

Watt Are You Doing

Second Delivery

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1 Introduction

This report focuses on documenting the results achieved in the second part of the Human Computer Interaction project.

Throughout this project, we have been developing the prototypes for our application, Watt Are You Doing, a Web-based home energy audit app for monitoring and controlling the energy usage of home appliances to reduce energy bills. In the previous delivery, we presented our project vision, showed the analysis we conducted on our user surveys, and described personas and the application's functionalities.

The second part of this report focused on the construction of the lo-fi prototypes and the conduction of heuristic evaluations on them. In this report, we will be talking about all the steps we took in this phase, including the functionalities we chose to focus on from now on, the defined tasks and respective usability requirements, the wireframes created and the wireflows for each task, and the results of the heuristic evaluations we received, as well as the corrections to be performed on the next project phase.

2 Project Abridged Description

Recapitulating our project theme, Watt Are You Doing is a Web application aiming to ease the trouble of checking how much energy our homes spend. For this purpose, our program will allow the user to analyze graphically the consumption/production of each home appliance throughout time, give tailored suggestions to reduce energy consumed or money spent and allow to control devices directly on the platform.

2.1 Most Important Functionalities

From the functionalities we have defined in the previous phase for our application, we decided that the three functionalities we're focusing in our project will be:

- **Dashboard** - Presented as our application's main screen, the dashboard provides users with a graphical summary of the consumption/production patterns, through multiple time periods, providing other filtering options, as well as statistical information regarding the overall consumption, the top spending appliances, suggestions and alerts, etc.
- **Device Search** - The search mechanism will allow users to search devices, with adequate filtering options, making devices more accessible and easing the organization of appliances in the platform.
- **Device's Detailed Analysis** - The application will provide a comprehensive view that englobes most of the application's core features, such as exhibiting the information and state of the appliance, presenting the consumption trends, and indicating suggestions to improve power usage for the device.

2.2 Tasks and Usability Requirements

Based on the previous functionalities, and also taking the activity scenarios we created on the previous phase as inspiration, we defined the following user tasks, which correspond to common activities a normal user will take part in when using our application. For each task, we will also mention the usability requirements we established to evaluate the quality of our prototype, concerning our project goals.

2.2.1 Obtain Details of a Specific Device

The objective of this task is for the user to locate a specific device quickly using the search function, and then access its detailed description and control settings with ease. It is comprised of the following steps:

1. Search for the devices with the tag "Kitchen".
2. Find the device named "Refrigerator".
3. Obtain more details about its consumption trends.

Usability Requirements:

- Efficacy:
 - 80% of users should be able to find the search page without aids.
 - 90% of users must be able to obtain detailed information about devices without aids.
- Efficiency:
 - Average time to find the search page should be less than 10 seconds, and to perform the other steps should be approximately 8 seconds for each
 - 95% of users must be able to accomplish each step with less than 8 clicks.
- Satisfaction:
 - Over 85% of users should report that the page flow is adequate.
 - Over 75% of users should report low difficulty in performing these actions on their first try

2.2.2 Analyze Energy Usage by Time Period and Device Tags

This task consists of the user exploring energy consumption patterns over various time periods, using the consumption trend graphs, refining the analysis by filtering devices based on specific tags, and comparing the energy consumption/production between the different options. It comprises the following steps:

1. Observe the overall home energy consumption throughout the last 7 days.

2. Obtain the energy consumption of all devices within the last 24 hours.
3. Filter the devices in the energy trend graph to the ones with the tag "Rooms".

Usability Requirements:

- Efficacy:
 - 90% of users should be able to find the "time period" and "filter by tag" options on their first attempt.
- Efficiency:
 - Users should be able to switch between 24-hour and weekly views within 4 seconds on average.
 - Over 80% should be able to switch options with no more than 2 clicks.
- Satisfaction:
 - 95% of users should report that the dashboard is easy to locate and understand.
 - Over 85% of users should report ease of use in the filtering options.
 - Less than 10% of users should report any dissatisfaction with the ease of comparison.

2.2.3 Investigate Top Energy Spending Devices

For this task, the user needs to identify the household devices consuming the most energy, receive their details, understand the factors contributing to their inefficiency, and apply the given suggestions to optimize their energy usage. It englobes the steps below:

1. Locate the device with the highest energy consumption.
2. Find details about the device.
3. Read the suggestions on how to solve its problematic energy usage.
4. Perform the first suggestion inside the application.

Usability Requirements:

- Efficacy:
 - 95% of users should find the highest energy consuming devices on the dashboard on their first try.
- Efficiency:
 - Each operation should take less than 10 seconds.
- Satisfaction
 - Over 90% of users should be satisfied with the flow of the application.
 - Over 85% of users should report low difficulty in performing these actions.

3 Prototype's Wireflow

For this phase of the project, we also developed the low-fidelity prototypes using Figma.

We started by following the Crazy 8 methodology and prototyped the 3 main pages: dashboard, device, and search page using pen and paper. Eventually ending up with 32 ideation designs before agreeing on the best ones and transforming them into Figma wireframes.

We decided to use Figma due to its functionalities and past experience. As suggested by the teacher, we took advantage of a plugin named "Paper Kit", which has a toolkit of pre-designed components that eased creation and guaranteed consistency across pages.

Some of the main concerns when developing our wireframes were the quantity, quality and relevance of information by page, as well as the design consistency, in order to provide an intuitive flow across the application.

3.1 Template Wireframes

Before focusing on the particular instances of the different pages, we made templates of each page, to better visualize the overall looks of the application and improve on this designs before moving on. Moreover, having perfected these template designs guaranteed that developing the wireflows was easier since we only had to adapt the pages to their intended functionalities.

Screenshots of these wireframe templates are shown below:

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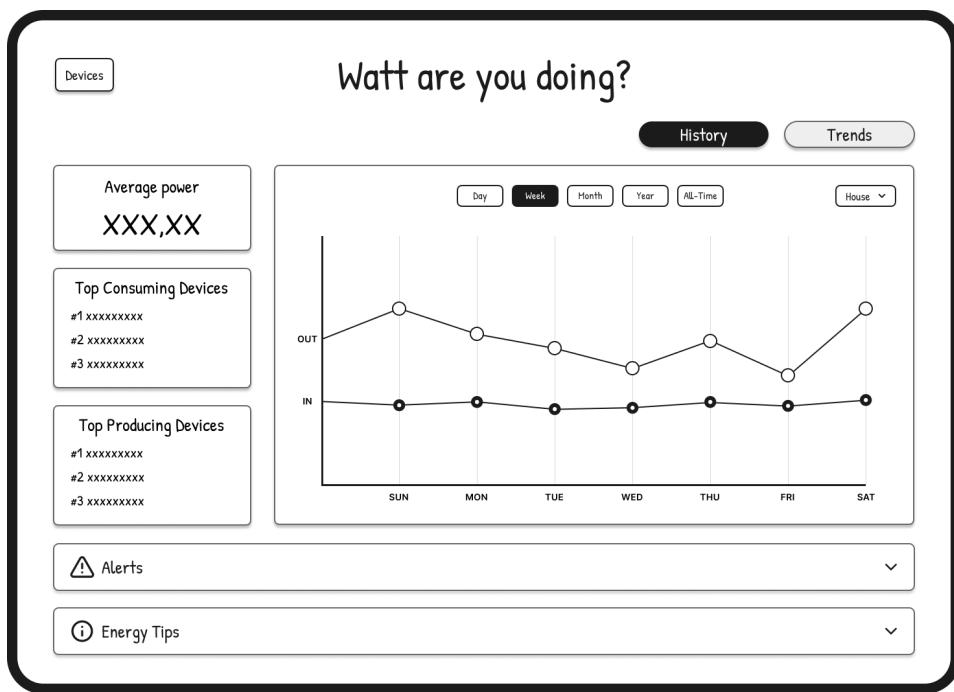


Figure 1: Dashboard template

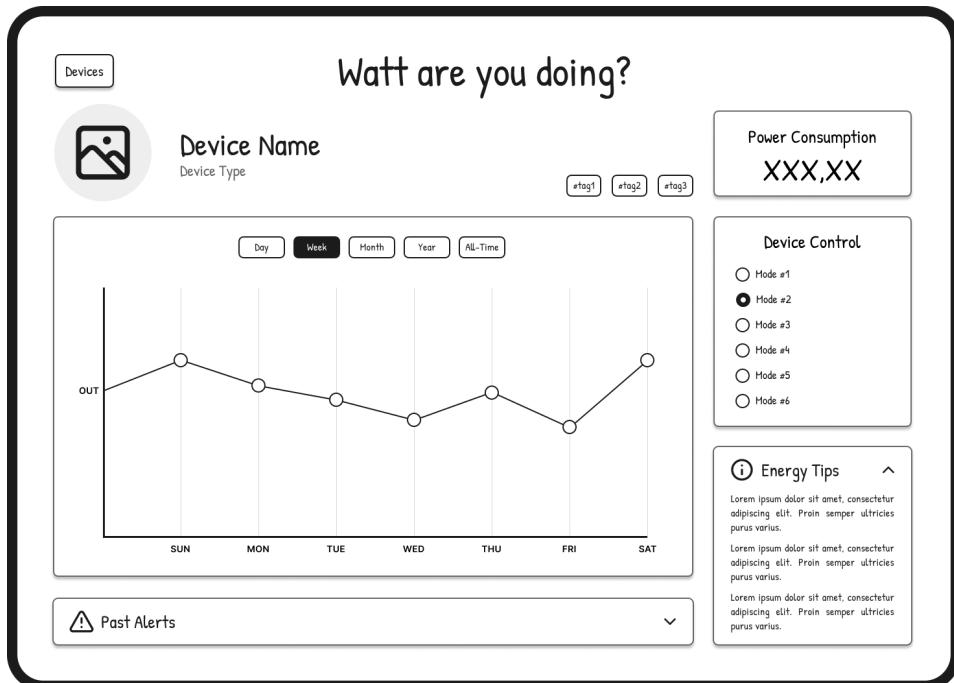


Figure 2: Device View template

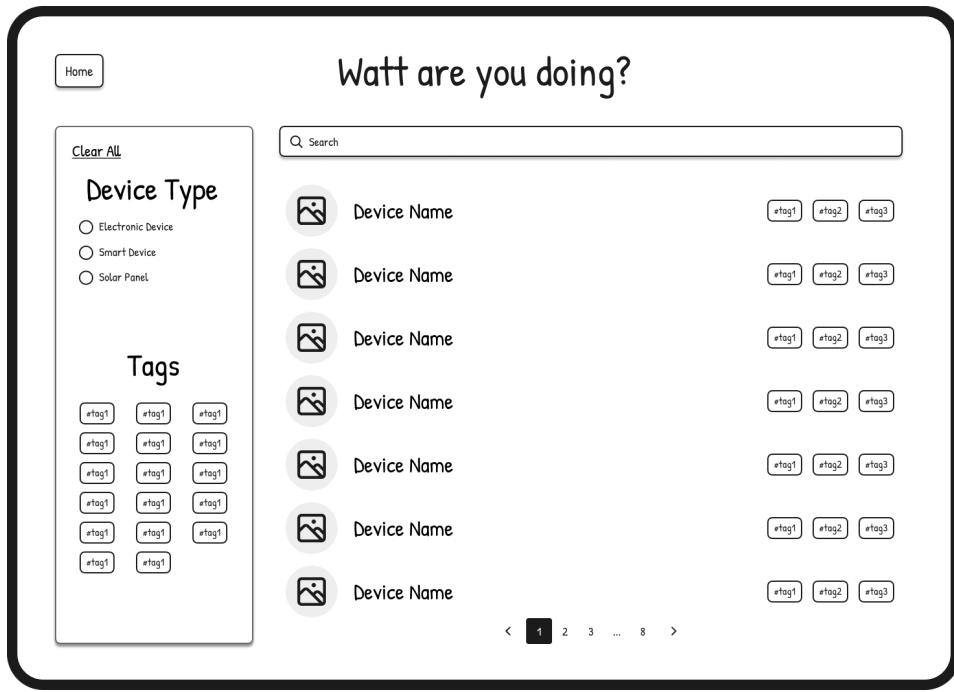


Figure 3: Search template

Having shown these templates, we will now present the wireflows for each of the specific tasks, in order. For each wireflow, we will also briefly summarize the steps needed to execute the tasks.

3.2 Wireflow 1: Obtain Details of a Specific Device

For the first wireflow, the goal was to visit the search page, filter devices with the "Kitchen" tag, select the refrigerator and view details of the device in its corresponding page.

We start in the dashboard (as we will always do in these wireflows) and the first step is to click on the "Devices" button on top to open the search page.

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Figure 4: Wireflow 1: Steps 1 to 2

On the search page, we can now click on the "Kitchen" tag on the left side of the page, which will filter the devices shown on the right to be only devices with that specific tag.

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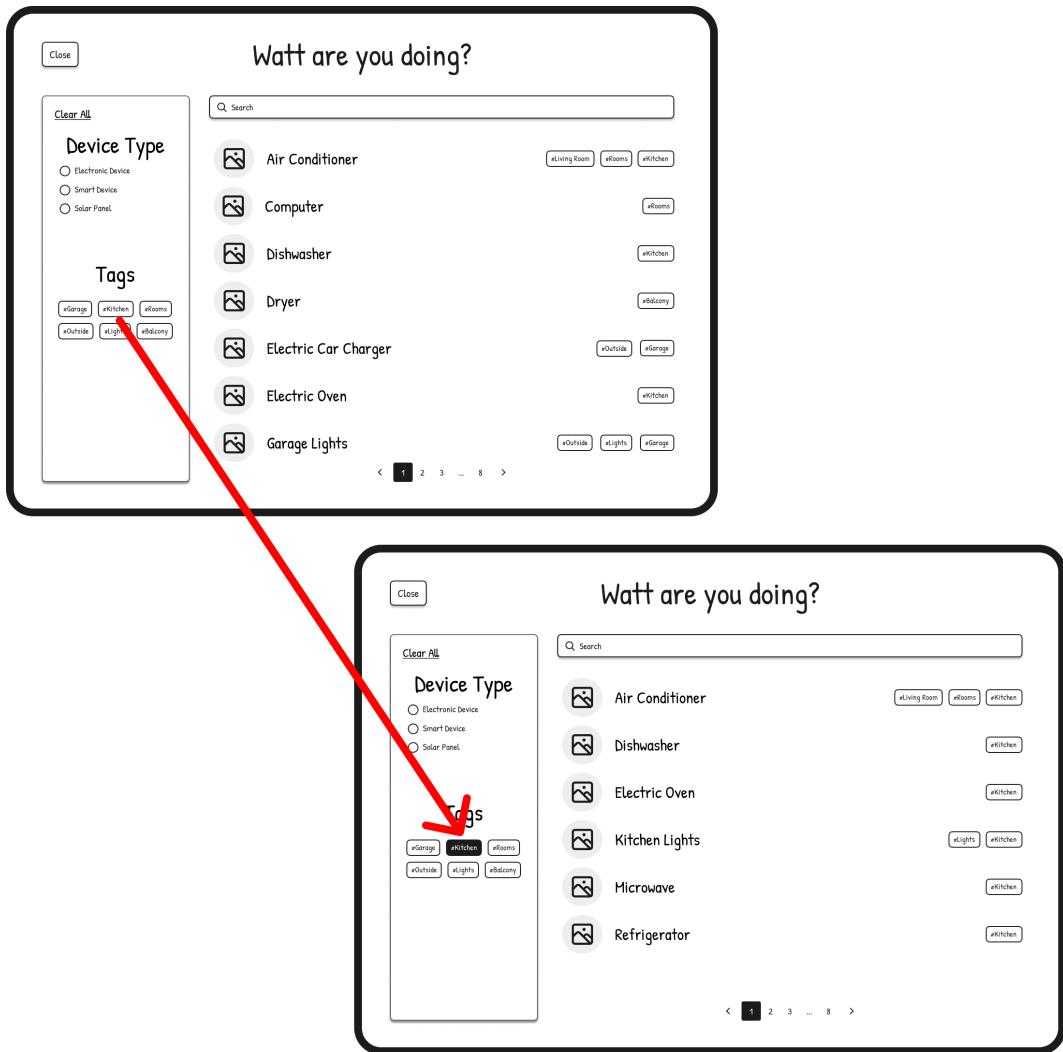


Figure 5: Wireflow 1: Steps 2 to 3

Analyzing the results, we can now click on the Refrigerator device and we will be redirected to the device page, where we can learn more about the energy spending history of this device.

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Figure 6: Wireflow 1: Steps 3 to 4

3.3 Wireflow 2: Analyze Energy Consumption by Time and Tags

For this wireflow, the goal was analyze the consumption of the last week (7 days), change the display to show data from the last day (24 hours) and filter the graph to only show data related to specific divisions of the house, in this case, "Rooms".

Starting in the main dashboard, we can already see the information tracked from the past week, and right in the center, we have a graph showing an overview of the most important information, as well as different filters. This element is the focus of this task.

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Changing the display from 7 days to 24 hours, only takes one click on the time filters located just above the graph itself, which can be done as seen below.

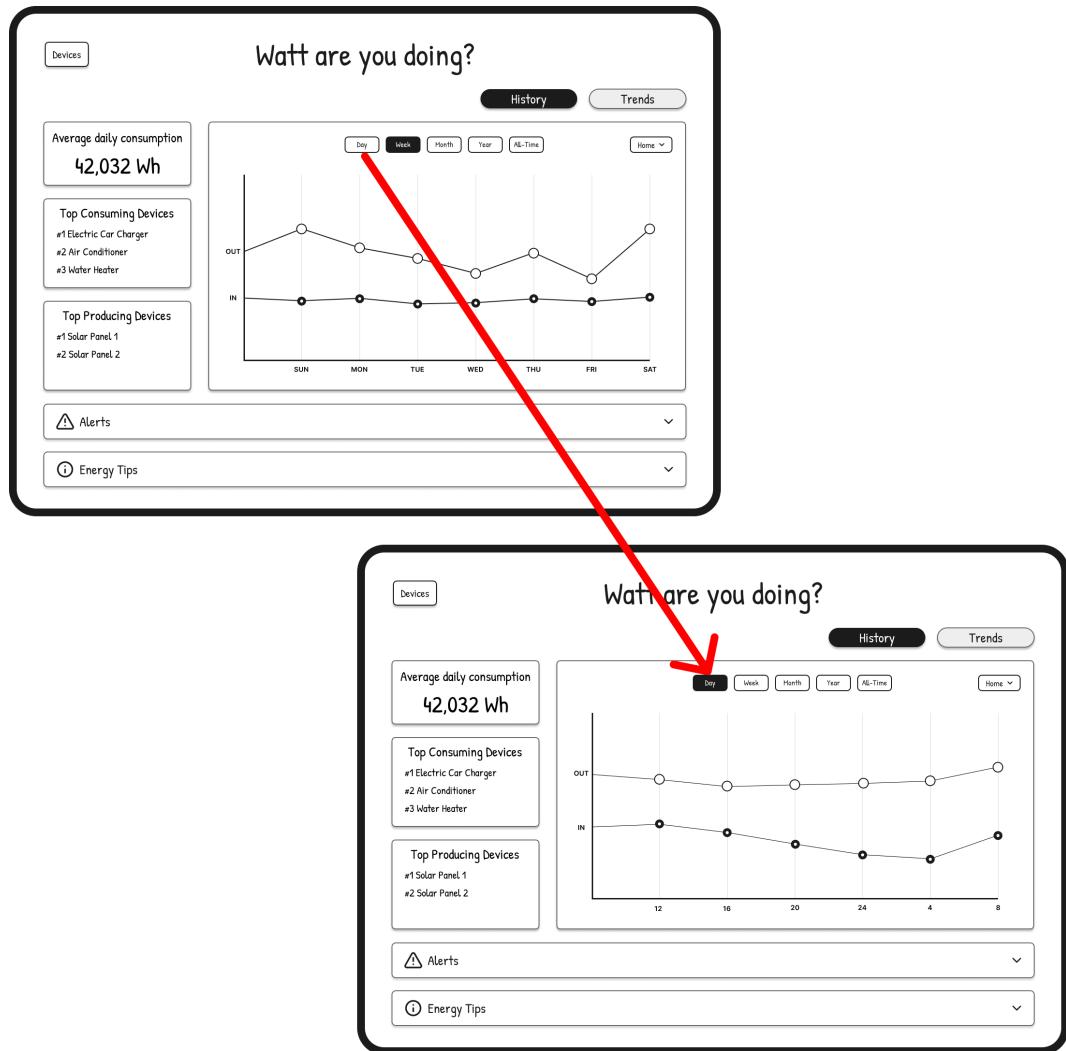


Figure 7: Wireflow 2: Steps 1 to 2

Finally, to retrieve the information of specific portions of the habitation, the user can take advantage of the dropdown on the right, which when expanded, reveals all the rooms that can be selected to filter the data.

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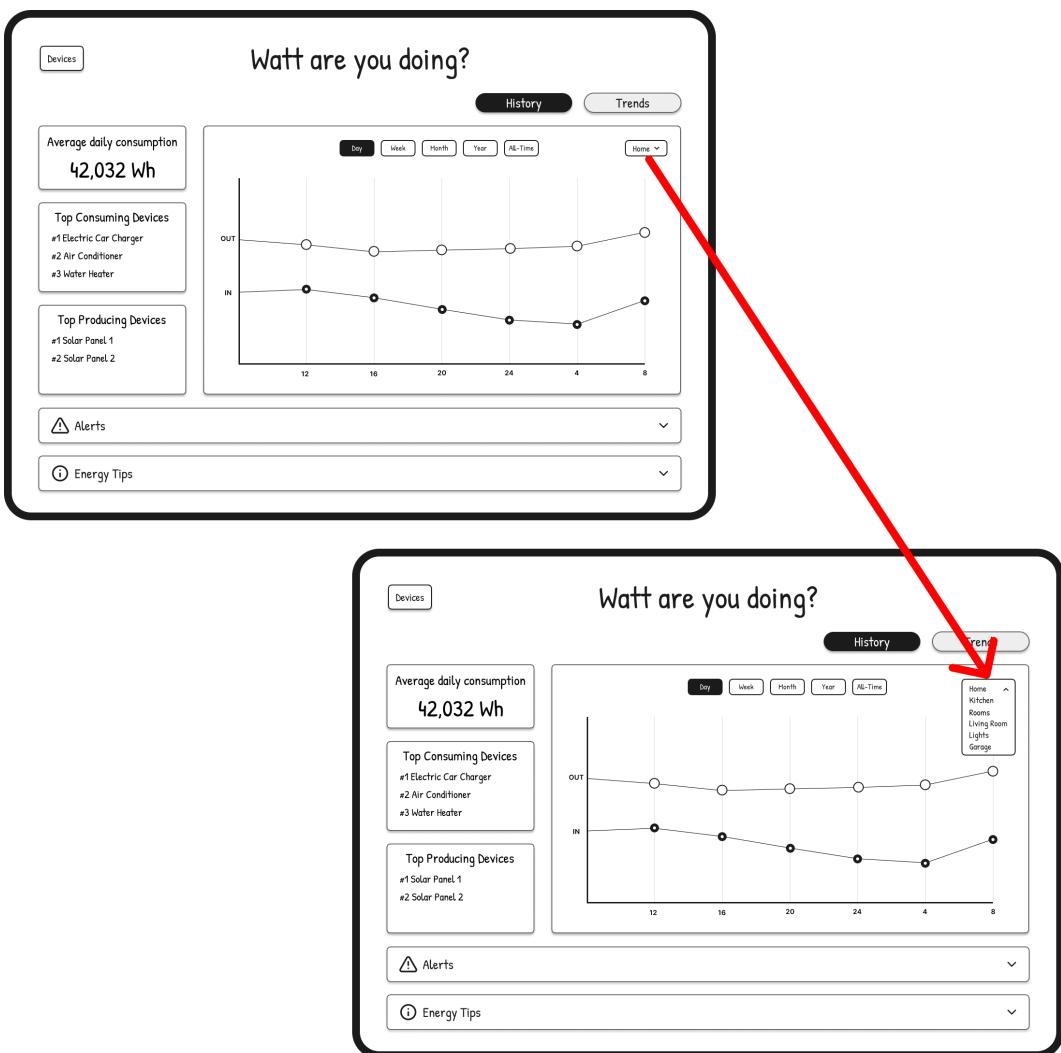


Figure 8: Wireflow 2: Steps 2 to 3

By selecting the "Rooms" option, the graph will be updated to only show data from that specific tag.

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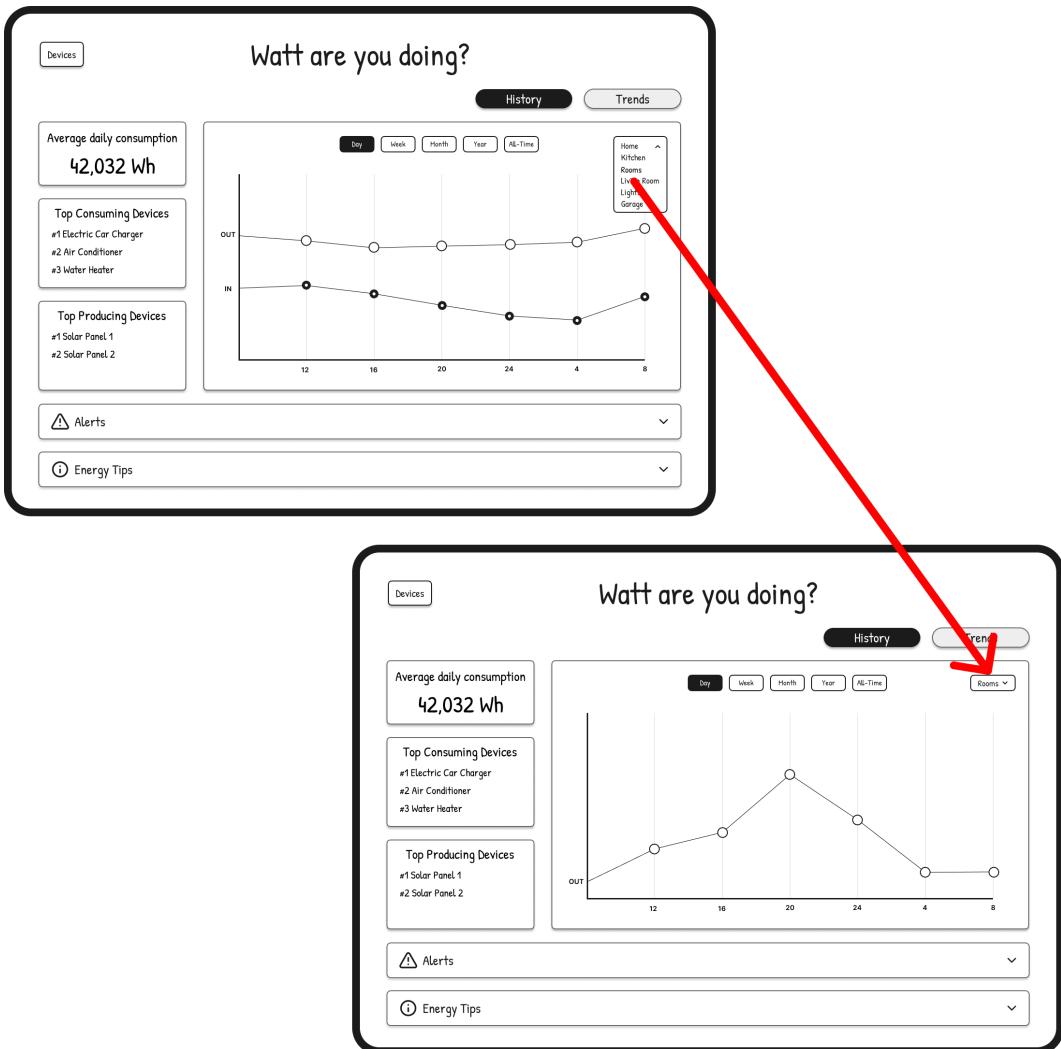


Figure 9: Wireflow 2: Steps 3 to 4

3.4 Wireflow 3: Investigate Top Energy Spending Devices

This final wireflow is the one that we consider more complex, hence highlighting it in the class presentation. The flow consists on locating the device with the highest energy consumption, obtaining more details about it, reading tips and suggestions on how to improve its energy consumption and finally execute the suggestion presented.

Once again, starting from the main dashboard, we can see that the left side has some relevant informative sections on the top spending and producing devices. By clicking on the first device in the "Top Consuming Devices" section, we are taken to that device's page.

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Figure 10: Wireflow 3: Steps 1 to 2

Here, we can already see some details about its history, current consumption, and possibly even alerts, but the information we need is located on the bottom right side in the "Energy Tips" section. This section would ideally start as open and take the rest of the sidebar, but for better testing, we decided to start with it closed and have a dropdown indicator that the user had to open in order to check the tips.

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Figure 11: Wireflow 3: Steps 2 to 3

Reading the suggestion, we can conclude that it is recommended to power off the device for now, and turn it back on later. The final step is to do just that, by pressing the "Power" toggle button on the "Device Control" section.

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Figure 12: Wireflow 3: Steps 3 to 4

4 Digested Heuristic Evaluation Results

In order to evaluate the effectiveness of our design, we performed an in class heuristic evaluation with our colleagues, asking them to perform our tasks and get a sense of the use of our wireframes. We measured the amount of time and number of clicks each person took to accomplish the tasks and then asked them what their opinion was concerning the use and flow of our website. With the goal of acquiring the maximum feedback possible, we also performed an identical heuristic evaluation outside of class.

During each evaluation, we tried to be the most honest possible and not give any suggestions that could interfere with the quality of the data, therefore, questions about how to do a certain step were never answered but were registered as a sign of initial hesitation toward the flow and design of our application.

Having said this, the majority of the feedback we received was related to the graph representation, the lack of focus on important information, some complicated flows, a lack of user freedom, and some minor inconsistencies. In this section we develop the details of these complaints, explain their importance and evaluate their severity.

4.1 Graph Representation

Our graph is one of the main elements in our dashboard and across all pages that have information about energy consumption. We consider it to be one of the most important points of transmission of information to the users. Therefore, we took careful notice of all the problems, hesitancy, and confusion that the individuals presented when interacting with the graph.

The first issue presented was the lack of vertical scale. This made it difficult to understand how the values compared with each other.

Additionally, it was reported that there was an abundance of information in the graph. The critics were mainly due to the existence of two lines that confused users on what kind of data they were looking at.

This complaint was mainly related to the Consistency and Standards heuristic and was given a very low severity of 1.

4.2 Important Information Presentation

Having in consideration that our main objective is to help our users achieve a more sustainable and efficient consumption of energy, it is of the highest importance to inform a user of detected problems as soon and as clearly as possible.

Despite this, it was very easy for a user to unintentionally ignore a device alert of unusual consumption.

This complaint was mainly related to the Consistency and Standards heuristic and was given very low severity of 1.

4.3 Complicated Flow to Add and Remove Devices

This complaint is mainly associated with the Efficiency of Use heuristic. We noticed from the received reports that the flow to add and remove devices was unnecessarily complicated. In fact, while it was an important feature, we didn't have good support for this functionality.

This problem was given a severity of 3.

4.4 Lack of Confirmation for Destructive Actions

Our project is based on the possibility of performing certain actions to the imported devices, such as turning them off or changing their settings. So, it's crucial that users are given the possibility of returning to a previous state and are asked to confirm their actions before performing them.

In the initial wireflows, we didn't include this, creating a severe problem related to the heuristic "User Control and Freedom". Even though our reviewing peers gave this severity a level of 1, as this issue facilitated destructive actions, we believe it must be considered to have a severity of 3.

4.5 Exporting Data to Other Formats

Since we want to appeal to as much of the public as possible, it is important that a user may be able to access its data in whichever form it prefers. Despite this, our prototype only allowed users to view their data on a single in-app format, which was pointed out by some more experienced users as a possible future inconvenience.

This went against the heuristic "Flexibility and Efficiency of Use" and was considered a problem with low severity of 1.

4.6 Minor Inconsistencies

Throughout the reviewing session, our peers indicated some minor inconsistencies that, while not violating a heuristic per se, made their use of the app less pleasant. These criticisms were mainly related to font size, icon use, and the display of data in different units. We also were criticized for the relative lack of documentation that violated the heuristic "Help and Documentation".

As this version still consisted of wireframes, it is to be expected that the design choices pointed out would not be as user-friendly as is intended for an official release. However, it was a good reminder to pay closer attention to these issues on the next prototype. Because of this, the pointed-out problems were considered as having a low severity of 1.

5 Corrections to Perform in the Next Phase

In this section, we will describe how we decided to incorporate the received feedback into our next prototype.

5.1 Clearer Graph

Based on the feedback received, we decided to completely redesign the graph. Removing information overload and giving more control to the user was our main focus. Therefore, we plan to add a clearer vertical scale, the possibility to choose what is presented (choosing to either see consumption or production lines or both), and, finally, allow easier access to more specific information when hovering on a point of the graph.

To showcase our plan, we include here a high-level design of the changes:

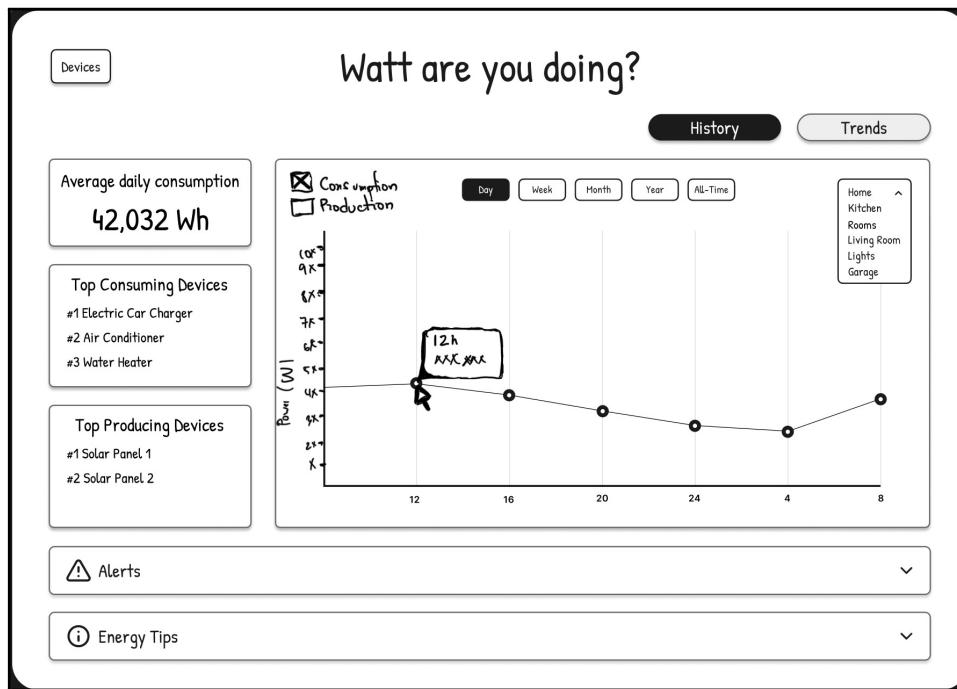


Figure 13: Graph Redesign

5.2 Pop-up System

In order to better communicate unusual device behavior, we added a pop-up system in which, when an unusual consumption is first detected, a pop-up notification will appear on the main screen, informing the user about the

problem and, when clicked, redirecting them to the device page where they can better understand the problem and check for improvement suggestions.

We present here a high-level design of our idea:

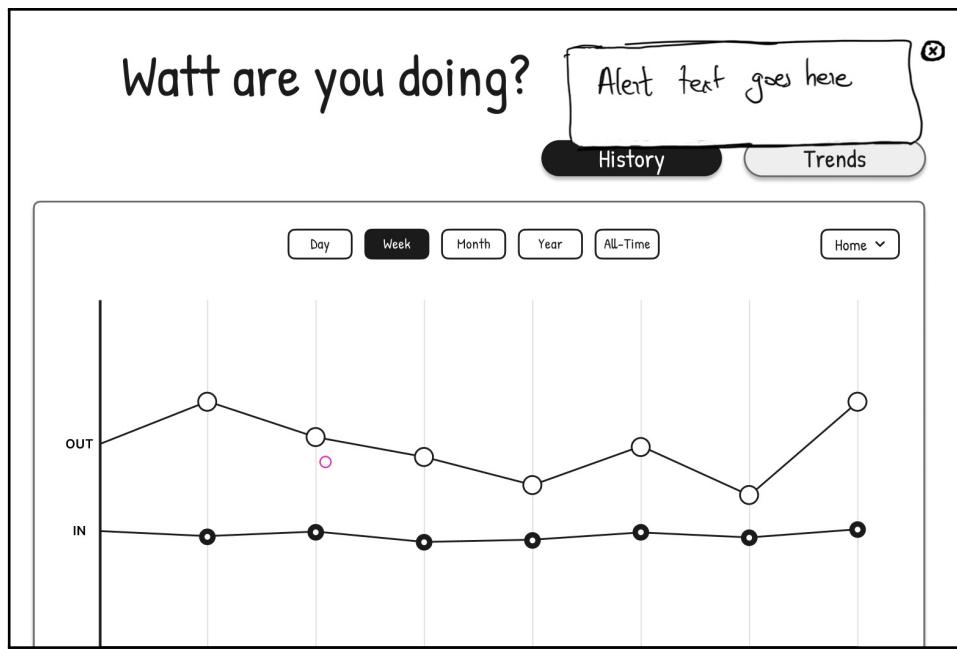


Figure 14: Alert Pop-up

5.3 Improve Addition and Removal of Devices

To facilitate the process of adding and removing a device, we are planning to include a button in the listing page of devices, to allow the addition of devices, and include an option to remove the device in the settings and options of that device.

We include a high-level design of this proposal below.

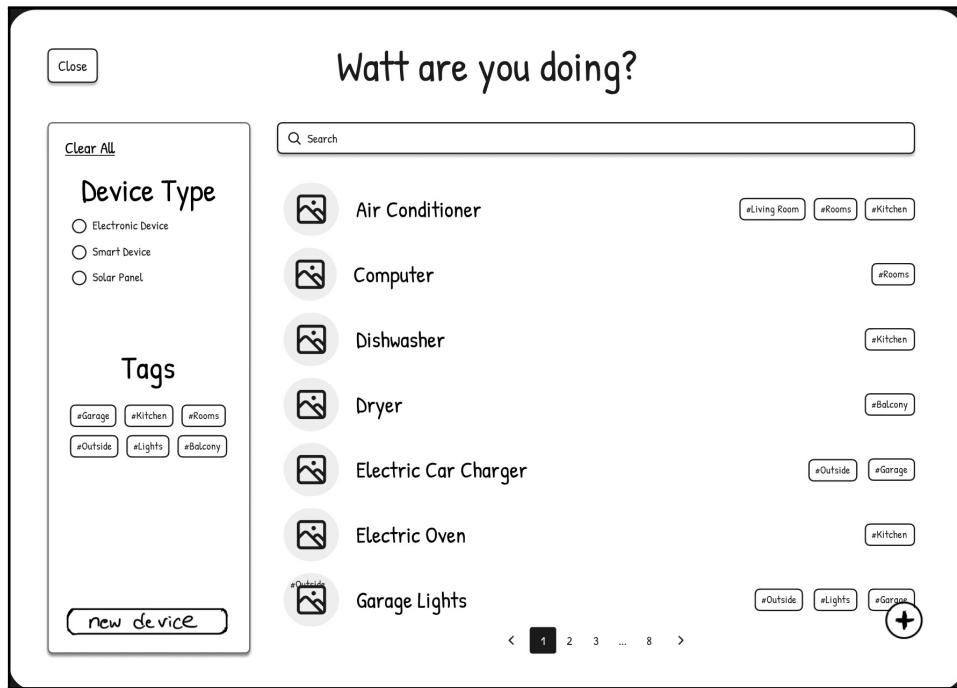


Figure 15: Add Device

5.4 Command Confirmation

In order to prevent users from removing a device, or changing its settings accidentally, we will add a system in which any of these alterations require confirmation from the user as presented on the following figure.

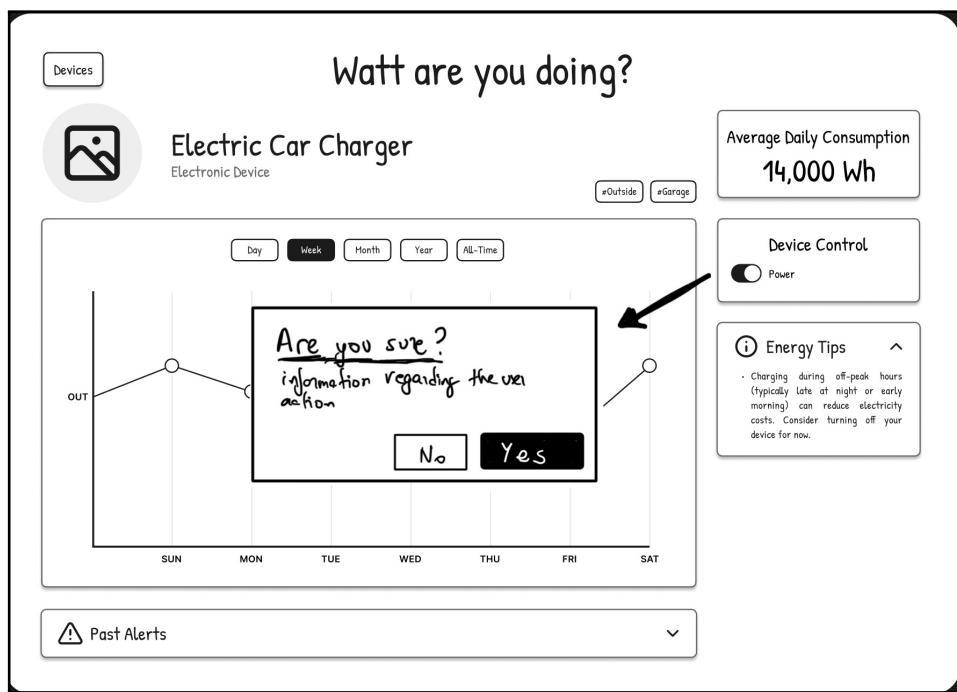


Figure 16: Confirmation Pop-Up

5.5 Allowing the exportation of data to other formats

To facilitate the flow for expert users, we plan on adding functionality to export data to other formats, such as CSV and PDF.

6 Annexes

6.1 Sent Heuristic Evaluation Reports

HCI Winter Semester 2024 - 2025

Heuristic Evaluation Report

Class Nr.: LEIC04 - 12/11/2024 - Thiago Sobral Silva
Group evaluated: 04 - EnergySync
By group: 02

Problem #	Issue (include screenshot)	Heuristic(s)	Severity (1-4)
1	Texto demasiado pequeno (baixa acessibilidade). 	4. Consistency and Standards	2
2	Design cluttered (e pouco minimalistico). 	8. Aesthetic and Minimalist Design	3

Figure 17: Sent Heuristic Evaluation Report - Page 1

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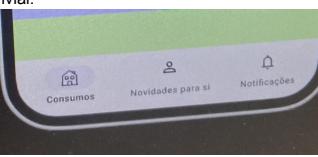
<p>3</p> <p>O botão que redireciona para a página do consumo dos dispositivos, no card da página de consumo, é muito pequeno (podia ser o card inteiro clicável, por exemplo).</p> 	<p>7. Flexibility and efficiency of use</p>	<p>2</p>
<p>4</p> <p>O flow é pouco eficiente (é necessário fazer demasiados cliques para chegar à página de gráficos).</p>	<p>7. Flexibility and Efficiency of Use</p>	<p>2</p>
<p>5</p> <p>Existe alguma inconsistência incomodativa entre os designs de botões e elementos textuais (certas páginas consiste num símbolo, noutras texto).</p> 	<p>4. Consistency and Standards</p>	<p>1</p>
<p>6</p> <p>Não há link para página inicial home (embora se possa voltar para trás, não é o mais intuitivo e podia ser acrescentado um botão na navbar). Desta forma, implica que seja memorizado um padrão para chegar à página inicial que não é trivial.</p> 	<p>5. Recognition rather than Recall</p>	<p>1</p>

Figure 18: Sent Heuristic Evaluation Report - Page 2

7	Apesar de a plataforma não ser muito complexa, não há qualquer ajuda ou documentação e podiam haver mais indicações visuais.	10. Help and Documentation	1
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NOTA: Além disso, consideramos que a linguagem era muito clara e natural pelo que seguia a heurística "Match Between the System and the Real World".

Figure 19: Sent Heuristic Evaluation Report - Page 3

6.2 Received Heuristic Evaluation Reports

HCI Winter Semester 2024 - 2025

Heuristic Evaluation Report

Class Nr.: LEIC04 - 12/11/24 - Thiago Sobral
Group evaluated: 02 - Watt are you doing?
By group: 04

Problem #	Issue (include screenshot)	Heuristic(s)	Severity (1-4)
1	As opções de filtragem, como filtrar os gráficos de consumo (por dia, mês, etc), ver elementos consumidores por tag, são demasiado pequenas, o suficiente para tornar a leitura difícil.	7	1
2	É demorado o processo de encontrar a opção de adicionar um dispositivo consumidor, ou mesmo a de removê-lo, e sendo estas duas funcionalidades importantes, poderia ser mais rápido encontrá-las.	3,7	3
3	O gráfico de consumo principal não tem escala para os valores de consumo.	2	1
4	O consumo geral do domicílio é expresso em Wh o que pode não dar termo de comparação ao utilizador.	2	1

Figure 20: Received Heuristic Evaluation Report - Page 1

	Average Daily Consumption 14,000 Wh		
5	O botão de desligar um dispositivo não requer confirmação e pode permitir que um utilizador desligue um dispositivo importante por engano. Device Control  Power	5	2

Figure 21: Received Heuristic Evaluation Report - Page 2