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BELLONA

CARBON CAPTURE AND STORAGE

MAKING IT HAPPEN

May 2008

CCSA Carbon Capture & Storage Association

ETP-ZEP European Technology Platform Zero Emission fossil fuel Powerplants

CO_2 Capture Project

CARBON CAPTURE AND STORAGE

MAKING IT HAPPEN

A High-Level Roundtable

co-organised by *Friends of Europe*, The Bellona Foundation

and the European Technology Platform

for Zero Emission Fossil Fuel Power Plants (ETP-ZEP)

With the support of the Carbon Capture and Storage Association (CCSA)

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TABLE OF CONTENTS

INTRODUCTION

This report presents the outcomes of *Friends of Europe*'s roundtable debate **"Carbon Capture and Storage: Making it happen"**, held on Tuesday 27 May 2008. The roundtable discussed the role of carbon capture and storage (CCS) in preventing climate change and the crucial issue of who would have to pay for it – industry, the EU or member states.

CCS involves reducing carbon emissions from fossil fuel power plants and other heavily emitting installations such as steelworks and cement factories. The process consists of three stages – capturing the carbon; transporting it by pipeline or ship; and storing it in suitable geological formations. Although there are no full-size CCS plants in operation, all the necessary technology is already in use for other purposes – it has just not been put together to create CCS.

While there are challenges in transporting and storing CO_2, they are relatively straightforward. Capture is the most complex and expensive stage, accounting for about 80% of the cost of CCS. There are three options:

- Pre-combustion capture converts the fossil fuel (the technology can be used for coal, oil or gas, and indeed for biofuels) into a mixture of hydrogen and CO_2 and then separates the CO_2, leaving the hydrogen to be used as a clean CO_2-free fuel.
- Oxyfuel capture burns the fossil fuel in pure oxygen rather than air. This raises the combustion temperature and produces CO_2 and steam. The CO_2 can be trapped by condensing the steam.
- Post-combustion capture removes CO_2 from the exhaust gases using solvents.

EU Energy Commissioner **Andris Piebalgs** set out the case for CCS and explained why industry should retain some of the risks of development. He added that he was interested to hear industry's views on how to proceed. CCS was not an energy priority, but a climate change issue, he pointed out.

The key issues around CCS are whether it has a role to play in cutting emissions, how important that role is and, if it does have a role, who should fund its development. The roundtable gathered together key stakeholders from the European Commission, the European Parliament, industry, the world of finance, national governments, NGOs and the research community.

With the exception of some environmentalists, there is consensus that CCS has a valuable role to play in reducing emissions and on the need to move forward quickly with the development of CCS. That is where agreement ends, though. What technology will emerge, who will pay for it, where demonstration projects should go – all these issues remain unresolved.

Progress is being made – but it is slow: the UK is currently considering entrants to its CCS competition, which will put forward funding for post-combustion CCS technology, while Sweden's Vattenfall has a number of projects ongoing and Norway's government has committed to funding the CCS costs of two full-scale gas-fired power plants.

Jerzy Buzek MEP, Andris Piebalgs and **Giles Merritt**

KEYNOTE ADDRESS

Friends of Europe's roundtable on CCS was kicked off by a keynote address from Commissioner Piebalgs, EU Commissioner for Energy, who said that the debate on CCS was extremely important. There were two sides to the debate that we should not forget – the reasons for which CCS is necessary and the need to garner public support for the technology.

Piebalgs told the roundtable about a letter he had received, urging him to resist calls from the oil and gas industry to pump taxpayers' money into the development of CCS. "So it is clear there is a part of society that is worried that CCS is putting money from taxpayers into the pockets of energy companies," he said. But for the Commissioner CCS is not an energy policy priority – it is a climate change priority. The EU would be able to meet its target to cut CO_2 emissions by 20% by 2020 (or 30% if other nations agreed on a global climate change deal). However, looking forward to 2050, when emission levels need to fall by 60-80%, "I cannot see how we can do this in Europe without CCS".

It was essential for keeping on board states such as Poland, where 90% of energy comes from fossil fuels, and others that have relied on coal and would like to work with clean coal in future. China, for example, endorses the spread of energy efficiency and renewable energy, but "we know that 70% of all its energy still comes from fossil fuel generation". Unconventional oil sources become more viable at an oil price of $130 a barrel, but their emissions are very high, he added.

Regulatory help

The European Commission is introducing two very important instruments to facilitate the uptake of CCS – the first was the draft Directive on Geological Storage of CO_2, on which Piebalgs called for more debate, because "if it is adopted without society knowing about it, there will be a backlash". The second weapon is the EU Emissions Trading Scheme (ETS), which provides the main incentive for industry to invest by giving the price signal necessary to encourage

CCS. "Both need to be discussed because if we get either one wrong the whole effort will collapse – these are the two cornerstones for the next steps we need to take," he added.

Why not just regulate like the EU did with cars (the Commission could make CCS technology mandatory on all new power stations), a technology producer had asked recently. By 2020, all power plants could be forced to be capture-ready with CCS and by 2025, and there could be regulation on the average amount of CO_2 per kW/h that installations would be allowed to emit, the producer had said. "I have some difficulty with regulation because we still do not know the real costs of CCS," Piebalgs said. "To have regulation, we need to have at least some idea of the costs. For that, we need demonstration projects and for the technology to be tested on a broader scale." The demonstration projects would also reveal whether there was any weight to the objections that organisations such as Greenpeace had raised, he added.

"CCS is necessary if we are serious about fighting climate change. It is not about pumping taxpayers' money into energy companies' pockets. I wish we could move to a carbon-free society without CCS, but [this] is not possible, so we should be serious about it."

Andris Piebalgs, EU Commissioner for Energy

Demonstration projects

So that is the third challenge – to have large-scale demonstration projects. According to the Commissioner, the industry is really engaged with this challenge, because they would prefer to stick with what they know. As their expertise is in fossil fuels, they would like to continue to work in this area, he noted. While Andris Piebalgs acknowledged that additional incentives would be needed in the first instance, "we want industry to take some risks," Piebalgs said. He supported the UK approach (it is funding one commercial-scale power plant

with CCS and will pay for the CCS aspect), but he did not see the same eagerness in other countries. “We need to discuss how to use the ETS mechanism from 2013, when we could have the right price,” but before that, “we need to support a limited number of demonstration projects”.

CCS was absolutely necessary to meet climate change goals globally, the Commissioner concluded, and the Commission had put in place the cornerstones. Action was now needed in the Council of Ministers and the European Parliament to move things forward from research and development to demonstration. “We need to find the best support schemes to allow the industry to go further, but we must not take away the commercial risks. Industry has to take part of the risk – it is not a free ride,” he said, calling on the industry to be more courageous while the political climate was right.

CCS AND CLIMATE CHANGE

Bridge to sustainability

CCS is necessary because we have a serious global warming problem and we need to see what kind of technological options we have to solve the problem, said **Frederic Hauge**, President of The Bellona Foundation. "If we are to come close to cutting CO_2 emissions by 50% over the next 40 years, there is no way around CCS," he said. He noted that for China and India, coal-fired energy was the only way they could create welfare, while CCS was the only way they could control their emissions. "CCS is the bridge to a sustainable society and there is an extreme need to encourage the early movers and risk-takers. I hope the industry and the Commission will reach agreement on how to finance a Flagship Programme to get the necessary experience," Hauge said. "If we react too late, we risk the EU being without influence on the technology," he added.

However, there is no new coal-fired power plant with CCS being developed because gas-fired combined cycle plants are cheaper, quicker and more flexible, said **Henry Edwardes-Evans**, Managing Editor of *Platts Power in Europe*. While Germany was developing some coal plants, a number of others had been put on hold for cost reasons, he added. Nor was there much in the way of new nuclear capacity coming on stream. So, would the ETS support CCS over the next few years? "I would suggest the contribution will be minimal over the next 10 years or so. The current ETS price of €25 per tonne is not nearly enough to support clean coal with CCS at current estimated costs," Edwardes-Evans said. Something

"CCS is the bridge to a sustainable society and there is an extreme need to encourage the early movers and risk-takers. I hope the industry and the Commission will reach agreement on how to finance a Flagship Programme to get the necessary experience."

Frederic Hauge, President of The Bellona Foundation

over €40 could be necessary, but there is potential for a limited number of CCS projects to receive multiple allowances from a CCS reserve fund, he added.

Short-term incentives

The key question, according to **Gardiner Hill**, Chairman of the CO_2 Capture Project Executive Board and BP's CCS Technology Director, was who would pay. In the long term, the carbon markets should provide sufficient incentive but they

"Time is short and there is a real urgency to deploy the technology now. […] Work is ongoing to define a flagship programme and a network of cooperation so there is a high degree of shared learning."

Gardiner Hill, Chairman of the CO_2 Capture Project Executive Board and BP's CCS Technology Director

are unlikely to help in the short term, so industry needs short-term transitional incentives, he said. **Giles Merritt**, Secretary General of *Friends of Europe*, asked whether the €10bn or so required for the Flagship projects was committed and if so, by whom? Piebalgs said the commitment should come from industry. "It is a business opportunity and there should be a risk element." Hill added: "Industry is prepared to play its role and I do not want to underplay the role the industry will play. The specific commitment by industry is likely to be determined by the nature of the project, since the risk and commercial factors will be project specific," but neither Hill nor Piebalgs would commit to specific figures.

Both the International Energy Agency (IEA) and the Intergovernmental Panel on Climate Change (IPCC) had talked about the cost-effective role CCS could play in cutting about a quarter of the emissions necessary to meet the targets, said Hill. The oil and gas industry was confident in the technology and expertise it could bring to bear on all of the challenges of CCS – capture, transportation and storage. "It is clear that Europe needs a roadmap for CCS deployment," he added.

While the EU had taken a leadership position on CO_2 capture with geological storage, more is needed to be done on the policy framework and to encourage public acceptance. Europe cannot solve climate change on its own, so it should work at engaging and encouraging the developing world, particularly China, to deploy CCS.

Technology is the answer

There was a great deal of support in the European Parliament for Piebalgs' position, said **Jerzy Buzek MEP**, Member of the European Parliament Committee on Industry, Research and Energy and Rapporteur on the Strategic Energy Technology Plan (SET-Plan). However, he said there were problems in connecting energy policy with action on climate change.

"We, as the European Union, decided to be a leader in fighting climate change and that was the reason we introduced a carbon cost with the ETS – for the first time in history," Buzek said. The cost of carbon to the EU economy is about €60-

70bn, but the EU still wants to be competitive. The only way to reconcile these two facts is through technology, he pointed out, highlighting how technological advances have brought down the cost of desulphurisation in power plants. "Fifty years ago, the costs were up to 50% or more of generating costs. Now, it is 5-6% – a marginal cost – and that is because of technology."

Options were limited in terms of energy supply, Buzek added: nuclear power, renewables and fossil fuels were all that was available. He noted that there were problems with public acceptance of nuclear power, and even if it were introduced, nothing would be ready for 15 years. Renewables were not suitable everywhere and would reach no more than 20% of capacity in the next 15 years. In fossil fuels, oil and gas use involved political dependence, while coal was the most damaging in terms of climate change, "so the only response is CCS – we do not have any other solution".

"[The EU] must help the first movers because [CCS] is a very risky investment."

Jerzy Buzek MEP, Member of the European Parliament Committee on Industry, Research and Energy and Rapporteur on the Strategic Energy Technology Plan

However, some incentives for CCS must come from the EU because "we have introduced a carbon cost at EU level and the development of CCS means added value at an EU level". "We should help the first movers because it is a very risky investment," Buzek said. "We must bring together all our experience, not develop it separately in member states." Developing CCS was vital, "because we need to influence the technology used for example in China, which is installing a new coal-fired power station every week". It was up to Europe to develop CCS and then take it to China, India, etc.

Urgent action

"I want to make the case for very, very urgent action," said **Graeme Sweeney**, who spoke in his capacity as Executive Vice-President for Future Fuels & CO_2 at Shell International, adding his voice to those calling for transitional support for the first movers. Global demand for energy is rising, and if not constrained it will triple by 2050. The number of people is expected to rise by 50%, while the number of cars by 100% "and for the first time, conventional oil and gas will not keep up with demand. We will need all the solutions available to us," Sweeney said. "Is CCS to be done at the expense of energy efficiency or renewable energy? Not at all, we will need them all, as well as unconventional oil, contaminated gas, coal and nuclear power – and all this energy will be produced in a world where climate constraints will be more severe than we think."

Energy efficiency and CCS are not in competition, he added. "It is not an either/or situation; it is an and/and situation." If CCS were not deployable by 2020, an extra 230 Gt of CO_2 would be emitted by 2050, the equivalent of an extra 1ppm CO_2 equivalent in the atmosphere for every year that CCS deployment is delayed. "But we will only get to deployment by 2020 if we start now, so there is no time left for the conversation." Demonstration projects are needed to validate the technology, to discover the true cost of CCS and to begin the process of bringing costs down. Sweeney said the support should take the form of CCS certificates that were tradeable within the ETS. "We need to close it out this year if we want demonstration projects up and running by 2015. It is essential and it is now that action is required," he concluded.

"Is CCS to be done at the expense of energy efficiency or renewable energy? Not at all, we will need them all, as well as unconventional oil, contaminated gas, coal and nuclear power. […] It is not an either/or situation; it is an and/and situation."

Graeme Sweeney, Executive Vice-President for Future Fuels & CO_2 at Shell International

Bernard Frois, Director of New Energy Technology Programmes for the National Research Agency at the French Commissariat à l'Energie Atomique (CEA), backed up this view, saying: "Either we do it fast or it has very little meaning."

Competition for cash

There was an immediate counterpoint to this argument from **Monica Frassoni MEP**, Co-President of the GREENS/EFA Group in the European Parliament and *Friends of Europe* Trustee, who asserted that CCS was not a priority for Europe, although it could be for other regions. Instead the EU should focus on expanding energy efficiency and renewable energy solutions. "We cannot have a strategy encompassing everything. We have to choose priorities. CCS is a technology that is not where we would like it to be. A lot of actors in the US, such as banks, are backing off from CCS – and their need for CCS is more urgent because they have more coal," Frassoni said.

"It has not been shown that the normal European citizen should spend money on CCS rather than on renewables and energy efficiency. There is competition for resources and you cannot deny that reality."

Monica Frassoni MEP, Co-President of the GREENS/EFA Group in the European Parliament

As a result, CCS should not get "double credits". "It will kill the ETS and take money away from renewables," she added. "It has not been shown that the normal European citizen should spend money on CCS rather than on renewables and energy efficiency. There is competition for resources and you cannot deny that reality."

Willy De Backer, Director of the Global Footprint Network Europe, likened the debate on CCS to the situation a few years ago with biofuels, and contended that we would see similar levels of disenchantment. "It is not just about who will pay. You have to consider the possibility of leakages and whether coal will really last for the predicted 200-300 years," he said. "If we are addicted to oil, as George Bush said, then we should get rid of it as soon as possible. CCS is a bit like de-

veloping a medication for a hash user so he can use heroin later."

The arguments for CCS were based on the premise that "we have to have the same lifestyle and level of consumption in future that we have now. We have to start looking at this as one planet with limited resources. Fossil fuels have given us an unsustainable lifestyle."

Hans Bolscher, Director for Climate and Energy at the Dutch Ministry of Housing, Spatial Planning and the Environment, thought that CCS was necessary and that the issue was quite simple. "If we want something new and we need it fast, governments have to pay at the beginning. However, this is on the condition that once the technology is established, industry takes over the cost and does not complain that they have to take over paying the full price." It would cost €10-15bn to get the demonstration projects established – not a big amount, Bolscher said. "We spend much more on less important stuff." Frois concurred, saying: "I don't think money is the real issue. No-one is taking into account the trillions we spend on energy every year."

Some countries, such as Poland, Romania and Bulgaria, just could not afford to fund the technology because they were still developing, said **Andrzej Siemaszko**, Director of the National Contact Point for EU Research Programmes at the Polish Institute of Fundamental Technological Research. He called for something like the structural funds. It would also be difficult for the Polish government to justify spending enormous sums on CCS research when climate change was just not an issue.

Rod Christie, CEO of General Electirc Energy in CEE, Russia and the CIS, agreed that government funding was not the right way to go. "We need to create a framework under the ETS and let the market decide how best to proceed," he said, although the first projects would need support.

Jan Panek, Head of Unit for Coal and Oil at the European Commission Directorate General for Energy and Transport, suggested that meeting global targets on cut-

ting emissions was impossible without CCS. "We have to recognise that, while it is a sensitive topic for quite a few people, it is a technology that is unavoidable."

However, **Gavin Edwards**, Head of the Climate and Energy Unit at Greenpeace International, said that his organisation believed that CCS was not necessary to deliver the targets. "The only thing holding us back is politicians stopping us from taking the brakes off the development of renewables, energy efficiency and combined heat and power. These are key if we are to be successful."

But renewables and energy efficiency are not enough, according to Hauge. "We cannot exclude CCS from our tools to fight global warming," he added. Sweeney supported this view, saying: "We can have coal with CCS or coal without CCS, but we will have coal, and that is not our choice." CO_2 is an issue that should unite us, he said, and Europe needs to decide whether it wants to be a leader on the issue. "Why would you not want to find out over the next decade – at a cost of less than 1% of the total value of the ETS – whether this will work? You should want to know the answers to these things before you decide not to do it."

A long way to go

Edwardes-Evans summed up the first session by saying the debate on CCS was split: on the one hand, there were industry representatives, environmentalists and policymakers who believed that CCS was one of a portfolio of technologies that was needed. "For them, it is an and/and/and situation where we would need CCS **and** renewables **and** nuclear **and** energy efficiency." On the other hand, some NGOs and others were saying that it was an either/or debate and that placing a priority on CCS was wrong. "There is still disagreement on quite fundamental issues, when the message coming from industry and the Commission is that we need to move as soon as possible," he said. "We do not have the support system in place in Europe for these projects yet. The big question will be whether that support system can come out of policy going forward in the Parliament."

WHO PAYS?

Opening the debate in the second session, Giles Merritt said that financing was "the elephant in the room". "Technologically and organisationally, we have covered a lot of ground in a short time, but I am struck by how little ground has been covered on the very crucial question of who is going to pay for what," he said.

The Stern report pointed out that dealing with climate change now would be cheaper than dealing with it later, said **Paal Frisvold**, Chairman of Bellona Europa. According to the draft Directive on geological storage, the cost of dealing with emissions without storage would be €40bn higher. "There are some very clear economic figures showing that there is a good case for incentivising CCS now," he added, "but where do we find that kind of money?"

The Commission had suggested that the ETS would make it less expensive to pay for CCS technology than to pay for the carbon emitted by 2020, and there were several ideas on how to pay for the 10-12 demonstration projects. These included earmarking part of the income from auctioning EU emission allowances (EUAs) from 2013 or the "double credit" system. Support for demonstration plants could be complemented by making CCS mandatory at some point in the future. This latter idea appealed both to environmentalists and industry, "which would prefer to have a line drawn in the sand, beyond which they knew CCS would be compulsory". There were a number of questions that needed to be answered, including the carbon price at which industry would be incentivised to invest in CCS projects, Frisvold added.

Faith in technology

Technology would bring down the cost of dealing with climate change, said **Olivier Appert**, CEO of the Institut Français du Pétrole (IFP) and Vice-Chair of the European Technology Platform for Zero Emission Fossil Fuel Power Plants (ETP-ZEP). While CCS would create extra costs initially, all of the technologies to be used were already available, making it possible to estimate costs even though no full-scale plant was available. "We need to do CCS at a lower level than the car-

"It will be possible to decrease the costs of [CCS] in the next 15 years through technological developments, the scale effect and learning by doing."

Olivier Appert, CEO of the Institut Français du Pétrole (IFP) and Vice-Chair of the European Technology Platform for Zero Emission Fossil Fuel Power Plants

bon price, which we will be able to do through research and development and the learning curve effect."

The present cost of CCS was estimated to be €50-100 per tonne of CO_2, depending on the type of technology and local conditions, Appert said. Of this, €30-60 per tonne went towards the capture, transport was about €3.5 per tonne for 100km, and injection was €20 per tonne for 1m tonnes per year, falling to €7 per tonne for 10m tonnes a year. This expense obviously translates into increased electricity costs – both from the capital expenditure for the equipment and infrastructure and to compensate for the drop in efficiency – and Appert said that for an oxyfuel coal-fired plant that translated to an extra €13.5 per MW/h, which could represent about 50% of the current price for coal or lignite, while costs for gas could be higher, reaching about €70 per MW/h, "so there will be significant costs by 2020," Appert said.

"However, it will be possible to decrease the costs in the next 15 years through technological developments, the scale effect and learning by doing." The Flagship Programme would offer important feedback, he added, and he saw no reason why costs could not come down from €45 per tonne to €25 per tonne for pre-combustion hard coal; from €30 to €15 per tonne for pre-combustion capture with lignite and €18 per tonne for oxyfuel. "It would be possible to comply with a carbon price of €20-30," he said.

Some projects would be able to demonstrate economic benefits – about 30m tonnes of CO_2 are being stored in a Texas oilfield, where it is lifting production

by 200,000 barrels per day, but the number of developments able to offer enhanced oil recovery (EOR) would be limited.

Lifting the price of coal

"I hate CCS," declared **Chris Davies MEP**, Member of the European Parliament Committee on Environment, Public Health and Food Safety and Rapporteur on CCS. "It is of no economic value – nothing more than a waste disposal mechanism. It is just that I hate coal more."

Davies stressed that to deal with global warming we have to look at the practical implications. China, India and the US are going to build 850 coal-fired power stations, so all our energy saving and renewable energy would count for nothing if they went ahead, Davies said. "If we do not reach agreement at Copenhagen, Europe's efforts will count for nothing – we have to promote CCS. China, India and the US need to realise they will have to pay a lot more if they want to use coal." One of the effects of CCS was to increase the cost of burning coal, so that would channel investment to alternatives to coal, he added.

""We have to promote CCS. China, India and the US need to realise they will have to pay a lot more if they want to use coal."

Chris Davies MEP, Member of the European Parliament Committee on Environment, Public Health and Food Safety and Rapporteur on CCS

According to Davies, outside the people gathered at the roundtable, there was a great deal of ignorance, fear and scepticism about CCS; recent developments in the biofuels sector should take away any arrogance that it was the answer to all our problems. However, the industry had an important opportunity to get its message across in the next few months, Davies said. The incoming French Presidency was committed to drawing up a CCS action plan and "you need to encourage France to be ambitious – you have just seven months to exert maximum

Paal Frisvold, Mark C. Lewis and **Chris Davies MEP**

pressure". Davies said he was focused on two deadlines: the first week of July was the cut-off date for submission of amendments to the draft directives on the ETS and geological storage of CO_2; while in the first week of October, the European Parliament discusses the drafts, and the Committee on Environment will vote on the proposals. "These votes are crucial if we are to raise ambitions before going into negotiations with member state governments," Davies said. "And because decisions are being made by the Environmental Committee, there are not many people you need to contact to make your views known."

While he thought the funding for CCS should come from electricity utilities' windfall profits, "I have no levers to pull to ensure that happens, so I will be putting forward a double credit system in order to 'force-feed' the development of CCS. CCS development should be able to qualify for a focused credit."

Limited impact on ETS

Davies refuted Frassoni's assertion that this would kill the ETS. "It would be

about 2.5% of the total volume of CO_2 being traded in Europe. If 2.5% will kill the ETS then the system is flawed." As long as the market knew what was happening, it would be able to cope with it. "The ETS is an artificial construct and we can build into it new rules," he added.

As for the Commission being unsure about mandating the introduction of CCS, Alstom had said that, by 2015, no new fossil fuel plant should be authorised without it. Other power plant manufacturers were expected to add their weight to these comments soon. "I believe mandating is necessary – when you introduce regulation, the lobbyists go away and then industry comes back a few years later and says they can meet the targets. It would give industry a strong incentive to meet targets and tell them there is not a cheap way out through coal." The discussion on CCS was characterised by a wide degree of ignorance and there was only a limited time to make a difference – there was a need to raise people's ambitions, he concluded. "We have to shock politicians into action by being absolutely blunt about what can be achieved if we are forced to."

His call for mandatory CCS was backed by **Nick Otter**, Director of Technology and External Affairs at Alstom Power Systems, who said: "Setting a date will send a very strong signal to the people who will have to invest in, implement and deploy these technologies – the electricity generators and the energy intensive industries."

Jeff Chapman, Chief Executive of the UK Carbon Capture and Storage Association (CCSA), said his organisation was addressing the most important policy priorities for CCS, namely the development of regulations and the need for financial incentives. "While we have enjoyed extremely good relations with the Commission and the Rapporteur on the development of robust and practical regulatory arrangements, we have not yet achieved the same progress on investment incentives." Article 10 of the draft ETS directive on earmarking of auction revenues was a welcome proposal, but it was not CCS-specific and it was being resisted by member states, which were not keen on mandating support through hypothecation.

Lack of incentives

"But maybe we are missing the point. What is missing is the incentive for member states to incentivise CCS projects," Chapman said. Nuclear and renewable energy had received billions in public support and "we must ensure CCS, which is not a mature technology, is similarly treated".

"What is missing is the incentive for member states to incentivise CCS projects. [Nuclear and renewable energy had received billions in public support and] we must ensure CCS, which is not a mature technology, is similarly treated."

Jeff Chapman, Chief Executive, UK Carbon Capture and Storage Association

The commitment of the European Council to 12 demonstration projects by 2015 was welcome, but it was not enough. Because it was only a joint commitment, not a joint and several commitment, it could be overridden by the commitment to the renewables target, "even though CCS may be more cost-effective". Only a handful of member states were willing and able to deliver CCS projects in the required timescale and it was essential their commitment was mobilised, he added, so that they did not support just one scheme but multiple schemes capable of significantly cutting EU-wide emissions.

Chapman suggested that one way of achieving this would be to trade renewable commitments for CCS. "I realise that this may be unpalatable for some, but all options are needed to fight climate change so politicians must not be selectively favourable." However, if this was not workable, he quickly added, some other way must be found to incentivise enough projects to make a material difference on emissions. "Otherwise, we are in danger of creating the illusion of progress where little exists," he said.

Alternative options

Chapman's arguments did little to sway Greenpeace's Gavin Edwards, who said that CCS could not deliver anything for the next 10-20 years. For every four

power stations built, he continued, you would need to build another to cope with the inefficiencies CCS caused. He highlighted the cancellation of FutureGen,

"[Industry] should put their own money into CCS development and come back when the technology is proven. Until then, we should use public money for proven winners in the fight against climate change – renewable energy and energy efficiency."

Gavin Edwards, Head of Climate & Energy Unit, Greenpeace International

problems with the BP/Rio Tinto project in Australia and the expense of CCS. He also pointed out the huge amount of CO_2 that would need to be buried (7bn tonnes) and questioned whether the capacity was there. "It is problem upon problem upon problem." There was much that could be done to encourage renewables or introduce energy efficiency, he added. "The EU has failed even to ban incandescent light bulbs, and other inefficient lighting, which could cut 265 power stations at a stroke."

If industry wanted to develop CCS, "then they should put their own money into CCS development and come back when the technology is proven. Until then, we should use public money for proven winners in the fight against climate change – renewable energy and energy efficiency."

Market forces

Ultimately, the consumer would pay for CCS, said **Mark-C Lewis**, Managing Director for Global Commodities Research at Deutsche Bank. He delivered an impassioned plea for the free market to be allowed to do its work to deliver the optimum price to encourage CCS. "The last thing you need is mandatory targets – either you have mandatory targets or a free market. As a policymaker, you cannot pretend you know any better than the market." There should never have been free allocation of permits in the ETS. Without them, the carbon price would now be about €40 per tonne, enough to encourage CCS. "CCS needs a market allowed

to operate freely. Once you have set a cap you should let the market get on with it."

Panek, from the Commission, said it was aware of the shortcomings of free allowances and that was why it was moving to full auctioning by 2020.

The idea that you could provide all of Europe's power needs through renewable energy was fantasy and needed to be understood as such, Lewis said. "Fossil fuel is here to stay whether you like it or not, so it has to be as sustainable as possible. CCS is the only option at the moment. Deliver a cap that provides enough of an incentive and you will get there." However, Panek said financial help was needed for a limited period to fund the demonstration projects before the industry took on the bill.

Davies called Lewis' free market appeal "fantastic tosh" and pointed out that a great many bankers were currently getting rich on the carbon markets that had been created precisely by the political interventions he so condemned, which set up that market in the first place. He also pointed out that climate change was, as Nicholas Stern pointed out, "a catastrophic market failure".

"As a policymaker, you cannot pretend you know any better than the market. […] CCS needs a market allowed to operate freely. Once you have set a cap you should let the market get on with it."

Mark-C Lewis, Managing Director for Global Commodities Research at Deutsche Bank

Bridging the gap

Kate Hampton, Director of Market Development and Head of Policy at Climate Change Capital, brought the discussion back down to earth, asking: "What are the necessary criteria in terms of a market mechanism?" She contended that it had to be urgent, it had to take place at EU level (because member states would

not fund projects of the necessary scale), it had to be performance-based and it had to be time- and volume-limited.

A transitional mechanism was necessary, she continued, because the carbon price was currently low and would rise over time, while the cost of the technology started high and would come down over time, "so we have to do something to bridge the gap". Only the first movers should be rewarded, she added, and the effect of any incentives on the carbon markets would be negligible. At the Commission's definition of full scale (400MW), CCS would abate only 2.5m tonnes of CO_2 a year per plant. Using double crediting would mean about 30m tonnes a year, which "would have no material impact on the carbon price at all". The impact of renewables, energy efficiency and the Clean Development Mechanism were far more important.

Chapman was unsure how workable EU funding was, however. "If we rely on the European Commission, we might be waiting a very long time." Funding at member state level was the most efficient way to proceed because they had the options and the flexibility to tailor the necessary funding packages within their own fiscal regime. Lewis was adamant that if the carbon price was high enough, investors in coal-fired power stations would lose their shirts "and investors will demand answers". "Let people build coal-fired power stations and they will find out it was a stupid idea," he added. In terms of funding CCS, auctioning allowances from 2013 would raise around €30bn a year, some of which could go towards the demo projects.

Total's Senior Adviser on CCS, **Luc de Marliave**, said there should be demonstration projects, research and technology at a smaller scale. "If you start directly at a very large scale, we will have a lot of problems," he said. There was also a danger that a carbon price sufficient to incentivise CCS would drive energy intensive industries out of the EU through carbon leakage. "We have to be careful with industries that cannot pass on the costs to their customers, such as petrochemicals."

There was no sense in making CCS mandatory until the technology was available,

said RWE Senior Project Consultant **Heinz Bergmann**. Everyone agreed that 2015 was the earliest possible date for demonstration projects to be in operation. There was a need, not only for funding but also for a coordinated network of plants to avoid duplication and to allow knowledge-sharing.

Technology transfer

The issue in developing markets is access to energy, according to **Michele de Nevers**, Senior Manager at the World Bank's Environment Department. "For energy to be affordable, coal will be part of the mix for the foreseeable future, so CCS presents a very interesting opportunity to ensure an expansion of energy access alongside a reduction in greenhouse gas emissions," she said. "However, the evidence on technology transfer in other areas, including renewables, is that it is very difficult." Simply developing the technology in Europe and trying to transfer it would not work, and the World Bank "would encourage you to involve key developing countries in this process so their access to this technology can be managed effectively."

Willy de Backer said he found two of the premises of the discussion very fatalistic. First was the assumption that China's emissions would continue to rise at the current rate and could only be tackled through CCS. The second was the resignation to the continued use of coal. "I find it amazing that no-one thinks we can move beyond fossil fuels quickly," he said. "And the Chinese are already discovering the costs of coal in terms of environmental problems. They will not continue developing coal power at the same pace."

Mark Johnston of E3G, an NGO, sought to highlight the bigger picture, saying that Europe had a climate goal of keeping global warming below 2°C. The work Europe was doing at the moment was aimed at cutting its emissions by 20%, to rise to 30% if a post-Kyoto agreement was reached. However, it was the 30% target that corresponded to the 2°C goal. "That is why it makes sense to act now and accelerate CCS technology development."

But little progress has been made, according to **Heleen de Coninck**, Unit Policy Studies Group Manager for International Climate and Energy Issues at the Dutch

Energy Research Centre. In her previous position at the IPCC she had drawn up a list of the available technologies for CCS, she said. "We have not moved one bit towards more mature technologies in four years," she said. "It is very disappointing and more should have been done." Given all the companies that were claiming they would put up money for CCS projects, she added, "has anyone done an evaluation of how much is available and whether it is anywhere near the amount we need?" It would also be useful, she said, to know exactly what banks needed to make a project viable from their point of view.

"CCS is in its infancy," Appert said, "and like anything in infancy, it is weak. We need to be sure we do everything possible to make sure this technology emerges in the long term."

Articles of faith

This kind of statement aroused suspicion from Bolscher, who said that the debate had left him feeling like he was in church. "There are a lot of people saying what they believe in: 'I believe in the free market; I believe in renewables; I believe in CCS'," he said. "I believe that we need it all. Investment in CCS should not come at the expense of other solutions. It is not that much money – it would be easy to make a little change to the budget."

Davies agreed that the sums involved were not huge and urged those present to remember how European negotiations worked. "You start high and end up low. If we do not start off with high ambitions, we will end up with very little. We have to stop building coal-fired power stations and CCS is the only way to do it. It is the way to alleviate the emissions problem while keeping the lights on."

He suggested that companies were not matching their words with actions. "I think there are a lot of cowards here without confidence in what they are saying about CCS."

Summing up, Frisvold said that the market could sustain the industry once it was established and deliver rationalisation but that "the market cannot deliver a shift in technology". However, there had been other suggestions, including double

credits, earmarking the proceeds of allowance auctions, government support, feed-in tariffs, and allocating a small portion of the EU budget. “Whatever we do, the market mechanism will be distorted, so we need to look for the least distorting mechanism.”

He finally stressed that “China has to be part of the equation” of CCS, and emphasised that making CCS mandatory would be a focal point of future discussions.

AN ESSENTIAL WEAPON IN THE FIGHT AGAINST GLOBAL WARMING

The single most realistic solution for reducing greenhouse gas emissions rapidly and drastically is CO_2 capture and storage (CCS). Europe has both a duty and the ability to become a global first mover on CCS in line with its ambitious climate change commitments.

EU leaders have committed themselves to stabilising global warming at no more than 2°C over pre-industrial levels. Energy scenarios which keep global warming within that limit are based on large-scale deployment of CCS starting in 2015-2020. As the cradle of the industrial revolution and the fossil fuel economy, Europe must play a leading role in this.

CCS a bridge to the renewable economy

CCS is an essential and pragmatic solution in a world that by 2050 will need to have cut greenhouse gas emissions by 50-85 per cent from current levels and yet will remain partly dependent on fossil fuels due to rising energy demands. The critical contribution of CCS has been identified by the Intergovernmental Panel on Climate Change (IPCC) for its potential to substantially reduce global greenhouse gas emissions. The Bellona Foundation has recently published an article in the International Journal of Greenhouse Gas Control which estimates that CCS alone could reduce global annual CO_2 emissions in 2050 with 33 per cent compared to emissions in 2007. Even Nicholas Stern, known for his technology-neutral approach, has embraced the opportunities CCS represents. Climbing out of poverty will require higher energy consumption in most of today's emerging economies. They have until recently contributed very little to greenhouse gas emissions, and their claim for more energy is certainly fair. Coal is the only readily available and abundant energy resource for many of these countries – including India and China. If world leaders seize the opportunities CCS represents, the technology has the unique advantage of allowing these countries to develop without adding to climate change.

Energy efficiency and renewable energy will be vital in curbing emissions. But the International Energy Agency (IEA) estimates that even if policies currently being considered to increase renewable energy generation and energy efficiency are implemented, there will still be a 20 per cent increase in CO_2 emissions by 2030. In other words, renewable energy and energy efficiency will not curb emissions quickly enough to prevent climate change. This makes CCS an essential bridge between today's energy system, 80 per cent of which is made up by fossil fuels, and the long-term goal of relying solely on renewable energy.

Mandatory CCS

The Bellona Foundation welcomes the European Commission proposal for a directive to enable safe and environmentally sound geological storage of CO_2. Such a clear and predictable legal framework is the very foundation for enabling CCS.

In order to stay below 2°C global warming, we need to go further than enabling – we need to mandate CCS. Beyond 2020, no new fossil fuel power plants in the EU should be allowed to start operations without CCS. And soon thereafter, existing power plants will need to be retrofitted with CCS.

The bill should be borne by the electric utilities, according to the "polluter pays" principle. This will lead to a price increase, but the Commission's own impact assessment shows only a modest raise resulting from the widespread deployment of CCS.

Demonstration needed

The technology that will make up CCS-equipped power plants exists already. However, we need to validate the technology at a full-scale power plant. This is why we cannot say with certainty how costly it will be, or which technologies are most viable. That is why we need demonstration of CCS

in full-scale power plants. EU leaders at their spring summit in 2007, which set the EU's climate targets, called for a mechanism to stimulate the construction and operation of up to twelve large scale demonstration plants by 2015 to test out different combinations of technologies, fuels and geographical locations for CCS.

CCS represents an additional cost for the power plant operator, both at the investment and the operations stage. Even if many companies want to position themselves as first movers on CCS, and even if the fact that CCS reduces the amount of emission allowances needed by utilities, there is currently no business case for constructing full-scale power plants with CCS.

Financial incentives are needed for the demonstration plants. Regardless of their shape, such incentives should be limited in time and in volume of stored CO_2. They should be transparent, allocated on a competitive basis and paid upon demonstrated storage only.

Member States have several tools at their disposal. They may themselves decide to fund plants – as has already been promised by the Norwegian and UK governments. The Commission has signalled that they will consider favourably any such state aid for CCS projects. In the next phase of the EU Emission Trading Scheme (ETS), starting in 2013, the Commission has proposed a transition to auctioning of emission allowances – this will provide a huge revenue flow for national treasuries that could be used to fund CCS demonstration. Member States may alternatively adopt feed-in tariffs for electricity generated with CCS, a tool that a majority of Member States have already used successfully to stimulate renewable energy. A feed-in tariff is effectively a long-term regulated price that means electricity consumers foot the bill for CCS.

If the Member States are to be relied upon for funding CCS demonstration, there are nevertheless several drawbacks. Because the business case for CCS is limited, Member States are not likely to be enthusiastic first movers. Most Member States will rather wait and see. Those Member States that do decide to fund CCS demonstration will probably prefer the more mature technologies that are cheaper today (post-combustion CO_2 capture) rather than the more novel technologies that may have greater potential in the long run (e.g. pre-combustion CO_2 capture). Last but not least, it is very unlikely that individual Member States will allocate any significant resources to CCS demonstration in China. Yet, as outlined above, the "China factor" is what makes CCS an essential part of the fight against climate change.

By deciding the financial incentives at the EU level, these drawbacks can be avoided. There seem to be two main options if a mechanism is to be adopted in time for plants to start operating by 2015. Demonstration plants could be granted "CCS demonstration credits" that could then be sold in the ETS once storage has been demonstrated. This could be adopted as a part of the current review of the ETS directive. An alternative approach is to use the funding model for the Galileo programme, whereby EU budget underspending would be reallocated to the demonstration plants. Such underspending will be available in 2008, as recent increases in world market prices for food and feed result in large underspending of the Common Agricultural Policy.

In any case, support mechanisms for demonstration of CCS shall be no free lunch for the power sector. Nor shall they take emphasis away from renewable energy or energy efficiency as the only long term solutions. They shall merely demonstrate in practice a weapon without which we know we cannot win the fight against climate change.

CONCLUSION

CCS is important not just from an environmental point of view but from the perspective of energy security as well. If we can use coal without damaging the environment, it reduces our reliance on oil and gas. Most importantly, though, it allows the massive economic development underway in China and other emerging markets to proceed without driving the world to environmental catastrophe.

Many at this roundtable stressed the need for urgent action, but it is clear that many issues remain to be decided. To a large extent, all relevant parties have accepted the need for action and they are now just wrangling over who will pay. The Commission wants industry to shoulder part of the burden and it has agreed to do that. It has clearly seen which way the wind is blowing and accepts that it will have to act. Above all, it wants regulatory certainty and assurance that it will not be liable for problems that emerge during the development process.

Brussels would probably prefer member states to foot the bill rather than paying for it itself, while industry seems divided on the issue. However, the sums involved are not that large in the context of total energy expenditure. In the long term, it is agreed, the carbon price will provide sufficient incentive to support CCS but the technology needs a push in its initial stages.

Those against CCS try to link it to biofuels and nuclear power, raising doubts about its safety and sustainability. Yet the oil industry has been pumping natural gas – a far more environmentally damaging product – into oilfields for years without complaint or problems. The argument of CCS sceptics thus looks more like an attempt to slow the flow of money to CCS on the basis that it will be diverted from other environmentally friendly activities. This leads to the situation where the fossil fuel industry is pleading for public money to develop a new, untried technology while some environmentalists argue that we should focus on proven technology such as renewable energy and energy efficiency.

The suspicion remains that, despite the important role it could play in cutting emissions at home, Europe sees CCS principally as an opportunity to reap the economic benefits of exporting technology to China rather than a solution to its own emissions problems and that is why progress – which is urgently needed – is slow.

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