



To the SET Plan Secretariat  
For the attention of Karina Firkaviciute

Subject: Response to issues paper No. 9- CCS and CCU

date: 25 April 2016

Dear Ms. Firkaviciute,

Many thanks for the opportunity to comment on the present issues paper for CCS. In this input letter we describe the position of ETP ZEP on the proposed targets/priorities.

We welcome the Introductory part of the issues paper clearly pointing out the need for CCS, especially after the COP21 agreement to move towards a target of 1.5°C warming, substantially below 2°C warming compared to pre industrial time. Concurrent with the Paris agreement, the world needs to change the emission trajectory as fast as possible and to balance greenhouse gas sources and sinks in the second part of this century to achieve the targets. The timely availability of sinks clearly calls for fast deployment of CCS in power, industry and biofuels. There may also be an urgent need for massive deployment of carbon negative solutions employing bio-CCS. It is thus not a question whether CCS is to be deployed at commercial scale but rather when and how we choose to pay for it. Delay in the deployment of CCS will cause unnecessary costs due to misallocation of resources, making the ramp up task more difficult and will certainly delay the dates for reaching CO<sub>2</sub> emissions milestones. The later the introduction the more costly and demanding this will be on resources. Means to ease the transition and opportunities for an early start should indeed be taken into account, most notably the use of CO<sub>2</sub> in products, as a solvent and EOR to gain experience and to strengthen individual project business cases.

We also welcome your action list. Actions have to be taken now to support CCS infrastructure investment to make CCS, which is already a competitive low carbon technology, timely available for large scale deployment by 2025-2040. It is thus commendable that the paper mentions storage as a key element and that it describes actions to make a European transport and storage infrastructure available. This is a key element for deploying CCS in Europe as it cannot be sourced from technology and service providers elsewhere. We fully agree that it is important that PCI's are developed to this end because an infrastructure cannot be based solely upon connecting nationally developed infrastructures.

European Technology Platform for Zero Emission Fossil Fuel Power Plants

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With respect to the Issues paper No 9 ZEP would like to provide the following comments:

1. The issues paper should strongly reflect the urgency of making CCS investible. The paper seems to suggest that CCS won't be deployed until 2030. ZEP underlines that action is needed now because of the significant lead times and in order to retain economically important CO<sub>2</sub>-emitting industries and associated employment. Without CCS these industries will simply have to leave the European Union if we wish to meet the emissions reductions. The issues paper proposes that member states won't have to decide until 2030 on whether they will opt for CCS to achieve their targets. ZEP is of the opinion that industry and other stakeholders cannot be asked to invest in CCS in the next decade if member states decide only in 2030 whether to embrace CCS. The issues paper mentions the objective of delivering feasibility studies for applying CCS in all major clusters of energy and carbon intensive industries by 2035. ZEP believes that this is much too late. Such feasibility studies should be carried out as soon as possible, in order to unlock the time consuming transition process to a new low-carbon industrial society and prevent technology-lock-in. CCS is not the kind of technology that can be picked up from the shelf in 2030 and plugged in. Even though we understand that the paper can be interpreted in different ways we ask that the issues paper makes it absolutely clear that no time can be lost with taking actions for making CCS investible. The significant lead time for the development and permitting of geological storage, of the order of 7 – 10 years suggests that activities should start as soon as possible.
2. ZEP asks for more attention and action for regulatory aspects because the market for electricity and the financial instruments alone may not be able to sufficiently drive deployment. The only financial instrument to incentivise the deployment and operation of CCS has been the ETS. The price of EUA's has been too low for CCS projects to be bankable by investors. This has not affected deployment of solar and wind energy as these do not rely on the ETS. The consequent increase in peak electricity production has depressed the market for electricity, reducing the ability of utilities to invest in CCS. Therefore the long term business case for CCS will not only need to be shaped by the ETS and other financial incentives but possibly also by the regulatory framework (a group of adjustments of the regulatory framework that could include an EPS and support to offset the negative impact it will have on industry). We suggest an action to develop and implement the policy and regulatory frameworks necessary to make CCS investible at the earliest opportunity
3. ZEP asks for an effective set of objectives. In 2015 ZEP discussed with commissioners Maroš Šefčovič and Miguel Arias Cañete an executable plan for enabling CCS in Europe. This plan is built on ZEP's insights into the principles for making CCS investible in Europe and is supported by the commissioners. Therefore we ask that it is to be taken into account. The principles that are essential for deployment of CCS include the need to decouple the business of capture of CO<sub>2</sub> from transport and storage, the need to develop CCS in phases through (expanding) infrastructure hubs, the need to optimise available funding and create mechanisms to commercialise CCS. In addition, much more attention needs to be given to CCS for the energy

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intensive industry. Table 1 of annex I proposes a set of objectives that respects these principles and builds on new insights, as an alternative to the set of objectives proposed in the issues paper.

4. ZEP proposes a simplified and more appropriate set of KPIs (Key Performance Indicators). Table 2 of the annex proposes a set of KPIs which ZEP considers are appropriate. A recent study of ZEP (the Market Economics 4 study) demonstrates that the true value of CCS lies in its ability to provide a low cost route to decarbonisation. For power this includes the provision of stability to the grid. This huge value from CCS is hardly affected by changes in LCoE, since the alternatives are much more expensive. Therefore ZEP believes that deployment indicators will be more appropriate. LCoE indicators, as suggested in the issues paper, could provide additional reference for the impact of R&D efforts for power plants only, but need to be chosen so that they are relevant for the role that power plants are expected to play in the integrated energy system of the future (load following and intermittent rather than base load). For industrial processes we propose to define deployment indicators. We note that Europe seems to be lagging behind on many of the proposed KPIs, therefore we suggest to develop a small set of leading and realistically achievable indicators. The ZEP is ready to work with you over the coming weeks to firm this up.
5. While ZEP agrees that CCU will be a technology that can be helpful, it believes that the true potential of the contribution of CCU for atmospheric CO<sub>2</sub> emission abatement still needs to be established. The work on CCU should therefore not distract from doing what is really needed: making CCS investible.
6. ZEP considers that the role of hydrogen in the future energy and transportation system must be seen in conjunction with CCS. Sustainable production and use of hydrogen, 96% of which is currently produced with fossil fuels, will in the near future inevitably require CCS. This should be expressed in the set of objectives and KPIs.
7. ZEP asks for a strong commitment of EC and member states to demonstration project realisation, either in EU member states or in other Set Plan countries such as Norway. The purpose of the demonstration projects is to move to the next stage of the innovation and implementation process. Industrial companies have invested heavily over the last decade to create CCS technologies that are now ready for demonstration and deployment. The appetite for further investment by industry will be dependent on a clear indication that there will be either a market incentive or regulatory requirement. The funding mechanisms of the modernisation and innovation funds, if applied and targeted at CCS demonstration, could form such an indication and could make demonstrations bankable.
8. ZEP asks for clear commitment of member states to CCS and CCU by 2020, expressed in a 'CCS master plan' or 'CCS roadmap' for each relevant member state. Such master plans are needed for CCS because of the long lead times associated with development of CCS and required infrastructure.

9. ZEP considers targeted R&I actions for CCS and CCU to be important. Albeit CCS can be deployed it is not yet optimised. Similar to technologies for photo-voltaic energy and offshore wind energy CCS needs a significant R&I effort to improve its competitiveness. At present CCS R&I is underfinanced in the H2020 programme and the volume of actions is not consistent with the large expectations that rest with CCS and CCU. A ramp up is required to ensure efficient and next generation technologies for Bio-CCS, CCS for hydrogen production and the integration of CCS in the energy system, in particular as regards fuel flexibility and operational flexibility. R&I is also necessary to strengthen the link with low emission mobility, in particular regarding the production of biofuels and hydrogen. Furthermore the CCU topic needs to be researched especially with respect to new concepts with a storage efficiency close to geological storage. This is typically research at a low Technology Readiness Level, to be carried out in the timeframe 2020-2030.

For your convenience annex II contains a word-version of the issues paper No. 9 with some detailed comments on particular parts of the paper. Please let us know if you would like to discuss any of the above or if you would like additional information.

In your document that describes the implementation process and expected outcomes you ask a number of questions, the answers to which we provide below.

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Question: Do you agree with the targets set in the issue paper?

Answer: The objectives as stated in the issues paper are: “deliver the commercial-scale demonstration of the full CCS chain, and further reduce the costs of CO<sub>2</sub> capture through Research and Innovation”. ZEP agrees to both objectives but underlines that the main objective is to make CCS investible so that it can be commercially deployed. This requires a range of R&I activities that go well beyond demonstration and cost reduction and include i.a. the removal of barriers for

- The development of infrastructure that enables industries to join the CCS value chain.
- The integration of CCS and RES into an integrated energy system
- A regulatory framework that can drive the deployment of CCS

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Question: Do you think that the level of ambition is correct?

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Answer: ZEP thinks that the correct level of ambition is “to make CCS technology investible”.

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Question: Are there any standing issue(s) in the way of reaching the proposed targets/priorities?

Answer: As argued in the first part of this input paper the issues are urgency, focus and commitment. ZEP is concerned about the perceived lacking of the sense of **urgency**. It is not only important to achieve the objective of having an investible technology but it is even more important to achieve this target as soon as possible. This sense of urgency does not emanate from the issues paper. ZEP believes that the task of making CCS investible requires sufficient **focus** of all parties involved (industry, EC and member states). While certain activities, e.g. CCU-research, will certainly be helpful they should not distract. ZEP asks **commitment** from all parties involved to make CCS investible as soon as possible. In that respect ZEP asks that member states decide on their commitment to CCS well before 2035, the year suggested in the issues paper.

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Question: What are your specific recommendations on prioritising R&I activities on these issues (and building where appropriate on relevant existing initiatives)?

Answer: Priorities follow from ZEP’s executable plan that was discussed with commissioners Maroš Šefčovič and Miguel Arias Cañete and our joint input with the EERA CCS JP to the integrated roadmap under the SET Plan. Additional to the CCS demonstration project, the plan prioritises the development of infrastructure hubs for local clusters of industry for gathering CO<sub>2</sub> from multiple sources and providing access to bankable storage. It also stresses the importance of CCS for energy-intensive industry.

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Question: Who are the best placed actors to implement the targets/priorities (Industry, EU, Member States, regions, groups of countries/organisations/etc.),?

Answer: ZEP believes that the magnitude of the task of making CCS investible requires full commitment of all stakeholders: industry, European Commission, the CCS relevant Set Plan countries as well as local organisations.

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Question: identify possible barriers (when not done already in the Integrated Roadmap) related to regulation, cooperation issues, standardisation / industrialisation / manufacturing, socioeconomics, etc.

Answer: As argued in the first part of this input paper ZEP is of the opinion that the market for electricity and the financial instruments alone may not be able to sufficiently drive deployment of CCS. The long term business case for CCS will not only need to be shaped by the ETS and other financial incentives but possibly also by the regulatory framework (a group of adjustments of the regulatory framework that could include an EPS and support to offset the negative impact it will have on industry). We suggest an action to develop and implement such policy and regulatory frameworks necessary to make CCS investible at the earliest opportunity

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Question: Identify possible gaps or duplication of efforts in the R&I priorities (based on the Integrated Roadmap);

Answer: ZEP has not identified such duplication of efforts, the concern is the low share of funding which is directed to CCS and CCU.

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Question: Identify priorities where there is scope for and benefit in more coordination and/or cooperation across EU, Member States, regions, Research Institutions and/or industry;

Answer: ZEP stresses the need for joint actions in transport and storage including the application of ship transport. This is an activity that could benefit from more co-operation and joint action like PCI's. It is also clear that the CCS and Hydrogen communities must co-operate closer- especially in the fields of CCU, industrial use of hydrogen from fossil fuels with CCS. This includes co-production of renewable hydrogen and hydrogen from fossil fuels with CCS and common use of infrastructure.

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Question: Identify best practices of past or present coordination and/or cooperation that can be used as an example or as a starting point.

Answer: ZEP expresses its appreciation for the efforts made by Member States, the European Commission and industry for their continuing support for the CCS demonstration projects.

**With kind regards,**



**Graeme Sweeney**  
**Chairman ETP-ZEP**

## Annex I: proposed objectives and KPI's

proposal for objectives
<p>2020 proposed key objectives and targets by 2020</p> <ol style="list-style-type: none"> <li>1 completed CCS projects currently in pipeline</li> <li>2 3 developed clusters / storage hubs               <ul style="list-style-type: none"> <li>completed feasibility studies</li> <li>an approved project of common interest</li> <li>market-maker frameworks for T&amp;S infrastructure on commercial basis</li> <li>incentivised value chain where needed</li> <li>an initiative for an industrial CCS demo-project in any of the clusters</li> </ul> </li> <li>3 storage projects</li> <li>3 appraise sufficient geological storage capacity : 6 gigatonnes</li> <li>4 new technologies               <ul style="list-style-type: none"> <li>for cost reduction in value chain,</li> <li>for integrating CCS&amp;RES and</li> <li>capture processes in energy-intensive industries</li> </ul> </li> <li>5 explore CCU(S)               <ul style="list-style-type: none"> <li>feasibility studies for CCUS for fuel and Value added chemicals</li> </ul> </li> <li>6 CCS master plan' or 'CCS roadmap' developed by member states</li> </ol> <p>2030 proposed key objectives</p> <ol style="list-style-type: none"> <li>1 roll out CCS clusters</li> <li>2 pilots for CCUS technologies for value added chemicals</li> <li>3 develop retrofit power plants by 2040</li> </ol>

Table 1, proposed set of objectives

proposal for KPIs
<p>deployment indicators</p> <ul style="list-style-type: none"> <li>integrated demos in operation</li> <li>CO2 avoided</li> <li># member states actively supporting CCS</li> <li># industry sectors actively pursuing CCS</li> <li># companies actively pursuing CCS</li> </ul>

Table 2, proposed KPIs

## Annex II to ZEP's response to Issues paper No. 9

### commented version of issues paper No 9

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#### Purpose of this document

This document is intended to inform the discussions between the Commission, the Member States and stakeholders regarding the implementation of the actions contained in the SET-Plan Communication ("Towards an Integrated Strategic Energy Technology (SET) Plan: Accelerating the European Energy System Transformation" (C(2015)6317)), and specifically the actions concerned with the priority number 9 on CCS. It is part of a series of Issues Papers jointly prepared by the EC services. These documents will serve as a starting point for discussions with Member States and stakeholders in the development of new research and innovation cooperation at European and national level, especially as regards activities going beyond the Horizon 2020 programme. Each Issues Paper aims to define (a) the level of ambition of the Commission, the Member States and stakeholders (in terms of priorities and targets), (b) the modalities for the implementation and (c) the timing for achieving results and adopting expected deliverables.

Stakeholders are invited to take position on the proposed targets in accordance with the guidelines set out in the paper ***The SET Plan actions: implementation process and expected outcomes*** and submit their positions to SET-PLAN-SECRETARIAT@ec.europa.eu by **25 April 2016** at the latest. All relevant documents and material are available on the SETIS website <https://setis.ec.europa.eu/>.

#### Introduction – CCS

When assessing how to meet long term decarbonisation objectives, the Energy Roadmap 2050 as well as other reports have shown that fossil fuels might remain part of the global as well as of the European energy mix, not least because they will continue to be used in many industrial processes. CCS is at present one of the key promising technologies that can help reduce CO2 emissions in the power generation sector and the only pathway for very stringent GHG emission reductions from specific energy and/or carbon intensive industries that generate CO2 as part of their production processes. In order to achieve the greenhouse gas emission reductions needed for keeping the global temperature rise this century well below 2 degrees Celsius as agreed at COP21 in Paris, CCS will need to be deployed from around 2030 onwards also in the fossil fuel power sector. For limiting this even further to 1.5 degrees Celsius, negative emissions may need to be achieved, e.g. by applying biomass conversion technologies with CO2 capture and storage (Bio-CCS).

Robert van der Lande 20/4/2016 12:15

**Comment [1]:** They will remain part

Robert van der Lande 22/4/2016 15:23

**Comment [2]:** CCS should be deployed as soon as possible and not be postponed to 2030. No time to lose. The danger of this statement is that politicians use it as an excuse to do nothing for 15 years and leave it to their successors. There seems to be little comprehension of what is required to move the technology to the point where it is ready for commercial deployment. ZEP urges to change the text accordingly.

In order to realise its potential, CCS needs to become a cost-competitive technology and gain public acceptance (mainly regarding storage safety), so that it could start to be commercially deployed and thus contribute to the low-carbon transition of the European economy. The assessments made in the context of the EU's Roadmap for moving to a competitive low carbon economy in 2050 and the Energy Roadmap 2050 see CCS, if commercialised, as an important technology contributing to low carbon transition in the EU, with 7% to 32% of power generation using CCS by 2050, depending on the scenario considered. Furthermore, in these scenarios, by 2035 CCS starts to contribute on a broader scale to reducing CO2 emissions from industrial processes in the EU.

### Why taking action now on CCS?

CCS has not yet taken off in Europe for a variety of reasons. However, the need for large scale demonstration, as a necessary step for its commercialisation and deployment, has not receded; on the contrary it has become more urgent. Commercial scale CCS demonstration projects are necessary in order to confirm CCS's technical and economic viability as a cost effective measure to mitigate greenhouse gases (GHG) in the power and industrial sectors. While CCS is not currently projected to significantly contribute to helping reach the EU's 2030 climate and energy targets and objectives, a "lock-in" into an energy infrastructure, which is not in line with the EU's long term decarbonisation objectives must be avoided. Failure to timely demonstrate CCS may therefore call into question new investments in fossil fuel power plants and CO2-emitting industries with large implications for Europe's economy and employment.

An analysis by the JRC (Global Energy & Climate Outlook, <https://ec.europa.eu/jrc/en/geco>) concludes that in case the 2° Celsius objective is taken seriously, most global investment in the power sector is expected to be renewables (see graph below), but average yearly investments of approximately US\$ 100 billion would be in coal and gas power plants with CCS:

Without CCS demonstration projects in Europe, it could prove very costly, difficult or even impossible to reach the agreed climate targets and the EU will not achieve technology leadership in this area and miss out on economic opportunities.

CCS is also necessary in carbon-intensive industries to reduce process emissions that cannot be avoided. Further delays may ultimately result in the need of the European industry to purchase CCS technology from non EU countries in the future. While purchasing CO2 capture technologies is at least possible, this is not an option for establishing the necessary infrastructure for CO2 transport and storage. Many of the existing upstream oil and gas infrastructure in the North Sea will be decommissioned in the coming years. Delaying CCS development would mean precluding possible synergies resulting in higher investment needs in the future. Also the market-penetration of possible fuels and other products from conversion of CO2 (CCU) is a process which needs time and demonstrations should therefore be initiated as soon as possible. [A failure to make CCS available](#)

Robert van der Lande 19/4/2016 08:27

**Comment [3]:** CCS is already a low carbon energy technology that is very cost competitive compared to most renewable energies. ZEP does agree that the competitiveness of all low carbon energy technologies vis-à-vis unabated energy technologies needs to be improved. We ask that the text be rewritten accordingly.

Robert van der Lande 22/4/2016 15:24

**Comment [4]:** CCS is already commercially available. The incentive scheme for low carbon energy technologies and a further reduction of the cost of CCS are needed so that the technologies can compete with unabated energy technologies and become investible. We ask that the text be changed accordingly.

Robert van der Lande 18/4/2016 11:50

**Deleted:** assessments

Robert van der Lande 22/4/2016 15:25

**Comment [5]:** It is important to be clear about the reasons: The only financial market mechanism to incentivise the deployment and operation of low carbon technology has been the ETS. The price of the ETC has been too low, partly due to confidence impacted by the financial crisis, to be bankable by investors. The deployment of Solar and Wind has been financed by direct subsidies designed avoiding the market to ensure bankability for small and large investors. So even though more expensive in terms of dispatchable low C2 emitting electricity these technologies have been deployed avoiding the market mechanisms. The effective increase in electricity production in Europe has depressed the market price. This has reduced the utilities ability to invest in any low emission technology.

Robert van der Lande 18/4/2016 12:03

**Comment [6]:** This suggests that CCS will not be deployed before 2030. ZEP is of the opinion that CCS should be deployed a.s.a.p., therefore proposes to delete this part of the sentence.

Robert van der Lande 22/4/2016 15:26

**Comment [7]:** . ZEP suggests that reference is made to the ZEP ME4 report. It shows that the lowest cost system for Europe can be achieved with a portfolio of technologies with CCS. A mechanism to incentivize bankable investment in Low CO2 emitting technologies is missing in Europe.

[and accessible for industry will almost certainly result in a decline of certain of Europe's economically and vitally important industrial activities](#)

### Overall objectives and targets

The key technology-related objectives for CCS, both in the short and longer term, are to deliver the commercial-scale demonstration of the full CCS chain, and to [further](#) reduce the costs of CO2 capture through Research and Innovation.

[Demonstration](#) will require maximising the use of strategic EU funds, especially the Innovation Fund, but also, if appropriate, the Connecting Europe Facility - CEF - and the Modernisation Fund. In particular, it will require establishing a reliable long-term business case for operating a CCS installation - based on a reformed Emission Trading System (ETS) but, if necessary, complemented by Member State support instruments [and adjustments of the regulatory framework](#). Last but not least, it requires increasing public awareness of the societal benefits of CCS and increased collaboration between EU Member States and Associated Countries.

The estimated overall availability of permanent geological storage capacity in Europe is equivalent to over 300 Giga tonnes (Gt) of CO<sub>2</sub>. Total CO<sub>2</sub> emissions from EU power generation and industry are around 2.2 GtCO<sub>2</sub> annually. Therefore, there is no doubt that there are sufficient suitable storage sites to hold the CO<sub>2</sub> captured in the EU for decades to come. Storage capacity in the North Sea alone has been estimated at over 200 GtCO<sub>2</sub>. The **detailed appraisal of storage capacity** in selected regions will be a key facilitator for commercial CCS deployment.

While sufficient storage capacity exists in Europe not all capacity is accessible or located close to CO<sub>2</sub> emitters. Hence a [cross border transport infrastructure is necessary](#) to efficiently connect CO<sub>2</sub> sources to sinks. Under the regulation on "Guidelines for Trans European Infrastructure", CO<sub>2</sub> transport infrastructure projects can qualify to become **Projects of Common Interest** and can eventually be eligible for funding. [Additional](#) infrastructure will [have to be developed at local](#) level in order to become the nucleus of a **CO<sub>2</sub> hub that can develop into a cross-border network**.

Enhanced hydrocarbon recovery, especially enhanced oil recovery (EOR) combined with permanent storage is currently the only available large scale carbon capture and use (CCU) option which would actually remove relevant volumes of CO<sub>2</sub> permanently from the atmosphere. Also other CO<sub>2</sub> utilisation options could help improving the economic case for CO<sub>2</sub> capture, but further research & innovation activities are necessary for them to have a chance to make a [meaningful contribution to our greenhouse gas reduction objectives](#) and should therefore be intensified.

### Proposed key objectives and targets in CCS and CCU by 2020:

- At least one commercial-scale CCS demonstration project operating;
- Completed feasibility studies on applying CCS to a set of clusters of major industrial CO<sub>2</sub> sources (at least 3 clusters in different regions of the EU);

Robert van der Lande 22/4/2016 15:29

**Comment [8]:** Industrial companies have invested heavily over the last decades to create CCS technologies that are now ready for demonstration and deployment. The appetite for further investment is now very low in the absence of a clear indication that there will be either a market incentive or regulatory requirement to implement. The purpose of the demonstration is to achieve the next stage of the innovation proposes. We wish to remind that CCS equipped plants are a key part of the lowest cost solution. The available funding mechanisms should be directly applied and targeted at CCS demonstrations on Power and Industry. In a market where the utilities are not making money they can not invest in anything. Future CCS demonstrations projects will require full funding of the cost by a mechanism that is bankable and independent of the current business model of the operators. The UK CfD as recommended by the ZEP Market Economic Report was and is a good model. After the UK competition cancellation an even greater incentive will now be needed before industry players will be persuaded to take the L... [1]

Robert van der Lande 18/4/2016 17:28

**Comment [9]:** The long term business case for CCS will not only need to be shaped by the business case and the financial components of ETS but also by the regulatory framework (e.g. EPS). This requires policy measures

Robert van der Lande 22/4/2016 11:06

**Comment [10]:** because storage capacity is not evenly distributed among Member States, and because significant economies of scale can be reached through clustering, the development of European infrastructure must start from the start of CCS.

Robert van der Lande 18/4/2016 12:17

**Deleted:** Nevertheless, initially CCS projects will most often explore CO<sub>2</sub> storage sinks in the vicinity of capture points, hence

Robert van der Lande 18/4/2016 12:17

**Deleted:** first

Robert van der Lande 18/4/2016 12:18

**Deleted:** national

Robert van der Lande 12/4/2016 17:29

**Comment [11]:** ZEP asks to mention that CCU may be helpful for the circular economy but is not likely to significantly contribute to the reduction of emission of greenhouse gases.

Robert van der Lande 22/4/2016 15:30

**Comment [12]:** We propose to re-arrange these objectives so that they align with the executable plan that was discussed by ZEP with commissioners Sefovic and Canete. See our letter with the response to the issues paper

- At least one additional CCS demonstration project, preferably with an industrial source from which CO2 can be easily captured, having taken positive FID, which could be possibly funded from the part of the Innovation Fund available before 2021 (50 million allowances from Market Stability Reserve plus leftover money from NER300);
- At least 1 Project of Common European Interest identified for CO2 transport infrastructure, preferably related to storage in the North Sea;
- An up-to-date atlas of the geological storage capacity that has been identified by various national authorities in Europe. This will provide additional certainty that the required CO2 storage capacity will be available when needed;
- At least 3 pilots on promising new capture technologies, and at least one to test the potential of Bio-CCS;
- At least 3 new CO2 storage pilots, in preparation or operating in different settings; [bankable storage](#)
- Completed feasibility studies for the use of captured CO2 for fuels and value added chemicals;
- At least 4 pilots on promising new technologies for the production of value added chemicals from captured CO2;
- Setup of 1 Project of Common European Interest for demonstration of different aspects of industrial CCU, possibly in the form of Industrial Symbiosis.

Robert van der Lande 22/4/2016 15:31

**Comment [13]:** ZEP considers 2020 unrealistic. An FID by 2020 would require that feasibility studies should start in 2016. This is not the case

Robert van der Lande 12/4/2016 18:04

**Comment [14]:** ZEP proposes to delete this objective as it gives too much weight to CCU, a technology that will contribute marginally to reduction of emissions

#### On the road to 2030:

- MS to deliver on their 2030 nationally determined contributions to the COP21 agreement, and in particular decide on the need for CCS to achieve these targets and make them compatible with the 2050 long-term emission targets;
- MS having prepared plans for retrofitting until 2040 at least 90% of their fossil fuel power plants capacity which they expect to be still operational beyond this date.
- MS having prepared, if appropriate in regional cooperation with other MS, feasibility studies for applying CCS in all major clusters of energy and carbon intensive industries in the EU by 2035, cooperating across border for transport and storing CO2.
- Further develop the potential of the industrial use of captured CO2, in particular through a Project of Common European Interest

Robert van der Lande 18/4/2016 12:43

**Comment [15]:**  
- Is it reasonable to expect industry to invest from 2020-2030 in pilots and demos while member states may decide in 2030 that they don't want to use CCS? -2030 too late.

Robert van der Lande 12/4/2016 17:50

**Comment [16]:** ZEP strongly objects: feasibility studies need to be completed much earlier.

#### Some basic Key Performance Indicators (2010 €)

Metric		Target 2020	Target 2030
<b>Levelised Cost of Electricity*</b>			
Coal power plant with CCS (post-combustion / oxy-combustion)	€/MWh	70.2 / 66.4	68.2 / 63
NG power plant with CCS	€/MWh	87.4	84
<b>Cost of CO2 avoided*</b>			
Coal power plant with CCS (post-	€/t CO2	26.1 / 20.1	26.3 / 17.8

Robert van der Lande 22/4/2016 11:10

**Comment [17]:** The KPI table, in its present form, focuses on cost of electricity with CCS while cost is not the real barrier to implementing CCS. Member State support and policy are more important

combustion / oxy-combustion)			
NG power plant with CCS	€/t CO2	45.3	40.5
<b>Efficiency indicators</b>			
Plant efficiency - coal with CCS (post-combustion / oxy-combustion)		35 / 37	35 / 39
Plant efficiency – NG with CCS		52	55
Average capture rate		85	95
<b>Deployment indicators</b>			
N° of demo projects with positive FID		2	15
Permits for CO2 storage		2	15
CO2 stored	Mt/yr	1	15

Robert van der Lande 22/4/2016 10:06

**Comment [18]:** This indicator rewards polluting fuels. It should be replaced by "CO2 avoided".

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### Some recommendations on financing CCS demonstration and deployment

As regards early demonstration of CCS, the use of the ERA-Net instrument can be a useful tool to facilitate the pooling of the available funding from the EU and Member States to reach a critical mass. This should be considered in particular to enable first-of-a-kind CCS demonstrators.

For large-scale demonstration and deployment, which requires levels of funding surpassing the capacities of Member States and European Research Framework Programmes, the stakeholders (industry and Member States) should set up and agree on a list of potential CO2 clusters or other projects of national, regional or common interest, which would also serve to prioritise the use of the existing or planned financial instruments like the Innovation Fund. Experience gained in commercial-scale CCS demonstration projects will also serve to prioritise research funding.

## Annex: Relevant actions of the 'Towards an Integrated Roadmap' document of the SET Plan

### A. Proposed targeted R&I actions

#### Advanced Research Programme

##### 1. CO2 Capture

- Action 1: Basic R&D for supporting pilots and demonstration actions
- Action 2: Proof of concept of efficient capture technologies for pan-industrial utilisation

##### 2. CO2 Storage

- Action 1: European ATLAS of potential storage sites
- Action 2: Improved methods for site characterisation
- Action 3: Improved methods for site monitoring
- Action 4: Improved methods for safe storage exploitation

##### 3. Competitive Carbon Capture and Storage (CCS) Value Chains

- Action 1: Basic R&D and infrastructure for effective design and operation of CO2

- transport systems
- Action 2: Developing advanced materials for CCS applications and key enabling technologies

#### **4. Conversion of CO2 from Process Flue Gases**

- Action 1: Advanced olefin production from CO2
- Action 2: Demonstration of fine chemicals from CO2
- Action 3: Access to competitive CO2 for chemical conversion

### ***Industrial Research and Demonstration Programme***

#### **1. CO2 Capture**

- Action 1: Piloting of promising capture technologies
- Action 2: Prove options to utilise the full potential of bio-CCS

#### **2. CO2 Storage**

- Action 1: Start-up and management of up to six new CO2 storage pilots

#### **3. Competitive Carbon Capture and Storage (CCS) Value Chains**

- Action 1: CO2 transport pilots for effective design and operation of CO2 transport systems
- Action 2: Efficiency improvement and key enabling technology development for CCS

#### **4. Conversion of CO2 from Process Flue Gases**

- Action 1: Demonstration of industrial scale production of polymers from CO2
- Action 2: Demonstration pilot for mineral production from CO2

### **B. Framework conditions - policy measures**

#### ***Innovation and market-uptake programme***

#### **1. CO2 Storage**

- Action 1: Start-up and management of CO2 storage demonstration projects
- [Action 2: develop framework to enable construction T&S infrastructure on commercial basis](#)

#### **2. Competitive Carbon Capture and Storage (CCS) Value Chains**

- Action 1: Pan-European transport of CO2
- Action 2: Develop tools for understanding integration and cross-cutting issues
- Action 3: Demonstrate Large Scale Integrated CCS plants

#### **3. Conversion of CO2 from Process Flue Gases**

- Action 1: CO2 based products should be recognized as renewable products and benefit from appropriate support