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Executive Summary

This deliverable defines the specifications to be demonstrated in the three pilot clusters in Greece, Slovenia and Finland during the final piloting Phase of the project.

The goal of Phase 1 of the pilots' execution was to co-create an MVP of the iFLEX Framework and application-specific iFLEX Assistants (M14) as well as to deploy these into a pre-pilot consisting of few selected users in order to collect feedback and validate against certain functional requirements. Accordingly, the goal of Phase 2 was the utilization of the feedback from Phase 1, in order to improve the iFLEX Framework and Assistants with new functionalities and enhanced user experience and their validation with small-scale pilots (M25). Current Phase, Phase 3 introduces the large-scale pilot utilising all the lessons learned in Phases 1 and 2. For the final demonstration of iFLEX Assistants in Phase 3, any missing functionality has been added, focusing on fine-tuning the Quality of Service (QoS) and user experiences based on the Phase 2 feedback.

In Phase 3 pilots are scaled up to include more engaged end-users and technical functionalities, in order to collect feedback and validate the final iFLEX Assistants (M36). The target of each pilot for Phase 3 can be summarised as follows:

Greek Pilot

In Phase 3 the Greek pilot is expanded to reach 50 households (with up to 100 users based on the 2011 Greek Census[1]). All households are equipped with real-time smart meters at a sampling rate of 30 sec. A subset of 35 households are equipped with smart plugs on energy consuming appliances to monitor ON/OFF and consumption of specific heavy loads such as dishwashers, washing machines and A/C units. A further subset of up to 10 households is to be equipped with remotely controlled relays to manage the activation (ON/OFF) of water boilers. Following Phase 2 validation the pilot is expected to be fully operational with iFLEX Assistant and DR services deployed and running.

Slovenian Pilot

Phase 3 pilot expands results of the first phase in several ways. In technical, i.e., functional terms, the focus is on exploiting the HEMS system functionalities not just for energy data monitoring but also for appliance control for flexibility management. In piloting terms, user base will be expanded to approximately 40 residential, 2 small business and 1 large industrial pilot end points, moreover merits of price signals, option to maximize self-consumption, increase user devices power utilization, and incentives for flexibility engagement will be evaluated. Activities are also planned on self-consumption for optimisation of renewable energy use. Last but not least, more focus will be put on testing advanced iFLEX security features.

Finnish Pilot

Phase 3 pilot expands existing pilot environment with following improvements. First, iFLEX Assistant deployed in the apartment building is used to reduce the peaks in the district heating consumptions and optimize the energy consumption. Heat pump control is also integrated in iFLEX Assistant. Second, phase 3 pilot focuses on displaying the benefits of iFLEX system for the apartment residents with advanced user interface. UI particularly focuses on demonstrating the benefits of cutting peaks in district heating and electricity demand and therefore empowering consumers to participate. Third aspect of the Phase 3 pilot is enabling the aggregation of multiple buildings.

[1] ELSTAT (2014). Hellenic demographic census 2011, accessed from https://www.statistics.gr/documents/20181/1210503/A1602_SAM01_DT_DC_00_2011_03_F_GR.pdf/e1ac0b1c-8372-4886-acb8-d00a5a68aabe

1 Introduction

1.1 iFLEX Project

The iFLEX project is an EU-funded project under the H2020 program and its aim is to empower energy consumers to participate in DR programs by adjusting their energy consumption in response to the demand response signals or incentives, such as price signals. In order to support the consumers in managing their flexibility potential, the project will develop an intelligent personal assistant, called the iFLEX Assistant for optimising the comfort, energy usage and cost on behalf of the consumers while respecting their preferences.

The various application-specific modules developed by the technology providers which are involved in the project will be integrated into a holistic software framework for flexibility and energy management, namely the iFLEX Framework. The iFLEX Framework and the corresponding iFLEX Assistant prototypes as well as associated services will be demonstrated in three European countries, namely Greece, Slovenia, and Finland each one with different focus area. More than 600 consumers will be part of the pilots, mainly comprising residential buildings but also small industries and a supermarket.

In addition, the validation in the three pilots will mainly focus on the following areas:

1. To demonstrate the applicability of the iFLEX Assistant prototypes for minimizing the imbalances and harnessing the flexibility of smart homes in Southern European climate.
2. To demonstrate the iFLEX Assistants in efficient operation of the electricity grid with high share of RES in Central European climate.
3. To demonstrate the iFLEX Assistants in the context of holistic flexibility management services in Nordic climate.
4. To design and execute common validation for iFLEX Assistants demonstrated in the three pilot clusters.

1.2 Scope of the report

This report follows the previous two revisions (D7.1, D7.2) of the pilot specifications plan per pilot cluster and mainly describes the available technologies, and infrastructure as well as the functional requirements to be demonstrated on top of users selected for this phase. D7.1 served as a starting point where a pre-pilot with the MVP of the iFLEX Framework and Assistants was deployed with a least number of users contacted and primarily engaged [1]. D7.2 utilised the feedback gained through concentrated communication effort and the preparation of informed consent forms as part of Pilot recruitment. Furthermore, initial troubleshooting identified the need to update and expand each pilot cluster [2]. This report culminates iFLEX pilot design fully utilising the experience gained from all technical deployments. The development of each pilot phase, although marked by discrete starting and ending milestones, has been in essence an ongoing effort, improving continuously pilot clusters in terms of recruitment and technical capabilities.

1.3 Pilots Context

The iFLEX Framework will be demonstrated and validated in all three pilot clusters. Application-specific iFLEX Assistants will be developed by using the iFLEX Framework modules and next will be integrated to the DR and holistic energy management services provided by project industrial partners. These services include a) flexibility aggregation services for energy markets operated by ECE and HERON, b) RES aggregation services operated by OPTIMUS, c) technical DRM services provided by ICOM and SCOM, d) distribution management system operated by ELE, e) ESCO-type services provided by CAVERION, and f) flexibility market platform for utilities and retailers provided by ENERIM.

A summary of the pilot clusters to be deployed over the three Phases foreseen until the end of the project is presented in the following table (Table 1).

Table 1: Summary of pilot clusters

Cluster Type	Focus	Energy Vectors	Type of Loads	Production & Storage	Consumer Types	Building Types
Greek	Integration of smart homes into the grid. RES and DSF aggregation (VPP) for energy market operation.	Electricity, heat	smart devices, water heaters	PVs	Residential	Subset of 50 households
Slovenian	Integration of high share of RES; efficient operation of the power grid. Aggregation of flexibility for peak reduction and RES integration.	Electricity	home appliances, industrial loads	PVs, small HPP	Residential Industrial	100 homes & small enterprises
Finnish	Holistic energy mngt; Local aggregation at apartment building and district levels. Link with INTERRFACE and OneNet for DSO/TSO DR markets.	Electricity, district heating, waste heat	heat pumps, lighting, freezers & coolers, appliances	Thermal mass of the building as heat storage	Residential Commercial	Block of apartments & supermarket

A detailed analysis of the effort undertaken in Tasks 7.1 defining pilot specifications in the three Phases of iFLEX and the continuous user recruitment effort is presented in Sections 3.1-3.3 for each of the three pilot clusters. This report is then used as a schematic to outline necessary input for Phase 3 developments in pilot operation and validation with respect to Tasks 7.2 and 7.3.

1.4 Structure of the report

The report is structured as follows:

i. In this chapter, Chapter 1 a general introduction of the iFLEX project as well as of this report is made.

ii. Chapter 2 outlines the user engagement approach and co-creation activities during the second phase of the pilots' execution. In addition, the recruitment procedure per pilot cluster is presented in detail.

iii. Chapter 3 describes Phase 3 specifications per pilot cluster as well as the technical requirements to be deployed during the second phase of the pilots' demonstrations, including the engagement of different end-users, gathering their requirements and preferences.

iv. Chapter 4 provides the main conclusions of this report.

1.5 Abbreviation Terms

Table 2: List of Abbreviations

Term	Definition
BC	Business Case
BMS	Building Management System
DR	Demand Response
DRM	Demand Response Management
DSO	Distribution System Operator
ESCO	Energy Service Company
EV	Electric Vehicle
HEMS	Home Energy Management System
HPP	Hybrid Power Plants
KPIs	Key Performance Indicators
MVP	Minimum Viable Product
TSO	Transmission System Operator

UC	Use Case
VPP	Virtual Power Plant
HVAC	Heating, ventilation, and air conditioning

2 User Engagement Activities

2.1 Introduction

In piloting phases and in its associated tasks, user engagement is divided into three phases, each consisting of several agile co-creation iterations. The goal of the first phase (Phase 1) of the pilots' execution was to co-create an MVP of the iFLEX Framework and application-specific iFLEX Assistants (M14) as well as to deploy these into a pre-pilot consisting of few selected users in order to collect feedback and validate against certain functional requirements.

In the second phase (Phase 2), the feedback from Phase 1 was utilized to improve the iFLEX Framework with new functionalities and enhanced user experience. At the end of this phase (M25), the improved iFLEX Framework and Assistants developed on top of the framework were validated with small-scale pilots. Phase 3 introduces the large-scale pilot utilising all the lessons learned in Phases 1 and 2. For the final demonstration of iFLEX Assistants in Phase 3, any missing functionality has been added, and the focus is on fine-tuning the Quality of Service (QoS) and user experiences based on the Phase 2 feedback. As large-scale demonstration, pilots are scaled up to include more engaged end-users and technical functionalities in order to collect feedback and validate the final iFLEX Assistants (M36).

This section outlines the different actors and their roles in the iFLEX project, pilot-specific information on the user inclusion/exclusion criteria as well as the recruitment and informed consent procedure followed by each pilot cluster. The methods and tools used to engage users during the pre-pilot phase is also described per pilot.

2.2 Types of actors participating in the user engagement process

The target for one of the iFLEX key performance indicators (KPIs) is to include up to 6 different actors, including consumers, prosumers, DSOs, retailers, aggregators, technology providers, who will contribute to the co-design of iFLEX Assistant concept. The user engagement activities along with the actors participating in these actions will be tackled according to the procedure followed in the iFLEX project deliverable D2.2-User engagement and co-creation framework and plan [[3].

The following table (Table 3) illustrates the different types of actors and their representation in the iFLEX project originally included in [3].

Table 3: Types of actors in the iFlex project

Actors	General description	Representation in iFLEX
Consumers	A party that consumes electricity.	Consumer representatives *(from non-energy – consumer's rights protection, legal and other socio-economic perspectives)*: • In-JeT APS (IN-JET) • Zveza potrošnikov Slovenije Društvo (ZPS) The iFLEX pilot clusters involve two types of participants (end-users): • Residential consumers / prosumers • Small commercial consumers / prosumers All participants are existing customers of one or more of the project partners in the pilot clusters: Greek cluster • Residential customers. Slovenian cluster • 100 households and small enterprises Finnish cluster • Apartment buildings, supermarket
Prosumers	Prosumers are generally defined as electricity consumers that produce part of their electricity needs from their own power plant and use the distribution network to inject excess production and to withdraw electricity when self-production is not sufficient to meet own needs.	

Distribution System Operator (DSO)	A party responsible for operating, ensuring the maintenance of and, if necessary, developing the system in a given area and, where applicable, its interconnections with other systems, and for ensuring the long-term ability of the system to meet reasonable demands for the distribution of electricity.	• Elektro Celje d.d. (ELE)
Retailers	Electricity retailers (sometimes referred to as power companies) purchase electricity from the wholesale market to sell it to residential and business consumers.	• ECE d.o.o. (ECE) • HERON
DR/RES Aggregators	As an electricity grid participant, the DR Aggregator tracks companies' consumption and TSO/DSO as well as Market Operators' requirements in real time. The DR Aggregator provides uninterrupted grid balancing to optimise energy use and pays its customers for making their consumption flexibility available. The RES Aggregator is a market entity that acts as an intermediary between RES units and the wholesale electricity market. It ensures the collective participation of diversified and geographically dispersed RES assets to the wholesale electricity market, leading to higher economic benefits for RES owners, by exclusively undertaking the inherent imbalance costs.	• HERON • Optimus Energy S.A. (OPTIMUS)
Technology providers	Technology providers, represented and contributing to the co-design of iFLEX Assistant concept	• Smart Com d.o.o. (SCOM) • EMPOWER IM Oy (ENERIM) • Institut "Jožef Stefan" (JSI) • Athens University of Economics and Business (AUEB) • Intracom Telecom (ICOM) • Caverion Suomi Oy (CAVERION)

2.3 User Engagement and Co-Creation Activities

The table below (Table 4) describes a general overview of the different user engagement and co-creation activities that will be used by the pilot clusters during the third phase of the pilots' execution. A more detailed description of the method and tools used by each pilot cluster during the third phase is provided in the pilots' specification section.

Table 4: Overview of user engagement & co-creation activities

Appoach	Input	Output
Assess final designs of natural user interfaces for customer (end-user) participation in DR actions.	Data on end-user experiences of i) using the iFLEX Assistant and ii) participating in DR events, collected through questionnaires and interviews.	End-user evaluation of the iFLEX Assistant as a tool for making participation in demand response easy and attractive.
Assess iFLEX Assistant end-user interface, namely the developed (mobile or web) app, with respect to usability for active participation in DR. Includes assessment of functionalities and data presentations/visualisations in the app.	Usability testing with pilot end-users, focusing especially on user satisfaction (i.e. usefulness, trust, pleasure, and comfort). A combination of questionnaires, interviews and focus groups will collect feedback from end-users.	Usability evaluation result of iFLEX end-user interface. End-users' overall satisfaction with and acceptance of the iFLEX Assistant. End-user suggestions for future improvements/changes (if applicable).
Evaluate end-user experience, acceptance, and satisfaction.	User Experience Questionnaire (UEQ) to pilot end-users (assessing attractiveness, perspicuity, efficiency, dependability, stimulation, and novelty).	Overall UEQ evaluation of iFLEX Assistant.
Demonstrate and test feedback mechanisms of the iFLEX Assistant.	Collect data submitted via the feedback mechanisms in the iFLEX Assistant.	Assessment on impact on thermal comfort. Assessment of user acceptance of thermal comfort levels.
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2.4 Recruitment of Participants and Informed Consent

2.4.1 Greek Pilot

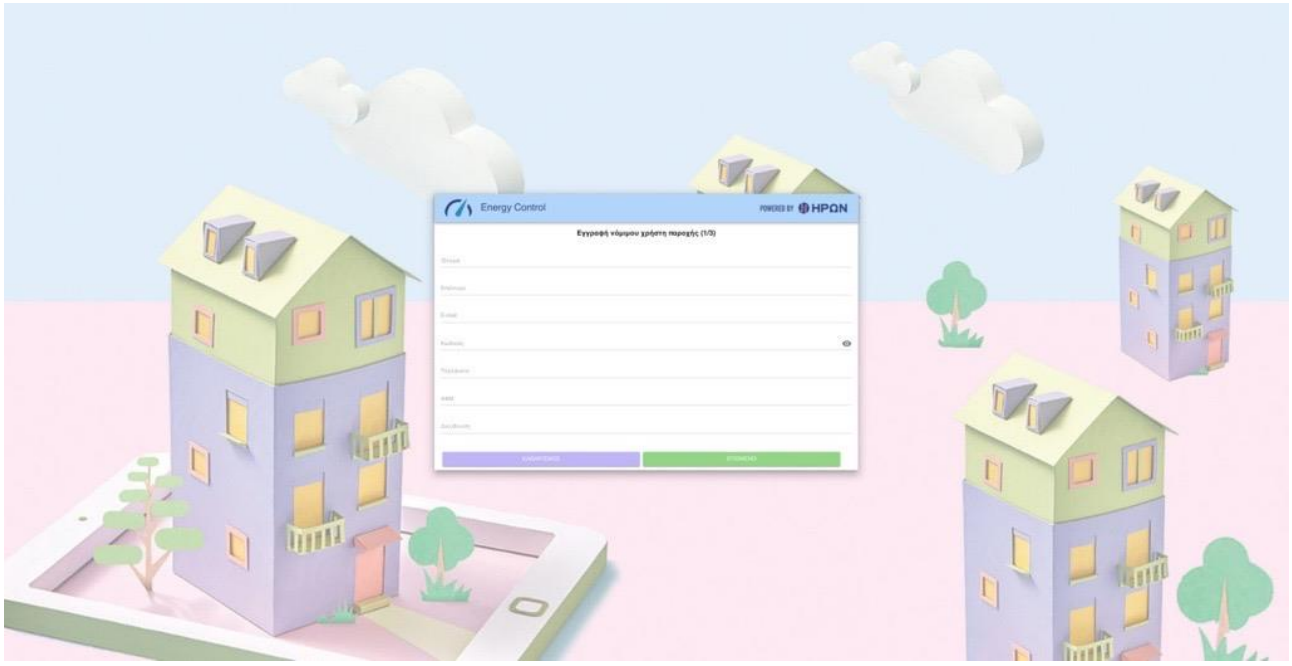
2.4.1.1 Recruitment Procedure

In the context of the iFLEX project, residential consumers, clients of HERON, were invited to participate in the pilot execution which foresaw, amongst others, the installation of additional smart meters, smart sensors as well as IoT sensors for real-time monitoring of energy and non-energy data. HERON's communication plan was to address the target group of its own clients in order to achieve best results possible for each pilot phase, stressing however that participation is completely voluntary.

Initially, employees of HERON and their family members with already installed smart meters in their households were contacted. Gradually the pilot opened to HERON's business partners and indirect acquaintances. Registration occurs through a link that gives them access to a dashboard which contains relevant consumption analytics from the web view of HERON's "Energy Control" app. The registration is successfully accomplished only when the consumer has acknowledged that s/he has read the privacy notice and has accepted the relevant terms and conditions for participating along with the provision of his/her consent online at the time of registration to participate in the pilot. The privacy notice and terms and conditions cover all HERON's platform users whose data is handled for all HERON's Horizon 2020 and Horizon Europe projects.

Upon registration, users are given a survey that aims to provide information on the energy consuming devices in their households. Specifically:

- Identify energy class and weekly usage patterns of energy consuming appliances such as washing machine, dryer, dish washer, A/C, electric water boiler etc
- Identify heating source (Natural Gas / Oil or electricity through A/C, heat pump etc)



Specifically, users that will test iFLEX solutions are given additional terms and conditions and are presented with a data usage consent that will enable the use of iFLEX Assistant features, integrated in HERON's Energy Control app. This two-step process is necessary given that iFLEX participants will gain access to HERON's app with the additional iFLEX features. The registration as well as the informed consent statement have been covering all remaining phases of the pilot execution, thus consumers will have to follow only once the relevant acceptance procedure.

In addition, information about the iFLEX project in general and the Greek pilot in particular was published on HERON's Social Media accounts (LinkedIn) as well as on the iFLEX project website and newsletters.

During the third phase of the Greek pilot execution, the following residential consumers are anticipated to be engaged:

1. At least 50 households consisting of ca up to 100 participants will be equipped with real-time smart meters.
2. A subset of 10 households to be equipped with remotely controlled relays to manage the operation of heavy consuming appliances (such as water heaters).
3. A subset of 35 households to be equipped with two-sets of smart plugs. A 16 A smart plug to monitor heavy loads such as washing machines and a 12 A smart plug to monitor lighter loads such as electronic devices.

The inclusion and exclusion criteria for participation in Phases 1 and 2 of the Greek pilot identified in D7.1 S2.4.1.2 [1] remain unchanged for Phase 3. Furthermore, the Greek pilot builds upon the informed consent procedure described in the iFLEX project deliverable D10.1-H Requirement No.1 [4] with some modifications. As consumers were approached and asked to register in HERON's platform, several legal complexities were identified. Most notably, HERON's legal team realised that some of the prospective iFLEX users were not the legal owners of the electricity supply, that is, they were not the bill payers. This relates to a common approach in many Greek families in which the parent or one partner pays the bill for their child or for the couple respectively. The legal challenge here was that in the pre-pilot phase, it was implicitly assumed that the user was the legal owner, without being specified in the consent process. An additional issue was that there were

not clauses regarding fair usage of the smart metering equipment, prohibiting unauthorised users from tampering with the installed equipment.

Addressing these issues, proved challenging and lead to an overhaul of both HERON's Energy Control app and iFLEX specific consent forms after consultations with HERON's DPO and the organisation's legal team.

2.4.1.2 Ethics

Ethics and privacy issues have been tackled according to the procedures specified in the iFLEX deliverable D10.2 [4]. At present stage, no ethical issues have been identified that in any way impact the preparation or implementation of the phase 3 pilot.

As Phase 3 kicks off, the project's ethics checklists will be completed again to ensure continued compliance as new pilot participants are entered into the pilots. Informed consent procedures are in place and consent is obtained as required.

The information material (privacy policies) and informed consent forms have been reviewed and updated with information about partners' Joint Controller Agreement (including contact information to all project partners) and more detail on the sharing of personal data within the project.

The Data Protection Impact Assessment (DPIA) has been revisited specifically in preparation for phase 3. No updates necessary.

The monitoring and management of ethical issues will continue throughout Phase 3. The results (ethical issues identified, actions taken etc.) will be documented in the forthcoming compliance monitoring report (D1.12, end of project).

2.4.2 Slovenian Pilot

2.4.2.1 Recruitment Procedures

In the first iteration of the Slovenian pilot, five end-users were invited to join the project voluntarily. We also looked for potential participants among ECE and ELE employees who already have a smart electricity meter, a solar power plant and a heat pump installed in their houses. HEMSs also were installed in their households before implementation. The plan of the Slovenian cluster has been to test the registration procedure, to test the new equipment (HEMS) and to get feedback from the users, which would be useful in further pilot executions.

Potential users have been approached in person. Initially they received the link via email to the registration web page through which they accessed to apply for the project. The users that registered to the pilot accepted the relevant terms and conditions for participating. All service information for the end-users will be made available through telephone communication.

In Phases 2 and 3 of the Slovenian pilot, the approach to engaging pilot users was tailored to their subscription package. Based on factors such as geographical location, network stability, and distribution operator, a group of 2,300 potential users was identified, consisting of those in the self-supply package (i.e., those with installed solar power plants) and the heat pump (HVAC) package (i.e., those who use heat pumps for heating or preparing sanitary water). The group was further refined by analysing their consumption patterns and local weather conditions over a one-year period, and selecting users whose electricity usage was dependent on temperature conditions. This resulted in 778 heat-dependent households where electricity was assumed to be the primary source of heating. Each of these users was personally contacted by mail and provided with a detailed description of the iFLEX project and a questionnaire to complete. The questionnaire aimed to gather information on the consumer's electrical generator and consumer technologies, basic data (such as access to the Internet, smartphone usage, and ownership of the property), and willingness to participate in iFLEX workshops. Feedback could be submitted in writing via an enclosed envelope, electronically via email, or by scanning a QR code that directed to an online questionnaire. Of the 119 returned questionnaires, 82 technically suitable potential users were identified and invited to participate in the iFLEX project. These users confirmed their cooperation by signing a mutual agreement and agreeing to the processing of their personal data. The iFLEX project team then proceeded to place each user into the project.

The inclusion and exclusion criteria for participation in the Slovenian pilot identified in D7.1 S2.4.2.2 [1] remain unchanged for Phases 2 and 3. Similarly, there have been no changes in the Informed Consent Procedure outlined in D7,1 S2.4.2.3.

2.4.2.2 Ethics

Ethics and privacy issues have been tackled according to the procedures specified in the iFLEX deliverable D10.2 [5]. At present stage, no ethical issues have been identified that in any way impact the preparation or implementation of the Phase 3 pilot.

As Phase 3 kicks off, the project's ethics checklists will be completed again to ensure continued compliance as new pilot participants are entered into the pilots. Informed consent procedures are in place and consent is obtained as required.

The information material (privacy policies) and informed consent forms have been reviewed and updated with information about partners' Joint Controller Agreement (including contact information to all project partners) and more detail on the sharing of personal data within the project. An amendment has been made to specify that there is an exchange of data between the team of installers and the Slovenian pilot partner.

The DPIA for the Slovenian pilot has been updated with information on the collection of location photographs and the use of paper-based informed consent forms. This update did not change the result of the DPIA (low residual risks; measures approved).

The monitoring and management of ethical issues will continue throughout phase 3. The results (ethical issues identified, actions taken etc.) will be documented in the forthcoming compliance monitoring report (D1.12, end of project).

2.4.3 Finnish Pilot

2.4.3.1 Recruitment Procedures

The phase 3 user recruitment will follow similar procedures as in Phase 1 and 2. In the first phase, the end-users of the Finnish pilot included the building's facility manager (i.e., Caverion) and the ~140 residents of the pilot building. All the residents have access to the End-user interface tailored for the apartment building. Additionally, the residents had the option to 1) order apartment specific thermal comfort sensors and 2) provide apartment specific feedback about the thermal comfort by registering to the iFLEX Assistant via the end-user interface. In the Phase 1 four residents registered to the pilot and ordered the sensors. In Phase 2, we aimed to motivate more residents to order the sensors and register to the iFLEX Assistant. The potential participants were recruited by approaching the residents of the apartment building by e-mail. The residents were informed about the piloting activities and provided with a link to a web page that can be used to register to the pilot. All residents were provided with a possibility to access the building-level end-user interfaces. This interface can be used to monitor building related data (electricity consumption, district heating consumption, CO_2 footprint, and average thermal comfort), as well as, to provide anonymous feedback. In addition, the registered residents were provided with means to monitor their own apartment's thermal comfort and provide feedback.

The registration occurred through the user interface where the resident entered his/her name and apartment number. The resident had to accept the informed consents for participating to the research and for allowing the data collection.

After a few months of data collection period, a survey was implemented for the registered residents. The survey includes questions about the following topics:

- Residents background and awareness of consumption and consumption habits
- Flexibility: residents' willingness and incentives
- Feedback about user interface and iFLEX project
- Needs for data visualization
- Possible changes in consumption habits due to data visualization

In the Phase 3, a pilot advertisement campaign will be organised to inform the pilot building residents about the pilot. During this campaign it is also possible for residents to order apartment specific thermal comfort sensors. This requires sharing of personal data and signing of an informed consent. In the third phase we will also include a supermarket to the pilot via the MakingCity co-operation (elaborated in more detail in D8.4). No personal data is collected in this pilot.

Inclusion and exclusion criteria and the Informed Consent Procedure described in S2.4.3.2 and S2.4.3.3 in D7.1 [1] remain unchanged.

2.4.3.2 Ethics

Ethics and privacy issues will be tackled according to the procedures specified in the iFLEX deliverable D10.2 [5]. At present stage, no ethical issues have been identified that in any way impact the preparation or implementation of the phase 3 pilot.

As Phase 3 kicks off, the project's ethics checklists will be completed again to ensure continued compliance as new pilot participants are entered into the pilots. Informed consent procedures are in place and consent is obtained as required.

The information material (privacy policies) and informed consent forms have been reviewed and updated with information about partners' Joint Controller Agreement (including contact information to all project partners) and more detail on the sharing of personal data within the project.

The Data Protection Impact Assessment (DPIA) has been revisited specifically in preparation for phase 3. No updates necessary.

The monitoring and management of ethical issues will continue throughout phase 3. The results (ethical issues identified, actions taken etc.) will be documented in the forthcoming compliance monitoring report (D1.12, end of project).

3 Phase 3 Pilot Specifications

The section describes the specifications for Phase 3 pilots. Phase 3 pilots extend Pre-pilot and Phase 2 efforts, aiming to demonstrate the Minimum Viable Product (MVP) of the iFLEX Framework and Assistants at a large scale. Focus of this section is specifically to describe how Phase 3 pilots extend Phase 2 pilots.

3.1 Greek pilot

3.1.1 General Overview

Phase 3 pilot builds upon the experience accumulated through Phase 1 and 2 trials in which HERON's energy monitoring infrastructure was deployed and tested. In Phase 1, a number of selected users had a smart meter installed in their home and could access their electricity consumption, active power and power factor calculations. Furthermore, through an API, HERON's platform was integrated into iFLEX Framework allowing data crucial for the under development iFLEX Assistant to be harvested. In Phase 2, more users entered the pilot and HERON's API was updated to include more IoT devices, while the electrical boiler's remote control through a relay was tested in lab environment. Moreover, the initial version of the iFA web app was developed and has been validated by potential end-users through a usability test. Finally, Optimus Energy has provided to ICOM an API to monitor real-time imbalances of the 500 KWp PV plant that is dedicated to iFLEX.

3.1.2 Phase 3 Scope

During the Phase 3, HERON's contribution will be mainly focused on demonstrating the following use cases from D2.1-Use Cases and Requirements [6]: BUC-5 concerning customer's load profile analysis/overview, the deployment of HLUC-1 concerning energy management in an optimal way as well as HLCU-2: Manage flexibility requests or price signals at individual premise level. The contribution of Optimus Energy will be mainly focused on demonstrating HLUC-1 concerning energy management in an optimal way and HLUC-2: Manage flexibility requests or price signals at individual premise level. The use cases mentioned above are also available in Annex A.

In Phase 3, sufficient consumption data will be provided from HERON's customers who will be asked to offer balancing services to Optimus Energy based on the scheduled use of their water boiler for those who will have a smart relay installed. However, and in order to utilise the expanded flexibility through the Phase 2 and 3 IoT devices, real-time advice will be offered to those who will have a smart plug installed to monitor the usage of their washing machines or A/C units.

In addition, HERON's Pilot Phase 1 and 2 setups will be extended to include more residential customers that will accept to participate by installing smart meters, remotely controlled relays for managing the operation of electric boilers and smart plugs that monitor heavy consuming appliances providing valuable data for the iFLEX Assistant to learn the behaviour of the consumers and their environment. As regards the iFLEX web app, it is enhanced with new features. The users will be able to have a clearer overview of their costs and savings, set and track goals, and receive customized energy advice.

Finally, besides the 500 kWp ground-mounted PV plant already monitored by iFLEX during Phases 1 and 2, additional medium-size ground-mounted PV plants currently represented in the Greek wholesale electricity market by Optimus Energy are reviewed as candidates to be added in Phase 3 setup. This will augment iFLEX RES portfolio whose operation will be coordinated with the extended end-user DR portfolio under a bilateral trading scheme to obtain mutual benefits with respect to the independent participation of RES and DR resources in the wholesale electricity market. In this context, the end-user DR households' portfolio will be regularly called on to internally address and mitigate RES generation imbalances before the RES Aggregator needs to perform balancing through third parties in the relevant markets. This will be enabled via the operation of ICOM's Demand Response Management System (DRMS). The DRMS will receive requests for flexibility by the RES Aggregator's (Optimus) system, dispatch appropriate DR events to the iFA end-users to fulfil the request, and report back to the RES Aggregator on the aggregated flexibility. The exact number and maximum capacity of the additional PV plants that will be involved in the augmented RES portfolio will be indirectly determined by the attained number of end-user households that will be actively engaged during Phase 3. This serves the need to obtain comparable RES and end-user DR portfolios in terms of aggregated capacity, so that more realistic and concrete conclusions are derived from their coordinated operation.

3.1.3 Description of Phase 3 Technical Assets

Table 5: Summary of the Greek pilot technical assets

Name of the pilot:	*Demand side flexibility of smart homes in southern Europe distribution grid-Greek Cluster*
Pilot Location	Greece
Partners	● HERON - Electricity generator and Supplier ● Optimus Energy-RES aggregator ● ICOM – Solution Provider (Demand Response platform –outcome of T4.3- and mobile app with natural user interface features – outcome of T3.3)
Type of consumers	Residential
Number of sites	Up to three sites (Athens, Thessaloniki & Volos)
Number of buildings	Corresponding number of residential apartments in blocks of houses or detached houses: at least 15 households, with a subset of ca 40 users
Infrastructure to be used in Phase 3 pilot	- **HERON infrastructure assets**: 1. At least 50 households (with up to 100 users) with real-time smart meters (sampling @ 30 sec). 2. A subset 10 households to be equipped with remotely controlled relays to manage the activation (ON/OFF) of heavy consuming appliances (such as water heaters, electric space heaters). 3. A subset of 35 households to be equipped with smart plugs to monitor heavy loads 4. Extension of HERON's energy metering and actuation platform to enable inventory of IoT assets (smart plugs and smart meters), remote device control and DR communication with the iFLEX Assistant. **- Optimus Energy asset:** 1. A single 500 kW ground-mounted PV plant with available generation forecasts and real-time measurements (sampling ∀5 min – 15 min). 2. Additional geographically dispersed PV plants may be employed to provide flexibility for iFLEX users, if needed. Optimus Energy assets are shaped into an augmented RES portfolio whose operation will be coordinated with the extended end-user DR portfolio to internally address and mitigate uncontrollable RES generation imbalances under a bilateral trading scheme to obtain mutual benefits with respect to the independent participation of RES and DR resources in the wholesale electricity market. The exact number and maximum capacity of the additional PV plants that will be involved in the augmented RES portfolio will be indirectly determined by the attained number of end-user households that will be actively engaged towards the end of Phase 3. **- ICOM assets**: 1. The iFA web app, integrated into HERON's mobile app, which enables the interaction of pilot users with their iFAs. 2. The DRMS, which receives flexibility requests and dispatches appropriate DR events to the iFAs in order to aggregate the needed flexibility from the pilot users.
Demonstration Topic	● Consumer-centred energy management

3.1.4 Phase 3 Anticipated Objectives

The main goal of second phase pilot is to implement and fully demonstrate advanced demand side flexibility scenarios that require the interaction between a DR and a RES Aggregator with end-consumers offering balancing services, bringing complex procedures from trading and operation rooms to end-users' mobile devices.

The detailed objectives of Phase 3 pilot are:

1. Contact a sufficient number of residential customers and try to engage up to 100 residential customers to participate in this phase.
2. Install at least 50 smart meters, providing a pool of up to 100 residential customers to interact with iFLEX Assistant.
3. Provide Phase 3 piloting end-users with real-time and historical data visualization:
   - Consumption at phase and/or smart plug, relay level,
   - Total consumption
4. Install relays for water heaters and smart plugs for specific loads in a subset of 60 residential customers to control and/or monitor their operation.
5. Enable participating users to setup time schedules through a user interface (mobile app) to be used for automated activation and control their flexible devices.
6. Identify the flexibility potential of participating users by analysing their flexibility preferences as specified from the user interface (mobile app).
7. Detect in real-time the status of connected appliances by monitoring their resulting consumption.
8. Validate user acceptance and understanding of consumer behaviour through a user interface.
9. Showcase synergies and coordinated operation of residential assets (e.g., home appliances) and enrolled RES unit(s) for minimizing unavoidable RES generation imbalances.
10. Elaborate the necessary customizations and extensions of HERON's platform to secure the smooth integration of individual components and communication with the iFLEX Assistant.
11. Develop a DRMS which orchestrates the dispatch of DR events to iFAs based on the flexibility requests of the RES Aggregator for mitigating its imbalances, as well as the A&M Interface component of the iFA to enable the interaction with the DRMS.
12. Assess design of natural user interfaces for customer participation in DR actions (e.g., comfort preferences, personalised notifications, DR event participation).
13. Deploy the new features added to the iFLEX app, which provide the users with insights into their energy costs, enable them to set and track their own goals, and offer them energy advice.

3.1.5 Phase 3 Activities

This paragraph summarizes the main activities that will be implemented during Phase 3 of the Greek pilot to meet the objectives described above.

1. Communication of residential users belonging to HERON's clientele to inform them on the pilot activities and ask them to participate in the final phase of the pilot execution in a continuous recruitment effort.
2. Experiment with residential end-users interacting with the electricity grid under real-life conditions.
3. Collect, harmonise, and store data from various data types and sources such as, historical and real-time energy consumption collected from individual smart meters, electricity tariffs, generation forecasts, real-time production measurements of Optimus Energy RES units and weather and grid CO_2 data.
4. Data will be analysed and will be made available to residential end-users, while load patterns will be identified considering electricity consumption per device and/or total consumption on a daily and/or monthly basis to make customers aware of their energy wastages.
5. Provide RES unit forecasting and real-time generation data for monitoring purposes for all RES units that formulate the augmented RES portfolio in Phase 3.
6. Calculate RES generation imbalances at unit and aggregator level on the basis of the above generation forecasts and respective real-time measurements. These data will serve as an input for subsequently triggering end-user households' assets to properly respond and mitigate RES generation imbalances.
7. Based on the RES Aggregator's input, dispatch appropriate DR events to the pilot users in order to aggregate the requested flexibility.

8. Receive feedback from the pilot users on their satisfaction from the services and incentives offered in the Greek pilot of iFLEX.

In addition, the following activities relate to the development of HERON's Energy Control App and integrated iFLEX Assistant which will be tested by up to 100 iFLEX users:

1. Feedback will be requested with regards to their preferable ways for them to provide constraints and preferences when participating in a DR program, as well as the desired level of autonomy (e.g. manual feedback vs delegation of the decision to the iFLEX Assistant.
2. Identify consumer preferences based on the usage of specific home appliances, such as water heaters and appliances monitored by the smart plugs, as well as consumer comfort limits.
3. Perform first level API customizations and extend HERON's metering platform to support advanced control and DR communication with the iFLEX Assistant.
4. Provide data to the end-users regarding their consumption (aggregated and asset specific) so that they can make informed decisions regarding their participation in DR events.
5. Support consumers in their participation in DR events through appropriate incentives that translate into monetary or other (real-life) rewards.

3.1.6 Phase 3 Associated KPIs

1. ***KPI6a****: Number of consumers in the pilots*
   Target*: at least 100 consumers in up to 50 households*
   Validation Measures: *Total number of consumers/prosumers in the Greek pilot.*

2. ***KPI6b:*** *Number of consumer groups targeted with novel demand response services*
   Target*: Up to 10 households with smart relays and up to 35 with smart plugs*
   Validation Measures: *Total number of different consumer segments that will be engaged with demand response through the third phase.*

3.2 Slovenian Pilot

3.2.1 General Overview

The third and final phase piloting builds on results of the first and second pilot phase. In the first two phases network grid segments for piloting were selected and an initial set of piloting end-users contacted. The requirements for the HEMS system have been clearly defined and installed at selected end-users. The HEMS systems have been fine tuned for the end-user's environment. APIs and services have been defined to integrate the HEMSes into iFLEX Framework. The iFA mobile app's second version with support for Slovenian language has been developed, which enables the interaction of pilot participants with their personal iFAs. The project strives for continuous end-user engagement, making efforts to involve users frequently and extensively.

3.2.2 Phase 3 Piloting Scope

Phase 3 will tackle the following challenges:

1. Recruitment of the second phase group of pilot users and setting a base for the third phase recruitment round,
2. Deployment of HEMS systems to pilot users and their smooth integration with the iFLEX Framework,
3. Continuous improvement, testing, maintenance and operation of iFLEX Framework background components: RAI, Digital Twin, Automated Flexibility Management,
4. Integration with background components and testing of EUI solution with the end-users,
5. Integration of external DR management system, which will distribute DR events to the pilot users, as well as iFA's A&M Interface component to interact with this system,
6. Implementation and evaluation of a number of use cases planned in the project: PUC-1 Manage my preferences, PUC-4 View reports on participation or engagement, PUC-7 Monitor my energy in real-

time, PUC-8 Offer flexibility, PUC-9 Optimize schedule considering prices and/or incentives and PUC-10 Increase self-balancing through forecasting and automation,

7. Engage with the end-users and enable co-creation: collect feedback, consult during deployment, evaluation and testing and provide third phase inputs to design and technical WPs.

3.2.3 Description of Phase 3 piloting Technical Assets

Table 6: Summary of the Slovenian pilot technical assets

Name of the pilot	*Flexibility pilot for efficient operation of the electricity grid with high share of RES in Central European climate (Kozjansko and Savinjska dolina, Slovenia)*
Pilot location	Slovenia
Partners	ECE - Electricity supplier ELE – DSO IJS – Scientific institute SCOM - ICT solutions company
Type of consumers	Residential consumers/prosumers, industrial consumers/prosumers
Number of sites	Two sites (Kozjansko and Savinjska dolina)
Number of clients	40 residential end points, 2 small business facility and 1 large industrial facility
Number of buildings	43
Available infrastructure	1. **ELE**: ○ Data from 10.000 households and small industrial users equipped with smart electricity meters (sampling ∀15 min.) ○ Local Data from 200 local substations equipped with smart electricity meters (sampling ∀15 min.) ○ Application “MojElektro” for consumption and production data visualization 2. **ECE**: ○ 43 households and industrial end points equipped with HEMS ○ Application “Moj ECE” for consumption and production data visualization **3. JSI:** ○ Resource Abstraction Interface (RAI): a cloud instance for collection of data from external data sources like HEMS and AMI systems and for offering the data resources in a unified way to other system components ○ Data analytic pipeline for network load, generation and household occupancy forecasting ○ Machine learning and cloud infrastructure, HW and SW ○ Security and privacy services as were presented in D4.7 **4. SCOM:** ○ Smart metering data ingestion system ○ Secure end user piloting engagement system **5. ICOM:** ○ iFA mobile app, which enables the interaction of pilot users with their iFAs
Extend pilot setups with more assets	N/A
Demonstration Topic	PUC-1, PUC-4, PUC-7, PUC-8, PUC-9 and PUC-10 demonstration activities

ELE will provide GIS data for testing areas and electricity consumption and production data for a subset of 100 residential and industrial users for at least one-year period.

An indicative list of the readings that will be made available are the following:

- Active Power (P),
- Active Energy (E),
- Reactive Power (Q),
- Current (I),

- Voltage (V).

ELE will also provide climate data:

- Average temperature
- Average sunlight
- Rainfall.

ECE will provide for the 43 end points of pilot phase 3 data from HEMSs and in case of prosumers also data about production of electricity from PV. Data from HEMS'es will be available in near real-time for later processing. The following data from pilot selected devices will be available:

- Heat pump (HVAC):
    - All room temperature,
    - Outside temperature,
    - Sanitary water temperature,
    - Heating water temperature,
    - Consumed energy and in time power consumption,
    - Other diagnostic data.
- Solar power plant (PV):
    - Active and reactive power and energy production,
    - Electric current and voltage per phase,
    - Sine wave Frequency,
    - Other diagnostic data.
- Smart distribution meter:
    - Exported to the grid or imported from the grid active or reactive power and energy,
    - Electric current and voltage per phase (phase to neutral line and phase to phase),
    - Sine wave Frequency.
- Smart plug (for devices that support ON/OFF control):
    - Active power consumption,
    - Electric voltage and current (single phase to neutral line),
    - Logic relay state (ON or OFF).

JSI will provide a cloud platform with HW and SW needed to serve the smart metering data ingestion system, weather data ingestion system, prosumer backend systems and ML data analytics.

3.2.4 Phase 3 Piloting Objectives

1. Continuously improve awareness about potential pilot users and acquire user base for Phase 3 piloting
2. Continuous integration of the smart metering data into the iFLEX Framework
3. Installation of HEMS systems at acquired pilot users
4. Continuous integration of installed HEMS systems with the iFLEX Framework, further validate PUC-1 and PUC-7 use cases
5. Test improved Digital Twin capabilities on broader range of users and data, validate PUC-4 and PUC-8 use cases
6. Test Automated Flexibility Management in relation to PUC-9 and PUC-10 use cases
7. Test external DR management system and A&M component within the context of PUC-4 and PUC-9

use cases

8. Testing of advanced security features
9. Continuous assessment of the data and data flows for fulfilment of Data Management Plan
10. Get feedback from Phase 3 pilot end-user and evaluate iFLEX Assistant as a service,
11. Critically assess reached objectives,
12. Provide final feedback to technical work packages and include awaited iFLEX Assistant and tools improvements in the third phase piloting plan.

3.2.5 Phase 3 Piloting Activities

1. Initially selected network segments are continuously monitored for changes in network conditions to be able to adapt the selection according to the number of acquired pilot users. Potential pilot users consumption is studied and most promising users, based on their thermal characteristics and location, are invited in the project. User base is constantly expanded both through direct communication with candidates and through invitation campaigns, if needed,
2. The process of ingest of smart metering data is on-going activity. According to adaptation and updates of network segments and acquired pilot users the process needs to be updated and extended,
3. The rest of the HEMSes will be installed and updated with newly developed software's and features at acquired pilot users. Different setups are foreseen with different equipment. The primary target are users with strong thermal characteristics, preferably both in winter and summer. PVs are a plus,
4. The HEMSes will be further integrated in the iFLEX Framework, in particular in terms of control capabilities and extended data from the pilot users equipment. The EUI will be designed and integrated with the RAI to answer the needs to implement PUC-1 Manage my preferences and PUC-7 Monitor my energy in real-time use cases,
5. The Digital Twin (DT) will be tested regarding needed capabilities for implementation of PUC-4 View reports on participation or engagement and PUC-8 Offer flexibility use cases. The data collected in the pilot will be used to build models needed to provide information on participation in DR events and available pilot user household flexibility,
6. The core of the piloting activities will be oriented towards implementation of the PUC-9 Optimize schedule considering prices and/or incentives and PUC-10 Increase self-balancing through forecasting and automation use cases. The extended DT models (5) will be used to plan for optimized end-user household response implemented through HEMS integration (4),
7. While for the pilot user enrolment updated baseline security features are still in place, in Phase 3 the advanced security features developed in WP4, based on Self Sovereign Identity principles will be tested,
8. From DMP point of view the pilot will actively follow the process of acquiring of new users (activity 1) and HEMS installations (activity 3) to detect possible new data sets or flows within the project. The updates will be recorded in the DMP,
9. Through the pilot activities the pilot users' feedback will be actively looked for to be able to improve the end-users experience according to the provided comments and suggestions. Besides the technical feedback also end-user feedback will be passed back to technical work packages,
10. User integration system and tools for development and deployment/update of an iFLEX Assistant evaluation instances into the pilot. The tools have been established and tested in the first pilot phase.

3.2.6 The final effort of the Phase 3 pilot will be an evaluation of achieved objectives and associated KPIs . Phase 3 Associated KPIs

1. ***KPI6a: Number of consumers in the pilots***

Target: *80-100 residential consumers (40 measuring points), 2 small business (101 consumers) facility and 1 large industrial facility (190 consumers)*

Validation Measures: *Total number of consumers/prosumers in the iFLEX pilots*.

2. ***KPI6b: Number of consumer groups targeted with novel demand response services***

Target: 2 (i.e., households and small industrial units)
Validation Measures: *Total number of different consumer segments that have been engaged with demand response through the pilots.*

3. ***KPI6c: Increased consumer flexibility for grid stability and RES integration***
   Target: 15%
   Validation Measures: The average flexibility. Accuracy of pilot participants that is validated in grid stability/RES integration cases is compared to relevant results reported in the literature. Load forecasting model.

3.3 Finnish Pilot

3.3.1 General Overview

In Phase 3 pilot a new building will be added to the Finnish pilot. The new building comes from the co-piloting with the MAKING-CITY project. The new building is a supermarket that is located in the MAKING-CITY Oulu pilot (positive energy district in Kaukovainio area). Please refer to the deliverables D8.4 and D8.5 for further details on the co-piloting with MAKING-CITY.

The supermarket has an advanced heating, ventilation, air conditioning and refrigeration (HVAC-R) system responsible for generating cooling (freezers and fridges), and heating (space heating and domestic hot water). The supermarket also has a significant amount of local energy production from solar panels so the store is self-sufficient during the summer times. The integrated HVAC-R system will provide the flexibility for the site. To facilitate the energy and flexibility management, a new iFLEX Assistant will be developed and deployed into the supermarket. The goal of the iFA is to provide benefits for the building owner by optimal energy and flexibility management.

In addition to the supermarket, the third phase pilot will include the apartment building that was already part of the phase one and two pilots. The iFLEX Assistant deployed into the apartment building manages the energy and flexibility of a centralized HVAC system. The iFA provides benefits for the whole building community. I.e., it is typical in Finnish apartment buildings that the majority of the energy costs, including space heating (apartments and common areas), domestic hot water heating, sauna, and common area lighting is paid by the building community (also known as the housing cooperative).

The iFAs will be connected to the Enerim's Aggregation Platform that operates in the Nord Pool intra-day market. The integration with the OneNet platform is also organised via the Enerim's Aggregation Platform. Please refer to D8.4 and D8.5 for further details on the federated pilot with the OneNet and the MAKING-CITY projects. For both buildings the iFLEX Assistant will forecast the baseline load and flexibility (includes also district heating for the apartment building) and activate the flexibility according to the request from the Enerim's Aggregation Platform. Additionally, the iFAs will provide implicit DR capabilities and optimize flexibility according to local incentives.

3.3.2 Phase 3 scope

In Phase 3 pilot, the main focus will be on replicating the solutions in a new pilot building with different flexible assets and technical constrains. Moreover, Phase 3 pilot will focus on aggregation of the pilot sites to the Nord Pool intraday market. Nord Pool intraday test market will be used in the piloting. Additionally, the federated pilot (started in the phase 2) with OneNet will be continued by adding the supermarket from the MAKING-CITY project. New features for the iFA such as combined implicit and explicit demand response will be also tested in the Finnish pilot.

3.3.3 Description of Pilot Phase 3 Technical Assets

Table 7: Summary of the Finnish pilot technical assets

Name of the pilot	*Holistic flexibility management pilot in Nordic climate*
Pilot location	Finland
Partners	CAVERION - Building automation & facility manager ENERIM - Technology and service provider for Energy Suppliers VTT - AI based modelling and optimization
Type of consumers	- Residential, shared infrastructure for heating, warm water and common building infrastructure - Commercial, can produce and store heating and cooling energy. Produces electricity with solar panels. Uses and can produce district heating energy.
Number of sites	2
Number of clients	- Apartment building with 93 apartments. Facility manager + up to 5 residents registered to the pilot with their credentials. - A supermarket (2000 m^2).
Number of buildings	2
Available infrastructure	Apartment building: - Building automation system installed in the apartment building. Monitors and controls, heating, ventilation, warm water, lighting, elevator, sauna. - Historical data on selected measurement points available, interfaces implemented in the first phase pilot - oBix server for storing measurement data and Python API for accessing data - Machine learning and physics-based methods for modelling building infrastructure and consumption. Supermarket: - Monitoring of: Cold storage equipment; Heat pump process – various process measurements; Energy consumption – general electricity usage, energy usage of heating system; Other building automation measurements – temperature of indoor air, outdoor air, air conditioning. - Monitored data is saved to VTT servers - Machine learning and physics-based methods for modelling building thermal dynamics.
Planned pilot infrastructure improvements for the phase 3	Additional sensors for apartments for environmental monitoring
Demonstration Topic for phase 3	Apartment building: - District heating and electricity demand peak cutting, energy optimization, resident empowerment for participating demand response activities, aggregation concepts Supermarket: - Flexibility prediction, heating optimization

In Phase 3 iFLEX Assistants are deployed into two sites. The first site is an apartment building with 90 apartments. This building was already part of the Phase 1 and Phase 2 pilots. As a new building a supermarket (from the MAKING-CITY project) is included to the Phase 3 pilot.

The apartment building is equipped with a Building Management System (BMS). The BMS provides means to monitor and control following assets: district heating substation, radiator-based heating network, heating of domestic hot water, exhaust air heat pump and related ventilation solution, lighting, electric sauna and elevators (only monitoring). BMS also provides an access to monitor temperature and humidity in the corridors and shared spaces of the apartment buildings

Following measurements are currently available from the pilot building:

1. Building level electricity consumption (1-hour time resolution including several years history, new data with 1-minute resolution).
2. District heating energy consumption (1-hour time resolution including several years history, new data with 1-minute resolution).
3. Local weather data including outside air temperature, relative humidity, and optionally solar radiation (1-hour time resolution including several years history).
4. Building level electricity consumption by network analyser (phase level voltage, current, power and frequency at 1–5 s time resolution).
5. Ventilation units' return air temperature and optionally return air relative humidity and CO_2.
6. Indoor air temperature, relative humidity, and CO_2 of selected apartments on different parts of the building.
7. District heating, heating network, domestic hot water and exhaust air heat pump supply and return water temperature and related setpoint values.
8. Status information (percentage or on/off) on water pumps', fans', control valves' and heat pump compressor status.
9. Extract air temperature of the exhaust air heat pump.

The supermarket is controlled and monitored through an online control interface provided by Caverion. The heating system control is optimized to store or use all of the heat pump produced heat. The heating system can be controlled with the hot water temperature.

The following measurements are currently available from the supermarket:

1. Total electricity consumption of the building
2. Electricity consumption of the heat pump compressors (1-minute resolution with a couple of years of history)
3. Electricity production of the solar panels (1-minute resolution with a couple of years of history)
4. District heat consumption
5. Heat demand of the heating equipment using hot water (directly measured by an energy meter from the outgoing and incoming water flow) (1-minute resolution with around 6 months of history)
6. Local outdoor temperature (1-minute resolution with a couple of years of history)
7. Indoor temperature (2 sensors) (1-minute resolution with a couple of years of history)
8. Ventilated air temperature (1-minute resolution with a couple of years of history)
9. Hot water storage temperature (3 sensors) (1-minute resolution with a couple of years of history)

The Finnish pilot will use an existing platform for storing measurement data for ML data analytics (Machine learning and physics-based methods for modelling building infrastructure and consumption).

3.3.4 Phase 3 Anticipated Objectives

The main goal of Phase 3 pilot is to implement and deploy iFLEX Assistant to the supermarket demonstration site, continue optimization activities in the both pilot sites and co-operate with OneNet and MAKING-CITY projects via a federated pilot provided. The detailed objectives of Phase 3 pilot are:

1. To implement and deploy a new iFLEX Assistant for the supermarket from the MAKING-CITY project.
2. To integrate the supermarket with Enerim's Aggregation Platform.
3. Utilizing iFLEX Assistant to optimize energy efficiency of the apartment building and the supermarket.

4. To systemically evaluate and compare benefits of the local optimization made by the iFLEX Assistant in the HOAS building and the new supermarket pilot.
5. Evaluate the novel baseline and flexibility forecasting models against SotA methods in the pilot sites.
6. To aggregate the pilot sites from iFLEX and MAKING-CITY sites (i.e., apartment building and supermarket) with the ENERIM's Virtual Power Plant platform to Nord Pool intraday market (and the OneNet platform).

3.3.5 Phase 3 Activities

Following activities are planned to be executed in Phase 3 of the project:

1. Implementation and utilization of iFLEX Assistant for local optimization in supermarket
    a. Implement and deploy iFLEX Assistant to supermarket pilot, where role of the iFLEX Assistant is to control the consumption of heat of the heating system optimally
    b. Design and implement optimal control method for supermarket pilot. Utilize the control method and metrics from MAKING-CITY project
    c. Validate the benefits of the control optimization in the supermarket pilot and compare the optimization results with the normal operation
2. Improvements for the HOAS building pilot:
    a. Integrate tree-based methods e.g. random forest and LightGBM to modelling pipeline and evaluate all available forecasting models against current SoTA methods
    b. Develop automatic model deployment for the HOAS pilot iFLEX Assistant
3. Evaluate iFLEX Assistant with ENERIM demand response aggregation platform and demonstrate aggregation capabilities also in Phase 3

3.3.6 Phase 3 Associated KPIs

1. ***KPI6a:*** *Number of consumers in the pilots*
   Target: *93 apartments and roughly 140 residents. All the residents are given access to the apartment building level end-user interface. Additionally, the supermarket will provide a new large consumer for the 3rd phase pilot.*
   Validation Measures: *Total number of consumers/prosumers in the iFLEX pilots.*

2. ***KPI6b: Number of consumer groups targeted with novel demand response services***
   Target: *3*
   Validation Measures: *Total number of different consumer segments that have been engaged with demand response through the pilots*.

3. ***KPI5a:*** *Technology readiness of the iFLEX Framework and iFLEX Assistant prototypes*
   Target: 7
   Validation Measures: *The full iFLEX Assistants demonstrated in operational environment.*

4. ***KPI3a:*** *Level of interoperability (coverage of common standards)*
   Target: *100%*

5. ***KPI3b*** *Compliance with relevant EU privacy and data management regulation and standards*
   Target: *YES*

6. ***KPI2a:*** *Increased accuracy of consumer load forecasting compared to state-of-the-art methods*
   Target: *20%*
   Validation Measures: *The results are compared to the state-of-the-art consumer load forecasting models and percentage decrease of forecasting error is calculated.*

7. ***KPI2b:*** *Increased accuracy of flexibility modelling compared to state-of-the-art methods.*
   Target: *15%*

Validation Measures: *The results are compared to the state-of-the-art consumer load forecasting models and percentage decrease of forecasting error is calculated.*

8. ***KPI2c:*** *Increased effectiveness of automated flexibility management compared to standard methods*
   Target: *10%*
   Validation Measures: *The results obtained by the iFLEX Assistant is compared to the current algorithms used for energy management in the building. The iFLEX Assistant is optimization is run every other day to have as similar conditions for the baseline and the iFA. Percentage improvement in the automated flexibility management is calculated by comparing the to the current baseline.*

9. ***KPI6c:*** *Increased consumer flexibility for grid stability and RES integration*
   Target: *15%*
   Validation measures: *The increase of flexibility obtained through more accurate models and more optimal flexibility management algorithms is calculate based on the results measured in the pilots.*

10. ***KPI5b****: Number of innovative demand response and holistic energy management services*
    Target*: 3 (for the Finnish pilot), 5 (for the whole project)*
    Validation measures: *Count the total number of new demand response and energy services, including holistic energy management services combining energy with non-energy benefits.*

4 Conclusions

This document is the third and final version of the Pilot Specifications documents and mainly describes the available technologies, infrastructure as well as the functional requirements to be demonstrated by iFLEX end-users.

The main objective of this report was to set the requirements and the various application-specific modules for the iFLEX Framework in Phase 3, based on the different focus areas of the three pilot countries, namely Greece, Slovenia and Finland. In this context, the updating and assessment of the iFLEX Assistant users' interface will be performed, with a number of selected users of each pilot to be contacted and primarily engaged, leading to the demonstration version of iFLEX Assistant. This process, as well as the co-creation activities deployed during the project's final phase will lead to the expansion and conclusion of the available technologies and infrastructure per pilot cluster. Phase 3 aims to utilise the maximum pool of iFLEX end-users and provide detailed feedback on user requirements and preferences.

5 List of tables

5.1 Tables

6 References

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