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Abstract:

This report documents the outcomes of the design process for the WiseHOME application, which is an integral part of the WiseGRID product ecosystem. The WiseHOME app will be the entry point for residential consumers or prosumers to the WiseGRID product ecosystem. The document highlights all intermediate design results, such as use cases, software architecture, web design and requirements for information exchange with WiseCOOP, which will hold and provide the information to be visualised.

Keywords:

WiseHOME app, residential energy management, prosumer awareness

Revision History

Revision	Date	Description	Author (Organisation)
V0.1	06.09.2017	ToC proposal for partner feedback	Antonis Papanikolaou (HYP)
V0.2	05.03.2018	Sections 2 & 3 added, ToC elaborated	Antonis Papanikolaou (HYP)
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V0.6	20.04.2018	Feedback provided from project internal review process	Alvaro Nofuentes (ETRA), Alberto Zambrano (ETRA), Katerina Papadimitriou (EDA), Ine Swennen (ECO), Vincent Dierickx (EID).
V1.0	24.04.2018	Revision of deliverable text based on partner feedback and generation of final version	Antonis Papanikolaou (HYP)

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EXECUTIVE SUMMARY

The WiseHOME app is the tool of the WiseGRID framework that serves as the interface with the residential electricity consumer or prosumer. Its initial goal is to provide a deep and comprehensive understanding of the energy consumption of the household to the user, in order to raise awareness about how energy is consumed, e.g. its time profile, what is the impact on total electricity intake from the grid, etc. In addition to this, WiseHOME will also inform the user about the state and performance of other assets he may have in the home, such as local generation, stationary batteries or EVs for instance. Finally, the WiseHOME tool will also serve as the interface toward the user for the deployment of implicit (price-based) demand response campaigns by the supplier and/or cooperative within the context of the WiseGRID project. The main novelty of WiseHOME is the enabling, development and delivery of human-centric demand response services in order to lower – or even eradicate – the consumer acceptance barrier that is typically observed in the deployment of price-based DR schemes.

WiseHOME is a key component in order to achieve one of the main goals of the project, namely to empower citizens to become active participants in the energy system. The first prerequisite for this empowerment is the availability of tools that enable citizens to have a profound understanding of their energy related behaviours and consumption/generation patterns. This understanding, achieved using an energy monitoring tool via visual analytics, enables residential users to adapt their patterns to achieve their own objectives, e.g. energy cost reduction or maximization of self-consumption. By offering a direct link with the supplier/cooperative, WiseHOME opens up a new world of opportunities, including the communication and achievement of energy-related goals at the level of a neighbourhood or a cooperative, which can be facilitated using price-based DR schemes. Dynamic prices can serve as a proxy either for actual cost of energy in the wholesale market or for availability of renewable energy in the supplier generation portfolio – or any other metric that the supplier/cooperative wishes to communicate – and can be used as a tool to urge consumers to alter their consumption patterns in response to their increase or decrease. As a result, WiseHOME becomes a valuable tool in the hands of the residential consumer/prosumer and the supplier/cooperative in order to actively engage citizens in the energy system and empower them to take their energy fate in their own hands.

1 INTRODUCTION

1.1 PURPOSE OF THE DOCUMENT

The purpose of the present report is to document the outcome of the design process for WiseHOME and to serve as a specification for the upcoming development of the tool.

The report contents have been generated from a collaborative and iterative process between the WiseGRID partners who are responsible for tool development and the pilot site partners who represent the target users. The goal was to understand the real intentions and wishes of end users as well as the requirements of the pilot site partners who would champion the deployment and use of the WiseHOME app by their clients. This document aims to guide the reader through the process and its intermediate outcomes so as to aid understanding about the choices and constraints that lead to the final design results.

Disclaimer: all the information that is shown in the user interface mock-ups is dummy information. Real information (e.g. smart meter measurements) will become available during the implementation of the WiseHOME app and the integration with the WiseGRID product ecosystem.

1.2 SCOPE OF THE DOCUMENT

This report aims to document all the necessary information regarding: i) the targeted use cases that were agreed with the pilot partners of the project as the most likely candidates for demonstration; ii) the visual aspects of WiseHOME – which is primarily an application/user interface for residential users; iii) the architecture of the ICT system which includes the back-end components; iv) the specifications of the mechanism for information exchange with the tool of the cooperative or retailer that is going to supply the information to be visualised.

1.3 STRUCTURE OF THE DOCUMENT

The document is structured as follows:

- Chapter 2 illustrates the requirements (initially documented in WiseGRID D2.1"WiseGRID requirements, Use cases and pilot sites analysis") that are applicable to the WiseHOME app in order to inform the reader about the starting point of the design process;
- Chapter 3 documents a few use cases that were developed in order to communicate and collect feedback from potential interested parties regarding how the users are expected to interact with WiseHOME;
- Chapter 4 briefly explains how WiseHOME fits in the overall architectural diagram of the WiseGRID product eco-system;
- Chapter 5 documents the architecture, the deployment view and several technical aspects of the WiseHOME tool;
- Chapter 6 includes several screenshots of the WiseHOME web app that were developed in order to elicit feedback from the pilot project partners so as to ensure compliance with their expectations; and
- Chapter 7 documents in detail the requirements for the information that will have to be provided to WiseHOME so that the latter visualises it for the user.

2 WISEHOME REQUIREMENTS

During the initial stages of the WiseGRID – namely Work Package 2 "WiseGRID Use cases, requirements and KPIs definition" -, the project consortium elaborated the requirements for each of the WiseGRID products in order to steer their development toward the achievement of the integrated WiseGRID system objectives. This chapter depicts the requirements that were generated for the WiseHOME application in order to familiarise the reader with the consortium expectations from the WiseHOME application.

To enhance the readability of the requirements, an important distinction must be made. They contain two different types of requirements:

- Requirements on the WiseHOME app – what the app must do or offer;
- Requirements of the WiseHOME app in order to function as expected.

To clarify this ambiguity, the requirements list will be divided in two separate tables. They are illustrated below.

Table 1 – Initial requirements on the WiseHOME app

Requirement ID	Description	Type
HOM_001	End users should get access to energy consumption, local generation (if any) and storage (if any) information (real time and historical) in a personalized way	Functional and data requirements
HOM_002	End users should get access to energy cost & CO2 intensity information (real time and historical data) in a personalized way	Functional and data requirements
HOM_003	End users should get informed about retailer prices and available tariff schemas	Functional and data requirements
HOM_004	Along with real time information end users will receive information about short term consumption and generation forecast	Functional and data requirements
HOM_005	Advices and recommendations about efficient energy usage should be triggered to the end users	Functional and data requirements
HOM_006	Notifications about activation of manual driven Demand Response strategies should be available via WiseHOME app	Functional and data requirements
HOM_007	The end users should get informed about incentives (for DR participation) or penalization (for non DR participation)	Functional and data requirements
HOM_008	The app should be as user-friendly as possible	Usability and humanity requirements

Requirement ID	Description	Type
HOM_009	Consumer or prosumers need to have an opt-out option for DR/ADR programs (if ADR is exploited in the project).	Functional and data requirements
HOM_010	The application GUI should be designed in a user-centric way i.e. involving the feedback of the end user at the design phase	Look and feel requirements
HOM_011	The granularity of consumption and generation information presented to the consumers/prosumers should be at least (min) at an hourly level	Functional and data requirements
HOM_012	WiseHOME app should include remote control of smart devices for end users	Functional and data requirements
HOM_013	WiseHOME app should illustrate cost savings	Functional and data requirements
HOM_014	WiseHOME shall allow its users to set constraints to the remote control of the smart appliances	Operational requirements
HOM_015	Notifications about activation of Automated Demand Response Strategies should be available via WiseHOME app	Functional and data requirements
HOM_016	End users should get informed about active DR contracts in a personalised way	Functional and data requirements
HOM_017	End users should get informed about the best practices towards optimally participating in active DR contracts	Functional and data requirements
HOM_018	Simple analytics over historical data (consumption/ generation/ cost etc..) will be provided by the tool	Functional and data requirements
HOM_019	End users (prosumers) should get access to local generation data, if any	Functional and data requirements
HOM_020	End users (prosumers) should get access to local storage data if any	Functional and data requirements
HOM_021	Apart from DR strategies, ESCOs and Aggregators may trigger additional messages to the portfolio users via the app	Functional and data requirements
HOM_022	The application will support social networks integration, to allow that way comparison with similar peers	Functional and data requirements

Requirement ID	Description	Type
HOM_023	The end users will be able to configure the WiseHOME app settings (username, password, social media connection)	Functional and data requirements
HOM_025	Data must be presented in an accessible, understandable and flexible format	Usability and humanity requirements
HOM_027	End user credentials are required for accessing the app	Security requirements
HOM_029	The structure of the app should address scalability requirements	Performance requirements
HOM_030	Access on the WiseHOME should not be dependent on the connecting device	Operational requirements
HOM_037	Anonymizing data from private EVs	Security requirements
HOM_038	WiseHOME app should include a user support section	Usability and humanity requirements
HOM_039	Private EV owners / end users should get access to EV management for domestic charging	Functional and data requirements
HOM_040	WiseHOME app shall allow its users to set constraints on the use of their data	Usability and humanity requirements
HOM_041	WiseHOME will be able to execute the home EVSE's flexibility offers (V2H and/or smart charging capabilities)	The scope of the product

Table 2 – Initial requirements of the WiseHOME app

Requirement ID	Description	Type
HOM_028	Data should be consistent ensuring that way the reliability of the app	Performance requirements
HOM_031	Under automated demand-response, cleanest energy sources must always be prioritized against fossil-fuel based ones	Operational requirements
HOM_032	Remotely controllable loads	Operational requirements
HOM_033	Real-time monitoring information about indoor/exterior conditions in buildings	Functional and data requirements
HOM_034	Maintenance of devices information (solar panels, boilers, air conditioning...)	Operational requirements

Requirement ID	Description	Type
HOM_035	Calculation of the optimal power term for each prosumer	Operational requirements
HOM_036	Market information availability	Functional and data requirements
HOM_037	Anonymizing data from private EVs	Security requirements
HOM_042	WiseHOME must have access to assets-to-be-controlled or their load controller via remotely accessible APIs (preferably over IP, e.g. REST interfaces)	Operational requirements

3 BESPOKE USE CASES OF THE WISEHOME APPLICATION

This chapter aims to provide a documentation of several diverse use-cases that have been discussed with the consortium so that they can be used as guidelines for the design and development of appropriate functionalities and interfaces of the WiseHOME app. In the final sub-section, the use-cases that have been selected for testing during the WiseGRID field tests will be presented.

3.1 SCENARIO & USE CASE DOCUMENTATION

The section provides the high level description of scenarios and concrete use cases in which the WiseHOME app is put into action. The use cases provide insights on the details of the functionality of the application and necessary user actions. The home resident is the main actor in all the use cases documented in this chapter.

It is important to clarify at this point that these use cases correspond to detailed user interactions with the application and do not directly refer to the WiseGRID project level use cases as documented in D2.1"WiseGRID requirements, Use cases and pilot sites analysis". They are definitely linked as illustrated in Table 3 below.

3.1.1 Use case summary

The table below provides an overview of the use cases that have been elaborated, discussed and scrutinised within the consortium in an effort to identify the ones that are feasible to demonstrate during the pilot trials as well as those that can provide the highest demonstration value for the project.

Table 3 – Potential use cases

Scenario	UC ID	Title of WiseHOME app Use Case	Linked to WiseGRID project UC
01	**UC.01.01**	Registration to WiseHOME app	Pre-condition
01	**UC.01.02**	WiseHOME configuration	Pre-condition
02	**UC.02.01**	Energy consumption monitoring	HL-UC 7_SUC_3.1
02	**UC.02.02**	Local energy generation and self-consumption monitoring	HL-UC 7_SUC_3.1
02	**UC.02.03**	Energy cost monitoring	HL-UC 7_SUC_3.1
02	**UC.02.04**	Alternative electricity tariff plan evaluation	HL-UC 7_SUC_3.3, HL-UC 7_SUC_3.4
02	**UC.02.05**	Emissions monitoring	HL-UC 7_SUC_3.1
03	**UC.03.01**	Residential manual control action	HL-UC 7_SUC_3.3, HL-UC 7_SUC_3.4
03	**UC.03.02**	Automated human-centric home control	HL-UC 7_SUC_3.3
04	**UC.04.01**	Manual response to dynamic prices	HL-UC 7_SUC_3.3, HL-UC 7_SUC_3.4
04	**UC.04.02**	Automated response to dynamic prices	HL-UC 7_SUC_3.3
04	**UC.04.03**	Manual demand response to peak price notification	HL-UC 7_SUC_3.4
04	**UC.04.04**	In-app manual demand response to peak price notification	HL-UC 7_SUC_3.3
04	**UC.04.05**	Cooperative-initiated automated response to critical peak price	HL-UC 7_SUC_3.3,

			HL-UC 7_SUC_3.4
05	**UC.05.01**	Benchmarking consumption against peers	HL-UC 7_SUC_3.2
05	**UC.05.02**	Monitoring cooperative performance	HL-UC 7_SUC_3.2

3.1.2 Scenario.01 – Registration & Configuration

This scenario outlines the initial steps necessary for the setup of the application before the first use.

3.1.2.1 UC.01.01: WiseHOME account creation & initial set-up

Use Case Description	
ID	UC.01.01
Title	Registration to WiseHOME app
Triggering event	User-initiated action
Description	This use case describes the initial actions that are required before the user can start using the WiseHOME app.
Basic Path	1. The user opens the WiseHOME URL in her browser. 2. She registers to the application by creating a new user account. During this process some information is collected. This may include a unique e-mail address or username that will be used as the key for user identification in the WiseHOME app, a secret password that will be provided by the user. 3. The user also specifies the ID of the respective SMX as well as the co-operative/retailer that she collaborates with. 4. The user accepts the WiseHOME app terms & conditions. **5.** The user logs on the WiseHOME app and is led to the personalized user page.
Exceptional path	Username unavailable: the user will be prompted to select another username. Terms & conditions not accepted by the user: registration will be denied automatically.

3.1.2.2 UC.01.02: WiseHOME app configuration

Use Case Description	
ID	UC.01.02
Title	WiseHOME configuration
Triggering event	User-initiated action
Description	This use case deals with all the upfront configuration and commissioning steps that must be performed by the user in order for the WiseHOME to start working normally.
Basic Path	1. The user logs on to the WiseHOME app. 2. The user selects the Setting tab. 3. The user fills in the following fields with the appropriate information.

	• Information source/stream for home energy consumption. This will most likely be either the SMX ID or the customer number that is provided by the retailer/ cooperative (the entity that is offering the WiseHOME app). This information is **mandatory**. • List of available generation devices in the home (and source of metering information) (**mandatory** – if generation devices exist) • List of storage devices in the home (and source of metering information) (**mandatory** – if storage devices exist) • List of available remotely controllable devices in the home (and access means/credentials) (**optional**) • List of electricity consuming devices that are sub-metered (and source of information) (**optional**) • Current tariff plan (**optional** – to be retrieved from the retailer if not provided by the user) • Home characteristics (area, number of residents, etc.) (**optional**, if supplied it may be used to normalise the energy use among cooperative members and enable more fair comparisons) • Demand Response campaign options (choice of campaign type – dynamic or peak price -, choice of manual/automatic control – who controls loads according to price -) (**optional** – no selection means no participation) 4. The user saves the settings.
Exceptional path	Information unavailable to the user: If the user does not have the necessary information to enable the integration of the WiseHOME app with some residential assets/ devices, the corresponding information will not be displayed in the app. The absolutely necessary information, which includes the SMX ID or customer number, should be retrieved by the user from the retailer/cooperative if the user does not already know it. WiseHOME cannot retrieve it automatically.

3.1.3 Scenario.02 - Monitoring of home energy-related performance

This scenario aims to and describes the various use cases – facilitated by the WiseHOME app – that can raise the awareness of the residential user about his energy consumption and provide the user sufficient information so as to make better, informed decisions in the future regarding energy management in the home.

3.1.3.1 UC.02.01: Energy consumption monitoring

Use Case Description	
ID	UC.02.01
Title	Energy consumption monitoring
Triggering event	User-initiated action or default application view
Description	This use case includes functionalities related to the visualization of energy consumption so that the resident can understand his consumption habits and identify opportunities for optimization.

Basic Path	The user launches the application. The dashboard on the first screen illustrates information about the instantaneous power and cumulative energy consumption of his home as well as information about the energy cost. By pressing on the consumption icons, the user is confronted with historical traces of aggregated residential consumption. The graph annotates existing constraints (e.g. the maximum allowable capacity for the connection type) The user drills in specific time periods to identify short-term consumption patterns (subject to measurement sampling frequency). The user clicks on the aggregated consumption line on the diagram to show a breakdown of consumption per device (subject to availability of sub-metering information for devices)
Exceptional path	

3.1.3.2 UC.02.02: Local energy generation & self-consumption monitoring

Use Case Description	
ID	UC.02.02
Title	Local energy generation and self-consumption monitoring
Triggering event	User-initiated action or default application view
Description	The purpose of this use case is to visually provide the necessary information so that residents can understand their generation and self-consumption patterns, with the ultimate aim to stimulate them to increase self-consumption by shifting demand to times of local RES generation.
Basic Path	The user launches the application. The dashboard on the first screen illustrates information about the electricity generation of local assets as well as the break-down of the consumed energy into self-produced and imported from the grid. By pressing on these figures, the user is confronted with historical traces of local generation. A line graph showing the time-series of generation. A third line indicates self-consumption as a percentage of generated energy (as a function of time). It is colour coded to indicate further opportunities for self-consumption at specific time intervals. When the user clicks on the self-consumption line, a graph showing consumption breakdown (as a function of time) is shown for the time period under investigation to inform him about the devices that consumed during that time (if the appropriate sub-metering information per device is available).
Exceptional path	

3.1.3.3 UC.02.03: Energy cost monitoring

Use Case Description	
ID	UC.02.03
Title	Energy cost monitoring
Triggering event	User-initiated action
Description	This use case aims to raise awareness about the energy cost of consumers and indicate demand patterns that cost more than necessary.
Basic Path	The user launches the application. The dashboard depicts information about the current cumulative energy cost (from the start of the applicable billing period) so that the user can keep track of his energy costs. There is also a clear indication whether the current energy costs are higher or lower compared to the costs for the same period the previous year and by how much.
Exceptional path	

3.1.3.4 UC.02.04: Alternative energy tariff evaluation

Use Case Description	
ID	UC.02.04
Title	Alternative electricity tariff plan evaluation
Triggering event	User-initiated action
Description	Energy cost is a significant family expenditure and it is very reasonable for citizens to seek energy tariff schemes that can reduce this expenditure. The WiseHOME app will provide to the user the opportunity to evaluate the impact of alternative tariff schemes and quantify the potential benefits or losses.
Basic Path	The user launches the application and selects the “Information” tab. The tab displays two figures, one comparing the two alternative tariffs supplied by the retailer and a second one showing the household energy cost under each of the tariff as a function of time, clearly showing the difference in resulting total energy cost.
Exceptional path	

Nota bene: after deliberation with the pilot partners in the project, it became evident that the most likely route for the replication of the WiseHOME app is via the commercial party with which the residential consumer already has an active relationship, for instance the cooperative or the retailer. Such entities are reluctant to offer the consumer the capability to define any arbitrary plan. So, the tariffs plans to be compared will be provided by this party.

3.1.3.5 UC.02.05: Local emissions (equivalent) monitoring

Use Case Description	
ID	UC.02.05

Title	Emissions monitoring
Triggering event	User-initiated action
Description	This use case aims to inform the user of the degree of "cleanliness" of this energy consumption, i.e. the relative amount of emissions compared to the average. This indicator will be calculated based on the percentage of consumed energy that is self-consumed (either at the home or at the cooperative level) since it is impossible for residential consumers to keep track of CO_2 factors of energy from the grid and adapt their consumption patterns.
Basic Path	The user launches the application and selects the "Collective reports" tab. The tab displays a gauge illustrating in scale from brown to green (or equivalent) the relative degree of emissions of the home energy consumption.
Exceptional path	

3.1.4 Scenario.03 – Smart Home energy management

3.1.4.1 UC.03.01: Residential manual device control

Use Case Description	
ID	UC.03.01
Title	Residential manual control action
Triggering event	User-initiated action
Description	This use case refers to the case where the user wants to manually change the indoor conditions in his home (e.g. temperature).
Basic Path	The user opens the Smart Home tab of the WiseHOME app The user selects and clicks the appropriate device (e.g. A/C for temperature control). The user adjusts the setpoint (e.g. temperature) according to his preference.
Alternative path	The user directly controls the device via other means (e.g. IR remote control). In this case, the WiseHOME app will not be able to learn from this user action. Also, unless some way to receive the device setpoint is established, the WiseHOME app will not have information about the correct state of the device.

3.1.4.2 UC.03.02: Automated human-centric home control

Use Case Description	
ID	UC.03.02

Title	Automated human-centric home control
Triggering event	WiseHOME detects uncomfortable indoor conditions
Description	This use case is applicable when the temperature in the home moves outside the comfort zone of the residents, as this has been learnt during profiling. In this case and, if the appropriate setting has been selected, the WiseHOME app will adapt the setpoint of the HVAC system – assuming appropriate control channels are in place.
Basic Path	The user is informed about the control action of the WiseHOME app.
Exceptional path	-

3.1.5 Scenario.04 – Demand Response

3.1.5.1 UC.04.01: Dynamic prices & manual control

Use Case Description	
ID	UC.04.01
Title	Manual response to dynamic prices
Triggering event	Notification by retailer/cooperative via WiseHOME
Description	This use case describes the manual response that residential users are expected to perform when the electricity price exceeds a predefined threshold.
Basic Path	WiseHOME alerts the user to a notification that has been sent by the retailer/cooperative when the electricity price exceeds a predefined threshold that has been specified either by the user or by the retailer. The user clicks on the “Smart Home” tab and changes the setpoints of devices in order to adjust energy consumption (if remotely controlled devices exist in the home and are integrated with the WiseHOME app).
Exceptional path	The user manually changes the setpoint or switches off devices that are not accessible via the WiseHOME app in order to avoid excessive energy costs.

3.1.5.2 UC.04.02: Dynamic prices & in-home automated control

Use Case Description	
ID	UC.04.02
Title	Automated response to dynamic prices
Triggering event	WiseHOME detects energy cost reduction potential while maintaining indoor conditions within comfort zone.
Description	Dynamic electricity tariff plans hold significant promise for energy cost reduction. Achieving the potential benefits, however, relies on the appropriate shifting of electricity demand to times of lower prices. Citizens are unlikely to want to constantly track electricity prices and

	modify their electricity demand accordingly; automation is expected to help alleviate this burden for them. This use case describes cases where the WiseHOME app takes initiative and proposes specific cost-reducing actions to the user, who simply has to authorize them.
Basic Path	WiseHOME generates a notification about an upcoming setpoint change command it intends to dispatch in order to reduce energy cost (while maintaining comfort within user preferences). The user is probed to authorize the command. The user authorizes the command. WiseHOME sends the setpoint command to the device.
Alternative path	The user does not authorize the command.

3.1.5.3 UC.04.03: Peak prices & manual control

Use Case Description	
ID	UC.04.03
Title	Manual demand response to peak price notification.
Triggering event	DR event (price signal)
Description	The purpose of this use case is to illustrate what should happen when a DR event for a peak price arrives to the WiseHOME app (the user is notified) and the user has opted to act manually upon such events.
Basic Path	Notification for peak price arrives to the user. The user changes the setpoint of the building loads manually (without WiseHOME intermediation).
Exceptional path	

3.1.5.4 UC.04.04: Peak prices & in-app manual control

Use Case Description	
ID	UC.04.04
Title	In-app manual demand response to peak price notification.
Triggering event	DR event (price signal)
Description	The purpose of this use case is to illustrate what should happen when a DR event for a peak price arrives to the WiseHOME app (the user is notified) and the user has opted to act manually upon such events.
Basic Path	Notification for peak price arrives to the user. The user opens the WiseHOME app (and logs on if necessary). The user clicks on the “Smart Home” tab. The user selects the most appropriate consuming device and clicks on its link.

	The user provides a new setpoint for the selected device. The user repeats steps 4 -6 until the user is satisfied that all unnecessary demand has been shut down or minimized. (Optional) The user should also turn off (or minimize consumption) of any consuming devices that cannot be remotely controlled by the WiseHOME app.
Exceptional path	

3.1.5.5 UC.04.05: Peak prices & cooperative automated control

Use Case Description	
ID	UC.04.05
Title	Cooperative-initiated automated response to critical peak price.
Triggering event	DR event (price signal)
Description	This use case is included as a forward-looking mechanism whereby the cooperative can take initiative and control loads of the consumer in a manner similar to Direct Load Control when electricity price is too high. This case is futuristic and will not be available in the WiseGRID implementation due to lack of control infrastructure and consumer reluctance.
Basic Path	WiseHOME informs the user about control signals from the retailer or cooperative acting upon the building loads. Depending on the SLA, the user needs to authorise/accept the incoming commands or need not do anything.
Exceptional path	

3.1.6 Scenario.05 Engagement & social collaboration

3.1.6.1 Benchmarking own performance against peers

Use Case Description	
ID	UC.05.01
Title	Benchmarking consumption against peers.
Triggering event	User-initiated action
Description	This use case describes a feature which allows users to benchmark their energy consumption against that of peers. This requires some normalization of consumption to avoid comparisons that do not make sense.
Basic Path	Visualization of energy consumption against that of top-performing and average (or median) peer in the appropriate tab of the application.
Exceptional path	

3.1.6.2 Monitoring performance at the cooperative level

Use Case Description	
ID	UC.05.02
Title	Monitoring cooperative performance
Triggering event	User-initiated action
Description	This use case facilitates the capability of each cooperative member to monitor the cumulative performance of all cooperative members across several indicators, for example energy consumption and generation, emissions, self-consumption, etc.
Basic Path	The user clicks on the "Collective performance" tab. Several visualizations directly illustrate the cumulative generation/consumption time-series of all cooperative members.
Exceptional path	

3.2 USE CASE SELECTION FOR IMPLEMENTATION

Some of the use cases described in the previous sub-section have strong requirements on the availability of infrastructure at the domestic buildings of the pilot sites, including for example electricity loads that are remotely controllable via IP-based protocols. Based on bilateral discussions with the pilot partners of the project it became obvious that even if some homes may have such infrastructure, it is highly unlikely that residents will be willing to allow research tools to directly access and control it. This stems mainly from their risk aversion toward tools that are a product of research efforts and which include innovations that have not been tested in the market. This means that the use cases that were related to direct control of devices in the home were not maintained in the final list of use cases to be implemented.

As a result, the selected use-cases which steered the design and implementation efforts of the WiseHOME app were the following:

Table 4 – Selected use cases for implementation

UC ID	Use Case title
UC.01.01	Registration to WiseHOME app
UC.01.02	WiseHOME configuration
UC.02.01	Energy consumption monitoring
UC.02.02	Local energy generation and self-consumption monitoring
UC.02.03	Energy cost monitoring
UC.02.04	Alternative electricity tariff plan evaluation
UC.02.05	Emissions monitoring
UC.04.03	Manual demand response to peak price notification
UC.05.01	Benchmarking consumption against peers
UC.05.02	Monitoring cooperative performance

4 WISEHOME AS AN INTEGRAL COMPONENT OF THE WISEGRID DR FLOW

The WiseHOME application is the dedicated user interface for residential consumers and prosumers who want to take part in the WiseGRID ecosystem, or parts of it enabled by market actors such as retailers or energy cooperatives.

The figure below provides a snapshot of the tools that comprise the WiseGRID ecosystem, including:

- The target users of each tool, and
- The high-level interactions among tools expressed signals for the preparation and/or activation of services they provide to one another or to the grid.

The WiseHOME app is positioned as a tool for the domestic prosumer – it is actually the only tool that directly interfaces domestic users. It interacts with other tools, such as WiseCOOP and WG RESCO in order to properly exchange the necessary information that will enable it to provide the target services to its user.

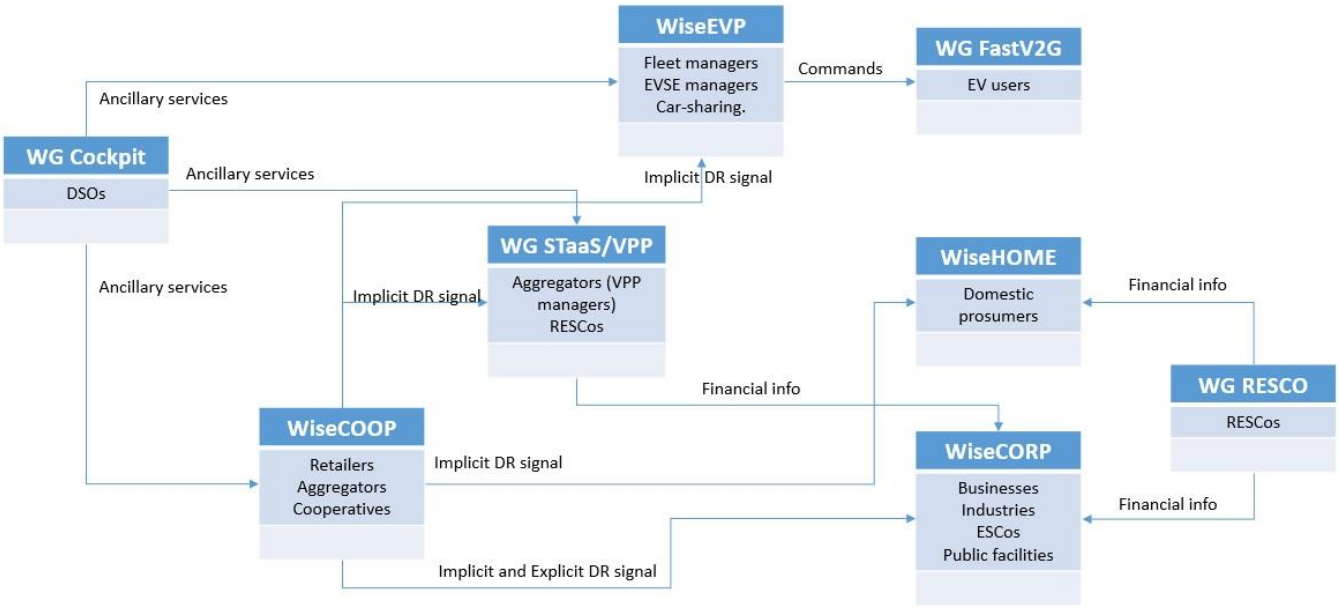

Figure 1 - High-level WiseGRID ecosystem architecture

More details about the interaction between WiseHOME and the other WiseGRID tools are provided below:

- **WiseHOME & WiseCOOP**: this is the main interaction that is foreseen in the project as any residential consumer or prosumer will have a commercial relationship with a retailer. WiseHOME will serve as the user interface, which the retailer will utilise to convey information to its customers.
- **WiseHOME & WG RESCO**: the intention of this interaction is to inform the prosumers who have provided their space (e.g. rooftops) for installation of renewable generation sources about the benefits they are entitled to from the RESCO. These will be mainly financial benefits that can be seen as rewards for the home owner.

5 WISEHOME ARCHITECTURE

This chapter aims to make the reader aware of the internals of the WiseHOME software architecture as well as implementation details, e.g. technologies, deployment, etc. The WiseHOME is primarily a web app – which means that its front-end is prominent as it is the component that is visible to the end user – but the bulk of the implementation is in the back-end where all the material for visualisation is created.

5.1 ARCHITECTURAL STYLE

The WiseHOME software architecture is based on the MVC pattern. Model–view–controller (MVC) is an architectural pattern commonly used for developing user interfaces that divides an application into three interconnected parts [1].

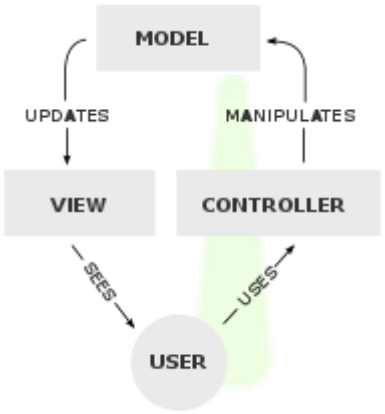

Figure 2 - Model-View-Controller architectural pattern

As with other software patterns, MVC expresses the "core of the solution" to a problem while allowing it to be adapted for each system. Particular MVC architectures can vary significantly from the traditional description here.

Components

- The model is the central component of the pattern. It expresses the application's behaviour in terms of the problem domain, independent of the user interface.[6] It directly manages the data, logic and rules of the application.
- A view can be any output representation of information, such as a chart or a diagram. Multiple views of the same information are possible, such as a bar chart for management and a tabular view for accountants.
- The third part or section, the controller, accepts input and converts it to commands for the model or view.[7]

Interactions

In addition to dividing the application into three kinds of components, the model–view–controller design defines the interactions between them.

- The model is responsible for managing the data of the application. It receives user input from the controller.
- The view means presentation of the model in a particular format.

- The controller is responsible for responding to the user input and perform interactions on the data model objects. The controller receives the input, optionally validates it and then passes the input to the model.

5.2 SECURITY CONSIDERATIONS

Data security and privacy is of utmost importance for the WiseHOME app and for the WiseGRID eco-system as a whole. As a result, the design and implementation of the WiseHOME app took into account from the beginning a number of relevant requirements to ensure that user data will not be compromised.

State of the art techniques and mechanisms will be used to achieve this goal:

- Secure communications using the https protocol with information encryption under TLS1.2;
- Username & password hashing for local storage security.

In addition to the aforementioned tools, it is even more important to mention that WiseHOME will not store information that can be considered sensitive or personal. The pieces of information that will be asked from the user in order to complete the registration will be the following:

- Cooperative / retailer with whom the user has an active commercial engagement: this information will dictate which instance of WiseCOOP will be probed to obtain the information for visualisation;
- Username: an alias of choice of the user, it does not have to be linked to his name;
- Password: in order to authenticate users when accessing the WiseHOME app;
- E-mail: the user will be able to ***optionally*** provide his e-mail address so as to receive notifications via e-mail.

In addition to the above, the WiseHOME app will need to know how to specify the specific home when it requests information from WiseCOOP. This necessitates the availability of some type of unique ID for the home, based on which WiseCOOP can retrieve and deliver the relevant information. This ID can – for instance – be the serial number of the smart meter of the connection, the customer number used by the cooperative bookkeeping system, or any other ID that can be supplied by WiseCOOP. The user will have to provide this ID to the WiseHOME app during configuration.

5.3 WISEHOME ARCHITECTURE

Figure 3 depicts the software architecture of the WiseHOME software, focusing on the back-end that performs all the necessary communications and processing in order to generate and send the HTML that is rendered on the user's browser.

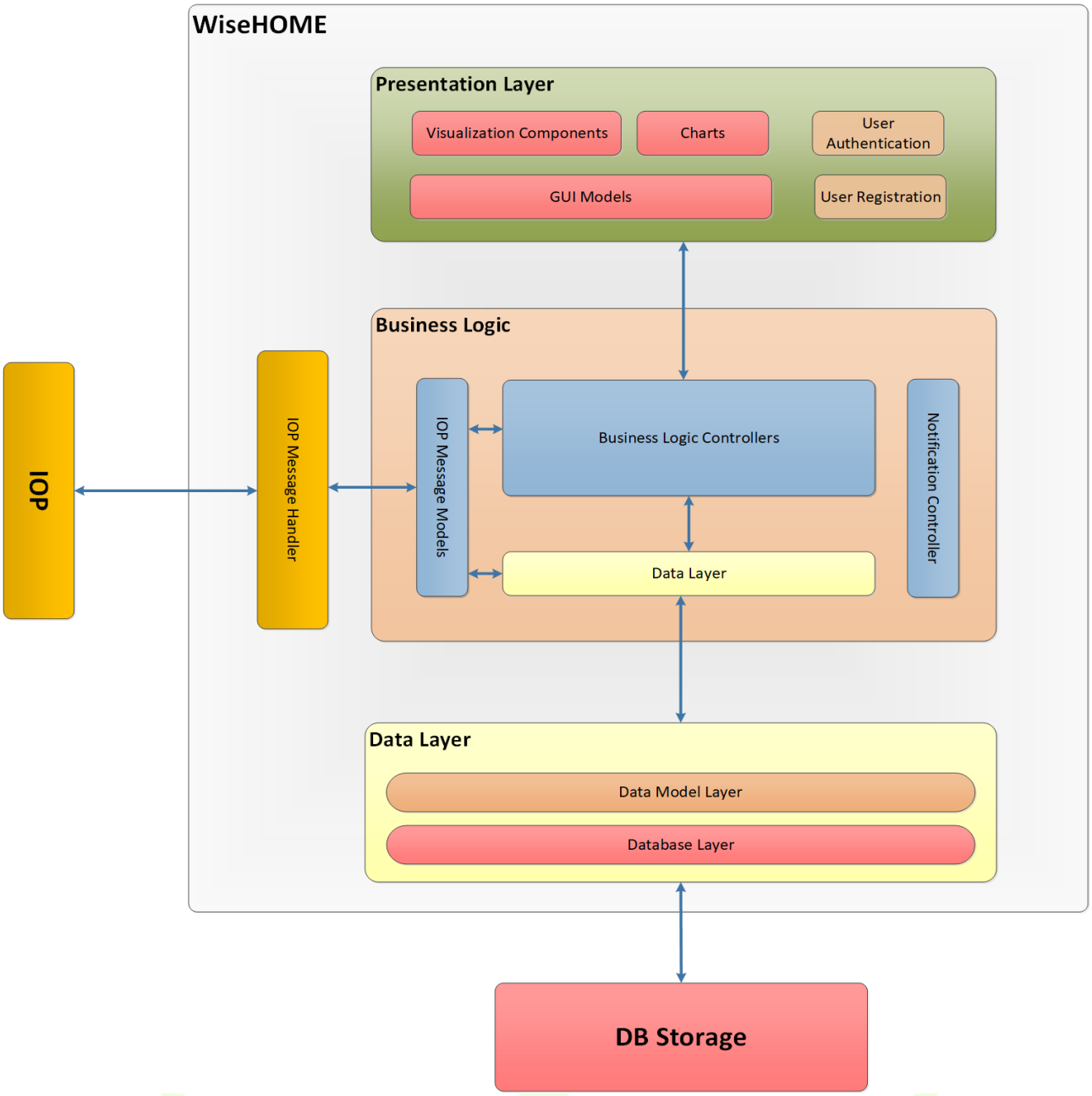

Figure 3 - High-level software architecture of the WiseHOME product

The following paragraphs briefly describe the purpose of each of the components.

5.3.1 DB Storage

The back-end of the WiseHOME app needs a persistent data storage facility. The information to be stored there is minimal, but since WiseHOME will perform the user management (registration, authentication, etc.) it requires access to persistent storage.

5.3.2 Data Layer

Responsible for model, orchestrate and manage relational databases.

5.3.3 IOP Message Handler

Responsible for establishing connection with IOP (RabbitMQ configurations), handling messages and wrapping them to the respective ***IOP Message Models.***

IOP Message Models

Data models of all respective messages. More information about these messages is documented in the following project deliverables:

- D4.2 WiseGRID interoperable Integrated Process (WG IOP);
- D7.1 WiseCOOP and WiseCORP Apps Design;
- D10.2 DR Framework Specifications.

5.3.4 Business Logic

Business Logic Controllers

Contains the core functionality and the business logic of WiseHOME app. Orchestrates the different components in order to be served on the presentation layer.

5.3.5 Presentation Layer

GUI Models

As we follow the MVC Architecture as software methodology approach, every aspect should be modelled in order to be manipulated by the Business Logic Layer. GUI Models refer on modelling every UI aspect in terms of Chart Graphs, Chart Pies, other Visual Components etc.

Visualization Components

Visualization of components such as:

- Traffic lights
- Pie Component
- Gauges Component
- Information modules

Chart Components

Chart Plots such as:

- Line time series
- Area time series
- Comparative charts

5.3.6 Implementation technologies

The implementation of the WiseHOME application involves a number of different technologies. The paragraphs below indicate which implementation technologies are involved in each aspect of the implementation.

Core WiseHOME app (MODEL – CONTROLLER Aspect)

- **Hibernate 5**: Framework for persistent DB modelling and Java DB Query language.
- **SpringMVC**: Java application framework, used in a wide range of Java applications. It was used for the development of the core J2EE applications. For specific aspects of the implementation Spring MVC packages were used, namely Spring Web and Spring Security Frameworks for web applications and authentication/authorization respectively.
- **Java 8:** Programming language.

Front End (VIEW Aspect)

- **HTML/HTML5**: Mark-up language that enables the delivery of rich visualisation through a browser.
- **JSP**: Java Server Pages was used for the dynamic generation of web pages based on HTML, XML and other document types.
- **JSP Tiles**: Technology for the generation of page fragments which can be assembled into a complete page at runtime. It was used in order to reduce the duplication of common page elements or embedded within other tiles to develop a series of reusable templates.
- **JQuery**: Cross-platform JavaScript library designed to simplify the client-side scripting of HTML.
- **CSS3:** Language that defines the style of web pages, CSS3 is the latest version of the standard CSS language.
- **D3.js:** JavaScript library for visualizing data with HTML, SVG, and CSS. Responsible for all the visual and chart components.

Database

- **MySQL Server:** the WiseHOME database is based on this technology. A separate database was used to store only the necessary information locally (at the deployment site of the entire back-end WiseHOME core) without communicating them over the WG IOP.

Web Services

- **RabbitMQ (AMQP):** the WG IOP – the main communication infrastructure of the WiseGRID product ecosystem – is based on the RabbitMQ framework, so the WiseHOME app also includes wrappers to interface with it.
- **REST JSON:** internal communications of the WiseHOME implementation rely on this architectural style.

Logging & infrastructure

- **Log4j**: Logging framework used to manage the framework.
- **Maven:** Tool used to manage the software project. Maven can manage a project's build, reporting and documentation from a central piece of information**.**
- **Tomcat 8:** Application server
- **Apache:** Web Server, load balancer.

5.4 WISEHOME DEPLOYMENT

Figure 4 illustrates the expected deployment of the software components described in the previous sub-section. All the relevant components will be deployed on the same machine, which will be a private cloud in the premises and fully controlled by a consortium partner, e.g. Hypertech in this specific case.

This machine will host all the necessary functionalities in a local application server instance as well as an instance of web server and a database instance. Should scalability issues arise due to extensive use of the WiseHOME during the demonstration activities, this setup can be replicated to further machines within company premises. For purposes of commercial exploitation of the WiseHOME app, this software bundle may be moved in the future to a server hosted by a cloud service provider in order to improve its scalability and

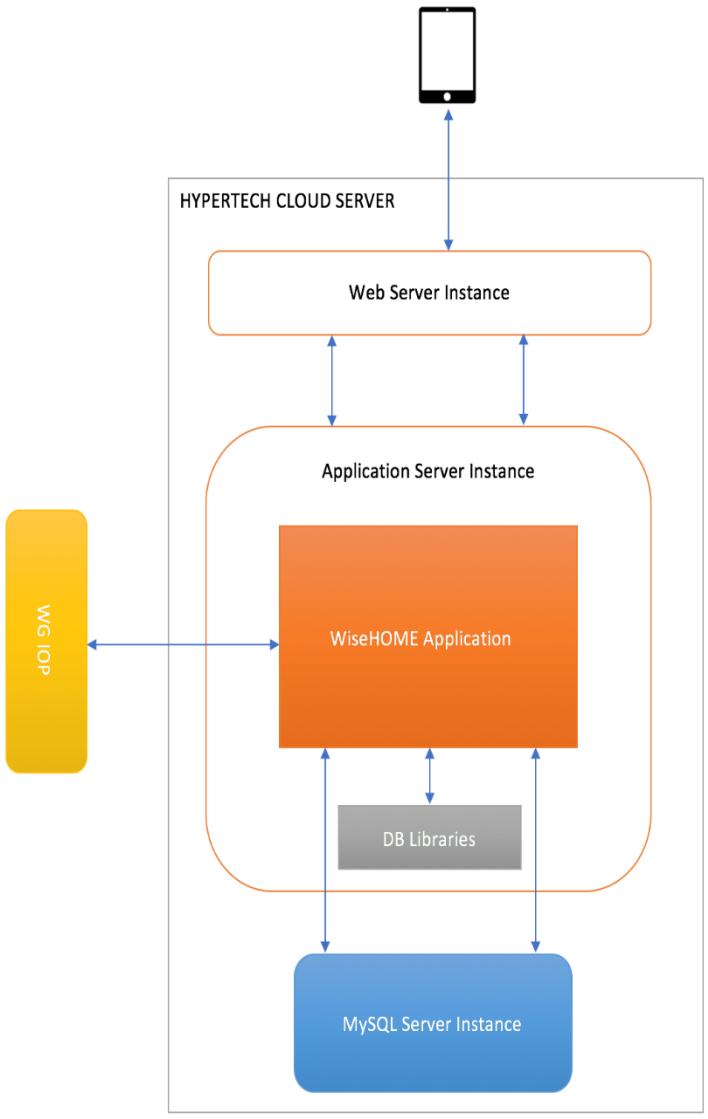

Figure 4 - Deployment of WiseHOME software components

reliability.

5.5 INFORMATION SOURCES

The WiseHOME application is meant to be a tool that is offered by retailer and / or other Smart Grid actors to the customers/ members so that the latter can have enhanced visibility on their energy-related activities, including energy consumption, generation, cost, etc. It is especially tuned for active energy consumers and cooperatives, it has a separate view for collective reports that illustrate the performance of the entire group of consumers (be they customers of the same retailer or members of the same cooperative) that illustrate information about the grid friendliness or the CO_2 intensity of the collective consumption.

It is thus evident that WiseHOME is not a standalone application, but is encapsulated in a wider ecosystem in order to function properly and achieve its business objectives – which directly reflect the objectives of the cooperative or retailer. On a more technical note, this has direct consequences on the management of the information that is visualised by WiseHOME. All of the information is available to the corresponding retailer/ cooperative and some of the information is exclusively available to these parties.

Within the WiseGRID product ecosystem, retailers and cooperatives are envisaged to use the WiseCOOP product in order to manage their daily activities. Everything from standard billing activities to more novel demand response campaign management will be handled by this product. As a result, it has been collectively decided within the consortium that all dynamic information that will be visualised by WiseHOME will be retrieved from the WiseCOOP tool. Dynamic, in this context, means all information apart from user credentials (that will be locally managed by WiseHOME) and basic configuration information that is necessary in order to identify the user (e.g. SMX ID and cooperative ID). All other information will be retrieved from WiseHOME on the fly for visualisation purposes using the message specifications described in Section 7. This decision has important positive repercussions on security and data privacy as well. It will make it much easier for the WiseGRID tools to handle any request from a user to provide or even delete any piece of information (owned by the user) that is stored within the WiseGRID system.

5.6 COMMISSIONING PROCESS

In order to visualise correct information to the app user, the WiseGRID tools – especially WiseCOOP & WiseHOME – need to know what a number of parameters, including:

- Which smart meter belongs to the specific user/ home
    - WiseHOME must be able to associate an app user (who for the app purposes is represented only by a username & password combination) with a specific home or a specific smart meter. The selection actually depends on how WiseCOOP – the retailer/ cooperative – tool has structured its information repository. The information should be provided in the form of a unique identification code, which can be verified with a simple request to the appropriate WiseCOOP instance and will be eventually used in all information-related transactions between the WiseGRID to identify the specific home.
- What equipment is available in the specific home
    - Homes may be equipped with any number of different energy-related devices or equipment. All home have some sort of heating/ cooling system and lighting infrastructure. They may also be equipped with batteries or renewable generation sources, however. The tools must be aware of the devices that are available in order to appropriately configure the user interface and visualise the proper information.
- How can the measurements corresponding to this equipment be obtained
    - Knowing the availability of equipment is the first step, how to obtain the relevant measurements is also critical. For instance, some devices may be able to report their status and measurements by themselves such as batteries. Other devices may require external measurement

equipment, e.g. the heating/ cooling system will likely need a sub-meter (or equivalent) in order for the WiseGRID tools to monitor its energy consumption. The WiseGRID products need to know where they can obtain the necessary information.

- How to cluster equipment sets into semantically coherent group
    - The generation of comfort profiles demands that the indoor temperature be correlated with user actions in order to understand which preferences lie within his comfort boundaries. If a home has multiple temperature/humidity sensors deployed (or multiple heating/cooling systems controlling different parts of the home), the WiseGRID tools must know which measurements or information can be semantically linked because they correspond to a single tuple of user and home space in order to automatically derive valid conclusions.
- etc.

The aforementioned information must be specified by the appropriate actor – e.g. the home resident or the retailer/ cooperative – during a commissioning step. For the proper design of this step, it is mandatory to have representative information about the pilot sites in order to cover their eventual requirements. As a result, further elaboration of this step has been postponed to the implementation phase of the WiseHOME. By then, more information will be available about the pilot site characteristics, infrastructure and their particular requirements. This information will be documented in deliverable D14.1 “Analysis of the Demo sites technical data and integration and demonstration planning” and will become the stepping stone for all eventual adaptations and configurations of the WiseHOME app in order to fulfil its promise.
During the implementation of the WiseHOME app, all these issues will be considered and properly addressed. The outcome will be documented in deliverable “D11.2 WiseHOME implementation & lab-testing”.

6 WISEHOME WIRE-FRAMING & MOCK-UP

This chapter illustrates and describes the user interface of the WiseHOME web app as it has been designed based on the existing input from the pilot site partners and the requirements documented in deliverable D2.1 "WiseGRID requirements, Use cases and pilot sites analysis".

The final layout and contents of the WiseHOME front-end have been fine-tuned after several iterations between Hypertech – as the WiseHOME developer – and the project pilot site partners – and mainly ECO-EID. The latter provided feedback based on their past experiences with facing residential consumers/prosumers and had the final word in the final views that comprise the app.

The main guidelines that were provided by the pilot site partners during these iterations were the following:

- The user interface should be simple and easily understandable: the average user will not be number-savvy and may not be very interested to comprehend and interpret complicated KPIs. Hence the UI should provide information that can easily be grasped by users and should be relevant to the aspects the user cares about the most, e.g. energy consumption, cost, CO2 intensity, power consumption (especially in countries with connection power caps).
- Messages from the cooperative/ retailer regarding upcoming electricity price spikes cannot be sent often: to keep users engaged and active when price signals arrive, they should not be bothered too often as fatigue will make them unresponsive in the longer term.
- Provide the user perspective on the performance of collective group of users: given that the most relevant pilot partners of the consortium are cooperatives, it is important to them to treat individual consumers as part of a larger group – typically a very energy conscious one. To achieve this goal, WiseHOME visualises metrics that are related to the collective performance of the cooperative members, such as CO_2 intensity which is closely related to self-consumption of renewable generation at the cooperative level or grid friendliness which is a proxy for stress on the distribution grid imposed by the consumption of the cooperative members.
- Illustration of dynamic price benefits: it is to the benefit of retailers and cooperatives to make energy consumers aware of their consumption patterns as well as of ways they can save on energy costs by adjusting them to times of cheaper electricity. Hence, the WiseHOME app visualises a dynamic price tariff to illustrate the average cost (e.g. per kWh) and expose the consumers to such concepts. It further visualises the impact on the energy cost that such a dynamic tariff would have. As a result, the user can experiment with shifting his energy consumption patterns and get immediate feedback about the energy cost under flat and dynamic tariffs. This feedback can be provided as often as on a daily basis, which becomes a valuable tool for the consumer in order to understand the benefits of dynamic prices and train himself to adopt energy habits that can lower his energy bills. So, when he can decide to switch to a dynamic price electricity plan he will have full knowledge of what to expect.

As mentioned beforehand, WiseHOME is a web application that must be accessible from various devices with different screen sizes. As a result, one of the major requirements was that of responsive web design, so that the interface renders well on any device and hence is usable regardless of the device of choice of the user.

In the remainder of this chapter the user interface will be briefly explained and two versions will be shown, one is the render for large screen – e.g. a computer screen – and the second is the render for a small screen – e.g. a smartphone screen.

6.1 LARGE SCREEN

6.1.1 User registration

The following is the first screen that a new user will encounter. It asks him to register to the application using a username and a password. The user can optionally provide an e-mail address, if he wants to receive reminders or messages via e-mail. Finally, the user is also asked to provide the cooperative (or retailer) with which he has a commercial engagement. This information is necessary so that WiseHOME knows which WiseCOOP instance to contact in order to obtain the user's energy related information.

It is evident that during registration, no personal information is collected for the users. The e-mail is provided only voluntarily and will not be used by WiseHOME for any other purpose than for notifications regarding his energy-related information.

At some stage, the user will also have to specify a unique ID that indicates the home or smart meter that he is associated with. Using this ID, WiseHOME will probe WiseCOOP for the user's energy information. This ID may be asked during the registration phase in the final WiseHOME implementation or during the commissioning phase.

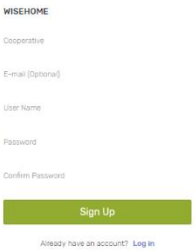

Figure 5 - User registration screen

6.1.2 Log in screen

After a user is registered in the WiseHOME app, he will encounter the following screen each time he accesses the web app in order to provide his credentials and log in.

Figure 6 - Log in screen

6.1.3 Operation

The main contents of the web app are split into three distinct screens or dashboards, including:

- Individual reports: this dashboard displays information about the performance of the user's home in terms of energy;
- Collective reports: this dashboard visualises information about the collective performance of the group comprising the portfolio of the retailer or the members of the cooperative;
- Cost information: this screen illustrates useful information about the electricity price and the energy cost for the particular household.

In order to provide useful information to the user, a lot of the information provided in the graphs is comparative against past reference periods of the same home. Given the seasonality of energy patterns as well as the diverse requirements of individual users, WiseHOME allows the user to define the reference period of choice. There are four available options: day, week, month and year. This reference period is selected from 4 buttons on the top right of the main user interface screen.

6.1.3.1 Tab 1: Individual reports

The screen showing information about the user's home energy performance shows a variety of metrics.

The actual power component illustrates the current instantaneous power consumption, as well as how this relates to the maximum allowable power consumption based on the existing supply contract.

The consumption pie chart shows information about the actual energy consumption of the household, compared against the consumption of a past reference period. The rightmost pie chart indicates how much of the consumed energy was imported from the grid and how much was self-generated. On the bottom half of this screen there is information about the energy cost and potential rewards from participation in demand response programs as well as information about the status of renewable and storage devices available in the home.

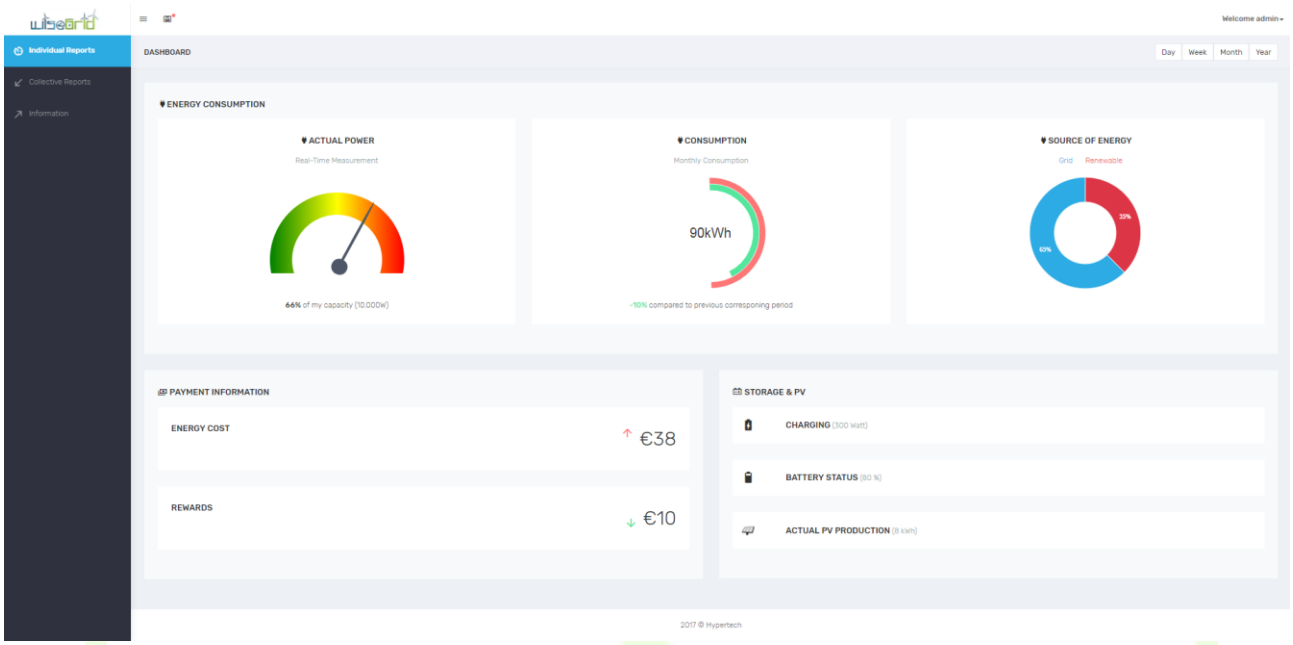

Figure 7 - Individual reports screen

6.1.3.2 Tab 2: Collective reports

The collective reports tab illustrates information about the performance of groups of energy consumers. The three graphs visualise the following:

- Local generation: the percentage of energy that was imported (and consumed) from the grid versus the percentage of consumed energy that was generated within the neighbourhood or cooperative by some renewable energy source that belongs to it;
- CO_2 intensity: this metric is meant to represent the carbon footprint of the energy consumed collectively and is effectively calculated using a CO_2 intensity factor. The more red the reading is, the more polluting are the energy sources that generated the electricity consumed. When renewable sources produce, this reading will lean toward the left/green side;
- Grid consumption: this metric depicts whether the dynamics of the collective energy consumption are aligned with the needs of the distribution grid. For instance, the grid typically has a peak in the evening of weekdays and further energy consumption at that period can stress it. A green reading on the traffic light means that the time profile of the consumption does not inflict further stress of the grid, and energy is consumed mostly at times of low overall demand. A red reading indicates that the collective consumption follows the time patterns of the overall grid demand, hence adds to the grid stress.

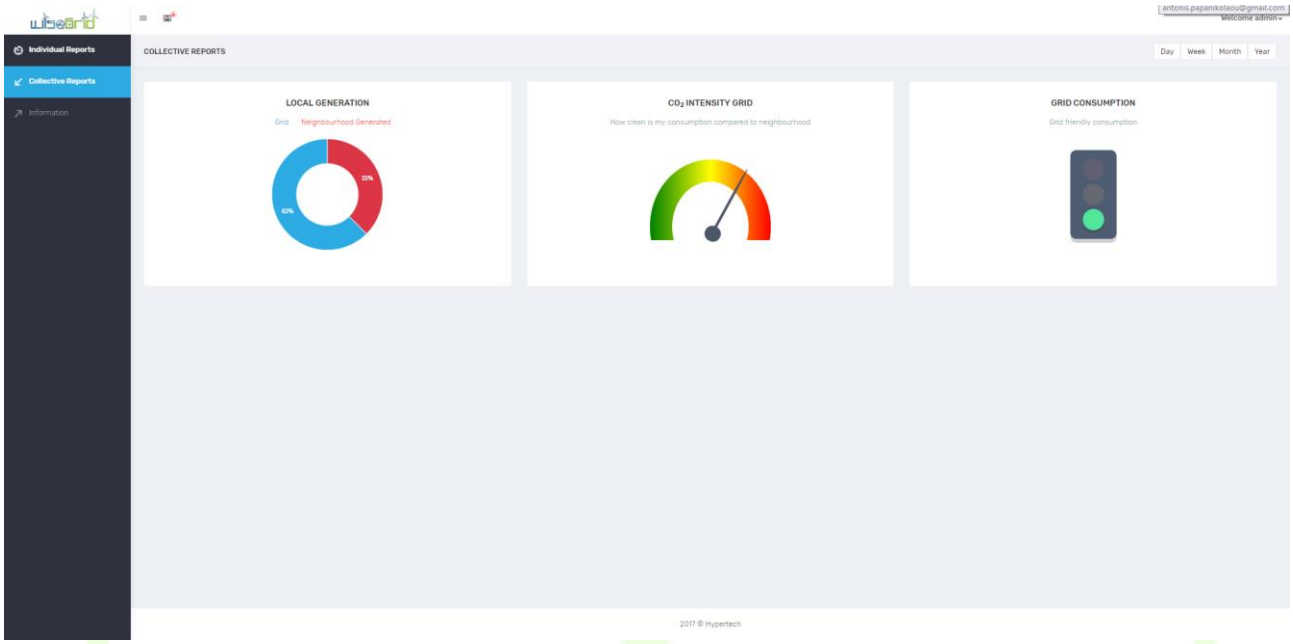

Figure 8 - Collective reports screen

6.1.3.3 Tab 3: Cost information

The purpose of the tab is twofold. On the one hand to inform the user about his energy cost in a graphical manner and by showing the evolution of cost. On the other hand, it also illustrates the impact of a dynamic tariff of the energy cost of the consumer. The figure in the left shows the dynamic electricity price, while the right figure shows the cumulative energy cost for the period of reference. The difference in total energy cost caused by the application of dynamic prices can be become evident in this manner. Furthermore, an interested user can also look into and anticipate price patterns, so as to schedule his energy consumption accordingly and reduce his energy costs.

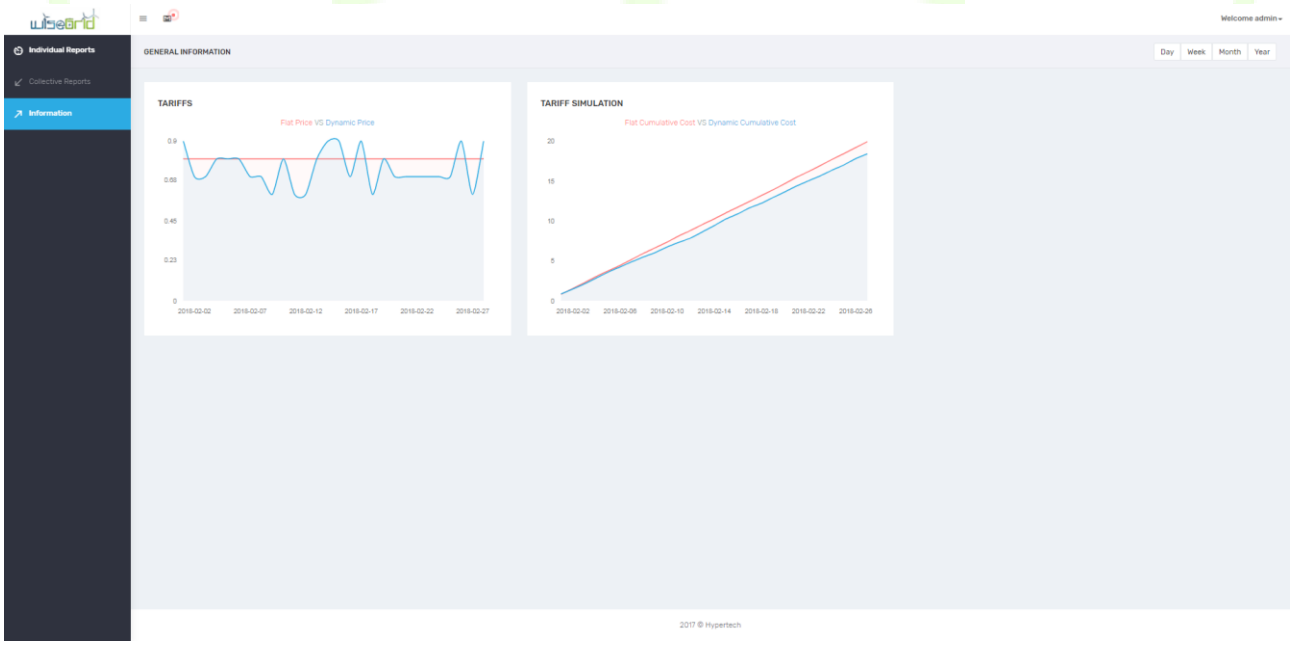

Figure 9 - Cost information screen

6.1.3.4 Notifications centre

The WiseHOME app includes a notification centre which will be used by any smart grid actor who wants to contact the user. The most frequent use will be the transmission of demand response requests by the retailers or the cooperative, so that the user can anticipate and respond to very high price signals.

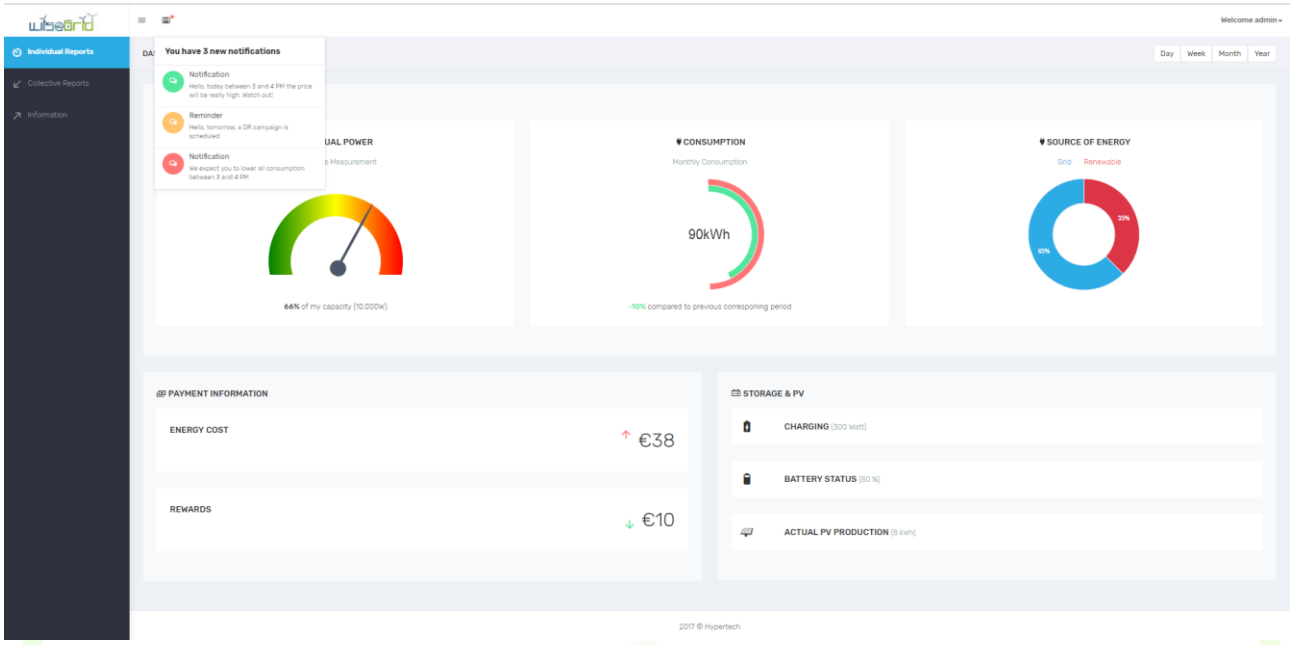

Figure 10 - Notifications centre screen

6.2 SMALL SCREENS

The design of the WiseHOME app has been performed in a fully responsive manner. This enables the user to use it from any device he has available without hampering accessibility or visibility. The following sub-sections illustrate how the WiseHOME app appears in a smartphone screen. These specific screenshots have been captured from a Pixel 2 smartphone device, but any modern smartphone should provide the user with a similar look and feel of the app. Only small deviations are expected due to potentially different screen aspect ratios and resolutions.

The various user interface elements and components (charts, diagrams, etc.) are exactly the same as previously described. Please refer to the sub-section 6.1 for clarifications.

6.2.1 User registration

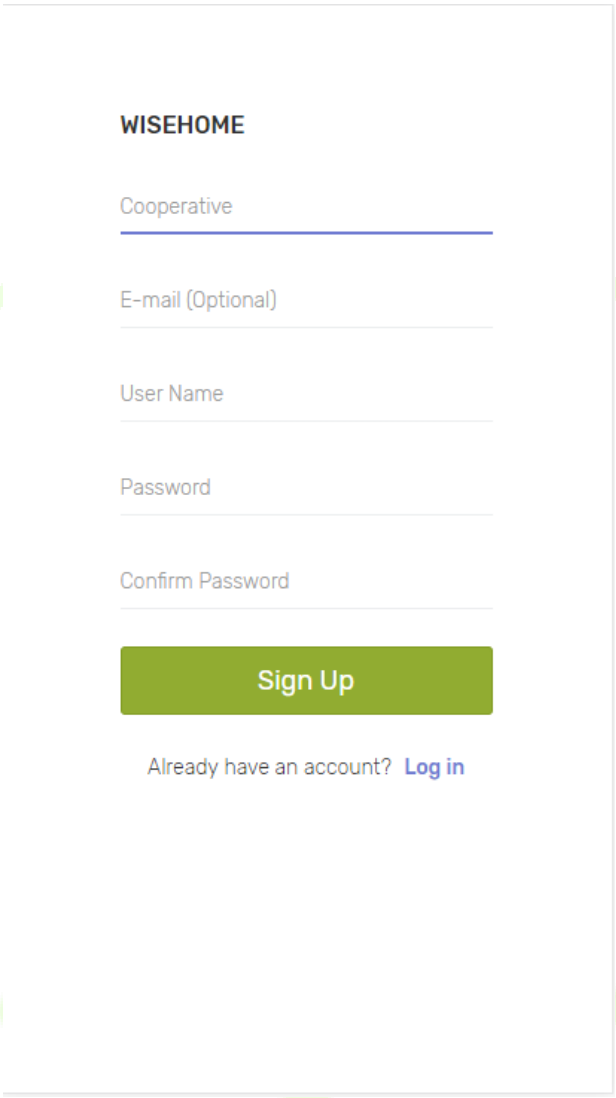

Figure 11 - User registration screen on smartphone display

6.2.2 Log in screen

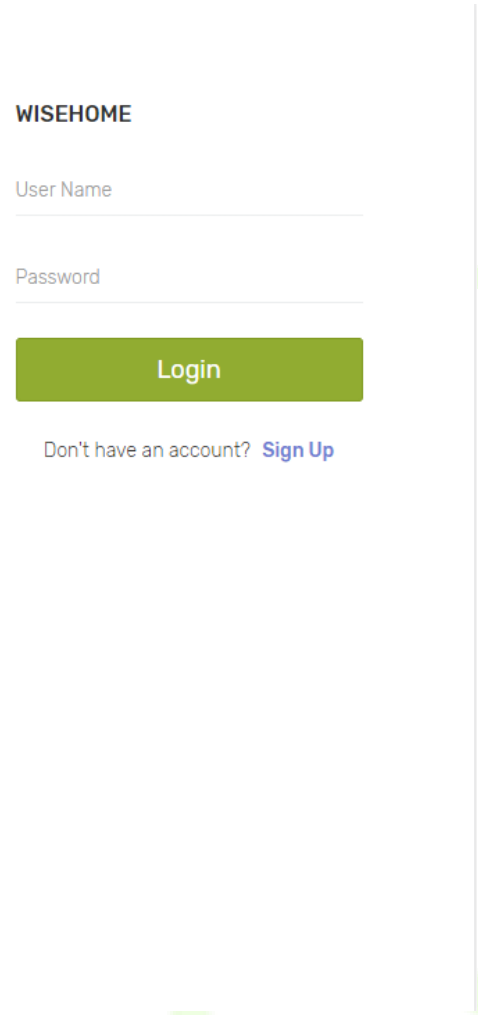

Figure 12 - Log in screen on smartphone display

6.2.3 Menu

Given the limited screen size of a smartphone, the menu is not shown by default. When the user touches an icon (three horizontal lines) in the top right side of the screen, the following menu appears.

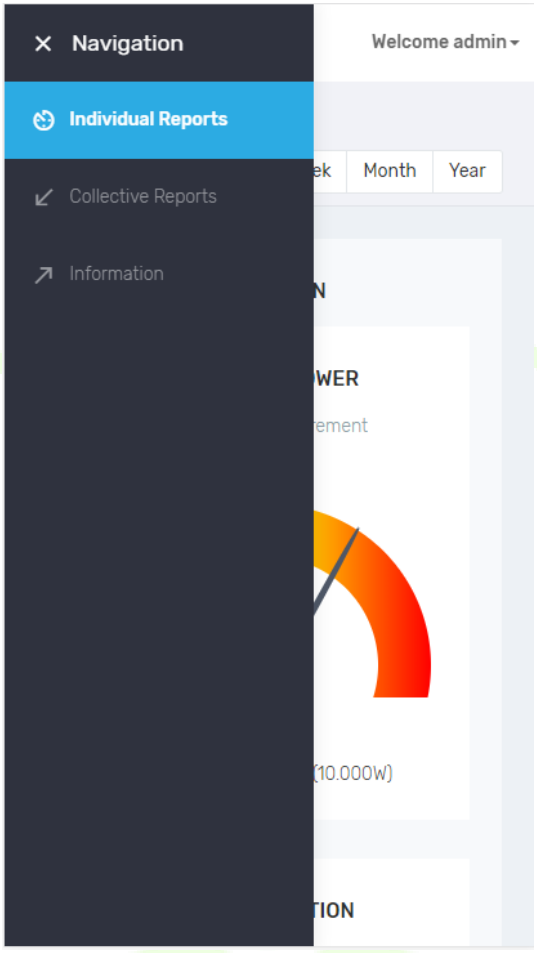

Figure 13 - App menu on smartphone display

6.2.4 Operation

6.2.4.1 Tab 1: Individual reports

The following screens correspond to the diagrams and charts explained beforehand. Multiple screen shots are provided, since the user will have to scroll down in order to see all the components.

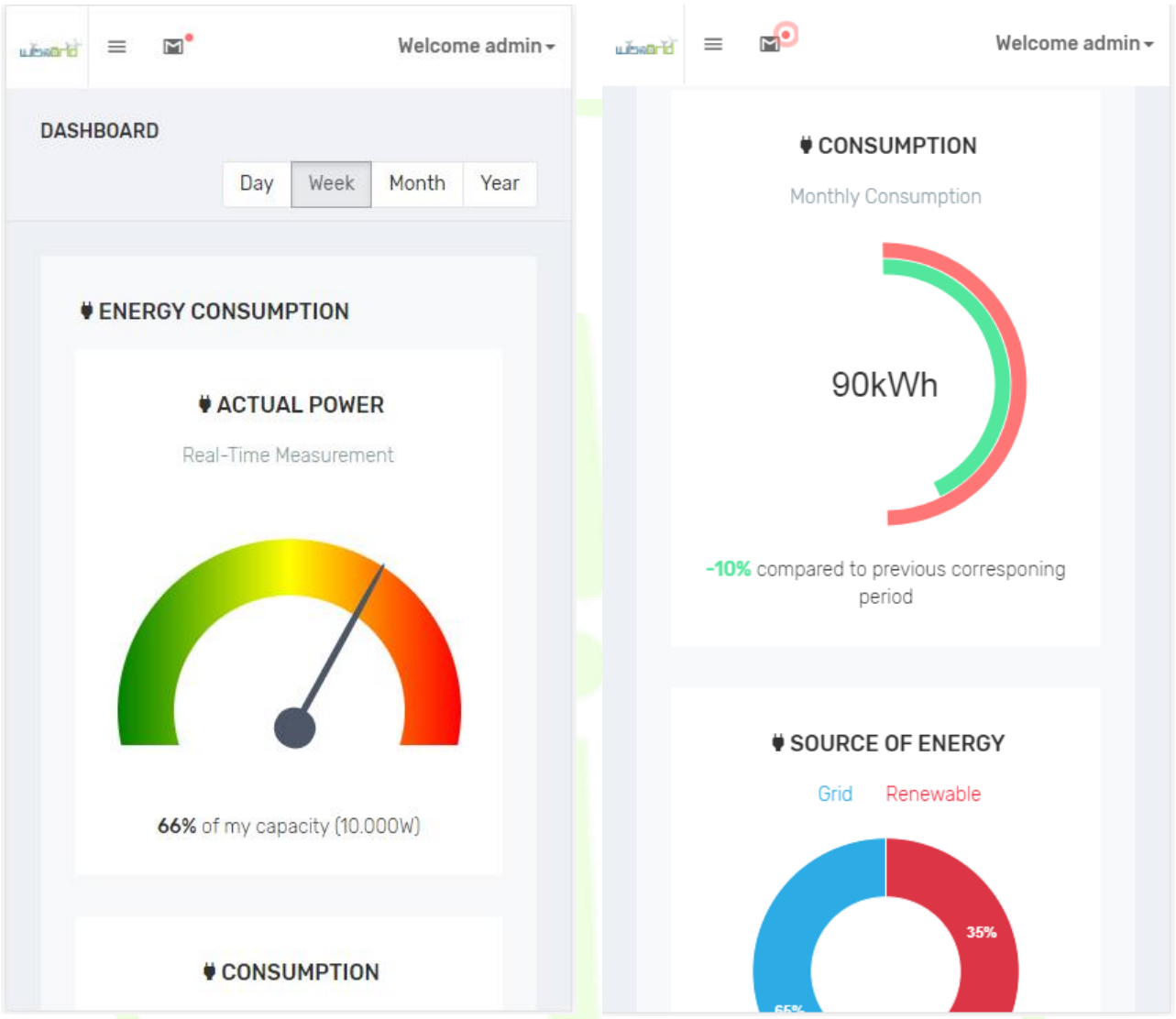

Figure 14 - Individual reports screen on smartphone display

6.2.4.2 Tab 2: Collective reports

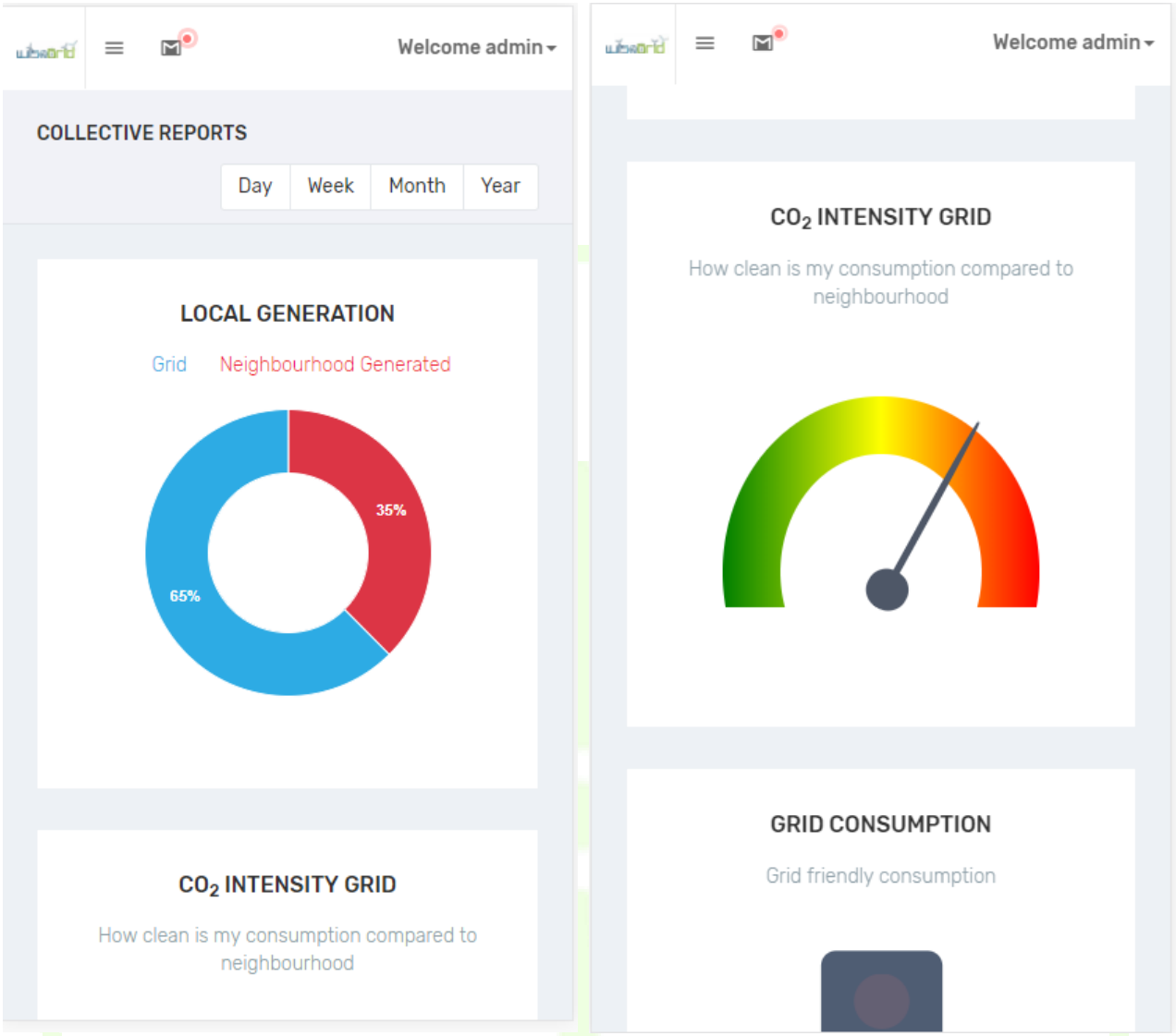

Figure 15 - Collective reports on smartphone display

6.2.4.3 Tab 3: Cost information

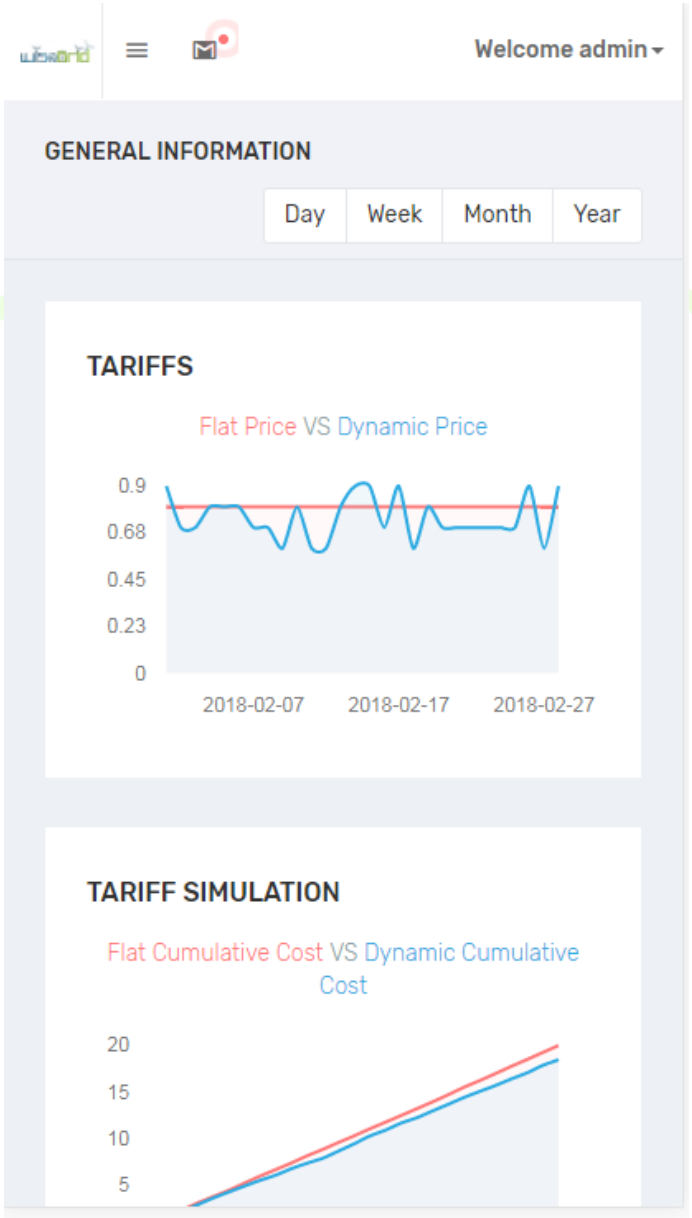

Figure 16 - Cost information on smartphone display

6.2.4.4 Notifications centre

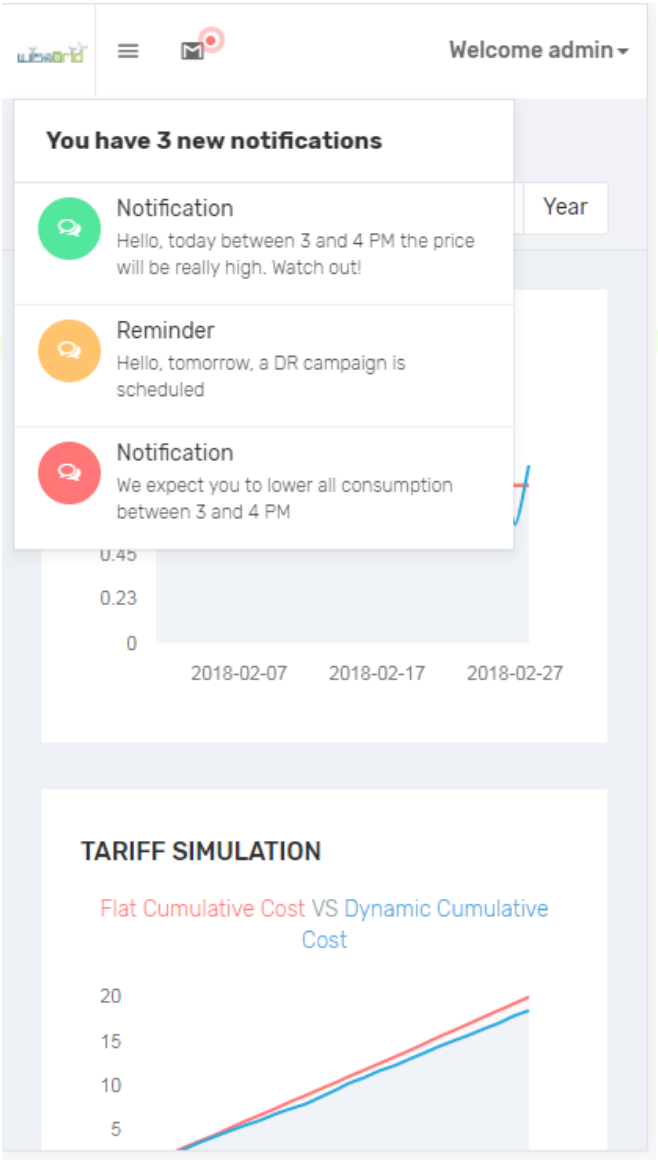

Figure 17 - Notifications centre on smartphone display

7 INTEGRATION WITH DATA SOURCES

7.1 INFORMATION SOURCES

The WiseHOME application is envisaged to become a tool provided by retailers, cooperatives and aggregators to their customers or members in order to stimulate their awareness and engagement with energy-related issues. As such, the application will be owned and offered by these actors and as a result all the information required for visualizations will be contained in the WiseCOOP databases.

This chapter will provide more details regarding the information required for the visualizations, including descriptions and message specifications in order to ease the integration efforts.

Information requests will be published to the WG IOP via specific messages. These messages will be received by the appropriate instantiation of WiseCOOP – the one of the retailer/ cooperative/ aggregator – who has the respective building in its customer portfolio. WiseCOOP should interpret the messages based on the definitions provided below and prepare and publish the corresponding response to the WG IOP.

7.2 INFORMATION REQUIREMENTS

The WiseHOME application will rely on information from other tools in order to show the necessary visualizations to the home resident. This information is summarised in the following tables per tab of the web application and for the reference time periods defined in collaboration with the perspective customers of the WiseHOME app.

7.2.1 Individual report tab of WiseHOME app

Table 5 – Information requirements from WiseCOOP for the visualisation of the individual reports

WiseHOME Tab		**Reference Period**			
Individual Reports		Day	Week	Month	Year
Widget 1:	***Instantaneous Power***	**Required Data**			
		Instantaneous Power Consumption			
		Connection Capacity			
Widget 2:	***Energy Consumption***	**Cumulative energy consumption visualization**			
		Cumulative daily energy consumption until now (<=24h)	Cumulative weekly energy consumption until now (<=7 days)	Cumulative monthly energy consumption until now (<=1 month)	Cumulative annual energy consumption until now (<=12 months)
		Cumulative energy consumption for the same calendar day of previous year	Cumulative weekly energy consumption for the same week of previous year until corresponding day	Cumulative energy consumption for the same month of previous year until corresponding day	Cumulative energy consumption during the same previous year until corresponding day
		Cumulative energy consumption for the	Cumulative energy consumption for the whole	Cumulative energy consumption for the full month of previous year	Cumulative energy con-

		same day (24h) of previous year	week (7 full days) of previous year		sumption during the entire previous year
		Energy consumption time-series			
		Energy consumption time-series until now (<=24h) in 15 min intervals	Energy consumption time-series until now (<=7 days) in 6 hour intervals	Energy consumption time-series until now (<=1 month) in daily intervals	Energy consumption until now (<=12 months) in weekly time intervals
		Energy consumption time-series for the same calendar day of previous year in 15 min intervals	Energy consumption time-series for the same week of previous year until corresponding day in 6-hour intervals	Energy consumption time-series for the same month of previous year until corresponding day in daily intervals	Energy consumption time-series during the same previous year until corresponding day in weekly time intervals
Widget 3:	***Energy Source***	**Cumulative electricity source information**			
		Cumulative grid-imported electricity consumed this day until now	Cumulative grid-imported electricity consumed this week until now	Cumulative grid-imported electricity consumed this month until now	Cumulative grid-imported electricity consumed this year until now
		Cumulative PV generation during the current day until now	Cumulative PV generation during the current week until now	Cumulative PV generation during the current month until now	Cumulative PV generation during the current year until now
		Cumulative feed-in during the current day until now	Cumulative feed-in during the current week until now	Cumulative feed-in during the current month until now	Cumulative feed-in during the current year until now
		Time-series of grid-imported electricity consumed this day until now in 15 min intervals	Time-series of grid-imported electricity consumed this week until now in 6-hour intervals	Time-series of grid-imported electricity consumed this month until now in daily intervals	Time-series of grid-imported electricity consumed this year until now in weekly intervals
		Time-series of local PV generation during the current day until now in 15 min intervals	Time-series of PV generation during the current week until now in 6-hour intervals	Time-series of PV generation during the current month until now in daily intervals	Time-series of PV generation during the current year until now in weekly intervals

		Time-series of feed-in during the current day until now in 15 min intervals	Time-series of feed-in during the current week until now in 6-hour intervals	Time-series of feed-in during the current month until now in daily intervals	Time-series of feed-in during the current year until now in weekly intervals
Widget 4:	***Costs***	**Cumulative cost information**			
		Cumulative energy cost of grid-imported energy for the current day until now	Cumulative energy cost of grid-imported energy for the current week until now	Cumulative energy cost of grid-imported energy for the current month until now	Cumulative energy cost of grid-imported energy for the current year until now
		Daily PV operation costs	Weekly PV operation costs	Monthly PV operation costs	Annual PV operation costs
		Time-series of cost information			
		Time-series of energy cost of grid-imported energy for the current day until now in 15 min intervals	Time-series of energy cost of grid-imported energy for the current week until now in 6-hour intervals	Time-series of energy cost of grid-imported energy for the current month until now in daily intervals	Time-series of energy cost of grid-imported energy for the current year until now in weekly intervals
Widget 5:	***Rewards***	**Cumulative reward information**			
		Cumulative income from electricity feed-in to the grid for the current day until now	Cumulative income from electricity feed-in to the grid for the current week until now	Cumulative income from electricity feed-in to the grid for the current month until now	Cumulative income from electricity feed-in to the grid for the current year until now
		Cumulative income from participation in explicit DR campaign for the current day until now	Cumulative income from participation in explicit DR campaign for the current week until now	Cumulative income from participation in explicit DR campaign for the current month until now	Cumulative income from participation in explicit DR campaign for the current year until now
Widget 6:	***Storage/PV***	**Real-time storage/generation information**			
		Battery Charging State			
		Battery State of Charge (%)			
		Instantaneous PV Generation Output			

7.2.2 Collective reports tab of WiseHOME app

Table 6 – Information requirements from WiseCOOP for the visualisation of the collective reports

WiseHOME Tab		Reference Period			
Collective Reports		Day	Week	Month	Year
Widget 1:	***Local Generation***	**Cumulative cooperative electricity generation data**			
		Cumulative grid imported electricity consumed by the cooperative during the current day until now	Cumulative grid imported electricity consumed by the cooperative during the current week until now	Cumulative grid imported electricity consumed by the cooperative during the current month until now	Cumulative grid imported electricity consumed by the cooperative during the current year until now
		Cumulative PV generation from cooperative during the current day until now	Cumulative PV generation from cooperative during the current week until now	Cumulative PV generation from cooperative during the current month until now	Cumulative PV generation from cooperative during the current year until now
		Cumulative electricity feed-in by cooperative during the current day until now	Cumulative electricity feed-in by cooperative during the current week until now	Cumulative electricity feed-in by cooperative during the current month until now	Cumulative electricity feed-in by cooperative during the current year until now
		Time-series of cooperative electricity generation data			
		Time-series of grid imported electricity consumed by the cooperative during the current day until now in 15 min intervals	Time-series of grid imported electricity consumed by the cooperative during the current week until now in 6-hour intervals	Time-series of grid imported electricity consumed by the cooperative during the current month until now in daily intervals	Time-series of grid imported electricity consumed by the cooperative during the current year until now in weekly intervals
		Time-series of PV generation from cooperative during the current day until now in 15 min intervals	Time-series of PV generation from cooperative during the current week until now in 6-hour intervals	Time-series of PV generation from cooperative during the current month until now in daily intervals	Time-series of PV generation from cooperative during the current year until now in weekly intervals

		Time-series of electricity feed-in by cooperative during the current day until now in 15 min intervals	Time-series of electricity feed-in by cooperative during the current week until now in 6-hour intervals	Time-series of electricity feed-in by cooperative during the current month until now in daily intervals	Time-series of electricity feed-in by co-operative during the current year until now in weekly intervals
Widget 2:	***CO_2 - Intensity Grid***				
		Average normalised CO_2 intensity for the current day (%)	Average normalised CO_2 intensity for the current week (%)	Average normalised CO_2 intensity for the current month (%)	Average normalised CO_2 intensity for the current year (%)
Widget 3:	***Grid friendly consumption***	**Required Data**			
		To what degree collective demand followed generation to maximise self-consumption during the current day	To what degree collective demand followed generation to maximise self-consumption during the current week	To what degree collective demand followed generation to maximise self-consumption during the current month	To what degree collective demand followed generation to maximise self-consumption during the current year

7.2.3 Information tab of WiseHOME app

Table 7 – Information requirements from WiseCOOP for the visualisation of the cost information

WiseHOME Tab		**Reference Period**			
Info		Day	Week	Month	Year
Widget 1:	***Tariffs***	**Electricity price information**			
		Flat electricity price (euro cents) per kWh			
		Time-series of dynamic price (euro cents) per kWh for the current day until now in 15 min intervals	Time-series of dynamic price (euro cents) per kWh for the current week until now in 6-huor intervals	Time-series of dynamic price (euro cents) per kWh for the current month until now in daily intervals	Time-series of dynamic price (euro cents) for the current year until now in weekly intervals
Widget 2:	***Tariff Simulation***	**Energy cost information**			
		Time-series of energy bill (euros) information under flat price for the current day until now in 15 min intervals	Time-series of energy bill (euros) information under flat price for the current week until now in 6-hour intervals	Time-series of energy bill (euros) information under flat price for the current month until now in daily intervals	Time-series of energy bill (euros) information under flat price for the current year until now

					in weekly intervals
		Time-series of energy bill (euros) information under dynamic price for the current day until now in 15 min intervals	Time-series of energy bill (euros) information under dynamic price for the current week until now in 6-hour intervals	Time-series of energy bill (euros) information under dynamic price for the current month until now in daily intervals	Time-series of energy bill (euros) information under dynamic price for the current year until now in weekly intervals

7.2.4 Horizontal requirements

In addition to the content-based requirements that are specified in the above tables, additional requirements include:

1. All aforementioned information should be searchable and retrievable via a unique ID (e.g. the smart meter ID)
2. Real-time measurements are required from all wrappers that implement interfaces to building devices in order to extract the device operational states

7.3 MESSAGE SPECIFICATIONS

WiseHOME will visualise information that will be obtained from the WiseCOOP product via the exchange of messages. This will happen in a request-response paradigm, whereby WiseHOME will publish requests for specific information in the WG IOP and the appropriate WiseCOOP instance – in case many are operational – will create and publish the appropriate response.

The following sub-sections define the details of the messages to be exchanged in order to ensure seamless information exchange.

7.3.1 Structure of generic message part

Apart from the parts of the messages that are related to the energy-related information to be exchanged, a preamble in the messages is required so that the tools can manage the communications. The following table supplies the necessary information.

Table 8 – Preamble specification for info exchange between WiseCOOP and WiseHOME

NN	*Name*	*M/O*	*Values*	*Description*
1	**"Sender"**	O	sender product ID	*Unique identifier of WiseHOME or WiseCOOP instance depending on which tool is sending the message*
2	**"Recipient"**	O	recipient product ID	*Unique identifier of WiseHOME or WiseCOOP instance depending on which tool is the target received of the message*
3	**"conversationID"**	O	Unique ID generated by WiseHOME instance during request generation	*Unique ID of conversation that comprises a request and a response between specific WiseHOME & WiseCOOP instances*

4	**"messageType"**	O	Enumeration	*REQUEST, RESPONSE*	*Specifies whether the message is a request for information sent from a WiseHOME instance or a response with information from a WiseCOOP instance*

This preamble includes the minimum required information so that products can associate messages to each other (e.g. responses with requests). The data fields are straightforward:

- Sender is the product that sends the message. WiseHOME will send the request and WiseCOOP will send the response. The most important aspect in this attribute is that it must specify exactly which instance of the two tools is the sender, in case multiple instances/deployments of WiseHOME and WiseCOOP are simultaneously active. For the WiseGRID purposes the WiseCOOP ID can be one of the pilot sites of the project, but in general any enumeration can be used.
    - The ID of each WiseHOME instance will be based on a combination of data from the username, the SMX ID and others.
    - The ID of the WiseCOOP instance will be one of the following: ECOPOWER, ENERCOOP, TERNI, HEDNO_MES, HEDNO_KYTH. The baseline assumption is that there will only one deployment of WiseCOOP instance per pilot site during the project pilot activities.
- Recipient is the target message recipient, same things apply as above.
- conversationID is a unique identifier that is common to a pair of request and response messages. It is a temporary value that has a lifetime starting from the generation of the request in WiseHOME and ending when the appropriate response from WiseCOOP is received. It will be used to keep track of message pairs that comprise a “conversation” in order to easily which data corresponds to which request.
- messageType is a field that specifies the type of the message, whether is a request or a response. It is useful for properly parsing and interpreting the message, even though semantically this information can be extracted from combinations of the other fields.
- Whether the contents of the generic message part will be used depends on the final configuration of the WG IOP. If the AMQP protocol is used with Virtual Hosts, then this information is redundant per message because the communication channel will be established up from between specific WiseCOOP and WiseHOME instances. Otherwise, this information may be needed per message.

7.3.2 Structure of information request message from WiseCOOP

The following table presents the structure of the message that will be sent by WiseHOME to WiseCOOP as a request for information that will provided by WiseCOOP and visualised in the front-end of the WiseHOME app.

Table 9 – Structure of request message (WiseHOME requests information from WiseCOOP)

NN	Name	M/O	Values		Description	Data type of expected response	Unit
1	"reference"	M	Enumeration with available values:	*USER*			-
				PILOT_SITE			-
2	"assetKey"	M	*Unique User/Cooperative Identifier*		*SMX ID or Pilot Site ID for WiseGRID purposes*		-
3	"dataType"	M	Enumeration with type of requested data:	*TIMESERIES*	*Expected type of data that should be included in the response (in case of time-series or cumulative data the respective time duration will be specified by the startTime, endTime and Interval parameters)*		-
				CUMULATIVE_DATA			-
				REALTIME MEASUREMENT			-
				ENUMERATION			-
				PERCENTAGE			-
				AVERAGE			
4	"metricType"	M	Enumeration with available types:	*ENERGY_CONSUMPTION*	*Consumption of grid imported energy for the time period specified*	*Float*	*kWh*
				ENERGY_COST	*Cost of grid-imported electricity for the specified time*	*Float*	*euro*
				SUPPLEMENTARY_COSTS	*Any costs incurred for electricity procurement beyond energy costs charged by the retailer or cooperative (e.g. roof-top PV rent or amortization)*	*Float*	*euro*

				POWER_MEASUREMENT	*Instantaneous power consumption*	*Float*	Watt
				CAPACITY	*Nominal connection capacity*	*Integer*	Watt
				PV_PRODUCTION	*Energy generation of the PV for the specified time period*	*Float*	kWh
				SELF_CONSUMPTION	*Self-consumed electricity for the specified time period*	*Float*	kWh
				CO2_EMISSIONS	*Normalised CO2 intensity of collective electricity consumption*	*Integer [0-100]*	%
				GRID_FRIENDLY_CONSUMPTION	*Friendliness of grid-imported consumption for grid*	*Enumeration*	Red, Yellow, Green
				FLAT_PRICE_PER_KWH	*Electricity price per kWh under flat tariff scheme*	*Float*	euro cents
				DYNAMIC_PRIC_PER_KWH	*Electricity price per kWh under dynamic tariff scheme*	*Float*	euro cents
				FLAT_COST	*Cost of consumed electricity for specified time period under flat tariff*	*Float*	euro
				DYNAMIC_COST	*Cost of consumed electricity for specified time period under dynamic tariff*	*Float*	euro
				BATTERY_SOC	*Battery state of charge*	*Integer [0-100]*	%
				BATTERY_CHARGE_AVAILABLE	*Instantaneous available charge in battery*	*Float*	Watt
				BATTERY_CHARGING_STATUS	*Operational mode of the battery*	*Enumeration*	Disconnected Connected Charge

							Discharge Standby Error Busy Islanding
5	**"startTime"**	O	*if **NULL**, last available data must be sent.*		*Timestamp specifying the start time in case a cumulative amount or a time-series is requested*	*Timestamp*	-
6	**"endTime"**	O	*if **NULL**, equals to current time (now)*		*Timestamp specifying the end time in case a cumulative amount or a time-series is requested*	*Timestamp*	-
7	**"Interval"**	O	Enumeration with available values:	*15 MIN*	*Enumeration specifying the time interval required when a time-series is requested*		-
				6 HOURS			-
				DAY			-
				WEEK			-

A few clarifications follow:

- The column M/O specifies whether a field is mandatory or optional. Optional fields will be included in the request message only when appropriate. More specifically, the optional fields specify a time duration and a sampling interval. So they are necessary when the requested information is a time-series or a cumulative value only.
- Time-series of energy consumption and generation or cost/price information is expected to include only the respective values within the specified interval, not the cumulative progression (hence, the evolution does not have to be monotonically increasing).
- The field “reference” dictates whether the requested energy related information (e.g. consumption, generation) is that of the individual home or of the entire cooperative.
- The field “assetKey” uniquely indicates which home or cooperative information is requested. In case of homes, the assetKey will be the SMX ID. In case of pilot site, the assetKey will take one of the following values, ENERCOOP, ECOPOWER, HEDNO_KYTH, HEDNO_MES, TERNI.

- The field “datatype” specifies the desired data format. Some information can be delivered as single values (cumulative_data) accumulating many values or can be delivered as time-series showing the detailed evolution of the value of the respective metric. Datatype clarifies what exactly is requested by WiseHOME in order to create the visualisation that the user has asked for.
- Some parameters – such as *CO2_EMISSIONS* & *GRID_FRIENDLY_CONSUMPTION* – are provisionally specified here in terms of measurement unit and data type. Their calculation method is not clear and must be defined by the project pilot partners and provided to the WiseCOOP developers in order to comply with the aforementioned specifications.

7.4 WG IOP INTEGRATION

The messages described above will be exchanged via the WG IOP as JSON messages. The exact configuration of the IOP in terms of topics and virtual hosts will define the specific integration aspects. In any case, the exchanged messages include all the necessary information to facilitate end-to-end communication. The following sub-sections provide samples of the request and response messages.

7.5 SAMPLE REQUEST MESSAGE

The following message is an example of a WiseHOME instance with ID ""001DK1004" asking the WiseCOOP instance of "ECOPOWER" for the following information:

- The time-series of energy consumption of the home with assetKey "DK1004" between 10:45 and 11:15 on 18/7/2017 in intervals of 15 minutes; and
- The cumulative energy cost of the same home from 10:45 on 18/7/2018 until today.


```
{
  "header": {
    "Sender": "001DK1004",
    "Recipient": "ECOPOWER",
    "conversationID": "ECPDK1004001",
    "messageType": "REQUEST"
  },
  "body": [
    {
      "reference": "USER",
      "assetKey": "DK1004",
      "dataType": "TIMESERIES",
      "metricType": "ENERGY_CONSUMPTION",
      "startTime": "2017-07-18T10:45:01.898Z",
      "endTime": "2017-07-18T11:15:01.842Z",
      "sampleTime": "15 MIN"
    },
    {
      "reference": "USER",
      "assetKey": "DK1004",
      "dataType": "CUMULATIVE_DATA",
      "metricType": "ENERGY_COST",
      "startTime": "2017-07-18T10:45:01.898Z",
    }
  ]
}
```


Figure 18 - Example of request message

7.6 SAMPLE RESPONSE MESSAGE

The following text box illustrates the associated response to the request above. The Sender and Recipient


```
{
  "header": {
    "Sender": "ECOPOWER",
    "Recipient": "001DK1004",
    "conversationID": "ECPDK1004",
    "messageType": "RESPONSE"
  },
  "body":[
    {
      "reference": "USER",
      "assetKey": "DK1004",
      "dataType": "TIMESERIES",
      "metricType": "ENERGY_CONSUMPTION",
      "endTime": "2017-07-18T11:15:01.842Z",
      "sampleTime": "15 MIN",
      "metricTimeseries": [
        {
          "value": 1.49,
          "timestamp": "2017-07-18T10:45:01.908Z"
        },
        {
          "value": 0.44,
          "timestamp": "2017-07-18T11:00:01.833Z"
        },
        {
          "value": 2.07,
          "timestamp": "2017-07-18T11:15:01.842Z"
        }
      ]
    },
    {
      "reference": "USER",
      "assetKey": "DK1004",
      "dataType": "CUMULATIVE_DATA",
      "metricType": "ENERGY_COST",
      "startTime": "2017-07-18T10:45:01.898Z",
      "value": 250.10
    }
  ]
}
```


Figure 19 - Example of response message (to the request illustrated in Figure 18)

IDs have been swapped and the conversationID remains the same to allow WiseHOME to associate the two messages.

7.7 INFORMATION STORAGE

The WiseHOME application will rely on other WiseGRID tools for the information to be visualised. Most information will be available by WiseCOOP, especially information that relies of metering data for its calculation. WG STaaS/VPP may also be involved – as it directly monitors and controls all batteries – in order to provide information about the status and activity of any battery installed in the home. In all cases, the information exchanged will comply with the format specified in Chapter 7.

Beyond temporary caching for visualization purposes, energy-related information will not be stored in a locally deployed database. The only information which will be managed by the WiseHOME is the credentials of the user – username & password; the cooperative or pilot site where the user belongs; his SMX ID – or other unique ID such as the home connection point code - as well as configuration information regarding available equipment in the home.

8 CONCLUSIONS

The previous chapters of this report have documented the outcomes of the design process of the WiseHOME application.

In order to wrap up the material and provide some conclusions to the reader, the present chapter aims to highlight how the original requirements were met or if they were not met to explain the reasons why.

Table 10 illustrates the status of the requirements imposed by the WiseHOME app in order to deliver a fully-fledged functionality that included features beyond what is currently documented in this report. Out of the requirements list, several key requirements were achieved – such as information consistency and market information availability – which ensures that the basic functionality will be able to operate without problems. Some requirements – that if met could unlock further WiseHOME functionalities or services – will probably not be achieved due to the lack of infrastructure in the lab and field sites for testing purposes. Two main requirement classes that fall under this category is the availability of remotely-controllable residential loads and the availability of EV charging stations at homes. The lack of these renders several potential functionalities as useless, hence it makes no sense to clutter the user interface with such information that will most likely confuse the user rather than provide any value.

Table 10 – Requirements of the WiseHOME app and compliance justification

Requirement ID	Description	Type	Achieved
HOM_028	Data should be consistent ensuring that way the reliability of the app	Performance requirements	Y
HOM_031	Under automated demand-response, cleanest energy sources must always be prioritized against fossil-fuel based ones	Operational requirements	?
HOM_032	Remotely controllable loads	Operational requirements	?
HOM_033	Real-time monitoring information about indoor/exterior conditions in buildings	Functional and data requirements	?
HOM_034	Maintenance of devices information (solar panels, boilers, air conditioning...)	Operational requirements	?
HOM_035	Calculation of the optimal power term for each prosumer	Operational requirements	?
HOM_036	Market information availability	Functional and data requirements	Y
HOM_037	Anonymizing data from private EVs	Security requirements	?
HOM_042	WiseHOME must have access to assets-to-be-controlled or their load controller via remotely accessible APIs (preferably over IP, e.g. REST interfaces)	Operational requirements	?

Table 11 highlights the requirements on the WiseHOME app, what the app should provide along with an indication whether the requirement was met, and if not a brief explanation.

Table 11 – Requirements on the WiseHOME app and compliance justification

Requirement ID	Description	Type	Achieved
HOM_001	End users should get access to energy consumption, local generation (if any) and storage (if any) information (real time and historical) in a personalized way	Functional and data requirements	Y
HOM_002	End users should get access to energy cost & CO2 intensity information (real time and historical data) in a personalized way	Functional and data requirements	Y
HOM_003	End users should get informed about retailer prices and available tariff schemas	Functional and data requirements	Y
HOM_004	Along with real time information end users will receive information about short term consumption and generation forecast	Functional and data requirements	?
	After extensive deliberation within the consortium – including partners representing end users, it became clear that the forecast information does not provide any added value to the residential user. Such forecasts are available with WiseCOOP and can be visualised by WiseHOME, but were deemed as too complex information for the average residential user and without value.		
HOM_005	Advices and recommendations about efficient energy usage should be triggered to the end users	Functional and data requirements	?
	This is indirectly achieved via the communication of price signals to the residential prosumers. However, more detailed and personalised recommendations would require the availability of knowledge about the home loads and the usage patterns (via sub-metering infrastructure) as well as user comfort preferences. This information will not be available from homes in the WiseGRID demonstration sites due to lack of infrastructure, so more detailed and personalised advice cannot be provided.		
HOM_006	Notifications about activation of manual driven Demand Response Strategies should be available via WiseHOME app	Functional and data requirements	Y
HOM_007	The end users should get informed about incentives (for DR participation) or penalization (for non DR participation)	Functional and data requirements	Y
HOM_008	The app should be as user-friendly as possible	Usability and humanity requirements	Y

Requirement ID	Description	Type	Achieved
HOM_009	Consumer or prosumers need to have an opt-out option for DR/ADR programs (if ADR is exploited in the project).	Functional and data require-ments	Y
HOM_010	The application GUI should be designed in a user-centric way i.e. involving the feedback of the end user at the de-sign phase	Look and feel re-quirements	Y
HOM_011	The granularity of consumption and generation infor-mation presented to the consumers/prosumers should be at least (min) at an hourly level	Functional and data require-ments	Y
HOM_012	WiseHOME app should include remote control of smart devices for end users	Functional and data require-ments	N/A
	Remotely-controllable devices will not be available in the residential premises of the demonstration sites, so such a functionality would be impossible to implement.		
HOM_013	WiseHOME app should illustrate cost savings	Functional and data require-ments	Y
HOM_014	WiseHOME shall allow its users to set constraints to the remote control of the smart appliances	Operational re-quirements	N/A
	As mentioned above, the lack of remotely controllable loads renders the achievement of this requirement impossible.		
HOM_015	Notifications about activation of Automated Demand Response Strategies should be available via WiseHOME app	Functional and data require-ments	Y
HOM_016	End users should get informed about active DR contracts in a personalised way	Functional and data require-ments	Y
HOM_017	End users should get informed about the best practices towards optimally participating in active DR contracts	Functional and data require-ments	Y
HOM_018	Simple analytics over historical data (consumption/ gen-eration/ cost etc..) will be provided by the tool	Functional and data require-ments	Y
HOM_019	End users (prosumers) should get access to local genera-tion data, if any	Functional and data require-ments	Y
HOM_020	End users (prosumers) should get access to local storage data if any	Functional and data require-ments	Y

Requirement ID	Description	Type	Achieved
HOM_021	Apart from DR strategies, ESCOs and Aggregators may trigger additional messages to the portfolio users via the app	Functional and data requirements	Y
HOM_022	The application will support social networks integration, to allow that way comparison with similar peers	Functional and data requirements	?
HOM_023	The end users will be able to configure the WiseHOME app settings (username, password, social media connection)	Functional and data requirements	Y
HOM_025	Data must be presented in an accessible, understandable and flexible format	Usability and humanity requirements	Y
HOM_027	End user credentials are required for accessing the app	Security requirements	Y
HOM_029	The structure of the app should address scalability requirements	Performance requirements	Y
HOM_030	Access on the WiseHOME should not be dependent on the connecting device	Operational requirements	Y
HOM_038	WiseHOME app should include a user support section.	Usability and humanity requirements	?
	This requirement has not been met in the current phase of the WiseHOME app design and development, but the necessary extensions can be made during the implementation phase if more details are provided about the requirement.		
HOM_039	Private EV owners end users should get access to EV management for domestic charging.	Functional and data requirements	N/A
	The demonstration sites will not have EV charging stations in the homes, so this requirement cannot be met.		
HOM_040	WiseHOME app shall allow its users to set constraints on the use of their data.	Usability and humanity requirements	Y
HOM_041	WiseHOME will be able to execute the home EVSE's flexibility offers (V2H and/or smart charging capabilities)	The scope of the product	N/A
	As mentioned above, this is not possible due to the lack of residential charging stations.		

9 BIBLIOGRAPHY

[1] Wikipedia, "Mdel-View-Controller," [Online]. Available: https://en.wikipedia.org/wiki/Model%E2%80%93view%E2%80%93controller.

10 ACRONYMS

Acronyms List	
A/C	Air Conditioning
ADR	Automated Demand Response
DB	Database
DR	Demand Response
ESCO	Energy Services Company
EV	Electric Vehicle
EVSE	Electric Vehicle Supply Equipment
HTML	Hyper Text Markup Language
IR	Infrared
KPI	Key Performance Indicator
MVC	Model View Control
PV	Photovoltaic
REST	Representational State Transfer
SLA	Service Level Agreement
SMX	Smart Meter Extension
UC	Use Case