22

Carbon Capture and Storage in Norway

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Carbon Capture and Storage in Norway

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Contents

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Executive Summary

The underlying motives for the Norwegian support of Carbon Capture and Storage – abbreviated from now on as CCS – is very much connected to Norway's status as the world's 5th largest oil exporter (2005). The Norwegian oil industry, represented by the mainly government-owned StatoilHydro, is without doubt a driving force behind CCS in Norway. Because StatoilHydro is increasingly looking abroad for new business, the importance of CCS for its domestic operations may on the other hand be less than expected. Diminishing oil reserves and production in Norway reduces the importance of CCS compared to StatoilHydro's growing operations in other countries.

If CCS becomes an important part of the solution to reducing CO_2 emissions in other countries, this may also have beneficial effects for oil production in Norway. CO_2 that is captured from power plants may be used as a means of increasing the pressure in oil fields, and help extract more oil. This process is called Enhanced Oil Recovery, or EOR for short. More CCS plants built all over the world may speed up the learning process, and help bring down the unit cost. Lowering the cost of CCS technology may increase its use in EOR, and consequently help to prolong oil extraction in Norway. The economic benefits from this may be huge, in the area of thousands of billions of Norwegian Kroner.

The Norwegian government's plan for mitigating greenhouse gas emissions appears to be to buy emission credits from abroad, and to use CCS domestically to reduce emissions. The lack of other strong domestic measures in the government's mitigation plan is due to several factors. CCS and emission credits from abroad reduce the need for unpopular domestic taxes and other limitations on CO_2 emissions. Due to Norway's huge surplus of cash from its oil and gas revenue, it is also very easy for Norway to buy all its emission credits. One or two week's surplus revenue from oil and gas extraction is enough to cover Norway's total emissions today, without any hardship or sacrifice by its population. There is no need to wait till 2030, as the government has pledged, to become carbon neutral. Norway has the financial resources to do so today.

Norway officially wants to share CCS technology with the rest of the world, because it promises to be a solution with a high potential for making effective reductions in CO_2 emissions. It gives Norway a more positive image abroad, as well as a valuable political asset in many situations. It is also probably better for the Norwegian conscience to offer a technological solution to the world than just buying emission credits. This is not to say that the official Norwegian motivation for supporting CCS is not sincere. However, there may also be a beneficial PR effect, of which the Norwegian government is probably well aware.

The environmental organisations and the wider environmental movement in Norway have contributed to a lack of critical debate about the shortcomings and unproven aspects of CCS technology in Norway. The environmental foundation Bellona has been a leading, consistent and very vocal advocate for CCS since 1996 in Norway. Environmental NGOs such as Friends of the Earth/Norges Naturvernforbund, Nature and Youth/Natur og Ungdom and Zero have supported Bellona to a varying degree. WWF Norway has been mostly silent. Two organisations, Greenpeace and The Future in Our Hands, have recently become more openly critical. So has the broad umbrella organisation, Forum for Development and Environment. The latter organisation is only active in climate negotiations, and not domestically.

Strong economic and political motives, combined with a partly positive and partly

silent NGO community have contributed greatly to the present strong commitment towards the use of CCS in Norway. Overall, the strength of this commitment has had a negative effect on efforts to reduce the GHG emissions in sectors other than the oil and gas sector, especially the transport sector, where the emissions are growing fastest. Emissions from the oil and gas sector are predicted to peak in a relatively short time, and then be gradually reduced in the years to come, both in absolute and relative terms. This will happen even without the use of CCS, due to the rapid extraction and depletion of the Norwegian offshore oil reserves. To the extent that CCS has overshadowed the mitigation potentials and reduced the efforts in the other sectors of the Norwegian economy, it may prove to have been a costly detour on the road to a climate-friendly Norway.

Why is Norway investing heavily in CCS?

The coal industry and the power generators in Germany and the United states are among the biggest and most important driving forces for CCS in their respective countries, according to the Greenpeace report False Hope[1] These industries also play a significant role in the international debate. The coal extraction industry and the coal-based power producers want to prolong the useful lifetime for their respective resources and investments. However, they face increasing public and political pressure to reduce emissions. In this situation, CCS may seem to be a god-sent opportunity to continue their present operations. Norway, on the other hand, does not have a big coal industry and no coal-consuming electrical generating capacity connected to the grid.

Hey, big spender!

When people from other countries look at the official Norwegian support of CCS as a climate mitigation option, several questions arise. One is connected to the fact that Norway is spending more on research and development of CCS per capita than many other nations. Norway, Canada and the Netherlands are among the top spenders relative to GDP.[2] Why does the Norwegian government spend so much money per capita on CCS, when in comparison the US for example allocates far less relative to GDP to the same technology? [3]

The aim of R&D programmes for capital-intensive technologies in Norway, including CCS, is to invest strategically in order to profit from cooperation with bigger nations. This is a fairly natural course of action for a small (although rich country) with limited resources and therefore limited possibilities to finance very expensive technology research programmes on their own. The aim is to get bigger nations to bear the brunt of the development costs, and for Norway to participate enough to reap the benefits of a technological breakthrough. However, one may question if this strategy will work with CCS in light of the actual spending by other, bigger countries.

The US government has a very similar rhetoric to Norway about the importance of CCS as a climate mitigation alternative. Even if the US government is spending less than Norway per capita, the total expenditure has of course been much bigger. What has US spending on CCS achieved so far? MIT – Massachusetts Institute of Technology – has evaluated the US programme to demonstrate commercialisation of large-scale CCS. The conclusion is that it is not on track, given the timeframe necessary to bring these technologies to market.[4] R&D funding for CCS in the EU has also turned out to be far less than is probably needed, despite ambitions to build 12 large plants by 2015.

1 False Hope. Why carbon capture and storage won't save the climate. Greenpeace, May 2008.
2 http://www.cicero.uio.no/publications/detail.aspx?id=4078&lang=no#details Read 15 April 2008
3 http://www.cicero.uio.no/fulltext/index.aspx?id=3580&lang=no Read 15 April 2008
4 State of the World 2008, p 79

The Norwegian programme needs to develop, in co-operation with the other, bigger nations, CCS methods that can operate on a commercial basis within a timeframe that can give this technology a meaningful role. In 2006, the Norwegian government signalled an ambition to take the lead in the development of CCS, at least verbally. The Prime Minister, Jens Stoltenberg, started talking about establishing the first full-scale CCS plant in Norway as the equivalent to the US landing on the Moon.[5] Whether the actual funding and timeframe for the Norwegian development project matches this ambition, is still an open question. Norway wants to be a big spender, but is Norway big enough?

Big Oil, little coal

Norway has almost no coal extraction, except on Spitsbergen Island in the Arctic. This is a relatively small and heavily subsidised operation. Its continued existence is mainly a result of Norway's need to maintain a physical presence in the resource-rich Arctic. The only coal-based electricity generation plant is also here, but the power station is not connected to the main Norwegian grid. The small Norwegian coal extraction operation (2.4 million tons/year)[6] is therefore not an important motive for supporting R&D in CCS, and neither is the tiny power station on Spitsbergen Island.

What Norway has is a relative abundance of oil and gas from offshore fields in the North Sea and further north on the continental shelf outside the coast. In 2006 Norway was the 10th biggest oil producer, but the 5th largest oil exporter in the world. The relatively large export share is due to Norway's small population (4.5 million), and low domestic consumption. Almost all the natural gas that is not used internally in oil and gas extraction is also exported, most of it by pipeline to the EU countries. In 2006 Norway ranked as the third largest gas exporter, and the 5th largest gas producer in the world.[7]

StatoilHydro, which is majority-owned by the government, with 62.5 per cent of shares, produces 80 per cent of the total Norwegian oil and gas production.[8] The company is a result of a merger in 2007, when the oil and gas company Statoil acquired the oil and gas division of Norsk Hydro. StatoilHydro is one of the world's largest vendors of oil, and a significant vendor of gas in the European market. The rest of the oil and gas from the Norwegian fields is produced by a number of foreign-owned oil companies with comparatively small shares of total production.

StatoilHydro is a commercial operation, with the government acting as a regular majority shareholder on the board of the company. The government exercises its political authority over the oil and gas sector, including StatoilHydro, through general taxation and environmental taxes, allocation of areas for oil extraction and other economic and administrative regulation of the activities of oil and gas companies. This means that StatoilHydro's business strategy is decided within the company, and the government seldom tries to intervene as long as the money flows. On the other hand, there are

5 http://www.regjeringen.no/nb/dep/smk/Statsministerens-kontor/Statsminister_Jens_Stoltenberg/Taler-og-artikler/2006/Rodgronn-manelanding.html?id=273361 Read 15 April 2008

6 http://www.snsk.no/internet/no/Vedlegg/aarsberetninger/Eng_Store_Norske_aarsrapp_2006.pdf Read 10 April 2008

7 http://www.regjeringen.no/en/dep/oed/Subject/Oil-and-Gas.html?id=1003 Read 10 April 2008

8 http://www.regjeringen.no/en/dep/oed/Subject/State-participation-in-the-petroleum-sec/StatoilHydro-ASA.html?id=444383 Read 10 April 2008

obviously many links between the political system and StatoilHydro, as well as many channels for informal consultations that can also influence the way CCS has become so important in Norwegian politics. This interplay is to some extent described in the book "Gasskraft" by Andreas Tjernshaugen.[9] For our purpose it is enough to say that StatoilHydro and its predecessors, Statoil and Norsk Hydro's oil and gas division, have played a largely independent role in the debate about CCS, despite the fact that both Statoil and Hydro, and now the combined company StatoilHydro, had and still have the Norwegian government as its majority owner.

Cutting down, moving out

Since Norway is a big oil and gas-exporting nation, it is natural to ask how important CCS is for the Norwegian oil and gas industry. What role does CCS play in its strategies to meet the need for reduced CO_2 emissions? The answer is maybe a bit surprising: The Norwegian oil and gas industry as such may not depend heavily on CCS as part of a long-term solution for its oil production at the present, even it if did play an important part in the introduction of CCS into the Norwegian debate around 1995–1996. Both the then separate companies Statoil and Norsk Hydro, clearly announced their interest by financing their own research programmes and plans when CCS first entered the Norwegian debate. The industry's enthusiasm gradually cooled when the high cost of CCS became clear as a result of the first research projects.

After that they urged the government to finance R&D and to cover the extra cost of CCS, and even take the responsibility for the transport and the safe storage of CO_2.[10] After a long and complicated political process the industry has also achieved this goal, to a large extent. The government has pledged that it will finance part of the extra cost of including CCS in the two gas-fired power stations that are either running (Kårstø) or in the process of construction (Mongstad). A government-financed company, Gassnova, has also been started. Gassnova has been given operational responsibility for the capture, transport and storage of CO_2 from the power plants at Kårstø and Mongstad. This entails responsibility for running the capture facility, building the pipelines to the reservoirs in the North Sea where the CO_2 will be stored, and then monitoring and ensuring the safe storage of the CO_2. The Norwegian government has also promised to finance the storage of the CO_2 captured from the first gas-fired power plants equipped with CCS. [11]

A number of options exist for the reduction of CO_2 emissions that do not depend on CCS, from the offshore fields. The main reason why these other options are not implemented is the increased cost of oil extraction. The technological complexities of retrofitting existing oil production platforms, where space and time for retrofitting is very limited, make these options very costly. A shutdown of production to put in more energy-efficient electricity generation equipment would be costly if it were done on an individual platform. On the other hand, it is possible to supply platforms with electricity from land by cables. Separate platforms could also be set up that act as power stations for several production platforms in the vicinity. These options have not been fully exploited. It can be argued that even if the industry has actively explored the potential

[9] Andreas Tjernshaugen: Gasskraft. Tjue års klimakamp. Pax Forlag, Oslo 2007.
[10] Andreas Tjernshaugen: "Gasskraft," Pax Forlag, Oslo 2007 p 162
[11] http://www.gassnova.no/wsp/gassnova/frontend.cgi?func=frontend.show&template=home&language=UK&lang=en&site=gassnova Read 15 April 2008

and cost of CCS in the initial stages of the debate, the debate has also reduced the pressure on the industry to implement other policies than CCS for CO_2 reduction.

Another reason for the oil and gas industry's gradual loss of enthusiasm is that emissions from the oil and gas sector in Norway are expected to peak and then gradually diminish after 2010. A scenario drawn up by the Norwegian State Pollution Control Board (SFT) estimates that emissions from the oil and gas sector in Norway will be around 16 million tons of CO_2-equivalents in 2010, and emissions will be reduced to about 12 million tons in 2020.[12] This is the base scenario, without any further instruments and measures being introduced to regulate the emissions. The scenario also assumes that there will be no new giant oil fields like the Ekofisk field in the future. Nobody knows for sure what can be found in the Barents Sea, but 10–15 years of active exploration have so far not turned up any large finds.

The relative importance of the oil and gas sector for national emissions grew considerably between 1990 and 2005 as the extraction of oil increased, but it will decrease both in absolute numbers and in relative importance from now until 2020. If the share of oil and gas is around 25 per cent of the total in 2010, it will be reduced to about 19 per cent by 2020, according to the scenario. Emissions will probably continue to decrease after that, following the reduced output from the oilfields in the future. The Norwegian government says openly that oil production will fall in the years to come, but it expects gas production to increase.[13] Even so, CO_2 from the increase in gas production will not compensate for the decrease in CO_2 emissions from the oil production. Norwegian oil production has in fact already peaked. Production volume has been reduced by 30 per cent over the last 6–7 years.[14] This trend will continue, as the oil reserves are gradually depleted. More than 50 per cent of the proven reserves have already been extracted, and no new, large fields have been discovered for a relatively long period of time.

StatoilHydro is very intent on securing new resources outside Norway, as the prospects for oil production in Norway diminish. According to their website, the company is active in 40 countries all over the world. StatoilHydro has for example recently purchased a stake in oil extraction from tar sands in Canada. It is active in offshore fields, including those of several African countries (Nigeria, Angola) and in Azerbaijan by the Caspian Sea. [15] Recently StatoilHydro has also secured a stake in the development of a gas field in the Russian part of the Barents Sea.[16]

CO_2 emissions from StatoilHydro's oil production outside Norwegian borders do not affect the national Norwegian Kyoto targets. Emissions are always counted in the country where extraction takes place. CO_2 emissions from its gradually decreasing Norwegian production are consequently of less importance than if it had continued to be a purely domestic operation. StatoilHydro's motives to press for the introduction of CCS in connection with the Norwegian oil production, at least in the short and medium term, is therefore probably less important than it was in 1995–1996.

On the other hand, StatoilHydro also has an interest in CCS for its continued extraction of oil and gas in the longer term. However, it has the flexibility to switch operations to countries where there is less pressure to reduce CO_2 emissions. Many developing countries are in a much weaker position to impose restrictions on the oil

12 http://www.sft.no/publikasjoner/2254/ta2254.pdf Read 10 April 2008
13 http://www.regjeringen.no/en/dep/oed/Subject/Oil-and-Gas/Norways-oil-and-gas-resources.html?id=443528 Read 10 April 2008
14 http://www.regjeringen.no/pages/1988897/PDFS/STM200620070034000DDDPDFS.pdf p. 97 Read 11 April 2008
15 http://www.statoilhydro.com/en/ouroperations/pages/default.aspx Read 10 April 2008
16 http://www.statoilhydro.com/en/NewsAndMedia/News/2007/Pages/StatoilHydroGazpromAgreement.aspx Read 14 April 2008

companies than the Norwegian government. This probably lessens their motivation to develop CCS for use in its foreign operations.

Oil companies traditionally have also always been interested in extracting the available resources in the shortest possible time. They then take the profits and invest them in new fields, rather than stretching the production period from any single field in order to secure a longer-term profit from existing fields. Both the flexibility and the quick extraction policy tend to favour short- and medium-term solutions, rather than long-term solutions. CCS promises to be a solution in the longer term, if it can be made commercially viable and ecologically safe. The Norwegian oil industry at present would therefore most probably tend to look for other options than CCS as their main strategies. In this respect, the Norwegian oil and gas industry is probably more or less in line with its "sisters", the big international oil companies, as it has been described in the Greenpeace report.[17]

CCS and the national mitigation plan

The governing coalition of political parties in Norway at present (2008) consists of the Labour/Social Democratic party, the Socialist Left party and the Centre/agrarian party. The government declared its intention in 2007 to reduce the emissions of GHG gases by 30 per cent compared to Norway's emissions in 1990 by 2020, and to become carbon-neutral in 2050.[18] [19]

In 2008, Norway advanced the date for climate neutrality from 2050 to 2030 in a statement issued together with three other countries at the launch of a UNEP initiative. [20]

The pledge has been held up by NGOs and others as an example for other countries to follow. So how does the Norwegian government plan to fulfil the pledge? How big is the challenge, and in which sectors are the challenges most acute?

Norway is 7th in a list of the world's top ten carbon emitters with 5.3 tons per capita. The next countries above it are Canada and the USA, with 5.4 and 5.5 tons respectively. Top of the list is Qatar, another small, oil-rich nation, with 22.4 tons. The world average is only 1.3 tons, by comparison. [21] The average in many developing countries is so low that an automatic dishwasher in Europe is for example responsible for emitting as much carbon into the atmosphere in a year as three Ethiopians![22]

In which sectors of the Norwegian economy and society are the challenges greatest? This can be read from a scenario drawn up in 2007.[23] As described above, the emis-

17 False Hope. Why carbon capture and storage won't save the climate. Greenpeace, May 2008.
18 http://www.regjeringen.no/pages/1988897/PDFS/STM200620070034000DDDPDFS.pdf p 36 Read 11 April 2008
19 http://www.regjeringen.no/en/dep/fin/campaign/Carbon-Neutral-Norway/General-information/Norwegian-Climate-Policy.html?id=479386 Read 15 April 2008
20 http://peopleandplanet.net/doc.php?id=3209 Read 15 April 2080
21 Carbon Dioxide Emissions from Fossil Fuel Burning Per Person for Top Ten Countries and World, 2006 Earth Policy Institute at: http://www.earthpolicy.org/Indicators/CO2/#top Read 10 April 2008
22 Carbon Dioxide Emissions Accelerating Rapidly, Frances C. Moore, Earth Policy Institute 9 April 2008, read 10 April 2008
23 http://www.sft.no/publikasjoner/2254/ta2254.pdf p 14 Read 10 April 2008

sions from Norway's oil and gas extraction are going to decline because of diminishing oil extraction. Today this accounts for about 25 per cent of the total national emissions, and is expected to fall to 19 per cent by 2020. Other industries have a 27 per cent share of the total at present, and this figure is expected to increase only slightly.

The rapidly rising emissions from the transportation sector are in contrast a major challenge in the climate context. The transport share is today around 25 per cent. Car ownership is widespread, the population fairly dispersed and even the bigger urban areas rely heavily on private cars for transportation. Norwegians also fly 10 times more than other Europeans per capita. Emissions from transport are therefore expected to grow, both in total and in relative importance to national emissions. In total, the scenario shows an increase from 12.5 million tons in 2005 to 16.5 million tons in 2020. This means that transportation will increase its relative share from 23 per cent in 2005 to 28 per cent in 2020.

The power sector is important in most other countries in a climate mitigation context. In Norway the power sector in contrast does not offer great possibilities for emission reductions, since it is almost 100 per cent renewable hydropower. When the gas-fired power plant on Kårstø started commercial production on 14 December 2007,[24] this renewable percentage was reduced to about 97 per cent. The gas-fired power plant at Kårstø can supply about three per cent of Norwegian electricity requirements, or 3.5 TWh if it is run at full capacity.[25] Most of the available, economically viable hydropower projects have already been developed. Public resistance has increased to the point that it is difficult to get permits for new, big projects. Domestic consumption of electricity has been stable since 1998, and Norway has had a net export of 3 TWh per year on average since the year 2000.[26] Further increase in domestic electricity consumption or exporting of electricity to other countries must most likely be covered by other sources than hydropower. In this situation gas-fired power plants are the main option for large amounts of new electric production capacity. Gas-fired power stations have consequently also been central to the Norwegian climate debate for the last 20 years. It is worth noting that there are several gas-fired power stations in Norway that are not connected to the grid, but only supply oil and gas terminals for processing on land. These stations have only occasionally caused debate and protests. The main focus has been on those connected to the national grid and intended as a source of supply for all sectors, except the oil and gas sector.

The Norwegian Climate Mitigation plan

The scenario for the development of Norwegian emissions described above has also been part of the background for the mitigation policies envisioned by the government White Paper[27] in 2007. The Norwegian environmental NGOs have been fairly unified in their demand for stronger policies for domestic reductions than those proposed by

[24] http://www.naturkraft.no/default.asp?V_ITEM_ID=735 Read 15 April 2008
[25] http://www.naturkraft.no/default.asp?V_ITEM_ID=725 Read 15 April 2008
[26] http://framtiden.no/200802202151/meninger/klima/manelanding-eller-buklanding.html Read 15 April 2008
[27] http://www.regjeringen.no/pages/1988897/PDFS/STM200620070034000DDDPDFS.pdf Read 11 April 2008

the government in its mitigation plan. One of the main weaknesses in their eyes is the lack of strong domestic measures to meet the projected increase in the transportation sector. The many plans for new infrastructure (roads, airports) in the transportation sector will most certainly contribute to more emissions. The climate mitigation plan lacks instruments that can integrate policies on road construction, building of airports and other infrastructure into the plan. Criticism has also been directed at the lack of action in all the other sectors, where there are obvious and well-documented actions that could be taken. A government-appointed panel issued a report in 2006 listing a great number of such policies and measures that could bring Norway's GHG emissions down and fulfil Norway's Kyoto obligations chiefly by domestic action.[28]

The government's pledge to build full-scale CCS plants at gas-fired power stations used for general supply – at both the existing Kårstø plant and the new plant being built at Mongstad – has also been a hot issue. After many rounds of what the supporters of CCS looked at as broken promises, the government finally said on 18 December 2007 that the planned gas-fired power plant at Mongstad will be equipped with a CCS plant, but not from the start of operation. A test plant will be built first, and this will probably be operational by 2011. The decision to build a full-scale CCS plant at Mongstad will not be taken until 2012, after analysing the results from the test plant. A full-scale CCS plant is therefore unlikely to be operational before 2014, at the earliest.[29]

For some time uncertainty about how the ESA – Efta Surveillance Agency – would interpret the EU rules about government support cast a shadow over the entire project. This uncertainty was resolved in July 2008, when ESA issued a press release stating that they gave the green light to the Norwegian government and its financial support of the project.[30]

The NGOs have not been alone in their criticism of the lack of strong domestic action in the Norwegian mitigation plan. Sweden's former Prime Minister, Göran Persson, has also been publicly critical about the lack of strong domestic action in the Norwegian plan, and most recently about the lack of meaningful action at the municipal level.[31] A government-appointed panel has also found that it is possible to achieve significant reductions with comparatively low costs.[32]

Given the lack of strong domestic action to fulfil Norway's Kyoto obligations, the government's pledge to become carbon neutral by 2030 seems to be difficult to fulfil. But the Norwegian government did not specify how it would reach the goal. Both before and after the conclusion of negotiations on the Kyoto Protocol, different governments have refused to set a limit on how much of its obligations Norway should meet by using what are known as flexible mechanisms: Emission trading, Joint Implementation and the Clean Development Mechanism – CDM. Environmental organisations have been fairly united in their demand that Norway should do as much as possible by domestic implementation, and at least 50 per cent domestically. The present government in turn has insisted that Norway should only do domestically what is cheaper to do in Norway than by buying emissions credits from the flexible mechanisms.

In connection with the launch of a new website, www.CarbonNeutralNorway.no, the

28 A Climate-friendly Norway. http://www.regjeringen.no/nb/dep/md/aktuelt/nyheter/2006/A-climate-friendly-Norway.html?id=419654 Read 2 September 2008

29 http://www.regjeringen.no/nb/dep/oed/tema/CO2/co2-handtering-pa-mongstad.html?id=502210 Read 15 April 2008

30 http://www.regjeringen.no/upload/OED/pdf%20filer/Mongstad%20ESA/Green%20light%20to%20the%20Norwegian%20State's%20investment%20in%20Mongstad_16juni08.pdf Read 2 September 2008

31 http://www.nrk.no/nyheter/distrikt/more_og_romsdal/1.4729551 Read 15 April 2008

32 Lavutslippsutvalget.

Minister of Finance, Ms. Kristin Halvorsen, expressed the government's intention to make full use of the international emissions trading mechanisms.[33]

> *– International emission trading will be an important instrument to reduce global greenhouse gas emissions. Norway intends to make full use of the carbon markets to secure effective and affordable reductions in GHG emissions. Norway will actively contribute to the development of this market, said Kristin Halvorsen.*

Norway can now reap the benefits of efforts made during negotiations for the Kyoto Protocol to get the flexible mechanisms included in the Protocol. The peculiar Norwegian circumstance in this respect is that buying emission credits from other countries is also easier for Norway than almost any other country. Norway has an income from its oil and gas extraction that is far in excess of what can be spent domestically without creating serious inflation. The surplus revenue is invested in stocks and property abroad by means of what is called the Norwegian Pension Fund. When the oil and gas is gone, the interest from the investments will in the future be used to pay for Norwegian pensions and other material welfare benefits. The Pension Fund has already amassed a fortune of 2000 billion NOK or around 250 billion Euros, and is still growing. In 2015 it is expected to reach 4300 billion NOK or 530 billion Euros.[34] This means that Norway can pay for a huge amount of emission credits abroad, without having to take money away from other purposes in the present government budgets. A whole year's emissions in Norway amount to around 54 million tons of CO_2-equivalents today. This would cost maybe 6–8 billion NOK to cover by buying emission credits from abroad at the present price for emission credits. Norway could become "carbon neutral" TODAY, using a relatively small part of its economic surplus from oil and gas extraction! Financially, there is no need to wait until 2030 for Norway to do so, since it would only require one week's growth of the Norwegian Pension Fund![35]

CCS is the other part of the Norwegian government's plan to fulfil its Kyoto obligations, and in a longer timeframe, become carbon neutral. This goes a long way in explaining the present strong Norwegian interest in CCS. It has long been an established government policy to find cost-effective ways of climate mitigation, e.g. ways of meeting Norway's obligations in the cheapest possible way. Whether CCS fits this description is debatable, to say the least, when you look at the challenges ahead. The government is on the other hand obviously counting on a big reduction in cost per ton of CO_2 avoided in the future through CCS. Even if this hope is not fulfilled, the Norwegian government also has the option of buying emission credits to cover its needs. You could say that the Norwegian government will win either way, at least in the first commitment period. However, as many, included the NGOs have pointed out, this lack of urgency to reduce emissions now may turn out to be negative in the next commitment period, when the necessary cuts will be bigger and the cost of emission credits will be higher.

The Norwegian Prime Minister, Jens Stoltenberg, caused a media storm when he claimed that building a full-scale CCS plant in Norway should be the Norwegian equivalent of a moon landing![36] Afterwards, the conflicting messages about how this should be achieved in reality caused many sarcastic comments from the political op-

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33 http://www.regjeringen.no/en/dep/fin/campaign/Carbon-Neutral-Norway/News-Archive/New-site-Carbon-Neutral-Norway.html?id=480381 Read 15 April 2008

34 http://www.norges-bank.no/Pages/Article____42083.aspx Read 14 April 2008

35 http://framtiden.no/200705042032/pressemeldinger/klima/klima-handling-na.html Read 15 April 2008

36 http://www.regjeringen.no/nb/dep/smk/Statsministerens-kontor/Statsminister_Jens_Stoltenberg/Taler-og-artikler/2006/Rodgronn-manelanding.html?id=273361 Read 15 April 2008

position and in the media. It is easy to see the political value of having a grand project in order to motivate his own party. Mr. Stoltenberg may also have a desire to better Norway's image abroad as a climate pioneer.

The fact that Norway is uniquely able to buy whatever it needs to become carbon neutral, and without any hardship or sacrifice by the Norwegian population is hardly something that will cause widespread admiration or enthusiasm among other nations. It is far more likely to cause envy and condemnation of a super-rich nation that can buy itself out of the need to reduce its domestic emissions. It is far better for the Norwegian reputation abroad if the country can contribute to a technical solution available for use by anyone. And at the same time create a technology that can be exported with profit!

Domestically the government is trying to avoid politically costly implementation measures such as higher gasoline taxes and taxes on airfares, restrictions on private car use etc. Every government wants to stay in power. Many voters would probably respond to tough domestic climate action by voting at the next elections for a party other than the current party in power.

CCS plays a prominent role in the present Norwegian government pledge for Norway to become carbon neutral in 2030. A change in government would probably not lead to a very different situation. The political parties represented in the Norwegian Parliament (except one, which denies the reality of human-induced climate change) reached a climate accord in 2007, in which the common attitude towards CCS is positive.[37]

If you weigh the different Norwegian stakeholders and their relative interest in CCS against each other, the politicians in Norway at present probably have at least as big a need for CCS as the oil extraction business, and maybe bigger. The "naturally" declining emissions caused by reduced domestic oil production and the gradual shift of StatoilHydro's operations to other countries is the main reason for this.

However, CCS did not achieve its present prominence in the Norwegian mitigation plan without previous development and debate. CCS has been propelled to its present position by previous chains of events. In particular, CCS has been the result of a peculiar Norwegian political trauma: 20 years of NGO-led resistance against gas-fired power plants.

Gas-fired power plants: a national trauma

Conflict over the construction of gas-fired power plants to supply the national grid with electricity has at times dominated the political agenda in Norway over the last 20 years or so. It has also played a prominent part on a more permanent basis throughout this period, and even caused the resignation of a Norwegian government, when the first government of Prime Minister Kjell Magne Bondevik resigned on 9 March 2000. This resignation has been claimed as being a "world first", e.g. the first government crisis in a parliamentary democracy caused by an environmental issue. In the words of Andreas Tjernshaugen in his

[37] http://www.stortinget.no/diverse/klimaforlik.html Read 14 April 2008

book "Gasskraft", the issue has been a national trauma for much of the last 20 years. [38]

In countries that rely on a mix of coal, oil, fossil gas and nuclear power for their electricity supply, the reasons for the conflict may be difficult to understand. Electricity produced from gas-fired power stations emits less CO_2 per kWh than a comparable coal- or oil-fired power station. In many countries the transition from coal to gas in the electricity sector is an important measure in reducing national GHG emissions. Norway is different, because until recently the Norwegian power supply has relied almost totally on renewable hydropower. The introduction of fossil fuels in power generation would therefore have a negative effect on CO_2 emissions. Each such power plant is also potentially a big point source of emissions. One typical 420 MW plant could increase the national emissions of Norway by 5–6 per cent alone, without CCS. It would therefore have a significant impact on Norway's possibilities to reduce its GHG emissions in total. Gas-fired power plants consequently became a natural focus for the NGOs in a climate context. They also became a symbolic rallying point for a coalition of environmental organisations and political parties in the general climate debate.

CCS as political "glue"

The Norwegian environmental NGOs achieved success in bringing the issue to the forefront of the public debate in the early 1990s, as described in Mr. Tjernshaugen's book "Gasskraft".[39] As a consequence, it also became a highly divisive issue in Norwegian politics, both between the political parties and inside the parties. Norway has had a succession of mostly minority governments and often coalition governments, since the 1980s. The present red-green coalition government has a majority backing in Parliament, and is in fact an exception from this pattern. In every combination of political parties that have formed successive coalition governments over the last 20 years there has been at least one party opposed to gas-fired power plants. In the case of single-party minority governments, such as the Social Democratic (Labour) governments of Mr. Jagland and the first government of Mr. Stoltenberg, there was significant internal opposition within the Social Democratic party to gas-fired power plants, even if the official position was in favour. The two Social Democratic governments also relied on other political parties in the Parliament to stay in power, again with opposition to gas-fired power plants as a critical factor determining their support. Several other political parties have also experienced considerable internal conflict over this issue. They include the Socialist Left party that is part of the present governing coalition, and the Social Democrats and Center party. (March 2008).

Given that the power plants were so critical in determining who would govern Norway, CCS became a tempting possibility for the politicians to "have their cake, and eat it too". CCS made it seemingly possible to have gas-fired power plants, but without increasing CO_2 emissions into the atmosphere. CCS made it possible to reach a compromise between those in favour and those against the power plants, and pave the way for successive governments from Mr. Jagland's Social Democratic (Labour) government in 1997 and onwards. It is therefore fair to say that CCS has become the "glue" in Norwegian politics since it was introduced in 1995–1996.

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38 Andreas Tjernshaugen, "Gasskraft", Pax forlag, Oslo 2007, p. 221

39 Andreas Tjernshaugen, "Gasskraft", Pax forlag, Oslo 2007 p 115

Against this background, most of the political parties do not have a strong interest in looking critically at the realities of CCS. The old adage "Don't look a gift horse in the mouth" seems quite appropriate here. Nobody wants to take a hard look at the realities of storing CO_2 underground for thousands of years, or the other negative consequences of the technology. The Norwegian debate (as in other countries) has mostly been about the cost of carbon capture, and different methods and strategies for achieving the lowest cost, in the short-term perspective as well as in a longer perspective. The critical question about the safety of the CO_2 storage against leakage has therefore hardly been debated publicly. An important reason for the lack of public debate has also to do with the attitude towards CCS among the environmental NGOs and foundations.

CCS – a divisive issue among NGOs

At the same time as CCS become a prominent part of the political debate and later of the national mitigation plan, CCS also became a highly divisive issue for the environmental organisations and the wider environmental movement. The broad alliance of environmental NGOs, labour unions, church organisations and political parties managed to postpone the construction of gas-fired power plants for 17 years, from the first debate in 1990 until the power plant at Kårstø started production on 14 December 2007. In this, they defeated the industry and its political supporters. However, the broad alliance that managed to postpone the construction of gas-fired power plants split over the issue of CCS. The split has meant that the environmental organisations have either actively supported, passively accepted or until recently been silent or not very vocal in their opposition.

The leading advocate of CCS since 1995–96 among the NGOs in Norway has been the environmental foundation Bellona. [40] Bellona, led for the last 20 years by Frederic Hauge, has been actively campaigning for CCS both in Norway and inside the EU Commission since 1996. Bellona is a purely national entity (although with branch offices abroad) and gets almost all the funding for its CCS work from different commercial corporations and interests, as well as the Norwegian government. Bellona organised a hearing about CCS in the European Parliament recently together with MEP Chris Davies, which was also attended by the Norwegian Minister of Oil and Energy were also present.[41] Bellona is also represented on various expert committees in the European Union handling CCS.

Former employees from Bellona have formed the organisation Zero – short for Zero Emissions Organisation – which is also promoting CCS.[42] Zero is exclusively funded by the industry, with some government support.

Nature and Youth, an environmental organisation for people up to 25 years of age, is formally part of FOE Norway but follows a very independent line on most issues. The organisation has previously played an important part in the opposition to gas-fired

40 http://www.bellona.org/position_papers/WhyCCS_1.07 Read 15 April 2008
41 http://www.bellona.org/articles/articles_2008/co2_eu_hearing Read 15 April 2008
42 http://www.zero.no/om/20030515-2.php Read 15 April 2008

power plants. It has a positive view on CCS, as seen in its platform.[43] Nature & Youth has been actively campaigning for CCS, most recently in connection with negotiations between the political parties in the Norwegian Parliament about a broad climate agreement. Nature and Youth had a leading role in convincing the party convention of the Socialist Left party in 2005 to accept CCS. By doing so, Nature and Youth helped pave the way for the participation of the Socialist Left party in the present governing coalition, together with the Social Democrats (traditionally a proponent of gas-fired power plants) and the Centre party.[44]

Norges Naturvernforbund, representing Friends of the Earth in Norway, does not campaign actively for CCS. Its position has shifted over the years. Originally it merely said that gas-fired power plants, with or without CCS, were unnecessary for the supply of the Norwegian electricity system. Between 2005 and 2007 it was a more active supporter of CCS, saying that energy efficiency and renewable energy are not enough to cut emissions as much as needed. Since 2007 its position has been that if gas-fired power plant are built anyway, they should be equipped with CCS.[45]

Taking a more intermediate position is WWF in Norway. It does not oppose CCS as an instrument for reducing CO_2 emissions, but neither does it mention CCS in its proposal for a Climate Friendly Norway and the way this can be achieved. [46]

On the opposite side you have Greenpeace and another Norwegian organisation, The Future in Our Hands (FIVH). Both question the possibility of safe storage in the longer term, as well as the feasibility of using CCS as a major technology to reduce emissions, taking the long lead-time and cost of development of the technology into account. Both point to more efficient energy use and increased use of renewables as the major strategy for combating the climate problem. Greenpeace and FIVH have also questioned the net impact of CCS if the CO_2 should be used for EOR – Enhanced Oil Recovery – and asked if this will not lead to actually more CO_2 being released into the atmosphere because of the extra oil that is produced. When the additional oil is burned, it will release CO_2 to the atmosphere that will, at the best, equal the amount of CO_2 being stored in the reservoir. Most likely, the extra oil produced by pumping CO_2 into the reservoir will lead to a net increase in the total amount of CO_2 reaching the atmosphere.

One question in the debate on CCS in Norway has been what technology should be used for the first full-scale CCS plant. The only technology available at the moment that has been used in large-scale operations, is a method using a group of compounds called amines to bind the CO_2 in the flue gas. This technology does not promise great possibilities for bringing down the cost of carbon capture, according to a panel of experts appointed by the Norwegian government. Consequently, the panel recommended that a standard procedure for technology development should be followed, with different technologies for CO_2 capture being tested. On the basis of these tests, a decision on which technology to use in a full-scale CCS plant could then be reached. Greenpeace in Norway has supported this approach. In connection with the debate over a full-scale CCS plant at the Kårstø power plant, several organisations, headed by Bellona, argued that it would be important to get a first full-scale CCS plant in place here as quickly as possible. The importance of getting a full-scale plant was so high

43 http://www.nu.no/midcom-serveattachmentguid-7a0b54109c4b11dc9ffcafb32cb9d69cd69c/plattform07.doc Read 15 April 2008

44 Andreas Tjernshaugen, "Gasskraft", Pax forlag, Oslo 2007, p 176

45 http://www.naturvern.no/data/f/1/05/60/7_2401_0/NNV_prinsipprogram_vedteke_paa_LM_2007.pdf Read 15 April 2008

46 http://www.wwf.no/om_wwf/dette_jobber_med/klima/vare_losninger/et_klimavennlig_norge/index.cfm Read 15 April 2008

that it would be better with old technology such as amine-based capture technology, rather than testing out several new technologies before committing to one in particular. Greenpeace argued that if one were going to spend billions of Norwegian Kroner (NOK) on CCS, it would at least be more sensible to spend the money on a technology that promised to significantly bring down the cost per ton captured. However, Greenpeace also pointed out the shortcomings of the whole CCS chain, including the lack of knowledge about storage.[47]

The Executive Director of FIVH, Arild Hermstad, clearly expressed the views of his organisation when it was reported on 18 December 2007 that the government had abandoned the plan to introduce a full-scale CCS plant at the Mongstad gas-fired power plant from the start of operation. Mr. Hermstad said that this demonstrated the danger of one-sided focus on such technologies, because while the debate about CCS has been going on in Norway, the government has done very little to use other instruments to reduce domestic GHG emissions.[48] In a debate article written together with Peter M Haugan, professor of Geophysics at the University of Bergen, Norway, and Jon Hille, the authors give a more detailed analysis of the problems connected with CCS.[49] In the article, the net effect of using CO_2 to push more oil from underground deposits – Enhanced Oil Recovery or EOR – is estimated to emit 1.8 times as much CO_2 into the atmosphere as building a conventional gas-fired power plant and venting the emissions directly into the atmosphere. The possibilities of finding reservoirs that can hold CO_2 stored underground for thousands of years is also clearly a field in which we have very little knowledge, according to the article.

The broad umbrella organisation, Forum for Development and Environment, has also adopted a critical position regarding CCS.[50] The Forum generally organises participation by Norwegian NGOs in different UN negotiations and coordinates the work of NGOs to allow negotiation from common positions. It keeps a low profile domestically and is only active within the UN climate negotiations in the debate about CCS.

Lack of initial opposition from the NGOs

From the review above it is possible to conclude that the widely varying views held by the different organisations have contributed to the lack of a serious and critical debate about CCS and its shortcomings in Norway. This is not the whole explanation, but it is at least an important part. A broad coalition led by the environmental NGOs was able to delay conventional power plants for 17 years. But when Bellona embraced CCS and became the most vocal supporter and actively campaigned for CCS as THE solution, the other organisations either joined in on Bellona's side, or for a long time became invisible in the debate. The reasons for supporting Bellona's positive advocacy of CCS or keeping a low profile were in the beginning partly tactical. Those critical of CCS

47 http://www.greenpeace.org/norway/press/releases/fornybar-energi-og-smartere-en Read 15 April 2008

48 http://framtiden.no/200712202150/pressemeldinger/klima/skrinlegg-mongstad-kraftverket.html Read 15 April 2008

49 http://framtiden.no/200802202151/meninger/klima/manelanding-eller-buklanding.html Read 15 April 2008

50 http://www.forumfor.no/v_bibliotek/387.pdf Read 2 September 2008

also saw the tactical value of using CCS as way of delaying the construction of conventional power plants without CCS. If this was not motivation by itself, the perceived risk of an open debate about CCS was and is a supporting motive. The organisations were afraid of hurting the credibility of the collective environmental movement by openly disagreeing about the methods to reach commonly held goals. As we see, this has changed during the last few years. One reason for this is that it has become all too obvious how CCS has become a substitute for other actions to reduce CO_2 emission domestically in Norway.

Norway as a CCS advocate internationally

Another question that is natural to ask is: Does the (relatively) heavy spending on CCS R&D make Norway an important player in the debate about CCS internationally? If so, how does Norway try to influence the debate?

CCS in the Kyoto Protocol

Norway is a strong supporter of the UN, and contributes generously to many of its operations and programmes. Norway has also been active in development aid and in other ways supported the developing nations. As a consequence, Norway enjoys in general a fairly positive reputation in international negotiations under the UN. This has also been a valuable asset in climate negotiations. Norway was an early supporter of the Kyoto Protocol under the then Prime Minister Gro Harlem Brundtland. Later, it sided with USA, Australia, Japan and other nations, the so-called "Umbrella Group". This (unofficial) group of nations was heavily criticised by the international NGO network Climate Action Network (CAN), for blocking progress in finalising the Kyoto Protocol. In the climate negotiations in Marrakech in 2001 Norway finally left the Umbrella Group and sided with the EU. Since 2001 Norway has aligned itself more closely with the EU, basically in order to get access to the early emissions trading system that the EU has organised. Since 2001 the EU has incidentally has also shown increasing interest in CCS as a mitigation technology.

In the ongoing climate negotiations, Norway is now arguing for CCS to be included in the Clean Development Mechanism (CDM) under the present protocol.[51] If the parties to the Protocol accept CCS projects in principle as part of the CDM, the board that evaluates and accepts projects can also include CDM projects if they fulfil the requirements regarding methodology for accounting etc. So far, Norway has gained some support from the EU and other countries, but Brazil and other developing countries have opposed the inclusion of CCS in the CDM. How much influence Norway is able to wield on this issue, is difficult to say. In general, small nations like Norway can only influence international negotiations by the strength of their argument, since

[51] http://www.regjeringen.no/nb/dep/md/aktuelt/nyheter/2007/CO2-handtering-til-u-land-gjennom-gronne.html?id=493390 Read 15 April 2008

it does not have the economic might or other means of exerting power of the big nations. If Norway has had an influence on the climate negotiations in the past, it has been because of the arguments and expertise it could bring to the negotiating table. CCS is undoubtedly an area where Norway has expertise to bring, but the question remains: how good are the arguments?

The future of CDM as part of a future climate agreement for the period after 2012 is under debate, and no one can say at present if it will survive in the present form, or if it will be substituted by a radically different system. The Climate Action Network (CAN) is highly critical of CDM because of the previous experience with the many projects that have had negative environmental and/or social impacts in the host countries, as well as highly questionable real climate benefits. CAN therefore demands a totally different system with real environmental and social integrity, or if the system is kept in its present form, it should at least have a very much stricter set of criteria for the adoption of projects.[52]

The NGOs following the negotiations as part of Climate Action Network have already adopted a common position that they do not want CCS as part of CDM within the first Kyoto period, up to 2012. The reason given for this has been that the technology is largely untested. It needs to be much more developed and tested in affluent areas of the world that have the necessary technological and scientific expertise before it is applied in developing countries with much poorer scientific and technological resources to monitor for leakage etc. The monitoring of CO_2 deposits to prevent leakages and other technical problems are at present also outside the scope of most developing countries.[53]

So why is Norway promoting CCS in the climate negotiations? The official answer is that Norway wants to help developing countries to put this technology into practice, and because inclusion of CCS projects in the CDM will be the best way of securing a standardised set of rules for an environmentally safe way of using CCS. This is not necessarily untrue, but there are also other plausible reasons behind Norway's efforts to include CCS in the CDM, as we shall see.

One interpretation is that Norway sees the need to spread the technology and increase the number of projects. A greater number of projects will speed up the learning process and reduce the cost per ton of captured CO_2. In the development of new technologies, one often talks about "learning curves". Simply put this means that there is a relationship between the number of units of a product and the cost of production for one unit. A commonly used example is the production of the processors that are at the heart of PCs and a lot of other applications. A doubling of the number of units produced usually leads to a 50-per-cent reduction in production cost. This is then the typical "learning curve" for this particular technology. By getting CCS included in CDM, the hope is that it will lead to many more units being built with the help of the extra money that selling CDM certificates can provide.

The idea is to create a win-win-win situation. First, the Norwegian government hopes to buy CDM certificates from CCS plants in other countries in order to cover Norwegian Kyoto obligations. Then, because of the lower cost of CCS as a result of more units being built, CCS will also become cheaper to build in Norway. This will make future oil and gas extraction from the (rapidly diminishing) Norwegian oil and gas fields more economical. The Norwegian government also hopes to get other countries to

[52] http://www.climnet.org/pubs/CAN%202008%20March%20Article%209%20submission_FINAL.pdf Read 15 April 2008

[53] http://www.climnet.org/EUenergy/CCS/positions/NGO%20position%20on%20CCS%20in%20CDM.pdf Read 15 April 2008

provide money for CCS projects through technology transfer funding. Several mechanisms are being set up to help the developing countries to combat climate change by enabling them to use more advanced technology. If CCS could be one of the technologies financed through these mechanisms, it would be even better for Norway.

Air Pollution & Climate Secretariat
(former Swedish NGO Secretariat on Acid Rain)

The essential aim of the Secretariat is to promote awareness of the problems associated with air pollution and climate change, and thus, in part as a result of public pressure, to bring about the needed reductions in the emissions of air pollutants and greenhouse gases. The aim is to have those emissions eventually brought down to levels that the environment can tolerate without suffering damage.

In furtherance of these aims, the Secretariat:

- Keeps up observation of political trends and scientific developments.
- Acts as an information centre, primarily for European environmentalist organizations, but also for the media, authorities, and researchers.
- Produces information material.
- Supports environmentalist bodies in other countries in their work towards common ends.
- Participates in the lobbying and campaigning activities of European environmentalist organizations concerning European policy relating to air quality and climate change, as well as in meetings of the Convention on Long-range Transboundary Air Pollution and the UN Framework Convention on Climate Change.

Norway has taken a particularly close interest in the development of carbon capture and storage (CCS), despite the fact that the country's oil reserves are dwindling.

Strong economic and political motives, combined with a partly positive and partly silent NGO community, has contributed strongly to the present powerful commitment towards the use of CCS in Norway.

The overall effect of this commitment has been a negative impact on efforts to reduce emissions of greenhouse gases in other sectors, especially the transport sector, where emissions are growing fastest.

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