MESG

MESTRADO EM ENGENHARIA DE SERVIÇOS E GESTÃO

Designing Services for Sustainability: The case of home energy consumption

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Dissertação de Mestrado

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2011-07-01

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Abstract

Focusing on environmental sustainability and narrowing to the home energy consumption realm, this research explores and gathers Service Design methods to embrace a methodological approach able to support the designing of services for sustainability.

Considering that Service Design can be used to nurture behavioral change, thus, to foster more sustainable practices within energy consumption, and adopting a customer-centric perspective, this dissertation comprises two main stages of Service Design: (1) the study and understanding of customers and their context and (2) the translation of that information into a new service system and service evidences, that were materialized into a prototype.

Therefore, the methodological approach included a qualitative study, using Grounded Theory methods, to understand the current customer experience in home energy consumption, so that customer experience requirements were identified. Once extracted the findings from the qualitative study, Service Design methods were gathered and adapted to support the design of the service, considering the identified requirements in the very beginning of the service concept definition, and highlighting the ability to foster sustainable practices in the service encounter level, as well as resorting to service evidences to explore design possibilities.

Understanding home energy consumption and eliciting requirements for the incorporation of sustainable practices allowed us to go beyond the mere interaction, and explore a systemic approach, considering that services exist within a context, surrounded by other services and entities.

As a result, the methodological approach supported the definition of a technology-enabled service concept in which the customer is able to consult energy consumption information, connect with the energy supplier and browse energy related contents – through *Casa da Luz* service –, receive warnings on energy waste detected or even observe her/his family's position within a social network community and share achievements. This outcome provided understanding on the methodological approach ability to support the design of a technology-enabled service that seeks to satisfy needs, meet experience requirements and trigger sustainable behaviors.

Desenhar Serviços para a Sustentabilidade: O caso do consumo de energia doméstico

Resumo

Focando-se na sustentabilidade ambiental e mais especificamente no consumo de energia doméstico, esta investigação explora e reúne métodos de Desenho de Serviços para construir uma abordagem metodológica capaz de suportar o desenho de serviços para a sustentabilidade.

Considerando que Desenho de Serviços pode ser usado para encorajar a mudança de comportamentos, nomeadamente, para promover práticas mais sustentáveis no consumo de energia, e adoptando uma perspectiva centrada no cliente, esta dissertação compreende duas etapas principais do Desenho de Serviços: (1) o estudo e compreensão dos clientes e do seu contexto e (2) a tradução dessa informação num novo sistema de serviço e em evidências de serviço, materializadas num protótipo.

Assim, a abordagem metodológica incluiu um estudo qualitativo, utilizando métodos da *Grounded Theory*, para o estudo da experiência do cliente no consumo de energia em casa, de modo a identificar requisitos de experiência do cliente. Extraídos os resultados do estudo qualitativo, métodos de Desenho de Serviços foram reunidos e adaptados para apoiar o desenho do serviço, considerando os requisitos identificados no início da definição do conceito de serviço e destacando a capacidade de promover práticas sustentáveis ao nível da experiência de serviço, bem como recorrer a evidências de serviço para explorar possibilidades de design.

A compreensão do consumo de energia doméstico e a descoberta de requisitos envolvidos na incorporação de práticas sustentáveis permitiu ir além da mera interação, e explorar uma abordagem sistémica, considerando que os serviços existem num contexto, envolvidos por outros serviços e entidades.

Como resultado, a abordagem metodológica suportou a definição de um conceito de serviço prestado com recurso a tecnologia, em que o cliente é capaz de consultar informações sobre o consumo de energia, de se ligar ao fornecedor de energia e navegar nos seus conteúdos - através do serviço *Casa da Luz* -, receber alertas quando é detectado desperdício de energia ou mesmo conhecer a posição da sua família enquadrada numa comunidade de uma rede social e partilhar experiências de sucesso. Este resultado permitiu compreender a capacidade abordagem metodológica para o desenho de um serviço prestado por via de tecnologia, que visa satisfazer necessidades, atender a requisitos de experiência e desencadear comportamentos sustentáveis.

Acknowledgements

This dissertation is a milestone in my personal, academic and professional life. It is a result of hard, but enthusiastic work that wouldn't be possible without the support of many people to whom I would like to present my gratitude.

I am deeply grateful to my advisor, Professor Lia Patrício, for her constant support and encouragement, for guiding me with thoughtful advice and for believing in my capacities.

I am also grateful to Professor Nuno Nunes, at Universidade da Madeira, whose advice and support about the research were crucial to make the data collection possible as well as to guide the subsequent work.

I appreciated all the support that Faculdade de Engenharia da Universidade do Porto provided me within SINAIS research project. I am grateful for allowing me to open my mind to new horizons.

I also would like to express my gratitude towards SINAIS research team at Madeira, Madeira Tecnopólo and University of Madeira for receiving me during my stay for data collection purposes.

I would like to thank all the families that freely participated in the research, whose kindness for letting me in their houses will never be forgotten. Meeting them and interacting with them was a wonderful experience.

My closest friends, I thank for their friendship, love and support every time I needed.

Last but not the least, I dedicate this dissertation to my parents, brother and godmother whose love and everyday support made me a happy person, seeking for my dreams.

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List of Acronyms

CERs	Customer Experience Requirements
CVC	Customer Value Constellation
GOA	Goal-Oriented Analysis
GT	Grounded Theory
LOHAS	Lifestyles of Health and Sustainability
MSD	Multilevel Service Design
PM	Power Meter
SEB	Service Experience Blueprint
SSME	Service Science Management and Engineering
VCE	Value Constellation Experience

1 Introduction

The progressive pervasiveness of services within the most advanced economies (Chesbrough and Spohrer 2006) and the increasing awareness of sustainability issues, both globally and locally, make us believe that designing services for sustainability can be one possible path to contribute to a better present, without jeopardizing the future.

In fact, in what concerns to Service Science Management and Engineering (SSME), the use of Service Design to influence people's behavior within service systems has been identified as a research opportunity (Ostrom et al. 2010).

Focusing on environmental sustainability and narrowing to the home energy consumption realm, this research explores and applies Service Design Methods to the design of a technology-enabled service able to foster sustainable practices in everyday energy consumption behaviors. Therefore, Service Design is seen as potentially related to behavioral change. And, the lack of customer awareness within home energy consumption (Fischer 2008; Pierce and Paulos 2010), the increasing availability of eco-feedback technologies (Fitzpatrick and Smith 2009; Froehlich, Findlater, and Landay 2010), the emergence of Lifestyles of Health and Sustainability – LOHAS (Friend 2009) and the technology infusion in services (Bitner and Brown 2006) are some reasons that justify this approach.

Adopting a customer-centric perspective, this dissertation comprises two main stages of Service Design: (1) the study and understanding of customers and their context and (2) the translation of that information into a new service system and service evidences, that were materialized into a prototype.

Resorting to the Analysis-Synthesis Bridge Model (Dubberly, Evenson, and Robinson 2008) adapted for Service Design, for (1) we conducted a qualitative study, using Grounded Theory Methods, to understand the current customer experience in home energy consumption, so that we could identify Customer Experience Requirements (CERs). Then, for (2) we modeled the customer experience and the service solution and also translated it into service evidences, combining Multilevel Service Design methods (Patrício et al. 2011) with Goal-Oriented analysis concepts and notation (Mylopoulos, Chung, and Yu 1999), Greenprinting (Patrício, Fisk, and Grove 2009) and prototyping.

As a result, we achieved a technology-enabled service concept in which the customer is able to consult energy consumption information, connect with the energy supplier and browse energy related contents, through *Casa da Luz* service, receive warnings on energy waste detected or even observe her/his family's position within a social network community and share achievements. This outcome provided understanding on the methodological approach ability to support the design of a technology-enabled service that seeks to satisfy needs, meet experience requirements and trigger sustainable behaviors.

1.1 SINAIS and home energy consumption

This dissertation is integrated in SINAIS Research Project. SINAIS stands for Sustainable Interaction with social Networks, context Awareness and Innovative

Services. It involves Carnegie Mellon University, University of Madeira, University of Porto and Catholic University (Project Reference: CMU-PT/CPS/0004/2008).

SINAIS project, apart from other areas, has been studying home energy consumption and the opportunities related to fostering sustainability in everyday lives. Based on Human-Computer Interaction, machine learning and motivational theories, a system was idealized and engineered. The two major objectives were settled: collect data to support the development of a system capable by itself of identifying energy consumption per appliance, not needing human intervention, and design a technology through which energy information could be provided so that it could foster sustainable practices within energy consumption behaviors. For that, a notebook was installed and linked to the energy meter of each recruited house, which both enabled the collection of energy consumption data and function as an eco-feedback technology.

Therefore, since early 2010, the process of recruiting families to take part of the research process began. To better define the sample of households, data on the consumption of mean voltage energy by households was analyzed (approximately 40.000 families) for the last three years. The data were provided by Empresa de Electricidade da Madeira, the only, thus, monopolist, energy supplier in Madeira. The referred analysis gave the insights to focus the family selection on the parish of Santo António, nearby Tecnopólo. Families from two blocks of apartments were invited to participate in a study involving the track of their energy consumption behaviors through a notebook, named Power Meter (PM), which connected to their energy meter, fixated to the wall (Appendix A). Initially, there was some sample mortality, due to either lack of willingness in participating in the study or because people started to use the computer for other purposes, consequently, the recruitment of single-family houses was made.

From the beginning of September, data started to be collected: energy consumption value each 30 seconds, power events (meaning turning on and off devices) each 200 seconds and user events (mouse and face movements). Data were collected and stored in a Data Warehouse, supported by an OLAP server. That data are now supporting the creation of the system able to identify appliances and their individual consumption.

In the beginning of March there were twenty-one families that took part in the sample. Each family had accepted to have a computer fixated to the wall near their energy meter inside their house, so that, any member of the family could visualize the information displayed.

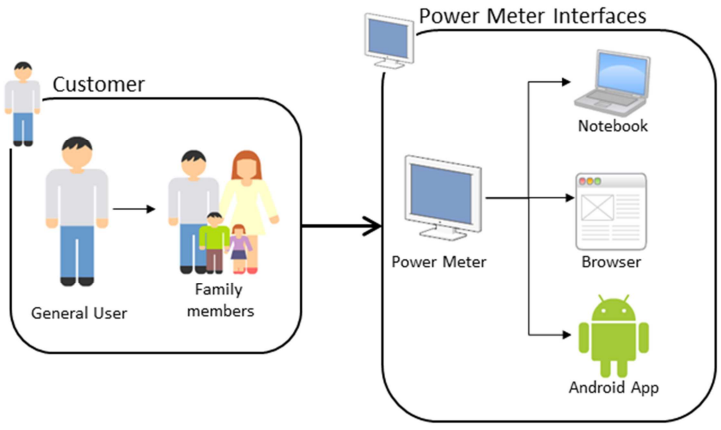

Figure 1 - User interaction with the Power Meter

In Figure 1, the general user represents any member of the family who interacts with the available interfaces of the PM, via browser and android application were recent improvements. There was a first version of the interface that was later substituted by an improved one, version 2.0, aiming to be more user-friendly and simpler to analyze. The 2.0 version allows the user to browse energy consumption information per hour, day, week, month and year and also see the objectives defined in Stepgreen (Appendix A).

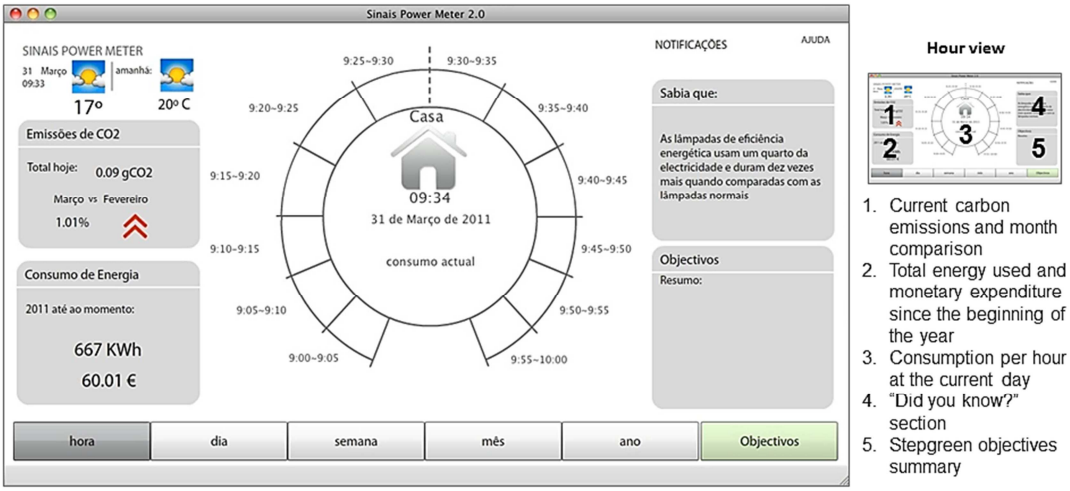

Figure 2 - Power Meter hour view

For instance, choosing hour view provides energy consumption information for a certain period of hours of the current day (Figure 2) and also informs about carbon emissions, total energy used, in terms of quantity and money spent since the beginning of the year, provides some tips and also displays objectives defined in Stepgreen. Stepgreen.org (Stepgreen 2011) was created by faculty and students at Carnegie Mellon University, Cornell University and University of Massachusetts at Boston. The website enables the users to commit to more sustainable practices (actions) in energy consumption behaviors and track their savings over time. Its purpose is to increase the awareness of people's actions and their consequences, providing them the knowledge to support more conscious decisions. Therefore, its integration in the PM's interface is important to provide the link to a community and the sharing of experiences, as well as add a new interface – the browser - in which PM information is displayed.

1.2 Research Objectives

Focusing on environmental sustainability and narrowing to the home energy consumption realm, this research main goal is to effectively gather Service Design Methods and embrace a methodological approach able to support the design of a technology-enabled service that seeks to satisfy needs, meet experience requirements and trigger sustainable behaviors.

Considering the two stages of Service Design to address in this research, the research objectives were: (1) study and understanding customers and their context, exploring attitudes, behaviors and experience requirements involved in home energy consumption and in the adoption of sustainable practices; and (2) orchestrate Service Design Methods to better support the design of a technology-enabled service, comprising the development of a new service concept provided through the PM and aiming at fulfilling

needs, meeting experience requirements and fostering sustainable practices in everyday energy consumption. The intention is to go beyond the interaction in itself and consider the provision of a service that exists within a context, surrounded by other services and entities, and which comprises a valuable offering to the customer.

1.3 Research Method

The research focus, the initial revision of literature and a first exploratory study gave the insights to build the subsequent methodological approach (Figure 3). Resorting to the Analysis-Synthesis Bridge Model (Dubberly, Evenson, and Robinson 2008) adapted for Service Design, it involved understanding of the current customer experience, modeling of the customer experience, modeling of the service solution and its prototyping and implementation (Patrício et al. 2011).

To understand the current customer experience within home energy consumption, comprising the first phase of Bridge Model, we performed a qualitative study, involving Grounded Theory (GT) Methods and using a Computer-Assisted Qualitative Data Analysis Software to support the analysis. This comprised thirty-one interviews, aiming at understanding customers' home energy consumption behaviors and explore CERs involved in the overall experience of incorporating sustainable practices within home energy consumption.

Then, in stage (2) we embraced the other three phases of Bridge Model, supported by Service Design Methods. We modeled the customer experience, then the service solution and finally prototyped the design solution. For this stage we combined Multilevel Service Design methods (Patrício et al. 2011) with Goal-Oriented analysis concepts and notation (Mylopoulos, Chung, and Yu 1999), Greenprinting (Patrício, Fisk, and Grove 2009) and prototyping for evidencing (Samalionis 2007).

Figure 3 - Research Method

1.4 Document Structure

This document is organized in the following sections:

- Section 1: Introduction – defines the research project focus, contextualizes the research within SINAIS and identifies the research objectives and methods.
- Section 2: Conceptual Background and Literature Review - discusses relevant fields and studies and sets the conceptual background of the research.
- Section 3: Methodology – presents the methods and techniques used.
- Section 4: Understanding Home Energy Consumption – presents findings from the qualitative study, explores home energy consumption specificities and CERs.
- Section 5: Designing the Service – resorts to a set of methods and visual representations to the service concept and service evidences.

2 Conceptual background and Literature Review

Considering the research objectives, the conceptual background and the literature review were focused on two main vectors: (1) the study and understanding of what involves home energy consumption, considering the realm of environmental sustainability, psychological studies and the emergence of eco-feedback technologies, and (2) the revision of Service Design Methods to better support the choice in terms of methodological approach for designing a service to foster sustainable behaviors.

2.1 Study and understanding of home energy consumption

2.1.1 Sustainability and LOHAS

The 1970s mark the beginning of a growing concern of the impact that economic development represents on environmental issues, being particularly important the United Nations Conference on the Human Environment, at Stockholm in 1972 (UNEP 1972). Later, in 1987, took place Brundtland Commission, in which the concept of sustainable development was brought up and defined as: “Sustainable development seeks to meet the needs and aspirations of the present without compromising the ability to meet those of the future.” (UN 1987), a widely known definition, even in the present.

In 1992, the United Nations Conference on Environment and Development or Rio Summit (UN 1992) resulted in an important outcome: Agenda 21, where it is made clear the definition of three dimensions that support any kind of sustainable development: environment, social and economic. This marks the very beginning of the concern on the integration of economic, environmental and social objectives, towards a sustainable development or, synonymously, sustainability.

Moreover, European Union states the strategy towards sustainable development as a “continuous long-term improvement of quality of life through the creation of sustainable communities able to manage and use resources efficiently, able to tap the ecological and social innovation potential of the economy and in the end able to ensure prosperity, environmental protection and social cohesion.” (ECE 2010). The 2020 strategy is, thus, supported by three main drivers (EU 2010): smart growth, focusing in the importance of knowledge, innovation and education; sustainable growth, related to resource efficiency and eco-friendly production as well as competitiveness; and inclusive growth, ensuring that employees have a more active participation and formation and that poverty is eradicated.

Given the evolution of times and societies, with it evolved the meaning of sustainability, the ways to address it and even the form of its representation (Adams 2006). After many modifications, it is common to see sustainability major pillars represented as interconnecting circles, symbolizing the idea of integration of economic, environmental and social objectives toward a sustainable future, with social equity, local environment protection and sustainable economy (Figure 4). The interconnection of sustainability pillars raises the knowledge of their interdependence, hence, one can say that impacting in a certain pillar will have consequences in the other two, as well, as trade-offs might be triggered.

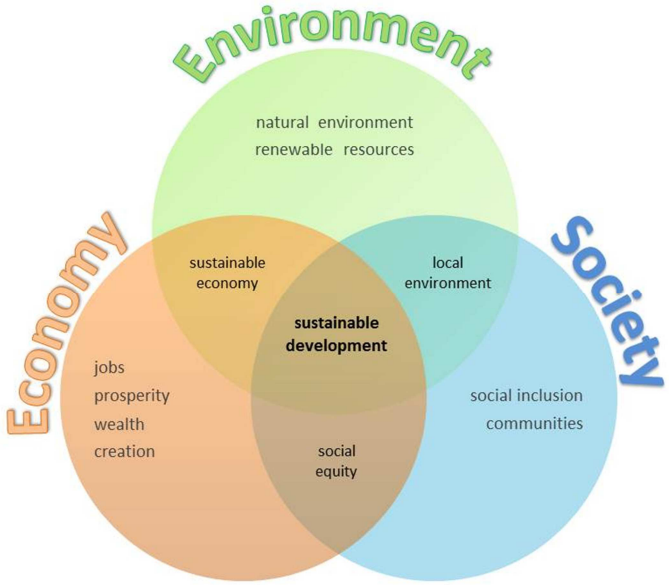

Figure 4 - Sustainability interconnected pillars adapted from Forestry Commission (2010)

In parallel to global consciousness and political measures towards a more sustainable development, a new trend has emerged in the consumption market, that is, the appearance of a new and growing group of consumers: LOHAS. Lifestyles of Health and Sustainability, or LOHAS, is an acronym to describe a market segment which takes health, sustainability, environmental and social responsibility as concerns at the moment of buying a product or service (Moxie 2008). LOHAS consumers, or also called conscious consumers, are growing rapidly throughout the world, changing consumption patterns as they are advocates of their particular lifestyle (Friend 2009). Moreover, Fraj and Martinez (2006) confirm the increasing market of consumers that are aware of environmental problems and take some action to solve them.

In fact, Friend (2009) highlights that enterprises must be aware of this trends and besides making money they must also make sense, in order to reach this new and growing consumer market. Furthermore, this type of consumers is generally willing to pay more for products and services that can be related to the lifestyle they advocate. This increasing market may be one good opportunity for innovating in services, namely in what concerns to new solutions to foster more a sustainable practices within energy use, considering that these type of consumers are “solutions focused and information hungry using modern communication channels to source, search and vet their decisions” (Moxie 2008).

2.1.2 Focusing on environmental sustainability: home energy consumption

Despite the fact that energy consumption touches social, economic and environmental perspectives of sustainability, due to energy’s transversal presence, we highlight the more direct impact on environmental sustainability. According to Goodland and Daly (1996), environmental sustainability refers to the maintenance of natural capital, thus, seeks to protect raw materials and resources in order to ensure human welfare. It is linked to the imposition of limitations within consumption, so that the rhythm of nature renewal can overcome the consumption pace.

In this order of ideas, we will refer to sustainable practices/behaviors or sustainable energy consumption considering it in terms of environmental sustainability. Nevertheless, the term sustainable consumption may raise complex discussions, such as the reference to a specific moment, context or problem (OECD 2002). We will consider that sustainable consumption behaviors may include any kind of act towards the conservation of energy or the use of renewable sources.

Considering an individual household, it may not be significantly relevant in the whole picture of energy consumption, however, the sum of every households may raise many environmental problems, if their consumption patterns are not adequate to the existing possibilities (OECD 2002). For many years, policies have only focused on the production side, therefore, there is a revealed urgency at rethinking the role of households and the impact of their consumption patterns. Hence, offering services able to foster sustainable consumption of energy resources should be addressed as a means to seek for a better future scenario. Living better shouldn't mean spend more, and that is a particularly relevant issue in OECD countries which reveal more energy use, due to higher incomes, larger homes and more energy-dependent equipment (EIA 2010).

In what concerns to energy itself, which we consider as a synonym to electricity, it is referred as intangible and only the lack of it may praise its importance for making our daily routines possible, maintaining a certain quality of life. One can say that energy, as a service, relies on the low-involvement service category (Djik 2011). In fact, Fischer (2008) argues that energy, whose presence is noticed through its manifestation, differs from goods, being untouchable and of indirect consumption, through appliances, devices and other energy services. Furthermore, the author presents different perspectives regarding the concept of sustainable energy consumption from the perspective of the consumer, namely the choice between energy sources, from more environment-friendly to less ones, and the choice between appliances and devices, their mode of use and maintenance. We would add the importance of conservation behaviors, as energy invisibility leads to a lower awareness of its use, in terms of the frequency and quantity, and there isn't a direct perception, thus, lacks of involvement of the user.

When it concerns to residential buildings, some factors may be taken into account as they interfere with the amount of energy used, namely, the physical size of the building, the income level of its occupants, the weather severity, among other factors (EIA 2010). Therefore, it is expected that smaller houses are related to lower energy consumption, mainly because they usually have less occupants and appliances and require less energy for heating and lighting.

Because "energy is deeply implicated in all material and immaterial aspects of our being" (Pierce and Paulos 2010), environmental sustainability urges for increasing awareness of energy consumption behaviors in households and behavioral change, particular in what concerns to relevant behaviors.

2.1.3 Understanding energy consumption behaviors

Based on environmental psychology theories, Steg and Vlek (2009) refer to pro-environmental behavior as behavior that seeks for the minimum impact on environment

or even has positives consequences over it. They identify three main drivers of pro-environmental behavior: motivational, contextual and habitual behaviors.

Motivational factors include the weighing of benefits and costs, moral and normative concerns and affect. The weighting of benefits and costs assumes that individuals make conscious decisions, after a cost-benefit evaluation, hence, Steg and Vlek (2009) refer to the Theory of Planned Behavior (Ajzen 1991) as a theory that has proven to be a good predictor of environmental behavior. In terms of moral and normative concerns, the authors affirm that the more the individuals subscribe to certain beliefs and values, the more they are likely to engage pro-environmental behaviors.

Because human behavior doesn't only rely on motivation, contextual factors also explain and drive behavior, in the form of constraints or facilitators that influence human response, such as availability.

Finally, habitual behaviors are presented as actions that individuals take and that are not reasoned but that play a role in driving pro-environmental behaviors. This last driver concerns to a behavior that "is habitual and guided by automated cognitive processes, rather than being preceded by elaborate reasoning." (Steg and Vlek 2009).

Therefore, and considering the incorporation of sustainable practices in energy consumption behaviors, we are leaded towards the distinction of two main types of behavior within home energy consumption: conscious and reasoned behavior, that results from an elaborated decision process, on the one hand, and habitual behavior, on the other hand, that might be linked to the invisibility of energy.

To understand conscious behaviors, we will resort to the Theory of Planned Behavior developed by Ajzen (1991) as an extension of the Theory of Reasoned Action (originally proposed by Fishbein and Ajzen 1975). The central factor of the theory is considering the existence of motivational factors that influence the willingness of performing a behavior, that is, there are intentions of behavior, and from intention to behavior there is a step to take.

Theory of Planned Behavior states that there are three predictors of behavioral intention: attitude toward a behavior, which refers to desirability of the behavior, what the individual thinks and feels towards a behavior; subjective norm, comprising social norms and their pressure on the individual's act; and perceived behavioral control, referring to perception of the difficulty or easiness of performing a behavior (Figure 5). Furthermore, the theory considers three important explainers of human behavior: behavioral beliefs, affecting attitude toward a behavior; normative beliefs, affecting subjective norms; and control beliefs, affecting the perceived behavioral control.

The general rule supporting the theory states that "the more favorable the attitude and subjective norm with respect to a behavior, and the greater the perceived behavioral control, the stronger should be an individual's intention to perform the behavior under consideration." (Ajzen 1991). Hence, knowing how attitudes, subjective norms and perceived behavioral controls affect behavioral intentions (or directly behavior, in terms of perceived behavioral controls) and consequently behaviors, as well as, understanding the beliefs determining each construct, may constitute a means to change human behavior towards more sustainable consumption lifestyles.

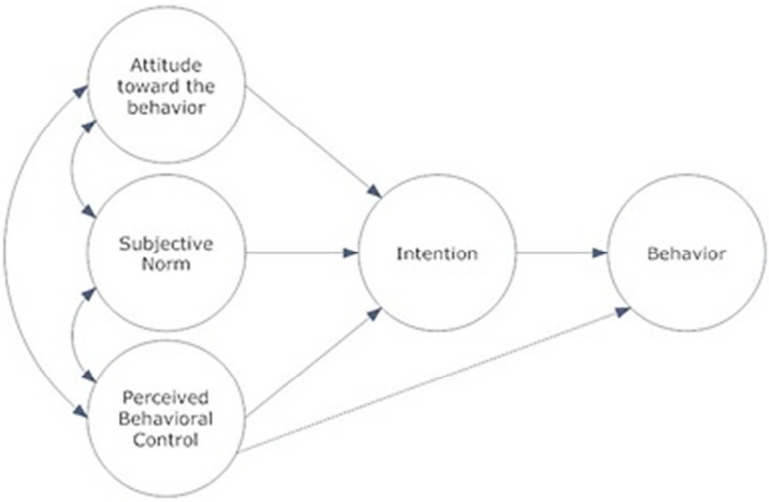

Figure 5 - Structural Diagram of Theory of Planned Behavior (Ajzen 1991)

Theory of Planned Behavior considers that past behaviors may in part influence future behaviors, and for that purpose Ajzen (1991) introduces the concept of habits. Furthermore, energy consumption can be related to habitual elements, due to the fact that, within households, the activity of energy consumption is performed under similar physical and social environments (Aarts, Verplanken, and Knippenberg 1998). The intangibility of energy consumption may suggest its frequent association to automatic behaviors that are performed efficiently, effortlessly and unconsciously, rather than resulting from a conscious process of decision (Pierce, Schiano, and Paulos 2010).

Aarts, Verplanken, and Knippenberg (1998) argue that Theory of Planned Behavior (Ajzen 1991) disregards the repetitive nature of many behaviors related to health, security and environment. This means we are in the presence of habits, whose strength increases through positive reinforcements. Habits are goal-oriented automatic behaviors that are mentally represented and are activated through situational cues. Moreover, the authors emphasize that the source of a habitual response may be triggered upon the perception of appropriate stimuli that retrieves from memory the habitual response, whose cognitive structure had been learned and stored. Once established, habitual behaviors don't require a process of reasoning, therefore, under the right stimuli that habitual response that leads to the desired goal will be recovered from memory.

Steg and Vlek (2009) recognize the merit of environmental psychology in promoting sustainability through behavioral change, as it provides a systematic approach to assess, understand and change environmental behavior. Therefore, the given discipline has proven to be able to support the study and understanding of energy consumption behaviors within households. For that purpose, Fischer (2008) presents a model developed by Matthies (2005), fruit of a deep review within the referred discipline. The given model focuses on environmental relevant behavior and distinguishes two types of actions: habitual behaviors and conscious decisions; and identifies the important sequential elements that complete the decision process, which are: norm activation, motivation, evaluation and possible redefinition and the decision in itself (Figure 6). The main contribution of this model is in the relationship that it establishes between end results (the action resultant of the decision process) and motives under the process.

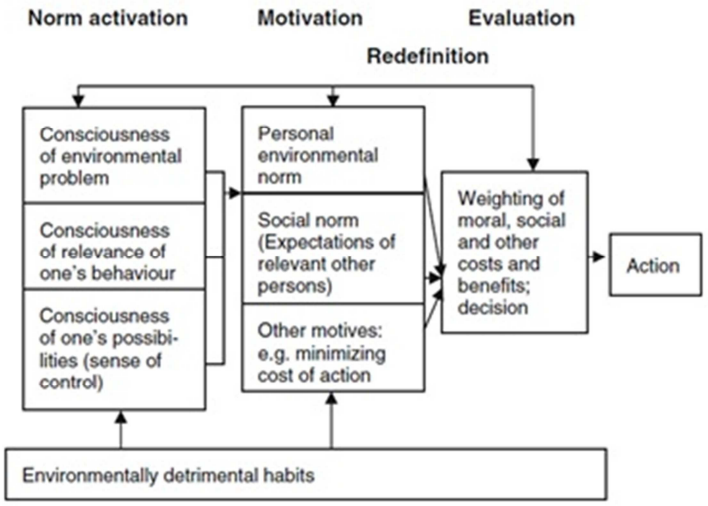

Figure 6 - Heuristic Model of Environmentally Relevant Behavior (Matthies 2005 quoted in Fischer 2008)

According to Fischer (2008), the referred model considers the existence of two types of behavior: habitual and conscious, corroborating what we previous reviewed. However, it adds the idea that many habits turn to be environmental detrimental, meaning that the environment is not an issue taken in consideration. Hence, when the individual is confronted with a situation to which there is no habitual/routine solution, the process of norm activation begins and with it the first step that may lead to the change of energy consumption behaviors. The realization that one's behavior is relevant to solve the problem is crucial to this model and that may be the answer to solve sustainability problems, namely, energy consumption behaviors, in terms of reducing their impacts.

The next step, motivation, is "a process of weighing and evaluating different motives" (Fischer 2008), in which the individual balances personal, social or other norms that have influence in her/his decision behavior. And because norms may interfere with each other, the following phase is evaluation of moral, environmental, personal and social benefits and costs that the person will face if s/he takes the pro-environmental behavior. The redefining process may occur if there is the need to adapt norms or motives, in the light of the available information. In the end, the decision and consequent action may, under certain circumstances, turn into a routine. One limitation of Matthies (2005) model is that it assumes that the individual has a considerable amount of information to support this first phase, which may be difficult to observe in reality, however it may provide knowledge to sustain eco-feedback technologies as Fischer (2008) argues.

2.1.4 Technologies to foster sustainable practices: eco-feedback technologies

There is a recognized need for energy engagement, because "energy has been designed not to matter to us" (Pierce and Paulos 2010), therefore, on-time feedback may be the way to raise cognitive awareness and motivate energy conservation behaviors.

Feedback, being direct or indirect, is essential to increase individuals' awareness of energy consumption behaviors, concludes a metareview performed by Darby (2001). Furthermore, the author argues that displays installed at home to monitor those behaviors should provide an accessible and clear experience, in order to be effective in terms of one's learning and control of energy use. In fact, the same study concludes that

appropriate feedback may succeed not only in increasing awareness, but also may reduce consumption of the order of 10%.

In what concerns to technologies providing energy consumption information, Fitzpatrick and Smith (2009) refer to the existence of two types of displays that provide direct feedback on energy consumption at home: smart meters that are associated to utility providers and "on-shelf devices" that are bought and installed by the user. The latter progressively proliferating and being acquired by consumers.

This kind of technology is identified as eco-feedback technology by Froehlich, Findlater, and Landay (2010). Grounded on environmental psychology and human computer-interaction, these authors define: "Eco-feedback technology provides feedback on individual or group behaviors with a goal of reducing environmental impact." Moreover, they argue that eco-feedback technologies rely on the hypothesis that there is a lack of awareness in what concerns to one's life, behaviors and their impact in environmental sustainability, and, the increasing availability of sensing systems and devices that interactively present data should be seen as an opportunity. In fact, the same authors reviewed the main techniques in terms of motivating pro-environmental behaviors, highlighting the importance of (1) presenting specific, relevant and on time information that reaches attention balancing the cognitive load, (2) setting directive and energizing goals that persistently aim at stimulating environmental sustainable practices, (3) comparing behaviors within the same individual or between individuals, possibly resorting to social networks, (4) defining a commitment of behavioral change, either public or private, (5) persuading behavioral change through incentives or rewards (even game-like) and, finally, (6) feedback itself, which is embedded in all the previous techniques for effectiveness, and that can be referent to a specific behavior or to a more macro level.

Fischer (2008) reviewed several studies on the effects of feedback on energy consumption and the results showed that the best successful feedback types involved frequently computerized feedback, updated, rich in additional information and interactive, also specific per appliance or device and presented in a pleasant way.

Furthermore, resorting to the previously presented model developed by Matthies (2005) (section 2.1.3), we can focus on the ways eco-feedback technologies may influence one's behavior through the presentation of specific information. For instance, Fischer (2008) argues that the feedback provided should capture the attention of the individual in terms of showing information related to the energy consumed in daily activities, so that, s/he faces a certain problem and realizes that her/his behavior is relevant to solve it, motivating one's action. These findings support the importance of eco-feedback technologies (Froehlich, Findlater, and Landay 2010), establishing a close link between specific energy consumption behaviors and presenting the motives to persuade the individual to adopt more sustainable actions within energy consumption (Fischer 2008).

The provision of continuous feedback will support the formation of habitual behaviors, preferably not environmentally detrimental, and support conscious decisions based on updated information, in an interactive way. In terms of eco-feedback technologies, it is important to retain that any type of behavior that is performed frequently may turn into a habit, needing less effort and conscious attention. When the habit is formed, the

behavior needs no reasoning, being performed efficiently and effortlessly (Aarts, Verplanken, and Knippenberg 1998; Pierce, Schiano, and Paulos 2010).

Moreover, under the hypothesis that "one-size does not fit all", He, Greenberg, and Huang (2010) conducted a study, whose theoretical framework was the Transtheoretical Model, to evaluate existing feedback technologies from a motivational perspective. Their hypothesis regarded that the same feedback may have different effects on individuals, motivating some, but having diverse effects on others. In fact, the point is that eco-feedback technologies aim both to inform, but mainly they ought to motivate sustainable energy consumption behaviors. For instance, to overcome the lack of strong motivation in what concerns to energy conservation, Pierce, Schiano, and Paulos (2010) suggest that resorting to scripting (scripts may be in the imperative form, functioning as user manuals) and social norms (perceived as the behaviors that are socially approved) should be considered in the design of interactions with the feedback technology.

And, beyond encouraging the individual to adopt a certain behavior, making a commitment, it also requires the continuity of that commitment, observable in future situations, thus, sustaining behavioral change (He, Greenberg, and Huang 2010). For instance, LOHAS market may be a segment to target, due to its increased awareness and, possibly, easily motivation through eco-feedback technologies.

Finally, Froehlich, Findlater, and Landay (2010) refer to the need of integrating knowledge from both environmental psychology and Human-Computer Interaction, so that the understanding of energy consumption behaviors is enriched by the visual design of eco-feedback technologies and vice-versa. And, we believe that service design can integrate this approach through the provision of a technology-enabled service that promotes not only sustainable behaviors, but also "experientially meaningful and environmentally sustainable interactions and practices with and around energy in everyday life (Pierce and Paulos 2010). " The aim is to go beyond the interaction in itself and consider the provision of a service that exists within a context, surrounded by other services and entities. Moreover, that service's existence shall be justified by the value perceived by the customer/user of it and deeply linked to customer experience requirements.

2.2 Service Design Methods

2.2.1 Designing Services for Sustainability

Over the last 50 years services have conquered a relevant position in the economic panorama in the most advanced economies (Chesbrough and Spohrer 2006). Service economy has grown, new services appear, especially technology-enabled services and, therefore, new approaches and disciplines are configured to sustain innovation. Spohrer et al. (2007) justify the emergence of Service Science, Management and Engineering (SSME) with the contribution of different fields of knowledge and the increasing pervasiveness of services.

Diverse disciplines are seen as complementary to participate in the study and development of new and better services. SSME appears as an effort to integrate academic silos and gather them around a common set of problems (Chesbrough and

Spohrer 2006). Considering that Service Design aims to be a cross-disciplinary activity, enabling the link between service strategy, innovation and implementation (Ostrom et al. 2010), it is projected to be collaborative so that we have a holistic view of the service experience. To be effective, service design must be an activity involving operations, design, engineering, technology and marketing, hence, needs the silos to be eliminated.

The distinctive characteristics of services – customer participation in the service process, simultaneity between production and consumption, perishability, intangibility and heterogeneity – justify the need for their careful engineering, design and further management (Edvardsson et al. 2000; Fitzsimmons and Fitzsimmons 2008), as well as, present challenges to service innovation. In this sense, Bitner, Ostrom, and Morgan (2008) postulate that the challenge can be partially associated to the fact that "Services are fluid, dynamic, and frequently co-produced in real time by customers, employees, and technology". Furthermore, the emergence of technology-enabled services is overcoming these peculiarities and creating new challenges, fostering innovation within the service sector (Sandström et al. 2008), improving customer autonomy and rising connectivity. Being an exchange of value between the provider and the customer, the more a service is knowledge-intensive, for instance, through the use of technology, the more it requires the participation of the client as an actor whose performance has impact on the overall satisfaction (Spohrer et al. 2007).

Within SSME, Ostrom et al. (2010) identify the use of Service Design to influence behavior of people within service systems as a research opportunity, referring to the importance of learning more about culture- and market-specific needs for the design of services, and of adapting methods and processes to obtain the best result. Hence, Service Design has potential to be related to behavioral change, thus, to foster more sustainable practices within energy consumption.

Moreover, Manzini (1999) emphasizes the shift of paradigm, from product-oriented to product-service oriented, as the first step towards sustainability and highlights the importance of introducing change that will lead to new standards of behavior and strategies. Furthermore, the appearance of the technology-enabled services, as a result of the information-services oriented paradigm, is pointed as crucial to trigger the environmental reorientation of today's economy and society.

"Design for Sustainability or D4S, including the more limited concept of Ecodesign, is one globally recognized way companies work to improve efficiencies, product quality and market opportunities (local and export) while simultaneously improving environmental performance" (Crul and Diehl 2005). Additionally, we believe that customers, who are seeking for solutions to their needs, should be involved in the pursuit for sustainability, through the change of their consumption behaviors. Therefore, Service Design for Sustainability goes beyond designing "green" services, but aims to embrace the challenge of how to meet consumer needs and, simultaneously, influence their attitudes and behaviors towards sustainability.

In what concerns to the case of home energy consumption, Djik (2011) took part in the performance of an international study (nine countries) on people's practices and motivations in relation to everyday energy use. Sustained on an ethnography-based design research that included observations, semi-structured in-depth interviews and

documentation in photography and video, Djik (2011) presents some findings observed in participants: energy usage is viewed as an abstract matter; there are misperceptions about the most demanding devices; several references are made to the insufficiency of energy provider services to help monitoring and managing energy consumption; the existence of children is referred as an interference on the ability of controlling usage; the lack of spare time to spend on learning more about their energy usage. Furthermore, and in what concerns to service design fostering behavioral change, the need to take into account customer everyday practices and routines is highlighted. The study constitutes an early stage of understanding customers' interest and willingness in altering their daily routines in energy consumption and briefly exploring how energy providers could support their customers with new services and tools; however, it doesn't present a method neither techniques to design services to foster sustainable practices.

2.2.2 Service Design and Multilevel Service Design

Being considered a holistic, multidisciplinary and integrative field (Moritz 2005), Service Design aims to foster innovation through its support for the creation of new services or improvement of existing ones, to build solutions that are "useful, usable, and desirable from the client's point of view and effective, efficient, and distinctive from the supplier's point of view." (Mager 2008).

According to Edvardsson et al. (2000), Service Design activities appear within the context of service development, considering that the customer and his/her needs and all the relevant characteristics must be in the center of the design process. For that, these authors consider three main components of Service Design: the service concept, the service system and the service process. The service concept summarizes and synthesizes the ultimate goal of meeting customers' needs in an unique way, considering the involving service system, people, technology and resources, and the process through which there is the exchange of value (Edvardsson et al. 2000; Bettencourt 2010).

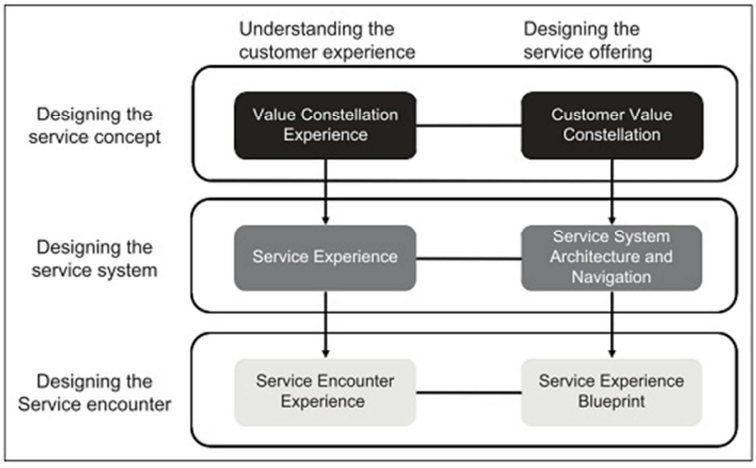

Figure 7 - Multilevel Service Design: general model (Patrício et al. 2011)

However, the proliferation of service offerings through multiple interfaces and comprising diverse relationships with entities external to the firm, was the opportunity Patrício et al. (2011) saw for developing Multilevel Service Design (MSD). Uniting contributions of different but complementary fields, MSD emphasizes the systemic

view over the firm view – comparing to Edvardsson et al. (2000) –, highlighting that service offerings and customer experiences shall be seen and designed incorporated in a larger system that goes beyond firm limits.

MSD synthesizes contributions from new service development, interaction design and the emerging field of Service Design, aiming at both understanding the customer experience and designing the service offering (Figure 7). It seeks for developing service offerings considering three hierarchical levels: (1) the service concept, considering Value Constellation Experience (VCE) and the Customer Value Constellation (CVC), (2) the service system, considering the architecture and navigation for the service experience and drills down to the service encounter basis (3) using Service Experience Blueprint (SEB) for designing each service encounter experience.

The method itself begins with the study of the customer experience, possibly resorting to both qualitative and quantitative methods. The qualitative study, comprising, for example, observation, in-depth interviews, focus-groups, enables the mapping of the customer activity, the service activities and tasks and understanding the customer experience.

The second step is the design of the service concept, which means considering the service offering in a much wider perspective than the one suggested by Edvardsson et al. (2000). This step holds the understanding the VCE, which means understanding the various activities of the experience, the interactions between the customer and related service organizations and the most important experience factors. Because the experience exists within a systemic context, CVC is designed to better comprehend the set of service offerings and how they are interconnected to provide the VCE.

Descending to the firm level, the design of the service system involves understanding the service experience, that is, all the interactions between the customer and the firm's service system to accomplish one or more activities of VCE. Considering the various interfaces that might be available for the same service activity, Service System Architecture (static) and Service System Navigation (dynamic) orchestrate those interfaces to guide the customer to the best combination which will result in a more pleasant experience.

Finally, and drilling down to the design at the service encounter level, touchpoints or service encounters between the customer and the service are approached with the understanding of the service encounter experience, with a strong focus on interaction design, and resort to Service Experience Blueprint diagrams (section 2.2.4).

Answering to the increasing need for a systematic and holistic approach to develop, design and redesign complex service systems, MSD is sufficiently flexible and modular to be used to the extent of management and design needs.

2.2.3 Customer Experience Requirements and Goal Oriented Analysis

Technology-enabled services emphasize the role of customers as co-producers of the service and responsible for the service delivery (Bitner and Brown 2006). And considering that "a service experience is the sum total of the functional and emotional outcome dimensions of any kind of service" (Sandström et al. 2008), then each service

experience is unique and particular to each customer that plays an active role in the service process. Nevertheless, the service experience requires the presence of emotional or functional cues that guide the customer and result in “cognitive, affective, and behavioral reactions associated with a specific service event.” (Padgett and Allen 1997)

Resorting to Service Design techniques, the design of the service experience can be associated to the concept of customer journey, defined by Mager (2009), as the several touchpoints – points of contact with the service provider – with which a customer interacts as well as the activities s/he performs. Hence, offering of a consistent journey of activities and points of contact with the customer requires our deepest attention so that the experience is pleasant for the customer (Evenson 2005). Zomerdijk and Voss (2009) highlight the need for adopting a process that starts at the comprehention of clients and their needs, being functional or emotional, to sustain the development of services and the design of involving experiences. In this sense, customer experience requirements (CERs), defined as the "customer perceived attributes of the interaction with the service provider that contribute to satisfaction and usage of the service" (Patrício et al. 2004), highlight the focus on customer needs and perceptions, in alignment with the Service Design focus on the customer and on the overall experience.

From a HCI perspective, interaction design addresses customer experience through a four-steps process that comprises (1) the identification of user needs and their translation to requirements, (2) the design of alternative solutions to meet those requirements, (3) using prototypes to communicate the different alternative designs and (4) the evaluation of them in terms of user experience (Preece, Rogers, and Sharp 2007).

Moreover, within requirements and software engineering, Goal-Oriented Analysis (GOA), apart from object-oriented analysis, is able to deal with non-functional requirements, like usability or flexibility, associating them with softgoals and distinguishing them from functional requirements or goals (Mylopoulos, Chung, and Yu 1999). In fact, non-functional requirements are attributes the stakeholders would like the system to have so that the interaction experience is more satisfactory, and for their analysis Mylopoulos, Chung, and Yu (1999) created this framework: (1) define the softgoals that represent the non-functional requirements obtained from stakeholders; (2) for each softgoal create the softgoal tree, decomposing in other softgoals; (3) gather the softgoals so that positive and negative interferences are evidenced; (4) analyze if the softgoals are satisfied. Functional requirements or goals are the functionalities the system should have, which are organized in goal trees, and decomposed in subgoals. Functional goals are then related to softgoals, so that their compatibility is analyzed.

Taking into account that CERs are themselves attributes of the interaction within a service, requirements of an experience, we can treat them as non-functional requirements. Therefore, GOA may, in early stages, help in the specification of customer’s needs into requirements, namely, experience requirements. Later it may provide a support for choosing the most appropriated design among different alternatives, taking into account the emotional and functional components of the service (Patrício, Fisk, and Cunha 2008).

Considering MSD methods, namely the level of service concept definition and the VCE, we will use GOA concepts and notation to better understand the experience factors and

incorporate them from the very beginning of the method. This configures a new approach and one practical contribution to the method.

2.2.4 Service Experience Blueprint

Each activity of a service offering must be designed and managed, taking into account the various interactions between the client and the system interfaces, so that the service experience is memorable (Pine and Gilmore 1998). Considering the design basis of service experience encounters, Bitner, Ostrom, and Morgan (2008) argue that the Service Blueprint is an adequate technique able to support the design of customer experiences, due to its flexibility and capacity of adaptation. In fact, Shostack (1984), who earlier introduced Service Blueprint as a promising technique that offered advantages in terms of controlling and monitoring service operations, recognized the technique's flexibility to encourage creativity.

The given technique aims at presenting an overview of the key service elements and activities, inter-relating them through their orchestration. Furthermore, "service blueprints are first and foremost customer-focused, allowing firms to visualize the service processes, points of customer contact, and the physical evidence associated with their services from their customers' perspective" (Bitner, Ostrom, and Morgan 2008)

Service Blueprint allows the definition of customer roles and activities, providing cues through physical evidence, the representation of frontline employees' activities and their interaction with customers, as well as setting the line of visibility (activities that are kept away from the customers' sight) and the definition of backstage activities. However, in what concerns to technology-enabled services there is the need to incorporate technological interfaces and components in the design of the service blueprint and for that purpose, Mager (2009) refers to the definition of the line of IT interaction (part of the frontstage activity), substituting the line of interaction, which a customer faces when using technology-enabled services.

The increasing infusion of technology in services and the emergence of multi-interface service offerings highlight the importance of incorporating technological components in methods like the Service Blueprint (Bitner, Ostrom, and Morgan 2008) and adopt a more cross-disciplinary approach, just like Service Design is characterized (Moritz 2005). Resorting to research methodologies from Marketing and methods from Human-Computer Interaction and Software Engineering, Service Experience Blueprint (SEB) is a multi-disciplinary method developed by Patrício, Fisk, and Cunha (2008) for multi-interface and technology-enabled service experiences. It sustains a systematic process of CERs' incorporation, able to be understood both by managers and software engineers.

Regarding that the customer experience is a result of every single moment of contact with the firm through different interfaces or channels, SEB method allows service managers and interaction designers to choose the best combination of interfaces for each service encounter, ensuring a strong customer orientation due to the incorporation of CERs. Adopting a multi-interface perspective, the method also supports more elaborate decisions on the investment on interfaces, prioritizing those that have more impact on the client overall experience. Actually, it corroborates with the new paradigm within services, because it allows modularity, where different segments of clients co-create

value in real time, considering their preferences in terms of channels and navigation patterns for each service encounter activity.

SEB method comprises three main steps: the evaluation of the service experience for each service activity; designing the service at the interface level; and designing the service at the concrete level of the interface. Therefore, it starts with the study of the experience requirements for each activity of the service encounter, paying attention to the available interfaces to provide the service. Resorting to qualitative and quantitative research methods, CERs are depicted, their importance is defined and they are prioritized for each activity in the service encounter. GOA is, then, used to understand the desired experience for each service activity, through the decomposition and prioritization of softgoals. The multi-interface service is designed, defining the specialization and integration of the various interfaces. Finally, drilling down to the concrete level, resorting to SEB diagrams, each interface is designed to sustain the service activities and better satisfy CERs, smoothly guiding the client to the interfaces that result in the best overall service experience.

SEB diagrams consider the existence of backend systems and their actions to enable the provision of a service through technology, therefore, represent an evolution comparing to Bitner, Ostrom, and Morgan (2008) Service Blueprint as they include the actions of a supporting system, with impact on the overall experience.

2.2.5 Embedding Greenprinting in SEB diagrams

Greenprinting (Patrício, Fisk, and Grove 2009) answers to the ultimate goal of fostering sustainable practices through services encounters, as it integrates environmental awareness within the steps of creating SEB diagrams. In parallel, Greenprinting aims to provide a valuable service experience for the customer, enhancing it through the incorporation of CERs.

Considering already existent service offerings, the process suggested by Patrício, Fisk, and Grove (2009) involves mapping the current service experience and generate ideas for improvement, evaluate those ideas in terms of their benefits' and costs' feasibility, develop and assess the impact and, finally, implement. Regarding the overall service experience, Greenprinting can be introduced to either the frontstage or the backstage aspects of Service Design. In the frontstage, green paths are created for engaging the customer in greener practices along the service experience, so that customers can freely choose between the "normal" path and the greener one.

We believe that besides the applicability in already existing offerings, Greenprinting can lead the design of a service from scratch. Instead of creating alternative green paths, it could be embedded in the SEB diagram, where the technology enabling the service fosters sustainable behaviors and the customer chooses them.

2.3 Tangibilizing through service evidences

Once service encounters are designed resorting to blueprints, tangibilizing the design solution may enhance the final result by considering the overall experience. In this sense, Samalionis (2007) presents evidencing, which consists of mapping the

assumptions about the future service, in a kind of "archaeology of the future", which enables making qualitative judgments about the implications of design. The author refers to the enactment of experiences, but also assumes simpler ways of evidencing the service, through *faking*, which involves the creation of materials involved in the service provision to better understand the design implication on the overall experience.

For this purpose, and considering the technology-enabled service to design, we see low fidelity prototyping as an adequate approach to tangibilize the design solution, so that the experience requirements are refined and better orchestrated. Furthermore, this kind of service evidences may comprise themselves physical evidences of the SEB diagrams, as they tangibilize the service experience to offer at each touchpoint.

2.4 Main conclusions

There has been a strong focus on incorporating sustainability matters on the design of more sustainable services. Though, there is a revealed urgency at rethinking the role of customers and the impact of their actions. Offering services able to foster sustainable practices in home energy consumption should be addressed as a means to seek for a better future scenario. But, there is no systematized approach within Service Design to respond to this issue.

Regarding the conceptual background and revised studies, we were able to gather the understanding of what involves home energy consumption, considering the realm of environmental sustainability, psychological studies and the emergence of eco-feedback technologies. Additionally, and taking into account that understanding we addressed Service Design Methods so that we could have a deeper knowledge on the possible approaches for designing services for sustainability.

In this sense, we believe that MSD methods (Patrício et al. 2011) comprise a very systematized approach, with contributions from new service development, interaction design and Service Design, aiming at both understanding the customer experience and designing the service offering. However, this approach is not oriented to the design of services to foster sustainable behaviors. Furthermore, MSD seems to be too dense for smaller projects, highlighting the need to develop more agile methodologies and to adapt MSD methods to the extent of management and design needs.

Aiming at filling the gaps, our contribution to Service Design comprises the adaptation of MSD and the incorporation of other methods to support the design of services for sustainability, seeking to satisfy needs, meet experience requirements and trigger sustainable behaviors. Hence, adopting a customer-centric approach, we consider the adaption and use of MSD (Patrício et al. 2011) as a framework combined with GOA (Mylopoulos, Chung, and Yu 1999) concepts and notation to better explore the CERs in the service concept level. To model the service solution the configuration of a possible customer journey (Evenson 2005; Mager 2009) within the service system is useful for depicting touchpoints or service encounters to be designed. Drilling down to the design at the service encounter level, in SEB diagrams (Patrício, Fisk, and Cunha 2008; Patrício et al. 2011) the integration of Greenprinting (Patrício, Fisk, and Grove 2009) permits to highlight the service ability to foster sustainable practices and the customers' more sustainable practices fostered by the service.

3 Methodology

To achieve the research objectives, the methodological approach was conceived to embrace two main stages of Service Design: (1) the study and understanding of customers and their context and (2) the translation of that information into a new service system and service evidences. To systematize this approach, we resorted to the Analysis-Synthesis Bridge Model (Dubberly, Evenson, and Robinson 2008) (Figure 8) adapted for Service Design, which involves, the understanding of the current customer experience, the modeling of the customer experience, the modeling of the service solution and its prototyping and implementation (Patrício et al. 2011). By using models for framing the object of study, Analysis-Synthesis Bridge Model brings the gap between analysis and synthesis (Dubberly, Evenson, and Robinson 2008).

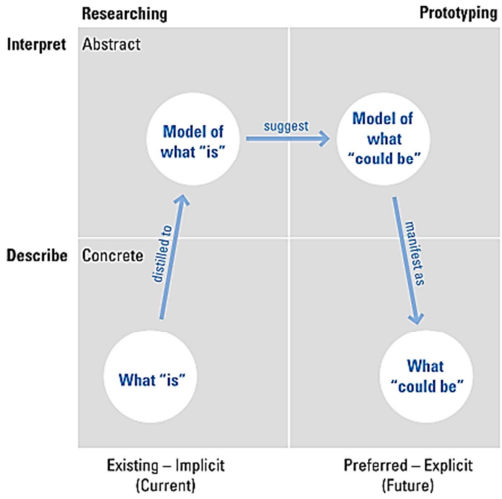

Figure 8 - Analysis-Synthesis Bridge Model (Dubberly, Evenson, and Robinson 2008)

Stage (1) was to understand the current customer experience within home energy consumption – the first phase of Bridge Model. We performed a qualitative study, involving Grounded Theory (GT) Methods and using a Computer-Assisted Qualitative Data Analysis Software to support the analysis. This comprised thirty-one interviews, to understand energy consumption behaviors and explore CERs involved in the overall experience of incorporating sustainable practices within home energy consumption.

Then, in stage (2) we considered the other three phases of Bridge Model, supported by Service Design Methods. We modeled the customer experience, then the service solution and finally prototyped the design solution. For this stage we combined Multilevel Service Design methods (Patrício et al. 2011) with Goal-Oriented analysis concepts and notation (Mylopoulos, Chung, and Yu 1999), Greenprinting (Patrício, Fisk, and Grove 2009) and prototyping.

3.1 Study and understanding of home energy consumption

3.1.1 Qualitative Research and Grounded Theory Methods

"Research begins with curiosity." (Auerbach and Silverstein 2003), and within qualitative research the curiosity is focused on the social milieu. Neuman (2006) affirms

that qualitative researchers look at social life as qualitative matter, adopting different points of view to explain how people construct interpretations and meanings of specific things. Therefore, they borrow ideas from the people they study, seeking for examining attitudes, distinctions, and motifs. Some critics point out that qualitative data is fuzzy and elusive, however, Neuman (2006) argues that this is not necessarily true. Qualitative data can have its own logic and document real events, record what people say, and how they say, observe specific behaviors or even study visual images. Being grounded in the data, qualitative research can be sustained by GT methods, as they provide flexibility and openness for shaping the research question along with the data collection and analysis, as well as encourage constant questioning and comparison.

Neuman (2006) refers to four main characteristics within qualitative design research:

1. Social context is critical, as certain action, answer or meaning is related to that particular social context, thus, research is integrated within a specific culture, set of values, meanings, ways of living life and interpreting experiences.
2. Ability to gather diverse materials, sources of data and articulate them so they make sense in telling the "story" – this ability is called bricolage.
3. Focus on cases, meaning participants, analyzing contingencies in their own setting, and focus on the process, through the depiction of the sequence of events, of what happens first and what follows that.
4. Data are mainly presented in the form of words, descriptions of particular events, hence, it requires the assignment of its significance and coherence, making it understandable and manageable for its analysis and subsequent development of theories.

GT methods have proven to be very suitable for exploring, understanding and learning more about people's experiences and events in their lives, as they allow the openness needed to see data in new ways and explore new ideas (Charmaz 2006), aiming to see through participants eyes. Therefore, grounded theories are constructed by subjects, influenced by the interactions between the people involved in the research process, aiming to study descriptions of the "world" rather than the exact reality. Being flexible, GT is also systematic, providing guidelines for better collect and analyze data (Charmaz 2006).

We can highlight two main principles of GT (Auerbach and Silverstein 2003): (1) questioning, rather than reasoning, as research participants are considered the source of the knowledge, the experts on the phenomenon of study; (2) generating hypotheses through theoretical coding, which allows us to ground our hypotheses in what the research participants say. These methods are focused on collecting data from the individual involved in the phenomenon of study, hence, Charmaz (2006) affirms that it all starts with data, with its collection through observation, interaction with participants, interviews, focus groups, or even the collection of pictures and videos. However, this is not all, as GT requires that the data verify these criteria: quality, credibility, suitability and sufficiency.

Auerbach and Silverstein (2003) suggest that GT allows the researcher to admit that s/he may not know enough to pose a specific question from the very beginning of the

research. Therefore, allows the researcher to gather and analyze data and, then, define the question to direct his research. In fact, GT supports the openness to new uses and perspectives. The basic idea within GT is to choose research participants that have lived through the phenomenon under study, because they are experts on it. Furthermore, in GT there are no variables to operationalize, because the objective is to construct interviews that allow participants to talk about their lives and experiences.

Barney G. Glaser and Anselm L. Strauss were the precursors of GT methods, with their book entitled *The Discovery of Grounded Theory* (1967). Charmaz (2006) affirms that they were advocates of the development of theories from research grounded in data, proposing that the qualitative analysis could be as systematic as quantitative, and able as well to generate theory. They invoked the involvement of the researcher both in data collection and analysis, grounded on the data, rather than on preconceptions and resorting to constant comparison. Furthermore, they considered that sampling should not seek for representativeness, but rather aim at the construction of the theory, therefore, maximizing variability; and they understood that literature review should be conducted after the analysis was done, avoiding preconceived ideas.

In this sense, Glaser and Strauss introduced the term *theoretical sensitivity*, which means the researcher capacity of reflect upon the data collected and depict relevant data (Kelle 2005). They argued that theories would emerge from data, if the researchers approach the empirical field without any preconceived ideas and use their theoretical sensitivity. Still, there was no clear guidance for how to pursue this purpose.

Glaser and Strauss started to follow different directions and later, in 1990, Anselm Strauss and Juliet Corbin wrote *Basics of Qualitative Research*, where they refined the framework of GT methodology, namely by presenting a more liberal position towards literature review, allowing the use of any kind of literature at any moment of the research (Kelle 2005), however advising to avoid a thorough literature review that could inhibit the openness that characterizes GT. This triggered the splitting between Glaser and Strauss, Glaser arguing that allowing that was against the foundations of GT and accusing them of forcing data (Bringer 2006).

Analyzing these outcomes, Kelle (2005) suggests that researchers always have to carry theoretical knowledge, so that they are able "to understand, explain and describe empirically observed phenomena". In fact, the function of reviewing previous literature is to define the focus and more relevant topics to explore (Bringer 2006). Charmaz (2006) adopts a constructivist approach, assuming that neither data nor theories are discovered, but rather that we create grounded theories based on our past and present, through interactions with people, perspectives and research practices. This last perspective was the one followed in this research project. Literature Review was progressively written, during the research, but initially was crucial to create the conceptual background, so that concepts were wisely applied, and to understand the possible methods to address the research goals. Initial reading was the sufficient to understand possible factors implicated in the research focus (Bringer 2006), but we stayed open-minded to what participants exposed.

3.1.2 Data Collection Method

According to Charmaz (2006), gathering data is deeply associated to three main issues: the object of study, the research problem to pursue and the methods available for the collection. GT methods revealed the fit to the problem of studying and understanding the incorporation of sustainable practices within home energy consumption as they corroborate with Service Design focus: the people to whom the service is intended must be "at the heart of the design process" (Løvlie, Downs, and Reason 2008).

Hence, gathering data through GT methods results in rich data, addressing the attitudes, intention, behaviors and experiences of participants. Resorting to quantitative techniques would not provide the needed understanding of people's practices and their inner opinions, neither would offer the openness to new possibilities.

Flexibility within GT allows the researcher to adopt a method and later adapt it to better suit the purpose of the research (Corbin and Strauss 1990; Charmaz 2006). Above all, the important is to stay open to new ideas and topics participants might bring up.

Among the possible methods within GT, we chose semi-structured in-depth interviewing for gathering data. For that purpose, guidelines from Charmaz (2006) and Foddy (1993) where crucial to define the study design as well as perform the interviews. Furthermore, the constant encouragement for the participants to tell more about a certain topic, to express feelings and opinions went along with the search for the identification of activities, routines, experiences and CERs, to sustain Service Design methods.

3.1.3 Sampling Method

To address the purposes of the research, the sample was constituted taking into account an important factor: having installed the PM at home and experienced the interface. We understood that having a group of people who knew and had contact with the device and other group in the opposite situation could leverage variability and subsequent theoretical saturation of categories (Charmaz 2006). The aim was to ensure representativeness and consistency of concepts and categories, and not to generalize findings to a broader population, following GT methodology (Corbin and Strauss 1990).

The twenty-one families with the PM were contacted and one member of each family was invited to participate in the study. Within that group, fifteen family members accepted it. Taking into consideration the geographical position of those families, the other group of participants was gathered from families living in close blocks of flats or single-family houses and who did not have contact with the PM. The sample totaled 31 participants.

Following GT Methods, the sample was not closed before we started the data collection, because, as data were collected, we gained insights that guided the composition of the sample (Charmaz 2006). Hence, its constitution was made along the data collection and concerning insights from interview to interview, as an evolutionary approach (Corbin and Strauss 1990).

3.1.4 Interviewing

The data collection started in the 28th of March and ended at the 12th of April, comprising thirty-one interviews, mainly performed at the houses of the participants and according to their availability. The interview always begun with an introduction to the project, contextualizing the purpose of the research, but avoiding influencing the opinion or reactions of the participants. Then two copies of an informed consent were presented for the participant to read and sign if agreed and then the interview started. All this information is available in Appendix B. Under the consent of the participants each interview was recorded for analysis purposes.

Depending on the participants openness to talk, the interview varied being more structured for the participants who were more timid and reticent to talk, and more unstructured, near to a normal conversation, for those more communicative. To support the interview, probes were defined, so they could guide the data collection.

Firstly, we addressed energy consumption routines, as a warm-up question for the participant to remember aspects of her/his own everyday life. Then we approached the posture and attitudes towards the energy consumption at home, as a mean for retrieving attitudes and drivers for energy consumption behaviors and depicting habitual and reasoned behaviors. The relationship with the energy supplier was the following topic, where we addressed the relationship established and explored energy service issues. The question about a situation of power failure was used to explore valuable information related to attitudes towards energy or the relationship with the energy provider. Then, we introduced the concept of sustainability and environmental sustainability to understand the existing practices, followed by the topic on how could the participant and the whole family be more sustainable at energy consumption. The PM experience was the last question, applied to the participants with the device installed in their houses, and addressed aspects of interaction as well as service-related issues. Every interview ended with questioning if the participant would like to add something else to what was said (Appendix B).

In terms of participants' socio-demographic characteristics, we can summarily say that the overall sample had 68% of female participants, 71% college graduate and 90% employed (Appendix C). There is some unbalance observed in terms of education degree, which may be explained by the more openness towards technology, that is, the PM, as education degree is higher. The average length of interviews was 25 minutes.

Apart from the thirty-one interviews applied to customers, there was one exploratory interview to a member of the direction of the energy supplier at Madeira (Appendix D), that brought more sensitivity to the home energy consumption and related issues.

3.1.5 Coding and Data analysis

To support coding the data and the subsequent analysis, we resorted to NVivo (QSR NVivo), a Computer-Assisted Qualitative Data Analysis Software, that allows enough flexibility for exploring the data and staying grounded to it.

To allow coding and analysis, the interviews were literally transcribed and stored at the software. To support the emergence of categories, initial coding (Charmaz 2006) – or

open coding (Corbin and Strauss 1990) – , was concentrated on three main interviews. That helped the first contact with the data and the coding process itself, as well as, allowed the identification of what kinds of data we would collect next. Once interviews were all coded, focused coding (Charmaz 2006) – or axial coding (Corbin and Strauss 1990) – was the next step, towards strengthening developed categories, making them coherent.

"Qualitative research is research that involves analyzing and interpreting texts and interviews to discover meaningful patterns descriptive of a particular phenomenon."(Auerbach and Silverstein 2003). Hence, once coding was done, the analysis took place, through querying the data using the available resources of NVivo, whose results are presented in section 4.

3.2 Service Design Methods

Bearing in mind the Analysis-Synthesis Bridge Model approach, and after the qualitative study has provided the needed understanding on the current customer experience within home energy consumption, we resorted to Multilevel Service Design (MSD) methods (Patrício et al. 2011), revised in section 2.2, to support the design of the service enabled by the PM.

The modeling of customer experience was achieved through the design of Value Constellation Experience (VCE) and Customer Value Constellation (CVC), comprising the service concept definition. VCE allowed the mapping of the main activities involved in the experience of incorporating sustainable practices in home energy consumption, while CVC sustained the understanding of the set of entities and services involved around that experience. For better supporting the service concept definition, we embedded the CERs in the VCE through GOA concepts and notation (Mylopoulos, Chung, and Yu 1999). That enabled the link between the more abstract level of the service concept definition with the more concrete level of service encounters, as well as permitted the reconfiguration of CVC.

To model the service solution, the understanding of customer experience pemitted the configuration of a possible customer journey (Evenson 2005; Mager 2009) within the service system for depicting touchpoints or service encounters to be designed. For their design we used Service Experience Blueprint diagrams (Patrício, Fisk, and Cunha 2008; Patrício et al. 2011), in which we embedded Greenprinting (Patrício, Fisk, and Grove 2009) to highlight the service ability to foster sustainable practices and the customers' more sustainable practices fostered by the service.

Finally, and to tangibilize the design solution, we conceived a low-fidelity prototype of the service concept, incorporating the identified CERs and translating the concept into service evidences. This follows what Samalionis (2007) refers as evidencing, which involves mapping assumptions about the future service, in a king of "archaeology of the future", which enables making qualitative judgments about the implications of design. This kind of service evidences may comprise physical evidences of the SEB diagrams, as they tangibilize the service experience to offer at each touchpoint.

The results of this methodological approach are exposed in section 5.

4 Understanding Home Energy Consumption

Regarding the first phase of the methodological approach, this section explores the main findings obtained through interviews' content coding and analysis. The purpose is to gather as much information as possible to sustain the elicitation of CERs that can guide the subsequent design of the service. Semi-structured interviewing revealed to be adequate as it enabled the gathering of rich data as Charmaz (2006) describes it. We believe that having two distinct groups of participants, in terms of contact with the PM, had positive effects on the richness of data gathered, nurturing variability.

Firstly, we introduce the categories and how they were organized for analysis purposes. Then, we attempt to present the various categories in a narrative manner. We begin by exploring the topic of energy daily consumption, then we present the energy supplier side and the relationship established; further we address energy consumption control, then current sustainable practices; moreover, we report the experience fifteen participants had with the PM and provide some insights of suggestions and desired improvements captured. Finally, as a wrap-up of the whole section, CERs and related to goals are elicited, so that information can be used to effectively design the service.

4.1 Organization in categories

Staying faithful to the fundamentals of Grounded Theory meant defining the categories grounded on the data. Therefore, their existence is related to references of participants and resulted of constant coherence analysis. Creating categories, followed by transcription, was the deepest contact with data and revealed to be very complex and required discipline. The process started with the coding of three interviews that seemed richer, so that the categories could be shaped. Each three interviews, categories were analyzed in terms of coherence and reshaped if necessary.

Because data were too dense and related to a few themes, there was the need to gather categories in groups, so that they could be better organized, and also identify sub-categories to address specificities of the major category (Appendix E).

4.2 Energy daily consumption

When asked about daily routines that were implicated in energy consumption, participants frequently referred to certain activities, such as preparing meals or cleaning, and to appliances that allowed the performance of those activities (Appendix F). In fact, this highlights the peculiar case of energy supply service, as the satisfaction towards it is very much related to the daily use of energy and the success in indirectly consuming it through appliances, lights or other electrical dependable engines (Fischer 2008). These are artifacts, physical entities that play an important role in the service provision (Constantine 2008), that is, through which the service of energy supply is provided and are crucial for home energy consumption. Furthermore, these characteristics contribute to the invisibility of energy consumption or the lack of awareness (Fischer 2008; Pierce and Paulos 2010). This invisibility was actually an attitude referred by four participants (Appendix G), justifying the difficulty in managing consumption.

"We all have vices.[…] I turn this on and I don't see."

Male, 59 years old, without Power Meter, Attitude towards his family energy consumption

It was interesting to address the participants posture and attitudes towards their own consumption (Appendix G), as many assumed they were aware, and paid attention to their energy consumption. It was also frequent referring trying to moderate consumption, avoiding unnecessary use or justifying that their consumption is necessity-pushed.

"When it is needed, then we use it"

Female, 35 years old, with Power Meter, Posture towards energy consumption

Educating their own children so that they would replicate certain practices was commonly referred, along with stating the impact that children seem to have on home energy consumption expenditure.

"…having an eight-year-old son, it turns to be very difficult, because for him, all has to be turned on…"

Female, 41 years old, without Power Meter, Children Impact on Consumption

Within the sample fourteen families resort to the services of a housekeeper, mainly one day a week. This fact led to understand that home energy consumption is not only related to activities of the family members and that a third person, responsible for certain activities that are energy demanding, ends up playing an important role on the overall expenditure and we think it should be another factor to consider when, for instance, the person is opting for an energy service.

"Having a person at home during the day, I think it is influent, because she vacuums, she irons and, eventually, uses the washing machine. And those are appliances that I think they have a lot of influence in the energy bill."

Male, 38 years old, with Power Meter, Housekeeper influence on energy consumption

4.3 The Energy Supplier

Along with the various interviews applied to customers, there was the interest to interview someone that could represent the energy supplier operating in Madeira.

With this interview we were introduced to the particularities of energy service. Hence, at Madeira, there is one monopolist energy supplier and there are certified entities that function as intermediates to establish the connection between the house and the supplier. The customer may opt between different energy voltages and choose the tariff that best suit energy needs. Once the contract is established the means of contact between the enterprise and the customer are the monthly invoices and leaflets (on current campaigns and with advice) sent through letter, the website, the physical stores and a call center. The customer can choose to read the meter and contact the enterprise within a certain period, but if s/he opts not to do it the enterprise estimates the consumption. Every three months a technician from the enterprise reads the house meter so that any necessary adjustments are made – and, this happens either the customer reads or does not read the meter.

4.3.1 Relationship with the energy supplier

The interesting side of interviewing people is that we capture emotions and subtle gestures or forms of expressing opinions that are sometimes more revealing than words. In what concerns to how participants described their current relationship (Table 1) with the energy supplier, it was quite frequent the reference to its distance and to the mere relationship where the client is provided with the service, receives the invoice and makes the payment. Some even referred there was no relationship.

"They provide the service and I pay. It is basically that."

Male, 37 years old, with Power Meter, Current Relationship with the Energy Supplier

Lack of contact or willingness to offer alternatives was associated to the existing monopoly.

"They have never called me…I think it is related to not having any competition."

Female, 30 years old, without Power Meter, Energy Supplier Approach to customers

Table 1 - Coding Tree for the Current Relationship Category

Current Relationship	Sources	%
Distant	15	48%
Service-Invoice-Payment	13	42%
No problems	6	19%
We don't have a relationship	6	19%
Impersonal	5	16%
Reference to the Monopoly	5	16%
Quick Solver	3	10%
Client-pushed	2	6%
Through Relative	1	3%
Close	1	3%
Emotional link	1	3%
Hard to get information	1	3%
Provides the information I need	1	3%
Total	**31**	**100%**

Besides the distant relationship, some participants referred to the inexistence of energy-supply related problems and those who had problems, highlighted the agility of the supplier in supporting them.

"…within half an hour they intervened, it was at a Friday night, so…I was satisfied with the service"

Male, 37 years old, without Power Meter, Energy Supplier Performance

Moreover, many participants expressed the desired relationship they would like to have, being clear the willingness for more proactivity (Table 2), followed by advice on how to reduce consumption.

"They should analyze and should see where I could reduce…they could say «look, it is here where you are failing»"

Male, 48 years old, without Power Meter, Desired Relationship with the Energy Supplier

To understand the interactions between the enterprise and the client, we captured every mean of contact the participants referred (Appendix H), the most relevant being the invoice, followed by the leaflets. A few affirmed to read the meter, and only five people referred to have used the site. The participants revealed reduced direct contact with the enterprise.

Table 2 - Coding Tree for the Desired Relationship Category

Desired Relationship	Sources	%
Proactive approach	10	32%
Advice to reduce consumption	5	16%
Add info to invoice	2	6%
More information	2	6%
Call clients	1	3%
Easier to reach	1	3%
Electronic Invoice	1	3%
Emails	1	3%
More campaigns to increase conservation	1	3%
Total	**16**	**52%**

Being the invoice the most referred mean of contact, some problems were raised related to its interpretation or the understanding of certain items, that are not clear, or statistics that are difficult to interpret, which then leads to only focusing on the price to pay.

"I think it is not explained very well. Generally, I look at the total and do not look at the rest"

Female, 35 years old, without Power Meter, Invoice interpretation difficulties

The payment method, being through bank transfer, direct debit or at physical stores, has consequences on how the individual perceives her/his household consumption. Some affirmed that did not chose direct debit for the sake of being aware of how much they are spending and to better manage their expenditure. Others, among the 48% of those who choose direct debit, confessed that many times did not pay attention to the invoice. Only four participants mentioned going to the physical stores for payment purposes.

4.3.2 Fostering sustainable practices

For sustainability matters, our interviewee in the enterprise referred the campaigns for the adoption of economic bulbs, as well as *bi-horária* tariff, which stipulates two different prices per kilowatt, so that the customer is encouraged to use energy more intensively off-peak hours, when the price is lower.

In what concerns to the campaigns, slightly half of the participants acknowledge its existence, mainly through leaflets, but only four of them adhered. The others who didn't, some already had, while others justified that the bulbs offered were not compatible with their installation.

Within the sample of thirty-one customers, twelve affirmed to have chosen the *bi-horária* tariff and there were three participants that were not sure if they had it or not (Appendix I). Furthermore, it was clear that the acknowledgement of the service existence was mainly related to customers curiosity or advices from friends and family that already knew or had subscribed the service.

"It was through a relative who lives in Lisbon, that told me he had that tariff and that probably I could find it here."

Female, 41, with Power Meter, How have acknowledged *bi-horária* tariff

Some concerns were highlighted such as knowing how much would be saved or the preference for a different timetable. Those who referred that did not have the off-peak service justified their choice by the presence of the housekeeper during the day or by

concerns of bothering neighbors. The timetable was another issue, as some did not know it or had the wrong information.

In what concerns to influencing consumption patterns and behaviors (Appendix J), 61% of the participants considered that the energy supplier had no influence on their consumption behaviors. Two participants explained the lack of proactivity by the fact that the enterprise would lose if it helped the customers embracing other consumption patterns. The 32% that admits some influence, suggested that it was mainly through the leaflets and advice.

"Sincerely, I think they don't [have any influence]. I think they would lose if every consumer was aware and consumed each time less…"

Female, 26 years old, without Power Meter, Energy Supplier influence on consumption

4.4 Energy Consumption Control

When asked about how they manage to control their consumption, the most frequent reference was to the invoice (Table 3), as it is the primary source of energy-related information to the consumer, mainly for noticing the monthly variability on consumption. A few participants referred to be able to understand certain periods where the consumption is higher as they relate it to the use of a specific appliance or to a certain season.

"...in the winter, because we had a harsh winter, we used the heater…the heater leaded to oscillations in the invoice…"

Female, 37 years old, without Power Meter, Control through invoice

Table 3 - Coding Tree for the Energy Consumption Control Category

Energy Consumption Control	Sources	%
Invoice	**26**	**84%**
Variability on consumption	10	32%
Comparing own Invoices	7	23%
Understand peaks of consumption	6	19%
Price focus	5	16%
Average of consumption	4	13%
Statistics displayed	1	3%
Power Meter	**15**	**48%**
Periods of (greater) consumption	11	35%
Appliance consumption	5	16%
Suggestions displayed	4	13%
Monetary Expenditure	2	6%
Abnormal consumption	1	3%
Compare with others	**8**	**26%**
Clamp connected to energy meter	**1**	**3%**
Energy Meter	**1**	**3%**
Thermostat Display	**1**	**3%**
Total	**31**	**100%**

Even if the PM does not provide information per appliance, some participants revealed being able to detect peaks of consumption when using certain devices. Some even turned on the appliances to see the feedback on the PM.

"For example, if we turn everything off, we know that the fridge's energy consumption is low. That is it, we confirmed there [Power Meter]"

Female, 35 years old, with Power Meter, Control through Power Meter

Furthermore, comparing with others seems to be a way of knowing the family's performance, if it is spend too much or is within the average.

"I notice, talking with my brothers in law and even with my mother and my father, that they spend almost the same energy as us…"

Female, 39 years old, with Power Meter, Control by comparing with others

The participants that mentioned the energy meter, the clamp or the thermostat display revealed an attention towards energy consumption above the observed in the sample.

4.5 Sustainable practices in everyday energy use

Everyday energy consumption and control seem to lead the participants to adopt certain sustainable practices (Appendix K), being the most frequent the use of economic bulbs or the acquisition of efficient appliances. The group of participants with *bi-horária* tariff also demonstrated to commit to certain routines and adapt their chores so that they could take advantage of the service.

"Having I opted for this tariff, I have to take the most of it, right?"

Female, 45 years old, with Power Meter, Commitment to *bi-horária* tariff

"For me it is indifferent. It is a matter of habit."

Female, 30 years old, with Power Meter, Chores changed due to *bi-horária* tariff

Six participants mentioned they have specific devices to switch off several appliances. The presence of lights as directly associated to energy saving was quite common – the use economic bulbs, turn off lights, use natural light as possible. Furthermore, participants also referred they avoided using certain appliances, like the oven or the dishwasher (Appendix L).

Among many reasons to conserve energy (Table 4), saving money was the most mentioned, followed by the information available that advises on what one can do to save. Environmental concerns and sensitivity to energy waste marked their presence, as did the reference to the sum of little acts to foster change.

"…we had not always had environmental concerns, rather we focused on the monthly bill"

Male, 27 years old, with Power Meter, Drivers for Sustainable Practices – Save Money

"I read an article…where they talked about excessive consumption of stand-by. At the time I had no idea that stand-by implied such an excessive consumption and so I applied that switch"

Male, 37 years old, with Power Meter, Drivers for Sustainable Practices – Information Available

However, as participants talked about the incorporation of sustainable practices within their everyday life and daily energy consumption, they also demonstrated certain attitudes, being clear the strength of implemented habits and routines, which inhibit the adoption of more sustainable practices. Furthermore, some stated that it was difficult to do better than they already did, and did not know how they could improve, as their consumption was the strictly necessary.

"I see my daily behaviors, during the week and in the weekend and I cannot see where I could save more electricity. I cannot see where I could do it"

Female, 31 years old, with Power Meter, Attitude towards incorporating sustainable energy practices

The incapacity of seeing the results of changes on behaviors or on appliances was pointed as critical and revealed a certain discouragement towards keeping the change.

"I think we consume very little, we follow every recommendation and we try to reduce everything possible, but we feel we are paying more!"

Male, 59 years old, without Power Meter, Attitude towards incorporating sustainable energy practices

Table 4 - Coding Tree for the Drivers for and Attitudes towards Sustainable Practices Categories

Categories	Sources	%
Drivers for Sustainable Practices	**31**	**100%**
Save Money	26	84%
Information Available	11	35%
The sum of little acts	9	29%
Environmental Concerns	8	26%
Sensitive to Energy Waste	8	26%
Increased Awareness	5	16%
Professional Career	5	16%
Family legacy	4	13%
Education	2	6%
Save resources	2	6%
Sensitive to sustainability concerns	2	6%
Social Consciousness	2	6%
Personal Satisfaction	2	6%
Attitudes towards sustainable practices	**30**	**97%**
Habits and routines are strong	12	39%
It is difficult to do better	10	32%
I don't see the reflection of changes	8	26%
Comfort comes first	5	16%
I don't have enough information	4	13%
Commitment to reach something	3	10%
I know things I could do	3	10%
Importance of Rules and Incentives	3	10%
Saving is not my priority	2	6%
Deal with greater consumptions first	1	3%
Policies are needed	1	3%

4.6 Power Meter Experience

Fifteen of the participants had contact with the PM, and at the time of the interview, they already had the device for at least six months. To understand their type of usage, we captured the frequency of interaction within the Type of User category (Table 5). This category characterizes the PM user according to the frequency of interaction with the device. The most common was to mention the occasional interaction, meaning not daily, but some days in the week. However, there were other participants who referred they rarely interacted with the PM, mentioning the lack of interactivity and dynamic in terms of information and arguing that the fact that the netbook was closed presented some issues.

The most frequent mentioned type of interaction with the device was visual (Table 5), and a few revealed they used to turn appliances on and off so that they could visualize the feedback on the PM and understand the impact of those appliances on consumption.

"I turn on and off and see the fluctuation."

Female, 45 years old, with Power Meter, Interaction with the device

Table 5 - Coding Tree of Type for the User and User Interaction Categories

Categories	Sources	%
Type of User	**15**	**100%**
Occasionally	7	47%
Frequent	5	33%
Rarely	3	20%
User Interaction	**15**	**100%**
Visualize	13	87%
Turning on and off	4	27%
Afraid of exploring the technology	3	20%
Through 3rd person	2	13%
Total PM users	**15**	**100%**

In fact, nine of the users associated their perceptions in terms of most demanding appliances to be based on the information provided by the PM. Furthermore, some revealed that they were afraid of exploring the device and/or that they used the device through a member of the family, not directly (Table 5).

Table 6 - Coding Tree for the Impact on Consumption Category

Impact on Consumption	Sources	%
Yes	**12**	**80%**
How		
Increasing awareness	7	47%
Acknowledge appliances Consumption	3	20%
Know the real consumption	3	20%
Reduction reflected in the invoice	3	20%
Better management of expenditure	2	13%
Change consumption pattern	2	13%
Avoid wasting energy	2	13%
Awareness of Stand-by Consumption	1	7%
Avoid using certain device	1	7%
Substitute Appliance	1	7%
Support Investment Decisions	1	7%
Through 3rd person	1	7%
Initially	**2**	**13%**
Requires more interaction	1	7%
Less than expected	**2**	**13%**
No	**3**	**20%**
Only to realize what we already knew	2	13%
Routines already formed	2	13%
Total PM users	**15**	**100%**

80% of the participants considered the PM had impact on consumption (Table 6), mainly explained by the increased awareness related to the information available through the device. However, others referred there was an initial impact, associated to the curiosity, and revealed the need for more interactivity, as curiosity fades away.

"…in the beginning I used to notice what was there [Power Meter]…But not now. …there is no interest… if only it had more interaction…"

Male, 39 years old, with Power Meter, Impact on consumption behaviors

Three participants mentioned no influence, due to the strength of routines and/or because it was only to realize what they already knew, presenting no other valuable impact.

"It was a way to visualize what I already knew, to see the oscillations in a graphic."

Male, 38 years old, with Power Meter, Impact on consumption behaviors

For instance, it was curious to notice that participants without the PM referred siglightly more sustainable practices that the ones with the device (Appendix M) – a difference of six more references. That may suggest that the referred sustainable practices are published and shared, independently of the device's presence.

Ulwick (2002) considers that customers have a "limited frame of reference", corroborating with the Leonard and Rayport (1997) idea that asking customers for improvements will lead mainly to incremental and not disruptive innovation. In fact, this was interest to notice along the interviews, as we confirmed it. Nevertheless, we understood it was important to register the proposed suggestions on the device (Table 7), as they revealed wishes from the participants' perspective. However, as the interview was conducted, people talked about other needs, desires and actual behaviors that could sustain the design of the service, which were then combined.

Table 7 - Coding Tree for the Suggested Improvements Category

Suggested Improvements	Sources	%
Consumption per Appliance	6	40%
Customized Suggestions	3	20%
Consumption per Room	2	13%
Compare different periods	1	7%
Consumption per Activity	1	7%
How much each member consumes	1	7%
How to reduce consumption	1	7%
LCD instead of notebook	1	7%
Search for past information	1	7%
Summary Reports	1	7%
Total expenditure equal to invoice	1	7%
Warnings	1	7%
Total PM users	**11**	**73%**

Some interest was shown towards the existence of customized suggestions, involving the analysis of their own consumption behaviors and the retrieve of results and advice.

"I prefer results, like, show me the report and as quick as possible of what is going on."

Female, 30 years old, with Power Meter, Suggestion – Summary Reports

Table 8 - Coding Tree for Energy Supplier and Power Meter Category

Energy Supplier and Power Meter	Sources	%
Offer the device	4	27%
Communication	2	13%
For EEM to retrieve data	2	13%
Suggestions	2	13%
Allow comparison with standard	1	7%
Identify energy waste	1	7%
On the Internet linked to customer ID	1	7%
Past info about consumption	1	7%
To control consumption	1	7%
Warnings	1	7%
Total PM Users	**11**	**100%**

Considering participants' opinion on how the link between the PM and the Energy Supplier could be (Table 8), there were mentioned the use of the device for energy supplier communication purposes or to connect to the customer ID in the energy

supplier's website. Moreover, there was the reference to warnings about payment to be processed or on the more intensive use of *bi-horária* tariff.

4.7 Customer Experience Requirements

To represent CERs of the overall experience of incorporating sustainable practices in home energy consumption, we aggregated all the information related to: the energy supplier (desired relationship, invoice interpretation and adjustments), suggested improvements on the PM, participants' opinion on how the link between the PM and the Energy Supplier could be, behaviors already performed to control consumption, or that are indirectly performed through the PM, and the needs expressed (Table 1; Table 2; Table 3; Table 4; Table 5; Table 6; Table 7; Table 8; Table 9).

Considering the aggregation of needs in Table 9, it is clear the incidence on advice on how to reduce consumption.

"I don't have concrete data to tell me «Look, at that month, your electricity bill rose because you had that behavior»"

Female, 50 years old, without Power Meter, Need

Furthermore, participants referred they would like more advice and information on energy supplier services and tariffs or even that they would like to be warned, for instance, that consumption overpassed a certain limit. Among those who have the PM, two mentioned they would like more contact and support.

"…there is no information system there that alerts us «there is an excessive energy consumption at the televisions area»"

Male, 36 years old, without Power Meter, Be Warned

Table 9 - Coding Tree for the Needs Category

Needs	Sources	%
Advice on how to reduce consumption	18	58%
More info about own consumption	7	23%
Advice on EEM alternative tariffs and services	6	19%
Know consumption per appliance	6	19%
Be warned	4	13%
Compare with a standard	3	10%
Make comparisons present vs. past	3	10%
Advice and Support on PM use	2	6%
Know consumption per room	2	6%
Know daily consumption	2	6%
Periodic contact	2	6%
Allow comparison with invoice	1	3%
Clarify common sense ideas	1	3%
Energy consumption information online	1	3%
Interactivity	1	3%
Know consequences of changes	1	3%
More info about the project	1	3%
Penalize the waste	1	3%
Share my experience with others	1	3%
Total	**25**	**81%**

In fact, because we are designing the service from scratch, the process was quite difficult, as there were no specific requirements related to activities of an existing service. Therefore, the task was to catch every experience, need, desired improvement or behavior already performed that could be supported by the service. Then, the

identification and distinction between functional and non-functional requirements took place and they were orchestrated in higher-level categories of CERs. The coding tree in Table 10 helps understanding the most referred requirements, being functional (goals) or non-functional (CERs), that we subsequently used to design the service.

Table 10 - Coding Tree for the Customer Experience Requirements and related goals

CERs and related goals	Sources	%	CERs and related goals	Sources	%
1. Informative	31	100%	**2. Educational**	27	87%
Energy consumption information	27	87%	How to reduce consumption	18	58%
Consumption per appliance	15	48%	Advice through invoice	8	26%
Consumption in a given period	13	42%	Increase awareness	7	23%
Consumption per room	4	13%	Incentives to increase energy conservation	1	3%
Past information	2	6%	Clarify common sense ideas	1	3%
Consumption per activity	1	3%			
Consumption per member	1	3%			
Invoice	26	84%			
Variability on consumption	10	32%			
Compare own invoices	7	23%			
Understand peaks of consumption	6	19%			
Price focus	5	16%			
Average consumption	4	13%			
Statistics	1	3%			
Energy Supplier services and tariffs	17	55%			
3. Interactive	26	84%	**4. Supportive**	25	81%
Comparisons	22	71%	Accessible	16	52%
Different periods	9	29%	Provide information on Energy Supplier services and tariffs	18	58%
With others	8	26%	Support and advice on PM use	3	10%
Own invoices	7	23%	Periodic Contact for PM user	2	6%
Present vs. past	3	10%	Transparent	12	39%
With the standard	3	10%	Help with invoice interpretation	7	23%
System and invoice	2	6%	Explain items in invoice	2	6%
Energy consumption information online	7	23%	Explain statistics displayed	2	6%
Linked to customer ID on energy supplier website	1	3%	Explain Energy Supplier Adjustments	5	16%
Communication	5	16%	Ensure matching between system and invoice	2	6%
Electronic Invoice	3	10%			
Emails	2	6%			
Rules, Incentives and Penalties	3	10%			
Share my experience with others	1	3%			
5. Proactive	17	55%	**6. Results-oriented**	16	52%
Present alternative Energy Supplier services and tariffs	6	19%	Expose consequences of changes	11	35%
Customized suggestions	5	16%	Management of consumption	6	19%
Warnings	5	16%	Identify energy waste	2	6%
On energy waste	1	3%	Support change on consumption pattern	2	6%
By email	1	3%	Support choosing alternative appliance	1	3%
On tariff usage	1	3%	Support investment decisions	1	3%
On payment to be processed	1	3%	Support substitution of appliance	1	3%
Consumption analysis proving statistics	2	6%	Summary reports	1	3%
Phone call contact	1	3%			
7. Technology-related	4	13%			
Fixation safety	2	6%			
Visual (screen)	2	6%			
System's speed	1	3%			
Total	31	100%	**Total**	31	100%

CERs represent the ultimate goal of creating value to the customer providing a pleasant service experience. Following Berry, Carbone, and Haeckel (2002) they may be translated in the form of clues or specificities of the service. For delivering a satisfactory experience, the service must take into account not only the circumstances within the service itself, but the experiences and practices of the customer in his/her everyday life, on a more systemic way following MSD methods (Patrício et al. 2011).

These CERs, as non-functional requirements, are associated to expressed desires, needs, and experiences towards the energy service, the PM and the experience of managing energy and incorporating sustainable practices.

Informative is both related to most all participants' desire for detailed energy consumption information (per appliance, period, room, activity, member), and to the need of enabling the link with the energy supplier – providing more information on invoices and their contents or on services and tariffs, as a way of nurturing a more close link with the enterprise.

Educational, also very frequent, is associated to some participants' expressed willingness of receiving advice on how to reduce consumption, as some assume they don't know what they could do to improve. Here is also the presence of the energy supplier through the importance given to the advice through invoices or in what concerns to incentives given to reduce or change habits. Furthermore, there is a reference to the need to clarify common sense ideas.

Interactive, refers to the willingness for more interaction with the PM, allowing the user to make comparisons – for instance, between different periods or even with other families, or with a standard family with similar characteristics – and sharing experience with others, so that curiosity for the devise does not fade away; and with the energy supplier, providing the information online linked with the client area in the enterprise website or permitting the contact with the supplier.

Supportive is firstly and foremost related to relationship participants referred they had or they would like to have with the energy supplier, thus, it comprises their willingness for a more close connection and contact (accessibility) as well as more information provided on adjustments and invoices (transparency). Then, in what concerns to the PM experience, more support and advice were mentioned as desirable (accessibility), and transparency in terms of ensuring the match between the device and energy supplier contents.

Proactive involves the relationship participants desired they had with the energy supplier and also works with expectations built around the PM functionalities. Therefore, it includes warnings, customized suggestions or presentation of alternative services or tariffs that are proposed by the system without the interference of the participant.

Results-oriented is the CER that involves some participants reference to the importance of knowing the results of certain practices or their willingness for more direct ways of knowing what can be done or how is their performance. It also comprises the individual initiative to analyze, explore and support decisions or even the provision of summary reports that do not require any further analysis effort from the individual.

Finally, technology-related CER, resulting from participants opinions on the device and the system performance, is not directly related with the service experience, but influences it indirectly through interaction. For that, it was not included in the association of the CERs with the Value Constellation Experience.

5 Designing the Service

Based on the MSD general model (section 2.2.2, Figure 7) developed by Patrício et al. (2011), we took into account its flexibility and adapted it for the purposes of the research. Firstly, for the service concept definition, we used both the VCE and the CVC concepts. Nonetheless, to be able to incorporate the identified CERs we resorted to GOA concepts and notation so that we could associate each CER to the activities on the overall experience, as an attempt to make the more abstract level of service concept communicate with the service encounter design basis. Then, once defined the service concept and reconfigured the CVC, we configured a possible customer journey to support the drilling down to the level of service encounters and used SEB diagrams to design the interaction between the customer and the PM services, considering Greenprinting (Patrício, Fisk, and Grove 2009) as a method to support the design of the service capable of fostering sustainable practices. Within MSD methods, we did not explored the design of the service system, in terms of Service System Architecture and Navigation, as it seemed unnecessary for approaching the problem. However, the design of a possible customer journey within the service system allowed the representation of the touchpoints or service encounters.

The design of the service took into account the following issues:

- the desired transition from a very embryonic service concept to a developed one that would take into account the identified CERs and related goals;
- the ultimate goal of designing a technology-enabled service, so that the PM plays an important role as an enabler of the service;
- Service Design methods adapted and orchestrated to support the design of a technology-enabled service with the capacity of fostering sustainable behaviors.

5.1 Towards the service concept definition

Considering the overall experience of *incorporating sustainable practices in home energy consumption*, the analysis and resultant findings of the interviews allowed the identification of the main activities within the VCE (Figure 9), starting with the daily use of energy, followed by consumption control, then to the adoption of certain measures so that the consumption is more sustainable and ending with the feedback from the changes adopted.

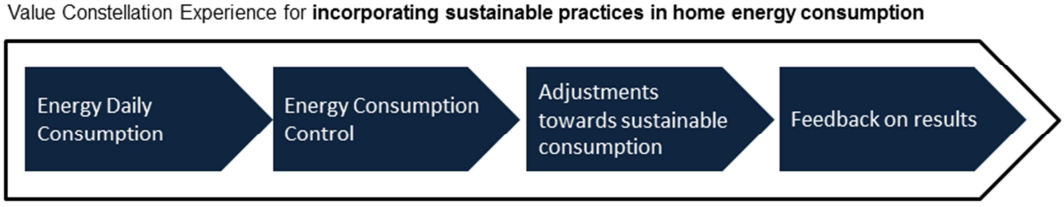

Figure 9 - VCE for incorporating sustainable practices in home energy consumption

To understand the context within the experience exists, we mapped the CVC for the experience, considering the existing and embryonic service concept (Figure 10).

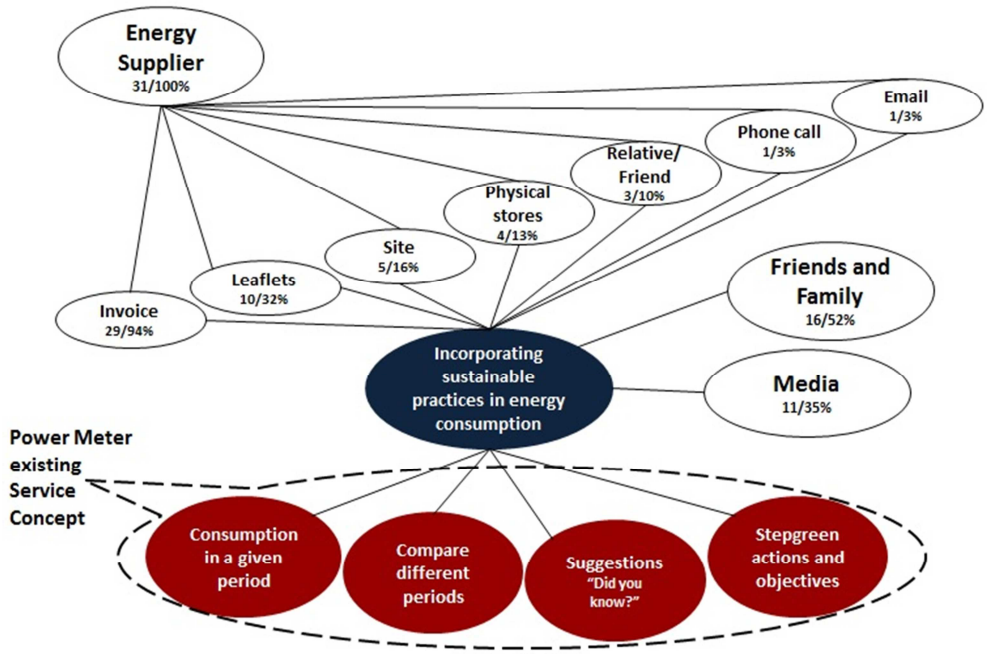

Figure 10 - Existing Service Concept positioning in the CVC for incorporating sustainable practices in home energy consumption

As Figure 10 shows, currently, neither of the entities, namely the energy supplier, friends and family and media, that play a role in the overall experience of incorporating sustainable practices in home energy consumption are linked to the existing service concept. Furthermore, the current services provided by the PM are not interconnected.

Being the ultimate goal to provide a satisfactory overall experience supported by services provided by the PM, we resorted to GOA concepts and notation (Figure 11) to associate CERs to the main activities within VCE. This was the approach we understood to be suitable for establishing the connection between the more abstract level of service concept and the design at the customer journey in the service system and service encounter levels. This approach guided the subsequent redefinition of the current CVC, considering every need, suggestion, wish, or already performed behavior that could be supported by the PM (Figure 12, Figure 13, Figure 14, Figure 15).

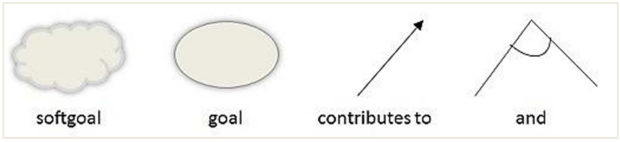

Figure 11 - GOA concepts and notation

Considering the CERs and related goals previously identified (section 4.7, Table 10) and having defined the main activities included in the VCE, then we associated each activity or group of activities with the CERs.

To support everyday consumption and its control (Figure 12), the experience should be both educational and informative, so that the increased awareness, the advices and consumption information available help making right choices. Also, the communication with the energy supplier shall be leveraged by the availability of the invoice in the system, allowing the control activity through analysis functionalities.

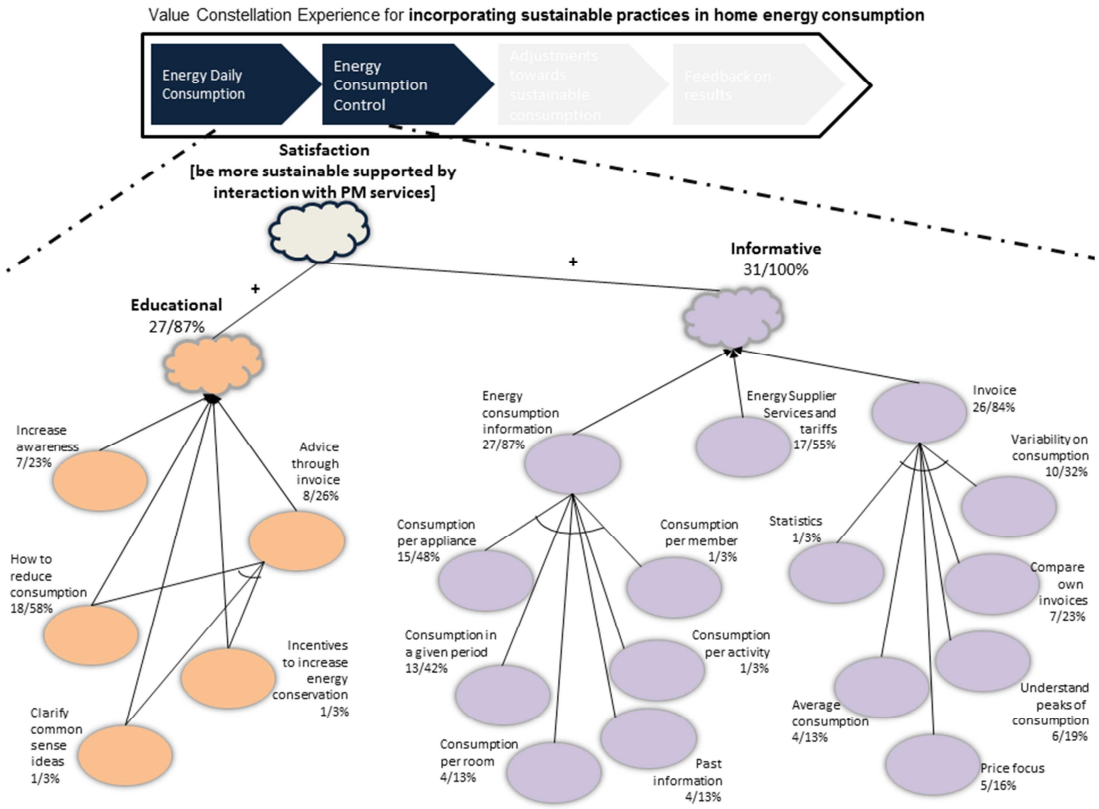

Figure 12 - CERs and goals associated to Energy Daily Consumption and Energy Consumption Control

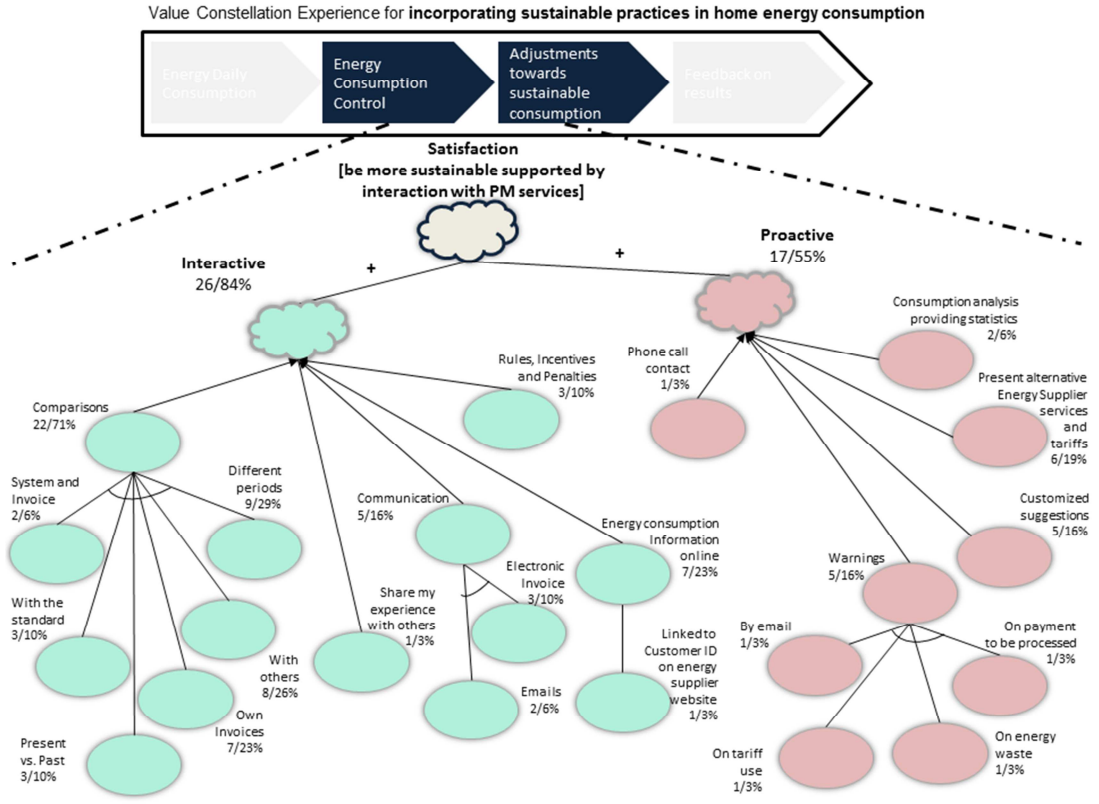

Figure 13 - CERs and goals associated to Energy Consumption Control and Adjustments towards sustainable consumption

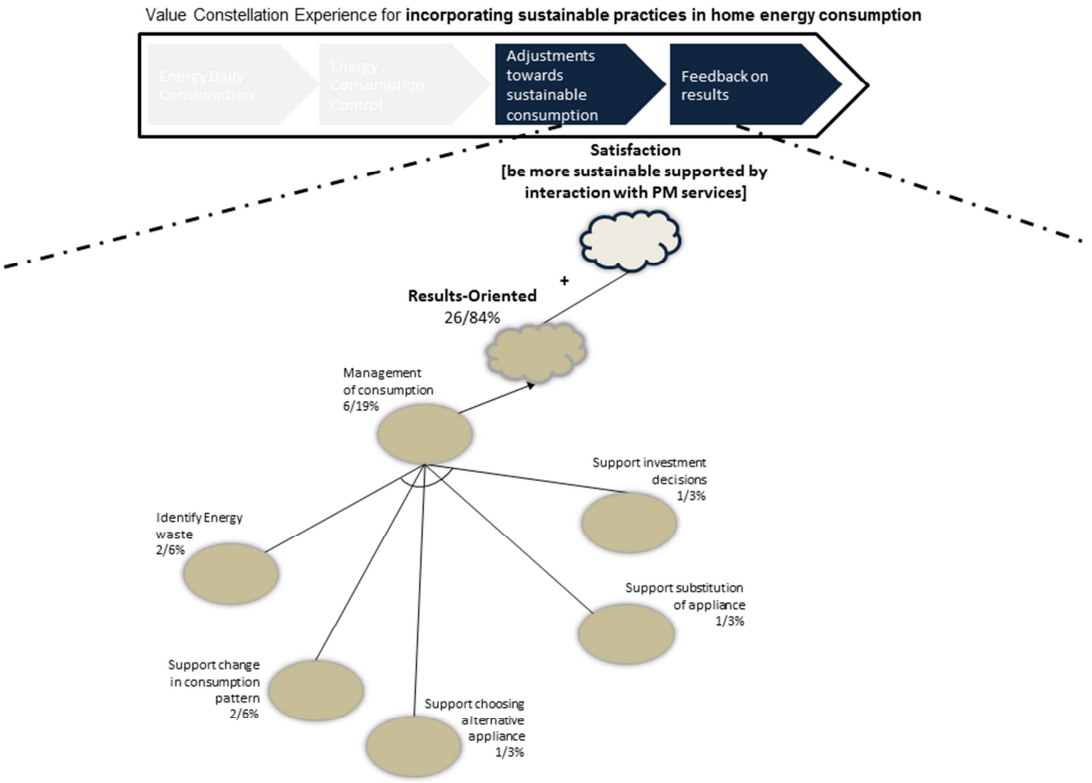

Figure 14 - CER and goals associated to Adjustments towards sustainable consumption and Feedback on Results

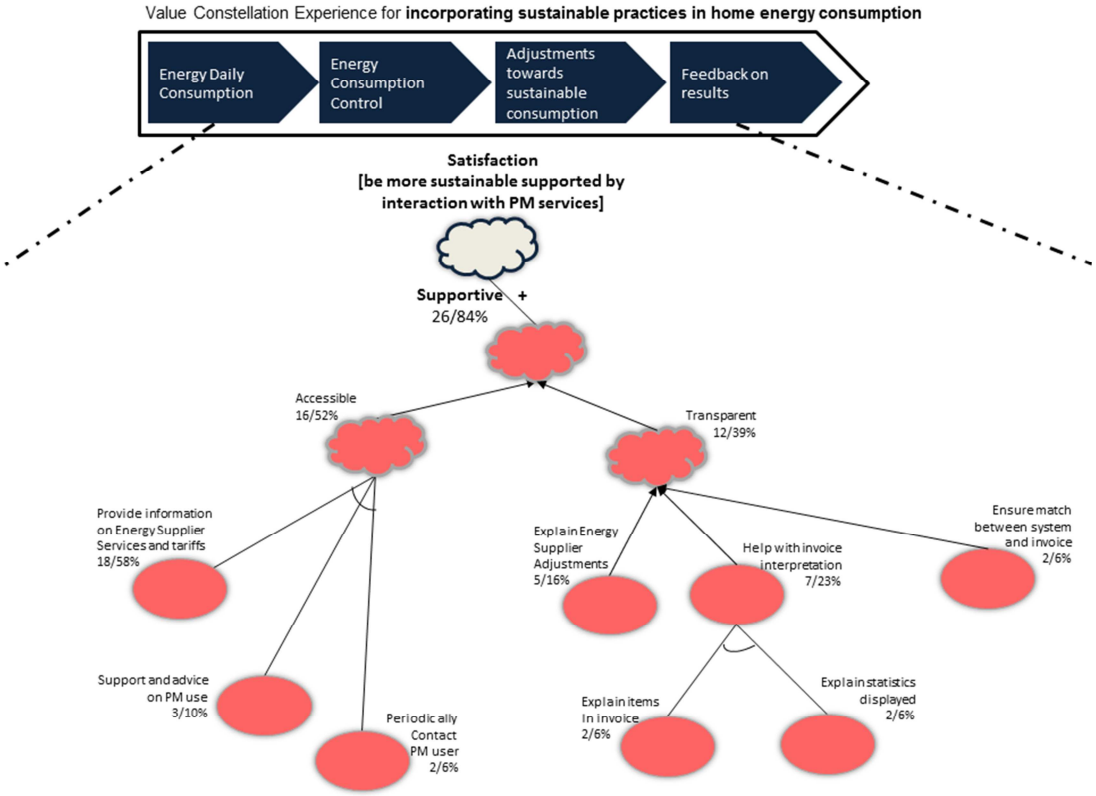

Figure 15 - CER and goals associated to all the activities in the VCE

Considering activities of control and adjustments towards sustainable practices (Figure 13), both interactivity and proactivity are highlighted: interactivity is important for letting the customer actively use the system to support the analysis of own consumption or even to bridge the communication with the energy supplier, whereas proactivity may be in the form of warnings, periodic analysis or presentation of alternative energy services to better suit the consumption patterns.

Bearing in mind the activities of adjustments followed by feedback on results (Figure 14), the results-oriented CER answers the need for a concrete knowledge about the consequences of sustainable practices, therefore, supporting investment analysis, the choice for another appliance or even the change on the consumption pattern.

Finally, and comprising the overall experience, the supportive CER (Figure 15) comprises the required accessibility on providing information related to the energy supplier or advice and support on the use of the PM; and transparency by explaining aspects related to energy supplier adjustments or to the invoice interpretation, and ensuring that the information provided by the PM meets the one provided by the energy supplier.

After the association between CERs and activities within the VCE, we were able to redesign the CVC and define a new service concept (Figure 16). Now, the energy supplier and friends and family are linked to this new service concept, in which the services are also interconnected.

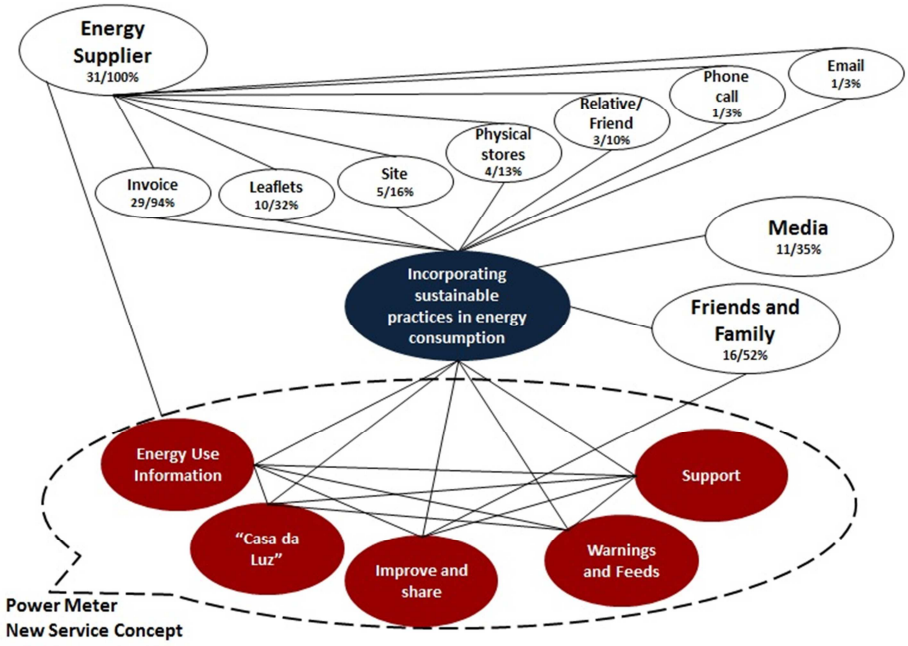

Figure 16 - New Power Meter Service Concept and reconfiguration of the CVC for incorporating sustainable practices in home energy consumption

The new service concept comprises the following services: Energy Use Information, *Casa da Luz*, Improve and share, Warnings and feeds and Support.

Energy use information service is mainly oriented to provide information on consumption in a given period (hour, day, week, month, year), per appliance, room, activity or member. Moreover, the customer may browse for past information, for

example, through the use of a calendar displayed to support this purpose. Also, this service allows invoice collection, presents automatic statistics and customized suggestions, resulting from periodic analysis to the energy consumption data collected. Feeds of news on sustainable practices, or about energy supplier's new services, tariffs and campaigns are also included.

The service *Casa da Luz* (literally, house of light) was given that name because it was a very commonly term said in interviews, referring to the local energy supplier and revealing a certain emotional link. We understood that it would be a suitable name for this service that allows the customer to connect to the enterprise through her/his client ID to enhance a direct contact with energy supply-related contents and services, retrieve data from the enterprise's website or simply direct to the client area on that website. It includes e-invoice reception, presenting the price and statistics, and help with invoice interpretation on specific items and statistics. Moreover, comprises the analysis of variability on consumption through the comparison of own e-invoices; displays information on energy supplier tariffs, services and current campaigns. The contact between the customer and the enterprise is enhanced as *Casa da Luz* allows direct contact with the energy supplier by email and provides other possible ways for it. Warnings on payment processed or on invoice reception are included.

Improve and Share is the service where the customer immediately observe how has been the family's performance compared to the standard family with similar house characteristics. Bearing in mind the Stepgreen integration, the customer is able to specify actions for her/himself, visualize other family members' actions, observe the family's position within the community ranking and share achievements. This integration with Stepgreen, that requires a web-service to allow the access, leverages the capacity of the PM in fostering sustainable practices as it configures a way of setting incentives for the adoption of better behaviors. Furthermore, the customer has the possibility of using functionalities for analyzing the energy consumption pattern or resorting to simulators to support investment decisions, to understand the impact of the housekeeper in the overall consumption or to analyze the suitability of an energy tariff.

Warnings and Feeds service responds to the expressed need for proactivity and interactivity. Warnings can include the detection of energy waste (for example, an exceeded limit, configured by the customer) or an abnormal consumption, the advice on a more intensive use of *bi-horária* tariff (if applicable and in result of a periodic analysis of energy consumption data), the payment of the energy bill to be processed or an e-invoice that was received, and alternative energy supplier services or tariffs that could better fit consumption pattern. There is the possibility of configuring the system so that warnings are received by email and/or SMS. Feeds are also configurable by the customer and may comprise suggestions on how to reduce consumption, news related to the energy sector or sustainability issues.

Finally Support exists to answer to any need of further information related to: the energy supplier, in terms of services and tariffs, adjustments or invoice items and statistics; and the PM, offering advice on its use and a (configurable) periodic contact. The support services were integrated along the service, being always available the direct contact by email. Furthermore, in the PM interface the customer can use a specific section *Suporte*, in which s/he can fill in the form to quickly get in touch with the

support service of the PM (Appendix S). It is also available a *Frequently Asked Questions* section and the contact for a call center.

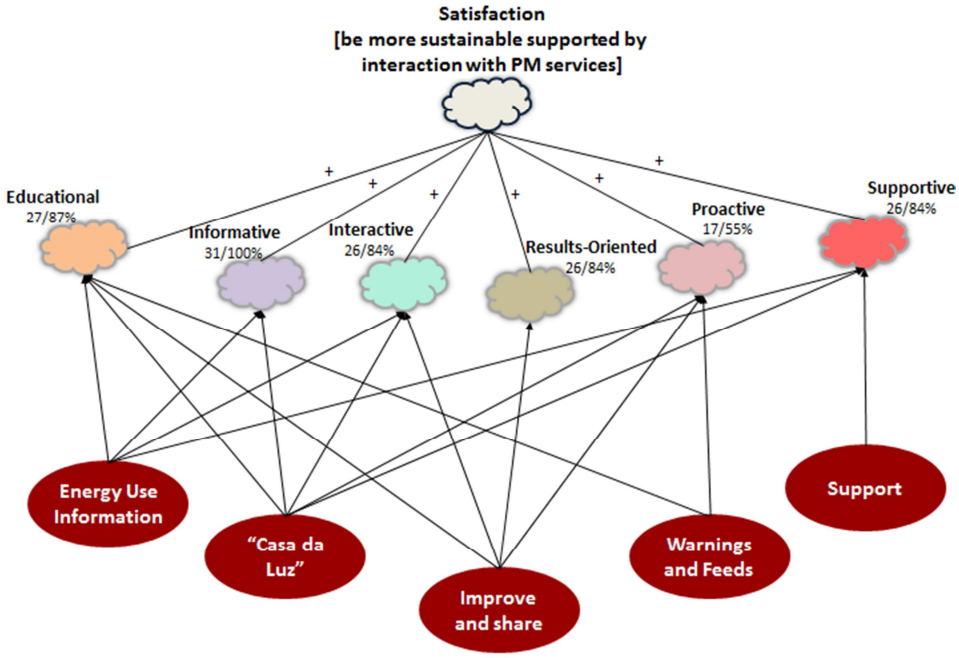

Figure 17- Satisfying CERs through services from the new service concept

Each service within the service concept was a result from the consideration of CERs within the overall experience of incorporating sustainable practices in home energy consumption (Figure 17). Even though we associated specific CERs with certain activities in the VCE, we believe that the interconnectivity between the services and the immersion of experience requirements from the beginning of the service concept definition will leverage the ability for satisfying multiple CERs through each service within the service system.

5.2 Mapping the service system for a Customer Journey

Following MSD methods, to better understand the customer experience we shall decompose the customer activities for the different levels of the customer experience, that is, service concept (through VCE), service system and service encounter. Hence, we followed that approach for the identified services, except for Support. Drilling down these levels permitted the identification of service encounters or touchpoints, in which the customer actually interacts with the service for a specific purpose.

Bearing in mind, for example, the Energy Use Information service, in the VCE and considering the first two activities of Energy Daily Consumption and Control, we identified the energy use information experience, which then led to the service encounter *consult energy consumption information and statistics* (Figure 18).

The same process was applied to the other services (except for Support) which resulted in the identification of other service encounters (Appendix N): *check latest e-invoice and use help*, within *Casa da Luz* service; *check Stepgreen updates and share*, part of Improve and Share service; and *check warning received and choose solution*, related to

Warning and Feeds service. For comprising a simple interaction the service encounter *ask for support* – associated to the Support service – was only prototyped.

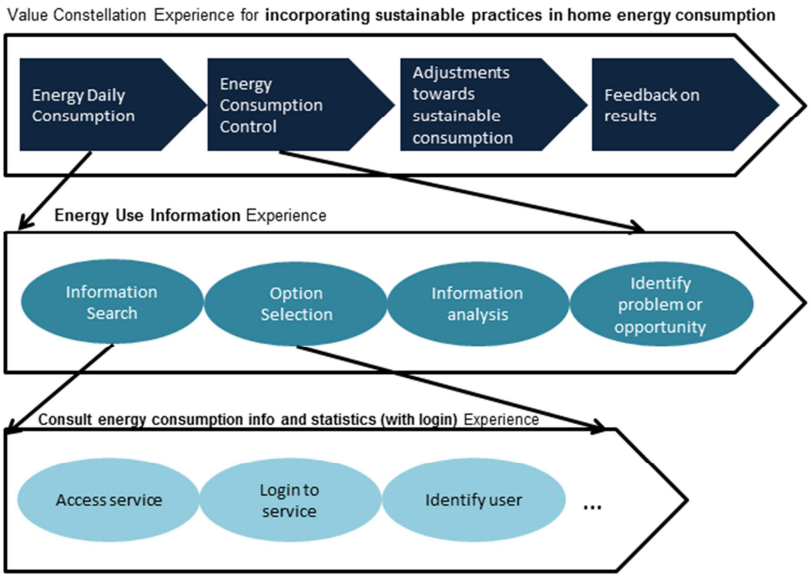

Figure 18 - Decomposition of customer activities for the different levels of the customer experience for Energy Use Information

To better understand the overall service system, Figure 19 illustrates a possible customer journey. Considering the identified service encounters, we represented the touchpoints with white border circles. The green circles are touchpoints, whose related service aims directly at fostering sustainable practices.

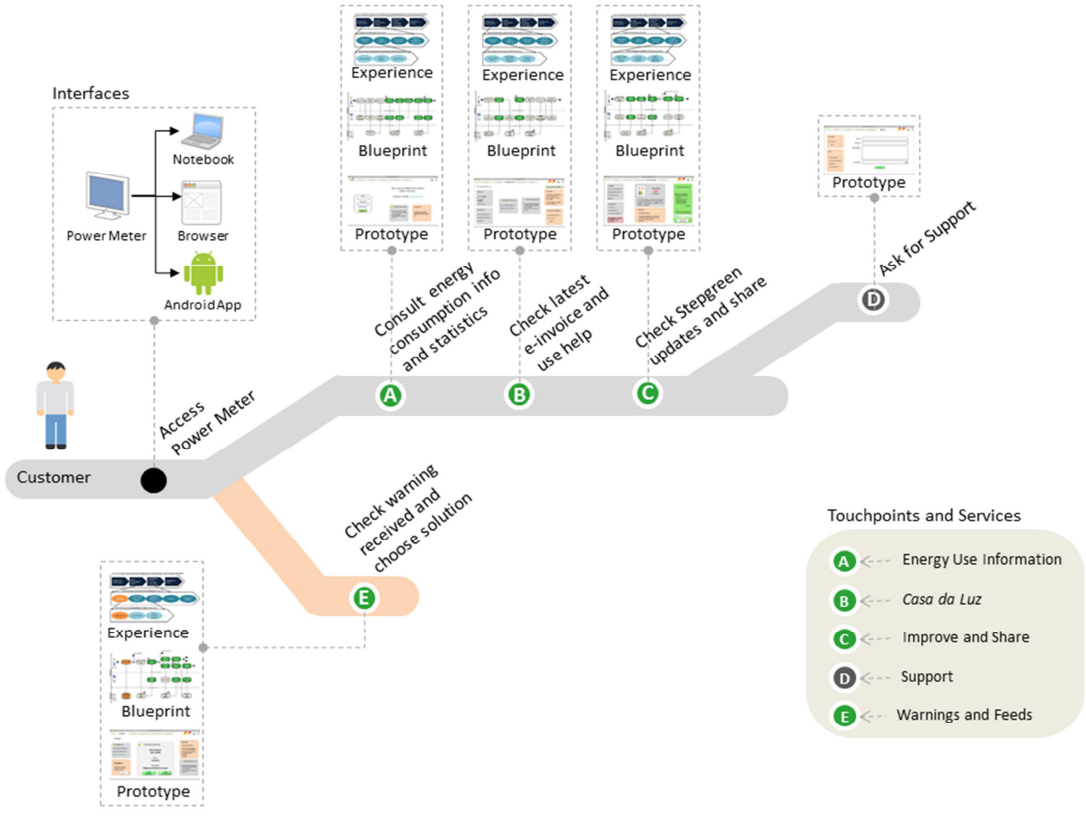

Figure 19 - A possible Customer Journey within the service system

Therefore, we consider two scenarios: (1) the customer chooses to interact with the PM, for consulting energy consumption information, checking the last e-invoice and Stepgreen updates or (2) the customer receives a warning by email and that triggers the interaction to check the warning and choose a solution. In (1) s/he may choose to ask for support.

5.3 Designing the service encounters

Considering the scenarios of interaction and the touchpoints illustrated in Figure 19, we present the design of three service encounters: (A) consult energy consumption information and statistics, from Energy Use Information service; (B) check latest e-invoice and use help, within *Casa da Luz* service; and (E) check warning received and choose solution, related to Warning and Feed service. For that, we resorted to SEB diagrams, in which we embedded Greenprinting, to highlight both the PM actions that foster sustainable practices and the customer sustainable actions or increased awareness (Figure 20).

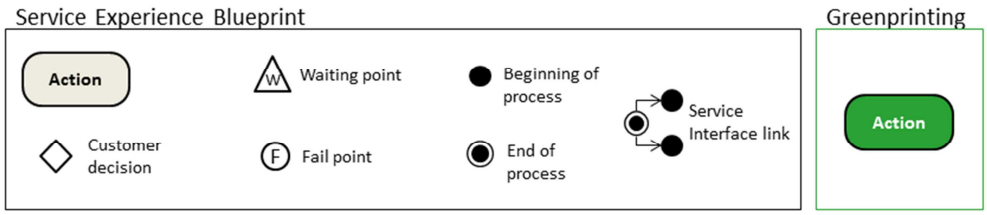

Figure 20 - SEB symbols (Patrício et al. 2011) and Greenprinting Action (Patrício, Fisk, and Grove 2009)

The design of service encounter (C) is in Appendix R and the prototype for (D) is in Appendix S.

To better understand the possible customer interaction with the service system, we prototyped each service encounter, from A to E; these service evidences can be consulted from Appendix O to S. In fact the prototype, being a physical evidence of the blueprint, comprises a way of tangibilizing the service to offer at each touchpoint.

5.3.1 Consult energy consumption information and statistics

Admitting this is the first access to the interface (Figure 21) the customer has to login to the service and identify which member of the family is, so that the information displayed is personalized. Then, in the Summary section (Figure 22), s/he can visualize the latest updates, the consumption of the current day as well as is able to check any warnings or new feeds. Admitting s/he go to *Consumos* section and chooses to see consumption per appliance, s/he will be presented with the default information (in this case, consumption per television). In terms of Greenprinting, during this service encounter, the PM displays energy consumption information that we believe will increase the customer's awareness, who by visualizing may adopt more sustainable practices. Possible points of failure may be related to the incapacity of the system retrieving information, which may lead to waiting points on the customer's side.

The whole interaction can be consulted in the prototype provided in Appendix O.

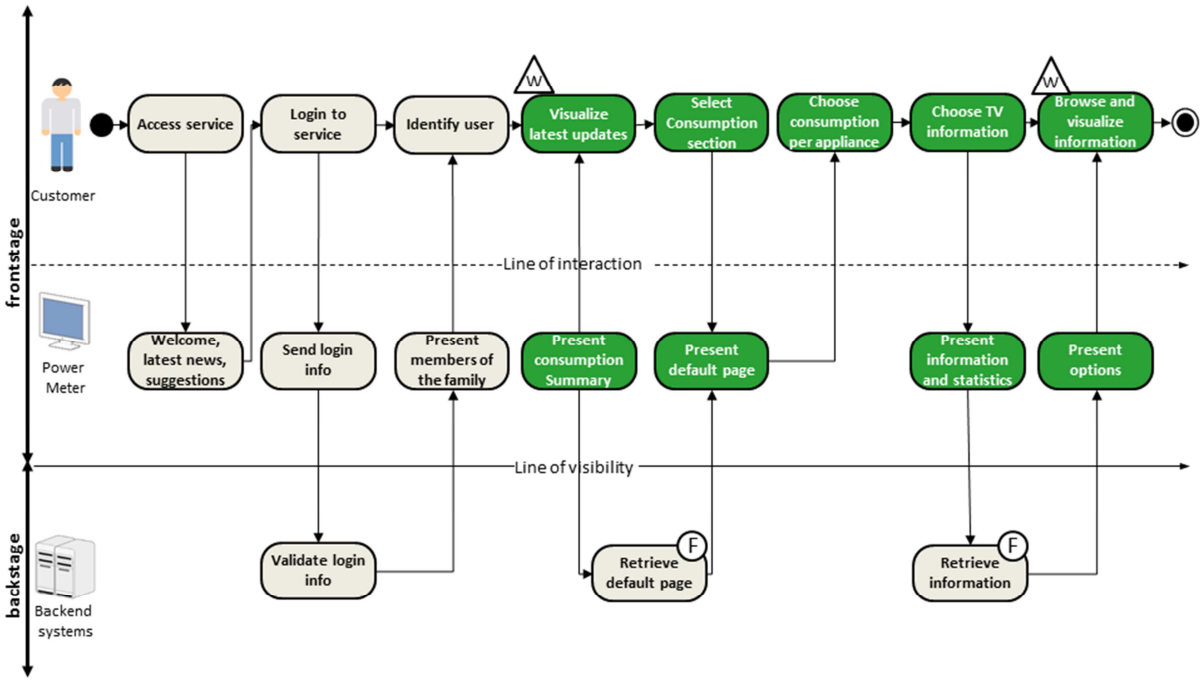

Figure 21 - SEB diagram for Consult energy consumption info and statistics (with login)

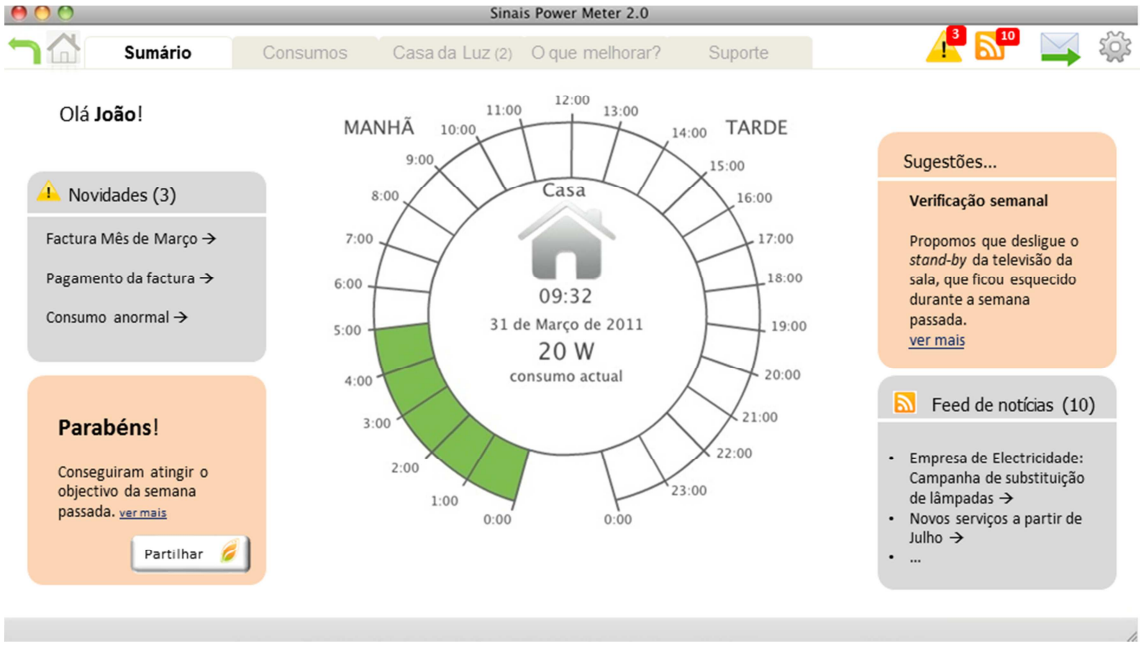

Figure 22 - Prototype of *Summary Page*

5.3.2 Check latest e-invoice and use help

Considering the customer is already using the PM, in this service encounter, s/he may access the *Casa da Luz* section for consulting the latest e-invoice (Figure 23) provided in PDF format. Note that other invoices besides the latest are available. Then, admitting s/he needs help in interpreting a specific item, the customer may select the help button which will highlight the items for which there is help available. Hence, the customer selects the item and visualizes the details displayed (Figure 24; Appendix P).

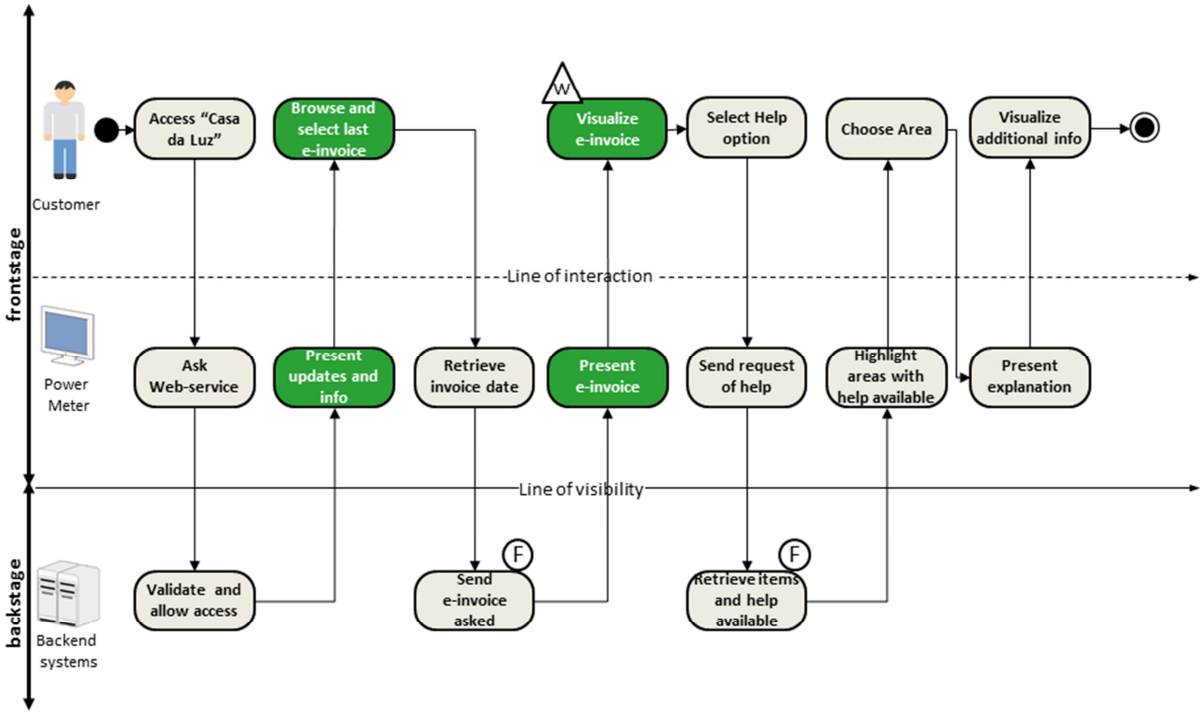

Figure 23 - SEB diagram for check latest e-invoice and use help

Within this service encounter, possible points of failure may be related to the systems inefficacy in retrieving e-invoices or help functionalities.

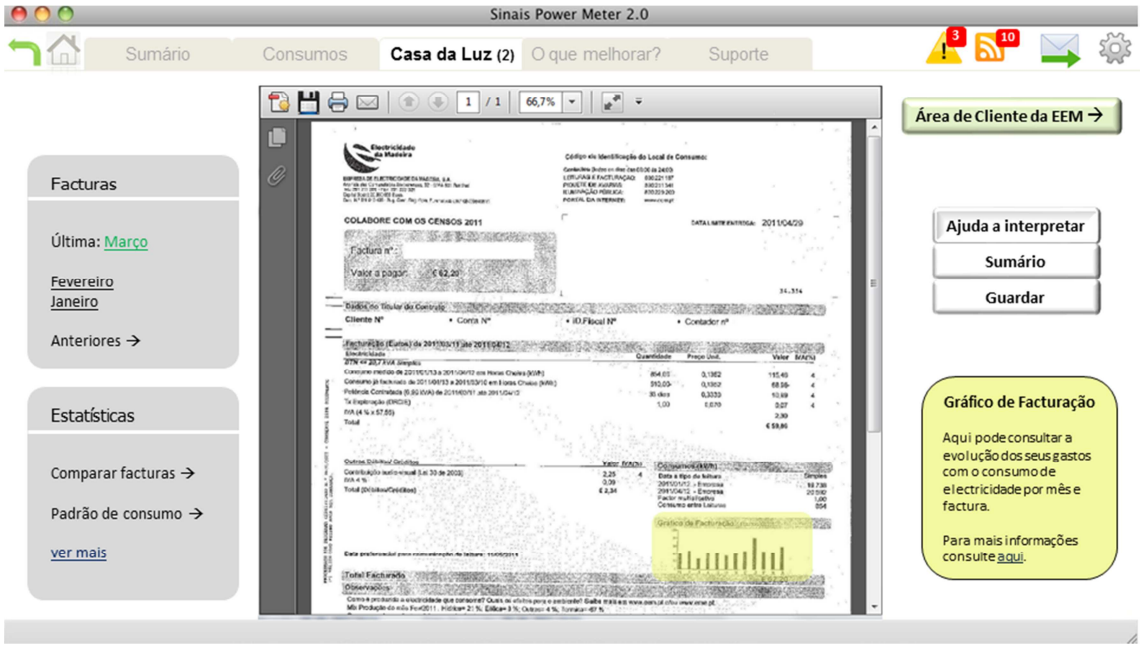

Figure 24 - Prototype of *help with invoice interpretation*

This service encounter for allowing the user to consult the invoice in PDF format, avoids the waste of paper, enabling a sustainable practice, even if it is not included in the energy consumption area. Besides, it ensures transparency, identified in the Supportive CER group, along with comprising an interactive way of getting help and more information to better understand the contents of the invoice.

5.3.3 Check warning received and choose solution

As Figure 25 illustrates, in this service encounter the customer receives an email notifying of an abnormality detected in the consumption (that is an external stimuli is identified with the orange color) and s/he can ignore it or decide to check its details. If s/he chooses the latter, that email may provide the link to the web interface of the PM, for convenience purposes. Then, the customer can opt between ignoring, asking for a customized analysis, through email (which leads to another interface), or asking for an automatic analysis, built on-time by the system and constituting a less customized but faster and more practical approach. Considering this last option, the interface will retrieve alternative solutions. Then the customer chooses one solution, which the system registers, and then implements it. The prototype of this service encounter is presented in Appendix Q.

From the moment of browsing options, it is clear that the PM presents possibilities to foster behavioral change and the customer, by choosing those actions, may then apply those changes. Possible moments of waiting can be related to the delay of the system in retrieving information or the solutions in the case of automatic analysis.

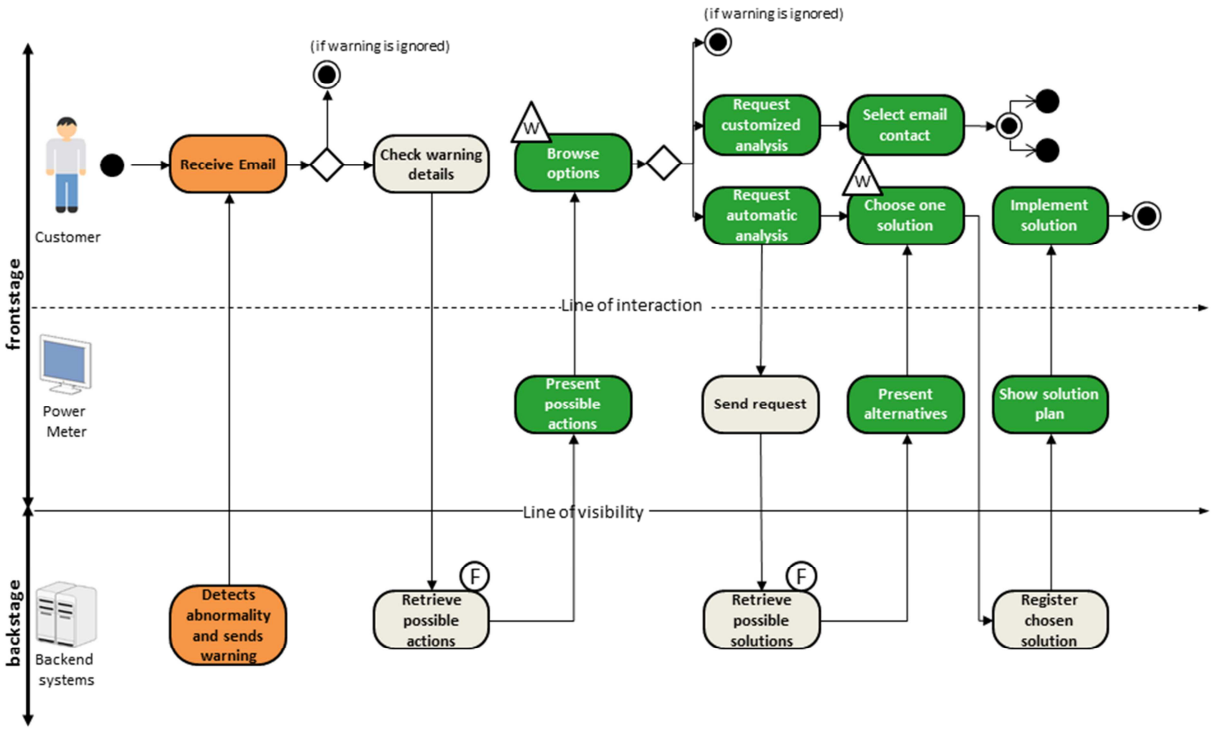

Figure 25 - SEB diagram for check warning received and choose solution

6 Conclusion and Future Work

Bearing in mind environmental sustainability concerns and focusing on the case of home energy consumption, we adopted a customer-centric approach, in which we explored the everyday practices of home energy consumption. The research main objectives were to effectively design a tecnhlogy-enabled service to foster sustainable behaviors and to understand the potential of adopting a methodological approach able to both design services and services able to foster sustainable practices. This comprised two main stages of Service Design: the study of customers and their contexts and the translation of the gathered information into new service systems and service evidences.

Understanding home energy consumption and eliciting requirements for the incorporation of sustainable practices allowed us to go beyond the mere interaction, and explore a systemic approach, considering that services exist within a context, surrounded by other services and entities.

To accomplish the design of the service system we used MSD (Patrício et al. 2011) as a framework. Because MSD is not specifically oriented for the design of services for sustainability and is too dense for small projects, we took into account its flexibility and adapted it. Hence, the main adopted changes were the incorporation of CERs through GOA (Mylopoulos, Chung, and Yu 1999) concepts and notation to better understand the customer experience, considering a customer journey (Mager 2009; Evenson 2005) to have a more systemic view and embedding Greenprinting (Patrício, Fisk, and Grove 2009) in SEB diagrams.

We understand this research is yet the very beginning of a greater challenge. For future work, in what concerns to the immediate result of this research – the technology-enabled service – we consider the test of the prototype in order to understand the reactions of customers and the improvements to be implemented. For that purpose, the study in more detail of each service encounter experience requirements related the new service concept would provide very rich information. Additionally, we consider exploring how the design solution leverages the customers drivers for sustainable practices. Then, we would like to successfully establish a link with the energy supplier, as we believe there would be benefits to both sides.

In terms of giving a contribution to the emerging field of Service Design and considering the aim of fostering sustainable practices, the main future work comprises the creation of a systematized methodology, regarding the criteria proposed by Forlizzi, Zimmerman, and Evenson (2008) to assess the research contribution. That methodology shall ensure the incorporation of sustainability from the very beginning of the design process, being flexible enough to be adaptable to smaller or bigger design projects and comprising a systemic approach capable of addressing more complex service systems.

In spite of the indicated opportunities for future work, we believe to have met the research goals as the qualitative study, based on Grounded Theory Methods, and the gathering and adaptation of Service Design Methods provided the need understanding to support the design of the technology-enabled service that seeks to satisfy needs, meet experience requirements and trigger sustainable behaviors.

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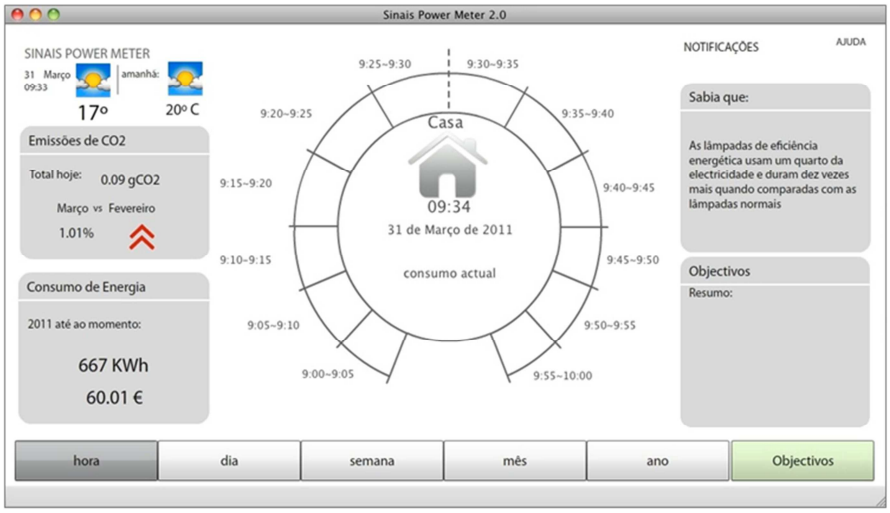
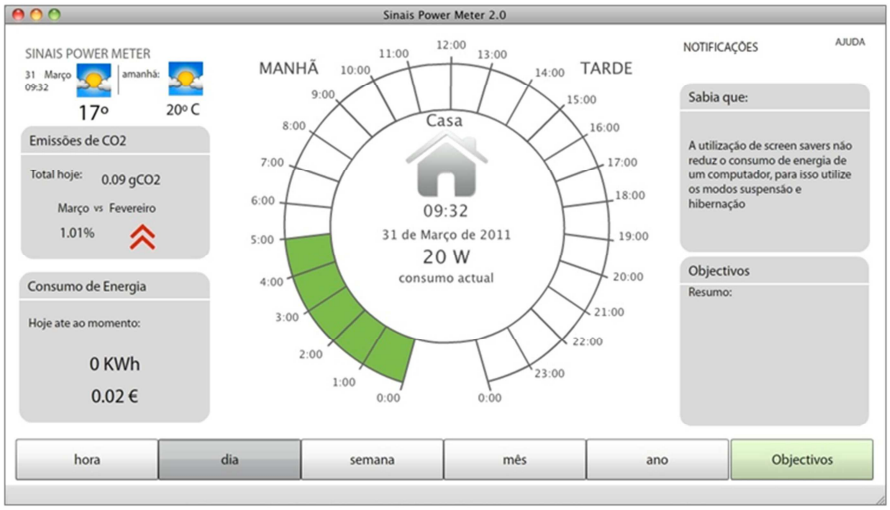
APPENDIX A: Power Meter and navigation in version 2.0 interfaces



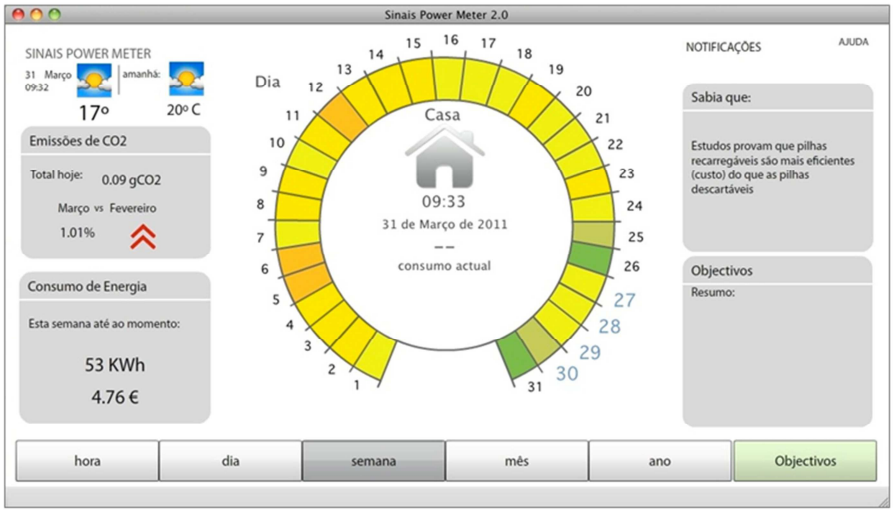
Hour view

1. Current carbon emissions and month comparison
2. Total energy used and monetary expenditure since the beginning of the year
3. Consumption per hour at the current day
4. "Did you know?" section
5. Stepgreen objectives summary



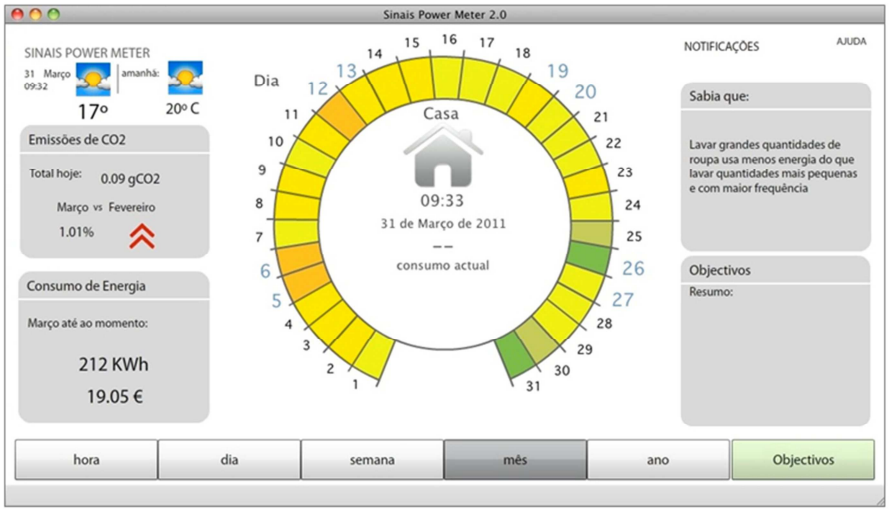
Day view

1. Current carbon emissions and month comparison
2. Total energy used and monetary expenditure since the beginning of the day
3. Consumption per hour at the current day
4. "Did you know?" section
5. Stepgreen objectives summary



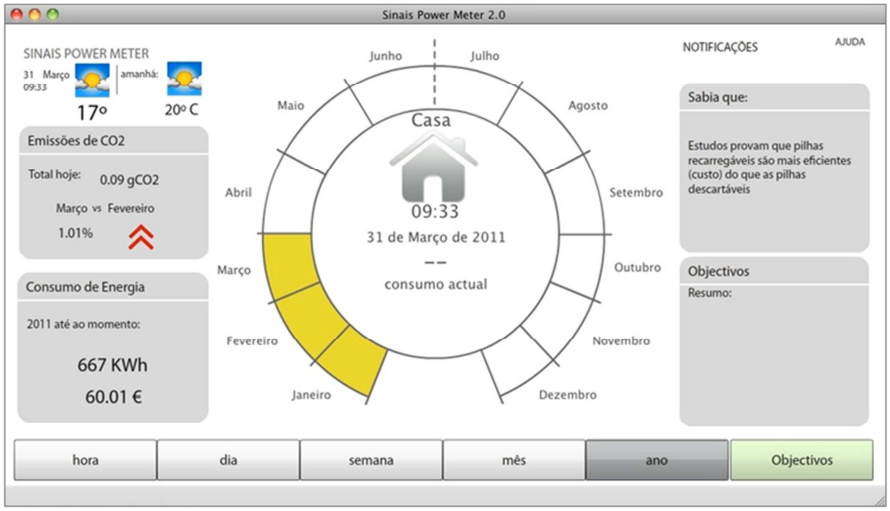
Week view

1. Current carbon emissions and month comparison
2. Total energy used and monetary expenditure since the beginning of the week
3. Consumption per day at the current month and week
4. "Did you know?" section
5. Stepgreen objectives summary



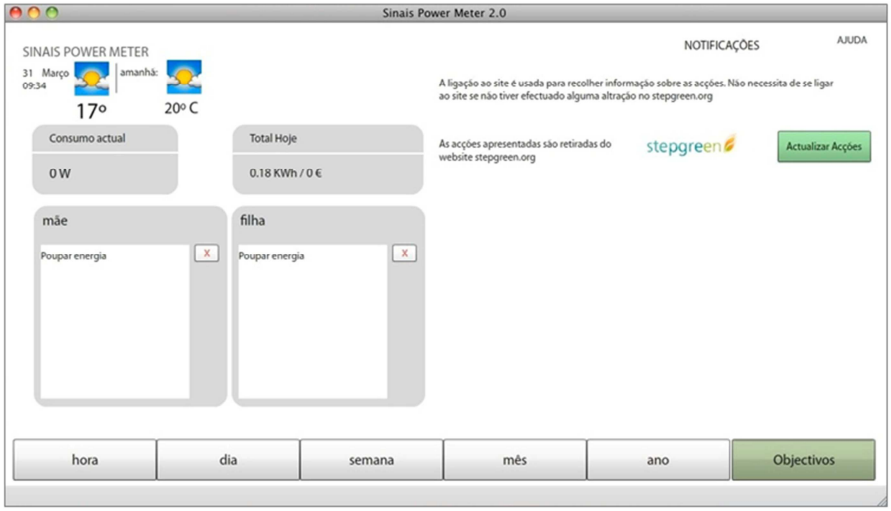
Month view

1. Current carbon emissions and month comparison
2. Total energy used and monetary expenditure since the beginning of the month
3. Consumption per day at the current month
4. "Did you know?" section
5. Stepgreen objectives summary



Year view

1. Current carbon emissions and month comparison
2. Total energy used and monetary expenditure since the beginning of the year
3. Consumption per month at the current year
4. "Did you know?" section
5. Stepgreen objectives summary



Stepgreen Integration

1. Update actions from Stepgreen website
2. Momentary consumption
3. Total energy consumption and monetary expenditure of the day
4. Actions for members of the family

APPENDIX B: Interview Protocol and Questions

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Entrevista

ID

Boa tarde. Desde já gostava de agradecer a sua disponibilidade. O meu nome é Ana Rita Viana. Sou estudante de mestrado e bolseira de investigação, na FEUP, no âmbito do projeto SINAIS, o qual é realizado em parceria com a Universidade da Madeira. O projeto de investigação em que estou envolvida tem como enfoque o desenho de serviços para a sustentabilidade e o estudo pretende abordar atitudes e comportamentos em torno do consumo de energia, tendo como objectivo apresentar um contributo para o desenho de serviços associados à eletricidade consumida em casa.

Desta forma, é importante perceber como é que os consumidores finais de energia vêem a sustentabilidade e de que forma esta poderá existir nas práticas diárias de consumo de energia.

A participação na entrevista é voluntária, sendo que a mesma será gravada em áudio para posterior análise. Terá uma duração a variar entre 30 minutos e uma hora. Se em algum momento se sentir incomodado com alguma questão ou assunto abordado sinta-se livre para não responder ou para pedir para terminar a entrevista. Será salvaguardada a confidencialidade dos dados.

A informação recolhida da entrevista será de grande relevância para a qualidade do resultado final da investigação.

Há alguma questão que gostaria de colocar?

Pode ler e, se estiver de acordo, assinar o consentimento informado.

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Consentimento Informado

Projeto de Investigação: Desenho de Serviços para a Sustentabilidade

Foi-lhe pedido a participação neste estudo conduzido por Ana Rita Viana, no âmbito do Mestrado em Engenharia de Serviços e Gestão e do projecto SINAIS. Leia por favor a informação que se segue e esclareça qualquer dúvida que tenha antes de decidir ou não participar.

• Esta entrevista é voluntária. Tem o direito de não responder a qualquer questão e terminar a entrevista em qualquer momento por qualquer razão. Espera-se que a entrevista demore entre meia hora e uma hora.

• A informação recolhida é confidencial e não será usado o seu nome ou qualquer outra referência em concreto relativa à sua pessoa.

• A entrevista terá de ser gravada de forma a poder ser referenciada no processo em estudo. A sua permissão para gravar poderá ser revogada em qualquer momento.

As informações aqui recolhidas serão guardadas em lugar seguro até dois anos depois do término deste estudo e depois serão destruídas.

Por favor leia e confirme,

[ ] Eu compreendi os procedimentos acima descritos, as minhas dúvidas foram esclarecidas e concordo participar neste estudo. Ficarei com uma cópia de formulário.

[ ] Dou permissão para a entrevista ser gravada.

[ ] Dou permissão para que a informação recolhida seja publicada com objectivos científicos, sem referência ao nome ou a qualquer informação do entrevistado.

Nome do entrevistado _____

Assinatura do entrevistado_____ Data _____

Assinatura do investigador_____ Data _____

Por favor disponha do meu contacto para qualquer informação:

Ana Rita Viana
Mestrado em Engenharia de Serviços e Gestão
Faculdade de Engenharia da Universidade do Porto
Email: [redacted]@gmail.com | [redacted]@fe.up.pt
Telefone pessoal: (00351) [redacted]

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Guião de Entrevista

1. **Gostava que me falasse de um dia semanal típico em sua casa.**

   Probes

   Enumeração de hábitos/rotinas.

   Que refeições são feitas habitualmente em casa?

   Quantos elementos da família estão simultaneamente em casa?

   Que aparelhos são mais utilizados?

   Que outras atividades são muito comuns (Ver TV, utilizar a internet, consolas de jogos,…)

O consumo de eletricidade está muito presente nas rotinas diárias de uma família, sendo essencial para que se garanta qualidade de vida e conforto.

2. **Fale-me sobre a forma como lida com o consumo de eletricidade em casa. Como caracteriza o consumo de eletricidade pelo seu agregado familiar?**

   Probes

   Que comportamentos de consumo são mais comuns?

   Faz gestão do consumo e/ou controlo os gastos?

   Como faz a gestão do consumo? Recorre a alguma tecnologia? Se sim, explorar.

   Recorre a fontes de informação? Quais?

   Que problemas encontra na gestão da eletricidade consumida? Fale-me sobre esses problemas e a sua origem.

   A invisibilidade do consumo de eletricidade e o impacto na gestão.

   Que atividades considera serem as mais gastadoras de energia? Quem normalmente as executa?

3. **No geral, que relação tem com a empresa que lhe fornece energia, a Empresa de Eletricidade da Madeira? Como descreve o seu impacto no âmbito do seu consumo diário?**

   Probes

   È uma relação próxima? Contacta diretamente com os colaboradores?

   Que serviços tem contratados? (fornecimento de eletricidade apenas?)

   (Se aplicável) Fale de uma última experiência de contacto com a empresa.

   Como paga o seu consumo de eletricidade: débito direto,…

   Em que medida a EEM o ajuda a lidar/gerir com o seu consumo?

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Que postura é que a empresa adopta: é proactiva a dar conselhos e sugestões? Por exemplo, a EEM é proactiva em analisar se para determinada família compensa ter contador bi-horário e recomenda? Ou então sugere que lave a roupa a partir das 22h porque aí está a consumir energia renovável?

Potencialidade do Power Meter como tecnologia mediadora entre o cliente e a EEM.

4. Já esteve numa situação de falha de eletricidade? Fale-me sobre essa experiência.

Probes

O que sentiu?

Que impacto teve no seu conforto?

Depois dessa experiência, a sua perspectiva sobre o valor da eletricidade na sua vida alterou-se?

Habitualmente define-se sustentabilidade como a "satisfação das necessidades do presente sem comprometer a capacidade de satisfazer as necessidades de gerações futuras". Posto isto, e no que respeita a comportamentos sociais que promovem a sustentabilidade ambiental, podem-se enumerar a reciclagem, a reutilização de materiais, de equipamento, de roupa, a utilização de aparelhos domésticos mais eficientes, o recurso a transportes públicos diariamente…

5. Fale-me da sua experiência associada a comportamentos sustentáveis.

Probes

Captar informação relativa a comportamentos sustentáveis de consumo em geral e de consumo energético em particular.

Esse comportamento foi desempenhado por si ou por outra pessoa?

O que é que o levou a assumir esse comportamento? Levantamento de drivers.

(Se aplicável) Sentiu-se influenciado por algo ou alguém?

(Se aplicável) O que sentiu na altura?

Em que medida foi influenciado pela empresa que lhe presta o serviço?

Em que medida a empresa que lhe presta o serviço lhe auxiliou?

Em que medida valoriza comportamentos/medidas/políticas orientadas à sustentabilidade por parte de empresas que lhe prestem serviços?

Depois dessa experiência, tornou a imitar/repetir esse comportamento?

Como avalia o seu contributo para a sustentabilidade ambiental? Considera-o relevante?

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6. **Numa situação em que pretendia melhorar o seu comportamento de energia de forma a torna-lo mais sustentável, fale-me de estratégias que adoptaria para tentar cumprir com o objectivo.**

Probes

Pode tratar-se de redução de consumo, de utilização mais intensiva de energia em alturas mais económicas e em que se utiliza energia de fonte renovável.

Que mudanças surgiram/surgiriam com carácter positivo no seu dia-a-dia?

E que mudanças surgiram/surgiriam com impacto negativo no seu dia-a-dia, nomeadamente na sua qualidade de vida que lhe causaram/causariam alguma preocupação ou desconforto?

Que preocupações, se for o caso, lhe suscitou/suscitaria a resposta ao desafio?

Na eventualidade de existirem crianças, em que medida isso teria consequências na capacidade de resposta ao desafio?

(Se aplicável) A que fontes de informação recorreu/recorreria?

Sentiria necessidade de recorrer a ajuda externa? A alguma entidade? Qual?

Em que medida a EEM o poderia ajudar na concretização desse objectivo?

Na situação de ter instalado em casa o Power Meter.

a. **Fale da sua experiência com o Power Meter. Em que medida o Power Meter o ajuda a melhorar o seu comportamento de consumo de eletricidade, tornando-o mais sustentável?**

Probes

Explorar a forma como o participante vê a tecnologia e avalia (se acha relevante, se acha dispensável,..) o seu impacto no seu consumo diário de eletricidade.

Captar aspectos de interação.

Levantar potenciais melhorias a introduzir.

7. **Para terminar a entrevista, há algum aspecto/assunto que gostaria de acrescentar?**

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Peço-lhe agora que me forneça os seguintes dados sociodemográficos:

Ficha sociodemográfica do Entrevistado (com Power Meter)

Sexo	☐ Feminino	☐ Masculino		
Idade	___			
Ocupação	☐ Empregado	☐ Desempregado	☐ Reformado	☐ Estudante
Formação	☐ Primária	☐ 9º Ano	☐ 12º Ano	☐ Superior
Tipo de Habitação	☐ Moradia	☐ Apartamento		
Potência contractada	___			
Elementos Família	☐ 1	☐ 2	☐ 3	☐ 4
Disponibilidade para voltar a ser contactado			☐	

Muito obrigada pela sua participação no estudo. Se pretender mais informação sobre o estudo ou a entrevista poderá contactar-me por email ou telefone.

Gostava de ser informado sobre os resultados do estudo? Se sim, pode fornecer-me o seu email?

Email_____

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Ficha sociodemográfica do Entrevistado (sem Power Meter)

Sexo	☐ Feminino	☐ Masculino		
Idade	___			
Ocupação	☐ Empregado	☐ Desempregado	☐ Reformado	☐ Estudante
Formação	☐ Primária	☐ 9º Ano	☐ 12º Ano	☐ Superior
Tipo de Habitação	☐ Moradia	☐ Apartamento		
Potência contractada	___			
Elementos Família	☐ 1	☐ 2	☐ 3	☐ 4
Idades	_____			
Nº PC	_____			
Internet?	☐ Sim	☐ Não		
Redes Sociais?	☐ Sim	☐ Não		
Casa	☐ Alugada	☐ Própria		
Disponibilidade para voltar a ser contactado			☐	

Muito obrigada pela sua participação no estudo. Se pretender mais informação sobre o estudo ou a entrevista poderá contactar-me por *email* ou telefone.

Gostava de ser informado sobre os resultados do estudo? Se sim, pode fornecer-me o seu email?

Email_____

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APPENDIX C: Participants Socio-demographic characteristics

Participants Information	Sources	%
Gender	**31**	**100%**
Female	21	68%
Male	10	32%
Age	**31**	**100%**
<30	2	6%
30-35	9	29%
36-39	8	26%
40-45	5	16%
46-49	2	6%
50-55	4	13%
>56	1	3%
Education Level	**31**	**100%**
High school	9	29%
College graduate	22	71%
Occupation	**31**	**100%**
Employed	28	90%
Unemployed	1	3%
Working Student	2	6%
Type of house	**31**	**100%**
Apartment	22	71%
Single-family house	9	29%
Interview Length	**31**	**100%**
< 25 min	22	71%
>= 25 min	9	29%
Interview Place	**31**	**100%**
Home	23	74%
Other	8	26%

Age	Female	Male	PM		%	Distribution
			Yes	No		
<30	1	1	1	1	6%	6%
30-35	9	0	4	5	29%	35%
36-39	2	6	5	3	26%	61%
40-45	4	1	3	2	16%	77%
46-49	1	1	1	1	6%	84%
50-55	4	0	1	3	13%	97%
>56	0	1	0	1	3%	100%
Total	21	10	15	16	31	31
% Total	68%	32%	48%	52%	100%	100%

Occupation	Female	Male	PM		%	Distribution
			Yes	No		
Employed	20	8	12	16	90%	90%
Unemployed	1	0	1	0	3%	94%
Working Student	0	2	2	0	6%	100%
Total	21	10	15	16	31	31
% Total	68%	32%	48%	52%	100%	100%

Education	Female	Male	PM		%	Distribution
			Yes	No		
High school	5	4	3	6	29%	29%
College graduate	16	6	12	10	71%	100%
Total	21	10	15	16	31	31
% Total	68%	32%	48%	52%	100%	100%

Interview Length	Female	Male	PM		Global
			Yes	No	
Average	23	27	27	23	25

APPENDIX D: Questions for the Energy Supplier Interview

FEUP FACULDADE DE ENGENHARIA
UNIVERSIDADE DO PORTO

DEIG Departamento de Engenharia Industrial e Gestão

MESG Mestrado em Engenharia de Serviços e Gestão

SINAIS Sustainable Interaction with Social Networks, context Awareness and Innovative Services

Guião de Entrevista

Pode-me expor os **serviços** que a EEM tem disponíveis para o cliente final?

- Se for interessante, explorar cada um dos serviços
- Averiguar se existem serviços que promovem comportamentos sustentáveis
  - enquanto inibidor do consumo – taxas;
  - ou incentivando a utilização de energias renováveis;
  - ou apelando a comportamentos sustentáveis.

Fale-me sobre como se inicia um **contracto** de fornecimento de energia.

- Processo
- Actividades
- Pontos de contacto com o cliente
- Pessoas da empresa envolvidas

Pode-me explicar como é que o serviço é **apresentado** ao cliente?

- Que interface de contacto?
- Há intermediários?
- Como é que a informação é exposta?
- Que pessoas da empresa estão envolvidas?

Depois de o serviço de electricidade ser estabelecido, pode-me falar sobre a **relação** que existe entre a empresa e o cliente?

- Existe algum tipo de relação?
- Quem é que despoleta o contacto?
- A relação é cultivada?
- Recorrem a: Panfletos? Emails? Site? Dicas?
- Contacto Pessoal?

Em que medida a EEM tenta **influenciar** os comportamentos de consumo das famílias do Funchal?

- Existem campanhas que promovam a adopção de comportamentos sustentáveis?
- De que tipo?
- Através de que canal?
- Sabem se chega às pessoas?
- Sabem se têm efeito? Como?
- Apresentam às famílias os resultados da sua adopção?
- Existem serviços específicos que tenham esse intuito?
  - Exemplo muito falado: tarifa bi-horária - como é apresentada? Parte da empresa ou do consumidor? Há alguma forma de publicitação dessa possibilidade?

A própria empresa tem alguma **política** de sustentabilidade?

- Tem comportamentos sustentáveis? Quais?
- De que tipo? Qual o pilar de sustentabilidade em causa?
- Divulgam-nos aos consumidores finais? Ou a outras empresas?
- Sentem feedback por parte dos consumidores finais face a essas práticas?

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APPENDIX E: Groups of Categories, Categories and Subcategories

Categories	Sources
A. Energy Use and Control	
Energy Use	
Activities	31
Appliances	31
Specificities	14
Energy Consumption Control	31
Most demanding activities or appliances	
Formation of perceptions	30
Most demanding activities	7
Most demanding appliances	28
Posture towards energy consumption	31
Attitudes towards energy consumption	29
B. Energy Supplier	
Relationship Supplier-Client	
Current Relatioship	31
Desired Relationship	16
Energy Service-related	
Adjustments	8
Means of contact	31
Payment Method	29
Fostering Sustainability	
Bi-horária tariff	27
Economic light bulbs campaign	17
Impact on Consumption	29
C. Sustainability in Energy Use	
Current sustainable practices	31
Attitudes towards sustainable practices	30
Drivers for sustainable practices	31
Possible strategies	18
Other sustainable behaviors	31
D. Power Meter Experience	
Type of User	15
Impact on Consumption	15
User Interaction	15
Problems faced	4
Reaction to New Version	9
Suggested Improvements	11
Energy Supplier and Power Meter	13
E. Needs	24
F. CERs and goals	31
H. Customer Value Constellation	31

APPENDIX F: Coding Trees for the Activities and Appliances Categories

Activities	Sources	%
Prepare Meals	**31**	**100%**
Dinner	30	97%
Breakfast	25	81%
Lunch	14	45%
Tea	1	3%
Cleaning	**30**	**97%**
Laundry	30	97%
Dishes	21	68%
House	13	42%
Entertainment or Work	**29**	**94%**
Personal Care	**12**	**39%**
Total	**31**	**100%**

Appliances	Sources	%
TV	31	100%
Washing Machine	29	94%
Computer	28	90%
Iron	24	77%
Microwave	23	74%
Dishwasher	22	71%
Lights	21	68%
Oven	19	61%
Cooker	18	49%
Vacuum Cleaner	11	35%
Toaster	10	32%
Fridge	9	29%
Kettle	7	23%
Coffee Machine	5	16%
Game Console	5	16%
Music Player	5	16%
Cable TV Box	4	13%
Heater	4	13%
Mobile Phone Charger	4	13%
Drying Machine	3	10%
Bimby	2	6%
Dehumidifier	2	6%
Freezer	2	6%
Juice Squeezer	2	6%
Alarm Clock	1	3%
Fryer	1	3%
Grill	1	3%
Hairdryer	1	3%
Total	**31**	**100%**

APPENDIX G: Coding Tree for the Posture and Attitudes towards energy consumption Categories

Categories	Sources	%
Posture towards energy consumption	**31**	**100%**
I am aware	13	42%
I educate my own children	12	39%
We moderate consumption	7	23%
I manage consumption	4	13%
I don't manage consumption	2	6%
I am very aware and interested	2	6%
Sometimes I forget	1	3%
Better to change than to produce more energy	1	3%
Attitudes towards energy consumption	**29**	**94%**
Having children impacts	14	45%
My consumption is necessity-pushed	13	42%
Energy is very expensive	7	23%
My consumption is conscious	6	19%
Energy is invisible	4	13%
My consumption is regular	4	13%
I know the weight of energy in my budget	1	3%

APPENDIX H: Coding Tree for the Means of Contact Category

Means of Contact	Sources	%
Invoice	29	94%
Leaflets	10	32%
Meter Reading	6	19%
Site	5	16%
Physical Stores	4	13%
Relative or Friend	3	10%
Email	1	3%
Phone Call	1	3%
Total	**31**	**100%**

APPENDIX I: *Bi-horária* tariff adhesion and related subcategories

Bi-horária Tariff	*Bi-horária* Attribute		
	Yes	No	Not sure
Acknowledge	**11**	**6**	**0**
Own Interest	8	3	0
Family, Friends	5	3	0
Leaflet from EEM	2	0	0
Media	1	0	0
Relative or Friend at EEM	1	0	0
Simulator in EEM website	1	0	0
Concerns	**7**	**8**	**2**
Know how much will save	4	3	0
Better if different timetable	3	4	1
Pay extra to have *bi-horária*	2	0	0
Lack of information	1	0	1
No impact	1	0	0
Spend too little in *bi-horária*	1	0	0
Bother neighbors	0	1	1
Housekeeper during the day	0	2	0
Timetable	**10**	**5**	**2**
Known	8	3	0
Incorrect	2	0	2
Unknown	0	2	0
Total	**12**	**16**	**3**
% Total	**39%**	**52%**	**10%**

APPENDIX J: Coding Tree for the Impact on Consumption Category

Impact on Consumption	Sources	%
Does not consider any influence	**19**	**61%**
No variation on invoice amount	2	6%
EEM would lose	2	6%
Only by campaigns	1	3%
Invoice reflects behaviors	1	3%
No contact from EEM	1	3%
Admits there is some influence	**10**	**32%**
Leaflets and advice	7	23%
Due to bi-horária	1	3%
Weight on family budget	1	3%
But I focus on the price	1	3%
Total	**29**	**94%**

APPENDIX K: Coding Tree for the Current Sustainable Practices Category

Current Sustainable Practices	Sources	%
Economic bulbs	19	61%
Use Efficient Appliances	18	58%
Turn off the lights	16	52%
Avoid using certain devices	14	45%
Bi-horária usage	12	39%
Use only if completely loaded	12	39%
Unplug appliances	9	29%
Turn off stand-by	8	26%
Use of natural light as possible	8	26%
Turn off appliances	7	23%
Device to switch plug off	6	19%
Appliance strictly needed use	5	16%
Minimize usage	5	16%
Select economic programs	3	10%
Washing Machine in the evening	3	10%
LED lights	2	6%
Choose between devices	1	3%
Total	**31**	**100%**

APPENDIX L: Current Sustainable Practices and Appliances Matrix

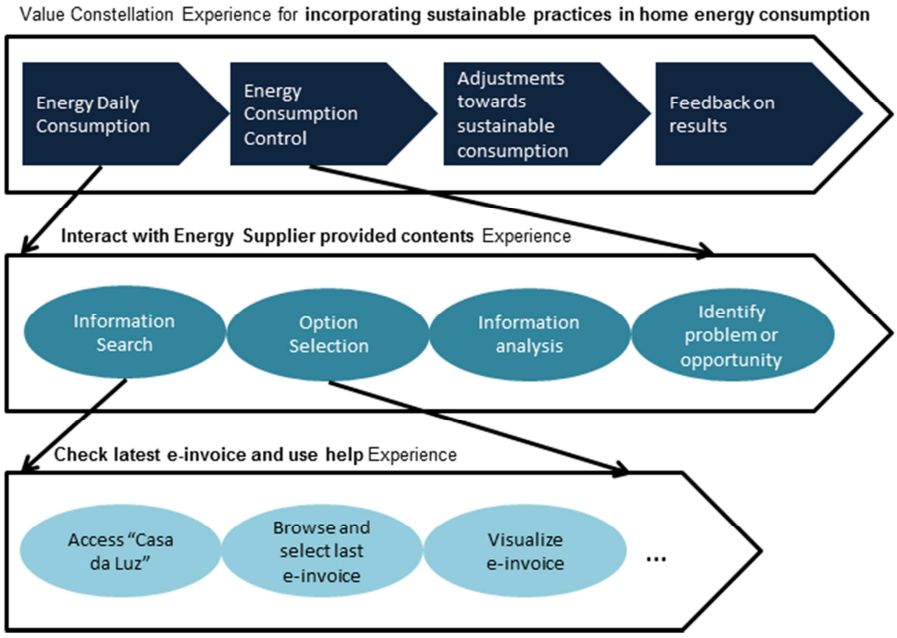
Current sustainble Practices and Appliances Matrix	A : Alarm Clock	B : Bimby	C : Cable TV Box	D : Coffee Machine	E : Computer	F : Cooker	H : Dehumidifier	I : Dishwasher	J : Drying Machine	K : Freezer	L : Fridge	M : Fryer	N : Game Console	O : Grill	P : Hairdryer	Q : Heater	R : Iron	S : Juice Squeezer	T : Kettle	U : Lights	V : Microwave	W : Mobile Phone Charger	X : Music Player	Y : Oven	Z : Toaster	AA : TV	AB : Vacuum Cleaner	AC : Washing Machine
1 : Appliance strictly needed use	0	0	0	0	1	0	0	0	1	0	1	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0
2 : Avoid using certain devices	0	0	0	0	0	0	0	2	3	0	0	0	0	0	0	2	1	0	0	1	0	0	0	6	0	0	0	0
3 : Bi-horária usage	0	0	0	0	1	0	0	7	0	0	1	0	0	0	0	1	3	0	2	0	0	0	0	0	0	0	0	11
4 : Choose between devices	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	1	0	0
5 : Device to switch plug off	1	0	1	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	2	0	0
6 : Economic bulbs	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	4	0	0	0	0	0	0	0	0
7 : LED lights	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
8 : Minimize usage	0	0	0	0	0	1	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	1
9 : Select economic programs	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
10 : Turn off appliances	0	0	1	0	1	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	2	0	0
11 : Turn off stand-by	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	5	0	0
12 : Turn off the lights	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	10	0	0	0	0	0	1	0	0
13 : Unplug appliances	0	0	0	0	1	0	0	0	0	0	0	0	1	0	0	0	0	0	0	1	1	4	1	1	1	2	1	0
14 : Use Efficient Appliances	0	0	0	0	0	1	0	1	0	0	4	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	3
15 : Use of natural light as possible	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0
16 : Use onlyif completely loaded	0	0	0	0	0	0	0	7	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	6
17 : Washing Machine in the evening	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	2

APPENDIX M: Power Meter Attribute and Current Sustainable Practices Category

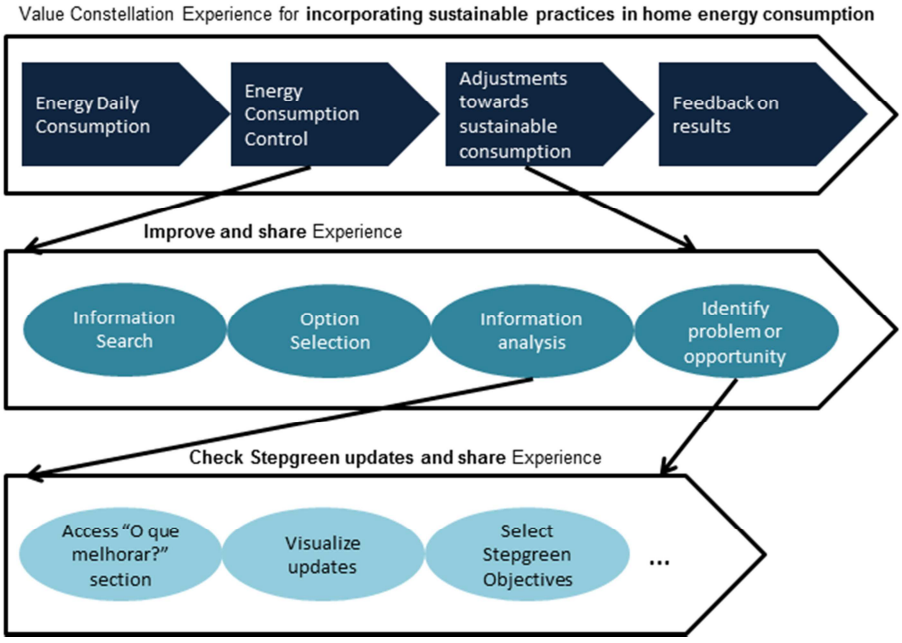
Power Meter and Current Sustainable Practices	Power Meter Attribute	
	Yes	No
Appliance strictly needed use	2	3
Avoid using certain devices	9	5
Bi-horária usage	7	5
Choose between devices	0	1
Device to switch plug off	3	3
Economic bulbs	10	9
LED lights	0	2
Minimize usage	1	4
Select economic programs	1	2
Turn off appliances	4	3
Turn off stand-by	3	5
Turn off the lights	8	8
Unplug appliances	3	6
Use Efficient Appliances	8	10
Use of natural light as possible	5	3
Use only if completely loaded	5	7
Washing Machine in the evening	2	1
Total	**15**	**16**

APPENDIX N: Understanding the customer experience

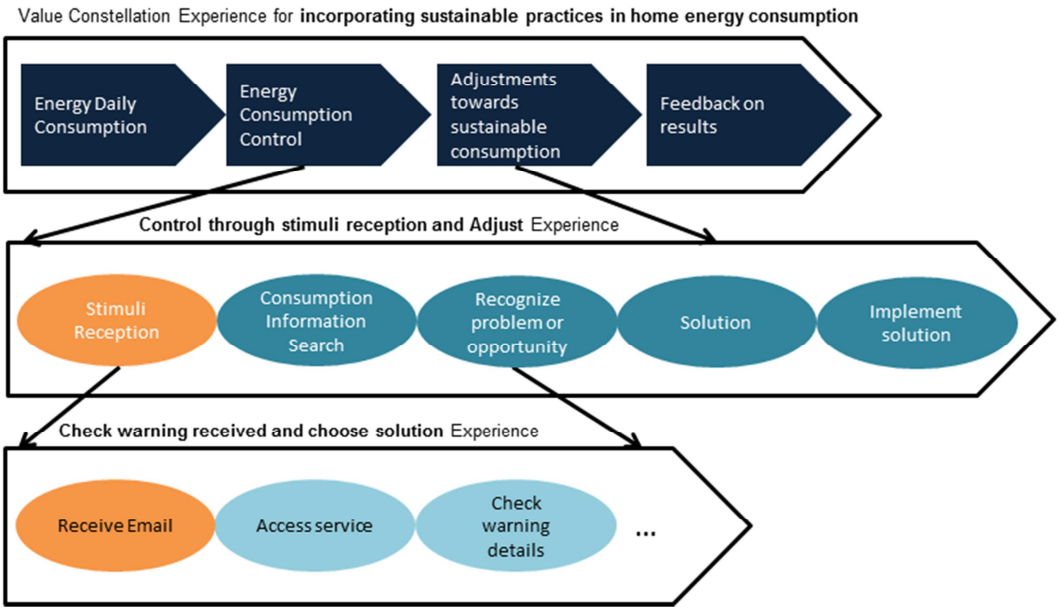
- Service encounter “Check latest e-invoice and use help”



- Service encounter “Check Stepgreen updates and share”

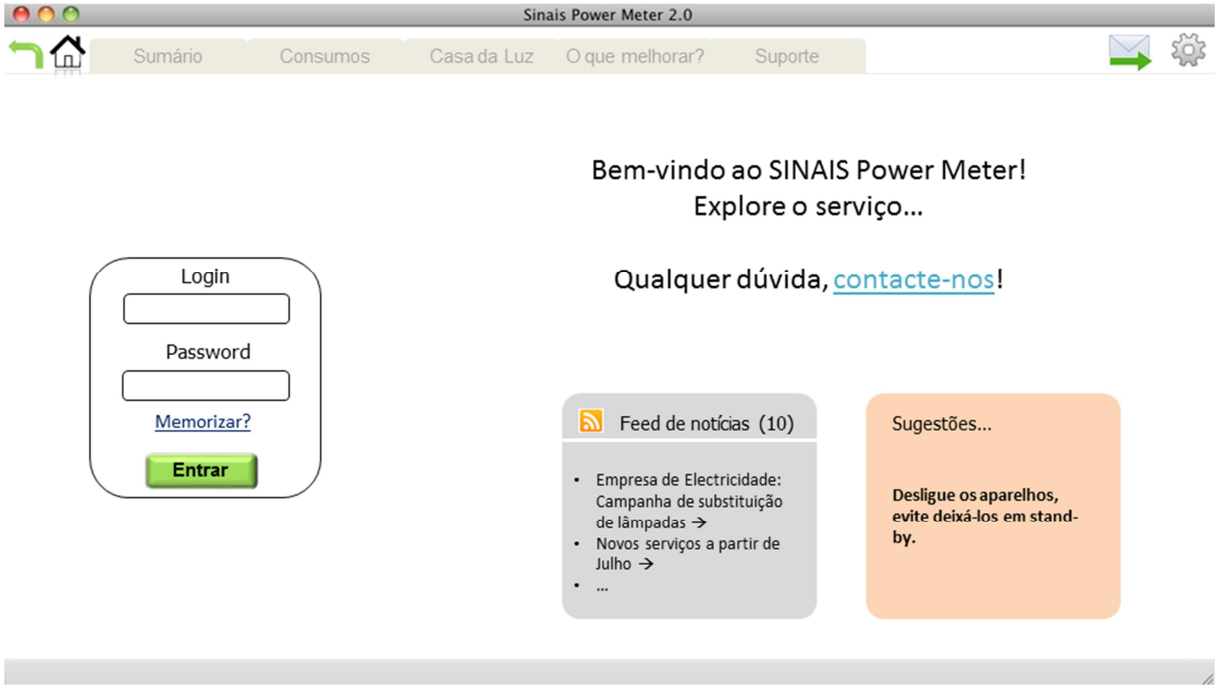


- Service encounter “Check warning received and choose solution”

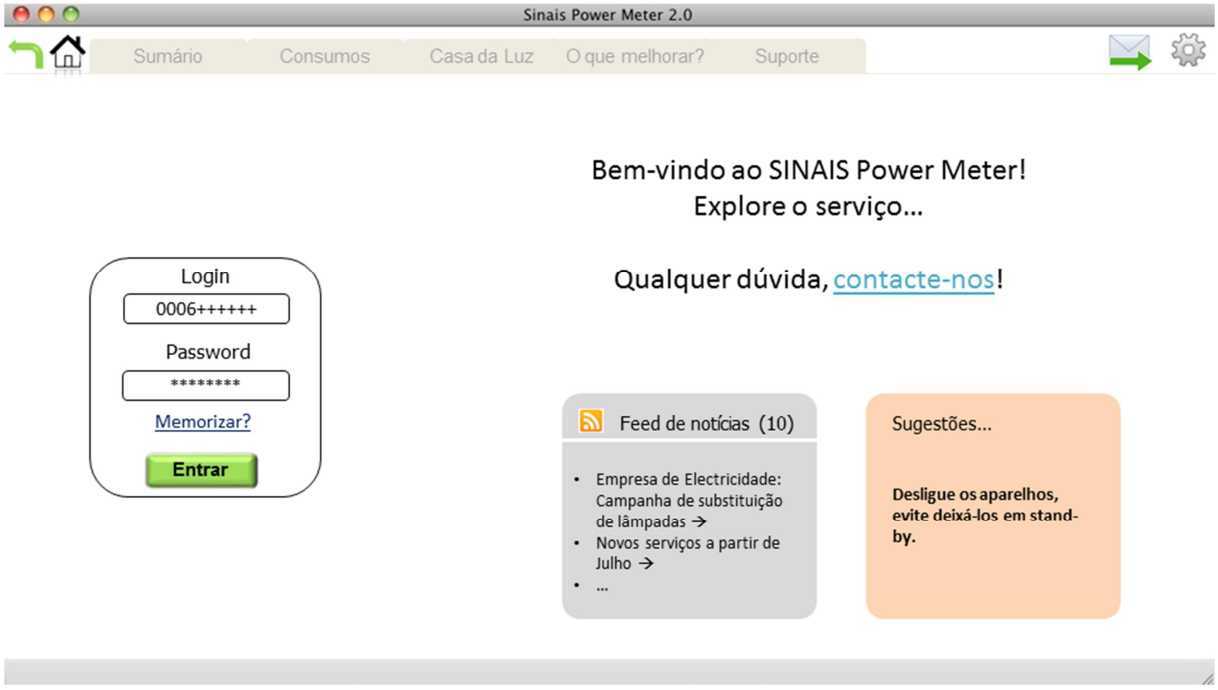


APPENDIX O: Prototype of the service encounter "Consult energy consumption information and statistics (with login)"

1. Access service



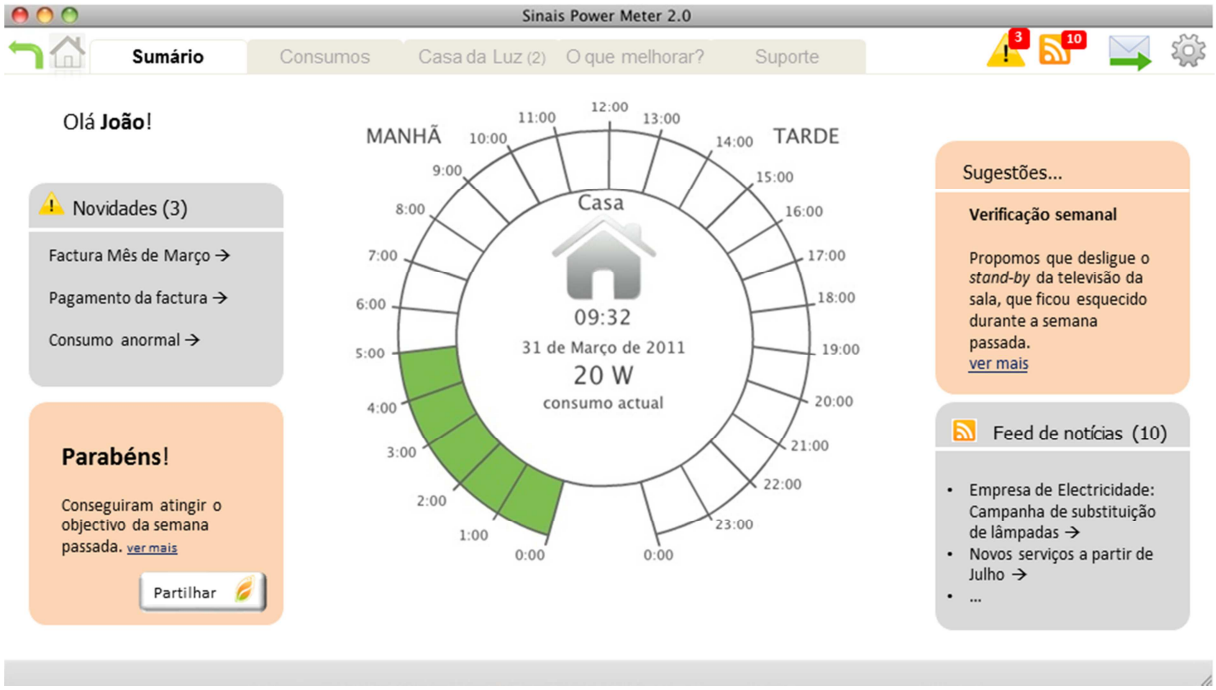
2. Login to service



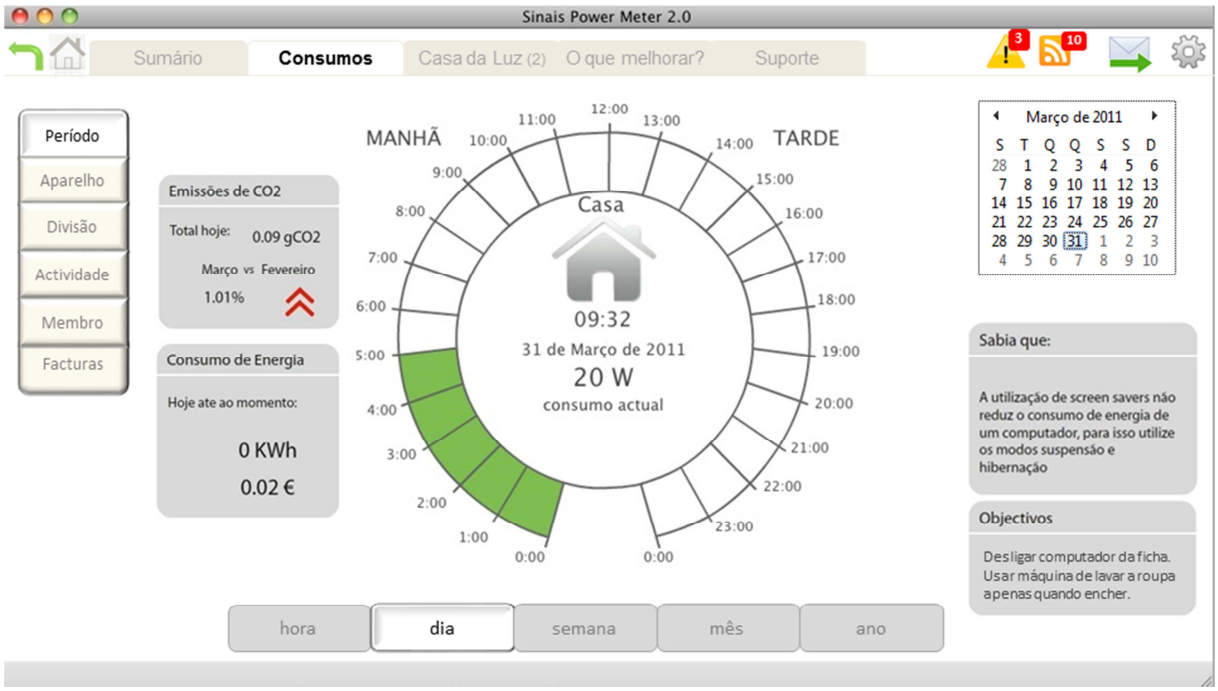
3. Identify user

3. Identify user

4. Visualize latest updates



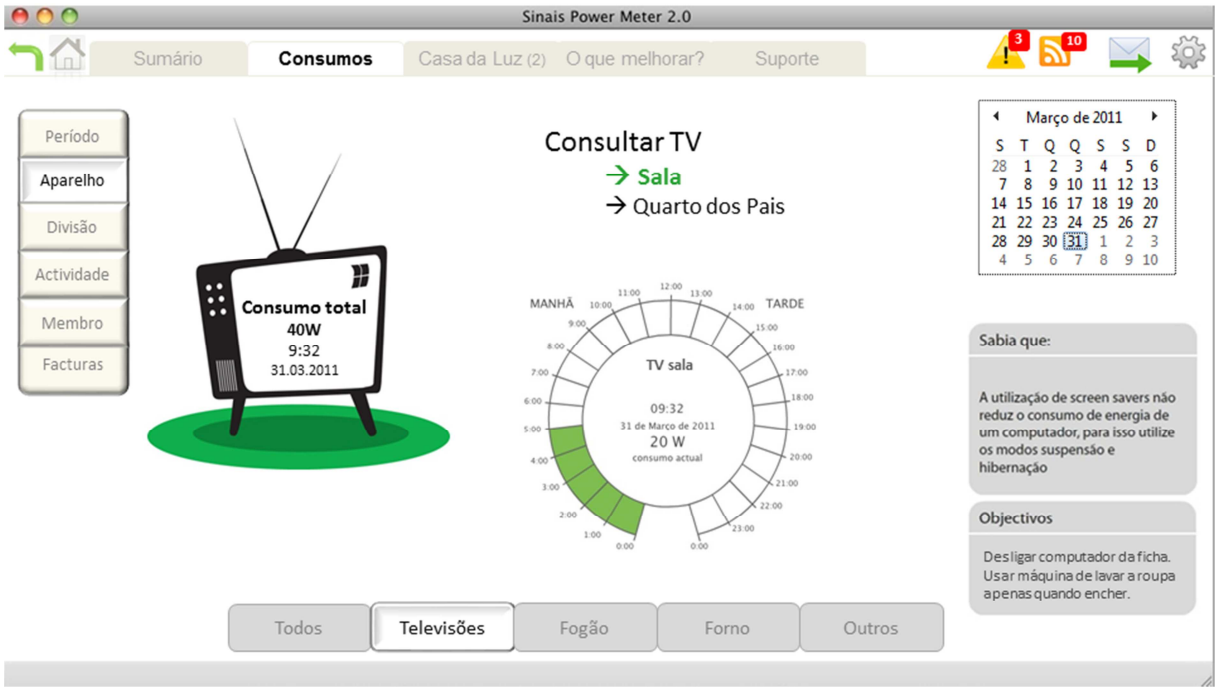
5. Select Consumption section



6. Choose consumption per appliance

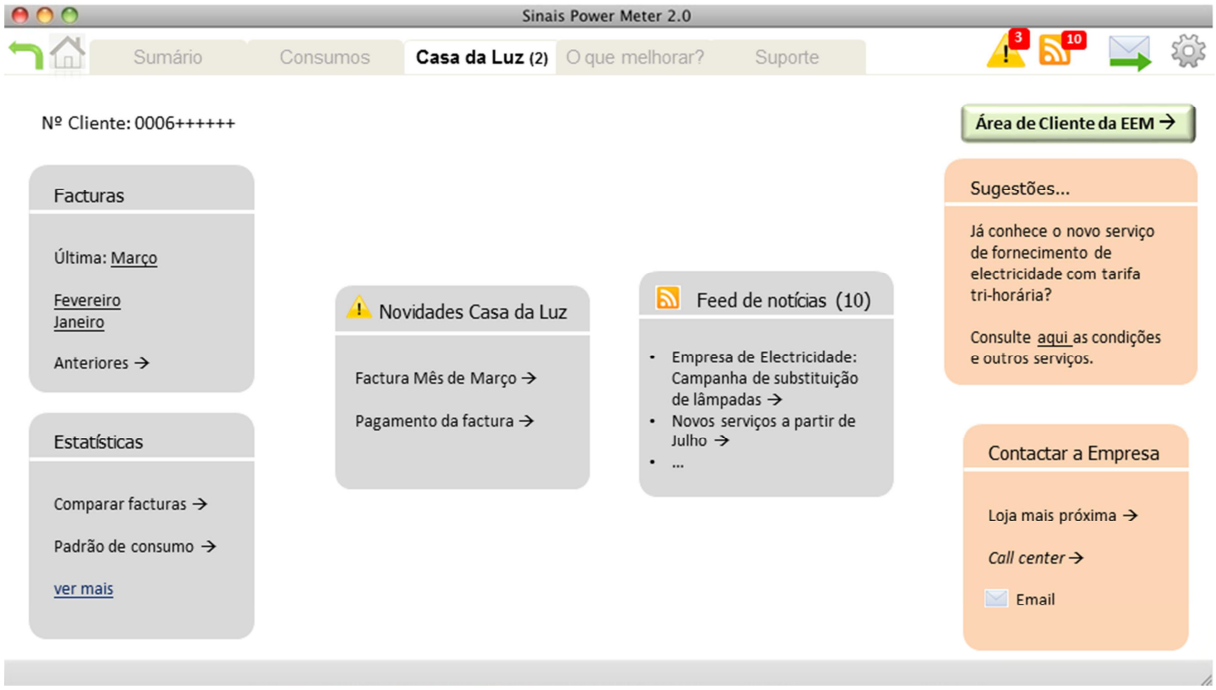
7. Choose TV information

8. Browse and visualize information

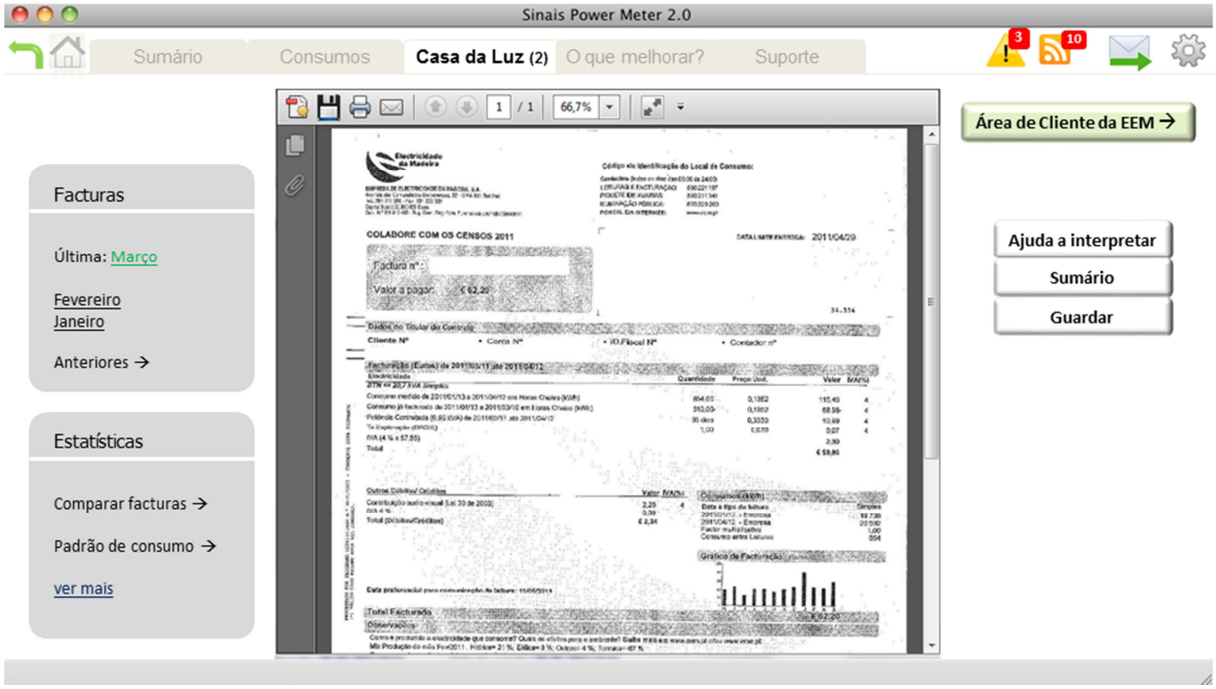


APPENDIX P: Prototype of the service encounter "Check latest e-invoice and use help"

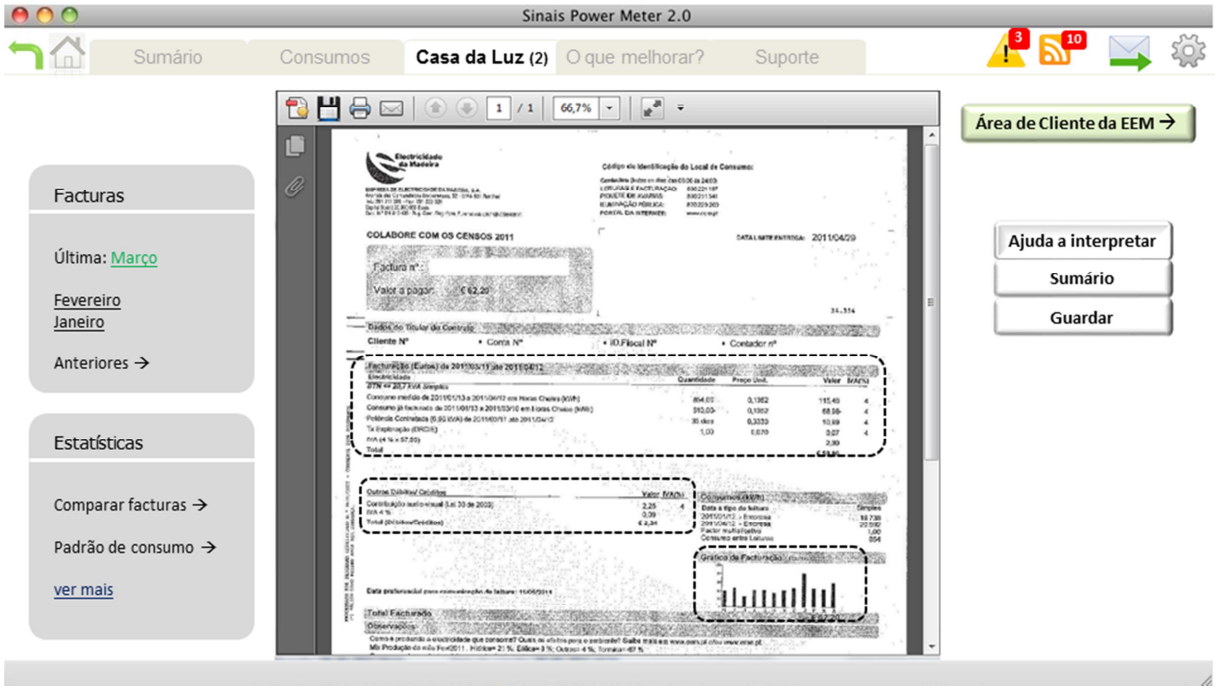
1. Access "Casa da Luz" section



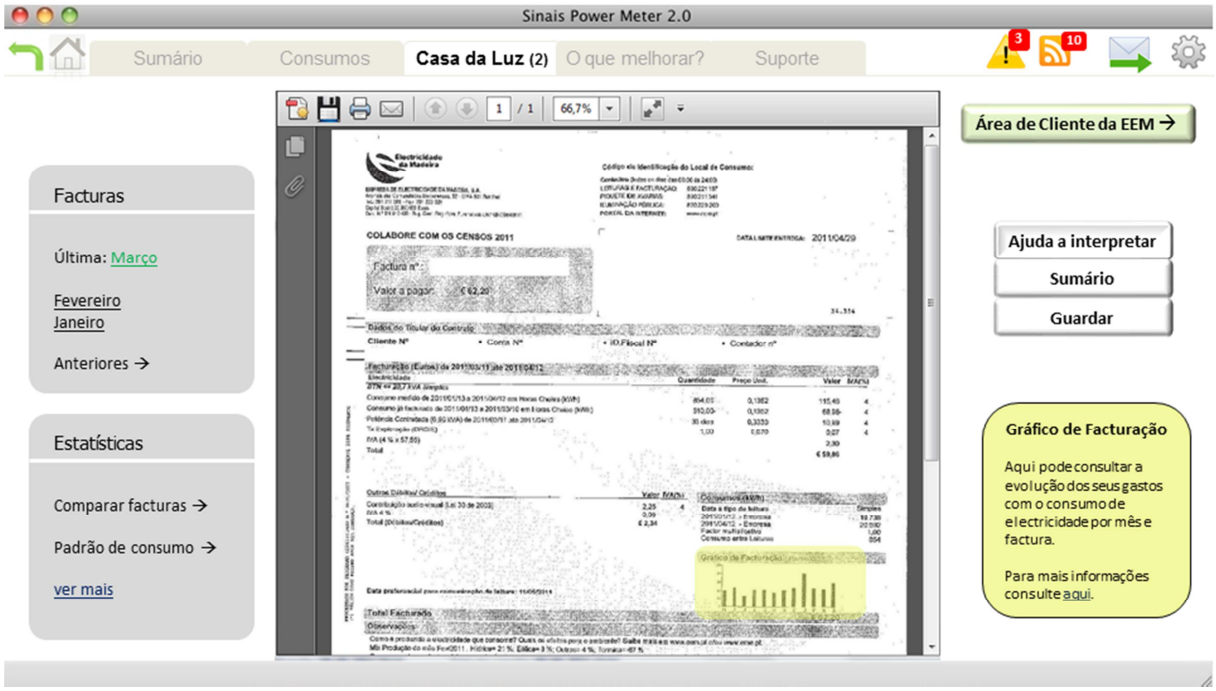
2. Browse and select last e-invoice
3. Visualize e-invoice



4. Select Help option

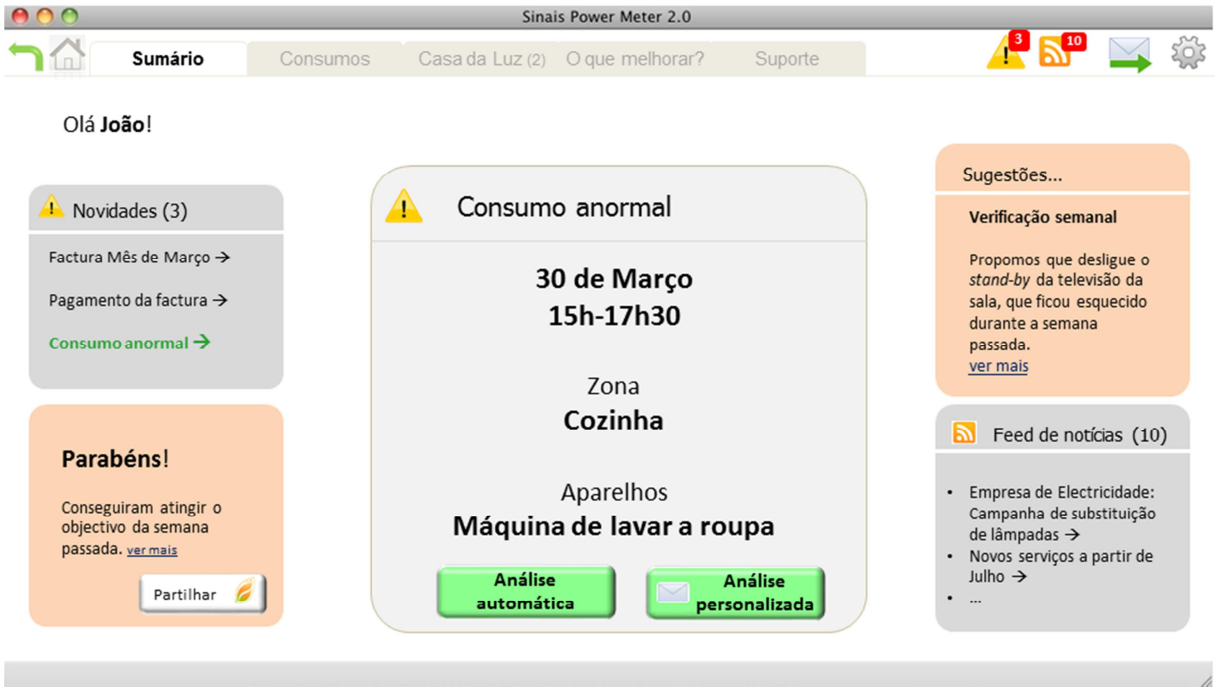


5. Choose area
6. Visualize additional info

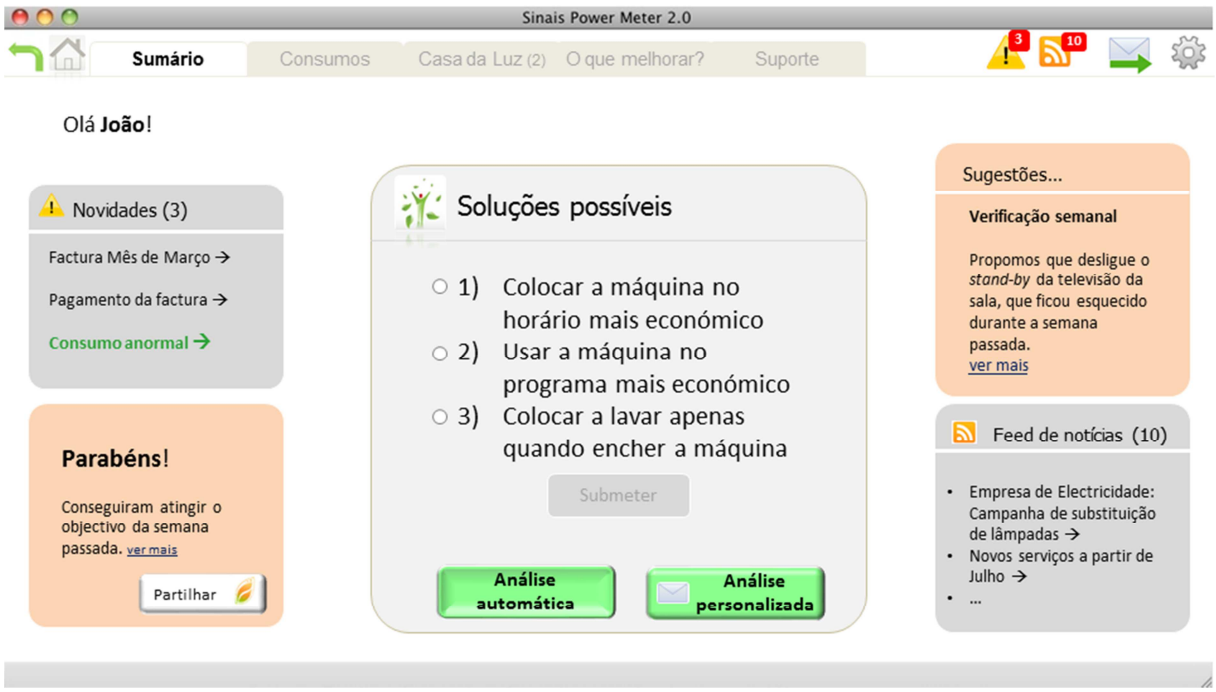


APPENDIX Q: Prototype of the service encounter "Check warning received and choose solution"

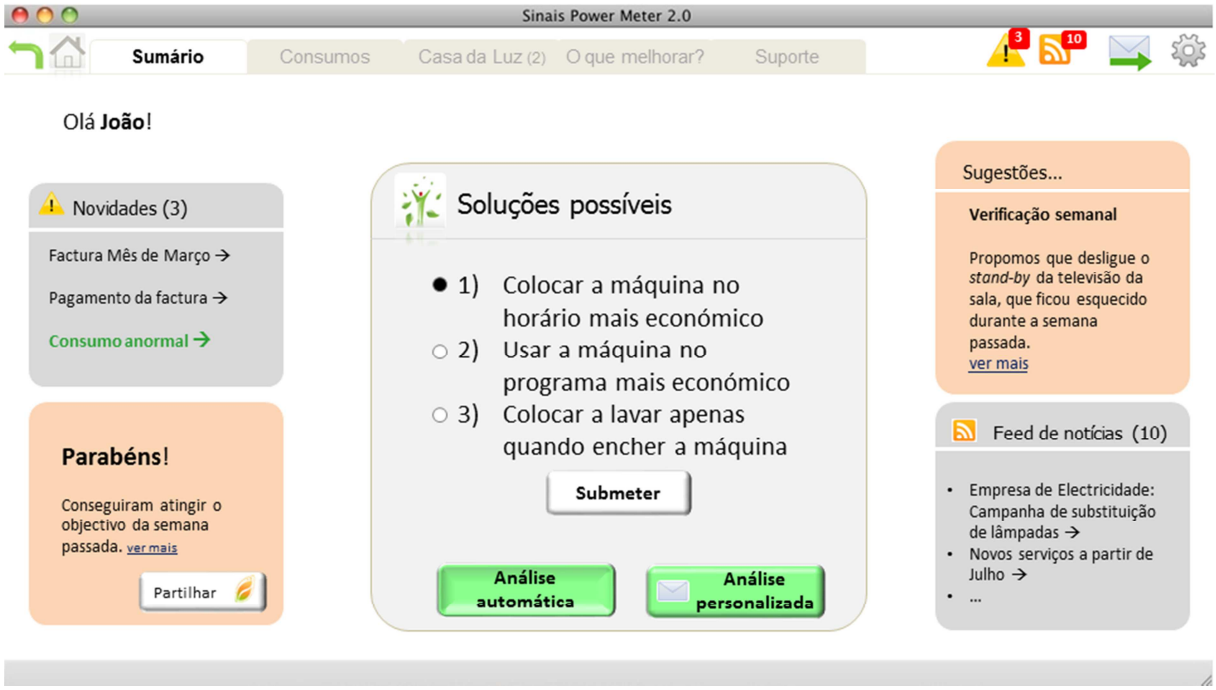
1. Check warning details
2. Browse options



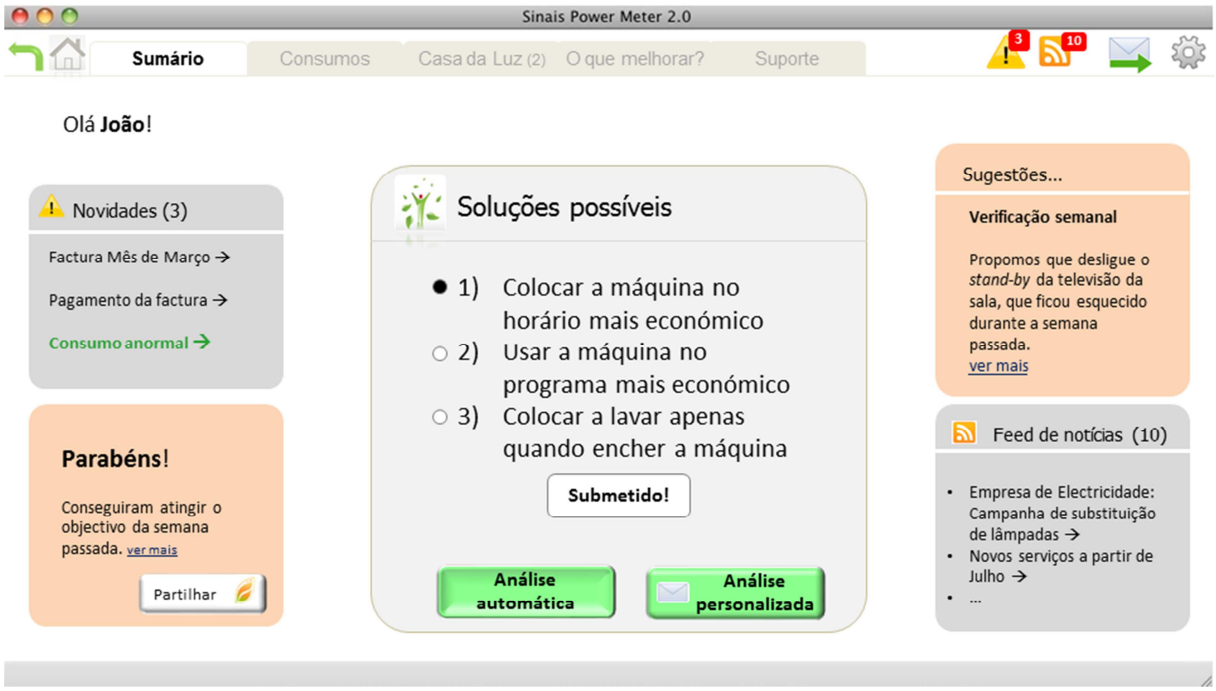
3. Request automatic Analysis



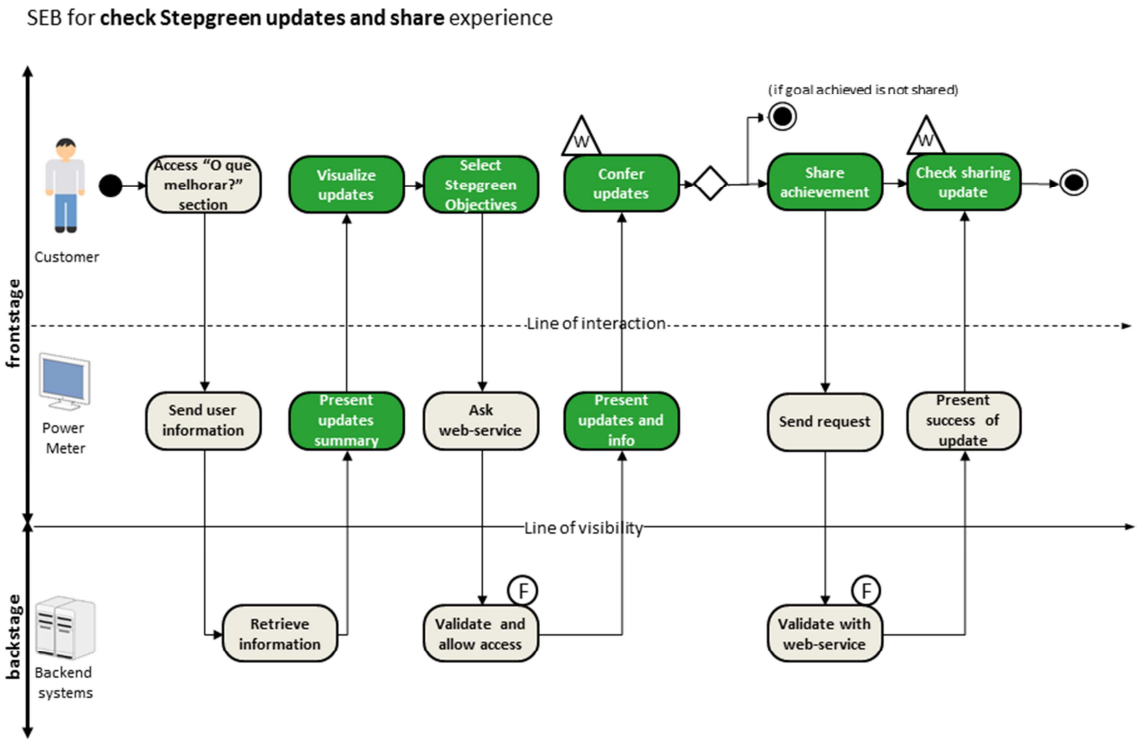
4. Choose one solution



4. Choose one solution
5. Implement solution



APPENDIX R: SEB diagram and Prototype for the service encounter "Check Stepgreen updates and share"



1. Access "O que melhorar" section
2. Visualize updates
3. Select Stepgreen Objectives

4. Confer updates

5. Share achievement

6. Check sharing update

APPENDIX S: Prototype for the service encounter “Ask for Support”