Barriers of small-scale hydropower in the Netherlands

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Abstract

One of the biggest current challenges for Earth and humanity is climate change. To lower the impact of already existing effects and decrease potential future effects of rising temperatures, countries have decided on actions with the goal of keeping the temperature rise no higher than 1.5°C. One part of those actions is a transition in the energy system from polluting fossil fuels to renewable energy carriers, such as wind, solar, or hydropower.

In the Netherlands, hydropower is clearly lagging behind compared to other European countries, for various reasons. Some pioneering companies are still trying to utilize the potential of hydropower they see in the large water system in the Netherlands. However, they are struggling to progress and deploy their solutions, as happened at the Bosscherveld project in the south of the Netherlands, Maastricht. The companies involved there claimed that stakeholder processes were the main causes for barriers that stalled project advancements.

Within energy transition projects, stakeholder management often causes problems, and the actual factors that make an actor oppose or stall a project are multifaceted and hard to grasp. Additionally, there is a lack of tools and methods for a company working on technologies in this field to gain a thorough understanding of their stakeholders and translate that understanding into concrete strategic decisions on how to behave in such a project. With this research it was attempted to identify the most important stakeholder-related factors for a company to consider when working within an energy transition based project. This should add managerial guidance as well as the ability to assess the status of a project. For a company already working on the project or that joins it, they can estimate the condition the project is in and see what is missing for its success, improving the overall certainty for potential revenues.

With a mixed-framework approach consisting of the definition of the main structural components and policies of the technology innovation system (TIS) surrounding the SHP, a classic stakeholder analysis using a power-interest-grid, and semi-structured interviews to create an expert model for the small-scale hydropower (SHP) project has been applied. The first two areas were mainly used to get an understanding of the technology's surrounding market and to make assumptions regarding the roles involved in the project. The interviews were aimed to fully understand the project's processes and each stakeholder's perceptions on barriers in those processes, so that an ideal process and the stakeholders' views on most important factors for such a project could be derived.

With this approach it was possible to identify 25 stakeholder-related factors that are important to consider for a company working on such a project, as well as understanding their interconnections and reasons for why they are important. The factors then could be classified into themes

covering *Motivation, Purpose, Effective Teamwork, Investment, Entrepreneurial Activities, Base of Collaboration, and Macro-Environment* and clustered into areas that build the **Foundation of the Venture** the factors that are **Supporting Collaboration**, and the ones that influence and define the **Stakeholder Interest**. The first area consists of factors, that need to be present at the beginning of the project or need to be established within the starting phase such as resources, a business model, and trust. The factors to support the collaboration are fostering continuous interaction and general rules for how it should be worked together, such as planning and ownership. The factors of stakeholder interest, achieve a higher resolution of how a stakeholder's interest is formed, and what should be looked at during the stakeholder analysis, to understand the actors positioning within and towards the project, like a stakeholder's drive, their personal vision, or simply what they can gain from the project. This must be done on a continuous bases, since a stakeholder's motivation and gains can change due to unforeseeable events or a change in for instance a country's policy.
Therefore, it could be seen that not one or a few instances or factors could be identified that resulted in the halt of the project, but a variety of aspects combined hampered its progress.

Furthermore, it has been pointed out that the previously identified factors are only partly addressed by an adapted TIS framework by Ortt and Kamp (2022), which has been applied at the end of the research, due to its claim that it had an improved managerial perspective for companies working in a niche environment, trying to bring their technology to a wide market diffusion.
The possibility of generalizing the conclusions regarding the crucial factors regarding stakeholder participation for a company working on an SHP project in the Netherlands are limited due to the specificity of the project and the limited number of stakeholders and perspectives that could be gathered. Therefore, it is suggested to investigate additional hydropower projects in the Netherlands, compare them with the Bosscherveld case, and see whether the concluded factors can capture the dynamics there as well or if further refinements are necessary.

Contents

Nomenclature

Abbreviations

EIA	Environmental Impact Assessment
EU	European Union
IPCC	Intergovernmental Panel on Climate Change
NGO	Non-Governmental Organization
NIMBY	Not-In-My-Backyard
PIG	Power-versus-Interest Grid
PPP	Public-Private Partnership
RES	Renewable Energy Systems
RWS	Rijkswaterstaat
SHP	Small-scale Hydropower
SME	small and medium-sized enterprise
SNM	Strategic Niche Management
TIS	Technological Innovation System
USP	Unique selling points

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1 Introduction

As an introduction into the topic and where problems arise within it, first some background information and previous developments are presented. Subsequently, the problem itself is described and it is shown how this research is intending to resolve the arising obstacles with the later stated research objectives and conclusively the research questions. Before starting with this I would like to describe my own background, interests and perspective, to be able to explain, realize, understand and eventually prevent biases.

I am a person with a multidisciplinary background starting with more practical experience gathered through an apprenticeship in mechatronics. Intrigued and fascinated by the practical side of technology and how it is a crucial resource to a company, I continued my career with a more academic approach doing a bachelor's degree in industrial engineering. Though, doing it in a dual system together with a medium-sized internationally-acting company from Germany, I always had the connection to the industry and thought about topics taught in the degree from a company's perspective. Having worked on different topics from different fields within the company, I found the internationally and sustainability-focused ones as most intriguing. Along the bachelor's degree the wish began to form to be able to create something that is not the usual, which did not feel achievable with my bachelor's degree and also not with the focus on industrial engineering. This lead me to TU Delft were I started my MSc in Management of Technology. TU Delft immediately creates the feeling that you can achieve your dreams and that a lot is possible. The future-oriented program I studied, helped me shaping my dreams and goals. Especially, the topic of sustainability attracted and fascinated me most, embodying my dream into an idea that I want to contribute positively in this field in the future. Courses like inter- and intra-organizational decision making and sustainable innovations and transitions showed me, that in order to create change, not only the technology or one company is important, but that in today's globalized world, where the majority of problems and hence, projects are of multilateral nature, collaboration between parties is paramount. Furthermore, policy and therefore policy makers play an important role in enhancing and provoking change and which direction this change might take.

During my bachelor thesis I worked on a change management issue within a medium-sized company in Germany, where we needed to implement a maintenance management system, that mainly would be used by the maintenance workers. The goal of this implementation was to digitize processes, lower the down-times of our production machines, and to overall increase the efficiency in the maintenance department and hence our machines. The project was stakeholder-focused from the beginning, since it was clear, that as long as the people working with the software were not convinced, they would not use it properly, and the main goal of an increased efficiency would not be achievable.
Within the project and afterwards, we were facing a lot of issues with stakeholder opposition, despite involving them and making them partly responsible for the development and customization of the software, so that it would perfectly fit their daily working structures.

That project was "only" within an organization, and stakeholder questions were already central to its success. Thus, I could only imagine what level of complexity would be added with having an inter-organizational project, where whole different actors from different transdisciplinary domains would need to work together, with different interests and different believes. The course inter- and intra-organizational decision making pointed me towards these questions again and intrigued me to think about them further.

All this brought me to the point that I wanted to do a thesis that brings together my background, my interests, and my goals. I searched for a project that has a company perspective, being in the field of sustainability and energy transition and is center to stakeholder issues and questions.
Having my background and what drives me clear I will now focus on the thesis background, the problem definition, and the approach that will be taken within the thesis.

1.1 Background

Climate change currently is one of the biggest pressuring challenges. With the increasingly high greenhouse gas occurrence in Earth's atmosphere, enhanced by human behavior specifically due to energy production with the combustion of fossil fuels, the need for change is omnipresent. (Olabi and Abdelkareem, 2022) This change leads to the presently worldwide ongoing Energy Transition, where it is tried to move away from unsustainable fossil fuels towards renewable and consequently more sustainable alternatives. This Energy Transition comes with several challenges, one of which is energy security. Renewable energy sources often come with the pitfall that they are intermittent, meaning they are not always available on-demand and that therefore there can be a disparity between energy production and energy use. (Luo et al., 2015)
Additionally, new solutions from different sectors are needed, in order to make the switch and to create the same amount of electricity that now is so conveniently producible with fossil energy carriers.

One renewable energy source that usually is not depending on the weather or the time of the day is hydropower. Commonly needing large scale sites, a solution that is attracting attention is small-scale hydropower (SHP), which according to the European Small Hydropower Association (ESHA) could significantly contribute to achieving the EU's sustainability targets. (Manders et al., 2016) SHP often are run-of-river solutions where the turbines are placed in or close to a river in a bypass, using its constant flow to generate steady and reliable, green electricity. Other than large-scale hydropower, which often alters entire landscapes and their ecology, SHP is widely perceived as having less hazardous impacts on the environment. Though, some studies have shown that, depending on the SHP design and set-up there can be negative effects on the adjacent environment such as river fragmentation, as well as effects on the water flow and fish stocks, which eventually can create a social impact of the technology. (Harlan et al.,

2021) Despite, Manders et al. (2016) and ESHA see a high potential for renewable electricity generation with SHP also in the Netherlands, which surprisingly, has not been captured yet. In fact, the Netherlands are lagging behind the average EU developments regarding SHP and also scholarly studies are rare. This might be due to several reasons, one of which could be the "highly-institutionalized wet network" and hence the Rijkswaterstaat. (Manders et al., 2016) Additionally, often the lack of stakeholder involvement and the disparity between ecological and energy-related goals can cause problems and delays.

The Dutch company FishFlow Innovations currently tries to introduce these SHP systems into the Dutch market and eventually wants to deploy them in other European Countries and globally. FishFlow is a company working on water screws and turbines to generate electricity from water streams and currents. With these technologies they have different application areas ranging from screw pumps used in canals and water gates with a diameter from 0.8m-5.0m to bigger tidal turbines used in the open sea or tidal barrages with diameters up to 10m. For their solutions they claim three main value propositions and unique selling points (USPs):

1. Efficiencies up to more than 90%.
2. Being free from maintenance (or if it had to happen, then it could be done as easy and simple as possible) and extremely long-lasting.
3. Being 100% fish and sea-life friendly.

As their variance of products, so are their projects ranging from small-scale 'neighborhood' projects to large multi-actor projects such as tidal bridges in Oman and Indonesia, where in sum over 900 of their tidal turbines will be used to provide the surrounding areas with electricity generated from present fast moving stream currents.

Since several years now already, FishFlow is trying to set up a SHP plant close to Maastricht in the Netherlands, being able to generate almost 1 MWh. However, within this project, a couple of unexpected barriers are faced, which will be presented more thoroughly in the subsequent chapter.

Since in the Netherlands, there are only a few SHP and some micro-scale plants (Manders et al., 2016) its developmental environment can be seen as a niche within the Dutch energy market, and the energy transition in general, where it is necessary to gain credibility and acceptance to diffuse into a wider market. Regarding niches, there are different approaches of Strategic Niche Management (SNM) to cope with the particular surroundings present. According to Ortt and Kamp (2022) for a company, it is crucial to know which kind of niche strategy to use and that it could significantly increase the chance of success. Especially with the risks and uncertainties a company operating within this niche is facing regarding investments and more importantly, the return on investments, having the right strategy is decisive. However, to find the right strategy can be difficult.

The subsection of sustainable innovations often is not necessarily in favor of the market meaning that especially early versions are inferior regarding price and performance, which is why policy support might be needed to break out of the niche and to diffuse on a larger scale. Regarding research, it means that it is often focused on the policy side, neglecting the company's perspective and their need for practical strategy suggestions for working within the socio-technical system. The strategies of companies and how they are formed were not given much attention and also SNM would lack a "managerial perspective". (Ortt and Kamp, 2022) For this, Ortt and Kamp (2022) suggest using a Technological Innovation System (TIS) approach to be able to draw the bigger picture of the factors and actors around a technology in order to understand which niche strategies might be most beneficial. This approach will be explained more thoroughly later.

1.2 Importance of stakeholders in Energy infrastructure projects

As stated above, the currently ongoing energy transition is not necessarily in favor of the market. According to literature, it can even be seen as an imposed one, which can create additional barriers such as social opposition, political conflicts, and questions regarding policy and agency. Grünewald et al. (2012) Fri and Savitz (2014)
In the projects often different stakeholders or people from different domains are involved, being people from public institutions, private persons, private companies, and NGOs. All these stakeholders are having a different interest and a certain power to influence the process and progress of a project.

Within energy infrastructure projects, stakeholders are often opposing which can be due to several different reasons. The opposition can be out of reasonable, quantitative reasons, but also out of emotional attachments, personal historical experiences or even political beliefs, that can be harder to comprehend.
Non-collaborative stakeholders can have a significant impact on the success of a project, either by delaying or hampering the progress or even stopping it entirely, causing a failure of the project. Especially within energy transition related projects, the topic of stakeholders and their involvement can be paramount. This will be explained in more depth at a later stage.

The water sector in the Netherlands is world-widely known for their professional and successful way of dealing with the fact, that many parts of the country are below sea level, and still make it possible for a region to thrive and be economically successful. For centuries, this water sector in the Netherlands was formed, and certain governance structures with different responsibilities were shaped. The main institutions in control of the water are Rijkswaterstaat, the water boards and the municipalities or provinces. (Keller and Hartmann, 2020) In an informal talk with water-governance experts and professors at TU Delft it was discovered, that a project such as the Bosscherveld one, usually has these three parties involved, resulting in a more complex governance process.

To get a first glance of what might be the problem within the project and to create a first understanding of the stakeholders, a preliminary project analysis is necessary.

1.3 Problem definition

Specifically for FishFlow and their project, the main underlying problem is, that despite investing time and money in developing a project in a new field in the Netherlands, they are not able to finalize and execute it, creating a return and time to focus on further projects. It seems like there is a clear mismatch between the perception of the technology, its impact, and its benefits from the company and the decision maker's side. Hence, after the preliminary project analysis, the assumption can be made, that the main reason hampering the project's progress is a failure in collaboration and communication between the managing companies and the institutional decision makers, consisting of the water board, the Rijkswaterstaat, and the municipality of Maastricht. However, what the actual, specific issues were and how the dynamics between the stakeholders were, still remains unknown. Hence, strategy suggestions are difficult to formulate.

As presented in the background, SHP has high potential to contribute to the energy transition in the Netherlands, however is lacking policy support, making companies and entrepreneurs responsible for pioneering in this field. Still being a new market within the country, uncertainties about barriers and potential revenues are hampering the efforts done by these actors. These uncertainties are creating difficulties for the companies in formulating sound strategies in order to circumvent the barriers arising in such a new market. For that a framework to guide through these uncertainties, focusing on stakeholder inclusion is missing and only broad recommendations are present, without hands-on suggestions. Without a clear guidance of their actions, companies are facing ambiguity for their return on investments which eventually might force them to focus on other projects and pathways. This could then slow down the whole energy transition within the Netherlands and enhance climate change and other energy-related issues.

1.4 Research Objective

The main objective of this research is to identify the central reasons the SHP project at the Bosscherveld lock is not proceeding from a stakeholder analysis perspective and how they form the barriers the managing companies are facing in the SHP project at the Bosscherveld lock. For this, previous processes and dynamics are mapped and the main issues should be identified.

With the findings gathered, it is being investigated and assessed whether the technology innovation system framework is sufficient to represent the ambiguity a company working on an SHP project in the Netherlands can be confronted with and if the stakeholder dynamics resulting in this ambiguity adequately represented. At the end of this thesis, it should be clear whether the framework is a satisfactory tool to use for an energy infrastructure project, involving a high amount of stakeholder processes. If this is not the case, suggestions will be made on adapting

the framework adding a higher focus on stakeholders and including the dynamics that need to be considered in such a project. Then a remark can be made whether it could be a valuable tool for companies working in the field, increasing their chance of success with their projects.

1.5 Research Questions

To put this research in the right direction, research questions are needed, which, once they are answered, reveal the points necessary to reach the formulated research objective.

Main research questions

What are the factors related to stakeholder participation which are pivotal to the outcome of a particular small-scale hydropower project in the Netherlands?

To answer this research question, it will be to looked at the stalled project in more depth and identify crucial points for the halt. For this, it will be studied what has happened so far and the different stakeholders involved in the processes will be analyzed to understand their interest and believes. While doing so a TIS for the technology used by FishFlow will be created in order to paint a clear picture of the surroundings with focusing on the crucial factors and especially the actors and the socio-technical environment. Such as with the criticism on Not-In-My-Backyard (NIMBY) however, also here perspectives can quickly be assumed, and maybe wrong conclusions could be drawn. Therefore, within the TIS, the focus will lay on engaging with the actors (FishFlow, governmental, societal...) to identify their real views and opinions. With this, suggestions will be given on which niche strategies FishFlow or a SME in this market generally should consider to be able to implement their SHP project.

With the information gathered it will be assessed whether the TIS framework is a useful tool for looking at such a project, and improvements will be suggested if necessary, to include a better stakeholder focus within it.

Looking at these steps the following sub-questions can be derived to formulate a structured approach to take on the research main research question.

Subquestions

1. Who are the most crucial stakeholders that influenced the project's progression along the timeline?
2. What aspects of stakeholder-participation serve as barriers or support for the SHP project?
3. To what extent can the TIS framework serve as a tool to guide a company within these kind of projects?

The following project description is supposed to give more background understanding of the current situation of the Bosscherveld project. The ensuing literature part will help understanding the approach chosen for the research. Furthermore, it can be seen as a toolbox of which

throughout the research it can be made use of to create rigid and structured solutions.

1.6 Project description: preliminary project analysis

To find out where to focus on regarding the stakeholders, a preliminary project analysis was conducted, with the goal of creating a better understanding and to being able to adjust the focus of the actual research, based on the findings. For that, FishFlow provided project documents and some information during initial talks for clarification of questions. With that, a timeline with events drawn from the documents was generated. There, gaps and insufficiencies were identified that can be used for the final problem definition. The created timeline can be found in Appendix A and is described subsequently.

The project area is in Maastricht, more specifically the Bosscherveld lock. The lock was built in 1930 and connects the Maas and the Zuid Willemsvaart canal. Besides being merely a connection of the two water ways, it also serves as a drainage system for the elevated side of the Maas and is supposed to ensure feeding into downstream waters in Flanders. There, the stream is needed as a source for drinking water but also industry, especially agriculture. Besides the lock, the Voedingskanaal found in the south of the lock (see Figure 1.1) serves this purpose.

To improve the water flow and ensure a steady water feeding of Flanders, different solutions were discussed. The one chosen for being the best regarding the feeding purpose, was a bypass solution, also benefiting shipping and nature besides industry and agriculture. In this solution, two tubes were meant to be set up on the south side of the lock through which a steady water flow could be established. Having this solution planned, two ex-Rijkswaterstaat employees suggested implementing a SHP into these bypass tubes to create an additional function of generating electricity, which could be used as sustainable energy source in the region. Where this bypass and hydropower plant would be located can be seen in Figure 1.2.

In 2007 the project was informally started, with a declaration of intent between the Rijkswaterstaat and the WaterPotentieel BV (a company which was set up of the previously mentioned ex-Rijkswaterstaat employees). In 2011, this declaration of intent was then formalized into an official contract called a Public-Private Partnership (PPP), which is needed every time a governmental institution wants to work together with a private company. Within the contract, certain rules and requirements regarding the project were recorded. Among others it was for instance stated that the realization of the project was expected to happen in 2012 and that as soon as the construction order from Rijkswaterstaat was given, that it was a legal obligation for WaterPotentieel BV to carry the project out. Furthermore, it said that Rijkswaterstaat had to provide the land, "as far as they own it".

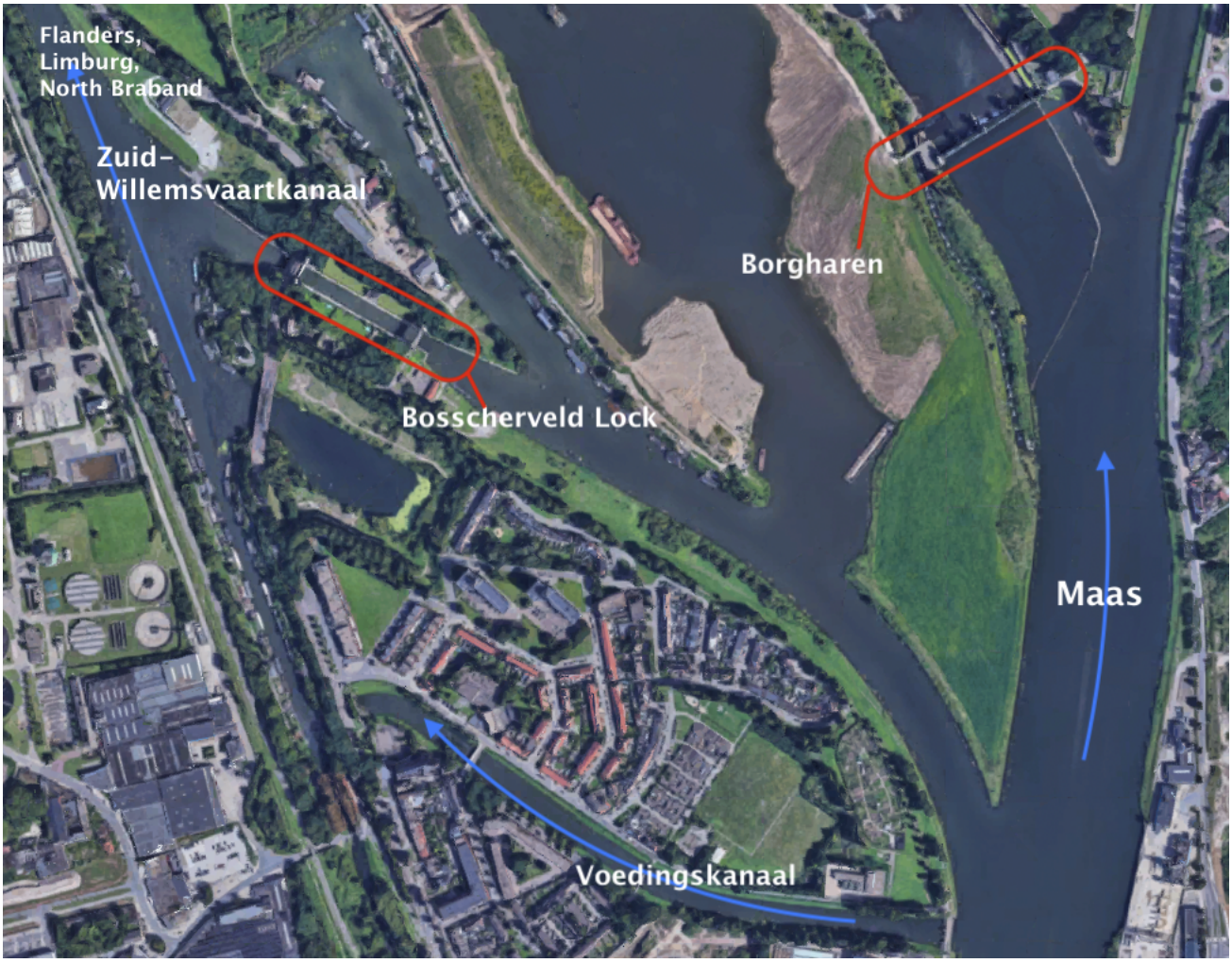


Figure 1.1: Map Bosscherveld in Maastricht

In 2010 a periodical safety testing was conducted by the DHV BV regarding the flood defense capabilities of the lock. The lock had failed this test and the conclusion was that the flood defense capabilities were insufficient. Information regarding, whether changes or improvements were made is not present. However, according to FishFlow, the SHP would even be able to improve the flood defense potential, due to steel sheets that would be added due to the construction.

Other than stated in the PPP, in 2012 no realization of the project happened. Instead, there was an investigation of the impact the bypass and the SHP could have on fish migration, conducted by the ATKB. Concerns were made clear from NGOs like the Sportvisserij and the Fish Stock Improvement Maas. However, the ATKB came to the conclusion, that overall, the whole site would not have negative impacts and even positive side effects for different fish species living in the area could be achieved. The fish-friendly turbines from FishFlow would not harm the fish and would not increase fish mortality like other solutions would do.
Furthermore, as stated by FishFlow, they had made investments in 2012, being hiring new employees, to cope with the expected additional workload, resulting from the project at the Bosscherveld lock.

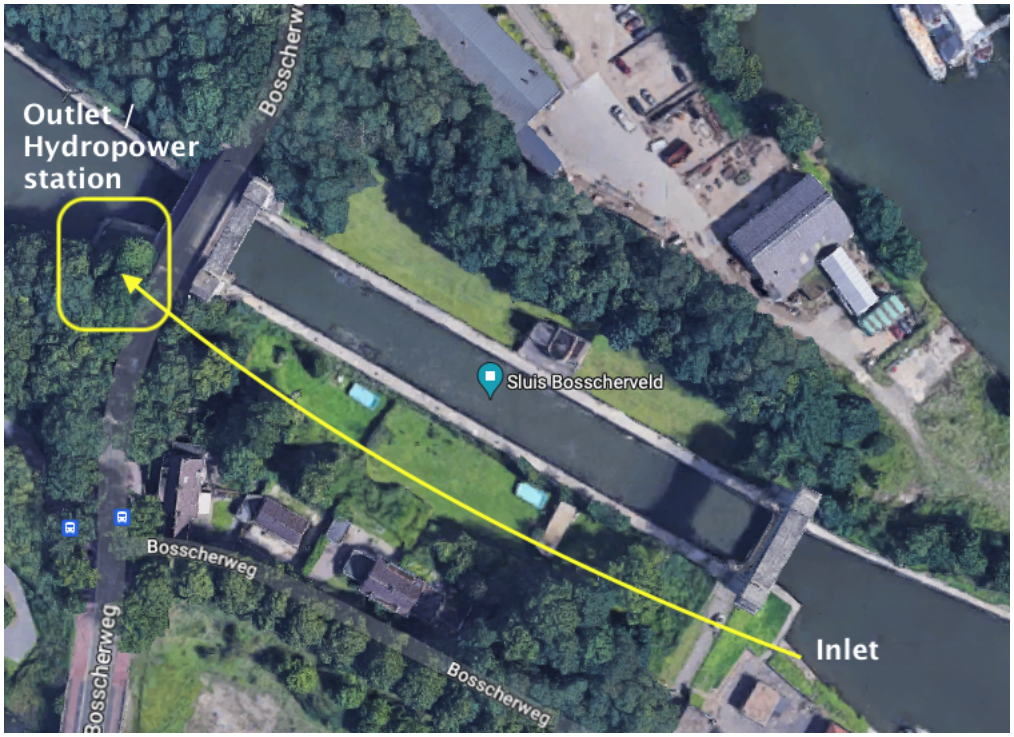


Figure 1.2: Bypass and Hydropower Location

In 2013 the rules for building and a zoning plan was provided from the municipality of Maastricht. There, it is stated what needed to be considered during the construction phase, for instance regarding noise, vibration, and storage of building material.

Afterwards, in 2015, a couple of drawings and visualizations as well as calculations and reports about the construction of the project were created.

In 2016 an Environmental Impact Report was made by an Environmental Impact Assessment (EIA) committee. This committee comes from the company Witteveen + Bos, an infrastructure management and construction consultancy, and close cooperator of FishFlow. No severe negative impacts of the bypass and the SHP could be identified.

In 2018 there was an email correspondence between FishFlow and Witteveen + Bos regarding a collision protection that was missing in the planning yet. According to FishFlow, the project initiators added it to the requirements then, and it had not been discussed before.

In 2019, a project plan was presented by WaterPotentieel BV talking about the steps that need to be done to roll-out and execute the project.

So far, no physical work on the project site has been done. Even though initially a declaration of intent was set up and afterwards an official agreement about the partnership and the plan

of setting up the bypass with the SHP next to the Bosscherveld lock, until today, no visible progress has been achieved.

According to FishFlow, investments were made and actions towards collaborating with the most important stakeholders were taken. Having most of the technological barriers figured out, the project stopped for reasons that the company itself does not understand. According to Fishflow, their technology and how it would be implemented within the project has a lot of advantages over other and previous solutions regarding efficiency, durability, and maintenance. Eventually, it could be a stepping stone to deploying more SHP and would help the region and the Netherlands in its whole on the path towards the decarbonization of their energy system. Despite these clear-seeming advatages for FishFlow, the project was not followed through from the responsible people in the government and decision makers.

According to Ellen Minkmann, the project site is probably owned by three different parties. The lock itself being a part of the water ways used by commercial ships, is under the duty of the Rijkswaterstaat. Two dikes surrounding the lock are part of the primary flood defense system of the province of Limburg. Flood defense areas are governed by the regional water boards, here being the water board of Limburg. The road and bridge at the end of the lock is owned by the municipality of Maastricht.

1.7 Relevance to Management of Technology

The research is conducted to finalize my master's and to obtain a degree in Management of Technology. For that, certain criteria must be met and the research needs to be in line with the program.

This research is focused on stakeholder management of a company working in the field of energy transition, trying to deploy their unique technology into the market. This combines several areas of the degree.

It is focused on strategic behavior and decisions of a technology-focused company and tries to improve the base they can make their decision upon within projects, to diffuse their systems into the market. It is done from a company perspective, and besides stakeholder engagement touches upon entrepreneurial activities necessary to overcome barriers typical to a technology in its pre-diffusion phase.
To conduct this research, methods from the curriculum such as stakeholder management and engagement techniques and parts of the Technology Innovation Systems framework are being used.

2 Literature

The literature review focuses on the topics and areas mentioned in the background part of the introduction and will present more in-depth information about them. In order to be able to understand forces and processes within the energy market in general and later also the SHP market, first the energy transition, its reasons and its implications for the energy market are being looked at. After having talked about the particularities of the energy and the SHP market, the focus is set on TIS and stakeholder analysis as tools for the investigation of a project's surroundings. Regarding that it is being shown how TIS might be helpful in order to make the decisions for niche strategies and how stakeholder analysis can be used to understand the dynamics of actors involved or affected by a project and that will eventually lead to a project implementation.

The scientific literature presented in this chapter was acquired by doing computerized searches of Google Scholar and Scopus. Keywords like *energy transition, small-scale hydropower, energy market, technological innovation system, stakeholder management, stakeholder engagement* as well as their synonyms and combinations of such were used.

2.1 Energy Transition

The term Energy Transition describes the process of a system to shift from one domain of energy source to a different one. These shifts can entail a complete stop of the one energy source and moving to another one or just a change in access or sourcing. Energy Transitions have happened several times in the past already and can have a number of reasons, which can differ in the severeness and therefore in the urge and need of the transition. (Araújo, 2014) The previous energy transitions (e.g. from wood to coal and coal to oil and gas) happened somehow on an "automatic pilot", which can be explained with commercial aspirations of the market after a breakthrough innovation in the field occurred. By changing from the one energy source to another, electricity could be produced cheaper and in vaster amounts, benefiting grid companies, the economy, and therefore also the general public. (Fri and Savitz, 2014) These economically driven forces provided innovations and reduced barriers significantly.

The currently ongoing global Energy Transition however has different dynamics and became a necessity which is (yet) not primarily economically driven. While Earth's population is still growing exponentially, energy demand is rising accordingly. Fossil fuels are still the main source of energy, yet their use is not sustainable, hence their availability is shrinking with its use over time. Furthermore, they are responsible for producing a high amount of greenhouse gases and other emissions created in the necessary combustion processes. The increasing amount of these emissions in the atmosphere can affect citizen's health and eventually create a rise in the global temperature, which will have even more hazardous effects on the environment and Earth's inhabitants. (Olabi and Abdelkareem, 2022) Thereby, according to the Intergovernmental Panel on Climate Change (IPCC), it is clear that the rise in the temperature and the currently on fossil

fuels reliant energy sector are linked directly. This underscores the need to transit and move to sustainable alternatives and that sticking to the old procedures will have precarious effects on the planet and the society.(Bagliani et al., 2010) To mitigate these negative effects caused by global warming, 196 countries agreed in the Paris Climate Agreement to take on responsibility and to take action to lower CO2 emissions. (UN, 2016) Without an Energy Transition the goals fixed in this contract would not be achievable.

According to Fri and Savitz (2014) the fact that the current energy transition is not a natural market pull, yet more an organizational push creates more difficulties than a usual system shift would already have. One of those difficulties is, the lack of naturally occurring innovations and their funding through the market, since "the value of mitigating climate change is a public good, not one that markets can easily capture". Another one is the fact, that today's investments are highly costly and only pay-off in decades. Therefore, the investments are not directly benefiting the investor themselves but future generations. Fri and Savitz (2014) describe that as efficiency paradox which entails the relevance of personal decision making. With the fact that these individuals are not immediately benefiting and monetary incentives for change are lacking, additional barriers are created.
Geels et al. (2008) sum these dynamics up in three main problems regarding green technologies, that can be named for the 'carbon lock-in' we find ourselves in and that are the reasons for why those more sustainable alternatives do not compete on the same level with fossil solutions.
First, as partly mentioned before, green alternatives are usually more expensive than existing solutions, especially in their initial phase. The advantages they provide do not benefit people on an individual level, but only on a large societal level. Nevertheless, the investments and costs are often to be borne on a personal level by the end consumer or a sole investor.
Second, prospect markets are carrying a high degree of uncertainty and planned governmental regulations are unclear. That results in hesitant commitment of large companies. They often do go in the direction of sustainable developments, however these uncertainties prevent them to be fully engaged in them.
Lastly, through long historical developments, existing technologies are locked-in into their socio-technical systems. These developments have created advantageous network externalities and regulations in favor of the fossil market, built a strong infrastructure, and solidified their connection within the society. If sustainable technologies now mis-match this state, they may face additional barriers.

Since, this energy transition hence can be seen as an imposed one, some of these barriers can for example be social opposition and political conflicts. It also creates questions regarding policy and agency. (Fri and Savitz, 2014) (Grünewald et al., 2012) According to Jacobsson and Bergek (2011) it is clear, that policies promoting sustainable technologies are necessary to achieve meeting the climate targets and that without policy support and the right guidance of institutions, the necessary push of the market is difficult to accomplish. However, often it is the case, that renewable energy technologies face difficulties to diffuse in an early stage due to blocking mech-

anisms within an institutional framework. Though, what actually the main challenges in this process are remains difficult to comprehend. (Mignon and Bergek, 2016)

Besides those social and market related hurdles, switching from the currently incumbent energy system which is based on fossil fuels to a renewables-focused one comes with additional difficulties regarding technology and feasibility. With trying to achieve the goal of relying on more sustainable energy systems, currently the reliance on for example wind energy or solar energy are inevitable. However, these (like most of the renewable energy sources) are "variable renewable energy" sources and are intermittent in nature, which means that they are not always available. (Olabi and Abdelkareem, 2022) Furthermore, the switch from a non-renewable focused to a renewable-focused system requires a shift from a more centralized to a decentralized system. With having more renewable energy power plants deployed over the country, naturally people on a local scale are more easily affected. (Bagliani et al., 2010) This affection and how actors might react to it require different actions in the decision-making for policy makers as well as managers working on the development of renewable energy systems (RES).

Ultimately, to resolve the presented problems and difficulties within the current energy transition, there is no single solution, a single technology or a special policy change that could create the necessary impact. There must be changes on multiple levels, technical, societal, and systematical being in the energy, transport or food systems. These changes entail not only technological progress but also transitions within markets, governmental institutions, behavioral patterns and even cultures. To include all these elements and components a socio-technical approach must be taken. (Geels et al., 2008)

2.1.1 Formation of People's Perceptions of Energy Transition Projects

As mentioned above, the current energy transition has specific traits that can enhance opposition by people and create the need of policy support. Public resistance can be formed from a lack of acceptance of new developments and technologies. Technology acceptance as a term can mean different things. In the topic of RES and the energy transition, it is often used to describe whether the society being on a local, regional, or national scale supports or opposes to a certain energy technology or a certain energy related project. Several surveys have shown, that in general the society does support the setting up of more RES. However, actual projects trying to implement these RES often met opposition, hence there was a lack of acceptance for those projects. (Devine-Wright, 2009)

Researchers have tried to come up with concepts in order to understand processes and relations regarding these projects to eventually create a foundation for strategies to lower or even to circumvent these oppositions. One of the most prominent one is the term Not-In-My-Backyard (NIMBY). It intends to explain especially local opposition with being protective actions. According to NIMBY, people generally support certain technological developments, however only

when they will not be deployed close to their homes, since the proximity might for example damage the landscape view, decrease property value or other reasons. Furthermore, according to NIMBY, opposition arises from ignorance and selfishness of citizens, valuing their own well-being over the ones from the general public. This is explained by a lack of knowledge about the problem and the technology that tries to solve it, called the "information-deficit perspective", resulting in the suggestion that in order to lower opposition, this knowledge deficit would just need to be resolved by making more information about facts available. (Devine-Wright, 2009)

The NIMBY theory however has been critiqued by several researchers already since the 1990s. (Sovacool et al., 2022) According to O'Connor et al. (2022) it is a highly simplified model which especially in today's rapidly changing world is not accurate enough, which is why more investigation and an actual understanding of people's consciousness is necessary. Chiefly, regarding such a multifaceted topic like the energy transition, NIMBY would not fully capture people's attitudes towards the involved technologies.
In general, there are different drivers and reasons for people forming their opinions and perceptions. These drivers can for example be political ideology, the degree of identification with a place, general views about (climate) science, or risk-averseness respectively risk-taking attitude. (Sovacool et al., 2022) Furthermore, contextual factors depending on the country and for example the degree of equality that is dominant or the current unemployment rate can have an effect on the public's perceptions. (Sovacool et al., 2022)

Devine-Wright and Batel (2017) state, that people's opinions about energy related technologies in the perimeter of their homes form due to different types of place attachments, which can be on a local, regional, or even on a global scale. These attachments in turn can be evoked due to a variety of partly very personal matters and experiences. Depending on whether a person is more attached to for example the local or the global scale, different perceptions are likely to be present and hence call for different strategies and approaches in decision making.
According to Lienert et al. (2015) people's perceptions are also linked to their feelings about a certain topic and what they associate a project with and that these feelings of course again can form through different personal experiences. The authors however also state, that from a generally good feeling towards the energy transition, opposition can begin once the people are being affected personally, since they did not understand its magnitude and that its implementation would reach them at some point.
Mueller et al. (2017) say that regarding public opposition the proximity of a certain energy infrastructure project to inhabitants does matter, stating this in their "proximity hypothesis". However, these projects can also contribute to an area, increasing its place distinctiveness which can result in support. (Devine-Wright and Batel, 2017)

Among others, the used sources request or even demand a higher degree of public involvement in these type of projects and especially having more research in the field. According to Knudsen et al. (2015) the decision maker in these kind of projects needs to see the interests of everyone

affected. However, currently there is a limited body of research regarding the planning processes on a local scale and how these are perceived by stakeholders. A pitfall pointed out by Hess and Sovacool (2020) is that policy-makers often frame the public as being one homogeneous group without any differences between the individuals in this group.

In general, researchers from the social science field regarding energy infrastructure projects agree that NIMBY is not able to capture all the forces and drivers actually building opinions, oppositions as well as support. The theories and especially their critiques show, that the reasons for a person's opposition are difficult to assume and can easily become complex and hard to comprehend. Furthermore, just as with Hess and Sovacool (2020) finding that the public is often seen as one group by the policy-makers, the same could be assumed for the industry actors and how they see governmental institutions and the people working within them. This demonstrates the importance of engaging with stakeholders, no matter if they are private citizens or individuals working in an institution.

2.1.2 Small-scale Hydropower

Renewable energy sources are mostly relying on natural resources which occur in different places in different amounts. While some countries for instance benefit from a high amount of sunlight that can be used for solar power generation, others are more prone to use wind turbines, due to strong winds and flat areas where the turbines can be set up. Both types of electricity generation are relatively mature, yet they are intermittent, since due to weather conditions or the time of the day, their availability is limited.
Another renewable energy source that is widely used is hydropower, which compared to solar and wind energy is less intermittent. hydropower plants are usually set up in large scale sites, where water is stored in natural or artificial lakes which flow is restricted by a dam. Whenever electricity is needed, the water can be released through turbines which then generate power on demand. The pitfall of this energy source though is, that to set up such a hydropower plant, the site must meet specific landscape requirements. Due to its enormous size and the need for a significant enough elevation, potential sites that suit these requirements are limited. If the lakes are being set up artificially by damming a river, entire landscapes and the nature must be altered, which can have harmful effects on the environment including animals and humans living in the specific area. Furthermore, initial investments for such large power stations are immense. Despite these negative effects, hydropower is supposed to be the most mature of all RES and comes with advantages such as cost-effectiveness, efficiency, and maintenance, over other solutions. (Manzano-Agugliaro et al., 2017)
As mentioned in the introduction, a type of hydropower plant that has significantly smaller destructive effects on the environment is SHP. The definition of what small-scale means can differ between countries, however in Europe, hydropower is often referred to as small-scale if the power plant has under 10 MW installed capacity. (Manzano-Agugliaro et al., 2017)
Instead of setting up enormous, cost-intensive dams, SHP often are implemented into an already

steady water flow either directly into a river or a bypass or run-off river solution. It can appear in a lot of different shapes and set-ups. In Figure 2.1 an example of a simple SHP solution can be seen.

Figure 2.1: Example SHP (Weisz, 2020)

Even though the capacity of each SHP is considerably smaller compared to the large-scale sites, if diffused widely, the technology can make a significant contribution to the EU's decarbonization and energy transition targets. (Manders et al., 2016) However, how much SHP is used among different states differs noticeably and developments are further in some countries compared to others. In Figure 2.2, the development and diffusion of SHP in year 2010 throughout Europe can be seen.

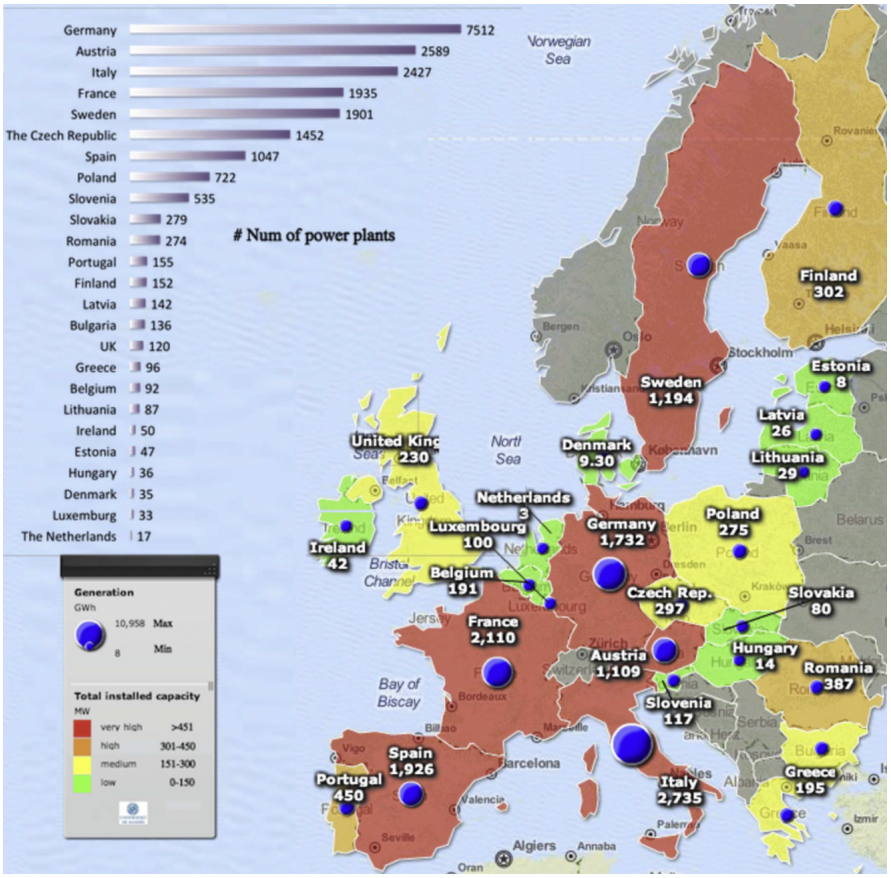


Figure 2.2: Number of SHP sites and installed capacity in Europe (Manzano-Agugliaro et al., 2017)

As can be extracted from the map there are vast differences in the use of SHP and hence the exploitation of its potential among the different EU states. What stands out is that despite being an economically successful country, the Netherlands are lacking far behind the other states in the EU, only having 17 SHPs with 3 MW of installed capacity. The differences of the developments within the countries can be explained by several reasons such as geographical circumstances. In the case of the Netherlands this would be the lack of larger elevations throughout the country, which is mostly flat. Though also past policy decisions, the previous center of the energy systems, and the current research focus can have an effect. (Manders et al., 2016)
Although the Netherlands does not have large hills, the numerous water gates and weirs, which are widely used in the water infrastructure to regulate water levels, secure drainage and bridge height differences for ships and boats, have potential and create opportunities to implement SHP. (Manders et al., 2016)

Despite the fact that compared to large-scale hydropower no entire landscapes need to be altered, it does not mean that SHP has zero effects on its environment. Since it is planted inside a river or its bypass, it can modify the present aquatic habitat and can form a barrier for fish migration. Depending on the turbine it can not only hinder but also kill fish during the process of electricity generation due to high rotation speed of the rotor. (Okot, 2013)

2.2 Technological Innovation System

As by now already known from the previous literature chapters, regarding sustainable technologies especially in the energy related field, besides looking at the technology itself, a complete view of the actors and policies surrounding is vital. A framework that tries to include this complete view is the Technological Innovation System framework (TIS). With creating a TIS for a technology or a project, it is possible to establish a bigger picture of the socio-technical environment including all the crucial factors and actors. The framework was first developed by Carlsson and Stankiewicz (1991) and tries to display the dynamics of interacting agents from a certain industrial area within an institutional infrastructure. Since then it was used and refined multiple times attempting to capture recent developments especially also within the sustainable and energy market. By today it has become one of the two most dominant perspectives when studying sustainability transitions. (Bergek, 2019)
According to Bergek et al. (2008) a TIS study can be used by policy makers to comprehend the dynamics of a system surrounding an innovation. However they say, that the analysts can face difficulties due to the lack of practical guidelines on how to do it, which is why they developed a scheme of analysis to apply the TIS. This scheme is divided into 6 steps that are:

1. Define the TIS focus
2. Identify structural components
3. Map the functional pattern of the TIS
4. Assess the functionality of the TIS and set process goals
5. Identify inducement and blocking mechanisms
6. Specify key policy issues

Defining the focus of the technological innovation system and hence the analysis of its factors and actors can differ based on the ambition of the study and the involved stakeholder's interests. One starting point for defining the focus could be the choice whether to concentrate on a specific product respectively a product group or on a knowledge field. This decision can be seen as the first part of the analysis. (Bergek et al., 2008)
Further it has to be decided if the study will be rolled out to get more specific in-depth understanding of a topic or if a broad perspective is chosen to capture a wide field surrounding the topic of concern. Additionally the range of application of the technology needs to be set.(Bergek et al., 2008) To decide on these factors can be difficult and certainly, according to Bergek et al. (2008), is not always straightforward. For a researcher new to the field of interest, it can be helpful to first start with a broad focus and narrow it down along the line. One last point for defining the focus and hence the boundaries of a TIS are of geographic nature. Despite TIS often having a global character due to the contemporary globalized world, it can make sense to limit the investigation on a certain spatial area, which can help to capture aspects and dynamics that are specific to a certain region. (Bergek et al., 2008)

As a second step structural components need to be defined. For that, a list of actors needs to be identified, which can be done in several ways such as desk research or interacting with industry experts ("gurus"), research organizations, and companies from the field of concern. These actors can be part of formal or informal networks, which also should be displayed to understand connections and dynamics among them. Lastly, institutions ought to be identified, since they can either set a supportive or a discouraging environment for a technology and some cases they need to be aligned in the right way to enable the diffusion of a technology. Bergek et al. (2008) even state that "firms compete not only in the market but also over the nature of the institutional set-up".
Wieczorek and Hekkert (2012) distinguish the different actors based on their roles in the economy, being: "civil society, government, non-profit organizations (NGOs) companies (start-ups, small and medium-sized enterprises (SMEs), multinationals, large firms), knowledge institutes (universities, technology institutes, research centres, schools), and other parties (legal organisations, financial organisations/banks, intermediaries, knowledge brokers, consultants)". Then there is the field of institutions which can be divided into hard institutions that focus on rules and norms and soft institutions that are more common habits or routines used by individuals of the society. The dynamics regarding those institutions - no matter if hard or soft - are shaped through spatial, historical, and socio-cultural particularities.
Especially in an emerging system, there is a high degree of uncertainty regarding the structural components since relevant actors sometimes do not even recognize that they are part of a network. Hence, also for the researcher, they might be difficult to identify. Therefore, the mapping of such structures must be an iterative process, where actors might be added while gaining more knowledge and insights during a project. (Bergek et al., 2008)

In the third step seven specific functions are introduced and investigated within the TIS. These functions are mapped and assessed whether how well they are represented within the system. A brief description of those functions is presented subsequently.
Knowledge development and diffusion describes how much understanding and awareness about the technology of concern is present among the actors and structural components ranging from industry, institutions, down to the society being the consumers of such technology. The presence of the function could be measured by for instance number of projects, amount of academic citations, or number of patents.
Influence on the direction of search means that for a TIS to develop, industry actors and institutions need to have certain visions or expectations regarding the technology. These expectations can be influenced by sufficient incentives and inducements to proceed in the field. This can happen through different ways, being for instance institutional subsidies, changes in the landscape (e.g. climate change debates), or positive developments regarding the technology in other countries, showing that it can be successful and profitable. Bergek et al. (2008) suggest measuring or indicating these developments with qualitative factors, being trust in growth potential, monetary incentives (e.g. tax reduction in energy sector), regulatory pressure, interest of prominent customers.

Entrepreneurial experimentation is an important factor to reduce the uncertainty that is naturally occurring especially in emerging TIS. This experimentation involves interrogating of latest and new technologies and their applications, which implies success and failure and hence learning for future operations. To quantify this, the number of projects, variety of applications and amount of new actors entering the market can be used. (Bergek et al., 2008)

Market formation usually happens in three different stages. Depending on the degree of maturity of the technology and its market, it might start into a nursing market, develop into a bridging market and finally, if being successful, may arrive in a mass market. Depending on the market a technology is currently in, different dynamics are present and different challenges are faced. While the size of a market can be described more easily, what drives a market formation is harder to capture. For that, the analyst requires in-depth understanding of the TIS and the market it is in. They need to assess what phase it is currently in, how the demand looks like and whether there are institutional stimuli present. For that quantitative data about the market size as well as qualitative investigation regarding market strategies of actors are useful. (Bergek et al., 2008)

Legitimation for the technology must be given by the most relevant societal and institutional actors, meaning that it must be seen as desirable and appropriate by them. Only then resources can be mobilized and required political strength can be gained to push towards the transition. Furthermore, the function of legitimation focuses on dynamics and activities, fostering the technology's legitimacy. To understand the degree of legitimation one should try to cope the alignment among the TIS, the current constitution, and the perspectives and opinions from industry actors and the society. There it is important to recognize who of those structural components influences legitimation and how they can affect it. (Bergek et al., 2008)

Resource mobilization is a function that captures the resources (e.g. financial capital, human capital, complementary assets) and how they are available and could be used for the technology development within the TIS. Thus financially for instance, capital must be present, but additionally the desire to invest, hence a vital investment culture would be beneficial. This could be measured by looking at the available capital in general but also the value of venture capital. For human resources the number of certain university degrees and the labour market can be taken under investigation to have a glimpse of its availability.

Development of positive externalities is one of the key functionalities that can have an advantageous influence on the other named processes. This development can be formed for instance, by the entrance of new companies into the TIS. This can resolve some of the initial uncertainty, form a market, create and improve the legitimation of the central technology. The entrance can also help form coalitions and partnerships to foster advocacy, create leverage and mobilize resources for further developments within the TIS, by an improved direction of search. An increase in the number of active stakeholders also enhances the development and diffusion of knowledge and brings more actors that experiment, thus validate some pathways and invalidates others. This last function can not be looked at independently but influences all the other previously mentioned functionalities. (Bergek et al., 2008)

In a fourth step after the functional pattern has been mapped, the functionality of the TIS is being assessed, meaning that it is being looked at not how the TIS functions but how well it functions. Furthermore, goals of the processes within the TIS are being specified. According to Bergek et al. (2008) a TIS can find itself in different stages of developments with each phase having different requirements and demands for the in step 3 mentioned functionalities. When having clear in which stage the TIS is, it is possible to compare the present functions with the requirements and assess, whether they are well represented. In order to determine the stage a TIS is in, factors such as time (i.e. how long the development has been going on), degree of uncertainties regarding the technology, advancement of price/performance ration of the technology, degree of diffusion, articulation of demand, and the status of development of positive externalities. Depending on the degree of progess in the named fields, a TIS could be either in a formative or a growth phase and, being in the one or the other, needs to meet different requirement regarding their system functionalities. However Bergek et al. (2008) state that each TIS must be looked at individually and that there is no recipe for a "desired" functional pattern, since every technology might have its own specialities. For a TIS finally, goals can be specified regarding how the pattern should look like to reach certain functionalities, and what wants to be achieved with the TIS development.

Step five tries to identify inducement and blocking mechanisms within the TIS. These mechanisms can be of different nature, but overall they can be identified by looking at whether the functional pattern of the TIS complies with the requirements of the stage it is currently in.

In the sixth and last step of the TIS scheme of analysis key policy issues are being identified. This can be done in the way that the set goals from step four are being compared with the identified inducement and blocking mechanisms from the previous step. (Bergek et al., 2008) argue, that policy should nurture the functionalities of a system, hence if there are blocking mechanisms that withhold the TIS from reaching the defined goals, it is an issue that needs to be addressed and straightened up by policy. This creates the perspective, that in case failure of technology development within a TIS occurs, it is not necessarily a market but a systems failure.

2.2.1 Critiques

The TIS framework tries to capture the surroundings of a technology within a sustainability transition so that policy issues can be identified and the policy maker could intervene to lower barriers and induce positive pathways. Though, when using it as a tool it can quickly become opaque for the policy analyst, which is why (Bergek et al., 2008) came up with the previously described functional analysis and a six-step approach to steer through the micro and macro-environment of a technology. However, after reviewing recent developments within the TIS framework literature, (Bergek, 2019) states that the functions framework might not be equally suitable for all types of contexts. Furthermore, she points out that investigating and interpreting of some functions "has resulted in a limited understanding of the mechanisms behind them".

More specifically, three of the previously from her and her colleagues defined functions (i.e. entrepreneurial experimentation, market formation, development of positive externalities) are not well represented. In fact, she suggested more qualitative analysis should be done in those fields, to have a more in-depth understanding and to set the base to create a causal connection between an incident and a functional process.

When looking at a system with the TIS framework, the analysts develops a snapshot of the current situation, hence, if not continuously applied and updated, it is of static nature. Socio-technical systems and their inherent conflicts however are of dynamic nature which can create a mis-match when looking at it statically, so that some crucial insights might get lost. (Cuppen, 2018) Furthermore, as seen in the information about types of opposition and the specific stakeholder dynamics of the energy transition however, it is crucial to also include past developments and the ongoing advancements, being regulatory or of other kind.

It is important to recognize that the concept of TIS has two significant limitations. The first one is that the framework predominantly emphasizes the significance of institutions, which means that it primarily operates at a macro level. Nevertheless, Edquist (2001) pointed out that innovation is a product of both individual and collective efforts. The TIS framework underplays the significance of individuals (micro level), even though they also play a crucial role in driving innovation, as noted by Hekkert et al. (2007).
As stated before, the TIS framework clearly has a policy focus. With applying it, it can be identified whether the current situation of a system blocks or induces developments for a certain technology, and whether policy intervention is needed. (Wieczorek and Hekkert, 2012) However, eventually, the technology needs to be finalized and put into the market. For that, private companies are crucial. They are the entrepreneurs within the TIS framework that need to experiment, succeed, or fail and learn to make a technology in the system work. Though, their perspectives and needs within these systems are somehow underrepresented. According to (Ortt and Kamp, 2022) the TIS approach is clearly lacking a managerial, a company perspective.
Companies working within the sustainability transition or other emerging and quickly changing markets are facing barriers within the TIS and can easily struggle to understand them and to find the right strategies to circumvent them.

2.2.2 TIS Framework Adaptation

Ortt and Kamp (2022) came up with a way of including the company perspective within the TIS framework. That way it can be transformed from a mere policy focus to becoming a tool a company can use to orient themselves within the TIS and make confident strategic decsions on which pathway to take within it. In general Ortt and Kamp (2022) describe that a basic TIS consists of the structural components:

1. Technology

2. Network of actors
3. Supporting institutions
4. Demand side

To include the company perspective the structural components have been slightly modified and the area of technology has been split up into four more precise perspectives. Ortt and Kamp (2022) justifies this with the fact, that 'Technology' would be too broad to take on a company view since the technology is a company's main resource and hence needs more consideration. This results in these seven building blocks:

1. Product performance and quality
2. Product price
3. Production system
4. Complementary products and services
5. Network formation and coordination
6. Customers
7. Innovation-specific institutions

Ortt and Kamp (2022) then argue that as soon as one or multiple of the mentioned building blocks are either insufficiently met or entirely missing, a barrier for the diffusion of the technology within the TIS is created. To understand such barriers, they came up with the so-called 'influencing conditions' which try to explain certain barriers and the reasons for their existing.

1. Knowledge and awareness of technology
2. Knowledge and awareness of application and market
3. Natural, human and financial resources
4. Competition
5. Macro-economic and strategic aspects
6. Socio-cultural aspects
7. Accidents and events

To then, based on the outcome of the analysis of the building blocks and the influencing conditions, choose for the right strategy Ortt and Kamp (2022) suggest combining social-technical and innovation and strategic management approaches. Having this knowledge gained through the TIS study with taking on the more managerial perspective of a company rather than an outside policy maker's perspective helps with specifying which niche introduction strategies to

adapt and when.

However, also here some criticism can be expressed. Still the framework is a static tool, not looking at dynamic developments. Furthermore, the historical perspective is lacking and is not specifically mentioned as a building block or a function. It is being said that engaging with stakeholders is necessary, but how specifically this should be done is neglected. Regarding stakeholder engagement it also depends on the type of technology the framework is used for. In Ortt and Kamp (2022) research it seems like it is used for merely a consumer product, where stakeholder engagement is of less importance and can be limited to market/economic analysis, engagement with potential customers.

As could be seen from the previous literature, the stakeholders within an energy infrastructure related project can form their perspectives and opinions out of several different motives. Neither the current building blocks, nor the influencing conditions seem to be able to capture the complex reasons a stakeholder can have to form their perspective towards a certain technology or a project. Assuming, knowing those stakeholder dynamics helps a company to prevent certain barriers from composing, the framework does not provide sufficient advice and hence does not fully display the company perspective of a company working in the area of energy transition projects.

2.3 Stakeholder Analysis

Due to the progressively interconnected world the consideration of stakeholders within projects and project management over the past gained more and more importance. Especially public problems like for example global warming affects plentiful diverse people and organizations. Since within such problems, the power of decision making is often shared and no one actor usually owns the problem. Therefore, it is often difficult to say who truly is in charge of a project. With many individuals concerned or affected, there is some joint responsibility. Taking stakeholders into account is hence an imperative facet to inspect and evaluate a problem and which solutions might work. However, what should be noted is that not every stakeholder group needs to be equally satisfied. Since with the complexity of these project it is, bluntly said, impossible to meet every stakeholder's needs, it is important to determine who the most important ones are and to focus on meeting their goals and requirements.(Bryson, 2004)

To handle this additional level of complexity within a project different stakeholder analysis tools and techniques had been invented. These tools are supposed to help identify present or potential issues within a stakeholder network and aid in resolving these issues. Furthermore, they ought to help identifying the most crucial stakeholders that are in key position, hence their satisfaction might be highly beneficial for the success of the project. Here, knowing about the stakeholders, their positions of power and their level of interest in a project, helps to make strategic decision regarding which people should be involved when and how. Bryson (2004) has reviewed several

of these techniques and described the, according to him, most important ones. Subsequently, one of those tools, the power-versus-interest grid is described.

Power versus interest grids

Power-Interest-Grids are a quick way to map the stakeholders involved in or affected by a project. The grid is a matrix where the dimensions are, as could be anticipated from the tool's name, a stakeholder's interest and power towards the project. Interest in that case should be defined in a political way rather than just inquisitiveness. This could be regarding how well a stakeholder might think about the project because of different personal reasons, or if for example a success of a project would benefit the stakeholder in a strategic way or their personal beliefs in general. A stakeholder's power is defined by how much influence they can have on the future of the issues in hand due to their position within the stakeholder network, formally or informally. (Bryson, 2004)

By assessing whether a certain stakeholder or a stakeholder group has a high or low interest and a high or low power regarding the topic, a 2x2 matrix will be formed, when putting them into the power versus interest grid (see Figure 2.3). This results in having the stakeholders grouped in four categories being:

1. Players (high interest & high power)
2. Subjects (high interest & low power)
3. Context setters (low interest & high power)
4. Crowd (low interest & low power)

This categorization can help identifying the stakeholders, that are crucial to be considered. It can further help with understanding coalitions of actors, that have the same interests and which ones should be supported or discouraged.

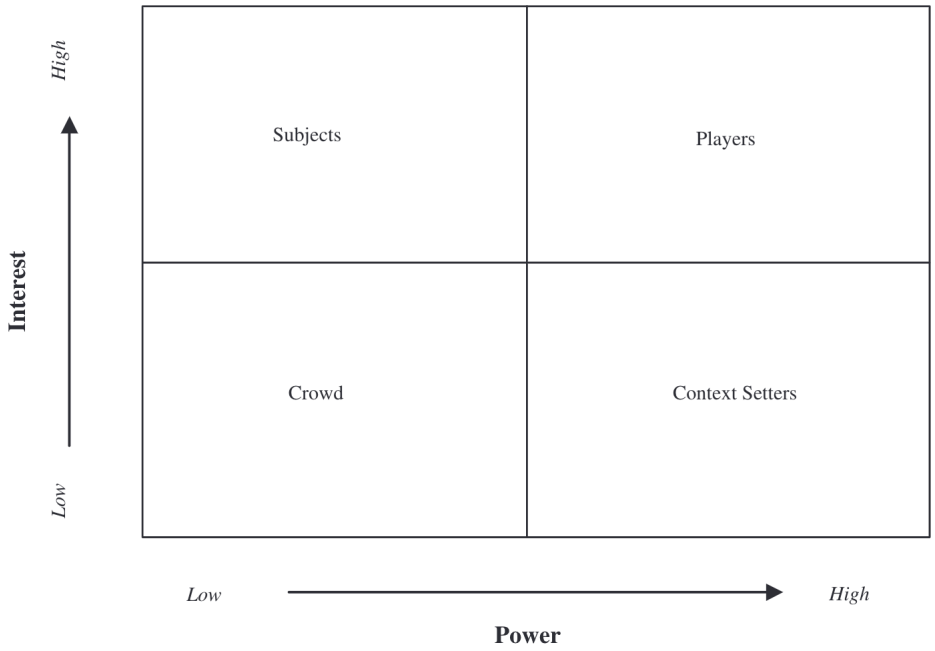


Figure 2.3: Power versus interest grid (Bryson, 2004)

2.3.1 Critiques

The Power-versus-interest grid and other stakeholder analysis techniques and methods described by Bryson (2004) however are often based on assumptions. Through information gathering with desk research, the power and the interest, how stakeholders are related to each other, and where the interest and the power comes from, are often speculated. As learned from the literature however regarding the critique on NIMBY, assumptions in these topics can be difficult, since it is hard to capture the whole story of a stakeholder. Things like their personal believes and reasoning for decisions can be missed, which can invalidate the assumptions and create a mismatch with the actual situation. These then in turn can result in a barrier, that an analyst misses and will not be able to understand.

Furthermore, the stakeholder analysis techniques are usually used with a strategic intention. There, companies use the tools to label certain stakeholders and to base decision on it. It is not really about understanding them and collaborating but more for persuasion and convincing them about a certain project or to change their views on topics. (Bryson, 2004) So often it is not about co-creation and meeting everyone's needs, but more about avoiding barriers on the way to achieve the own or the company's goal. The studies are therefore often merely focused on participation or the influence of certain stakeholders on a problem. It is imperative to explore ways to actively engage stakeholders and determine an efficient method to attain the objectives of organizations or policies by influencing their behaviors. (Wang et al., 2012)
Therefore, as part of a stakeholder analysis engaging with them is paramount, to gain the right and necessary insight to make confident decisions regarding how it should be interacted with actors.

2.4 Mental Models

Within qualitative research a challenge is to ensure rigor when analyzing an instance. Compared to quantitative methods, it is more difficult to assess whether a research is "good" and to ensure adequacy and objectivity. (Yadav, 2022) A way to gather qualitative research data are interviews. Subsequently, recommendations for interviews are described and how data collection and analysis can be done in a structured way attempting to ensure rigor in the approach. One technique to ensure that systematic way of working is the mental models approach.

Mental model research is a form of investigation of stakeholders that goes beyond merely looking at the role-dependent power and potential interest of an actor, but is more focused on gaining an in-depth understanding of a stakeholder's believes and opinions regarding certain topics. With that, it makes it possible to get an understanding of their decision making and behavior as well as the factors that influence it.
With this understanding it is possible to create strategies regarding communication to address people's comprehension and opinion regarding complex issues. The science-informed and evidence-based approach helps to gather information from stakeholders systematically. The methodology can be used by decision makers, for them to know how to interact with certain actors, how to design their policies and how to communicate risks amongst them. Past research has shown, that to effectively engage with people, one must primarily and thoroughly understand their mental models. (Wood et al., 2016) This can in turn have a positive effect on the ambiguity of a project and lower uncertainties decision makers are often facing. (Otto-Banaszak et al., 2011)
A mental model can be defined as the beliefs an individual has towards certain issues and what they base their decisions on. This mental model develops over time throughout the individual's life based on socialization, the person's values and experiences. It is then used to assess certain situations and make inferences for their own actions. For instance, it then would have an influence regarding how the individual stands towards certain technologies or whether or not they support the development of a power plant. (Wood et al., 2016)
These mental models cannot be observed, but need to be investigated and inferred from empirical research. They could be displayed with influence diagrams, where it is shown how certain factors influence a person's perception of an issue. With understanding the present mental models of stakeholders, a decision maker can identify values and perceptions as well as knowledge gaps and misconceptions. With having these factors identified, sound decisions regarding the organization of stakeholder processes and the whole project plan can be made. (Wood et al., 2016)

Through intensive studying of a small group of individuals high-quality data sets can be created, that can ensure confidence when using these data sets for decisions as a decision maker. This makes mental modeling being perceived as one of the most robust qualitative research methods. To apply this method Wood et al. (2016) have identified six key steps (see Figure 2.4).

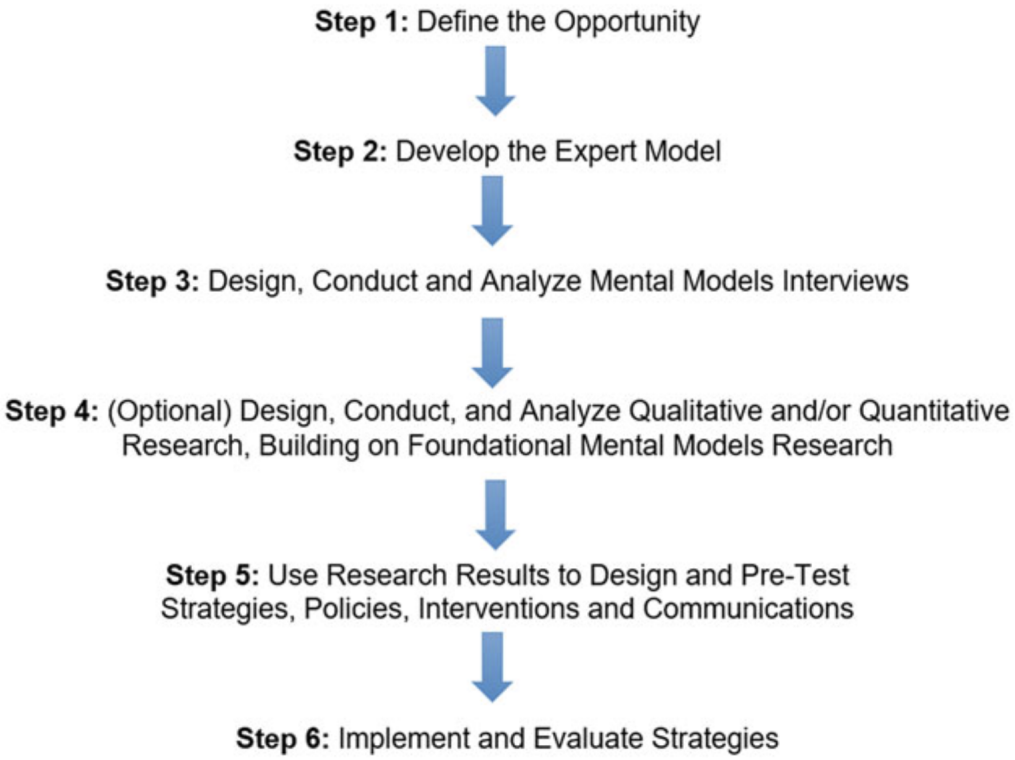


Figure 2.4: 6 key steps of mental modeling

Although Wood et al. (2016) mention that every project is unique, and hence not all steps always apply or maybe some of them have to be adapted, a short overview through the process of applying the approach is given subsequently.

Define the Opportunity

As a first step within the approach, the opportunity of the research has to be defined, meaning that the desired outcome and goals of the investigation need to be characterized. This includes the favorable behaviors of stakeholders within the project.

Develop Expert models

Second, an expert model for the project needs to be created. An expert model can be seen as a summary of the perspectives and knowledge of experts within the field the project is situated. To create such a model, a start is to look into relevant general literature from the field of interest, but also specific literature provided by the client. Furthermore, expert interviews should be held to gain further information, insights, and specialist knowledge in the area. It is imperative to develop a holistic view of the subject which should involve a thorough understanding of the interconnections and relationships between certain elements of the domain.

Thereby it should be observed how the experts in the field approach problems and make decisions. This can create insights into their mental models and help identifying patterns and connections that can be incorporated into the expert model.

The gathered information can then be brought together in an influence diagram, where knowl-

edge regarding relevant variables and relationships are displayed and it is shown how they have an effect on the interest.
Later in the process, these expert models can then be used to guide through the interviews. Finally the discovered stakeholder's mental models can be compared with those expert models.

Design, Conduct and Analyze Mental Models Interviews

Next up in the mental models process are semi-structured interviews that are conducted one-to-one with individuals representing the stakeholder groups. Preferably these individuals should be selected from a larger group to ensure random sampling and to have a certain level of confidentiality. Within these interviews, the focus is laid on key topics identified in the expert models. At the beginning of the interview, the questions should be more of a broader nature, asking the interviewees to think freely about specific topics. With that approach, it is tried to identify the present mental model, to understand how they are generally thinking about certain matters. There the interviewer should try to have their interview partners to speak at length, so that topics of interest for the interviewee are more prone to emerge. While the interview is proceeding, the questions are ought to become more and more specific and to be narrowed down to ensure that all relevant variables of the expert model are covered.
After the interview has finished, the gathered data is being coded and analyzed in comparison to the expert model. While doing so it is tried to describe the interviewee's and hence the stakeholder's beliefs regarding: "their values, interests, and priorities; what they know; what they don't know or misunderstand; what they want to know; and who and what communications processes they trust". (Wood et al., 2016) In that way, critical gaps between what the expert perceives as right and what the stakeholder is thinking can be identified. Having this knowledge, can form the base for the development of well focused policies, strategies, and interventions.

Design, Conduct, and Analyze Qualitative and/or Quantitative Research, Building on Foundational Mental Models Research

In the fourth step additional qualitative data gathered through for instance focus groups or additional quantitative data collected through surveys could be added to get an even better picture of the dynamics of a project and could improve the mental model perspective.

Use Research Results to Design and Pre-Test Strategies, Policies, Interventions and Communications

As mentioned before, through step 3 and as a result of the mental models research, critical gaps or where alignment is present between the experts and ordinary stakeholders were being discovered. Based on these findings, strategies and policies, and plans for communication or necessary interventions, can be developed.

Implement and Evaluate Strategies

The in the previous step defined strategies now must be implemented into the project. After the implementation the effects should be evaluated and based on the evaluation possibly adapted.

Depending on the type and length of the project, reoccurring evaluation and reassessments might be necessary to create a dynamic view that includes and considers recent developments

2.5 Conclusion literature and identified research gaps

As seen from the literature the currently continuing energy transition comes with several challenges and particularities that can be seen as different to previous energy transitions. It is the first transition, that is not merely guided by market forces, but more by scientists and governments trying to push renewable energy solutions to become the major form of electricity generation, even though, they are more expensive and sometimes inconvenient compared to the incumbent fossil fuel solutions. Because of that, and the decentralized nature of renewable energy solutions, projects from that field can quickly become a political issue for people that are working within such a project or that are passively affected by it. Their opinion towards this specific project can then be formed through several different circumstances, past experiences and beliefs that should be included in the decision making in those projects.

To accomplish the energy transition and to make it a success, several different technologies will be needed and different countries focus on different types, depending on the resources they have to offer, or what fits their infrastructures best. One of these technologies is hydropower and a specific type of it SHP. Hydropower has some advantages over other renewable energy sources, one of it being its constant availability. However, often it is quite cost intensive and can have a high impact on the surrounding environment, nature, and animals living in that area. These are disadvantages that SHP does not necessarily have, which for some applications makes it a good and sustainable alternative. But even with this type of electricity generation, problems can arise, that can be technology, policy, or society related.

A tool to capture the fields surrounding a technology such as SHP in an area and to identify where structures might be lacking coherence is the TIS. This framework looks at different areas around a technology and tries to capture their dynamics in one big picture. It is mainly used by policy makers or analysts, to investigate where a system might create barriers and support or intervention might be needed. Within this system it needs companies and entrepreneurs that push the technology forward by testing and adjusting it in order for it to eventually successfully diffuse.
Due to the high policy focus of the TIS framework, these entrepreneurs can have difficulties using the tool for their advantage. They can lack guidance and specific instruction on how to steer through the actors and factors within the system. Therefore, Ortt and Kamp (2022) developed an adaptation of the framework to include this company perspective and to make it more accessible and suitable to use. This adaptation however, seems to be very focused on the technology or the product of the company, since it is something which they can actively influence and modify to adjust to certain market needs. Though, the stakeholder focus and how the company should deal and cope with the relationships to other actors within the network, which

are especially critical in energy transition related projects, appears to be neglected, resulting again in not providing well guided actions for a company's strategist to direct it through the system and to show them how to make confident decisions on how to collaborate with who.

Bryson (2004) has stated the hypothesis "strategic management processes that employ a reasonable number of competently done stakeholder analyses are more likely to be successful – that is, meet mandates, fulfill missions and create public value – than those that do not". Therefore, if wanting to include a company perspective into the TIS framework to improve the certainty this company bases their strategic decisions on, a number of specific stakeholder analysis tools ought to be included. If the goal is to include a better guidance for a company, and for them to have a structured approach to be able to make confident decisions these considerations are to be added.
However, as mentioned, when working with and elaborating on those analysis tools, mostly they are based on assumptions and important information, that might be crucial to understand the whole picture of the stakeholders and the dynamics of their decisions, could be missed. Furthermore, they are focused on identifying opportunities for decision makers on how to persuade them and circumvent their points of concerns rather than to include their ideas and co-create. In addition, the definition of interest is insufficient, since especially within the power versus interest grid, it is not clearly visible, whether an interest is positive or negative, it can just be high or low. Also it is neglected, how and due to which reasons this interest is formed.

In conclusion, there is no TIS framework with a company perspective, that covers the factors important for an energy transition related project. Neither is there one, that includes appropriate guidance for a company to show them how to engage and interact with the stakeholders, and what factors they should focus on, to lower potential stakeholder-formed barriers. However, to ensure this guidance, an idea of the variety of factors that are important to consider with interacting with the stakeholders of the project, must be given.
Those divergences could be solved, if there was a framework, that tells a company working in the field of energy transition in a structured why, what factors regarding stakeholders they need to consider when collaborating with them.

3 Methodology

As has been described in the introduction and the literature section, stakeholder dynamics can be decisive for an energy transition related project, and for FishFlow it is clear, that issues between the stakeholders were the main reason for the SHP project in Maastricht to stall. The goal of this research is to answer the previously stated research questions.
The TIS framework is generally well suited for studying sustainable transitions and the emergence of new technologies, such as SHP in the Netherlands, to foster those transitions. However, the framework is mainly focused on policy developments and neglects the company perspective. Hence its utility to be used by managers to assess their current position within the system and to create a base for confident decisions is low. Therefore, Ortt and Kamp (2022) have created an adaptation of the TIS framework, to include this managerial perspective, by adding a higher company internal view which focuses on aspects regarding the company's technology or product. Therefore, the framework aims less on policies and circumstances in the macro-environment, which for analyzing an energy transition related project, since it often needs policy support, could be disadvantageous. Furthermore, the inclusion of and engaging with stakeholders within the framework appears to be neglected.
Though, stakeholder analysis and engagement are important factors that can decide over success or failure of an energy transition project. Thus, certain stakeholder analysis tools, as presented by Bryson (2004), are useful to understand the actors and how they stand towards a project. Those tools however are often based on assumptions and try to gain the most benefit for the company by persuasion and need satisfaction rather than co-creation through stakeholder involvement.
To move beyond assumptions regarding stakeholder engagement, as has been presented, the mental models approach can be valuable to understand actor's foundations for their believes, thought processes and decision making.

To answer the research question, a qualitative approach, consisting of different parts of the presented methods and frameworks, is used in order to create a path that considers and captures the aspects important for analyzing an SHP and its stakeholder dynamics. The combination of those components lead to the findings regarding the most important stakeholder participation related factors within an SHP project in the Netherlands. By having identified those factors it could be assessed whether the framework by Ortt and Kamp (2022) is suitable to study an energy transition related project, or in other words, if it can capture the stakeholder dynamics of such a project and includes the factors that had previously been identified. By analyzing the stalled project and identifying the most important factors, and by assessing whether the framework by Ortt and Kamp (2022) can be a useful tool for managers working in the field, the companies working on this project can be supported in their decision making, but also future projects on SHP within the Netherlands can be aided. How and why the different parts of the frameworks and methods were used and how they can complement each other is described subsequently. The approach has been visualized in Figure 3.1.

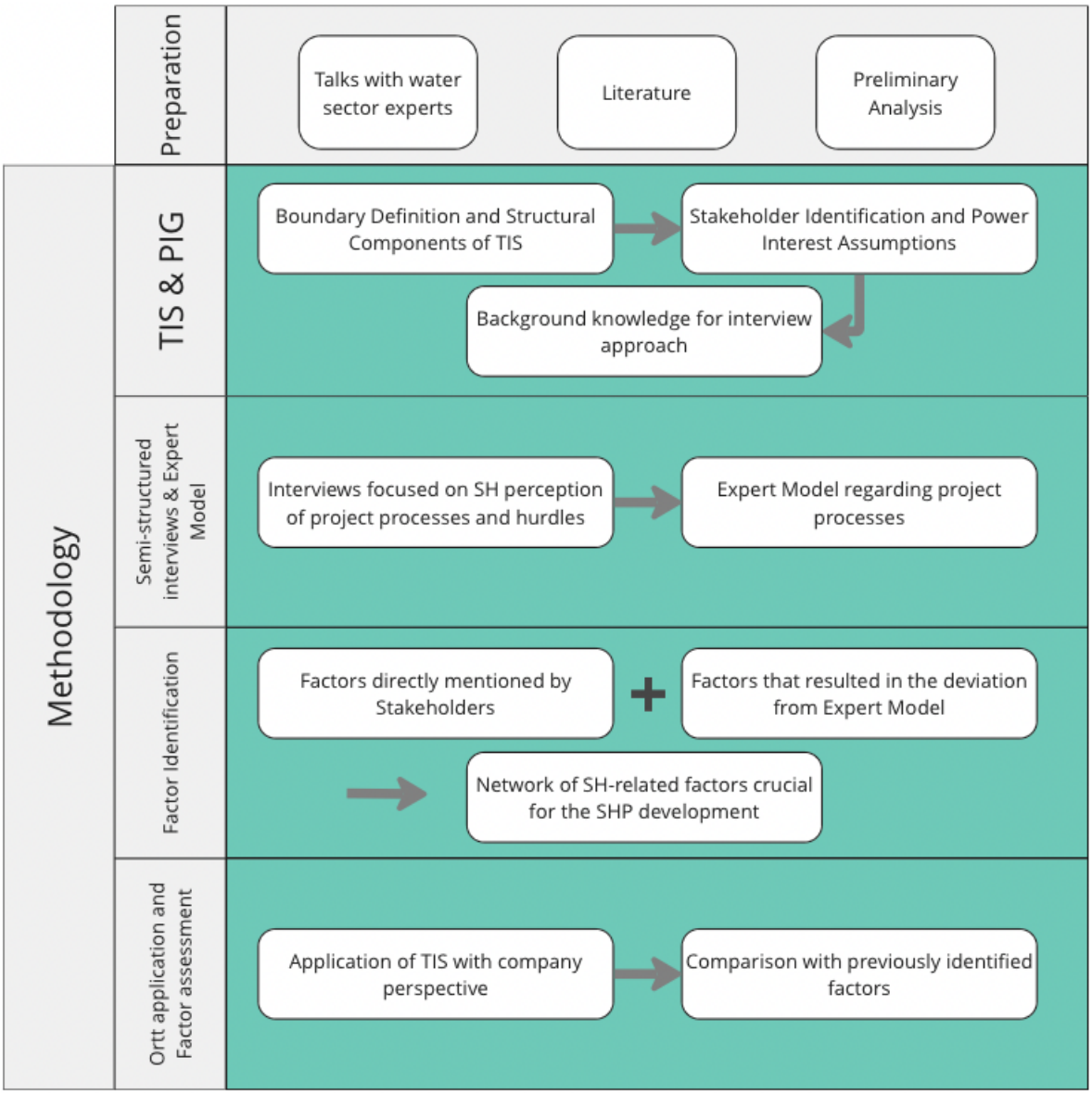


Figure 3.1: Methodology Visualized

3.1 Research approach

Based on the advantages and disadvantages of the presented frameworks and tools, a mixed framework approach is chosen to conduct this research to eventually understand the main factors regarding stakeholder-participation a company working on an energy transition related project needs to consider to be successful. As was mentioned before, energy transition related projects are often less attractive regarding profits, which is why they rely on the right policies to support their development. Therefore, the policy perspective of the TIS after Bergek et al. (2008) was used to define the boundaries of the present TIS of SHP in the Netherlands and its structural components. There, policy dynamics within the Netherlands and its water sector were captured. To then go from the macro-level, which is pictured through the TIS, to the micro-level the companies are acting on within the project, the Power-Interest-Grid as a tool to identify the actual stakeholders was applied. Within the tool, the actors' power and interests

were assumed, based on their theoretical roles and responsibilities. To define the main TIS structures and specify policies, roles, responsibilities and hence potential interest of the actors involved, the required information was collected through literature review, preliminary analysis of project documents, and informal interviews with experts in the Dutch water sector.
After gaining knowledge regarding the TIS and the actors surrounding the project, to get closer to answering the research question and to identifying the stakeholder-related factors that might have stalled the project, the stakeholders had to be engaged with. For that, semi-structured interviews are used, focusing on the stakeholders' perceptions of the project processes, which factors might have been the main reasons for its lack of progression and hence how improvements of the processes could have been reached.
Overall 10 stakeholders have been interviewed over a period of approximately 6 weeks. 3 out of those 10, being Sportvisserij, TenneT, and ATKB, appeared to not be as involved into the project processes. Therefore, their answers could be used as additional background information and understanding of the context, but were of less use to identify the stakeholder-related factors and creation of the expert model.

To go beyond the assumptions stakeholder analysis techniques often are based on and to fully understand the actors' decision making, the mental models approach was chosen. The mental models approach aims to understand how individuals perceive and make sense of the world around them, and how they use this understanding to make decisions and solve problems. It involves identifying and analyzing mental models by comparing them to a field-specific expert model. By understanding mental models, the approach aims to improve communication, collaboration, and decision-making among individuals and groups with different perspectives and backgrounds. To apply this method, an expert model, capturing expert's perspectives on an instance, needs to be present, where the individuals beliefs can be contrasted to. For this particular SHP project in the Netherlands, an expert model is not yet present. Though, the directly involved stakeholders serve as experts for the project's processes, since they were the ones making decisions. Therefore, with the information gathered from the interviews, an expert model was created, combining the expert's opinions and depicting an optimal project process.
Besides the factors that were directly mentioned by the interviewees, the ideal expert model could be used to understand the subjective views of the participants, and derive additional factors, if the respondents for instance described circumstances within the project deviating from the optimal processes pictured in the model. A combination of both investigation techniques led to a network of interrelated stakeholders-linked factors crucial for the project's progression or halt that were clustered into themes and building blocks.
Lastly, the for the company perspective adapted framework by Ortt and Kamp (2022) was applied, focusing on the areas which include stakeholder views. To do so, first the by Ortt and Kamp (2022) defined building blocks were investigated. Subsequently, from insufficient building blocks arising barriers were tried to be explained by the influencing conditions. While doing so, it could be seen to what extent the identified factors are represented within the framework and assessed whether a further adaptation or a change of focus for the framework would be necessary

to become a tool for companies working specifically in the energy transition field.

4 Results

For the expert analysis first some foundational knowledge was built up to understand the technology and the market surrounding the SHP in Maastricht. From that a preliminary TIS, looking at the main structural components and the policies present, was created to give a visual overview about the institutions and stakeholders including their domains and from which policies they are affected.
The identified stakeholders were then mapped in a power interest grid. Their roles are being analyzed and accordingly their power and interest regarding the project assumed and visualized to give a first idea of their possible viewpoints from the information accessible from desk research and first informal expert interviews.

The knowledge created from the TIS and the stakeholder examination, can be used as a preparation for the interviews of experts involved in the Bosscherveld project. The specific interview roll-out and analysis is the main focus of the following section.

As could be seen in the chapter 2.3 regarding the preliminary project analysis as preparation for the project, a first look was taken into some documents, provided by one of the managing companies being FishFlow Innovations. Additionally, desk research of the field and the industry was undertaken and three informal expert interviews were held focusing on the water sector in the Netherlands, and the involvement, specialities, and importance of institutions. From those information it is now possible to describe and define a first TIS to display the surrounding of the Bosscherveld project.

4.1 Technological Innovation System for SHP in the south of the Netherlands

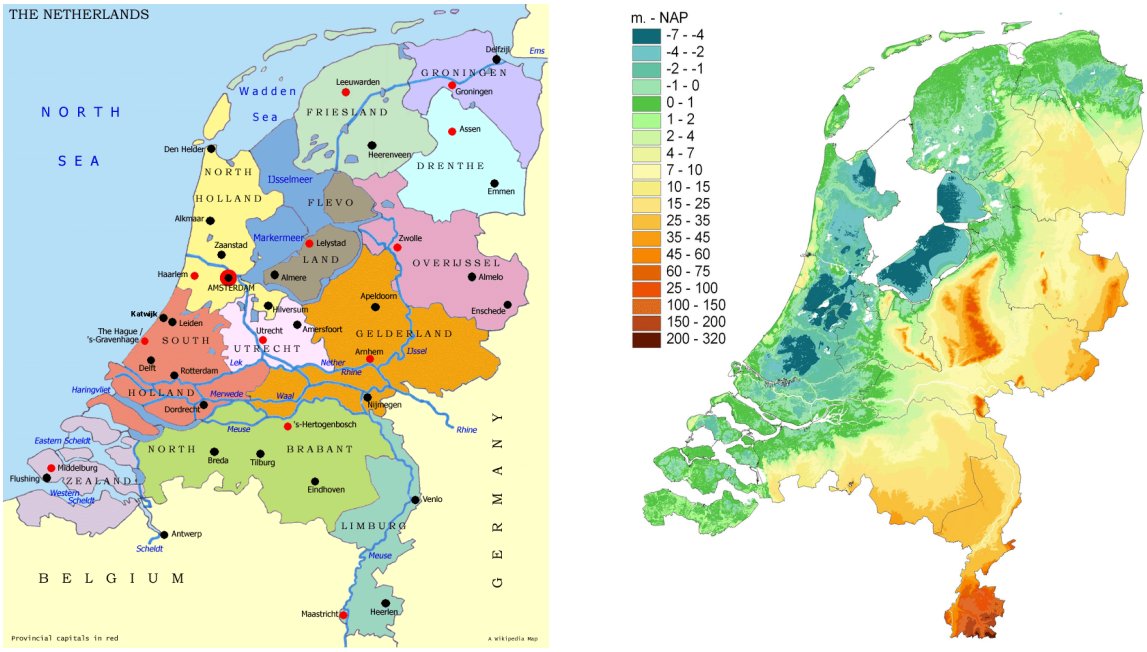
With the TIS approach, crucial structural components surrounding SHP in the Netherlands are identified. Here, the policy focus of the classic TIS approach can be beneficial, since in the currently ongoing energy transition, policies are crucial to push certain technologies and transitions, due to their often inferiority compared to the incumbent systems.
For this study mainly stakeholder dynamics are paramount. Therefore, after the definition of the boundaries of the system and identification of structural components those structural components are being looked at in further analysis.

4.1.1 Focus of the TIS

Bergek et al. (2008) explained that as a start of a TIS study, the focus and boundaries of the TIS have to be defined. There, questions whether to focus on a certain product or a knowledge field need to be defined, or whether the goal is to gain specific in-depth understanding or a broad perspective should be answered. Also a geographical delimitation is required.

To start with setting geographical boundaries, within this project, the focus will be laid on the

south of the Netherlands, more specifically the provinces of Limburg and North-Brabant, and Gelderland. However, since those regions and especially their water systems are interconnected closely with near-border regions of Belgium and Germany, also those areas are being touched on and how they might influence the decisions made within the provinces of interest. The decision for this scope is based on first, the fact that the project is situated in Limburg, namely Maastricht. Second, those regions are the ones with the biggest elevation present in the Netherlands, as can be seen in Figure 4.1, hence they encompass the majority of hydropower projects, similar to the one in Maastricht.



(a) Provinces and Rivers

(b) Topography

Figure 4.1: Maps of the Netherlands

Given the fact that a project regarding SHP is investigated, it is logical to set the focus on small- or medium-sized hydropower technologies, respectively, run-off river solutions. This excludes large-scale hydropower systems. Those systems are not considered since on the one hand, they are hard to compare with SHP due to their different advantages and disadvantages and on the other hand simply, since they are not present in the Netherlands.

For this study a broader perspective is chosen, to capture dynamics within but also outside the project and the system it finds itself in. While doing so, it is not only focused on the application in the Bosscherveld project, but on a wider range of applications being other hydropower projects in the Netherlands, and potential projects with approximately the same function.

Since the goal is to eventually improve the company's perspective within the TIS framework of a company that is working in the field of energy transition, more specifically an SHP project, it is tried to incorporate this view in the subsequent considerations.

4.1.2 Structural components

The actors and structural components of the present TIS, are identified through desk research and informal talks with experts from that area, being professors from TU Delft, who are specialists within the water sector in the Netherlands regarding institutions and juridical legislation, the CEO of FishFlow innovations, and people from the Delta Future Lab, Team Limburg, who work on several projects in that area regarding water management. With the information from those meetings, the following structural components were mapped in the style of the template presented by Vroon et al. (2021) (seen in Figure 4.2) and are explained in the following paragraphs, where some main policies are captured as well.

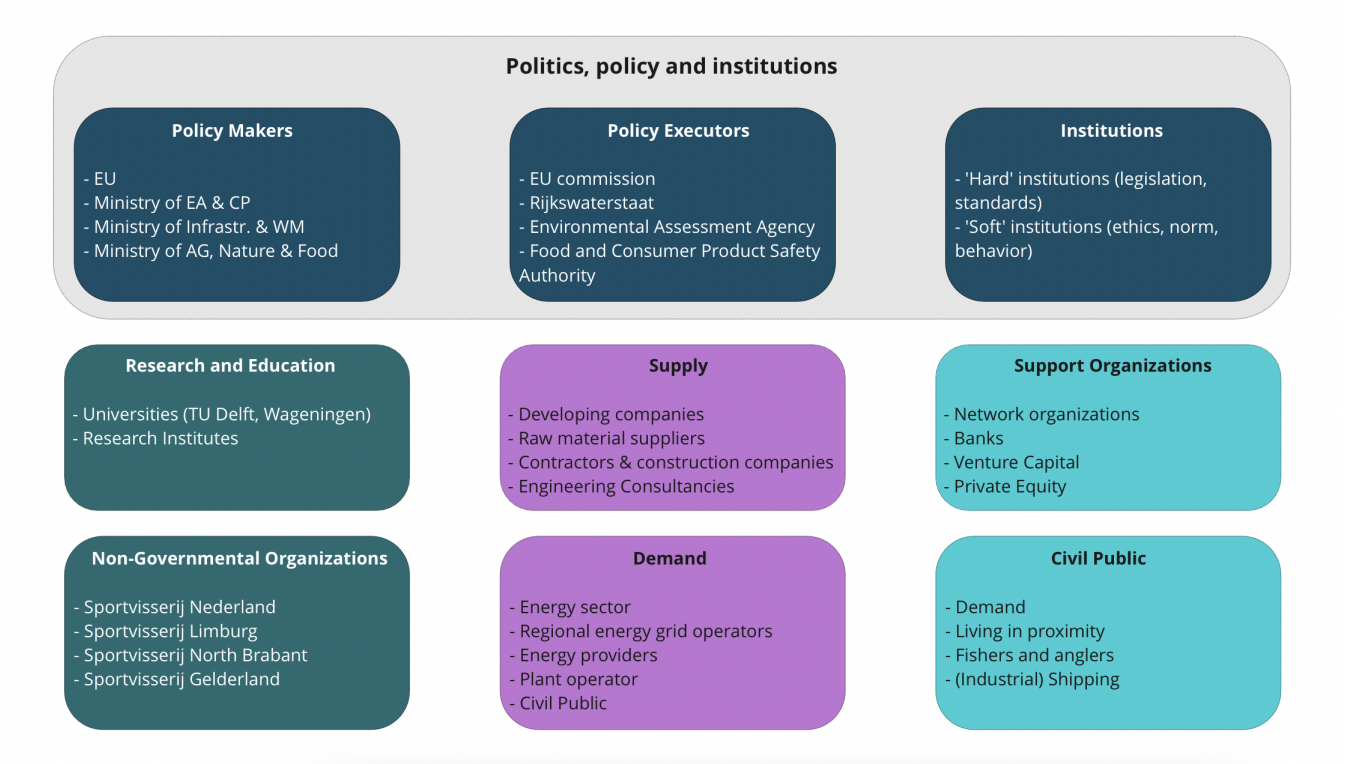


Figure 4.2: TIS for SHP in the South of the Netherlands

Politics, Policy and Institutions for a SHP project in the Netherlands involves several governmental parties from the country, but, since it belongs to the European Union, also the EU. In general in the area of politics, policy, and institutions, it can be distinguished between the policy makers and the policy executors. Being an EU country, the Netherlands have to comply to given policies and rules expressed by the EU, such as the European Water Framework Directive (EC, 2021) or the initiatives to meet the goals of the Paris Climate Agreement. (UN, 2016) Within the Netherlands, the government or its ministries can set certain goals and guiding principles. Concerning the reduction of greenhouse gas emissions, one of those policies is the moving from fossil fuels to RES for electricity generation. (Government, nda)

Regarding SHP, the ministries that can potentially affect its developments are the ministry of

infrastructure and water management, the ministry of agriculture, nature and food, and the ministry of economic affairs and climate policy. Each ministry has different executives bodies and committees that take action, pursue, and try to achieve those goals. Accordingly for SHP developments that appear to be Rijkswaterstaat, the Environmental Assessment Agency, and Food and Consumer Product Safety Authority. (Government, ndb) (Keller and Hartmann, 2020)

The policies from the Dutch government concerning SHP would be mainly also the urge to comply with the Paris Climate Agreement, but also the WaterWet. The WaterWet is a policy which includes several laws regarding the water quality, water use, and reducing environmental impacts. It is operative since 2009 and consolidated eight previous water laws into one. This change was done in order to simplify processes for company working on projects in the water sector, so that they only have one authority to contact and deal with for licensing and permitting, being the Rijkswaterstaat. Within the WaterWet there are demanded several permits that need to be acquired when working on projects that affect the surface and groundwater bodies, regarding environmental impact, water quality, water levels, shipping, or safety. (RWS, ndb)

Since as explained in the literature section, the main environmental issues with SHP can be fish mortality, regarding such projects the **Non-governmental Organizations** are mainly the different ranges of the Sportvisserij association. Sportvisserij is organized in one overarching mother organization, being Sportvisserij Nederland and has several branches that are responsible for the provinces of the country. The association is mainly concerned with fish-stocks mainly due to two reasons. One, out of environmental motivation, to conserve native fish species and hence aquatic crucial habitats, and second, being an organization for sport and commercial fishers to ensure they can work and ensure their income and/or enjoy following their sports and passion. (Sportvisserij, nd)

Research and Education can be undertaken by different universities. For the field of SHP that are the TU Delft, being a university with excellent expertise in water management and hydraulic engineering. A university concerned with environmental impact for instance for the agriculture or the health of the water habitat in general is the University of Wageningen. Besides universities, distinct research institutes are involved in the deployment of SHP, such as the ATKB, a research organization mainly concerned with aquatic ecology, soil & water, geophysical survey, and terrestrial ecology.

Support Organizations that can aid the development especially for a company working within the field, are banks and venture capitalists, providing financial resources for the development and implementation of the technology and its solutions. Besides financial support, also managerial or technological support can be gained from consultancies or networks within the industry.

One of the central actors within the **Supply** for a SHP project is the company that develops and delivers the technology, and that wants to diffuse it widely. Besides that different actors

can give different types of supply for the development of such a project. Those different supply types can be in a physical sense, being raw material and production machines, but also human resources to actually do the work. Those hands and machines to do the work can either be from the developing company themselves or from partnering companies and contractors. Further, supply can be seen in a more intangible sense, being know-how, experience, and consulting from engineering or management consultancies.

The **Demand** side of such a project can be seen on different levels. For the technology central to the SHP plant, the plant operator is the customer with the main demand. The plant operator at the same time becomes an electricity producer who trades the electricity on energy markets. There, the energy providers buy the electricity dependent on the demand their customers, and therefore the end-consumers of the electricity, businesses or the civil public, have. Simultaneously, the demand for renewable energy is fostered by the policy makers who, as said before, set or respectively try to comply to the goals and thresholds from for instance the Paris Climate Agreement. Therefore, the demand is created by the civil public's electricity needs, but the demand specifically for sustainable energy is shaped through the policy makers generated pathways.

As just mentioned, the **Civil Society** on the one hand creates the demand for a SHP plant. On the other hand, they can be people who are affected directly by the power station. This could be if they live or do activities in close proximity to the site. Therefore close inhabitants should be considered, but also fishers and anglers who would like to follow their hobby in the area of the site. Another group of actors to be considered are people that use the canals and ship locks for shipping, being the field of industrial shipping, hence using it for their work, but also for leisure activity, when enjoy holidays on a boat.

4.2 Power-Interest-Grid

Having the structural components of the TIS of SHP in the south of the Netherlands clear, it is then important to focus on the actors and stakeholders specifically important for the project at hand, and how their interest and power are respectively should be regarding the development of the project. The degree of their power and interest is derived from their roles and how their general interest and their leverage on such projects look like. Those actors are mainly extracted from the documents preliminarily analized at the beginning of the thesis and are slightly extended with the knowledge gathered through the previously mentioned informal talks with TU Delft professors.
With the power-interest-grid it becomes clear which actors might be the most crucial ones, thus, the most important ones to engage with. Those are shown in the top right quadrant and are classified as 'Players'. For classifying those stakeholder however, it is important to define what power and interest imply in this project. The dimension of power can be seen as quite straightforward. It stands for the degree of meaningful influence an actor can have on the success or failure of the project. Having a high power means that with the actions of this particular stakeholder, they can influence the project's pathway by a lot and are able to make decisions crucial

its progression. The definition of interest can be a bit more challenging. It must not be seen as an actor simply being intrigued by the project or interested about the outcomes, yet should be understood as a political interest. In the Bosscherveld project, high interest therefore could mean, that an actor or their organization would benefit directly. Furthermore, it could mean that, if an actor shares the values created through the project, those values could be boosted by the project's success.

The assessment of the interest and power each stakeholder, leads to the subsequent power-interest-grid (Figure 4.3) which will be elaborated in the ensuing passages.

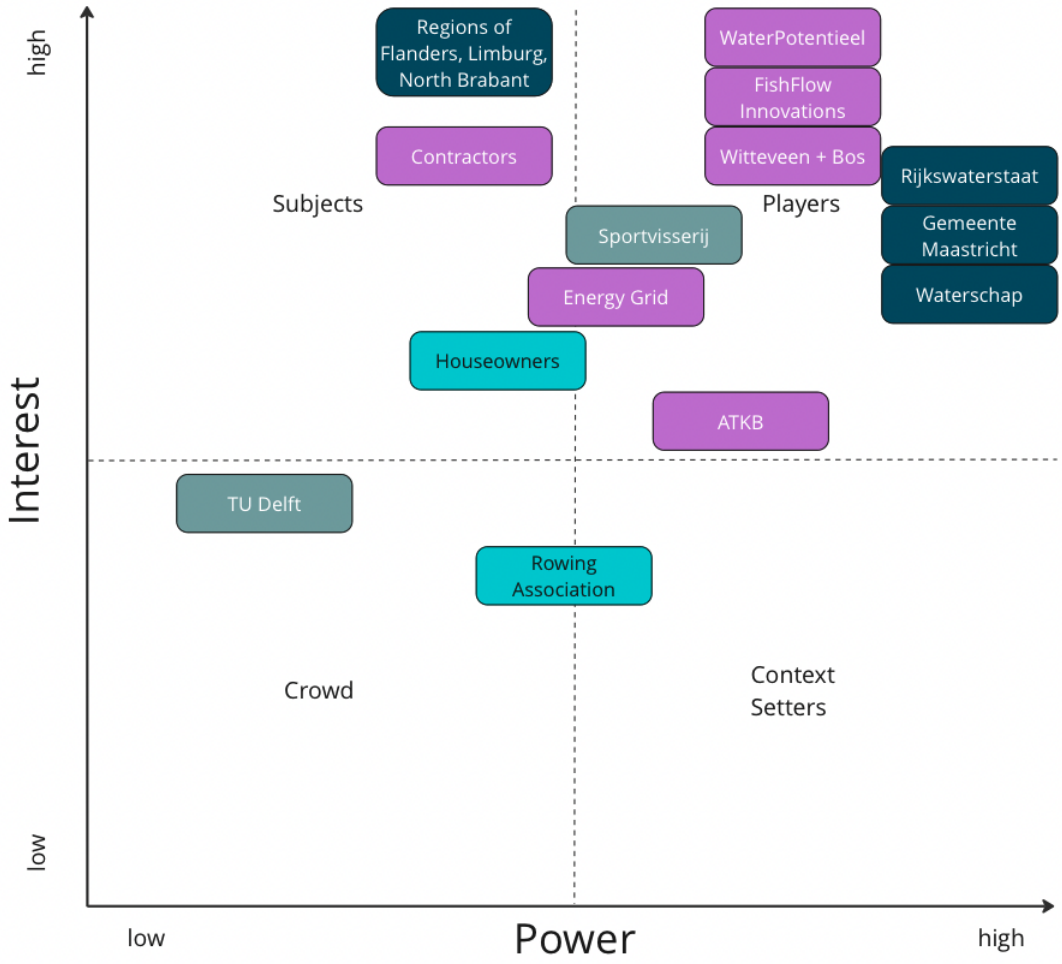


Figure 4.3: PIG for SHP in the South of the Netherlands

4.2.1 Players

The actors defined as players are the ones that should have the most extensive involvement into the project's processes. These are mainly the project initiators and managing companies and the governmental institutions responsible in the area.

WaterPotentieel BV is the company which initiated the whole project. It was founded by

an ex-Rijkswaterstaat employee who had the idea of setting up the hydropower station next to the Bosscherveld lock after he retired. From the beginning he had the support of another past colleague who acted as an advisor in the project. Later a third person joined the company to support with the management.
Being the project initiator, the stakeholder's interest in the project's success should be high, since usually with starting a venture, the founder aims for making a profit. Simultaneously, they have the control over processes and a plan for resource allocation. Therefore, their power on influencing the project's outcome is high.

A partner of WaterPotentieel in the project is **FishFlow Innovations BV**. They are providing the main technology central to the hydropower plant, being the fish-friendly screw turbines, which assure efficiency from above 90%. Being a business opportunity for FishFlow, their interest in the project is high, since its success would create profit and possibly future business opportunities in case the system turns out to be prosperous.
Being experienced with different types of water infrastructure projects **Witteveen + Bos BV** supports the project with their expertise in engineering and management consultancy. Completing the area of the managing companies, from this point of view all three have the same power in respectively influence on the project. They all share similar interests, being the completion of the project and hence creating and capturing revenues from it.

The managing companies are facing three governmental institutions within the project. Being the executive agency of the Ministry of Infrastructure and Water Management, the one mainly responsible for the motor and water infrastructure of the country is **Rijkswaterstaat**. Regarding motor infrastructure they are mainly in charge of the building and maintenance of motor ways, bridges, tunnels, and surrounding areas. For the water infrastructure they are concerned with the main water ways used for industrial shipping. To ensure that the shipping industry can function well within the country, Rijkswaterstaat needs to ensure the water levels on the big water ways and connecting canals. To establish a uninterrupted water traffic, they also need to maintain necessary water infrastructure such as sluices, water gates and weirs, that are needed to one, control the water levels and second, to ensure ships can travel through canals with varying heights. Finally, they are liable to safeguard and improve the main flood protection systems alongside those canals within the south of the Netherlands, but also the immense dams in Zeeland, protecting the country from high levels in the North Sea. Besides the management, development and improvement of the road and water network, they are eager to create a sustainable living environment and want to become energy neutral themselves by 2030. (RWS, nda)

Besides Rijkswaterstaat also the Waterschappen or **water boards** are managing the waters in the Netherlands. In general their work is very similar, but overall it can be noted, that Rijkswaterstaat is more responsible for the main, large national water ways and the water boards for smaller canals and rivers. Also there, they are responsible for flood protection and ensuring that the landscape promotes water storage and drainage systems in case of high waters. Fur-

thermore, they ensure the water levels with weirs, locks and pumping stations. Additionally, they are ought to maintain clean surface water and manage purification of rain and waste water. (OnsWater, nd) (Keller and Hartmann, 2020)

The **Municipality Maastricht** rounds up the triumvirate of the institutions regarding the project. Besides also being responsible for some water management tasks, especially regarding sewage systems, the province owns some of the land surrounding the lock. Furthermore, they are obliged to present a regional energy strategy regarding the development of electricity management and generation in their region. Being a close collaborator with the other two governmental institutions and needing to follow the national energy policies, this creates high power and high interest for the municipality towards the project. (Limburg, nd)

A company engaged into the project and focused on the impact assessment of the hydropower station on fish migration is the **ATKB**. ATKB is a consultancy focused on research around soil and aquatic ecology. Within their research they want to give sustainable advice and provide the best answers to the questions of their customers. With being committed to topics mainly regarding the impact of projects on the environment they are having interest in the Bosscherveld project. Furthermore, they have a certain degree of power, since when their assessment concludes the technology being hazardous on the aquatic live, it would form a significant barrier for the hydropower plant. However, finally, it is an ordinary job for them, where they simply look at the facts and state their evidence-based opinion regarding the topic.

Apart from the managing companies and consultancies involved in the project's development and the governmental institutions concerned with it, non-governmental organizations (NGOs) are having a certain power and interest in it as well. One of them is the **Sportvisserij** association. As explained before, they are advocates for the sport fishers, commercial fishery industry and fish and aquatic life in the Dutch rivers and canals. With knowing from the provided background information from the literature section, although having less environmental impact than large-scale hydropower plants, small-scale hydropower plants can still have serious effects on the the aquatic ecosystems. Being concerned with the conservation of native fish species and resettling species that were native but went extinct, hydropower plants can be a threat to their mission and goals, which is why they have a high interest in the project, to ensure that it is as fish-friendly as stated. With their legal department they can have significant power on a project's progress, in case the project plan or its results are not in line with the goal of creating a healthy aquatic ecosystem. (Sportvisserij, nd)

With the country's plan of becoming more sustainable and more reliant on renewable energy solutions, the whole **energy grid** needs to change and adapt accordingly. Eventually, the hydropower system at the Bosscherveld lock would need to be connected to the grid. Since they need to transform to a more sustainable system, the project could be in favor of this transition, which is why the energy grid might has a slight interest in it.

4.2.2 Subjects

The **Regions of Flanders, Limburg, and North Brabant** appear to have a high interest into the projects success. This is due to the fact, that they were one of the first initiators before the project had started. According to the documents, Flanders (Belgium) but also Limburg and areas of North Brabant rely on the water that comes to them through the Zuid-Willemsvaart canal from the Meuse. Being concerned about the water levels in their regions, since agriculture and other sectors highly depent on it, they made a request to Rijkswaterstaat in Limburg to come up with a solution to ensure the water security in their regions. After numerous investigations of several solutions, the bypass known as being a part of the current Bosscherveld project, was concluded to be the best option to create a more optimal, steady, and controllable flow of water from the Meuse to the Zuid-Villemsvaart and hence to the affected regions. However, never being mentioned again in the project documents, it does not appear like they exercised a lot of power on the project and its progress.

Another stakeholder group that is merely being subject to the project are the **contractors** and engineering offices, that elaborate on the construction and design on the site. They have done their calculations and delivered the work necessary for the managing companies to plan and to apply for permits. They have an interest in the project being developed due to the profit they generate from it but also, due to potential future assignments based on the work they created in Bosscherveld.

Next to the Bosscherveld lock there are approximately three houses and therefore **inhabitants and homeowners** that would be affected during the building processes. Besides the construction phase and the digging processes in their gardens, after those phases are done they would not be affected by the hydropower plant that much. Since the land is owned by Rijkswaterstaat they would not have too much power to oppose to the project, however would probably still have some interest in knowing how, when and for how long construction would take. Further, a question they might have could be, what if there are problems with the pipes after the constructions are finished? Could they be affected by leckages and hence flooding in their gardens? Those might be questions that concern them, which increases their interest.

4.2.3 Crowd

According to the documents and statements from FishFlow, before the project started there were testings regarding the efficiency and fish-friendliness of the screw turbines at **TU Delft**. There, a smaller model of the turbine was used to show possible effects of the turbines in larger scale. According to the documents, the testing went well, and the previously defined assumptions and goals were possible to reproduce and verify.

On the lower side of the Bosscherveld lock, namely at the Zuid-Willemsvaart canal, there is a **rowing association** that has their club house next to the water. Therefore, the rowers train and practice on the canal and would not want to be disturbed by additional currents created by the hydropower plant. However, they impacts seem not to be noticeable which is why their interest is assumed to be comparatively low. Also their power on influencing the project's outcome does not appear to be significantly high.

4.3 Expert Model

On the path to create valid mental models for actors involved in energy transition projects, an expert model must be created. In this section the interviews necessary to derive the information to build those expert models for the project's processes as well as the perspectives on the most important factors causing barriers are analyzed. Additionally, information about the semi-structured interviews, necessary for the data collection, are presented. Finally, the data gathered is analyzed and crucial inferences from the interviews regarding the perspectives of actors are drawn.

According to the mental model's approach, first, the opportunities or the goal of the analysis needs to be defined. The goal of the analysis of the project is to know where things went wrong between the stakeholders and to see what would need to be done to improve the collaborative processes and to eventually make the project a success. For that, the main misconceptions of stakeholders, that created barriers should be identified so that the problems can be resolved, or the information can be used for future projects to avoid those barriers. Afterwards, the mental models should be identified, that can be used as an attempt to understand the reasons for such misconceptions.

For that, the preferred outcome would be to have identified one main barrier that hampered the project's progress, and where suggestions on how to circumvent or resolve this barrier are quite clear. However, also the identification of multiple smaller obstacles that with their combination create the stalling of the project would be appreciated, so that strategies could be formed regarding which hurdles should be tackled first and how. This goal can be achieved by:

- Understanding the Dutch water sector, the present responsibilities and its involvement into decisions influencing the energy transition in the Netherlands.
- Gaining awareness for the most influential factors and developments in policy decisions.
- Grasping who else is involved in the project what values and interests drive their decisions within.
- Identifying the main communicative mismatches causing the blocking of the project's progress.

- Gain understanding for the people's decisions and their view and opinions on the project.
- Creating strategies on how to overcome these blocking mechanisms or to at least overcome the current frozen status of the project.

To create the expert model, first different kind of documents regarding the project, which were provided by FishFlow Innovations, were investigated. These documents range from official contracts regarding the private and public partnership between the Rijkswaterstaat and the WaterPotentieel BV, to more specific technical documents about the construction of certain areas of the project. By looking at these documents a first understanding of the project itself and the benefits its implementation could bring was gained. Besides these documents three informal expert interviews were held. Two of those experts, Ellen Minkmann and Eric Mostert, are TU Delft professors who are specialists for projects within the water sector of the Netherlands from a managerial and juridical perspective. The third expert was an employee of the Waterboard in Limburg who provided insights in regional and national policies within the water sector of the Netherlands, and how they are related with EU directives.
The best case scenario for the contract partner and other active actors involved, should have been that after the public and private partnership was signed, the construction order should have followed and the project could have been executed.

4.3.1 Interview Setup

For the expert interviews a semi-structured interviewing approach was chosen. This approach enables a guided interview but also allows the interviewee the elaborate more or less on certain things or maybe even entirely new topics, which can lead to new discoveries that first had not been considered. As suggested by the mental models approach, to understand the interviewees backgrounds, potential biases and angle of perspectives, the interview starts with broad questions. With those questions past experiences from the field of interest are being captured and viewpoints disconnected from the issues of the project of focus can be identified. Gradually, the questions are then becoming more project specific create an understanding of the interviewees thoughts about the project itself.

The stakeholders identified in Figure 4.3 as 'players' are of main focus for the interviews. To get in contact with the people working in the different domains or institutions on the project, a snowballing approach was used, starting with the main point of contact of FishFlow Innovations. Through them it was possible to reach out to some key personnel involved into the project. It was tried to talk to multiple people from one stakeholder field. In that way it was considered, that a single person's opinion does not necessarily have to equal the institutions opinion and that different people in an institution can have different perspectives on the project, due their position within the institution, but also due to their personal background. Therefore, it was attempted to see the interviewees as individuals, with own ideas and attitudes to avoid generalizing their statements for their whole company or institution. At the same time, scope and scale of the research needed to be taken into account, which is why the focus laid on the people

who were mostly involved into the project.
To understand their backgrounds but also their project specific perspectives, roughly the following questions were asked. However, depending on their expected role and their type of involvement, the questions might have been adapted slightly to fit the individual interviewee more exactly.

Broad Background Questions

- What is your academic and professional background?
- What is your role within your organization?
- What project are you or have you been working on?
- Have you worked on other energy transition and/or water sector related projects before?
- Have you faced any opposition or problems (maybe even similar to the ones from this project) before?

Project Specific Questions

- When and how did you get involved in the project?
- How was the starting process of the project?
- What was your particular role in the project, what was your goal and how were the responsibilities shared?
- How was the contact with other stakeholders and who did you have the most contact with?
- If you look at the project timeline, are there any wrong conceptions?
- What do you see as the main problems of the project?
- How do you assess the current status of the project and what needs to happen for it to be realized?

4.3.2 Method of analysis

The two main goals of the interviews were one, to fully understand the project processes as they were and second, to identify the factors perceived by the stakeholders as being the main causes for the lack of progress and hence the barriers. From that it was intended to develop an expert model regarding energy transition projects.
To start with the analysis of the interviews it might be of advantage to recall the main issues from the preliminary analysis. Those were that first, the intention from both sides, the project initiators being WaterPotentieel and the institutional partner being RWS, to start and execute the project and contracts regarding those intentions were set up and signed. Despite those intentions, the project did not seem to progress and no physical work on site had been done

so far. FishFlow claimed that the main barrier for the project were on the stakeholder side namely the lack of seriousness or will to accomplish it from RWS. From FishFlow's side the project looked technologically ready, all the permits had been prepared and the information had been sent. Despite that preparation the project did not get the final approval and had not been carried out, which for FishFlow is incomprehensible. What is clearly visible in the project timeline (Appendix A) created from project documents, is that there were several gaps without any events and contact. After first only briefly having heard FishFlow's perspectives and the project documents, the interviews with all crucial stakeholders ought to discover a complete view on the project circumstances and a clear picture on the roles of the people involved.

Therefore, the focus was laid on understanding the involvement processes and the stakeholder's motivation to be a part of the project and how and why they either supported or maybe even blocked the project's progress. Furthermore, it was tried to understand the processes over time, for instance if certain interests into the project have changed over time and why. In order to extract those information from the interviews their summaries were analyzed as follows:

- What different perceptions of the project are there? Are there common issues or differing views on what needs to be overcome for the project to happen?
- How is/was their involvement compared to the information gathered in the preliminary analysis?
- What are the people's and their institutions actual roles and how do they compare to their perceived roles?
- What are their power and interest compared to the investigation in the preparatory analysis?
- What did each stakeholder perceive as reasons for the lack of progress within the project?

Finally, a list of all the mentioned factors that according to the stakeholders hampered the project's progress was created. They were analyzed regarding the number of stakeholders mentioning the factors as barriers. All factors that were mentioned by more than 2/3 of the actors, are concluded as being the most crucial ones. However, also the ones mentioned only by less or even one person, were investigated and put in perspective and relationship to the remaining factors.

To give a complete understanding of what created the barriers for the progress of the project, first the Expert Model will be presented, and hence how an optimal process according to the stakeholders should look like. Subsequently, the different perspectives of the stakeholders regarding the actual project processes are summarized. With that background knowledge, the derived factors and how they affected each other are presented which bring reason behind the barriers perceived by the stakeholders.

4.3.3 Results Expert Model

From the interviewees statements regarding their perceived problems within, and their general perspectives on the project the expert model for an optimal project process for a local energy transition project in the Netherlands is derived (Figure 4.4). Along this project process, it can be seen how some of the later concluded factors play a role in maintaining an eye-level working environment and faster a positive and efficient collaboration.

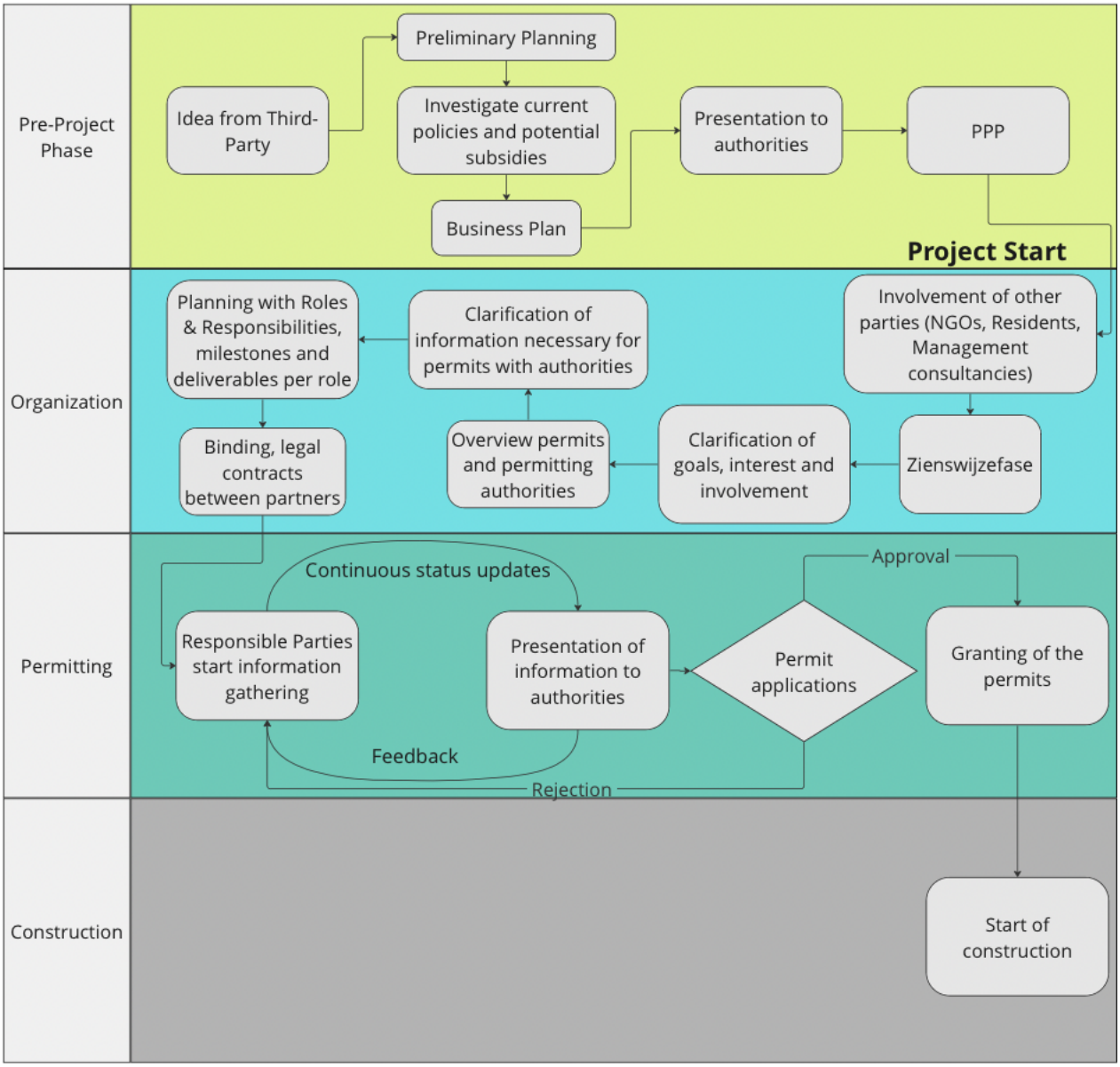


Figure 4.4: Optimal Project Processes

At the beginning of the venture, the third-party initiator needs to have a clear idea of their own drive and ambitions and needs to be aware to what extent these ambitions or this vision can be shared by other parties. For this, already at this stage of the project, while doing the preliminary planning, assumptions should be made for future partners, regarding their main drivers, materializing the likelihood of their engagement and commitment. This can be a role-based analysis,

where the information comes from recent developments and current policies. From these policies, potential subsidies can be concluded, which are crucial to develop a sound business plan, for the operation phase, but yet especially also for the project phase. With that, assurance regarding financial resources along the project phase and profitability after finishing the project can be captured, which can increase the chances, that other parties involved, can share the vision, or at least assess it better. After presenting this valid business plan to the authorities a PPP can be set up, which defines the official start of the project.

Then, all potentially important parties need to be involved and come together in the Zienswijzefase, where everyone's perspectives, concerns and drivers regarding the project can be issued. With that, a clear definition of the goals and interests, and hence the involvement of each party can be made. Additionally, there it has to be made clear, who is the main owner of the project and thus who will always retain a complete overview of its processes and current status.
Next an examination of all the necessary permits and all the responsible permitting authorities has to be made. Then, those authorities can be approached regarding the information and knowledge that need to be obtained for each of those permits.

With having all this information clear, a precise and concrete planning can be made regarding the responsibilities of each party and person involved in the project. Milestones can be set and deliverables bound to those milestones defined. Since different people or partners might be working on several permits, the responsibilities ought to be shared with the authorities in charge so that contact persons are clear for all sides.
Lastly, binding legal contracts between the parties should be erected, even if there are long-lasting old relationships between them. In those contracts the responsibilities and deliverables as well as the compensation for it should clearly be recorded to avoid future confusion and lack of leverage over each other. This would especially come in handy, once the project is stalled, and parties do not stick to what was agreed on before.

Once all this planning is done, the companies involved can start to gather the information necessary to acquire the permits. While doing so, they may update the project owner who then updates the authority in charge continuously to clarify possible confusion on the authority's side, in case certain information takes longer to obtain. This first keeps everyone, including the project owner, updated about the current processes, and shows a certain seriousness about the venture towards the authorities. Simultaneously, they are able to give feedback on the information presented so far. In case the process is stalling at any point of the process, the third-party initiator needs to take responsibility and approach the party accountable for the delay in a proactive manner. While doing so, they constantly need to assess the project's surroundings and to reassess the stakeholders main drivers and reasons to be dedicated and work at the project.

Through this processes of close collaboration, the information for the permits should be possible to be gathered in a structured way, resulting in a complete application. In case they are rejected,

the people responsible need to revise them and implement the feedback given by the authorities. While doing this, they need to consider the time and make sure, that certain permits do not expire already while working on the approval of others. The times how long the permits stay valid should be acknowledged within the planning of the permitting work. In case the permits are granted and all verified, construction can start.

Throughout the whole project processes communication is crucial, especially among the managing companies, but also between them and external parties such as the authorities, NGOs and the residents from the area. Otherwise, particularly once the project processes slow down, negative assumptions tend to appear, where one side accuses the other of not working properly. From hindsight, those accusations are hard to assess and to prove or disprove. The better option would be, through continues exchange of information about the status of certain matters, avoid those assumptions and accusations from arising.

This proactive communication and engaging with people can be nurtured with ownership, entrepreneurial activities, and persistence. For the project initiator, or the company in the middle of such a venture, it has to be clear that different stakeholders have different motivations and drivers, and that, even though a situation appears to be a win-win, one side still might need the project more than the other, or at least out of different reasons that can create different urges. These factors need to be taken into account to understand the degree of commitment brought to the table by different stakeholders.
Through convincing stakeholders from the vision behind the project, the drive of each one can be affected positively as well. However, to make this vision achievable and shareable, a good planning is essential.

Especially in a bureaucratic sector such as the water sector in the Netherlands, where one project or water infrastructure asset might be subject to multiple authorities a detailed description and universal understanding of the responsibilities can be decisive. With having this definition clear, it is also unambiguous who, or within an organization, which level to talk to. Further, with a explicit responsibility division and legal contracts as a foundation, obligations and thus leverages between actors are present. The right entrepreneurial behavior then helps to keep the project processes in line and to overcome barriers and hurdles.

4.3.4 Results Stakeholder Perceptions on Project Processes and Hurdles

In the following paragraphs when talking about the interviewees, anonymized abbreviations are used. The team members of WaterPotentieel are mentioned as WP1, WP2, and WP3. The employees of RWS are shortened with RWS1 and RWS2. Accordingly the interviewed people from FishFlow, Witteveen+Bos, and Sportvisserij are abbreviated with FF1, WB1, and SV1.

Regarding the project processes and roles there are different perceptions for the main reasons

regarding why the project started. RWS' perspective is, that it started mainly because the planned extension of Maastricht, whereas WaterPotentieel is certain that it was because of the request from the regions subsequent of the Bosscherveld lock. Witteveen + Bos on the other hand, sees an investigation of the DHV as the starting point. All those events could be connected, however whichever one was the real base of the starting of the project, can have an effect on who might have a bigger leverage on the project's progress today and who might need to be included now in order to push the project further, being either Maastricht, Flanders, or the DHV.

The permitting processes for a SHP in the Netherlands can easily become complex, since there are several permits to obtain for such a venture that need to be granted from different authorities and are not supposed to be older than a certain time period. Both RWS employees agree that the permitting environment can be complicated and both admit they would not have the best overview about it, also due to the fact, that RWS has an extra permitting department, therefore, they are not personally responsible for granting those permits. However, they do know, that a part of the permits need to be obtained from the municipality and the water permit from RWS. From the company side, Witteveen+Bos was mainly working on the environmental and the felling permits necessary for the hydropower station construction. WP1 was working on the water permit for the bypass and got some support from Witteveen+Bos, though it has never been obtained. Nowadays, the environmental permits are expired and would need to be re-applied to. To gather the final information for all the remaining permits, according to WP3, this would cost €50,000, but he is hesitant since he is worried, that RWS could slow down the processes and the investment could be lost. However, over all the the ball is now in WaterPotentieel's court to move the project forward.

All of the project companies have identified the commitment of RWS and their drive as crucial factor that slowed down the processes. However, they have different reasons why they think that. WP1 and WP3 expect that RWS is less committed now than at the beginning of the project, because their main reason for the necessity of the bypass has disappeared, since the main requester did not ask further for the new connection of the water systems. Furthermore, the old connection (the Voedingskanaal, 1.1) appears to work just fine despite its age. WP2 however, states that more the fact that generating electricity is not the main business of RWS and hence the people working there also have no interest and no ownership in it. FishFlow and Witteveen+Bos have their reasoning for the lack of drive mostly coming from information provided by WaterPotentieel, but also partly from personal experience throughout the project. For FishFlow that would for instance be the fact that RWS would come to meetings unprepared or would lose the documents they had sent them. Witteveen+Bos claims that with previous projects fully owned by RWS it was different. There, RWS bolstered and pushed their projects and ensured a smooth process.
RWS partly agrees to the loss of the main driver being Maastricht not properly extending anymore and Flanders or the other Dutch provinces not asking for improved water levels anymore. However, they insist, that in fact the project would still be a win-win also for them. RWS1

stated, that they are aware of the age of the Voedingskanaal and that they know that it at some point would need to be changed or at least needed maintenance. Therefore, they know that eventually a new connection would be indispensable, and having the cost shared and the construction done by a third party is still a clear advantage for them.

Furthermore, WaterPotentieel claimed that the reorganization and constantly having new personnel in managing positions at RWS would create problems for the project. The employees from RWS agreed, that the organization indeed is changing and the focus moved from engineering to maintenance and contracting. However, they do not see it as a problem for the project per se. Although what they do see as a problem for the project's progress is the lack of commitment and motivation of WaterPotentieel. Since RWS does not have the main need right now for the project, and they are not the main owners of the venture, they do not feel to be in the position or the responsibility to push and promote the project. According to them, they are willing to help and support and make the processes smoothly, but they would not start calling WaterPotentieel asking about the project's progression. Since WaterPotentieel was the initiator of the project, RWS would expect them to be proactive and entrepreneurial. They said this entrepreneurial drive was missing on the side of WaterPotentieel and it seemed that this project would not be the initiator's main focus. This perspective is backed by FF1, who does not understand why they do not put more pressure on RWS and proactively advance the project. In fact, Witteveen+Bos stated that no one seems to really own the project and would take responsibility for the planning and development of the project.

All of the stakeholders have the opinion, that the processes were continuous and steady at the beginning of the project, but then slowed down along the line. Just as with RWS losing the drive or the main necessity, the same happened with WaterPotentieel. FishFlow and Witteveen+Bos both observed, how the project initiators were getting older, which might have affected their capabilities to promote the project further. WP3 indeed said, that due to his age it was difficult to get any loans from the banks to invest into the permitting processes. The replacement who got involved, WP2, was younger and could have been the decisive factor to accelerate the project again. However, he had a very busy schedule and other project involvements already, which makes it difficult to give his full attention and commitment to this project, according to the other stakeholders.

Furthermore, the main motivation of the people from WaterPotentieel and what was at stake for them with the project might also have been a factor that created a hurdle. Other than FishFlow and Witteveen+Bos, two companies that have profits and their future success and existence as a company as a driver, for WaterPotentieel, it was something extra. WP3 had stated, that indeed, the first idea to start the project was partly to keep himself active during retirement and WP1 mainly got involved to help him a bit with the contracts. Although, they had a vision behind the venture, wanting to deploy the systems globally, the success in a project had never been a stressing necessity. Also WP2 had other projects in the pipeline, so for him it was not the main

and only focus either.
In addition, after a while not even for FishFlow and Witteveen+Bos the project was still a main necessity. Although FF1 stated, that by not having the project ready he has already lost €4-5 million from potential projects that could have developed from potential investors seeng the system running and working, simultaneously, they have build similar systems elsewhere and have other big projects planned. Therefore, they do not have to fully rely on the revenues and future earnings created from the Bosscherveld project. Also Witteveen+Bos would have not earned immense returns from the project, and they were mainly involved to help FishFlow.

Everyone working on the project agrees, that the Bosscherveld project alone will not majorly contribute to a more sustainable energy mix in the Netherlands. However, the vision of the impact it yet could create differs. All members of WaterPotentieel and FishFlow see the Bosscherveld project as stepping stone for multiple future projects that eventually could have a decisive impact in the Netherlands, and even worldwide, if deployed globally. For RWS however, according to RWS1, the main focus for the contribution to a more sustainable energy grid lays on wind parks, since they see more potential in it. According to WaterPotentieel, they also understand the other side, since it might be difficult to share the vision, considering that two retired engineers without large financial resources would have such a large goal. In fact, WP2 had stated that even with the most ambitious vision, within the Netherlands, SHP could probably only generate electricity equal to 2-3% of the whole energy mix. However, he also states that this would be better than nothing. This view is partly shared by RWS2, who says that a small contribution is better than no contribution. However, it can be said that indeed a small contribution or a small impact has less effect on the drive of the project parties than a larger one.

As the impact of the project might not be the biggest one, also the return created by it carries uncertainties and different perspectives with it. While FishFlow believes WaterPotentieel could make a lot of money with the hydropower plant due to the currently high electricity prices, WP3 is a bit more hesitant, since he knows operation and construction costs had gone up as well. WP2 believes, that the project would not yield the highest profits, hence the return on investments would be low. This in turn again makes it harder to share the vision of deploying the system widely, since it makes it more difficult to attract future investors. Likewise, RWS1 cannot see a clear business plan so far and he thinks that the alternating energy prices make it difficult to create a valid business model.
Besides the low returns, the lack of financial resources of WaterPotentieel are widely perceived as a problem, by RWS but also by FishFlow and Witteveen+Bos and WP1. Surely, a lot can be covered by subsidies, but according to RWS1 and WP1 also those subsidy suppliers have their demands, and it certainly could not all be covered with them. Everyone across the stakeholders agrees, that financial resources are crucial and necessary to obtain the information necessary to apply for the permits, and WaterPotentieel simply does not have them.

Additionally, the fact that RWS does not get any return of it, is perceived as a potential hurdle

by WP2. However, RWS stated that this would not affect their processes, since it is never the case that RWS actively creates returns or direct benefits with such project, as can be seen by the two hydropower projects in Lith and Linne.

Furthermore, claims were made by WaterPotentieel that RWS would not have the budget anymore to invest into the bypass construction. However, those claims could not be confirmed.

A special part of this project is, that the two initiators are ex-RWS employees and that a lot of the agreements the project was constructed on, were gentleman's agreements, as WP3 said. WP2 and FF1 both said, that the fact, that the initiators worked at RWS before, could create hurdles for the project, since those interpersonal relationships could create dynamics that are hard to grasp. Therefore, assumptions were made regarding those relationships, that either the truth sometimes was withheld to not offend or hurt anyone. Furthermore, it could also be that there were negative relationships that could have an affect on the project's progress from either side.
The fact, that the project is based on gentleman's agreements lowers the obligations of any stakeholder and the legal leverage project parties have, since according to WP3, the PPP or instance is not an official legal document. Even the collaboration of WP2 within WaterPotentieel is not based on a contract and no salary or gains for him are defined, which on the one hand might lower the active involvement of WP2 and on the other hand decreases the power of WP3 to oblige WP2 to work on the project.

From this summary it can be seen, that there are several reasons that were not in the project's progress' favour, and that there are also still some misconceptions and different perspectives. With certainty it can be said, that a mix of a lot of different factors might had the project stalled, and there is no one reason to be pinned down. It did not seem that there is one actor who has a complete overview about the current and the past processes and it does not seem that there is one main owner or manager of the project. At the same time it does not seem like there is one party who can be blamed as the main barrier for the project, but that it is the accumulation of mistakes in collaboration from several parties, that combined, slowed don the progression. Finally, several assumptions of stakeholders were made along the project timeline, some of which could be validated through the interviews. Some of them however still stand, and could not be validated nor invalidated.

Besides the different perspectives and assumptions, it can be said, that the preliminary analysis was mostly sufficient and had captured the involved stakeholders. However, the assumed power and interest regarding the stakeholders has to be slightly adjusted and differences between assumptions based on the stakeholders roles and the conclusions that can be made regarding actual power and interest after engaging with them become visible (see Figure 4.5). On the left side, marked with the letter A, the original PIG from Figure 4.3 can be seen. However, the stakeholders, whose power and interest was wrongly assumed are indicated by non-filled boxes.

On the right side of Figure 4.5, marked with the letter B, the new and adjusted PIG is displayed.

Compared to the power-interest-grid created from the preliminary analysis (Figure 4.3) it is noticeable, that the regions of Flanders, Limburg, and North-Brabant have gained a lot of power. Originally they had been placed in the top left corner and hence had been identified as 'subject', since based on the project documents, they were not involved and only mentioned briefly within the processes. The now significantly higher allocated power as can be seen in 4.5 can be explained by the discovery from the interviews, that they could put pressure on RWS by re-requesting improved water levels. Hence, they are able to create a higher urgency for RWS to work on the project. Furthermore, after talking to Sportvisserij it became clear, that they have a very high power within the water sector in the Netherlands, and that they would have a higher interest in the project than anticipated, since it could bring change to the problem of fish mortality SHP is currently associated with. However, they would only become real advocates for the project, if they would see clear planning and proof of how fish-safe the system really is.

Moreover, other than previously expected, the power and interests between the managing companies FishFlow, Wittveeen+Bos, and WaterPotentieel differ quite largely. Eventually, as being the main initiator, and the main owner of the project, WaterPotentieel would have the highest power among them, to bring the project forward. However, due to their lack of commitment, it appears that they themselves do not have the highest interest in succeeding. FishFlow Innovation, has less power, since they were restricted by WaterPotentieel to talk to RWS. Furthermore, their interest has deteriorated along the project-timeline, since other projects came up, that ensured them revenues and possibilities to use their screw-pumps in RES projects. Witteveen+Bos was mainly involved to help FishFlow. Since they would have never yielded much from the project, the interest got lower.

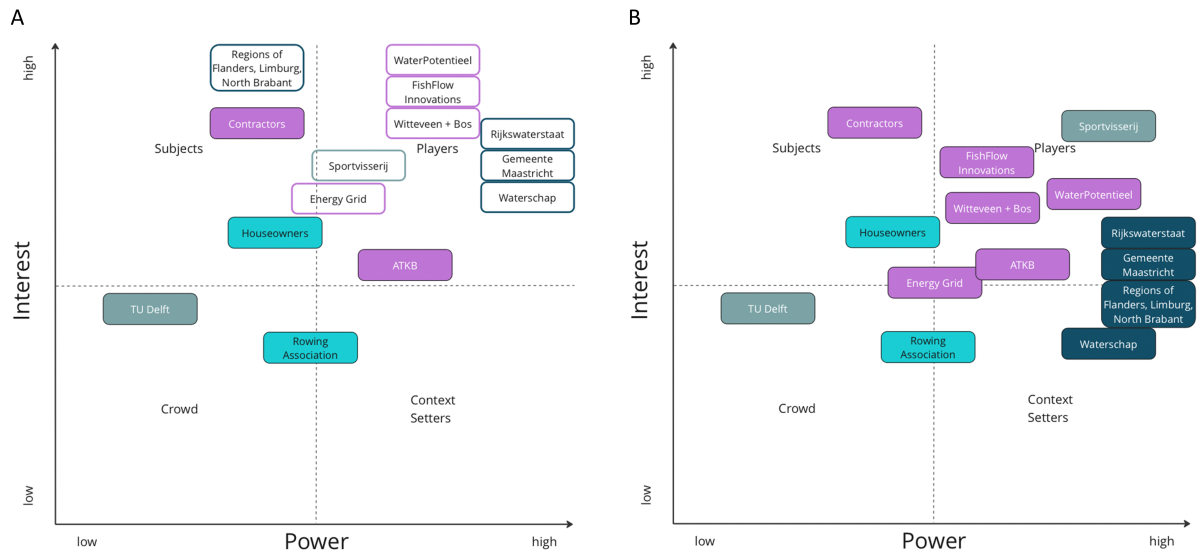


Figure 4.5: Updated Power-Interest-Grid including stakeholders' perspectives

4.3.5 Results Crucial Factors from the Bosscherveld Stakeholder Dynamics

As could be seen in the previous section, the stakeholders identified several different factors and circumstances as influencing the over all project's progression, mostly negatively. Three of the factors were mentioned by the majority of the stakeholders being *Commitment*, *Drive*, and *Resources*. Besides those three factors, several different factors were either mentioned directly, belonged to a certain theme of statements that explained the same area, or could be derived by comparing the statements to the ideal expert model. A list of factors identified from each stakeholder interview can be seen in Figure 4.6.

Factors	WP1	WP2	WP3	FF1	WB1	RWS1	RWS2
Drive	X	X		X		X	X
Need	X	X				X	X
Vision	X	X	X				
Resources	X	X	X	X	X	X	X
Interpersonal relationships	X	X		X			
Subsidy schemes	X						
Personal arrangements	X	X	X				
Permits	X		X		X		X
Legal obligation	X		X				
Changing personnel	X	X	X				
Ownership		X	X	X	X		
Environmental contribution		X				X	
Developments policies in macro-environment		X					
Yield / Incentives		X	X		X	X	
Focus of stakeholder		X	X				X
Commitment	X		X	X	X	X	X
Planning			X		X	X	
Trust			X				X
Continuity of communication					X		X
Business model						X	
Responsibilities						X	
Pro-activity				X		X	X
Grit				X			
Time						X	

Figure 4.6: Overview Factors and Stakeholders

Those factors and additional dynamics then have been captured and clustered into themes in Figure 4.7. Subsequently, those factors and the dynamics of how they are influencing one another are condensed and described.

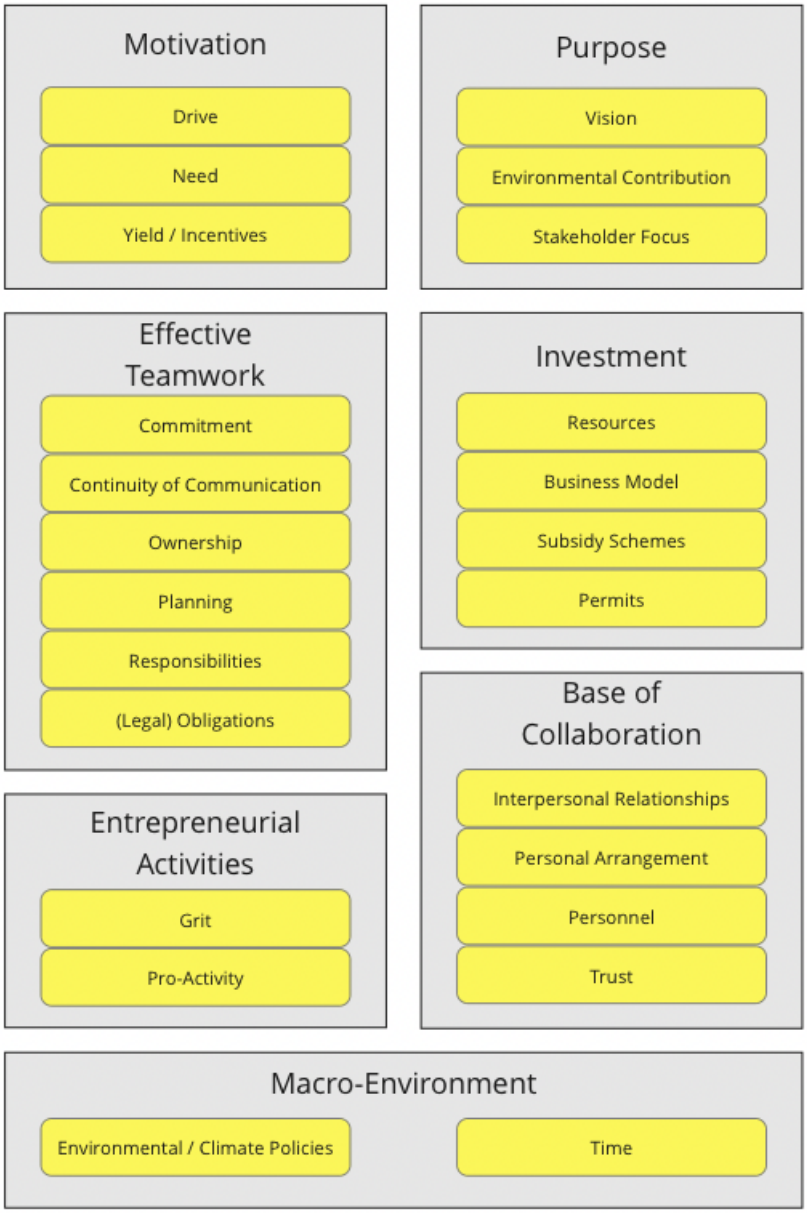


Figure 4.7: Clustered Factors and Themes

Motivation

5 out of the 7 involved stakeholders have identified the *drive* of certain other stakeholders in the project as being one of the main causes for the lack of progress. The drive, or the main reason for the involvement of a stakeholder can be hard to grasp however it consists partly of a need and can also be influenced by the yield or an incentive a stakeholder can achieve with taking part in the project and once it is successful. All those factors can have an effect on the motivation of a certain stakeholder, depending on their role and personality. Apart from the more quantitative factors like need or yield, drive can add a personal perspective and values to the theme of motivation, like passion and the believe in contributing to something bigger.

Purpose

The theme motivation and also the previously mentioned drive is directly influenced by the fac-

tors belonging to the theme purpose. With the purpose a stakeholder sees behind the project, their motivation can be either higher or lower. The feel of purpose for a stakeholder can be build up by the three factors that belong to the theme.
It has been mentioned several times by the stakeholders that the vision behind the project plays a crucial role, and more specifically, the ability of collaborating stakeholders to share this vision. That is partly because the environmental contribution, meaning the positive impact on the energy system of the SHP with the electrical capacity it generates, is considerably low. Therefore, the initiating companies say that in order to contribute to the sustainable developments of the Netherlands or even globally, the vision, that the system could be deployed widely must be shared. This could be easier if the direct environmental contribution of the project was higher.
Lastly, a stakeholder's general focus can create the feel of purpose for their contribution to the project. If for instance the main focus of RWS' work was positive contribution to a renewable energy system, the employees working at the institution, would see it as their mission to focus on such a project and assess it from that angle. However, as stated earlier, their main focus in the water sector is the maintaining of the correct water levels.

Effective Teamwork

Every project party obviously recognized the multiple, long gaps along the project-timeline. The majority sees the commitment and working attitude of other parties as one of the biggest hurdles for the project's success, which goes in mutual directions, meaning RWS blaming the companies not being proactive and the companies saying RWS would not be committed to the project and slow down the processes. According to both sides, the continuity of communication is lacking, which affects the project's progression, especially compared to the beginning of the project, where communication was more frequent. The lack of communication, is a breeding ground for negative assumptions regarding why the other parties are nor working, mostly concluding in the other party not being committed enough. If especially the initiating party is perceived as not being committed, shows lack of ownership of the project, and makes it more difficult for other stakeholders to believe into the possibility of them achieving the vision. Not having a real project owner can result in not having someone who sees themselves responsible for creating a clear project plan which includes certain milestones being the achievement of the permits for example. Further, someone who clearly identifies and divides roles and responsibilities and hence obligations is missing. This division of responsibilities however is crucial to know who is in charge of which part of the project's progression, and who could be held responsible in case things are not how they should be. This is only possible, if certain obligation had been defined. Ideally, those obligations wold be defined witch concrete contracts, so that there is even some legal leverage towards other parties, in case they lack commitment and are not delivering what was stated in the contract.
Besides obligations and responsibilities, compensations should be clearly specified, which in turn directly related to the factor yield / incentives, hence it can enhance a stakeholders motivation to be more involved in the project.

Investment

The lack of resources, mainly financial, has been identified by every stakeholder as being one of the main problems within the project. These financial resources are mainly needed due to the high amount of information that needs to gathered by the initiating party to be able to apply for the necessary permits. The permits are from several different fields considering environmental impacts on for instance the aquatic ecosystem, but also the effect on the dykes during the construction or if any hazards for shipping or swimmers could be created by the SHP. To cover the multiple fields of expertise engineering companies and environmental assessors need to be involved to gather the necessary information. Those need to be compensated for their work. However, acquiring subsidies can take time and progress needs to be presented when reapplying for them. To bridge gaps when subsidies are not present yet and partners already demand their payments, initial financial resources can be crucial.

The planning of subsidies and financial resources should also be considered during the factor 'planning' from the 'effective teamwork' theme. All in all those ideas should be included in a sound business model, where there is an overview of the investments necessary and the returns that will be created once the project is completed.

The financial planning as well as a valid and sound business model can be crucial for other stakeholders to be able to share the vision and start believing into the achievements aspired by the project initiators. As RWS1 had stated in the interview, for him it difficult to see and share the business idea behind the venture, since he does not know about the financials and what returns can be expected from the SHP plant.

Entrepreneurial Activities

For a technology or its application in an early stage, such as the fish-friendly screw turbine in the SHP plant in combination with the lock-bypass, barriers in the processes of development and construction are natural. To overcome those barriers a certain grit of an entrepreneur is needed to push their project, as had been pointed out by FishFlow. This grit also involves a certain amount of risk-taking, which in turn is related to resources. If the project initiator for instance had more financial resources, he could be more likely to take the risk of investing again and potentially failing again due to RWS not taking good care of the documents. Though the action could also be granted with success. If there are complications or people not working, the initiator needs to try to find solutions for those problems. This relates directly to commitment and ownership of the theme 'effective teamwork'. If it had been defined generally but also through the way of working who is the clear owner of the project, this owner (ideally being WaterPotentieel), would have been responsible to work proactively to keep the project going. This as well was pointed out by RWS, when they said that they are not the main owner, and they do not have the main urge to get the project done quickly, so they would expect more pro-activity from the initiating side, rather than not hearing from them for months or sometimes even years.

Base of Collaboration

As defined by the stakeholders, some factors created an unstable base for the whole collabora-

tion around the Bosscherveld project. One being interpersonal relationships. Especially when different stakeholders are close to each other, it can cause interpersonal dynamics, which are hard to grasp and comprehend from an outside perspective. They could cause positive as well as negative effects. Those negative effects could be due to the circumstance, that they do not want to hurt or disappoint each other by telling the truth in case it is not desirable for one side. It can also hamper the collaboration when people just personally do not like each other and therefore do not want to help each other because of that. Both are possibilities and assumptions stated by WP2 and FF1.
Furthermore, the fact of not having concrete contracts but having many parts of the project based on personal arrangements or as called by WP3 "gentleman's agreements", can build an unstable foundation for the collaboration. This directly connects to the necessity of planning and legal obligations as described in the part regarding 'effective teamwork'. Especially when building a project on personal arrangements, it can cause barriers, when the personnel those arrangements was constructed with, leaves the institution or moves into a new position. Then it becomes difficult to work with the new personnel in the position on arrangements that were done with someone else. Particularly if then there are no valid legal documents regarding the collaboration, it can hamper the progress or even bring the project to a complete halt.
Finally, between the stakeholders there must be trust in each other's abilities and commitments. If within a project the trust between parties gets distorted it can have tremendous effects on other factors and hence project dynamics. In the Bosscherveld project for instance the trust from WaterPotentieel in RWS working-attitude got disturbed when RWS lost project documents that were sent to them to apply for the permits. Because of the resulting delay reapplications for permits became necessary. Now, the project initiator, WP3, is hesitant to invest more money to reapply for the permits, since he cannot rely on the whether RWS will take good care of the documents this time or not, and his money would be lost. At the same time, RWS has lost trust or belief into the seriousness of WaterPotentieel and even if at some point everything necessary was prepared, if they would be able to realize the project, let alone the ambitious vision.

Macro-environment

Climate policies were identified to be in the right direction and in favor of the project, due to the need of transforming the Dutch energy system into a sustainable, preferably carbon neutral one. Simultaneously, environmental policies especially regarding water systems, are not necessarily disinclined towards the project, however the policies to protect the water systems made a variety of permits essential that need to be granted before being able to build. Therefore, RWS, mainly RWS1 has identified, that the timing for such a project can be crucial, and that with the increasing duration it takes, the uncertainty about new environmental laws that might make the project implementation more difficult increases as well. As an example he took an upcoming policy regarding the sufficiency of the dykes. Due to the growing danger of floods in Limburg, especially boosted by the floods of the recent years, the requirements for dyke protection, also during the construction phase, might rise. This could hamper the project, since the bypass would need to pass through one of those dykes.

The above explanations and interconnections are further refined and displayed in Figure 4.8. There it can be seen, that an additional clustering into factors that mainly support collaboration, factors that describe the stakeholder interest and factors that overall build the foundation of the venture was undertaken. Through that, the factors could be visually divided into aspects that ought to be present at the beginning of the venture that create a base to start. If some of those factors are not existing at the start they should be cultivated early on or a sound planning on how to obtain them should be present. The factors belonging to supporting collaboration are influencing the quality of the teamwork during the project. The area of stakeholder interest includes the factors that continuously need to be checked and reassessed by the project team, to have the position and motivation of each stakeholder clear also along the project process.

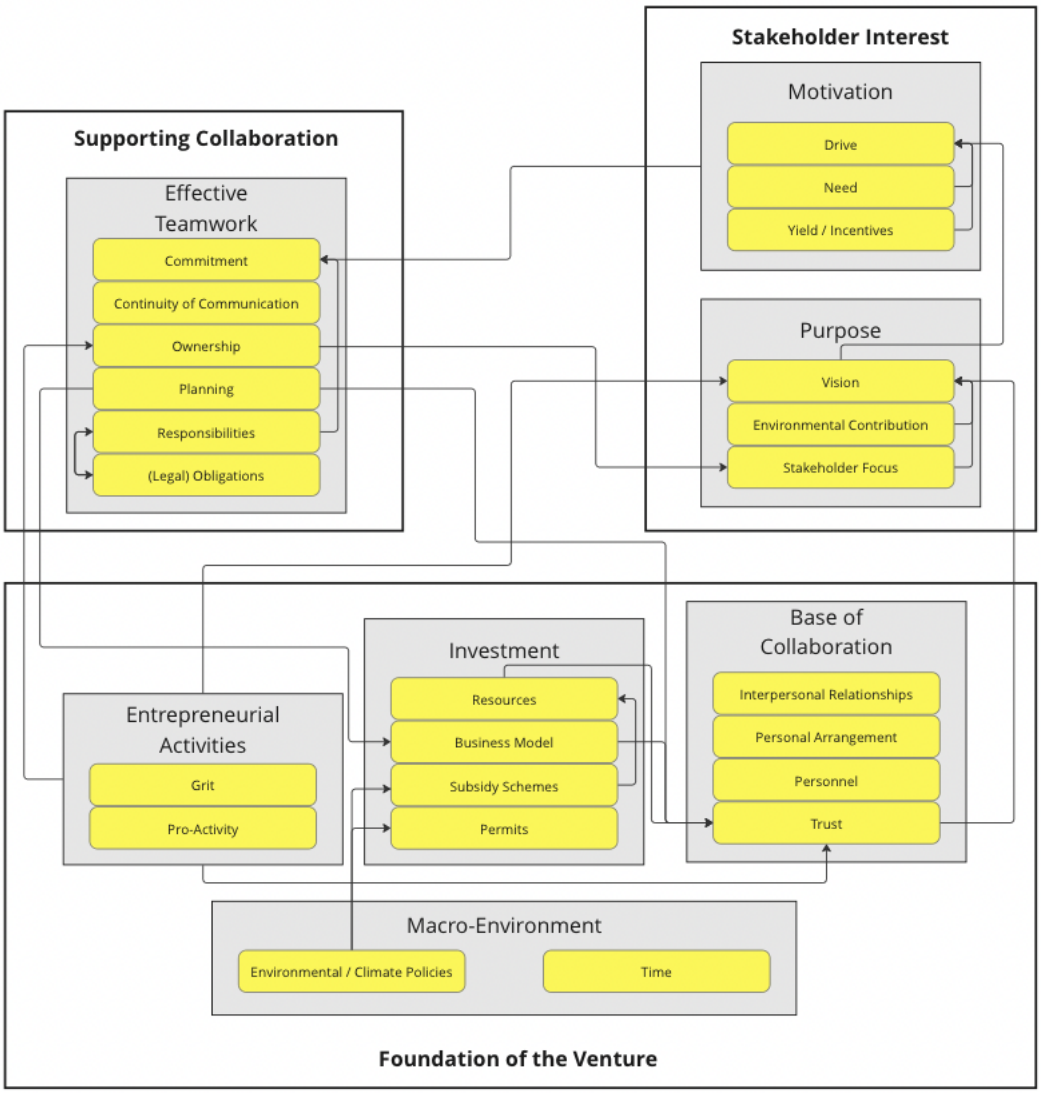


Figure 4.8: Factor Influence Diagram

4.4 Adapted Framework Application & Adequacy Assessment

To see to what extent the from the interviews identified factors are covered by the TIS framework of Ortt and Kamp (2022), and hence if it is adequate to be used for such projects, it was briefly applied to see, if all the dynamics described in the previous section could be captured. While applying, it was mainly focused on the building blocks and influencing conditions that include a stakeholder view. Since the identified factors and dynamics are mainly stakeholder related, the other building blocks and influencing conditions could be neglected within this analysis.

4.4.1 Framework Application

Product performance and quality

The building block product performance and quality is not focused on stakeholder involvement, however it does look at how the technology is perceived by customers based on its performance. With the information given, it can be compared to competing solutions.

The solution at the Bosscherveld lock with FishFlow's turbines is of high quality and high durability resulting in extremely high efficiency. Furthermore, compared to other present SHP solutions in the Netherlands they have the unique characteristic to be 100% fish-friendly. However, if assessing the product performance based on the overall generated electricity, compared to the other SHP solutions as well as other RES such as wind or solar, the system at the Bosscherveld lock is lower, due to the low head difference of approximately 4m. Though, if the performance is measured regarding their water level management capabilities, compared to the Voedingskanaal, or especially just the lock considering the Voedingskanaal would not exist anymore, the performance can be considered fairly high.

Network formation and coordination

The building block network formation and coordination is focused on potential stakeholders of the company, however mainly on actors and their coordination along the supply chain necessary to create the final product. Ortt and Kamp (2022) describe, that besides the coordination of the actors, a shared vision regarding the innovation and TIS is important. Regarding the Bosscherveld project the supply chain for manufacturing and delivering the turbines would be mainly the responsibility of FishFlow. They had once stated that, due to Russia's war in Ukraine, currently it can be difficult to get materials quickly. However, in general they have this covered. Furthermore, a shared vision between WaterPotentieel and FishFlow exists, since they both would want to deploy the systems widely.

Customers

Customers are being described as an important TIS building block, where potential customers and their needs must be identified. The customer of an energy system like planned at the Bosscherveld lock, can be seen on several levels. The end-user of the generated electricity is the general public. Though once the electricity is being generated at the SHP, it is being sold through energy traders to electricity providers. However, the party that mainly needs to be convinced

at this early stage is the governmental partner, who grants the permission for building the SHP plant. Furthermore, with the Bosscherveld project being a special case, besides the SHP, the bypass is a side-product of the set-up that would be built by the project companies and partly financed by RWS, subsequently having its ownership transferred to RWS. Especially for the part of the bypass, that makes RWS indeed a customer. This customer's need, needs to be identified. As earlier presented, for the Bosscherveld project, the need of RWS would be having the bypass to be able to control and maintain the water levels for the provinces in the North-East of the lock.

Innovation-specific Institutions

This building block mainly focuses on policies, laws, standards and regulations important for the technology's development and its design. For the Bosscherveld project, two areas of policies are applying. That is one, policies resulting from the Netherlands' strive to achieve the thresholds defined in the Paris Climate Agreement, which results in subsidy schemes promoting those developments. Two, the water framework directive which is aimed on preventing the deterioration of European water bodies and ensuring the integrity of the aquatic ecosystems. From especially the latter one, a variety or regulations in form of permits are present, that intend to cover several areas regarding environmental impact, to avoid undesirable effects resulting from project by or inside the water. Those permits, as discussed earlier, have not been entirely obtained as of today. Besides being a customer of the SHP, RWS being one of the regulators that grants the permits, they are also a part of the innovation-specific institutions, more on an operational level.

Knowledge and awareness of technology

This influencing condition is mainly concerned with the knowledge of the company of their technology, and hence know-how or intangible resources. Some of this knowledge needs to be transferred across actors. Knowledge can be seen as a resource. Within the Bosscherveld project, the project initiator as being a civil engineer who had worked on hydropower stations before does have some knowledge about the area. According to Witteveen+Bos, the new partner inside WaterPotentieel does not have the technical knowledge to go ahead technologically.

Knowledge and awareness of application and market

A good awareness and knowledge of the application and the market it will be in, including the different relevant actors, as well as interacting with them can have positive effects on the project developments. Interaction with the actors surrounding the Bosscherveld project was certainly present, as could be seen from the previous analysis and the interviews. However, there it became also visible, that the interaction had gaps and deteriorated over time.

Natural, human and financial resources

Regarding natural resources, the height differences between the Maas and the Zuid-Willemsvaart canal and the water flow in the area are sufficient to generate electricity with an SHP. Regarding human resources, as could be seen from the interviews, while within FishFlow the expertise regarding the technology and its application exists, WaterPotentieel might be lacking some of this

expertise in order to sufficiently support its development. The area that is majorly incomplete are financial resources.

Competitions

As partly discussed in the building block "product performance and quality" the main competition for the project is either not doing it and hence having RWS relying on the Voedingskanaal or the lock itself to control the water levels. Regarding contribution of electricity to the energy system, the main competition are other hydropower installations, other renewables or even still the incumbent fossil fuel industry, which generates electricity cheaper and more convenient. For the Bosscherveld project itself, other companies that are already operating SHP's in the area (e.g. Vattenfall, RWE) could implement a similar idea there, if WaterPotentieel does not get off the ground. However, they would probably need to change the whole design since they are not in the possession of FishFlow's technology, hence to ensure complying to the thresholds of fish mortality they would need to implement different solutions to do so.

Macro-economic and strategic aspects

The macro-economic environment around the project could on the one hand foster the development of SHP, due to the need for reliable renewable energy systems. On the other hand, the current economic recession could indeed affect the government's and hence RWS budget for the building of the bypass.

Socio-cultural aspects

With those aspects norms and values of potential customers as well as other stakeholders can be captured, that are more informal compared to what was captured in the institutions-section. The water sector in the Netherlands has a long history and reaches back centuries, due to their need to free land from water in order to use it as agricultural land. Therefore, also water authorities are present since a long time and have grown in structure and complexity. Within this water system there is RWS, which is responsible for building, maintaining and improving the national water ways. For those water ways it is their duty to ensure the water levels necessary to ensure industrial and private shipping on those water ways. To realize those responsibilities, especially in the past, sometimes sophisticated engineering solutions were needed, an example of which would be the delta works including several storm surge barriers, that became necessary after a great flood in 1953. However, according to some stakeholders from WaterPotentieel, but also from RWS, their focus is changing from being great engineers trying to solve crucial problems, to a company that mainly deals with asset management and maintenance as well as contracting. At the same time, the inner structure of RWS is changing, where the know-how is becoming more centralized in the headquarters in Utrecht, causing experts not being in close proximity to local projects anymore. The company side within the Bosscherveld project now suspects, that if RWS still had the know-how and the engineering focus from before, they might have been more interested in developing the SHP solution, since it is according to RWS1 "a charming technological idea".

Furthermore, within the socio-cultural aspects, the way of doing business within RWS can captured and how it changed today, regarding personal or gentleman's agreement. According to WP3 in the past gentleman's agreement were used more often, project parties took them seriously and stuck to what was agreed on there. Nowadays, according to him, this has changed and in more contemporary times they are not used that much anymore, due to issues that were created through agreement-parties trying to change what was given consent to earlier.

Accidents and Events

This final section focuses on internal or external accidents or events that can have an impact on the other building blocks of the TIS, negatively or positively. Currently, Russia's war in Ukraine has certainly an effect of many different systems. Through the dependency of Europe on Russian gas, suddenly the possibility of energy scarcity or even potential black-outs were discussed. That comes with positive and negative effects for renewable energy developments. It became clear that society is still far of to rely fully on RES due to its general deployment but also due to the intermittency of many renewable energy solutions. As shown earlier, hydropower is not prone to intermittency, however the lack of direct electricity contribution of the Bosscherveld project, could also lead the focus on other, bigger and more easily accessible solutions such as natural gas.

Simultaneously, effects of climate change also in Europe are gradually more noticeable which leads to an increase of climate protests and hence the urge also by politics towards society to concentrate more on promoting those solutions.

Project conclusion based on the adapted framework

When applying the TIS framework after Ortt and Kamp (2022), first the building blocks are investigated. If all building blocks are sufficient, the diffusion of the technology should be of no concern. If they are insufficient, barriers might be created. These barriers can then be explained by looking at the influencing conditions.

As could be seen from the application of the framework, regarding the building blocks, product performance and quality is partly sufficient. The Bosscherveld project and the fish-friendly turbines that would be used have some clear advantages compared to direct competing technologies. However, compared to other RES such as wind and solar or compared to the Voedingskanaal (which implies not building the SHP) there are valid concerns regarding effort and return.

As described above, the building block of network formation and coordination appears to be sufficient.

For the building block customers it is important that potential paying customers and hence a need is present. For the Bosscherveld project, this is partly sufficient. First of all, currently there is a general need for RES in the Netherlands. Furthermore, RWS technically needs the bypass to ensure and improve the water levels after the lock. However, as was seen from the interview results, RWS does not see the Bosscherveld project as being able to satisfy the need for renewable energy, since they would want to aim more for windparks to cover it. As could be seen also the need for the improved water connection is less apparent, since the authorities who

first had it, never followed-up on it.
Regarding the innovation-specific institutions, the building block is partly sufficient in the way that the environmental policies resulting from the Paris Climate Agreement can act as a support for RES developments. Simultaneously, the European Water Framework Directive can make things more difficult for working on projects that interfere with aquatic ecosystems, since more permits are needed.

The influencing condition natural, human and financial resources, affects the building block product performance and quality in the way that, if there was a bigger height difference present at the Bosscherveld lock, more electricity could be generated. This would then have an effect on the perception of the venture by the customers, and how they compare the solution to other alternatives.
Within the influencing condition of knowledge and awareness of application and market it was identified that actor-interaction can foster positive developments. What was seen in the Bosscherveld project is, that the interaction with RWS had gaps and deteriorated over time. This could have had an effect on the building block customers and how they perceived the solution compared to other solutions, since they did not believe in the project to happen anymore.
The competitors being an influencing condition, influence the building block of product performance and quality, since as being discussed above, there are alternatives to the Bosscherveld project, that either imply higher electricity generation or less overall effort.
The macro-economic and strategic aspects condition can have an effect on the innovation-specific institutions, being governmental policies to cope with the rising renewable energy demand. Furthermore, the current economic recession, might influence the customers assessment of the necessity of an investment in the technology and hence influence the urgency of the need. That might also account for RWS since future budgets are therefore uncertain.
Since within the socio-cultural aspects it was described how the water sector has formed overtime, explaining the main responsibilities of RWS, it has an effect on their, and hence the customer's, need. Having the duty of maintaining and sustaining the right water levels within the country, the need for the bypass around the Bosscherveld lock is present. However, it also decreases the perception of the need for the SHP as a RES, since RWS has never been eager to work in that field, but had the main focus on the water system and not on energy production.
Accidents and events with regards to the current Russian war in Ukraine, influence the perception of the product performance and the need for customers. With having to face potential energy scarcity, RES development could be supported. Though, it can make the competition being cheaper and more secured energy from fossil fuels more attractive again, hampering RES improvements. However, at the same time, climate protests create a bigger urge and need for fostering its developments.

4.4.2 Framework Adequacy

As has been discovered earlier, especially in energy transition related projects, stakeholder dynamics can be decisive and hence, are crucial to be considered by a company. To know which stakeholder-related aspects are specifically important for a company to consider within these projects, the previous analysis resulted in the factors presented in Figure 4.7.
With having applied the framework by Ortt and Kamp (2022) on the Bosscherveld project in the previous section, it can now subsequently be shown, how well all the aspects pointed out by the stakeholders are covered within the framework.

For that in Figure 4.9 it has been visualized which factors have been covered fully (blue) and which ones have been discussed partly (turquoise). The factors that remained yellow, are the ones that were not included based on the framework application.

Covered Factors
The framework covers the factor resources fully, saying that having the right amount of human, natural, and financial resources can influence the developments positively. Especially financial resources were a decisive factor within the Bosscheveld projet. But also know-how and hence the ability to transfer the idea and promote it is seen by Ortt and Kamp (2022).
The permits, that have been pointed out by multiple stakeholders to cause problems with the project's progression is covered with the building block innovation-specific institutions, since they come from laws and regulations that need to be considered for the SHP systems.
Those permits are influenced by environmental and climate policies. Therefore, they are also covered by the building block innovation-specific institutions, though are also influenced by the macro-economic and strategic aspects as well as accidents and events, that can cause a change in those policies.

Partly Covered Factors
Discovering the need of a stakeholder is partly considered within the framework. However, it is only focused on the customer of the technology and does not indicate that it is important to understand the needs of the actors surrounding the technology or the implementation project.
Within the framework it is talked about vision and that this vision must be shared among stakeholders. Yet, the focus mainly lays on stakeholders involved in the supply chain of the technologies and does not include the vision of for instance important decision makers in the technology's pathway.
The area of environmental contribution of the project is partly covered by seeing this contribution as a competitive advantage over other solutions in the market or as a decisive factor for customer, or in the Bosscherveld project RWS to choose for the solution. Nevertheless, a stakeholder's environmental contribution as a person is neglected, although it could be why he or she becomes involved in and possibly promotes the project, since it might be seen by him or her as part of his or her personal purpose or goal.
The stakeholder focus is partly mentioned through the influencing condition socio-cultural as-

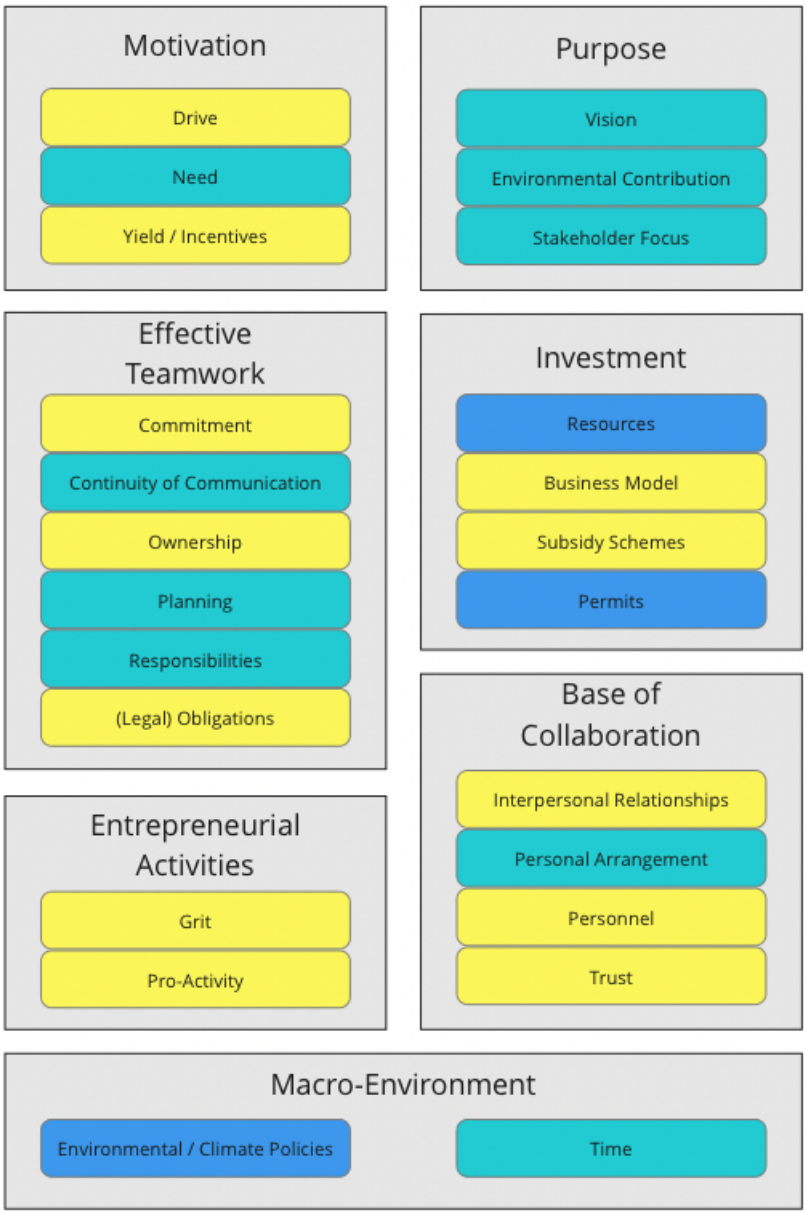


Figure 4.9: Sufficiency Framework - Factors and Themes

pects since it shows how structures within an organization or society can have formed this focus. Such as how RWS's focus was formed and now currently is changing.

Within the influencing condition knowledge and awareness of application and market, it is stated that interacting with stakeholders is important. Nonetheless, no clear guidelines are stated. It is not clearly mentioned regarding what interaction is important and if it is supposed to be on a continuous bases.

Regarding planning, the building block network formation and coordination, provides that along the supply chain sufficient coordination must be present. However, it neglects coordination of every involved stakeholder and also the other parts necessary for planning like for instance a clear role division and milestone planning.

Just as the stakeholder focus, also the responsibilities are partly covered by the socio-cultural

aspects of the framework. Due to those aspects, specific responsibilities for roles can be formed. Certain values can also influence the feeling of being responsible for something. Still it does not include the focus and interconnection to the planning and the necessity of responsibility division. Besides the stakeholder focus and the responsibility factor, also personal arrangements as being influential for the project's success, can partly be explained with the socio-cultural aspects. The fact that they exist come from older and collegial working structures, that nowadays, and especially once the stakeholders were not colleagues anymore do not withstand anymore.
Lastly, time is partially being covered by the conditions accidents and events and macro-economic and strategic aspects. Those conditions can of course create an environment, where, if timed right, the policies can promote the development and deployment of the technology. However, it neglects the process component looking at the duration of the project itself as being of concern for the success of its development. Time also includes, that due to the length of the project problems can arise, that partly can be because of policy changes, but also connecting it to the motivation of stakeholders and the trust and belief they still have into a successful implementation.

5 Conclusion

The goal of this research was to answer the at the beginning of this report expressed research question. With the results from the previous chapter, this research question is subsequently attempted to be answered.

5.1 Main Research Question

The main research question was: *What are the factors related to stakeholder participation which are pivotal to the outcome of a particular small-scale hydropower project in the Netherlands?*

The most crucial stakeholder-related factors that influenced the project's progression were identified in several steps, first looking at the structural components of the technology innovation system and then doing a stakeholder analysis based on a power-versus-interest grid identifying the most important stakeholders for the project. There, the power and interest of the actors were assumed based on their roles and a preliminary analysis of project documents. Following this, semi-structured interviews were conducted to understand the actual project processes and the different perspectives of the involved stakeholders better. This lead to an expert model, where the optimal project processes are captured and certain responsibilities of stakeholders were noted. Based on that, a more accurate power-versus-interest grid could be created. From that and the general interview conclusions, it can be inferred that the most crucial stakeholders are WaterPotentieel, being the main project initiator and responsible for pushing and promoting the project, Rijkswaterstaat, being partly project owner and gatekeeper over the water system and Sportvisserij which has a large legal leverage and the resources to stall certain projects in case they are not in line with environmental thresholds. Lastly, the municipality of Maastricht as well as the provinces of Flanders, North-Brabant and Limburg would have the power to create bigger urgency for the project since it has been their request for improved water levels that started and brought it on RWS' agenda. Their lack of involvement deteriorated the commitment of RWS.
The aspects of stakeholder-participation that served as barriers or support within the SHP project were derived from the semi-structured interviews with the previously identified stakeholders, where the focus laid on the perceptions of the stakeholders regarding project processes and hurdles they had experienced. Those aspects were clustered and summarized in Figure 4.7.

To answer the research question it can be said that there is no one factor within the stakeholder participation, that created a barrier. Also can it not be said, that a small amount of factors created the halt of the project. The factors that were mentioned by the majority of the stakeholders, being more than two thirds, are:

- Drive
- Resources

- Commitment

However, those factors are embedded in a variety of different factors that can be seen in Figure 4.7, which are all interconnected and influence each other as seen in Figure 4.8. Although, the lack of commitment for instance was perceived by the majority of the people involved in the project, it can be seen more as a result of the combination and interaction of other factors such as the lack of vision, lack of pro-activity and the low drive of the stakeholders.

Overall, the in total 25 factors could be clustered within certain levels, resulting in three main units that are pivotal for a project to be considered. Those are the factors that build the **Foundation of the Venture**, the ones that mainly **Support Collaboration** during the project processes, and the ones that attempt to further decrypt the **Stakeholder Interest** including the personal drive but also the theoretical role's focus.

Therefore, it can be concluded that there is no one or a few factors that are pivotal for the outcome of the SHP project, but more a combination and interaction of numerous different factors.

5.2 Inferences and Relevance

Besides the answer to the main research question, it can be concluded that, although the adapted framework by Ortt and Kamp (2022) incorporates a managerial perspective for a company to find guidelines and support to bring their technology into large-scale diffusion, for a technology that is used in a system where several stakeholders are involved in the system-development processes, it is insufficient to capture all the important factors. It neglects guidelines on what specifically needs to be looked at by the company when working with several stakeholders that are necessary to complete the implementation. Therefore, from this specific project it can be learned, that the framework by Ortt and Kamp (2022) does not cover all the stakeholder-specific factors necessary to ensure smooth project processes towards a project completion. However, it does cover the factors *Resources, Permits,* and *Environmental and Climate Policies* fairly well. As a result from this research it can be inferred, that within projects including several stakeholders whose perspectives need to be included, it can not be used as a stand-alone tool, but would need some extension on itself or supported by other stakeholder engagement methods.

The assumption that the adapted TIS framework could be used to investigate an SHP project was based on the fact that a usual TIS framework is well suited to study sustainable transitions however lacks guidance and a company perspective, which was implemented by Ortt and Kamp (2022). This mixed-framework approach consisted of the macro-level policy focus of the TIS and the micro-level focus of stakeholder analysis, investigating individuals' beliefs with looking at mental models. Throughout the research, it became clear that for energy transition projects there is an interplay between those levels. Supporting policies are needed in order to push certain technologies and projects, but individuals working on the projects, either within the companies or on the operational level of the institutions, need to implement them. Therefore, to contribute

to the ability of companies working in the field to improve their strategic orientation or for investigating such a project as a researcher it is therefore pivotal to have a view on both areas, the special individual circumstances and the policy view the TIS includes.

Further it can be learned, that as the project initiator, as long as not all the responsibilities for the project management are transferred to a consultancy, they are the main project owner and need to act like one. They can use the in Figure 4.7 defined factors to look at themselves and the different stakeholders involved in the project and investigate their positions regarding them. Additionally, they can examine and ensure the right project foundation by looking at the macro-environment, but also with ensuring the right planning and setting up valid contracts. They need to have their own motivation for the start-up clear and have their vision defined. With a solid planning, a clear responsibility allocation, and a sufficient idea of the different needs and drivers of the diverse partners within the project, they need to make sure that their vision can be shared by the partners so that they see and connect to the purpose of the project. Within the planning, a realistic overview of the resources and the business model as well as a consideration of the permits and milestones must be included. Since the project's progression is the initiators main responsibility, they need to be the one to be pro-active, show grit to circumvent upcoming barriers and to push the project forward. Based on that a proper co-creation in the project can be established.

These inferences are focused on this specific case, however for instance the expert model can be helpful for any energy transition related project, where partnerships between private companies and public institutions, or other institutions that grant permits for the construction and operation phase, are necessary. It can be used as a guideline for the planning or the project pathway. Also the identified factors are generalizable for such circumstances, since they are valuable to foster productive and efficient collaboration, point out the main resources and conditions that should be present when starting a venture, and show what to look for within the other actors of a project to understand their interest.

However, just as within this project there is the particularity of the interpersonal relationships between the project initiators and RWS, there might be other unique features in projects that are investigated in the future. Therefore, every case should still be looked at with care, and major differences or special circumstances should be taken into account.

5.3 Conclusion Bosscherveld Project

Besides answering the research questions an important part of this research was finding out what stalled the project in general, and based on that which recommendations could be given to the companies working on the SHP, to still make it a success. As discussed earlier, to explain the project's halt, there is no one or a couple of factors that can be framed as the main reason. It is rather an interplay of several aspects influencing one another that led to the lack of progress.

Looking at the network of factors from Figure 4.8 the different clusters can be used to explain the main problems of the project.

Starting with the Foundation of the Venture on hindsight it can be said, that some crucial factors necessary to build a solid base for the undertaking were missing, while some were in favor of the project. Looking at the macro-environment, the project initiators had the right timing, and climate policies regarding resulted in subsidy schemes that could be used for the development of the project. At the same time however, in order to protect the Dutch waterways from an ecological side, numerous permits needed to be necessary, which were costly. From the beginning it was clear, that the financial resources were not present, and a sound business plan, taking into account the investments and returns was missing, or at least was not presented to RWS. Furthermore, despite having the idea for the project, entrepreneurial behavior was lacking, meaning that the pro-activity and the essential grit of the project initiator was flawed, which could have improved the whole continuity of the project. The base of collaboration was unstable, as turned out later on during the project. Most of the project, due to the collegial relationships between the initiators and the project partners from RWS, was based on personal or "gentlemen's" agreements. Furthermore, contact persons were hard to define, since from the side of RWS personnel was changing continuously and the people, who those agreements were made with, were not in the same position anymore. The new people in the responsible positions, where not as big supporters as the previous ones and appealed to the agreements that had been made before. Lastly, at the beginning of the project the partners trusted in each other. However, over time due to it becoming clear that resources were missing and increasing response times from both sides - WaterPotentieel and RWS - diminished the belief into the the project still being wanted from the collaborators.
Finally, for the Foundation of the Venture it can be observed, that many of the included factors were not and still are not satisfactory, which creates a fragile base the project was build upon.

Regarding the collaboration and teamwork among the project parties, it can be seen, that non of the factors was fully supporting a fruitful collaboration. As stated by the interviewees, there was a lack of commitment from WaterPotentieel as well as from RWS, which had different reasons regarding the perception of the need for the project for RWS, but for WaterPotentieel it is hard to reason for. Furthermore, from a certain point the continuity of communication between the project parties dropped drastically, which was influenced by the lack of ownership of the project initiator and the lack of the previously discussed pro-activity, which WaterPotentieel as being the owner of the venture would need to have brought to the table. Moreover, a real project planning was missing, which could be seen in the lack of a sound business plan, and affected the trust from RWS in the capabilities of WaterPotentieel to go forward with the project. Lastly, since the collaboration to a large extent was based on personal arrangements, no definite contracts with defined responsibilities and hence obligations also from a legal perspective were and are not given. This in turn also affects the commitment of working on the project, since for no one within the project it is a designated duty.

The stakeholder interest has certainly changed over time, with RWS having less of a need or at least less urgency for building the project due to the lack of pressure from the first requesters for improved water levels. But also for the project initiator as well FishFlow the need for the project has decreased. FishFlow could have gained a lot of additional revenue from potential projects resulting from the success of the Bosscherveld venture. However, with time, they found other ways and project, in which their technology can be applied. Although the project was started with the vision, that the concept could be used all over the country to help decarbonizing the Dutch energy grid, a real need or necessity also for the initiators was not present. In fact, it was first initiated with the idea to stay busy during their retirement. Furthermore, for some of the project parties (i.e. Witteveen+Bos and RWS) no real incentive or yield would have resulted from the project's success and the implementation would have needed to be driven by altruistic behavior. This could have been positively influenced by a higher environmental impact and an easier to share vision, creating the feeling of purpose behind the project and for the stakeholders the impression of contributing positively to something. Since the contribution the initiators are aiming for, does not necessarily align with for instance RWS' usual focus, being the water level management, the vision is harder to perceive affecting the sense of purpose for them. Additionally, factors from the other clusters hampered the sharability of the vision, being among others the lack of resources, pro-activity, planning, business validity, and the age of the initiators. Though, since the contribution of the SHP project are comparatively low, for stakeholder to be committed, it highly depends on the vision to be shared among them.

5.4 Recommendations Bosscherveld Project

Based on the analysis, the applied tools and the results, final recommendation regarding how the project could be improved can be made. In general, as concluded in the previous section, with looking at the factors and seeing how the actual project processes have differed from the expert model seen in Figure 4.4, some things did not go right within the project. Any of those aspects that can get fixed would help to get the project started again, but more specifically, the following actions could improve the current halt-status and restore a flowing project.

Involve the right stakeholders

Since the project companies do not have any leverage over RWS to speed up their processes, they could create more urgency with involving the provinces that had initially asked for the improved water levels. As could be seen in 4.5 they have more power within the project, than previously expected. If provinces put higher pressure on RWS by demanding a solution for better controlled water levels, it could increase the commitment of RWS.

Another way to increase their leverage would be through close involvement of Sportvisserij. As known from the interview with the lawyer from the association, they have large resources and do not hold back to use them in legal cases. Although so far there has not been a legal violation, they could become a strong advocate also on the path towards reaching their vision, once

the project companies convinced them with showcasing how fish-friendly the system would work.

Get things straight with RWS

The project companies and RWS currently find themselves in a stalemate situation, where both sides are blaming one another for not pursuing the project and not being committed enough in order to make it work. Assumptions on both sides have arisen regarding budget limitations or the need of the project in general. Before continuing to work on the project, those assumptions or maybe partly misassumptions need to be clarified so that it can be started with a clean sheet again. The interest and need as well as the urgency for the project, must be honestly discussed. Then, it should be honestly assessed whether the parties still believe the project will be happening or not, and what finally would need to be done for it to progress and to be finished.

Improve planning

After the steps that need to be undertaken have been defined, an entire and complete planning must be done, including a transparent assessment of which (financial) resources are necessary, where they would come from and hence whether the project is achievable. This leads to the point of setting up a sound and honest business plan. Since a lot of this venture is based on a vision, this vision should be quantified and included in the business plan. For instance, WP3 had talked about several sites suitable for potential SHP's after the same blueprint. Those sites should be included in the business plan with cost and revenue estimates, giving RWS and other potential investors a hint of how likely it is to achieve. Furthermore, based on those sites a better estimate on the environmental contribution should be made, making it easier for partners to share the vision.

Improve Collaboration

Once those actions have been taken it should be stuck to the expert model. Along the project processes, WaterPotentieel must take an ownership position and foster intensive communication between all actors, so that the latest status updates can be shared and no doubt arises within a stakeholder, in case certain processes take longer than expected. Within the planning, robust contracts must be considered and signed including milestones and responsibilities regarding who needs to deliver what and when.

6 Reflection and Future Research

Finally, it is being reflected on the research done within this master thesis and potential limitations are shown. From those limitations and the results presented in the previous chapter, ideas for follow-up and future research are recommended.

Robustness of factor derivation

The basis from which the factors have been derived is only one project. This project did not reach its full development and implementation. For studying the factors which might have hampered the project from reaching its construction phase, this was of advantage. However, due to that, the factors are mostly only based on negative experiences within the project, and the ones now discovered to foster a good project flow, were more inferred from expecting that it would be good, if the negative factors had been avoided. Therefore, in order to achieve a higher degree of robustness and certainty about the validity of the factors, further projects should be investigated. There, successful and unsuccessful projects should be examined in order to create a complete picture based on perspectives from all kind of experiences.
With looking at additional projects, the in this research discovered factors can be compared to the ones from other projects and after contrasting the specific circumstances, validated or invalidated.

Include perspectives from Maastricht or the Belgian province Flanders

Within the project processes, the municipality of Maastricht, as well as the provinces that had requested improved water levels more than 20 years ago, were not involved. Therefore, in the analysis of the project documents and neither from the project participants, there was much information about them to be gathered. Unfortunately, in the duration of the thesis, it was not possible to identify and talk to responsible people from those institutions, since according to the project parties they also did not have proper contacts to them. In order to complete the view on the project, all parties that had an interest in it, Maastricht as well as the provinces in the North-East of the lock, should be talked to and their perspectives should be included. With that it could be understood, why they never came to RWS again to ask for the bypass to be used for the water level management. Furthermore, from the perspective of WaterPotentieel they could create the leverage and push necessary to get also RWS to actively promote the project.

Include perspectives from real SHP expert

While talking to the stakeholders involved in the project, no matter if company parties, the employees of RWS or Sportvisserij, no one had a complete overview of the current state of hydropower in the Netherlands. Often there were two examples given of other SHP being situated close to Lith and Linne. However, at some point one in Born was mentioned and Manders et al. (2016) has discovered two more, one in Hagestein and one in Roeven-Nederweert. Once it is really clear, which other sites exist in the Netherlands and which other ventures are currently planned or also stalled such as the one in Borgharen, those locations could be investigated and the hurdles or promoting factors could be identified. With that it could be seen if the case at

Bosscherveld is a usual case and SHP projects are typically that difficult to implement, or if it is rather particular. Showing this expert the here identified factors as well as the expert model, could validate the findings or could unravel room for improvement.

Specificity and stage of the case project

Without having the knowledge of other SHP projects in the Netherlands, it is hard to assess, how special or specific the Bosscherveld project and its processes and circumstances are. However, the fact that it is initiated by two ex-RWS employees does add a level of the complexity when trying to comprehend the stakeholder dynamics within the project. Since it is difficult to assess, whether and how the collegial relationships might have affected the project's processes, the discovered factors must be treated with caution.

Furthermore, it must be considered, that the case project never progressed beyond the permitting stage. Therefore, all factors that were discovered in this research are mainly focused on the pre-project, planning and permitting phase. It can be assumed that the majority of the factors might also be suitable for the construction, project-closing and operation phase, since during all the phases stakeholder interaction will be crucial and resources and planning for instance will be needed. However, once the construction phase starts, the project becomes more visible to project external actors, such as the civil public and residents living close to the project site. From then onwards, and preferably already before, the engagement with the public becomes more important, to please them during a phase of probable noise and visual disturbance.

As a result, it must be taken into account, that the identified factors do not stem from a complete project, where all project phases were included. If in the future, more SHP project are being investigated, also those ones should be included, where all the project phases are present, to see, whether the network of factors would need to be extended.

Suitability of the used adapted framework

The framework by Ortt and Kamp (2022), the discovered factors were compared with, is an adaptation of a TIS framework to support a company, which radically new technology is currently in the diffusion phase. For that a company within a TIS must exist.

Within the Bosscherveld project, the company mainly responsible for the implementation of the system, WaterPotentieel, was founded to implement the SHP at the lock in Maastricht. They themselves are therefore still in a pre-establishment phase. It would mainly be the operator of that SHP and would also not be the owner of the technology, being the advanced screw turbines. This on the other hand would be FishFlow. In this analysis however, since WaterPotentieel is the main initiator, their perspective was taken.

Furthermore, the innovation provided by FishFlow is not a radically new technology, but more an incremental or a process innovation that improved the previous state of turbines. It could still disrupt the SHP market in the Netherlands, however this market is not really existing yet. Therefore, since the framework might not be the perfectly suited one to study this project, it is natural that some areas of the framework do not apply and that it does not cover all factors that were discovered regarding stakeholders. However, it can still be stated that the discovered

factors should be included in a framework for a company acting within the SHP market in the Netherlands.
An additional suggestion for future research here would be to study other renewable energy system projects within the Netherlands, to determine to what extent the factors might be the same or differ, if the renewable energy technology changes.

Bias of interview statements
To add on the previous point of reflection, when using information gathered from interviews, this data always needs to be looked at with care and has to be cross checked. It is expected that the interviewees are genuine, and that they tell what is the reality and how they perceived it. However, their perspectives can be biased, they might hold back certain circumstances to not hurt anyone or not to put the blame on someone or themselves. This possibility can be reduced by conducting interviews with multiple people and to try to understand their viewpoints.
Further, this issue could be lowered, by increasing the data set, hence talking to more stakeholders from multiple hydropower projects in the Netherlands, making it possible to triangulate the recorded statements.

Further investigation of commitment of individuals within energy transition
As has been discussed in the literature, regarding energy transition, an issue is, that the benefits created by the actions taken, due to their currently low performance and returns, are often not captured by the ones investing resources into it. (Fri and Savitz, 2014) Therefore, the commitment of individuals cannot always be driven merely by monetary incentives and profits. Instead, it might be driven by altruism, the feeling of purpose or simply an imposition of a higher level (e.g. higher institutional level, management).

Looking at the investigations within the TIS framework and as can be seen in Figure 4.2 there is a clear orientation of the government towards RES. The ministry's executors however (in the case of the Bosscherveld project RWS), while saying they want to become climate neutral in 2030, do not directly state how they would contribute to the energy transition. The two RWS-employees interviewed during the project investigations stated as well, that their main responsibility is maintaining the water infrastructure and the water levels. In regards of renewable energy production, if there was a movement towards it, they would, according to RWS1 probably focus on wind parks instead of the development of local RES. Hence, the vision or mission of RWS in terms of renewable energy contribution, appears to be vague and undefined, which might not be enough to create the necessary ownership and commitment needed to support such a project.

It would be interesting to investigate further, exactly what the goals on each institutional level are and precisely which steps are planned to be undertaken to reach those goals for renewable energy development. Based on that, it could be further looked at, how it is intended to create commitment and agency from the operational employees within the institutions for the energy transition, since presumably, non of them would benefit directly of it.

For this kind of investigation, a tool or framework with an integrative approach that can provide a holistic view combining macro- and micro-level perspectives would be beneficial. With this framework, an alignment of the goals and visions on each level could be favored.

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A Preliminary Project Timeline

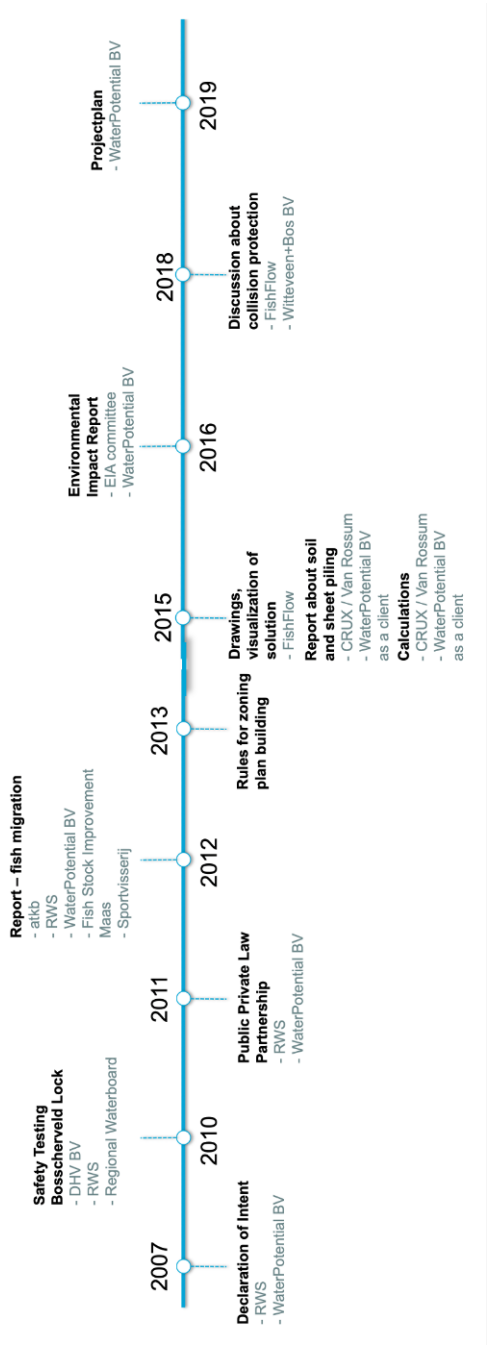

Figure A.1: Preliminary Project Timeline

B Interview Summaries

In this Appendix the conducted stakeholder interviews are being summarized. The participants are categorized by the companies / the institutions they work for.

B.1 WaterPotentieel BV

B.1.1 WaterPotentieel Project Participant 1

Background Information

The interviewee is an retired Rijkswaterstaat employee, who has worked at RWS since 1970 and now is between 65 and 75 years old. In his career at RWS, he moved several times within the Netherlands to different and had different job descriptions. He ended up first being the head of the district Maastricht and subsequently became the head of the RWS in Limburg. After two serious floods happened in the area of Maastricht in 1993 and 1995, his main job was to manage the widening of the Maas (Grintmaas to Zandmaas) in order to protect the area from additional floodings. Within this project (1995 – 2005) he was mainly responsible for ensuring the collaboration of all the actors from the municipalities, provinces and construction companies. The project was well organized and became a success as also could be seen during the floods from 2021. Therefore, other than first thought RWS is also responsible for flood prevention. Waterschap is more focused on small rivers when it comes to this field, but the RWS is focused on large projects, especially when they affect the main water ways of the country. Within RWS he worked together with the person who later will become have the main idea for WaterPotentieel and the hydropower project. Before the project start a different colleague had once mentioned that there would be an opportunity to use the natural height difference at Bosscherveld to build power station.

Project Specific Information

According to the interviewee the whole project started with a request from Flanders (Belgium) in around 2000, where they asked for more controlled water levels. Thereupon, Rijkswaterstaat had commissioned several engineering bureaus to suggest different solutions on how that could be done. The bypass solution was chosen to be the best and most suitable one. Already before, another colleague from the project initiator saw the potential of a hydropower station at the Bosscherveld lock due to its 3,80m height difference. The project initiator then saw the opportunity to implement this power station together with the bypass to create a win-win situation. He then asked the interviewee to support him, since he knew him from work and knew that he was pretty good with contracts and juridical things. However, hydropower always had a bad reputation in the Netherlands, due its high contribution to fish mortality. There was set a norm that a maximum of 10% of the fish stock is permitted to die due to hydropower in the Maas. The project initiator then contacted FishFlow Innovations due to their innovative screw pumps that claim 100% fish-friendlyness. The collaboration appeared to be promising.
In the meantime the interviewee, had become chairman of the VBC (an association incorpo-

rating the needs of the sport fishery and professional fishery, striving for healthy waters and sustainable fishing). He presented the solution in front of the association but they were skeptical. To convince the VBC, they requested an assessment by the RIZA (which since 2007 is included within the RWS). The RIZA approved that the solutions looks very promising, which made the VBC more confident in the alternative. They also presented the plan to the ecology department of RWS, where they have been met with approval.
In 2007 the declaration of intent between WaterPotentieel BV and the minister / RWS was signed and the interviewee made a planning for the necessary permits. Within the declaration of intent it was stated that WaterPotentieel would get the necessary area for the power station for free. With the declaration of intent, RWS stated that they would provide 1.5 million € to build the bypass. The power station however would not be their project, and they also would not provide any monetary means for it.
Still at the beginning of the project, the interviewee involved Witteveen + Bos, since he knew them from previous projects, knew how they worked, and that they are good for advice for financing, drawings, and calculations.
Since a lot of the financing was supposed to be through subsidies, in 2010, the project initiator involved a third person into the WaterPotentieel, who was supposed to be knowledge with subsidies, due to previous jobs.

Apparently, the contact with RWS was always really good, since the interviewee knew a lot of people still, that he himself had hired. Along this process the interviewee has claimed and identified several main causes for the delay and the stalling of the project. In general, RWS did not have a real interest in it for themselves or for the Netherlands. Everything got started through the request from Flanders, which then caused RWS to start considering the bypass. Since Belgium however, never again had made contact or seemed to be really needing the bypass, RWS did not follow through with it, since it would have just been additional costs and no real positive impact for their usual jurisdiction. The same applies to Limburg and Brabant, since they also did not request it any further after their first contact. Additionally, RWS usually focuses on big impactful projects, like big dykes, wind-turbines or infrastructure projects. For them to make a move on their own, this project would just be a bit too small. Of course there is a vision behind this project, and considering that it could lead to more projects in the Netherlands (new hydropower, or retrofitting older ones with higher fish mortality) or even internationally, it could become interesting for RWS, however they would need to share this vision. And especially due to the fact, that the two main drivers of the project are two retired men “without” money, it makes it harder to see and recognize this vision. Also the fact, that they were ex-RWS employees, might cause a problem. According to the interviewee, he believes, that even if RWS shared the vision, as long as not all permits and a concrete planning about the subsidies and money are present, they would not push it any further, since then it could become a political issue, since people might say, that the two initiators would get a special treatment. The interviewee also states that he thinks that if it were a big known company with enough financial resources, the vision could be more easily shared, since RWS would know that they could proceed with coming

projects and that they would have the resources to diffuse the technology further.

Although the planning for the subsidies was there, and money could have been gathered, it would have first not been possible to cover 100% through subsidies and second, these subsidies take time. This makes it hard to start such a project without money at the beginning, since once the contractors are commissioned, they want to be paid, which can be difficult if the subsidy money is not already available. RWS would have been able to provide this money, since they could make 50% of their 1.5million € immediately available, however for that they would make a move, which will not happen due to the reasons mentioned previously.

Besides the money, personnel changes also made the progress of the project more difficult. The director / minister who had signed the initial declaration of intent had left and the new person in charge is not a big supporter of the project. Also the statement, that WaterPotentieel would get the land necessary for the power station for free, does not stand anymore.
Another issue at the beginning of the project was, that the WaterWet became active right after the first permits were planned and requested. This WaterWet made it necessary to reapply for some of those permits.

B.1.2 WaterPotentieel Project Participant 2

Background Information The interviewee is 35-50 years old and has a background in managing complex issues specifically regarding sustainability, since he is involved in the energy transition in the Netherlands for the last 10 years. There he has worked a lot with ministers and in social innovation and governance.

Project Specific Information
He is involved in the project at the Bosscherveld lock since 2011 and works as an advisor for WaterPotentieel. Within the project team consisting of WaterPotentieel, Witteveen + Bos, and FishFlow, he thinks that they are complementing each other very well. According to him within the project there are many dynamics causing it to be stuck, such as lack of ownership, acting on the wrong level, and not having the right people involved who believe in its contribution to the energy system. In general, he thinks there are multiple problems, which are hard to grasp since they are partly based on personal relationships or inner-institutional dynamics that are created due to several multifaceted reasons.

The interviewee states that first of all, compared to other sections within the energy sector that contribute to the energy transition like wind and solar, this project and hydropower in the Netherlands in general are “peanuts” due its potential share that it could contribute to a sustainable energy mix. However, it is still a sustainable development that does contribute positively. Therefore, he believes that the people at RWS are the wrong people to talk to, since they are on the wrong level. According to him, there are three levels within the institution.

- The operational level that just makes the projects work / or not
- Visionary level focused on sustainable developments
- Directory level, responsible for main strategy decisions

Right now he believes that the people they are working with from RWS are from that 1. Level. They have a perspective on the project that is only focused on the direct pros and cons of the project and its direct effects (which are not too big). He says that they would need to start talking to people from the second level, people that see the vision behind this project, understanding that it could be used as a prototype / pilot and that with its development it could benefit to a more sustainable transition in general. People would be needed that would want to cocreate together and resolve issues together. However, this willingness is not present, and he states certain hypotheses trying to explain why this is the case.

These hypotheses are as follows:
Since the project was initiated by two ex RWS employees, they have certain relationships to the people who are still working at RWS and on this project. These can be positive but also negative relationships and dynamics, that can influence the project in a certain way. To a certain extend the project was founded on agreements between colleagues. These agreements were made 20 years ago, so the basis for these agreements might have changed. For example the fact that WaterPotentieel would get the land transferred from RWS does not work anymore, since RWS is not the sole owner anymore.

Second, as mentioned before already, the people that could see the project's contribution to climate change are not part of the discussion and they are not being talked to and the people they are talking to do not really believe in the project and its vision. Since the people that WaterPotentieel are working with are not really promoting the project, they are considering approaching higher level management, to increase their leverage. However, they are aware that this could backfire and create more opposition. To approach the mid-level people can be difficult, since people there often change quickly and often they would not want to go to the operational level since they know that there are collegial conflicts, which they don't want to get involved with.

Third, from RWS perspective, the real reason for building the bypass has disappeared, being providing Flanders with a steady and controlled waterflow. This feeding has been done and is still done through the Voedingskanaal to the south of the lock, which is owned by the province. RWS thought that with adding the bypass, which would have been under their jurisdiction, they could gain more control over the water levels in Flanders and could avoid needing to deal with the province in this regard. However, it turned out, that the feeding through the Voedingskanaal works perfectly fine, which makes the bypass obsolete.

Additionally, he believes financial reasons are also slowing down the project's progress. The budget reserved for the bypass could well be used for other purposes. However, if they admitted this and would state publicly, that the bypass and hence the power station is not necessary anymore and hence will not be realized, they would need to compensate the companies that put resources in it. Therefore, they rather try to slow it down and have it dying out. And this seems to be the case already since a few years after the project had started.
All those hypotheses are merely assumptions, derived from different developments and puzzle pieces.

They now want to involve the minister with a letter; however the timing is hard to get right. Due to the war in Ukraine, the energy topic is a very recent one, which could be of advantage but also of disadvantage since the minister could be additionally busy and would see this "mini" project more a s a burden, since even with the right vision it will only contribute to 2-3% of the whole Dutch energy mix at most. And even if they get the timing right, the involvement could hinder the project, since the operational people might feel offended and could slow the processes down even more. This is why, besides the right timing also the incentives for the lower level are necessary, but what is decreasing this incentive is the lack of scalability, since there are limited potential sites in NL which will always prevent the technology from being a decisive factor in the energy transition.

Regarding incentives a problem is, that the project will not create a large return on investments, and also RWS would not be paid, lowering their incentives and additionally making it harder to envision a large scale diffusion, since for follow-up projects, investors would be needed, though they would be hard to attract, if the return on their investments will be low. All these points make it hard to imagine for RWS how it could scale up and contribute larger to the energy transition.

Another crucial assumption the interviewee stated is that the purpose of RWS has changed and that it will change even further in the future. Its purpose now is mainly about managing risk within NL regarding flooding and flood protection, which is becoming a more stressing topic due to climate change.

According to the interviewee, it is possible that RWS sees a hydropower station (or multiple once) as additional variables in the water sector that adds complexity and possibly problems in managing the water levels. Besides the Dutch citizens, then also the power station owners would become stakeholders for RWS, whose needs they need to serve. So in case the water flow is not present anymore, those are people that could complain since they are not able to generate as much electricity as usual. This would become even more difficult if there were 6-8 sites. So in fact, RWS would have additional complexity and responsibility, but don't get anything in return. "WaterPotentieel wants to use water like wind, but for RWS water is not like wind, since they need to control the water levels. Their main responsibility is maintaining water levels

on a national level and not using the water system for energy purposes.

To address all these hypothesis, the interviewee says that it is necessary to speak to the right people. However, he is not sure if the people they and I have contact with are the right people to talk to about these things. He says that at RWS the people in charge of the project might not even be aware of their own role in the project and might not get the support they would need from RWS to actually change something. He suggested that I should gather some hypotheses together and discuss them with RWS. They (WaterPotentieel) would have asked those questions but again they don't feel like they are talking to the right level, since the people they are talking to do not have an ownership in sustainable energy. The only ownership would have is project focused and whether it can be done or not.

Furthermore, RWS has changed in the 20 years. Previously they were an organisation that was based around technical engineers. Now they turned into an organization focused on contracting and taking care of contracts and juridical things. Therefore, they hired more people with a law background, and less with an engineering background. They have changed from managing less turbulent situations to situations with a lot higher complexity and with much more risk, also due to climate change. Now there is different thinking within RWS, from a technical organization that builds genius water solutions to a company that is mainly taking care of juristic things and contracts.The project at the Bosscherveld lock is kind of drifting inside this change, with at the beginning being an interesting technical project to now discussions about contracts and responsibilities.

He compared the Bosscherveld project with another project that was once presented to the RWS, where solar panels were supposed to be placed next to highways serving multiple purposes like building a wall, reducing noise, and generating electricity. With these benefits, however there would have been additional risks created, for example regarding maintenance or what happens if people crash into the solar panels. RWS would not benefit off it directly, only through public appraisal, if it is a success. However, there is also the risk of public disapproval, if negative effects happen, where RWS would need to take the blame. Therefore, eventually RWS needs to balance out risks and benefits and make their decision based on that.

B.1.3 WaterPotentieel Project Participant 3

Background Information

The interviewee has studied civil engineering at TU Delft. His final project was regarding the dam system at Oosterschelde. After the big flood, it was a discussion whether they should entirely close the connection to the see or keep it open. Together with a team of interdisciplinary students he suggested a version in between, which eventually was chosen by the government to become the actual solution. They got a price for it and it is still being used today. Afterwards he started working at Rijkswaterstaat. After he few positions he ended up working in Limburg

where he was involved into some hydropower projects (Lyth and Linne). He really enjoyed the type of studies with new technologies and ideas and saw the positive contribution behind it. Though, he also experienced the downside, being the high fish-mortality of those sites and he decided that this should never happen again. Another area he was mainly involved with was the modernization of the Maas route. His responsibility there was mainly for the shipping. Since the route was more than 100 years old and too small, it had to be widened for bigger ships to navigate through it. The project was very successful but due to the floods in 1993 and 1995 the political focus changed, and flood protection became the center of attention. Then he also had to work more on that. At the same time the construction of two hydropower plants in the Maas (Lith and Linne) was almost finished, however also that got delayed due to the focus on flood protection, but got finished eventually. Nowadays flood protection the project is almost finished and only some last sites in the Julianakanaal are missing. Once he turned 60 there was a program at Rijkswaterstaat which enabled older employees to retire early with very good conditions. It was a bit difficult for him, since he loved his job, but he could not refuse the offer. Then he and his wife travelled the world for a year, but once that was done, he felt the urge to do something new. Due to his affinity for hydropower and from his work at Rijkswaterstaat he still knew one site where a potential small plant could be set up. That is how he started the project at Bosscherveld. He likes that it keeps him active, even though there are no profits yet.

Project Specific Information

The interviewee first took the initiative in 2005, when he went to Rijkswaterstaat to present his ideas in meetings with old colleagues. From there it took some years until things got more serious when he finally made an appointment with Rijkswaterstaat regarding the cooperation to build the hydropower station (on own risk) and they signed the private public partnership (PPP). It felt like a good start. Besides the hydropower station, a bypass would be built around the lock that is important for the functioning of the power station, but also mainly for securing the water levels of the Zuid-Willemsvaart canal, which was of level of national authority. Before, there were studies on how to ensure those water levels best and the bypass was concluded to be the finest one. In the agreement it was stated that this bypass would be paid by Rijkswaterstaat (€1.5 million), however the work required would be done by WaterPotentieel.

They (WaterPotentieel and Rijkswaterstaat) agreed on dividing the project into two parts (one was the hydropower plant, the other the bypass). The interviewee also wanted the permits to be entirely separated so that WaterPotentieel would gather the permits for the hydropower plant and Rijkswaterstaat the ones for the bypass. However, RWS did not agree to this. They wanted that WaterPotentieel gather all the permits for both parts of the project. Overall, he thinks however, that is was a good approach to do it like that, since the bypass was also crucial for his power plant and in the WaterPotentieel would earn all the profits from the generated electricity. After everything is finished, the bypass would then get into the ownership of RWS.

From his previous position he knew people from Witteveen + Bos which he contacted to collab-

orate on the project. Witteveen + Bos then involved FishFlow into the project. The interviewee really liked the technology of FishFlow, since it was safe for fishes and due to the previous bad experiences with fish mortality, Rijkswaterstaat would only give out permits for fish safe solutions.

After the PPP was signed, the interviewee gave the responsibility for the permits for the hydropower station (WaterWet, building permit) to Witteveen + Bos and paid them on own risk, since he believed into the project (100,000 – 200,000€). After 2 years of working on it and good collaboration with RWS they had gathered all the information for the permits could be applied for, and they got approved. At the same time however, RWS was in a reorganization period and the directors responsible changed, which according to the interviewee was not too good for the continuity of the project.

Once the permits for the power station were gathered, his colleague started working on the permits for the bypass, who invested time and money into gathering the necessary information. For that they needed to prepare a planning of the whole system in collaboration with FishFlow, which worked out well. Then Witteveen + Bos tried to finalize those permits. At first it worked well, but then problems started. Accumulating the information was expensive getting loans difficult due to the interviewee's age. Due to that, another partner had joined WaterPotentieel who was younger and an acquaintance of the interviewee's daughter, and who had experience working on complex sustainability related projects.

This personnel annexed a big share of the responsibilities and daily work, which is why from there the interviewee got a bit more excluded from the project. In general he did not have a problem with it since he also had other problems (health issues), and essentially never intended to the project all by himself. In fact, before he had talked to two other potential partners (bigger companies) but they wanted to own the whole project and cut the interviewee out of it completely. Since the he saw potential in the whole system also to be used at other sites and he still wanted something to do, this was not an option for him. The partnership with the acquaintance did not include any payment, however also no obligations for him. According to the interviewee, this is part of the problem, since without any real obligations and an already full time schedule, he will not be someone that really pushes the project. At the same time, he took too many things under his responsbility including financial and technical things which he should have just given to Witteveen + Bos. Furthermore, "he would like to stay friends with everyone" but in these projects it is not always possible.

When they started working on the permits for the bypass, RWS requested quite some technical information. The new partner in the company had then made a contract with Witteveen + Bos to prepare the needed information and to offer support during the construction processes over 140000-150000€. Thereby the whole package including managing permits and construction was passed to Witteveen + Bos' responsibility. They would have done it together with FishFlow

since they have good contacts to different contractors. The interviewee would have wanted to pay this sum together with his partners, but it never happened due to budget limitations.

In 2016, the interviewee founded a new BV with his children and the acquaintance as his partners. Though at the same time, it became clear that RWS did not really have the money for the bypass anymore, since they had other projects coming up that were of higher political interest due to floods that had happened in the meantime. And to pay anything to WaterPotentieel, they first would need to show RWS the preparation of the whole work including the bypass-permit. So, Witteveen + Bos and FishFlow finished all the documents and sent them to RWS in Utrecht and then waited for a reply. According to RWS, they at some point had lost the documents, though found them again after 8-9 months. This behavior did not feel encouraging for the interviewee. Though, the documents were looking good and only 2% were missing in order for them to be complete. Those 2% were then added by Witteveen + Bos and FishFlow, but RWS again first did not have time to look at it and then again stated that the 2% were missing. After some time, the obtained permits expire and need to be reapplied for, which is what happened in the project. For this reapplication, all information would need to be updated. WaterPotentieel blames RWS for the delays and hence also for the necessary reassessments, because they "don't do what they should do".

Due to his experience from working at RWS, he does not think that these working procedures are normal. He sees the PPP as a gentlemen's agreement, and should be taken seriously from both sides, which he thinks is not the case. Now RWS is saying that some parts of the agreement were mistakes and meant differently, but they were written down and signed. However, the interviewee knows, that the PPP is not a juridical document, and he would not be able to sue them over it.

In the past these PPP were used more often, but also frequently caused problems, which is why usually nowadays they are not really used anymore. However, in the past, these agreements were taken more seriously and not like today, that one side could just say they would not have time for it and break the agreement.

Furthermore, the interviewee stated that the whole structure of RWS has changed compared to the past. They are now structured in several departments, who are specialists only in their certain field (hydraulic, traffic, ...). Furthermore, it got more centralized and a lot of the know how gets bundled in The Hague. Before the work was more on a regional / local level and the people who worked on a certain project were somehow connected to the region. Now it is more specialized for certain expertise not for a certain region leading to a disconnection of regional issues (e.g. if there is a hydraulic question for the project in Limburg, or a stressing permit, people from the Hague might have a look at it).

Not everything is worse due to that, since for example before it was almost like 11 "kingdoms"

spread over the country and now it is more interconnected and focused on the projects. But it also comes with downsides, being the disconnection of the regional needs. Also, the departments are quite separated and it is hard to see the connections between them. In general, a lot of the know-how has left RWS and they work together more with contractors for a lot of technical matters. Their main responsibility is becoming more focused on juridical matters.

The interviewee thinks though, that the people involved into the Bosscherveld project are still mostly the "old" people, and everything could be finished, but it does not have any priority, which is why it is not being pushed forward. He does not feel that he can do anything about it. He does not have the leverage to oblige them to work on it. He feels like the only thing he can do is keep the relationships good, but only for a certain amount of time. After a while it is going too far.

The current situation of the project is, that the acquaintance wanted to push the project and asked Witteveen + Bos what needs to be done to finish the permits. According to them 50,000€ would be required to do so. However, WaterPotentieel thinks RWS should pay this, since they are the cause of the delay. The apparently, RWS said they only have 10,000€. The interviewee says he could put the money in, but at the same time, it seems risky, considering that RWS could lose the documents again and delay the process again, hence the 50,000€ would be lost. Though, to go further, RWS expects WaterPotentieel to renew the permits.

The interviewee does not understand how the project cannot be on top of RWS' agenda due to electricity generation but also due to water distribution, which is one of their main responsibilites. There are continuous droughts in Limburg and Brabant, and the bypass could improve that. To stress that, the acquaintance now wants to talk to the minister of climate change to get more political support. For the interviewee this seems to be one of the only options. However, due to the limited availability of the acquaintance, it takes a lot of time to prepare such a pitch.

Regarding the business plan of the project, the power plant could provide electricity for 1000 households. Investments now are a lot higher than expected, however electricity prices have risen accordingly. Therefore, revenues are hard to estimate. Besides his work on the project, he is still active in other organizations regarding shipping navigation and a delta commission. During the work there he made several proposals for water management and also discovered more locations where his idea could be developed. The Bosscherveld project could be the perfect pilot project, so it could be shown to investors to develop it at more locations. He could think of 6-7 more sites already only in the Julianakanaal and the Zuid-Willemsvaart canal, and some in Belgium. He believes it could be a great contribution to fight climate change, on an energy level but also on a water distribution level, since the turbines can even be used as pumps which can help with the latter. However, RWS did not appear to be interested in it. Though, he sees a lot of potential in the Netherlands, but also worldwide, for example in developing countries.

In his opinion, RWS should start focusing also more on climate change and energy other than only shipping and flooding.

B.2 Witteveen + Bos BV

Background Information

The interviewee is a civil engineer who has worked for Witteveen + Bos for several years. In his earlier years at Witteveen + Bos he worked as a civil advisor in the local area of Maastricht and then has changed into the claims and disputes department, where he also became a member of the council of arbitration. Now he is more like a freelancer that works as a close advisor for Witteveen + Bos. When the Bosscherveld project started he was a project leader for a new local community that was being built close to the lock. When WaterPotentieel started the project, he was asked to help with his expertise. Within the project he often acted as a mediator between WaterPotentieel and the RWS, when it came to disputes or problems. In 2011 he became head of the department for contracts and was mainly responsible for cost controlling and project management. Before the Bosscherveld project he had not been involved in other hydropower or energy transition related projects, but with other projects focused on infrastructure development. There he also often had to work in close collaboration with RWS, however, it always worked smoothly. Therefore, the experiences in the present project were also him unusual.

Project Specific Information

Witteveen + Bos and FishFlow are having are having a partnership for such projects, which is why the interviewee and the CEO of FishFlow, are knowing eacher other quite well and are close to each other. Now the interviewee is not that involved in the project anymore, but was quite closely involved in the beginning.

The first time Witteveen + Bos and the interviewee got involved into the project was in 2007/2008, just after the idea was formed, respectively the declaration of intent was issued. There the interviewee took on the role as an advisor for WaterPotentieel, focused on the technical aspects of the project. As a first step they invited 2-3 hydropower turbine manufacturers to present their solutions. Due to their high efficiency and fish-friendliness, in 2010, FishFlow was chosen, by WaterPotentieel and Witteveen + Bos, for being the best to collaborate with in this project.

According to the interviewee, the project started already before the declaration of intent, with a study of the DHV, regarding the water feeding capabilities of the lock, and that it could be improved by including a bypass system to ensure a steady water flow. Then two retired RWS engineers suggested putting a hydropower plant inside the bypass to generate electricity from that steady water flow. After it seemed like the idea was perceived as a positive addition, they started the company WaterPotentieel BV.

For Witteveen + Bos and the interviewee, this WaterPotentieel BV was the main contact throughout the whole process of the project. There, he was mainly advising them for technical issues, when they were speaking to RWS. Besides WaterPotentieel however, they also mainly talked to the Municipality of Maastricht, RWS, and FishFlow.

The contact with the Municipality was mainly regarding getting the necessary permits for the construction of the hydropower plant. A permit regarding the einvironmental impact was granted in 2011. However, since the construction did not happen within a few years, the permit lost its validity. Therefore, it would need to be applied for a new one. Though from the interviewees perspective the processes getting the permit approved, was rather smooth and worked with quick and short communication.

B.3 FishFlow Innovations BV

Background Information

Before the interviewee founded FishFlow Innovations he was a fisherman at the lake Ijsselmeer and had to take over his father's company when he was 16. At some point he invented a technology how to catch several fish at once without killing them. Then he started collaborating with the Dutch consultancy Witteveen + Bos, since they had the assignment to clean lakes, and needed his technology to take out all the fish. A friend of his who was involved in that project was also involved in a project of the water board, where a lot of fish were dying in the pumping stations. The interviewee then developed the first fish-friendly water pump, which was working very well, regarding fish-safety, but according to him not good enough regarding efficiency. Then he started researching and inventing regarding that and at some point developed a highly efficient, closed screwpump made out of composite, which is 100% fish-friendly. This pump can also be used as a turbine generating electricity.

Nowadays it is attracting world-wide attention and might be successful in global project for example in the UK, Indonesia, New Zealand, and Oman, which would finally make them "to a big company" due to the enormous revenues created from there.

He believes that it is not difficult to create something new. If there is a problem you just need to search for a solution and build it. Then you show to people how and that it works and then you have a job. He is a doer and doesn't wait for long discussions and agreements. He prefers to just start and implement his ideas immediately. Due to the success of his ideas he formed a partnership with Witteveen + Bos, where they advise each other, provide each other with projects/problems, and solve them together. FishFlow then designs and calculates the necessary screw. But there are no invoices or payments between them. Compared to previous projects and project issues, the project at Bosscherveld is a very unique case.

If things do not go as planned and he thinks it is due to certain personnel he calls them directly

and tries to resolve issues. He says that other stakeholders in such projects do not need to be his friends, but he needs the work to be done.

In a meeting with difficult partners, he usually first raises his voice to create authority and then is able to talk to people from a different angle. When he sees that projects do not work the easy or normal way, he does not shy away from taking the hard way.

Project Specific Information
The project at Bosscherveld would have been a good opportunity to build a system of a small-scale hydropower and use it as a example for future customers, so they could come buy and get convinced by how it worked. This would be especially beneficially for the Dutch and European market. Apparently, a lot of potential customers were waiting a long time for that project to be ready, so they could come and have a look at it. According to the interviewee, due to the delay he already lost 4-5million € of revenues from projects that could have developed based on the Bosscherveld example. The people who were interested in it, were mainly smaller private parties, but also governmental agencies for example from England. And in the end they (RWS) cost him this money.

The project started with the initiative that the Municipality of Maastricht was going to extend the city with a residential area. That area would have conflicted with the old "Voedingskanaal", which served as the connection between the Maas and the Zuid-Willemsvaart canal. Since Rijkswaterstaat then would have not been able to control the water levels there anymore (because using the shiplock for that purpose is hard to control), they started with plans for the bypass next to the ship lock of Bosscherveld. The interviewee's customers (WaterPotentieel) then saw the opportunity to add a hydropower plant into this bypass. Rijkswaterstaat was going to pay €1.5 million for the bypass, but the interviewee thinks, now they do not want the bypass anymore and they don't want to pay anymore.

In the interviewee's opinion, if that was the case, they (RWS) should come to WaterPotentieel and FishFlow, tell them they don't need or want the bypass solution anymore, and due to that reimburse them for the expenses they had in the previous development processes. But there is nothing like that coming from the other side. The information that Maastricht does not want to extend anymore he got from WaterPotentieel. When they had prepared everything for the permits, they (FishFlow) had sent it to Rijkswaterstaat. After half a year of no response they called the recipient of the documents, who said the papers never arrived. However, through contacts to the post office of Rijkswaterstaat, they found out the documents landed on the recipient's desk in time. So thinks they were lying to him, which he really does not like. He believes that Rijkswaterstaat "lost" and did not approve the permits for the bypass, since they knew already that Maastricht was not going to extend and hence the bypass was not necessary anymore.

So far FishFlow would have invested about €200,000 and Witteveen + Bos around €160-170,000.

Mainly caused by working hours, designing, drawing, meetings throughout the last 14 years.

In the beginning of the project he was doing some testing together with TU Delft, since there was some opposition regarding whether putting a hull around the screw, increases the resistance. According to the interviewee it makes the resistance disappear, resulting in very high efficiency. This could be proven with the testing.

According to him the tasks between the managing companies were divided in three areas. The idea came from WaterPotentieel. The management was mainly done by Witteveen + Bos and the actual building of the system was under FishFlow's responsibility. The contact with Rijkswaterstaat was mainly done by WaterPotentieel, since they were afraid that the interviewee would say something wrong to them.

He advised WaterPotentieel that in order to push the project forward and to get more leverage, they should make an appointment with the minister, talk about what happened, so they get the money. But that takes them $\frac{3}{4}$ of year, which according to him shows that there is no grit. It makes him a bit angry that it is not going forward and that Rijkswaterstaat is not doing their job, and he finds it wondering that WaterPotentieel never raises their voice, because it is obviously not going as discussed.

He saw that the people from WaterPotentieel were getting older and hence involved a third, younger guy. According to him he is a good guy, but he has a lot of work next to the Bosscherveld project. And for him, with such a project you need to concentrate only on that and show commitment for it.

Regarding the collaboration with Sportvisserij, they did not get deeply involved, but according to the interviewee they trust him. So when he says his technology is fish safe, then they believe it and let him do his work. For instance, there is a project in Amerongen for hydropower, where he was involved and due to his involvement Sportvisserij had no problems with it. However, eventually the project was dropped due to lack of money of the initiators. In general, Sportvisserij would be not against hydropower, but against fish-mortality, which can be circumvented with his technology.

But still he involved them all the way at the beginning at the project, to show the plans to them. Since this is how you should start such a project, first involve the NGO's.

In return of their work, FishFlow would have mainly benefitted from a share of the revenue created by the electricity generation, since the turbines would have stayed in the ownership of FishFlow. That is due to a law that they were not allowed to be sold, since they were mainly developed through a certain fund. However, in the end the whole operation would probably cost him money, which would have been okay for him though since he could have gained other

potential projects from it. However, now they have other big projects coming up, so it is not that much about the money right now, more about the behavior of the people involved in the project (especially from the governmental side). He thinks that the people working there are lazy and that they come to meetings unprepared, which shows their lack of commitment and interest in the project. And the interest has changed because the bypass is not a necessity anymore. Witteveen + Bos would be paid by WaterPotentieel afterwards, once the hydropower plant is operating. And he thinks they could make a lot of money with the electricity (due to the currently high electricity costs, but also since it could be used in close proximity, maybe directly from the companies there, which saves a lot of costs).

The interviewee right now is not intending to build a similar project somewhere else to use it as a presentation project, since he is very busy with the Delta21 project, where his screw turbines would be used in a large-scale energy storage system outside of Rotterdam.

The current state of the project he assesses that the only way of resolving the issues is to go to the Hague and talk to minister to gain a bigger leverage from the political side. However, this is what he is telling already for 7-8 years. He would tell them there how he thinks Rijkswaterstaat is doing their job and that they have to pay the partners involved back their money.

However, he thinks that to finally realize the project, they would need a different partner than WaterPotentieel, because they are just not going for it. He also thinks that one of the problems might be that, since the initiators are ex-RWS employees, they do not want to offend anyone at RWS but also what could affect the whole situation is that they might have bad relationships with their ex-colleagues. The people from WaterPotentieel would never raise their voice and they do not seem to have the right spirit. He said “they are no business people”.

Regarding Rijkswatersaat he said as well, that different regions of the Rijkswaterstaat also work differently and are either more or less easy to work with. This he got confirmed from the Rijksdienst vor Ondernemend Nederland (RVO) in the Hague. It could have different reasons, regional cultural behavior, but also just the personnel themselves. That there are always a lot of promises, but often they are not being realized. He has a lot better experiences with for example the Rijkswaterstaat in South and in North Holland. There project go very quickly, they have a problem, they consult him and he can start working sometimes before having contracts or anything ready. There you can trust the people and they trust them.

If hypothetically the project would still go through, he thinks it could be realized within 10 months.

B.4 Rijkswaterstaat

B.4.1 Person 1

Background Information

The interviewee has studied civil engineering at TU Delft. There he was more focused on management, rather than technical topics. Once he finished in 1987 he first had to serve the military duty for 1 $\frac{1}{2}$ years after which then he started working as a general contractor at a Dutch concrete company in 1990. There, for 10 years, he mainly worked on utility projects such as constructing hospitals and schools and started getting into project management. From there we switched to RWS into a project management position.

RWS is responsible for big projects in NL regarding highways and the main water ways, which are used for industrial shipping. There they ensure the water levels and monitor the water quality. His main responsibilities were several big highway projects, where they built entire new motor ways.

Nowadays he has a position that is split 50/50. One half of his responsibility is asset management and maintenance for RWS' assets (water locks, highways, canals), where he needs to make sure that they stay up-to-date or extend them if needed. This is also the case, because the potential for building new big projects in NL is decreasing, due to the lack of space. In that sense RWS responsibility is changing in general. The other half he works as "opdracht[...]", where he is responsible for the projects in one of the 7 regions RWS responsibilities are split into. There, the work necessary to ensure the quality of the water motorways, are investigated by the engineering department. They then develop vacancies for such projects, which can be taken over by external contractors. The interviewee's responsibility there is to intervene in case things are not going as planned. Then he gets informed by the engineering department, and he needs to look for solutions, if for example more time or money is needed and discuss it with the ministry. There he says, early warnings are always better.

Project Specific Information

He is involved into the Bosscherveld lock since it is one of RWS' assets. He got involved in 2015 once one of the previous directors left and transferred the project to him. Before there were a couple of people involved. In general he is not working a lot on it, due to the fact that it is pretty quiet on the other side.

The project was initiated by a third party – a private party – being the WaterPotentieel BV. According to him it officially started with the PPP (public private partnership) and there would be no official documents before. In this document it is stated that WaterPotentieel would build the bypass which includes a hydropower plant. RWS would pay for the construction of the bypass and would become the owner of that. WaterPotentieel would be the owner of the power station. To proceed it was stated that WP would need to gather all the necessary permits, and

develop and design the plans further. For RWS, the bypass pipe would be very interesting, since it would connect two water systems, and they could use it to control the water levels and the water exchange between those systems. The power plant is more like a charming idea for RWS, but not really important. RWS does have the goal to become climate neutral, however their strategy to get there is more focused on big wind parks, which are more efficient then small power plants all over the water system. They like the idea in general, but it is not how they see the future of contributing to a more sustainable energy system.

For RWS the most important thing is the connection of the two water systems, and if it is done through a pipe which is even build by someone else, it would be a win. Although, there is a connection already (Voedingskanaal) which serves the desired function. However, this connection is already older than 100 years, so far still functioning well, but at some point it certainly would need maintenance. Since the old connection still works fine, there is no urgency from RWS side to build the bypass. If hypothetically this old kanaal collapses for instance in 5 years, then the urgency would look different of course. So over all they know, that at some point this other solution will be necessary, and having someone else building it, would be a benefit. Another benefit (not a huge one since so far there were no issues) would be that the connection would then be owned by the RWS, since the old one now is on the properties of the municipality.

So as said before RWS' desire for the power station is more that it is a charming idea and that they would like to make it possible for the other parties, but from a sustainability perspective it is not needed.

There are several permits with certain steps and from several institutions that need to be acquired before one can start building. There are for example zoning permits. Then it is required to talk to the people living in the area of the power station, so they have the opportunity to oppose to it.

There are also permits that would need to be granted by RWS. The interviewee said that he could help of course to get them as soon as possible and to tell WP what is necessary to acquire those permits. Issuing those permits though, would be under the responsibility of the permitting department of RWS.

The interviewee does not know about exactly about the status of the permits. He thinks WP had talked to the municipality, and that there were no major problems, just a few small things they would have to change.

Then there is a water permit, where he doesn't know exactly who is giving it out, maybe even RWS themselves. He believes that there was a water permit gathered for the power station but not for the bypass yet.

To ask for a certain permit, the requesting party has to prepare and gather the information necessary to obtain it. And this information for the water permit of the bypass had not been gathered yet. A part of the water permit is the environmental impact assessment. This assessment must not be older then a few years, so he believes it would need to be updated. Of course, all this gathering of information and requesting and updating costs money.

From his understanding, with the Bosscherveld project, WaterPotentieel wants to create a pilot which they can show to future investors for further projects at other locks within the Netherlands. For that they must have a certain business case which he does not know about. However, he does see that the letter of intent was set up more then 10 years ago, and that the project is certainly not proceeding well, and that there are many long gaps within the process. Sometime he would not hear anything from WP for more than half a year, which is why the progress is hard to assess for RWS. Right now, they are close to the point where they have to decide if they continue as a supporter of the project or not (go/no-go decision).

The business case from his point of view would be very important. WP needs to invest their own money for paying the engineering companies that gather the information to gain the necessary permits. A lot of it should be possible to cover with subsidies. However, also those have certain demands that need to be fulfilled. They also only last for a certain amount of years, and the last thing he heard was that they needed to apply for a new one. He believes, if this new round of subsidies was not be given, the project would be almost over (but he doesn't know about the status).

He believes that the business model of WP could be difficult, since it is hard to say how much return can be created due to the alternating electricity prices, and that these changing prices need to be covered within the business plan.

In case it turns out the business case was not valid and WP goes bankrupt, it should be (he also thinks they agreed on it) that this would not affect the feeding functions of the bypass, since it should be separated from the electricity generation. Either way though, it would not be good, if there was standing a construction that is not used, so it would be agreed on WP still having to destruct it, in case the business is a failure.

Currently RWS is waiting for input from WP to go to the next step and make the go/no-go decision. This input would mainly be WP showing that they are having all the permits ready. The last time he had contact with WP (about half a year ago) it was made clear, that the initiative now would lay on WP's side. They need to present their business case and show that they will get the business subsidies and everything. RWS is not chasing the progression, since for them the project is not a necessity. Even though, it would be nice to have the bypass built by someone else, if the old one collapses and WP is not ready, RWS would build it themselves. But overall, RWS would appreciate if the bypass would be build. According to the interviewee, that have agreed a couple of times already, also to pay for the bypass. They would still need to

reassess the numbers they agreed on, since things are getting more expensive, but that should be of no problem.

If all permits are gathered (especially the WaterWet) and everything looks good, WP and RWS would need to revise the agreement and finalize the terms about how to proceed, since the old agreement is too old to be used. This would then include more detailed specification, detailed timetables, and a detailed understating of responsibilities. If all this is finalized they could start executing the project.

The interviewee sees it as a problem that the project implementation is taking that long, since with increasing time, new issues can arise. An example of this is the increasing requirements of dykes. The dyke that would need to be penetrated to build the bypass now is considered a high-level protection. That means that WP would need to show that they could ensure full flood protection after but also during the project implementation. In that sense things are not getting easier but more difficult.

B.4.2 Person 2

Background Information
The person is a 50 – 65 years old Dipl. Engineer with 20 years of experience working in the development and maintenance of water infrastructure at RWS south Netherlands, including the Bosscherveld project. He also has previous experience working for several engineering offices, including Witteveen + Bos, and has a wide range of experience. He was involved in the project at Bosscherveld all the way from the beginning in 2007.

While working at RWS he gained experience regarding other hydropower plant project such as the ones in Lyth and Linne from the 1970s, built and operated by Vattenfall and RWE. There RWS encountered several circumstances regarding for instance water supply, that in the summer it can become difficult to supply the water levels that are needed for the turbines to work due to drought. Further, if there is a malfunction at the power plant, RWS might have to organize with the weir that no water goes through the turbines. There, the collaboration with Vattenfall and RWE works quite well. However, they have learned that especially the old plants are not fish-friendly at all.

Another hydropower project close to Bosscherveld, called Borgharen, is permitted, however the company in charge is yet hesitant and not certain about whether they want to make the investment or not. Besides that, some other smaller pilot projects were planned around Limburg and Brabant, one of which was built in Tilburg. Furthermore, there is a sluice in Born which has 4 pumps where one of them was inverted into a turbine to generate electricity (similar to the amount in Bosscherveld). The revenues from this turbine go directly on the account of RWS and can be used within their budget. It worked well, yet unfortunately, some wood went inside

and broke it. Now it is waiting to be repaired.

Usually, RWS is not keen to build their own hydropower plants and would not initiated it themselves, though here it was not possible differently, since it was entirely within a RWS-installation and it was not possible to separate it.

For those kinds of projects, there are different departments affected within RWS (planning, maintenance, project realization, permits). If there is a third-party initiator, they ask RWS what needs to be done to get a permit, then they prepare the information within a plan and present it to RWS. If from RWS side everything looks good and there are no risks for sluices and water ways, then there is no problem to proceed.

Project Specific Information

Compared to those projects, Bosscherveld was different. In Bosscherveld a hydropower plant and two bypass pipes were plant, where RWS also had an interest into those pipes. The situation at the site is, that there is an old Voedingskanaal that ensured the water provision for Belgium, Limburg and Brabant. 18 to 19 years ago, the municipality of Maastricht approached RWS with the plan to expand the city in that area, but since it was state-owned property it was not that easy. The idea was, that RWS would transfer the whole area to Maastricht. This would also make RWS' work easier, since they would then only need to ensure that the water keeps flowing. A contract was set up between Maastricht and the state, which includes that as long as RWS does not have a solution for the sluice they can use the Voedingskanaal for the connection of the waterbodies. RWS started investigating for potential solutions and found a bypass next to the Bosscherveld sluice as the best option. However, that option would have costed several million € which RWS did not have.

Then suddenly, WaterPotentieel approached RWS with their idea and RWS saw the opportunity for an agreement saying that WaterPotentieel will pay 100% of the hydropower plant and 50% of the pipes. The other half for the pipes would be provided by RWS. Therefore, it became a project partly owned also by RWS.

So far, nothing practical has happened on site regarding the project, but also Maastricht so far only realized 10-20% of their expansion plans. At the beginning there were many requests regarding when the project was going to be ready because they had too little water on the other side. The interest from those parties was high. But now no one asks or wants anything anymore, no one really cares. So for RWS it appears, that everything is fine and that "as long as no one contacts him again, it stays how it is for the next 100 years".

Regarding the project's processes there were many talks with WaterPotentieel. Then they created a concept, RWS had a look at it and expressed a few thing they wanted to have changed. First it was a bit difficult, but then they managed. Then there were some discussions regarding costs, but nothing major. Years passed by, some more investigations and examinations had to

be done and a second permit was needed. In the Netherlands there are a lot of laws and for everyone an initiator needs a permit. The interviewee admits, it is not easy to gather all of them, but WaterPotentieel needed a lot of time until they were out of money and often RWS did not hear from them for a year. Then they suddenly appeared again and wanted that everything goes quickly, but they themselves were not as fast again. Then more years passed by until today still nothing has happened. The last time he heard from them is again 1 year ago.

Regarding the permits, the interviewee says he does not have the best overview but there is a building permit which would need to be granted from the municipality. Then there are permits regarding monuments, which he thinks also applied here. Furthermore, RWS needs to grant them the WaterWet (WaterWet), which involves several permits regarding construction on state-owned land, a water permit (involves the amount that would be used), and one regarding how it affects the shipping and that everything needs to be safe. For instance, that no currents are created that push away ships or pull in people. To get those permits time and money needs to be invested and it can become difficult. Therefore, RWS is mainly there for the technical compliances of a project.

Besides those permits, also the Rijksvastgoedbedrijf (RVB) is involved, since for the operation state property would be used (the land, but also the water is state-owned). Therefore, WaterPotentieel would have needed to pay for the land but also per cubic-meter water that flows through the turbines. Thus, it can be seen as an economical permit, but it can sometimes be perceived as weird, that first you get subsidies from the state to build the site, but on the other hand you then have to pay for use.

Within the project the interviewee's tasks were mainly to check, together with other experts, if the things handed in were technologically good. After everything was checked by him and his colleagues, he would send the things back to WaterPotentieel. There it was mainly about topics of the construction processes, if for example the old sluice could sustain the vibration of the construction but also the operation of the system. Also whether the inlet or the outlet of the system could affect ships or swimmers were on his desk. Furthermore, since it needed to be shown that the dyke would not collapse during the construction and afterwards once the system is ready.

He believes that, even though everything took so long and there were some communicational gaps, at some point the concept looked really good and only the text for the permit had to be changed. But then RWS did not hear anything anymore, which was wondering. And since it was mainly a third-party initiative, RWS will not call them every week and ask where the documents are. But still, RWS would of course also have benefited from the bypass.

Nowadays, even if WaterPotentieel picked up the initiative a bit more again, the hope on RWS' side that the project could be a success has almost vanished. They do not believe WaterPoten-

tieel calls tomorrow and wants to start building.

If at some point the bypass becomes a necessity, and WaterPotentieel is not ready, RWS would just build the bypass themselves, since now they have some information about it already. Though, then it would be solely the bypass without a hydropower station. Which he regrets. He always thought it was a nice, smart project and that it makes sense to use the water flow there and therefore, it is a shame if it never gets realized.

His personal impression was, that for WaterPotentieel, this project never seemed to be their main focus or their main business. Especially compared to FishFlow you could see a difference. With FishFlow you could see they have experience and they know that you need to invest, put people on it, so that within 1-1 $\frac{1}{2}$ years the project is done. Also Witteveen + Bos had their assignment, budget and planning and they wanted to get it done. But with WaterPotentieel he never felt this drive or pressure to invest and to make it work, since the mentality was missing. WaterPotentieel consisted of one ex-RWS employee and a young collaborator, who was doing the majority of the work, but still not enough and not forward-going enough.

Finally, he believes that although in the Netherlands there are not as big height-differences as in other European countries, there is still a lot of water which holds a lot of potential for small hydropower plants. “Better small then none.”

B.5 Sportvisserij

Background Information

The interviewee works as a lawyer at Sportvisserij Nederland. The organization has over 700,000 members in the Netherlands and tries to be an advocate for the sport fishery, commercial fishing industry and lastly the fish in the Dutch rivers. One of the ways they help those parties is to offer them juridical help when they need to be strengthened or they have a case they cannot handle themselves. The Netherlands has a large water system and hence a lot of factors can affect the water biotopes and fish populations. Within that Sportvisserij tries to take the right actions and make the right choices on how to positively affect the fish and fishermen. Things that can harm the biotopes can be power plants, that discharge their warmed up cooling water into the rivers. Especially in summer it could get too hot for the fish to thrive in those waters. Another example are pharmaceutical companies that release medicine into the water. Lastly, but also high on the list of potential threats for the fish are hydropower stations, which is why they got involved into several of such projects in the Netherlands.

One of them is the Borgharen project, which is closely located to the Bosscherveld project. In the Borgharen project, Sportvisserij is a representative of sport fishermen and the fish, and they are strongly opposing to the proposed solutions.

Currently they are trying to bring back wild salmon populations, which had gone extinct in that area. For that species, hydropower stations and their turbines would cause a big problem, since they are a migrating species and would need to pass through the turbines.

Project Specific Information
With those projects usually Sportvisserij is called already at the beginning by the project initiators to discuss some terms and develop things the right way to not have an harmful impact or upset Sportvisserij, since they know that the NGO would face them in court, if things are damaging for the environment. In general Sportvisserij is pretty high in their standards, therefore it usually does not happen that they immediately give their consent when they got presented a project. However, the Bosscherveld project could have been one of those, since on first sight, it is concerning a canal, so fish migration is of less importance an and obviously having a fish friendly turbine is a big plus, which would get them at least interested in the project. But in most cases, they by default say that they oppose at least to some extend before giving a consent.

In general, initiators of hydropower plants need certain permits, including water permits that are given out by the Rijkswaterstaat. RWS often involves Sportvisserij in their projects and the permit trajectories, often before the permit was granted so that Sportvisserij can state their comments on the circumstances. Those comments are usually taken very seriously by RWS. In the Borgharen project, RWS did reject some of the stated concerns. Now they are having issues with the permits and Sportvisserij took them to court. Due to that trial, the project had to be downgraded by three turbines. Sportvisserij then took it further into a higher court but lost, and the Borgharen project therefore got the permits granted. Now there is a discussion about a environmental permit, since the project site is close to a Natura 2000 area. This will probably lead to another court case with the province of Limburg, since there they would be the ones giving out the permit. RWS respects Sportvisserij as a third party and usually involves them earlier to see their opinion, also because they know otherwise a project will quickly be drawn to the court.

At the beginning of these kinds of projects, there is usually something called a Zinsvijsefase (phase of judgement formation). In this phase usually everything that is known is put on the table and everyone can say what the think of it. Usually, it is prohibited to be skipped and if it happens, SV will bring the case to court anyway, which is why it would be better to always involve them early. Regarding the connection between SV and RWS, it is not like they actively work together, but that both strive for the best and most inclusive solution, which is why RWS is often advised by SV. The interviewee does not know if that phase had happened within the Bosscherveld project.

In fact, he and Sportvisserij in general was not that much involved into the project. However, if it is a way to use hydropower without fish mortality it certainly sounds interesting. He does remember that the turbines were tested at a different site, and fish mortality was almost non-

existent. At some point Sportvisserij was proposing if those turbines could not be added to the existing hydropower plants and also for the Borgharen project, but the operators rejected these ideas, saying it would not be possible.

According to the interviewee it is important that the information used for the decision whether a permit is given or not, must be recent. In the Borgharen case, there were old information used (from 2012 & 2015) and they still got the permit confirmed, which he does not agree with.

In his opinion, the solution of FishFlow has a high potential. First of all, there is a huge request for sustainable energy right now and in the future, and the best solution would be having hydropower without any negative environmental impacts and without harming the fish. If it actually works, he would want to put the turbines in all the hydropower plants. However, to judge those if they are actually that positive, he would need to see it in practice. Therefore, in the first phase of such a project it is always difficult to say with certainty whether the impact is actually that positive, which is why they would still be curious and positive about the idea, but it would be difficult for Sportvisserij to be a strong advocate. But if it has proven itself in practice, Sportvisserij would probably push the technology.

Within the Netherlands, RWS is usually always involved into the hydropower projects, since the waterways are their responsibility and they own the weirs. Within the area of Bosscherveld, since according to the interviewee fish migration is not that big of a problem, what could be more important for RWS is, that they are responsible to maintain the water levels there. With having a third party being WaterPotentieel in the area, this could make this responsibility more complicated.

With the other example in Lyth for example, due to Sportvisserij's initiative, Vattenfall now needs to highly decrease the activity of the turbines at the power station to safe the fish, which of course costs them money. So right now the situation can be seen like a triangle consisting of Vattenfall, Sportvisserij, and Rijkswaterstaat, and they are often fighting in one way or another over some permits, rules and regulations.

B.6 ATKB

Background Information
The interviewee works at ATKB as an advisor for projects in the aquatic field with a focus on fish migration. In this field he has already 33 years of working experience, while working in several consulting companies and being self-employed for five years. For 12 years he has now been working for ATKB in the aquatic ecology department.

ATKB and the interviewee work closely together with Rijkswaterstaat. He is being booked by RWS 3 months per year for 11 years already, to give advice on fish migration in several projects

regarding fish ways next to sluices and hydropower installations. Water flow is a very important characteristic for a migrating fish species and can be reduced by water locks.

Project Specific Information
The report written about the Bosscherveld project it was investigated if the bypass and hydropower plant could have a negative impact on the migration of silver eels and silver molts (not regarding fish mortality, but it would be unwanted if the fish passed through the turbines and end up in the Zuid Willemsvaart canal, since from there they would not be able to find their way to the sea). No negative impacts were observed. At other installations like in Lith, high fish mortality is observed, which of course also is unwanted.

With these projects RWS can be seen in the middle between energy corporations and environmental advocates to try to satisfy company needs while ensuring environmental standards. There they must provide guidelines, rules, and permits for these hydropower installations. In general, he believes that the environmental standards in the Netherlands also through the water directive framework and EU guidelines are well considered. Their collaboration with RWS starts with them having a concern and then approaching ATKB. Although they are closely collaborating, ATKB remains an independent actor, that has the safety of nature in mind.

The environmental assessment usually is done within a couple of months. However, he mentioned that the project itself often is quickly delayed through necessary permit applications that always include high costs. Often a lot of research must be done even before the project actors are eligible to apply for a permit. This bears high uncertainty for a company / an entrepreneur regarding their revenues and are additional costs to already high construction costs. Therefore, it must be crucially investigated whether a project once operating yields enough revenues to get a return on the investment.

The interviewee knows the CEO of FishFlow and thinks “he’s a good guy” that has good ideas and inventions to ensure fish-friendliness. Though, during the investigation of an initiative, usually he is not in contact with other actors from the project. Sometimes questions are being clarified through the RWS, however large collaborative discussions are not present. Although being an independent investigator, Rijkswaterstaat also “does not like it” when ATKB starts talking to hydropower companies or the nature organizations, since they are commissioned by RWS. Then sometimes after the report is submitted, RWS gets back to them to have some questions clarified, and afterwards the collaboration is finished. According to the interviewee, it is rare that all the stakeholders are working together on such a project.

Within RWS, they have different departments involved in such a project. There is a team of ecologists, a permitting team, and a juristic team focused on the law and treaties behind such projects. The interviewee sees himself almost like a part of the permitting team, focused on the area of fish migration. Within this team, meetings about subjects can arise more frequently,

which is why he sees this connection as a closer collaboration. Nevertheless, he would like to emphasize that they are working independently, without RWS bias, and more advise them on certain issues like state-of-the-art technology.

Regarding the Bosscherveld project, the report was accepted and the findings were not causing a barrier for the project's progress. He did hear that the project was not progressing, but does not have information about the collaborative processes between RWS and other stakeholders.

Finally he offered to share some more contacts from RWS and Sportvisserij, to comprehend their perspectives of the processes as well.

B.7 TenneT

Background Information
The interviewee works at TenneT for now 2 $\frac{1}{2}$ years, though during the interview he did not act as spokesperson for his company but as a private person with experiences from the field, expressing his own opinion. In his daily work he is mainly working on future oriented project for the improvement of the operating of power stations and the energy grid.

Project Specific Information
He is not directly involved into power station projects and hence does not have direct experience for instance for the management and collaboration of such projects. However, he could give some insights about general responsibilities of the grid company like TenneT being that for a project like the one at the Bosscherveld lock, TenneT would probably not need to be involved, since it is very small-scale and the electricity output not high enough. TenneT is more focused on very large producers or consumers, or generally more for the infrastructure including power lines, with which they connect the regions of a country. Though a company that fits the small-scale and that at some point would be responsible for the connection of the SHP to the grid would be Enexis – a distrubtion systems operator. Eventually they need to be involved by the relevant authority since it must be applied to get a capacity connection to the grid. These slots are becoming less, due to the energy transition and decentralization of the energy grid. He suggests that I talk to them regarding the revenue structure of the grid provider and what they think the process of involvement with them should look like. When I contact them, I should approach people working at customer service or account managing.

Regarding the question who usually has the project lead in such projects, his answer was that it can differ from case to case, since sometime the managing processes are covered by the owner, and sometimes this owner hires a managing company to take care of these tasks.

Stakeholders that according to him are yet to be taken into account are people living in the area, since they might want the nature surrounding their homes to be as natural and pure as possible.

He knows of cases where this has been a major problem with problems focused for instance on wind turbines and solar panel fields. Furthermore, the people living there would not directly benefit from the generated electricity, since it would just be lead into the main energy grid and then the people would still get their electricity through their normal energy provider.

Finally, within the municipality, the focus should be laid on their regional energy strategies (RES) department, since they need to present a plan to the national government on how to implement a certain amount of green energy within their grid until 2030. Therefore, for them this project would surely be interesting, and they could act as main advocates. If they were not included yet, this could be important to push the development further.