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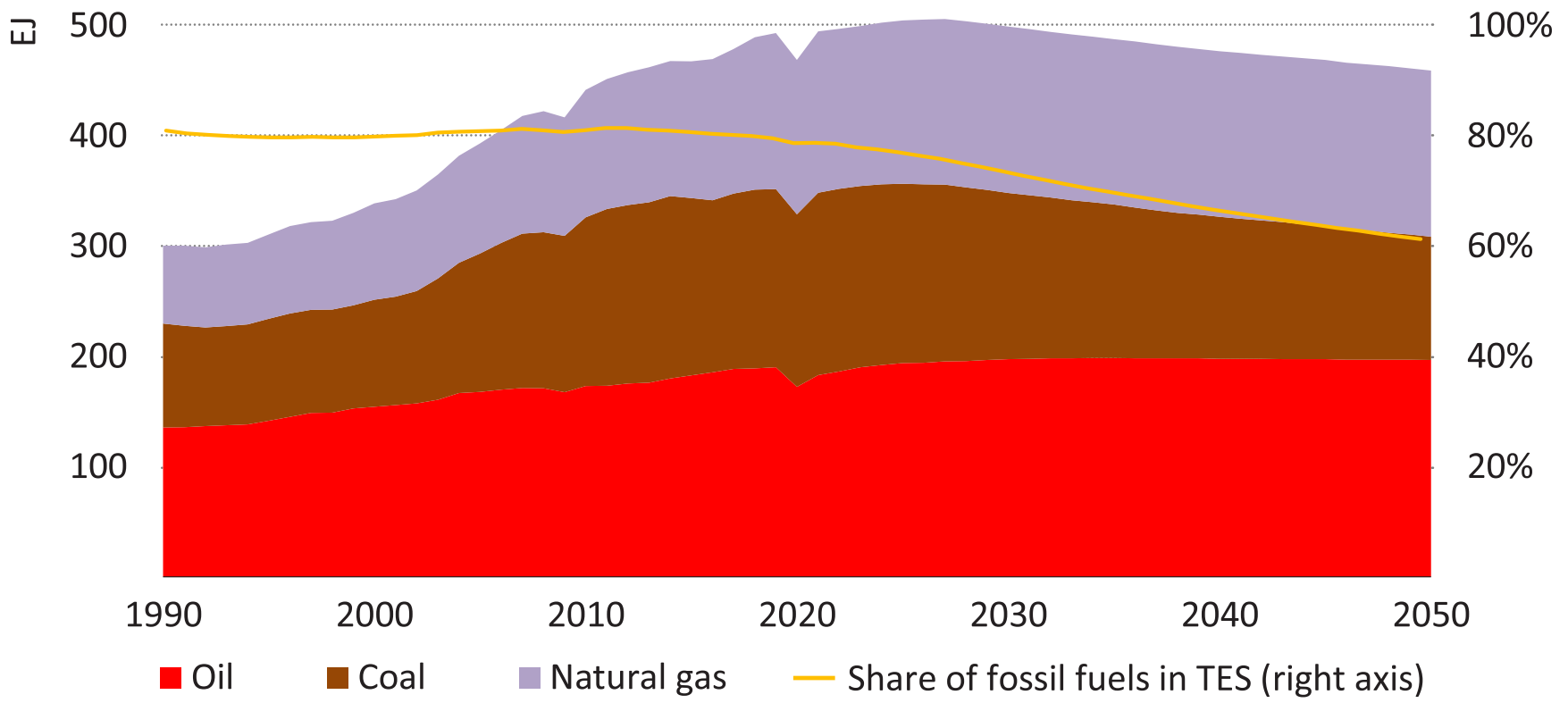
World Energy Outlook - 2022

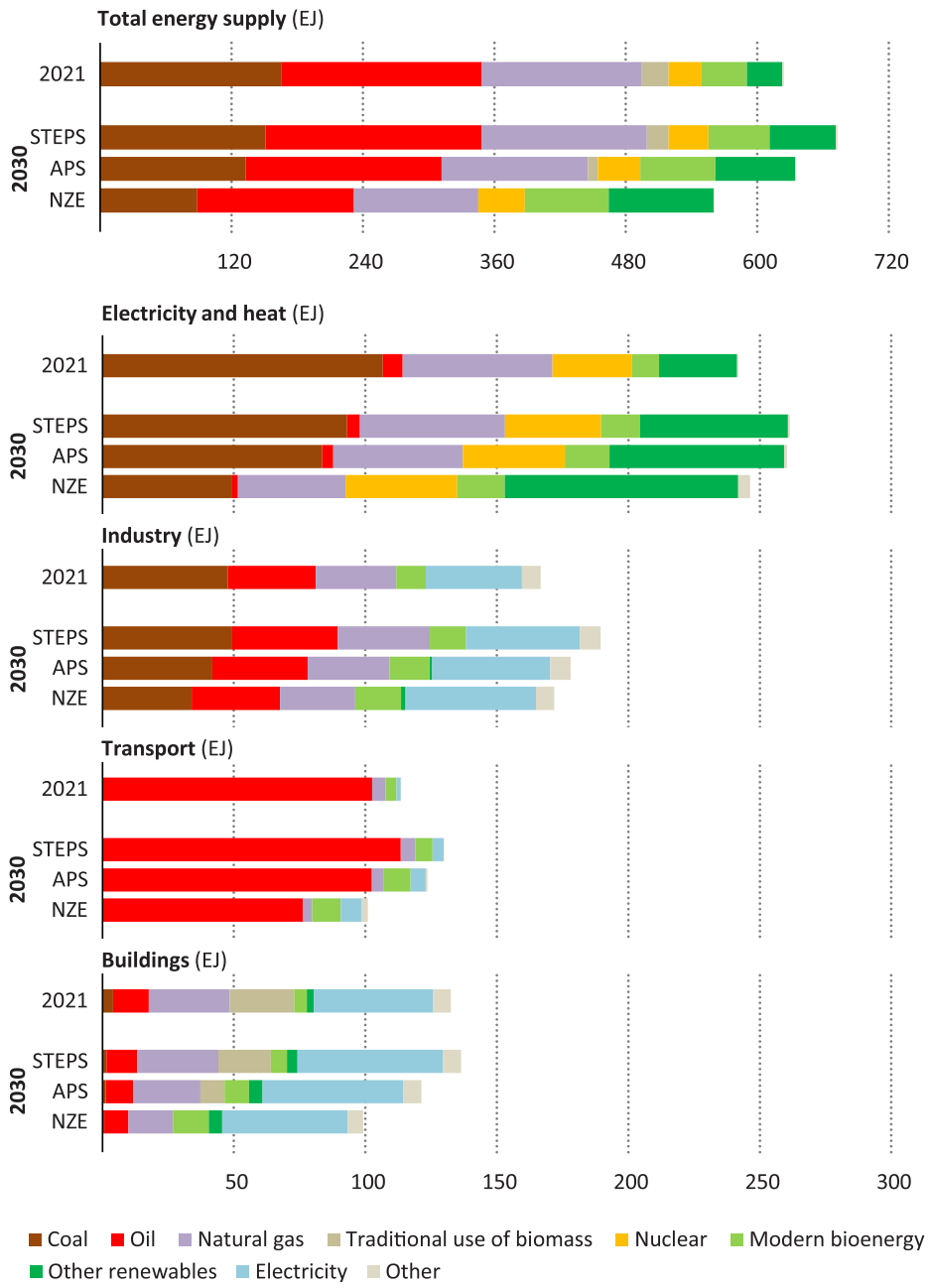
Fossil fuel demand in the STEPS, 1990-2050



Total fossil fuel use sees a definitive peak for the first time in this year's STEPS. The share of fossil fuels in the energy mix falls to around 60% in 2050, a clear break from past trends

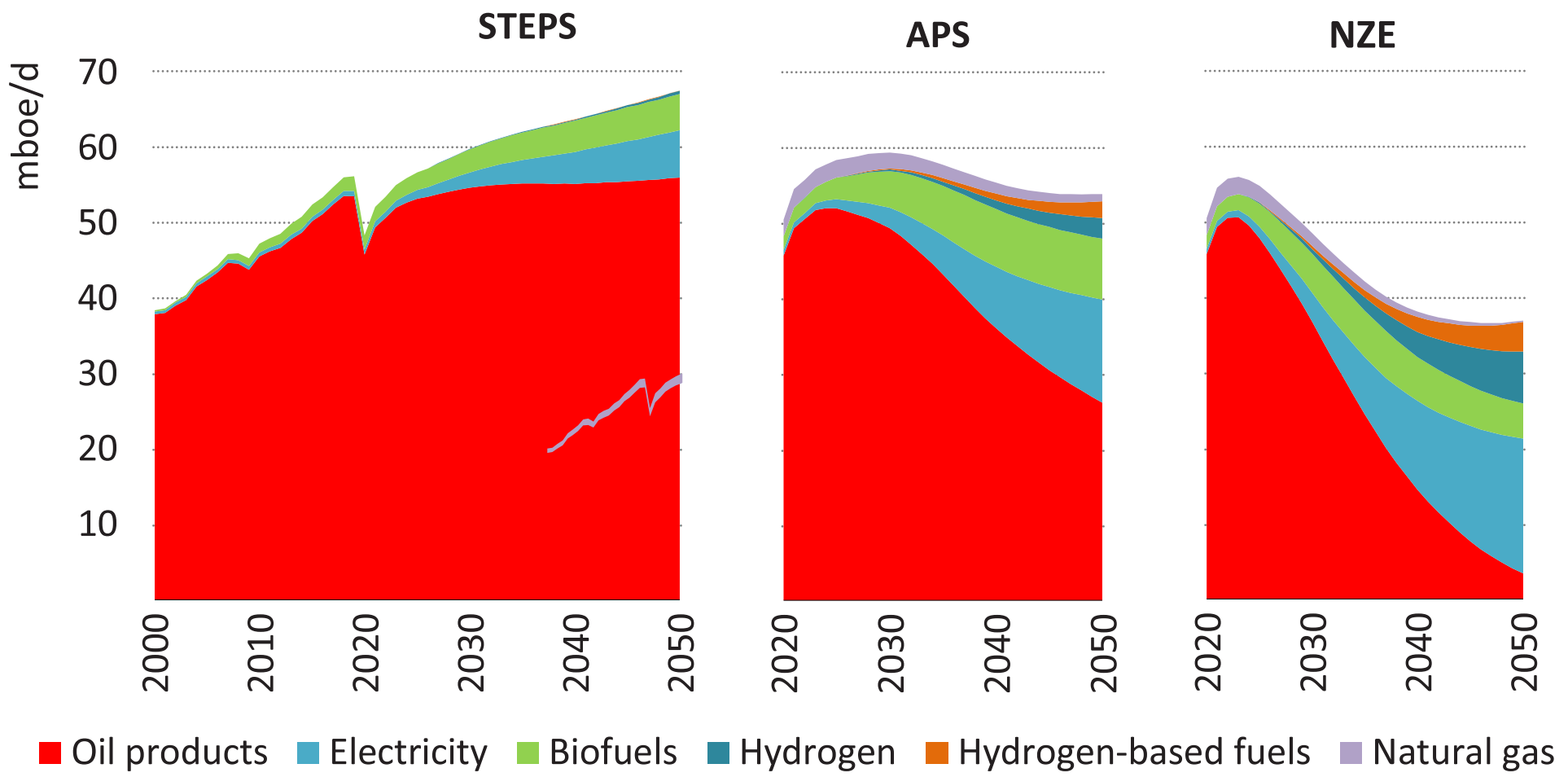
Note: EJ = exajoule; TES = total energy supply.

Global energy supply and demand by sector, scenario and fuel



Energy efficiency, electrification and expansion of low-emissions supply are the hallmarks of rapid transitions to 2030

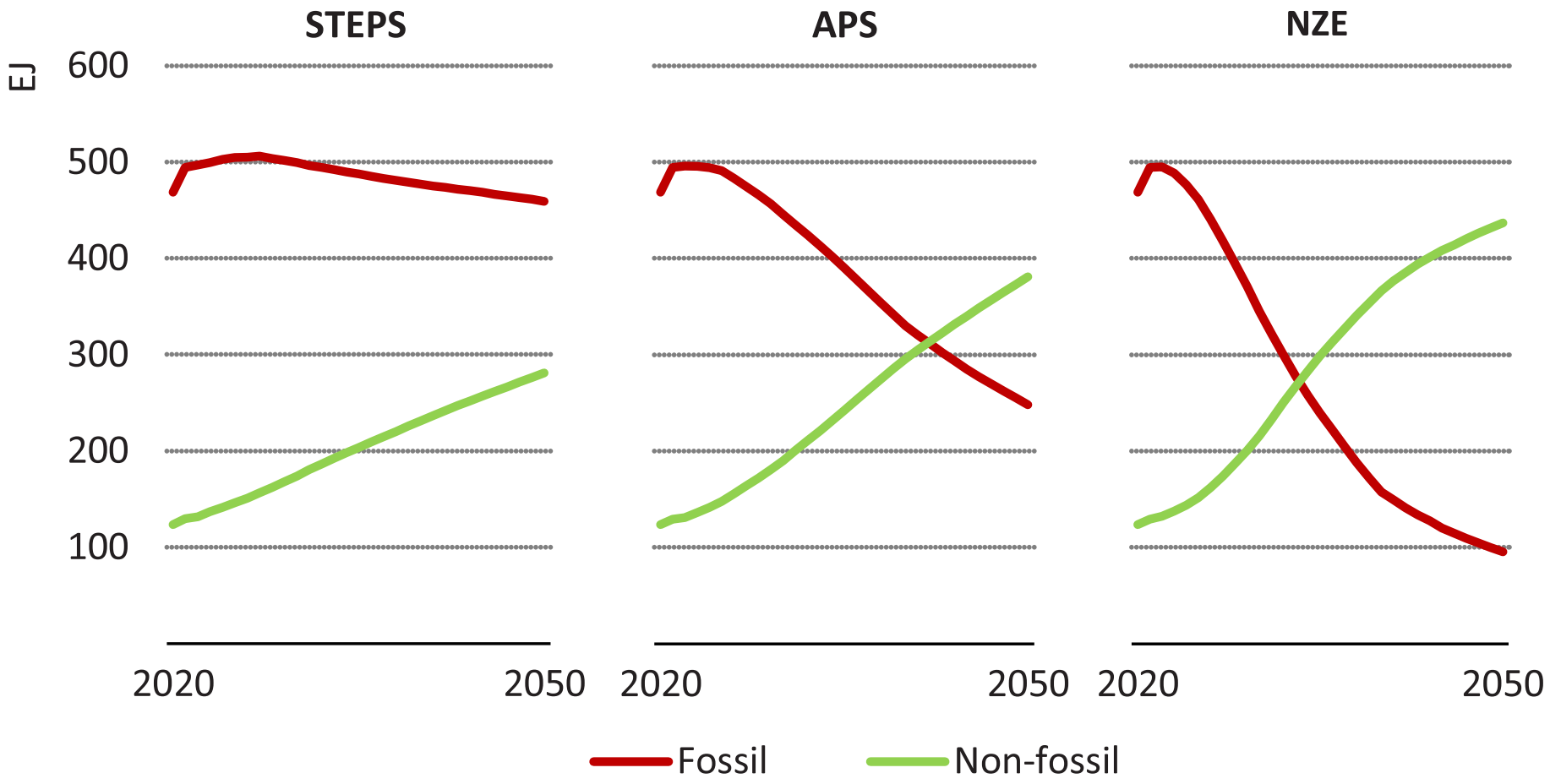
Energy use in transport by scenario, 2000-2050



Transport has long been the bedrock of oil demand, but its role weakens in the APS and NZE Scenario as electricity displaces very large volumes of oil

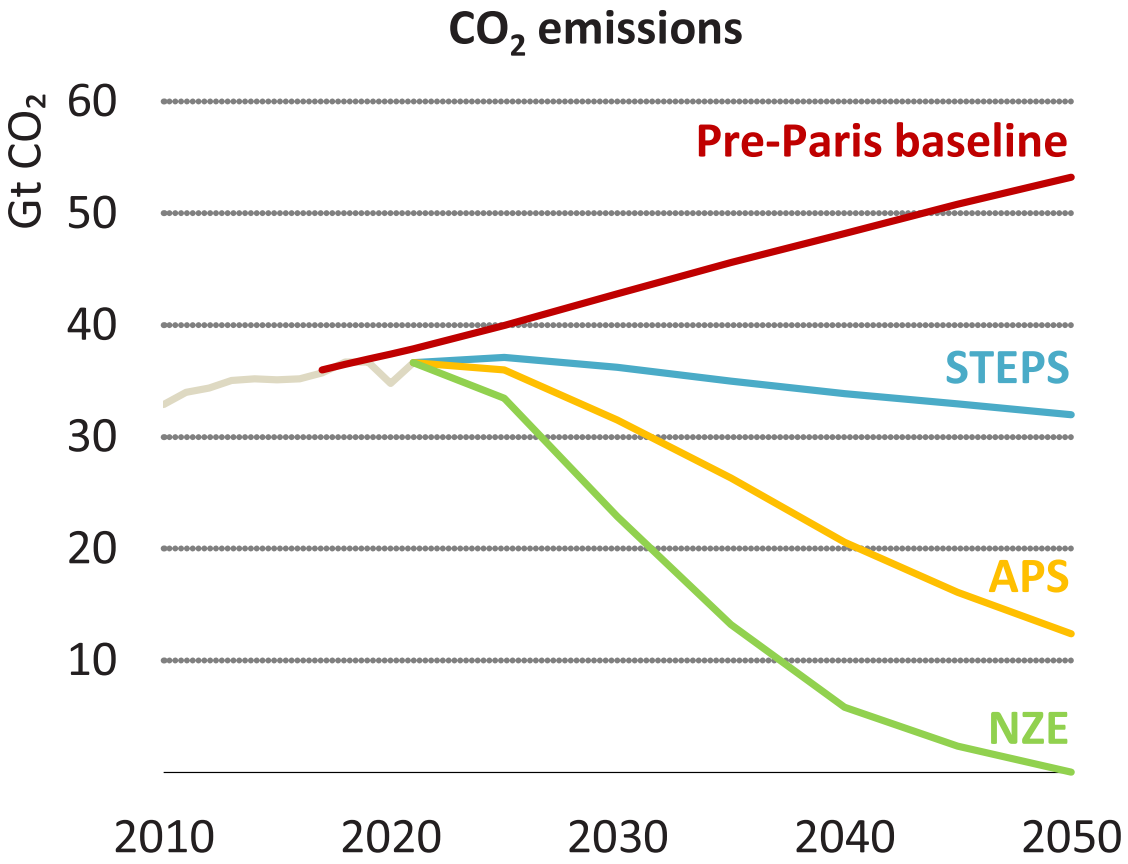
Note: mboe/d = million barrels of oil equivalent per day.

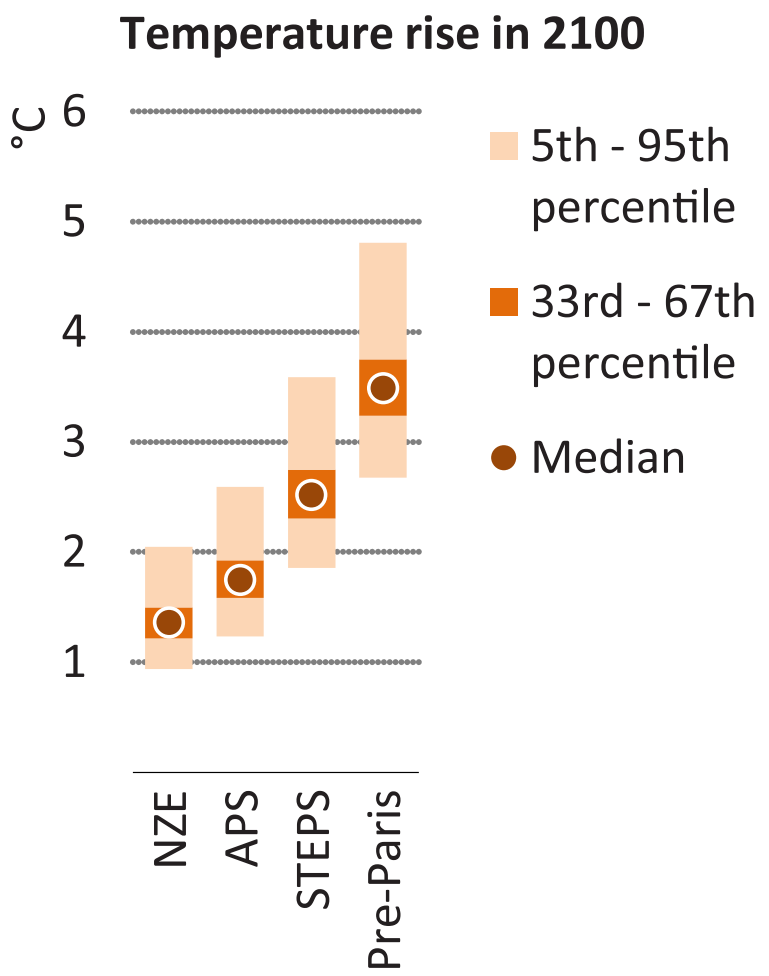
Fossil and non-fossil energy supply by scenario, 2020-2050



There is an orderly process of change in the global fuel mix in all WEO scenarios, with the main differentiating feature being the rapidity of transition from fossil fuels

Energy-related and process CO_2 emissions, 2010-2050 and temperature rise in 2100 by scenario

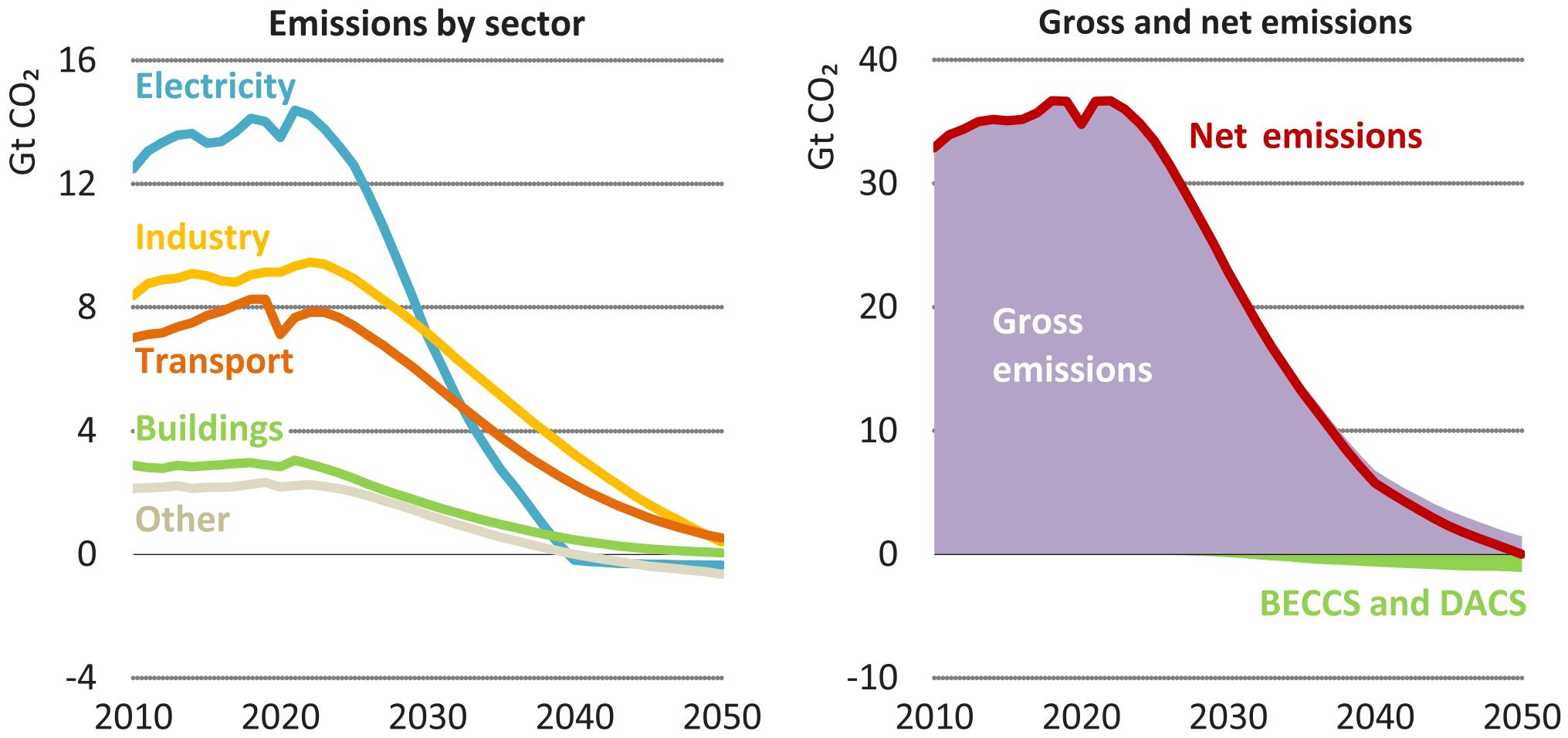




Policy and technology advances since 2015 have shaved 1 °C off the temperature rise in 2100 but stated policies still lead to a temperature rise well above the Paris Agreement goals

Notes: Pre-Paris trajectory is based on the Current Policies Scenario from the *WEO-2015* (IEA, 2015). Temperature rise estimates are relative to 1850-1900 and match the IPCC Sixth Assessment Report definition of warming of 0.85 °C between 1995-2014 (IPCC, 2022a).

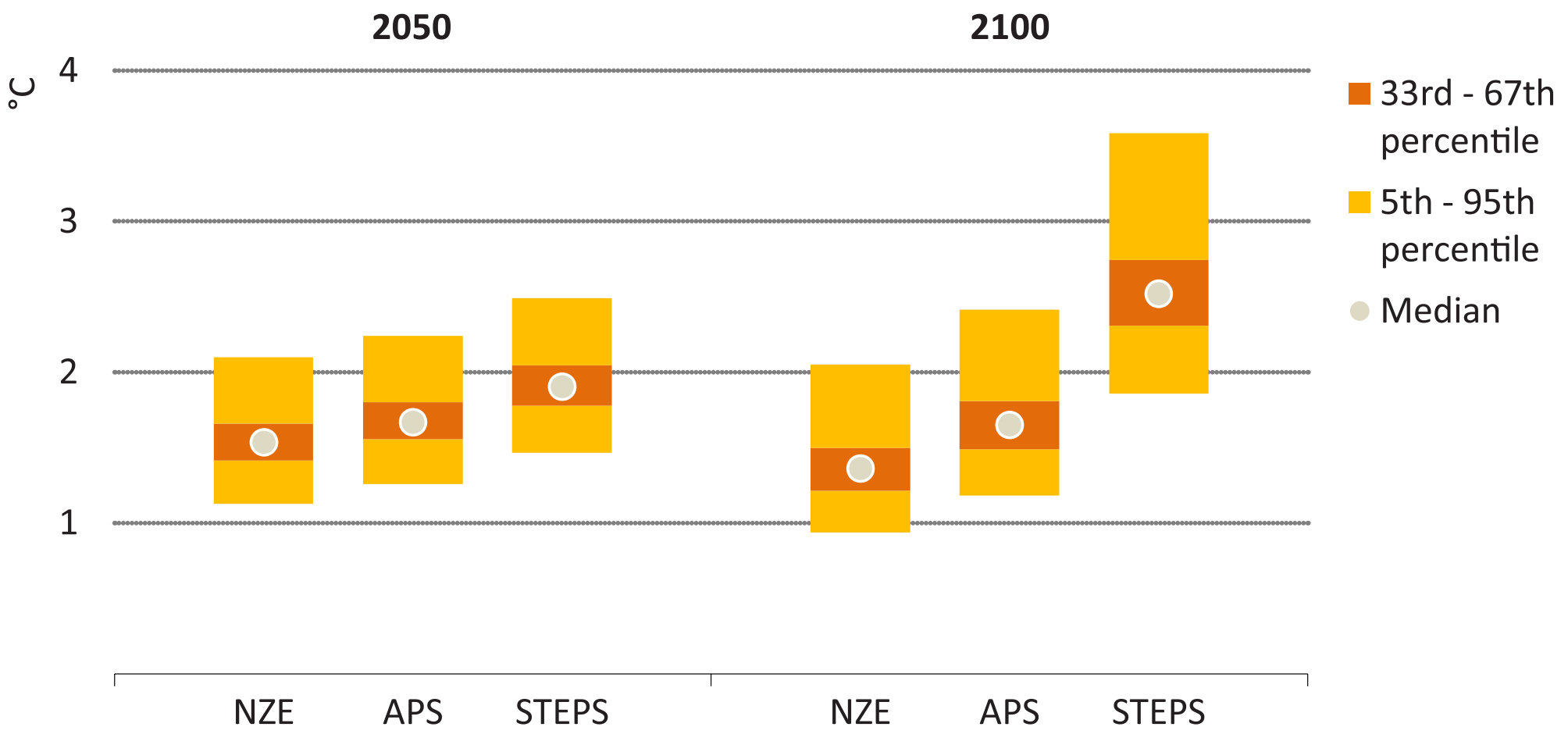
Energy-related CO_2 emissions by sector and gross and net emissions in the NZE Scenario, 2010-2050



The power sector leads emissions reductions to 2030, but all sectors contribute to the net zero emissions goal, with residual emissions in 2050 balanced by atmospheric removals

Notes: BECCS = bioenergy equipped with CCUS; DACS = direct air capture and storage. Other includes agriculture and other energy transformation sectors.

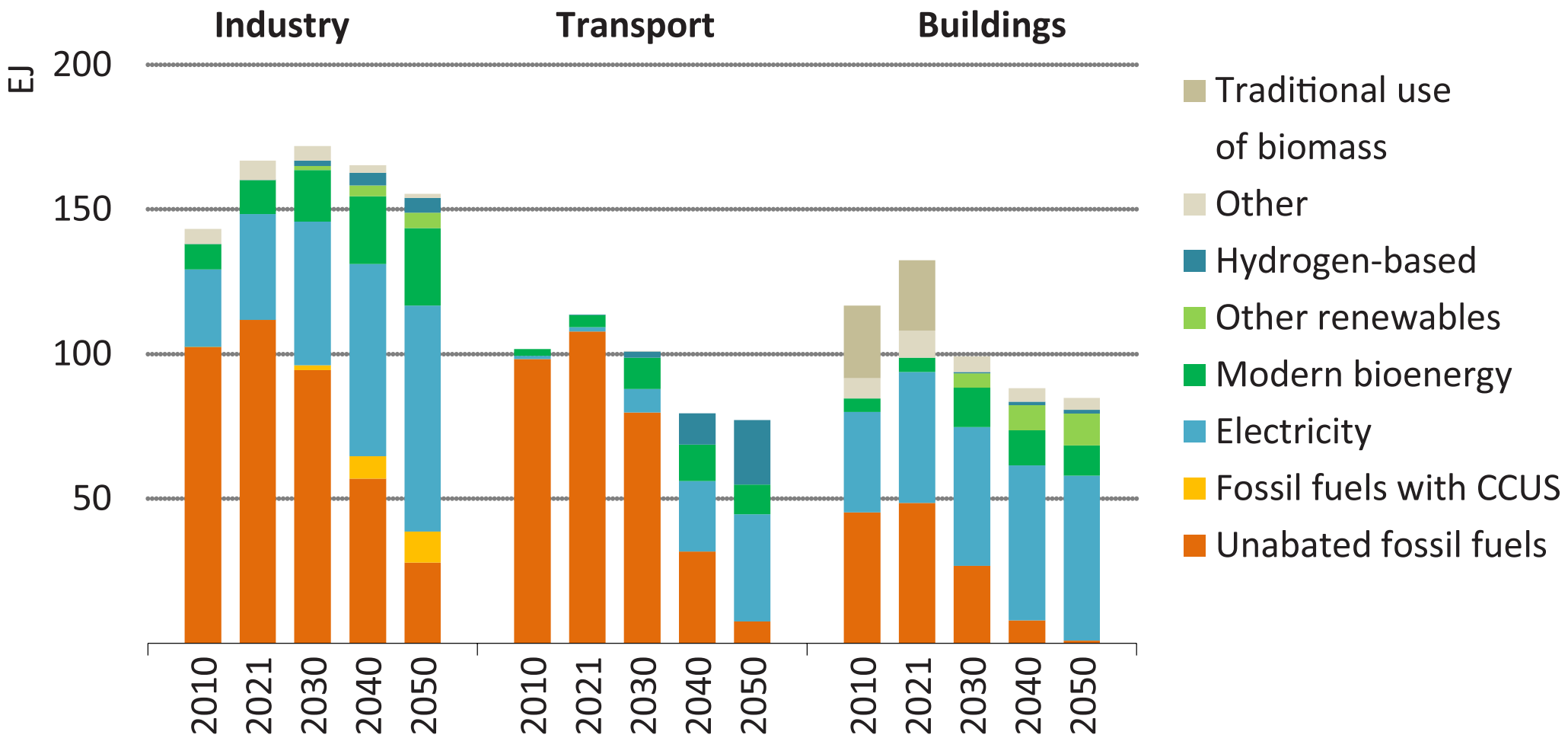
Temperature rise in 2050 and 2100 in the *WEO-2022* scenarios



Temperature rise peaks at less than 1.6 °C in 2050 in the NZE Scenario and falls to around 1.4 °C by 2100. In the STEPS, it exceeds 2 °C around 2060 and continues rising

Notes: NZE = Net Zero Emissions by 2050 Scenario; APS = Announced Pledges Scenario; STEPS = Stated Policies Scenario. Temperature rise estimates in this section are relative to 1850-1900 and match the IPCC Sixth Assessment Report definition of warming of 0.85 °C between 1995-2014 (IPCC, 2021).

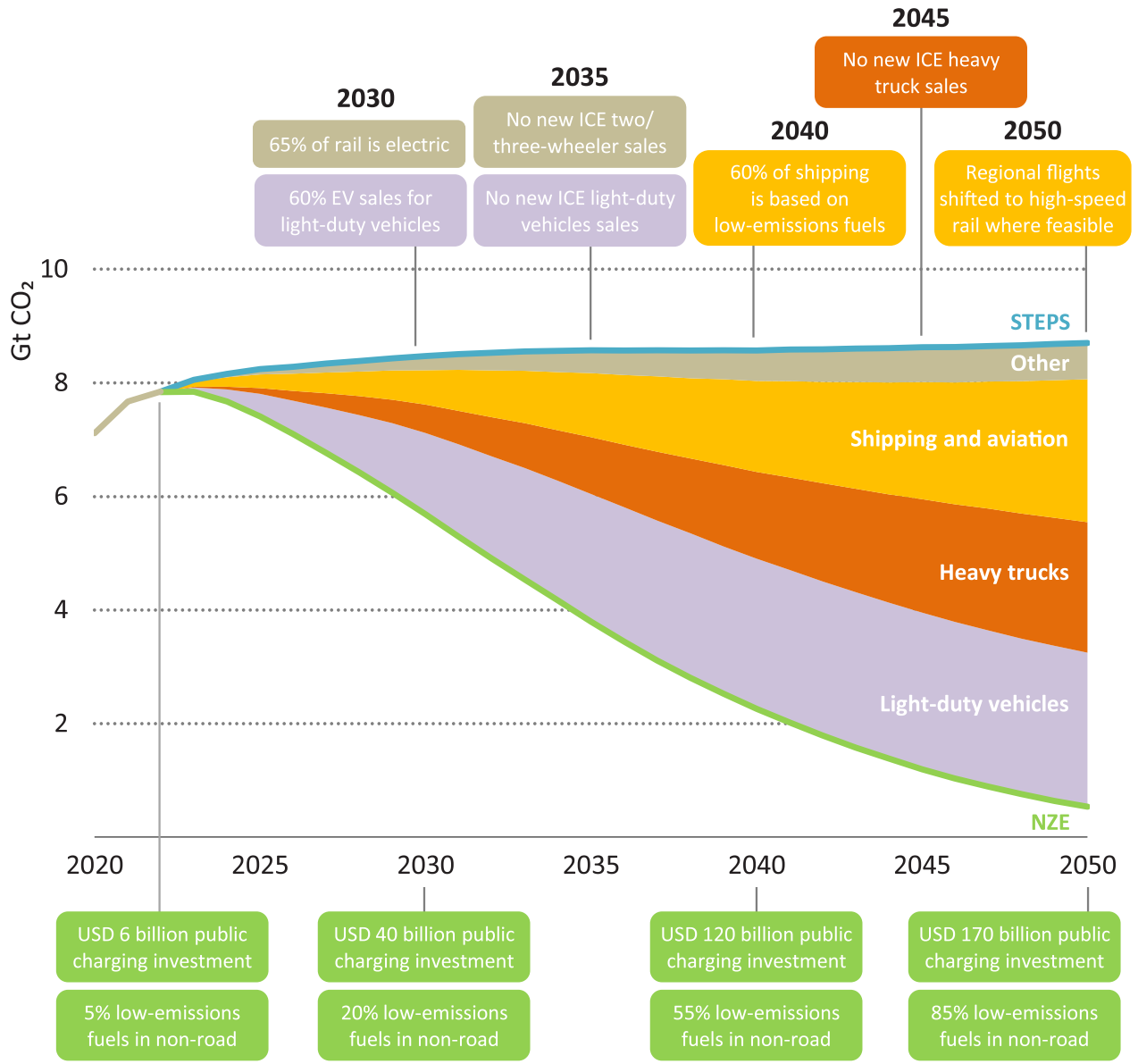
Total final consumption by source in the NZE Scenario, 2010-2050



End-use sectors come to be dominated by electricity, which provides more than half of total final consumption by 2050

Note: Other renewables include solar thermal and geothermal used directly in end-use sectors.

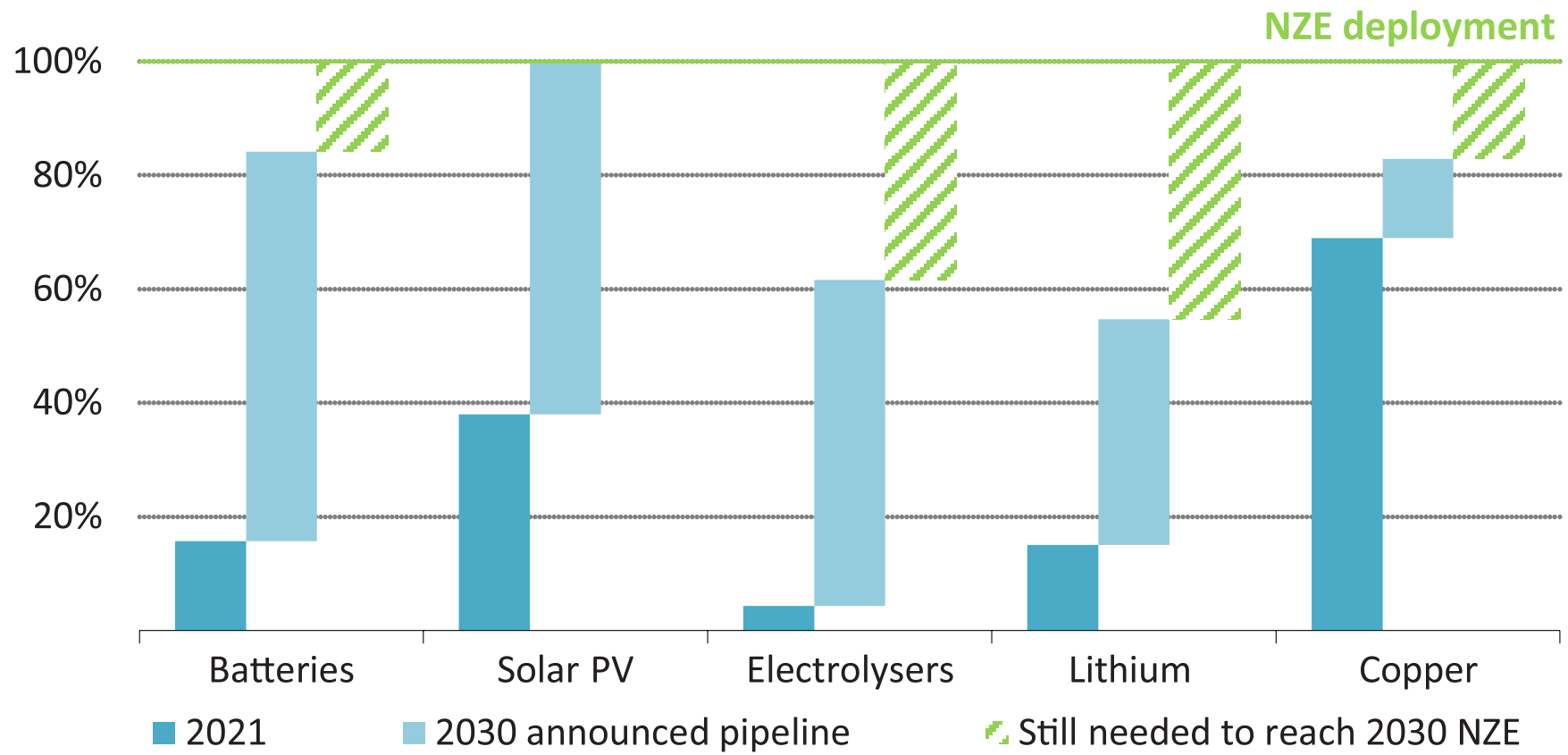
Emissions reductions and key milestones in transport in the NZE Scenario relative to the STEPS, 2020-2050



Electrification of road transport and rail brings rapid and massive emissions reductions; behavioural changes and low-emissions fuels are key in aviation and shipping

Notes: ICE = internal combustion engine. Light-duty vehicles include passenger light-duty vehicles and light commercial vehicles. Other includes two/three-wheelers, buses, rail, pipeline and non-specified. Non-road includes aviation, shipping and rail modes. Low-emissions fuels include biofuels and low-emissions hydrogen and hydrogen-based fuels.

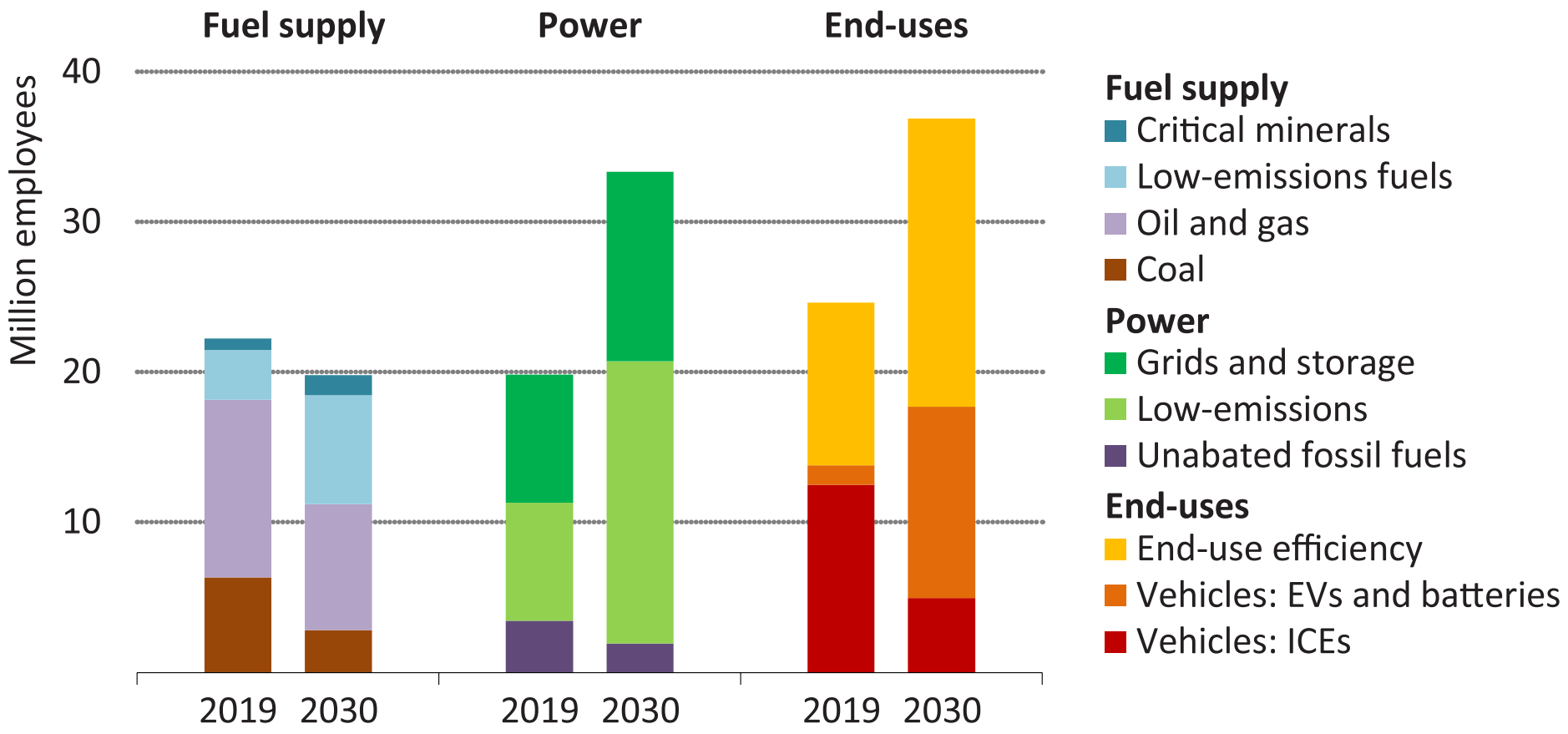
Production or throughput capacity in 2021, assuming full implementation of announced project pipelines and NZE Scenario deployment levels in 2030



A number of clean technology value chains have announced supply capacity that approaches the level required in the NZE Scenario by 2030

Note: This figure assumes full implementation of announced project pipelines, including speculative projects. For all technologies, the figure shows annual production capacity in 2030 relative to the level of annual demand or capacity addition in the NZE in the same year.

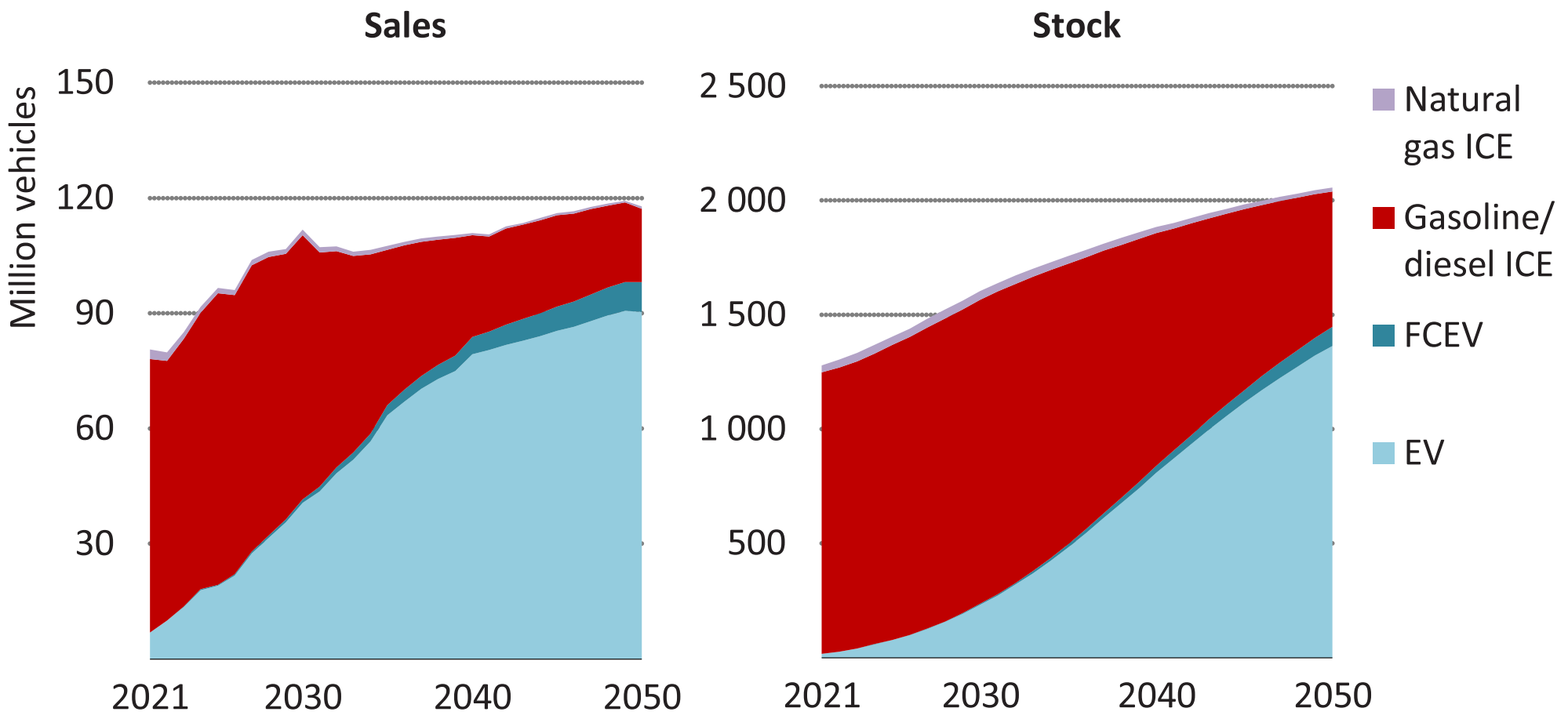
Energy employment by technology in the NZE Scenario, 2019 and 2030



The share of energy sector employment related to clean energy increases from around half today to 80% by 2030

Note: EVs = electric vehicles; ICEs = internal combustion engines.

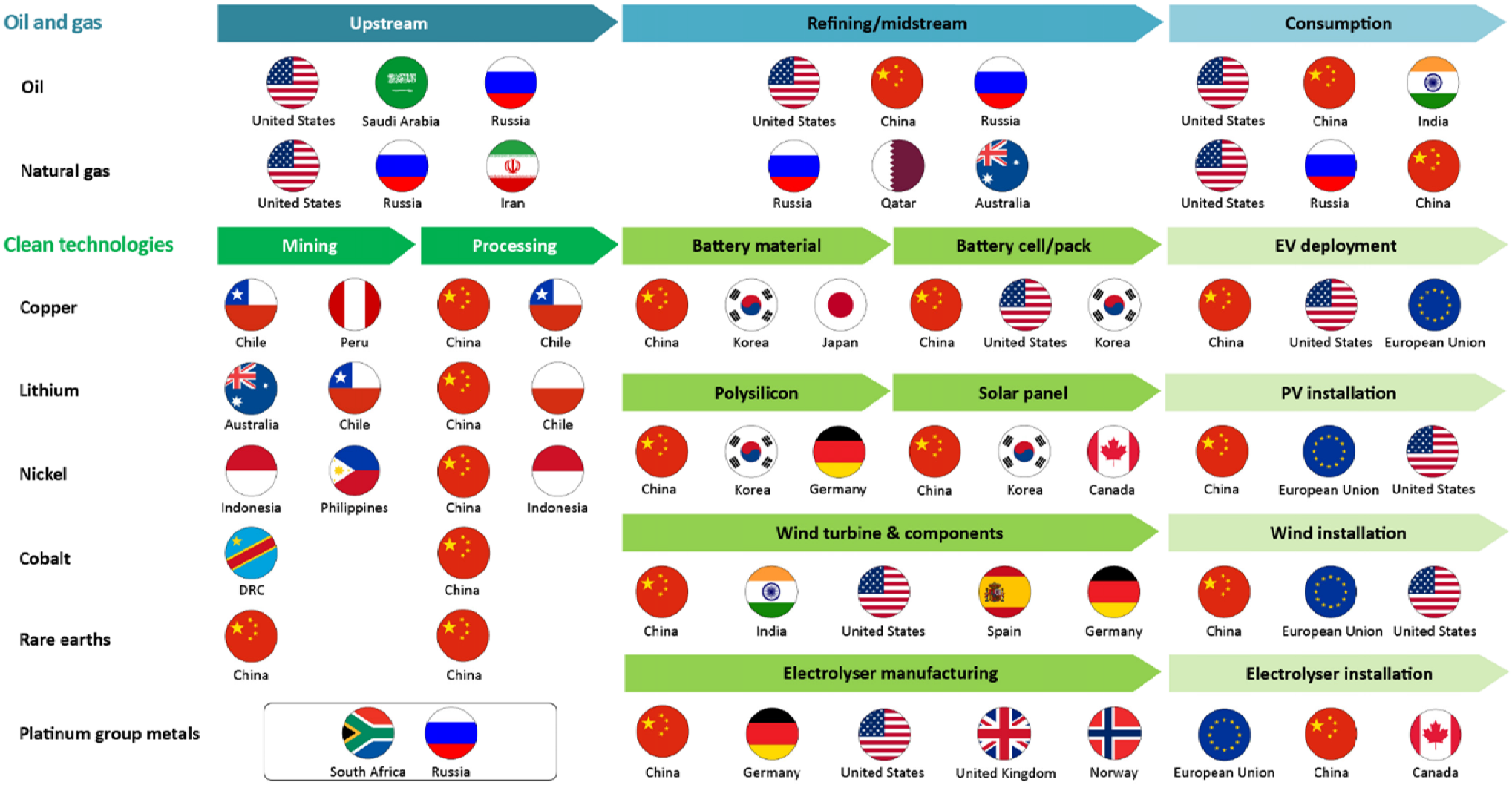
Stock and flow of passenger cars by type in the APS



Even in scenarios that feature rapid reductions in sales of ICE cars, oil use in road transport does not disappear quickly

Notes: FCEV = fuel cell electric vehicle; ICE = internal combustion engine; EV = electric vehicle, which includes battery electric and plug-in hybrid models.

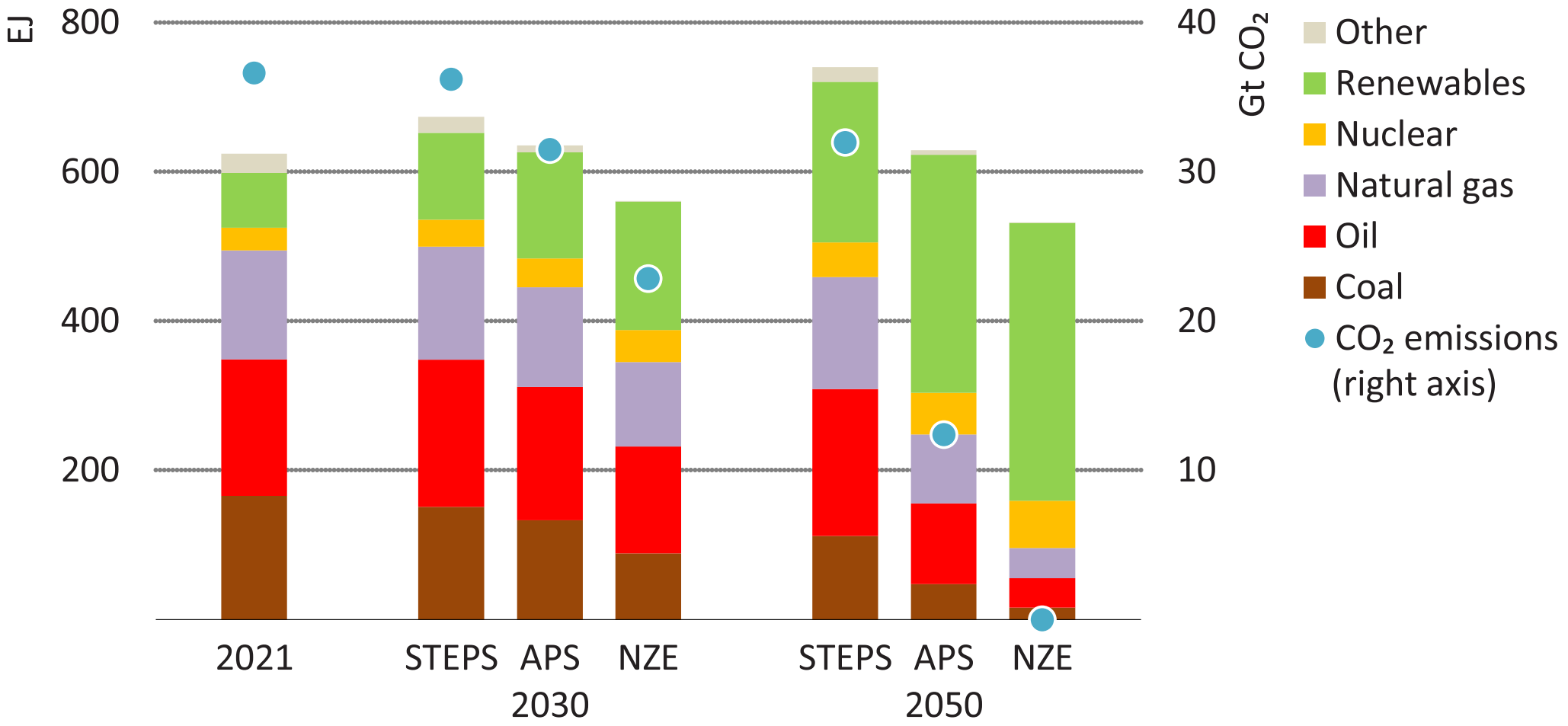
Indicative supply chains for oil and gas and selected clean energy technologies



Transition to a clean energy system brings new energy trade patterns, countries and geopolitical considerations into play

Notes: DRC = Democratic Republic of the Congo. Largest producers and consumers are noted in each case to provide an indication, rather than a complete account.

Total energy supply by fuel and CO_2 emissions by scenario



Renewable energy increases more than any other energy source in each scenario; CO_2 emissions hold at current levels in the STEPS to 2030, but drop14% in the APS

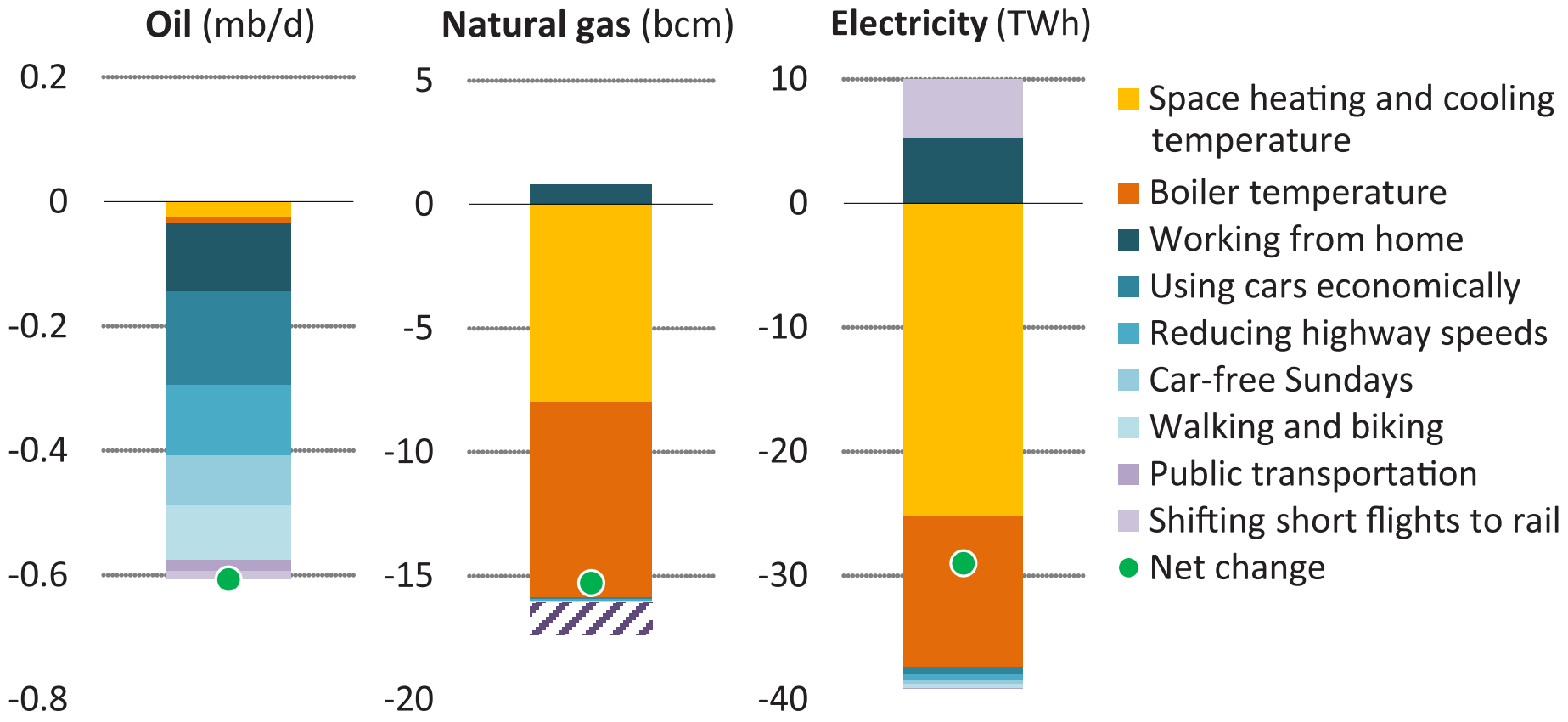
Notes: EJ = exajoule; Gt CO_2 = gigatonnes of carbon dioxide; STEPS = Stated Policies Scenario; APS = Announced Pledges Scenario; NZE = Net Zero Emissions by 2050 Scenario.

Key energy indicators by scenario, 2010-2050

			STEPS		APS		NZE	
	2010	2021	2030	2050	2030	2050	2030	2050
Access (million people)								
Population without access to electricity	1 392	754	663	727	292	112	0	0
Population without access to clean cooking	2 916	2 386	1 880	1 601	783	535	0	0
Premature deaths from (million people):								
Ambient air pollution	n.a.	4.2	4.8	7.1	4.6	6.5	3.3	2.9
Household air pollution	n.a.	3.6	2.9	3.0	1.6	1.9	1.0	1.2
Energy-related CO_2 emissions (Gt)	**32.9**	**36.6**	**36.2**	**32.0**	**31.5**	**12.4**	**22.8**	**0**
CO_2 captured via CCUS	0	0.04	0.1	0.4	0.5	4.3	1.2	6.2
Primary energy supply (EJ)	**542**	**624**	**673**	**740**	**636**	**629**	**561**	**532**
Share of unabated fossil fuels	81%	79%	74%	61%	69%	34%	59%	10%
Energy intensity of GDP (GJ per USD 1 000, PPP)	5.1	4.3	3.4	2.2	3.2	1.9	2.9	1.6
Electricity generation (1 000 TWh)	**22**	**28**	**35**	**50**	**36**	**61**	**38**	**73**
CO_2 intensity of generation (g CO_2/kWh)	524	459	325	158	280	41	165	-5
Share of low-emissions generation	32%	38%	53%	74%	59%	91%	74%	100%
Total final consumption (EJ)	**383**	**439**	**485**	**544**	**451**	**433**	**398**	**337**
Share of unabated fossil fuels	69%	66%	64%	57%	61%	36%	56%	15%
Share of electricity in TFC	17%	20%	22%	28%	24%	39%	28%	52%

Notes: Gt = gigatonnes; CCUS = carbon capture, utilisation and storage; EJ = exajoule; GJ = gigajoule; PPP = purchasing power parity; TWh = terawatt-hour; kWh = kilowatt-hour; TFC = total final consumption. STEPS = Stated Policies Scenario; APS = Announced Pledges Scenario; NZE = Net Zero Emissions by 2050 Scenario.

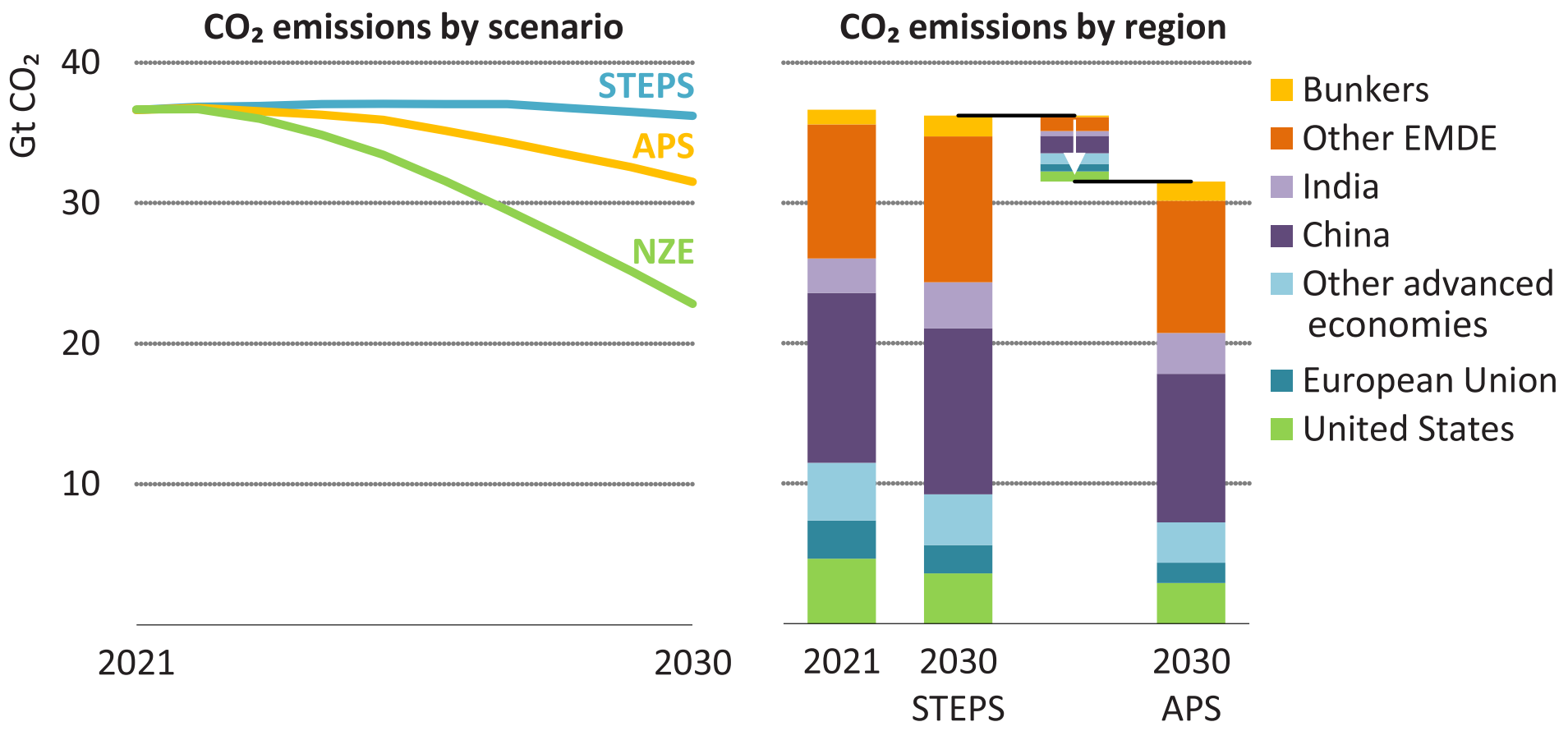
Oil, natural gas and electricity demand reductions from EU citizen actions based on the *Playing My Part* recommendations



Behavioural changes could immediately save 0.6 mb/d of oi 17 bcm of gas and 30 TWh of electricity a year

Notes: mb/d = million barrels per day; bcm = billion cubic metres; TWh = terawatt-hour. The hashed area for natural gas shows the amount of gas that could be displaced from the reduction of electricity consumption. Energy impacts of working from home and shifting short flights to rail are net negative and represent energy savings. In the *Playing My Part* report, 0.6 mb/d of oil savings and 17 bcm of natural gas savings were calculated including indirect fuel savings from lower electricity consumption, which is shown separately in this figure.

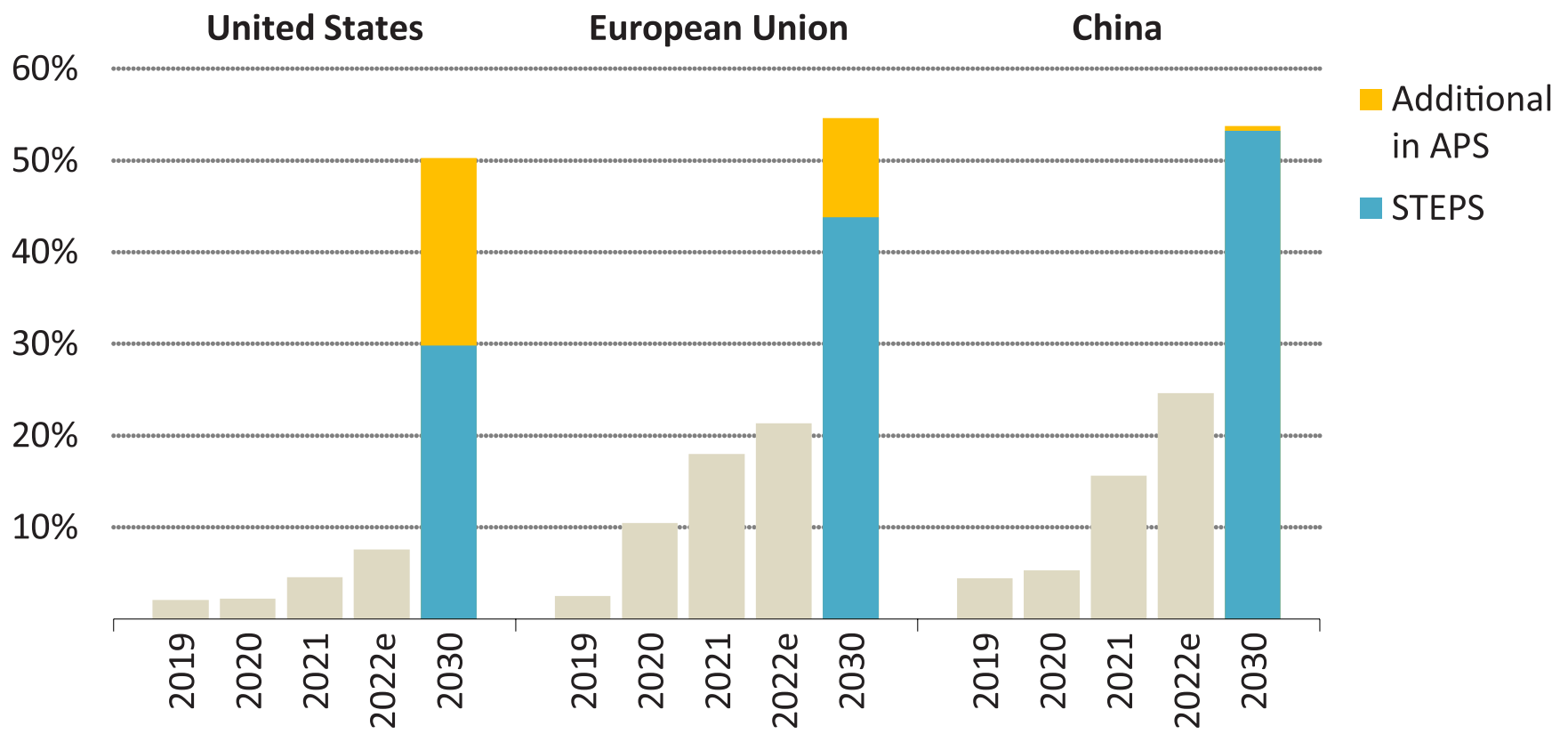
CO_2 emissions by scenario and by region, 2021 and 2030



While global emissions stay broadly flat in the STEPS to 2030, they fall by almost 5 Gt in the APS, with more than half of the difference from China, United States and European Union

Notes: Gt CO_2 = gigatonnes of carbon dioxide; EMDE = emerging market and developing economies

Market share of electric cars in key markets by scenario to 2030

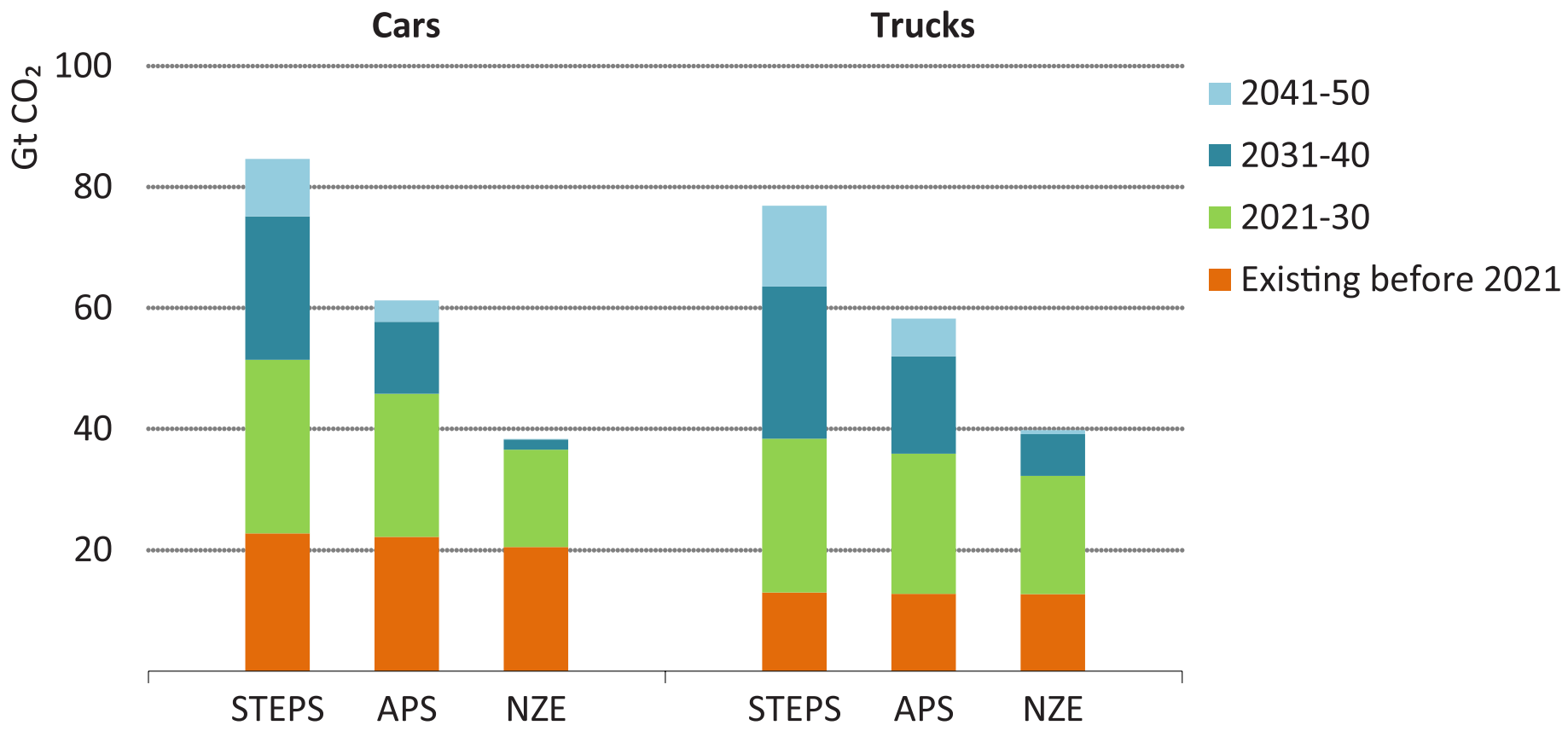


Half of all the cars sold in the world's largest car markets are electric by 2030 in the APS, building on recent momentum

Note: 2022e = estimated values for 2022.

Source: IEA analysis based on data from EV Volumes (2022).

Cumulative emissions from cars and trucks by age band and scenario, 2021-2050



Timely restrictions on new ICE vehicles are key: cars and trucks yet to be purchased risk locking in 120 Gt of CO_2 to 2050 in the STEPS, more than triple the lock in from today's fleets

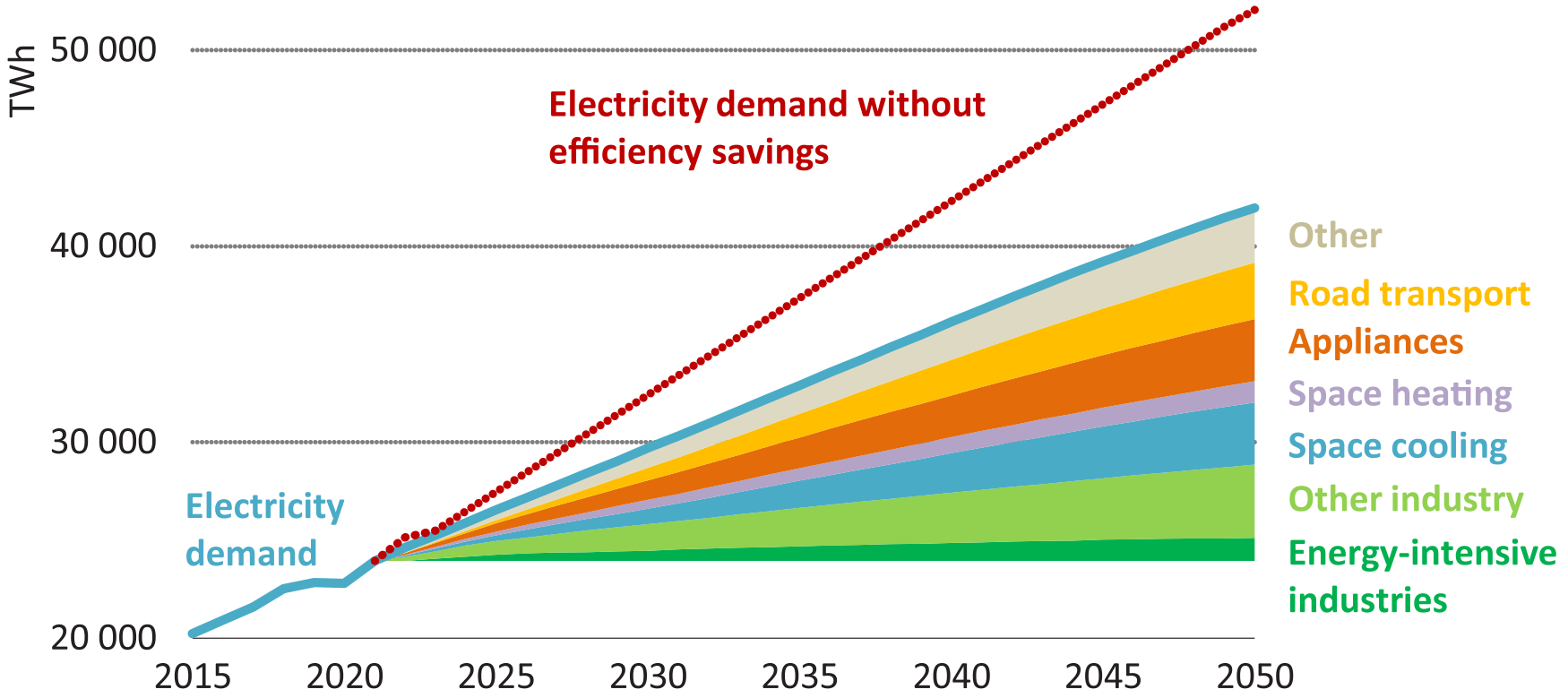
Notes: Gt CO_2 = gigatonnes of carbon dioxide. Trucks = light commercial vehicles, medium-freight trucks and heavy-freight trucks; ICE = internal combustion engine.

Global electricity demand and supply by scenario (TWh)

			STEPS		APS		NZE	
	2010	2021	2030	2050	2030	2050	2030	2050
Buildings	9 637	12 594	15 383	21 940	14 889	19 623	13 293	15 850
Industry	7 450	10 166	12 036	15 073	12 471	18 332	13 776	21 697
Transport	295	441	1 169	3 607	1 570	7 845	2 236	10 243
Hydrogen production	-	2	159	663	879	5 714	2 464	11 433
Global electricity demand	**18 548**	**24 700**	**30 621**	**43 672**	**31 752**	**53 810**	**33 733**	**62 159**
Unabated coal	8 670	10 201	9 044	5 892	8 076	1 580	4 666	0
Unabated natural gas	4 855	6 552	6 848	6 658	6 100	3 577	4 977	82
Unabated oil	969	682	432	312	363	175	180	3
Fossil fuels with CCUS	-	1	5	133	75	1 338	282	1 317
Nuclear	2 756	2 776	3 351	4 260	3 547	5 103	3 896	5 810
Hydropower	3 449	4 327	5 078	6 809	5 213	7 543	5 725	8 251
Wind	342	1 870	4 604	10 691	5 816	17 416	7 840	23 486
Solar PV	32	1 003	4 011	12 118	4 838	18 761	7 551	27 006
Other renewables	411	859	1 380	2 833	1 707	5 153	1 948	5 762
Hydrogen and ammonia	-	-	9	44	79	567	603	1 467
Global electricity supply	**21 539**	**28 334**	**34 834**	**49 845**	**35 878**	**61 268**	**37 723**	**73 232**
Renewables share	*20%*	*28%*	*43%*	*65%*	*49%*	*80%*	*61%*	*88%*

Notes: TWh = terawatt-hours; CCUS = carbon capture, utilisation and storage; PV = photovoltaics. STEPS = Stated Policies Scenario, APS = Announced Pledges Scenario; NZE = Net Zero Emissions by 2050 Scenario. Electricity demand is defined as total gross electricity generated less own use generation, plus imports, less exports and transmission and distribution losses. Other sources are included in electricity supply.

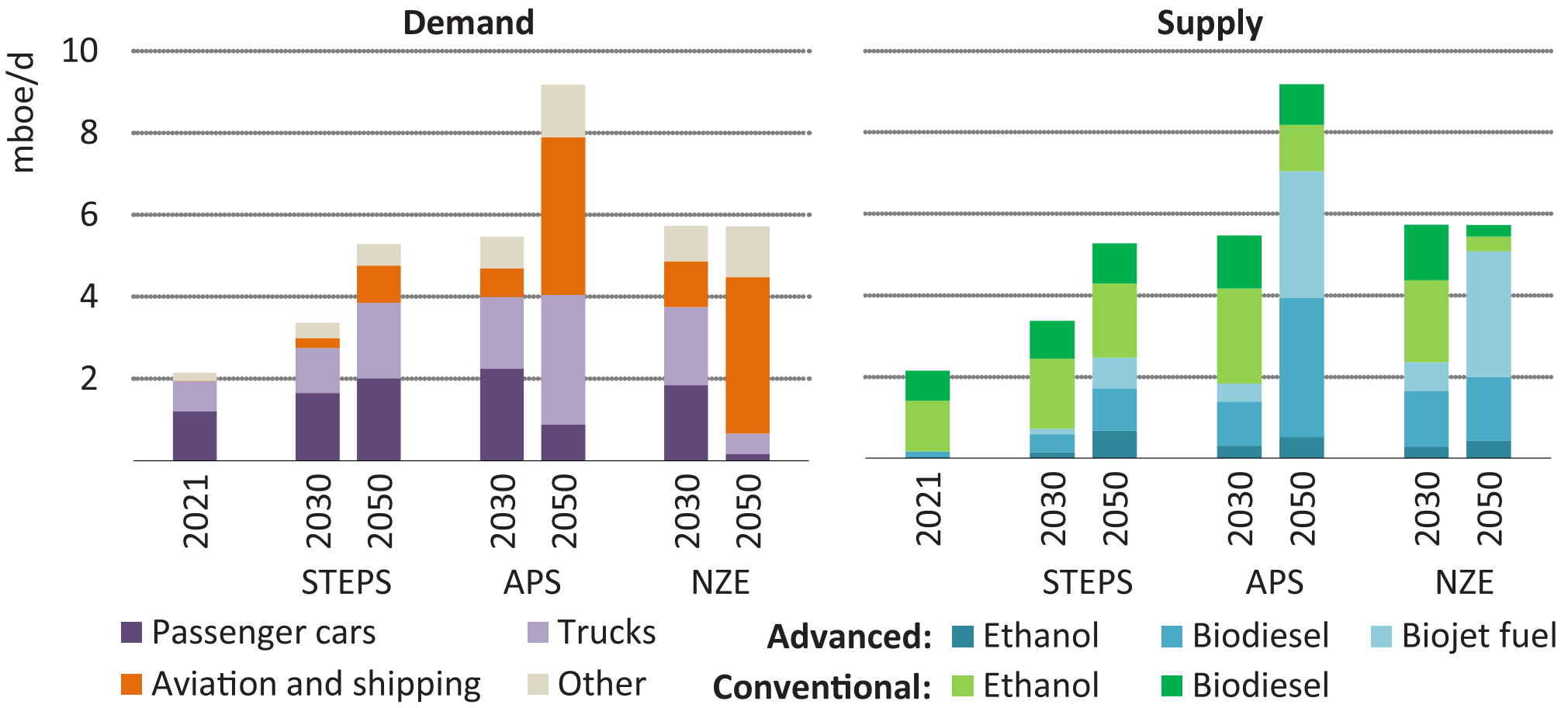
Global total electricity consumption with and without energy efficiency gains in the STEPS, 2015-2050



Energy efficiency gains cut electricity consumption growth by around 10 000 TWh in the STEPS by 2050

Note: Efficiency gains are mainly due to stricter fuel economy standards in road transport; minimum energy performance standards and labels in the buildings sector; technological improvements and material recycling in industry.

Liquid biofuel demand and supply by scenario



Liquid biofuel use increases in all scenarios, more than doubling to 2030 in the APS and NZE Scenario, with increasing shares produced from non-food crop feedstocks

Note: Other includes other transport, industry, buildings and agriculture.

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