ZEP Briefing – 2040 EU Climate Target

Summary

On 6 February 2024, in line with the scientific advice by the European Scientific Advisory Board on Climate Change (ESABCC) and based on a detailed Impact Assessment, the European Commission presented a **90% net GHG emission reduction compared to 1990 levels as the recommended target for 2040** (link to the communication). The recommendation for 2040 emissions reduction target outlines the path to climate neutrality in 2050 as required under the European Climate Law.

In addition, it includes an **impact assessment** evaluating different emission reduction targets in accordance with an **indicative greenhouse gas budget for the 2030–2050 period** (link to the impact assessment). The objective of this Communication is to inform the preparation of the post-2030 framework. It does not propose new policy measures or set new sector-specific targets.

The 90% target is based on a thorough impact assessment that looked in detail at the implications of three target options for 2040:

- Option 1: a reduction of up to 80% compared to 1990, consistent with a linear trajectory between 2030 and 2050
- Option 2: a reduction of 85-90%, compatible with the level of net GHG reduction that would be reached if the current policy framework were extended to 2040 and
- **Option 3: a reduction of 90-95%**

Targets/objectives

A 90% emissions reduction is in line with the minimum recommendations of the ESABCC as well as the EU's commitments under the Paris Agreement (link to the recommendations). Achieving this target will require several enabling conditions, such as the full implementation of the agreed 2030 framework.

Selected excerpts:

- *"To deliver a reduction of net GHG emissions of 90%, the analysis in the impact assessment shows that the level of **remaining EU GHG emissions in 2040 should be less than 850 MtCO2-eq**[1] and **carbon removals** (from the atmosphere through land-based and industrial carbon removals) **should reach up to 400 MtCO2**."*

[1] Excluding emissions from the LULUCF sector

- *"In line with the international commitment to transition away from fossil fuels, policies should ensure that **any remaining fossil fuel combustion will be coupled as soon as possible with carbon capture (utilisation) and storage**."*

CCS/CCU/CDR

Selected excerpts:

- *"All zero and low carbon energy solutions (including renewables, nuclear, energy efficiency, **storage, CCS, CCU, carbon removals**, geothermal and hydro-energy, and all other current and future net-zero energy technologies) **are necessary to decarbonise the energy system by 2040**."*

- A 90% target "*is accompanied by **faster investments for deployment** of novel low carbon technologies such as **hydrogen production by electrolysis, carbon capture and use and industrial carbon removals between 2031 and 2040***".

- *"Industrial decarbonisation will also have to address "process emissions" not related to fuel combustion. For these, carbon capture[2] can be a solution. The **2040 target entails an earlier deployment of carbon capture**. Part of it will allow to **generate industrial carbon removals which would complement land-based removals** sequestering carbon in biomass and soils to contribute to the 90% reductions of net GHG emissions."*

- *"The **development of CO2 value-chains through carbon capture and use** (CCU), nature-friendly biobased materials, mechanical and chemical recycling can all **boost the development of non-fossil feedstock** to substitute fossil fuels in carbon-based products."*

- *"The **enhanced use of biomass residues and waste, advanced biofuels, BECCS technologies, and biobased products** should be accompanied with **clear rules that promote sustainability** and consider the impacts on the size of the natural carbon sink in the LULUCF sector."*

- *"The Communication on **Industrial Carbon Management** outlines a **roadmap to deploy the necessary CCS and CCU technologies** for hard-to-abate sectors, stressing the need for a regulatory framework in areas such **as injection and transport of CO2**, as a precondition to create a single market for CO2."*

[2] Carbon capture includes carbon captured from industrial processes, power and heat production, biogas upgrade and direct air capture

Financing

Selected excerpts:

- "***Energy system investment needs amount to close to €660 billion*** *(equivalent to 3.2% of GDP)* ***per annum on average over the entire period*** *(against €250 billion over 2011-2020, or 1.7% of GDP, a decade with relatively low investments in the energy system), and* ***yearly spendings in transport[3] to about €870 billion*** *(equivalent to 4.2% of GDP, a similar proportion of GDP as in 2011-2020). Option 3 brings some energy system investments forward to the 2030s, with an* ***average annual investment of €710 billion over 2031-2040****."*

- *"The* ***resulting energy system costs***[4] *are also similar across options, ranging from 12.4% (Option 1), 12.7% (Option 2) to* ***12.9% of GDP (Option 3) in 2031-2040****, a moderate increase compared to the 11.9% of GDP spent in 2011-2020, and then fall to about 11.3% for 2041-2050. The* ***cost of fossil fuel imports decreases significantly under Option 3****, to less than 1.4% of GDP by 2040 and less than 0.6% in the last decade (against 2.3% over 2010-2021 and 4.1% in 2022 during the recent energy crisis),* ***saving about €2.8 trillion over 2031-2050****."*

- *"****Public sector support and direct investment*** *should be* ***strategically deployed****, also by frontloading and maximising existing resources with large-scale pooling of funding, making it* ***accessible in the fastest and simplest way possible*** *and facilitating synergies between different instruments."*

[3] Investments in the transport sector reflect the expenditures on vehicles, rolling stock, aircraft and vessels plus recharging and refuelling infrastructure. They do not cover investments in infrastructure to support multimodal mobility and sustainable urban transport. In particular, the acquisition costs of private vehicles represent about 60% of the total

[4] The energy system cost is broader than the investments and consists of the capital cost (annualised investment cost) and the energy expenditures for economic activities. See the impact assessment for more details.

Tables

The tables below provide additional indications into the role of carbon capture:

Table 6: Industrial carbon capture and use

	2040			2050
Carbon Captured – MtCO2/year	**S1**	**S2**	**S3**	**S3***
By Source	**86**	**222**	**344**	**452**
Industrial Processes	37	123	137	136
Power (fossil fuels)	26	41	32	55
Power (biomass) and DACC**	16	54	153	232
Biogenic (upgrade of biogas into biomethane)	7	4	22	30
By Application (use and storage)	**86**	**222**	**344**	**452**
E-fuels	43	75	101	147
Synthetic materials	0	0	0	59
Underground storage	42	147	243	247

Note: *S1 and S2 values for 2050 are similar to S3 and represented in more details in Annex 8. **Includes carbon for storage (DACCS) and use.

Source: PRIMES.

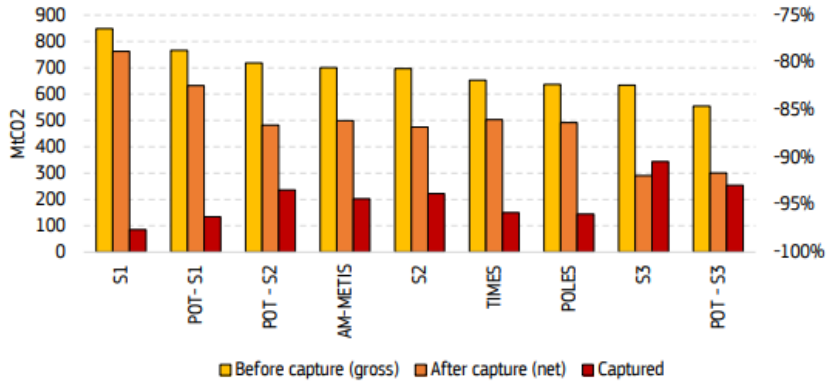
Table 10: Summary of key energy indicators

	2030	2040			2050
		S1	S2	S3	S3**
Policy relevant indicators					
Energy-related CO2 reductions vs 2005	-58%	-83%	-90%	-94%	-103%
RES share in Gross FEC	42.4%	65%	72%	75%	89%
FEC reduction vs 2015 ([55])	-19%	-34%	-34%	-36%	-40%
Energy indicators - Supply					
Gross Available Energy (Mtoe)	1160	1022	1021.	1018	1032
- Fossil fuels	663	375	311	275	150
- of which for non-energy use	*96*	*96*	*96*	*96*	*80*
- of which captured	*1.8*	*11.5*	*13.2*	*13.3*	*24*
- Nuclear	139	129	129	129	142
- Renewables	328	482	544	613	691
Net imports (Mtoe)	572	347	298	267	153
Import dependency (%)	50%	34%	29%	26%	15%
Hydrogen production (Mtoe)([56])	9	60	76	100	185
e-Fuels production (Mtoe)	2	15	27	37	60
Energy indicators – Power generation					
Gross electricity generation (TWh)	3362	4563	4899	5212	6922
Net installed power capacity (GW)	1617	2181	2377	2525	3256
- Fossil fuels	238	172	164	156	142
- Nuclear	94	71	71	71	71
- Renewables	1285	1939	2142	2298	3027
Storage and flexibility options (GW)	172	213	254	275	238
Final Energy					
Final Energy Consumption (Mtoe)	764	622	614	604	555
Electricity share in FEC	33%	48%	50%	51%	62%
e-Fuels share in FEC	0%	1%	3%	5%	7%

*Note: GAE does not include ambient heat from heat pumps. E-Fuels include power-to-liquid and power-to-gas fuels but not hydrogen. Storage technologies include only battery and pumped-hydro storage, whose decline between 2040 and 2050 is due to the projected increased use of power-to-X technologies. The analysis is based on the 2019 NECPs and national legislation as of March 2023. **S1 and S2 values for 2050 are similar to S3 and represented in more details in Annex 8.*

Source: PRIMES.

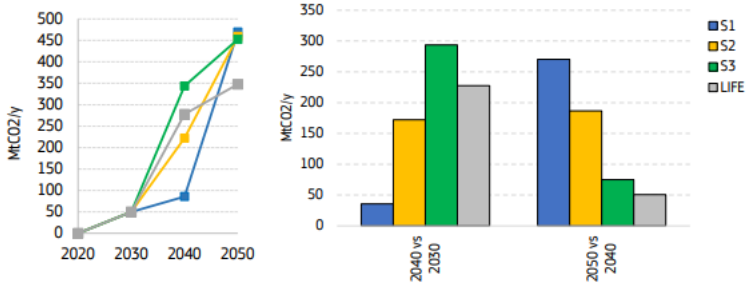
Figure 7: Energy and Industry CO2 emissions in 2040



Note: Emissions (left) and relative reductions vs 1990 (right).

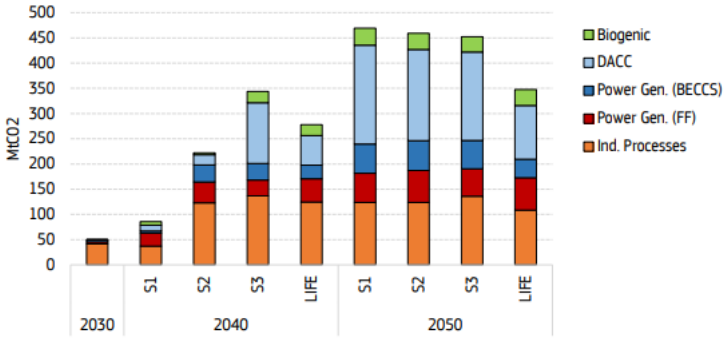
Sources: AMADEUS-METIS, EU-TIMES, POLES, POTEnCIA, PRIMES.

Figure 8: Total (left) and additional (right) carbon captured yearly in selected years



Source: PRIMES.

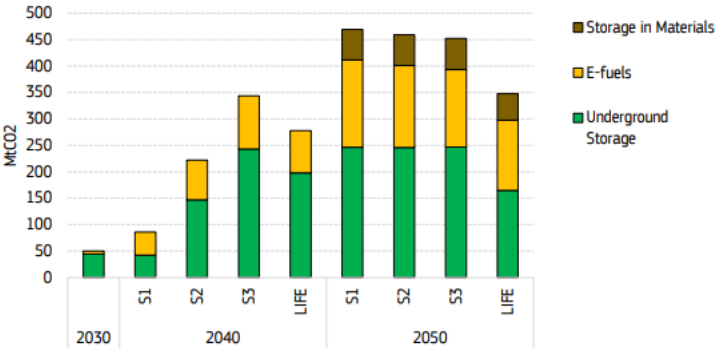
Figure 9: Carbon captured by source



Note: Biogenic carbon indicates the carbon resulting from the upgrade of biogas to biomethane.

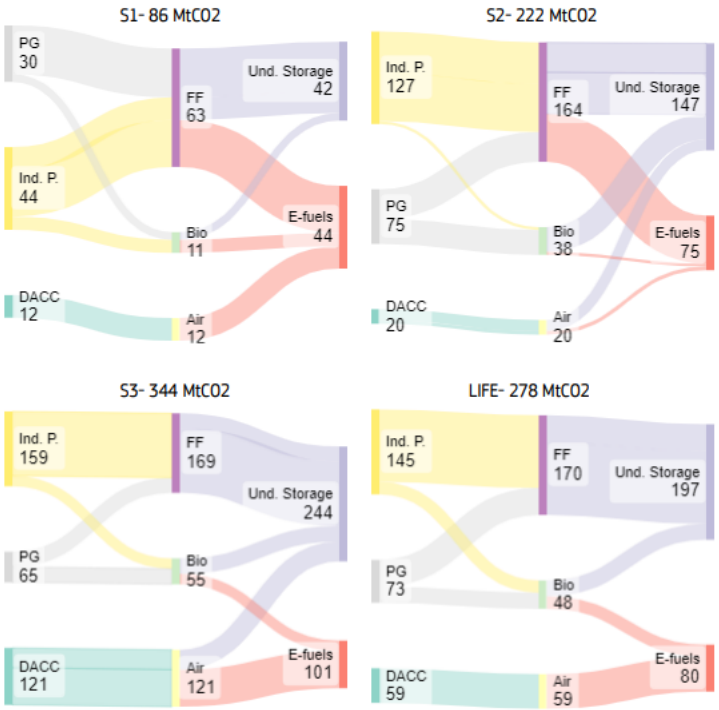
Source: PRIMES

Figure 10: Carbon Captured by end application



Source: PRIMES.

Figure 11: Flow of captured carbon in 2040



Note: "Ind. P." stands for Industrial processes and include fossil carbon from industrial processes as well as carbon of biogenic origin coming from the upgrade of biogas to biomethane. "FF" stands for "fossil fuels". "PG" stands for "power generation". "Bio" refers to CO2 produced by the combustion of biomass in power generation and produced during the upgrade of biogas into biomethane. "DACC" stands for "Direct Air Capture of CO2", for underground storage (DACCS) or use in efuels.

Source: PRIMES.

Table 30: Effectiveness: Deployment of technologies and security of energy supply

Specific objective		Assessment criteria		Option 1	Option 2	Option 3
SO5	Deployment of technologies	Investment	Progress achieved in 2040 (% 2031-2050)	43%	48%	54%
		RES deployment	Progress achieved in 2040 (% 2031-2050)	47%	56%	64%
		H2 production	Progress achieved in 2040 (% 2050)	32%	41%	54%
		Carbon capture	Progress achieved in 2040 (% 2050)	19%	49%	76%

Specific objective		Assessment criteria	Option 1 vs 2	Option 2	Option 3 vs 2
SO6	Security of energy supply	Energy dependence (2040) (Fossil fuels imports / GAE)	+5pp	29%	-3pp
		Fossil fuel imports costs (2040) (bn EUR 2023)	+6%	277	-4%