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Timescapes of CCS projects: is deferring projects and policies just kicking the can down the road?

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Abstract

CCS is considered a transition measure to a completely sustainable energy regime. Nonetheless, in recent years, several projects have been cancelled or postponed. This raises some questions about temporal issues.

This study defines temporal features (i.e. frame, timing, tempo, and duration) for policy making and deployment of large-scale CCS projects. According to this study, it appears that CCS deployment is lagging behind due to institutional inertia and poor temporal fit. Thus, unless significant progress is made in a very few years, CCS will lose ground to other alternatives. Timing should be taken into consideration in every matter of CCS.

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Keywords: CCS; Carbon Capture and Storage; time; temporal; climate change; policymaking; policy; GHG

1. Introduction

Carbon Capture and Storage (CCS) is considered a medium-run strategy for the reduction of CO_2 and dealing with climate change, given the still high cost of renewable energy in combination with deceptively sufficient amounts of fossil fuel. In other words, CCS is a transition measure on the road to a complete sustainable energy regime, because

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from the policymaker's viewpoint (especially those in countries possessing reserves of fossil fuel) this technology is an easy means for sustainable development compared to other options. In addition, IPCC reported that it is not possible to "limit likely warming to below 2°C if bioenergy, CCS, and their combination (BECCS) are limited" [1]. Nonetheless, in recent years, several notable demonstrations, R&D and large-scale projects have been cancelled or postponed, including the "moon-landing[1]" Norwegian CCS project. Although most of the postponements are usually justified tentatively by authorities, it seems many of them are in reality a decision to push the burden to the future. Considering the crucial need to rein in climate change and the fact that the international community did not meet the Kyoto protocol goals, the increasing trends of cancellation and postponement of such projects further complicate this issue. This raises some questions about temporal issues: What is the importance of temporal features in CCS development? If CCS is a medium-run option, how long will this intermediate stage take? How long can a project of medium-run technology be postponed?

This study addresses these questions by focusing on temporal fit, or the "temporal connection between institutions and the biophysical systems" [2], and timescapes or the temporal features that show how time influences the way we deal with political, social and environmental problems [3]. Practical regulations, long-term government strategies, demonstration projects and diffusion of mature technologies all work with different conceptions of time – and not just the length of time it takes to implement something. The duration, order, and tempo of events varies. Each system has its own particular timescape, and sometimes systems are able to connect and work together like cogs in a machine – but not always.

The objectives of this research are to define the frame (i.e. in what time frame? – boundaries, beginning and end), timing (i.e. "when? – synchronization and co-ordination"), tempo (i.e. "at what speed? – pace and rate of change") and duration (i.e. "how long? – extent, temporal distance and horizon") of policy making and implementation of large-scale CCS projects [4].

I compare the timescapes of high-level scenario and road map work and those of project-level cancellations and analyse the similarities and differences between them. The analysis is based on earlier case studies on the experiences of European countries with focus on three cases: Finland, Germany and Norway [5] [6]. I will use the analysis to put forward an argument on mismatches of timescapes and how they are used. Differing timescapes can sometimes hinder action, but can also be a source of creativity and enable success. I identify the characteristics of situations where CCS was able to use mismatched timescapes, and when problems arose.

2. Background

2.1. Global status of CCS

For curbing CO_2 emissions, we need CCS not only because we will continue to rely on fossil fuel in the future according to some scenarios [7], but also because CCS is needed for industries such as cement and steel production. However, currently only 15 large-scale[2] CCS projects are running around the world, with the total capacity for capturing of 28 million tonnes of CO_2 per year [8]. Of those 15 projects, merely four of them utilize geological CO_2 storage (Figure 1). That is a minute amount compared to the IEA CCS scenario of 6000 million tonnes annual CO_2

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[1] http://blogs.nature.com/news/2013/09/norway-scraps-large-scale-carbon-capture-plan.html

[2] According to the definition of the Global CCS Institute, a large-scale CCS project is a project with the capacity for at least 800,000 t CO_2 /year for a coal–based power plant [9].

reduction by 2050 [7]. Viewed in this way, it is vital to speed up the process of CCS deployment in terms of both policy and the technical side.

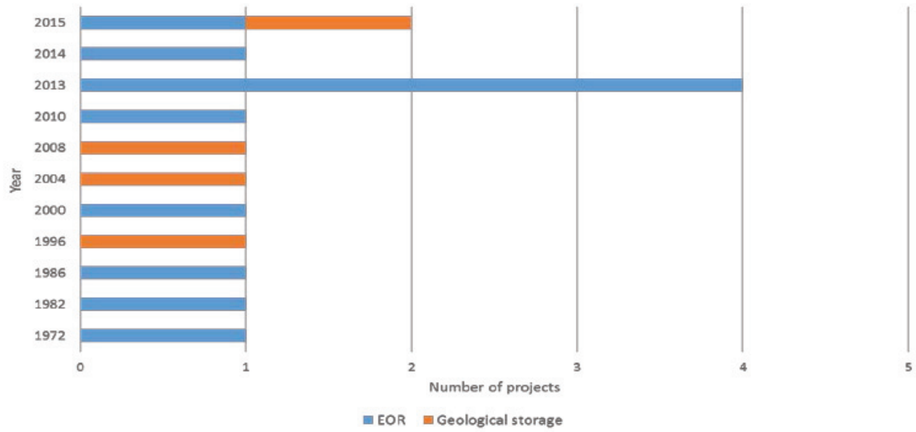

Figure 1 Large-scale operating CCS projects all around the world (data from the Global CCS Institute [9])

2.2. Status of CCS in our case studies

The case studies of this research are Finland, Norway and Germany. In this section I provide an overall image of CCS in these three countries.

2.2.1. Finland

Fossil fuels (42%) and nuclear energy (18.3%) are two major sources of energy in Finland [10]. Although fossil fuels play a major role in the energy mix of Finland, CCS has not drawn the attention of Finnish policymakers and industries yet due to several reasons, among them the lack of potential storage sites. Therefore, the most feasible options would be transporting the captured CO_2 abroad, mainly either to the North Sea or the Barents Sea [11]. Although no active CCS project exists in Finland, some R&D projects in Finland have emerged, such as utilization of CO_2 in mineral carbonation in steel production factories, one of the largest CO_2 sources in Finland [11]. Based on the Eurobarometer survey, 41% of Finnish respondents considered CCS as an effective tool for combating climate change, while 42% did not see it as effective and 17% did not answer. When they were asked if they would be concerned if “a deep underground storage site for CO_2 were to be located within 5 km of your home”, Finnish respondents answered “very concerned” less (12%) compared to the other countries. Finally, just 28% of respondents in Finland expressed interest in being involved directly in the decision-making process regarding implementation of the technology [12].

The only planned CCS project is at the Meri-Pori coal-fired power plant which would capture 1.5 Mt CO_2 annually. That would be about 1.5 % of CO2 emissions in Finland based on 2007 levels [13]. This project was cancelled in 2010 due to lack of financial support and incentives, although the public supported the project.

2.2.2. Germany

Germany’s energy demands rely heavily on fossil fuels, which make up 78% of Total Primary Energy Supply (TPES) [14]. Consequently, several CCS projects have been initiated in Germany to mitigate CO_2 emissions. Nonetheless, considerable opposition to CCS implementation exists among politicians, NGOs and the general public.

A couple of CCS R&D projects in Germany have been carried out by the government or public-private partnerships, such as the COORETEC initiative, which was established to support the development of technologies aimed at mitigating CO_2 emissions. Another is the GEOTECHNOLOGIEN, a research and development consortium with partners from both industry and academia [15]. In addition, two projects working with CO_2 storage in depleted natural gas fields have been carried out: CO2Sink at Ketzin, and the CLEAN-project. Additionally, several CO_2 capture projects have been carried out by the private sector, such as Vattenfall, RWE and E.ON. [16]. Currently, CCS is not included in Germany's policy agenda, and current legislation does not allow any large-scale CO_2 storage [17].

According to the Eurobarometer survey, just 23% of German respondents considered CCS as an effective tool to combat climate change, while 34% did not believe it was. An additional 43% of respondents “did not know” what the technology is. Concerning storing CO_2 5km from their homes, 23% of respondents were “very concerned”. Finally, 49% of respondents stated that they want to be involved in the decision-making process surrounding implementation of the technology [12].

The Schwarze Pumpe project was a landmark in the CCS scene of Germany. The Vattenfall demonstration CCS plant is the 30MW at the Schwarze Pumpe, where a lignite coal power plant exists. The capture technologies were Oxyfuel and post-combustion with capacity of 75000 tons/year CO_2 captured [18]. This project is considered one of the most successful Oxyfuel demonstration projects. However, much opposition to Vattenfall’s activities in Brandenburg arose, including organized protests and political activities, which led to cancellation of the CCS project [15; 16].

2.2.3. Norway

Norway is the biggest oil exporting country in Europe; however, 99% of its electricity consumption is generated by hydropower. The rest of the electrical energy demand is intended to be provided by gas-fired power plants. These plants are expected to develop more in the future by supplying the increasing demand of electricity at the rate of 1-1.5% per year [19]. So, in order to prevent the increase of GHG emissions as a consequence of the growth of gas-fired power plants, CCS has been at the centre of attention in Norway. The build-up of a well-performing CCS innovation system has made Norway an international leader in the field of CCS [20]. In 2001, the government announced that it would no longer grant permission for building fossil fuel-based power plants without CCS [21]. The importance of CCS in Norway was illustrated in a speech by former Prime Minister Stoltenberg in January 2007, in which he compared CCS developments in Norway with the moon landing of the US in 1969. Hence, the government has shown both considerable support for CCS projects and effective policy towards CCS development, such as in the form of a carbon tax for offshore petroleum activities, which led to the involvement of the private sector in this program, or the policy initiative demanding CCS application for every new fossil fuel-based power plant [22]. The ultimate goal of the CCS program in Norway is to reduce GHG emissions by 30% by 2020 and to be carbon neutral in 2050 [23]. Norway did not take part in the Eurobarometer survey; however, some studies show that public awareness about CCS in Norway is relatively higher than in any other European countries [24; 25].

Implementation of CCS at Mongstad was one of the biggest of its kind. Mongstad is a major industrial refinery and a big source of CO_2 emission in Norway [22]. The goal of the Mongstad project is to capture CO_2 from gas-fired power plants [26]. Thus, the Norwegian Statoil and Norwegian government in 2006 started a cooperation to fulfil the aim of the project [22]. The outline of the plan indicates that the Norwegian government decided to overcome most of the uncertainties with an accurate and developed plan. Ex-Prime Minister Jens Stoltenberg said of the Mongstad project: "with this project we are writing industrial and environmental history" [27]. One of the integral parts of the Mongstad project was the Test Center (TCM), which was supposed to be the first phase of the project before the full-scale CCS plant. TCM’s main objective was to examine the technical process, cost and the risks involved in order to apply the technology on a larger scale [26]. The project was initiated in 2006. The first stage was planned to be started at 2011. There were two technologies that were supposed to be applied: amine and chilled ammonia absorption. The CO_2

capture potential was claimed to be 100,000 tons per year. The full-scale CCS facility at Mongstad was planned to be operational in 2014. Nevertheless, it was postponed to 2016 [28]. Finally, in 2013 the government announced the termination of the project [29]. The facility was expected to capture at least 1.5 million tons of CO_2 per year, with the captured CO_2 being transported to and stored in Utsira or the Johansen formation [30].

3. Data and Methods

I analysed a varied data set, including 19 semi-structured in-depth qualitative interviews, which we conducted with experts in Finland, Germany, and Norway; newspaper materials and data on Finland and Norway; and policy documents and reports, mainly The Global Status of CCS 2015, to map the various CCS timescapes they describe, using methods of qualitative institutional analysis. Theoretically, this research is based on the temporal theories of Barbara Adam, which were discussed in the introduction.

Regarding the interviews, for each country we had interviewees from a governmental body, an NGO, a research institute and an energy company. In the interviews, we discussed projects in different countries, but mostly focused on notable (cancelled) projects such as Mongstad in Norway, Meri-Pori in Finland and Schwarze Pumpe in Germany.

4. Results

"CCS is essential": that is the gist of the latest report of The Global Status of CCS [8]. The ultimate goal of the technology is to contribute to the scenario of keeping global warming below 2 degrees by 2050 compared to 2010 levels [7]. Furthermore, the EU aims to reduce greenhouse gas emissions by 40% by 2030 compared to 1990 levels [8]. Nonetheless, my analysis indicated a lack of interest exits among most major stakeholders, such as in heavily industrial Germany, which has the highest share of EU GHG emissions [31]. For instance, this lack of interest indicated in an interview with a German scientist:

"I think people should be more intelligent than to have a lot of tons of waste put under the ground for a long time. There are more efficient ways to produce energy than that. So, I think we should concentrate more on renewable energy systems for long-term."

Despite that, one German scientist and an environmental social scientist share the same opinion that perhaps CCS could be a solution for some (industrial) cases (but not in Germany) for the short-term and not at all for long-term. I observed a lack of political will and incentives in Finland, although scientific stakeholders recommend CCS due to the rather high reliance of Finnish energy demands on fossil fuel, as was reflected in the interview with a scientist in Finland:

"At the moment if you want to reduce carbon dioxide emissions properly, say, at coal power stations or in coal-intensive industries, in practice the only possibility is CCS".

Furthermore, while a common sense exists among most of the main Norwegian stakeholders regarding implementation of CCS, the "moon-landing" commercial-scale project of Mongstad was cancelled. Norwegian interviewees were concerned about temporal issues as it was raised by an authority:

"CCS soon or late should be implemented on large scales: It's a matter of when, not if".

Moreover, an experienced CCS expert from one company asserted:

"CCS is a key tool in tackling climate change. However, it will not go on commercial-scale until 2030 at the earliest".

All in all, a mismatch appears between the current status of CCS and the desired scenarios. In other words, a considerable mismatch exists between the amount of time businesses and policymakers want to spend on CCS projects and the amount of time it actually takes to carry them out. This same inconsistency appears even within an individual country on a different level. For example in Germany, on the state level an interviewees said:

“CCS is not an option for Germany… it is too late for implementation of CCS technology, rather we should focus on renewables.”

In contrast, on the federal level an authority said:

“CCS is an effective and efficient climate protection technology and it is worthy of being implemented.”

It is evident that 2020 would be either a milestone or a dead end for commercial full-scale deployment of CCS (*timing*) considering lead time, and the fact that the tempo of cancellation or postponement of projects has fairly accelerated since a few years ago, even in leading countries such as Norway. According to the Global CCS Institute, in addition to the current 15 large-scale facilities, a few more large-scale projects will become operational by 2017 [8]. Nevertheless, even the capacities of this number of large-scale facilities are infinitesimal in comparison with the annual CO_2 emission worldwide and the goal of limiting rising temperatures to 2 degrees by 2050 that needs to be reached. The institute considers the current period of 2015-2017 as “a landmark period for CCS projects”. So, whether postponements or cancellations occur during this time, it may ring the alarm as a sign of the failure of the role of CCS in possible scenarios (*tempo*). Interestingly, the concerns about timescapes and CCS tempo were discussed in a few articles in two well-known Finnish and Norwegian newspapers—as for instance it is quoted by Mikkola [32]:

“In Finland the abandoning of Meri-Pori means that it is at least too late to get to the front line.” (Helsingin Sanomat 10.30.2010)

“But will the technology make it in time to mitigate climate change? [...] This is too slow.” (Helsingin Sanomat 8.11.2010)

Most of the interviewees declared that CCS policy and regulations are lagging behind the technical development, which delays the progress of CCS. A private sector interviewee from Finland asserted:

“There is no technical barrier; the lack of legislation is an obstacle.”

Comprehensive specific laws and regulations about CCS exist only in five countries: Australia, Canada, the United Kingdom, the United States and Denmark [8].

Considering the “essential” role of CCS in meeting the goal of less than 2 degrees temperature increase by 2050 (*duration*), the current *timeframe* is retarding progress. Brad Page of the Global CCS Institute emphasised this fact [8:1]:

“While CCS has made great progress this decade, it is abundantly clear that we must sharply accelerate its deployment.”

Or, as one scientist from Finland mentioned in an interview:

“There is more talk about CCS than action.”

An interviewee from a German NGO hopelessly asserted that:

"CCS comes too late to solve the problem… it has lost its bridging function to a future in which renewable energy will be dominant."

5. Discussion and Conclusions

This analysis defined temporal features concerning deployment of large-scale CCS projects. According to the evidence from this study, it appears that CCS deployment is not burgeoning— even in some so-called frontrunner countries such as Norway or countries greatly reliant on fossil fuels like Finland and Germany— due to institutional inertia and poor temporal fit. In other words, the timescape of CCS is obscure. Nonetheless, when it comes to the CO_2 emissions share of my case studies, it seems a drop in the ocean compared to gigantic CO_2 emitters such as the USA, China and India. If the goal of restricting global warming to 2 degrees is due to reduce at least 60% of GHG emissions by 2050 compared to 2010, then the feasibility of that goal is really questionable considering all the postponements and delays in CCS deployment. The current CCS carnage is as absurd as what Albert Camus described in The Myth of Sisyphus [33]: a futile search. On one side, some see CCS as a Faustian technology[3], and on the opposite, some are developing and promoting CCS as a bridging technology, but at the same time delaying large-scale deployment of CCS projects as they just kick the can down to the road. Despite the realization of the absurd CCS situation, Camus has an answer for us: we require revolt[4]!

In summary, unless some significant progress appears in a very few years, CCS will lose ground to other alternatives. Time is a key issue which should be taken into consideration in every matter of CCS, from technical development of the technology to policymaking and project planning. Considering that, we should have a clear understanding of the multidimensional features of temporality – the features which were discussed in this article.

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[3] For example see: "CO_2 capture and storage: Another Faustian Bargain?" by Spreng et al. [34]

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