Zero emissions platform

The European Commission's Communication on CCS

ZEP's response

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European Technology Platform for Zero Emission Fossil Fuel Power Plants

Contents

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Introduction

CCS: critical for European jobs, industry *and* the environment

The European Commission's Communication[1] on CO_2 Capture and Storage (CCS) technology reaffirms its critical role in meeting the EU's energy, climate and societal goals. Indeed, CCS is not only "vital for meeting the Union's greenhouse gas reduction targets", it provides a "very visible link between jobs in local communities and continued industrial production."

This view is shared by the Zero Emissions Platform (ZEP), a unique coalition of companies, scientists, academics and environmental NGOs united in their support for CCS as a key enabler for decarbonising Europe – within a portfolio of technologies including greater energy efficiency and renewable energy.

Europe cannot be decarbonised cost-effectively *without* CCS

It is increasingly clear that CCS offers a uniquely broad range of societal benefits:

- **CCS is the only technology that can substantially reduce CO_2 emissions from fossil fuels**, **while ensuring security of energy supply**. Fossil fuels currently account for 80% of global energy demand – and rising. In the power sector alone, CCS must therefore account for 19% to 32% of the EU's total emissions reductions by 2050.[2]

- **CCS will preserve thousands of jobs in industries *beyond* power**, such as iron, steel, cement, refining – expected to account for half of the global emissions cuts required by 2050 from CCS.[3] Indeed, in some sectors, CCS is the *only* means of achieving deep emission cuts. As several have almost pure CO_2 streams, this also dramatically reduces the cost of CO_2 capture, while clustering different CO_2 sources to a transport network will result in significant economies of scale for both industrial *and* power projects. *Please refer to ZEP's report,* "*CO_2 Capture and Storage (CCS) in energy-intensive industries: an indispensable route to an EU low-carbon economy"*.[4]

- **Bio-CCS is the only large-scale technology that can *remove* CO_2 from the atmosphere** and is applicable to both power and industrial sectors. When combined with sustainably sourced biomass, it means CCS can actually move beyond zero emissions to deliver net *negative* emissions (in addition to any emissions reductions achieved by replacing fossil fuels with the biomass). The need for more powerful technologies to keep global warming below 2°C is recognised in the EU Energy Roadmap 2050 and internationally, and is already being deployed at industrial scale in the U.S. *Please refer to ZEP's repo*rt, *"Biomass with CO_2 Capture and Storage (Bio-CCS) – The way forward for Europe".*[5]

- **CCS will complement the large-scale deployment of intermittent renewable energy** by providing both low-carbon baseload *and* balancing generation – ensuring a reliable energy supply.

- **Europe cannot be decarbonised cost-effectively *without* CCS**; in fact, the costs of meet global climate targets would be over 40% higher.[3]

With annual investments worth billions of euros, CCS will therefore create *and* preserve jobs, boost industry and fuel economic growth, enabling Europe to compete on the world stage as a leader in low-carbon energy technologies. However, while it has all the skills, technology and expertise required, it is currently falling behind countries such as Canada, Australia, China and the U.S. in the demonstration and deployment of CCS.

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[1] http://ec.europa.eu/energy/coal/ccs_en.htm
[2] EU Energy Roadmap 2050: http://ec.europa.eu/energy/energy2020/roadmap/doc/com_2011_8852_en.pdf
[3] International Energy Agency (IEA)
[4] www.zeroemissionsplatform.eu/library/publication/222-ccsotherind.html
[5] Published by ZEP and the European Biofuels Technology Platform: www.zeroemissionsplatform.eu/library/publication/206-biomass-with-co2-capture-and-storage-bio-ccs- the-way-forward-for-europe.html

Post-demonstration CCS will be cost-competitive with other low-carbon power options

While individual elements of the CCS value chain are proven, the technology as a whole is still at the start of the learning curve, with huge potential to drive costs down, from both technology refinements and economies of scale. This is why confidence in the technology is so high and why final investment decisions have already been taken on large-scale demonstration projects worldwide.

The ZEP cost reports[6] also give confidence that following a successful demonstration, CCS will be cost-competitive[7] with the full range of low-carbon power options, including on-/offshore wind, solar power and nuclear. This is echoed in the report published by the UK's CCS Cost Reduction Task Force in May 2013.[8] Finally, unlike renewable energy, the operation of fossil fuel power with CCS can also be adjusted according to demand, with no need for back-up. *N.B. Cost-competitiveness is generally presented simplistically in terms of €/tonne of CO_2 avoided, but this can be misleading when applied to different technologies; the cost €/unit of production is a more accurate metric (e.g. €/MWh for low-carbon power) and incentives should be re-designed accordingly.*

The combination of CCS with Enhanced Oil Recovery (EOR) may create a significant revenue stream for a CCS developer, considerably improving the business case. EOR may therefore play a role in facilitating early CCS deployment and infrastructure.

Finally, as with any technology, CCS will also benefit from ongoing R&D. Indeed, its prioritisation in the EU Framework Programmes for research has given Europe a leading edge and now that these have been replaced by Horizon 2020, CCS should continue to feature prominently in order to keep abreast of other world players.

If urgent policy action is taken, CCS can still be widely deployed by 2030

Until recently, Europe led the world in supporting CCS, yet in the past 12 months it has been unable to deliver any large-scale CCS demonstration projects. There was deep disappointment that no projects were selected in the Phase I of the 'NER300'[9] – despite the fact that it was set up expressly to "help stimulate the construction and operation of up to 12 commercial (CCS) demonstration projects" (Article 10a.8, EU ETS Directive). Nevertheless, viable projects are still being progressed in several European countries.

The window of opportunity is vanishing fast. Additional policy action is therefore vital to ensure early CCS demonstration in Europe – and wide deployment by 2030. 'Business-as-usual' is not an option.

As the CCS Communication confirms, it is the lack of a solid business case that is still hampering the development of CCS in Europe, i.e. the absence of:

1. Transitional measures to cover the incremental costs of demonstration and early deployment projects *over the lifetime of the projects*
2. Long-term investor confidence, i.e. a strong and robust EUA price under the ETS
3. A robust regulatory framework that supports the business case for *all* investors in the CCS value chain: the current regime is creating investment hurdles, not confidence.

All three factors have a strong interdependency and are a prerequisite for demonstration, post demonstration and the wider deployment of CCS.

[6] www.zeroemissionsplatform.eu/library/publication/165-zep-cost-report-summary.html
[7] €70-90/MWh for CCS with coal, €70-120/MWh with gas, operating in baseload (7,500 hours equivalent full load each year); fuel costs for hard coal and natural gas are 2.0-2.9 €/GJ and 4.5-11.0 €/GJ respectively
[8] A collaboration between Department of Energy and Climate Change, The Crown Estate and industry: www.gov.uk/government/publications/ccs-cost-reduction-task-force-final-report
[9] In 2008, the EU agreed to set aside 300 million Emission Unit Allowances (EUAs) from the New Entrant Reserve (NER) under the EU Emissions Trading Scheme (ETS) Directive to demonstrate CCS and innovative renewable energy technologies

The way forward

As the CCS Communication confirms: "an urgent policy response is required":

- **Ensure CCS is fully integrated in the EU 2030 Energy and Climate Policy framework**
  ZEP believes that EU energy and climate policies must strike a balance between sustainability, competiveness and security of supply, taking into account the current economic situation, as well as the policies of Europe's major trading partners. It is therefore essential that CCS is fully integrated into a holistic Energy and Climate Policy framework for 2030. This should be coordinated with structural reform of the ETS in order to strengthen the EUA price and provide a long-term incentive for investment – in particular, by setting a tighter cap out to 2030 and beyond.

- **Support CCS demonstration and early deployment projects in Europe**
  Early CCS demonstration is vital in order to build public confidence, drive down costs and ensure wide deployment by 2030. This means creating a solid business case for CCS via the implementation of transitional measures to cover the incremental costs of CCS – and create a level playing field with other low-carbon energy technologies. Measures should have the least negative effect on the ETS and electricity markets, with a phasing-out plan developed as the ETS strengthens and the technology matures, allowing CCS to stand on its own merits in the longer term (see Questions 2 and 3). ZEP also recommends the establishment of up to six new CO_2 storage pilots[10] to complement demonstration projects, accelerate state-of-the-art technology and increase public confidence in CO_2 storage.

- **Remove unnecessary burdens and uncertainties on storage providers**
  Several legal concepts in the 'CCS Directive' (2009/31/EC) impose unreasonable – and unnecessary – burdens, risks and uncertainties on storage providers. ZEP is also concerned that some Member States that have transposed the Directive have introduced hurdles and show-stoppers that virtually paralyse deployment. ZEP has identified a number of issues, together with potential solutions, which should be addressed in the review of the Directive, scheduled for 2015. These include (but are not limited to) requirements under financial liability, the transfer of responsibility and third party access. ZEP recommends that the review be initiated at the earliest opportunity in 2013.

- **Ratify the London Protocol amendment as a matter of urgency**
  The amendment to the London Protocol must be ratified as a matter of urgency in order to allow cross-border CO_2 transport and subsea storage for relevant Member States. Pending these ratifications, ZEP supports the IEA's working paper on options under international law to enable transboundary movement of CO_2 for sub seabed storage.[11]

- **Start developing a CO_2 infrastructure *now* – ahead of wide-scale deployment**
  Large-scale CCS requires a CO_2 transport infrastructure of considerable legal and commercial complexity. However, if different CO_2 sources are located in close proximity, they can share both transport and storage infrastructure, thus benefitting significantly from economies of scale. With lead times of 6 to 10 years, early strategic planning is therefore vital. Support measures are also needed for first movers – both for the development of CO_2 infrastructure in its own right and for CCS projects of Common Interest that provide transport and/or storage infrastructure with additional spare capacity *beyond* that required for any first end-to-end demonstration project. Finally, transport infrastructure cannot be developed without a comprehensive CO_2 storage atlas, which should be urgently progressed. *Please refer to ZEP's report, "Building a CO_2 transport infrastructure for Europe".*[12]

[10] www.zeroemissionsplatform.eu/library/publication/224-storagepilotsreport.html N.B. This is in addition to the continuation of existing CO_2 capture and storage pilots which will also provide support to demonstration projects

[11] "Carbon Capture and Storage and the London Protocol: Options for Enabling Transboundary CO_2 Transfer, OECD/IEA, 2011: www.iea.org/publications/freepublications/publication/CCS_London_Protocol.pdf

[12] www.zeroemissionsplatform.eu/library/publication/221-co-2transportinfra.html

ZEP's response to the Communication on CCS

Question 1

Should Member States that currently have a high share of coal and gas in their energy mix as well as in industrial processes, and that have not yet done so, be required to:

a. *develop a clear roadmap on how to restructure their electricity generation sector towards non-carbon emitting fuels (nuclear or renewables) by 2050*
b. *develop a national strategy to prepare for the deployment of CCS technology.*

- **CCS should be fully integrated into an EU 2030 Energy and Climate Policy framework** that strikes a balance between sustainability, competiveness and security of supply, taking into account the current economic situation, as well as the policies of Europe's major trading partners. **Member States should then be encouraged to develop roadmaps and national strategies** for achieving clear decarbonisation targets. This includes actions to ensure the technological readiness of *all* key low-carbon technologies so Member States have the range of options necessary not only to reduce emissions cost-effectively, but address supply and demand variations.

- Roadmaps should cover national economies at large – including the power sector, carbon-intensive industries *(*e.g. iron, steel, cement, refining) and other emitters such as transport and building whose emissions reduction targets are also not achievable without CCS. Given the cross-border impacts of national energy policy, roadmaps should consider the potential impact on other Member States, as the wider implementation of CCS will, in some cases, depend on the availability of shared transport and storage infrastructure. The impact at regional and European level should also be considered, where a Member State depends on imports or exports to balance its energy production/demand.

- ZEP recommends that Member States provide the Commission with periodic updates on progress made in delivering the roadmap, as well as any changes.

Question 2

How should the ETS be re-structured, so that it could also provide meaningful incentives for CCS deployment? Should this be complemented by using instruments based on auctioning revenues, similar to NER300?

- As stated in Question 1, it is essential that CCS is fully integrated into a holistic Energy and Climate Policy framework for 2030. This means taking into account the current level of demonstration and deployment of all the low-carbon technologies identified as key to decarbonising Europe – and ensuring that they receive the support they need to become commercially available.

- In the long term, ZEP believes the ETS to be the most cost-efficient mechanism for driving decarbonisation in the EU. However, the financial crisis, oversupply of EUAs and impact of EU targets and support schemes for other low-carbon technologies have driven the EUA price down to a level where, in the short term, the ETS provides no incentive to invest. ZEP agrees with the CCS Communication that today "it is clear that no rationale exists for economic operators to invest in demonstration CCS". This situation will continue until it has undergone structural reform – in particular, setting a tighter cap out to 2030 and beyond.

- However, even if action is taken now, it will not result in EUA prices that are high and robust enough to deploy CCS at the rate required to achieve energy and climate goals for 2030. It is important to remember that CCS is at a different stage from other low-carbon technologies: while individual elements of the value chain are proven, it still needs to be scaled up to large, integrated demonstration projects, with huge potential to drive costs down – from both technology improvements and economies

of scale. Early movers will therefore incur significant upfront costs, with little transport and storage infrastructure in place and an uncertain environment for long-term investment.

- **Transitional support measures are therefore essential to drive CCS deployment and create a level playing field with other low-carbon energy technologies**. Such measures should have the least possible negative effect on the ETS, with a phasing-out plan developed as the ETS strengthens and the technology matures, allowing CCS to stand on its own merits in the longer term.

- At EU level, the European Energy Programme for Recovery (EEPR) has provided some capital support, but was insufficient to ensure the delivery of any single demonstration project. NER300 was expected to provide further capital funding, but this did not materialise in Phase I because relevant governments were not able to confirm the level of co-funding they would provide. However, it seems that this was the result of small differences in timing and viable projects continue to be progressed in several European countries.

- ZEP therefore supports the **establishment of a 'CCS Fund'** large enough to support EU demonstration projects in both the power and industrial sectors. Funding could come from the European Commission (e.g. by setting aside sufficient EUAs from the New Entrants Reserve; or earmarking funds from the EU budget, not unlike EEPR) and from Member States (e.g. by using some of the proceeds from ETS auctions, or already established national carbon taxation schemes).

  The distribution of funds should also take into account the lessons learned from recent EU funding schemes. The single objective should be the delivery of a significant EU CCS programme, funding a strategic (but flexible) number of projects that deliver both economies of scale and the surrounding transport and storage infrastructure. The scheme should therefore avoid setting a maximum percentage contribution of the fund for any single project. It should also be mindful of the impact of surrounding issues, including Member State contribution and the relationship to other EU policy mechanisms such as the EEPR. Above all, it should ensure that *the power plant can dispatch and operate over the lifetime of the project* so that the return on the CCS element is indeed realised.

Question 3

Should the Commission propose other means of support or consider other policy measures to pave the road towards early deployment, by:

a. a support through auctioning recycle or other funding approaches
b. an Emission Performance Standard
c. a CCS certificate system
d. another type of policy measure

- As stated in Question 2, CCS is at the start of the learning curve, with huge potential to drive costs down. Early movers, however, will incur significant upfront costs, with little transport and storage infrastructure in place and an uncertain environment for long-term investment. As with any low-carbon technology, investors in CCS need a stable, predictable pathway for deployment.

- EU targets and support measures – particularly feed-in tariffs – have proved highly successful for other low-carbon technologies, such as wind, solar and energy efficiency. In their current form, feed-in tariffs for RES are technology specific, applicable to the whole industry, not just for technology demonstration and open ended. However, they have also dramatically undermined opportunities for other low-carbon energy technologies, such as CCS, which does not benefit from such support measures and which has had to rely solely on the ETS as an incentive to invest; this has not proved effective.

- Yet based on scenarios outlined in the EU Energy Roadmap 2050[2], **CCS will need to account for 19% to 32% of the EU's total emissions reductions by 2050 *in the power sector alone*** –

equivalent to 150 GW to 250 GW of fossil fuel power plants equipped with CCS. This indicates a steep deployment curve, with 25 GW to 125 GW installed CCS capacity by 2030 in order to achieve EU energy and climate goals. Transitional support measures are therefore essential to cover the incremental costs of CCS demonstration and early deployment projects – and create a level playing field with other low-carbon energy technologies.

- It is important that support measures have the least possible negative effect on the ETS and electricity markets and are phased out as the ETS strengthens and the technology matures so CCS can stand on its own merits in the longer term. Investors, on the other hand, need to be sure that the power plant can dispatch and operate *over the lifetime of the project* so that the return on the CCS element is indeed realised. The goal: to provide a robust, predictable revenue stream and earn an appropriate level of return for investors. National governments are already moving in this direction, underlining the urgency of the situation.

- Support measures are also needed to stimulate CCS in industry sectors *beyond* power (e.g. iron, steel, cement, refining) – now expected to deliver 50% of the global emissions reductions required from CCS by 2050 (IEA). Indeed, in some industries, it is the only means of achieving deep emission cuts. As several have almost pure CO_2 streams, this dramatically reduces the cost of CO_2 capture, while clustering different CO_2 sources to a transport network will result in significant economies of scale for both industrial *and* power projects. Yet many of these industries face a high risk of 'carbon leakage'[13] due to the global trade of their products. Additional measures are therefore essential to create a long-term business case for CCS. *For more detailed recommendations on specific industry sectors, please refer to ZEP's report,* "*CO_2 Capture and Storage (CCS) in energy-intensive industries: an indispensable route to an EU low-carbon economy*".[14]

- ZEP has assessed the following measures:

  - **Feed-in tariffs are proven to work**, offering financial support to power plants in a form that best ensures access to the electricity grid, reducing both revenue and price risk. Given that electricity markets are an area of national jurisdiction, FITs should be explored at Member State level where, if set correctly, they will be sufficient for CCS-equipped plants to displace unabated facilities in the merit order curve – independent of the EUA price. Feed-in tariffs – or similar mechanism – have therefore already been introduced or are being proposed in some Member States.

  - **Where feed-in tariffs are not possible, CCS certificates (CCSCs) could be an option** if carefully designed for a defined volume, as a transitional support measure for the development of CCS reflecting the EU Energy Roadmap 2050. ZEP recognises that when considering this option, specific issues have to be addressed, such as the high transaction costs incurred in setting up the system, while the market for such a small volume could be open to competitive misbehaviour. Furthermore, investors still carry the main risk since forecasting the price of the CCS certificate may be challenging and the return on investments may fall due to low CCSC prices. In the certificate system, the power plant receives money only if it is actually operated – unless, under the CCSC scheme, plants are guaranteed to dispatch and operate over the lifetime of the project.

    A CCS certificate scheme could prove successful in moving CCS forward if the following principles were adhered to:

    - The design of a certificate scheme must ensure that the operator of a CCS plant has a high and certain level of dispatch into the grid.
    - Certificates could be supplied to CCS projects in proportion to the plant's low-carbon power output.

[13] "Carbon leakage" refers to the re-location of investment in carbon-intensive activities to countries where there are fewer constraints on emissions

[14] www.zeroemissionsplatform.eu/library/publication/222-ccsotherind.html

- Certificates could be tradable, so that CCS projects can raise funds by selling certificates in order to provide revenue support and therefore financial assurance of the operation of the plant.
- To function effectively, a system of CCSCs would need to be related to a commitment to deliver a defined volume of low-carbon power output.
- The demand for certificates would therefore be driven by other operators needing to purchase certificates in order to meet this defined volume of CCS capacity.
- Having a defined volume of CCS backed by tradable measures would allow CCS investments to be taken where they were most cost-effective. As with the ETS, operators could choose whether it was more effective to make their own investments or buy equivalent certificates.
- Any system of certificates should be designed in such a way as to avoid any negative interaction with the existing ETS. Measures to ensure this could include making CCSCs fungible with a certain number of EUAs, or retiring EUAs, as CCSCs are supplied into the market.
- The design of any system of CCSCs should also seek to learn lessons from the ETS experience, including issues of price stability and interaction with other energy and climate policies.

ZEP would be pleased to offer further advice to the Commission on the feasibility and design of such a scheme. It should also be assessed if it could apply to industrial sectors.

Question 4

Should energy utilities henceforth be required to install CCS-ready equipment for all new investments (coal and potentially also gas) in order to facilitate the necessary CCS retrofit?

- **The first priority is to enable the delivery of CCS demonstration projects in Europe**. Once CCS has been demonstrated technically and market conditions have been established to make the technology commercially viable, operators will have the incentive to construct CCS facilities as part of their new projects. Until then, measures to ensure that sufficient space is available to retrofit CO_2 capture facilities in new plants are justified and should apply to both fossil fuel power plants and carbon-intensive industrial installations.

- Without CCS, power plants and industrial installations risk becoming stranded assets as the economy is decarbonised.

- With reference to the Large Combustion Plant Directive (2001/80/EC, Article 9a), ZEP would like to draw attention to three key aspects of CCS-readiness:

  1. Investors and competent authorities need greater clarity on what is required to fulfil the conditions set for CO_2 capture-readiness, the feasibility of establishing CO_2 transport and the availability of CO_2 storage.
  2. If the conditions for CCS-readiness are not met, it should be clarified whether or not the competent authority will grant the operating licence for the power plant.
  3. Some power plants may be tailored to operate as peak-shavers, with correspondingly low load-factors. To the extent that both investors and the relevant authorities recognise such an operational mode for the plant, it should be assessed whether CCS-readiness is strictly necessary.

  ZEP therefore recommends that a review of this directive takes place no later than 2015 in order to provide clarity on the above. This could take place either independently, or as a part of the review of the CCS Directive.

Question 5

Should fossil fuel providers contribute to CCS demonstration and deployment through specific measures that ensure additional financing?

- CCS is an end-of-pipe technology and should be supported by those who bear the emissions liability. However, **the development of CCS will have profound and far-reaching benefits for society** – not only complementing intermittent RES with a reliable supply of low-carbon energy, but creating *and* preserving jobs, skills and investment in a wide range of industry sectors. This suggests that support should come from a much broader base – including fossil fuel providers, utilities, governments and consumers.

Question 6

What are the main obstacles to ensuring sufficient demonstration of CCS in the EU?

- EU CCS demonstration projects remain viable and executable in several European countries. Their **successful delivery depends on both the European Commission and Member States having an active and supportive policy for CCS**, aligned at all levels of Government.

- This includes the urgent implementation of transitional support measures to cover the incremental costs of CCS, create investor confidence and ensure a level playing field with other low-carbon energy technologies (see Question 3).

- The current regulatory framework is imposing unreasonable – and unnecessary – burdens, risks and uncertainties on storage providers. These include (but are not limited to) requirements under financial liability, the transfer of responsibility and third party access, and should be addressed in the review of the Directive, scheduled for 2015. However, ZEP recommends that this process starts at the earliest opportunity in 2013.

- CCS is on the critical path, with no margin for delay: CCS must be commercially viable by 2020-2025 in order to ensure wide deployment by 2030 – and the delivery of EU climate goals.

Question 7

How can public acceptance for CCS be increased?

- The success of any new technology is dependent on the public recognising both its benefits and inherent safety. While some onshore CO_2 storage projects have had difficulties in convincing the public of the unique benefits of CCS, others have experienced a positive response. Indeed, small-scale projects have been operating successfully in Europe since 1996, but are generally unknown to the wider public.

- **Large-scale CCS demonstration projects are key to building public confidence** as it is seen that CO_2 storage is both safe and reliable – using the same natural trapping mechanisms that have already kept huge volumes of CO_2 underground for millions of years. The technology for CO_2 storage is also very similar to that used by the oil and gas industry for decades – to store natural gas underground or for EOR.

- The portfolio of **new storage pilots proposed by ZEP[10] will also provide visible showcases of CO_2 storage**, with independent research organisations playing a major role and local communities actively involved.

- The public should be assured that far from competing with renewable energy, CCS *complements* its intermittency by providing back-up power – ensuring a constant energy supply. In fact, when CCS is combined with renewable energy in the form of sustainably sourced biomass – in effect, *removing* CO_2 from the atmosphere – it can deliver larger emissions reductions than renewable energy on its own. A *combination* of technologies is therefore needed to decarbonise Europe, including renewable energy, greater energy efficiency – and CCS.

- It should also be communicated that while CCS is the only technology that can capture at least 90% of emissions from the world's largest emitters, it can be applied to a wide range of CO_2 sources – not just coal; and a wide range of industry sectors – not just power. Indeed, in some heavy industries such as steel and cement, CCS is the *only* means of achieving deep emission cuts.

- In short, **CCS will have a profound impact on the European economy: it will not only ensure a reliable supply of low-carbon energy, but create – *and* preserve – jobs, skills and investment in a wide range of industry sectors, potentially worth billions of Euros annually**. This is particularly important where projects offer a significant *local* benefit in terms of employment or the regional economy.

- Support at Government level is therefore essential, with CCS clearly integrated into national or regional plans for 'green growth' – backed up by comprehensive educational programmes.