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Executive Summary

This deliverable defines the initial specifications to be demonstrated in the three pilot clusters in three European countries, Greece, Slovenia and Finland during Phase 1 (pre-pilot). Phase 1 of the pilots serves as a starting point where a pre-pilot with the Minimum Viable Product (MVP) of the iFLEX Framework and Assistants will be demonstrated with a small number of users. Each pilot cluster has defined a set of inclusion and exclusion criteria that will be applied in the selection and recruitment procedure of users for their pilot. In addition, each pilot has identified some concrete activities that will be carried out to inform and encourage users to participate in their pilot. Only existing customers (Greek and Slovenian pilot) and building residents (Finnish pilot) are eligible for participation in the pre-pilots. They will primarily be contacted via telephone and email and provided with link to more online information and registration. All users will be duly informed of the data that will be collected and processed in each pilot and pilot-specific informed consent will be collected. The user engagement and the informed consent will be managed in accordance with the framework defined in D2.2-User engagement and co-creation framework and plan [1] as well as in D10.1 H – Requirement No. 1 [2] iFLEX deliverables respectively.

The pilot specifications per pilot cluster will be described and will mainly focus on the available technologies, and infrastructure as well as on the functional requirements to be demonstrated on top of selected users for this phase. The scope and objectives for each pre-pilot are described in detail and related to project KPIs. Another key objective of the three pre-pilots is also to collect user feedback on the design of the MVP which will be used to enhance and refine user requirements for the iFLEX Assistant that will be deployed in the next pilot phases, namely Phase 2 and Phase 3.

The overall scope of each of the pre-pilots can be summarised as follows:

Greek Pilot

The pre-pilot will run on residential consumers belonging to the clientele of HERON who will accept to participate in the demonstrations by interacting with the electricity grid under real-life condition to offer real-time visualization of energy consumption through a natural user interface, such as a mobile application and/or a web-based platform. This group of consumers will serve as the frontrunners providing feedback with regards to the mobile application for interacting with their personal iFLEX Assistant. Feedback will be requested with regards to their preferable ways for them to provide constraints and preferences when participating in a Demand Response (DR) program as well as to exploit the existing users' needs. The pre-pilot is expected to be deployed with a subset of 10 residential customers.

Slovenian Pilot

The initial piloting phase in Slovenian pilot will be focused on setting up conditions for successful second and third phase piloting. Focus will be on equipment in the field, availability of local renewable energy sources, both PV and Hydro Power Plants (HPP), smart metering coverage, etc. The input sources (smart metering, Home Energy Management System (HEMS), weather, energy prices, energy composition, etc.) will be assessed and their integration with the background system will be tested. The pre-pilot will be deployed with 5 residential users.

Finnish Pilot

The scope of the Finnish pilot is mainly on the HLUC-3: Manage flexibility at building community level. In particular, the technical functionalities related to enabling explicit demand response at the apartment building level will be demonstrated and evaluated. The pre-pilot will be deployed with an apartment building with 90 apartments, a facility manager and up to 5 residents registered to the pilot with their credentials.

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 is the first of the three revisions (D7.1, D7.2 and D7.3) 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 selected users for this phase. This phase will serve as a starting point where a pre-pilot with the MVP of the iFLEX Framework and Assistants will be deployed with the least number of users to be contacted and primarily engaged. Key part of this task is gaining user's feedback as result of the user recruitment activities through questionnaires, communication, preparing informed consent forms etc. In addition, the initial pilot specifications per pilot cluster will be described and will mainly focus on the available technologies, as well as on defining the requirements to be demonstrated on top of selected users for the next pilot phases.

1.2.1 Pilots Context

The iFLEX Framework will be demonstrated and validated in all three pilot clusters with their own focus areas. In this context, application-specific iFLEX Assistants will be developed by using the iFLEX Framework modules and, then 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 EMPOWER.

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 200 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 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 Task 7.1-Initial Pilot Specifications for each cluster is presented in sections 3.1-3.3 respectively. The results of this Task will be used as an input to Tasks 7.2 and 7.3.

1.3 Structure of the report

This document 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 first phase of the pilots' execution. In addition, the recruitment procedure per pilot cluster is presented in detail.

iii. Chapter 3 describes the initial pilot specifications per pilot cluster as well as the technical requirements to be deployed during the first 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.

1.4 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

2 User Engagement Activities

2.1 Introduction

In piloting phases and in its associated tasks, user engagement will be divided into three phases, each consisting of several agile co-creation iterations. The goal of the first phase (Phase 1) of the pilots' execution is to co-create an MVP of the iFLEX Framework and application-specific iFLEX Assistants (month 14) 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 is utilized to improve the iFLEX Framework with new functionalities and enhanced user experience. At the end of this phase (month 25), the improved iFLEX Framework and Assistants developed on top of the framework will be validated with small-scale pilots. In the third phase (Phase 3), any missing functionality is added, and the focus will be on fine-tuning the quality of service (QoS) and user experiences based on the Phase 2 feedback. At this phase, the pilots are also scaled up to include more engaged end-users and technical functionalities in order to collect feedback and validate the final iFLEX Assistants at a larger scale (month 36).

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 [1].

The following table (Table 3) illustrates the different types of actors and their representation in the iFLEX project originally included in [1].

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
Aggregators	As an electricity grid participant, the aggregator tracks companies' consumption and TSO/DSO as well as Market Operators' requirements in real time. The aggregator provides uninterrupted grid balancing to optimise energy use and pays its customers for making their consumption flexibility available.	• 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 (EMPOWER) • 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 describes a general overview of the different user engagement and co-creation activities that will be used by the pilot clusters during the first phase of the pilots' execution. A more detailed description of the method and tools used by each pilot cluster during the first phase is provided in the pilots' sepecification section.

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

Appoach	Input	Output
Energy metering platform customization for real-time data visualization.	Elaborate the necessary customizations and extensions of the energy metering platform.	Secure the smooth integration of individual components and communication with the iFLEX Assistant.
Assess prototype design of natural user interfaces for customer participation in DR actions.	Feedback will be requested with regards to users' preferable ways to provide their constraints and preferences when participating in a DR program, as well as the desired level of autonomy (e.g. manual feedback or automatic actuations).	In-app analytics for user journey and navigation through different functionalities and features. Define the level of autonomy in users' descision making versus delegation of the decision to the iFLEX Assistant.

Assess iFLEX Assistant end-user interface virtual models, e.g. wireframes and/or mock-ups through one-on-one interviews with end-users participating in the first piloting phase.	With a given consent, iFLEX Assistant can report back through a web-portal how it is being used, end-users' expectations and upon analysis provide a significant potential for improvements.	Initial sketch of the iFLEX Assistant to showcase basic functionalities and user interface details, such as details on data, actuator functionality and market access.
Evaluate the technical and behavioural possibilities and limitations of using iFLEX Assistant, which are needed in the modelling and the development of a digital twin of the prosumer/consumer.	With a given consent, iFLEX Assistant can report back through a web-portal how it is being used, end-users' satisfaction on the provided services and upon analysis provide a significant potential for improvements.	Interacting with end-users to gain their feedback and suggestions for potential improvements.
Demonstrate and test feedback mechanisms of the iFLEX Assistant.	Include residential end-user feedback and preferences on thermal comfort at the building level (average of the apartment temperature and humidity measurements).	Interacting with end-users to gain their feedback and suggestions for potential improvements on designing and developing the iFLEX Assistant interfaces.
Develop visualizations for building-level energy consumption (electricity and district heating), and CO_2 carbon footprint.	Include residential end-user feedback and preferences.	Interacting with end-users to gain their feedback and suggestions for potential improvements on designing and developing the iFLEX Assistant interfaces.

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 that belong to the clientele of HERON will be invited to participate in the pilot execution which foresees, 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. During the engagement procedure, it will be stressed that participation is completely voluntary.

HERON's communication plan is to address the target group of its own clients in order to achieve best results possible for each pilot phase. In the beginning, HERON clients that are already aware of such initiatives will be contacted since they could serve as frontrunners. In this context, employees of HERON and their family members with already installed smart meters in their households will be contacted first. Next, additional residential customers will be approached through telephone communication, email and relevant questionnaires performed in HERON's stores and potentially through HERON's external partners (agents). In addition, information about the iFLEX project in general and the Greek pilot in particular will be published on HERON's website as well as on the iFLEX project website and newsletters.

Consumers who will express their interest in participating in the Greek pilot will be invited to register online in the energy metering platform of HERON. The registration will be 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 registration as well as the informed consent statement will cover all three phases of the pilot execution, thus consumers will have to follow only once the relevant acceptance procedure.

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

1. A subset of 10 households to be equipped with real-time smart meters.

2. A subset 10 households to be equipped with remotely controlled relays to manage the operation of heavy consuming appliances (such as water heaters).

2.4.1.2 Inclusion/exclusion criteria

Inclusion Criteria:

1. A residential customer of HERON,
2. Customers should be above the age of 18,
3. Residing on Athens, Thessaloniki, Thiva or Volos,
4. Installation of smart meter and/or other smart device is a prerequisite.

Exclusion Criteria:

1. Participants that do not fall into points (1)-(4) of the inclusion criteria,
2. Participants that are unable to accept the informed consent form due to cognitive or other health related issues (physical or mental),
3. Participants who have already specified in their private contract with HERON that they do not wish to receive promotional offers or other marketing information from HERON.

2.4.1.3 Informed Consent Procedure

The Greek pilot will follow the informed consent procedure described in the iFLEX project deliverable D10.1-H Requirement No.1 [2].

During the recruitment and enrolment procedure that will be deployed in the pre-pilot phase, a detailed information sheet on the Greek pilot including also detailed information related to the collection and processing of personal data (see below) will be provided to the consumers who will be contacted. In case any of the persons being contacted refuses to participate in the pilot, HERON will simply make a note on the decline and keep this record for administrative purposes to keep track of who has been contacted and to ensure that they will not be contacted again unless it is stated otherwise by the consumer.

Potential pilot participants will have a dedicated contact point in HERON to ask questions and get feedback on the pilot during the enrolment phase as well as during the piloting execution. In addition, all pilot participants will be provided with technical support in case an unexpected interruption of the collection of their consumption data takes place.

All interested consumers willing to participate in the Greek pilot at the time of registering in the HERON's online metering platform will receive the information sheet through a popup window with all the relevant information about the iFLEX project and the Greek pilot that they have been invited to participate in. The information sheet will be in Greek language and HERON's customers will be voluntarily invited to participate, allowing them to have the time to decide as well as ask questions to the Greek pilot representative before finalising their registration. Only the customers that have accepted electronically the terms and conditions (tick-box) and, as such having provided their consent will be entitled as eligible users to participate in the Greek pilot.

Due to privacy protection issues, the Greek pilot host should not disclosure the personal details of the recruited participants to the other project partners but confirm in writing (email) to the iFLEX Ethical Manager that all users that have accepted to participate in the pilot have provided their consent electronically prior to the pilot start. This email will confirm the number of pilot users during the first phase, the start date and that all pilot participants registered to the HERON's platform have also accepted the relevant terms and conditions.

The informed consent will specify but not limited to:

- What type of personal data will be collected from the pilot participant,
- The purpose and usage of the collected data,
- Participants' rights with respect to their personal data and how to exercise these rights,
- How the personal data is stored and handled,
- How long the personal data is stored,

- Details on data processing and analysis.

In the case of any changes to the project and/or the pilot's duration and/or scope, all the participants will be immediately informed of that fact and they then will have to decide whether they consent to continue their participation or if they wish to withdraw.

2.4.1.4 Ethics

Ethics checklist will be completed prior to the pilot start and thus prior to the collection or processing of personal data. In addition, the informed consent form, the DPIA template as well as the ethics checklist will be provided to the iFLEX Ethics Advisory Board for review and will be included in the forthcoming deliverable D1.10-Annual Compliance Monitoring Report 1 and prior to the start of personal data collection.

Ethics and privacy issues will be tackled according to the procedures specified in the iFLEX deliverable D10.2-POPD – Requirement No.2 [3]. In this context, all consumers will be informed during the enrollment procedure that their participation is voluntary and that they can opt out of the pilot any time/phase. In this case, consumers should send their request to the appointed person in HERON, the pilot representative. Consent withdrawal at any time during the pilot execution shall not affect the lawfulness of the processing based on consent before its withdrawal. HERON will inform the iFLEX Ethics Advisory Board if any amendments take place between the pilot phases and will act accordingly, i.e. will contact other customers and try to recruit them in the pilot execution.

As far as personal data is concerned, no identifiable personal data such as names, surnames, address will be shared with project partners. The data to be collected will be done so only upon consent is provided to participate in the project's pilot and once the relevant smart devices and/or other smart devices will be installed in the households. The data collected and to be processed will be stored in HERON's cloud server within the European Union where all the security measures like firewall and security updates take place before put in usage in the iFLEX project. In addition, HERON employs appropriate technical and organizational measures aimed at the safe processing of personal data and the prevention of accidental loss or destruction and/or unauthorized access to, use, modification, or disclosure.

It should be noted that GDPR guidelines are followed whenever necessary, thus access must be authorized by HERON and will be restricted to iFLEX partners. All personal data will be pseudonymized by HERON prior to it being shared and processed. Personal data which have been pseudonymized and/or anonymized may also be used for dissemination and publication purposes, e.g., in deliverables, articles, and papers in the context of the project. In addition, HERON employs encryption techniques when storing sensitive information like user passwords/ emails in its databases. More specifically, HERON uses encryption techniques for data recovery, such as the b-crypt password-hashing function that is based on the Blowfish cipher.

The personal data that will be collected and the purposes for which they will be used within the Greek pilot and in the general context of iFLEX project are presented in Table 5:

Table 5: Personal data collection and processing purposes

Categories of Personal Data	Processing Purposes
Identification data such as full name, address, etc.	For the participation in the iFLEX project
Electricity consumption data, apartment/household & environment readings data (such as temperature, humidity, presence, etc.), user preferences, relay's actuations.	For the conduction of the research in the context of the project IFLEX (including energy consumption forecasting, environmental control, adapting to the end-user behavior (for automated decision making), statistical analysis (of any kind, including for validation purposes), project KPI calculations, profiling.
Contact details, such as phone number, email address	The need to contact for matters regarding the implementation of the project such as unexpected interruption of the collection of consumption data.

Participants may request, at any time, access to their personal data or that their data is rectified or deleted by contacting via email to HERON's appointed person. Deletion of personal data prior to the end of the project

will render the consumer's participation in the pilot void, meaning that his/her personal data will not be used at all.

Personal data will be deleted from all project repositories by the person appointed by HERON responsible for the data collection who is also responsible for confirming to the project's Ethics Advisory Board and to the Ethical Manager that the data has been deleted. In any case, data will be deleted when its purpose for being collected has been fulfilled.

2.4.2 Slovenian Pilot

2.4.2.1 Recruitment Procedures

In the first iteration of the Slovenian pilot, five end-users will be invited to join the project voluntarily. We will also look 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 will also be installed in their households before implementation. The plan of the Slovenian cluster is 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 will be approached in person. In the beginning they will receive the link via email to the registration web page through which they will be able to apply for the project. The users that register to the pilot will have to accept the relevant terms and conditions for participating. All service information for the end-users will be available through telephone communication.

2.4.2.2 Inclusion/exclusion criteria

Inclusion Criteria:

1. A residential customer of ECE,
2. The measuring point is located in the ELE's distribution area,
3. End-users should be above the age of 18,
4. At the household's testing site need to be connected PV and heat pump,
5. Remote reading smart meter must be installed in the household.

Exclusion Criteria:

1. Participants that do not fall into points (1)-(5) of the inclusion criteria,
2. Participants that are unable to accept the informed consent form due to cognitive or other health related issues (physical or mental),

   Participants who have already specified that they do not wish to receive promotional, offers or other marketing materials from ECE.

2.4.2.3 Informed Consent Procedure

In general, the informed consent procedure will be in-line with the iFLEX informed consent procedure specified in the project deliverable D10.1 [2]. In accordance with the general regulation on the protection of personal data of the European Union - GDPR (see also [3]) and arising from Slovenian legislation on privacy protection, we will prepare an explicit consent for participating users, which will inform them what personal data we will collect for the iFLEX project, how and where will be processed and stored, and what will happen to the data after the project is completed. We will also remind them of the privacy rights they will have as a participant in the pilot project.

All information obtained during the pilot's lifetime will be stored in pseudonymous form in the project cloud within the European Union and will not be transferred to third countries. The data will be protected by effective standardized security methods, including data encryption.

After participant's explicit consent is given and the project equipment is setup at participant's home, two sets of data will be collected by the project:

- data collected from smart meters and
- data obtained from HEMSs.

The collected and processed personal data in the project will be pseudonymized. The pseudonymization will be done at Elektro Celje after the customer explicit consent will be given. Customer – measurement point – identifier in the project is random and opaque. The mapping between the identifier and measurement point will be stored at Elektro Celje.

The following data will be collected and controlled by the project:

- Area Data: smart grid technical data denoting the location of the household in electrical grid. Care will be taken that more than 10 participants are involved in the pilot from a single substation in the later phases of the project. The data is stored in the cloud. The data controller of this data is Elektro Celje d.d.
- Smart Grid Metering Data: electrical power consumption data obtained from smart meters in 15 min intervals. The data is stored in the cloud. The data controller of this data is Elektro Celje d.d.
- HEMS metering data: household devices consumption data collected through HEMS installed in the household and stored in the cloud. The data controller of this data will be ECE, d.o.o.
- Interviews: interviews with the pilot participants and target user groups in early stages of the project, the interviews will be pseudonymous. The interviews data controller will be the partner doing the interviews, JSI.

2.4.2.4 Ethics

Ethics and privacy issues will be tackled according to the procedures specified in the iFLEX deliverable D10.2 [3]. Prior to collection of personal data an ethic checklist and DPIA as are described in this deliverable will be prepared and provided to the iFLEX Ethics Advisory Board.

2.4.3 Finnish Pilot

2.4.3.1 Recruitment Procedures

In the first phase, the end-users of the Finnish pilot include the building's facility manager (i.e., Caverion) and residents of the selected apartment building. The residents will be informed about the piloting activities and provided with a link to a web page that can be used to participate to the pilot. All residents are 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. Additionally, the first five residents that decide to register to the Finnish pilot with their name and apartment number are provided with means to provide feedback and monitor their apartment's thermal comfort. The residents that register to the pilot have to accept the informed consent before they can be included to the pilot.

2.4.3.2 Inclusion/exclusion criteria

Inclusion Criteria:

1. A resident of the apartment building used for piloting,
2. Customers should be above the age of 18.

Exclusion Criteria:

1. Participants that do not fall into points (1)-(2) of the inclusion criteria,
2. Participants that are unable to accept the informed consent form due to cognitive or other health related issues (physical or mental).

2.4.3.3 Informed Consent Procedure

When a resident register to the Finnish pilot informed consent is collected from them via the web page used for registering.

The Finnish pilot participants (Caverion, Enerim and VTT) will provide the iFLEX EAB with a copy of the English version of the informed consent form for approval before sharing it with the end-users. The informed consent will specify but not limited to:

- What type of personal data will be collected from the pilot participant,

- The purpose and usage of the collected data,
- Participants' rights with respect to their personal data and how to exercise these rights,
- How the personal data is stored and handled,
- How long the personal data is stored,
- Who will process and analyse the data.

All residents registering to the Finnish pilot via the web page, will receive an information sheet with all relevant information about the project and the particular pilot that they have been invited to participate. The information sheet will be in Finnish language. Only the users that have accepted the terms of conditions and have accepted the informed consent will be able to participate in the Finnish pilot.

2.4.3.4 Ethics

Ethics and privacy issues will be tackled according to the procedures specified in the iFLEX deliverable D10.2 [3]. Prior to collection of personal data an ethic checklist and DPIA as are described in the deliverable will be prepared and provided to the iFLEX Ethics Advisory Board.

3 Initial Pilot Specifications

The section outlines the initial pilot specifications as well as the technical requirements to be deployed during the first phase (Phase 1: Pre-pilot) of the pilots' demonstrations.

3.1 Greek pilot

3.1.1 General Overview

The full scope of the Greek pilot is to offer a setup for deploying and testing use cases that provide an effective way to harness flexibility on both the demand and generation side. The team of local partners participating in the cluster consists of 3 members, HERON, Optimus Energy and ICOM, creating a complete chain. HERON will examine a robust solution for DR and customer engagement-related activities (through the provision of adequate incentives). Optimus Energy will be able to closely investigate a holistic approach for the management of its represented generation fleet. ICOM will provide a DR solution, facilitating the formulation and management of DR programs by a DR Aggregator (e.g. HERON, OPTIMUS), the participation of enrolled prosumers in such programs and the transformation of the required flexibility to DR signals towards the customers. Moreover, the application of the iFLEX Assistant in the Greek pilot will highlight additional potential synergies between the three parties and the common benefits that can be derived by their cooperation.

The key concept to be fully exploited is the implementation of advanced demand side flexibility scenarios, considering the:

- optimization of a diversified flexibility portfolio, comprising consumption end-users, heating applications with an internal flexibility-based link to distributed renewable generation assets,
- interoperability of home-IoT technologies,
- synergies between demand and generation side flexibility for minimizing total imbalances.

3.1.2 Phase 1: Pre-Pilot Scope

During the pre-pilot phase, HERON's contribution will be mainly focused on the deployment of the following use cases from D2.1-Use Cases and Requirements [4]: 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 the deployment of 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.

The pre-pilot will run on residential consumers belonging to the clientele of HERON who will accept to participate in the demonstrations by interacting with the electricity grid under real-life condition to offer real-time visualization of energy consumption feedback through a mobile app and/or a web-based platform. This group of consumers will serve as the frontrunners providing feedback with regards to the mobile application that ICOM in collaboration with HERON will implement as part of T3.3 for interacting with their personal iFLEX Assistant. This pilot specific collaboration will result in an integrated mobile application to exploit the existing users' needs and will be customised for consumption data visualization and control.

Feedback will be requested with regards to users' preferable ways 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).

In addition, the HERON's pre-pilot setup will be extended to include more residential customers that will accept to participate by installing smart meters and remotely controlled relays for managing the operation of heavy consuming appliances, such as water heaters, and electric space heaters providing valuable data for the iFLEX Assistants to learn the behaviour of consumers and their environment.

Furthermore, a 500-kW ground-mounted PV plant currently represented in the wholesale electricity market by Optimus Energy will participate in the pre-pilot setup, so that an augmented common portfolio of this RES unit and the aforementioned end-user demand flexibility resources is formulated. 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.

3.1.3 Description of Pre-Pilot Technical Assets

Table 6: 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: Subset of 200 households.
Infrastructure to be used in pre-pilot	- **HERON infrastructure assets**: 1. A subset of 10 households 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. Extend HERON's energy metering and actuation platform to enable 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)
Extend pilot setups with more assets	During Phases 2 & 3 the pilot setup will be extended to include additional: • IoT sensors able to characterize climate conditions (e.g., temperature, humidity, light) and home usage patterns (door contacts, human presence) in real-time as well as controllers to monitor and control home appliances (Target up to 50 households). • Wi-Fi electricity smart meters (Target up to 200 households). • Medium-size ground-mounted PV plants to form 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. • Dispatchable distributed biomass unit that will form a common portfolio with the extended end-user DR resources and, therefore, leverage the provision of flexibility services especially during periods when end-user response is below the expected levels.
Demonstration Topic	• Consumer-centred energy management

3.1.4 Phase 1: Pre-Pilot Anticipated Objectives

1. Contact a sufficient number of residential customers and try to engage up to 20 residential customers to participate in this phase.
2. Make available a subset of 10 residential customers equipped with smart meters.
3. Specify criteria for end-users.
4. Prepare and put in use informed consent form for participation in the piloting activities.
5. Provide phase 1 piloting end-users with real-time and historical data visualization:
   - Consumption at phase and/or relay level,
   - Total consumption
6. Install relays/controllers for water heaters in a subset of 10 residential customers to control their operation.

7. Enabling participating users to setup time schedules through a user interface (mobile app) to be used for automated activation and control their flexible devices in the next pilot phases.
8. Identify the flexibility potential of participating users by analysing their flexibility preferences as specified from the user interface (mobile app).
9. Detect in real-time the status of connected appliances by monitoring their resulting consumption.
10. Showcase how the operation of water heaters can be centrally managed, by testing load shifting scenarios.
11. Showcase the benefits of data analytics applications and services (e.g., load profile analysis, data management, etc.).
12. Validate user acceptance and understanding of consumer behaviour through a user interface.
13. Showcase synergies and coordinated operation of residential assets (e.g. home appliances) and enrolled RES unit for minimizing unavoidable RES generation imbalances.
14. Elaborate the necessary customizations and extensions of HERON's platform to secure the smooth integration of individual components and communication with the iFLEX Assistant.
15. Assess prototype design of natural user interfaces for customer participation in DR actions (e.g. comfort preferences, personalised notifications, DR event participation).

3.1.5 Phase 1: Pre-Pilot Activities

This paragraph summarizes the main activities that will be implemented during the first phase 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 first phase of the pilot execution.
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. Necessary data related to the operation of the RES unit (e.g., generation forecasts, real-time production measurements) will also be collected and stored.
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.
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 in the next pilot phases for subsequently trigger end-user households' assets to properly respond and mitigate RES generation imbalances.

In addition, the following activities outlined henceforth are mapped to Task 3.3 for the assessment in the pre-pilot phase of the MVP outcome of this task:

1. Demonstration to the end users of a mobile application that will be used for interacting with their personal iFLEX Assistant.
2. 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.
3. Identify consumer preferences based on the usage of specific home appliances, such as water heaters and electric space heater as well as consumer comfort limits.
4. Perform first level API customizations and extend HERON's metering platform to support advanced control and DR communication with the iFLEX Assistant.

5. Recruited consumers will be granted with access to HERON's metering platform from where they will be able to monitor in real-time their consumption (total, phase, and/or relay-level).
6. Recruited consumers will be able to detect their home devices' status on real time and may gain awareness of their availability to participate in DR events in real-time.

3.1.6 Phase 1: Pre-Pilot Associated KPIs

1. ***KPI6a**: Number of consumers in the pilots*
   ***Target**: >5*
   ***Validation Measures:** Total number of consumers/prosumers in the Greek pilot during the initial stage (M14).*

2. ***KPI6b:** Number of consumer groups targeted with novel demand response services*
   ***Target**: 1*
   ***Validation Measures:** Total number of different consumer segments that will be engaged with demand response through the pre-pilot phase will be residential consumers.*

3.2 Slovenian Pilot

3.2.1 General Overview

The initial piloting phase in Slovenian pilot will be focused on setting up conditions for successful second and third phase piloting. If the scope of the challenges identified will be successfully addressed, they will provide a fruitful ground for further piloting phases.

3.2.2 Phase 1: Pre-Pilot Scope

The first phase will tackle the following challenges:

1. Optimal selection of the network grid segments for piloting. Focus will be on equipment in the field, conditions in the LV segments, availability of local renewable energy sources, both PV and HPP, smart metering coverage, etc.,
2. Recruitment of a small focus group for piloting and setting up the procedures and services needed to set up recruitment process and informed consent procedure as are envisioned in the project,
3. Define requirements for target HEMS system and test such a system in working conditions with the focus group,
4. Activate available infrastructure and background components and systems (developed in previous projects) and adapt them to novel piloting environment and requirements,
5. Asses the input sources (smart metering, HEMS, weather, energy prices, energy composition, etc.) and test their integration with the background system,
6. Initiate work on digital twin and evaluate first machine learning algorithms developed in WP3, like load forecasting,
7. Evaluate a sketch of iFLEX Assistant interfaces defined in WP4 and EUI as being designed in WP3,
8. Get early feedback from the initial focus group and evaluate the initial piloting phase. Based on this information a new plan for next piloting stage will be prepared and a feedback to technical working groups will be provided as well.

3.2.3 Description of Pre-Pilot Technical Assets

Table 7: 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	5 residential users
Number of buildings	5
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**: ○ 5 households and industrial users equipped with HEMS ○ Application “Moj ECE” for consumption and production data visualization **3. JSI:** ○ Prosumer Cloud Service: a cloud instance for collection of data from external data sources like HEMS and AMI systems ○ Data analytic pipeline for network load forecasting ○ Mobile application for visualizing the data and analytic results ○ Machine learning and cloud infrastructure, HW and SW **4. SCOM:** ○ Smart metering data ingestion system ○ Secure end user piloting engagement system
Extend pilot setups with more assets	N/A
Demonstration Topic	Consumer-centered energy management. Regulation of production resources for prosumers.

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 5 users of pilot phase 1 data from HEMSs and in case of prosumers also data about production of electricity from PV.

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 1: Pre-Pilot Anticipated Objectives

1. Study and select appropriate network segments for piloting – local substations,
2. Select appropriate HEMS for initial piloting phase setup and evaluation,
3. Specify criteria for end-users for first phase piloting,
4. Engage first phase target number of end-users,
5. Prepare initial version of end user explicit consent for participation in the piloting activities,
6. Set up privacy aware legal background for processing of the end user personal data,
7. Provide and evaluate secure and privacy aware system for end user engagement,
8. Provide piloting users access to smart metering data (recent and historical data),
9. Provide piloting users access to climate data,
10. Integrate selected HEMS with iFLEX Assistant,
11. Setup and evaluate initial iFLEX Assistant marketing interfaces,
12. Setup and evaluate initial security and privacy mechanisms,
13. Setup and evaluate initial iFLEX Assistant backend system,
14. Provide initial version of a prosumer digital twin,
15. Prepare initial versions of prosumer consumption and production forecast,
16. Evaluate possibilities of secure and privacy aware machine learning in iFlex Assistant,
17. To demonstrate and evaluate the end-user interface(s) of the iFLEX Assistant,
18. Setup integration tools and system for bridging development environment and production piloting,
19. Get feedback from first pilot phase end-user and evaluate iFLEX Assistant as a service,
20. Critically assess reached objectives and sketch the second phase piloting plan,
21. Provide feedback to technical work packages and include awaited iFLEX Assistant and tools improvements in the second phase piloting plan.

3.2.5 Phase 1: Pre-Pilot Activities

1. Study the ELE distribution network and select up to two network segments as a target for piloting. The selection will be based on deployed metering equipment in the segment, close to critical amount of local PV based generation and availability of HPP generation. The segments will be selected in a way to provide 80%/20% ratio of residential to small industrial consumers and prosumers,
2. The HEMS system will be deployed for the first time in the pilot. To enable the deployment, requirements for the HEMS will be collected, the HEMS market in Slovenia studied and appropriate HEMS solution selected. The HEMS solution will be evaluated in the first piloting phase with a small number of end users,
3. The criteria for end-user selection for the first phase piloting will be defined, following a general technical criterion for end user selection. Known end-users, close to both ELE and ECE will be able to reach the first piloting phase objectives. Selected end-users will be contacted to reach the target number of phase one end users,
4. The first phase piloting end-users will be enrolled through secure and privacy aware enrolment system. A background system will be adapted and set-up for this purpose. An initial explicit consent will be prepared and tailored to the project needs and used in the engagement process. The enrolment system will be evaluated with a help of initial piloting users,
5. A privacy aware legal background for processing of end-user privacy sensitive data will be studied and realised. Solutions used in previous projects will be considered and appropriate one realised in accordance to the piloting requirements,

6. Smart metering data of the pilot users will be provided in historical and D-1 form, continuously. The background ingest system will be adapted and deployed for provisioning of the data into the end-user iFLEX assistance instance, all in cooperation with WP4 task T4.2,
7. Real-time weather data and weather prediction data will be provided to the end-user iFLEX Assistant. Background ingest system for weather data will be adapted and deployed for provisioning of the data to the end-user iFLEX Assistant. Additional weather sources will be considered for ingestion, all in cooperation with WP4 task T4.2,
8. Selected HEMS will be initially integrated with the iFLEX Assistant. The HEMS will be protocol, semantic and security-wise integrated with the Assistant. The data coming from HEMS will be ingested in the iFLEX Assistant backend system. Actuator functionality of the HEMS will be exported to the Assistant, all in cooperation with WP4 task T4.1,
9. Initial marketing interfaces of the iFLEX Assistant will be provided and evaluated. The initial interfaces will be based on OpenLEADR[1] implementation. Integration with the iFLEX Assistant will be evaluated an ability as well of OpenLEADER to fulfil the project marketing interfaces requirements, all in cooperation with WP4 task T4.3,
10. Initial set of security and privacy mechanisms for the protection and access control to the end user data and interfaces will be evaluated. The background security and privacy mechanisms will be adapted and evaluated. Novel security mechanisms for trust and identity management will be evaluated and its potential for integration in the iFLEX Assistant will be assessed, all in cooperation with WP4 task T4.4,
11. Secure and privacy aware backend system for the iFLEX Assistant will be provided. The background backend system will be adapted and evaluated for the project purpose. The backend to be used has been developed in the Flex4Grid project. It consists of a database, REST interfaces for data access, backend management and security and privacy services provisioning. The system will be adapted for the project purpose and extended to support other interfaces, like marketing interface. All the work will be done with cooperation with WP4 task T4.4,
12. Based on the backend system and all the interfaces, the implementation a digital twin of the prosumer or consumer will be developed and deployed. An initial forecasting service for the prosumer or consumer will be developed and initially provided within the twin, all in cooperation with WP3 task T3.1,
13. Initial evaluation of potential of secure and privacy aware machine learning will be implemented in the context of the digital twin. A library, providing federated learning, differential privacy, homomorphic encryption algorithms and secure multipart computation PySyft[2] will be used and the potential of its application to functionality and algorithms needed to fulfil expected iFLEX Assistant functionality will be assessed, all in cooperation with WP4 task T4.4,
14. Initial sketch and evaluation of the iFLEX Assistant end user interface will be done in the first piloting phase. At least one of the web or mobile interfaces will be set-up as a mock-up and initially evaluated. Fully functional end user interface itself is not the primary objective of the first piloting phase but the interfaces providing the data, actuator functionality, market access and potential ML functionality and their potential representation within the end user interface. The piloting evaluation will be performed with cooperation with WP3 task T3.3,
15. Setup integration system and tools for development and deployment of an iFLEX Assistant evaluation instances into the pilot. Initial activities will be related to the setup of the systems and tools and evaluation of potential integration with the piloting activities. Expected result of the activity is a clear understanding how to deploy initial version of the iFLEX Assistant into the pilot and how to update the assistant instances if needed,
16. Initial evaluation of iFLEX Assistant will be conducted via one-on-one interviews with end-users included in the first piloting phase. Interviews will provide feedback on the end-user experience with the iFLEX Assistant, their expectations of the proposed service, and their satisfaction with the iFLEX Assistant implementation, functionality, and end-user interface communication. We will also evaluate

[1] See OpenLEADR GitHub page fro details: https://github.com/OpenLEADR/openleadr-python
[2] See PySyft GitHub page for details: https://github.com/OpenMined/PySyft

the technical and behavioural possibilities and limitations of using iFLEX Assistant, which are needed in the modelling and the development of a digital twin of the prosumer/consumer,

17. The final effort of the first piloting phase will be an evaluation of achieved objectives and associated KPIs and a sketch of a plan for second piloting phase. The evaluation will include clear feedbacks to the involved technical work packages WP3, WP4 and WP6, as well work packages WP2 and WP5.

3.2.6 Phase 1: Pre-Pilot Associated KPIs

1. ***KPI6a: Number of consumers in the pilots***
   Target: *5*
   Validation Measures: *Total number of consumers/prosumers in the iFLEX pilots*.

2. ***KPI6b: Number of consumer groups targeted with novel demand response services***
   Target: 5
   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***
   KPI2b: *Accuracy of load forecasting*
   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 the 1st phase, the Finnish pilot demonstrates and evaluates how the iFLEX Assistant provides flexibility management at an apartment building level. A typical situation in Finland is that the majority of the energy costs in an apartment building, including heating (apartments and common areas), warm water, sauna, and common area lighting is paid by the building community (also known as housing cooperative).

3.3.2 Phase 1: Pre-Pilot Scope

To address this important consumer sector, the Finnish pilot aims to demonstrate and evaluate how the iFLEX Assistant optimizes the flexibility at the apartment building level in order to provide benefits for the whole building community. The scope of the Finnish pilot is thus mainly on the HLUC-3: Manage flexibility at building community level (see Annex A). In particular, during the first phase, we will demonstrate and evaluate technical functionalities related to enabling explicit demand response at the apartment building level.

3.3.3 Description of Pre-Pilot Technical Assets

Table 8: 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
Number of sites	1

Number of clients	Apartment building with 90 apartments. Facility manager + up to 5 residents registered to the pilot with their credentials.
Number of buildings	1
Available infrastructure	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 need to be implemented). oBix server for storing measurement data. Machine learning and physics-based methods for modelling building infrastructure and consumption.
Extend pilot setups with more assets	N/A
Demonstration Topic	Flexibility management and sector integration at building community level (apartment building).

In the 1st phase of the Finnish pilot, the iFLEX Assistant will be deployed into an apartment building with 90 apartments. 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).

Following measurements are currently available from the pilot building:

1. Building level electricity consumption (1-hour time resolution including several years history).
2. District heating energy consumption (1-hour time resolution including several years history).
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 following measurements could be obtained with additional investments (these investments are still under consideration and the final decisions will be made before the iFLEX Assistant deployment):

1. District heating power and energy in 1-minute time resolution (e.g. via additional card installed in official district heating meter).
2. Electric sauna stove, elevators and exhaust air heat pump related fast power and energy measurements.

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 1: Pre-Pilot Anticipated Objectives

The main goal of the first phase pilot is to demonstrate and evaluate the feasibility iFLEX Assistant in explicit demand response at apartment building level. Both electricity and district heating energy vectors will be covered. The detailed objectives of the first phase pilot are:

1. To validate the technical functionality related to data collection (online and historical) and control of flexible resources.
2. To provide forecast on the buildings' electricity and district heating consumption (baseline consumption without demand response events) and evaluate the initial accuracy of the forecasts against measurement data.
3. To demonstrate and evaluate the how building's thermal mass can be used as a source for flexibility by controlling HVAC the building. Indoor air temperature and relative humidity values will be monitored for ensuring occupants' thermal comfort.
4. To evaluate how accurately the initial iFLEX Assistant is able to estimate the building's flexibility and response to flexibility activations.
5. To demonstrate visualization features at building (electricity and district heating consumption, CO_2 footprint, average thermal comfort) and apartment level (thermal comfort).
6. To evaluate the end-user feedback features, including feedback on thermal comfort and general feedback on the end-user interface and the features desired by the user.

3.3.5 Phase 1: Pre-Pilot Activities

Following activities are planned to be executed in the 1st phase of the project:

1. Implementation of iFLEX Assistant services on top of the existing building energy management system. Below is a list of the main implementation activities that need to be executed before pilot deployment. Each activity is mapped to a task in the description of action:
    a. Implement open interfaces to the Building Energy Management System (BEMS) of the apartment building (T4.1 & T4.4): Interfaces will be implemented for energy consumption data (most recent and historical data), including district heating and electricity measurements at the building-level. Additionally, interfaces will be developed to access heating process and thermal comfort data (most recent and historical data). Finally, interfaces for controlling the heating, ventilation and air-conditioning (HVAC) of the building will be implemented.
    b. Design and implement models for buildings energy consumption and flexibility forecasting (T3.1 & T3.2): Models for 1) forecasting building's heat demand under normal conditions, as well as, 2) predicting how the indoor temperature change when the amount of energy is varied will be developed.
    c. Design and implement control mechanism to support explicit demand response (T3.4): Control methods and architecture (combining rule-based and model-based control) to experiment with explicit demand response at the building level will be designed and implemented.
    d. Implement Aggregator interfaces for explicit demand response (T4.3 & T4.4): Interfaces for visualizing the baseline forecast and flexibility offers to the Aggregator will be developed. The interface will enable activation of the flexibilities.
    e. Implement selected visualization and feedback mechanisms for the end-user interface (T3.3 & T4.4): We will develop visualizations for building-level energy consumption (electricity and district heating), CO_2 carbon footprint, and thermal comfort at the building level (average of the apartment temperature and humidity measurements). Additionally, apartment specific visualizations on thermal comfort will be provided for residents registering to the pilot. Moreover, all residents will be provided with mechanism to provide anonymous feedback on their thermal comfort and the end-user interface (e.g. suggest new features or improvements). Registered users can specify the feedback at apartment level.
2. Communication to the building owner and residents of the apartment to inform them on the piloting activities and ask them to participate to the pilot.
3. To deploy the iFLEX Assistant to the apartment building to collect, visualize and manage energy and flexibility in the apartment building.
4. Experiment and demonstrate building-level energy visualization features, including electricity and district heating consumption, CO_2 footprint, and average thermal comfort of the building.

5. Experiment with following technical options for flexibility management:
    a. Indoor temperature reduction (and boosting) so that the thermal comfort of residents is not compromised. This will be done e.g. by changing the heating system's supply water setpoint value. Flexibility will be validated indirectly via district heating and/or exhaust air heat pump estimated energy use. Indoor air temperature and relative humidity values will be monitored for checking occupants' thermal comfort. Residents will also provide feedback on their thermal comfort via the end-user interface.
    b. Ventilation rate reduction (and boosting) in apartments and common spaces in regulation limits by changing the speeds of the exhaust fans. This will be validated by building level network analyser (phase level voltage, current, power and frequency at 1–5 s time resolution). Indoor air temperature, relative humidity and CO_2 values will be monitored for checking indoor air quality.
    c. Domestic hot water temperature reduction (and boosting) within safety limits. Flexibility will be validated indirectly via district heating and/or exhaust air heat pump estimated energy use. Hot water temperature values will be monitored for ensuring safety limits.
6. Demonstrate and evaluate the iFLEX Assistant's flexibility and baseline forecasting functionalities.
7. Demonstrate and test feedback mechanisms of the iFLEX Assistant, including feedback on thermal comfort of the residents and their improvement proposals for the end-user interface.

3.3.6 Phase 1: Pre-Pilot Associated KPIs

1. ***KPI6a:*** *Number of consumers in the pilots*
   Target: *90 apartments (5 consumers targeted with personal monitoring and services)*
   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*
   Validation Measures: *Total number of different consumer segments that have been engaged with demand response through the pilots*.

4 Conclusions

The document describes the initial pilot specifications as well as the technical requirements to be deployed during the first phase (Phase 1: Pre-pilot) of the pilots' demonstrations, including the engagement procedure of selected end-users, gathering their requirements and preferences, as well as their feedback. This document is the first version of all three revisions to follow and mainly provides the initial set of the available technologies, and infrastructure per pilot cluster as well as the co-creation activities to be demonstrated on top of selected users for this phase.

The main objective of this report is to set the requirements and the various application-specific modules to be developed as the MVP of the iFLEX Framework in the pre-pilot phase starting from M4 till M14 and will act as a basis for the iterative approach to be followed in the next phases of the project in the three pilot countries, namely Greece, Slovenia and Finland, each one with different focus area. In this context, initial design and assessment of the iFLEX Assistant users' interface will be performed in each pilot site with a small number of selected users to be contacted and primarily engaged.

Another key objective of this report is to collect in all three pilot the users' feedback on the MVP which will be used for potential improvements as well as to enhance and refine user requirements for the iFLEX Assistant that will be deployed in the next pilot phases, namely Phase 2 and Phase 3. User engagement and co-creation activities will be pilot-specific thus it is important to allow technical details and functionalities to be developed individually under the same umbrella of the iFLEX Framework and Assistants.

5 List of figures and tables

5.1 Tables

5.2 Figures

6 References

[1] iFLEX Project, “D2.2-User engagement and co-creation framework and plan,” 2021.
[2] iFLEX Project, “D10.1 H – Requirement No. 1,” 2020.
[3] iFLEX Project, “D10.2 POPD – Requirement No. 2,” 2020.
[4] iFLEX Project, “D2.1-Use cases and requirements.,” 2021.

7 Annex A: Use Cases

7.1 BUC-5: Added value services: Customer load profile analysis and overview

Stakeholder Perspective: Consumer
Other Stakeholders: Retailer

Scope

The consumer is offered with load profile analysis for its consumption. The electricity consumption is summarised per hour/day/week/month, per device and/or per activity domain, so that the consumer can observe any wastages of energy or home network leaks. This service could be offered by a retailer to its customers as an add-on service.

Objectives
To present to the consumer a detailed analysis of its electricity consumption.

Description
As a competitive advantage or as an extra service, a retailer can provide its customers a detailed analysis of their consumption profiles. The consumption information can be provided in various levels of detail, on a temporal basis hourly/daily/weekly/monthly, on a device basis, or on the basis of activity category. Consumption will be monitored on a power (KW) / energy (KWh) basis, and will be presented in comparative/illustrative manner to the user (e.g., in pie charts, bar charts etc.), so that the main drivers of consumption are revealed. This information can be derived based on the analysis of the metered electricity consumption, based on clustering of energy data and with the combination of sensor readings, such as temperature, humidity, motion, etc. Importantly, the analysis of consumption data can be kept local at customer premises, if needed.

Assumptions

- The Consumer has expressed interest for detailed energy-consumption data analysis.
- Smart meters provide regular measurements.
- Sensor readings are available (through EMS or directly).
- The Consumer has provided consent to process its energy consumption data.

7.1.1 HLUC-1: Manage energy of the premises in an optimal way

7.1.1.1 General information

Scope and objectives of the use case	
Scope	Describes the process followed by iFLEX Assistant for optimally managing the energy of a premise, pursuing different objectives e.g. lowering energy costs, increasing sustainability.
Objectives	1. Monitor in real-time the energy flow within the premises. 2. Increase self-balancing through advanced monitoring and personalised automation. 3. Monitor sustainability performance. 4. Receive customised energy advice.
Related business case(s)	• BUC-5 Added value services: Customer load profile analysis and overview • BUC-6 Increase self-balancing through advanced monitoring and automation
Related user experience goal(s)	To be competent, independent and in control
Name of author(s)	ICOM

Key performance indicators			
ID	**Name**	**Description**	**Reference to mentioned use case objectives**
KPI4a_DoA	Return on Investment for prosumers in the base scenarios	Calculation of Return on Investment through a Cost Benefit Analysis (CBA)-based technoeconomic evaluation under various business modelling scenarios. A sensitivity analysis will also be performed for alternative settings, e.g. changes to electricity tariffs.	Increase self-balancing through advanced monitoring and personalised automation (PUC-10). Monitor in real-time the energy flow within the premises (PUC-7).
KPI4c_DoA	Monetary benefits to the consumer in the base scenarios	Decrease of costs for the consumer compared to current situation.	Increase self-balancing through advanced monitoring and personalised automation (PUC-10). Monitor in real-time the energy flow within the premises (PUC-7).
KPI10a	Increase self-consumption ratio	Increase self-consumption ratio of own PV-generated energy by scheduling accordingly the operation of dispatchable devices and assets.	Increase self-balancing through advanced monitoring and personalised automation (PUC-10).
KPI10b	Reduction in curtailed PV-generated energy [%]	Reduce the curtailment of PV-generated energy, in cases this is imposed by relevant DSO's rules. This goal is enabled via scheduling accordingly the operation of dispatchable devices and assets. Compare with the current state.	Increase self-balancing through advanced monitoring and personalised automation (PUC-10).
KPI3a	Environmental sustainability metrics	Define at least three sustainability metrics to be presented as a goal, measured and followed.	Monitor sustainability performance (PUC-3).
KPI3b	Improve progress	Improve engagement and progress of following the metrics by 10%.	Monitor sustainability performance (PUC-3).
KPI5a	Engage end users	Engage a number of end users in energy advice use case (more the 50).	Receive customised energy advice (PUC-5).
KPI5b	Advice applied	Estimated number of end users apply the advice successfully (30%).	Receive customised energy advice (PUC-5).

Classification information
Relation to other use cases
• HLUC-2 Manage flexibility requests or price signals at individual premises level (extended by) • HLUC-3 Manage flexibility requests or price signals at building level (extended by) • PUC-1 Manage my preferences (includes) • PUC-2 Integrate iFLEX Assistant (includes) • PUC-3 Monitor my sustainability metrics (includes) • PUC-5 View energy advice (includes) • PUC-7 Monitor my energy in real-time (includes) • PUC-10 Increase self-balancing through forecasting and automation (includes)
Level of Depth
High
Prioritisation
High

Generic, regional or national relation
Generic
Nature of the use case
Technical
Further keywords for classification
Energy management, energy monitoring, energy advice, energy efficiency, sustainability

7.1.1.2 High-Level Analysis

Narrative of use case
Short description
The iFLEX Assistant is charged with the task of optimally managing energy scheduling within the end-user's premises based on the economic and/or sustainability motives of its user. It also equips the user with the ability to monitor energy flow and performance metrics as well as receive advice aiming to drive the user towards a more sustainable behaviour.
Complete description
The iFLEX Assistant will enable the realisation of advanced energy management and monitoring of the end-user's premises. To accomplish this target, it has to exploit the locally installed EMS and make use of a set of diverse functionalities. Real time energy monitoring By exposing power generation and consumption in real time and providing an alert mechanism, the iFLEX Assistant can facilitate improving the energy performance of the premises and directing the end user towards sustainable and energy efficient behaviour. Self-balancing enhancement Especially in the case of prosumers, the iFLEX Assistant can utilise its advanced monitoring and automation features in order to improve their self-balancing. The automation goal can be tailored to the preferences of the end user. Namely, it can be influenced by economic reasons and aim at reducing energy costs by considering the electricity tariffs - provided by the Energy Supplier - or ecologically driven and pursue maximising self-consumption of own PV-generated energy. Weather data are taken into consideration in order to improve the automation schedule. Sustainability performance monitoring The iFLEX Assistant will enable the user to set environmental sustainability goals as well as keep track of progress towards achieving them and sustainability performance in general. Key metrics will be visualised and presented to the end user assisting into gaining deeper insights on sustainability. Energy advice provision The end user will be offered the ability to opt for and follow tailored energy advice based on own personal motives. Possible objectives of the advice are cost reduction, improvement of energy efficiency or sustainability.

Use case conditions
Assumption(s)
• An Energy Management System (EMS) is installed and provides the status of local assets and relays the control commands of controllable ones. • A Weather Service is integrated and able to provide weather data • A Meter Data Administrator provides smart meter data to the iFLEX Assistant • A Market Interface enables communication of energy market data (energy tariffs).
Precondition(s)
• The iFLEX Assistant is parameterised and fully operational. • The iFLEX Assistant is able to communicate with EMS, Weather Service, Market Interface and Meter Data Interface

• The end user has provided consent to share certain energy metrics in order to receive tailored alerts and energy advice. • The end user has provided consent to receiving alerts and energy advice.

Actors		
Actor name	**Actor type**	**Further information**
Consumer/Prosumer	Person	Wants to reduce energy costs and/or increase sustainability.
Energy Supplier	Business entity	Wants to foster the engagement of its customers.
Meter Data Administrator	Business entity	Provides smart meter data measurements to iFLEX Assistant.
Energy Management System	System	Assists the iFLEX Assistant in improving energy management through monitoring and control of devices.
Weather Service	Application	Weather forecasts can be exploited in order to improve the energy scheduling.

Diagram(s) of use case

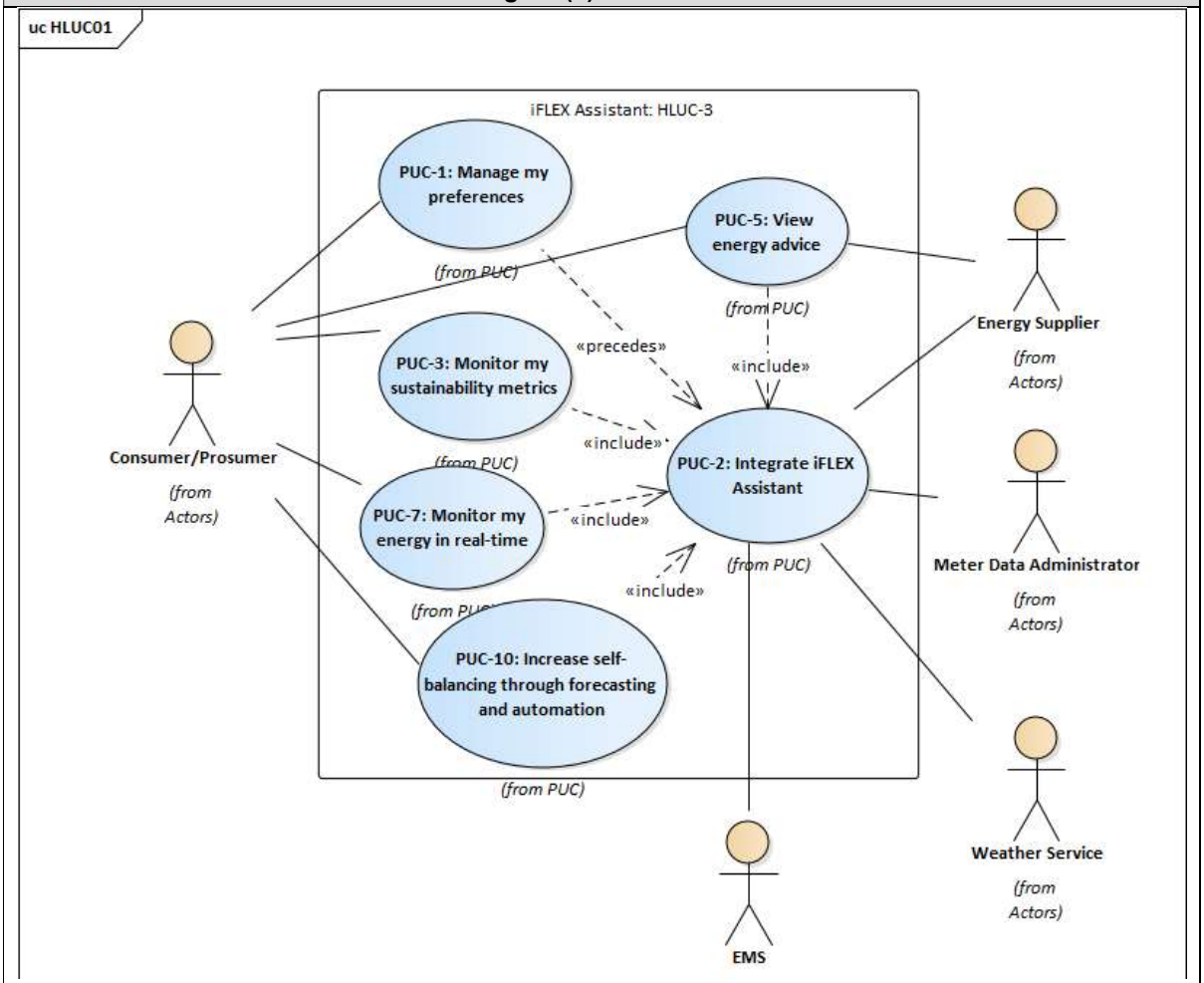

Figure 1 HLUC-1 UC Diagram

7.1.2 HLUC-2: Manage flexibility requests or price signals at individual premise level

7.1.2.1 General information

Scope and objectives of the use case	
Scope	Describes the process followed by the iFLEX Assistant for managing external flexibility requests or price signals at individual premises level (e.g. household), ensuring optimal operation of the end-user's energy system.
Objectives	1. Offer flexibility 2. Optimise schedule considering prices and/or incentives 3. View metrics on participation/engagement 4. Register for a new flexibility service
Related business case(s)	• BUC-1 Optimise operation by leveraging flexibility from consumer/prosumer through DR • BUC-2 Optimise grid operation by leveraging flexibility from consumer/prosumer through DR • BUC-7 Optimise end-user's energy consumption based on own preferences and market price signals • BUC-8 Offer flexibility through participation in explicit demand response programmes
Related user experience goal(s)	To be smart, cost-efficient and meaningful
Name of author(s)	IN-JET

Key performance indicators			
ID	**Name**	**Description**	**Reference to mentioned use case objectives**
KPI2a_DoA	Increased accuracy of consumer load forecasting compared to state-of-the-art methods	The results are compared to the state-of-the-art consumer load forecasting models and percentage decrease of forecasting error is calculated. Evaluation is performed using a variety of data sets (collected in the project), data amounts and load forecasting lengths and average performance of the approaches is calculated.	Offer flexibility (PUC-8).
KPI2b_DoA	Increased accuracy of flexibility modelling compared to state-of-the-art methods	The results are compared to the state-of-the-art flexibility modelling results and percentage decrease of forecasting error is calculated. Evaluation is performed using a variety of data sets (collected in the project), data amounts and flexibility forecasting lengths and average performance of the approaches is calculated.	Offer flexibility (PUC-8).
KPI6c _DoA	Increased consumer flexibility for grid stability and RES integration	The average flexibility of pilot participants that is validated in grid stability/RES integration cases is compared to relevant results reported in the literature.	Offer flexibility (PUC-8).

KPI2c_DoA	Increased effectiveness of automated flexibility management compared to standard methods	The results are compared to typical flexibility management algorithms in a wide variety of DR optimisation targets and incentives. Percentage improvement of rewards (incentive-specific) is calculated. Evaluation is performed using a variety of data sets (collected in the project), and incentives, and an average performance of the approaches is calculated.	Optimise schedule considering prices and/or incentives (PUC-9).
KPI4a_DoA	Return on Investment for prosumers in the base scenarios	Calculation of Return on Investment through a Cost Benefit Analysis (CBA)-based technoeconomic evaluation under various business modelling scenarios. A sensitivity analysis will also be performed for alternative settings, e.g. changes to electricity tariffs.	Optimise schedule considering prices and/or incentives (PUC-9).
KPI4c_DoA	Monetary benefits to the consumer in the base scenarios	Decrease of costs for the consumer compared to current situation.	Optimise schedule considering prices and/or incentives (PUC-9).
KPI4a	Effective engagement and participation reporting	Being able to report on engagement and participation in short, timely and effective manner. Measured by a number of reports read and reacted to in mid-term period.	View metrics on participation/engagement (PUC-4).
KPI4b	Engagement impact of reporting	Being able to engage the end user notably better than without reporting.	View metrics on participation/engagement (PUC-4).
KPI6a	Percentage of the end users that asked for a new flexibility service	Percentage of the eligible pilot end users that asked for a new flexibility service using the relevant feature of the iFLEX Assistant.	Register for a new flexibility service (PUC-6).

Classification information
Relation to other use cases
• HLUC-1 Manage energy of the premises in an optimal way (extends) • PUC-1 Manage my preferences (includes) • PUC-2 Integrate iFLEX Assistant (includes) • PUC-4 View reports for participation/engagement (includes) • PUC-6 Register for a new flexibility service (includes) • PUC-8 Offer flexibility (includes) • PUC-9 Optimise schedule considering prices and/or incentives (includes)
Level of Depth
High
Prioritisation
High
Generic, regional or national relation
Generic
Nature of the use case
Technical

Further keywords for classification
Demand side flexibility, implicit demand response, explicit demand response

7.1.2.2 High-Level Analysis

Narrative of use case
Short description
Consumer and Prosumers of individual premises (e.g. households) would like to benefit by providing flexibility to the electricity system. The iFLEX Assistant is assigned with the task of managing participation in flexibility programmes, scheduling the operation of the end-user's energy system in the most optimal way either based on price signals or flexibility requests – respecting the preferences of the end user.
Complete description
The end user would like to provide flexibility to the electricity system whereby the user's electricity consumption/load shifts in reaction to price signals or to specific flexibility requests in an easy, simple and 'quiet' manner. To realise this operation, the iFLEX Assistant incorporates several functionalities. Energy Management A basic functionality of the iFLEX Assistant (see HLUC1) is managing energy scheduling within the end-user's premises based on the economic and/or sustainability motives of its user. It also equips the user with the ability to monitor energy flow and performance metrics as well as receive advice aiming to drive the user towards a more sustainable behaviour. Offer flexibility to the relevant market actors By learning the consumption behaviour of the user and relevant energy systems, the iFLEX Assistant exposes the available flexibility and baseline profile to the relevant market actors (e.g. Aggregator) to enable the realisation of explicit demand response. Optimise energy schedule considering prices and/or incentives Based on the characteristics of the demand response program enrolled and the user preferences, the iFLEX Assistant calculates and devises an optimal energy scheduling of the premises' dispatchable devices and assets. View reports for participation/engagement To help the user understand and follow the results of demand response participation and the associated rewards, the iFLEX Assistant provides analysis and visualisation of the outcome. The report is parameterised by the Flexibility Procurer (e.g. Aggregator, Energy Supplier) who provides the DR program. Register for a new flexibility service The iFLEX Assistant showcases the demand response programmes that are relevant to the end user based on household characteristics and user preferences and enables the end user to expose interest in these flexibility services.

Use case conditions
Assumption(s)
• The end user is registered to a demand response program • An Energy Management System (EMS) is installed and provides the status of local assets and relays the control commands of controllable ones. • A Weather Service is integrated and able to provide weather data • A Meter Data Administrator provides smart meter data to the iFLEX Assistant • A Market Interface enables communication of market data (energy tariffs and flexibility requests).
Precondition(s)
• The iFLEX Assistant is parameterised and fully operational. • The iFLEX Assistant is connected to the EMS.

• The iFLEX Assistant communicates with the Weather Service • The EMS has access to smart meter, sensors and dispatchable devices and assets • The end user has provided consent on sharing baseline load and flexibility information with the Flexibility Procurer and has signed an agreement detailing power and compensation aspects

Actors		
Actor name	**Actor type**	**Further information**
Consumer/Prosumer	Person	Motivated by economic, environmental and personal reasons
Energy Management System	System	Manages the energy operation of the household, communicates control signals from iFLEX Assistant, provides sensing data to iFLEX Assistant
Energy Supplier	Business Entity	Leads and coordinates the reporting on flexibility services participation
Aggregator	Business Entity	Aggregates several consumers and/or prosumers for flexibility market services.
Meter Data Administrator	Business Entity	Provides smart meter data measurements to iFLEX Assistant.
Weather Service	Application	Provides weather forecasts, which can be considered in the optimisation of the energy scheduling.

Diagram(s) of use case

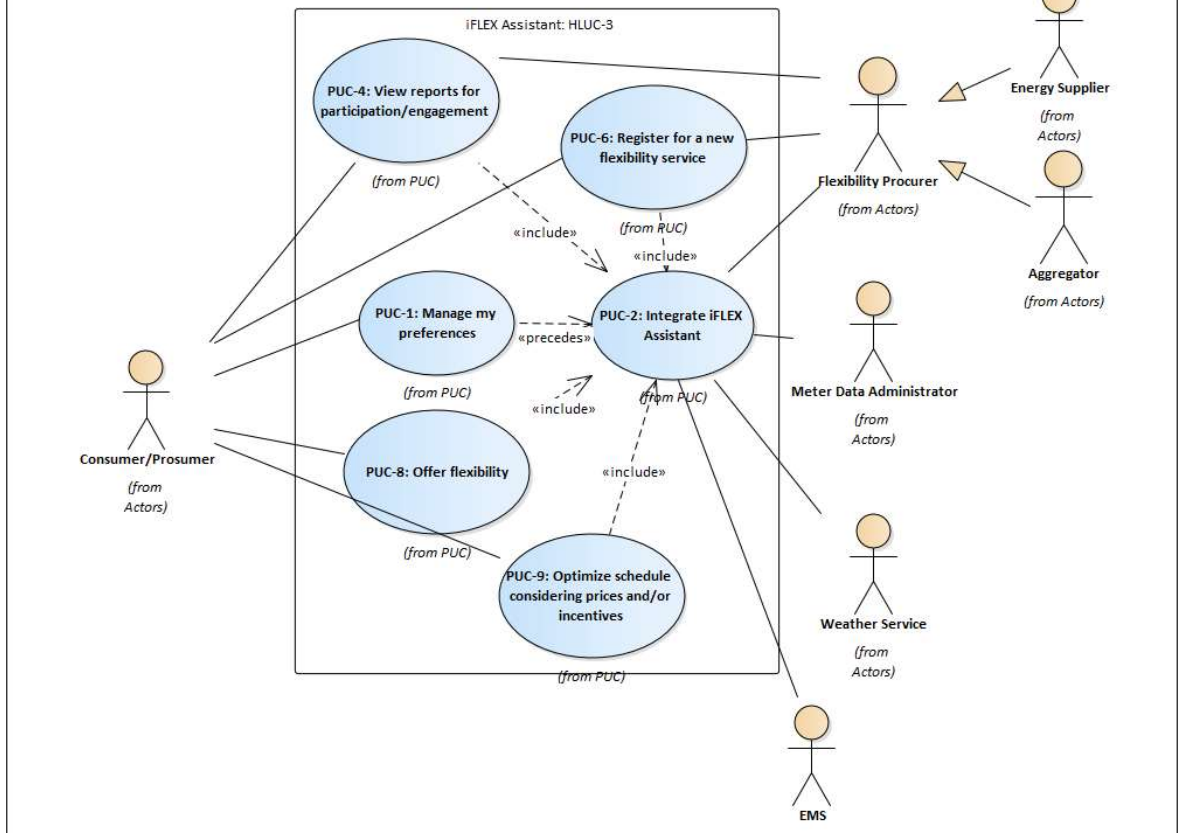

Figure 2 HLUC-2 UC Diagram

7.1.3 HLUC-3: Manage flexibility requests or price signals at building level

7.1.3.1 General information

Scope and objectives of the use case	
Scope	Describes the process of managing flexibility in context of apartment buildings. This use case covers both implicit demand response (i.e., flexibility management with respect to external price signals) and explicit demand response. It also covers flexibility management across heat and electricity vectors.
Objectives	The main objective is to maximise consumer benefits by managing flexible resources within a building. Consists of following sub-objectives, which are represented as individual Primary Use Cases (PUC): 1. Offer the building's flexibility for aggregators (PUC-8) 2. Optimise schedule of flexible resources considering prices and/or incentives (PUC-9) 3. Provide end user with means to view reports on participation/engagement (PUC-4)
Related business case(s)	• BUC 1 Optimise operation by leveraging flexibility from consumer/prosumer through DR

	• BUC 2 Optimise grid operation by leveraging flexibility from consumer/prosumer through DR • BUC 3 Offer flexibility of a multi-vector energy system (building community) to the energy market. • BUC 4 Optimal energy consumption for multi-vector energy system (building community) based on the behaviour of consumers and market signals.
Related user experience goal(s)	To be smart, cost-efficient and meaningful
Name of author(s)	VTT

Key performance indicators			
ID	**Name**	**Description**	**Reference to mentioned use case objectives**
KPI2a_DoA	Increased accuracy of consumer load forecasting compared to state-of-the-art methods	The results are compared to the state-of-the-art consumer load forecasting models and percentage decrease of forecasting error is calculated. Evaluation is performed using a variety of data sets (collected in the project), data amounts and load forecasting lengths and average performance of the approaches is calculated.	Offer flexibility (PUC-8).
KPI2b_DoA	Increased accuracy of flexibility modelling compared to state-of-the-art methods	The results are compared to the state-of-the-art flexibility modelling results and percentage decrease of forecasting error is calculated. Evaluation is performed using a variety of data sets (collected in the project), data amounts and flexibility forecasting lengths and average performance of the approaches is calculated.	Offer flexibility (PUC-8).
KPI6c _DoA	Increased consumer flexibility for grid stability and RES integration	The average flexibility of pilot participants that is validated in grid stability/RES integration cases is compared to relevant results reported in the literature.	Offer flexibility (PUC-8).
KPI2c_DoA	Increased effectiveness of automated flexibility management compared to standard methods	The results are compared to typical flexibility management algorithms in a wide variety of DR optimisation targets and incentives. Percentage improvement of rewards (incentive-specific) is calculated. Evaluation is performed using a variety of data sets (collected in the project), and incentives, and an average performance of the approaches is calculated.	Optimise schedule considering prices and/or incentives (PUC-9).
KPI4a_DoA	Return on Investment for prosumers in the base scenarios	Calculation of Return on Investment through a Cost Benefit Analysis (CBA)-based technoeconomic evaluation under various business modelling scenarios. A sensitivity analysis will also be performed for alternative settings, e.g. changes to electricity tariffs.	Optimise schedule considering prices and/or incentives (PUC-9).

KPI4c_DoA	Monetary benefits to the consumer in the base scenarios	Decrease of costs for the consumer compared to current situation.	Optimise schedule considering prices and/or incentives (PUC-9).
KPI4a	Effective engagement and participation reporting	Being able to report on engagement and participation in short, timely and effective manner. Measured by a number of reports read and reacted to in mid-term period.	View metrics on participation/engagement (PUC-4).
KPI4b	Engagement impact of reporting	Being able to engage the end user notably better than without reporting.	View metrics on participation/engagement (PUC-4).

Classification information
Relation to other use cases
• HLUC-1 Manage energy of the premises in an optimal way (extends) • PUC-1 Manage my preferences (includes) • PUC-2 Integrate iFLEX Assistant (includes) • PUC-4 View reports for participation/engagement (includes) • PUC-8 Offer flexibility (includes) • PUC-9 Optimise schedule considering prices and/or incentives (includes)
Level of Depth
High
Prioritisation
High
Generic, regional or national relation
Generic
Nature of the use case
Technical
Further keywords for classification
Demand side flexibility, implicit demand response, explicit demand response, building community, flexibility management

7.1.3.2 High-Level Analysis

Narrative of use case
Short description
A building community would like to gain benefits by providing flexibility to the electricity system and/or district heating system. The iFLEX Assistant manages the flexible resources (e.g. building's heating, and warm water) in order to maximise the consumer benefits. When necessary, control actions and/or new schedules are approved either by a resident (apartment level actions) or facility manager (building level control).
Complete description
The iFLEX Assistant's end users are the facility manager and potentially the residents of a building community who would like to provide flexibility to the electricity and/or district heating system whereby the building's load is shifted in reaction to price signals (e.g. optimisation across electricity and district heating prices) or to specific external requests in an easy, simple and 'quiet' manner. Offer flexibility to the relevant market actors The iFLEX Assistant will learn the normal consumption behaviour and flexibility at the building level in order to provide aggregators (Energy Suppliers and/or District Heating Companies) with flexibility offers. The flexibility at the building-level is mainly based on the thermal mass of a building. The facility manager and/or residents will specify the limits for their flexibility (e.g. minimum and maximum temperatures in apartments). Optimise energy schedule considering prices and/or incentives The iFLEX Assistant aims to minimise the costs and maximise the rewards of a building community by searching optimal control policies for flexible resources such as heating, ventilation, air conditioning, and warm water. In the optimisation the iFLEX Assistant may utilise models for flexible resources, load (and generation) forecasts, weather forecasts, the current status of the controllable assets and the user's preferences (automatic vs manual control actions). The UC covers also scenarios where costs are optimised across different energy vectors. In practice, this can include e.g. optimisation of HVAC costs across electricity (heat pump) and district heating vectors with different pricing schemes. Depending on the user's preferred configuration for different flexible resources and the prices/incentives in general (defined in PUC-01) the iFLEX Assistant will either automatically control the devices or propose DR actions that need to be accepted by the end user (i.e., facility manager in the case of building-level control and residents in the case of apartment-level flexibility management). In the case the end user wants to accept the flexibility management actions manually, the user receives a notification of the DR event in the chosen interaction form of the iFLEX Assistant, including information about time, (price) and duration. The notification also consists of a suggestion of the optimal control actions calculated by the iFLEX Assistant. Upon approval of a schedule, the iFLEX Assistant shall communicate the control scheme to the controllable devices through the Building Energy Management System. View reports for participation/engagement The end user can follow the premise status during the flexibility management and receive notifications if action is required to fulfil the target – compliance in the case of explicit DR, optimal costs in case of implicit. After the event, the user accesses the user interface to view the related cost and the savings. If the flexibility service is an example of explicit demand response, the percentage and cost of non-compliance is also shown (if applicable). The report is parameterised by the Flexibility Procurer (e.g. Aggregator, Energy Supplier) who provides the DR program.

Use case conditions
Assumption(s)
• User is registered to a DR program and/or has a contract with dynamic electricity and/or district heating prices • A Building Energy Management System (BEMS) provides the status of local assets and relays the control commands of controllable ones. • A Weather Service is providing weather data. • A Meter Data Administrator provides smart meter data to the iFLEX Assistant. • A Market Interface enables communication of energy and flexibility market data.
Precondition(s)
• The iFLEX Assistant is parameterised and fully operational. • The iFLEX Assistant is connected to the BEMS. • The iFLEX Assistant communicates with the Weather Service. • The BEMS has access to smart meter, sensors and dispatchable devices and assets. • The iFLEX Assistant has access to the end-user's electricity price scheme. • The end user has provided consent to receiving alerts and energy advice. • The end user has provided consent on sharing baseline load and flexibility information with the Aggregator and has signed an agreement detailing power and compensation aspects

Actors		
Actor name	**Actor type**	**Further information**
Resident	Person	End user of the iFLEX Assistant, who is motivated by economic, environmental and personal reasons.
Facility manager	Person	End user of the iFLEX Assistant in the case of apartment and commercial buildings, who is motivated by economic reasons.
Building Energy Management System	System	Manages the energy operation of the building, communicates control signals from iFLEX Assistant, provides sensing data to iFLEX Assistant.
Energy Supplier	Business Entity	Supplies electricity to the building and residents. Residents and the building can have different electricity suppliers. Can act as an aggregator. Would like to achieve optimal balancing and benefits from electricity market trading.
District Heating Company	Business Entity	Produces and distributes district heating. Provides district heating tariffs. Can act as an aggregator. Would like to optimise district heating production and benefit from optimal electricity trading (CHP plant).
Aggregator	Business Entity	Aggregates several consumers and/or prosumers for flexibility market services.
Meter Data Administrator	Business Entity	Provides smart meter data measurements to iFLEX Assistant.
Weather Service	Application	Provides weather forecast used in flexibility management. This information is important for heating/cooling related flexibility.

Diagram(s) of use case

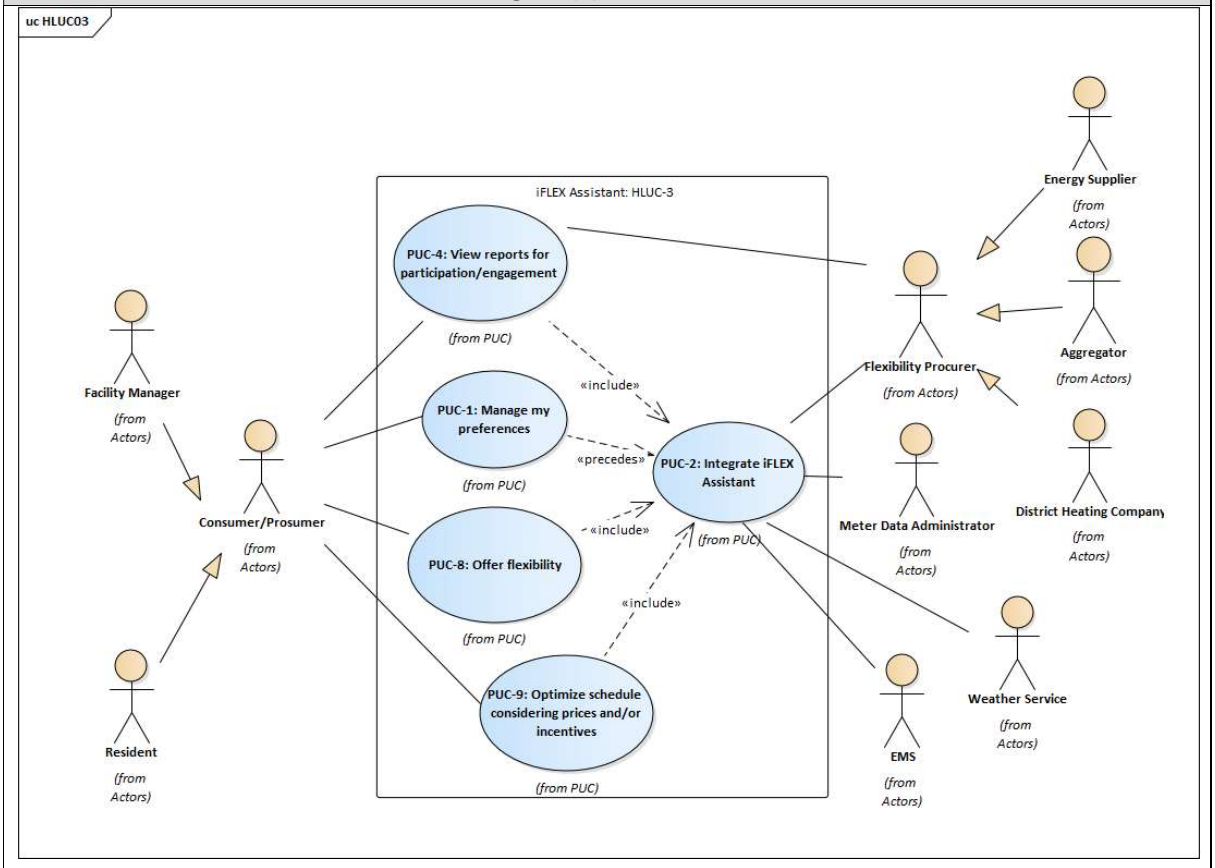

Figure 3 HLUC-3 UC Diagram