Watt Are You Doing

First Delivery

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1 Introduction

This report aims to document the results achieved in the first part of the Human Computer Interaction project.

For this project, we were asked to ideate a mobile or web application that revolves around energy and develop a user interface for it. This delivery focused on the conception of the project's idea and user and task analysis, which will define the application's requirements for the future.

In this report, we will describe what we achieved in the first part of the project. More specifically, we will talk about the project idea we decided on and some similar systems. We will also explain the questionnaire we created, summarize the results obtained and perform a PACT analysis on them, describe some personas that align with the data, and highlight the functionalities we deem the most useful and meaningful for the final result.

2 Project Idea

For the project idea, the main restriction we were given was that the system must be centered around energy, such as an application for monitoring energy consumption or controlling electric devices.

Based on this information, we decided that we will be creating a **home energy audit app**. This idea arose from the fact that many people do not know about the power consumption in their homes, so our solution aims to provide more information to the user about the energy spent by each device. To help reduce the electricity bill, the platform will also be able to give tips and perform actions, like suggesting better hours to recharge devices or configuring smart appliances directly. Below, we present a description that better summarizes the idea behind our project:

"All-in-one web platform for energy profiling of all devices in a household. The solution will display graphically real-time data and records of the energy spent by each appliance. It will also be able to pinpoint the least energy-efficient devices and, if applicable, provide suggestions, to reduce their power consumption/cost. The users will also be able to monitor application energy consumption on smart devices, in order to improve battery life. Users will be able to register different devices, either smart devices with monitoring software or other electronics through the use of sensors. Users will also be able to filter/sort their devices by tag and power consumption."

3 Related Apps

During our research stage, we noticed that there existed some apps that already fulfilled some part of our idea. However, they had either problems of usability or didn't accomplish all that we were thinking.

Having said this, the platforms and apps we found online were the following:

- **EDP RE:DY** - This app allows users to monitor their energy consumption as well as their expenses and also control remotely associated devices[2].
- **Brightly** - Brightly has an energy management software focused on monitoring and comparing energy waste in a professional environment[5].
- **Hark** - One of Hark's main products is the Hark Connect software that allows users to monitor industrial devices and assets, namely their energy consumption[6].
- **SMA Energy** - By using the SMA energy app it is possible to monitor and control someone's solar panel energy production and usage[1].
- **Freedompro** - Through Freedompro's products it is possible to manage and monitor the energy usage of a house's devices[3].
- **Google Home** - By using Google Home a customer can control and manage their home devices remotely and from anywhere[4].

3.1 Our application

Our web platform should implement the best features from these apps by allowing users to monitor their energy consumption, like with EDP RE:DY and Hark, but with a focus on a domestic environment and differentiation between devices like in Freedompro. An integration with solar panels is also logical similar to the one found in SMA Energy. The service should also be accessible from anywhere like with Google Home. Finally, a system of recommendations regarding each device's consumption should also be implemented.

4 The Questionnaire

We opened the form to the public on the 1st of October and closed it on the 7th of October. During these days, we had 100 answers.

Analyzing the information, there is obviously a big diversity of respondents from different backgrounds and different age groups. While there was a significantly higher number of female respondents, we were able to obtain information about the different genders.

The results of the questions can be found in the annexes [8.2].

5 PACT Analysis

Even before starting the questionnaire, we thought about some topics that we wanted to address. This way, we could create a better profile of our future users and understand what their main needs are.

For this, we divided the information we wanted to know using the PACT framework.

5.1 Starting to plan for PACT

Knowing that we were going to need to profile the users and understand the current solutions, the following paragraphs contain some of the topics we wanted to address.

To start, in the ”People” section, we believed the crucial information that we needed to collect was the average age, gender, and knowledge about energy. Additionally, it was also important to know their economic conditions and understand their openness to change. We were already aware that our user group would be particularly heterogeneous in certain aspects but wanted to know some characteristics they all shared.

In terms of ”Activities”, we wanted to know what apps and platforms they currently use to manage energy at their home, how frequently they use them and in which ways these systems impact their life and energy consumption. We also decided to question whether they currently use these apps alone or share access to these apps with the whole household. Understanding if they wanted to have an app running passively or if they preferred an app they could actively interact with on a day-to-day basis was also important.

In ”Context”, we needed to know how the population that used some software of energy management learned to use their current apps and in what context they used them.

Finally, during the analysis of ”Technology”, it was important for us to know where the data is stored (do people use a home server or rely on cloud servers), how the data from sensors is transmitted and whether there was the need for info in real time. Additionally, information such as in what type of devices do people use their energy management systems was also relevant.

5.2 Our PACT profile

Having in consideration the information that we wanted to capture in each part of the PACT framework, we include our conclusions in the remaining subsections.

5.2.1 People

Using the questionnaire as the basis of our information, we were able to make the following conclusions. We noticed that 31% of youngsters, from 16 to 20, use some energy management app, compared to 27% e 15% on the age gap 51-65 and 21-35, respectively.

Knowing this, we came to the conclusion that while young adults believe they need an energy management system, when they reach the age gap 21-35 there seems to be a drop in adoption, probably due to additional work responsibilities that remove time available for this. Only after reaching 50, there seems to be an increase in the use of similar apps.

Despite 72% of people showing their openness to change by stating that they would like to start monitoring their own energy consumption, about 51% of people don't have enough knowledge about their house energy consumption.

Due to the reported frequency of access to the app, we can also understand that our users will tend to be infrequent users. However, they have several devices, with 61% of people stating that they have more than one intelligent device, such as smart lights.

At the moment and respectively, 18% and 25% of males and females do use software that allows them to manage energy consumption, showing a very small difference across genders. A common motivation across all was the management of costs and understanding which appliances are spending the most energy.

We don't have any information about special needs due to blindness or color blindness.

5.2.2 Activities

In terms of Activities, we rapidly noticed that there was some diversity in the way activities are performed. In fact, while most people (above 80%) believe it's important that information is given in real-time, it was not reported that there was a need to check information very frequently. Most, 46% would like to check weekly summaries, and 36% monthly summaries.

Based on this, it's possible to conclude that users prefer to receive a big quantity of information presented in a compact way that can be checked back routinely. Despite being an important topic, the users show that the length of time they can spend on this task of managing their consumption is small. Through conversations with some respondents, they report feeling the need to know what is happening at the current moment to make immediate decisions, but they will only thoroughly investigate the data weekly or monthly.

The tasks users reported being more useful were understanding the best schedule to charge their devices, finding the appliances with the highest en-

ergy consumption, detecting applications running in the background, and finally optimizing energy consumption based on solar panels and configuring definitions for devices.

At the moment, we noticed that most respondents, around 11%, use a solution by EDP to manage their energy. Following comes SMA Energy and other less used software, such as Brightly, Hark, and Google Home.

5.2.3 Context

Getting into Context, we noticed that around 50% of the users of energy management software say they met their current platform through their family or friends. From this information, we can conclude that they had some support from these people to start using them to explain their usage and probably expect to use this kind of system cooperatively.

Additionally, taking into account the majority of the apps people report using, which are mobile-oriented, we notice they can be used in several contexts. We can expect that these apps are currently used from the comfort of the home while commuting or at work. Therefore, there will be a wide range of situations where people can manage their energy or control their appliances.

Finally, people addressed that their favorite functionalities of their software related to the control of their energy bill, while also caring for solar energy' production control and management of intelligent appliances.

5.2.4 Technology

Analyzing the current existing solutions, we noticed several trends. First, while some apps use cloud based systems to store information, the most used app, EDP RE:DY, takes a different approach. In fact, EDP RE:DY uses a box inside clients' homes to collect data and manage it. This box is connected to the router and is also used to send information to the App. Therefore, this app guarantees some privacy by self hosting data.

This platform also gives information about energy consumption in real time. It also includes some information about energy production on solar panels. Additionally, the app also allows control of the lights and other smart devices.

We noticed that most of the alternative platforms consist of mobile applications. However, some of them are also accessible on the web.

Most of these solutions use plug extensions appliances to manage how much energy is used and to control the devices. Data is inserted automatically using these appliances. As seen above, there was a substantial number of people that declared the need for real time information.

Google Home and other apps more focused on smart devices management share a protocol to connect with those smart devices called ”Matter”. Using this guarantees that more devices can be connected and that users can change apps whenever they want.

6 Personas and Activity Scenarios

This section of the report will contain the personas we created for this project. Since each of them is associated with a specific activity scenario, after describing each persona, we will also present the activity scenario associated in order to make it more engaging and easy to analyze.

Due to the results we obtained from the questionnaires, we ended up with two very distinct but complementary personas that we believe cover every main aspect of the project we want to develop and the issues we are trying to address.

6.1 Persona 1 - Bernardo Lima

The first persona is Bernardo Lima, a 53 year old accountant from Porto. Bernardo is married and a father of two children. He has an important position on a large firm and a very full daily schedule. Despite this, he likes to spend his free time at home relaxing with the family.

Figure 1: Picture of Bernardo Lima

Motivators

- **Save money**: Bernardo is very concerned about his expenses and always tries to spend as little as possible. This is something he also tries to teach to his children.

- **Being Accomplished**: Bernardo always dreamed of being a successful person, which motivates him to work very hard. He is always trying to do more and climb the ranks of the company.
- **Control freak**: Bernardo feels like he is constantly responsible for his actions, so he always strives to stay on top of the problem and to solve every problem as soon as possible.

Behaviors

- **Spending time with family**: Besides the family that lives with him, his brothers are his neighbors and during the weekends they often spend time together.
- **Plays Basketball**: Despite his age, he was always a fan of basketball and plays friendly matches every Wednesday with a group of friends from work.
- **Tracking his Portfolio**: As a secondary source of income, he also invests in the stock market and likes to track his expenses and stock portfolio.
- **Watching Movies**: As a solo hobby, he likes to watch and review movies. Every month, he participates in a film club where they share their opinions on their most recent watches.

Needs

- **Work-Life Balance**: Needs to have free time where he can play basketball or spend time doing his hobbies so that he can rest from his work.
- **Reliable Supportive Network**: Trustworthy family and friends give him the energy and encouragement to follow his dreams.
- **Health and Fitness Maintenance**: Due to his very tight schedule, Bernardo spends his days dealing with huge amounts of stress. Pairing that with his age, it's evident that he needs some way of unwinding his mind and staying healthy.

Frustrations

- **Responsibility Overload**: Bernardo loves his job and taking care of his family, but he can't be everywhere all the time and sometimes he feels overwhelmed with responsibilities and tasks that he must do.

- **Road Traffic**: Every single day, he has to take a 45-minute drive to his office. This challenge is always bringing a splash of uncertainty into his life because he never knows what the traffic is like and how that single drive might affect his entire schedule.

6.2 Activity Scenario 1

Bernardo Lima likes to always be on top of everything. He works a strict corporate job and lives his life on a tight schedule. He lives in a big house with a lot of smart devices.

Every day, during breakfast, Bernardo wants to know the energy consumption of his daily routine, to make sure he isn't wasting any more energy than he needs to. He opens the application and takes a look at the overall spending patterns of the last 24 hours, as well as the top appliances that spend more money.

In case he notices that something is off, he searches and filters through the connected energy consumption items to find the culprit. Having these kinds of filters is very useful, as he has a lot of different connected devices and wants to quickly find what is causing the issue.

Finally, he has recently entered the market in renewable energies and solar panels by installing 5 of those in their home so he would like to see the results of this change in the app.

6.3 Persona 2

The second persona is Laura Araújo, a 26 year old kindergarten teacher from Lisbon. Laura is in a relationship of 5 years with her boyfriend and the couple is now making a huge transition into adulthood. She has always lived with her parents but 3 months ago, she was presented with the opportunity to start working, the only problem is that the job is far from where she lives. Despite her hesitations, her boyfriend eventually convinced her to take on the challenge and learn to be more independent.

Motivators

- **Stability**: Laura is aiming to stabilize her life after leaving home to a new city, by moving into a nice and simple apartment with her boyfriend and integrating with the local community.
- **Being Kind and Helpful**: She worries a lot about how people see her and wants to help and be liked by everyone around her. She is constantly

Figure 2: Picture of Laura Araújo

checking up on those around her and wants to make the world a better place.

- **Children**: Since she was little, she developed a love for caring for younger children and decided that's what she wanted to do for the rest of her life. She recently finished her degree in education sciences and will start working full time in a kindergarten.

Behaviors

- **Socializing with her Friends**: Most of Laura's friends are from her hometown and live far away, but she still keeps in contact with them through social media, video calls, and birthday parties. She likes to remember her teenage years and the things they did together.
- **Spending time with her boyfriend**: Having moved in with her significant other, they often do simple activities together, like going to the mall, watching films/series at home, or trying new recipes.
- **Working at the Kindergarten**: She does not have the most complex schedule, but she is very passionate about the kids in her care and makes sure to keep an eye on each one at all times, which can be very stressful.

- **Books, Cartoons, and Anime**: She is fascinated with the animation styles and fantastic storylines of the modern anime and cartoons. Besides this, she also likes to read young adult novels and mysteries.

Needs

- **Support and Guidance**: This is the first time Laura is staying more than 2 weeks away from her hometown and she suddenly realizes about the many challenges and chores that must be done to take care of everything. She needs advice and help to stabilize and be able to deal with everything new in her life.
- **Making Connections**: Moving to a new city can be scary because you most likely don't know anyone there. This was the case for Laura and she wants to find a way to start meeting new friends and socializing with people from her new town.
- **Settling down**: For now, everything seems new in Laura's life, but what she really wants is a stable normal life where she can have free time to do what she wants. She is also very invested in her relationship and what to settle down soon.

Frustrations

- **Professional Career**: Although Laura was always passionate about kids, she knows that it's not the type of career to get promotions and raises in salary. She does what she loves, but sometimes, she wonders if she really made the right choice.
- **Moving Far From Home**: From her workplace to her old house, it takes 80 minutes by car. It's not that far away, but Laura is still worried she might start losing touch with her friends and family.

6.4 Activity Scenario 2

Laura recently got a new job in a town far from where she lives. She was a little skeptical about going but eventually found a new apartment to stay in. Luckily, her boyfriend also managed to find a job nearby so they will be living together and sharing the apartment for the first time.

As a couple entering adulthood, they want to start paying attention to their expenses and managing their finances. They are not too strict about it, but about every two weeks they would like to have a chat and track their

recent expenses. During this meeting, they want to quickly see how much energy they spent and easily compare it to the weeks prior.

Since they didn't have any experience and are still getting accustomed to all of this, they like to check for suggestions and tips to save even more. Lastly, sometimes they need to work a lot from their home office, so it's useful to be able to categorize their appliances by region.

7 Functionalities

Based on the data retrieved from the questionnaire and the activity scenarios we described for each persona, we were able to raise the following functionalities that we think should be integrated into the final product:

Login for Personal Profile To ensure that users keep their information safe, whether from their personal profile or their devices, the login functionality will ensure they have their information private and secure from unauthorized access. Each user will have a unique account where their data, settings, and device profiles will be safely stored. This will also allow users to access the platform on almost any device, so users can easily monitor and control their devices from any browser, whether from a desktop, laptop, smartphone, etc.

24-Hour / Weekly / Monthly Dashboard The application will provide an intuitive overview of the user's consumption patterns through the dashboard. The dashboard will not only allow to monitor the energy usage in real-time, though the usage of charts and graphs, but also compare the consumption trends between different time periods.

Top Spending Appliances When optimizing the power consumed, it is imperative to pinpoint the devices that consume the most energy or that are the most inefficient, so that they are prioritized. This functionality will allow the user to rank the devices based on their energy consumption, leading to easier optimization.

Device's Detailed Analysis Through the app, the user will be able to access detailed information about each device, from its power consumption trends to efficiency ratings, power state, and anomalies that might be harming the device's efficiency.

History Comparison Features With this functionality, users will be able to compare the power that devices consumed throughout different time periods, such as the energy spent in this week vs this month. This way, the user will get a better understanding of each device's state, whether they are facing problems that aggravate its consumption or the effect of repairing/upgrading a device.

Add and Remove Appliances Easily In our platform, any home appliance can be effortlessly registered. To add a device, the user will need to install

our specialized software, for smart devices, or add a plug sensor, for other electronic devices. From there, it's just a question of connecting the devices to the local network and they will be ready to use. Removing a device will be even easier since the user only needs to blacklist the device from the platform. Removed devices can have their sensors reused on other devices, promoting flexibility and ecological standards.

Search, Tag, and Filter Devices If the user ends up registering many appliances, it is imperative to have a search functionality for easier access to a certain device. In our platform, devices can be tagged for better sectioning, such as identifying "kitchen" or "living room" devices. The user will also have many filtering options, such as filtering by consumption level and by smart/electronic device, to further narrow down the options presented.

Information About Solar Panels For houses that use solar panels, it is very useful to receive detailed information about them. Through our platform, users will be able to monitor the energy that each solar panel produces, compare the total energy produced with the total power consumed, and get data about the battery state and the financial savings got from the use of the solar panels, among other minor functions.

Tips and Suggestions to Improve Spending Habits One of our main objectives is to ease the power consumption optimization of all the devices of a household, so our application would not be complete without personalized suggestions to improve power consumption habits and reduce the power bill. The platform will provide tips and suggestions, depending on each device, such as the best time to use a device (because of lower energy costs at certain times of the day).

Power Control and Automatic Adjustment of Smart Devices Digital devices are in another class from standard electronic devices, so their optimizations should be. As its most unique functionality, our platform will be able to add personalized suggestions and control actions for smart devices, like measuring and closing the most energy-intensive applications, giving control over their power state (on, off, hibernate, etc.) and automatically adjusting their settings for increased battery life and performance per watt.

7.1 Most Important Functionalities

From the mentioned functionalities, we next highlight the ones that we think are the most relevant, and the reasons behind our choice. These will be chosen for the next project steps to be further developed in the prototype. Some of the functionalities below result from two or more of the previous ones, since they are closely related and can be combined as such.

- **Dashboard** - This is the main screen of our platform, and is responsible for graphically summarizing all the information of the system in different time periods, being crucial for all the users. It can also provide information regarding the top spending appliances, further focusing the user's attention.
- **Search Devices** - Through the search mechanism, users will be able to filter and organize the appliances in the platform, being essential for most users, especially those with more devices registered.
- **Device's Detailed Analysis** - It's in the detailed analysis of the device that resides most of the application's core features, such as the exhibition of the information and state of the appliance, the showcase of its consumption trends and the indication of suggestions to improve its power usage.

8 Annexes

8.1 Questionnaire

8.1.1 Description

Title: Opinião sobre Plataforma de Gestão Energética @Home

No âmbito da cadeira de Interação Pessoa-Computador, a equipa L0402 pretende desenvolver uma aplicação web que permita o controlo do consumo energético e gestão de dispositivos, quer estes sejam eletrodomésticos clássicos ou dispositivos inteligentes.
Este sistema tem como objetivo final ajudar os seus utilizadores a poupar energia com sugestões personalizadas ao seu perfil de consumo e tipo de dispositivo.
Este inquérito pretende compreender qual o perfil dos nossos utilizadores e compreender em que funcionalidades nos devemos focar para que o nosso produto se adapte à sua vida.
As respostas adquiridas neste inquérito serão tratadas de acordo com o RGPD. Não são associadas quaisquer informações pessoalmente identificáveis às suas respostas.

8.1.2 Questions

1. Idade
    - 16-20
    - 21-35
    - 36-50
    - 51-65
    - 66+
2. Género
    - Masculino
    - Feminino
    - [Open-ended response] Outra opção...

3. Quantos destes dispositivos tem em casa?

    - Eletrodomésticos (ex. Frigorífico, Máquina de lavar,..)
    - Dispositivos inteligentes (inc. luzes inteligentes,..)
    - Paineis Solares

    Columns: 0, 1-7, 8-15, 16+

4. Quanta energia mensal a sua casa gasta (em KWh)?

    - 0-170
    - 171-330
    - 331-500
    - 501+
    - Não sei

5. Utiliza algum sistema de gestão de energia e dispositivos em sua casa?

    - Não utilizo nenhum sistema
    - App EDP Energy
    - Brightly
    - Hark
    - SMA Energy
    - [Open-ended response] Outra opção...

6. [Open-ended response] Que funcionalidades usa/gosta mais no seu atual sistema de gestão de energia

7. Como descobriu o seu atual sistema de gestão de energia?

    - Amigos
    - Família
    - Website/Blog
    - Revista/Jornal
    - Cartazes
    - Redes Sociais

8. Estaria interessado em monitorizar o seu consumo de energia?
    - Sim. Já o faço
    - Sim. Ainda não faço, mas gostava de começar
    - Não
9. [Max. 3 choices] Que tipo de sugestões de poupança e gestão de energia gostaria de receber?
    - Melhor horário para carregar ou usar dispositivos
    - Dispositivos com maior consumo (ou pior eficiência)
    - Detetar aplicações de dispositivos inteligentes a correr em segundo plano
    - Configurar definições dos dispositivos
    - Otimização consumo da energia elétrica produzida por painéis solares
    - [Open-ended response] Outra opção...
10. Com que frequência gostaria de monitorizar o seu consumo energético?
    - Diariamente
    - Semanalmente
    - Mensalmente
    - Anualmente
11. Considera importante monitorizar o consumo energético em tempo real?
    - Sim
    - Não
12. [Open-ended response] Tem alguma sugestão que gostaria de dar?
13. [Open-ended response] Caso queira participar em futuros protótipos e testes da aplicação por favor deixe aqui o seu e-mail:

8.2 Questionnaire Results

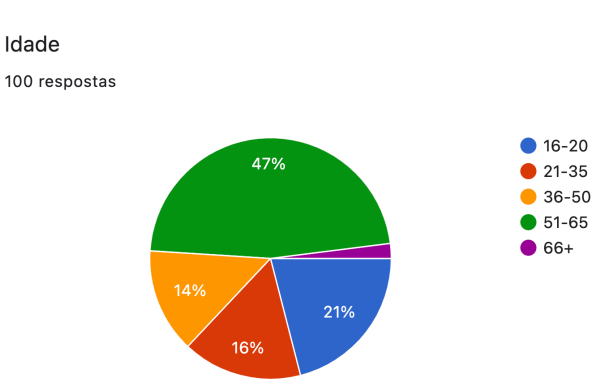

Figure 3: Responses to question 1 - ”Idade”

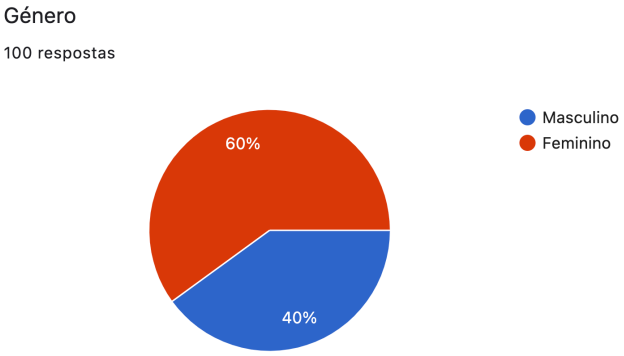

Figure 4: Responses to question 2 - ”Género”

Figure 5: Responses to question 3 - ”Quantos destes dispositivos tem em casa?”

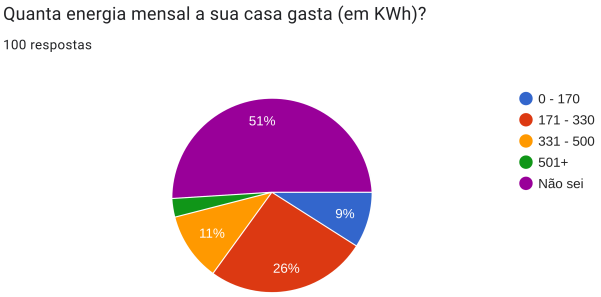

Figure 6: Responses to question 4 - ”Quanta energia mensal a sua casa gasta (em KWh)?”

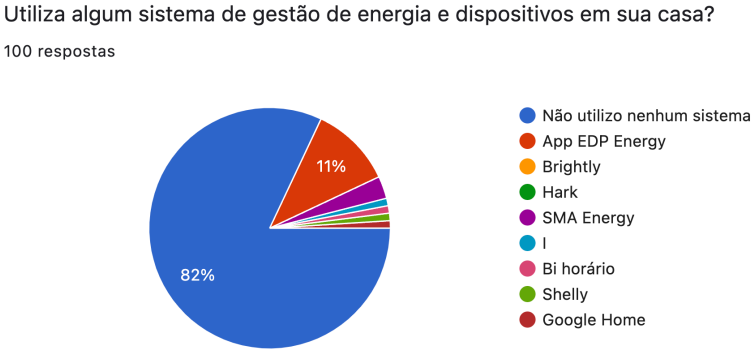

Figure 7: Responses to question 5 - ”Utiliza algum sistema de gestão de energia e dispositivos em sua casa?”

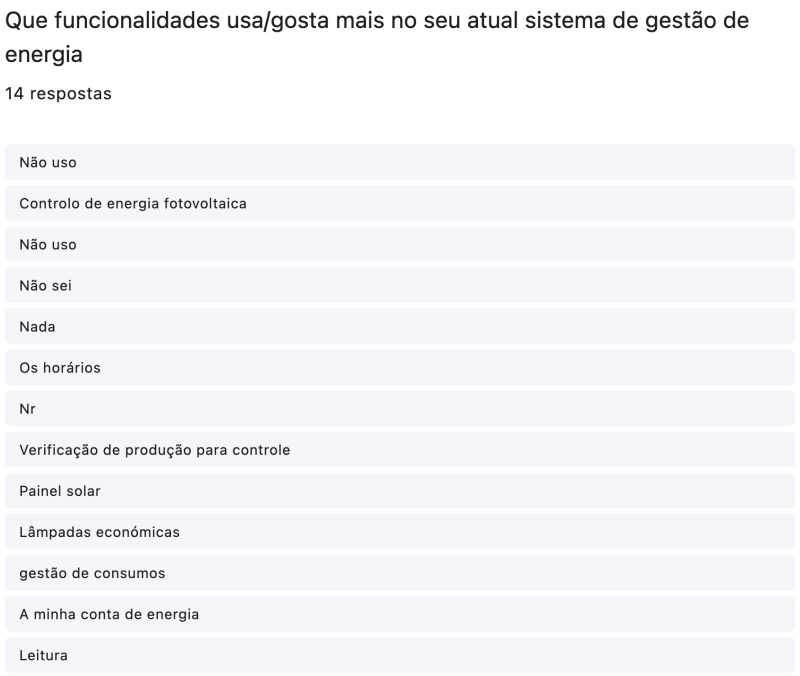

Figure 8: Responses to question 6 - ”Que funcionalidades usa/gosta mais no seu atual sistema de gestão de energia”

Figure 9: Responses to question 7 - ”Como descobriu o seu atual sistema de gestão de energia?”

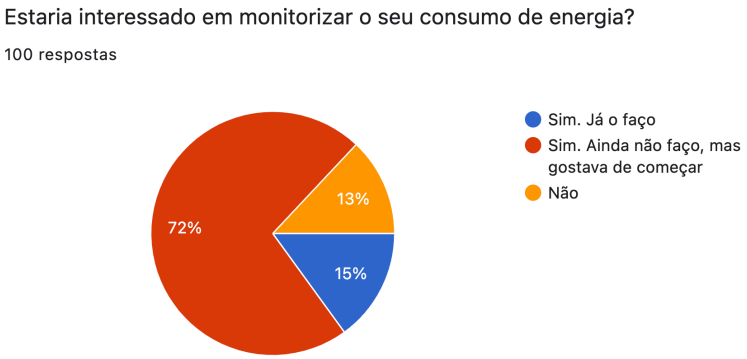

Figure 10: Responses to question 8 - ”Estaria interessado em monitorizar o seu consumo de energia?”

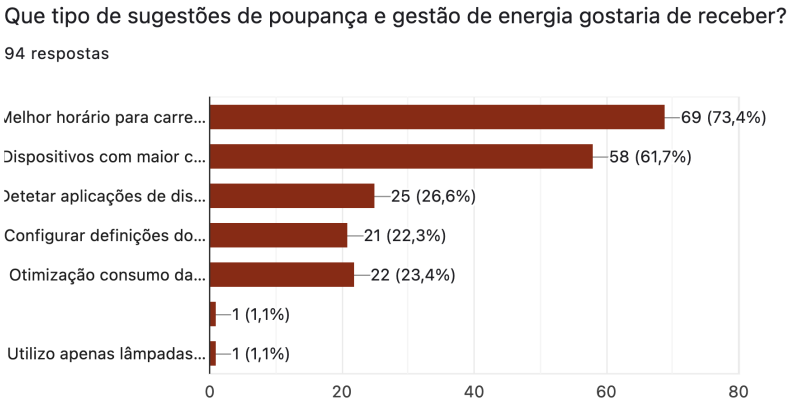

Figure 11: Responses to question 9 - ”Que tipo de sugestões de poupança e gestão de energia gostaria de receber?”

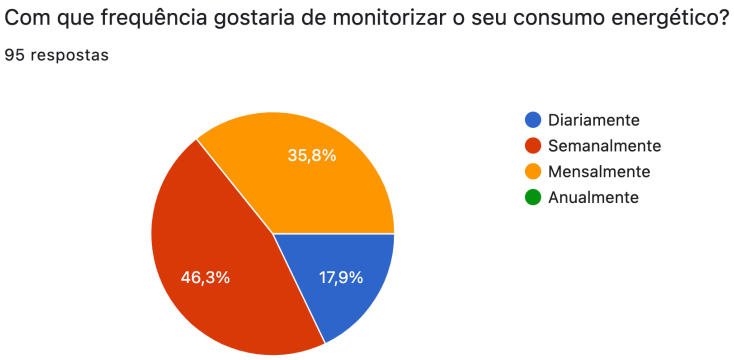

Figure 12: Responses to question 10 - "Com que frequência gostaria de monitorizar o seu consumo energético?"

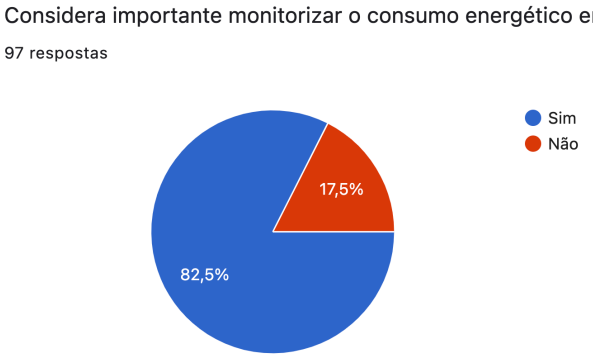

Figure 13: Responses to question 11 - "Considera importante monitorizar o consumo energético em tempo real?"

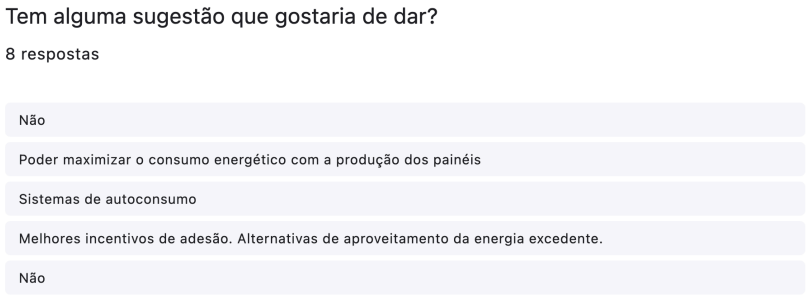

Figure 14: Responses to question 12 - "Tem alguma sugestão que gostaria de dar?"

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