

Integrated Demand REsponse SOlution Towards Energy POsitive NeighbourhooDs

WP 3: User engagement process

*T3.4: Smart mobile client and personal energy
performance assistant design*

D3.4 Personal energy performance assistant design

The RESPOND Consortium 2018



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EXECUTIVE SUMMARY

This deliverable presents the design of the RESPOND personal energy performance assistant. This assistant is aimed at providing users with an intuitive and simple mobile app towards their engagement.

Nowadays the importance of smartphones in our everyday life is undeniable. Especially in the most technologically advanced countries and regions, mobile apps are nearly a requirement for the daily activities. It can be said that apps have become a necessity, more than a preference. However, according to studies, more than 75% of users open an app once and never come back. Therefore, the design of the app has to be carefully considered.

With regards to the design proposed in this deliverable, existing mobile apps have been analysed, as well as the latest app design techniques and methodology. Furthermore, latest trends in users experience have been investigated, with views to proposing a high-quality and engaging mobile app. Last but not least, the feedback from RESPOND project partners have been collected. This information has been valuable, as they cover different areas of expertise related to the DR in dwellings.

Although this deliverable focuses on the design aspect of the mobile app, at the moment of delivering this document, the app has already started to be developed. Similar to other software developments, the final design of the mobile app is subject to changes with respect to the design presented here. However, the use of mockups and the early feedback from other partners, are expected to minimize these changes.

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ABBREVIATIONS AND ACRONYMS

DR	Demand Response
HAN	Home Area Network
MVVM	Model-View-ViewModel
RES	Renewable Energy Source
UI	User Interface
UX	User Experience

1. INTRODUCTION

The purpose of this document is to present the design of the RESPOND mobile app that participants will use. It is part of the *WP3: User engagement process*, and a direct output of *T3.4: Smart mobile client and personal energy performance assistant design* which started in month 7 and ends in month 12.

The outcomes of this task are expected to enable the integration of personal assistant activities in *T5.4: Integration with desktop dashboard and smart mobile client*.

The rest of the document is structured as follows. Section 2 explains the methodology followed for the design process. In section 3, some related existing apps are analysed, focusing on the interaction and how they face the challenges posed by DR programs. Section 4 shows a set of best practices considered in the design process. Section 5 presents the app mockups. These mockups have been very useful, as they offered a preliminary view of what the mobile app looks like. Section 6 explains the feedback received after showing the mockups to the RESPOND partners, and Section 7 shows the current app design state. Finally, in section 8 the conclusions of the deliverable are drawn.

2. METHODOLOGY

The RESPOND mobile app design process started with an analysis of the existing apps and frameworks. This analysis has been done with views to discover the design patterns and methods to achieve attractive and adaptable mobile apps, without neglecting their performance. Furthermore, this study has also contributed to discover how others deal with Demand Response programmes and the current techniques towards the engagement of users.

Precisely the user engagement, which is one of the main factors determining the success of the RESPOND project, will be further studied in *D3.1: Criteria and framework for recruiting and engaging* and *D3.2: Respond User Engagement Strategy*. This deliverable will focus on the user engagement related to the mobile apps.

In order to agree the appearance of the screens, the creation of mockups have been really helpful. These mockups have allowed an early detection of potential design flaws. This early design problem detection allows an increased efficiency and huge cost savings, as the later the detection, the costlier and time consuming the problems will be to fix.

The mockups were then shared with the rest of the RESPOND partners, and the received feedback. This feedback was used to make some minimal design changes ahead of its implementation. The feedback received was stored in a live document accessible for all the RESPOND partners, and it is expected to gather future reviews of the RESPOND app users. This transparency is key to the constant improvement of the design.

Finally, the actual implementation of the mobile app will be undertaken.

3. SMART HOME APPS

In this section, a brief overview of existing Smart Home Apps is shown.

3.1 SAMSUNG SMARTTHINGS

SmartThings¹ connects wirelessly with a wide range of smart devices and makes them work together. SmartThings allows the monitoring, control, and automation of a wide range of connected devices (e.g. lights, speakers, locks, thermostats and sensors) in a home. It is worth mentioning that as SmartThings supports a vast spectrum of third-party products, these products can be from various manufacturers. For example, a dweller can set connected lights to turn on and off at the touch of a button, at the same time each day, when they open doors and windows, when motion is detected in their home, or when they say “Turn on the kitchen lights.” Furthermore, hundreds of individual devices can be connected at any one time to a SmartThings Hub (or a compatible device with SmartThings Hub functionality), so the user never needs to worry about having too many smart devices at home. Figure 1 shows the app.

¹ <https://www.smarthings.com/>

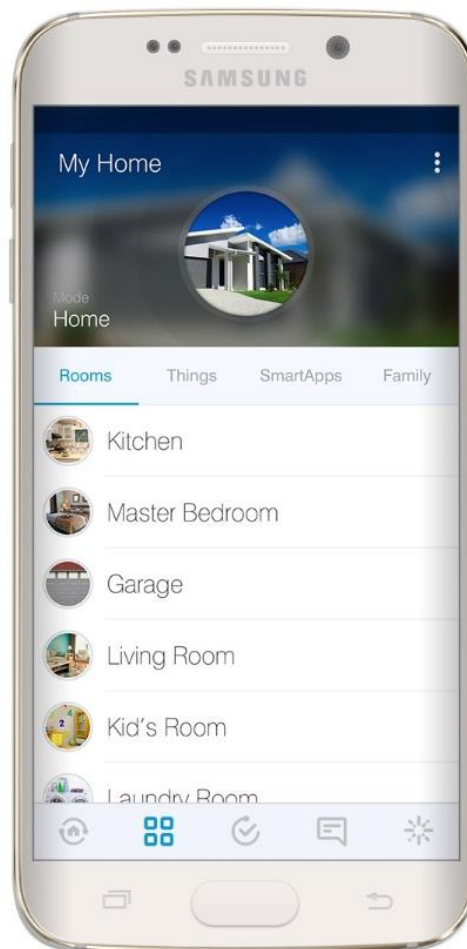


Figure 1: Samsung SmartThings app

3.2 BIDGELY HOMEBEAT

The HomeBeat App² is built on Bidgely's HomeBeat energy disaggregation platform. Using either low or high resolution data, Bidgely positively identifies and tracks the major appliances in the home – including air-conditioning, electric heating, pool pumps, refrigerators, electric water heaters – to provide consumers with personalized tips for saving energy and money. Consumers that use HomeBeat App form new energy habits that lead to increased satisfaction with their utility, monthly savings on their energy bill, and an ability to engage with their energy use

The Bidgely HomeBeat consumer engagement mobile app delivered an average of 30% load reduction for peak events in a recent trial in Australia. Recently, Australian utility United Energy conducted a trial in its 640,000-customer service territory using the Bidgely HomeBeat consumer engagement mobile app to more effectively engage its customers in Demand Response — when utilities ask consumers to mitigate their energy usage through peak events in exchange for rewards. The results of the trial were significant, with the app helping to average greater than 30% load reduction for peak events which occurred during

² <https://www.silverspringnet.com/app/bidgely-homebeat-web-mobile/>

Australia's 2015-16 summer season. Bidgely's HomeBeat app "leverages the Bidgely insights platform to analyze both home-area-network (HAN) and AMI smart meter data streams to disaggregate and identify usage patterns for specific appliances." This allows Bidgely to act as an in-home energy advisor, identifying ways in which the average consumer can reduce energy costs through unplugging certain always-on devices or turning off the air-con before going away for the weekend. Specific to United Energy's Demand Response concerns, the HomeBeat app also "gamifies" Demand Response, using in-app push and email notifications to alert users to times when they can be rewarded for using less electricity. Figure 2 shows the Bidgely HomeBeat app [1].



Figure 2: Bidgely HomeBeat app

3.3 TRANSPOWER DEMAND RESPONSE

New Zealand's national grid operator Transpower, which runs the country's high-voltage electricity transmission network. Demand Response is a Transpower initiative that helps it manage current power requirements as it plans for the future. The program allows electricity customers to bid to curtail their electricity consumption for a set period and be paid to do so. The option was first offered to Transpower's biggest customers and is gradually being rolled out to smaller consumers, too.

The demand response app³ is also the best tool to use when you participate in the demand response programme and associated events. The demand response app is available on iOS and Android platforms and works with mobile phones as well as tablets.

Once the user is accepted into the demand response programme, they are provided with an account, so they can use the app to see all the information about demand response events as they occur. They can use the app to put in a bid to participate in a demand response event, and to be advised if it is accepted. Finally, they can also send information from the app via email to others who are part of their demand response team – and the app will inform them about how they performed during the demand response event and estimate their payment. Figure 3 shows a screenshot of the app.

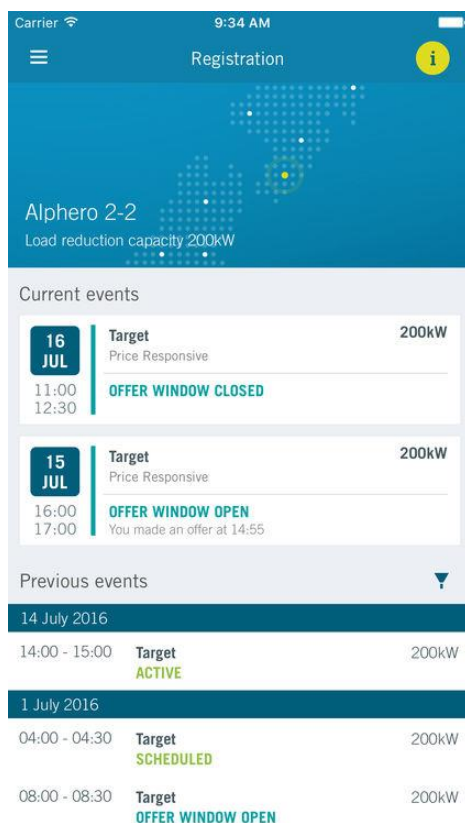


Figure 3: Transpower Demand Response app

³ <https://www.transpower.co.nz/keeping-you-connected/demand-response/demand-response-mobile-app>

3.4 IFTTT

IFTTT⁴ derives its name from the programming conditional statement “if this, then that.” What the company provides is a software platform that connects apps, devices and services from different developers in order to trigger one or more automations involving those apps, devices and services.

The automations are accomplished via applets — which are sort of like macros that connect multiple apps to run automated tasks. Applets can be turned on or off using IFTTT’s website or mobile apps (and/or the mobile apps’ IFTTT widgets). Developers can also create their own applets or make variations of existing ones via IFTTT’s user-friendly, straightforward interface. Typically, developers launch their IFTTT presence with applets they create, and then the user community builds on top of those applets. IFTTT applets can use JavaScript, advanced filtering and other tools to create new interactions.

Support for JavaScript helps IFTTT partners creating robust applets compared to the more limited IFTTT recipes of last years. Some custom JavaScript that will filter things automatically can also be developed, so that an applet will, for example, turn on multiple lights at home if somebody arrives after 6 p.m. or just the porch light if anyone arrives home before 6 p.m. That sort of functionality wasn’t possible with the simpler recipes but is doable with applets. To date, IFTTT has more than 550 partner services and IFTTT’s community of 11 million users run over 1 billion applets each month, according to the company [2]. Figure 4 shows the IFTTT app.

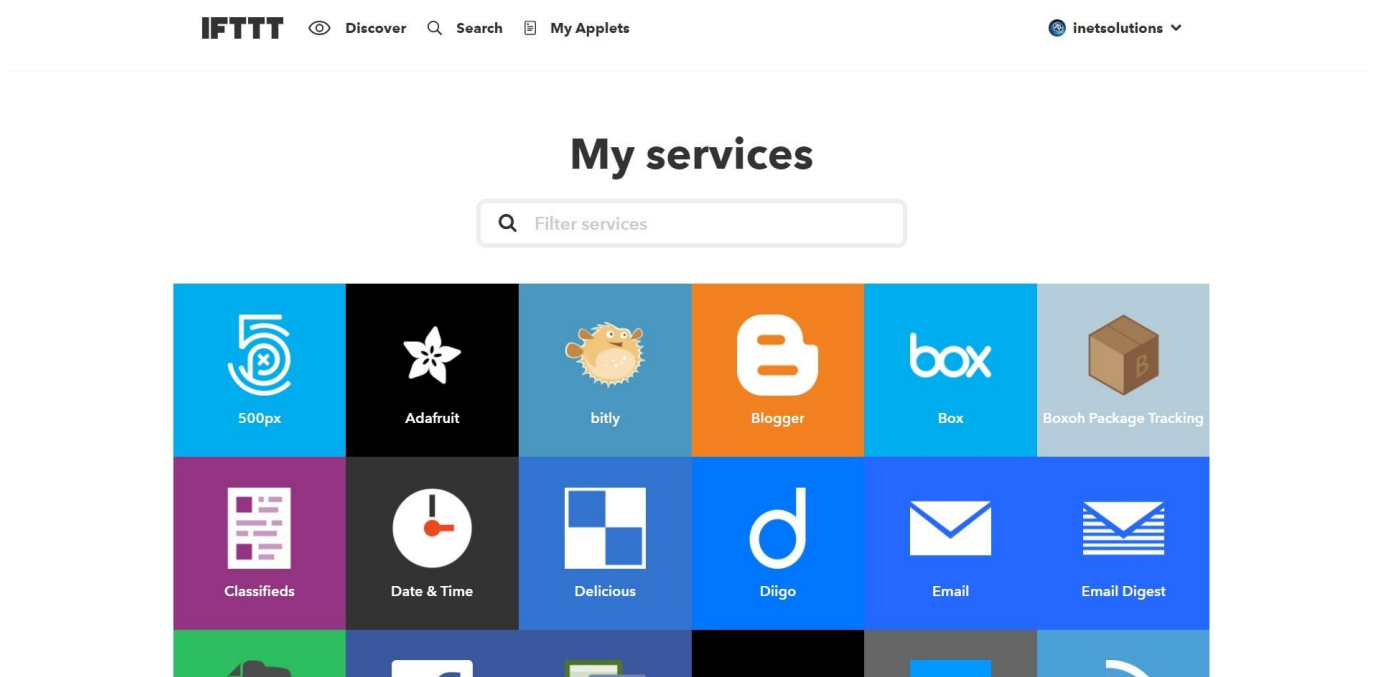


Figure 4: IFTTT app

⁴ <https://ifttt.com/>

4. DESIGN CONSIDERATIONS

The requirements for a comfortable mobile experience change every day [3]. The age where user's desires are transforming technology and technology is transforming user's expectations is here. Google as one of the main UX (User Experience) trendsetters, describes the main UX principles for mobile apps in these stages [4]:

1. **Adopt** – principles aimed at directing a user's initial experience with a product, creating positive onboarding and effortless learning.
2. **Use** – focusing on a user's goals and expectations, providing error-free and effective task completion every time.
3. **Return** – engaging a user and staying relevant in a user's everyday life.

Adopt

A research by Localytics shows that 24% of users never return to an app after the first use [5]. Proper onboard techniques decrease this number to 9 percent, even the 61% of the users will return to the app eleven or more times. How this onboard process will engage users?

- *Fast and practical splash screens.* The first thing that the user sees when loading the app is a splash screen. A good example of a splash screen is for example, one that contains a loading animation or actionable tips that will help users onboard without overwhelming them.
- *Simple registration.* Forcing users to create an account to use the app can cost a huge percent of potential users. Sometimes, users do not give valid information since they do not know how it is going to be used. The usage of social login to allow users to enter with existing Facebook or Google ID, simplifies the process.
- *Successful training.* The expectations of the user should be satisfied by means of guidelines through the first interaction and offer to create a "test" task.
- *Un-intrusive permissions.* Asking for permission to use for example phone's camera, geolocation or similar features as a first approach, without giving the proper context, is a bad practise. When a person has already used the app, he/she will feel more engaged with it, if he/she feels the power of giving permissions.

Use

Nowadays, smartphones have become the primary tool for accessing information. Quick and easy use will ensure that the user will find the app useful and meaningful. To do so, the following points might help on the usage of an app:

- *Addressing user's goals.* It is important that key functions of the app fit the user needs.
- *Unique mobile possibilities.* Mobile apps allow other possibilities that a lot of websites do not. For example: Offline work, send notifications, use of features that a normal PC do not have such as GPS, camera etc. New capabilities of smartphones are allowing the apps to reach new capabilities/functionalities.

- *Design for “hand use”.* Desktop and mobile experiences are essentially different. This should be taken into consideration, depending on the user’s interaction and type of content. Figure 5 shows the common ways people hold their phones.

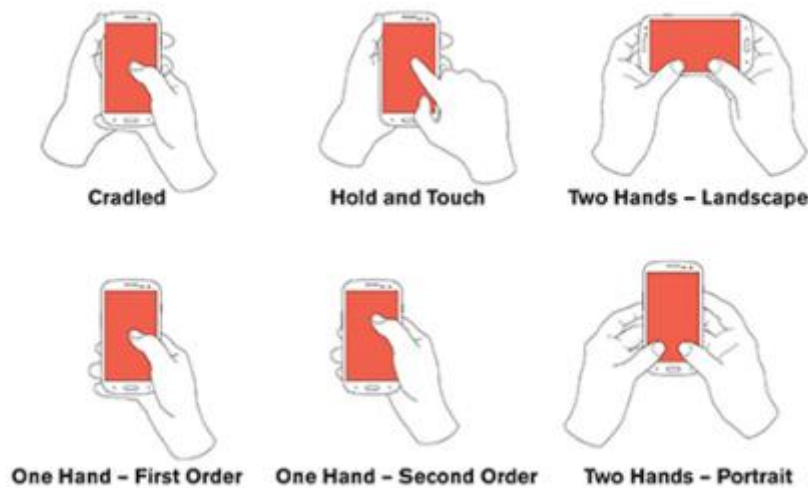


Figure 5. Common ways people hold their phone.

- *Seamless transition between platforms.* Rich content should be left to desktops and tablets, because smartphones are used for quick search, notifications etc.
- *Positive offboarding.* Similar to onboarding, ending customer relationships is also important to establish trust. This gives more reasons to users to come back and use the app again.

Return

Engagement and grow retention rate are important to allow mobile apps to be used again. To do so, the following points might help to let the app become part of user’s routine:

- *Relevant notifications.* Most of the users are grateful for notifications that remind important things and enhance productivity, nevertheless these notifications should be personalized and totally aligned with the user’s needs. Gathering data about usage patterns will contribute in this aspect.
- *Narrow-focused widgets.* This first impression will help to attract users to use more functionalities of the app.
- *Personalization.* Classifying users will allow to offer personalized content, experience tailored options foster emotional connection to an app, increasing retention rate.

4.1 INTERFACE DESIGN

The design of mobile apps user interface trend keeps changing constantly depending on user needs. Trends that apply to UI mobile apps are the following:

- *Overlapping effects.* Creating a sense of space is important to allow the app being more eye-catching and distinctive.
- *Color gradients.* Besides having a single color, adding color gradients and different graphics, make the user experience much more attractive. Figure 6 shows a good example of how to use color gradient effectively.

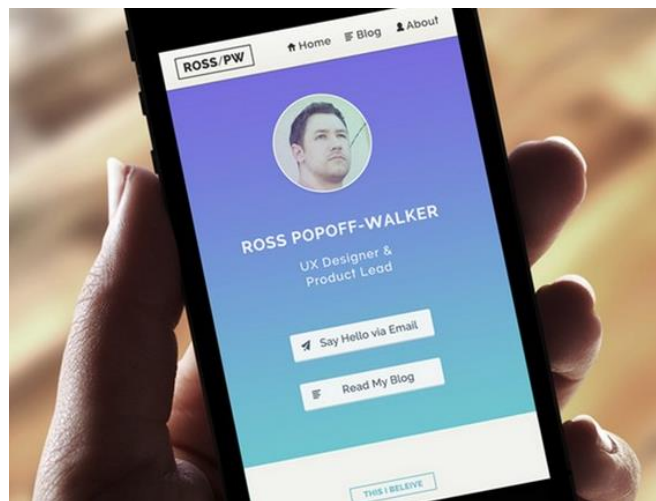


Figure 6: Color gradients example

- *Opacity.* Transparency and opacity setting are nice way to have an excellent design work.
- *Simple curves and geometries.* Simple and natural design style lets the user to be more focus on the major functions and features of a mobile app.
- *Functional animations and interactions.* Add more interaction designs for some details of mobile app interfaces, will allow users to communicate with apps easily and also get feedback soon.
- *Quick loading.* When pictures take long to load, users will proceed onward to some other page or even utilize another app that loads the images faster.

Following Apple indications [6] (that could be also applied to Android apps), these are some examples of guidelines to deliver engaging and unique user experiences:

- *Formatting content.* Create a layout that fits the screen of the device. Users should see primary content without zooming or scrolling horizontally as shown in Figure 7.

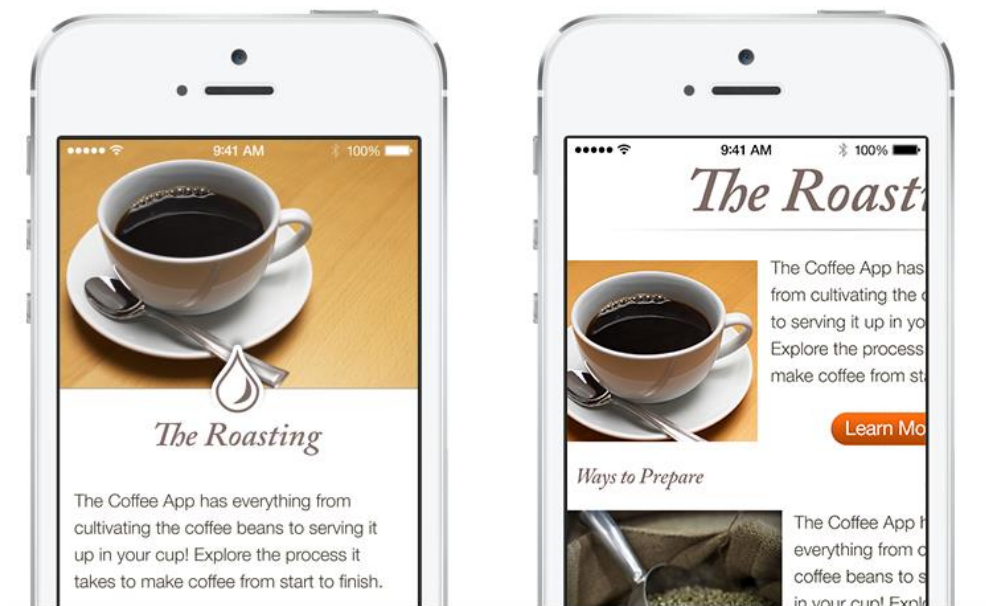


Figure 7: On the left, a layout that fits the screen. On the right, a layout that does not fit on the screen.

- **Touch controls.** Use UI elements that are designed for touch gestures to make interaction with your app feel easy and natural. Figure 8 shows two calendar: on the left, one that may be easier to select a date, and on the right, a calendar where interaction might be more cumbersome.

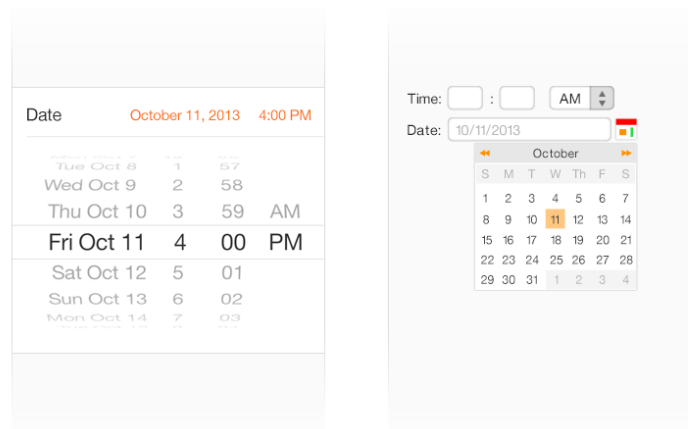


Figure 8: On the left, a calendar that is easy to use. On the right, a calendar that may be more cumbersome to interact with.

- **Hit targets.** Create controls that measure at least 44 points x 44 points, so they can be accurately tapped with a finger as shown in Figure 9.



Figure 9: Controls that may be easy to be tapped.

- **Text size and contrast.** Text should be at least 11 points so it's legible at a typical viewing distance and the contrast between the font color and the background of text is legible (Figure 10).



Figure 10: Examples of adequate and inadequate text size and contrast.

- **High resolution.** Provide high resolution improves user's experience. This applies to images as shown in Figure 11.



Figure 11: High resolution vs low resolution images.

- **Organization.** Create an easy-to-read layout that puts controls close to the content they modify. Figure 12 is a good example of well-organized and badly-organized set of controls.

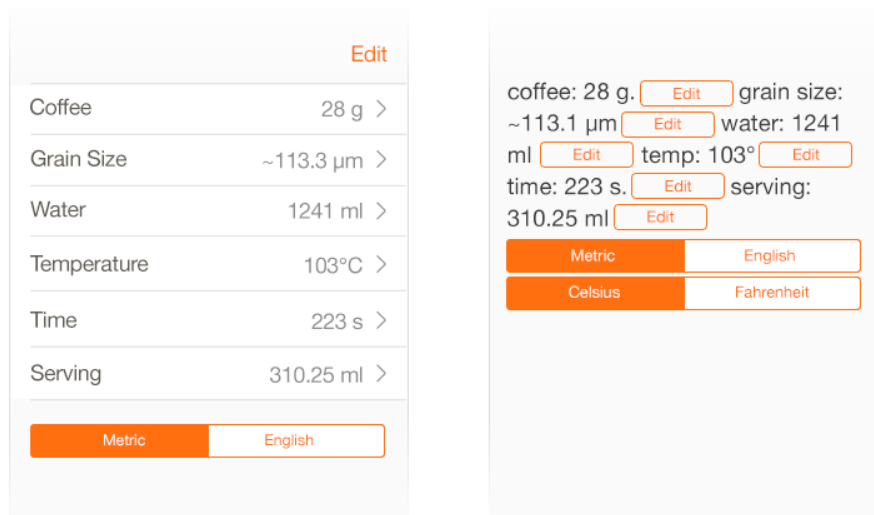


Figure 12: A well organized set of controls compared to a badly organized set of controls.

- **Alignment.** Align text, images and buttons to show users how information is related. An example is shown in Figure 13.

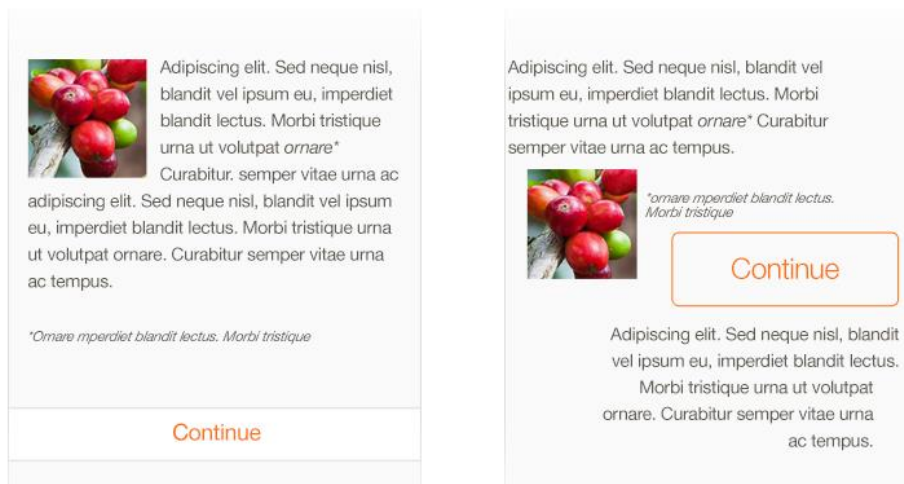


Figure 13: Text alignment example

According to Steve Hoober's research [7], 49% of people hold their smartphones with one hand, relying on thumbs to do the heavy lifting. Smartphone use is defined by three basic handholds [8], and we often shift among them, as shown in.

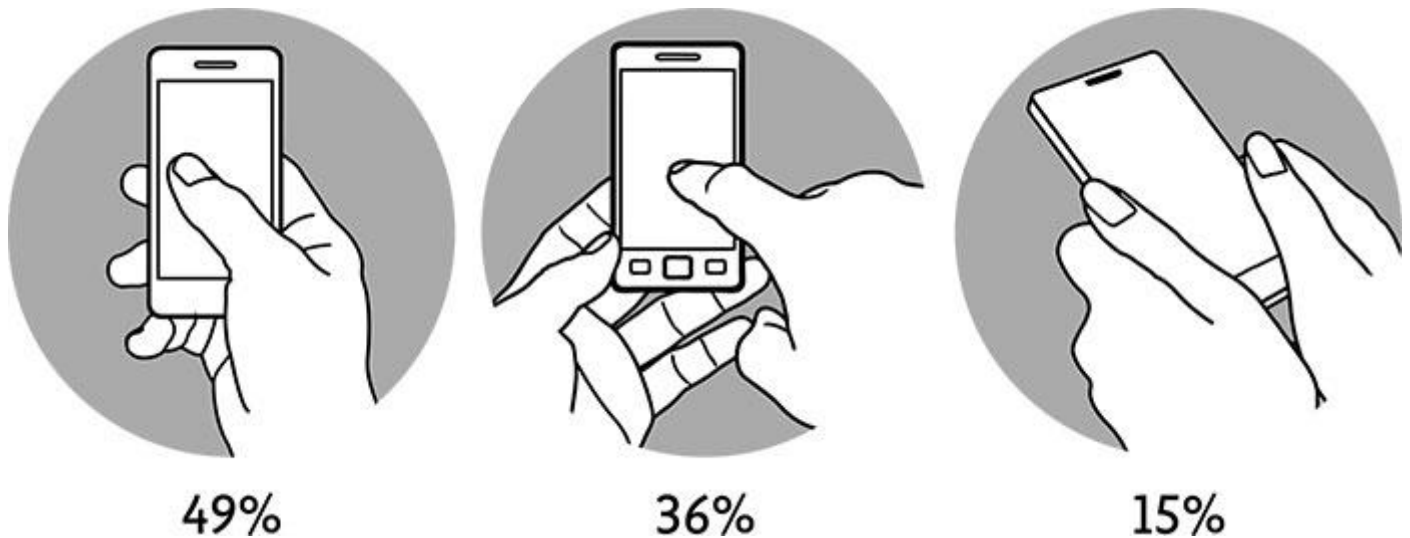


Figure 14: Smartphone use is defined by three basic handholds.

The green thumb zone shown in Figure 15 is the most comfortable and accurate region of phone screens for one-handed users. Avoid the red-zone reach, or at least compensate with larger-than-usual touch targets.

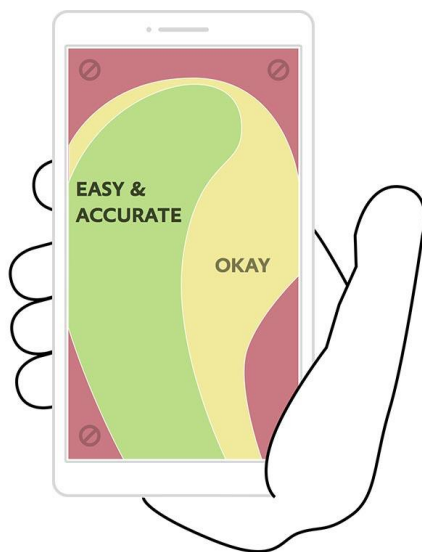


Figure 15: Most comfortable and accurate region of phone screens for one-handed users

With this understanding of hand placement, we can conclude that certain zones for thumb movement apply to most smartphones. Easy-to-reach, hard-to-reach and in-between areas are visualized in Figure 16 [9].

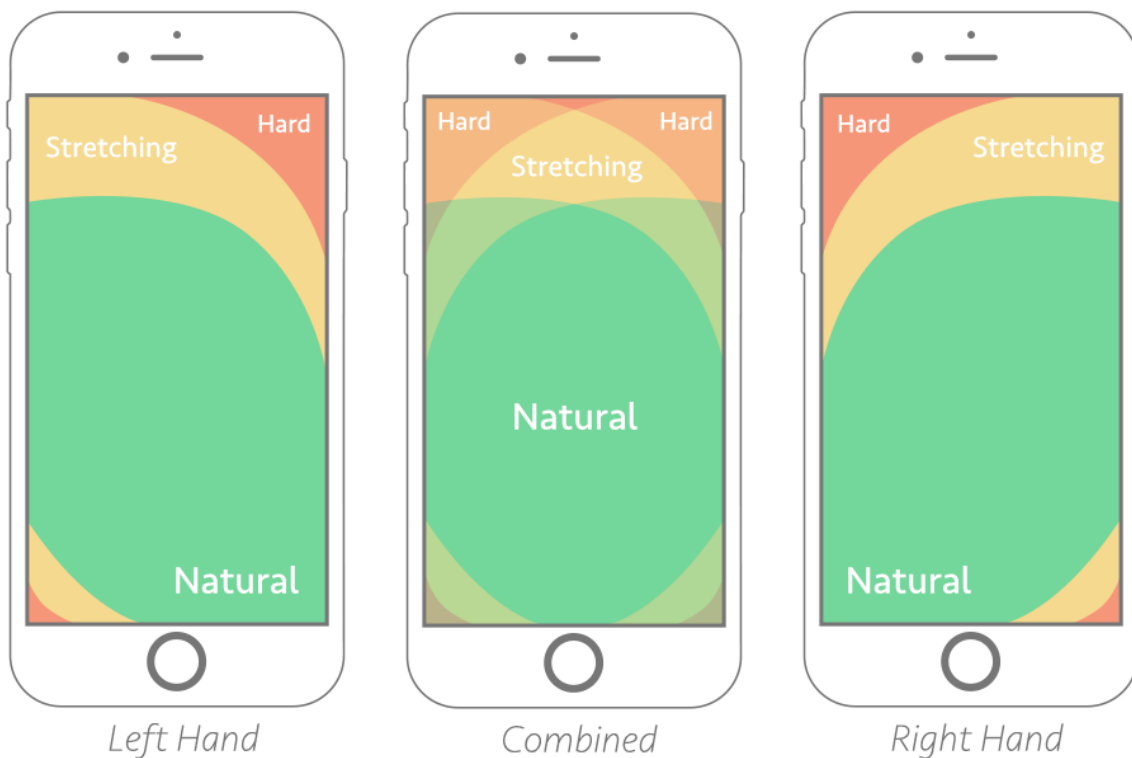


Figure 16: Easy-to-reach, hard-to-reach and in-between areas in phone screens

4.2 MODEL-VIEW-VIEWMODEL (MVVM)

Development technologies like Windows Forms, WPF, Silverlight, and Windows Phone provide a default experience that leads a developer down the path of dragging controls from a toolbox to a design surface, then writing code in the form's code-behind file. As such applications grow in size and scope and are modified, complex maintenance issues begin to arise. These issues include the tight coupling between the UI controls and the business logic, which increases the cost of making UI modifications, and the difficulty of unit testing such code.

The Model-View-ViewModel (MVVM) pattern helps to cleanly separate the business and presentation logic of an application from its user interface (UI). Maintaining a clean separation between application logic and the UI helps to address numerous development issues and can make an application easier to test, maintain, and evolve. It can also greatly improve code re-use opportunities and allows developers and UI designers to more easily collaborate when developing their respective parts of an app. Figure 17 shows the structure of the MVVM pattern.

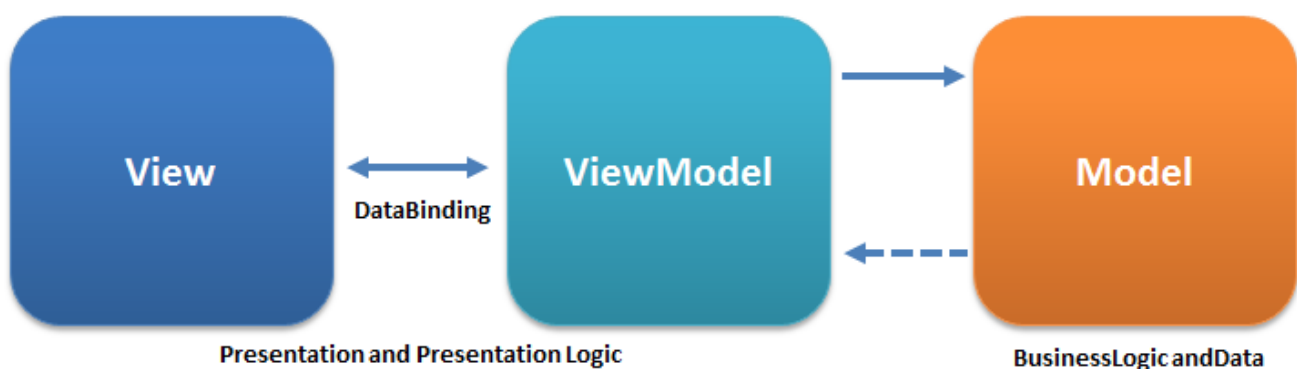


Figure 17: MVVM Pattern

The main motivations for implementing an application using the MVVM pattern are that [10]:

- It provides separation of concerns. Tightly coupled, change resistant, brittle code causes all sorts of long-term maintenance issues that ultimately result in poor customer satisfaction with the delivered software. A clean separation between application logic and the UI will make an application easier to test, maintain, and evolve. It improves code re-use opportunities and enables the developer-designer workflow.
- It is a natural pattern for XAML platforms. The key enablers of the MVVM pattern are the rich data binding stack of the Silverlight platform, and dependency properties. The combination of these provides the means to connect a UI to a view model.
- It enables a developer-designer workflow. When the UI XAML is not tightly coupled to the code-behind, it is easy for designers to exercise the freedom they need to be creative and make a good product.
- It increases application testability. Moving the UI logic to a separate class that can be instantiated independently of a UI technology makes unit testing much easier.

4.3 USER ENGAGEMENT

The users' active engagement with the RESPOND mobile app (and the RESPOND DR programme in general) is essential for the success of RESPOND. For this reason, RESPOND Task *T3.2 User engagement approach* has developed a set of recommendations on how to ensure user engagement (see deliverable *D3.2 Respond User Engagement Strategy*). Many of these relate to the design of the RESPOND mobile app, and they are summarized in the following (further details can be found in D3.2):

- **Involvement of users in final design:** A well-functioning and easy-to-use mobile app is key to ensure user engagement. This goes for the user interface as well as for the functionalities that “lies behind” the mobile app user interface (e.g. programmes for automated DR response). For this reason, experiences and input from the prospective users at the pilot sites will be involved in the final designing of the mobile app. This will be done on basis of focus groups carried out in RESPOND Task *T3.3: Detailing the user context and improvements of the user interaction*. At two focus groups at each pilot site, a selection of participants from the pilot households will discuss a mock-up of the mobile app, including its DR functionalities. Based on the discussions, suggestions for specific adjustments to the final mobile app design are developed.
- **Option for overriding DR automation:** The RESPOND platform/solution includes elements of automated remote control of parts of the households' energy consumption (e.g. space heating in the Aarhus pilot). In addition to providing options of relevant user pre-settings (e.g. minimum and maximum temperatures for the automated heating control), it is particularly important to include a functionality that makes it easy for the users to override the automated control. This is important in order to provide the users with (a feeling of) control, as experiences of inconvenience or discomfort related to the automated control schedules otherwise could jeopardize the households' continued participation in the DR programme.
- **Appliance-specific consumption data and real-time feedback:** To support households' active engagement in changing their consumption patterns, it is relevant to include appliance-specific consumption data. Furthermore, studies indicate the importance of real-time (or close to real-time) feedback, as this also supports cycles of experiential learning.
- **Timely and personally tailored DR action recommendations:** The mobile app should include a module that makes it possible to provide the users with timely and personally tailored DR recommendations. Studies show that practical and “hands-on” recommendations on how to change practices in order to, e.g., time-shift consumption are important to people and their prolonged engagement. This could be done through push-notifications on the mobile phone, indicating when to time shift consumption, and including suggestions on how to do this. However, it is important that the information is delivered timely, not too frequently and to some extent is tailored to the characteristics of the individual household (e.g. what appliances the household has installed).

Neighbour comparison: In order to support the continued engagement with the RESPOND DR programme and the mobile app, the particular neighbourhood approach of the RESPOND project will be exploited through a mobile app feature making it possible for the households to follow their own DR performance and compare this to their neighbours. This is done by developing an indicator (“score”) of the share of the

individual household's energy consumption supplied by locally produced renewable energy. In other words: The percentage of the energy consumed within a certain period that has been supplied by local renewable energy source (RES). This can be compared to historical RES-shares for the individual household (so that the household members can follow the development in their DR performance; e.g. if they are getting better or worse in utilizing local RES through DR actions). In addition to this, and likely more important, the mobile app will provide a comparison of the individual households local RES-share with the average share of the neighbourhood and the average share of the 20% best performing. This will support user engagement by drawing on the dynamics of normative social influence and elements of competition (see also deliverable D3.2).

5. Mock Up

In this section, snapshots of the RESPOND mobile app mockup are shown. Designing application mockups or wireframes, allows for a more progressive development pace. Graphic designers and designers of user interfaces play an important role in this. Creating these mockups or templates allows early detection of user errors that would be made when using the application. Also, designing the wireframes, prevents misunderstandings with the client, reasonable and quality utilization of the time for development of these applications respecting the deadline.

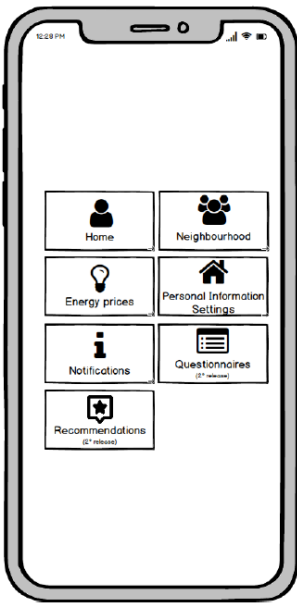
These mockups have been designed taking into consideration the aforementioned interface design principles, and the final goal of the app. They have been developed using Balsamic Mockup⁵ software. In this section, the more representative snapshots for each app section are shown. All the designed screens are shown in Appendix A. Mobile App Mockup. It is worth noting that not all the screens will be shown to all the users. Instead, each user will visualize only the relevant screens for his/her house.

Loading screen. This is the screen that will be shown while the app is loading.

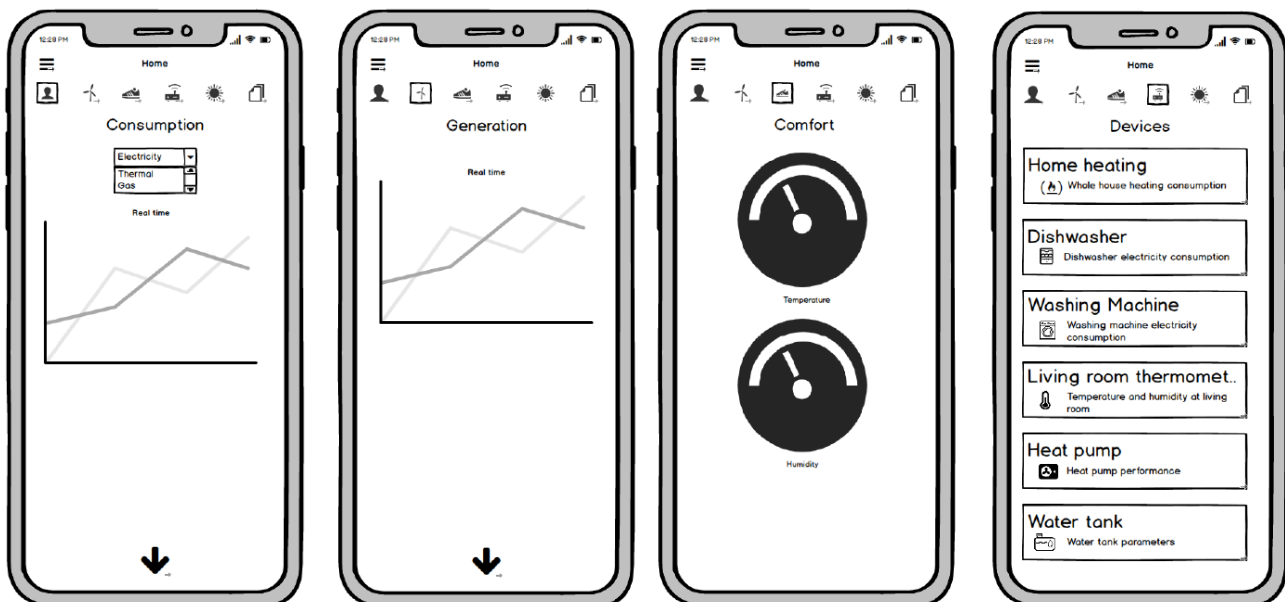


Main page. This is the screen that will be shown once the app is loaded. From this menu, the user will be able to go to the desired section.

⁵ <https://balsamiq.com/>



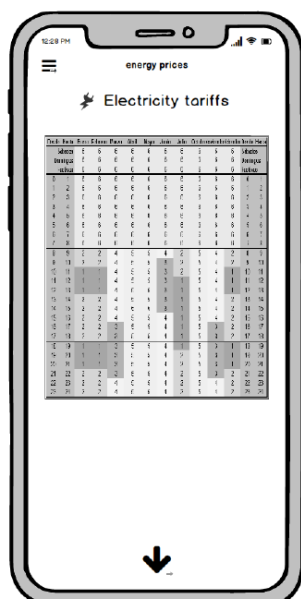
Home. This section comprises a set of screens. The Consumption screen shows the real time consumption of a house, the historical, and the comparison with the neighbourhood consumption levels. The Generation screen shows the energy generated in the neighbourhood (in the case of the Danish and Spanish pilot site) or at a home level (in the Irish pilot site). There are also screens that visualize the house comfort levels, the devices or equipment installed in each house, the weather forecast, and different reports.



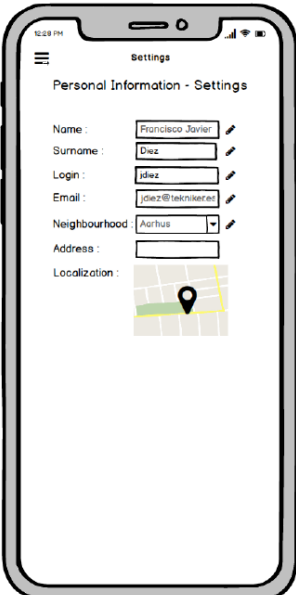
Neighbourhood. In this section, the consumption, the generation and the devices or equipment of the neighbourhood are shown.



Energy prices. This screen shows the tariffs of electricity, gas and thermal energy.



Personal Information. This screen shows the personal information and settings of the user.



Settings

Personal Information - Settings

Name : Francisco Javier

Surname : Diez

Login : diez

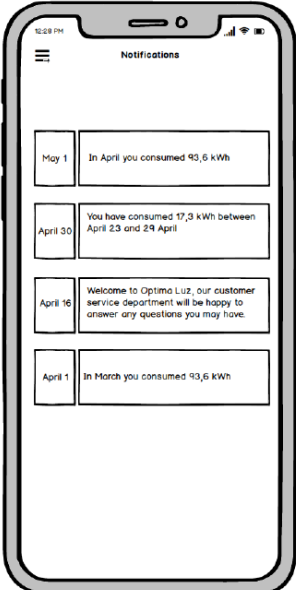
Email : jdiez@tekniker.es

Neighbourhood : Aarhus

Address :

Localization :

Notifications. This screen shows the historical of received notifications.



Notifications

May 1	In April you consumed 93,6 kWh
April 30	You have consumed 17,3 kWh between April 23 and 29 April
April 16	Welcome to Optima Luz, our customer service department will be happy to answer any questions you may have.
April 1	In March you consumed 93,6 kWh

6. FEEDBACK

After the initial mobile app mockup design task undertaken by TEK, it has been shown to the rest of the RESPOND partners in order to gather their impressions and opinions, with views to its improvement. In total, 86 feedback comments were received, which came mainly from the following partners: AAU, AUR, DEX and IMP. Furthermore, the received feedback comments were collected in an Excel sheet, and for each comment, the following information was written:

- ID: The unique identifier number of the feedback
- Section: The section or part of the mobile app mockup to which refers.
- Idea: Description of the feedback.
- Who: The partner that gave the feedback.
- Status: The current status of the feedback. Four status categories have been defined: (1) Version 1, for feedback that will be satisfied for the first version of the mobile app; (2) Version 2, for feedback that will be satisfied in a future second version of the mobile app; (3) Done, for feedback that is already satisfied in the current mobile app mockup; and (4) Under consideration, for feedback that is still unclear whether they will be done in the first or future versions of the mobile app.
- Related To: The identifier of another feedback to which it is related. This relation is mainly understood as a similarity between two feedback comments.
- Comments: Answer to the feedback from TEK.

The Excel sheet with the feedback is a live document, accessible to RESPOND participants via the shared document repository of the project. A snapshot of the Mobile App Feedback Sheet at the moment of writing this deliverable, is shown in Appendix D. Mobile App Feedback Sheet.

7. CURRENT DESIGN

This section shows the current design of the mobile app at the moment of writing this deliverable. The design of the mobile app is subject to changes in future versions, depending on the received feedback.

7.1 OVERVIEW

The mobile app design is founded on the mobile mockups. These mockups were delivered to all RESPOND partners, and they were modified according to the received feedback. For each section in the app, a couple of screenshots are shown. A more exhaustive compilation of screenshots for the iOS and Android operating systems can be found in Appendix A and Appendix B. It is also important to note that each user will have access to a set of screens according to its dwell and neighbourhood features. For example, if a user without a tumble dryer accesses the “Appliances” section, he/she will not see a tumble dryer appliance.

7.2 NAVIGATION DIAGRAM

Figure 18 depicts the navigation diagram of the app.

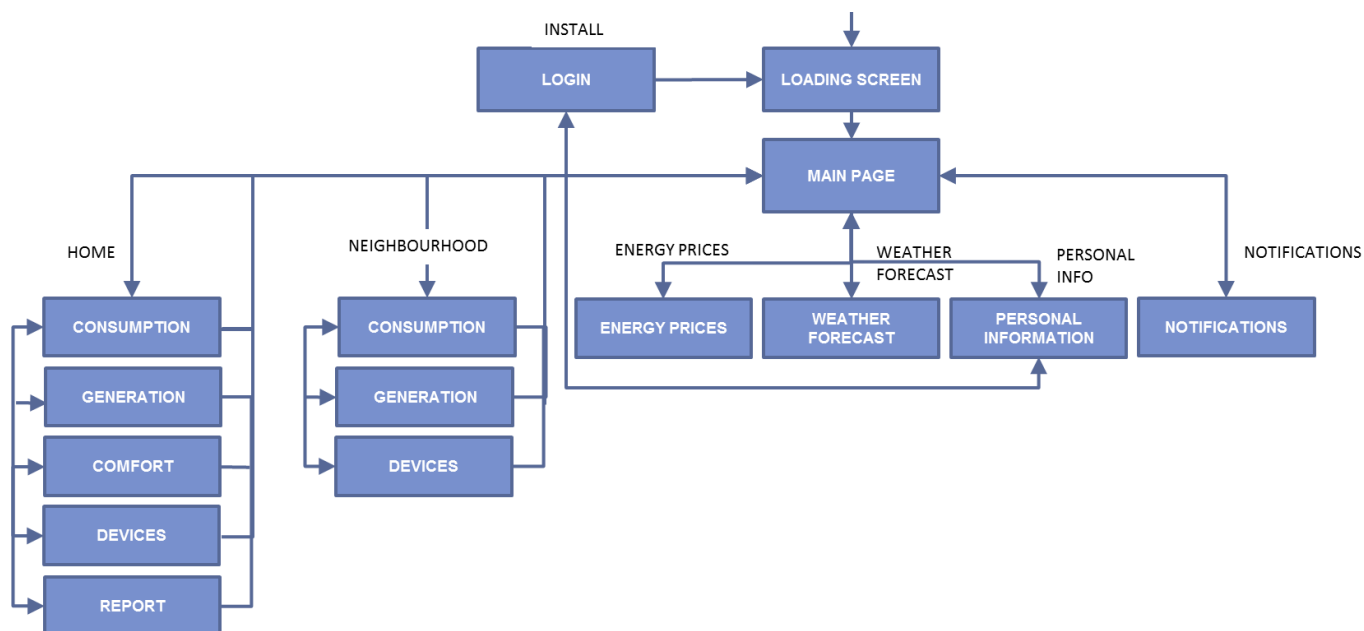


Figure 18: Mobile app navigation diagram

7.3 My HOME

This section comprises a set of screens where users will visualize information related to their homes. Figure 19 shows the real time electricity consumption screen for an Android device (on the left), and the thermal consumption compared with the neighbourhood consumption for an iOS device (on the right).

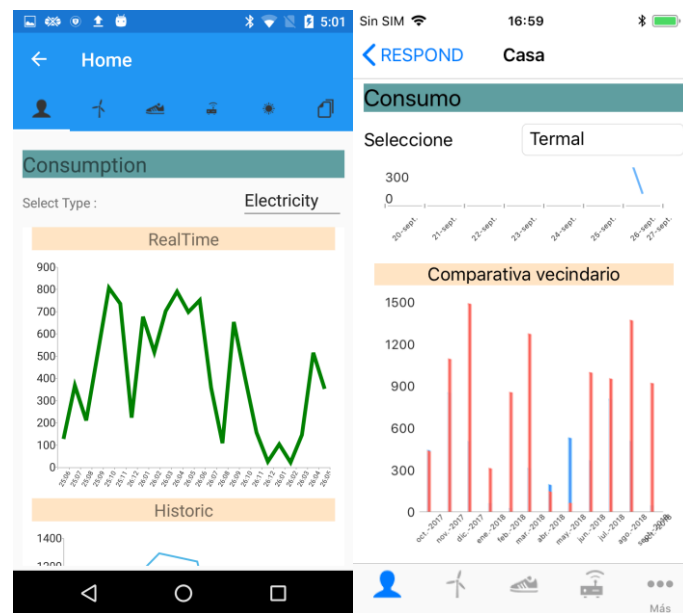


Figure 19: On the left, the real time home electric consumption for Android. On the right, the thermal consumption comparison with the neighbourhood consumption for iOS.

The screenshots related to *Generation*, *Comfort*, *Devices* and *Report* could be found in Appendix B and C.

7.4 NEIGHBOURHOOD

In this section, users will be able to access the information related to their corresponding neighbourhoods. Figure 20 shows the real time consumption for an Android device (on the left), and the real time energy generation for an iOS device (on the right).

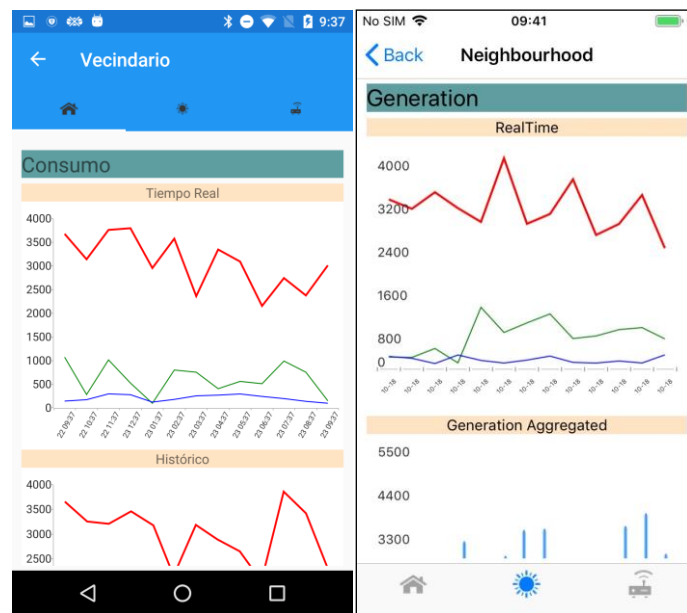


Figure 20: On the left, the real time neighbourhood consumption for Android. On the right, the neighbourhood energy generation for iOS.

The screenshots related to *Generation*, and *Devices* could be found in Appendix B and C.

7.5 ENERGY PRICES

Figure 21 shows the hourly energy tariffs. On the left side, an Android device screenshot is shown, while on the right side, the energy tariffs for iOS.

Precio Energía				Energy Prices			
Hora	Ayer	Hoy	Mañana	Hour	Yesterday	Today	Tomorrow
0	58,62	58,62	58,62	0	63.92	79.2	63.92
1	69,55	69,55	69,55	1	66.94	67.55	66.94
2	78,58	78,58	78,58	2	49.86	59.49	49.86
3	66,97	66,97	66,97	3	52.37	77.54	52.37
4	76,73	76,73	76,73	4	79.65	65.21	79.65
5	48,52	48,52	48,52	5	63.85	67.88	63.85
6	54,38	54,38	54,38	6	62.36	48.03	62.36
7	74,63	74,63	74,63	7	63.44	79.39	63.44
8	48,04	48,04	48,04	8	56.58	52.62	56.58
9	67,32	67,32	67,32	9	51.62	71.82	51.62
10	50,97	50,97	50,97	10	68.55	76.97	68.55
11	63,92	63,92	63,92	11	65.39	72.4	65.39
12	60,27	60,27	60,27				
13	69,92	69,92	69,92				
14	58,02	58,02	58,02				

Figure 21: On the left, the energy prices for Android. On the right, the energy prices for iOS

7.6 PERSONAL INFORMATION

The RESPOND mobile app also is designed to show the user's personal information. In Figure 22, this information is shown both for Android and iOS devices.

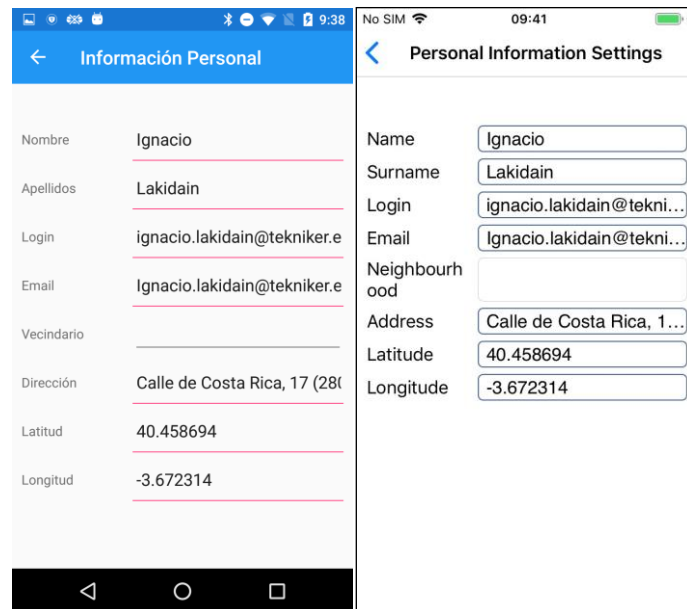


Figure 22: The personal information screen for Android (on the left) and iOS (on the right).

7.7 WEATHER FORECAST

The weather forecast report is also considered an important information for the RESPOND mobile app user. The X shows the visualization of the weather forecast in Android and iOS devices.

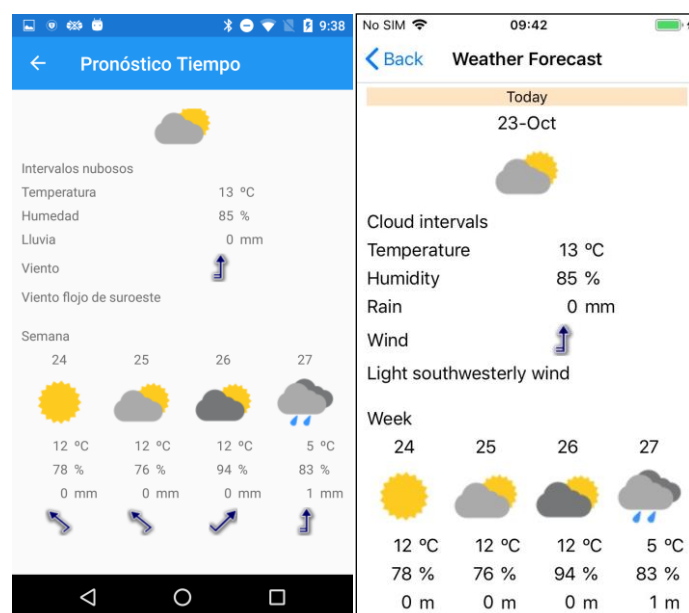


Figure 23: The weather forecast screen for Android (on the left) and iOS (on the right).

7.8 NOTIFICATIONS

The occupant will receive some types of notifications as alarms, warnings and recommendations. These notifications will be received as push messages instantly but after there are reviewed all the notifications could be viewed in the notifications section.

8. CONCLUSIONS

Smartphones are mainstream now, therefore they can be used as a tool for user engagement. The RESPOND project proposes the creation of a mobile app as a way of leveraging the advent of smart phones. However, in order to achieve the involvement of the users with the project, it is necessary to offer an intuitive, simple and useful interaction.

This is why, the design of the RESPOND mobile app has been carefully performed. For that purpose, the state of the art of existing mobile apps have been reviewed, especially the focusing on the ones facing DR problems.

One of the requirements of the app is its usage by users of different profiles. That is, bearing in mind that the RESPOND users have different nationalities, different participation levels, and different levels of climatic problem awareness, it is important to make a design that suits their necessities. As a consequence, getting users feedback will play a key role in achieving a good user experience.

Although all the aforementioned aspects have been considered in the app design process, likewise in any software app, the app is subject to changes. However, these changes are expected to be of bounded complexity.

REFERENCES

RESPOND DOCUMENTS

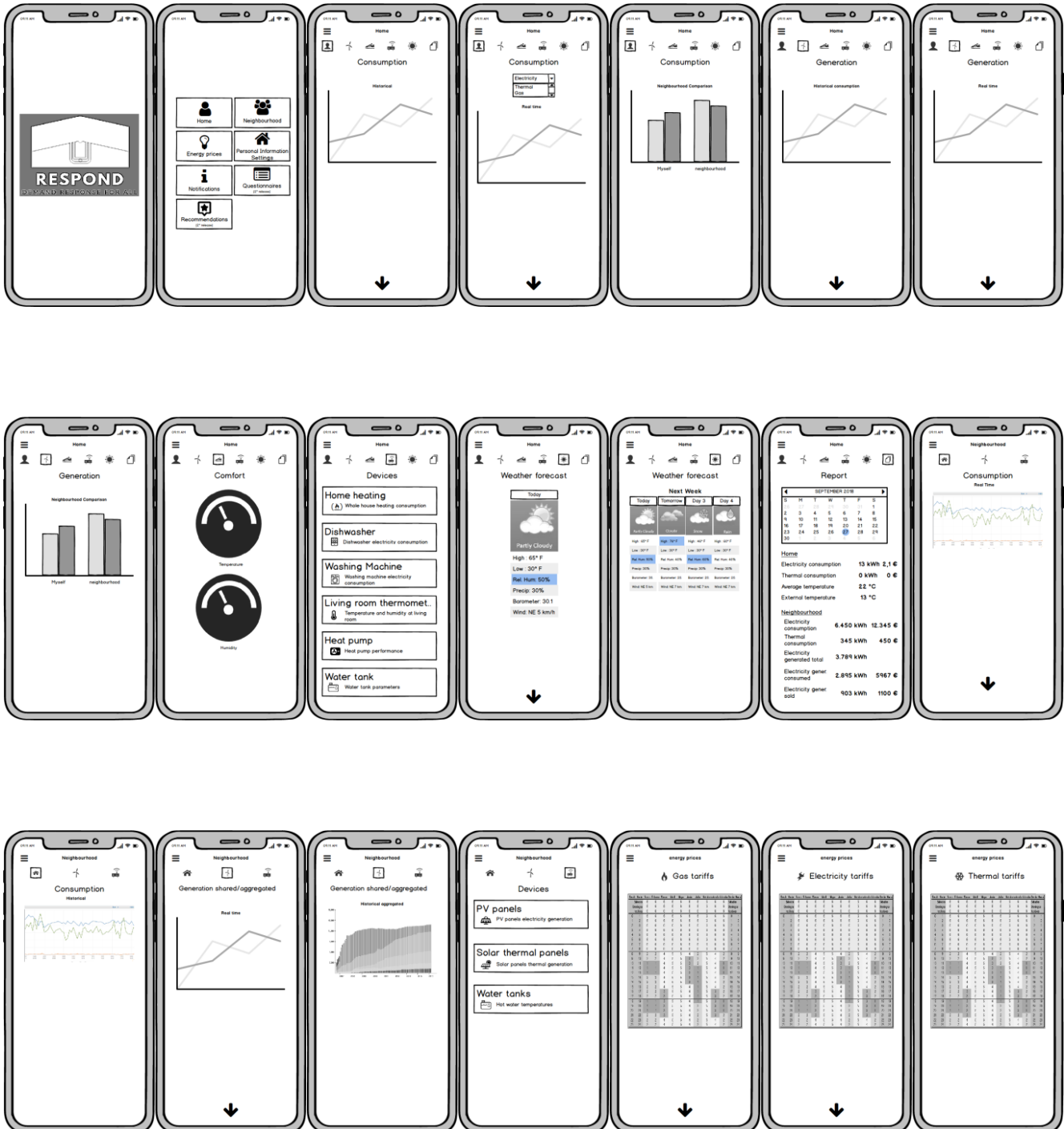
- D1.4 Pilot specific demand response strategy
- D2.1 RESPOND system reference architecture
- D3.1 Criteria and framework for recruiting and engaging
- D3.2 RESPOND User Engagement Strategy

EXTERNAL DOCUMENTS

- [1] [Online]. Available: <https://cleantechnica.com/2016/05/05/bidgely-demand-response-trial-averaged-30-load-reduction-peak-events/>. [Accessed 25 September 2018].
- [2] [Online]. Available: <https://www.computerworld.com/article/3239304/mobile-wireless/what-is-ifttt-how-to-use-if-this-then-that-services.html>. [Accessed 25 September 2018].
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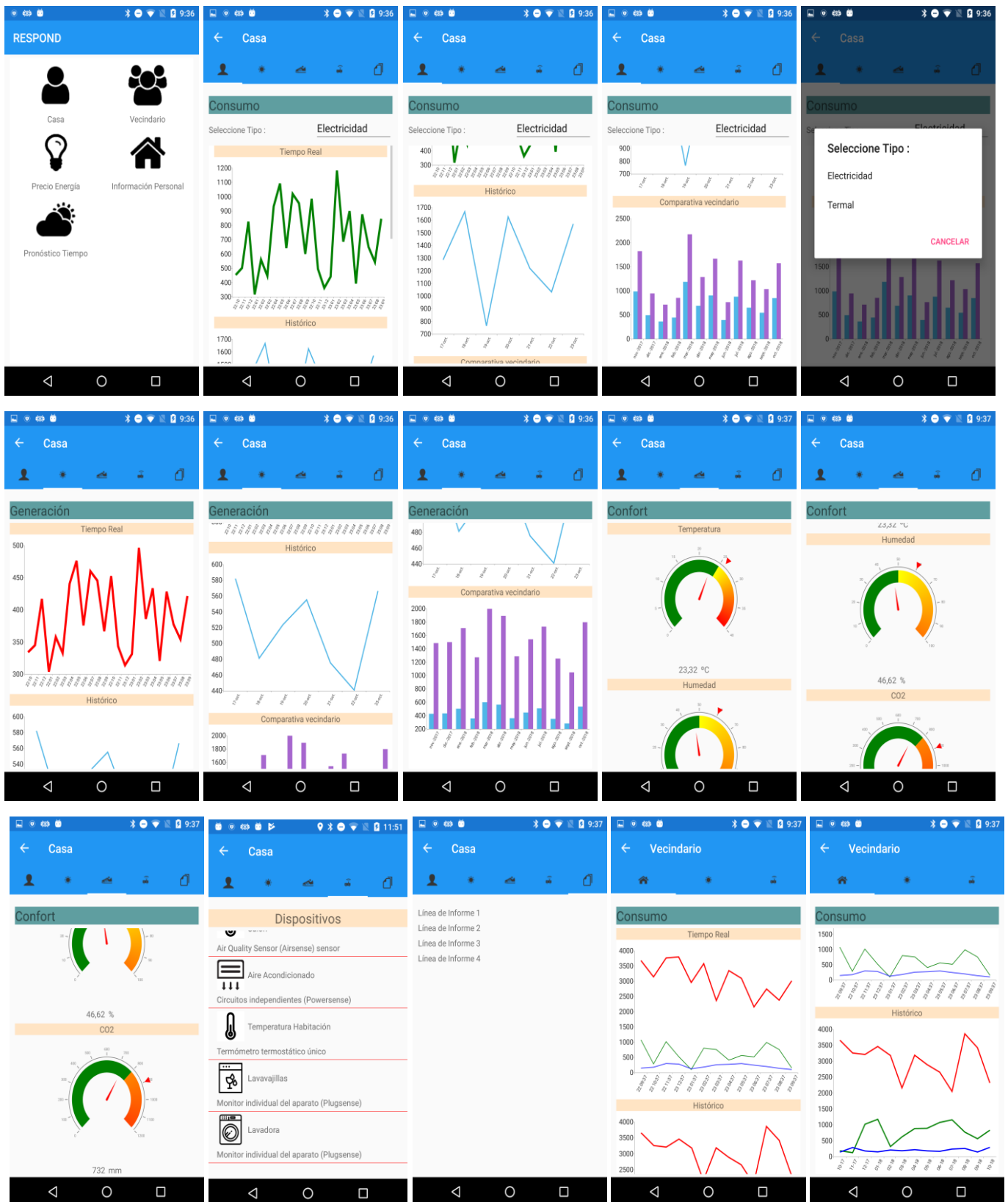
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- [10] [Online]. Available: [https://docs.microsoft.com/en-us/previous-versions/msp-n-p/hh848246\(v=pandp.10\)](https://docs.microsoft.com/en-us/previous-versions/msp-n-p/hh848246(v=pandp.10)). [Accessed 25 September 2018].

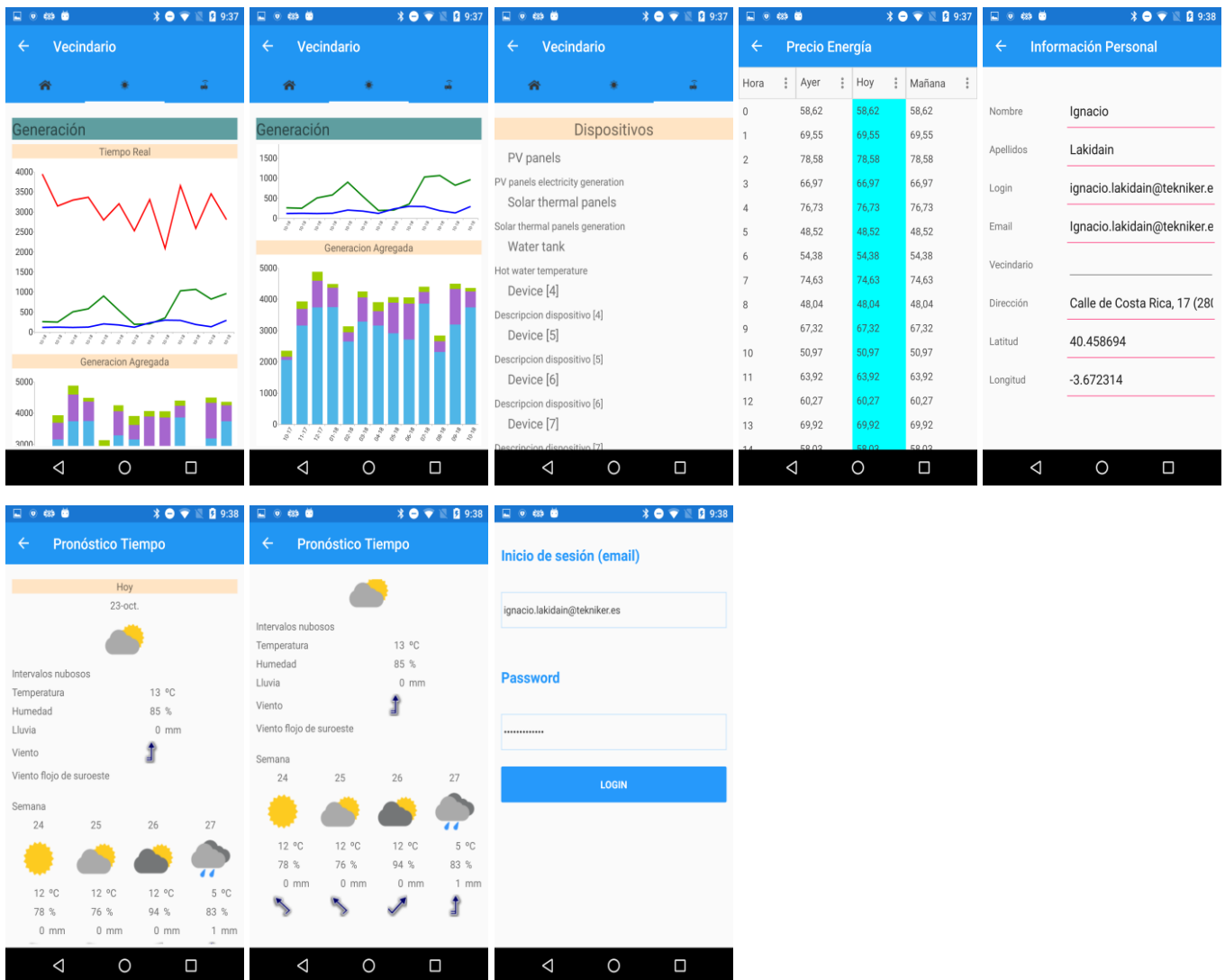
APPENDIX A. MOBILE APP MOCKUPS



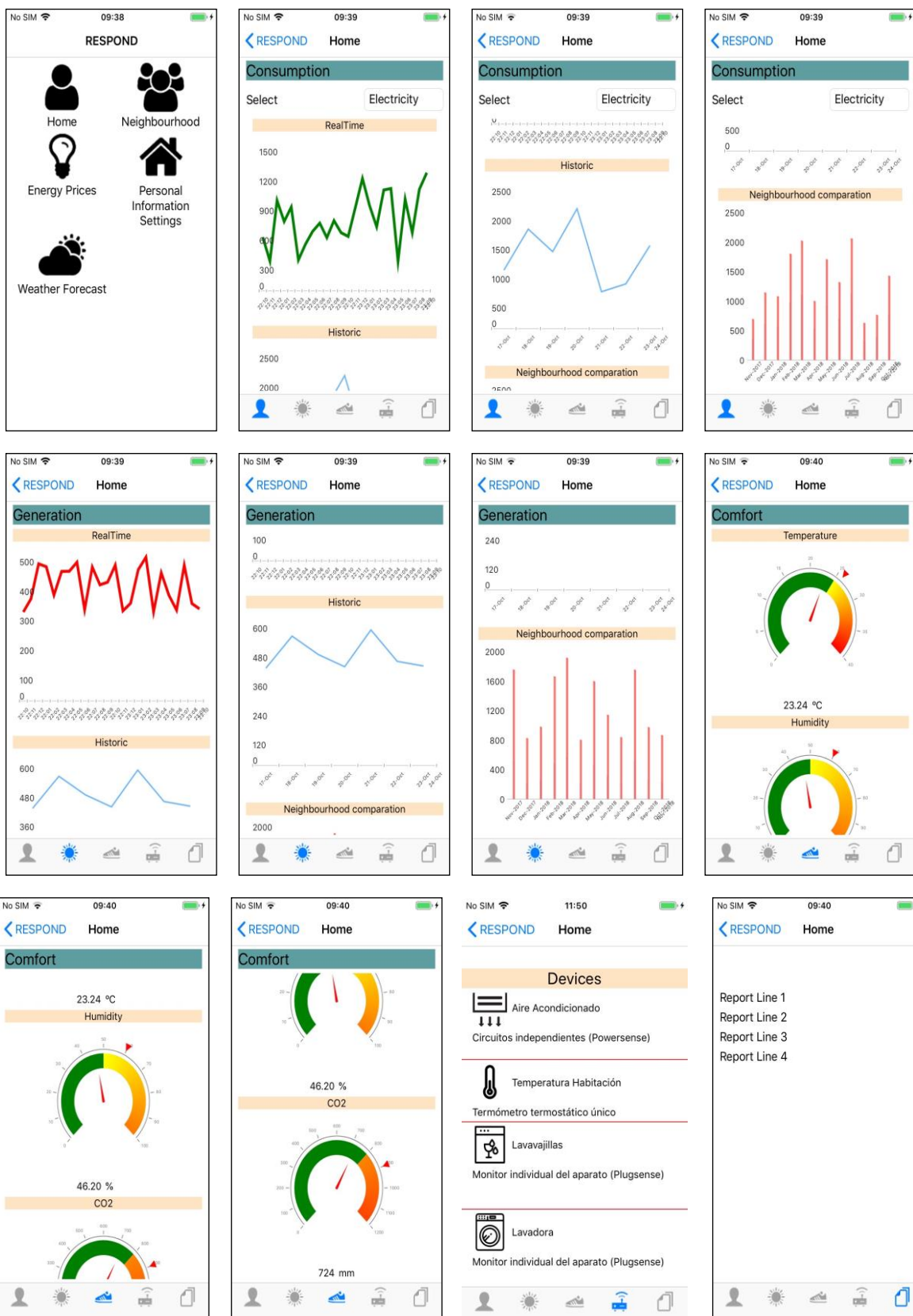


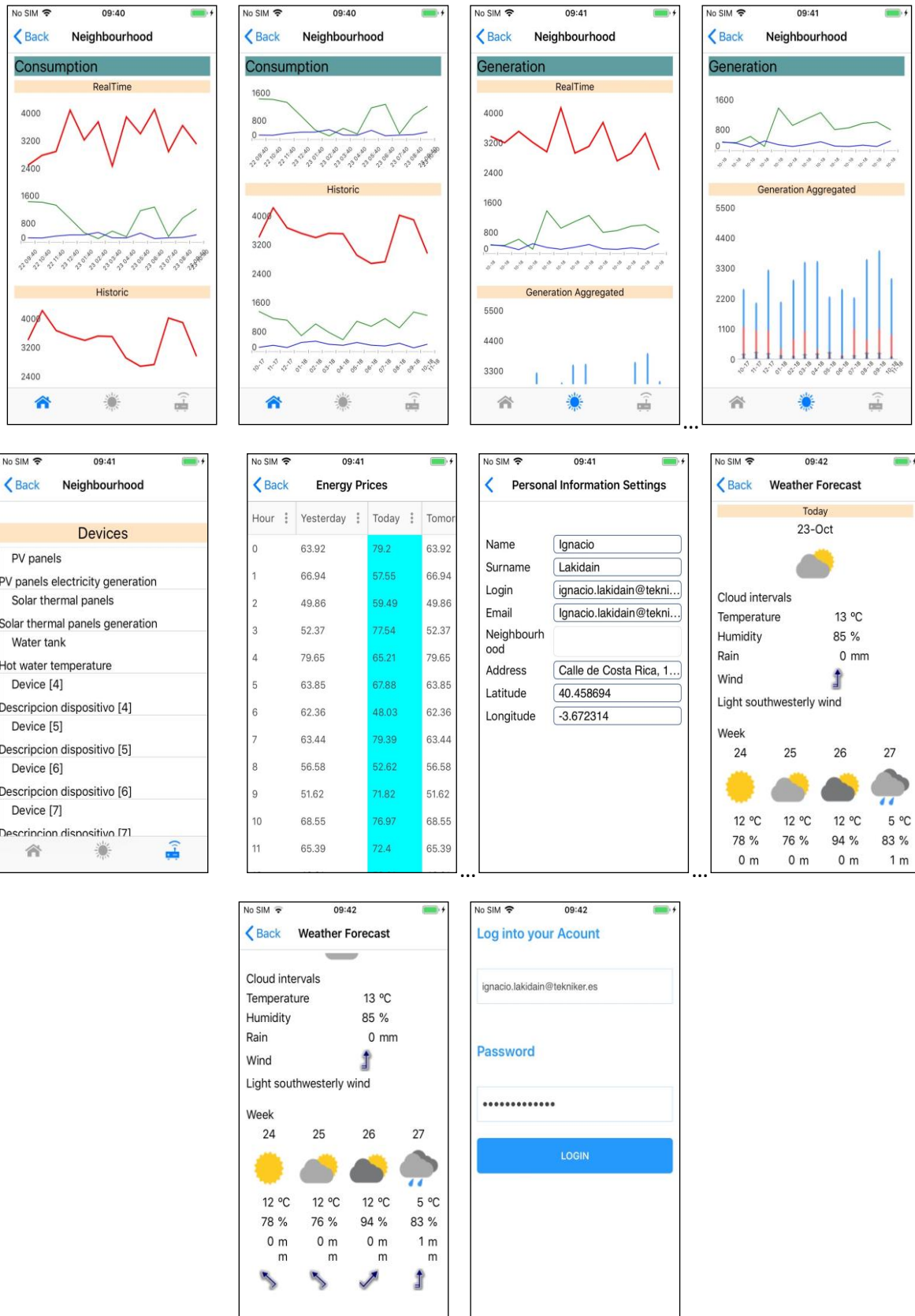
APPENDIX B. MOBILE APP SCREENSHOTS FOR ANDROID





APPENDIX C. MOBILE APP SCREENSHOTS FOR IOS





APPENDIX D. MOBILE APP FEEDBACK SHEET

ID	SECTION	IDEA	WHO	STATUS	RELATED TO		COMMENTS
I01	RESPOND Main Page	Show important notifications	DEX	Version 1			
I02	RESPOND Main Page	Include some direct links/buttons e.g. to Home-Comfort-1 to make access easier. Or maybe that is provided by the “headers”?	AAU	Done	I74		This is how this page can be accessed: Home - Comfort
I03	Initial page/Respond Main Page	Consider to combine these two pages to reduce the number of pages and to only have pages that are somehow useful (a logo only is a page that would make us annoyed in the long run). So please place the logo on top of the Respond Main Page.	AAU	Done			The initial page it is shown only for 2 seconds, while the app initializes
I04	Initial page/Respond Main Page	Performance summary or the most relevant DR related data could be presented already on the home screen of the app	IMP	Under consideration			
I05	Initial page/Respond Main Page	Introduction of widget tool that will be always active on the mobile home screen also visualizing the most relevant DR related data: 1) recommended actions (e.g. simple recommendation as lower or increase the consumption - indicated by arrows), 2) potential savings to be achieved (and total savings achieved so far); 3) else (other KPIs)?	IMP	Version 2			

I06	Home-xx	My house , site, property... instead of Home, it is a little bit confusing.	DEX	Under consideration	I28	I73	My House or My home?
I07	Home-Consume-1/2/3	Graph that shows both actual consumption and recommended consumption profile could be introduced as our goal is to motivate the user to follow the recommended consumption profile	IMP	Version 2			
I08	Home-Consume-1	Add titles to axis to know what the chart refers to.	AUR	Version 1			
I09	Home-Consume-1	Real time chart. How much data will it show? The previous 24 hours?	AUR	Version 1			Yes, today refers to the previous 24 hours
I10	Home-Consume-1	Perhaps you could also show how much of my electricity consumption there is green/cheap for example. 60% or how much is own production from PV	AUR	Under consideration			Depends on the data gathered from each pilot
I11	Home-Consume-1/2	Energy source in real time . + Energy source historical . Both could be seen on the same screen	DEX	Done	I19	I49	They are both on the same page, and they the second page can be seen scrolling down.
I12	Home-Consume-1 (and more general)	Now, electricity and thermal can be chosen from a drop-down menu. Wouldn't it be more intuitive if it was more like two "buttons" that the user can switch between (by pressing either the Electricity or Heat "button")? This is probably a more general comment - i.e. I prefer "buttons" instead of "drop-down menus" whenever possible/feasible (with the exception of situations with many alternative choices, of course).	AAU	Under consideration			

I13	Home-Consume-1	What is the time resolution on the graph? It is important that the system is as close to "real-time" as possible - e.g. updating every 5 minutes (or even more frequently, if possible). It is probably a good idea to make the initial version of the graph to be a daily profile (showing the profile of the current day). But could be good, if people can easily "zoom out" and "zoom in". For instance shift to a week profile or even monthly/annual profiles. And the opposite way: Close in and see details in the consumption within the last hour etc. This in order to make it possible for people to actively experiment with their own consumption and see what influence this has on their own energy consumption profiles. I don't know how difficult this is to realize (programming etc.), but would be great. [Some / most of this comment probably also relates to Home-Consume-2]	AAU	Done			Further tests need to be done in order to achieve a balance between the resolution and easy-to-use.
I14	Home-Consume-2	As far as I've understood the approach in our project, the two main types of actions that people can do in RESPOND are either 1) save energy (reduce energy consumption) or 2) shift consumption in time (peak-shaving or shifting to hours with local electricity generation). As these are the two main activities/actions, I think it should be possible for the app users to get information about how well they	AAU	Version 2			

		perform in either saving energy and/or time shifting energy. One way to do this would be to compare the household's current profile/consumption with the profile of a previous period. If we have the historical data (a baseline), this could be - e.g. - comparing the average daily load profile (24 h) of the last week with the average load profile of the previous week/month/year. In this way, the users can be able to see if their actions (saving energy or moving consumption in time) have had an effect. The profile comparison is, of course, mainly about time shifting, while it would be an idea on the same graph to have also the total energy consumption (e.g. the total energy consumption of the previous week compared with the energy consumption of the week before / the average weekly consumption of the last year). Maybe this extra function could be added via a new button " COMPARE YOUR CURRENT CONSUMPTION WITH PREVIOUS PERIODS ".				
I15	Home-Consume-3	Comparison me vs neighbourhood. Two tabs could be included in the bottom / at the top so this comparison will be deleted.		Under consideration		
I16	Home-Consume-3	The idea of comparing the household with the neighbours is good and follows our "neighbourhood-approach" in RESPOND.	AAU	Version 2		

		<p>Here, I think we should be inspired by previous designs that attempts to utilise the influence of <i>descriptive social norms</i> on people's behaviour. It is not clear what it is more exactly that is compared on this screen, but - referring back to the previous point about the two main types of actions that households can perform - it could be two different things: 1) The average consumption per household (perhaps also per person - but less important, I think) compared to the average per household (person) consumption of the neighbours. Also, I would suggest adding a third column, which shows the average consumption of the 20% homes consuming the least (i.e. the "top 20% performers"). The latter column can motivate people to reduce their own consumption even more. Further, 2) there could be another graph that compares the households' performance with regard to time shifting their own consumption with the average performance of their neighbours (and perhaps also the 20% best performers). This is of course a much trickier one to make... One way to do it could be by developing an indicator of the percentage of the daily load profile that has been shifted from hours with high energy prices to hours with low energy prices. For instance at the Aarhus pilot, this</p>					
--	--	--	--	--	--	--	--

		would be the percentage of the electricity consumption shifted from the period of - roughly - 10 am to 3 pm to other hours of the day. This could be shown for the latest week/month compared to the load profile shift percentage of the previous week/month/year (this should be based on averaged profiles, of course). Like with energy saving, "shift percentage" of the individual household can be compared to the average "shift percentage" of the neighbourhood and of the top 20% performers, respectively. Perhaps this indicator can be measured in both percentage and number of kWh's shifted. I don't know how difficult it is to construct this sort of measures/indicators (you are the ones who can judge what is realistic or not given your RESPOND main hours at TEK) - however, my main message here is that it is important that we are able to give the participants (users) a way of estimating how well they perform with regard to saving energy and time shifting their own consumption. Finally, a minor detail: Shouldn't the left bars be named "My home" and not "Myself"?				
117	Home-Consume-3	Are we comparing Euros or kWh?	AUR	Under consideration		Initially, kWh. We will consider to select between Euros and kWh

I118	Home-Consume-3	Perhaps it is possible to show how big a part there is from own PV production for myself compare to neighbourhood	AUR	Under consideration			Depends on the data gathered from each pilot
I119	Home-Generation-1/2	Real Time + Historical: Both could be seen on the same screen	DEX	Done	I11	I49	They are both on the same page, and they the second page can be seen scrolling down.
I120	Home-Generation-1/2	Symbol. Should the symbol refer to renewable energy production in the country (in Denmark) Or should it refer to ALBOA's own energy production - then a 'sun' is better as symbol. We don't have local wind power.	AUR	Version 1			The symbol for generation section will be changed by a sun. Besides, the current symbol for the weather (a sun image) will be replaced by a symbol with sun and clouds
I121	Home-Generation-3	Comparison me vs neighbourhood. Two tabs could be included in the bottom / at the top so this comparison will be deleted.	DEX	Under consideration			
I122	Home-Generation-3	I think this will be on the neighbourhood level at most pilots (perhaps except for Aran Islands). Thus, it doesn't make sense to compare your own generation with the generation of the neighbourhood (no. 3).	AAU	Version 1			This Home-Generation page is only shown for the Aran pilot site, where energy is generated by each house.
I123	Home-Generation-3	What is shown in this figure? Is it consumption of renewable energy from the local production from PW or is it from the Danish general consumption?	AUR	Done			This comparison between you generation and the neighbourhood generation does not have any sense for the Danish pilot. It is only for the Irish pilot. Therefore, for a Danish user, this screen will not be shown.
I124	Home-Comfort-1	The “header” symbol (a running shoe?) seems funny and we do not connect that with the indoor climate (temperature, relative humidity and air quality). Maybe use a symbol of a thermometer.	AAU	Version 1			

I25	Home-Comfort-1	Symbol. It is a funny one	AUR	Version 1	I24		
I26	Home-Comfort-1	Charts. It could be nice to see the normal/ideal area for example as green	AUR	Version 2			
I27	Home-Comfort-1	Charts. Perhaps one more circle with CO2?	AUR	Version 1			
I28	Home-Comfort-1	Add a symbol for “Air Quality”.	AAU	Version 1			
I29	Home-Comfort-1	Include the units, for temperature °C, for relative humidity % and Air Quality ppm. Change “Humidity” to “Relative Humidity”. Change “.Comfort” to “Indoor Climate” or “My Indoor Climate”.	AAU	Version 1			
I30	Home-Comfort-1	We would like to be able to see how the three indoor climate parameters, temperature, relative humidity and air quality, develop/change over time. It would be nice if it was possible by a touch of the icons to get to a window/screen with a graph similar to graphs in e.g. Neighbourhood-Consume-1.	AAU	Under consideration			
I31	Home-Comfort-1	The possibility of overviewing different time intervals (like it is possible by the Netatmo app) would be useful to learn about one’s own indoor climate. For inspiration maybe try to Google “Netatmo app” and look at the pictures from the app. For example, the graph for the parameters is shown simply by tilting the mobile.	AAU	Under consideration			
I32	Home-Devices-1	My house. Appliances instead of devices	DEX	Done	I06	I73	It is still need to be decided which are the devices to be placed

I33	Home-Devices-1	What should this page show? Does it refer to management or to see your consumption? It would be nice only to see devices for the individual family. In ALBOA they don't have Heat pump and water tank.	AUR	Version 1			Each user will visualize only the devices he/she has on his/her house.
I34	Home-Devices-1	I think it makes sense to have a number of pre-set appliances - in particular those we have talked about previously, i.e. dishwasher and washing machine (and water tank/heat pump). But I would vote for having a few (e.g. 2) optional appliances that the user can define themselves. I.e. a few smart plugs that they can define as, e.g., their e-bike charging, auxiliary heater, game console ... This is also to invite the users to get involved in processes of experimentation and learning on their own. Furthermore, we are not sure whether the Living room thermometer belongs to this screen. It has its own screen "Home-Comfort-1" that gathers all indoor climate measurements?	AAU	Done			The devices shown in this page will depend on the devices installed within the house. The option that lets users add new devices, is left for future work
I35	Home-Weather-1/2	Weather forecast in main page and follow you into detail (second page)	DEX	Under consideration	I31		
I36	Home-Weather-1-1	a direct link from the Main Page to the weather forecast section	AAU	Under consideration	I30		
I37	Home-Weather-1-1	Temperature in °C rather than °F	AUR	Version 1			

I38	Home-Weather-1-1	Perhaps there could be a conclusion : today it is a good day to use electricity for the next two days it will be rain	AUR	Version 2			This conclusion will probably go on the Recommendations section. But it could also appear here. It will be considered for a future version
I39	Home-Report-1	Report could include swap, tabs , to allow an easier reading	DEX	Under consideration			
I40	Home-Report-1	I guess, this is a page for the more "nerdy" types. I'm not sure how important the total energy figures for Neighbourhood are to people. But maybe it doesn't do any harm... To people, average figures for neighbourhood households (perhaps similar to themselves with regard to household size, i.e. segmented) make more sense in general. But this is covered by my previous suggestions. Make it clear that "average" means average of that particular day (if that is what it means). Replace "Thermal consumption" with "Heat consumption".	AAU	Under consideration	I47	I50	
I41	Home-Report-1	Calendar. a week starts with Monday in Denmark	AUR	Under consideration			
I42	Home-Report-1	Is it possible to mark several days and then see for example consumption for a week?	AUR	Version 2			
I43	Home-Report-1	Home - Electricity Consumption. How much did I use of PV?	AUR	Under consideration			It is particular for the Danish pilot
I44	Home-Report-1	External temperature. Is it important to know this info?	AUR	Done			Yes, we consider it is important

I45	Home-Report-1	Neighbourhood - Electricity Consumption. It is not possible to compare with my home. The consumption could be shown per person or per home. I would love to compare with me self or my home.	AUR	Done			It is not a comparison. It is the aggregated consumption
I46	Home-Report-1	Neighbourhood - Electricity sold. It is actually negative to sell electricity to the grid. How can that be showed? another text: "Use of PV 80%" - graph in colour (red, yellow, green)	AUR	Version 2			Both information could be shown
I47	Neighbourhood- Consume-1/2	I guess, this is a page for the more "nerdy" types. I'm not sure how important the total energy figures for Neighbourhood are to people. But maybe it doesn't do any harm... To people, average figures for neighbourhood households (perhaps similar to themselves with regard to household size, i.e. segmented) make more sense in general. But this is covered by my previous suggestions. Make it clear that "average" means average of that particular day (if that is what it means). Replace "Thermal consumption" with "Heat consumption".	AAU	Done	I40	I50	Neighbourhood consumption is aggregated
I48	Neighbourhood- Consume-1/2	Neighbourhood tab could include features (such as rank, or a score board) that indicate in some way the comparison between the neighbours (or with the neighbour with the best performance in an anonymized way) to engage them into the	IMP	Version 2			

		social competition; it's a question whether the dwelling/apartment owner is interested in the energy consumption of entire neighbourhood					
149	Neighbourhood-Generation-1/2	Real Time + Historical: Both could be seen on the same screen	DEX	Done	I11	I19	They are both on the same page, and they the second page can be seen scrolling down.
150	Neighbourhood-Generation-1/2	I guess, this is a page for the more "nerdy" types. I'm not sure how important the total energy figures for Neighbourhood are to people. But maybe it doesn't do any harm... To people, average figures for neighbourhood households (perhaps similar to themselves with regard to household size, i.e. segmented) make more sense in general. But this is covered by my previous suggestions. Make it clear that "average" means average of that particular day (if that is what it means). Replace "Thermal consumption" with "Heat consumption".	AAU	Done	I40	I47	Neighbourhood generation is aggregated
151	Neighbourhood-Devices	Only relevant for the family should be showed. ALBOA do not have solar thermals panels or water tanks.	AUR	Done			
152	Energy-prices-Electricity/gas/Thermal	is not useful to display this information on the app, it is better to know the economic benefit from DR actions	DEX	Version 2			
153	Energy-prices-Electricity/gas/Thermal	a more simple design where people can easily get an overview of the prices for today and tomorrow.	AAU	Under consideration			

154	Energy-prices-Electricity/gas/Thermal	In the Aarhus pilot, we plan to combine static time-of-use pricing in the shape of a fixed tariff-structure throughout the day for the summer period (with PV power production) with instances of extra cheap electricity prices (on days with much sunshine). The latter, we think, should be communicated via push-messages in the morning (like "The day today will be a sunny day, and you will get extra cheap electricity between 11 am and 2 pm", e.g.). This also reminds me of another important feature, which the app hopefully can integrate: Push-messages , like the one mentioned.	AAU	Version 2			
155	Personal Info-Settings	Ask the user to use current location, GPS ; instead of showing the map	DEX	Version 2			
156	Personal Info-Settings	Login no. Mail as login	DEX	Version 1			
157	Personal Info-Settings:	Wouldn't it be an idea to include also the household size (number of adults and children living in the household) in order to make it possible, perhaps, to segment the homes into types?	AAU	Version 1			
158	Personal Info-Settings:	Localization of app should be envisioned to engage the users (translation of user interface into Danish and Spanish language, etc.)	IMP	Version 1			This was already planned
159	Personal Info-Settings:	I would like to have more settings - number of people in the household	AUR	Version 2			
160	Personal Info-Settings:	- do I want to see prices in euro or kroner	AUR	Version 2			

I61	Personal Info-Settings:	-choice of Celsius or Fahrenheit		Under consideration	I37		
I62	Personal Info-Settings:	an idea... - choice of family I want to compare myself with (drop down menu with types of familys	AUR	Version 2			
I63	Notifications-1	Alerts in the app, notifications as native in the mobile.	DEX	Done			This was already planned. The notification screen is aimed to review old notifications, rather than receiving new ones
I64	Notifications-1	This is an important feature. See also previous comment on push-messages. This page could also include feedback about the indoor climate . For example: “The last week the temperature has been a bit high. If you lower the temperature 1°C you will save around 5%” and “The last week the relative humidity/CO2 has been rather high. If you air out a little more it will fall and you will reduce the likelihood of mould growth in your dwelling”.	AAU	Version 2			
I65	Device-1	Not relevant for Danish pilot site	AUR	Done	I71	I72	
I66	Device-2	Perhaps some of the families don’t want remote control socket - is it possible to remove the page as "not relevant"	AUR	Under consideration			
I67	Device-2	It may not be all the Danish families who get the remote control socket on the dishwasher. Could it be possible to choose a dry tumble or television?	AUR	Done			

I68	Device-3	Perhaps some of the families don't want remote control socket - is it possible to remove the page as "not relevant"	AUR	Done			
I69	Device-4	There is more than one thermostat	AUR	Done			If there is more than a thermostat, there will be shown
I70	Device-4	Set point temp is missing here	AUR	Version 2			It is a thermometer. In the case of a thermostat, the image will show a thermostat (with the set point included)
I71	Device-5	Not relevant for Danish pilot site	AUR	Done	I65	I72	
I72	Device-6	Not relevant for Danish pilot site	AUR	Done	I65	I71	
I73	Device-1 to Device-6 Hist.	Maybe control appliances better	DEX	Under consideration	I06	I28	It is still need to be decided which are the devices to be placed
I74	Device-1 to Device-6 Hist.	We miss calendar here	DEX	Version 2			
I75	Device-1 to Device-6 Hist.	swap the devices and show together the control and the consumption	DEX	Under consideration			
I76	Device-1 to Device-6 Hist.	Till 5 appliances, you will have the whole description available and if you swap you will see the following appliance. Instead of pressing.	DEX	Under consideration			
I77	Device-1 to Device-6 Hist.	If this is the main entry point for the users with regard to control (remotely) their appliances, it is also important to include the option of overriding the automatic demand response management that is foreseen for the Aarhus pilot with regard to heating.	AAU	Version 2			This issue needs to be further discussed

178	Device-1 to Device-6 Hist.	Another thing: I'm not sure how the user navigates from the Main Page to the Devices pages. Shouldn't this be included as a menu option on the Main Page ?	AAU	Done	102		This is how this page can be accessed: Home - Devices
179	Device-1 to Device-6 Hist.	Finally, I'm missing the " get back " or " return " option on the pages of the individual devices. I.e. getting back from, e.g., Device-1 to Home-Devices-1	AAU	Done			Each page has the option of returning to the Main Menu. The "back" option will depend on the buttons offered by each terminal (e.g. phone)
180	Device Neigh-1	What is it useful for? I would like to see if they use all the PV production	AUR	Done			It shows the production in real time
181	Device Neigh-2/3	Not relevant for the Danish pilot site	AUR	Done			
182	General	We miss also the Demand Response actions like economic benefit for the user , if he is available or not, number of activations etc.	DEX	Version 2			
183	General	We miss also social and user engagement	DEX	Version 2			It is needed to see the content
184	General	As the users of mobile app will be the dwelling residents (potentially with low IT literacy), we should keep the app as simple as possible and leave too technical things for DEXMA dashboard (e.g. indicating the savings in EUR instead of KWh such as on Notifications tab); Energy prices tab: what in the case of variable pricing schemes (depending on the amount of energy which is demanded and similar)?	IMP	Under consideration			
185	Uncategorised	Select date range is missing	DEX				It will depend on the page