CCS: a key driver for successful climate change mitigation

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From the Arctic cold of Northern Norway and the burning heat of the Sahara desert to the wide open prairie of the USA and Canada, carbon capture and storage (CCS) is already being put to use on an industrial scale. CCS is a climate mitigation tool with demonstrated effect that captures the greenhouse gas carbon dioxide (CO_2) from large point sources and locks it away in deep geological reservoirs away from the atmosphere. If we need to achieve significant CO_2 reductions in the coming decades – and I believe this to be the case – CCS should play a crucial part alongside energy efficiency, fuel switching (e.g. coal to natural gas) and renewable energy. Handling CO_2 represents such an important challenge for the oil and gas industry as a whole, that most likely we will have no option but to fully implement and utilise all these tools in our efforts to successfully manage climate change mitigation.

A credible role for CCS

Can we possibly move from our status quo towards a fully-fledged CCS industry over the next 10-30 years? There are no straight answers to that question, but in my opinion the one thing most needed is a sufficiently high and global cost of emitting CO_2 to the atmosphere to support climate change mitigation. This may seem like an unexpected point of view coming from an international oil and gas company. However, it is my belief that nothing is gained by the industry ignoring the issues in our global society as a whole. Producing enough and affordable energy in order to raise the standard of living of billions of impoverished people in developing countries is one of those critical issues that needs to be addressed and resolved. Climate change is another – and very closely linked – challenge.

Extensive experience with geo-storage

Several aspects of the CO_2-capture, transport and geological storage process are already quite well known to the oil and gas industry. Even so, when compared to the huge global climate change mitigation task at hand, the CCS process as a total chain from source to sink is still in its infancy. There are about five CCS-projects of significance in the world today: Sleipner (Norway), Snøhvit (Norway), In Salah (Algeria), Rangely (USA) and Weyburn-Midale (USA/Canada). These projects all have in common that the CO_2-capture takes place at high pressure and that the cost is baked into the larger cost of the facility as a whole. Thus far no large scale CO_2-capture projects from flue gases (power plants, industrial flue gas) have been realised. Cost estimates for such plants vary by several hundred per cent depending on country, company, retrofit or new-build, brown-field or green-field and so forth. The cost structures are uncertain, particularly for the large CO_2-capture structures and technologies needed. This is one of the main reasons why the Norwegian government, Statoil and Shell joined forces to build the US$900 million European CO_2 Technology Centre Mongstad in order to test and verify improved CO_2-capture technologies from combustion sources. Earlier this year, South Africa's Sasol also joined the consortium

There is a substantial and growing support of CCS in the political sphere. One prime example is that the European Union has now started its CCS Demonstration Programme which currently includes six demonstration projects that should be operational by the end of 2015. For the EU, this demonstration programme is essential in order to accelerate technology development, drive down costs, build public confidence – and ensure CCS is commercialised by 2020. As a global solution to combat climate change, CCS is also seen as a way to boost European industry, creating new jobs and promoting technology leadership. As part of the EU recovery package, €1.050 billion has therefore been set aside for funding these demonstration projects.

The new energy and climate package from the EU includes a CO_2-storage directive as well as a revision of the EU emission trading system (EU ETS) that provide regulatory framework and financial incentives for CCS. The CO_2 storage Directive has now to be transposed in EU Member States before June 2011. It proposes rules for managing environmental risks and addresses issues such as exploration permits, storage permits, CO_2 stream, leakages, closure and post-closure obligations by operators and transfer of responsibility. As part of the revision of this Directive in 2015, the EU could even introduce mandatory CCS for all new power plants.

Commercial challenges

A variety of unsolved issues must be addressed and solved before CCS can realise its full potential as a mainstream mitigation vehicle:

- The industry must be convinced that the long-term cost of emitting CO_2 to the atmosphere will be as high or higher than the cost of CCS.
- The capital cost and energy use associated with CO_2-capture must be reduced.
- The risk and liability issues associated with the operation and the CO_2-management after the storage has been closed needs to be fully examined and resolved. The risks of seepage from a storage reservoir are low. However, the financial burden may be perceived as too high for industry and insurance companies compared to the long-term cost savings.
- Agreements allowing countries to store CO_2 in other countries need to be put in place in order to allow for large-scale CO_2

projects such as in the North Sea and elsewhere. In this specific case the recent change of the London Protocol is an important step forward in the right direction.

• The general public and key regulators must identify, understand and support CO_2-storage as a sound, safe and sustainable way of managing CO_2.

CO_2 is today mostly emitted without cost

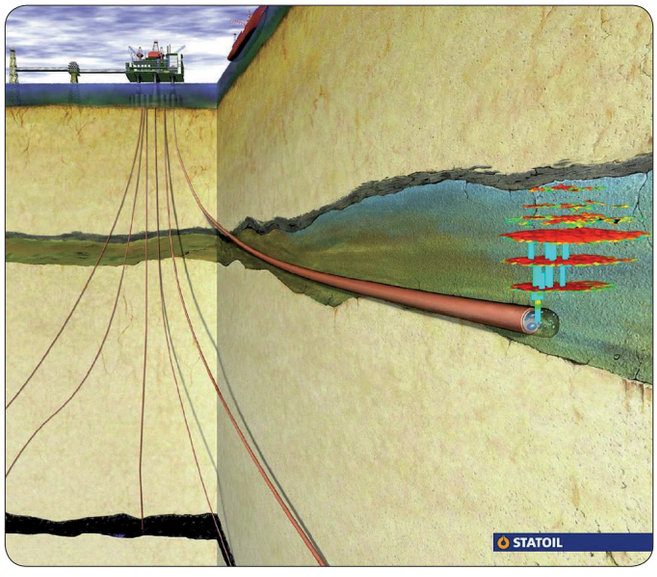
For centuries, mankind has been emitting CO_2 to the atmosphere. For the most part these emissions do not have any costs attached. One of the most important factors holding back the deployment of CCS – and indeed all other climate change mitigation efforts – is therefore the lack of a world-wide, sufficiently high and predictable CO_2 price.

CO_2 and enhanced oil recovery (CO_2-EOR)

In 1972, the use of injected CO_2 for getting more oil out of old reservoirs was tested in Texas for the first time. The US is still the front-runner in regards to this oil recovery technology, having some 100 ongoing projects based on naturally occurring CO_2-reservoirs. These projects have provided instrumental learning which has greatly benefited the development of the CCS technology used in projects around the world. A system of 5,000 kilometres of CO_2-pipelines is in place to transport CO_2 in the US and in recent years the technology of CO_2-EOR has spread to countries such as Canada, Brazil, Mexico, Trinidad & Tobago, Turkey, Slovakia and others. Moving forward, it is expected that the Middle East will be an interesting region for CO_2-EOR developments. In October 2009, Saudi Aramco announced that they will be injecting nearly a million tonnes of CO_2 per year from 2013 into the Ghawar oil field. This, I understand, is a pilot project to explore the opportunity for later, larger scale CO_2-EOR in this mammoth field, the world's largest known oil accumulation.

Next steps?

It is my opinion that CCS will move towards becoming more than a strategy for 'clean coal', the current focal point of CCS in energy policy worldwide. However, I find it likely that the major oil and natural gas companies will continue to dominate geological storage of CO_2, while other players will dominate the capture and transportation business. My reasoning for this is as follows; the oil and gas companies have many years' experience of extracting oil and gas from and injecting fluid substances back into geological formations. Secondly, the oil and gas companies are moving into reservoirs with increasingly carbon-heavy oil. Finally, the industry must start to prepare and adjust to these new technologies and tools since regulators and the public in the future will no longer



The Sleipner CO_2-injection located in the middle of the North Sea was the world's first CCS scheme with climate change mitigation as its sole purpose. Here some one million tonnes of CO_2 per annum has been injected into a sandstone formation located one thousand metres below the sea-bed since its start in 1996

approve the high CO_2 emissions of today's and the industry have no option but to enforce sustainable operations.

With time, CCS will not only become an integrated part of the oil and gas industry, but it will also be adopted by utilities owning power plants fired by coal, oil, natural gas and biomass. We will also see CCS in the fuel transformation sectors (e.g. refineries) and in emission-intensive industrial sectors such as cement, iron and steel, chemicals, pulp and paper. The present policies and technologies do not take this variety into account, but I think they should, and in ways that does not give rise to serious distortion of competition.

We are also observing an emerging CCS-technology which is highly compatible with energy efficiency, alongside which renewables, fuel switching and nuclear can make a real difference in the fight against climate change. Pioneers among industrial actors, governments, researchers and environmental NGOs are also enthusiastically exploring this path. There are of course, some groups sceptical towards CCS that question its safety and whether the CCS technology will shift the focus from renewable energy or energy efficiency. In my opinion we need all these tools to address climate change and secure sufficient and affordable energy. Therefore, my hope is that CCS will take its place – and be broadly accepted – as a climate solution from an industry seeking not only to be part of the problem, but also aspiring to be a significant part of the solution. ❑