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La domanda energetica globale 2030-2050: le sfide del futuro

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World energy outlook

- La fragilità dei mercati energetici odierni mette ancora più in evidenza l’importanza della sicurezza energetica ed I modi in cui sistemi energetici più efficienti e più puliti possono ridurre i rischi connessi con la critica situazione edistente.
- Analisi solide e indipendenti e approfondimenti basati sui dati sono essenziali per affrontare le incertezze e le criticità legate al tema dell’energia.
- I rischi geopolitici aumentano, ma gli equilibri di mercato sottostanti stanno preparando il terreno per una forte competizione tra diverse fonti energetiche e tecnologie
- L'energia pulita sta entrando nel sistema energetico a un ritmo senza precedenti, con oltre 560 gigawatt di nuova capacità di fonti rinnovabili aggiunti nel 2023, con un tasso di crescita del 15% annuo. Ma l'implementazione è tutt'altro che uniforme tra le diverse tecnologie e nei diversi Paesi.
- La Cina ha rappresentato il 60% della nuova capacità rinnovabile aggiunta a livello mondiale nel 2023 e la sola generazione di energia solare fotovoltaica cinese è destinata a superare, entro il 2030, l’attuale domanda totale di elettricità degli Stati Uniti.

China

Population
million people

2023
1419

2050
1307

GDP
trillion USD
(2023, PPP)

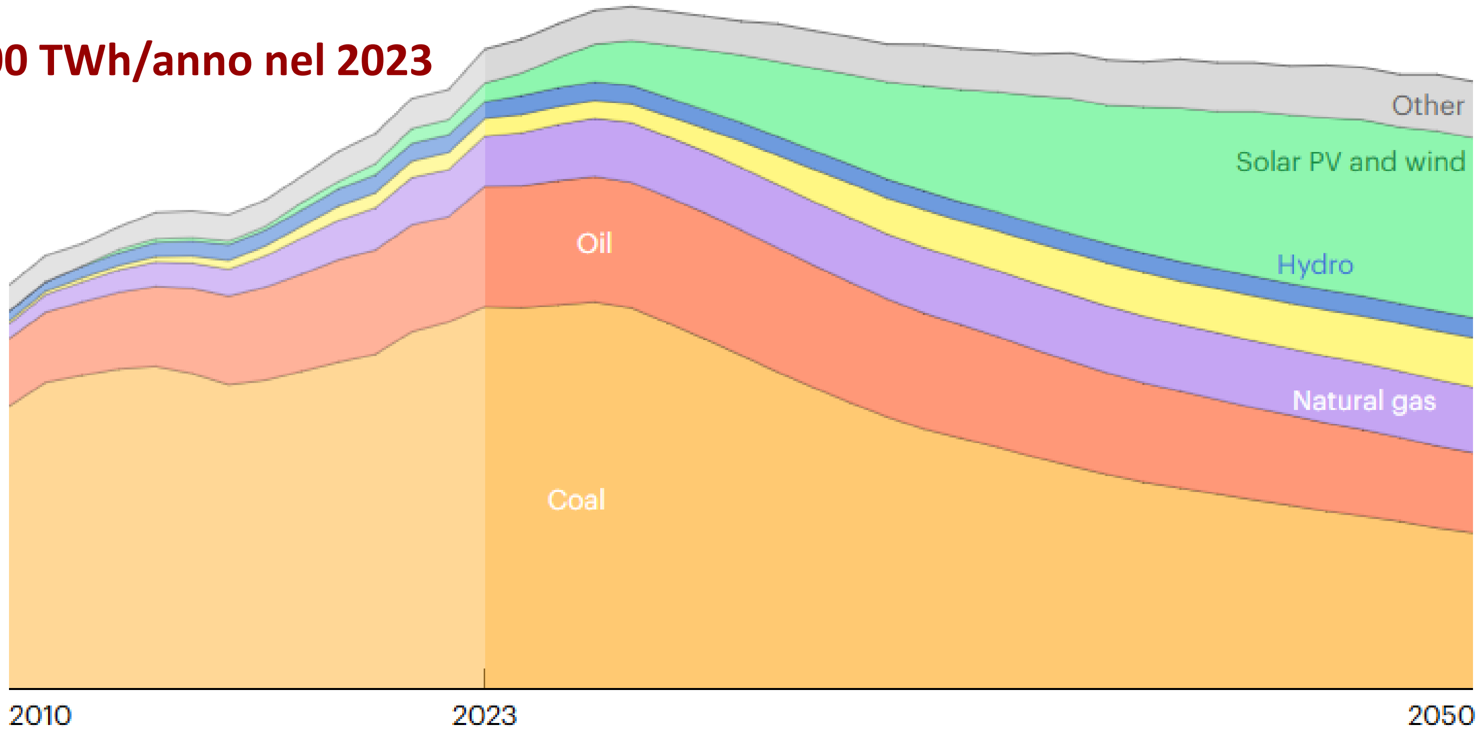
2023
33.5

2050
69.3

Energy demand in the Stated Policies Scenario

200 EJ

50.000 TWh/anno nel 2023



2060
Net zero emissions target

25%
Share of energy demand from non-fossil fuels by 2030, compared to 14% in 2023.

Before 2030
Target to peak emissions

10%
Aim to reduce PM2.5, NOx and VOC emissions in cities compared with 2020 levels.

IEA, WEO 2024

United States

Population
million people

2023
338

2050
373

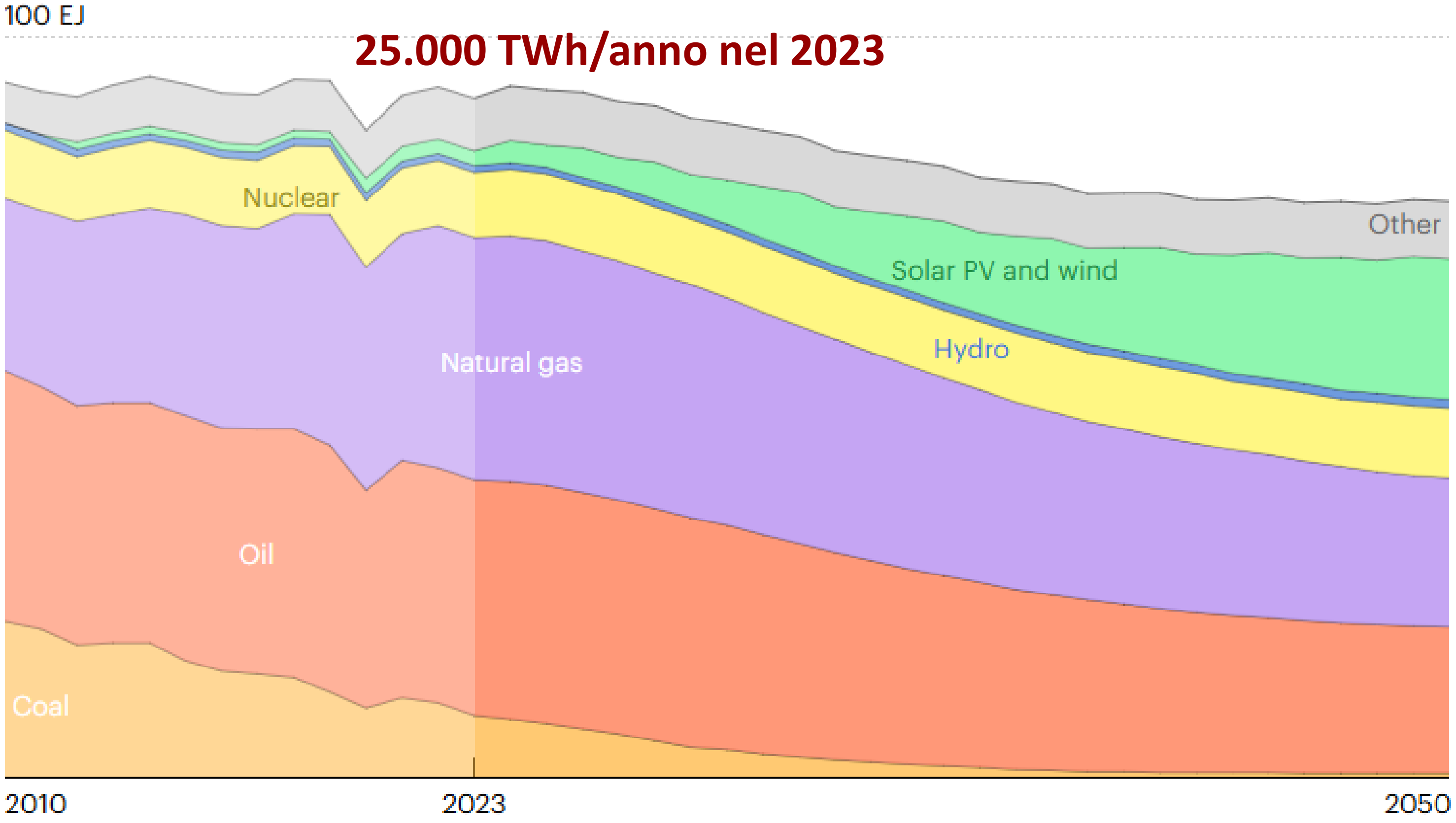
GDP
trillion USD
(2023, PPP)

2023
27.5

2050
46.1

2050
Net zero emissions target year

Energy demand in the Stated Policies Scenario



560 billion USD
Support for energy security, clean energy and mass transit under the Inflation Reduction Act and Bipartisan Infrastructure Investment and Jobs Act

50-52%
GHG reduction target by 2030 from 2005 levels under the updated Nationally Determined Contribution

IEA, WEO 2024

European Union

Population
million people

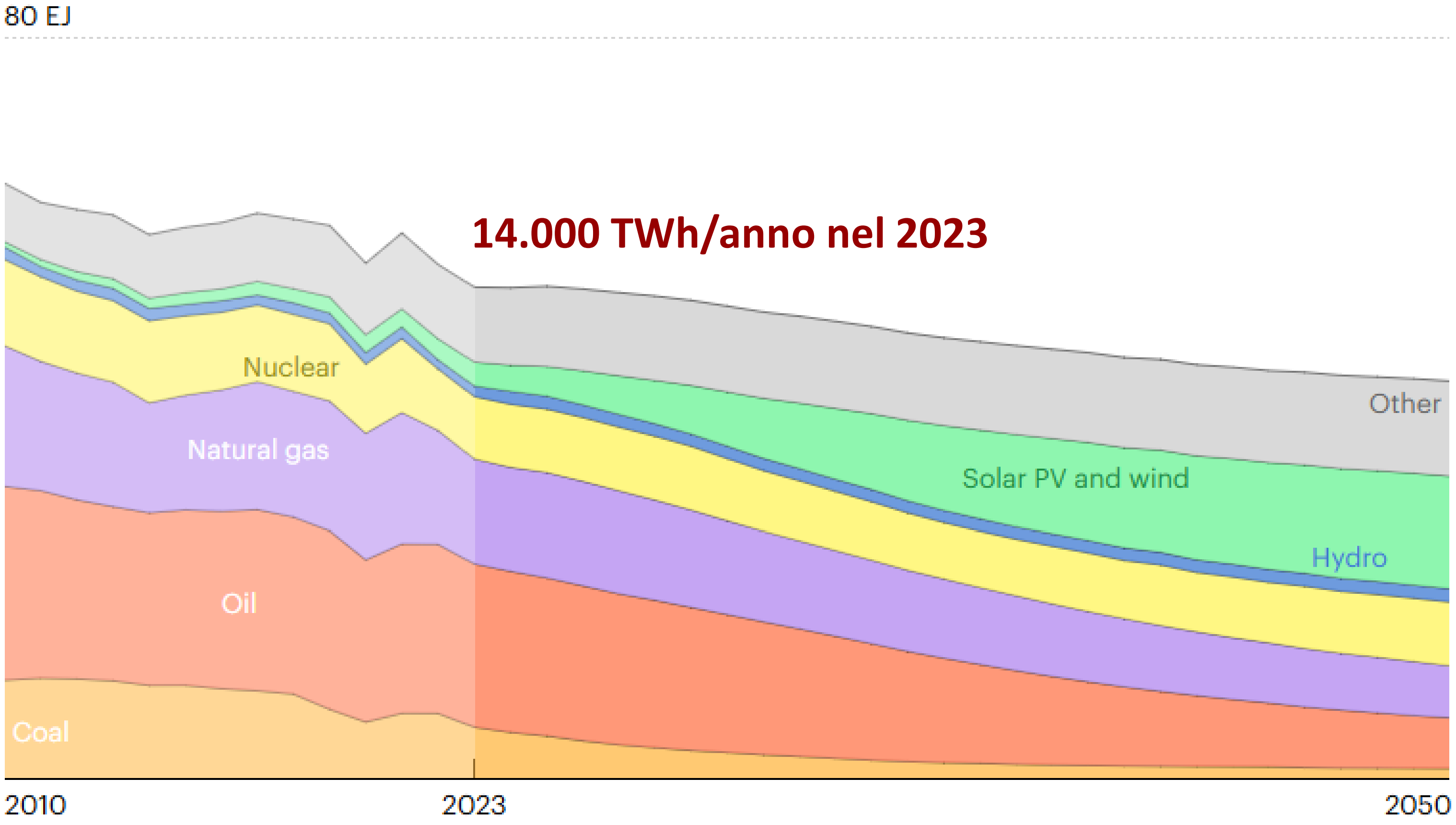
2023: **449** | 2050: **425**

GDP
trillion USD
(2023, PPP)

2023: **25.4** | 2050: **35.1**

2050
Net zero emissions target year

Energy demand in the Stated Policies Scenario

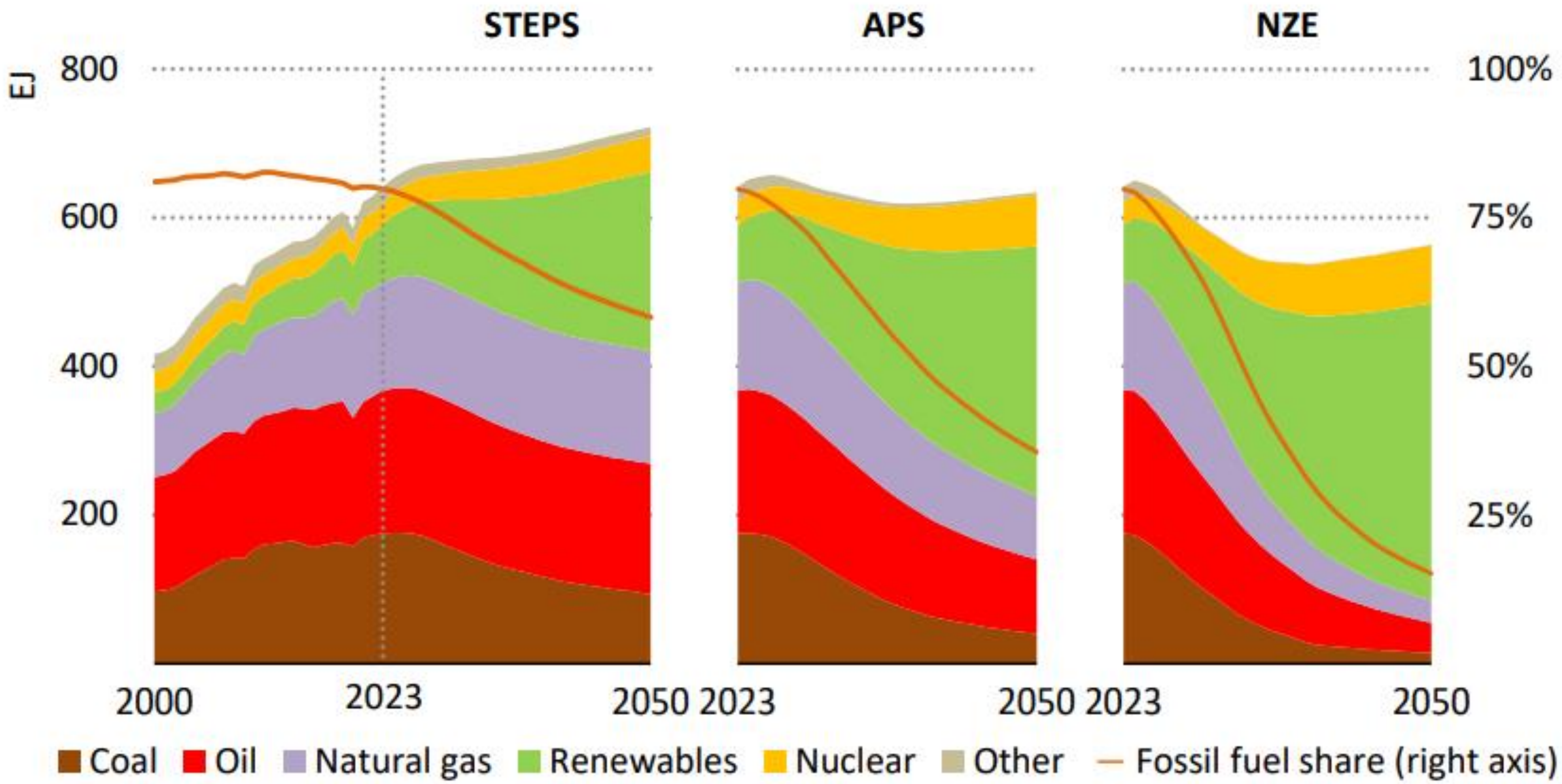


596 billion USD
Emergency affordability support allocated from 2021 until today

42.5%
Binding target for share of energy from renewable sources by 2030

IEA, WEO 2024

Figure 3.1 ▷ Global total energy supply by source and fossil fuel share by scenario, 2000-2050

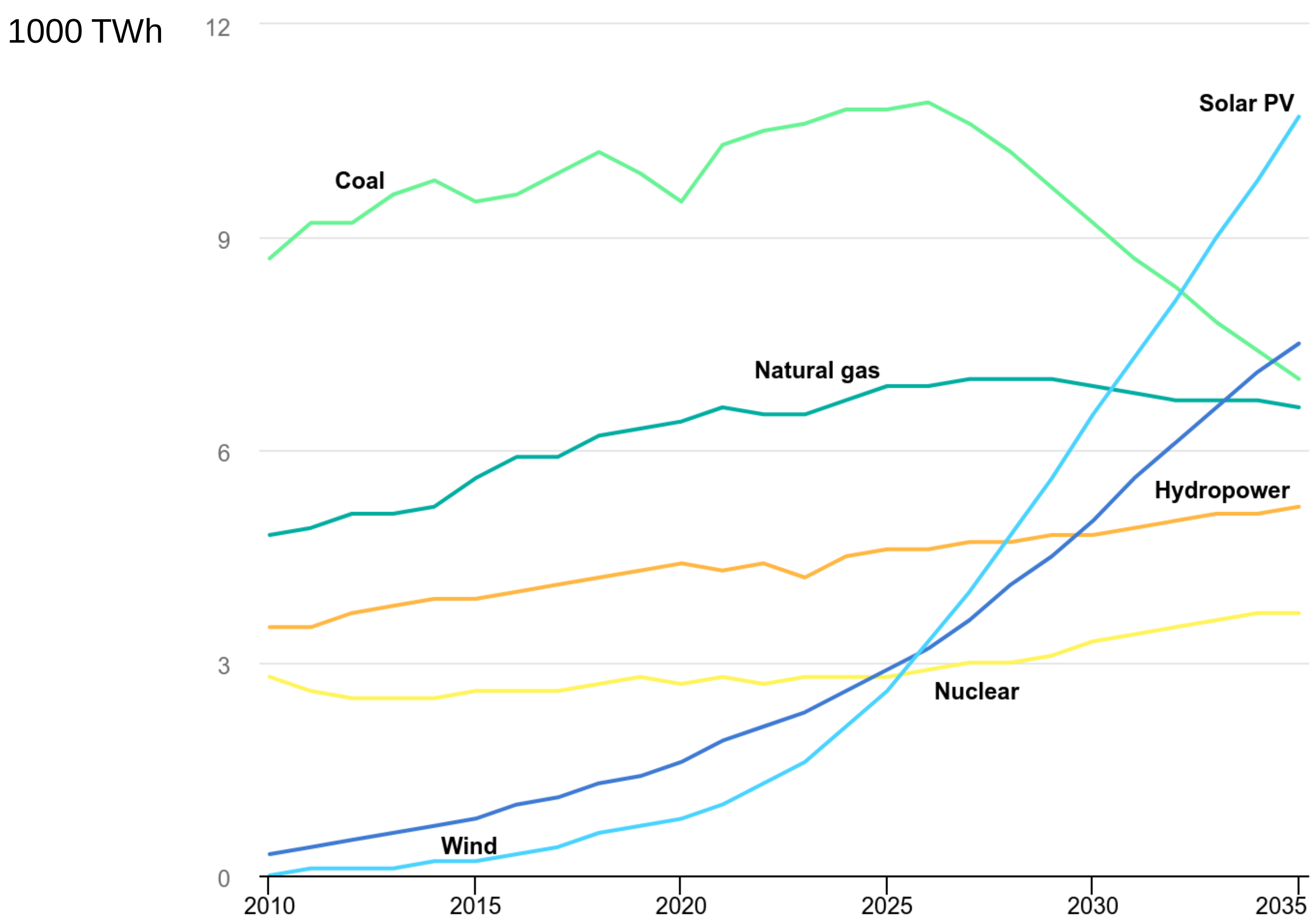


Each fossil fuel peaks by 2030 in all scenarios and then declines over time as renewables and other low-emissions sources of energy increase strongly

Notes: EJ = exajoules; STEPS = Stated Policies Scenario; APS = Announced Pledges Scenario; NZE = Net Zero Emissions by 2050 Scenario. Renewables includes modern bioenergy. Other includes the traditional use of biomass and non-renewable waste.

IEA, WEO 2024

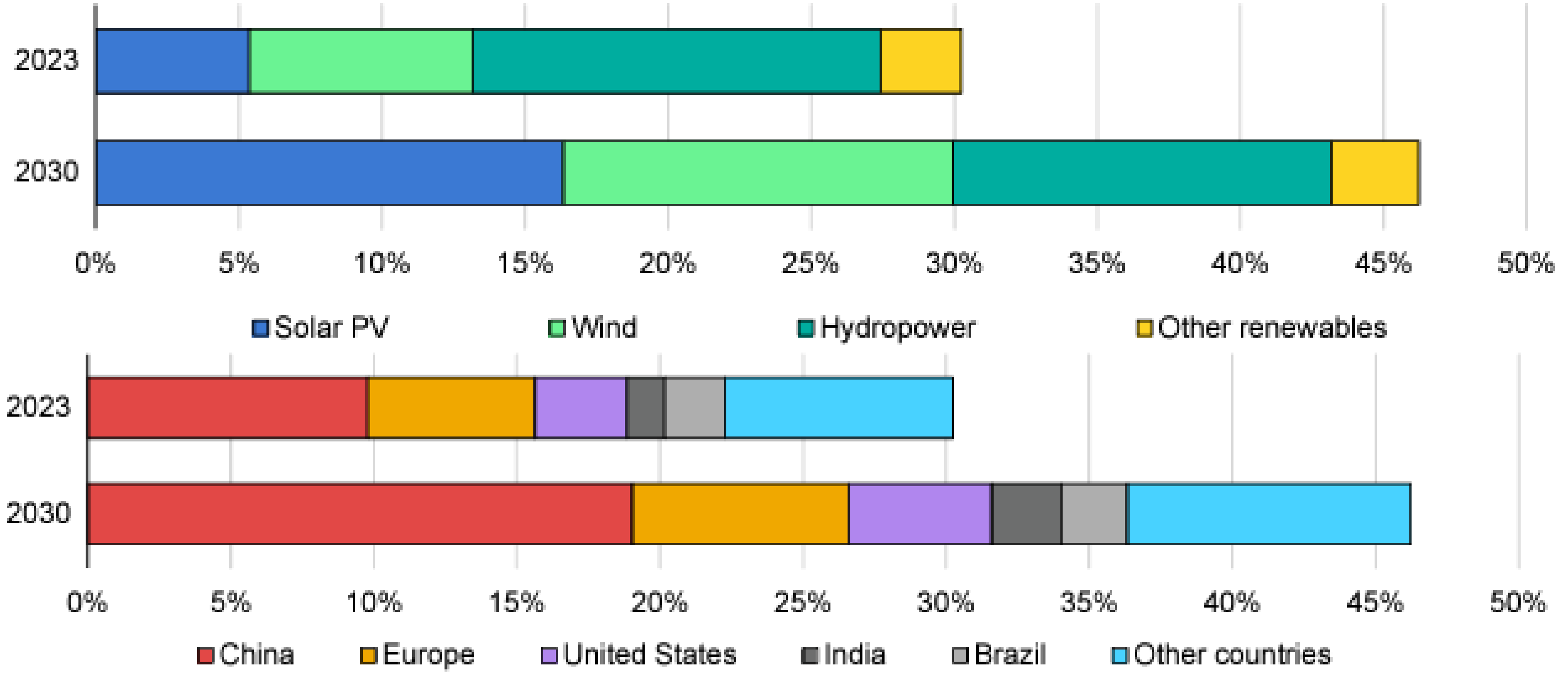
World electricity generation in STEPS



Nel 2023:
18.000 TWh/anno (60%) fossile
9.000 TWh/anno (30%) RES
3.000 TWh/anno (10%) nucleare

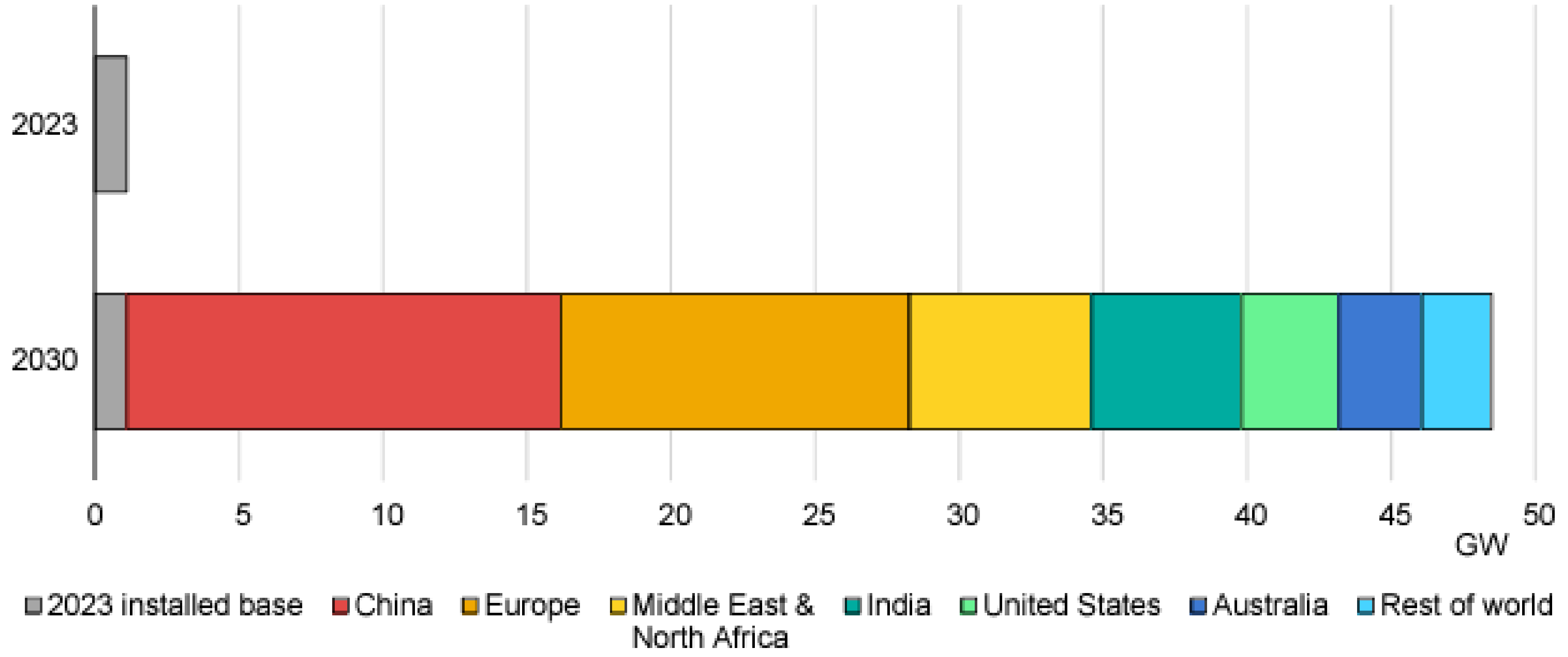
IEA, WEO 2024

Global electricity generation by renewable energy technology and country/region, main case, 2023 and 2030



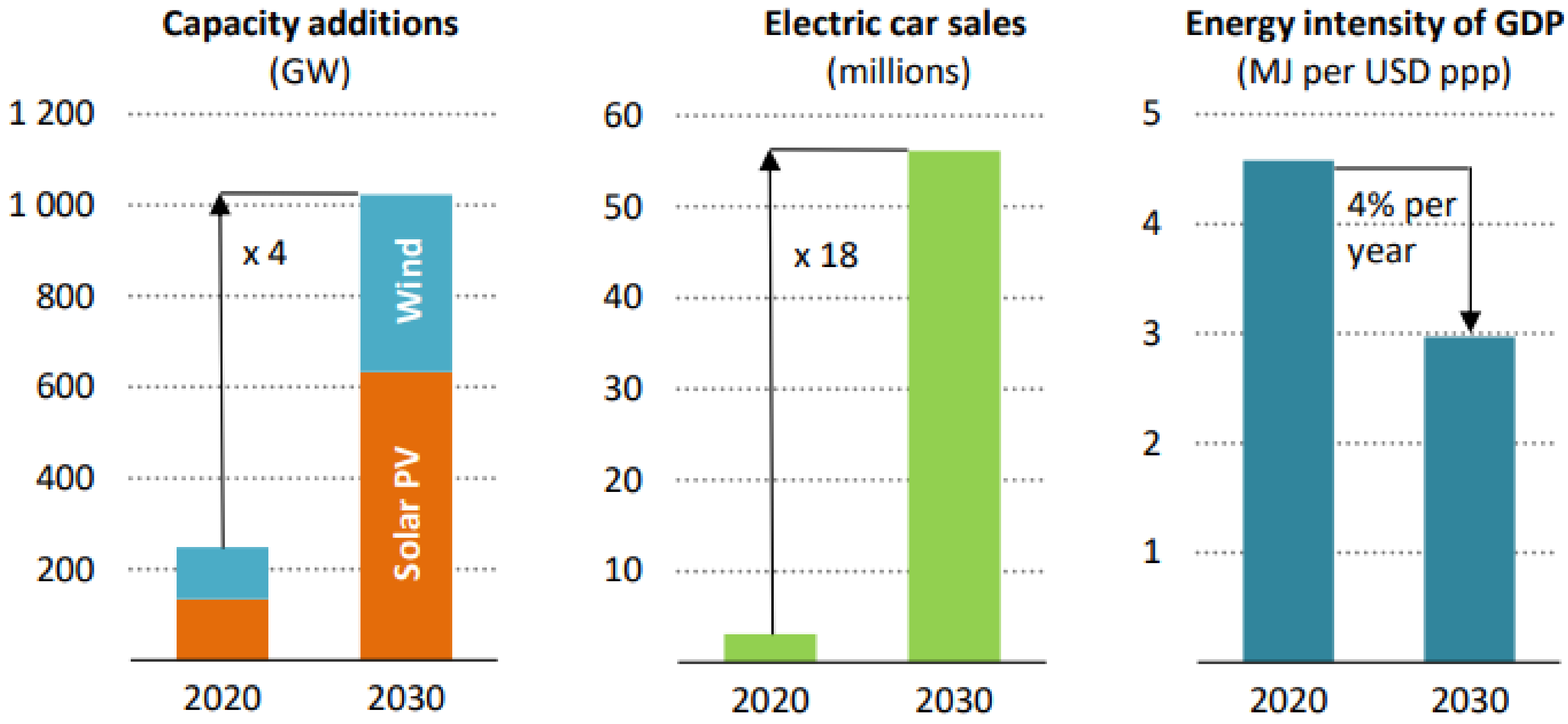
Notes: The electricity generation trajectories for wind and solar PV indicate potential generation, including current curtailment rates. However, they do not project future wind and solar PV curtailment, which may be significant in some countries by 2028. The "Increasing VRE Penetration Leads to Rising Curtailment" section in Chapter 2 discusses some recent trends.

Installed electrolyser capacity and hydrogen production in 2023 and 2030



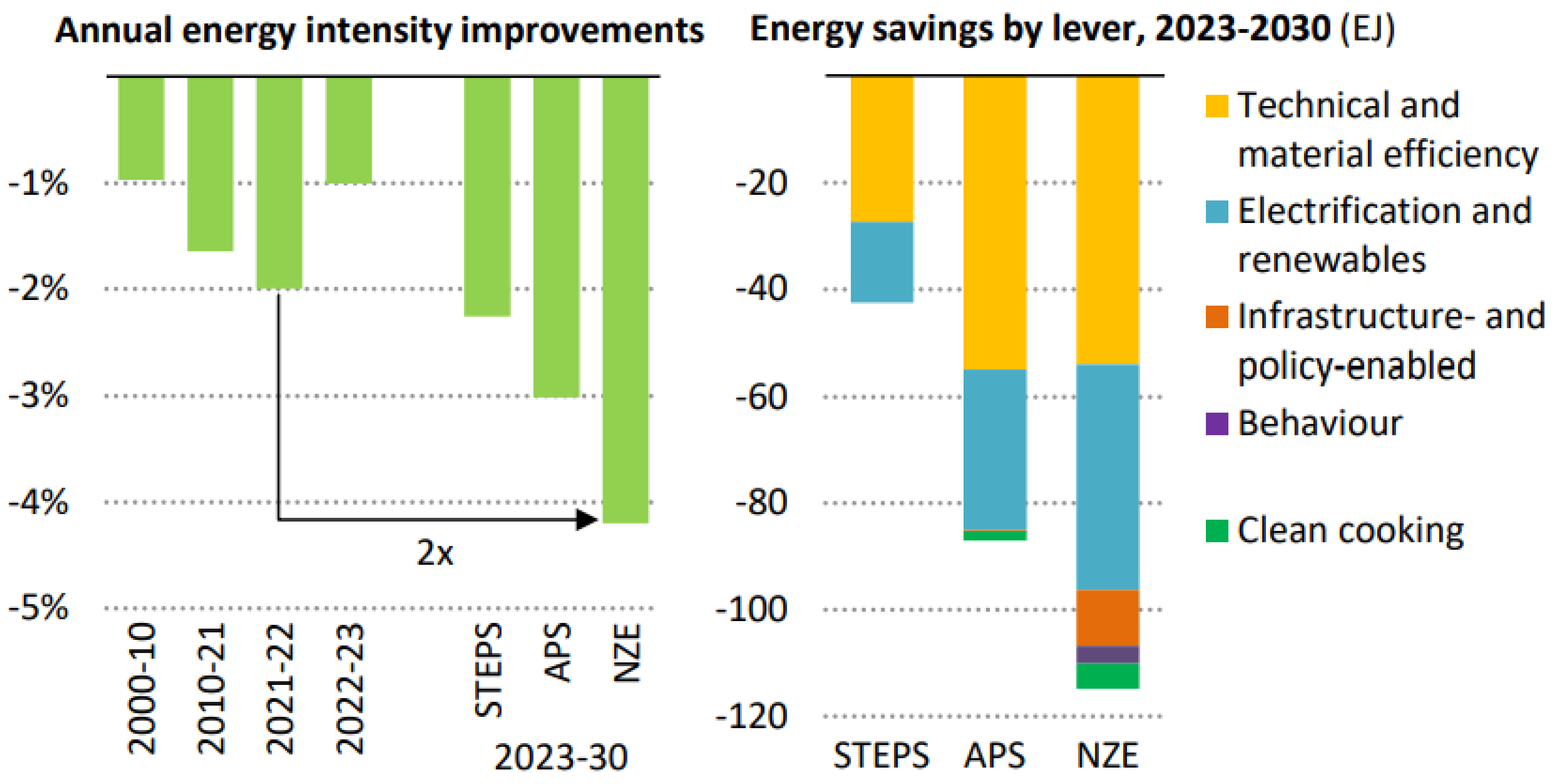
Sources: The 2030 electrolyser forecast is based on bottom-up project assessments and top-down policy and market evaluations. The main source is the IEA's Global Hydrogen Database. Selected projects from this database were included in the forecast based on their status and an assessment of their ability to commission before 2030. The project pipeline also includes additional projects from other sources such as developer announcements, auction winners, and databases on electrolyser orders. Top-down estimates reflect anticipated demand driven by policies and regulations, not tied to specific projects.

Key clean technologies ramp up by 2030 in the net zero pathway



Note: MJ = megajoules; GDP = gross domestic product in purchasing power parity.

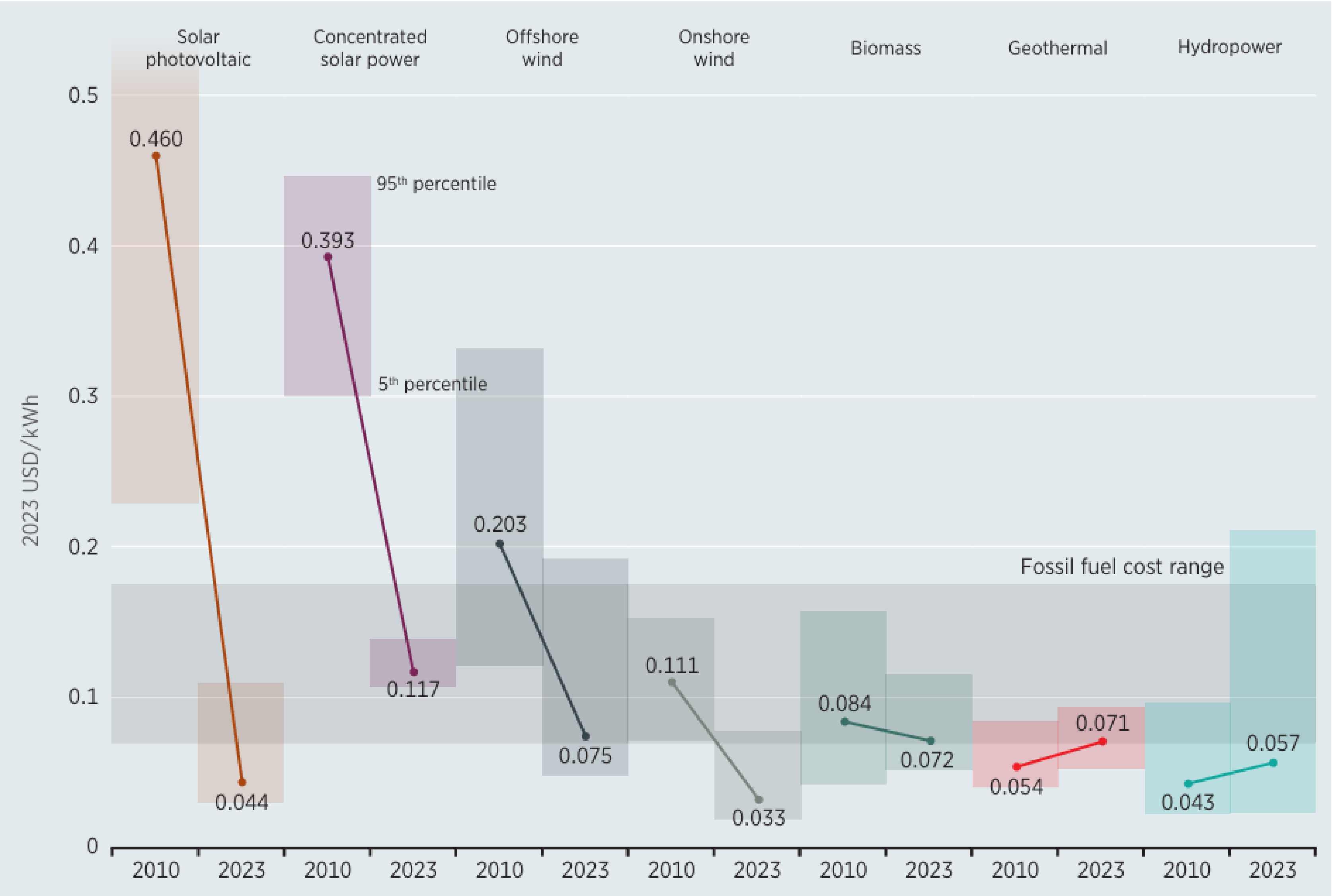
Figure 3.2 ▷ Global annual energy intensity improvements, 2000-2030, and cumulative energy savings by lever and scenario, 2023-2030



Energy intensity improvements this past year fell far short of what is needed to double energy efficiency by 2030; action is needed on a number of fronts to close the gap

Notes: EJ = exajoules. Energy intensity is defined as the ratio of global total energy supply per unit of gross domestic product.

Figure S4 Global LCOE from newly-commissioned, utility-scale renewable power technologies, 2010 and 2023



Note: These data are for the year of commissioning. The thick lines are the global weighted average LCOE value derived from the individual plants commissioned in each year. The LCOE is calculated with project-specific installed costs and capacity factors, while the other assumptions, including weighted average cost of capital (WACC), are detailed in Annex I. The grey band represents the fossil fuel-fired power generation cost in 2023, while the bands for each technology and year represent the 5th and 95th percentile bands for renewable projects.

B.4 Electricity generation technology costs

Table B.4a ▷ Technology costs in selected regions in the Stated Policies Scenario

	Capital costs (USD/kW)			Capacity factor (%)			Fuel, CO_2, O&M (USD/MWh)			LCOE (USD/MWh)			VALCOE (USD/MWh)		
	2023	2030	2050	2023	2030	2050	2023	2030	2050	2023	2030	2050	2023	2030	2050
United States															
Nuclear	5 000	4 800	4 500	90	90	85	30	30	30	110	110	110	110	110	110
Coal	2 100	2 100	2 100	40	20	n.a.	35	35	35	105	165	n.a.	105	160	n.a.
Gas CCGT	1 000	1 000	1 000	55	40	15	35	40	40	60	70	120	55	70	75
Solar PV	1 110	690	480	20	22	23	10	10	10	55	35	25	65	60	60
Wind onshore	1 500	1 430	1 370	42	43	44	10	10	10	40	35	35	45	50	50
Wind offshore	4 060	2 760	1 980	41	46	49	35	25	15	125	80	55	130	90	65
Electricity generation costs										60	70	70			
European Union															
Nuclear	6 600	5 100	4 500	70	75	75	35	35	35	170	135	125	160	120	110
Coal	2 000	2 000	2 000	20	n.a.	n.a.	155	170	180	290	n.a.	n.a.	245	n.a.	n.a.
Gas CCGT	1 000	1 000	1 000	20	10	n.a.	130	110	120	205	260	n.a.	150	155	n.a.
Solar PV	750	480	340	14	14	14	10	10	10	50	35	25	60	65	70
Wind onshore	1 630	1 550	1 490	29	30	30	15	15	10	60	55	50	70	75	75
Wind offshore	3 120	2 280	1 660	50	55	56	15	10	10	70	45	35	70	65	60
Electricity generation costs										130	110	80			
China															
Nuclear	2 800	2 800	2 500	80	70	70	30	30	30	75	80	75	75	80	75
Coal	800	800	800	55	35	15	55	50	50	70	80	120	70	70	90
Gas CCGT	560	560	560	30	20	15	80	70	75	100	105	115	85	70	60
Solar PV	670	410	280	13	13	13	10	10	10	50	30	25	70	70	70
Wind onshore	990	940	900	24	25	26	10	10	10	45	40	40	55	50	55
Wind offshore	2 380	1 720	1 260	32	37	40	20	15	10	90	60	40	95	60	40

Notes: O&M = operation and maintenance; LCOE = levelised cost of electricity; VALCOE = value-adjusted LCOE; kW = kilowatt; MWh = megawatt-hour; CCGT = combined-cycle gas turbine; n.a. = not applicable. Cost components, LCOE and VALCOE figures are rounded. Lower values for VALCOE indicate improved competitiveness.

Sources: IEA analysis; IRENA (2024).

Table A.20: Nuclear generation (TWh)

				Stated Policies			Announced Pledges		
	2010	2022	2023	2030	2035	2050	2030	2035	2050
World	**2 756**	**2 684**	**2 765**	**3 266**	**3 746**	**4 460**	**3 462**	**4 332**	**6 055**
North America	935	902	908	919	948	997	944	1 003	1 250
United States	839	804	808	820	831	863	831	878	1 101
Central and South America	22	23	24	33	51	70	34	54	77
Brazil	15	15	15	24	37	45	24	37	41
Europe	1 032	749	766	779	765	834	795	802	1 172
European Union	854	609	616	617	564	630	617	600	860
Africa	12	10	9	24	44	68	29	52	103
Middle East	0	29	40	46	80	108	48	113	220
Eurasia	173	226	223	219	246	315	219	255	401
Russia	170	223	220	216	239	305	216	247	383
Asia Pacific	582	746	796	1 245	1 612	2 067	1 393	2 054	2 832
China	74	418	435	623	898	1 159	737	1 258	1 720
India	26	46	48	128	201	337	128	206	345
Japan	288	56	88	202	210	206	226	242	289
Southeast Asia	0	0	0	0	0	41	0	24	98

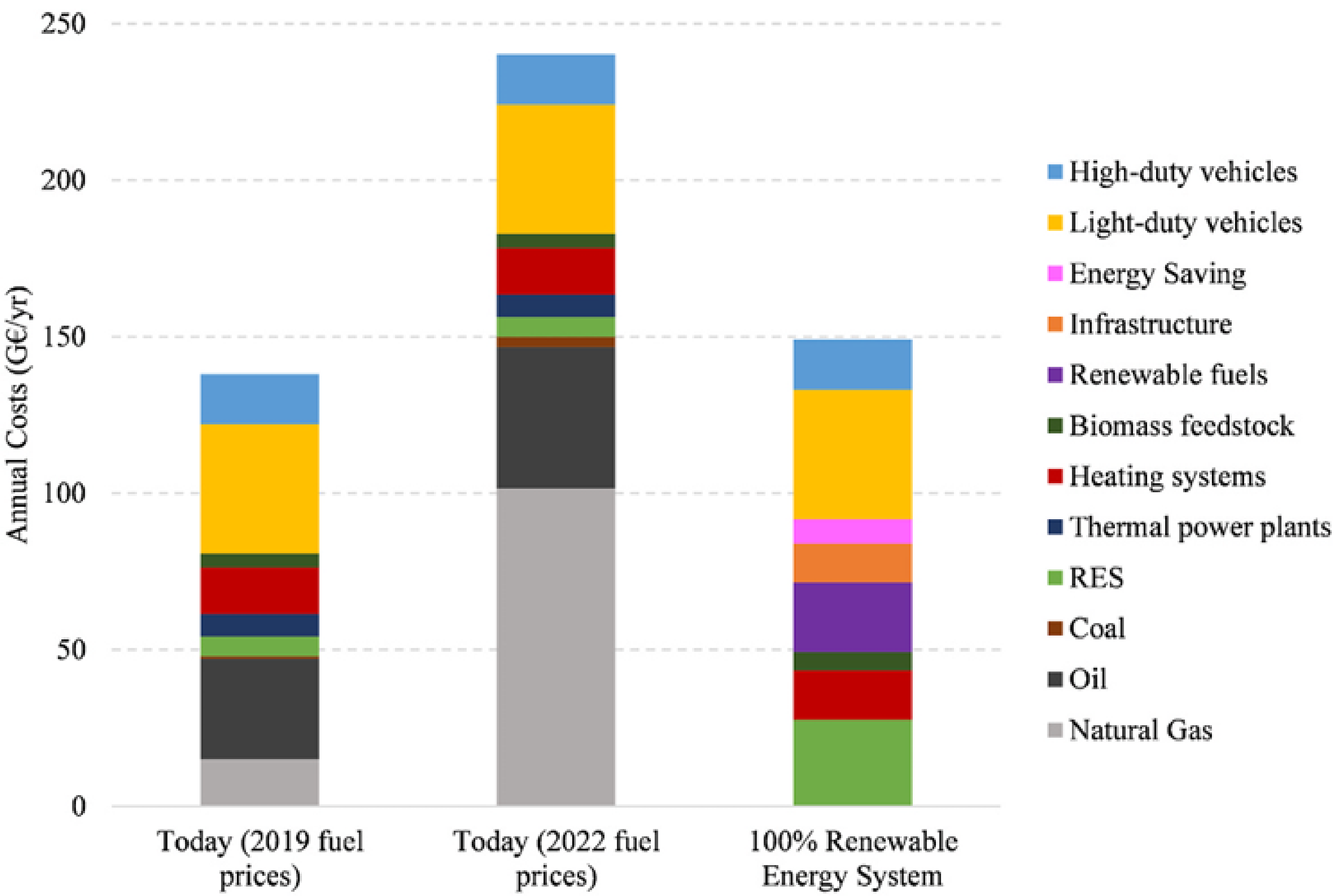


Fig. 7. Annual costs of the current energy system with the 2019 fuel prices, with 2022 fuel prices and for the 100 % RE Italy scenario.

Socio-economic implications of implementing a carbon-neutral energy system: A Green New Deal for Italy , L M Pastore , L de Santoli, Energy 322 (2025) 135682

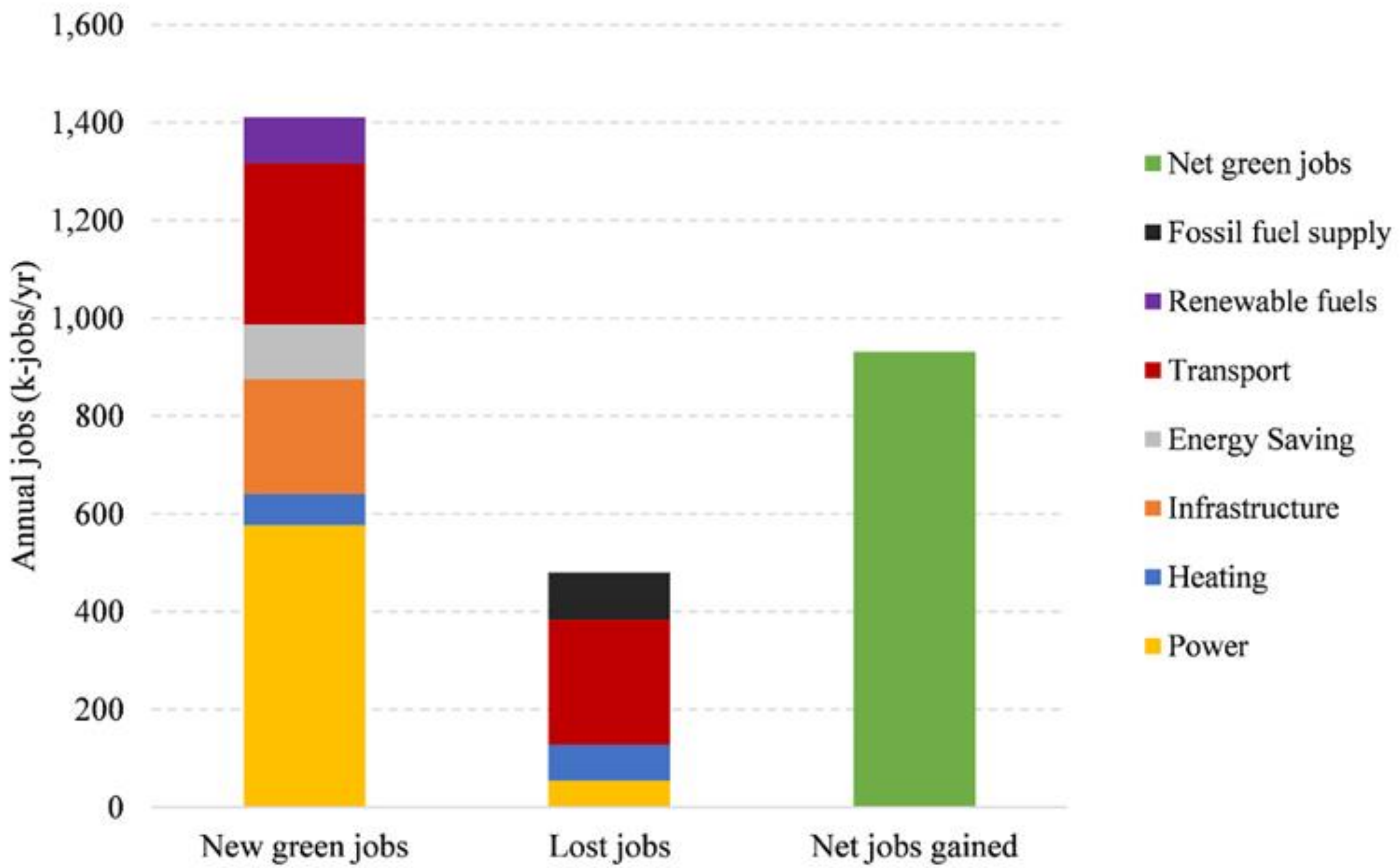


Fig. 10. New green jobs, jobs lost, and net jobs gained in the 100 % RE Italy scenario.

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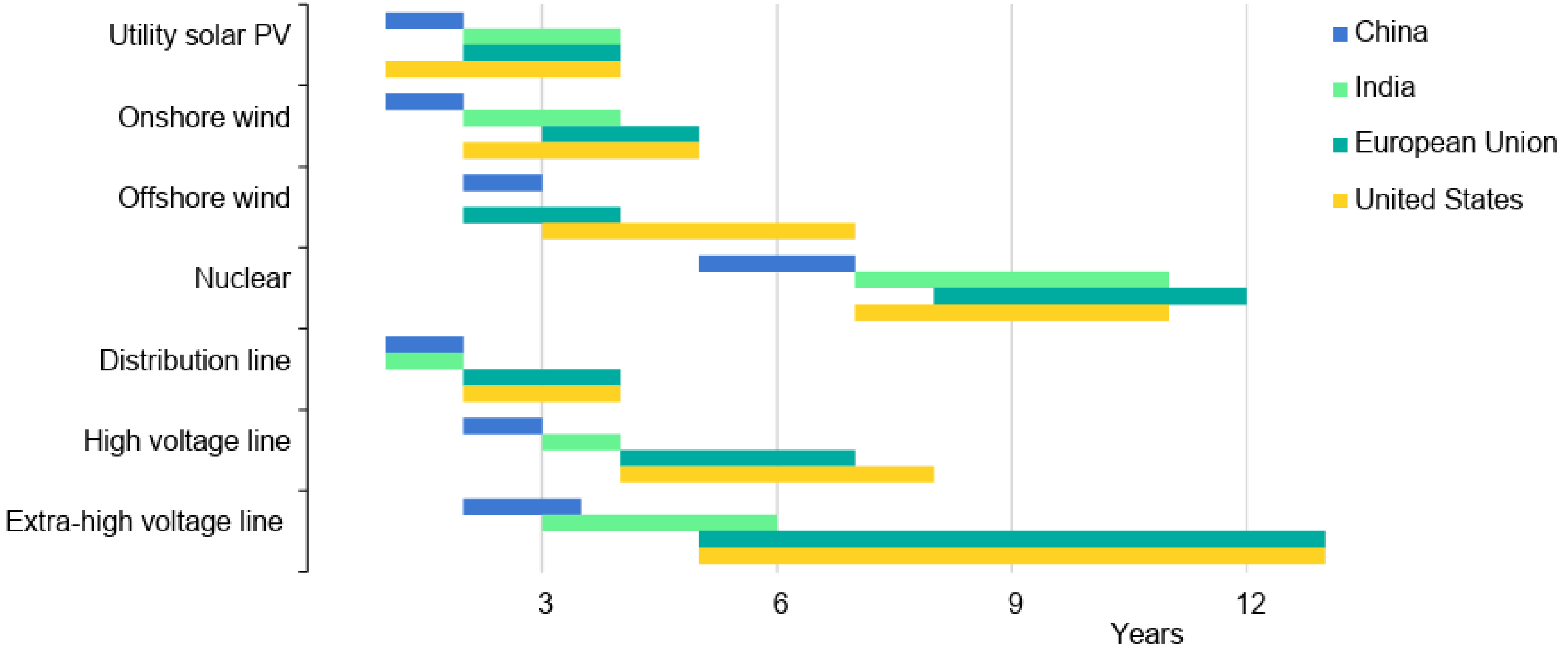
Figure 1.6 Typical development time for selected power plants and electricity grids



The Path to a New Era for Nuclear Energy, IEA, 2025

Conclusioni

- ❑ Importanza delle analisi di scenario di decarbonizzazione con riferimento ai costi e tempi di ogni tecnologia e alla loro integrazione

- ❑ Importanza delle strategie di standardizzazione dei progetti, semplificazione dei processi autorizzativi e garanzia di un quadro normativo stabile

- ❑ Definizione del quadro finanziario legato alle politiche industriali

- ❑ I paesi della EU27 e gli obiettivi del 2030

- ❑ Attenzione ai Data Center e all'IA: al 3% (2023), 3-4% (proiezione al 2030, 1200 TWh/anno nel mondo, 150 in Europa).

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