BACHELOR THESIS

DESIGN OF AN ENERGY MONITORING INTERFACE FOR BUSINESSES

UNIVERSITY OF TWENTE.

Ipsum

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DESIGN OF AN ENERGY MONITORING
INTERFACE FOR BUSINESSES

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SUMMARY

From april 2016 to july 2016 an energy monitoring interface was developed for Ipsum as part of the bachelor assignment for the study Industrial Design at the University of Twente. A prototype was created, based on user analysis, user interface design knowledge and usability tests. Stakeholders, potential clients and the staff of Ipsum were included in the design process in order to deliver a valuable prototype. This report describes the iterative and user centred design process to underpin design decisions. The result of the assignment are an interactive protoype and recommendations for further development.

SAMENVATTING

Van april 2016 tot en met juli 2016 werd een grafische interface ontwikkelt die inzicht geeft in het energie verbruik. Deze bachelor opdracht werd uitgevoerd voor Ipsum en de studie Industrieel Ontwerpen aan de Universiteit van Twente. Een prototype van de interface werd gebouwd, gebaseerd op een gebruikers analyse, design kennis en gebruikstests. Belanghebbende, potentiële klanten en de werknemers van Ipsum werden bij het ontwerp betrokken om een prototype van meerwaarde op te leveren. Dit verslag beschrijft het ontwerpproces om ontwerp keuzes te onderbouwen. Het resultaat van de opdracht zijn een prototype en aanbevelingen voor een vervolg ontwerp.

Figure 1-1 Ipsum's dataflow: 1. Collect data 2. Send it to database 3. Run the algorithm 4. Get smart insight

INTRODUCTION

This chapter will give a brief introduction about Ipsum and its unique selling point. Furthermore it will elaborate the goal of the bachelor assignment and the main steps that were taken to complete it.

Ipsum is an electricity monitoring startup that exists since 2013. Ipsums goal is to give smart insight into the energy consumption of companies and private consumers. By gaining insight, customers are able to reduce their energy consumption, save money and have a positive effect on the environment. Ipsum's unique selling point is the ability to detect the consumption of distinct electronic devices by analysing only the total energy consumption of, for example, a household with one single sensor. A lot of electricity monitoring companies already exist. Whereas most of them only give insight into the total consumption of a household or an office, Ipsum can go further and give personal feedback on device level without costly sensor installation for every appliance. The value they offer to their clients is insight into energy consumption, tailored advice and consequently a reduction in energy costs.

To achieve this costeffectly measuring method, Ipsum makes use of some core elements. Those are: the smart meter, a dongle and the algorithm. The smart meter is a fairly new electricity meter that can measure electricity data digitally. All dutch electricity grid operators are currently installing them for free in every household. The smart meter however does communicate the data it measures only with the grid operator, once every 15 minutes. To receive data more frequently one can plug a so called dongle into a port on the smart meter (Figure 1-2). The function of the dongle is to send electricity consumption data via internet to a database every 10 seconds. Once the raw data has reached Ipsum's database it runs through the algorithm. The algorithm analyses fluctuations in the total energy consumption and then splits the total consumption into consumption data of single devices. This is possible because every device has a characteristic influence (''fingerprint'') on the total consumption when being turned on, while running and when being turned of.

To receive electricity data, Ipsum plugs a so called ''dongle'' (Figure 1-2) into a port on the smart meter. The function of the dongle is to send electricity consumption data via internet to a database every 10 seconds. Once the raw data has reached Ipsum's database it runs through an algorithm that splits the total consumption data into the usage of single devices.

Figure 1-2 A dongle, produced and sold by fifthplay

At this moment Ipsum is at the stage where the hardware and the algorithm are working stable. Now Ipsum's goal is to deliver value to potential clients by developing front-end solutions that give insight and advice on energy consumption. For more information about ipsum visit the website on: www.ipsumenergy.com

THE ASSIGNMENT

Ipsum distincts their clients by consumer clients and business clients. Consumers are families or small households that aim to reduce their energy consumption. Ipsum is currently developing an iPhone app and a web application with the same functionalities for this purpose. For business clients, that want to improve the energy efficiency of office buildings, there is currently no front end solution available.

The bachelor assignment is therefore: Develop an interface for business clients that gives insight in the electric energy consumption data of buildings and motivates users to realise energy savings. Current potential clients of Ipsum are ABN Amro and the University of Twente. Both of them are available for interviews and usability tests.

MAIN STEPS

In order to complete the assignment it was split up into two central questions and related subquestions:

1. What are the users' needs?
   - What are the goals/missions of users?
   - What do users expect from Ipsum?
2. What motivates users to reduce their energy consumption?
   - Why do users want to save energy?
   - What do they do with energy data?

In order to answer those questions a roadmap with three main phases was planned. While executing the planning it was adjusted according to the availability of test users. The final planning consists of three main phases as stated below.

1. General analysis, Ideation, Evaluation of ideas, User analysis (4 april - 30 april)
2. Prototype I and its evaluation (1 may -27 may)
3. Prototype II and its evaluation, Conclusions and recommendations (30 may - 1 july)

GENERAL ANALYSIS

This chapter explains the formation of a first set of requirements based on the initial assignment, market research, a first general target group analysis and the hook-theory by Nir Eyal.

GENERAL REQUIREMENTS

To begin, a first set of general requirements based on the initial assignment was created. Those requirements were validated in discussion with Peter de Bie, the founder of Ipsum.

- The interface needs to be accessible 24/7 via internet.
- Users have to login to view the interface.
- The interface allows Ipsum to create and modify user profiles
- The interface can be adjusted to the style of any business client (e.g.: ABN-Amro, UT)

- The interface gives insight into energy consumption:
  - The user can select different datasets (timeunit, device category , unit/metaphor).
  - The user can compare data.
  - The user can share data (print, download, mail).

- The interface motivates the user to reduce energy consumption:
  - The interface gives tips on energy reduction (Turn off the printers at night).
  - The interface shows the potential benefit of actions (You can save 1000€/year).
  - The interface gives feedback on actions/inactions (Congratulations, you saved 1000€).

MARKET ANALYSIS

Based on the general requirements, similar energy monitoring products for the professional market were researched and analysed by their features.

Figure 1-3

WATTICS

‘’Wattics Energy analytics is a comprehensive, web-based, energy management software platform that provides real-time energy data, projections of savings, IPMVP measurement and verification, tariff analysis, energy performance assessment, reporting and much more.’ (Wattics.com, 2016) Wattics’ interface allows users to create notifactions and to track the progress of saving actions. Wattics customers are in the retail, manufacturing and hospitality sector.

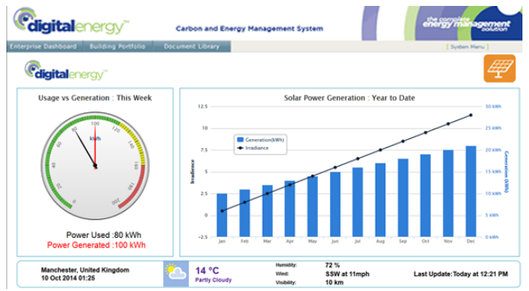


Figure 1-4

DIGITALENERGY

‘’Digitalenergy (...) provides applications for reducing energy costs and consumption in buildings. As an Energy Management System it collects energy data and uses it for three main purposes: Reporting, Monitoring and Engagement - enabling efficient Management and Operation.’’ (Digital energy, 2016)

EPORTAL

‘’ePortal is an energy monitoring software that enables you to monitor, analyze and understand your energy consumption in an easy and social way.

Figure 1-5

[...] Based on extensive experience, commitment and knowledge of the expectations and needs of the end user, we established ePortal: an easy to use energy monitoring software for employees, energy and facility managers in industry, retail and buildings.’’ (Eportal, 2016) Next to energy monitoring, eportal offers invoice control, budget analysis and project tracking. Energy monitoring includes gas, electricity and water.

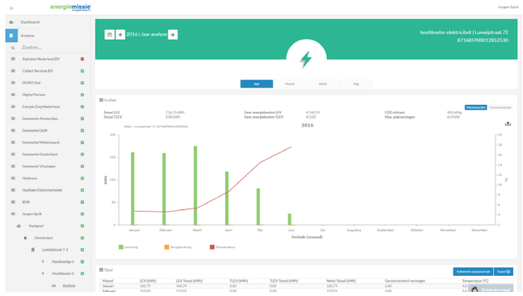


Figure 1-6

ENERGIEMISSIE

Energiemissie is an independent dutch energiemonitoring company that advertises with a user friendly, complete and webbased energiemonitor. They are partners of companies and the government. Next to the monitoring system they also provide advice to reduce the energy consumption. (Energiemissie bv, 2016)

Figure 1-7

SMAPPEE

The only company that comes close to Ipsum's service is Smappee. Smappee is a belgian company that offers hardware and software that enables private consumers to identify and name different appliances. As an appliance starts consuming energy, a change in the total consumption is registered and saved. The consumer can then name this change/appliance. Users have to name the appliances one by one until all household appliances have been named. The software remembers the characteristic consumption of appliances and recognises them from then on. As stated earlier, Samppee only focuses on the private consumer market. A business to business solution has not yet been announced.
(Smappee, 2016)

CONCLUSION

There are a lot of products that offer insight into energy consumption but none of them does exactly what Ipsum aspires do. No company advertises with the capability to identify energy consumption of appliance categories without the installation of separate sensors or manual input (Smappee).Common interface elements are a dashboard, an overview of the total consumption, a meter (data input) selector and the possibility to select different types of graphs and periods. Energy usage is often displayed in kW and euros and can in some cases be combined with a billing function. Advice is a value, promised by all companies, but Wattics is the only one that integrated an advanced savings advice feature into their interface.
The market analysis provided inspiration for first ideas and gave a better view on the scope of an energy monitoring interface.

GENERAL TARGET GROUP

The target group, as stated in the assignment, are businesspeople. This is a very broad term that needs to be specified so that one can link more specific requirements to it. Potential business clients of the interface are employees of ABN Amro and the University of Twente. The period between the start of the assignment and the first arranged interviews left time for a general analysis of the target group. The master thesis by Suzanne Vosslamber (''The Requirements for feedback to save energy: A comparison between professionals in small to medium sized enterprises and consumers'') was a very helpful tool to get a grip on the target group and their basic requirements. Next to general research on the subject she conducted 15 interviews with professionals. Her master thesis was written in cooperation with Ipsum.

According to Vosslamber and Siero et al. (1996) comparison is a feature that drives the reduction of energy consumption. Siero et al. (1996) showed that "...employees in a metallurgical company save more energy when they receive comparative feedback than employees who only receive information about their own performance" (p. 11). By comparison one refers to historic comparison (temperature corrected) and the comparison with similar consumers on a regional level or nation wide. Furthermore Vosslamber states: "... a solution should pay attention to engagement as it is a term for sustained impact of any feedback system '' (p.14).

She offers two propositions that would promote engagement. One is an energy champion that is responsible for a part of the total energy consumption in order to motivate coworkers to make efficient use of energy. The second proposition is the gamification of the energy reduction challenge which would include the whole staff and an adequate rewarding system.

At the core of Vosslambers research lies the outcome of the interviews. Between april and may 2013 she interviewed 15 professionals aged between 27 and 61 (M = 44.6 years SD = 10.8).
The result of the study are requirements for feedback to save energy, linked to two personas: The money saver and the environmentalist.
The money saver's priority is to reduce energy costs. Sustainable effects of energy savings are seen as a positive side effect. On the other hand, the environmentalist's first priority is the reduction of the carbon footprint to ensure the wellbeing of the planet and its population. The cost benefit is perceived as a nice extra in his case.
Both personas are linked to different sets of requirements. However, at this stage I chose to not make a distinction between the personas presented by Vosslamber and to merge their requirements into one, more general list. The reason for this is that Vosslamber's personas do not distinguish users needs by hierarchy or responsibility. A user's responsibility within a company has a huge influence on his goals related to energy saving and the motivation to achieve them. However the proposed requirements by Vosslamber served as a valuable addition to the initial set of requirements given by Ipsum. The requirements as given by Vosslamber are gathered in the list below:

- The displayed data needs to be customisable (period, space, device, unit).
- Energy should be displayed in euros, Kwh, and CO2. Metaphors like trees, leaves or other unconventional energy units are optional.
- Allow to break down feedback per device and space/building and take into account different characteristics of buildings like for example isolation or m2 for comparability.
- Include comparisons with previous years, quarters months and the own mean.
- Make it possible to compare own usage and savings with colleagues and other companies.
- Show/compute the effect of every action immediately without a notification.
- Provide a history function of at least 5 years. Make it possible to select a specific period.
- Energy related ips are tailored to the subject and its situation. Allow for the user to influence the tips they receive.
- An energy usage overview should be sent to the user by email.
- A web application can be accessed via a desktop PC, tablet or mobile phone.
- Allow for the user to choose a preferred feedback frequency (weekly, daily, etc ...).
- Users want to receive neutral tips that include the expected effect of an action.
- Users want to receive a reward and/or positive feedback after executing an action.
- Users can set boundaries that trigger notifications or alarms.
- In general users want to use graphics and tables to gain insight into their consumption.
- Energy usage: Line chart with two lines or a Bar graph
- Energy savings in the past: Line chart or bar graph
- Broken down feedback: Pie chart, drop down menu and tables
- Comparison: Bar graph with two bars
- Feedback History: Undefined

Wishes:

- Make it possible to let Ipsum switch devices on or off in an intelligent way
- Users can influence appearance (font,color) of the feedback they receive
- A mobile application
- Intelligent feedback system that will think for and with the user

CONCLUSION

Suzanne Vosslamber's thesis was a valuable input regarding the formation of requirements. Her findings confirmed assumptions that were made in the very first set of requirements, like the wish to compare energy data by using units like kWh, CO2 and €. For a better overview all requirements are merged into a list on page 17.

MOTIVATION (HOOKED)

One of the central questions I want to answer with this bachelor thesis is: ''What motivates users to reduce their energy consumption?'' By looking at Vosslamber's personas one can already identify two important motivations: Positive environmental effects and cost reduction. If users should achieve those goals by making use of Ipsum's interface, one also has to answer a more general question: ''What motivates users to make use of the interface on a long term?''

The book ''Hooked: How to build habit forming products'' by Nir Eyal answers this question with an interaction concept that arranges triggers, actions, rewards and investments in a way that results in a long term human product interaction (Figure 1-8). In the following paragraph the theory by Nir Eyal will be summed up. You can watch his talk as an addition by following the link (CMX, 2014).
Later, his theory will be used as an inspirational tool for possible interface features.

Figure 1-8 The hook by Nir Eyal

THE THEORY

For any behavior to occur, motivation, ability and a trigger needs to be present (Fogg, 2015). According to Fogg, six factors influence motivation: seeking pleasure, avoiding pain, seeking hope, avoiding fear, seeking acceptance and avoiding rejection.
When it comes to the ability to execute a behavior, also six factors play a role: time, physical effort brain cycles (mental effort), social deviance, and routine.
When motivation and ability are present, a trigger can provoke the desired behavior.
The trigger is an internal (emotional) or external (mail, notification, doorbell) call to action. While external triggers are very common, like newsletters, push notifications or any kind of advertisement, internal triggers require some time to establish. An internal trigger is an association in the user's mind. This could be for example the habit to buy books on Amazon instead of going to a bookstore or to relieve the feeling of uncertainty by using a search engine like Google.
The trigger is followed by an action. An action is a minimal effort that is required to get a reward. This can be as simple as a click on a link in an e-mail, or the login on a website.
After the action comes the variable reward. The reward should satisfy the user's craving or ''scratch his itch''. Variability creates uncertainty which adds some kind of mystery to an action. Variable rewards have been shown to increase the users frequency to come back.

Eyal classifies rewards into three categories:
Social: cooperation, reputation,...
Material or information resources: money, etc ...
and Self achievement: mastery, competency,...
When the user received the reward he was looking for, he should enter the last phase of the hook. The investment phase lets the user perform actions in anticipation for a future reward to make a next pass through the hook more likely. An investment can for example load a next trigger. It happens for example when one sends a message on whatsapp, which will result in a notification when the reply arrives. Another form of investment is to store value, which improves the product for further use. This could be for example the music you add to your iTunes library or the linkedin profile one fills out.

IS THERE AN IPSUM-HOOK?

In order to deliver a long term user experience to the users of Ipsum's energy monitoring interface I filled in the different phases of a ''Ipsum hook''.

Motivations

Motivations are driven by six factors according to (Fogg, 2015). For every factor I listed a possible motivation that may drive any kind of user to make use of the interface.

- Seek pleasure in being in control.
- Avoid ''pain'' / negative effects from superiors for not reaching sustainability goals.
- Seek hope to obtain future financial and environmental benefits.
- Avoid the fear of not being in control and missing chances.
- Seek acceptance by being part of a worldwide sustainable trend.
- Avoid rejection by acting for society.

Abilitys

Users can be unable to make use of the interface. Thinking about those possible inabilities of the user helped to broaden the vision of the user.

- No Time: Make the interface available 24/7, Automatically save unfinished progress.
- Physical effort only occurs when no device with an internet connection is available. Mobile devices would minimize physical effort.
- Brain cycles: Simple graphs, known units (€), clear structure, clean styling.
- Social deviance: The interface should fit within the style of the user and could contain social community elements.
- Non-Routine: Include widely used interface elements to make the user feel ''at home''.

Triggers

External: Different categories of notifications that leave room for imagination:

- A major event has been detected at floor 7. Click here to view more information.
- You can save 1000 € per year with this advice! Click to view the instructions.
- You made one step towards a sustainable future for ABN-AMRO. From now on building X will release 50 ton of CO2 per year less ...

Internal: Frequent use of the interface can create awareness of the price behind the pressing of an on/off button of a device. When uncertain, the interface can be consulted. The craving for a relief of uncertainty would be an internal trigger. Another possible internal trigger could be the feeling of not being as active or up to date as other users.

Action

- Click on a link in a website/ notification.
- Login.
- Tap on the app icon.

Variable Reward

Social: Reputation for successful energy saving, feedback from others.

Resources: Insight into the consumption of a specific device(-group) and the possible benefits.

Self achievement: Personal feedback on actions to track the own progress.

Investment

Load a trigger:

- Communicate with others inside the application (Share/like/comment/reply).
- Set events that trigger custom feedback/ notifications on the consumptions of devices.

Store value:

- Create an advice.
- Save advice for later.
- Rate advice on executability (like/dislike).
- Explore data and store the settings of favourite graphs (dashboard).
- Complete advice to gain reputation.

Other:

- View/Share progress.
- Rate/Browse progress of others.
- progress of others.
- View, share, print, download reports,custom data and graphs.
- Share, print, download.

CONCLUSIONS

The hook concept by Nir Eyal served as a valuable source of inspiration for interface features. Social features for example would have the potential to load many external triggers like notifications for comments, likes and reactions. A newsfeed with the actions of others could for example set an internal trigger linked with the feeling of not being as active or up to date as others. The idea to store value in the application during the investment phase leads to the possible feature that lets users select and store favourite graphs. An advice-todo list that lets the user focus only on advice that is relevant to him also emerged as a possible feature. In order to stay up to date and to be able to act when necessary users could also create their own external triggers in the form of personalised notifications.

All named features served as an input for the next phase, the ideation phase. To sum up this chapter I will present its outcome in the form of a merged set of requirements. This list contains general requirements, validated by Peter de Bie, and target group specific requirements as gathered by Suzanne Vosslamber.

MERGED LIST OF REQUIREMENTS

GENERAL

1. The interface has to be accessible 24/7 via a desktop PC, laptop, tablet or mobile phone.
2. Users have to login to view the interface.
3. The interface allows Ipsum to create and modify user profiles.
4. The interface can be adjusted to the style of any business client (e.g.: ABN-Amro, UT).

INSIGHT

5. Energy usage/savings are displayed in euros, kWh and CO2. Metaphors are optional.
6. The data that is displayed is customisable by: period, space, buildings, device, unit.
7. Comparisons are possible and include data of the previous years, quarters, the own mean, colleagues and other companies.
8. Data from at least 5 years ago can be viewed.
9. Users can share data (print, download, mail).

MOTIVATION

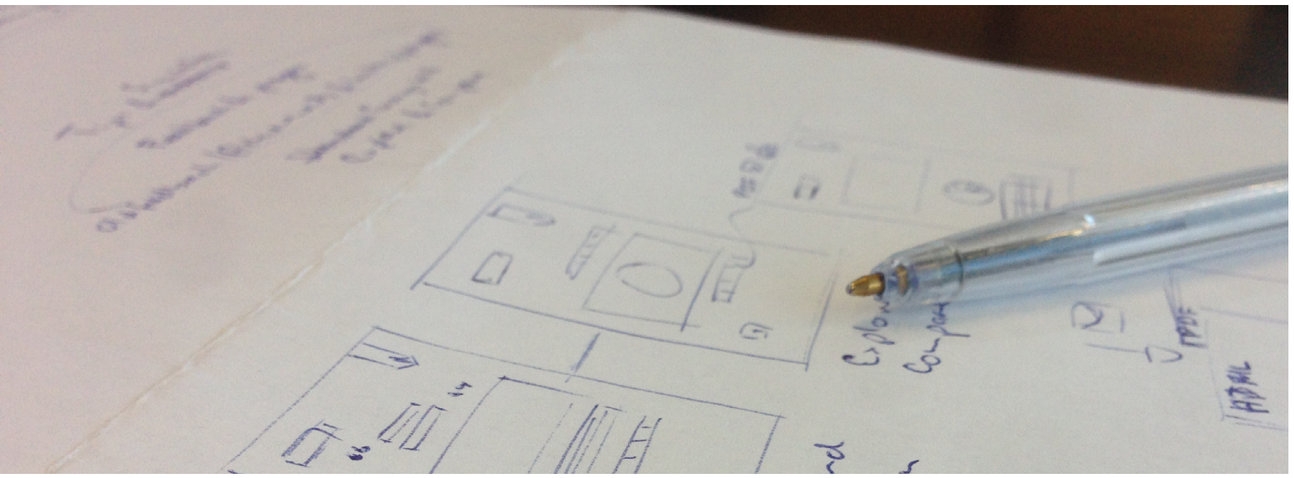
10. An energy usage overview (bill) can be sent to the user by email.
11. The user can choose the preferred notification frequency (daily, weekly, monthly, yearly).
12. The interface gives tips on energy reduction (Turn off the printers at night).
13. The interface simulates and shows the potential benefit of actions (You can save 1000€/year).
14. The interface gives positive feedback on actions (Congratulations, you saved 1000€).
15. Users can set boundaries that trigger notifications or alarms.

VISUALISATION

16. Users use graphics and tables to gain insight.
17. Energy usage: Line chart with two lines or a Bar graph.
18. Energy savings in the past: Line chart or bar graph.
19. Broken down data: Pie chart, drop down menus and tables.
20. Comparison: Bar graph with two bars.
21. Data History: Preferably a graphic.

WISHES

22. The interface can switch devices on or off in an intelligent way.
23. Users can influence appearance (font,color) of the feedback they receive.
24. The interface is accesible as a mobile application.



IDEATION

Before reaching out to potential users, sketches of potential interface features were created, based on the first set of requirements. The goal of those sketches was to give users an impression of potential interface elements. I chose hand drawn sketches over precise vector files to keep details at a minimum and to underline that those ideas were still open for change and feedback.

IDEAS

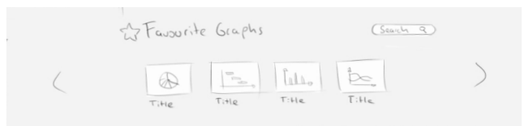
In total I sketched 11 different elements to cover the total amount of 21 requirements. The numbers in brackets indecate the requirements that are covered by the elements. In order to satisfy the general requirement 1, all elements are considered to be part of a webapplication that is accesible via a webbrowser. The acces device has not yet been defined by user analysis. Larger versions of the sketches can be found in the appendix from page 74.

CHARTMAKER (5, 6, 7, 8, 9, 16, 17, 18, 19, 20)

In order to gain insight into energy consumption the user needs to be able to explore all existing data. Users want to be able to view data depending on different periods, locations and device categories (6). This data can then be displayed in different chart types and units (5). A possibility could be to build a chartmaker that enables users to choose all properties to create exactly the chart they want to view. The chartmaker lets the user chose an input data category (location, device, energy price, temperature or average) on the left panel. To choose the right data inside a category, a drill down piechart appears, as a navigation tool (Interactive example: http://bl.ocks.org/kerryrodden/477c1bfb081b783f80). By clicking on a part of the chart one penetrates a category (e.g. City-> building -> floor -> room). The functionality can be compared with a standard tree structure, except that it also carries information about relative importance (size of a piece) and uses less vertical space. When all desired input data has been added to the chart in the middle, the user can customise this data with the settings panel on the right by chosing an appropriate chart type (16, 17, 18, 19, 20), unit (5) and period (6). Once a graph has been created it can be saved online as a favourite graph, shared, printed or downloaded (9).

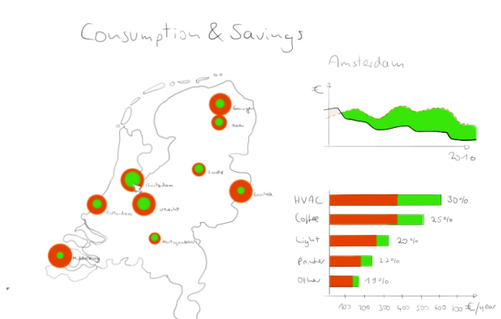
FAVOURITE GRAPHS

To access graphs that have been saved online the user can choose them from the “favourite graphs” library. A small preview icon and a title help to recognise the desired chart.



CONSUMPTIONS AND SAVINGS (7, 20)

To maintain an overview of different buildings spread over some area (country, city, campus...), one can use the interactive map “Consumption and Savings”. This feature informs about the total consumption (radius of the red circle) and the realised savings (radius of the green circle) of different buildings. When a building is selected, the graphs on the right side display the the consumptions and the savings of a selected building as a line graph and as bar graph on device level.

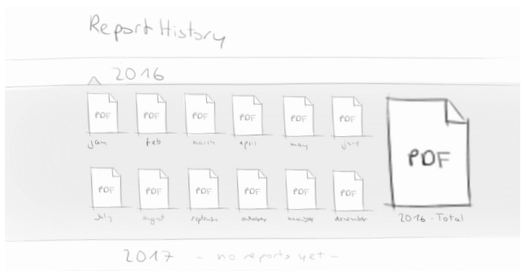


DASHBOARD (7, 16)

The dashboard lets the user chose favourite graphs, facts or rankings add to an overview for quick access. The data on the dashboard is updated in realtime and customisable. By clicking on a tile, a bigger, more detailed version opens up in a new window.

REPORTS (8, 10, 16, 21)

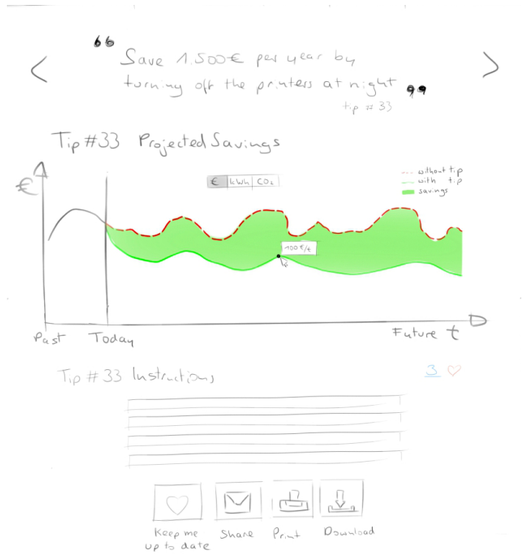
Users receive reports at a desired frequency (10). The content of a report is customised to the needs of each user. Reports are sent to the user as a pdf in an e-mail attachement. In order to keep those attachements organized, the report history feature automatically stores all of them in an online library. Thus, by clicking on an icon, one can view historical data in form of a customised report (21).



TIPS (12, 13)

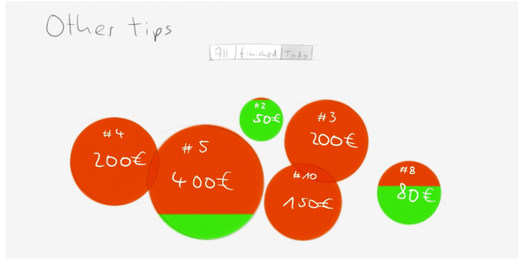
To help the user achieve savings, the interface displays tips. To catch the users interest, a short “quote” informs about the subject of a tip and its possible benefit. If interested, the user can view more details by looking at the graph that projects

those savings into the future. In combination with detailed instructions below, the user should be able to achieve the savings. The user can also choose to only stay updated about the progress of the tip when somebody else is already on it. Sharing printing and downloading is also possible.



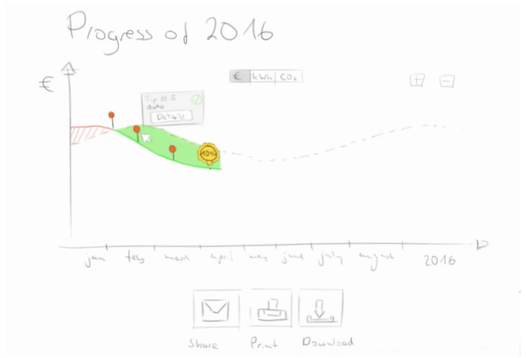
OTHER TIPS (12,13)

All existing tips are displayed as bubbles. Its possible benefit determines its size and the green area the progres. A click on a tip reveals detailed info as mentioned above. The user can switch between 3 categories. All tips, finished tips and tips that are still on the todo-list.



PROGRESS (5, 14)

To track the progress and the influence of tips on the total consumption, a progress graph can be consulted. The unit of the y-axis can be switched to euros, kWh or CO2 (5). The red and green areas indicate the difference between the actual consumption and the previous consumption. Green areas stand for realised savings (positive progress) and red areas for a regression. The red pins stand for the enddates of finished tips. By clickinging on a pin one can view more info about this tip to understand the shape of the graph. Badges appear along the graph to indicate major steps, like for example, a reduction of 10%.



NOTIFICATIONS (11)

Notifications are external triggers, that inform the user about reports, news concerning tips, and information about general progress, e.g. when the 10% boundary has been reached. Next to the frequency users can chose between sms and/or mail notifications.

CUSTOM NOTIFICATIONS (15)

If users want to track a specific device or building they can also create custom notifications. By choosing a value (e.g.:consumption of the printers) a condition and a medium, the user can be notified about specific events (e.g.: Send a sms when the printers consume energy after 20:00).

MY ACCOUNT (2, 3)

In order have a customised interface, users need an account to log in. They need to be able to update their personal information like a phone number or email adress to receive notifications. Their position in a company and the location where they are working defines the scope of the data they can acces. Ipsum already has diverse back-end tools to manage user accounts (3). A new database containing buisness customers will need to be added.

MENU BAR (4)

All elements will be part of one interface. To enable the user to switch between features, one needs to group them in a logical way and provide some sort of menu. I chose for a sticky top menu bar, because of its popularity and simplicity. This makes sure that it will be recognised intuitively. The Abn logo on the right is a placeholder for any client logo (4). The categories / menu items have not yet been defined.

CONLUSION

The presented elements fulfil the first set of 21 requirements. But, they also rely on assumptions I made during the process. Those assumptions lie in the user interaction, the readability of graphs and the importance and grouping of different elements. In order to improve features that are hard to understand and to eliminate features that are not important, I conducted card sorting sessions and interviews, which will be elaborated in the following chapter.

Printed interface elements have the advantage that it is very easy to arrange them and to add notes, if desired. To be able to group all elements, users needed to really understand their function. This makes it easy to discover unclear features as questions will arise.
After creating groupings, users used Post-its to name them.

EVALUATION OF IDEAS

Potential users took part in card sorting sessions to discuss the clearness and usefulness of interface features. The result was constructive feedback on each element and a possible structure of interface elements.

CARD SORTING

‘’Card sorting is a method used to help design or evaluate the information architecture of a site. In a card sorting session, participants organize topics into categories that make sense to them and they may also help to label these groups’’ (Assistant secretary for public affairs, 2016). Classical card sorting sessions are held by using plain cards with only text on them. In order to facilitate the communication and to prevent misunderstandings I used sketches as cards. Also in addition to the grouping I could ask for feedback on those sketches. This enabled me to scrap certain features and to improve others. In other words, the card sorting sessions with printed versions of the interface elements enabled me to evaluate assumptions about user interaction, the readability of graphs and the grouping of elements. In total four card sorting sessions were conducted, two of them with potential clients.

FEEDBACK & CONCLUSIONS

CHARTMAKER

Feedback: A potential user on a higher hierarchical level stated that there is no need for this kind of tool, but that it may be useful for users that are really into details, such as the company Innax. Another potential user, who works on energy management daily, considered it as a useful feature. He only feared, that if users could make their own graphs, it would lead to chaos. Chaos, in that sense, refers to a large number of inconsistent graphs.

Conclusion: The chartmaker is a useful feature for a limited group of users that are into detailed information. The chartmaker offers a lot of freedom but requires a specific idea of what kind of data one wants to view. An improved version should be suitable for a larger target audience and prevent chaos because of inconsistent graphs .

FAVOURITE GRAPHS

This feature was perceived without critics. A possibility to store personally important graphs was considered as a logical necessity.

CONSUMPTION AND SAVINGS (MAP)

Feedback: The map displays only one category of buildings. ABN Amro splits their estate into three categories: Main offices, Client offices and ATMS. The map feature is only useful if it covers the area of interest. For the University of Twente, as a potential client, this area would be limited to the campus and its buildings for example. Potential users considered this feature as an added value. The bubbles that were used to indicate the consumptions and savings caused confusion. They resembled the bubbles from the ‘other tips’’ - feature.

Conclusion: A map feature should offer the possibility to view more categories and compare similar objects. An improved version should also be visually distinct from the ‘’other tips’’ feature.

DASHBOARD

Feedback: The dashboard was perceived as a useful feature. Users asked whether tiles would be clickable. They uttered the desire to zoom in on striking information. Another suggestion was to add a graph with temperature information to facilitate the analysis of variations in energy consumption.

Conclusion: A dashboard is a known feature that should be part of the interface. Cross-links to more detailed information are a must.

TIPS

Feedback: The possibility to see the benefit of a tip-execution got positive feedback.

Users liked the presence of an ‘’Keep me up to date’’-button and some suggested to add a feature that would let them plan the execution of tips. One user stressed that the word ‘’tip’’ would not grasp the effort and complexity that is linked to the execution. After considering some alternatives, ‘’Saving option’’ was chosen as a better word. Besides, not all saving options have a fixed end date and need to be monitored. While, for example replacing light bulbs results in certain benefits after the date of their installation, some saving options would require constant attentiveness (eg: turning off the light).

Conclusion: Tips on energy reduction are wanted feature. The name tip should be changed to something more specific, like ‘’saving option’’.

Saving options that require constant attention should be trackable.

OTHER TIPS

The representation of ‘‘other tips’’ in the form of bubbles wasn’t directly understandable to all users. A list was considered as a more appropriate method of presentation.

The bubble representation should either be improved on readability or replaced by a list.

PROGRESS

Feedback: The progress graph was perceived as a useful goal tracking tool. Questions emerged concerning mouseover interactions on the graph. Once the cursor hovers over a certain region of the graph, a time block should be highlighted and the corresponding energy consumption/saving of that period should be displayed, according to a user. The progress graph should also take into account differences in temperatures. If one compares the actual consumption with the consumption of a year in the past, differences in temperature falsify the comparison and would result in fake savings or losses. The energy data of temperature dependent appliances like air conditioning is prone to this kind of errors.

Conclusion: Mouseover interactions on graphs should inform about point and area data (e.g. kW and kWh). The reference line that makes it possible to indicate savings should take varying temperatures into account.

REPORTS

Feedback: The file format suggested by this feature is pdf. One user uttered that he would prefer Word-files over pdf files to be able to edit given information and to add comments. ABN is currently working on a data storage system that organises all of their files. Users did not know how far the development of the system was, but suggested to maybe combine it with the reports feature. Users were neither enthusiastic nor unhappy about the feature in general.

Conclusion: Reports should be also be available in word format. A report library is not an essential feature of the interface.

NOTIFICATIONS

Feedback: Custom notifications were considered a useful feature. Whereas users who would not execute saving options themselves did not want to receive specific notifications, a user that is actively working on energy reduction, considered it as a useful feature. According to this user, alarms should be relatable to specific appliances and or actions in order to be valuable. Another user suggested that notifications should not only come as emails or sms, but also as in app notifications.

Conclusions: Customisable notifications should be part of the interface, although they will be used more by technical staff. In-app notifications will be an addition to mail and sms.

ACCOUNT

The account feature was perceived as a required standard feature. No positive or negative critics were mentioned.

Conclusion: An account option is a mandatory feature, but it isn’t perceived as exciting.

GENERAL REMARKS

Users suggested general features they would like to be part of an interface:

Sharing options via email should give the possibility to add personal text.

One should be able to further edit raw data of an exported graph in excel. Users should be able to give feedback and recommendations concerning the interface.

Conclusions: Exportable or sharable data should leave room for customisation. A feedback system should be integrated into the interface to make continuous improvements possible.

GROUPINGS

When it came to grouping interface elements and to give a name to those groups, results differed largely from one another. Some participants created only two groups, while others created four. The result were three different groupings. The first one was formed by a potential client.

GROUPING 1

- **Awareness**: Consumption and savings (Map), Progress, Tip, Other tips
- **Communication**: Notification settings, Custom notifications, Favourite graphs
- **Dashboard**: Dashboard, Report history, Chartmaker
- **Personal info**: My account

GROUPING 2

- **Overview and Savings**: Dashboard, Progress, Consumption and savings (map), Chartmaker, Favourite graphs
- **All savings listed**: Other tips, Tip info
- **Admin and settings**: Notification settings, Report history, Account, Custom notifications

GROUPING 3

- **Dashboard and Graphs**: Dashboard, Progress, Consumption and savings (Map), Chartmaker, Favourite graph library, Other tips, Tip
- **Settings and Configurations**: Notification settings, Report history, Account, Custom notifications, Custom graphs

Although the groupings and their namings were quite diverse some patterns did arise.

Some elements always appeared in pairs:

- Progress + Consumptions & savings (map)
- Dashboard + Chartmaker
- Tips + Other tips
- Notification settings + Custom notifications

CONCLUSION:

Some elements have a stronger connection than others. The pairs that emerged may be used as an inspiration for the formation of menu items.

CONCLUSION

The card sorting sessions served as useful first evaluation. The constructive feedback on each element and the possible structure of interface elements formed the basis for the development of an interface prototype. The first set of requirements was adjusted based on card sorting sessions and interviews. The updated list of requirements can be found on page 33, at the end of the next chapter.

USER ANALYSIS

This chapter contains the results of three interviews. The results consist of a brief stakeholder analysis, the definition of different user types and an adjusted set of requirements.

GOAL OF THE USER ANALYSIS

The initial user group consists of business clients of Ipsum. This, of course, is a fairly broad description of a target group. The goal of the user analysis is thus to get a better grip on the needs of users, their context and other stakeholders. Furthermore not all users will have the same needs and motivations. This requires the distinction between user types. In order to form user types, or personas, I conducted three interviews with potential clients. Two interviewees at the ABN and one at the University of Twente. Those interviews were conducted at an early stage of the development, in combination with the card sorting sessions. At later stages of the development three similar interviews were held, that fostered the distinction between user types. Finally, the list of requirements will be updated to integrate the new knowledge about users.

STAKEHOLDERS

A result of the interviews was the discovery of different stakeholders related to the development of an energy monitoring interface. The (simplified) relations of ABN related stakeholders are represented in Figure 1-9. To validate the information I gained from the interviews I talked to Peter de Bie (CEO and founder of Ipsum), who confirmed the relations between Ipsum and its stakeholders. In the following paragraph I will present each stakeholder briefly.

ABN-AMRO

ABN-Amro is a potential client of Ipsum. They need data about their energy consumption to realise energy savings for image purposes. According to an interviewee the ABN is recognised as one of the least sustainable banks. Facility management and the energy management of ABN offices have been outsourced to Engie (former: Cofely).

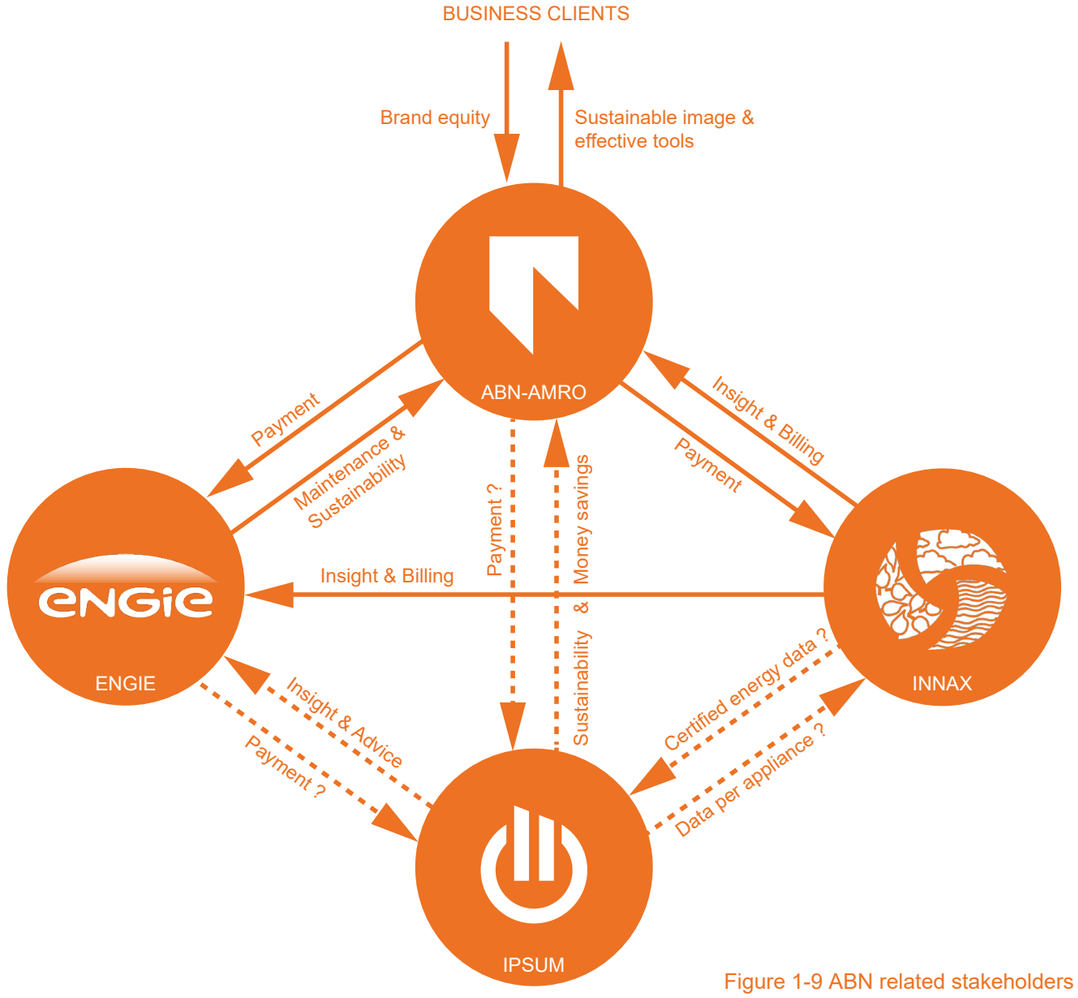


Figure 1-9 ABN related stakeholders

ENGIE (FORMER: COFELY)

Engie manages ABN offices including their energy consumption. A service they offer to their clients, such as ABN, is the reduction of energy usage. Currently they receive data about the total energy consumption of buildings, from Innax, an energy monitoring company. Engie has operational staff at each location of the ABN: around 50 employees for 14 main offices. Engie is interested in energy analysis that are more valuable than those delivered by Innax. Ipsum's service could help Engie in fulfilling their customer's wishes which makes Engie also a potential client of Ipsum.

INNAX

Innax installs measurement hardware and analyses energy data. They offer a broad range of other inspection services like fire protection and maintenance (Innax.nl, 2016). A web-based portal called E-view, as well as reports are used as information channels. Their measured data is certified and is used for the creation of energy bills of large energy suppliers. Innax does not measure data per appliance, but per meter. Data is available to clients, around one day after the actual measurement. Innax is interested in energy data on appliance level which is why they already contacted Ipsum for sample data.

IPSUM

Ipsum aims to deliver more valuable insight into energy consumption than Innax does at the moment. As Ipsums service is similar to Innax service one would expect active competition. In reality Innax service focusses on the total consumption and certified billing, which Ipsum does not offer. Ipsum focusses on lower level consumptions and analysis that result in energy savings. After talking with employees of Innax on may 26 it emerged that Innax and Ipsum could eventually coexist as partners of Engie and the ABN. Figure 9 has been created for ABN related stakeholders. Although the stakeholders related to the UT are not represented in a figure it is worth mentioning them in the following paragraphs.

UNIVERSITY OF TWENTE &
FACILITAIR BEDRIJF

The University of Twente consists of a total of 56 buildings that need to be managed, maintained and consume energy. Therefore the UT has its own facility department called “facilitair bedrijf” to take this responsibility. They currently use an energy monitoring software by Delta Controls, called Enteliweb to track and reduce their energy consumption. The interest of the Facilitair bedrijf in Ipsum shows that Enteliweb does not suffice. A user friendly interface that includes all desired features has good chances of being adapted, next to or as a replacement of Enteliweb.

DELTA CONTROLS

Delta controls is a canadian company that offers a broad range of building management tools. Enteliweb is one of their products, designed to give insight into electricity consumption (Deltacontrols, 2016). It gives insight on a building level and comes with features such as a dashboard and alarms. According to the interviewee, the software lacked some features.

CONCLUSION

There are three main categories of stakeholders: Facility management companies like the facilitair bedrijf and Engie, building owners or renters such as the ABN and the University of Twente and energy monitoring companies like Delta controls and Innax. As I already stated in the market analysis none of them gives insight into energy data on appliance level and often offers fairly complex software features that do not satisfy all users needs. Facility management companies need to be closely integrated during the development of an interface, as they will use it the most. Higher institutions need to be kept satisfied, which is possible by empowering their facility management companies to operate efficiently and effectively. Concurring products of other energy monitoring companies needs to be tracked to stay competitive.

POSSIBLE USER TYPES

With the two propositions by Suzanne Vosslamber on how to promote engagement in mind (Energy champion, Community game), I formed three different arrangements of different users types prior to the interviews. Those user types were made to let the potential users choose one option or a combination of several options that best fits their context and their notion of how the interface will be used in their working environment.

OPTION 1 - HIERARCHICAL

Users are related to one another hierarchically. High order users can access more data than others and have a greater responsibility. Actual energy savings are realised by low order users on a smaller scale. The user types of this option are called main user, sub user and individual user.

Main User

Responsibility: All subsystems (e.g.: one building)
Motivation: Financial benefit and sustainability
Task: Track progress and set milestones for subusers

Sub User

Responsibility: One subsystem (e.g: one floor)
Motivation: Fulfil obligations of the main user / compare with other sub users
Task: Analyse and motivate individuals to realise energy savings

Individual User

Responsibility: One set of devices (e.g.: lights, printers…)
Motivation: Fulfils obligations of the subuser / compare with other individual users
Task: Execution of specific device related tasks

OPTION 2 - CENTRAL

The responsibility of energy savings is given to one person that executes tasks and leads other employees in energy management.

Energy Consultant (intern or extern)

Responsibility: All subsystems (e.g.: all buildings)
Motivation: Financial benefit and sustainable image
Task: Executes and assigns tasks to other employees

OPTION 3 - COMMUNITY

Energy saving becomes a challenge among all employees of a business.

All employees

Responsibility: Own consumption
Motivation: image, social pressure, rewards
Task: Everyone can acces all data and execute every task in exchange for rewards

INTERVIEW RESULTS

The needs and motivations of the interviewees at the ABN and the University of Twente were different. I summed up the results of the interview transcripts in the following two paragraphs:

ABN-AMRO

The two interviewees at the ABN occupy managing functions (sustainable banking, product and contract managing for maintenance) and prefer to keep track of trends and global performance of buildings. Their primary motivation of energy saving is the ability to promote a sustainable image towards clients, staff and partners of the ABN. Both of them will decide whether or not Ipsums interface will be implemented. They consider offering Ipsums interface to their own business clients and partners if it works for them.
The primary device they use are laptops, which they use to work on and share standard files like pdfs, jpgs and Ms Office files. They only want to log in to a web application from time to time, but still wish to receive daily reports on big exceptional events, the overall progress, a top ten and consumption forecasts. Additionally they want to be able to choose which data they want to view. Data should be real time and its visualisation influenceable. Both interviewees do not want to be notified about by small events or details (e.g.: The printers are still turned on).
Furthermore, not every ABN employee should judge energy related issues because of the complexity of the main building. In addition, workplaces at the office are flexible which makes it difficult to link the energy consumption of specific devices to employees. Still, they want to create awareness by distributing info through screens of a narrowcasting system, mails or newsletters.
The interviewees would only see added value in this if any information given to employees includes simple and executable instructions.

One interviewee is responsible for the energy consumption of more than 300 ABN buildings and handed the task to realise energy savings to the facility management company Engie. Engies staff will execute tasks and run projects in close cooperation with the ABN to reduce energy consumption. According to their wishes the webapp should be available in dutch.

Conclusion:

Among many other valuable insights, as stated above, two user types emerged. A monitoring user, represented by the two interviewees and an executing user, including the staff of Engie, that will ultimately realise energy savings. The gamification option is not suitable for the ABN main building because of its complexity, flexible workplaces and the limited influence of employees on electricity consumers such as lighting or heating which is regulated by Engie.

UNIVERISTY OF TWENTE

The interviewee at the University of Twente is responsible for contract management and the efficient usage of energy. He is interested in detailed data on energy consumption and states that money saving is the goal behind efficient energy usage. He would use a web application longer than one hour per week and will share data via email and paper. His primary device is a desktop PC and he frequently uses pdf, jpg, word and excel files. The interviewee wants to receive reports in word format on a daily basis. He prefers word and excel files because they give him the possibility to edit data and add text.

When it comes to structuring responsibility he would like to have a team of around 10 to 15 energy specialist (his colleagues) that leads around 100 - 200 individual users. He states that without a community, energy savings are not realisable. A web application, according to him, should contain data about total savings, the progress made in a year, well-founded predicted savings, the biggest consumers, the energy price, temperature corrections with degree days and the best savers in a justifiable ranking.

Conclusion:

The outcome of the interview shows that for the interviewee a mix between two user types is the most desirable: A group of energy specialists (10 - 15 people) and a community of ‘‘normal’’ employees (100 - 200 people). This comes pretty close to the sub user and the individual user of the hierachical option.

Figure 1-10 Interior of the ABN main office (Technoproject, 2016)

USER TYPES

The responses of both interviews diverge from one another which can be related to their diverging job descriptions and motivations. In order to respond to both needs, four user types were formed. A scenario has been written to better illustrate the relations between users and the interface and can be found in the appendix on page 80.

MONITORING USER

The monitoring user is responsible for energy savings within a company. That is not his only priority as he has to manage other projects. He ensures that all parties work the way the higher management intends and tracks the progress of energy saving projects. He is goal oriented and needs frequent input to be sure that saving goals are being reached and align with the possibilities of the company. Together with other managers and technical staff he decides on the execution of energy saving projects.

INDIVIDUAL USER

The individual user is part of the normal working staff of a company. He or she does not really have a relation with the energy consumption of his or her devices as their actual job has their first priority. Therefore, executing users give individual users access to a (restricted) part of the energy data. This allows for individual users to be aware of their excessive energy consumption and to reduce it by following the instructions of the executing user. Executing users can track their progress and support them if necessary.

EXECUTING USER

The executing user is the one that is responsible for partly choosing and executing the most promising saving options. He knows how to adjust electrical appliances in a building and therefore has the task to optimize the energy consumption of those devices. If the execution of a energy saving task requires approval, the executing user contacts the monitoring user. The executing user has daily interaction with the interface and tracks the progress of his actions. He has the ability to create accounts to give individual users access to specific data in order to stimulate energy savings.

ANALYSING USER

Ipsum does not only show raw data to their clients but also provides insight that emerges out of the data. To minimize the effort Ipsum, plans on writing code that automatically detects potential savings and informs executing users about possible improvements. Ipsum will deliver insight, show potential savings and has the ability to manage user accounts and licences.

ADJUSTED LIST OF REQUIREMENTS

The interface now has to satisfy the requirements of four different user types. New requirements have been highlighted. The numbers in brackets show which user type most emphasised the new requirement. No requirement is strongly linked to individual users (3) as no interviews were conducted with them. Old requirements remained unchanged or were adjusted just slightly.

1 - Monitoring user
2 - Executing User
3 - Individual User
4 - Analysing User

Figure 1-11 One tower of ABN main office at Amsterdam

ADJUSTED REQUIREMENTS

GENERAL

1. The interface has to be accessible 24/7 via a desktop PC or a laptop (1,2)
2. Users have to login to view the interface.
3. The interface enables the analysing and the executing user to create and modify user profiles.
4. The interface can be adjusted to the style of any business client by Ipsum (e.g.: ABN-Amro, UT).
5. The interface allows monitoring users to promote their business as sustainable. (1)
6. Data has to be accessible after maximum 15 minutes. (1,2)
7. The interface can monitor the energy data of more than 300 different buildings. (1)
8. The language of the web application has to be primarily dutch and secondly english. (1,2)

INSIGHT

9. Energy usage/savings are displayed in euros, kWh and CO2. Metaphors are optional.
10. The data that is displayed is customisable by: period, space, buildings, device, unit.
11. Comparisons are possible and include data of the previous years, quarters, the own mean, colleagues, other companies and all office buildings of a business. (1)
12. Data from at least 5 years ago can be viewed.
13. Users can share data (print, download, mail).
14. The interface can export jpegs, pdfs, excel-files and word-files. (1,2)

MOTIVATION

15. An energy usage report/overview can be sent to the user by email. (1)
16. The interface can generate user specific reports/overviews. (1,2)
17. A report can contain: Exceptional events, overall progres, a top ten ranking, goal tracking.
18. The report/overview frequency can be set by the user. (1,2)
19. The user can choose a preferred frequency for any kind of notification (always, daily, weekly, ...).
20. The analysing user can create saving options for executing users. (2,4)
21. The interface gives well-founded tips on energy reduction (Turn off the printers at night).
22. The interface predicts and shows the potential benefit of actions (You can save 1000€/year).
23. The interface gives positive feedback on actions (Congratulations, you saved 1000€).
24. Users can set boundaries that trigger notifications or alarms.

VISUALISATION

25. The data can be split up into separate categories (e.g.: Main offices, Client offices, ATMs). (1)
26. Users can use graphics and tables to gain insight.
27. Energy usage: Line chart with two lines or a Bar graph.
28. Broken down data: Pie chart, drop down menus and tables.
29. Comparison: Bar graph with two bars.
30. Data History: Preferably a graphic
31. Energy savings in the past: Line chart or bar graph.

WISHES

32. The interface can switch devices on or off in an intelligent way
33. Users can influence appearance (font, color) of the feedback they receive
34. A mobile application for tablet or mobile phone (2)
35. Connect the report library with existing data storage systems (1)

PROTOTYPE 1

This chapter is about the scope of the product development, the goal of the interactive prototype and the reasoning behind different core elements of it.

PRODUCT DEVELOPMENT SCOPE

After the user analysis I had a better picture of the scope of the interface. To structure further development I grouped requirements, formed them into functional blocks and linked them to user types. Later, priorities were given to different functionalities to narrow down the scope to the most viable interface features. Those functionalities and their prioritization were presented to the team of Ipsum for general feedback and feedback on realisability. The final outcome is presented in Figure 1-12 on page 35. The monitoring and the executing user have a high influence on whether or not Ipsums interface will be implemented. Therefore I chose to only develop interface parts for the monitoring and the executing user to focus the limited time. Still, I kept in mind future compatibility with features that I chose to leave out.

INSIGHT

The main goal of the following elements is to give the user insight into relevant data. Data can be explored, graphs can be created and information can be stored for a quick acces.

EXPLORE DATA

(4, 5, 7, 9, 10, 11, 12, 13, 14, 25-30)

The data explorer enables the user to view all energy related data in an intuitive way. The amount of data that can be accessed differs per user/account. This is the core of the interface and has therefore been chosen to be build.

DASHBOARD

(4, 5, 7, 9, 10, 11, 12, 13, 14, 25-31)

The dashboard is customisable and can be filled with interesting information. The data displayed is live. The dashboard is an addition to a dataexplorer, much like a personal filter. It will be developed, because of its added value for the monitoring and the executing user and the positive feedback this feature received in cardsorting sessions.

DEDICATED CHART MAKER

(5, 7, 9, 10, 11, 12, 13, 14, 20, 21, 22, 25-31)

An analysing user will need to have insight into all data and all possible combinations of it. Ultimately a dedicated chart maker will be a complexer version of the dataexplorer and allow for less common, more experimental analysis. This chartmaker will serve as a tool for the creation of saving options. I chose to not develop it, as it will not be used by the executing or monitoring user.

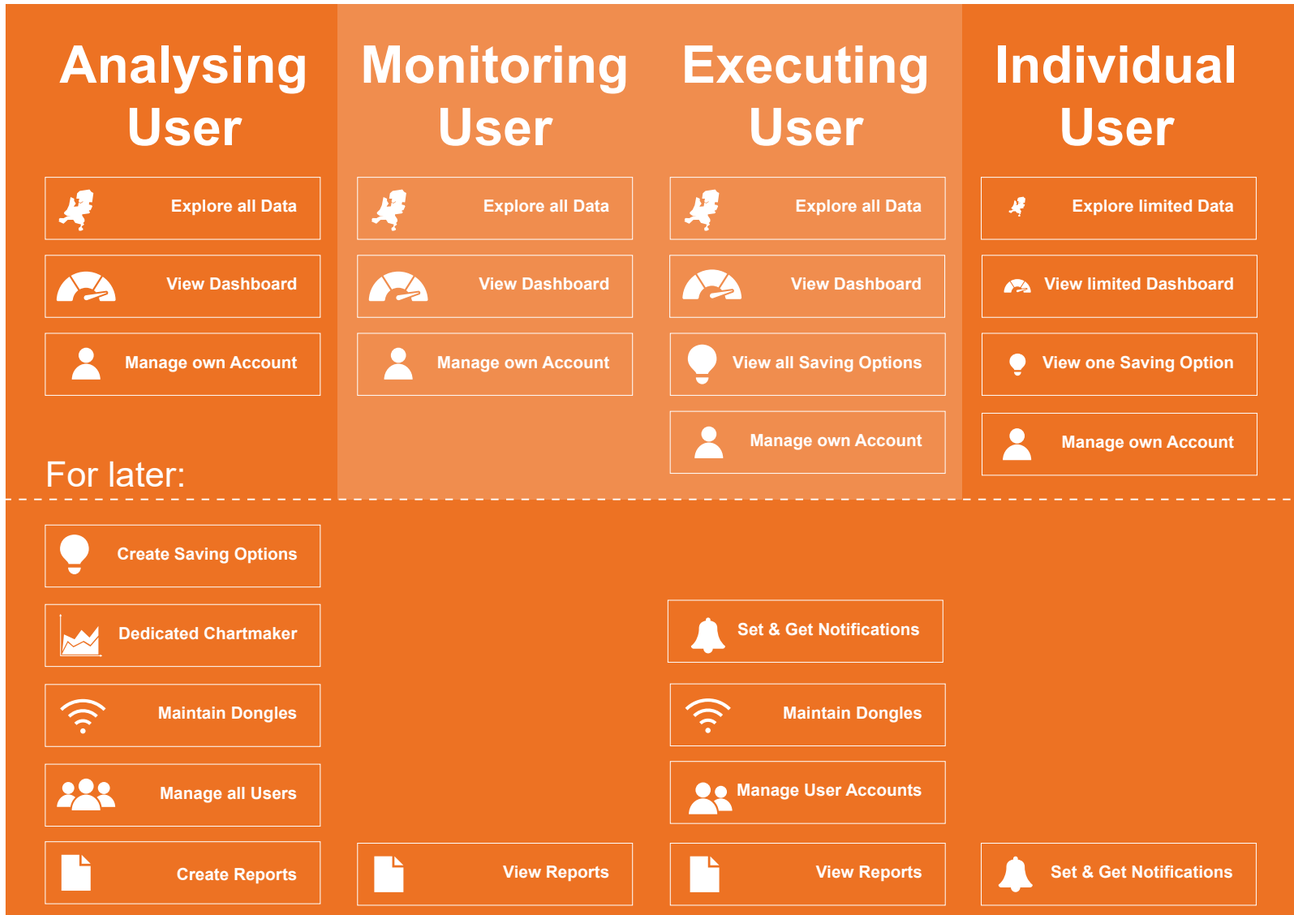
CREATE REPORTS (15, 16, 17, 18, 25-31)

Reports will be personalised and have to be created at some point. A report-template that is automatically filled in with current data can be used for this purpose. This feature will operate in the back-end of the webapplication and will be managed and maintained by the analysing user. Therefore I chose to not focus on this feature.

VIEW REPORTS (15, 16, 17, 18, 25-31)

Individual reports should be accessible in some way (e-mail, pdf, word). Currently it is technically not yet possible to send (or push) e-mail notifications to users. Also the contents of reports differ largly per user which makes it hard to create anything but a fairly empty standard template. Because of those two reasons I chose to not focus on a report feature yet. (Later, in this report I will re-introduce this feature as an addition to the dashboard-feature. At a chosen frequency, the dasboard content can be exported and sent to the user).

Figure 1-12 Functional blocks and their prioritization



MOTIVATION

The ultimate goal of the interface is to motivate users to execute energy saving projects. Pure insight into electricity consumption data does not suffice. To support the user in the process, multiple features will be integrated in the interface.

CREATE SAVING OPTIONS (TEMPLATES) (4, 20, 21, 22)

The analysing user can create ‘’saving option’’-templates. Those templates are automatically filled with actual data of clients to help them reduce energy consumption. For example, a template can be made for devices that are turned on outside of working hours. For a specific client this will trigger a saving option for his coffee machines if they consume energy late at night. This feature will only be used by analysing users. Therfore I chose not to develop it yet.

VIEW SAVING OPTIONS (4, 20, 21, 22, 23, 31)

The executing user views specific saving options that are relevant to him. Once he receives information about a saving option he can do three things: Share it with others, dismiss it or execute it. Much like the dataexplorer, this feature carries core functionalities of the interface and will therefore be build.

MANAGE USER ACCOUNTS (3, 4)

The analysing and the executing user can create and modify user accounts to give restricted access to other users for motivational purposes. This feature will not be build for the analysing user, as Ipsums employees currently already have a user management system. The choice, to not include individual users in the development yet made it superfluous to develop this feature for the executing user. I chose to not develop it as one of the first features to keep the focus on more important ones.

SET & GET NOTIFICATIONS (19, 24)

Custom notifications enable users to keep track of important events and to react accordingly. This feature was appreciated during the card sorting analysis and the interviews. Even though it needs to be included because of its motivational value I chose to not develop it for a first version. I chose to do so to prevent running out of time. (Eventually I had enough time left to integrate a ‘‘Notification’’-feature in the second prototype)

ADMINISTRATION

To make all features possible that were named before some administrational features need to be integrated as well.

DONGLE MANAGER (6)

In order to keep the data flowing it is important to quickly react to hardware problems that can arise from dongles (Figure 1-2 on page 9). Operational staff could identify malfunctioning dongles and replace them with new ones. This feature is important, but does not directly contribute to insight or motivation of users which is why I chose to not develop it yet.

MANAGE OWN ACCOUNT (2, 8)

Users can manage their own personal information, change their password and set their language preference. This feature belongs to the fundamental parts of any interface which is the reason why it will be part of a first prototype.

CONCLUSION

After the user analysis, a lot of requirements and ideas emerged. It was helpful to structure them into functional blocks and to clearly define the scope of the product development. In the following chapters I will describe the development of a dataexplorer, a dashboard, the user account and a feature to view saving options.

GOAL OF THE PROTOTYPE

Adobe Illustrator and Axure were used to build an interactive website. The goal of the prototype was to use it for evaluations with potential users. A web based prototype can come very close to what a final product may look like. Whereas paper prototypes only allow for simple interactions, digital prototypes allow for rich interactions and are quickly adjustable .

For a better understanding of the interface elements, I advise to view the first prototype on:
portfolio.io.utwente.nl/student/batzkej/ipsum/
The interface works best in the chrome browser. By refreshing the page, all changes will be restored. Note: Not all features that will be described have been realised.

INTERFACE ELEMENTS

The following pages will briefly explain general design decisions and the function of all main interface elements.

GENERAL

Flat design

Throughout the design of the interface I used flat design principles as a guide for the styling of interface elements. Flat design principles encourage to use simple, two-dimensional geometric forms with an emphasis on functionality. Flat design has a serious appearance and does not distract users with superfluous visual effects like glossy buttons or vivid 3 dimensional effects.

Responsiveness

The interface is intended to be responsive to the users screen size. It is possible to achieve responsiveness by using Axure, but it is also very time consuming. Therefore I chose to focus on the content of the prototype and to leave responsiveness for a final product.

Medium

One outcome of the interviews was that the primary device of users is either a desktop pc or a laptop. Therefore I designed the interface as a web application that can be accessed via a browser with a computer mouse as a primary input device. The advantage of web applications, compared to native apps, is that they can be improved without having the user to constantly update to a newer version. As a developer one is not limited by the restrictions of app-platforms like Apple’s appstore or Google’s playstore. Therefore it has advantages to start the development with a flexible web application and to move to a native, touchscreen optimized application at a later stage of the development.

Branding

In order to relate the interface to the branding of a client, some key colors can be adjusted. Those colors are used for scales and graphs throughout the whole interface and provide a look and feel to that connects with the style of the client. Effectively only two key colors are needed. One that stands for positive interface elements and one that is related to more negative elements. In the case of ABN, yellow indicates little savings or excessive energy consumption whereas the turquoise green is related to a lot of savings and reduced energy consumption. In order to create a scale that contains various steps (e.g.: five), colors in between can be generated by using Illustrator’s blend tool.

Customisability

For this prototype, all features are designed to match the needs of the ABN-Amro. Of course the ABN should not be the only client to use the interface, which is why many variables have to be adjustable to the specific needs of clients. Customisable variables are: the color theme,

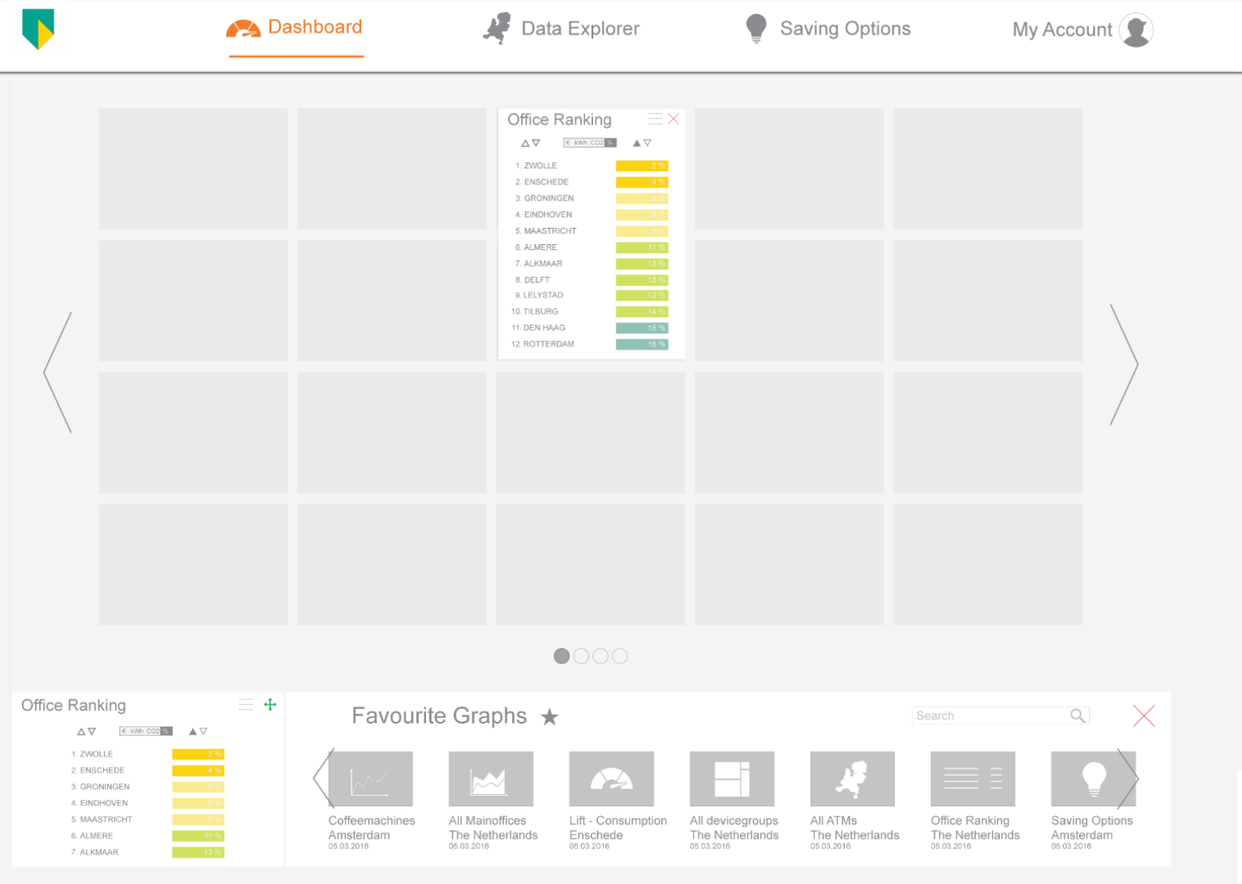


Figure 1-13 The dashboard

the building categories, building details (square meter, number of employees, location), the reference line in the graphs (page 40) and the desired goal consumption.

MENU

The function of the menu is to facilitate the navigation between different features of the interface. I chose for a top menu, which is widely used around the web to ensure that it will be recognised. Icons next to menu items were used to indicate the content of a feature and to increase the recognisability. The orange slider is an additional visual aid to indicate the currently selected menu option, next to the color change from gray to ‘’ipsum-orange’’.

The logo on the left top corner is a placeholder for any client logo and underlines that the application has been adjusted to the clients needs.

DASHBOARD

The main purpose of the dashboard is to serve as a customisable start screen. It enables users to get insight into information that is valuable to them right after launching the application. All data on the dashboard is automatically updated. The purpose of the gray background grid is to indicate the position and the sizes of tiles. Tiles can be moved freely from one position to another and are supposed to automatically snap to the grid. The grid allows tiles in different sizes: small (1x1), tall (1x2), wide (2x1) and large (2x2). Tiles are clickable and allow for the user to quickly jump to the origin of the information inside the data explorer. By clicking on ‘’+ add a graph’’ at the bottom, a library containing favourite graphs opens up. Any graph throughout the application can be stored here and dragged onto a page of the dashboard as a tile.

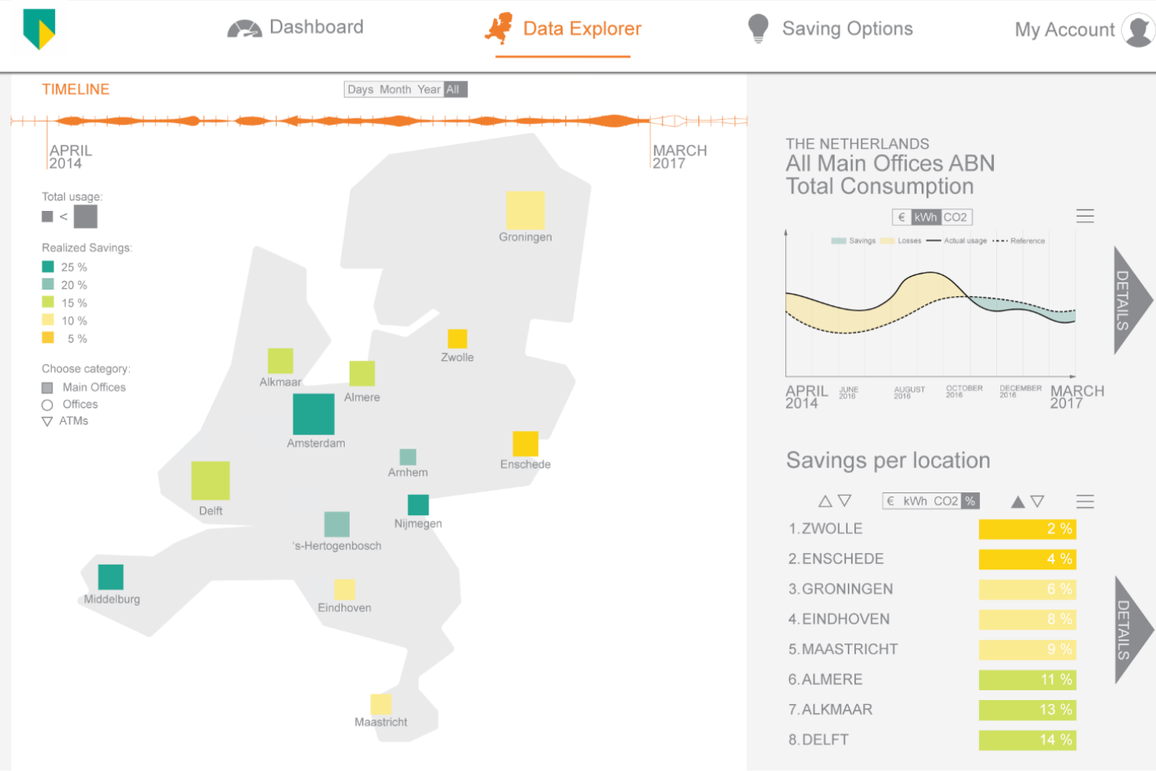


Figure 1-14 The data explorer

DATAEXPLORER

Users need an intuitive way of getting insight in all energy data of a lot of buildings. One of Nielsen’s heuristics states that a match between the system and the real world improves the usability of an interface. That is why instead of using an alphabetic tree structure menu (like most energie monitoring applications do) I used an interactive map. The position of the different buildings matches with their location in the real world. Users can zoom in and out by clicking on different locations to reveal more information (in this case only Amsterdam is zoomable). The strength of a map-overview is that it can also carry additional information to guide the users attention. Every location or building is represented as a coloured square. The size of a square indicates the importance (average total consumption) of a building and the color gives a rough feeling about whether it is on track or not. A yellow square indicates that just few savings have been realised at that location. It therefore requires more attention in order to reach the envisioned goal. Green locations are close to reaching the saving goal and do not require much attention. When comparing buildings, it is important that they belong at least to the same category. To switch between different building categories, users can click on either of the three options on the left (Figure 1-14). The number of categories depends on the client.

Timeline

All data is linked to a specific period. The timeline at the top enables users to adjust the period of the visible data by dragging the end dates. The granularity of the timeline can be set to days, months and years. When the “all’’ option is selected, the end- and start date sliders jump to the outermost positions and the granularity adjusts to the best matching option to display all available data. The thickness of the orange area in between both sliders is an indicator for the total consumption of all buildings over time. Major peaks or lows serve as an orientation and can guide the users attention to specific periods.

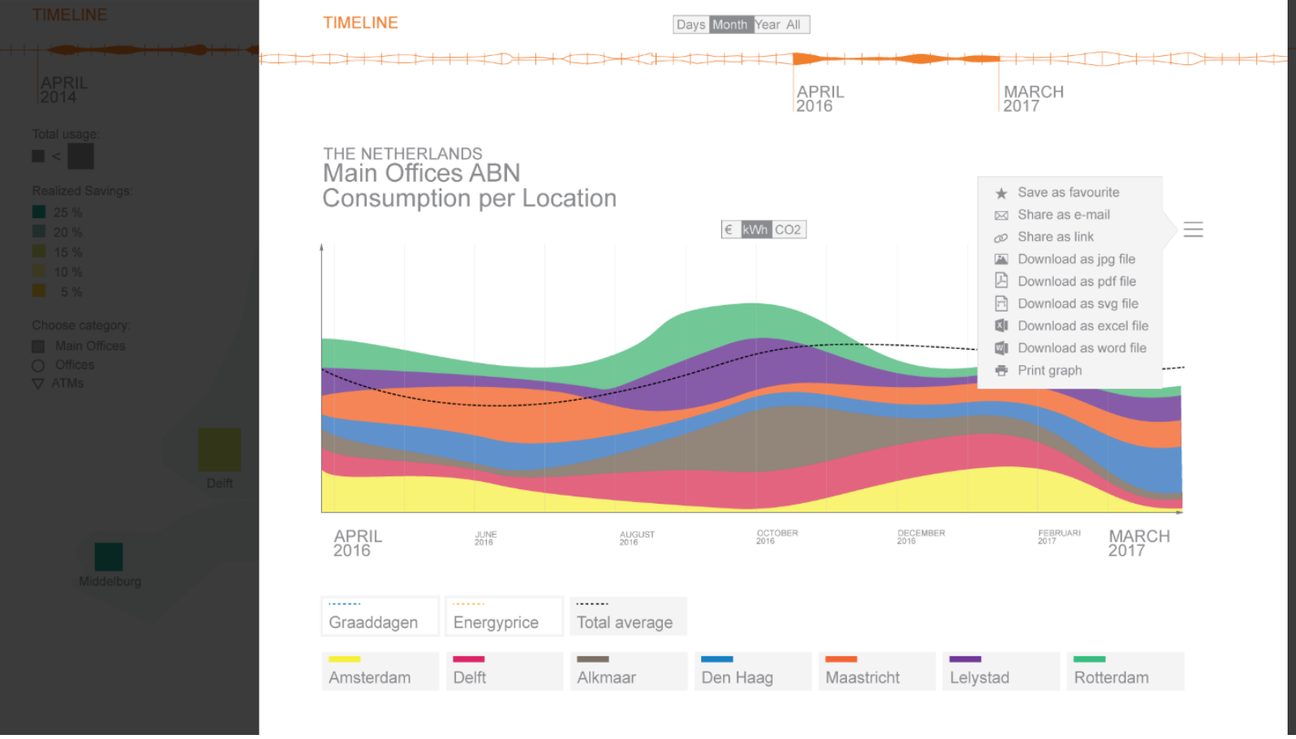


Figure 1-15 Energy consumption per location in a stacked area graph

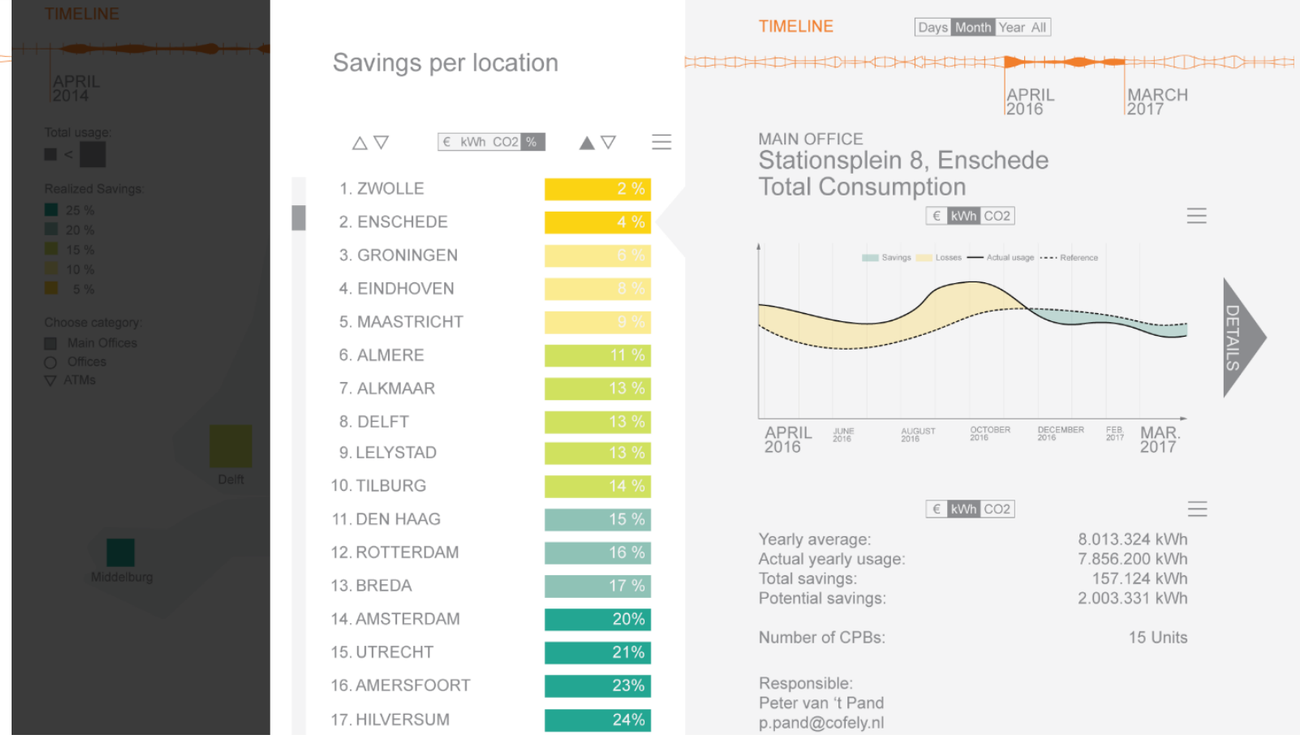


Figure 1-16 Energy savings per location in a ranking and detailed info per location on the right

Graphs

Users want to be able to compare data from different locations or appliances. The sidebar (Figure 1-14) gives access to customisable graphs to include this requirements. Depending on which location has been selected on the map, the information on the sidebar adjusts accordingly. If one zooms in on one building, a treemap that shows blocks per appliances becomes visible (click twice on Amsterdam in the prototype). The size of each block correlates with its consumption. This helps to quickly identify large consumers. By selecting a block, more information appears in the sidebar. One graph displays the consumption and the other graph (list) displays savings. By clicking on the "details" buttons, more information becomes available. With the first graph (Figure 1-15), users can compare the consumption of different locations or appliances in a stacked area graph and select and deselect their items of interest by clicking the buttons below. The reference line adjusts itself accordingly. The second graph (Figure 1-16) shows a ranking of all buildings or appliances. By selecting an item on the list users can view more detailed data on the right to evaluate the reasoning behind the ranking position (Enschede and Amsterdam can be selected in the prototype). The "details"-button reveals the consumption as a stacked area graph for different appliances for more detailed analysis. Additional facts give extra insight. The unit switch can show the same data as euros, kwh or co2.

Reference line

Every graph contains a reference line. The reference line is the heart of every graph and enables the user to form well founded statements about excessive energy consumption or savings of a building or an appliance. The reference line is calculated individually per building or appliance and scaled to its specific properties. I will illustrate the calculation of the reference line by giving an example: Given a certain amount of buildings spread over a country, it is difficult to compare one building with another because of several factors. Differences in exterior temperature influences the energy consumption as well as the size of a building and the number of people that actually work there. The area of windows and their orientation, as well as the isolation of walls also has an influence on the temperature inside the building next to many other factors. The goal of a reference line is to include as many of those factors as possible to make a valuable comparison/evaluation possible. To achieve this, one needs to know all important variables of all buildings and apply the "rule of three". As an example we will take building A, B and C, each with a known total consumption data of a specific year, the temperature data of this year, the number of square meters and the number of employees that worked there. By using degree-days (www.degreedays.net/introduction) one can correct the consumption data of all temperature related appliances. If one does so, the total energy consumption data will be affected and either increase or decrease at specific periods. Next, one divides the total consumption data by the number of (relevant) square meters, then by the number of employees. Per location, one will end up with a graph that shows the temperature corrected energy consumption data per 1 square meter per 1 employee. If one now combines those three graphs to calculate their average over time, one obtains a "golden" scalable reference line. If building A wants to know whether it is performing well compared to B and C, the "golden" reference line can be scaled up by multiplying it with the number of employees and the square meters at building A. Finally a reverse temperature correction finishes the calculations and results in a valuable reference line. This line can then be used to evaluate the performance of building A.

Hamburger menu (Figure 1-15)

A hamburger menu is a commonly used menu type that is represented by three horizontal stripes. Users can download data in certain formats, share it in different ways or save it as a favourite. "Save as favourite" saves the graph to the library under the dashboard. Later users can drag it onto their desired dashboard page.

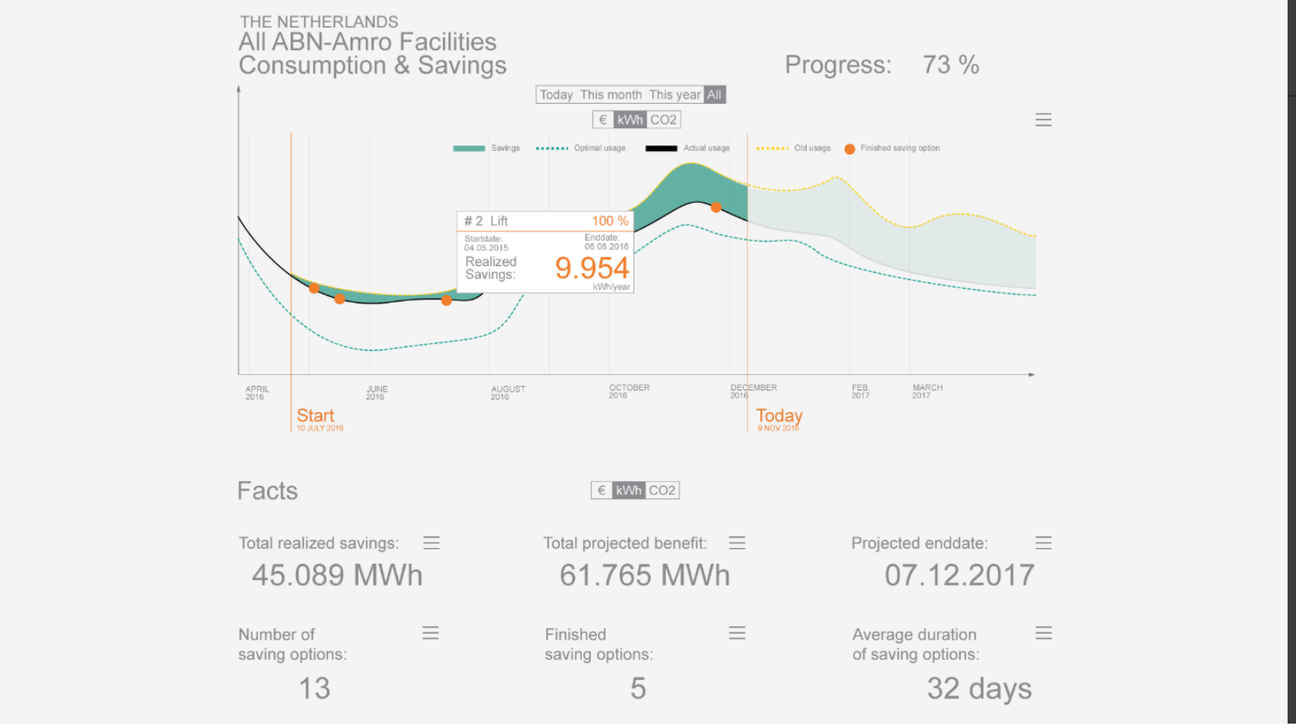


Figure 1-17 Realised saving options are represented as orange dots

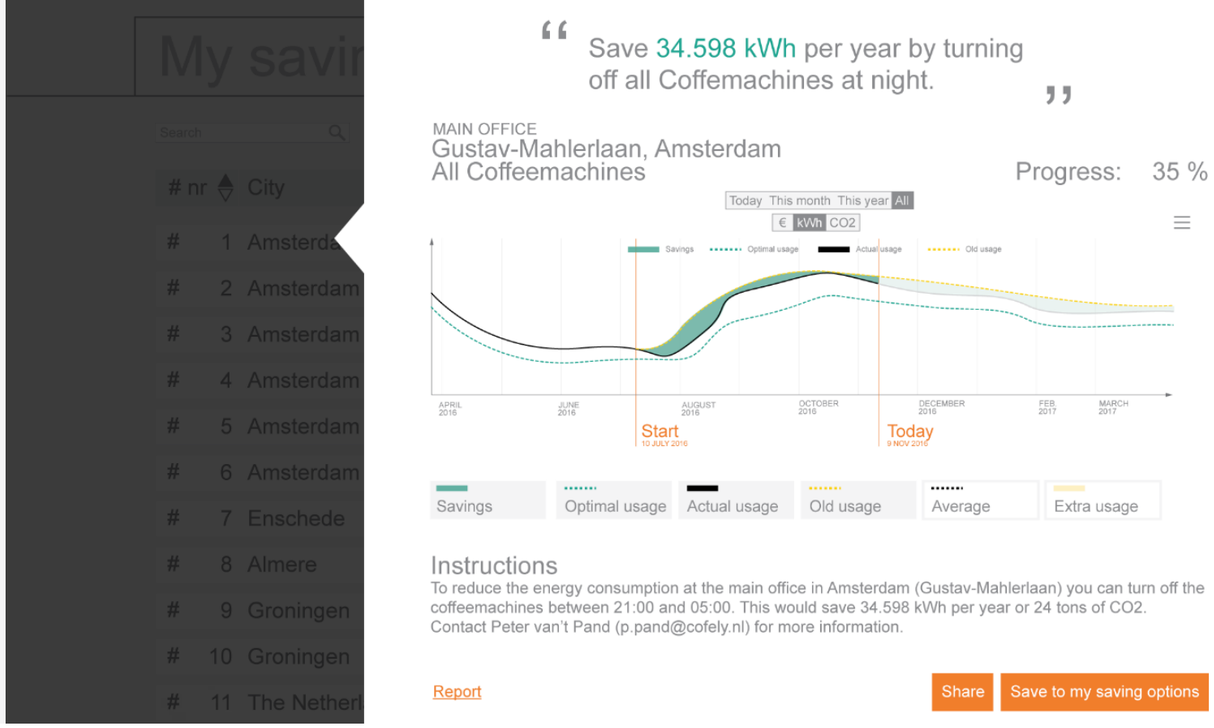


Figure 1-18 A graph and instructional text give insight in possible savings

SAVING OPTIONS

The menu item called “Saving Options” leads the user to a feature that helps him track and execute tasks that reduce the energy consumption. Those tasks can be very diverse and complex. In order to develop a feature that covers the whole complexity of project planning, financial budgets, deadlines, realisability and other factors a fairly broad and sophisticated interface feature would be required. Each of those factors depends on the client and his partners which makes it challenging to satisfy all needs. Therefore the main function of this feature is to start a discussion about potential savings that can serve as a motivation to start an energy saving project. The first graph that becomes visible shows the total progress. The orange lines span the period since the introduction of the interface until today. The legend indicates the purpose of each line, whereas the green area is the most apparent element of the graph. It stands for the savings that have been achieved. The orange dots mark the end dates of energy saving projects. This means, that an orange dot appears on the graph, once the projected energy savings of a “saving option” have been reached or surpassed. A click on the dots reveals more information about it, including relevant dates, the savings and the appliance category. Numbers and facts below the graph give extra information. To view details of different “saving options” the user can select different item in the list below. The “My List feature” is a personal list that helps users to maintain an overview and to focus on “saving options” that are important to them. In the prototype the advice about the coffee machine and the lift is clickable. Once a tip has been selected, an information sheet (Figure 1-18) becomes visible. Here the user has the possibility to inform himself about the importance and the realisability of the advice. The graph forecasts savings and a short text informs about actions that can be performed in order to realise those savings. Like i already mentioned earlier, the advice has been generated automatically based on general advice templates that have been prepared by the analysing user (Ipsum). The user can now either share the insight to discuss it’s realisability with others, save it to his own list or report it to Ipsum as an impracticable advice by clicking on “report” on the left corner. Ipsum can use this information to improve its advice-templates. Furthermore the user has the possibility to adjust the displayed period and unit of the data and can toggle the visibility of lines in the graph by using the buttons below. As a whole the saving options feature gives advice about savings to start a discussion about the realisability and can serve as a motivation to start a project. During a project it can be used to track progress.

ACCOUNT (NO FIGURE)

Different user types require different features of the interface and different data. Ipsum will provide monitoring users and executing users with accounts, that are optimized to their needs (e.g.: data access scope). A monitoring user will not spend time on detailed information about single saving options but will most likely stay on the dashboard once it shows all relevant information. Still he needs to have access to all detailed data in order maintain the overview or to inform himself about the progress of different projects. Executing users will most likely want to analyse data and advice concerning their own location or building. It should be possible to adjust the scope of the “saving option” feature to his location to prevent interference of executing users on different locations. Exchange should still be possible and can be carried out through the orange “share” button (x) that is available on every advice information sheet. Furthermore users have the possibility to adjust their personal information, their language preferences, notification preferences for reports and their personal password. The image and the personal data can be used by Ipsum or other users to contact one another.

CONCLUSION

While designing, I worked with requirements and assumptions. Assumptions were made regarding the usability, readability and the structure of the information. In order to discover and improve bad assumptions, usability tests were conducted.

EVALUATION OF PROTOTYPE 1

This chapter will discuss the outcome of two usabilty tests with monitorig users. The flaws and problems that were discoverd formed the basis of an improved second prototype.

GOAL AND METHOD

The goal of the evaluation was to discover flaws and problems of the interface in order to improve them. To do so, a list with tasks that users had to execute by using the interface was prepared (page 82). Those task were structured in such a way that most features of the interface were covered. One session took around 30 minutes. After the completion of all tasks related to one main function of the interface there was given room to questions and suggestions. To analyse the performance of the interface all activities on the screen and the voice of the test person were recorded. Users signed an informed consent prior to the tests which enabled me to analyse the recorded data.

On the 20th of may two usability test were conducted at the main office of the ABN-Amro in Amsterdam. One of the test persons worked for the ABN and had already participated in a first interview. The other test person worked for Engie and would use the interface as a monitoring user as well. Prior to the usability test with him an interview was conducted to get an impression of his function and needs. The outcome of the interview confirmed previous insights about stakeholders, user types and requirements.

INTERVIEW RESULTS ENGIE

The interviewee is a monitoring user inside of Engie who aims to track the progress and trends of energy consumption from time to time (once a month or more). He wants to receive reports at a preferred frequency and look at real time data within a web application.

Engie, as a company, wants to save energy in order to deliver an extra service to their clients. The interviewee wants energy-saving to become a culture within the company like it already is the case with safety. The buying department of Engie talks about the implementation of new tools or technology once a month. They will decide whether or not Ipsums web application will be implemented. For large sums also the head office will decide. They are open for new technology and often carry out pilot projects together with their client ABN-Amro.

Next to technical solutions, the interviewee thinks that behavioural change makes up a big part when it comes to energy saving possibilities. Engie has around 50 employees that ensure the maintenance of 14 main buildings of the ABN in the Netherlands. This year they will be equipped with iPads to monitor maintenance information and will therefore be able to receive push notifications. In his opinion, the current software provided by Innax is difficult to use and too complex. The staff has difficulties to use it for their purposes. An application that provides insight up to appliance level would help them to act more structured. He emphasises that the energy consumption depends on the number of people that are present in a building. The interviewee would like to encourage the display of infographics in the lobby of the building via the narrowcasting system. He would like to share data within the web application and likes to use excel and pdf files. The preferred language for the interface would be dutch.

RESULTS

The detailed results of the usability tests can be viewed in the appendix on page 88. This paragraph sums up general results to improve the readability.

USER FEEDBACK

The conclusion of the usability tests was that a few big and lot of small properties of the interface had to be adjusted to better fulfill the expectations of the users. User remarks required a restructuring of the data explorer and a redesign of the “saving options” function. Next to those big adjustements, a lot of small issues regarding consistency and readability had to be solved. Even though prototype 1 leaves room for improvement, the general structure and the core functions were understood and appreciated. The customisable dashboard received positive feedback as well as the general look and feel.

FEEDBACK FROM IPSUM

In order to ensure the realisability of the interface a meeting with Albert Molderink, Gerbrand Bosch and Vincent Bakker was scheduled. All of them work for Ipsum as computer scientists and are familiar with the underlying processes of data collection and data processing. Even though not all functions of the interface can be realised with the current functionalities of the back-end, they were considered executable in the near future, except for one feature. Prototype 1 shows data per single appliances on the lowest level. This is not possible as the algorithm can only detect appliance categories but not distinct appliances of the same category. Therefore one can only distinguish between single appliances if they have been detected by different sensors. It depends on the electrical architecture of a building whether it is possible to install sensors per floor level or not. As a future vision floor levels can be integrated in the classification of energy data.

CONLUSION

The usability tests revealed a lot of small and big issues that did arise while using the prototype. The following chapter will describe how those issues were resolved with an improved second prototype.

PROTOTYPE 2

The feedback from the usability tests formed the basis for improvements of the interface, next to additional problems that were discoverd in the process. The following paragraphs will cover the reasoning behind small and big adjustments.

IMPROVEMENTS

For a better understanding, I advise to view the prototypes on:
portfolio.io.utwente.nl/student/batzkej/ipsum/
The interface works best in the chrome browser. The login in data is: Ipsum, 12345. Alternatively, a click on “Forgot your password?” will fill in the right login information for quicker access. By refreshing the page, all changes will be restored.

Note: Not all adjustments were actually integrated in the second prototype due to limited time. However some of those features are integrated in prototype 3.

GENERAL

A lot of little inconsistencies regarding letter size, line thickness and background color were cleaned up to make the interface look more appealing. For this reason, all sidebars now have a white background throughout the whole interface. Some elements, were cramped and made the interface look messy (e.g.: image on page 41). More empty space was introduced to make it easier for users to focus on one element at a time.

Colorblind users should not be excluded from the usage of the interface, as around 4,5% of the population worldwide is affected by a form of it (Colourblindawareness.org, 2016). The interface was analysed with the help of a browser plugin called Spectrum (Lvivski, 2014) to identify usability problems that could arise from inappropriate color choices.

The stacked area graph (Figure 1-27 on page 51) strongly relies on the color-relation between its legend buttons and the areas in the graph. Some colors are hard to distinguish for color-blind persons, which makes reading the graph difficult. Therefore, users should be able to link the information on the buttons and the areas in an additional way. While hovering over a button, the related area should stand out from the others. This can be achieved by highlighting the borders of an area. Reciprocally, while hovering over the graph with the mouse, additional information should appear to link the area to the corresponding location or appliance.

Furthermore, the light green of the scale (15%) looks very similar to the dark yellow (5%) for users that suffer from deuteranopia (green weakness). The color was therefore adjusted to a darker tone (Figure 1-19). Other color choices did not introduce problems for users that suffer from protanopia (red weakness) or tritanopia (blue-yellow weakness).

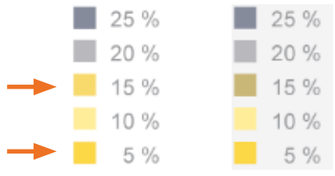


Figure 1-19 Deuteranopia is a green-weakness

MENU

As explained in the previous chapter, the name “Saving Options” was ambiguous. The term “Potential Savings” now refers to the same functionality but in a more precise way. The letter size and the height of the menu bar have been reduced to leave more room to the actual content of the web application. The former dashboard icon has been replaced by four rectangles in order to create a relation with the tiles which are characteristic for the dashboard feature.

HAMBURGER MENU

“Save as a favourite” has been renamed to “Save to dashboard library”, which makes it more obvious what the effect of a click will be. After a click, a dialogue appears to confirm that the selected graph has been successfully added to the library. This removes uncertainty and also offers the option to directly jump to the dashboard feature (Figure 1-20).

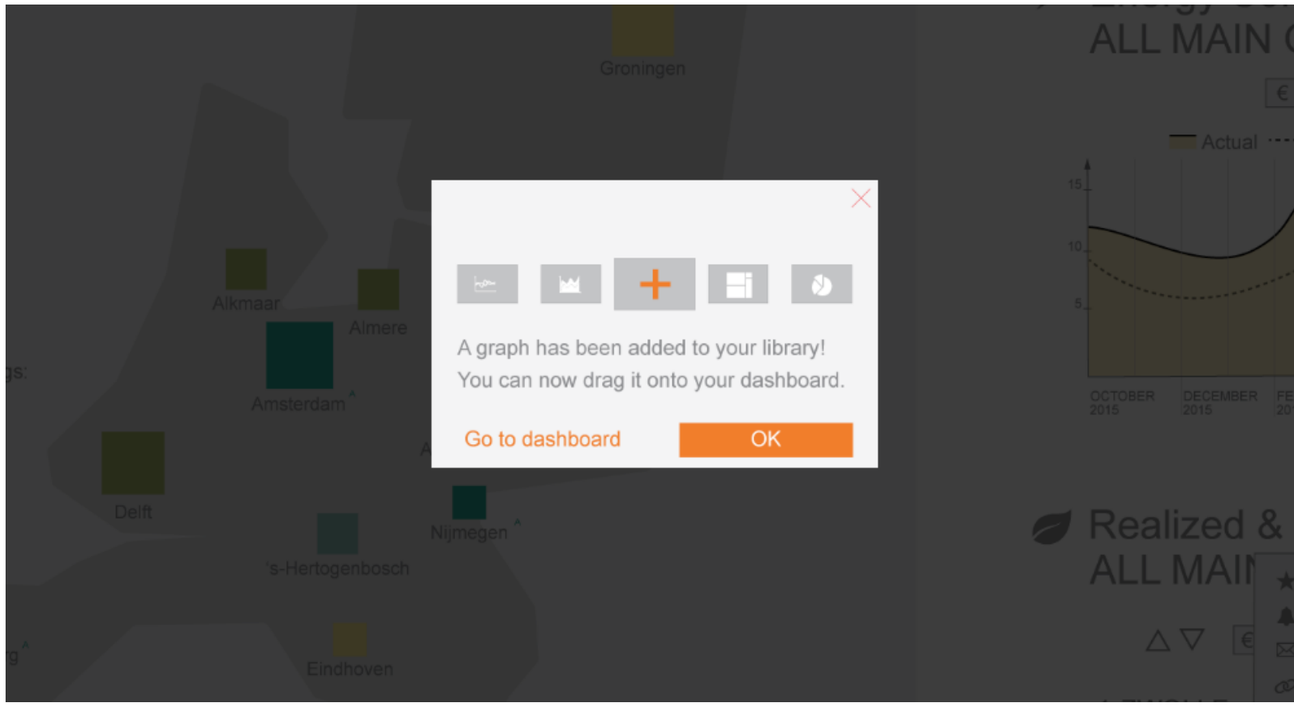


Figure 1-20 A graph has been added

DATA EXPLORER

The structure of the data explorer has been simplified. Figure 1-23 and fFigure 1-25 represent the previous and the actual content structure and their crosslinks. The labels next to the arrows refer to the button/function that allows switching from one state to another. The new structure (fFigure 1-25) is more consistent and interconnected while it allows for more functionality than the first structure. This is possible because crosslinks (magnifying glasses) have been added to lists (Figure 1-21). Clicking on the orange magnifying glasses makes quicker navigation possible.

(In the prototype this feature works for the list items of Amsterdam and coffee machines).

Finally, users can zoom in on interesting information without ending up in a dead-end.

Figure 1-21 The magnifying glass icon

Graphs

Icons underline that both charts in the sidebar display different information (Figure 1-22). Also shorter and bigger titles draw more attention and require less time to be understood.

The savings ranking has been transformed into a bar chart. Additionally to their color, the width of the background blocks now carries information.

Instead of a “details button” the charts in the sidebar are now directly clickable. Additionally to the changing mouse pointer, a magnifying glass appears around the icon to indicate clickability. Magnification stands for zooming, or getting more into detail by enlarging something. This underlines the relation between the icon and the function. If the function of the magnifying glass is not clear to the user, he will probably hover above it with the mouse. A small info-box will then explain: “Click to see more detail”.

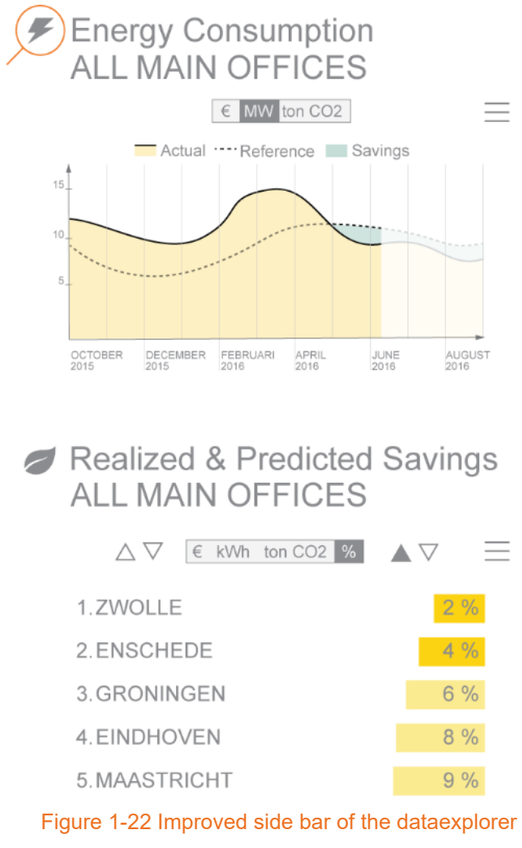


Figure 1-22 Improved side bar of the dataexplorer

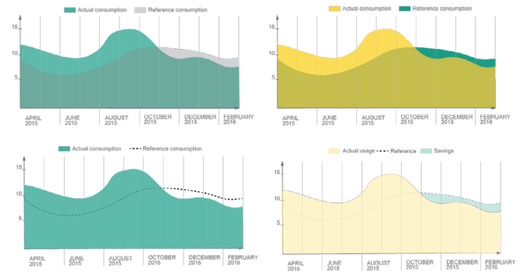


Figure 1-24 Alternative data visualisations

The unit switch above graphs now indicates CO2 in tons. Tons of CO2 is a common unit to compare the environmental impact of appliances and buildings.

The purpose of the line graph is to display the energy consumption relative to a reference line while also showing savings. The previous graph was not intuitively clear to all users. Four alternatives were created (Figure 1-24). While the top alternatives may be visually more appealing, it is harder to focus on the main purpose of the graph because of overlapping areas that introduce additional, unnecessary colors. The chosen graph represents the energy consumption as a yellow area with a black line on top. The reference consumption is represented as a dashed line to draw less attention.

The space between the reference line and the actual consumption is colored greenish to indicate savings. Losses do not have an own color, like they had in the previous graph. This makes the graph easier to read and removes the uneasiness of highlighting negative feedback. Predicted data is presented with even lighter, faded colors to induce uncertainty ((Figure 1-22).

The y-axis of graphs now show up to 3 values to give users a feeling for the scale of the data. When users hover over a specific area of the graph, detailed data can be inspected (view prototype 3 for this feature). Some vertical lines in the graph were slightly elongated to visually connect them to the descriptive labels of the x axis (months). This has been done to prevent erroneous graph interpretations.

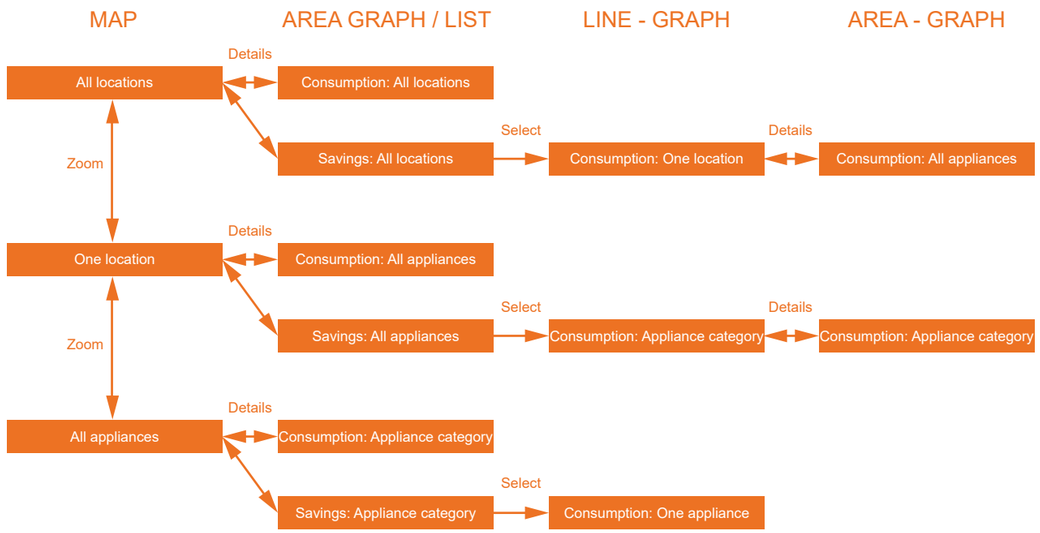


Figure 1-23 The previous structure had dead-ends

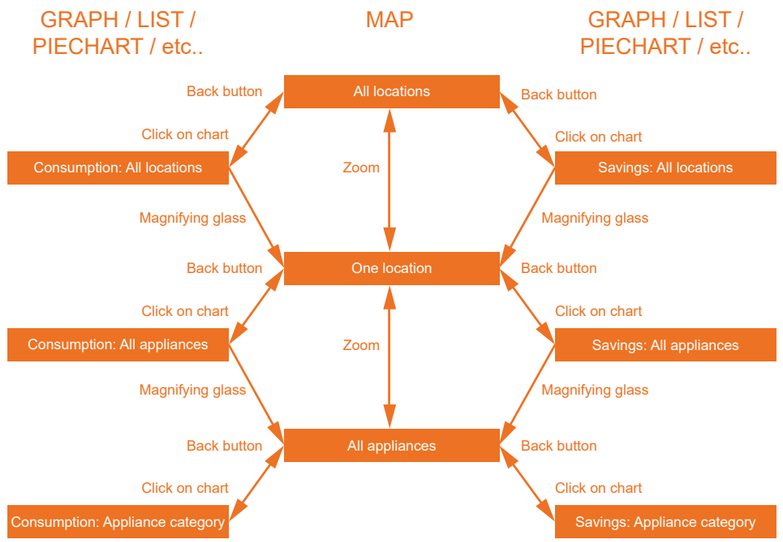


Figure 1-25 The improved structure is more interconnected

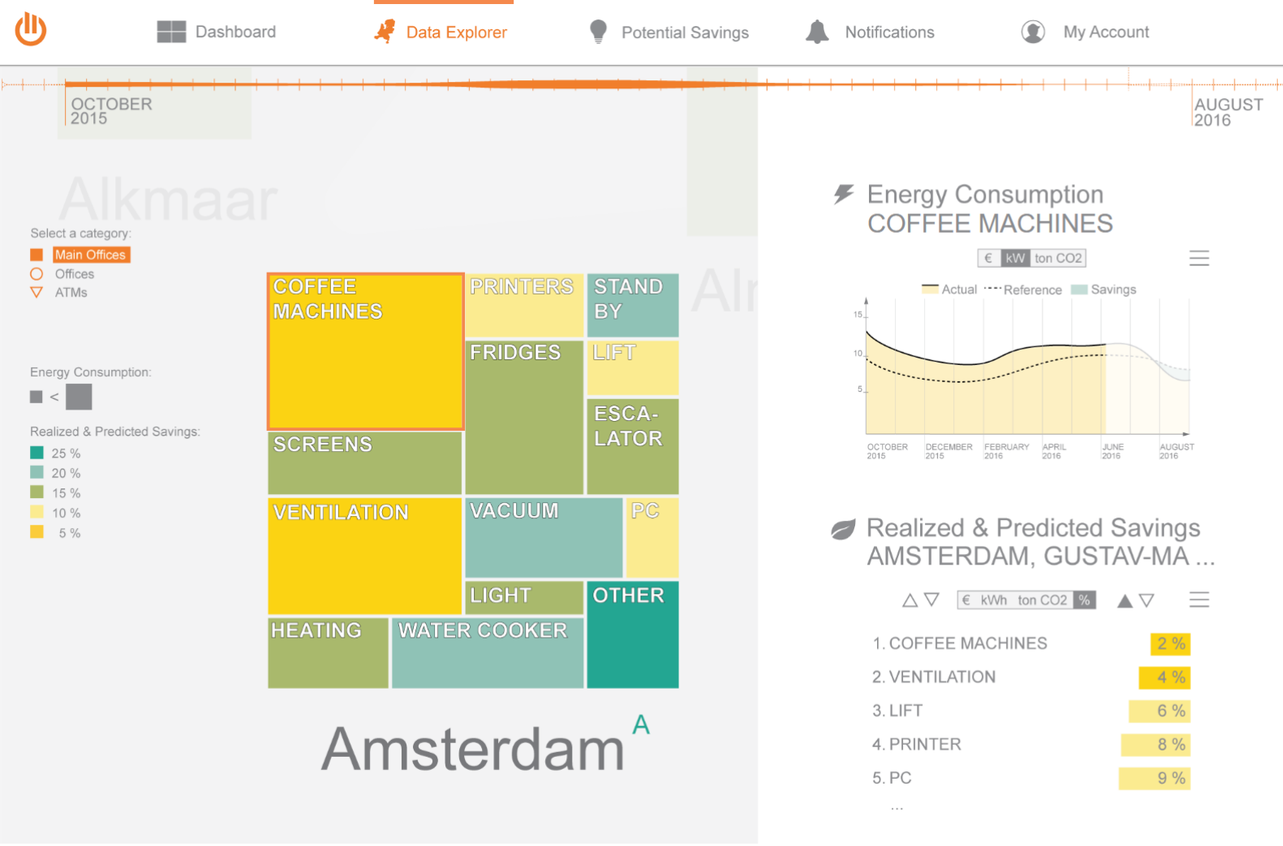


Figure 1-26 The data explorer at the “treemap”- level

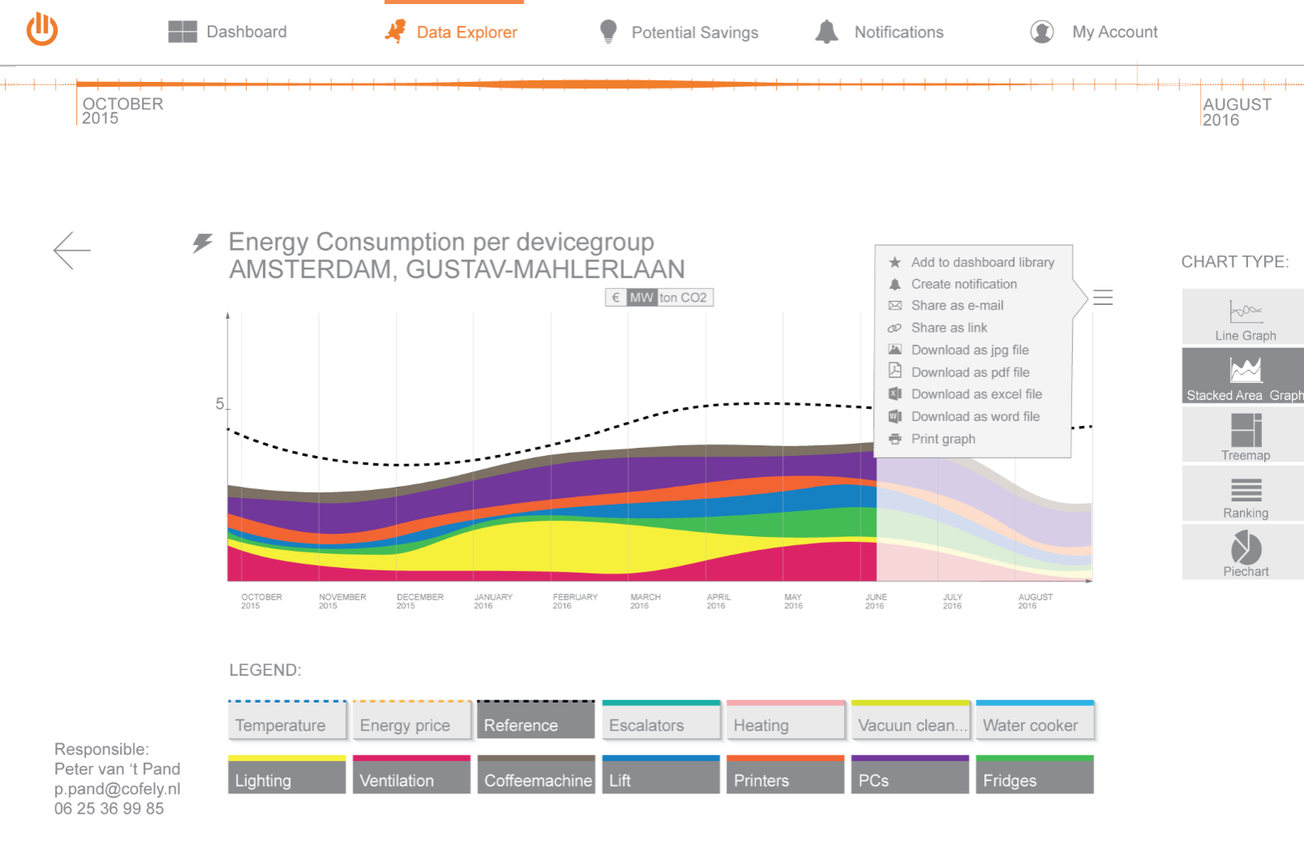


Figure 1-27 A stacked area graph can reveal consumption relations over time

At the lowest detail level, appliances can only be viewed as appliance categories, and not as single appliance per room, due to technological restrictions by Ipsum (page 45).
The treemap is now clickable (Figure 1-26). The orange frame highlights the selected appliance category. The according consumption graph appears on the right (only the title adjusts itself in the prototype). Also the colors of the treemap have been adjusted so that they match the legend. Now their color carries information and is also more visually appealing. The labels of other locations (Alkmaar, Almere) distracted users. Now they are less apparent and faded out.

The legend on the left side of the map has been adjusted as well. The color of the blocks now indicate savings depending on the time that has been chosen on the timeline. If only a period in the future has been selected, the title of the legend will indicate “Predicted Savings”. If the user uses the timeline to only view historical data, the colors will only indicate savings from the past, or “Realised Savings”. A period that covers both the future and the past will make the colors of the legend correlate with realised and predicted savings. Therefore the title of the legend states “Realised & Predicted Savings” in the example (Figure 1-26). This gives users the freedom to either browse all data in order to discover potential savings in the future or to explore the reason why some locations performed better than others in the past. Unfortunately it would have been very time consuming to simulate this functionality in a prototype, as all graphs would need to be interactive or at least changed. Nevertheless this functionality makes up an important part and has to be tested with a more complex prototype.
The category selector (Figure 1-26) has become more apparent. It is now located above the legend and the selected category is highlighted with an orange background. This makes it more obvious which category has been selected.

Stacked area graph

A stacked area graph helps to roughly compare the proportions of energy consumption over time but it does not give information about precise data. Therefore, now more chart types are available with the chart type selector on the right (not clickable in the prototype). A piechart and a treemap are for comparing the cumulative energy consumption over a period, a ranking helps to identify the highest and lowest consumer and a line graph is handy for the comparison of few consumers in order to discover similarities and divergences.
Users are not always familiar with stacked area graphs, whereas both test persons interpreted them correctly. Some users were not sure whether the areas were cascaded or stacked. To assure users that they are correctly interpreting the graph, the chart type selector on the right indicates the chart type as a text. The title “stacked area graph” is self explanatory and users can now be sure that the areas are indeed stacked and not cascaded.
If the mouse hovers over a part of a graph, detailed information should pop up to enable users to compare the consumption at a specific time. A vertical line appears and a small info box with detailed consumption data per appliance (This feature has been included in prototype 3).
The legend-buttons under the graph area graph have been redesigned. Light buttons with drop shadows indicate that they have not yet been selected. Dark buttons look flat, as if they have been pressed. The buttons are not clickable in the prototype, but working buttons should have a smooth transition from one state to another to strengthen a intuitive on/off - perception.

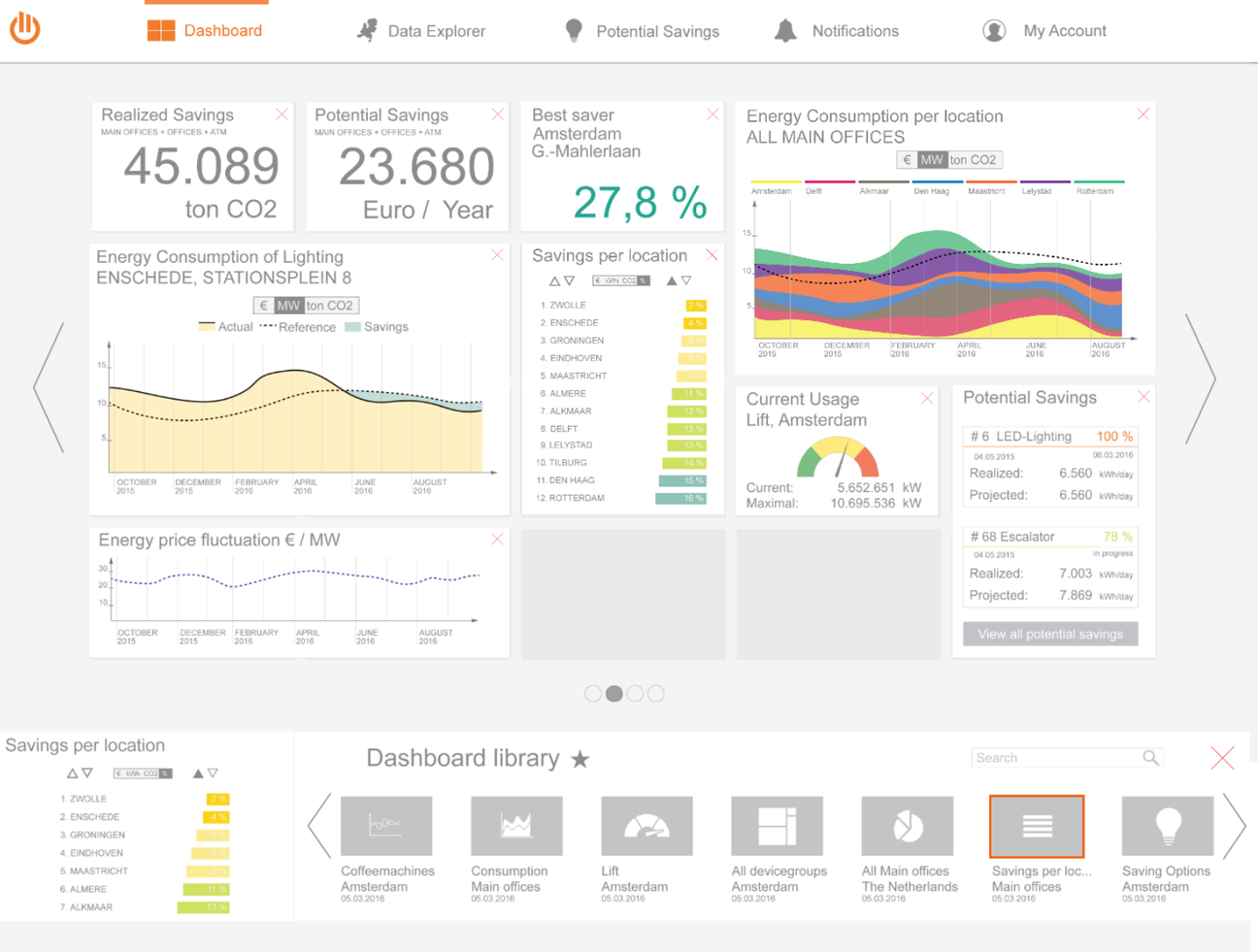


Figure 1-28 All example tiles of the dashboard

The black area that functioned as a back button (Figure 1-15) has been replaced by an actual back button in the top left corner (Figure 1-27). This saves space and is usability-proof, as back buttons are part of nearly every interface.
The name and contact details of the responsible person of a location is displayed in the bottom left corner (Figure 1-27). This an extra bit of information is placed at a rather unobtrusive place so that the focus of the user stays on the data.

Timeline

The timeline now stretches across the whole width of the screen to indicate that it has influence on the map and the sidebar (Figure 1-26). The timeline also moves up when it is not in focus to hide its title and the granularity switch. This has been done to simplify the interface by only showing information when it is necessary. The usability of this feature needs to be tested.

DASHBOARD

The dashboard feature did not undergo big structural changes like the dataexplorer. Most adjustments were realised in order to improve the correctness of graphs and the realism of the prototype by making all tiles draggable.

Graphs

The lift graph now clearly states that it indicates the current usage and not savings.
Saving options have become potential savings. This makes it more obvious that the numbers displayed in kwh/year are projected and realised

Figure 1-29 The redesigned “Potential Savings” - feature

savings. A click on the “view all potential savings” -button brings the user to the menu, potential savings. The graph about the lighting and the energy consumption per location got a legend.
The bar below the dashboard is now called dashboard library. When the dashboard library is opened, the user automatically scrolls down, to display the whole library. When the library is closed, it scrolls up again.

Tiles

It is now possible to drag the preview window and the gray icons directly onto the dashboard (only lift and savings per location work in the prototype) after selecting them. Tiles do not yet snap to the grid but all of them are draggable now.

POTENTIAL SAVINGS

The former “saving option” feature has been redesigned (Figure 1-29). While the core functionality remained unchanged, the structure and the layout were upgraded. With the new layout, users do not have to scroll down anymore. Also, the timeline feature has been added to graphs where necessary to replace the switches. The new structure is based on the mindpath of the user and the questions that have to be answered before executing actions based on the advice. The user will have to answer the following questions before taking action and beeing able to realise savings:

Is this relevant to me?

The potential savings that are displayed should be filterable by location and device category so that the user knows whether he can do something about it or not in terms of responsibility.

Is there a relevant benefit?

The possible benefit is proportional to the interest of the user in an advice. Therefore the projected benefit has been included as a rankable list item. The benefit is also displayed in the quote and in the graph in the sidebar (green area).

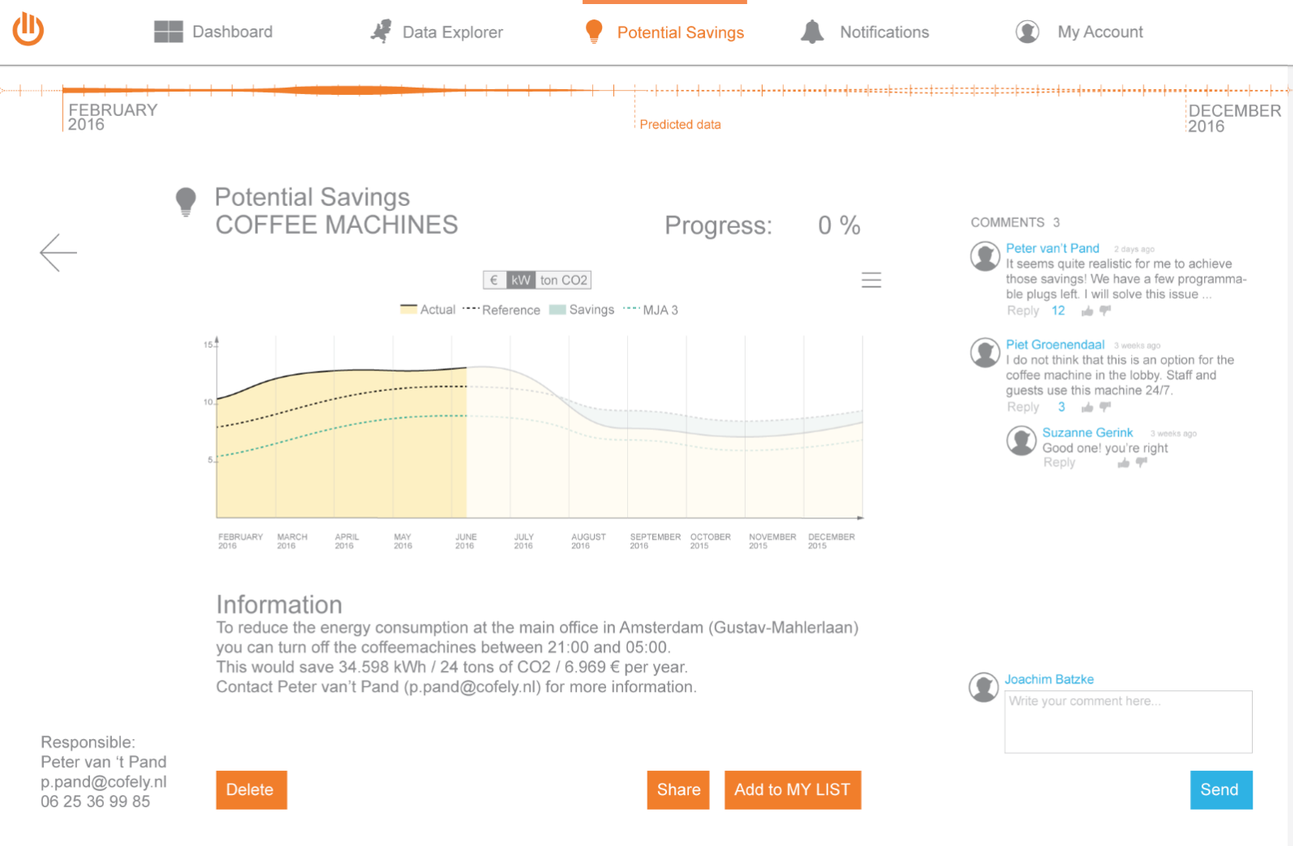


Figure 1-30 Potential savings for coffee machines

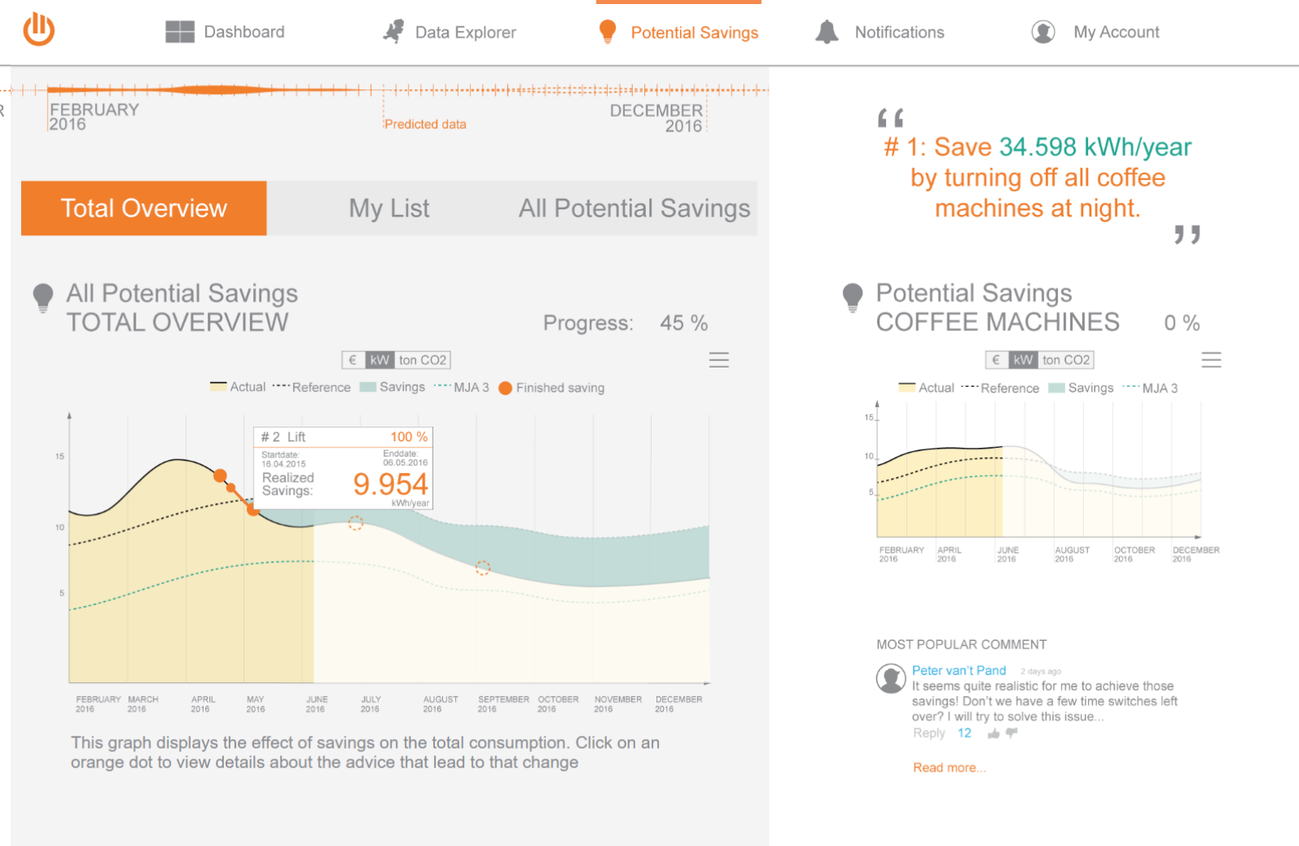


Figure 1-31 The "Total Overview" shows the effect of savings on the total consumption

Is it realisable?

If a potential saving is relevant and has a promising benefit, the user will want to know whether it is executable. The quote gives a first taste of the actions that need to be taken in order to realise the savings. Also the comments of other users help to answer this question. To gain more information the user can click on the graph, like in sidebar of the dataexplorer. An informational text below the graph explains the reasoning behind the potential savings and gives a general solution to the problem. Now, it is up to the user to think of other, more detailed factors that may have an influence on the realisability. The investment of time and cost depends on a lot of parameters and is therefore not simulated by the interface. The comment section allows for users to share and store their thoughts or insights. If the advice does not apply for the user, the delete button removes it from his list. If advice does not apply it is very useful for ipsum to get to know why. For this purpose, a dialogue window should let the users chose from a list of reasons. If the advice is realisable, users can add it to "My List" for quicker access.

Do actions have an effect?

If all of the questions above could be answered with a yes, the user will probably initiate actions, tasks or projects in order to achieve the goal. Of course, users want to know whether their actions had the desired output. The "My list" - option gives them quick access to their current saving options. The consumption graph automatically updates so that one can track if any progress has been made. Also the progress is presented as a percentage next to the graph. If users want to they can also put that graph on their dashboard. Either in full size or several small preview versions, as shown in example tile on the dashboard (Figure 1-28).

If one of the previous questions has been answered with a no, the user will probably not execute the task himself. Therefore, he still has the possibility to share the advice or his comments, in order to help others to realise savings.

After the successful realisation of a few potential savings, users can view their influence on the total energy consumption. The card sorting sessions indicated that a progress graph would be a useful feature for goal tracking. Therefore the option "Total Overview", helps users to estimate the scale of their impact and which actions contributed the most. In practice this means that the period and impact of an action are displayed when the user hovers over an orange dot. The period linked to a dot is an indication for the complexity/scale of a project. In combination with the benefit one can make statements about the efficiency of the project realisation. Dashed orange dots appear if already realised potential savings fell back into old, inefficient behaviour or if they have not been started yet. For example, a behavioural change in the consumption of lighting has been successfully introduced, but for some reason the consumption exceeds the desired value again. Users are then triggered to trace the origin of that change.

ACCOUNT

Additionally to the account, a login screen has been build. It offers standard functionalities, like a password reset, but not the option to create an account. Accounts are created by Ipsum and executing users. The bar at the bottom shows the loading progress to indicate that the interface did not "freeze" and that the user simply has to wait until all data has been loaded. No labels or numbers have been added to the bar, in order to keep it simple. Loading bars are very common and are sure to be understood. A logout button

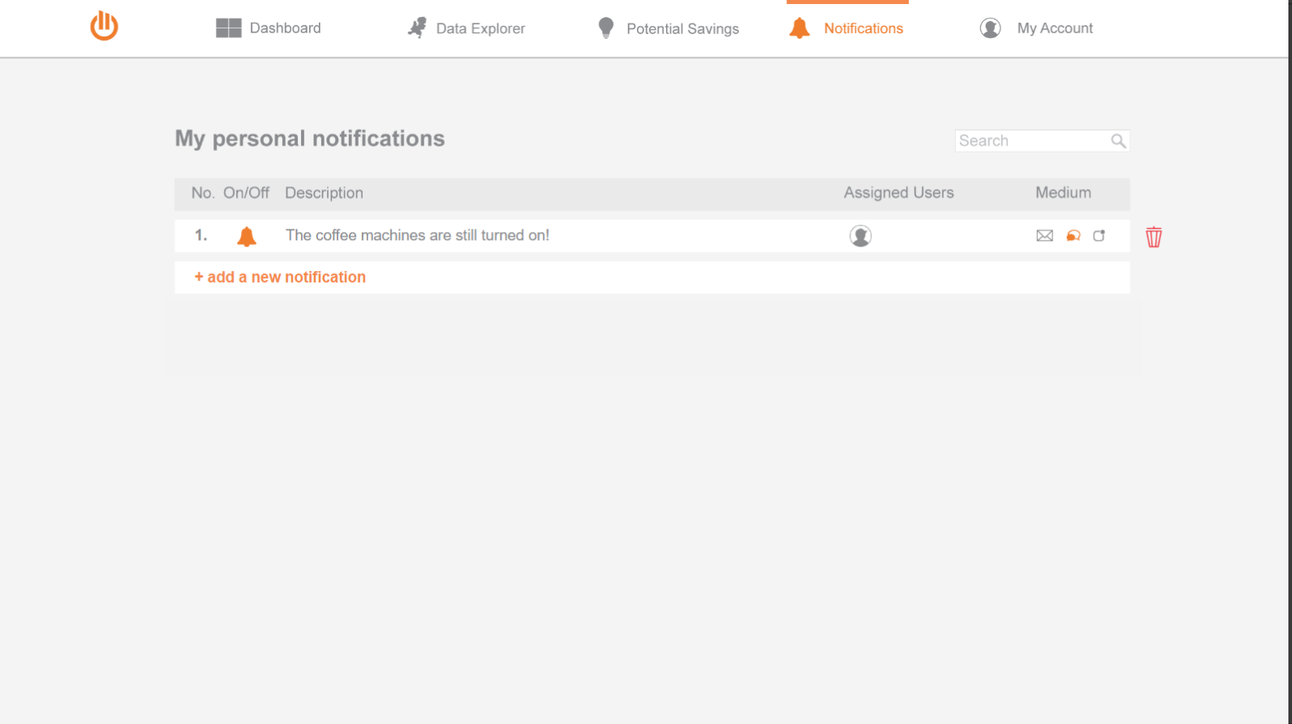


Figure 1-32 All notifications are presented in a list

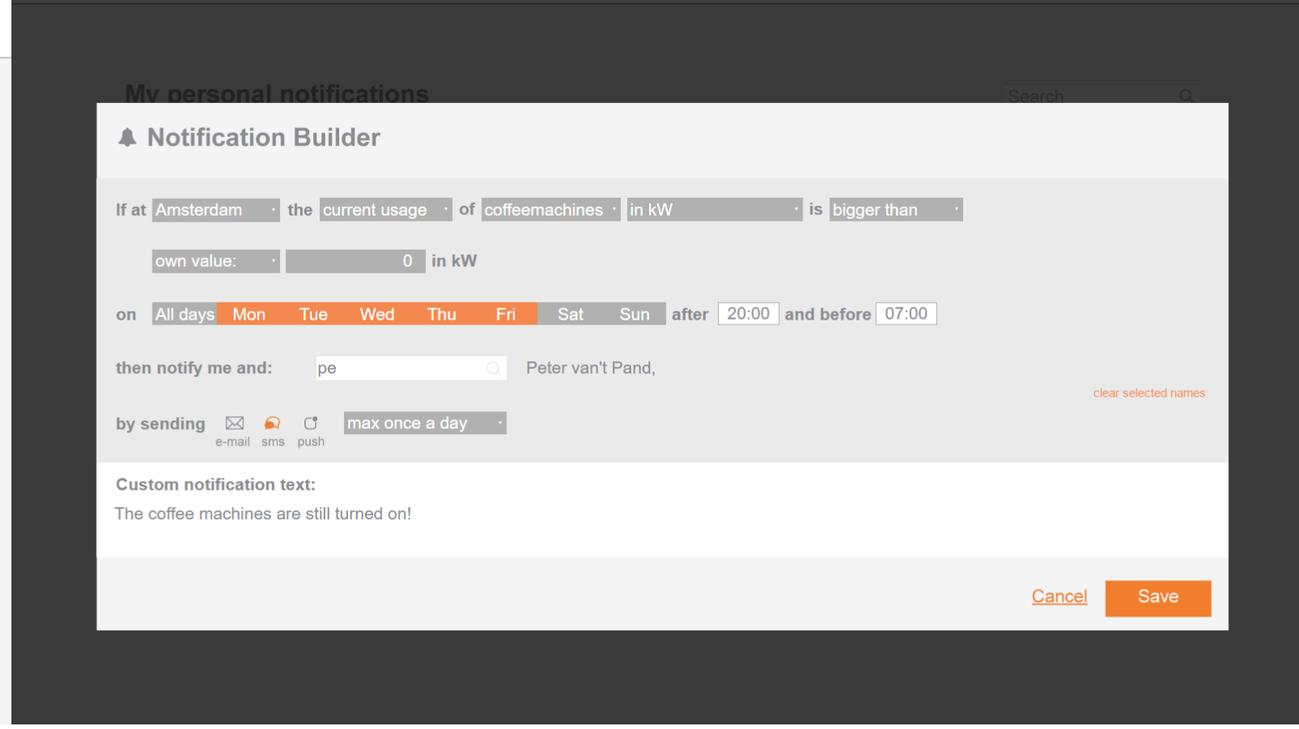


Figure 1-33 Customisable notification texts make notifications personal

has been added. The button was not placed in the menu to make it less apparent and to prevent frequent logouts. Users do not like to login every time they want use the web application which can be prevented if they simply stay logged in.

All text fields are now interactive to increase the realism of the prototype. Also one can choose between the languages with a dropdown menu. The notification settings were not expected to be part of the account option. Therefore they have been removed. The new “Notifications” - menu item gives room to this functionality.

NOTIFICATIONS

Custom notifications (Figure 1-32) enable users to keep track of important events and to react accordingly.

This feature has already been mentioned in the chapter about the product development scope on page 36. The redesign of the first prototype left enough time to integrate this feature for the second evaluation.

The notifications feature is in essence a list of custom notifications that can be created, edited, deleted and switched on and off.

The notification builder (Figure 1-33) supports the user in choosing and arranging all variables that are needed to create a custom notification for any appliance. Those variables are: a location, an appliance, a data category, a unit, a condition, a second data input, a time frame, a medium, a notification text, and recipients. The best way to understand the feature is by trying it out.

Users can form conditional sentences by selecting options from dropdown menus. In order to prevent errors, the unit drop down menu switches from time dependent units to time independent units according to the choice made for the second drop down menu. Users can either chose an own value for their condition or a dataset of another location or devicegroup. Their choice influences the appearance of matching drop down menus to prevent conflicting choices. For this reason the first unit selector presets the unit that is displayed at the end of the second line.

After selecting the data the user can choose the timeframe that conditions the importance of a notification by selecting weekdays and a period for all of those days.

Additional recipients can be selected from a dropdown list. Only user accounts of the same client can be selected here. A notification will appear as a suggestion among their own notifications list where they can turn it on or off, edit it or delete it.

The next step is to define a notification medium and the maximum notification frequency to prevent spam. Finally a custom notification text has to be filled in. This text will appear in every notification the user receives and helps to distinguish it from others. If all variables have been adjusted to the users preference he can confirm his choices by clicking “Save”. To prevent that users forget to enter a custom notification text, an orange frame appears around the textbox if it is empty. “Cancel” can be clicked at any time. It will close the notification builder and discard changes. A notification is shown as an “uncompleted notification” in the list, if no description has been added yet. By clicking on the orange bell icon (Figure 1-32), users can turn them on or off at any time. This way they do not have to delete and rebuild them. A notification can be deleted with a click on the bin icon.

CONCLUSION

The prototype has been improved and extended based on user feedback. The development of the interface is hereby not finished because all adjustments and the interface have to be put to a test. New usability problems will arise from changes and unpredictable behavior of users will influence the development of an even further improved prototype. In the following chapter the results of a second evaluation will be presented.

EVALUATION OF PROTOTYPE 2

In this chapter the result of four usability tests with potential clients will be presented. The evaluation of the second prototype is the final step of the bachelor assignment and will lay the foundation for further development.

GOAL OF THE EVALUATION

Like for the first evaluation, the goal was to discover problems that emerge when potential users interact with the prototype. An adjusted usability test was conducted that also treated the new notification feature (page 85). Four test users participated, including one monitoring user and three executing users. Two of them had not been interviewed yet, all of them were first time users.

INTERVIEW RESULTS

Two executing users were interviewed. The first one works for Engie and is responsible for the maintenance and facility management at the main office of the Abn-Amro in Amsterdam. The second interviewee is an energy consultant for Strukton Worksphere. Strukton is a construction and railway company with over 6,200 employees.

1. EMPLOYEE OF ENGIE

The interviewee currently uses Innax's E-view to get insight into the energy consumption of the main building of the ABN Amro. E-view only displays the total energy consumption data which is why he expects that Ipsum's web application would be an improvement. A core business of Engie is the delivery and the saving of electric energy. Therefore, his main motivation to reduce energy consumption comes from his job position. He is responsible for the technical maintenance and management of the whole main office of the ABN and would spent around 1 hour per week on analysing energy consumption. He would give access to the interface to two co-workers but does not want to give an account to a lot of people. In his opinion, the less people have access to the data, the less questions there will be.

Engie can decide about the execution of energy saving actions to a certain degree. Important financial decisions will have to be taken in cooperation with ABN real estate. He would share information primarily within his team by using powerpoint presentations and pdf documents. Data may only leave the building with the permission of the ABN. The interviewee does not want to receive pro active mails. In contrast to that he wants to receive custom notifications that inform him about alerting consumption. The main language of the interface should be dutch. For sharing purposes it should also be english.

CONCLUSIONS

The interviewee confirms existing requirements and fits within the profile of an executing user because he actively spends time on energy savings. It is important to recognise that his motivation to reduce the energy consumption comes from his job position and does not require additional proactive triggers. For him the web application should be a neutral tool that does not ask for attention, except when it comes to custom notifications.

2. ENERGY CONSULTANT OF STRUKTON

The interviewee is one of around 15 energy consultants at Strukton. Her goal is to reduce the energy consumption of buildings for business clients of Strukton in order to save money. She does not require external motivation, as her job requires her to focus on energy savings daily. She is an executing user and directs technical staff, located at different buildings, to realise possible savings that she, her colleagues, the client and the technical staff evaluated to be realisable. She wants to share pdf-, excel-, word- and image files via mail, and in some cases, whatsapp. Pdf files are intended for clients as they cannot be modified. She also likes the idea of sharing links to live data. Strukton works with monthly, half-yearly and yearly reports and predictions. Data from Ipsum's web application could be added to those reports. The interviewee would like to receive alerts based on daily energy consumption. She would like to use Ipsum's web application to identify unusual and inefficient energy consumption of different appliances.

If Ipsum's web application can deliver additional value she can advise the contract manager of a project to chose Ipsum as a partner. The primary language of the interface should be dutch.

CONCLUSIONS

The interviewee fits in the profile of an executing user because she analyses energy data and decides on the execution of energy saving projects. Her requirements for an interface do not differ significantly from the requirements of other executing users. She is younger than other interviewees and more open to recent communication methods like links to cloud data and whatsapp.

RESULTS OF THE USABILITY TEST

The detailed results of four usability tests can be read on page 92 in the appendix.

The usability tests revealed many small issues that required improvement. For example users did not recognise the hamburger menu and failed to add graphs to the dashboard library. Next to those issues users suggested new features that could be worth integrating in a future version of the prototype. The presentation of opening and closing times of buildings in graphs was one of them. Many issues that appeared in the first usability test could be fixed by the improvements and did not reappear. One good example herefore is the restructured and improved version of the potential savings feature. In a nutshell the usability test were a useful and necessary part of the development and provided enough material to build an improved third prototype.

RECOMMENDATIONS

The development of a complex energy monitoring interface has just begun and there is still a lot of room for improvement. Many small to medium changes still have to be undertaken in order to continue the development.

Based on recommendations, a third prototype should be build and tested with potential users to guarantee a user centred outcome. Fast prototyping programs like Axure speed up the making of prototypes because the interface is still at a stage that requires flexibility to react to user feedback. Promising results of evaluations can then lead to a parallel development of a "real" prototype build in html, css and javascript that can be connected to actual data. Therefore, the following recommendations should be included in the development of a third "fast" prototype. The first part of the recommendations covers improvements inspired by the evaluation in the previous chapter. The second part gives general recommendations that should be considered for subsequent development.

RECOMMENDATIONS BASED ON USER FEEDBACK

MAIN MENU

1. The clickability of the main menu can be underlined by introducing hover effects. (E.g.: An orange background that appears while hovering over a menu item)

HAMBURGER MENU

2. The "add to dashboard library" option should not stay in the hamburger menu, but be more apparent, next to a graph. (E.g.: An orange plus-sign next to every graph) Also, right clicking on a graph should open a context menu that gives users all options.

DATAEXPLORER

3. According to users, the squares on the map view should also display numbers to enable better comparisons. To prevent an information overload, numbers only appear when users hover over a square (Figure 1-34). The previous coloring often lead to confusion and people did not know how interprete it. The new version contains three areas that indicate the ratio between the most important key numbers of a location. User can now make precise comparisons and have a more detailed overview. This can help monitoring users to identify locations that have the highest potential to improve.
4. Two zoom button should be added to the map view (Figure 1-34).
5. A click on the total consumption graph in the sidebar should not directly lead to a stacked area graph, but to a bigger version of the total consumption graph. The chart type selector should therefore also contain an option that brings up this merged area graph (Figure 1-35).
6. A bar chart should be included as a chart type in the chart type selector. It is commonly used and handy for comparisons of accumulated data. The granularity of the x axis can be adjusted with the switches of the timeline.
7. Some chart types are not known to users. A small clickable question mark on each chart type button reveals more information (Figure 1-35).
8. This question mark should also be added to graphs on the dashboard.
9. The unit switch is a clickable element. To make its interactivity more recognisable it

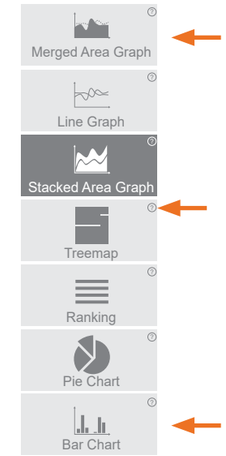
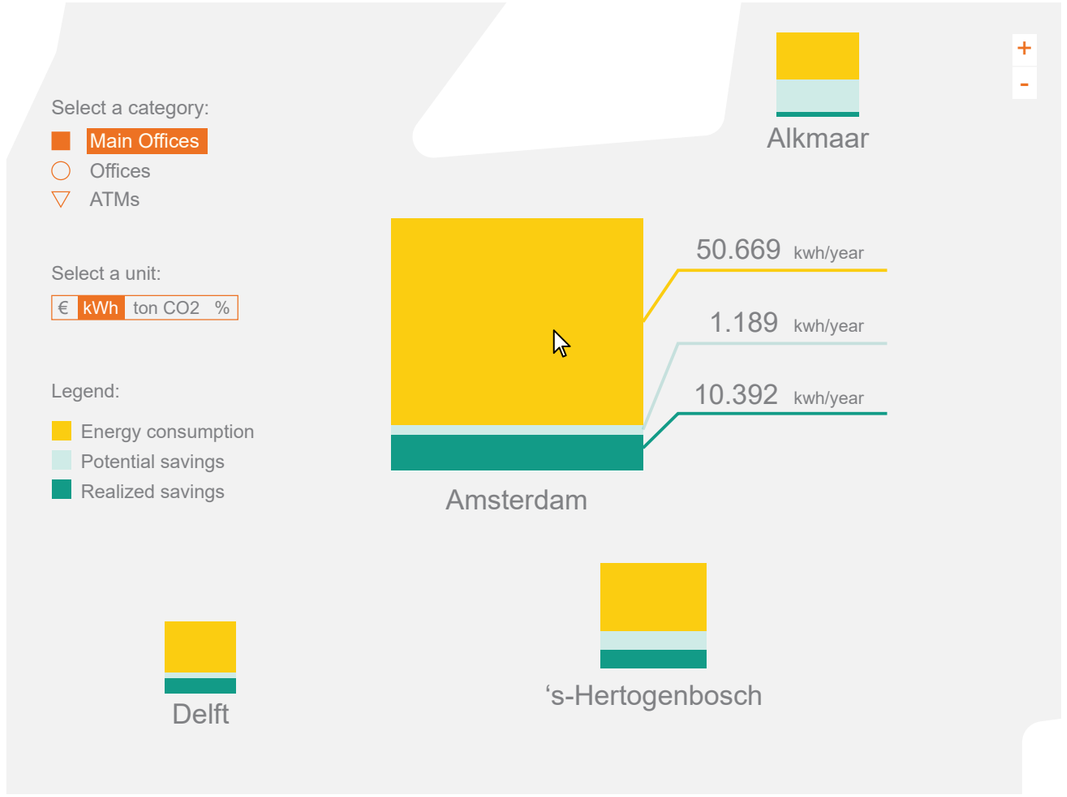


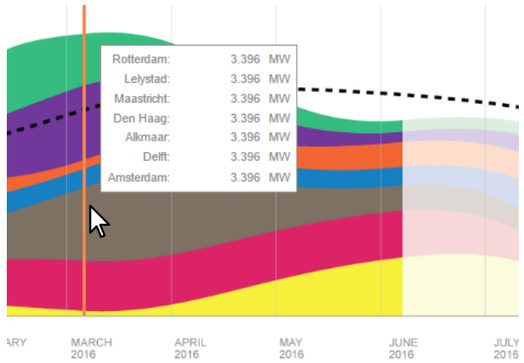
Figure 1-35

Figure 1-34 A potential improvement of the current data explorer



should also become orange, like various other clickable elements (Figure 1-34).

10. The y axis of graphs only shows 3 items which is not enough to analyse data. For the next prototype one should test how to display data the best when users hover over it. Prototype 3 gives a preview about how it may work:



11. The auto-hide function of the timeline caused confusion and should be disabled.
12. A click on a list entry should enable users to jump to that specific location or appliance. The clickable surface of the magnifying glass alone is not big enough.
13. Huge buildings should be split up into logical sub categories, that refer to the electrical wiring architecture. This can be building parts, floor levels or, if possible, even rooms. The appliance architecture should be as detailed as possible in order to give the best insight. The first prototype included the separation of appliance categories by location, which can serve as an inspiration.
14. Opening and closing times of buildings are an important variable that should be included in the interface. They should be a part of the reference line calculation. Also they should be added to the notification builder as a standard period that users can select for notifications. The possibility to compare data from when a building it is open compared to when it is closed requires a change of the graph's background color. For example, a darker background tone could indicate when a building is officially closed. This would help to identify unnecessary consumption. By adding a switch to the timeline that has the option to select either "Opened", "Closed" or "Both", users could refine graphs even more.
15. The legend-buttons below graphs should also contain buttons that add data from previous years. For example, a button with the label "2014" would add a line to the graph and enable comparisons with historic data from 2014.
16. A button that selects / deselects all legend-buttons should be added to speed up the process of data selection.

DASHBOARD

17. It should be possible to drag and drop graphs from anywhere to the dashboard.
18. Tiles should be draggable from one dashboard page to another.
19. A hamburger menu should be placed on each dashboard page. This would allow users to export and share multiple graphs as a pdf, a word file, etc..
20. kWh should be used to display the energy price.

POTENTIAL SAVINGS

21. Users want more information about potential savings. A link in the description of a potential saving can lead to informative pages that give more information about a specific subject. For example, some keywords in the description could be automatically linked to google.
22. More research should be done concerning, if users want to discover and create their own "potential savings" along side of Ipsum's advice. If so, a "Potential savings - builder" should be included. It would enable users to create and share their own saving insights to start a discussion about its realisability and to track progress.
23. The list item name "Status" is should be replaced with "Progress". "Progress" is used next to graphs and should be used consistently.
24. The bottom of the sidebar can already contain buttons that allow, sharing, deleting and adding to "My List".
25. Users should be able to jump to dates that other users mentioned in their comments by clicking on them. While writing a comment, users should be able to mark a correlating period on the chart. Their comment will then appear as clickable to other users and bring them to the right data.

NOTIFICATIONS

26. A tutorial can help first time users to understand all functions of the notification builder.
27. The orange frame around the text box was not apparent enough. By letting it flash a few times it would become even more obvious that no text has been entered yet.
28. The bell icon that is used to switch notifications on and off should not only change its color (dark gray vs. orange), but also give feedback in form of a small info text that appears after a click: The notification is now turned on/off.

GENERAL RECOMMENDATIONS

This paragraph lists general recommendations that should be considered for subsequent development of the interface.

The calculation of the reference line(s) should be discussed with each business client. For some locations it might be possible to integrate live data, like the number of employees that are present, or additional factors that have already been determined and can be used to strengthen the validity of the reference line (e.g.: square meters of windows facing south).

To help out first time users, there should be some sort of tutorial that guides them through the possibilities and limits of the interface. This can either be a pdf handout, an instructional video or an interactive tutorial inside of the web application.

The prototype has been designed in english to make it accessible to a larger audience and to match the language of this report. However, the preferred language among dutch business clients is dutch. Therefore, the interface should be translated to dutch, but also offer english as a second language. Users stated that they would use english graphs for sharing purposes. It may be useful to let users not only select the language of the whole interface but also when downloading, exporting or sharing information. Users could for example have the option to choose for a "download language" when they download a graph.

In order to keep the interface user friendly even after a launch, some sort of feedback system should be integrated. This can either be a simple feedback e-mail address or a more advanced feedback system, like usabilla.com

CONCLUSION

The recommendations form the basis for an improved third prototype. Not all of them will be realisable or will fit the user's needs, which has to be tested by carrying out usability tests. At least they can serve as an inspiration for subsequent development.

CONCLUSION

This chapter answers the central questions of the assignment and recapitulates the development process.

CENTRAL QUESTIONS

The bachelor assignment consisted in developing an interface for business clients that gives insight in the electric energy consumption data of buildings and motivates users to realise energy savings. In the beginning the assignment was split into two central questions and related sub-questions (page 9). First, “What are the users’ needs?” and second “What motivates users to reduce their energy consumption?” Both questions could be answered with the results of six interviews, four card sorting sessions, and six usability tests with potential users of the interface.

WHAT ARE THE USER’S NEEDS?

The user’s needs are defined by their goals, which vary with their job description. Some users want to improve the sustainable image of their employer, some want to keep all facilities in a building running efficiently and others want to decrease the energy consumption of buildings as their only goal. Users expect from Ipsum to gain insight into energy consumption on appliance level. As a result they expect to be able to analyse energy data more efficiently and to realise savings.

Even though users have different goals, all users want to be able to make valuable statements about the energy consumption of appliances and buildings. Those statements enable them to take action, realise energy savings, save money or promote their business.

Therefore, users are in need of different types of visualisations that help them analyze energy data (page 33: Adjusted list of requirements).

WHAT MOTIVATES USERS TO REDUCE THEIR ENERGY CONSUMPTION?

Users are already motivated to reduce their energy consumption. It is either part of their job description or promising because of the sustainable and monetary benefit. Motivation is present, what misses is the right data that justifies energy saving actions. To unleash their motivation, the interface enables them to analyse relevant data, suggests potential savings and allows for progress tracking.

WHAT'S NEXT?

As already stated in the previous chapter, the development of the interface has just begun and needs to be continued by developing a third interactive prototype that includes all recommendations. As a next step, all changes need to be validated by a series of usability tests with potential users.

Even though there is still room for improvement and extension, some properties of the interface should remain unchanged. This includes the core features of the current prototype:

- A dashboard that allows for a quick and customisable overview for any kind of user.
- An interface like the dataexplorer that facilitates browsing through all energy data and their relations.
- A possibility to identify and track savings to initiate energy saving projects.
- A notifications feature that allows to customise alerts and react to events in real time.

Those features emerged out of a user centred design approach and are very likely to satisfy the client’s needs.

Another fact that needs to be kept in mind for further development, is that different user types with different needs exist. This knowledge is important when it comes to evaluating and sorting contradictory user feedback. Once the web application goes live, new user accounts must be split into at least two different categories of monitoring and executing users (page 31). This allows for optimisable account presets and the integration of user type specific feedback in the future.

FINAL CONCLUSION

Although there is still room for improvement I am satisfied with the current state of the interface development. The interviews and usability tests with six different potential clients were eye opening and essential to give a reasonable direction to the development. I am pleased that there was enough time for a third evaluation, the evaluation of prototype 2, additionally to the initial planning. The result of the bachelor assignment is therefore an interactive prototype plus a list of recommendations based on user feedback.

Finally, I want to thank all employees of Ipsum, every interviewee and my tutors for their support and feedback. I hope that Ipsum can benefit from the results in order to offer smart insight and to realise smart savings.

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CREDIT

Through out the interface and the report icons were used. All icons that I did not design were downloaded from the www.nounproject.com. Therefore, hereby my credit to the creators of the following icons:

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APPENDIX

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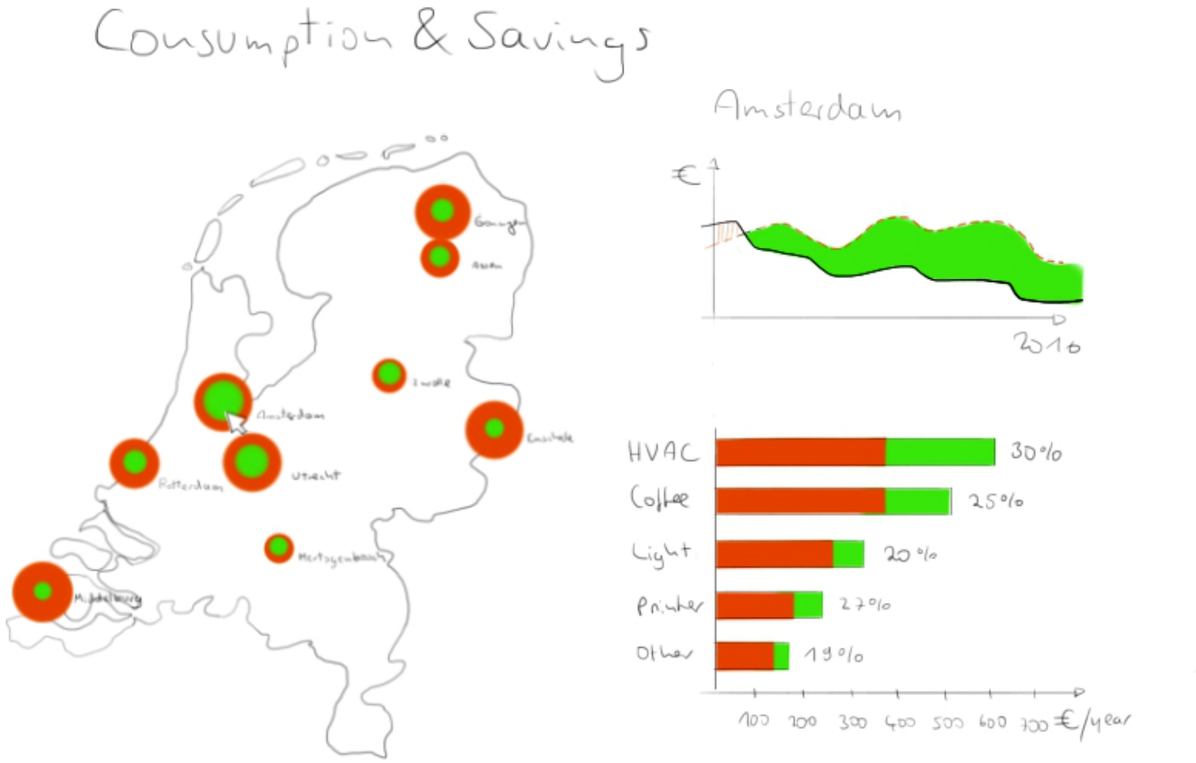
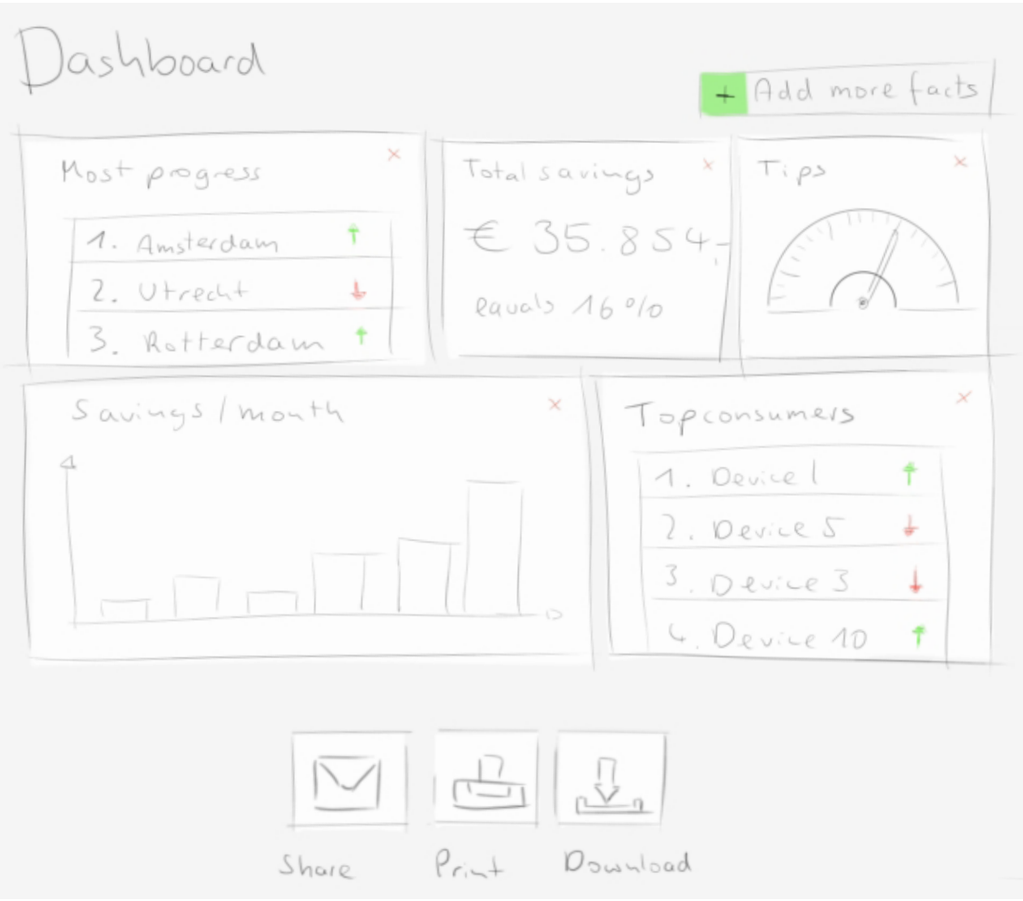
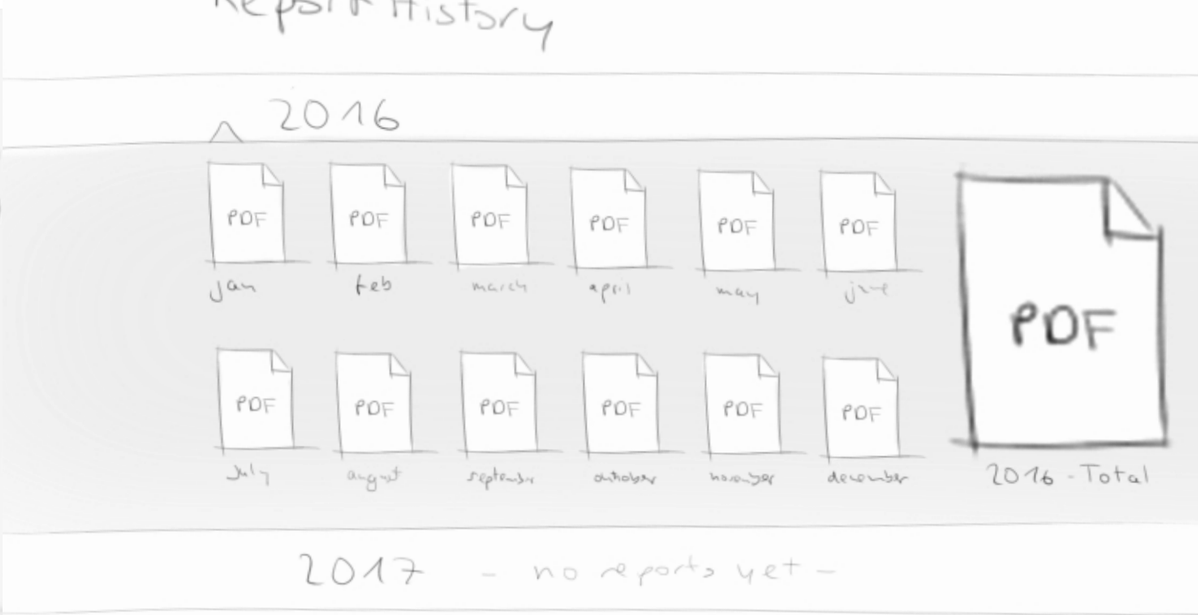
USABILITY TEST RESULTS 2 92

IDEAS


Consumption & Savings
Amsterdam
€
2016
HVAC 30%
Coffee 25%
Light 20%
Printer 27%
Other 19%
100 200 300 400 500 600 700 €/year


Dashboard
+ Add more facts
Most progress
1. Amsterdam
2. Utrecht
3. Rotterdam
Total savings
€ 35.854,-
equals 16 %
Tips
Savings / month
Topconsumers
1. Device 1
2. Device 5
3. Device 3
4. Device 10
Share
Print
Download


Input Data
Custom Set 1
Custom Set 2
New Location
Add
Device
Energy price
Temperature
Average
Chart-Maker
Reset Zoom
- last used graph -
CustomSet1 | CustomSet2
Save
Share
Print
Download
> Settings
Chart type
Unit
€ kWh CO2
Period
year month week day hour
custom period


Report History
2016
PDF
jan
feb
march
april
may
june
july
august
september
october
november
december
2016 - Total
2017 - no reports yet -

Favourite Graphs

Search

Title Title Title Title

Custom Notifications

Send a mail when the total consumption decreases by 10%

Send a sms when the printers consume energy after 20:00

New Notification

medium value comparison reference

Send if

Cancel Save

Other tips

All finished Todo

#4 200€

#5 400€

#2 50€

#3 200€

#10 150€

#8 80€

"Save 1.500€ per year by turning off the printers at night"

tip # 33

Tip #33 Projected Savings

€ kWh CO_2

without tip

with tip

savings

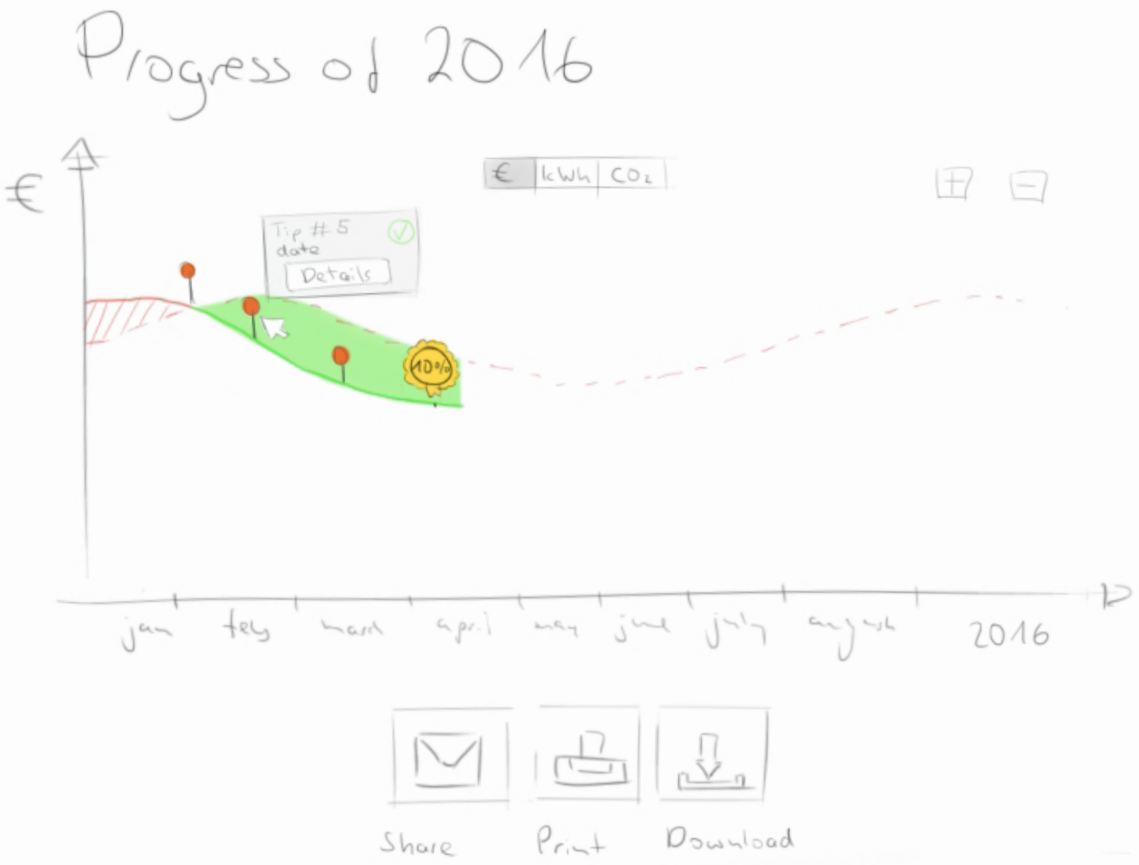
100 €/t

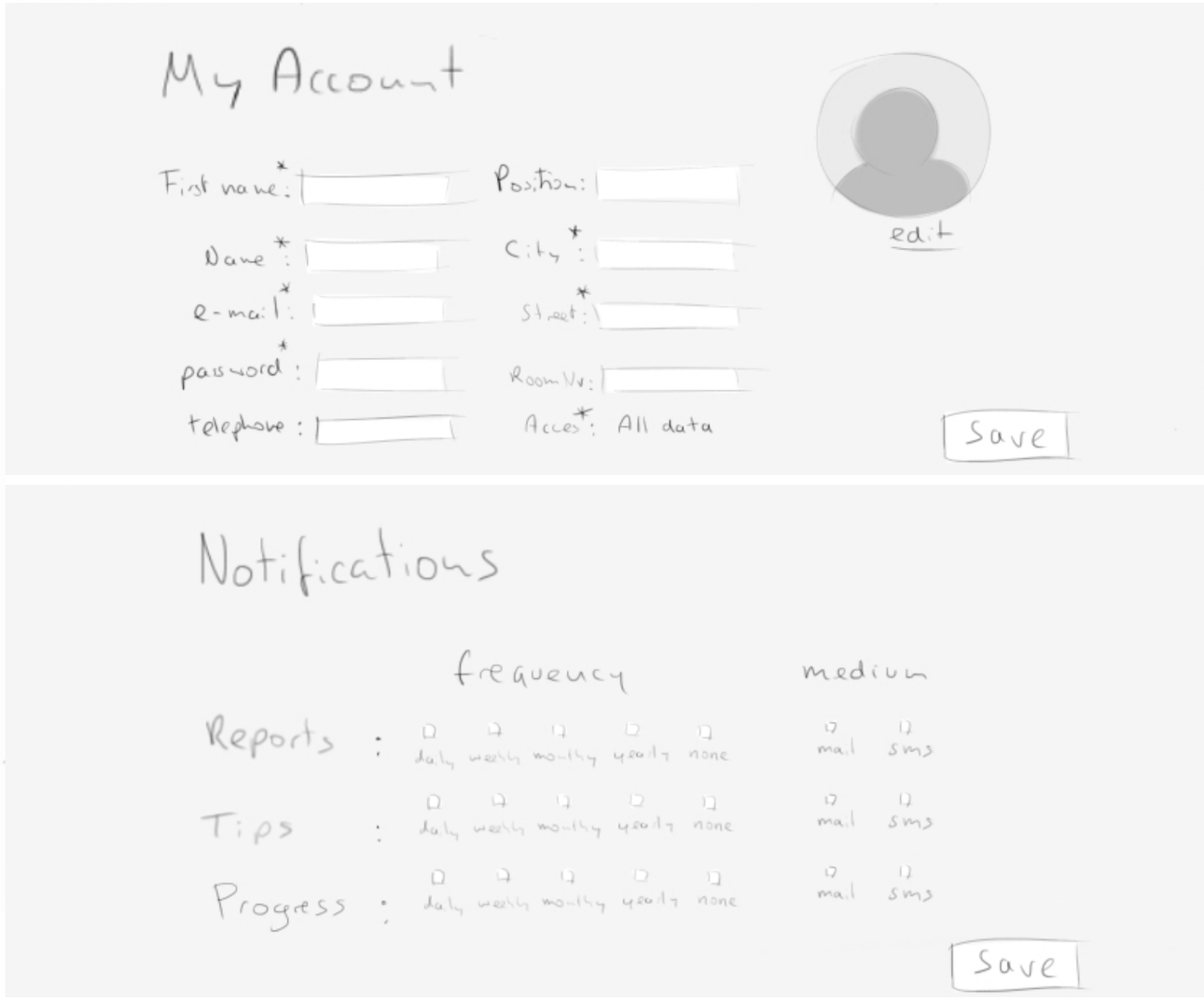
Past Today Future t

Tip # 33 Instructions

3

Keep me up to date Share Print Download


Progress of 2016
€
€ | kWh | CO2
Tip #5
date
Details
100%
jan
feb
march
april
may
june
july
august
2016
Share
Print
Download


My Account
First name*:
Name*:
e-mail*:
password*:
telephone:
Position:
City*:
Street*:
Room Nr:
Acces*: All data
edit
Save
Notifications
frequency
medium
Reports :
Tips :
Progress :
daily
weekly
monthly
yearly
none
mail
sms
Save

INTERVIEW

Toestemmingsverklaringsformulier

Titel onderzoek: Open interview en card sorting sessie voor webapp design
Verantwoordelijke onderzoeker: Joachim Batzke

Mijn doel is het ontwikkelen van een webapplicatie die inzicht geeft in het energieverbruik en motiveert om energie te besparen. Het doel van het interview is het verkennen van de eisen en wensen van gebruikers binnen ABN-AMRO. Op basis van deze eisen zullen ideeën en concepten worden gemaakt. Deze zullen samen met gebruikers verder worden geëvalueerd en leiden tot een functioneel prototype. Na afloop van het interview zou ik graag eerste ideeën aan u willen presenteren in de vorm van een card sorting sessie. Het doel hiervan is het ordenen en rangschikken van functies. Het interview en de card sorting sessie zullen in totaal ongeveer een uur duren. Om achteraf de data te kunnen analyseren zal ik audio en/of videomateriaal op nemen.

In te vullen door de deelnemer
Ik verklaar op een voor mij duidelijke wijze te zijn ingelicht over de aard, methode, doel en belasting van het onderzoek. Ik weet dat de gegevens en resultaten van het onderzoek alleen anoniem en vertrouwelijk aan derden bekend gemaakt zullen worden. Mijn vragen zijn naar tevredenheid beantwoord. Ik begrijp dat audio en videomateriaal of bewerking daarvan uitsluitend voor analyse zal worden gebruikt. Ik stem geheel vrijwillig in met deelname aan dit onderzoek. Ik behoud me daarbij het recht voor om op elk moment zonder opgaaf van redenen mijn deelname aan dit onderzoek te beëindigen.

Naam deelnemer: …….

Datum: 21.04.2016 Handtekening deelnemer: …..…….

In te vullen door de uitvoerende onderzoeker
Ik heb een mondelinge toelichting gegeven op het onderzoek. Ik zal resterende vragen over het onderzoek naar vermogen beantwoorden. De deelnemer zal van een eventuele voortijdige beëindiging van deelname aan dit onderzoek geen nadelige gevolgen ondervinden.

Naam onderzoeker: Joachim Batzke

Datum: 21.04.2016 Handtekening onderzoeker: ...…….

1. Waarom wilt u energie besparen?

2. Wie zal allemaal over de invoering van de webapp beslissen?

3. Er zijn meerdere opties om verantwoordelijkheid over het energieverbruik te verdelen. Welke van de volgende opties past het beste bij ABN-AMRO?

- ❏ Hiërarchisch (Hoofd gebruiker, sub gebruiker, individuele gebruiker)
- ❏ Een Energie Specialist (intern or extern)
- ❏ Community (iedereen is even verantwoordelijk)
- ❏ Anders, namelijk:

4. Wie zal er gebruik maken van de webapp binnen ABN-AMRO? Hoeveel mensen?

5. Zou ik mensen die gebruik zullen maken van de webapp mogen benaderen voor het evalueren van concepten?

6. Zou u gebruik maken van de webapp?

7. Wat is uw leeftijd?

8. Wat is uw doel binnen ABN-AMRO en welke taken voert u uit om dit doel te bereiken?

9. Wat verwacht u van de dienst van Ipsum?

10. Met welk toestel wilt u het liefst energiegerelateerde informatie bekijken?
- ❏ Smartphone
- ❏ Tablet
- ❏ Laptop
- ❏ Desktop pc
- ❏ Anders, namelijk

11. Welke taak zal u voornamelijk uitvoeren wat betreft energie besparing? Waarom?
- ❏ Omzetten van tips / besparingsopties
- ❏ Overzicht over de totale vooruitgang houden
- ❏ Zelf data analyseren en grafieken maken
- ❏ Zelf tips / besparingsopties aanmaken
- ❏ anders, namelijk

12. Welke specifieke informatie wilt u uit de webapp halen? Eigen ideeën:
- ❏ Totale besparing (euro/kwh/co2/%)
- ❏ De vooruitgang in het jaar
- ❏ De invloed van enkele tips / besparingsopties op de totale vooruitgang
- ❏ Hoeveel er nog kan worden bespaard
- ❏ De grootste verbruikers (regio's, gebouwen, verdieping, device groep, devices)
- ❏ De beste spaarders (regio's, gebouwen, verdieping, device groep, devices)
- ❏ Het aantal tips / besparingsopties dat nog kan worden uitgevoerd
- ❏ De verloop van de energieprijs
- ❏ De verloop van de temperatuur
- ❏ Anders, namelijk...

13. Met wie zou u specifieke energie gerelateerde informatie of besparingsopties willen delen? Waarom?

14. Hoe zou u deze informatie willen delen?
- ❏ Met een stick
- ❏ Cloudstorage
- ❏ Printen
- ❏ Via de mail
- ❏ Sms
- ❏ Whatsapp
- ❏ Anders, namelijk

15. Welke bestand formaten zou u hiervoor het liefst gebruiken? (of welke programma's)
- ❏ pdf
- ❏ jpg, png
- ❏ word
- ❏ excel
- ❏ linkje
- ❏ anders, namelijk

16. Wilt u jaar/maand/week verslagen ontvangen? Zo ja, wat moet er in komen te staan?

17. Wilt u zelf alarms kunnen zetten? Zo ja welke bijvoorbeeld?
(Mail als de printers na 20:00 nog aan staan)

18. Hoeveel tijd wilt u aan het gebruik van de webapp besteden? (elke dag 1 uur, een uur per week, niet langer dan 1 uur per maand)

19. In welke taal moet de webapp beschikbaar zijn? Liever Engels of liever Nederlands?

CARD SORTING

Card Sorting Script

Benodigdheden:
Papieren Prototypes, post-its, pen, papier, camera

1.Introductie:
"Ik heb potentiële functies van de webapp geschetst. Deze functies staan open voor feedback. Alles kan worden aangepast. Ik zal elke functie toelichten en vragen erover beantwoorden. Dan zal ik u vragen om de functies te ordenen zoals u het handig vind.
Zou ik te toelichting van de kaarten mogen opnemen?"

Elke kaart toelichten en op een toevallige volgorde op de tafel plaatsen.

2."Heeft u nog vragen over de kaarten?"

3."Zijn er kaarten die missen? Zo ja schrijf of teken het op papier."

4. "Nu zou ik u willen vragen om de kaarten te sorteren naar categorieën. Doe dit in overleg en door hardop te denken. Er zijn geen foute combinaties. U kunt ook kaarten weg laten"
Zou ik het sorteren mogen filmen?

"Zou u meer kunnen vertellen over deze groep?"

5. "Welke namen zou u aan de categorieën geven? Schrijf de namen op post-its "

"Wat bedoelt u met deze categorie naam?

6. "Welke groepen waren moeilijk om te maken?"

7. "Waren er kaarten die niet echt bij een categorie passen?"

8. "Bedankt voor het meedoen! Heeft u nog vragen?"

9. Ik zal u feedback meenemen bij het maken van concepten. Deze concepten zou ik graag willen toetsen op gebruiksvriendelijkheid. Zou dat rond 12 mei kunnen?

10. Ik zal een mail sturen voor het afspreken van een datum voor de evaluatie.

SCENARIO

A scenario helps to imagine future use cases of a product. It can be a helpful tool for generating new ideas and can explain the human - product relation in an illustrative way. The following scenario describes the interaction of the four user types with the envisioned interface.

‘’THE INEFFICIENT ESCALATOR”

Analysing user

At the office of Ipsum energy, Peter logs in to the interface. On his newsfeed he can see that currently all dongles are online and thus all data goes exactly where it belongs to. He chooses the ABN client from a list of all sorts of different clients and looks at the energy consumptions of the building in Amsterdam. Yesterday he discovered an abnormality concerning the energy consumption of the escalators in the main buildings. The problem is that the escalator runs without a single stop all day. This is not normal because at other locations it normally stops when its movement detectors do not detect any person that wants to make use of it, in order to save energy. For some reason that is not the case at the main building. Today Peter wants to write the code that automatically notifies users at Engie about this kind of problems so that they can address the issue.

With his dedicated chartmaker he identifies the different types of escalators and their average energy consumption. He adds code to the analysing engine that will trigger a notification including a graph with live data when escalators behave strangely. This code will now also work for all other clients.

Executing user

Around 11:00, Henk, the energy responsable of the ABN main office in Amsterdam, looks at his mobile phone because he received a notification. A new saving option regarding the escalators could save around 1500 euro per year. He walks over to his desktop pc to log in to the ipsum website. Next to his personal dashboard a small icon indicates that a new saving option requires his attention. He clicks on it and opens a graph that simulates the savings he could achieve by improving the efficiency of the escalators. He reads the information that comes with the simulation and identifies the escalator as the one in the entry hall. He has experience with this escalator and chooses to look at it first before contacting the manufacturer. As he approaches the escalator in the entry hall he recognises that it actually behaves as described. After a short inspection he realises that the movement detectors do not work at all. In order to repair this issue he would need the support of the manufacturer. This kind of repairs fall under the normal service contract and do not require the permission of ABN management. By the end of the day the sensors have been replaced by a service worker and Henk can now clearly see that the escalator stops from time to time and effectively uses less energy. He marks the saving option as completed. The service worker wants to be sure that the sensors work properly for the next days. Therefore Henk creates a restricted account for him that allows him to track the energy consumption of the escalator. The service worker will now be able to contact Henk to arrange maintenance meetings in case of strange behavior. Henk is happy that the issue could be solved that fast and browses through the saving options that are still in progress. He sees that a saving option concerning the printers has experienced a backwards trend. He choses to remind the individual users on the third floor to encourage them to turn off their printers after leaving the office.

Individual user

Piet looks at his computer screen as he receives a new mail. It’s a reminder that he should turn of the printers before leaving the office. Since two weeks he responsible for the printers on his floor. He is quite sure that he turned off all printers yesterday before leaving at 20:00. The consumption graph shows that at 21:00 all printers were turned on again and stayed on during the whole night. This could have only been Nienke, the new trainee that often works until 22:00 to finish her thesis. He prints the graph with euros as a unit, grabs two cups of coffee and walks over to Nienkes desk to explain to her the energy reduction mission of the ABN. Nienke is impressed by the ambitions of ABN and promises to pay attention to the printers in the future.

Monitoring user

The next morning the head of the sustainability project at the ABN opens his mail program to start the day. He clicks on the Ipsum report mail. The title of the mail indicates that a progress of 1.5 % has been made yesterday. That makes him curious and he clicks on the link that leads him to his dashboard. The progress graph of the main office, that is part of his dashboard, indicates that the execution of “advice #54” resulted in the progress. He clicks on the link to read about the saving option. He is happy about the progress and decides to present the progress of the recent month to the marketing departement. He saves the progress graph since the beginning of the year and includes the total percentage of energy reduction and the equivalent number of tons of co2 emissions that were saved. He attaches the pdf files to a mail and clicks on send.

USABILITY TEST 1

Usability test

Opstelling:
Laptop op tafel, proefpersoon zit op een stoel, de onderzoeker op een stoel ernaast. Het VLC screencapture program en het ingebouwde microfoon in de laptop worden gebruikt om achteraf data in de vorm van een video te kunnen analyseren.

Introductie:
Het doel van deze test is om de effectiviteit, efficiëntie en tevredenheid meten wat betreft het gebruik van de webapplicatie. Ik ga u taken geven en u gaat proberen deze taken uit te voeren. Het gaat er niet om om u te testen! Als er iets niet lukt of niet duidelijk is ligt het aan de webapplicatie en hoor ik het graag om het achteraf te kunnen verbeteren. Daarom wil ik u vragen om zo veel mogelijk hardop te denken terwijl u de taken uitvoert.

De test duurt niet langer dan 30 minuten en u mag op elk moment stoppen.

Dataexplorer:

U wilt de elektriciteits data van alle ABN vestigingen verkennen. Waar zou u klikken?

Leg in u eigen woorden uit wat u op de map aan de linkerkant ziet.

Hint: U kunt normaal in en uitzoomen op de map door te scrollen. U moet voor dit prototype klikken i.p.v. te scrollen. Er is nu ook alleen data voor Amsterdam beschikbaar.

U kijkt nu naar de data van alle hoofdvestigingen. Waar zou u klikken om het verbruik van alle Geldautomaten te tonen?

We kijken nu even naar het totale plaatje dus niet alleen de map.

Welke periode omvat de data die u ziet?

Wat zou u doen om het tijdperk van de weergegeven data aan te passen?

Welke vesting bespaard het minst? Hoeveel procent?

Hoeveel procent bespaard de vestiging die iets meer bespaard dan Delft?

Sla de ‘’Savings per location’’ lijst op als favoriete grafiek.

Ga dan terug naar de map.

Sinds welke maand is het energieverbruik van alle hoofdvestigingen gezamenlijk lager dan het referentie verbruik?

U wilt meer weten over de grafiek van het totaal verbruik van alle vestigingen. Waar zou u klikken?

Wat denkt u gaat er gebeuren als u op de details button ernaast klikt?

Wat toont deze grafiek?

U wilt alleen het verbruik van Amsterdam en Rotterdam in de grafiek zien. Wat moet u doen?

Ga terug naar de map.

Welke devicegroup in Amsterdam bespaard het minst energie?

Zoom verder in op Amsterdam. Wat ziet u?

Welke koffiemachine in Amsterdam verbruikt het meest?

Mist u soorten grafieken of informatie?

Dashboard

Ga naar het dashboard.

Dit is een leeg dashboard. Voeg een grafiek toe. De grafiek heet ‘’office ranking, the netherlands’’

Voeg een tweede grafiek toe. De grafiek heet ‘’lift consumption, enschede’’

Verplaats de twee grafieken naar een andere plek.

Sluit het menu met de favoriete grafieken.

Ga naar pagina 2 van het dashboard.

Leg kort in je eigen woorden uit wat elke grafiek inhoud. Als je eentje hebt uitgelegd mag je de grafiek weg klikken.

Welke informatie zou u hier verder graag willen zien?

Saving options

Ga naar de saving options

Wat geeft de grafiek aan?

Welke saving option heeft dit jaar de grootste invloed op de energiebesparing gehad?

U wilt het ‘’total realized savings’’ toevoegen aan uw dashboard. Wat moet u doen?

(ga terug naar saving options)

Van alle saving option die er zijn, met welke kunt u het meest besparen?

Laat meer informatie over de coffeemachine saving option in amsterdam zien.

U wilt de grafiek die u ziet aanpassen. Op welke manieren kan dat?

Voeg deze saving option toe aan het de lijst met de voor u belangrijke besparings opties

Wat is uw mening naar de bedoeling van de lijst: My saving options

Account

Nu komt een taak die niet perse iets met de saving options te maken heeft.

Stel in dat u een keer per week een rapport ontvangt

Bedankt voor het meedoen. De taken zitten er op.

Wat vindt u nuttig aan de applicatie en wat mist u nog?

USABILITY TEST 2

Usability test

Opstelling:
Laptop op tafel, proefpersoon zit op een stoel, de onderzoeker op een stoel ernaast. Het VLC screen capture program en het ingebouwde microfoon van de laptop worden gebruikt om achteraf data in de vorm van een video te kunnen analyseren.

Introductie:
Het doel van deze test is om de effectiviteit, efficiëntie en tevredenheid te meten wat betreft het gebruik van de webapplicatie. Ik ga u taken geven en u gaat proberen deze taken uit te voeren. Het gaat er niet om om u te testen! Als er iets niet lukt of niet duidelijk is, ligt het aan de webapplicatie en hoor ik het graag om het achteraf te kunnen verbeteren. Daarom wil ik u vragen om zo veel mogelijk hardop te denken terwijl u de taken uitvoert.

De test duurt ongeveer 45 minuten en u mag op elk moment stoppen.

Heeft u nu nog vragen?

Log in

Log in: de gebruiksnaam is ipsum, het wachtwoord is 12345

(Algemeen)
Een paar minuten verkennen:
Wat kun je allemaal met deze applicatie?

Data explorer:

U wilt de elektriciteits-data van alle ABN vestigingen bekijken. Waar zou u klikken?

Welke ABN vestiging presteert het slechts.

Evtl. Hint: U kunt normaal in en uitzoomen op de map door te scrollen. U moet bij dit prototype klikken i.p.v. te scrollen. Er is nu ook alleen data voor Amsterdam beschikbaar.

Waar zou u klikken om het verbruik van alle geldautomaten te tonen?

Wat zou u doen om het tijdperk van de weergegeven data aan te passen?

Sinds welke maand zijn alle hoofd vestigingen gezamenlijk goed bezig?

Welke vestiging bespaart meer bespaart dan Maastricht?

Zorg ervoor dat de ‘’savings per location’’ lijst aan het dashboard kan worden toegevoegd.

(Ga terug naar de map)

Welke vestiging heeft het meest verbruikt in maart 2016

U wilt alleen het verbruik van Amsterdam en Rotterdam in de grafiek zien. Wat moet u doen?

U wilt deze data als piechart zien. Wat moet u doen?

(Ga terug naar de map)

Wanneer was in Amsterdam het verbruik van de verlichting het hoogst?

Welke conclusies kunt u verder nog uit de stacked area grafiek halen?

Zoom nog verder in op Amsterdam. Wat ziet u?

Wat is uw eerste indruk van deze manier van data verkennen?

Mist u data of soorten grafieken?

Dashboard

Voeg de lijst van net toe. De grafiek heet ‘’savings per location’’

Voeg een tweede grafiek toe. De grafiek heet ‘’lift Amsterdam’’

Verplaats de twee grafieken naar een handige plek.

Sluit de dashboard library

Ga naar pagina 2 van het dashboard. Zit hier nuttige informatie tussen?

Welke informatie zou u hier zelf willen plaatsen?

Wat is uw eerste indruk van het dashboard?

Potential savings

Waarmee kunt u het meeste energie besparen?

Is de besparing van de koffie machines in Amsterdam haalbaar?

Hoe kunt u potentiële besparingen als deze toevoegen aan de lijst?

Wat is u eerste indruk van het potential savings - feature?

Wilt u ook zelf potentiële savings aanmaken?

Notifications

U wilt een ontvangen als de coffee machines in Amsterdam buiten de werktijden nog aanstaan.

Peter van’t pand moet ook een bericht krijgen als dat zo is.

Zet deze notificatie tijdelijk uit.

Verwijder de notificatie.

Wat is u eerste indruk van deze functie?

Account

Verander de taal van de webapplicatie naar het Nederlands

Log uit

Bedankt! De taken zitten er op.

Hoe vond u het gaan?

Welke functionaliteiten mist u nog?
(Evtl. weer inloggen)

USABILITY TEST RESULTS 1

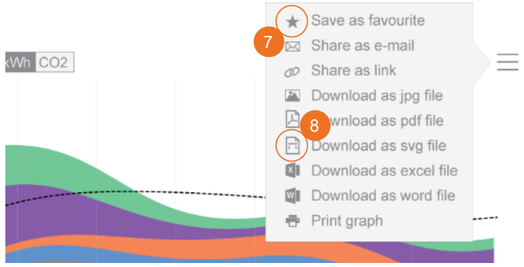
The analysis of the video files was condensed into keywords. Some outcomes only required simple adjustments, others were more complex. All outcomes were combined into a list of 42 items. This list was used to create a todo list for an improved version of the prototype. For a better understanding the numbers are used to indicate the points of interest in the prototype.

GRAPHS

1. CO2 is not a unit. It should be either kg, ton or m^3 of CO2.
2. The y-axis of graphs does not show values. At least one should be shown value to give a feeling for the scale. More data should become visible while hovering over the graph.
3. The vertical lines in the graph should have a stronger connection to the description on the x axis to prevent errors while reading.
4. Users had difficulty to interpret line graphs. Different, more readable alternatives should be considered.
5. The purpose of the buttons below a graph should be more apparent. The word “Legend” could be added as a title.
6. It is not clear which buttons are pressed and which buttons are not.

HAMBURGER MENU

7. “Save as a favourite” does not describe the

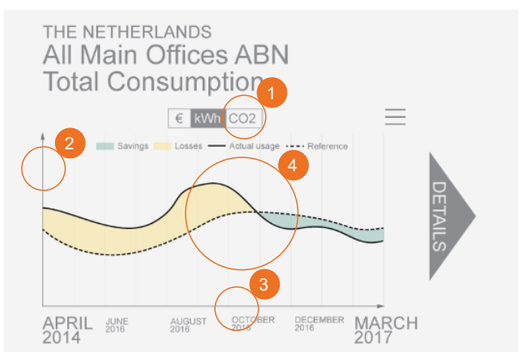


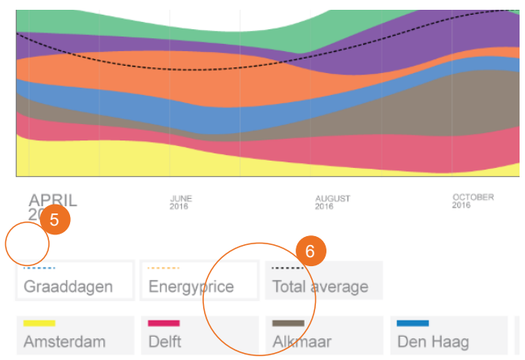
function very well because users do not associate it with the dashboard. It should be changed to “Save to dashboard library”.

8. Users do not use svg-files.
9. Users were not sure whether they had added a graph or not. Users need some kind of confirmation or feedback that their action had the desired effect.
10. The menu buttons on dashboard-tiles do not carry any functions. They can be left out.

EXPLORER

11. The details button need next to the graphs is not clearly linked to the graph. Users do not know what to expect if they click on them. The buttons should be replaced by a clearer alternative.
12. The structure is not always consistent. Extra facts about consumption are only available via the list about the savings.
13. The squares on the map should show potential savings. Knowledge about already realised savings is not very important to monitoring users. Potential savings would make users



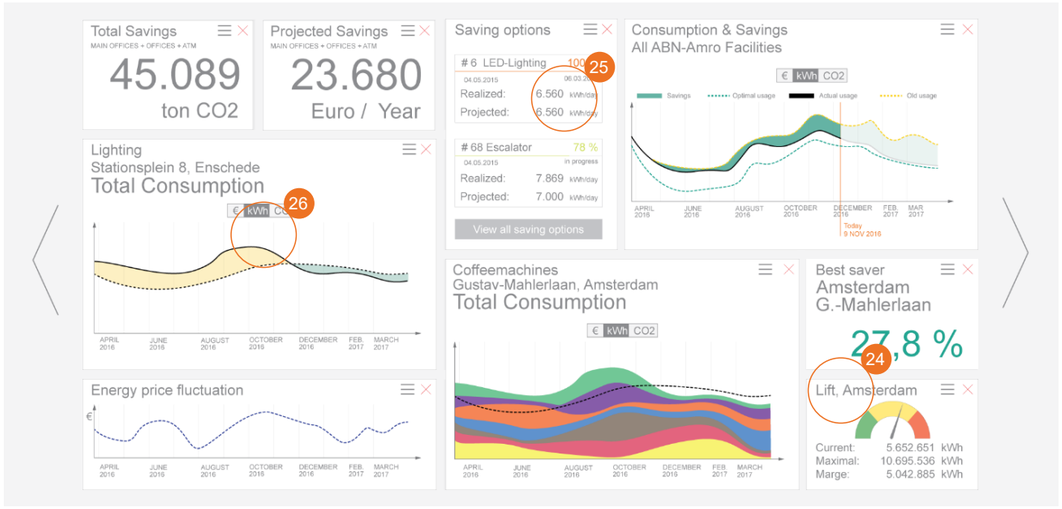


curious about their origin.

14. The colors of the treemap should be adjusted so that they match the legend. Random colors help distinguish the blocks but do not carry any information. This would also make it more consistent.
15. When zoomed in on one location (treemap view) the names of other locations (Alkmaar) distract users. Those labels should not be visible or at least less apparent.
16. The black area that functions as a back button takes a lot of space and is not clear to all users. A normal back-button at the top left corner was suggested as an alternative.
17. The link between the graphs on the right and the map was not always recognised. The titles of the graphs are too complex for a quick recognition.
18. The white background behind the map makes the interface look inconsistent, as a light gray is the main background.
19. The Main office- /office- /atm- selector was recognised but users were not sure which option had been selected. This can be made more apparent.
20. Users often clicked on the ranking to view data about energy consumption. There should be a clear indication about the content of each graph.
21. The timeline is visually connected only with the map, whereas ist also influences the data in the graphs on the side. It should stretch across the whole width of the screen.
22. Users are not familiar with stacked area graphs, whereas they interpret them correctly. To assure them that they are correctly reading the graph it should be possible to clearly identify it as a stacked area graph.
23. A stacked area graph helps to compare the proportions of energy consumption over time but does not give information about precise data. More graph types should be available in the data explorer to view precise data.

DASHBOARD

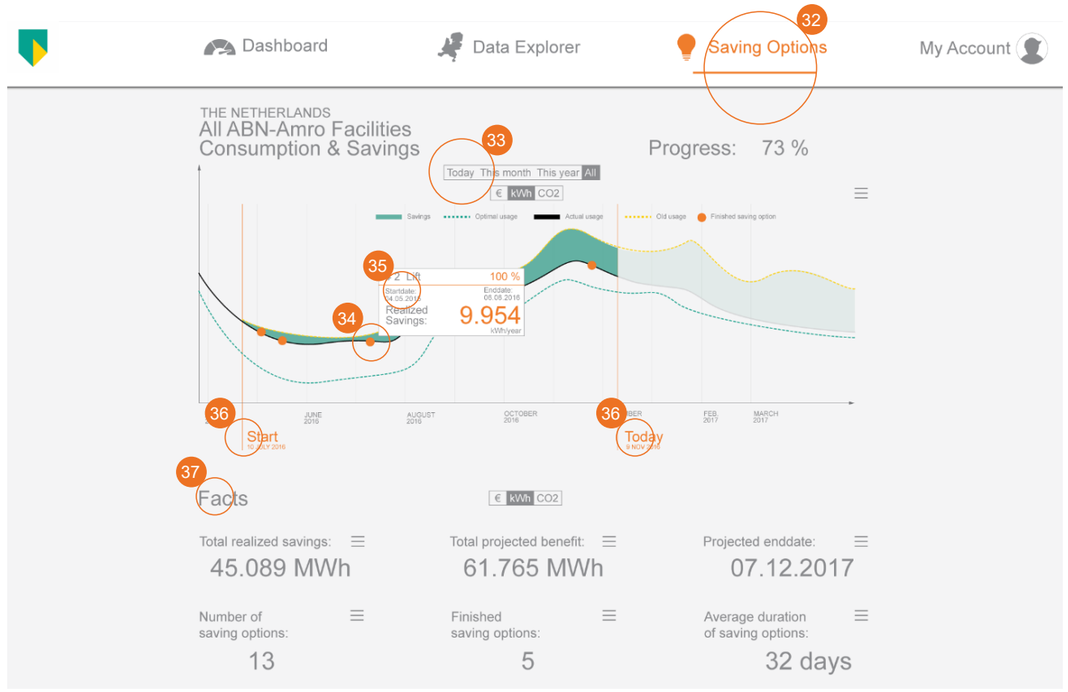
24. The title of the lift graph does not show whether savings or consumptions are displayed.
25. The title “saving options” does not specify whether realised savings or realised consumptions (in kwh/ year) are displayed.



26. The graph about the lighting in enschede and the graph about the coffee machines both require a legend.
27. “Add to dashboard: Favourite graph” should become : “Add a graph from the dashboard library” to match the adjusted menu item (7).
28. Users have to scroll up and down because of the dashboard library. A user “lost” the menu bar because of the scrolling.
29. Users tried to drag the gray icons from the dashboard library directly to the dashboard. Also instead of clicking on the green drag icon, they dragged the preview graph. This behaviour was intended but did not work yet.
30. Not all tiles of the dashboard are draggable. This feature can be added to make usability tests more realistic.

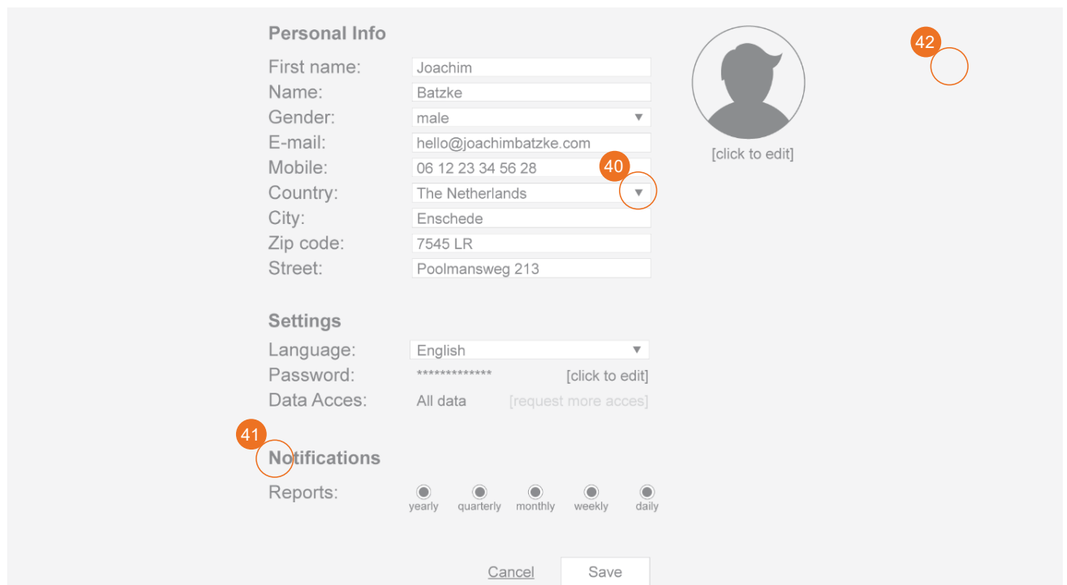
SAVING OPTIONS

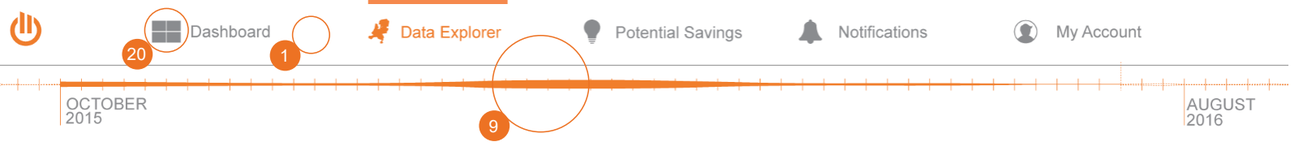
31. Users did not find the list with all potential savings at the bottom because they had to scroll. In order to make the interface more consistent no scrolling should be required.
32. “Saving Options” is not a handy name because of its ambiguity. It can be related to “saving a document”. Alternatives would be: Potential savings, Energy advice, Improvements, etc..
33. The period of the graphs can only be adjusted with a switch that has four options, which is quite limiting.
34. After clicking on an orange dot the information block does not disappear when clicking somewhere else.
35. Users have to calculate the duration of the execution of a task with the given dates. This is time consuming and and can be prevented by showing the period of the advice-execution, on the graph.
36. User dragged the start date and the enddate lines because of the visual relation with the timeline. This is not intended.
37. The facts were considered confusing and superfluous. As they do not add value they can be left out.
38. The “report” button is ambiguous as it could also mean: create a report. It should be called something like: Not executable, Delete, This is a bad advice, etc.
39. When looking at an advice, users try to estimate whether it is realisable or not. They should be able to share or store their conclusions with other users. One user suggested to integrate this functionality in the interface.

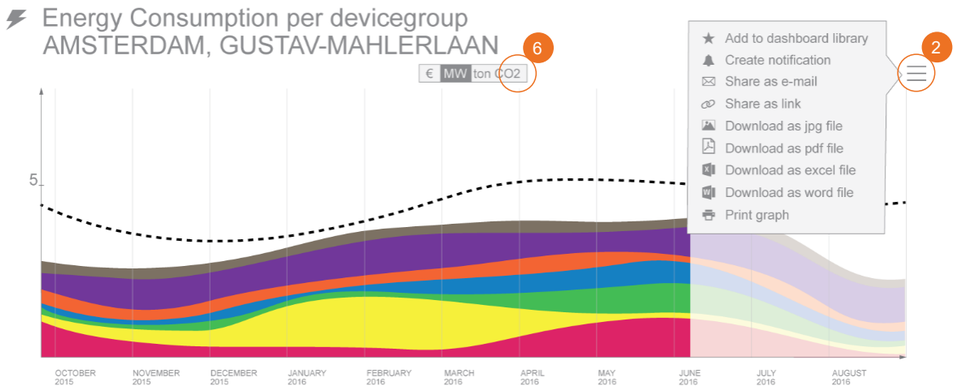


ACCOUNT

40. To increase the realism of the prototype the text frames and dropdown menus should become clickable.
41. The notification settings were not expected to be part of the account feature. It should be located at a more logical place.
42. There is neither a logout button nor a login page. They should both be added.







USABILITY TEST RESULTS 2

The video material of four usability tests has been analysed and grouped. The following list presents all issues that emerged:

MENU

1. The main menu bar was not instantly recognised as a menu bar by two users when they had the task to explore the interface.

HAMBURGER MENU

2. The hamburger menu was not clicked when users had to add a graph to the dashboard library.

DATAEXPLORER

3. Users uttered that the coloring of the squares did not give enough information and that numbers should be added.
4. Zooming in and out on the map was not intuitive (mostly because zooming by scrolling does not work in the prototype).
5. Users expected a bigger version of the total consumption graph when they clicked on the preview graph on the sidebar and not a stacked area graph.
6. The unit switch above graphs was not recognised by one user.
7. Users tried right clicking on a graph to add it to the dashboard.
8. Chart Selector: “Treemap” is an unknown chart type.
9. The timeline caused confusion by moving unpredictably.
10. Users clicked on ranked-list entries to get more info about it before clicking on the orange magnifying glass.

Suggestions made by users:

11. One user wants the width of the map (and the sidebar) to be adjustable.
12. In the data explorer, offices should be split up into more detailed subcategories and stories
13. Opening / closing times should be considerd.
14. Make it possible to compare different years (2014, 2015 button among the other buttons that trigger a overlay including the same chosen locations/ device groups).
15. Add icons of appliances to the treemap.
16. Add a bar chart as a chart type.
17. Add a “select all”- “deselect all” - button to the legend buttons below the graph.

DASHBOARD

18. One user did not know how to read the stacked area graph on the dashboard.
19. Users tried to drag tiles across multiple dashboard pages.
20. Users tried to drag graphs from the data explorer onto the “dashboard”-menu-item in order to place it on the dashboard.
21. A user tried to drag a graph back in the library.

Suggestions made by users:

22. Make the dashboard exportable for reports.
23. The energy price graph needs to display data in kWh and not in MW because energy is billed per kWh.

POTENTIAL SAVINGS

24. Users want more certainty concerning tips: Are there comparable results? etc..
25. One user would like to create own “Potential savings”.
26. The list item name “Status” is not clear to users.

Suggestions made by users:

27. Add buttons to the bottom of the sidebar (share, add to my list etc)
28. Make it possible to link specific data in a graph to comments
29. Give room to other relevant data that may influence the decision whether or not to take action (maintenance costs of appliances, product lifetime, etc...)

NOTIFICATIONS

30. The creation of a notification seemed too complex for one user while it worked completly fine for others.
31. The orange frame around the “custom notification” text frame was not apparent enough.
32. Users found the on/off function for notifications but were not sure whether the effect would what they expected.

LOGIN & ACCOUNT

- No issues -

GENERAL SUGGESTIONS

33. One user wants to compare data from open hours and closed hours.
34. Users suggested to create the reference line(s) in cooperation with them.