WindFace

Giving wind data an interface

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The Project

Norway is one of the leading nations in the world when it comes to production of renewable energy. Still, knowing where the best positions to place wind turbines are, is not easy to learn. That is why Ida Marie Solbrekke at Bergen Offshore Wind Centre (BOW) has made a dataset containing a lot of historical data about offshore wind, to make the positioning of wind parks, and the subsequent production of clean energy, an easier task.

This project report is written for the course MIX250, in the study program media and interaction design at the University of Bergen. It presents the collaboration between four students and Bergen Offshore Wind Centre (BOW). The goal of this project has been for us to help Ida Marie Solbrekke, a doctoral research fellow in offshore wind energy, visualize the dataset NORA3-WP, which she made as her doctorate.

About BOW

BOW is the University of Bergen's investment in offshore wind. They coordinate and strengthen the research and education in offshore wind energy. They aim is to contribute science, knowledge and technology to the UN's seventh sustainability goal; affordable and clean energy for all. They focus on three areas; wind resources, placement of wind turbine parks and operation of wind turbine parks. (BOW, 2021)

This project is one of the first interdisciplinary projects for the faculty of Mathematics and Natural Sciences and the faculty of Social Sciences.

The Challenge

Solbrekke has made the dataset NORA3-WP, which stands for NORwegian hindcast Archive's offshore Wind Power data set, and contains data measurements of 41 different wind and ocean variables. She gave us the challenge:

Design a web-based visualization tool for the dataset NORA3-WP, that will be useful for both experts and non-experts.

By expert *we mean people who are familiar with scientific data, are used to working with raw data or know the science behind it. This could be scientists, meteorologists or others.*

By non-expert *we mean people without a scientific background, who might need some translation or contextualization of the data to make it useful. This might be journalists, developers, students or others.*

Research

We had an initial interview with Solbrekke, where we learned more about the field of offshore wind. She also presented her data set, showing the timeframe of the data, which variables it holds and what they meant. Going into the *Sprint*, we needed to know more about our potential users – both experts and non-experts. We conducted qualitative interviews with three potential users and two stakeholders.

These are the user needs we discovered:

Experts:

- would use our visualization to determine where to build wind parks
- almost exclusively use pc in their research
- need to be able to download the data in specific file formats
- need to know what has been done to the data set to convert it from raw data to visualization
- need a lot of data and many different variables
- need to be able to determine the boundaries of the data

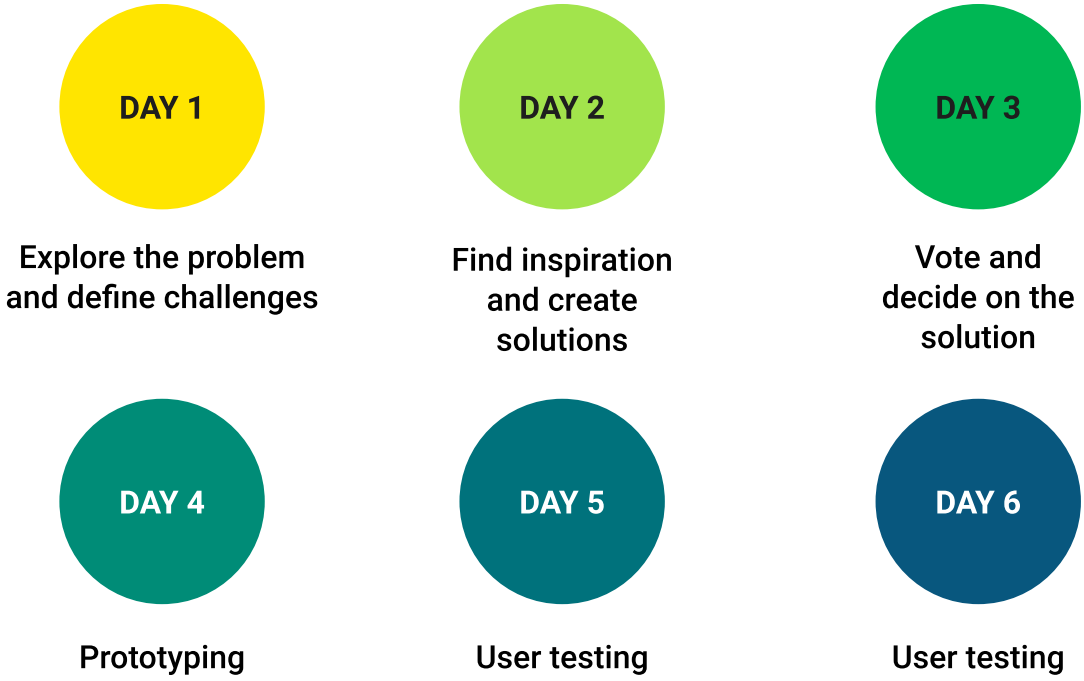
Non-experts:

- uses pc almost exclusively
- need the raw data translated into a more understandable language
- need data from a few select variables
- need to be able to clearly see areas with high potential

Sprint

To design a solution we used *Google Design Sprint*, an intensive five day process designed to solve complex problems (Knapp, 2016). Solbrekke was our decider, meaning she would have the final word in important decisions. One of us facilitated the Sprint and did not participate in the tasks.

Because of the pandemic, we did the sprint online. It's hard to concentrate in front of the computer for too many hours, so we split the first two days into three. We also spent two days user testing instead of one. We used Zoom to communicate, and Miro as a digital whiteboard for doing the sprint tasks.



In the first days of the sprint, we created some guidelines to keep us focused on the end goal throughout the process. These guidelines take the form of "How Might We"s, "two year goal" and "sprint questions".

Sprint

“How Might We”s:

HMWs focus on how to turn a problem into a solution. Here are some of the questions we came up with:

HMW create an intuitive navigation and filtering system, that even a non-expert understands?

HMW turn the data into information that the users can relate to?

HMW make the data understandable to non-experts?

HMW select the most relevant information?

Two year goal:

The two year goal is meant to make us think, optimistically, ahead to where our solution could go in the future. It helps us think about why we want to make what we are making. We each made a Two year goal, and chose one:

In two years the visualization of the data is so good that it is used by politicians, in school education and in presentations to researchers and investors on a daily basis.

Sprint questions

The sprint questions focus on the team's ability to develop a product that would tackle the challenges. The three questions were chosen by the decider.

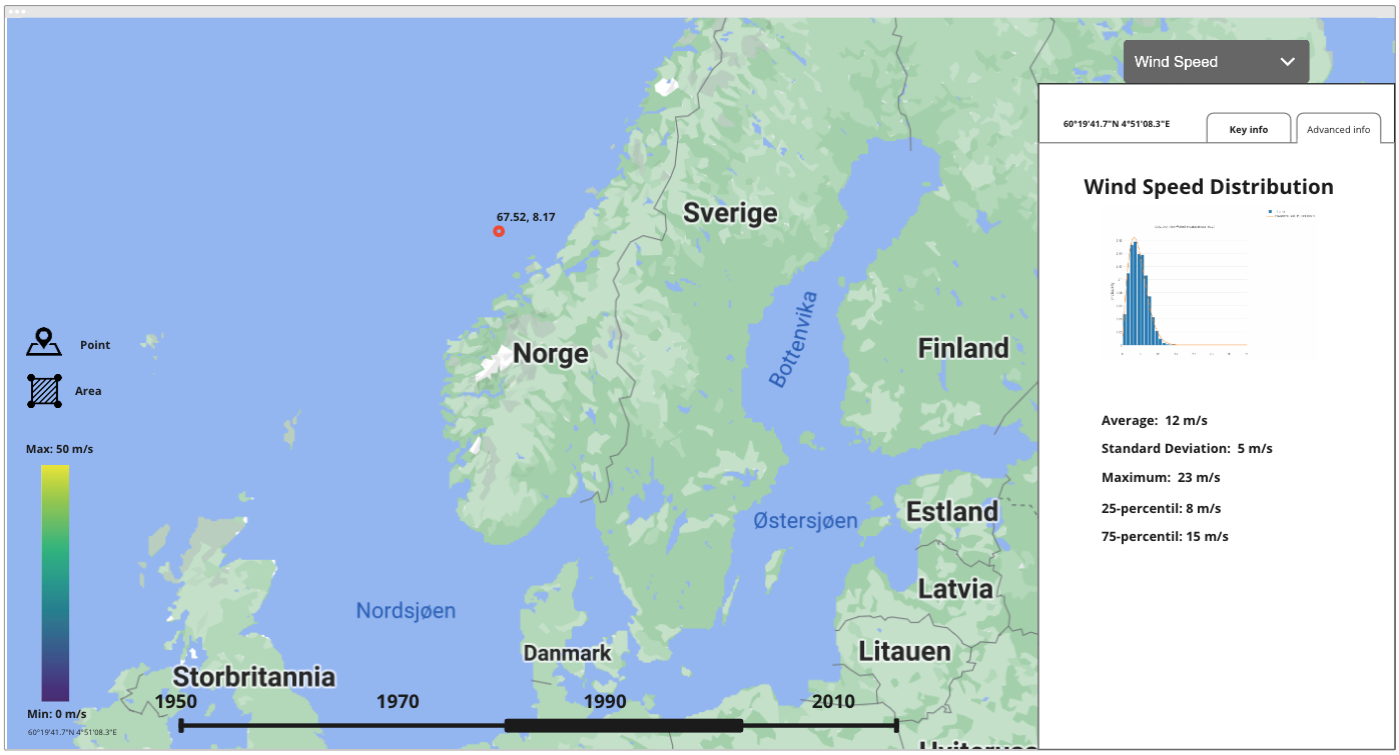
Can we use intuitive and "simple" solutions without losing scientific depth and professionalism?

Can we meet the needs of both experts and non-experts without having too much information and data in one place?

Can we create an intuitive variable filtering system?

Solution sketching and storyboarding

Based on the two year goal and our sprint questions, we each made a solution sketch. The top voted solution sketch was then used to create a storyboard, which became the foundation for the first prototype.



Screenshot from storyboard made in Miro

Sprint

Prototyping

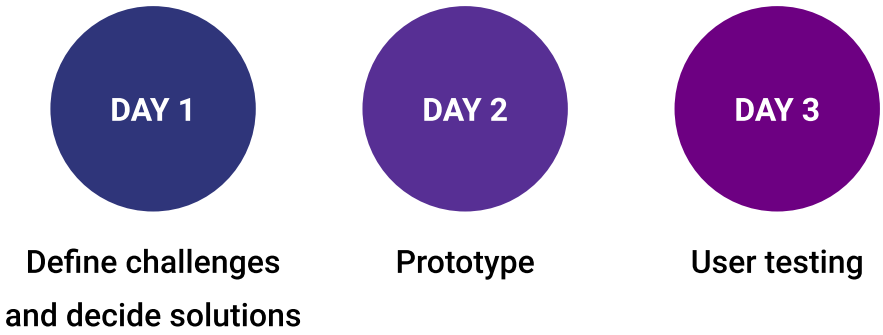
On the fourth sprint day we made a prototype based on the top voted solution sketches and the storyboard. In this prototype we focused on implementing the most important features. We wanted the most important features to be tested early on to know if we were going in the right direction.

User testing

In this first test, we did a walkthrough of the prototype with five experts and one non-expert. We gave each participant the same specific tasks and asked them to think out loud before clicking on anything. This test uncovered several interesting issues with our first prototype, which we will address later in the report.

Iteration sprint

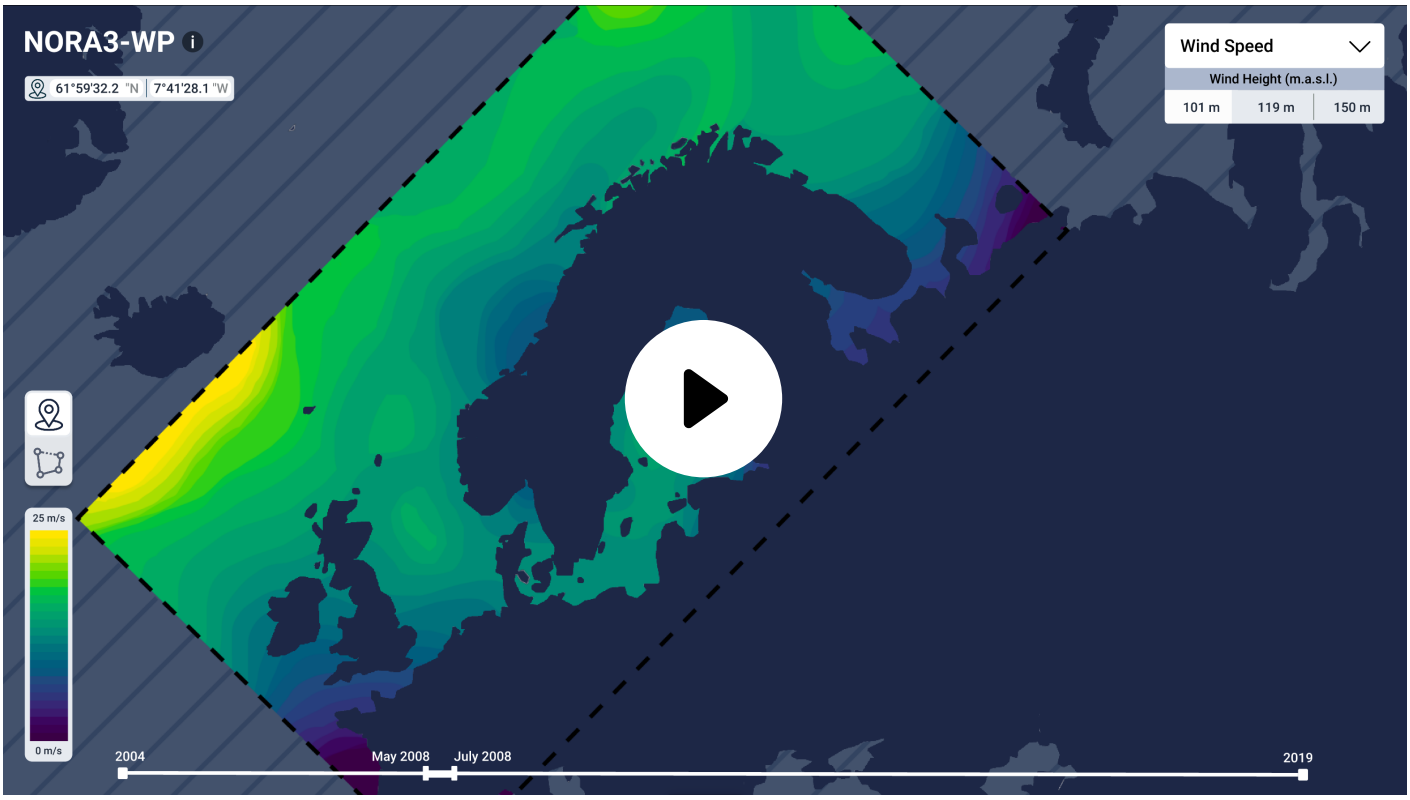
We also did an iteration sprint where our focus was to add new elements, and improve existing elements from our first prototype. Solbrekke joined this time as well. We weren't able to find enough new testers for the second user test, so we ended up user testing on two of the experts and the non-expert from round one.



Final Prototype

Welcome to WindFace – Giving wind data an interface. This video is a short walkthrough of the final prototype and its most important features.

Click on the map to play video!



Click on the circles to explore the different iterations of the prototype.

First Prototype

Second Prototype

Final Prototype

The Process

Through the course of this project we have made a lot of changes to the prototype. Based on feedback from the user tests we made several improvements on the original design.

Viridis

To visualize the data in the map, we used the viridis colormap. The scale goes from a dark purple to a bright yellow, and has some big advantages over other commonly used colormaps, like Jet. Viridis has a wider range of brightness, making it easier to distinguish between colors. It is also readable for the colorblind, and works well for printing in black and white (Nathaniel Smith, 2015).

The original Viridis color scale

Readability in the map

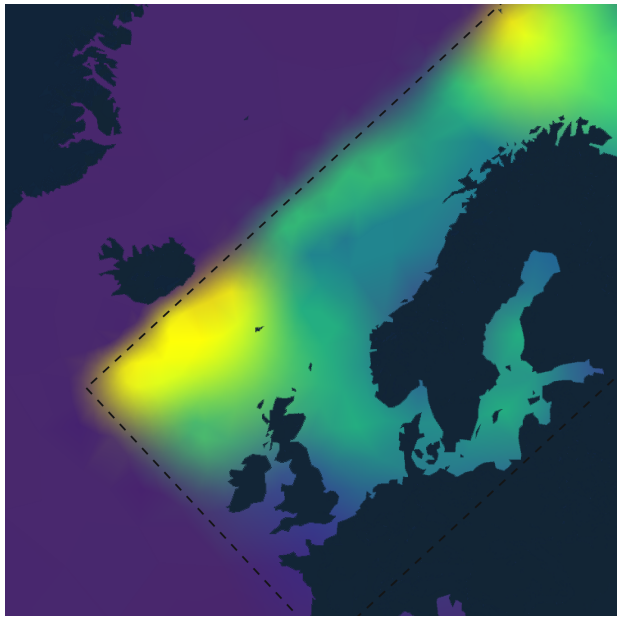
In the first prototype the users found it difficult to read the color values in the map. This was because they could only see what the maximum and minimum colors represented in the color chart, and then had to estimate what a certain tint of green meant. It was also difficult to pinpoint where a specific color from the map was in the color chart, since the colors blended into each other in the map.

To solve these issues, we divided the color chart into 25 parts, each representing one m/s change in wind speed. We also changed the map to reflect this, now showing clear lines between the different values. We also decided that an indicator should move up and down in the color chart as you move the mouse across the map, to indicate the value of the point you are hovering over. We unfortunately couldn't implement this in Figma, because of its limitations.

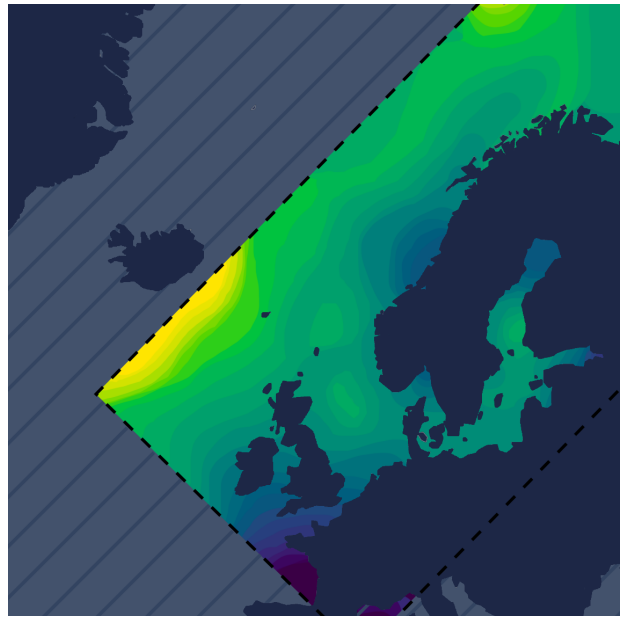
The scale we implemented in prototype 2

Color outside the map

In the first prototype, we used the darkest purple color in Viridis outside of the area the data set covers. This color equals the value 0 m/s in the map. In the first user test, it was pointed out that the colored background indicates that there is data outside of the covered area, and that the value is 0 m/s. To better signify that the outside area has no data, we changed the color to a gray that is not present in the Viridis color palette. In the second test, there was no confusion.



Colors in prototype 1



Colors in prototype 3

Simple design

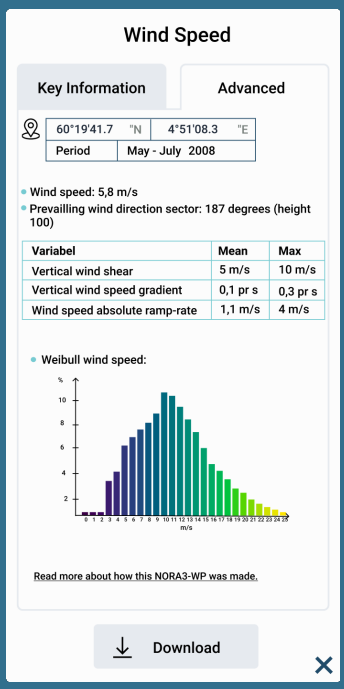
During our research phase, we found several examples of interactive data visualization maps that were overloaded with tools and information boxes. We found these overwhelming. During our initial interviews with wind experts, they mentioned this as well. Therefore, we decided to show as few elements as possible when a user opens the map, and rather give the user the option to see more as they explore. This way the users are not overwhelmed by choices. As a bonus, this makes it easier to take nice screenshots of the map for investor presentations, the media, politicians and for use in education, which helps achieve our two year goal.

Information box

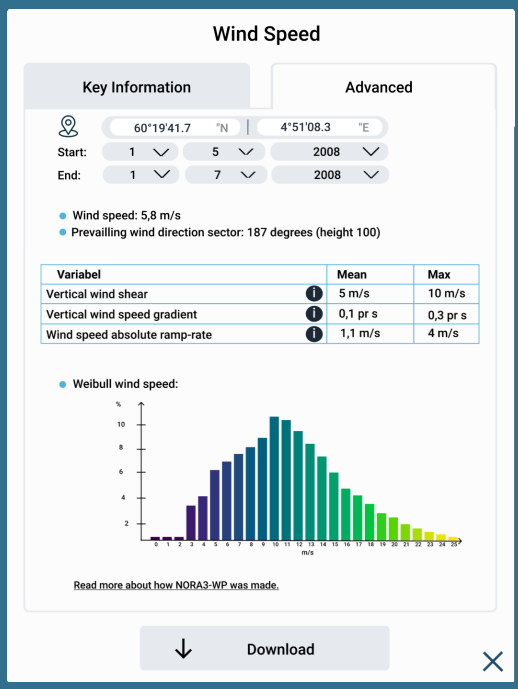
Initially we wanted the information boxes to be quite narrow, so finding a new point in the map would be easy. This was not a problem in the first prototype, as we had very little information to put in them. After completing the second prototype, we found that the information was quite crammed in the information boxes, so we decided to give the content some more room. The map still has quite a bit of space, and since you should be able to pan and zoom in the map, we think choosing a new point will still work well.

In the first user test, the experts focused a lot of their attention on the contents of the boxes, which at the time contained placeholder information. They were sceptical about the information, and instead of giving feedback on how the design could be better, we got more feedback about what was wrong with the content. In hindsight, we think it would have been better to not fill the information boxes at all. We could then have asked the users what information they would expect to find, or what information they would find useful. Doing this is not typically a good idea in a user test, as they most of the time don't know what they want until they see it. However, in this case, most of the users we tested are wind experts, and probably know quite a bit about what information is useful to them in their everyday work.

Prototype 1



Prototype 2



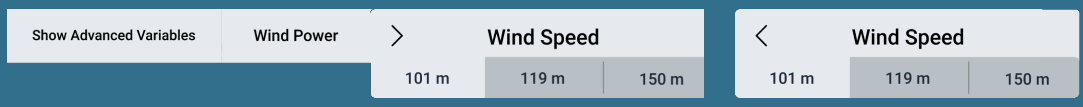
Prototype 3

Variable selector

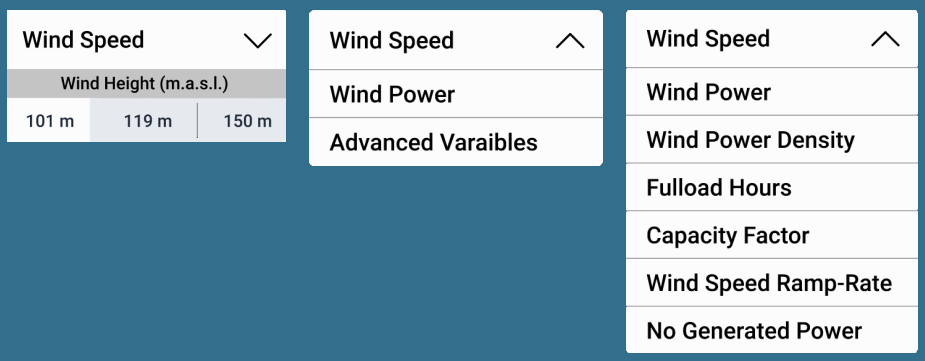
In the first user test, the variable selector caused some confusion. Three of the six users couldn't find it before we pointed it out, and five of them didn't quite understand how it worked. One user said he didn't understand that the variable selector was a menu that could be clicked, and that he might have understood it if it looked like a dropdown menu instead. For the second prototype we swapped the fold out menu with a dropdown menu, and in the second user test there was no confusion.

In the first and second prototypes a lot of the variables in the variable selector were hidden under a "Advanced Variables"-button. In the second user test, one of the users pointed out that this was unnecessary, and only caused the users to click additional times before seeing what variables they had access to. In the final prototype, all the variables are shown when you open the menu.

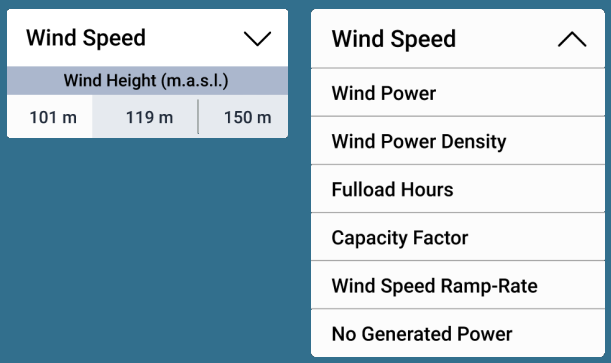
Prototype 1



Prototype 2



Prototype 3



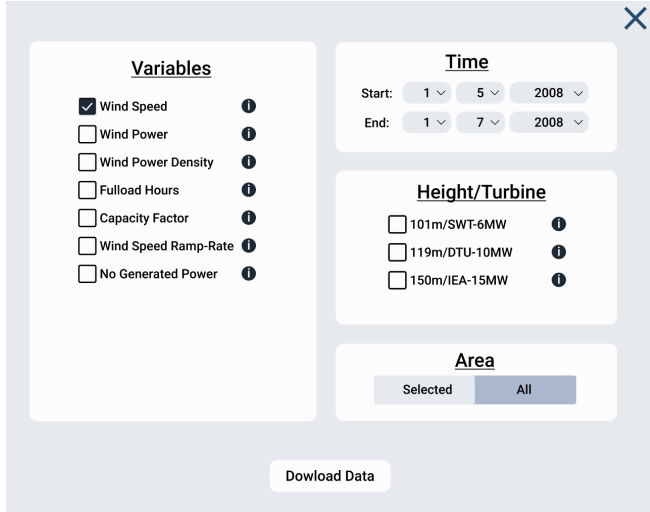
Point/area selector

In the first prototype the area and point selector were buttons with a dark background. In the tests, some of the users didn't know if they needed to click on one of them before clicking anything else. In the second prototype we made them into a toggle switch to reduce confusion. We also changed all the elements on the left to a lighter color to match the right side. In the second test we got much better results, and by the third prototype the design was improved further.

The evolution of the point/area selector

Download window

An important feature of our design is the ability to download raw data from the data set. We didn't design or implement this in our first prototype as we wanted to see whether we were going in the right direction first. After implementing the download window in the second prototype it got a lot of positive feedback, and was intuitive to all the users. They especially liked that they could download the data in a variety of file formats.



Learnings

1. Communication is key.

Throughout this project we've been working together with an actual client, and one of the things we learnt was the importance of clear communication. In the beginning of the project, BOW expected us to be able to deploy the website by the end of the semester. Aligning BOW's expectations with what was possible for us, and vice versa, was therefore a crucial first step in the collaboration. This made us realize just how important good communication is with your client, and we made sure to keep in touch with BOW frequently throughout the rest of the process.

2. The interview guide matters.

Before the first user test we made an interview guide, but it was not well enough adapted to our prototype. This resulted in us lacking some useful data about a few of the elements of the first prototype. If we were to do this again, we would do a couple of dry runs of the guide to make sure that we would get all the information we needed.

3. Test more.

Ideally, we would have wanted to test each prototype with new users. Unfortunately, the one non-expert tested both prototypes. We got a lot of useful information from the users, but we should have tested with more non-experts to validate our findings and ensure usability for both our target groups.

4. Sprinting online works great.

Doing a sprint remotely was also a great learning experience. It worked surprisingly well, and is something we will most certainly think of as an option moving forward. The user tests worked especially well. Our users seemed used to being in voice calls and sharing their screen, so we had no technical issues. We also didn't take up too much of their busy schedules, as they didn't need to travel to a test location – which in many cases takes longer than the actual test.

5. Prototyping tools have a lot of limitations.

While using Figma to develop the prototype was efficient, the limitations of the software made the prototype quite limited in its functionality. The users could only click on one point in the map and see data about that point. They could also not try the "area select"-tool, which is an important feature. Other things we could do to improve usability, like hover effects or micro animations, are difficult to create Figma with this many data points. While the tests gave us a lot of insight, there is still a lot of functionality that needs to be tested after it is implemented in code. An extensive framework would need to be in place to be able to show the data in real time in the interface, and this would take too much time for us to implement. As such, we still think prototyping all the versions in Figma made the most sense for this project.

Next Steps

Ida Marie Solbrekke and Bergen Offshore Wind Centre see great potential in this project, and they are eager to get our design developed and deployed. Together, we applied for funding from UiB idé, which is part of the Division of Research and Innovation. This is a fund given to innovative student projects, which would act as a starting point for developing the project. Unfortunately, our application was turned down. However, we will explore other opportunities to develop the design.

"The collaboration between me (on behalf of BOW) and the students has been excellent. Everyone has listened to each other, provided insights and comments, and respected each other. All the students, and me as the company, got to play their role in the development of WindFace. We in BOW hope this project, and the resulting prototype, can be further developed into a complete and fully functioning product. I, on behalf of BOW, would like to thank the students for a great collaboration"

– Ida Marie Solbrekke, Doctoral research fellow in offshore wind energy at BOW, GFI and UiB.

Throughout the project we have learned a lot, and we have thoroughly enjoyed working with Solbrekke. We would like to thank her for a great collaboration and we wish her all the best going forward with her doctorate.

Sources

Bergen Offshore Wind Centre (BOW). Downloaded from: https://www.uib.no/en/bow (April, 2021).

Knapp, Jake with Zeratsky, John and Kowitz, Braden (2016). *Sprint: How to solve big problems and test new ideas in just five days.* Simon & Schuster Paperbacks, New York.

Nathaniel Smith (2015) *A Better Default Colormap for Matplotlib.* Downloaded from: https://www.youtube.com/watch?v=xAoljeRJ3lU (April 22nd, 2021).

Links to prototypes and video:

Prototype 1:
https://www.figma.com/proto/1CNLdzwb3fhRGAio0xYLCW/MIX250---BOW%3A-Prototype-1?node-id=36%3A51&scaling=scale-down&page-id=0%3A1

Prototype 2:
https://www.figma.com/proto/mODOe6pHGbF9OSpk3mD6E4/MIX250---BOW%3A-Prototype-2?node-id=62%3A1&scaling=scale-down&page-id=0%3A1

Prototype 3:
https://www.figma.com/proto/rcTawvcvaWfOc0fD8iA5cx/MIX250---BOW%3A-Prototype-3?node-id=62%3A178&scaling=scale-down&page-id=0%3A1

Youtube video:
https://youtu.be/SyvA_Pd3GEs