North Sea Energy

Stakeholder perception research on Platform Electrification

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Het project is uitgevoerd met subsidie van het Ministerie van Economische Zaken, Nationale regelingen EZ-subsidies, Topsector Energie uitgevoerd door Rijksdienst voor Ondernemend Nederland.

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Executive summary

The NSE project is about North Sea Energy System integration. This involves several technologies that can be deployed in the North Sea to deliver system integration opportunities which can contribute in reaching the Paris agreement. Among others, the opportunities that have been explored are hydrogen production, carbon capture storage (CCS) and platform electrification (PE). This research will focus on PE due to the knowledge gap remaining pertaining to public engagement, compared to CCS and H_2.. And due to its potential to function as a bridge towards CCS and H_2 activities in the future with the re-use of O&G infrastructure. On the short term PE entails the electrification of the processes on O&G platforms, supplied with electricity from for instance offshore wind parks, replacing the gas combustion generators currently powering the processes.

Better insights in stakeholder awareness and perception may lead to the development of effective stakeholder engagement strategies and thus contribute to societal embeddedness of these technologies. The main goal of this research as part of the NSE programme, is to derive the stakeholder perception of PE and determine building blocks for stakeholder engagement strategies.

To gain better insight in the relevant perspectives in the discussion on PE, the Q-methodology is used. In the Q-methodology respondents express their views on a statement in the context of all other statements presented. This enables the understanding of the perspectives to be more holistic and with a higher level of detail than just being opponent of proponent. Hence, representativeness in the Q methodology pertains the representativeness in perspectives, rather than in numbers or in the population. For this research literature analysis, social media search, stakeholders (=perspective) selection and interviewing took place. This results in 41 statements, divided over 6 categories: 1) Economic, 2) Technical, 3) Policy and regulations, 4) Communication and Stakeholder engagement, 5) System integration, and 6) Environment and nature. In an online survey respondents (n = 29) were asked to sort these statements in a bell-chart-structure (Q-sort). The respondents affiliations ranged from oil & gas sector, other North Sea users, knowledge institutes and the public. With a factor analysis the respondents were clustered on similar statements. These concourses were used to build the perspective map. The qualitative data derived from the interviews is used for the interpretation. This resulted in a set of perspectives, its corresponding narrative and a ‘condition’ map. These results were discussed with a small group of stakeholders to get their feedback and actually to start the stakeholder engagement process.

The research has delivered the next findings based on the applied method.

- First, PE is not widely known and that is confirmed by the stakeholders.
- Respondents tend to disagree more on the categories economic and environmental impact and communication than on technology and policy aspects. On the statements pertaining to the policy and regulatory aspects, and communication and stakeholder engagement, respondents tend to agree more.
- Differences in perspective are identified for economic, technical and system integration factors. This variety could indicate that in these three categories, drivers, interests and motivations between stakeholder groups differ the most.
- It is observed that there are more arguments supporting a role for PE compared to the arguments against. There is also more diversity found in the arguments pro PE. This entails that for a storyline in favour of PE, there are more arguments to use as buildings blocks. However, the fact that the positive arguments outnumber the negative arguments, does not imply that the case against PE is weaker, compared to the pro-case. The arguments on the con-side may target the public interest to a larger extent, compared to the technical or economic benefits which might be limited to the O&G companies alone. This pertains for instance to the following arguments: 1) the Oil & Gas sector maintaining their strong position amid the energy transition and 2) the negative impact on the ecosystem and fishery by PE and its enabling infrastructure. This means that in stakeholder engagement the perspectives always have to be put against the multidimensional motivations of stakeholders.
- The requirement map (p. 21) shows concerns of stakeholders, like environmental impact on eco-systems and spatial planning issues and the little being known on this impact. It is emphasized by stakeholders that research and programme activities for new technologies should take into account stakeholders and the public in an early stage of development and strategy definition.

- Other important requirements of stakeholder engagement are intensive cooperation for research and decision making between all relevant stakeholders, exchange of information on operations, and adjustments of regulations. Establishment of a long term roadmap enables the alignment of grid developments and investment decisions.

In order to create a shared and supported understanding on the role of PE in the North Sea, this study recommends to start the involvement and engagement of the public to create the necessary support for PE. The fact that the public is not yet familiar with PE, provides opportunities to engage them from the start of the development. PE in system integration is a complex topic and engagement should start with a story that is close to the public, preferably visually supported. The bigger picture of PE in the context of development in the North Sea and in relation to Energy and Climate pathways can contribute to a convincing story. The engagement strategy should take into account the public concerns.

Stakeholder engagement strategies will have to cope with the fragmented field of perception by drafting information and engagement activities that combine and align the perceptions of these stakeholders. The identified perspectives, the relation between them, and the underlying motivations and values should be embedded in the stakeholder engagements strategies as integral part of a PE project. Three questions could form the basis for PE projects in the North Sea (derived from the perspective map, pertaining to the diversity in motivation and drivers of the stakeholders.):
(1) Who should benefit? And who is necessary to realize the benefits?
(2) What are the impacts? And how is the impact perceived?
(3) Why and how to provide the benefits?
For each PE project, a joint effort by all relevant stakeholders to answer these questions could contribute in gaining trust and willingness to support the greater good and public interest. In all cases a resilient stakeholder engagement strategy should include procedures on how to update insights on the joint efforts, as the stakeholder field, and motivations may change over time.

In all stakeholder engagement strategies regarding PE and other North Sea System Integration-projects it is recommended:

(1) to start with ‘why’ the project benefits the North Sea and its stakeholders. From here inspiration can be drawn that brings parties together.
(2) to understand that tailored communication towards all stakeholders is key.
(3) to manage relationships and expectations.
(4) to work together based on joint interests, resources and challenges.

For future research on PE (and for North Sea System Integration-projects) it is recommended to involve stakeholders and have them involved in the formulation of research questions to ensure that their concerns are thoroughly addressed. This can be supported by more reflective and action research activities on North Sea energy system integration projects.

1. Introduction

1.1 Relevance of Public Perception

The North Sea Energy program (NSE) investigates opportunities for climate synergies that arise when making smart connections between renewable offshore energy generation, e.g. offshore wind, and existing Oil and Gas (O&G) infrastructure. This is also called system integration. By looking to identify and research opportunities for system integration, NSE addresses the potential benefits for the use of space, costs and benefits for the environment and the impact of system integration on different economic sectors and stakeholders.
Through smart links and synergies between the various offshore technologies, a sustainable energy hub can be created in the North Sea to contribute in the Paris agreement. Among others, the opportunities that have been explored are hydrogen production, carbon capture and storage (CCS) and platform electrification (PE). The main goal of the current research is to derive the public perception on platform electrification and determine building blocks for stakeholder engagement strategies by North Sea actors, which can empower the role and implementation of PE with stakeholder and public support.

Stakeholder attitudes, including those of the public, towards energy system integration will be an important factor in the successful implementation of projects with energy system integration technologies. Examples are carbon capture & storage (CCS), electrification of oil and gas platforms or energy islands. Both governments and project organisations can learn from experiences related to other projects in the past in order to set up effective engagement strategies towards stakeholders and create an 'effective operating environment' (Global CCS 2010). Previous experiences showed that attention for stakeholders is very important (e.g. CCS Barendrecht, Illinois) (Brunsting et al., 2011; Hunda & Greenberg, 2011). Therefore, for the development of system integration at the North Sea, it is important to get better insights in stakeholder awareness and perception of these topics. Better insights may lead to the development of effective stakeholder engagement strategies, contributing to speeding up energy transition and scaling up promising technologies.

For many Dutch inhabitants, the North Sea is, psychologically speaking, far away. Wind turbines on land often encounter fierce protests of local communities. Although offshore wind can potentially have less opposition, compared to wind at land, it is of the utmost importance to take care of the environmental aspects as would be done on land, including the landscape preferences of the public (Wolsink, 2010). The distance in knowledge and engagement of the public towards energy related activities, shows similarities to these activities on shore, however there are significant differences related to e.g. lower levels of public knowledge on the technologies, a fundamentally different offshore context and different stakeholders (Wiersma & Devine-Wright, 2014).

The North Sea has many more stakes for economic (fishery, tourism, transport) and environmental reasons (ecosystems, nature) and these stakeholders might influence the public perception on activities in the North Sea, such as PE and the continuation of platforms in the North Sea. System integration and the coordination of the various activities, to ensure that can co-exist and collectively contribute towards the climate goals is a complex challenge (NSE2, 2019).

1.2 Research Scope: Platform electrification as part of system integration

The North Sea hosts several important (economic) activities, including oil and gas production, wind energy production, fisheries, sand and shell extraction, shipping, areas for military use, nature reserves, and recreational activities. The area thus has an important economic and environmental function for the Dutch economy. Because the geographical area is limited, there is an ongoing competition for space. By smartly combining various uses of the North Sea, the competition for space may be reduced, which improves the balance between energy production, food production and ecological value.

One of the important activities in the North Sea is energy production and transport. In order to realize the energy transition, in line with the Paris agreement, sustainable production and smart integration of systems

are needed. Re-use of existing O&G infrastructure (pipelines, platforms and depleted fields) may open the route towards a North Sea scenario for energy production at reduced costs and might play a major role in our new energy system. This energy transition is a complex process of technology, governance, business models and actors and requires multiple changes at once. Re-use of O&G infrastructure is an example of system integration at North Sea, that involves different technologies. The North Sea thus can be an important area where this energy transition takes place. Several system integration options exist that could enable and accelerate this transition, in NSE2 (2019) the following options are proposed:

- Electrification of O&G platforms to decrease emissions and feed other future activities with clean energy
- Offshore Power2Gas on existing gas platforms and energy islands
- Carbon Capture and Storage using existing gas pipelines and depleted fields
- Energy storage using existing offshore assets

These options may jointly lead to an accelerated growth of sustainable energy production at the North Sea. Effective system integration at the North Sea requires the use of several technologies which may be implemented in different combinations. More specifically, three technologies are promising: Carbon Capture & Storage (CCS), Hydrogen conversion and Platform Electrification (NSE2, 2019). Both CCS and Hydrogen conversion are not solely offshore technologies; they can be implemented on shore as well, and these technologies have attracted ample research on both technical and social aspects. For CCS the CATO programme[1] analysed the public perception and how and under what conditions CCS could be implemented. PE entails the electrification of the processes on O&G platforms, supplied with electricity from for instance offshore wind parks, replacing the gas combustion generators currently powering the processes. Research by Beekman, Wissink, van der Veer, Koornneef and Peters (2019) explored the benefits and potential for PE for NexStep, the national platform on platform decommissioning, and reported the following:

- PE reduces the CO_2 and NO_x emissions from O&G platforms
- PE enables the prolonged lifetime of O&G platforms, by delaying the decommissioning. Decommissioning costs are delayed costs which can be invested in sustainable offshore projects.
- PE contributes in the attainability of CCS with existing assets
- PE contributes in the attainability of offshore Hydrogen production, compression and distribution on platforms and energy islands
- Energy storage in depleted offshore fields.
- Combinations of the above

However, PE is a novel solution for the North Sea, only one platform has been electrified up to 2019, and little to no research has been conducted on PE from the social perspective. Due to the great potential for PE to function as a transition technology, and the fact that very little is known on the public perception regarding PE, this research will focus on PE. In this research we will explore what arguments can be used pro and against PE, and to what extent these arguments can influence the public perception and stakeholder engagement.

1.3 Public perception: previous research

Several studies on public perception of hydrogen and CCS have been performed, e.g. Ricci, Bellaby and Flynn (2008) and Itaoka, Saito and Sasaki (2017). These studies show that, in general, public awareness and knowledge of hydrogen technologies and their role in future society are largely absent. But despite these low levels of awareness and knowledge of hydrogen and fuel cells, people show positive to neutral attitudes towards hydrogen (Itaoka et al., 2017). In some countries CCS is evaluated negatively, due to the fear of leakage of CO_2 and, consequently, the lack of confidence in the safety of geologic storage (Dowd, et al, 2014). This lack of confidence is remarkable, as studies have shown that geological storage of CO_2 is secure, even over a long time period (>10.000 years) (Alcade et al., 2017; Miocic et al., 2019). This example makes clear that the attitude of the public towards a technology is not always aligned with outcomes of scientific research.

Moreover there is a vast information provision from various channels, which can impact and shape public perception. To benefit from the reach of fast social media in spreading news and impact stakeholder engagement strategies, there is a need for scientifically sound and convincing stakeholder information. Based on previous research concerning public perception on CCS, the following advises may improve stakeholder engagement strategies (ter Mors, 2019; Best-Waldhober, 2015; Best-Waldhober & Daamen, 2006):

- Improve knowledge and awareness. The general context and role of hydrogen and CCS in the future energy system should be clear and communicated to the relevant stakeholders. Their effectiveness in tackling energy and environmental problems and understanding the context of deploying blue hydrogen (role of hydrogen and CCS) should be made clear.
- Establish trust. When engaging stakeholders sound, reliable and impartial information should be consolidated and channelled by a trusted source (i.e. a balanced consortium of partners) of information.
- Address local and project specifics. It is important to take into account the possible benefits and costs for local stakeholders and understand local needs regarding communication and engagement. Stakeholders engagement is highly project specific.
- Clarity on benefits and costs. The benefits and costs (monetary and non-monetary) for stakeholders, including the public, should be clear and taken into account in engagement strategies.
- Perceived justice. Overall regulatory and institutional framework and perceived justice are important in the engagement process.
- Take caution with compensation and remuneration. Compensation and remuneration measures can take various forms, but should be handled with care regarding form and timing.

In this research, we will explore stakeholder awareness and perception of PE, by exploring the arguments given in favour or against PE.

1.4 Reading guide

This report presents the result of WP2.2 of the NSE program. It starts with a description of platform electrification in energy system integration, based on other work in the NSE-program and a first general analysis of the different stakeholders involved. Chapter 2 describes the methodology that is based on both quantitative and qualitative research in the Q-methodology. Chapter 3 presents the results of this research with a focus on the qualitative interpretation of the collected data. Chapter 4 gives the headlines of a reflection by stakeholders in a joint stakeholders session with the aim to identify joint messages for PE and for system integration at the North Sea in general. The conclusions of this research and recommendations for effective stakeholder engagement strategies will follow in Chapter 5.

2. The research approach

In recap, the aim of this study is to derive building blocks for stakeholder engagement in the North Sea, with the focus on PE. To this end a research approach is drafted which:

- Identifies and selects relevant stakeholders, taking into account representativeness. This entails a stakeholder sample reflecting a balances representation of the variety of perspectives present in the stakeholder population (Cuppen, 2010).
- Starts off with a framework for stakeholder engagement and can embed the derived building blocks in a framework to shape steps towards stakeholder engagement. For this study elements from the framework for community engagement in offshore wind as proposed by (Klain, Satterfield, Battista, & Chan, 2017) in *figure 1* are used to shape the methodology.

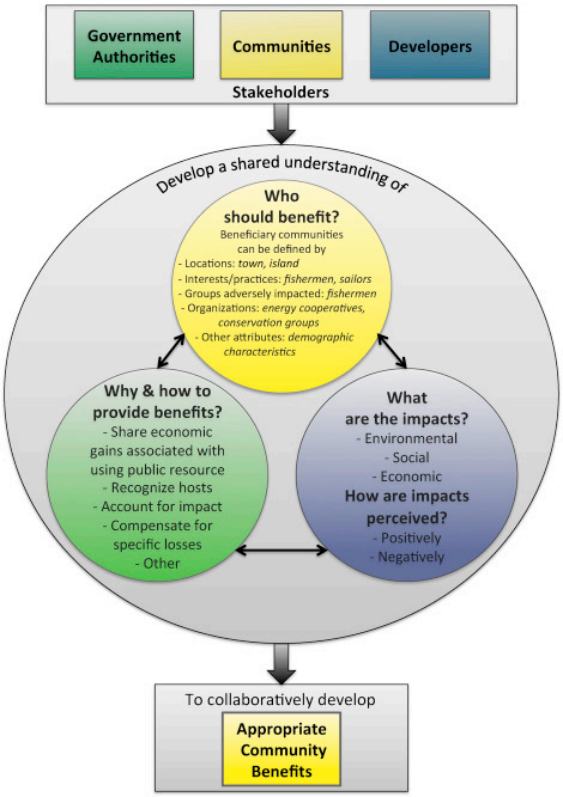


Figure 1: A framework for community engagement, adapted from (Klain et al., 2017)

2.1 The Q-methodology

To gain better insight in the relevant perspectives in the discussion on PE, the Q- methodology is used (TNO, 2018). The Q-Methodology originated in the 1930s and underwent continuous development that resulted in an integrated general method to research people's subjectivity (Stephenson, 1953). The main aim of a Q-study is to distinguish people's perceptions of their world from the perspective of self-reference, and without necessarily predefined categories of factors by the researcher. Instead of asking respondents for their views on isolated statements, as is done in conventional surveys, in the Q-methodology respondents express their views on a statement in the context of all other statements presented. This enables the understanding of the perspectives to be more holistic and with a high level of detail (Cuppen, Bosch-Rekveldt, Pikaar, & Mehos, 2016).

Moreover, the Q-methodology is a mixed-methods methodology meaning that both qualitative and quantitative methods (factor analysis, where the respondents are the variables and the statements are the

cases) are combined. Consequently, the Q-methodology combines the open nature of interviews with the structuring qualities of quantitative methods.
In addition, the Q-methodology aims to provide insights on the variety of perspectives among the population (Cuppen E. , 2010). Hence, representativeness in the Q-methodology pertains the representativeness in perspectives, rather than in the population. It is not the aim to generalise outcome towards the population. For this reason, the procedure for sampling respondents differs from that in conventional survey research. Instead of random sampling and aiming for large sample sizes, the Q-methodology relies on purposive sampling and smaller sample sizes (Brown, 1996).

For these reasons the Q-Methodology is argued to be a suitable method to conduct the research on the public perceptions with respect to platform electrification and its role in the North Sea. A subject on which very little is known on how it is perceived by the public. In *figure 2* it is illustrated how the Q-methodology is operationalised for this research.

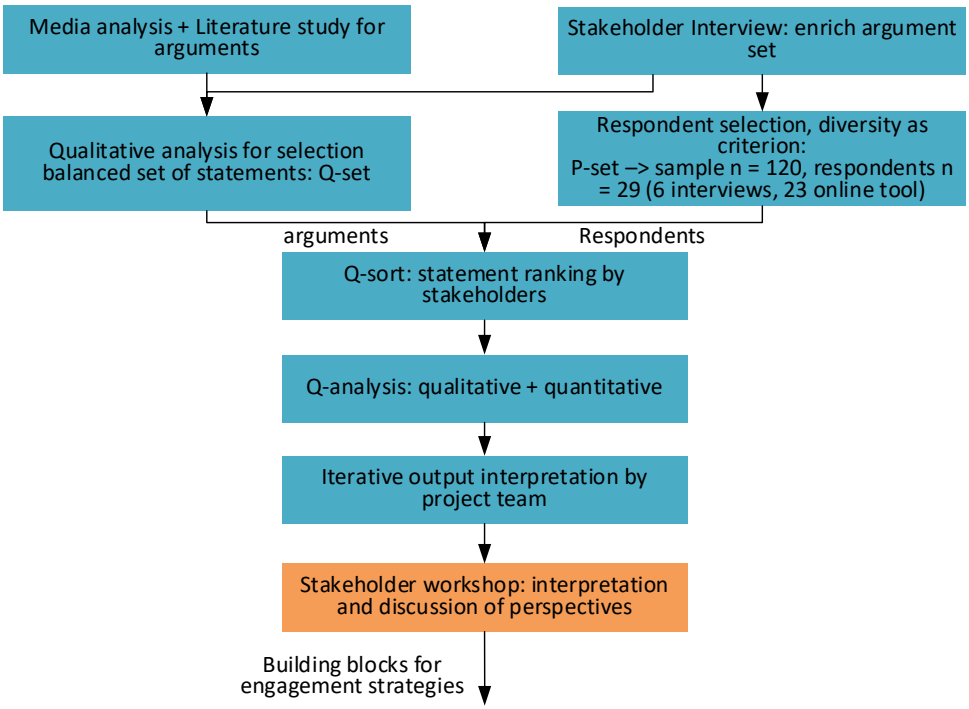


Figure 2: Research flow diagram

2.2 Research Operationalisation

2.2.1 Stakeholder selection

The P-set, that is the sample of stakeholders, was drawn from a stakeholder analysis through desk research on energy related activities in the North Sea. Stakeholders to include in the Q-set, hence to approach for participation in the study, were selected based on the actor type. Respondents were selected from stakeholder groups: Oil & Gas companies, environmental organizations, government, and knowledge institutions. This yielded in a Q-set of 120 potential respondents, in the end 29 responded to the request.

2.2.2 Data collection: Interviews and a digital tool

The Q-methodology entails a unique data collection method in which participants sort a set of statements (Q-set) in a bell chart (as displayed in *figure 15* in appendix E), based on the extent to which they agree or disagree with the statement. These 120 potential respondents are approached to participate in the research,

and to keep that participation feasible within the given resources, a distinction was made to select key organisations within each stakeholder category and approach them through interviews, while the remaining stakeholders were approached digitally. Of the 29 respondents, 6 were interviewed face-to-face and 23 provided input over the digital tool. The list of interviewees may be found in *Appendix A.*

The purpose of this interview is twofold, first, through the interview the Q-set was enriched via a Snowball method. Second, the respondents were asked to fill in the Q-sort and comment on each decision made. This provided us with more context on the decisions made, compared to the digital tool where the options to elaborate on the choices are limited. For this study, the web-based Q data collection software by https://qmethodsoftware.com was used.

2.2.3 Defining the Q-set

Literature research and expert interviews

As previously mentioned, the respondents were asked to sort statements in the Q-set, representing the various perspectives on the topic. These are statements representing the concourse or flow of communicability of the research topic (Brown, 1996). They can be collected from e.g. interviews, reports, blogs or websites which address the subject (Cuppen et al., 2016). In this study the statements are based on facts regarding PE derived from reports, but also on opinions on PE and its role and impact on the North Sea. The sorting of these statements provides a mean to derive the perception of the respondent on the subject. The statements are derived from literature research on PE, and an analysis of social media and news outlets for information of the public view on PE and related topics. Moreover, the interviews with the key stakeholders resulted in additional statements to include in the Q-set.

Media Analysis

The media analysis entailed a social media and search engine analysis with a search period ranging from May 2018 until June 2019, with the goal to derive the public debate on PE among citizens. The direct actors and experts in the North Sea, are directly approached via interviews or the online tool, hence LinkedIn is not included as this is a platform where the traffic will be generated by this category. The social media analysis included Twitter, Facebook, and Instagram. A trial account of BuzzSumo and several search engines (Google.com, Startpage.com, DuckDuckGo.com) were used.

The Q-set

Eventually the interviews and desk research resulted in 41 statements around the research topic, divided over 6 categories: 1) Economic, 2) Technical, 3) Policy and regulations, 4) Communication and Stakeholder engagement, 5) System integration, and 6) Environment and nature. The statements can be found in *Appendix C*.

Each statement was added to the online tool for sorting. The participants then sorted the statements in two phases (this procedure also holds for the face-to-face sessions):

1) The first phase or pre-sorting involves arranging the statements in three piles. For example, the participant groups the statements according to which ones they agree with, disagree with, and feel neutral or uncertain about.
2) Next comes the actual sorting. In this phase, the participant must consider how strongly they feel about each statement. They place each one along a response grid or Q-sort structure, which the researcher provides. The Q-sort structure is displayed in appendix E.

The resulting Q-sort or arrangement of cards on the grid is purely subjective, based on the respondent's knowledge, own feelings or opinions. There are no right or wrong answers. The Q-sort structure is typically in the shape of a normal distribution or bell curve, with the majority of statements placed towards the middle or neutral area and fewer on either end. The distribution can be narrow or wide.

2.2.4 Respondent management

For analysis purposes, the stakeholders were aggregated to four groups. *Figure 3* depicts this aggregation and the amount of respondents per category.

This way, a more meaningful analysis can be conducted. The categorization is as follows:

- The O&G industry: companies active or involved in production of oil and/or natural gas, and the operation and decommissioning of platforms, such as Shell, NAM, NexStep.
- Other North Sea Users: represented by (logistic) service and technology providers, the offshore wind industry (NWEA), the TSO (TenneT), fishery (VisNed) and other economic activities in the North Sea
- Knowledge stakeholders: the knowledge institutions: universities and their 'knowledge and innovation top sectors, but also the consultancy and advisory firms active in the offshore industry.
- The public: represented by policy makers, environmental NGOs and citizens of The Netherlands.

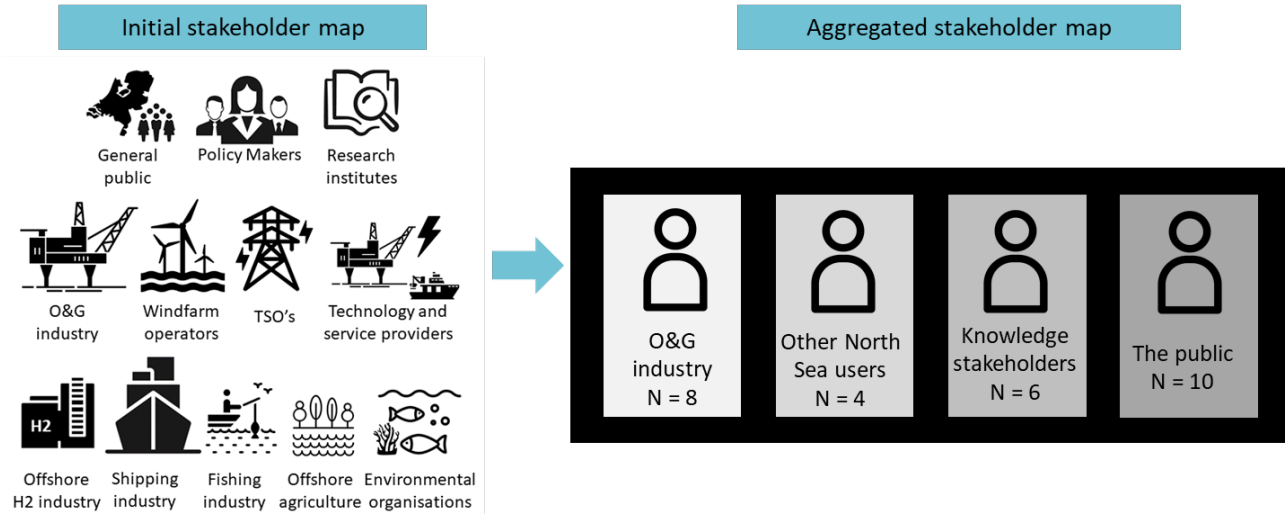


Figure 3: The initial stakeholder map as established for Platform Electrification in the North Sea, and the aggregated stakeholder map for analysis

2.3.5 Q Analysis

After the data is acquired on the Q-sort, a factor analysis is conducted to cluster the respondents which sorted the statements similarly. In this factor analysis, the respondents are thus the factors, while the statements are the cases, resulting in each cluster being a factor. These statement clusters or concourses were used to build the perspective map (see *figure 7*).

The qualitative data derived from the interviews is used for the interpretation. The interpretation and derivation of the clusters are an iterative process, resulting in set of perspectives and its corresponding narrative. Part of the rich data derived from the interviews are the requirements for PE to be successful and supported in the North Sea, as proposed by the key stakeholders. These requirements will be arranged and presented in the "requirements map".

3. Results

In this chapter the results from the Q-methodology to establish public perception on PE will be presented. First, we address the current public debate on PE, then the derived elements for arguments from literature and interviews are presented, followed by the presentation of the distribution of agreement, disagreement and dispute over the six categories as introduced in paragraph 2.3.3. The results are presented for each of the involved stakeholder groups. The perspective map, and finally the requirements map, concludes this chapter.

3.1 A public debate on platform electrification?

The analysis of social media, i.e., Twitter, Facebook, and Instagram, showed little to no interest in the topic of O&G platform electrification yet. Posts and tweets came from companies or their employees; with likes and reposts limited to a few, or none. The absence of PE on social media suggests this topic is not, or hardly, known to the public.

A list of search terms and the number of relevant hits is listed in *Appendix D*. A list of search terms and the number of relevant hits is listed in *Appendix D*. Based on the search terms (see appendix 2), 83 sources have been found. The reporting is neutral (e.g., news about partnerships) or positive (e.g., opportunities in the energy transition). Negative messages are rare; they concern technical problems (e.g., a power cable comes loose and hinders shipping / fishing).

It seems that PE specifically is not a subject people talk about on social media, or during coffee breaks or with friends at parties. The concept seems not to be known or not to be popular. However, there is ample public debate on the decommissioning activities of O&G platforms in the the North Sea. Moreover, public debate targets the North Sea as the new power plant for the Netherlands. In *Figure 4* an excerpt of these messages is presented. For O&G platform decommissioning the messages target the environmental risks of leaving decommissioned platforms in the North Sea. On the other hand, the messages target the potential downsides of the big move towards offshore wind. It is argued that we are treating the North Sea as the garbage bin for everything we do not want on land, not taking into account the potential impact on the environment. The negative framing on the activities in the North Sea could shape the public perception and significantly derail the progress we make in the North Sea, in particular regarding the renewables. This also pertains to the potential role of PE in making the transition of a fossil based North Sea towards a sustainable energy based North Sea.

Figure 4: An excerpt of tweets on the potential downside of energy generation in the North Sea

3.2 Argument map

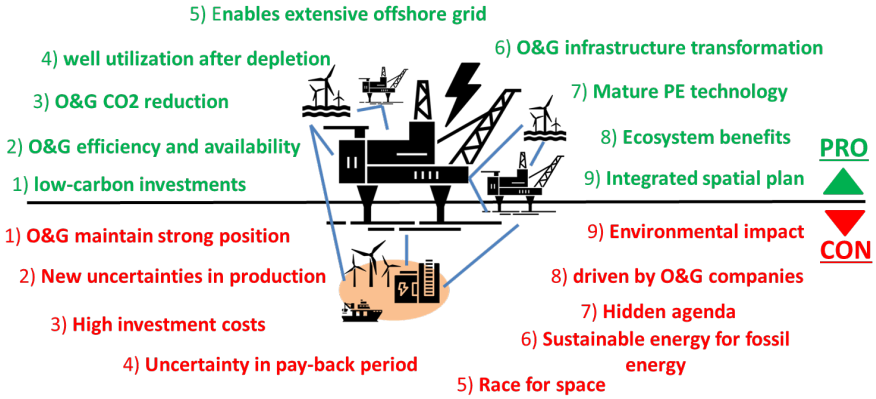


Figure 5: The argument map based on the literature study, presents in an aggregated manner the arguments pro and con towards PE

Previous research – e.g. (Elgaas, Hjertvikrem, Hua, Tryti, & Glomsaker, 2018; Fowler, et al., 2018; Riboldi, Voller, Korpas, & Nord, 2019; Beekman, Wissink, van der Veer, Koornneef, & Peters, 2019) - yielded several argumentative elements for, and against PE. These are presented in *figure 5*. The arguments found in literature, were also mentioned in the interviews, or interviewees agreed that these indeed are arguments for or against PE. In the following sub-section we will proceed with the results from the Q-sort where statements constituted from the argument elements as presented in *figure 5* were sorted by the stakeholders.

3.3 Results from the Q-methodology

3.3.1 The general distribution of perceptions among six categories

Figure 6 visualizes to what extent the respondents agree or disagree with the statements per category. The statistics indicate the share of statements on which the four stakeholder categories, 1) collectively agree with (green), 2) collectively disagree with (red), or 3) where there is a dispute. These categories are the same as the categories presented in paragraph 2.3.3, according to which the statements can be categorized. The green share of the bars indicate the share of statements within that category which all respondents unanimously agree with. Red indicates the share of statement with which all respondents disagree, and blue represents the share of the statements where the respondents are divided in agreement and disagreement. From these results, insights can be derived on categories where efforts are necessary to align perceptions of the stakeholders, namely the categories where there is a large share of statements where there is dispute over (Blue). For instance in the category of system integration, where it is of the utmost importance to align stakeholder interests, it can be observed that the perceptions of the stakeholders signify a large amount of dispute.

The technical category is also characterized by a large amount of dispute. However, in this category the dispute can be explained to a large extent by the lack of knowledge on the technical aspects of PE. This reasoning is based on the feedback received from respondents who filled in the tool online, while the stakeholders interviewed also expressed knowledge gaps pertaining to the technical aspects. As a result, and due to the fact that for the Q-sort respondents have to make choices for the ranking of the statements (no statement can be left unsorted), the respondents often chose to place the technical statements on which they lack knowledge, and also no fact-based opinion, on the neutral or disagree side of the bell-chart (see *figure 16* in appendix E for this bell-chart).

The large unity in disagreement on the environmental side is predominantly on the statement that for PE scarcely available sustainable energy is wasted on the O&G production. Moreover, there is in general a disagreement on the negative environmental impact of PE.

However there is a category of stakeholders which strongly agree with these negative environmental impacts, namely the environmental organization categorized as “Stakeholder in the North Sea”.

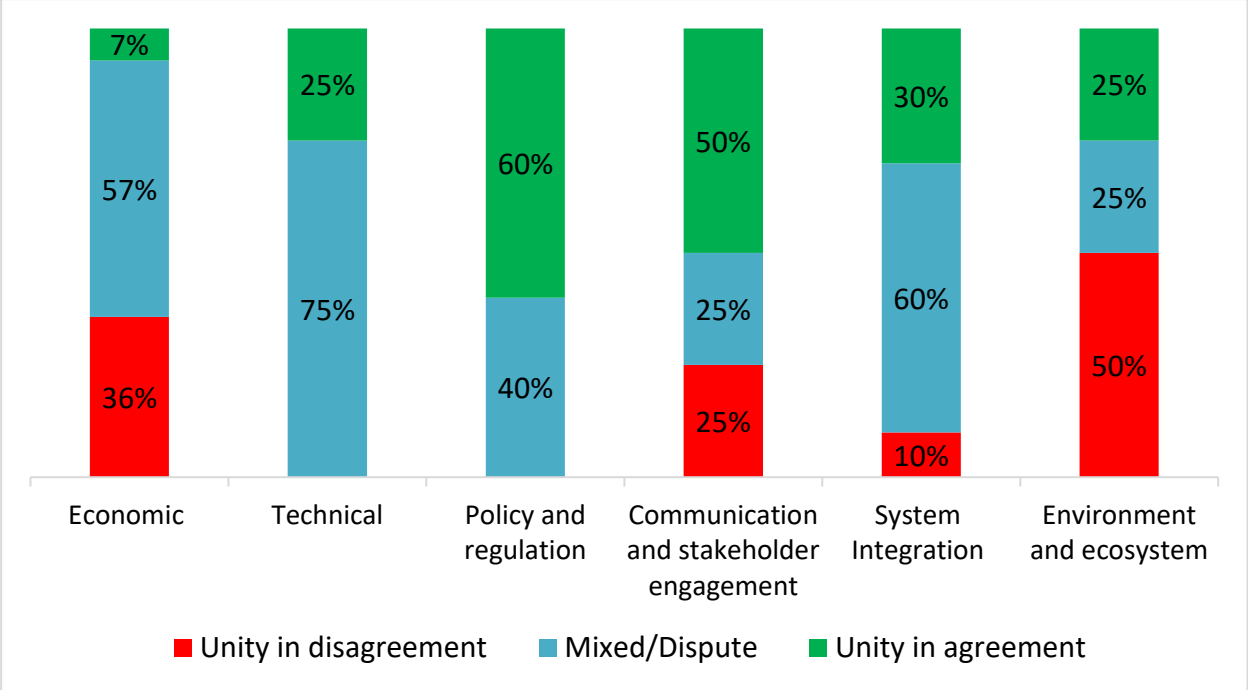


Figure 6: The distribution of stakeholder perceptions in terms of unity in disagreement (red), unity in agreement (green), and dispute (blue)

Table 1: Aggregated representation of the unity on disagreement or disagreement and the dispute among stakeholders for the statements presented

Technical factors		
No unity in disagreement	Dispute on the **maturity of PE technology** and **the required changes in the offshore grid** to enable PE	Unity in agreement on **the increase in platform efficiency** due to PE
Economic factors		
Unity in disagreement that there are **insufficient platforms** for PE and that there is **too much uncertainty in payback opportunities** after PE	Dispute **on the benefits of PE for security of supply** and **platform decommissioning costs**, that **PE keeps O&G firms alive**, and that **the wind sector is essential for PE**	Unity in agreement on **the need of O&G cooperation** for the financial feasibility of PE
Public support, policy and regulation		
No unity in disagreement	Dispute on **the need of government subsidies** for PE to be feasible, and the **need for new methods of tendering** offshore energy	Unity in agreement on unity on the responsibility of the government **to establish roadmaps** and **adjust legislation** to enable PE
Communication and citizen engagement		
Unity in disagreement that successful and large scale PE requires **the involvement of the Dutch citizens**	Dispute on the statement that the **Dutch citizens are not interested** in PE	Unity in agreement on the need for **cooperation among O&G firms**, but also with **other NS**

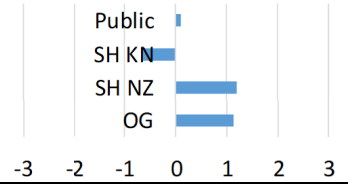
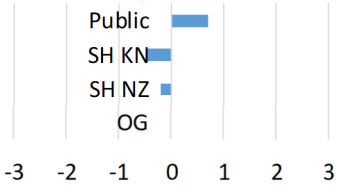
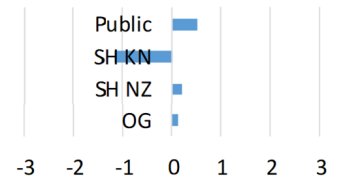
		sectors and stakeholders for successful PE implementation
Environmental factors		
Unity in disagreement that for PE **sustainable energy is wasted** on the production of fossil energy	Dispute on the **positive and negative impact** of PE on the North Sea environment	Unity in agreement that PE **reduces emissions** of the O&G sector and this is necessary to reach climate goals
System Integration		
Unity in disagreement that **PE enforces the race for space** in the NS and that subsequently platforms need to be decommissioned before any other step	Dispute on **the impact of PE on the congestion of the grid**, **the impact on fishery**, and **the lack of joint research** on the potential of PE	Unity in agreement that PE brings **synergy between the offshore wind and O&G industry**, incentivizes the **development of the offshore grid**, and that **chain-integration** is key for system integration.

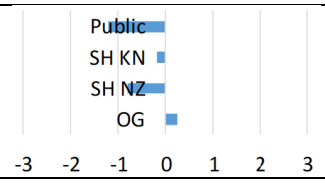
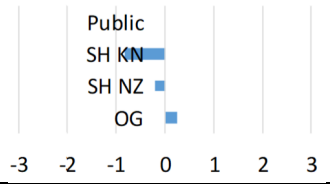
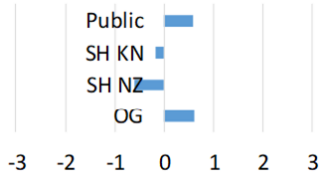
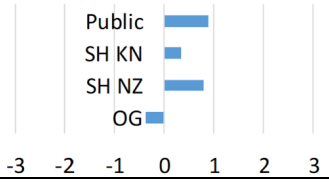
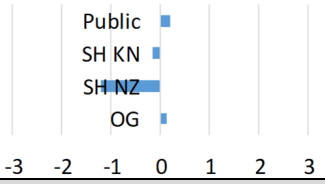
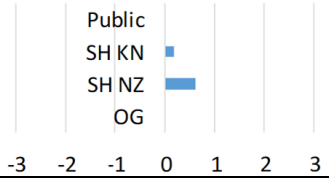
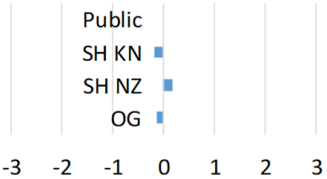
A more in-depth analysis on how the various stakeholders relate to each other in terms of the unity in agreement or disagreement, and dispute will be further elaborated below.

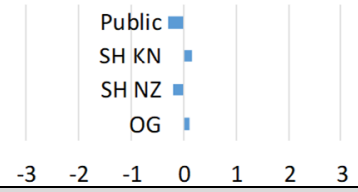
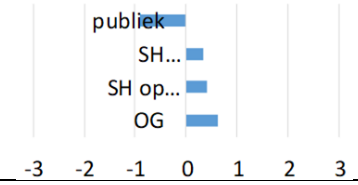
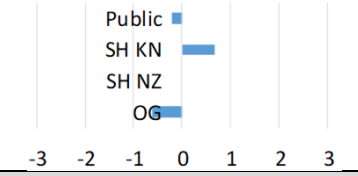
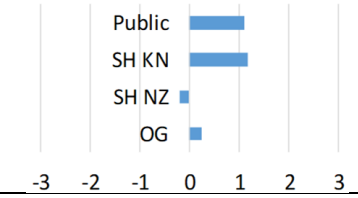
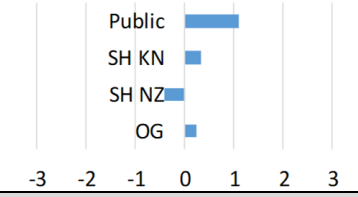
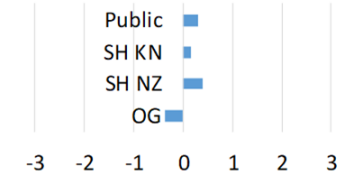
3.3.2 The variety of perceptions over the stakeholders

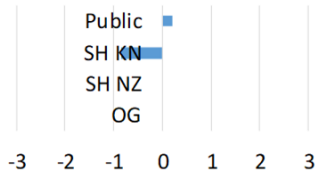
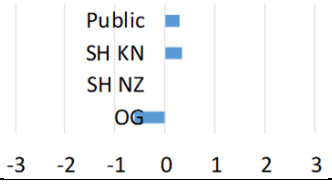
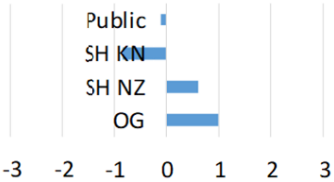
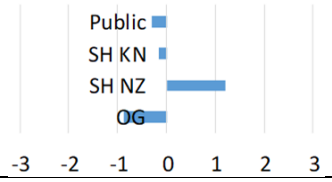
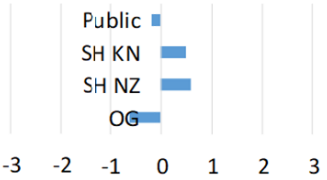
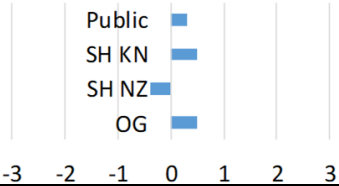
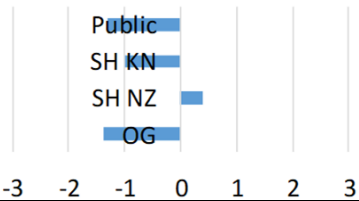
In appendix B, the collective perception of each statement per stakeholder group (as introduced in paragraph 2.3.4) is displayed. In *Table 1*, the middle column depicts the dispute between stakeholders. The following table will filter out these statements which entail dispute and elaborate on the main differences in perception **between** stakeholder group. These findings are derived from the quantitative analysis of the data, and interpreted using the interview data.

Table 2: Main findings among stakeholders, a combination between the quantitative and qualitative analysis

Statement	Description on dispute
Economic	
PE ensures smart use of natural gas 	Between the O&G industry, the stakeholders in the North Sea and the Public there is significant agreement, however the knowledge stakeholders do not agree.
PE brings economic advantage by postponing the dismantling of platforms 	The O&G industry is neutral on this statement, as PE comes with high investments which may rule out the economic benefit. In line with this, the other stakeholders in the North Sea and the knowledge stakeholders disagree. The public agrees with this statement when also given the information O&G platform decommissioning will cost the tax-payer around 5 billion euros.
Oil & Gas companies remain strong through platform electrification 	This is a statement with which the public and the other stakeholders in the North Sea agree. The respondent from the O&G industry noted the generally negative public image of O&G companies in the Netherlands; it is believed that this image affects the public perception of this statement. However, the knowledge stakeholders disagree. The O&G industry agree with the statement and see PE as one of important prerequisites for them to maintain relevance in the future.
PE presents new financial risks for the O&G operator	Other than the O&G industry, all other stakeholders disagree with this statement. The new financial risks, e.g.

	due to the uncertainty of electricity prices and security of supply as mentioned by the respondent from the O&G industry, present a big barrier for the O&G firms to decide on PE investments.
PE requires high investments 	The public is neutral on this statement, the expressed lack of knowledge on the investment needs for PE among the respondents may also play a significant role in the neutral ranking of this statement by the public. Where the O&G industry moderately agrees, there is disagreement among the North Sea stakeholders and the Knowledge Stakeholders.
Oil & Gas companies interfere in the sustainable sector with PE 	This is agreed with in a negative perception by the public, and in a positive perception by the O&G industry. On the other hand the North Sea and Knowledge stakeholders moderately disagree with the statement with no further information on the negative or positive perception.
PE is not possible without the offshore wind sector 	The only stakeholder in disagreement with this statement is the O&G industry, with the argument that the platforms can also connect to the grid on shore.
The risks and uncertainties for O&G companies in PE and System Integration are great, but dealing with them is familiar to them 	Relatively low agreement by the public and O&G industry. The North Sea stakeholders, strongly disagree and mention that the risks due to a more interconnected network of cables and pipelines, and electricity as energy carrier, can be much higher than anticipated.
Technical	
PE provides increased platform efficiency through digitization Operations & Maintenance 	This is a prime example of a statement which was difficult to rank by respondents and where they expressed that technical knowledge on PE is required. As a result, the overall perception is closely surrounding neutral.
PE is a mature technology 	This is a prime example of a statement which was difficult to rank by respondents and where they expressed that technical knowledge on PE is required. As a result, the overall perception is closely surrounding neutral.

The offshore grid requires significant changes in design and operation strategy for local demand 	This is a prime example of a statement which was difficult to rank by respondents and where they expressed that technical knowledge on PE and grid development is required. As a result, the overall perception is closely surrounding neutral.
Policy and regulations	
PE cannot do without government support 	Agreement on this statement by all stakeholders, except the public. It is mentioned that government support (e.g. financially) for O&G infrastructure is an argument the public will not agree with.
For system integration new criteria are needed in tendering, to stimulate the integration of H2 in the offshore wind business model 	The need for new methods of tendering is proposed by the offshore wind sector and agreed with by the knowledge stakeholders. Where the other North Sea stakeholders are neutral on this statement, the O&G industry and the public disagree.
Communication and Stakeholder engagement	
PE demands broader involvement than just the O&G industry 	Other than the North Sea stakeholders, all other stakeholders collectively agree with this statement. No further information on the disagreement by the North Sea stakeholders could be derived from interviews.
The average Dutch resident is not interested in PE 	Other than the North Sea stakeholders, all other stakeholders collectively agree with this statement. Interviews state among others the distance between citizens and O&G platforms, and the technical nature of PE as reasons for the limited interest.
System Integration	
PE reduces congestion on the grid 	This is a statement which was difficult to rank by respondents and where they expressed that technical knowledge on the offshore grid is required. As this knowledge is limited for many stakeholders, they rank the statement as neutral. As a result, the general perception looks rather neutral, where the public, North Sea stakeholders and Knowledge stakeholders tend towards agreeing, and the O&G industry tends towards disagreeing.

PE reduces transmission losses on the grid 	This is a statement which was difficult to rank by respondents and where they expressed that technical knowledge on the offshore grid is required.; as this knowledge is limited, many stakeholders rank the statement as neutral. As a result the general perception looks rather neutral, with the public tending to agreeing, and the Knowledge stakeholders tend towards disagreeing.
PE allows more wind energy to be connected to the grid 	This is a statement which was difficult to rank by respondents and where they expressed that technical knowledge on the offshore grid is required, where this knowledge is limited many stakeholders rank the statement neutral. As a result the general perception surrounds neutral, where the public and Knowledge stakeholders tend towards agreeing, while the O&G industry tends towards disagreeing.
PE gives O&G infrastructure a new purpose in accelerating the energy transition 	Large agreement by the North Sea stakeholders and the O&G industry, while the Knowledge stakeholders and public disagree.
Fishery are particularly affected by the increase in cables in the North Sea 	This is a statement which all stakeholders, except for the North Sea stakeholders (this includes fishery), disagree with. The respondent from the fishing sector mentioned that this can be attributed to insufficient knowledge on how fishery operates and may be impacted by subsea cables.
There is a lack of joint research into the potential and location for PE 	This is a statement which the O&G industry disagree with, it is stated by the respondents from the O&G industry that joint research occurs sufficiently. However, cooperation in other, more tangible forms, can improve.
Environment and Nature	
PE benefits the ecosystem 	Agreement by the public, knowledge stakeholders and the O&G industry, and disagreement by the North Sea stakeholders. Noteworthy is that respondents expressed knowledge gaps surrounding these benefits during the interviews, the main perception of these benefits is thus that little is known.
Platform Electrification has disadvantages for the ecosystem 	Strong disagreement by the public, knowledge stakeholders and the O&G industry, and agreement by the North Sea stakeholders. Also regarding the disadvantages the respondents expressed that these are not clear to them, hence these questions call for further research on the possible disadvantages too.

3.4 From the Q methodology towards stakeholder engagement strategies

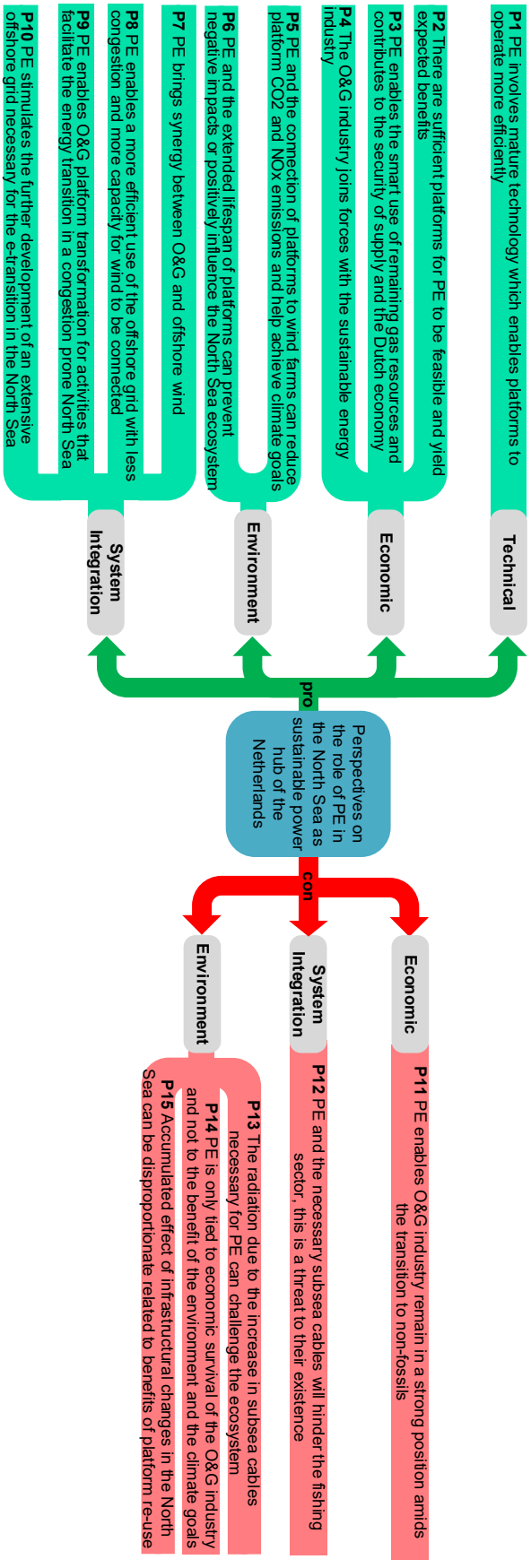


Figure 7: Perspective map derived from the stakeholders via the Q-Methodology

3.4.1 Perspectives derived from the Q methodology

In *Figure 7*, the perspective map is displayed. These perspectives, or argument concourses**,** are derived from the correlation between the ranking of statements by the stakeholders in the Q-sort. The map consists of 10 positive perspectives (P1 – P10) and 5 negative perspectives (P11 – P15), which should collectively be taken into account by actors when proceeding with PE projects. At first glance, it can be observed that there are more arguments supporting a role for PE in the North Sea as a next step towards a more sustainable energy system in the Netherlands, compared to the arguments against. Over the categories there is also more diversity in the arguments pro PE. This entails that for a storyline in favor of PE, there are more arguments to use as buildings blocks. However, the fact that the positive arguments outnumber the negative arguments, does not imply that the case against PE is weaker, compared to the pro-case. The arguments on the con-side, i.e. the O&G sector maintaining their strong position amid the energy transition and the negative impact on the ecosystem and fishery by PE and its enabling infrastructure, may target the public interest to a larger extent, compared to the technical or economic benefits which might be limited to the O&G companies alone. The perspectives always have to be put against the multidimensional motivations of stakeholders, see paragraph 3.3.2 for more on this.

Perspective P2, P3 and P4 combined indicate the Economic concourse of why PE is an attractive proposition to contribute in the sustainable transformation of the North Sea, where the incumbent O&G industry joins forces with the upcoming renewable energy industry, and where the remaining natural gas resources are being put to use in a smart way, hereby contributing in the security of supply of natural gas in the near future. This is opposed by the economic perspective that due to PE, the O&G industry will remain in a strong position (P11).

P7, P8, P9 and P10 are positive perspectives all pertaining to the benefit of PE for System Integration in the North Sea. P7 can be compared to P4 as they both address the cooperation between the O&G industry and the renewable energy industry, where P7 focuses on the economic benefits of these two sectors cooperating, P7 focuses on the technical synergies between these two sectors, e.g. for optimal spatial use and energy exchange. The benefits for offshore renewable energy production are also linked to P8, P9 and P10, however, the last three perspectives focus on the grid and its optimal utilization due to the synergies.

The other negative perspectives focus on two aspects, first that is the risks of PE and the supporting infrastructure, e.g. sub-sea cables, for other activities in the North Sea such as fishery (P12). And second, the risks of negative impacts on the environment and ecosystems in the North Sea (P13, P14 and P15). Opposing the negative perspectives pertaining the environment, are P5 and P6 as positive perspectives on PE. P5 targets the immediate problems in the Netherlands regarding NOx and CO_2, and how PE can contribute in tackling these issues. P6 targets the positive impact which maintaining offshore structures in place can have on the local North Sea ecosystem.

3.4.2 How to incorporate perspectives in stakeholder engagement strategies

Via abovementioned perspectives the research provided an explorative first picture of stakeholders' values and positions, reaching further than simplified divisions between proponents and opponents. By presenting the stakeholders with a comprehensive set of arguments pertaining PE, the multi-dimensional positions of the stakeholders could be derived. This means that there are different issues which result in different perspective taken by stakeholders, which entails that stakeholders cannot be simply categorized as proponent or opponents. Similar concerns may have different motivations, e.g. there is concern on the impact of increasing amounts of sub-sea cables for PE, and for fisheries this concern is motivated by the possible impact it may have on their operations, while for the nature conservation organizations this concern may pertain to the impact on fish and the North Sea ecosystem. By uncovering these motivations, effective strategies can be built to accommodate multiple stakeholders coherently. For project developers in PE, taking this nuanced picture into account in project management and stakeholder engagement, strategies can have great benefits for the successful implementation of PE, by creating societal value and mutual benefits.

After identification of the relevant perspectives, as is done in this study for PE in general, platform operators should specify these perspective specifically for their project. The stakeholder field may be different per platform, e.g. depending on the distance to shore or to wind parks. Hereby it is essential to take into account both the positive and negative perspectives when engaging in activities to inform and involve stakeholders. The identified perspectives, the relation between them, and the underlying motivations and values should be embedded in the stakeholder engagements strategies as integral part of a PE project.

Finally, a stakeholder engagement strategy should include procedures on how to update these insights, as the stakeholder field may change over time, and the motivations per stakeholder can also change over time. It is thus a dynamic process, where the platform operator should continuously keep the relevant stakeholders (including the public) engaged according to their perspectives and the extent to which they desire to be engaged. This results in resilient stakeholder engagement.

3.5 A requirement map derived from empirical data

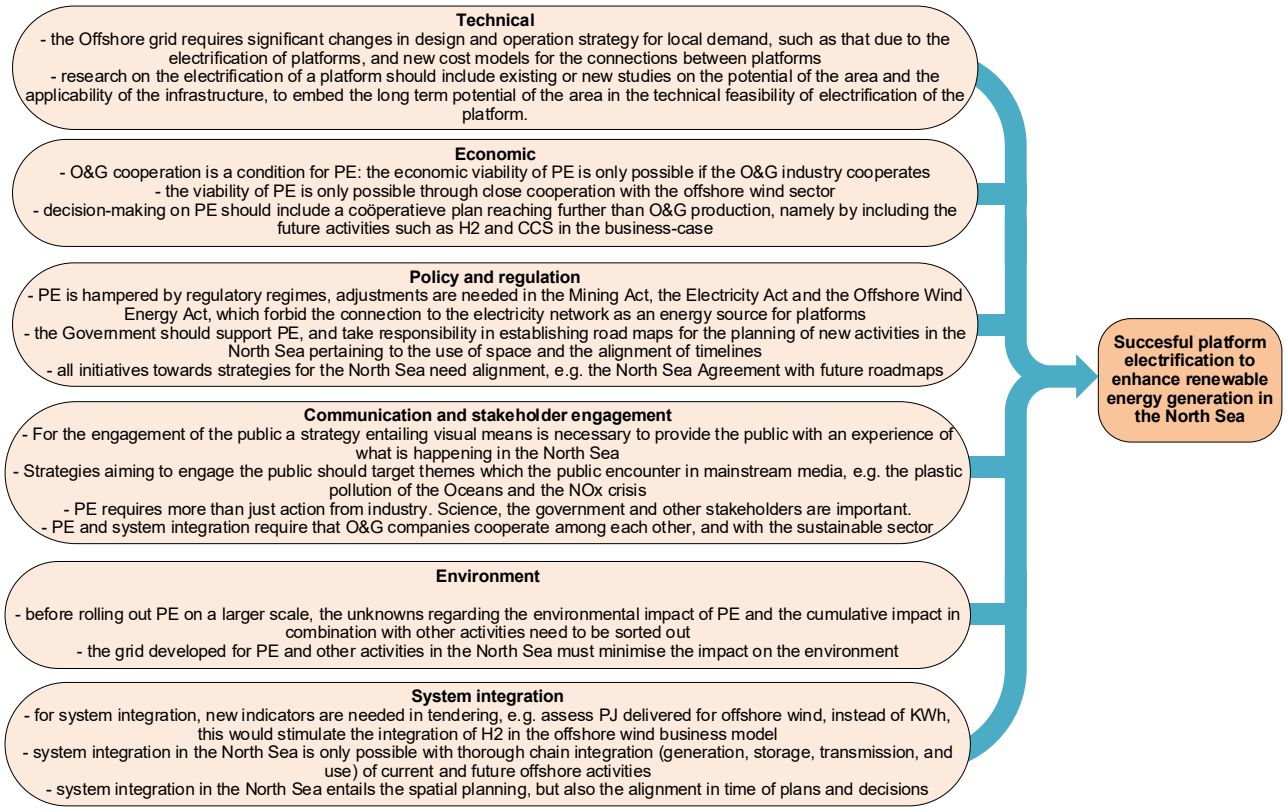


Figure 8: Requirement map – requirements posed by the stakeholders for successful implementation of platform electrification and system integration in the North Sea

In *figure 8* the requirement map is displayed, presenting requirements for a supported implementation of PE which are derived from the six interviews with key stakeholders. This requirement map recommends requirements which can be included in project management and stakeholder engagement strategies as a mean to: 1) deal with the potential downside of PE, and its enabling infrastructure, 2) barriers towards PE implementation, e.g. regulatory barriers, and 3) opportunities to enhance the role of PE and the engagement of stakeholders.

The factors identified in the Requirements-map all represent issues that must be resolved in order for PE to have a significant role in the North Sea. The requirements are derived from the interviews, where these requirements are mentioned as a reaction on the statements, e.g. the stakeholders agree that PE reduces the emissions of the O&G sector, however, the technical feasibility research on the electrification of a platform should include research on the potential of the area and the applicability of the infrastructure for

CCS and/or H_2, to embed the long term potential of the area in the technical feasibility of electrification of the platform. From the side of the TSO the offshore grid will need to adapt their offshore grid development to facilitate the offshore use of electricity.

For activities such as PE to gain in relevance in the North Sea, stakeholders also mention the requirement to engage on intensive cooperation ranging further than the O&G industry alone. This cooperation should not only target the co-creative development of knowledge, e.g. in the form of joint research, but also the actual decision-making on investments for PE and platform re-use. Joint efforts on investments and the execution of projects are aimed to benefit from the economies of scale and reduce the high costs associated to PE and furthermore CCS and H2 production and distribution
On the regulatory side, several regulatory frameworks need to be adjusted for platforms to directly acquire power from the offshore grid. And the government is expected to take responsibility in the establishment and execution of roadmaps which to guide and integrate the developments in the North Sea towards the efficient contribution of the North Sea to the common goal of a climate neutral energy system in the Netherlands.

As previously mentioned, some consequences of PE will undeniably have keen public interest, such as the possible negative impact on the ecosystems in the North Sea. This issue must be very thoroughly and transparently researched and communicated. Moreover, future grid development to enable PE and other activities in the North Sea should include the environmental impact as a requirement and aim to minimize or ideally prevent this impact.

Pertaining to system integration, the research yielded requirements in the field of chain integration, new tendering models to integrate, e.g. Hydrogen and PE, in the business models of offshore wind, and the need to target the spatial alignment of activities in the North Sea. Also, these activities need to be aligned in time, so that the current infrastructure can indeed be utilised for future activities such as CCS.

To tackle each of the requirements towards efficient use of the North Sea, with support from all stakeholders - especially the public - collaboration within the helix of the O&G industry, offshore wind industry, governments, TSO, knowledge institutions and (representatives of) the public is necessary. The requirements explicitly touch upon the interest of all groups in this quadruple helix. It is recommended to include these requirements in the development of roadmaps for the North Sea and discuss these requirements with other frameworks being established for the North Sea, such as the North Sea agreement.

4. Stakeholders reflections

This section will present the results from the stakeholder session on platform electrification[2]. In the session with representation of the Nature and preservation organisations, TSO, Fishing sector, O&G industry and NSE partners, the aim was threefold:

1. Presentation of the results to the stakeholders and jointly reflect on these results. This also entailed a discussion on how these results can be used by the stakeholders in their own communication and stakeholder engagement strategies.
2. Presentation of the general NSE3 storyline to the stakeholders and gather their feedback on this storyline in order to improve it. Because this aim was related to the Communication team of NSE it is not included in this report.
3. How the engagement of the stakeholders can be established in follow up research for North Sea Energy.

4.1 Stakeholder feedback on the results

First of all, the stakeholders agree that it is a great challenge to communicate towards the public on subjects which are technically complicated and complex in the context of the North Sea such as PE. Even for the stakeholders already active in the North Sea, the actual impacts of new activities or bringing activities closer to each other, e.g. offshore wind and offshore O&G, requires in depth knowledge on the actual operations of the stakeholders in the North Sea. The lively discussion during the stakeholder session surfaced the limited extent to which stakeholders are aware of each other's activities and the interactions between these activities. To educate the public on these complicated and complex activities, in order for them to have a well-informed perception, remains a challenge and questions arise to what extent and how the public and stakeholders further away from the activities can be informed and engaged.

An unexpected outcome for the participants is the unity in agreement that PE does not entail the spillage of scarcely available sustainable energy on the production of gas in favour of the O&G industry. It is stated that the O&G industry has to invest significant efforts and resources to convince the public on its intentions in the energy transition. An explanation on this finding can be related to the respondents placing the overarching goal, climate neutral in 2050, in front of the questionable public image of the O&G industry. Increasing the set of respondents with more valid representation of the population may change these results: for this study, the main share of the respondents can be identified as "energy enthusiasts".
The need was emphasized to link PE with other activities in the North Sea, such as CCS and H_2 production and distribution, and utilise PE as a strategic linking bridge towards these activities. Subsequently, it is important to establish a joint storyline for energy system integration at the North Sea and co-create this together with the other stakeholders with interests in the future activities.

There was a perceived inadequacy in the embedding of nature and environmental impact in the statements. Whereas nature is mentioned in certain statements, it is stated that nature should not be treated as a stakeholder, but as the starting point from which you operate. Therefore, nature is recommended to be integrally embedded in the NSE research. This recommendation is enforced by the finding resulting from the stakeholders interviews that many questions remain regarding the negative impacts of activities in the North Sea. In particular the cumulative impact of all activities in the North Sea remains with significant research questions. Thorough research on these unknown cumulative consequences is needed. Roadmaps are required, in which activities in the North Sea are planned and aligned with nature and its carrying capacity as a starting point. These roadmaps will make sure that the cumulative impact on nature is kept within responsible bandwidths.

Among the participants, there were remaining questions regarding the impact of an increase in subsea cables for electrification activities in the North Sea on fishery and nature. Notions were made on how these

[2] Utrecht, 28 of November 2019

impacts could be mitigated, for instance by laying cables at depths which do not interfere with fishing activities. Agreements were made for follow up on this topic and to minimize this impact in future.
There is general agreement that the results of this study provide useful insights on the arguments which can be used pertaining to Platform Electrification and system integration in the North Sea. The fact that the set of respondents of the questionnaire offers a wide representation of stakeholder perspectives in the North Sea adds to the value of the insights. The recommendation is to use the qualitative knowledge gathered in NSE3 and focus on the reach of more citizens and stakeholders in NSE4 for the quantitative substantiation of the findings.

4.2 Stakeholder engagement in follow up research

The final part of the stakeholder session addressed the engagement of stakeholders in the next step of the North Sea Energy program, follow up research activities and system integration. Here it was discussed that research programmes on energy system integration, like NSE, should, in general, improve stakeholder engagement, reaching further than the O&G industry, and for instance have better involvement of nature and preservation organisations and organisation related to other economic activities in the North Sea such as fishery, and the offshore wind industry. And the inclusiveness of these stakeholders could also incentivise an increased role by the TSO. The role for the nature and preservation NGOs and the other economic activities in the North Sea can be found in the joint definition of research questions and in the sounding board of these programs.

Moreover, it is stated that for the effective engagement of stakeholders the threshold of stakeholder communication should be lower. For instance, it is suggested to interact with actual fishermen, instead of with the representing organisation alone. This will bring other issues and stakes at the tables, because these are dependent on the location of their activities in the North Sea, the business model, among others. Given that next research steps might be more location specific, this requires the NSE program to incorporate a more thorough stakeholder selection process, based on the locations in the North Sea targeted by NSE research. The various nature and preservation organisations might have different agendas as well. Subsequently stakeholder engagement entails that having a single organisation representing nature and preservation or fishery, does not necessarily include all interests adequately. An improved and more diverse stakeholder engagement in next research programmes is expected to improve the understanding of the actual stakeholders for the goals of NSE, and the other way around, this interaction will provide support and a more detailed context to the field in which NSE operated.

Finally, it is recommended to align stakeholder engagement with other initiatives in the North Sea. In particular the North Sea Agreement is mentioned. This agreement is now the leading framework for the activities in the North Sea. Next research programmes with thorough stakeholder engagement should take the interactions and agreements as included in the North Sea Agreement as a starting point to minimize confusion among stakeholders. Related to the time planning of the NSE4 stakeholder engagement strategy, it is recommended to commence on the active participation of the stakeholders after these stakeholders have had the time and space to embed the North Sea Agreement in their operations.

5. Conclusions and recommendations

We are engaging in a complex assignment to utilise the North Sea as efficiently as possible in the energy-transition to meet the goals an comply with the Paris agreement, while establishing a sustainable, reliable and future-proof energy system for the Netherlands. In this transition of the North Sea and unlocking low carbon energy potential, we currently still have the Oil &Gas infrastructure like drilling platforms. Some of these platforms can play an enabling role in the energy transition, for instance to facilitate an hydrogen industry or to use for Carbon Capture and Storage. To both of these ends, platform electrification (PE) can play a pivotal role. To get public engagement to empower the development and implementation of PE this research derived the public perception on PE, with the so-called Q-methodology and determined building blocks for a stakeholder engagement strategies. It is a first effort to exploratively derive argument concourses for PE and requirements, based on the interests and values of stakeholders in the North Sea and the public. In this concluding section we will address the main findings and recommendations towards proceeding steps towards stakeholder engagement and further research.

5.1 Main findings

First, PE is not widely known and that is confirmed by the stakeholders, the lack of social media messages and discussion on PE or on system integration options offshore in general, supports this finding. This lack of public interest complicates the possibilities to get an idea of the perceptions by using the (social) media channels and to get respondents involved.

Before addressing perspectives which can be utilized in the engagement strategies, the following paragraph will first shed some light on the different perceptions of the stakeholders and public of the factors relevant for PE.

The factors relevant for PE are divided in six categories: 1)Technical factors, 2) Economic factors, 3) Public support, policy and regulation, 4) Communication and citizen engagement,5) Environmental factors, and 6) System integration. The respondents are clustered into the 4 stakeholder categories, i.e. O&G industry, Offshore stakeholders, Knowledge stakeholders, and the Public. All respondents disagree significantly more on economic and environmental impact and communication than on technology and policy aspects. On the statements pertaining to the policy and regulatory aspects, and communication and stakeholder engagement, respondents respectively agree unanimously with over 60% and 50% of the statements. *Table 3* elaborates on these results for each category of statements.

Table 3: Elaboration on the perceptions of stakeholders, presented in terms of unanimous agreement by all respondents (green), unanimous disagreement (red), and a mix between agreement and disagreement among the respondents

Technical factors		
No unity in disagreement	Dispute on the **maturity of PE technology** and **the required changes in the offshore grid** to enable PE	Unity in agreement on **the increase in platform efficiency** due to PE
Economic factors		
Unity in disagreement that there are **insufficient platforms** for PE and that there is **too much uncertainty in payback opportunities** after PE	Dispute **on the benefits of PE for security of supply** and **platform decommissioning costs**, that **PE keeps O&G firms alive**, and that **the offshore wind sector is essential for PE**	Unity in agreement on **the need of O&G cooperation** for the financial feasibility of PE
Public support, policy and regulation		
No unity in disagreement	Dispute on **the need of government subsidies** for PE to be feasible, and the **need for new methods of tendering** offshore energy	Unity in agreement on unity on the responsibility of the government **to establish roadmaps** and **adjust legislation** to enable PE
Communication and citizen engagement		
Unity in disagreement	Dispute on the statement that the **Dutch citizens are not interested** in PE	Unity in agreement on the need for **cooperation among O&G firms**, but also with **other NS sectors and**

that successful and large scale PE requires **the involvement of the Dutch citizens**		**stakeholders** for successful PE implementation
Environmental factors		
Unity in disagreement that for PE **sustainable energy is wasted** on the production of fossil energy	Dispute on the **positive and negative impact** of PE on the North Sea environment	Unity in agreement that PE **reduces emissions** of the O&G sector and this is necessary to reach climate goals
System Integration		
Unity in disagreement that **PE enforces the race for space** in the NS and that subsequently platforms need to be decommissioned before any other step	Dispute on **the impact of PE on the congestion of the grid**, **the impact on fishery**, and **the lack of joint research** on the potential of PE	Unity in agreement that PE brings **synergy between the offshore wind and O&G industry**, incentivizes the **development of the offshore grid**, and that **chain-integration** is key for system integration.

When zooming into the responses where there is significant dispute, or difference in perception between the stakeholders, Economic factors, technical factors and system integration are the categories where respondents differ in perspective on respectively 8 out of 14, 3 out of 4, and 6 out of the 10 statements. This variety signifies that in these three categories, drivers, interests and motivations between stakeholder groups differ the most. Stakeholder engagement strategies will have to cope with this fragmented field by drafting information and engagement activities and measures which combine and align the perceptions of these stakeholders.

It is possible to derive an perspective map based on the statements, the research yielded 10 positive perspectives (pro PE) and 5 negative perspectives (con PE), which should collectively be taken into account by actors when proceeding with PE projects. At first glance, it can be observed that there are more arguments supporting a role for PE in the North Sea as a next step towards a more sustainable energy system in the Netherlands, compared to the arguments against. Over the categories there is also more diversity in the arguments pro PE. This entails that for a storyline in favor of PE, there are more arguments to use as buildings blocks. However, the fact that the positive arguments outnumber the negative arguments, does not imply that the case against PE is weaker, compared to the pro-case. The arguments on the con-side, i.e. the O&G sector maintaining their strong position amid the energy transition and the negative impact on the ecosystem and fishery by PE and its enabling infrastructure, may target the public interest to a larger extent, compared to the technical or economic benefits which might be limited to the O&G companies alone. The perspectives always have to be put against the multidimensional motivations of stakeholders, see paragraph 3.3.2 for more on this.

Finally, several requirements should be met when implementing Platform Electrification. These conditions show concerns of stakeholders, e.g. environmental impact on eco-systems and spatial planning issues. Interviews with stakeholders surfaced concerns on the impact of new and old assets in the North Sea, this as a consequence of the remaining research gaps on the impact of individual activities, and the accumulated impact of the activities. By not paying attention to these concerns and extract these questions in research programmes, these concerns can take on a life on their own. It is emphasized by stakeholders that research and programme activities for new technologies should take into account stakeholders and the public in an early stage. One supported options would be to include these stakeholders in defining research questions and sound boarding the results. Important other requirements are intensive cooperation for research and decision making between stakeholders active in the North Sea and exchange of information on actual operations and bringing activities closer to each other. Another condition is the adjustments of regulations. Establishment of long term roadmap enables the alignment of grid developments and investment decisions.

5.2 Recommendations for stakeholder engagement

5.2.1 Recommendations for PE projects

Because the concept is not widely spread over the public, and subsequently there is not yet a shared perception on PE among the stakeholders and public, the conditions are there to start the involvement and engagement of the public to create the necessary support for PE. Now, it is the right moment for actors to take into account the identified arguments and establish an engagement strategy which can shape the public perception towards gaining and maintaining the public and stakeholder support for PE and the related activities in the North Sea. In order to create a shared and supported understanding on the role of PE in the North Sea, this study recommends the following questions to be answered for each PE project in the North Sea (derived from the perspective map, pertaining to the diversity in motivation and drivers of the stakeholders, and based on the framework presented by Klain et al., 2017):

1) *Who should benefit? And who is necessary to realize the benefits?*
   Based on the interests, distance to the North Sea and the subsequent impact by offshore activities these stakeholders can be profiled and linked to the desired benefits for these parties to support the case. Moreover, it is necessary to determine the parties necessary to realize these benefits, with the eye on system integration.
2) *What are the impacts? And how is the impact perceived?*
   Impact can be assessed in terms of the environment, society and economy. Important is to understand how these impacts are perceived. First and foremost efforts should aim to maximize the positive impact, while negating the negative impacts. The negative perception of the impact can also be addressed via information campaigns.
3) *Why and how to provide the benefits?*
   With insight on who should beefit of PE and how the impact of PE is perceived, the proceeding phase is to determine why and how the benefits can be conveyed to the stakeholders. To this end the following should be considered: 1) how to share the gains from the use of public resources, 2) account for the impact (both positive and negative), 3) create coalitions to realize shared benefits via synergies of system integration.

A stakeholder engagement strategy should include procedures on how to update these insights, as the stakeholder field, motivations may change over time. This results in resilient stakeholder engagement.

For effective engagement the message towards the public will have to be targeted to the audience with a direct link towards platform electrification. One starting point could be re-use of platforms for energy transition with the limited space on North Sea. Other important elements of the stakeholder engagement strategy include:

- Themes in the North Sea on which there is a public perception and active public debate, e.g. the plastic pollution of the Oceans issue which is in the media on a daily basis. Build North Sea storylines on system integration around these themes, e.g. how O&G assets can be utilized to clean the North Sea from plastics.
- Visual means to provide the public with an experience of what is happening in the North Sea as this is relatively far from their sight.
- A clear story on the bigger picture of PE, how dos PE fits in context of developments on the North Sea and in relation to Energy and Climate pathways?

From the authors expertise we would like to repeat that proper stakeholder engagement is crucial in order to achieve and uphold trust and commitment with external stakeholders. Although lessons learned for stakeholder engagement in general is not part of this research, we will reiterate the lessons from a previous study conducted by TNO on stakeholder analysis and engagement and that is aligned with referred studies for stakeholder engagement for CCS. This TNO-study provided some ground rules, rules meant to stimulate effective behaviour instead of only trying to realize efficiency or trying to strive for individual gain (Geerdink et al, 2015). These lessons are advised to be taken into account:

- Start with why: seek for the inspiration, collective interests, challenges and resources, that brings parties together
- Communication is key: In stakeholder engagement, everything starts with communication between people. Four levels of communication can be defined: (1) Content, (2) Process & structure, (3) Relations and atmosphere and (4) Emotions. In practice we tend to only use the first two levels, but it is important to also address the levels 3 and 4; prepare for how to deal with these levels. Open communication, to

inform stakeholders, respecting different views and interests, transparency of process, fairness, are all crucial (Slob, 2015). Communication is highly project specific.
- Relationship and expectation management: a key aspect of all stakeholder engagement processes, is creating and maintaining trust and relationships. Trust is an important carrier for collaboration between stakeholders. Managing expectations is also an important factor influencing the relationships and trust between stakeholders to achieve inclusive participation (Slob, 2015). Consolidation and channelling of information should take place by a trusted source.
- Working together: At the beginning of a collaboration process it is important to define the principles on which you plan to work together. In essence, when a group of stakeholders is trying to reach a common goal, the rules of the game must be defined for how to treat each other and behave when communicating with each other.

5.2.2 Recommendations for future PE research from engagement perspective

The lack of public perception, but especially knowledge of the subject, makes it difficult to "measure" perception. Because it is a complicated and complex subject, you cannot tell this quickly and easily. This therefore requires a balanced story, entailing for instance the perspectives around PE derived by this research.

Integrate the concerns and the requirements in the message of the research programmers. A joint effort by all stakeholders to help to meet the conditions will gain trust and willingness to support for the greater good and public interest.

It is important to involve a much larger stakeholder group, especially the individual players instead of the lobby organization. Stakeholders are vastly different from each other and very location specific. The more a project relates to a specific location e.g. the electrification of a specific platform, the more the individual stakeholders relevant for that location will need to be involved.

The same is recommended for future research on system integration in the North Sea, such as NSE. Let the stakeholders also formulate questions that you should include in this study, so that their concerns and questions are also invested and much richer information is created. When it comes to joint research and joint fact finding on the concerns and the mentioned conditions it is recommended to involve different stakeholders in follow up research to prevent that conditions take on a life on its own, e.g. the radiation of cables in an off shore grid and the impact on environment. We recommend to do more reflective and action research on stakeholder engagement in the domain of re-use and decommissioning of platforms in particular, and for integrated energy systems (like NSE) in general.

It is recommended to include the requirements and conditions in the development of roadmaps for the North Sea and discuss these requirements with other frameworks being established for the North Sea, such as the North Sea agreement.

5.3 Reflections on public perception research with Q methodology

During this project, it became clear that the execution of the Q-Methodology went different than initially expected. The lack of social and public media sources was a signal that there is no current public debate on PE. On top of that the majority of the respondents had very little prior knowledge on the subject of platform electrification. This formed a significant challenge to derive the statements and use these to get perspectives of respondents on PE.

Second, the number of respondents was lower than anticipated. When looking up literature where the Q methodology is applied to produce reliable and relevant perspectives, the sample size varies from 19 Q sorts (Cuppen, Bosch-Rekveldt, Pikaar, & Mehos, 2016), to 71 Q sorts (Ellis, Barry, & Robinson, 2007), and more. No literature could be found which argues the minimal sample size for Q results to be considered as reliable, on the contrary the aim of the Q methodology is not to strive for representativeness in the population, but rather for representativeness in the perspectives. To this end the sampling for the Q methodology focuses on

small and purposed samples, rather than large samples through random sampling which is desired for conventional surveys to be statistically sound. The strength of the Q-Methodology thus lies in the exploration of the existence, diversity and background of stakeholder perspectives. The quantitative analysis has the added value to structure the qualitative findings, rather than to underpin these with statistically significant quantitative results. With this said, the team has the appropriate confidence that the results derived are relevant and trustworthy, improving our understanding on the diversity of stakeholder perspectives on the subject of PE in the North Sea.

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Appendices

Appendix A: List of interviewees and respondents

Organisation	Function
Oil & Gas	
NAM	Energy Transition Manager
NEXSTEP	General Manager
North Sea Stakeholders	
TenneT	Strategic Offshore Grid Planning
VisNed	Director
Knowledge Stakeholder	
NWEA	Branch Specialist Offshore Wind energy
H2 Table Climate Agreement	Chairman
Public	
Municipality of Ameland	Councillor
Stichting de Noordzee	Director + Project Manager Offshore Energy

Appendix B: Statement perception by the stakeholders

Figures 9 to 14 display the average ranking of each statement per stakeholder group. S1 denotes statement 1, and the statements can be found in Appendix C. The red bars indicate that all stakeholder groups rank that particular statement negative on average, implying that on average they do not agree with that statement. Green indicates that the stakeholder groups agree with the statement, and blue signifies that there is division among the stakeholder groups between positive and negative average rankings.

Figure 9: Economic

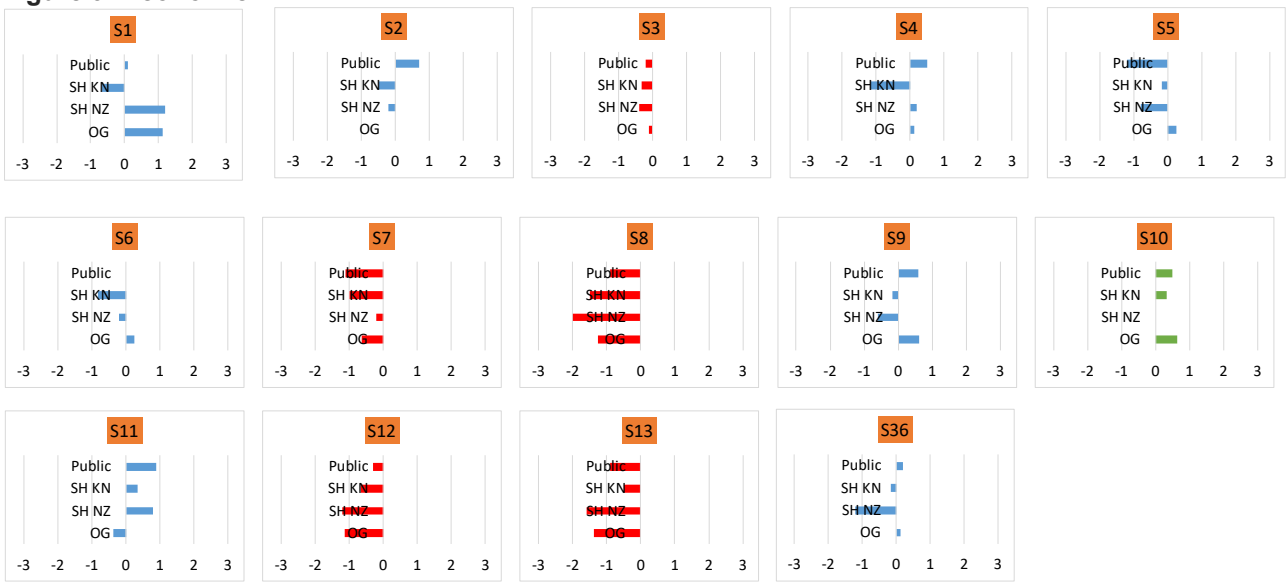


Figure 10: Technical

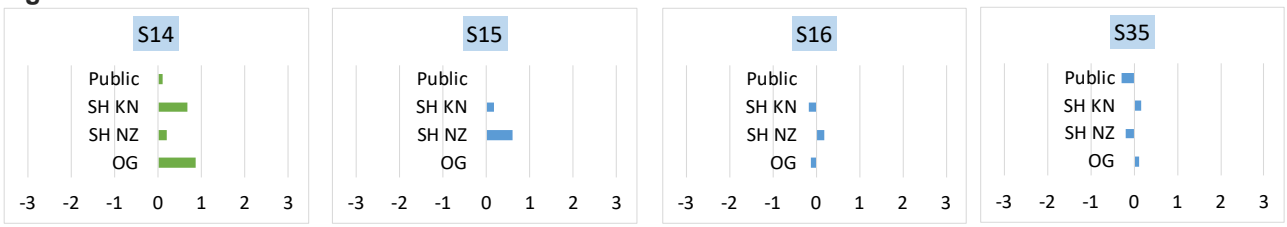


Figure 11: Policy and Regulation

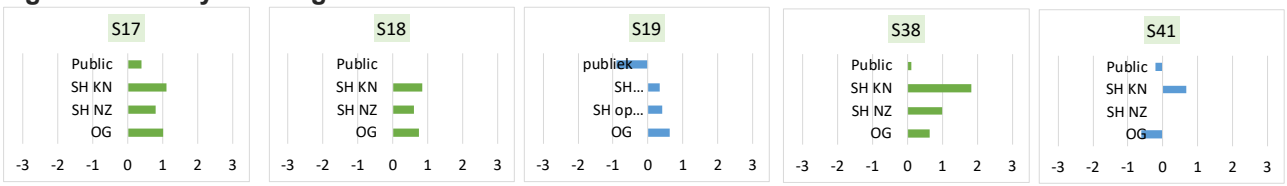


Figure 12: Communication and Stakeholder Engagement

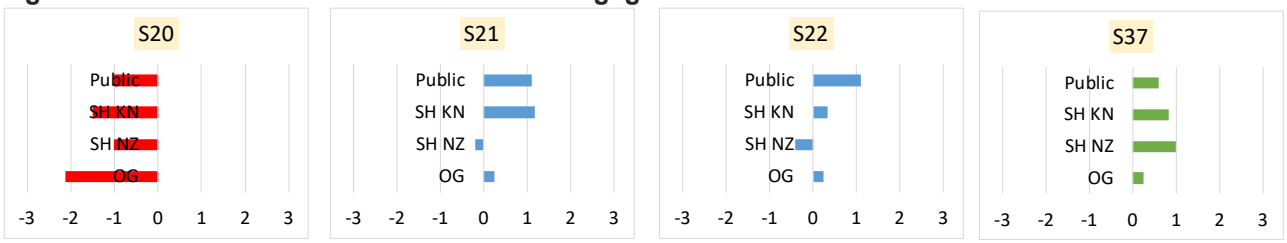


Figure 13: System Integration

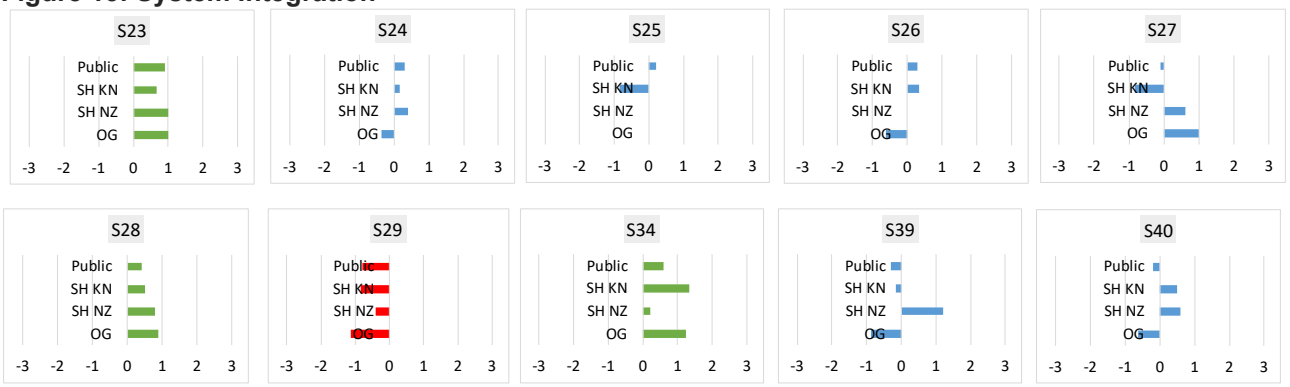
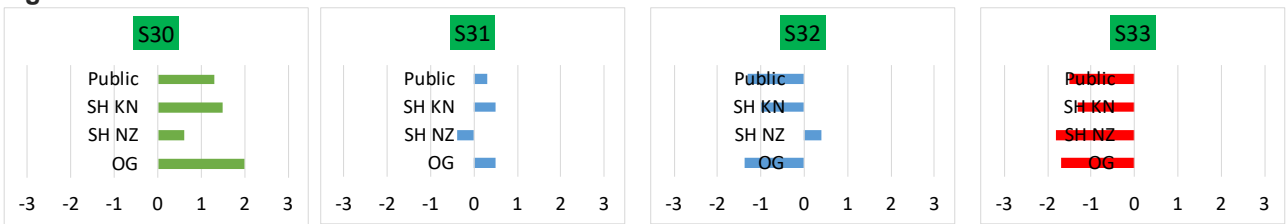


Figure 14: Environment and Nature



Appendix C: The statements as presented in the Q-Sort

Economic statements:

1. **Platform Electrification (PE) ensures smart use of natural gas**: offshore Oil & Gas (O&G) consumes 6% of gas production, PE enables new and high-quality use and income from this share of gas.

2. **Platform electrification gives economic advantage by postponing the dismantling of platforms**: PE and the possible extended lifespan of the platforms directly benefit the government and taxpayers because of the state's participation in the Oil & Gas activities, via the postponement of the dismantling costs and longer earnings time.

3. **PE is a prerequisite for low-carbon investments, needed to cope with increased pressure from investors to reduce the carbon footprint of their portfolio**, and for R & D companies to obtain low-carbon financing.

4. **Oil & Gas companies remain strong through platform electrification**: supported by the government, the strong position of large R&D companies in the North Sea will be maintained.

5. **Platform Electrification presents new financial risks for the O&G operator**: PE makes O&G operators dependent on electricity suppliers. Due to the increasing mix of intermittent electricity and the subsequent volatility in the electricity price, this poses financial risks.

6. **Platform Electrification requires high investments**: Operational R&D benefits are challenged by high investment costs for PE.

7. **Platform Electrification gives uncertainty in return of investment possibilities**: the future income from non-O&G activities for empty O&G fields and infrastructure are too uncertain to electrify platforms and / or to invest in infrastructure, such as cables.

8. **Platform Electrification has a hidden, non-energy transition agenda**: R&D companies do not intend to use PE because of the energy transition, as the follow-up is not supported by an investment agenda. PE gives them the opportunity to be fossilized for longer.

9. **Oil & Gas companies interfere in the sustainable sector with PE**: PE is driven by O&G companies and interdependencies are created between the sustainable energy sector and the established R&D sector.

10. **Oil & Gas cooperation is a prerequisite for PE:** the economic viability of PE is only possible if the R&D industry cooperates

11. **Platform Electrification is not possible without the offshore wind sector**: the viability of PE is only possible through close cooperation with the offshore wind sector.

12. **Back-up electricity from the mainland breaks business case PE**: PE may need back-up power from the mainland at times when there is little to no wind, and this requires additional investments that can break the business case.

13. **There are too few platforms for cost-effective platform electrification**: the number of platforms in the North Sea that can be electrified is not sufficient to make PE attractive.

36. **The risks and uncertainties for O&G companies in PE and System Integration are great, but dealing with them is familiar to them.**

Technical statements:

14. **Platform Electrification provides increased platform efficiency by electrically driven machines and equipment**: PE can improve the operational efficiency of R&D platforms through higher system efficiency with the elimination of gas generators and the installation of electrically driven machines.

15. **Platform Electrification provides increased platform efficiency through digitization Operations & Maintenance**: PE can improve the operational efficiency of O&G platforms via smart (digitized) O&M resulting in higher platform availability and lower maintenance costs.

16. **Platform Electrification is a mature technology**: the PE technique is mature enough to realize. This has been made possible by improvements in factors such as: reliability of the electrical system, solutions for storing electrical energy, cheaper and competitive electrical drives and solutions for processing and using the available data in electrical systems.

35. **The offshore grid requires significant changes in design and operation strategy for local demand**, such as that due to the electrification of platforms, and new cost models for the connections between platforms.

Policy and regulatory statements:

17. **Platform Electrification reinforces the need for an integrated spatial plan**: PE reinforces the need for an integrated North Sea spatial plan for synergy with competing and existing sectors / activities such as shipping, fishing and defence.

18. **Platform Electrification does not fit into current regulatory frameworks**: PE is hampered by current regulatory regimes. Adjustments are needed in the Mining Act, the Electricity Act and the Offshore Wind Energy Act, which impede the connection to the electricity network as an energy source for O&G activities.

19. **Platform Electrification cannot do without government support**: the Dutch government must fully support PE as part of offshore system integration due to the many advantages in terms of legislation and subsidies

38. **The government has a major role in setting out route maps with an overview of which activities, will be added when and where;** these are crucial for system integration.

41. **For system integration new indicators are needed in tendering, for example, consider PJ supplied for offshore wind, instead of KWh.** This stimulates the integration of H2 in the offshore wind business model.

Communication and Stakeholder engagement statements:

20. **Platform Electrification requires involvement of Dutch residents**: for a successful implementation of PE in the North Sea it is important to involve and inform Dutch residents from the start.

21. **Platform Electrification demands broader involvement than just the O&G industry**: PE requires more than just action from industry: science, government and other stakeholders are also important.

22. **The average Dutch resident is not interested in PE**: The Dutch people are not interested in PE and other activities in the North Sea that require integration

37. **Platform Electrification and system integration require that O&G companies work together**, but also with the sustainable sector. O&G companies now operate mostly in isolation

System Integration statements:

23. **Platform Electrification means synergy between O&G and offshore wind**: PE makes it possible for O&G platforms to be connected to offshore wind farms, this stimulates synergy between the offshore O&G industry and the offshore wind industry.

24. **Platform Electrification reduces congestion on the grid**: if offshore wind energy is used for PE, this reduces the load on the offshore grid and this can reduce the levelled costs for offshore wind.

25. **Platform Electrification reduces transmission losses on the grid**: PE with the use of offshore wind energy reduces the load on the offshore grid and this reduces the transmission losses of electricity over the offshore grid.

26. **Platform Electrification allows more wind energy to be connected to the grid**: PE with the use of offshore wind energy, reduces the load on the offshore grid and this results in the potential to connect more wind turbines with a higher total rated power to the offshore -just

27. **Platform Electrification gives O&G infrastructure a new goal for accelerating the energy transition**: PE makes it possible to transform O&G platforms into infrastructure for activities that facilitate the energy transition such as wave and tidal energy, CCS, or hydrogen production, buffering and transport

28. **Platform Electrification increases need for an offshore electricity grid**: PE reinforces the need for an extensive offshore electricity grid, this offshore electricity grid enables future activities in the North Sea that require a sustainable energy supply
29. **Platform Electrification exacerbates the battle for space in the North Sea**: PE and the potentially extended lifespan of R&D activities and infrastructure competes with the space for other functions such as offshore wind energy, and shipping. It will be very busy in the North Sea. With system integration for sustainable energy, we first have to clean up the existing R&D infrastructure.

34. **System integration in the North Sea is only possible with strong chain integration** (generation, storage, transmission, and use) of existing and future offshore activities.

39. **Fisheries are particularly affected by the increase in cables in the North Sea**, good dialogue and joint research are needed to ensure that fishing can continue to exist.

40. **There is a lack of joint research into the potential and location for PE, in relation to offshore wind, to bring those fields closer together and integrate them.**

Environment and Nature statements:

30. **Platform Electrification means a emission reduction for the O&G sector**: PE and the connection of O&G platforms to wind farms can reduce CO2 and NOx emissions on platforms, this is necessary for achieving the climate objectives.

31. **Platform Electrification benefits the ecosystem**: PE and the subsequent extended lifespan of platforms can reduce subsurface disruption and prevent or even positively influence damage to the North Sea ecosystem

32. **Platform Electrification has disadvantages for the ecosystem:** the extensive offshore electricity grid that may be needed for PE can create challenges for the ecosystem.

33. **Platform Electrification wastes scarce renewable energy on O&G**: scarce renewable energy should be used for high-quality purposes and for the citizen as end-user, rather than for fossil energy production.

Appendix D: social media analysis

Social media search terms (and number of relevant hits: total 83):

Platform electrification (0)
Platform electrification North Sea (6)
Oil platform electrification (2)
Energy platforms (0)
Offshore injection of hydrogen (5)
Power-to-x Offshore (4)
P2X offshore (2)
wind electricity by cable (4)
offshore power grid (5)
offshore power cables (7)
converted offshore oil and gas platforms (5)
offshore grid (3)
decarbonization of oil and gas platforms (4)
North sea wind power hub (8)
Other related topics (28)

Appendix E: The bell-chart structure for the Q-sort

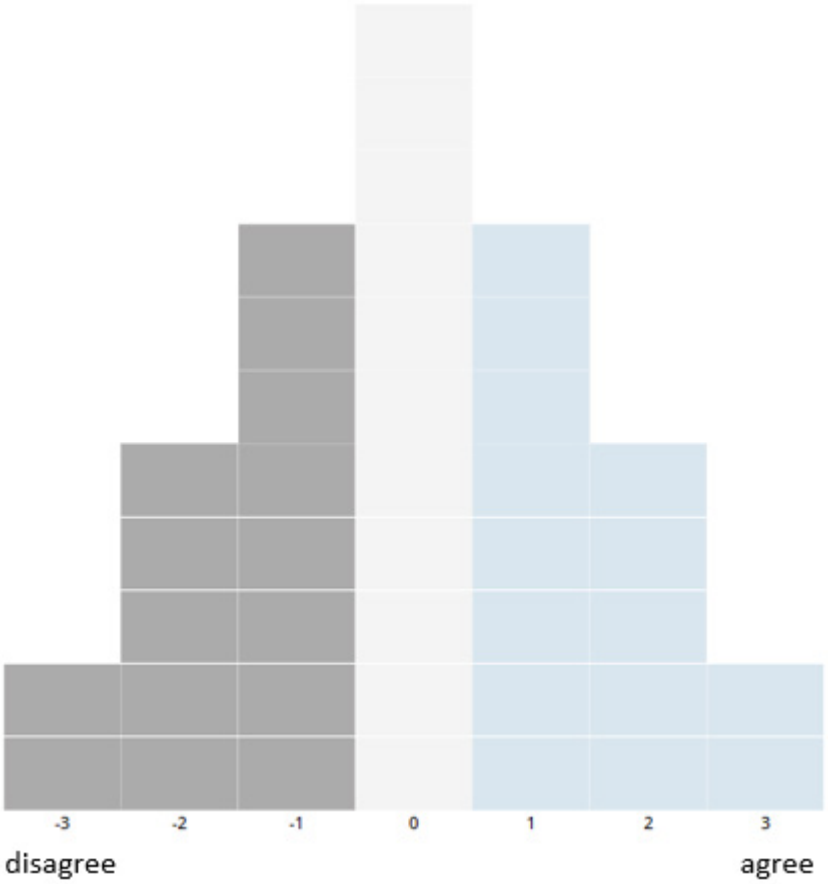


Figure 15: The bell-chart structure for the Q-sort