

Carbon Dioxide Removals in EU Member States

National frameworks for Carbon Dioxide Removals: State of play and how to improve it

Nils Meyer-Ohlendorf

Deyana Spasova

1 September 2022



Contact

Dr. Nils Meyer-Ohlendorf
Head, International and European Governance
Ecologic Institute
Pfalzburger Straße 43/44
10717 Berlin

E-Mail: nils.meyer-ohlendorf@ecologic.eu

Suggested citation

Meyer-Ohlendorf, Nils, Deyana Spasova (2022): Carbon Dioxide Removals in EU Member States. Ecologic Institute, Berlin.

Acknowledgements

The European Climate Foundation funded this report. Ecologic Institute is very appreciative of this support. Opinions expressed in this report represent the views of the authors and do not necessarily represent the position of the European Climate Foundation. Thomas Legge (European Climate Foundation), Hugh McDonald (Ecologic Institute), Mark Preston (Bellona), Felix Schenuit (Stiftung Wissenschaft und Politik) and Wijnand Stoefs (Carbon Market Watch) commented on previous drafts. The responsibility for the content of this publication lies solely with the authors.

Ecologic Institute: Science and policy for a sustainable world

Ecologic Institute is an independent, academic think tank for environmental research and policy analysis. Since our founding in 1995, Ecologic Institute has been dedicated to improving environmental policy, sustainable development and policy practice. Through findings and ideas Ecologic Institute helps to mainstream environmental issues into other policy areas. Strengthening the European and international dimensions in research, education and environmental policy discourses is a key priority. Ecologic Institute has offices in Berlin, Brussels and Washington DC.

Today more than 100 employees work for Ecologic Institute. Our colleagues come from over 25 countries. Offering diverse expertise and skills, our experts cover the entire spectrum of environmental policy, sustainable development and socio-ecological research in inter- and transdisciplinary projects. Our staff researches, supports and evaluates national, European and international political processes and brings together actors from science, politics and practice. The results are in-depth analyses and practical recommendations. In cooperation with leading American and German universities, the Institute is also active in education.

Ecologic Institute is a private, non-profit institution financed through its project work. Funding partners include the European Commission, the European Parliament, the German Federal Ministry for the Environment, the German Federal Ministry of Education and Research, the German Federal Environment Agency and various foundations.

Ecologic Institute is a member of the Ecological Research Network (Ecornet).

Ecologic Institute is a registered charity. Donations are tax deductible.

Ecologic Institute in Washington DC is an IRC 501 (c) (3) non-profit organization.

Further information: www.ecologic.eu

Contents

Contact	1
Suggested citation	1
Acknowledgements.....	1
Ecologic Institute: Science and policy for a sustainable world.....	2
List of Figures	5
Abbreviations.....	5
Summary and recommendations	6
1 Introduction.....	11
2 CDR frameworks in EU Member States	14
2.1 Austria.....	14
2.2 Belgium.....	15
2.3 Bulgaria.....	17
2.4 Croatia.....	18
2.5 Cyprus.....	19
2.6 Czechia	20
2.7 Denmark.....	22
2.8 Estonia	24
2.9 Finland	26
2.10 France	27
2.11 Germany	30
2.12 Greece.....	32
2.13 Hungary	33
2.14 Ireland	35
2.15 Italy.....	37
2.16 Latvia.....	38
2.17 Lithuania.....	39
2.18 Luxembourg	40
2.19 Malta.....	41
2.20 Netherlands	42
2.21 Poland.....	43
2.22 Portugal	44
2.23 Romania.....	45



2.24	Slovakia	46
2.25	Slovenia	47
2.26	Spain	48
2.27	Sweden	49
3	References	51

List of Figures

Figure 1: Possible pathways for Austria from 2020–2050 for GHG emissions and compensation through net carbon stock change and carbon capture.....	14
Figure 2: Total GHG emissions broken down between EU ETS, Effort Sharing and LULUCF (in MtCO ₂ eq) excluding emissions trading as of 2013 for the WEM scenario.....	15
Figure 3: Production of CO ₂ emissions in individual categories.....	21
Figure 4: Time schedule for CCS in Denmark until 2025.....	23
Figure 5: GHG emission trends by scenario in the Finnish LTS.....	26
Figure 6: Land sector sinks under a WAM scenario of the French NECP.....	28
Figure 7: Distribution of carbon budgets under a WAM scenario of the French LTS.....	28
Figure 8: Projections for LULUCF categories (ktCO ₂ eq).....	37
Figure 9: GHG emissions and removals from LULUCF categories.....	39

Abbreviations

BECCS	Bioenergy with Carbon Capture and Storage
CAP	Common Agriculture Policy
CCS	Carbon Capture and Storage
CCU	Carbon Capture and Utilisation
CCUS	Carbon Capture Utilisation and Storage
CDR	Carbon Dioxide Removal
DAC	Direct Air Capture
DACCS	Direct Air Carbon Dioxide Capture and Storage
ECL	European Climate Law
ESR	Effort Sharing Regulation
ETS	Emissions Trading System
EW	Enhanced Weathering
GHG	Greenhouse Gas
IPCC	Intergovernmental Panel on Climate Change
LTS	Long-Term Strategy
LULUCF	Land Use, Land-Use Change, and Forestry
MRV	Monitoring, Reporting and Verification
NBS	Nature-Based Solution
NECP	National Energy and Climate Plan
RRP	Recovery and Resilience Plan
R&D	Research and Development
TBS	Technology-Based Solution
UAA	Utilised Agricultural Area
WAM	With Additional Measures
WEM	With Existing Measures

Summary and recommendations

To limit global warming to below 2°C or even 1.5°C compared to preindustrial levels, drastic and immediate emission reductions are indispensable, but not sufficient on their own. Carbon dioxide removals (CDRs) are another element of successful climate action. The Intergovernmental Panel on Climate Change (IPCC) calls them “**unavoidable**”.

Although unavoidable, **no Member State has a dedicated strategy for CDRs**. Member States do not address CDRs in a comprehensive and strategic manner and provide no leadership to make CDRs the endgame of climate action – if emissions near zero. While Member States regulate many aspects of nature-based CDR options, they often only *describe* other CDR options, if at all.

This is a problem. It is unlikely that the deployment of CDR options at the required scales will happen as a side effect of other policies. Large-scale CDR deployment will not happen by accident, but needs time, incentives, and clear rules. Without strategic orientation, it is also difficult to balance the multiple implications of each CDR option for societies, economies and ecosystems.

More specifically, the CDR frameworks of most Member States suffer from the **following shortcomings**:

- **No hierarchy between reductions and CDRs:** Compared to emission reductions, CDR is an inherently weaker method of climate protection. All CDR concepts face challenges that reductions do not, ranging from permanence of storage to sustainability. Removed and stored CO₂ can leak, while emission reductions cannot. Technology-based CDR options might be able to address problems of permanent storage, but they struggle with biodiversity problems, land use challenges, issues of energy consumption and high costs. CDRs are also less effective at avoiding warming than equivalent amounts of avoided emissions – because of the asymmetry of Earth feedbacks. In short, one tonne of CO₂ in does not equal one tonne of CO₂ out (Zickfeld, 2021).

Despite these inherent differences, most Member States treat removals and reductions equivalently. In an ambiguous way, most national climate neutrality targets consider reductions and CDR as currencies of the same value. Only Germany, Portugal and the EU have targets in law that differentiate between reductions and CDR (separate targets). Sweden has a separate target based on a decision by Parliament. The national Long-Term Strategies (LTSs) of Belgium, Hungary, France, the Netherlands and Spain quantify reduction requirements to achieve climate neutrality. Not a single Member State has introduced other safeguards potentially addressing the equivalence problem, such as discount factors. **The absence of clear hierarchy and the silence on the equivalence problem are major shortcomings of current national CDR frameworks.**

- **No strategic approach to CDRs:** Member States do not have a strategic and comprehensive approach to CDRs. Rules relevant for CDRs are spread across various policies and laws. These policies and laws address specific CDR aspects as part of other policy areas, notably land use. National LTSs often only *describe* possible CDR options, avoiding political and regulatory choices. Except Germany, no Member State has concrete plans to develop a dedicated CDR strategy. According to the climate programme of the Danish government, bioenergy with carbon capture and storage (BECCS), direct

air capture (DAC), and pyrolysis could be used to offset the remaining emissions in all sectors in 2050.

Accordingly, Member States are not publicly weighing advantages and disadvantages of specific CDR options and therefore do not prioritise them or combinations of them. This is another important shortcoming. Societies need to understand and discuss the multiple implications of each CDR option in their full complexity. They must turn their insights into political choices and – ultimately – regulations.

- **Lack of quantified CDR targets:** Quantified targets are the basis for progress monitoring, and thereby for accountability. They are the backbone of robust climate strategies. Despite their importance, only Portugal sets a quantified CDR target for 2050 in law. Germany's climate law stipulates minimum contributions from nature-based solutions (NBS) to meeting climate targets but has no CDR target as such. The LTSs of Slovenia and Spain contain quantified CDR targets for natural sinks. A report from the Swedish government quantifies in broad terms possible contributions of specific CDR options for achieving Sweden's climate targets. Other Member States with a climate neutrality target only state in general terms that removals will offset remaining emissions, without providing further details.
- **Focus on natural sinks:** Compared to technology-based solutions (TBS), NBS play a prominent role in all national CDR frameworks. Many Member States aim to achieve higher levels of CO₂ absorption and to create stable and climate resilient forest ecosystems. Some Member States quantify areas to be restored or afforested, or the extent of wood harvesting (LTS of Austria, Finland, Flanders, France, or the National Energy and Climate Plan (NECP) of Ireland). Germany's climate law stipulates amounts to be sequestered by the Land Use, Land-Use Change, and Forestry (LULUCF) sectors.

In addition to targets, national frameworks contain numerous statements on measures such as sustainable forest management, soil protection, rewetting, carbon farming and improving climate resilience of ecosystems (especially forests). These mostly general and descriptive statements have little normative value and carry little political clout. They often only reiterate existing policies and laws.

- **BECCS:** The LTSs of France, Italy, the Netherlands, Romania and Wallonia mention BECCS as a CDR option – in descriptive and general terms. Sweden quantifies possible bio carbon capture and storage (bio-CCS) removals but does so only in a government report. For Wallonia, Belgium's LTS states that the electricity sector could consider negative emissions through BECCS but also highlights the problems associated with geological storage of CO₂. France considers BECCS to be the only lever to generate negative emissions in the long term. Portugal's LTS does not consider BECCS to be cost-effective for producing e-fuels. Because of sustainability concerns, Sweden plans to use only waste biomass for bio-CCS. No CDR framework mentions the uncertainties of the removal potential of BECCS nor its negative impacts on biodiversity, water, soil, and land.
- **Direct Air Carbon Capture and Storage (DACCS) and Enhanced Weathering (EW):** Only the CDR frameworks of Denmark, Germany, Greece and Italy mention DACCS. DACCS's removal potential is estimated in the Danish government's Climate Program 2021. Denmark is also preparing an analysis of the framework conditions for promoting DACCS. Germany, Greece and Italy address neither DACCS's removal and innovation potentials nor its demand from renewable energy sources. National CDR frameworks do not address EW.

- **Accounting:** With the exception of Germany and Greece, national CDR frameworks do not include removal-specific accounting rules. The climate laws of Germany and Greece require the adoption of such accounting rules.
- **Investment needs and incentives:** The LTSs of Hungary and Greece quantify the investments needed for the deployment of CDR. Many Member States offer specific subsidies and other incentives for NBS and fossil CCS. Sweden's 2021 budget earmarks funding for bio-CCS and rewetting peatland.

These subsidies are not part of an overall effort to scale up CDRs but are rather enshrined in policies and laws specific to other areas such as land use or industry. As another incentive, Flanders and France plan carbon markets as a platform for negative emissions projects.

- **International cooperation:** A few Member States discuss possible international cooperation regarding CDR practices. The government of Denmark states that the country must be able to import and export CO₂ to and from other countries. Lithuania has expressed plans to carry out a detailed analysis of the feasibility and usefulness of projects implemented with other EU Member States. According to the LTS of Malta, the island could serve as a test bed for new carbon capture technologies of other countries.

The LTS of Flanders contemplates the possibility of achieving climate neutrality outside its own territory – without specifying whether this means intra-EU activities only or also measures outside the EU. The Dutch LTS discusses Member States' contributions to global CDR efforts. Austria's LTS points out that storing CO₂ outside the country (transported via pipelines) could be "considered" as a possible alternative in the long term. Sweden's "supplementary measures" of buying foreign credits might also include some types of CDR.

No country discusses details for transporting CO₂ across borders – neither issues of technical feasibility nor legal obstacles.

- **Public participation and political processes:** No Member State conducted public consultation or other public engagement activities specific to CDR. If at all, CDR rules were part of public engagements in the adoption of LTSs, NECPs or climate laws. In its climate law, Germany assigns the responsibility for meeting CDR targets to federal ministries.
- **Confusion in terminology:** National frameworks do not define CDR. This can lead to confusion. CCS is sometimes mentioned as a method to compensate residual emissions – although CCS is a technology to avoid emissions but not one to remove CO₂. A similar problem occurs with carbon capture and utilisation (CCU). Although generally only a method to delay emissions from entering the atmosphere, CCU is occasionally considered a tool to ensure industrial emission reductions of 100%.

Target Design	
Separate and quantified targets for emission reductions and CDR	<p>Flanders (LTS: 85% reductions by 2050);</p> <p>France (Climate Law: climate neutrality and emission reductions of 83.3% ("a factor of six") emission reductions by 2050; Government decree: carbon budgets including amounts of CDR generated by the LULUCF));</p> <p>Hungary (to achieve climate neutrality in 2050, LTS assumes 95% reductions);</p> <p>Netherlands (Climate Law: climate neutrality and emission reductions of 95% by 2050);</p>

	Portugal (Climate Law: 90% reductions - 10% CDR); Spain (LTS: 90% reductions - 10% CDR by 2050); Sweden (Parliament decision based on Climate law: 85% reductions - 15% CDR by 2045, including international offsets); Wallonia (LTS: 95% reductions - 5% CDR by 2050).
Separate targets for TBS (BECCS, DAC)	Wallonia (LTS: 5% CDR through BECCS, electricity sector could consider negative emissions through BECCS)
Separate and quantified targets for re-forestation and afforestation	Flanders, Germany, Ireland
Separate and quantified CDR target for LULUCF	Germany (Climate Law), Ireland (NECP), Lithuania (NECP)
Plans to adopt a specific CDR Strategy	Germany (Coalition agreement: to adopt long-term strategy that addresses approximately 5% unavoidable residual emissions)
Measures	
Farm subsidies conditional, inter alia, on compliance with mitigation measures	Czechia (LTS), Luxembourg (LTS), France (Label Bas Carbone), Sweden (bio-CCS); Common Agriculture Policy (CAP) Strategic Plans in Member States, in varying form.
Other Issues	
International cooperation	Austria, Denmark, Flanders, Lithuania, Malta, Netherlands
Public participations	No Member State conducted public consultations specific to CDR.
Investment estimates	Greece, Hungary
Storing CO ₂ outside own territory	Austria, Denmark, Flanders
Carbon market as a platform for negative emissions projects	Flanders, France

To address the shortcomings in existing national frameworks and to develop an adequate framework for CDRs, Member States should consider the **following recommendations**:

- **Quantified and separate targets for emission reductions and CDR:** To address the equivalence problem, national CDR frameworks should contain targets that are clearly distinct from reduction targets. To ensure high levels of transparency and accountability, national frameworks should contain quantified CDR targets – either in metric tonnes or in percentage shares of the country’s overall climate targets. National climate neutrality targets that quantify the share of CDRs and/or emission reductions can serve the same purpose – but only in the long term. For a robust CDR framework, countries should establish their targets in laws, most probably in their climate laws.
- **Long-term targets and interims targets:** Such CDR targets should cover the period until climate neutrality is achieved and beyond – when net negative emissions have become necessary. For a credible CDR framework, interim targets for the next two decades should complement long-term targets.
- **CDRs are the younger sibling of emission reductions:** No CDR option is as safe as leaving gas, coal and oil in the ground, the world’s best “sinks”. For this reason, national frameworks should strengthen the “reductions first” principle – like the provisions in the

EU Climate Law (ECL). According to the ECL, emission reductions must be the priority, while removals are only an auxiliary – though necessary – means of climate action.

- **Restoration of degraded ecosystems first:** The restoration of degraded ecosystems is a no-regret option. It offers many co-benefits for nature, strengthens climate resilience of ecosystems, is immediately available at low costs, and does not require large areas of additional land. It has the potential to remove and store large amounts of CO₂. National frameworks should prioritise the restoration and protection of forests, peatland, and other ecosystems.
- **BECCS:** In many scenarios, BECCS are among the central options for removing and storing substantial amounts of CO₂. However, the national frameworks should treat this option with caution because its removal potentials are rife with uncertainties, while negative impacts on biodiversity, water, soil, and land use are often likely to occur. Carbon debt is another challenge that BECCS must overcome.

National frameworks should help ensure that Member States do not repeat past mistakes in bioenergy support – a genuine risk for BECCS’s deployment at large scales. They should avoid creating further biomass demand. For this reason, only residual biomass should be used (bio-CCS instead of BECCS). Pilot projects are a good way to test the ability of BECCS facilities to obtain net removals and their sustainability impacts.

- **DACCS and EW:** No Member State has a framework governing DACCS and EW. Estimates of their removal capacities vary significantly – largely dependent on the abundance of clean energy. Against this backdrop, Member States should define criteria for establishing frameworks that would make these CDR options a viable pillar of the country’s efforts to remove CO₂ in a cost-effective, energy-efficient and sustainable manner. While stressing the innovation potential of these solutions, national frameworks should also be realistic about the associated additional energy demand from renewable energy sources – in the context of a decarbonised economy which will consume considerably more electricity from renewables.
- **Clear definition of CDR:** Member State frameworks should include definition of CDR, making a clear distinction between CDR, CCS and CCU.

1 Introduction

To limit an increase in temperature to well below 2°C or below 1.5°C compared to pre-industrial levels, drastic and immediate reductions of greenhouse gas (GHG) emissions are essential, but likely insufficient. According to the IPCC, effectively all emission reduction pathways that limit warming to 1.5°C (>50%) with no or limited overshoot, and those that limit warming to 2°C (>67%), assume that CO₂ is removed from the atmosphere (CDR).¹ The deployment of CDR to counterbalance hard-to-abate residual emissions is “unavoidable”.²

Although unavoidable, **the scale and timing of CDR deployment varies hugely**. While some scenarios, for example, assume that BECCS removes about 30 GtCO₂ between 2020 and 2100, others estimate as much as 780 GtCO₂³ – a 26-fold difference.⁴ Estimates for CDR through DACCS differ even more: between 0-310 GtCO₂ will have to be removed between 2020 and 2100. Despite these vast differences, one thing is evident: the world will have to remove very large amounts of CO₂ if mitigation efforts remain too slow. At the same time, current global rates of CDR deployment are far below those in modelled pathways limiting global warming to 1.5°C or 2°C.⁵ The IPCC states that policy instruments, greater public support and technological innovation could address this problem.

EU policies and laws recognise the importance of CDRs and have already made them an important element of EU climate action:

- **Climate neutrality target 2050:** The new ECL establishes a legally binding target for the EU to become climate neutral by 2050. By then, GHG emissions and removals regulated in the EU must be balanced (Article 2.1).
- **Net GHG target for 2030:** The ECL sets an EU net GHG emissions target for 2030. Accordingly, emissions must be at least 55% below 1990 levels after deduction of removals. The contribution of net removals to target achievement is limited to 225 MtCO₂eq.
- **Net negative emissions after 2050:** According to Article 2.2 of the ECL, the EU shall aim to remove more GHG than it emits after 2050 – which would result in net negative emissions.
- **LTSSs:** According to Article 15.4 of the Governance Regulation, Climate Strategies of the EU and Member States should contribute to achieving a balance between emissions and removals.

¹ See IPCC, 2021a.

² See IPCC, 2021a.

³ “In modelled pathways that report CDR and that limit warming to 1.5°C (>50%) with no or limited overshoot, global cumulative CDR during 2020-2100 from Bioenergy with Carbon Dioxide Capture and Storage (BECCS) and Direct Air Carbon Dioxide Capture and Storage (DACCS) is 30-780 GtCO₂ and 0-310 GtCO₂, respectively. In these modelled pathways, the AFOLU sector contributes 20-400 GtCO₂ net negative emissions. Total cumulative net negative CO₂ emissions including CDR deployment across all options represented in these modelled pathways are 20-660 GtCO₂. In modelled pathways that limit warming to 2°C (>67%), global cumulative CDR during 2020-2100 from BECCS and DACCS is 170-650 and 0-250 GtCO₂ respectively, the AFOLU sector contributes 10-250 GtCO₂ net negative emissions, and total cumulative net negative CO₂ emissions are around 40 [0-290] GtCO₂. (Table SPM.1) (high confidence)” (IPCC, 2021, p. 34).

⁴ It is important to note that the median annual BECCS deployment by 2050 is more than land sinks remove today: BECCS approx. 9 GtCO₂/yr, Land approx. 7.4 GtCO₂/yr: <https://www.negemproject.eu/wp-content/uploads/2022/05/NEGEM-Briefing-on-role-of-CDR-in-IPCC-AR6-WGIII.pdf>

⁵ See IPCC, 2018.

- **The LULUCF Regulation:** The LULUCF Regulation sets the “no debit” rule, stipulating that accounted emissions do not exceed removals from the LULUCF sectors (Article 4). This Regulation is being amended. If the Commission’s proposal for a revised LULUCF Regulation would be adopted, the Regulation would also establish new CDR rules for the time after 2030, including quantified removal targets for Member States of 310 MtCO₂ by 2030. The European Parliament has endorsed this target.

With the Commission's communication on carbon cycles⁶ of December 2021, the **political debate in the EU on CDRs has gained additional momentum**. The negotiations on the reform of the EU Emission Trading System (EU ETS) and the Climate Action Regulation (alias Effort Sharing Regulation (ESR)) have added to this growing momentum. Discussions in the Parliament indicated growing openness to including CDR for compliance purposes. In addition, the Commission will make a legislative proposal on the certification of CDR in autumn 2022. Depending on the outcomes of these negotiations, CDR provisions in EU law could be mushrooming.

What are CDRs?

According to the IPCC, CDR refers to anthropogenic activities that remove CO₂ from the atmosphere and store it durably in geological, terrestrial, or ocean reservoirs, or in products.⁷ The IPCC defines CDRs as “the withdrawal of greenhouse gases from the atmosphere as a result of deliberate human activities”.⁸ Since this is the opposite of emissions, practices or technologies that remove CO₂ are often described as achieving “negative emissions”.

In broad terms, these activities can be grouped into (1) nature-based removals (“enhancing biological sinks of CO₂”) and (2) technology-based removals (“using chemical engineering to achieve long-term removal and storage”). Nature-based CDRs include, for example, restoring degraded ecosystems, afforestation and reforestation, rewetting of peatland, ocean fertilisation, or soil carbon sequestration. Technology-based options are, for example, BECCS, DACCS or EW. BECCS combines nature-based options with technical storage.

Estimated storage timescales vary from decades to centuries for methods that store carbon in vegetation and through soil carbon management, to ten thousand years or more for methods that store carbon in geological formations.⁹ However, there is no agreement on what defines “permanence”.

Estimated technical geological CO₂ storage capacity is about 1000 gigatonnes of CO₂. This is more than the amount of CO₂ storage needed by 2100 to limit global warming to 1.5°C, although the regional availability of geological storage could be a limiting factor.¹⁰

With this in mind, it is important to note that CDR is different from CCS of fossil CO₂. CCS does not actively remove CO₂ from the atmosphere but prevents it from entering the atmosphere. However, CCS can be a component of a CDR system if the feedstock is of atmospheric or biogenic origin. For similar reasons, CCU is not a CDR method – unless the CO₂ is stored in a product for a “*climate-relevant time horizon*”¹¹, which is rarely the case.

⁶ European Commission, 2021.

⁷ IPCC, 2021: C.11.1.

⁸ <https://www.ipcc.ch/sr15/faq/faq-chapter-4/>

⁹ IPCC, 2021: C.11.1.

¹⁰ IPCC, 2021: C.11.1.

¹¹ IPCC glossary: <https://www.ipcc.ch/sr15/chapter/glossary/>

Against this background, this **report maps and assesses the policy frameworks relevant for CDR in the 27 EU Member States**. For this purpose, the report discusses the following questions:

- **Strategy:** Do Member States take comprehensive and strategic approaches to CDR, or are CDR policies scattered across different policies? Are contributions of CDR to national climate targets quantified in laws and/or policies? Do Member States have specific and concrete plans to develop CDR policies in the future?
- **Equivalence:** Do Member States treat CDRs and reductions alike, or do they recognise the inherent differences between CDR and emission reductions? In this context, are national CDR targets and policies separate from reductions?
- **Trade-offs and benefits:** Different CDR options have different advantages and disadvantages – in terms of biodiversity, water and soil impacts, risks of impermanence, or reliability of monitoring, reporting and verification (MRV). Considering these differences, do Member States regulate different CDR options individually? Do Member States have specific rules for TBS, such as BECCS or DAC and for NBS, such as restoration of degraded ecosystems, afforestation, soil management or specific land use practices?
- **Importance:** As an indication of the importance attributed to CDR in Member States: are CDR requirements enshrined in laws or are they only part of national strategies and plans?
- **Incentives:** Do Member State laws and policies contain incentives and enablers for the deployment of CDR, such as subsidies and other incentives for research, development and demonstration of CDR options, or agreed methods for MRV of carbon flows?
- **Political process and public consultation:** What are the political processes for adopting CDR policies? What are the roles of parliaments, governments, and other state bodies? Was the public consulted and were stakeholders involved?

To provide answers, the report maps and assesses relevant provisions in the **following documents**:

- National climate laws,
- NECPs,
- LTSs,
- and CAP Strategic Plans.

Within its scope, the report provides for an **overview** of CDR frameworks. It does not aim to provide a comprehensive and detailed assessment but examines the general CDR frameworks in Member States. Interviews with selected national CDR experts complemented this assessment. Although not CDR methods, the report touches occasionally on CCS and CCU because (1) they are a component of BECCS, a widely discussed CDR method, and because (2) most national frameworks mention them as important elements of their path towards climate neutrality.

2 CDR frameworks in EU Member States

2.1 Austria

Austria adopted a **climate law** in 2011. The law makes no provisions for CDRs.

Austria's NECP does not refer to TBS. For the forestry sector, the plan states that sustainable forest management will be prioritised. This includes an increase in forest growth with the aim of improving carbon sequestration in forest stands. Carbon pools in forest floors and in biomass should be increased. For this purpose, site-adapted and high-performing tree species should be planted “to achieve a high level of CO₂ binding, to create stable forest ecosystems and to produce large quantities of wood for material-rich and energy purposes” (BMLRT, 2019, p. 136). In the agricultural sector, the focus will be on measures that support the targeted build-up and preservation of humus in both conventional and organic farming.

Austria's LTS contains no quantified CDR targets for specific years, but rather the obligation to remove all residual emission by 2050 – either through TBS or NBS. The strategy does not define CDR but mentions nature-based sinks (forests) and technical sinks (“CCU and CCS”), for which it also outlines possible contributions. The LTS also states that existing laws currently prohibit the storage of CO₂ in geological formations in Austria. According to the LTS, storage capacities in Austria are limited to 400 - 510 MtCO₂, or 6,5 times the country's annual CO₂ emissions. The LTS points out that storing CO₂ outside Austria (transported via pipelines) could be “considered” as a possible alternative in the long term.

Additionally, although the LTS does not contain quantified targets, it includes various scenarios outlining possible contributions of CDR to achieving climate neutrality (Figure 1). Figure 2 provides an overview of total GHG emissions and their distribution in the EU ETS, Effort Sharing and LULUCF until 2040.

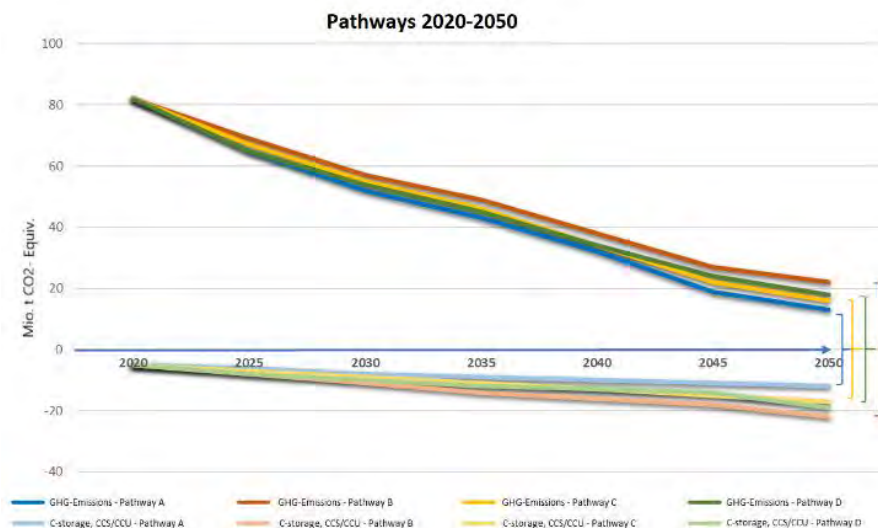


Figure 1: Possible pathways for Austria from 2020–2050 for GHG emissions and compensation through net carbon stock change and carbon capture. Source: BMLRT, 2019.

	2005	2010	2015	2020	2030	2040
Total (excluding LULUCF)	92.6	84.8	78.9	79.7	74.0	71.0
ETS	35.8	32.7	29.5	28.7	26.1	25.6
Effort Sharing	56.7	52.0	49.3	50.9	47.9	45.4
LULUCF	-10.7	-5.9	-4.6	-4.2	-2.7	-1.2

Figure 2: Total GHG emissions broken down between EU ETS, Effort Sharing and LULUCF (in MtCO₂eq) excluding emissions trading as of 2013 for the With Existing Measures (WEM) scenario. Source: BMLRT, 2019; Federal Environmental Agency.

Austria's CAP strategic plan describes the factual context and outlines several measures designed to remove CO₂ through natural processes. Measures include, for example, humus preservation and soil protection, the promotion of organic agriculture, and a bog strategy primarily aimed at preserving intact bogs and restoring damaged bogs. The plan also contains measures for sustainable forest management, as well as quantified targets for the share of utilised agricultural area (UAA) under supported commitments to reduce emissions or to maintain or enhance carbon storage (including permanent grassland, permanent crops with permanent green cover, agricultural land in wetland and peatland). According to this target plan, the share of UAA will first peak at 49.6% in 2026 and later in 2028.

	NECP / LTS	CAP strategic plan
CDR Target / Scenarios	2050 climate neutrality with removals for residual emissions	-
NBS/TBS for CDR	NBS: Contributions but not quantified TBS: Contributions from CCU and CCS but not quantified	NBS: No overall quantified target but target plans for land use
BECCS	-	-
EW	-	-
DAC	-	-
LULUCF	Quantified projections	-
Agriculture	Measures to support the build-up and preservation of humus	Measures to remove CO ₂ through natural processes and quantified UAA indicators
Forestry	Measures for sustainable forest management	Various measures outlined
Carbon farming	-	-
Public consultation	-	-

2.2 Belgium

Belgium has no climate law.

Belgium's NECP states that Flanders is committed to supporting CCS networks and CCU installations but is silent on TBS. According to the document, Flanders aims to create 10,000 additional hectares (ha) of forest by 2030, and 4,000 ha by 2024. In general terms, the NECP intends to focus on achieving the conservation objectives under the Natura 2000 policy and on

creating natural spaces with significant carbon storage potential. The plan also states that Flanders is in the process of drawing up a specific programme to restore and develop wetlands for the purpose of carbon storage and as climate buffers. The impact on Flemish carbon stocks will be systematically analysed and every effort will be made to limit the impact on the Flemish LULUCF balance.

The NECP also contemplates a **Flemish carbon market** to serve as a platform for developing projects to achieve negative emissions. This market is intended to be an independent and voluntary market to trade CO₂ certificates.

The **NECP of Wallonia** states that the region's afforestation potential is limited, and that carbon farming offers opportunities to increase carbon sinks. The document contains a description of existing policies, such as a ban on ploughing permanent grassland in 91 of the 240 Natura 2000 sites. It states that the intensity of biomass removal must be compatible with the long-term maintenance of soil fertility.

Belgium's LTS differentiates between Flanders and Wallonia, as well as the capital Brussels – as according to Belgium's constitution, CDR deployment lies with the competences of the regions. **Flanders** aims for an 85% reduction by 2050. As a densely populated area, Flanders has little space for additional forests and limited potential for geological storage of CO₂. For these reasons, the LTS states that climate neutrality can in principle be achieved outside the Flemish territory, with some countries or regions achieving negative emissions while others continue to emit.

The **LTS also calls for an optimal carbon absorption in soil and biomass** but – in the absence of accurate data – does not quantify contributions to an overall objective. It reiterates the afforestation targets of the NECP and states that Flanders will protect peatlands from degradation and restore disturbed systems by 2050. Flanders will also optimise grassland management based on carbon storage potential and extend the grassland area where possible. It will develop incentives to convert as many fields as possible into more carbon-rich grasslands or agroforestry systems. In forest management plans and natural areas, due attention will be given to resilience to the expected impacts of climate change.

Regarding **Wallonia, the LTS** aims to achieve carbon neutrality in 2050 through reductions of 95%, complemented by carbon capture measures with CCU and negative emissions (BECCS). More specifically, the electricity sector could consider negative emissions through BECCS. The LTS highlights the problems associated with geological storage of CO₂ as it is geographically confined, currently unprofitable, and potentially conflicts with other uses such as natural gas storage, coal re-exploitation and geothermal energy.

Wallonia's CAP strategic plan also includes quantified targets for the share of UAA for carbon storage in soils and biomass, which will peak at 68.95% in 2028. The plan also contains various measures for forest management, as well as for increasing carbon stocks in agricultural soils and maintaining carbon storage, including through the preservation of permanent meadows, encouraging intercropping, and protecting wetlands and peatlands. Several eco-schemes for carbon storage are mentioned, with measures such as improving organic matter levels, maintaining extensive grasslands, trees and meadows, and prohibiting certain phytosanitary products.

In the **CAP strategic plan of Flanders**, the share of UAA for carbon storage in soils and biomass will peak at 18.98% in 2028. The plan specifically outlines that this will be achieved through various eco-schemes and a focus on organic farming.

	NECP / LTS	CAP strategic plan
CDR Target / Scenarios	2050 climate neutrality	-
NBS/TBS for CDR	TBS: CCS and CCU to be supported (<i>Flanders</i>) CCU to compensate for 5% residual emissions (<i>Wallonia</i>)	-
BECCS	Compensating for 5% residual emissions (<i>Wallonia</i>)	-
EW	-	-
DAC	-	-
LULUCF	Quantified targets and commitments	-
Agriculture	Programme for restoration and development of wetlands for the purpose of carbon storage (<i>Flanders</i>)	Measures for increasing carbon stocks and maintaining carbon storage in soils, and quantified UAA indicators
Forestry	Various measures outlined	Measures for forest management (<i>Wallonia</i>)
Carbon farming	Only mentioned (<i>Wallonia</i>)	-
Public consultation	-	-

2.3 Bulgaria

The **2014 Climate Change Mitigation Act** of Bulgaria stipulates that 71% of auction revenues of all GHG emission allowances allocated to the country for industrial installations are to be used to finance various measures, including:

- Forest sequestration, including on the territory of other EU Member States,
- Environmentally-safe CCS in geological formations and in particular from fossil fuel-fired power plants and from industries and sub-industries, including in third countries.

Bulgaria's NECP states that GHG removals are mainly attributable to forests. Forests and grasslands are the two LULUCF categories which play the role of GHG removers, while cropland, settlements and grasslands are CO₂ emitters. According to the plan, projections for the LULUCF sector included in the National Forest Inventory do not consider large-scale afforestation a likely development in Bulgaria. Additionally, the plan contains projections for emissions and removals by the LULUCF sector until 2030.

For the agriculture sector, the NECP refers to various measures, including such set out in the National Air Quality Control Programme 2020-2030 and the Third National Climate Change Action Plan (beyond 2030) – i.e., composting and anaerobic conversion of livestock manure into biogas. Additionally, the NECP contains projections for emissions and removals by the LULUCF category until 2030, as well as measures for biogas capture.

The InvestEU programme is referred to as a source for funding enabling infrastructure for CCS systems in the NECP. Under the document's With Additional Measures (WAM) scenario, investment projections for biomass plants with CCS have been carried out for the periods 2021-2025, 2026-2030 and 2021-2030.

Bulgaria has not submitted an LTS.

The sustainable management of forest areas, timber and carbon stocks in forestry biomass is a key objective of the **Bulgarian CAP strategic plan**, as according to it, the forestry sector has the highest share in carbon emissions removals. According to the plan, 5.98% of UAA is to be utilised for carbon storage in soils and biomass by 2029.

	Climate law	NECP	CAP strategic plan
CDR Target / Scenarios	-	-	-
NBS/TBS for CDR	TBS: No quantified targets, but measures for financing CCS in geological formations	TBS: Investment projections for biomass plants with CCS	-
BECCS	-	Measures for biogas capture	-
EW	-	-	-
DAC	-	-	-
LULUCF	-	Quantified projections until 2030	-
Agriculture	-	Various measures Quantified projections until 2030	Objectives for carbon storage in soil and biomass and quantified UAA indicators
Forestry	Measures for financing forest sequestration	Various measures and projections outlined Removals mostly attributable to forests	-
Carbon farming	-	-	-
Public consultation	-	-	-

2.4 Croatia

The **Climate Change and Protection of the Ozone Layer Act** stipulates that Croatia must ensure that emissions do not exceed removals for the period from 2021 to 2025 and from 2026 to 2030 “in the accounting categories of all land together” (Croatian Parliament, 2019). The law also states that revenues from the sale of allowances will be used to finance the improvement of monitoring carbon stocks in forests, sustainable use of forest resources and wood products, as well as environmentally-safe geological CCS, especially from fossil fuel power plants and certain industrial sectors and subsectors.

Croatia’s NECP does not provide any targets for CDR. It states that in the period 2015-2050, coal and natural gas thermal power plants are not expected to advance technologically except in the context of CCS development. According to the plan, the potential of and possibilities for CCS should be considered at the national level. Plans for the development of a storage capacity evaluation study and an action plan (part of a National Feasibility Study) for preparatory activities for CCS projects are underway. The NECP states that there are plans to inform the public about CCS technologies. According to the document, research on geological CO₂ storage is still pending.

According to the NECP, sustainable forest management measures will be carried out between 2021 and 2030. These measures include reforestation, transfer of forest stands to a higher cultivation form and selection of species for replenishment. Decarbonisation measures for the LULUCF and agriculture sectors include carrying out activities that contribute to increasing carbon storage in forests - particularly in biomass storage - and defining the potential and benefits of various agroforestry technologies to increase soil carbon sequestration.

The creation of a platform for the collection, use and storage of CO₂ is also anticipated between 2021 and 2030. According to the NECP, research into the potential for geological storage of CO₂ in Croatia and subsequent implementation of projects will be carried out within the framework of this measure. A National Feasibility Study with an action plan for preparatory activities for CCS projects is also planned. The study will cover the capture stages of emission sources,

transport and storage of CO₂, and the connection of the carbon transport system with other EU countries.

Additionally, the interested public will be informed about CCS technologies. Funding for this measure is estimated at HRK 1 million. Research will be monitored through publications, while geological storage projects will be monitored through reports submitted to the competent authority by the bodies implementing the projects and through reports sent by the competent authority to the European Commission.

According to the **LTS of Croatia**, the country has technical and natural prerequisites for the use of CCS technology. In one of the two scenarios presented in the strategy – the Strong transition scenario (NU2) - CCS is required in gas power plants, as well as in the cement and processing industries and the industry for fertiliser production after 2040. Moreover, the LTS specifies that carbon stocks in forest biomass will increase to make the land use and forestry sectors a permanent GHG sink and that the use of wood products in traditional and new products will be encouraged.

The **CAP strategic plan of Croatia** lists a wide range of ecosystem measures, including those aimed at maintaining permanent grasslands and increasing carbon sequestration, as well as measures for sustainable forest management. The share of UAA for carbon storage in soils and biomass will amount to 52% for every year between 2024 and 2027.

In the **Croatian Recovery and Resilience Plan (RRP)**, CCS is referred to as a most important technology with a strong potential. Croatia is also said to have experience in the technological application of CCS. The document foresees investments that would ensure a reduction in the industry's CO₂ footprint. An investment of HRK 100 million for a pilot project for CCS is to be completed by 2026.

	Climate law	NECP / LTS	CAP strategic plan	RRP
CDR Target / Scenarios	-	CCS necessary for climate neutrality in one scenario	-	-
NBS/TBS for CDR	NBS/TBS: Financing through allowances' sale	CCS development plans	-	Pilot CCS project by 2026
BECCS	-		-	-
EW		-	-	-
DAC	-	-	-	-
LULUCF	Emissions must not exceed removals from 2021 to 2025 and from 2026 to 2030	Various measures	-	-
Agriculture	-	Various measures, including agroforestry	Prescribed practices within eco schemes and quantified UAA indicators	-
Forestry	-	Measures for sustainable forest management	Measures for sustainable forest management	-
Carbon farming	-	-	-	-
Public consultation	-	-	-	-

2.5 Cyprus

Cyprus has no climate law and no LTS.

The country's **NECP** does not consider TBS due to a lack of available data. Afforestation is considered to be the main LULUCF-related measure relevant for Cyprus. However, afforestation measures discussed in the NECP are deemed a low-potential option with high uncertainty regarding their feasibility.

The **CAP strategic plan of Cyprus** mentions various measures for agriculture and forestry. These include measures relating to specific CAP objectives - for soil, wetlands and peatlands protection and conservation, as well as for carbon sequestration in new forest stands. However, the plan does not quantify UAA shares for carbon storage in soils and biomass and only mentions planned measures such as subsidies for the use of manure in arable crops as a crucial factor in achieving the indicator's targets.

	NECP	CAP strategic plan
CDR Target / Scenarios	-	-
NBS/TBS for CDR	-	-
BECCS	-	-
EW	-	-
DAC	-	-
LULUCF	-	-
Agriculture	-	Various measures for protection and conservation
Forestry	-	Measures for sustainable forest management
Carbon farming	-	-
Public consultation	-	-

2.6 Czechia

Czechia has no climate law.

Geological storage of CO₂, among other fields, is a priority area for research, according to the **Czech NECP**. The document regards CCS and CCU as “technological solutions for the gas sector decarbonisation” and states that “a combination of natural gas with CCS or CCU may be considered for the storage or utilisation of carbon produced from natural gas splitting” (MPO, 2019, p. 137). Specific decisions on the use of such technologies are expected to be made in the period 2020-2030. According to the NECP, priority is given to the protection and restoration of natural and near-natural ecosystems with high carbon storage potential.

In the agriculture and forestry sectors, measures include the development of organic farming and sustainable management of permanent grassland.

The country's **LTS** aims to achieve 80% reduction by 2050 - compared to 1990 - and features eight different scenarios for 2050. It includes a graph of CO₂ emissions from different categories, including CCS (Figure 3).

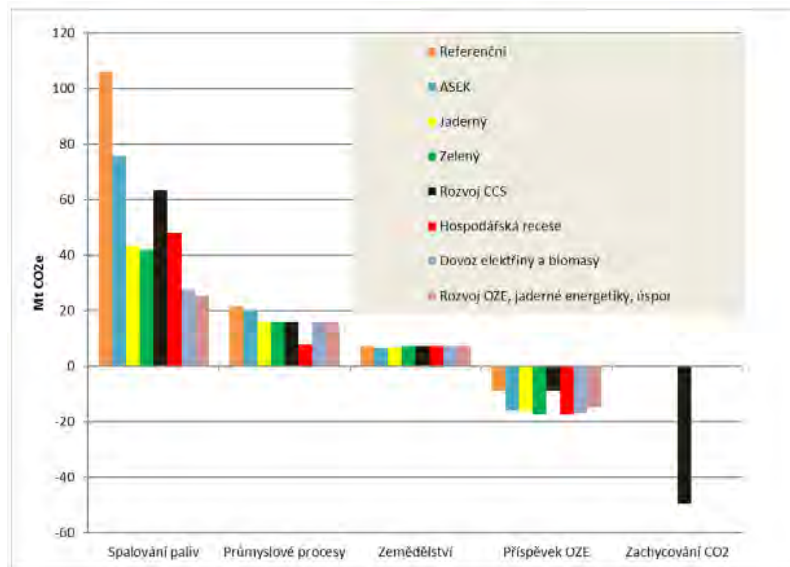


Figure 3: Production of CO₂ emissions in individual categories. Source: MŽP, 2017; Enviro s.r.o.

The **LTS does not quantify removals and does not refer to TBS**. It states that farm subsidies are conditional on, inter alia, compliance with mitigation measures such as the protection of soil organic matter, especially for carbon-rich soils and the restoration of dried peatlands and wetlands. According to the LTS, forest subsidies should only support stands with a natural species and should not support the afforestation of natural habitats.

An intervention for carbon storage in soils and biomass in **Czechia's CAP strategic plan** refers to the Strategy of the Ministry of Agriculture 2030 and its priorities such as promoting sustainable management of natural resources and restoring landscapes that, according to the CAP plan, meet the requirements for farming referred to as "carbon agriculture". Forest management measures and in particular afforestation are also mentioned. According to the CAP plan, the target value for the share of UAA for carbon storage in soils and biomass is 29.46%.

	NECP / LTS	CAP strategic plan
CDR Target / Scenarios	80% emission reductions but no target for CDR	-
NBS/TBS for CDR	TBS: CCS and CCU considered but no policies	-
BECCS	-	-
EW	-	-
DAC	-	-
LULUCF	Quantified projections	-
Agriculture	Various land use and mitigation measures	Various measures, including for "carbon agriculture" and quantified indicators for UAA
Forestry	Various measures, excluding afforestation	Various measures, including sustainable forest management and afforestation
Carbon farming	-	-
Public consultation	-	-

2.7 Denmark

The **Danish climate law** stipulates that Denmark is required to achieve a “climate-neutral society” by 2050 but makes no provisions for CDRs. The law lists various principles for climate action. According to Article 2 of the law, the Minister of Climate, Energy and Supply sets a national climate objective at least every five years for a 10-year period.

As a key objective, the **Danish NECP** aims to ensure that emissions do not exceed removals as accounted for in the LULUCF sector. To this end, the NECP points to Denmark's ban on burning straw residues on fields, its public afforestation activities, a grant scheme for afforestation on private agricultural land and a subsidy for conversion of arable land on organic soils to nature. The NECP also refers to research enabling negative CO₂ emissions through new combustion-related technologies.

Denmark's LTS of December 2019 does not specify the contributions of CDR to achieving its climate neutrality target. The LTS states that residual emissions are “counter-acted by removals by sinks in the LULUCF sector” (KEFM, 2019, p. 36). The role of LULUCF in relation to the 2030 and 2050 targets has not yet been decided.

The **Danish CAP strategic plan** includes quantified expected effects of various eco-schemes aimed at reducing emissions or maintaining or enhancing carbon storage. These include, for example, a one-year scheme aimed at providing an additional year of no-till for pastureland that has not been ploughed for at least two consecutive years. This is expected to contribute to a carbon uptake of 30 kgCO₂eq/ha/yr, which is equivalent to a climate impact of 110 kgCO₂eq/ha/yr. Another eco-scheme, requiring mowing, plant cover and no application of fertiliser will lead to potential reductions of methane emissions and an expected climate impact of about 2.6 tCO₂eq/ha/yr. The strategic plan also estimates that the share of UAA for carbon storage in soils and biomass will peak in 2028 at 43.6%.

In June 2020, the Danish government published the **Climate Agreement for Energy and Industry** with the aim to develop, expand and integrate green technologies in the energy and industry sectors, ensuring a GHG reduction of 3.4 MtCO₂eq in 2030. In the agreement, a technology-neutral, market-based subsidy pool “to capture, utilise and store CO₂” comprising DKK 16 billion is estimated to have a reduction potential of 0.4 MtCO₂eq/yr in 2025 and 0.9 MtCO₂eq/yr in 2030 (Government of Denmark, 2021, p. 2).

The **2021 Climate Programme of the Danish government** estimates that CCS has a technical potential of further 3.5 - 8 MtCO₂eq in 2030. The document also discusses DAC which is expected to result in reductions of 0.5 MtCO₂eq by 2030 and to be further developed and thus play a larger role in 2050. The potential of BECCS is estimated to be 0.1 – 3.1 MtCO₂eq in 2030. According to the climate programme, BECCS, DAC, and pyrolysis¹² could be used to offset the remaining emissions in all sectors in 2050, and their removal potential is estimated at 8.5 - 14 MtCO₂eq in 2030.

In December 2021, the Danish government published the strategic document **A Road Map for the Capture, Transport and Storage of CO₂**. The strategy builds on the previous CO₂ Storage Agreement from June 2021. According to the roadmap, CCS “is crucial for Denmark to achieve climate neutrality by 2050” (Government of Denmark, 2021, p. 2). One of the document's main principles is that the country “must be able to import and export CO₂ to and from abroad”

¹² Pyrolysis is the process of converting agricultural residues into fuel and biochar through thermal decomposition in the absence of oxygen. Biochar is obtained from the thermochemical conversion of biomass and can trap CO₂ in soil for thousands of years.

(Government of Denmark, 2021a, p. 9). The strategy is built upon the following specific initiatives for the long-term development of CCS:

- Market-based deployment through taxes and expenditures for quota purchases
- Promotion of negative emissions through negative tariffs or subsidies
- Promotion of CCS through EU regulation
- Research
- Development of Denmark as a European hub for CO₂ storage
- Promotion of capture technologies within DAC

In the short term, the subsidy pool is to be granted to operators of capture facilities who subsequently purchase transport and storage. The funds will be received for one tonne of CO₂ reduced. The legal basis for municipalities to participate in activities such as CCS will also be re-evaluated. In 2022, the development of infrastructure for carbon capture utilisation and storage (CCUS) will be discussed. Figure 4 provides an overview of CCS actions and measures until 2025, as listed in the roadmap.

Additionally, the government’s agreement on **Investments in a Continuously Greener Denmark** from December 2021 sets aside another DKK 2,5 billion for CO₂ capture, estimated to reduce emissions by 0.5 million tonnes in 2025 and 2030.

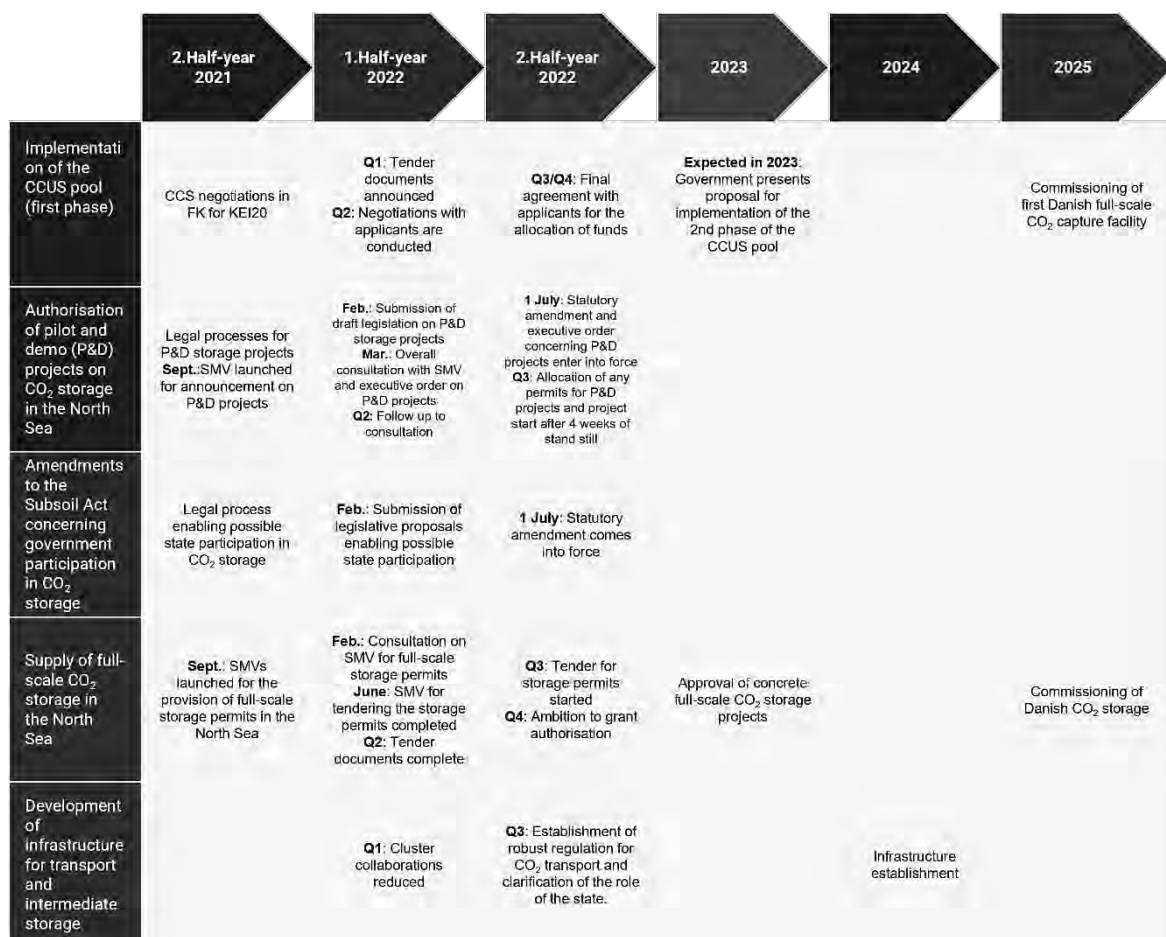


Figure 4: Time schedule for CCS in Denmark until 2025. Own depiction, based on Government of Denmark, 2021.

	Climate law	NECP / LTS	CAP strategic plan	Other government documents
CDR Target / Scenarios	2050 climate neutrality No CDR provisions	-	-	Estimations of potential removals
NBS/TBS for CDR	-	-	-	Estimations of potential removals and CCS investments totalling DKK 18,5 billion
BECCS	-	-	-	Estimations of potential removals
EW	-	-	-	-
DAC	-	-	-	Estimations of potential removals and a governmental analysis of the framework conditions for the promotion of DAC
LULUCF	-	Quantified projections Removals and sinks in LULUCF to offset residual emissions	-	-
Agriculture	-	Various measures	Various measures, quantified expected effects of eco-schemes and quantified UAA indicators	-
Forestry	-	Various measures	Various measures	-
Carbon farming	-	-	-	-
Public consultation	-	-	-	-

2.8 Estonia

Estonia has no climate law.

According to the **Estonian NECP** projections, the LULUCF sector will remain a carbon sink until 2030, after which the sector is expected to become a GHG source. The main reason for this is emissions from arable land and a reduction in the amount of carbon stored in forests, as the replacement of older forests with newer ones will lead to a reduction in forest stock.

The **NECP** provides no CDR target and only reiterates the no-debit target of the LULUCF Regulation. The plan lists a variety of forestry and agricultural measures. These include reforestation with the aim to increase the net growth of forests and their carbon capture capacity, as well as promoting the regeneration of managed private forests with tree species compatible with the habitat. The NECP refers to the Estonian Rural Development Plan 2014-2020, according to which maintenance contributes to an improved carbon capture capacity of a forest stand, prevention of storm damage and carbon storage in long-lived products when wood is utilised in the timber industry.

The NECP also quotes the National Forestry Accounting Plan and the 2021-2030 Forestry Development Plan as the documents outlining the carbon capture obligation of managed forest land, determinant for the volume of wood fuel production and use. The key aim of the 2021-2030 Forestry Development Plan “is to ensure the productivity and viability of the forests, as well as their diverse and efficient use” by increasing forest growth and carbon capture capacity through forest management activities (MKM, 2019, p. 73). Additionally, the Forest Act of Estonia obliges forest owners to ensure reforestation within a maximum of five years after logging or a

natural disaster, which assists consistent carbon capture in woodlands and the preservation of the GHG capture level of forests.

The **LTS of Estonia** states that the country aims to reduce its emissions by about 80% by 2050 (compared to 1990). The goal includes all main GHGs, covers all sectors, but excludes LU-LUCF, international maritime transport and aviation. Remaining emissions in 2050 are to be compensated by enhanced carbon sequestration.

According to the LTS, CCUS technology today enables carbon capture in industry and the burning of fuels, its transport by ship or pipeline, its use in products and services and its storage deep underground. Currently, 30 million tCO₂/yr is captured, but projections indicate that this volume could reach 2.3 billion tCO₂ in 2040, representing 7% of the required reduction in cumulative emissions.

According to LTS, **Estonia does currently not have suitable geological conditions for storing CO₂**. The country is carrying out a comprehensive study on the feasibility of investing in carbon capture infrastructure to help minimise GHG emissions in the Estonian oil shale industry.

Concerning **agriculture**, the LTS states that the carbon stock of soils will be increased and maintained. Land areas of significant carbon stock will be developed and maintained. Farmers are encouraged to increase the soil’s carbon stock, shape and maintain permanent grasslands, small wetlands and buffer zones, and reduce the cultivation of peat soils. Unnecessary removal of organic substance from the soil should be avoided.

Concerning **forestry**, the LTS states that sustainable forest management should help increase carbon sequestration. Timber use will be consistently expanded and the carbon stock in timber products and buildings will be increased. Preservation of the current forest lands will be facilitated, and techniques to increase carbon sequestration and reduce emissions will be prioritised in other land use categories. Moreover, the carbon stock in the peat layer of mires will be preserved or increased. Further drainage of mires will be avoided, and near-natural water regimes will be restored in drained peatlands where possible.

The **Estonian CAP strategic plan** includes various “environmentally friendly” measures, including those for the protection and maintenance of grassland and peatland and improving soil carbon storage, as well as forest management measures. The plan envisions a peak 79.93% share of UAA for carbon storage in soils and biomass in 2028, while the following year the share is expected to be 2%.

	NECP / LTS	CAP strategic plan
CDR Target / Scenarios	80% emission reduction by 2050 with enhanced carbon sequestration to offset remaining emissions	-
NBS/TBS for CDR	TBS: CCUS projections for 2040	-
BECCS	-	-
EW	-	-
DAC	-	-
LULUCF	Quantified projections	-
Agriculture	Various measures	Various measures, including for improved soil carbon storage and quantified UAA indicators
Forestry	Various measures, including sustainable forest management and reforestation	Various measures for sustainable forest management
Carbon farming	-	-
Public consultation	-	-

2.9 Finland

According to its new **climate law**, Finland aims to achieve climate neutrality by 2035 and negative emissions thereafter. In addition, the law stipulates specific targets for the emissions covered by the ESR and the EU ETS: -60% by 2030, -80% by 2040, and -90% by 2050 (with an aim of -95%) – all compared to 1990 levels. **The Finnish climate law does not contain quantified targets for CDR.** It requires the government to approve climate plans for the land use sector. The plans are to include, among others, a target for GHG emissions and removals in the land use sector, and measures to reduce emissions and increase removals.

The **Finnish NECP** makes no mention of technical sinks and makes no provisions for CCS. It only refers to a Nordic Energy Research project enabling negative CO₂ emissions through new combustion-related technologies.

To achieve climate neutrality by 2035 and negative emissions thereafter, the **NECP calls for strengthening carbon sinks.** In the LULUCF sector, emissions should not exceed sinks in the periods 2021-2025 and 2026-2030, as stipulated by the LULUCF Regulation. In addition, a climate programme for the land use sector will be drawn up in line with the Government Programme.

The **Finnish LTS** reiterates the 2035 climate neutrality target. The document includes three scenarios for achieving climate neutrality – the “continued growth” scenario, the “saving” scenario, and the WEM scenario. An annex quantifies the reductions of specific sectors and outlines the removal amounts required to achieve climate neutrality for all LULUCF categories. With its focus on modelling, the Finnish LTS does not outline measures required to generate CDRs. Figure 5 shows GHG emission projections in the three scenarios of the Finnish LTS.

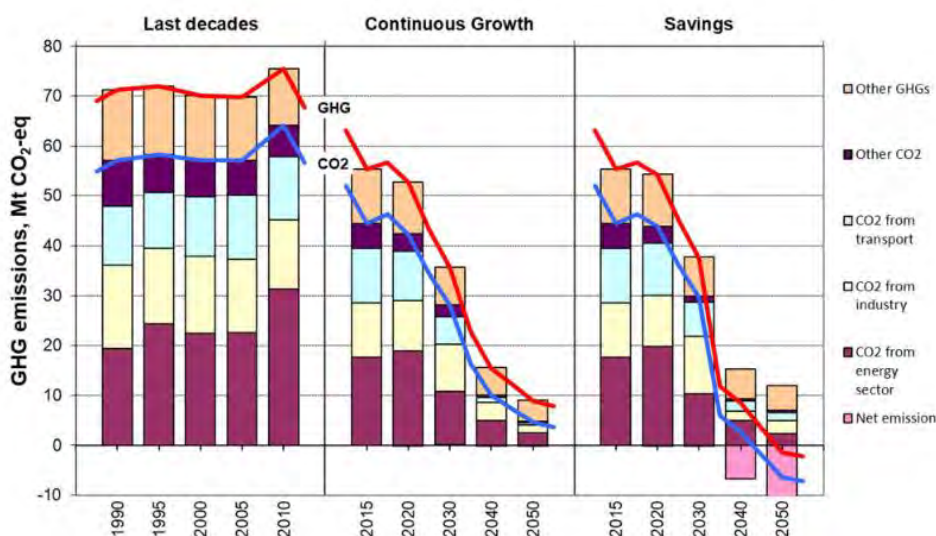


Figure 5: GHG emission trends by scenario in the Finnish LTS. Source: TEM, 2020.

Moreover, the Finnish government is already preparing a **wide range of additional measures in the land sector** to reduce emissions and enhance removal by sinks.¹³ These include developing guidance instruments and incentives for maintaining and strengthening carbon sinks and storage of forests and soil, safeguarding the management, growth capacity and health of forests, preventing land-use change and maintaining and managing growth conditions in agricultural soils. The measures include, for example, promoting continuous plant cover and cultivation

¹³ See Finnish Government, 2019.

techniques to sequester carbon or reduce emissions, piloting carbon sequestration and storage markets, promoting the use of diverse forestry and forest management methods, and mitigating deforestation to settlements and to cultivation through various means. Due to the early stage of the plan, the impact of such additional measures on the forest land sink cannot yet be estimated.

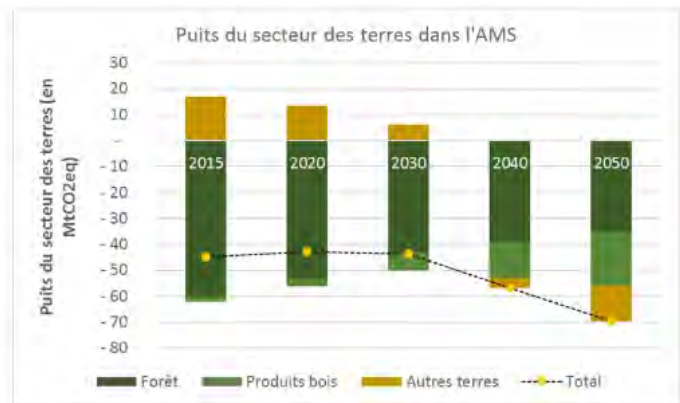
In its **CAP strategic plan**, Finland relies on various eco-schemes for improving carbon sequestration in soils and grasslands. The plan also includes measures for sustainable forest management. Finland plans to reach a peak share of 76.96% of UAA for carbon storage in soils and biomass in 2028.

	Climate law	NECP / LTS	CAP strategic plan
CDR Target / Scenarios	2035 climate neutrality Specific targets for EST and ETS emissions but no quantified targets for CDR	2035 climate neutrality	-
NBS/TBS for CDR	-	-	-
BECCS	-	-	-
EW	-	-	-
DAC	-	-	-
LULUCF	Quantified removals as scenario outcomes	Emissions must not exceed sinks	-
Agriculture	-	-	Various measures and quantified UAA indicators
Forestry	-	Various measures	Various measures for sustainable forest management
Carbon farming	-	-	-
Public consultation	-	-	-

2.10 France

The long-term target of France, according to the 2019 revision of its **climate law**, is climate neutrality and at least 83.3% (“a factor of six”) emission reductions by 2050. The law also includes intermediate emission reductions targets (i.e., 40% reductions in 2030) but **no specific targets for CDRs**. The contribution of bio-sourced materials to the storage of carbon and the preservation of natural resources is mentioned, and the use of such materials in building construction or renovation is encouraged.

The **NECP of France** estimates removals in the forestry sector accounting for 55.4 MtCO₂eq for the period 2021–2025 and 57.3 MtCO₂eq for the period 2026–2030. According to the plan’s projections, forest carbon sinks will decrease over the 2021-2030 period due to robust forest management aimed at increasing the production of wood materials. Projections also foresee “a reduction in the rate of anthropogenic development and ploughing of grassland and an increase in forest cover” (MTE, 2020, p. 59). Figure 6 provides an overview of sinks in the land use sector.



Puits du secteur des terre dans l'AMS	Carbon sinks in the land sector under WAM scenario
Puits du secteur des terre (en MtCO2eq)	Carbon sinks in the land sector (in MtCo2eq)
Forêt	Forest
Produits bois	Wood products
Autres terres	Other land
Total	Total

Figure 6: Land sector sinks under a WAM scenario of the French NECP. Source: MTE, 2020.

In the long term, the NECP stipulates that a small number of large CCS or CCU facilities are to be supported. The plan estimates that the sinks provided by the land sector together with CCS will compensate for residual non-energy emissions and the residual emissions from fossil fuels that are still used for certain means of transport (e.g., aviation).

A **government decree**¹⁴ sets legally-binding carbon budgets (2019-2023, 2024-2028, 2029-2033), which take into account emissions and removals from the LULUCF sector, among other main sectors.

The **LTS of France** restates the country’s climate neutrality target under the climate law and includes a dedicated chapter on carbon budgets. The strategy also discusses the distribution of carbon budgets under a WAM scenario (Figure 7).

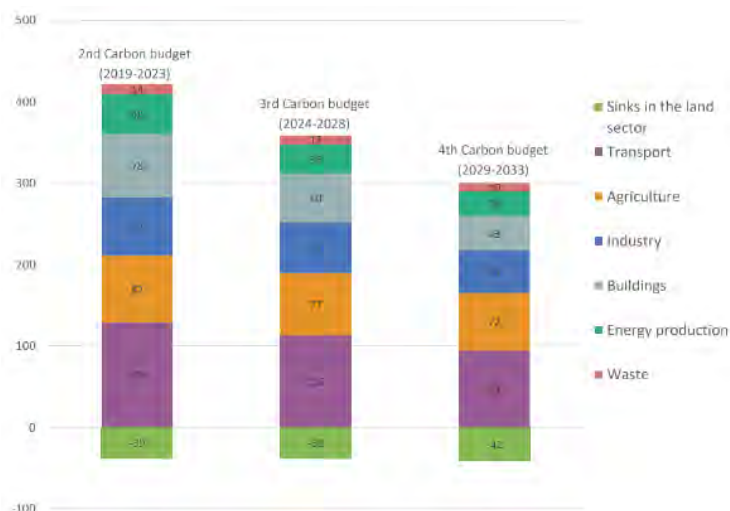


Figure 7: Distribution of carbon budgets under a WAM scenario of the French LTS. Source: MTE, 2020a.

¹⁴ Decree no. 2020-457 of April 21, 2020, on national carbon budgets and the national low-carbon strategy. See https://www.ecologie.gouv.fr/sites/default/files/joe_20200423_0099_0004%281%29.pdf.

The French LTS relies on remaining emissions in 2050 to be compensated by natural and technical sinks. It specifically states that achieving carbon neutrality requires compensating emissions with carbon sinks such as human-managed ecosystems (forests and farmland), products and materials from the bioeconomy based on plant matter (wood and straw) and industrial processes (CCUS). Natural sinks are expected to double - from 30.7 MtCO₂ in 2019 to 67 MtCO₂ in 2050, and 10 MtCO₂ of bioenergy emissions are expected to be captured and stored.

The LTS also stipulates that climate neutrality potentially requires **BECCS**. BECCS is regarded as the only lever that may allow negative emissions to be generated in the very long term. The reuse of existing infrastructure is foreseen in the deployment of technologies such as BECCS. In the industrial sector, the LTS anticipates avoiding around 6 MtCO₂ and generating around 10 MtCO₂eq negative annual emissions by 2050. The strategy also provides both quantitative and qualitative data for biomass and anticipates 460 TWh consumption of biomass resources in 2050. It specifically states that disruptive technologies must be developed and adopted to capture emissions associated with biomass combustion.

The potential of CCS in industry is estimated to be approximately 1 - 1.5 GtCO₂. According to the LTS, the geological CO₂ storage potential in France is still not well known on land and unknown at sea.

The French long-term vision incorporates various **measures and projections for forest and land sector sinks**. The LTS scenario expects a projected forest sector carbon sink of around 55% compared to 1990 levels. Forests and soils are an important element of France's CDR strategy, which relies on improved forestry management and a "carbon pump", preserving forested areas and monitoring forest soil carbon content. Maximising soil cover is also part of the envisioned efforts. In the long term, the strategy aims to reduce reliance on the carbon sink of forests in favour of the sink associated with harvested wood products.

The **CAP strategic plan of France** contains various measures for sustainable forest management and sustainable agricultural practices, including grassland and soil preservation. According to the plan, France aims to commit 26.2% of UAA to carbon storage in soils and biomass between 2024 and 2028.

The **K6 program under the Innovation Fund** plans to combine cement production with CCS, which would result in the first carbon neutral cement in Europe and an avoidance of 8.1 MtCO₂eq emissions over the first 10 years of operation. The captured CO₂ will be transported to the Dunkirk port, where the further development of a strategically-important CO₂ export hub is planned (European Commission, 2022). The **RRP of France** also includes CCS as part of the strategy to decarbonise industry, although it does not provide specific targets. It also emphasises the use of wood and bio-sourced materials in buildings and France's aim to preserve undeveloped land, due to its contribution to carbon storage.

Additionally, France has its own **framework for voluntary carbon reduction - Label Bas Carbone**, or the French Carbon Standard. Adopted by the French Government in 2018, it is based on 11 standardised methodologies, including those for forestry (afforestation, coppicing, and restoration) and agriculture (reductions in cattle and dairy farms or field crops due to GHG mitigation measures), to name just a few. Emission reductions can then be traded for payment after a five-year project period. The Label Bas Carbone is result-based. Companies, organisations and private persons can offset their emissions by purchasing the emission reductions determined by these methodologies (European Commission 2019). The scheme considers co-benefits of carbon reductions and tries to avoid negative environmental impacts – which also determines projects' eligibility to participate.

The first phase of public consultation on the expected French Energy and Climate Strategy took place from November 2021 to February 2022 and involved discussions about emission reductions, including the role given to forests and wood products in the document.

	Climate law	NECP / LTS	CAP strategic plan	RRP
CDR Target / Scenarios	2050 climate neutrality but no CDR target	2050 climate neutrality	-	-
NBS/TBS for CDR	-	No target Measures and scenario outcomes are provided for various sectors	-	TBS: No target; CCS part of the strategy for decarbonising industry
BECCS	Bio-sourced materials encouraged for the construction or renovation of buildings for carbon storage purposes	Scenario outcomes and both qualitative and quantitative information BECCS is a potential requirement for climate neutrality	-	-
EW	-	-	-	-
DAC	-	-	-	-
LULUCF	-	Quantified projections	-	-
Agriculture	-	Various measures for carbon storage within soils	Various measures for sustainable agriculture and quantified UAA indicators	-
Forestry	-	Various measures and projections for forest sinks	Various measures for sustainable forest management	Measures for extending the forest carbon sink in buildings
Carbon farming	-	-	-	-
Public consultation	-	-	-	-

2.11 Germany

Germany’s climate law contains some detailed CDR provisions. According to section 3a, the contribution of the LULUCF sector to climate change mitigation should increase. By 2030, the sector should sequester at least 25 MtCO₂eq. Sequestration will increase to at least 35 MtCO₂eq by 2040, and to at least 40 MtCO₂eq by 2045.

It is important to note that these rules do not set a maximum CDR contribution to meet Germany’s climate targets but allow for any higher CDR contribution (“*at least*”). In other words, there is no ceiling for CDRs – unlike the relevant provisions of the ECL.

In addition to these targets, the **law assigns responsibility to the federal ministries** whose remit gives it primary competence for the LULUCF sector. The ministry has the task of presenting and implementing the national measures required for compliance with the CDR targets. The Federal Government can enact statutory instruments to establish rules on accounting, natural disturbances, reporting and monitoring.

Germany’s NECP includes several measures for nature conservation, forestry and agriculture. These involve improved support measures for developing climate-resilient mixed forests, including enhancing carbon reservoirs and structural diversity in forests. Concrete objectives comprise the reforestation of deforested areas (180,000 ha, as of September 2019) and the acceleration of climate change adaptation in forests. Additionally, the plan foresees the improvement of agricultural structures and coastal protection.

The plan also mentions the Climate Protection in Agriculture and Forestry research initiative, which aims to enhance sinks in soils and forests and develop strategies for land degradation neutrality in the use of soils and land.

The **NECP also discusses the development of DAC, CCS and CCU technologies**. According to the plan, DAC is gaining momentum and will receive funding as a carbon technology under the Seventh Energy Research Programme. The NECP addresses the **Carbon avoidance and utilisation in primary industries programme**, aimed at reducing emissions in primary industry, including through CCU and CCS technologies. The programme’s objectives include, among others, modelling and developing European cooperation on CCS in the deep substratum below the North Sea, where extensive carbon storage capacities exist. The programme also strives to model and develop regional, supra-regional and potentially European CO₂ networks and standards for carbon flows in transport, and to facilitate the modification and scaling of carbon capture methods in industry.

To some extent, **Germany’s 2018 LTS** is outdated by the climate law and the coalition agreement of November 2021. It states that additional CDRs should come from agriculture and forestry but contains no quantified CDR targets or specific measures. It hints in vague terms at the possibilities to avoid residual emissions from industries through CCU or CCS.

Germany’s CAP strategic plan foresees financial support for various measures to reduce emissions or to maintain or enhance carbon storage, i.e., for the development of permanent grassland, soil protection and rewetting measures. The plan also includes various measures for sustainable forest management. The UAA share for carbon storage in soils and biomass set out in the plan will peak at 2% in 2028.

Germany’s coalition agreement calls for various measures to strengthen sinks, such as a revision of the forest law to build resilient forests, programmes to help foresters make their forests more climate resilient, halting logging in old-growth, natural forests in public ownership, programmes to strengthen CO₂ absorption of oceans (seaweed), and support for wood construction. Acknowledging the need for TBS, the agreement commits the government to develop an LTS to eliminate the unavoidable residual emissions of about 5%.

In August 2022, energy companies **Wintershall and Equinor** agreed to cooperate on a CCS project that includes the construction of a 900-km pipeline to transport CO₂ from an energy hub in northern Germany to storage sites in Norway. The pipeline’s transport capacity will be 20 to 40 million metric tons annually.

	Climate law	NECP / LTS	CAP strategic plan	Coalition Agreement
CDR Target / Scenarios	Negative emissions after 2050	-	-	-
NBS/TBS for CDR	-	-	-	Strategy to deal with 5% of residual emissions
BECCS	-	-	-	-
EW	-	-	-	-
DAC	-	Research	-	-
LULUCF	2030: at least 25 MtCO ₂ eq 2040: at least 35 Mt 2045: at least 40 Mt After 2050: negative emissions	Quantified projections	-	-
Agriculture	-	Improvement of agricultural structures	Various measures, including	-

			agroforestry and quantified UAA indicators	
Forestry	-	Various measures Reforestation of deforested areas (180,000 ha, as of September 2019).	Various measures for sustainable forest management	Various policies
Carbon farming	-	-	-	-
Public consultation	-	-	-	-

2.12 Greece

The **draft climate law of Greece** includes a 2050 climate neutrality target, and its policies and measures are aimed at reducing emissions and increasing carbon sinks. According to the law, various facilities (i.e., environmental infrastructure systems, poultry farms) are required to reduce their emissions by at least 30% by 2030 compared to 2022 levels (Article 16). To meet this target, Article 28 of the climate law stipulates that calculation rules for carbon offsets achieved through planting, afforestation and reforestation, as well as for alternative methods of compensation of CO₂ should be established. The law foresees an annual progress report on climate change and mitigation which would include data on national emissions and sinks from LULUCF activities.

Greece's NECP states that the vulnerability of forest ecosystems to climate change will be assessed with the aim of, inter alia, "mitigating climate change by increasing carbon capture and storage in forest ecosystem" (YPEN, 2019, p. 105). The development of decarbonisation technologies including CCUS is planned as a policy measure. GHG emission reductions are also expected to face the challenge of "ensuring the capture, storage and utilisation of carbon dioxide from power generation plants using conventional fuels and industrial uses" (Ministry of the Environment and Energy, 2019, p. 85). The NECP also mentions sustainable forest management as a planned policy measure for reducing emissions, while the Rural Development Programme is said to promote a more intensified implementation of forestation.

The **Greek LTS** includes four scenarios – EE1.5 and EE2 (Energy Efficiency and Electrification in 1.5°C and 2°C scenarios) and NC1.5 and NC2 (New Energy Carriers in 1.5°C and 2°C scenarios). According to the LTS, the deployment of natural carbon sinks and CCS technologies to address residual GHG emissions is a requirement for a socially-just transition. However, in the two 1.5°C scenarios, CCS and CCUS technologies will only be used to a limited extent and only for emissions from sectors that cannot be reduced by other suitable means, e.g., industry. CCS is nevertheless expected to contribute to the elimination of GHG emissions in electricity production entirely, based on the 1.5°C scenarios. The LTS indicates that the development of carbon storage facilities is limited due to the low availability of suitable underground space in Greece. Storage capacity will not exceed 140 million tCO₂. However, according to the LTS, this potential is sufficient due to the small quantities of natural gas expected in 2050 and the emissions from industrial processes which could not be eliminated without CCS.

The **LTS also includes quantitative information about the electricity generation and power of CCS units and CO₂ capture and use**. In the EE1.5 and NC1.5 scenarios, electricity generation from CCS units will account for 1.8 TWh biomass and 2.3 TWh natural gas, and 1.5 TWh biomass and 11.8 TWh natural gas, respectively. The power of CCS units will be based on 0.3 GW biomass and 0.5 GW natural gas in the EE1.5 scenario and 0.3 GW biomass and 1.6 GW natural gas in the NC1.5 scenario. In the EE2 scenario CO₂ capture does not exist. In the NC2 scenario, CO₂ capture from biomass accounts for 2.7 Mt and 2.1 Mt from air and does

not exist in the form of capture from industrial processes or fossil fuel combustion. In the EE1.5 scenario, CO₂ capture from biomass is 0.9 Mt, from industrial processes – 4 Mt, from fossil fuel combustion – 1.7 Mt, and does not exist in the form of air capture. The NC1.5 scenario foresees 2.9 Mt CCS from biomass, 5.6 Mt – from air, 4.6 Mt – from industrial processes and 5.4 – from fossil fuel combustion. Total CO₂ use will account for 0 Mt in the EE2 scenario, 4.8 Mt in the NC2 scenario, 6.7 Mt in the EE1.5 scenario and 18.4 Mt in the NC1.5 scenario.

According to the LTS, scenarios serving a 2°C objective do not include CCUS technologies, and sectors such as industry retain GHG emissions.

The **LTS also provides investment cost calculations** for various power generation CCS technologies, as well as for capturing CO₂ from air (absorption technology).

The **CAP strategic plan of Greece** contains various measures for carbon sequestration in agriculture and forestry, i.e., forest fire protection, pasture management, agroforestry. The plan allocates 24.33% of UAA to carbon storage in soils and biomass in 2027 but does not include targets for 2028 and 2029.

	Climate law	NECP / LTS	CAP strategic plan
CDR Target / Scenarios	2050 climate neutrality	-	-
NBS/TBS for CDR	-	Quantitative data about CCS and CO ₂ capture and use based on scenario outcomes, including cost calculations TBS: CCUS development planned	-
BECCS	-	-	-
EW	-	-	-
DAC	-	Quantitative data based on scenario outcomes and cost calculations	-
LULUCF	-	-	-
Agriculture	-	-	Various measures for carbon sequestration in agriculture and land use and quantified UAA indicators
Forestry	Plans for calculation rules for carbon offsets through planting, afforestation and reforestation	Various measures including sustainable forest management	Various measures for carbon sequestration in forestry
Carbon farming	-	-	-
Public consultation	-	-	-

2.13 Hungary

According to its **climate law**, Hungary will achieve full climate neutrality by 2050, i.e., remaining domestic GHG emissions and removals will be in balance by that year.

The **Hungarian NECP** states that the share of forest covered, and other tree stock areas will be significantly increased, consistent with the National Forest Strategy and with the aim to increase CO₂ sink capacities. Furthermore, Hungary seeks to improve the resilience of forests to environmental change to maintain the carbon storage capacity of forests. The plan does not focus on TBS and only mentions that power stations with CCS will be available after 2030.

The LULUCF sector is overall considered to be a sink, owing to the substantial CO₂ absorption of forests resulting from significant volumes of forestation and sustainable forest management in recent decades. No trend can be identified in the sector’s net sink rate due to the complex dynamics of the accounted processes; results fluctuate significantly. The average sink rate equaled 3.5 MtCO₂eq, fluctuating between 0.4 MtCO₂eq (2000) and 5.8 MtCO₂eq. In 2017, forests captured 4.9 MtCO₂eq.

Hungary’s LTS reiterates the climate neutrality target of the climate law. To achieve climate neutrality by 2050, the LTS expects GHG emissions to be reduced by around 95% compared to 1990. New technologies are needed to achieve reductions of this scale, and emissions from power generation, transport, agriculture, fisheries, as well as forestry, among others, must be reduced to zero.

The **Hungarian LTS** contains three main scenarios for GHG emissions up to 2050. Two of them reach climate neutrality by 2050. In these two scenarios, CCUS technologies become commercially viable in the energy and industrial sectors after 2030 and are regarded as essential for achieving the goals of the LTS. Further investment will be necessary in the development of CCUS technology. High uptake of biomass-based electricity generation with CCUS technology will further increase the share of renewable energy. Based on projections, biomass will account for zero CO₂ emissions and with CCUS technology negative emissions can be expected.

In addition to CCUS, an **increase in natural sink capacities is needed** - mainly through the absorption of CO₂ by forests and maintaining forests as the natural sink with the most potential, as well as rethinking economic and financial incentives for forestry. The LULUCF sector will require significant investments to enhance net CO₂ capture (sink capacities) after 2030. This applies in particular to measures that aim to improve forest resilience, reduce logging in the medium term and increase afforestation efforts in the long term. The afforestation programmes will utilise more resilient variants of local native tree species. For sustainable forestry, the focus must be on maintaining stocks with the optimal CO₂ equilibrium and business model (regarding area and age structure) needs to be emphasised. Furthermore, interventions should support the conservation and development of forests while protecting their natural levels despite climate change impacts.

The **LTS specifies the investment costs necessary for the LULUCF sectors**. It also distributes the costs of investments to be made over the period up to 2050 are between different sectors. Increasing the CO₂ sequestration capacity of the LULUCF sector will cost approximately HUF 964 billion.

CAP strategic plan measures to reduce emissions or maintain or improve carbon storage in soils and biomass include an agroecology programme and payments to encourage the maintenance of agroecological land use change. Improving the carbon sequestration of soils is also planned. The target share of UAA for carbon storage in soils and biomass is 13.21% for the years between 2023 and 2029.

	Climate law	NECP / LTS	CAP strategic plan
CDR Target / Scenarios	2050 climate neutrality	2050 climate neutrality	-
NBS/TBS for CDR	-	CCS and CCUS available after 2030	-
BECCS	-	-	-
EW	-	-	-
DAC	-	-	-
LULUCF	-	Various measures and quantified projections	-

Agriculture	-	-	Measures for enhanced carbon storage in soils and biomass and quantified UAA indicators
Forestry	-	Various measures, including for improving forests' sink capacities	-
Carbon farming	-	-	-
Public consultation	-	-	-

2.14 Ireland

The **Irish Climate Action and Low Carbon Development Act** was adopted in July 2021. It includes a 2050 climate neutrality target.

Promoting the use of harvested wood in longer lived products and expanding planting in forests and soil management are among the key policies and measures of the decarbonisation dimension of **Ireland's NECP**. The document also discusses the country's dependency on peat for electricity generation. It mentions the three peat-fired generating plants in the country (which total 350 MW of electricity). One of them – Bord na Móna is expected to cease harvesting peat before 2030. In addition, Ireland has committed to stop burning coal and peat for power generation past 2025 and 2030, respectively. Once this has been achieved, and due to the absence of nuclear power generation and limited hydropower generation, the Irish government has recognised CCS as “as a potential bridging technology that could support the transition to a low carbon energy future” (DECC, 2019, p. 71). Ireland has also adopted a five-year review process to inform decisions on the regulatory and permitting systems for CCS. Moreover, suitable reservoirs for CO₂ storage are being explored.

In Ireland, a **Steering Group was established in 2019 to examine the feasibility of CCS utilisation** in the country and to develop policy in the area. According to the NECP, the group is examining the feasibility of the Ervia Cork CCS project, which was successfully granted Horizon 2020 funding and which applied for additional Connecting Europe Facility funding in Q2 2020. The feasibility study measures the potential of CO₂ capture from power plants, Ireland's only oil refinery and possibly other industrial emissions, and storing the CO₂ in the depleted Kinsale Gas field.

According to the NECP, **Ireland also aims to achieve 26.8 MtCO₂eq GHG removals in the LULUCF sector over the period from 2021 to 2030**. Key targets to achieve this include:

- A yearly average of 8,000 ha of newly-planted forest and sustainable forest management of existing forests (up to 21 MtCO₂eq cumulative removal).
- At least 40,000 ha/yr of reduced management intensity of grasslands on drained organic soils (4.4 MtCO₂eq cumulative removal).
- Improved management of grasslands, tillage land and non-agricultural wetlands (1.4 MtCO₂eq cumulative removal) (DECC, 2019).

Ireland has no LTS.

The objectives of Ireland's **CAP strategic plan** include improving the protection and management of existing carbon stores, including grasslands and peatlands, and increasing the carbon sequestration potential of forests and woodlands. According to the plan, Ireland also aims to maintain permanent grassland based on a ratio of permanent grassland in relation to agricultural area. This is done with the aim to safeguard grassland against conversion to other

agricultural uses to preserve carbon stock. The ratio must not decrease by more than 5% compared to the reference year 2018, and remedial measures are to be implemented if this value is exceeded. The plan also strives to introduce requirements to protect carbon-rich wetlands and peatlands from 2024 onwards.

Various support measures in the strategic plan correspond with the objective of reducing emissions or maintaining or enhancing carbon storage in soils and biomass. Actions specifically aimed at this objective are: planting trees, extensively grazed permanent pasture, Brassica fodder crop, Green Manure, Low input grassland, planting new hedgerows, minimum tillage, field margins, fallow land, low input peat grassland. According to the plan, an investment of EUR 10 million/yr will support the achievement of the target of 9.32% UAA for carbon storage in soils and biomass (for the years 2025 – 2027). Other measures include actively restoring blanket bogs and developing a framework to facilitate carbon farming in the future.

In addition to these documents, **Ireland has the “Ag Climatise” roadmap towards climate neutrality**. This roadmap outlines six key tasks, one of which is to increase the carbon sequestration and carbon storage potential of the country’s land use sector. Concrete actions include establishing expertise in grassland soil carbon fluxes, increasing afforestation levels to 8,000 ha/yr and cooperating with other Member States and the European Commission in the development of a regulatory system for carbon farming.

Actions described in **Ireland’s Climate Action Plan** comprise promoting forest management initiatives to increase carbon sinks and stores, reducing the management intensity of grassland on drained organic soils by 80,000 ha and carbon sequestration of grassland on mineral soils by 450,000 ha, both by 2030.

	Climate law	NECP / LTS	CAP strategic plan	Other government documents
CDR Target / Scenarios	2050 climate neutrality	-	-	-
NBS/TBS for CDR	-	Measures and capacity estimations for geological storage of CO ₂ Reviewing of CCS potential	-	-
BECCS	-	-	-	-
EW	-	-	-	-
DAC	-	-	-	-
LULUCF	-	Various targets	-	Increase the carbon sequestration and carbon storage potential of the land use sector a key task
Agriculture	-	-	Various measures for existing carbon stores and quantified UAA indicators	Various measures
Forestry	-	Estimations for removals from afforestation	-	Various measures, including to increase forests’ carbon sinks and stores
Carbon farming	-	-	Plans to develop a framework	Developing a regulatory system
Public consultation	-	-	-	-

2.15 Italy

Italy has no climate law.

The **NECP of Italy** contains projections about emissions and removals from various categories of the LULUCF sector until 2035 (Figure 8).

	2005	2015	2020	2025	2030	2035
LULUCF (Land Use, Land Use Change and Forestry)	-28,383	-39,379	-25,980	-22,767	-23,429	-26,228
Forest areas	-34,477	-39,922	-27,519	-23,075	-22,749	-24,382
Cropland	1,459	2,160	1,059	975	891	806
Grazing areas	-2,643	-6,926	-4,341	-4,478	-4,785	-5,096
Wetland	8	130	167	230	292	355
Settled areas	7,801	4,956	4,561	3,902	3,244	2,585
Other areas	0	0	0	0	0	0
Products of forest management	-531	223	93	-321	-321	-497

Figure 8: Projections for LULUCF categories (ktCO₂eq). Source: MISE, MATTM, MIMS, 2019; ISPRA.

According to its **LTS**, Italy aims to achieve climate neutrality by 2050, with “the remaining GHG emissions [...] compensated by removals of CO₂ and the possible use of geological storage and reuse of CO₂ (CCS-CCU)” (MATTM et al., 2021, p. 4). Italy aims to re-establish a natural carbon sink of 45 MtCO₂ by 2050 through fire suppression and sustainable soil management. The LTS also aims to increase soil carbon through improved agricultural and land use practices.

To close the remaining gap of about 20-40 MtCO₂eq, CCS can be used in large industries and the electricity generation sector. Electricity generation also offers the opportunity to subtract CO₂ from centralised emission sources (CCU and CCS) powered by bioenergy and natural gas for storage (determining “negative emissions” only if CO₂ comes from biological sources) and for re-use in the production of “new carbon-free alternative fuels (hydrogen/e-fuels)” (MATTM et al., 2021, p. 31).

Direct heat generation without CO₂ emissions and its application in more advanced systems such as DAC is also discussed in the LTS.

The **Italian CAP Strategic Plan** does not provide any indicators for the shares of UAA for carbon storage in soils and biomass. Nevertheless, it includes various eco-schemes and sustainable agriculture measures such as grassing of tree crops and improving the quality of soils. The plan also contains measures for sustainable forest management.

	NECP / LTS	CAP strategic plan
CDR Target / Scenarios	2050 climate neutrality	-
NBS/TBS for CDR	NBS/TBS to compensate for remaining emissions	-
BECCS	-	-
EW	-	-
DAC	Only mentioned	-

LULUCF	Quantified projections	-
Agriculture	Various measures	Various measures for sustainable agriculture
Forestry	Various measures	Various measures for sustainable forest management
Carbon farming	-	-
Public consultation	-	-

2.16 Latvia

There is no climate law in Latvia.

Latvia's NECP sets target indicators for the LULUCF sector. Between 2021 and 2025, GHG emissions must not exceed removals in the following elements of the sector: afforested land, deforested land, managed forest land, managed cropland and managed grassland. In the period 2026–2030, this also includes managed wetland. According to the NECP, CCS should be allocated 2% of investment in total research and innovation investments in the field of energy for the period 2021-2027.

The **LTS of Latvia has two strategic objectives – to reduce GHG emissions in all sectors and to increase CO₂ removals**. The strategy's overarching target is to achieve climate neutrality by 2050. The LTS explicitly states that non-reducible GHG emissions will be compensated by removals in the LULUCF sector. Net-zero emissions are already an objective for the LULUCF sector in 2040. In that same year, total GHG emissions, including the LULUCF sector are expected to be 76% below 1990 levels and 38% less in 2030 compared to 1990. In 2030, GHG emissions after removals from the LULUCF sector are expected to be ≤1047 ktCO₂eq. Projections show that the quantity of GHG emissions to be compensated with removals in 2050 is around 3.6 MtCO₂eq.

In the long term, the development of CCS and CCU technologies and in particular natural CCS systems in the manufacturing sector is regarded as “possible to develop” (Latvia, 2019, p. 33). However, according to the LTS, although research on CCS continues, it has been determined that its efficiency is too low and that it is currently economically unfeasible. The potential of CCU is to be evaluated.

The **CAP strategic plan of Latvia** foresees a peak share of 23.41% for UAA carbon storage in soils and biomass in 2027. Additionally, the plan includes support for “environmentally and climate-friendly agricultural practices”. Sustainable agriculture measures mentioned in the document include promoting the maintenance of carbon stocks and grassland conservation. Measures for sustainable forest practices are also planned, including support for private forest owners for forestry activities that promote forest stands' resilience to climate change and increase their CO₂ sequestration capacities.

	NECP / LTS	CAP strategic plan
CDR Target / Scenarios	2050 climate neutrality	-
NBS/TBS for CDR	CCS investment estimations	-
BECCS	-	-
EW	-	-
DAC	-	-
LULUCF	Target indicators and quantified projections	-
Agriculture	-	Various measures for sustainable agriculture and quantified UAA indicators

Forestry	-	Various measures for sustainable forest management
Carbon farming	-	-
Public consultation	-	-

2.17 Lithuania

Lithuania has no climate law.

Lithuania’s NECP foresees approximately 8 MtCO₂eq to be removed in the LULUCF sector annually. The document also includes projected GHG emissions and removals from different LULUCF categories (Figure 9).

Moreover, according to the NECP, the development of CCUS technologies and the analysis of their application are necessary. Measures in the industry sector include a feasibility study of CCUS technology and conducting a detailed analysis of the feasibility and benefits of projects carried out with other EU countries to the geological structures of which the CO₂ captured in Lithuania could be exported.



Figure 9: GHG emissions and removals from LULUCF categories. Source: LR V, 2019.

Lithuania’s LTS sets a 2050 climate neutrality target. The modelling indicates that up to 20% of emissions will be shifted out of the LULUCF sector and “only environmentally safe carbon capture and utilisation technologies are applied [...] to offset GHG emissions in sectors where there is no technological potential for zero emissions” (LRS, 2021, p. 15). These targets are to be met by maintaining and increasing the sustainable use of forests, agricultural land and wetlands, natural sinks and the use of CCU. In addition, research and development (R&D) will be carried out in CCU and climate-smart agriculture and forestry. CCU will also be used to ensure industrial emission reductions of 100% compared to 2005.

The country’s CAP strategic plan envisions almost 22% of UAA for carbon storage in soils and biomass in 2027 but provides no data beyond this year. The plan includes various measures for soil preservation and grassland and wetland management until 2035, as well as afforestation measures.

	NECP / LTS	CAP strategic plan
CDR Target / Scenarios	2050 climate neutrality, with LULUCF and CCU removals	-
NBS/TBS for CDR	CCUS development necessary; Investment estimations for CO ₂ storage	-

BECCS	-	-
EW	-	-
DAC	-	-
LULUCF	Quantified projections	-
Agriculture	Various measures	Various sustainable agriculture measures and quantified UAA indicators
Forestry	Various measures	Afforestation measures
Carbon farming	-	-
Public consultation	-	-

2.18 Luxembourg

The objective of **Luxembourg’s climate law** is to contribute to the implementation of the objectives of the Paris Agreement. To this end, the law aims to achieve “net zero emissions” by 2050. The law defines this objective as “the state in which any residual anthropogenic GHG emissions are offset by equivalent anthropogenic removals” (Grand Duchy of Luxembourg, 2020). The climate law contains provisions for sectoral targets. Accordingly, a regulation determines the annual emission allocations for sectors and 10-year intervals.

Luxembourg’s NECP states that the country will further encourage the European Commission to adopt a comprehensive net-zero strategy and will “advocate a policy of not promoting nuclear power, coal, fracking, or the capture and storage of carbon dioxide”, except carbon sequestration in forests and agricultural sinks (MECDD, 2020, p. 7). According to the NECP, subsidies for increasing semi-natural and climate-resilient forest management will be established. To enhance carbon sinks and prolong storage, measures such as reforestation, increased use of wood products in the construction sector and improved cascading use of wood are foreseen. Moreover, a research project will formulate guidelines to encourage the development of humus as a carbon sink, building up on the ongoing promotion of reduced tillage and cover crops and the existing ban on ploughing permanent grassland in sensitive areas.

Luxembourg’s LTS reiterates the climate neutrality target of the climate law. As a guiding principle, the LTS will exploit the potential to reduce anthropogenic GHG emissions so that removals will only have to compensate for unavoidable residual emissions.

The **LTS does not refer to TBS**. It includes guidelines related to forestry and carbon sinks. The main policy includes improving resilience and sustainable forest management, utilising more wood as building material, using organic carbon in agricultural land, restoring biotopes, planting hedges and trees, minimising soil sealing and converting monocultures into mixed forests.

Moreover, the LTS includes measures for preserving, improving or restoring forest soil functions, including water and carbon reservoirs and nutritional sources. In this context, the current ban on ploughing permanent grassland in sensitive areas and the promotion of conservation tillage and cover crops contribute to the partial maintenance of existing carbon sinks. The need to increase carbon sequestration in agricultural soils is supported by reduced tillage, conservation of plant cover and complete preservation of permanent grassland. This includes extending the area of permanent grassland, strengthening measures that minimise cropland plowing, and promoting intermediate and intercropping crops and grass strips. Additionally, the LTS lays out plans for detailed guidelines to promote crop diversification. Agroforestry projects are also planned to strengthen farmland as a carbon sink.

The **CAP strategic plan of Luxembourg** contains sustainable agriculture measures including organic farming and improving soil quality. According to the document, special emphasis will

be placed on maintaining permanent and temporary grasslands to promote carbon sequestration, which is also to be promoted in soils. An increase in the production of fodder, especially through temporary meadows is also planned. The strategy discusses Luxembourg's great opportunities for carbon sequestration, as 32.5% of the country is covered with forest, 60% of agriculture land is occupied by meadows and pastures, there is an increased use of intermediate crops by farmers and there is a high share of grassland. Moreover, the plan specifies that the share of contracted land aimed at protecting biodiversity and/or landscapes and forests was 87% in 2020. The plan envisions an 85.59% share of UAA for carbon storage in soils and biomass between 2023 and 2029.

In order to improve the sustainable and nature-oriented management, the **Grand Ducal Regulation of 16 April 2021 ("Klimabonus Bësch")** introduces a premium for the provision of ecosystem services in the forest environment. The aim is to preserve the many services that forest ecosystems provide to society, namely soil protection, water and air filtration, the preservation of biodiversity and a recreational environment or even ecological tourism, or the supply of natural products such as wood. This close-to-nature logging method also allows forests to better adapt to the effects of climate change and to maintain carbon absorption.

	Climate law	NECP / LTS	CAP strategic plan	Klimabonus Bësch
CDR Target / Scenarios	2050 climate neutrality, with compensation by anthropogenic removals	2050 climate neutrality	-	-
NBS/TBS for CDR	-	Will not promote CCS, except for carbon sequestration in forests and agricultural sinks	-	-
BECCS	-	-	-	-
EW	-	-	-	-
DAC	-	-	-	-
LULUCF	-	Quantified projections	-	-
Agriculture	-	Various measures, including agroforestry, and guidelines	Various measures for sustainable agriculture practices	-
Forestry	-	Various measures, including sustainable forest management, and guidelines	-	Various measures for adaptation and maintaining carbon absorption
Carbon farming	-	-	-	-
Public consultation	-	-	-	-

2.19 Malta

The **2015 Climate Action Act of Malta** does not set a long-term climate target but stipulates that a national low-carbon development strategy (an LTS) must be formulated to help achieve long-term emission reductions and improve removals by sinks in all sectors. According to the Act, the government must also develop and publish national inventories of emissions and removals by sinks, as well as formulate and update policies on measures for climate change mitigation, including the enhancement of these removals.

Afforestation has been undertaken as a measure to enhance removals in Malta's LULUCF sector in accordance with **Malta's NECP**. However, the scale of afforestation projects and the

subsequent removals is estimated to be very limited due to the geographical limitations of the island.

Malta's LTS was published in October 2021 and sets a 2050 climate neutrality target. The LTS explicitly excludes any contributions to the target from CDRs and states that both removals and the potential for afforestation in Malta are very low due to the limited size of the island, its climate and topography and the pressure on land use by farming and other uses. According to the strategy, Malta, in partnership with larger countries and private partners, can serve as a test bed for new technologies such as carbon capture.

Investments referred to in the **CAP strategic plan of Malta** are expected to contribute to reducing GHG emissions and enhancing carbon sequestration by converting land from seasonal to permanent crops. The document also contains a SWOT analysis on the same topic. Additionally, the plan includes measures for enhanced soil management, afforestation and development of woodland on agricultural and non-agricultural lands, as well as enhancing tree cover and soil quality. There are no indicators for UAA for carbon storage in soils and biomass.

	Climate law	NECP / LTS	CAP strategic plan
CDR Target / Scenarios	-	2050 climate neutrality	-
NBS/TBS for CDR	-	Malta can serve as a test bed for carbon capture technologies	-
BECCS	-	-	-
EW	-	-	-
DAC	-	-	-
LULUCF	-	Quantified projections	-
Agriculture	-	-	Various measures for sustainable agriculture
Forestry	-	Afforestation measures (limited potential)	Various measures for sustainable forest management
Carbon farming	-	-	-
Public consultation	-	-	-

2.20 Netherlands

The **Dutch Climate Act** stipulates that the Netherlands must reduce its GHG emissions by 95% by 2050 compared to 1990. It determines that the Netherlands should be climate neutral by 2050.

CCS technologies are specifically referred to in the **Dutch NECP**. According to the NECP, CCS may be used to reduce emissions in industry and could play a key role in achieving negative emissions in the future and setting the stage for green hydrogen and CCU development.

The NECP also foresees emission reductions and carbon storage through smart land use. Measures include afforestation and prevention of deforestation, expanding natural areas, restoring landscape structures, as well as sustainable management and use of agricultural soils, which will be the focus of the Dutch government in 2030.

The **Dutch LTS** restates the target of climate neutrality by 2050 and makes references to negative emissions. It describes in general terms that negative emissions can take various forms, and references measures such as rewetting peatland, expanding the natural area, restoring landscape and limiting deforestation or planting trees. It also points to the significant potential in the Netherlands to retain the CO₂ captured in vegetation beyond the harvest, such as using

wood as a building material, producing and recycling bioplastics and combining bioenergy with CCS. The LTS also states that the Netherlands offers ample opportunities for CCS and BECCS. It raises the question of the extent to which the Netherlands can contribute to global CDR efforts but does not provide answers.

Various eco-schemes in the **CAP strategic plan of the Netherlands** are in line with the objective of reducing emissions or maintaining or enhancing carbon storage in soils and biomass. According to the document, a decision on a plough ban, which would lead to the promotion of carbon sequestration, is pending. Moreover, a link between climate and carbon will be included in the finalised version of the Dutch CAP plan. The strategy plans a 40.64% share of UAA for carbon storage in soils and biomass from 2024 to 2028.

	Climate law	NECP / LTS	CAP strategic plan
CDR Target / Scenarios	2050 climate neutrality	2050 climate neutrality	-
NBS/TBS for CDR	-	TBS: CCS may be used to reduce emissions in industry and could play a key role in achieving negative emissions CCU development possible	-
BECCS	-	Only mentioned	-
EW	-	-	-
DAC	-	-	-
LULUCF	-	Quantified projections	-
Agriculture	-	Various measures	Various eco-schemes aimed at enhancing carbon storage in soils and biomass, and quantified UAA indicators
Forestry	-	Various measures, including sustainable forest management	-
Carbon farming	-	-	-
Public consultation	-	-	-

2.21 Poland

There is no climate law and no LTS in Poland.

The **Polish NECP** provides little information on removals and most data on TBS is contained in its annexes. The document mentions the Forest Carbon Farm pilot project and its aim to achieve increased carbon retention in forests. The plan also provides projections for GHG emissions and removals from the LULUCF sector. Moreover, the NECP discusses support measures for energy, including the construction and modernisation of CCS infrastructure, which is to be funded by the Connecting Europe Facility over the period 2021-2025.

According to the **annexes to the NECP**, the development of carbon processing technologies, the use of CO₂ in carbochemistry and the production of fuels from carbon, including biofuels, hold greater potential for the clean use of fossil fuels in power generation than CCS, the wide application of which is considered very difficult. The development of CCUS and its use in fossil fuel combustion is considered. R&D efforts for CCS and CCUS will focus on:

- Capture from gases from air combustion of primary energy carriers, especially coal.
- Pre-combustion carbon capture where fuels are in the form of synthesis gas or natural gas and carbon and hydrogen streams are separated. The hydrogen is then to be used

for electricity generation, while carbon streams are to be made suitable for storage or sequestration.

- Oxy-fuel combustion technologies, in which oxygen is used instead of air in the combustion process and H₂O and CO₂ are easily captured after steam condensation.

Additionally, **technology cost assumptions** are presented, including for CCS. The profitability of the industrial use of CCS in power generation does not appear optimistic. A planned CCS project in Belchatów is also mentioned – however it has been abandoned after proving to be economically not viable. The NECP states that CCS installations can only be competitive if prices of CO₂ emission allowances exceed EUR 50/t.

The **Polish CAP strategic plan** includes measures for sustainable agriculture and forestry, including soil protection and increasing the absorption and storage of carbon through afforestation of agricultural land. Other actions included in the plan are establishing agroforestry systems and preserving grassland. There are no indicators for UAA for carbon storage in soils and biomass.

	NECP	CAP strategic plan
CDR Target / Scenarios	-	-
NBS/TBS for CDR	TBS: Cost assumptions for CCS CCUS considered R&D efforts for CCS and CCUS	-
BECCS	-	-
EW	-	-
DAC	-	-
LULUCF	Quantified projections	-
Agriculture	-	Various measures for sustainable agriculture, including agroforestry
Forestry	Aims to achieve increased carbon retention in forests	Various measures for sustainable forest management
Carbon farming	-	-
Public consultation	-	-

2.22 Portugal

Portugal's climate law obliges the Portuguese State to achieve climate neutrality by 2050, which translates into a neutral balance between GHG emissions and the sequestration of these gases by the various sinks. The law also commits the government to study, until 2025, an earlier target of climate neutrality by 2045.

Specifying this target, the law determines that emissions must be reduced by at least 90% compared to 2005 levels by 2050 (excluding soils and forests), i.e., **a maximum of 10% may be removed to achieve climate neutrality in the sectors covered**. The law does not quantify the contributions of CDR to the interim targets of 2030 (-55%) and 2040 (-65 to -75%). The law includes a target for the net sink of the LULUCF sector, of at least 13 MtCO₂eq on average between 2045 and 2050.

The **Portuguese NECP** includes provisions for reducing emissions with a focus on sustainable, organic, conservation and precision agriculture, integrated production practices, biodiverse pastures and reduced emissions from animal effluents and synthetic fertilisers. According to the NECP, spatial planning will include the reinforcement and management of potential carbon sinks and forests in particular. To increase the natural sink capacity of agriculture and forests, the NECP foresees increasing the sequestration of agroforestry areas and reducing emissions

and/or increasing soil sequestration. For such management practices, investment will be needed, including for the promotion of the role of forests as a sink and the increase of their resilience to climate change. One investment option, mentioned in the Portuguese NECP, is the Innovation Fund, which focuses on funding the construction and maintenance of CCS and CCU technologies.

In its **LTS**, Portugal regards CCS technologies as “an important option in decarbonisation of the energy system”, albeit with technical and economic viability only in the cement sector – and only under the condition that national cement production is large enough to justify the creation of a CO₂ transport and storage network (MAOT, 2019, p. 41). In that vein, BECCS and CCU are not considered cost-effective for e-fuel production.

Organic farming, preservation of permanent grasslands and improving the content of organic matter in soils are among the measures identified in the **Portuguese CAP strategic plan** to reduce emissions or maintain or improve carbon storage. Strengthening the characteristics and size of regional forests for carbon sequestration and storage purposes is also an objective of the document. According to the plan, the share of UAA for carbon storage in soils and biomass will peak at 33.28% in 2026.

	Climate law	NECP / LTS	CAP strategic plan
CDR Target / Scenarios	2050 climate neutrality – 90% reductions and max. 10% removals	2050 climate neutrality	-
NBS/TBS for CDR	-	CCS viable in cement sector CCU not seen as cost-effective	-
BECCS	-	Not seen as cost-effective	-
EW	-	-	-
DAC	-	-	-
LULUCF	Quantified target of at least 13 MtCO ₂ eq removals on average between 2045 and 2050	Quantified projections	-
Agriculture	-	Various measures	Various measures for sustainable agriculture and quantified UAA indicators
Forestry	-	Various measures	Various measures for sustainable forestry
Carbon farming	-	-	-
Public consultation	-	-	-

2.23 Romania

No climate law or LTS have been published in Romania.

The **NECP of Romania** outlines measures to reduce GHG emissions in the water resource sector, one of which is ensuring methane capture. In the forestry sector, reforestation is seen as key to emission reductions and is considered to have high potential in the country. Increasing GHG removals in the forestry and land use sectors is considered critical for decarbonisation. Several strategic objectives are outlined for the forestry sector, mostly revolving around the sustainable management of existing and future forests and taking carbon storage into account. In the agriculture sector, for the period 2016-2030, promoting technologies and practices for carbon sequestration among farmers is listed as a specific objective for reducing GHG emissions.

The **CAP strategic plan of Romania** contains various measures for sustainable agriculture, such as the cultivation of green crops on arable land and organic farming. Forest maintenance, including afforestation, is also an objective of the strategy. The plan states that 9.18% of UAA will be used for carbon storage in soils and biomass between 2025 and 2028.

	NECP	CAP strategic plan
CDR Target / Scenarios	-	-
NBS/TBS for CDR	-	-
BECCS	-	-
EW	-	-
DAC	-	-
LULUCF	-	-
Agriculture	Objective for promoting technologies and practices for carbon sequestration among farmers	Various measures for sustainable agriculture and quantified UAA indicators
Forestry	Various measures such as sustainable forest management and reforestation	Various measures for sustainable forest management
Carbon farming	-	-
Public consultation	-	-

2.24 Slovakia

Slovakia does not have a climate law.

The **country's NECP** provides scenario projections for the LULUCF sector. The document excludes CCS from its modelling, but states that projects are underway to convert suitable geological structures into underground gas storage facilities and for CCS purposes.

Slovakia's LTS sets out a climate neutrality target of 2050. In both the WEM and WAM scenarios of the document, Slovakia does not meet this target without measures additional to the ones already presented in the scenarios. A projected emission gap of 14 MtCO₂eq remains, which corresponds to emission reductions of 80% compared to 1990, while according to the LTS, the target emission gap should be 7 MtCO₂eq. The LTS states that the difference is likely to be offset by removals mainly from the LULUCF sector and provides WEM and WAM scenario projections of emissions and removals from the sector until 2040. In the WAM scenario emissions account for -4.36 MtCO₂eq in 2040.

The LTS also points out that removals in Slovakia come **mainly from its forests** and outlines various measures for sustainable forest management, including maintaining and restoring grassland and protecting and restoring peatlands and wetlands in river basins. The LTS specifically states that CCS was excluded from the modelling. However, promoting the research and the application of CCS and CCU technologies is listed as one of the additional measures to achieve climate neutrality.

According to the **CAP strategic plan of Slovakia**, several interventions will contribute to reducing emissions or maintaining or improving carbon storage. These include agroforestry, organic farming, sustainable management and grassing of arable land and protection and conservation of biodiversity, as well as three eco-schemes. Various sustainable forest management measures and measures for improved carbon sequestration in soils are also planned. In 2027, the plan foresees the peak of UAA for carbon storage in soils and biomass – 25.44%.

	NECP / LTS	CAP strategic plan
CDR Target / Scenarios	2050 climate neutrality CCS specifically excluded from modelling	-
NBS/TBS for CDR	Converting suitable geological structures for CCS purposes underway CCS and CCU are additional measures for climate neutrality	-
BECCS	-	-
EW	-	-
DAC	-	-
LULUCF	Quantified projections Compensation for remaining emissions	-
Agriculture	-	Various measures for sustainable agriculture and quantified UAA indicators
Forestry	Various measures for sustainable forest management	Various measures for sustainable forest management
Carbon farming	-	-
Public consultation	-	-

2.25 Slovenia

There is no climate law in Slovenia.

The **Slovenian NECP** examines CCS to some extent and regards the technology as an opportunity to significantly reduce CO₂ emissions. According to the plan, CCS technologies will become more important if electricity demand is not replaced by renewables, nuclear power plants or gas-fired power plants - which, however, is not expected to happen before 2040. Emission reductions by 2040 will also depend on the decision about the closure of the Šoštanj thermal power plant or its upgrade to a CCS or CCU plant. The NECP also provides an assessment of the investment needed for the implementation of a CO₂ capture and compression system with a 50% and a 90% capture in 2035 and 2040, respectively. Additionally, the document presents various sustainable forest management solutions.

The **Slovenian LTS** aims for climate neutrality by 2050 and states that removals will offset the remaining GHG emissions. According to the LTS, removals include sinks in the LULUCF sector and “direct capture of GHG emissions” (MOP, 2021, p. 3). By 2030, the LULUCF sector must stop producing net emissions and according to WAM scenario projections, by 2040, it would be possible to maintain net sinks at -3.1 MtCO₂eq or increase them by at least -2.5 MtCO₂eq by 2050. The LTS aims to ensure a 100% increase (or 370 ktCO₂eq) of the carbon stock change in harvested wood products and a 100% decrease in the emissions from settlement growth or building development and similar land in 2050 compared to 2005. The LTS outlines various measures for sustainable forest management but states that Slovenia has limited possibilities to increase the forest sink.

The LTS also stipulates that the use of CCU technologies is expected in the cement industry and the manufacturing of metals after 2040. The strategy discusses the need to ensure support for pilot projects, appropriate infrastructure and a regulatory framework for such technologies. Slovenia will promote the development of similar technologies and in particular “ensure financial resources for the investments which have the largest potential for carbon capture and storage and those which will ensure the improvement of natural habitats and the implementation of sustainable solutions” (MOP, 2021, p. 87).

Various interventions for reducing emissions or maintaining or improving carbon storage are included in the **Slovenian CAP strategic plan**, including organic farming and greening of arable land as well as different eco-schemes. Other measures are forest restoration, including investments in the rehabilitation and restoration of natural forests, and maintaining grasslands. The UAA target for carbon storage in soils and biomass is 41.4%.

	NECP / LTS	CAP strategic plan
CDR Target / Scenarios	2050 climate neutrality with remaining emissions offset by the LULUCF sector and "direct capture of GHG emissions"	-
NBS/TBS for CDR	Assessment of investment costs for CO ₂ capture CCU in the cement sector after 2040	-
BECCS	-	-
EW	-	-
DAC	-	-
LULUCF	Quantified projections	-
Agriculture	-	Various measures for sustainable agriculture and quantified UAA indicators
Forestry	Various measures, including increasing forests' sink (limited)	Various measures for sustainable forest management
Carbon farming	-	-
Public consultation	-	-

2.26 Spain

The **Spanish climate law** requires Spain to achieve climate neutrality by 2050. It does not quantify CDR contributions to meeting this target. The law requires competent public administrations to promote carbon sinks, as well as their evaluation and accounting based on existing information sources. According to Article 26, public administrations encourage citizens and companies to increase the CO₂ sequestration capacity of the carbon sinks.

The **Spanish NECP** restates the 2050 climate neutrality goal of the climate law. The plan includes measures such as afforestation, promoting sustainable coniferous forest management, application of thinning schemes to increase carbon removals, promoting conservation agriculture and maintenance of plant cover. It contains indicators for emissions and GHG absorption, including for the LULUCF sector. The NECP also provides LULUCF projections for 2030 and 2050.

Spain's LTS sets a path to reducing GHG emissions by 90% in 2050 compared to 1990. To achieve climate neutrality, natural sinks should absorb at least the remaining 10%. The absorption capacity of natural sinks by 2050 is estimated at 37 MtCO₂eq. In more general and descriptive terms, the LTS states that the creation of wooded afforested areas, the sustainable management and restoration of wetlands and the promotion of agroforestry systems are important measures to this end.

The LTS refers to a package of **measures aimed at improving the organic carbon of agricultural and forestry soils by increasing carbon sequestration while generating more resilient systems** and other co-benefits including in the areas of food security, biodiversity, and hydrological cycle regulation. The LTS also states CCUS could play a role in eliminating hard-to-abate emissions from industry.

Measures identified in the **Spanish CAP strategic plan** include extensive agriculture, conservation agriculture practices and sustainable forest management. 32% of UAA will be committed to reducing emissions or maintaining or increasing carbon storage in 2029.

	Climate law	NECP / LTS	CAP strategic plan
CDR Target / Scenarios	2050 climate neutrality No CDR targets	2050 climate neutrality – 90% emission reductions and 10% natural sinks	-
NBS/TBS for CDR	-	Natural carbon sinks should absorb remaining 10% CCUS could play a role in offsetting emissions from industry	-
BECCS	-	-	-
EW	-	-	-
DAC	-	-	-
LULUCF	-	Quantified projections	-
Agriculture	-	Various measures includ- ing for improved organic carbon of agricultural and forestry soils	Various measures for sus- tainable agriculture and quantified UAA indicators
Forestry	-	Various measures includ- ing sustainable forest man- agement	Various measures for sus- tainable forest manage- ment
Carbon farming	-	-	-
Public consultation	-	-	-

2.27 Sweden

According to **Sweden’s climate law**, the government’s climate policy must be based on the long-term, time-bound emissions’ target adopted by the Riksdag, Sweden’s Parliament. According to the Parliament’s respective decision of 1 January 2018, Sweden must achieve zero net emissions of GHG by 2045. According to the same decision, GHG emissions from activities in Sweden should be at least 85% lower than in 1990. The remaining 15% can be achieved through so-called supplementary measures such as increased carbon sequestration in forest and land, CCS technologies and emission reduction efforts outside of Sweden. After 2045, Sweden should achieve negative emissions. Intermittent targets for reductions in emissions from sectors outside the EU ETS compared to 1990 levels include 75% with a maximum of 2% from additional measures (2040), 63% with a maximum of 8% from additional measures (2030) and 40% with a maximum of 13% from additional measures (2020). The Swedish government aims to achieve these targets entirely with national measures.

The **NECP of Sweden** states that additional measures such as net removals by forests and land, reductions through investments in other countries and capture and storage of biogenic carbon dioxide (bio-CCS) may be undertaken to meet the 2045 climate neutrality goal, although no decision has been made so far. In 2019, the *Industriklivet* (Industrial Evolution) initiative aimed at resource optimisation, energy efficiency measures and carbon neutrality in industry, received an additional SEK 200 million from the Swedish parliament, in parts to facilitate the financing of measures contributing to negative GHG emissions.

According to the **Swedish LTS**, supplementary measures to achieve net-zero emissions, may be (1) increased CO₂ removal in forests and land, (2) verified emission reductions from investments in other countries, and (3) negative emission technologies such as biogenic carbon

dioxide (BECCS). According to the strategy, to achieve 85% emissions reductions by 2045, “the capture and storage of carbon dioxide emanating from fossil fuels may be counted as a measure where no other viable alternatives exist” (MoE, 2020, p. 10). The LTS does not quantify contributions from supplementary measures. Because of sustainability concerns, Sweden intends to use only residual biomass for bio-CCS.

The **CAP strategic plan of Sweden** states that the potential to store carbon in biomass and in soils must be exploited and that there are capacities to increase carbon storage in agricultural land by cultivating intermediate and catch crops. Crop management and increased carbon sequestration in soils are among the objectives of the plan. The document refers to the Swedish Forest Agency and its assessment that the need for carbon storage in biomass and soils can be met to a large extent in forests. The strategy plans a share of 7.65% UAA for carbon storage in soils and biomass in 2028.

Next to these documents, Sweden’s government and shareholders (such as NGOs and business) have produced a report for attaining removals.¹⁵ According to this report, Sweden’s CDR options for 2045 are distributed as follows: (1) increasing carbon sinks in forests and land by 2.7 MtCO₂eq/yr, (2) BECCS by 3-10 MtCO₂eq/yr, (3) other removal technologies with unknown quantities, and (4) verified emission reductions in other countries by 0 to “very great” MtCO₂eq/yr. The policy framework also quantifies a CDR target for 2030, using the same categories as for the 2045 target. The report was the basis for further discussions but has not led to the adoption of specific CDR targets or contributions of specific CDR methods to achieving climate targets. This may change when Sweden revises its climate action programme in 2023.

	Climate law	NECP / LTS	CAP strategic plan	Government report on CDR
CDR Target / Scenarios	2045: at least 85% reductions, 15% offset by various means After 2045: negative emissions	2045 climate neutrality	-	Quantified CDR target for 2030
NBS/TBS for CDR	CCS technologies and emission reduction efforts outside of Sweden possible	Bio-CCS considered	-	LTS to deal with 5% of residual emissions
BECCS	-	-	-	Quantified options for 2045
EW	-	-	-	-
DAC	-	-	-	-
LULUCF	-	Quantified projections	-	-
Agriculture	-	-	Various measures for sustainable agriculture and quantified UAA indicators	-
Forestry	-	-	-	Various policies Quantified options for 2045
Carbon farming	-	-	-	-
Public consultation	-	-	-	-

¹⁵ SOU, 2020.

3 References

- BMLRT. 2019. 'Long-Term Strategy 2050 - Austria'. Federal Ministry of Sustainability and Tourism. https://unfccc.int/sites/default/files/resource/LTS1_Austria.pdf.
- Croatian Parliament. 2019. *Climate Change and Ozone Layer Protection Act. OG*. Vol. 127/19. https://ilo.org/dyn/natlex/natlex4.detail?p_isn=111299.
- DECC. 2019. 'National Energy & Climate Plan'. Department of Communications, Climate Action and Environment of the Government of Ireland. https://energy.ec.europa.eu/document/download/f40d561f-b86d-4b21-9484-38eea8a269f3_en?filename=ie_national_necp_main_en.pdf.
- European Commission. 2019. 'Carbon Farming Schemes in Europe - Roundtable'. European Commission. https://ec.europa.eu/info/sites/default/files/food-farming-fisheries/events/documents/carbon-farming-schemes-roundtable-background_en.pdf.
- . 2021. 'Sustainable Carbon Cycles'. COM(2021) 800 final. Brussels: European Commission. https://ec.europa.eu/clima/document/download/26c00a03-41b0-4d35-b670-fca56d0e5fd2_en?filename=com_2021_800_en_0.pdf.
- . 2022. 'Innovation Fund. Driving Clean Innovative Technologies towards the Market. K6 Program.' European Commission. https://ec.europa.eu/clima/system/files/2022-04/if_pf%202022_k6_en.pdf.
- EZK. 2019. 'Integrated National Energy and Climate Plan'. Ministry of Economic Affairs and Climate Policy. https://energy.ec.europa.eu/document/download/906bf304-e536-4274-92d5-16c3bc6e8d65_en?filename=nl_final_necp_main_en.pdf.
- Finnish Government. 2019. 'Programme of Prime Minister Sanna Marin's Government 2019'. Government of Finland. <https://valtioneuvosto.fi/en/marin/government-programme>.
- Government of Denmark. 2021a. 'A Road Map for the Storage of CO₂. The First Part of a Complete CCS Strategy.' Government of Denmark.
- . 2021b. 'A Road Map for the Capture, Transport and Storage of CO₂. The Second Part of a Complete CCS Strategy.' Government of Denmark.
- Grand Duchy of Luxembourg. 2020. *Law of December 15, 2020 Relating to the Climate and Modifying the Amended Law of May 31, 1999 Establishing a Fund for the Protection of the Environment*. <https://legilux.public.lu/eli/etat/leg/loi/2020/12/15/a994/jo>.
- IPCC. 2018. 'Global Warming of 1.5°C. An IPCC Special Report on the Impacts of Global Warming of 1.5°C above Pre-Industrial Levels and Related Global Greenhouse Gas Emission Pathways, in the Context of Strengthening the Global Response to the Threat of Climate Change, Sustainable Development, and Efforts to Eradicate Poverty'. Summary for Policymakers. IPCC.
- . 2021a. 'Climate Change 2022. Mitigation of Climate Change.' AR6 WG III. IPCC. <https://www.ipcc.ch/report/ar6/wg3/>.
- . 2021b. 'Summary for Policymakers'. In *Climate Change 2021: The Physical Science Basis. Contribution of Working Group I to the Sixth Assessment Report of the Intergovernmental Panel on Climate Change*. IPCC. https://www.ipcc.ch/report/ar6/wg1/downloads/report/IPCC_AR6_WGI_SPM.pdf.
- KEFM. 2019. 'Denmark's Long-Term Strategy to the EU'. Ministry of Climate, Energy and Utilities. https://ec.europa.eu/clima/sites/lts/lts_dk_en.pdf.
- Latvia. 2019. 'Strategy of Latvia for the Achievement of Climate Neutrality by 2050'. https://unfccc.int/sites/default/files/resource/LTS1_Latvia.pdf.
- LR V. 2019. 'National Energy and Climate Action Plan of the Republic of Lithuania for 2021-2030'. Ministry of Energy. https://energy.ec.europa.eu/document/download/158579ca-4c5c-4fdb-8dba-4faf93e49f06_en?filename=lt_final_necp_main_en.pdf.
- LRS. 2021. 'Resolution on the National Agenda for the Governance of Climate Change'. XIV-490. Vilnius: The Seimas of the Republic of Lithuania. <https://unfccc.int/sites/default/files/resource/Lithuanian%20Climate%20Change%20Management%20Agenda%202021%20EN.docx>.

- MAOT. 2019. 'Roadmap for Carbon Neutrality 2050 (RNC2050). Long-Term Strategy for Carbon Neutrality of the Portuguese Economy by 2050.' Ministry of the Environment and Energy Transition. https://ec.europa.eu/clima/sites/lts/lts_pt_en.pdf.
- MATTM, MISE, MiPAAF, and MIMS. 2021. 'Italian Long-Term Strategy on Reducing Greenhouse Gas Emissions'. Ministry of the Environment and Protection of Natural Resources and the Sea, Ministry of Economic Development, Ministry of Agricultural, Food and Forestry Policies, Ministry of Infrastructure and Transport. https://ec.europa.eu/clima/sites/lts/lts_it_it.pdf.
- MECDD. 2020. 'Luxembourg's Integrated National Energy and Climate Plan for 2021-2030'. Ministry of the Environment, Climate and Sustainable Development. https://energy.ec.europa.eu/document/download/ea6672bd-119d-46eb-9945-00976d759594_en?filename=lu_final_necp_main_en.pdf.
- MISE, MATTM, and MIMS. 2019. 'Integrated National Energy and Climate Plan'. Ministry of Economic Development, Ministry of the Environment and Protection of Natural Resources and the Sea, Ministry of Infrastructure and Transport. https://energy.ec.europa.eu/document/download/091f93d5-d9cd-4391-8641-efabefde4153_en?filename=it_final_necp_main_en.pdf.
- MKM. 2019. 'Estonia's 2030 National Energy and Climate Plan'. Ministry of Economic Affairs and Communications, Ministry of the Environment, Ministry of Rural Affairs. https://energy.ec.europa.eu/document/download/8f421ab2-518a-4f60-8c68-8291907768c4_en?filename=ee_final_necp_main_en.pdf.
- MoE. 2020. 'Sweden's Long-Term Strategy for Reducing Greenhouse Gas Emissions'. Ministry of the Environment. https://unfccc.int/sites/default/files/resource/LTS1_Sweden.pdf.
- MOP. 2021. 'Resolution of Slovenia's Long-Term Climate Strategy until 2050 (ReDPS50)'. Ministry of environment and spatial planning. https://unfccc.int/sites/default/files/resource/LTS1_SLOVENIA_EN.pdf.
- MPO. 2019. 'National Energy and Climate Plan of the Czech Republic'. Ministry of Industry and Trade. https://energy.ec.europa.eu/document/download/19180bfc-d1fe-421b-ba6c-c09729601091_en?filename=cs_final_necp_main_en.pdf.
- MTE. 2020a. 'Integrated National Energy and Climate Plan for France'. Ministry of the Ecological Transition. https://energy.ec.europa.eu/document/download/258065a2-2fa0-466a-9f90-79252b753c8a_en?filename=fr_final_necp_main_en.pdf.
- . 2020b. 'National Low-Carbon Strategy. The Ecological and Inclusive Transition towards Carbon Neutrality.' Ministry of the Ecological Transition. https://unfccc.int/sites/default/files/resource/en_SNBC-2_complete.pdf.
- MŽP. 2017. 'Climate protection policy in the Czech Republic'. Ministry of the Environment of the Czech Republic. https://www.mzp.cz/cz/politika_ochrany_klimatu_2017.
- SOU. 2020. 'The road to a climate-positive future'. State public investigations. <https://www.regeringen.se/4a9e84/contentassets/1c43bca1d0e74d44af84a0e2387bfbcc/vagen-till-en-klimatpositiv-framtid-sou-20204>.
- TEM. 2020. 'Finland's Long-Term Low Greenhouse Gas Emission Development Strategy'. Ministry of Economic Affairs and Employment. <https://unfccc.int/documents/254391>.
- YPEN. 2019. 'National Energy and Climate Plan of Greece'. Ministry of the Environment and Energy. https://energy.ec.europa.eu/document/download/5046bd30-d887-4e90-92d7-76a35db85db8_en?filename=el_final_necp_main_en.pdf.
- Zickfeld, Kirsten. 2021. 'Why CO2 Removal Is Not Equal and Opposite to Reducing Emissions'. Carbon Brief. 21 June 2021. <https://www.carbonbrief.org/guest-post-why-co2-removal-is-not-equal-and-opposite-to-reducing-emissions/>.

Ecologic Institute

www.ecologic.eu

FB: /Ecologic.Institute

Twitter: /EcologicBerlin

