SET-Plan Declaration of Intent on strategic targets in the context of Action 9 'Renewing efforts to demonstrate carbon capture and storage (CCS) in the EU and developing sustainable solutions for carbon capture and use (CCU)'

Purpose of this document

This document[1] summarises conclusions reached between research and industry stakeholders and those SET-Plan countries that have chosen to take part[2] in the definition of strategic R&I targets for the SET-Plan Action 9 on 'CCUS'. With this Declaration of Intent, interested parties agree to act in a coordinated way and to address all relevant issues in order to attain the agreed targets.

This agreement follows a broad consultation with a panel of stakeholders' organisations (see Annex 1) representing the different actors involved in the CCS/CCU value chain as well as the research and academic community. This document takes into consideration the corresponding Input Papers available on SETIS (https://setis.ec.europa.eu/towards-an-integrated-SET-Plan) and the discussion with the countries participating in the SET-Plan and stakeholders which took place on 24 May 2016.

The stakeholders agree to highly ambitious targets in an endeavour to maintain global leadership in the sector, to put forward their best efforts in a coordinated way between public and private sectors, and to jointly address all relevant issues in order to attain the agreed targets.

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1 This document has no legally binding character, and does not prejudge the process or final form of any future decisions by the European Commission

2 *BE, DE, ES, FI, FR, IT, NL, NO, RO, UK.*

Introduction – CCS

The Energy Roadmap 2050 as well as other reports have shown that fossil fuels will very likely 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 one of the key promising technologies that can 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 as soon as possible. For limiting this even further to 1.5 degrees Celsius, negative emissions may need to be achieved, e.g. by applying sustainable biomass conversion technologies with CO2 capture and storage (Bio-CCS).

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.

Except for the Sleipner/Gudrun and Snøhvit projects in Norway, CCS has not yet taken off in Europe. The main reason is the lack of a business case for operating a CCS installation, but also problems with public acceptance for onshore storage of CO2, the lack of a transport infrastructure and concerns about longer-term liability have hindered developments. 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 CO2 emissions in the power and industrial sectors as well as to guide future research. A "lock-in" into an energy infrastructure that 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.

Time is of the essence. For Europe to retain economically important energy-intensive industries and the associated employment, no time can be lost. The significant lead time for the permitting and development of geological storage, of the order of 7-10 years, require that activities are to start as soon as possible. Without CCS in Europe, it could prove very costly and 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; it may ultimately result in European industry having to purchase CCS technology from non-EU countries.

Establishing the necessary infrastructure for CO2 transport and storage is equally important. Much of the existing upstream oil and gas infrastructure in the North Sea will be decommissioned in the coming years[3]. Delaying CCS development could potentially mean missing the opportunity to

[3] According to a 2015 study by Wood Mackenzie, oil companies are likely to halt output at 140 offshore UK fields during the next five years, even if crude rebounded from $35 to $85 a barrel

capitalise on existing wells, platforms and pipelines before they are decommissioned and precluding possible synergies with enhanced hydrocarbon recovery, resulting in higher investment needs in the future. Also the market-penetration of possible fuels, chemicals and other products such as minerals from conversion of CO2 (CCU) is a process which needs time, and demonstrations of solutions with a net CO2 avoidance should therefore be initiated as soon as possible.

Overall objectives for CCS and CCU

The key technology-related objectives for CCS, both in the short and longer term, are to deliver the demonstration and commercial-scale deployment of the full CCS chain, and to reduce the costs of CO2 capture and storage through research and innovation.

Reducing the cost of capture will require the piloting of promising capture technologies with a significantly low energy penalty. Capture technologies will have to cope with the load-flexibility of power plants, while minimising the penalties both in efficiency and cost.

The estimated theoretical availability of permanent geological storage capacity in Europe is equivalent to over 300 billion tonnes (Gt) of CO2[4]. Total CO2 emissions from EU power generation and industry are around 2.2 GtCO2 annually. Therefore, there could in principle be sufficient suitable storage sites to permanently hold the CO2 captured in the EU for decades to come. Storage capacity in the North Sea alone has been estimated at over 200 GtCO2. The **detailed appraisal of cost-effective ('bankable') storage capacity** in selected regions will be a key facilitator for commercial CCS deployment; it will provide additional certainty that the required CO2 storage capacity will be available when needed. **Pilots** should be developed in regions where future deployment can be envisaged.

Early CCS projects will most likely explore CO2 storage sinks in the vicinity of capture points, and the required infrastructure will therefore most likely be initiated at national level in **CO2 hubs and clusters** in order to achieve economies of scale by sharing CO2 transport and storage infrastructure. Where applicable, such clusters could use synergies with Enhanced Oil Recovery (EOR) and local CO2 utilisation networks. Regional opportunities exist for coupling hydrogen production and CCS, possibly using common infrastructure.

While sufficient storage capacity exists in Europe, not all capacity is accessible or located close to CO2 emitters. For a wider deployment of CCS, a **cross border transport infrastructure** is therefore necessary to efficiently connect the CO2 hubs and clusters to sinks. Under the regulation on "Guidelines for Trans European Infrastructure" and if supported by EU Member States, CO2 transport infrastructure projects can qualify to become **Projects of Common Interest** and could receive EU funding from the **Connecting Europe Facility**. In this context, it is important to underline that cross-border transport of CO2 at sea requires the ratification of the amendment to the London Protocol[5] .

Enhanced hydrocarbon recovery (EHR, or EOR in case of oil production) *combined with permanent storage* is currently the only available large scale carbon capture and use (CCU) option which could store significant volumes of CO2 taking into account the scale of the climate challenge. EHR/EOR can

[4] http://www.geology.cz/geocapacity

[5] Global agreement regulating disposal of wastes and other matter at sea. The 2009 Trans-boundary amendment for CO2 export needs 30 countries to ratify in order to come into force. Only 2 countries have ratified so far (Norway and UK). As a result, export of CO2 is still not permitted for offshore storage, unless for utilisation e.g. EOR

improve the business case for CCS operators, and could therefore be a catalyst for the early deployment of CCS in Europe. Also, other CO2 utilisation options could help improving the economic case for CO2 capture, but further research & innovation activities are necessary for them to have a chance to make a meaningful contribution to the greenhouse gas reduction objectives and should therefore be intensified.

Agreed specific targets for CCS and CCU

By 2020:

- At least one commercial-scale[6], whole chain CCS project operating in the power sector;
- At least one commercial-scale CCS project linked to an industrial CO2 source, having completed a FEED study;
- SET Plan countries having completed, if appropriate in regional cooperation with other MS, feasibility studies on applying CCS to a set of clusters of major industrial and other CO2 sources by 2025-2030, if applicable involving cooperation across borders for transporting and storing CO2 (at least 5 clusters in different regions of the EU);
- At least 1 active Project of Common European Interest for CO2 transport infrastructure, for example related to storage in the North Sea;
- An up-to-date and detailed inventory of the most suitable and cost-effective geological storage capacity (based on an agreed methodology), identified and accepted by various national authorities in Europe;
- At least 3 pilots on promising new capture technologies, and at least one to test the potential of sustainable Bio-CCS at TRL 6-7;
- At least 3 new CO2 storage pilots in preparation or operating in different settings;
- At least 3 new pilots on promising new technologies for the production of fuels, value added chemicals and/or other products from captured CO2;
- Setup of 1 Important Project of Common European Interest (IPCEI) for demonstration of different aspects of industrial CCU, possibly in the form of Industrial Symbiosis.
- By 2020, Member States having delivered on their 2030 nationally determined contributions to the COP21 agreement, and having identified the needs to modernise their energy system including, if applicable, the need to apply CCS to fossil fuel power plants and/or energy and carbon intensive industries in order to make their energy system compatible with the 2050 long-term emission targets.

[6] Commercial-scale projects: projects involving the capture, transport, and storage of CO2 at a scale of at least 800,000 tonnes of CO2 annually for a coal–based power plant, or at least 400,000 tonnes of CO2 annually for natural gas–based power generation and emissions–intensive industrial facilities (definition by GCCSI)

Some basic Key Performance Indicators		
Deployment indicators	Target 2020	Target 2030
Minimum N° of commercial-scale CCS projects in the power sector	1[7]	10
Minimum N° of commercial-scale CCS projects in the CO2 emission intensive industry	1[8]	5
Permits for CO2 storage	2	15
Minimum amount of CO2 permanently removed from atmosphere (Mt/yr)	3[9]	15

Recommendations for 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 and Innovation 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, InnovFin, Connecting Europe Facility, European Fund for Strategic Investments and European Structural and Investment Funds. Experience gained in commercial-scale CCS demonstration projects will also serve to prioritise research funding.

Demonstration should also explore how CCS can optimally fit in a future energy system, interlinking with renewables, hydrogen production, energy storage and the manufacturing/process industry.

Deployment will require the use of strategic EU funds, especially the **Innovation Fund**, but also, if appropriate, the **Connecting Europe Facility** 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)**, if necessary complemented by Member State support instruments and regulations. Possible measures proposed by several stakeholders are incentives such as the proposed **Contract for Difference** (CFD) in the UK, or **Emission Performance Standards** (EPS).

The business model and liability provisions for CO2 capture and CO2 transport/storage are very different. Hence, incentives appropriate for power generators to capture CO2 may not stimulate market conditions for storage and vice versa. Several stakeholders therefore advocate **decoupling capture from transport and storage**[10] as an essential step for the market uptake of CCS. Addressing the liabilities will need new insurance products to be developed by the market, which is only possible when there is sufficient evidence that the risk of leakage is minimal when geological storage of CO2 is conducted in accordance with the requirements of the CCS Directive.

[7] Operational
[8] With completed FEED
[9] Including natural gas processing plants in Norway
[10] See http://www.zeroemissionsplatform.eu/news/news/1650-zep-executable-plan-for-ccs-in-europe.html

Deployment of CCS also requires increasing **public awareness** of the societal benefits of CCS. Successful demonstration of CCS and increasing the number of storage pilots, with **active public engagement** at all stages of project development, will be needed to accelerate this process.

Advancing the state-of-the-art, in particular of capture technologies, will benefit from **international collaboration** in research and innovation; a lot can also be learned from full-chain projects in the US and Canada. In parallel, **education and training** in CCS technologies and their implementation will be needed to build-up and maintain a skilled workforce in this field.

Next steps

The stakeholders agree to develop within 6 months a detailed implementation plan for the delivery of these targets, determine joint and/or coordinated actions, identify the ways in which the EU and national research, innovation and other programs could most usefully contribute, identify the contributions of the private sector, research organizations, and universities, identify all issues of a technological, socio-economic, regulatory or other nature that may be of relevance in achieving the targets, and report regularly on the progress with the purpose to monitor the realisation of the targets and take rectifying action where and whenever necessary.

Annex 1

List of invited and spontaneous contributors

European Technology Platform for Zero Emission Fossil Fuel Power Plants (ZEP)
EERA JP CCS
European Cement research Academy (ECRA)
European Cement Association (CEMBUREAU)
European Steel Technology Platform (ESTEP)
European Steel Association (EUROFER)
EUTurbines
European Power Plant Suppliers Association (EPPSA)
European Turbine Network (ETN)
Union of the Electricity Industry (EURELECTRIC)
European Technology Platform for Sustainable Chemistry (SUSCHEM)
Sustainable Process Industry through Resource and Energy Efficiency (SPIRE) Public-Private Partnership
European Chemical Industry Council (CEFIC)
Energy Materials Industrial Research Initiative (EMIRI)
Global CCS Institute (GCCSI)
European Network for Research in Geo-Energy (ENeRG)
CO2GeoNet Association
European Association for Coal and Lignite (EURACOAL)
International Association of Oil and Gas Producers (IOGP)
Research Council of Norway
British Research Council (EPSRC)
British Geological Survey
EERA JP AMPEA
European Platform of Universities in Energy research & Education (EUA-EPUE)
Lodz University of Technology
CO2Chem Network
UK Centre for Carbon Dioxide Utilization
French Ministry of Environment, Energy and the Sea, DG Energy and Climate
The SCOT Project