User-Centred Energy Systems

Developing a household energy planner through norm creative design

Users TCP Gender and Energy Task, subtask 3

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Contents

Summary

The design portion of the project, led by Boid as part of the wider research initiative, focuses on developing technical interventions that integrate norm critical design to sustainable energy consumption in Swedish households. This approach seeks to shift the focus from a traditionally male mindset in energy saving activities, which often emphasizes long term, technical solutions, to a more behavior-based approach traditionally associated with women, emphasizing daily energy use and planning.

The findings from the pre-study highlighted significant gender-based differences in energy consumption patterns and responsibilities, highlighting the need for inclusive design that primarily addresses behavioral aspects.

The design process involved iterative conceptualization, co-creation workshops, and engagement with field experts to refine the concept. The first concept iteration focused on making energy consumption visible and interactive within the household using a clock analogy, smart plugs, diodes, and a central interface to alert and engage members in energy management. Feedback from these iterations led to the development of a calendar concept, designed to blend into household environments and support planning and decision-making around energy use.

The proposed solution, a low-energy e-paper poster, functions as a simple yet comprehensive calendar integrating e.g. weather and energy forecasts and household activities, designed to engage all household members in energy planning and consumption. Key aspects of the design include its focus on future planning rather than past consumption and its integration with existing digital tools and platforms for ease of use. The design includes many norm-creative aspects, e.g. the importance of making energy information accessible and understandable to all household members, thereby distributing responsibility and knowledge more equitably.

Introduction

Transitioning to sustainable energy use and addressing gender inequality in Swedish households both revolve around taking responsibility and planning ahead. Typically, women take on the role of project manager in Swedish households, shouldering much of the mental load to organize day-to-day responsibilities and of decision-making. In contrast, men tend to make long-term and occasional decisions of larger financial magnitude - a male-coded approach to sustainable energy consumption that invests in technology solutions at a systemic level. However, Swedish households must adopt a behavior and adaptability-based approach, typically associated with women, to transition to renewable energy faster.

The proposed household planner challenges the male interpretation privilege of household contributions to sustainable energy use by focusing on everyday activities and people using electricity, rather than technical data and information, such as many mobile applications

focus on. And while most energy consumption data is hidden in personal letters, password-protected customer pages or meters and cabinets in garages or basements, this planner makes all information visible and central in the home, shedding light on the mental load of household planning and inviting all household members to participate.

The low-energy e-paper poster resulting from this concept is a calendar view that includes an extra layer of information on the energy forecast. It offers users quick, at-a-glance information and the opportunity to plan energy-related and other activities. The planner's style and design can vary, but it generally aims to blend into the interior design, like a traditional poster or wall calendar.

Project background

Boid's part in subtask 3 aimed to explore and implement norm critical design at a practical level. Boid's contribution was to develop and implement technical interventions that support inclusive energy use and challenge prevailing norms in sustainable energy consumption in the specific context of Swedish households.

Pre-study

During the project Boid worked together with the other researchers in the annex by conducting their own research as well as collecting input and feedback. Apart from the exchange with the group, Boid conducted literature studies and collected and read case studies concerning energy consumption and/or gender norms. General desk research was used in order to further educate ourselves about norm creativity in preparation for the design concept work. We were particularly interested in research, case studies, products, services, communication - anything where gender and energy meet. Even more so where they meet on household level.

Some of the design principles applied in the project are:

- inclusive design, which strives to serve a full spectrum of people,
- user centered design - an iterative process which focuses on the user of a product or service and their need in each phase of their process,
- activity centered design, which is based on user centered design but has a behavioral aspect of assuming the user will learn to adapt if the product is designed according to the intended activities and tasks.

Within these methods we regularly touch upon questioning norms. However, the pre-study gave us a better foundation from which to design and illustrated clearly how norms and gender issues boil down to power, since power is not something you have but something

that is produced and found in structures, norms & expectations. Some of the societal norms we have looked at in the project are social class, sex, generation, education and household norms.

Knowledge Overview

This preliminary study resulted in a KJ-analysis (a method first used by Jiro Kawakita, to organize data and ideas) to give a brief knowledge overview of the insights and ideas that the resulting work is based on. In the KJ analysis we summarized our findings; there were interesting numbers and statistics, though some of them were rather old, dating back to 2008.

We looked at social and personal norms, at direct and indirect efforts to broaden them, and we found examples of how consumption differs between women and men.

Information on behavior such as risk taking or how behavior impacts in comparison to demographics were also extracted within the KJ analysis. A behavioral aspect that stood out particularly was taking responsibility and was therefore highlighted in the summary. That is why the final KJ analysis summary divided the data into five groups: numbers and statistics, norms, energy consumption by gender, behavior and responsibility.

Select Numbers

Consumption (source 2008)

- women consume less energy per year than men overall (44,000 kWh vs 53,000 kWh)
- more than 70% of women can imagine consuming with less climate impact, and the corresponding figure for men is just under 60%
- 40% of men's energy consumption goes to transport, the corresponding figure for women is 25%

Education (source approx. 2018/2019)

- a woman with a degree in civil engineering earns an average of SEK 23.8 million during her working life, while a man with the same education earns an average of SEK 25.4 million
- the proportion of women graduating from civil engineering/university engineering: energy technology has increased by 11% in 10 years
- the higher the level of education, the lower the proportion of women who graduate from STEM courses (science, tech, engineering, mathematics)
    - Bachelor: 40% women
    - Masters: 36% women
    - PhD: 33% women

Work life (source approx. 2018/2019)

- in private energy companies globally (based on 135 companies), women make up 23% of employees
- in private energy companies globally (based on 153 companies) women make up 20% of board member

Norms

Social norms constitute attitudes, behaviors, opinions and perceptions that are considered *accepted in a given group in a given context*. Personal norms however, constitute attitudes, behaviors, opinions and perceptions that the individual considers *morally right*. Although, a personal norm is often the same as an accepted social norm. In terms of sustainable consumption, it is often required that the norm becomes personal in order to possibly induce a behavioral change in the individual, e.g. "Lisa doesn't stop eating meat for the sake of the climate just because her colleagues do. Lisa stops eating meat when she herself thinks it's morally right".

This relates to the theory of knowledge-action-gap and value-action-gap, which in short states that both subject knowledge and a value-driven (moral) intention are required to change one's behavior. If both knowledge and moral intention exist, there may still be obstacles (e.g. economic or social vulnerability) that can stand in the way of a change in behavior.

Direct norm intervention is a call to action where consequences or personal responsibility are made visible. E.g. “70% of your neighbors take public transport, do you?”

Indirect norm intervention is a gentler call to action that indirectly, often unconsciously, hopes to create a change in norms, e.g. placing the most climate-friendly option at the top, or informing about sustainable consumption and thus potentially signal that sustainability should become the new norm.

Energy consumption by gender

- Women drive more energy-efficient cars, eat less meat and more environmentally friendly food.
- Men use more direct energy (differs slightly depending on source and/or country) and energy advice today is mostly directed at direct energy consumption - therefore more relevant for men than for women
    - Direct energy - energy that you actively consume, e.g. refueling the car or using the washing machine
    - Indirect energy - energy that someone consumes due to your consumption, e.g. buying a t-shirt that has been produced in a factory somewhere else.
    - Sometimes the difference between direct and indirect energy is subtle or blurred, e.g. food items often require indirect energy consumption due to

production and transport and direct energy consumption in order to cook or heat them.

- Consumption patterns accompany new generations. Young men consume more energy on cars and transport. Young women buy more clothes and consumer products (e.g. beauty products) - and therefore we can expect that differences between men and women in energy consumption will persist (this is an hypothesis).
- Men have a higher energy intensity (energy amount per monetary value) on their purchases than women.

Behavior

Behavior and values influence more than demographics and home types when it comes to energy consumption at the household level. Energy consumption in two similar homes with a similar demographic composition can differ by a factor of 10. Many factors affect the individual's relationship with e.g. potentially reduced energy consumption - factors may be personal, value-driven, economic, societal or temporal to name a few.

If we are to create a concept that people will want and are able to use, we must take the relationship between these factors into consideration. This also applies to the interface that the concept contains (e.g. platform fatigue). Even though feedback on energy consumption can enlighten and provide incentives for energy conservation, it cannot in itself change the contextual circumstances that govern people's energy consumption. A concept that provides feedback is not enough. Some research indicates that women find it more important to change their energy behavior than to invest in energy efficient technical solutions.

Responsibility

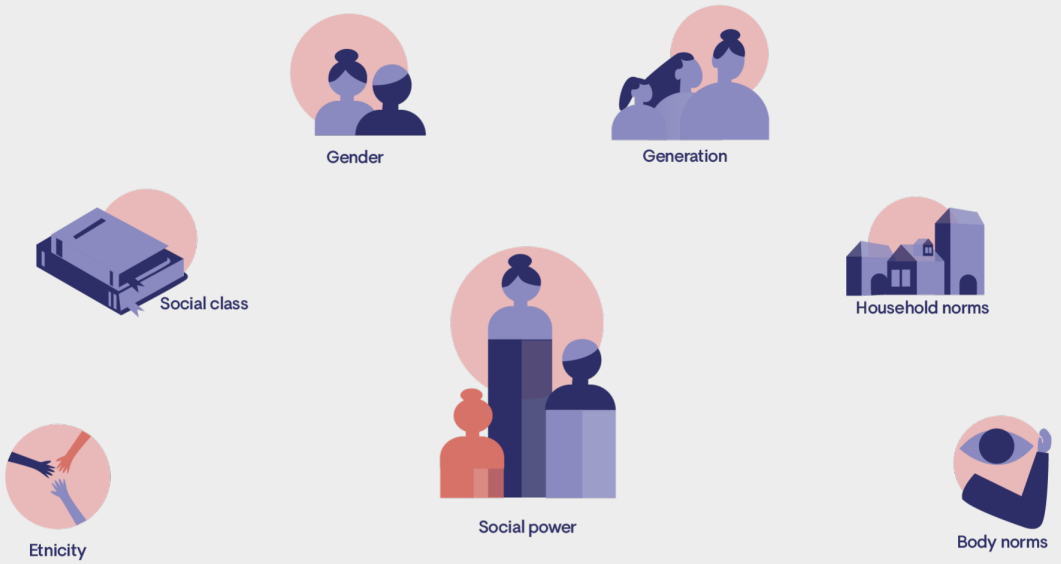
Women and men have clear areas of responsibility in households. Women tend to take more responsibility for adjusting energy behavior, while men tend to take more responsibility for reducing the climate impact through energy efficient technical solutions, e.g. to install solar cells on the roof or invest in a different heat source.

Choosing the focus area

Boid was asked to design interventions that support inclusive energy use and challenge prevailing norms in sustainable energy consumption in Swedish households. However, no specific product or service had been defined in the application ,so we began our work by having to find and define our focus area from the vast amount of possibilities within what was being discussed in the project group.

Based on the findings and insight of the preliminary study and knowledge overview, Boid tried to identify overlapping patterns in the challenges within the energy sector with the challenges of gender norms on Swedish household level.

Gender norms



While the term gender generally refers to the sex of an individual, gender research as applied in this project looks at gender as a larger variety of social norms such as ethnicity, social class, age or ability, all of which influence the social power of individuals or groups. Again, power is not an innate quality but rather a product of social structures, norms & expectations.

To accommodate the important role of gender in the project Boid has adapted a norm creative approach to the design task.

The norm creative process begins with norm critique. First, we bring norms to light and raise awareness about expectations for people in areas such as gender, ethnicity, class, age, sexuality, physical and mental ability, to name a few. Once these norms are visible, we can then use creativity to explore how they influence people, processes, decisions and opportunities. The norm creative design process translates norm critical insights into physical or digital solutions (products or services) that can help broaden existing norms.

While norm creative work must take into account many possible social norms, the differences in traditionally male and female coded behavior and expectations

surrounding energy consumption was supposed to be central to Boid's work. These gender norms are among the strongest norms there are, and are found in all different social classes, ethnicities and cultures. This project therefore chose to focus specifically on gender norms to avoid developing gender-neutral or gender-blind design solutions. At the same time, we were still highly aware of other social norms, such as household norms for example. We have specifically tried to broaden the norm of the heteronormative couple relationship with children as the standard household constellation. Other examples with great importance in the context are norms around age or class that can affect the acquisition and use of a design solution in the form of a technical intervention. One of the tools we used for this was idea generation using the Nova deck, a collection of norm creative working methods published by Vinnova.

As indicated in the knowledge overview, our key findings for the gender research involved behavioral differences concerning household tasks, particularly in regard to planning activities and taking responsibility for short term vs long term decisions. Women tend to own responsibility for short term activities and decisions to a larger extent than men. Examples for short term responsibilities are meal planning, grocery shopping, preparations for important events, managing appointments, cleaning and laundry as well as planning for trips and keeping household members equipped with adequate clothing. Meanwhile men tend to be responsible for long term activities and decisions to a larger extent than women. This may include monthly or seasonal chores as well as one-time decisions like household investments. Examples could be car services, paying bills or installing household equipment.

The frequency and relentlessness of short-term responsibility is such that it craves consistent thinking and planning ahead of time. This is why the project refers to this role in a household as the ***thinking project manager***, meaning the person who carries most of the mental load of cognitive housekeeping. Depending on the individual household and household constellation this role may be shared or rely mostly or entirely on one person. However, we find that on average it is mostly a role held by women.

Energy Research

Transitioning to more sustainable energy consumption usually involves either reducing the amount of energy consumed, using energy more efficiently or transitioning to renewable and sustainable energy sources. Many efforts in sustainable energy consumption are made on a systemic level involving policies or large-scale infrastructure. While other subtasks in this project have been looking at just those perspectives, our focus was energy consumption on household level.

At the beginning of the project, the importance of household efforts was not as highlighted in public discussion as it is now towards the end of the project. Recent events connected to the surge of energy prices, such as the war in Ukraine, have both brought to light the vulnerabilities of our energy market and the importance of energy

efficient and resilient households. Energy prizes being a large incentive for any changes being made on household level, recent developments on the energy market have brought along more general awareness and knowledge of energy consumption.

During the project we divided energy consuming activities in households into three categories: **active energy consumption** (cooking, using electric devices, etc.), **passive energy consumption** (heat, lighting, etc.) and **responsibility and planning of energy consumption** (paying bills, installing technical upgrades, lifestyle adjustments, tracking consumption etc.).

Within this last category of responsibility and planning we found striking parallels to our previous finding concerning male and female coded household responsibilities. As in our gender research we can see that the typical male coded approach towards energy consumption is characterized by long term decisions such as the investment in technical upgrades and it is largely motivated by financial incentives. Men also tend to make use of smart-home solutions to a larger degree than women. This approach has historically taken more space in the general discussion around more sustainable and cost-efficient household energy consumption.

The typical female coded approach is based in behavioral adjustments and mindset shifts connected to day-to-day activities that need continuous attention. In order for us to transition to renewable sources faster, to be more resilient to less stable energy supply in the future and for households to manage rising prices more flexibly, we must embrace and apply both approaches. In other words, this project wanted to highlight that smart users, not just smart homes, may be the missing link towards more sustainable energy consumption. And while developments on the energy market during the course of this project have brought this behavior tied approach closer to the surface of the general discussion, the practice of behavioral change is still bound to the imbalance of gender norms in Swedish households.

As the thinking project manager, women are often responsible for activities that serve the entire household. Therefore, women bear a lot of the responsibility for adjusting energy behavior connected to those activities. At the same time those same activities such as laundry or cooking often demand a lot of energy while holding a relatively low status. Consequently, any behavioral shifts such as timing these household activities according to varying energy prices over the course of the day, bear heavier on the thinking project manager and add to their mental load.

This is why Boid has chosen planning and taking responsibility for energy consumption, the intersection where both our gender research and energy research overlap, as the focus area for the design work.

The Knowledge-Value-Action Gap

As part of the norm creative process ,we highlighted how expectations for women and men typically differ when it comes to consuming energy sustainably. In order to translate these insights into behavioral shifts where cognitive housekeeping connected to energy consumption would be shared more equally among household members, our design had to make the prevailing norms visible.

To do that we had to understand where current behavior comes from and what obstacles may impede bringing about change. Insights into the challenges people face in obtaining knowledge about the issue at hand, whether they care about it, and how they can be convinced to act upon their values are collectively known as the knowledge-value-action gap.

- Examples that prevent people from obtaining **knowledge** include a lack of access to information, disinterest, misunderstandings, or misinformation.
- Obstacles preventing people from **caring** about an issue may include conflicting values, disinterest, societal norms, or even denial.
- The final and most significant hurdle that may prevent people from **acting** upon their values includes time and planning constraints, competing priorities, feeling overwhelmed, becoming too comfortable, or lacking access to necessary resources.

These obstacles can result in either a knowledge-action gap or a value-action gap, which hinder people from participating and driving progress.

By studying the knowledge-value-action gaps for energy behavior and cognitive housekeeping we tried to identify where to target our design as well as foresee possible hindrances in the application of a design solution. How do we get people to know about gender and energy issues? How can we bring them to care about these challenges and wanting to see change or improvement? And finally, how do we get people to act upon this knowledge and conviction and weave it into their behavior?

In the field of household energy planning and responsibility, we often encounter significant knowledge and value-action gaps. For instance, energy planning and responsibility frequently rest with a single household member, or the division of responsibilities is divided between long-term and short-term decisions and activities. This segregation creates a situation where some household members are prevented from acquiring knowledge, developing a sense of responsibility, and taking action towards energy conservation.

Another significant finding in our research on household energy planning and responsibility pertains to the interfaces used to communicate information about energy consumption to household members. These interfaces may include energy bills, forecasts, statistics, or meters. However, many of these interfaces are challenging for the entire household to access. Some are accessible only through personal logins or

directed to a single individual, such as a personal letter. They may be located in places that are less frequently visited by all household members, such as electrical cabinets in garages or basements, or may be installed as applications on mobile phones, often accessed by only one member of the household.

Additionally, the language used in these interfaces may be unfamiliar or abstract, making it difficult to understand how to translate the information into daily routines. Many of the energy interfaces we have observed either reinforce gender norms, such as targeting only one person or focusing on technical aspects rather than behavioral ones or are entirely gender-blind and do not address gender norms at all.

That is why we chose to focus our design work specifically on creating an energy interface that is more accessible to the entire household, hoping to highlight the problem and promote knowledge among all household members about energy consumption and its impact while also broadening current norms by helping to distribute energy planning and responsibility more evenly among household members.

The Design Process

The design process in this project was an all-encompassing phase including design sprints, workshops, feedback sessions and student work.

Research Through Design

In the project, we have used the strategy *research through design*, a methodology that emphasizes the role of design practice in generating new knowledge and insights. It means using design as a research tool to explore and understand complex problems or phenomena. This approach emphasizes the importance of iterative concept generation and experimentation as a means of generating and refining new ideas.

The basic idea behind research through design is that by designing and building early concepts, innovators can test and refine their ideas in a tangible way. This process allows us to explore different possibilities and to gain a deeper understanding of the needs of all stakeholders, who get an opportunity to react to concrete ideas. Instead of collecting a large amount of data and information first which is then packaged in a design proposal with the hope that the communication has been interpreted correctly, design proposals are introduced early in the course of the project and used as a tool to provoke reactions from the user and can be evaluated in the complexity of the context.

Co-creation Workshop in Nösund

In the spirit of research through design we presented our ideas and concepts about designing an alternative energy planning interface early to the rest of the project group in a co-creation at the project conference in Nösund.

At the co-creation workshop, we formed three groups consisting of 4 participants each and tasked them with brainstorming alternative energy interfaces in four different areas:

1. Paying energy bills
2. Making energy consumption visible
3. Planning for energy production/consumption
4. Free ideas for other areas (within a household)

Once the general brainstorming was complete, each group was asked to refine their ideas and present a single concept. Participants were encouraged to provide details, use cases, and invent contexts that imagined who would use the interface, how, why, and where, as well as what type of household would benefit most.

Finally, the groups analyzed and discussed their ideas from the perspective of different norms, such as gender, age, physical ability, household type, ethnicity, culture and language, class and any other relevant norms they deemed important. In doing so, they applied their knowledge of norms and inclusion to ensure their ideas were inclusive and accessible.

The ideas generated during the workshop were diverse, encompassing a range of formats, from big to small and from digital to physical.

- Group 1 came up with the concept of a public energy phone booth that would cater to both online and offline users. This booth would provide unbiased energy advice and help users pay their bills while also offering information about consumption in a relatable and practical manner.
- Group 2 proposed a business model for an independent and trustworthy organization that would track and map household energy data. This organization would allow energy communities to donate and share energy data with one another, and the monitor displaying this information would be located in the entry area of a home.
- Lastly, Group 3 suggested a button system for tracking energy usage by household members. Buttons would be placed on key energy-consuming devices, allowing for easy tracking of who performs which tasks and which tasks consume the most energy.

In addition to the discussion areas provided by boid during the third and final part of the co-creation session, other topics of discussion included energy literacy, abuse, and integrity. These discussions sparked interesting conversations at the conclusion of the workshop.

Here are a few key takeaways from the discussions at the conference in Nösund, some of which have played a large role during the development of the design proposal later:

- The needs of children, pets, and frail individuals can play a decisive role in energy activities and decisions, both directly and indirectly. While it may not always be possible to include all household members, such as children or those with cognitive impairments, in the decision-making process, interfaces that are transparent, visible, and accessible can involve and respect all members simply by providing feedback and information.
- Historically, households were more energy resilient as they relied on fewer or no electrically powered appliances. Light, heat, and household chores were managed using other resources and manual labor. While we can draw inspiration from such historical solutions towards energy-resilient living, it is essential to remember that much of this resilience was maintained by women who were tied to their households by labor.
- Modern technical solutions have brought about new household tasks and responsibilities, including digital housekeeping, involving the setting up, handling, and maintaining of household smart home devices and interfaces. This also affects the amount of cognitive housekeeping, referring to responsibilities related to planning and foresight.
- Justice and sufficiency are crucial factors to consider when designing norm-creative energy solutions. As people's living conditions, circumstances, and values can vary significantly, it can be challenging to determine what constitutes enough or too much consumption and what prices are fair. While this is a complicated issue with no simple answer, those who already consume the least amount of energy should not be the only ones shouldering the burden of the problem.
- Donating energy may be an alternative incentive for promoting behavioral change regarding energy consumption, rather than relying solely on monetary incentives. However, this donation should not be anonymous or abstract but rather handled on a more personal level within virtual energy communities. For instance, "I can more easily tolerate a slightly colder apartment and warm myself with an extra sweater if I know that my behavior will provide a hot dinner for granny."

Design Sprint 1: The First Concept

After receiving insights from the group at Nösund and several internal workshops and ideation sessions, Boid continued with a design sprint to develop a conceptual idea for a design intervention that would involve all household members and provide respect and status to daily project management activities in the household.

Specifically, the purpose of the concept was to clarify the power dynamics related to gender issues by making visible the momentary effects of energy-demanding activities.

This visualization would not be directed at an individual in the household, like current solutions in apps, websites, and personally addressed letters, but instead, would be connected to the activity itself through a common and inclusive interface centrally located in the heart of the home. The interface would also enable household members to prioritize certain activities over others to avoid using too much energy at the same time and to jointly adapt to the electricity grid's load and the household's own power peaks. In this way, the prototype would become a catalyst for communication about energy between household members, creating respect and attention for both female- and male-coded essential activities in the household and distributing these activities among several household members.

Moreover, the concept would enable concrete handling of the smart electricity grid of the future, electricity grid load, and pricing according to power peaks, something that most electricity companies have already embraced in their business models. The interface includes a load forecast, allowing users to relate to and plan the day's energy consumption.

The concept consisted of three parts.

1. A number of **smart plugs** were connected to various strategically important energy-demanding equipment. However, unlike most smart plugs, these plugs were rather connected to the cord of the device (like a travel adapter) and therefore tied to the individual energy activities, and not designed to be an extension of the wall socket. During tests these smart plugs would measure the current power from the outlet.

   Note: This part of the concept could be replaced by other means to access the same data, for example future smart grid technology.

2. A number of connected **diodes** were placed next to the strategically selected energy activities in the home. These diodes did not necessarily have to be on the product itself, but where the activity started/was carried out (e.g. where the car keys hung/at the electric car's charging station, and not in the car). When the household's preset power threshold was reached, the diodes would start to pulse.

   Note: The power threshold could be connected to the power forecast from the electricity company and shift in correspondence to it. It could also be a fixed threshold that they always aimed to stay below. This was perhaps due to energy agreements and the companies' business model.

3. At the same time as the diodes started pulsing, an audio signal was heard from the **central interface** which was placed in a strategic place of the home where everyone in the household could see and interact with it. This interface would collect data from all smart plugs to see which machines used the most energy in real time and alert the diodes when too much effect was consumed, and the

household's preset power threshold was reached. Designed to be a provocative design research tool the alert with both visual and audible signal would not cease until energy consumption was adjusted or the threshold overruled in the interface. Another provocative idea was to give essential activities, for example those that the entire household would benefit from, precedence over activities that may be considered a luxury. In practice that would mean that non-essential activities would be encouraged to be turned off first. The central interface, connected to the household's electricity provider, would also provide a forecast of the load on the electricity grid. By visualizing high or low load on the grid or even providing information on planned power outages, the household would have the opportunity to plan their energy use in advance.

Side note: The above concept was derived at the beginning of 2022, before the energy crisis dramatically changed the general narrative. At that point in time the idea of planning ahead most energy craving activities in order to consume energy at a lower price for the environment and the wallet was not yet a commonplace mindset. Swedish households have long been able to use electric energy whenever and how much they wanted as both supply and energy prices were not much to worry about. Thus, the idea of planning energy consumption in advance was and was meant to be a bit provocative. In the spirit of research through design we wanted to test ideas that would provoke reaction and insight from users and others beyond subtleties.

Student Work - The Energy Clock

During the project Boid had the opportunity to work with a group of students who were working on their Bachelor's thesis to design and test a first iteration of our early design concepts and ideas. The opportunity to co-create with others, in this case other designers, is beneficial to the norm creative process as personal bias is more likely to be discovered and ideas may sprout from a wider range of norms and frames of reference.

Boid challenged the student group to design and build a testable prototype of the above-described concept. The group consisted of six students and worked on the given tasks for a period of about five months.

Following is a summary written by the students (for more detailed information we refer to the full report):

The purpose of this bachelor thesis has been to create and evaluate a concept that will make the instantaneous power of energy-consuming activities visible. The concept should also simplify planning and responsibility for household energy in a sustainable and equal way. Furthermore, the concept should empower all members of the household to contribute. To get a more profound knowledge of the problem the group began with a pre-study. This contained market research to analyze the current situation, a literature study, and interviews with potential users.

The initial interview study found that, in a household, one person is often singularly responsible for electricity-related tasks, and the only person in the household to have a good understanding of how much electricity the household used. Which person in the household was responsible often came down to technical interest or knowledge.

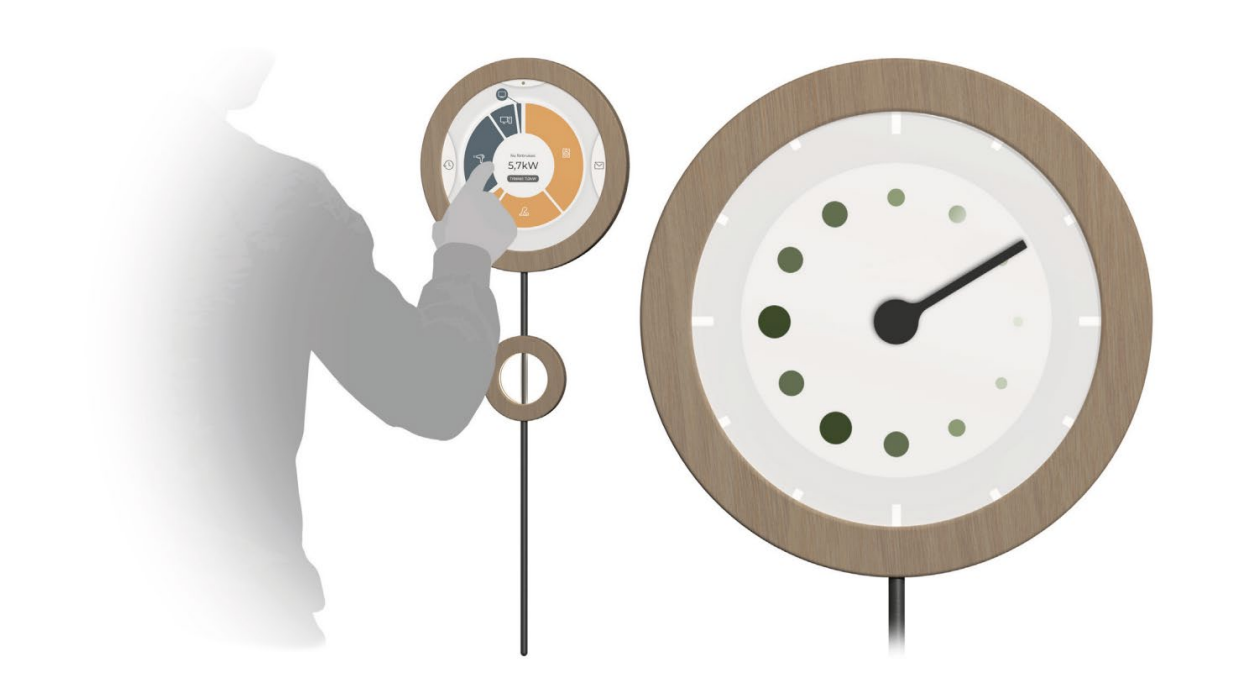
Based on the results obtained from the initial study, the group continued with the ideation phase. The main aim of the ideation phase was to generate numerous ideas concerning shape and function. Thereafter, the ideas developed into various concepts. To continually evaluate progress with Boid, meetings were held every week to discuss the concepts. The ideation phase was an iterative process, which means that the group kept working through ideas to improve the product throughout the whole design process.

The concepts were finally narrowed down to a single concept which was chosen in large part due to its simplicity and feasibility. A central part of the project is to increase the inclusion of energy-related tasks for all members of a household. It is, therefore, necessary that the product appeals to all, not only those with a technology interest. For this project, the ability to create a working prototype was also essential for testing, which had to be considered during concept selection.

The concept consists of an energy clock with an associated ring made of wood, see the picture below. Users can interact with the energy clock in the form of a touch screen. In the interface information about when it is best to use power, energy consumption history and real-time details about power consumption can be found. As the power at any given moment is increased the ring moves up, towards the screen. If power decreases the ring moves down. This way only a glance at the product will indicate power usage. The product should be placed in a central location in the household, where all members spend time daily. Through this, the product becomes a natural part of the entire household's everyday life. Indicators, which also demonstrate the energy consumption using light, are additionally placed around key power-consuming appliances. The purpose of the indicators is to extend energy awareness throughout the home, where the actual power consumption takes place.

In connection with the concept development, physical representations were built to evaluate the ideas in collaboration with users. To estimate the usability observations and interviews were conducted with several users. They were asked to interact with the prototype and complete some assignments. Afterward, a more extensive test in the use environment was held. The participating household had the product at home for five days and was then interviewed regarding their experience.

How well the product contributes to adjusting behaviors linked to gender and energy consumption needs to be studied over an extended period to get more reliable results. The tests however showed that the concept essentially meets the requirements specified at the beginning of the project.



Picture: Illustration of student concept - The Energy Clock

Our evaluation

The student's work helped us reflect on the initial concept and see which elements were most important to bring along into a further iteration of the interface and which were not contributing to our overall goal of designing a norm creative household and energy planner. And while the students incorporated all the initial concept's elements and managed to build and test their design, Boid felt that the result was too focused on the technical elements of the concept whereas the norm creative aspects gave way to compromises. We specifically felt that the focus of the energy clock lied too much on current consumption and historic energy data rather than focusing on how to plan energy consumption ahead of time.

Below is a summary of our comments:

What worked well:

- The spatial inclusion of all household members by placing the interface in the kitchen or hallway, at the heart of the home, was well received.
- The idea of using energy conservative e-paper screens was well received with the students and users during the tests, balancing the contradictory fact that introducing an electrically powered device would be counterintuitive to a concept that is meant to optimize overall energy consumption.
- To ask people to adjust their behavior did not meet as much resistance as anticipated. It is important to note here that this could be due to the test circumstances, where the students had personal connection to the testers. Furthermore, a shift in general behavior and attitude in Swedish society could be observed during the course of the project, as the energy crisis was progressing,

and energy literacy increased. By energy literacy we mean the general knowledge about energy consumption, pricing and impact.

What did not work:

- Overall, the interface of the student work was quite complex and inexplicit as it was made up of several different views and functionalities, making it rather similar yet harder to read compared to existing interfaces, such as energy provider mobile applications.
- Specifically, the *at a glance* information about the energy status was hard to read and understand.
- While integration of the interface into an existing routine was suggested and encouraged by Boid, the integration into a clock and execution of that was too bulky. As the design of the clock's interface was kept simplistic and used only one handle, the user could only guess at the exact minute of the current time. Moreover, the energy forecast integrated into the clock face was hard to read and interpret as there was no intuitive way of telling whether a small circle meant much or little energy.
- By choosing a clock as a bearer for the energy interface, the students chose to use a round format. While this indeed strengthens the association with a known and common interior design object, other information and views inside the interface were not well adapted to the format.
- Overall, the chosen design felt anchored by the limitations of the building of the prototype.
- Generally, the student interface focused mostly on technical information regarding energy use, while norm creative functionality, such as prioritizing certain activities and supporting and making visible the cognitive housekeeping were not addressed enough.

What was missing:

- The concept was missing the connection between activity and specific person, which would easily make visible to all how responsibility for which kind of activities within the household was divided.
- The design was also missing the possibility of planning one's energy consumption ahead of time.

Design Sprint 2: From Clock to Calendar

As established earlier, all gender norms boil down to power. Knowledge is a means of gaining power. Therefore, any insights to household members about their and their fellow household members consumption of energy is power as well. If we can diversify this power by bringing knowledge and subsequent action to the entire household in an integrated and consistent way, we may be able to broaden gender norms in energy consumption gradually and permanently.

Therefore, Boid continued with another design sprint, this time focusing on a more simplified, norm creative and integrated version of the energy planner. We focused on the following aspects:

- Behavioral adaptation that would challenge the prevailing male interpretation privilege in how to make energy consumption more sustainable.

- Spatial and cognitive inclusion that would allow and invite all household members to participate in planning and thereby support the thinking project manager and make responsibility and power visible.

- Planning energy in advance and gradually gaining a feel and knowledge over energy supply, cost and environmental impact, rather than a focus on energy consumption history and statistics or drastic intervention that is not anchored in current household routines.

A commonly used analogy during the project when talking about energy literacy was that, just like time, energy is rather abstract until you have exposed yourself to various experiences with it in the context of real life and seen it change over the course of some time. With time we learn from a young age to read a clock, a calendar, the names of the weekdays and we are constantly surrounded by clocks and calendars that mark and visualize the measurement of time, so we gain an almost inert feel for it. However, despite using electricity every single day, energy in terms of kW and kWH remain abstract almost ungraspable units to most people, as energy consumption is almost exclusively tied to daily activities and needs beyond the purpose of using energy in itself.

If the clock is a tool to show what is now, the calendar is a manifestation of planning around time in advance. It seemed therefore fitting to shift from the integration of our energy interface into a clock toward an integration into a calendar. This would not only give us the opportunity to focus more on future consumption rather than past consumption, it would also make energy activities more visible, allow us to tie those activities more clearly to individual household members and support the thinking project manager to a greater extent. Energy consumption is therefore seen more clearly in context with activities rather than as an abstract number or stack in a graph.

In this way the interface also shifts from being a tool for energy visualization to being an integrated household planner. Just like we have identified planning as a common theme for both gender and energy challenges, we want to combine aspects from both, common energy information interfaces and planning tools directed at the “thinking project manager” often referred to as “mom planner” that would help with organizing the schedule and activities of household members as well as meal planning and keeping on track with chores and events.

Additionally, we wanted to simplify both the interface in itself and the interaction and building of it. Therefore, we kept the prominent placement of it at the heart of the home and turned it into an e-paper poster-style calendar with touch screen abilities.

Aesthetically it is important to us to aim at a design that resembles a printed calendar or poster rather than a common web application. We hope that this interior design approach combined with the e-paper screen that is not back lit and only uses electricity if any changes in the display happen, will make it easier for the planner to be perceived as an everyday object that can be integrated in existing routines and not be yet another screen.

Apart from the inflation of screens in our lives, people frequently report platform fatigue as a reason not to adapt new tools intended for behavioral change. The current concept relies therefore on exclusively using external API's that many people already commonly use.
Data from the following existing tools and platforms may be used for the proposed interface:

- An existing digital calendar API, such as the data from a household member's google calendar
- Energy forecast data, possibly provided by the energy provider or from an aggregated source
- A weather API
- Notes (possibly tied to notes on the mobile phone)
- Data from a digital shopping list the household may already use
- Reminders

There may be other interesting data, depending on which household will be using the planner. However, for now we are keeping the concept as simple as possible.

Also, the planner as it is proposed now and as it will in part be tested further on, will not in fact measure actual consumption on site like the previous concept, but rather focus on providing information on what is now and what is to come. The idea is to encourage the inclusion of energy information into considering one's activities and behavior without force, so as to not further burden the thinking project manager. By not focusing on past consumption but looking ahead we want to remove stress and possible guilt for behavior that had to prioritize other factors than energy consumption as well as remove an element of competition and the focus on data. Additionally, this information is already available elsewhere and not essential to the intended effect of our design solution.

While the aesthetics of the poster style planner may vary according to the users' personal style and taste, we have exemplified the information shown in the planner in a design suggestion with the following basic layout:

"At a glance" information

The top and/or background of the poster contains *at a glance* information that shows the status right now and is comprised of information about:

- The current energy situation concerning pricing and environmental impact
- Today's date
- The time right now
- The weather right now, including temperature, precipitation, clouds, wind etc
- Possibly this part of the planner could also show reminders set in the phone or in the future right in the planner

Weekly calendar

The main body of the planner would be filled with a weekly calendar. We settled on a weekly view as a daily view did not provide us with the foresight needed for activity planning and a monthly view did not allow for the space and detail needed to adjust individual activities to daily energy fluctuations.
Besides providing an overview of planned activities, the calendar provides:

- Energy forecast information, as a visual background to the calendar
- Weather forecast per day (not hourly)
- Different colors for different calendars, for example per person (this is if the e-paper display supports color)
- Planning short and long term. Swiping left and right would provide access to previous weeks or weeks to come.
- Moving about, adding or removing activities in a kanban style, an intuitive and easy method where cards or notes of information are moved about into different places on a board or screen.

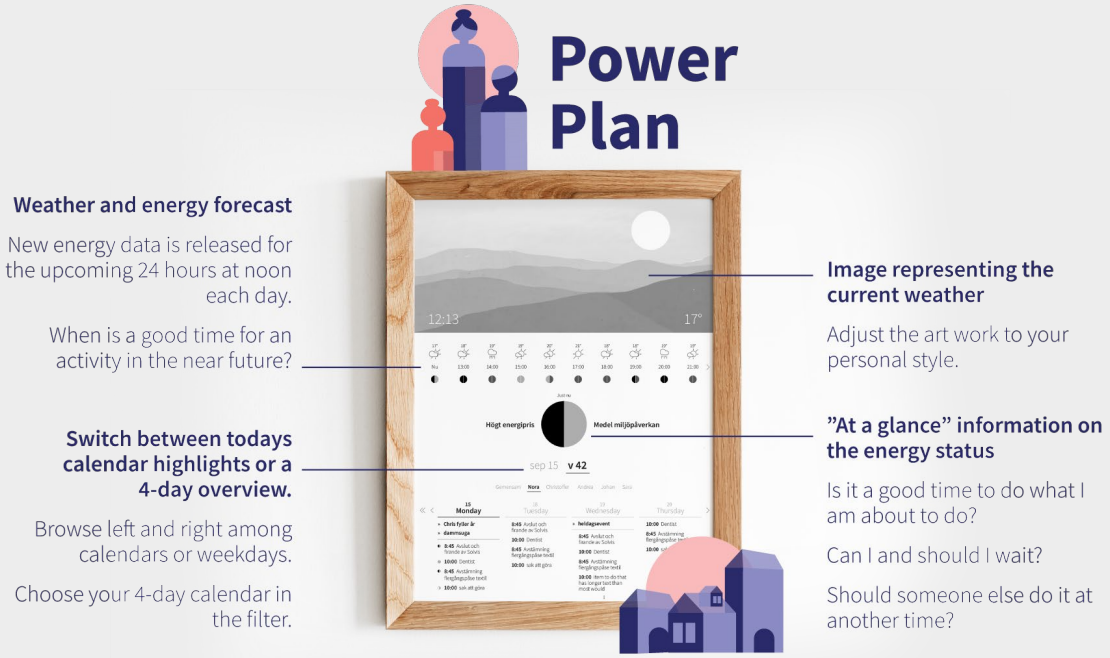
Activity pop up view

When clicking into any activity or creating a new activity, a detailed view would appear as a pop up. Here a user would plan out the calendar entry as accustomed from common digital calendars. In addition, the view would allow users to set an activity to *essential*, which would mark it as an activity that benefits the entire household or especially important. In times of low energy availability these activities would stand out as those that must be prioritized. Assigning essential activities to specific household members would also make the responsibility for such efforts visible and possibly highlight any unbalances.

Lists and routines

Finally, there would be a part of the interface that may be hidden at the bottom of the screen most of the time and be accessed by clicking or swiping it into view. The part would hold additional tools that a thinking project manager may need to share with the household to a larger extent. This could be:

- A *parking spot* for routine or frequently recurring activities or such activities that will have to be planned in the future
- Lists such as shopping lists, chores, check lists or to do's



Picture: Illustration of calendar concept

Workshop and Discussion with Experts

After the second sprint Boid conducted another workshop during which project partners from across the subtask could give us feedback both as experts within the fields of gender and energy as well as people who live in homes and plan and perform energy related activities in their daily lives. Fortunately, our participants ranged in age, nationality and background, which we see as beneficial to being able to broaden our own norm driven frame of reference. It was also important for Boid to capture perspectives from our fellow researchers that may be incorporated into our design proposal.

Once again, the workshop was designed as a co-creation workshop where participants were divided into two groups. Each group was presented with a different set of two use cases (making it 4 use cases in total) in which our proposed design concept would be placed. The use cases included a retired couple living in a country house, a large family with small children living in an apartment, students in a shared living arrangement and a single parent with a teenaged child who lived with their other parent every other week.

We provided the participants with further details about these imaginary use cases and people, such as their background, income and education as well as interests and general beliefs.

We then asked the workshop participants to discuss and fill in the use cases with the help of the following questions:

- Where in the home should the concept be placed?
- How would this household use the calendar?
- What is missing in the concept?
- Would the concept work in this household?
- What works well? Badly?
- How does the concept contribute to broadening norms in this household with regard to energy/in general?

Some things that seemed to work well

- Combined with a clear onboarding process, the interface in general seemed to be able to cover the needs of many different types of households.
- The visual background to the calendar communicating the energy forecast was easy to understand.

Some things that could be improved

- Setting activities to be *essential* was less relevant in a shared living situation where tasks tend to be more connected to specific people.
- A filter functionality could help us further simplify the visual expression and readability of the poster.
- In part time living situations people may only be in contact with the concept part time. As the idea is to subconsciously create a mindset to follow an estimated forecast over time, a future iteration might consider a complementary mobile application.

Conclusion and Future Work

In addition to this project, Boid also applied for a small grant from the HSB Living Lab on Chalmers University Campus which led to another iteration of concept design and extended testing. We refer to the full report for more detailed information.

Furthermore, Boid has an ongoing discussion with a company which has developed a framework for e-ink screens. Although no specific cooperation has been agreed upon, Boid intends to continue inquiring about possible cooperation in the future when findings from the tests at HSB Living Lab may be iterated once more.

While some future iterations are still distant and unknown, the insights during the project have already given us many indications as to how the interface may be improved, completed or changed.

One major ambition is to keep working with the user experience design of the interface. Both to better exemplify that it can be adapted to various tastes and interior design styles, but also to make it as adaptable to user needs as possible to ensure it will be adapted and integrated in household routines and provide long term behavioral change and contribute to more sustainable and empowered households.

In addition to the current functionalities, in the future the planner could serve not only as an interface between energy, household activities and household members but also as a platform for energy providers, technicians and users to interact. This functionality would provide information and security for people with questions about their energy consumption or in some cases production, lowering the hurdle for people of a less technical mindset to also engage in such activities concerning systemic changes and investment in technology such as the installation of solar panels for example.

This notion is also supported by studies conducted by our project partner Sylvia Breukers from Duneworks in the Netherlands. The study took a closer look at smart grid communities and found among many other things that information and communication in relation to the technical equipment could be more inclusive and accessible.

By implementing this, the household planner could serve as a means of broadening gender norms around sustainable energy consumption in both directions, inviting all household members to engage on a behavioral level as well as equipping companies and potential customers for technical upgrades with a way of communicating at a household anchored and inclusive
level.

While the energy crisis in Europe, partly brought about by the war in Ukraine, also brought along with it a dramatic shift in mindset toward energy use and energy literacy (meaning the general knowledge about energy consumption, pricing and impact) the gender norms around energy consumption in Swedish households have not undergone an equally dramatic shift. Boid feels that the design solution proposed in this project has benefited from recent developments on the energy market, as rising prices and the following rise in demand for more information in the form of energy tracking applications have confirmed that households are capable of adapting to changes in energy supply. It is also clear to us from observations that engaging in discussions about energy is common in many different types of households. In order to make sure that energy efficiency and resilience is not upheld at the cost of women and more ingrained in future generations' mindset, we hope that we can continue work on our inclusive household planner even after this project has come to an end.

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