



Horizon 2020 – LCE-2017 - SGS

FLEXCoop

Democratizing energy markets through the introduction of innovative flexibility-based demand response tools and novel business and market models for energy cooperatives

WP7 – System Validation and Impact Assessment



FLEXCoop

D7.3 – Report on FLEXCoop Framework deployment at Pilot Sites -Preliminary Version

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Author(s): Laura Morcillo (ETRa), Pau Pañella (Som Energia), Rene van Vliet (ODE), Dominique Doedens (Escozon), Chazapi Francesca (Hypertech)

Editor: Laura Morcillo (ETRa)

Lead Beneficiary of Deliverable: ETRa

Contributors: ETRa, CIMNE, Som Energia, ODE, Escozon, Hypertech, DTU

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Internal Reviewers: Jordi Cipriano (CIMNE), Hrvoje Keko (KONČAR)

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FLEXCOOP CONSORTIUM PARTNERS

Fraunhofer	Fraunhofer-Gesellschaft zur Förderung der angewandten Forschung e.V.
ETRa	ETRA INVESTIGACION Y DESARROLLO SA
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EXECUTIVE SUMMARY

The present deliverable is the second outcome of Task 7.2. “System Deployment in Pilot Sites”. This deliverable depends on the deployment plan described in D7.1 (M16) and will impact the second phase of Task 7.2 (Month 30 to 33), related to the submission in M33 of D7.6. “Report on FLEXCoop Framework deployment at Pilot Sites –Final Version”. The scope of D7.3 is to describe the first phase of the FLEXCoop Framework Deployment of all the necessary equipment installed in both FLEXCoop pilot sites (Spain and The Netherlands), as well as to detail the plans for the installation tasks in each pilot site, the equipment description and the system configuration.

The D7.3 “FLEXCoop Framework Deployment at Pilot Sites -Preliminary Version” is linked with the submitted deliverables from Task 4.1- D4.2 “Open Smart Box (OSB) Prototype – Preliminary Version” (M20) and Task 7.1- D7.2 “FLEXCoop Evaluation Framework and Respective Validation Scenarios” (M22). The description of the installed equipment was described in D4.1 and D4.2, including updates of the last installed equipment that will be detailed in D4.6 “Open Smart Box (OSB) Prototype – Final Version” (M32)

The final detailed attunements in the deployment phase in each pilot site (including the detailed deployment at the Dutch Pilot Site) and the last system configuration of the whole FLEXCoop solution will be delivered in the final version of the FLEXCoop Framework deployment at pilot sites (D7.6), which is the last deliverable of T7.2. From Month 26 to 35, the pilot roll-out phase will take place based on the deployment of the FLEXCoop system at pilot sites (Task T7.4).

This deliverable is structured as follows:

- Section 2 presents the update of the pilot planning and time plan for the installation process
- Section 3 details the updates at the initial trial FLEXCoop installation in friendly users’ dwellings.
- Section 4 describes the updated issues regarding the selection of pilot participants and the installation phase in each pilot site, including the pilot site activities that took place from M16-M26.
- Section 5 provides the bill of materials for end-users regarding the FLEXCoop equipment installation description.
- Section 6 explains the risks, lessons learned and detected problem during the installation phase.

Finally, conclusions are summarised in Section 7, and the document ends with references in Section 8.

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ABBREVIATIONS

BoM	Bill of Materials
D	Deliverable
DHW	Domestic Hot Water
DR	Demand Response
H2020	Horizon 2020 Programme
HVAC	Heating, Ventilation, and Air Conditioning
KPIs	Key Performance Indicators
M	Month
OSB	Open Smart Box
PMV	Performance, Measurement and Verification
PV	Photovoltaic panels

1. INTRODUCTION

With the aim to install a fully-fledged interoperable tool suite for energy cooperatives and prosumers to trigger explicit Demand Response (DR), FLEXCoop Task 7.2 aims to coordinate the deployment in the two pilot sites of the project.

The previous deliverable (D7.1) presented the pilot planning, the trial installation (with related Bill of Materials (BoM) included), assigned roles in the deployment process, installation guideline of the FLEXCoop equipment, and other topics [1].

The aim of D7.3 is to report the updates regarding: the pilot planning, the trial installation, and the selection process of pilot users. This document describes also the installations that have taken place until November 2019 in the Spanish Pilot Site, including the Bill of Materials of the purchased equipment. It includes the installation plan of the Dutch Pilot Site, as well as the pilot site activities from M17-M26. At the end of the document, there is a section dedicated to the detected risks impacted by the deployment process, highlighting the lessons learnt and the next steps to solve problems and mitigate risks in the deployment.

2. PILOT PLANNING UPDATE

This section aims to provide an update of the pilot planning and the installation time plan delivered in D7.1:

1. The initial trial FLEXCoop installation in friendly users' dwellings consisted in the installation of the FLEXCoop solution in three friendly users' dwellings from M9 to M20 (June 2018 – May 2019).

A new friendly user in the Dutch Pilot Site additionally participated in this trial at M21 of the project (July 2019). There is also an update about the friendly user from the Spanish Pilot Site. See Section **Fehler! Verweisquelle konnte nicht gefunden werden.** for detailed information.

2. The selection of pilot users from the two cooperatives in Spain and the Netherlands.

Finding out how to connect a water-to-water heat pump to the FLEXCoop solution and to find out which brand of heat pump was suitable was a long process. As a result, there was a continuous selection process of pilot participants in the Dutch pilot site; this phase will complete in December 2019 instead of being completed in February 2019. In the case of the Spanish Pilot Site, this process initially finished on April 2019. However, two pilot users had to leave the project due to personal reasons, so we had to select 2 pilot participants in September 2019. See Section **Fehler! Verweisquelle konnte nicht gefunden werden.** for detailed information.

3. The FLEXCoop installation phase in 17 selected dwellings from pilot users.

This phase has a duration of 9 months, from M17 to M26 (February – November 2019). The installation time plan was updated from the one delivered at D7.1. This deliverable shows in Figure 1 the updated deployment tracking time plan created for the Spanish pilot site. In the Spanish Pilot Sites, 7 installations of the FLEXCoop solution have been performed until November. An extra installation has initiated connecting the OSB with the HVAC, but more devices should be deployed; this installation and other one will be performed in December 2019. In the Dutch pilot site, there are 6 installed OSBs. See Section 4 for detailed information about the installation phase.

The integration of the FLEXCoop system with existing devices will be defined in T6.4, with the collaboration of the technical partners from the consortium. The integration of FLEXCoop components, preliminary testing, and pre-pilot validation is divided in two phases: the first one that originally lasted 9 months, from M18 to M26 (01/03 - 18/11/2019) has been delayed until December 2019; and the second one that lasts 4 months, from M29 to M32 (01/02 - 01/05/2020).

After this deployment plan, the OSB full demonstration (delivered in D4.6) and the pilot roll-out and demonstration of the FLEXCoop solution (delivered in T7.4) will start in M26 (November 2019), lasting 10 months until M35 (August 2020), which is the timeframe of the complete delivery of the final FLEXCoop solution. The D4.6 will include the updated information about the installed equipment in the pilot sites (to be delivered in M32 according to the DoA). The other installed equipment information was included in D4.1 and D4.2.

According to the Performance, Measurement and Verification (PMV) methodology defined in FLEXCoop D2.5, the FLEXCoop models will provide a continuously auto-calibrated baseline that uses data from the minimum number of recent days needed to obtain a high accuracy. There will be automated DR flexibility events performed during this period. Although the DR events will be automated-controlled, participants will have options to opt out temperature or other comfort categories' preferences. Feedback from participants will be gathered via questionnaire or participation in workshops/living labs.

Item	Pilot user ID	Receipt of Equipment & allocation	Visit Scheduled	Completeness of Installation
1	FL1S	30/11/2018	14/12/2018	01/02/2019
2	FL7S	8-18/07/2019	06/09/2019	06/09/2019
3	FL16S	11/10/2019	13/11/2019	13/11/2019
4	FL22S	11/10/2019	29/10/2019	29/10/2019
5	FL2S	03/12/2019	12/12/2019	
6	FL3S	03/12/2019	19/09/2019 1st visit to install OSB and connect to HVAC. 2on visit on 16/12/2019	
7	FL17S	11/10/2019	11/11/2019	11/11/2019
8	FL5S	03/12/2019	8 or 10/01/2020 TBD	
9	FL27S	28/10/2019	25/11/2019	
10	FL28S	28/10/2019	03/12/2019	03/12/2019

Figure 1: Spanish Pilot Site Installation Tracking

Item	Pilot user ID	Receipt of Equipment & allocation	Visit Scheduled	Installation	Next Steps
1	DE001	30/11/2018	14/12/2018	14/01/2019	
2	DE002	30/11/2018	14/12/2018	14/02/2019	
3	DE003	Unsuitable			
4	DE004			30/10/2019 Installation of smartbox connected to heat pump	Check smartbox performance (11/2019)
5	DE005			05/11/2019 Installation of smartbox connected to heat pump. Control of heat pump is not possible	Ask for Software Update of the heat pump (11/2019)
6	DE006		19/11/2019		Same heat pump as DE011. Wait until that installation works
7	DE007	Unsuitable			
8	DE008	Unsuitable			
9	DE009	Unsuitable			
10	DE010	Unsuitable			
11	DE011	05/10/2019			Pending to install IP connection
12	DE012	30/10/2019 Intesitebox and smartbox	05/11/2019	Planned for next month	Planned installation of clamps and sensors
13	DE013			20/10/2019 Installation of smartbox connected to heat pump. Control of heat pump is possible	Ask if data from user will be available
14	DE014	Unsuitable			
15	DE015	Unsuitable			
16	DE016	Potential new pilot user under examination			Same heat pump ad DE011. Ask price of IP module
17	DE017	Potential new pilot user under examination			Check if internet connection works
18	DE018	Potential new pilot user under examination			Contact the end-user
19	DE019	Potential new pilot user under examination			Contact the end-user

Figure 2: Dutch Pilot Site Installation Tracking

3. INITIAL TRIAL FLEXCOOP INSTALLATION

In D7.1, three trial installations were performed in both pilot sites: two in the Netherlands and one in Spain. The collection of real-time data from these friendly users is ongoing.

The **Spanish friendly user** is installing PV panels (expected date 11/12/2019), so the FLEXCoop solution will include PV production data by deploying a new clamp smart meter (see section **Fehler! Verweisquelle konnte nicht gefunden werden.** to check his/her BoM).

In the case of the two **Dutch friendly users**, we followed two different approaches for measuring PV production. In one case we installed a smart clamp in the fuse box for measuring the PV production. In the other case, a connection with the PV inverter was proposed directly through an API without the need of further equipment. This way, we aimed to identify different ways of gathering the required information for making comparison and conclude to the most reliable solution. However, we are still not able to gather generation data from these users. In the second friendly user, the inverter has still not been connected to the internet. Hopefully, these issues will be solved soon by the pilot responsible partners.

The Dutch pilot households are heated with gas. The alternative is an electric heat pump. Because of the Dutch policy to transition away from gas heat pumps are getting more and more popular although it is currently more expensive to heat a house with an electric heat pump than with gas. A heat pump will also be the main consumer of electricity in a household. That is why we decided to focus on pilot users with heat pumps.

It took some time to find out a way to connect the heat pump to the FLEXcoop solution. Originally there was a suggestion to install flow and temperature meters in the heating system. To try out this solution, ODE looked for a new friendly user with a heat pump.

At the beginning of July 2019 (M21 of the project) a new Dutch friendly user participated at the FLEXCoop project. At the beginning, a candidate user that was proposed was really keen on participating in FLEXCoop activities. However, the user had a self-customised complex heat pump solution that is not met elsewhere. To this end, a decision was taken to remove this user for the demonstration purposes as the investigation of this specific case to identify a solution, would require a lot of effort, which would not be replicable to other cases.

Thus, another candidate user was proposed by the pilot partners. The user had already a smart heat pump, connected to internet, with all the necessary equipment to test the FLEXCoop solution. Then, purchase of equipment for heat pump operation monitoring and control was not necessary. Therefore, the only device the user received and installed was the OSB in order to be connected to the heat pump through the same network. All the equipment communicated with remote control and thus, the data collection process to create the baseline began smoothly for this user.

4. UPDATED PILOT USERS SELECTION & INSTALLATION PHASE

4.1. Spanish Pilot site

The selection process of end-users to participate in the project, participation engagement techniques, and the workshops organised with them (until January 2019) were described in D7.1. The attached documentation of this process (designed questionnaires to select end-users, consent forms' location, etc.) was included in D7.1 and has not changed.

To summarize, Som Energia presented 27 possible end-users in the FLEXCoop plenary meeting in Athens (23-24 October 2018). On December, Som Energia had a pre-final list of 15 candidates, and they distributed a detailed pilot survey, provided by Hypertech, to these 15 candidates in order to select 9 final end-users needed for the project. This detailed survey gathered detailed information about the characteristics of the in-home devices. Hypertech did the final selection of the pilot end-users, by taking into account some consideration provided by Som Energia.

Apart from the workshop with the pre-final candidates on January the 31th 2019 in Barcelona, the detailed survey for the final selection was ready on February 2019. No more workshops had been done so far. However, numerous contacts by telephone and email had been needed by Som Energia to provide the needed feedback to Hypertech. The final selection candidates list was ready on September 2019.

Regarding the installation phase, there have been deployments in 7 dwellings until November 2019. In December 2019, three installations will take place. This delay is due to time constraints related mainly to:

- delays due to the necessity to re-evaluate the questionnaires filled-in by the end-users (see also section 6) and make two and sometimes three rounds of questions to the users to clear up the specificities of their dwellings in order to ensure that the FLEXCoop solution will fit their purposes while serving FLEXCoop scope and objectives. This, in turn, led to delays in structuring the Bill of Material (BoM) with the final equipment that is needed to be bought per each end-user,
- delays on the delivery of equipment by suppliers and the difficulties to set up appointments between end-users and installers.

Furthermore, two initially selected users chose to withdraw from the project. Personal reasons forced the withdrawal of those end-users. Therefore, two other users were investigated. Surveys were made and assessment of their capability to be part of the FLEXCoop demonstration took place. This caused also a small delay in the process. However, thanks to a continuous communication between the involved partners and the intensive work made, these will cause a delay of a few weeks in the overall initial planning,

Som Energia provided 3 different budgets from three different installing companies to support transparency in the decision-making to choose the best installing company to install the FLEXCoop solution in the Spanish pilot site. These budgets are stored by Som Energia due to GDPR reasons.

4.2. Dutch Pilot site

The selection process of end-users to participate in the project, participation engagement techniques, and the scheduled workshops until M16 of the project were described in D7.1. The attached documentation of this process (designed questionnaires to select end-users, consent forms' location, etc.) was included in D7.1 and has not changed.

The 19th September 2019, an information meeting was organized with all the potential pilot users. Currently and as commented before, the switch to heat pumps is not common in the Netherlands. So, the people who have a heat pump are early adopters. The users showed their interest in new developments and to participate in the FLEXcoop project. They experience that a heat pump is a heating device that slowly reacts (i.e. when a temperature is set, it takes some time for the system to reach this temperature). That also means that the user set one temperature and they do not change the settings very often. The FLEXcoop solution must deal with this.

All the pilot users, where we installed an OSB, have signed a consent form.

With the premise to assess the flexibility potential of heat pumps, seventeen potential pilot users who had this equipment have been selected in a step by step process. In the Netherlands, the majority of the heat pumps are not air-to-air but air-to-water, the majority of them having unique integrated controllers and communication interfaces, which are brand and model specific. Air to air heat pumps can be measured and controlled by a third-party device which can be used

with all brands of heat pumps. A same kind of solution is not available for air to water heat pumps, so for these cases we are looking for ad-hoc solutions for each heat pump.

In particular, all the selected users have got diverse heat pumps models (with specific requirements and characteristics), and each one must be analysed for its suitability in the project. When asked by ODE, some heat pumps' brand suppliers do not want to give access to control the system, so it makes these dwellings with these brands unsuitable to participate in the project. Due to these technical requirements and specificities, the selection process is still ongoing and implies a delay in the deployment, postpone to the end of December 2019.

It should also be mentioned that in the Netherlands, the Dutch prosumers are primarily interested on heat pumps incorporation in a Demand Response framework, because heat pumps have a significant load. This is why, the Dutch business scenario has also been structured in such a way. To this end, after advising by the Dutch pilot partners, a decision was made to primarily focus on the integration of heat pumps in the pilot users. Thus, despite the diversity on the heat pump types, our first priority was to match this requirement in order for providing finally a viable business case that it is of interest for the users.

After investigation, Hypertech identified the way to interface with some of the brands and models available at the pilot candidate users. Thus, the deployment process has been made progressively. A first step was to check the connectivity of these HVAC with the OSB and perform some initial tests to validate that the interface has been established and we can indeed monitor and control the system through the OSB. This has already been successfully performed in two dwellings, that have two heat pumps' brands that work. Two brands are under investigation. Other brands cannot be connected. So, from the original list of potential pilot users, several of them were not suitable. These neglected users have been replaced by 4 new potential users, suggested by two local installers of heat pumps.

Once there is a confirmation to control and monitor the heat pumps, the second step is to install home Energy Meter clamps. If the PV Installation is also connected to the internet it can be directly connected to the OSB. If not, additional Energy Meter clamp will be installed, as well as other sensors and metering devices.

4.3. Pilot site activities

Other possible actions in which Pilot users and Cooperatives might get involved during the project concerns the participation in workshops about FLEXCoop project activities, and other project activities.

For end-users:

- In the case of the Spanish pilot site, end-users and Som Energia got involved in a workshop on 31/01/2019 which took place in Barcelona. In this project, Som Energia presented an overview of the project to possible end-users and a detailed time-plan. The friendly end-user had participated in the workshop, so direct personal feelings feedback regarding the FLEXCoop solution could be provided to the possible end-users.

- In the case of the Dutch Pilot Site, ODE organised in 19/09/2009 an information meeting about the FLEXCoop project with the potential pilot users to present an overview of the project and analyse their needs.
- In the Netherlands, a workshop in January 2020 will take place with other local cooperatives to share information learned at the FLEXCoop project.
- Additional workshop could take place at the deployment of the Prosumer/Aggregator Application (January or February 2020). Som Energia plans to set up a workshop with the final end-users in January/February 2020 in order to show the Prosumer App to the end-users and also to inform them regarding the updated time-plan.

ODE plans to set up a workshop with the final end-users in February/March 2020 in order to show them the Prosumer App, and also to inform them regarding the updated time-plan.

- Workshop will take place for the final evaluation towards September 2020.

For EU cooperatives:

- Activities will take place at the EU level in the form of living labs workshops in order to reflect on business models for cooperatives (Q4 2019). Concretely, this living lab took place on 15 November 2019, and regards the business models in relation to the flexibility and aggregation for solar and wind parks on one side, and the flexibility of households in the other side.

The timeline below summarises the main planned workshops:

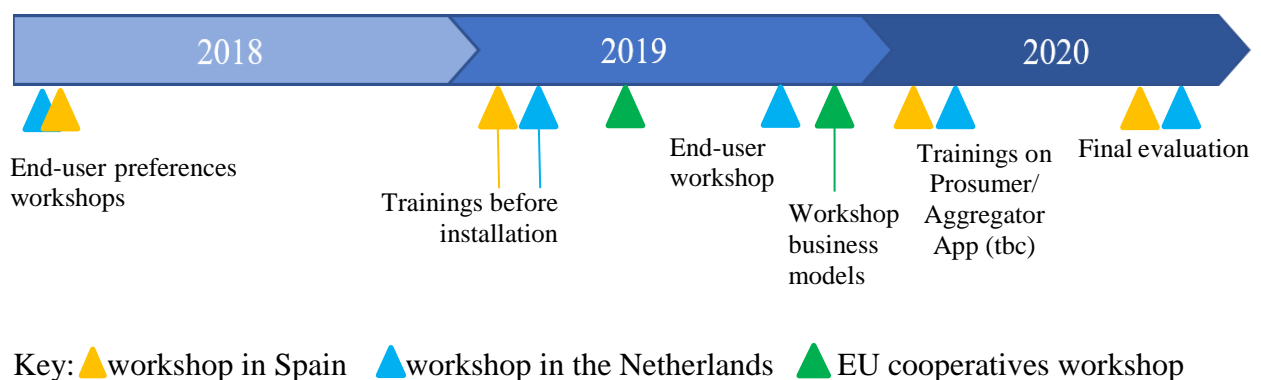


Figure 3: Timeline of workshop activities for end-users and cooperatives

5. EQUIPMENT INSTALLATION DESCRIPTION

This section includes the bill of materials of the purchased equipment for ten dwellings from the Spanish Pilot Site. The equipment was installed in each dwelling according to the time plan delivered in Figure 1. In the case of three Spanish pilot end-users, the deployment will be done during December.

5.1. Bill of materials for the Spanish Pilot Participants

In the following tables, the costs of the purchased equipment and labour costs are specified per user. Users are anonymised through a code labelling (FL”number”S) in order to protect personal data. In some cases, the final real cost reported here may differ from the cost reported in the BoM due to different reasons:

- a) The purchase process has been done by groups of end-users in order to get special discounts when buying bigger number of equipment. For instance, equipment from FL16S, FL17S and FL22S; FL27S and FL28S; FL2S, FL3S and FL5S, have been bought together.
- b) Shipment costs are shared by different end-users and equipment.
- c) Vesternet is the main supplier and sends the bills in pounds, so conversion to euros may change along the time.

Moreover, in some end-users the deployment has not been done yet, so the labour cost is still unknown.

Friendly User FL1S – Living room + 3 rooms						
Heat Pump						
Device Name	Where to be installed	How to be installed	Unit Price	Quantity	Total Price	Without VAT
Z-Wave Plus Aeotec Clamp Power Meter - Three Clamps (60A)	Fuse box. Measure total home consumption and Heat Pump consumption	20'	120,19 €	1	120,19 €	100,15 €
IntesisBox WIFI - DAIKIN AC (DK-RC-WMP-1)	Heat Pump Thermostat	20'	201,59 €	1	201,59 €	177,30 €
Electric Domestic Hot Water (DHW)						
Device Name	Where to be installed	How to be installed	Unit Price	Quantity	Total Price	Without VAT
Z-Wave Plus Aeotec Smart Switch 6 - Schuko	Fagor CB-100N (1800W) plug	DiY	72,52 €	1	72,52 €	72,52 €
Other equipment required (off-the-self sensors, total consumption metering, etc.)						
Device Name	Where to be installed	How to be installed	Unit Price	Quantity	Total Price	Without VAT
Z-Wave Plus Aeotec Clamp Power Meter - Three Clamps (60A)	Fuse Box (For total consumption metering)	20'	120,19 €	1	120,19 €	100,15 €
Z-Wave Plus Aeotec MultiSensor 6	living room + 3 rooms	DiY	52,46 €	3	157,08 €	125,66 €
P 5 V 2 A USB Adaptor, black	Multisensor adaptor	DiY	5,99 €	3	21,92 €	17,97€
Z-Wave Plus Aeotec Range Extender 6 - EU	Living room	DiY	21,94 €	1	21,94 €	17,99 €
Vesternet Shipment cost		-	-	-	15,40 €	12,16 €
PV production						
Device Name	Where to be installed	How to be installed	Unit Price	Quantity	Total Price	Without VAT
Z-Wave Plus Aeotec Clamp Power Meter - Three Clamps (60A)	Inverter switch	20'	120,19 €	1	120,19 €	100,15 €
Labour Costs						
2 hours of work (25€/h + travel expenses)					117,13 €	96,80 €
Total Equipment and installation Cost:					967,95 €	764,68 €

Table 1: Bill of materials of Spanish friendly user

FL7S User – Living room + 3 bedrooms						
Equipment Required (off-the-self sensor, total consumption)						
<i>Device Name</i>	<i>Where to be installed</i>	<i>How to be installed</i>	<i>Unit Price</i>	<i>Quantity</i>	<i>Total Price</i>	<i>Without VAT</i>
Z-Wave Plus Aeotec Clamp Power Meter - Three Clamps (60A)	Fuse Box (total home consumption + heat pump consumption)	20'	113,12 €	1	113,12 €	94,27 €
Domestic Hot Water (DHW)						
<i>Device Name</i>	<i>Where to be installed</i>	<i>How to be installed</i>	<i>Unit Price</i>	<i>Quantity</i>	<i>Total Price</i>	<i>Without VAT</i>
Z-Wave Plus Aeotec Smart Switch 6 - Schuko	DHW tank wall plug Consumption Monitoring + Remote Control	DiY	68,32€	1	68,32 €	56,92 €
HVAC System Control + Sensing						
<i>Device Name</i>	<i>Where to be installed</i>	<i>How to be installed</i>	<i>Unit Price</i>	<i>Quantity</i>	<i>Total Price</i>	<i>Without VAT</i>
IntesisBox DK-RC-WMP-1	HVAC thermostat	DiY	178,96 €	1	178,96 €	147,90 €
Z-Wave Plus Aeotec MultiSensor 6	Living room, kitchen, and 3 rooms	DiY	61,58 €	5	307,89 €	246,31€
Z-Wave Plus Aeotec Range Extender 6 - EU	Room1	DiY	42,56 €	2	85,12 €	68,10 €
P 5 V 2 A USB Adaptor, black	Multisensor	DiY	5,99 €	5	42,61 €	35,22 €
Vesternet Shipment cost		-	-	-	26,30 €	20,78 €
Labour Costs						
3,5 hours of work (25€/h + travel expenses)					148,11 €	122,40 €
Total Equipment and installation Cost:					970,43 €	766,64 €

Table 2: Bill of materials of Spanish user FL7S

FL16S User -Living room + children room installation

Equipment Required (off-the-self sensor, total consumption)						
Device Name	Where to be installed	How to be installed	Unit Price	Quantity	Total Price	Without VAT
Z-Wave Plus Aeotec Clamp Power Meter - Three Clamps (60A)	Fuse Box (total home consumption + living room HVAC consumption)	20'	114,13 €	1	114,13 €	95,11 €
HVAC System Control + Sensing						
Device Name	Where to be installed	How to be installed	Unit Price	Quantity	Total Price	Without VAT
IntesisBox IS-IR-WMP-1	HVAC living room + 2 children bedrooms	DiY	113,58 €	3	340,74 €	336,39 €
Z-Wave Plus Aeotec MultiSensor 6	Living room + 2 children bedrooms	DiY	61,02 €	3	183,06 €	144,62 €
Qubino Smart Plug 16A	Living Room HVAC wall plug. Consumption Monitoring	DiY	55,86€	1	55,86€	46,17 €
P 5 V 2 A USB Adaptor, black	Multisensor adaptor	DiY	5,99 €	3	17,97 €	14,98 €
Vesternet Shipment cost		-	-	-	9,84 €	7,77 €

Labour Costs

? hours of work (25€/h + travel expenses)	? €	? €
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Total Equipment and installation Cost: ? € ? €

Table 3: Bill of materials of Spanish user FL16S

FL17S User - Living room						
Equipment Required (off-the-self sensor, total consumption, HVAC consumption)						
<i>Device Name</i>	<i>Where to be installed</i>	<i>How to be installed</i>	<i>Unit Price</i>	<i>Quantity</i>	<i>Total Price</i>	<i>Without VAT</i>
Z-Wave Plus Aeotec Clamp Power Meter - Three Clamps (60A)	Fuse Box (total home consumption + living room HVAC consumption fuse)	20'	114,13 €	1	114,13 €	95,11 €
Domestic Hot Water (DHW)						
<i>Device Name</i>	<i>Where to be installed</i>	<i>How to be installed</i>	<i>Unit Price</i>	<i>Quantity</i>	<i>Total Price</i>	<i>Without VAT</i>
Z-Wave Plus Aeotec Range Extender 6 - EU	Third floor wall plug	DiY	42,94 €	1	42,94 €	33,92 €
Qubino Smart Plug 16A	DHW tank wall plug (Consumption Monitoring + Remote control)	DiY	55,86€	1	55,86€	46,17 €
HVAC System Control + Sensing						
<i>Device Name</i>	<i>Where to be installed</i>	<i>How to be installed</i>	<i>Unit Price</i>	<i>Quantity</i>	<i>Total Price</i>	<i>Without VAT</i>
IntesisBox IS-IR-WMP-1	Living room HVAC	DiY	141,93 €	1	141,94,00 €	112,13 €
Z-Wave Plus Aeotec MultiSensor 6	Living room	DiY	61,02 €	2	122,04 €	96,41 €
P 5 V 2 A USB Adaptor, black	Multisensor adaptor	DiY	5,99 €	2	11,98 €	9,98 €
Vesternet Shipment cost		-	-	-	9,84 €	7,77 €
Labour Costs						
? hours of work (25€/h + travel expenses)					? €	? €
Total Equipment and installation Cost:					? €	? €

Table 4: Bill of materials of Spanish user FL17S

FL22S User - – Kitchen + Dining room installation

Equipment Required (off-the-self sensor, total consumption)						
Device Name	Where to be installed	How to be installed	Unit Price	Quantity	Total Price	Without VAT
Z-Wave Plus Aeotec Clamp Power Meter - Three Clamps (60A)	Fuse Box (total home consumption + heat pump consumption)	20'	114,13 €	1	114,13 €	95,11 €
Domestic Hot Water (DHW)						
Device Name	Where to be installed	How to be installed	Unit Price	Quantity	Total Price	Without VAT
Z-Wave Plus Aeotec Range Extender 6 - EU	Living room DHW tank wall plug (Consumption Monitoring + Remote Control)	DiY	42,94 €	1	42,94 €	33,92 €
Qubino Smart Plug 16A		DiY	55,86 €	1	55,86 €	46,17 €
Control + Sensing						
Device Name	Where to be installed	How to be installed	Unit Price	Quantity	Total Price	Without VAT
Philips HUE Bridge	Living room	DiY	50,98 €	1	50,98 €	42,13 €
Z-Wave Plus Aeotec MultiSensor 6	Living room	DiY	61,02 €	3	183,06 €	144,62 €
Philips Hue White ambiance LED light. E27.	Living room	DiY	19,99 €	4	86,46 €	71,45 €
P 5 V 2 A USB Adaptor, black	Living room	DiY	5,99 €	3	17,97 €	14,98 €
Vesternet Shipment cost		-	-	-	9,84 €	7,77 €
Labour Costs						
2 hours of work (25€/h + travel expenses)					42,40 €	40,00 €
Total Equipment and installation Cost:					603,64 €	476,87 €

Table 5: Bill of materials of Spanish user FL22S

FL27S User – Living Room installation						
Equipment Required (off-the-self sensor, total consumption)						
<i>Device Name</i>	<i>Where to be installed</i>	<i>How to be installed</i>	<i>Unit Price</i>	<i>Quantity</i>	<i>Total Price</i>	<i>Without VAT</i>
Z-Wave Plus Aeotec Clamp Power Meter - Three Clamps (60A)	Fuse Box (total home consumption)	20'	113,12 €	1	113,12 €	89,36 €
Sensing devices						
<i>Device Name</i>	<i>Where to be installed</i>	<i>How to be installed</i>	<i>Unit Price</i>	<i>Quantity</i>	<i>Total Price</i>	<i>Without VAT</i>
Z-Wave Plus Aeotec MultiSensor 6	Living room	DiY	60,48 €	4	241,92 €	191,12 €
P 5 V 2 A USB Adaptor, black	Multisensor	DiY	5,99 €	4	23,96 €	19,97 €
Domestic Hot Water (DHW)						
<i>Device Name</i>	<i>Where to be installed</i>	<i>How to be installed</i>	<i>Unit Price</i>	<i>Quantity</i>	<i>Total Price</i>	<i>Without VAT</i>
Qubino Smart Plug 16A	DHW tank wall plug (Consumption Monitoring + Remote Control)	DiY	58,89 €	1	58,89 €	48,67 €
Vesternet Shipment cost		-	-	-	14,64 €	11,56 €
Lighting						
<i>Device Name</i>	<i>Where to be installed</i>	<i>How to be installed</i>	<i>Unit Price</i>	<i>Quantity</i>	<i>Total Price</i>	<i>Without VAT</i>
Philips HUE Bridge	Living Room	DiY	50,98 €	1	50,98 €	42,13 €
GUI single bulk	Living Room	DiY	23,00 €	1	23,00 €	18,17 €
E27 single bulk	Living Room	DiY	26,00 €	2	52,00 €	41,08 €
Labour Costs						
? hours of work (25€/h + travel expenses)					? €	? €
Total Equipment and installation Cost:					? €	? €

Table 6: Bill of materials of Spanish user FL27S

FL28S User – Kitchen + Dining room installation						
Equipment Required (off-the-self sensor, total consumption)						
<i>Device Name</i>	<i>Where to be installed</i>	<i>How to be installed</i>	<i>Unit Price</i>	<i>Quantity</i>	<i>Total Price</i>	<i>Without VAT</i>
Z-Wave Plus Aeotec Clamp Power Meter - Three Clamps (60A)	Fuse Box (total home consumption, PV production)	20'	113,12 €	2	226,24 €	178,73 €
Sensing devices						
<i>Device Name</i>	<i>Where to be installed</i>	<i>How to be installed</i>	<i>Unit Price</i>	<i>Quantity</i>	<i>Total Price</i>	<i>Without VAT</i>
Z-Wave Plus Aeotec MultiSensor 6	Living room + extra room	DiY	60,48 €	5	302,40 €	238,90 €
P 5 V 2 A USB Adaptor, black	Multisensor adaptor	DiY	5,99 €	5	29,95 €	24,96 €
Domestic Hot Water (DHW)						
<i>Device Name</i>	<i>Where to be installed</i>	<i>How to be installed</i>	<i>Unit Price</i>	<i>Quantity</i>	<i>Total Price</i>	<i>Without VAT</i>
Qubino Smart Plug 16A	DHW tank wall plug (Consumption Monitoring + Remote Control)	DiY	58,89 €	1	58,89 €	48,67 €
Vesternet Shipment cost		-	-	-	14,64 €	11,56 €
Generic Devices						
<i>Device Name</i>	<i>Where to be installed</i>	<i>How to be installed</i>	<i>Unit Price</i>	<i>Quantity</i>	<i>Total Price</i>	<i>Without VAT</i>
Z-Wave Plus Aeotec Range Extender 6 - EU	Living room	DiY	42,57 €	1	42,57 €	35,48 €
Lighting						
<i>Device Name</i>	<i>Where to be installed</i>	<i>How to be installed</i>	<i>Unit Price</i>	<i>Quantity</i>	<i>Total Price</i>	<i>Without VAT</i>
Philips HUE Bridge	Living room	DiY	49,99 €	1	49,99 €	41,31 €
E14 single bulk	Living room	DiY	24,9 €	1	24,90 €	19,67 €
E27 single bulk	Living room	DiY	26,00 €	12	312,00 €	246,48 €
Labour Costs						
? hours of work (25€/h + travel expenses)					? €	? €
Total Equipment and installation Cost:					? €	? €

Table 7: Bill of materials of Spanish user FL28S

The equipment purchases for the following end-users (FL2S, FL3S and FL5S) haven't finalized at the time of writing this deliverable. So, the equipment cost of those users is the cost reported in the BoM. Final cost may differ due to shipment costs, size of the purchase (number of items may mean special discounts) and conversion from pounds to euros in the case of Vesternet supplier. Moreover, due to the deployment hasn't been done yet, labour costs are still unknown.

FL2S User - Living room installation						
Equipment Required (off-the-self sensor, total consumption, A/C Consumption Living Room, A/C Consumption Room)						
Device Name	Where to be installed	How to be installed	Unit Price	Quantity	Total Price	Without VAT
Z-Wave Plus Aeotec Clamp Power Meter - Three Clamps (60A)	Fuse Box (total home consumption + 2 x heat pump consumption))	20'	113,58 €	3	340,74 €	283,95 €
HVAC System Control + Sensing						
Device Name	Where to be installed	How to be installed	Unit Price	Quantity	Total Price	Without VAT
IntesisBox IS-IR-WMP-1	Living room HVAC	DIY	150,00 €	2	300,00 €	250,00 €
Z-Wave Plus Aeotec MultiSensor 6	Living room	DIY	66,36 €	4	265,44 €	221,20 €
Z-Wave Plus Aeotec Range Extender 6 - EU	Range Extender	DIY	42,57 €	1	42,57 €	35,48 €
P 5 V 2 A USB Adaptor, black	Multisensor adaptor	DIY	5,99 €	4	23,96 €	19,97 €
Vesternet Shipment cost		-	-	-	? €	? €
EV						
Device Name	Where to be installed	How to be installed	Unit Price	Quantity	Total Price	Without VAT
Z-Wave Plus Aeotec Range Extender 6 - EU	Living room	DIY	42,57 €	2	85,14 €	70,95 €
Qubino Smart Plug 16A	DHW tank wall plug (Consumption Monitoring + Remote Control)	DIY	68,15 €	1	68,15 €	56,79 €
Labour Costs						
? hours of work (25€/h + travel expenses)					? €	? €
Total Equipment and installation Cost:					? €	? €

Table 8: Bill of materials of Spanish user FL2S

FL3S User - Living room installation						
Equipment Required (off-the-self sensor, total consumption, heat pump consumption)						
<i>Device Name</i>	<i>Where to be installed</i>	<i>How to be installed</i>	<i>Unit Price</i>	<i>Quantity</i>	<i>Total Price</i>	<i>Without VAT</i>
Z-Wave Plus Aeotec Clamp Power Meter - Three Clamps (60A)	Fuse Box (total home consumption + HVAC consumption + PV production)	20'	113,58 €	2	227,16 €	189,30 €
Sensing devices						
<i>Device Name</i>	<i>Where to be installed</i>	<i>How to be installed</i>	<i>Unit Price</i>	<i>Quantity</i>	<i>Total Price</i>	<i>Without VAT</i>
Z-Wave Plus Aeotec MultiSensor 6	Living room	DiY	66,36 €	3	199,08 €	165,90 €
P 5 V 2 A USB Adaptor, black	Multisensor adaptor	DiY	5,99 €	3	17,97 €	14,98 €
Vesternet Shipment cost		-	-	-	? €	? €
DHW						
<i>Device Name</i>	<i>Where to be installed</i>	<i>How to be installed</i>	<i>Unit Price</i>	<i>Quantity</i>	<i>Total Price</i>	<i>Without VAT</i>
Qubino Smart Plug 16A	DHW tank wall plug (Consumption Monitoring + Remote Control)	DiY	68,15 €	3	204,45 €	170,38 €
HVAC System control						
NIBBE HVAC controller premium service	Not applicable	-	24,90 €	1	24,90 €	20,58 €
Generic devices						
<i>Device Name</i>	<i>Where to be installed</i>	<i>How to be installed</i>	<i>Unit Price</i>	<i>Quantity</i>	<i>Total Price</i>	<i>Without VAT</i>
Z-Wave Plus Aeotec Range Extender 6 - EU	Range Extender	DiY	42,57 €	3	127,71 €	106,43 €
Labour Costs						
? hours of work (25€/h + travel expenses)					? €	? €
Total Equipment and installation Cost:					? €	? €

Table 9: Bill of materials of Spanish user FL3S

FL5S User - Living room installation						
Equipment Required (off-the-self sensor, total consumption, heat pump consumption)						
<i>Device Name</i>	<i>Where to be installed</i>	<i>How to be installed</i>	<i>Unit Price</i>	<i>Quantity</i>	<i>Total Price</i>	<i>Without VAT</i>
Z-Wave Plus Aeotec Clamp Power Meter - Three Clamps (60A)	Fuse Box (total home consumption + HVAC consumption + PV production)	20'	113,58 €	2	227,16 €	189,30 €
HVAC System Control + Sensing						
<i>Device Name</i>	<i>Where to be installed</i>	<i>How to be installed</i>	<i>Unit Price</i>	<i>Quantity</i>	<i>Total Price</i>	<i>Without VAT</i>
IntesisBox IS-IR-WMP-1	Next to HVAC indoor unit	DIY	180,00 €	1	180,00 €	150,00 €
Sensing devices						
<i>Device Name</i>	<i>Where to be installed</i>	<i>How to be installed</i>	<i>Unit Price</i>	<i>Quantity</i>	<i>Total Price</i>	<i>Without VAT</i>
Z-Wave Plus Aeotec MultiSensor 6	Living room	DIY	66,36 €	3	199,08 €	165,90 €
P 5 V 2 A USB Adaptor, black	Multisensor adaptor	DIY	5,99 €	3	17,97 €	14,98 €
Vesternet Shipment cost		-	-	-	? €	? €
DHW						
<i>Device Name</i>	<i>Where to be installed</i>	<i>How to be installed</i>	<i>Unit Price</i>	<i>Quantity</i>	<i>Total Price</i>	<i>Without VAT</i>
Qubino Smart Plug 16A	DHW tank wall plug (Consumption Monitoring + Remote Control)	DIY	68,15 €	1	68,15 €	56,79 €
Generic devices						
<i>Device Name</i>	<i>Where to be installed</i>	<i>How to be installed</i>	<i>Unit Price</i>	<i>Quantity</i>	<i>Total Price</i>	<i>Without VAT</i>
Z-Wave Plus Aeotec Range Extender 6 - EU	Range Extender	DIY	42,57 €	1	42,57 €	35,48 €
Labour Costs						
? hours of work (25€/h + travel expenses)					? €	? €
Total Equipment and installation Cost:					? €	€

Table 10: Bill of materials of Spanish user FL5S

6. RISKS & LESSONS LEARNED

The risks that we have detected during the deployment process are described in Table 11 and detailed, including the lessons learned, as follows:

- Although questionnaires were prepared in a friendly, simple and comprehensive approach incorporating images and explanations, many questionnaires were not filled in a correct way. The reason for this seems to be twofold:
 - Diversity in the terms used in different countries to describe the same equipment
 - Many consumers / prosumers have limited awareness on the specificities of their loads

To tackle this issue, frequent communications were required for detailing open questions and acquire common understanding

- Users in Spain are used to turn off their wi-fi connection. This may lead to gaps in data. To tackle this, Som Energia proposed to inform users that this should not be done during project demonstration. However, in a real-life application, something like this should also be taken into consideration
- Users in the Netherlands are primarily interested in the heat pump devices participation in DR programs. There is not so much interest in other load devices.
- In the Dutch pilot site, the type of heat pump (air to water) led to a significant delay because there are no standardised controllers and communication interfaces, and also some brand suppliers are not willing or able to share information. In the case for the air-to-air heat pump there was no issue, because there are third party solutions to connect these systems to a solution like FLEXCoop.
- We have two users in Spain and one in Netherlands that were withdrawn for the project. Different reasons led them to this decision. In the case of Spain one withdrawal was due to personal reasons and the other one was related to home remodelling. In the last case, non-electrical heating system was about to be installed (pellet heating system), so the desired home characteristics were not found anymore. In the Dutch case, the user was very concerned about the impact of the project on personal privacy. Although we explained the user how privacy was handled on a professional way at the FLEXCoop project, the user did not want to join anymore.
- Difficulties in scheduling appointments between installers and end-users and delivery of equipment by suppliers caused delays in the deployment because of their mismatched availability or time constraints. The prediction of such issues is not easy to estimate but jeopardise the deployment time-plan.

No	Risk Description	Probability	Impact	Risk Mitigation	Affected Milestone
2	Pilot deployment constraints and poor quality of data to validate the result.	High	Medium	Detailed assessment of the pilot sites / instructions on actions from the users to be avoid (e.g. turn off the router) / constant communication.	MS 6
6	Problems and delays with the installations in the pilot end-user premises.	High	Medium	<p>Already some installations are in progress/frequent communication between the pilot partners, the end-users and the technical partners.</p> <p>Contingency plans in case there are delays or devices not working properly. Weekly telcos for the deployment follow-up</p>	MS6

Table 11: Detected risks for the deployment process

7. CONCLUSIONS

The pilot planning, described in Section 1, comprises the updates in the deployment process from January 2019 (M16) to November 2019 (M26). There is an updated description of the different phases of the deployment and the Spanish and Dutch installation tracking.

The initial trial update regards the inclusion of one extra friendly user in the Dutch Pilot Site and a modification by the Spanish friendly user who will install PV panels in December.

The selection process finished in September 2019 in the Spanish Pilot Site, while is ongoing in the Dutch Pilot Site. Regarding the installation phase in the Spanish Pilot Site, there have been deployments in 7 dwellings until November 2019, and other three installations will take place on December 2019. This delay is due to the withdraw from the project of two users that were replaced by other ones, leading to a delay on the purchasing of material and its delivery, together with difficulties in scheduling appointments among installers and end users. In the Dutch Pilot Site, the Dutch prosumers are primarily interested on heat pumps incorporation in a Demand Response framework. At first, seventeen potential pilot users with heat pumps were selected, but as they have different heat pumps models with different technical requirements and specificities, the selection process is still ongoing and implies a delay in the deployment, postpone to December 2019.

During 2019, three workshops have been organised, one in each pilot site. The third workshop was a living lab about business models for cooperatives in relation to the flexibility and aggregation for solar and wind parks on one side, and the flexibility of households in the other side.

Section 5 presents the bill of materials to purchase equipment to install in the Spanish users' dwellings, including the total equipment cost and the labour costs for the installation of the equipment. An explanation of mismatched costs has been provided in the sake of transparency.

The last section of this document points out the risks and lessons learned in the deployment process in both pilot sites, including a table describing the risks, mitigation plan and impact on milestones 6 of the FLEXCoop project. In summary, although there are ongoing installations, there are also delays and some constraints in the deployment. The mitigation plans to reduce the impact of these risks are the constant communication between the involved partners, especially with pilot partners and the FLEXCoop technical coordinator, to perform a deployment follow-up and actuate quickly.

As stated in the Executive Summary, this is the preliminary version of the FLEXCoop deployment at pilot sites from Task 7.2. The final version of the deployment (D7.6) will be delivered in M33 and it will include the deployment details performed after December 2019, after the fulfilment of the optimisation of the whole FLEXCoop solution and roll out of the second trial phase.

8. REFERENCES

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