

**Securing the business case for
CCS as a key enabler for the
decarbonisation of Europe**

ZEP Strategy Review, January 2012

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Executive summary

CCS must be “feasible for widespread use by 2030” to deliver EU Energy Roadmap 2050

Since the Zero Emissions Platform (ZEP) was founded in 2005, CCS in the European Union (EU) has moved rapidly from development to demonstration on the road to wide deployment: billions of euros have been invested by industry, funding has been achieved for an EU CCS demonstration programme and a common legal framework has been established. As importantly, the ZEP cost reports¹ now give confidence that **following a successful demonstration, the current suite of CCS technologies will be cost-competitive with the full range of low-carbon power options**, including on-/offshore wind, solar power and nuclear.

In short, there is no doubt that CCS can deliver, as one of the key technologies earmarked by the European Commission for decarbonising the energy sector in Europe. This is confirmed by international developments, where final investment decision (FID) has already been taken on large-scale demonstration projects in Australia, Canada, China and the U.S.

The key role of CCS in meeting EU climate targets therefore remains indisputable, as confirmed by the new EU Energy Roadmap 2050² which states that “For all fossil fuels, Carbon Capture and Storage will have to be applied from around 2030 onwards in the power sector in order to reach decarbonisation targets”³. The International Energy Agency (IEA) goes even further in its 2011 World Energy Outlook, warning that “If CCS is not widely deployed in the 2020s, an extraordinary burden would rest on other low-carbon technologies to deliver lower emissions in line with global climate objectives”. Indeed, the costs of achieving such objectives *without* CCS would be over 70% higher.

CCS will therefore play a critical role in decarbonising Europe – not only in power production and heavy industry, but in enabling the large-scale deployment of renewable energy which requires the complementary use of fossil fuel power generation. In fact, CCS can be applied to a whole series of applications, including combining with sustainable biomass to deliver carbon-*negative* solutions. The result: Europe will not only enjoy security of energy supply, but a surge in economic growth – creating “green” jobs, boosting industry and promoting technology leadership.

Confidence in the technology remains high – but a weak carbon price threatens demonstration and deployment

However, while confidence in the technology remains high, the fall in the carbon price could have a severe impact on both CCS demonstration *and* deployment: not only is significantly less funding available for the “NER 300” scheme, but the long-term business case for CCS has been seriously undermined.

It means CCS has now reached a “tipping point” in Europe, where its success or failure depends on what measures are taken to counteract these developments and ensure the window of opportunity is not missed. This demands urgent action by ZEP and a fundamental change in pace and direction by:

1. Applying a strong focus on critical issues through the formation of new working groups (WGs). Small, flexible and populated by members with highly specialist experience, these WGs will be able to act quickly and decisively, driving real change.
2. Establishing a long-term, *microeconomic* business case for industry and a *macroeconomic* business case for society as the foundation for both demonstration *and* deployment: **a successful demonstration of CCS technology is a pre-condition for commercial deployment; but without a long-term business case, demonstration projects will not happen.**

¹ www.zeroemissionsplatform.eu/library/publication/165-zep-cost-report-summary.html

² December 2011: http://ec.europa.eu/energy/energy2020/roadmap/doc/com_2011_8852_en.pdf

³ 80-95% decarbonisation overall by 2050

3. Prioritising activities to support NER 300 candidates as the most urgent requirement over the next six months.

Key issues⁴

- Industry has already demonstrated its willingness to take on a major portion of the costs and risks of investing in CCS technology. However, as NER 300 funding will probably cover significantly less than 50% of the incremental costs, financial support from Member States (MS) is essential⁵. However, there is concern that MS governments may not contribute, or reaffirm their commitment, due to lack of political will and/or the financial crisis.
- FID may not be taken on demonstration projects due to concern over the long-term business case for CCS, with expectations of a low, stagnant carbon price for the foreseeable future.
- An optimal portfolio of demonstration projects, as outlined in ZEP's proposal, is unlikely to be realised.
- The CCS Directive⁶ has not been transposed in some Member States that have applied for NER 300 funding, or may be transposed in such a way that does not favour CCS.
- Public and political resistance has manifested towards onshore CO₂ storage, yet it is significantly cheaper than offshore and key to the long-term business case for CCS in most MS. Gaining public confidence through the demonstration of onshore storage – via both demonstration *and* pilot projects – is therefore vital.

Synopsis of strategy

- **Support NER 300 candidates**

To date, ZEP has adopted a broadly EU-level approach which has been extremely successful in achieving EU-level objectives. While this will continue, MS governments of NER 300 candidates will also now be targeted in a tailored campaign which makes the micro- and macroeconomic case for CCS in their country (e.g. climate, energy mix/security, competitiveness, jobs), together with solutions to any specific obstacles/issues. ZEP will also actively support the projects themselves, as appropriate.

- *New Temporary Working Group (TWG) Demonstration Programme (within Taskforce Demonstration and Implementation, TFDI) of country specialists to draw up country-specific position papers utilising, i.a., national CCS roadmaps.*
- *TWG Market Economics (see below) to propose options for interim measures to enable project developers to take FID, while the long-term business case for CCS is established. This includes structural and cohesion funds which are essential for co-funding demonstration projects in some MS.*
- *Members of the Government Group to help identify key points of contact in relevant ministries.*
- *Taskforce Public Communication (TFPC) to actively support national campaigns via translated CCS toolkits, op-eds in national media, events/debates, online tie-ups with national constituencies etc.*

- **Provide flexible solutions to any knowledge gaps in the EU CCS demonstration programme**

In the light of current circumstances, a reassessment of the second tranche of the NER 300 may be highly beneficial in order to ensure that the goals of the EU Energy Roadmap 2050 are met. This includes practical and flexible solutions to any knowledge gaps, e.g. as there may be

⁴ Based on the results of a ZEP survey among project developers

⁵ Even if Member States replicate the contribution of NER 300 funding, a gap of hundreds of millions of euros in incremental costs could remain per project, except under specific conditions such as the use of CO₂ for Enhanced Oil Recovery (EOR)

⁶ EU Directive on Geological Storage of CO₂ (2009/31/EC)

insufficient demonstration projects with onshore storage, large R&D pilot projects with CO₂ storage should also be supported, with a primary focus on onshore.

- *ZEP⁷ to propose to the European Commission and European Investment Bank (EIB) complementary selection criteria for ranking projects for NER funding (see page 9).*
- *New WG Storage R&D (within Taskforce Technology (TFT) to generate proposals for the urgent development of large storage pilot projects with CO₂ storage (see below).*
- *New WG Global Links (within TFDI) to establish close links with other international CCS programmes/projects to close any knowledge gaps, building on the strong base for knowledge sharing established by the European CCS Demonstration Project Network.*

- **Create a secure environment for long-term investment**

It is clear that without a long-term business case for CCS neither demonstration nor commercial projects will attract investment. This means creating a level playing field for all low-carbon energy technologies and strengthening a carbon market which is expected to continue to be weak, despite the prospect of deep CO₂ reduction targets.

As the economic viability of CCS depends on a strong carbon price within the EU Emissions Trading Scheme (ETS), there is therefore an urgent need to correct and recalibrate the current business model with additional financial incentives (e.g. floor prices, contracts for differences etc.), but could also include other measures.

Such an approach will not only provide the least cost reduction pathway, but the most efficient use of all available energy resources and maturing technologies (e.g. Solar Thermal, Offshore Wind and CCS). It can also be argued that the rapid global deployment of CCS will benefit other industries (e.g. cement, iron) by providing a natural, long-term ceiling on the carbon price and a level of certainty for the cost structure of the energy market in the 2020s.

- *New TWG Market Economics to identify the market conditions necessary to accelerate the deployment of CCS in the EU, including supplementary mechanisms for the first generation of commercial CCS projects and the design of the next phase of the EU ETS. These should cover the whole range of CCS applications, including power production, heavy industry and fuels transformation, and when combined with sustainable biomass.*

- **Accelerate the appraisal, characterisation and demonstration of CO₂ storage**

Potential storage sites should be appraised and characterised as a matter of urgency as the most critical element of a CCS project, taking ~5 years to evaluate – especially deep saline aquifers which have the largest potential capacity but are the least explored. However, balanced attention should be paid to all storage options – on- and offshore – including, but not dependent on, EOR.

- *New WG Storage Infrastructure (within TFT) to promote the urgent appraisal and characterisation of storage sites.*
- *New WG Storage R&D (within TFT) to generate proposals for the urgent development of large storage pilot projects in order to build public confidence, supported by TFPC.*

- **Accelerate a long-term plan for CO₂ transport infrastructure**

While large-scale CO₂ infrastructure applies mainly to commercial CCS deployment, early strategic planning is vital due to the long lead time and its importance in achieving economies of scale. While ZEP should play a complementary role on transport infrastructure, it should lead the debate on storage as the critical issue.

⁷ TFDI to author

- *WG Transport Infrastructure (within TFDI) to support CO₂ Europe's findings, with priority given to establishing the business model for transport infrastructure; accelerating the development of EU and national master plans; and developing CO₂ clusters and over-sized pipelines – with any cross-border restrictions removed.*
 - *Ensure CCS is properly represented in the EU energy infrastructure package, including the 12 strategic energy infrastructure corridors, with at least one project of common interest (PCI).*
- **Increase R&D focus on facilitating commercial deployment**

EU and national R&D programmes require increased funding, coordination and focus on facilitating commercial deployment, e.g. second-generation technologies; Monitoring, Verification and Reporting (MRV); identification of synergies with industrial applications; and the building of large pilot/medium demonstration projects. Attention should be given to the entire CCS value chain, with particular emphasis on onshore storage in order to build public confidence.

 - *WG European Industrial Initiative (EII) (supported by TFT) to work with the CCS EII and the European Energy Research Alliance (EERA) to bring industry, the EU and MS closer together.*
 - *WG Global Links (supported by TFT) to liaise with other industry sectors (e.g. chemicals, steel, cement, refineries) to evaluate synergies and identify joint R&D projects.*
 - *TFT to update its long-term R&D plan by adding price tags, prioritising topics and including the results of spearhead projects as the basis for the next EU Framework Programme.*

1 Supporting the EU CCS demonstration programme

1.1 Current status of the NER 300

EU funding for the first tranche of CCS demonstration projects is now well under way: one billion euros has been distributed to six projects under the European Energy Programme for Recovery (EEPR) and the selection process for one of the world's largest grant schemes – the “NER 300” – is on track.

Timeline

The NER 300 call for proposals was published on 9th November 2010; projects had to submit their applications to Member States (MS) by 9th February 2011; and MS had to submit the applications they supported to the European Investment Bank (EIB) by 9th May 2011.

EIB will complete its due diligence assessment by 9th February 2012 and this will form the basis of the final selection of probably four to six demonstration projects by the EU's Climate Change Committee (CCC). Award decisions for this first tranche are envisaged for the second half of 2012, with projects operational four years after the award decision in the second half of 2016.

Submissions

Altogether, MS submitted 13 CCS applications to the EIB, including four of the six EEPR projects (Rotterdam-Maasvlakte (ROAD) and Compostilla did not apply). As the Longannet project is no longer supported by the UK government and Vattenfall took the decision to withdraw from the Jämschalde project following insufficient support for a suitable CCS Directive in Germany, competition is therefore now between the following 11 projects:

Post-combustion

- Porto Tolle, EEPR, Italy, hard coal, offshore storage
- Belchatow, EEPR, Poland, lignite, onshore storage
- Turceni, Romania, lignite, onshore storage
- Peterhead, Scotland/UK, gas, offshore storage
- Hunterston, Scotland/UK, hard coal, offshore storage

Pre-combustion

- Don Valley, EEPR, England/UK, hard coal, offshore storage
- Eston Grange, England/UK, hard coal offshore storage
- North Killingholme, England/UK, hard coal offshore storage

Oxy-fuel

- Drax, England/UK, hard coal, offshore storage

Industrial applications

- Florange, France, steel factory, onshore storage
- Green Hydrogen Project, Netherlands, offshore storage.

Selection criteria

Criteria for the ranking of projects were defined as follows:

- Financing under NER 300/EEPR will comprise a maximum of 50% of the relevant costs (i.e. the additional investment costs of CCS technology net of NPV of operating costs and benefits during the first 10 years of operation).
- Full funding will be made to projects which store at least 75% of the projected total amount of CO₂ in the 10-year period from entry to operation. Upfront payment is possible if MS guarantee that funding will be returned proportionately if less CO₂ is stored.

- At least eight CCS demonstration projects will be funded: at least one and a maximum of three in each category; at least three with hydrocarbon reservoir storage; and at least three with storage in a deep saline aquifer.
- CCS projects will be ranked together (no sub-categories) in order of increasing requested amount of public funding per unit of performance (€/tonne CO₂ stored).
- At least one and no more than three projects (CCS plus renewable energy projects) are funded within one MS, excluding trans-boundary projects.
- Award decisions will be conditional upon all relevant national permits and FID being secured within 24 months of award decisions (36 months, in the case of CCS with deep saline aquifer storage).

The total amount of funding will be limited to 15% of the total available allowances for each project.

However, with the fall in the carbon price, not only is significantly less funding available for the “NER 300” scheme, but the long-term business case for CCS has been seriously undermined. The result: support from MS governments is now essential – both to close the gap in NER 300 funding and for the implementation of interim measures which will enable project developers to take FID, while the long-term business case is established.

1.2 Support NER 300 candidates

At MS level, the WGS proposes to focus on MS governments of NER 300 candidates in a tailored campaign which makes the micro- and macroeconomic case for CCS *in their country*. WGS sees three levels of engagement for raising political support for CCS demonstration projects:

1. National position papers on CCS

Two parts:

A: The case for CCS in their country: a position paper signed by key ZEP members in each country. This should spell out the arguments for deploying CCS, e.g. climate, energy mix/security, competitiveness, jobs. For Poland and Romania, work undertaken in the Bellona Road Maps could serve as a useful source; for the UK and the Netherlands, several road maps already exist. They lay out the cost of CCS, the emission reductions, and the level of investment over time.

B: The list of issues that need to be resolved, *focusing on solutions to specific obstacles in their country*, e.g. transposition of the Directive, lack of public support, commercial and regulatory barriers, infrastructure etc.

2. *National position paper on CCS, plus a series of meetings in relevant capitals*: in the run up to the vote in the EU Council of Ministers in 2008, several members of the CCS leadership group toured the capitals of Europe with a view to promoting a better understanding of the NER 300 scheme. This is a model that could be used in today’s context.

3. *A combination of the above*: i.e. position paper, a series of targeted meetings and an event.

At local level, the WGS proposes that support should also be offered to the projects themselves, where appropriate.

1.3 Propose interim measures to enable project developers to take FID

When the EU set out to establish a CCS demonstration programme, the price of CO₂ in the ETS was in the region of €30 per tonne. This provided a significant stimulus for action, both directly as a result of the carbon price itself and indirectly through the NER 300 scheme which therefore had a potential reserve of some €9 billion. The prospect of a 10-12 project demonstration programme was very real. In

addition and perhaps most importantly, with the ETS past the Phase I doldrums and a robust Phase II underway – with the prospect of significant allowance scarcity extending through Phase III – potential CCS investors believed that the business case was real and sustainable.

Today, the picture is very different. The EU CO₂ price is at ~€8 with little prospect of tangible upward movement. The NER300 may deliver as little as €2.5 billion in total, with possibly only €2 billion (or less) for CCS. A 10-12 project demonstration programme is no longer possible under these conditions and the business case for an individual project is poor at best.

A correction that delivers a much better EU-wide business environment for CCS may take some years to deliver, yet we know that the need to demonstrate and commercialise CCS is a much shorter-term imperative. This then argues for an interim approach, probably for the balance of this decade.

ZEP should therefore undertake a rapid review of possible interim measures, including regulatory policies, carbon price support mechanisms and fiscal support – as well as structural and cohesion funds which are essential for co-funding demonstration projects in some MS. National governments are already moving in this direction, underlining the urgency of the work.

A key consideration for ZEP is the balance between short-term implementation of early CCS and the long-term impact on the ETS and competitiveness if such programmes became both widespread and institutionalised.

1.4 Provide flexible solutions to any knowledge gaps

In the light of current circumstances, a reassessment of the second tranche of the NER 300 may be highly beneficial in order to ensure that the goals of the EU Energy Roadmap 2050 are met. This includes practical and flexible solutions to any knowledge gaps, e.g. as there may be insufficient demonstration projects with onshore storage, large R&D pilot projects with CO₂ storage should also be supported, with a primary focus on onshore.

WGS therefore recommends that ZEP should propose to the European Commission and European Investment Bank (EIB) complementary selection criteria for ranking projects for NER funding, based on the following project criteria:

- **Funding commitment:** what is the capacity and expressed willingness of the MS government to contribute to funding the remaining costs of the demonstration project? What is the willingness of the industrial partners in the given consortium to contribute financially? What other funding sources exist?
- **Transposition of the CCS Directive:** what is the likelihood of successful transposition in time for the NER 300 decision? (Without a successful transposition, there will be no permits – transposition is required before allocation of funds). What is the likelihood of finding solutions to any issues that need to be resolved in the permitting process?
- **Public perception:** what is the likelihood that the demonstration project could be met with serious opposition from civil society?
- **Nature of the power plant:** age and standard of the power plant to be retrofitted or new build. In the case of retrofit, the longer the remaining life the better.
- **Timing of the project:** the expected timeline for start of operation, plus certainty of delivery
- **Transport mode, route and costs:** testing of different transport mode is desirable. Contribution to large-scale CO₂ infrastructure, as recommended in ZEP's 2008 proposal: "If two projects are equal, a project is preferred if it contributes to the development of a large-scale transportation infrastructure in Europe."

1.5 Highlight the critical role of CCS in decarbonising Europe

The largest survey of public awareness of CCS in the EU (Eurobarometer) shows that only 1 in 10 claims to know what CCS is. Yet it will play a critical role in decarbonising Europe as a key enabler for the shift to a low-carbon economy. This includes:

- **Power production with CCS** – abating at least 90% of emissions from the world’s largest emitters, while enabling the large-scale deployment of renewable energy which requires the complementary use of fossil fuel power generation
- **Industrial applications of CCS**, e.g. steel, cement, chemicals, aluminium, fertiliser, refineries, pulp and paper. For some sectors, it is the *only* large-scale abatement option available.
- **Sustainable biomass with CCS** – the *only* large-scale technology that can remove CO₂ from the atmosphere and deliver carbon-negative solutions (power production, biofuels production and industrial applications)
- Methane extraction from **deep unmineable coal beds with CCS** – giving access to vast new quantities of energy.
- The production of large volumes of **CO₂-free Hydrogen** which can then be used for electricity or as a fuel.
- The use of CO₂ in **enhanced oil/gas recovery (EOR/EGR)** and industrial processes, as well as enhancing the growth of biomass, can also play an important role in achieving a profitable value chain for CCS and is therefore key to accelerating investments in early CCS opportunities.

The result: Europe will not only enjoy security of energy supply, but a surge in economic growth – creating “green” jobs, boosting industry and promoting technology leadership.

1.6 Organisational actions

- *TFDI* to draw up additional selection criteria to complement the already established ranking of projects for NER funding for presentation by ZEP to the European Commission and EIB.
- *New TWG Demonstration Programme* (within TFDI) of ZEP country specialists to:
 - Draw up an engagement plan, utilising the advice of the Government Group to identify key points of contact in relevant ministries in MS governments, ensuring regular follow-ups and the ability of multi-stakeholder groups to react rapidly to key issues. If possible, organise a professional team on the ground in each capital.
 - Produce country-specific position papers utilising, i.a., national CCS roadmaps.
 - Explore the possibilities for supporting demonstration projects at a local level.
- *TWG Market Economics* to assess and recommend options for interim measures to support demonstration projects taking FID, focusing on MS where projects are likely to progress.
- *New WG Global Links* (within TFDI) to establish close links with other international CCS programmes/projects to close any knowledge gaps, building on the strong base for knowledge sharing established by the European CCS Demonstration Project Network.
- *Taskforce Public Communication* (TFPC) to actively support national/local campaigns by:
 - Collaborating on translated toolkits and expanding ZEP online presence through online tie-ups with national CCS constituencies
 - Collaborating with national CCS constituencies to identify key events and co-produce events/debates in order to engage public opinion and key stakeholders
 - Engaging with national media in cooperation with CCS constituencies e.g. via op-eds.

2 Creating a secure environment for long-term investment

2.1 Industry needs a strong price signal for investment

CCS is unique as a CO₂ emissions mitigation technology in that it requires a clear price on carbon to underpin the business case for implementation (apart from cases where it may be mandated by government). Alternative energy technologies and energy efficiency projects do not necessarily require a price on carbon, but the business case for implementation is enhanced if there is one. Nevertheless, in all cases of high capex investment, including CCS, long-term price certainty and stability is an important consideration.

This means that CCS is absolutely dependent on the nature of the policy framework implemented to reduce societal emissions: the higher the carbon price, either explicitly through an emissions trading scheme or implicitly within a given policy measure (e.g. CCS feed-in-tariff), the more attractive the proposition. This is even more critical in the early deployment years when costs are generally higher as the technology continues to mature. **As market makers, governments therefore have some obligation to ensure delivery of the necessary price signal for investment.**

Core to EU efforts to build a climate policy framework and put a price on carbon is the EU Emissions Trading Scheme (EU ETS). The ETS covers power generation and major industry in Europe and through a reducing issuance of emission unit allowances (EUAs), delivers a carbon price into the industrial economy. This, in turn, is the principle mechanism for driving the long-term deployment of CCS in the EU.

However, as a result of over allocation, energy policy design and macroeconomic shock delivered by the financial crisis, the carbon price is struggling and now stands at ~€8 per tonne of CO₂. Estimates show that the ETS is 400 million EUAs in surplus (long) in Phase II – with an additional potential for 800 million CERs (units from the UNFCCC Clean Development Mechanism) to enter the system, giving a total EUA equivalent length of 1.2 billion EUAs going into Phase III (the equivalent of 20 large coal-fired power plants running continuously for the whole of Phase III).

Nevertheless, the system still has the capacity to absorb all this over the coming years, to the extent that by 2020 there could be a short position of 400 million EUAs (i.e. reductions that will have to be found). A Deutsche Bank analysis sees this being largely absorbed by fuel switching (coal to natural gas) at a modest carbon price, with existing gas turbine generation capacity allowing this to happen relatively easily. However, there are further potential downsides:

- The same analysis assumes that neither the EU Energy Efficiency Target (the focus of the upcoming Energy Efficiency Directive) nor the even higher profile Renewable Energy Target will be met. Of course if renewable energy supply continues to surge, as it has done in recent years thanks to the efforts in Spain (equivalent to 800 million EUAs), the 400 million EUA short position may quickly evaporate.
- Deutsche Bank assumed that the aviation emissions trading proposal will go into full operation, with both incoming and outgoing flights covered by an expanded ETS. Their analysis reckons aviation to be some 400 million EUAs short through to 2020, so if this important add-on to the ETS does not happen, or is significantly delayed (now in the courts), then the entire ETS will be flat through to 2020.

In addition, despite the gathering storm clouds, Deutsche Bank did not factor in the possibility of a second major economic downturn.

2.2 Establish a level playing field for all low-carbon energy technologies

So the reality is that although the ETS carbon price has some potential upside, it could well remain very weak for a number of years on the back of a long supply-demand position. This is problematic. Although the allowance-based system will always ensure that emissions are reduced to the level of the cap, if this happens with a carbon price in single figures, the system will not deliver on its further critical underlying objectives, which are:

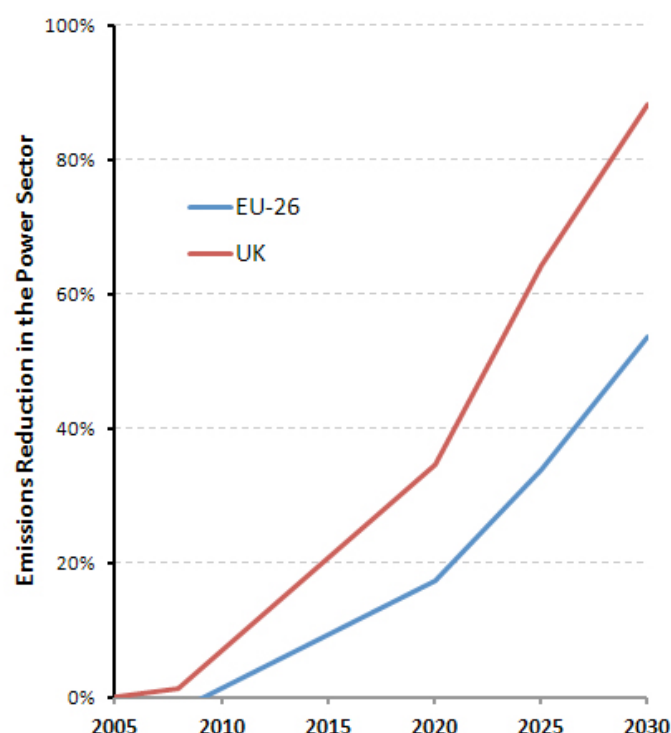
- Being a long-term incentive to drive technology development – in particular, CCS
- Acting as an early trigger to begin the major task of decarbonising the power sector with a particular need to guide investment into the 2020s
- Assisting developing countries in beginning the task of emissions reduction
- Demonstrating the effectiveness of carbon pricing through an ETS with the goal of encouraging similar systems elsewhere
- Supporting the carbon market approach agreed under the Kyoto Protocol.

The combination of reduced emissions as a result of the recession in the EU and the impact of a plethora of Member State (MS) and EU-wide supplementary policies operating in the ETS space have led to this overhang of allowances. The market has no confidence that this trend will in any way change. So despite the prospect of longer-term deep reduction targets (see below), the carbon price remains stagnant and low.

In contrast to the above and looking beyond 2020, the EU Energy Roadmap 2050 signals a very marked change for the power sector. Even deeper reductions are legislated by the UK 4th Carbon Budget targets.

Fuel switching (to natural gas) and renewable energy will play important roles through to 2030, but these reduction targets will also require the use of fossil fuel generation in different operation modes. This will mean investment decisions for the continuous deployment of CCS starting in the 2020 timeframe (for 2026 and later start-up). Deployment decisions in the early 2020s will therefore need some proof of concept and, more importantly, proof of cost demonstration projects to be running from 2015, with others following in the period to 2020.

This sets up a paradox within the ETS where we are certain of the need for CCS deployment, but do not have the confidence to invest due to the uncertainty surrounding the very policy instrument that has been designed to underwrite deployment.



2.3 Correct the carbon market model and move forward

While the ETS model (in combination with the NER 300 scheme), is right approach for the EU, there is therefore an urgent need to correct and recalibrate. In any case, this is the model that exists today and will exist for at least this decade, so it is the one we must work with.

The WGS therefore proposes that a new Temporary Working Group Market Economics (TWG ME) be formed in order to advise on the market conditions necessary to accelerate the deployment of CCS in the EU, for example:

- An immediate set-aside (withdrawal) of some 1.4 billion EUAs to remove the current surplus and in effect reboot the system. This could be withdrawn progressively over two to three years by reduced auctioning.
 - TWG ME to give views on the impact of such an allowance withdrawal and if this should constitute the ZEP position on the matter.
 - TWG ME to consider timing, any necessary staging and the impact of set-aside (for later) vs. full withdrawal.
- The Commission proposes to the EU Parliament and Council of Ministers a design for Phase IV of the ETS – extending out to at least 2030 – in order to establish clear and unambiguous long-term reduction targets.
 - TWG ME to advise on the necessary design conditions for Phase IV and considers the ideal timing for a Phase IV Directive.
- The inclusion of a carbon floor price in the design of Phase IV of the ETS, probably implemented through a declared reserve price for Phase IV auctions. This would serve primarily as a protection mechanism against future macro economic shocks to the ETS, as has been delivered by the financial crisis.
 - TWG ME to collate external/academic evidence for such a recommendation and considers the appropriate price level for implementation.
- Ensuring that the deployment phase (i.e. once through a clear demonstration period) of energy technologies operates on a “level playing field” basis, rather than having certain technologies favoured by individual policy instruments.
 - TWG ME to provide advice on the impact of known supplementary policies and identifies particular policies on which ZEP should focus.
- The implementation of further supplementary mechanisms to encourage at least the first generation of CCS projects, but recognising that such measures can undermine the carbon market and may open the CCS industry to the criticism of a “tilted playing field”.
 - TWG ME to assess a range of options, including regulatory policies, carbon price support mechanisms and fiscal support, with a view to determining measures that ZEP could support. In general, regulatory policies must take into account any impact on European and global competition.

Such an approach is clearly of benefit to the EU, although it remains a complex argument in that the implicit carbon cost within, say, the Renewable Energy Directive may not be recognised, while a transparent €50 (say) carbon price is seen as inflationary and potentially leading to outcomes such as energy poverty in some communities.

Nevertheless, a robust carbon market approach operating without specific technology policies offers the EU the opportunity for the least cost reduction pathway. It encourages the most efficient use of all available resources and maturing technologies such as Solar Thermal, Offshore Wind and CCS. This is a strong argument to make, albeit complex in construction.

Society also includes other industries such as cement, iron and steel, chemicals and non-ferrous metals. They may initially react very negatively towards a higher carbon price, believing that it will

undermine their competitiveness. However, there could also be some medium-term beneficiaries in this group who will continue to benefit from some free allocation, even into the 2020s.

Indeed, in the longer term, the more rapid deployment of CCS is in their interest. It offers a natural long-term ceiling on the carbon price and some level of certainty as to the cost structure of the energy market in the 2020s. Conversely, the unknown cost of meeting deep reduction targets without the certainty of technologies, such as CCS, is a greater threat.

The renewable energy sector may be both winners and losers under the five-step proposal. If some of the specific technology policies that drive their industry are removed they could lose out, but there will be gains for others as the carbon price rises. At issue is the fact that the underlying implicit carbon price driving their industry today is, in some instances, higher than the price needed to deploy CCS.

2.4 Organisational actions

- A new *Temporary Working Group Market Economics (TWG ME)* to be formed in order to advise on the market conditions necessary to accelerate the deployment of CCS in the EU. The result: a clear and coherent set of approaches that encompasses the entire range of CCS applications.
 - Reporting directly to the Coordination Group, it should ideally consist of up to 10 members drawn from the “Chief Economist” office that many companies now operate. Where such an office is not in place, or there are no staff available in a given company or organisation, TWG ME will accept members with a clear understanding of and long standing association with the ETS. Partnerships with organisations concerned about the current state of the ETS and the low level of the carbon price may also be established. If insufficient ZEP members are appointed, the use of specialist consultants may be considered, but financing this will require further consideration.
 - TWG ME should meet up as necessary until the end of Q1 2012, at which point it should have completed its work. After this it will only reform at the specific request of the ZEP Advisory Council (AC).
- *Taskforce Public Communication* to communicate the various arguments outlined above and further articulated by the new TWG.

3 Accelerating CO₂ transport *and* storage infrastructure

3.1 Promote early strategic planning to facilitate CCS roll-out and reduce costs

CO₂ infrastructure comprises both transport and storage infrastructure. Demonstration projects are not dependent on over-sized transport infrastructure – storage is the primary bottleneck. However, while large-scale transport infrastructure applies mainly to commercial CCS deployment, early strategic planning is vital due to the long lead time and its importance in achieving economies of scale.

CO₂ transport infrastructure

CO₂ transport infrastructure (including pipelines and ships) is the enabler for CCS. For new entrants, it offers access at lower cost compared to stand-alone CCS and is therefore key to making CCS attractive to power production and heavy industry. Post 2020, the large-scale roll-out of CCS will require substantial investment in CO₂ infrastructure. However, as planning and development will take time – and must take place well before the building and construction of CCS plants – it must be initiated immediately, otherwise roll-out will be delayed and costs significantly higher.

However, this presents a dilemma: while the availability of transport capacity is an enabler and will positively influence the roll-out, investment will depend on that roll-out – yet investment decisions in infrastructure need to be taken *before* investment decisions in CCS. Any deployment plan must therefore take this into account, for example, by recognising that initial point-to-point transport lines for CCS projects will be built as the backbone for future development – even though they may be in excess of the requirements of the project itself.

CO₂ storage infrastructure

Atlases are currently being developed on potential storage capacity across Europe, on- and offshore. However, as they aim only to provide general information, there remains an urgent need to appraise and characterise individual storage sites required for actual FIDs on storage, which can take ~5 years.

There are several storage categories: onshore, offshore and EOR, depleted oil and gas fields (DOGF) and deep saline aquifers (SA), each of which has their advantages and issues: onshore storage faces the issue of public acceptance, while offshore storage comes at a substantially higher price; and EOR in European oil fields still requires many potential sites to be appraised and characterised. Unlike DOGF, however, SA often still require characterisation.

Storage is, in many ways, the critical element – the key to the success of CCS and highly time-critical. WGS therefore recommends that ZEP leads the debate on storage and collaborates with other EU initiatives, such as CO₂ Europipe, on transport infrastructure.

3.2 Support CO₂ Europipe proposals for transport infrastructure

A roadmap and actions for the development of transport infrastructure have been developed by the CO₂ Europipe consortium. Their main findings/recommendations may be summarised as follows:

Political support

- **The EU needs to give a clear signal on CCS.** It should be very clear that CCS is a key part of the solution – as outlined in the EU Energy Roadmap 2050. At present, this clarity is lacking: on the one hand it supports the CCS demonstration programme; on the other, key Member States (MS) hesitate.
- **Ensure the key players in CO₂ infrastructure commit to development.** These are primarily the North Sea basin countries (UK, Netherlands, Norway) and high-carbon countries (Germany, Poland).

Planning

- **Set planning in motion.** At EU level, a master plan should be developed that displays a vision. This should then be operationalised at MS level in national master plans.
- **Start with storage qualification.** Appraisal and characterisation of a storage site takes ~5 years. This lead time should be reduced and storage qualification start immediately in order to be ready in time for the first demonstration projects.

Business environment for transport

- **Choose an infrastructure business model** in which an independent owner operates on a cost+ basis, supported by an EU-expert authority post 2015.
- **Onshore storage is key** in the initial phase. A sequential development of infrastructure is then anticipated (as has happened, for example, with gas infrastructure). Offshore storage has an additional price tag of €50 to €80 billion.
- **Clustering is key.** Sharing infrastructure reduces costs – including both power and industrial applications.
- **Investigate the link between EOR and CCS** as they have a mutual interest. EOR could be part of the solution for CCS. However, there is a short window of opportunity: CCS should be abating 10s of millions of CO₂ annually by 2020; if it comes too late, the benefits vanish.

Regulation

- **Develop EU standards** for CO₂ transport and best practice cases
- **Find an interim solution for the London Protocol issue⁸** – this may be not needed for the demonstration projects but surely thereafter.
- **Outstanding issues**, e.g. liability, financial security etc.
- **Harmonise risk assessment for onshore pipelines**

R&D

- Close knowledge gaps
- Pay particular attention to the characterisation of SA as they are less well-researched compared to DOGF.

WGS recommends supporting these proposed actions, with priority given to:

1. Advising on the business model for infrastructure
2. Accelerating the infrastructure planning process (the development of master plans by EU and key MS)
3. Developing CO₂ clusters.

3.3 Accelerate the appraisal and characterisation of CO₂ storage

Regarding storage infrastructure, WGS recommends establishing a new WG Storage Infrastructure (within TFDI) in order to:

- Promote the urgent appraisal and characterisation of CO₂ storage as this is on the critical path for the large-scale roll-out of CCS. Balanced attention should be paid to all storage options – onshore, offshore and EOR – each has their role to play.
- Investigate the link between EOR and CCS as it could be a significant driver and convince emitters to “jump on the band wagon”.

⁸ There is an urgent need for Contracting Parties to ratify the amendment to Article 6 of the London Protocol in order to enable the export of CO₂ for the purposes of CCS

3.4 Ensure CCS is properly represented in the European energy infrastructure package

On 19th October, the European Commission unveiled its proposal for a regulation on "Guidelines for trans-European energy infrastructure"⁹, in which it:

- Recognises that CCS is part of its scope, with estimated financing needs of €2.5 billion until 2020 (~1% of total needs)
- Notes that for 2014-2020 a budget has already been created of €9.1 billion for energy under the "Connecting Europe Facility"
- Recommends three actions:
 1. Grant priority to 12 strategic energy infrastructure corridors and projects, and set rules for identifying projects of common interest (PCIs)
 2. Assign national competent authorities to coordinate the permitting for these PCIs
 3. Use its methodology for cost benefit analyses of cross-border projects.

The proposal also determines the conditions for the eligibility of PCIs for financial assistance under the "Connecting Europe Facility".

3.5 Organisational actions

- Revitalise *WG Transport Infrastructure* (within TFDI) with the task of supporting CO₂ Europe's findings and ensuring CCS is properly represented in the 12 strategic energy infrastructure corridors and projects of the European energy infrastructure package and has at least one PCI.
 - Re-staff with members affiliated to organisations that have a clear interest in transport infrastructure (both potential users and investors).
 - Identify and invite persons that are involved in infrastructure development to become members of the Advisory Council. They should be affiliated to companies involved in pipeline infrastructure, shipping solutions, CO₂ hubs, or other relevant organisations.
- *New WG Storage Infrastructure* (within Taskforce Technology (TFT)) to promote the urgent appraisal and characterisation of storage sites, and investigate the link between CCS and EOR.

⁹ Adoption by the European Parliament and the Council scheduled for the end of 2012 for entry into force at the beginning of 2013

4 Increasing R&D focus on facilitating commercial deployment

4.1 Increase R&D funding and coordination between EU, national and industry programmes

There is currently insufficient public and private R&D funding to support timely CCS deployment, with national and EU R&D programmes often too focused on basic research. Closer coordination is therefore needed between EU, national and industry programmes within the European Industrial Initiative (EII) on CCS and the European Energy Research Alliance (EERA) in order to achieve key Strategic Technology Energy (SET) Plan objectives.

ZEP should continue to act as the advisor to the EU on R&D, while improving its advisory role towards Member State (MS) governments. It should also liaise with other industry sectors (e.g. steel, chemicals, cement, refineries) in order to maximise synergies and identify joint R&D projects.

4.2 Support the demonstration of CO₂ storage as the most critical element

The majority of R&D funding is spent on capture topics, which does not reflect the importance of CO₂ storage as the most time-critical element in the CCS value chain – both for demonstration and deployment, and building public confidence. Onshore storage, in particular, is key to the success of CCS and high priority should be given to large pilot projects that demonstrate the reliability and safety of transport and onshore storage, with a focus on monitoring, reporting and verification (MMV).

Accelerating the demonstration of the entire CCS value chain is essential and may require funding mechanisms in addition to the EU Framework Programme (FP), e.g. the second tranche of the NER 300 scheme.

4.3 Advance next-generation CCS technologies

Priority should also be given to projects aimed at lowering the costs of CCS (capital as well as operational), e.g. new solvents, carbonate looping, efficient storage management etc. – as described in ZEP's long-term R&D plan¹⁰.

4.4 Organisational actions

- *WG EII* (supported by TFT) to work with the CCS EII and EERA to bring industry, the EU and MS closer together, including:
 - Promoting better representation of MS in the CCS EII
 - Identifying the potential alignment of funding, programmes and calls between the EU and MS
 - Setting up a series of meetings with the European Commission, Government Group and key MS to discuss R&D priorities.
- *New WG Storage R&D (within TFT)* to generate proposals for the urgent development of large storage pilot projects, supported by TFPC.
- *New WG Global Links (within TFDI, supported by TFT)* to liaise with other industrial sectors in order to maximise synergies and identify joint R&D projects.
- *TFT* to revise ZEP's long-term R&D plan by:
 - Adding price tags

¹⁰ www.zeroemissionsplatform.eu/library/publication/95-zep-report-on-long-term-ccs-rad.html



- Focusing not only on technology research, but development and demonstration, as prioritised by WGS
- Including the results of spearhead projects as the basis for FP8, plus learnings from demonstration projects

All outcomes should be discussed in the CCS EII and the plan updated every two years.

- *ZEP* (members of TFT as well as the Advisory Council) should approach MS to propose topics for R&D calls.

TFT activities to be supported by *TFPC*, members of the Government Group and individual companies in their home countries, as appropriate.