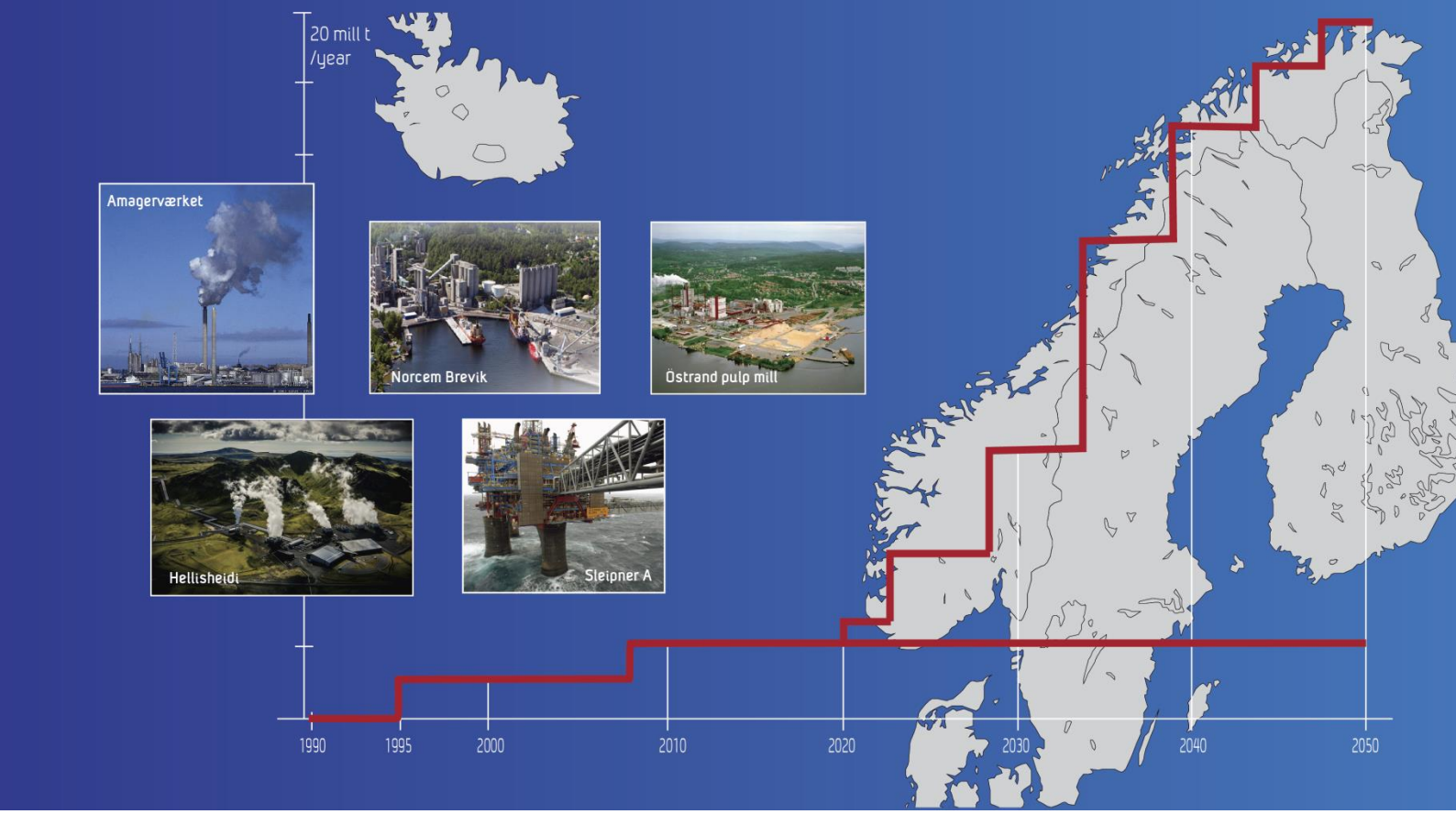


A stakeholder map for CCS communication

Peter Stigson, Jens Jacob Kielland Haug

NORDICCS Technical Report D 2.2 1201

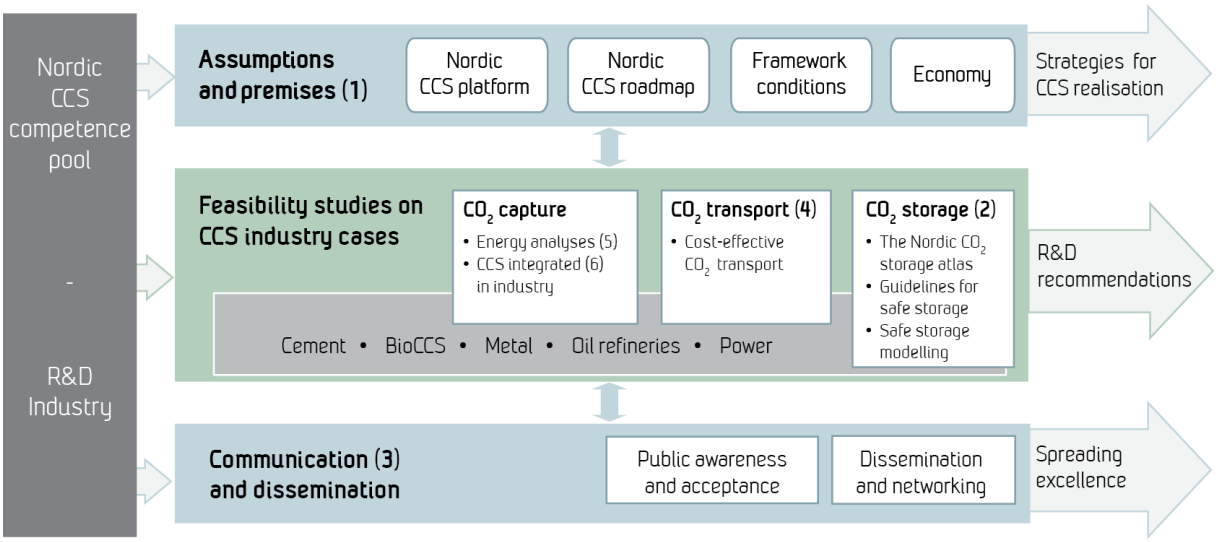
October 2013

norden
Top-level Research Initiative

nordiccs
Nordic CCS Competence Centre

CO_2

NORDICCS concept:



Partners:

VTT · CHALMERS UNIVERSITY OF TECHNOLOGY · IVL Swedish Environmental Research Institute · SGU Sveriges geologiska undersökning Geological Survey of Sweden · GEUS · Orkuveita Reykjavíkur · SINTEF · NTNU · UiO : University of Oslo · tel-tek · University of Iceland · Statoil · GASSCO · NORCEM HEIDELBERGCEMENT Group · VATTENFALL · CO_2 TECHNOLOGY CENTRE MONGSTAD

Contact: Centre Director Nils A. Røkke • + 47 951 56 181 • Nils.A.Rokke@sintef.no
www.sintef.no/NORDICCS

Summary

This report presents a methodological approach to portray the communication between different carbon capture and storage (CCS) stakeholders on different topics. The central elements in the analysis is to analyse what knowledge that is perceived to be a barrier for activities in CCS, which actors that are perceived to have this information and how the communication is working with those actors. The background is that a lack of knowledge and information, or asymmetries thereof, may form barriers to promote CCS activities. The CCS infrastructure is furthermore complex, including a range of stakeholders and technologies and span over capture, transport and storage. Hence, the need for learning and the communicational landscape are likewise broad and multi-contextual.

Keywords Communication, Stakeholder analysis, Industry, Policymaker

Authors Peter Stigson, IVL Swedish Environmental Research Institute, Sweden
peter.stigson@ivl.se
Jens Jacob Kielland Haug, SINTEF ER, Norway
jens.jacob.kielland.haug@sintef.no

Date October 2013

About NORDICCS

Nordic CCS Competence Centre, NORDICCS, is a networking platform for increased CCS deployment in the Nordic countries. NORDICCS has 10 research partners and six industry partners, is led by SINTEF Energy Research, and is supported by Nordic Innovation through the Top-level Research Initiative.

For more information regarding NORDICCS and available reports, please visit http://www.sintef.no/NORDICCS.

Summary

This report presents a methodological approach to portray the communication between different carbon capture and storage (CCS) stakeholders on different topics. The central elements in the analysis is to analyse what knowledge asymmetries and deficits that are perceived to be a barrier for CCS activities, which actors that are perceived to have this information and how the communication is working with those actors. The background is that a lack of knowledge and information, or asymmetries thereof, may form barriers to take action on CCS (e.g. investments and policymaking).

The CCS infrastructure is complex, including a range of stakeholders and technologies and span over capture, transport and storage. Hence, the need for learning and the communicational landscape are likewise broad and multi-contextual. A methodology is presented that aims to summarize and present survey data on communicational aspects in an easy to understand form while acknowledging this complex context. The survey and methodology are tested through a case-study of perceptions within the Swedish and Norwegian industry sectors. These two settings represent two different CCS contexts where the public debate and progress on implementing CCS differs as well as the point sources to which capture would typically be applied.

Although the survey response rate was low and that the findings thus should be treated with caution, a main finding is that the perceptions are relatively similar in Norway and Sweden despite these differences. The communication with media, general public, financial institutions and insurance companies is seen as least important, as these actors are perceived to possess low knowledge on several knowledge areas. Conversely, the importance of communication with academia, industries and technical suppliers is seen as most important due to a higher perceived level of knowledge. Two of the topics that are most important in both countries to increase action on CCS are policy and costs. Regarding policy, communication with the actor perceived as clearly most knowledgeable on this topic – policymakers – has challenges in both countries. On costs, the communication with the actors most knowledgeable on this topic, technical suppliers and industries, differ somewhat in the two counties. While the communication works well in Norway, Swedish respondents state that the communication with these actors has a clear potential for improvement. Further comparing results from Sweden and Norway, the results differ most between the countries in relation to the importance of communicating with NGOs. In Norway, the importance of communicating with NGOs mainly concerns policy and acceptance, and in Sweden regarding environmental issues. Moreover, the Norwegian respondents perceive the communication as functioning better than the opinions of Swedish respondents.

The stakeholder map can visualize these kinds of patterns and consequently be used as a strategic tool to identify where strengthened and targeted communication is needed for increased learning and action on CCS. Suggestions are given to improve the survey for future use.

Contents

Summary **1**

1 Introduction **5**

2 Survey **6**

3 Mapping methodology **7**

4 Results from the surveys **11**

4.1 Background 11

4.2 Knowledge - industry knowledge and desired knowledge 12

4.3 How is the communication working with different actors? 14

4.4 Implications for the potential of increased knowledge transfer 15

5 Evaluation of the methodology applied **18**

6 Conclusions **20**

7 References **21**

Appendix 1 – Survey **23**

1 Introduction

Developments in Europe and elsewhere have pointed to acceptance and communication as important cornerstones for successfully implementing CCS projects.[1] This is partly due to large knowledge asymmetries on CCS[2]. Analysing and dealing with these asymmetries in strategic decision-making in both policymaking and industries has been highlighted by a strong body of literature.[3] There is consequently a need for learning between a broad set of stakeholders concerned with CCS developments. However, studies of the Nordic situation, with a focus on relevant stakeholder groups and their questions around CCS developments are lacking. The report therefore contributes to such analyses through developing a methodology for mapping stakeholders and knowledge on a comprehensive set of topics that may form barriers for action on, and understanding of CCS.

The aim to develop a methodology for mapping stakeholders includes describing their knowledge, lack of knowledge, and desired knowledge against other stakeholders and topics in terms of communication on different topics and between different stakeholders. This includes a tool for the mapping as well as a survey design to populate the tool with data. This exercise provide insight as to who needs what information from whom and what conditions for knowledge transfer that exist which in turn potentially can increase CCS activities through dealing with knowledge asymmetries and barriers through highlighting needs for learning and communication. The tool is intended for policymakers, industries, researchers and other organisations in situations where an overview of communicational needs and function is of interest.

The methodology is meant to be usable to analyse the relationships between all stakeholder groups concerned with CCS. For that reason, we have chosen to use Microsoft Excel as a readily available software. However, due to a limited budget, the survey focus has been on the industries' perceptions of the communicational relationship between the industry sector and policymakers. Including additional stakeholder groups would mean developing additional surveys. Insights on how this could be carried out are given below on basis of lessons learnt in this report. By testing the survey on the relationship between industries and policymakers, the analysis aims to support an improved dialogue on CCS between these stakeholder groups and thereby potentially more informed decisions on the possibilities for demonstration and deployment of CCS is in the Nordic countries.

Developing the methodology, including the survey and how to depict the responses, is part of a broader set of tasks to analyse the communicational landscape of CCS under WP2 of the NORDICCS project. Additionally, the methodology aims to support WP 1 and the development of a CCS Roadmap as well as WP 0 in terms of project dissemination.

The report consists of two main sections. The first is a description of the quantitative methodology to aggregate and portray the relationships between topics and actors through using survey data. The second is a disaggregated qualitative analysis to discuss the results of each survey question. This is followed by an evaluation of the methodology and survey as well as lessons learned for future analyses.

---

[1] E.g. de Best-Waldhober et al, 2009; Hansson and Bryngelsson, 2009; Johnsson et al, 2010; Reiner, 2008, Wallquist et al, 2010.

[2] EC, 2011; Stigson et al, 2012.

[3] E.g. Edelenbos et al, 2009; Scholes and Clutterbuck, 1998; van den Hove, 2006.

2 Survey

To map industrial perspectives, a questionnaire survey (Appendix 1) was sent to purposively selected stakeholders. The stakeholders were selected using recommendations from the NORDICCS project participants in all Nordic countries. The aim was to send out 300 questionnaires to allow for comparisons between countries and industry sectors. However, this proved more difficult than expected and in the end 192 names were retrieved from the project participants. SurveyMonkey[4] was selected as the online survey program and the survey was sent to the CCS industry – here defined as industrial companies currently involved in CCS as well as industrial companies that may become users of CCS. The initial response was low, in total only 25 out of the 192 answered the survey, a response rate of 13%. It was therefore decided to focus on the CCS industries in Sweden and Norway. This decision was made partly due to the authors' origins and the practicality of using Swedish and Norwegian key persons with an extensive industry and policy network in the follow-up of non-responses. The latter resulted in some increase in Norwegian survey replies. In total, 11 responses were received from the Swedish industries (out of 48, 23%) and 13 from the Norwegian industries (out of 27, 48%). The low response rates have implications for the possibility to generalize the findings, i.e. this study should ideally be replicated using a larger sample.

The survey consists of a quantitative and qualitative section. A total of 24 questions were asked regarding respondents views on knowledge and communication with various stakeholders, including policymakers. The quantitative part consists of closed “tick the box” questions. The qualitative part consists of open ended questions about the relationship between the industries and policymakers, where respondents were free to elaborate on specific questions.

Two central elements in the survey are stakeholder groups and topics. The stakeholder groups and topics included in terms of the communicational questions are described in Table 1. These topics are also included as obstacles to CCS activities, but then in more detail (see Appendix 1, question 12).

[4] For more information, see www.surveymonkey.com.

Table 1 – Stakeholder groups and topics included in communicational questions in survey

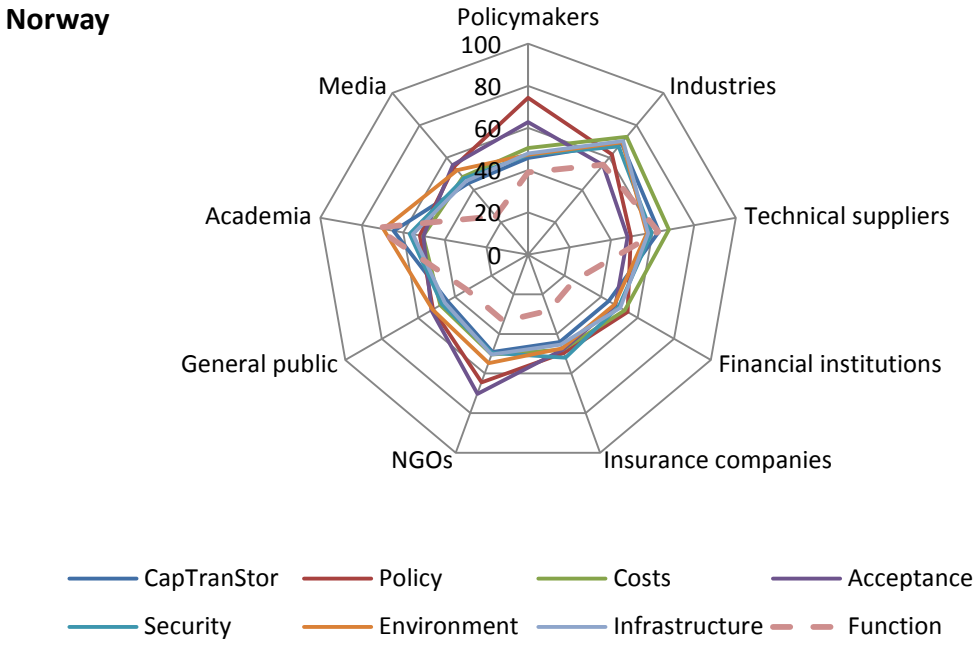
Stakeholder groups	Topics
Policymakers	Capture technology
Industries (emitters)	Transport solutions
Technical suppliers	Storage (availability, safety, etc.)
Financial institutions	Policy
Insurance companies	Costs
NGOs	Public acceptance
General public	Security
Academia	Environmental effects
Media	Infrastructural challenges

As a consequence of the low response rates, the data have been treated with caution. However, where results from the quantitative part of the survey have appeared with clear significance, these results have been included in the analysis. Clear significance has been set to either above 35% in one category or a total of 60% for two categories (e.g. in question 17 this means above 35% in either of the alternatives Very poor communication or Poor communication or above 60% in the two categories combined). The exception is question 15, regarding which actors that possess knowledge about several different knowledge areas. As this question is a multiple choice question, the limit for significance has been set to 50%. In certain cases where it is considered relevant, results below these figures have been included, however, only if the figure is close to the percentage limit. For the questions about the respondents' background, these limits are not relevant and will be rendered without a percentage limit.

3 Mapping methodology

The methodological focus on topics that may form barriers for different stakeholders to increase CCS activities reflects the objective of the NORDICCS project to stimulate CCS developments in the Nordic countries. The choice of methodology is based on CCS as a combination of technologies, operations and stakeholders, thus being set in a truly multi-dimensional and multi-stakeholder context. The method used is a Microsoft Excel generated radar chart (Figure 1) that on the one hand show to the perceived function, and on the other hand the perceived importance of different topics and stakeholder interactions.

Figure 1 – Function and importance of communication in Norway (example)



This methodology highlights connections that are important when aiming to analyse communication priorities to deal with knowledge asymmetries and knowledge-based barriers on specific topics. While the responses may allow for individual analyses on how single actors perceive communication with other stakeholders, it is mainly seen as a tool to aggregate actor into stakeholder groups and thus analyse how groups perceive other groups.

The complexity of the CCS context means that portraying all stakeholders and topics can likewise be complex. Different software exists, such as multivariate analysis software, which may provide the possibility to integrate all variables into higher aggregated indexes and more comprehensive figures. Such software however typically necessitates licenses and knowledge on how to operate them, contradicting our aim to provide a methodology which can be more readily used and understood. Also, such software typically reduces transparency of how the results were produced. However, a methodology focussing on limited stakeholders or topics for each figure means that the number of figures will grow to a large number if one would aim to analyse all stakeholders' interaction with all other stakeholder groups on all topics – i.e. showing the complete communicational landscape and all bilateral communication therein. In this work we have nevertheless favoured the latter approach. There are, however, possibilities to narrow down the number of figures, associated with the advantage of less work and easier depiction but also disadvantages of offering less information. This is further discussed below.

The nomenclature used is the following:

X	*Group X (receivers, seeking information)*	
Y	*Group Y (senders, providing information)*	
T	*Topic*	
a	*Group X's level of knowledge on topic i (0-3)*	*(Q13)*
b	*Importance of topic T to stimulate Group X's CCS activities (0-3)*	*(Q14)*
c	*Group X's perception of Group Y's knowledge about topic i (0-3)*	*(Q15)*
d	*Group X's view on how well communication with Group Y is working(0-4)*	*(Q17)*
e	*Group X's trust in Group Y (0-3)*	*(Q18)*
I	*Importance*	
F	*Function*	

Note: See Appendix 1 for questions.

The importance (*I*) of communicating on a topic with a specific actor group is given a numerical value through the level of knowledge that the respondent perceives to have on a specific topic (*a*), the importance of knowledge about a topic to stimulate CCS activities (*b*), and to which degree a stakeholder group is perceived to have this knowledge (*c*).

$$I_T = \sum_{i=T} ((4 - a_i) + b_i + c_i) \quad \text{Eq. 1}$$

Survey software can typically be programmed to give a numeric value of the responses as well as an average. This can be used in the analyses to calculate a value for the importance and function of communication. We programmed the software to give values 1 to 4 for questions with four response categories and 1 to 5 for questions with five response categories.

Question 13 that provides *a* was posed differently to the other questions, and as this was not programmed into the software, a high value means that *Group X* has good knowledge, hence reducing the importance of communication. Therefore its value is reversed.

Question 15 did not give a numerical average rating, meaning that the factor *c* has to be constructed. The value is created in a range of 1-4 through the percentage of respondents assigning a stakeholder group with having knowledge about a topic (Eq. 3).

$$c = 1 + \left(3 \cdot \frac{\%\ of\ positive\ responses}{100}\right) \quad \text{Eq. 2}$$

The third equation (Eq. 3) provides the function (*F*) of the dialogue. This is calculated through two variables that are not topic specific, instead describing the perceptions of *Group X* on aspects that influence how the communication with *Group Y* works or can be expected to work. The first variable, *d*, describes how well the communication is working. Perceptions on this may include various aspects that are part of forming a functioning communication, such as communicational channels and arenas

for dialogue, facilitation of dialogue etc.[5] The second variable, *e*, is the trust that *Group X* has in *Group Y* in general. Both variables are seen as critical aspects, meaning that *d* and *e* are multiplied, allowing for both to nullify the other. For example, *Group X* may meet with *Group Y* regularly, providing ample occasions to discuss CCS and other matters. However, if there is no trust, the messages may be disregarded.

$$F_Y = \sum_{i=Y} (d_i \cdot e_i) \qquad \text{Eq. 3}$$

Through aggregating the values of how *Group X* perceive the communication with stakeholder *Group Y* on topic *T* by means of importance (*I*) and function (*F*), a figure can be produced that highlight disconnects between these two latter functions of a well-functioning dialogue. Using radar charts, the maximum aggregate values of *I* and *F* should ideally match or the fraction of a full value should be used. To provide a larger freedom in designing the survey, such as allowing different ranges of response values for different questions, it is recommended that fractions of maximum values are used. Hence:

$$I = \frac{I_T}{I_{max}} \qquad \text{Eq. 4}$$

and

$$F = \frac{F_Y}{F_{max}} \qquad \text{Eq. 5}$$

Nevertheless, it should be remembered that the axis values of *I* and *F* are relative to each other. This means that whether or not the *F*-value exceeds the *I*-value has no bearing on whether the function acknowledges the importance. However, it highlights trends in a comparison between topics and stakeholders. This is useful as the radar chart methodology can portray the perceived:

1. Importance to communicate on a single topic
2. Importance to communicate on a single topic relative other topics
3. Importance to communicate on different topics with a single actor group
4. Importance to communicate with a single actor group relative other actor groups
5. Function of communication with a single actor group
6. Function of communication with a single actor group relative other groups
7. Relative discrepancies between importance and function (in a comparison of all values)

While Figure 1 overlay perceptions on topics in one country, one can also overlay same topic for different countries to compare concerns between regions. This can be helpful in analysing effective

[5] Important building blocks of a well-functioning dialogue include, e.g. credibility and trust, arenas and channels for communicating, understandable language and messages, and timeliness.

strategies in knowledge and experience transfer between regions, such as is the focus of the NORIDCCS project.

4 Results from the surveys

To allow for an identification of who needs what information from whom and what the conditions for knowledge transfer looks like, we have posed several questions that in different ways can shed light on these overarching objectives. The first section of the survey provides some background information about the Swedish and Norwegian industries (e.g. nationality of company/organisation and involvement in CCS activities). The second section deals with the respondents' own knowledge and perceptions of other stakeholders' knowledge as well as the relationship with other actors. The last section, which constitutes the main qualitative part of the survey, concerns the dialogue with policymakers and how the industries perceives the dialogue that takes place during policy processes.

4.1 Background

The Swedish and Norwegian industries operate in countries with, inter alia, different political, economic and social contexts. A majority of the Swedish respondents operate in the fossil power and heat industries (63.6%), and bioenergy power and heat industries (63.6%).[6] However, representatives from all sectors were represented. In Norway, the fossil power and heat industries were also well represented (60%) as well as the fossil fuel industries (70%). Moreover, the refinery sector was well represented in Norway (40%).

In both Sweden and Norway, the responses were relatively evenly spread among respondents from business organisations, privately owned companies, publicly listed companies and state owned companies. Sweden had a larger share of privately owned companies (36.4%), whereas Norwegian respondents were more likely to work in a publicly listed company (38.5%).

In both countries a significant share of the employees works in an organisation with over 250 employees (63.6% in Sweden and 50% in Norway). In Norway, 50% of the respondents work in an organisation with fewer than 50 employees, compared to 27.3% in Sweden

With regard to the size of the organisation in terms of approximate turnover, a majority of the respondents in Norway (75%) works in an organisation with a turnover of more than €50 million, whereas Swedish respondents were evenly spread between 2-50 €million (44.4%) and more than 50 €million (44.4%).

A majority of the Norwegian respondents have worked with CCS for more than five years (84.6%), whereas Swedish respondents were evenly spread between 2-5 years (45.5%) and more than five years (36.4%). The percentage of respondents working less than two years was in both countries below 20%.

With regards to the respondents' current activities in the field of CCS, 36.3% of the Swedish respondents and 15.4% of the Norwegian respondents are not currently active in the field of CCS. However, their answers are included in the analysis as they all have worked within the field of CCS.

[6] As the organisations can be operational in more than one specific sector, the respondents were able to choose more than one alternative

Of those currently active in CCS activities, a large share of the Swedish respondents (63.6%) is currently working with technology development. These numbers were even higher in Norway (92.3%). In contrast to the Swedish industries (18.2%), the Norwegian industries are also heavily involved (61.5%) in technology deployment (i.e. investing in CCS applications). The Norwegian industries are involved in all three infrastructure stages, i.e. capture, transport and storage (all above 80%), whereas the Swedish industries are more strongly involved in capture (71.4%) than transport and storage (both 57.1%).

The responses differed somewhat between the two countries as per when the respondents expected to become more active in the field of CCS.[7] In Sweden, 45.4% of the Swedish respondents do not expect to become more active. The remaining share expects to become more active both before 2015 and between 2015-2020. The respondents expects to become active in all parts of the CCS infrastructure in these two periods, as the responses are relatively evenly spread among capture, transport and storage (ratio 50%-80%). In Norway, only 25% of the Norwegian respondents did not expect to become more active. Of the remaining, a majority expect to become more active both before 2015 and between 2015-2020. As opposed to the Swedish respondents, some of the Norwegian respondents also expect to become more active between 2020-2025 and after 2025. Also, there is a tendency among the Norwegian respondents that the further into the future, the more the respondents expect to become active in transport and storage compared to capture.

4.2 Knowledge - industry knowledge and desired knowledge

In the following, we will provide some key results from the survey on what constitutes current industrial knowledge and which knowledge that is regarded as essential for further CCS development.

4.2.1 Industry knowledge

Insight into the industries' knowledge can be helpful in identifying potential knowledge gaps within the industries that can be filled by other stakeholders. The latter is particularly relevant when the industries own perceived knowledge is seen in relation to how it perceives the knowledge of other stakeholders, which will be subject for further investigation below.

A noticeable difference between Swedish and Norwegian respondents is that the latter in general perceive themselves to have more knowledge than their Swedish counterparts. In both Sweden and Norway, knowledge about capture technology scores highest as it receives over 60% when the categories Good knowledge and Very good knowledge are combined. In Norway, all the knowledge areas exceed 60%, except for knowledge about security (54.6%) which scores the lowest in Norway. In Sweden, no other knowledge area exceeds 60% when the two categories are combined, however, when the categories Good knowledge and Some knowledge are combined, all areas exceeds 60%. In Sweden, knowledge about infrastructural challenges (from capture to transport and finally storage) scores the lowest (33.3% have Good knowledge or Very good knowledge). Only a marginal part (below 15 %) of the respondents in both countries perceives themselves to have No knowledge about different knowledge areas.

[7] The respondents were able to choose more than one alternative

In sum, apart from the mentioned topics, the knowledge is relatively evenly spread in both countries and Norwegian respondents generally perceive themselves to have more knowledge than their Swedish counterparts. The latter may partly be explained by looking at how many years the respondents have been working with CCS.

4.2.2 What knowledge is important to stimulate activities in CCS?

To gain further insight of the communicational landscape, we posed the question of how important knowledge is on different topics to stimulate activities in CCS. The general result in both countries is that increased knowledge about several topics is essential to further stimulate activities in CCS. In Norway, all topics exceed 60% when the categories Important and Very important are combined. This is also the case in Sweden, except for the categories Capture technology and Transport solutions (however, their combined score is close to 60%). A marginal share considers knowledge about the various aspects as Not important in both countries (below 15% on all topics).

There are no large differences between the different topics in each country, but in both countries knowledge about policy is regarded as a key topic. In Norway, it is the second most important area (36.4% Important and 54.5% Very important) next to costs (45.5% Important and 54.5% Very important). In Sweden, knowledge about policy is the most important area (44.4% Important and 44.4% Very important).

4.2.3 Who has the knowledge?

Having highlighted increased knowledge on a number of topics as important to stimulate industrial activities in CCS, it is relevant to see which stakeholders who are deemed to possess this knowledge and thus potentially functioning as knowledge providers.

The results were relatively similar in the two countries, although with some exceptions. Emitting industries (i.e. power production and process industries), technical suppliers and academia are perceived to have the highest knowledge on most topics in both countries. For these three stakeholders, the topics that receive the highest scores are technical knowledge areas costs, while they are perceived to have lower knowledge about "soft" topics such as policy and public acceptance. As for academia, respondents in both Sweden and Norway perceive the knowledge to be low with regards to policy (25% in Sweden and 9.1% in Norway). Furthermore, academia is seen to have little knowledge about costs (9.1%) and public acceptance (18.2%) in Norway.

General public and media in both countries are considered to possess least knowledge. The general public and the media did not score above 50% in either of the countries, and on most topics they are commonly considered to have no knowledge.

Policymakers in both countries are seen to have extensive knowledge on some topics and little knowledge in others. They score high on knowledge about policy (100% in Sweden and 90.9% in Norway) and high (63.6%) on public acceptance in Norway. On all other topics policymakers score very low, below 12.5% in in Sweden and below 9.1% in Norway.

The knowledge among NGOs is seen to be relatively low on many topics in both countries. In Norway, the highest score is by far knowledge on public acceptance (90.9%) but knowledge on policy (54.5%) also receives a significant score. In Sweden, knowledge on environmental effects (62.5%) is the only topic that receives a score above 50%.

Financial institutions and insurance companies are not perceived to possess any considerable knowledge. These actors do not score above 50% on any knowledge topic in Sweden or Norway, except for insurance companies in Sweden (50% on knowledge about security).

4.3 How is the communication working with different actors?

The possibility to transfer the above knowledge however depends on the communicational relationship between the industries and relevant actors. In the following we will therefore provide more detail on how communication is considered from the industries' viewpoint, which includes trust as and an important factor in the communicational relationship.

4.3.1 Communication with actors

Both the Swedish and Norwegian industry respondents perceive the communication to work best with academia. In Norway, 40% perceive the communication to work Well enough and 60% Very well. In Sweden, these numbers are 57.1% (Well enough) and 28.6% (Very well) in Sweden.

The communication with other emitting industries and technical suppliers is also seen as well functioning in Norway, as both actors receive above 60% when the categories Well enough and Very well are combined. The situation in Sweden is somewhat different, as 42.9% believe the communication with both other industries and technical suppliers to be Poor.

The communication with policymakers in Sweden appears to have a clear potential of improvement as 85.7% characterises the communication as Poor. The picture in Norway is more mixed, as 36.4% believe the communication to work Well enough, however, 45.5% believes the communication to be Poor.

The communication with financial institutions is identified as having room for improvement. In Norway, 60% believes the communication with financial institutions to be Poor or Very poor (the score for Sweden is 57.4%). Moreover, a substantial share of the Norwegian respondents (30%) answered that there are No existing communication with financial institutions, adding to the impression of clear communication challenges. It should, however, be noted that the perceived need for communicating with financial institutions is likewise low.

Communicational challenges also appear to exist between the Norwegian industries and insurance companies. Here, 20% view the communication as Very poor and 30% states Poor communication as well as 30% answering that there is No existing communication. In Sweden, a majority also perceive the communication with insurance companies as not working well, as 42.9% states that it is Poor and 28.6% believes it is Very poor.

On the one hand, no substantial challenges are identified with regards to the communicating with NGOs in Sweden and Norway (neither in Sweden or in Norway the categories Very poor and Poor combined exceeds 60%). However, on the other hand, the communication is not seen as working Very well (below 20% in both countries). The largest share in both countries, hence perceives the communication to work Well enough.

The views on communication with the general public differ between Sweden and Norway. In Norway, there is a substantial share (40%) that thinks the communication is Poor, but there is an equal share (40%) that perceives the communication to be working Well enough. In Sweden, 71.4% of the respondents identify the communication as being Poor.

The communication with the media comes out with the lowest score in both countries. In Sweden, all respondents (100%) states that the communication is Poor and in Norway a majority (60%) regards the communication as Poor or Very poor.

4.3.2 Trust in actors

As a determinant of how messages will be perceived by the receivers, an important aspect of a communicational relationship between two actors is how trustworthy the parties perceive each other to be. The communication channel might work well, but the message may be disregarded if the actor is not seen as trustworthy.

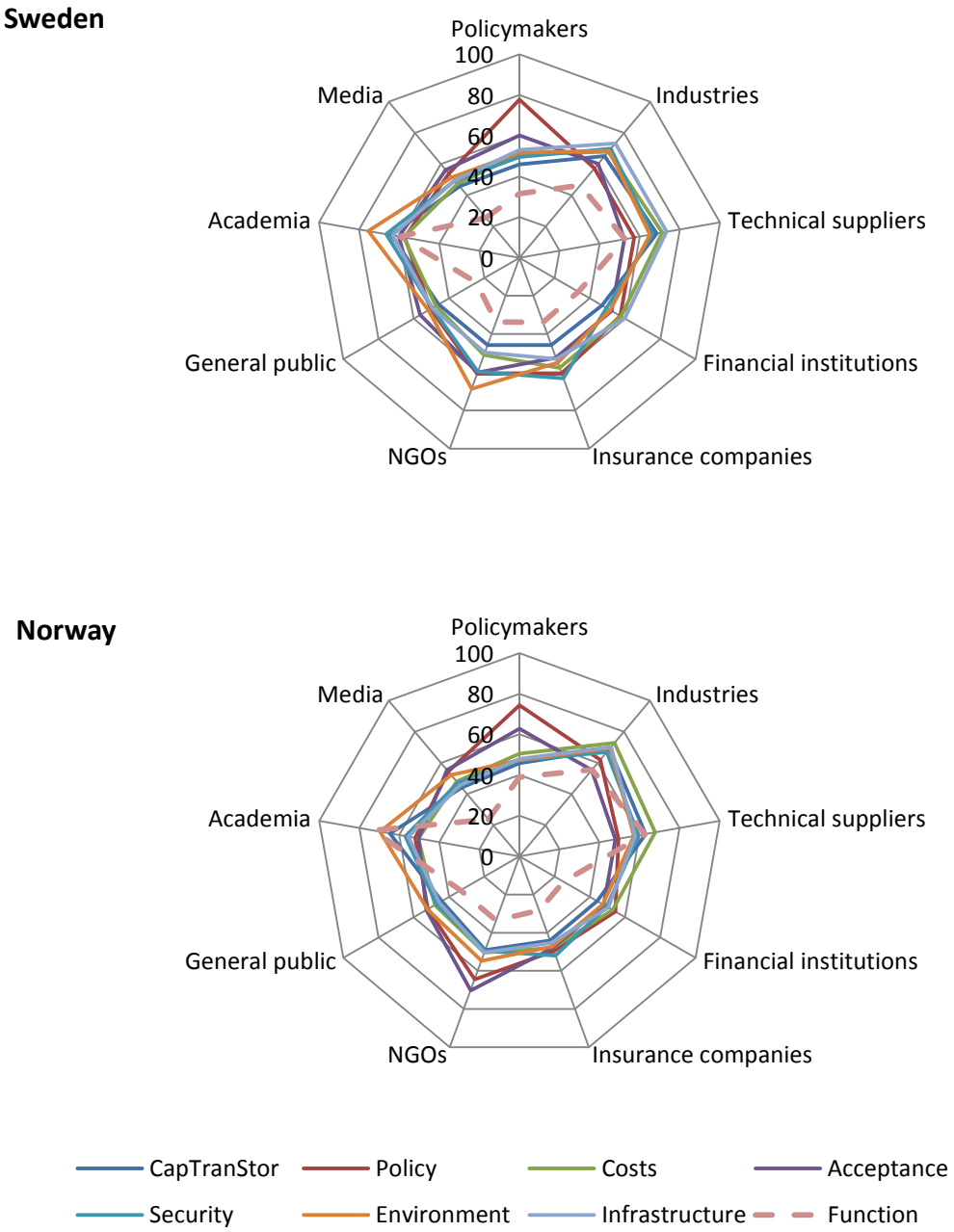
In Norway, the most trusted actor is academia (63.6% regards academia as Trustworthy and 27.3% as Very trustworthy). Technical suppliers also scores high (45.5% states Trustworthy and 18.2% Very trustworthy). At the other end of the scale, the media stands out as the least trustworthy (63.6% states Not trustworthy). Other actors are located in the category Mostly trustworthy, and as such, no major trust challenges seem to exist.

Similar to the Norwegian context, Swedish academia (62.5% states Mostly trustworthy and 12.5% Very trustworthy) and technical suppliers (62.5% states Trustworthy) scores high on trustworthiness together with other industries (50% states Trustworthy). The least trusted actor group in Sweden are NGOs (37.5% states Not trustworthy), the media (42.9% states Not trustworthy) and the general public (62.5% states Not trustworthy). Other actors are firmly located in the category Mostly trustworthy.

4.4 Implications for the potential of increased knowledge transfer

In the previous section, we have identified how important knowledge about different topics is to stimulate activities in CCS among Swedish and Norwegian industries. Some general trends have been identified, and in the following we will highlight some of the most interesting findings in more detail. This mainly focuses on the communication with those actors who are perceived to possess knowledge about a topic, as this represents an important possibility for knowledge transfer as a means to stimulate action. It is, however, important to notice that several other areas and links could be explored, based on the data provided by this survey. This will be addressed in the evaluation of the methodology. It should however also be noted that the response rate from the survey was low and the discussion below thus should be interpreted in this context.

Figure 2 – Function and importance of communication in Sweden and Norway



When discussing the potential for, and results of, increased knowledge transfer, an important factor is the relative importance of knowledge and increased knowledge from an overall perspective. How does knowledge compare to other factors, which influence a company's interest and action on CCS? The respondents were therefore asked to rate the extent to which a number of potential obstacles influence their interest and action on CCS. Neither in Norway, nor in Sweden was a lack of knowledge seen as a major potential obstacle. Only 25% in Norway and 30% in Sweden stated that lack of knowledge had a Large influence or a Very large influence. Other areas, such as policy and costs were seen as substantially bigger obstacles. Naturally, a well-functioning communication is an important aspect to allow for a dialogue on concerns on these topics and potential policy responses.

Nevertheless, knowledge is de facto seen as important, although not most important, to stimulate activities in CCS in both countries. In Norway, academia, industries and technical suppliers stand out as the actors with the highest potential for knowledge transfer. This is due to these actors being perceived as highly knowledgeable on several topics important to the respondents. At the same time, communication with these actors is regarded as well-functioning. The foundation for a continuation of the latter is also present, as academia is the most trusted actor group and the other two actor groups are deemed trustworthy.

The picture is somewhat different in the Swedish context. Similar to the Norwegian case, academia stands out as being a current and future important communication partner, as academia scores high on several topics as well as communication. However, with regard to communication with industries and technical suppliers, a substantial share perceives the communication to be Poor. This could be an area for improvement, as both the industries and technical suppliers are seen to have extensive knowledge in several areas. It is however important to point out that the foundation for a well-functioning communication is present due to the industries and technical suppliers perceived trustworthiness. A good starting point for improved communication hence exists between the groups.

As knowledge about costs was seen as essential for Swedish respondents to stimulate activities in CCS (this was also seen as the single most important issue in Norway), an improved communicational relationship with technical suppliers and the industries could be of great importance for the Swedish industries, seeing that these actors are seen to have extensive knowledge on cost related issues. Knowledge about costs is also scarce among the other actor groups, adding to the importance for the Swedish industries to improve their communication. Knowledge about costs is also seen to be possessed by these actors in Norway, but as mentioned above, the communication is currently working well. Worth noticing is that academia – the actor with the best score on communication and a high score on knowledge on several topics in both countries – is not considered as knowledgeable on this topic. This is also the case for knowledge about policy, which was regarded as the second most important knowledge area in Norway and the most important area in Sweden.

This raises the question of what actors are perceived as knowledgeable on policy issues. Perhaps unsurprisingly, Swedish and Norwegian policymakers are those who are seen as having most knowledge on this issue. Also, Norwegian NGOs are seen as highly knowledgeable on policy. Public acceptance is also a topic where policymakers in both countries are seen as having high knowledge. However, policymakers in both countries are seen as possessing marginal or no knowledge in all other knowledge areas, including knowledge about costs. This is strongly related to policy and a respondent from Norwegian industry points to a perceived knowledge deficit among policymakers with regard to potential for mitigating carbon dioxide emission by different technologies. The respondent argues that this result in policies not providing sufficient financing policies to reduce capital expenses of CCS in relation to its potential relative other technologies and their respective support.

While the importance of communicating with policymakers thus being high, it is evident that the communication with policymakers could be improved. A clear majority in Sweden perceive the communication to be Poor and the qualitative answers confirms the potential and need for an improved dialogue. Moreover, a significant share of Norwegian respondents considers the communication to be Poor. However, this share is somewhat smaller than in Sweden and there is

also a rather large share stating that the communication is working Well enough. The conclusion is that there is a need and potential to improve the dialogue also in Norway. This is further substantiated by industries in both countries perceiving policymakers as relatively trustworthy.

In Sweden, a lack of time and resources is brought forward as a communication barrier. One respondent also thinks it is difficult to identify who to contact when seeking a dialogue with policymakers. Allocation of more resources for both industries and policymakers to facilitate an improved dialogue is highlighted as important by one respondent. One of the Norwegian respondents argues that ideology and unrealistic expectations on renewable energy production is a barrier to the communication about CCS with Norwegian policymakers. Trust is brought forward as another barrier, as one respondent perceives policymakers to lack trust in industries operating in the fossil industry. The EU ZEP initiative[8] is identified as a very positive measure for improved communication and this type of public communication, supported by policymakers, is seen as a step in the right direction by one of the Norwegian respondents. Close dialogue and contact with policymakers are generally seen as the most important factors to strengthen the communication with policymakers in both countries.

Finally, communication with the media, general public, financial institutions and insurance companies are seen as least important, due to these actors being perceived as possessing little or no knowledge on most topics in both countries. In both Sweden and Norway, the media and the general public are deemed least knowledgeable. Several of the respondents, particularly Norwegian respondents, highlight what they think is a lack of knowledge about CCS in the media. One of the respondents argues that the media is not interested in facts, unless it is a catastrophe or crisis or similar. Moreover, media is not seen as trustworthy, further complicating the possibility for an effective knowledge exchange.

The other actor with the lowest score on knowledge – the general public – scores poorly on communication in Sweden, whereas the picture is somewhat less clear in Norway. Adding to this, a large share of the respondents in Sweden perceives the general public as being Not trustworthy, which is a challenging starting point for improved communication.

5 Evaluation of the methodology applied

The task to link a multi-contextual topic such as that of CCS with a methodology that is relatively easy to use by a broad set of intended users proved to be a challenge. While hand-sketched maps can easily use different colours and other characteristics to highlight different meanings, this is likely to be less reproducible and comparable between used in different analyses and by different analysts. We therefore decided to use a computable Microsoft Excel based methodology as this is a readily available software. More complex software can provide more insights, however then arguably also loosing transparency and possibly software licensing costs.

The main advantage of this stakeholder map is that it can be used as a tool to identify priorities for communication to increase action on CCS through overcoming knowledge asymmetries. One

[8] Founded in 2005, the European Technology Platform for Zero Emission Fossil Fuel Power Plants (ZEP) is a coalition of stakeholders (European utilities, petroleum companies, equipment suppliers, scientists, academics and environmental NGOs) supporting CCS. More info: http://www.zeroemissionsplatform.eu/about-zep.html

example of this, described in the previous section, is that policymakers in Sweden and Norway are perceived to have extensive knowledge about the important topic policy, but that the communication was generally seen as poor and to an extent lacking trust. By developing a stakeholder map, these kinds of patterns becomes apparent. This can be beneficial for a range of actors and all of the stakeholders identified in this study could potentially benefit from such information. It is important to underline that the different potential users will have different objectives for using the stakeholder map, an industrial organisation will have another focus than an interest organisation or academia.

The questions and aspects that are combined and aggregated can display results that can also contribute with relevant information when seen separately (as described in 4.2 and 4.3). By joining questions in a different way that used here can highlight other interesting correlations. One example could be to complement the existing question 12 (aspects that are perceived as obstacles) and question 17 (how the communicational relationship is with relevant actors) by adding a question about which actors that are important to resolving the identified obstacles. By cross-connecting these questions into a map this can provide insights into challenges that needs to be solved, as well as providing a basis for the further work in identifying suitable measures to address the identified challenges.

Moreover, it can be argued that *b* (Q14) can be used to reduce the number of topics necessary to analyse, i.e. topics of less importance to stimulate activities does not need to be analysed. However, it has been shown that discrepancies are common if comparing industries' risks perceptions and *de facto* risks that have resulted in early CCS projects having been postponed, restructured or cancelled.[9] This speaks in favour of analysing all topics that may introduce risk perceptions to engage in CCS. Another possibility is to co-analyse Q14 and Q15 for a direct mapping of aspects to stimulate activities and who has this knowledge. This would however not acknowledge the actual functioning of the communication between these actors and thus not to which extent that it is likely to form an obstacle for CCS activities.

If similar surveys is carried out for other stakeholders, e.g. for policymakers, discrepancies could be identified between the industries' and policymakers' perceptions of how important certain topics are. One of the findings in this study was that Swedish and Norwegian policymakers are perceived by the industries to possess little or no knowledge on several issues. One of these areas was knowledge about costs, one of the most important identified areas to gain knowledge from the industries' point of view. Carrying out a similar survey on policymaker perceptions could facilitate a comparison based on how policymakers see their knowledge in this area (question 13 in the survey) and then assess whether this should be evaluated as a prioritised area for improvement. This could be beneficial both for the industries and the policymakers and be of academic interest, as it is of societal importance whether policymakers have the sufficient knowledge basis to make decisions affecting the development of CCS.

Looking at the survey, we exclude Q16 in the quantitative analysis as it relates to current and planned activities and not all respondents have on-going or planned activities. Admittedly, it also lacks precision in what the respondents may perceive to be dependent on, given that different actors are engaged in different CCS activities. It could however have a value to provide a comparison of the

[9] Stigson et al, 2012.

results of the suggested methodology. In that case, it is however recommended that the question is rephrased as “In regards to overcoming the most important barriers to invest in CCS, to which extent are you depending on other stakeholder groups?”. This would, on the other hand, broaden the analysis to include also other factors than communicational, as is the focus of the suggested methodology. It would then ideally be grouped together with Q12 on a separate survey page to provide a set of dependent variables.

Another improvement regarding the questionnaire would be to have four categories, not five, in Q17. The number of response categories should, if possible, be kept equal in the questions included in the equations 1 and 2. Five categories with two categories on each side of the middle category makes easy to identify where the majority of the responses exists, supporting the aim of the methodology as being easy to use. This, together with standardised and precise category names makes the numerical rating average an efficient tool in identifying relevant results and trends in the material.

Responses concerning capture, transport and storage proved to be quite similar, meaning that they were summarised into one value. A benefit of this is the improved possibility to overlay these three topics into one radar chart without cluttering it with too many lines. However, some minor differences existed and for a detailed analysis, one option would be to draw up more radar charts where different topics could be clustered. An option for this could be to include capture, transport and storage in one chart, policy and costs in another, infrastructure and security in a third and finally acceptance and environment in a fourth.

With low response rates, the relevance of a qualitative analysis of the survey results increases. However, qualitative responses were often short and not contributing with substantial new knowledge. Also, the amount of respondents skipping these questions was significantly higher than for the other questions. Despite this, the qualitative questions where useful. They first of all served to strengthen the validity of the quantitative results by functioning as a control mechanism and by elaborating on the results from the quantitative questions that had quantitative significance. Secondly, they provided some additional information that the quantitative questions did not cover. In sum, using both quantitative and qualitative data is seen as useful to increase the validity of the results from the survey as well as contributing with complementary knowledge.

6 Conclusions

The rationale for studying the possibility for a stakeholder map on communication is twofold. Firstly, developments in Europe and elsewhere have pointed to communication and acceptance as important cornerstones for successfully implementing CCS projects. Secondly, failing to identify a methodology deemed appropriate for the CCS context as a multi-stakeholder and multi-dimensional set of technologies and actors, a new methodology was identified as valuable.

The two central elements in the analysis are perceptions of important knowledge and communication and how a lack of knowledge may form barriers for CCS. This includes who is perceived to have this information and how the communication is working with that stakeholder group. Through a survey, perceptions on importance of communication on a topic with a specific actor group as well as the function of the dialogue with that actor group can be identified. This gives insights into knowledge asymmetries and strategies to deal with such asymmetries through

communicational strategies. The developed methodology was tested through analysing responses from industry stakeholders in Norway and Sweden. While the response rate was low, the CCS community is, at least in Sweden, not very large in terms organisations having experiences on CCS, meaning that the relative response rate in this perspective was higher. The choice to focus on industry stakeholders was close at hand due to NORDICCS being user-driven. For a broader analyses, a more generic survey that focus on perceived barriers for CCS and communication as a way to bridge these barriers could be developed.

A low response rate has implications for the ability to generalize from the findings, i.e. the findings in this study should be replicated by a larger sample. However, some general and significant trends could be identified through the survey responses and these trends can function as input in further work.

The industry respondents perceive the communication with media, general public, financial institutions and insurance companies as least important, as these actors are perceived to possess low knowledge on several knowledge areas. Conversely, the importance of communication with academia, industries and technical suppliers is seen as most important due to a higher perceived level of knowledge. Two of the topics that are most important in both countries to increase action on CCS are policy and costs. Regarding policy, communication with the actor perceived as clearly most knowledgeable on this topic – policymakers – has challenges in both countries. On costs, the communication with the actors most knowledgeable on this topic, technical suppliers and industries, differ somewhat in the two counties. While the communication works well in Norway, Swedish respondents state that the communication with these actors has a clear potential for improvement. Further comparing results from Sweden and Norway, the results differ most between the countries in relation to the importance of communicating with NGOs. In Norway, the importance of communicating with NGOs mainly concerns policy and acceptance, and in Sweden regarding environmental issues. Moreover, the Norwegian respondents perceive the communication as functioning better than the Swedish respondents.

7 References

de Best-Waldhober M, Daamen D, Ramirez A et al (2009) Informed public opinions on CCS in comparison to other mitigation options. Energy Procedia 1:4795–4802

Edelenbos, J., van Schie, N., Gerrits, L., 2010. Organizing interfaces between government institutions and interactive governance. Policy Sciences 43: 73-94.

EC, 2011. EU Special Barometer: Public Awareness and Acceptance of CO2 capture and storage. European Commission.

Hansson, A., Bryngelsson, M., 2009. Expert opinions on carbon dioxide capture and storage: a framing of uncertainties and possibilities. Energy Policy 37:2273–2282

Johnsson, F., Reiner, D., Itaoka, K., Herzog, H., 2010. Stakeholder attitudes on Carbon Capture and Storage: An international comparison. International Journal of Greenhouse Gas Control 4: 410-418.

NORDICCS, *(forthcoming)*. Nordic CCS Roadmap. The Nordic CCS Competence Centre. See http://www.sintef.no/NORDICCS

Scholes, E., Clutterbuck, D., 1998. Communication with stakeholders: An integrated approach. Long Range Planning 31:227-238

Stigson, P., Lind, M., Hansson, A., 2012. Obstacles for CCS deployment: An analysis of discrepancies of perceptions. Mitigation and Adaptation Strategies for Global Change 17:601-619.

van den Hove, S., 2006. Between consensus and compromise: acknowledging the negotiation dimension in participatory approaches. Land Use Policy 23:10-17.

Wallquist, L., Visschers, V.H.M., Siegrist, M., 2010. Impact of knowledge and misconceptions on benefit and risk perception of CCS. Environmental Science & Technology 44:6557–6562.

Appendix 1 – Survey

1. In which sector is your company or organisation active? *(multiple choice)*
    a. Power and heat industry (fossil)
    b. Power and heat industry (bioenergy)
    c. Fossil fuel industry
    d. Biofuel industry
    e. Cement industry
    f. Pulp and paper industry
    g. Iron and steel industry
    h. Mining industry
    i. Aluminium
    j. Refinery
    k. Other

2. Status of organisation *(single choice)*
    a. Privately owned company
    b. State-owned enterprise
    c. Business organisation

3. Size of organisation (approx. number of employees) *(single choice)*
    a. Below 50
    b. 50-200
    c. 201-1000
    d. Over 1000

4. Size of organisation (approx. turnover) *(single choice)*
    a. Less than 2 million Euro
    b. 2-50 million Euro
    c. More than 50 million Euro

5. Nationality of company or organisation (if multinational, please answer your office location) *(Single choice)*

6. What is your position in the company or organisation? *(open question)*

7. How long have you been working with CCS? *(single choice)*
    a. Less than 2 years
    b. 2-5 years
    c. More than 5 years

8. Further use of this questionnaire *(single choice)*
    a. Answers in this questionnaire may be used for public use
    b. Information given in this questionnaire may be used within the NORDICCS project and made public only in aggregated results

9. Are you currently active in the field of CCS? *(multiple choice[10], matrix)*
    a. Capture
    b. Transport
    c. Storage
        i. Yes, in technology deployment (i.e. investing in CCS applications)
        ii. Yes, in technology development (i.e. R&D)
        iii. No

10. Are you expecting to become MORE active in the field of CCS? *(multiple choice, matrix)*
    a. Capture
    b. Transport
    c. Storage
        i. Yes, before 2015
        ii. Yes, between 2015-2020
        iii. Yes, between 2020-2025
        iv. Yes, after 2025
        v. No

11. Are you expecting to become LESS active in the field of CCS? (if "yes" on question 9) *(multiple choice)*
    a. Capture
    b. Transport
    c. Storage
        i. Yes, before 2015
        ii. Yes, between 2015-2020
        iii. Yes, between 2020-2025
        iv. Yes, after 2025
        v. No

[10] Response options i, ii, iii (…) refer to y-axis response options in matrix questions.

12. To what extent do the potential obstacles below influence for your company's (business organisation's) interest and/or action on CCS? *(multiple choice, matrix)*
    a. No influence
    b. Small influence
    c. Medium influence
    d. Large influence
    e. Very large influence
    f. Don't know/Hard to say
        i. Lack of technology
        ii. Lack of public policies
        iii. Lack of regulatory stability
        iv. Lack of political interest
        v. Lack of financing (support to capital expenses, e.g. grants)
        vi. Lack of financial incentives (support for operational expenses, e.g. carbon tax)
        vii. Lack of public acceptance
        viii. Lack of suitable storage sites (in the short term)
        ix. Lack of storage capacity (in the longer term)
        x. Security of operations
        xi. Environmental concerns (other than emissions of carbon dioxide)
        xii. Dependence on other actors
        xiii. Other *(open response option)*

13. How would you rate your knowledge about the following aspects? *(multiple choice, matrix)*
    a. No knowledge
    b. Some knowledge
    c. Good knowledge
    d. Very good knowledge
        i. Capture technology
        ii. Transport solutions
        iii. Storage (availability, safety etc.)
        iv. Policy
        v. Costs
        vi. Public acceptance
        vii. Security
        viii. Environmental effects
        ix. Infrastructural challenges (from capture to transport and finally storage)
        x. Other *(open response option)*

14. How important is knowledge about the following aspects to stimulate activities in CCS for your company or organisation? *(multiple choice, matrix)*
    a. Not important
    b. Somewhat important
    c. Important
    d. Very important
        i. Capture technology
        ii. Transport solutions
        iii. Storage (availability, safety etc.)
        iv. Policy
        v. Costs
        vi. Public acceptance
        vii. Security
        viii. Environmental effects
        ix. Infrastructural challenges (from capture to transport and finally storage)
        x. Other *(open response option)*

15. In your view, who has this knowledge? *(multiple choice, matrix)*
    a. Policymakers
    b. Industries (emitters)
    c. Technical suppliers
    d. Financial institutions
    e. Insurance companies
    f. NGOs
    g. General public
    h. Academia
    i. Media
    j. Other
        i. Capture technology
        ii. Transport solutions
        iii. Storage (availability, safety etc.)
        iv. Policy
        v. Costs
        vi. Public acceptance
        vii. Security
        viii. Environmental effects
        ix. Infrastructural challenges (from capture to transport and finally storage)
        x. Other *(open response option)*

16. In regards to your current or planned CCS activities, to which extent are you depending on other stakeholder groups? *(multiple choice, matrix)*
    a. Not dependent
    b. Somewhat dependent
    c. Dependent
    d. Highly dependent
        i. Policymakers
        ii. Industries (emitters)
        iii. Technical suppliers
        iv. Financial institutions
        v. Insurance companies
        vi. NGOs
        vii. General public
        viii. Academia
        ix. Media

17. How is the communication working with these actors? *(multiple choice, matrix)*
    a. Very poor
    b. Poor
    c. Well enough
    d. Very well
    e. No existing communication
        i. Policymakers
        ii. Industries (emitters)
        iii. Technical suppliers
        iv. Financial institutions
        v. Insurance companies
        vi. NGOs
        vii. General public
        viii. Academia
        ix. Media

18. In general, how trustworthy do you find these actors?
    a. Very trustworthy
    b. Trustworthy
    c. Mostly trustworthy
    d. Not trustworthy
        i. Policymakers
        ii. Industries (emitters)
        iii. Technical suppliers
        iv. Financial institutions
        v. Insurance companies
        vi. NGOs
        vii. General public
        viii. Academia
        ix. Media

19. What are the most important aspects influencing the dialogue with policymakers? *(open question)*

20. Is there a need to improve the communication? *(open question)*

21. If yes, what are the barriers today? *(open question)*

22. If yes, how can these barriers be overcome? *(open question)*

23. What is working well in your communication with policymakers? (*open question)*