Carbon Direct

Driving deeper decarbonization

Implications of the EU's ambitious new goals and targets



Dr. Wilfried Maas, Justine Davids, Vish Arora, and Dr. Julio Friedmann • *March 2024*

Carbon Direct

Driving Deeper Decarbonization

Implications of the EU's ambitious new goals and targets

Dr. Wilfried Maas, Justine Davids, Vish Arora, and Dr. Julio Friedmann

March 2024

Introduction **3**
- The EU's 2040 climate target 3
- Industrial carbon management 5

Building industrial carbon management in Europe **6**
- Implementing change 7
- Defining a critical new sector 7
- Carbon management infrastructure 10

Impacted sectors **10**
- Heavy industry 11
- Agriculture 11
- Industrial carbon removals 12

The journey ahead **12**
- Benefits and investments needed 12
- Catalyzing the scale-up of CDR 13
- Looking forward 14

KEY TAKEAWAYS

- → The EU has set a higher ambition: The EU's new communications dramatically accelerate reduction timelines on the path to climate neutrality.
- → Carbon management is required: As part of their accelerated timeline, the EU has added carbon management in all forms, including carbon dioxide removal, carbon capture use and storage, and recycling of carbon dioxide (CO_2) into products. This is detailed in the new Industrial Carbon Management communication and, if implemented, would occur across industrial sectors.
- → The plan calls for tonnes of action: The 2030 and 2040 targets require rapid growth of all forms of carbon management, including growth of 6–10 times current amounts of carbon captured by 2030 (to 50 $MtCO_2$/year) and up to 100 times by 2040 (to 280 $MtCO_2$/year).
- → **Carbon dioxide removal is essential:** The new accelerated goals cannot be met without CO_2 removal at a significant scale. Residual emissions from hard-to-abate sectors will need to be balanced by CO_2 removal at significant scales; up to 400 $MtCO_2$ /year by 2040.
- → Investments now will reduce future costs: Investment costs for the entire EU plan represent a substantial fraction of GDP. However, the cost of inaction is estimated to be far higher.
- → **Every week is infrastructure week:** The communications support the need for expanded infrastructure investments, including in CO_2 transport and storage, to realize 2040 climate goals.

Introduction

On February 6th, 2024, the European Commission announced two keystone policies; the EU 2040 Climate Target Communication[1] and the Industrial Carbon Management (ICM)[2] strategy. Combined, these documents bring deep decarbonization into sight for 2030 and the decades to come. They confirm the critical role of carbon dioxide removal (CDR) in decarbonizing hard-to-abate sectors along with technologies such as clean fuels; carbon capture, utilization, and storage (CCUS); and other forms of emissions abatement. Here, Carbon Direct provides commentary on these solutions and their roles in sustaining rates of deep decarbonization through 2040 and beyond.

The EU's 2040 climate target

The European Climate Law,[3] effective as of July 2021, defines the EU's legally binding commitment to reach net zero by 2050. It contains an interim 2030 target,[4] which prescribes a 55% net reduction in greenhouse gas (GHG) emissions and is currently undergoing implementation. This target is supported by a package of EU policies collectively known as "Fit for 55." The law also includes a requirement for the European Commission to propose a 2040 climate target following the first Global Stocktake of the Paris Agreement, which concluded in October 2023. Following a public consultation[5] and extensive internal assessment, the Commission published its recommendations in February 2024. Energy and climate policy frameworks resulting from these recommendations will be established by the next European Commission following the 2024 European elections.

Based on a comprehensive impact assessment of three target options, the Commission recommends an economy-wide, net GHG emissions reduction for Europe of 90% by 2040.[6,7] If this target is achieved, the anticipated residual emissions are anticipated to be approximately 850 million tonnes of carbon dioxide equivalent ($MtCO_2e$) in 2040 (equivalent to about 18% of the emissions produced by the EU in 1990).[8, 9] To achieve the 2040 target, both industrial and nature-based carbon removals will be required to remove and store up to 400 $MtCO_2e$.[10]

The European Commission's impact assessment provides a treasure trove of detailed analysis used in determining climate ambition for the EU, and providing a roadmap to achieve this ambition. It clearly signals a direction for the EU's climate agenda beyond 2030 and identifies key industrial sectors that will need to adapt to align with targets. The projected GHG emissions trajectory by sector is shown in figure 1.

---

[1] European Commission. Commission presents recommendation for 2040 emissions reduction target to set the path to climate neutrality in 2050. https://ec.europa.eu/commission/presscorner/detail/en/IP_24_588.
[2] European Commission. Commission sets out how to sustainably capture, store and use carbon to reach climate neutrality by 2050. https://ec.europa.eu/commission/presscorner/detail/en/IP_24_585.
[3] European Commission. 2023. European Climate Law. https://climate.ec.europa.eu/eu-action/european-climate-law_en#:~:text=The%20European%20Climate%20Law%20writes.
[4] European Commission. 2030 climate targets. https://climate.ec.europa.eu/eu-action/climate-strategies-targets/2030-climate-targets_en#:~:text=In%202023%2C%20the%20EU%20adopted.
[5] European Commission. EU climate target for 2040. https://ec.europa.eu/info/law/better-regulation/have-your-say/initiatives/13793-EU-climate-target-for-2040/public-consultation_en.
[6] EUR-Lex. Commission Staff Working Document Impact Assessment Report Part 1 Accompanying The Document Communication From The Commission To The European Parliament, The Council, The European Economic And Social Committee And The Committee Of The Regions Securing our future Europe's 2040 climate target and path to climate neutrality by 2050 building a sustainable, just and prosperous society. https://climate.ec.europa.eu/document/download/768bc81f-5f48-48e3-b4d4-e02ba09faca1_en.
[7] Net GHG reduction targets in 2040 of up to 80% (option 1), 85–90% (option 2), or 90–95% (option 3) were assessed.
[8] The total net GHG emissions in 1990, under the United Nations Framework Convention on Climate Change scope for EU-27 nations, was 4,658 $MtCO_2e$.
[9] European Commission. Progress Report 2023 Climate Action. https://climate.ec.europa.eu/document/download/60a04592-cf1f-4e31-865b-2b5b51b9d09f_en.
[10] Industrial carbon removal approaches include both engineered (e.g., direct air capture) and hybrid (e.g., bioenergy with carbon capture and storage) solutions.

While the rate of emissions reduction projected for 2030–2040 is comparable to that planned for the preceding 2020–2030 decade, the additional climate solutions needed to deliver these reductions from 2030–2040 are vastly different and represent deeper decarbonization. These solutions need to be established and start scaling today to prepare to meet projected goals.

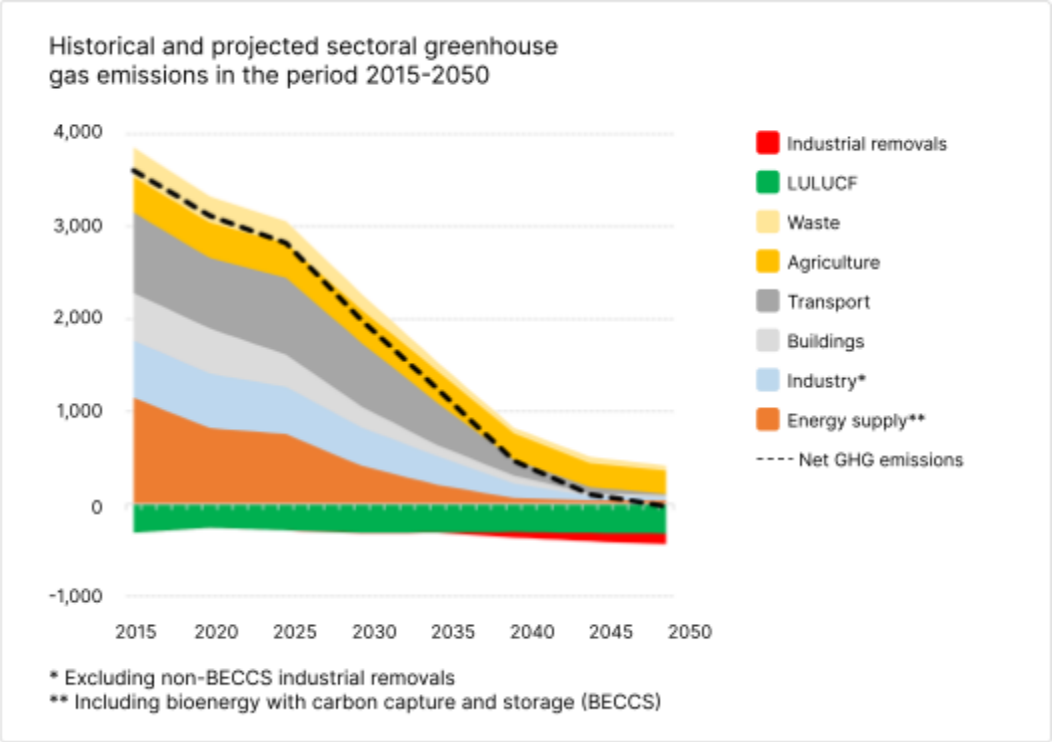


Figure 1. Total abatement for proposed 2040 EU targets in all sectors. This includes increases in nature-based and industrial CO_2 removals, in part because of a near-zero reduction in agricultural emissions. Source: European Commission. 2024. 2040 climate target. Licensed under CC BY 4.0.

Under the European Green Deal, a network of supporting legislation[11] is in place to implement the 2030 climate target, known as "Fit for 55." Likewise, once the 2040 target is adopted, it will require a wave of accompanying "Fit for 90" policies and frameworks to ensure the achievement of this new climate ambition. **Figure 2** illustrates how recent announcements and future new policies will likely fit into the EU's existing climate framework. The 2040 target is aligned with an already-announced EU Green Deal Industrial Plan[12] and the associated Net-Zero Industry Act[13] which seek to enhance the EU's manufacturing capability and competitiveness for net-zero technologies and infrastructure.

[11] European Parliament. 2019. Legislative Train Schedule. https://www.europarl.europa.eu/legislative-train/theme-a-european-green-deal.
[12] European Commission. 2023. The Green Deal Industrial Plan. https://commission.europa.eu/strategy-and-policy/priorities-2019-2024/european-green-deal/green-deal-industrial-plan_en.
[13] European Commission. Net-Zero Industry Act. https://commission.europa.eu/strategy-and-policy/priorities-2019-2024/european-green-deal/green-deal-industrial-plan/net-zero-industry-act_en.

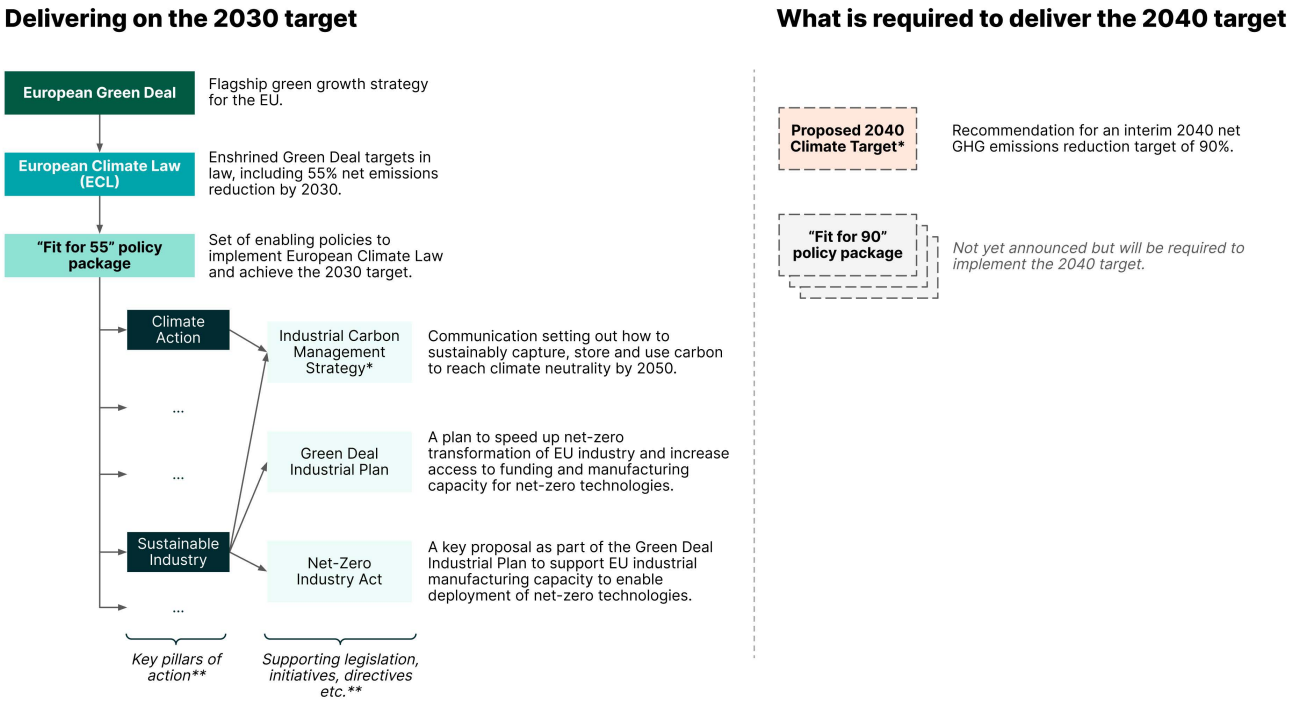


Figure 2. Illustrative representation of where announced policies will fit in the wider array of climate and environmental policies as part of the European Green Deal. Note: *Announced 6th Feb 2024. **Not all shown. Source: Carbon Direct.

Industrial carbon management

Planned reductions in EU industrial emissions will largely result from improved efficiency and the switch to low-carbon energy sources like renewable power and hydrogen. However, the Commission also recognizes the need for holistic industrial carbon management (ICM), which they define as "the suite of technologies, infrastructures, policies and business models for the capture of carbon dioxide (CO_2), its transport, storage, and utilization as feedstock in industrial processes." Specifically, the European Commission will rely on carbon capture and storage (CCS) technology to address residual emissions through the capture and permanent storage of CO_2. According to their 2040 climate target impact assessment, "CCS must be deployed at large scale to complement other mitigation actions to address hard to abate emissions [. . .] and to achieve climate neutrality by 2050." While nature-based carbon removal solutions are expected to play an essential role, the Industrial Carbon Management commentary notes that they will not be sufficient on their own.

The range of pathways connecting CO_2 emissions sources, capture facilities, transport infrastructure, utilization, and storage into value chains are shown in figure 3. Depending on the source of the CO_2 and its use case, the ICM strategy may differ. For example, when applied to fossil fuel sources, CCS is used to reduce supply chain emissions; but when applied to biogenic or atmospheric sources, CCS can be used for removal. Carbon capture and utilization (CCU), when applied to biogenic or atmospheric sources, can replace fossil fuel usage in the creation of carbon-neutral products, such as biofuels or e-fuels.

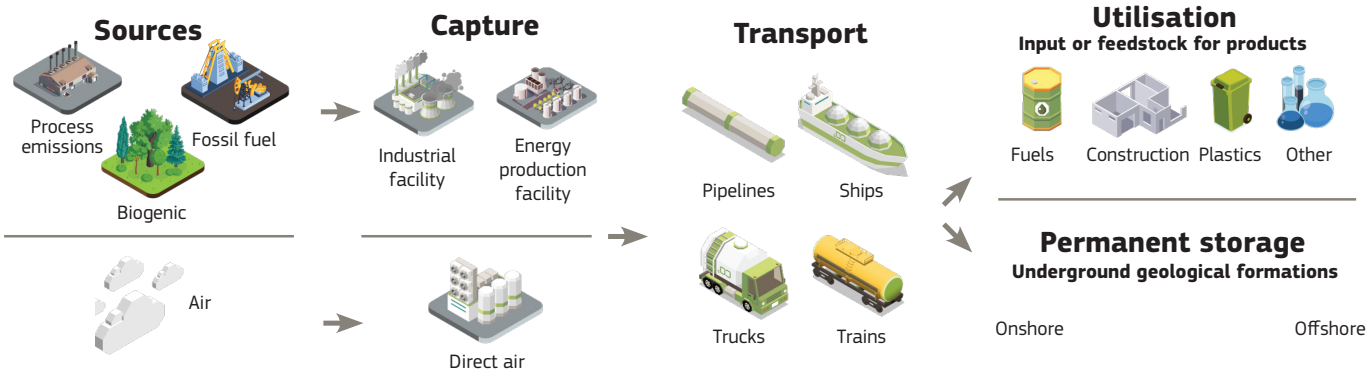


Figure 3. Components of industrial carbon management (ICM), including multiple sources such as process, fossil, biogenic, and atmospheric; multiple points of capture; multiple modes of transportation; and either storage, such as in carbon capture and storage (CCS), or use, such as in carbon capture and utilization (CCU). Source: European Commission. 2024. Factsheet Industrial Carbon Management. Licensed under CC BY 4.0.

As part of wider plans to achieve the 2040 climate target, the Commission's communication on ICM provides new nomenclature, definitions, and roles. It also provides a medium-term focus on implementation of 2030 targets, while keeping it in the perspective of 2040 goals. However, it does not set specific standards for qualification nor identify which authorities within the Commission will be responsible for implementing key aspects of ICM. To partially address these gaps, a policy framework is envisaged that would deploy aspects of ICM including single-market transport infrastructure, capture and storage of CO_2, removal of CO_2 from the atmosphere, and the use of captured CO_2 as a non-fossil feedstock. In addition to policies that create an enabling environment for ICM, public awareness, EU-member state cooperation, and international cooperation is needed.

The Commission's 2040 climate target impact assessment and ICM strategy clearly indicate that CDR, CCS, CCU, CCUS, and clean fuels are all indispensable solutions required to achieve the EU's goal of 90% net GHG emissions reductions by 2040.

Building industrial carbon management in Europe

The Commission communicates eight building blocks for achieving its stated 2040 climate targets. These are stated in their 2040 Climate Target Communication as:[14]

1. "A resilient and decarbonised energy system for our buildings, transport and industry.
2. An industrial revolution with competitiveness based on research and innovation, circularity, resource efficiency, industrial decarbonisation and clean tech manufacturing at its core.
3. Infrastructure to deliver and to transport and store hydrogen and CO_2.
4. Enhanced emissions reductions in agriculture.
5. Climate policy as an investment policy.
6. Fairness, solidarity and social policies at the core of the transition.
7. EU climate diplomacy and partnerships to encourage global decarbonisation.
8. Risk management and resilience."

[14] European Commission. Communication from the Commision to the European Parliament, the Council the European Economic and Social Committee and the Committee of the Regions. https://eur-lex.europa.eu/legal-content/EN/TXT/PDF/?uri=CELEX:52024DC0063.

Several of these building blocks are reliant on a few key technology pathways, such as CDR and clean hydrogen. These stand out based on their radical projected growth in the coming decades. Substantial work will be required to create and deliver on these building blocks. **CDR, CCS, CCU, CCUS, and clean fuels are embedded in nearly all of them**. This document focuses on ICM pathways such as CDR, CCS, CCU, and CCUS and their associated infrastructure and sectoral implications. A separate document will discuss the production and use of clean fuels in support of Europe's strategic climate plan.

Implementing change

The Commission's recent announcements are part of a 15-year forward program of regulation, incentives, investment, innovation, and infrastructure development that is built upon prior laws, taxonomies, and statutes to achieve the proposed 2040 objectives. Although 15 years may seem like a long time, it is a very short timeline to achieve implementation at this scale. For example, the permitting process alone for individual facilities can take from 7–15 years. Financing and construction of facilities can take an additional 5–15 years. Overall, the projected scale-up of ICM reflects growth of up to 100 times the current operating capacity of CCU, CCS, and CDR technologies, which is ambitious but daunting.

While the Commission highlights these intersecting and cross-cutting sectors and topics in their climate target, planning for them is not yet comprehensive. Many additional actions will be needed to achieve the stated goals. The Commission's published documents discuss plans for some of the necessary actions in detail, but some lie outside the scope of these plans (e.g., electric transmission expansion, potential trade challenges, etc.). In the coming years, readers should anticipate modification and clarification to the currently proposed plans alongside intense public and political debate concerning the speed and specifics of implementation. To close important gaps, operators, investors, the public, and other stakeholders will need clear guidelines for building facilities, infrastructure, and human capital in support of technology scale-up. Development of existing 2030 targets[15] may provide a model for creating a process to achieve 2040 climate and the ICM targets. However, it is important to recognize that these will need to be modified in the ever-changing political, economic, and social realities on the road ahead.

> The European Commission's communications on their 2040 climate goals and their ICM strategy consider feedback from previous conversations within the EU around deep decarbonization while balancing the future need for CDR. For this reason, when referring to CDR technologies within potential regulatory ideas and guidance, the EU has labeled such topics as "reductions" rather than "removals." Carbon removal may not be explicitly articulated as one of the eight building blocks for achieving the 2040 target, but it is essential for the realization of these blocks.

Defining a critical new sector

The Commission's communication on 2040 climate targets states that there is "a growing need for industrial carbon management and carbon removals." Specifically, this implies a need for around 75 million tonnes of carbon dioxide per year ($MtCO_2$/year) in industrial removals by 2040, including a large portfolio of bioenergy with carbon capture and storage (BECCS), direct air capture and carbon storage

[15] European Council Council of the European Union. Fit for 55. https://www.consilium.europa.eu/en/policies/green-deal/fit-for-55-the-eu-plan-for-a-green-transition/.

(DACCS), and other novel approaches as shown in figure 4.[16] Considering this along with the Commission's associated communication on their ICM strategy, ICM has emerged as a critical new sector and enterprise for the EU as a whole. Ultimately, ICM will need to have its own regulatory framework, supply chains, and trained workforce to realize these plans.

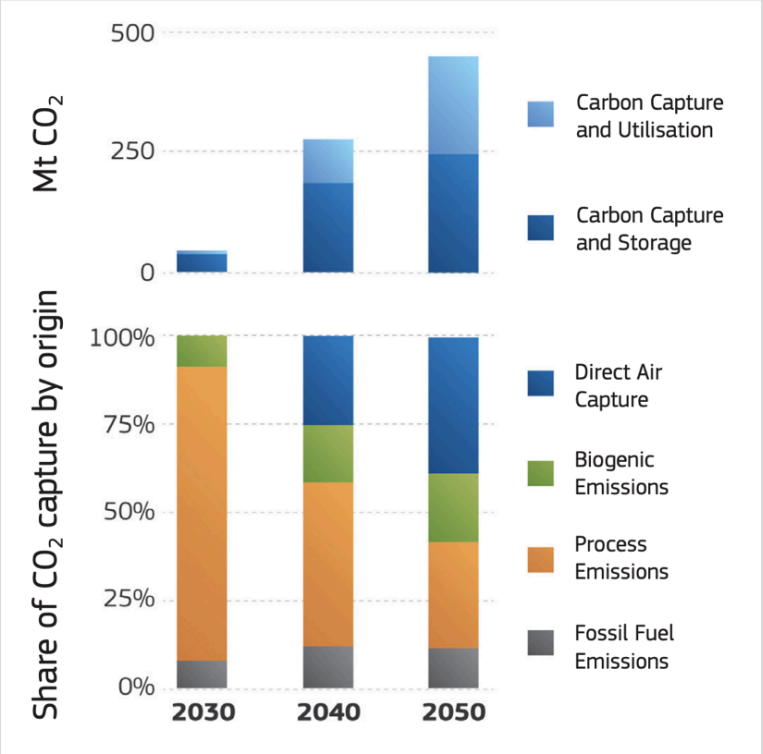


Figure 4: Total volume of CO_2 captured for storage and use projected for 2030, 2040, and 2050 (top) and relative fractional contributions by CO_2 source (bottom). Source: European Commission. 2024. Factsheet Industrial Carbon Management. Licensed under CC BY 4.0.

- → **Atmospheric CDR**: In atmospheric CDR, biogenic or atmospheric CO_2 is captured and results in removals from the atmosphere. This pathway includes industrial applications (e.g., DAC), hybrid solutions (e.g., BECCS and BiCRS), and nature-based removals (e.g., reforestation).
- → **CCS**: In CCS, emissions of fossil, biogenic, or atmospheric origin are captured and transported for permanent storage. This pathway includes programs for durable CDR, including DAC and BECCS, as well as capture from industrial facilities (e.g., steel mills, cement plants, hydrogen facilities, and biorefineries).
- → **CCU**: In CCU, industry uses captured CO_2 as a substitute for fossil-based carbon in synthetic products or fuels. This pathway includes converting CO_2 into fuels, like e-methanol or sustainable aviation fuels, as well as using it in creating building materials and polymers.

[16] 75 $MtCO_2$/year needed in 2040 as per scenario S3 of the impact assessment. Note that only carbon captured, and then permanently stored, from the atmosphere or from biogenic sources is considered an industrial removal. Figure 4 (top) shows carbon captured from all sources, including process emissions.

The ICM strategy sets ambitious goals for these three pillars to grow. This includes a 10-fold increase in the supply of captured CO_2 over six years, from the less than 5 $MtCO_2$/year[17] currently captured to roughly 50 $MtCO_2$/year by 2030.[18] This is anticipated to scale further, up to 280 $MtCO_2$/year in 2040 and 450 $MtCO_2$/year by 2050,[19] resulting in an estimated growth of 60–90 times the current supply in just 15–25 years.

Over the coming decades, the Commission's strategy also incorporates a profound shift in the sources and fate of captured CO_2. Specifically, it starts with CO_2 captured from byproduct process emissions (e.g., from cement or steel production) but rapidly shifts to CO_2 sourced from biomass (e.g., BECCS) or directly from the air (e.g., DACCS). By 2040, biomass and direct air capture will be used to source about 50% of the total CO_2 captured. Storage of CO_2 is projected to grow from 195 $MtCO_2$/year in 2040 to 247 $MtCO_2$/year in 2050. Utilization of CO_2 is projected to grow from 88 $MtCO_2$/year in 2040 to over 200 $MtCO_2$/year in 2050. Together these amounts represent a total carbon management enterprise of about 450 $MtCO_2$/year. Over this time, the share of CO_2 captured from fossil fuel systems will remain a relatively small fraction, even as the total volume of captured CO_2 grows. An indicative flow of captured CO_2 in 2040 is illustrated in figure 5, showing two of the three scenarios modeled as part of the Commission's impact assessment.[20, 21]

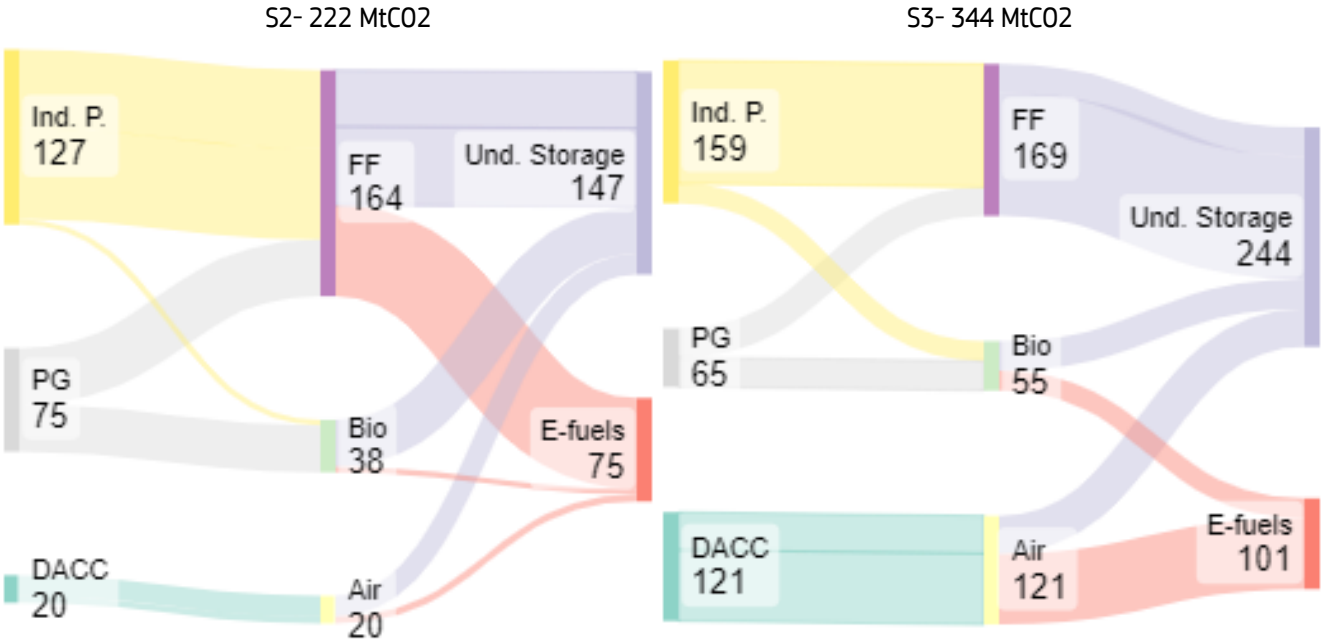


Figure 5: Sankey diagrams showing the flow of captured CO_2 in 2040 in scenarios S2 (left) and S3 (right) of the European Commission's impact assessment. Under all scenarios, the large majority of CO_2 moves to geological storage. Note: "Ind. P." stands for industrial processes and includes process emissions, fossil carbon from industrial processes as well as carbon of biogenic origin coming from the upgrade of biogas to biomethane. "FF" stands for fossil fuels. "PG" stands for power generation. "Bio" refers to CO_2

[17] International Association of Oil & Gas Producers. CO2 storage projects in Europe. October 2023. https://iogpeurope.org/wp-content/uploads/2023/10/Map-CO2-Storage-Projects-in-Europe.pdf.
[18] European Commission. Factsheet Industrial Carbon Management. https://ec.europa.eu/commission/presscorner/detail/en/fs_24_587.
[19] Ibid
[20] Note that the data represented for 2040 in figure 4 is an average of modeled scenarios, S2 and S3. For further details see the Commission's impact assessment.
[21] EUR-Lex. Commission staff working document impact assessment report Part 1 Accompanying the document Communication from the commission to the european parliament, the council, the european economic and social committee and the committee of the regions Securing our future Europe's 2040 climate target and path to climate neutrality by 2050 building a sustainable, just and prosperous society. https://climate.ec.europa.eu/document/download/768bc81f-5f48-48e3-b4d4-e02ba09faca1_en?filename=2040%20Climate%20Target%20Impact%20Assessment_en_0.pdf.

produced by the combustion of biomass in power generation and produced during the upgrade of biogas into biomethane. "DACC" stands for direct air capture of CO_2, for underground storage (e.g., DACCS) or for use in e-fuels. Source: Source: European Commission. 2024. Impact Assessment Report. Licensed under CC BY 4.0.

To facilitate this rapidly growing and changing enterprise, the Commission's ICM strategy proposes multiple frameworks to ensure that industrial carbon removals are properly incentivized. Framework details are still to be developed and published. These details could include setting specific objectives for industrial carbon removals, identifying a pathway for creating a carbon removals registry, or integrating carbon removals into the EU Emissions Trading System (EU ETS).

These frameworks will be developed in parallel with the buildup of private enterprises and societal infrastructure. Attention in these frameworks to capabilities, financing, technology development, and standardization provide recognition of, and exemplify the value of, the ICM industry. They will aim to enable project development, construction of facilities, and a shared infrastructure (see figure 3). The success of ICM as a new sector will depend on growing a vibrant and adaptive economy around these enterprises.

Carbon management infrastructure

To achieve the EU's ambitious carbon management goals, many sectors will rely on new and essential infrastructure. To bring low-carbon products to market, carbon management reductions and removal projects will need pre-investment in specific, low-carbon infrastructures with sufficient capacity, access, and commercial terms for their continued operations. This will include point-source capture projects at fossil power stations, blue hydrogen production for transportation and heavy industry, new CDR and storage projects (e.g., DACCS and BECCS), dedicated pipelines, port terminals, ships, CO_2 storage hubs, and CO_2 networks.

A new study[22] carried out by the Commission's Joint Research Centre estimates that CO_2 transport infrastructure could span up to 7,300 km and deployment could cost up to €12.2 billion by 2030, with these figures increasing to around 19,000 km and €16 billion by 2050. If these numbers seem large, consider that the expected annual costs for new electricity projects are anticipated to be about €100 billion by 2030[23] and add over 43,000 km of new transmission cables by 2040.[24] Importantly, as fossil sources are displaced, diminished, or decommissioned, some infrastructure that was initially built to manage today's fossil and industrial process emissions may be transitioned over time for use in CO_2 removal or may be repurposed for clean fuel transmission and transportation (e.g., e-methanol or renewable methane).

Impacted sectors

To achieve the Commission's 2040 climate goals, dramatic decarbonization of all primary economic sectors will be required along with a pronounced increase in CO_2 removals, both nature-based and industrial. The sectors illustrated in **figure 1** contain multiple subsectors (e.g., transportation includes light-duty passenger transport, aviation, and shipping) which independently require substantial investment

[22] European Commision. CO2 transport infrastructure: key to achieving climate neutrality by 2050. February 2024. https://joint-research-centre.ec.europa.eu/jrc-news-and-updates/co2-transport-infrastructure-key-achieving-climate-neutrality-2050-2024-02-06_en.
[23] European Parliament. Energy transition in the EU. November 2023. https://www.europarl.europa.eu/RegData/etudes/BRIE/2023/754623/EPRS_BRI(2023)754623_EN.pdf.
[24] Entsoe. High-Level Report TYNDP 2022. https://eepublicdownloads.blob.core.windows.net/public-cdn-container/tyndp-documents/TYNDP2022/public/high-level-report.pdf.

and new infrastructure.[25] Some sectors will decarbonize by shifting from fossil sources of energy to new fossil-free sources. For example, the 2040 plan includes phasing out coal power generation by 2030—to be replaced by predominantly renewable power generation with electricity storage. The sectors where reduction, removal, and clean fuels will play the largest roles are discussed below. These include key, hard-to-abate sectors, such as heavy industry and agriculture, as well as new CDR technologies.

Heavy industry

Recent climate targets and plans, as communicated by the EU, will affect all heavy industries including steel, cement, chemical, fertilizer, aluminum, and glass production. Many of these industries have already started to analyze pathways for their continued operations in a future, net-zero EU. Based on the latest proposed targets, these plans will likely need to accelerate. The largest industrial emitters (except chemical production) also fall under the EU's carbon border adjustment mechanism (CBAM),[26] which supports an equivalent carbon price for imported materials compared to domestic production.

As shown in figure 4, process emissions make up a large total volume and fraction of the projected CO_2 capture in coming decades. These emissions come primarily from industrial sectors. For example, one tonne of newly manufactured cement yields one tonne of CO_2, and 55% of that tonne of CO_2 is from process emissions. Steel manufacture also results in high process emissions. One produced tonne of primary steel yields three tonnes of CO_2, 60% of which are from process emissions. To reach EU climate targets, these emissions must be directly managed, through CCS or CCU, to avoid shutting down production. A common infrastructure focusing on heavy industries has been proposed that includes the Porthos project in Rotterdam, Project Greensand in the Baltic Sea, Northern Lights in the North Sea, and the Delta-Rhine Corridor project, which is designed for both CO_2 and hydrogen transport.[27]

Agriculture

During the Committee's final stage of developing their communications on climate goals, a 2040 target to reduce agricultural emissions reduction by 30% was removed. Instead, a Strategic Dialogue on the Future of EU Agriculture[28] was included. This was partially in response to political pushback from farmers and agricultural organizations on EU rules that were proposed earlier.

Carbon Direct anticipates that, with the currently proposed planning, deep abatement within the agricultural sector may not be possible by 2040. Even with the stated targets (as illustrated in figure 1), plans around reduced use of fertilizers, and the long-term potential for methane and nitrous oxide reduction using new technology, emissions from agriculture do not significantly vary over time.[29]

The agricultural sector will be amenable to achieving net reductions through carbon removal applications. The Commission's communication on 2040 climate targets discusses options for carbon removal through new and modified farming practices. It also discusses options to confirm the contribution that land use, land-use change, and forestry (LULUCF), including reforestation, could make to achieving near-term goals for 2030 and to longer-term targets for 2040 and beyond. These two approaches will likely provide

[25] Note that some CO_2 removal, specifically from BECCS, is represented in the "energy" sector.
[26] European Commission. 2023. Carbon Border Adjustment Mechanism. https://taxation-customs.ec.europa.eu/carbon-border-adjustment-mechanism_en.
[27] Delta Rhine Corridor. For More Movement on Energy and Climate in Europe. https://www.delta-rhine-corridor.com/en.
[28] European Commission. Strategic Dialogue on the future of EU agriculture. https://commission.europa.eu/strategy-and-policy/priorities-2019-2024/european-green-deal/agriculture-and-green-deal/strategic-dialogue-future-eu-agriculture_en.
[29] The carbon footprint from fertilizer manufacturing is included in heavy industrial emissions. Only emissions from fertilizer use are included in the agricultural sector.

significant, additional environmental and ecosystem benefits. Crucially, as highlighted in the Commission's impact assessment, without a policy for LULUCF beyond 2030 net removals from this sector would be limited to 230 $MtCO_2e$, falling short of the estimated 333 $MtCO_2e$ needed by 2050 and beyond.

While the majority of removal volumes required to reach climate neutrality by 2050 are represented by land-based approaches, the Commission's analysis projects needed industrial removals of more than 100 $MtCO_2e$. Notably, the EU Council and Parliament recently reached a provisional agreement on a differentiation for certification of permanent (i.e. industrial) and temporary carbon storage, including carbon stored in soils or long-lasting products, which is expected to facilitate the scale-up of carbon removal in Europe.[30]

Industrial carbon removals

Industrial carbon removals, utilizing CCS, are anticipated to increase—making up approximately one-third of total CO_2 removals in 2050 and representing 114 $MtCO_2e$. To achieve this, the Commission has proposed that 50 $MtCO_2$/year be stored by 2030, a goal that is in line with the proposed Net-Zero Industry Act.

To realize this scale in the coming years, policy options and support mechanisms for industrial carbon removals are needed, including guidance on if and how to account for them in the EU ETS. The European Climate Law acknowledges industrial carbon removal value chains as key to achieving EU carbon neutrality objectives. As such, the EU has formed an objective to boost research, innovation, and early-of-a-kind demonstrations for novel, industrial CDR technologies supported by Horizon Europe[31] and the EU Innovation Fund.[32] Many member states have mapped theoretical geological storage sites, which now need to be turned into bankable CO_2 storage capacity. Knowledge on the creation of safe geologic storage and transportation of CO_2 will be needed, along with workforce development, to effectively develop carbon management projects.

The journey ahead

Benefits and investments needed

The Commission anticipates that deep, cross-sector decarbonization and a clean energy transition are likely achievable with limited overall macroeconomic impacts. They point to the uncoupling of EU gross domestic product (GDP) growth from EU GHG emissions, which has already been realized. The Commission positions this as a trend that is expected to continue, though a faster rate of emissions reduction is needed moving forward.

Consideration of future economic impacts is a key motivation in progressing toward climate neutrality. Warming effects between now and 2050 are similar across different scenarios, with the impacts of a no-action scenario being significantly higher in the latter half of the century. The Committee's impact assessment provides different scenarios with substantiations for the costs of the energy transition, losses

[30] European Council Council of the European Union. Climate action: Council and Parliament agree to establish an EU carbon removals certification framework. February 2024. https://www.consilium.europa.eu/en/press/press-releases/2024/02/20/climate-action-council-and-parliament-agree-to-establish-an-eu-carbon-removals-certification-framework/.
[31] European Commission. Horizon Europe. https://research-and-innovation.ec.europa.eu/funding/funding-opportunities/funding-programmes-and-open-calls/horizon-europe_en.
[32] European Commission. Innovation Fund. https://climate.ec.europa.eu/eu-action/eu-funding-climate-action/innovation-fund_en.

in fossil and CO_2 revenues, and benefits from decreased dependence on and reduced cost of fossil fuel subsidies and imports (which are anticipated to drop 80% by 2040). The Commission acknowledges that under a global-damage scenario, as compared to a global-action scenario, the impacts of climate damage on the overall economy will be reflected by an estimated 1% reduction in EU GDP over the next few years and a 2.3% drop by mid-century. In case of uncontrolled climate change, these impacts could possibly become much higher in only a few decades.

While macroeconomic effects are limited, they do not negate the massive investment and evolution of activities that are required to implement the clean energy transition. As estimated in the Commission's assessment, the average annual investment in the energy system, excluding transport, will need to increase to about €660 billion per year from 2031–2050. Compared to the low levels of energy system investment from 2011–2020 (1.7% of GDP), this represents an increase of almost doubled investment (3.2% of GDP from 2031–2050). In the transport sector, annual investment is expected to increase to about €870 billion but will remain broadly constant as a share of GDP, at around 4.2%. Whether these levels of investment will be achieved depends on future political climates, funding availability, and the competition of priorities for EU businesses and member states.

Catalyzing the scale-up of CDR

The following interventions and supporting structures could catalyze the scale-up of CDR to meet needed levels as outlined in the Commission's 2040 Climate Target and ICM communications:

SEPARATE AND TIME-BASED TARGETS FOR CDR

The EU must establish distinct and separate targets for nature-based CDR, industrial CDR, and CO_2 transport and storage infrastructure in order to give clear signals to affected industries. Beginning this process today is critical to stimulating investment in early projects and enabling the learning, innovation, and cost reduction needed for CDR scale-up. These immediate actions would create demand for high-quality credits and help set standards for durable CDR in Europe, standards which could also be adopted abroad. Target setting has been effective in accelerating other decarbonization levers, such as renewable power generation. It is also possible to cascade these targets in an increasingly-mandated plan to expand the required CDR fraction of removals for industries reporting to the EU ETS.

IMPORTS AND CARBON TRACKING

To achieve its goals, the EU must import critical feedstocks for many economic sectors, including the emergent sector of ICM. These can range from unfinished raw materials (e.g., forestry residues and wood pellets), to intermediate products (e.g., low-carbon hydrogen and ammonia), to finished low-carbon goods (e.g., sustainable aviation fuels). While some of these materials are defined in the EU's taxonomy for sustainable activities and are covered by CBAM, important gaps remain around carbon accounting, life-cycle estimates, and appropriate sustainability metrics and guardrails. The EU will need to create standards and define key metrics for these imports to speed investment, avoid carbon leakage, and prevent unintended social and environmental challenges.

INTERNATIONAL COLLABORATION

The potential or required use of international carbon credits in meeting 2040 goals for permanent removals has not yet been developed nor been mentioned in EU communications. However, due to cross-border atmospheric exchanges, industrial removal projects need to be constrained to locations within the EU. International collaboration with nations, companies, innovators, and high-quality CDR projects outside of the EU can contribute to European ambitions, either through the voluntary carbon

market or more regulated markets (e.g., Article 6.4 of the Paris Agreement). As a prime example, with DACCS projects the locations of atmospheric removal and storage facilities are inconsequential to their climate change impacts. Facilities may be located closer to higher-quality renewable energy and CO_2 storage resources, even if they are outside of the EU. Section 5.4 of the Commission's communication on ICM aligns well with this option and supports their future work to accelerate international cooperation, promote harmonized reporting, and coordinated accounting of ICM activities. Already, partnerships around indigenous technologies and projects in the United States, Kenya, India, Chile, and Namibia reflect the potential opportunities for faster deployment, lower costs, and improved trade.

EVOLUTION TOWARD A SINGLE CARBON MANAGEMENT MARKET

The move toward a single EU market for carbon management depends on the development of cross-border infrastructure for transport and storage of CO_2. A single carbon management market would align with making reductions for the EU ETS, the single carbon market for industrial emissions, which ICM aims to enable.

Looking forward

The forward-looking ICM communication published by the European Commission is a great start in accelerating deep decarbonization and is consistent with the EU's planned, net-zero trajectory. However, it represents only the first step in a long process. Actualizing regulations and deployment of technologies to meet the goals of the Commission's ICM strategy will rely on a few critical factors. These factors, such as the national and EU-level elections taking place in 2024, will impact the policy deployment timeline. Milestones or timelines, to ensure progress is made on turning the recommendations into actionable policy, have not yet been set or laid out. Releasing such milestones to the public would support the Commission's goals for transparency and holding committees accountable. The clean energy transition is a relay race that is focused on nearer-term targets while also providing direction for the phases thereafter. As plans laid out by the Commission come to fruition in 2030 and 2040, goals for 2050 and beyond will become more achievable.

In the two communications from the Commission discussed here, they do not formally acknowledge the need for equity and climate justice. Greater community engagement and a focus on minimizing disproportionate impacts on historically disadvantaged communities remains important work within the EU and in their international partnerships. Adding this extra layer of focus to the Commission's proposed engagement with the public could lead to better outcomes for all involved and build greater institutional trust both within and outside the EU.

The European Commission's recent communications on 2040 climate targets and ICM underscore goals to reach net zero by 2050 to continue climate efforts in the period beyond. Negative emissions achieved through carbon capture technologies are required to meet these objectives. If these ambitious goals are realized, European industry will thrive in the emerging global market for clean technology.