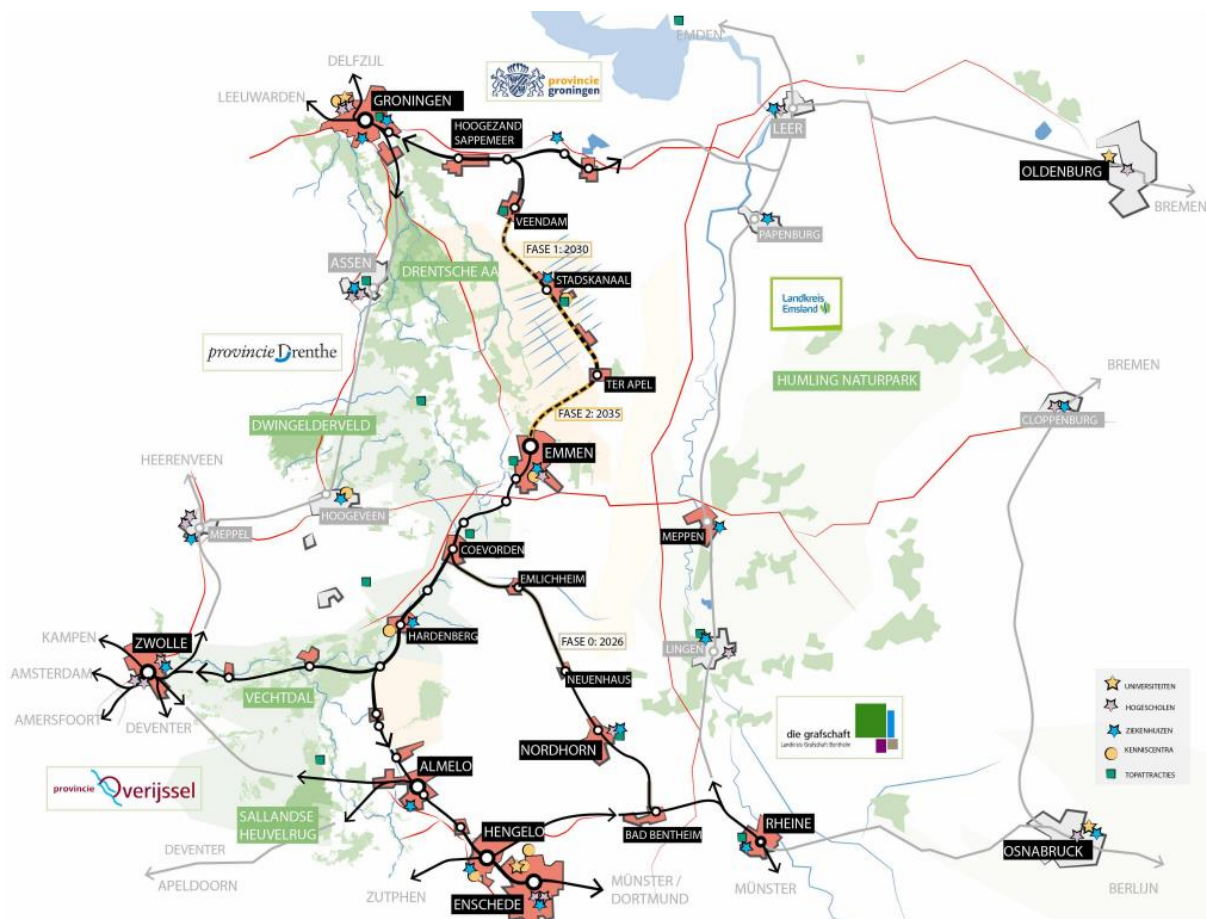


The potential of hydrogen in the Nedersaksenlijn case

The province of Drenthe is leadpartner of the EU funded project Excellent Hydrogen Regions in Europe (EHRIN). EHRIN is a small-scale project with partners from Germany, Sweden and The Netherlands. The aim of the project is to strengthen network structures for the governance of hydrogen developments. Exchange of knowledge, sharing of experiences and challenges and dissemination of result is key in building multistakeholder networks for driving innovations like hydrogen. The province of Drenthe used the 'Nedersaksenlijn' as a case to get stakeholders together.



The Nedersaksenlijn is a future train service which connect the city of Groningen and the city of Enschede via the east border of the Netherlands. In the current situation 35 kilometers of rail track is missing:

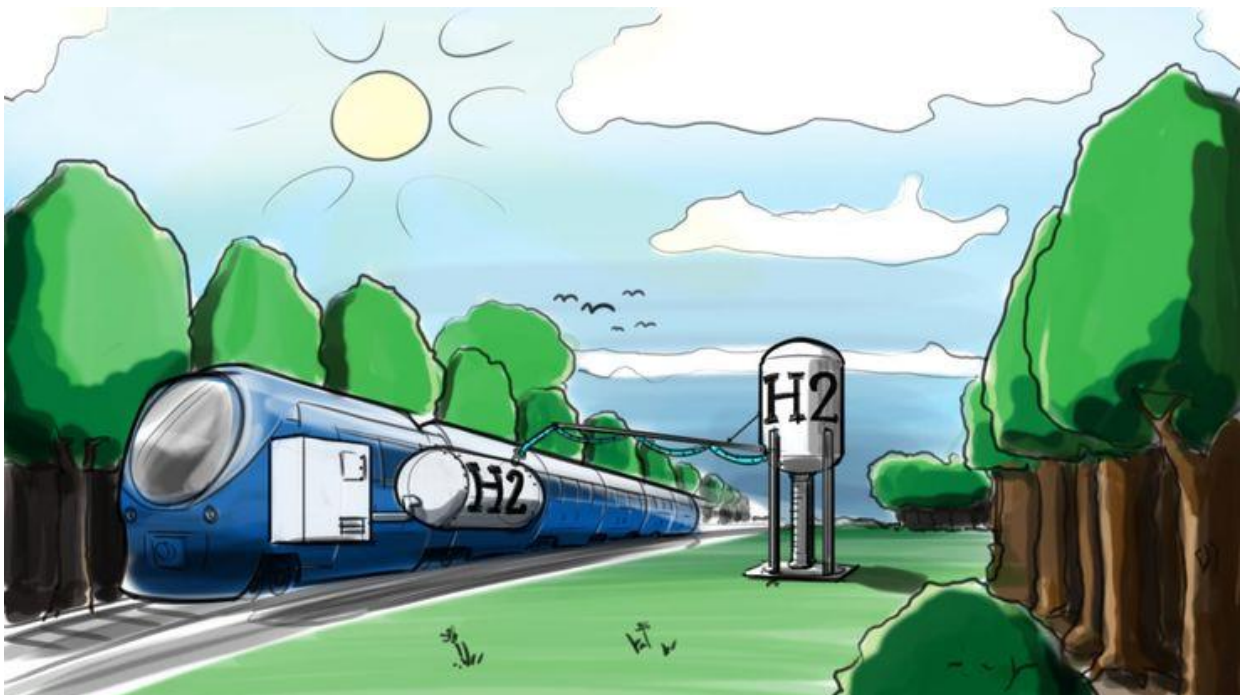


The northern part is operated by a diesel engine train (Groningen – Veendam) and a heritage steam train (Veendam – Stadskanaal). While the southern part – except for the crossborder line to Nordhorn which will be operated from 2027 – is electrified. The challenging question is which type of fuel will be used for the future Nedersaksenlijn?

This topic was discussed during an interactive session which took place during the Deltaplan Congres 2024 in the theater in the city of Meppel. Forty experts with different backgrounds attend the session. Among them were representatives of public transport companies like NS and Arriva and public officers from local, regional, provincial and the national government.



Together with a battery train a hydrogen powered train is a likely solution for the lack of electrified rail track. The possibilities to implement a hydrogen train in the near future will be investigated.



STAKEHOLDER ANALYSIS

The potential of hydrogen in the 'Nedersaksenlijn'

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29-01-2024

provincie Drenthe

Interreg
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Stakeholder Analysis 'Nedersaksenlijn'

The research into the application of hydrogen in the 'Nedersaksenlijn' is a crucial initiative not just to transform the mobility infrastructure but also to stimulate positive advancements in the regional hydrogen economy. There are various parties and stakeholders that play a role in the implementation of hydrogen in the Northeast of the Netherlands (Groningen, Drenthe, and Overijssel). This stakeholder analysis aims to provide an in-depth insight into the various actors/parties involved in the implementation of hydrogen technology into the 'Nedersaksenlijn' and its surrounding area.

Through a comprehension of the project's dynamics, we aim to identify the interests, influences, expectations, and interrelationships of key stakeholders. The information can be used to develop strategies to optimize collaboration and address potential challenges effectively. In conclusion, this analysis will enhance our understanding of the potential of hydrogen within the 'Nedersaksenlijn' as part of project EHRIN.

Overview stakeholders

- Provinces of Groningen, Drenthe, and Overijssel
- ProRail: Oversees the railway network in the Netherlands, acting as the railway manager and is, therefore, responsible for the construction, maintenance, management, and safety of the railway (ProRail, 2024b).
- Arriva: Functions as the provider of passenger transport on regional railway lines in the Netherlands, including the 'Nedersaksenlijn', which integrates into the regional railway network in the Northern Netherlands (Arriva, 2024).
- The Ministry of Infrastructure and Water Management: Focuses on a well-organized, clean, and safe environment. Its focus extends to developing connections across road, rail, water, and air (Ministry of Infrastructure and Water Management, 2024).
- NAM (Nederlandse Aardolie Maatschappij – Dutch Oil Company): Explores the utilization of existing gas infrastructure for future sustainable solutions, considering pipelines and locations. Additionally, it explores possibilities regarding blue hydrogen for a rapid transition to hydrogen (NAM, 2024).
- Hynetwork Services: A 100% subsidiary of N.V. Nederlandse Gasunie. It aims to develop and manage a large-scale hydrogen infrastructure in the short term. Existing gas transport networks are repurposed, and new pipelines are installed where the current network proves unsuitable. The primary focus is on establishing the hydrogen network in Drenthe and Overijssel (Hynetwork Services, 2024).
- The Ministry of Economic Affairs and Climate: Responsible for coordinating decisions and permits related to hydrogen, aiming to achieve a climate-neutral society while providing clean, reliable, and affordable energy (Ministry of Economic Affairs and Climate, 2024).
- Alstom: An international company dedicated to sustainability in the transportation sector, specializing in the production of hydrogen trains that contribute to the sustainable development of mobility in Europe (Alstom, 2024). In 2020, Groningen conducted test runs with this type of hydrogen train (ProRail, 2024a). Ultimately, in November 2022, the province initiated a procurement process for four additional hydrogen trains (Province of Groningen, 2022).
- Engie: An energy supplier actively participating in the green hydrogen chain in the Northern Netherlands (HydroNetherlands). Engie is involved in hydrogen production and has expertise in hydrogen refueling stations, playing a role in the introduction of the first hydrogen train in the Netherlands (Engie, 2024).

- Municipality of Emmen: Emmen holds a strategic position in the ‘Nedersaksenlijn’ given its significant industry, including the gas purification plant (GZI Emmen). The ‘GZI Next’ project aims to explore sustainable activities for this location, potentially including hydrogen production and a hydrogen filling station (GZI Next, 2024).
- Interreg: A European financing instrument with a focus on pioneering and environmentally friendly solutions for regional challenges in Europe (Interreg, 2024).
- Oost NL: The regional development agency (ROM) in Overijssel. The ROM strengthens the regional economy by innovating in sustainability, investing in fast-growing businesses, and attracting and retaining foreign companies in the region (Oost NL, 2024).
- NOM: The regional development agency for Groningen, Drenthe, and Friesland. It strengthens the regional economy by innovating in sustainability, investing in fast-growing businesses, and attracting and retaining foreign companies in the region (NOM, 2024).
- New Energy Coalition (NEC): A network of knowledge institutions and businesses collaborating to accelerate the energy transition for a sustainable future. While its primary focus is on Groningen, Drenthe, and Friesland, the network also engages in (inter)national partnerships with regions and countries (New Energy Coalition, 2024).
- Holthausen Clean Technology: A company located in Hoogezand, primarily dedicated to converting vehicles into hydrogen vehicles. This entity has extensive knowledge of the use of hydrogen in mobility and is additionally responsible for hydrogen refueling stations (Holthausen Energy Points, 2024).
- Residents of Groningen, Drenthe, and Overijssel.
- Environmental Organizations

In conducting the analysis, it is initially crucial to differentiate between primary and secondary stakeholders. Primary stakeholders, being the key contributors, also align most closely with the project's interests. Their influence is often important and plays a significant role in the project's success. On the other hand, secondary stakeholders are relatively further removed from the project but share common interests. Importantly, it does not imply that the influence of these stakeholders is less compared to the primary stakeholders. The secondary stakeholders are not actively engaged in the day-to-day execution or decision-making of the project (Currie, Seaton & Wesley, 2009).

Below, the primary stakeholders are listed, considering their interests and influence (power) on the project.

Primary Stakeholders

Province of Groningen, Drenthe, and Overijssel

The development of the 'Nedersaksenlijn' and the determination of the type of train that will be operational are initiatives led by the Provinces of Groningen, Drenthe, and Overijssel (Province of Groningen, Drenthe & Overijssel, 2024). The interests of these stakeholders primarily revolve around regional mobility improvement, sustainability, and positive economic developments in the region. The provinces influence local infrastructure and actively participate in decisions related to mobility.

ProRail

This stakeholder is responsible for the construction of the railway track and implementing necessary adjustments (ProRail,2024). The primary interest lies in efficient railway management. When introducing hydrogen, considerations must be made for a heavier vehicle than usual (adjustment of the soil), potentially involving detours to refueling stations. ProRail's task is to ensure and manage safety, therefore, the influence of ProRail is crucial in decisions related to the railway infrastructure.

Arriva

In its role as the service provider, Arriva holds responsibility for operating a train on this regional railway line. Arriva has a direct interest in the successful implementation of a hydrogen train, aligning with its commitment to promoting sustainability and green passenger transport. Furthermore, it can enhance its reputation as a sustainable transportation company. The influence of Arriva is moderate and depends on the policy decisions made by the provinces and ProRail. This influence is exercised through discussions and collaborations.

Ministry of Infrastructure and Water Management

As a department within the Dutch government, the Ministry of Infrastructure and Water Management plays a significant role in national mobility policy and infrastructure. Sustainability is an important consideration in its interests. This department holds influence over the policymaking of national infrastructure projects.

Ministry of Economic Affairs and Climate

The department, specifically orientated toward achieving a climate-neutral society with a strong open economy concentrated on coordinating economic policies in connection with sustainability. Concerning the potential of a hydrogen train on this railway, this stakeholder holds a policy influence. Additionally, it manages permits that have implications for the implementation of a hydrogen train.

NAM (Nederlandse Aardolie Maatschappij – Dutch Oil Company)

This national institution has historically supplied energy to society and industry, primarily through natural gas. Since the cessation of natural gas, the focus has shifted, and the current emphasis for the NAM is on the implementation of hydrogen as an alternative energy source (NAM, 2024). The interest of the NAM revolves around ensuring safe and efficient storage and transport of hydrogen. In a project like the 'Nedersaksenlijn', where the potential of hydrogen is explored, the influence of the NAM primarily lies in its involvement in hydrogen logistics and infrastructure.

Hynetwork Services

A subsidiary of Gasunie responsible for establishing a hydrogen network in the Netherlands, Hynetwork Services' main interest lies in the development of hydrogen infrastructure and its impact on the regional economy. The focus includes considering the possibility of fostering more hydrogen related businesses in various locations across the Netherlands. In this project, the stakeholder's influence primarily lies in its role of constructing the hydrogen network in the Northern Netherlands, with the identification of favorable locations for protentional hydrogen refueling station and storage places.

Alstom

As an international company in the sustainable transportation sector, Alstom concentrates on the development and sale of hydrogen trains in Europe. It is also engaged in technological advancements related to heavy hydrogen vehicles. The influence of Alstom relies in this context on its ability to serve as a supplier of hydrogen trains on this railway. Consequently, the company can actively participate in the project implementation of a hydrogen train between Groningen and Enschede.

Engie

An energy company engaged in the production and distribution of electricity and natural gas, as well as providing services to the energy sector, Engie is currently part of the green hydrogen chain in North Netherlands (HydroNetherlands). Engie is responsible for supplying green hydrogen and installing refueling facilities to promote sustainability. This stakeholder positively influences the project as a hydrogen supplier. Furthermore, Engie possesses knowledge of implementing hydrogen in trains and hydrogen refueling stations, contributing to the overall hydrogen infrastructure in the Netherlands.

Municipality of Emmen

Emmen has a strategic position due to its geographical location and the presence of a significant industry, including the gas purification plant (GZI Emmen). With the reduction in natural gas usage, the focus has shifted towards sustainable energy. The GZI Next project will investigate sustainable initiatives at this site, including hydrogen production and distribution (Gasunie, 2024). Exploring this industry/location is crucial for realizing hydrogen in the 'Nedersaksenlijn'. Emmen's interest in the GZI Next project primarily revolves around enhancing the sustainability of the city and the region. The municipality's influence on the 'Nedersaksenlijn' project primarily stems from its role in local governance and regional developments.

Interreg

This European financing entity will contribute to the possibilities of hydrogen in the 'Nedersaksenlijn'. It is crucial to evaluate the funding level that Interreg can offer for this project. The significance and influence of this stakeholder are both considerable.

New Energy Coalition (NEC)

This network comprising knowledge institutions and businesses accelerates the pace of the energy transition. With multiple knowledge institutions and businesses involved, this stakeholder holds a crucial position, bringing expertise to the energy transition. The primary interest of this party is the energy transitions towards a sustainable future, and its knowledge significantly impacts the research into the potential of hydrogen in the 'Nedersaksenlijn' and its surroundings.

Holthausen Clean Technology

This family-owned business located in Hoogezand plays an important role in the hydrogen environment in the Northern Netherlands. The company is involved in converting existing fossil fuel vehicles into hydrogen vehicles and oversees hydrogen refueling stations in the region, known as 'Holthausen Energy Points' (Holthausen Energy Points, 2024). This stakeholder aims to be responsible for sustainable refueling stations in the region's future, offering opportunities for a potential refueling station for hydrogen trains in the 'Nedersaksenlijn'.

Secondary Stakeholders

Oost NL

This regional development agency, with a focus on Overijssel, holds a crucial position in the regional economy. When exploring the potential of hydrogen, it is essential not to underestimate this stakeholder. Their objectives include regional development, investments in sustainability, and facilitation of business establishments in the region. Initiatives promoting hydrogen usage, such as introducing a hydrogen train in the 'Nedersaksenlijn', generate demand for hydrogen-related businesses in the region. The influence of this stakeholder will primarily be at the regional level, with a focus on developing and supporting hydrogen initiatives.

NOM

This regional development agency, concentrating on Groningen and Drenthe, is crucial to the regional economy. When exploring the potential of hydrogen, it is essential not to underestimate this stakeholder. Their objectives include regional development, investments in sustainability, and facilitation of business establishments in the region. Initiatives promoting hydrogen usage, such as introducing a hydrogen train in the 'Nedersaksenlijn', generate demand for hydrogen-related businesses in the region. The influence of this stakeholder will primarily be at the regional level, with a focus on developing and supporting hydrogen initiatives. NOM has a partnership with NEC (New Energy Coalition).

Residents of Groningen, Drenthe, and Overijssel

Because part of the railway line still needs to be constructed, and the potential establishment of a hydrogen network may occur, this project has implications for the environment and the community. Key concerns of local communities primarily revolve around environmental protection and safety. The influence of this stakeholder on the project primarily resides in opinions and the acceptance of hydrogen projects.

Environmental Organizations

For this project, adjustments will be required in the environment, including installing new railway tracks, hydrogen refueling stations, and hydrogen storage facilities. These changes will impact the environment based on how they are implemented. The primary interests of environmental organizations will revolve around sustainability and nature protection. The initial phase may not raise many concerns when promoting hydrogen use, but understanding its potential impact on the physical nature will be a more significant challenge. The influence of this stakeholder on the project will be through influencing policy formulation and regulations related to environmental issues.

Schematic overview of the stakeholders

Table 1: Schematic table of the primary stakeholders (made by author, 2024)

Stakeholder	Interests	Influence	Involvement	Attitude
Province of Groningen, Drenthe & Overijssel	Regional mobility improvement, sustainability, economic development.	On local infrastructure and mobility decisions.	Actively involved in local projects, positively critical.	Positive, if it stimulates regional development and sustainability goals.
ProRail	Efficient railway management, and sustainable mobility.	Important role in the rail infrastructure. Development of new rail facilities or the adjustment of it.	Active in rail projects, proactive in infrastructure development.	Positive, if the project improves the railway infrastructure and ensures safety.
Arriva	Sustainability & Operational Efficiency.	Policy decisions.	Direct impact on services.	Positive, if project aligns with sustainability goals.
Ministry of Infrastructure and Water Management	National mobility policy, sustainability, infrastructure.	Policy making, national infrastructure projects.	Active in policy making, coordination in national projects	Positive, if the project aligns with national policy goals and promotes sustainability.
Ministry of Economic Affairs and Climate	Coordination of economic policy, and sustainability.	Policy making, permit coordination.	Active role in economic policy, coordination of permits.	Positive, if the project contributes to climate goals and promotes clean, reliable energy.
NAM	Safe and efficient hydrogen storage and transport.	Involvement in hydrogen logistics and infrastructure.	Active in hydrogen related projects, involved in infrastructure developments.	Positive, if the project aligns with future sustainability goals for gas infrastructure.
Hynetwork Services	Development of hydrogen infrastructure, regional economy.	Crucial role in the construction of the hydrogen network in the Northern Netherlands.	Leading role in hydrogen infrastructure, regionally involved.	Positive, if the project contributes to the development of hydrogen infrastructure.
Alstom	Development and sales of hydrogen trains, technological progress.	Supplier of hydrogen trains, involvement in project implementation.	Actively involved in implementation, technologically innovative.	Positive, if the project promotes the sale of hydrogen trains and contributes to sustainability in the transportation sector.
Engie	Development and sales of hydrogen trains, technological progress.	Supplier of hydrogen trains, involvement in project implementation.	Actively involved in implementation, technologically innovative.	Positive, if the project promotes green hydrogen production and aligns with the company's sustainability goals.
Municipality of Emmen	Sustainable activities at GZI location.	Local governance and influence on local developments.	Actively involved in GZI Next and sustainability projects.	Positive, if the project promotes sustainable activities and aligns with local policy goals.
Interreg	Financing innovative solutions and sustainable projects in Europe.	Funding at the European level.	Funding partner for regional development.	Positive, if the project aligns with the innovation and climate goals of Interreg and contributes to the European hydrogen economy.
New Energy Coalition	Acceleration of the energy transition of a sustainable future.	Expertise in energy transition and sustainability.	Active role in regional and international collaboration.	Positive if it contributes to energy transition and sustainability goals.

Table 2: Schematic table of the secondary stakeholders (made by author, 2024)

Stakeholder	Interests	Influence	Involvement	Attitude
Oost NL & NOM	Strengthening of the regional economy.	Focused on regional economic developments	Actively involved in sustainability innovations in the region.	Positive, if the project strengthens the regional economy and aligns with sustainability goals.
Residents of Groningen, Drenthe, and Overijssel	Safety in the region and environmental protection.	Opinions and acceptance.	Moderate, impact on the local community.	Variable, depending on individual perspectives.
Environmental Organizations	Sustainability and environmental protection.	Influence on policy formulation and regulations.	Role in environmental issues.	Positive, if sustainability is promoted, and the environment is minimally burdened.

Tables 1 and 2 present a structured overview of the interests, influence, involvement, and attitudes of all stakeholders, both primary and secondary. Identifying interests enhances our understanding of the objectives pursued by each stakeholder. Determining influence allows us to recognize which stakeholders can significantly impact decision-making regarding hydrogen-related issues. Structuring the involvement is a crucial aspect of fostering effective communication and collaboration. Lastly, it is important to examine the attitudes of the various stakeholders. To ensure the success of the project and capitalize on hydrogen opportunities in the 'Nedersaksenlijn', it is imperative to evaluate when different stakeholders will embrace a positive attitude towards the project. This involves considering what is needed for stakeholders to adopt a favorable stance on the project.

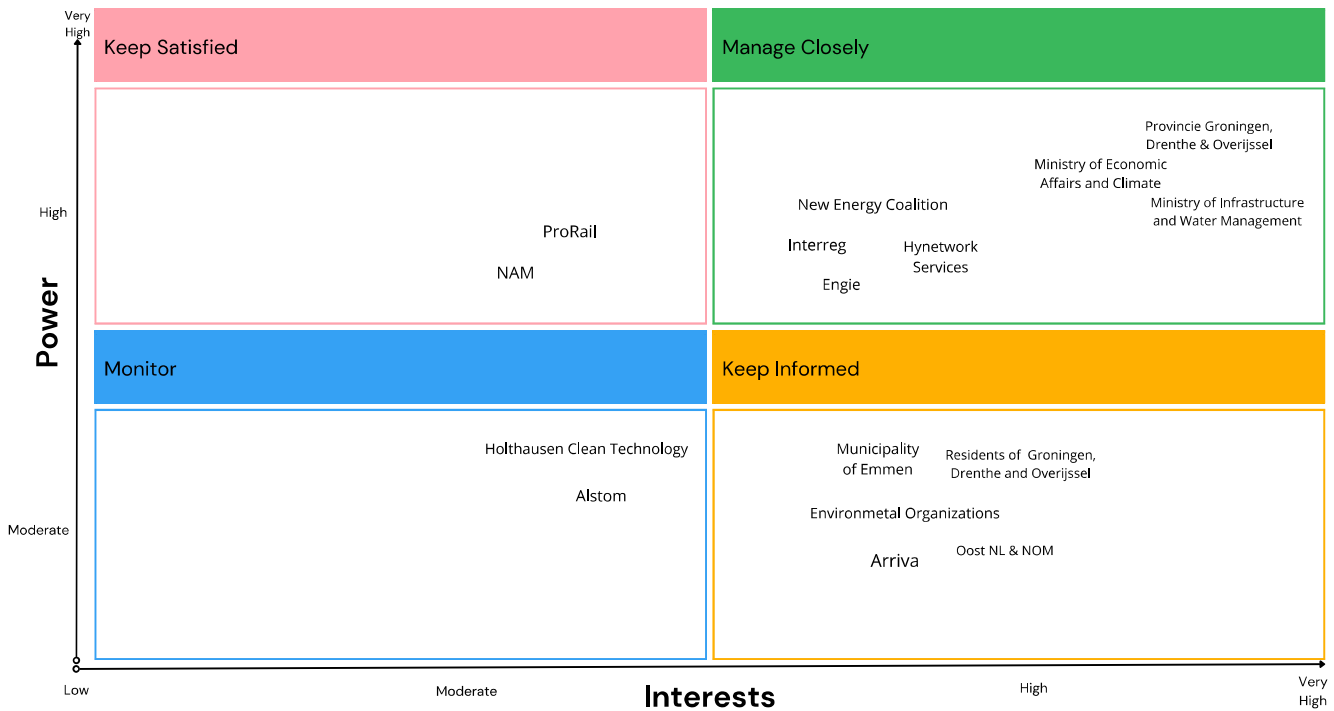
Stakeholder matrix

In addition to identifying primary and secondary stakeholders, a stakeholder matrix has been employed. This stakeholder management tool provides a more structured overview of the various stakeholders and their involvement in the project. The stakeholder matrix has been completed considering the interests and influence of each stakeholder. For each stakeholder, the level of interest and influence (power) on the projects and their outcomes has been assessed and categorized from low to very high. Table 3 presents a schematic overview of the level of interest, influence, and involvement of all stakeholders. With this, the matrix, which is presented in Figure 1, has been made.

Table 3: Schematic overview of Interests, Influence, and Engagement (made by author, 2024)

	Interests (Low, Moderate, High & Very High)	Influence (Low, Moderate, High & Very High)	Engagement (Low, Moderate, High & Very High)
Province of Groningen, Drenthe, and Overijssel	Very High	High	Very High
ProRail	Moderate	High	High
Arriva	High	Moderate	High
Ministry of Infrastructure and Water Management	Very High	High	Very High
Ministry of Economic Affairs and Climate	Very High	High	High
NAM	Moderate	High	Moderate
Hynetwork Services	High	High	High
Alstom	Moderate	Moderate	Moderate
Engie	High	High	High
Municipality of Emmen	High	Moderate	Moderate
Interreg	High	High	High
Oost NL & NOM	High	Moderate	Moderate
New Energy Coalition	High	High	High
Holthausen Clean Technology	Moderate	Moderate	Moderate
Residents of Groningen, Drenthe, and Overijssel	High	Moderate	Moderate
Environmental Organizations	High	Moderate	Moderate

Figure 1: Stakeholder matrix (made by author, 2024)



This stakeholder matrix provides an overview of all relevant stakeholders along with their position in the matrix. This allows for a distinction within the overall stakeholder group. By identifying key figures, we gain insights that enable us to concentrate efforts on these stakeholders, optimizing the project's chances of success. Additionally, it clarifies which parties need to be primarily informed to maintain a positive attitude among these stakeholders.

The information derived from this matrix will contribute to more effective and targeted future steps, resulting in an increased likelihood of success. Ultimately, through collaborative efforts with key figures, ensuring the satisfaction of the 'keep satisfied' stakeholders, involving the observer, and providing regular updates to the interested stakeholders on development and progress, a strong partnership will be fostered.

Challenges for the future

Having identified all stakeholders, it is crucial to analyze the future challenges associated with implementing hydrogen in the 'Nedersaksenlijn'. This examination aims to determine which stakeholder(s) can contribute to addressing these challenges.

Infrastructure & Technology

- Adapting the railway infrastructure for a hydrogen train involves substantial investment and significant time commitment. Moreover, consideration for safety measures and potential detours to hydrogen refueling stations are essential.
- The technical complexity of establishing hydrogen refueling stations and storage facilities near the railway line demanding careful planning, requiring collaboration among stakeholders.

Safety & Regulation

- The introduction of a new train model, specifically the hydrogen train, requires a comprehensive safety assessment, mainly due to its increased weight. It is essential to closely examine the impact of this increased weight on both the railway and the underlying ground. The integration of hydrogen into the railway sector and the broader region is dependent on obtaining various permits and complying with laws and regulations regarding hydrogen transport and usage.

Financing

- Challenges arise in securing sufficient funding for the implementation of the hydrogen train, the development of hydrogen infrastructure, and the necessary modifications to the overall infrastructure.
- The economic viability of the project presents a challenge, considering the costs associated with hydrogen and operational expenses.

Engagement & Acceptance:

- The support and acceptance of local communities in the changes to the environment and region are crucial for the success of the project.

Environmental Impact & Sustainability

- Implementing changes in the physical environment, like establishing a hydrogen network and new refueling stations, will be challenging for the concerns of environmental organizations.
- Moreover, ensuring the production of green hydrogen is a critical factor in maintaining the project's environmental benefits.

Figure 2: The challenges along with the associated stakeholders (made by author, 2024)

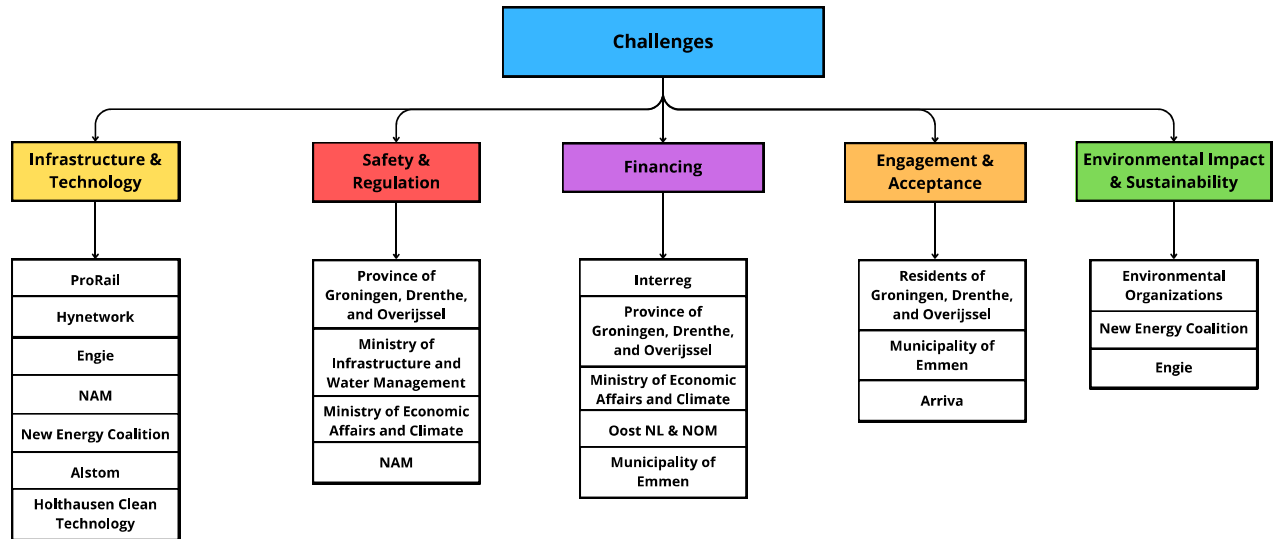


Figure 2 provides an overview of the challenges and the associated stakeholders capable of influencing these specific challenges. Each challenge involves multiple stakeholders, emphasizing the need for effective collaboration. The collaborative effort considers the expertise of each stakeholder, enabling them to complement one another within their respective domains. This collaborative approach is designed to boost the success of the hydrogen implementation in the ‘Nedersaksenlijn’ and its surroundings.

Conclusion

This stakeholder analysis provides a detailed insight into the various stakeholders involved in the implementation of hydrogen in the ‘Nedersaksenlijn’. The analysis has offered an overview of the interests, influences, involvement, and attitudes of both primary and secondary stakeholders. From this overview (Table 1 & 2), it became clear that the interests and influences of the stakeholders vary significantly. The matrix (Figure 1) provides a comprehensive snapshot of each stakeholder’s current position within the project. Additionally, challenges in infrastructure, safety, financing, engagement, and environmental impact are emphasized (Figure 2).

The successful implementation of hydrogen requires close collaboration among a diverse range of stakeholders, taking into consideration their individual interests and influence. The strategic mapping of potential collaborations (Figure 2) is crucial to ensuring the project’s sustainable success.

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