and actuation devices, the ones manufactured by Develco and Energomonitor are devised to be installed.

2.1 DEVELCO

Some of the devices available in the Develco catalogue[1] are foreseen to be installed in the test houses of Aarhus (Denmark) and Aran Islands (Ireland).

2.1.1 SENSORS AND ALARMS

- Humidity Sensor: The Humidity Sensor monitors temperature and humidity levels in a building. By supervising the indoor climate, the ZigBee based Humidity Sensor helps maintain the ideal comfort level and protect interior, electronics, musical instruments, furniture, artwork, and any other humidity-sensitive household item.

Figure 1: Develco Humidity Sensor

- Window Sensor: The Window Sensor detects and reports opening and closing of the doors and windows. Easily installed on any door or window, the sensor triggers a signal when parted. The sensor also features a built-in temperature functionality. The functionalities of the Window Sensor make it ideal for automatic lighting, access control, and home security solutions.

Figure 2: Develco Window Sensor

2.1.2 SMART PLUGS

- Smart Plug Mini: The Smart Plug Mini is the world's smallest. It is an intelligent remotely controlled adapter that monitors the power consumption as well as enables the user to control electrical equipment by switching it on or off remotely. The Smart Plug Mini is easy to use, since it requires no installation. The user just has to put it into an electrical outlet and then plug in the desired electrical device.

Figure 3: Develco Smart Plug Mini

- Type G (British): Used in: UK, Ireland, Hong Kong, Malaysia, Qatar, Saudi Arabia, Singapore, and United Arab Emirates.

Figure 4: Develco Type G (British)

- Type K (Danish): Used in: Denmark, India, Jordan, South Africa, and Morocco.

Figure 5: Develco Type K (Danish)

2.1.3 SMART RELAYS

- Smart Cable: Smart Cable converts conventional power cables to a remotely controlled unit, which allows users to monitor their power consumption. The Smart Cable enables the user to control plugged in electrical devices, with the option to switch electronic equipment on or off.

Figure 6: Develco Smart Cable

- Smart Relay 30A: With this ZigBee relay for heavy loads, the user is able to switch devices and equipment on/off remotely. It consists of a plug-unit with built-in relay communicating with a gateway that supports ZigBee. This smart relay also features a power meter functionality.

Figure 7: Develco Smart Relay 30A

- Smart Relay 16A DIN: The Smart Relay DIN 16 A enables the user to switch equipment on or off remotely. It grants wireless on/off control of clusters, groups of appliances, or individual elements. It also features a power meter functionality, granting the user access to monitoring the power - giving an increased overview of what unit groups consume most power and when.

Figure 8: Develco Smart Relay 16A DIN

2.1.4 METER INTERFACES

- Prosumer Meter: The Prosumer Meter is designed to integrate household's solar power modules in the smart energy or smart home solution. It allows the user to monitor the energy production combined with the consumption, and gives an overview of the total result of this.

Figure 9: Develco Prosumer Meter

- External Meter Interface: The External Meter Interface serves as a ZigBee interface for your electronic meters at home. The meter interface collects the information from the existing meters, and sends the data via ZigBee communication to appliances in the building. The user can simply follow the energy consumption through a display, a computer or a mobile phone.

Figure 10: Develco External Meter Interface

- Kamstrup Interface: The meter interface equips Kamstrup meters with wireless communication. The module is mounted under the standard meter cover and is compatible with single and poly phase meters. In addition to the standard ZigBee metering functionality, the device supports a complete KMP protocol via ZigBee tunnel cluster, providing extended meter functionality.

Figure 11: Develco Kamstrup Interface

2.1.5 GATEWAYS

- Squid.link Gateway: The Squid.link Gateway is a modular platform for flexible Home Area Network.It connects wireless devices through a communication protocol and reports data back to the user's computer or smart phone. The Squid.link Gateway is configurable and an extremely flexible solution for connecting networks based on different technologies.

Figure 12: Develco Squid.link Gateway

2.2 ENERGOMONITOR

Some of the devices available in the Energomonitor catalogue[2] are foreseen to be installed in pilot sites of Madrid (Spain).

2.2.1 MONITORING SETS

- Optosense: The Energomonitor Optosense set measures electricity consumption or production by reading the optical impulse output of a digital electricity meter.

Figure 13: Energomonitor Optosense

- Powersense: The Energomonitor Powersense set measures electricity consumption or production by induction coils installed on 1- or 3-phase wires leading to your main breaker cabinet/panel.

Figure 14: Energomonitor Powersense

- Powersense DIN Rail: The Powersense DIN Rail sensor measures AC electricity consumption or production in 1- or 3- phase installations.

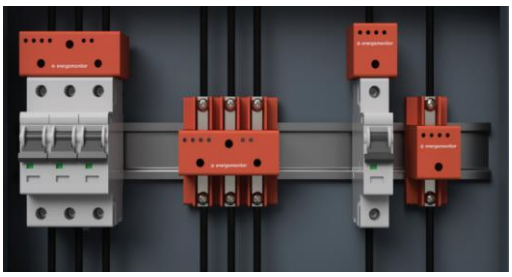

Figure 15: Energomonitor Powersense DIN Rail

- Relaysense Gas: The Energomonitor Relaysense Gas set measures gas consumption by reading the impulse output of a gas meter.

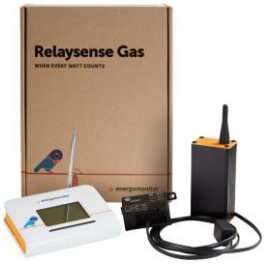

Figure 16: Energomonitor Relaysense Gas

- Relaysense Water: The Energomonitor Relaysense Water set measures water consumption by connecting to the impulse counter of a suitable water meter.

Figure 17: Energomonitor Relaysense Water

- Thermosense: The Energomonitor Thermosense set is a thermometer for indoor or outdoor use.

Figure 18: Energomonitor Thermosense

- Airsense: The Energomonitor Airsense set monitors complex air quality in the room – carbon dioxide (CO2) concentration, temperature, humidity and noise level.

Figure 19: Energomonitor Airsense

- Plugsense: The Energomonitor Plugsense set measures consumption over concrete appliances and can be switched on and off remotely.

Figure 20: Energomonitor Plugsense

- Portasight: Portable display gives you all the important information within arm's reach anywhere in your house.

Figure 21: Energomonitor Portasight

2.2.2 GATEWAYS

- Homebase: Is the heart of Energomonitor installation, wirelessly picking up data from up to 30 transmitters in the house through encrypted radio protocols.

Figure 22: Energomonitor Homebase

3. RECRUITMENT OF PARTICIPANTS

For each pilot site, some meetings were arranged with the neighbours, in order to recruit them to be participants of the RESPOND project demonstration. This is how the test houses for the RESPOND project were selected. This section offers a brief overview of the participants' recruitment process. This process will be further extended on *D3.2 RESPOND user engagement strategy*.

3.1 AARHUS (DENMARK)

First meeting was held at the housing association on the 30/01/2018. The meeting was an information meeting about the RESPOND project and all residents of the pilot building blocks of the association had been invited by personal letters. Thirteen residents showed up to the meeting (representing 9-10 dwellings). The meeting also included a short workshop, in which the participants discussed key questions related to their daily habits. The findings from this workshop will be reported in *D3.1 Criteria and framework for recruiting and engaging*. At the meeting, five dwellings agreed to participate. In the following two months, further dwellings were approached through direct personal contact made by AURA and ALBOA, and by the end of March, 20 dwellings had agreed to participate. The dwellings represent a relative good mixture with regard to age (although a bias towards residents older than 30 years), education and household size and also include diversity with regard to ethnic background. All dwellings have completed a questionnaire (sociological data) as part of the recruitment process.

3.2 ARAN ISLANDS (IRELAND)

In the case of the Aran pilot, the partner involved opted not to hold public meetings but instead to advertise the project in the locality and to contact the households in the area that met the project criteria. This was unique to this site as it has a population of 880 people and houses which met the criteria (PV panels, heat pumps etc.) were very easily identified. Meetings with the households in question were held on the 6th, 12th and 22nd of February 2018 where a detailed explaination of the project was given, and the DR concept was explained. After meeting with seven households, 5 agreed to participate.

The Aran partners hope to recruit 20-24 houses to the project, and have since began a second recruitment drive to add more participants. Some houses on the island have recently been retrofitted with the required equipment and since our second round of recruitment four more participants signed up, and the partner is currently in the process of completing the pilot typology for these dwellings.

3.3 MADRID (SPAIN)

First meeting was held the 26/02/2018. During the annual ordinary neighbours meeting where around 20 people attended, RESPOND project was introduced and a sample of Energomonitor's devices were shown. 11 dwellings agreed to take part in the trials. Since the goal of the project is to recruit 24 houses, some bilateral meetings are currently scheduled to enrol more participants.

Furthermore, some of the initial volunteers have contacted again during June 2018. The reason was, on the one hand, to start the installation of the necessary devices and, on the other, to arrange bilateral interviews where the necessary energetic and sociological inputs will be collected.

4. DEVICES TO BE INSTALLED

As previously mentioned, the pilot sites that have been chosen for deployment of RESPOND solution are quite diverse in terms of legacy equipment. In the dwellings, there are no systems for monitoring energy demand directly on the household devices, beside the general electricity, gas and water consumption meters that are deployed by the utility companies. Although there exist sites where remote monitoring of consumption is possible, those systems are usually deployed by utility companies that do not share the collected data. In order to be able to remotely monitor the total household energy consumption, the consumption of individual appliances, and other relevant parameters as well as to control some household appliances, this section details the equipment devised to be installed in each test house of the three pilot sites.

4.1 AARHUS (DENMARK)

The Table 1 shows the devices to be installed in each house.

Device to be installed	Function	DR objective
Develco Squid.Link Gateway	Gateway	Provide connectivity to other components
Develco Kamstrup Interface	Transmission of the data monitored by Kamstrup MC 602 calorimeter	DR actions outcome result verification by means of the thermal consumption
Kamstrup MC 602 Calorimeter	Monitoring of thermal energy consumed	DR actions outcome result verification by means of the thermal consumption
Develco External Meter Interface	Transmission of the data monitored by electricity meter	DR actions outcome result verification by means of the electric consumption
Thermostat	Monitoring of the temperature of the room in which it is installed, and controlling the radiator's activation according to DR actions	Radiator's activation and deactivation
Develco SmartPlug 1	Monitoring of the dishwasher's power consumption, and controlling the dishwasher's activation according to DR actions	Dishwasher's activation and deactivation
Develco SmartPlug 2	Monitoring of the washing machine's power consumption, and controlling the washing machine's activation according to DR actions	Washing machine's activation and deactivation
Develco window sensor	Monitoring of the temperature of the room and the state of the window in which it is installed	Comfort conditions verification including air change rate, in order to

		decide if any DR action related to comfort is necessary
CO2 sensor (manufacturer not decided yet)	Monitoring of the CO2 levels of the room in which it is installed	CO2 conditions verification, in order to consider if any DR action related to comfort is necessary

Table 1: Devices to be installed in Aarhus houses

Test houses have already installed the following equipment that is devised to be considered in DR actions.

- Dishwasher
- Washing machine
- Radiator
- ABB B23 113-100 Electricity meter

Furthermore, test houses have deployed the following equipment that, although not being considered suitable for DR actions (in particular for activation/deactivation actions), has the potential for DR actions. In fact, they could provide DR flexibility in terms of manual interaction, such as lowering the fridge temperature by the dweller.

- Fridge
- Freezer
- Stove

The Table 2 shows the devices to be installed in the common area.

Device to be installed	Function	DR objective
Develco Squid.Link Gateway	Gateway	Provide connectivity to other components
Develco Prosumer Meter	Monitoring of electric energy consumed, electric energy sold and electric energy generated by the PV panels	PV panels energy consumption and generation verification

Table 2: Devices to be installed in Aarhus common area

The common area has already installed the following equipment that is devised to be considered in DR actions:

- REC Twinpeak 2S 72 PV Panels
- Danfoss TripleLynx Inverter

4.2 Aran Islands (Ireland)

In the Aran Islands case, each house has its own characteristics and different appliances are available. Therefore, in this section, each house is individually detailed.

The Table 3 shows the devices to be installed in House 1:

Device to be installed	Function	DR objective
Develco Squid.Link Gateway	Gateway	Provide connectivity to other components
Develco Prosumer Meter	Monitoring of electric energy consumed, electric energy sold and electric energy generated by the PV panels	PV panels energy consumption and generation verification
Develco External Meter Interface	Transmission of the data monitored by electricity meter from the grid	DR actions outcome result verification by means of the electric consumption
Develco Humidity Sensor (3)	Monitoring of the temperature and humidity of three spaces	Comfort conditions verification, in order to decide if any DR action related to comfort is necessary
Develco Smart Cable 1	Monitoring of the Heat Pump's power consumption	Heat pump's activation and deactivation
Develco Smart Cable 2	Monitoring of the electrical heater's power consumption, and controlling the electrical heater's activation according to DR actions	Electrical heater's activation and deactivation
Develco SmartPlug 1	Monitoring of the dishwasher's power consumption, and controlling the dishwasher's activation according to DR actions	Dishwasher's activation and deactivation
Develco SmartPlug 2	Monitoring of the washing machine's power consumption, and controlling the washing machine's activation according to DR actions	Washing machine's activation and deactivation
Develco SmartPlug 3	Monitoring of the tumble dryer's power consumption, and controlling the tumble dryer's activation according to DR actions	Tumble dryer's activation and deactivation

Table 3: Devices to be installed in Aran Island house 1

House 1 has already installed the following appliances and equipment that are devised to be considered in DR actions.

- ET 660250WW PV Panels
- Electric Vehicle Renault Fluence
- Daikin Heat Pump
- Aurora Inverter

- Dishwasher
- Washing machine
- Tumble Dryer
- Electrical Heater

Furthermore, House 1 has deployed the following equipment that, although not being considered suitable for DR actions (in particular for activation/deactivation actions), it could provide DR flexibility in terms of manual interaction, such as lowering the freezer temperature by the dweller.

- 2 Freezers
- Dehumidifier

The Table 4 shows the devices to be installed in House 2:

Device to be installed	Function	DR objective
Develco Squid.Link Gateway	Gateway	Provide connectivity to other components
Develco Prosumer Meter	Monitoring of electric energy consumed, electric energy sold and electric energy generated by the PV panels	PV panels energy consumption and generation verification
Develco Smart Cable 1	Monitoring of the Heat Pump's power consumption	Heat pump's activation and deactivation
Develco Smart Cable 2	Monitoring of battery's power consumption when charging/discharging	DR actions outcome result verification by means of the battery's power consumption when charging/discharging
Develco External Meter Interface	Transmission of the data monitored by electricity meter from the grid	DR actions outcome result verification by means of the electric consumption
Develco Humidity Sensor (3)	Monitoring of the temperature and humidity of three spaces	Comfort conditions verification, in order to decide if any DR action related to comfort is necessary
Develco SmartPlug 1	Monitoring of the electrical heater's power consumption, and controlling the electrical heater's activation according to DR actions	Electrical heater's activation and deactivation
Develco SmartPlug 2	Monitoring of the washing machine's power consumption, and controlling the washing machine's activation according to DR actions	Washing machine's activation and deactivation
Develco SmartPlug 3	Monitoring of the tumble dryer's power consumption, and controlling the tumble dryer's activation according to DR actions	Tumble dryer's activation and deactivation

Table 4: Devices to be installed in Aran Island house 2

House 2 has already installed the following appliances and equipment that are devised to be considered in DR actions.

- ET 660250WW PV Panels
- Battery
- Solis Inverter
- Mitsubishi Heat Pump
- Washing machine
- Tumble Dryer
- Freezer
- Electrical Heater

Furthermore, House 2 has deployed the following equipment that, although not being considered suitable for DR actions (in particular for activation/deactivation actions), it could provide DR flexibility in terms of manual interaction, such as lowering the freezer temperature by the dweller.

- Freezer

The Table 5 shows the devices to be installed in House 3:

Device to be installed	Function	DR objective
Develco Squid.Link Gateway	Gateway	Provide connectivity to other components
Develco Prosumer Meter	Monitoring of electric energy consumed, electric energy sold and electric energy generated by the PV panels	PV panels energy consumption and generation verification
Develco External Meter Interface	Transmission of the data monitored by electricity meter from the grid	DR actions outcome result verification by means of the electric consumption
Develco Humidity Sensor (3)	Monitoring of the humidity and temperature of three spaces	Comfort conditions verification, in order to decide if any DR action related to comfort is necessary
Develco Smart Cable	Monitoring of the Heat Pump's power consumption	Heat pump's activation and deactivation
Develco SmartPlug 1	Monitoring of the dishwasher's power consumption, and controlling the dishwasher's activation according to DR actions	Dishwasher's activation and deactivation

Develco SmartPlug 2	Monitoring of the washing machine's power consumption, and controlling the washing machine's activation according to DR actions	Washing machine's activation and deactivation
Develco SmartPlug 3	Monitoring of the tumble dryer's power consumption, and controlling the tumble dryer's activation according to DR actions	Tumble dryer's activation and deactivation

Table 5: Devices to be installed in Aran Island house 3

House 3 has already installed the following appliances and equipment that are devised to be considered in DR actions.

- ET 660250WW PV Panels
- Solis Inverter
- Mitsubishi Heat Pump
- Dishwasher
- Washing machine
- Tumble Dryer

Furthermore, House 3 has deployed the following equipment that, although not being considered suitable for DR actions (in particular for activation/deactivation actions), it could provide DR flexibility in terms of manual interaction, such as lowering the freezer temperature by the dweller.

- 3 Freezers
- Electric oven

The Table 6 shows the devices to be installed in House 4:

Device to be installed	Function	DR objective
Develco Squid.Link Gateway	Gateway	Provide connectivity to other components
Develco Prosumer Meter	Monitoring of electric energy consumed, electric energy sold and electric energy generated by the PV panels	PV panels energy consumption and generation verification
Develco External Meter Interface	Transmission of the data monitored by electricity meter from the grid	DR actions outcome result verification by means of the electric consumption
Develco Humidity Sensor (3)	Monitoring of the humidity and temperature of three spaces	Comfort conditions verification, in order to decide if any DR action related to comfort is necessary
Develco Smart Cable	Monitoring of the Heat Pump's power consumption	Heat pump's activation and deactivation

Develco SmartPlug 1	Monitoring of the dishwasher's power consumption, and controlling the dishwasher's activation according to DR actions	Dishwasher's activation and deactivation
Develco SmartPlug 2	Monitoring of the washing machine's power consumption, and controlling the washing machine's activation according to DR actions	Washing machine's activation and deactivation
Develco SmartPlug 3	Monitoring of the tumble dryer's power consumption, and controlling the tumble dryer's activation according to DR actions	Tumble dryer's activation and deactivation

Table 6: Devices to be installed in Aran Island house 4

House 4 has already installed the following appliances and equipment that are devised to be considered in DR actions.

- ET 660250WW PV Panels
- Solis Inverter
- Mitsubishi Heat Pump
- Dishwasher
- Washing machine
- Tumble Dryer

Furthermore, House 4 has deployed the following equipment that, although not being considered suitable for DR actions (in particular for activation/deactivation actions), it could provide DR flexibility in terms of manual interaction, such as lowering the freezer temperature by the dweller.

- Freezer
- Electric oven

The Table 7 shows the devices to be installed in House 5:

Device to be installed	Function	DR objective
Develco Squid.Link Gateway	Gateway	Provide connectivity to other components
Develco Prosumer Meter	Monitoring of electric energy consumed, electric energy sold and electric energy generated by the PV panels	PV panels energy consumption and generation verification
Develco External Meter Interface	Transmission of the data monitored by electricity meter from the grid	DR actions outcome result verification by means of the electric consumption
Develco Humidity Sensor (3)	Monitoring of the humidity and temperature of three spaces	Comfort conditions verification, in order to decide if any DR action related to comfort is necessary

Develco Smart Cable	Monitoring of the Heat Pump's power consumption	Heat pump's activation and deactivation
Develco SmartPlug 1	Monitoring of the washing machine's power consumption, and controlling the washing machine's activation according to DR actions	Washing machine's activation and deactivation
Develco SmartPlug 2	Monitoring of the tumble dryer's power consumption, and controlling the tumble dryer's activation according to DR actions	Tumble dryer's activation and deactivation

Table 7: Devices to be installed in Aran Island house 5

House 5 has already installed the following appliances and equipment that are devised to be considered in DR actions.

- ET 660250WW PV Panels
- Solis Inverter
- Mitsubishi Heat Pump

Furthermore, House 5 has deployed the following equipment that, although not being considered suitable for DR actions (in particular for activation/deactivation actions), it could provide DR flexibility in terms of manual interaction, such as lowering the freezer temperature by the dweller.

- Freezer
- Electric oven

4.3 Madrid (Spain)

The Table 8 shows the devices to be installed in each house.

Device to be installed	Function	DR objective
Energomonitor Homebase	Gateway	Central gateway for radio communications and internet access
Energomonitor Optosense	Monitoring of electric energy consumed	DR actions outcome result verification by means of the electric consumption
Energomonitor AirSense	Monitoring of the humidity, temperature and CO2 of the room in which it is installed	Comfort conditions verification, in order to decide if any DR action related to comfort is necessary
Energomonitor Relaysense Gas	Monitoring of gas consumed	DR actions outcome result verification by means of the gas consumption
Energomonitor Relaysense Water	Monitoring of water consumed	DR actions outcome result verification by means of the water consumption

Energomonitor Thermosense	Monitoring of the temperature of the room in which it is installed	Comfort conditions verification, in order to decide if any DR action related to comfort is necessary
Energomonitor Portasight	Monitoring of the humidity and temperature of the room in which it is installed	Visual feedback of consumption and comfort parameters for end user
Energomonitor Plugsense 1	Monitoring of the dishwasher's power consumption, and controlling the dishwasher's activation according to DR actions	Dishwasher's activation and deactivation
Energomonitor Plugsense 2	Monitoring of the washing machine's power consumption, and controlling the washing machine's activation according to DR actions	Washing machine's activation and deactivation
Energomonitor Powersense	Monitoring of the air conditioner's power consumption	DR actions outcome result verification by means of the air conditioner's power consumption

Table 8: Devices to be installed in Madrid houses

Test houses have already installed the following appliances and equipment that are devised to be considered in DR actions.

- Dishwasher
- Washing Machine
- Air conditioner

Furthermore, test houses have deployed most of the following equipment that, although not being considered suitable for DR actions (in particular for activation/deactivation actions), it could provide DR flexibility in terms of manual interaction, such as lowering the fridge temperature by the dweller.

- Fridge
- Oven
- Induction cooker
- Microwave oven

The Table 9 shows the devices to be installed in the common area.

Device to be installed	Function	DR objective
Energomonitor Homebase	Gateway	Central gateway for radio communications and internet access
Energomonitor Optosense	Monitoring of electric energy consumed.	DR actions outcome result verification by means of the electric consumption

Table 9: Devices to be installed in Madrid common area

The common area has already installed the following equipment that is devised to be considered in DR actions:

- Trend IQ251 central heating boiler
- Cx2000-9/Sagecom Electricity meter
- Istameter radio net 3/Ista water meters
- IM-RM G100 DIN Dresser gas meter

During the RESPOND project, in addition to Energomonitor's devices, the following equipment will be installed in the common areas:

- Thermosolar system
- 6 Siemens QAE2120.010 temperature sensors
- 2 electronic heat meters Siemens UH50
- Siemens RMS705B solar regulation control unit
- Siemens OZW722.01 web server for remote communications
- Energomonitor Optosense

The thermosolar system performance will be monitored by the temperature sensors and the heat meters. All of them are expected to be connected to the control unit that will be available for remote access through the web server. All Siemens devices will use KNX communication protocol. Furthermore, a heat meter is intended to be placed in the primary thermal circuit in order to measure the real solar production, while the other one will be located in the return circuit to quantify circuit loses. As regards for the temperature sensors, they will be installed in the cold water input, solar panels input and output, thermosolar circuit water tank, SHW water tank and SHW output. This way, in addition to enabling the adjustment and measurement of thermosolar system's performance, it will provide trials participants with thermosolar SHW availability and production, in order to modify their consumption timeframes.

In order to ensure interoperability with legacy hardware and software and the new thermosolar system, OGEMA (Open Gateway Energy MAnagement) will also be deployed. OGEMA [3] is an example of open source software platform that supports standardized building automation and energy management applications. The software is designed to be installed on a gateway computer between the customer and the smart grid. It is manufacturer and hardware independent, designed to be easily extendable by means of plugins (i.e. communication drivers) which support different communication protocols and enable translation from and to proprietary data formats (Zigbee, Z-Wave, Modbus, BACnet, KNX).

5. CUSTOMIZATION OF HOME AUTOMATION EQUIPMENT

RESPOND platform aims to integrate the devices from both Develco and Energomonitor in a unified manner, in order to ease deployment, debugging and future system maintenance. Nevertheless, there exists a difference in hardware and software implementation of devices produced by different vendors.

In order to overcome this issue and seamlessly integrate them with the rest of the system, a (mainly software) customization of proprietary platforms is required.

Develco gateway on one side has a Zigbee/Zwave interface that is used to provide a reliable connection to sensors, smart meters and actuators. On the other side, it can be connected to the MQTT broker [4] that is part of the RESPOND cloud platform via Wi-Fi or Wired LAN connection (see Figure 23). Develco gateway supports MQTT protocol that is used to either send the measurements from the gateway to the cloud platform or to receive control actions from the platform to e.g. turn on/off the switch in a smart plug or smart relay. The format of the MQTT message payload is however proprietary and it has to be translated into the Canonical Data Model (CDM) that will be used by the rest of the system to ensure interoperability among different system components. This translation of proprietary data format into CDM will be performed on gateways themselves, and therefore their customization is required.

Energomonitor offers a cloud platform for data storage and visualisation, while Develco just provides hardware. Energomonitor sensors and actuators employ a proprietary communication protocol (Chirp) to communicate with the corresponding gateway which is then connected via wired LAN connection to the MQTT broker deployed as a part their proprietary cloud platform. The data received by Energomonitor's MQTT broker are stored and made available to the end user via intuitive user interface. In order to integrate Energomonitor's devices in the same manner as the ones provided by Develco, a so called "Bridge service" will be developed. The bridge service is a continuously running server software that will on side gather data collected by Energomonitor cloud platform and send them to the RESPOND cloud platform by using MQTT protocol. The payload of the MQTT messages will be structured according to the same CDM data format as the one that will employed by Develco. In such a way, from the point of view of RESPOND MQTT broker, both Develco gateway and Energomonitor system will act in the same manner resulting in a more stable and maintainable system.

Once the data reach the RESPOND MQTT broker, they are parsed by the Telegraf component of the TICK stack [5] and stored in Influx database that is particularly suitable for storage of time series type of data. There will also exist Chronograf and Kapacitor components that will be used for configuration and real-time processing of measurements collected by both Develco and Energomonitor devices deployed in pilot sites.

Finally, MQTT broker will also be used to route the control action issued by analytic services (e.g. optimization service), to a specific smart plug or relay.

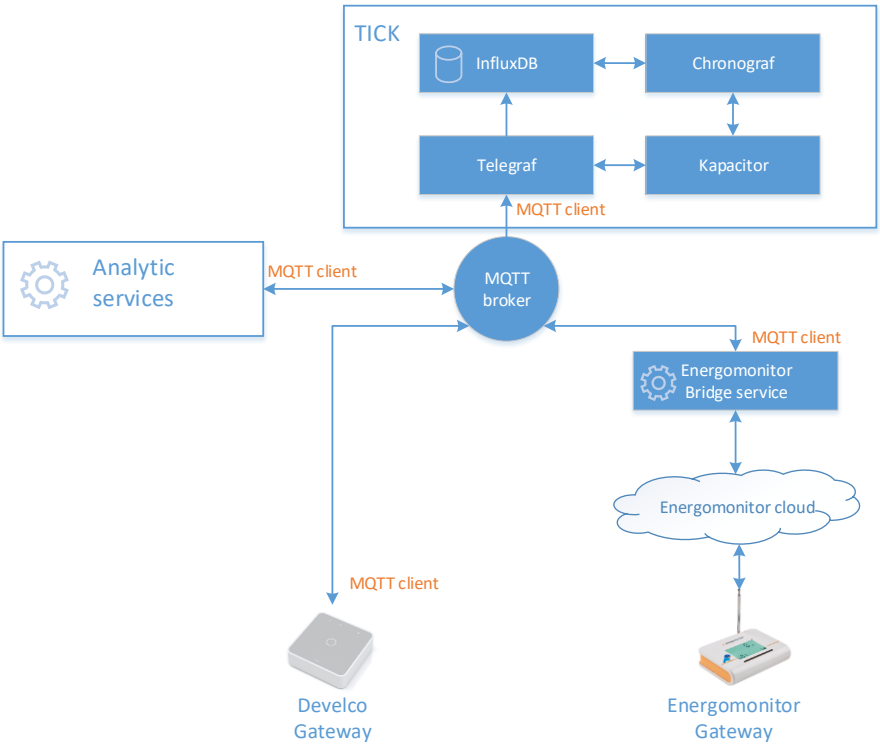

Figure 23: Integration of Home automation equipment with RESPOND cloud platform

6. DEPLOYMENT PLAN PER PILOT SITE

According to the current plan, the recruiting of test houses, installation of devices and baseline measurement have to be done in parallel for the three pilot sites. After doing the baseline measurement, the different use cases defined for each pilot site have to be executed. At the moment of writing this deliverable, each pilot site has already succeeded in recruiting test houses. The next step consists in installing the necessary devices and equipment. The deadline for this task is stipulated 31/08/2018 in order to have one additional month until the end of *T2.4* and be able to solve eventual delays than can be experienced.

For the purpose of elaborating the initial RESPOND deployment plan, it has been necessary to interact with tasks *T1.4 Demand response actions discovery for each pilot*, *T2.1 System architecture design*, *T2.2 Seamless integration of RESPOND technology tiers* and *T3.2 User engagement approach*.

Below in the following paragraphs it is shown the detailed deployment plan scheduled for each pilot site and its specific casuistic along with a dwelling plan and the location of the devices to be deployed.

6.1 Aarhus (Denmark)

Denmark is hosting a pilot located in Aarhus, more precisely in a state of social apartments. There are 20 dwellings taking part in RESPOND trials.

Below a table with the tasks for the early deployment plan is shown. Some of them have been already fulfilled while the other ones will be done in the upcoming months.

Task	Duration	Start date	End date
Early deployment at pilot sites	**550 days**	**22-01-2018**	**28-02-2020**
Participants Recruitment	110 days	22-01-2018	08-06-2018
Selection of 20 test houses	50 days	11-06-2018	17-08-2018
Equipment installation	**10 days**	**20-08-2018**	**31-08-2018**
Devices Installation	10 days	20-08-2018	31-08-2018
Equipment installation verification	0 days	31-08-2018	31-08-2018
Baseline measurements	**150 days**	**03-09-2018**	**29-03-2019**
Monitoring of baseline data	150 days	03-09-2018	29-03-2019
Storage of baseline data	150 days	03-09-2018	29-03-2019

Baseline Measurement Stop	0 days	29-03-2019	29-03-2019
Demand Response platform deployment	**240 days**	**01-04-2019**	**28-02-2020**
User engagement approach	240 days	01-04-2019	28-02-2020
User interactions	240 days	01-04-2019	28-02-2020
Mobile user interactions	240 days	01-04-2019	28-02-2020

Table 10: Danish Pilot Site initial deployment plan

- *Early deployment at pilot Site* [22/01/2018 to 28/02/18]: This task is intended to study and select the participants in the trials among the inhabitants of the pilot.
  - *Participants Recruitment* [22/01/2018 to 08/06/18]: During this task, several actions such as workshops and bilateral meetings are held to select participants.
  - *Selection of 20 test houses* [11/06/2018 to 17/08/18]: During this period, the final participants of the pilot site must be identified and their consent must be collected.
- *Equipment Installation* [20/08/2018 to 31/08/18]: During this period, all the necessary metering equipment will be installed in the selected houses, in order to start acquiring baseline measurements. Meanwhile, some components of the cloud platform will also be deployed in order to receive and store the data sent by the equipment.
  - *Devices Installation* [20/08/2018 to 31/08/18] Installation of the necessary devices.
  - *Equipment installation verification* [31/08/2018 to 31/08/18] The verification that the installation of the previous step is finished.
- *Baseline measurements* [03/09/2018 to 29/03/19]: During this period the platform will collect measures before starting DR actions to be able to compare and analyse the results.
  - *Monitoring of baseline data* [03/09/2018 to 29/03/19]: Period of time when data related to energy and electricity among others, will be monitored.
  - *Storage of baseline data* [03/09/2018 to 29/03/19]: Period for storing the baseline data.
  - *Baseline measurement stop*: [29/03/2018 to 29/03/19]: After this date, the platform will keep collecting data while DR actions will start.
- *Demand Response platform deployment* [01/04/2019 to 28/02/20]: Deployment of all the components of the RESPOND solution.
  - *User engagement approach* [01/04/2019 to 28/02/20]: Engagement activities for trial participants,
  - *User interactions* [01/04/2019 to 28/02/20] Use of the PC RESPOND solution dashboard by participants.
  - *Mobile app user interactions* [01/04/2019 to 28/02/20] Use of the mobile app RESPOND solution dashboard by participants.

Following, the 2D plans for the test houses in the Danish pilot site are shown. Each house has three stages: the first floor, the ground floor, and the basement.

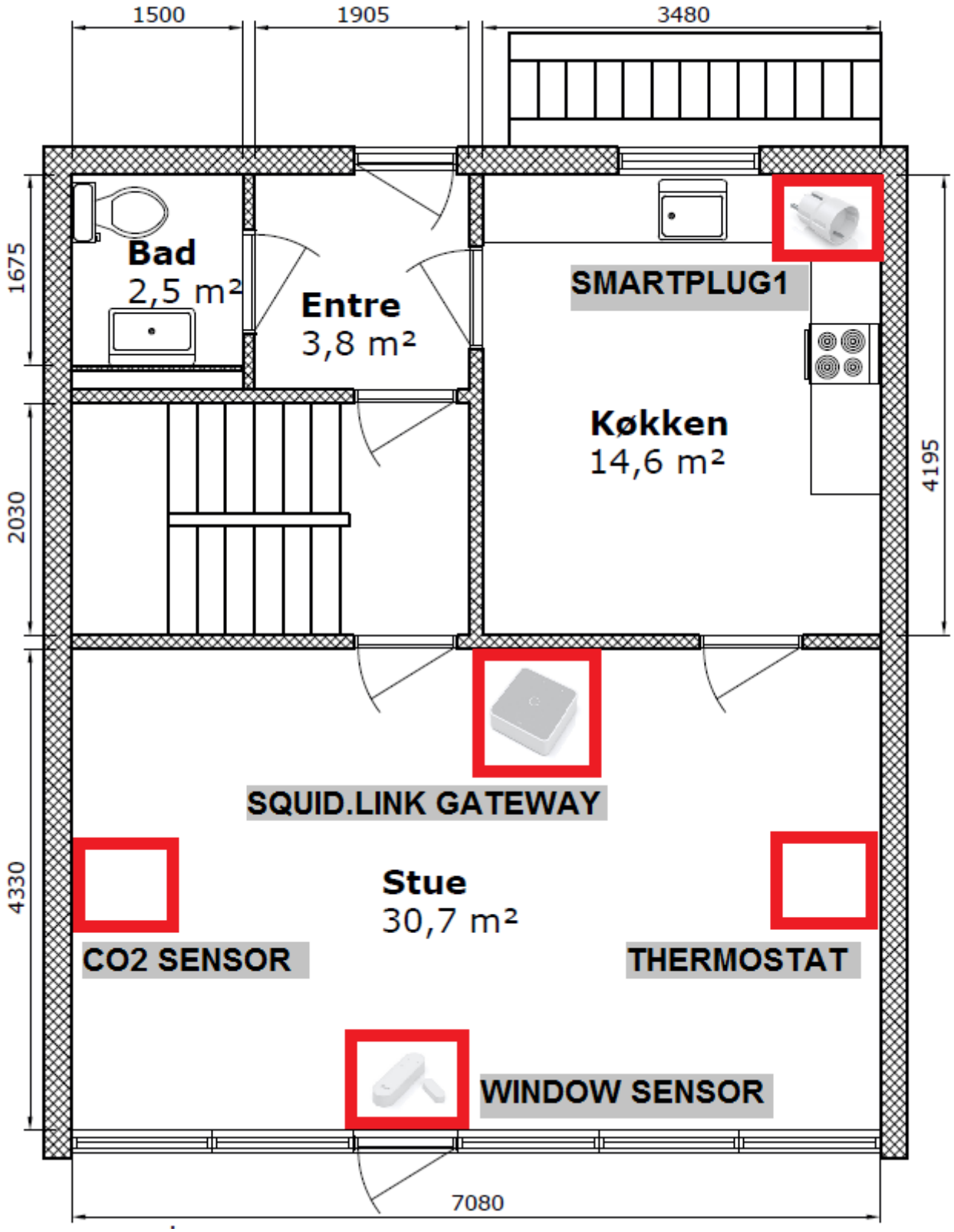

Figure 24: 2D plan of the ground floor in Aarhus houses

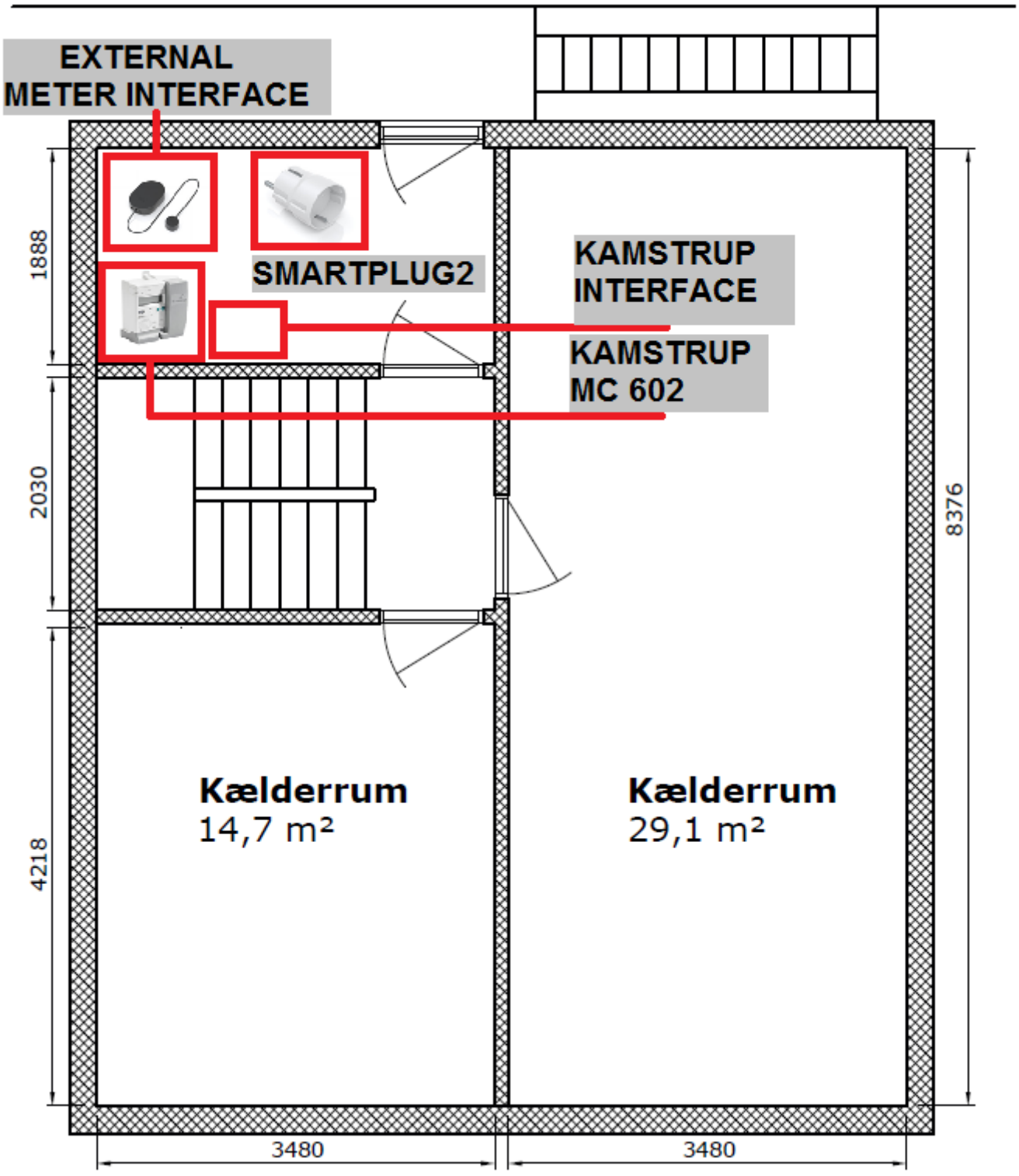

Figure 25: 2D plan of the basement in Aarhus houses

The Develco Squid.link gateway will be installed in the living room. In this room, the window sensor (measuring both window's status and temperature) will be installed, alongside with a CO2 sensor to monitor the air quality of the room. Last but not least, a thermostat will also be installed in order to control

radiators' activation. In the kitchen located in the ground floor, a Develco Smart plug will be installed in the dishwasher, in order to control its activation and deactivation. As regards the basement, a Kamstrup MC 602 and a Develco Kamstrup Interface will be installed to monitor the thermal energy consumed. Furthermore, a Develco External Meter Interface will be installed to transmit the data monitored by the ABB B23 113-100 electricity meter. Finally, a Develco Smart plug will be installed to control the washing machine's activation.

6.2 Aran Islands (Ireland)

The Irish pilot is located in Aran Islands, located in the west of Ireland. There are 20 dwellings intended to take part in RESPOND trials.

Below a table with the tasks for the early deployment plan is shown. Some of them have been already fulfilled while the other ones will be done in the upcoming months.

Task	Duration	Start date	End date
Early deployment at pilot site	**550 days**	**22-01-2018**	**28-02-2020**
Participants Recruitment	100 days	22-01-2018	08-06-2018
Selection of 20 test houses	50 days	11-06-2018	17-05-2018
Shipment of equipment	5 days	02-07-2018	06-07-2018
Equipment installation	**10 days**	**20-08-2018**	**31-08-2018**
Equipment installation verification	0 days	31-08-2018	31-08-2018
Baseline measurements	**150 days**	**03-09-2018**	**29-03-2019**
Monitoring of baseline data	150 days	03-09-2018	29-03-2019
Storage of baseline data	150 days	03-09-2018	29-03-2019
Baseline Measurement Stop	0 days	29-03-2019	29-03-2019
Demand Response platform deployment	**240 days**	**01-04-2019**	**28-02-2020**
User engagement approach	240 days	01-04-2019	28-02-2020
User interactions	240 days	01-04-2019	28-02-2020
Mobile user interactions	240 days	01-04-2019	28-02-2020

Table 11: Irish Pilot Site initial deployment plan

- *Early deployment at pilot Site* [22/01/2018 to 28/02/18]: This task is intended to study and select the participants in the trials among the inhabitants of the pilot.
  - *Participants Recruitment* [22/01/2018 to 08/08/18]: During this task several actions such as workshops and bilateral meetings are held to select participants.
  - *Selecting 20 test houses* [11/06/2018 to 17/08/18]: During this period, the final participants of the pilot site must be identified and their consent must be collected.
  - *Shipment of equipment* [02/07/2018 to 06/07/18]: It is necessary to send the equipment from Denmark to the Aran Islands.
- *Equipment Installation* [20/08/2018 to 31/08/18]: During this period, all the necessary metering equipment will be installed in the selected houses, in order to start acquiring baseline measurements. Meanwhile, some components of the cloud platform will also be deployed in order to receive and store the data sent by the equipment.
  - *Equipment installation verification* [31/08/2018 to 31/08/18] The verification that the installation of the previous step is finished.
- *Baseline measurements* [03/09/2018 to 29/03/19]: During this period the platform will collect measures before starting DR actions to be able to compare and analyse the results.
  - *Monitoring of baseline data* [03/09/2018 to 29/03/19]: Period of time when data related to electricity among others, will be monitored.
  - *Storage of baseline data* [03/09/2018 to 29/03/19]: Period for storing baseline data.
  - *Baseline measurement stop* [29/03/2018 to 29/03/19]: After this date, the platform will keep collecting data while DR actions will start.
- *Demand Response platform deployment* [01/04/2019 to 28/02/20]: Deployment of all the components of the RESPOND solution.
  - *User engagement approach* [01/04/2019 to 28/02/20]: Engagement activities for trial participants,
  - *User interactions* [01/04/2019 to 28/02/20] Use of the PC RESPOND solution dashboard by participants.
  - *Mobile app user interactions* [01/04/2019 to 28/02/20] Use of the mobile app RESPOND solution dashboard by participants.

6.3 Madrid (Spain)

The third pilot is located in Madrid, Spain's capital. There are 24 dwellings along with some common areas of a residential complex (3 buildings) taking part in RESPOND trials.

Below a table with the tasks for the early deployment plan is shown. Some of them have been already fulfilled while the other ones will be done in the upcoming months.

Task	Duration	Start date	End date
Early deployment at pilot sites	**140 days**	**22-01-2018**	**03-08-2018**

Participants Recruitment	140 days	22-01-2018	03-08-2018
Selection of 20 test houses	0 days	03-08-2018	03-08-2018
Equipment installation	**20 days**	**06-08-2018**	**31-08-2018**
Equipment installation verification	0 days	31-08-2018	31-08-2018
Baseline measurements	**150 days**	**03-09-2018**	**29-03-2018**
Monitoring of baseline data	150 days	03-09-2018	29-03-2018
Storage of baseline data	150 days	03-09-2018	29-03-2018
Baseline Measurement Stop	0 days	29-03-2018	29-03-2018
Demand Response equipment deployment	**10 days**	**01-04-2019**	**12-04-2019**
DR Equipment Installation	10 days	01-04-2019	12-04-2019
DR Equipment Installation verification	0 days	12-04-2019	12-04-2019
Demand Response platform deployment	**230 days**	**15-04-2019**	**28-02-2020**
User engagement approach	230 days	15-04-2019	28-02-2020
User interactions	230 days	15-04-2019	28-02-2020
Mobile user interactions	230 days	15-04-2019	28-02-2020

Table 12: Spanish Pilot Site initial deployment plan

- *Early deployment at pilot Site* [22/01/2018 to 03/08/18]: This task is intended to study and select the participants in the trials among the inhabitants of the pilot.
  - *Participants Recruitment* [22/01/2018 to 03/08/18]: During this task, several actions such as workshops and bilateral meetings are held to select participants.
  - *Selection of 24 test houses* [03/08/2018 to 03/08/18]: During this period, the final participants of the pilot site must be identified and their consent must be collected.
- *Equipment Installation* [06/08/2018 to 31/08/18]: During this period, all the necessary metering equipment will be installed in the selected houses, in order to start acquiring baseline measurements. Meanwhile, some components of the cloud platform will also be deployed in order to receive and store the data sent by the equipment.
  - *Equipment installation verification* [31/08/2018 to 31/08/18] The verification that the previous step is finished.
- *Baseline measurements* [03/09/2018 to 29/03/19]: During this period the platform will collect measures before starting DR actions to be able to compare and analyse the results.
  - *Monitoring of baseline data* [03/09/2018 to 29/03/19]: Period of time when data related to electricity among others, will be monitored.
  - *Storage of baseline data* [03/09/2018 to 29/03/19]: Period for storing baseline data.

- *Baseline measurement stop* [29/03/2018 to 29/03/19]: After this date, the platform will keep collecting data while DR actions will start.

➢ *Demand Response equipment deployment*: [01/04/2019 to 12/04/19]: Period reserved to install specific equipment for demand response (control) actions and deploy the rest of the cloud platform components.

- *DR Equipment Installation*: [01/04/2019 to 12/04/19]: Installation of the DR equipment.
- *DR Equipment Installation verification*: [12/04/2019 to 12/04/19]: The verification that the previous step is finished.

➢ *Demand Response platform deployment*: [15/04/2019 to 28/02/20]: Deployment of all the components of the RESPOND solution.

- *User engagement approach*: [15/04/2019 to 28/02/20]: Engagement activities for trial participants,
- *User interactions*: [15/04/2019 to 28/02/20] Use of the PC RESPOND solution dashboard by participants.
- *Mobile app user interactions*: [15/04/2019 to 28/02/20] Use of the mobile app RESPOND solution dashboard by participants.

Following, the 2D plan of a test houses in the Madrid pilot site is shown, alongside with the potential location of the devices to be installed.

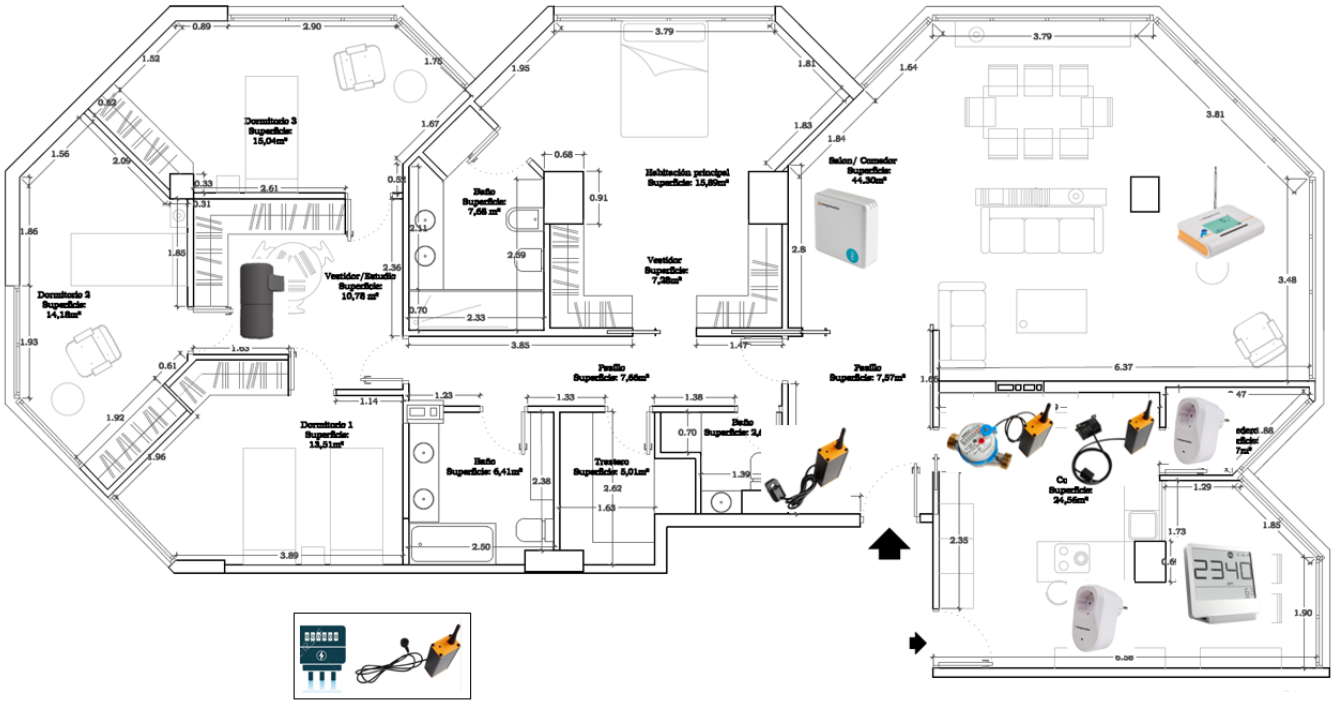

Figure 26: 2D plan of the Madrid houses and devices deployment plan

The Energomonitor Homebase will be installed in the living room, near the router's location, in order to ensure Internet access. In this room, the Energomonitor Thermosense (measuring temperature) will also be installed, while the Energomonitor Airsense (measuring temperature, CO2 and humidity) will be

located in the bedrooms to compare variations among locations. Both water and gas meters will be installed in the kitchen, were utility meters are located. The kitchen will also hold the Energomonitor Portasight display (measuring temperature) as well as the Energomonitor Smart Plugs installed in the dishwasher and washing machine. The electricity wire sensor will be installed in the main electrical panel of the house monitoring air conditioner circuit, while the optical sensor will be installed in the utility electricity meter located in the building's common meters room (in the basement).

7. CONCLUSIONS

Deliverable *D2.3*, as it has been demonstrated above, is clearly focused on resolute steps to carry out the early deployment of some components of the RESPOND DR solution, rather than on more theoretical studies.

These concrete actions have been designed taking into account the specific characteristics, requirements and use cases of each of the three pilot sites of the project (Aarhus, Aran Islands and Madrid).

As a general conclusion it is necessary to point out the key importance of fulfilling deadlines looking to avoid delays in the execution of the rest of the project. It is of main importance to start acquiring data as baseline as soon as possible to have plenty of time to test the implementation of RESPOND solution within the trial and analyse the effects in participants (energy and sociological aspects) in comparison with the original situation.

Another lesson learned during the elaboration of this deployment plan together with the first deployment actions already carried out in some pilot is the different between ideal paper-based ideas and the difficult process to execute then in the non-perfect real world. It is key to bear this in mind in order to elaborate realistic proposals with enough time and flexible enough to adapt to any inconveniences that can arise during the project.

A final reflection is related with the ICT point of view. It worth's to spend all the necessary time to find the more suitable design of hardware architecture and communications flows and format in order to be all aligned and avoid future problems that can threat the development of the project or cause delays on it.

This deployment plan is subject to changes, due to the problems that may arise during installation phase, or potential DR monitoring and control opportunities. The final equipment deployment will be reflected in *D2.4 Early deployment activities report*.

REFERENCES

RESPOND DOCUMENTS

D1.1 Pilot technical characterization and operational scenarios

D1.3 RESPOND strategy to support interoperability

EXTERNAL DOCUMENTS

[1] Develco catalogue. https://www.develcoproducts.com/media/3701/product-catalogue-v35.pdf (Last accessed on: 26/07/2018)

[2] Energomonitor catalogue. https://drive.google.com/file/d/0Bx_LgxtRLIojeFFTWkdjNHZHbEE/view (Last accessed on: 26/07/2018)

[3] OGEMA: http://www.ogema.org (Last accessed on: 26/07/2018)

[4] MQTT Broker. http://mqtt.org (Last accessed on: 26/07/2018)

[5] TICK Stack: https://www.influxdata.com/time-series-platform/ (Last accessed on: 26/07/2018)