REPORT – Strategic Concept Digital Hydrogen & Stakeholder Platform

LIHYP

Linking Hydrogen Power Potentials

Work Package 1 – Pioneering Hydrogen Collaboration: Launching the NSR Platform

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Table of Contents

List of Figures

List of Tables

Acronyms

API	Application Programming Interface
EHE	Energy Hub Emsland Entwicklungsgesellschaft mbH
HTA	Hierarchical Task Analysis
LIHYP	Linking Hydrogen Power Potentials
MVP	Minimum Viable Product
NSR	North Sea Region
SME	Small and Medium Enterprise
UI	User Interface
UNO	Carl von Ossietzky Universität Oldenburg
WCAG	Web Content Accessibility Guidelines
WP	Work Package

1 Introduction

The project “Linking Hydrogen Power Potentials” (LIHYP) brings hydrogen demand-supply and stakeholders together and raises potential for future aligned collaboration. The project initiates opportunities to accelerate market introduction of hydrogen applications, leading to regional hydrogen value chains connected in the North Sea Region (NSR). The project will realize different pilots for the use of hydrogen such as hydrogen cargo bikes, hydrogen driven freight train, hydrogen bus station and living labs in the Netherlands, Belgium, Denmark, France and Germany. A NSR hydrogen platform marketplace will be held up for linking relevant stakeholders and a solid database for demand, production and supply of hydrogen will be created. Different roadmaps for business modelling will help entrepreneurs, investors and public authorities to plan hydrogen in the NSR. Together all partners will take first steps for cross-border system integration for hydrogen infrastructures, harmonization and standardization.

The focus of Work Package 1 (WP1) is the establishment and implementation of the so-called NSR Hydrogen Triple Helix Platform. The platform should act as a marketplace for at least 2,000 associates and serve as a hub for contact, information sharing, and collaborative planning, supporting members in informed decision-making for hydrogen applications. The development of the platform is carried out by the Energy Hub Emsland Entwicklungsgesellschaft mbH (EHE) in close collaboration with the Carl von Ossietzky Universität Oldenburg (UNO).

As the leader of WP1, the EHE coordinates the entire platform development process, including the strategic conception with a special focus on usability, external stakeholder identification and communication, the overall perception of the platform as well as a dedicated communication campaign launched through various channels to raise awareness of the platform’s capabilities as a solution provider. In addition, the EHE implements the front-end of the platform. UNO provides the back-end development, including the database and the corresponding application programming interface (API) for displaying information on the platform. UNO also provides the domain for the platform’s website.

This report serves as a deliverable for the first activity of WP1 “Strategic conception of a digital Hydrogen & stakeholder platform” and describes the development process of the front-end structure and design of the platform While design adjustments remain technically possible during the development phase, it is crucial to finalize and agree on the platform’s visualization and basic functionality beforehand to avoid inefficiencies, increased costs, or delays in the implementation process. The strategic platform conception leads to a so-called “Minimum Viable Product” (MVP), which is the basis/roadmap for starting the front-end implementation.

The report gives an overview of the steps in the overall design process and describes the steps taken from the general idea of the platform to the finalization of the MVP. Chapter 2 “Background” provides definitions of some relevant terms and expressions related to the design process. Chapter 3 then gives a detailed overview of the strategy development process itself. Section 4 “Results” presents the results of the analysis for all the use cases considered. The design of the prototype is described in Section 5. Section 6 describes the composition and role of the so-called “expert committee” during the implementation process.

2 Background

2.1 Use Cases

Use cases are used to define the functional requirements of a system. They describe the possible interactions between users and the system that are required to achieve the goals defined in a use case. Use cases are particularly helpful in communication between stakeholders and developers. Within the preliminary study, use cases serve as the basis for further analyses and the development of prototypes.

2.2 User Stories

User stories are used to capture and structure requirements in agile project management. The user's perspective is used to describe requirements in a clear and easy understandable way. Each user story consists of a short description containing three essential elements:

1. the role of the user
2. the intended goal and
3. the purpose of the requirement (optional).

2.3 Hierarchical Task Analysis

Hierarchical Task Analysis (HTA) is used to break down user interactions in a software system into detailed structured tasks. This enables a systematic analysis and optimization of the software application process. In most cases, HTA aims at organising tasks into subtasks. The order and structure of the specific user goals are visually documented, either in a hierarchical graphical structure or in a tabular text format. A structured plan describes how each of the defined goals will be achieved through interaction with the application.

2.4 Wireframing & Prototyping

In software development, wireframes and interactive prototypes are used to plan, validate and refine the design and functionality of an application at an early stage.

In this context, so-called “low-fidelity“ and “high-fidelity” approaches play an important role. Low-fidelity wireframes are simple, often sketchy visualizations of the intended user interface. They can be hand-drawn on a piece of paper or created using simple software tools. These prototypes aim to visualize basic ideas and structures without considering details such as colours, fonts or interactivities. Usually, they are applicated during early project stages.

In contrast to that, high-fidelity prototypes provide a much more detailed and realistic representation of the future product. They include visual elements such as colours, fonts and layouts and often simulate interactivity and user flows.

2.5 Minimum Viable Product

A Minimum Viable Product (MVP) is the first version of a real software product that includes a minimum set of functionalities required to provide a usable software that meets the core user demands. The use of an MVP allows a first draft of a software product to be quickly rolled out to a selected target group for testing and evaluation, with the aim of avoiding long-term strategic mistakes.

An MVP is particularly relevant for usability testing. By conducting usability tests together with a group of selected software users, developers can identify potential missing elements, functionalities and bugs at an early stage of a project. From a project management perspective, the use of an MVP in software development projects offers the opportunity to minimize major risks, as necessary changes to a product can be made at an early stage of a project.

3 Strategy Development

3.1 Requirement Analysis

The first step is to define the requirements as Use Cases, which are then further specified as user stories from the user's perspective. The HTA serves to precisely describe the interaction of the users with the platform. Based on the HTA results, different wireframes are prepared for graphical visualization. Afterwards, the proposed visualizations are discussed and adapted together with the project partners.

3.1.1 Identification & Description of Use Cases

A total of 8 Use Cases have been defined to comprehensively cover the different user scenarios of the NSR Hydrogen Triple Helix Platform. In the following, Use Case 3 “Best practices and pilot projects” serves as an example of how the strategy development works. The results for the other Use Cases are presented in Chapter 4 Results. Table 1 provides an overview of the framework conditions for Use Case 3.

Table 1: Overview - Use Case 3.

Use Case 3: Best practices and pilot projects	
Story	As a company, I would like to receive information on best (and less successful) practices, gain new ideas and get a deeper insight into the LIHYP pilot projects.
Actor(s)	Company (CEO, management).
Case	The user selects in advance which information is to be displayed (e.g. "Hydrogen use") and navigates through projects in list or map views.
Intention	Gain inspiration for your own projects and make potential contacts.
Goal	Pilot projects and best practices are presented in sufficient detail.

Use Case 3 aims at sharing knowledge, know-how and practical experience on innovative hydrogen projects. This is relevant for companies who either want to present their own hydrogen projects to a wider public and thus increase their visibility in the field of hydrogen projects, or who want to learn about successful, proven solutions (“Best practices”) as well as ideas and approaches that have been less successful (“Bad practices”). This mutual exchange of experience and expertise will serve as a basis for the initiation of further projects and thus promote the international hydrogen economy.

3.1.2 User Stories

Table 2 gives an overview of the different User Stories defined for Use Case 3. The corresponding User Stories for the other Use Cases are presented in the results section (Chapter 4). Each User Story can be clearly assigned to the Use Cases by the respective ID and describes what a future platform user wants to achieve by using the platform (specific user objective) and why this is important (concrete actions). In general, User Stories are much more concrete and precise than the general Use Case description.

Table 2: User Stories - Use Case 3.

ID	As a...	I would like to...	so that I...
/US3001/	company	know best and bad practices of hydrogen pilot projects	can get in touch with them and gain knowledge and insights.
/US3002/	LIHYP participant, company planning H2 pilot projects	share information about my pilot projects	can get more attention for my pilot (from politicians, potential customers)
/US3003/	public authority, cluster organization / multiplier	know project developments in my area and beyond	can support my local businesses
/US3004/	company	gain insights into pilot projects	can identify potential project partners for my own projects

In the general Use Case description, it was initially assumed that Use Case 3 would be most relevant to companies who either want to present their own hydrogen pilot projects or companies looking for innovative new ideas. When defining the user stories, additional potential users could be determined. Additional stakeholders could also be public authorities as well as cluster organisations or multipliers since they want to gain insights into current project developments in their area and surroundings.

Especially for LIHYP project members, Use Case 3 is highly relevant, as the WP2 pilots can present their projects on the platform.

3.1.3 Hierarchical Task Analysis

After defining the Use Cases and concrete User Stories, a HTA has been carried out to clarify the individual user interactions with the user interface of the platform which are required to meet the specific user objectives. The HTA consists of an interaction plan in a tabular form (Table 3) and a hierarchical diagram (Figure 1 and Figure 2), both describing/visualizing the necessary interactions between user and platform. For the sake of clarity, the HTA visualizations for the other Use Cases are not included in this report. If required, the further analysis could be provided by the WP1 team on request.

Table 3: HTA interaction plan- Use Case 3.

Plan ID	Plan description	Plan sequence
/HTA3001/	Call up pilot projects on the map	[1.1.] - [1.2. - 1.2.1.] - [1.5.]
/HTA3002/	Call up pilot projects in a list view	[1.1.] - [1.2. - 1.2.1.] - [1.4. - 1.4.2.]
/HTA3003/	Call up pilot projects on the map in my area	[1.1.] - [1.2. - 1.2.1.] - ([1.3. - 1.3.2. - 1.3.2.1. - 1.3.2.2. - 1.3.2.2.1.]) || ([1.3. - 1.3.3. - 1.3.3.1. - 1.3.2. - 1.3.2.2. - 1.3.2.2.1.]) - [1.5.]
/HTA3004/	Call up pilot projects in a list view in my area	[1.1.] - [1.2. - 1.2.1.] - ([1.3. - 1.3.2. - 1.3.2.1. - 1.3.2.2. - 1.3.2.2.1.]) || ([1.3. - 1.3.3. - 1.3.3.1. - 1.3.2. - 1.3.2.2. - 1.3.2.2.1.]) - [1.4.]
/HTA3005/	Search for pilot project and display in a list view	[1.1.] - [1.2. - 1.2.1.] - [1.4. - 1.4.1.] - [1.4.2.]
/HTA3006/	Call up information about a project	[1.1.] - [1.2. - 1.2.1.] - ([1.4. - 1.4.2. - 1.4.2.1.] || ([1.5. - 1.5.1.])
/HTA3007/	Call up detailed information about a project	[1.1.] - [1.2. - 1.2.1.] - ([1.4. - 1.4.2. - 1.4.2.1.] - 1.4.2.1.1.) || ([1.5. - 1.5.1. - 1.5.1.1.])
/HTA3007/	Call up the project status of pilot projects in a specific year	[1.1.] - [1.2. - 1.2.1.] - [1.3. - 1.3.4. - 1.3.4.1.] - ([1.4. - 1.4.2. - 1.4.2.1.]) - || ([1.5. - 1.5.1.])
/HTA3008/	Set project-specific filter and call up pilot project	[1.1.] - [1.2. - 1.2.1.] - [1.3. - 1.3.1.] - ([1.4. - 1.4.2. - 1.4.2.1.]) - || ([1.5. - 1.5.1.])

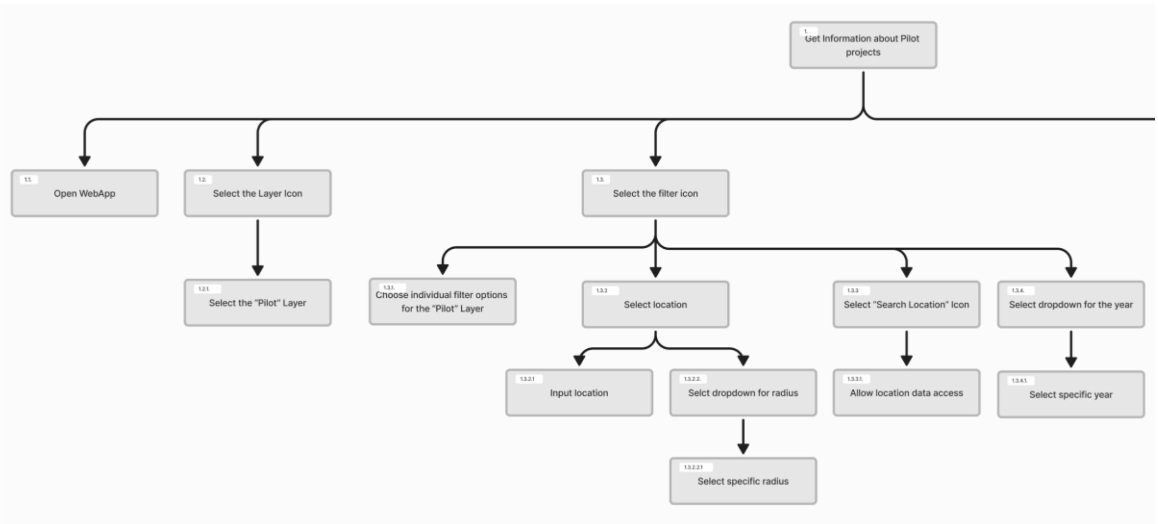

Figure 1: HTA hierarchical diagram – Use Case 3 (Part 1).

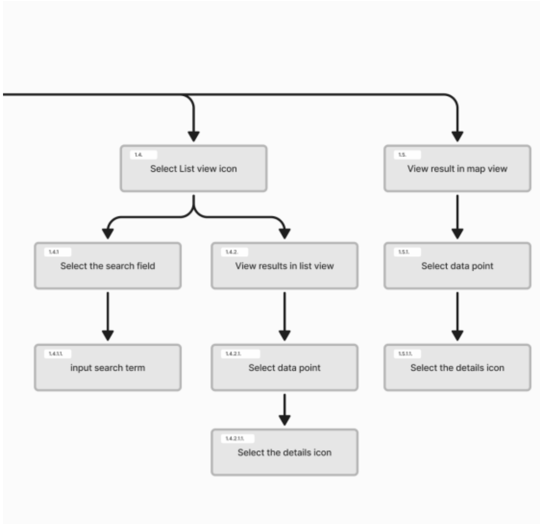

Figure 2: HTA hierarchical diagram – Use Case 3 (Part 2).

The interaction plan in Table 3, in combination with the diagram in Figure 1 and Figure 2, describes step by step which steps and clicks the user has to perform on the platform's website in order to retrieve the desired information. For example, a user wants to call up pilot projects on the map (/HTA3001/). The first step is to open the WebApp ([1.1.]), then to select the layer icon ([1.2.]) and then the "Best practices and pilot projects" layer ([1.2.1.]). In the last step, he will be able to see the result of his query on the map ([1.5.]). The methodology applied allows for a detailed analysis of each interaction a user could theoretically have with the platform, and therefore also offers the possibility of optimizing user flows.

3.1.4 Wireframing

After defining Use Cases, User Stories and conducting an HTA, the information gathered is translated into a wireframe, a first draft visualization of what the platform's user interface might look like. Using wireframes is a quick and easy way to give ideas of how a website or web application could look like while adjustments regarding structure and design are easy to implement. The first draft visualization of the NSR Hydrogen Triple Helix platform is shown in Figure 3. During several meetings together with the project team the draft structure and design have been adapted several times. PLEASE NOTE that the visualization in Figure 3 represents NOT the final platform design. Figure 3 only serves as an illustration of how the process of the front-end development of the platform works. The final platform design including UI elements, fonts, colors, etc. will be presented in Chapter 5 "Prototyping".

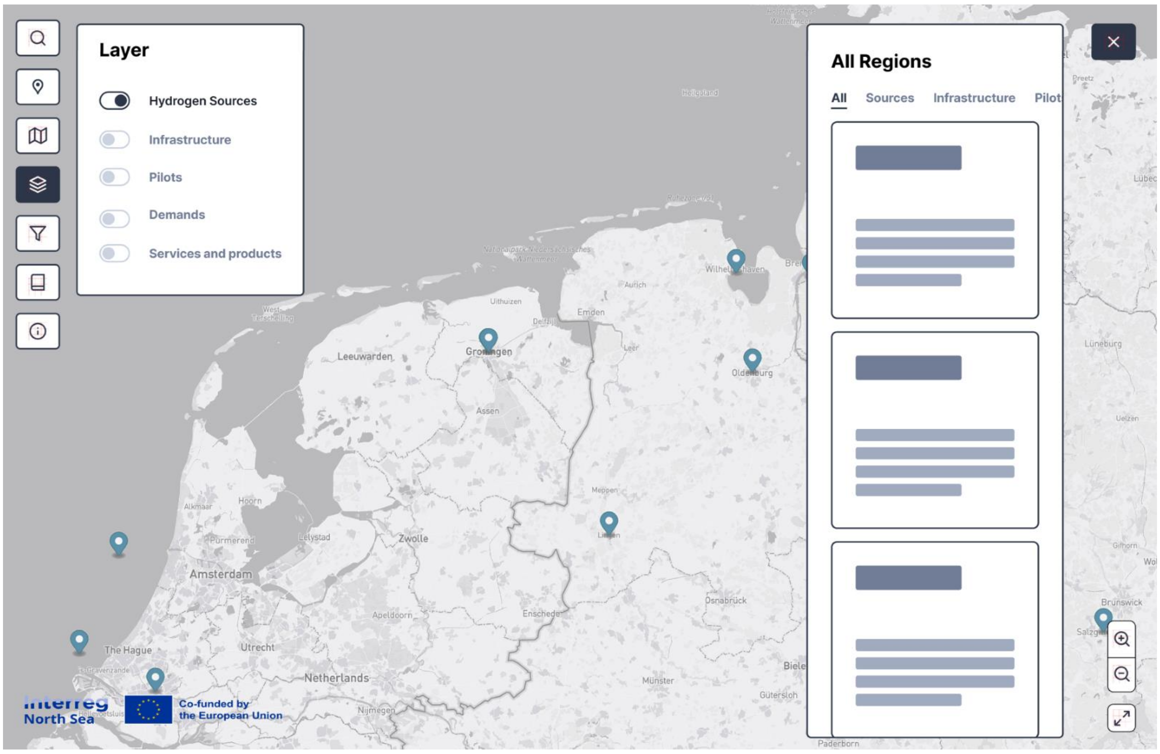

Figure 3: Wireframe - Version 1.

3.2 Feature Prioritization

3.2.1 Order of Implementation

The requirements analysis provides the basic framework for the development of the NSR Hydrogen Triple Helix Platform. A total of 8 Use Cases were identified. User Stories have been prepared for each of the Use Cases. In the following, the so-called User Stories are referred to as “Features”. The term “Features” is commonly used when talking about programming implementations. After setting up the basic platform (map, color scheme, fonts, etc.), the individual features will be implemented in a certain order. To determine the concrete order of implementation, the features have been prioritized using an evaluation matrix (Table 4).

Table 4: Evaluation matrix for Feature prioritization.

Rating number	1	2	3
Benefit	Little benefit	medium benefit	High benefit
Implementation effort	difficult	medium	simple
Data procurement effort	difficult	medium	simple
Operating expenses	difficult	medium	simple

Each feature is rated in 4 different categories, for each category a number between 1 and 3 has been assigned. In terms of benefit, a score of 3 means that the benefit of the feature to be implemented is quite high for the uses of the platform, while a score of 1 means that the benefit is low. For the evaluation of the effort for programming implementation, data procurement and operating expenses of the platform, a score of 1 means that the effort is quite high because the implementation, data procurement or the later operation is quite difficult, while a score of 3 means that it is quite easy. After rating the different categories for each feature, an average priority was calculated. Table 5 shows the ratings in the different categories and the resulting calculated prioritizations for Use Case 3. The prioritizations for the other Use Cases are shown in Chapter 4 “Results”.

Table 5: Prioritization - Use Case 3.

User Story ID	Benefit	Implementation	Data procurement	Operating expenses	∑
/US3001/	3	3	3	3	9
/US3002/	2	3	3	2	5,3
/US3003/	3	3	3	3	9
/US3004/	2	3	3	3	6
Average					**7,3**

The calculated priorities serve as an indicator for the order of implementation of the features. However, synergy effects may occur between different features during implementation due to similar structures and/or similar data to be retrieved, so that the final order of implementation will be determined not only by the calculated priorities, but also by the real implementation effort. In addition to that, the LIHYP project partners provided so-called “personal priorities”, independent of the rating in the different categories, which will also be considered.

3.2.2 Minimum Viable Product (MVP)

The first implementation step of the real NSR Hydrogen Triple Helix Platform will be the realization of an MVP, a first usable draft version of the platform with a minimum of basic functionalities. Based on the calculated and personal priorities, the features of Use Case 3 will be implemented on the platform first. This approach allows for comprehensive feedback from the LIHYP project partners and potential future platforms, including usability tests regarding the overall performance of the application. The following specific requirements, broken down into different sub-categories, will be considered when implementing the MVP:

Functional requirements:

- An interactive map for displaying pilot projects
- General and individual filter options for pilot projects

- Contact information for operators of pilot projects
- A map and list view of data points
- An administrative management of data points
- Detailed information on pilot projects
- A search function

Non-functional requirements:

- The Web Content Accessibility Guidelines will be considered
- The platform is web-based and optimized for desktop and mobile devices.
- The multilingualism of the platform is considered (English, German, other European languages).
- The platform should be in operation 24/7 with an availability >99%

Quality requirements

- Loading times should not exceed 2 seconds for all standard queries
- Smooth zoom and pan functionality in the map view should be guaranteed
- Large amounts of data should be processed without loss of performance
- Data should be updated regularly
- Expandability should be considered for easy integration of new data and information layers
- Continuous integration of the software should be considered by implementing a CI/CD pipeline for easy release of patches and updates

Technical requirements:

- The platform is based on modern web technologies
- The map functionality of the platform is provided by a modern map framework

3.3 Technology Analysis

The following subsections 3.3.1 and 3.3.2 provide a brief overview of the different front-end technologies, the specific map technologies considered and the final technology choice.

3.3.1 Front-end technologies

React, Vue.js, Angular and Svelte frameworks were investigated for front-end programming.

Performance

Svelte differs from the other frameworks due to its compiler-based architecture. In contrast to React, Vue.js or Angular, which require a runtime library, Svelte generates the written code in optimized JavaScript code. This eliminates a non-negligible overhead.

DOM management

React and Vue.js use virtual DOM management, which is more efficient than direct DOM manipulation, but requires additional resources. Svelte, on the other hand, does not use a virtual DOM and thus enables the user interface to be updated directly.

Bundle size

The bundles generated by Svelte are significantly smaller compared to other frameworks, as no runtime library needs to be integrated. Angular, on the other hand, generates very large bundles due to its integrated functionality, which can increase loading times. React and Vue.js generate smaller bundles than Angular, but they are still larger than Svelte.

Development time

Svelte has a minimalist syntax that can significantly reduce development time. It requires less boilerplate code and makes it possible to write reactive components directly without having to use additional libraries such as Redux (for React).

Flexibility and expandability

The modular architecture of Svelte offers flexibility for future extensions to the platform. The strict structure of Angular can lead to limitations as the range of functions grows. React and Vue.js offer more flexibility but require a larger code base and more complex integrations.

Conclusion

Overall, Svelte offers a combination of performance, small bundle size and expandability that are crucial for the development of the card-based hydrogen platform.

3.3.2 Map Technologies

The selection of a suitable map technology is essential for the functionality of the hydrogen platform, as the interactive map forms the core of the application. Various options were investigated, including *Mapbox*, *Google Maps*, *Leaflet* and *OpenLayers*.

Mapbox is characterized by a high degree of flexibility and adaptability. It offers extensive APIs and tools that allow map styles, layers and interactions to be tailored precisely to the requirements of

the project. In particular, the *Mapbox Studio* application developed by *Mapbox* offers a simple user interface for customizing the map design.
Other providers, such as *Google Maps*, offer simple integration, but are limited in their customization options, as the map styles are largely predefined. Although *Leaflet* is flexible, it requires the integration of numerous plugins to achieve the functional scope of Mapbox. *OpenLayers* also offers a high level of customization options but is significantly more complex to implement and has a smaller community.

Map customization is a high priority in this project, which is why Mapbox, with its ability to customize maps, is an optimal choice for the development of the platform.

4 Results

4.1 Use Cases

Table 6: Overview - Use Case 1.

Use Case 1: Hydrogen sources	
Story	As a small and medium-sized enterprise (SME), I would like to get in touch with suitable hydrogen suppliers who can meet my hydrogen requirements in terms of quantity, quality and other factors.
Actors	SMES
Case	Identify potential suppliers
Intention	Identifying potential suppliers for hydrogen
Goal	Providing contact details of several suitable suppliers who can meet the company's specific needs.

Table 7: Overview - Use Case 2.

Use Case 2: Infrastructure	
Story	As a municipality, I would like to receive information about existing and planned hydrogen infrastructures in my region.
Actors	Municipality (regional developer).
Case	The user receives an interactive map showing hydrogen infrastructures, including the planned realization dates. Various filter options make it possible to narrow down the results according to specific criteria
Intention	Identify current and future infrastructures.
Goal	Provision of relevant information on existing and planned hydrogen infrastructures.

Table 8: Overview - Use Case 4.

Use Case 4: Planning	
Story	As a project developer, I would like to optimize my project plans
Actors	Project developer
Case	User decides what is shown on the map.
Intention	Improve knowledge about regional hydrogen development to help in decision-making.
Goal	All relevant projects, sources and infrastructures are displayed on the map with relevant information.

Table 9: Overview - Use Case 5.

Use Case 5: Demand	
Story	As a user, I would like to know the hydrogen demand in certain regions in order to identify the lack of hydrogen coverage.
Actors	Project developer
Case	The user can display different estimates of hydrogen demand on the map.
Intention	Various forecasting models for hydrogen demand are provided at regional level.
Goal	The identification and visualization of regional supply gaps in the hydrogen infrastructure.

Table 10: Overview - Use Case 6.

Use Case 6: Monitoring	
Story	As a regional administrative unit, I would like to have the opportunity to monitor the development of the hydrogen economy in my region.
Actors	Regional administrative unit
Case	The user can monitor the status of hydrogen projects along the entire hydrogen value chain.
Intention	The development of the hydrogen economy is visualized and put into context (e.g. through median values, comparisons with other regions or benchmarks).
Goal	The provision of data points that make it possible to analyze the progress and performance of the hydrogen economy in a region.

Table 11: Overview - Use Case 7.

Use Case 7: Legal provisions	
Story	As a company, I want to know the regulatory differences between regions.
Actors	Company, public administrative unit
Case	The user can compare regulations between regions with different granularity.
Intention	The regulatory differences between regions are presented in order to provide companies and public administration units with a sound basis for decision-making. This facilitates the evaluation of location conditions, investment opportunities and compliance with legal requirements.
Goal	The provision of information on legal provisions that enables companies and public administration units to compare regulatory differences between regions in detail.

Table 12: Overview - Use Case 8.

Use Case 8: Services and products	
Story	As a company, I would like to receive information about available services and products in my region and beyond, as well as offer my own products and services in order to optimize my business activities.
Actors	The company
Case	The user can display available services and products in certain regions. The user can register their own products and services on a platform and make them available.
Intention	Companies should be able to identify potential service providers and product suppliers to fulfill their own business needs. Companies can make their products and services accessible to a wider audience in order to increase their reach and sales.
Goal	The provision of functionalities that enable companies to discover services and products in their region and beyond and to present their own offers,

4.2 User Storys

Table 13: User Stories - Use Case 1.

ID	As a...	I would like to...	so that I...
/US1001/	company (end consumer)	identify sources of hydrogen (production) in my area and beyond	can get in touch with potential sellers (pipeline delivery).
/US1002/	company (end consumer)	identify suppliers for hydrogen in my area	can get in touch with potential suppliers (pipeline, trailers).
/US1003/	company (gas supplier, HRS)	identify bottling centers in my area	I can fill my own trailers.
/US1004/	company	obtain price estimates (production and transportation) over time	plan my transformation process more economically.
/US1005/	company, public authority	developments of HRS in my area and beyond.	can identify usable HRS for my needs.
/US1006/	cluster organization / multipliers	know current and planned developments in hydrogen production and distribution	can support my own company (strategic processes, deliveries).

Table 14: User Stories - Use Case 2.

ID	As a...	I would like to...	so that I...
/US2001/	company	know general pipeline developments in my area and beyond	can identify the possibility of H2 projects.
/US2002/	company	know pipeline connection points (in concrete terms) in my area	identify possible connection points for my company.
/US2003/	gas grid operator (DSO)	know general pipeline developments in my area and beyond	can identify potential requirements for hydrogen distribution networks.
/US2004/	gas grid operator (DSO)	know pipeline connection points (in concrete terms) in my area	can identify specific connection points for hydrogen distribution networks.
/US2005/	public authority	know general pipeline developments in my area and beyond	politically support the hydrogen supply for my local companies.
/US2006/	cluster organization / multipliers	know current and planned developments in the pipeline infrastructure	can support my own companies (strategic processes, lobbying).
/US2007/	company (large-scale)	know when pipeline connections between potential sources and my company will be available	plan/optimize my hydrogen supply.
/US2008/	company and public authority	know the capacity of the HRS	can identify possible connection points for other hydrogen applications.

Table 15: User Stories - Use Case 4.

ID	As a...	I would like to...	so that I...
/US4001/	project developer	see summarized information about pilots, infrastructure, needs and hydrogen sources in my region and beyond	can plan my optimal project location.
/US4002/	project developer	see combined information on demand and hydrogen sources	can use this as the basis for an initial feasibility study for my hydrogen projects.
/US4003/	public authority	see summarized information about pilots, infrastructure, needs and hydrogen sources in my region and beyond	can support local infrastructure planning in my district.
/US4004/	public authority	see combined information on demand and hydrogen sources	can estimate the need for additional hydrogen projects.

Table 16: User Stories - Use Case 5.

ID	As a...	I would like to...	so that I...
/US5001/	public authority	know the total demand for hydrogen (estimate) within my regional boundaries	can politically support hydrogen development in my district.
/US5002/	public authority	know finely granulated hydrogen requirements (X km * Y km / heat map)	politically can support hydrogen development in specific areas (e.g. industrial parks).
/US5003/	company	know the hydrogen demand	identify future production sites and customers.
/US5004/	company	know hydrogen requirements for mobility applications	can plan the construction of HRS infrastructures.
/US5005/	public authority	know hydrogen requirements for mobility applications	can support the HRS infrastructure.

Table 17: User Stories - Use Case 6.

ID	As a...	I would like to...	so that I...
/US6001/	public authority	compare information about pilots, infrastructure, needs and hydrogen sources in my region and beyond	can monitor developments in my region and others.
/US6002/	public authority	compare more detailed information on regions (inhabitants, number of companies)	can monitor developments in my region and others.
/US6003/	public authority	compare strategic goals with real developments	can adapt political and strategic measures.

Table 18: User Stories - Use Case 7.

ID	As a...	I would like to...	so that I...
/US7001/	company	know the regulatory differences between different regions	can identify potential challenges and opportunities in cross-border H2 projects and business.
/US7002/	public authority	know best practices on policy, regulation and standards	parts of it into local regulations.

Table 19: User Stories - Use Case 8.

ID	As a...	I would like to...	so that I...
/US8001/	company	know possible services and products in my region and beyond	identify the right product supplier for my own needs.
/US8002/	company	inform others about my own products and sell them	optimize my sales.

5 Prototyping

5.1 Introduction

The next step is to design a prototype of the MVP based on the results of the requirements analysis. Developing a prototype before starting with the full platform implementation allows for extensive testing of the detailed user flows, thus identifying potential problems and necessary change requests at an early stage of the project. The prototype not only serves as a fundamental basis for the full implementation but also facilitates the validation of the conceptual platform design with project members and stakeholders. Unlike a wireframe, a prototype not only constitutes layout and arrangement of elements, but also considers fonts, colour schemes and the interactivity of UI elements, providing a more detailed functional representation of the intended product.

5.2 Design Scheme & Accessibility

The primary colours "Ocean" (a shade of blue) were chosen for the dark mode and "Ice" (a shade of white) for the light mode. This choice of colour is intended to emphasise the association with hydrogen, the central theme of the platform, and to create a calm, minimalist look that focuses on the content and does not visually overwhelm the user.

The colour scheme also provides a good basis for compliance with the design-related accessibility guidelines of the Web Content Accessibility Guidelines (WCAG). These state that text must be easy to read, which is achieved by providing sufficient contrast between the chosen text and background colours.

To meet WCAG "AAA" requirements, contrast levels must be at least *7:1* for normal text and *4.5:1* for large text, so that visually impaired people or people with color vision deficiency can also recognise text and UI elements.
In the prototype, the contrast value between text and background is *11.42:1* in light mode and *9.05:1* in dark mode, which meets the requirements. Text and backgrounds were checked using the "Contrast Checker" online tool on the *WebAim* website.

Another key component of the design is the implementation of so-called “glass morphism” for the backgrounds of the UI elements that sit directly above the map. This glass-like blurring ensures that there is always a visual connection to the map, the main component of the platform, even when using the UI elements. This effect can be seen in Figure 4.

Figure 4: Glass morphism effect.

5.3 Integration of Requirements

The requirements defined during the strategy development (Chapter 3) have been considered when designing the prototype of the MVP. The following is an explanation of how the prototype's user interface (UI) elements meet these requirements.

The landing page of the prototype (Figure 5) consists of an interactive map with coordinates representing the pilot project locations. Icons in the bottom left corner can be used to zoom in and out of the map. The general design approach is minimalistic, intentionally reducing visual clutter to ensure that the user's attention is drawn to the map, which serves as the primary focus of the platform.

The top left menu bar of the prototype contains four icons that allow users to interact with different features of the platform. The first icon opens a menu (Figure 6) that allows the user to select the layers to be displayed on the map. The MVP prototype only includes the best practices and pilot projects layer. However, placeholders for additional layers have been included in the design proposal, illustrating that the platform will include more data layers in the future.

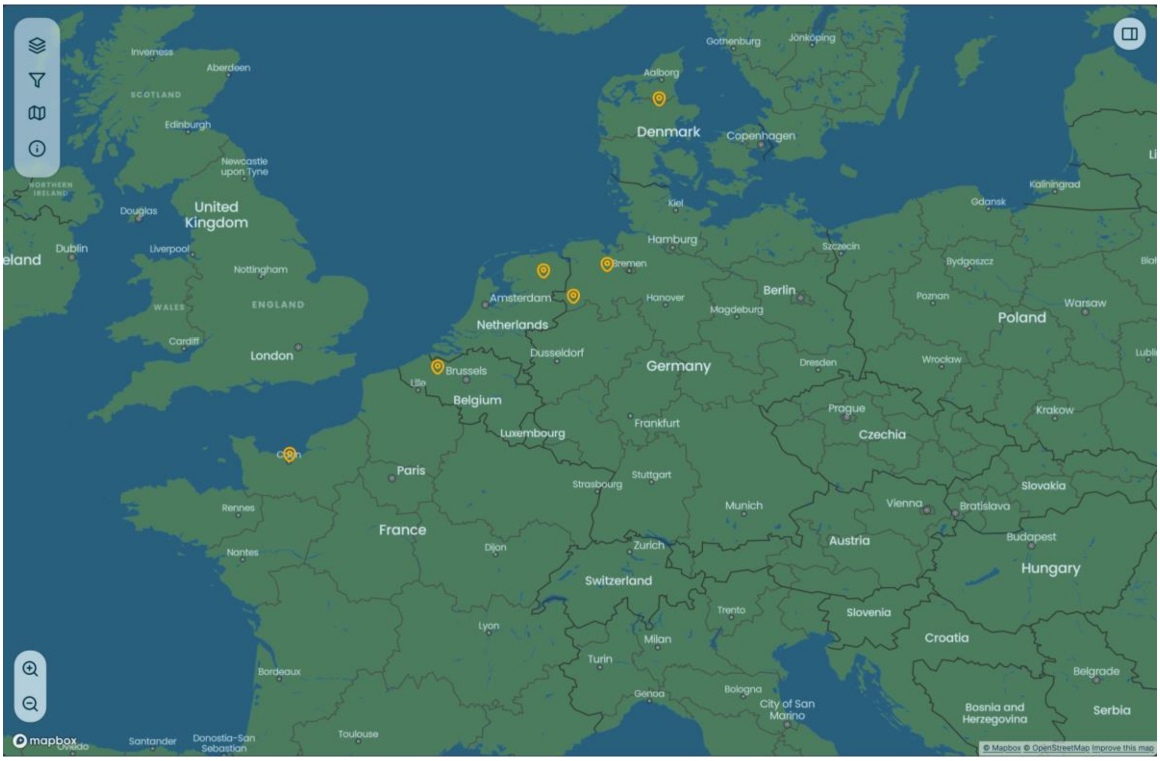

Figure 5: MVP prototype - Start page.

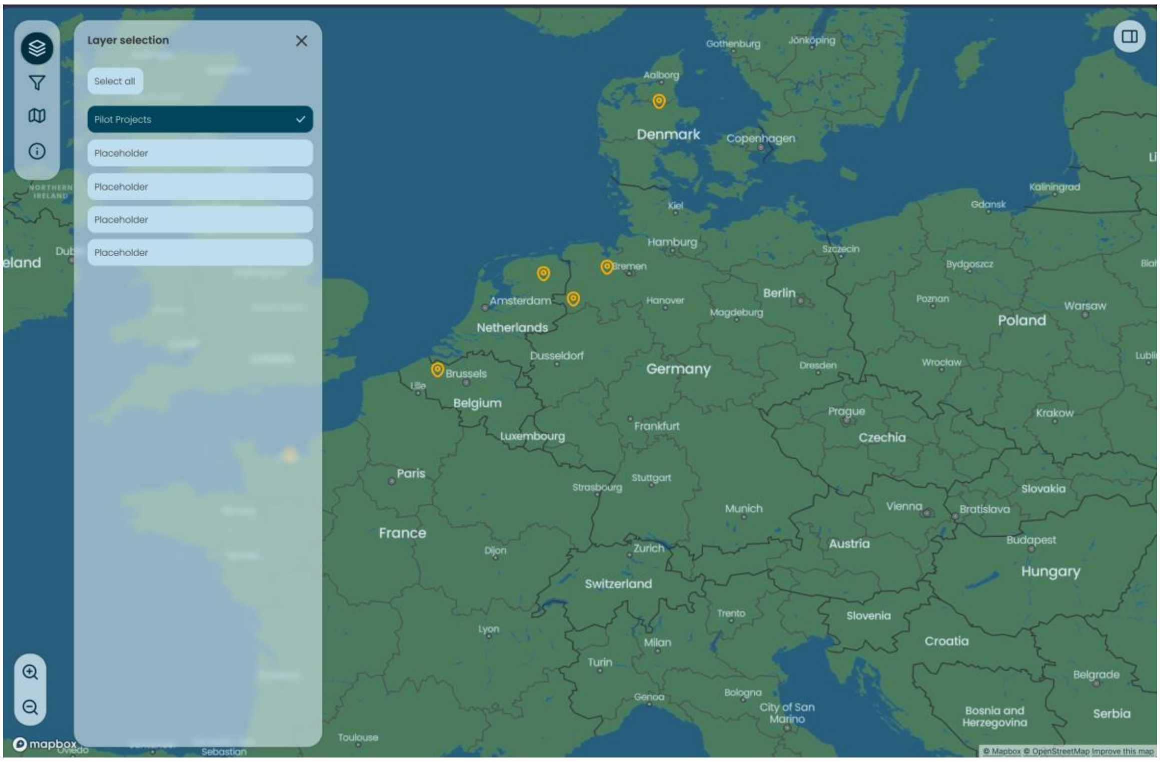

Figure 6: MVP prototype - Layer selection.

Figure 7 shows the data filtering menu. Users can set a point for their own location (based on address/coordinates) and a radius around their own location. Besides this, a year can also be selected. In addition, layer-specific filter options are offered for each layer that is enabled.

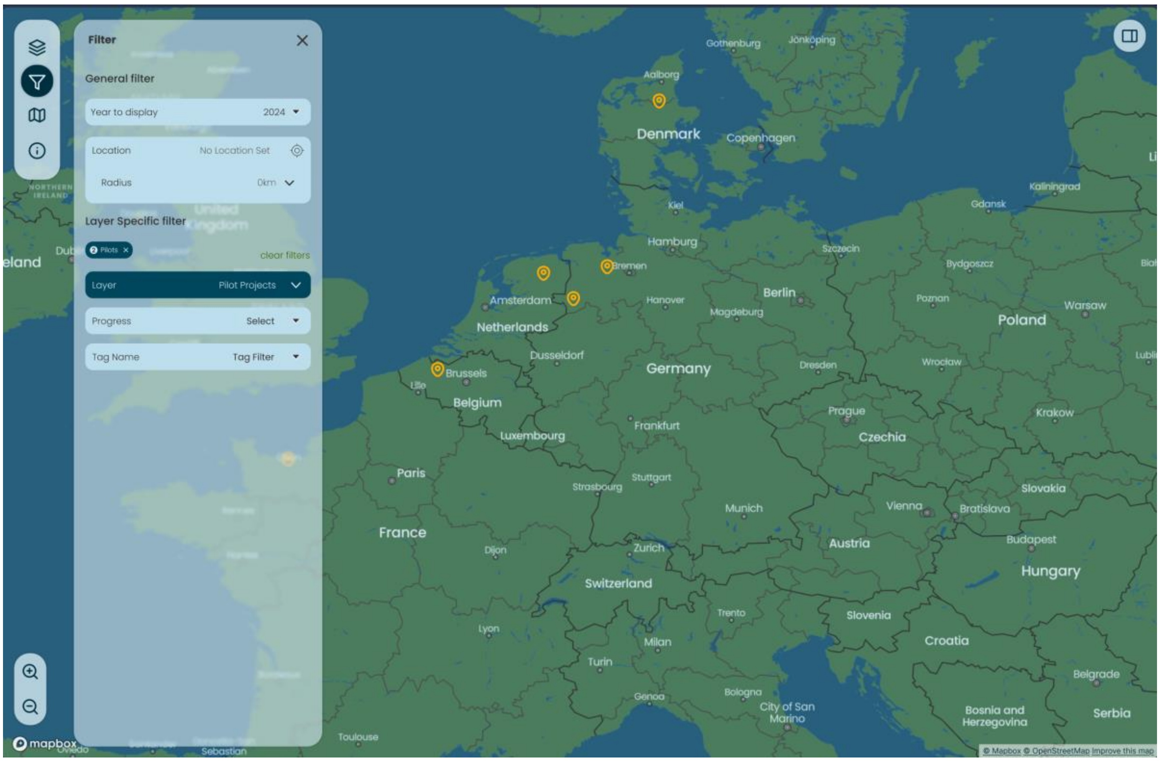

Figure 7: MVP prototype - Filter selection.

The MVP prototype also includes a so-called map mode, which allows the selection and comparison of different geographical regions, such as countries or districts. Comparisons could be made in terms of regulatory frameworks, general hydrogen developments or more. Although the comparison feature is not required for the implementation of Use Case 3 and therefore not for the MVP, it must be considered at this stage of platform development due to the overall software architecture. The map mode selection is illustrated in Figure 8. Placeholders for switching between different map modes have also been included.

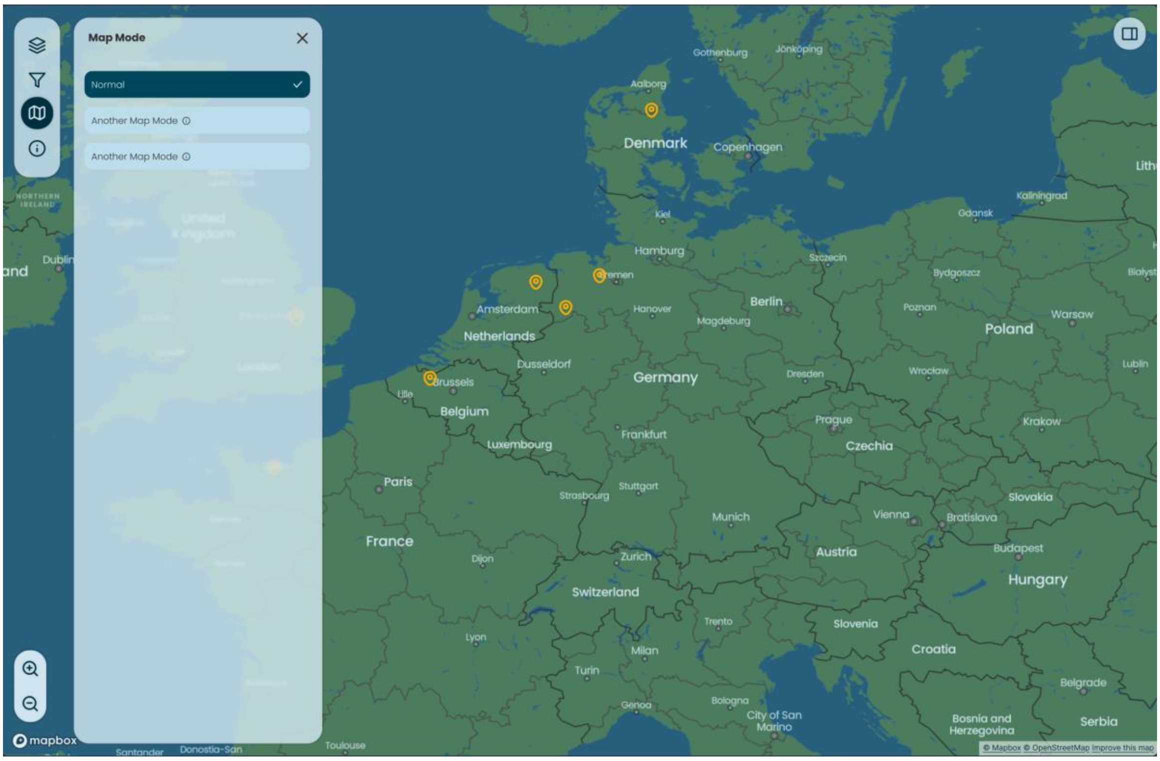

Figure 8: Map mode selection MVP prototype.

In addition to the map view of the data points (shown in Figure 6), it is also possible to display data points in a list format (Figure 9). For this purpose, a UI element on the right-hand side has been integrated into the prototype. This UI element also integrates a search function that allows the user to find specific data points. Furthermore, also in the list view it is possible to set additional filters. As with the map mode, this functionality is not required for the implementation of Use Case 3, but must be considered at this stage due to the software architecture.

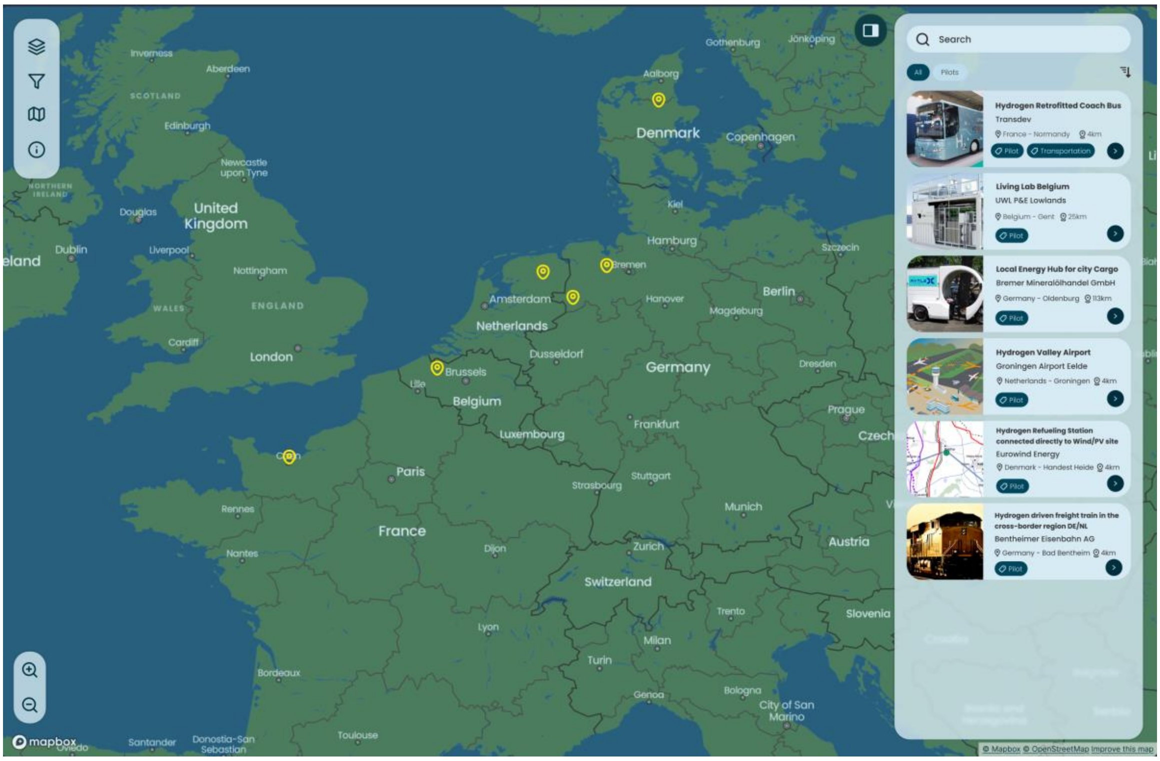

Figure 9: MVP prototype - List view.

By selecting a project on the map or from the list, it is possible to open the information view as shown in Figure 10 (the French pilot Transdev has been chosen as an example). This view provides basic information about a pilot, such as contact person, project status, a brief description, etc. This view can be expanded as shown in Figure 11. The “detailed view” provides enough space for a comprehensive, much more detailed project overview. The middle section allows to display images in the slide gallery, add video material or other supporting documents such as reports, data files and more. The left and right section are both filled using a tab system. The number of tabs as well as the general number of characters is not limited, and the tabs can be named individually by the respective project owner. The space on the left can be used to provide any kind of general project information, the space on the right is designed to display relevant data, this could be e.g. hydrogen quantities, relevant monitoring data such as temperatures and so on. The chosen design proposal allows for a uniform presentation of all types of pilot projects on the platform, while at the same time providing enough space for individual project specific details.

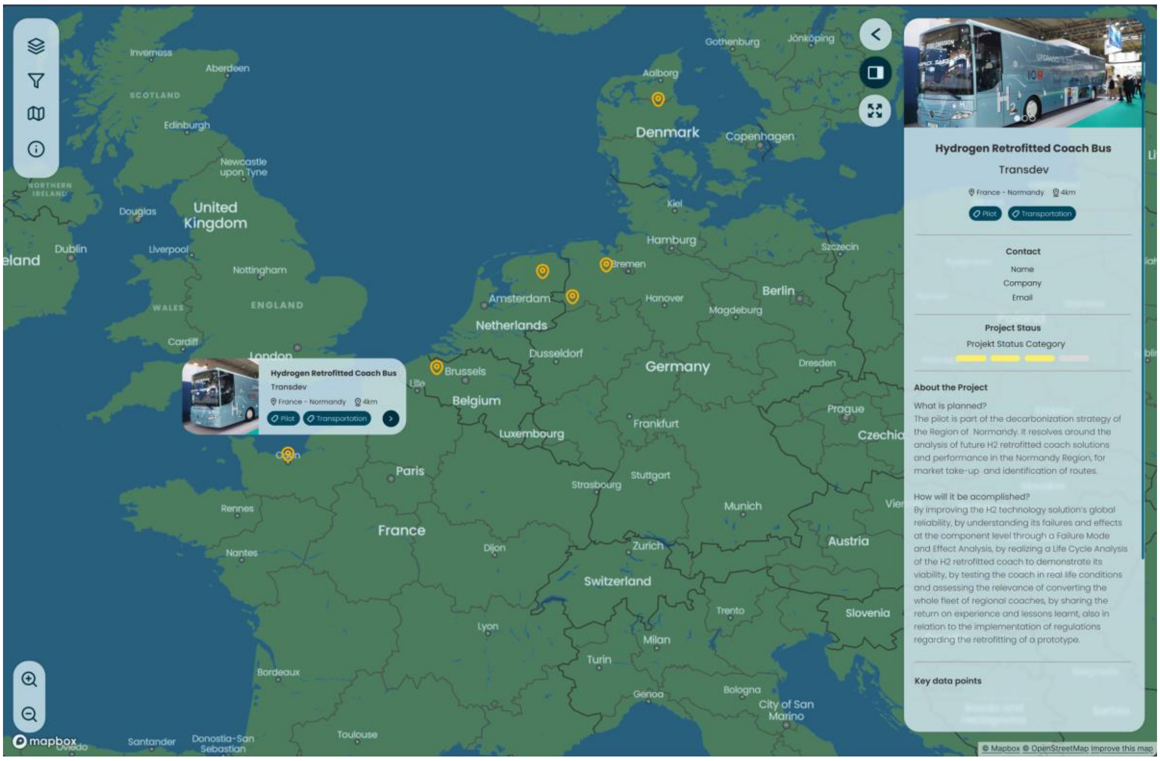

Figure 10: MVP prototype - Information view.

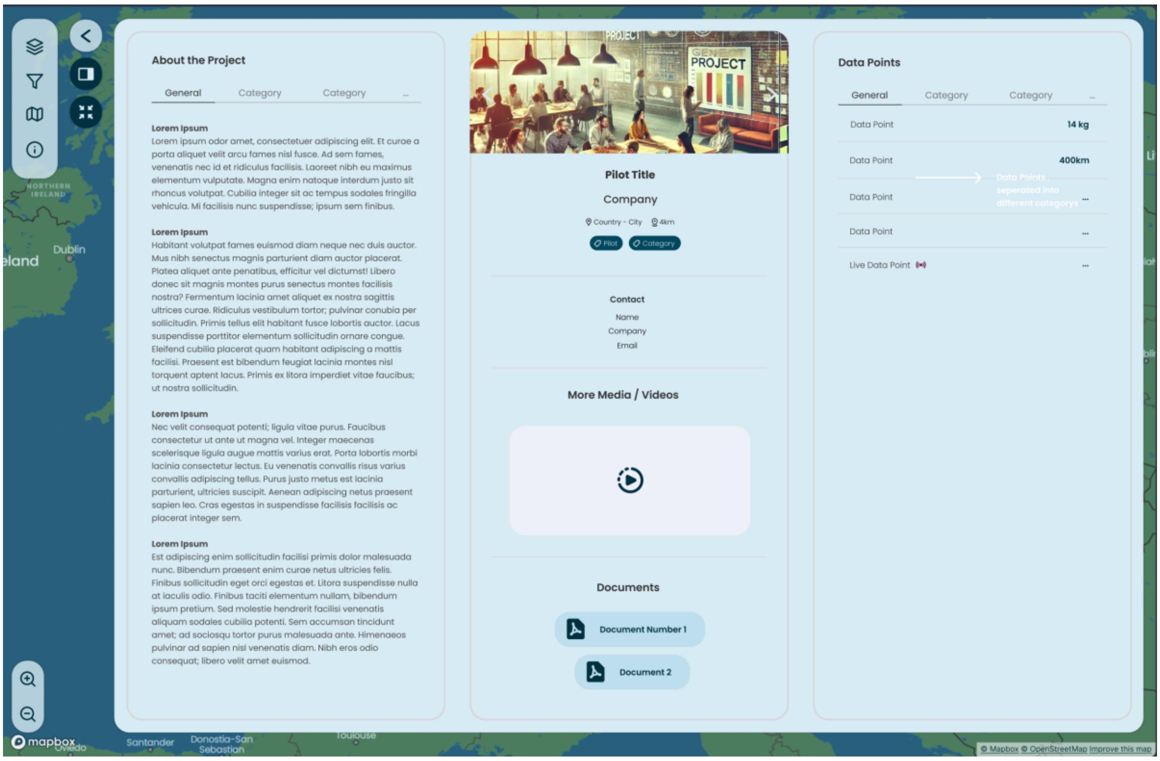

Figure 11: MVP prototype - Detailed view.

6 Expert Committee

The entire platform development and implementation process (front-end and back-end) will be accompanied by a so-called “expert advisory committee”. In total, 10 programming sprints are currently planned so the expert advisory committee will be active until the end of the LIHYP Project (02/2027). During each sprint, there will be a virtual expert meeting to discuss the recent progress of development, give feedback on implemented features, discuss new ideas for features and finally prioritize the backlog list for the next development phase. The members of the expert advisory committee therefore are representatives of future platform users. Their feedback and input will ensure that the platform will meet the specific user needs and demands in the end.

The concrete expert committee tasks are:

1. Testing the platform features: the members will get access to the latest version of the platform and test newly implemented features as well as the platform in general and give feedback
2. Fill in the feature backlog list: the members can generate ideas on new features which should be implemented on the platform and present them to the committee for discussion (“feature request”)
3. Prioritizing the backlog list: the members will vote for features, leading to a prioritization for the development process

The WP1 lead decided to adopt a flexible approach for the expert advisory committee. Thus, the number of experts and the experts themselves can change over time. Changing experts will lead to more diversified feedback as well as new ideas for feature requests due to the different backgrounds of the varying committee members and in general, an increased visibility of the platform itself regarding the future platform users. Besides this, having a flexible expert advisory committee will be less time extensive for the experts themselves since also participating in at least one meeting can have a significant contribution for the development. It is intended to have at least one member from each country during each meeting.

A short onboarding video will be recorded, which the experts can use for their personal preparation. The video will show how they can get access to the respective platform version, how to use it and what the expected contribution of the experts is.

A kick-off workshop with the WP1 partners is planned for March 2025. The first meeting of the expert advisory committee will be in April 2025. The topic will be the discussion of the MVP (first draft of the real platform & Use Case 3 “Best practices and pilot projects” implemented). Afterwards, the virtual meeting will take place every six weeks (coupled with the programming sprints). Suggestions for experts to invite will be gathered from the LIHYP project team. Possible committee members could be different stakeholders like representatives from municipalities/cities, companies who might be users and/or producers of hydrogen (SME focus), IT/Web specialists or research institutes.