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Comparative study of the regulatory and tariff framework and the support measures implemented for CO2 transport in the regions and countries bordering the Walloon region

A report for CWaPE

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ACER	European Union Agency for the Cooperation of Energy Regulators
ACM	Dutch Authority for Consumers and Markets
BECCS	Bioenergy with Carbon Capture and Storage
BIK	Federal Subsidy Programme for Industry and Climate Protection
BMWK	German Ministry for Economic Affairs and Climate Change
BNetzA	German Energy Regulation Authority
Capex	Capital Expenditure
CCS/CCUS	Carbon, Capture, Utilization, and Storage
CfD	Contract for Difference
CNO	Carbon Network Operator
CRE	French Energy Regulatory Commission
CWaPE	Walloon Energy Commission
DAC	Direct Air Capture
DACCS	Direct Air Carbon Capture and Storage
DEA	Danish Energy Agency
DEI+	Demonstration of Energy and Climate Innovation
DUR	Danish Utility Regulator
EC	European Commission
EKOO	Energy & Climate Research and Development Program
EUDP	Energy, Development and Demonstration Program
EU ETS	EU Emissions Trading System
EU IF	EU Innovation Fund
EZK	Dutch Ministry for Economic Affairs
FID	Final Investment Decision
GHG	Greenhouse Gas
ICMS	Industrial Carbon Management Strategy
JRC	European Commission Joint Research Council
KSpTG	German Law on Carbon Storage and Transport
mtpa	Megatons per year
NECP	National Energy and Climate Plan
NZIA	Net Zero Industry Act
PCI/PMI	Project of Common Interest/Project of Mutual Interest
PEPR	Priority Research and Equipment Program
R&D	Research and Development
RVO	Netherlands Enterprise Agency
SDE++	Stimulation of Sustainable Energy Production and Climate Transition
SodM	Dutch State Mine Supervision
TEN-E	Trans-European Network for Energy
TSO	Transmission System Operator
T&S	Transfer and Storage
VEKA	Flemish Energy Agency

VNR	Flemish Utility Regulator (since January 2025)
VREG	Flemish Energy Regulatory Authority (until end of 2024, then VNR)
ZiBaC	Zone Industrielle Bas Carbone

Résumé exécutif

Contexte

La Wallonie s'efforce de décarboniser son économie. Conformément à la stratégie de la Région wallonne, elle vise à réduire ses émissions de gaz à effet de serre (GES) de 55 % d'ici 2030 et d'au moins 95 % d'ici 2050, par rapport aux niveaux de 1990. La capture, le transport et le stockage du CO2 s'imposent comme des éléments clés pour atteindre cet objectif. Cette évolution s'inscrit dans une tendance plus large en Europe, où les émetteurs et les gouvernements étudient de plus en plus le captage et le stockage du carbone (CSC) comme technologie cruciale pour réduire les émissions dans des secteurs difficiles à décarboniser. La « Stratégie de gestion industrielle du carbone » (Industrial Carbon Management Strategy, ICMS) de la Commission européenne pour 2024 met notamment l'accent sur la création d'un marché industriel européen de gestion du carbone d'ici 2030.

La Wallonie étant une région enclavée, dotée d'industries difficiles à décarboniser et ne disposant pas de capacité de stockage domestique facilement accessible, le développement d'un réseau wallon de transport de CO2 est essentiel, tant pour l'exportation du CO2 capté localement que pour le transit de volumes en provenance d'autres pays (par exemple, de l'Allemagne). Publié au Moniteur belge le 12 juillet 2024, le décret du 28 mars 2024 relatif au transport de dioxyde de carbone par canalisation (ci-après : « décret CO2 ») a établi le cadre juridique permettant de développer en Wallonie les secteurs de transport, de distribution et de valorisation du CO2. Le décret désigne la Commission wallonne pour l'Énergie (CWaPE) comme le régulateur du marché du transport de CO2 par canalisations dans la Région wallonne et lui confie de nouvelles missions, dont l'élaboration et l'adoption d'une méthodologie tarifaire pour les tarifs de raccordement, d'utilisation et de services auxiliaires applicables au réseau de CO2, ainsi que l'éventuel approbation de ces tarifs.

Le présent rapport a été préparé par NERA pour soutenir la CWaPE dans le développement d'une réglementation et d'une politique de soutien efficaces pour le transport de CO2 en Wallonie. Son analyse économique comparative d'autres juridictions européennes vise à éclairer l'élaboration d'un cadre économique solide. À cette fin, NERA a étudié l'état actuel du marché du CO2, les mécanismes de soutien dans d'autres pays (directs et indirects) ainsi que les cadres réglementaires relatifs au transport de CO2 dans plusieurs juridictions de l'UE à l'avant-garde du développement d'infrastructures de CO2, notamment : i) en Flandre, ii) au Danemark, iii) en France, iv) en Allemagne et v) aux Pays-Bas. La réglementation européenne pertinente et les dispositifs de soutien mis en place par l'UE sont également analysés. Une analyse théorique plus générale des cadres réglementaires et des modèles de tarification possibles pour le transport du CO2 complète ces études de cas.

Le besoin d'une intervention du marché

Le déploiement des réseaux de transport du CO2 est une entreprise complexe comportant de multiples dimensions interdépendantes, qui met au défi la fourniture de telles infrastructures par le secteur privé, notamment :

- Une tarification insuffisante de l'externalité produite par le CO2. Le prix actuel du système d'échange de quotas d'émission de l'UE (SEQE) tourne autour de 70 €/t, ce qui ne suffit pas, à lui seul, à soutenir le développement du CSC et du transport de CO2. Certaines études (parues

notamment dans la revue *Nature*[1]) estiment en effet le coût social du CO2 à 185 $/t (environ 175 €/t)[2], un niveau auquel le CSC associé au transport de CO2 est bien plus susceptible d'être rentable. Parallèlement, la plupart des parties prenantes conviennent que des mesures initiales doivent être prises dès aujourd'hui pour réduire les coûts et développer l'infrastructure nécessaire, en prévision d'une hausse des prix du SEQE qui rendrait le CSC compétitif au début des années 2030.[3]

- Des risques inter-chaînes dans la chaîne de valeur. Le déploiement de réseaux de transport de CO2 et d'infrastructures associées nécessite le développement simultané de projets de capture, de transport et de stockage. Le retard de l'un de ces maillons entraîne la sous-utilisation de l'ensemble de la chaîne. En outre, la chaîne de valeur étant centrée sur un nombre limité d'émetteurs, la faillite d'un seul utilisateur pourrait avoir un impact négatif notable sur la viabilité du système dans son ensemble.
- Des désavantages pour les premiers investisseurs. Dans toute nouvelle classe d'infrastructures, il est probable que les coûts diminuent au fil du temps. Cette perspective peut dissuader certains acteurs d'être les premiers à s'engager et à supporter les coûts initiaux, plus élevés.

Ces particularités peuvent rendre nécessaire la subvention du développement des infrastructures de transport de CO2 ou la mise en place de mécanismes d'atténuation des risques. En outre, dès lors qu'elles sont déployées, ces infrastructures ont tendance à présenter un caractère monopolistique ; par conséquent, les tarifs payés par les utilisateurs (ayant investi dans des équipements de CSC) pourraient nécessiter une régulation s'ils ne sont pas fixés dans le cadre de contrats commerciaux de longue durée.

L'état du marché

Notre étude des plans relatifs au développement d'infrastructures de transport de CO2 dans cinq pays / régions proches de la Wallonie (Flandre, Allemagne, France, Pays-Bas et Danemark) fait apparaître un grand nombre de projets, dont plusieurs interconnexions transfrontalières. Cependant, seuls quelques projets ont franchi le cap de la décision finale d'investissement : CO2TransPorts en Belgique et aux Pays-Bas, le projet Greensand au Danemark et Porthos aux Pays-Bas. À ce jour, aucun projet allemand ni français n'a atteint ce stade.

Mécanismes de soutien public

Le soutien public au développement du réseau de transport de CO2 peut prendre deux formes :

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1 Nature est l'une des principales revues scientifiques multidisciplinaires axées sur les sciences naturelles. Des informations sur le facteur d'impact de la revue et d'autres indicateurs de la revue sont disponibles ici : https://www.nature.com/nature-portfolio/about/journal-metrics.

2 Voir Rennert, K., Errickson, F., Prest, B.C. et al. Des preuves exhaustives impliquent un coût social plus élevé du CO2. Nature 610, 687–692 (2022). https://doi.org/10.1038/s41586-022-05224-9. Dans l'article, le coût social du dioxyde de carbone mesure la valeur monétisée des dommages causés à la société, notamment en raison de l'impact du climat sur l'agriculture, la mortalité, la consommation d'énergie et l'élévation du niveau de la mer.

3 Selon la stratégie de gestion du carbone industriel de l'UE, un marché commercialement viable commencera à prendre forme après 2030, où les investisseurs pourront obtenir un rendement compétitif sur le capital investi en fonction du prix du carbone de l'UE.

- Un soutien financier direct aux opérateurs de canalisations, conçu pour réduire le risque d'actifs échoués pour les fournisseurs d'infrastructures et limiter la part du coût de l'infrastructure répercutée sur les utilisateurs.
- Un soutien financier indirect, octroyé à d'autres maillons de la chaîne de valeur (en général des émetteurs), qui utilisent ensuite une partie de ce soutien pour conclure des contrats commerciaux avec les fournisseurs d'infrastructures de transport.

Soutien financier direct au transport du CO2. Divers fonds de l'Union européenne (le Mécanisme pour l'interconnexion en Europe – MIE, le Fonds européen pour l'innovation, etc.) ont versé, au total, plus de 3 milliards d'euros à des projets de CSC ces dernières années. À ce stade, aucun des gouvernements nationaux étudiés n'a mis en place un dispositif de financement direct de grande ampleur. Pourtant, les régimes de subvention danois soutiennent l'ensemble de la chaîne de valeur, y compris les fournisseurs de services de transport et de stockage du CO2. En France, la CRE (Commission de régulation de l'énergie) préconise toutefois des aides publiques ciblées au profit des infrastructures de transport de CO2, notamment pour dimensionner de manière optimale l'infrastructure dès l'investissement initial (en la « surdimensionnant »). Aucun mécanisme de ce type n'a cependant été mis en place jusqu'à présent. Par ailleurs, le projet de stratégie allemand de gestion du carbone envisage l'utilisation de garanties d'État pour financer les projets d'infrastructures de CO2, mais la récente dissolution du Parlement allemand a retardé sa mise en œuvre.

Soutien financier indirect au transport du CO2. Plusieurs pays soutiennent indirectement le transport de CO2, généralement par l'une des deux manières suivantes :

- Via un mécanisme semblable à un contrat carbone pour différences (CCfD), qui rémunère les émetteurs pour la différence de coût entre la réduction d'une tonne de CO2 grâce à une technologie innovante (CSC, par exemple) et le prix du SEQE. De tels schémas existent au Danemark et aux Pays-Bas, et sont prévus en Allemagne et en France[4] ; et / ou
- Des financements R&D pour les technologies de CSC sont également proposé en Flandre, au Danemark, en France et au Pays-Bas.
- En outre, le Danemark a recours à des taxes vertes et l'Allemagne dispose également d'un programme financé par des subventions qui soutiendra l'utilisation des infrastructures de transport du CO2 par les émetteurs une fois que l'utilisation du CSC dans le cadre de la loi révisée sur le captage et le stockage du carbone aura été adoptée par le Parlement.

Par ailleurs, certains pays (Allemagne, Pays-Bas, etc.) ont introduit un soutien non-financier, sous forme d'accélération des procédures d'autorisation. L'utilisation relativement limitée du financement direct (par opposition au financement indirect) s'explique notamment par :

4 La Flandre dispose également d'un programme pilote de CCfD, mais le programme n'est actuellement pas ouvert aux projets CSC.

- Le fait qu'une baisse du coût de l'infrastructure de transport de CO2 profite autant, voire davantage, aux flux en transit qu'aux flux domestiques, alors que la charge financière pèse uniquement sur les contribuables nationaux[5] ; et
- La facilité, pour un mécanisme de financement indirect (comme les CCfD), de faire correspondre précisément la fourniture d'infrastructures de transport de CO2 à une demande identifiée, émanant d'acteurs ayant remporté ces CCfD.

Réglementation économique des tarifs de transport de CO2

Dans l'élaboration d'une réglementation et d'une méthodologie tarifaire, l'autorité de régulation doit se prononcer sur différents points, parmi lesquels :

- Faut-il recourir à une régulation axée sur les coûts, ou bien autoriser des tarifs négociés commercialement, assortis d'un contrôle limité ? Des modèles hybrides sont envisageables (par exemple : la régulation intervient seulement si certains seuils de tarifs ou de taux de rendement sont dépassés) ;
- La conception des tarifs, notamment :
  - S'il faut appliquer des tarifs spécifiques à un itinéraire/*cluster* ou des tarifs uniformes à l'échelle d'une région/d'un pays ;
  - Comment gérer les flux transfrontaliers et de transit et s'il faut appliquer des remises spécifiques pour ceux-ci ;
  - S'il faut autoriser le profilage temporel des tarifs afin de maintenir les tarifs initiaux acceptables au début et quel type de mécanismes déployer pour assurer le recouvrement ultérieur des recettes initialement retardées ; et
- Faut-il prévoir des mesures spécifiques encourageant un surdimensionnement initial du réseau pour anticiper une demande future ?

Cadre réglementaire : Dans sa Stratégie de gestion industrielle du carbone de 2024, la Commission européenne a indiqué qu'un cadre réglementaire européen plus détaillé pour le transport de CO2 pourrait voir le jour une fois la nouvelle Commission en place (ce qui a eu lieu début décembre 2024). Entre-temps, la plupart des pays que nous avons étudiés ont initialement opté pour un régime de règlementation léger, basé sur la négociation commerciale, plutôt que pour un modèle entièrement réglementé. La France est la seule juridiction (avec le Royaume-Uni, qui ne fait pas partie de cette étude) à envisager spécifiquement une approche réglementée. En 2024, la CRE a d'ailleurs proposé qu'un modèle définitif de régulation soit arrêté au terme d'une consultation publique et intègre au minimum : i) une séparation comptable, ii) l'approbation des plans de développement du réseau par le régulateur, iii) un modèle de base d'actifs réglementé et iv) un soutien supplémentaire sous forme de garanties pour atténuer le risque asymétrique de pertes dans le cadre d'un modèle règlementée.

[5] Dans ce rapport, nous faisons une distinction entre les infrastructures de transport intra-*cluster* (locales) et les infrastructures de transport suprarégionales qui sont utilisées pour relier les *clusters* locaux ainsi que pour transporter des volumes depuis ou vers les pays voisins. Nous désignons par volumes de transit ceux qui proviennent d'un pays/territoire étranger, traversent la Wallonie et se terminent dans un autre pays. Le réseau suprarégional reliant les *clusters* locaux sera probablement utilisé à la fois pour i) le transport de volumes nationaux au-delà des *clusters* locaux et ii) les volumes de transit.

Cependant, la majorité des pays ayant opté pour un régime de règlementation léger (Danemark, Flandre et Pays-Bas) ont inscrit dans leur législation des clauses de révision, qui permettent l'introduction d'une réglementation plus étendue au cas où le cadre actuel ne conduirait pas à un développement satisfaisant.

Conception des tarifs : La plupart des pays comptent d'abord sur la négociation commerciale, si bien que les règles formelles de tarification (par exemple, la tarification par distance ou uniforme, différenciation entre flux nationaux et internationaux, modulation temporelle, etc.) restent limitées. Cependant, quelques indications informelles ressortent :

- Danemark : il n'existe pas de régulation ex ante, mais la Danish Utility Regulator (DUR) a publié des orientations sur les critères qui pourraient être utilisés en ex post si un opérateur de canalisations refuse un accès. Les lignes directrices de la DUR suggèrent une préférence pour des tarifs basés sur les coûts (probablement des tarifs basés sur les différences). Elles semblent aussi restreindre la possibilité du profilage des tarifs, car il ne sera pas possible pour l'opérateur de la canalisation de récupérer tout déficit initial au cours des années suivantes si les redevances qui ne sont pas basées sur les coûts sont interdites[6] ;
- Flandre : le rôle du régulateur dans la conception des tarifs est très limité. Les opérateurs de canalisations proposeront leurs tarifs, et le régulateur vérifiera leur conformité à certains principes généraux. Toutefois, la structure du marché flamand, qui prévoit des opérateurs distincts pour les canalisations dans différents *clusters* et pour le réseau régional concerné, rend très probable que les tarifs diffèrent selon les segments du réseau. Fluxys, qui se porte candidat pour devenir opérateur du réseau régional, a précisé publiquement en 2022 son approche probable : tarification fondée sur les coûts, sans modulation temporelle, tarifs spécifiques par *cluster* et tarifs proportionnels à la distance pour le réseau supra-régional, sous forme de capacités « ship-or-pay »[7].
- France : la CRE recommande que les tarifs puissent différer entre les différents réseaux de CO2 et même à l'intérieur de ceux-ci, mais ne précise pas encore s'ils devraient être fondés sur la capacité ou sur la distance.
- Allemagne : le pays ne dispose pas encore d'un cadre tarifaire définitif. Dans le projet de stratégie de gestion du carbone (Carbon Management Strategy, CMS) de septembre 2024, le gouvernement allemand tablait sur des tarifs négociés commercialement, fondés sur les coûts. Le CMS reconnaît toutefois la nécessité de i) réduire les tarifs pour les premiers utilisateurs, ii) diminuer les tarifs pour les émetteurs éloignés afin qu'ils puissent supporter le coût spécifique de leur raccordement, et iii) prévoir des garanties publiques pour atténuer les risques, en complément des CCfD. Le CMS de septembre 2024 ne comportait cependant pas de mesure tarifaire concrète sur ces points. L'effondrement du gouvernement en novembre 2024 a par ailleurs entravé la poursuite de ces travaux.

[6] Le profilage des tarifs exige que l'opérateur de la canalisation soit en mesure de facturer des tarifs supérieurs aux coûts au cours des années ultérieures afin de récupérer le déficit des années précédentes..

[7] Fluxys (septembre 2022) : Information Memorandum for CO2 infrastructure. Lien : https://www.fluxys.com/-/media/project/fluxys/public/corporate/fluxyscom/documents/energy-transition/co2/2021-12-14---information-memorandum-co2-main---december-21.pdf. En janvier 2025, Fluxys n'avait pas publié de méthodologie tarifaire actualisée.

Incitations à la capacité et investissement en avance sur la demande : La plupart des pays étudiés s'en remettent à une négociation commerciale des tarifs d'accès et à un soutien indirect du développement du réseau via des aides destinées aux émetteurs. Une telle approche risque de limiter le dimensionnement du réseau aux niveaux soutenus par la demande immédiate et ne fournit aucune atténuation du risque de contrepartie en cas de faillite de l'expéditeur ; ce qui peut alourdir les primes de risque liées au développement des canalisations, limiter leur dimensionnement et, en fin de compte, freiner le déploiement du CSC.

Si la CWaPE souhaite encourager la création d'une capacité de transport de CO2 au-delà de la demande immédiate, elle pourrait envisager un modèle inspiré du « réseau de base hydrogène » en Allemagne, où des tarifs inférieurs au coût sont appliqués au départ pour rendre le service abordable pour les premiers utilisateurs[8]. Dans ce schéma, des garanties d'État couvrent une partie substantielle du risque qu'un déficit tarifaire initial (dus à la faible demande au départ) ne puisse pas être récupéré ultérieurement. Adopter un modèle similaire pour le transport de CO2 permettrait de réduire le coût d'accès initial pour les nouveaux émetteurs, de soutenir un investissement en avance sur la demande et de favoriser une montée en puissance progressive du marché du CO2 capté et transporté.

[8] Bundesnetzagentur (6 juin 2024), WANDA Beschluss GBK-24-01-2#1. Lien https://www.bundesnetzagentur.de/DE/Beschlusskammern/GBK/Rahmen_Ebene1/WANDA/Wanda_Festlegung.pdf?_blob=publicationFile&v=4 et loi sur l'industrie énergétique 8Energiewirtschaftsgesetz, EnWG), article 3c.

Executive Summary

Background

Wallonia is striving to decarbonise its economy. Based on the Walloon Region's strategy, it aims to reduce its greenhouse gas emissions by 55% until 2030 and at least 95% compared to 1990 levels by 2050. Capture, transport and storage of CO2 are emerging as key elements of achieving this goal. This reflects a broader European trend: European emitters and governments increasingly explore carbon capture and storage as a key technology to reduce emissions in hard-to-abate sectors. The European Commission's 2024 "Industrial Carbon Management Strategy" focusses on the creation of a European industrial carbon management market by 2030.

As Wallonia is a landlocked region with substantial presence of hard to abate industries but no easily accessible domestic CO2 storage capacity, the development of a Walloon CO2 network will be key for the export of domestically captured CO2 and the transit of volumes e.g. from Germany. Published in the Belgian Official Journal on 12th July 2024, the decree of 28th March 2024 relating to the transport of carbon dioxide by pipeline (hereinafter: "CO2 decree") established the legal framework to enable the development of CO2 transport, distribution and recovery sectors in Wallonia. It designates the Walloon Energy Commission (CWaPE) as the regulator of the CO2 transport market by pipeline in the Walloon Region. It grants new missions to CWaPE, including the development and adoption of a tariff methodology relating to the tariffs for connection, use and ancillary services applicable to the CO2 network and the subsequent approval of tariffs.

This report was prepared by NERA to support CWaPE during the development of efficient and effective CO2 transport regulatory and support policy for Wallonia. Its comparative economic analysis of other European jurisdictions is intended to inform the development of a sound economic framework. To this end, NERA has analysed the current status of the CO2 market, direct and indirect state support mechanisms and regulatory frameworks for CO2 transport in the following EU jurisdictions leading the development of CO2 infrastructure: i.) Flanders, ii.) Denmark, iii.) France, iv.) Germany and v.) the Netherlands. Relevant regulation and support systems provided by the European Union are assessed as well. A more general, theoretical analysis of possible CO2 transport regulation and pricing models complements these case studies.

The need for market intervention

The deployment of CO2 transport networks is a complex endeavour with multiple interlocking dimensions, challenging the private sector provision of such infrastructure, namely:

- Insufficient pricing of the externality imposed by CO2 emissions. While the current EU ETS price of around 70 EUR/t is insufficient to support the development of CCS / CO2 transport on its own, academic studies in leading journals like Nature[9] estimate the social cost of carbon dioxide at

[9] Nature is one of the leading multidisciplinary science journals with a focus on natural sciences. Information on the journal's impact factor and other journal metrics can be found here: https://www.nature.com/nature-portfolio/about/journal-metrics.

185 $/t (175 EUR/t)[10], a level at which CCS with CO2 transport is much more likely to be cost effective. At the same time, most stakeholders agree that initial steps towards CCS development need to be taken today in order to trigger cost reductions and availability of the required infrastructure when ETS prices rise to make CCS a cost-effective solution in the early 2030s. [11]

- Cross-chain risks along the infrastructure value chain. The deployment of CO2 transport networks and associated infrastructure requires the concurrent development of capture, transport and storage projects. The delay of any of these chain links leads to the underutilisation of all chain links. Moreover, because of the necessary focus of the value chain on a small number of emitters, the bankruptcy of any one user of the infrastructure is likely to have a material negative impact on the system as a whole.
- First mover disadvantages. Any new infrastructure class is likely to exhibit falling costs across future vintages, which may make any one user reluctant to be the first mover and to lock themselves into the expensive early infrastructure.

The above features can lead to the need to subsidise the development of CO2 transport infrastructure and / or to provide risk mitigants. At the same time, once deployed, CO2 pipeline infrastructure exhibits monopolistic tendencies and the tariffs for its use by captured customers that have invested in CCS equipment may need to be regulated unless they have been fixed in long-term commercial contracts.

The state of the market

Our review of the plans for the development of CO2 transport infrastructure in five countries / regions in the vicinity of Wallonia (Flanders, DE, FR, NL, DK) has shown a large number of projects including cross-border interconnections in each of the territories. On the other hand, only a small number of projects have reached final investment decision including CO2TransPorts in Belgium and the Netherlands, Project Greensand in Denmark and Porthos in the Netherlands while not a single German or French project has reached that stage yet.

State support mechanisms

Financial support for the development of the CO2 transport network can come in the form of:

- Direct financial support to pipeline operators designed to reduce stranding risks for infrastructure providers and to reduce the cost of the infrastructure that has to be passed on to users; and
- Indirect financial support, i.e. support to other parts of the value chain (usually emitters) who then use part of that support to conclude commercial contracts with the providers of transport infrastructure.

[10] See Rennert, K., Errickson, F., Prest, B.C. et al. Comprehensive evidence implies a higher social cost of CO2. Nature 610, 687–692 (2022). https://doi.org/10.1038/s41586-022-05224-9. In the article, the social cost of carbon dioxide measures the monetised value of the damages to society, including due to climate impact on agriculture, mortality, energy consumption and sea-level rise.

[11] According to the EU Industrial Carbon Management Strategy, a commercially viable market will begin to take shape after 2030, where investors can earn a competitive return on invested capital based on the EU carbon price.

Direct financial support to CO2 transport infrastructure providers is provided by various EU funds (e.g. CEF and EU innovation Fund), which together have paid in excess of EUR 3bn to CCS projects in recent years. There is no large-scale use of this instrument by national governments that we have surveyed. However, the Danish subsidy schemes support the full value chain, including to CO2 transport and storage providers. Moreover, the French regulator CRE calls for targeted public investment aid schemes for CO2 transport infrastructures, in particular to ensure optimal long-term sizing right from the initial investment, i.e. initial oversizing of the infrastructure but no such instrument has been put in place yet. Similarly, the German draft carbon management strategy considers the use of state guarantees for financing CO2 infrastructure projects, but its implementation has been delayed by the recent collapse of the German government.

Indirect funding to CO2 transport is provided by several countries, usually in one of two formats:

- A "carbon CfD like" mechanism that pays emitters for the difference in cost between the saving of a tonne of CO2 using an innovative technique such as CCS and the cost of the EU ETS price. Such schemes are in place in Denmark and the Netherlands and planned in Germany and France[12]; and / or
- R&D funding for CCS technologies that are available in Denmark, Flanders, France and the Netherlands.
- In addition, Denmark employs green taxes and Germany also has a grant-funded programme that will support emitters' use of CO2 transport infrastructure once the use of CCS under the revised carbon capture and storage law has passed through parliament.

Various countries (e.g. Germany and the Netherlands) have also provided non-financial support, e.g. in the form of accelerated permitting. Reasons for the limited use of direct funding relative to indirect funding may be that:

- Direct funding to lower the cost of CO2 transport infrastructure benefits transit volumes at least as much as domestic volumes (while the cost only falls on domestic taxpayers)[13]; and
- The use of indirect funding mechanisms like carbon CfDs that provides funding to emitters, makes it easier to match the provision of CO2 transport infrastructure to known demand (as generated by those who have won carbon CfDs).

Economic regulation of CO2 transport tariffs

In defining a regulatory and tariff methodology, a regulator has to make choices along the following dimensions:

- Whether to engage in cost-based regulation or whether to allow for commercially negotiated tariffs with limited oversight. Hybrid models that only intervene when certain tariff or IRR thresholds are breached are also possible;

12 Flanders also has a carbon CfD pilot programme but the programme is not currently open to CCUS projects.

13 Throughout this report, we distinguish between **within-cluster (local)** transport infrastructure and **supraregional** transport infrastructure that is used to connect local clusters as well as to transport volumes from or to neighbouring countries. We refer to **transit** volumes as those that originate in one foreign country / territory, cross Wallonia and terminate in another country. The supraregional grid connecting local clusters will likely be used for both i) the transportation of domestic volumes beyond local clusters and ii) transit volumes.

- How to design tariffs, including
  - Whether to apply route / cluster-specific tariffs or whether to apply uniform tariffs across a region / country;
  - How to deal with cross-border and transit flows and whether to apply specific discounts for these;
  - Whether to allow for temporal profiling of tariffs in order to keep initial tariffs acceptable to early network users and what kind of mechanisms to deploy to ensure the later recovery of initially delayed revenues; and
- Whether to provide specific incentives to develop capacity ahead of demand.

Regulatory model: In its 2024 ICMS, the European Commission announced the likely development of a more detailed European level regulatory package for CO2 transport once the new Commission is seated (which took place in early December). In the interim, most of the countries that we have reviewed have initially opted for a light-touch commercially negotiated model rather than a fully regulated one with France being the only country (in addition to the UK, which is not part of this study) that is currently looking to follow a regulated route. In 2024, the French regulator CRE has proposed that the final regulatory model should be decided following public consultation with minimum standards of i) accounting separation, ii) approval of grid development plans by the regulator, iii) a regulated asset base model and iv) additional support in the form of guarantees to mitigate asymmetric downside risk in a regulated model.

However, nearly all countries that have opted for a light-touch regime (Denmark, Flanders and the Netherlands) have review clauses in their legislation that allow for the introduction of more extensive regulation in case the current framework does not lead to satisfactory development.

Tariff design: With most countries relying on a commercial negotiation model, there is only limited formal guidance on tariffication (e.g. route vs. uniform tariffs, differentiation between domestic and cross-border flows and temporal profiling) although most countries provide some informal pointers e.g.

- While Denmark does not currently engage in ex ante regulation, the Danish Utility Regulator does provide some guidance on the criteria it may use in ex post reviews, should a pipeline operator deny access. Guidance by the DUR suggests a preference for cost-based, i.e. likely difference-based tariffs. DUR guidance also seems to limit the ability to profile tariffs as it will not be possible for the pipeline operator to recover any initial shortfall in later years if charges that are not cost-based are prohibited.[14]
- Flanders foresees a very limited role in tariff design for the regulator, with pipeline operators proposing their tariffs and the regulator merely reviewing compliance with certain high-level principles. However, the structure of the Flemish market that envisages separate operators for pipelines in different clusters and for the relevant regional network makes it very likely that tariffs will differ across network segments. Fluxys, a candidate to become the regional network operator, has also provided some additional insight into its likely approach to tariffication in a public 2022

[14] Profiling tariffs requires the pipeline operator to be able to charge above-cost tariffs in later years to recover the shortfall in the earlier years.

document, namely the use of cost-reflective tariffs without temporal profiling, cluster-specific tariffs and distance-based tariffs on the supraregional network; all charged as "ship-or-pay" capacity tariffs.[15]

- In France, the regulator (CRE) recommends that tariffs can be set differently between and within the different CO2 networks but the CRE reports available to date do not go into further detail regarding whether capacity or distance-based tariffs should be used.
- Germany does not yet have a formalised tariff framework. The September 2024 draft carbon management strategy (CMS) indicates that the German government was primarily expecting CO2 transport infrastructure to be developed based on commercial negotiation resulting in cost-based tariffs. At the same time, the CMS recognised the potential need for i) reducing tariffs for initial users, ii) reducing tariffs for emitters in remote locations that would not be able to bear the specific network cost of connecting them and iii) risk-mitigating mechanisms, e.g. state guarantees to complement indirect funding through carbon CfDs. The September 2024 CMS did not yet contain any specific tariff measures to address any of the challenges identified and the government collapse in early November stalled the momentum for further development.

Capacity incentives / investment ahead of demand: Most countries in the sample opt for commercial negotiation of access tariffs and indirect support of network development through funding made available to emitters. This setup is likely to limit the dimensioning of the network to levels backed by demand at the time and does not provide any risk mitigation against counterparty risk in case of shipper bankruptcy; thus potentially increasing the risk premiums associated with pipeline development and limiting the sizing of the pipelines, which in turn hinders the development of CCS.

If CWaPE wants to provide incentives for the development of CO2 transport capacity ahead of immediate demand, it may need to develop a model that follows the Germany hydrogen core grid where below-cost tariffs are used in the early years to ensure that tariffs remain affordable for early adopters.[16] At the same time, the state guarantees (the majority of) the risk of any shortfall in the future if the tariff deficit incurred in the early low demand years cannot later be recovered. Adopting a similar model for CO2 transport can reduce the initial cost of joining the system for new emitters and thus provide a pathway to investing ahead of demand and growing demand gradually.

[15] Fluxys (September 2022): Information Memorandum for CO2 Infrastructure. Link: https://www.fluxys.com/-/media/project/fluxys/public/corporate/fluxyscom/documents/energy-transition/co2/2021-12-14---information-memorandum-co2-main---december-21.pdf. As of January 2025 Fluxys has not published an updated tariff methodology.

[16] Bundesnetzagentur (06 June 2024), WANDA Beschluss GBK-24-01-2#1. Link https://www.bundesnetzagentur.de/DE/Beschlusskammern/GBK/Rahmen_Ebene1/WANDA/Wanda_Festlegung.pdf?_blob=publicationFile&v=4 and Energy Industry Act 8Energiewirtschaftsgesetz, EnWG), section 3c.

1. Introduction

Wallonia is striving to decarbonise its economy. Based on the Walloon Region's strategy, it aims to reduce its greenhouse gas emissions by 55% until 2030 and at least 95% compared to 1990 levels by 2050. Capture, transport and storage of CO2 are emerging as key elements of achieving this goal. This reflects a broader European trend: European emitters and governments increasingly explore carbon capture and storage as a key technology to reduce emissions in hard-to-abate sectors. The European Commission's 2024 "Industrial Carbon Management Strategy" focusses on the creation of a European industrial carbon management market by 2030.

The establishment of an integrated European carbon market requires the developments of CO2 transport infrastructure; both within and across countries. Individual European jurisdictions vary in terms of their role in a future European CO2 network and the status quo of the regulatory framework for these new grids. Thus, key challenges for the successful development of a European CO2 network lie in the interdependence of projects along the value chain developed across jurisdictions and the need for temporal coordination.

As Wallonia is a landlocked region with substantial presence of hard to abate industries but no easily accessible domestic CO2 storage capacity, the development of a Walloon CO2 network will be key for the export of domestically captured CO2 and the transit of volumes e.g. from Germany. Published in the Belgian Official Journal on 12th July 2024, the decree of 28th March 2024 relating to the transport of carbon dioxide by pipeline (hereinafter: "CO2 decree") established the legal framework to enable the development of CO2 transport, distribution and recovery sectors in Wallonia. It designates the Walloon Energy Commission (CWaPE) as the regulator of the CO2 transport market by pipeline in the Walloon Region. It grants new missions to CWaPE, including the development and adoption of a tariff methodology relating to the tariffs for connection, use and ancillary services applicable to the CO2 network and the subsequent approval of tariffs.[17]

CWaPE wishes to define a regulatory and pricing framework that supports the development of a CO2 transport network in the Walloon Region and more broadly in Belgium while ensuring the competitiveness of Walloon industry. In addition, CWaPE wants to give adequate consideration to transit flows.

This report was prepared by NERA to support CWaPE during the development of efficient and effective CO2 transport regulatory and support policy for Wallonia. Its comparative economic analysis of other European jurisdictions is intended to inform the development of a sound economic framework. To this end, NERA has analysed the current status of the CO2 market, direct and indirect state support mechanisms and regulatory frameworks for CO2 transport in the following EU jurisdictions leading the development of CO2 infrastructure: i.) Flanders, ii.) Denmark, iii.) France, iv.) Germany and v.) the Netherlands. Relevant regulation and support systems provided by the European Union are assessed as well. A more general, theoretical analysis of possible CO2 transport regulation and pricing models complements these case studies.

[17] Thus, the competencies of CWaPE surpass those of Flemish regulator VNR. In Flanders, the (designated) CO_2 transport operator will develop the tariff methodology with VNR's competencies restrained to the approval of the tariffs.

The remainder of the report is structured in the following way:

- Chapter 2 provides an overview of key **economic theory** considerations regarding **design options** for CO2 pipeline infrastructure regulation. We outline the general aims of regulatory and support schemes, especially for new grid infrastructure, identifying the key challenges CO2 regulation needs to address. Taking the policy guidelines and specific rules guiding CWaPE's efforts into account, we outline the various design dimensions of regulatory, tariff and support frameworks:
  - The CCS value chain and the perimeter of intervention;
  - Targets and support schemes along the CCS value chain;
  - Regulatory models to address natural monopoly concerns in the T&S segments;
  - Tariff design and efficient signals for infrastructure investment; and
  - Incentives for infrastructure capacity development and overcome cross-chain risks.
- In Chapter 3, we outline the status quo of **carbon capture policy,** the **carbon markets** and key projects in each jurisdiction under consideration. We also outline the role each jurisdiction will likely play in a future European CO2 network. This section provides background information for the analysis of subsidy and regulatory regimes provided for each region or country in subsequent chapters.
- Chapter 4 analyses available EU-level and national/ regional **subsidy systems** affecting the development of CO2 networks. We provide an overview of key direct subsidy systems providing government support to CO2 infrastructure projects and indirect systems providing government support to other parts of the value chain, in particular to emitters, the future end-users of pipeline infrastructure. The analysis shows the broad range of different design options for subsidies with carbon CfDs emerging as an important indirect subsidy option while investment grants, sometimes combined with volume risk mitigants are common designs for direct subsidies.
- Chapter 5 reviews the **regulatory systems** in the selected jurisdictions to the extent they have already been spelt out. We consider key aspects, such as the form of access regulation or the lack thereof, emerging tariffication approaches and known capacity incentives. Taken together, this information provides insights into the business models and risk-return profiles for CO2 pipelines. Various countries and regions such as Denmark, Flanders, Germany and the Netherlands look set to rely on light-touch regulation and market-based approaches for the initial stage of CO2 network development. France is currently developing more full-scale economic regulation of access charges. Multiple jurisdictions including Denmark, Flanders and the Netherlands also provide options for regulators or governments to review market progress and to react to unsatisfactory developments with the introduction of a more formalised tariff methodology.
- Chapter 6 provides the conclusion and key take-aways.

2. Economic theory and regulatory options

This section provides a theoretical analysis of possible CO2 transport regulation, pricing and support models. It elaborates on the selection of the criteria and policy dimensions guiding our case study analysis that follows in the subsequent chapters.

2.1. General aims of regulatory and support schemes

The cost-effective deployment of a CO2 value chain at the scale required to meet the European and national decarbonisation objectives (see section 3.2) requires a well-designed policy and regulatory framework. This is because there are several market failures and barriers (see below). These market failures affect the business case for CCS and can lead to sub-optimal levels of private investments in CCS infrastructure. The market failures differ across the CO2 value chain, but can be broadly classified into the following categories:

- **The primary market failure in the CO2 capture segment is the CO2 emission externality**: A key reason impeding the development of CCS at scale by the private sector is that the expected returns from capturing CO2 are smaller than the cost of abating CO2 through CCS. Currently, emitters' returns are tied to the avoided cost of purchasing ETS rights at the prevailing market price. As of today, the market value of CO2 rights in Europe is insufficient to cover the cost of carbon reduction via CCS. However, academic studies in leading journals like Nature estimate the social cost of carbon at 185 $/t (175 EUR/t)[18], a level at which CCS with CO2 transport is much more likely to be cost effective. Moreover, most stakeholders agree that initial steps towards CCS development need to be taken today in order to trigger cost reductions and availability of the required infrastructure when ETS prices rise to make CCS a cost-effective solution in the early 2030s. [19] As we discuss in section 2.3.2 below, various policy instruments can be used to overcome this failure, including for example carbon contracts for difference.
- **Significant coordination requirements across different parties, each specialising in one segment of the value chain create cross-chain risks**: Another reason potentially preventing a market-based development of CCS is that CCS projects require substantial coordination efforts across the entire value chain. CCS projects are typically developed by multiple parties, each specialising in different parts of the value chain (e.g., capture developer, transport operator, storage operator). These parties therefore need to coordinate significantly from project development to execution and operation and depend on each other with respect to all project-related decisions including timing of investments, location, volumes and technical specifications. This coordination requirement and interdependency of all parties across the value chain translates into cross-chain risks, namely:
  - **Risk of not having access to the required infrastructure**, often referred to as the "chicken and egg problem", which arises because of the long lead times of CCS projects and decisions to develop different parts of the value chain often being taken before there is certainty

[18] See Rennert, K., Errickson, F., Prest, B.C. et al. Comprehensive evidence implies a higher social cost of CO2. Nature 610, 687–692 (2022). https://doi.org/10.1038/s41586-022-05224-9

[19] According to the EU Industrial Carbon Management Strategy (ICMS), a commercially viable market will begin to take shape after 2030, where investors can earn a competitive return on invested capital based on the EU carbon price. Thus, the ICMS expects the ETS price to increase sufficiently for a commercial market to emerge.

around access to the required infrastructure (for the capture plant) or that infrastructure will be sufficiently utilised (e.g., because pipelines and storage are developed ahead of capture).

  - **Counterparty risk and risk of low utilisation of the transport and storage infrastructure** arising from the dependence of the infrastructure on a small number of customers. Having to rely on a small number of customers is likely to make private operators of that infrastructure demand long-term contracts and high credit rating from their counterparts to avoid a situation where part of the pipeline falls empty. In the same vein, pipeline and storage facilities are unlikely to build much, if any spare capacity into their infrastructure as they will seek to refinance the full cost of the infrastructure from their long-term contracts with such anchor clients likely unwilling to finance spare capacity that might be made available to their competitors at lower prices later. Hence, privately financed pipeline projects will likely be built to current demand, even where the creation of some spare capacity may be more economical than expansion at later stages, should demand turn out to be higher than anticipated. Where an anchor client fails nonetheless, this cross-chain risk therefore creates a long-term volume risk for the transport and storage operators and may require regulatory intervention as we further discuss in section 2.3.5 below.
  - **Risk of stranded assets** due to the interdependencies between parties specialising in different parts of the value chain means that if one part of the CCS chain fails or becomes permanently unavailable (or its construction delayed or interrupted) it causes another part of the value chain to lose revenue or incur additional costs as a result.

- **First mover disadvantages** from expected cost savings and / or uncertainty about the availability of the transport infrastructure can discourage the early adoption of CCS technology and thus stall demand for CO2 transport. This situation may create a need to provide risk mitigation mechanisms that protect early adopters from a cost disadvantage associated with having invested into earlier, more expensive vintages of the CCS value chain in order to make such early investments that create cost reductions for future investments economically viable.
- **The CO2 transport and storage infrastructure segments are generally considered natural monopolies due to high fixed costs**: Typically, the cost structure of the CO2 transport and storage (T&S) segment is characterised by high fixed costs, which makes it inefficient to have more than one provider of such infrastructure. Therefore, T&S providers are typically considered natural monopolists once possible clients have invested into CO2 capture equipment. Hence, in the absence of material competitive pressure, the T&S provider will have an incentive to set inefficiently high prices to the detriment of users, which may ultimately result in a sub-optimal deployment of CCS infrastructure. In such circumstances, regulatory intervention is required to address the monopoly power of the T&S providers (see Section 2.3.3). However, the monopoly nature of carbon transport and storage providers is not uniformly evident across all aspects, as factors such as alternative abatement methods and the availability of different transport modes (e.g. via ship and pipe) can exert a degree of competitive pressure. This primarily applies to supraregional networks. In contrast, the local network connecting emitters to the supraregional grid is more likely to hold a monopoly position, once in place. Also, new entities within the value chain, e.g. DACCS[20] and BECCS[21] providers are comparatively free in their choice of location and

[20] Direct Air Carbon Capture and Storage

[21] Bioenergy with Carbon Capture and Storage

thus the T&S infrastructure that they connect to; providing another competitive element between T&S providers. As we discuss in Section 2.2 below, it follows that different projects (or clusters of projects) may warrant different degrees of regulatory intervention depending on the structure of the market and competitive pressure in the market.

Resolving these market failures requires a comprehensive policy and regulatory intervention package that is tailored to address the specific failures and barriers to investment in CCS. The regulatory and policy framework should set conditions for aligning private and public investment incentives and enabling markets to work more efficiently so that CCS is deployed at the scale required to meet the decarbonisation objectives at least cost.

As we describe more in detail in the next section, there is a wide range of regulatory and policy measures that can be taken to address each of these market failures. In practice, well-designed regulatory and policy frameworks strive to achieve the best balance amongst the following principles of good regulation:[22]

- *Efficiency* – The policy and regulatory intervention should maximise economic efficiency by addressing specific market failures and minimise distortions in well-functioning markets.
- *Effectiveness* – The regulatory and policy measures should effectively address the identified market failure or barrier to investment.
- *Proportionality and timeliness* – The policy interventions should be proportionate and cost-effective, whilst decision making should be timely to address the sectors' needs.
- *Transparency and clarity*– The policy intervention should be transparent and easy to understand for all stakeholders in the sector.

These principles can therefore guide regulators in the assessment of the pros and cons of different regulatory and policy design options with the purpose of identifying those options that strike the best balance amongst all principles. That said, these principles are general principles and policy makers but especially each regulator, including the CWaPE, will need to put these into the local context and assess each policy option against the specific policy and regulatory objectives it aims to achieve. We describe CWaPE's policy objectives and specific guidelines in the next section.

2.2. Policy guidelines and specifics guiding CWaPE

Published in the Belgian Official Journal on 12th July 2024, the decree of 27th March 2024 relating to the transport of carbon dioxide by pipeline (hereinafter: "CO2 Decree") established the legal framework for the development of the CO2 transport, distribution and recovery sectors in Wallonia.

This CO2 decree designates the Walloon Energy Commission (CWaPE) as the regulator of the CO2 transport market by pipeline in the Walloon Region. It grants new missions to the Walloon Energy Commission, including that of adopting a tariff methodology relating to the tariffs for connection, use of and ancillary services applicable to the CO2 network and to the local CO2 branch. The decree also tasks CWaPE with approving tariff applications that are consistent with the methodology.

[22] These principles (or variants thereof) are typically adopted by regulators across Europe.

Based on information provided to us by CWaPE, in the developing the tariff methodology, it must account for the principles and guidelines provided in the CO2 Decree, namely:

- Tariffs should be transparent, non-discriminatory and fair to users;
- Tariffs should include the cost of connection to the network, usage of the network and ancillary services;
- Tariffs should provide a fair balance between the quality of the services provided and the cost to users;
- Tariffs should allow for a fair profit margin;[23] and
- Depreciation periods are to reflect the expected economic lifetime of the assets.[24]

In practice, we understand that CWaPE's key objective is to define a tariff methodology that allows for the provision of a competitive solution for the Walloon region which does not hinder the development of the industry in the region whilst addressing the market failures identified in the previous section. In doing so, CWaPE will need to consider:

- The structure of the Walloon industry, including location and distribution of emitters in the area and the possible impact of distance to exit points from the Belgian CO2 (various ports and interconnection points with neighbouring networks).
- The broader structure and organisation of the Belgian CCS market as well as regional and cross-border dependencies that shape the role of Wallonia within the Belgian and European CO2 network, as well as the potential impact of tariff design choices on transit routes through Wallonia (and Belgium).[25]
- The interplay between the tariff methodology for transport in Wallonia and the wider regulatory and policy framework for supporting the development of the CCS value chain in Wallonia, including subsidies and support schemes that address market failures in other segments of the value chain and complement the tariff framework for transport.
- The interplay between the Walloon tariff methodology and that being developed in Flanders, to ensure the best possible harmonisation of approaches in Flanders and the Walloon region, whilst prioritising the competitiveness of the Walloon region. This includes also taking into account differences in the timing and process for the development of the tariff methodology across the two regions. In Flanders, VNR (formerly VREG) will review any tariff proposal submitted by the grid operator but will not develop its own methodology. In contrast, CWaPE will develop the regulatory framework and the tariff methodology independent of a grid operator. Thus, CWaPE

23 We note that this is a common concept also applicable to other energy networks in Belgium although differences in risk may may imply differences in what constitutes a fair margin.

24 It is NERA's understanding that this does not rule out a non-uniform depreciation profile as long as the technical lifetime constraint is considered.

25 Transit flows tend to display a higher price sensitivity because they are not geographically bound to a certain region in the way that flows tied to stationary emissions sources are. E.g. flows from the German North Rhine Westphalia area could in principle flow through the Netherlands, Denmark or Belgium depending on the cost of the different routes available. Hence, Walloon policy makers will need to balance the desire to finance a material share of the transport infrastructure from transit fees against the risk of potential sources of transit volumes opting for a different route and thus being lost entirely to the Walloon network, which would raise the unit cost of the network to the remaining (domestic) users.

will develop a "neutral" system which is not tailored to the preferences of a specific company or market organisation.

- The long-term uncertainty of CCS demand in Wallonia, Belgium and Europe and the tariff impact for early users of the CO2 networks.

CWaPE may also have to adjust its approach since CO2 transport is not yet fully subject to independent regulation but instead has to take into account potentially evolving political guidance in the field of CO2 transport market development.

2.3. Identification of policy design dimensions of the regulatory, tariff and support framework

In this section we outline the dimensions along which regulatory and support policy can differ and the spectrum of regulatory and policy options available to regulators and policy makers to address the abovementioned failures and barriers in the CO2 transport and storage segments.

2.3.1. The CCS value chain and defining the perimeter of intervention

To understand the extent to which the market failures and barriers to investment identified in section 2.1 above affect the CCS sector in each country, regulators and policy makers should start by mapping the existing (or potential) CO2 value chain within their country. This includes for instance: assessing the number, geographical spread and distribution of hard and impossible to abate sources of emissions; the geological availability of onshore and offshore storage (if any), as well as the potential for export of CO2 from CCS; the position and role of a country within a future cross-border CO2 infrastructure network; as well as the political support around CCS, including any restrictions on the use of CCS across sectors as set out by national strategies and policies. Also, policy makers and regulators, should assess the number and type (public vs. private) of players involved (or potentially involved) in the CCS value chain. This is particularly relevant to assessing the extent to which there is scope for competition along some segments of the value chain and if regulatory intervention is needed to align public and private investment incentives.

Having a detailed understanding of the existing and future organisation and market for CCS within the country, and its position relative to the wider European CCS market, is key to defining the perimeter of regulatory and policy intervention. For example, as we describe in section 3.1 below, Belgium and the Wallonia region will be a net exporter of CO2 to neighbouring EU countries and the Wallonia region may also be a transit region for CO2 from other EU countries / regions. It is therefore key for CWaPE to also consider how the tariff and support framework affects cross-border transit as well as emissions sources in different parts of the region.

2.3.2. Targets and availability of support schemes along the CCS value chain

One initial step for the development of the CCS value chain is setting national and regional CCS targets to signal the governments' commitment for CCS as a decarbonisation technology. For instance, at the EU level, the NZIA mandates a geological carbon storage capacity of 50 mtpa by

2030, 280 mtpa by 2040, and 450 mtpa by 2050[26] (see section 3.2). Belgium does not yet have national or regional CCS targets although the respective regional strategies in Flanders and Wallonia both recognise the importance of CCS in principle. Well-defined or legally binding targets associated to CO2 reduction and CCS development provide reassurance and certainty to investors that the CO2 infrastructure and framework for its development will be available.

Alongside defining clear national and regional targets for CCS development, policy makers and regulators should establish regulatory frameworks that encourage investments in low-carbon technologies such as CO2 pipelines and overcome the barriers described in section 2.1 above. Carbon pricing is the primary policy instrument to address the CO2 emission externality. In Europe, the ETS provides a market-based instrument although other tools could be used (e.g. a tax on carbon). However, as noted, as of today the price of CO2 in the ETS is not sufficient to cover for the cost of CO2 reduction through CCS technologies while most stakeholders agree that initial steps towards CCS development need to be taken today in order to trigger cost reductions and availability of the required infrastructure when ETS prices rise to make CCS a cost-effective solution. As such, in the initial phases of the CCS value chain development, policy makers may need to complement the ETS with other support schemes to make the business case for CCS commercially viable for private investors. These support schemes could take different forms, including for example carbon contracts for difference to integrate the revenues / cost savings emitters obtain from the ETS with government subsidies (this scheme exists in the Netherlands and is planned for CCS in Germany and France, as described in section 4 below).

The recipients of the above subsidies and support are typically the emitters and carbon capture developers with the objective of these schemes to addressing the revenue shortfall caused by the CO2 emission externality. The idea is that emitters will use part of the subsidy to cover the cost of the transportation infrastructure. However, policy makers should also assess the need for subsidies and support schemes tailored to the T&S segments to overcome the cross-chain risks and the uncertainty during the initial development stages of T&S projects. This can include for example:

- **Direct financial support** in the form of grants and loans that contribute towards the project development costs reducing financing costs for investors and thus tariffs for users of the CO2 transport infrastructure. Examples include funding available at the European level under CEF programme or national R&D funding provided by governments to support the development of new low carbon technologies (e.g., Netherlands).
- **Indirect financial support schemes** in the form of allowing the cost of T&S to be covered through the subsidy schemes available to emitters. The availability of subsidies to emitters can help with the negotiation and agreement of T&S charges between emitters and T&S operators by allowing emitters to pay cost-reflective tariffs for the infrastructure. The latter approach has been adopted in the Netherlands and Denmark for example (see section 4).
- **Non-financial support** in the form of accelerated or simplified permitting requirements, which help reduce the long lead times and uncertainty around timing associated with CCS projects and

[26] European Commission (2024): Net Zero Industry Act. Link: https://eur-lex.europa.eu/legal-content/EN/TXT/PDF/?uri=OJ:L_202401735. For comparison, a Working Group Paper of European stakeholders estimates that in order to reach its climate targets, annual EU storage capacities of 80 mtpa by 2030, 300 mtpa by 2040, and 450 mtpa by 2050 are required. Link: https://cdn.catf.us/wp-content/uploads/2023/05/31163741/ccus-europe-vision-report.pdf.

can help overcome cross-chain risks. In the Netherlands, for example, the government granted the largest CCS project in the country (Aramis) strategic status to accelerate its development by providing for accelerated permitting (see section 3.7) while the draft carbon storage and transport law in Germany also foresees material simplification of the permitting process (see section 5.5).

2.3.3. Regulatory models to address the natural monopoly concerns associated to the transport & storage segments of the CCS value chain

As noted in section 2.1 above, due to concerns that transport infrastructure may constitute a natural monopoly, regulators may define network access conditions and limit the level of tariffs CO2 transport operators can charge to ensure third-party access to the infrastructure. At the European level, the Directive on the geological storage of CO2 (2009/31/EC), referred to as the "CCS Directive", aims to establish a legal framework for environmentally safe geological storage. The CCS Directive covers a wide range of topics associated to the CCS value chain including a requirement in Article 21 to provide third-party access to the CO2 transport and storage infrastructure. Whilst the requirement sets the foundations for ensuring that competing parties can have "fair and open access" to CO2 transport and storage infrastructure, the Directive does not provide detailed guidance on how those principles should be implemented or enforced in practice by regulators nationally. In its Industrial Carbon Management Strategy, the European Commission has announced the need to work on a more detailed regulatory package for CO2 transport after the EU elections this year but no emerging themes on the content of such a package have become public yet.

In practice, to address natural monopoly concerns around access and tariffs, regulatory models can span from fully regulated, regulatory asset base (RAB) approaches (typically used in the gas and electricity network sectors) to light-touch regimes where tariffs remain subject of commercial negotiations entirely or until they breach a cap (often used in sectors where there might be some competitive pressure, e.g. electricity interconnectors, fibre networks). This continuum of regulatory models shows that there is no one-size fits all approach and – as our case studies below show – different member states in Europe have taken different approaches to limiting CO2 transport and storage tariffs and defining access rules.

The exact choice of approach will depend on the structure and organisation of the T&S market, especially the extent to which infrastructure providers are constrained by competitive pressures[27], and the ability of different regulatory approaches to meet the regulator's objectives. In general:

- **Full cost-based regulation of tariffs and access terms**, using a regulatory asset base (RAB) based approach, is adopted where there is no competitive pressure in the provision of infrastructure and regulation is required to address the natural monopoly concerns around pricing and access conditions. This approach is commonly used in the gas and electricity network sectors and ensures a high level of protection for the users of the infrastructure, results in an

[27] Competitive pressure may emerge initially between different transportation modes (pipeline, truck and ship) as well as between different pipeline routes. However, once built or refurbished, pipelines for CO_2 become the cheapest mode of transportation so competition becomes limited to different pipeline routes, if available.

overall de-risking of the project by providing regulatory certainty of cost recovery[28] but is more burdensome to implement for regulator and market players. Also, it may stifle innovation or competition from alternative infrastructure routes to emerge (e.g., transport of CO2 via ship) if the protections provided by the RAB regulation allow pipelines to operate under a materially lower cost of capital than alternative modes of CO2 transport that face commercial risk. The RAB + government downside protection approach is used for CO2 transport and storage in the United Kingdom, where the government has defined a RAB-based regulatory framework as well as for hydrogen transport in Germany[29]. It is also foreseen for CO2 transport in France (see section 5.4). Such an approach can be considered particularly conducive to stimulating demand for CO2 transport because prices are kept relatively low while the supply of CO2 transport services depends on whether the allowed returns are consistent with the risk that remains with the infrastructure operator. In some cases, the cost-reflective tariff in the initial phases of infrastructure development can be commercial unviable for early users. While RAB-based tariffs generally fall below commercial tariffs, they may still be "too high" in early grid development stages when the number of initial grid users is limited whereas costs are largely independent of usage. In such cases, public subsidies for emitters or infrastructure providers (see section 4) or deferred tariffs (see section 2.3.4) can be used to create a more palatable tariff trajectory for users while ensuring a reasonable prospect of infrastructure cost recovery and thus investment.

- **Commercial long-term contracts between emitters and T&S providers subject to standard competition law** sit at the other end of the spectrum and leave market parties free to negotiate and agree T&S terms and conditions. This approach may be adopted in the initial stages of the market development, to allow the regulator time to assess whether more intervention is needed and where it is believed that there is sufficient competitive pressure on the infrastructure provider to not apply monopoly prices or unfair conditions to third parties. This approach assumes that there is no or very limited monopoly power by the infrastructure provider, sufficient competitive pressure in the market, and that ex post enforcement under competition law is sufficient to discourage or correct anticompetitive behaviour by infrastructure operators. One reason why there may not be any monopoly power for the operators of yet-to-be-built infrastructure is that emitters can often choose emissions savings over CCS and CO2 transport if the pricing of the CO2 transport infrastructure is prohibitive.

  This approach is also used in cases where infrastructure is used for the sole purpose of self-use / self-consumption with no possibility of third-party access (e.g., a pipeline connecting an oil field and a refinery belonging to the same entity). In that case, incentives between parties are aligned and there is no risk of abuse of monopoly power. As such, we have seen this approach being historically used in the unregulated oil and gas infrastructure sections (offshore and onshore pipelines connecting production / storage fields and the processing facilities). This approach has the advantage of being simple to implement from a regulators' perspective, and

[28] Cost recovery is ensured where there are either captured customers, e.g. in electricity networks or where the government provides a commitment to ensure cost recovery in case demand does not materialise, e.g. the German H2 „core grid" where the German government concluded a long-term contract with future H2 network operators guaranteeing that it will cover ~75% of any shortfall relative to the regulated tariff.

[29] See the European Commission state aid decision for a description of the German hydrogen core grid and the protections that it provides. European Commission (2024): State Aid SA.113565 (2024/N) – Germany. Aid for the construction of the Hydrogen Core Network in Germany. Link: https://ec.europa.eu/competition/state_aid/cases1/202438/SA_113565_72.pdf

applying such an approach would likely allow the CCS infrastructure provider to capture the full value of the CCS infrastructure. It can therefore be an effective way of ensuring the supply of CO2 transport infrastructure (because of the expected higher profitability of the infrastructure, while potentially creating problems for CO2 transport demand because tariffs tend to be higher than under a regulated scenario).

- **Hybrid approaches such as price caps or rate of return corridors** sit in between the previous two approaches and are typically used by regulators as a solution that balances the need to intervene in the market to address monopoly power concerns with minimising market distortions through strict economic regulation as well as minimising the administrative costs for all stakeholders. Examples of such approaches include the "next best alternative approach" which seeks to mimic the cost that a user would face when using the next cheapest alternative and has been used by a number of regulators in the district heat sector (e.g. Netherlands and Italy). Another example is the cap-and-floor scheme used for electricity interconnectors between UK and various neighbouring countries[30] and for fibre networks for instance in the Netherlands[31] where the regulator will intervene to limit tariffs (or returns) only if the returns achieved by the infrastructure operator move outside a pre-defined internal rate of return corridor. The challenges associated with these approaches is that may leave room for windfall gains (or losses) if the cap or returns are set too generously (or narrowly) and may still expose infrastructure providers to substantial volume risk, which in turn may limit willingness to invest if there is no concurrent prospect of risk-adjusted returns.

As local conditions regarding the availability of possibly competing infrastructure, carbon transport options and interconnectedness of the network will differ, the appropriate form of regulation may differ from one country to the other, as our case studies below show.

2.3.4. Tariff design choices and their implications

In addition to decisions regarding the depth of intervention with regard to overall tariff levels, regulators may also intervene in tariff design and structure for CO2 transport infrastructure or leave these choices to infrastructure operators. Key questions of tariff design involve:

Route-specific vs. country/ region-wide tariffs

Under the "Entry-Exit" regime, which is standard for natural gas networks, tariffs have been decoupled from the distance over which commodities are shipped, with uniform "postage-stamp" tariff models applied instead. National and regional regulators, as well as European policymakers, need to consider whether the application of a route-specific tariff model might be preferable for CO2 networks.

It is likely that CO2 networks will initially emerge in the form of distinct geographical clusters, potentially even run by different operators. These clusters will predominantly align with the current

30 E.g. Ofgem (2022) Cap and Floor Financial Model (CFFM1H) Actual Cost of Debt (ACOD), Link: https://www.ofgem.gov.uk/sites/default/files/2022-08/CFFMH1%20ACOD%20Greenlink.pdf.

31 Netherlands Authority for Consumers and Market (2008), Policy rules: Tariff regulation for unbundled fibre access (2008), Link: https://www.acm.nl/sites/default/files/old_publication/publicaties/9713_202874%20Policy%20rules%20tariff%20regulation%20fibre.pdf and Authority for Consumers and Market (2009) Tariefbesluit: Ontbundelde glastoegang (FttH), Link: https://www.acm.nl/nl/publicaties/publicatie/9834/Tariefbesluit-ontbundelde-glastoegang-FttH.

production localities of industries that are challenging to decarbonise, such as steel, cement, and petrochemicals. Evidence from European regulatory agency ACER suggests that pipeline kilometres are the main cost driver for CO2 networks with pipeline diameter playing a more limited role.[32]

By directly tying the cost of usage to the cost of the local CO2 network, regulation can provide incentives for co-ordination amongst users within a cluster to maximise utilisation and limit tariff volatility that could otherwise arise from the application of a country-wide tariff system during the build-up phase: Consider a situation where a country has started the development in the lowest cost cluster and then adds a second cluster hat has significantly higher cost per unit. Under a country-wide tariff such a development would lead to a sudden jump in the tariffs paid by users in the initial cluster; potentially rendering some of the initial applications in the first cluster unviable. Knowing about the risk of such a development could in turn render potential users in the early cluster reluctant to connect in the first place. Hence, it may be necessary to develop other solutions including e.g. separate support schemes for potential remote users of the Carbon network (like biomethane-CCS and remote industrial sites) to cover the cost of connection to the network where a cost-benefit analysis suggests wider benefits of a connection that would be lost if these sites were required to pay for their connection at the high cost of a route-specific tariff.

At the same time, transit volumes are likely to use the longest section of the network; from one border of the country to another while domestic users will normally only use part of the network. Hence, the use of a uniform tariff for any inter-regional network is likely to lead to a cross-subsidy from domestic users to transit volumes. Economically, such a cross-subsidy may be locally efficient if certain potential transit volumes could otherwise choose to eschew a country entirely and thus refrain from contributing to the cost of the country's CO2 network at all.

The extent to which this is relevant in each country depends on the number of individual clusters that are expected to emerge within the country, the potential transit flows as well as the number of potential operators of CO2 transport infrastructure. With Wallonia serving as a transit country for CO2 according to some studies but not others[33], Wallonia's ability to attract transit flows through tariff design will be a key challenge for CWaPE's tariff setting. At the same time, the relatively small size of Wallonia and the plans for interconnection of the different clusters by Fluxys (see Figure 3.) are likely to make the issue of cross-cluster variation in costs less acute for Wallonia relative to locations with geographically more spread-out clusters, such as Germany and the UK.

Finally, Fluxys' proposal to use distance-based tariffs in Flanders (see section 5.3) is likely to put most of the Walloon industry looking to use Flemish pipelines and ports at a disadvantage relative to Flemish industry. Independent of its design, the Walloon tariff methodology will not be able to fully remedy this disadvantage, as Walloon tariffs would always come on top of the distance-based Flemish tariffs. The disadvantage could be mitigated by keeping the cost of the grid usage to domestic users low by ensuring i) that the tariff structure encourages transit use of the Walloon network in a way that maximises the contribution of transit use to the cost of the local network and ii) the availability of public subsidies for the Walloon grid or Walloon emitters (also see section 4).

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32 See PwC (2023): Unit Investment Cost Indicators - Project Support to ACER. Section 8.5.1 discusses unit costs for carbon dioxide pipelines and finds that the cost of adding an additional kilometer of pipeline is equivalent to roughly tripling the diameter of the pipeline, which is equivalent to increasing volume by a factor of ~9x.

33 For instance, while a study by the EU JRC does not consider Wallonia a transit country in the scenarios under consideration, Fluxys' plans include transit flows through the region (see section 3.2 and 3.4).

Rules for cross-border and transit tariffs

As noted above, given the location of Wallonia, cross-border tariff design is going to be important to ensure efficient transport of CO2 across Belgium. Drawing on the experience from the gas transport networks and the current debate in connection with the revision of the Gas Package, regulators in Europe will need to assess the extent to which CO2 networks that use entry / exit tariffs should apply rebates at cross-border points and/or regional borders, such as the border between Wallonia and Flanders in Belgium. Rebates or the non-application of tariffs at cross-border points within Europe and Belgium would increase trade within the EU and favour the users of storage sites developed within the EU over those outside the EU (especially Norway or UK). Critics of removing cross-border tariffs note, however, that this may reduce tariff cost-reflectivity. Instead, cross-border or distance-based tariffs ought to reflect the higher cost of transporting gas or carbon over longer distances. Also, the non-application of tariffs at cross-border points might reduce the incentives for certain states to develop their local storage resources, especially when faced with local public opposition.

It is our understanding that there is no geologically viable onshore storage option in Belgium and hence that any Walloon CO2 would need to be shipped cross-border. Hence, the question of cross-border tariffs primarily becomes one of how to deal with transit flows, as all domestic users would face similar costs under an entry-exit regime.[34] Doing so requires consideration of the contribution of transit flows to lowering the unit cost of pipelines used by domestic capacity and competition between alternative pipeline routes in Northwestern Europe.

EU regulation provides varying levels of detail on the calculation of cross-border tariffs and rebates for different gas networks. For natural gas networks the Network Code (NC TAR) generally prescribes the application of the same reference price methodology to all entry and exit points in a system only allowing for discounts in clearly defined circumstances:

- Regulators may grant discounts at entry and exit points from and to storage facilities, LNG facilities and infrastructure ending the isolation of Member States' gas transmission systems. Regulators may also provide ex-ante or ex-post discounts for standard capacity products for interruptible capacity.[35]
- The code also explicitly defines potential exemptions and adjustments for entry-exit systems where more than one transmission system operator is active or systems which cover more than one Member State.[36]

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34 Under an entry-exit system, any flow originating in Wallonia would be liable to pay one (domestic) entry tariff and one (cross-border) exit tariff with no differentiation between domestic users of the network. The key question then becomes one of how to deal with cross-border entry capacity, i.e. flows that originate outside of Wallonia and transit through the region before exiting it again.

35 Official Journal of the European Union (17/03/2017), Commission Regulation (EU) 2017/460 as of 16 March 2017 establishing a network code on harmonised transmission tariff structures for gas, Art. 9 and 16, Link: https://eur-lex.europa.eu/legal-content/EN/TXT/HTML/?uri=CELEX:32017R0460.

36 While the NC TAR allows for the use of separate tariffs, it prescribes the application of the same reference price methodology in entry-exit systems within Members States with more than one transmission system operator. See Official Journal of the European Union (17/03/2017), Commission Regulation (EU) 2017/460 as of 16 March 2017 establishing a network code on harmonised transmission tariff structures for gas, Art. 6(3), 10 and 11., Link: https://eur-lex.europa.eu/legal-content/EN/TXT/HTML/?uri=CELEX:32017R0460.

- The EU Gas Regulation allows for discounts on capacity-based tariffs at interconnection points for renewable and low-carbon gases from 2025 onwards.[37]

The European Union Agency for the Cooperation of Energy Regulators (ACER) is monitoring national regulators' compliance with the Network Code and the provision of discounts and has demanded adjustments to proposed tariffs in the past.[38]

For hydrogen networks, EU regulation focusses on facilitating cross-border flows, encouraging mutual consultations amongst regulators of adjacent countries on methodologies for hydrogen network access tariffs for entry and exit points at interconnection points. Such tariffs must not restrict or distort cross-border trade, while hydrogen network operators and regulators should pursue the convergence of tariff methodologies and further regional integration. Discounts are discussed in the EU guidelines for tariffs at entry and exit points from and to gas storages and LNG facilities.[39]

In contrast, there are limited rules for transboundary CO2 transport: EU guidelines simply provide that regulators must meet the requirements of the directive and Community legislation e.g. the principles of transparent and non-discriminatory tariffs ensuring a fair and open access to the grid.[40] No further guidance regarding for setting cross-border tariffs has been provided by the EU as of January 2025. However, according to the ICMS[41], the Commission was set to start the development of a possible future CO2 transport regulatory package in 2024 thus paving the way for potential future guidance. As of today, the EU leaves regulators and operators of CO2 transport infrastructure substantial leeway to design and set tariffs for cross-border flows.

As set out above, the unit cost of the network to local users is minimised by a tariff structure that encourages transit use of the Walloon network in a way that maximises the contribution of transit use to the cost of the local network. Doing so will require i) an understanding of the availability of alternatives for potential users of the Walloon CO2 transport system and ii) an understanding of the cost of those routes to understand the extent to which there will be a willingness of potential transit customers to commit to the Walloon system at different tariff levels. On that basis, it will be possible

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37 Official Journal of the European Union (15/07/2024), Regulation (EU) 2024/1789 of the European Parliament and the of the Council of 13 June 2024 on the internal markets for renewable gas, natural gas and hydrogen, Art 3c, 17 and 18 (4). Link: https://eur-lex.europa.eu/legal-content/EN/TXT/PDF/?uri=OJ:L_202401789

38 For instance, Belgian regulator CREG originally provided a 100% discount on the entry tariff to support renewable gas in its gas transmission tariffs methodology for the regulatory period from 2020 to 2023. ACER considered this as not aligned with Art 6 (3) of the Network Code and CREG subsequently abolished the discount. The Estonian regulator envisioned tariffs applicable to exit points with Russia which were not derived from the reference price methodology in its gas transmission tariffs published in September 2019. ACER considered this not in line with the Network Code as the reference price methodology had to be applied to all entry and exit points in a given system. See, ACER (06/04/2020) ACER Report on Tariffs – Country Assessments, p. 9 and 29. Link: https://www.acer.europa.eu/sites/default/files/documents/Publications/ACER%20Report%20on%20TAR_final_country%20sheets.pdf

39 Official Journal of the European Union (15/07/2024), Regulation (EU) 2024/1789 of the European Parliament and the of the Council of 13 June 2024 on the internal markets for renewable gas, natural gas and hydrogen, Art 3c, 7 and 17. Link: https://eur-lex.europa.eu/legal-content/EN/TXT/PDF/?uri=OJ:L_202401789

40 Official Journal of the European Union (05.06.2009), Directive 2009/31/EC of the European Parliament and of the Council of 23 April 2009 on the geological storage of carbon dioxide, Art. 21 and 24. Link: https://eur-lex.europa.eu/legal-content/EN/TXT/PDF/?uri=CELEX:32009L0031

41 European Commission (2024): Towards an Ambitious Carbon Management for the EU, p. 10. Link: https://eur-lex.europa.eu/legal-content/EN/TXT/PDF/?uri=CELEX:52024DC0062.

to better understand the implications of certain rebates at cross-border points (within the realm of what is permitted by EU regulations) on domestic utilisation and tariff levels. Such modelling is outside the scope of the current study.

It is also worth noting that in the longer term, the non-application of cross-border tariffs at interconnection points within the EU may lead to the creation of an inter-TSO compensation scheme. Such a scheme would allow TSOs to ensure recovery of costs and financeability of certain routes, which would otherwise allocate the cost of transit flows to domestic users. Since CCS infrastructure is only emerging across Europe, and little harmonisation has yet occurred at the EU level in the CCS sector, such a policy could only be pursued under a wider review of the European CCS Directive and requires a willingness to harmonise CCS tariffs across Europe; suggesting that such a change would not occur in the short-term.

The design choice around cross-border tariffs is particularly acute when applying an entry-exit regime over more distance-based regimes for CO2 transport tariffs; where cross-border flows are not specifically disadvantaged against non-cross-border flows in the way they are under a standard entry-exit system that only levies charges at the end points of each grid.

However, it may be locally efficient for regions "downstream" of emitters (e.g. Flanders in relation to Wallonia) to consider cross-border rebates even under a distance-based system to avoid flows being diverted to technically more costly but lower priced (e.g. because of subsidies or regulation) routes in other regions (in this case, e.g. France, which is planning to use regulated tariffs (see section 5.4) that can be cheaper for the end user). Such a diversion could in turn lead to the loss of volumes for the downstream (in this case Flemish) network and in turn higher network unit costs for domestic (in this case Flemish) users of the network. A quantification of this effect is outside the scope of this study.

Temporal profiling

Since CCS applications and CO2 infrastructure are only just emerging across Europe, regulators need to ensure that tariffs are financially sustainable for early users. Dedicated deferral and / or support mechanisms may help transport network operators to bear possible under-recovery during the early stages of network development when demand for CO2 network and storage capacity will potentially be low compared to the overall capacity of the network. "Standard" tariffs based on annual costs and volumes could be undesirable as they may not encourage any customers to connect (since the first customers to connect to a network sized to expected eventual demand would face very high tariffs) and may not ensure a financeable revenue recovery profile for infrastructure providers. This situation could discourage investment in the first place. In such circumstances regulators, especially those opting for RAB-based regulatory approaches as described above, could consider temporal profiling in allowed revenue design. This approach was applied in Northern Ireland in the gas distribution sector (when it was started up in the 1990s) and provides a useful precedent for setting regulated tariffs in conditions of demand uncertainty and early adoption.[42]

The RAB for gas distribution companies in Northern Ireland was set using a relatively standard building blocks approach but revenues included an additional element, referred to as the so-called profiling adjustment. To incentivise customers to switch to gas in the early stage of network

[42] Competition and Markets Authority (19/12/2012), Phoenix Natural Gas Ltd price determination (CC), Link: https://www.gov.uk/cma-cases/phoenix-natural-gas-ltd-price-determination.

development, the recovery of economic cost was re-profiled into the future when customer numbers and demand were expected to grow. The profiling adjustment element of the RAB thus captures the value of deferred revenues from the early period when demand was low and was calculated as the difference between actual revenues and cost-reflective revenues during any single year. The recognition of the profiling adjustment as part of the RAB in the licence served as investor protection as it ensures that the distribution companies will be allowed to recover the historical deferred revenues in the future through customer charges. A similar approach is used by the German hydrogen grid and could also be considered for CO2 transport tariffs to help overcome some of the cross-chain risks in the CCS sector described in the previous section.

2.3.5. Incentives for the development of infrastructure capacity "ahead of demand"

A key feature of CO2 networks is that demand is expected to grow but future demand is uncertain and closely linked to political decisions for its viability, even in the long-term. At the same time, the marginal cost of adding capacity to an existing pipeline / building a second pipeline is likely to be significantly more costly than starting off with a larger pipeline in the first place. Consequently, risk averse transport operators may have an incentive to limit the size of their pipelines to the capacity "underwritten" by current demand, while governments may have an incentive to promote the creation of "spare capacity" during the construction of the initial pipeline network that provides a relatively low-cost option in case CCS demand grows and to ensure decarbonisation targets are met.

The degree of "spare capacity" should be sized based on a cost-benefit analysis with the amount of "spare capacity" put in place chosen to balance the benefits of the optionality of the "spare capacity" against the cost of the expected "idle capacity". By organising and facilitating "open seasons" that bring together potential demand when new investments are proposed, governments can focus demand and reduce the need for "spare capacity". This approach is often adopted by governments as well as private operators to size the capacity of new infrastructure projects in the gas sector, including interconnectors, storage and LNG capacity.

However, to attract private investment under a scenario where governments may have an interest in promoting the creation of "spare capacity" (up to the efficient level or potentially beyond for political reasons), regulators will need to put in place consistent approaches to creating an expectation of recovery of the investment into CO2 transport and storage capacity including investment in such "spare capacity". In doing so, they may also need to coordinate with the regulators of "downstream" capacity, in order to ensure that incentives for the provision of "spare capacity" are in place over the entire length of the possible pipeline as opposed to on the "domestic" segment only. In the absence of direct inter-state coordination, a state entity from the upstream region can also book "backstop" capacity on the whole network down to the terminal / storage that is most likely to be used by emitters from the upstream region. This will help address the cross-chain risks affecting the CO2 transport and storage segments (described in section 2.1 above) by providing network operators both in the upstream and downstream region with improved stability of demand.

The choice around the specific approach to be adopted to encourage capacity development is necessarily tied to regulatory model adopted to address the natural monopoly concern described in section 2.3.3 above, namely:

- Under a **commercial model** where private infrastructure investors build capacity that is primarily backed by long-term contracts with individual and credit-worthy off-takers already at the point of investment, "spare" capacity will likely be limited to capacities where usage is sufficiently likely for there to be a reasonable expectation that future demand (at market prices) will cover at least the (marginal) cost of capacity.
- Under a **regulated model,** operators' willingness to provide "spare capacity" will depend on the downside protection mechanisms (if any) that regulators incorporate in return for the capping of the upside of the return distribution.

We discuss some of the key regulatory challenges and opportunities in setting up these models below.

Capacity expansion under a commercial model

In principle, there are various investors that have experience handling unregulated oil and gas pipeline development that could also handle CO2 infrastructure development. However, capacity development under such a model may be limited by the aforementioned constraints on the extent to which unregulated operators will be able to invest ahead of uncertain demand.

It is also worth stressing that such an approach might rule out some of Europe's largest emitters as customers, if these do not have the credit rating to back a long-term contract on their own, which in turn could materially reduce demand for CCS. Moreover, in a worst-case scenario, where there is no clear commitment by regulators to refrain from regulation in case of strong demand, any investment may be undermined: This will be the case if investors and off-takers are concerned that future regulation will de-value their investments by either forcing them under regulation at tariffs that do not reflect the costs of unregulated development (hitting the pipeline operator) or creating regulated competition and thus lower cost transport options (hitting the off-taker of the more expensive transport contract or the pipeline operator if the off-taker then has to renegotiate the transport contract to remain in business).

Hence, any viable capacity development under the commercial model will likely need to be backed by a firm commitment to exempt the infrastructure from regulation and third-party access rules for a specified period of time (as is the case with many LNG terminals in Europe) or unless it crosses certain pre-defined excess internal rate of return thresholds (as is the case for e.g. Dutch fibre networks). In a similar vein, the Dutch competition and markets authority granted an informal exemption from third party access rules and tariff rules for the first tranche of CCS transport and storage capacity for the major CCS project in the country (Aramis) to provide sufficient certainty to the project developers that they will be able to recover their costs (see section 5.6 below).

Development of transport capacity ahead of demand under a regulated model

The development of "spare capacity" under a regulated model can be driven by a pre-agreed "network development plan" that foresees the roll-out of a level of transport and storage capacity that is pre-agreed with the respective state authorities.

Such a situation has historically occurred when e.g. gas grids have been rolled out to new areas or when airports have been expanded. Similar to the Northern Irish case described above, one approach in such cases has been to use back-end loaded (annuity-type) depreciation profiles that start with charges that are initially below cost recovery levels and that "roll up" the under-recovery into the asset base, to be charged to future consumers when the "regulatory account" / "roll-up" is eventually

unwound. Because of the delayed cost recovery these schemes generally come with somewhat higher financing costs than "classical" regulatory approaches.

However, such an approach will only be able to underpin the investment into CO2 T&S capacity when there is a reasonably certain prospect of demand materialising at a level that allows cost recovery. Recent discussions[43] in the hydrogen network sector cast doubt on the extent to which a simple "regulatory account" model would be able to support the roll-out of regulated carbon networks that would face uncertain utilisation on the downside (especially when asked to provide significant "spare capacity" ex ante) while only realising capped upside.

Policy makers should therefore consider other solutions that allow the state to provide some downside protection against lower-than-expected demand, especially when it is asking infrastructure operators to provide "spare capacity" for which there is currently no market demand:

- One simple option to encourage such "spare capacity" can be for the state to act as the "buyer of last resort" offering to book spare T&S capacity if it goes unsold on the open market; periodically re-offering it to the secondary market. Doing so would help develop a liquid secondary market; although safeguards (e.g. a commitment to not offer capacity on the secondary market below the regulated price) would need to be put in place to ensure this approach does not crowd out genuine primary market demand. Also, this policy would still need to weigh the benefit of the spare capacity optionality against the cost to taxpayers of the infrastructure being under-utilised.
- An alternative form of providing government "insurance" for the provision of "spare capacity" against long-term volume risk is the German H2 core grid model for hydrogen networks described above. The basic model suggests that the grid operators first build up an initial grid from their own funds. The grid fees will initially be capped at a level that does not cover the full annual cost of the network but would be allowed to rise above the cost-reflective level as demand picks up.[44] All costs, revenues and the appropriate return are booked onto an "amortisation account". If utilisation is insufficient and the amortisation account is not yet balanced at a certain "fork in the road" date, the state would cover the (majority of the) balance and thus provide a degree of insurance for the grid operators.

  The latter model requires decisions on e.g. the volume and timing of the balancing guarantee to be granted, e.g. regarding the amount of capacity to be underwritten by the host government (which could be revenues relating to all capacity or only "spare" capacity not confirmed in an open season but considered valuable by the host government). Such

[43] Several hydrogen production and infrastructure projects have been paused or shelved recently often due to increased investment costs and economic risks, including e.g. a pipeline connecting Norway and Germany and a green hydrogen plant connected to an oil refinery in Heide/ Germany. Moreover, the European Court of Auditors voiced scepticism regarding the EU's industrial policy on renewable hydrogen, including the target of 10 mt renewable hydrogen production and import by 2030 and the respective demand development. See: Bloomberg (2023) Orsted walks away from green hydrogen project citing high costs, Link: https://www.bloomberg.com/news/articles/2023-11-21/german-oil-refinery-shelves-hydrogen-project-citing-high-costs; Hydrogen Insight (22/09/2024) Planned hydrogen pipeline between Norway and Germany scrapped by Equinor, Link: https://www.hydrogeninsight.com/production/planned-hydrogen-pipeline-between-norway-and-germany-scrapped-by-equinor/2-1-1713642; European Court of Auditors (2024) The EU's industrial policy on renewable hydrogen, Link: https://www.eca.europa.eu/ECAPublications/SR-2024-11/SR-2024-11_EN.pdf.

[44] See the European Commission state aid decision for a description of the German hydrogen core grid and the protections that it provides: https://ec.europa.eu/competition/state_aid/cases1/202438/SA_113565_72.pdf

"guarantee" models make it easier to convince a private investor to include "spare capacity" in its initial investment decision, as the "public good" that is spare capacity also comes with a public insurance option. At the same time, financing costs, and hence consumer tariffs, could fall; albeit at the cost of increased risk exposure by the state and ultimately taxpayers.

Below, we review the plans for a CCS sector in general and CO2 transport in particular across a range of different countries neighbouring Wallonia. In that context, we assess the extent to which these regions provide subsidies to their CO2 transport sector. We also consider the extent to which these regions have already designed their access regulation frameworks and how they have addressed the challenges set out above.

3. Stock-taking

In this chapter, we outline the status quo of **carbon capture policy,** the **carbon markets** and key projects in each jurisdiction under consideration. We also outline the role each jurisdiction will likely play in a future European CO2 network. This section provides background information for the analysis of subsidy and regulatory regimes provided for each region or country in subsequent chapters.

3.1. Wallonia

Wallonia aims to achieve carbon neutrality by 2050 by reducing greenhouse gas emissions by at least 95% compared to 1990 levels, in line with federal-level targets. Until 2030 the region aims to achieve emissions reductions of 55%.[45] The rapid development of CCUS technologies is identified as an essential measure to decarbonise the Walloon industry in the region's Air Climate Energy Plan 2030 (Plan Air Climate Energie; PACE). This plan was accompanied by a call for (pilot) projects targeting capture, storage transport and use of CO2 with a total budget of 8m EUR.[46]

The PACE 2030 also notes that CO2 transport logistics are a key challenge along the CO2 value chain and states Wallonia's ambition to become a key player in the transport, distribution and sequestration/ usage of CO2.[47]

The region is currently developing its regulatory framework for CO2 transport, after the March 2024 CO2 decree established the legal framework for the development of CO2 transport, distribution and recovery in the region. As designated regulator of the pipeline-bound CO2 transport market, CWaPE is preparing to define a regulatory framework and tariff methodologies for local and regional networks.[48] (See also section 2.2).

The Walloon regulation for CO2 transport will be shaped by the region's industrial structure and location within Europe:

- Wallonia hosts several large industrial emitters looking into CCUS to reduce their emissions. The framework and methodology have to maintain and strengthen Wallonia as a competitive location for industry while providing incentives for the CO2 industry to ramp up in the upcoming years.
- Wallonia's landlocked location and cross-regional as well as international interconnectedness affect the region's role in a future Belgian and European CO2 network. Wallonia is also

45 See e.g. Regional policy declaration (2024-2029) p.67. Link: https://www.wallonie.be/sites/default/files/2024-07/DPR2024-2029.pdf

46 The Walloon Air and Climate Agency (undated) 0Carbon4Wal. Link: https://awac.be/2023/06/05/0carbon4wal-appel-a-projet-de-recherche/ Note: According to this source this call for project only took place in 2023 so far and there is no indication whether another round is currently prepared by the Walloon government.

47 Walloon Government (21/03/2023) Pace 2030, Ch 3.1.4. Link: https://energie.wallonie.be/servlet/Repository/pace-2030-02_03_2024.pdf?ID=73812.

48 Walloon Parliament (28/03/20249, Décret relatif au transport de dioxyde de carbone par canalisations en Région wallon esp. chapter 2 and 8. Link: https://wallex.wallonie.be/files/pdfs/20/106144_D%C3%A9cret_relatif_au_transport_de_dioxyde_de_carbone_par_canalisations_22-07-2024-.pdf

dependent on the planning and progress of CCUS and CO2 infrastructure projects in adjacent regions and countries.

Various CCUS projects developed by the Walloon industry will rely on a CO2 transport network.[49]

Figure 3.1 : Overview of industry CCS projects in Wallonia

Source: NERA analysis, based on map provided by the Government of Wallonia.

These include:

- Project **GO4ZERO** in Obourg, which focuses on the decarbonisation of clinker and cement production by 2029. The project was initiated in early 2024 and first production is scheduled for early 2027. From 2028 a complete CO2 value chain will be developed with gaseous CO2 being transported via pipeline to the export hubs in Ghent, Zeebrugge and Antwerp in Flanders.[50] The project was selected by the EU Innovation Fund in 2023 for grant funding.[51]
- Project **co₂ncreat** in Saint-Georges-Sur-Meuse and Hermalle sous Huy focusses on the production of innovative building materials with a negative carbon footprint. A 2km pipeline will transport CO2 captured during lime production to a separate facility where it will be permanently sequestrated into building materials. Fluxys[52] is one of the consortium partners contributing its expertise in pipeline construction and operation..[53] The project received a EUR 4.5m grant from

49 Note that we do not include the Leilac (Lixhe) project, which according to its website currently no plans to actually store or use the captured CO2 and does not provide any indication that it would rely on pipeline infrastructure. We have also excluded Project Columbus, which has been terminated according to information provided by CWaPE.

50 Holcim (2024): GO4Zero – Key steps. Link: https://www.go4zero.com/en/key-steps

51 European Commission (2024) Projects selected for grant preparation. Link: https://climate.ec.europa.eu/eu-action/eu-funding-climate-action/innovation-fund/calls-proposals/large-scale-calls/projects-selected-grant-preparation_en

52 Simultaneously, Fluxys is a potential candidate to become CO2 network operator in Wallonia.

53 co2ncreat (2024) Project website. Link: https://co2ncreat.com/

the EU Innovation Fund in 2023.[54] Financial Close date for the project is 30th June 2025, and entry into operation is expected for June 2026.[55]

- Project **Anthemis** in Antoing is a large-scale carbon capture project linked to a cement plant located more than 100km from the coast. It is set to reduce emissions of more than 800,000 t CO2 per year. Completion of the project is scheduled for 2029. Currently Fluxys is designated to be responsible for the connection to the CO2 network for transport to Zeebrugge and Ghent by the project partners.[56]
- Project **Globe** in Marche-les-Dames focuses on CCS during fired dolime production processes. The initial test phase is schedule for between 2024 and 2027, with the full project to be launched in 2031. The final project will be connected to the CO2 pipeline network for transportation to hubs and storage facilities.[57]
- Project **HECO2** is a project evaluating different options for decarbonising Walloon industry. It includes two CCS-projects, project **Saturn** and project **Butterfly**. Project Saturn in Châtelet will test carbon capture technologies in different industrial production processes. The project is currently under way and in the final stages. Injection into the CO2 network and/or exports to storage facilities in the North Sea will be assessed.[58] A final prototype for the capture mechanism is expected by the end of 2024. Project Butterfly in Seilles focusses on the decarbonisation of lime production. It is an industrial-scale demonstrator facility to capture and concentrate CO2 for subsequent utilisation. The project started in 2023, and first trial campaign targets are set for Q4 2024. Project HECO2 is part of the European Recovery and Resilience Facility and was awarded funding of EUR 44m by the Walloon Government in 2022.[59] Of this, EUR 5.4m were awarded to project Butterfly, and EUR 6.8 to project Saturn.

If realised, these projects will contribute to the initial domestic demand for CO2 pipeline capacity in the short- to medium-term. Thus, a timely provision of the necessary CO2 infrastructure and information on the expected tariff methodology will be key for industry players investing in CCUS at their current locations in Wallonia.

In this context, the new Federal Governments' revised tax policy will support investments in CCU/CCS projects across the country. The Government Agreement of 31st January 2025 plans to support climate-friendly technologies by rendering the respective investment deduction simpler, more

54 Offshore Energy (11/01/2023) EU Innovation Fund boosts Belgian companies' CO2ncrEAT project. Link: https://www.offshore-energy.biz/eu-innovation-fund-boosts-belgian-companies-co2ncreat-project/

55 European Commission (2024): Innovation Fund Project Factsheet – CO2ncrEAT. Link: https://ec.europa.eu/assets/cinea/project_fiches/innovation_fund/101103194.pdf

56 OneStoneConsulting (01/03/2024): Heidelberg Materials' Anthemis CCS project in Belgium. Link: https://ccf2up.com/heidelberg-materials-anthemis-ccs-project-in-belgium/ and Heidelberg Materials (2024): Capture du carbone (CCS). Link: https://www.heidelbergmaterials-benelux.com/fr/belgique-ciment/capture-du-carbone-ccs

57 Lhoist (2024) GLOBE. Link: https://www.lhoist.com/fr-FR/globe.

58 Liege Creative (12/03/2024) Capture du CO2 en Wallonie: potentiel et enjeux. Link: https://www.liegecreative.be/evenements/capture-du-co2-en-wallonie-potentiel-et-enjeux and aperam (29/09/2022) HECO2, un projet d'innovation vers la décarbonation pour le site de Châtelet. Link: https://www.aperamchatelet.be/fr/heco2-un-projet-dinnovation-vers-la-decarbonation-pour-le-site-de-chatelet/

59 Wallonian Parliament (13/06/2023): Decarbonization Projects of Walloon Industrial Companies. Link: https://www.parlement-wallonie.be/pwpages?p=interp-questions-voir&type=28&iddoc=121190

accessible and harmonise them at 40%. Crucially, the Government announced the removal of existing restrictions on European subsidies for CCS/CCU investments.[60]

3.2. EU level

During its 2019-2024 term, the European Commission set out various targets for carbon capture and storage, but it left the details of the regulation and support for CO2 transport networks to its successor, the Commission that recently started its 2024-2029 term.

Until the end of 2023, the European Commission had only set out safety standards and rules for non-discriminatory access to CCS infrastructure in its 2009 CCS Directive. Although several Member States had already included CCS/CCU in their draft National Energy and Climate Plans or their Recovery and Resilience Plans (NECPs), a coherent EU policy framework was missing. The **Industrial Carbon Management Strategy (ICMS)** from February 2024 was the first document designed to develop a framework for industrial carbon management along the entire value chain that includes non-discriminatory, open-access, transparent, multimodal, cross-border CO2 transport and storage infrastructure.[61] Moreover, it sets out the ambition to consider if and how to account for industrial carbon removals in the EU Emissions Trading System (EU ETS), as they are currently not covered by it. As a (non-binding) communication rather than legislation, the ICMS only sets out to initiate preparatory work from 2024 in view of a proposal for a possible future CO2 transport regulatory package. This regulatory package is expected to address rules for the governance of and access to future CO2 transport networks, which are not further elaborated on by the ICMS itself. See section 5.1 for more details.

Based on the EU's carbon capture and emission targets, a February 2024 publication by the European Commission Joint Research Centre (JRC) modelled that a European interconnected CO2 transport network could reach a length of 6,700-7,300 km by 2030 and might extend to between 15,000 and 19,000 km by 2050. Its deployment could cost between about EUR 6.5bn and EUR 19.5bn by 2030 (JRC estimate) [62], rising to between EUR 9.3bn and EUR 23.1bn in 2050 (EC ICMS estimate). The JRC paper locates the majority of potential carbon storage capacity in the North Sea and Baltic Area with a large emissions cluster in the Low Countries' industrial and chemical areas with an extensive port infrastructure. The JRC estimates that a comprehensive cross-regional transport and storage system will develop in the Northwest of Europe, whereas transport from emitters to carbon sinks in Southern Europe will be more local and decentralised. The JRC identifies an EU-wide bottleneck regarding carbon storage and transport, since carbon capture projects tend to be less costly and have shorter lead times than transport and storage projects. While CO2 transport by pipeline will thus be vital in

60 See e.g. Bird&Bird (05/02/2025) Belgium - Federal Government Agreement 2025-2029: Innovation and taxation, Link: https://www.twobirds.com/en/insights/2025/belgium/federal-government-agreement-2025-2029-innovation-and-taxation

61 European Commission (2024): Towards an Ambitious Carbon Management for the EU. Link: https://eur-lex.europa.eu/legal-content/EN/TXT/PDF/?uri=CELEX:52024DC0062.

62 Tumara, D., Uihlein, A. and Hidalgo González, I. Shaping the future CO2 transport network for Europe, European Commission, Petten, 2024, JRC136709. Link: https://publications.jrc.ec.europa.eu/repository/handle/JRC136709

the long term, more readily available alternative transportation modes, particularly shipping, will have to be relied upon in the short term.

The **Net Zero Industry Act (NZIA),** adopted by the European Parliament in June 2024 sets out precise CCUS targets for Europe. It mandates a geological carbon storage capacity of 50 mtpa by 2030, 280 mtpa by 2040, and 450 mtpa by 2050.[63] To help reach these targets, it supports project development, for example with accelerated permitting procedures, but provides neither financial support nor more clarity on the regulatory framework for CO2 transport pipelines.

A call for binding European carbon transport regulation (as envisaged by the ICMS) was reiterated at the fourth ICM Forum 2024 in Pau, France in October 2024, where six Member states signed a joint declaration to urge the Commission to pass relevant legislation no later than 2025.[64]

The so-called Draghi Report from September 2024 emphasises the critical role of CCUS in the EU's efforts to decarbonise its electricity sector and the broader economy. It proposes the use of ETS and CBAM revenues to provide capex and opex support for decarbonisation in affected industries, and thus beyond the current focus on construction and infrastructure. The report explicitly proposes the use of CCfDs and increased R&D and deployment funding for CCUS technologies, amongst others. It also highlights the need for CO2 storage sites and transport infrastructure as one of the barriers to the expansion of carbon capture technologies in Europe.[65]The new European Commission 2024-2029 ("Von der Leyen II") plans to develop the EU policy framework along the carbon value chain. It has pledged to develop the **Clean Industrial Deal** in the first 100 days of the mandate, which focuses on decarbonisation, clean technologies, and incentivising investment. The Commission also plans to present an **Industrial Decarbonisation Accelerator Act**, which focuses on clean tech in the industrial sector and further speeding up bureaucratic procedures as already set out in the NZIA.[66] In a new **European Climate Law**, the Commission intends to enshrine the target of 90% emission-reduction for 2040, paving the way for its ultimate net-zero target[67] that will only be achievable with

63 European Commission (2024): Net Zero Industry Act. Link: https://eur-lex.europa.eu/legal-content/EN/TXT/PDF/?uri=OJ:L_202401735. For comparison, a Working Group Paper of European stakeholders estimates that in order to reach its climate targets, annual EU storage capacities of 80 mtpa by 2030, 300 mtpa by 2040, and 450 mtpa by 2050 are required. Link: https://cdn.catf.us/wp-content/uploads/2023/05/31163741/ccus-europe-vision-report.pdf. In January 2025, the Commission published the first four draft acts detailing the implementation of NZIA for consultation. However, none of these explicitly concerns CC(U)S and/ or CO2 infrastructure. The draft implementing decision for certain selection criteria for net-zero strategic projects for additional manufacturing capacity. The criterion "best available net zero technology" may theoretically include technologies involving CC(U)S. See European Commission (27.01.2025), Commission seeks views on provisions to implement the Net-Zero Industry Act, Link: https://single-market-economy.ec.europa.eu/news/commission-seeks-views-provisions-implement-net-zero-industry-act-2025-01-27_en

64 Joint Statement for Establishing an Appropriate European Framework for Cross-Border CO2 Transport Infrastructure, 2024. Link: joint_statement_ccus.pdf. The signatories were Denmark, Germany, France, Netherlands, Sweden and Finland.

65 Mario Draghi for the European Commission (2024), The future of European competitiveness, p.38-39, 99, 108, and 121. Link: https://commission.europa.eu/topics/eu-competitiveness/draghi-report_en

66 See the Mission Letters for the EU Commissioner-Designate for Prosperity and Industrial Strategy (2024): https://commission.europa.eu/document/download/6ef52679-19b9-4a8d-b7b2-cb99eb384eca_en?filename=Mission%20letter%20-%20S%C3%89JOURN%C3%89.pdf.

67 European Commission (2024): Political Guidelines or the Next European Commission 2024-2029, p. 8. Link: https://commission.europa.eu/document/download/e6cd4328-673c-4e7a-8683-f63ffb2cf648_en?filename=Political%20Guidelines%202024-2029_EN.pdf.

extensive use of CCS and CO2 transport. The mission letter to the commissioner-designate for Climate, Net Zero and Clean Growth further includes the demand for "work" on CO2 transport and storage, specifically market and cost structure, third-party access, technical standards, and investment incentives for new infrastructure.[68] As one of the first official communications of the new commission on the matter, the January 2025 **Competitiveness Compass** emphasises the need for accelerated investments in grid infrastructure, including in CO2 transport networks and storage systems.[69]

A November 2024 Status Report on the current technological and commercial status of CCUS in Europe by the JRC gives recent insights into current carbon transport cost and common business models along the value chain.[70] Although costs can vary significantly depending on distance, volume, and geographical location, the JRC estimates that CO2 transport costs are in the range of 2-15 EUR/tCO2 for pipelines, and 12-30 EUR/tCO2 for shipping. Another finding is that business models for CCS projects in the EU changed from when it was a first-of-a-kind-technology to the anticipated commercial application of CCS. Whereas previous individual projects included operations along the entire value chain, novel projects focus on individual steps in the value chain to mitigate risk and to increase scalability. Moreover, whereas companies originally involved in CCUS value chains were oil and gas enterprises (which still remain heavily involved), new players are emerging as a consequence of the business model shift, such as companies in the chemical, engineering, energy infrastructure, and shipping sectors.

EU Funding for carbon transport is mainly sourced from the **EU Innovation Fund**, financed by revenues from the EU Emissions Trading System (EU ETS), the InvestEU Fund, and the Connecting Europe Facility (CEF). CEF funding is open for projects of common interest (PCIs) and projects of mutual interest (PMIs), key cross-border infrastructure projects that link the energy systems of EU countries and benefit from accelerated permit granting, improved regulatory conditions, and increased public exposure.[71] The ICMS further encourages Member States to propose Carbon Contracts for Difference (CCfDs), schemes with subsidies covering the difference between the ETS carbon price and an agreed strike price to represent the project's CO2 abatement costs. In the ICMS, the Commission announced work to create an EU-wide CO2 investment atlas aimed to help investors identify potential storage and transport opportunities. More detail on EU funding opportunities is provided in section 4.1.

In the absence of progress on pan-European regulation on CO2 transport to date, multiple countries bordering the North Sea have signed bilateral memorandums of understanding facilitating the cross-border transport of CO2. For instance, in April 2024, Belgium, Denmark, the Netherlands and Sweden signed bilateral agreements with Norway to remove obstacles for a CCS market in the North Sea

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68 European Commission (2024): Mission Letter to the Commissioner-Designate for Climate, Net Zero and Clean Growth, p. 6. Link: https://commission.europa.eu/document/download/27658b9f-f1f8-4e3a-b265-1ccbd7c2af82_en?filename=Mission%20letter%20-%20HOEKSTRA.pdf

69 European Commission (29.01.2025), A Competitiveness Compass for the EU, p. 9, Link: https://commission.europa.eu/document/download/10017eb1-4722-4333-add2-e0ed18105a34_en

70 MARTINEZ CASTILLA, G., TUMARA, D., MOUNTRAKI, A., LETOUT, S., JAXA-ROZEN, M., SCHMITZ, A., INCE, E. and GEORGAKAKI, A., Clean Energy Technology Observatory: Carbon Capture, Utilisation and Storage in the European Union - 2024 Status Report on Technology Development, Trends, Value Chains and Markets, Publications Office of the European Union, Luxembourg, 2024, p. 6 and 42-44.

71 A useful overview of current CO2 PCIs/MCIs can be found on the EU Commission's PCI/MCI Transparency Platform: https://ec.europa.eu/energy/infrastructure/transparency_platform/map-viewer/main.html.

region. [72] One of the flagship, cross-border CO2 transport projects emerging from these cooperations is the CO2 Highway Europe project which aims to connect planned CO2 hubs in Belgium, France and the Netherlands with storage facilities at the Norwegian continental shelf. The planned offshore pipeline is being developed by Equinor and currently projected to be more than 1.000 km long with an annual capacity of 18m t from 2030.[73]

Figure 3.2 illustrates the potential CO2 transport grid in Europe by 2050, as modelled by the February 2024 JRC paper.[74] It is worth noting that none of the scenarios presented in the JRC paper consider substantial flows from Germany through Wallonia but rather expect German flows to travel straight North; with Walloon emissions travelling through Flanders, either for further northward offshore transport or for onshore transport to Germany or the Netherlands. However, JRC's modelling is somewhat independent of projects actually planned. Some of these, for instance the North Sea CO2 Corridor, seem to envision flows from neighbouring countries through Wallonia according to the project description . [75]

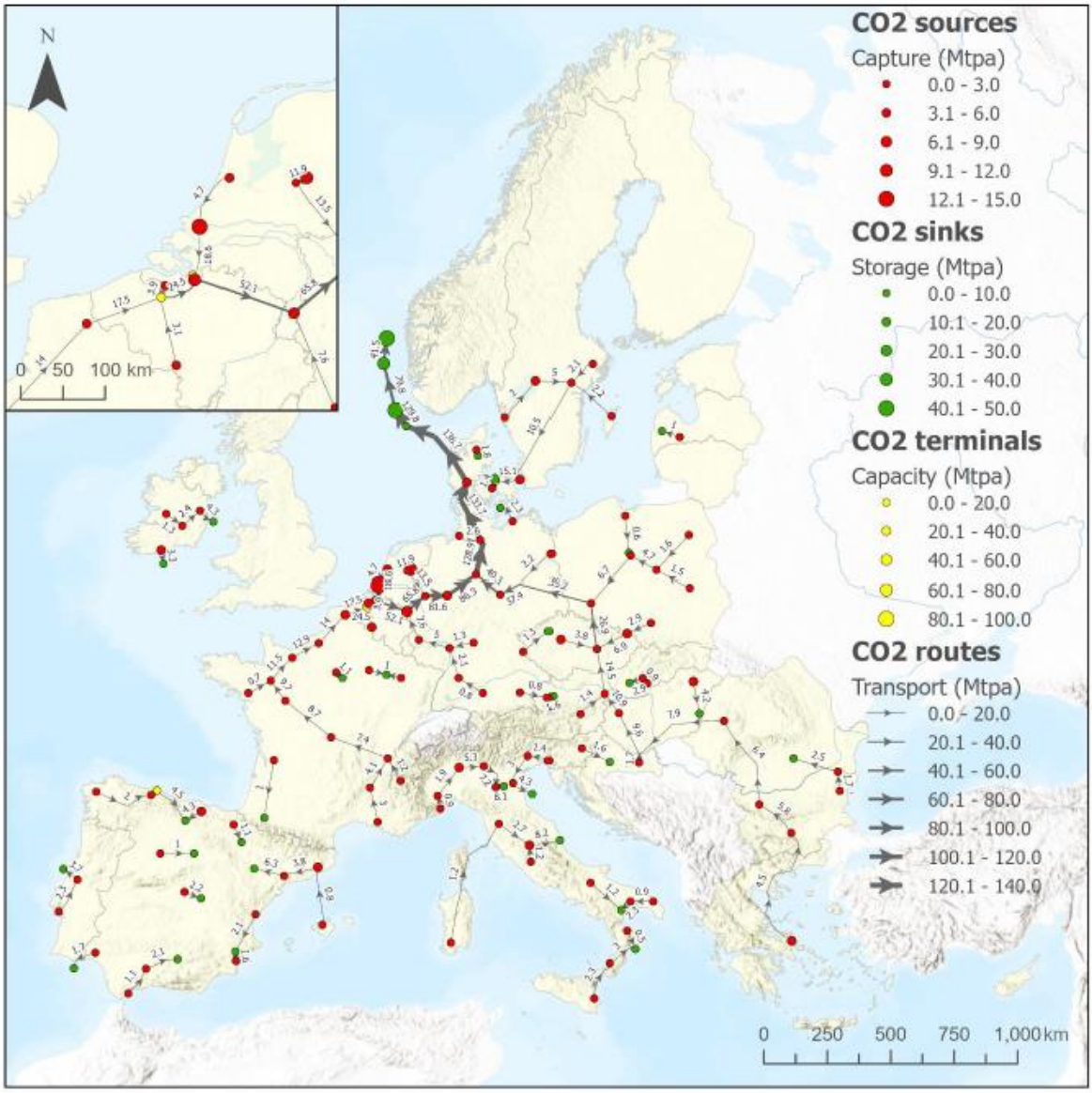
[72] Government of Norway (2024): Five northern European countries conclude international arrangements on transport and storage of carbon across borders. Link: https://www.regjeringen.no/no/aktuelt/five-northern-european-countries-conclude-international-arrange-ments-on-transport-and-storage-of-carbon-across-borders/id3035286/

[73] Equinor (as of Feb 2025), Co2 Highway Europe, Link: https://www.equinor.com/energy/co2highwayeurope

[74] See Tumara, D., Uihlein, A. and Hidalgo González, I. Shaping the future CO2 transport network for Europe, European Commission, Petten, 2024, JRC136709, p. 48 and 69. It is important to note that the paper considers different scenarios that either exclude or include non-EU storage capacity in the UK and Norway. Figure 3.2 illustrates the scenario in which Norwegian capacities are available to EU the transport grid. Since storage locations in the UK are only available after 2035 when a significant portion of the transport network is already formed and directed towards the Norwegian part of the North Sea, availability of additional storage capacity in the UK would not significantly alter this estimate. However, without Norwegian storage capacities, offshore storage sites off the cost off the Netherlands would become economically feasible. This would likely have an impact on the expected volumes transported from or through Wallonia to Denmark, and subsequently affect the specific transport infrastructure needs in the Walloon region.

[75] OGE-Presentation on CO2 transport infrastructure, given at the conference „Science meets Business IV", September 5-6 2024, p. 5. Link: https://sci4climate.nrw/wp-content/uploads/2024/10/20240906_WtW_Forum_3.2_Brauner_OGE_CO2-Infrastruktur.pdf.

Figure 3.2: Potential 2050 CO2 transport grid scenario (incl. Norwegian CO2 sinks)



Source: Tumara, Uihlein, and Hidalgo González (for EU JRC) (2024).

3.3. Denmark

The Danish 2020 Climate Law targets a 70% reduction in greenhouse gas (GHG) emissions by 2030 (relative to 1990) and climate neutrality by 2050. To reach this goal, Denmark aims to develop domestic CCUS projects along the entire value chain. The country tracks the rollout of CCUS projects, regulation, and funding in its latest draft National Energy and Climate Plan (NECP).[76] According to the NECP Denmark has a CO2 capture potential of 15.3 mtpa by 2030, with 4.4 mtpa coming from industry emissions, and 10.9 mtpa coming from heat and electricity, waste incineration, and biogas.

[76] The Danish Government (2024): Denmark's Updated National Energy and Climate Plan, esp. p. 33-38. Link: https://commission.europa.eu/document/download/13353c72-43bc-486e-bc82-9e8ea7588734_en?filename=DK_FINAL%20UPDATED%20NECP%202021-2030%20%28English%29.pdf.

In 2020 the Danish Parliament adopted the Climate Agreement for Energy and Industry which allocates a total of EUR 2.2 bn (DKK 16.6 bn) towards CCUS projects (CCUS Fund), demands the creation of a Danish CCS strategy, and makes regulatory changes to enable the capture, transport, and storage of CO2 in Denmark and to facilitate cross-border transport.[77] In 2021, the Danish government released its CCS strategy, starting the process for granting storage permits, disbursing the first phase of the CCUS Fund, and defining the aim of making Denmark a European hub for storing CO2.[78]

The Act on Pipeline Transport for CO2 from June 2024 and the Executive Order on Pipeline Systems for the Transport of CO2 set to come into force in December 2024 set out a "light touch" regulatory approach recommending negotiated third-party access to pipeline infrastructure.

On 19th December 2024, the Danish Parliament passed legislation on CO2-capture in the utility sector which came into force on 1st January 2025.[79] The new legal framework enables municipal and private companies to establish and invest in CO2 capture as part of their electricity and heat production activities. The law also enables companies to benefit from saved CO2 quotas, CO2 taxes climate credits (for storing biogenic CO2) and the sale of CO2 to finance CCS.[80]

Currently, Denmark has provided six permits for exploration of CO2 storage sites in multiple licensing rounds.[81] The country's total storage capacity is estimated at 12.000-22.000 mt in the NECP, the vast majority of which is held offshore in depleted oil and gas fields and saline aquifers Figure 3.1. In January 2025, the Danish Energy Agency opened the fourth tender for licences for the exploration of offshore CO2 storage.[82] Denmark expects substantial imports of CO2 for storage from other European countries and has entered several bilateral agreements to support and facilitate

77 Danish Ministry for Climate, Energy and Utilities (2020): Climate Agreement for Energy and Industry. Link: https://www.kefm.dk/Media/8/8/aftaletekst-klimaaftale-energi-og-industri%20(1).pdf.

78 Danish Ministry of Climate, Energy and Utilities (2021): A Road Map for the Capture, Transport, and storage of CO2. Link: https://www.en.kefm.dk/Media/637849284671255278/Endelig%20aftaletekst_CCS.pdf.

79 Danish Parliament (Folketinget) (2024) L 77 Forslag til lov om CO2-fangstaktiviteter i forsyningssektoren.. Link: https://www.ft.dk/samling/20241/lovforslag/l77/index.htm

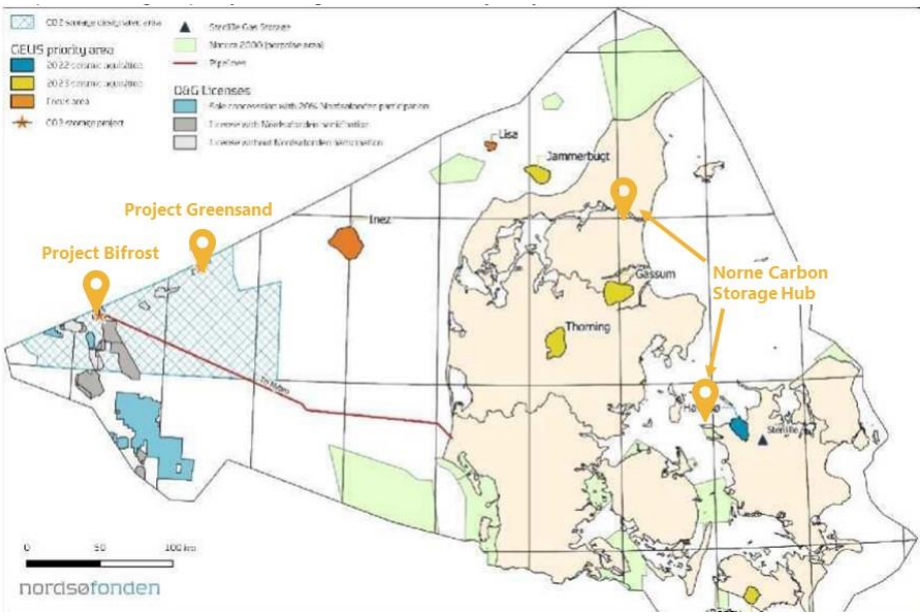
80 According to market participants, the law contributes to equalising municipal and private companies in the competition for public CCS funds and was therefore welcomed by e.g. the Danish district heating association Danish District Heating. See: Danish Offshore Industry (19/12/2024) The Danish Parliament adopts new law on CO2 capture in the utilities sector. Link: https://www.doi.dk/en/artikel/folketinget-vedtager-ny-lov-om-co-sub-2-sub-fangst-i-forsyningssektoren

81 Danish Energy Agency (2024), The Danish Energy Agency opens public consultation on multi-billion fund for CO2 capture and storage. Link: https://ens.dk/en/press/danish-energy-agency-opens-public-consultation-multi-billion-fund-co2-capture-and-storage

82 Danish Energy Agency (09/01/2025) The Danish Energy Agency opens for applications for exploration and CO2 storage near the Danish coast. Link: https://ens.dk/en/press/danish-energy-agency-opens-applications-exploration-and-co2-storage-near-danish-coast

international transport.[83]In addition, the country signed a bilateral memorandum with Norway to facilitate the cross-border transport of CO2 between the two countries.[84]

Figure 3.3: Eight potential storage sites as well as offshore activities identified in the NECP



Source: NERA based on Danish NECP 2024, p. 36.

According to the high-level information provided in the 2023 NECP, Denmark planned to use a variety of CO2 transport modes, including national and transnational pipelines, maritime transport and port reception facilities, intermediate storage and truck transport.[85] However, no such reference can be found in the 2024 NECP. We also understand from discussions with local stakeholders that Denmark has made plans for the regulation of cross-border CO2 pipelines but awaits EU legislation on the matter before proceeding.[86] As of February 2025, no applications for CO2 pipelines have been submitted to the Danish Energy Agency.[87]

The European Commission's JRC forecasts significant pipeline-bound transit flows through Denmark in a future European CO2 grid, fostered by its location. While an offshore pipeline would provide a

83 Danish Ministry of Climate, Energy, and Public Services (2022): Memorandum on Cross Border Transportation of CO2 with the Purpose of Permanent Geological Storage. Link: https://www.fdfa.be/sites/default/files/2023-02/1289_MoU%20in%20het%20Engels.pdf . The agreement was signed in line with the London protocol (1972) on the prevention of marine pollution. Furthermore, Denmark signed bilateral agreements with countries such as France Germany and Sweden.

84 Danish Ministry of Climate, Energy and Utilities and Norwegian Ministry of Energy (2024): Memorandum of understanding on cross-border transportation of CO2 with the purpose of permanent geological storage. Link: https://www.regjeringen.no/globalassets/departementene/ed/bilder-nyhetsaker/henrik/mou-cross-border-co2-no-dk_final.pdf

85 The Danish Government (2023) Denmark's National Energy and Climate Plan, p. 4.

86 Also note that, the IEA's Denmark 2023 Policy Review (p.42) urges the country to lead negotiations towards EU-wide rules for cross-border CO2 transport. Link: https://iea.blob.core.windows.net/assets/9af8f6a2-31e7-4136-94a6-fe3aa518ec7d/Denmark_2023.pdf]

87 Confirmed by the Danish Energy Agency in bilateral communication with NERA. The Agency commented that they continue to see interest in establishing CO2 pipelines in Denmark.

more direct connection between emission centres in Northwestern Europe and large storage capacity off the Danish and Norwegian coasts, lower cost favours an onshore transport infrastructure through Denmark (also see Figure 3.2).[88] That said, several CO2 infrastructure projects are currently being developed in Denmark that rely on offshore over onshore transportation[89], e.g.:

- **Project Greensand** is the most mature CO2 storage project as cross-border CO2 emissions from Belgium were injected for the first time in early 2023. Subsequently, the final investment decision for the first project stage was taken in late 2024 with official storage scheduled to start in late 2025/ early 2026. The project is initially set to store up to 1.5 mtpa CO2 and up to 8 mtpa from 2030. The Danish Government is supporting the project with c. DKK 205m (EUR c. 33m).
- **Norne Carbon Storage Hub** is a cross-border project including CO2 infrastructure downstream of carbon capture and purification spread across two separate storage facilities in Northern Jutland and Western Zealand. The project will provide 12 mtpa of LCO2 reception capacity, 10 mtpa of pipeline transport capacity to injection wells, and a 0.75-1 mtpa injection rate per storage site. It is set to store 2.3 mtpa by 2026 and 20-30 mtpa by 2030. The project received PCI status in 2023 and final investment decision was expected for December 2024.[90] In January 2025, the Commission awarded the project a CEF grant of c. EUR 12m for construction of quay, receiving terminal and pipeline infrastructure.[91]
- **Project Bifrost** is a CO2 transport and storage project to develop an open access infrastructure connecting European industrial hubs to offshore underground storage in the Danish North Sea. : Phase 1 will see the development of 2-3 mtpa CO2 transport and storage capacity by 2030, phase 2 is expected to add an additional 10 mtpa by 2032. The project received PCI status in 2023 and is supported by the Danish Government. The feasibility study is expected to conclude in 2024. [92] Preliminary information suggests a final investment decision may be taken in late 2025 or early 2026.[93]

See appendix A.1for more detailed information on these projects. In general, Denmark provides a somewhat unusual case study within Europe as it is looking to import rather than export CO2 emissions. On the one hand, this may mean that Danish sites like Greensand can be off-takers for Walloon emissions. On the other hand, whether Wallonia could benefit from substantial transit flows,

88 See Tumara, D., Uihlein, A. and Hidalgo González, I. Shaping the future CO2 transport network for Europe, European Commission, Petten, 2024, JRC136709, p 20.

89 It is worth noting that the Tumara et al. / JRC report algorithmically models a cost-optimal transport system. I.e. it does not fully incorporate plans for already existing transport pipeline projects.

90 As of January 2025 no update on the final investment decision has been published by the project developers. The Danish Energy agency confirmed in November 2024 that Norne Thorning Storage ApS has applied for an exploration license. See Energistyrelsen (11/11/2024) Two companies want to store CO2 in the Danish subsurface, Link: https://ens.dk/en/press/two-companies-want-store-co2-danish-subsurface.

91 Planning and approval of the North Sea CO2 transport corridor in Germany.

92 European Commission (2023): PCI Implementation Plan: Norne – Transportation Infrastructure in Denmark. Link https://ec.europa.eu/assets/cinea/PCI/files/PCIFiche_13.10_1st_PCI_PMI_list.pdf.

93 Total during European Commission (30/03/2023), The emerging EU CO2 transport and storage market (Workshop), P. 34, Link: https://climate.ec.europa.eu/system/files/2023-05/policy_ccs_implementation_presentations_20230330_en.pdf.

e.g. from France to Denmark will depend on the grid development in France, Flanders, Germany and the Netherlands.

3.4. Flanders

Flanders hosts Europe's largest integrated fuel and chemical cluster; industries very interested in the development of CCUS who have undertaken various industry-led initiatives to advance CCUS (see below and appendix A.2).

To this end, the "Flemish Climate Strategy 2050", published in 2019 proposes a CO2 pipeline network "backbone" to facilitate CCUS applications.[94] The subsequent 2021 concept note "Vision on CCUS: carbon capture, reuse, and storage" identifies specific infrastructure needs, such as the development of a CCUS backbone in the port areas.[95] The concept note sets out seven objectives for future Flemish CCUS policy, including the formation of a multi-stakeholder infrastructure task force, to further explore possibilities for pipeline expansion and reuse. However, neither Flanders nor Belgium have currently set out specific CCS targets for themselves.

In its 2023 Energy and Climate Plan 2021-2030 the Flemish Government emphasises the need for an efficient CO2 transportation infrastructure to support the decarbonisation of the fuel and chemical industry in the region. It emphasises the role of the infrastructure working group within the "Climate Leap" programme (see section 4.3) in identifying industrial needs for CO2 infrastructure and the need for authorities and pipeline companies to explore relevant routes. The plan also outlines Flanders' aim to secure European funding for CCUS projects including by providing co-financing for promising projects. With regards to non-domestic storage capacities the plan emphasises the intention to build partnerships with "*pioneering*" countries on CCUS.[96] These include cooperations with Norway, the Netherlands and Denmark on storage[97] and Germany and France regarding potential volumes to be transported via the Flemish networks. While Flanders currently focusses on the development of CO2 hubs, the region strives to become a transit region in the longer term.

Subsequently, the Flanders government set out a general regulatory framework on 29 March 2024, passing the Decree on the transport of carbon dioxide via pipelines ("CO2 Decree") and complementing it with an implementing decision in June 2024 that provides more details on the process for appointing network operators. In a "light touch" approach, the decree allocates the lead role for developing the regulatory / tariff framework to the pipeline operator; with the regulator

94 Flemish Government (2019): Flemish Climate Strategy 2050, p. 19. Link: https://assets.vlaanderen.be/image/upload/v1658319019/VlaamseKlimaatstrategie2050_gqrltw.pdf

95 Flemish Government (2021): Vision on CCUS: Carbon Capture, Reuse, and Storage. Link: https://assets.vlaanderen.be/image/upload/v1659014412/Conceptnota_-_visie_op_CCUS__koolstof_opvang_hergebruik_en_opslag_2021_wcj9ao.pdf

96 Flemish Government (2023): Ontwerp Vlaams Energie- en Klimaatplan 2021-2030, p. 219-220. Link: https://publicaties.vlaanderen.be/view-file/56259

97 In addition to Memoranda of Understanding Flanders signed in collaboration with Wallonia and the Federal Government with the Governments of Norway, Denmark and the Netherlands, Flanders and the Federal State have signed a Memorandum of understanding with Norway regarding an offshore pipeline for transportation of CO2 to Norwegian storage facilities in June 2024. Negotiations on a convention

merely reviewing the proposals (see section 5.3 for more details).[98] There is currently no legislation in place that provides for explicit financial support to the CCU / CCS sector but some industry decarbonisation programmes exist that provide some cross-industry support also for innovative CCS projects (see section 4.3 for more details). Moreover, we understand that the Flemish Government and VLAIO are currently investigating potential additional support measures for CCU / CCS, including the introduction of Carbon CfDs.[99]

Flemish regulator VNR[100] is obliged to monitor the development of the CO2 infrastructure. By 30th June 2027 and then every five years thereafter, VNR has to publish a report on the development of i.) local clusters; ii.) the regional network; iii.) liquefaction terminals; iv.) direct pipelines and v.) closed industrial carbon dioxide networks.[101] This will contribute to the Flemish Government's evaluation reports on the regulation of the CO2 infrastructure (see section 5.3.)[102]

Flanders, and Belgium as a whole, lack local storage capacity onshore and hence instead expects to rely on its existing pipeline network and ports facilitate the organisation of CO2 transport in Northwestern Europe.[103] To this end, Flanders is part of the North Sea Basin Task Force set up to coordinate managing and regulating the transport, injection and permanent storage of CO2 in the North Sea sub-seabed.[104]

To facilitate cross-border CCUS activities the region has entered a number of agreements with other European countries. In 2022 Flanders, the Federal Belgian State and Denmark agreed a cooperation

98 Moniteur Belge (2024): Décret relatif au transport de dioxyde de carbone par canalizations. Note that the 2023 Flemish Energy and Climate Plan 2021-2030 previously indicated the consideration of stronger regulation and the provision of regulated tariffs "*if necessary*". See Flemish Government (2023), Ontwerp Vlaams Energie- en Klimaatplan 2021-2030, p. 220. Link: https://publicaties.vlaanderen.be/view-file/56259

99 This is reflected in the coalition agreement and the Belgian statement on Member State Contribution CCUS under the NZIA and was also communicated by VEKA. See Flemish Government (2024) Vlaams Regeerakkoord 2024-2029. Samen werken aan een warm en welvarend Vlaanderen, p. 51, Link: https://publicaties.vlaanderen.be/view-file/69476; and Federal Belgian and Regional Governments (not dated): Member State Contribution CCUS – Net Zero Industry Act (NZIA), p. 5, Link: https://www.cnc-nkc.be/sites/default/files/report/file/nzia_ccus_art.2123_lidstaatrapportering.pdf.

100 In Flanders, three agencies collaborate on matters related to CCS and CO2 infrastructure: VNR is responsible for regulatory matters especially related to the CO2 transport infrastructure, as defined in the CO2 Decree (see section 5.3.). VLAIO is responsible for financing aspects, especially subsidy programs for CC(U)S. VEKA is leading the development of core CCS policies and legislation. For this study NERA spoke with VNR and VEKA. NERA also reached out to VLAIO but did not receive a response.

101 CO2 Decree, Art 92, Link: https://etaamb.openjustice.be/fr/decret-du-29-mars-2024_n2024003725.html

102 According to VEKA the Flemish government that took office after the mid-2024 elections continues to strongly support the use and ramp-up of CCS. This is reflected e.g. by the coalition agreement's support for major CCS and CCU projects in Flemish ports. See Flemish Government (2024) Vlaams Regeerakkoord 2024-2029. Samen werken aan een warm en welvarend Vlaanderen, p. 51, Link: https://publicaties.vlaanderen.be/view-file/69476.

103 Joint Conciliation Committee (2023): Draft Update on the Belgian National Energy and Climate Plan, p. 125. Link: https://commission.europa.eu/document/download/592ce466-d54d-4633-a908-ea936aa5269c_en?filename=Belgium%20-%20Draft%20updated%20NECP%202021-2030%20EN.pdf . See also Global CCS Institute (November 2023): CCS in Europe - Regional Overview, p. 16. Link: https://www.globalccsinstitute.com/wp-content/uploads/2023/12/CCS-in-Europe-Report_updated-15-12-23.pdf

104 More generally, the North Sea Basin Task Force aims to coordinate infrastructure development and expansion focussing on cross-border compatibility.

to facilitate cross-border transport and permanent geological storage of carbon.[105] Similar memoranda governing basic rules of cooperation (rather than specific projects) were signed with the Netherlands in 2023, and with Norway in 2024.[106] In March 2023, Project Greensand (see section 3.3) performed the world's first cross-border carbon storage activity, injecting 12.000 tCO2 of Flemish origin into a depleted Danish gas field.[107]

Flanders itself hosts several CCUS projects at different stages of development described in detail in the appendix A.2. These include:

- **CO2TransPorts**, a cross-border project focussed on the connection of three industrial clusters Antwerp, North Sea Port and Rotterdam via an onshore CO2 grid. The grid is planned to be connected to Dutch offshore storage sites via an offshore pipeline.[108] A final investment decision was taken in 2020, construction began in 2021 and operation is planned to start in 2026, with a transport capacity of up to 10 mtpa.[109]
- **Antwerp@C**, an open-access, modular CO2 facility providing port infrastructure for cross-border CO2 transport. The first project phase is set to provide 2.5 mtpa of initial export capacity with an additional expansion of up to 7.3 mtpa envisioned at a later point. The project received funding for feasibility studies from the Flemish Government and EUR 144.5m general project funding from the European Commission. The Open Season for initial demand for the project closed in February 2022.[110] Initially the FID was expected for end of 2022 and later postponed to the end of 2023, with the project set to become operational in H2 2026.[111] As of November 2024, a final investment decision is still pending.[112]

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105 Danish Ministry of Climate, Energy, and Public Services (2022): Memorandum on Cross Border Transportation of CO2 with the Purpose of Permanent Geological Storage. Link: https://www.fdfa.be/sites/default/files/2023-02/1289_MoU%20in%20het%20Engels.pdf . The agreement was signed in line with the London protocol (1972) on the prevention of marine pollution.

106 These memoranda were signed together with Wallonia. See the Memorandum of Understanding from June 2023 with the Netherlands (link: https://assets.vlaanderen.be/image/upload/v1687770246/img20230623_12455766_1_lrvsui.pdf) and the Memorandum of Understanding from April 2024 with Norway (link: https://assets.vlaanderen.be/image/upload/v1713359045/20240415_signed_MoU_CCS_BE_NO_z82q5d.pdf=.

107 European Commission (2023): Country Report on the Implementation of the CCS Directive, p. 3. Link: https://climate.ec.europa.eu/eu-action/industrial-carbon-management/deploying-industrial-carbon-management-europe/country-reports-implementation-ccs-directive_en. The CO2 was produced at the INEOS oxide plant in Zwijndrecht, Belgium.

108 International Association of Oil and Gas Producers Website (November 2024): Interactive Map of European CCS Projects. Link: https://iogpeurope.org/european-ccs-projects-map/#

109 International Energy Agency (2022): Belgium 2022 Energy Policy Review, p. 45. Link: https://iea.blob.core.windows.net/assets/638cb377-ca57-4c16-847d-ea4d96218d35/Belgium2022_EnergyPolicyReview.pdf

110 Fluxys (2024), CO_2: Preparing to build the network, Link: https://www.fluxys.com/en/projects/carbon-preparing-to-build-the-network#

111 European Commission (30/03/2023): The emerging EU CO2 transport and storage market, p. 132 Link: https://climate.ec.europa.eu/system/files/2023-05/policy_ccs_implementation_presentations_20230330_en.pdf

112 Borealis (undated): The Antwerp@C project takes a major next step towards halving CO2 footprint. Link: https://www.borealisgroup.com/news/the-antwerp-c-project-takes-a-major-next-step-towards-halving-co2-footprint

- **Kairos@C**, a combination of capture, purification, liquefication, storing and shipping infrastructure for CO2 from local industry clusters, with the potential to reduce over 14 mt of CO2 emissions over the first 10 years of operation (1.4 mtpa).[113] As of November 2024, a final investment decision is yet to be made.
- **Zeebrugge CO2 Collection Hub**, comprising an onshore transmission facility at Zeebrugge and a 1,000km export pipeline to offshore carbon storage facilities in Norway. The planned pipeline capacity amounts to 20 to 60 mtpa of CO2. Further connections e.g. to Dunkirk are also planned. The project is at the feasibility stage and an investment decision expected by 2025. [114]
- **EU2NSEA**, focussed on developing a cross-European CO2 network to connect offshore storage facilities in Norway. The planned capacity is estimated to be 20 to 40 mtpa, and cumulated yearly injection rates at offshore storages sites are estimated at >25 mtpa. Facilities in Flanders, e.g. export terminals in Zeebrugge, play a key role in the project's scope. Feasibility studies are being carried out in 2024/5, with a final investment decision currently scheduled for Q4 2025 and commissioning expected for 2029. In January 2025, the Commission awarded c. EUR 14m for preparatory studies under the CEF programme. [115]
- **Ghent Carbon Hub**, a carbon storage liquefaction, and shipping terminal near Ghent's port with an expected capacity to process 6 mtpa CO2 (c. 15% of Belgian industrial emissions). A feasibility study has started, and commissioning is provisionally targeted for 2027.

Figure 3.4 below provides an overview of the location and planned interconnection of the various projects, as depicted by Fluxys, the national gas transport operator and a stakeholder involved in most of the aforementioned initiatives and candidate to become the regional network operator.[116]

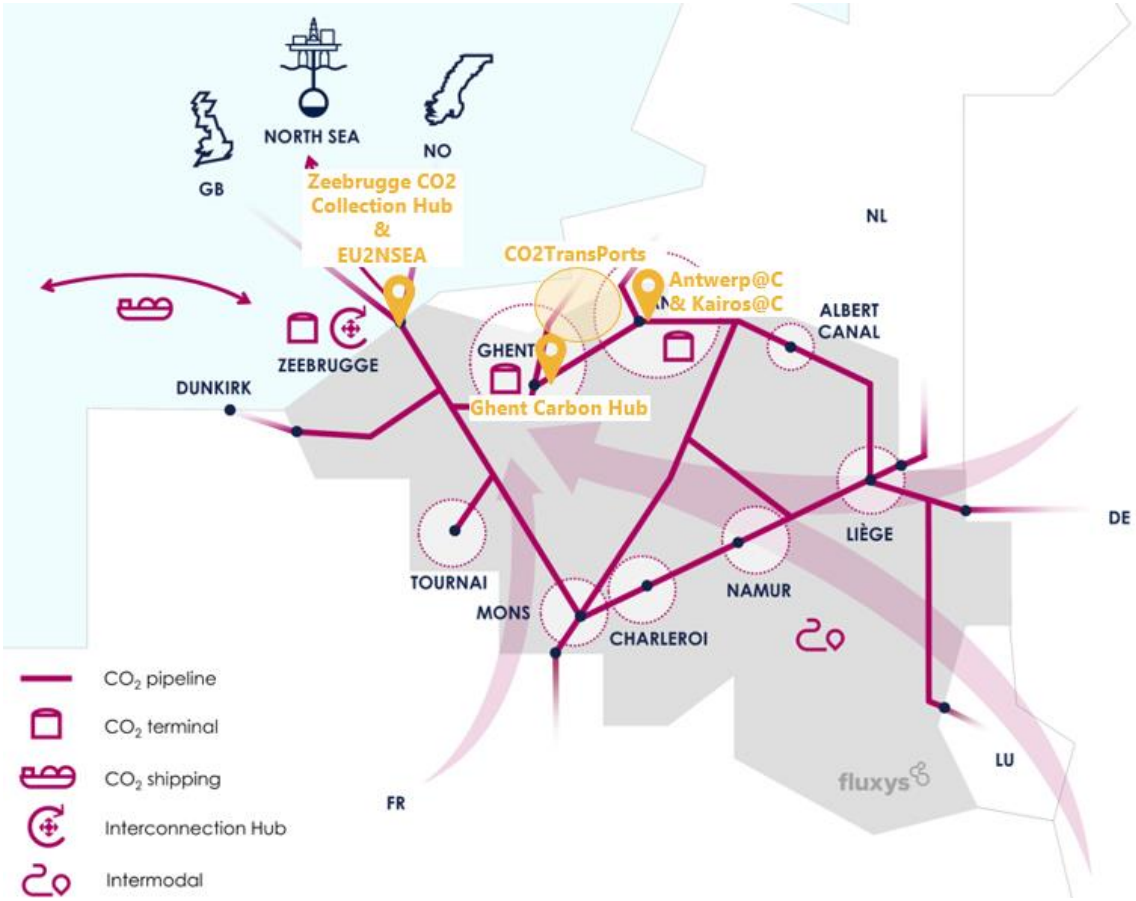
[113] European Commission (2022): Kairos@C. Building strong momentum for massive decarbonisation in the EU through a unique end-to-end CCS project. Link: if_pf_2022_kairos_en.pdf

[114] Equinor (November 2024). Link: https://www.equinor.com/news/fluxys-and-equinor-launch-solution-large-scale-decarbonisation

[115] See European Commission (30.01.2025) EU invests over €1.2 billion in cross-border infrastructure contributing to build our Energy Union and to boost competitiveness, Link: https://ec.europa.eu/commission/presscorner/detail/en/ip_25_377.

[116] Fluxys (November 2024): CO_2: Preparing to build the network . Link: https://www.fluxys.com/en/projects/carbon-preparing-to-build-the-network

Figure 3.4: Overview of planned CCS and CO2 transport projects (for all of Belgium)



Source: NERA based on Fluxys Website, Nov. 2024.[117]

The wealth of planned projects highlights Flanders' aspiration to be an interconnected CO2 hub, also building on its coastal and port infrastructure and existing industrial clusters. The above map also highlights the opportunity that Flanders' ambition brings for Wallonia, which has the potential to act as a transit country for German and French volumes that need to go through Wallonia to reach Flemish export infrastructure.

Key issues for the success of the transit opportunity will be tariffication at the Flemish-Walloon and international borders, as well as the interconnectedness of the Flemish plans, which have not yet reached a final investment decision (with one exception).

3.5. France

France published its CCUS strategy in July 2024 following a consultation of the draft strategy published in June 2023. In addition, the regulator, Commission de Régulation de l'Energie (CRE),

[117] Fluxys (November 2024). CO_2: Preparing to build the network Link: https://www.fluxys.com/en/projects/carbon-preparing-to-build-the-network

published two reports on CCUS in September 2024.[118] As of January 2025 CRE has not issued additional details and the further timeline is currently unclear.

France plans to follow a cluster-based approach to carbon capture and infrastructure development with several hubs in industrial centres across the country. The current strategy does not envision a full interconnectivity between these clusters. (See also Figure 3.5 below.) The French CCUS strategy foresees 3 phases for its CCUS deployment: [119]

- 2025-2030, capturing 4 to 8 Mtpa CO2/year from core industry, particularly in the industrial port hubs of Le Havre, Dunkirk, Saint-Nazaire and the Rhône corridor.[120]
- 2030-2040, capturing 12 to 20 MtCO2/year, driven by the development of new CCS networks through onshore storage facilities, regulatory changes in the European carbon market and the extension of CO2 capture to other emitting sectors, such as waste incineration, and to part of biogenic emissions.
- In 2040-2050, the profound decarbonization of industry and the achievement of climate neutrality should require the capture of 30 to 50 MtCO2/year. These volumes will require the capture of all residual emissions from high-emission industrial sites, and the development of new CO2 sources, such as biorefinery or, if necessary, atmospheric CO2 capture (Direct Air Capture, DAC).

In terms of CO2 storage, France is working within the European and bilateral frameworks to facilitate access to storage facilities in the North Sea and Mediterranean, which in the short term represent the only operational outlets for French emissions. France signed a strategic partnership in January 2024 with Norway (the most advanced European country in terms of CCUS) to store 1.5 MtCO2/year by 2025 and then up to 5 MtCO2/year by 2026 in storage sites in the Norwegian North Sea.[121] By 2030, France is aiming to develop national storage capacities, by assessing French storage potential and financing actions to improve knowledge of the subsoil. [122] However, on 30th November the project sponsors including Terega (the TSO) and emitters Lafarge, Arcelor Mittal and Repsol announced that they had scrapped the Pycasso project in Southwestern France (the light blue Southern onshore storage area in the image below) due to local opposition and concerns over potential risks.[123]

Figure 3.5 shows the main capture, transport and storage areas identified by the French CCUS Strategy, highlighting the decentralized plan for CO2 development in France. In January 2025 the

[118] CRE (2024): Rapport de la CRE sur le cadre de régulation des infrastructures d'hydrogène et de dioxyde de carbone. CRE (2024): Le captage et la chaîne de valeur du dioxyde de carbone.

[119] Ministère de l'économie, des finances et de la souveraineté industrielle er numerique (2024): État des lieux et perspectives de déploiement du CCUS en France, p. 12ff.

[120] The strategy expects that two CCUS hubs could be deployed by 2030 with the first potentially operational as early as 2028.

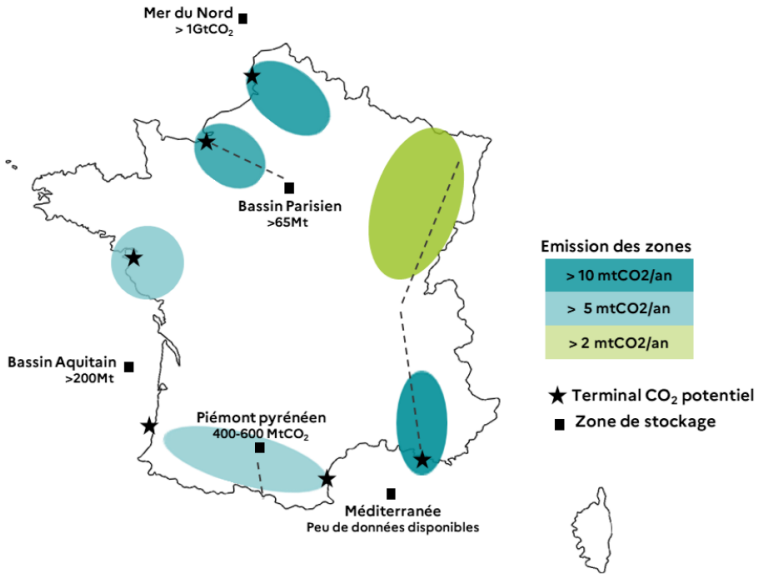
[121] See Dametis (10/09/2024) Stratégie CCUS et capture du CO2 : où en est la France ?, Link:https://www.dametis.com/strategie-ccus-et-capture-co2-ou-en-est-la-france/

[122] Ministère de l'économie, des finances et de la souveraineté industrielle er numerique (2024): État des lieux et perspectives de déploiement du CCUS en France, p. 4.

[123] See Carbon Herald (29/10/2024) Pycasso Project Abandoned: A Setback For France's Carbon Capture Goals, Link: https://carbonherald.com/pycasso-project-abandoned-a-setback-for-frances-decarbonization-goals/

Commission awarded funding of c. EUR 25m for preparatory studies for three French CO2 transport projects.[124]

Figure 3.5: French Emission Zones and Planned Storage Areas



Source: Ministère de l'économie, des finances et de la souveraineté industrielle er numerique (2024): État des lieux et perspectives de déploiement du CCUS en France, Figure 1.

3.6. Germany

Germany had essentially outlawed CCS in 2012 when it passed a law that delegated permitting of CCUS to state governments who were reluctant at the time because of local opposition. Discussion of CCUS as a realistic possibility restarted in the early 2020s, with the government starting an extensive participation process in October 2022 to develop a Carbon Management Strategy (CMS) involving industry, NGOs and various other stakeholders. In parallel, the German Government developed a draft revision of the carbon transport and storage law (KSpTG) that had its first reading in parliament on 27th September 2024. The development of a policy framework for CCUS was interrupted by the collapse of the three-party government coalition in November 2024 which interrupted both the processing of the CMS and the passage of the KSpTG through parliament.

The existing draft Carbon Management Strategy (CMS) dated 11th September 2024 estimates that 34 mtpa of CO2 from hard-to-abate sources have to be captured in 2045 to reach GHG neutrality in

[124] Two projects are located in the Grand Ouest and the Rhone area, while the third project concerns the connection of the French CO2 network to CO2 Highway Europe (see section 3.2). See European Commission (30.01.2025) EU invests over €1.2 billion in cross-border infrastructure contributing to build our Energy Union and to boost competitiveness, Link: https://ec.europa.eu/commission/presscorner/detail/en/ip_25_377.

that year.[125] Germany will likely rely substantially on CO2 exports, to storage facilities in other European countries, e.g. in the North Sea.

The draft law on carbon transport and storage (KSpTG) contains a number of legislative changes necessary for the implementation of the CMS. The law allows for nationwide offshore storage and provides the option to allow onshore carbon storage within their territory to the individual federal states ("opt-in"). While the KSpTG was not passed before the federal election and has to be processed in the next legislative period, it is equally unclear whether any federal states would indeed be willing to take on local opposition to develop onshore storage facilities.[126] Given the previously negative position on CCS in Germany, development of storage capacity before 2030 is currently considered unlikely by authorities and market participants.[127]

To enable exports of CO2, e.g. to offshore storage facilities in Norway, the remaining minority coalition government put an amendment of the London Protocol up for ratification by Parliament on 2nd December 2024.[128] The amendment is a necessary step to legalise commercial offshore transport and storage of CO2. It was not passed in the final parliamentary sessions before the election of a new parliament on 23rd February 2025, despite a supporting position of the second chamber, the Federal Council.[129] In April 2023, Denmark and Germany signed a joint declaration to cooperate on CCUS and set up a working group. Its tasks comprise developing a regulatory framework for CCUS and consider a bilateral agreement enabling cross-border CO2 transportation and storage.[130]

The expected focus on CO2 export to non-domestic storage facilities will affect the layout of the German CO2 grid. International storage capacities in the North (Denmark, Norway) and Northwest (Belgium, Netherlands) will be connected to several emission clusters in the Ruhr area, the Rhine-Neckar area, the cement industry in North Rhine-Westphalia and the Central German Chemical

125 Federal Government (11/09/2024) Carbon Management Strategie der Bundesregierung – Entwurf BMWK. Link: https://www.klimareporter.de/images/dokumente/2024/09/carbon-management-strategie-breg.pdf.

126 One aspect currently under discussion is whether CO2 infrastructure needs to be classified as of „extraordinary public interest". The current KSpTG draft does not include such a provision, but market participants indicated that this could be crucial for the timely development of a CO2 pipeline infrastructure. Source: Oral statements at Forum für Zukunftsenergien (04/12/2024): CCS in Deutschland – Welche Möglichkeiten der Dekarbonisierung ergeben sich perspektivisch für die Industrie? (in-person conference).

127 Oral statements by representative of BMWK and various representatives of the industrial sector in context of the following conference: Forum für Zukunftsenergien (04/12/2024): CCS in Deutschland – Welche Möglichkeiten der Dekarbonisierung ergeben sich perspektivisch für die Industrie? (in-person conference).

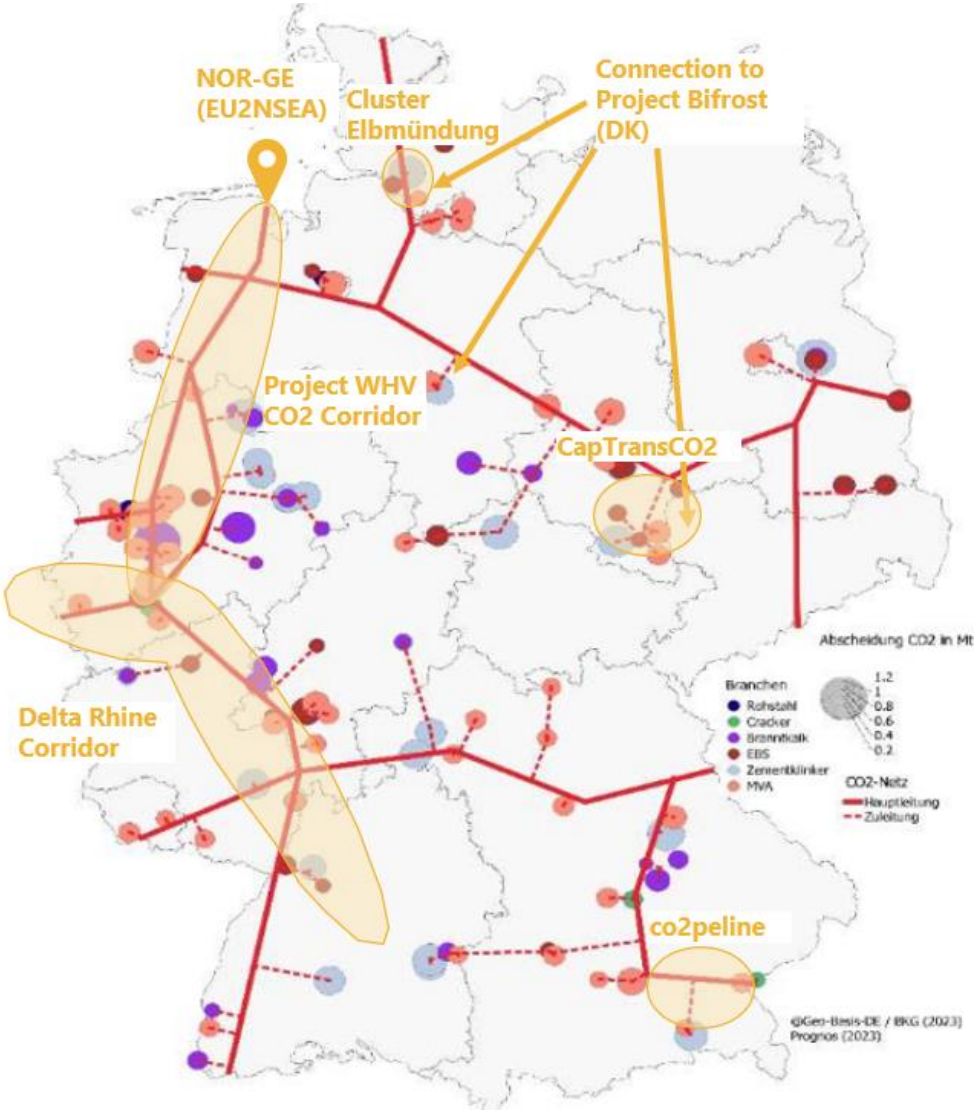
128 Bundesregierung (02/12/2024): Bundesregierung will Export von CO2 erlauben. Link: https://www.bundestag.de/presse/hib/kurzmeldungen-1032298.

129 See Deutscher Bundestag (as of 11/02/2025) Gesetz zu den Entschließungen LP.3(4) vom 30. Oktober 2009 und LP.5(14) vom 11. Oktober 2019 über die Änderung des Artikels 6 des Protokolls vom 7. November 1996 zum Übereinkommen über die Verhütung der Meeresverschmutzung durch das Einbringen von Abfällen und anderen Stoffen von 1972 (Londoner Protokoll), Link: https://dip.bundestag.de/vorgang/gesetz-zu-den-entschlie%C3%9Fungen-lp34-vom-30-oktober-2009-und/317514

130 Joint Declaration of Intent (24/04/2023). Link: https://www.bmwk.de/Redaktion/DE/Downloads/Energie/joint-declaration-germany-denmark-cooperation-carbon-capture.pdf?__blob=publicationFile&v=6.

Triangle (*Chemiedreieck*). The draft CMS estimates that a German CO2 grid could span 4,500 km in 2045 (see Figure 3.6).

Figure 3.6: Potential German CO2 grid in 2045



Source: Prognos AG, 2023.[131]

In 2023, Germany and Norway agreed to initiate a joint feasibility study analysing the possibilities for CO2 transport from Germany to Norway (and for hydrogen transport from Norway to Germany).[132] The Ministry for Economic Affairs and Climate Action (*Bundesministerium für Wirtschaft*

131 The German Ministry for Economic Affairs and Climate Action (September 2024): Draft Carbon Management Strategy, p. 25. Link: https://www.klimareporter.de/images/dokumente/2024/09/carbon-management-strategie-breg.pdf.

132 The Norwegian Government (January 2023): Joint Statement of Germany and Norwegen on Hydrogen. Link: https://www.regjeringen.no/no/aktuelt/dep/smk/pressemeldinger/2023/tettere-samarbeid-mellom-norge-og-tyskland-for-a-utvikle-gronn-industri/joint-statement-germany-norway-hydrogen/id2958105/. See also the Global CCS Institute (March 2024): CCS in Germany's Decarbonisation Pathway. – State of Play and Forward. Link: https://www.globalccsinstitute.com/wp-content/uploads/2024/03/CCS-in-Germany.pdf.

und Klimaschutz; BMWK) envisions a rollout of the CO2 grid from North to South. During the development phase of the grid until 2030, alternative transport routes such as shipping, rail, and truck will also be relevant.

Private sector estimates of a future CO2 grid exceed the Government's plans. The Association of German Cement Producers estimates a required transport volume for the sectors cement, lime and waste to energy to be 35 mtpa by 2040 (relative to 34 mtpa in the CMS), with additional capacities required for CO2 from biogenic sources, and transit flows.[133] A study commissioned by the Association estimates a total of 4,800 km of pipelines (relative to 4,500 in the CMS) but does not substantially differ geographically from the CMS' forecast shown in Figure 3.6. The study estimates the cost for such a network at EUR 14bn and the transportation cost at EUR/t CO2 25-35.

Three distinct major project clusters are developing carbon transport systems in three German regions However, no single CCS project in Germany has reached a final investment decision yet:[134]

- In **Western Germany**, gas TSO OGE plans to develop a CO2 grid with a major North-South axis along the Rhine and two parallel east-west-axes in Southern and Northern Germany.[135] OGE anticipates export flows through their grid to Norway (via Wilhelmshaven), Belgium, the Netherlands, and Denmark. Import and transit flows are anticipated from France, Switzerland, Austria, and the Czech Republic.[136] Four separate pipeline projects are being developed by OGE, none of which have taken a final investment decision yet:
  - A 70 km network of pipelines near Brunsbüttel (**Cluster Elbmündung)** in Northern Germany to connect local emitters to recycling and storage sites. The project's realisation is planned for the late 2020s.

[133] VDZ (2024): Anforderungen an eine CO2-Infrastructure in Deutschland – Voraussetzungen für Klimaneutralität in den Sektoren Zement, Kalk und Abfallverbrennung, p. 9-14. Link: https://www.vdz-online.de/fileadmin/wissensportal/publikationen/zementindustrie/VDZ-Studie_CO2-Infrastruktur-Deutschland.pdf.

[134] In addition to the various pipeline projects in Northwestern Europe, e.g. the multimodal C Zero hub in Duisburg will provide storage and barge loading capacity to export CO2 to a variety of CO2 storage sites in the North Sea as part of the cross-border Nautilus CCS project. This project focusses on collecting, transporting and storing carbon from French and German industrial emitters. As exports are ship- rather than pipeline-based, this project, this transport route could be an alternative for emitters, especially during the ramp-up phase. See European Commission (15/05/2024), Technical information on PCI and PMI, p. 86, Link: https://energy.ec.europa.eu/document/download/944b96b9-4efd-44a3-bbfe-45b752b0b55f_en?filename=Technical_document_1st%20PCI_PMI%20list_15.05.2024_FINAL.pdf

[135] See the OGE Website (22/11/2024): Our CO2 transportation grid starts, Link: https://oge.net/en/co2/co2-grid.

[136] OGE (5-6/09/2024-Presentation on CO2 transport infrastructure, given at the conference „Science meets Business IV" , p. 5. Link: https://sci4climate.nrw/wp-content/uploads/2024/10/20240906_WtW_Forum_3.2_Brauner_OGE_CO2-Infrastruktur.pdf.

  - **Project WHV CO2 Corridor** is to connect an export hub in Wilhelmshaven with emitters in East Westphalia and the Ruhr area. The connection is to be established by 2045.[137] Under the CEF scheme, the project received c. EUR 6m for preparatory studies in January 2025.[138]
  - The **Delta Rhine Corridor** will connect clusters in the Rhineland Region, the Ruhr Area, Rhineland-Palatine, the Dutch Chemelot Industrial Park[139], and the Rotterdam Area to CO2 export infrastructure in the Rotterdam harbour (see section 3.7). A feasibility study for the project was launched in 2024 with construction currently set to begin in 2028. The project has received PCI status and was awarded EUR 9m CEF funding for preparatory studies by the Commission in January 2025.[140]
  - Cross-border pipeline project "**North Sea CO2 Corridor**" is to connect emission clusters in Southern Germany and the Rhineland to the Belgian CO2 network to establish a connection to Antwerp and future offshore pipelines. In January 2025, the Commission awarded c. EUR 3m for a study to support the planning and approval of the project.[141]

- In **Central Germany**, emitters are developing the **CapTransCO2** project to capture, process, and transport CO2 from process emissions for later storage and utilisation. A state subsidised feasibility study was conducted from 2021 to 2023. It estimates an emission potential of 4.9 mtpa of CO2 by 2030 from process emissions, biogenic sources and waste to energy. At a later stage export to long-term storage sites is considered. Commissioning is planned for 2033.
- In **Southeastern Germany**, the **co2peline** project seeks to connect carbon emitters in Bavaria and Upper Austria with industrial centres in Southeast Bavaria where the CO2 will be used in industrial processes.[142] A subsequent expansion to other parts of Bavaria and other international carbon transport networks for access to permanent geological storage sites is considered by the developing consortium. A feasibility study has been presented in 2023.

A variety of additional, cross-border CO2 transport infrastructure projects are currently under study/ early-stage development:

- An onshore pipeline system for CO2 connecting Leipzig and Hannover with Hamburg, for further exports to Denmark via shipping or onshore pipeline to **Project Bifrost** (see section 3.3) is planned.

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137 OGE (2024)::OGE Sustainability Report (March 2024), p. 49-50. Link: OGE_Nachhaltigkeitsbericht_2023_EN.pdf. For example, the Norwegian carbon storage project "Northern Lights" is currently anticipating that shipping routes to carbon storage sites in Norway will begin, inter alia, in Wilhelmshaven.

138 See European Commission (30.01.2025): EU invests over €1.2 billion in cross-border infrastructure contributing to build our Energy Union and to boost competitiveness, Link: https://ec.europa.eu/commission/presscorner/detail/en/ip_25_377.

139 Chemelot is an industrial complex primarily for the chemical industry located in the Dutch province of Limburg.

140 See European Commission (30.01.2025): EU invests over €1.2 billion in cross-border infrastructure contributing to build our Energy Union and to boost competitiveness, Link: https://ec.europa.eu/commission/presscorner/detail/en/ip_25_377.

141 See European Commission (30.01.2025): EU invests over €1.2 billion in cross-border infrastructure contributing to build our Energy Union and to boost competitiveness, Link: https://ec.europa.eu/commission/presscorner/detail/en/ip_25_377.

142 CO2Pipeline (03/12/2024): Project website, Link: https://www.co2peline.com

- **CO2nnectNow**, a carbon terminal for carbon collection via pipeline or rail for further transport to the North Sea, with an interim storage capacity of 50,000 tonnes and an eventual transit flow capacity of 10 mtpa. Project partners are Wintershall Dea and HES Wilhelmshaven. Feasibility studies have been concluded, and a possible commissioning date estimated for 2029.[143]
- The **NOR-GE Project**, a sub-project of EU2NSEA (see Appendix A.2), is to develop a 900-kilometre-long pipeline connecting the CO2 collection hub in Wilhelmshaven to Norwegian storage sites.[144] The pipeline project has a planned capacity of 20 to 40 mtpa and an expected commissioning date in 2030. The project also considers transport by ship on the same route as an early deployment solution.[145]

Given Germany's expected substantial reliance on CO2 export (potentially including through Belgium), CCS developments in Germany have a direct impact on Wallonia both in terms of the transit flows they generate but also in light of Germany's need to create competitive cross-country infrastructure to support exports. The planning and layout of key German infrastructure projects will determine the degree to which Wallonia will benefit from CCS projects by German emitters. Currently, the plans for the North Sea CO2 Corridor indicate a route crossing Wallonia, while the Delta-Rhine Corridor project focusses on a connection to the Netherlands. While Germany was progressing its regulatory framework (see section 5.5) and support schemes (see section 4.5) throughout 2023 and 2024, the collapse of the government in November 2024 halted any progress before the federal election on 23rd February 2025.

3.7. Netherlands

The Dutch Climate Act (Klimaatwet) of 2019 sets legally binding greenhouse gas (GHG) emissions reduction targets for the Netherlands. The Dutch Climate Act was last updated in 2023, to reflect the tightening of the climate targets at the European level under the Fit-for-55 package and European Climate Law.[146] Under the latest Climate Act, the Netherlands has committed to achieving climate neutrality by 2050 and carbon neutrality in the electricity sector by 2035. To achieve these goals, the Climate Act also mandates the reduction of at least 55 per cent emissions by 2030 compared to 1990 levels. In practice, according to the latest National Energy and Climate Plan (NECP) 2021-2030, the government set the actual target at 60 per cent to facilitate reaching the 55 per cent goal even in case of shortfalls.[147]

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143 Deutsche Verkehrs-Zeitung (25/03/2024): „Wilhelmshaven; CO2-Hub könnte 2029 in Betrieb gehen". Link: https://www.dvz.de/unternehmen/see/detail/news/wilhelmshaven-co2-hub-koennte-2029-in-betrieb-gehen.html

144 Wintershall Dea and Equinor plan to jointly apply for offshore CO2 storage licenses and aim to store 15-20 mtpa of CO2 on the Norwegian Continental Shelf.

145 Wintershall Dea (August 2022): Wintershall Dea and Equinor partner up for large-scale CCS value chain in the North Sea. Link: https://wintershalldea.com/en/newsroom/wintershall-dea-and-equinor-partner-large-scale-ccs-value-chain-north-sea.

146 Climate Change Laws of the world (n.d.): Climate Act (Klimaatwet). Link: https://climate-laws.org/document/climate-act_4bc4%3Fl=netherlands&c=Legislation.

147 European Commission (June 2024), Update of the National Energy and Climate Plan 2021-2030, p. 28.

The updated target was set ahead of the election of the new Dutch government on 2nd July 2024, and as such these values are subject to change based on the new government's statements.

In this context, the Netherlands does not have a formal target for Carbon Capture Storage (CCS). However, the Dutch government sees CCS as "crucial" to achieving its emission targets and carbon neutrality by 2050,[148] and a "necessary solution" to achieving CO2 reduction in sectors where affordable sustainable alternatives are not (yet) available in the short term.[149] Specifically, the Dutch government expects CCS to contribute the most to its emission reduction targets for the industrial sector. In a joint letter in October 2023, the Minister for Climate and Energy and the State Secretary of Economic Affairs and Climate noted that 33.2 mtpa CO2 emissions had been reduced in 2021.[150] To achieve the Dutch emissions reduction target of 66 per cent compared to 1990 levels (when total industry emissions were c. 86.8Mt), the industrial sector has to further reduce its emissions by 23.6 mtpa.[151] According to the Dutch government, CCS has the potential to contribute up to half of that reduction target by 2030.[152]

Despite the lack of formal targets for CCS in the Netherlands, in its NECP 2021-2030, the Dutch government supports the scaling up of European CO2 injection and storage capacity as set out in the recently approved European Net Zero Industry Act (NZIA) which foresees a target of 50 mtpa of CO2 injection and storage capacity by 2030 at the European Union level.[153] Whilst the obligation to meet the target is set on EU oil and gas producers (and not Member States), the NZIA will contribute to the development of the CCS sector in the Netherlands: based on publicly announced industry initiatives to develop CO2 storage sites in the North Sea, the government expects around 10-15 mtpa of injection capacity to come online by 2030.[154]

Several CO2 infrastructure projects are currently underway in the Netherlands, which are at different stages of development. The two major projects are Porthos and Aramis in the Port of Rotterdam.

Porthos Project. The project aims to capture CO2 emissions from industry in the Port of Rotterdam and transporting and storing them in a depleted gas field under the North Sea.[155] The project is led by a consortium including the Port of Rotterdam, Gasunie (a limited company, fully owned by the Dutch state, and managing the existing gas transport network) and EBN (a natural gas exploration, production, transport and sale company owned by the Dutch Government). The CO2 transport

148 Ministry of Economic Affairs (EZK) (3 October 2023), Marktontwikkeling en ordening van CO2-transport en opslag, Brief aan Tweede Kamer der Staten-Generaal, Kamerstuk 32 813, n. 1298, 3 oktober 2023.

149 Ministry of Economic Affairs (EZK) (June 2024), Update van het Integraal Nationaal Plan Energie en Klimaat 2021-2030, p.70 ("NECP 2021-2030" hereafter).

150 Ministry of Economic Affairs (EZK) (3 October 2023), Marktontwikkeling en ordening van CO2-transport en opslag, Brief aan Tweede Kamer der Staten-Generaal, Kamerstuk 32 813, n. 1298, 3 oktober 2023.

151 Ministry of Economic Affairs (EZK) (3 October 2023), Marktontwikkeling en ordening van CO2-transport en opslag, Brief aan Tweede Kamer der Staten-Generaal, Kamerstuk 32 813, n. 1298, 3 oktober 2023.

Rijksoverheid (August 2024), Emissieregistratie – Overzicht broeikasgassen. Link: https://www.emissieregistratie.nl/data/overzichtstabellen-lucht/broeikasgassen.

152 Ministry of Economic Affairs (EZK) (3 October 2023), Marktontwikkeling en ordening van CO2-transport en opslag, Brief aan Tweede Kamer der Staten-Generaal, Kamerstuk 32 813, n. 1298, 3 oktober 2023.

153 European Parliament and Council (June 2024), Regulation (EU) 2024/1735, Art. 20.1.

154 NECP 2021-2030, p.70.

155 The field's capacity is equal to 37 mtpa. Source: Porthos (as of 2024), Project website. Link: https://www.porthosco2.nl/en/project/#:~:text=Porthos%20will%20store%20about%2037,infrastructure%20started%20in%20early%202024.

service will be operated by Gasunie which will provide a local low pressure connection network between the emitters in the Rotterdam Port area. Storage will be provided by separate operators.

The Porthos CO2 transport and storage infrastructure has been set up as an open-access and non-discriminatory system to which multiple companies (emitters) can connect. Capture is the responsibility of the emitters in the Port of Rotterdam area and Porthos will exclusively provide the transport and storage services.

As the project was being developed, Porthos organised an open season for emitters to express interest in accessing the CO2 transport and storage infrastructure. Following the open season, Porthos signed transport and storage contracts with four emitters (Air Liquide, Air Products, ExxonMobil and Shell) that together booked the full capacity of the project. Overall, 2.5 mtpa are planned to be captured and stored from hydrogen production by Air Liquide and Air Products and the Shell and ExxonMobil refineries for a period of 15 years.[156]

The Porthos project received financial support and subsidies for its development:[157]

- In 2018 Porthos received a EUR 1.2 million subsidy from the Netherlands Enterprise Agency (Rijksdienst voor Ondernemend Nederland, RVO) for the preparatory studies and €6.5 million in subsidies from the European Commission under the Connecting Europe Facility (CEF) Energy funding program for engineering studies, impact assessments and technical planning.[158]
- For the realisation of the infrastructure, Porthos was recognised as a Project of Common Interest (PCI) and received a EUR 102 million grant in 2021 from the CEF.
- In 2021, Porthos' customers (emitters) were awarded SDE++ subsidies. As explained in Section 4.6 below, the Stimulering Duursame Energieproduktie en Klimaattransitie (SDE++) subsidy scheme (SDE++) is the main government program for encouraging CCS development in the Netherlands and allows for bridging any difference between the cost of the European Emission Trading Scheme (ETS) and the total cost of capture, transport and storage.

The final investment decision (FID) for Porthos was taken in October 2023. Construction of the Porthos infrastructure started in early 2024 and the system is expected to be operational during 2026.[159]

Aramis Project. The project is a collaboration between TotalEnergies, Shell, EBN and Gasunie and will allow for the transport and storage of CO2 from industry in the Rotterdam area to an offshore depleted gas field in the North Sea.[160] As Figure 3.7 shows, the CO2 is captured by emitters,

156 Porthos (as of 2024) Project website. Link: https://www.porthosco2.nl/en/project/.

157 Porthos (as of 2024) Project website. Link: https://www.porthosco2.nl/en/faq/.

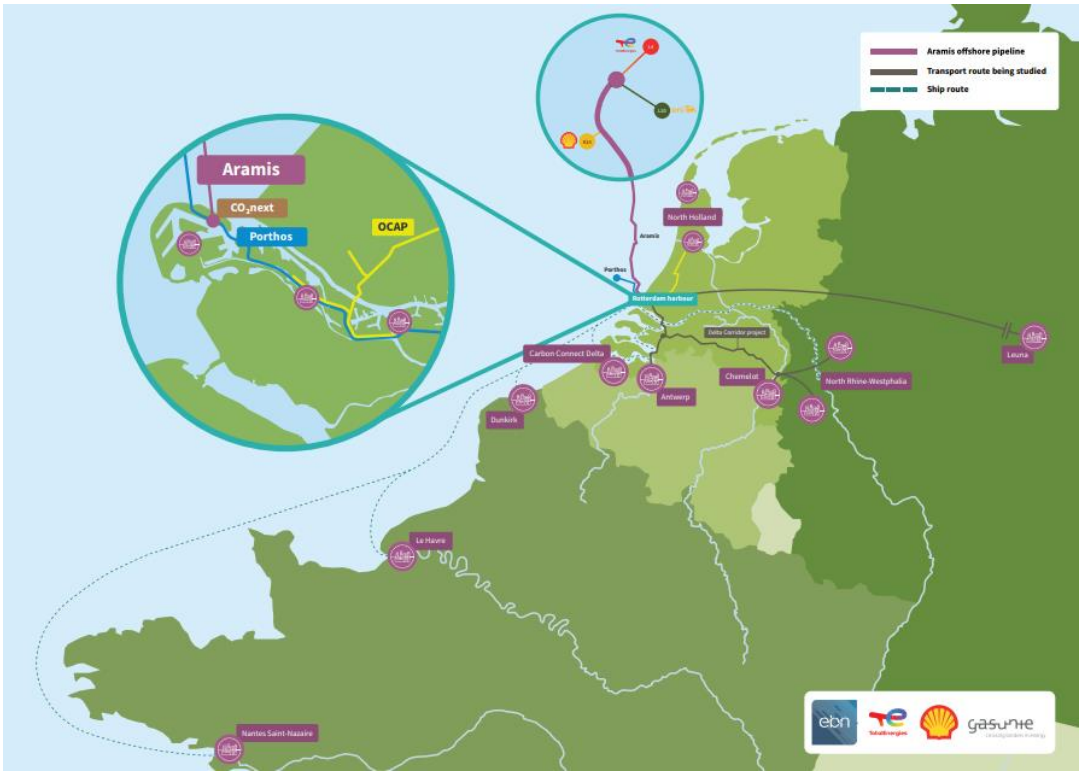
158 European Climate, Infrastructure and Environment Executive Agency (June 2024), CEF Energy: reducing the carbon footprint of European industrial hubs. Link: https://cinea.ec.europa.eu/news-events/news/cef-energy-reducing-carbon-footprint-european-industrial-hubs-2024-06-28_en#:~:text=CEF%20Energy%20funding%20for%20crucial,and%20compliance%20with%20environmental%20regulations.

159 Porthos (as of 2024) Project website. Link: https://www.porthosco2.nl/en/project/.

160 The combined capacity of the depleted fields is 400 mtpa: Source: Aramis (as of 2024) Project website, Link: https://www.aramis-ccs.com/faq/#:~:text=The%20project%20expects%20to%20transport,400%20Mt%20of%20storage%20capacity

transported via onshore pipelines or ship to the CO2 collection hub and then transported through an offshore pipeline to the offshore distribution platform in the North Sea. From there, the CO2 is further transported to the injection platforms operated by the different storage companies (TotalEnergies, Shell and Eni) and injected by the latter via wells into the depleted gas fields.[161] To launch the project, Aramis aims to transport a minimum of 7.5 mtpa of CO2 through the offshore pipeline, which is based on the current reservoir capacity of the storage operators.[162] However, the offshore pipeline has been designed to transport up to 22 mtpa to various storage facilities in the North Sea – which provides opportunities for expansion if demand for CO2 storage increases in the future.

Figure 3.7: Schematic Illustration of Project Aramis



Source: Aramis (August 2024), Aramis Brochure, p.7, link: https://www.aramis-ccs.com/files/Aramis-brochure_aug24_ENG.pdf

From a commercial perspective, the Aramis project aims to operate as an open-access transport infrastructure system open to third parties in line with the EU CCS Directive transposed in the Dutch Mining Act (see section 5.6 for further details).[163] However, following an informal assessment by the ACM (the Netherlands Authority for Consumers and Markets), it was agreed that the first 5 mtpa of transport would be jointly marketed by TotalEnergies and Shell to emitters under a 15-year transport

[161] Aramis (August 2024), Aramis Brochure. Link: https://www.aramis-ccs.com/files/Aramis-brochure_aug24_ENG.pdf.

[162] Aramis (August 2024), Aramis Brochure, p.8. Link: https://www.aramis-ccs.com/files/Aramis-brochure_aug24_ENG.pdf.

[163] Aramis (August 2024), Aramis Brochure, p.4. Link: https://www.aramis-ccs.com/files/Aramis-brochure_aug24_ENG.pdf.

and storage contract with a jointly determined tariff for all CCS services.[164] The rationale for the joint-marketing effort between two competing actors (TotalEnergies and Shell), as explained by the Aramis project partners to the ACM, is that the risks associated to the Project are very large – due to the very high upfront costs - and a 5 mtpa "start-up" volume (around 20 per cent of the pipeline capacity) is required to reduce the risk and promote the launch of the project.[165]

The remaining capacity will be used by the project parties (TotalEnergies and Shell) and will also be open to third parties in competition with each other. Third parties will be granted access to the Aramis infrastructure under reasonable, open and non-discriminatory terms and conditions in line European CCS Directive, as transposed in the Dutch Mining Act.[166] See Section 5.6 for more details on the current light-touch regulatory regime applied by Dutch authorities.

In December 2023, the European Commission designated the Aramis project as a Project of Common Interest (PCI) and granted a €124 million subsidy under the CEF programme for the construction of the offshore pipeline and offshore distribution platform.[167] Another CEF grant worth EUR 55m for construction works of the L10 CO2 storage facility which is part of the Aramis project, was awarded by the Commission in January 2025.[168] According to the Dutch government, it is expected that the CO2 emitters using the Aramis system will apply for support from the Dutch Government via the 2024 SDE++ subsidy scheme.[169]

Finally, in December 2022 the Dutch government has added the Aramis project to its multi-year energy and climate infrastructure programme (*Meerjarenprogramma Infrastructuur Energie en Klimaat*, MIEK). This means that Aramis is a designated project of national importance and therefore gets priority over other projects in the planning process by grid operators as well as being given access to "acceleration options" to shorten permitting procedures and avoid delays.[170]

The project has recently moved into the Front-End Engineering Design (FEED) phase, with plans for further development in 2024 and final investment decision by 2025. If these timelines are met, commercial operation is expected in 2028, with expansion and scale up to the 22 mtpa capacity expected only after 2030.[171]

As the above projects show, an important role in developing the CCS infrastructure and market is currently being played by Dutch state-owned companies (namely EBN and Gasunie). However, as

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164 ACM (27 June 2022), No action letter for the Agreement between Shell and TotalEnergies regarding a joint marketing initiative for CCS services (project Aramis), p.2.

165 ACM (27 June 2022), No action letter for the Agreement between Shell and TotalEnergies regarding a joint marketing initiative for CCS services (project Aramis), p.2.

166 ACM (27 June 2022), No action letter for the Agreement between Shell and TotalEnergies regarding a joint marketing initiative for CCS services (project Aramis), p.3.

167 Aramis (August 2024), Aramis Brochure, p.11, link: https://www.aramis-ccs.com/files/Aramis-brochure_aug24_ENG.pdf

168 See European Commission (30.01.2025) EU invests over €1.2 billion in cross-border infrastructure contributing to build our Energy Union and to boost competitiveness, Link: https://ec.europa.eu/commission/presscorner/detail/en/ip_25_377.

169 Xodus (June 2024), 2024 SDE++ Aramis Carbon Capture and Storage Fee Review, Public Summary, p.3.

170 RVO website (June 2024), Hulp bij energie-infrastructuurprojecten in ruimtelijke plannen. Link: https://www.rvo.nl/onderwerpen/energiesysteem/energie-infrastructuur-ruimtelijke-plannen.

171 Aramis website. Link: https://www.aramis-ccs.com/project/. Accessed on 05.12.2024.

the CCS market develops over the coming five years, the Dutch government has stated that it will consider gradually reducing its commitment and public participation to allow more room for private players.[172]

Besides the Porthos and Aramis projects, there are a number of cross-border projects involving the Netherlands. Amongst those, on 5th December 2024 the Dutch government took the decision to prioritise the transport of CO2 and hydrogen through the **Delta Rhine Corridor (DRC)** over other transport modalities initially considered as part of the project, including ammonia and HVDC cables.[173] According to the Dutch government, the project as initially conceived proved to be too ambitious and complex, resulting in delays in its delivery. By limiting the scope to CO2 and hydrogen transport only, the project can proceed with a more certain timeline.[174] According to Gasunie, the hydrogen pipeline will be commissioned between 2031 and 2032, and the CO2 pipeline in 2033 at the latest.[175] The project involves BASF, Gasunie, OGE and Shell for the transport of CO2 and H_2 between Germany and the Netherlands (see Figure 3.) and includes a possible future expansion to Belgium (Antwerp). The project was included in the list of projects of common interest, resulting in an accelerated timeline for the licensing of this project.[176] The Commission granted the project EUR 9m funding for preparatory studies in January 2025.[177]

[172] Ministry of Economic Affairs (EZK), Kamerbrief over aanbieding rapport Verkenning van de marktordening voor Carbon Capture and Storage, Brief aan Tweede Kamer der Staten-Generaal, Kamerstuk 32 813, n. 1375, 16 april 2024, p.1-2.

[173] Ministry of Climate and Green Growth, Kamerbrief over scope en vervolg Delta Rhine Corridor, p.1. Link: https://open.overheid.nl/documenten/6321fef5-16b2-494a-8f08-ba2dd11e23f6/file

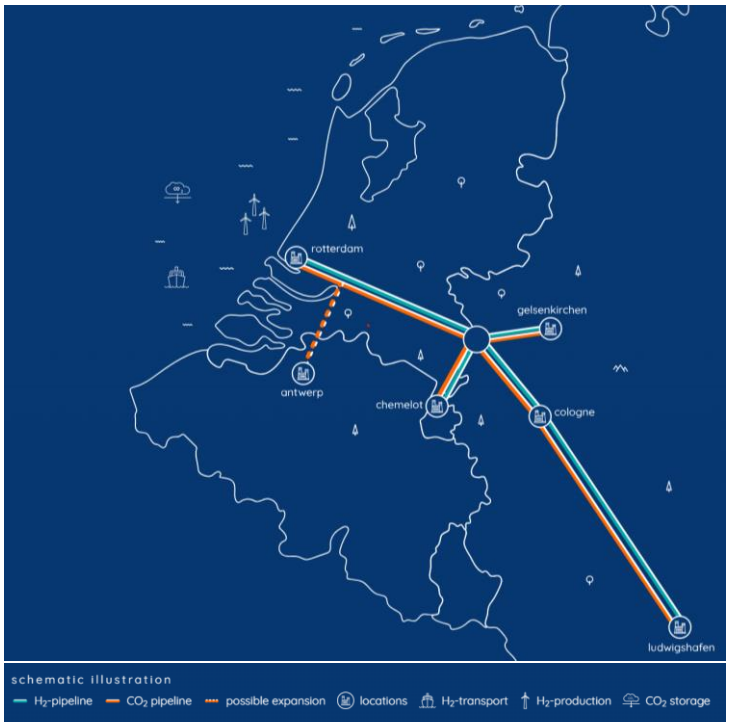
[174] Ministry of Climate and Green Grwoth, Kamerbrief over scope en vervolg Delta Rhine Corridor. Link: https://open.overheid.nl/documenten/6321fef5-16b2-494a-8f08-ba2dd11e23f6/file

[175] Ministry of Climate and Green Growth, Kamerbrief over scope en vervolg Delta Rhine Corridor, p.4. Link: https://open.overheid.nl/documenten/6321fef5-16b2-494a-8f08-ba2dd11e23f6/file

[176] DRC website. Link: https://www.delta-rhine-corridor.com/en

[177] See European Commission (30.01.2025) EU invests over €1.2 billion in cross-border infrastructure contributing to build our Energy Union and to boost competitiveness, Link: https://ec.europa.eu/commission/presscorner/detail/en/ip_25_377.

Figure 3.8: Schematic Illustration of the Delta Rhine Corridor CO2 and Hydrogen Project



Source: DRC website, link: https://www.delta-rhine-corridor.com/en

4. State support mechanisms

This section details the public support mechanisms that are set or planned for each actor in the value chain concerned by region and country (e.g. carbon contracts for difference, subsidised loans, …), their duration and their amount. We analyse both direct subsidies provided to CO2 transport projects directly and indirect subsidies provided e.g. to emitters.

Table 4.1 summarises the key subsidy regimes in each jurisdiction under consideration, highlighting the broad variety of scheme designs.

Table 4.1: Summary of direct and indirect subsidy regimes across jurisdictions

	EU	Denmark	Flanders	France	Germany	Netherlands
Direct support schemes						
Programme	(1) Connecting Europe Facility (Energy) (2) EU Innovation Fund	(1) CCUS Fund, CCS Fund, NECCS Fund*	N/A	N/A	N/A	N/A
Design	(1) CEF: Grants for PCI/PMI projects based on calls for proposals.[178] (2) EU IF: Support via grants, auctions, project development assistance and other financial instruments	(1) Tender for subsidies per t CO2 captures. Contracts with different lengths from 8 to 20y.	-	-	-	-
Budget [EUR]	Combined c. 68.5bn (partially depending on carbon price)	(1) 5.35bn (combined)	-	-	-	-
Availability	(1) CEF: 2021-2027 (2) EU IF: 2020-2030	(1) CCS Fund**: 2025 tender announced	-	-	-	-

[178] As indicated throughout chapter 3 and in section 4.1 below, various projects were granted status as projects of „projects of common interest" (PCI) and are eligible for funding from the CEF programme.

	Denmark	Flanders***	France	Germany	Netherlands
Indirect support schemes					
Programme	(1) CCUS Fund, CCS Fund, NECCS Fund* (2) EUDP (innovation) (3) Green tax	(1) Moonshot programme (2) Various funding schemes for e.g. feasibility studies, R&D projects, adoption of sustainable innovation …	(1) Carbon CfDs (planned) (2) Priority Research and Equipment Program (PEPR) (3) Zone Industrielle Bas Carbone (ZiBaC)	(1) Carbon CfDs (2) Federal Subsidy Programme for Industry and Climate Protection (BIK)	(1) SDE++ (2) R&D: DEI+, TSE Industry Studies and R&D
Design	(1) Tender for subsidies per t CO2 captures. Contracts with different lengths from 8 to 20y. (2) Subsidies for energy projects based on application assessment (3) Green tax for industry subsidies fund for CCS	(1) Support for industrial research/ innovations (2) Differs	(1) 15y CCfD: Auction plus qualitative criteria. Option for advance payment (2) Research subsidies (3) Subsidies with call for proposals	(1) 15y opex subsidy to emitters (2) Capped investment support	(1) SDE++: De facto one-sided carbon CfD (15y) also for CO2 capture, transport and storage; paid to emitter/ capture facility owner (2) Different subsidy and allocation approaches
Budget	(1) 5.35bn (combined) (2) 347m (total active) (3) N/A	(1) 400m (2) N/A	(1) Carbon CfD: N/A (2) PEPR: 35m (2023) (3) Part of France 2030 (total budget of 5.6bn)	(1) Carbon CfD:14.8bn (2) BIK: 3.3bn	(1) 6.7bn for CCS in 2024 (2) Combined 94.4m in 2024
Availability	(1) CCS Fund**: 2025 tender announced (2) continuous (3) N/A	(1) 2020-2040 (2) Differs	N/A for all programs	Uncertain for both programs	(1) SDE++: Phased approach (2) Various duration periods

	EU	Denmark	Flanders	France	Germany	Netherlands
Outlook						
Current initiatives	ICMS encourages member states to offer Carbon CfDs European Competitiveness Fund planned Target expansion, creation of single market for CO2 / regulatory package planned	Green Tax Reform: In 2025 increase and expansion of CO2 tax Potential fixed subsidy per t CO2 avoided for industry via auctions	Government is evaluating introduction of Carbon CfDs for CCU/CCS projects	-	Potential introduction of securities/ guarantees for financing of infrastructure projects	-
Policy change?	High, positive: expansion of tool-box expected although unclear how much funding will be available	Medium, positive: expansion of toolbox expected, but no further funds planned	High, positive: expansion of indirect subsidies with a structure program considered	High uncertainty due to government instability	Highly uncertain due to upcoming election and lack of secured funding	Limited, SDE ++ an established programme

Source: NERA analysis.

*Notes: * The funds provide support for the full CCS value chain, including CO2 transport providers and therefore classify as both direct and indirect subsidies. ** The CCUS Fund was integrated into the CCS Fund after the first round. No further tenders currently planned under NECCS fund. *** Like Walloon companies, Flemish companies will benefit from the removed tax restrictions concerning European funding for CCS/CCU investments. As a federal policy providing indirect support for projects across Belgium, it is not explicitly discussed here. Further information can be found in section 3.1.*

4.1. EU level

The European Commission provided new impetus for the development of a framework for the entire CO2 value chain in its 2024 ICMS (see section 3.2.). The ICMS stresses the need for investment and funding for research, innovation and early deployments as the European Commission estimates investment needs for transport infrastructure at EUR 6.2 to 9.2bn by 2030 and EUR 9.3 to 23.1bn until 2050.[179] The CCUS Forum expects a commercially viable market providing competitive returns to investors to emerge after 2030, as the EU ETS price signal will be essential for the commercial viability of CCS projects. Thus, the ICMS concludes that additional EU and national funding is necessary to support the scale up of industrial carbon management solutions, especially until 2030.[180]

Currently, the general use of CCS is supported by a panoply of EU funding regimes.[181] EU funding for carbon transport is mainly grant-based and sourced from the **EU Innovation Fund**, financed by revenues from the EU Emissions Trading System (EU ETS) and the **Connecting Europe Facility (CEF)**.[182]

The **EU Innovation Fund** provides funding for climate projects in sectors covered by the EU ETS. The Fund focusses on support for technologies which are not yet commercially viable but represent breakthrough solutions or are sufficiently mature for application on a pre-commercial scale. Its expected budget for the period 2020 to 2030 amounts to about 40bn EUR and is generated by ETS auction revenues. Hence, the exact size of the fund depends on the ETS price and the ensuing auction revenues. Grants are awarded mainly through calls for proposals and increasingly through competitive bidding processes. As of January 2025, 95% of projects received funding through calls for proposals, i.e. "regular funding".[183] The Fund provides up to 60% funding of relevant costs for regular grants and up to 100% funding when competitive bidding is used as allocation instrument. To date, the Innovation Fund has allocated support under the EU ETS Directive to 26 large- and small-scale CCS and CCU projects with more than EUR 3.3 billion in grants.[184]

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179 European Commission (2024): Towards an Ambitious Carbon Management for the EU, p. 20. Link: https://eur-lex.europa.eu/legal-content/EN/TXT/PDF/?uri=CELEX:52024DC0062.

180 As referred to in European Commission (2024): Towards an Ambitious Carbon Management for the EU, p. 20. Link: https://eur-lex.europa.eu/legal-content/EN/TXT/PDF/?uri=CELEX:52024DC0062.

181 While this report focusses on key subsidy programs for CO2 infrastructure, an overview of the main EU funds for CCS more generally is provided here: Global CCS Institute (February 2024): From proposals to reality: How EU funds can help jump-start CCS projects. Link: https://www.globalccsinstitute.com/wp-content/uploads/2024/02/From-Proposals-to-Reality-How-EU-Funds-Can-Help-Jump-Start-CCS-Projects-GCCSI.pdf

182 The Horizon Europe funding programme also supports CCUS-related research but does not have a focus on industrial-scale applications. See European Commission (27/02/2024): Driving the green revolution: the crucial role of carbon capture and utilisation research & innovation in the EU's industry transition, Link: https://projects.research-and-innovation.ec.europa.eu/en/strategy/strategy-2020-2024/environment-and-climate/european-green-deal/green-deal-projects-support/green-deal-resources/driving-green-revolution-crucial-role-carbon-capture-and-utilisation-research-innovation-eus

183 Projects are scored and ranked based on a set of criteria including i.) effectiveness of GHG emissions avoidance; ii.) degree of innovation; iii. project maturity; iv. replicability and iv.) cost efficiency.

184 EU Commission (as of 2024), What is the Innovation Fund. Link: https://climate.ec.europa.eu/eu-action/eu-funding-climate-action/innovation-fund/what-innovation-fund_en

CEF funding is open for projects of common interest (PCIs) and projects of mutual interest (PMIs), key cross-border infrastructure projects that link the energy systems of EU countries and benefit from accelerated permit granting, improved regulatory conditions, and increased public exposure.[185] The CEF energy strand has a budget of EUR 5.8bn for the period 2021-2027, and funds both the creation of new and the upgrade of existing infrastructure through project investments.[186] Twelve PCIs and two PMIs are currently being registered under the thematic area "cross-border carbon dioxide network", thus being eligible for CEF funding.[187] In January 2025, the Commission awarded funding worth EUR 250m to support the construction of three projects and the financing of nine preparatory studies for CO2 infrastructure under the CEF.[188]

The ICMS further encourages Member States to propose Carbon Contracts for Difference (CCfDs), schemes with subsidies covering the difference between the ETS carbon price and an agreed strike price to represent the project's CO2 abatement costs: To close the current gap between the carbon price and thus the cost for conventional solutions and the cost of carbon management projects, the ICMS promotes the implementation of Carbon Contracts for Difference (CCfDs) by Member States. CCfDs cover the difference between a carbon reference price (e.g. the EU ETS price) and a "strike price" reflecting a project's cost which is usually identified through competitive bidding (see Figure 4.1). Thus, CCfDs can de-risk investments by securing predictable revenues to project developers and investors. Member States need to notify state aid when implementing a CCfD regime.

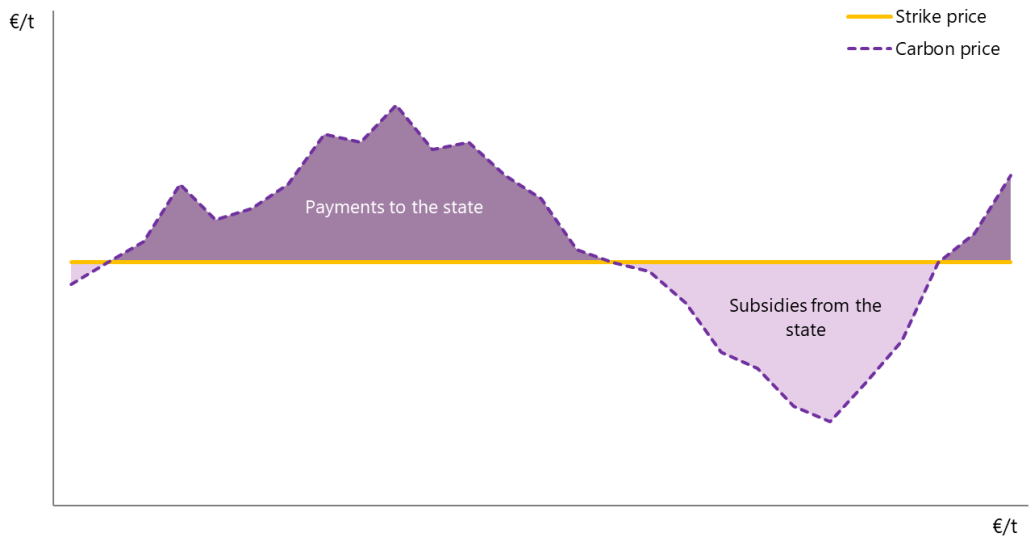
185 A useful overview of current CO2 PCIs/MCIs can be found on the EU Commission's PCI/MCI Transparency Platform: https://ec.europa.eu/energy/infrastructure/transparency_platform/map-viewer/main.html.

186 European Commission Website, Connecting Europe Facility – Performance. Link: https://commission.europa.eu/strategy-and-policy/eu-budget/performance-and-reporting/programme-performance-statements/connecting-europe-facility-performance_en.

187 European Commission (2023): Annex VII - The Union List of Projects of Common Interest and Projects of Mutual Interest. Link: https://energy.ec.europa.eu/system/files/2023-11/Annex%20PCI%20PMI%20list.pdf.

188 Grants for project construction were awarded to Prinos storage facility in Northern Greece (c. EUR 120m),; North Sea L10 CO2 storage facility on the Dutch continental shelf (c. EUR 55 m) and Norne CO2 facility in Denmark (c. EUR 12m). The projects receiving financing for preparatory studies are located in e.g. in France, the Baltics, Germany and the Netherlands. See European Commission (30.01.2025) EU invests over €1.2 billion in cross-border infrastructure contributing to build our Energy Union and to boost competitiveness, Link: https://ec.europa.eu/commission/presscorner/detail/en/ip_25_377.

Figure 4.1: Illustration of a two-sided carbon CfD



Source: NERA analysis.

Regarding the allocation of national funds, the ICMS also promotes the use of an EU-wide "auction-as-a-service" mechanism to allocate national budgets to projects located in the respective countries via a common EU-wide competitive bidding mechanism.[189]

The new European Commission 2024-2029 ("Von der Leyen II") further plans to set up the **European Competitiveness Fund**, aimed at financing strategic technologies, including clean industry. The fund would be part of proposals for the next EU budget for the period 2028-2034 and would support Important Projects of Common Interests (IPCEIs).[190]

The new Commission has also set out to expand on the ICMS targets by enhancing carbon removals and integrating them to a Single Market for CO2, addressing the hard-to-abate sectors and accelerating the work on carbon credits in its mission letters.[191] Moreover, besides the further

[189] European Commission (2024): Towards an Ambitious Carbon Management for the EU, p. 22. Link: https://eur-lex.europa.eu/legal-content/EN/TXT/PDF/?uri=CELEX:52024DC0062. The first competitive bidding mechanism and "auction-as-a-service" support is currently used in the Innovation Funds auctions for renewable hydrogen production in the EU.

[190] Reuters (July 2024): EU executive to propose competitiveness fund for strategic technologies. Link: https://www.reuters.com/world/europe/eu-executive-propose-competitiveness-fund-strategic-technologies-2024-07-18/#:~:text=The%20European%20Commission%20will%20propose%20a%20European%20Competitiveness,and%20biotech%2C%20the%20head%20of%20the%20Commission%20said. See also European Commission (September 2024): Letter to the Executive Vice-President-designate for Prosperity and Industrial Strategy,p. 6. Link: https://commission.europa.eu/document/download/6ef52679-19b9-4a8d-b7b2-cb99eb384eca_en?filename=Mission%20letter%20-%20S%C3%89JOURN%C3%89.pdf.

[191] While the mission letter does not explicitly state the referred to carbon credit-related initiatives, the EU started exploring the introduction of emissions removal credits into the carbon market in 2024. See: Reuters (17/04/2024) EU considers bringing emissions removal credits into carbon market, Link: https://www.reuters.com/markets/europe/eu-considers-bringing-emissions-removal-credits-into-carbon-market-2024-04-17/.

implementation of the Innovation Fund, the Commission will look into investment incentives for new CO2 infrastructure in addition to regulatory provisions.[192, 193]

National subsidy regimes providing state aid need to notify the EU Commission to obtain clearance. The German and French CCfD regimes both obtained state aid clearance (see sections 4.4 and 4.5). Similarly, grant-based subsidy programs for CCS like the German Federal Subsidy Programme for Industry and Climate Protection obtained state aid approval (see section 4.5). The state aid approval for the new Danish CCS fund is currently pending (see section 4.2).

Below we provide more detail on the funding opportunities which have been taken up / expanded upon by national governments.

4.2. Denmark

Denmark provides substantial subsidies for CCUS via a number of schemes. Denmark has set up three funds totalling more than DKK 35bn (EUR 4.7bn) to subsidise the development of CCUS projects in Denmark via tender procedures. As three funds support the full CCS value chain, providing subsidies based on the stored amount of CO2, they provide **direct and indirect subsidies** to transport infrastructure:[194]

- The **CCUS Fund** is set up to support projects focusing on the capture and storage of fossil and biogenic CO2 in a market-based and technology neutral manner from 2025/2026. Subsidies are to cover costs at all stages of the CCS value chain and are paid to those capturing the CO2 (winners of the first auctions included Ørsted power stations, a cement group and a waste and energy management company).[195] Payment is per ton of CO2 captured and permanently stored and will be adjusted for CO2 taxes (e.g. taxes for negative emissions) and the ETS price. The total funding of the scheme amounts to DKK 8bn (EUR 1.1bn). After its full implementation up to DKK 815m (EUR 109m) can be provided to recipients annually. The fund is expected to achieve 0.9

[192] European Commission (2024)Mission Letter to the Commissioner-Designate for Climate, Net Zero and Clean Growth, p. 6. Link: https://commission.europa.eu/document/download/27658b9f-f1f8-4e3a-b265-1ccbd7c2af82_en?filename=Mission%20letter%20-%20HOEKSTRA.pdf.

[193] In addition to official plans, the International Association of Oil & Gas Producers Europe (IOGP Europe) called for the creation of a "European CCS Bank" in December 2024. According to the proposal, such a bank could award CCfDs via auctions under the Innovation Fund from 2025 onwards, to de-risk capture projects and incentivize CO2 capture for strategic industries.
See Energy Industry Review (20/12/2ß24) European CCS Bank: A Game-changer for the EU? Link: https://energyindustryreview.com/environment/european-ccs-bank-a-game-changer-for-the-eu/.

[194] Danish Energy Agency (2024): CCS tenders and other funding for CCS development. Link: https://ens.dk/en/our-responsibilities/ccs-carbon-capture-and-storage/ccs-tenders-and-other-funding-ccs-development; Updated website (from January 2025): https://ens.dk/en/supply-and-consumption/ccs-tenders-and-other-funding-ccs-development.
See also The Danish Government (2024): Denmark's Updated National Energy and Climate Plan, esp. p. 33-38. Link: https://commission.europa.eu/document/download/13353c72-43bc-486e-bc82-9e8ea7588734_en?filename=DK_FINAL%20UPDATED%20NECP%202021-2030%20%28English%29.pdf. Further information were provided by the Danish Energy Agency in bilateral communication with NERA.

[195] See Danish Energy Agency (15/05/2023) The first tender of the CCUS subsidy scheme has been finalized: the Danish Energy Agency awards the contract to Ørsted's full scale CCS project, Link: https://ens.dk/en/press/first-tender-ccus-subsidy-scheme-has-been-finalized-danish-energy-agency-awards-contract.

mtpa CO2 emissions reductions from 2030. It operates with a support period of up to 20 years via an opt-out contract[196] and was intended to be implemented in two phases:

  - Phase 1 aims to achieve 0.4 mtpa CO2 emissions reductions from 2025/2026. Emitters (either a major carbon source or a consortium of smaller sources) were awarded funding following a competitive auction and then obliged to procure transport and storage services on top the sequestration investment. In May 2023, the Danish Energy Agency (DEA) awarded the first contract of c. DKK 8bn (EUR 1bn) to a full-scale CCS project developed by Ørsted, which will store 40,000 t CO2 annually for 20 years from 2026. Three companies competed in the negotiated tender procedure following a prequalification stage.
  - Phase 2 was to be designed at a later point based on insights from Phase 1 and new market developments. However, this phase was merged into the CCS Fund (see below).

- The **CCS Fund** is set to support the capture and storage of fossil and biogenic CO2. The fund was initially set up as part of the Green Transition Fund established in 2022. in the context of the green tax reform for the Danish industry and to complement the CCUS and the NECCS Funds. It was thus partly financed by the new carbon tax. The previously envisioned second phase of the CCUS Fund and the CCS fund were merged in 2023.[197] The fund is expected to support the reduction of 2.3m tCO2 emissions annually from 2030. In October 2024, the DEA announced the first tender round to allocate c. DKK 28.7bn (EUR 3.85 bn) of subsidies to be paid out over a 15-year period. This amounts to an annual subsidy of max. DKK 1.8bn (EUR 0.24 bn) from 2029 to 2044.[198] The pre-qualification period for the tender is closing in March 2025 with final offers due in December 2025. The DEA expects an award in April 2026.[199] The state-aid approval of the new fund by the European Commission is pending as of 10th February 2025.[200] The projects will have to provide full capture and storage from 2030. Funding is paid per ton of CO2 captured and stored and contracts may be awarded to more than one bidder. Players throughout the CCS value chain (incl. point source, CO2 transport or CO2 storage provider) and bidders covering the entire value chain are eligible for the tender.[201] The fund is designed to maximise competition for funding to obtain the highest possible carbon emissions reductions at the lowest possible cost, according to the DEA.[202] Key tender design elements include:

196 The winner has the right to opt-out of the contract after 2030, if a winner considers the sale of captured CO2 to other offtakers (e.g. industry) more profitable.

197 The merged CCS Fund is therefore financed from a variety of sources including the reformed carbon tax/ the Green Transition Fund.

198 Confirmed by the Danish Energy Agency in bilateral communication with NERA.

199 Information provided by the Danish Energy Agency in bilateral communication with NERA.

200 Confirmed by the Danish Energy Agency in bilateral communication with NERA.

201 Besides individual entities from any part of the CCS value chain, consortia of multiple entities from the entire value chain or a "fourth party" subcontracting with all parts of the CCS-value chain are eligible, as confirmed by the Danish Energy Agency in bilateral communication with NERA. Like for the CCUS fund, the winners will have the option to opt out of the contract after 2030.

202 Offshore energy.Biz (09/10/2024), Denmark sets aside $4.2 billion as part of its third fund for carbon capture and storage, Link: https://www.offshore-energy.biz/denmark-sets-aside-4-2-billion-as-part-of-its-third-fund-for-carbon-capture-and-storage/.

  - A prequalification stage which requires candidates to meet certain minimum requirements regarding their economic and financial capacity. While the CO2 must be captured from a point source in Denmark for the project to be eligible, it may be stored abroad.[203]; and
  - An award stage where bids are evaluated based on the proposed subsidy (80%) and the project maturity (20%). Bids will be ranked according to their performance on the two criteria to identify the project(s) with the best price-quality ratio.

- The **NECCS fund** supports projects focusing on the capture, transport and underground storage of biogenic CO2 to support the increase of negative emission reductions. The fund's volume of DKK 2.5bn (c. EUR 0.4bn) is set to secure negative emissions of 0.5 mtpa from 2025 onwards through carbon capture and storage. Support is awarded per ton of CO2 stored for up to eight years via an opt-out contract. In April 2024, the DEA awarded subsidy contracts to three projects with a combined capture and storage capacity of c.160,000 tCO2 per year from 2026 to 2032, falling short of the original auction target. The subsidy is paid once the captured CO2 is permanently stored. To safeguard against overcompensation, the scheme includes a clawback mechanism in case biogenic CO2 is included in the EU ETS.[204] Despite not all funds available being awarded, there is no further tenders for NECCS projects planned.

According to the Danish Energy Agency, no further funds have been decided so far.[205]

In addition, CCS projects including transportation infrastructure may benefit from other funding options for innovative projects and related research. For instance, the Energy Technology Development and Demonstration Program (EUDP) supports innovative green energy technology demonstration projects since 2007. The program's key objectives are the reduction of CO2 emissions and ensuring security of supply. Since its establishment, the programme has supported more than 1,200 projects with about DKK 6.2bn (EUR 0.83bn). While the programme is technology neutral, existing CO2 transport and storage projects such as Project Greensand and Project Bifrost have benefited from the scheme (see section 3.3). Applications are assessed by the DEA based on a number of criteria, including innovativeness, commercialisation potential and contribution to climate-policy targets.[206]

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203 Confirmed by the Danish Energy Agency in bilateral communication with NERA.

204 Clawback mechanisms more generally refer to the repayment of (excess) subsidy granted to the beneficiary by the state, e.g. if the subsidised volumes were not delivered or producers started to benefit from additional subsidy or revenue streams after the payment of the subsidy under consideration. Such a mechanism was requested by the EU Commission in context of its state aid approval for the NECCS fund. The Commission required that aid per tonne of captured and stored CO2 granted under the scheme will be reduced, if emitters of biogenic CO2 become obliged to participate in the EU ETS. The clawback mechanism was implemented by the Danish Energy Agency. While the EU ETS currently does not recognise negative emissions, the Commission is set to assess how they could be accounted for and covered under the ETS. See: European Commission (20/12/2023), State Aid SA.108284 (2023/N) – Denmark - RRF: State aid scheme for Carbon Capture and Storage in Denmark, para 63. Link: https://ec.europa.eu/competition/state_aid/cases1/202403/SA_108284_B009218D-0100-C51C-BBF1-B642183ED8A0_87_1.pdf; and Danish Energy Agency (2022 or 2023) Tender materials NECCS, Appendix 5, section 2.1.3 -2.1.6, Link: file:///C:/Users/leonie.janisch/Downloads/appendix_5_-_subsidy_and_economy_scheme_10112023_ren%20(1).pdf.

205 Confirmed by the Danish Energy Agency in bilateral communication with NERA.

206 Danish Energy Agency (2024): Energy Technology Development and Demonstration Program. Link: https://ens.dk/en/our-responsibilities/research-development/eudp and EUDP (2024), About the EUDP (website). Link: https://eudp.dk/en/om-eudp.

These measures are complemented by additional schemes incentivising decarbonisation efforts by industry players (**indirect support**). Since 2022 a green tax for the industry applies, creating the highest corporate carbon tax in Europe and a subsidy fund for the capture and storage of CO2 from both fossil and biogenic sources.[207] From 2025, a new CO2 tax for fossil fuel usage in the industry will be implemented. Amongst others, this will see the existing CO2 tax on fuels being increased by 400% and the introduction of a CO2 emissions tax also for companies covered under the EU ETS 1.

As part of this Green Tax Reform package, Denmark is also considering a state aid scheme to support the decarbonisation of industrial processes, particularly the fuels used. It started an initial consultation process to this end in August 2024. Beneficiaries will receive a fixed rate for each documented ton of CO2 emission avoided, following an auction with a pay-as-bid approach. An adjustment mechanism will reduce future aid payments if the funding gap of the project is lower than the subsidy payment. The DEA will annually recalculate the funding gap for each project. In contrast to e.g. the German carbon CfD system, no payments from the beneficiaries to the Danish state are envisioned ("**one sided CfD**").[208]

4.3. Flanders

Multiple Flemish CO2 infrastructure projects are receiving EU funding (see appendix A.2). However, there is currently no dedicated large-scale incentive / support regime for CCS/CCU and CO2 infrastructure projects in place in Flanders. On the other hand, we understand that the Flemish Government and VLAIO are currently investigating potential additional support measures for CCU/CCS, including the introduction of Carbon CfDs.[209]

Some **indirect subsidy** programmes to support the development of CCU/CCS projects are already in place. To foster the progress of innovative technologies, the Flemish "Moonshot" programme provides support to research into key innovations in the industrial sector. One programme ("MOT3") focusses on the efficient capturing of CO2. [210] The Flemish Government will invest EUR 400m or EUR 20m annually from 2020 to 2040 via the Moonshot programme. Flanders also provides various funding mechanisms for CCUS projects at different development stages, e.g.

- Pre-FEED Feasibility Study Funding that provides support for early-stage feasibility studies focussing on technical and financial viability;

[207] The Danish Government (2022): Green Tax Reform. Link: https://www.regeringen.dk/media/11468/aftaletekst-groen-skattereform.pdf.

[208] Danish Energy Agency (02/08/2024): State aid for decarbonisation of industrial processes in Denmark – operation aid scheme under the Danish Green Tax Reform. Link: https://ens.dk/sites/ens.dk/files/Statistik/hoeringsnotat.pdf.

[209] This is reflected in the coalition agreement and the Belgian statement on Member State Contribution CCUS under the NZIA and was also communicated by VEKA. See Flemish Government (2024) Vlaams Regeerakkoord 2024-2029. Samen werken aan een warm en welvarend Vlaanderen, p. 51, Link: https://publicaties.vlaanderen.be/view-file/69476; and Federal Belgian and Regional Governments (not dated) Member State Contribution CCUS – Net Zero Industry Act (NZIA), p. 5, Link: https://www.cnc-nkc.be/sites/default/files/report/file/nzia_ccus_art.2123_lidstaatrapportering.pdf.

[210] VLAIO (2024) Programma Klimaatsprong, Link: https://www.vlaio.be/nl/over-ons/programma-klimaatsprong.

- Strategic Ecological Support (STRES) that supports SMT and large-scale industrial companies to initiate strategic changes granting a maximum of EUR 1m in subsidies over a three-year period; and[211]
- Co-Financing for EU Innovation Fund Projects to enhance the feasibility and financing structure of CCUS innovations.[212]

Similarly, the Flemish Agency for Innovation and Entrepreneurship (VLAIO) managing various initiatives to support innovation and investments in the industry provides grants, amongst others for research and innovation projects related to CCUS.[213]

The Moonshot programme is linked to the broader "Climate Leap" (Klimaatsprong) programme, set up to support the transition of the Flemish industry to carbon neutrality. The programme is to provide short- and long-term policy recommendations for long-term legislative and policy frameworks, a multi-year industrial transition programme and an industrial support programme for innovation and implementation as well as funding in form of pre-financing investment projects to secure and strengthen the competitiveness of the Flemish industry.[214] CCUS applications are one of various transition paths until 2050 considered by the programme. Policy recommendations are divided into six pillars, one of which concerns the financing of the transition, including the pre-financing of investment projects to protect the Flemish industry's international competitiveness during the transition. Another pillar emphasises the need to launch an industrial support programme to support innovation and implementation of remission reduction measures.[215] The first programme note, setting out general actions until 2050, was approved by the Flemish Government in June 2023, but does not contain an indirect subsidy programme accessible for CCUS applications.[216] The new Flemish Government intends to start a **participatory process** within Klimaatsprong to identify infrastructure needs and potential solutions with relevant stakeholders. [217]

In 2024 Flanders introduced a new carbon CfD-based pilot programme linked to the Climate Leap programme, to foster the decarbonisation of Flemish industries. However, eligibility was restricted

[211] See also Vlaanderen (as of Feb 2025) Strategic Econology Support, Link: https://www.vlaanderen.be/en/strategic-ecology-support.

[212] A full overview of the programmes can be found here Federal Belgian and Regional Governments (not dated) Member State Contribution CCUS – Net Zero Industry Act (NZIA), p. 5, Link: https://www.cnc-nkc.be/sites/default/files/report/file/nzia_ccus_art.2123_lidstaatrapportering.pdf.

[213] Institute for European studies & others (not dated): Contextanalyse en roadmapstudie – Vlaamse industrie koolstofcirculair en CO2-arm, P.197, Link: https://www.moonshotflanders.be/sites/moonshot/files/docs/Internationale-positionering-status-en-potentieel-van-Vlaanderen.pdf.

[214] Flanders Industry Innovation Moonshot (2024) MOT3 Electrification & radical process transformation, Link: https://www.moonshotflanders.be/en/research/mot-3-electrification-radical-process-transformation. See also: VLAIO (2024) Programma Klimaatsprong, Link: https://www.vlaio.be/nl/over-ons/programma-klimaatsprong.

[215] Another pillar emphasises the general need to develop basic infrastructure to support the energy and climate transition.

[216] VARIO (March 2023): Klimaatsprong Programmanota. Link: https://publicaties.vlaanderen.be/view-file/54794.

[217] Federal Belgian and Regional Governments (not dated) Member State Contribution CCUS – Net Zero Industry Act (NZIA), p. 3, Link: https://www.cnc-nkc.be/sites/default/files/report/file/nzia_ccus_art.2123_lidstaatrapportering.pdf.

to projects involving electric boilers and heat pumps.[218] The Flemish Government and VLAIO are currently assessing an extension of the programme to provide **opex support** for the Flemish industry. As part of this evaluation, it will decide whether to extend the program to support major CCS / CCU projects in Flemish ports as well.[219]

Finally, the new Government announced its intention to explore **other support** programs for CCS and CCU projects in Flemish ports, but their potential design is yet to be revealed.[220]

Beyond the support available at the regional level, 15 industrial stakeholders, including Fluxys and emitters such as Arcelor Mittal and BASF have recently (June 2024) appealed to Federal Belgian authorities for financial aid to facilitate risk reduction for investments in CO2 storage and infrastructure.[221]

4.4. France

Several French CCS projects have received funding from European schemes[222], such as the European Innovation Fund & CEF facility (see section 3.2)[223] and the Horizon Europe programme, which funds R&D projects.[224]

In addition, the French government has already installed several distinct support schemes:[225]

- The Priority Research and Equipment Program (PEPR) *"Supporting innovation to develop new, largely decarbonized industrial processes"* (SPLEEN) is designed to encourage and support upstream research activities in the field of industrial decarbonization. Of the ten projects launched in 2023 with a budget of EUR 35m, six are linked to CCUS topics.
- "Zone Industrielle Bas Carbone" (ZIBaC) is a scheme to support CCUS territorial planning in hubs that will make it possible to finance a number of studies in connection with CCUS,

218 See e.g. Deloitte (11/06/2024) New low-carbon transition financing instrument to be launched in Flanders. Link: https://www.deloitte.com/be/en/services/tax/blogs/new-low-carbon-transition-financing-instrument-to-be-launched-in-flanders.html.

219 For its evaluation, the Government will also rely on a benchmark study to assess similar instruments used by neighbouring countries. Due to the clear separation between grid operators and emitters, Carbon CfDs would not provide subsidies for transport activities. See Flemish Government (2024) Vlaams Regeerakkoord 2024-2029. Samen werken aan een warm en welvarend Vlaanderen, p. 51, Link: https://publicaties.vlaanderen.be/view-file/69476; and Federal Belgian and Regional Governments (not dated) Member State Contribution CCUS – Net Zero Industry Act (NZIA), p. 5, Link: https://www.cnc-nkc.be/sites/default/files/report/file/nzia_ccus_art.2123_lidstaatrapportering.pdf.

220 Federal Belgian and Regional Governments (not dated) Member State Contribution CCUS – Net Zero Industry Act (NZIA), p. 5, Link: https://www.cnc-nkc.be/sites/default/files/report/file/nzia_ccus_art.2123_lidstaatrapportering.pdf.

221 The Brussels Times (19/06/2024): Belgian industry calls on authorities to support CO2 storage. Link: https://www.brusselstimes.com/1100503/belgian-industry-calls-on-authorities-to-support-co2-storage.

222 Ministère de l'économie, des finances et de la souveraineté industrielle er numerique (2024): État des lieux et perspectives de déploiement du CCUS en France, p. 16.

223 See Euroepan Commission (as of December 2024): What is the Innovation Fund?, Link: https://climate.ec.europa.eu/eu-action/eu-funding-climate-action/innovation-fund/what-innovation-fund_en.

224 See French Economics and Finance Ministry (Jul-24): État des lieux et perspectives de déploiement du CCUS en France, pp.16 & 17 & fort he Horizon Europe programme, Link: https://research-and-innovation.ec.europa.eu/funding/funding-opportunities/funding-programmes-and-open-calls/horizon-europe_en

225 Ministère de l'économie, des finances et de la souveraineté industrielle er numerique (2024): État des lieux et perspectives de déploiement du CCUS en France, p. 15ff.

focusing in particular on relevant CO2 flows within industrial zones, infrastructure and infrastructure reuse, and the economic relevance of CCUS. ZIBaC is part of the France 2030 investment plan with a total budget of EUR 5.6bn. By 2024, several major CO2 emitting industrial clusters (including Dunkirk, Fos-sur-Mer, Saint-Nazaire, Le Havre) have received subsidies under the ZIBaC framework for decarbonisation projects.[226] The call for projects was open until May 2023.[227]

The French government plans to extend the above support schemes by introducing carbon contracts for difference **(carbon CfDs).**[228] In January 2024, the French Government initiated discussions with the European Commission to validate the French support mechanism. The support will be granted to industrial emitters to finance additional capex and opex linked to capture, transport and storage infrastructures. The funding will be granted for a period of 15 years with an annualized payment of the aid based on the emissions sequestered and only to projects which require a total support of above EUR 20m over the period. From June to September 2024 the government consulted with stakeholders on a call for tenders. The government proposes to select projects based on the auction price in EUR/tCO2e and two additional criteria (a decarbonization ambition criterion based on the amount of CO2 saved which offers a bonus of up to 20% and a criterion of consistency with the national decarbonization strategy which offers a malus of up to 20%). Further, the government suggested that applicants may request an advance of up to 50% of the capex and 30% of the total amount. The consultation also served as a first call of interest with the planned auctions scheduled to take place in early 2025.[229] On 18th December 2024, the European Commission approved the maximum EUR 3 bn scheme as in line with its state aid requirements.[230]

The CCUS strategy expects that CCUS will initially be focused on hard to abate emissions from the chemical industry, the cement industry, the steel industry, and the aluminium industry. However, the CCUS also strategy postulates that ultimately, other sectors, such as waste incineration, biomass processing, the paper sector and even the agri-food industry, could also deploy CCUS projects, depending on the developments of the ETS. [231] It is currently unclear whether the fact that the CCUS strategy creates these two groups means that carbon CfDs will only be available to the former companies, with CCUS in the latter limited to commercial deployment.

The carbon CfDs will provide **indirect support** for the development of transport infrastructure by allowing manufacturers to commit to long-term contracts for a period of 15 years, thus providing transport network developers with revenue certainty designed to support the build of new infrastructure.

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226 Global CCS Institute (2024): The status of CCUS in France: Present and future opportunities.

227 French Government (not dated): Favoriser le développement de Zones Industrielles Bas Carbone (ZIBaC), Link: https://agirpourlatransition.ademe.fr/entreprises/aides-financieres/20220204/favoriser-developpement-zones-industrielles-bas-carbone-zibac.

228 Ministère de l'économie, des finances et de la souveraineté industrielle er numerique (2024): État des lieux et perspectives de déploiement du CCUS en France, p. 19.

229 Republique Francaise (2024): cahier des charges de l'appel d'offres « grands projets industriels de décarbonation 2024 ». See also https://agirpourlatransition.ademe.fr/entreprises/actualite-entreprises?ressource_id=1132.

230 European Commission (19/12/2024) Commission approves French State aid scheme to support decarbonisation of industrial sector. Link: https://ec.europa.eu/commission/presscorner/detail/en/ip_24_6434.

231 Ministère de l'économie, des finances et de la souveraineté industrielle er numerique (2024): État des lieux et perspectives de déploiement du CCUS en France, p. 19f.

Additional **direct support** for CO2 transport infrastructure may come from the CEF facility that is open to projects that have qualified as PCIs. Currently, France has several projects with CCS hubs that have qualified as PCIs, including:

- The D'Artagnan project (capture and storage hub in Dunkirk), which has received around EUR 150m in support from the CEF facility;[232]
- the Callisto projects (capture and storage hub in the Mediterranean basin);
- Nautilus (CO2 export network to the North Sea including the industrial zone of Le Havre and Dunkirk as well as German emitters), both of which have qualified as PCIs but have not yet obtained funding; and
- Pycasso (onshore transport and storage hub in the South-West of France)[233], which had obtained PCI status but was announced as cancelled on 30th October (see section 3.5).

In its report, CRE calls for targeted public investment aid schemes for CO2 transport infrastructures, in particular to ensure optimal long-term sizing right from the initial investment, i.e. initial oversizing of the infrastructure,[234] but no such instrument has been put in place yet.

4.5. Germany

Before the collapse of the government coalition, Germany had foreseen two main support instruments for the development of the carbon storage and transport infrastructure, namely:

- Carbon CfDs; and
- direct grants for emitters under the Federal Subsidy Programme for Industry and Climate Protection (Bundesförderung Industrie und Klimaschutz; BIK) scheme.

Both instruments focus on supporting emitters rather than the transport and storage infrastructure per se. CCUS-related projects, including transport infrastructure, will thus likely benefit from **indirect subsidies** provided to the German industry rather than direct support:[235]

- **Carbon contract for difference (CCfDs; "Klimaschutzverträge")** are contracts awarded to emitters by competitive tender that reduce the cost gap between low-carbon industrial processes and less costly conventional processes through a 15-year opex subsidy designed to compensate lower than necessary CO2-prices. CCfDs are open to companies implementing different carbon emission abatement technologies, not just CCS projects. During the first phase

232 See European Commission/ EU Funding & Tenders Portal (as of December 2024) D'Artagnan: Dunkirk CO2 Hub Phase I, Link: https://ec.europa.eu/info/funding-tenders/opportunities/portal/screen/opportunities/projects-details/43251567/101147522/CEF2027.

233 Ministère de l'économie, des finances et de la souveraineté industrielle er numerique (2024): État des lieux et perspectives de déploiement du CCUS en France, p. 22f.

234 CRE (2024): Rapport de la Prospective de la CRE sur le CCUS, p. 68.

235 As outlined also in the draft CMS strategy, funding is focused on emission sources where CCUS is the only technological and economical option for emissions reductions. These include in particular sectors such as lime, cement, waste to energy and parts of the chemical industry. E.g. the steel sector is currently not considered a hard-to-abate sector and will thus not be eligible for CCs subsidy schemes. See: Tagesspiegel Background (September 2024): CCS-Förderung; Stahlindustrie schaut in die Röhre. Link: https://background.tagesspiegel.de/energie-und-klima/briefing/ccus-foerderung-stahlindustrie-schaut-in-die-roehre

15 projects, mostly focussing on hydrogen, received funding totalling EUR 2.8 bn in Oct 2024.[236] CCS projects were not eligible during the first round as the revised KSpTG (see section 5.5) has not yet entered into force thus making CCS currently illegal. The second phase with a volume of EUR 12bn was set to focus on CCS projects with an auction taking place after passage of the necessary KSpTG through parliament. However, the Government suspended the round due to a lack of funding security[237] following the collapse of the government coalition. As of January 2025, a launch of the second round before a new government is formed is considered unlikely by market observers. Nevertheless, the responsible Federal Ministry for Economic Affairs and Climate Action continues the next auction round's preparations to facilitate its speedy implementation if the KSpTG will be passed, the future budget will provide the required financing and the European Commission approves the provision of state aid.[238] In January 2025 the Ministry published an updated draft of the subsidy guidelines confirming the eligibility of CCS and CCU projects, focused especially on reducing process emissions in specific industries.[239] However, the main opposition party CDU is sceptical of the instrument of CCfDs per se, putting a continuation of the programme under a government they are part of in jeopardy.[240]

- The **Federal Subsidy Programme for Industry and Climate Protection** (Bundesförderung Industrie und Klimaschutz; BIK) launched in late August 2024. Its first round closed on 30th November. The programme is open for all sectors and aims to support innovative small and medium-sized projects, not necessarily using CCUS technology. The programme consists of two subsidy modules:
  - Module 1 focusses on industrial companies planning to decarbonise their processes by reducing at least 40% of their CO2 emissions through innovative or research projects. The maximum subsidy a company can obtain is capped at EUR 200m.
  - Module 2 is aimed at CCUS projects. In the first round, investment support and subsidies were granted to projects in the lime, cement and thermal waste treatment sectors as well as in the chemical, glass and ceramics industry. Investment support is capped at EUR 30m and support for industrial research projects at EUR 35m.

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236 Federal Ministry for Economic Affairs and Climate Action (2024): Habeck Presents First Carbon Contracts for Difference. Link: HYPERLINK "https://www.bmwk.de/Redaktion/DE/Pressemitteilungen/2024/10/20241015-habeck-uebergibt-erste-klimaschutzver.

Federal Ministry for Economic Affairs and Climate Action (15/11/2024): Klimaschutzverträge – Vorbereitendes Verfahren, Link: https://www.klimaschutzvertraege.info/thema/aktuelles_vorbereitendes_verfahren

238 The draft subsidy guidelines therefore contain specific clauses enabling the ex-post withdrawal of subsidy notices granted in this second tender, if the required budgetary means will not become available. This was criticised as increasing investment uncertainties by industry representatives. See Tagesspiegel (24/01/2025) Klimaschutzverträge stehen CO2-Speichern offen, Link: https://background.tagesspiegel.de/energie-und-klima/briefing/klimaschutzvertraege-stehen-co2-speichern-offen.

239 While the Ministry indicated a high interest in CCS and CCU projects with 130 project outlines submitted during earlier stages of the second tender rounds's preparations. Which industries may use CCS and thus may benefit from the second tender is subject to (political) debates and yet to be determined by the final Carbon Management Strategy. See Tagesspiegel (24/01/2025) Klimaschutzverträge stehen CO2-Speichern offen, Link: https://background.tagesspiegel.de/energie-und-klima/briefing/klimaschutzvertraege-stehen-co2-speichern-offen.

240 Handelsblatt (28/11/2024): Klimaschutzverträge vor dem Aus – Keine Chance für zweite Ausschreibungsrunde. Link: https://www.handelsblatt.com/politik/deutschland/transformation-klimaschutzvertraege-vor-dem-aus-keine-chance-fuer-zweite-ausschreibungsrunde/100090735.html.

In general, projects by small- and medium sizes companies must have a minimum total investment volume of EUR 500,000 and projects by large companies must have a minimum investment volume of EUR 1m to be eligible for the programme. For projects with a volume of at least EUR 15m, co-financing of 30% by the federal states is planned. Subsidies will be awarded in annual tenders until 2030 and projects need to be implemented and subsidies paid until the end of 2035. The total budget amounts to about EUR 3.3bn. The programme obtained state aid clearance in April 2024.[241]

However, the future of both schemes is currently uncertain given the collapse of the previous government and the lack of formal governing coalition until at least a few weeks after the Federal Elections in late February 2025. For the moment, a representative of the BMWK indicated that processes to prepare future rounds of both schemes are ongoing to facilitate a fast continuation once the budget situation is resolved.[242]

A dedicated, **direct support mechanism for CO2 transport infrastructure** is yet to be developed by the German government. The draft CMS leaked in September 2024 indicated the potential introduction of securities or guarantees for financing of infrastructure projects. Such instruments, likely provided by Germany's state-owned investment and development bank KfW, were set to be evaluated in the first half of 2025.[243] The disruption of the timeline for a regulatory framework for CCUS due to the breakdown of the Government coalition will likely delay this evaluation. A representative of the BMWK indicated on 4th December 2024 that the Ministry is currently evaluating such instruments and that a working group might be implemented on this matter. [244]

The focus on indirect CCS subsidies to the emitting industries mirrors the projects currently under development in Germany, which will be key suppliers of transit flows through Wallonia (see section 3.6). The potential stop of the CCfD programme, one of the key drivers for industrial interest in CCUS, has the potential to undermine the development of large-scale CCUS projects, which would have provided significant demand for pipeline capacity in Europe. The current challenges faced by multiple parts of the German industrial sector further hamper the rapid implementation of costly decarbonisation projects more generally and of demand for CO2 transport more specifically.

4.6. Netherlands

The Netherlands promotes CCS mainly through the Stimulering Duursame Energieproduktie en Klimaattransitie (SDE++) subsidy scheme of the Rijksdienst voor Ondernemend Nederland (Netherlands Enterprise Agency or RVO).[245]

This programme gives financial support to companies and non-profits engaged in large-scale renewable energy production and CO2 emission reduction projects. The objective of the scheme is

241 Federal Ministry for Economic Affairs and Climate Action (10.04.2024), Dekarbonisierung für den industriellen Mittelstand. Link: https://www.bmwk.de/Redaktion/DE/Pressemitteilungen/2024/04/20240410-dekarbonisierung-fuer-den-industriellen-mittelstand.html.

242 Oral statement by Malte Bornkamm, BMWK, at Forum für Zukunftsenergien (04/12/2024): CCS in Deutschland – Welche Möglichkeiten der Dekarbonisierung ergeben sich perspektivisch für die Industrie? (in-person conference).

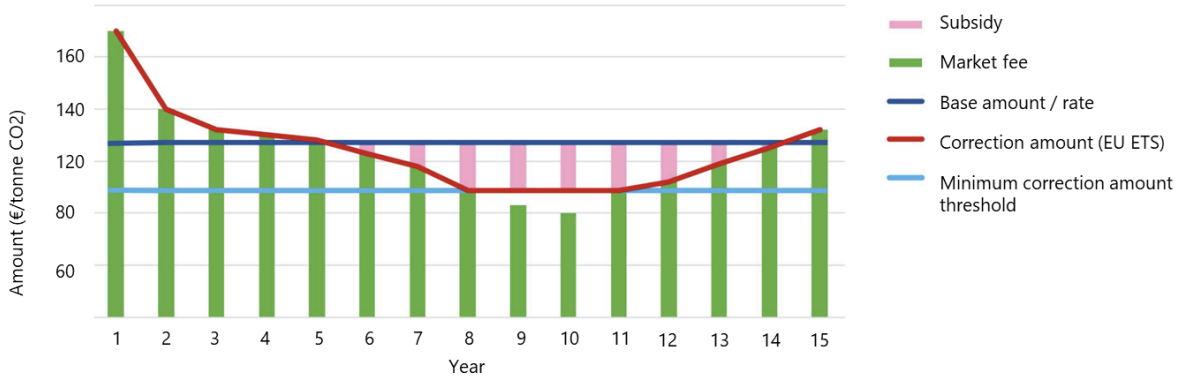
243 Tagesspiegel Background (16/09/2024): CO2-Pipeline soll 4500 Kilometer lang werden, Link: https://background.tagesspiegel.de/energie-und-klima/briefing/co2-pipeline-soll-4500-kilometer-lang-werden.

244 Oral statement by Malte Bornkamm, BMWK, at Forum für Zukunftsenergien (04/12/2024): CCS in Deutschland – Welche Möglichkeiten der Dekarbonisierung ergeben sich perspektivisch für die Industrie? (in-person conference).

245 RVO (2024): 2024 SDE++ Brochure, link: https://english.rvo.nl/subsidies-financing/sde/apply.

to subsidise only the unprofitable component of each technology. For CCS projects, the SDE++ scheme covers the financial gap between the European Emissions Trading System (ETS) price ("correction" amount) and the marginal costs of emissions reduction for a period of 15 years ("base" rate).[246] In determining the level of the subsidy, the value of revenues generated from the EU ETS scheme (correction amount) is updated annually, whilst the value of the marginal costs of emission reduction through CCS (base rate) is fixed for the entire duration of the scheme. Therefore, as Figure 4.2 shows, when the market value increases (e.g. via an increase in EU ETS price), lower levels of subsidy are received by emitters (and vice versa).[247] The SDE++ scheme is essentially a one-sided carbon CfD, meaning that if revenues from the EU ETS scheme (correction amount) are above marginal costs (base rate), the value of the subsidy is equal to zero but emitters do not have to return the additional revenues to the government.

Figure 4.2: Schematic Illustration of the SDE++ Scheme for CCS



Source: Ministry of Climate and Green Growth (2024), SDE++ 2024 Stimulation of Sustainable Energy Production and Climate Transition, p. 9.

The SDE++ covers the capture, transport and storage of CO2. The scheme therefore provides for an indirect support to the T&S costs. The subsidy is requested and granted by the CO2 emitter and owner of the capture facility but includes also an amount to cover for the costs of transport and storage that are paid to the third-party infrastructure providers. Emitters applying for the subsidy must submit prices for the different components of the total CCS costs.[248] The reasonableness of the price for transport and storage components is assessed separately by a specialised external advisor on behalf of the RVO.[249] For example, for the Aramis project the T&S allowances published by the external consultant on behalf of RVO as of 2024 are 90.6 EUR/t and 112.8 EUR/t for gaseous and liquid T&S respectively.[250] As the Aramis' FID is only expected in 2025, the actual figures are pending and are continuously being revised due to project cost increases related, for example, to design

246 Marginal costs are calculated based on a review of the project costs, by an external consultant and the ministry for each technology.

247 RVO (2024): 2024 SDE++ Brochure, link: https://english.rvo.nl/subsidies-financing/sde/apply.

248 ACM (27 June 2022), No action letter for the Agreement between Shell and TotalEnergies regarding a joint marketing initiative for CCS services (project Aramis), p. 2.

249 ACM (27 June 2022), No action letter for the Agreement between Shell and TotalEnergies regarding a joint marketing initiative for CCS services (project Aramis), p. 2.

250 Xodus (June 2024), 2024 SDE++ Aramis Carbon Capture and Storage Fee Review, p.7.

development and price inflation.[251] We understand the tariffs will be reviewed and confirmed in Q1 2025, once the FEED is completed, when more detailed cost information will be available.[252]

The scheme is open only for storage in gas fields in the Netherlands and the Dutch part of the Continental Shelf.[253] We understand the Dutch government may consider opening the scheme to non-Dutch fields as opening markets to outside the Netherlands would increase competition, maximising CO2 reduction at the lowest possible social cost.[254]

The SDE++ programme runs yearly through a phased approach. The latest SDE++ 2024 round closed in October 2024 and a total budget of EUR11.5bn was made available,[255] of which a total of around EUR 6.7bn will be allocated to CCS projects – of which the Aramis emitters are likely going be the prevailing beneficiaries.[256]

As described in Section 3.7 above, in spring 2021, Porthos' customers were awarded an SDE++ subsidy for a total maximum amount of EUR 2.1bn in grant money.[257] The EUR 2.1bn in funding is a budget reservation rather than the actual expense for the Dutch government: it constitutes the maximum amount that may be paid to eligible CCS recipients over a term of 15 years. The actual total will depend on the evolution of the ETS price and – as noted by Porthos – it is expected to be significantly lower, since the ETS rate is expected to rise further in the years ahead.[258]

Besides the SDE++ scheme, the Netherlands encourages the development of CCS through other public funding and initiatives mainly focused on the R&D and initial development phases of CCS. These include amongst others:[259]

- **DEI+ (Demonstration of Energy and Climate Innovation)** is a grant scheme intended to reduce CO2 emissions by supporting innovative technologies and the application of sustainable energy production, including amongst others CCUS.[260] In the application period that went from 21st November 2023 to 29th August 2024, the Dutch Government made available EUR 141m for DEI+, but only EUR 37m were awarded.[261]

251 Xodus (2022), Final Report – Public.

252 Xodus (June 2024), 2024 SDE++ Aramis Carbon Capture and Storage Fee Review.

253 RVO website, link: https://english.rvo.nl/subsidies-financing/sde/apply.

254 Tweede Kamer (April 2024), Brief van de Ministers van Economische Zaken en Klimaat en voor Klimaat en Energie end de Staatssecretaris van Economische Zaken en Klimaat, p. 5.

255 RVO website, link: https://english.rvo.nl/subsidies-financing/sde/apply.

256 ICIS, Dutch government allocates €6.7bn to CCS projects. Link https://www.icis.com/explore/resources/news/2023/04/27/10879919/dutch-government-allocates-6-7bn-to-ccs-projects/.

257 Porthos (as of 2024) Project website. link: https://www.porthosco2.nl/en/dutch-government-supports-porthos-customers-with-sde-subsidy-reservation/.

258 Porthos (as of 2024) Project website. link: https://www.porthosco2.nl/en/dutch-government-supports-porthos-customers-with-sde-subsidy-reservation/.

259 List prepared based on our review of the Implementation Report to the European Commission on the Geological Storage of Carbon Dioxide (CCS Directive) for the Netherlands, published in 2023.

260 Dutch Government (as of December 2024): Subsidy Demonstration Energy Innovation (DEI+), link: https://business.gov.nl/subsidy/demonstration-energy-innovation-dei-subsidy/.

261 Rijksdienst voor Ondernemend Nederland (September 2024), DEI+: Energy and Climate Innovations. Link: https://www.rvo.nl/subsidies-financiering/dei/dei-energie-en-klimaatinnovaties.

- **TSE Industry Studies** is a first come, first serve grant programme for entrepreneurs researching the feasibility of innovative projects which will reduce carbon emissions by 2030, including feasibility studies related to the capture, use and storage of CO2. The total TSE budget for 2024 is equal to EUR 26.4m.[262]
- **TSE Industry R&D (Energy & Climate Research and Development, EKOO)** is tender based scheme for decarbonisation solutions for industry. Applications are ranked on the likeliness that the project succeeds on the market, how well they fit within the themes of the subsidy, the amount of innovation, and the quality of the application. The highest ranked applications receive funding. The subsidy covers the costs of industrial research and development, with percentage varying by company size. The total TSE R&D budget for 2024 is equal to EUR 3.0m.[263]

5. Regulatory framework for CO2 transport

This section presents, by region and country, a full description of the existing regulatory framework and the chosen or planned business model including the transport network access model, the envisaged tariff model, and the tariffs applied as far as known.

[262] RVO (as of December 2024): TSE Industrie studies, link: https://www.rvo.nl/subsidies-financiering/tse-industrie-studies#voor-welke-onderwerpen-vraagt-u-subsidie-aan%3F-.

[263] RVO (as of December 20254): Energie & Klimaat Onderzoek en Ontwikkeling (EKOO) , link: https://www.rvo.nl/subsidies-financiering/ekoo#aanvragen.

Table 5.1: Regulatory regimes for pipeline-bound CO2 transport

	Denmark	Flanders	France	Germany	Netherlands
Future role in European CO2 network	Storage and transit Import focus	Hub and transit Export focus	Decentralised CCS development Export focus	Decentralised CCS development and CO2 transit Export focus	Hub and transit Export focus
Status regulatory framework	Advanced	Advanced	Work in progress	Progress in recent years but now uncertain	Advanced
Business model/ role of (non)-regulated allowed revenues	Limited regulation	Limited regulation	Full regulation of pipeline transport likely	Negotiated access based on conditions set by BNetzA	Limited regulation
Tariffication	Market-based approach (bilateral tariff negotiations)	Market-based approach, methodology by grid operators. Fluxys proposes postage stamp tariffs (local) and distance-based tariffs (regional).	Tariff and access rules to be set by regulator RAB approach, conversion of natural gas asset base Diverging tariffs for local and regional networks	Limited information No amortisation account (contrast to H2 network) Cost-based tariffs to be charged by operators	Market-based approach and no formal price regulation of tariffs
Capacity incentives	N/a, market-based approach	N/a, market-based approach	Pending	N/a, market-based approach	N/a, market-based approach
Implications for Walloon region	Limited. Flexibility to react to market ramp-up might attract flows.	High. Tariffication may create cost disadvantage for Walloon industry	Limited. Timeline for interconnection relatively long	High. Connection to Walloon network dependent on demand development.	High. Grid development in NL will affect layout of transit routes across Europe.
Other aspects	Regulator may provide standards for establishment of prices and conditions	Government to evaluate progress every 5y, may decide to introduce common tariff methodology	CRE proposition to decide regulation after public consultation (min. every 3 years)	Regulatory framework was to be developed in carbon management strategy, which has been halted following government collapse	Government may decide on regulatory measures depending on CCS market development

Source: NERA analysis.

5.1. EU level

The 2024 ICMS emphasises the need to deploy an infrastructure to transport large CO2 volumes within the future single CO2 market to meet future demand by industrial carbon management projects. Key requirements for the market to evolve are a functioning cross-border, open-access, multi-model CO2 infrastructure with non-discriminatory access and contract and price transparency.

While the previous Commission notes that such networks are currently not regulated at EU level, it indicates the need for a future policy and regulatory framework to optimise and harmonise CO2 infrastructure development across Europe in the ICMS. This includes the repurposing of existing infrastructure and the consideration of interactions with electricity, gas and hydrogen sectors to ensure system integration within the EU energy system. Cross-border network planning should be developed in coordination with the industry and could be coordinated across jurisdictions also with the support of European coordinators nominated by the Commission. These coordinators may also inform the development of a *"fit for purpose regulatory framework"*. The ICMS emphasises the need for a participatory approach to network planning where stakeholders provide input through consultation processes or the CCUS Forum stakeholder platform.[264]

The previous Commission planned to provide more guidance on how it envisages future regulation of CO2 networks in a dedicated CO2 transport regulation package. The timeline for this package was however left to the new Commission.

5.2. Denmark

The Danish regulatory framework for CO2 transport follows a market-based approach with negotiated third party access leaving tariff negotiations mostly to the network operators and users (who are the ones who have received the subsidies under the funds set out in section 4.2).

This "light touch" regulatory approach is set out in the Act on Pipeline Transport for CO2 from June 2024 and was recently amended by the Executive Order on Pipeline Systems for the Transport of CO2.[265] The Danish framework provides for negotiated, non-discriminatory third-party access to the pipeline infrastructure and potential ex-post regulation by the regulatory authority:

- The network operator must decide on requests for access and report the outcome to the Danish Energy Agency (DEA). Tariffs and conditions for pipeline transportation are subsequently negotiated between the network operator and the potential user and must be published and reported to the Danish Utility Regulator (DUR). The DUR ensures that access is granted under reasonable, objective, transparent and non-discriminatory prices and conditions. Thus, prices and conditions must be set without discrimination between different applicants for access to a pipeline.
- Negotiated prices and conditions do not require DUR approval but can be subject to ex-post adjustment if the DUR finds them in breach of the regulation. Alternatively, applicants can

[264] European Commission (2024): Towards an Ambitious Carbon Management for the EU, p. 9-10. Link: https://eur-lex.europa.eu/legal-content/EN/TXT/PDF/?uri=CELEX:52024DC0062.

[265] See the Act on Pipeline Transport for CO2, 2024, esp. Chapter 4 and 5. Link: https://www.retsinformation.dk/eli/lta/2024/612. See also the Executive Order on Pipeline Systems for the Transport of CO2, 2024. Link: https://www.ft.dk/samling/20231/lovforslag/L117/bilag/9/2854881.pdf.

complain to the DUR about a rejection of a request for access, the conduct of negotiations or the prices and conditions for access to the pipeline systems. When DUR is assessing prices and conditions, a number of principles need to be taken into account:[266]

  - Prices and conditions shall be set based on the services provided and independent of the potential users' profitability.
  - Tariffs must cover i.) the operating cost incurred by the operator due to the use; ii.) new investments associated with the use and iii.) additional settlement costs resulting from the pipeline usage.
  - If users use additional capacity previously designated to a third party, tariffs and conditions for the use of this capacity must include risk-adjusted, market-based returns reflecting the risk of these investments not being fully utilized.
  - Tariffs should reflect a reasonable profit for the network operators and shall not include repayments of investments which have already yielded or are expected to yield a reasonable return.

- Network operators are required to publish standard prices and conditions for access to the pipeline systems.
- The DUR may develop and publish standard agreements for third-party access and guidelines on how prices and conditions can be established.
- Unbundling of CO2 transportation and other businesses along the CO2 value chain is required in the form of separate accounts for these activities.

This approach leaves the development and tariffication of CO2 transport pipelines primarily to negotiation between the pipeline operator and private parties. The Danish focus on private agreements is likely to limit the dimensioning of the network to levels backed by demand at the time and does not provide any risk mitigation against counterparty risk in case of shipper bankruptcy; thus potentially increasing the risk premiums associated with pipeline development and limiting the sizing of the pipelines (also see section 2).

During the consultation, various market participants advocated for the regulation of prices for third-party access, due to a perceived risk of unreasonable high prices of negotiated third-party access due to a monopoly position of the infrastructure operator and concerns regarding the effectiveness of DUR's supervision. In its response the DEA argued that the political framework conditions for CCS emphasise the need of a market-based approach with negotiated access, prohibiting a regulated approach.[267]

It is our understanding from discussions with stakeholders that Denmark plans to provide further regulation for regional and cross-border pipeline infrastructure, once the respective EU regulation and guidelines have been published. Without specific mechanisms to support "spare capacity" (see

[266] Executive Order on Pipeline Systems for the Transport of CO2, 2024, Art 14. Link: https://www.ft.dk/samling/20231/lovforslag/L117/bilag/9/2854881.pdf.

[267] See Høring Portalen (2024) Høring over forslag til bekendtgørelse om rørledningsanlæg til transport af CO2 – Høringsnotat, esp. p. 2, Link: https://prodstoragehoeringspo.blob.core.windows.net/b664c9d1-51ab-4a6c-9a56-b55ae7fe55ba/H%C3%B8ringsnotat.pdf .

section 2.3.5), the existing Danish framework is prone to fostering the emergence of smaller networks tailored to the needs of the specific auction winner. Certain market participants have criticised the Danish model as insufficient to promote the financeability of a broader CO2 transport infrastructure.[268]

5.3. Flanders

Flanders' general regulatory framework is set out in the Decree of 29 March 2024, on the transport of carbon dioxide via pipelines ("CO2 Decree") [269] In June 2024, the Flemish Government subsequently approved a decision to implement the CO2 Decree defining key elements of the Flemish regulation on the carbon transport through pipelines:[270]

- The creation of **local CO2 clusters[271]** and the subsequent appointment of an operator for each local CO2 cluster, for a renewable term of 20 years. Local network operators will be appointed by the ministry following market requests and a designation procedure and content for the designation similar to that of the regional carbon network operator. Every two years the cluster operators have to provide an indicative development plan, following consultation with relevant market players.[272]
- The development of a **regional CO2 transport network[273]** to connect the clusters, which will be operated by a single entity. The appointment of a single carbon network operator (CNO)[274] for regional CO2 transport across local clusters will be for a renewable term of 20 years. A call for applications to become Flanders' CNO has been published on 6th November 2024. Thereafter, candidates have ninety days to hand in their application to the Flemish Energy Agency (Vlaams Energie- en Klimaatagentschap; VEKA). Once the completeness of the application is confirmed by VEKA within thirty days, VNR and VEKA evaluate the applications against the designation conditions and criteria within three months. After both agencies provide their reasoned advice, the Flemish Government subsequently has nine months to designate the CNO considering the different designation criteria. A similar procedure is provided for the designation of the local network operators, with the only difference that the call for applications has to be triggered by a candidate. While there is no formal date for the CNO to provide tariff proposals, the proposal's

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268 Various conversations at CO_2nnecting Europe (2025). See https://co2hubeurope.dk/news-resources/ for a summary and recording of the conference.
Moreover, Deloitte argues that only the current UK CCS framework is holistic and bankable in contrast to the systems set up in Denmark, the Netherlands , Norway and the United States. See Deloitte (2023)

269 Moniteur Belge (2024): Décret relatif au transport de dioxyde de carbone par canalisations. Link: https://etaamb.openjustice.be/fr/decret-du-29-mars-2024_n2024003725.html. Most provisions of the decree came into force on 26th August 2024, while some provisions will only come into force on 30th June 2025.

270 Vlaamse Regering (June 2024): Besluit van de Vlaamse Regering over het vervoer van koolstofdioxide via pijpleidingen in het Vlaamse Gewest. VNR clarified to NERA that the Flemish Government can define further provisions on various aspects of the CO2 Decree, including on i.) safety guidelines and ii.) public service obligations.

271 Local clusters consist of networks of pipelines transporting carbon dioxide between producers in a geographically defined area. They bear resemblance with distribution networks for electricity and gas.

272 CO2 Decree (29 March 2024), Art 19.

273 CO2 Decree (29 March 2024), Art 32 sets out the tasks of the regional system operator.

274 Note that the function of what is called the regional network operator (or CNO) in Flanders is analogous to what is called a supraregional network operator as discussed in section 2.1.

development will likely align with the expected timeline of the network development. [275] Every two years, the transport system operator has to provide an indicative development plan, covering e.g. estimates of capacity requirements, an investment programme for the construction of the regional network and the connection with pipeline systems in adjacent regions. During the preparation of the development plan, national and international market players and relevant authorities have to be consulted. The plan has to be approved by the Government on advice of VNR .[276]

- The local and regional network operators will be regulated by VNR to guarantee the provision **of non-discriminatory third-party access** to their networks to ensure efficient infrastructure use. As set out in more detail below, Flanders chose a rather light-touch approach leaving the development of a tariff methodology to network operators.
- **Legal unbundling obligations** mandate the CNO and regional cluster operators to be legally independent from companies engaged in CO2-emitting activities or CO2 reuse. This is to ensure decision making based solely on the interests of the CO2 transport system and its users.
- In addition, the framework allows for **closed industrial networks** owned by individual companies. These networks have to be part of an integrated production and/or operation process and do not fall under the same regulation as the aforementioned local and regional networks.
- Provisions for the **operation of liquefaction terminals** for transport or shipment to off-takers or storage sites, e.g. unbundling rules and non-discriminatory access.

With regard to **tariffication**, the role of VNR, as the regulator supervising the CO2 pipeline infrastructure development, is limited: The decree stipulates that **operators** of local networks and regional networks respectively **submit tariff proposals** to the VNR for approval.[277] If approved, the tariffs for regional and local networks are valid for the following two years, an ex-post application being prohibited by the Decree. Decisions by the regulator can be appealed by the CO2 infrastructure operators and third parties according to rules specified by the CO2 Decree.[278]

According to the decree, tariffs for local and regional networks have to meet common regulatory principles, i.e. they have to be transparent, objective, non-discriminatory, based on actual costs and a reasonable profit margin and have to offer a fair balance between the service quality and the prices to users. In addition, depreciation periods have to reflect the expected economic lifetime of the pipelines. When developing the tariff proposal, the regional system operator is also obliged to consult the relevant network operators in the other Belgian regions. VNR has to evaluate and approve whether the tariff proposals by the system operators meet the tariff principles stated by the Co2 Decree, so – for now – there will **not be a common tariff methodology provided by the regulator**; nor will tariff approaches necessarily be the same across Flemish networks. VNR's role is essentially limited to evaluating the tariff proposal and its underlying assumptions. The details of the

[275] Moniteur Belge (2024): Decision of the Flemish Government on the transport of carbon dioxide via pipelines in the Flemish Region, § 38. Link: http://www.ejustice.just.fgov.be/eli/besluit/2024/10/25/2024010132/staatsblad. Further details on the process were provided to NERA by VREG.

[276] CO2 Decree (29/03/2024), Art 32 and 39. Art 39 also specifies that the CNO needs to consult all relevant domestic and international stakeholders and relevant governmental authorities on the draft development plan.

[277] CO2 Decree (29/03/2024), Art 65 and 66 respectively.

[278] CO2 Decree (29/03/ 2024), Art 67.

evaluation processes – if any – are yet to be established by VNR. That said, NERA understands from communications with VNR that it is considering providing on the content of the proposals. For example, the valuation of repurposed assets will be given specific attention according to VNR. VNR further clarified that the CO2 decree provides that the agency has to consult the competent authorities of the Belgian regions prior to approving the tariff proposal of the CO2 network operator.[279]

This approach may be altered, depending on the progress of the CO2 infrastructure market, as the need for a tariff methodology will be regularly reviewed by the Flemish Government. The Government is obliged to provide the Flemish Parliament with an evaluation report assessing the implementation and effects of the Decree very five years, with the first report due before 1st July 2028.[280] This report must at least evaluate the efficiency of the market structure for pipeline-bound CO2-transport, the effectiveness of the tariff principles and the need to introduce a tariff methodology.[281]

As of September 2024, Fluxys (Belgium's gas TSO) plans to start transmitting CO2 for industry in Belgium in 2026 via its subsidiary Fluxys c-grid which is preparing its application to manage the CO2 transport networks in Belgian regions.[282] Simultaneously, the company is undertaking preparations to develop a regional CO2 transport network. [283] It has published an information memorandum last updated in 2022[284] that sets out both a tariff methodology and a timeline for rolling out specific projects to start developing a carbon transport network. Their proposed regional tariff methodology[285], the implementation of which is conditional on the official selection of Fluxys as single CNO and subsequent approval of the methodology by the VNR, sets out the following principles:

- **Annual tariff** determination, assuming a flat injection profile within a given year. Tariffs would reflect the cost of building and operating the respective transport infrastructure.
- **"Postage stamp" tariffs within individual local CO2 clusters** which are independent of the transport distance within a single local cluster (exit-entry tariff model). Tariffs may vary across clusters as they are specific to the respective individual infrastructure and its utilisation.[286]
- A **distance-based regional tariff** will be applied for transport across local clusters via the regional network infrastructure operated by the CNO; potentially disadvantaging industrial

279 CO2 Decree (29/03/2024), Art 66 §3.

280 CO2 Decree (29/03/ 2024), Art 93.

281 VNR is obliged to provide a report on the development of the CO2 sector a year before the Government report is published.

282 Fluxys (30/09/2024), Results for the first half of 2024 – press release, p. 5: Link: https://ml-eu.globenewswire.com/Resource/Download/3ffa8326-52ce-4fd9-a081-f9e950c11ec0.

283 Fluxys (2024): Out CO2 infrastructure projects. Link: https://www.fluxys.com/en/about-us/energy-transition/our-co2-infrastructure-projects.

284 Fluxys (September 2022): Information Memorandum for CO2 Infrastructure. Link: https://www.fluxys.com/-/media/project/fluxys/public/corporate/fluxyscom/documents/energy-transition/co2/2021-12-14---information-memorandum-co2-main---december-21.pdf.

285 Fluxys terms this a „transmission" tariff.

286 While Fluxys does not elaborate, usually tariffs for heavily used infrastructure should be lower than for less used infrastructure.

emitters further from the export hubs (i.e. Walloon and international emitters) compared to Flemish emitters.

- Following general principles, tariffs will be **non-discriminatory**, so different network users will be charged the same if they use the same transport routes.

Fluxys proposes that the resulting tariffs be applied via long-term subscriptions for pipeline capacity services in the form of "ship-or-pay charges" which are independent of the actual use.[287]

Since Fluxys' latest publicly available proposal was published in 2022, it does not take the 2024 CO2 Decree into account. Fluxys has not published an updated methodology proposal as of January 2025.

5.4. France

The CCUS strategy foresees that CO2 infrastructure will be owned by private investors. Under the CCUS strategy, the aim is for the first CO2 transport network on the national territory to be commissioned by 2028. To establish regulatory conditions that are consistent with this timeline, the French government and regulator CRE conducted a consultation with industrial stakeholders and financiers in 2023. The government concludes that stakeholders supported the establishment of economic regulation under the following conditions: [288]

- The regulatory framework is known or established before investment decisions or the signing of access contracts between industrial users and transport operators have taken place and / or it does not call into question contracts already concluded.
- The framework is adapted to the different characteristics of CO2 transport and other energy networks, e.g. the limited number of customers and infrastructures currently being deployed.
- The government sets out that the fragmentation of the CCS value chain requires a more flexible regulatory approach than for electricity and gas, which are much more mature markets. A regulation concerning access to the main network (collection and transport), open to third parties and connecting different clusters and storage sites is envisaged.

In a separate report, the regulator CRE sets out the following principles regarding the proposed approach to regulating CO2 transport networks: [289,290]

Capturing CO2 is in the competitive domain, so it does not appear necessary to regulate it.

Collecting CO2 and feeding it into the trunk pipeline network may compete with unregulated activities (road, river or rail transport). In order to allow manufacturers to organize themselves within

[287] Note that Fluxys also provides some indicative information on terminal-specific terminalling tariffs which will depend amongst others on storage sizing and availability of subsidies.

[288] Ministère de l'économie, des finances et de la souveraineté industrielle er numerique (2024): État des lieux et perspectives de déploiement du CCUS en France, p. 21ff.

[289] Ministère de l'économie, des finances et de la souveraineté industrielle er numerique (2024): État des lieux et perspectives de déploiement du CCUS en France, p. 23f.

[290] CRE (2024): Rapport de la CRE sur le cadre de régulation des infrastructures d'hydrogène et de dioxyde de carbone. p. 59f.

the hubs, CRE considers that it is preferable to provide for negotiated access, with (only) transparency and non-discrimination obligations, controlled by CRE.

Pipeline transport, liquefaction terminals and CO2 storage will most likely constitute natural monopolies. CRE therefore recommends that those have regulated third-party access, with tariff and access rules set by the regulator in the future. Regulation should be decided following public consultation (at least every 3 years), taking into account the following minimum standards:

- Accounting separation (horizontal and vertical) of the activities of transporting CO2 by pipeline, storage and liquefaction from other activities of the value chain is necessary at a minimum to allow for oversight of the profitability of these infrastructures and where applicable, to establish regulated usage rates reflecting the costs.
- Approval of network plans made by CO2 transport operators by the regulator.
- Regulation uses a regulatory asset base. Natural gas assets converted to transport CO2 should be transferred to the new operator at their value in the regulated "natural gas" asset base
- Tariffs can be set differently between and within the different CO2 networks but the CRE reports available to date do not go into further detail regarding whether capacity or distance-based tariffs should be used.
- Additional support, e.g. in the form of a guarantee-system for the operators is required but the CRE report currently does not contain further discussion of the possible design of such guarantees.

The CCUS strategy supports the implementation of these CRE recommendations. As of January 2025 CRE has not issued further details in addition to the September 2024 reports and the further timeline is currently unclear.

5.5. Germany

Context and status quo

The regulation of CO2 transport pipelines in Germany has not yet been formalised in a legislative / regulatory document. In February 2024 a "cornerstone" paper outlining the future CMS was presented by the German Government and passed Cabinet in August, before a full draft strategy by the BMWK was leaked in September 2024. The draft CMS contained a sketch of the government's approach to tariff regulation. Simultaneously, the government introduced a draft revision of the Carbon Transport and Storage Law (Kohlenstoffspeicher- und Transportgesetz; KSpTG) into parliament in September 2024.[291] The KSpTG contains various planning law provisions key for the development of CO2 pipelines but does not cover the regulation of tariffs in detail.

The collapse of the government coalition on 6th November 2024 disrupted the timeline for further development of CO2 transport and storage regulation and eventually led to its stalling before the election. Support for CCS varies across parties and thus parliamentary groups:

- SPD and Greens most recently formed a minority government and provided the majority of Cabinet officials that agreed on the draft KSpTG in its current form. However, some of their MPs

[291] The parliamentary process on this law has started and the first reading took place in September 2024, before the collapse of the Government coalition.

oppose a ramp-up of CCUS infrastructure because of its potential to displace other decarbonisation options.[292]

- CDU[293] and FDP[294] support the general aims of the draft law and may be willing to vote for it or an amended version in the next legislative period. Members of the CDU recently emphasised the importance of swift action on CCS legislation, signalling their willingness to potentially support the draft KSpTG. However, the CDU did not push for a passing of the law in the last parliamentary sessions before the election.[295] Both parties support a wider application of CCS, promoting technological flexibility for industrial emitters to reduce *economically* hard to abate emissions.

In short, while the new parliament may still contain a majority for passing the KSpTG or an amended version in principle, the timelines for the development of a regulatory framework for CO2 transport in Germany are currently highly uncertain. In this context, Germany hopes that the Industrial Decarbonisation Accelerator Act, announced by the incoming European Commission, will provide additional guidance on the regulation of cross-border CO2 transport.[296]

Draft regulation

The September 2024 draft CMS envisaged approving commercial carbon capture for all carbon emissions except for coal power plants, allowing offshore CO2 storage, speeding up permitting procedures, ratifying the London Protocol to allow CO2 export, and signing memoranda of understanding with other Member States on cross-border storage and transport.[297]

The existing outlines for CO2 network regulation focus primarily on private contracts without formal tariff regulation. The draft KSpTG allows for private financing and operations of CO2 pipelines and supports the rollout of a CO2 grid through accelerated permitting:

- CO2 pipeline networks may be operated either by private or public entities, with network operators obliged to ensure non-discriminatory third-party access to their network. However, the transport of CO2 sourced from coal combustion is prohibited.
- Network access is negotiated between consumers and operators, while the KSpTG contains a clause that allows the Ministry to authorise the regulator (the BNetzA) to provide further technical and economic conditions for access.[298]

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292 Bundestag Expert Hearings on the draft amendment to the law on capture and storage of carbon, November 6, 2024. Link: https://www.bundestag.de/dokumente/textarchiv/2024/kw45-pa-klimaschutz-kohlendioxid-speicherungsgesetz-1025478.

293 As of January 2025, the CDU is most likely to lead the next government based on polling data.

294 FDP was involved in the development of the law before it left the coalition government in early November 2024.

295 Handelsblatt (21/11/2024): Industrie pocht auf Gesetz zur CO2-Speicherung. Link: https://www.handelsblatt.com/politik/deutschland/dekarbonisierung-industrie-pocht-auf-gesetz-zur-co2-speicherung/100089531.html.

296 Statement by Sebastian Fischer, BMWK Delegate at the 2024 ICM Forum in Pau.

297 German Ministry for Economic Affairs and Climate Action (September 2024): Draft Carbon Management Strategy of the Federal Government. Link: https://www.klimareporter.de/images/dokumente/2024/09/carbon-management-strategie-breg.pdf.

298 Bundestag (2012): Law on the Storage of Carbon Dioxide, §33. Link: KSpTG.pdf., and Bundestag (2024): Draft Amendment to the Law on Storage of Carbon Dioxide. Link: Deutscher Bundestag Drucksache 20/11900

- Repurposing of gas pipelines for CO2 transport is permitted and regulated.

At the same time, the CMS recognised the potential need for i) reducing tariffs for initial users, ii) reducing tariffs for emitters in remote locations that would not be able to bear the specific network cost of connecting them and iii) risk-mitigating mechanisms, e.g. state guarantees to complement indirect funding through carbon CfDs. The September 2024 CMS did not yet contain any specific tariff measures to address any of the challenges identified.

The government does not appear to have considered in detail the introduction of an "amortisation account"[299] that it uses to de-risk the hydrogen network. Thus, CO2 network operators would have to charge cost-based tariffs in the early years of a CO2 network ramp-up already; likely relying on funding from the carbon CfDs provided to emitters to refinance these tariffs.

If this relatively limited regulatory framework is implemented by the (next) German government, CO2 network development could end up being driven by who wins support from carbon CfDs or similar instruments. Thus, the timeline for connection of the Walloon CO2 network to transit flows from Germany will heavily depend on CO2 transport demand development in Germany, which in turn will be closely linked to the availability of indirect funding.

In addition, the German practice of "parliamentary discontinuity" means that the new government will need to start a new legislative procedure rather than simply "picking up" the existing law; leading to expected delays in the passing of the law of one year at least.

5.6. Netherlands

The European CCS Directive was transposed into the Dutch Mining Law in 2011. Article 32 of the Mining Act regulates third-party access to CO2 transport and storage infrastructure on reasonable, transparent and non-discriminatory terms. The State Mine Supervision (SodM) has been designated as the supervisory body for monitoring third party access to the infrastructure. Parties can file a complaint to the SodM in case of unfair or discriminatory treatment in accessing CO2 transport and storage infrastructure in the Netherlands.[300] As of 2023, we understand that no complaints were filed.[301]

Besides the regulatory supervision role by the SodM, there is also monitoring of the market and alleged abuse of market power under Dutch competition rules and law. This is carried out by the Authority for Consumers and Markets (ACM) in the Netherlands and the European Commission (EC)

Gesetzentwurf der Bundesregierung Entwurf eines Gesetzes zur Änderung des Kohlendioxid-Speicherungsgesetzes. With the law not having passed Parliament, there was no basis for the Ministry to trigger this clause.

299 An amortisation account allows network operators to balance tariffs across the lifetime of an asset if the number of users is expected to change substantially over time. It allows operators to charge higher-than-cost-reflective tariffs in later periods to refinance lower-than-cost reflective tariffs during earlier periods. Such a mechanism allows tariffs charged to initial users of a developing CO2 or H2 network to be attractive. While a H2 network developer can deliver larger pipelines at lower initial cost, this creates a risk for the government and the TSO (who bears part of the cost of failure under the German model), if the run-up does not proceed as expected.

300 Ministry of Economic Affairs (EZK), Kamerbrief over aanbieding rapport Verkenning van de marktordening voor Carbon Capture and Storage, Brief aan Tweede Kamer der Staten-Generaal, Kamerstuk 32 813, n. 1375, 16 april 2024, p.5.

301 European Commission (2023), Member State report on Implementation of Directive 2009/31/EC on the Geological Storage of Carbon Dioxide ('CCS Directive') – The Netherlands, p.3.

at the EU level. As described in section 3.7 above, in 2022 the ACM provided an informal assessment of the competitive effects on the CCS market from the joint marketing initiative launched by TotalEnergies and Shell for the Aramis project, assessing that there was no anticompetitive effect or consumer harm.

Overall, the Dutch Mining Law does not foresee a role for formal price regulation of CO2 transport and/or storage tariffs. This reflects the view from the Dutch government that in the long-term a well-functioning and competitive CCS market will emerge, where investments in infrastructure will be driven by private entities competing at the national and European level and set transport and storage tariffs based on market outcomes.[302] Therefore, limited additional regulatory intervention is required beyond what is already included in the Mining Act regarding third-party access to transport and storage infrastructure.

However, as the CCS market is yet to fully develop and mature, the Dutch government will consider if new regulatory measures might be required to ensure reasonable, transparent and non-discriminatory access to CO2 transport and storage infrastructure. According to an independent study carried out on behalf of the Ministry of Economic Affairs (EZK), this is particularly relevant in the context of the Aramis project, given the large size of the project and the ownership model of the project (with private parties having potentially conflicting interests).[303] Therefore, the government might consider if additional regulatory intervention is required in the future (e.g. around tariffs and access terms).[304]

6. Conclusion

This report was prepared by NERA to support CWaPE during the development of efficient and effective CO2 transport regulatory and support policy for Wallonia. NERA has analysed the current status of the CO2 market, direct and indirect state support mechanisms and regulatory frameworks for CO2 transport in the following EU jurisdictions leading the development of CO2 infrastructure: i.) Flanders, ii.) Denmark, iii.) France, iv.) Germany and v.) the Netherlands. Relevant regulation and support systems provided by the European Union have been assessed as well.

We find that a large number of projects including cross-border interconnections in each of the territories are under development. On the other hand, only a small number of projects have reached final investment decision including CO2TransPorts in Belgium and the Netherlands, Project Greensand in Denmark and Porthos in the Netherlands while not a single German project has reached that stage yet.

We find that most countries in the sample primarily provide indirect support to the CO2 transport network in the form of support to emitters that the latter can then use to pay for the transport

[302] Ministry of Economic Affairs (EZK), Kamerbrief over aanbieding rapport Verkenning van de marktordening voor Carbon Capture and Storage, Brief aan Tweede Kamer der Staten-Generaal, Kamerstuk 32 813, n. 1375, 16 april 2024, p.1-2.

[303] Centre for Energy and Business and Economics Research (March 2024), Verkennig van de markordening vor Carbon Capture and Storage (CCS), p.6-7.

[304] Ministry of Economic Affairs (EZK), Kamerbrief over aanbieding rapport Verkenning van de marktordening voor Carbon Capture and Storage, Brief aan Tweede Kamer der Staten-Generaal, Kamerstuk 32 813, n. 1375, 16 april 2024, p.5.

infrastructure. The EU also provides direct support to transport infrastructure through its CEF and Innovation Funds but the use of direct funding is uncommon at the state level. Reasons for the limited use of direct funding relative to indirect funding may be that

- Direct funding to lower the cost of CO2 transport infrastructure benefits transit volumes at least as much as domestic volumes (while the cost only falls on domestic taxpayers); and
- The use of indirect funding mechanisms like carbon CfDs that provides funding to emitters, makes it easier to match the provision of CO2 transport infrastructure to known demand (as generated by those who have won carbon CfDs).

Most countries in the sample (except for France and the UK, which is outside the scope of this study) opt for commercial negotiation of access tariffs and indirect support of network development through funding made available to emitters. This setup is likely to limit the dimensioning of the network to levels backed by demand at the time and does not provide any risk mitigation against counterparty risk in case of shipper bankruptcy; thus potentially increasing the risk premiums associated with pipeline development and limiting the sizing of the pipelines.

If CWaPE wants to provide incentives for the development of CO2 transport capacity ahead of immediate demand, it may need to develop a model that follows the Germany hydrogen core grid where below-cost tariffs are used in the early years to ensure that tariffs remain affordable for early adopters. At the same time, the state guarantees (the majority of) the risk of any shortfall in the future if the tariff deficit incurred in the early low demand years cannot later be recovered. Adopting a similar model for CO2 transport can reduce the initial cost of joining the system for new emitters and thus provide a pathway to investing ahead of demand and growing demand gradually.

Our review of tariff designs (to the extent that they are sufficiently well defined already) has also shown a number of points that can inform CWaPE's tariff setting considerations:

- The use of cost / distance-based tariffs can exclude users in remote locations. It is also likely to favour domestic over transit users. In that sense, Fluxys' proposal to use a distance-based tariff in Flanders is likely to negatively impact the competitiveness of Walloon industry while increasing the risk that Walloon flows could divert to routes that are lower cost for shippers (e.g. regulated CO2 pipelines in France), which in turn would increase the unit cost of the Flemish network by lowering its utilisation;
- The case for providing comparatively lower tariffs for transit depends on whether there is a risk that potential transit flows could otherwise take a different route (e.g. northwards from Germany rather than to the West);
- The use of cluster-specific tariffs rather than one blended tariff across the whole of Wallonia can improve stability for industrial users of the CO2 network, as there is no risk that the price of the network will change materially from one year to the next if e.g. new clusters are added.

Appendix A. Project case studies in more detail

A.1. Denmark

Several CO2 infrastructure projects are currently developed in Denmark:

Project Greensand is Denmark's most mature project for storage of CO2.
In early 2023, cross-border CO2 emissions were injected into a depleted oilfield offshore for the first time ever after the project received the first full-scale storage permit for CO2 in the Danish North Sea. During this test period a total of 15.000 tCO2 from Belgian industry were injected. A final investment decision on the first commercial phase of the project was made in late 2024, and official storage is set to start by the end of 2025 or early 2026. [305] The project plans to store up to 1.5 mtpa from 2025/2026 and up to 8 mtpa of CO2 from 2030.[306] The project does not include an offshore pipeline and anticipates transport to the storage site entirely by ship. The project is developed by a consortium of 23 companies led by Ineos and Wintershall Dea and is based on a cross-border value chain. The Danish Government decided to support the project with DKK 7.41m (EUR 1m) in Phase 1 via the Energy Technology Development and Demonstration Program (EUDP), and a further DKK 197m (EUR 26m) through the EUDP that was in turn provided by the EU Innovation Fund.[307]

Norne Carbon Storage Hub is a cross-border project consisting of CO2 infrastructure downstream of carbon capture and purification. It includes CO2 compression facilities, pipelines, liquified CO2 (LCO2) ship receiving facilities, LCO2 storage facilities, and onshore CO2 injection and monitoring wells. The initial project scope is expected to cover Denmark Sweden, Belgium, and the UK.
Fidelis New Energy is coordinating the project, partnering with Ross Energy, Gas Storage Denmark, Port of Aalborg, and Port of Kalundborg. It was designated a Project of Common Interest (PCI) by the Commission in 2023. Feasibility studies have been concluded in June 2024, but permits are pending. A final investment decision was expected for December 2024. In January 2025, the Commission awarded the project a CEF grant of c. EUR 12m for construction of quay, receiving terminal and pipeline infrastructure.[308]

The project contains two separate storage facilities, Project Fyrkat and Project Trelleborg:

[305] World Oil (10/12/2024) INEOS-led Greensand to become first full-scale carbon storage facility in EU. Link: https://www.worldoil.com/news/2024/12/10/ineos-led-greensand-to-become-first-full-scale-carbon-storage-facility-in-eu/

[306] OffshoreEnergy.Biz (10/09/2024): Denmark's CO2 storage pilot project paves the way for large-scale CCS. Link: https://www.offshore-energy.biz/denmarks-co2-storage-pilot-project-paves-the-way-for-large-scale-ccs/ and Wintershall (08/03/2023): Wintershall Dea startet mit Projekt Greensand erste CO2-Speicherung in der dänischen Nordsee. Link: https://wintershalldea.com/de/newsroom/pi-23-05-0. See also CCS Europe (03/10/2024): https://www.ccs-europe.eu/greensand_ccs.

[307] Ineos (09/12/2021): Project Greensand to receive Danish Government funding of DKK 197 million (EUR 26 million) for CO2 storage in the North Sea. Link: https://www.ineos.com/news/ineos-group/project-greensand-to-receive-danish-government-funding-of-dkk-197-million-26-million-for-co2-storage-in-the-north-sea/.

[308] Planning and approval of the North Sea CO2 transport corridor in Germany.

- Project Fyrkat consists of a storage facility in Northern Jutland, its associated pipeline infrastructure and a LCO2 reception facility at the Port of Aalborg. The storage site will be connected to the Port of Aalborg through an 80km pipeline.
- Project Trelleborg includes a storage facility in Western Zealand, its associated pipeline infrastructure, and an LCO2 reception facility at the Port of Kalundborg. A 20 km pipeline will connect the Port of Kalundborg with the storage site.

LCO2 reception facilities at both ports are expected to have an initial capacity of 4 mtpa each, with a planned expansion at the Port of Kalundborg for an additional 4mtpa. Both pipelines will include local emitter tie-ins along the routes. In total, the Norne project will provide 12 mtpa of LCO2 reception, 10 mtpa of pipeline transport capacity to injection wells, and a 0.75-1 mtpa injection rate per storage site. It is set to store 2.3 mtpa by 2026 and 20-30 mtpa by 2030. Potential future expansions include the connection of both separate networks to optimize usage rates for the storage structures.

Project Bifrost is a CO2 transport and storage project to develop an open access infrastructure connecting European industrial hubs to offshore underground storage in the Danish North Sea. The project intends to repurpose existing oil and gas infrastructure offshore facilities and the offshore gas transportation system. The depleted Harald gas fields 260km off the shore will serve as key storage facility. New infrastructure and shipping will connect emission clusters primarily located in Denmark, Germany, Poland, and Sweden (see Figure A.6.1). Project development will stretch across two phases: [309]

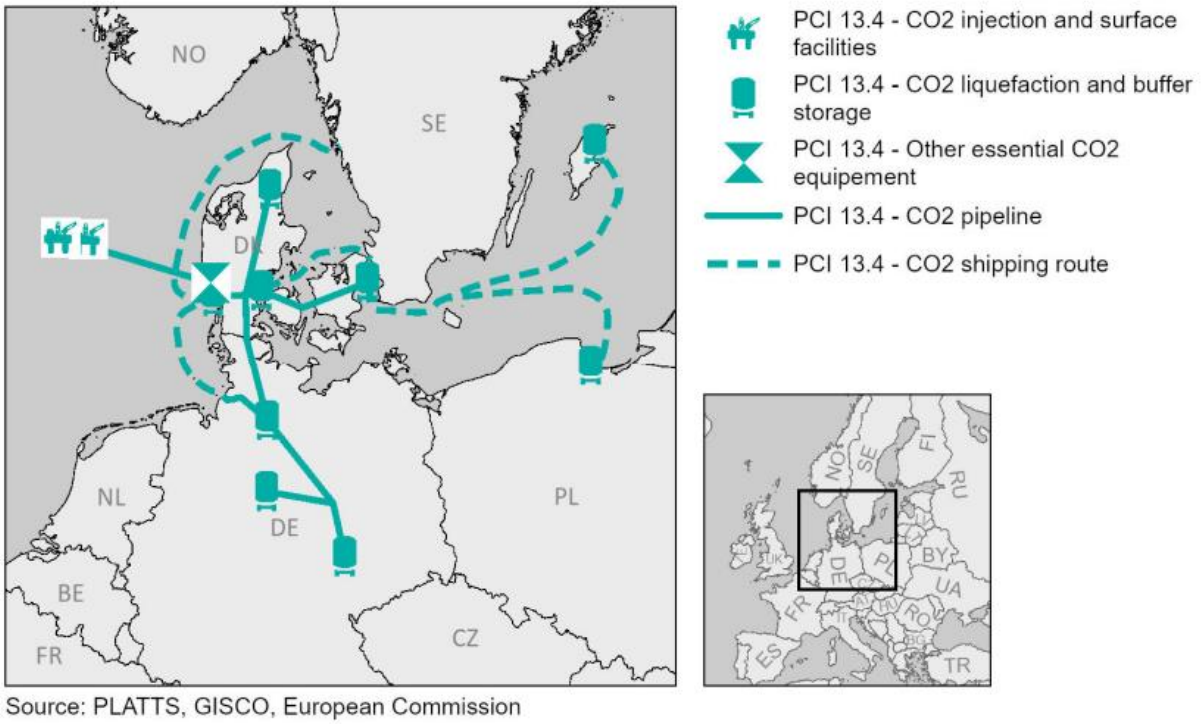
- Phase 1: Development of 2-3 mtpa CO2 of transportation and storage capacity to be commissioned by 2030, with CO2 will either being shipped directly to the offshore storage site or shipped to the onshore hub for further transport via offshore pipeline.
- Phase 2: Development of a national and cross-border onshore pipeline network to connect main industrial cluster in Denmark and Germany on the main Leipzig/Hamburg backbone route to additional storage sites in Denmark. The second phase is set to run from 2030 to 2032 and is expected to add up to 10 mtpa of storage and transport capacity.

Project Bifrost received PCI status in 2023 and was granted DKK 75.68m(EUR 10.15m) for feasibility studies from the Energy Technology Development and Demonstration Program (EUDP) via the Danish Energy Agency. The feasibility study is set to conclude in 2024, after which initial results will be published.[310] Total Energies SE coordinates the project in cooperation with Nordsofonden, Orsted Salg & Service, ARC – I/S Amager, BlueNord Denmark, Evida, and Ressourcecenter.

[309] European Commission (2023): PCI Implementation Plan: Norne – Transportation Infrastructure in Denmark. Link https://ec.europa.eu/assets/cinea/PCI/files/PCIFiche_13.10_1st_PCI_PMI_list.pdf.

[310] DTU Offshore Website, June 2024. Link: https://offshore.dtu.dk/research/ccs-research/bifrost-an-innovative-co2-storage-project.

Figure A.6.1: Schematic Illustration of Project Bifrost



Source: PCI-PMI Transparency Platform, European Commission.

A.2. Flanders

Flanders hosts several CCUS projects at different stages of development. These include:

CO2 TransPorts is a cross-border project that aims to construct an onshore CO2 transportation grid which will connect three industrial clusters: Antwerp, North Sea Port (serving Ghent, Terneuzen, Borssele and Vlissingen), and Rotterdam (which is developing CO2 storage capacity through the Porthos Project, see section 3.7). The onshore CO2 transportation grid will eventually connect to an offshore pipeline transporting CO2 from the Dutch coast to offshore storage sites in the North Sea.[311] The project is planned to start operations in 2026, with a transport capacity of up to 10 mtpa.[312] It has been declared a project of common interest (CPI) by the European Commission in 2020. A final investment decision was taken in 2020, construction began in 2021, and the commissioning date is set for 2026.

311 International Association of Oil and Gas Producers Website (November 2024): Interactive Map of European CCS Projects. Link: https://iogpeurope.org/european-ccs-projects-map/#

312 International Energy Agency (2022): Belgium 2022 Energy Policy Review, p. 45. Link: https://iea.blob.core.windows.net/assets/638cb377-ca57-4c16-847d-ea4d96218d35/Belgium2022_EnergyPolicyReview.pdf. According to the European Commission's Joint Research Council such a connection to Denmark is likely, if Northwestern Europe will be connected to Norwegian storage facilities. See Tumara, D., Uihlein, A. and Hidalgo González, I. Shaping the future CO2 transport network for Europe, European Commission, Petten, 2024, p. 34 and 48. JRC136709. Link: https://publications.jrc.ec.europa.eu/repository/handle/JRC136709.

Antwerp@C and Kairos@C. Antwerp hosts the largest integrated energy and chemicals cluster in Europe. The projects aim to build a shared carbon transportation infrastructure for a consortium of emitters in the region.

- The **Antwerp@C** open-access, modular CO2 transport and export facility is to provide the subsequent port infrastructure for the cross-border transport of CO2. A first possibility under consideration is to use the Northern Lights shipping and storage solution, by which carbon is shipped to be stored in facilities in and off the shore of Norway.[313] A second possibility is to transport CO2 by pipeline to Germany and the Netherlands (and possibly on to Denmark for final storage).[314] The first phase of the initiative is to cover 2.5 Mt/a of initial export capacity, with an additional expansion up to 7.5 mt/a at a later point. Antwerp@C received funding for feasibility studies from the Flemish Government and general project funding of EUR 144.6m by the European Commission's Connecting Europe Facility. Antwerp@C is being developed by a consortium of Air Liquide, BASF, Borealis, Exxon Mobil, INEOS, TotalEnergies, Fluxys, and the Port of Antwerp-Bruges. The Open Season for initial demand for the project closed in February 2022.[315] Initially the FID was expected for end of 2022 and later postponed to the end of 2023, also due to capex and energy cost increases, with the project set to become operational in H2 2026. [316] As of November 2024, a final investment decision is still pending.[317]
- **Kairos@C** encompasses the capture, purification, liquefication, storing and shipping of CO2 from local industry clusters. The project received EUR 356.9m of funding from the European Innovation Fund, a further EUR 10m from the Flemish Government. It has the potential to reduce over 14 mt of CO2 emissions over the first 10 years of operation (1.4 mtpa).[318] Kairos@C is a joint initiative of Air Liquide and BASF. As of 2024, a final investment decision is yet to be made.

[313] The Northern Lights is a project of mutual interest (PMI) and aims at storing CO2 from European emitters in Norwegian offshore storage sites. The Northern Lights Project involves promoters from Member States such as Frange, Belgium, Netherlands, Germany, and Sweden. As part of the project, a feasibility study for a liquid CO2 export terminal in Antwerp is being conducted in until December 2024. The study was supported with EUR 3.18 Mio by the CEF. However, the study is outside the scope of the Antwerp@c/Kairos@c-projects. Link: https://ec.europa.eu/assets/cinea/project_fiches/cef/cef_energy/12.4-0010-BE-S-M-20.pdf. See also: https://ec.europa.eu/assets/cinea/PCI/files/PMIFiche_13.13_1st_PCI_PMI_list.pdf.

[314] Port of Antwerp-Bruges (November 2024), Antwerp@C. Link: https://www.portofantwerpbruges.com/en/our-port/climate-and-energy-transition/antwerpc.

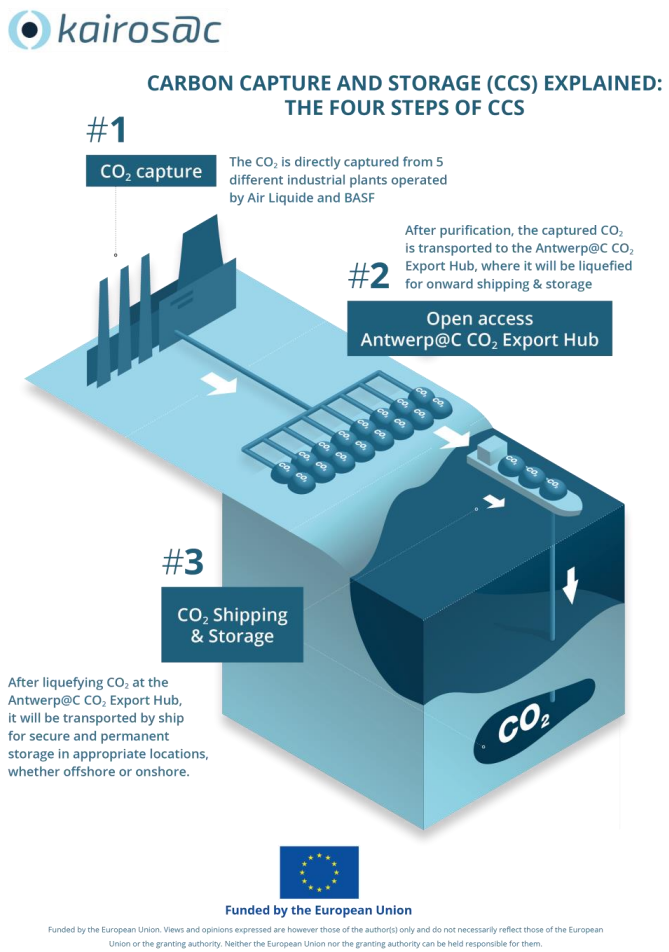
[315] Fluxys (2024), CO_2: Preparing to build the network, Link: https://www.fluxys.com/en/projects/carbon-preparing-to-build-the-network#

[316] European Commission (30/03/2023): The emerging EU CO2 transport and storage market, p. 132 Link: https://climate.ec.europa.eu/system/files/2023-05/policy_ccs_implementation_presentations_20230330_en.pdf.

[317] Borealis (undated): The Antwerp@C project takes a major next step towards halving CO2 footprint. Link: https://www.borealisgroup.com/news/the-antwerp-c-project-takes-a-major-next-step-towards-halving-co2-footprint.

[318] European Commission (2022): Kairos@C. Building strong momentum for massive decarbonisation in the EU through a unique end-to-end CCS project. Link: if_pf_2022_kairos_en.pdf

Figure A.6.2: Schematic Illustration of Kairos@C and Antwerp@C



Source: https://kairosatc.eu/

Zeebrugge CO2 Collection Hub. The project, developed by Fluxys and Equinor, comprises an onshore transmission facility at Zeebrugge and a 1000 km CO2 export pipeline for carbon storage under the seabed of the Norwegian continental shelf. While the onshore facility will be built and operated by Fluxys, the pipeline will be operated by Equinor and is planned to have a transport capacity of 20 to 40 mtpa. Liquefied CO2 from nearby hubs could be shipped to and fed into the Zeebrugge facility, and a pipeline branch to Dunkirk is also envisioned. The project is in the feasibility stage, with an investment decision expected by 2025.[319]

[319] Equinor (November 2024). Link: https://www.equinor.com/news/fluxys-and-equinor-launch-solution-large-scale-decarbonisation

EU2NSEA: The project aims to develop a cross-border CO2 network between Belgium, Germany, and Norway to also collect CO2 from European countries, with storage on the Norwegian continental shelf. Promoters are Equinor, Fluxys, and Wintershall Dea, and the project was declared a project of common/mutual interest by the European Commission (CPI/CMI). Flanders plays a key role in EU2NSEA's scope:[320]

- Capture at industrial emission sites in 8 EU member states (**Belgium**, Denmark, France, Germany, Latvia, the Netherlands, Poland, and Sweden), with fixed facilities to prepare the CO2 for further transportation.
- CO2 collection networks and hubs in 5 EU member states and 1 third country (**Belgium**, Denmark, France, Germany, the Netherlands, and Switzerland) linking industrial emission sites to **two central CO2 transhipment hubs/conditioning export terminals**; including inland pipelines interconnecting industrial CO2 emission clusters to the CO2 collection hubs, and facilities for receiving liquid CO2 by ship, barge or train, and further pre-conditioning, compression, and liquefaction equipment for cross-border transport.
- CO2 transshipment hubs/conditioning export terminals in **Zeebrugge** and Wilhelmshaven for collection, receiving, preconditioning, compression, and liquefaction equipment of CO2 for further cross-border transport.
- A CO2 transport pipeline infrastructure from export terminals in **Zeebrugge** and Wilhelmshaven to storage sites in the North Sea.
- Storage sites in the North Sea for the permanent safe geological storage of CO2, comprising sub-sea infrastructure and infrastructure within the geological formation.

Capacity of the carbon pipeline infrastructure is estimated to be 20 to 40 mtpa, and yearly injection rates of storages sites in the North Sea are estimated to jointly be >25 mtpa. Feasibility studies are being carried out in 2024 and 2025, with a final investment decision currently scheduled for Q4 of 2025. The project is expected to be commissioned in 2029. As of August 2024, no subsidies have been allocated to this project. Lastly, Belgian TSO Fluxys, together with OGE and Wintershall Dea, has signed a cooperation agreement in December 2023 to eventually build a cross-border CO2 pipeline ("**North Sea CO2 Corridor**", see section 3.6) between Germany and Belgian CO2 hubs currently under development. In January 2025, the Commission awarded c. EUR 3m for a study to support the planning and approval of the project.[321]

[320] European Commission (2024): EU2NSEA Implementation Plan. Linkhttps://ec.europa.eu/assets/cinea/PCI/files/PCIFiche_13.8_1st_PCI_PMI_list.pdf . See also https://www.equinor.com/energy/eu2nsea

[321] Wintershall Dea (August 2022): Wintershall Dea and Equinor partner up for large-scale CCS value chain in the North Sea. Link: https://wintershalldea.com/en/newsroom/wintershall-dea-and-equinor-partner-large-scale-ccs-value-chain-north-sea. and European Commission (2024): EU2NSEA Implementation Plan. Linkhttps://ec.europa.eu/assets/cinea/PCI/files/PCIFiche_13.8_1st_PCI_PMI_list.pdf . See also https://www.equinor.com/energy/eu2nsea

Figure A.6.3: Proposed CO2 pipeline from Germany to Zeebrugge

Source: Fluxys Website.

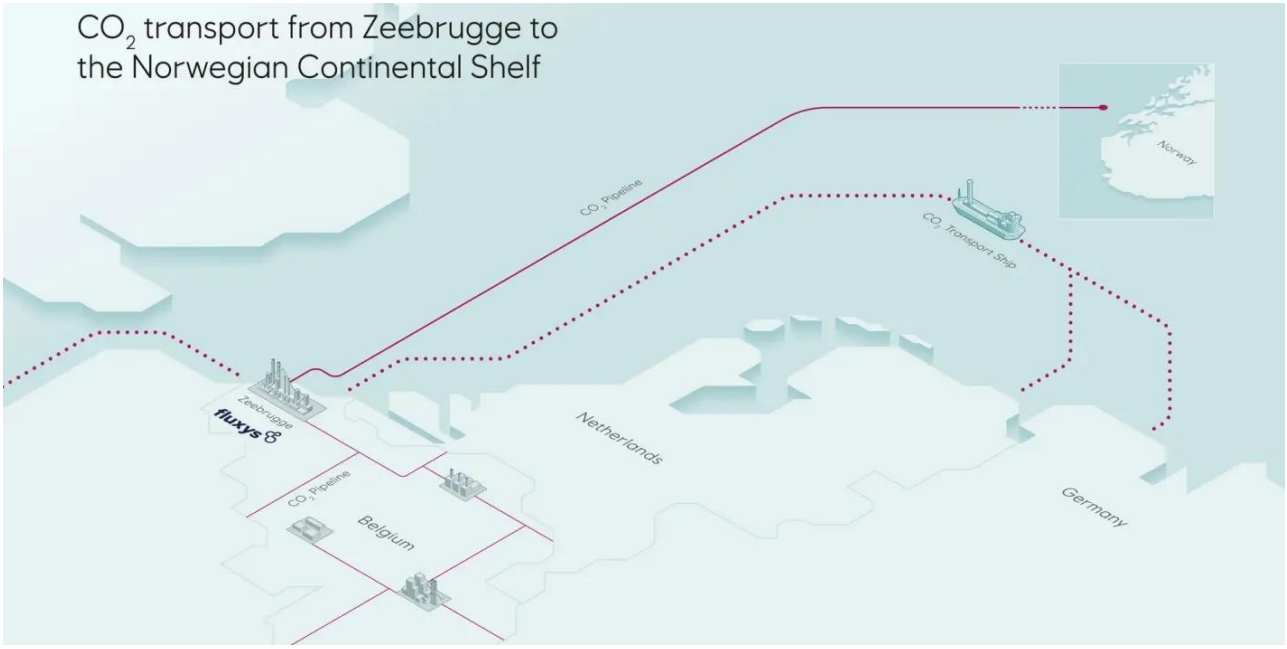
Ghent Carbon Hub. A carbon storage, liquefaction, and shipping terminal near Ghent's port is set to be built by Fluxys, North Sea Port, and ArcelorMittal. In December 2022, the European Commission announced a grant of EUR 9.6m to support the project.[322] A feasibility study has started, and commissioning is provisionally targeted for 2027. Ghent Carbon Hub is set to have the capacity to process 6 mtpa of CO2, equivalent to around 15% of Belgian industrial CO2 emissions.[323] Dimensioning, timing and phases will be defined during the Open Season for this project's network component which has not been scheduled yet.[324]

322 European Commission (2022): Over 600 Million Euros for Energy Infrastructure in Support of the European Green Deal and REPowerEU. Link: https://energy.ec.europa.eu/news/connecting-europe-facility-over-eu-600-million-energy-infrastructure-support-european-green-deal-and-2022-12-08_en.

323 Fluxys (November 2024). Link: https://www.fluxys.com/en/press-releases/fluxys-group/2022/220818_press_ghent_carbon_hub.

324 Fluxys (January 2022) Information Memorandum Proposal for CO2 infrastructure: Ghent. Link: https://www.fluxys.com/en/projects/carbon-preparing-to-build-the-network#.

Figure A.4: Schematic Illustration of Ghent Carbon Hub



Source: Equinor.[325]

A.3. Germany

Carbon transport systems are currently developed in three German regions:

- In **Western Germany**, gas TSO OGE plans to develop a CO2 grid with a major North-South axis along the Rhine and two parallel east-west-axes in Southern and Northern Germany.326 OGE proposes four separate pipeline transport projects which are currently at different early stages of development:
  - A network of pipelines around the Elbe estuary near Brunsbüttel (**Cluster Elbmündung)** . Spanning around 70km, the network is planned to be commissioned in 2028 and will connect a local cement plant to Brunsbüttel harbour for interim storage, and eventual shipping to permanent storage sites, once German legislation on CCS has progressed. OGE further foresees integration into a European pipeline network, including connections to storage sites in Denmark.[327]
  - A network of pipelines connecting a planned export hub in Wilhelmshaven (see below) to cement producers in East Westphalia and emitters in the Ruhr area (**Project WHV CO2**

[325] Equinor (29/06/2022): Fluxys and Equinor launch solution for large-scale decarbonisation in North-Western Europe, link: https://www.equinor.com/news/fluxys-and-equinor-launch-solution-large-scale-decarbonisation

[326] See the OGE Website (22/11/2024): Our CO2 transportation grid startsLink: https://oge.net/en/co2/co2-grid.

[327] OGE (10/09/2024): Public Notification. Link: https://www.wilster.de/fileadmin/Amtliche_Bekanntmachungen/2024_Amt_und_Gemeinden/BEkanntmachung_Nr._086.2024.pdf.

Corridor). The aim is to connect these clusters, which are estimated to produce around 30% of the hard- and impossible-to-abate emissions in Germany by 2045.[328]

  - The **Delta Rhine Corridor** will connect clusters in the Rhineland Region, the Ruhr Area, Rhineland-Palatine, Chemelot, and the Rotterdam Area to CO2 export infrastructure in the Rotterdam harbour (see section 3.7). A consortium of OGE, Gasunie, Shell, BASF and the Port of Rotterdam is developing the high-capacity pipeline. A feasibility studies for the project was launched in 2024 with construction set to begin in 2028. The project has been selected a Project of Common Interest by the European Commission but has not received any public funding yet.
  - Cross-border pipeline project "**North Sea CO2 Corridor**" is to connect emission clusters in Southern Germany and the Rhineland to the Belgian CO2 network to establish a connection to Antwerp and future offshore pipelines. In January 2025, the Commission awarded c. EUR 3m for a study to support the planning and approval of the project.[329]

- In **Central Germany**, emitters in the industrial cluster of the "chemical triangle" ("Mitteldeutsches Chemiedreieck")[330] are developing the **CapTransCO2** project to capture, process, and transport CO2 from process emissions for later storage and utilization. The project developers conducted a feasibility study between 2021 and 2023 was supported with EUR 311,000 by the BMWK.[331] According to the study, 4.9 mtpa of CO2 from process emissions, biogenic sources and waste to energy could be captured, rendering a pipeline transport system the only means of transport providing sufficient capacities. Two subsequent transport pipelines for access to German ports for export to offshore long-term storage sites are being considered, one to Hamburg/Stade on the North Sea, and one to Rostock on the Baltic Sea. Until commissioning in 2033 the total investments would amount to more than EUR 1bn or EUR 105 per t CO2, according to the study.
- In **Southeastern Germany**, the CO2peline project seeks to connect carbon emitters in Bavaria and Upper Austria with industrial centres in Southeast Bavaria where the CO2 will be used in industrial processes. The project aims to crease a circular CO2 economy by capturing carbon from the air, process emissions, and biomass, then store carbon on an interim basis, and finally utilise it as an input to industrial processes. A feasibility study has been presented in 2023 by a consortium led by Bavarian TSO bayernets GmbH. The first project stage envisions the construction of a transport pipeline between Upper Austria and Southeast Bavaria. A subsequent expansion to other parts of Bavaria and other international carbon transport networks for access to permanent geological storage sites is considered by the consortium.

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328 OGE (2024): OGE Sustainability Report (March 2024), p. 49-50. Link: OGE_Nachhaltigkeitsbericht_2023_EN.pdf. For example, the Norwegian carbon storage project "Northern Lights" is currently anticipating that shipping routes to carbon storage sites in Norway will begin, inter alia, in Wilhelmshaven.

329 See European Commission (30.01.2025) EU invests over €1.2 billion in cross-border infrastructure contributing to build our Energy Union and to boost competitiveness, Link: https://ec.europa.eu/commission/presscorner/detail/en/ip_25_377.

330 Located between Halle, Merseburg, and Bitterfeld.

331 On the results of the study, see Hypos (accessed on 25/11/2024) Wie stellen wir die Versorgung mit CO_2 als Rohstoff sicher?, Link: https://www.hypos-germany.de/wp-content/uploads/2024/10/4_Teil-2-Joerg-Nitzsche_DBI-CapTrans_CO2_Versorgungssicherheit.pdf.

A variety of additional, cross-border CO2 transport infrastructure projects is currently under development:

- An onshore pipeline system for CO2 connecting Leipzig and Hannover with Hamburg, for further exports to Denmark via shipping or onshore pipeline under **Project Bifrost** (see section 3.3).
- **CO2nnectNow**, a carbon terminal for carbon collection via onshore pipeline or rail for further transport to the Danish and Norwegian North Sea, with an interim storage capacity of 50,000 tonnes and an eventual transit flow capacity of 10 mtpa. Initial export is planned by ship, later export by pipeline (see the NOR-GE project below). Project partners are Wintershall Dea and HES Wilhelmshaven. Feasibility studies have been concluded, and a commissioning date estimated for 2029.[332]
- The **NOR-GE Project**, a sub-project of EU2NSEA (see section A.2). Project partners Wintershall Dea and Equinor intend to build an approximately 900-kilometre-long pipeline connecting the CO2 collection hub in Wilhelmshaven to storage sites on the Norwegian Continental Shelf.[333] The pipeline project has a planned capacity of 20 to 40 mtpa and an expected commissioning date in 2030. The project also considers transport by shipping on the same route as an early deployment solution.[334]

[332] Deutsche Verkehrs-Zeitung (25/03/2024): „Wilhelmshaven; CO2-Hub könnte 2029 in Betrieb gehen". Link: https://www.dvz.de/unternehmen/see/detail/news/wilhelmshaven-co2-hub-koennte-2029-in-betrieb-gehen.html.

[333] Wintershall Dea and Equinor plan to jointly apply for offshore CO2 storage licenses and aim to store 15-20 mtpa CO2 on the Norwegian Continental Shelf.

[334] Wintershall Dea Press Release (August 2022): Wintershall Dea and Equinor partner up for large-scale CCS value chain in the North Sea. Link: https://wintershalldea.com/en/newsroom/wintershall-dea-and-equinor-partner-large-scale-ccs-value-chain-north-sea.

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