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Transforming industrial clusters to implement the European Green Deal

JANUARY 2021

POLICY BRIEF

List of Authors

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About the Climate Friendly Materials (CFM) Platform

The Climate Friendly Materials (CFM) Platform analyses the transformation of basic material production and use to achieve climate neutrality by 2050. Its collective aim is to aid progress toward nationally-led industrial decarbonisation policy frameworks compatible with long-term EU strategy, and to capture the potential of a just and inclusive clean energy transformation.

Convened by Climate Strategies, the CFM Platform facilitates exchange between leading analysts, policymakers, industry leaders and other relevant stakeholders. It brings together think tanks and university research groups in Belgium, France, Germany, Hungary, the Netherlands, Poland, Spain and Sweden to enhance Europe's analytic understanding of how individual instruments fit together into a coherent policy package.

The authors would like to thank Karsten Neuhoff (DIW Berlin) for his valuable inputs and feedback on previous versions of the document. The authors would also like to thank representatives of various industrial clusters in Belgium and the Netherlands for their valuable input.

They also acknowledge funding from the European Climate Foundation (ECF).

Cover photo by by Scott Webb from Pexels
Report design by Wilf Lytton

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Key messages



Much of high-emitting industry in north-western Europe is organised in clusters. All five clusters in the Netherlands and Belgium investigated in this brief acknowledge the need for climate neutrality in 2050.



The clusters in the region spanning Antwerp, Rotterdam, and the Ruhr and Rhine river regions (ARRRA) are connected through advanced pipeline infrastructure, transporting e.g. hydrogen, ethylene and propylene.



Each cluster governs the transition to climate neutrality in 2050 differently, depending on the industries, history, legal situation and other contextual factors. This suggests that tailor-made policy on the part of the government is necessary.



Regional and national strategies and actions impacting the transition of these clusters are being developed, with the focus moving to implementation and investments (in e.g. infrastructure and industrial demonstrations).



All levels of governance have a role to play in coordination of actors inside their scope in the transition to climate neutrality. At cluster level this is the coordination of local companies and utilities, at national level the coordination beyond and between the clusters and at EU level the overall coordination of the industrial transition and cross-country linkages between clusters.



When it comes to financing the transition of climate friendly production the weight clearly resides with the national and EU levels. Similarly, regulatory interventions to facilitate the transition will reside more at the EU or national level, but cluster authorities are essential for facilitating the transition with the implementation of supporting policies.

Introduction

The European Green Deal aims to reduce European Union (EU) greenhouse gas emissions by 55% in 2030 compared to 1990 and reach net zero in 2050 (European Commission, 2019). Almost a third of greenhouse gas emissions in the EU originates from industry. In particular in north-western Europe, home to a substantial part of the EU's basic materials production, industry is heavily clustered. In other parts of the EU, industrial clusters are expanding or under development. Industrial clusters are large energy and feedstock users and need access to markets. They are connected through pipelines and power lines, as well as rail, road or river transport infrastructure. The formation or transformation of such clusters to comply with the climate neutrality and circularity aims of the European Green Deal is therefore as much an infrastructural as a climate policy challenge.

Clustered industry tends to outperform isolated plants in resource and energy efficiency, but the advantages or drawbacks of clusterisation for deep emission reductions and other more radical changes are less clear. Centrally led clusters may make transformations faster, but clusterisation can also lead to inertia, lock-in and collective action problems in governing the transition to climate neutrality and circularity (Janipour et al., 2020).

Transformations affect the need for infrastructure connections, which often cross national borders and bring up a new set of challenges. It is therefore key to understand how different clusters are organised internally and how the interconnecting infrastructure between clusters is shaped, and how those two factors impact each other.

This policy brief offers practical recommendations for the transformation and interconnection of clusters of the basic materials industry. First, we discuss the main characteristics (section I) and governance (II) of five industrial clusters in the Netherlands and Belgium. Then we discuss current key projects and developments between industrial clusters in Antwerp-Rotterdam-Rhine-Ruhr Area (ARRRA) (III), and we end (IV) with what national and EU policymakers could do to make sure that industrial clusters are enabled to make their important contribution to the European Green Deal.

I. Overview of five industrial clusters in Belgium and the Netherlands

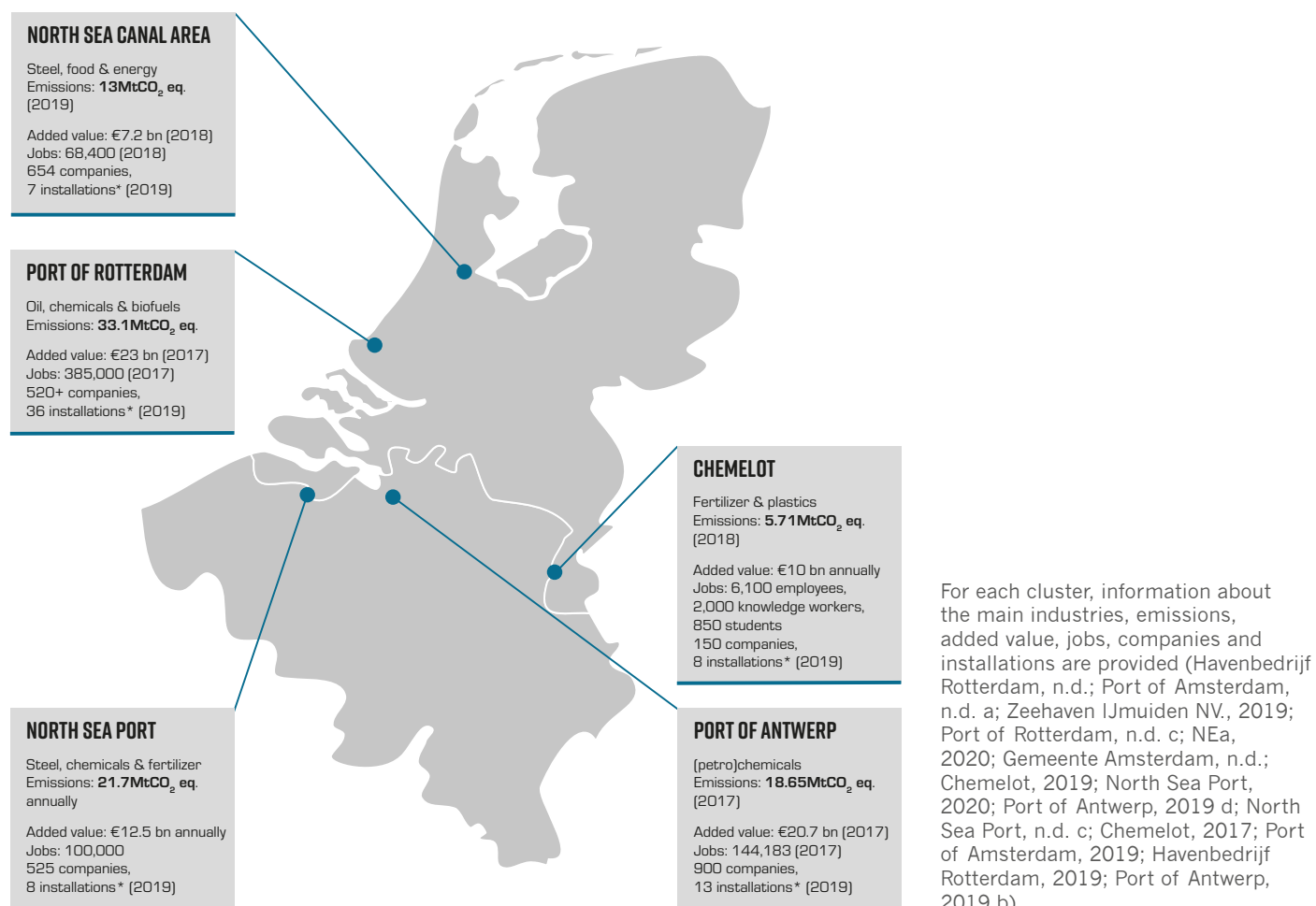
To gain a better understanding of the governance of industrial clusters in relation to climate and circular economy goals, an overview of the climate neutrality governance arrangements of five Dutch and Belgian industrial clusters was created. This was done by means of desk research and a series of short interviews. The considered clusters are:

1. Port of Antwerp (municipality of Antwerp, Belgium)

2. North Sea Port (municipalities of Ghent, Terneuzen and Vlissingen, Belgium and the Netherlands)
3. Chemelot (municipality of Sittard-Geleen, the Netherlands)
4. Port of Rotterdam (municipalities of Rotterdam, Moerdijk and Dordrecht, the Netherlands)
5. the North Sea Canal Area (municipalities of Amsterdam, Velsen, Beverwijk, Haarlemmermeer and Zaanstad, the Netherlands)

FIGURE 1

The location of the five clusters studied in this Brief



* installations emitting over 50,000 tons CO₂-eq. (in 2019).

The five clusters are closely connected to German industry, primarily in the ARRRRA (Antwerp-Rotterdam-Rhine-Ruhr Area) meta-cluster, which produces 40% of all chemicals in the European Union (Port of Rotterdam, n.d. a). An overview of the clusters and some key numbers, such as employment and turnover, can be found in Figure 1. These numbers illustrate that the industrial clusters are of significant economic value to the Netherlands and Belgium.

The industrial clusters in the ARRRRA region are connected by a network of pipelines that crosses national borders. The pipelines transport often fossil-based feedstocks and energy carriers, including naphtha, liquid hydrocarbon, ethylene, propylene, fuel oil and crude oil, but also hydrogen, nitrogen and oxygen. This network of pipelines is key for collaboration between the clusters in Belgium and the Netherlands, as well as with industrial sites in Germany and France (Port of Rotterdam, n.d. b).

The clusters emit a significant amount of greenhouse gas emissions. In Flanders, almost 29% of total greenhouse gas emissions in 2018 can be attributed to the industrial sector (Milieurapport Vlaanderen, n.d.). In the Netherlands, industry accounts for 31% of the emissions in 2019 (CBS, 2020). These emissions will have to drop to practically zero in the next thirty years if the climate neutrality ambitions formulated by the European Union as well as by national and local governments are to be achieved. Many industrial clusters, therefore, have developed plans and are initiating projects to reduce emissions.

II. Governance climate neutrality in the five industrial clusters

Multiple **levels of government** are involved in the governance of industrial clusters. The involved governments are the municipalities, provinces, national governments and the European Union (Port of Antwerp, 2019 b; Departement Omgeving, n.d.; Vlaamse Overheid, 2016; Belgian Greenhouse Gas Registry, 2020; Port of Antwerp, 2019 a; North Sea Port, n.d. a; North Sea Port, n.d. b; Chemelot, 2019; Chemelot, 2020 b; Chemelot, 2020 a; Havenbedrijf Rotterdam, 2019; Port of Rotterdam, n.d. c; Port of Amsterdam, 2019). In the Belgian clusters, the Flemish government also plays a role, and Water Boards, which manage water quality and quantity in the Netherlands, are seen as stakeholders in Dutch industrial clusters. Aside from the governments' regulatory tasks, such as environmental permitting and managing compliance with the EU ETS, governmental organisations are often involved in the governing bodies of the cluster. For example, the Administrative Platform of the North Sea Canal Area consists of members from the involved municipalities, from the Province of North Holland, and the Ministry of Infrastructure and Water Management, alongside members from the cluster's companies and Port Authorities (Port of Amsterdam, 2019). In the Port of Antwerp, ten out of eighteen members of the port authority's Board of Directors are members of the City of Antwerp City Council (Port of Antwerp, 2019 a). An overview of the involved governments and other governance structures of the clusters can be found in table 1.

Each of the clusters is also governed by the **European Union**. Large-scale industrial installations are part of the emission trading scheme (ETS) (European Commission, n.d.). In the Netherlands, the NEa (Nederlandse Emissieautoriteit) is responsible for monitoring compliance of the Dutch installations covered by the ETS (NEa, n.d.). In Belgium, the Belgian Greenhouse Gas Registry is equipped with this task (Belgian Greenhouse Gas Registry, 2020). The management of the ETS participants is individually managed in most of the clusters. This means that each company is responsible for managing its own entry in the scheme.

The exception is Chemelot, where the entries for the ETS are centrally organized by the Officer Emission Trading at Sitech Services BV for all GHG emitting installations on the Chemelot site (Chemelot, 2019).

Table 1 provides an overview of how the climate neutrality transition is governed in our five clusters, alongside other relevant details. Each cluster has formulated a strategy for the transition to a low-carbon economy. Every cluster employs some form of central organisation for this transition, but the governance varies considerably. In the Port of Rotterdam, the Port Authority is in charge of this transition (Port of Rotterdam, n.d. c). In other clusters, special platforms, projects or strategies have been formulated to initiate the transition towards climate neutrality and circularity (Port of Antwerp, 2019b; Noordzeekanaalgebied, 2019). In the North Sea Port, the partnership of Smart Delta Resources, with participation by provinces in Belgium and the Netherlands, a public investment firm and the Port Authority, coordinates through road mapping and feasibility studies, which involves the range of high-emitting plants (North Sea Port, n.d. a). In Chemelot, a sustainability team led by an internal service company and with participation from all large emitters is driving the change (Chemelot, 2020a). All clusters maintain that a cluster approach has value for climate neutrality through joint infrastructure and technological developments. Individual companies can benefit as well.

On climate neutrality, most of the clusters mention climate neutrality as a goal, but only several have formulated overarching projects working towards that goal. Some focus on CCUS as a key solution (e.g. North Sea Port, especially towards 2030), while others are identifying multiple ways of reaching climate neutrality in 2050 (e.g. Port of Rotterdam). In all clusters, the incumbent companies still play a role in 2050, although some clusters (especially Chemelot) also aim at attracting new spin-offs and entrepreneurial activity.

TABLE 1

Summary of governance in the five clusters in the Netherlands and Belgium

	Port of Antwerp	North Sea Port	Chemelot	Port of Rotterdam	North Sea Canal Area
State of the climate neutrality transition and coordination	A port policy striving towards climate neutrality has not yet been formulated. The Port of Antwerp fulfils a supporting role regarding climate policy in the harbour.	Collaboration between the companies, authorities and organisations in the Carbon Connect Delta project.	2050 strategy consisting of a broad vision, led by the Chemelot Sustainability Team, and projects for various technologies led by the individual companies.	A climate neutrality plan is available. The Port of Rotterdam Authority coordinates.	The platform energy transition (Energietransitie) NZKG.
Landowner	Port of Antwerp partially owns the land, but many companies own their own sites.	In Vlissingen and Terneuzen, North Sea Port Netherlands owns the land. In Ghent this is North Sea Port Flanders.	DSM Nederland BV.	The Port of Rotterdam Authority and the Moerdijk Port Authority.	Havenbedrijf Amsterdam NV and Zeehaven IJmuiden BV.
Number of companies involved in the cluster and number of installations* emitting over 50,000 tons CO₂-eq. (in 2019)	900 companies; 13 installations.	525 companies; 8 installations.	150 companies; 8 installations.	More than 520 industrial companies; 28 installations in Rotterdam and 8 in Moerdijk.	654 companies; 2 installations in Amsterdam and 5 in IJmuiden.

* Installations covered by the ETS

Port of Antwerp, 2019 c; North Sea Port, n.d. c; Chemelot, 2019; Havenbedrijf Rotterdam, n.d.; Port of Moerdijk, 2018 b; Port of Amsterdam, n.d. c; Belgian Greenhouse Gas Registry, 2020; Nea, 2020; North Sea Port, n.d. b; Port of Moerdijk, 2018 a; Zeehaven IJmuiden NV, 2018; Port of Amsterdam, n.d. b; Port of Antwerp, 2019 d; North Sea Port, n.d. a; Chemelot, 2020 a; Port of Rotterdam, n.d. c; Noordzeekanaalgebied, 2019.

Because many strategies are of recent date, and empirical data are still lacking, it is difficult to say which strategies will be successful. Literature suggests that good practices depend on the specific context, including the history of the industrial plants, the surroundings, the companies in the cluster and international trade exposure. It is therefore probably a good thing that each cluster follows its specific path.

Policymaking, however, is not necessarily aligned. Specific pathways of industrial clusters can be seen to contrast with generic climate policy instruments, such as a carbon levy for industry, that policymakers tend to favour. We offer that a **tailor-made transformational policy instrument mix**, taking into account the specific cluster governance, would have to be designed for each industrial cluster to enable its transition to climate neutrality.

III. Key projects, infrastructure, and future plans

The above has discussed five clusters in the ARRRR region, spanning the region from Antwerp and Rotterdam on the North Sea, along the lower Rhine and the Ruhr rivers, including parts of Germany and Northern France. The region hosts some of the most cutting-edge developments in breakthrough low-carbon technologies. One example is the *Cracker of the Future Consortium* (Scott, 2019), a consortium of six companies with petrochemical steam crackers in Europe aiming to jointly develop cracker technology that can replace gas-based furnaces with ones that use renewable electricity. Another example is *VoltaChem* (Voltachem, n.d.), “a business-driven Shared Innovation Program” which connects the electricity sector, equipment sector, and the chemical industry for joint development and implementation of new technologies and business models that focus on the use of renewable energy in the production of heat, hydrogen, and chemicals. Finally, the *SPIN – Industrial Innovation Excellence Cluster*, launched in November 2019 by the Ministry for Economic Affairs, Innovation, Digitalization and Energy of the State of North Rhine-Westphalia, in cooperation with several companies, aims to develop technologies, processes and products for CO₂-neutral energy systems and the digital transformation in industry, such as Power2X technologies.

The ARRRR region is also home to various large-scale CO₂ capture and storage project plans. Among others, there are the Antwerp@C project (a CCUS initiative of eight leading companies in the port area) and the Porthos CCS project (Port of Rotterdam, 2019), an initiative of Dutch natural gas company EBN, Gasunie and the Port of Rotterdam Authority with the objective to store approximately 2.5 million tonnes of CO₂ per year in depleted offshore gas fields beneath the North Sea, starting in 2024 (Porthos, n.d.).

The ARRRR industrial cluster already has a strong infrastructure backbone. Around 1,600 km of hydrogen pipelines span the area, mostly located in the Netherlands and Belgium (850 km), with smaller transport networks in Germany and France (390 and 303 km respectively).

The pipeline grid for chemicals between Antwerp, Rotterdam and Germany provides the companies with flexibility in case of steam cracker outages as well as an exchange of ethylene and propylene.

This infrastructure base will be further developed with new projects that enable the climate neutrality ambitions of the industrial clusters. As an example, the Green Octopus project aims to boost the development of offshore wind power in Europe and create a hydrogen infrastructure to connect the ports on the North Sea with industrial clusters in France, Belgium, the Netherlands and Germany by converting natural gas pipelines to hydrogen pipelines. Another example is the *Silver Frog project* (Hydrogen for Climate Action, 2019), which proposes the construction of manufacturing facilities for cutting-edge solar PV and water electrolysis technologies of a 2 GW solar module factory. This plant will help deploy 10 GW of renewable energy generation capacity to provide the electricity to produce 100% green hydrogen (although most of this will be wind power). The *Hy3 and RH2INE* projects (Energieagentur, 2020), launched in January 2020, will focus on the development of green hydrogen business models and infrastructure between the Netherlands and North Rhine-Westphalia.

The ARRRR region is also in the process of developing and implementing joint strategies for climate neutrality and the associated infrastructure needs. In 2017 a trilateral strategy (MWIDE, 2017) for the chemicals industry was developed between the governments of Flanders, the Netherlands and North-Rhine Westphalia (MWIDE, 2017). The trilateral region aims to become the global engine for a sustainable and competitive chemicals industry by 2030 through measures in research & innovation, energy & feedstocks, enhanced chemical infrastructure and policy coordination between the regions.

Similarly, the Smart Delta Resources (SDR) platform in the North Sea Port is a collaborative initiative of eleven energy- and feedstock-intensive companies that constitute the industrial cluster of the Schelde Delta (a river delta in the Netherlands and Belgium).

This platform aims to reduce the use of energy and feedstock through industrial cooperation between e.g. steel production (Ghent) and chemicals production (Terneuzen).

The innovative investments in climate friendly technologies, infrastructure development and strategic coordination between and in these clusters must also be seen within the national and EU context. Over the past few years, the EU and a number of its member states, including Germany, the Netherlands and Belgium, have launched initiatives to facilitate the industrial transition towards climate neutrality.

These include national climate laws with short- and long-term climate neutrality targets, dedicated hydrogen strategies, initiatives or plans, industrial strategies, decarbonization roadmaps, as well as infrastructure development and support for low-carbon technologies ([Overheid.nl](https://overheid.nl), 2019; Bundesanzeiger, 2019; Federal Ministry for Economic Affairs and Energy (BMWi), 2019; European Commission, 2019).

IV. Effective interventions for the industrial clusters towards climate neutrality

This section takes the findings from the previous sections on the governance of industrial clusters and suggests several interventions that help industrial clusters reach climate neutrality. Table 2 gives a non-exhaustive overview of strategies, policies and instruments that can be used to assist the transition to climate neutrality of interlinked industrial clusters, which is the situation in the ARRRR region.

The table looks at two dimensions. First, the **categories of intervention**, such as planning for a cluster transition, the infrastructure for the transition, innovation support, coordination of activities between different actors, financing the deployment of climate friendly processes and products and finally regulatory instruments to support the transition. Second, it looks at the different **levels of governance** that can affect or implement these instruments. Here we consider the subnational level and cluster level authorities, national governments, bi- or multilateral governance and the EU level.

When it comes to planning industrial cluster transitions towards climate neutrality, the authorities linked to the industrial cluster itself will need to be involved in setting out a local long-term strategy and planning. This in turn can help the national authorities in setting a national industrial strategy and regionally linked clusters to align their planning. Similarly, for infrastructure development it is expected that infrastructure needs for the cluster transition will first be looked at locally (e.g. cluster-based CO₂ and hydrogen backbones), again becoming part of national, regional and EU wide infrastructure plans.

Supporting innovative climate friendly technologies will require more national and EU level interventions through e.g. dedicated innovation support, in particular for high risk and high capital-intensive demonstration projects. At the cluster level, authorities can facilitate the implementation of new climate friendly technologies through logistical and practical support of local companies that seek to invest.

All levels of governance have a role to play in the coordination of actors inside their scope in the transition to climate neutrality. At the cluster level, this is the coordination of local companies and utilities, at national level the coordination beyond and between the clusters and at EU level the overall coordination of the industrial transition and cross-country linkages between clusters.

When it comes to financing the transition of climate friendly production the weight clearly resides with the national and EU levels. Similarly, regulatory interventions to facilitate the transition will reside more at the EU or national level, but cluster authorities are essential for facilitating the transition with the implementation of supporting policies.

In the ARRRR region, the authorities are gradually moving from planning and strategies towards the implementation of the climate transition (e.g. as shown in section III above). However, the scale of the challenge and relatively short time period to complete this transition will require scaling up of investments and more intensive coordination between regions. Furthermore, the use of new technologies including the use of climate-friendly energy and feedstock will require an enabling regulatory environment to address likely higher operational expenditures vis-à-vis incumbent production. Here relatively new instruments such as contracts for difference or product standards related to the carbon content of products can become important.

TABLE 2

Non-exhaustive overview of strategies and policy instruments at different governance levels to facilitate the transition of industrial clusters to climate neutrality by 2050

Activities	Sub-national/port/ cluster authorities	National governments	Bi/multi-lateral governance between countries with clusters	EU level
Planning for a cluster transition	» Development of roadmaps for clusters » Planning of infrastructure for climate friendly technologies » Mapping of cluster geography for future activities	» Development of roadmaps and national climate strategies » Development of industrial strategy » Development of strategy/roadmap on new resources (e.g. biomass, waste) and climate neutral energy supply linked to cluster and industry transition	» Strategic alignment and planning of linked clusters » Develop coordinated roadmaps between regions	» Establishment of long-term climate strategy giving signal and direction to the economy » Development of an EU Industrial strategy towards climate neutrality showing priorities and actions supported at EU level » Develop an EU Energy transition strategy that is firmly linked with industrial transition and industrial clusters » Highlight EU areas/ clusters with high potential/importance for transition and align EU instruments accordingly (e.g Connecting Europe Facility (CEF), Important Projects of Common European Interest (IPCEI)).
Infrastructure for transition	» Implementing climate friendly infrastructure within cluster boundaries (e.g. CO₂ and/or H₂ backbones)	» Support the development of infrastructure inside or between clusters » Secure new low-CO₂ energy carriers or other climate-friendly feedstock	» Facilitate development of connecting infrastructure and logistics between countries' clusters	» Further develop EU infrastructure plans for vectors relevant to climate friendly production (H₂, CO₂, ...) together with 10-20 year development plans » Align the Connecting Europe Facility with these plans » Dedicate part of the European Investment Bank project portfolio to climate-neutral infrastructure for clusters

Activities	Sub-national/port/ cluster authorities	National governments	Bi/multi-lateral governance between countries with clusters	EU level
Supporting innovation for climate-friendly industrial processes	» Assist with implementation of demonstration projects (e.g. connection to cluster infrastructure) » Assign development zones for climate-friendly demonstration projects » Assist projects with funding at national/EU level e.g. coordination of similar or linked projects » Support brownfield conversion to climate-friendly production	» Strengthen national innovation systems towards climate-friendly production » Support climate-friendly innovation across TRL levels via innovation instruments at national level » Support domestic projects in accessing EU funds	» Establish innovation chain cooperation (pilot-demo-commercial) across clusters. For instance agreement on types of technologies that will be supported to avoid duplication, or by supporting complementary technologies	» Dedicated R&D instruments such as EU ETS Innovation Fund and projects under Horizon Europe
Coordination of activities	» Facilitating of matchmaking between companies with similar or complementary climate friendly production » Facilitate Development of hubs (e.g. CO₂/H₂) for different companies in cluster	» Facilitate coordination between relevant national and sub-national actors (e.g. energy providers, grid companies, pipeline developers, technology providers, permitting authorities, companies, ...) » Ensure consistent implementation of roadmaps and strategies » Coordinate positions of relevant actors towards EU	» Develop joint positions towards EU level reflecting the common needs of the clusters transition	» Development of joint visions, support for long-term strategies » Identification of missing links » Coordination of infrastructure network development at EU level

Activities	Sub-national/port/ cluster authorities	National governments	Bi/multi-lateral governance between countries with clusters	EU level
Financing deployment of climate friendly production	» Low-cost leasing of land plots for climate-friendly production	» Fiscal incentives for climate-friendly production » Financial support (loans, grants, risk-sharing mechanisms) » Assign 'industrial climate neutrality' missions to national development bank(s) » Financially support IPCEIs	» Finance joint cross border projects e.g. by submitting joint projects for EU funding or bilateral financing agreements	» Enable financing of industrial climate transition projects and related infrastructure with support of EIB financing instruments » Development of ambitious green finance taxonomy for industry to give signal to financial sector » Design the IPCEI to facilitate state aid for industrial climate transition
Regulatory instruments to support transition	» Facilitate development of low-regulatory zones for climate-friendly innovation » Support companies with implementation of safety rules for infrastructure linked to new technologies (e.g. using H₂ and/or CO₂)	» Facilitate permitting for climate friendly investments » Contracts for difference or other instruments to cover higher OPEX for climate friendly technologies » Use public procurement to create market for climate friendly products » Use fiscal instruments to make climate friendly production more competitive (e.g. tax shift towards lower electricity prices and higher fossil fuel prices) » Introduce timely regulation for new vectors such as H₂ and CO₂ incl. on regulation of new networks » Develop consistent framework for low-regulatory zones to accelerate innovation	» Facilitating of cross-border infrastructure, logistics	» Develop product standard for climate friendly products and related processes (incl. circular/ efficient use of materials, life cycle accounting) » Facilitate state aid for industrial climate transition (e.g. IPCEI) » Further EU wide carbon pricing instruments such as the EU ETS (visibility of carbon price) » Develop mechanisms to prevent carbon of investment leakage as to ensure continued investment in innovative climate friendly processes » Proactive standards/ regulation on e.g. CO₂ capture and utilization, H₂ market to ensure transparency for investors

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