The European Network of Excellence on Geological Storage of CO_2
Association

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Input to the SET PLAN Issues Paper No 9 on CCS and CCU

"Renewing efforts to demonstrate carbon capture and storage (CCS) in the EU and developing sustainable solutions for carbon capture and use (CCU)"

The following input to Issues Paper No 9 has been generated by members of the CO_2GeoNet Association and is unanimously supported by the members of the Association. CO_2GeoNet Members have expertise in CO_2 storage and consequently, our response is primarily focused on this aspect of the CCS chain.

CO_2GeoNet thanks the EC for the invitation to respond to the draft Issues Paper on CCS and CCU and wishes to compliment the EC with the smart formulation of the targets for future research and innovation plans on CCS and CCU. Stakeholder discussions at the 10th CO_2GeoNet Open Forum emphasised that long term policy support is critical to deployment of CCS. The continued support of the Commission for CCS as part of a sustainable future is essential for stakeholder confidence and continues to pay dividends in terms of R&I outputs which are globally recognised.

The Association confirms that CCS is a crucial decarbonisation option for the power sector and carbon intensive industries. Yet, integration is key: CCS and CCU are not stand-alone solutions but should be studied in the context of the whole energy system, and in relation to renewables in particular.

A step change to deliver commercial scale deployment is urgently needed to meet the ambitious targets formulated in the COP21 Paris Agreement. For that reason, future research and innovation actions, including demonstration, in the SET Plan should be clearly linked to the timely commercial deployment of CCS and CCU, taking into account the decommissioning timeline of existing upstream oil and gas infrastructure in the North Sea. The costs of meeting the GHG emission targets are thought to be significantly higher without CCS. The more emission reduction measures will be delayed the more we will rely on creating negative emissions with bio-CCS or direct capture from the atmosphere and storage as indicated by the 5th IPCC report on mitigation of climate change. 'Locked in' carbon emission from both the power sector and carbon intensive industries need to be avoided. The competitiveness of the carbon intensive industry might be seriously affected if cost-effective CCS solutions are lacking.

It is recognized that Member States play a decisive role in implementing mitigation measures. National governments and the Commission are in the lead to build the required policy and market conditions for creating a prosperous investment climate for all mitigation measures including CCS and CCU.

The ambitious goals of the COP21 Paris Agreement require actors to increase momentum, by accelerating the implementing mitigation measures and increasing the size of the measures to an unprecedented scale. CCS is already at demonstration stage, we now need to take R&I actions to accelerate deployment. This requires further demonstration projects and development of a transport and storage infrastructure. CCS should *from the start* be organized with a focus on European hubs and clusters of CO_2 sources. These should include both the power sector *and* carbon intensive industries.

Techno-economically CCS is ready to be rolled out. R&I support is still important to refine specific aspects of CCS including methods for estimating bankable storage capacity, efficient site characterisation, storage site operation and management and practical approaches for effective public participation.

Developing a business model that works for transport and storage is also critical, to stimulate industry to keep investing in demonstration and commercial scale projects by providing the confidence of future cost-efficient options to deploy CCS.

Public acceptance is, besides a good business model and MS and EC (regulatory) support, one of the key elements required for successful deployment of CCS, in particular in populated onshore areas.

Summary of key input

SET PLAN Issues Paper No 9 on CCS and CCU describes the steps to be taken to support the timely development of CCS. As acknowledged in numerous studies, CCS will be a key element of the portfolio of measures available to EU Member States to meet emission reduction targets.

With a lead time of the order of 7 – 10 years, the development of storage capacity and storage infrastructure defines the pace of CCS deployment. The CO2GeoNet input to the Issues Paper No 9 focuses on storage and provides recommendations for improving the coverage of the storage part of CCS in the list of actions and performance indicators.

The key CO_2GeoNet recommendations for the Issues Paper No 9 are the following:

- Improve the reliability of capacity assessment in the Storage Atlas by robust capacity calculations and bankable storage capacity.
- Transport and storage (T&S) will need to be developed on a regional scale *from the start*, rather than a national scale. Cross border infrastructure should be a central issue and taken into account when constructing the first T&S elements as part of the first CCS project.

- Member States should be urged to develop Master Plans for CCS, according to the COP21 Paris Agreement, by 2020 at the latest.
- A reliable business model, regulatory framework and public acceptance are crucial aspects for successful deployment of CCS.

Actions and key performance indicators are proposed that are related to these recommendations.

Specific recommendations

In general, CO_2GeoNet is of the opinion that the level of ambition should be increased in order to assure the timely deployment of CCS in agreement to the high ambitions discussed during the COP21 in Paris. CCS is already at a demonstration stage and acceleration towards large scale deployment is now required.

By 2020:

- *"At least one commercial-scale CCS demonstration project operating;"*

  Presumably this should be "*At least one additional project*" as Sleipner is already operating at 1Mt/year where CO_2 is captured from a produced gas stream and stored in the deep subsurface below the North Sea.
  New demos should have the potential to serve as nucleus for future clusters and this should be a high-level criterion in evaluation, prioritizing and funding of proposed demo projects.

- *"Completed feasibility studies on applying CCS to a set of clusters of major industrial CO_2 sources (at least 3 clusters in different regions of the EU);"*

  This target is supported by CO_2GeoNet.

- *"At least one additional CCS demonstration project, preferably with an industrial source from which CO_2 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);"*

  This target is supported by CO_2GeoNet.

- *"At least 1 Project of Common European Interest identified for CO_2 transport infrastructure, preferably related to storage in the North Sea;"*

  The development of joint, large-scale transport infrastructure becomes important when CCS (and CCU) clusters start to develop. Synergy could be created by re-using (part of) the existing infrastructure for oil and gas exploitation. The decommissioning timeline of infrastructure should therefore be taken into account.

- *"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 CO_2 storage capacity will be available when needed;"*

  For a Storage Atlas to advance the current state of play it must be clear that site assessment needs to be performed using a universally agreed methodology. This may require access to more data/acquisition of new data. A portfolio of storage sites with bankable storage should be sufficient for at least the first two decades of storage.
  The Storage Atlas should be aligned with other activities on sustainable use of the subsurface for geo-energy applications.

- *"At least 3 pilots on promising new capture technologies, and at least one to test the potential of Bio-CCS;"*

  Bio-CCS should get more attention in the key objectives as it is considered important for reducing emissions and it is the only technology currently available that can result in large-scale negative emissions. Integration of this technology into a sustainable Europe is a great challenge due to competition for land use amongst other factors.

- *"At least 3 new CO_2 storage pilots in preparation or operating in different settings;"*

  'Different settings' should be made more specific in order for the pilots to target specific R&I questions. Pilot projects should be planned in areas and in storage media that have upscaling potential, and that can be used to test specific, complex aspects of storage. The projects should be lined up with the activities for the storage atlas. This could include, for example, (pressure) test injections to prove injectivity and indicate capacity in geological regions/formations which are expected to offer storage opportunities for the next trance of demonstration projects and for deployment of a CO_2 storage network. Investigation of the impact of heterogeneities, fracture networks and compartmentalisation on storage and pressure management options could also be considered as these topics were highlighted for research at the EERA-CO_2GeoNet workshop in Venice, 2015.

- *"Completed feasibility studies for the use of captured CO_2 for fuels and value added chemicals;"*

  No comment

- *"At least 4 pilots on promising new technologies for the production of value added chemicals from captured CO_2;"*

  No comment

- *"Setup of 1 Project of Common European Interest for demonstration of different aspects of industrial CCU, possibly in the form of Industrial Symbiosis."*

  The demonstration of 'different aspects' should be made more explicit. We would like to emphasize that CCU projects should clearly show how CO_2 will be permanently removed from

the atmosphere, e.g. by permanent geological storage, in order for CCU to contribute to the emission reduction targets.

On the road to 2030:

The number of demo projects in 2030 in the table with key performance indicators is not reflected in the key objectives and targets for 2030. It is recommended to include key targets for demonstration projects for 2030.

- *"MS to deliver on their 2030 nationally determined contributions to the COP21 Paris 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;"*

  Each Member State should be stimulated to develop a Master Plan for CCS as a contribution to the COP21 Paris Agreement in 2020, rather than in 2030 as currently stated in the Issues Paper. These Master Plans should include feasibility of national storage demonstration and/or commercial scale projects or projects in collaboration with other countries if national storage options are limited. In addition, the Master Plans should contain the regulatory framework to support the deployment of the storage projects.

- *"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."*

  Perhaps 2030 is too late for these plans. It would greatly help if MS have their roadmaps ready much earlier. Power plants and other stakeholders then have clarity about the viewpoint of MS regarding CCS. If such clarity comes only towards 2030, this could be an implicit message to power plants to wait.

- *"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 CO_2."*

  The potential of initial CCS projects to serve as nucleus of a CO_2 hub should be a high level criterion in evaluation, prioritizing and funding of the proposed demo projects. The hubs and clusters should be supported by large scale cross border infrastructure. For some Member States where storage opportunities are limited, cross border storage may be the only way forward for CCS.

  Storage capacity is not evenly distributed, as is the need for emission reduction through CCS. Significant cost reduction can be reached by combining transport and storage , and clustering should be a central goal in the development of the infrastructure.

  Such feasibility studies have been done, recently, for many clusters, e.g. Teesside, Humber and Rotterdam regions. These studies could be updated by 2020.

  Feasibility studies should be prepared by 2025 leaving 10 years for implementation.

- *"Further develop the potential of the industrial use of captured CO_2, in particular through a Project of Common European Interest."*

  No comment

KPIs

"N° of demo projects with positive FID"
We suggest to change this in "commercial scale demo projects" to make a KPI that really moves us forward towards deployment.

No KPIs have been defined for CCS in the carbon intensive industries. We recommend to develop these.

Levelised cost of electricity (LCOE) is not necessarily the only criterion, as it typically ignores price volatility on the power markets including CCS and the value of flexibility (ramping etc.). We recommend to include also other yardsticks for assigning a value to flexibility.

It is advised to develop a comprehensive, standardized Technology Learning Curve (TLC) based assessment methodology for scoring (past and future) R&I efforts. More coordination / synergy could be achieved by having a TLC-methodology: if all efforts could be expressed in those terms, be calibrated post-project execution in order to learn, be integrated and expressed in terms of synergetic effects, then all may benefit.

A more ambitious target than *"CO_2 stored 1 Mt/year by 2020"* is needed. Sleipner and Snohvit already store around 2 $MtCO_2$/year. A more representative target would be '*at least 3 Mt/yr'*.

Barriers and gaps

We currently observe that CCS demonstration projects fail, due to lack of/decreasing Member State (financial) support, due to a failing ETS and due to absence of public support. Actions need to be developed to accelerate CCS deployment and to use demonstration projects for informing and engaging the public.

Public acceptance is particularly important in densely populated onshore areas. The use of multimedia tools for dissemination of information to the public should be intensified as well as improved monitoring techniques to increase the confidence of the public in CO_2 storage.

Future CCS projects and networks will be subjected to strong fluctuations in the CO_2 streams through the CCS chain. Material properties and storage systems design must be able to cope with these fluctuations.

Of prime attention is to develop policies that support the transition from the demo to the early commercial deployment phase (well before 2030). Stakeholder discussions held during the review of the Storage Directive indicated that the ETS was viewed as a long term mechanism. The ETS remains an important part of a sustainable future but mechanisms which accelerate CCS in the short and medium term are needed. In case individual Member State instruments are introduced (or prolonged) in parallel to the ETS, it must be ascertained that these are fully consistent with and complementary to the long-term business case from the ETS. New rules should be established on how to achieve, within a Member State, policy consistency, with a view on achieving, both on the short-term and on the long-term, a credible investment climate for implementing SET Plan technologies (and technology development). This includes the shift in financing from public capital towards private capital or to mixed forms. An organisational model of the future CCS market with a market maker for transport and storage is to be developed.

Actors and areas of collaboration

In developing national and regional implementation plans for climate mitigation measures cooperation across the various mitigation technologies, in particular renewable and fossil fuel energy production and across energy and industry sectors should be promoted.

Practices from oil and gas industry for appraisal of production and gas transport and processing are instrumental for the development of the future CO_2 transport and storage infrastructure.

MS and the EC need to support the implementation of CCS up to the time that it can be deployed at full commercial scale. They should provide the financial and regulatory framework during the pilot and demonstration scale level of CCS.