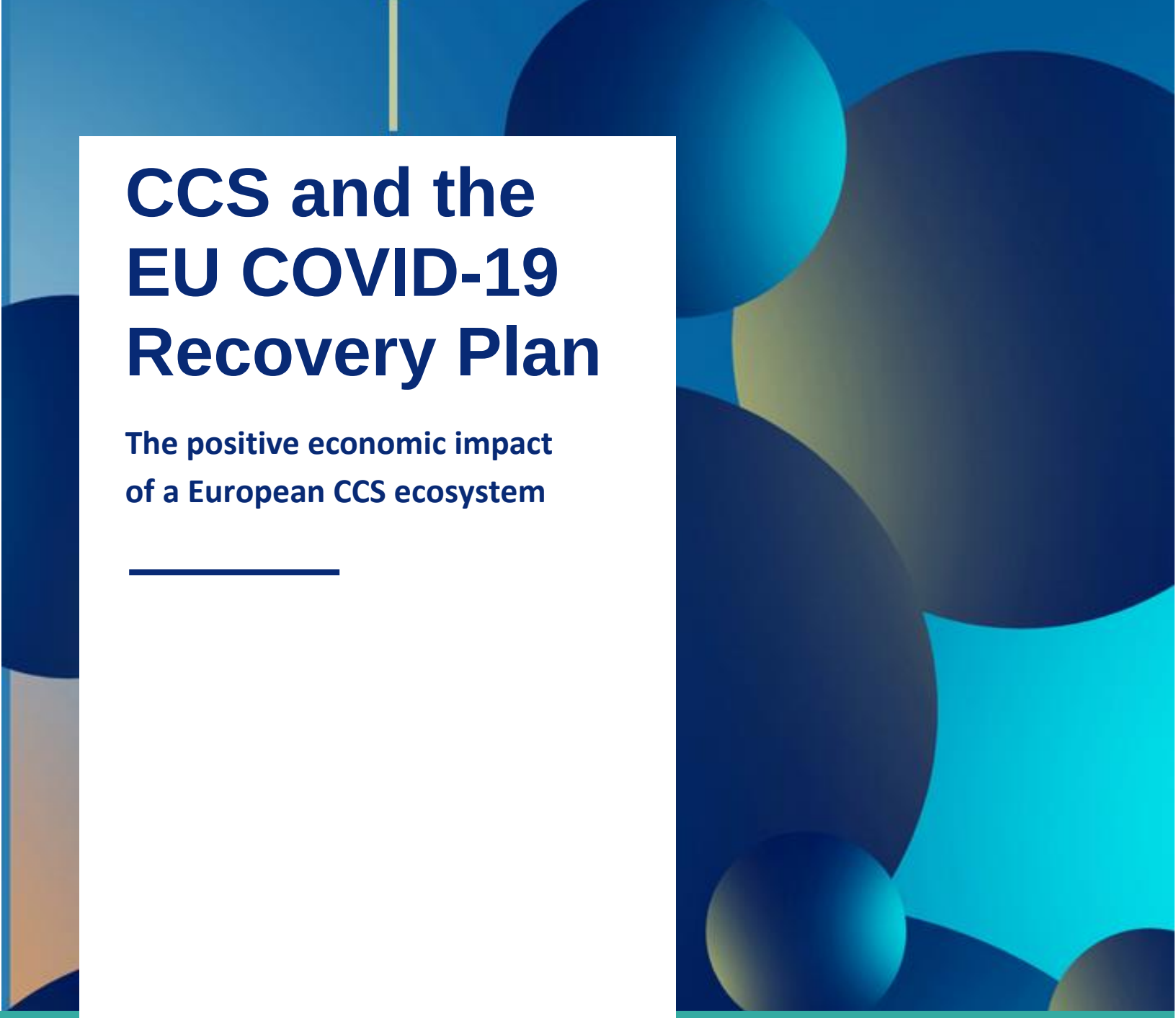

CCS and the EU COVID-19 Recovery Plan

The positive economic impact of a European CCS ecosystem

MAY 2020

Northern Lights PCI
https://northernlightsccs.com

A memorandum by the Northern Lights Project of Common Interest (PCI), consisting of projects from:
Acorn, Air Liquide, ArcelorMittal, Borg CO2, Ervia, Eyde Cluster, Fortum, Fluxys, H2 Eemshaven, HeidelbergCement, Net Zero Teesside, Nordland CO2 Hub, Northern Lights, Port of Antwerp, Preem, and Stockholm Exergi

What this memorandum aims at demonstrating:

CCS is a proven technology, necessary to decarbonise and safeguard European industry and jobs in a low-carbon economy

The industrial projects that together make up the Northern Lights PCI have an extraordinary potential to reduce Europe's CO2 emissions and create and protect thousands of jobs

The Northern Lights PCI partners are ready to quickly move into execution, given the right political and financial framework – we can do it with your help

CCS has a key role to play in Europe's green economic recovery

Europe is facing an unprecedented socio-economic crisis due to the COVID-19 outbreak, whose real impact is still to unfold. As the EU seeks solutions to reboot the economy and lead Europe out of the recession, we are presented with a unique opportunity to put the fight against climate change at the centre of the economic strategy. **Carbon Capture and Storage (CCS) projects that can rapidly move into implementation should be considered in any economic recovery plan**, due to their capacity to deliver quickly in terms of jobs and economic growth while delivering on the EU emission reduction targets.

CCS is a proven technology, necessary to achieve the EU's 2050 climate neutrality objective

CCS has great emissions reduction potential, as it prevents CO2 from being released into the atmosphere. Analysis by the most prominent international bodies, including the IEA and the IPCC, have consistently shown that CCS is an essential part of **the lowest cost path towards meeting the Paris Agreement goals.** Similarly, in the EU's Clean Planet for All[1], CCS is listed as one of the strategic building blocks to achieve climate neutrality. Moreover, when paired with bioenergy used for power generation or biofuel production, it is one of the few technologies that can deliver negative CO2 emissions.

CCS technologies are proven and commercially available today; they have been in operation since the 1970s with 19 large-scale CCS facilities currently operating globally. Geological permanent storage is safe and secure, with over 260 Mt of CO2 emissions from human activity already captured and stored[2]. Global estimates show that there are vast geological storage resources to meet the highest requirements for CCS to achieve climate change targets, including within Europe[3].

CCS can help safeguard existing industrial activity and jobs while decarbonising the economy

According to a 2018 Endrava report, emissions from power and heat plants, industrial sites and waste management installations in Europe account for two thirds of all CO2 emissions[4]. Decarbonising these sectors with renewables and energy efficiency alone will not suffice, as energy-intensive industries require high-temperature heat that cannot be easily or cost-effectively electrified and sectors such as cement or steel emit CO2 as part of their manufacturing process. CCS can play a crucial role in decarbonising European industry while maintaining its productivity, **both through the capturing of CO2 emitted by industries and through the manufacturing of clean hydrogen for transport, heat and power**.

Estimates show that European jobs linked directly and indirectly to the emergence of a market for CCS can reach 150,000 in 2050[5]. However, and crucially, by far the largest job and value creation effect of CCS is that **it enables a successful and just transformation of existing industrial activity into a low-carbon industry**, avoiding 'carbon leakage' and therefore protecting existing jobs. CCS can enable industrial regions in Europe to transform into low carbon regions, also with cleaner air and improved health. These reinvigorated regions will also attract new, low-carbon industries and the associated jobs and be central in the transition to a zero emissions economy.

[1] COM (2018) 773 – A Clean Planet for All: A European strategic long-term vision for a prosperous, modern, competitive and climate neutral economy
[2] 2019 Global Status of CCS Report, Global CCS Institute, 2019.
[3] The potential for CCS and CCU in Europe. Report to the thirty second meeting of the European Gas Regulatory Forum, IOGP, 2019
[4] Cauchois, G., Rambech, E., Vandenbussche, V. (2018). Potential for CCS in Europe: Report for NOROG. Endrava report 2018.
[5] Størset, S. Ø., Tangen, G., Wolfgang, O. and Sand, G. (2018). Industrial opportunities and employment prospects in large-scale CO2 management in Norway. SINTEF Report 2018:00450. Accesible here

CCS supports a clean hydrogen and circular economy

Decarbonisation of key sectors such as electricity generation, transport (particularly heavy-duty vehicles) and industrial processes that use high-grade heat and hydrogen as chemical feedstock will require the use of hydrogen in large quantities**.** Today, around 70% of hydrogen production comes from natural gas; if decarbonised with CCS, it will accelerate the establishment of clean hydrogen value chains. Such a development would create **a new low-carbon industry and jobs, with the potential to account for 24% of final energy demand and 5.4m jobs by 2050[6].**

As renewable electricity capacity continues to grow, electricity grids will have to be equipped to cope with intermittent generation and effectively meet rising electricity demand. **Hydrogen with CCS or CCGT with CCS, allows for low-carbon production of energy and can be easily stored to provide reliable clean power**

Finally, the development of CO2 capture facilities and transport solutions can speed up the industrial re-use of carbon, thus **acting as an enabler of carbon capture and utilisation (CCU) to deliver a circular economy**, since the deployment of these services is mutually beneficial for both CCS and CCU and will help bring costs down and create even more jobs.

A European CCS value chain to drive CCS development and industrial success

The Northern Lights Project of Common Interest (PCI) is a CO2 cross-border transport connection project where CO2 captured from industrial sites in Europe will be collected by ship and transported to the Norwegian Continental Shelf for permanent storage subsea, resulting in a full-scale CCS value chain. **Equinor, Shell and Total announced on 15 May 2020 that they have decided to invest in the Northern Lights transport and storage solution.** The investment decision is subject to final investment decision by Norwegian authorities and approval from EFTA Surveillance Authority (ESA).

The development of a European CCS ecosystem can be a powerful driver for carbon capture in Europe and globally

It is only after providing a secure and reliable CO2 transportation and storage network that European industries can start considering capturing their carbon. By offering an open source CO2 transport and storage network, **Northern Lights opens the possibility for any industrial site interested in capturing its CO2, to permanently store it safely**. Furthermore, the ship transport solution provides flexibility to reach multiple carbon emission points across Europe. **This will enable the first European full-scale CCS value chain, paving the way for cost reductions and a scale-up of CCS**. Northern Lights could also act as a reciprocal storage alternative to other CCS projects in Europe, making a European CCS network more robust and flexible. The Northern Lights PCI includes three projects with ambition to develop storage, in addition to the one in Norway: Acorn, Ervia and Net Zero Teesside.

Northern Lights can rapidly move into execution, delivering jobs, growth and emission reductions across Europe

Cross-border collaboration is one of the strongest assets of Northern Lights. Given positive investment decisions, the value chain could be operational in 2024, establishing an 'open source' network for transport and storage of CO2, protecting and creating jobs while capturing emissions. As it will be shown in the next section, the Northern Lights PCI is maturing several projects in many industries across Europe. The project is also in dialogue with around 15 additional European companies in different sectors and countries that also are exploring the option of having their CO2 stored.

[6] Hydrogen Roadmap Europe: A sustainable pathway for the European Energy Transition. FCH JU Report 2019. Accessible here.

CCS projects to kick-start European industrial decarbonisation

This section demonstrates how the Northern Lights PCI can contribute to Europe's economic recovery and accelerate the just transition to a net-zero future economy. It provides best available estimates of the effects that can arise from positive investment decisions in these CCS projects in the form of climate mitigation, timing of project phases, and job creation in each of the phases.

Climate mitigation and job creation potential

As can be observed in the table on the next page, **most of the projects are estimated to create around 1200 – 1500 full-time equivalents (FTEs) in total each over a 3-4 years period during the most job-intensive phase,** the detailed engineering and construction phase. The Ervia power/industrial cluster projects in Ireland may possibly create as much as 3500 FTEs jobs and the Net Zero Teesside cluster in England around 5500. **This in turn will create new permanent jobs ranging from 50 to 350 in each of the CCS operations**. The analysis shows that the transport and storage solution project, and the two most mature CO2 capture projects within the Northern Lights PCI network, Fortum Oslo Varme and Heidelberg Cement Norcem, are ready to move into the job-intensive detailed engineering and construction phase which follows immediately after positive investment decisions, which then would enable the start of operations as soon as 2024.

Crucially, the analysis demonstrates that there is a wave of CO2 capture projects in several European countries and several sectors which are being matured to start detailed engineering and construction in 2022 – 2025, thereby becoming ready to start operations in 2025-28. **These projects can provide considerable climate mitigation effects with annual CO2 emission reductions ranging between 500 – 6000 kilotonnes of CO2 per annum**. Several of the projects plan to capture CO2 of biogenic origin, thereby providing negative emissions.

Together, all the projects for which values have been provided, **are estimated to be able to provide CO2 reductions of up to 15 000 kilotonnes per annum, to create around 18 600 full time equivalents (FTEs) jobs in total over the development period and around 1170 permanent positions when in operation**. The job creation estimates focus solely on the jobs created in the specific projects. Many of these jobs (e.g. civil engineering) will be local/regional in nature, while others (e.g. studies and fabrication) will be relevant for the broader European industry.

Seven of the projects plan to be operational already in 2024-25, with the detailed engineering and construction phase starting about three years earlier, in 2021-22. The other five projects plan to be operational by 2028, also starting the job-intensive detailed engineering and construction phase about three years earlier, in 2024-25.

Further benefits

Most importantly, **these projects enable a successful transformation of existing industrial activity and tens, potentially hundreds of thousands of jobs into low carbon activity and jobs,** enabling a zero and low-carbon industry.

The estimations of employment creation above do not include the multiple jobs that will be created through the construction of equipment and technologies, such as those for capture, intermediate storage and ships. Furthermore, the large number of jobs will also generate consumption effects, resulting from the employed people's and companies' consumption, payment of taxes, etc. These are not estimated in the table above. In case there are any Competition Law concerns, costs and the levels of public support required are not included here. Such estimates are, however, being developed by the individual projects and can be communicated separately.

As can be seen in the PCI map on the previous page, there are also a few additional projects in the Northern Lights CCS PCI that are not presented here. Some of these are being developed with timelines that are equally ambitious as the ones presented and can be communicated by the individual projects.

Some of the projects being developed within the Northern Lights CCS network and PCI

	Transport & storage	CO2 capture projects									Reciprocal Storage / Full-chain projects		
Company	**Equinor, Shell, Total**	**Fortum**	**Heidelberg Cement**				**Arcelor Mittal**	**Borg CO2**	**Ervia**	**Stockholm Exergi**	**Pale Blue Dot**	**Net Zero Teesside**	**TOTAL**
Project	Northern Lights	Oslo	Norcem	Cementa Slite	Hannover	CBR Lixhe	Gent Carbalyst	Borg	Clusters	Stockholm	Acorn	Clusters	
Country	Norway	Norway	Norway	Sweden	Germany	Belgium	Belgium	Norway	Ireland	Sweden	Scotland	England	
CO2 emissions													
Total ktpa	N.A	460	800	1800	640	1200	390	700	3500	900	N.A	6300	
Biogenic part	N.A	50%	35%	12%	6%	20%	100%		5%	100%	N.A	2100	
Capture rate	N.A	90%	50%				90%	90%	95%	80-95%	N.A	95%	
CO2 avoided emissions, Total	N.A	410	400	1600	500	1000	350	630	3325	720-860	N.A	6000	≈15 000
Biogenic	N.A	205	140	180	25	180	350	430	166	720-860	N.A	2000	ktpa
Fossil & process	N.A	205	260	1420	475	820	0	200	3160	Zero	N.A	4000	
Direct CCS Jobs													
Early studies,Start		2017		2020	2021	2021	2021						
Months		15		36	24	24	24						
FTEs		19					15						
FEED study, Start	2018	2018	2018	2022	2023	2022	2023	2020-21	2021	2021	2020	2020	
Months	18	16	24	36	24	36	10	18	36	12-18	12	24	
FTEs	120	50	100	100	75	100	15	15	25	25-35	80	20	
Det. eng.&constr,													
Start	2020	2021	2021	2025	2025	2025	2025	2022-24	2024	2022	2021	2022	
Months	36	48	36	36	36	36	24	36	48	24-36	36	36	
FTEs	1200	1440	1050	1200	800	1000	150	1000+	3500	1000	1000	5500	
Total Development FTEs	1320	1509	1150	1300	875	136	180	1000+	3525	1025-35	1080	5520	≈18 625 FTEs
Operations, Start	2024	2024	2024	2028	2028	2028	2027	2025	2028	2025	2024/5	2025	
Months	240	120	240	240	240	240	300	120	240	Min. 240	240	240	
Permanent jobs	90	56	20	60	60	60	16	30-50	300	10-20	110	350	≈1177

Table 1: Some CO2 capture projects being developed within the Northern Lights CCS network and PCI. The estimates have been made by the companies that are developing the specific projects. "FTEs" is Full Time Equivalents, showing the total number of FTEs over the period in question. CO2 emissions are measured in kilotonnes per annum (ktpa). "Biogenic" is CO2 emissions resulting from combustion of biomass. The table does not include all the CO2 capture projects that are being developed within the Northern Lights CCS network and PCI.

Recommendations

EU policy can support and incentivise the development of cross-border CO2 transport and storage networks in Europe, including Northern Lights. Financial support and grants will be key to achieving early deployment of the CCS value chain in Europe. **Ensuring that CCS projects in Europe are eligible for EU and national public support and funding schemes should therefore be an important element in the Commission's approach to promoting economic recovery.**

In addition to financial support, regulatory frameworks such as the Energy System Integration, EU ETS, and the TEN-E Regulation will provide opportunities to develop the CCUS value chain in Europe. Under TEN-E, CO2 storage should be integrated into overall European infrastructure development and permitting procedures. **Additional methods of CO2 transport, such as by ship, should be recognised in key EU legislation like the EU ETS and TEN-E, in order to facilitate a greater range of CO2 transport solutions in Europe.** By creating a cross-border network of open-access CO2 transport and storage infrastructure, EU industrial plants and clusters can connect their CO2 emissions to shared infrastructure – and this common approach should be supported.

Supporting CCS now will not only stimulate new infrastructure projects and jobs, it **will also help to develop a more optimised energy and industry system, with shared CO2 transport and storage infrastructure connecting different industrial facilities and processes, all while making significant cuts to European CO2 emissions and helping to deliver on the Green Deal objectives.**

The Northern Lights PCI looks forward to working with EU and national policymakers to make this vision a reality.