Review of the CCS-directive

The CCS–Directive: A directive for the wrong direction
By NOAH Friends of the Earth Denmark

NOAH Friends of the Earth Denmark want to participate in the review of the CCS-directive with some fundamental objections to the very concept of carbon capture and storage.

We draw on some position papers and on our English language website about CCS: http://ccs-info.org besides the paper we published in 2010 about the climate efficiency of CCS.

The agenda is:

1. The idea
2. The timing and the urgency
3. The climate effects
4. The environmental effects
5. CCS and water
6. The proponents and their reports

Item 1: The Idea
The idea of capturing and then storing CO2, whether it stems from electricity generation plants, industrial processes or fuels production, may seem obvious and alluring at first glance.

It sounds almost too good to be true, if we can take care of climate change concerns and secure business as usual for everyone involved in producing, selling & buying and consuming fossil fuels and the electricity and industrial products that rely on these fuels. And it is too good to be true.

If such a first glance is not followed by a critical scrutiny of the whole idea but rather with a stream of reports that all are convinced of the advantages of CCS then the general public and decision-making politicians could be lured into a positive attitude and large hand-outs.

We have seen this happen at least with many politicians over the last 15 years where we have followed CCS.

Our critical faculties were alerted from the beginning when we saw who was behind the idea, namely the producers and big consumers of fossil fuels.

We have looked into different aspects of the technologies and this process has made us more and more convinced that CCS is not a proper tool for mitigating climate change and it cannot even be considered a 'bridging technology'.

We also object to the two most recent proposals to help CCS grow beyond the pilot and demonstration levels, namely Enhanced Oil Recovery and BECCS.

Item 2: The timing and the urgency

Any strategy and any tool for mitigating climate change must be able to deal with the urgency we are facing as humanity. The urgency is best expressed by calculating the remaining carbon budget and the greenhouse gas reduction pathway this budget requires.

We relied firstly on calculations made by ourselves as participants in the Sustainable Europe[1] project 1993-1999. In 2008 we updated these calculations with input from IPCC's AR4.
In April 2009 M. Meinshausen et al. published an article in Nature that established a GHG-budget that became a point of reference in the following years.
In 2008-2009 we were involved in the preparations for Stockholm Environment Institute's report for Friends of the Earth Europe: "Europe's Share of the Climate Challenge - Domestic Actions and International Obligations to Protect the Planet".[2]
Also Ecoequity's work with GDR, Greenhouse Development Rights has given us direction. We participated in their analysis of Denmark in a GDR perspective.[3]
The most dire – and compelling - predictions has come out of The Tyndall Centre for Climate Change (Kevin Anderson and Alice Bows). Here a quote from "Climate change going beyond dangerous – Brutal numbers and tenuous hope" by Kevin Anderson:

> "For long-lived gases such as CO2 and many other greenhouse gases, *cumulative* emissions, the stock that builds up in the atmosphere, is the quantity that matters. Every day we turn the lights on, every time we drive a car we add to the accumulating stock of atmospheric CO2. Our cumulative emissions – and our *carbon budget* – are pivotal to understanding temperature and climate change. This insight is fundamentally important; it exposes how inadequate it is to aim for long-term, gradual reductions to be delivered by future technology while highlighting the need for urgent and radical reductions that we need to bring about now. That is obviously much less attractive. Hence we shy away from addressing cumulative emissions. We much prefer to stick to long-term targets. They may prove meaningless with respect to global warming but they are tailored to cater for our cognitive dissonance. Bringing in the science reveals what we are not prepared to countenance – that we have to make changes to our lifestyles today." [4]

In IPCC's AR 5 the GHG-budget at last has made its way to the front. Here it is expressed in the RCPs (Representative Concentration Pathways) - where only one of them in fact, RCP 2.6, has a reasonable likelihood of securing a future below 2° C.

It is in this understanding of the limited GHG-budget that we wrote the paper "An assessment of cumulative CO2 reductions from carbon capture and storage at coal fuelled plants in a carbon

[1] Sustainable Europe was a project with 31 groups from the network Friends of the Earth Europe and with Wuppertal Institute as consultants. See endnote.
[2] Charles Heaps, Peter Erickson, Sivan Kartha, Eric Kemp-Benedict: *Europe's Share of the Climate Challenge - Domestic Actions and International Obligations to Protect the Planet.* www.sei-international.orgNovember 2009
[3] Sivan Kartha, Tom Athanasiou, Paul Baer and Eric Kemp-Benedict: *A Greenhouse Development Rights analysis of Denmark's role in a climate constrained world (in the context of the EU's proposed 2020 targets and approach to effort-sharing)*. Ecoequity and SEI. March 2009.
[4] http://www.whatnext.org/resources/Publications/Volume-III/Single-articles/wnv3_andersson_144.pdf

constrained world" in 2010[5]. The conclusion here is that if CCS is deployed in the manner prescribed in "IEA CCS Roadmap 2009"[6] then *only roughly 10% of the CO2 from the large point-sources in electricity generation would be stored - and not reach the atmosphere.* In other words: Approximately 90% of the emissions would reach the atmosphere and completely burst the narrow budget.

This, in our view, is the most compelling argument against CCS. Not the only one, though.

Item 3: The climate effects

The main argument *for* CCS is the hypothetical removal and storage of 85-90% of the emissions from e.g. a coal fired power plant.

Even without looking at the climate efficiency over time for the whole fleet of coal fired power plants (as we did in our paper) then the climate efficiency of a single plant is still far from the promised 85-90%. This is mainly due to the energy penalty that comes with CCS but it is also due to the very large infrastructure needed: the capture part, the pipeline and the injection facility. All this reduces the efficiency to roughly 70%. If the atmosphere has to receive 30% of these emissions it would already be more than the CO2-budget can allow.

For more: see http://ccs-info.org/climate-efficiency.html

Item 4: The environmental effects

CCS is inevitably causing a series of effects on the environment – before, during and after the capture. The greater part of these adverse effects are inevitable results of the energy penalty of CCS. But the capture process itself has also harmful effects with the large amounts of chemicals involved.

For more: see
http://ccs-info.org/environment.html
http://ccs-info.org/onewebmedia/Environmental%20Effects%20related%20to%20CCS.pdf

Item 5: CCS and water

Reports from The U.S. Department of Energy (DOE) in 2008 showed that CCS would add significantly to both the water withdrawal and water consumption.[7]

Thermoelectric generation without CCS is already responsible for the largest freshwater withdrawal in the US. With CCS it would basically double for some of the technologies.

The U.S. Geological Survey (USGS) estimated that thermoelectric generation accounted for approximately 41% of freshwater withdrawals, ranking slightly ahead of agricultural irrigation as the largest source of freshwater withdrawals in the U.S. in 2005. However, thermoelectric water consumption accounted for only 3% of total U.S. freshwater consumption in 1995 (Figure 1). A recent DOE/NETL study estimated that in 2005 total U.S. freshwater withdrawals for

[5] Kim Ejlertsen and Palle Bendsen: *An assessment of cumulative CO2 reductions from carbon capture and storage at coal fuelled plants in a carbon constrained world*. NOAH Friends of the Earth Denmark, July 2010. http://ccs-info.dk/cumulative_co2.pdf

[6] http://www.iea.org/papers/2009/CCS_Roadmap.pdf

[7] http://www.netl.doe.gov/File%20Library/Research/Energy%20Analysis/Publications/WaterRequirements.pdf

thermoelectric power generation amounted to approximately 146 billion gallon per day (bgd), while freshwater consumption was 3.7 bgd. When evaluated in terms of the two types of cooling water system designs described above, once-through systems are thought to have high withdrawal but low consumption, whereas plants equipped with wet recirculating systems have relatively low water withdrawal but high water consumption.

Source: Determining Carbon Capture and Sequestration's Water Demands,
http://www.powermag.com/determining-carbon-capture-and-sequestrations-water-demands/?pagenum=2

In this article (Determining Carbon Capture and Sequestration's Water Demands,) the authors describe various ways to '*mitigate the impacts of CCS on power plant water use and allow for continued development of energy resources.'*

Despite technological improvements with respect to cooling the freshwater requirements and pollution in the extraction of coal will continue and the water requirement due to the capture process will not be mitigated.

Therefore it remains in our view critical to thermoelectric generation with CCS that the water requirement will increase. Every summer both nuclear and fossil fired power plants have to reduce production or even shut down due to lack of cooling water.

See also: http://ccs-info.org/ccs-and-water.html

Item 6: The reports

Over the years a large number of reports and papers about CCS have been published, notably from bodies like IPCC and IEA, but also from universities, research institutions and special interest groups like the Carbon Sequestration Leadership Forum.

But none of them contain assessments of the mitigation potential of CCS over time.

The reports typically contain:

- a description of
    - different CO2-capture technologies
    - storage potentials
- assessments of
    - costs of capture, transport and storage
    - reduction potential for different technologies
    - risks of leakage

Most reports go directly to detailed descriptions of different technologies and to similar descriptions of storage possibilities.

Most reports seem more occupied by the costs of different technologies than their mitigation potentials.

Some reports address the liability issues related to storage (especially onshore) and some also address the necessary public acceptance of CO2-storage as a prerequisite for the wider deployment of CCS.

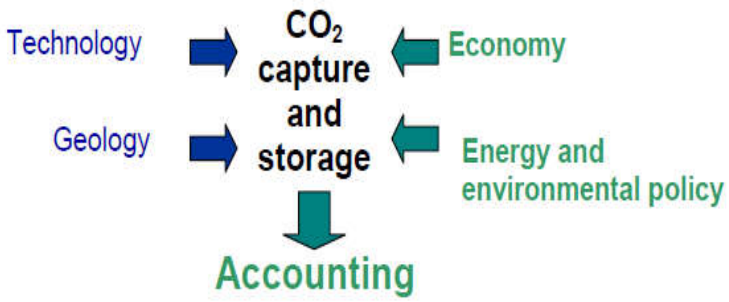
Some reports assess *environmental* impacts, but typically only at the capture-plant and after. Very few take into account also the upstream environmental impacts due to increased mining etc. This is similar to assessments of reduction potentials: it is the theoretical capture that is typically used.

The reduction potential is typically described on “plant level” or in a given year, typically 2030 and 2050. But it is not calculated against the overall emissions for the next 2-4 decades. If the budget approach (or the concept of environmental space) had been applied these calculations would have been inevitable.

“CCS will be vital to the decoupling of CO2-emissions from coal use” (Presentation by Paul Freund, IEA at CAN Europe conference 2004)

This is a claim that is repeated uncritically from report to report and from paper to presentation world wide – without any in-depth evaluation of the claim.

Figure 1: Factors influencing CCS and their Success in Reducing Anthropogenic CO_2 Emissions



Source: CARBON DIOXIDE CAPTURE AND STORAGE ISSUES – ACCOUNTING AND BASELINES UNDER THE UNITED NATIONS FRAMEWORK CONVENTION ON CLIMATE CHANGE (UNFCCC); IEA INFORMATION PAPER, 2005

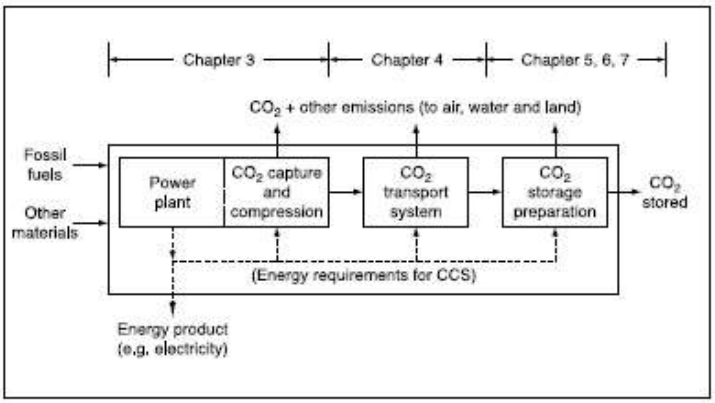


Figure 1.5 System components inside the boundary of Figure 1.4 for the case of a power plant with CO_2 capture and storage. Solid arrows denote mass flows while dashed lines denote energy flows. The magnitude of each flow depends upon the type and design of each sub-system, so only some of the flows will be present or significant in any particular case. To compare a plant with CCS to another system with a similar product, for example a renewables-based power plant, a broader system boundary may have to be used.

http://www.ipcc.ch/pdf/special-reports/srccs/srccs_chapter1.pdf

These figures are typical of the "inside-the-box"-thinking that is characteristic for many of the reports on CCS. Broader systemic considerations are not included: What are the scenarios CCS should fit into? How does CCS work with energy scenarios increasingly relying on renewables?

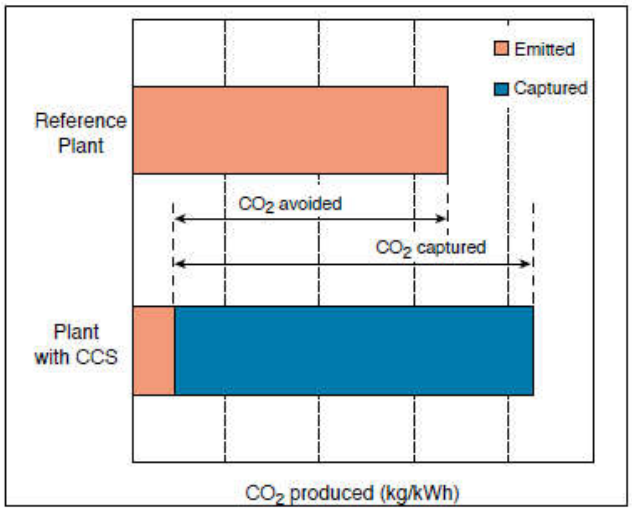


Figure SPM.2. CO_2 capture and storage from power plants. The increased CO_2 production resulting from the loss in overall efficiency of power plants due to the additional energy required for capture, transport and storage and any leakage from transport result in a larger amount of "CO_2 produced per unit of product" (lower bar) relative to the reference plant (upper bar) without capture (Figure 8.2).

IPCC, 2005
This is how the energy penalty is presented by bodies like IEA and IPCC.

It has set a standard that excludes the penalty pertaining to the mobilisation of extra fuel (e.g. mining and transportation of 25-40 % extra coal), the construction of the very large industrial plants that are the capture part plus the very large infrastructure that is necessary for the transportation of the captured and compressed CO2.

Altogether this has a large extra energy penalty.

But it also comes with a "steel penalty". Concerning the infrastructure see the quotes below from the Pembina report:.

> If CCS were to be implemented on a global scale, the volume of CO_2 to be transported would equal or surpass the combined volume of shipments of oil, coal, cement and cereals. The IEA cautions that: "In the long run, total CO_2 shipment could be of the same order of magnitude as shipments of all existing commodities put together. Therefore, the challenge of putting in place an appropriate transportation system for CO_2 should not be underestimated."[136]

Mary Griffiths, Paul Cobb, Tom Marr-Laing
Carbon Capture and Storage: An arrow in the quiver or a silver bullet to combat climate change?
November 2005

http://www.pembina.org.

It is remarkable that the fact that CCS is expected to result in large increases in water withdrawals as well as water consumption are omitted in the CCS-reports, especially when you consider that one of the most compelling arguments for CCS is the perspective that it may be applied to the expected growth in coal fired power plants in China, India and other fast growing economies.

In these countries it is well known that the contention over fresh water is tough and bitter between production of food and industrial purposes incl. power generation.

This is of course also the case in Southern parts of the US and in Southern Europe, especially France and Spain.

ENDNOTE

Sustainable Europe
From 1993-1999 Friends of the Earth Europe was running a very successful campaign called The Sustainable Europe Campaign. It was guided by the pioneering work done by Milieudefensie (FoE-Netherlands) in the run-up to the Rio Conference in 1992 and scaled up to a Europe wide campaign with participation of 31 national FoE-groups and with the Wuppertal Institute working as a consultant.

The fundamentals of the campaign was the concept of environmental space (ES) which, when speaking CO2, is defined as the science based recommendation for fulfilling the objective of the Climate Change Convention for 2050. For many years science has recommended a global halving of the emissions for 2050. The ES concept combined this scientific based limit set for the considerations for future generations with the normative global equity principle set for the consideration of present generations.

Combining a global halving of emissions with the world population we calculated the ES per capita and compared with the actual emissions in 1990 which was the reference year at that time. In that way we came up with solidly based targets for rich OECD countries. People could see the need for the global halving in emissions and they could see the fairness of the rich high emitters to do most (calculations in most cases turned out with 80-90% reductions). From this work combining science with equity the concept of Factor 10 emerged and for many years we marketed how the Factor 10 could be achieved by the combination of technology change and improvements combined with changes in lifestyle.

ES is described in dozens of reports with “Towards Sustainable Europe, The Study, 1995” as the first document of the FoEE ES campaign and the book “Sharing the World, 1998” that summed up the whole campaign.