Potsdam Institute for Climate Impact Research

Mercator Research Institute on Global Commons and Climate Change

Scientific advice for an EU-wide 2040 climate target and a greenhouse gas budget for the period 2030-50

Prof. Dr. Ottmar Edenhofer

Potsdam Institute for Climate Impact Research (PIK), Director
Mercator Research Institute on Global Commons and Climate Change (MCC), Director
Technische Universität Berlin, Chair Economics of Climate Change
European Scientific Advisory Board on Climate Change (ESABCC), Chair

Climate Change Advisory Council
19 July 2023

The ESABCC Report

- Published on 15 June 2023
- Comprehensive assessment of the latest available scientifically based GHG scenarios for achieving climate neutrality in the EU by 2050, in line with the goals of the Paris Agreement
- Based on rigorous analysis considering both fairness and feasibility
- Findings highlight the urgent need for ambitious actions to address climate change
- Outlines possible pathways and related overarching policy choices to achieve the necessary emission reductions

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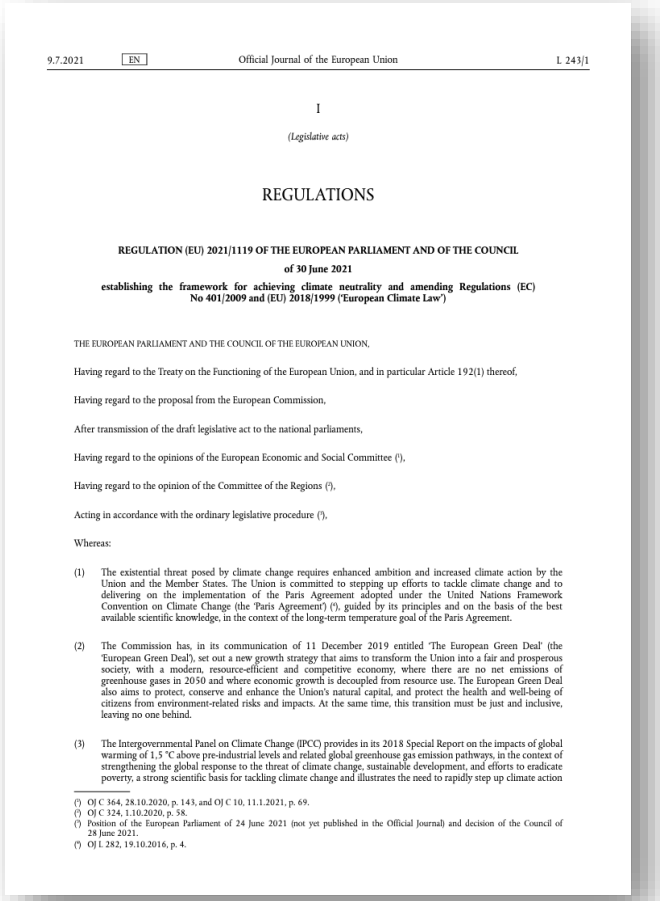
The EU's 2040 climate target

European Climate Law



9.7.2021 EN Official Journal of the European Union L 243/1

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(Legislative acts)

REGULATIONS

REGULATION (EU) 2021/1119 OF THE EUROPEAN PARLIAMENT AND OF THE COUNCIL
of 30 June 2021
establishing the framework for achieving climate neutrality and amending Regulations (EC) No 401/2009 and (EU) 2018/1999 ('European Climate Law')

THE EUROPEAN PARLIAMENT AND THE COUNCIL OF THE EUROPEAN UNION,

Having regard to the Treaty on the Functioning of the European Union, and in particular Article 192(1) thereof,

Having regard to the proposal from the European Commission,

After transmission of the draft legislative act to the national parliaments,

Having regard to the opinions of the European Economic and Social Committee (1),

Having regard to the opinion of the Committee of the Regions (2),

Acting in accordance with the ordinary legislative procedure (3),

Whereas:

(1) The existential threat posed by climate change requires enhanced ambition and increased climate action by the Union and the Member States. The Union is committed to stepping up efforts to tackle climate change and to delivering on the implementation of the Paris Agreement adopted under the United Nations Framework Convention on Climate Change (the 'Paris Agreement') (4), guided by its principles and on the basis of the best available scientific knowledge, in the context of the long-term temperature goal of the Paris Agreement.

(2) The Commission has, in its communication of 11 December 2019 entitled 'The European Green Deal' (the 'European Green Deal'), set out a new growth strategy that aims to transform the Union into a fair and prosperous society, with a modern, resource-efficient and competitive economy, where there are no net emissions of greenhouse gases in 2050 and where economic growth is decoupled from resource use. The European Green Deal also aims to protect, conserve and enhance the Union's natural capital, and protect the health and well-being of citizens from environment-related risks and impacts. At the same time, this transition must be just and inclusive, leaving no one behind.

(3) The Intergovernmental Panel on Climate Change (IPCC) provides in its 2018 Special Report on the impacts of global warming of 1,5 °C above pre-industrial levels and related global greenhouse gas emission pathways, in the context of strengthening the global response to the threat of climate change, sustainable development, and efforts to eradicate poverty, a strong scientific basis for tackling climate change and illustrates the need to rapidly step up climate action

(1) OJ C 364, 28.10.2020, p. 143, and OJ C 10, 11.1.2021, p. 69.
(2) OJ C 324, 1.10.2020, p. 58.
(3) Position of the European Parliament of 24 June 2021 (not yet published in the Official Journal) and decision of the Council of 28 June 2021.
(4) OJ L 282, 19.10.2016, p. 4.

- An **EU 2040 target** is needed for a '**gradual reduction**' of emissions, and an '**irreversible transition**'
- EU targets should be based on the '**best available science**'
- Within 6 months of the 1st global stocktake, the Commission will propose a 2040 target, considering **'the latest reports of the Advisory Board'**
- The Commission will publish the projected indicative GHG budget for 2030-2050, '**taking into account the advice of the Advisory Board**'

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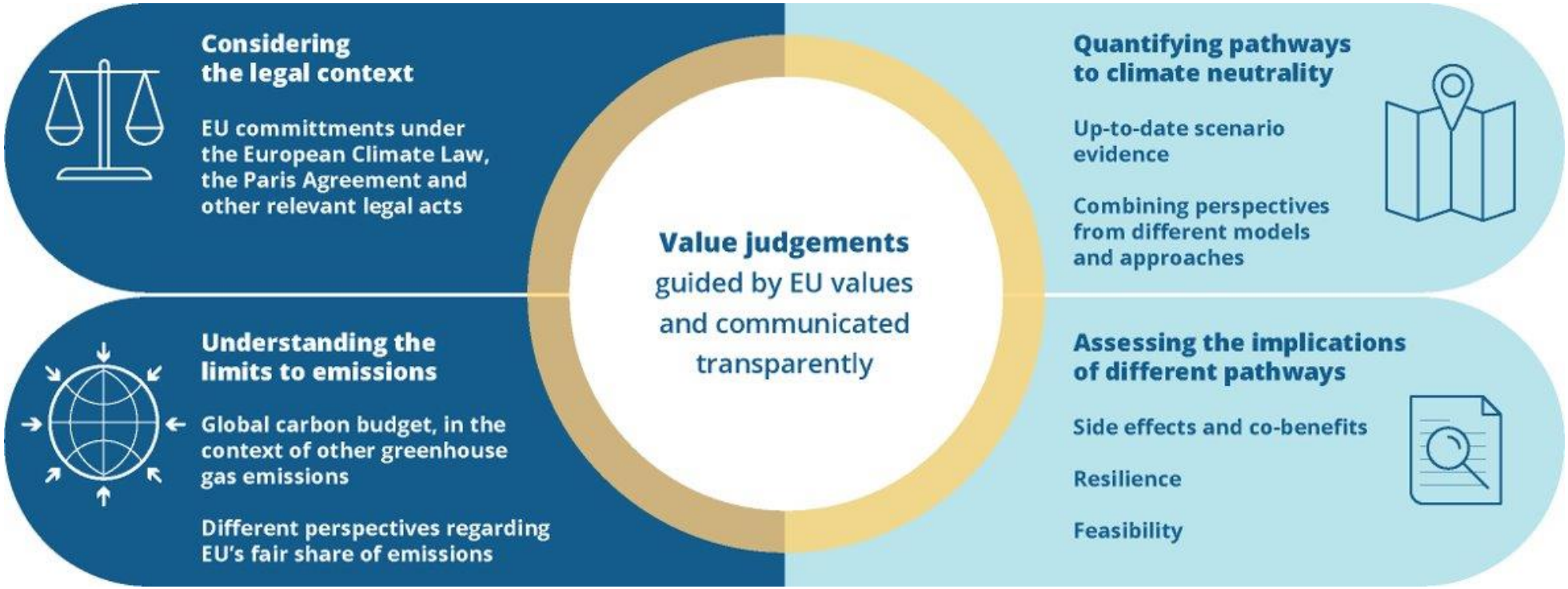
Initial advice published on 16 January 2023



#1

The Advisory Board recommends keeping the EU's greenhouse gas emissions budget within a limit of 11 to 14 Gt CO_2e between 2030 and 2050.

Staying within this budget requires emission reductions of 90–95% by 2040, relative to 1990.

This range considers multiple dimensions of fairness and feasibility of the emission reductions.

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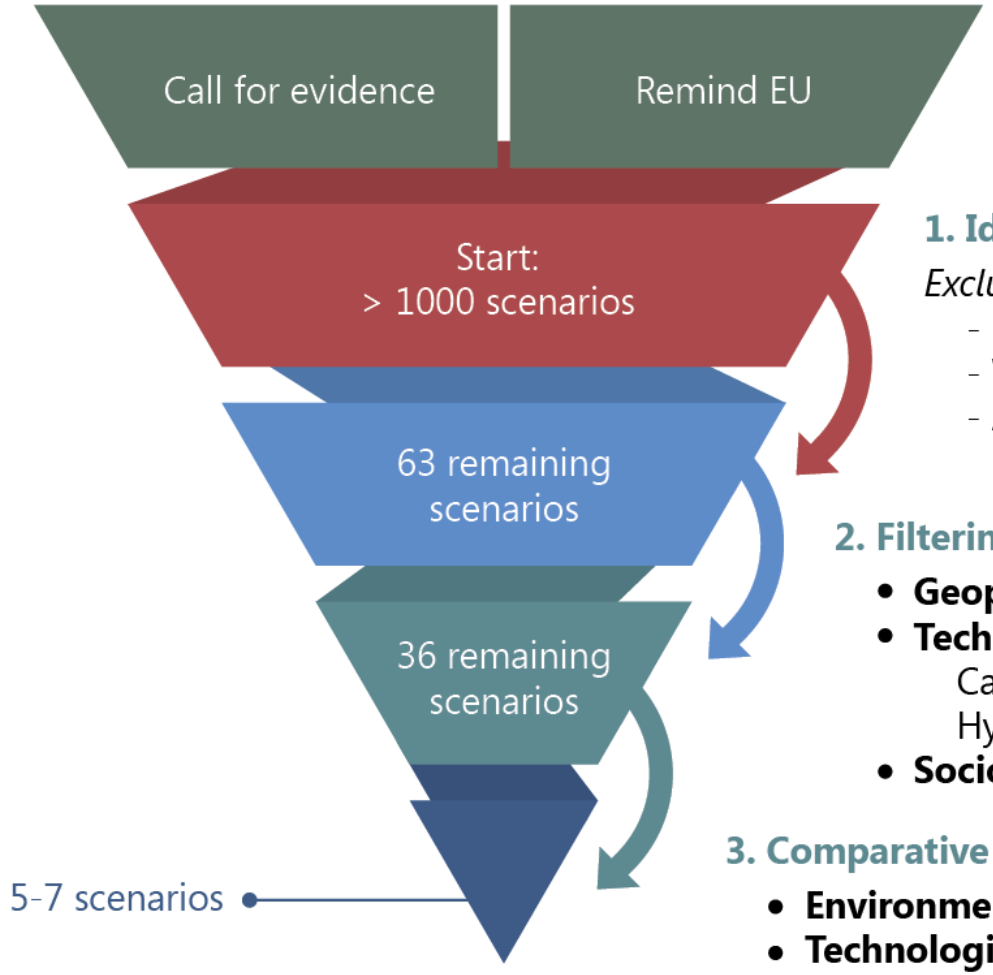
Considering the latest scientific evidence on emission scenarios compatible with 1.5°C and EU targets



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

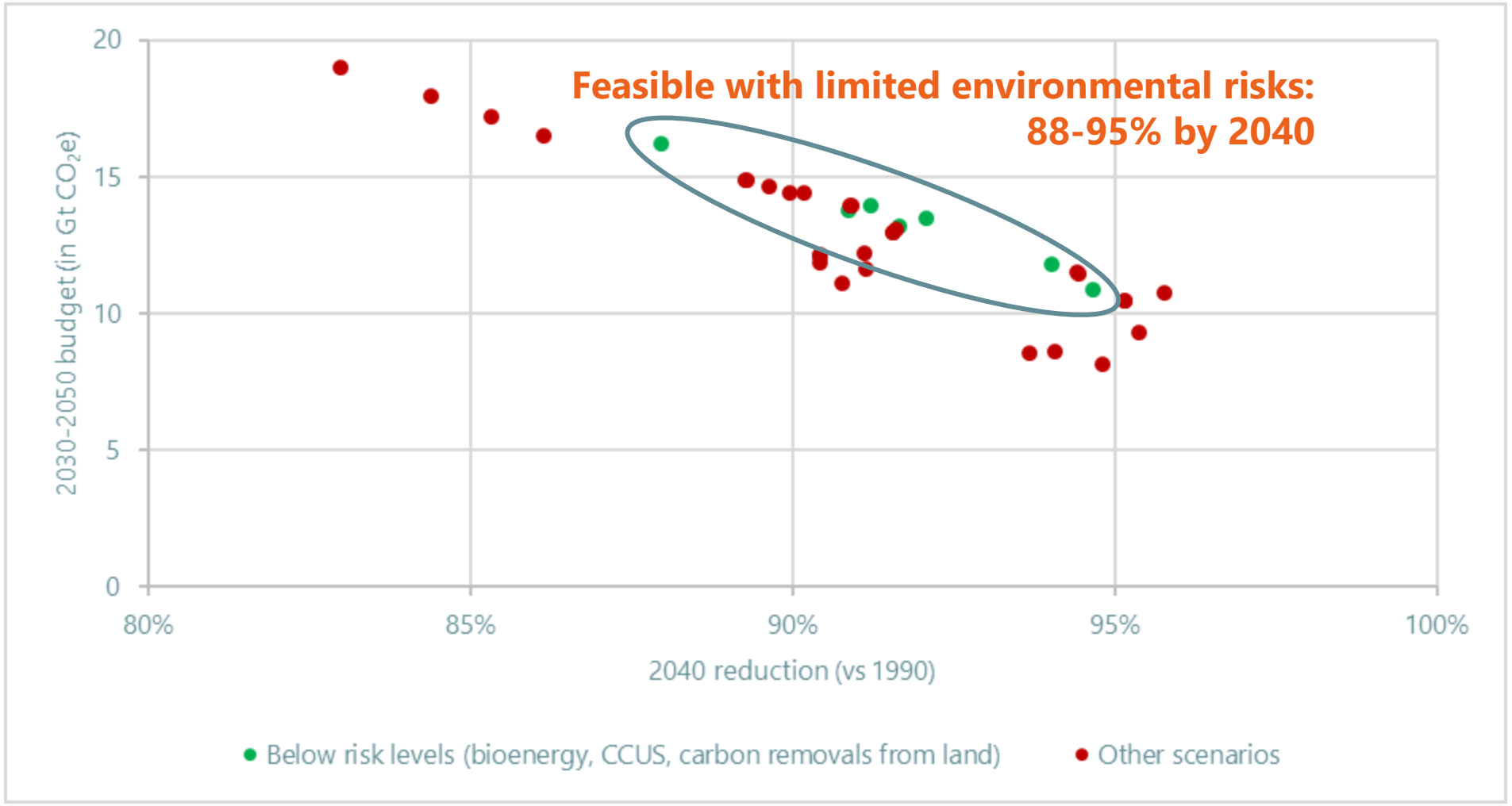
2. Filtering out scenarios with high feasibility concerns

- **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

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



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

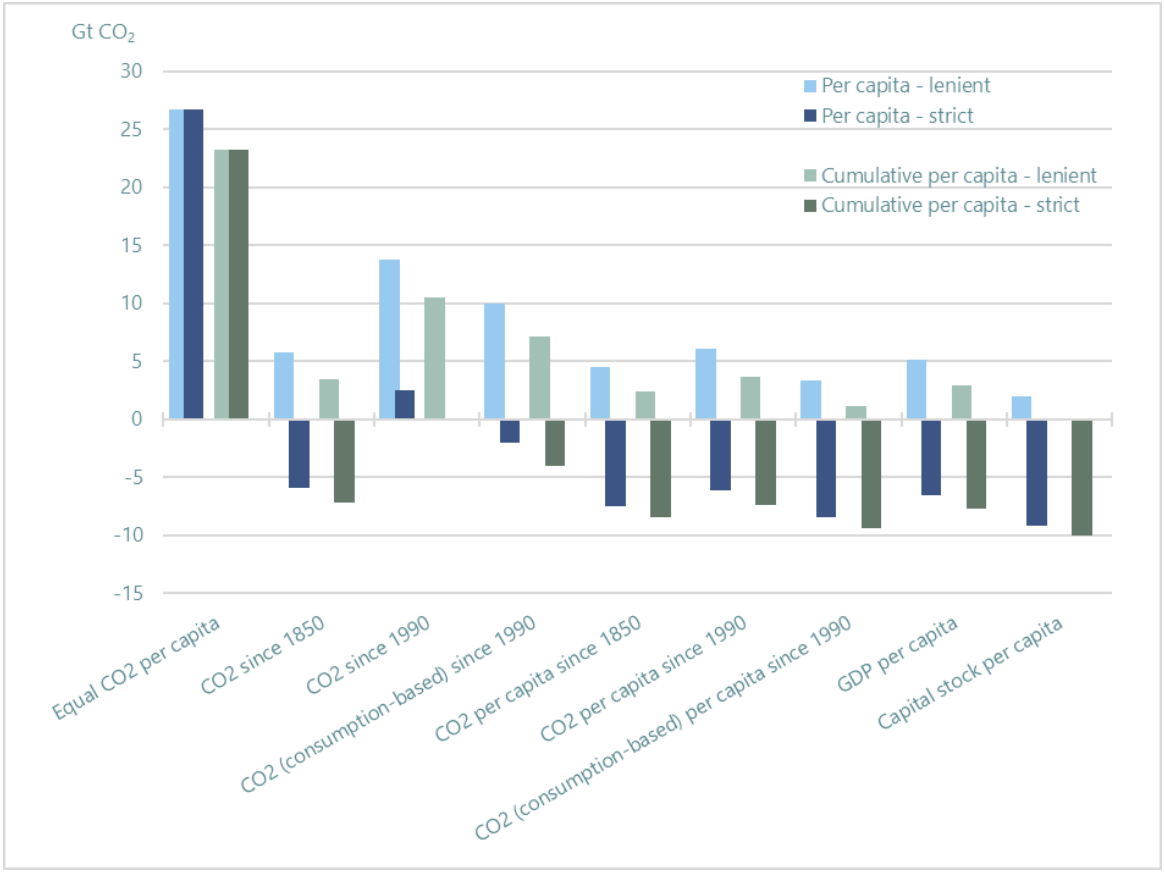
Range of scenarios	Number of scenarios	Implied range for an EU budget for 2030-2050 (Gt CO_2e)	Implied range for an EU 2040 reduction target (% reduction vs. 1990)
Scenarios	36	8-19	83-96%
within environmental risk levels (less reliance on CCUS, carbon removals from land, and bioenergy)	7	11-16	88-95%
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

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

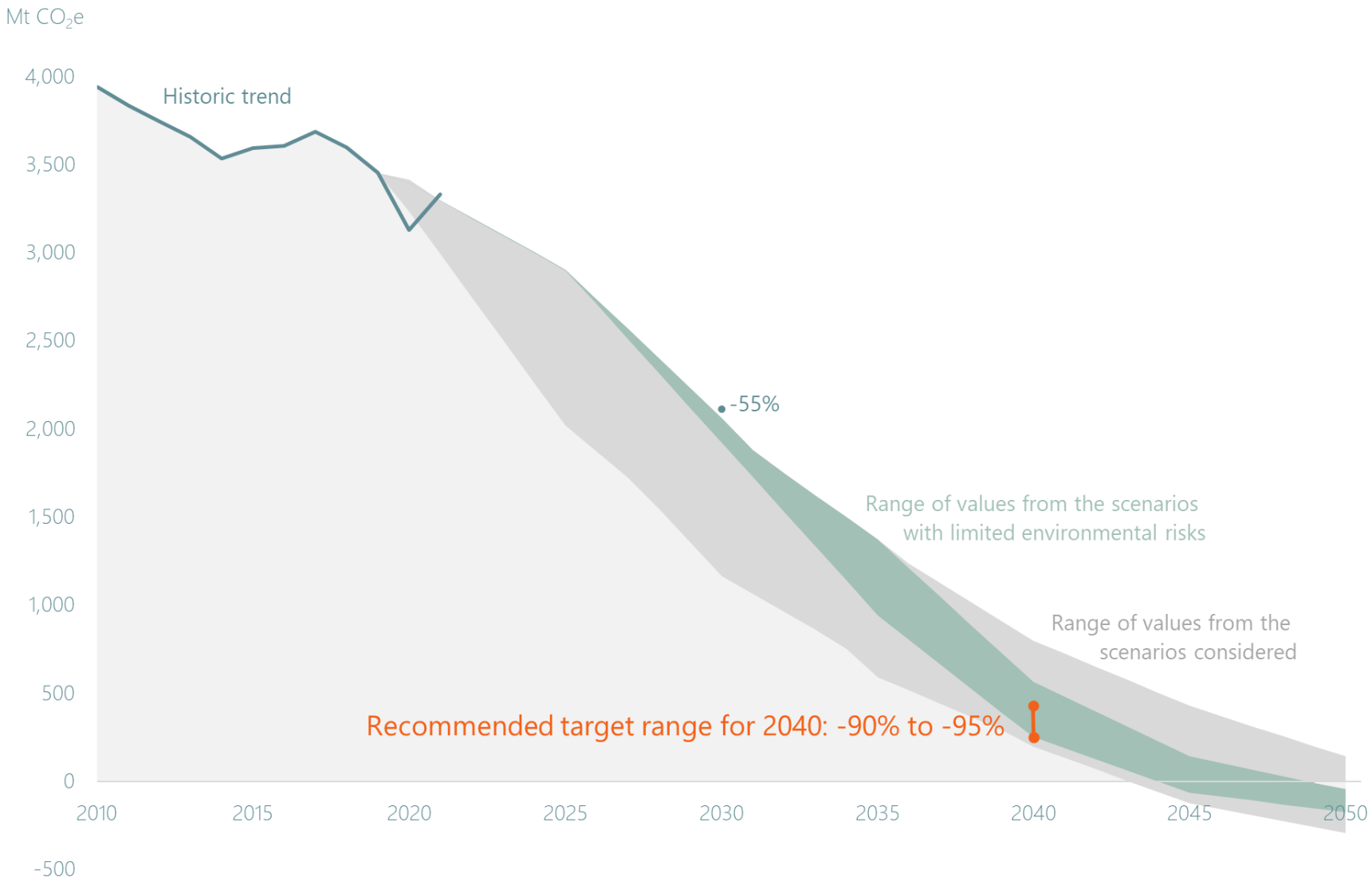


Source: Pelz et al. (2023)

Feasibility and fairness

	2040 reduction	2030-2050 budget
*Range informed by **feasibility***		
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*		
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 greenhouse gas emission reductions, and iconic pathways



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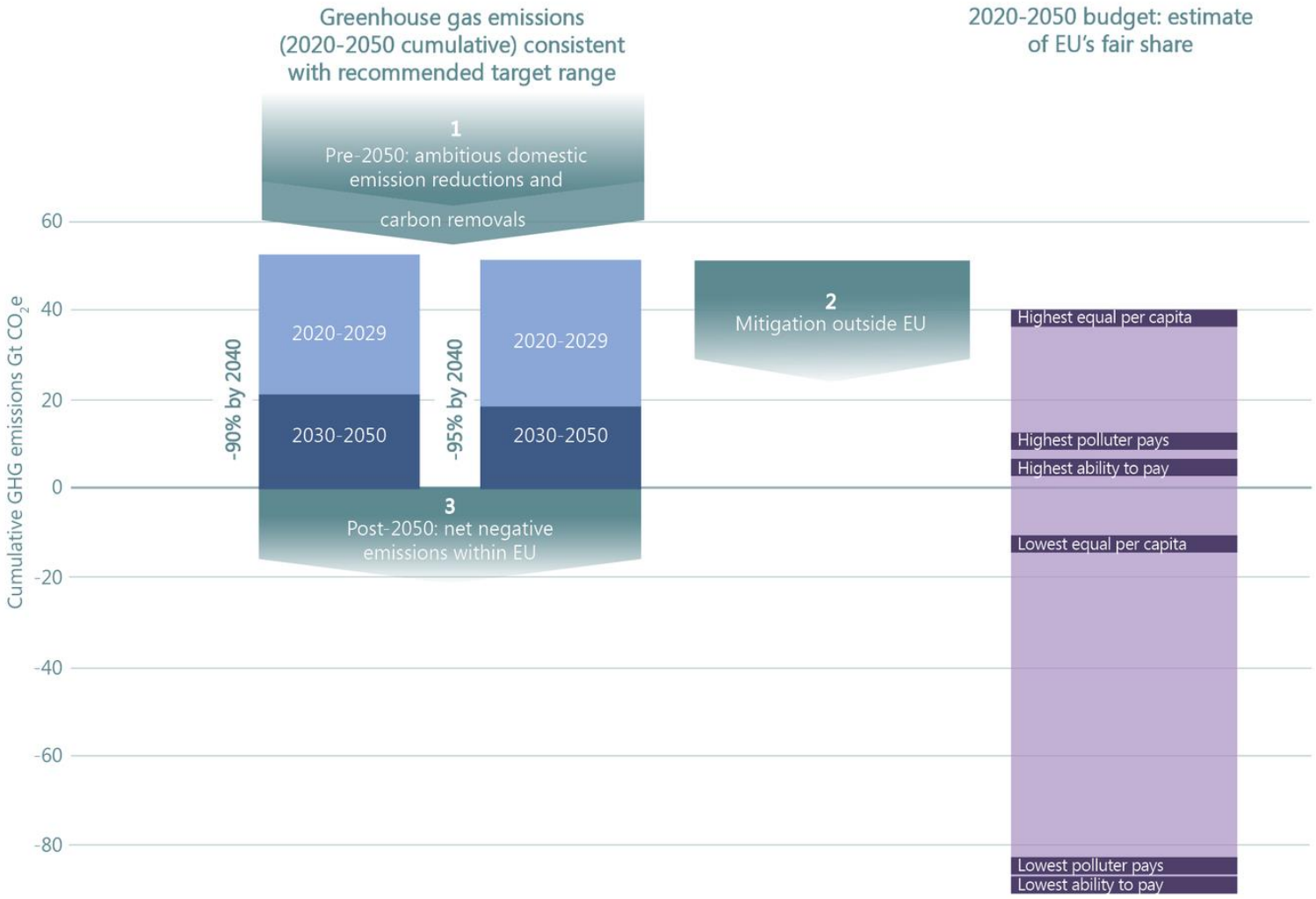
#2

Pursuing the more ambitious end of the 2040 target range improves the fairness of the EU's contribution.

Ambitious domestic emission reductions need to be complemented by measures outside the EU to achieve a fair contribution to climate change mitigation.

Reconciling feasible and fair EU contributions to global climate change mitigation



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#3

The EU 2030 target of at least 55% reduction compared to 1990 enables reaching the recommended 2040 target range and climate neutrality by 2050.

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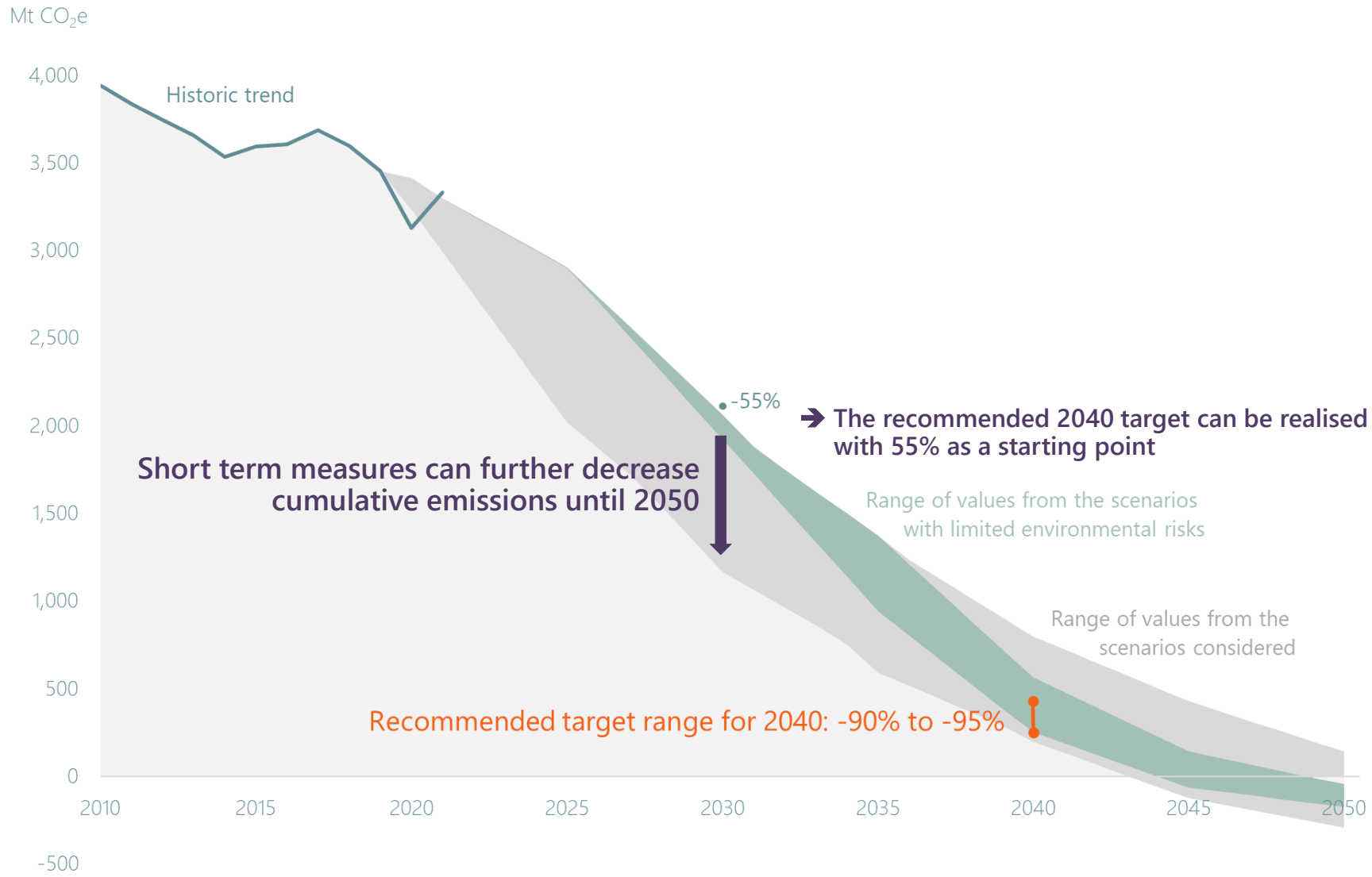
55% is an appropriate milestone towards climate neutrality



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#4

The recommended 2040 target requires rapid, inclusive and well-managed transitions to address environmental risks and technology scale-up challenges.

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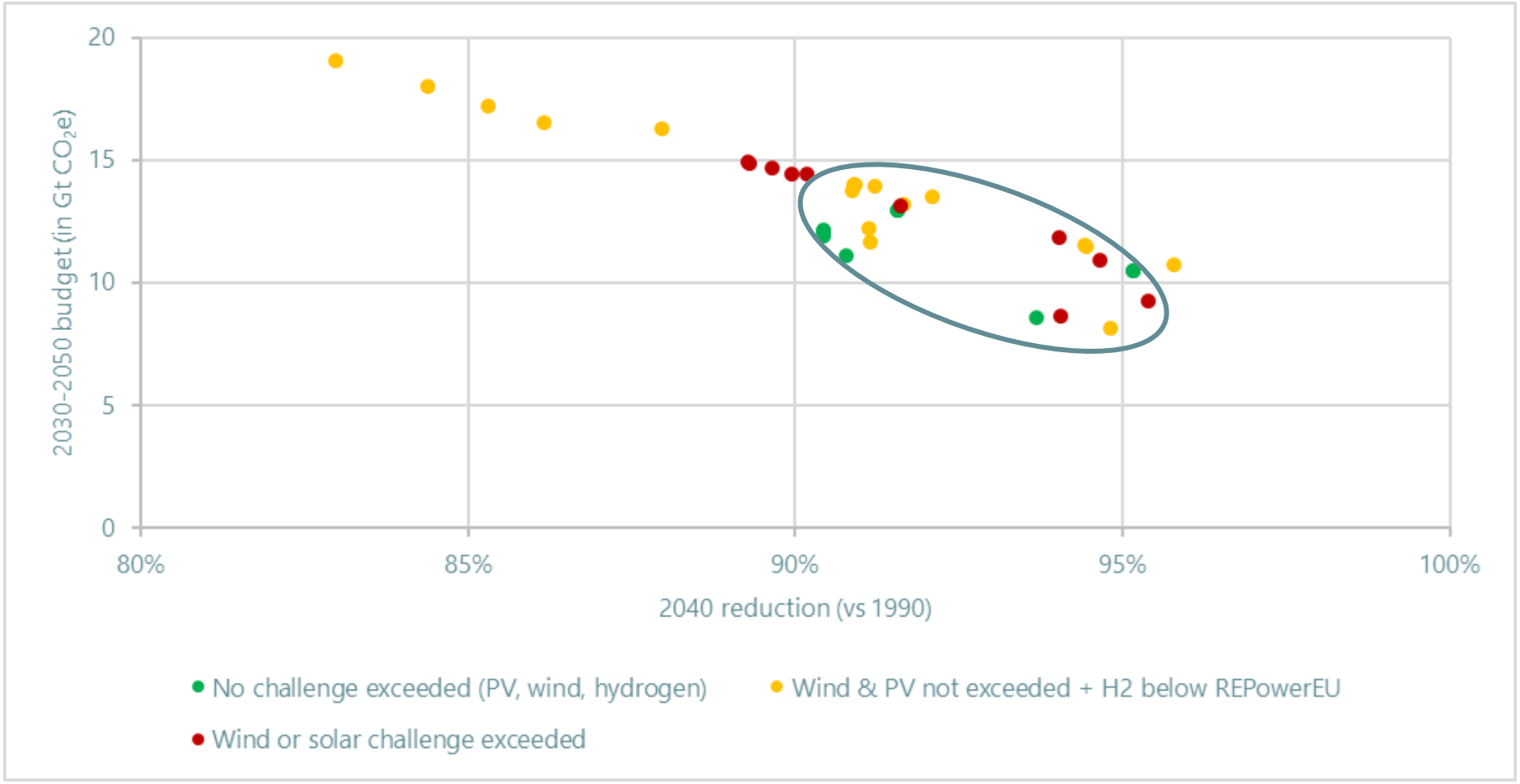
Challenges linked to scale up of solar photovoltaic, wind and hydrogen production should be addressed



#5

Achievement of climate neutrality within the EU is to be supported through investments in innovation and wider capacity development.

Economic and social implications largely depend on implementation

- Transitions need to be **inclusive and well-managed:**
  - accounting for local context
  - engaging stakeholders
  - ensuring equity and justice
- Investments in **innovation and wider capacity development** can expand the range of feasible mitigation outcomes:
  - further emission reductions
  - reduced need for carbon removals
- An **adaptive approach** will harness and accelerate the dynamics of the energy transition
- Pathways and other analysis indicate **numerous potential benefits** to climate action
  - better air quality and health outcomes
  - less dependent on imported fossil fuels
  - less water stress
- **Inequality and justice implications** must be addressed (despite limited macroeconomic and overall employment impact)
- Economic, social, and cost **benefits of demand-side action** (sustainable use of energy and resources)

#6

The required transitions can be achieved by distinct combinations of demand management and technology deployment.

Compared to pathways that prioritise supply-side technological solutions, pathways with lower energy and natural resource use:
- advance progress on the Sustainable Development Goals,
- enhance energy security,
- lower other risks.

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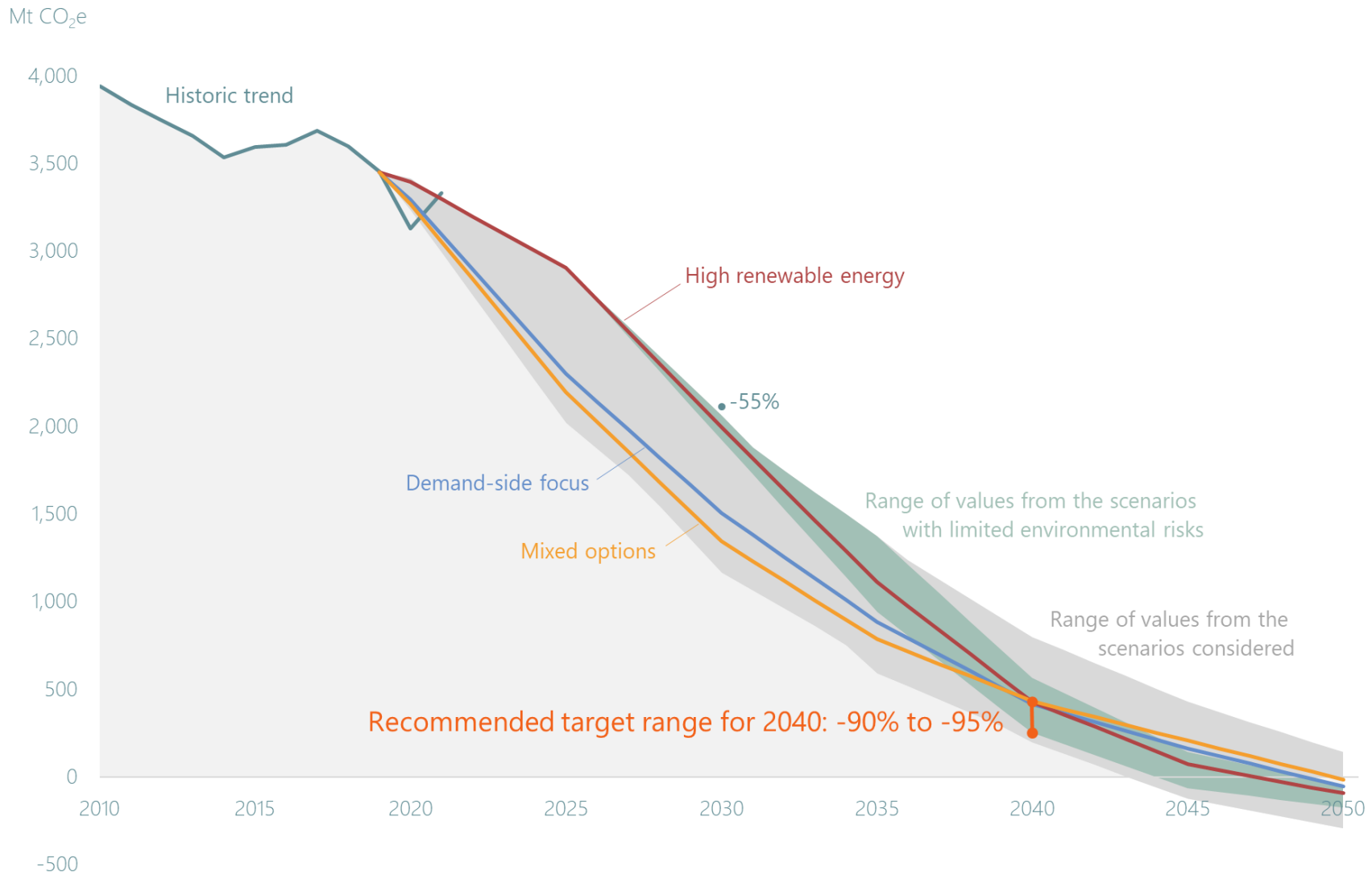
Recommended range of 2040 greenhouse gas emission reductions, and iconic pathways



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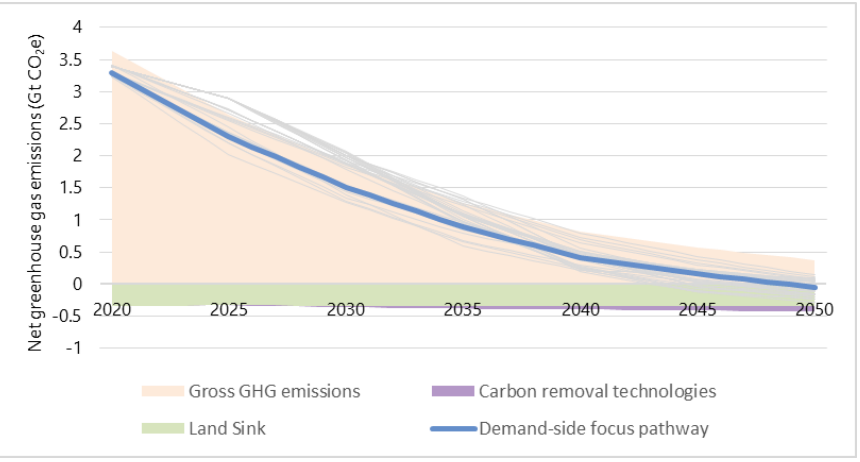
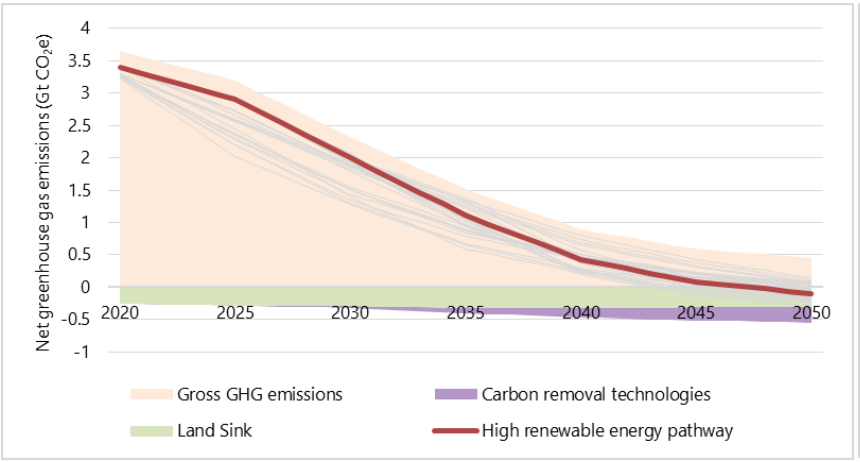
Iconic pathways illustrating choices and strategies to achieve climate neutrality by 2050

Demand-side focus pathway



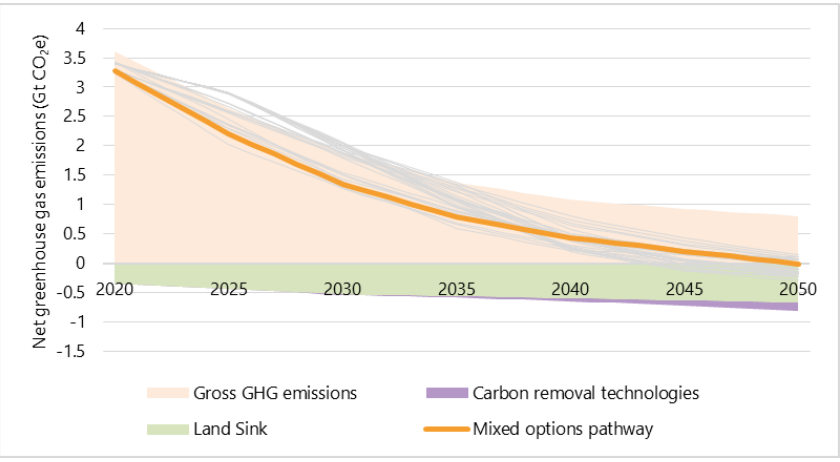
- Less resource-intensive lifestyles
- Lowest final energy demand in 2040
- Lowest reliance on carbon removals (from CCS and the land sink combined) by 2050

High renewable energy pathway



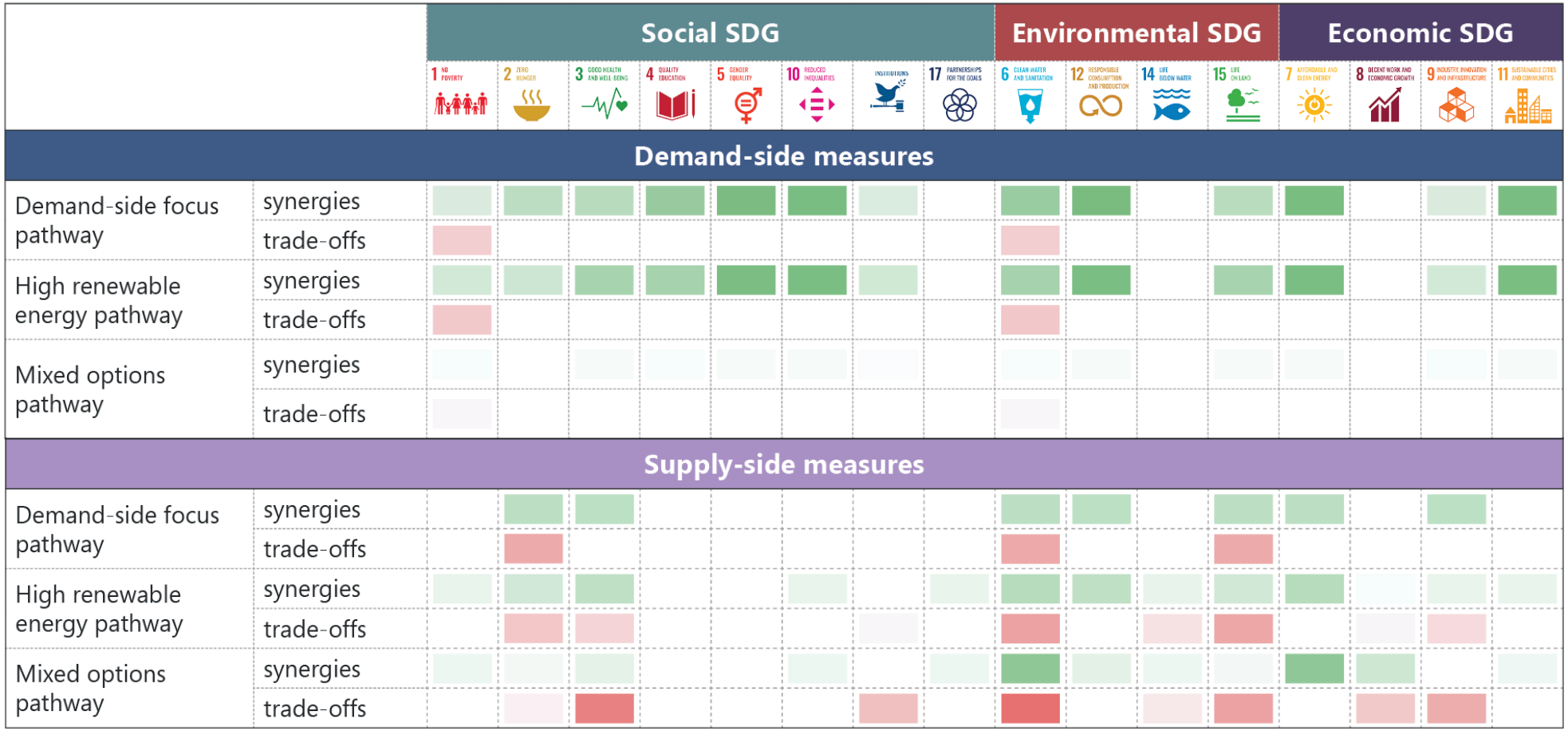
- Largest greenhouse gas budget
- High renewable energy deployment
- Highest deployment of non-biomass renewable energy
- Highest rate of electrification by 2040

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)

Potential SDG synergies and trade-offs: demand- and supply-side mitigation measures in iconic pathways



#7

There are different pathways to achieve climate neutrality. Decisive choices between various policy options therefore have to be made.

Common features shown in the assessed scenarios could helpfully guide further policy developments.

The scenarios considered present common features regarding sectoral emission reductions

- **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 146-614 Mt CO_2 in 2040
  - Land sink limited by climate impacts: 100-400 Mt CO_2 in 2040
  - Bioenergy with CCS + direct air carbon capture and storage: 46-214 Mt CO_2 in 2040

Conclusions

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