The role of carbon dioxide removals in the 2040 target

'Earth observation for monitoring, reporting and verification of carbon removals' conference
Copenhagen, 8-11 October 2024

François Dejean
Head of Secretariat

European Scientific Advisory Board on Climate Change

1. **The European Scientific Advisory Board on Climate Change**
2. Advice on the EU's 2040 climate target
3. 'Towards EU climate neutrality': progress, policy gaps and opportunities
4. Upcoming advice on carbon dioxide removals

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The Advisory Board

shall serve as a point of reference for the Union

on scientific knowledge relating to climate change

by virtue of its independence and scientific and technical expertise.

European Climate Law (EU) 2021/1119

The 15 Advisory Board members

European Scientific Advisory Board on Climate Change

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University of Copenhagen

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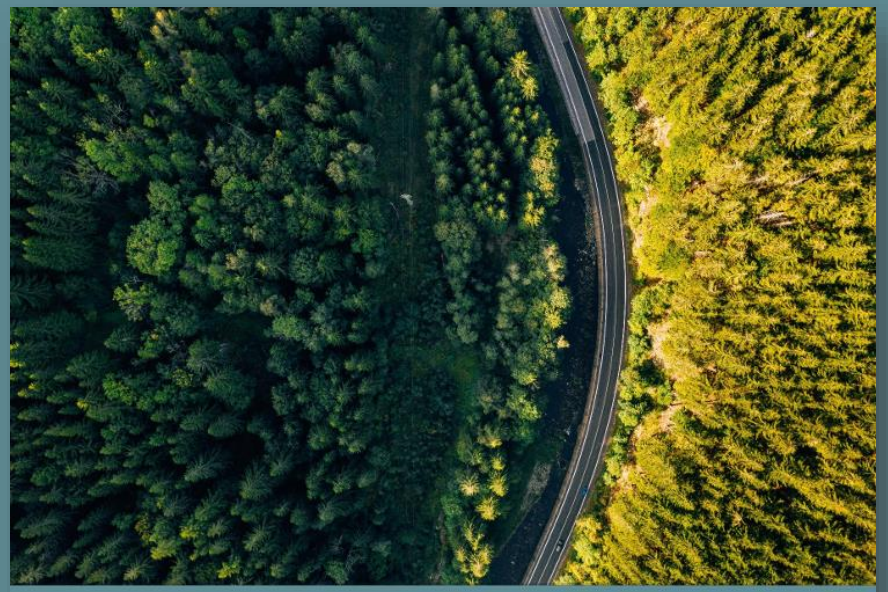

Scientific advice for the determination of an EU-wide 2040 climate target and a greenhouse gas budget for 2030–2050

15 June 2023

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An EU 2040 target considering feasibility and fairness

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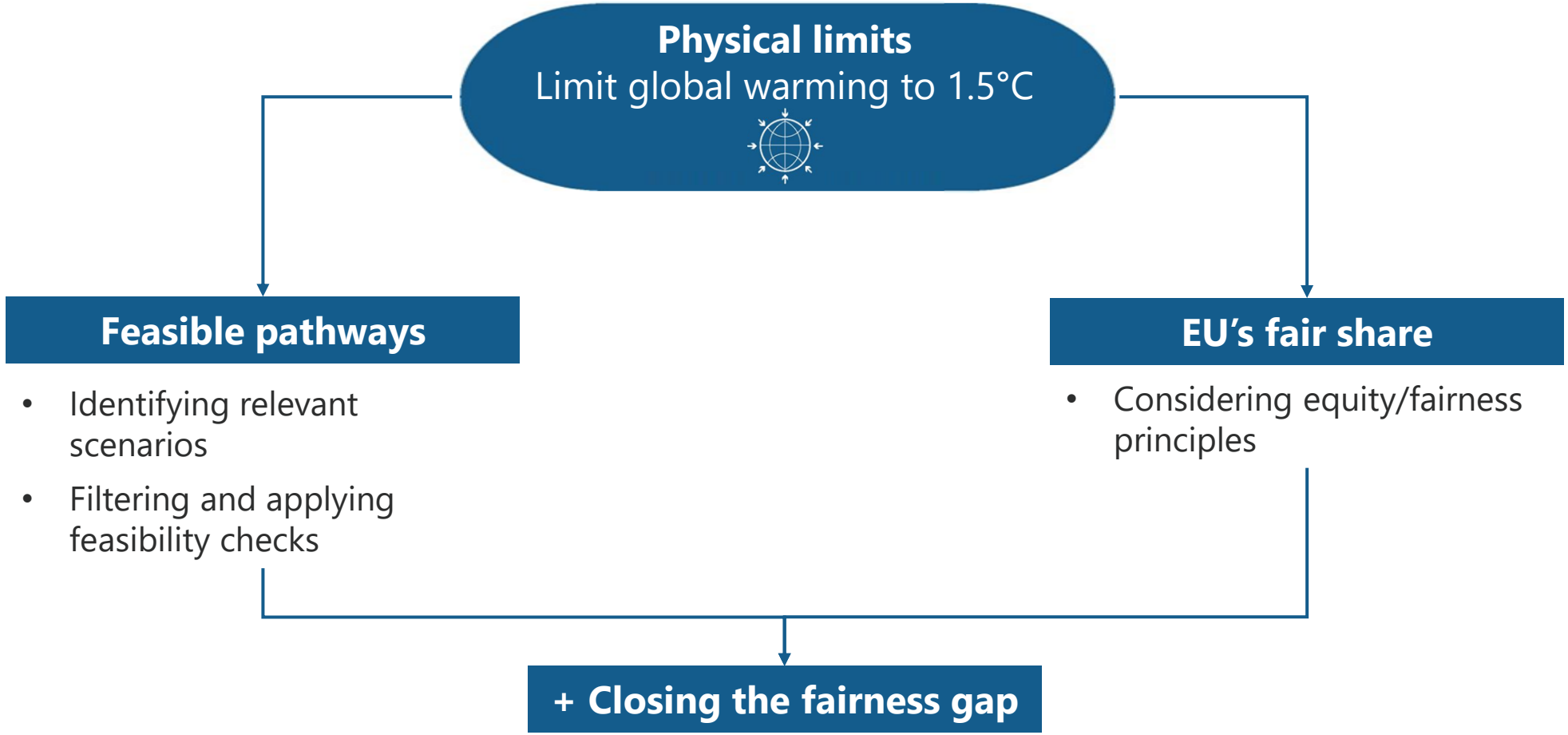

Using the latest scientific evidence to identify a range of feasible emission reductions in line with 1.5°C

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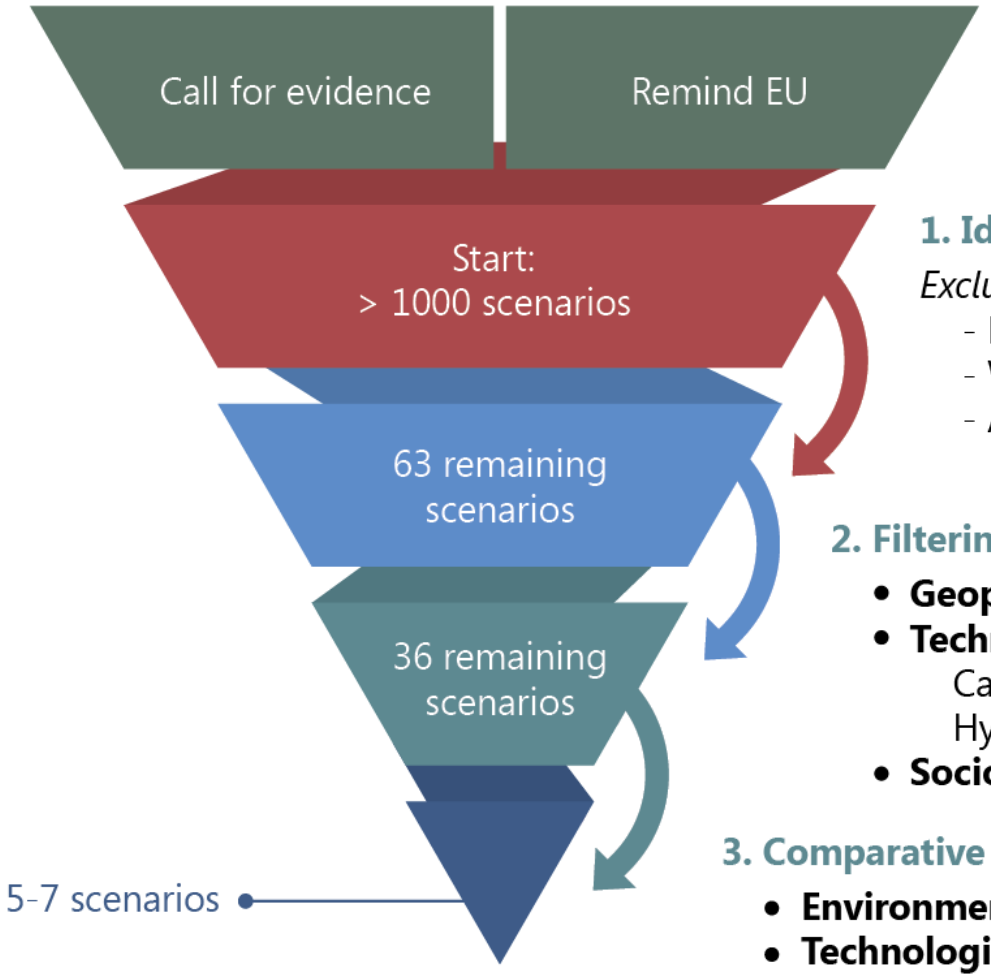

1. Identification and processing of scenarios

Exclusion of scenarios that:

- Did not contain sufficient data at EU27 level
- Were not consistent with existing EU GHG objectives
- Assumed highly implausible development on the short term

2. Filtering out scenarios with high feasibility concerns

- **Geophysical** - primary biomass: > 20 EJ
- **Technological**
  Carbon capture, utilisation and storage: > 500 Mt CO_2 in 2050
  Hydrogen: > 150 GW in 2030
- **Socio-cultural** - final energy demand: > 20% decline between 2020 and 2030

3. Comparative feasibility analysis

- **Environmental risks** - reliance on CCUS, carbon removals from land and bioenergy
- **Technological challenges** - rate of deployment of solar photovoltaics, wind and hydrogen

➔ **Feasible range for 2040: 88% to 95% net reductions** vs 1990

Assessing pathways' environmental risks from their reliance on CCUS, carbon removals and bioenergy use

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	Environmental risk level
Carbon capture, utilisation and storage	425 Mt CO_2 annually by 2050
Carbon removals from the land sink	Net sink of 400 Mt CO_2 per year by 2050
Bioenergy	9 EJ of annual primary bioenergy use by 2050

7 scenarios with limited risks associated with CCUS deployment, bioenergy deployment and size of land sink

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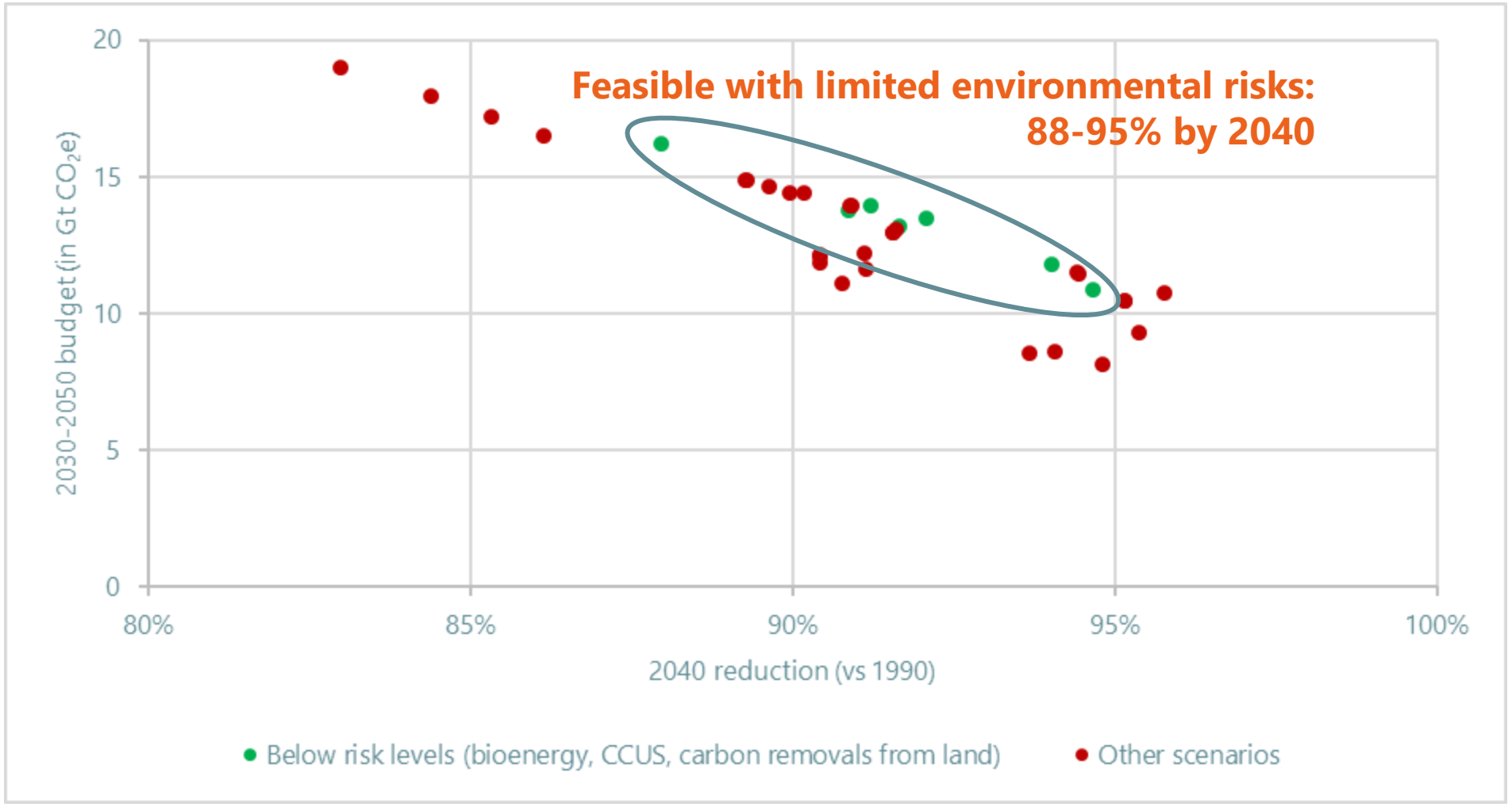

Feasibility: implied EU GHG emission budgets for 2030-2050 and 2040 reductions by different ranges of scenarios

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Range of scenarios	Number of scenarios	Implied range for an EU budget for 2030-2050 (Gt CO_2e)	Implied range for an EU 2040 reduction target (% reduction vs. 1990)
Scenarios	36	8-19	83-96%
within environmental risk levels (less reliance on CCUS, carbon removals from land, and bioenergy)	7	11-16	88-95%
within environmental risk levels **and** technological deployment challenge levels (less rapid scale-up of non-biomass renewables)	5	13-16	88-92%

Considering various approaches to EU's fair share of the global carbon budget

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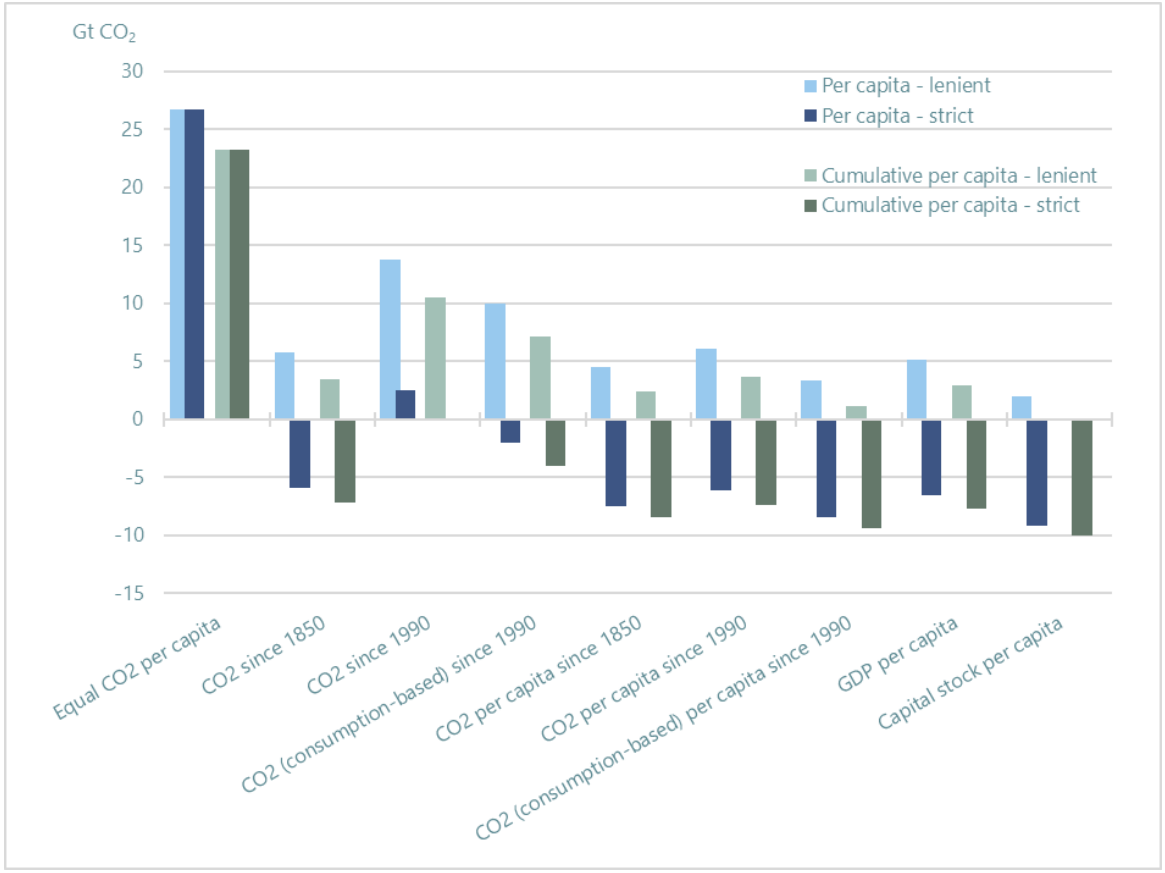
Approach	Equity principle
Grandfathering	Sovereignty
Immediate per capita convergence	Equality
Per capita convergence	Sovereignty / equality
Equal cumulative per capita emissions	Equality / responsibility
Ability to pay	Capability / need
Greenhouse development rights	Responsibility / capability / need
Cost-optimal	Cost-effectiveness

Source: modified from Table 1 of Van den Berg et al. (2020)

EU fair share carbon budget estimates from 2020



Source: Pelz et al. (2023)

Feasibility and fairness

	2040 reduction	2030-2050 budget
*Range informed by **feasibility***		
Noting that achieving the more ambitious end of this range implies challenging levels of energy technology scale-up	88% **to 95%**	**11** to 16 Gt CO_2e
*Minimum ambition informed by **fair share** estimates*		
Noting that emissions in the climate neutrality pathways exceed equity-based fair share estimates	**At least 90%**	**Up to 14** Gt CO_2e

Recommended range of 2040 GHG reduction vs 1990

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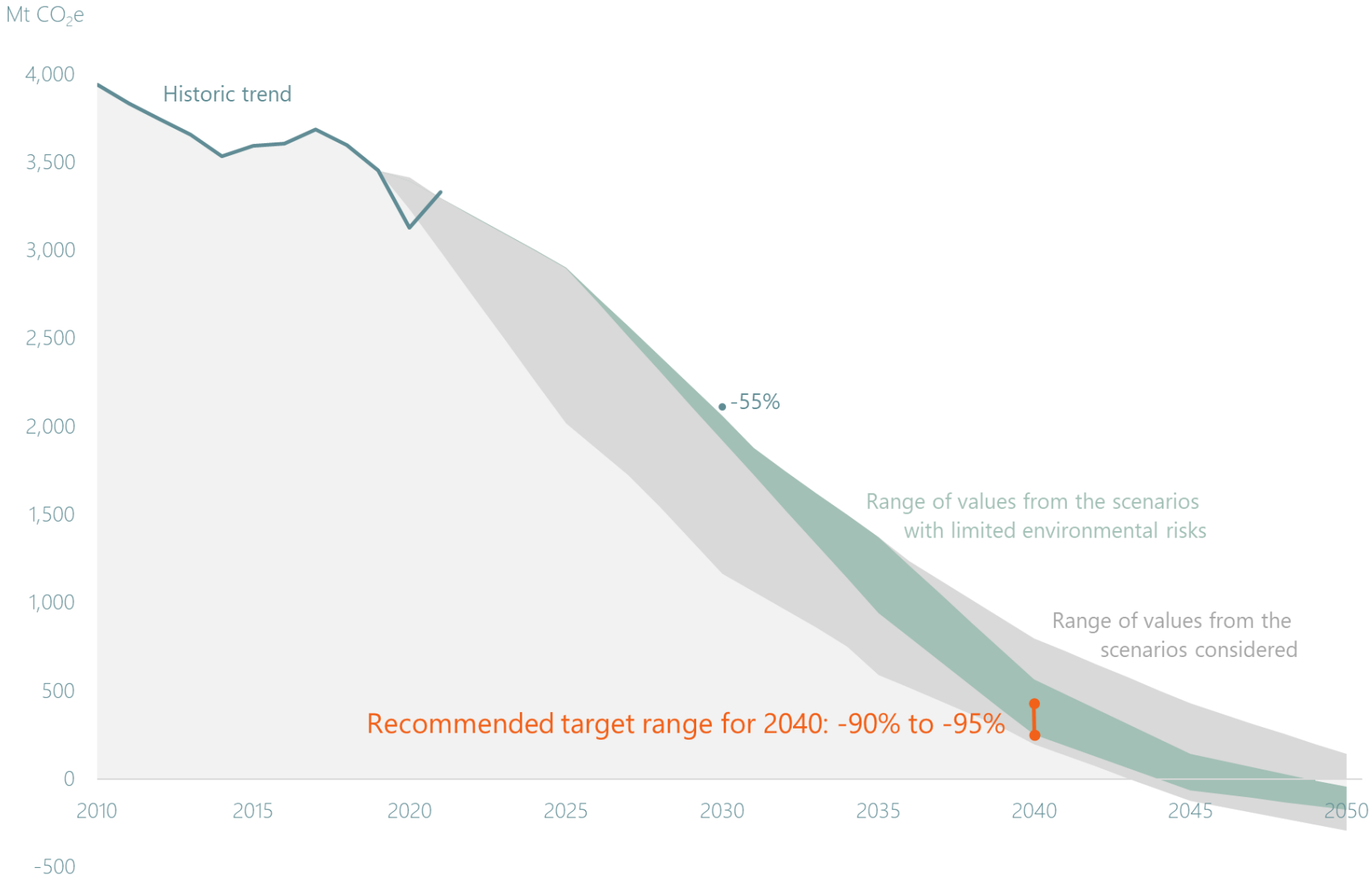

Reconciling feasible and fair EU contributions to global climate change mitigation

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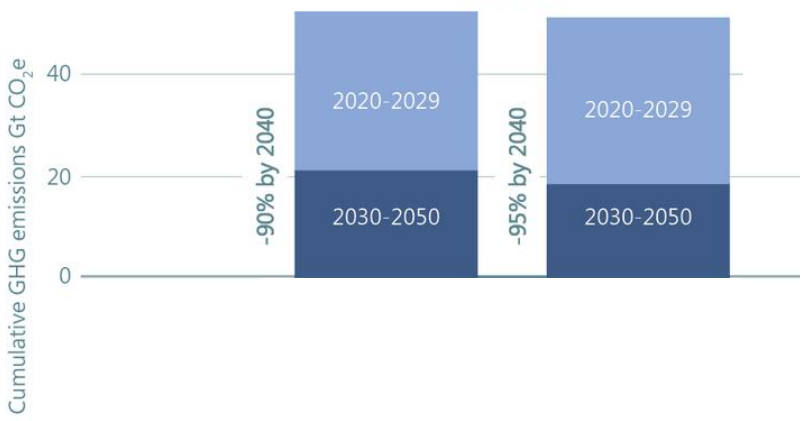
Greenhouse gas emissions (2020-2050 cumulative) consistent with recommended target range



Reconciling feasible and fair EU contributions to global climate change mitigation

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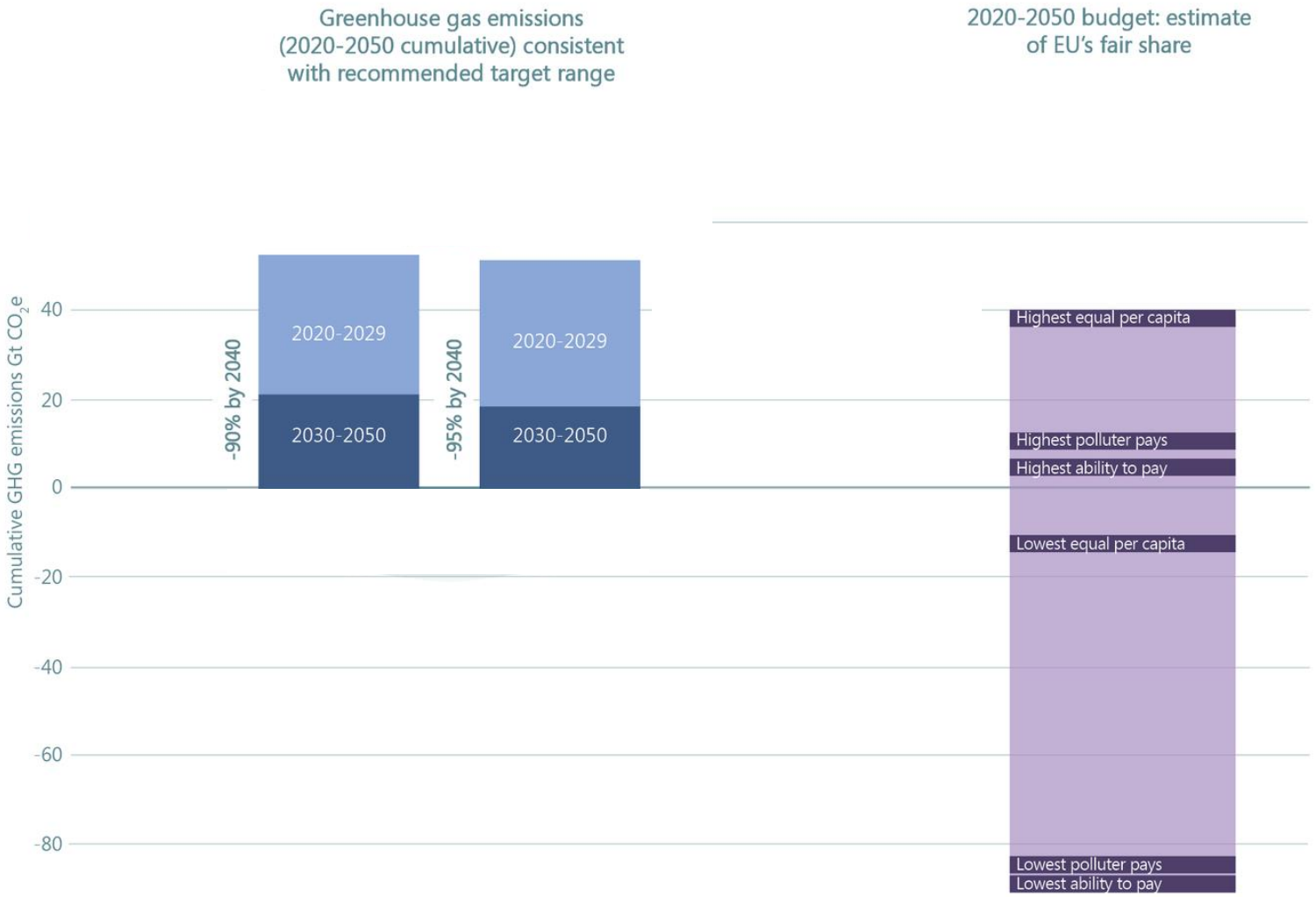

Reconciling feasible and fair EU contributions to global climate change mitigation

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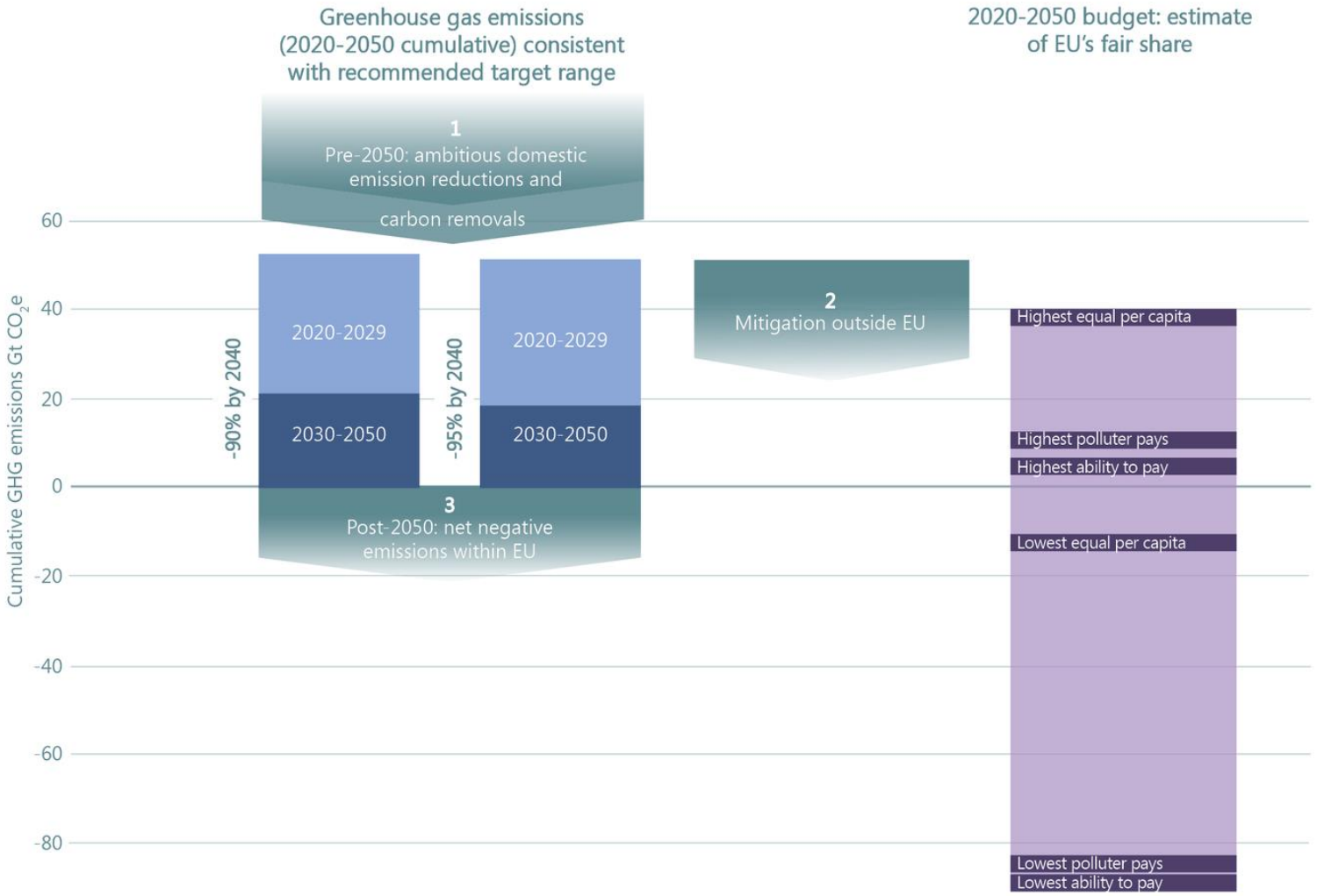

The recommended range of emission reductions can be achieved in various ways – choices must be made

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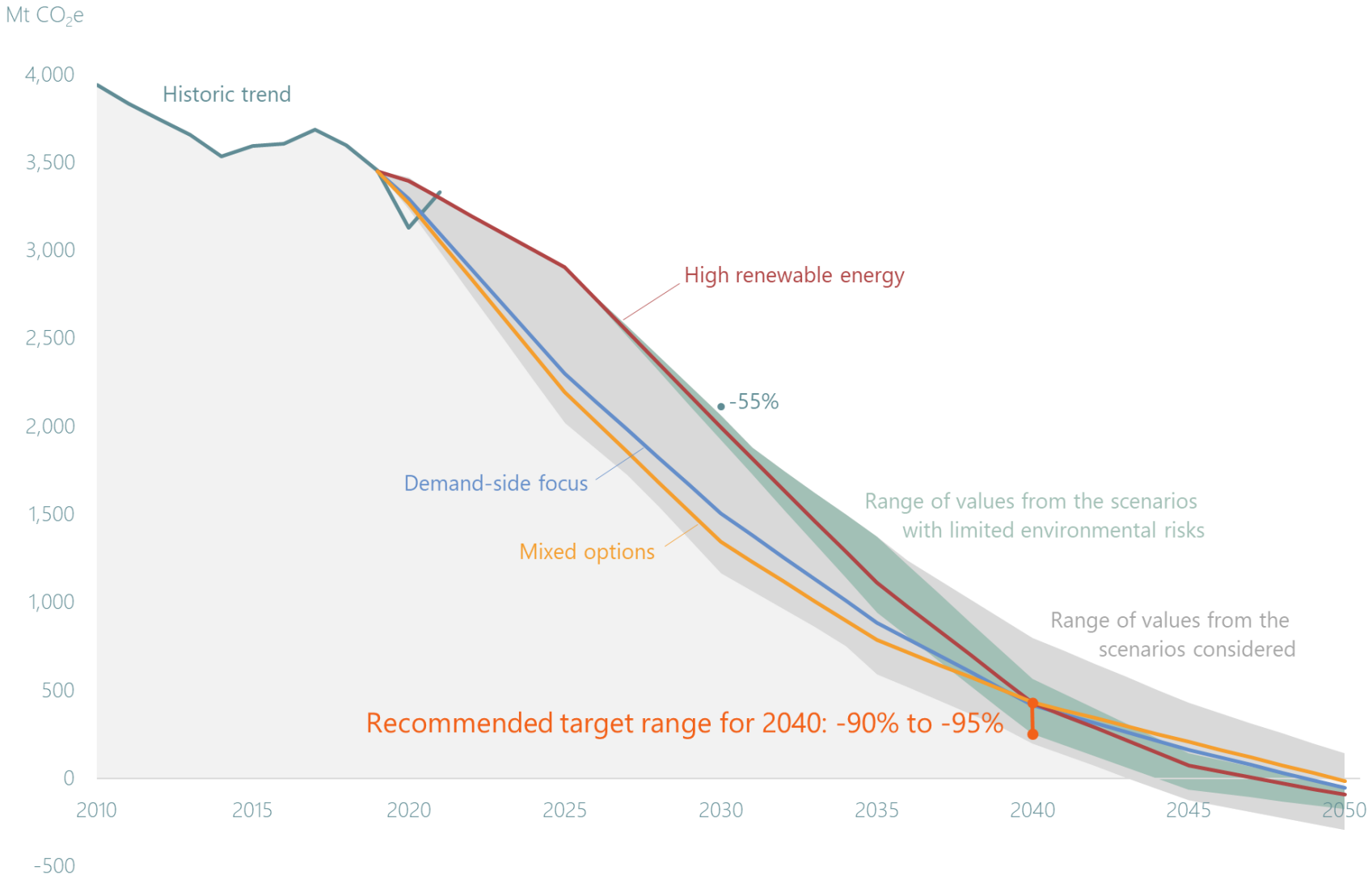

Iconic pathways illustrating choices and strategies to achieve climate neutrality by 2050

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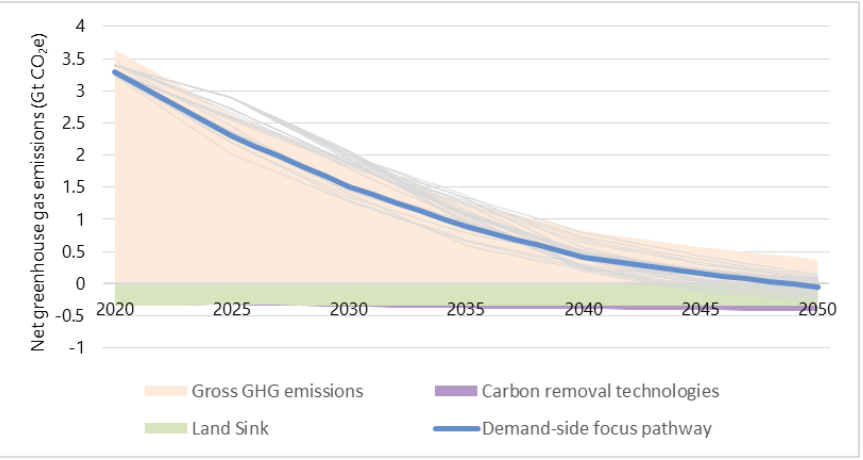
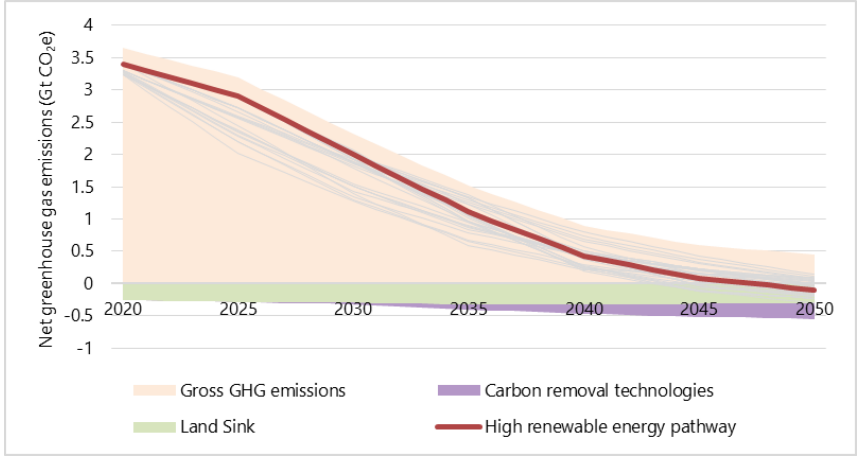
Demand-side focus pathway



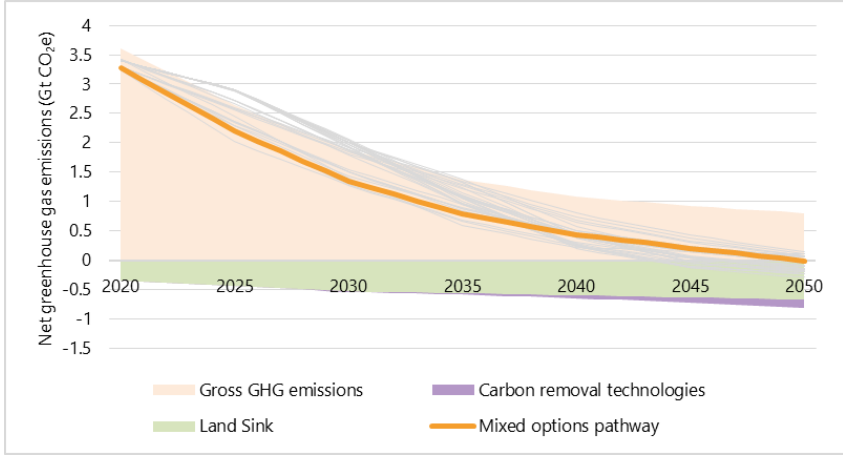
- Less resource-intensive lifestyles
- Lowest final energy demand in 2040
- Lowest reliance on carbon removals (from CCS and the land sink combined) by 2050

High renewable energy pathway



- Largest greenhouse gas budget
- High renewable energy deployment
- Highest deployment of non-biomass renewable energy
- Highest rate of electrification by 2040

Mixed options pathway



- Lowest cumulative emissions in the 2030-2050 period
- Greatest deployment of carbon removals (with specific focus on sustainable land-based removals)
- Increase in the contribution of nuclear power over time (as opposed to the two other iconic pathways)

The scenarios considered present common features regarding sectoral emission reductions

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- **Decarbonisation of the power sector:**
  - Share of electricity in final energy demand doubles
  - 70-90% wind, solar, hydro
  - Coal almost phased out by 2030, natural gas by 2040
  - Scale-up of bioenergy and hydrogen varies between scenarios
- **Reduction of total energy demand** by 20% to 40% compared to today, with significant reductions in transport, industry and residential/tertiary sectors
- **Reduction of non-CO_2 emissions** by 20% and 60% compared to today, with significant reduction in agriculture, energy and waste sectors
- **Scale up of carbon removals**, estimated to represent between 146 and 614 Mt CO_2 in 2040
  - Land sink limited by climate impacts, estimated between 100 and 400 Mt CO_2 in 2040
  - BECCS+DACCS between 46 and 214 Mt CO_2 in 2040

2040 scenarios bring carbon dioxide removals at scale

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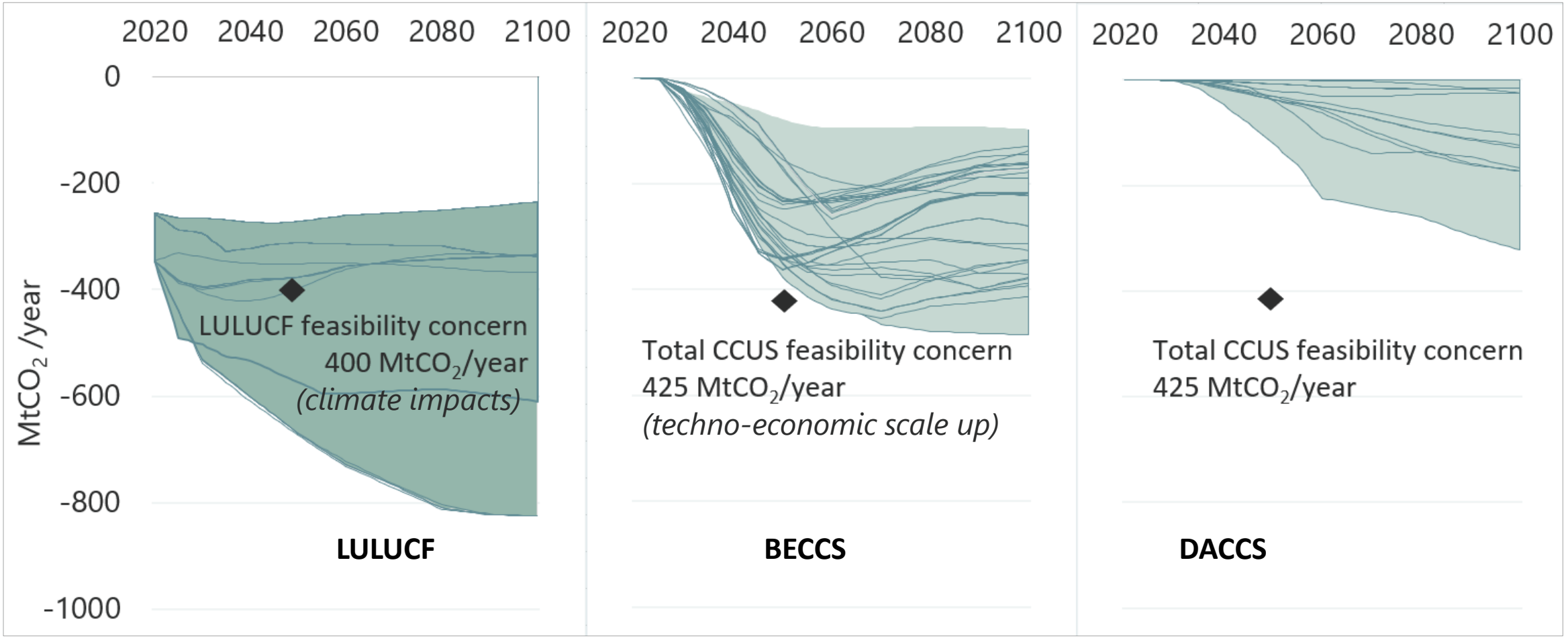

Net removals from LULUCF, BECCS and DACCS in the 36 filtered scenarios

Source: Advisory Board, 2023

All the scenarios analysed require large-scale deployment of carbon removals by 2050

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- Each scenario places a different emphasis on
    - the need for carbon removals
    - the extent to which its deployment is through the **enhancement of the sink** or **technologies such as BECCS**
- However, both sources are required, and both have important benefits and risks
- **Increasing the land sink** requires changes in land use and management practices, as well as resilience to climate change impacts
- **Scaling up other carbon removals technologies** requires **investment in new capacity** and **overcoming barriers** such as:
    - absence of market incentives and governance challenges
    - technological, social and environmental barriers that remain largely unexplored
- Significant **uncertainties** in scenarios regarding the **potential of emissions reductions**, and the **potential of removals**, especially from novel methods

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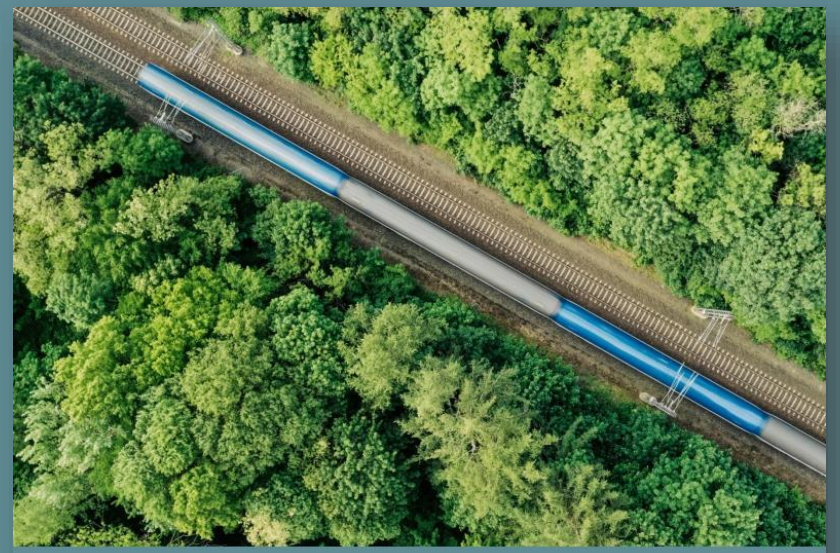

Towards EU climate neutrality

Progress, policy gaps and opportunities

Assessment Report 2024

18 January 2024

European Scientific Advisory Board on Climate Change

Current progress: pace of reductions needs to double up to 2030, and increase further post-2030

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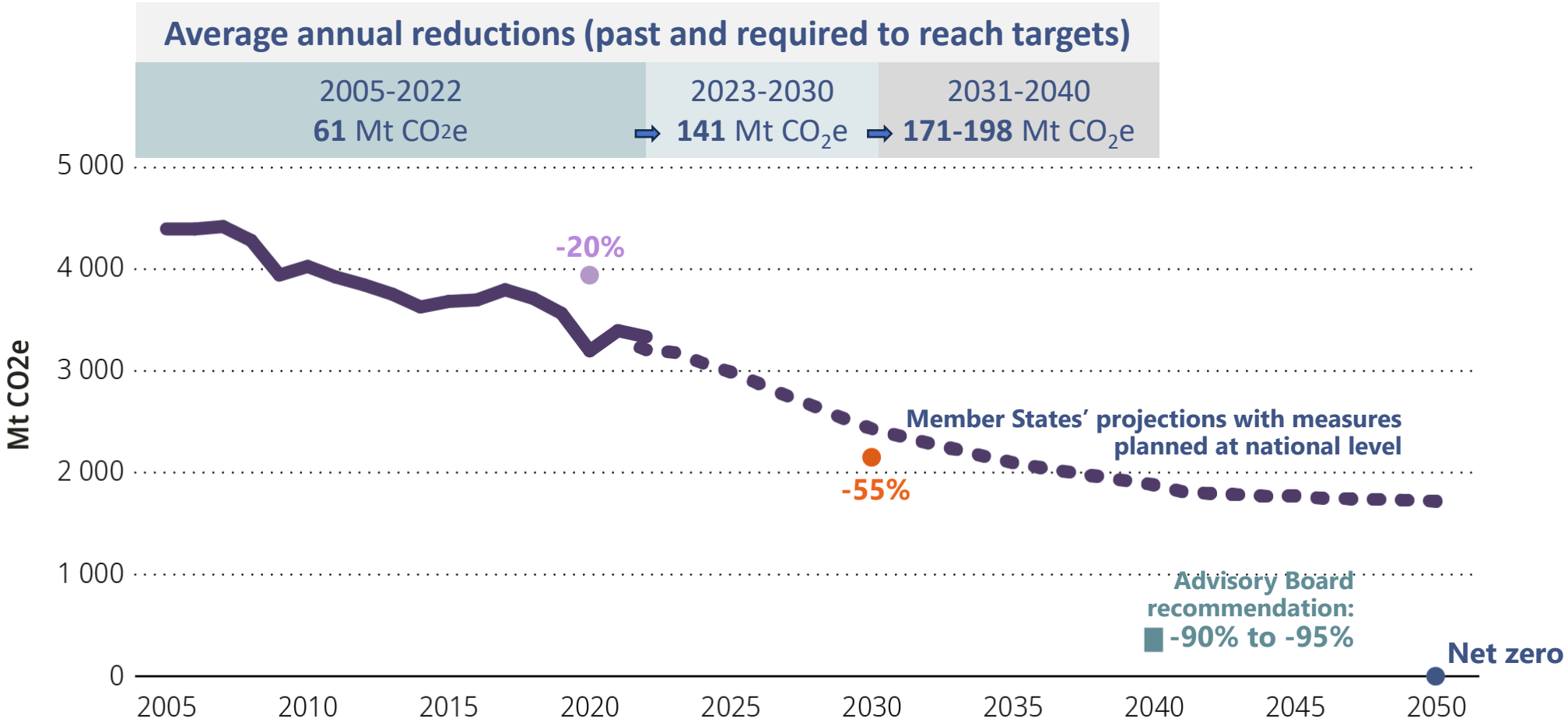

Source: Advisory Board based on GHG inventory data

‘Towards EU climate neutrality: Progress, policy gaps and opportunities’ (January 2024)

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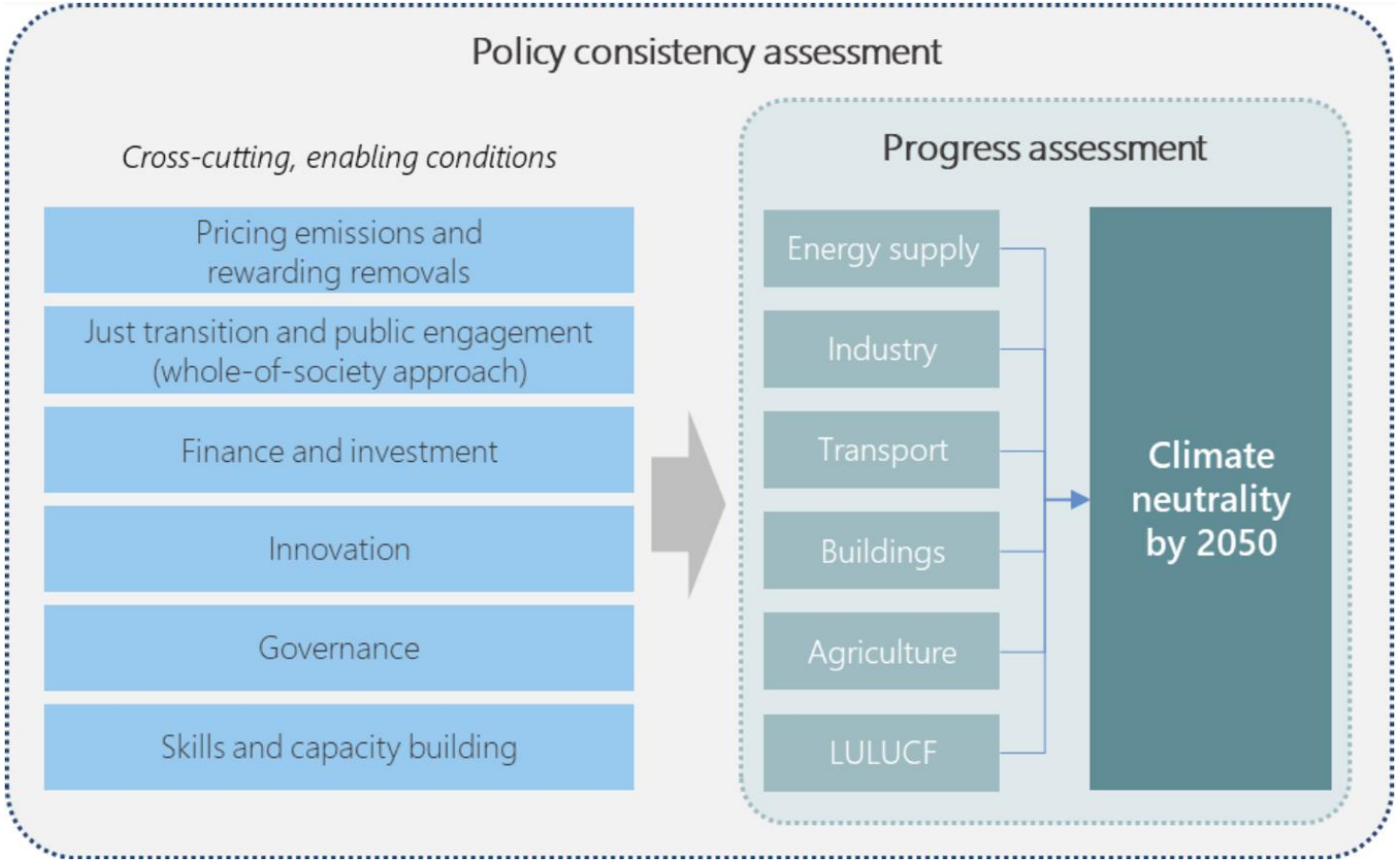

Reversing the decrease in the LULUCF carbon sink

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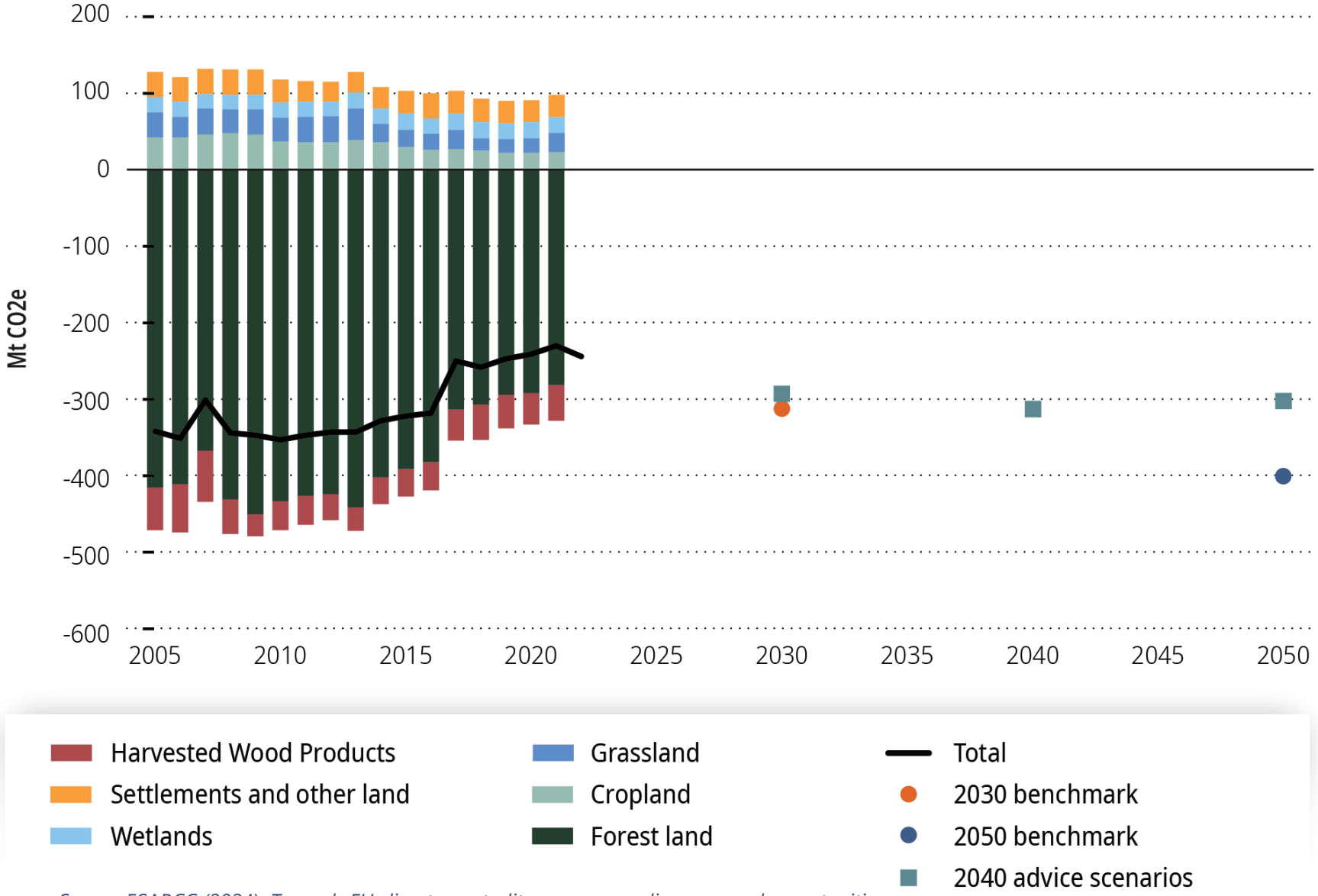

Source: ESABCC (2024), *Towards EU climate neutrality: progress, policy gaps and opportunities*

Policy recommendations to reverse the decrease in the LULUCF carbon sink

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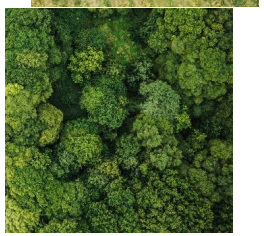

1. **Maintain and expand forests and wetland areas**
   ➔ To be better reflected in EU agriculture and bioenergy policies

2. **Increase the carbon sink in existing forests**
   ➔ Better target incentives for bioenergy use towards sectors with limited alternatives
   ➔ Start preparations to introduce GHG pricing in the LULUCF sector (financial incentive for forest managers to reduce emissions and increase removals)

3. **Reduce GHG emissions and increase removals in crop- and grasslands**
   ➔ Provide stronger incentives for GHG reductions and carbon removals

4. **Improve the resilience of ecosystems to current and projected climate change impacts**
   ➔ Increase efforts on adaptation
   ➔ Develop a contingency strategy

Recommendations on CCU/CCS

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- CCU/CCS is limited by its capital intensity and impacts on energy system.
  The value chain is **not yet mature**
- **Residual emissions** are not defined / no standards
- **Techno-economic aspects** limit the availability/certainty/ sustainability of CCU/CCS

→ CCU/CCS should be targeted towards **activities with no/limited alternatives**, avoid unnecessary fossil gas **infrastructure lock-ins**

→ **Energy efficiency 1st principle** should be systematically put into practice

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The EU is committed to net zero emission *by* 2050 and net-negative emissions thereafter

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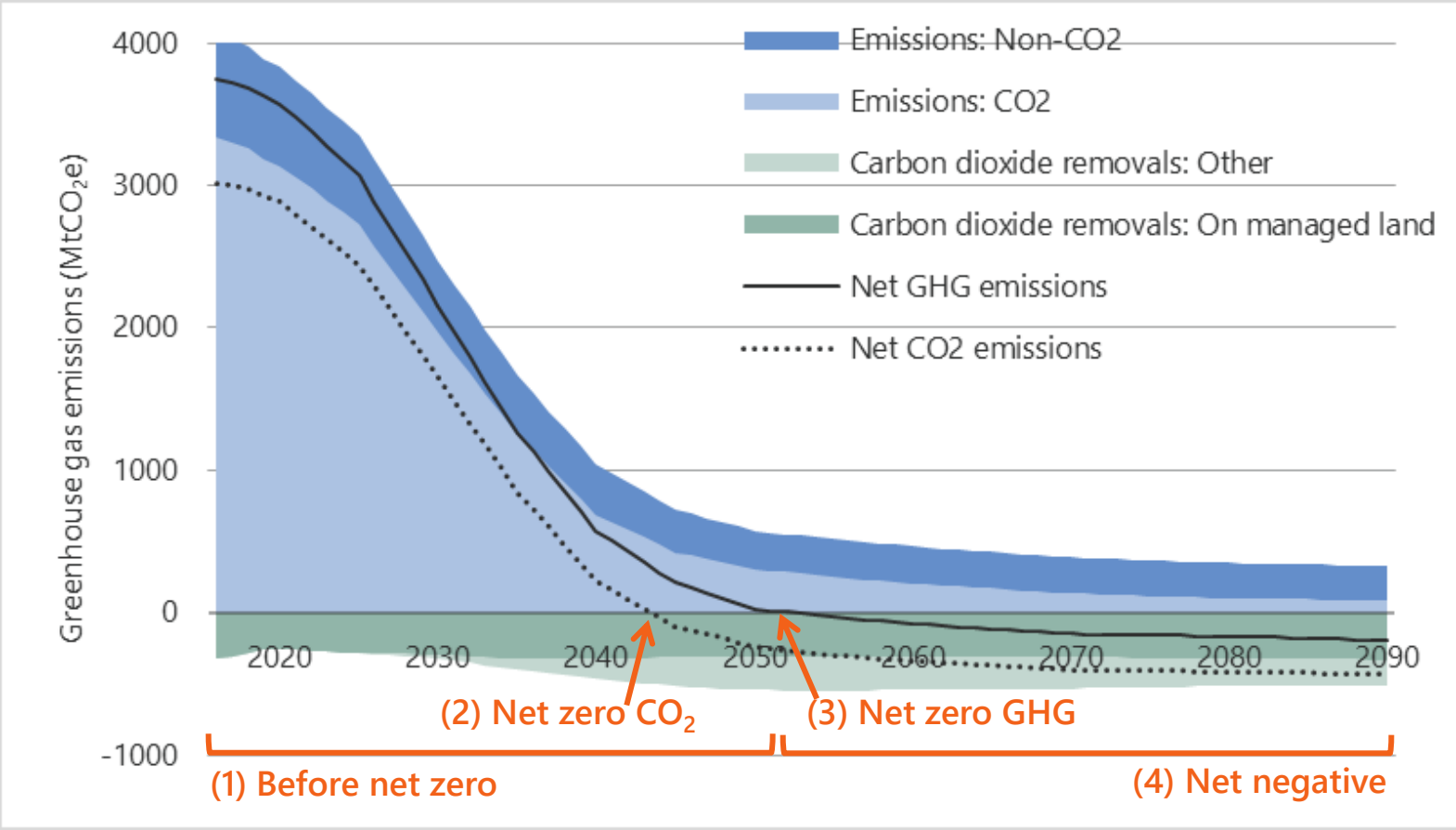

Example EU pathway ('High renewable energy'), Source: Advisory Board

Challenge for EU policy:
How to scale up removals sustainably?

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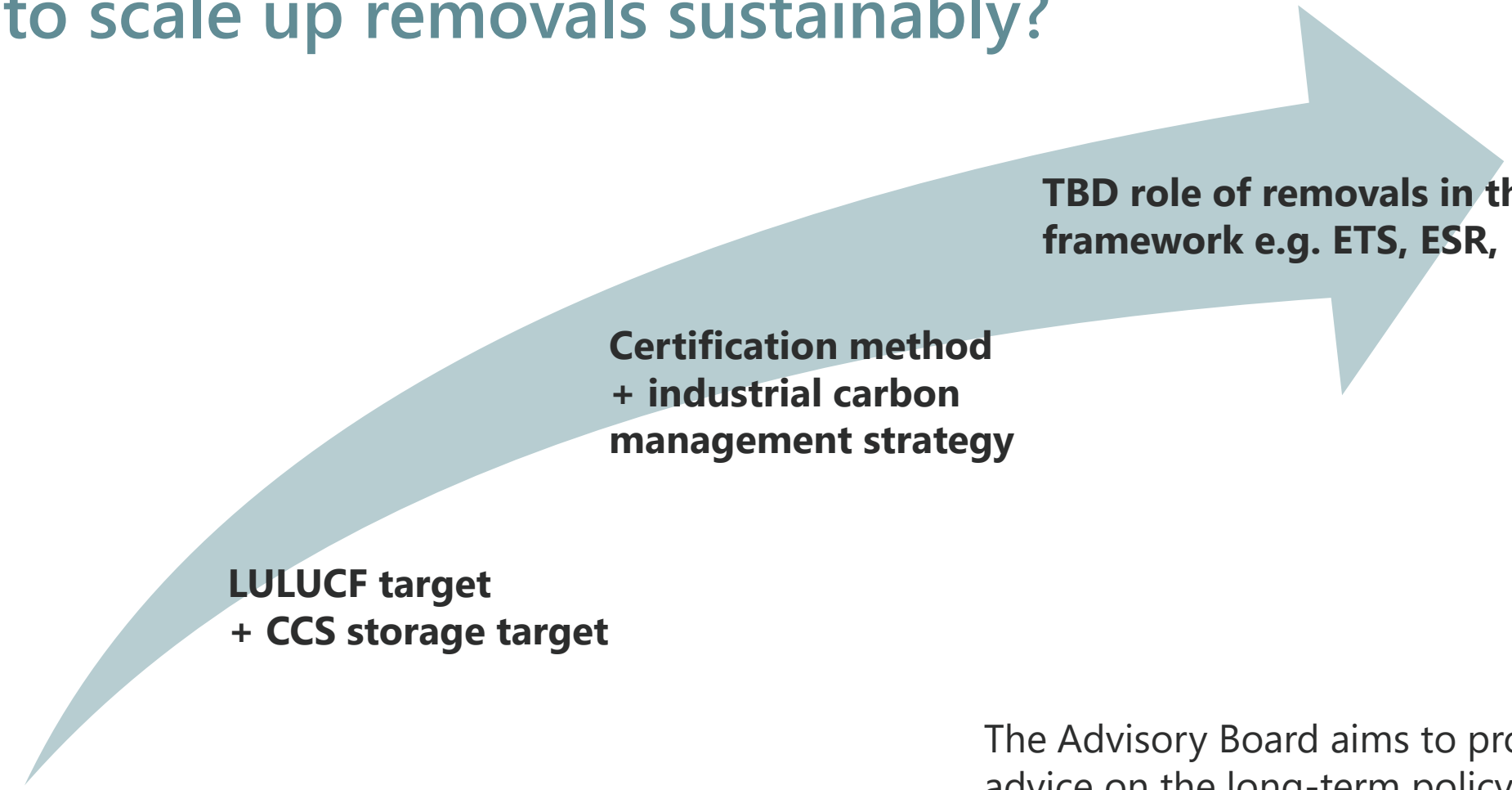

The Advisory Board aims to provide scientific advice on the long-term policy architecture and governance of removals in the EU.

Diverse removal methods with specific risks and benefits

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Years to decades | *Decades to centuries* | *Centuries to millennia* | *Ten millennia or longer*

above ground

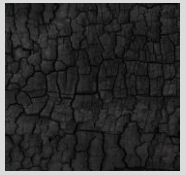
under ground

Soil carbon sequestration

Afforestation, reforestation & improved forest management

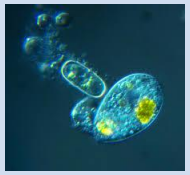
Peatland and coastal wetland restoration

Blue carbon management



Biochar

ocean



Ocean fertilisation

Ocean alkalinity enhancement

Enhanced weathering

Bioenergy with carbon capture and storage (BECCS)

Direct air carbon capture and storage (DACCS)

Carbon dioxide removals taxonomy, Source: adapted from IPCC, 2022, Images: Creative Commons.

The Advisory Board will provide the EU with scientific advice on carbon dioxide removals

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MRV remain the nuts and bolts of climate action – and for the scale up of carbon removals

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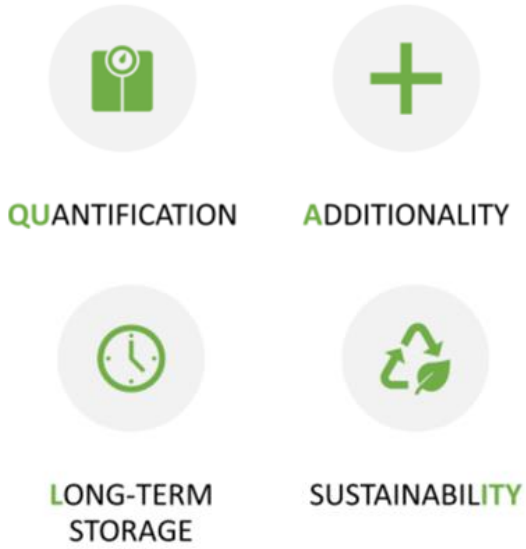
- **MRV is critical for climate policy implementation and accounting towards targets**
- **Certification** forms the basis to deliver labels, allocate subsidies and trade credits
  - Accurate **quantification** of removals
  - True **additionality** and no overestimation (over-crediting risk)
  - Monitoring the real **duration of storage**, with long-term liability mechanisms
  - Providing information on side-effects (→ help manage land use, biomass sourcing, climate impacts and **sustainability**)
  - **Tailored** to different removal methods, including newer innovative methods



- MRV can benefit from **emerging technologies**
- Accuracy to be balanced with **costs** and administrative burden - including with an enhanced use of satellite data
- An **EU-wide governance of greenhouse gas removals** to efficient stakeholder coordination at different levels

In conclusion…

1. In addition to strong incentives for **emission reductions**, **scaling up both land-based and technological removals** is needed for the EU to achieve its climate objectives

2. **Policy opportunities already exist** to protect and enhance EU's net carbon sink, and to support the deployment of novel technologies. However, **additional policy options remain necessary**

3. **Robust MRV is key** to monitoring progress, enforcing compliance, and enabling efficient implementation

4. Building an effective **governance of CDR** will require further **scientific insight and credible data**

European Scientific Advisory Board on Climate Change

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