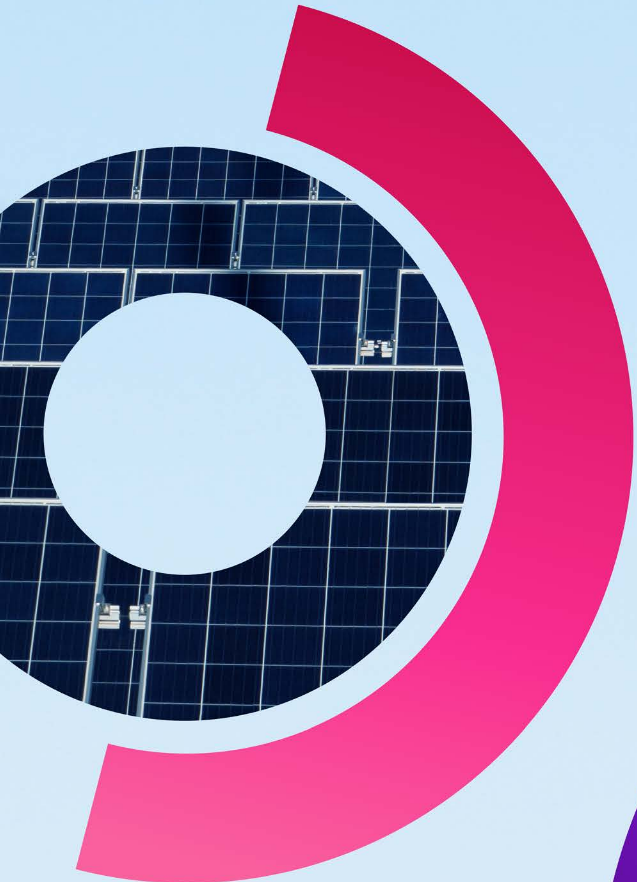
Report

Net zero risk in European climate planning:

A snapshot of the transparency and internal consistency of Member States' NECPs



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Who is ECNO?

The European Climate Neutrality Observatory (ECNO) aims to help the EU achieve climate neutrality by providing scientifically rigorous analysis of economy-wide progress and an impartial check on EU climate policy processes. As an independent observatory, ECNO seeks to inspire the uptake of better monitoring practices and policy making, as well as greater transparency on the EU's transition to climate neutrality by presenting a unique, comprehensive picture of the whole economy.

Find out more at **climateobservatory.eu**

Summary for Policymakers

Why NECPs matter

A climate neutral economy will not come about by chance. The pathways consistent with well-below two degrees require decisive action during this decade. Consistent and transparent planning, with a clear eye to intermediate targets, will be needed. National Energy and Climate Plans (NECPs) represent an opportunity for EU Member States to chart their next steps on the road to a net-zero economy by 2050. Clear and robust NECPs are one of the key tools available: done well, they should provide detailed information on how climate and energy targets will be implemented, with an integrated and considered view of how steps taken in different sectors will interact. They are also a powerful way to reinforce the collaboration and coordinated action across Member States if sufficient focus is set on the coherence across countries. Member States must finalise their NECPs by June 2024. Several good practice examples exist around the EU, at least on particular aspects of the NECPs, and should serve as inspiration. This report aims to share the strengths and weaknesses on the consistency of the draft plans of a few Member States and therewith aid all of them to deliver robust plans in their final versions.

Scope of work: uncovering inconsistencies

This report offers an analysis of five Member State draft NECPs and assesses them according to **transparency and internal consistency.** We interrogate the documents regarding four key cross-sector themes in order to both help directly improve the NECPs assessed, and to inform and strengthen European climate planning at large as regards the use of limited, cross-sector resources: renewable electricity and renewable hydrogen, land uses, bioenergy and long-term geological storage of CO_2. Therewith, it enables national administrations to improve the draft NECPs for their final version, shining a light on the areas where these current drafts typically lack coherence and clarity.

The report does not evaluate the likely effectiveness of the presented policies, nor the quality and inclusiveness of the drafting process. Rather, it highlights 'planning risk' areas in the draft plans with the aim of helping to ensure that Europe stays within the available pathways to timely climate neutrality, in this crucial decade of climate action.

Headline findings: the lack of transparency leads to risks of inconsistency

Our assessment finds that the five analysed draft NECPs lack a sufficiently detailed and systemic view of all the proposed measures. This gives rise to a risk of inadequate infrastructure, shortages of key resources and ultimately not delivering the targets. The analysed plans all fall short on policy detail and transparency, and in many cases, this leads to inconsistencies.

EU countries now have an opportunity to improve the plans by June 2024 when final versions are due. Also, while each country will need to submit a progress report every 2 years, the next round of new NECPs will only be due in 5 years' time (Governance Regulation[1], Art. 3). A clear course for implementation must therefore be laid out in the plans today, or the risk of missing the 2030 targets – and ultimately, the timely and cost-effective delivery of climate neutrality – is very high.

Our analysis gives insights on this lack of transparency at two levels, first with a view on total GHG emission reductions, and then by exploring four key research themes in detail.

Transparency gap towards the 2030 targets

The assessed country plans have a significant transparency gap as regards setting out how the 2030 emission reduction targets will be delivered. Among the five draft NECPs analysed, levers that would account for at least 14% of the stated reductions are not transparently laid out, and in one case more than 100% of the reductions are not transparently laid out (see Table 1). This transparency gap risks leading to what some actors refer to as an implementation gap[2]. It is expressed in the table both in absolute tons of carbon dioxide equivalents (t CO_2e) and as a percentage of the reduction which is not achieved between 2021 and 2030. We find that all analysed sectors contribute to this gap (for a visual representation and sectoral information, see section 1.3.2).

Table 1: Transparency gap of the plans analysed

Transparency gap as:	Italy	Hungary	Netherlands	Spain	Sweden
Absolute amounts in missing tons of CO_2e	44 MtCO_2e missing	16 MtCO_2e missing	17 MtCO_2e missing	13 MtCO_2e missing	11 MtCO_2e missing
Percentage of the reduction which is not explicity planned for between 2021 and 2030	-17% explicitly planned vs a -28% target leading to a **39% transparency gap**	+4% explicitly planned vs a -24% target leading to a **117% transparency gap**	-16% explicitly planned vs a -26% target leading to a **38% transparency gap**	-31% explicitly planned vs a -36% target leading to a **14% transparency gap**	[The emissions in the Swedish NECP become negative, making a percentage calculation impossible]

Our assessment is based primarily on the information set out in the draft NECPs, but we have also looked at specific plans when they were explicitly mentioned in the drafts as being an official policy contributing to a key topic (e.g., a separate national hydrogen or bioenergy strategy). It is, however, not always possible to state to which extent the transparency gaps are due to detailed plans actually not existing, and to which extent it is simply an incomplete representation of existing information. In all cases, given that the NECPs are intended to be both Member States', and the EU's most systematic and comprehensive statements of how to reach domestic and international emission reduction obligations, this missing information does suggest achievement of its targets is at risk.

The sections below highlight our conclusions on the key findings across the four research themes.

1. Renewable electricity and hydrogen

There is a significant difference between the quality of information in the different NECPs for renewable electricity as compared to renewable hydrogen. **On renewable electricity, the quality of information is high overall;** countries are far more detailed and advanced on their plans for renewable energy build-out than for renewable hydrogen, for example. Renewable electricity reporting especially lacks behind on the implications of the updated RE targets and the electrification of key sectors, especially industry. **In contrast, in all countries assessed, the quality of information in the NECPs for renewable hydrogen is low and should be improved** on all levels. The first indicators in the table are included in the Governance Regulation, i.e. (EC guidelines to Member States). The other indicators in the table are suggestions made by ECNO for more transparent monitoring of NECPs.

Table 2: Quality of information regarding renewable electricity

	Metric	Description	Rating
Cov. Reg.	Targets	Renewable Energy Directive II targets are stated and explained	
		Renewable Energy Directive III targets are stated and explained	
	Policy Support	Policies and measures to support renewable energy build-out detailed	
	Electrification	Electrification measures for industry clearly described	
		Electrification measures for transport clearly described	
		Electrification measures for buildings clearly described	
	Grid enhancement	Plans for grid infrastructure development detailed	
		Grid integration efforts & coordination within the EU described	
ECNO Indicators		Expected level of imported electricity, including from which country	
	Pipeline of projects	Planned & ongoing renewable energy projects within MS detailed	
		Capacity & timeline of renewable energy projects match RED targets	

Rating legend

High transparency: All countries included information and most or all countries included a good level of detail

Medium transparency: Most countries included information and some countries included a good level of detail

Low transparency: None of the studied countries included adequate information and only few countries provided any information at all

Table 3: Quality of information regarding renewable hydrogen

	Metric	Description	Rating
Cov. Reg.	Targets	Targets for production, consumption and integration stated	
	Infrastructure	Plans for infrastructure to support production, storage, transportation etc	
	Policy Support	Policies and measures to support renewable hydrogen detailed	
	Sectoral Integration	Strategies on integrating renewable hydrogen into transport described	
		Strategies on integrating renewable hydrogen into industry described	
	International Collaboration	Sourcing of imported hydrogen (within EU or from abroad detailed)	
		Collaboration between Member States on hydrogen imports	
		Collaboration with partners outside of EU on imported hydrogen	
		Planned & ongoing import capacities described	
ECNO Indicators	Pipeline of projects	Planned & ongoing renewable hydrogen projects within MS detailed	
		Capacity & timeline of renewable hydrogen projects match targets	

Rating legend

High coverage: All countries included information and most or all countries included a good level of detail

Medium Coverage: Most countries included information and some countries included a good level of detail

Low coverage: None of the studied countries included adequate information and only few countries provided any information at all

As with the quality of information, **the risk of inconsistency is higher on renewable hydrogen than renewable electricity** as targets, policies, plans and implementation are far less advanced. However, even on renewable electricity, some risks were identified, notably on translating the updated RED III targets into national legislation and achieving them, as most NECPs have not provided a clear view on how they have updated their measures. Some risks also remain on whether the countries are sufficiently addressing barriers to RE deployment and to what degree sufficient flexible generation is planned to accommodate the increasing shares of variable renewables (wind and solar).

Table 4: Risk of inconsistency regarding renewable electricity

Metric	Description	Rating
Targets	Alignment of national target(s) with Renewable Energy Directive II	
	Alignment of national target(s) with Renewable Energy Directive III	
Generation & capacity	Consistency between generation and capacity values per technology	
	Total renewable energy generation consistent with available potential	
Grid enhancement	Risk of failing to achieve the 15% interconnection target	
	Risk of renewable roll-out being hampered by inflexible grid operation	
Policy support	Barriers to renewable electricity roll-out addressed	
	Measures in line with stated targets and projects	

Rating legend

The risk of inconsistency is low across all countries

There is very mixed level of inconsistency risk across the studied countries

The risk of inconsistency is high across all countries

Table 5: Risk of inconsistency regarding renewable hydrogen

Metric	Description	Rating
Generation & capacity	Consistency between domestic production and capacity	
	Electricity demand for renewable hydrogen H_2 production accounted for	
International collaboration	Geographical detail on expected import sources	
	Cooperation with other countries on renewable H_2 strategies, import, connections	
	Clarity on which domestic and imported supply will cover renewable H_2 demand	

Rating legend

- The risk of inconsistency is low across all countries
- There is very mixed level of inconsistency risk across the studied countries
- The risk of inconsistency is high across all countries

Key risks identified:

- NECPs do not yet sufficiently reflect the implications of the **updated renewable energy target under the latest renewable energy directive (RED III)[3].** While countries only have to implement the provisions on targets until early 2025, the Fit for 55 package referenced in the NECP guidance foresees an increased RE target to at least 40% by 2030. Even though countries provided some initial insights on what they attempt to be doing in their NECPs, these are far from sufficient to ensure the updated targets can be reached in the short timeframe until 2030. For example, Sweden's NECP mentions the plan to adapt the national policy and plan for RE expansion in line with the increased RE targets under RED III but does not provide detail how this would be achieved. The Dutch NECP acknowledges the need to update in line with REDIII targets but expects not to even be able to meet the RED II targets. Hungary has increased its RE target but does not provide details how it relates to RED III and/or how it will be implemented.

- **Barriers to renewable development** such as permitting and siting are widely acknowledged as a major showstopper to RE development in the EU[4], but are not yet addressed with sufficient detailed in NECPs: The Swedish NECP mentions a contact point, but provides little detail as to what measures are taken to overcome the barriers. The Dutch NECP on the contrary provides a detailed description of policies and platforms designed to speed up the permitting process, at least one of the major barriers. Similarly detailed measures for barrier removal are described in the Spanish NECP, while the Italian and Hungarian NECPs restrict themselves to mentioning the existence of several barriers and the intention to address them without providing further detail on measures.

- **Flexibility at the grid level,** provided through options other than gas power plants[5], is only covered in a scattered and incomplete form in the NECPs. The Swedish NECP focuses at the level of demand response services. The Dutch and Spanish NECP mention the need for flexibility in several places but do not quantify it further or specify measures to support it. Italy goes as far as listing several areas of actions to enable flexibility but does not specify them further. Finally, the Hungarian NECP still mentions the construction of new gas plants to provide flexibility, acknowledges the need for more demand response measures but also requires flexibility options to be build first before RES gets deployed.

- Lastly **electrification measures** are described in all NECPs but are especially poorly detailed for the **industry sector.** Sweden discusses the need for electrification in industry but, while detailing a strategy for industry under the FossilFree Sweden initiative, does not clearly single out measures for electrification. The Dutch NECP focuses on other measures for decarbonisation of industry, such as CCS or hydrogen, the Spanish and Hungarian NECP focuses on energy efficiency measure for the sector and the Italian one focuses on the provision of RE for industry. Overall, the NECPs assessed seem to focus more on developing renewable hydrogen for industry decarbonisation while seemingly neglecting strong measures for the electrification of industry.

For renewable hydrogen, the analysis shows that the information provided in the NECPs is lacking detail at all levels. This is especially problematic as the latest RED III directive foresees the development of a "union strategy... on the basis of data reported by Member States" for hydrogen production[6]. Particularly planning for consumption, production and imports/exports bears a risk of inconsistency due to incomplete, missing or even inconsistent information in all analysed countries. It should further be noted that most of the NECPs use the term "renewable" or "green" hydrogen, but in some instances, countries do not specify and simply state "hydrogen".

- In Hungary, the estimates of projected domestic hydrogen production are less than half of the anticipated demand in 2030 of more than 4 TWh, leaving a substantial gap potentially to be filled with imports, however the NECP does not provide sufficient information on the sourcing of the imports and limited clarity on the required infrastructure.

- In contrast, in the Netherlands, the plans on renewable hydrogen deployment and production are very ambitious with more than 20 TWh to be produced. Yet the demand is estimated to be even higher, suggesting that the Netherlands will not cover all sectoral demand with domestic production and will need to import 5 TWh in 2030. Around 40 TWh of electricity will be needed in 2030 to cover the domestic renewable hydrogen production. This represents between 30% and

40% of the projected national renewable electricity production, which means a high share of renewable resources would be used with much lower efficiency than by using it directly as electricity.[7]

- In Spain more transparency is required: our estimates based on the figures found in the draft NECP and the hydrogen strategy suggest high production to the extent of potential exports, while the draft NECP itself speaks of the need for imports.
- And in Sweden, the draft NECP makes little effort to quantify renewable hydrogen production or consumption volumes, nor imports or exports, which risks leaving Sweden without viable plans for renewable hydrogen development to meet likely demand.

The more comprehensive information in the draft NECPs on renewable electricity as compared to renewable hydrogen reflects that plans are more developed on electricity. However, it will be important for countries to reach a level of maturity and explicitness as regards to realistic demand, and supply (including imports) projections for renewable hydrogen in order to guarantee that appropriate infrastructure can be built, electricity needs catered for, and demand levels met. Otherwise, the risk is that insufficient renewable electricity will be available to produce hydrogen and fossil-based alternatives will end up being used to make up for supply gaps, jeopardising emission reductions.

2. Land uses

All countries are missing sufficient information on land use and land use changes. While the basic requirements on land use from the European Commission's governance regulation are generally included in the plans, most countries remain quite abstract and do not provide additional granularity or details on how these ambitions will be reached. Most Member States provide a LULUCF (Land Use, Land Use Change, and Forestry) target, but fail to integrate concrete and quantitative actions to reach this target. Additionally, measures to limit natural disturbances (drought, forest fires, disease) are often missing, despite their increasing frequency.

Table 6: Quality of information regarding Land use, Agriculture and Forestry

	Theme	Indicator	Score
Gov. Reg.	**Land use monitoring**	Identification of improvements for data collection and land use monitoring	
Gov. Reg.	**Non-CO2 reduction target**	Specific reduction targets for non-CO_2 emissions from agriculture	
Gov. Reg.	**Net land use removals**	The objective to increase net removals from the land use sector	
Gov. Reg.	**Sustainable biomass use**	Measures for the sustainable sourcing and use of biomass	
ECNO Indicators	**Wetlands area evolution**	Restauration of wetlands from previously drained areas	
		Planification of land use changes due to wetland restauration	
ECNO Indicators	**Settlements area evolution**	Increase of constructed area	
		Demographic growth	
ECNO Indicators	**Croplands area evolution**	Plans to reduce food waste	
		Demographic growth	
		Reliance on first generation bioenergy crops	
		Implementation of agroecological practices considering influence on yields	
		Efficiency improvements leading to increased yields	
		Feed production for locally fed livestock	
ECNO Indicators	**Forest lands area evolution**	Wood production	
		Afforestation/reforestation	
		Natural carbon sink targets	
ECNO Indicators	**Grasslands area evolution**	Plans to increase protected grassland areas	
		Pasture demand for the livestock population	
		Natural carbon sink	

Rating legend

High coverage: All countries included information and most or all countries included a good level of detail

Medium Coverage: Most countries included information and some countries included a good level of detail

Low coverage: None of the studied countries included adequate information and only few countries provided any information at all

The lack of details on land use change projections, leads to potential internal incoherence of the projections and increases the risk of land competition. Trade-offs between the services that are expected to be provided from different land uses, and how these land uses are expected to be managed or restored in the coming years, are barely integrated in most plans, which can also lead to an overestimate of the sinks they will provide. Most plans also focus on mitigation through increasing carbon sequestration, but few integrate adaptation measures in a changing environment.

Table 7: Risk of inconsistency regarding land use and land use change

Theme	Potential inconsistency	Score
Land overlap	Are the expected increases in land area compensated by decreases of other lands?	
LULUCF target	Are the country's LULUCF ambitions aligned with the EU's removal targets?	
Forests	Are there plans to manage forests sustainably, to maintain productivity while increasing resistance and resiliency, hence maintaining their carbon sink potential?	
Croplands	Is the projected demand for food, feed, energy or industrial crops compatible with the existing utilised agricultural area (UAA)?	
Wetlands	Does the NECP consider and integrate the land use changes due to wetland restoration?	

Rating legend

- The risk of inconsistency is low across all countries
- There is very mixed level of inconsistency risk across the studied countries
- The risk of inconsistency is high across all countries

Key risks identified:

All NECP's lacked quantified targets or projections on land related issues, which hampered a deeper analysis. Countries need to anticipate potential land use changes linked to the implementation of different policies and measures, since **the risk of increased competition for land is real,** and could jeopardize future decarbonization efforts, or hamper lands from delivering services to society.

- Italy and Sweden have the highest risk of land overlap, with four times more indicators predicting a land increase than indicators predicting a land decrease.
- The Dutch draft NECP was the only one that met the LULUCF target imposed by the revised LULUCF regulation. Unless NECPs are improved, the risk of missing out on the overall 2030 target of 310 $MtCO_2$ removals across Europe is thus probable.
- A sustainable management of forests is ensured through the countries national forest strategies, which are mentioned in the draft NECPs. However, NECPs would benefit from integrating some key points of these strategies in order to better reflect the impact of these practices on emissions.
- Countries would benefit from having a clear view and estimate of the evolution of cropland area which was found to be quite uncertain across the board.
- All draft NECPs plan to restore wetlands, but none integrates the consequence this would have on the loss of croplands and forest lands. This lack of planning can further conflicts or inconsistencies in land uses.

Additionally, **key information is missing related to land use change and land carbon sink capacity.** No clear targets for these key measures lead to higher risks of missing out on national targets, such as land CDR and ultimately, the overall GHG reduction targets and the ability to meet net zero.

- Italy provides historical trends for all land uses but fails to integrate future projections. Our modelling however shows that there is a significant risk that Italy will not meet its LULUCF target as the modelled evolution of land use will capture less carbon than is required by the European Commission (-31 vs -36 $MtCO_2$). The LULUCF targets noted in the draft NECP also fall behind on the European targets.
- In the Netherlands, a lot of key information is missing, including quantified reforestation or wetland restoration targets, or measures to reduce or halt artificialisation. This lack in quantified projections prevents to plan land use change ahead, which raises the risk of competition for land.
- The Hungarian draft NECP lacks a LULUCF target and concrete measures to reach it. The plan assumes "climate policy legislation that ensures that the Hungarian forest sector approaches this [LULUCF regulation] target by 2030", without providing further details on specific policies or measures to reach it. The NECP would benefit from further details specific to LULUCF.
- The Spanish draft NECP provides the most detailed and thorough information regarding land management and land use change by 2030. Especially forest management, for which measures and actions are described to prevent forest fires and to maximise carbon sequestration. Reforestation and wetland restoration include quantitative targets, which shows the robustness of the strategy, and allows for an integrated analysis of the proposed measures.

3. Bioenergy

Overall, information regarding bioenergy demand was of high quality, while information regarding supply was significantly less so. The draft NECPs detailed specific targets related to bioenergy use; policies and measures to increase bioenergy use were also integrated into the draft NECPs, as were specific fuel switches to increase biofuel use in transportation. Regarding supply, information was of lower quality: few quantified targets for the production of advanced biofuels, no projection for different types of inputs, nor the imports or exports of bioenergy was addressed in the draft NECP. This of course has knock-on implications for the possibility of making correct planning assumptions as regards to land use and anticipating the risk of competition for land. Bioenergy can also have a direct impact on a country's natural CDR capacity when taking up land that could be dedicated to forests or grassland. This should be accounted for when increasing the reliance on bioenergy domestically.

Table 8: Quality of information regarding bioenergy

	Theme	Indicator	Score
Cov. Reg.	Targets	Renewable Energy Directive II targets are stated and explained	
		Renewable Energy Directive III targets are stated and explained	
ECNO Indicators	Sustainability	Include plans to promote second- or third generation (i.e. advanced) biofuels	
		Inclusion of sustainability criteria to the production of biomass	
		Mention of the cascading principle for the use of biomass	
		Considers the indirect impact of using biomass, especially linked to indirect land use change	
	Policy Support	Policies and measures to support renewable energy build-out detailed	
	Fuel switch	Integration of bioenergy in the heating sector clearly described	
		Integration of bioenergy in the production of electricity clearly described	
		Integration of bioenergy in the transport sector clearly described	
	Supply	Production of first-generation bioenergy described	
		Production of second-generation bioenergy described	
		Production of third-generation bioenergy described	
	International collaboration	Sourcing of imported bioenergy or bio raw materials (within EU or from abroad details)	
		Collaboration between Member States on bioenergy imports	
		Collaboration with partners outside of EU on imported bioenergy	
		Planned & ongoing import capacities described	

Rating legend

High coverage: All countries included information and most or all countries included a good level of detail

Medium Coverage: Most countries included information and some countries included a good level of detail

Low coverage: None of the studied countries included adequate information and only few countries provided any information at all

The analysis found that **there was a medium to high risk for the bioenergy strategies to be incoherent.** The biggest risk identified is the lack of consideration of the development of infrastructure that would be needed to support the massive bioenergy roll out foreseen in some draft NECPs. Bioenergy production must never be the priority use of biomass. To ensure this sustainable use of biomass, draft NECPs need to integrate into more details existing and future European directives (RED II & RED III) that provide sustainability targets and thresholds for bioenergy production. The lack of detail on measures aimed at increasing domestic production and supply compared to the increased demand for bioenergy points to high import scenarios, especially in the Netherlands. For other countries, this lack of information leads to uncertainties related to future import needs. This bears heavy risks, since foreign biomass can potentially be harvested unsustainably, and lead to deforestation. Domestic production and supply should be covered in draft NECPs, to anticipate future import needs, and ensure they can be provided from sustainable sources.

Table 9: Risk of inconsistency regarding bioenergy

Theme	Potential inconsistency	Score
Targets	Alignment of national target(s) with Renewable Energy Directive III	
Infrastructure	Plans for infrastructure to support production, storage, transportation etc.	
Policy Support	Measures in line with stated targets and projects	
Imports	Need for bioenergy imports to meet domestic demand	

Rating legend

The risk of inconsistency is low across all countries

There is very mixed level of inconsistency risk across the studied countries

The risk of inconsistency is high across all countries

Key risks identified:

In most plans the balance between production and demand of bioenergy is not well documented, leading to **risks on their sufficiency and uncertainties related to future imports or exports of bioenergy.**

- Countries should first question whether their projected demand is actually credible and desirable, considering biomass availability both domestically and in Europe, and the risks of importing biomass from outside Europe.
- The Netherlands projects a production of 2 billion cubic meters of biogas, which is not expected to fulfil future demand. Imports are therefore planned, but neither quantified, nor anticipated in terms of infrastructure development or partnerships.
- All countries plan to valorise more residues or waste to produce advanced biofuels, yet all lack clear strategies on how these residues will be collected, or to improve the infrastructure to allow for this collection and treatment of residues.

- The future of energy crops is well described in most NECPs. However, risks pertaining to land competition between food and energy crops are not integrated in the draft NECPs. Spain and Italy plan to reduce the use of energy crops, the Netherlands plans on capping the use of biofuels produced from food and feed crops. On the other hand, Hungary plans on increasing the use of first-generation biofuels which poses a major risk, increasing the reliance on energy crops in potential competition with food production and sovereignty.

Infrastructure developments would be key to supply this increased demand in bioenergy, not only for advanced biofuels. **However, few NECPs mention investments or a budget that would allow for the credible roll out of bioenergy country wide, implying a clear risk of delivery failure.** These needed infrastructure changes would include, but are not limited to, transforming refineries into biorefineries, developing biogas production plants, developing storage facilities for biogas and bioliquids, installing refining systems to remove impurities from biogas, expand refuelling stations for vehicles, modifying or replacing appliances and equipment to be compatible with biogas to ensure safety and efficiency, etc.

The bioenergy strategies should further be thought of carefully, as biomass supply has a direct impact on surrounding ecosystems, but also on ecosystems in exporting countries. A robust strategy should not only include plans to maximise its use, but also plans prioritize their use for specific end-uses, and to ensure a sustainable production and procurement. These are unfortunately often missing in NECPs and **lead to risks of unsustainable exploitation and biodiversity issues in the countries and abroad.** The cascading principle suggests that biomass should be valorised according to its highest economic and environmental added value. Following this principle, biomass should only be used for bioenergy when it cannot be used as wood products, reused or recycled. This is an important concept to prevent an overreliance on wood and ensure a sustainable wood procurement. Unfortunately, only the Netherlands specifically mentions this logic in their draft NECP.

The increased bioenergy ambitions of the different countries therefore bear multiple risks which, collectively, question the feasibility of the current bioenergy ambition.

4. Long-term geological storage (LTGS) of CO_2

In general, **the availability of information regarding the LTGS of CO_2 in the assessed NECPs is low.** The key factors contributing to this assessment was the lack of quantitative data related to this subject in some NECPs, missing metrics in others and lack of clarity with respect to some of the presented indicators. None of the countries managed to include all the metrics recommended by the EC. The lowest level of the information availability concerned the capacity of transport infrastructure and the level of inherent emissions resulting from industrial production processes that will have to be abated through CO_2 capture. The metric related to CCU was included despite CCU providing only short- to medium-term storage of CO_2. This was done to discern CCU and CCS, as in some of the NECPs it is not clear whether the captured gas will be later used or stored.

The quality and availability of data in this area is highly unequal, and in most cases low, which is a sign that plans regarding deployment of CCS/CCU are not well developed in investigated MS overall. This is concerning, given that the technology is crucial for decarbonising some industries, while investment in carbon capture and storage installations and transport infrastructure is associated with high costs. It is thus important to carefully plan further development in this area: on the one hand, to be prepared to capture inherent (non-avoidable) emissions, and on the other hand – not to invest excessively in CCS/CCU deployment in sectors where other alternatives exist.

Table 10: Quality of information regarding long-term geological storage of CO_2

	Theme	Metric	Score
Cov. Reg.	Inherent emissions	Assessment of the inherent process emissions that will have to be abated through CO_2 capture	
	Storage capacity	The total amount of CO_2 storage available for CO2 injection (annually)	
ECNO Indicators	Storage utilisation	The total amount of CO_2 actually injected (annually)	
	CCU	The total amount of CO_2 captured and dedicated to further utilisation (annually)	
	Transport infrastructure	The amount of CO_2 which can be transported to storage space with existing infrastructure	
	Captured emissions	The total amount of CO_2 captured (annually)	

Rating legend

High coverage: All countries included information and most or all countries included a good level of detail

Medium Coverage: Most countries included information and some countries included a good level of detail

Low coverage: None of the studied countries included adequate information and only few countries provided any information at all

The lack of details related to the implementation of CCS/CCU, paired with the fact that countries did not clearly rule out the use of the technology, is in itself a sign of low-quality planning. This may signal potential internal incoherence of the projections included in the plan, depending on the scale of expected CCS/CCU deployment.

Table 11: Risk of inconsistency regarding long-term geological storage

Theme	Potential inconsistency	Score
Sources	Sources of captured CO_2 not indicated clearly	
Destination	Destination of captured CO_2 not indicated clearly	
Export	Storage space in another country not secured (in case of CO_2 export)	

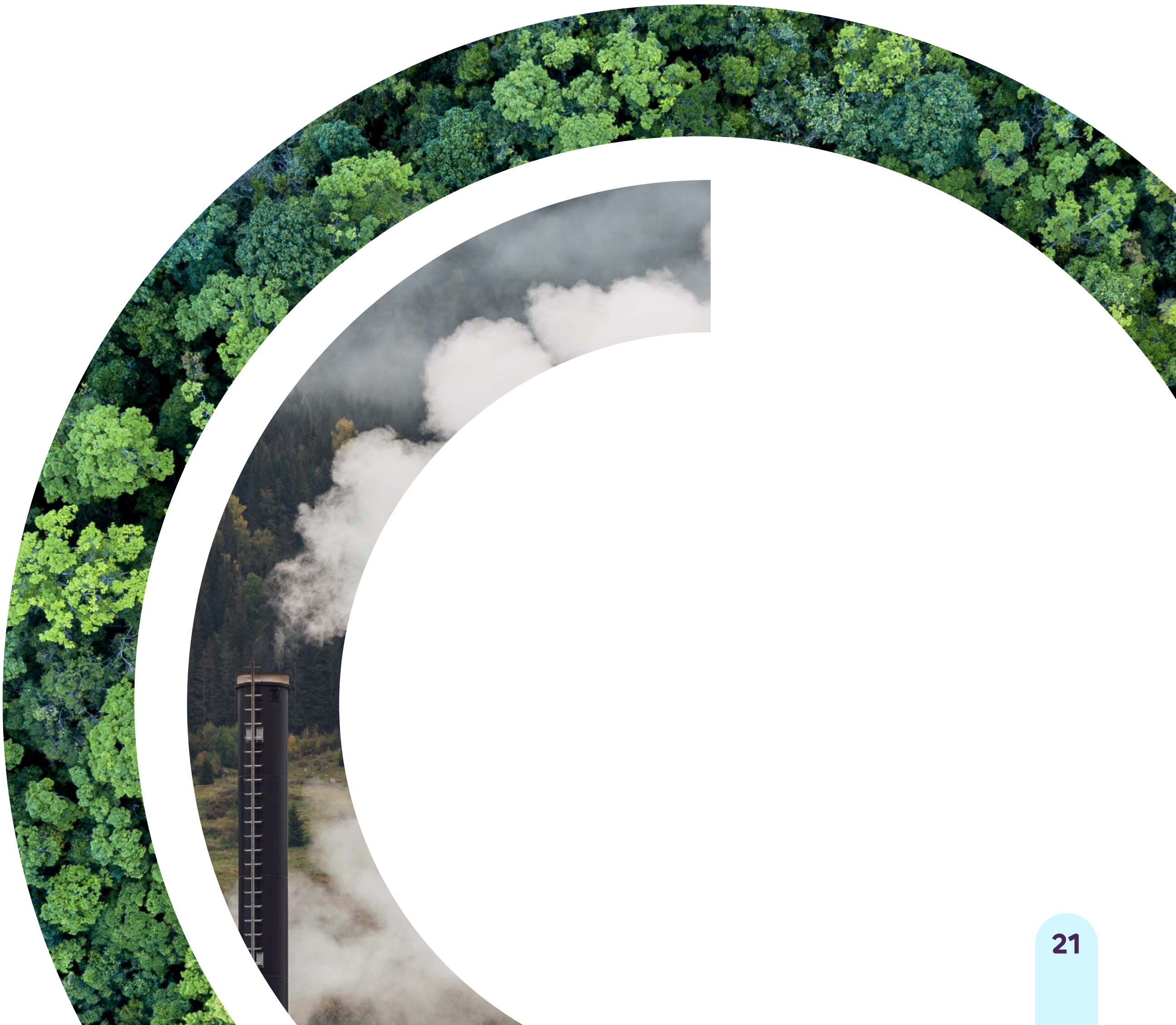
Rating legend

- The risk of inconsistency is low across all countries
- There is very mixed level of inconsistency risk across the studied countries
- The risk of inconsistency is high across all countries

Key risks identified:

- The Italian NECP relies heavily on CCS to stabilise emissions in the industrial sector (CCS abating the 15% to 20% of growth in emissions). Alternative decarbonisation measures (such as enhanced circularity, new industrial processes, electrification or alternative fuels) for the industry are not clearly stated in Italy's Plan, implying that CCS may be deployed not only to reduce inherent process emissions but also avoidable combustion emissions, which constitutes a risk of locking in fossil fuel dependency.
- In the Netherlands the ambition for deployment of CCS in chemicals and refineries sector is high: around 25% of their emissions are expected to be covered by CCS. For these two sectors, the NECP may be over-reliant on CCS since it does not specify any other ways of reducing emissions (such as electrification, recycling). In addition, the electrical energy needed in 2030 to capture this volume is estimated at 8 TWh for both sectors (without accounting for the energy for storage and transport of the captured CO_2). This figure represents almost 10% of the energy consumption of each respective sector in 2030.
- Spain declares that it will need to deploy LTGS of CO_2 technologies only to a limited extent. In order to achieve that, the country needs to perform deeper reductions in sectors other than industry, which may be difficult to achieve.
- In Hungary, the modeling results disclosed in the NECP show that after 2040, deployment of CCS results in negative emissions in industry and power generation sectors. However, the text of the Hungarian Plan states that due to insufficient domestic storage space, captured CO_2 will be mostly utilized, contradicting the modeling results.

- Swedish NECP hardly mentions any information related to LTGS of CO_2, except that the work on a CCS/bio-CCS strategy was launched in 2023. Thus the plan fails to describe some existing state-level policies and measures in this area (e.g. support-scheme for bio-CCS, National Centre for CCS). As a consequence, these actions may not be taken into account by other European countries in their own planning processes.
- Both, the too high and the too low ambition levels in the area of LTGS of CO_2 can impair the collective EU emission reduction potential. Over-reliance on these technologies on the national level may result in using more storage capacity than necessary, limiting possibilities for the other member states to permanently store their inherent emissions in available sites. On the other hand, too low ambition in the area of LTGS of CO_2 may suggest that the country has an above average mitigation or carbon potential in other areas (e.g. natural sinks), which will be used to achieve climate neutrality at the national level without CCS deployment. This, in turn, may force other European countries. to introduce more costly mitigation measures in order to meet the climate neutrality goal for the EU as a whole.



Recommendations for Policymakers

The NECPs are meant to convey the policies and measures to achieving Europe's climate and energy targets, and support putting concrete additional policies in place to reach them. However, this report finds that the draft documents are not sufficiently precise and complete to fulfil that purpose. All the plans analysed have a large transparency gap, which means that the measures included in the plans are not specific and/or comprehensive enough to reach the targets they have set for their country.

National policymakers should therefore consider the following recommendations to improve transparency and information in the NECPs ahead of submitting their final versions:

- **Clearly outline national targets relevant for climate and energy planning and develop a monitoring process:** Too often the plans include a list of policies and measures but do not provide a clear view on their actual impacts, both individually and taken altogether - and even less on interconnected issues such as the underlying need for renewable energy and resources. Member States can strengthen their NECPs by including clear national targets coupled with a clear monitoring mechanism that considers production/demand balances and domestic resources. Based on learnings from the five national plans assessed, countries can improve their drafts for example by outlining their contributions to the EU-wide renewable energy targets under the EU's Renewable Energy Directive (RED II and RED III targets), and indicate in their NECPs if they are on track to meeting those targets. Similarly, countries should communicate on their efforts to reach their LULUCF sequestration targets and specify how different measures contribute to that final target.

- **Be more specific on the measures included in their NECPs:** The national authorities should consider upgrading their plans with sufficient detail, even if this information may already be available in separate documents, as the plans need to be self-standing to stand against the scrutiny of the full range of stakeholders, with everyone ultimately involved in making these targets a reality. We focus in this report on elements that are often missing in the plans based on our detailed review, but there may be other aspects of the NECP that need further specifications as well.

- **Outline potential inconsistencies in the plan and how these have been addressed:** Our research analyses a few of the key areas of potential inconsistencies in NECPs. Policymakers need to be aware of these and make their strategic choices explicit in the document in order to adequately plan infrastructure, land use distribution, import plans and other parameters.

Both in its further interactions with countries, and in its review of the EU Governance Regulation, **the European Commission,** should consider to:

- **Make full use of the assessment of draft plans and country-specific recommendations to safeguard against the risk of inconsistencies:** Our analysis shows that risk of inconsistencies, such as risks of missing targets or undermining decarbonisation objectives, exist throughout the NECPs analysed. The European Commission should highlight these risks to Member States, including but not limited to the following areas:
    - Provision of sufficient detail (from planning to implementation) for achievement of updated RE and hydrogen targets
    - Clarify the demand for electrification and hydrogen use (sector coupling) in demand sectors, especially industry.
    - Properly document the risk of inconsistencies between the LULUCF and bioenergy targets. This could take the form of a specific reporting of bioenergy emissions.
    - Provide higher quality and detail regarding the deployment of CCS/CCU and their solutions for LTGS of CO_2.
- **Request that national plans explicitly identify key areas of a risk of inconsistency.** In addition to highlighting potential areas for risk of inconsistency to national policy makers, the European Commission should also ask national policy makers to proactively highlight potential areas with a risk of inconsistencies in their plans, including how they have or are planning to overcome them. Such risks might exist where planning might not be advanced sufficiently (e.g., for hydrogen) or recent legislation has not been implemented in national planning (e.g. the RED III directive).
- **Provide a clear view of how key risk areas will be addressed at EU level (if applicable).** Some issues with consistency might be best addressed at the EU level. These include especially those risks that require cross- border interactions between countries, such as import/ export balances or the use of resources in other countries (e.g., for CO_2 storage). These should be addressed in the work programme of the new Commission, e.g., via EU level agreements with other geographies on importing green hydrogen, an EU level mapping of carbon dioxide storage, or a clear standardised framework to report trans-border CO_2 flows.

1. Introduction

1.1 Why NECPs matter

In their NECPs, EU Member States are required to describe, in an integrated manner, their climate and energy objectives and targets – as well as the policies and measures to achieve them until 2030 (with an outlook to 2040 and the longer term). Specifically, they need to show how they will deliver on national binding emission reductions targets for sectors covered by the Effort Sharing Regulation (agriculture, road transport, buildings, waste and small industry) and for LULUCF (Land Use, Land Use Change and Forestry) sector, as well as how they will contribute to the EU's 2030 renewables and energy efficiency targets. Minimum national targets and contributions are based on the ambition levels set in the Effort Sharing Regulation (ESR), the LULUCF Regulation, the Renewable Energy Directive (RED) and the Energy Efficiency Directive (EED) respectively, but for some countries the NECP may be the main or only document setting out their milestone emissions reduction targets for 2030 and the key policies to achieve these.

The Governance Regulation sets the framework for the NECPs: they must be developed based on a common template and along common rules of planning, reporting and monitoring. Also as an integrated, cross economy plan it should be drafted with significant input across various ministries, therefore addressing key interdependencies, synergies and overlapping needs between sectors, and look at potential sequencing issues. For example, identifying the cumulative demands of transport, building and industry sectors for renewable hydrogen over time, and ensuring these are met by sufficient supply, and whether the production of this hydrogen can be fully provided by the additional renewable electricity in the planning.

NECPs were first adopted in 2019 and – as required by the Governance Regulation – they are being updated between 2023 and 2024, to better reflect the quickly changing scientific, political and legal environment, with more climate change related events and a heightened global political attention. This ongoing update is of the utmost importance, as EU climate and energy policies have evolved substantially since the NECPs were first drafted in 2019. After the launch of the European Green Deal, the EU has increased its climate target for 2030 from (gross) 40% to (net) 55% emission reductions and, to back it up, it revised its entire climate and energy framework under the ‘Fit for 55’ Package, which brought new legislative files and revised already existing ones. The ESR, LULUCF, RED and EED have all been revised as part of the package. Moreover, as a result of the COVID-19 pandemic and the war in Ukraine, the EU has also adopted the ‘Next Generation EU’ and the ‘REPowerEU’ policy packages, which have further increased ambition and provided substantial additional funding for climate action and the energy transition at the national level. To take full advantage of this important opportunity, and to ensure countries meet the updated ambition, information needs to be as detailed and transparent as possible.

The deadline for Member States to submit the draft updated plans was in June 2023. The draft NECPs are now continuously being analysed by the European Commission as they are officially released by the Member States, with an overall assessment and country-specific recommendations just published in December 2023. The final NECPs should take into account the European Commission’s recommendations and shall be delivered in June 2024.

1.2 Objectives of this NECP Assessment

In light of this process and the importance of the plans, the ECNO consortium has taken on the task of reviewing five draft NECPs that were available early on. The European Climate Neutrality Observatory (ECNO) is a new initiative spearheaded by a consortium of research organisations that aims to help ensure the EU achieves its climate goals, and most importantly the long-term climate neutrality target, by providing scientifically rigorous analysis of economy-wide on-the-ground progress and an independent check of the EU climate policy processes that drive it.

Through this report, we aim to encourage member states to improve the transparency and internal consistency of the final versions of the NECPs published mid-2024.

It has a dual purpose of supporting the five countries covered in our analysis to improve their NECPs assessed, and to inform and strengthen European climate planning at large, in particular regarding the use of limited resources that are required across sectors. The assessment should further provide valuable information to the European Commission and make their reviews of the draft NECPs and the recommendations to the Member States more impactful.

Why is this important? High quality information in the NECPs is essential for ensuring transparency, accountability and monitoring the progress of Member States' plans for accelerating the deployment of the key levers of the transition. A sufficient level of information in NECPs allows for a clear and open evaluation of policies and measures. Quality information also helps hold governments accountable for the commitments and initiatives set out. NECPs are a strategic planning tool that ensures decision makers and stakeholders have up-to-date information on a country's decarbonisation plans if they include high quality information. Additionally, quality information in NECPs provide short, medium, and long-term predictability for these key themes for all stakeholders involved.

Good quality of information can also be the basis for analysing existing progress and raising ambition as it fosters cross country learning, identifying good practices across Europe. This also enables stakeholders to suggest more ambitious policies, and monitor the impact over time, comparing progress to date to the relevant benchmarks.

1.3 Scope of the report and research approach

This report offers an analysis of five Member State draft NECPs and assesses them according to **transparency and internal consistency.** We interrogate the documents regarding four key cross-sector questions in order to both help directly improve the NECPs assessed, and to inform and strengthen European climate planning at large as regards the use of limited, cross-sector resources.

The report does not evaluate the likely effectiveness of the presented policies, nor the quality and inclusiveness of the drafting process. Rather, it highlights 'planning risk' areas in the draft plans with the aim of helping to ensure that Europe stays within the available pathways to timely climate neutrality, in this crucial decade of climate action.

Therewith, it enables national administrations to improve the draft NECPs for their final version, shining a light on the areas where current drafts typically lack coherence and clarity.

1.3.1 Specific research themes

To do this we have analysed the content of the draft NECPs published mid-2023 on four research themes detailed below. **The four themes have been selected due to their significance for the transition,** and the fact that they cover resources potentially relied on by several sectors – making the need for clear-sighted, integrated planning for their deployment, both within and between Member States, particularly important.

1. **Renewable electricity and hydrogen:** Analysis of the expected demand increases due to electrification across all sectors, compared to the planned level of renewable electricity production. Analysis of the anticipated hydrogen demand across sectors, compared to the domestic production and imports.
2. **Land uses:** Analysis of the expected services to be provided by different land uses, and the potential trade-off with lands' carbon dioxide removal (CDR) targets.
3. **Bioenergy:** Analysis of the expected bioenergy demand across sectors, compared to the domestic production and anticipated imports.
4. **Long-term geological storage of CO_2:** Analysis of the reliance on long-term geological storage of CO_2 compared to actual reductions of emissions. Analysis of the expected volume of captured CO_2 by source, compared to the domestic storage, export and use of CO_2.

1.3.2 Review of the quality and transparency of the NECPs

We examined whether the plans have specific coherence risks based on the information they include or that may be missing from their NECPs. They were analysed on 1) information quality and transparency and 2) internal consistency, using the two approaches described below.

Two complementary approaches	Quality / transparency	Risk of inconsistency
Review of the quality and transparency of the NECPs based on EU guidelines	Review of the policies and measures included or missing in the draft NECPs for the 4 research areas	Analysis of the risk of inconsistency of the 4 research areas based on a detailed review of the policies and measures included in the plans
Quantitative assessment based on scenario modelling	Analysis of the total emissions **transparency gap** based on modelling the draft NECP scenario	Complementary analysis of the risk of inconsistency of the 4 research areas based on modelling the draft NECP scenario

Analysing the transparency of the policies and measures based on EU guidelines

First on ***qualitative* reviews of the draft NECPs.** It examines whether countries are sufficiently comprehensive and specific in the information they include in their NECPs to facilitate practical planning (e.g., infrastructure) and later analysis. This means effectively testing the **completeness and transparency** of the policies and measures (PaMs) included, and highlighting where information is lacking on key parameters which have cross-sectoral implications. The guidelines shared by the European Commission to Member States are used as a reference, as this is where they specify the information that must be included in the plans. The research takes a detailed look at the quality of data included on the planned demand and supply of key resources, as over-reliance on these at the national or European level could put the transition at risk.

Analysing the risk of inconsistency of the policies and measures

As for the review of the transparency, this analysis is first based on the guidelines shared by the European Commission to Member States for drafting their NECPs.

Then based on this detailed review of the draft NECPs, the Pathways Explorer is used to ***quantitatively* assess the planned demand and supply of key resources** which are particularly crucial for the transition to be successful (where necessary using modelling-based inference), and to **identify potential inconsistencies** and double counting across sectors and countries. When key information was missing, the quantitative implications of the policies mentioned in the plans were inferred using the Pathways Explorer, a modelling framework which allows to reproduce the impact of these policies and measures (PaMs) on energy and emissions taking into consideration also interactions between sectors. In this way we were able to highlight key risks quantitatively.

Identifying the emissions transparency gap

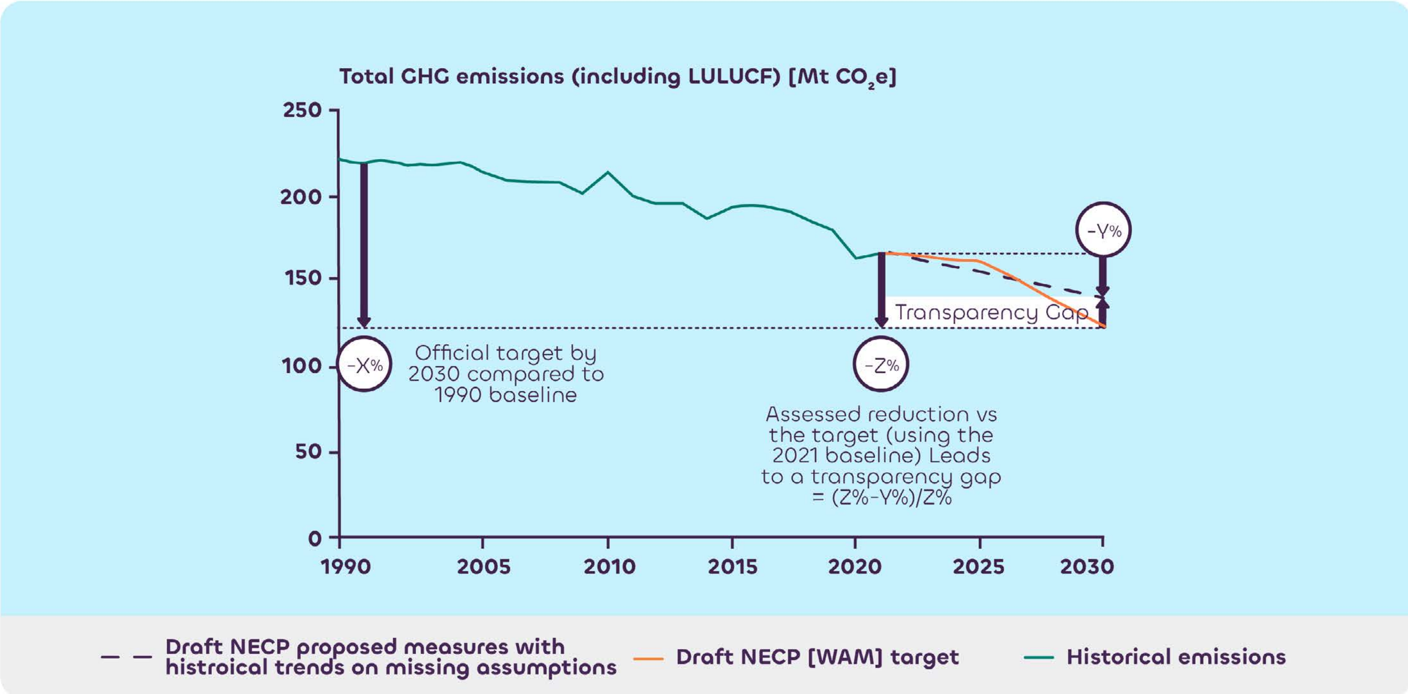
The model was then also used to estimate the **'Transparency Gap',** i.e. the gap between the measures actually described in the draft NECP and the high-level targets announced.

When missing, the implications of policies mentioned in the plans were inferred using the Pathways Explorer, a modelling framework which allows to reproduce the impact of these policies and measures (PaMs) on energy and emissions taking into consideration also external factors. This is called levers in the following. We quantified two scenarios for the five countries. Both scenarios reproduce the bottom-up levers or measures detailed in the plans, but differ on the interpretation of levers or measures not detailed in the draft NECPs.

1. The first scenario infers, for missing levers or measures, the required assumptions to reach the targets specified in the plans at the sectoral and total economy projections on energy and emissions. This is called the "Draft NECP (WAM)".
2. The second scenario assumes that when information is missing, levers or measures follow their historical trends. It therefore does not replicate the sectoral and total economy projections laid out in the draft NECPs on energy and emissions. This is what we call the "Draft NECP with historical trends on missing assumptions".

The difference between these 2 scenarios is what we call the **transparency gap.** This gap is also split by sector. It is illustrated in Figure 1 below.

Figure 1: Explanation of the transparency gap calculations



2. Cross-country thematic review

These sections offer a detailed look at the quality of information and the risk of inconsistency on the policies and measures for the four research areas as were provided by the Member States in their draft NECPs.

2.1 Renewable electricity and hydrogen

Electricity supply plays a central role in decarbonising energy supply and its importance will only increase over time through sector coupling, i.e., the electrification of demand sectors. Hydrogen can be used to decarbonise certain industrial sectors, as well as the transport sector, provided it is itself produced from renewable electricity. Member State NECPs should thus provide a transparent, coherent, and consistent plan for accelerating the deployment of both renewable energy and renewable hydrogen.

2.1.1 What and how we evaluate

This chapter evaluates the quality of information and the risk of inconsistency on the policies and measures for renewable electricity and renewable hydrogen provided by Member States.

The **quality of information assessment consists of eleven main metrics** – targets (RED II and RED III), pipeline of projects, grid enhancement, policy support, electrification measures (buildings, transport, industry), infrastructure development, sectoral integration, and international collaboration. These metrics can mostly be attributed to the EU guidance provided to Member States as they update their NECPs.

The **risk of inconsistency dimension consists of five main potential inconsistencies,** which complement the metrics for assessing the quality of information – targets, generation and capacity, grid enhancement, policy support and international collaboration.

2.1.2 Quality of information

Context – what does the legislation require?

The Governance regulation requires Member States to detail plans for the acceleration of the roll-out of renewable energy and hydrogen in the NECP. According to the EU guidance, the NECPs should provide an updated and ambitious Renewable Energy Directive target that contributes to the overall EU target. Further, to speed up the deployment of renewables across all sectors, the NECP should also add sub-targets for the transport, industry, and buildings sectors. Lastly, the guidance recommends for the NECPs to address barriers like permitting, and to outline measures such as on supporting power purchase agreements. The NECP should in addition detail plans on deploying renewable hydrogen for the transport and industry sector with information on infrastructure and investments. To contribute to the REPowerEU renewable hydrogen targets, the NECP should include plans for international initiatives and partnerships to support renewable hydrogen imports.

Results

The quality of information in the different NECPs vary significantly for renewable electricity and renewable hydrogen.

On renewable electricity, the quality of information is high, countries are far more detailed and advanced on their plans for renewable energy build-out than in sourcing renewable hydrogen, for example. However, even on renewable energy, there are some missing key points. Electrification measures for transport, buildings and industry are a crucial part of a country's national energy and climate plan as electrification is key to reducing emissions from these sectors and improving energy efficiency. Out of the five NECPs assessed, all provided some plans for electrifying the transport and buildings sector, however, clear, and quantitative targets were sometimes missing, more often in the transport sector than in buildings. Measures specifically for the electrification of industry were missing in all countries which is likely due to the heterogeneity of this sector. This is concerning due the focus on developing renewable hydrogen for the industrial sector, while overlooking measures for the electrification of industry.

Overall, the quality of information in the NECPs for renewable hydrogen is low. Member States offer a medium level of information for strategies on integrating renewable hydrogen into the transport and industry sector. However, the level of detail on policy support for renewable hydrogen was mixed with some countries doing well and others not providing any information. The NECPs mostly all offer some information on collaborating within Europe on renewable hydrogen, however there is a lack of information on sourcing imported renewable hydrogen and on detailed plans for collaborating with countries outside of the EU. In addition, none of the countries matched capacities and timelines to the stated targets, which is key for setting Member States on the trajectory towards meetings their renewable hydrogen targets. Further, the NECPs did not clearly describe how renewable energy targets are linked to renewable hydrogen development and did not adequately clarify how the increased demand of renewable electricity due to renewable hydrogen is accounted for in the plans. To keep up with projected demand for renewable hydrogen that is necessary for decarbonisation efforts, countries will need to include adequate policies and measures, production and importing targets, as well as plans for infrastructure development into their NECPs.

Renewable electricity

Table 12 rates the quality of information and describes the metric used to assess the quality of information across the Member States' plans for renewable electricity. The first indicators in the table are included in the Governance Regulation, i.e. (EC guidelines to Member States). The other indicators in the table are suggestions made by ECNO for more transparent monitoring of NECPs.

Table 12: Quality of information regarding renewable electricity

	Metric	Description	Rating
Cov. Reg.	Targets	Renewable Energy Directive II are stated and explained	
		Renewable Energy Directive III are stated and explained	
	Policy Support	Policies and measures to support renewable energy build-out detailed	
	Electrification	Electrification measures for industry clearly described	
		Electrification measures for transport clearly described	
		Electrification measures for buildings clearly described	
	Grid enhancement	Plans for grid infrastructure development detailed	
		Grid integration efforts & coordination within the EU described	
ECNO Indicators		Expected level of imported electricity, including from which country	
	Pipeline of projects	Planned & ongoing renewable energy projects within MS detailed	
		Capacity & timeline of renewable energy projects match RED targets	

Rating legend

High coverage: All countries included information and most or all countries included a good level of detail

Medium Coverage: Most countries included information and some countries included a good level of detail

Low coverage: None of the studied countries included adequate information and only few countries provided any information at all

Enhancing grid infrastructure is key for integrating large volumes of geographically disperse renewable electricity sources into the system. In addition, increased interconnection between Member States helps to smooth peaks in demand and supply and stabilise prices, strengthening energy security and resilience. All countries described plans for grid enhancement and infrastructure development, with Spain and Sweden giving details on individual, planned extension projects. Spain, Italy, the Netherlands, Sweden and Hungary all describe ongoing grid connection cooperation with neighbouring

European countries. Most countries spell out the expected level of imported electricity and some countries, e.g. Spain and Italy specify the countries that will supply the imports.

As mentioned, clear electrification measures should be a key part of Member State NECPs. The electrification of industry is a gap across all countries assessed. Only Sweden's NECP provides a list of measures to decarbonise industry, and also mentions how electricity consumption is expected to increase in the sector. Italy, the Netherlands, and Hungary all highlighted the role the electrification of heating will play in decarbonising the buildings sector, especially through home renovation programmes, subsidies for heat pumps and geothermal heating. On transport, all countries provide some information on tax incentives, benefits, and public spending to speed up the switch to electric vehicles, including increasing electric vehicle charging infrastructure. Most countries focus on the electrification of passenger and heavy-duty vehicles.

Outlining a pipeline of planned and ongoing domestic renewable energy projects is crucial for transparency, investor predictability, as well as accountability. Some NECPs provide detailed plans for the rollout of large-scale renewable energy projects including technology differentiation. The Netherlands offers a list of offshore wind projects, paired with timelines and a status update, while Hungary details its plans for solar PV projects. Across almost all countries, the capacity and timeline of projects match the targets. Italy, for example, provides renewable energy targets for each technology for 2020-2030, which all add up to the stated 2030 target for renewable energy.

On the Renewable Energy Directive (RED) targets, most countries explained their RED II targets well. For RED III targets, the information given in most NECPs was less clear. The RED III targets were provisionally agreed to only in March 2023[8] which may be part of the reason for the lack of clarity. Under the updated RED III targets, the NECPs should clearly describe how the country is contributing to reaching the EU's 2030 renewable energy target of 42.5% of overall energy consumption, and break targets down by sector. Some countries did not provide the overall contribution to the RED III target or the sector-level targets. Others only provided sector targets on transport, industry or buildings, e.g., Spain and Italy.

Renewable Hydrogen

Table 13 rates the quality of information and describes the metric used to assess this quality in the Member States' plans for renewable hydrogen. The first indicators in the table are included in the Governance Regulation, i.e. (EC guidelines to Member States). The other indicators in the table are suggestions made by ECNO for more transparent monitoring of NECPs.

Table 13: Quality of information regarding renewable hydrogen

	Metric	Description	Rating
Cov. Reg.	Targets	Targets for production, consumption and integration stated	
Cov. Reg.	Infrastructure	Plans for infrastructure to support production, storage, transportation etc	
Cov. Reg.	Policy Support	Policies and measures to support renewable hydrogen detailed	
Cov. Reg.	Sectoral Integration	Strategies on integrating renewable hydrogen into transport described	
Cov. Reg.		Strategies on integrating renewable hydrogen into industry described	
Cov. Reg.	International Collaboration	Sourcing of imported hydrogen (within EU or from abroad details)	
Cov. Reg.		Collaboration between Member States on hydrogen imports	
Cov. Reg.		Collaboration with partners outside of EU on imported hydrogen	
ECNO Indicators		Planned & ongoing import capacities described	
ECNO Indicators	Pipeline of projects	Planned & ongoing renewable hydrogen projects within MS detailed	
ECNO Indicators		Capacity & timeline of renewable hydrogen projects match targets	

Rating legend

High coverage: All countries included information and most or all countries included a good level of detail

Medium Coverage: Most countries included information and some countries included a good level of detail

Low coverage: None of the studied countries included adequate information and only few countries provided any information at all

To meet the REPowerEU target of 10 million tonnes of renewable hydrogen production by 2030, Member States should detail plans for renewable hydrogen infrastructure, projects, and incentives, according to the EU guidance on NECPs[9]. All countries assessed, apart from Sweden, provide some level of detail for renewable hydrogen production, consumption, and integration targets, although capacities and timelines for reaching those targets are missing. It is also not clear how the Member State targets are linked to the overall EU Hydrogen Strategy, which shows a risk of countries not aligning their targets with the EU targets. Most countries assessed mention some policy support for renewable hydrogen development. Italy provides the most detail by summarizing several investments in renewable hydrogen production projects, including a 500 million EUR investment in at least 10 hydrogen production projects in brownfield industrial areas. The Netherlands mentions investments as well, including a pilot industrial network of seven renewable hydrogen projects in the pipeline totalling 1.15 GW and supported by 800 million EUR in research and development funding. Additionally, Spain and Hungary support the development of demonstration and pilot projects, though the NECPs are missing details. However, for all countries assessed, it is unclear how the investments and projects in the pipeline add up to the stated targets. In addition, it is not clear in all NECPs assessed whether plans around renewable hydrogen is linked to the growth of renewables. It is likely that countries have not considered what renewable hydrogen development means for renewable electricity demand and targets. Lastly, it is worth noting that not only countries specify that hydrogen will be "renewable" or "green", some NECPs only say "hydrogen". Hungary does mention "low-carbon" hydrogen. However, it is promising that using "blue hydrogen" is not mentioned in any of the NECPs assessed. This likely indicates that countries intend to focus on producing hydrogen using renewable sources through electrolysers, at least for new hydrogen capacities added.

The quality of information on renewable hydrogen could be improved across the assessed NECPs. All countries stress the importance of renewable hydrogen in decarbonising industry, but few detail specific measures. Spain and Hungary both reference their national hydrogen strategies, Spain includes a goal of reaching 25% of the consumption of industrial hydrogen of renewable origin in 2030. Hungary estimates that more than half of renewable or low-carbon hydrogen can eventually be used for industry, but the NECP does not provide a timeline. Italy points to a 2 million EUR investment to incentivise decarbonising the industrial sector through renewable hydrogen. The Netherlands' NECP mentions the government is considering introducing a renewable hydrogen purchasing obligation in 2026 and features four industrial clusters in which renewable hydrogen would be integrated into. Sweden highlights the two pilot projects to produce fossil free steel from iron ore and a hydrogen storage facility to be constructed but does not mention any plans for renewable hydrogen production or transport. For the transport sector, Italy, Sweden, and Hungary provide strategies for integrating renewable hydrogen through investments for hydrogen refuelling stations for light and heavy-duty vehicles and rail transport. The NECPs assessed do not mention strategies for using renewable hydrogen for international aviation.

Under the EU Hydrogen Strategy, the EU is developing plans to import renewable hydrogen from countries outside of the EU, as well as facilitating collaboration on renewable hydrogen imports between Member States. The EU guidance on NECPs requests that national plans reflect international partnerships that will facilitate renewable hydrogen imports. Most countries mention the importance of working with international partners and Member States to import renewable hydrogen into Europe through the European Hydrogen Backbone. Italy emphasises how the partnership will link future renewable hydrogen production sites in North Africa to South Italy for distribution throughout the EU. Hungary, Sweden, and the Netherlands also mentions the European Hydrogen Backbone, as well as other regional partnerships such as the Clean Hydrogen Partnership, the Nordic Energy Policy Cooperation and the H2Global programme all to facilitate collaboration between Member States on hydrogen. Overall, details on cooperating between Member States are sparse beyond referencing certain partnerships. Further, while the Netherlands, Italy and Hungary give some information on import capacities - specific targets and sourcing for renewable hydrogen imports, whether from another EU country or internationally, are missing.

2.1.3 Risk of inconsistency

Context

The inconsistency check for renewable electricity and renewable hydrogen attempts to unearth inconsistent assumptions within an NECP, e.g., between stated targets and planned policies, as well to assess the risk of a country failing to meet a stated objective. These risks and/or inconsistencies could point to gaps in the policy landscape or to policies being too weak to achieve their stated objectives. Risks can also simply arise from a plan being unfinished and thus still uncertain in its outcome. Early identification of these risks and potential inconsistencies can help course correct in good time to change policies to achieve 2030 objectives.

Results

The analysis found that **only around a third of the potential inconsistencies are low risk.** As with quality of information, the risk of inconsistency is higher on renewable hydrogen than renewable electricity as plans are less advanced and thus no detailed, self-consistent strategies are communicated yet.

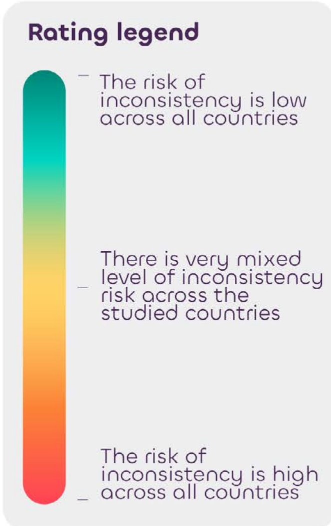
However, even on renewable electricity some risks were identified, notably on achieving the updated RED III targets as most NECPs either do not discuss measures and targets in sufficient detail to provide assurances and where they are discussed they are described as insufficient. Some risks also remain on whether planned policies will be sufficient to achieve the stated goals, with the exception of grid connections which are often already achieving goals.

Renewable electricity

Table 14 below rates the risk of inconsistency between the stated/expected targets on renewable electricity in Member States' plans and their current planning as reported in the NECPs.

Table 14: Risk of inconsistency regarding renewable electricity

Metric	Description	Rating
Targets	Alignment of national target(s) with Renewable Energy Directive II	
	Alignment of national target(s) with Renewable Energy Directive III	
Generation & capacity	Consistency between generation and capacity values per technology	
	Total renewable energy generation consistent with available potential	
Grid enhancement	Risk of failing to achieve the 15% interconnection target	
	Risk of renewable roll-out being hampered by inflexible grid operation	
Policy support	Barriers to renewable electricity roll-out addressed	
	Measures in line with stated targets and projects	



Between the countries analysed there is a low to medium risk that the targets set by the RED II directive for 2030 will not be reached: Only Sweden and Hungary state that they are confident about achieving their RED II targets, and several countries have missed the 2020 interim milestones. With a view to RED III targets, most countries report that current policies will not suffice. This suggests that countries need to increase their ambition levels with regards to RE implementation, especially considering the updated target.

Countries across the board need to update their planning to support the updated EU target for 2030 of 42.5% in final energy consumption, provisionally agreed in March 2023. Few countries clearly state the level of their updated target and how this relates to the overall EU target. This suggests that with current plans and targets that there is a low to medium risk that NECPs are inconsistent with the updated EU target (ambition gap).

Countries generally have taken account of the availability of land within their NECP and reported renewable uptake figures do generally not exceed the potential for renewable energy. However not all countries provide sufficient data on capacity development to allow for a comparison with RE potential/ available land. Some countries also mention that they have taken measures to ensure that siting restrictions are taken account of in developing renewable energy.

Barriers to renewable energy uptake, which would further increase the risk of an implementation gap between targets and policies/projects, have been addressed qualitatively in all NECPs to some degree with Spain and the Netherlands listing concrete measures aimed at reducing these barriers. However, the extent to which these seem sufficiently addressed, based on the information available in the NECP, varies and leads to a low to medium risk of inconsistency.

On grid connections to neighbouring countries, three of the countries already now exceed the 15% requirement. The other two lay out grid strengthening efforts but do not state which level of interconnection these efforts are expected to lead to. In sum, this leads to a low to medium risk on sufficient interconnection between MS. Similarly, the need for flexibility improvements, e.g., through demand response or storage, was discussed in most NECPs, but policy support was only described in high-level, qualitative terms. There remains thus a medium to high risk that integration of large amounts of RE could encounter flexibility hurdles in all assessed countries.

Renewable Hydrogen

Table 15 rates the risk of inconsistency between the stated/expected targets on renewable hydrogen in Member States' plans and their current planning as reported in the NECPs.

Table 15: Risk of inconsistency regarding renewable hydrogen

Metric	Description	Rating
Generation & capacity	Consistency between domestic production and capacity	
	Electricity demand for renewable hydrogen H_2 production accounted for	
International collaboration	Geographical detail on expected import sources	
	Cooperation with other countries on renewable H_2 strategies, import, connections	
	Clarity on which domestic and imported supply will cover renewable H_2 demand	

None of the NECPs provide sufficient detail to assess whether renewable hydrogen production is reflected in the electricity supply. Generally, NECPs mention the use of energy models such as TIMES that hint towards an integrated approach of demand and supply, but there is not sufficient data available to cross-check this for most NECPs. The situation is better for those countries that provide a table in the annexes, but the tables' design/ content unfortunately does not allow for a check on whether sufficient electricity supply was modelled for renewable hydrogen production, either from imports or domestic production.

2.1.4 Conclusions and recommendations

As all Member States finalise their updated NECPs, countries can improve their national plans based on lessons from the five Member States assessed. For transparency on achieving renewable energy targets, Member States can prominently feature both RED II and RED III targets, illustrate the policies and measures necessary to reach these targets, as well as express if they are on track, all to strengthen transparency and accountability. With the RED III targets agreed to in March of this year, it is imperative Member States specify how they plan to contribute to increasing the EU's share of renewable energy and offer targets for the transport, industry, and buildings sectors. To build upon transparent and detailed targets and policies, countries can provide an extensive list of upcoming, large-scale renewable energy projects, in addition to renewable hydrogen plans. In addition, electrification measures for sectors should be a key part of Member State plans. In the NECPs assessed, several countries did not adequately describe electrification measures for industry for example, which is notable considering the plans described for using renewable hydrogen for industry. There seems to be a risk that Member States focus solely on developing renewable hydrogen for industry without investing in electrification measures for industry. According to the EU guidance, initiatives and partnerships that spur collaboration between Member States and internationally on renewable hydrogen imports should also be featured prominently in NECPs. By learning from the NECPs assessed, Member States can ensure country plans are transparent, reduce the risk of inconsistencies and are effective in providing a high level of information for renewable electricity and renewable hydrogen.

2.2 Land-uses

Land is becoming more and more valuable with many competing uses and increased pressure from human activity. The demands in land services, including for the production of food, feed, bioenergy, and wood, are expected to evolve, especially with a society transitioning away from fossil products. At the same time, there is a need for higher capture of carbon while also supporting the preservation of biodiversity. The following analysis provides insights on how countries acknowledge and manage these competitive demands in their NECPs, to meet their diverse objectives.

2.2.1 What and how we evaluate

This chapter evaluates the quality of information and the risks of inconsistencies on the policies and measures influencing land use.

For the analysis of information quality, the availability of information over two levels is evaluated. First whether the basic requirements from the European Commission's governance regulation are addressed. Secondly, whether specific additional information is disclosed that would allow for a deeper analysis. To this end, sixteen indicators have been selected, (e.g., food waste prevention, afforestation, diet change, demographic growth, etc. (see Table 16 for the complete list of indicators). The analysis assesses whether each of these indicators are described in the NECPs.

The risk of inconsistency dimension consists of four main potential inconsistencies. For different land use categories, the analysis assesses how the trade-off is achieved between providing food and products to society, while in the meantime continuing to provide different services, such as regulating the water cycle, sequestering carbon, filtering the air, etc. To this end, three land uses have been analysed: forests, croplands, and wetlands. Inconsistencies related to grasslands and settlements have not been analysed because of a lack of information regarding their use and surface evolution. In addition to the view per land use, an overall assessment is provided, analysing how all land uses are expected to evolve over time and whether this is coherent for a country with a finite area. Finally, a last indicator assesses whether the country's land use strategy is aligned with the EU target for carbon sequestration in natural sinks.

2.2.2 Quality of information

Context

To assess the credibility of an NECP, it is essential that detailed information is provided. They allow to evaluate the feasibility of the targets, as well as the robustness of the underlying computations. Only when a certain level of information is provided, can inconsistencies in the NECP be spotted. Not disclosing some information hinders the big picture view or fails to integrate potential trade-offs. The Governance Regulation requires member states to communicate on their national land-based net carbon removals target. The national plans should go further than disclosing this target, but also indicate transparently how they intend to reach this target. Member States should also better integrate mitigation, adaptation and nature restoration measures. Countries are also expected to communicate on new measures to improve the monitoring of land-uses. Finally, countries are also expected to disclose measures to promote and implement energy efficiency measures related to biomass, including the supply of bio-based insulating materials.

Results

Two distinct assessments have been conducted, the first related to data that **must** be disclosed according to the governance regulation, the second related to data that **should** be disclosed for a deeper analysis.

The first assessment indicated that the requirements from the governance regulation are generally present. However, most countries seem to mention these for the sake of abiding by the governance regulation only: they remain quite abstract and do not provide additional details and transparency on how ambitions will be reached. Sometimes relevant information is not disclosed in the draft NECP but can be found in a separate document referred to by the draft NECP. For instance, measures to improve land monitoring are not covered, but NECPs refer to the country's national forest strategy which covers this topic more extensively. A short summary of the national strategies in the NECP would be welcome, when national plans refer to these external documents.

The second assessment evaluates the availability of more detailed information regarding countries' land use plans. Sixteen indicators have been selected to support the prediction of how certain land uses could evolve. The sixteen indicators were used as a benchmark, and the quality of information of the NECPs has been evaluated based on the extent by which these indicators could be answered by the information available in the draft NECP. Indicators that were most described were plans to "restore wetlands", or the "projected demographic growth". Other indicators were less often addressed in NECPs such as "the creation of protected grassland areas", "development of constructed areas", "wetland restoration planification", or "measures to improve yields through technological improvements". Overall, over 2/3 of the indicators could be answered based on the information available in the NECPs, which is sufficient for a preliminary analysis. A more robust analysis would require more thorough reporting on these different indicators, and consistency in the way they are reported across member states.

Table 16: Quality of information regarding Land use, Agriculture and Forestry

	Theme	Indicator	Score
Governance Regulation	Land use monitoring	Identification of improvements for data collection and land use monitoring	
	Non-CO2 reduction target	Specific reduction targets for non-CO_2 emissions from agriculture	
	Net land use removals	The objective to increase net removals from the land use sector	
	Sustainable biomass use	Measures for the sustainable sourcing and use of biomass	
ECNO Recommended Indicators	Wetlands area evolution	Restauration of wetlands from previously drained areas	
		Planification of land use changes due to wetland restauration	
	Settlements area evolution	Increase of constructed area	
		Demographic growth	
	Croplands area evolution	Plans to reduce food waste	
		Demographic growth	
		Reliance on first generation bioenergy crops	
		Implementation of agroecological practices considering influence on yields	
		Efficiency improvements leading to increased yields	
		Feed production for locally fed livestock	
	Forest lands area evolution	Wood production	
		Afforestation/reforestation	
		Natural carbon sink targets	
	Grasslands area evolution	Plans to increase protected grassland areas	
		Pasture demand for the livestock population	
		Natural carbon sink	

Rating legend

High coverage: All countries included information and most or all countries included a good level of detail

Medium Coverage: Most countries included information and some countries included a good level of detail

Low coverage: None of the studied countries included adequate information and only few countries provided any information at all

2.2.3 Risk of inconsistency

Context

The European Union has increased its objective for natural carbon removals up to 310 Mt CO_2 by 2030. To reach this target, it is crucial that each country contributes to this common goal. Each country has therefore its own carbon sequestration target for 2030. Similarly, the Carbon Removal Certification Framework will provide a framework on how to evaluate the quality of carbon removals. It is important that these criteria are shared by the different Member States to foster sound environmental practices that have a positive impact.

Member States need to align on targets and how to reach them, to contribute credibly to the Paris Agreement, and lead as an example for other countries. However, increasing the land sinks across the EU must be carefully planned as to ensure food sovereignty and other services provided by the different ecosystems. Inconsistencies will be raised where incompatible objectives are expected from a same land use. These inconsistencies will be evaluated for forest lands, croplands, wetlands, and more globally at national scale with the risk of land overlap.

Results

Based on the available information in the NECPs, the risk for four potential inconsistencies has been assessed. First, low inconsistencies are expected regarding the potential trade-off between forest products and sustainable forest management. Second, wetland restoration lacks important contextualisation to allow for a credible implementation, which leads to higher risks of inconsistencies. Third, cropland management also has a higher risk of inconsistency : based on information available in the NECPs, it is likely that countries would have to produce more from croplands (food, feed, energy, and industrial crops), while also supporting more extensive practices. This may increase the need in cropland area, which could have an adverse effect on the country's LULUCF ambition by affecting other land use evolutions. Finally, based on the tendencies regarding the evolution of each land use, a moderate **risk of land overlap and the risk of not meeting the LULUCF** target have been identified.

Forests are countries' most important carbon sink while also supplying raw materials for a wide range of products and energy. Forests should be managed accordingly to further increase their sink potential, while maintaining their productivity. NECPs should detail countries' plans to ensure forests do not lose their carbon sequestration capacity, making them resistant and resilient to increasing natural disasters. The Spanish draft NECP for example lists a series of measures to reduce the risks of forest fires. But overall, draft NECP lack clear and concrete measures for a sustainable management of domestic forest. However, the studied draft NECPs systematically refer to national strategic plans which aim to ensure sustainably sourced-wood and create extensive and resilient forests, rich in biodiversity. They include for example the Hungarian "Forest Act", the Italian "National Forest Strategy" or "National Forestry Accounting Plan", the Dutch "Forest Strategy", the "Spanish Forest Strategy", or "Spanish Forest Plan", and the Swedish "Forest Management Act" or "National Forest Programme". The NECPs would therefore benefit from including some key elements from these strategic plans, such as the future expected forest area, the share of sustainably managed forests, measures, and public funding to ensure improved forest management and ensure resiliency to natural disasters.

There are high uncertainties on the evolution of croplands. It is likely that croplands would need to produce more in the coming years: First, the population is expected to increase for all studied countries, meaning more people to feed. Second, they also need to produce more feed for a livestock which will be more locally-fed. Third, none of the analysed countries predicts a definite phase out of first-generation biofuels produced from crop products, with one country (Hungary) even set to increase its reliance on first generation energy crops. And finally, a biobased economy in 2030 could require more bio raw materials as an alternative to fossil raw materials, such as for insulation, textile, chemical products, etc. Regarding yields, no specific measures are mentioned in the draft NECPs related to technological improvements or research to increase yields. On the contrary, countries plan on increasing organic farming and agroecology which are expected to have lower yields in the short term. Both the increased demand for crop products, with lower yields on average lead to higher demand in cropland area.

On the other hand, the obligation to meet LULUCF targets could lead to the reforestation of croplands, or the restoration of wetlands that have been drained into croplands, leading to a decrease of the total area of croplands. This is not compatible with the previous assessment where cropland area should increase to be able to produce organically and more locally.

This is a clear inconsistency in most NECPs. A **clear roadmap should be developed specifically for the agricultural sector**, addressing how they could continue providing the increasing amount of services, while also contributing to carbon sequestration and biodiversity preservation.

Wetlands also have a crucial role to play when it comes to climate mitigation. It is therefore important that countries include plans to restore these degraded areas. Some NECPs were quite detailed in how many wetlands would be restored (Spain), and how much money would be allocated to that extent (Sweden). Other NECPs simply mention the objective to restore wetlands or plan to reduce emissions from these areas. However, wetlands restoration requires thorough planification since rewetting previously drained areas could mean losing large areas of croplands, grasslands or settlements. This is even more important in countries where large areas of wetlands were drained and converted to croplands (e.g. Netherlands and Hungary). The NECPs are lacking a systemic analysis on how land losses from wetland restoration would be compensated.

Bringing all this together, there is a risk of land overlap in the draft NECPs. In a finite country area, forests, wetlands, croplands, grasslands, etc. cannot all increase simultaneously. To better understand their respective evolution, the sixteen indicators discussed previously were analysed. Each indicator hints towards a projected increase or decrease of a certain land use. The more indicators projecting an increase of their specific land use, the higher the risk of land overlap. The ratio between indicators projecting a land increase versus indicators projecting a land decrease allowed to estimate the risk of land overlap in a country. Both Italy and Sweden had the highest risk of land overlap, with four times more indicators predicting a land increase than indicators predicting a land decrease. The Netherlands and Spain also have a risk of land overlap, with three and two times more indicators predicting a land increase. Hungary had the lowest risk of land overlap, with an equal number of indicators predicting a land increase and decrease.

Finally, the risk of not meeting the EU's net removal target of 310 Mt CO_2 by 2030 is probable. Future land use sinks have been assessed based on the Pathways Explorer model and validated with the LULUCF targets disclosed in the draft NECPs. Both values were then compared to the country's LULUCF target in order to assess the likelihood to reach the EU net removal target by 2030. The Netherlands managed to reduce emissions from their lands sufficiently to reach EU targets. Hungary plans to assume "climate policy legislation that ensures that the Hungarian forest sector approaches this target by 2030", without providing further details about what specific policy legislations are intended, and what specific targets are set. On the other hand, both Spain, Italy, and Sweden provide carbon sink projections that do not meet their national target laid down by the EU.

Table 17: Risk of inconsistency regarding Land use, Agriculture and Forestry

Theme	Potential inconsistency	Score
Land overlap	Are the expected increases in land area compensated by decreases of other lands?	
LULUCF target	Are the country's LULUCF ambitions aligned with the EU's removal targets?	
Forests	Are there plans to manage forests sustainably, to maintain productivity while increasing resistance and resiliency, hence maintaining their carbon sink potential?	
Croplands	Is the projected demand for food, feed, energy or industrial crops compatible with the existing utilised agricultural area (UAA)?	
Wetlands	Does the NECP consider and integrate the land use changes due to wetland restoration?	

Rating legend

- The risk of inconsistency is low across all countries
- There is very mixed level of inconsistency risk across the studied countries
- The risk of inconsistency is high across all countries

2.2.4 Conclusions and recommendations

The quality of information regarding Land use, Agriculture and Forestry in the draft NECPs could be improved by including key targets and information currently available in separate national strategies only. Similarly, the targets for non-CO2 emissions could be more granular, distinguishing targets relative to livestock farming and crop farming. Many indicators are missing that would allow for a deeper and more comprehensive analysis of the draft NECP. NECP should disclose projection for wood production, food waste, bioenergy production, expected yields evolution, protected area planification, wetlands planification, artificialisation planification, etc. to avoid any risk of inconsistencies.

The risk of inconsistencies was the highest for wetlands restauration with a definite lack of planning. The risk of land overlap, and the uncertainty related to cropland evolution was also moderate. Ultimately, the risk that forests would not be managed sustainably is quite limited, thanks to the many national strategies that exist to ensure a sustainable management of forest areas.

The NECPs would further benefit from **adopting a more global and integrative approach,** describing how the agricultural sector would look like in a few years from now, being influenced by multiple external factors that all have a specific impact on the sector: demand, yield, available land, etc. Similarly, that global view would allow project land use changes and identify risks of inconsistencies beforehand.

A general recommendation would be the production of key performance indicators (KPIs) as part of the NECPs. The Commission could produce a list of indicators to be communicated in each NECP. This would provide coherence between NECPs of multiple countries, which would ease the analysis of NECPs and identify potential inconsistencies. For example, asking countries to communicate on a target for food waste reduction, for wood production, for the creation of protected areas, etc. would help to concretely assess how LULUCF targets would be reached, to compare the ambition of different Member States, and to produce a coherent European roadmap.

2.3 Bioenergy

The transition to a low carbon society requires to shift away from fossil energy sources, including the use of biomass for energy production. Biofuels will be increasingly relied upon in the coming years to phase out natural gas, replace fossil fuel, or as an alternative to coal. However, they are only a viable alternative to the extent to which sustainable supply can be guaranteed. The following analysis provides insights on countries' current reliance on bioenergy, how they acknowledge the risks, and how they plan on addressing them in the following years.

2.3.1 What and how we evaluate

This chapter evaluates the quality of information and the risks of inconsistency on the policies and measures influencing bioenergy supply and demand. The analysis assesses how strongly different sectors, such as heating, electricity generation and transport, rely on bioenergy, and how that demand is met, either through domestic production or imports.

In terms of supply, the analysis will also evaluate the reliance on first generation (or simple) biofuels, versus the production of second generation (or advanced) biofuels issued from crop residues, manure, waste, etc.

The assessment of information quality consists of analysing 17 indicators to determine the quality of information according to 6 themes. The first set of indicators allows to determine if the targets set in the Renewable Energy Directives (RED II and RED III) are well stated and addressed by the draft NECPs. The second set of indicators assesses whether policies and measures to support the development of bioenergy are well detailed. The third set of indicators aims to determine whether the fuel switch from fossil fuels to biomass, is promoted and planned. The fourth set of indicators aims to check whether the production of different generations of bioenergy is well defined. The fifth set of indicators aims to establish whether biomass sustainability criteria are being considered. The sixth set of indicators looks at whether the international cooperation necessary for the exchange of sustainable biomass is anticipated and planned.

The risk of inconsistency dimension consists of analysing four main indicators which complement the ones used for assessing the quality of information. The first indicator concerns the alignment of national targets with the RED. The second indicator checks whether the national plans propose the development of the required infrastructure to support the production, storage, transport, etc. of biofuels. The third indicator assesses whether planned measures are aligned with declared targets and projects. Finally, the need for bioenergy imports will constitute the fourth indicator.

2.3.2 Quality of information

Context – what does the legislation require?

High quality information in the NECPs is essential to ensure transparency and accountability in the sustainable procurement of biomass, monitoring, and prioritisation of the use of biomass. High quality information also plays a crucial role in holding governments accountable for their commitments and initiatives.

The Renewable Energy Directives (RED II and RED III) establish sustainability criteria for biomass used in bioenergy to be considered eligible for support. This has as objective to ensure that the production of bioenergy aligns with environmental and climate goals. It sets greenhouse gas emission reduction targets, restricts the use of certain types of biomass, mandates sustainability certification and reporting, and addresses indirect land-use change effects, all aimed at promoting the sustainable production and use of bioenergy in the European Union. The RePowerEU regulation, both for aviation and maritime transport, requires an increasing share of renewable energy in the energy mix, which impacts the reliance on biofuels for existing vehicles or for heavy vehicles where electrification is difficult to achieve.

Results

The table below rates the quality of information and describes the metric used to assess the quality of information in the Member States' plans for bioenergy. The first indicators in the table are included in the Governance Regulation, i.e. (EC guidelines to Member States). The other indicators in the table are suggestions made by ECNO for more transparent monitoring of NECPs.

Table 18: Quality of information regarding bioenergy

	Theme	Indicator	Score
Cov. Reg.	Targets	Renewable Energy Directive II targets are stated and explained	
		Renewable Energy Directive III targets are stated and explained	
	Sustainability	Include plans to promote second- or third generation (i.e. advanced) biofuels	
		Inclusion of sustainability criteria to the production of biomass	
ECNO Indicators		Mention of the cascading principle for the use of biomass	
		Considers the indirect impact of using biomass, especially linked to indirect land use change	
	Policy Support	Policies and measures to support renewable energy build-out detailed	
	Fuel Switch	Integration of bioenergy in the heating sector clearly described	
		Integration of bioenergy in the production of electricity clearly described	
		Integration of bioenergy in the transport sector clearly described	
	Supply	Production of first-generation bioenergy described	
		Production of second-generation bioenergy described	
		Production of third-generation bioenergy described	
	International collaboration	Sourcing of imported bioenergy or bio raw materials (within EU or from abroad details)	
		Collaboration between Member States on bioenergy imports	
		Collaboration with partners outside of EU on imported bioenergy	
		Planned & ongoing import capacities described	

Rating legend

High coverage: All countries included information and most or all countries included a good level of detail

Medium Coverage: Most countries included information and some countries included a good level of detail

Low coverage: None of the studied countries included adequate information and only few countries provided any information at all

On the RED II and III targets, we refer to the analysis provided in section 2.1.2.

Further, NECPs integrate multiple measures and policies designed to support the investment in bioenergy production and utilization. Achieving the targets set by the RED requires further advancement in bioenergy production, particularly emphasizing the sourcing of raw materials. Policies and measures must be robust enough to effectively guide all endeavours and investments towards meeting these targets. For instance, Spain has outlined numerous measures with well-defined objectives, operational mechanisms, and designated responsible bodies, demonstrating a comprehensive approach to supporting the growth of bioenergy.

The fuel switch theme assesses the future use of biofuels in three distinct end-uses: heat, electricity production, and transportation. In all five NECPs, the role of biofuels in transportation was consistently thorough and well-supported, encompassing future blending obligations and biofuel consumption targets. However, the integration of bioenergy for heat or electricity production lacks uniformity across the analysed NECPs. We firmly advocate for achieving a comparable level of detail for these two end-uses as observed in the transport sector, as we believe it would significantly enhance the value of the NECPs.

The anticipated demand outlined earlier requires sufficient supply, ideally with at least reasonable levels of domestic production. The subsequent analysis delves into the information quality concerning the potential production of first, second, and third generation biofuels in the examined NECPs. Generally, the NECPs show a notable emphasis on second-generation biofuels, reflecting the widespread use of waste and residues for energy, attributed to their superior environmental benefits over first-generation bioenergy. A valuable enhancement to the NECPs would involve more extensive discussions on the dependence and anticipated production of both first and third-generation bioenergy within the ultimate domestic bioenergy mix.

A fourth aspect evaluates whether the NECPs incorporate objectives concerning the sustainable procurement of bioenergy. Biomass production requires the utilization of land and may potentially compete with food and feed production. Raw materials for bioenergy production, like soy or palm, can contribute to issues such as indirect land use change and deforestation, etc. The assessment therefore lists four indicators to evaluate whether the NECPs outline plans to ensure the sustainable production of biomass for bioenergy production. A first indicator assessed whether the NECPs plan to transition away from first generation bioenergy to second or third generation bioenergy. Hungary was the only country that predicts a higher reliance on first generation bioenergy. The impact of this decision on land competition and food production were missing from the draft NECP and should be included to provide a full evaluation of this decision. A second indicator consists in the inclusion of sustainability criteria for sourcing biomass dedicated to bioenergy production. Most of the countries address this risk by shielding behind the RED and its stringent guidelines related to biomass procurement. The third indicator is whether draft NECPs consider and integrate the cascading principle, which was only included in the Dutch draft NECP. The last indicator consists in the implementation of measures to prevent indirect land use change resulting from bioenergy production, which was addressed by Spain and Italy, but lacking from the other drafts.

Finally, for a comprehensive understanding of bioenergy demand and supply dynamics, it's crucial not to overlook the role of biomass imports and exports. The final evaluation theme examines whether NECPs address the prospective exchange of biomass with neighbouring countries. The Netherlands addressed the need for a certain quantity of biogas imports. Regrettably, none of the NECPs provide quantitative information on prospective exchange of biomass with neighbouring countries, thereby influencing the thoroughness of the assessment of bioenergy strategies outlined in the NECPs.

2.3.3 Risk of inconsistency

Context

The inconsistency check for bioenergy aims to identify discrepancies within an NECP, such as misalignments between stated targets and planned policies. It also assesses the risk of a country falling short of achieving its stated objectives and signals where a country's domestic production doesn't match its demand, and imports are too heavily relied upon. These identified risks or inconsistencies may highlight gaps in the policy framework or indicate that existing policies might be insufficient to meet their intended goals. Early recognition of these risks and likely inconsistencies provides an opportunity for timely adjustments, allowing for policy modifications to align with the objectives set for 2030. This proactive approach helps ensure that corrective measures can be implemented to enhance the likelihood of meeting – or encourage a review of the feasibility of - the stated goals.

Results

The analysis found that all potential inconsistencies were either medium to low risk, the biggest risk being the lack of consideration to the development of infrastructure to support a roll out of current bioenergy ambition. At a lesser extent, the NECPs would benefit from including specific targets per end use to compare with RED III targets. They could also be improved by integrating a more systemic set of measures and policies, that don't only focus on demand and use, but also on the sustainable production and supply of bioenergy and biomass. Overall, the need for bioenergy imports is quite low, except in the Netherlands where this need has been identified in the draft NECP.

Table 19: Risk of inconsistency regarding bioenergy

Theme	Potential inconsistency	Score
Targets	Alignment of national target(s) with Renewable Energy Directive III	
Infrastructure	Plans for infrastructure to support production, storage, transportation etc.	
Policy Support	Measures in line with stated targets and projects	
Imports	Need for bioenergy imports to meet domestic demand	

Rating legend

The risk of inconsistency is low across all countries

There is very mixed level of inconsistency risk across the studied countries

The risk of inconsistency is high across all countries

A first and major inconsistency NECPs could face, is that of not meeting the actual RED II renewable energy targets, and not achieving the more ambitious targets laid down by the RED III. Most countries have ambitious objectives for the use of renewable energy which should meet RED III targets. However, these objectives are only detailed for bioenergy used in the transport sector. A same level of detail for the use of bioenergy in heating and electricity production would be a great addition, to ensure alignment with RED III targets. More generally, we invite countries to also communicate more transparently on their future targets to ensure coherence with RED III targets.

Another inconsistency risk is related to the prediction of an increased use of bioenergy, without planning to develop the infrastructure to support this increased use. These needed infrastructure changes include, but are not limited to, transforming refineries into biorefineries, developing biogas production plants, developing storage facilities for biogas and bioliquids, installing refining systems to remove impurities from biogas, expand refuelling stations for vehicles, modifying or replacing appliances and equipment to be compatible with biogas to ensure safety and efficiency, etc. However, few NECPs mention investments or a budget to allow for the credible roll out of bioenergy country wide. Spain and Italy mention measure to transform refineries into biorefineries, or to support the injection of biogas into the gas network.

The proposed measures within the NECPs, as identified during the information quality assessment, would need to be sufficiently ambitious to attain the specified targets. While numerous policies have been outlined, encompassing blending obligations, quantified end-use targets, and financial support for bioenergy deployment and research and development, a notable observation is that most of these measures primarily focus on expanding bioenergy use. However, the NECPs lack crucial policies and measures aimed at significantly boosting the domestic production and valorisation of bioenergy to meet the growing demand. Based on this lack in transparency around production targets, a moderate risk of overreliance on bioenergy has been identified. However, while Spain is projected to become a net biogas exporter, the Netherlands are expected to rely on biogas imports. This indicates that more draft NECPs should be evaluated to more accurately identify potential risks of overreliance on biomass or risk of reliance on unsustainable foreign biomass. In any case, to limit such risks, countries should limit their bioenergy deployment to the amount of sustainably and domestically procured biomass, and avoid overreliance on imports.

2.3.4 Conclusions and recommendations

The analysis of the draft National Energy and Climate Plans (NECPs) reveals a consistent trend among countries in integrating RED II and RED III, particularly in the context of biofuels for transportation. The drafts showcase a comprehensive approach to biofuels in transportation, including blending obligations and consumption targets. However, a notable disparity exists in the treatment of bioenergy for heat or electricity production, with strong differences in quality across the analysed NECPs.

The predominant focus on second-generation biofuels underscores the global shift towards utilizing waste and residues for energy, as a replacement of first-generation bioenergy. Nevertheless, there is room for improvement in the NECPs, urging for more discussion on the reliance on first-generation bioenergy, and the need for more research into third-generation bioenergy.

One significant drawback is the lack of mention of investments or budgets to support credible bioenergy implementation on a nationwide scale. Enhancing the NECPs should involve setting realisitc production targets, designating responsible bodies, allocating dedicated budgets, introducing concrete initiatives to boost production, or discuss trade agreements for biomass procurement.

Finally, there are risks related to the significant bioenergy import dependency to meet European bioenergy targets. Bioenergy strategies should be thought of more carefully, as biomass supply has a direct impact on ecosystems also in exporting countries. A robust strategy should not only ensure that projections for use are realistic, but also that plans prioritize their use for very specific end-uses, and that they are based on sustainable production and procurement. These specifications are currently largely missing in NECPs which **leads to risks of unsustainable exploitation and biodiversity issues in country and abroad.**

Finally, the cascading principle suggests that biomass should be valorised according to its highest economic and environmental added value. Following this principle, biomass should only be used for bioenergy when it cannot be used as wood products, reused or recycled. This is an important concept to prevent an overreliance on wood and ensure a sustainable wood procurement. Unfortunately, only the Netherlands currently acknowledge this concept in their draft NECP.

2.4 Long-term geological storage of CO_2

Long-term geological storage of CO_2 will be crucial to achieve climate neutrality, as a mitigation option in industrial sectors with inherent (unavoidable) process CO_2 emissions. According to the EU's strategic long-term vision, BECCS and DACCS technologies could also play a key role in delivering negative emissions after 2050. This chapter however focuses only on carbon capture and storage (CCS) technologies and technological Carbon Dioxide Removals (CDR) only.

2.4.1 What and how we evaluate

This chapter evaluates the risk of inconsistency and quality of information of the policies and measures long-term geological storage (LTGS) of CO_2 provided by Member States.

The **quality of information dimension consists of six main metrics:** expected scale of CCS/CCU action (total amount captured), the capacity of local storage, expected utilisation of local storage capacity, assessment of inherent process emissions, the amounts of CO_2 captured dedicated to CCU and the capacity of transport infrastructure.

The **risk of inconsistency dimension consists of three main potential inconsistencies:** connected to the sources of captured emissions, their final destination and their export.

Many other metrics would deserve being detailed in the plans. The list of chosen metrics above is relatively focused as the descriptions related to the LTGS in the NECPs were generally found to be not detailed enough to analyse them more comprehensively. To minimize the risk of inconsistencies regarding LTGS, the countries deploying these technologies should disclose numerous other indicators related to the projected flows of CO_2 between different sources of the gas and final stages of the CCS/CCU process. Only then would it be possible to precisely determine the expected emissions reduction associated with the implementation of LTGS strategy. Ideally, this would further be accompanied by an estimate of inherent emissions, domestic storage potential, and transport and resource capacities.

2.4.2 Quality of information

Context – what does the legislation require?

The European Commission's recommendations to Member States on the content of the NECPs indicate that the following information related to long-term CO_2 storage should contain:

- Annual aggregated projection of inherent process emissions that will have to be abated through CO_2 capture
- Annual biogenic CO_2 emissions available for capture and storage
- Annual direct air CO_2 emissions captured
- Planned CO_2 transport infrastructure
- Geological CO_2 storage capacity (annually), of which hydrocarbon reservoirs that will be available at the end of exploitation

Long-term geological storage (LTGS) of CO_2 is currently the only available decarbonisation option for remaining emissions in certain hard-to-abate industries. Although for some EU member states (e.g. the Netherlands) these technologies are expected to play an important role in delivering the transition in the medium term, many of the EU countries can achieve their 2030 climate targets without wide-scale deployment of CCS. Beyond the 2030 horizon, these technologies are bound to become significantly more relevant due to their specific role in industrial decarbonisation, and later – due to their potential to deliver negative emissions. Actions taken by governments now are therefore critical for the development of these technologies into the necessary maturity.

Results

In general, **the availability of information regarding the LTGS of CO_2 in the assessed NECPs was low.** The key factor contributing to this assessment was the lack of quantitative data related to this subject in some NECPs, missing metrics in others and lack of clarity with respect to some of the presented indicators. None of the countries managed to include all of the metrics recommended by the EC.

The lowest level of the information availability concerned the capacity of transport infrastructure and the level of inherent emissions that will have to be abated through CO_2 capture. The first theme is probably missing in the documents because of complexities associated with the measurement. The absence of the second metric – assessment of the inherent process emissions– is more concerning. Without this information there are serious limitations to estimating reliably the scale of deployment of CCS/CCU technologies, which will be necessary for the EU to reach its 2030 and 2050 targets.

The quality of information was also found to be low. Some of the metrics are delivered in a more aggregated way, for example by disclosing the total amount of carbon, which is planned to be captured, without singling out the BECC or DACC. However, often metrics are omitted completely (e.g. in the case of inherent emissions). The current and future storage capacity provided the most detailed picture among the investigated themes, which is a positive sign as this metric is key for determining a country's LTGS strategy. The captured emissions was another one of the better-covered themes. However, one of the countries – Italy – delivered an estimated range, cumulative until 2050, which is information of lower quality than annual flows because it's not comparable internationally. The quality of data in the NECPs is also lowered due the lack of clarity. This is particularly true with respect to the divide between CCS and CCU, as well as BECC and DACC. For example, some NECPs consequently refer to 'CCS' in their strategic assessment, but on separate occasions mention also some CCU projects. This may imply that the size of CCU action is limited compared to CCS – but this information is not explicitly stated.

Table 20: Quality of information regarding long-term geological storage of CO_2

	Theme	Metric	Score
Cov. Reg.	Inherent emissions	Assessment of the inherent process emissions that will have to be abated through CO_2 capture	
	Storage capacity	The total amount of CO_2 storage available for CO2 injection (annually)	
ECNO Indicators	Storage utilisation	The total amount of CO_2 actually injected (annually)	
	CCU	The total amount of CO_2 captured and dedicated to further utilisation (annually)	
	Transport infrastructure	The amount of CO_2 which can be transported to storage space with existing infrastructure	
	Captured emissions	The total amount of CO_2 captured (annually)	

Rating legend

High coverage: All countries included information and most or all countries included a good level of detail

Medium Coverage: Most countries included information and some countries included a good level of detail

Low coverage: None of the studied countries included adequate information and only few countries provided any information at all

2.4.3 Risk of inconsistency

Context

The LTGS of CO_2 strategies of member states should be consistent both internally and across different member states to ensure that the plans are possible to be implemented.

As far as the internal consistency is concerned, the LTGS capacity should be used primarily to store inherent industrial process emissions and achieve negative emissions (to balance out emissions that cannot be abated), while CCU should be performed based on DACC and BECC to ensure the climate neutrality of final products. In this way, it is ensured that the carbon from fossil fuel use or industrial processes does not get released after the end of life of products produced based on CCU. Otherwise – by storing combustion emissions – the storage space is used inefficiently, and the risk of inconsistency between the short-term targets and long-term climate neutrality targets increases. Further consequences of storing combustion emissions include fossil lock-in risk, incurring unnecessarily high cost of transition, higher need to deploy essential infrastructure to transport and store CO_2.

International cooperation across Europe is also a very important aspect of the deployment of LTGS of CO_2 technologies. It is needed because access to appropriate storage space is unevenly distributed among the Member States. This creates a potential for inconsistency, as the sum of the amounts of CO_2 which are planned to be exported by different countries may be higher than the amount that the importers plan and are able to store. There are also further accounting risks related to international flows of captured CO_2, e.g. counting exported emissions as “stored” CO_2 in the exporting country, while the importing country decides to utilise rather than store this CO_2. For that reason, the reporting framework not only for the long-term storage itself, but also for the whole CCS/CCU chain, should be standardized and constructed in a way that eliminates the risk of double-counting. And finally, the planned construction of CO_2 transport network should be coordinated on the international level, as there are some obvious synergies to be explored arising from trans-border geographical optimisation.

Results

The results indicate that the risk of inconsistencies related to LTGS of CO_2 is medium. This conclusion is mainly driven by the availability of information.

Since Sweden and Spain did not disclose details about their strategies regarding LTGS of CO_2 in their NECPs, the risk of inconsistencies assigned to all three aspects was “medium” in their case. That is because on the one hand, the NECPs of these countries do not mention the influence of LTGS of CO_2 on GHG emissions, so the risk that such an impact was improperly accounted for is low. On the other hand, the absolute lack of details related to the implementation of CCS/CCU, paired with the fact that countries did not clearly rule out the use of the technology, may in itself be a sign of low-quality planning. This may signal potential internal incoherence of the projections included in the plan (depending on the scale of expected CCS/CCU deployment).

In the case of Hungary, the risk of three potential inconsistencies associated with CCS deployment – related to sources, destination and export of CO_2 – was assessed as high, contrary to Dutch and Italian NECPs, for which these risks were evaluated as low. In the Hungarian NECP, out of the three potential inconsistencies, the most prominent example of potentially inconsistent planning is the confusion about the destination chosen for the captured CO_2. Hungary declares that it will focus mainly on utilisation of the captured carbon, due to insufficient domestic storage space. However, the results of modelling indicate that CCS technologies are expected to deliver negative emissions in industry and power generation sectors from 2040 – which is impossible to achieve with CCU, since utilization usually does not offer durable storage. If Hungary would eventually decide to also deploy CCS (as implied by modelling results), then the NECP lacks the information about the secured storage space abroad. Moreover, only steel production was explicitly named as a priority source sector of captured carbon. The omission of other sectors for which these technologies are even more important (such as cement, where there are fewer decarbonization options), may indicate a risk that CCS/CCU deployment is treated primarily as a cost optimization strategy, with decarbonization dimension coming only as a secondary priority.

The assessment of the other NECPs did not deliver similar examples of conflicting information. It is worth noting, though, that neither Spain nor Sweden disclosed any details regarding the long-term carbon storage (with Sweden indicating only that the process of creating national CCS strategy is ongoing). For that reason, it is impossible to conduct comparably detailed analysis of the Spanish and Swedish NECPs.

Table 21: Risk of inconsistency regarding long-term geological storage

Theme	Potential inconsistency	Score
Sources	Sources of captured CO_2 not indicated clearly	
Destination	Destination of captured CO_2 not indicated clearly	
Export	Storage space in another country not secured (in case of CO_2 export)	

Rating legend

- The risk of inconsistency is low across all countries
- There is very mixed level of inconsistency risk across the studied countries
- The risk of inconsistency is high across all countries

2.4.4 Conclusions and recommendations

This part of the assessment focuses on long-term geological storage of CO_2. However, to properly evaluate the risk of inconsistencies and double counting, the balance of the whole CCS/CCU chain is taken into consideration. That is because proper carbon accounting should differentiate between different sources of captured emissions and options for their final destination, since depending on the combination of the two, the CCS/CCU action will have a different impact on net emissions.

The analysis of provisions regarding LTGS of CO_2 in 5 NECPs unveiled that the quality and availability of data in this area is highly unequal, and in most cases - low. This is a sign that plans regarding deployment of CCS/CCU are not well developed in investigated MS. This is concerning given the role that the technology is expected to play an important role in achieving net zero emissions in the whole economy, through both reducing inherent emissions (especially in the industrial sector) and providing negative emissions in the longer term. Therefore it is important to carefully plan further development in this area: on the one hand, to be prepared to cover inherent emissions reduction needs, and on the other hand – not to invest excessively in their deployment in sectors where other alternatives exist. Moreover, in the light of EU ETS revision – assuming gradual phase-out of free emission allowances in many industrial sectors in the period of 2026-2034 – investment in CCS/CCU technologies should not be postponed. That is why member states should be more transparent and/or enhance their modelling framework to include more quantitative indicators related to LTGS of CO_2.

What is especially concerning is that member states do not assess the volume of inherent emissions (i.e. emissions impossible to avoid on the process level) – so there is no way to know to what extent assumed CCS/CCU pathways stem from the technological necessity, and to what extent from economic optimization based on the assumed costs and availability of these options. The risks associated with this involve overinvestment in CCS/CCU in the medium term in order to realize the 2030-2040 targets, thus reducing emissions in sectors where there are other alternatives. This in turn could result in slower growth of these alternative technologies (e.g. green hydrogen production), and their limited potential for triggering reductions in the longer term. Another consequence of missing estimates of inherent emissions is the possibility of choosing suboptimal decarbonisation options from the perspective of the whole EU – some countries may rely on natural sinks on their decarbonisation pathway and abstain from LTGS of CO_2, thus forcing other countries to realise more difficult emissions reductions. Risks associated with overreliance on LTGS include also choosing more costly transition pathway than those assuming higher ambition regarding other decarbonisation measures, such as enhanced circularity, demand reduction etc. There are also limitations regarding storage capacity (mainly infrastructure-wise and from social acceptance perspective)[10].

Moreover, the analysis showed that there is an urgent need to develop uniform framework for reporting trans-border flows of emissions. The framework should take into account not only the source from which the emissions were captured, but also the final destination of the CO_2 in the importing country (i.e. whether it is stored or used, or further exported. Reporting standards would ensure that there is no double-counting of emission reductions. That is connected with another recommendation, that plans to export emissions should also include information about secured storage capacity in the receiving country.

A final conclusion following from the analysis is that only few countries clearly declare what part of the captured carbon will be stored, and what part is expected to be further used. However, CCS and CCU are not equivalent from the point of view of carbon accounting. Governments should make clear distinction between these technologies, not only in their communication, but also in their modelling.

3. Results of the modelling-based assessment per country

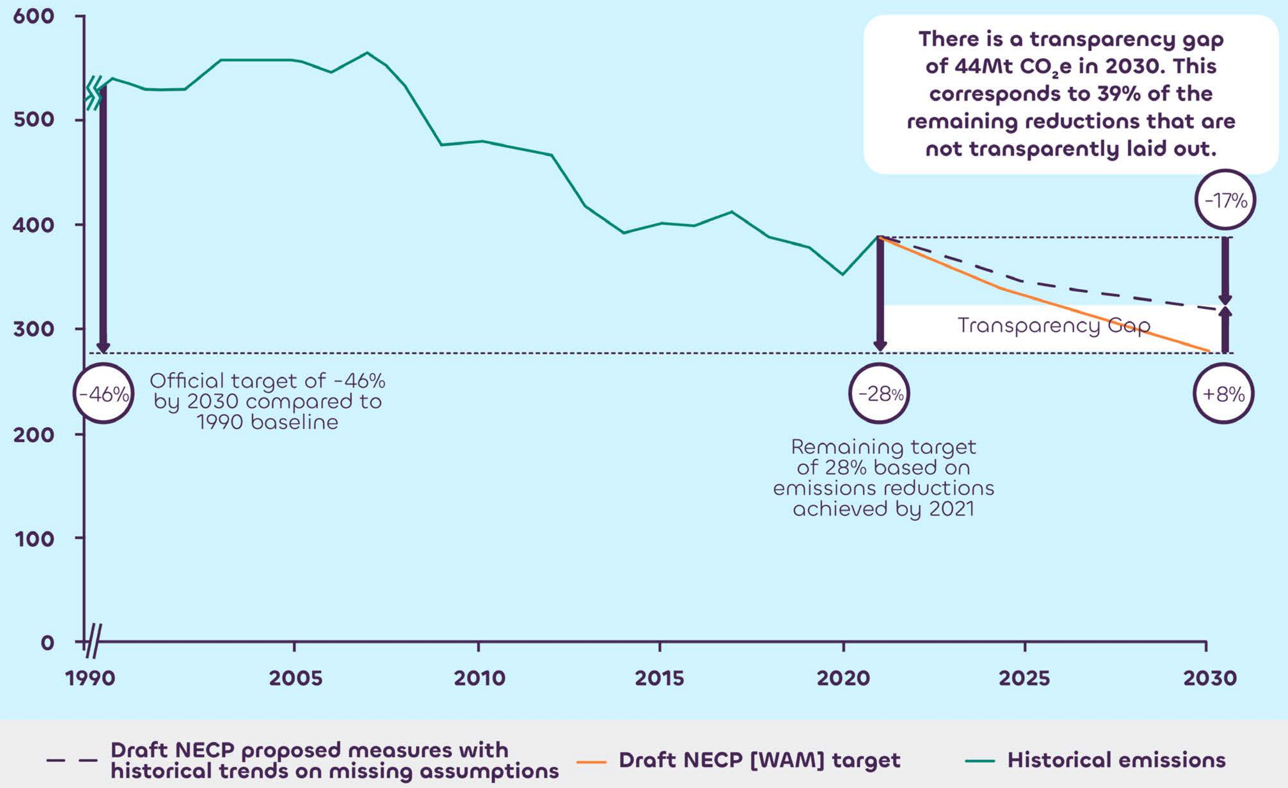
In this section we look at the results of the analysis we have undertaken country by country. By reproducing the draft NECP in the Pathways Explorer[11] and analysing the four themes based on the detailed PAMs and the underlying indicators modelled, we were able to carry out a detailed assessment of some of the critical issues of the four themes laid out above. The findings thus provide concrete insights of the strengths and weaknesses of the current draft plan for each country, and highlights issues that need urgent attention when finalising the plan.

3.1 Italy

3.1.1 Transparency gap on emissions

The lack of transparency on key measures can increase the risk of missing the emissions target. The transparency gap in the Italian draft NECP[12] is estimated at around 44 $MtCO_2e$: this corresponds to 39% of the remaining reductions that are not transparently laid out and for which historical trends assumptions were made. In other words, only 17% of the 28% of remaining reduction by 2030 compared to 2021 baseline are transparently described, as illustrated in Figure 2.

Figure 2: Italy, total GHG emissions (including LULUCF) [Mt CO_2e]



In Figure 2, the scenario "draft NECP (WAM)" corresponds to the scenario "With Additional Measures" (or WAM) published in the Italian draft NECP. Its emissions are including LULUCF.

The contribution to the transparency gap is generally higher in the sectors that emit the most and where the quality of information is poor. This breakdown does not follow the official CRF but is based on a cross-sectoral logic: if part of the transparency gap is due to electricity demand in buildings, it will be found in the buildings sector. To reduce the transparency gap, the final NECP may be completed with the missing indicators and metrics. For details of each sector, please refer to annexes “4.1 Country annexes”.

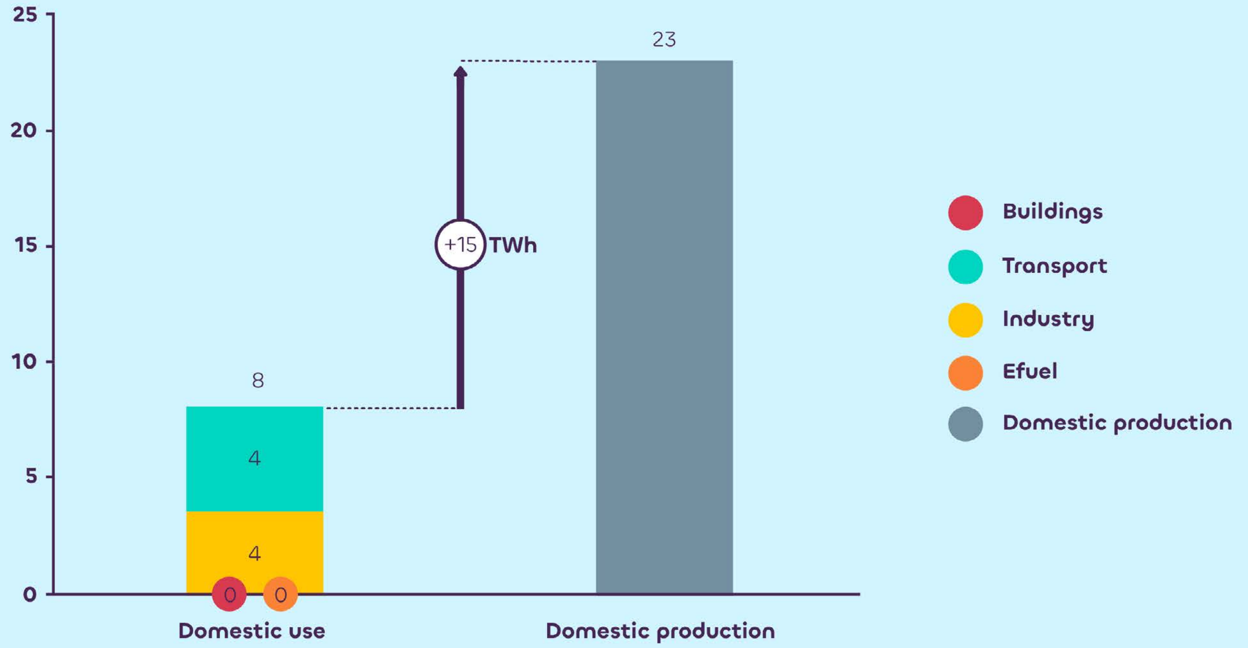
Table 22: Transparency gap per sector for Italy. For details of each sector, please refer to annexes “4.1 Country annexes”.

Sector	Sector contribution to the transparency gap
Buildings	+2.1 Mt CO_2e
Transport	+22.6 Mt CO_2e
Industry	+12.3 Mt CO_2e
Energy production	+5.2 Mt CO_2e
Agriculture, Forestry and land-use	+2.0 Mt CO_2e
Total	**+44.2 Mt CO_2e**

3.1.2 Hydrogen

The NECP draft is clear on the anticipated volumes of renewable hydrogen consumption in 2030: 4.5 TWh for transport and 3.8 TWh for industry. On the production side, however, the Italian draft NECP is less clear: it states that 3 GW electrolysers will produce 80% of this demand and that the remaining volumes will be imported[13]. On the other hand, the National Hydrogen Strategy[14], published in 2020, mentions the installation of 5 GW of electrolysers and the production of around 0.7 Mton/year of renewable hydrogen[15]. Assuming a lower heating value conversion factor (33.3 kWh/kg), this would correspond to a production of 23 TWh in 2030. The final Italian NECP should thus clarify, and be more consistent around, its hydrogen target for 2030.

Figure 3: Italy, estimated domestic use and production of hydrogen in 2030 [TWh]



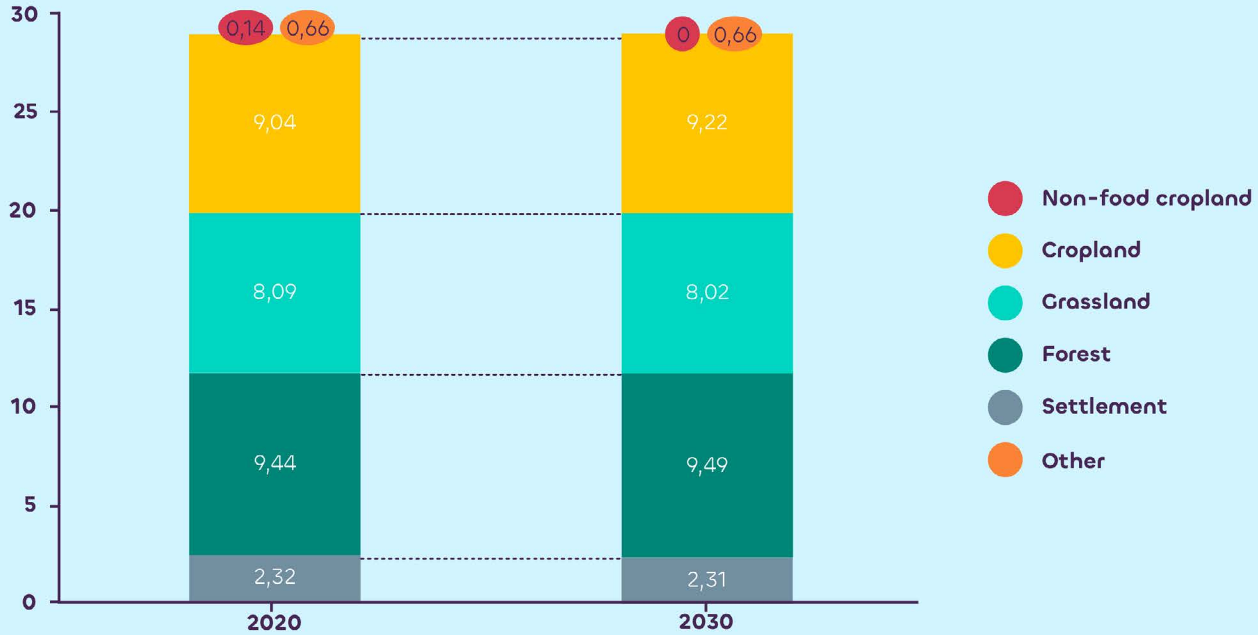
In the scenario derived from our modelling (see Figure 3) **Italy would be a net exporter in 2030, contrary to what is indicated in the NECP draft.** Following our model's assumptions on hydrogen production efficiency, electricity demand would be around 12 TWh for domestic hydrogen demand, and around 21 TWh for hydrogen exports. The total of 33 TWh of electricity would represent around 15% of RES electricity production in 2030.

3.1.3 Land-uses

The Italian draft NECP does not contain enough information regarding land use change by 2030. No quantified projections are shared regarding land use change. Similarly, few measures or policies are described that would support an eventual change in land use. Based on the available information, a decrease in non-food croplands has been projected with our model, with Italy aiming to reduce its reliance on energy crops. Little information is provided regarding projections of croplands, forests, or grasslands. When adding assumptions based on historical trends, to the few available measures, the land use evolution in the graph Figure 4 has been projected.

From these projected land use changes and measures to improve soil management, the evolution of carbon sequestration in Italian soils has been computed and is expected to increase by 2030 up to -30.59 $MtCO_2$. The Italian draft NECP projects an even bigger increase in sequestration up to -34.9 $MtCO_2$. However, both fall below the EU target of -35.8 $MtCO_2$, as required in the revised LULUCF regulation. **There is a significant risk that Italy does not meet its LULUCF target.** However, this conclusion is based on numerous assumptions, since key measures are missing that could have a big impact on land use change and resulting LULUCF emissions. For instance, Italy provides historical trends for all land uses, but fails to integrate future trends. Reforestation or wetland restoration targets could be included, but also measures that have a direct impact on land demand, such as food waste reduction policies, measures to reduce or halt artificialisation, etc. Once integrated, these measures allow to estimate more credibly the evolution of different land uses and to calculate more credibly the future land use sequestration capacity.

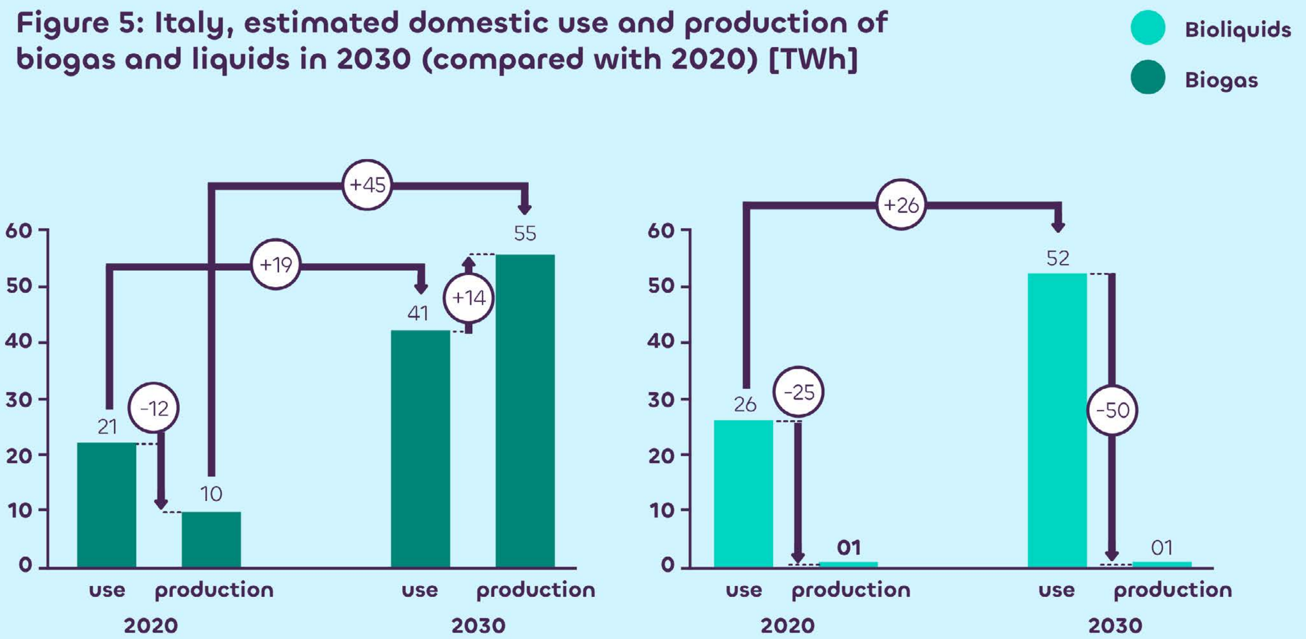
Figure 4: Italy, estimated land allocation in 2030 (compared with 2020) [M ha]



3.1.4 Bioenergy

The Italian NECP provides overall good information on the Italian bioenergy landscape in 2030, although it needs to ensure it is sustainably sourced. In the mimicked draft NECP, biogas for heating is expected to have replaced 10% of natural gas by 2030 and constitute 70% of the total biogas demand. Liquid biofuel in fuel blends for road transport is assumed to make up more than 10% of the fuel mix and accounts for about 80% of the total bioliquid demand. The production of advanced biofuels is prioritized in the model and in the draft NECP. The volume of advanced biofuels that can be produced depends on the availability of secondary raw materials and the extent of which they are collected and valorised. This biomass supply potential is unfortunately missing in the draft NECPs and would make a great addition, as it would highlight the eventual need for imports or exports. In the model , the production of liquid biofuels remains low as they are mainly first-generation biofuels, and the model thus projects to reduce their use, in line with Italy's objective to phase out first-generation biofuels.

Figure 5: Italy, estimated domestic use and production of biogas and liquids in 2030 (compared with 2020) [TWh]



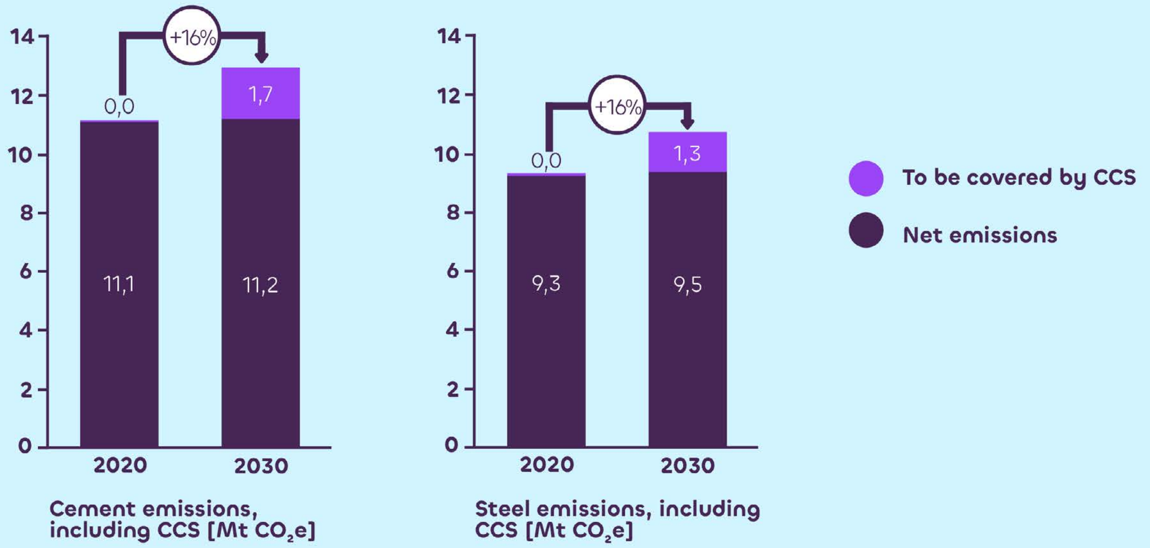
In the draft NECP, production targets are provided for biogas but not for liquid biofuels. The draft NECP projects a domestic production of 5.7 bcm (55.7 TWh), which closely matches our projections (55.0 TWh). Both academic research[16], as well as results from the European Commission[17], evaluate the potential biogas production as higher (63.5 TWh and 57.0 TWh respectively). There is therefore a **limited risk not to be able to reach this biogas production target, and a high probability to be able to cover domestic demand**, as shown in the graph Figure 5.

In terms of liquid biofuel production, the draft NECP would benefit from disclosing similar production targets to allow for a thorough assessment of the bioenergy strategy. The Italian NECP also describes the procurement of raw material, with 80% coming from waste and materials from the agricultural holdings producing them, and the remaining 20% from their crops of second harvest, which supports our assumption to phase out first-generation biofuels. Overall, the Italian NECP provides a high level of detail regarding bioenergy use and production, allowing for a deeper analysis and feasibility assessment.

3.1.5 Long-term geological storage of CO_2

The CCS ambition of the Italian draft NECP seems moderate, compared to the emissions of the sectors covered by CCS. In 2030, Italy plans to capture and store 3.6 $MtCO_2e$ with CCS technologies, mainly in cement and steel sectors. The information available in the NECP had to be supplemented by following assumptions: first, the 3.6 $MtCO_2e$ of CCS in 2030 are shared between cement industry (1.7 $MtCO_2e$), steel industry (1.3 $MtCO_2e$) and the remaining 0.6 $MtCO_2e$ of CCS are covered chemicals industry. The evolution of net GHG emissions and emissions covered by CCS is shown in graph Figure 6 for both sectors.

Figure 6: Italy, cement and emissions including CCS



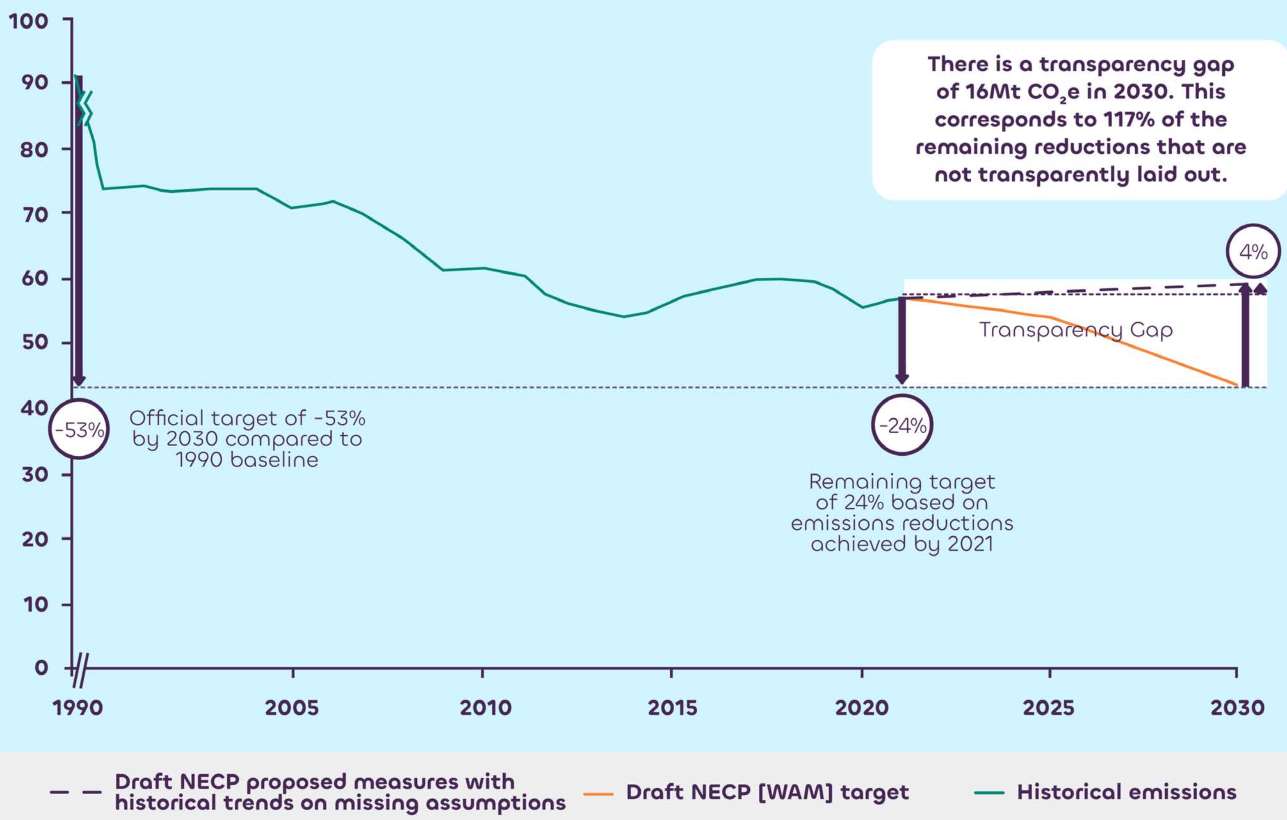
That ambition seems moderate since around 13% of cement emissions and 12% of steel emissions would be covered by CCS. In addition, the energy needed in 2030 to capture this volume is estimated at 0.4 TWh for the cement sector and 0.3 TWh for the steel sector (the energy for storage and transport of the captured CO_2 is not quantified). It represents respectively 2% of the cement energy consumption and 1% for the steel sector, which should therefore not generate any risk of supply.

3.2 Hungary

3.2.1 Transparency gap on emissions

The lack of transparency on key measures can increase the risk of missing the emissions target. The transparency gap in the Hungarian draft NECP[18] is estimated at around 16 MtCO_2e: his corresponds to a 4% increase in 2021 emissions if historical trends assumptions are made on indicators not available, instead of the 24% remaining reduction by 2030 compared to 2021 baseline, as illustrated in the Figure 7.

Figure 7: Hungary, total GHG emissions (including LULUCF) [Mt CO_2e]



In the graph, the scenario "draft NECP (WAM)" corresponds to the scenario "With Additional Measures" (or WAM) published in the draft NECP and is including LULUCF. However, since the LULUCF emissions are not reported in the draft NECP, the following assumptions have been made based on historical trend: -6 MtCO_2e per year from 2021 to 2030.

The contribution to the transparency gap is generally higher in the sectors that emit the most and where the quality of information is poor. This breakdown does not follow the official CRF but is based on a cross-sectoral logic: if part of the transparency gap is due to electricity demand in buildings, it will be found in the buildings sector. To reduce the transparency gap, the final NECP may be completed with the missing indicators and metrics. For details of each sector, please refer to annexes "4.1 Country annexes".

Table 23: Transparency gap per sector for Hungary. For details of each sector, please refer to annexes "4.1 Country annexes".

Sector	Sector contribution to the transparency gap
Buildings	+3.0 Mt CO_2e
Transport	+5.5 Mt CO_2e
Industry	+2.1 Mt CO_2e
Energy production	+1.9 Mt CO_2e
Agriculture, Forestry and land-use	+3.3 Mt CO_2e
Total	**+15.7 Mt CO_2e**

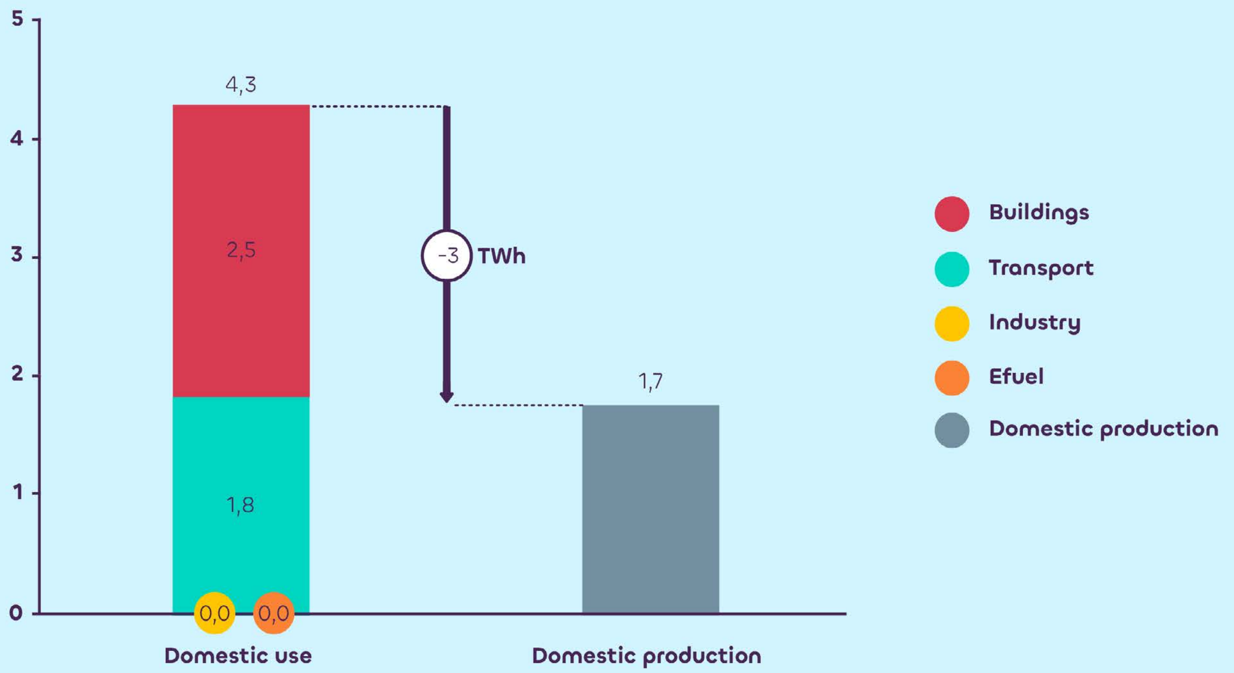
3.2.2 Hydrogen

Hungary's NECP draft contains some of the required information on hydrogen production and consumption, but as we find a likely gap in production to meet the overall hydrogen ambition, the plan would benefit from clarifying the source and volumes of imports.

On the production side, according to the National Hydrogen Strategy (2021), Hungary aims to produce 36 thousand tonnes of carbon-free and 16 thousand tonnes of low-carbon hydrogen by 2030. Assuming a lower heating value conversion factor (33.3 kWh/kg), this would correspond to a total production of 1.7 TWh in 2030, reproduced in the chart below. In contrast to this target, the draft NECP mentions at least 240 MW electrolyser capacity by 2030, potentially generating only about half of this amount (~0.8 TWh). The Hungarian draft NECP also does mention "low-carbon" hydrogen, making the source rather unclear.

With regards to consumption, our estimates for 2030 are based on a reproduction of the projections of the final energy consumption at the end of the draft NECP. According to them, the transport sector will consume the most hydrogen, while industrial hydrogen consumption remains quite low. In contrast to this estimation, the draft NECP cites Hungary's National Hydrogen Strategy focusing on both industrial and transport uses.

Figure 8: Hungary, estimated domestic use and production of hydrogen in 2030 [TWh]

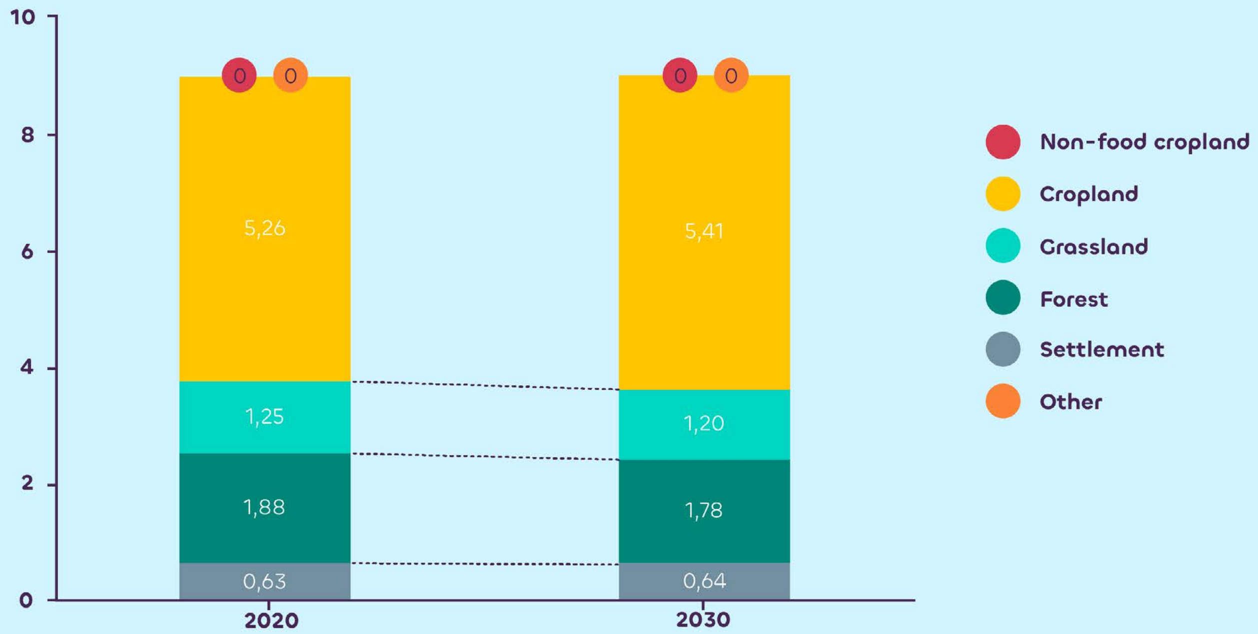


In the scenario derived from our modelling (see Figure 8), our estimates suggest that **Hungary will cover less than half of the total sectoral demand with domestic production** and will be a net importer of hydrogen by 2030. The draft NECP however provides no quantified information on imports. It briefly mentions EU cooperation but with very preliminary information. The final Hungarian NECP should contain this information in a transparent manner to avoid such inconsistencies.

3.2.3 Land-uses

The Hungarian draft NECP does not contain enough information about land use changes. Indeed, the draft NECP is quite vague regarding measures and targets related to agriculture, forestry, and land use. Based on the available measures influencing directly or indirectly the demand for land, we were able to project the evolution of certain land uses for 2030, as shown in the graph Figure 9. Assumptions were made regarding measures that were not described in the Hungarian draft NECP.

Figure 9: Hungary, estimated land allocation in 2030 (compared with 2020) [M ha]



Based on these assumptions and subsequent land use changes, the carbon sequestration in Hungarian soils is expected to increase by 2030. Sequestration from LULUCF is estimated to reach -6.6 $MtCO_2$ by 2030 in the projections from our model. The modelled WAM from the draft NECP showed that the **Hungarian LULUCF target will likely be reached** by a clear margin.

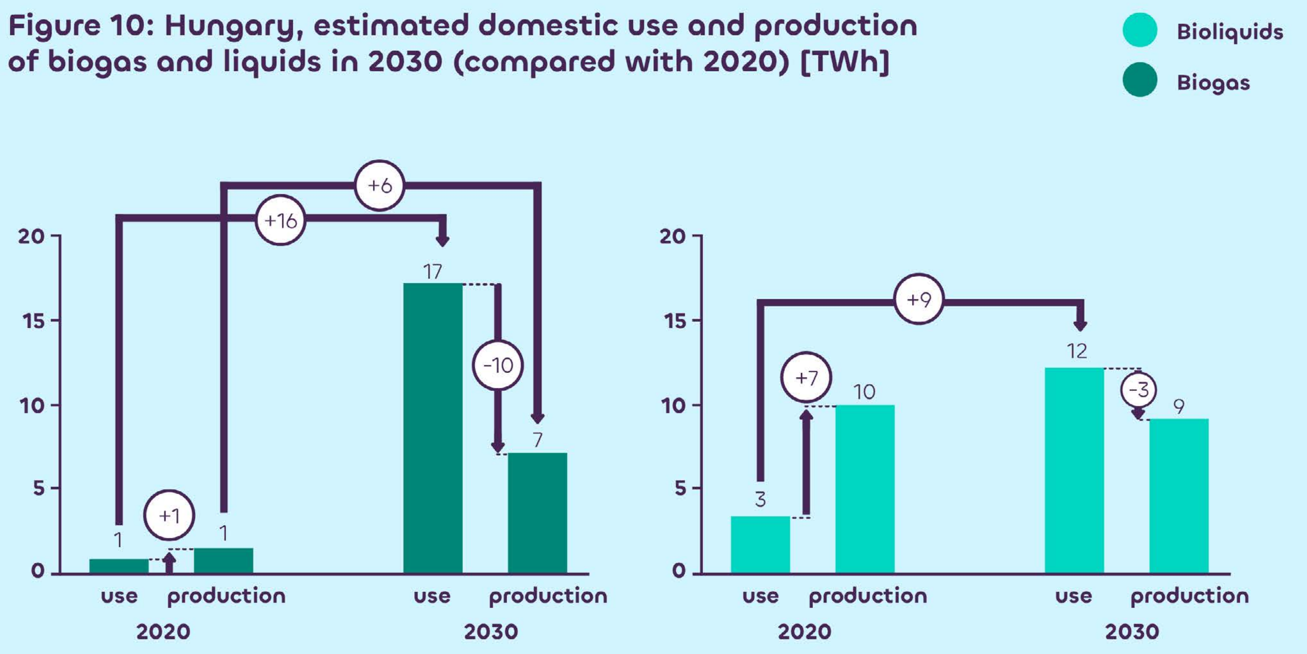
The revised LULUCF regulation expects by 2030 that sequestration from the land use and forestry sector increase to -5.7 $MtCO_2$. However, the Hungarian draft NECP lacks a LULUCF target. Hungary plans to assume “climate policy legislation that ensures that the Hungarian forest sector approaches this [LULUCF regulation] target by 2030”, without providing further details about what specific policy legislations are intended, and what specific targets are set. Key measures are missing, such as a quantified reforestation or wetland restoration targets, food waste reduction objectives, measures to reduce or halt artificialisation, etc. Once integrated, these measures will allow to estimate more credibly the evolution of different land uses. Having clear projections of the evolution of the different land uses is essential for multiple purposes. First it will allow to estimate the projected services that could be provided by the different lands. Hungary computes a limit to the supply of forest firewood by 2030, but this capacity is strongly correlated to the evolution of the forest lands. Secondly, it will allow to assess the country’s natural carbon removal capacity and whether Hungary can reach its target laid out by the EU in its revised LULUCF regulation. Finally, it will allow to spot potential threats or inconsistencies for 2030.

A major inconsistency currently is the decrease in forest area in the model, whereas the draft NECP plans to increase the area of forested land. This is due to the draft NECP providing clear and detailed projections for the energy and non-energy related emissions of the agriculture sector, while providing less details for the land use sector. Therefore, the replication aimed to match the agricultural emissions that led to a certain land demand, which resulted in deforestation. This is an interesting result, as it might highlight a weakness in the draft NECP, where energy and non-energy sectors are modelled separately with different models and could potentially be incompatible.

3.2.4 Bioenergy

Overall, bioenergy production and use are only vaguely integrated into the Hungarian draft NECP. An increased use of biofuels has been assumed in the model. Biogas will mainly be used for electricity production, and to a lesser extent for transportation and the production of heat. A final use of 17 TWh of biogas is obtained, to allow Hungary to reach its overall GHG emission target. Liquid biofuels will mainly be used for transportation. The production of liquid biofuels is not projected to decrease over time, in contrast to the other analysed NECPs. **Hungary further is set to rely even more on first-generation biofuels from food and feed than at present.** The multiple risks associated with the use of first-generation biofuels should be carefully accounted for and integrated in the country's energy strategy.

Figure 10: Hungary, estimated domestic use and production of biogas and liquids in 2030 (compared with 2020) [TWh]

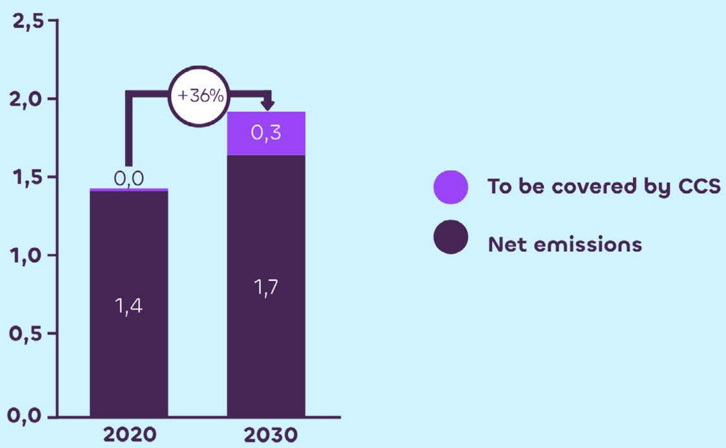


The modelled total use of 17 TWh of biogas is quite ambitious and in contradiction with the country's domestic production potential. This domestic production amounts to 7 TWh in the scenario, or to 1 bcm (9.8 TWh) in the European Commission's estimates[19]. Based on our modelling results shown in Figure 10, Hungary could become a net biogas importer putting even more pressure on the European biomass market.

3.2.5 Long-term geological storage of CO_2

The Hungarian draft NECP only mentions CCS as a measure to be applied in hard-to-abate industrial sectors. There is very little quantitative or qualitative information on the deployment of CCS/CCU, although the country declares CCS/CCU will be necessary to achieve climate neutrality. Due to the lack of quantified ambition, the assumption was made that CCS technologies plays a very limited role in 2030 and mainly in the cement sector, where there are fewer decarbonization options. More precisely, the graph Figure 11 shows the evolution of cement emissions assuming 0.3 $MtCO_2e$ of CCS in the cement industry.

Figure 11: Hungary, cement emissions [Mt CO_2e]



This moderate ambition implies an energy need of 0.1 TWh in 2030 to capture this volume (the energy for storage and transport of the captured CO_2 is not quantified). It represents 4% of the sectorial energy consumption, which should therefore not generate any risk of supply.

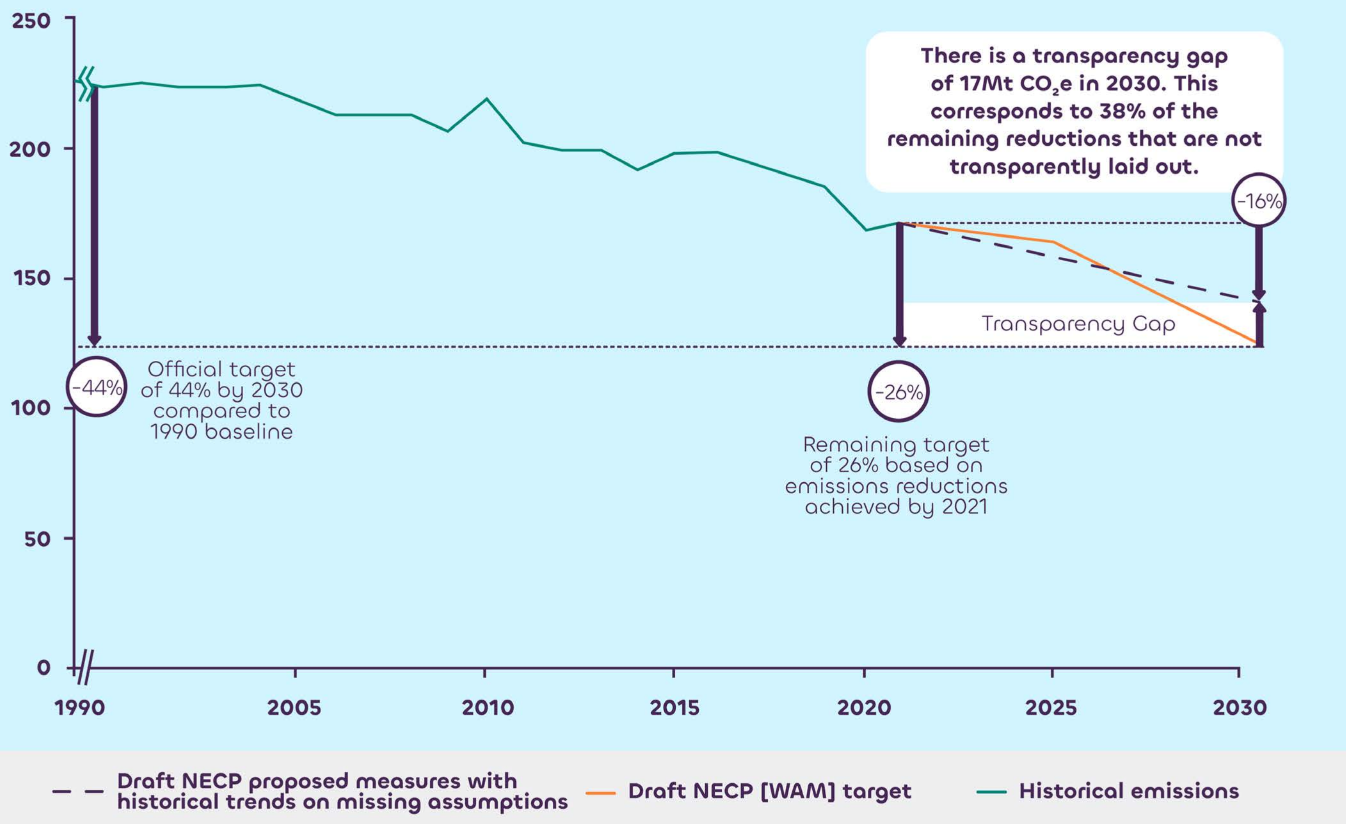
3.3 The Netherlands

3.3.1 Transparency gap on emissions

The lack of transparency on key measures can increase the risk of missing the emissions target. The transparency gap of the draft NECP of the Netherlands[20] is estimated at around 18 $MtCO_2e$: this corresponds to 38% of the remaining reductions that are not transparently laid out and for which historical trends assumptions were made. In other words, only 16% of the 26% of remaining reduction by 2030 compared to 2021 baseline are transparently described, as illustrated in Figure 12.

The scenario “draft NECP (WAM)” corresponds to the scenario “With Additional Measures” (or WAM) published in the appendix 5 of the draft NECP. Its emissions are including LULUCF. This scenario has been corrected to include the CO_2 captured presented in the appendix 5’s memo items, which was not included in total GHG emissions.

Figure 12: The Netherlands, total GHG emissions (including LULUCF) [Mt CO_2e]



The contribution to the transparency gap is generally higher in the sectors that emit the most and where the quality of information is poor. This breakdown does not follow the official CRF but is based on a cross-sectoral logic: if part of the transparency gap is due to electricity demand in buildings, it will be found in the buildings sector. To reduce the transparency gap, the final NECP may be completed with the missing indicators and metrics. For details of each sector, please refer to annexes "4.1 Country annexes".

Table 24: Transparency gap per sector for The Netherlands. For details of each sector, please refer to annexes "4.1 Country annexes".

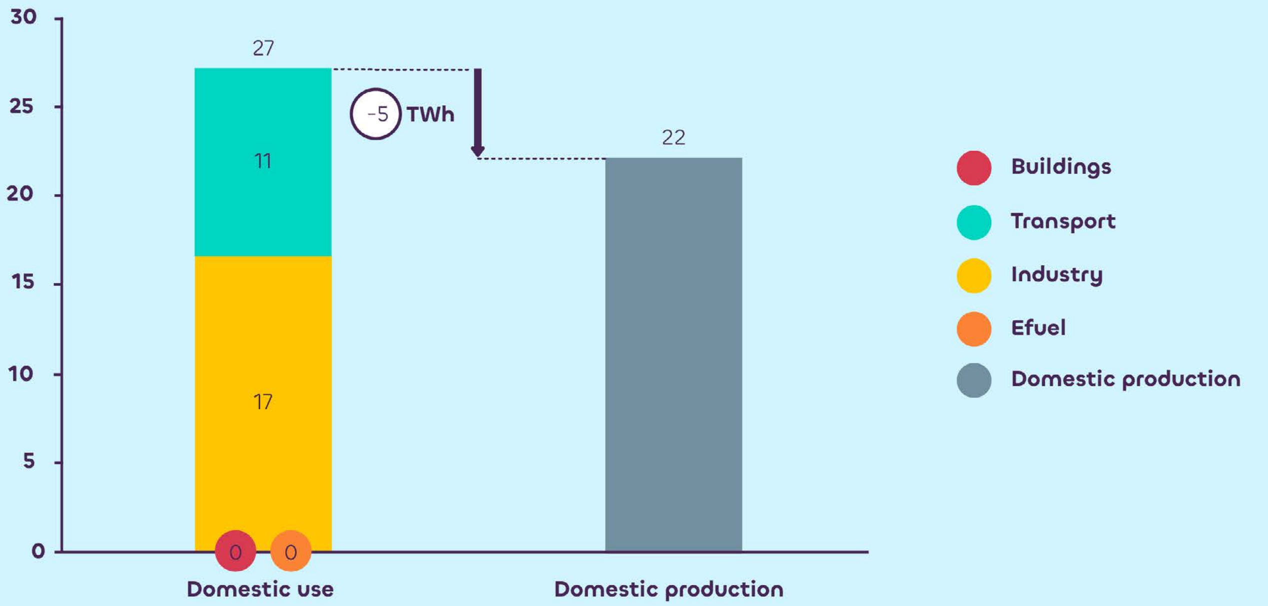
Sector	Sector contribution to the transparency gap
Buildings	+ 3.5 Mt CO_2e
Transport	+ 0.3 Mt CO_2e
Industry	+ 2.4 Mt CO_2e
Energy production	+ 5.3 Mt CO_2e
Agriculture, Forestry and land-use	+ 5.4 Mt CO_2e
Total	**+ 16.9 Mt CO_2e**

3.3.2 Hydrogen

The Dutch draft NECP contains targets for production, but no targets for consumption nor for imports or exports. The draft plan mentions between 3 and 4 GW of electrolyser capacity in 2030. The hydrogen production target is accompanied by a strategy to finance electrolyser installation, although the current strategy only plans support for a total installed capacity of 2.25 GW. The draft NECP does not mention any explicit targets for the consumption of hydrogen but sees a role for trucks and buses and to replace diesel trains and aviation. The NECP also directly references that the development of a hydrogen transport network is underway, although the initiative seemingly remains voluntary at this point and is demand driven.

Moreover, the draft NECP mentions the national hydrogen roadmap "Routekaart Waterstof"[21]. This roadmap suggests that the renewable hydrogen use will be between 11 and 22 TWh for industry and between 5 and 16 TWh for transport. For the production, the roadmap mentions a target of 22 TWh of renewable hydrogen by 2030, which would require between 6 and 8 GW electrolysis. However, this capacity is not aligned with what the draft NECP mentions. The final Dutch NECP should ideally contain this information in a transparent manner to avoid such potential inconsistencies.

Figure 13: The Netherlands, estimated domestic use and production of hydrogen in 2030 [TWh]



Assuming the average values of the intervals mentioned for the consumption, the Netherlands would be a net importer in 2030, as shown in Figure 13. These estimates suggest that the Netherlands will not cover all sectoral demand with domestic production and will need to import 5 TWh of hydrogen in 2030[22].

Following our model's assumptions on efficiency of hydrogen production, around 41 TWh of electricity will be needed in 2030 to cover the domestic production of 22 TWh of renewable hydrogen. **This represents between 30% and 40% of the renewable electricity production. These renewable electricity needs risk competing with other sectors that are relying on electrification to decarbonise.** The final NECP should thus be clear how the 22 TWh of hydrogen will be generated ; and if needed, adjust overall hydrogen ambition to a volume of renewable hydrogen that can realistically be produced.

3.3.3 Land-uses

The Dutch draft NECP does not contain enough information pertaining to land-use changes. Based on the available targets and measures influencing directly or indirectly the demand for land, the evolution of certain land uses has been projected for 2030 and is shown in the Figure 14 . Information that was used include the projected demography growth, livestock population decrease, forest strategy. Based on these land use changes, the carbon sequestration in Dutch soils is expected to increase by 2030. Based on these land use changes, the carbon sequestration in Dutch soils is expected to increase by 2030. Emissions from LULUCF will reach 1.85 $MtCO_2$ in 2030.

Both the approximated WAM from the draft NECP, as projections from the draft NECP, showed that the **Dutch LULUCF target is expected to be reached** by a clear margin. The regulation on LULUCF expects by 2030 that emissions from the land use and forestry sector decrease to 4.5 $MtCO_2$. The NECP projects to reduce emissions down to 3.7 $MtCO_2$, and our scenario projects an even bigger decrease in LULUCF emissions. There is therefore a limited risk that the Netherlands fail to deliver on their LULUCF objective. However, this conclusion is based on numerous assumptions, since key measures are missing that could have a big impact on land use change and resulting LULUCF emissions. For instance, quantified reforestation or wetland restoration targets, food waste reduction objectives, measures to reduce or halt artificialisation, etc are missing from the Dutch draft NECP. Once integrated, these measures allow to estimate more credibly the evolution of different land uses. Having clear projections of the evolution of the different land uses is essential for multiple purposes. First it allows to estimate the projected services that could be provided by the different lands. Could the forests in 2030 produce enough wood to meet the 2030 demand? Could the 2030 croplands produce enough food and feed, while in the meantime implementing an increasing share of sustainable practices as is proposed in the draft NECP? Secondly, it allows to assess the country's natural carbon removal capacity and whether the country's EU target could be reached. Finally, it allows to spot potential threats for 2030. In this case, losing 100 kha in grasslands could be worrying, as it would impact the natural habitat of many species, disturb the water cycle, influence air quality, etc.

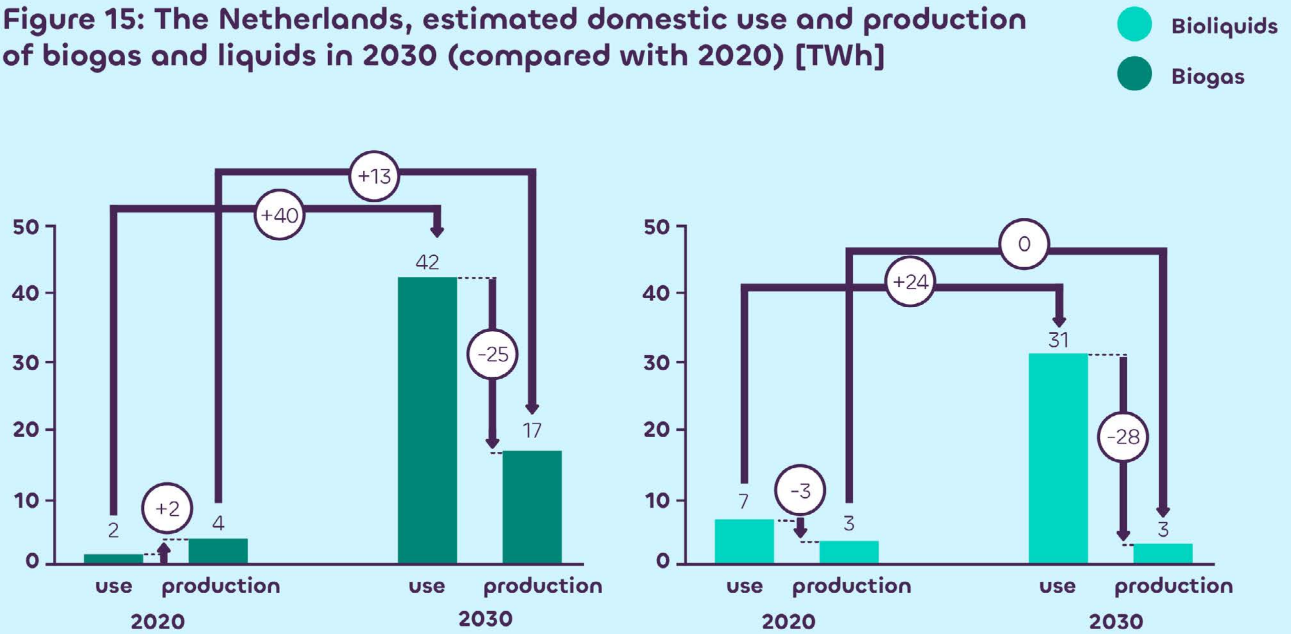
Figure 14: The Netherlands, estimated land allocation in 2030 (compared with 2020) [M ha]

3.3.4 Bioenergy

The Dutch draft NECP lacks concrete measures related to the production of bioenergy. These are crucial to assess the feasibility of the stated bioenergy targets and mind the gap between the projected production and use of bioenergy in 2030. The Dutch draft NECP however includes sustainability criteria to the production of biomass.

The measures regarding bioenergy use in the Dutch NECP are quite ambitious, with a final bioenergy demand projected to reach 40 TWh and 30 TWh respectively for biogas and liquid biofuel (see Figure 15). By 2030, 50% of this biogas demand will be used to replace natural gas in the built environment. For liquid biofuels, 50% supports the decarbonization of the transport sector, and 50% will be used in industrial processes. These ambitious assumptions were required to reach the ambitious decarbonization targets specific to each sector, and follow, when disclosed, measures from the draft NECP. In terms of production, the Netherlands are expected to produce less than 50% of their final use, becoming a net biogas importer. Similarly, the production of liquid biofuels is quite limited in the model, due to a progressive phase out of first-generation biofuels due to the uncertainty of the quantity of marginal land available in the Netherlands in 2030.

Figure 15: The Netherlands, estimated domestic use and production of biogas and liquids in 2030 (compared with 2020) [TWh]



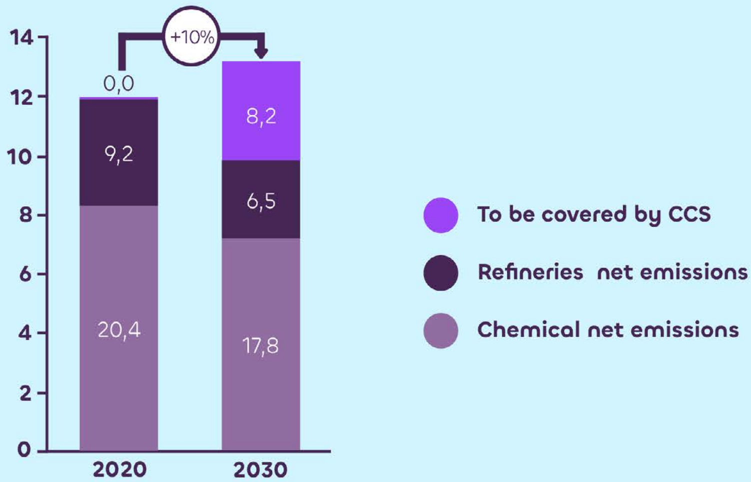
Production targets are provided for biogas but not for liquid biofuels in the draft NECP. A domestic production of 2 bcm (19.5 TWh) is assumed by 2030. This is an ambitious tenfold increase compared to the actual production of 0.2 bcm. There is a risk that the Netherlands will not reach this target, especially since our scenario predicts a slightly lower potential (17 TWh), and the European Commission predicts an even lower potential biogas production of only 1.34 bcm (13 TWh) by 2030[19].

In terms of liquid biofuel production, the draft NECP would benefit from disclosing production targets to allow for a thorough assessment of the bioenergy strategy. Both types of biofuels further lack concrete measures for how this energy source would be produced concretely, i.e. how much waste, manure, residues would be collected, or how many biogas plants or biorefineries need to be created. A large gap appears between projected use and production of both bioenergy vectors in 2030. This can be explained on the one hand by the ambitious targets related to bioenergy use and on the other hand, by the specificities of the Netherlands that limit the production of bioenergy. This highlights the need for biofuel imports and opens the door for possible environmental harms, such as importing unsustainable biomass from developing countries, causing deforestation or land grab. To avoid these negative impacts, the Dutch draft NECP proposes to abide by the strict RED guidelines and standards for the sustainable procurement of biomass. Further, the Dutch draft NECP is one of the few to acknowledge this gap between production and use in 2030, and to address it through imports of biofuel. Yet, they lack further details on import quantities, trade partners and balances. Overall, most targets are ambitious and transparent, yet fail to disclose concrete actions to achieve these, making it difficult to assess the feasibility of the bioenergy strategy, and its implications on European bioenergy sovereignty.

3.3.5 Long-term geological storage of CO_2

In 2030, The Netherlands plan to capture and store around 9MtCO_2e with CCS technologies, mainly in chemical industries and refineries. The draft NECP specifies that CO_2 capture and storage takes place mainly at chemical, refining and waste incineration plants. The information available in the NECP had to be supplemented by following assumptions: first, the chemical industry and oil refineries represents 8.2 MtCO_2e of the 9 MtCO_2e in 2030. Secondly, an increase in the production of chemicals was assumed to allow such levels of capture and net emissions (see Figure 16).

Figure 16: The Netherlands, refineries and chemical emissions, including CCS [Mt CO_2e]



That ambition seems high since around 25% of chemicals emissions and refineries emissions would be covered by CCS. For these two sectors, the NECP may be over-reliant on CCS since it does not specify any other ways of decarbonization (electrification, recycling). In addition, the energy needed in 2030 to capture this volume is estimated at 8 TWh for both sectors (the energy for storage and transport of the captured CO_2 is not quantified). It represents respectively almost 10% of the energy consumption of both sectors in 2030.

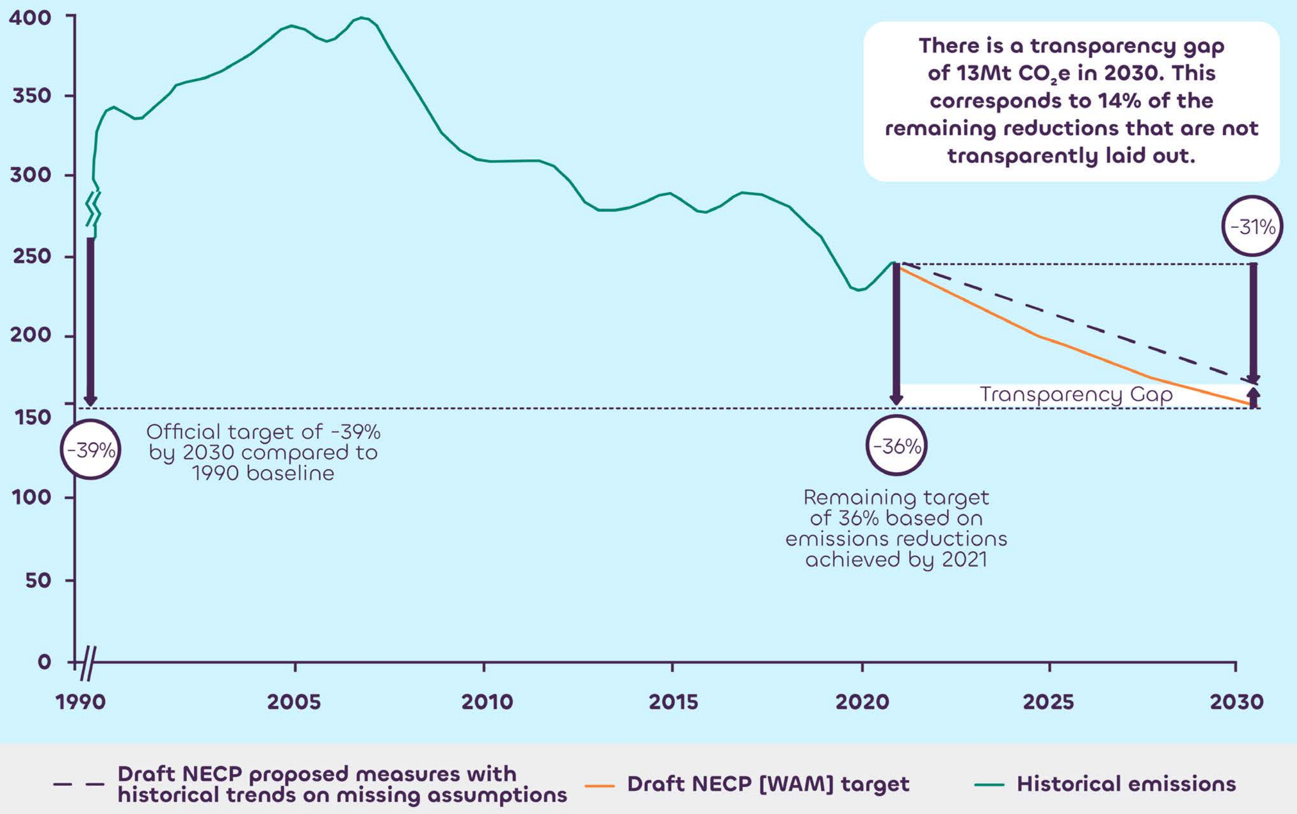
3.4 Spain

3.4.1 Transparency gap on emissions

The lack of transparency on key measures can increase the risk of missing the emissions target. The transparency gap of the Spanish draft NECP[23] is estimated at around 13 $MtCO_2e$: this corresponds to 14% of the remaining reductions that are not transparently laid out and for which historical trends assumptions were made. In other words, only 31% of the 36% of remaining reduction by 2030 compared to 2021 baseline are transparently described, as illustrated in Figure 17.

The scenario "draft NECP" corresponds to the 'With Additional Measures' (WAM) scenario published in the draft NECP. Its emissions are including LULUCF.

Figure 17: Spain, total GHG emissions (including LULUCF) [Mt CO_2e]



The contribution to the transparency gap is generally higher in the sectors that emit the most and where the quality of information is poor. This breakdown does not follow the official CRF but is based on a cross-sectoral logic: if part of the transparency gap is due to electricity demand in buildings, it will be found in the buildings sector. To reduce the transparency gap, the final NECP may be completed with the missing indicators and metrics. For details of each sector, please refer to annexes "4.1 Country annexes".

Table 25: Transparency gap per sector for Spain. For details of each sector, please refer to annexes "4.1 Country annexes".

Sector	Sector contribution to the transparency gap
Buildings	+2.1 Mt CO_2e
Transport	+4.7 Mt CO_2e
Industry	+0.5 Mt CO_2e
Energy production	+0.8 Mt CO_2e
Agriculture, Forestry and land-use	+4.8 Mt CO_2e
Total	**+ 12.9 Mt CO_2e**

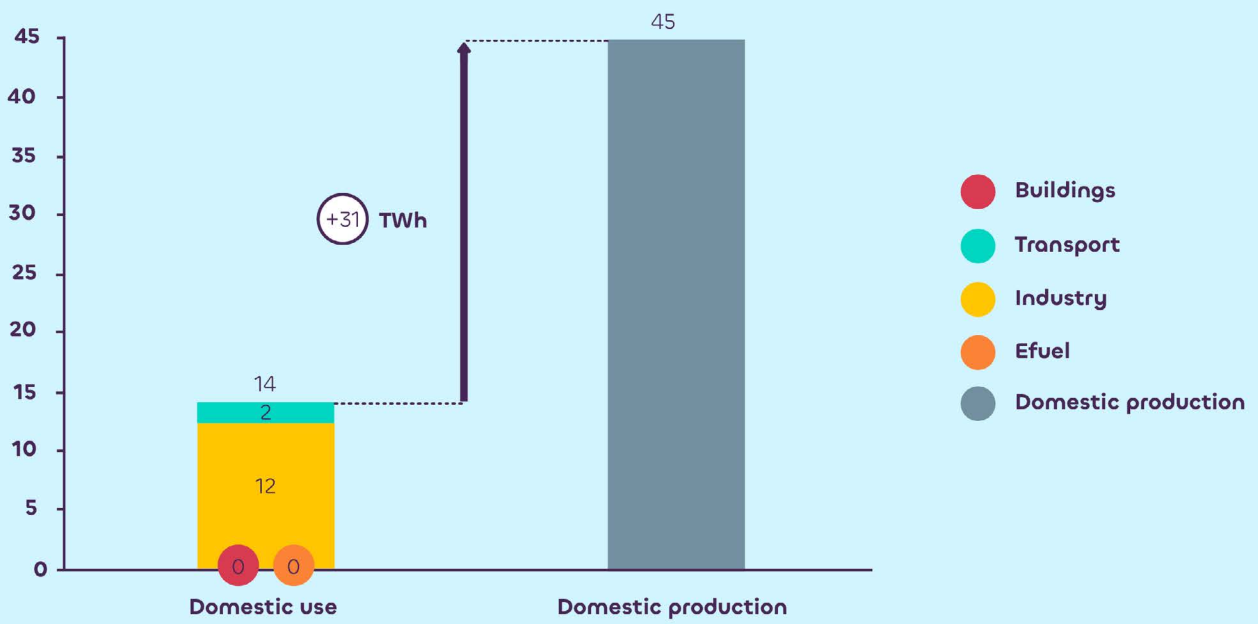
3.4.2 Hydrogen

While no overall targets for hydrogen production or use are provided in the draft NECP, there is reference to a Hydrogen Roadmap by the Spanish Government which forecasts the production of renewable hydrogen in Spain. The plan itself refers to a target of around 11 GW of electrolysers for renewable hydrogen production by 2030.

For consumption, the draft NECP mentions the need to promote the use of renewable hydrogen in different sectors, with a significant penetration in industry. However, it does not provide any quantified information about the volume of consumption in 2030.

Figure 18 shows the hypothetical hydrogen balance in 2030, based on available figures in the draft NECP and additional assumptions. On the domestic production side, we assume 11 GW of electrolysers and 4000 hours of production per year. The figures for the domestic use here were derived based on the main following assumptions: a switch between 5 and 15% to hydrogen of all the industrial sectors; 50% of the new zero-emissions trucks in 2030 are fuel-cell electrical engines. These assumptions do not directly come from the draft NECP, but are our own estimates based on its narrative, e.g. increasing hydrogen for long-distance transport.

Figure 18: Spain, estimated domestic use and production of hydrogen in 2030 [TWh]



These estimates suggest that Spain will cover all sectoral demand with domestic production and will be a net exporter of hydrogen by 2030. In contrast to this finding, the draft NECP in fact states that Spain will need to import hydrogen to meet its demand, particularly in the short-term. The final Spanish NECP should ideally contain more detailed information on expected consumption and by which sectors, to avoid such potential inconsistencies.

Following our model's assumptions on efficiency of hydrogen production efficiency, the level of production of renewable hydrogen suggested in the NECP (via the reference to the Hydrogen Roadmap) would require around 68 TWh of renewable electricity. This electricity demand would be around 21 TWh for domestic hydrogen demand, and around 47 TWh for estimated exports. The total of 68 TWh would represent around 26% of RES electricity production of Spain in 2030. This information is the result of our model, as it is not available in the NECP draft. It should be described in the final NECP.

3.4.3 Land-uses

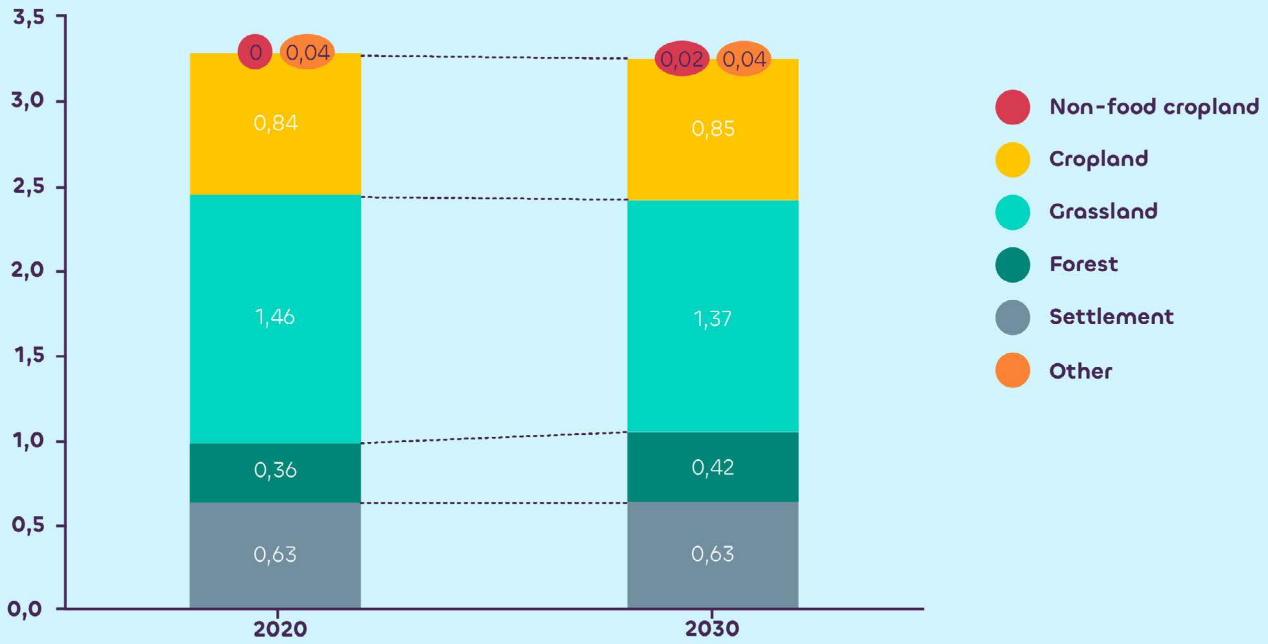
Of the five draft plans we examined, the Spanish draft NECP provides the most detailed and thorough information regarding land management and land use change by 2030. Especially forests, for which measures and key actions to prevent forest fires and to maximise carbon sequestration are described. A reforestation target of 20.000 ha per year is communicated and assumed in our model. By

2050, up to 50.000 ha of wetlands will be restored. For the purposes of this assessment, the evolution of other land uses have been estimated based on the information included in the NECP regarding key targets and measures, such as the desire to reduce food waste by 50% or the limited demographic growth. From these combined stated and estimated land use changes, the evolution of carbon sequestration in Spanish soils has been computed and is expected to increase by 2030 up to -48.3 $MtCO_2$. This estimation by our model is clearly not aligned with the stated target in the draft Spanish NECP (-34 $MtCO_2$). The gap is due to the lack of transparency on metrics that drive the LULUCF GHG emissions.

This would exceed the LULUCF GHG emissions target set out in the regulation which expects that by 2030 sequestration from the land use and forestry sector will increase to -43.6 $MtCO_2$. However, going by the figures stated in the draft NECP's WAM scenario, sequestration will increase only up to -34 $MtCO_2$, which is 22% below the expected EU threshold.

Reflecting on the discrepancy between the sequestration figure stated in the NECP and the computed result based on further details in the NECP, note that our model results are based on numerous assumptions and uncertainties, especially in a changing climate. The Spanish forests will be increasingly subjected to droughts and forest fires, which could explain the lower LULUCF sequestration ambition. Spain does show recognition of this risk in their draft NECP, providing measures to prevent forest fires. To make sure that the descriptions match the figures, it would be good to provide more detailed numerical computations regarding LULUCF projections. This would make it possible to evaluate assumptions and the probability to reach LULUCF targets.

Figure 19: Spain, estimated land allocation in 2030 (compared with 2020) [M ha]

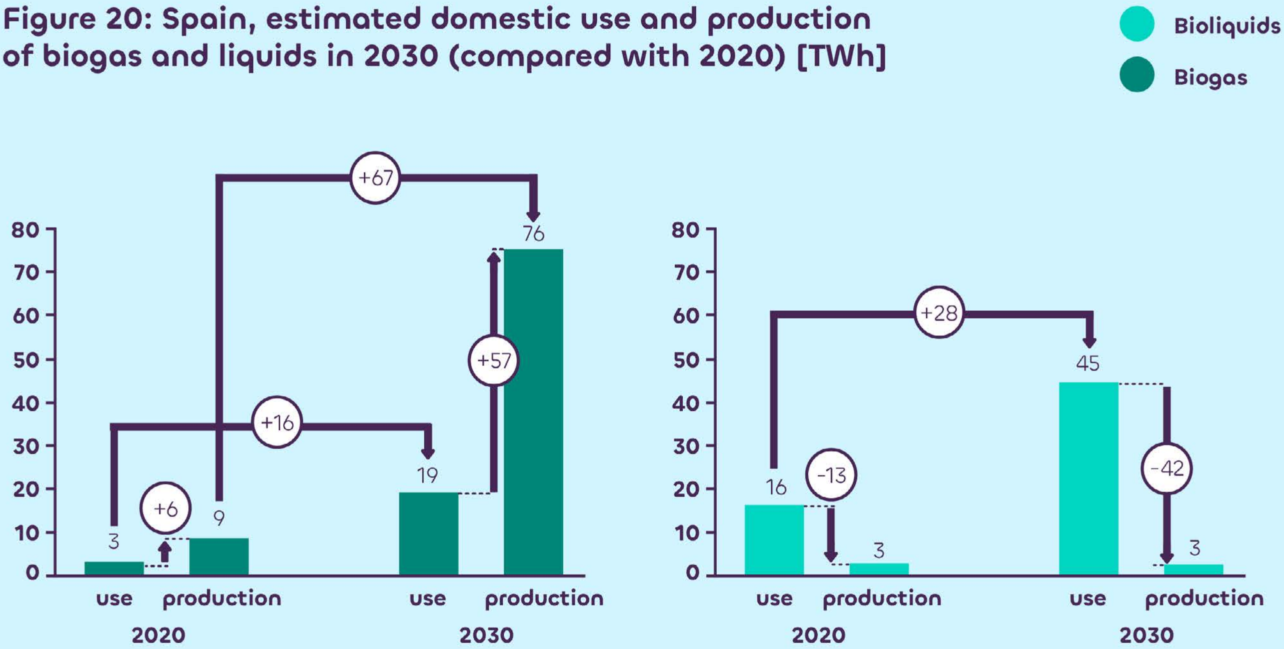


3.4.4 Bioenergy

The Spanish NECP provides overall good information on the Spanish bioenergy landscape in 2030, although more quantified targets could be provided. The Spanish draft NECP includes sustainability criteria to the production of biomass.

Spain expects by 2030 to rely on 20 TWh of biogas. In the modelling, these 20 TWh are mainly being used in the industry, and only to a lesser extent for the heating of buildings. Liquid biofuels will mainly be used for transportation with a target of 25.4 TWh in 2030, compared to 19 TWh in 2019. Domestic production of biogas allows to easily cover the domestic demand. However, the domestic production of liquid biofuel is significantly lower in our model, since the model only considers first-generation biofuels, and not secondary generation biofuels. The discrepancy between domestic use and production is the result of a limited production, echoing a limitation laid on the use of first generation bio-energy crops.

Figure 20: Spain, estimated domestic use and production of biogas and liquids in 2030 (compared with 2020) [TWh]



Our model projects a future demand of 19 TWh of biogas (see Figure 20). On the other hand, Spain aims to produce domestically 20 TWh of biogas. This amount is quite modest relative to the European Commission's estimate for Spain of 4.1 bcm[24] (40 TWh) of biogas and our model's heroic assumption of 76 TWh. Note that our model's estimate is an upper boundary representing the maximal potential, and in the case of Spain probably exceeds the realistic bioenergy potential. Spain further identifies in its NECP the need to increase biomass harvesting and to improve the maturity of different technologies. The Spanish draft NECP is thus quite explicit in its intentions around the use and production of biofuels, most notably measure 1.15 for the development of biogas and biomethane. An important focus should however be laid on the sustainable procurement of said biomass and putting a cap on the use of energy crops.

In terms of liquid biofuels, we model a low production because of a progressive phase-out of first-generation fuels. Due to a limitation of our model and the lack of data or reporting on second-generation biofuels, only first-generation biofuels are considered. This hypothesis is very limiting in the case of Spain since the draft NECP projects to have first-generation crops contribute to less than 3% of the total liquid biofuel production. The main use of liquid biofuels would be for transportation, as described in measure 1.12: "biofuels in transportation". With no clear value on the production of second-generation biofuels in the draft NECP, our model shows a gap between the modelled use that exceeds the limited production of first-generation fuels quite substantially. In order to clarify the reality of this gap, the final NECP should clearly present the objectives for the production of first- and second-generation biofuels.

3.4.5 Long-term geological storage of CO_2

The Spanish draft NECP does not mention any clear ambition on carbon capture. There is only mention of pilot projects in 2030.

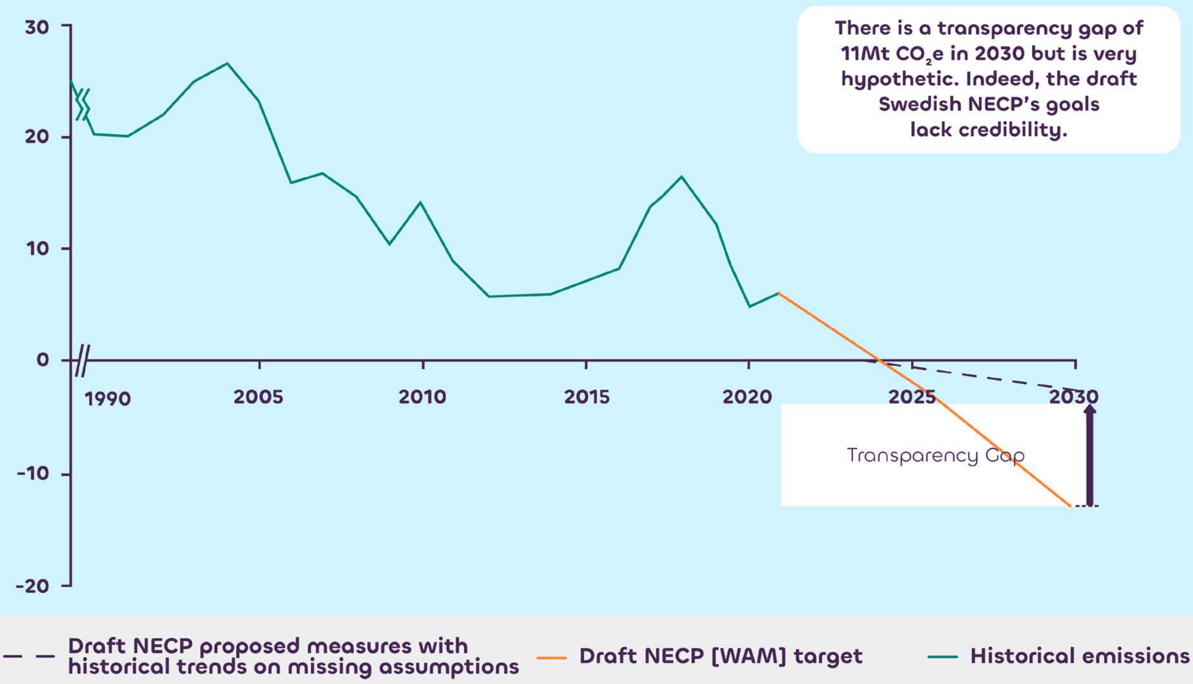
On the one hand, it does not seem likely that Spain will run into problems of relying on non-existent carbon capture, since our replication of the measures set out in Spain's NECP suggests that this technology will not be necessary to meet its targets. On the other hand, a risk of inconsistency is always there so long as figures or intentions are not stated explicitly. If Spain is not counting on CCS technology by 2030, the final NECP should mention this clearly and transparently.

5. Sweden

3.5.1 Transparency gap on emissions

This transparency gap in the Swedish draft NECP[25] is estimated at around 11 $MtCO_2e$ but is very hypothetic. Indeed, the draft Swedish NECP's goals lack credibility, with Section 3 offering no new policies compared to the 2019 NECP[26]. Climat targets were set by the previous government. The current government's decisions aren't reflected in the draft.

Figure 21: Sweden, total GHG emissions (including LULUCF) [Mt CO_2e]



The contribution to the transparency gap is generally higher in the sectors that emit the most and where the quality of information is poor. This breakdown does not follow the official CRF but is based on a cross-sectoral logic: if part of the transparency gap is due to electricity demand in buildings, it will be found in the buildings sector. To reduce the transparency gap, the final NECP may be completed with the missing indicators and metrics. For details of each sector, please refer to annexes "4.1 Country annexes".

Table 26: Transparency gap per sector for Sweden. For details of each sector, please refer to annexes "4.1 Country annexes".

Sector	Sector contribution to the transparency gap
Buildings	+0.2 Mt CO_2e
Transport	+0.5 Mt CO_2e
Industry	+0.9 Mt CO_2e
Energy production	+8.1 Mt CO_2e
Agriculture, Forestry and land-use	+0.9 Mt CO_2e
Total	**+ 10.5 Mt CO_2e**

3.5.2 Hydrogen

The Swedish draft NECP makes no effort to quantify hydrogen production or consumption volumes, nor imports or exports. This complete lack of information makes a quantitative estimate impossible since there would be too many degrees of freedom open for subjective interpretation.

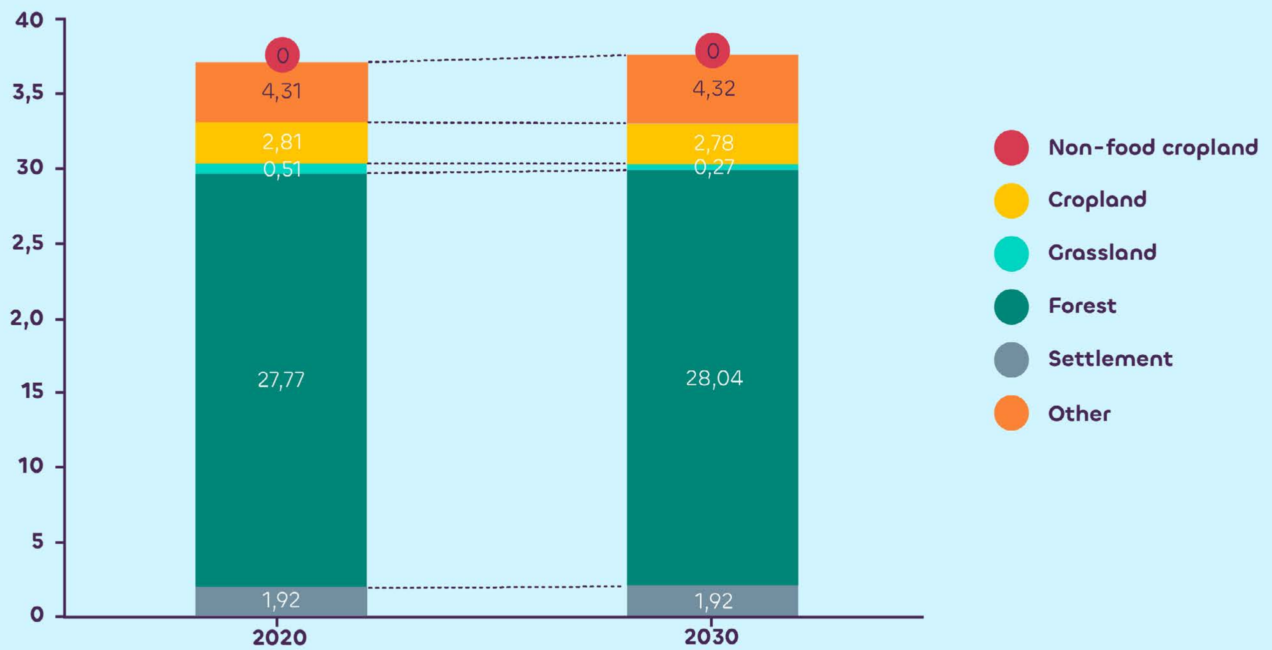
The brief information available is qualitative and can be summarised in a few sentences: the draft NECP mentions the cooperation with Nordic countries on offshore wind green hydrogen. The draft NECP plans 12 hydrogen refuelling stations. The final NECP should contain clear estimates of hydrogen production and consumption volumes in 2030.

3.5.3 Land-uses

The Swedish draft NECP does not contain enough quantitative information pertaining to land use change. Based on the disclosed measures, policies, and targets from the Swedish draft NECP, the following evolution of the land use was projected (see Figure 22) : the forest area was projected to slightly increase by 2030, motivated by two reasons. First, the desired implementation of the Forestry Act in Sweden, which proposes to manage productive and natural forests so that they continue to thrive, while providing economic value. Second, the objective to further increase the country's natural carbon sinks, which can among others be achieved through larger forest areas. Other lands are expected to increase by 2030 too, including the wetlands, for which the Swedish NECP projects to invest significantly into the rewetting and restoration. Finally, our model estimates a decrease of croplands over the coming years, mainly because of the objective to reduce food waste by 20%. Based on these land use changes, the evolution of carbon sequestration in Swedish soils has been computed and is expected to increase by 2030 up to -43.8 MtCO_2.

The approximated 'With Additional Measures' (WAM) scenario derived from the draft NECP, showed that the Swedish LULUCF target will likely not be achieved. The LULUCF regulation expects by 2030 that sequestration from the land use and forestry sector to reach -47.3 $MtCO_2$. Both the draft NECP and our model project sequestration to reach -43 $MtCO_2$, below the expected EU threshold. However, this conclusion is based on numerous assumptions, since not all targets have been described in the draft NECP. This highlights the need for a more quantified analysis on how land uses are projected to evolve, such as the number of hectares to reforest or wetlands to restore annually. This would contribute to a more robust forest strategy, and to anticipate potential wood supply in the coming years. This is even more important, as Sweden expects to increase its consumption of bioenergy, mainly using solid biomass.

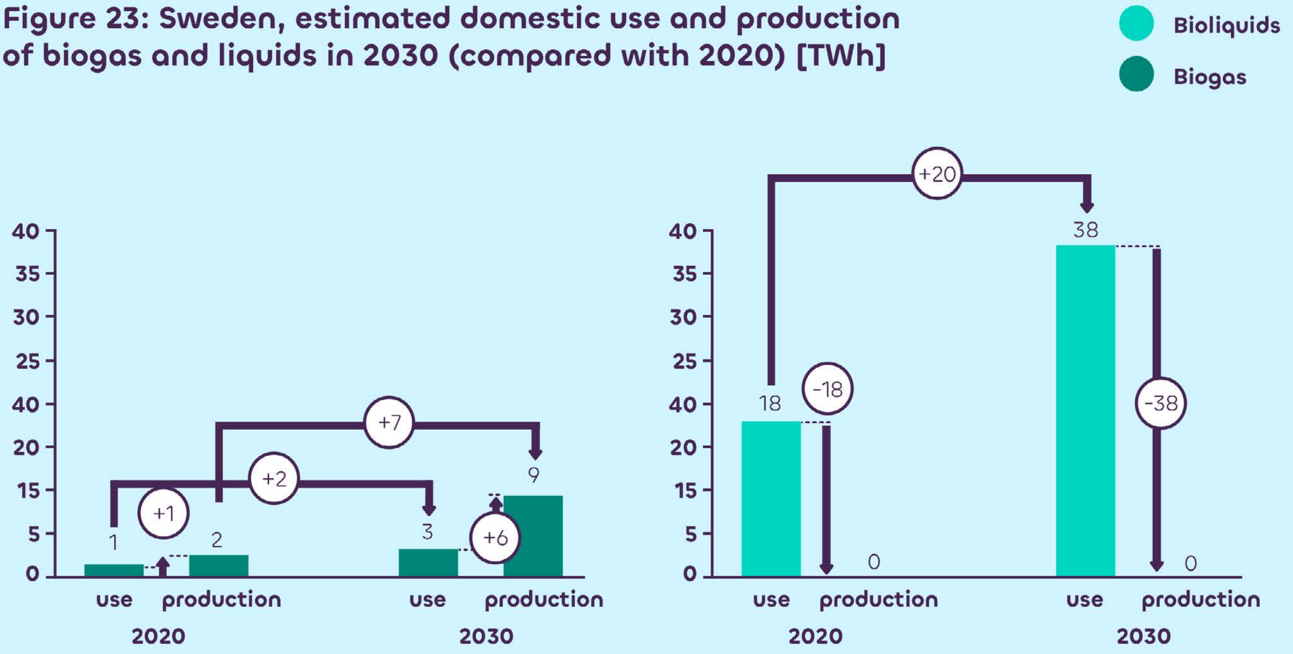
Figure 22: Sweden, estimated land allocation in 2030 (compared with 2020) [M ha]



3.5.4 Bioenergy

The Swedish draft NECP provides some useful information to assess its bioenergy strategy, although it lacks concrete measures and transparent targets to reach these objectives. Biogas is expected to contribute to a limited extent to the country's decarbonization efforts, with less than 5 TWh. Liquid biofuels are expected to contribute significantly more to the decarbonization of the energy sector, up to 40 TWh in 2030, most of it being used for transportation. Regarding the production of bioenergy, up to 9 TWh of biogas is expected to be produced through the valorisation of waste and residues. The production of liquid biofuels remains negligible as the use of first-generation crops is capped.

Figure 23: Sweden, estimated domestic use and production of biogas and liquids in 2030 (compared with 2020) [TWh]



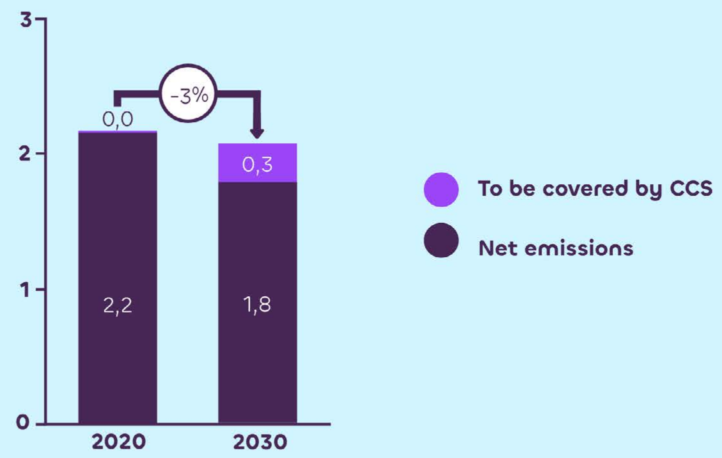
The approximation of the draft NECP projects a small increase in the use of biogas and a larger increase for liquid biofuels. No quantified targets are disclosed regarding their future use in the draft NECP. Regarding supply, research from the European Commission estimates the potential domestic production at 1.1 bcm[27] (10.7 TWh), which supports our findings of a domestic production of 9 TWh. Domestic biogas production should be able to cover the domestic needs, reducing the need for biogas imports. Future liquid biofuel production however will not be able to match the demand from the transportation sector. Imports of liquid biofuels will be needed to match the demand. This conclusion is also reached in the draft NECP. This specific need for biofuel imports opens the door for possible environmental harms, such as importing unsustainable biomass from developing countries, causing deforestation or land grab. The Swedish draft NECP does not integrate measures to limit the imports of unsustainable biomass. Despite relatively low ambitions regarding the use of biogas or liquid biofuels, the total bioenergy used in the industry or heating sector exceeds 100 TWh. Most of this demand is expected to be met by solid bioenergy which should be covered domestically. Sweden will need to put in place specific measures to ensure the sustainable management of their forests, while maintaining their capacity to produce both industrial roundwood, and fuelwood.

3.5.5 Long-term geological storage of CO_2

The Swedish draft NECP only mentions CCS as a measure when there are no reasonable alternatives. There is almost no quantitative or qualitative information on deployment of CCS.

Due to the lack of quantified ambition, the assumption was made that CCS technologies plays a really limited role in 2030 and mainly in the cement sector (see Figure 24). More precisely, the graph below shows the evolution of cement emissions assuming 0.3 $MtCO_2e$ of CCS in the cement industry. The assumption in this sector is based solely on the NECP's narrative of CCS deployment in sectors where there are no reasonable alternatives. Among Sweden's existing industrial sectors, cement is a sector that could fit this narrative.

Figure 24: Sweden, cement emissions [Mt CO_2e]



Due to the lack of quantified ambition, the assumption was made that CCS technologies plays a really limited role in 2030 and mainly in the cement sector. More precisely, the graph below shows the evolution of cement emissions assuming 0.3 $MtCO_2e$ of CCS in the cement industry. The assumption in this sector is based solely on the NECP's narrative of CCS deployment in sectors where there are no reasonable alternatives. Among Sweden's existing industrial sectors, cement is a sector that could fit this narrative.

This moderate ambition implies an energy need of 0.1 TWh in 2030 to capture this volume (the energy for storage and transport of the captured CO_2 is not quantified). It represents 6% of the sectorial energy consumption, which should therefore not generate any risk of supply.

Conclusions and recommendations

Conclusions and recommendations per theme are captured at the end of each section of the cross-country, thematic deep dives (Section 2). Overall conclusions and recommendations are set out in the Summary for Policymakers and the detailed recommendations to policymakers are captured below.

The NECPs are meant to convey the policies and measures to achieving Europe's climate and energy targets, and support putting concrete additional policies in place to reach them. However, this report finds that the draft documents are not sufficiently precise and complete to fulfil that purpose. All the plans analysed have a large transparency gap, which means that the measures included in the plans are not specific and/or comprehensive enough to reach the targets they have set for their country.

National policymakers should therefore consider the following recommendations to improve transparency and information in the NECPs ahead of submitting their final versions:

- **Clearly outline national targets relevant for climate and energy planning and develop a monitoring process:** Too often the plans include a list of policies and measures but do not provide a clear view on their actual impacts, both individually and taken altogether - and even less on interconnected issues such as the underlying need for renewable energy and resources. Member States can strengthen their NECPs by including clear national targets coupled with a clear monitoring mechanism that considers production/demand balances and domestic resources. Based on learnings from the five national plans assessed, countries can improve their drafts for example by outlining their contributions to the EU-wide renewable energy targets under the EU's Renewable Energy Directive (RED II and RED III targets), and indicate in their NECPs if they are on track to meeting those targets. Similarly, countries should communicate on their efforts to reach their LULUCF sequestration targets and specify how different measures contribute to that final target.

- **Be more specific on the measures included in their NECPs:** The national authorities should consider upgrading their plans with sufficient detail, even if this information may already be available in separate documents, as the plans need to be self-standing to stand against the scrutiny of the full range of stakeholders, with everyone ultimately involved in making these targets a reality. We focus in this report on elements that are often missing in the plans based on our detailed review, but there may be other aspects of the NECP that need further specifications as well.

  - Specifically, on supporting renewable electricity, policymakers can ensure the plans give a breakdown of clear policies and measures for promoting the deployment of renewables across all sectors, including on the electrification of transport, buildings, and industry. To expand upon this, Member States can offer a comprehensive list of planned or ongoing large-scale renewable energy projects, as well as measures to overcome major barriers such as permitting and siting.

  - In addition, to provide clarity on how Member States will contribute to the REPower EU **renewable hydrogen targets,** NECPs should be specific on incentives and policy support for the deployment of renewable hydrogen, including on additional renewables capacity required and on infrastructure to support production, storage and transportation. Member States can build upon these plans by defining production, consumption, and integration targets for renewable hydrogen, combined with clear timelines and capacities for planned projects.

  - Another way to improve the comprehensiveness and clarity of the NECPs would be to include more information related to **long-term geological storage of CO_2**, in particular an assessment of inherent emissions, capacity of transport infrastructure and clear distinction between carbon capture and storage (CCS) and carbon capture and utilisation (CCU) technologies. Enhancing the strategic planning in this area is particularly important in the light of the upcoming free allocation phase-out in the EU ETS system in certain industries (since 2026), which will affect the costs structure in the sector.

  - Specifically for **land use**, the quality of the NECPs could be improved by including key targets and information available in separate national strategies, instead of referring to these strategies which complicates accessibility and comparability. Targets (or indicative benchmarks) for non-CO_2 emissions should be more granular. NECPs would also be more robust if they share a roadmap with concrete measures and intermediary targets on LULUCF sequestration, supporting the country's natural carbon removal ambitions.

- On **bioenergy**, a notable disparity exists between biofuels which are quite well covered and the treatment of bioenergy for heat or electricity production, where it needs more details. The predominant focus on second-generation biofuels underscores the global shift towards utilising waste and residues for energy, driven by their superior environmental benefits over first-generation bioenergy. Nevertheless, Member States can improve their NECPs by offering a more inclusive discussion on both first and third-generation bioenergy. The NECPs should also mention investments or budgets to support credible bioenergy implementation on a nationwide scale. Enhancing the NECPs should involve setting specific production targets, designating responsible bodies, allocating dedicated budgets, introducing concrete initiatives to boost production, or discuss trade agreements for biomass procurement.

- **Outline potential inconsistencies in the plan and how these have been addressed:** Our research analyses a few of the key areas of potential inconsistencies in NECPs. Policymakers need to be aware of these and make their strategic choices explicit in the document in order to adequately plan infrastructure, land use distribution, import plans and other parameters.

Both in its further interactions with countries, and in its review of the EU Governance Regulation, the European Commission, should consider to:

- **Make full use of the assessment of draft plans and country-specific recommendations to safeguard against the risk of inconsistencies:** Our analysis shows that risk of inconsistencies, such as risks of missing targets or undermining decarbonisation objectives, exist throughout the NECPs analysed. The European Commission should highlight these risks to Member States, including but not limited to the following areas:
    - Provision sufficient detail (from planning to implementation) for achievement of updated RE and hydrogen targets
    - Clarify the demand for electrification and hydrogen use (sector coupling) in demand sectors, especially industry.
    - Properly document the risk of inconsistencies between the LULUCF and bioenergy targets. This could take the form of a specific reporting of bioenergy emissions.
    - Provide higher quality and detail regarding the deployment of CCS/CCU and their solutions for LTGS of CO_2.

- **Request that national plans explicitly identify key areas of a risk of inconsistency.** In addition to highlighting potential areas for risk of inconsistency to national policy makers, the European Commission should also ask national policy makers to proactively highlight potential areas with a risk of inconsistencies in their plans, including how they have or are planning to overcome them. Such risks might exist where planning might not be advanced sufficiently (e.g., for hydrogen) or recent legislation has not been implemented in national planning (e.g. the RED III directive).

- **Provide a clear view of how key risk areas will be addressed at EU level (if applicable).** Some issues with consistency might be best addressed at the EU level. These include especially those risks that require cross- border interactions between countries, such as import/ export balances or the use of resources in other countries (e.g., for CO_2 storage). These should be addressed in the work programme of the new Commission, e.g., via EU level agreements with other geographies on importing green hydrogen, an EU level mapping of carbon dioxide storage, or a clear standardised framework to report trans-border CO_2 flows.

4. Annexes

Country annex

4.1.1 Italy

Population by 2030: 60.1 million

Absolute amounts in missing tons of CO_2e: 44 $MtCO_2e$ missing

Good quality: The 2030 value is clearly mentioned in the draft NECP

Medium quality: The draft NECP mention qualitative information without clear 2030 value

Bad quality: The draft NECP does not include the 2030 value of the lever

Buildings

Subsector	Levers	Granularity	**2030 values** identified or inferred to mimic the draft NECP	**2030 values** with historical trends on missing information
Residential	**Living space per person (m²/capita)**	-	53 m²/cap (+3% wrt 2021)	Same assumption
	Renovation rate	-	2%	Same assumption
	Buildings envelope	Renovation depth	5% NZEB	5% NZEB
		Efficiency of new buildings	25% NZEB	5% NZEB
	Technological mix for heating	District heating	4%	Same assumption
		Renewable energies + electricity	36%	Same assumption
		Fossil fuels	60%	Same assumption
Services	**Floor area evolution**	-	+4% (wrt 2021)	Same assumption
	Renovation rate	-	3%	Same assumption
	Buildings envelope	Renovation depth	5% NZEB	5% NZEB
		Efficiency of new buildings	25% NZEB	5% NZEB
	Technological mix for heating	District heating	4%	Same assumption
		Renewable energies + electricity	36%	Same assumption
		Fossil fuels	60%	Same assumption

Transport

Subsector	Levers	Granularity	**2030 values** identified or inferred to mimic the draft NECP	**2030 values** with historical trends on missing information
Passenger	**Modal Share**	Active Transport	4%	3%
		Car and motorcycle	78%	80%
		Public transport	18%	17%
	Technology shift (new ZEV)	-	62%	12%
Freight	**Freight demand (excl international)**	-	191Gtkm (+6% wrt 2015)	212Gtkm (+18%)
	Modal Share	Road transport	86%	89%
		Rail transport	13%	11%
		Inland water ways	1%	0%
	Technology shift (new ZEV)	-	10%	0%
-	**Biofuel share (% of total inland)**	-	10% (vs 5% in 2021)	Same assumption

Sector	Subsector	Levers	Granularity	**2030 values** identified or inferred to mimic the draft NECP	**2030 values** with historical trends on missing information
Industry	-	**Production level**	Steel	24Mt (+10% wrt 2015)	Same assumption
			Aluminium	1Mt (+0% wrt 2015)	Same assumption
			Cement	21Mt (-7% wrt 2015)	Same assumption
			Chemicals	23Mt (+9% wrt 2021)	Same assumption
	-	**Secondary production share**	Steel	78%	76%
			Aluminium	100%	100%
			Cement (non-clinker content)	23%	22%
			Chemicals	7%	7%
	-	**Technology of primary steel**	-	75% BF-BOF 25% H2-DRI	Same assumption
	CCS	**All industrial sectors**	-	3.6 Mt CO_2e	Same assumption
		Detail per sector	Steel	1.3 Mt CO_2e	Same assumption
			Chemicals	0.6 Mt CO_2e	Same assumption
			Cement	1.6 Mt CO_2e	Same assumption
Energy supply	**Fossil fuels**	**Electricity production: phase-out of**	Natural gas	19.5 GW	Same assumption
			Oil and petroleum	0.9 GW	Same assumption
			Coal	0 GW	Same assumption
	Renewables	**Capacity**	Solar PV	78.45 GW	Same assumption
			On-shore wind	26.87 GW	Same assumption
			Off-shore wind	2.07 GW	Same assumption
	Nuclear	**Capacity**	-	0 GW	Same assumption
	Hydrogen	-	Imports	0%	0%
			Production	23 TWh	6.5 TWh
	Carbon capture	-	Electricity generation	0 Mt CO_2e	Same assumption
			Oil refineries	0 Mt CO_2e	Same assumption
AFOLU	**Diet**	**Consumption**	Calories	3360 kcal/cap	Same assumption
			Meat	1050 kcal/cap	Same assumption
	Food waste	**Food waste**	-	588.6 kcal/cap	Same assumption
	Agriculture	**Crop extensification**	Fertilisers	72 kg/ha	Same assumption
			Pesticides	4.68 kg/ha	Same assumption
			Cereal yield	14M kcal/ha	Same assumption
		Livestock extensification	-	0.0008 kg CO2eq/kcal animal products	Same assumption
	Land allocation	**Afforestation**	-	5000 ha/an	Same assumption

Country annex

4.1.2 Hungary

Population by 2030: 9.52 million

Absolute amounts in missing tons of CO_2e: 16 $MtCO_2e$ missing

Good quality: The 2030 value is clearly mentioned in the draft NECP

Medium quality: The draft NECP mention qualitative information without clear 2030 value

Bad quality: The draft NECP does not include the 2030 value of the lever

Sector	Subsector	Levers	Granularity	2030 values identified or inferred to mimic the draft NECP	2030 values with historical trends on missing information
Buildings	Residential	Living space per person (m²/capita)	-	34 m²/cap (+1% wrt 2021)	Same assumption
		Renovation rate	-	3.4%	1%
		Buildings envelope	Renovation depth	0% NZEB	Same assumption
			Efficiency of new buildings	100% NZEB	5% NZEB
		Technological mix for heating	District heating	15%	10%
			Renewable energies + electricity	48%	25%
			Fossil fuels	37%	65%
	Services	Floor area evolution	-	+5% (wrt 2021)	Same assumption
		Renovation rate	-	1% (in 2030)	1%
		Buildings envelope	Renovation depth	0% NZEB	Same assumption
			Efficiency of new buildings	100% NZEB	5% NZEB
		Technological mix for heating	District heating	16%	12%
			Renewable energies + electricity	8%	6%
			Fossil fuels	76%	82%
Transport	Passenger	Modal Share	Active Transport	5%	Same assumption
			Car and motorcycle	63%	Same assumption
			Public transport	32%	Same assumption
		Technology shift (new ZEV)	-	60%	2%
	Freight	Freight demand (excl international)	-	58Gtkm (+43% wrt 2021)	Same assumption
		Modal Share	Road transport	68%	Same assumption
			Rail transport	27%	Same assumption
			Inland water ways	5%	Same assumption
		Technology shift (new ZEV)	-	60%	3%
	-	Biofuel share (% of total inland)	-	19% (vs 6% in 2020)	Same assumption

	Subsector	Levers	Granularity	**2030 values** identified or inferred to mimic the draft NECP	**2030 values** with historical trends on missing information
Industry	-	**Production level**	Steel	0Mt (+0% wrt 2015)	Same assumption
			Aluminium	0.2Mt (+10% wrt 2015)	Same assumption
			Cement	4Mt (+95% wrt 2015)	Same assumption
			Chemicals	5Mt (+34% wrt 2015)	Same assumption
	-	**Secondary production share**	Steel	51%	37%
			Aluminium	No production	No production
			Cement (non-clinker content)	17%	9%
			Chemicals	22%	5%
	-	**Technology of primary steel**	-	100% BF-BOF 0% H2-DRI	Same assumption
	CCS	**All industrial sectors**	-	0.4 Mt CO_2e	0.3 Mt CO_2e
		Detail per sector	Steel	0.3 Mt CO_2e	0.3 Mt CO_2e
			Cement	0.1 Mt CO_2e	Same assumption
Energy supply	**Fossil fuels**	**Electricity production: phase-out of**	Natural gas	2.85 GW	Same assumption
			Oil and petroleum	0.4 GW	Same assumption
			Coal	0 GW	Same assumption
	Renewables	**Capacity**	Solar PV	11.6 GW	Same assumption
			On-shore wind	1 GW	Same assumption
			Off-shore wind	0 GW	Same assumption
	Nuclear	**Capacity**	-	2 GW	Same assumption
	Hydrogen	-	Imports	0%	0%
			Production	1.7 TWh	0.2 TWh
	Carbon capture	-	Electricity generation	0 Mt CO_2e	Same assumption
			Oil refineries	0 Mt CO_2e	Same assumption
AFOLU	**Diet**	**Consumption**	Calories	3380 kcal/cap	3470 kcal/cap
			Meat	1395 kcal/cap	Same assumption
	Food waste	**Food waste**	-	350 kcal/cap	480 kcal/cap
	Agriculture	**Crop extensification**	Fertilisers	97 kg/ha	113 kg/ha
			Pesticides	1 kg/ha	Same assumption
			Cereal yield	16M kcal/ha	Same assumption
		Livestock extensification	-	0.0007 kg CO2eq/kcal animal products	Same assumption
	Land allocation	**Afforestation**	-	-10000 ha/an	-40000 ha/an

ecno
European Climate Neutrality Observatory

Country annex

4.1.3 The Netherlands

Population by 2030: 18.5 million

Absolute amounts in missing tons of CO_2e: 17 $MtCO_2e$ missing

Good quality: The 2030 value is clearly mentioned in the draft NECP

Medium quality: The draft NECP mention qualitative information without clear 2030 value

Bad quality: The draft NECP does not include the 2030 value of the lever

Sector	Subsector	Levers	Granularity	2030 values identified or inferred to mimic the draft NECP	2030 values with historical trends on missing information
Buildings	Residential	Living space per person (m²/capita)	-	50m²/cap (-2% wrt 2021)	53 m²/cap (+2% wrt 2021)
		Renovation rate	-	3% in 2030	Same assumption
		Buildings envelope	Renovation depth	15% NZEB	5% NZEB
			Efficiency of new buildings	50% NZEB	5% NZEB
		Technological mix for heating	District heating	9%	Same assumption
			Renewable energies + electricity	31%	Same assumption
			Fossil fuels	60%	Same assumption
	Services	Floor area evolution	-	+2.5% (wrt 2021)	+7% (wrt 2021)
		Renovation rate	-	3% (in 2030)	Same assumption
		Buildings envelope	Renovation depth	15% NZEB	5% NZEB
			Efficiency of new buildings	54% NZEB	5% NZEB
		Technological mix for heating	District heating	9%	9%
			Renewable energies + electricity	36%	31%
			Fossil fuels	55%	60%
Transport	Passenger	Modal Share	Active Transport	15%	14%
			Car and motorcycle	73%	74%
			Public transport	13%	12%
		Technology shift (new ZEV)	-	100%	Same assumption
	Freight	Freight demand (excl international)	-	143 Gtkm (+29% wrt 2015)	137Gtkm (+23% wrt 2015)
		Modal Share	Road transport	53%	55%
			Rail transport	6%	5%
			Inland water ways	41%	40%
		Technology shift (new ZEV)	-	10%	0%
	-	Biofuel share (% of total inland)	-	9% (vs 6% in 2020)	Same assumption

	Subsector	Levers	Granularity	**2030 values** identified or inferred to mimic the draft NECP	**2030 values** with historical trends on missing information
Industry	-	**Production level**	Steel	7Mt (+3% wrt 2015)	Same assumption
			Aluminium	0.1Mt (+0% wrt 2015)	Same assumption
			Cement	2Mt (+0% wrt 2015)	Same assumption
			Chemicals	12Mt (+10% wrt 2015)	Same assumption
	-	**Secondary production share**	Steel	1%	Same assumption
			Cement (non-clinker content)	25%	Same assumption
			Chemicals	10%	Same assumption
	-	**Technology of primary steel**	-	100% BF-BOF 0% H2-DRI	Same assumption
	CCS	**All industrial sectors**	-	6.2 Mt CO_2e	Same assumption
		Detail per sector	Steel	0.4 Mt CO_2e	Same assumption
			Chemicals	5.8 Mt CO_2e	Same assumption
Energy supply	**Fossil fuels**	**Electricity production: phase-out of**	Natural gas	5.11 gw	Same assumption
			Oil and petroleum	0 GW	Same assumption
			Coal	0 GW	2.81 GW
	Renewables	**Capacity**	Solar PV	30.74 GW	Same assumption
			On-shore wind	7.32 GW	Same assumption
			Off-shore wind	21.29 GW	Same assumption
	Nuclear	**Capacity**	-	0.5 GW	Same assumption
	Hydrogen	-	Imports	0%	0%
			Production	14 TWh	4.5 TWh
	Carbon capture	-	Electricity generation	0 Mt CO_2e	0 Mt CO_2e
			Oil refineries	2.4 Mt CO_2e	4.5 Mt CO_2e
AFOLU	**Diet**	**Consumption**	Calories	3450 kcal/cap	Same assumption
			Meat	1484 kcal/cap	Same assumption
	Food waste	**Food waste**	-	515.7 kcal/cap	Same assumption
	Agriculture	**Crop extensification**	Fertilisers	240 kg/ha	Same assumption
			Pesticides	5.51 kg/ha	Same assumption
			Cereal yield	24.5M kcal/ha	Same assumption
		Livestock extensification	-	0.0013 kg CO_2eq/kcal animal products	0.0014 kg CO_2eq/kcal animal products
	Land allocation	**Afforestation**	-	5800 ha/an	12800 ha/an

Country annex
4.1.4 Spain

Population by 2030: 48.3 million
Absolute amounts in missing tons of CO_2e: 13 $MtCO_2e$ missing

Good quality: The 2030 value is clearly mentioned in the draft NECP
Medium quality: The draft NECP mention qualitative information without clear 2030 value
Bad quality: The draft NECP does not include the 2030 value of the lever

Sector	Subsector	Levers	Granularity	2030 values identified or inferred to mimic the draft NECP	2030 values with historical trends on missing information
Buildings	Residential	Living space per person (m^2/capita)	-	43.5 m^2/cap (+3% wrt 2021)	Same assumption
		Renovation rate	-	1.6% (in 2030)	Same assumption
		Buildings envelope	Renovation depth	10% NZEB	5% NZEB
			Efficiency of new buildings	100% NZEB	5% NZEB
		Technological mix for heating	District heating	12%	12%
			Renewable energies + electricity	40%	46%
			Fossil fuels	48%	42%
	Services	Floor area evolution	-	+2% (wrt 2021)	Same assumption
		Renovation rate	-	1.6% (in 2030)	1%
		Buildings envelope	Renovation depth	10% NZEB	5% NZEB
			Efficiency of new buildings	54% NZEB	5% NZEB
		Technological mix for heating	District heating	12%	12%
			Renewable energies + electricity	47%	42%
			Fossil fuels	41%	46%
Transport	Passenger	Modal Share	Active Transport	9%	Same assumption
			Car and motorcycle	63%	Same assumption
			Public transport	28%	Same assumption
		Technology shift (new ZEV)	-	96%	Same assumption
	Freight	Freight demand (excl international)	-	241Gtkm (+8%)	Same assumption
		Modal Share	Road transport	85%	Same assumption
			Rail transport	10%	Same assumption
			Inland water ways	5%	Same assumption
		Technology shift (new ZEV)	-	27%	0%
	-	Biofuel share (% of total inland)	-	8% (vs 5% in 2020)	Same assumption

Sector	Subsector	Levers	Granularity	**2030 values** identified or inferred to mimic the draft NECP	**2030 values** with historical trends on missing information
Industry	-	**Production level**	Steel	15Mt (+0% wrt 2015)	Same assumption
			Aluminium	2Mt (+0% wrt 2015)	Same assumption
			Cement	15Mt (+0% wrt 2015)	Same assumption
			Chemicals	18Mt (+5% wrt 2019)	Same assumption
	-	**Secondary production share**	Steel	68%	67%
			Aluminium	0%	0%
			Cement (non-clinker content)	19%	18%
			Chemicals	7%	7%
	-	**Technology of primary steel**	-	60% BF-BOF 40% H2-DRI	90% BF-BOF 10 H2-DRI
	CCS	**All industrial sectors**	-	0 Mt CO_2e	Same assumption
Energy supply	**Fossil fuels**	**Electricity production: phase-out of**	Natural gas	11 GW	Same assumption
			Oil and petroleum	0.6 GW	Same assumption
			Coal	0 GW	Same assumption
	Renewables	**Capacity**	Solar PV	62 GW	Same assumption
			On-shore wind	47 GW	Same assumption
			Off-shore wind	3 GW	Same assumption
	Nuclear	**Capacity**	-	5.7 GW	Same assumption
	Hydrogen	-	Imports	0%	0%
			Production	45 TWh	17 TWh
	Carbon capture	-	Electricity generation	0 Mt CO_2e	Same assumption
			Oil refineries	0 Mt CO_2e	Same assumption
AFOLU	**Diet**	**Consumption**	Calories	3260 kcal/cap	3350 kcal/cap
			Meat	1016 kcal/cap	1106 kcal/cap
	Food waste	**Food waste**	-	242.8 kcal/cap	Same assumption
	Agriculture	**Crop extensification**	Fertilisers	71 kg/ha	Same assumption
			Pesticides	1.7 kg/ha	Same assumption
			Cereal yield	9.5M kcal/ha	Same assumption
		Livestock extensification	-	0.0013 kg CO_2eq/kcal animal products	Same assumption
	Land allocation	**Afforestation**	-	19000 ha/an	Same assumption

Country annex

4.1.5 Sweden

Population by 2030: 10.6 million

Absolute amounts in missing tons of CO_2e: 11 MtCO_2e missing

Good quality: The 2030 value is clearly mentioned in the draft NECP

Medium quality: The draft NECP mention qualitative information without clear 2030 value

Bad quality: The draft NECP does not include the 2030 value of the lever

Sector	Subsector	Levers	Granularity	**2030 values** identified or inferred to mimic the draft NECP	**2030 values** with historical trends on missing information
Buildings	**Residential**	**Living space per person (m²/capita)**	-	49.5 m²/cap (-1% wrt 2021)	52.5 m²/cap (+3% wrt 2021)
		Renovation rate	-	2.5%	1%
		Buildings envelope	Renovation depth	15% NZEB	5% NZEB
			Efficiency of new buildings	50% NZEB	5% NZEB
		Technological mix for heating	District heating	48%	Same assumption
			Renewable energies + electricity	50%	Same assumption
			Fossil fuels	2%	Same assumption
	Services	**Floor area evolution**	-	+0% (wrt 2021)	+4% (wrt 2021)
		Renovation rate	-	2.5% (in 2030)	1%
		Buildings envelope	Renovation depth	15% NZEB	5% NZEB
			Efficiency of new buildings	54% NZEB	5% NZEB
		Technological mix for heating	District heating	48%	48%
			Renewable energies + electricity	45%	32%
			Fossil fuels	7%	20%
Transport	**Passenger**	**Modal Share**	Active Transport	6%	6%
			Car and motorcycle	73%	74%
			Public transport	21%	20%
		Technology shift (new ZEV)	-	85%	Same assumption
	Freight	**Freight demand (excl international)**	-	85Gtkm (+15%)	Same assumption
		Modal Share	Road transport	70%	Same assumption
			Rail transport	30%	Same assumption
			Inland water ways	0%	Same assumption
		Technology shift (new ZEV)	-	21%	0%
	-	**Biofuel share (% of total inland)**	-	46% (vs 22% in 2020)	Same assumption

Sector	Subsector	Levers	Granularity	**2030 values** identified or inferred to mimic the draft NECP	**2030 values** with historical trends on missing information
Industry	-	**Production level**	Steel	5Mt (+7% wrt 2015)	Same assumption
			Aluminium	0.2Mt (+10% wrt 2015)	Same assumption
			Cement	3Mt (+0% wrt 2015)	Same assumption
			Chemicals	6Mt (+20% wrt 2015)	Same assumption
	-	**Secondary production share**	Steel	37%	34%
			Aluminium	27%	23%
			Cement (non-clinker content)	28%	25%
			Chemicals	10%	7%
	-	**Technology of primary steel**	-	65% BF-BOF 35% H2-DRI	Same assumption
	CCS	**All industrial sectors**	-	0.3 Mt CO_2e	0 Mt CO_2e
		Detail per sector	-	Cement (0.3 Mt CO_2e)	Same assumption
Energy supply	**Fossil fuels**	**Electricity production: phase-out of**	Natural gas	36 MW	Same assumption
			Oil and petroleum	934 MW	Same assumption
			Coal	0 MW	Same assumption
	Renewables	**Capacity**	Solar PV	4.22 GW	3.17 GW
			On-shore wind	13.34 GW	13.34 GW
			Off-shore wind	5.55 GW	0.71 GW
	Nuclear	**Capacity**	-	8.02 GW	Same assumption
	Hydrogen	**-**	Imports	30%	Same assumption
			Production	2 TWh	Same assumption
	Carbon capture	**-**	Electricity generation	0 Mt CO_2e	Same assumption
			Oil refineries	0 Mt CO_2e	Same assumption
AFOLU	**Diet**	**Consumption**	Calories	3340 kcal/cap	Same assumption
			Meat	1365 kcal/cap	Same assumption
	Food waste	**Food waste**	-	340.4 kcal/cap	Same assumption
	Agriculture	**Crop extensification**	Fertilisers	30%	Same assumption
			Pesticides	2 TWh	Same assumption
			Cereal yield	0 Mt CO_2e	Same assumption
		Livestock extensification	-	0.0008 kg CO_2eq/kcal animal products	0.0007 kg CO_2eq/kcal animal products
	Land allocation	**Afforestation**	-	27000 ha/an	20000 ha/an

4.2 Detailed country ratings per theme indicators

4.2.1 Renewable electricity and hydrogen

Quality of information

Results per country

Theme	Metric	Description	IT	HU	NL	ES	SE
Renewable electricity	Targets	*Renewable Energy Directive II are stated and explained*					
		Renewable Energy Directive III are stated and explained					
Renewable electricity	Pipeline of projects	*Planned & ongoing renewable energy projects within MS detailed*					
		Capacity & timeline of renewable energy projects match RED targets					
Renewable electricity	Grid enhancement	*Plans for grid infrastructure development detailed*					
		Grid integration efforts & coordination within the EU described					
		Expected level of imported electricity, including from which country					
Renewable electricity	Policy Support	*Policies and measures to support renewable energy build-out detailed*					
Renewable electricity	Electrification	*Electrification measures for industry clearly described*					
		Electrification measures for transport clearly described					
		Electrification measures for buildings clearly described					
Hydrogen	Targets	*Targets for production, consumption and integration stated*					
Hydrogen	Pipeline of projects	*Planned & ongoing renewable hydrogen projects within MS detailed*					
		Capacity & timeline of renewable hydrogen projects match targets					
Hydrogen	Infrastructure	*Plans for infrastructure to support production, storage, transportation etc.*					
Hydrogen	Policy Support	*Policies and measures to support renewable hydrogen detailed*					
Hydrogen	Sectoral Integration	*Strategies on integrating renewable hydrogen into transport described*					
		Strategies on integrating renewable hydrogen into industry described					
Hydrogen	International Collaboration	*Sourcing of imported hydrogen (within EU or from abroad details)*					
		Collaboration between Member States on hydrogen imports					
		Collaboration with partners outside of EU on imported hydrogen					
		Planned & ongoing import capacities described					

Methodology details

Theme	Metric	Instructions
Renewable energy	Targets RED II	• Are RE targets under RED II stated and explained?
Renewable energy	Targets RED III	• Are RE targets under RED III stated and explained?
Renewable energy	Domestic project pipeline described	• Check for information on planned and ongoing renewable electricity projects within the country.
Renewable energy	Domestic project pipeline in relation to targets	• Does NECP set the capacity and timeline of these projects in relation to the stated targets. (If data available). Also check for inconsistencies here, e.g. do stated targets by technology add up?
Renewable energy	Imported electricity	• Check for details of expected imported electricity including its origin (which country)
Renewable energy	Grid infrastructure development	• Review existence/detail level of the plans for grid enhancement, and whether they mention relationship to RE build out
Renewable energy	Policy support	• Examine the policy measures mentioned to support renewable electricity development, including financial incentives, grants, subsidies, and regulatory frameworks.
Renewable energy	Electrification Industry	• Are electrification measures clearly described industry?
Renewable energy	Electrification Transport	• Are electrification measures clearly described transportation?
Renewable energy	Electrification Buildings	• Are electrification measures clearly described buildings?
Renewable energy	Cross national cooperation	• Review existence of intra-European grid integration efforts / coordination
Hydrogen	Targets	• Look for clear and ambitious targets for renewable hydrogen production, consumption, and integration in the NECP.
Hydrogen	Domestic project pipeline described	• Check for information on planned and ongoing renewable hydrogen projects within the country
Hydrogen	Domestic project pipeline in relation to targets	• Does NECP set the capacity and timeline of these projects in relation to the stated targets. (If data available). Also check for inconsistencies here, e.g. do stated targets by technology add up?
Hydrogen	Imported capacities described	• Check for information on planned and ongoing import capacities of renewable hydrogen
Hydrogen	Imported capacities in relation to targets	• Does NECP set the capacity and timeline of these projects in relation to the stated targets. (If data available)
Hydrogen	Infrastructure development	• Assess the plans for building infrastructure to support the production, storage, transportation, and distribution of renewable hydrogen.
Hydrogen	Policy support	• Examine the policy measures mentioned to support renewable hydrogen development, including financial incentives, grants, subsidies, and regulatory frameworks.
Hydrogen	Cross sectoral integration industry	• Look for strategies to integrate renewable hydrogen into industry
Hydrogen	Cross sectoral integration transport	• Look for strategies to integrate renewable hydrogen into transportation
Hydrogen	International cooperation: Sourcing	• Check detail on sourcing of imported hydrogen (within the EU or from abroad)
Hydrogen	International cooperation: EU	• Look for indications of collaboration between Member States to avoid double counting across borders of hydrogen imported from the EU.
Hydrogen	International cooperation: NonEU	• Check for collaboration with other international partners for hydrogen imported outside the EU.

Risk of inconsistency

Results per country

Theme	Metric	Description	IT	HU	NL	ES	SE
Renewable Electricity	Targets	*Alignment of national target(s) with Renewable Energy Directive II*					
		Alignment of national target(s) with Renewable Energy Directive III				N/A	
Renewable Electricity	Generation & capacity	*Consistency between generation and capacity values per technology*					
		Total renewable energy generation consistent with available potential					
Renewable Electricity	Grid enhancement	*Risk of failing to achieve the 15% interconnection target*					
		Risk of renewable roll-out being hampered by inflexible grid operation					
Renewable Electricity	Policy support	*Barriers to renewable electricity roll-out addressed*					
		Measures in line with stated targets and projects					
Hydrogen	Generation & capacity	*Consistency between domestic production and capacity*					
		Electricity demand for H_2 production accounted for					
Hydrogen	International cooperation	*Geographical detail on expected import sources*					
		Cooperation with other countries on H_2 strategies, import, connections					
		Clarity on which domestic and imported supply will cover H_2 demand					

Methodology details

Theme	Potential inconsistency	Description	Low	Medium	High
Renewable energy	Comparison of existing RES targets with RED II	Based on text in the NECP, what is the likelihood that the RED II target will be achieved?	Milestone targets have all be met so far and text states that target is expected to be met	Medium risk of missing 2030 target (without statistical transfers)	High risk of missing target (e.g. text states that target will be missed without additional policies)
Renewable energy	Comparison of updated RES targets with RED III	Based on text in the NECP, what is the likelihood that the RED III target will be achieved?	Milestone targets have all be met so far and text states that target is expected to be met	Medium risk of missing 2030 target (without statistical transfers)	High risk of missing target (e.g. text states that target will be missed without additional policies)
Renewable energy	Consistency generation & capacity	Are the targets consistent with generation capacity?	Consistent	Mostly consistent	Several inconsistencies
Renewable energy	Consistency with 15% grid interconnection	State level of interconnection planned and flag if very much lower	Already >15% or clear plan to get to 15%	15% goal mentioned, but not clear plan	No mention
Renewable energy	Land requirements / potential for solar / wind		Assessed in some detail and found to be in line with potentials	Not assessed in detail but don't fail basic sense checks	Amounts don't pass basic sense checks (unlikely to happen)
Renewable energy	Share of VRES vs storage capacities / flex options	Is there sufficient flexibility planned in the system to accommodate increasing shares of VRES?	Assessed in some detail / quantified	Assessed qualitatively	Not assessed
Renewable energy	Target vs policies	What is the share of targets to be fulfilled by large projects? Are both large projects and decentralised targets supported by policies?	Clear targets and policies for both parts (large and small projects)	Clear targets but unclear policies for either large or small	Unclear targets and/or unclear policies for small / no large projects mentioned
Renewable energy	Barrier removal	Addressing major barriers to RE uptake, including permitting, consistency, policy	Clear targets and policies for removing barriers	Issues described, but unclear path forward	Barriers not even mentioned
Renewable energy	Check electricity supply = demand	Also check if demand includes demand for green hydrogen	Model based and aligned	Model based but not clear if aligned	Not aligned/assessed
Hydrogen	Domestic production vs domestic electrolyser capacities	Is sufficient electrolyser capacity addition planned to achieve the planned amount of domestic production?	Model based and aligned	Model based but unclear whether aligned/assessed.	Not aligned/assessed
Hydrogen	Imports vs. domestic production	Is most of the planning based on imported hydrogen?	Imports <33%	Imports <67%	No information mentioned
Hydrogen	Geographic detail on hydrogen import sourcing	Is it clear where hydrogen is from?	Imports are clearly geography tied with amounts per country	Imports are clearly geography tied but no amounts per country	Imports not clearly geography tied
Hydrogen	Domestic vs import and cooperation support for import share	What is the share of targets to be fulfilled by imports EU or nonEU? Are both EU and nonEU imports supported by cooperation strategies?	Clear import targets and cooperation strategies for both EU and non-EU	Unclear import targets but clear cooperation strategies for either EU or non EU sources	Unclear import targets and/or unclear cooperation strategies for either EU or non EU sources

4.2.2 Long-term geological storage of CO_2

Quality of information

Results per country

Theme	Metric	Description	IT	HU	NL	ES	SE
LTGS of CO_2	Captured emissions	*The projected amount of CO2 captured annually*					
LTGS of CO_2	Storage capacity	*The assessment of domestic storage capacity*					
LTGS of CO_2	Storage utilisation	*Expected storage utilisation (both by domestic and imported CO2)*					
LTGS of CO_2	Inherent emissions	*The assessment of annual amount of inherent emissions in the economy*					
LTGS of CO_2	CCU	*The amount of captured CO2 that is expected to be reused*					
LTGS of CO_2	Transport infrastructure	*Planned capacity of CO2 transport infrastructure*					

Methodology details

Theme	Metric	Description
Long term geological storage of CO2	Captured emissions	• Is the projected amount of CO2 captured annually clearly stated?
Long term geological storage of CO2	Storage capacity	• Is the amount of storage space expected to be made available annually clearly stated?
Long term geological storage of CO2	Storage utilisation	• Check for information on planned and ongoing renewable electricity projects within the country.
Long term geological storage of CO2	Inherent emissions	• Does the NECP assess the amount of inherent emissions which will be produced by the whole economy annually?
Long term geological storage of CO2	CCU	• Check if the NECP determines how much of the captured carbon will be assigned to CCS and CCU
Long term geological storage of CO2	Transport infrastructure	• The capacity of the existing and planned CO2 transport infrastructure

Risk of inconsistency

Results per country

Theme	Metric	Description	IT	HU	NL	ES	SE
LTGS of CO2	Sources	*The main sources of captured CO2 are clearly stated to avoid confusion in carbon accounting*					
LTGS of CO2	Destination	*The final destination of captured CO2 (e.g. usage, domestic storage, export) is clearly indicated*					
LTGS of CO2	Export	*If the captured CO2 is to be exported, the relevant storage space in partner country is already secured*					

Methodology details

Theme	Metric	Instructions
Long term geological storage of CO2	Sources	• This potential inconsistency assesses if the NECP clearly states the main sources of captured CO2, to avoid confusion in carbon accounting (e.g. by accounting for CCS in industry in the same way as carbon removals by DACCS) and to make sure the technology is used in non-regret applications.
Long term geological storage of CO2	Destination	• This potential inconsistency assesses whether the NECP clearly states the final destination of captured CO2 (e.g. usage, domestic storage, export), to avoid confusion in carbon accounting (e.g. by accounting for CCS in the same way as CCU).
Long term geological storage of CO2	Export	• This potential inconsistency assesses whether the NECP has already secured storage in destination country if the captured CO2 is expected to be exported, to limit the risk of overreliance on certain storage capacities.

Suggested indicators

	Inherent process emissions	Non-inherent emissions	Biogenic emissions	Direct air CO2	Total
Available for capture		NA		NA	NA
Actually captured					
Stored domestically					
Exported					
Used further (CCU)					

The above table presents the stages of CCS/CCU process (rows) and sources from which CO_2 can come from (columns). Any element of the table corresponds to an indicator equal to the annual flow of CO_2 from the given source directed to a given stage of CCS/CCU process (e.g. the top left element corresponds to an indicator "An annual amount of CO_2 coming from inherent process emissions available for capture"). The elements marked in deep blue are key information expected to be found in the NECPs to allow for transparent carbon accounting, elements in light blue - complementary information which should be delivered in "best practice" documents (in addition to information outlined in the main text, regarding storage utilization, storage capacity and transport capacity).

4.2.3 Land uses

Quality of information

Results per country

Theme	Metric	Indicator	IT	HU	NL	ES	SE
Land uses	Land use monitoring	*Identification of improvements for data collection and land use monitoring*					
Land uses	Non-CO2	*Specific reduction targets for non-CO2 emissions from agriculture*					
Land uses	Net removals	*The objective to increase net removals from the land use sector, and*					
Land uses	Sustainable biomass	*Measures for the sustainable sourcing and use of biomass*					
Land uses	Wetlands area	*Restauration of wetlands from previously drained areas*					
		Planification of land use changes due to wetland restauration					
Land uses	Settlements area	*Increase of constructed area*					
		Demographic growth					
Land uses	Croplands area	*Plans to reduce food waste*					
		Reliance on first generation bioenergy crops					
		Implementation of agroecological practices considering influence on yields					
		Efficiency improvements leading to increased yields					
		Feed production for locally fed livestock					
Land uses	Forest lands area	*Wood production*					
		Afforestation/reforestation					
		Natural carbon sink targets					
Land uses	Grasslands area	*Plans to increase protected grassland areas*					
		Pasture demand for the livestock population					
		Natural carbon sink					

Risk of inconsistency

Theme	Metric	Description	IT	HU	NL	ES	SE
Land-uses	Land overlap	Are the expected increases in land area compensated by decreases of other lands?					
Land-uses	LULUCF target	Are the country's LULUCF ambitions aligned with the EU's removal targets?					
Land-uses	Forests	Are there plans to manage forests sustainably, to maintain productivity while increasing resistance and resiliency, hence maintaining their carbon sink potential?					
Land-uses	Croplands	Is the projected demand for food, feed, energy or industrial crops compatible with the existing utilised agricultural area (UAA)?					
Land-uses	Wetlands	Does the NECP consider and integrate the land use changes due to wetland restoration?					

4.2.4 Bioenergy

Quality of information

Results per country

Theme	Metric	Indicator	IT	HU	NL	ES	SE
Bioenergy	Targets	Renewable Energy Directive II are stated and explained					
		Renewable Energy Directive III are stated and explained					
Bioenergy	Policy Support	Policies and measures to support renewable energy build-out detailed					
Bioenergy	Fuel switch	Integration of bioenergy in the heating sector clearly described					
		Integration of bioenergy in the production of electricity clearly described					
		Integration of bioenergy in the transport sector clearly described					
Bioenergy	Supply	Production of first-generation bioenergy described					
		Production of second-generation bioenergy described					
		Production of third-generation bioenergy described					
Bioenergy	Sustainability	Include plans to promote second- or third generation (i.e. advanced) biofuels					
		Inclusion of sustainability criteria to the production of biomass					
		Mention of the cascading principle for the use of biomass					
		Considers the indirect impact of using biomass, especially linked to indirect land use change					
Bioenergy	International collaboration	Sourcing of imported bioenergy or bio raw materials (within EU or from abroad details)					
		Collaboration between Member States on bioenergy imports					
		Collaboration with partners outside of EU on imported bioenergy					
		Planned & ongoing import capacities described					

Risk of inconsistency

Results per country

Theme	Metric	Description	IT	HU	NL	ES	SE
Bioenergy	Targets	*Alignment of national target(s) with Renewable Energy Directive III*					
Bioenergy	Infrastructure	Plans for infrastructure to support production, storage, transportation etc.					
Bioenergy	Policy Support	*Measures in line with stated targets and projects*					
Bioenergy	Imports	*Need for bioenergy imports to meet domestic demand*					

4.3 References

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4.4 Indexes

4.4.1 Figures

4.4.2 Tables

4.5 Abbreviations

BECCS	Bioenergy carbon capture and storage
CCS	Carbon capture and storage
CDR	Carbon dioxide removal
CO_2	Carbon dioxide
CO_2e	Carbon dioxide equivalent
DACCS	Direct air carbon capture and storage
EC	European Commission
EP	European Parliament
ETS	Emissions Trading System
GHG	Greenhouse gas
LTGS	Long-term geological storage
LTS	Long-term strategy
LULUCF	Land use, land use change, and forestry
Mt	Million tonnes
NECP	National energy and climate plan
NECPR	National energy and climate progress reports
PaMs	Policies and measures

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