islander
ACCELERATING THE DECARBONIZATION OF ISLANDS' ENERGY SYSTEMS

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DEMAND RESPONSE APP USER GUIDE

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ABBREVIATIONS

List of abbreviations

App	Application
AYE	Ayesa Advanced Technologies
BCM	Elmy
DER	Distributed Energy Resource
DR	Demand Response
HES	Hybrid Energy Storage
KPI	Key Performance Indicator
KUL	KU Leuven
SEZ	Steinbeis Europa Zentrum

EXECUTIVE SUMMARY

This deliverable focuses on the development of a mobile application to enable the participation of the island's inhabitants in an energy service called Demand Response.

The objectives of the development of this application are twofold. The first is to offer users a tool that allows them to improve their electricity consumption (making them save on their electricity costs) by sending them recommendations.. These recommendations provide accurate information on actions that can be taken by the island's inhabitants to adapt their consumption to the needs of the electricity grid. To this end, both, the application and the associated IT platform, take into consideration the state of the grid, consumption and production forecasts, the availability of renewable energy on the island and the user's preferences. The second objective is to expand the use of the application among the island's inhabitants and increase their interest in using it for as long as possible. To achieve this other goal, the development of the app has taken into account the existing accessibility guidelines in the European territory, as well as different gamification.

The result of all the aforementioned actions is the development and implementation of an application, adaptable to iOS and Android operating systems, which allows to improve the behavior of the Borkum power grid and meet one of the main objectives of the project, to advance in the decarbonization of the island.

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1 INTRODUCTION

The ISLANDER project aims to establish the basis for achieving the decarbonization of the island of Borkum (Germany) by 2030. The actions carried out within the project seek to reduce dependence on the use of traditional fuels such as coal, gasoline or gas. To this end, different initiatives have been carried out, such as the installation of different renewable energy assets DER (Distributed Energy Resource) and HES (Hybrid Energy Storage) to increase the production and storage of renewable energy. The development of optimization and prediction algorithms to improve the management of the island's available renewable energy. And finally, the use of a computer platform and cell phone applications that work together to inform users of the status of the equipment installed on the island.

This paper presents the development of a mobile application to allow the inhabitants of the island to participate in an energy service called Demand Response (DR). This energy service is explained in more detail in the next point of this document. It is basically based on managing the energy consumption of the electrical devices that a user has connected to the grid in order to avoid consumption peaks and increase the energy valley zones of the market. In this way, the renewable energy available on the island can be used to the maximum and, at the same time, a stabilization of the state of the electrical grid is achieved, which improves its performance.

This deliverable contains all the relevant information grouped in several points so that any user can understand how the application works.

The first section includes an explanation of the basic concepts necessary to understand the energy service offered by the mobile application to users, the Demand Response. Next, a detailed explanation of the criteria followed to increase the app's accessibility is provided. The third point shows the design of the app and the functionalities it contains (user registration, dashboard, recommendations, user configuration and visualization of results). In the next two sections, an explanation of the Automatic and Default modes of operation is provided, designed to serve two types of users that can be found on the island, see below. Further on, in the sixth point, an explanation of the gamification approach is given, whose purpose is to increase the motivation of the inhabitants of the island to use this tool. Finally, the final conclusions obtained after carrying out the first proofs of concept are included.

It is important to emphasize that all the examples or sample images included in this document are initial mockups at the date of delivery of the document. The objective is to improve the design as the project progresses.

2 DR ENERGY SERVICES

At this point we will discuss the different types of energy management services that we intend to offer through the use of the application designed for the DR of the inhabitants of the island of Borkum.

In general, the electricity market is characterized by varying demand curves. These vary

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according to the needs of the customers and the energy available in the grid. The role of the grid operator is to try to match customer demand and available energy in the grid at all times, while ensuring that the grid load threshold is not reached. DR services try to provide additional support to the grid operator by reducing users' energy consumption at times of peak consumption. And by encouraging users to increase their consumption in those periods of time where the demand curve has valleys.

Numerous methods are available in the market to carry out this type of actions. Alston and Piette (Alstone & Piette, 2020) have differentiated 4 different types of actions depending on the time scale in which the operator intends to act (see Figure 1).

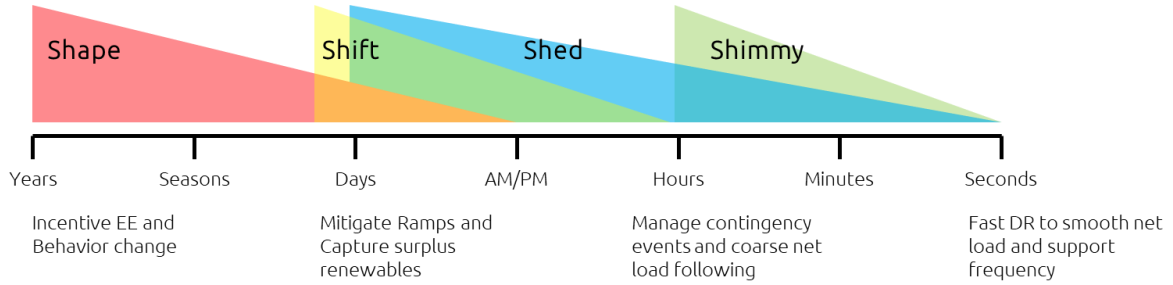

Figure 1. Categories of DR Service from years to seconds (Alstone & Piette, 2020)

As can be seen, Shape focuses on actions for energy use over long periods of time, ranging from hours to months or seasonal periods. Shift actions are measures to shift the hourly use of energy according to the availability of renewable electricity generation, i.e., measures to reduce load disconnection in order to reduce peak demand. On the other hand, Shed measures respond to critical moments in the grid by reducing the load. And finally, the actions called Shimmy involve a fast action to shape the demand according to the load in order to maintain the balance of the network. The latter can use renewable energy surplus at that time in the power grid.

In order to meet the decarbonization targets for the island of Borkum, it should also be considered that the above measures will be focused mainly on users with small consumptions more related to households or small/medium businesses, than for industrial facilities with large levels of energy consumption.

Later, in the following sections, as the different sections of the app are explained, it will be possible to see how the types of Demand Response mentioned above are included in the application. The reader can see that in order to carry out the actions mentioned, the application must consider the type of user to whom it is going to send an action recommendation, the availability of these people, the characteristics of their installation (home in most cases) and whether the action is going to be manual or automatic.

3 ACCESSIBILITY

This section is aimed to explain the importance of mobile app accessibility and provide the checklist to follow while developing the Demand response app.

Mobile applications have currently become an integral part of daily life, their role is now similar

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to that of "public places", therefore the accessibility of mobile apps becomes an essential factor.

The Web Content Accessibility Guidelines (WCAG), an internationally recognised accessibility standards created by the World Wide Web Consortium (W3C), apply to both web pages and mobile applications, including native and hybrid applications. These guidelines provide detailed explanations on how website and app owners can make their platforms accessible to users with various types of disabilities to avoid discrimination against them in everyday life.

It is not a well-known fact, but a large percentage of app users have a disability. When they try to download and interact with they expect to be able to use it the way they hoped, and if it doesn't work, they will simply delete it and another customer will be lost.

Accessible mobile app is crucial for people who have any type of these disabilities (Accessibility, 2023):

- Cognitive impairments. This includes conditions such as ADD, dyslexia, and Alzheimer's. These app users are either easily distracted or can't keep track of too many different screens or topics.
- Visual impairments. This includes color blindness, partial and complete blindness. People from this group rely on contrast and visual alternatives to process content.
- Auditory impairments. App users with partial or complete loss of hearing require alternatives of auditory format in order to process the app.
- Mobility impairments. Users with mild to severe mobile communication impairments will not be able to move dexterously or make targeted taps when using the app.

WCAG 2.0 guidelines are categorized into three levels of conformance in order to meet the needs of different groups of users and different situations: A (lowest), AA (mid range), and AAA (highest). Conformance at higher levels indicates conformance at lower levels. For example, by conforming to AA, the web page or mobile app meets both the A and AA conformance levels. Most web owners prefer AA accessibility level since it is both achievable and meaningful, while the design and development do not suffer too much.

To conform to WCAG 2.0 the app has to satisfy the success criteria. There are 78 success criteria in general, with each one assigned a level (Inclusion & Accessibility, 2023).

All success criteria must be testable, otherwise it would not be possible to determine whether a page met or failed to meet the Success Criteria. The Success Criteria can be tested manually or with help of accessibility tools.

Success criteria are assigned to one of three levels of conformance depending on different interacting issues. Some of the factors evaluated when setting the level:

- whether the success criteria is essential, meaning that without meeting it even assistive technology can't make content accessible
- whether there is a way to satisfy the success criteria for all types of content
- whether the success criteria requires special skills
- whether the success criteria would impose limits on functionality, design and presentation of the mobile app
- whether there are no workarounds if the success criteria is not met.

Conformance Levels: A, AA, and AAA (W3C, 2023).

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- Level A – Basic accessibility. This accessibility level is the most important for any application. In case a web page or mobile app doesn't meet success criteria of this level significant accessibility issues may arise that prevent users with disabilities from using the application.

  At this level, within the current guidelines (WCAG 2.1) there are 30 criteria that organizations must meet.
- Level AA – Strong accessibility. While level A allows organizations to cover the basics, level AA aims to make web content accessible in a wider variety of contexts.

  At Level AA, success criteria includes 30 criteria at Level A plus an extra 20 requirements.
- Level AAA – Excellent accessibility. Level AAA is the highest possible conformance level in WCAG and is definitely more difficult to achieve (for example, contrast ratio between text and background should be at least 7 to 1, pre-recorded video content must have a sign language translation etc). The goal should be to meet at least some of its success criteria.

  Level AAA includes 28 extra requirements apart from AA level criteria.

Demand response app should meet at least AA level.

Mobile Application Accessibility Checklist (AA level)

When it comes to making the Demand response app accessible to disabled users, there is a non-exhaustive list of success criteria the Ayesa developers should pay particular attention:

- Keep layouts consistent. The idea is to maintain all the content of the app and its multiple screens consistent, for example position navigation in the same location on all pages, keep the same order of components within navigational menus, give every page a title that clearly describes its content and purpose, use headings consistently.
- Pay attention to color contrast. Make sure to have a contrast ratio of at least 4.5:1 between controls or text and the background for small/normal text, with the exception of disabled components. Images should also be vetted for sufficient contrast. For the large text the contrast should be at least 3:1.
- Adjust tap target sizes. In case of multiple elements they should be large enough and have suficient space around so that the app users can easily tap them. This refers to the elements such as buttons and tappable icons.
- Make data entry easy. Try to provide easy methods for data entry in order to facilitate text entry for disabled users. You can reduce the amount of required text by adding checkboxes and auto-filling information such as the date and time. Another recomendation is to provide autofill and data sharing functionality.
- Simplify app gestures. All the actions needed to control a mobile application should be as simple as possible for the convenience of users with disabilities. Choose tap or swipe gestures over more complex ones.
- Test all the screens with the Screen reader tool. The screen reader should be able to describe all controls on the page when you tap on them, and the descriptions should be intelligible. Test your app with TalkBack (Android) and VoiceOver (iOS).
- Pay attention to scale factors. The UI should remain legible and usable at very large

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scale factors for text size and display scaling.

- Active interactions. Ensure that all active interactions do something. Any button that can be pushed should do something when pushed. For example, if you have a no-op callback for an onPressed event, change it to show a SnackBar on the screen explaining which control you just pushed.
- Errors. Important actions should be able to be undone. In fields that show errors, suggest a correction if possible.
- Color vision deficiency testing. Controls should be usable and legible in colorblind and grayscale modes.
- Context switching. Nothing should change the user's context automatically while typing in information. Generally, the widgets should avoid changing the user's context without some sort of confirmation action.

4 APP DESIGN

In this section we will explain the structure of the app and its main functionalities. The main objective is that the reader can understand in broad strokes how the application works, as well as the different sections of which it is composed. The registration or access process, the sections that make up the dashboard, the type of recommendations that can be received on the cell phone, the availability of the users and the visualization of the results obtained will be explained.

4.1 Registration

Registration is the first step in the use of the application, not including, of course, the downloading of the application to the user's cell phone.

In order to complete the registration process, the user must provide personal information in order to integrate it into the computer platform. In order to protect the confidentiality and personal data of all the inhabitants of the island who want to use the application that will be provided to them, the Islander project will follow the regulations applicable within the European Union. This involves taking legal action to allow the encryption of any personal data of these users.

The information that will be requested to complete the registration process in the application and later to be able to open and use it is the following:

- User's email. This parameter is necessary to be able to contact with the users, to carry out confirmation processes and to send relevant information regarding changes in the application and changes in the project if any.
- Password. The user must enter a secure and personal password. This password can be used not only to allow the registration of the person, but also to allow the access to the application, or even to recover the credentials in case of losing the cell phone or the access to the app.

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- **First name and last name**. This information will be treated confidentially by the application following the established criteria of data protection of the EU and the Islander project.

The following image shows the screen that all new users must fill in to be able to register and access the RD app. As can be seen, the above mentioned parameters are included.

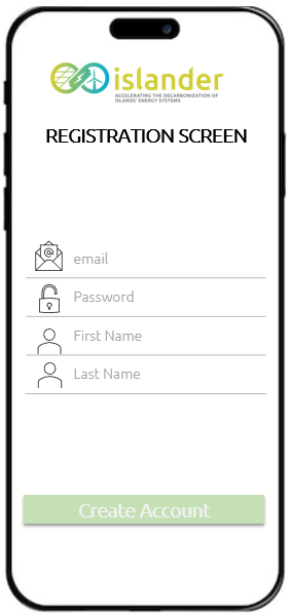

Figure 2 – Registration Screen for the DR app

4.2 Dashboard

The application dashboard is the main screen and probably the one most used by the user. This section includes the most relevant information that will be offered to the inhabitants of the island.

For its design, the recommendations provided by KUL, one of the partners of this project, have been considered. These actions are the result of a study called "Report on the Consumer engagement actions" (Leuven, 2023) where the main necessary aspects that a Demand Response application should contain are summarized based on an analysis of several studies that deal with this type of energy service (Schultz, 2015) (Valor, 2019), (White, 2019).

The main recommendations are listed below:

- Include feedback on energy consumption in terms of: kWh, cost (money) and environmental impact (CO_2)
- Include application notifications, to keep consumers engaged with the application
- Provide comparison feedback and include visualization of the behavior (colors or emoji's to indicate whether they are doing better or worse)
- Make the demand response app attractive
- Ensure trust in application and respect of one's privacy

Considering these criteria, the dashboard design shown in Figure 3 has been made.

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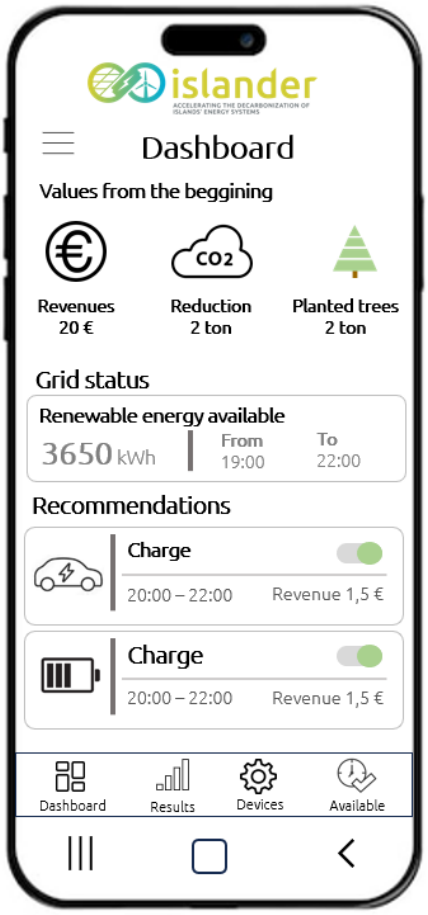

Figure 3 – Dashboard of the DR app

Each of the sections that appear in the initial dashboard will be explained below.

4.2.1 Prosumers'installations.

As mentioned above, it is necessary to provide special access for prosumers. In order to have quick access to the control of the installations and to be able to see the energy flow of the electrical network, an icon has been included in the dashboard of the application. By clicking on it, prosumers will access the monitoring of their devices on a separate screen. The design of this part of the app is shown in the following figure.

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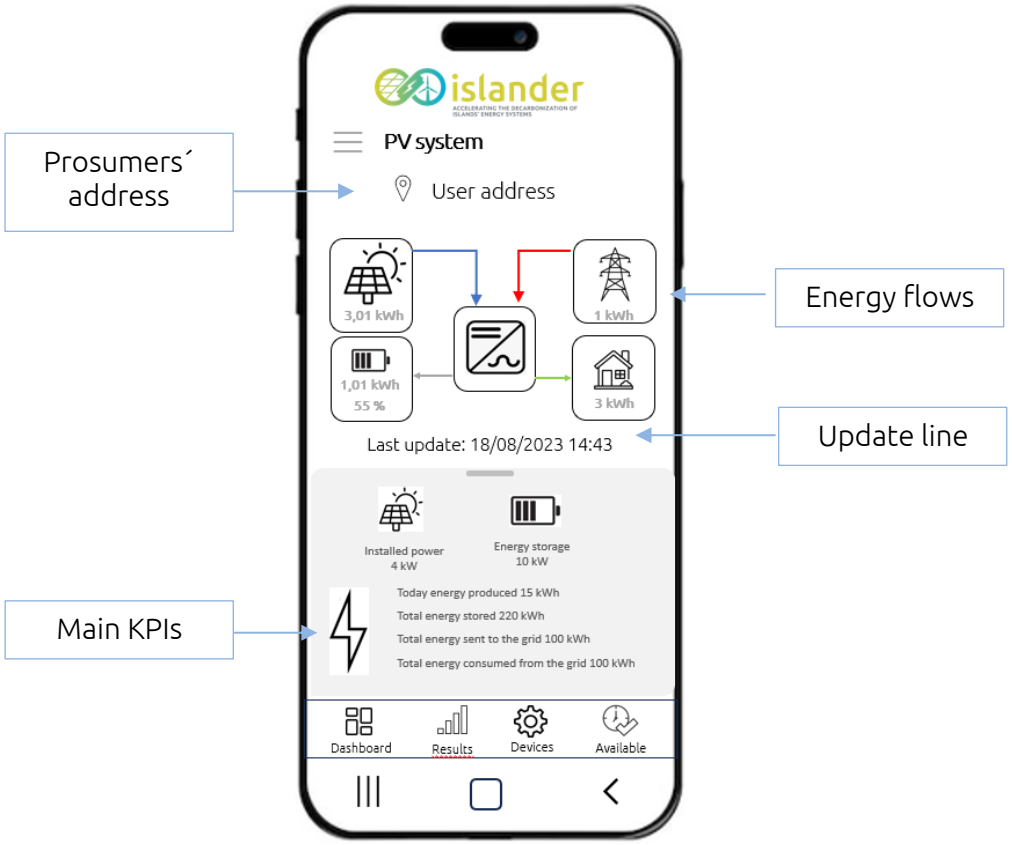

Figure 4 – Dashboard for the prosumers´installations

- Prosumers'address: It is convenient to include this information since a user may want to have this service in more than one house of his property located in a different address. Therefore, this information is needed in order to have a reference of what type of installation the application refers to.
- Energy flows: In the Islander project, optimization algorithms will be created to not only optimize energy consumption but also to determine the ideal times to feed energy into the grid. Since the prosumers will have installed:
  - A system of photovoltaic panels that generate energy to the home.
  - A Li-ion battery system that allows energy storage
  - And an inverter that distributes the energy flow between the panels, the batteries, the electrical grid and the house.

  It is necessary to have a diagram that shows in real time the state of the system. Thanks to this diagram each user can check by means of icons:
  - The energy provided by the photovoltaic modules
  - The charging and discharging energy of the batteries as well as the percentage of charge.
  - The charging and discharging energy of the grid
  - The energy consumption of the household

  The arrows have been identified in different colors to facilitate the understanding of the diagram. All of them indicate the direction of the energy flow starting from the central device, which is the inverter, since it is the one connected to all the others.

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- Upgrade line. Under these icons a line has been included showing the date with the last data update. In this way the user can check that the system is constantly updated.
- Main KPIs: A relevant information for this type of user is to see the accumulated result of the main KPIs that define this type of installations. These can be those shown in the image: Total energy produced, Total energy stored, Total energy injected to the grid, Total energy consumed from the grid.

4.2.2 Achievements

It has been previously mentioned that KUL's advice had been taken into consideration for the design of this application, since this partner had carried out a technical analysis of different studies available in the literature. The objective is twofold, to know the most relevant information that the application should contain and to give a sample of the most relevant features for the users. Following this advice, it has been concluded that users find it very useful to show the information through icons of the reward received, the amount of CO2 reduced, and the equivalence of their actions in number of trees planted.

For this reason, it was decided to display this information in the same block and place it at the top of the dashboard (see Figure). It is also worth mentioning that in order for the user to have a reference of the achievements, it has been decided to show this information taking as a starting point the first day of use of the application.

Figure 5 – Achievements

4.2.3 Status of the grid

The status of the gird is the next section of the application dashboard. In section 2 it has been mentioned that one of the goals of Demand Respone is to manage the energy consumption of the users by considering the level of energy flowing through the power grid. In order to motivate the people of the island and make them more aware of the available renewable energy they can make use of every day of the year, it has been considered appropriate to include a gadget with this information. As shown in the figure, the amount of renewable energy that will be available on the island is indicated on the left side. These predictions have been carried out by another partner involved in the Islander project, BCM. This partner

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developed prediction algorithms that allow you to know macroscopically the renewable energy that can be supplied by the island's facilities (Elmy, 2022). The result of this work allows to know the available renewable energy that can be available on the island for each day of the year.

Figure 6 – Status of the grid

4.2.4 Recommendations

The following section is one of the most relevant of the application. It shows the recommendations that the app sends to each person, taking into account aspects such as the type of user, their availability, the state of the grid, the weather, etc. The objective of these recommendations is to inform the inhabitants of the island of the actions they can carry out with each of the electrical devices they have associated in the app. These devices can be electric vehicle chargers, li-ion batteries, oven, thermostat, air conditioning, etc.

The widgets shown in the *Figure 7* contains the following information:

- Icon showing the type of device to which the recommendation refers.
- Action recommended by the app. It can be to allow charging or discharging, connect or disconnect a device. Even in the case of air conditioners or thermostats, an action can be included to tell the user whether to raise or lower the comfort settings by a few degrees.
- Button to accept or decline the recommendation
- Time frame indicating when to carry out the recommendation.
- Reward obtained in case of completing the recommendation

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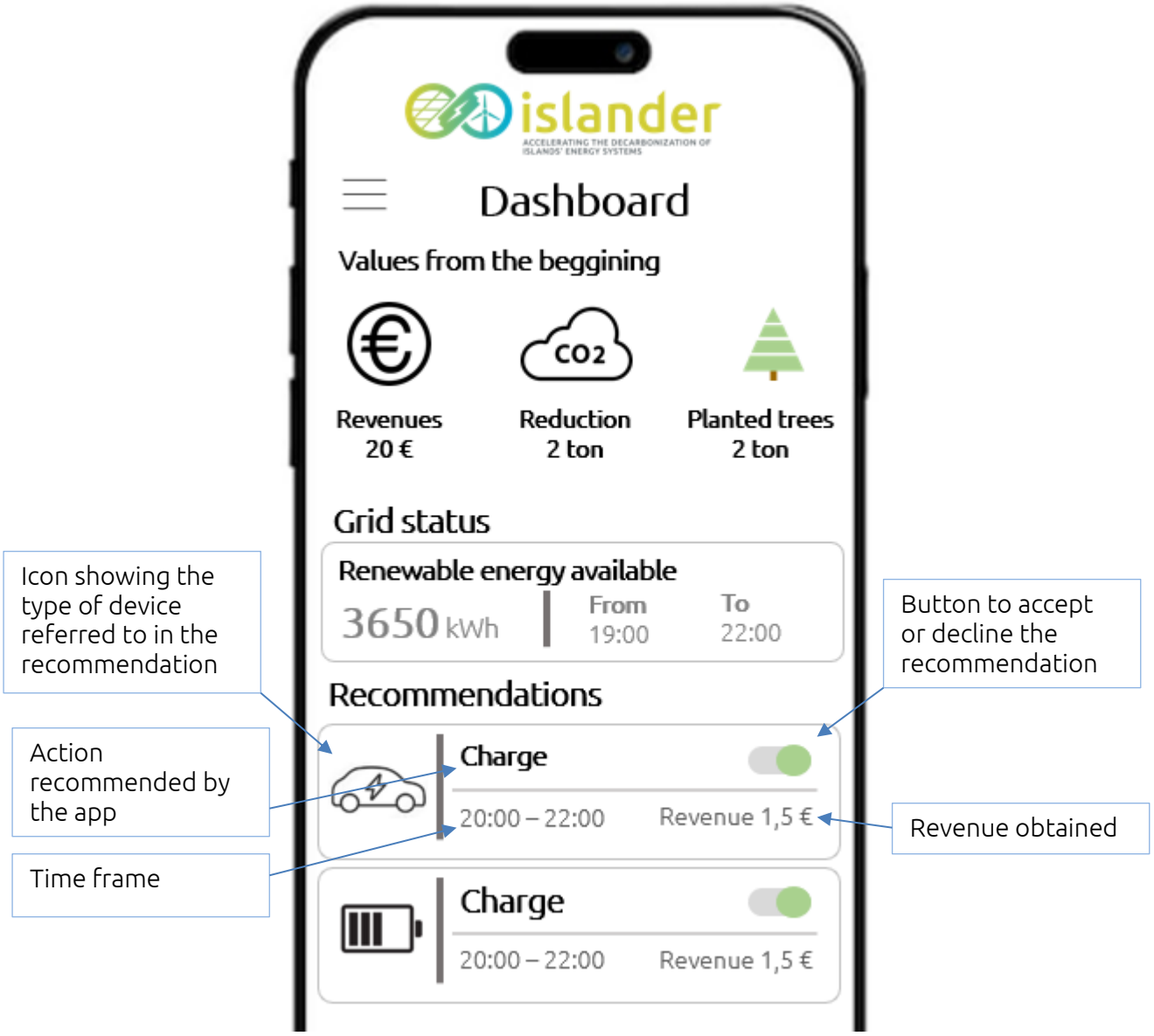

Figure 7 – Recomendations

By clicking on each of these widgets, the user can access another screen that provides more detailed information about the recommendation (see 4.3).

4.2.5 Pull-down menus

The designed app has too much information to be included in the dashboard. To solve this problem we have chosen to include in the lower part of the dashboard screen. This solution includes icons so that the user can navigate through the application and access the rest of the functionalities. All of them are explained in more detail below.

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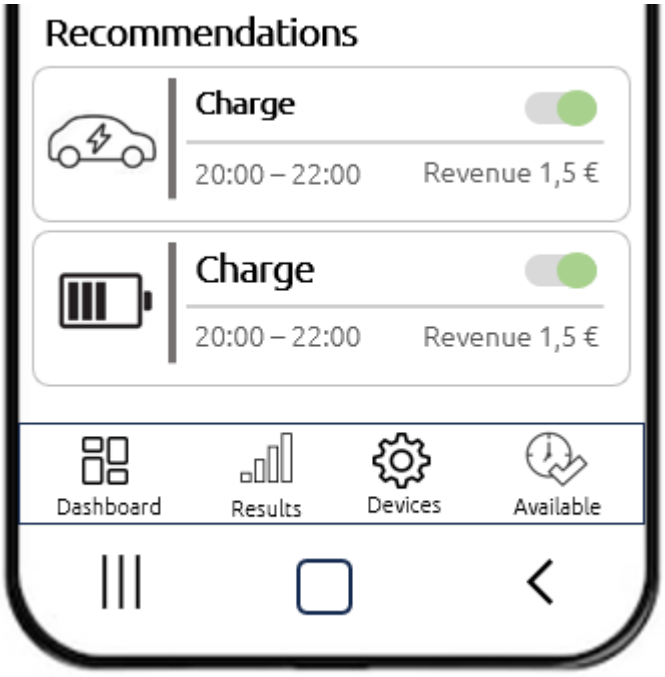

Figure 8 – Pull-down menus

- **Dashboard.** The first icon allows you to return to the main screen directly by clicking on it
- **Results**. Clicking on this icon takes you to the section of the app designed to display all the results obtained (see 4.5 Results)
- **Device**. This icon allows you to access the information of the devices that the user has associated in the app to participate in the RD
- **Available**. This last icon allows you to access a part of the application to select the user's availability to participate in the DR

Having explained all the aspects included in the Dashboard page, it is time to explain the rest of the app's features.

4.3 Recommendations

The Recommendations section is accessed by clicking on any of the widgets listed on the dashboard. This section provides detailed information on the action to be taken by the user in case he/she wants to participate in the RD. As in previous examples, all the items that make up this screen are detailed in the **Error! Reference source not found.**.

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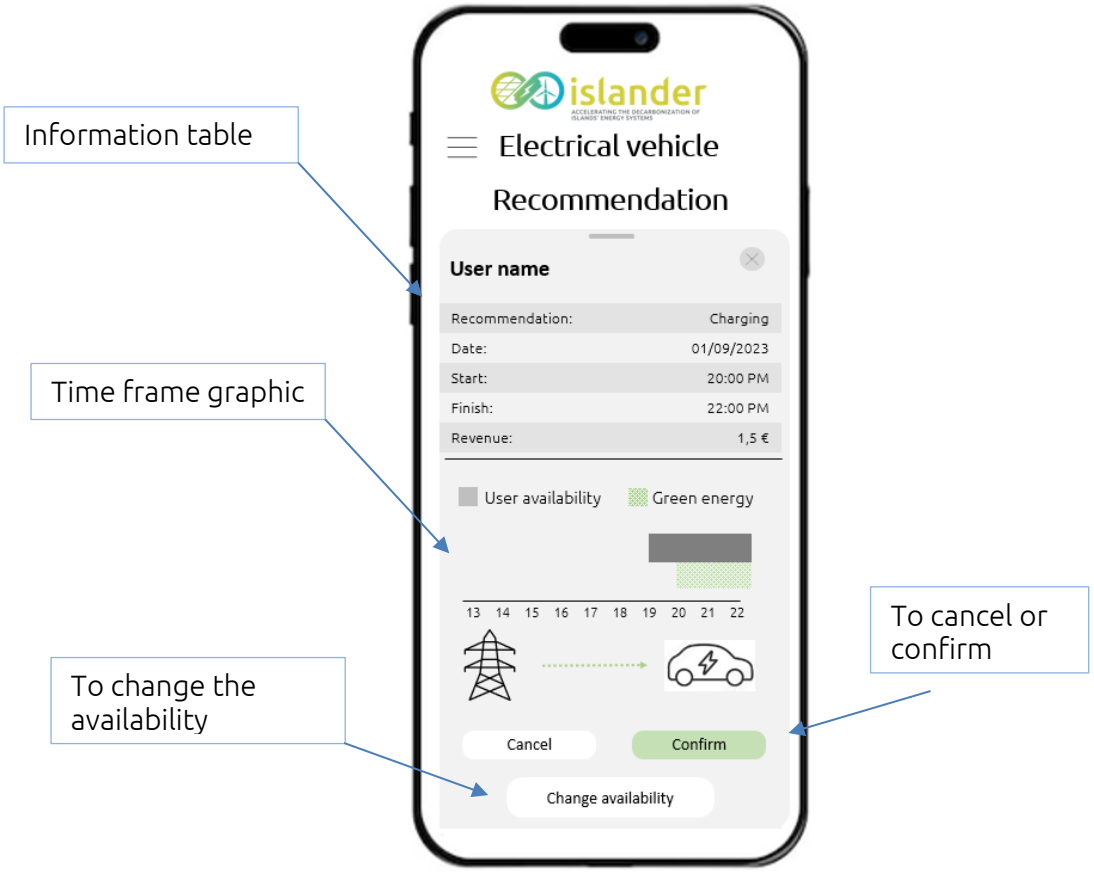

Figure 9 – Recommendations. Detailed information

- **Information table**. This part of the screen shows a table with the most relevant information of the recommendation sent by the app. The first row shows the action to be performed (in this case, charging the electric vehicle). The second row shows the date on which the action must be carried out. The next two rows detail the start and end time when the user can perform the recommendation. And the last row includes the reward offered.
- **Time frame graphic**. A time frame graphic has been included that shows the user's availability to participate in the Demand Response and the time frame that the app recommendation lasts. In the example case you can see that it coincides with the time frame that is expected to have an excess of renewable energy on the island.
- **To cancel or confrim**. The Cancel or Confirm buttons are used for a user to confirm that he/she is going to participate in the RD based on the information in the recommendation or on the contrary if he/she decides to decline in this event.
- **To chage the availability**. The button at the bottom of the screen allows the user to readjust his or her availability in case something unexpected has come up.

4.4 Availability

This section shows how the user can change the availability of the devices to be included in the application.

If a user decides to press this button, a screen like the one shown in Figure 10 opens. In this

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screen the availability of all the devices that each person has included can be changed.

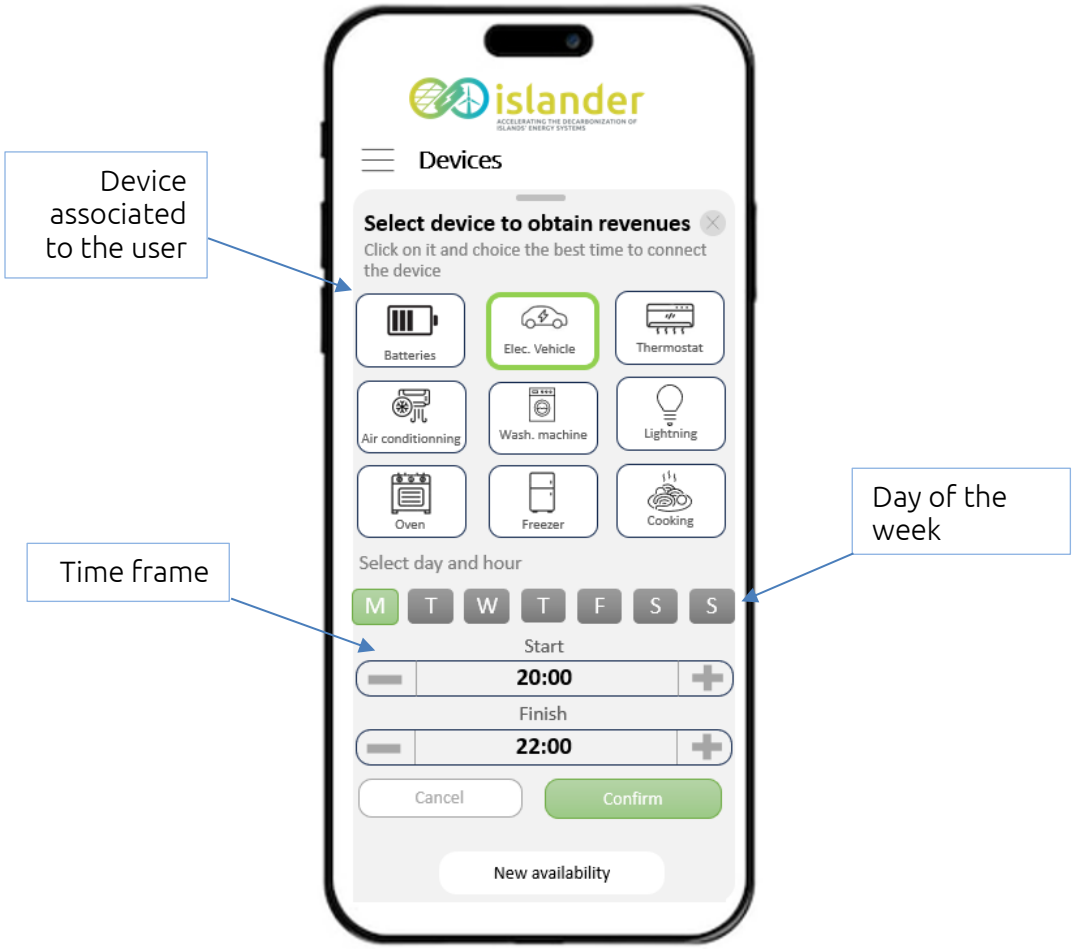

Figure 10 – Change the availability of the device

The app allows you to make changes using the following options:

- **Devices associated**. This section shows all the devices that the user has chosen to include in the app. The device currently being analyzed is marked with a thicker border.
- **Day of the week**. After the icons of the devices, a bar appears so that the user can choose the day of the week in which he wants to include the date in which the device will be connected to participate in the DR, either to increase its consumption or to reduce it.
- **Time frame**. In some cases the user may not want to change the day of the week and only modify the time of availability. With the buttons of the time frame, this person can include the start and end time.
- **New availability**. The button located at the bottom allows a user to include in the application all the time frames that he/she considers necessary for each device. In some cases, a device may be connected or available all day long, but in other cases the availability may be by time frame. By clicking this button, a new availability can be added and canceled or accepted using the options just above.

  If a user wishes to see all the availabilities that he has included in a device during a day or during the week, he only has to scroll the screen upwards and the graph shown in Figure 11 appears.

  A pie chart showing the time slots for the current day is displayed. If it is green, it means that the period of time encompassing the availability has not elapsed. Otherwise, it is

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shown in gray. This graph shows in the outer circle the hours of the day going from 0:00 to 23:59. The inner part of the graph shows two data, the sum of total hours available per day and the weekly sum.

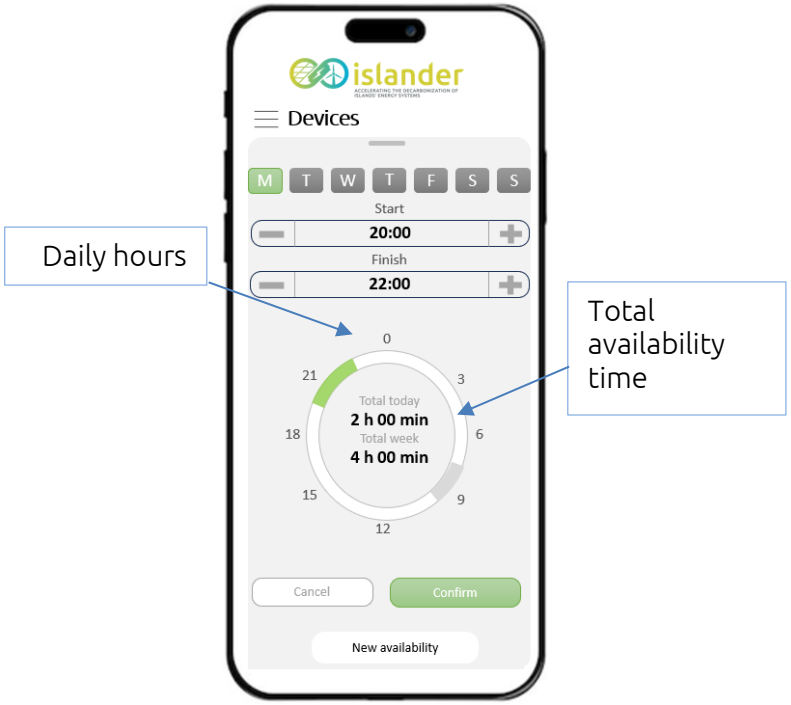

Figure 11 – Diagram that shows the availability of a device

A fixed bar has been included at the bottom of the screen to provide direct access to the most important functions of the app (Figure 12). The aim is to make the application as dynamic as possible and to facilitate the user's access to these services.

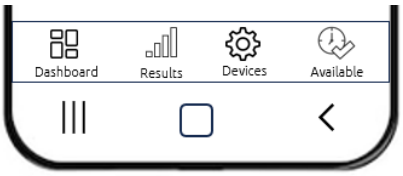

Figure 12 – Static bar with quick fuctions

If a user would like to directly access the functionality that allows him to see the results obtained, go to the screen of the devices included in the app, directly see the availability, go to the main page of the application, he can do so by clicking on the icons shown in this bar.

4.5 Results

The second icon of the fixed bar shown in Figure 12, allows the user to access the results screen (Figure 13). This section shows the results obtained from the actions carried out by the user. It has been preferred to group the representation of the results in different groups to speed up the review process by the user.

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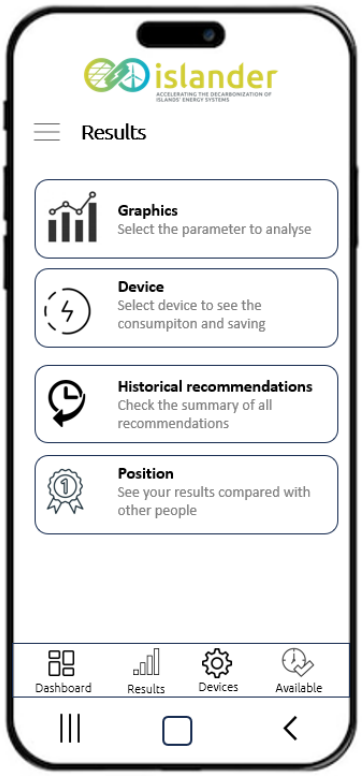

Figure 13 – Screen with the results categories

As can be seen in the figure, the sections into which it has been divided are Graphics, Device, Historical recommendations, Position. All of them are explained in more detail below.

4.5.1 Graphics

Clicking on the first of the widgets shown in Figure 13 takes you to the screen that allows you to analyze the results graphically (Figure 14). This option shows the results of the main parameters of the application: rewards obtained, CO_2 captured and energy saved.

- First, the application allows you to select the date range for which you want to perform the analysis.
- Next, a table is displayed containing a summary of the accumulated results of the mentioned parameters, during the selected period.
- The central part of the screen includes buttons for the user to select the temporality and the data to be compared. The result is displayed in the graph just below the selector.
- Finally, a button has been added that allows you to return to the results menu directly.

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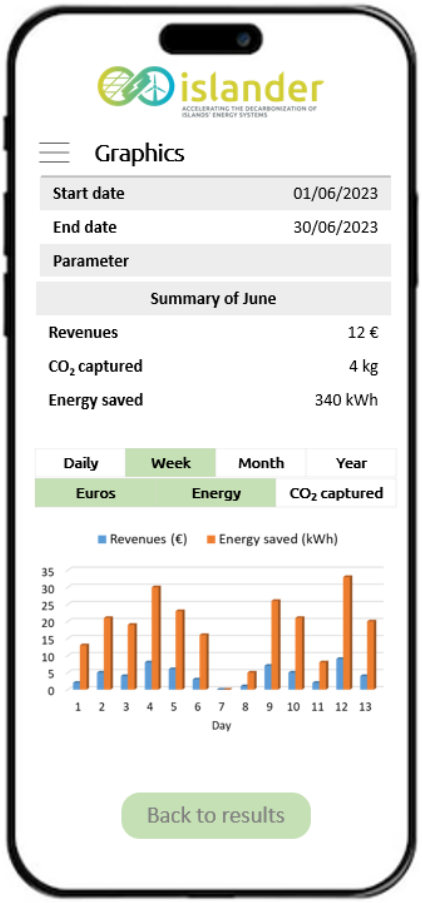

Figure 14 – Screen with graphic results

4.5.2 Device

The second widget allows access to the results analysis screen of devices(Figure 15) . In this section, a more detailed analysis of each of the electrical devices that the user has included in the app can be carried out.

The procedure is similar to the previous case. First select the range of analysis by setting the start date and end date. And second you select which parameter you want to analyze (reward, CO_2 captured, or energy saved). The application shows graphically the result associated with each device and the percentage it represents with respect to the total. A color graph has been included to facilitate the visualization and to have a better understanding of the degree of influence of each of the elements.

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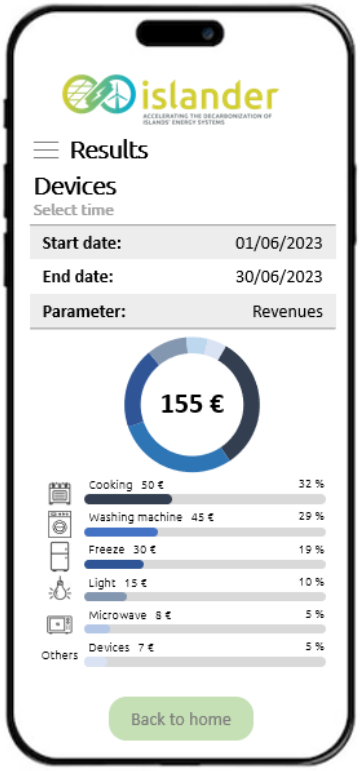

Figure 15 – Screen with results by devices

4.5.3 Historical recomendations

The third widget provides access to the history of recommendations sent to each user of the application (Figure 16). On this screen, each inhabitant of the island of Borkum can have a list of all the actions for which he or she has been asked to participate in the Demand Response. In each of them appears the device that is referred to, the date on which the recommendation was sent, the reward that was offered and whether the person confirmed or cancelled it.

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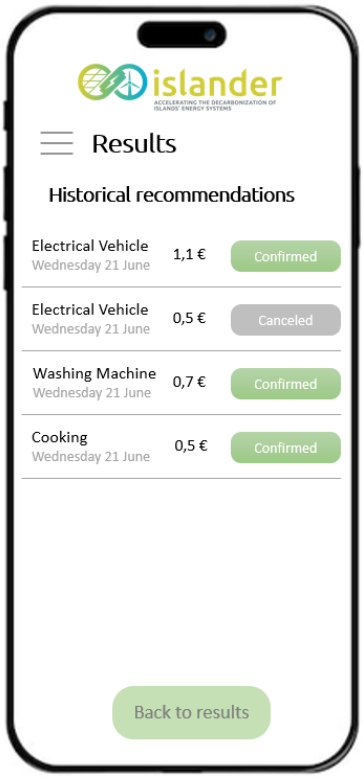

Figure 16 – Screen with historical recommendations

4.5.4 Positions

The last of the widgets included in the results screen is intended to show the position of the results of each user focused from two points of view. The first one is to make a comparison of the position of an inhabitant with respect to the results obtained by his neighbors. And the second is to show the evolution of the results of a user over a period of time.

Using these two views, the graphs shown in Figure 17Figure 17 have been created. As in previous examples, the user must first choose the analysis time and then the parameter to be analyzed to create the two graphs included.

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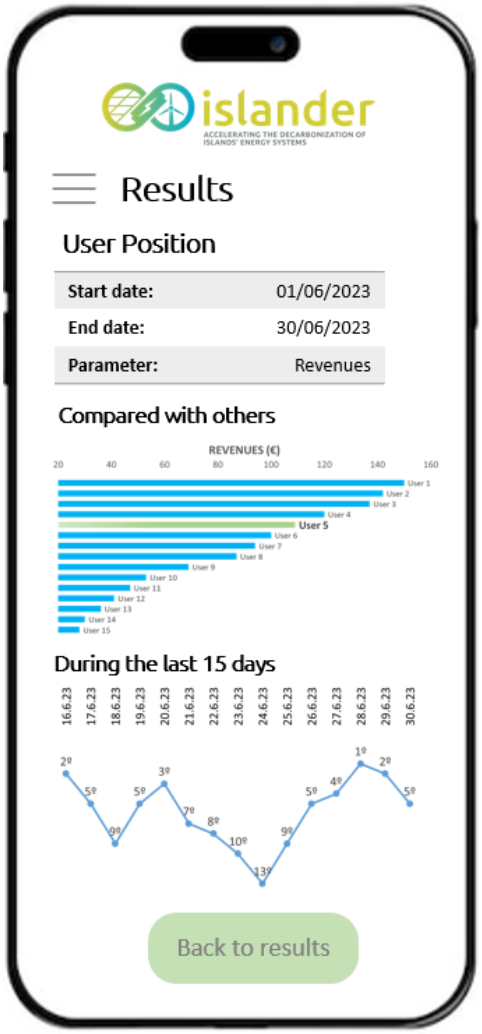

Figure 17 – Screen that shows the position of the user

5 OPERATIONAL MODES

In the previous points it has been explained the different features and functionalities that the RD app can offer. Additionally, it has been mentioned that on the island of Borkum there will be 2 types of users of the application. Those to whom the ISLANDER project will install in their homes/businesses photovoltaic modules, a battery system and a smart meter (33 users in total) and the rest of the inhabitants of the island.

The computer platform that will be developed in the project will be able to monitor and control the charging and discharging of the first group of users. The second group will have no control or monitoring of any kind. The difference of information that each user is able to share with the platform will make them receive one type of recommendation or another. In order for the system and the app to propose a participation in the Demand Response, the platform has to evaluate aspects such as the state of the network, the predictions of consumption and generation of electricity on the island, the electrical devices that each user

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has associated, the type of user (prosumer or not) and their availability or comfort parameters.

Another deliverable of the project called "Report on the enrollment and device management services" details the procedure by which a user of the island can enroll in the computer platform following a series of steps to participate in the RD. The result of this deliverable is an intelligent questionnaire that will allow each person to enter the information required by the app to send recommendations.

The questions included in this tool have been structured in different sections so that the platform and therefore the app allows to categorize each user. The sections are as follows:

- Smart enrolment design. In this first part the users will include personal information to identify them (email, address, first and last name, etc.) Also in this section the user can include the type of user he/she is. Prosumers, who in this case are called volunteers, can be differentiated between household or buildings depending on the type of user. And the rest of the inhabitants, called consumers, can be included in the questionnaire as residential, commercial or industry depending on the type of activity.

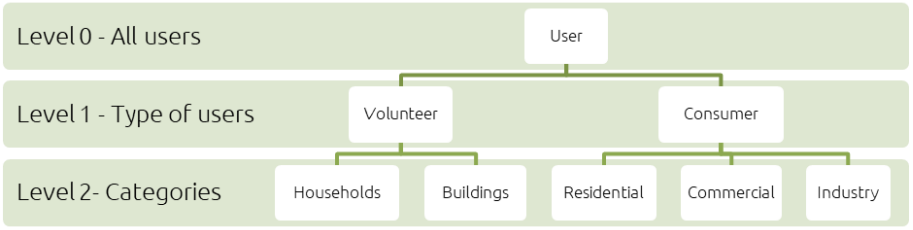

Figure 18. Different levels of user categorization

- Smart enrolment identification. The purpose of this section is to allow users to include the type of electrical devices they have connected, which the IT platform can then take into consideration when sending recommendations.
- Smart device use management. They have been included to know the comfort and availability parameters of the users. In this way the platform can know the consumption patterns of customers and be more accurate in sending DR participations.

With this information, the software platform is able to differentiate between the type of users it has associated and who wish to participate in the RD. Depending on their characteristics, the app can select the type of information it sends to each person.

Although most of the application's functionalities are common to both types of users, it is true that there are small functions that are only offered to prosumers. For example, the dashboard of the PV installations and batteries (see Figure 4), their actual consumption and production data, and if the situation requires it, the sending of more precise recommendations. The rest of the functionalities are shared by both types of users.

6 GAMIFICATION APPROACH

In this section of this deliverable, it is explained how we intend to incorporate the concept of

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Gamification into the RD app.

One of the objectives of the ISLANDER project is to encourage the inhabitants of the island of Borkum to be active and participate in all the proposals made by the partners that make up the consortium. Their participation in the project is essential for the objectives to achieve the best results for the decarbonization and energy dependence of the island.

Given that Demand Response is an energy service that takes this direction, it was thought appropriate to incorporate into the app the necessary tools to motivate the user to carry out the recommendations received. The greater the number of actions carried out, the more the user will reduce his consumption and therefore the better the island's electrical grid will perform.

To achieve this goal, a series of gamification features will be incorporated into the app to encourage users to follow the recommendations to improve their consumption and stabilize the network. The gamification approach can be approached from the following perspectives:

1. Goals: one of the ways to persuade users is by creating challenges and obtaining rewards. By setting interesting goals, people can be encouraged to participate in the project.
2. Education: The app can contain a section explaining the most fundamental concepts of RD and how the application works. In this way the user can have a better understanding of its usefulness.
3. Direct participation: To increase the use of the app it is necessary to involve the user by performing different actions. Including real-time monitoring and even alerting the user to the programming of electronic devices and seeing their results can increase interest in use.
4. Competition: Instilling friendly competition between users can help increase participation. Showing the achievements and evolution of a participant and comparing it with the rest of the inhabitants of the island can encourage people to want to improve their personal goals. And therefore, to improve the objectives of the island. Figure 17 shows an example of this concept.
5. Acknowledgements: Automatically recognizing or sending a recognition signal when certain achievements are exceeded reinforces people's positive behavior. This can be done by unlocking features in the app or by creating badges. This is positive for the purpose of the app.

7 MAIN CONCLUSIONS

This deliverable focuses on giving an overview of the functionalities of a mobile application that the project has developed to enable the participation of the citizens of the island of Borkum in an energy service called Demand Response.

The first point of the deliverable first provides an explanation of the objective it is intended to address. It then provides a broad sample of the functionalities that have been included in the app that is intended to be developed. An explanation of the different modes of operation is also provided. As well as a gamification approach to increase user participation.

After reviewing all these points, the main conclusion that can be drawn from this document is that the development of the app should evolve as the project progresses. In this way, updates

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can be offered to users to increase their interest in using the app. The implementation of the application in iOS and Android operating systems as well as the distribution and acceptance by the inhabitants of the island is one of the most important challenges to achieve.

Although at the date of delivery of this document has not been done, it is important to mention that the development of the app will include all relevant considerations that mark the European regulations to make the tool accessible to all people. Hence, from the delivery of this document until the completion of the Islander project, both the appearance of the app and the incorporation of new features may be modified. The objective of these updates is to improve usability and user experience.

In any case, any modification that may arise will of course lead to the updating of the information in this document.

DEVIATIONS

The delivery of the content of this document has suffered a small deviation of a few weeks. However, it has not affected the development of any other activity nor has it led to deviations from the actions foreseen in the project.

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