D103 of CCSP

A report on the acceptability of CCS in Finland

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Contents

1. Introduction

Deliverable D103 "A report on the acceptability of CCS in Finland" is one result of the first funding year in the five-year Carbon Capture and Storage Program (CCSP). The overall long-term objective of the CCSP is to develop Carbon Capture and Storage (CCS) related technologies and concepts relevant to Finnish conditions enabling piloting and demonstrations, which are a prerequisite for a commercial breakthrough of CCS technologies. The program is managed by CLEEN Ltd and in practice coordinated by the Technical Research Centre of Finland (VTT) (CCSP Fact Sheet, 2011). CLEEN, the Cluster for Energy and Environment, is part of Strategic Centres for Science, Technology and Innovation (SHOK) which carry out long-term cooperation in fields most crucial for the future. In its first year the Carbon Capture and Storage Program was funded by TEKES and the cluster of 16 industrial and 9 research partners.

Work Package (WP) 1 of the CCSP[1] is entitled "CCS related regulation, legislation and EHSS issues". EHSS stands for environment, health, safety and sustainability. WP1 is further divided into five sub-tasks of which Task 1.3 "Environment, Health, Safety and Sustainability Questions" also includes acceptability issues. The objective of Task 1.3 was (1) to establish Environment, Health, Safety and Sustainability (EHSS) criteria for the CCS chain and (2) to understand factors and interactions influencing public acceptability of CCS. (CLEEN Ltd's CCS Programme, Research Plan, 2010, p.22.) The focus of this Report is on acceptability.

According to the Research Plan "research will start with a literature review. The objective is to map the latest theoretical approaches and lessons learned and to apply the findings to the

[1] The Program consists of five Work Packages: WP 1, WP 2 CCS Concepts, WP 3 Capture Processes, WP 4 Processing and logistics and WP 5 Storage (CCSP Fact Sheet, 2011).

Finnish context. Public acceptability of CCS will be approached from the point of view of different Finnish actors. The key actors identified by discussions with the stakeholders will be interviewed. The objective is to map the spectrum of issues related to acceptability of CCS in the Finnish context." (CLEEN Ltd's CCS Programme, Research Plan, 2010, p.22.)

The three main research questions of the stakeholder interviews were defined as follows: (1) What kinds of expectations does your organization have regarding CCS technology? (2) What are the major concerns regarding CCS technology in Finland? (3) Is acceptability of CCS technology a concern in Finland? Why? Why not? Moreover, additional questions were asked to map the spectrum of issues related to acceptability in Finland. In the Report social acceptance was understood to refer to the willingness of actors to consider CCS technology as a viable alternative. Thus, social acceptance was understood broadly as the issues related to the technology are dependent on the perception of the actors.

The stakeholder interviews were conducted between November 2011 and January 2012. The interviews were not interpreted as the official statements concerning the CCS position of the organizations that the interviewees represented. The official statement of the organization regarding CCS was only requested in relation to the position of the organization on CCS technology. If the organization had a position on CCS, a document describing it was requested.

All twelve organizations interviewed are listed in Appendix 1. The interviewees, the representatives of the organizations, were promised anonymity. Although the interviews do not represent the official views of the respective organizations, the interviewees were CCS experts in their organizations, which should give an idea of how CCS is currently approached in Finland.

However, as there are currently no on-going plans to deploy CCS technology in Finland[2], and as according to current knowledge there is no suitable geological formation for CO2 storage in Finland[3], the interviewees occasionally perceived the issue to be very speculative and distant. CCS technology was also discussed only at general level without any references to a specific technology. Characterization of different CCS technologies and the different stages of the CCS chain, i.e. CO2 capture, transportation and storage, are excluded from the scope of this report (For more details see e.g. Mills, 2011; Teir et al., 2010, p.24–52.)

The structure of the report is as follows. In Chapter 2 the current context of the CCS issue in Finland is introduced. In Chapter 3 the focus is on understanding and defining acceptance and acceptability based on the current literature. Chapter 4 focuses on the interviews. Both the selection of interviewees and the interview method are introduced. In Chapter 5 the results of the interviews are presented as a typology of stakeholder concerns. The categories are modified from the typology by Wüstenhagen et al. (2007). Findings are summarized in Chapter 6. Matti Kojo (University of Tampere) was the main author of this Report, with contributions and comments from Anna Nurmi (University of Jyväskylä). Nurmi was also the main author of Chapter 2.

The report is one of the first social scientific studies to focus solely on the acceptability of CCS technology in Finland. Public awareness and acceptance concerning CCS have been noted in earlier reports (Teir et al., 2010, p. 109–117; Teir et al., 2011a,p.71), but the main focus has been elsewhere. At the time of launching the CCSP another Finnish social scientific research

[2] The Meri-Pori CCS retro-fit project was discontinued in 2010 (Teir et al., 2010, p.81).
[3] All deep rocks are assumed to be crystalline basement rock in Finland and thus not suitable for CO2 storage. The closest potential storage sites for Finland are the formations in the southern Baltic Sea (Teir et al., 2010, p.66).

project on CCS was started at the University of Helsinki.[4] The researchers of these two projects held the first joint CCS workshop in Joensuu in November 2011.

The authors gratefully acknowledge all the people who collaborated in this work by giving their time for interviews and commenting on the draft.

[4] Risk Governance of Carbon Dioxide Capture and Storage (RICCS) project, funded by the Academy of Finland.

2. CCS in the Finnish context

CCS technology has been studied in Finland, mainly from a technical perspective, for more than ten years (Arasto, 2011). The ClimTech Program launched in 1999, after the 1997 Kyoto climate negotiations, was one of the first programmes to consider the utilization of CCS in Finland (Koljonen et al., 2002). In the beginning of the 2000s research on mineral carbonation was also initiated in Finland (Sipilä et al., 2008, p.9). Oxyfuel combustion for Circulating Fluidised Bed technology (Oxy-CFB) has also been developed in Finland e.g. by Fortum, Foster Wheeler, Metso and the Technical Research Centre of Finland. The ClimBus Program[5] included CCS technology studies in the frames of the CCS Finland[6] project in 2008–2011. This project also outlined a roadmap for the application of CCS in Finland and followed the recent development in CCS regulation indicating the importance of societal aspect (Nieminen et al., 2009). The latest phase is the Carbon Capture and Storage Program (CCSP) introduced above. The Meri-Pori Retro-fit Project 2008–2010 was the first and so far the only demonstration project in Finland. The demonstration project FINNCAP was a joint project of the power companies Fortum and Teollisuuden Voima (Iso-Tryykkäri, Rauramo and Pekkanen, 2011). The project was, however, discontinued in 2010. CO2 is also separated at the Neste Oil refinery at Sköldvik and utilized e.g. in greenhouses and precipitated calcium carbonate (PCC). Thus it could be argued that the development of CCS in Finland has been technology and research driven.[7]

[5] ClimBus is TEKES' program for Business Opportunities in the Mitigation of Climate Change 2004–2009 (see Veijonen, Hoivala and Seilo, 2009, Eds, especially p.267–338).
[6] More about the CCS Finland project, see http://www.vtt.fi/proj/ccsfinland/index.jsp.
[7] E.g. in the ClimTech Program societal embedding, i.e. an interactive learning process amongst the groups of key actors, was already studied, but the focus was on innovations related to renewable energies and energy saving, not on CCS technology (see Väyrynen et al., 2002).

At the moment there is no clear CCS policy in Finland. The CCS Directive (2009/31/EY) was implemented in 2012[8]. Parliament forbid permanent storage of CO2 in Finland, but it obliged the Government to reconsider the issue and to take action in case the assessment regarding storage options would change. Furthermore, Parliament obliged the Government to advance climate change mitigation technology including CCS technology. (EV 49/2012 vp – HE 36/2012 vp.)

CCS could be described as new technology, where new regulation and changes to existing ones have to be made in order to ensure the continuity of the development. CCS is strongly related to the energy production palette. In Finland nuclear energy, hydroelectric power, coal, natural gas, wood and peat are the most used forms for producing electricity. According to the figures for 2011 nuclear energy accounts for 26.4% and hydroelectric power for 14.6%, coal for 11.8% of electricity production. Imported electricity amounts to 16.4%. (Finnish Energy Industries, 2012.) The greatest producers of CO2 in Finland are mainly in the power and heat sector and steel production. In 2010 the total amount of green house gas emissions in Finland was 74.6 Mt CO2 ekv., of which the energy sector accounts 81%. (OSF, 2010.) The largest CO2 point sources are in the power and heat sector, which would also have the greatest potential for the

[8] The preliminary debate on the Government bill (HE 36/2012 vp) was held on 2 May 2012 in Parliament. The next phase was the committee handling of the bill by the Environment Committee. The Finance Committee issued a statement to the Environment Committee on 30 May 2012 (TaVL 26/2012 vp - HE 36/2012 vp). At the committee's hearing ten experts presented their views. They represented the Ministry of the Environment, the Ministry of Employment and the Economy, the Geological Survey of Finland (GTK), the Finnish Funding Agency for Technology and Innovation (TEKES), the Technical Research Centre of Finland (VTT), Cuycha Innovation Oy, the Finnish Energy Industries, the Federation of Finnish Technology Industries and the Aalto University. Furthermore, VTT, GTK and WWF Finland submitted statements to the Environment Committee.
The Environment Committee submitted its report on 1 June 2012 (YmVM 2/2012 vp - HE 36/2012 vp). Then the bill was handled in the two readings of plenary session. In the first reading on 7 June 2012 the content of the bill was approved as such. Two Members of Parliament (Jukka Kärnä of the Social Democratic Party and Johanna Karimäki of the Green League) gave a speech regarding the issue. In the second reading on 12 June 2012 the bill was approved. Again, only two speeches were given in the reading by the MPs Ari Jalonen and Mika Niikko of the True Finns.

application of CCS technology (Teir et al., 2011b). These point sources are mainly situated on the Finnish coastline.

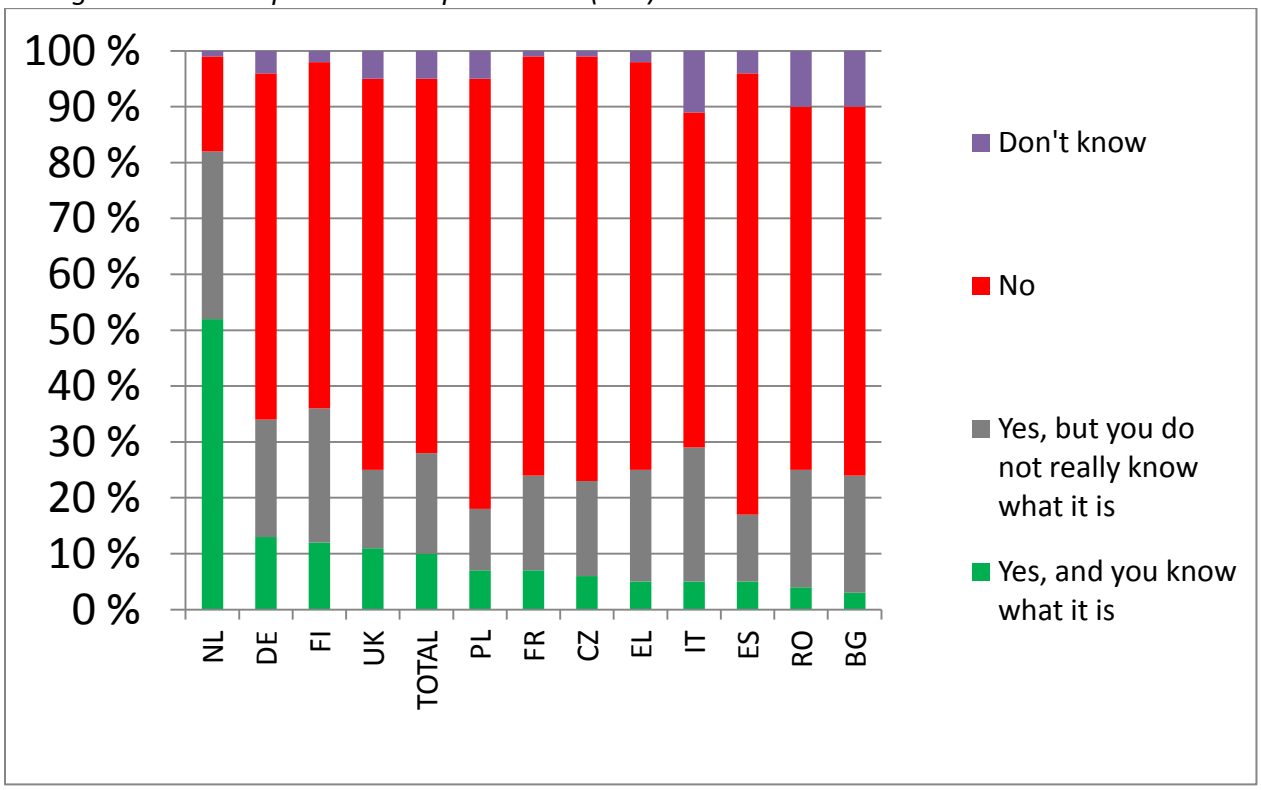
The Finnish bedrock is deemed unsuitable on geological grounds for long-term storage of CO2. The implementation of CCS technologies is tied to the possibility of transportation by ship or by pipeline across borders. One potential offshore storage formation would perhaps be in the North Sea, while suitable on-shore sites are thought to exist in Poland, Denmark and Germany. (Teir et al., 2011b.) Within the project of Meri-Pori the possibilities for both shipping and pipeline transfer to operational CO2 storage sites to e.g. the North Sea and the Barents Sea were assessed. During the time of the project it was estimated that off-shore storage could be a more promising method of transportation for the then planned demonstration project. (Kujanpää, Rauramo and Arasto, 2011.) The storage of CO2 in Finnish ground has also now been taken up in the regulations. In a draft proposal on a national implementation of the CCS directive the storage of CO2 in the Finnish bedrock is proposed to be forbidden. Also, a restriction on allowing transportation and storage only inside the EU or states belonging to the European Economic Area has been proposed. There is also a need for a change in the national legislation regarding off-shore storage if CO2 is considered as waste and is stored offshore and outside the borders of Finland. (Ministry of the Environment, 2011a.)

Finland is following the targets set by the EU for reducing greenhouse gas emissions by 20% by 2020 from the 1990 level. Finland moreover strives for a total 80% reduction in emissions by 2050 (Government of Finland, 2009). CCS is discussed as one possible solution in mitigating the emissions in the future, when other solutions are thought to consist of energy efficiency and renewables (Government of Finland, 2009; see also Government of Finland, 2008, p.49). CCS

technology is predicted to be commercially available after 2020. The reduction of greenhouse gas emissions is divided among different sectors according to the EU Emission Trading Scheme (ETS). Teir et al. (2011b), for example, stress that the price of the emissions allowances in the ETS is a critical factor for the utilisation of CCS in Finland. The prices for the emission allowances should also be predictable in the long-term in order to enhance investments in the technology in the industry sector. (Teir et al., 2011). National shifts in energy policy may also influence the development of CCS. It has been stated, for example, that the Finnish decision to increase nuclear power production will affect the willingness to invest in other energy technologies. The decision of the Finnish government to raise the taxation on fossil fuel will also have an effect as a decrease in investment on energy technology in the fossil fuel market. If the legislation of emission allowances changes in the future, also allowing negative emissions, the situation for CCS might change. Then CO2 capture from wood and bioenergy could also become cost-effective for CCS. (Teir et al., 2011a, p.18–21.)

Perhaps due to the current situation of the technology in Finland the public discussion of CCS is likewise not active. According to a survey of the Special Eurobarometer conducted in 2011, awareness of CCS is low in Finland but also in other countries, with the exception of the Netherlands, where 52% of the respondents stated that they had heard of CCS and knew what CCS is (52%) (See Fig. 1.).

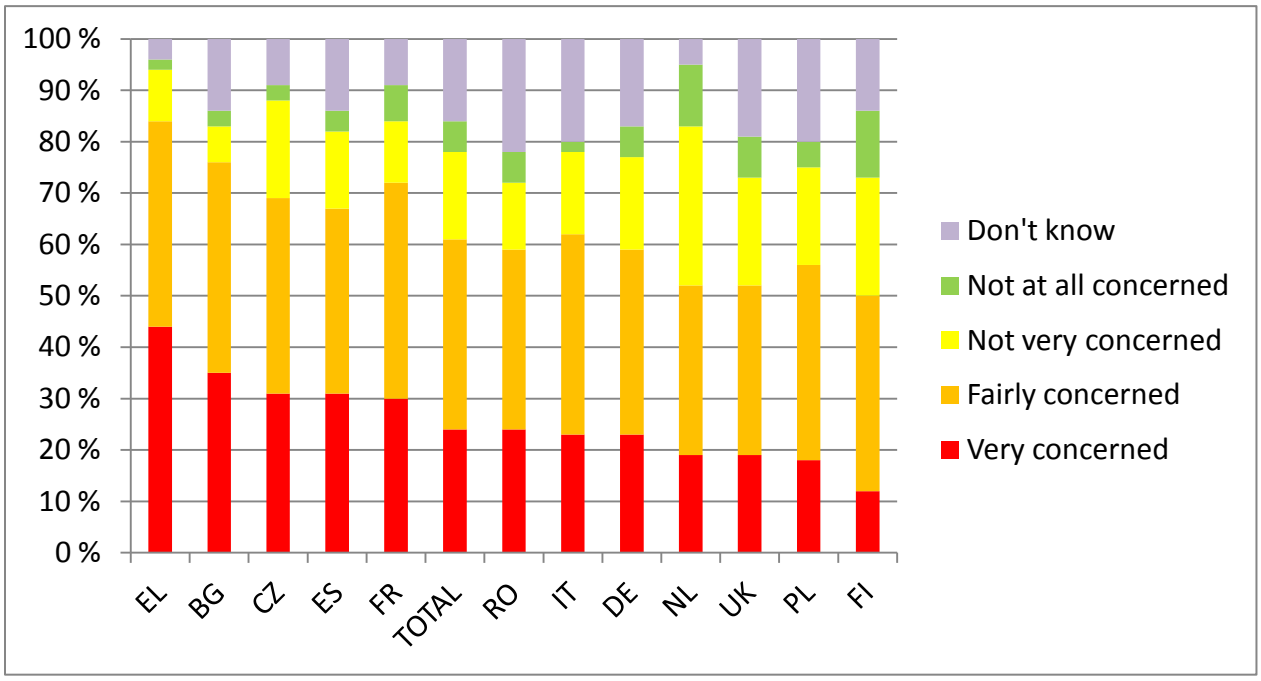
Figure 1. Have you ever heard of CO2 capture and storage, also known as carbon capture and storage or carbon capture and sequestration (CCS)?



Source: Special Eurobarometer, 2011, p.74, QE9.

Only 12% of the respondents in Finland thought they knew or understood what CCS is, still placing the Finns among the third most aware of the technology. According to the same survey the Finns are not very concerned about the risks of CCS. When in other countries storage, for example, could be an issue which raises some level of concern, in Finland 36% of the respondents said that they would not be concerned if a deep underground site were situated near their home, 12% said they would be very concerned and 38% fairly concerned (See Fig. 2.). Possible effects on the environment and health, as well as leaks during the operation of the site, were overall seen as most worrying in all countries. Transportation of CO2 also raised concerns. (Special Eurobarometer, 2011, p.75, p. 92.)

Figure 2. If a deep underground storage site for CO2 were to be located within 5 km of your home, do you think that you would be...?



Source: Special Eurobarometer, 2011, p. 91, QE16.

The results from a local survey were mainly congruous with the results of the Special Eurobarometer. According to a survey made during the Environmental Impact Assessment of the CCS project in Meri-Pori, local residents were asked about their views on the project. The results showed that the project in itself did not raise very many local concerns. One explanation could be that the power plant is already located in an industrial area. The plan was also to transport the captured CO2 abroad, thus the project did not include any local geological storage, which obviously influenced the attitudes. The greatest worries regarded increased volume in traffic in the area. The results also showed that unawareness of the project was quite high, especially when respondents were asked to assess risks. According to the survey 40–50% of the respondents were not able to take a stand on questions regarding risks in different

stages of the process. (Fortum, 2010, p.78–86.) Unawareness can often be one important factor when discussing acceptability, since people find it hard to relate to projects that they have no information on. Acceptability could, for example, be likened to the attitudes against different energy products, whereas Finns are very suspicious of using coal (Kiljunen, 2011). This may have an effect if investments in fossil energy production are increased due to CCS technology.

3. The framework for studying social acceptability from the viewpoint of stakeholders

Public acceptance and acceptability have been actively discussed in relation to different technologies – CCS among them – in recent years not only by the industrial actors interested in advancing the technology (e.g. Chrysostomidis et al., 2012; CCSA, 2011) but also by scholars (e.g. Huijts et al., 2007; van Alphen et al., 2007; Shackley et al., 2009; Terwel et al., 2011). One reason for being in the focus of attention is seen to be the lack of progress in the commercialization of technologies. For example, Gupta et al. (2011) note that public opposition to (controversial) technologies has frequently resulted in negative consequences for their commercialization. Unforeseen events and accidents affecting the public have resulted in fear and reluctance to adopt certain technologies and also in consumer rejection of the products of these technologies. These negative consequences have served to emphasize the importance of public acceptance in the strategic development, application and commercialization of technologies. (Gupta et al., 2011, p.2.)

In light of an analysis[9] of nearly 300 papers in social psychology and risk perception aimed at presenting an overview of the socio-psychological determinants of relevance to understanding public acceptance of technologies, Gupta et al. (2011) report a steady rise in the number of publications and determinants investigated that are found to impact acceptance. The authors further note that most of the research has been carried out in North America and North-West

[9] Their main research question was to identify which socio-psychological determinants of public acceptance of technology have been studied in the social science literature in the field of social psychology and risk perception (Gupta et al., 2011). Technologies covered were as follows: nuclear power, genetic modification, information and communication technology (ICT), pesticides, genomics, cloning, mobile phones, hydrogen power, nanotechnology and radio frequency identification technology (RFID). Articles focused on CCS technology were not included in the paper.

Europe and furthermore, "… research into public acceptance of new technologies has tended to occur post-commercialization when public concerns have begun to arise". (Gupta et al., 2011, p.9.) However, they state that there is an indication of "a shift in focus on public acceptance of technologies, from *post hoc* studies to a more proactive effort to identify public opinions and values prior to commercialization" (Gupta et al., 2011, p.9.) which is an example of examination of "society-technology" interaction.

Gupta et al. (2011) concluded that the models[10] used to predict public acceptance are becoming more complex, by adding, rather than replacing determinants. They coded altogether 31 determinants of technology acceptance. "Classical" determinants (such as risk perception, benefit perception, trust, knowledge, attitude, negative impact, individual differences) are part of research designs continuously, but some "new" determinants (such as heuristics, concern, risk assessment, positive impact, positive value) are also rising. Interestingly, the perceived risk was found to be the most frequently investigated determinant and cited more often than perceived benefits (Gupta et al., 2011, p.5, p.7–8, p.10.)

Wüstenhagen, Wolsink and Bürer (2007, p. 2684) note that social acceptance is an often used term in the practical policy literature, but clear definitions are rarely given. The terms (public) acceptance and (public) acceptability have also been used frequently and extensively in relation to CCS technology, but they are not defined rigorously or the terms are used interchangeably. A number of other terms (such as public support, public perception, public engagement, risk analysis, risk communication) have also been reported to be used interchangeably with public

[10] One example of the models introduced in the field of CCS is by Tokushige et al. (2007). In explaining acceptance of CO2 geological storage Tokushige et al. (2007, p.107, 110) have introduced a model consisting of five main factors: risk perception, benefit perception, trust and two perceptions relating to human interference with the environment.

acceptance and public acceptability (Greenberg and Gauvreau, 2010). Wüstenhagen, Wolsink and Bürer (2007) contribute to the discussion by distinguishing three dimensions of social acceptance based on the analysis of renewable energy innovations. The dimensions included in their conceptualization are as follows:

- **Socio-political acceptance**, which is the broadest, most general level. It refers to acceptance of technologies and policies by the public, the key stakeholders and policymakers.
- **Community acceptance,** which refers to the specific acceptance of siting decisions and projects by local stakeholders, particularly residents and local authorities. The focus is on procedural and distributional justice and trust.
- **Market acceptance,** which in a wider understanding of market acceptance, refers not just to consumers, but also to investors and the intra-firm situation. (Wüstenhagen et al., 2007.)

In this Report we understand *social acceptability* as a term consisting of different thematic dimensions whose priority is subject to constant societal debate and negotiation between the policymakers and the stakeholders. Thus we adopted the categorization of dimensions from Wüstenhagen et al. (2007) but instead of acceptance, which is the term used by Wüstenhagen and his colleagues we refer to Wolfe, Bjornstad, Russell and Kerchner, who make a distinction between technology acceptability and technology acceptance. Wolfe et al. define acceptability as "the willingness to consider the technology in question as a viable alternative" (Wolfe et al., 2002, p.140) whereas as acceptance refers to the decision to deploy, i.e. to "the formal decision

to implement the proposal" (Flynn, 2007, p.16). As evidence of acceptability they see willingness to negotiate about a technology which may be conditioned by different kinds of concerns. They therefore perceive their approach as a process rather than being outcomes oriented. Acceptability is seen as a continuum, not a dichotomy (Wolfe et al., 2002, p.140). Part of process-like nature of acceptability is that acceptability may change over time, positively and negatively. Acceptability as a social process, in which actors influence each other through various types of interaction, is also emphasized by Huijts et al. (2007, p.2780). The importance of context and considerations of alternatives have also been noted by Shackley et al. (2009). They summarize that

> "*the eventual acceptance of CCS as part of a portfolio of options is likely to depend on the awareness and perceptions of CCS as well as upon the perceived urgency and challenges of addressing climate change more broadly. (…) Public and stakeholder perceptions of CCS will therefore be affected by the level of concern over energy security, climate change and electricity prices, as well as how it is perceived in relation to other generation technologies.*" (Shackley et al., 2009, p.355.)

Thus, in defining acceptance and acceptability "willingness to consider the technology seriously" has been related to acceptance, too.

According to Flynn (2007, p.16–17) for Wolfe et al. acceptability deals with the extent to which the technology conforms with social values and norms "sufficiently well to be placed on the table as a viable alternative to other technologies". Thus, a technology may be technically feasible but not meet the test of social acceptability. This suggests that there is an easy and clear separation of 'technical' and 'social', but one must remember that there are differing

perceptions of technology, its maturity and its feasibility. For example, in the field of Science and Technology Studies it is noted that 'technical' and 'social' are entangled.

In the literature acceptance refers both to individual and community level. Shindler et al. note (by originally citing Brunson, 1996) that, in the long run, it may be more useful to refer to individual social-psychological process as leading to judgments of acceptability. Brunson reasons that judgments are made at the individual level but evolve in response to a host of factors; e.g., a person's evaluation is susceptible to the influence of others around him or her, which in turn also provides an impetus for group behaviours. Thus they argue that the term "social acceptability" could be reserved for references to some aggregate form of public consent whereby judgments are shared and articulated by an identifiable and politically relevant segment of the citizenry. (Shindler et al., 2002, p.4.) It could therefore be argued that at least two basic lines of studying acceptance can be identified: (1) the individual level and (2) the community level.

Continuity and level of community are also present in the definition by Huijts et al. (2007). For them "social acceptance is not just a matter of individual feelings and perceived risks and benefits, but predominantly [it] is a social process" (Huijts et al., 2007, p. 2780). They note that actors influence each other through various types of interaction. Public acceptance may depend on the views and information made available, often through the media, from professionally involved actors, such as the government and NGOs. They state that it may be difficult for laymen to understand, select and process this information well and to form balanced personal views on the technology. Huijts et al. conclude that people must therefore rely on others,

making trust an important factor of social acceptance. (Huijts et al., 2007, p. 2781; see also Tokushige et al, 2007.)

One starting point for studying acceptance/acceptability is to make a distinction between different actors of the field, for example between the lay public and stakeholders (van Alphen et al., 2007) or very similarly between the professionally involved actors (experts) and lay citizens (Huijts et al., 2007). van Alphen et al. (2007) define stakeholders as agents with a professional interest in CCS. Stakeholders include industry, non-governmental organizations (NGOs), governments and research institutions. This categorization is also applied in this study (See Chapter 4). Likewise Shackley et al. (2009) distinguish between 'stakeholders' – who have a professional and/or work-related interest in CCS – and the 'public' who do not have such an interest. According to van Alphen et al. (2007, p.4369) the issues concerning CCS are quite different for the lay public compared to the stakeholders. They explain the difference from actors' interests (or absence of interests). The stakeholders nearly always have a defined agenda or set of preferred policy objectives in mind when evaluating CCS, whereas the lay public does not have an *a priori* viewpoint (van Alphen et al., 2007, p.4369.)

Thus studies on the acceptance and acceptability of CCS can be categorized into those focused on public attitudes and those focused on stakeholder perception although there are also studies which have these both elements (Huijts et al., 2007). Studies on public attitudes are commonly based on surveys (e.g. Miller et al., 2007; Tokushige et al., 2007; Ha-Duong et al., 2009) although qualitative methods have also been applied e.g. in in-depth interviews (Wallquist et al., 2009) and focus groups (Oltra et al., 2010) to analyse lay people's acceptance and perception of CCS. Studies focused on stakeholders have used both surveys (Shackley et al.,

2009; Johnsson et al., 2010; Sala and Oltra, 2011) and different interview methods (a stakeholder workshop by van Alphen et al., 2007; open-ended interviews by Hansson and Bryngelsson, 2009).

Public surveys have been criticized for being ill-suited to examine opinions about CCS, because public awareness and knowledge of CCS have been found to be low. de Best-Waldhober et al. (2009, p.323) note that a possible low awareness of CCS makes measuring attitudes towards CCS rather tricky as a significant part of the respondents that has no knowledge of CCS may respond with ‘‘pseudo-opinions’’ or ‘‘non-attitudes’’ instead of refraining from giving their opinion. These “non-attitudes” have been seen as unstable and susceptible to influence and attitudes expressed by stakeholders (see Terwel et al., 2011). Terwel et al. (2011, p.182) note that while traditional surveys may not be the best tool to examine public opinions about CCS, they can be employed to assess levels of public knowledge and awareness of CCS and to identify information needs and public concerns regarding CCS.

This study focused on Finnish stakeholders to learn their opinions regarding CCS as there is already some information available about public attitudes to CCS in Finland (the Special Eurobarometer, 2011; see also Finnish Energy Attitudes, 2009) and as the surveys indicate that public awareness is at a rather low level in Finland, too.

The focus of the study can be argued by the central role of stakeholders both in policymaking and in public debate and opinion building. van Alphen et al. argue that (2007, p.4369) stakeholders can play a double role in the development of CCS technology. Firstly, stakeholders have a direct influence on the implementation of CCS projects and presumably also much better chances to influence policymaking compared to lay people. However, it should be noted

that there are also differences between the stakeholders, e.g. in forms of resources they can apply. Secondly, stakeholders can indirectly influence the deployment of CCS because of their ability to shape the public opinion. (van Alphen et al., 2007,p.4369.) In shaping public opinion the role of media and the portrayal of CCS have also been discussed and analysed (Buhr and Hansson, 2011; Buhr and Buhr, 2010; Huijts et al., 2007).

4. Method of Interview

The Report is based on interviews with twelve Finnish stakeholders representing industry, the authorities, NGOs and a research organization (Appendix 1). The interviewees were selected based on

(1) stakeholders' statements on the implementation of the Directive on the geological disposal of CO2,

(2) researcher's own consideration and

(3) interview feedback.

The stakeholder statements were collected by the Ministry of the Environment in Finland in 2011, when 27 stakeholders were asked to comment on the Finnish implementation of the CCS Directive (2009/31/EY) (Ministry of the Environment, 2011b). The list of the Ministry helped to identify the potential Finnish stakeholders, whereas the researcher's own consideration was used to confine the number of interviewees after reading the statements. At the end of each interview the interviewee was asked to recommend additional stakeholders who should be interviewed for the study. The question was asked to make sure that all potential stakeholders were identified and also to get an external idea as to which stakeholders were perceived by the interviewees to be the key actors. Altogether over 40 stakeholders were recommended by the interviewees. In Appendix 2 all recommended stakeholders are listed. Furthermore, the numbers of times they were recommended are given. Of these the Ministry of Employment and the Economy (MEE) and the Ministry of the Environment (ME) were the most frequently mentioned actors. However, they were both mentioned only four times. The Energy Market

Authority was the only actor interviewed which was not recommended by any of the interviewees. Otherwise the recommendations were quite evenly divided (from one to four mentions by one stakeholder), which could be seen to indicate that there is not just one key stakeholder on Finnish CCS issues above all others. Interestingly both political decision-makers and laypeople were recommended only once, which could be seen as an indication of expert driven issue.

The requests for an interview were either sent by email directly to a certain person in an organization if she or he was known to be involved in CCS issues or to a managerial level person with a request to redirect the request to the person responsible for CCS issues in the organization. None of the stakeholders that were asked to give an interview regarding CCS issues in Finland refused.

The first interviews were conducted in November 2011 and the last one in January 2012. The first author of the report conducted all twelve interviews. The length of an interview varied a quite lot, as the shortest one lasted about 45 minutes and the longest one almost one hour and 40 minutes. The length of a transcribed interview varied from nine to nineteen pages (from ~22000 to ~68000 characters with spaces). Transcriptions were done by Eeva Innola M.A. and Anna Nurmi M.Sc.

The method of the interview was based on semi-structured interview (Hirsjärvi and Hurme, 2000). The request for an interview was attached with the Factsheet of the Carbon Capture and Storage Program (CCSP, 2011). The sheet was the only piece of advance information on CCS technology the interviewees were provided with by the researchers. Thus very modest pre-informing took place (cf. de Best-Waldhober et al. 2009; Wallquist et al. 2010; Wallquist et al.,

2012) as the idea was to study stakeholders' current opinions about CCS technology. In practice, the CCSP Factsheet information served more as an introduction of the CCSP for the interviewees as not all of them knew the research programme beforehand.

The main research questions were the same for all the stakeholders, but some additional questions and amplifications were requested depending on the responses. The interview consisted of four parts which were as follows: (1) warm up and background of the interviewee, (2), main questions, (3) specific themes, and (4) recommendations for additional interviewees.

The analysis of the transcribed interviews was done by content analysis in where 'an expression of concern' was used as a unit of analysis. An expression of concern was defined as an expression of criticality, uncertainty, risk, threat, concern, challenge, problem or fear by a stakeholder due the main questions in the interview. The analysis covered the responses to the main questions, but not the specific themes in which structured themes regarding CCS were asked. One of the main open-ended questions was "What are the major concerns regarding CCS technology in Finland?" This exclusion was done in order to better understand the authentic concerns of the stakeholders interviewed. Inclusion of the responses in the specific themes in the analysis could possibly have biased the typology of concerns. Stakeholder concerns were classified into three main categories based on the typology by Wüstenhagen et al. (2007) (See Chapter 3). Thus the main categorization was theory oriented, whereas sub-categorization was empirically oriented. As a result the typology of stakeholder concerns was defined (See Table 1.). Concerns regarding CCS have also been categorized e.g. by Oltra et al. (2010) and Wallquist et al. (2009).

Table 1. Typology of the stakeholder concerns regarding CCS in Finland.

SOCIO-POLITICAL DIMENSION

- Policy and regulation
- Technology and technological development
- Storage of CO2
- Environmental and health hazards and risks
- Moral issues

MARKET DIMENSION

- Costs, cost efficiency and profitability
- Investment, investment risk and public subsidies

COMMUNITY DIMENSION

- Local impacts
- Local awareness

It is important to note that not all concerns necessarily have a negative meaning, i.e. there would be negative position on CCS technology behind a concern. In the interviews the representatives were asked if the organization they represented had a position on CCS (cf. Shackley et al., 2007, p. 5094–5095). Very few had one, but then the interviewees were asked to describe the stance of the organization towards CCS technology. Based on the information received the stakeholders were categorized into three groups: critical, neutral and positive (See Table 2.).

Table 2. Position of the organization towards CCS technology (based on the author's interpretation).

Critical	**Neutral**	**Positive**
Finnish Association for Nature Conservation (FANC), Greenpeace Nordic (GP), World Wild Life Fund Finland (WWF)	Energy Market Authority (EMA), The Ministry of Employment and the Economy (MEE), The Ministry of the Environment (ME), City of Raahe, the Local Environmental Protection Authority (Raahe) The Technical Research Centre of Finland (VTT)	The Confederation of Finnish Industries (CFI), The Finnish Energy Industries (FEI), Fortum Power and Heat Oy (Fortum), Helsingin Energia (HELEN).

All the environmental NGOs, interviewed, the Finnish Association for Nature Conservation (FANC), Greenpeace Nordic (GP) and the World Wild Life Fund (WWF), reported that they were either critical, skeptical or reserved. The Council of FANC had decided on the energy and climate policy messages on 28 November 2009 first aiming in 2030–2050 at a CO2 neutral society and then by 2050 at a carbon negative society (FANC, 2009). The main argument regarding CCS was that CCS does not provide a quick solution to climate change as the technology is undeveloped and economically unprofitable for large scale deployment. FANC argued that CCS might be used to legitimate burning of fossil fuels in the future. Furthermore, CCS could impair energy efficiency and prevent the market entrance of the technologies increasing the share of renewables. However, the FANC policy paper stated that in the long run CCS would be needed. Thus, new energy production plants should not be built without CCS

readiness. CO2 capture was also seen to be needed in bio-energy plants which would mean capturing of CO2 from the atmosphere. (FANC, 2009).

The position of WWF Finland was based on the WWF statement regarding the national implementation of the CCS Directive. According to WWF, the deployment of CCS technology will be nonexistent or marginal in the Finnish context. WWF is against building new coal-fired power plants and recommends an amendment to the legislation forcing the phasing out of all the Finnish coal fired plants still in operation or equipping the plants with CCS technology by 2020. As a requirement for licencing new condensate power plants, it was presented that they should be already equipped with environmentally sustainable CCS technology in the construction phase. Due to impaired energy efficiency WWF concluded that CCS technology should be considerably improved before it is profitable in applying in combined heat and power (CHP) production plants. In the event of improved technology, there is, according to WWF, a possibility to combine CCS technology with bio-energy CHP production. (WWF Finland, 2011.) In the case of Greenpeace the stand was based on the organization's international report (Greenpeace International, 2008), thus it was not country-specific. The main arguments of Greenpeace are that CCS cannot deliver in time to avoid climate change, that it wastes energy, that storing carbon underground is risky, that CCS is expensive and carries significant liability risks (Greenpeace International, 2008, p.5). These all were interpreted as critical positions towards CCS.

As positive were interpreted the Confederation of Finnish Industries (CFI), the Finnish Energy Industries (FEI), Fortum Power and Heat Oy (Fortum) and Helsingin Energia (HELEN). The representative of the CFI described the position as positive in general regarding the reduction

of greenhouse gases. The representative of the Energy Industries reported that the organization had an energy future vision which includes use of fossil fuels. Thus, CCS was seen as unavoidable, and even decisive regarding climate change (See also The Finnish Energy Industries, 2010). According to the representative of Fortum, CCS was seen as one possible path towards lower emissions in the large scale energy production (See also Fortum, 2009a; 2009b). However, the focus of interest of the company is on global and EU level, not on Finland. HELEN as a shareholder of the power company Teollisuuden Voima took part in the Meri-Pori Retro-fit project. Furthermore, the company planned deployment of CCS in the Vuosaari multi-fuel power plant approximately in 2030. (HELEN, 2010, p.12, 21.)

The other five stakeholders, Energy Market Authority (EMA), The Ministry of Employment and the Economy (MEE), The Ministry of the Environment (ME), the Local Environmental Protection Authority of Raahe and the Technical Research Centre of Finland (VTT), were categorized as neutral in relation to CCS technology.

5. Results

5.1. The Socio-political dimension

5.1.1 Policy and regulation

The concerns categorized as policy and regulation issues were related to legislation, agreements and regulations or the absence of these. As CCS technology is still in the development phase, agreements and regulation in the field are either missing or were deemed incomplete. Predictability and continuity were regarded as important features of CCS policy. A need for predictability was seen at both at the international and national level.

Uncertainty related to climate policy and emissions trading, which impacts greatly on the development of CCS policy, was mentioned. The representative of the Technical Research Centre considered the time schedules of climate targets and whether there will be a global climate agreement or European regulation only. The issue was how large the market would be under coherent regulations. Would the EU remain as one market area or could there be a global climate protocol?

Both the representative of the Energy Market Authority and the energy industry stated that continuity was needed as energy production facilities are long-term investments, thus the system should be predictable. Otherwise it would make already multifaceted investment decisions even more complicated.

The representative of the Energy Market Authority was also concerned about the incomplete regulation of CCS export. The interviewee noted that ship transportations, which are deemed essential for implementation in Finland (see Teir, et al.2011), are an unregulated issue. At the

moment it is unclear which authority would supervise a ship with a CO2 cargo when she departs from a Finnish harbour and travels outside Finnish territorial waters.

International co-operation and agreements were seen as vital for creating confidence on CCS application. The representative of the Finnish Technical Research Centre stated that "at least some kind of an international system is needed … As we are talking about really long time periods … . I believe that it [storing of CO2] would be easier to accept if there was international control" (translation by the author). Representatives of the energy industry also required agreements on storage site, price level and responsibilities before any CO2 capture could take place.

NGOs were concerned about the CCS lobby. Lobbying as such was seen as inevitable in relation to any technology with interests, but the threat in lobbying was that the technology might become more important than the goals which it is intended to achieve with the technology. Instead of the deployment of CCS in Finland representatives of NGOs required stronger policy commitment on renewables.

One interesting feature in policy issues was the question about the future of peat and CCS. CCS technology was described as the last lifeline of the peat industry as it attempts to gain acceptance for peat. The NGOs feared that with the help of CCS technology there would be more arguments that peat could be used as much as one wants to. The NGOs pointed out that all the environmental problems in the production of peat, i.e. impacts on water systems, destroying marshes and their natural values, would still remain.

5.1.2 Technology and technological development

The main arguments of the subcategory relate to (1) Uncertainty of CCS technology, (2) declined energy efficiency due to CCS and (3) path dependency. Uncertainty of CCS technology in general, as was raised especially by the representatives of NGOs. The representative of FANC stated that CCS is "hopelessly slow new technology and it's technically undeveloped and economically still so expensive that it cannot be a short-term solution for this" (translation by the author). There was a common suspicion that, regardless of all promised emission reductions, CCS technology could miss them and be merely support for the continuation of the coal industry. One reason for skepticism was the huge amounts of gas which should be processed and stored. So far end of pipeline technology has focused on capturing secondary subjects (such as sulphur) out of flue gas but now the aim would be completely different in scale. Declining energy efficiency was the most general unwanted issue in relation to CCS. This issue was raised both by the representatives NGOs, energy industry and authorities.

The development of technology and its relation to regulation was also raised as an issue. The concern was that if the development and preparation of regulations and legislation were based only on certain kind of CCS technology, this might hinder innovations and the development of new kinds of technologies as the technology developers might be given a signal that new technologies are not involved in emissions trading. Thus the interviewee feared a kind of path dependency due to too narrow definitions and lack of incentives for further technology development.

5.1.3 Storage of CO2

The major issue among the stakeholders interviewed was the absence of storage for captured CO2 in Finland. The absence was seen as a threshold with many implications. Firstly, it prevents the full-scale application of CCS technology in Finland as only CO2 capture, transportation and temporary storage are possible. Secondly, the absence of Finnish storage facilities requires that the Finnish actors join in an international storage project or plan if they wish to move forward. Thirdly, it slows down development and the application of CCS technology in Finland, as actors in other countries are able to implement demonstration projects more quickly.

One interviewee commented from an ethical point of view on the Government's proposal for CCS legislation prohibiting the storing of CO2 in Finland. The point was that if the State prohibits storing in Finland how could it be acceptable to store CO2 captured in Finland in another country? The interviewee thought that this might give a negative signal on the State's attitude to CCS.

A representative of the energy industry also raised a political concern – as he called it – related to storage. He contemplated whether the Finnish politicians and authorities had enough confidence that implementation was technically feasible.

5.1.4 Environmental and health hazards and risks

It was possible to identify three different types of concerns regarding the environmental risks of CCS. These three concerns were: (1) leakage, (2) effects on climate change and (3) transportation.

Most interviewees commented on leakage concerns, where the thought basically was that the CO2 would leak from the container or during transfer. Leakage was seen as a health hazard for those near the possible leakage area. Comments about a giant bubble that would displace oxygen were made. The possibility of leakage was also seen as a risk such that efforts at carbon capture would be useless, if it would in any case leak out somewhere.

The NGOs were skeptical about the usefulness of CCS technology. The NGOs saw a problem in the adaption of CCS technology in the sense that it might hinder or delay the efforts at climate change. The technology was seen to develop so slowly that other methods should be emphasized now. By focusing on the development of CCS technology it was thought that the development of renewables would suffer and it would be very harmful for the environment.

Transportation of CCS was seen to possibly cause environmental risk during ship transport because of leakage, but also because of an increase in traffic. If a pipe system were to be the mode of transportation, the construction of the pipes might also harm the environment.

5.1.5 Moral issues

Moral aspects were also touched on in the interviews. A representative of the authority raised a question if it is morally right to export captured CO2 elsewhere as it is produced in Finland. He equated this with the transportation of waste across borders. A representative of an NGO raised the moral aspect as she interpreted CCS technology as support for coal burning, which increases the demand of coal and thus coal mining, which, according to her, could in the worst case be pretty immoral places of work.

5.2. The market dimension

5.2.1 Costs, cost efficiency, profitability

Costs related to the application of CCS in Finland were a major concern for the stakeholders. Above all were the transportation costs of CO2 and impaired energy efficiency. As according to current knowledge there is no suitable geological formation for storing CO2 in Finland, captured CO2 should be transported e.g. to the North Sea by pipeline or by ships. (see Teir et al., 2009.) Sea transportation of CO2 as such was not seen as a major problem, although increased risk of ship accidents was mentioned. The main point was the huge volumes and ensuing costs. As the representative of a research organization argued

> *"… from the perspective of economic profitability we are in the backwoods … capabilities for storing CO2 are essentially weaker as our bedrock is different from elsewhere … meaning that in the first place this is not an optimal location [for a CCS facility]"*
> (Representative of the Finnish Technical Research Centre, translation by the author)

The representatives of the authorities noted that the whole idea of emissions trading is to steer emission reduction measures to those measures that are the most cost-efficient. From this perspective it was deemed good if CCS measures were also available for Finnish industry. Another authority was slightly concerned about the over-confidence of certain actors – especially those (sitting) in Brussels – regarding declining costs of CCS technology in the future. The interviewee thought that measures related to CCS had been within reasonable bounds in Finland. According to the interviewee there was no problem with the development of CCS and he hoped the technology would be near to commercialization by 2025, but as far as it is much

more expensive than other measures, one should not invest in it too much, which, according to the interviewee, would be a waste of money. It was also feared that costs due to deployment of CCS would be perceived as an extra burden by laypeople, which could decrease the acceptance of climate policy.

5.2.2 Investment, investment risk and public subsidies

Stakeholders' attitudes towards the investments needed for CCS were classified into three categories:

(1) Negative and critical attitudes against investing in CCS above all. This includes both investments in implementation and in R&D funding. The main concern behind this was that investments in CCS development could displace limited investments in other mitigation measures seen more efficient and sustainable than CCS.

(2) Investment in CCS only on market terms, meaning that an investor should have a chance to choose between feasible options. This attitude excluded any major public investments in CCS as the financial situation was deemed so bad.

(3) The third attitude was a concern about national means to arrange and share the investment risks in CCS.

A representative of an NGO expressed the fear that if companies invest in CCS technology they would have less resources for investing in energy efficiency and renewables. This would mean a continuation of business-as-usual and thus energy production based on fossil fuels. This is a frequent concern in relation to the CCS debate. In relation to public R&D funding the

representatives of NGOs interviewed had adopted slightly different lines as the representatives of the FANC and WWF were more critical, whereas the representative of Greenpeace was of the opinion that the amount of public R&D funding was of minor importance and that it was important that different measures are studied.

> *"If research and development input is focused on CCS then there is a great risk that renewable energy and energy efficiency will be excluded and there is a clear connection."*
>
> (representative of WWF, translation by the author)

On the other hand, a representative of a state authority did not share this concern. The argument was that as long as the investment were made by the company and based on market action in which one has the option for emission trade, nobody should have any objections. The representative was very convinced that the state would not be able to afford the development of CCS technology. The development of the technology was considered expensive and the discontinuation of the Meri-Pori retro-fit CCS facility was taken as an example of high costs which a company was also unwilling to pay. Thus, technology development should be based on others' funding. Investment risks in CCS technology were also considered high by the representative of a research organization. The major concern of the representative was the absence of national investment measures or a national investor capable of bearing the high risk. The Finnish subsidy policy for smaller scale R&D was appreciated but concern related to the large investment risks. The Finnish energy market without a state owned energy company which could take this kind of risks was compared in general to other countries with this possibility. Although this concern was expressed, the representative noted that the Finnish energy market is as a deregulated market in which all energy forms compete against each other

in economic terms. The representative also stated that the boiler manufacturers working in Finland are at a great advantage for CCS related R&D in Finland. The representative of the Ministry of Employment and the Economy had a different view on the home (national) market and CCS as he noted that there were no guarantees that CCS technology suppliers would be Finnish if it is compared with the case of biofuels.

5.3. The community dimension

5.3.1 Local impacts

It was surprising how few comments the stakeholders made regarding the community dimension. As local impacts, pipelines (land use), increased transportation, milieu and CO2 leakages with severe health impacts were mentioned. The stakeholders seemed to share the view that a possible CCS facility would be inbuilt as part of an existing industrial facility thus there would be fewer problems with fitting in. For example, the representative of the FANC thought that the technology would never be very profitable, and thus the possible new facilities would be located on the coastline to avoid building costly pipelines.

The stakeholders were surprisingly optimistic, as they saw almost no local problems in the deployment of CCS technology in Finland. The findings might reflect the Finnish pragmatic attitude towards new technology and a kind of an aquiescent tolerance, but the reader must pay attention to the fact that in Finland not a single CO2 storage siting process has been implemented so far. Neither has there been discussion on the option.

The reader should also note that only one of the twelve interviewees represented an organization which acts mostly at the local level. The others represented more or less the 'higher' national or policy level. The improbability and temporal remoteness of any application of CCS technology might also have affected concerns.

5.3.2 Local awareness

The sub-category reflects both the problem of storing CO2 and the difficulty of gaining local acceptance and at the same time the awareness and capability of local residents to take into account general principles and equality questions. A good example is that the representatives of the City of Raahe perceived that in a licencing process the local residents would be interested in ensuring that the rights of people living near the storage site would not be violated.

However, local awareness was also described ironically as one interviewee pointed out that local awareness could be described as a general attitude of "as far as the loader and the crane are not hanging over my backyard, people will feel pretty safe" (representative of City of Raahe, translation by the author). This duality can be seen as reflecting the diverse local opinions on new technological projects. There are divergent local opinions.

6. Summary

The objective of the Report was tripartite. Firstly, to map the latest theoretical approaches regarding social acceptance and acceptability of CCS technology. Secondly, to identify the Finnish key actors in relation to CCS issue. Thirdly, to map the spectrum of issues related to the acceptability of CCS in the Finnish context.

The findings of the literature review concerning CCS and acceptance were presented as a framework for the study (See Chapter 3). In the Report *social acceptability* is understood as a term consisting of different thematic dimensions, its priority being constantly subject to societal debate and negotiation between the policymakers and the stakeholders. The social acceptability of technology is important as successful development, implementation, deployment and operation of technology is dependent on wider societal values and norms. In practice social acceptance is often studied by surveys focused on laypeople and/or some selected stakeholders. Different interview methods are also applied. Semi-structured interview was selected as a method because it made it possible to ask clarifying questions which were deemed essential in a study aimed at mapping issues related to a relatively new and rarely discussed technology.

The Finnish key actors in relation to the CCS issue were identified by first reviewing stakeholder statements concerning the national implementation of the CCS directive. Then the researchers' own judgement was used to narrow down the number of interviewees. Altogether 12 stakeholders representing the energy industry, NGOs, the authorities and a research organization were interviewed in November 2011 and January 2012 (See Appendix 1.). In order to ensure that all significant stakeholders had been identified all the interviewees were asked

to name additional stakeholders for interview (See Appendix 2). The interviews were semi-structured as the main questions were open-ended.

The spectrum of issues related to the acceptability of CCS in the Finnish context was presented in Chapter 5. The concerns were sorted into three main dimensions, namely (1) socio-political, (2) market and (3) community. The main categorization was adopted from Wüstenhagen et al. (2007), but the sub-categories are based on analysis of the interviews. As the organizational position on CCS was elicited the stakeholders and their concerns can be presented as in Table 3.

Table 3. Organisational positions on CCS vs categorization of stakeholder concerns in Finland (based on the author's interpretation).

	DIMENSION								
	Socio-political					**Market**		**Community**	
	Policy and regulation	Techno-logy	Storage	Environ Health	Moral	Costs	Invest-ement	Local impacts	Local awareness
Positive									
CFI	X		X	X		X			
FEI			X			X			X
Fortum	X	X	X						
HELEN		X	X						
Neutral									
EMA	X	X	X	X	X	X		X	
ME	X	X		X		X			
MEE		X	X			X	X		
Raahe								X	X
VTT	X	X		X		X	X		
Critical									
FANC	X	X	X	X			X	X	
Greenpeace	X	X		X		X	X		
WWF		X		X	X		X		X

Industry: Confederation of Finnish Industries (CFI), Finnish Energy Industries (FEI), Fortum Power and Heat Oy (Fortum), Helsingin Energia (HELEN)

Authorities: Energy Market Authority (EMA), Ministry of Employment and the Economy (MEE), Ministry of the Environment (ME), City of Raahe, Local Environment Protection Authority (Raahe)

NGOs: Finnish Association for Nature Conservation (FANC), Greenpeace Nordic (GP), World Wild Life Fund Finland (WWF)

Research organization: The Technical Research Centre of Finland (VTT)

Table 3 gives a rough overview of the differences between the 'CCS related concerns' of the Finnish stakeholders. Methodologically all the expressions of stakeholder concerns were identified only from the interviewees' responses to the main open-ended questions in the interviews. No evaluation regarding the importance or priority of any issues for the stakeholders was made. If compared between the dimensions, the stakeholder concerns are focused on the socio-political dimension, which included five sub categories. Of these 'technology and technological development' issues were those most stakeholders mentioned whereas 'moral issues' were considered less frequently. The fact that community dimensions seems to be quite rarely a subject of a stakeholder concern may in part be due to the selection of the stakeholders, where the focus was on national level actors.

When the concerns of the stakeholders with a positive position on CCS are compared to the concerns of those with critical views, it seems that the former are more concerned with issues related to costs, storage of CO2 (absence of storage site) and policy and regulation issues, whereas the latter are concerned with environmental and health issues, investments (reduced investments in renewables due to CCS), public subsidies and technology issues. Thus, the agendas seem to differ as to which should be taken into account when preparing CCS policy or project measures.

Currently CCS technology is not a burning issue in Finland. The stakeholders interviewed stated that they followed the development of the technology at some level, but their main interests are elsewhere. Due to the current energy production mix in Finland, the absence of storage sites in Finland, the high costs and impaired energy efficiency, the deployment of CCS technology was not seen as realistic in the near future. The fact that there are currently no on-

going plans to implement CCS in Finland could offer a chance to be proactive and to give the stakeholders opportunities to exert influence on the framing of CCS policy in Finland. In practice, there could be interaction in relation to energy and climate policymaking but also to research and the development of CCS technology as these studies already began a decade ago.

Although NGOs have taken a critical position on CCS, one should note that e.g. according to FANC CCS technology is needed in the long run (FANC, 2009). However, the acceptance of CCS technology is conditional. For example, safeguarding development and investments in the renewables in energy policy are required. From this perspective the Finnish stakeholder concerns are similar to those expressed in other countries.

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Appendix 1. Finnish CCS stakeholders interviewed.

Industry

Confederation of Finnish Industries (CFI)

Finnish Energy Industries (FEI)

Fortum Power and Heat Oy (Fortum)

Helsingin Energia (HELEN)

Authorities

Energy Market Authority (EMA)

The Ministry of Employment and the Economy (MEE)

The Ministry of the Environment (ME)

City of Raahe, Local Environment Protection Authority (Raahe)

NGOs

Finnish Association for Nature Conservation (FANC)

Greenpeace Nordic (GP)

World Wild Life Fund Finland (WWF)

Research organization

The Technical Research Centre of Finland (VTT)

Appendix 2. The most frequently recommended stakeholders by the interviewees (Total number of recommendations).

Recommended actor	No
NGOs	
Greenpeace	3
Friends of the Earth	3
Finnish Association for Nature Conservation	3
World Wild Life Fund Finland	3
Raahen seudun luonnonystävät	1
NGOs (in general)	2
ENGOs (in general)	1
COMPANIES	
Fortum	3
Ruukki / Rautaruukki	3
industry, energy industry	2
Helsingin Energia	2
Energy companies of the cities, Oulu, Turku Energia	1
peat industry	1
Gasum	1
PVO	1
Neste Oil	1
Foster Wheeler	1
UPM	1
Equipment suppliers	1
RESEARCH	
Technical Research Centre of Finland	3
The Finnish Funding Agency for Technology and Innovation	1
Cleen	1
The Finnish Environment Institute	1
Finnish Institute of Occupational Health	1
Finnish Meteorological Institute	1
Universities of technology	1

Recommended actor	No
MEDIA	
Helsingin Sanomat	1
Finland's national public service broadcasting company, YLE	1
INTEREST GROUPS	
The Confederation of Finnish Industries	2
Finnish Energy Industries	2
Finnish Forest Industries	2
Technology industry	1
Metal Industry	1
Finnish Coal Info / coal users and importers	1
AUTHORITIES	
The Ministry of Employment and the Economy	4
The Ministry of the Environment	4
Centres for Economic Development, Transport and the Environment	2
Centre for Economic Development, Transport and the Environment in North Ostrobothnia	1
Statistics Finland	1
Council of Oulu Region	1
City of Helsinki and its administration	1
Local Environmental Protection Authority	1
The Energy Market Authority	0
POLITICAL PARTIES	
Political decision makers / members of the Environment Committee of Parliament	1
CITIZENS	
Lay-people	1