CLEAN AIR TASK FORCE

Funding Carbon Capture and Storage in Central and Eastern Europe

Strategies for Cost-Effective Deployment

Summary

For the Central and Eastern Europe (CEE) region to decarbonise its industries and maintain industrial competitiveness in the face of rising carbon prices, deploying carbon capture and storage (CCS) is essential. However, with the EU ETS carbon price yet to reach the levels necessary to make the business case for CCS deployment across all the sectors that will need these technologies, deploying projects will be contingent on supportive funding and financial de-risking measures. Government funding required for deployment can be dramatically reduced through the development of widespread CO_2 storage throughout the region, leading to large cost reductions and putting CEE industries at a competitive advantage over those exporting their CO_2.

This policy brief proposes a way forward for national governments and project developers in the CEE region to effectively deploy CCS at the lowest cost, drawing on examples from projects that have taken final investment decisions and are under construction. Governments in the region should take on a coordinating role to ensure that full chain projects progress to the construction phase and can leverage existing EU funds. By combining such an approach with cost-effective national funding instruments, such as carbon contracts for difference and access to green finance, a robust business case can be built for CCS projects in the region. This collaborative approach can bridge the funding gap, address financial barriers, and ensure the successful deployment of CCS technologies in the CEE region, ultimately leading to a competitive and clean industry for the region.

Figure 1: Central Eastern Europe Region (CEE)

Developing carbon capture and storage (CCS) is essential for the CEE region

Carbon capture and storage (CCS) is an essential set of CO_2 emissions mitigation technologies needed for Europe to achieve national climate targets and contribute to the EU's goal of climate neutrality by 2050.[1] The European Scientific Advisory Board on Climate Change indicates that up to 490 million tonnes of CO_2 may need to be captured and stored across the EU by 2050.[2] Such volumes show the necessity of rapidly deploying these technologies to both reduce CO_2 emissions from industry and to permanently remove CO_2 from the atmosphere.

1 International Energy Agency, 'CCUS in Clean Energy Transitions' (2020); Intergovernmental Panel on Climate Change, 'Working Group III Contribution to the Sixth Assessment Report of the Intergovernmental Panel on Climate Change'; European Commission, 'In-Depth Analysis in Support on the COM (2018) 773: A Clean Planet for All - A European Strategic Long-Term Vision for a Prosperous, Modern, Competitive and Climate Neutral Economy'; DNV, 'Pathway to Net Zero Emissions - Energy Transition Outlook 2021' (2021).

2 European Scientific Advisory Board on Climate Change., 'Scientific Advice for the Determination of an EU-Wide 2040 Climate Target and a Greenhouse Gas Budget for 2030–2050'

Figure 2: Fossil Industrial CO_2 Emissions in the CEE Region by Sector

Figure 3: Industrial Fossil CO_2 emissions by CEE country

Chemicals	Total Fossil Industrial Emissions ($MtCO_2$ /yr)	Primary Emitting Industry
Hungary	5.5	Chemicals
Bulgaria	6	Chemicals
Croatia	3	Cement
Estonia	0.9	Refineries
Czechia	11.9	Refineries
Latvia	0.9	Cement
Lithuania	4.5	Chemicals
Poland	35.5	Cement
Romania	10.1	Cement
Slovakia	11.5	Iron and Steel
Slovenia	0.7	Cement

Total CEE Industrial Fossil CO_2 Emissions: **90.5 Mt/yr**[3]

Many countries in the CEE region have substantial industrial bases (Figure 3) which will be increasingly exposed to rising carbon prices under the EU Emissions Trading System (EU ETS). For many of these sectors, such as cement and lime, CCS is likely to be the only viable path towards decarbonisation. Deploying carbon capture and storage would allow companies to avoid paying escalating carbon prices, and secure their industrial competitiveness in an increasingly low-carbon European economy while helping to prevent regional deindustrialisation.

[3] Data from Endrava Capture map, excluding the food and manufacturing sectors.

Additionally, building a dedicated CCS sector will enable these countries to become knowledge exporters in CCS technology and practices, which is a rapidly evolving and growing industry in its own right. Investing in CCS infrastructure such as CO_2 transport and storage now is more cost-effective than delaying until closer to 2050, at which point rapid deployment will be needed to meet decarbonisation targets. Such delayed action would require substantial and urgent investments without the support of mature on-the ground experience or talent bases, which could have been cultivated over time. Early implementation of CCS projects and achieving final investment decisions (FID) in this decade are therefore essential for the region's sustainable, economical, and just transition to climate neutrality.

Without deploying CCS and domestic CO_2 storage, the CEE region faces a competitiveness challenge

There is growing momentum in CCS development at the European level and in a number of Member States, exemplified by the European Commission's Industrial Carbon Management Strategy (ICMS), the adoption of the Net Zero Industry Act (NZIA), and national carbon management strategies. However, a concerning geographical disparity in terms of access to CO_2 storage is emerging which could have profound implications for industrial sectors in the region, creating an uneven playing field for industry in the EU. Currently, CO_2 storage projects in the CEE region constitute just 1.5% of total planned European CO_2 storage capacity, however, no projects in the region have secured storage licenses and are thus highly uncertain. Figure 4 highlights the shortage of proposed CO_2 storage sites in the CEE region relative to countries around the North Sea. This is despite the fact the CEE region constitutes almost 19% of Europe's industrial emissions and most countries in the region have large CO_2 storage potential.[4]

Barring the creation of new CO_2 storage projects around CEE, the region's industries will not have access to proximate CO_2 storage sites and would instead need to export their CO_2 over long distances in order to meet climate targets, incurring much higher costs as a result. This imbalance is already shaping project development by creating long value chains. For example, the Polish ECO_2 CEE project plans to export 3 Mt CO_2 annually to the North Sea while the EU2NSEA project plans to include emitters from Latvia. CATF analysis has shown that the average costs for deploying CCS in the region would be 40% lower if domestic storage resources are developed and available. An export-based model will effectively translate into a competitive disadvantage for CEE industry, compared to industry located around the storage sites in the North Sea.

Funding as the catalyst for CCS deployment

Deploying CCS, as with any large-scale emissions mitigation technology, involves imposing a significant financial burden both in terms of capital expenditure (CapEX) and operating expenses (OpEx). For example, the GO4ECOPLANET project at the Kujawy cement plant in Poland requires €265 million of capital investment.[5] This makes widespread deployment in line with European climate targets challenging without funding support at this stage of development.

The Industrial Carbon Management Strategy highlights existing EU funding for carbon management, including the and Connecting Europe Facility. Moreover, the strategy encourages Member States to implement incentives such as carbon contracts for difference (CCfDs) to further support these initiatives.

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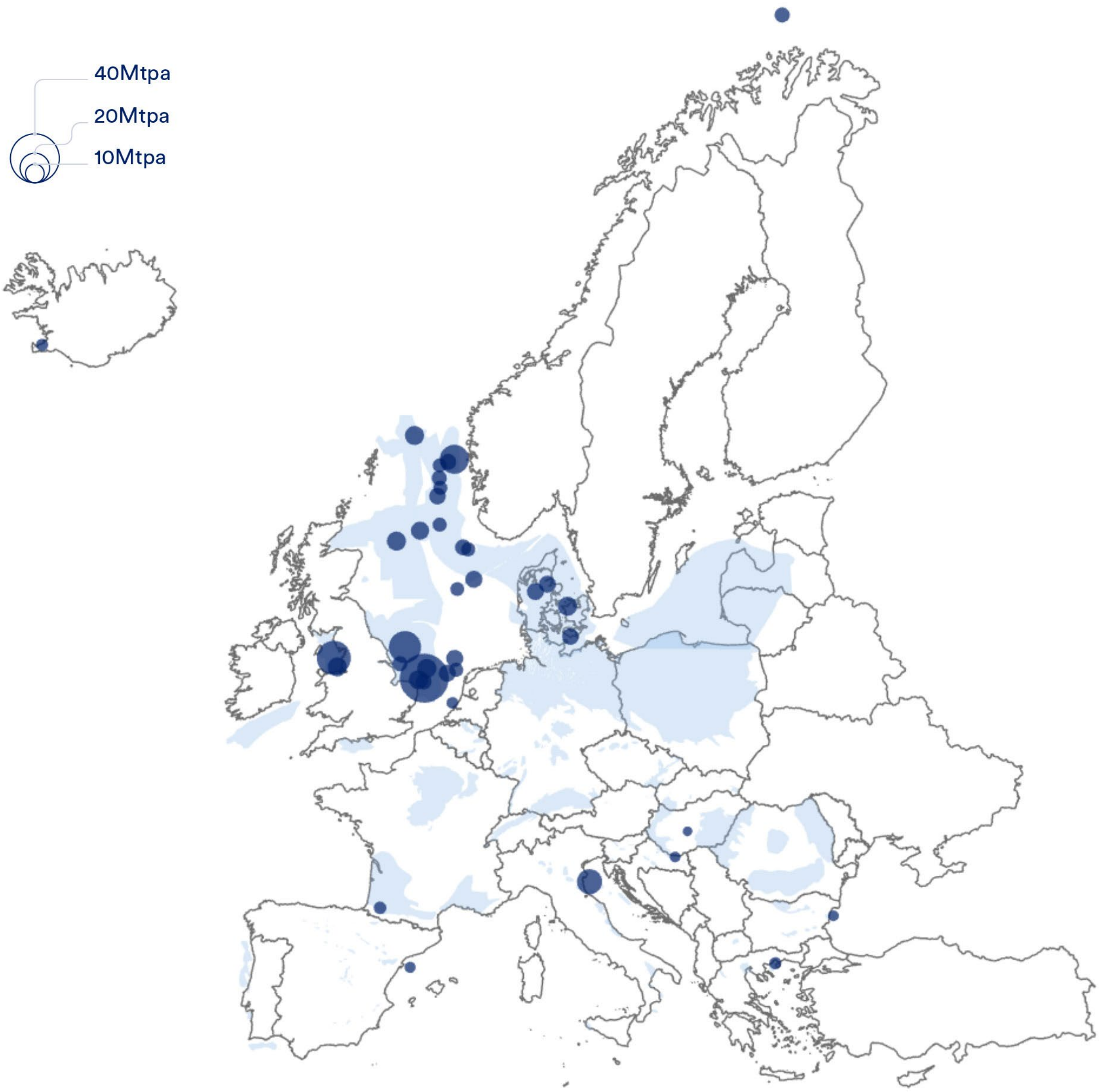
4 Excluding the sectors of food and manufacturing.

5 2022 figure. European Commission, 2022

Currently, the carbon price under the EU Emissions Trading System (EU ETS) is the principal driver for decarbonisation in the power and industrial sectors. While the avoidance of paying the carbon price through deploying CCS can present a positive investment case in the mid to long-term, in practice, the costs of the capture process, CO_2 transport, and CO_2 storage tariffs must be covered by equivalent income streams if projects are to be built today. The crux of the economic challenge for CCS lies in the significant funding gap between the high costs of deployment and the relatively low market price of CO_2. Uncertainty in the future price trajectory also discourages immediate investment.

Figure 4: Announced CO_2 storage projects in Europe, scaled according to maximum annual injection capacity in $MtCO_2$/year

Areas in light blue show regions of suitable storage geology as mapped by CO_2StoP



Early efforts to deploy CCS in the region including the Bełchatów project in Poland and the Getica project in Romania were ultimately unsuccessful due to a low carbon price and a lack of funding and support from Member States. Ensuring the success of this second wave of CCS projects in the CEE region within the next decade is essential to ensure equitable access to a pan-European CO_2 infrastructure. Although the region has multiple proposed capture projects, only Croatia, Hungary, and Bulgaria have proposed CO_2 storage projects and the capacity of these pales in comparison to capacity under development in the North Sea. To meet the necessary CO_2 storage volumes in line with climate modelling, many more CO_2 storage projects will be required in the CEE region.

Wide access to CO_2 storage can greatly increase project bankability

Each country in the CEE region faces a unique context for deploying CCS, shaped by differences in CO_2 geological storage potential and the scope, scale, and distribution of their industrial sectors. Each emitter also faces a different cost structure, dependent on the cost of capture at the installation and the assumed costs of transport and storage. These differences result in varying costs across countries and industries, influencing the point at which deploying CCS becomes cost-competitive versus continued emissions under the EU ETS. Taking country averages of these costs across emitters, Figure 5 shows that if a project were deployed and operational by 2030 in each CEE country, relying only on planned CO_2 storage hubs, the region's emitters would face an average cost gap of €10 to €47/tCO_2, depending on the country.[6] This gap shrinks over time as the EU ETS price rises, with some countries seeing emitters breaking even or saving money by deploying CCS in 2031 or 2032. It is not till 2035, however, that all countries in the region would see a net savings from deploying CCS in this scenario.

The cost projections in Figure 6 assume storage sites are developed in areas of suitable geology throughout the region, which we refer to as the widespread storage scenario. Therefore, the year by which the difference in the average cost of CCS and the projected ETS price is positive is brought forward significantly due to lower costs compared to exporting CO_2 over long distances. Using the same example as Figure 5, of a project being operational in 2030, the situation reverses under the widespread storage scenario, with emitters seeing average cost savings of €10 to €47/tCO_2 compared to paying the EU ETS price. This demonstrates the importance of developing proximate CO_2 storage resources and utilising the region's storage potential. This approach can reduce CCS deployment costs by between 23% to 48%, depending on the country, lowering the need for government funding to bridge the gap between the costs of deploying the technology and the EU ETS price, while also providing a competitive advantage for the region's industries producing decarbonised products.

Looking forward to 2035, Figure 7 shows that with an EU ETS price of close to €200/tCO_2, deploying CCS is, on average, more cost-effective than paying the EU ETS price across all CEE countries, even under the more storage restricted scenario. However, with widespread storage available, these cost savings from avoiding the carbon price could reach as high as €96/tCO_2.

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[6] Only large-scale, planned storage hubs with the potential for excess capacity and targeting operations by 2030 are considered. This comprises sites in the North Sea and Mediterranean regions and excludes smaller sites in the CEE region.

Figure 5: The difference in the average cost of CCS and the projected ETS price – Limited Storage Scenario (Export)[7]

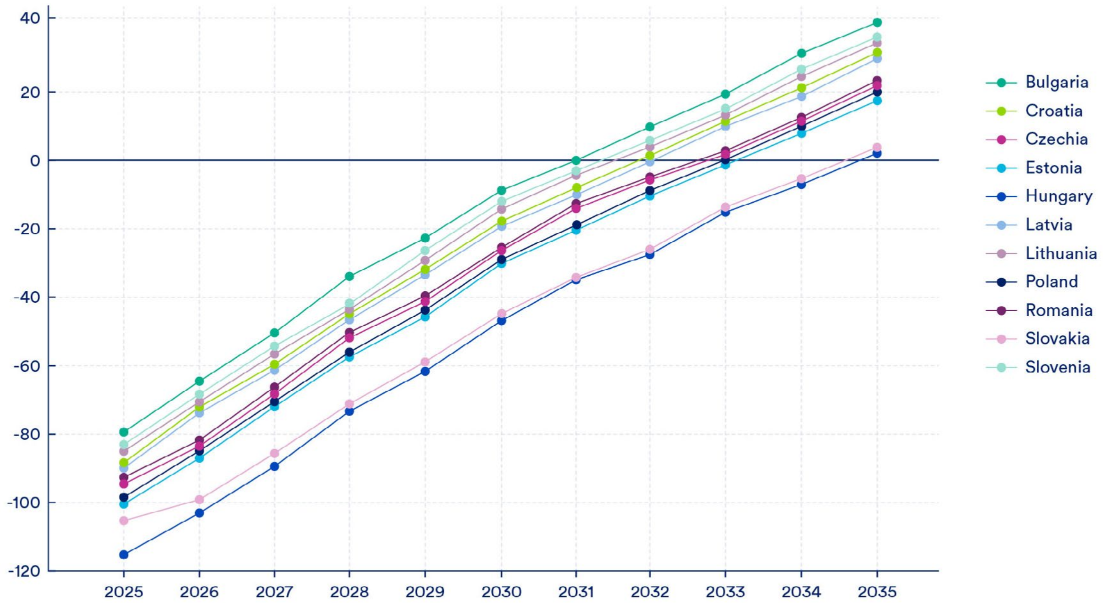
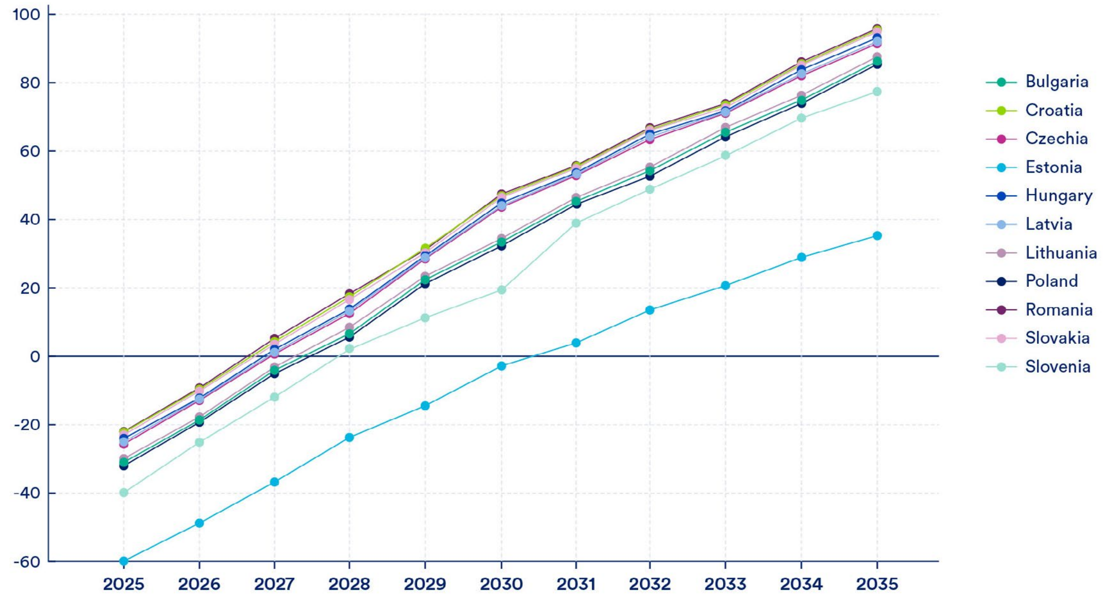


Figure 6: The difference in the average cost of CCS and the projected ETS price - Widespread Regional Storage Scenario (Domestic)



7 CATF Analysis of the average costs of capture, transport of storage across emitters in each country, minus the prevailing EU ETS price.

Figure 7: 2030 - The difference in the average cost of CCS and the projected ETS price by scenario

Scenario A: Limited storage

Net saving €/tCO_2

-47.0 | -9.6

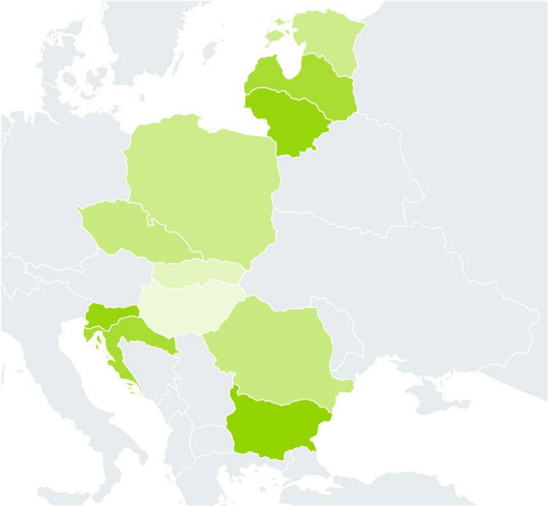
Scenario B: Widespread Storage

Net saving €/tCO_2

9.7 | 46.9

Figure 8: 2035 - The difference in the average cost of CCS and the projected ETS price by scenario

Scenario A: Limited storage



Net saving €/tCO_2

1.9 | 39.3

Scenario B: Widespread Storage

Net saving €/tCO_2

58.7 | 95.9

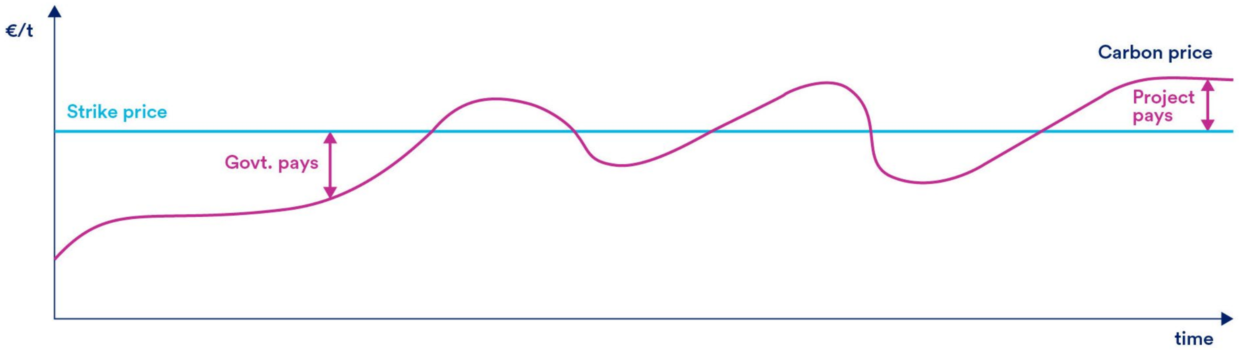
The need for CCfD support under current CO_2 storage constraints

As we have shown, a cost-optimised scenario with more CO_2 storage sites distributed across the CEE region significantly reduces project costs. These savings translate into lower government outlays for subsidies under mechanisms such as carbon contracts for difference (CCfDs). To illustrate how this would work in practice, we model a generic CCfD support scheme for a facility capturing 500,000 tonnes of CO_2 per year. In this example, the subsidy is paid to the emitter and passed down the value chain to cover transport and storage costs (see Box 1 below for assumptions). This example is representative of an asymmetric CCfD where the government pays the difference between a project's cost and the ETS price but does not require repayment if the ETS price exceeds the bid price.

Applying a subsidy similar to the Dutch SDE++ model (Box 1) under the more constrained CO_2 storage scenario, where only currently announced projects are available, each CEE country would require substantial annual financial support for a 0.5 $MtCO_2$/year project, ranging from €4.85 to €23.5 million[8] (Figure 10). In the asymmetric CCfD model assumed here, such payments continue until project costs fall below the EU ETS price, termed here the '*Subsidy End Year*'. At that point, the need for further subsidy is eliminated, but past payments are not recovered. In contrast, symmetric CCfDs, such as those currently used in the UK and Germany, include mechanisms to recoup excess revenue if the carbon price rises above the contract price allowing the government to recover some or all of its earlier support.

If governments invest now in expanding CO_2 transport and storage capacity across the CEE region, CCS deployment costs could potentially fall below the projected EU ETS price by 2030, (Figure 6). When this happens, no further payments are required under an asymmetric CCfD, a one-way mechanism in which government support only flows when project costs exceed the carbon price. In other words, once CCS becomes cheaper than the ETS, the subsidy phases out automatically. This makes regional storage development the most cost-effective way to minimise long-term public spending on CCS deployment.

Figure 9: Illustrative payment flows in a carbon contract for difference. Implemented policies often exclude payment from the project to the government (asymmetric payment)[9]



[8] This is a simplified model where CAPEX is not included in the total subsidy.

[9] Clean Air Task Force, 'Designing Carbon Contracts for Difference' (2024)

This being said, CCfDs may still be needed even in a scenario where average costs fall below the ETS price. Firstly, the EU ETS is inherently volatile; while long-term price trends may be upward, short-term fluctuations create uncertainty. A CCfD can provide price stability and help de-risk investment decisions. Second, CCS cost estimates are subject to inflation and unforeseen increases in capital or operational expenditure, meaning actual costs may rise above current projections. In both cases, and independent of the exact nature of the subsidy, either asymmetric or symmetric maintaining a contract mechanism ensures that projects remain viable even under adverse market or cost conditions.

Box 1: Sample Asymmetric SDE++-Style CCfD Subsidy Modelling for a 0.5 MtCO_2/yr Facility in the CEE region

The SDE++, used here as a representative example provides long-term support for the CO_2 abatement costs of emissions mitigation technologies. The subsidy is awarded based on the project's application amount (i.e. bid), which reflects its levelised cost of abatement (including both CAPEX and OPEX).

The mechanism works as follows, with contracts for CCS projects having unique features:

- A base rate is published by the RVO (Rijksdienst voor Ondernemend Nederland, or the Netherlands Enterprise Agency), representing the benchmarked maximum bid for each technology, based on analysis by PBL Netherlands Environmental Assessment Agency.
- Projects submit their application amount, which can be equal to or below the base rate, reflecting their expected cost per unit of CO_2 avoided.
- Each year, the correction amount (reflecting the average market value earned per unit of avoided CO_2) is subtracted from the awarded application amount.
- The difference — the so-called "unprofitable component" — is paid out over a 15 year period.

Modelling Assumptions

Applying this subsidy model to a CCS project in the CEE region will apply the following assumptions:

- Rising ETS price: €184.2/tCO_2 in 2032
- Capture plant capacity: 0.5 MtCO_2/year
- Build period: 2025–2030 (no CCfD payments during this time)
- Operation begins: 2030
- Subsidy estimate: max(Unit cost – ETS price, 0) × 0.5 Mtpa

Note: This formula is a simplified representation of the logic used in real-world asymmetric carbon contracts for difference (CCfDs), such as the Dutch SDE++. It illustrates how the difference between a project's bid price and the ETS price determines the subsidy level. Actual contract structures may include additional features such as payment caps, volume adjustments, and separate treatment of CAPEX and OPEX.

Figure 10: Subsidy to cover OPEX gap for a 0.5 Mt project in a scenario with only currently announced CO_2 storage projects available

9.85	Scenario	Unit gap (€/t)	Annual subsidy to project (Million €) in 2030	Subsidy End (CostParity) Year
Bulgaria	Announced Storage Projects	9.7	4.85	2031
Croatia	Announced Storage Projects	18.2	9.10	2032
Czechia	Announced Storage Projects	27.5	13.75	2033
Estonia	Announced Storage Projects	30.5	15.25	2034
Hungary	Announced Storage Projects	47.0	23.50	2035
Latvia	Announced Storage Projects	19.7	9.85	2032
Lithuania	Announced Storage Projects	16.0	8.00	2032
Poland	Announced Storage Projects	29.0	14.50	2033
Romania	Announced Storage Projects	26.5	13.25	2033
Slovakia	Announced Storage Projects	45.2	22.60	2035
Slovenia	Announced Storage Projects	13.8	6.90	2032

CAPEX support - the key to project delivery in the region

Even if the need for OPEX subsidies once a project is operational can be driven to zero by expanding CO_2 storage and thus lowering transport and storage costs, the upfront capital cost of a full-chain CCS project remains a major barrier to project development in the CEE region. Full-chain CCS projects worldwide demonstrate that capital investments routinely run into the hundreds of millions or even billions of euros (Figure 11).[10] While many CCfD mechanisms allow projects to recover capital costs through their bid price, including amortisation of CAPEX over the contract period, this recovery is only possible after the project reaches operation, and this assumes the project has secured sufficient finance upfront. Additional capital support instruments such as grants, concessional loans, or equity injections can therefore play a complementary role, especially in covering pre-award or funding development costs or enabling infrastructure that benefits multiple emitters.

10 Clean Air Task Force, Carbon capture and storage: What can we learn from the project track record? (2024)

Figure 11: Total CAPEX costs for CCS projects operational and under construction[11]

€867.8 million	Status	Capacity (Mt CO_2/yr)	CAPEX in EUR
Sleipner CCS	Operational	9.7	€260.3 million
Gorgon CO_2 Injection	Operational	18.2	€1.73 billion
Quest CCS	Operational	27.5	€495.4 million
Air Products Port Arthur	Operational	30.5	€374.0 million
Alberta Carbon Trunk Line	Operational	47.0	€752.5 million
Illinois Industrial CCS	Operational	19.7	€179.6 million
Boundary Dam CCS	Operational	16.0	€921.8 million
Petra Nova	Operational	29.0	€867.8 million
Northern Lights (Full Chain, including both capture projects)	Under Construction	26.5	€1.61 billion
Porthos	Under Construction	45.2	€1.30 billion

The large upfront CAPEX required to build carbon capture plants, and their associated transport and storage infrastructure remains the single largest hurdle to deploying CCS at scale. Yet, successful projects have shown that with the right combination of state intervention, blended finance, and project design, even multibillion euro CCS value chains can be brought to FID. This is elaborated in the case studies below.

Project Case Study 1: Porthos

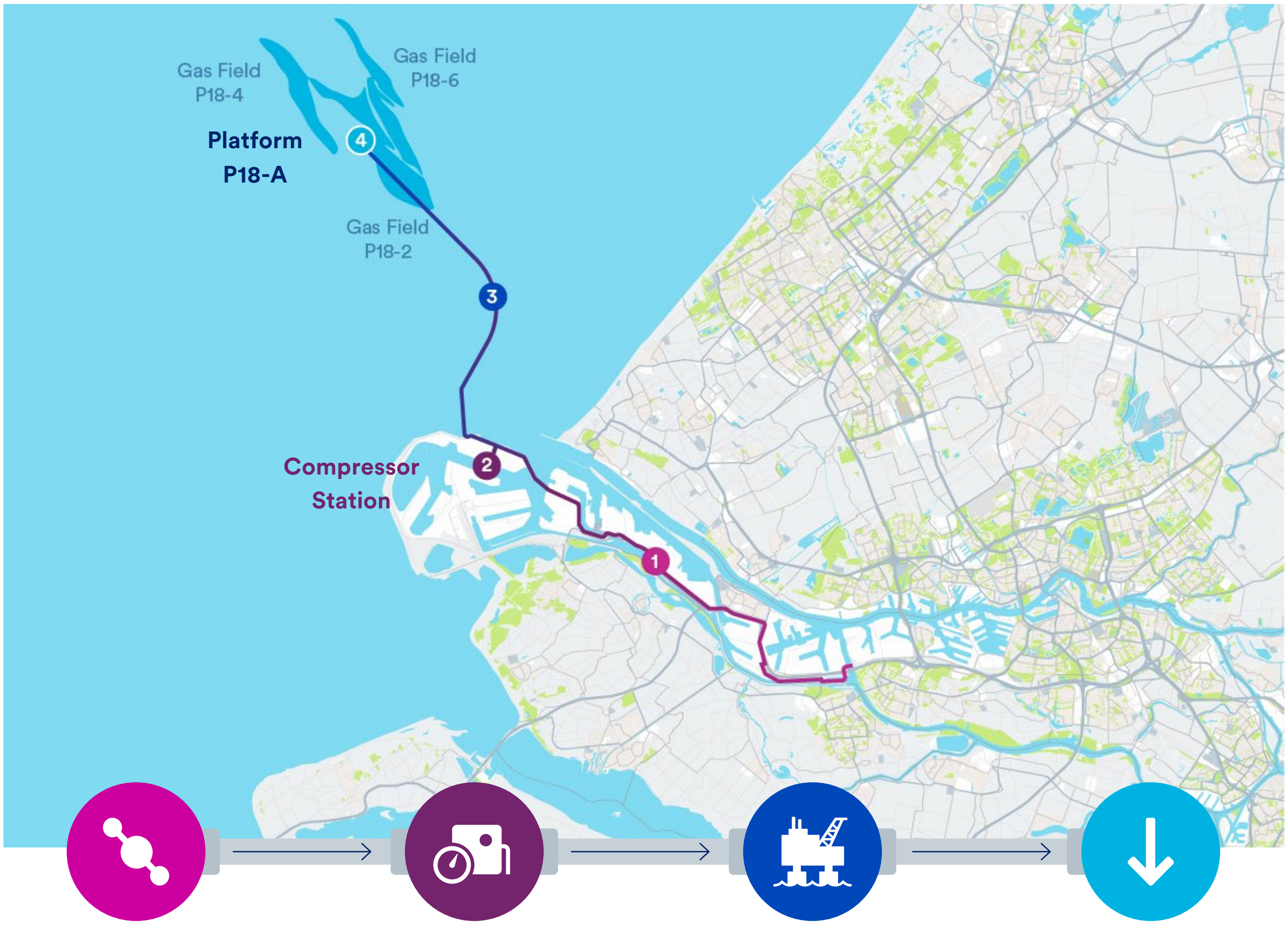
Porthos is a full-chain CCS project in the Port of Rotterdam, Netherlands, capturing CO_2 from local industry and storing it in a depleted gas field in the North Sea. It is developed by EBN, Gasunie, and the Port of Rotterdam Authority and aims to store ~2.5 $MtCO_2$/year. The project made a final investment decision in 2023, with operations expected in 2026.

Over its 15-year operational period, Porthos customers are eligible to receive up to €2.1 billion in SDE++ subsidies. These payments, designed to cover the gap between CCS costs and the EU ETS price, underpin the long-term business case by covering the cost gap. However, according to the Netherlands Court of Audit's 2024 report Carbon Storage Under the North Sea,[12] no subsidy payouts are currently expected. Due to higher-than-anticipated CO_2 prices, customers are projected to operate profitably without drawing on the SDE++ budget. The report notes that industry stands to benefit significantly from this structure, with customer returns projected as high as 34%, even without subsidy payments. Meanwhile, the government assumes long-term monitoring and liability responsibilities for the storage site after 2062, without sharing proportionally in the project's financial upside.

11 Porthos and northern lights project figures from project websites. Dollar to Euro exchange rate as of 22.04.2025

12 Netherlands Court of Audit, 'Carbon Storage Under the North Sea' (2024)

Figure 12: How the Porthos Project Works



The CO_2 captured from multiple sources in the area will be **transported through a collective underground pipeline** in the already existing pipeline strip of the Maasvlakte, Europoort and Botlek.

The CO_2 will then be **pressurised in a compressor station** to the required pressure and temperature for injection.

The pressurized CO_2 is **transported through an offshore pipeline to the former gas platform P18-A**, approximately 20km off the coast in the Dutch North Sea.

At the platform, the CO_2 will be **pumped more than 3km under the seabed into empty gas fields in the North Sea** located in a sealed reservoir of porous sandstone, ideal for the permanent geological storage of CO_2.

Figure 13: Key funding sources (CAPEX basis)

Source	Amount (m €)	% of CAPEX	Notes
Equity (EBN / Gasunie / Port of Rotterdam)	1 138.1	87.6 %	Joint venture partners fund the balance after grants and loans
EU CEF grant	108.5	8.3 %	Covered FEED and part of construction
State loan (to EBN)	53.4	4.1 %	Repaid over 2022–2038
Total CAPEX	**1 300**	**100 %**	

How the Porthos project reached final investment decision (FID)

Porthos reached FID in September 2023 through a layered public-private de-risking model:

- A €108.5 million EU Connecting Europe Facility (CEF) grant supported pre-FID development costs, including FEED and early construction, reducing the upfront equity requirement.
- A €53.4 million state loan to EBN, a partly state-owned entity, provided further near-term capital relief.
- The €2.1 billion SDE++ award provided customers with long-term revenue certainty, enabling them to sign capped transport and storage agreements, critical to enabling the joint venture to raise equity and secure investment.
- In late 2022, a legal challenge threatened project timelines. The Dutch Ministry (EZK) issued a €175.6 million guarantee, covering 80% of pre-investment risk, allowing contractors to mobilise and proceed.

Together, these instruments allowed the partners to commit ~€1.14 billion in equity (≈88% of CAPEX), and through the participation of state owned entities (SOEs), the project partners were able to accept a lower internal rate of return in view of achieving the Netherlands' 2030 climate goals.

Timeline of Key Milestones

- **2019–2020**: FEED and early development funded by CEF and EZK grants
- **June 2021**: €2.1 billion SDE++ award to four anchor customers
- **Late 2022**: Council of State challenge triggers EZK guarantee
- **Early 2023**: State loan issued to EBN; customer contracts finalised
- **Sept 2023**: FID confirmed with full CAPEX stack secured

Porthos demonstrates how capital grants and risk guarantees can complement CCfD-style operational support to unlock investment in shared CCS infrastructure. While the project may never draw on its SDE++ allocation, the presence of the contract de-risked the business case, enabling industrial customers to commit and infrastructure investors to proceed. Furthermore, the participation of SOEs allowed for the government to share the financial risk with the project partners and for the project to proceed with a lower IRR.

Through this layering of EU grants, national operating subsidies, state loan & guarantee, and equity, Porthos overcame cost-risk, revenue-risk and legal-risk hurdles, unlocking a final investment decision toward construction in 2024 and planned CO_2 injection by 2026.

Project Case Study 2: Northern Lights Phase 1

Northern Lights Phase 1 is a cross-border CO_2 transport and storage project in Norway, capturing CO_2 from industrial sources and shipping it to an offshore storage site in the North Sea. It is developed by Equinor, Shell, and TotalEnergies, with initial capacity of 1.5 $MtCO_2$/year. The project reached FID in 2020 and is expected to start operations in 2024. This project is the transport and storage component of Norway's broader Longship CCS initiative.

Figure 14: Northern Lights Value Chain

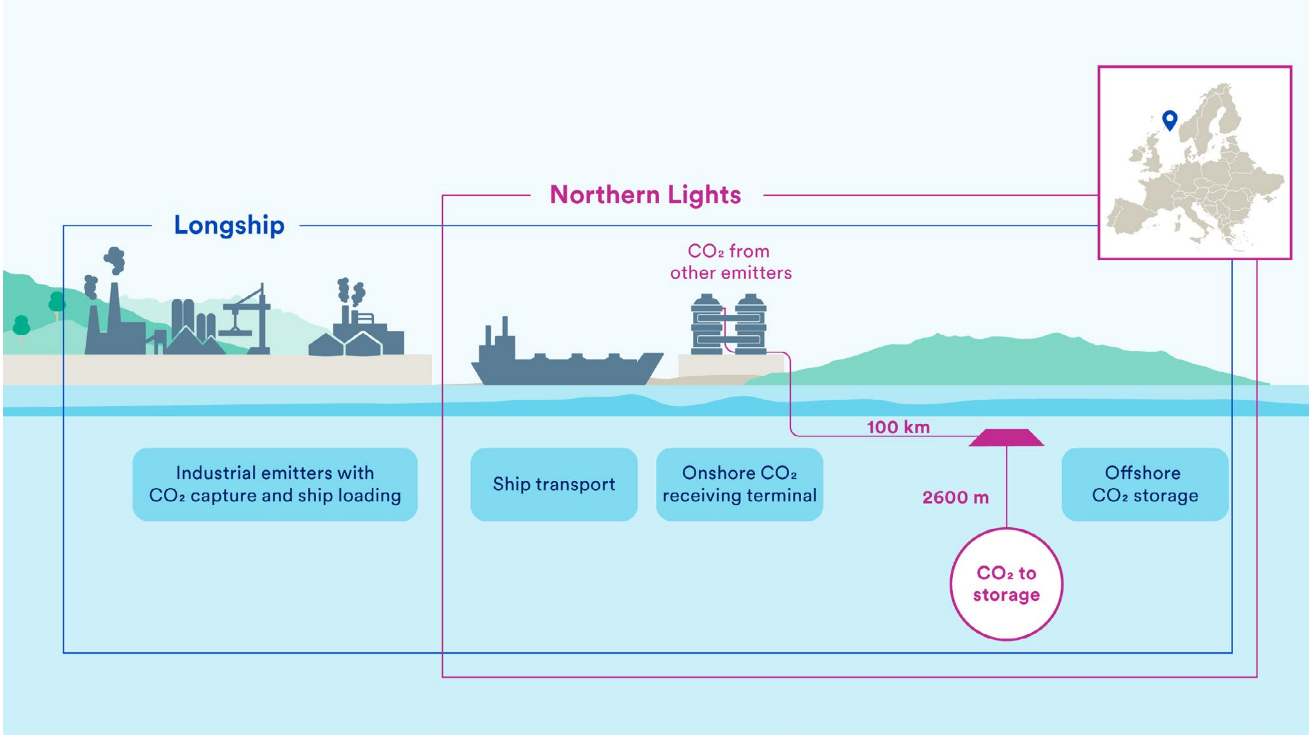


Figure 15: Northern Lights value chain project costs

Source	Amount (m €)	% of CAPEX	Notes
State support – capture	544.19	33.6 %	75 % of total capture CAPEX
State support – transport & storage	713.40	44.1 %	80 % of transport & storage CAPEX
Equity	360.62	22.3 %	Joint venture partners fund the balance after grants and loans
Total CAPEX	**1618.20**	**100 %**	Combined capture plants + transport & storage facility

How the Northern Lights project reached final investment decision (FID)

The Northern Lights value chain was derisked through a layered combination of state CAPEX sharing and guaranteed OPEX support which together limited equity requirements. In December 2020, Norway's Ministry of Petroleum and Energy, via Gassnova, a state-owned entity responsible for CCS development in Norway, formalised a State Support Agreement under the Longship initiative. This package committed up to 80% of the transport and storage capex on a P85[13] basis, and 75% of the CAPEX for an initial capture facility at the Brevik cement plant (0.4 Mtpa). It also provided OPEX support for the first ten years of operation at the capture facility. By capping the JV partners' potential losses on cost overruns and ongoing operational expenses, as well as providing a bankable CO_2 offtake agreement for part of the capacity, it derisked the investment sufficiently to trigger financial close for Phase 1.

Following its FID, Northern Lights secured additional long-term transport & storage contracts covering over 1.2 Mt/year of capacity:

- Yara International: 800 kt CO_2/year from its Sluiskil ammonia plant (signed August 2022)[14]
- Ørsted: 430 kt biogenic CO_2/year from two Danish biomass power stations (signed May 2023)[15]

These agreements, together with the volumes from the Brevik cement plant, secured all of Phase 1's 1.5 Mt/year capacity, providing predictable CO_2 volumes and supporting revenue certainty.

The financing structure of this project allocated risks clearly; the Norwegian state absorbed interface and cost overrun risks up to P85 and provided 10 years of OPEX support for the Brevik capture plant, ensuring steady CO_2 supply to the T&S system; the JV partners provided equity and took on operational risk; industrial customers carried capture obligations. After the KS2 external quality assurance report (Norway's mandatory second-phase review of major public investments assessing cost realism and governance) in June 2022 confirmed the project's cost estimates and governance framework, FID was formally reached, enabling construction to proceed toward the planned 2024 start of operations

In essence, Norway's government derisked both capital and operating expenditures, covering roughly three-quarters of the full chain costs, thereby giving industry partners the certainty needed to proceed to FID in 2022 and move into construction. In 2025, Northern Lights also reached Final Investment Decision on Phase 2, supported in part by EU Connecting Europe Facility (CEF) funding. Phase 2 expands on the original infrastructure, which was deliberately oversized; the offshore pipeline, for example, can handle up to 5 MtCO_2/year, far beyond the initial 1.5 MtCO_2 capacity. New commercial agreements have since been signed with Klemetsrud (Oslo) and Stockholm Exergi, further demonstrating the "snowball effect" of this publicly de-risked first wave and paving the way for a commercially viable CCS network.

13 P85 refers to the cost estimate at which there is an 85 % probability that actual project costs will not exceed the budgeted amount.

14 TotalEnergies, 'Norway Northern Lights Project Signs World's First Commercial Agreement' (2022)

15 Northern Lights, 'Northern Lights Enters into Cross-Border Transport and Storage Agreement with Ørsted' (2023)

Key Takeaways for CEE CCS Deployment

- **State as integrator and strategic investor**: Public bodies, including SOEs, play a critical role in convening cross-value-chain actors, accepting early-stage risk, and anchoring infrastructure development. Rather than funding the majority of CAPEX directly, the state can act as a first-mover investor or guarantor, target public funding toward future-proofing shared assets, and ensure alignment with long-term decarbonisation goals.Projects submit their application amount, which can be equal to or below the base rate, reflecting their expected cost per unit of CO_2 avoided.
- **Blended EU and national finance**: The EU Innovation Fund (IF) can provide grants covering up to 60% of total project costs, including both CAPEX and OPEX (typically over the first 10 years). This makes the IF especially valuable for CEE countries with higher perceived risk or cost of capital. However, most projects still require co-financing to cover the remaining 40%, which may come from national schemes (e.g. SDE++), EU instruments like the Connecting Europe Facility (CEF), public banks, or private capital. The blending of IF with other sources depends on project structure, and alignment of timelines and eligibility rules can be a key challenge.
- **Rigorous governance & derisking**: Independent cost and risk assurance processes — such as Norway's KS2 review, which validates project cost estimates and governance before public funding is approved — help reduce perceived project risk. Clear regulatory frameworks for transport infrastructure (e.g. permitting rules, access terms) also increase investor confidence. Together, these measures lower the project's risk profile and reduce the weighted average cost of capital (WACC), which is a key driver of overall project bankability.[16]
- **Cluster based models**: Aggregating multiple emitters around shared CO_2 transport and storage infrastructure, as seen in projects like Porthos and Northern Lights, spreads infrastructure costs across several users, creating economies of scale. This approach reduces unit costs for each emitter, improves infrastructure utilisation rates, and de-risks investment in shared assets like pipelines and storage sites. It also enables governments and investors to focus public support on a limited number of high-impact nodes, making large-scale CAPEX investments more bankable and accelerating regional decarbonisation.

The role of the three state-owned enterprises (SOEs), EBN, Gasunie, and the Port of Rotterdam Authority was also critical. Their ability to take a strategic, long-term investment view allowed the project to proceed despite inflationary pressures and a lower-than-expected return. This willingness to accept sub-commercial investment returns in pursuit of national climate goals illustrates how public ownership structures can be leveraged to drive CCS deployment, a potentially relevant model for CEE Member States.

By adapting these proven European approaches such as public-led risk sharing, blended EU and national grants, binding revenue-support contracts, and cluster integration, CEE countries can surmount the CAPEX barrier and catalyse their first wave of commercial CCS projects.

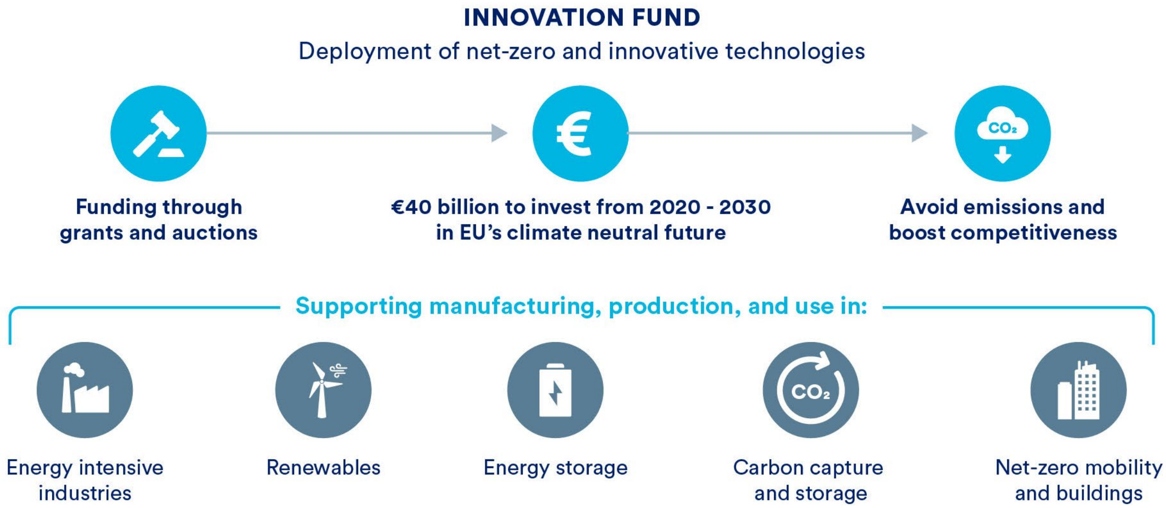
16 WACC is the project's discount rate, calculated as the weighted average of the cost of equity and the aftertax cost of debt, representing the required return investors demand for financing CCS projects.

Leveraging EU funding for completing the business case

Both national governments and some emitters in CEE can be more resource constrained than their counterparts in Western Europe. This means that tailoring a national approach to reduce the overall capital expenditure on projects is paramount. Blending funding approaches by making the best use of EU funding provides a strategic means by which to bridge this gap and bring the first CCS projects in CEE from the early stages of project development to FID all the way through to operation.

Projects developing CCS value chains in CEE face a complex and often fragmented funding landscape. Multiple funding streams exist at the European Union (EU) level, each with varying criteria, timelines, and capacities to support different segments of CCS projects, from capture to transport and storage infrastructure.

Figure 16: Northern Lights Value Chain

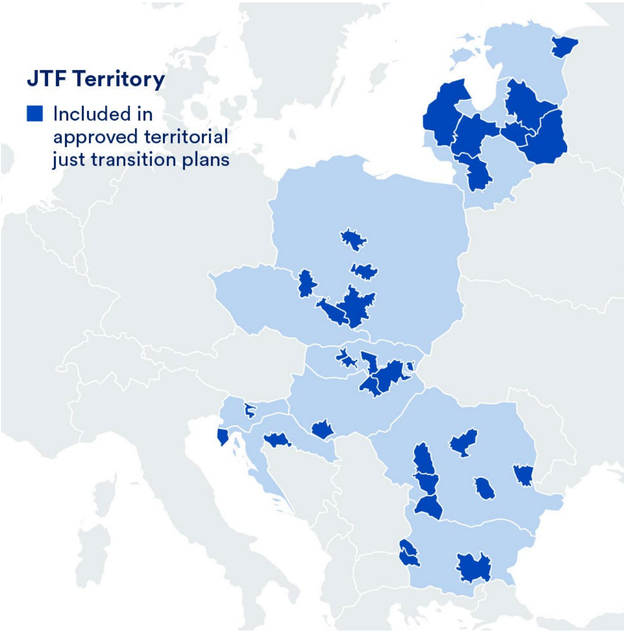


Among the most prominent funding instruments is the Innovation Fund, however, this fund has notable limitations. The fund is significantly oversubscribed, with demand consistently outstripping the available funds, with the 2023 call being six times oversubscribed relative to the initial budget of €4 billion. To address this, the Commission is now introducing the STEP Seal, a label awarded to high-quality project proposals that meet Innovation Fund criteria but are not selected due to limited budget. This designation is intended to guide Member States toward supporting these unfunded projects using national or EU co-financing, thereby preserving momentum and quality in the project pipeline. Additionally, the Innovation Fund predominantly finances capture projects, although in the latest round more storage projects have been selected for funding,[17] frequently omitting critical investments into associated CO_2 storage infrastructure, thereby creating gaps within CCS value chains.

[17] Clean Air Task Force, 'Innovation Funds Support for CCS Projects Beyond the North Sea Will Aid Decarbonisation' (2024)

Other EU mechanisms providing potential support include the Connecting Europe Facility (€5.84 billion for 2021–2027), Horizon Europe, the Recovery and Resilience Facility (RRF), and the Just Transition Fund (JTF) which funded the Anthemis project in Belgium, for implementing CCS technology at a cement plant in Antoing.[18] The Recovery and Resilience Plans (RRPs), which were introduced following the COVID-19 pandemic, offered member states unique opportunities to include CCS projects. Countries such as Croatia, Greece, and Belgium recognised this and allocated resources to projects. For example, Greece allocated €150 million[19] for the construction of the Prinos carbon storage facility and Belgium's RRP included various measures to invest in the development of carbon capture technologies, including a €95 million grant for the construction (or where possible, repurposing) and operation of 150 kilometres of pipeline capable of transporting hydrogen and CO_2.[20] Conversely, apart from Croatia which directed funding towards two capture projects, CEE countries have missed this opportunity, leaving substantial gaps in CCS funding at a national level, indicating a need for better strategic foresight and planning when new financial instruments are announced.

Figure 17: Map of Just Transition Fund Regions in CEE



Looking forward, the incoming European Commission's Clean Industrial Deal promises significant developments in terms of access to EU funding for CCS projects throughout Europe, aiming to mobilize over €100 billion towards EU-made clean technologies, including CCS. This initiative includes a Clean Industrial Deal State Aid Framework, aiming for simplified approval processes and the establishment of an Industrial Decarbonisation Bank with targeted funding from the Innovation Fund. Additionally, the European Investment Bank (EIB) will introduce dedicated instruments such as a CleanTech Guarantee Facility under InvestEU, designed explicitly to lower the risk and enhance the feasibility of CCS and related clean tech projects.

CEE countries must position themselves proactively to effectively capitalise on these forthcoming opportunities. Establishing clear national strategies, coordinating roles among relevant stakeholders, and ensuring readiness for swift application to these enhanced financial mechanisms will be critical. This approach facilitates project realization and ensures that funding contributes to integrated, economically viable, and sustainable CCS value chains across the region.

18 Anthemis CCS, 'Just Transition Fund Subsidies in Perspective for the Anthemis Project at the HeidelbergMaterials Cement Plant in Antoing' (2023)

19 European Commission, 'Commission approves €150 million Greek State aid measure funded under Recovery and Resilience Facility to support construction of carbon storage facility in Prinos' (2024)

20 Clean Air Task Force, 'Carbon Management EU Recovery Resilience Plans' (2021)

Financing Opportunities for CCS Projects in the CEE Region

Financial institutions play a critical role in providing the necessary capital for CCS projects. The European Investment Bank (EIB) offers loans, equity investments, and guarantees to mobilize additional commercial sources. Through the NET 300 Financial Advisory Support, the EIB provides free financial advice to improve the bankability and readiness of early-stage innovative low carbon projects, enhancing their chances of securing financing. Similarly, the European Bank for Reconstruction and Development (EBRD) provides direct finance through loans, equity investments, and guarantees. The EBRD also works indirectly through local financial institutions, offering lending, leasing, green bonds, and ESG-linked bonds. Targeted facilities priced below market terms, selective partial investment grants, and incentive payments are available to overcome specific barriers.

Green bonds are an emerging financing tool for large-scale CCS projects. Several major industrial emitters have already begun to leverage green bonds to finance CCS-related initiatives:

- **Heidelberg Materials:** In June 2024, the company issued its first green bond of €700 million, followed by a second €500 million bond in September 2024. Proceeds from these bonds are allocated to projects including the expansion of carbon capture technologies at cement plants, such as the Brevik CCS project in Norway.[21]
- **Dow Inc:** In February 2024, Dow completed its inaugural green bond offering, raising over $1.25 billion to support its decarbonisation and circular economy plans. A significant portion of the proceeds were earmarked for the construction of a new net-zero emissions ethylene plant in Alberta, Canada, which will incorporate carbon capture and storage.
- **CEMEX:** The company has updated its Green Financing Framework to include eligibility for financing decarbonisation technologies, including CCUS. This expansion allows CEMEX to issue financial instruments such as bonds and loans to fund its "Future in Action" program aimed at reducing carbon emissions.[22]

These bonds offer lower interest rates (a 'greenium') and potentially higher demand due to their sustainability focus. However, challenges include ensuring trading volume, higher emission costs, and restrictions on the use of proceeds to specific purposes aligned with the EU taxonomy. Despite these obstacles, green bonds can significantly lower interest costs compared to standard bank loans, providing flexibility and supporting the financing of large CCS projects with mature technologies.

To maximise the impact of available financial resources, strategic coordination is essential. This involves aligning national CCS projects with EU climate goals, streamlining funding applications, and reducing administrative burdens. Developing innovative financing mechanisms with other donors, such as the Green Climate Fund, which can also support CCS projects. Existing facilities like the European Investment Advisory Hub (under InvestEU) and the Innovation Fund Technical Assistance programme also support early-stage project development by helping applicants refine business models, financial structuring, and submission materials.

By leveraging these financing options and strategic state interventions, the CEE region can overcome financial barriers, attract investments, and advance CCS projects, significantly contributing to the region's climate goals and economic resilience.

21 AGG-Net, 'Heidelberg Materials Place First Green Bond' (2024)

22 CEMEX, 'CEMEX Updates Its Green Financing Framework to Strengthen Funding for Decarbonization Tech' (2023)

The need for state coordination in CEE CCS projects

The complexity inherent in navigating fragmented EU-level CCS funding underscores the necessity for proactive state involvement. CCS project development can typically take up to a decade from the initial planning stage to operation; without early public support, the necessary infrastructure will not be available in time for emitters that need to capture and store their CO_2. Traditionally, government roles[23] in supporting CCS deployment have been categorised as Supervisor, Instigator, and Owner, each reflecting differing levels of intervention.

The **Supervisor role** involves governments establishing foundational regulatory and legislative frameworks. This includes regulations for CO_2 storage, clear permitting processes, and long-term liability. Such regulatory certainty remains essential at every development stage, enabling private investment confidence and smooth market functioning.

When market incentives like the EU ETS carbon price fail to sufficiently incentivise CCS, governments adopt an **Instigator role**. This involves targeted temporary interventions, including subsidies for capital (CAPEX) and operational expenditures (OPEX), infrastructure oversizing to anticipate future demand, and strategic planning for CO_2 storage development.

The **Owner role**, involving direct governmental ownership of CCS infrastructure such as CO_2 transport and storage, represents the highest level of state involvement. In Denmark, this is mandated by legislation, with the state holding a 20% stake in CO_2 storage sites. In the Netherlands, while not legislated, a similar model exists in practice: the state-owned company EBN holds a 40% stake in Dutch CO_2 storage licenses. EBN and fellow public entity Gasunie, alongside the Port of Rotterdam Authority, also jointly own and operate the Porthos project, and are co-developers of the Aramis CO_2 transport and storage project. These examples reflect a policy choice to maintain state involvement in key CCS infrastructure, aligning investment decisions with long-term public interest.

A New Role: The Coordinator

To address the unique challenges faced by potential projects in CEE, such as fragmented funding, missed EU funding opportunities, and value chain misalignment—this paper proposes a distinct, integrative governmental role: **the Coordinator.** This role strategically combines financial coordination with long-term planning to accelerate CCS deployment in the region.

As Coordinators, CEE governments would proactively guide both the strategic direction of CCS projects and optimise access to EU funding instruments. Key actions under this role would include:

- **Strategic Alignment and Clustering:** Ensuring multiple emitters share transport and storage infrastructure, significantly lowering costs, reducing risks, and addressing current market fragmentation. This approach was highly effective in the Netherlands, which demonstrated how governments can play an important role in coordinating all the actors in the value chain and ensuring they develop according to a mutually beneficial timeline
- **Optimised EU Funding Access:** To access EU funding effectively, CEE Member States must go beyond embedding CCS in national decarbonisation plans and proactively develop comprehensive carbon management strategies. This includes national plans for transport and storage infrastructure, cluster identification, and geological mapping to give projects a credible foundation for EU funding bids. Governments should also consider establishing dedicated agencies or support units to help industrial emitters navigate complex EU funding processes, for example through a “one-stop shop” approach that streamlines applications and builds trust with project developers. For example, Holcim’s Martres-Tolosane CCS project in France leveraged a government-funded geological survey to support a successful Innovation Fund bid.

[23] Drivers and barriers towards large scale Carbon Capture and Storage (CCS) deployment and possible government responses Current insights from the Dutch perspective (2011)

- **Regional Collaboration and Cross-Border Projects:** Facilitating cooperation between neighbouring countries, which is essential given the inherently cross-border nature of optimal CO_2 storage and transport deployment.
- **Ensuring Harmonisation**: Aligning national CCS plans with broader EU climate targets, avoiding duplication of efforts and maximising resource efficiency.
- **Capacity Building among Administrative Authorities:** CCS deployment depends on timely and informed administrative decisions, particularly around permitting, planning, and environmental approvals. In many CEE countries, relevant authorities face gaps in technical understanding of CCS and often operate within procedures that are not designed with CO_2 transport and storage in mind. Building knowledge among civil servants and simplifying administrative processes is critical to accelerating investment timelines and avoiding bottlenecks at the project approval stage.
- **Dedicated CCS one-stop-shop**: Creating national CCS one-stop shop to streamline know-how on investments procedures and funding opportunities among investors and foster early, structured engagement with industry, academia, and civil society.

The Coordinator role directly responds to CEE's strategic gaps, ensuring cohesive, strategically aligned, and financially viable CCS value chains. With the upcoming Clean Industrial Deal, including new instruments like the Industrial Decarbonisation Bank and expanded InvestEU support, adopting this role will enable CEE governments to swiftly capitalise on emerging EU financial opportunities. Ultimately, this integrated governmental approach positions the region to achieve deep decarbonisation effectively, economically, and at the necessary pace.

Conclusions

In the face of rising EU ETS prices and the decarbonisation of industries in other European regions through CCS, deploying these crucial climate mitigation technologies in the CEE region will be critical for the region to both meet its climate target and prevent regional deindustrialisation. In a region with comparatively less budgetary room than governments in Western Europe, how funding mechanisms are designed and the means by which CCS is deployed will have profound effects on the overall costs incurred to make deployment a reality. With a rapidly shrinking window to deploy projects in the region, CEE governments should learn from first-mover states and projects to recreate the key enablers of success.

Firstly, developing clear national strategies to provide a vision for deployment can send important market signals and lay out a plan for deployment. These plans should be aligned with EU climate goals and targets, such as the Net Zero Industry Act's 50 Mt storage target. Governments in the region can also play an important role in coordinating stakeholders to streamline CCS deployment and align value chain actors. Adopting a coordinating role can also guide the strategic development of projects, maximise funding access, and improve regional cooperation for the cross-border transport of CO_2.

This coordinator role can ensure that domestic CO_2 storage resources are developed, which this report has shown is one of the principal means by which overall project costs can be reduced when compared to an exporting scenario. To make domestic storage a reality, ensuring regulatory clarity and building administrative capacity to streamline permitting and approval processes will be key enablers.

By utilising a mix of available EU and national financial instruments, as well as mobilising private capital through innovative financing like green bonds, the total costs incurred by governments to cover the cost gap between project costs and the EU ETS price can be further reduced. De-risking instruments will also be key, such as carbon contracts for difference (CCfD), as was the case in the success of projects such as Porthos and Northern Lights, which also saw substantial involvement from state owned entities. By taking a coordinated approach that minimises costs through the development of the most cost-effective storage options, CCS deployment in the region can move from concept to reality.