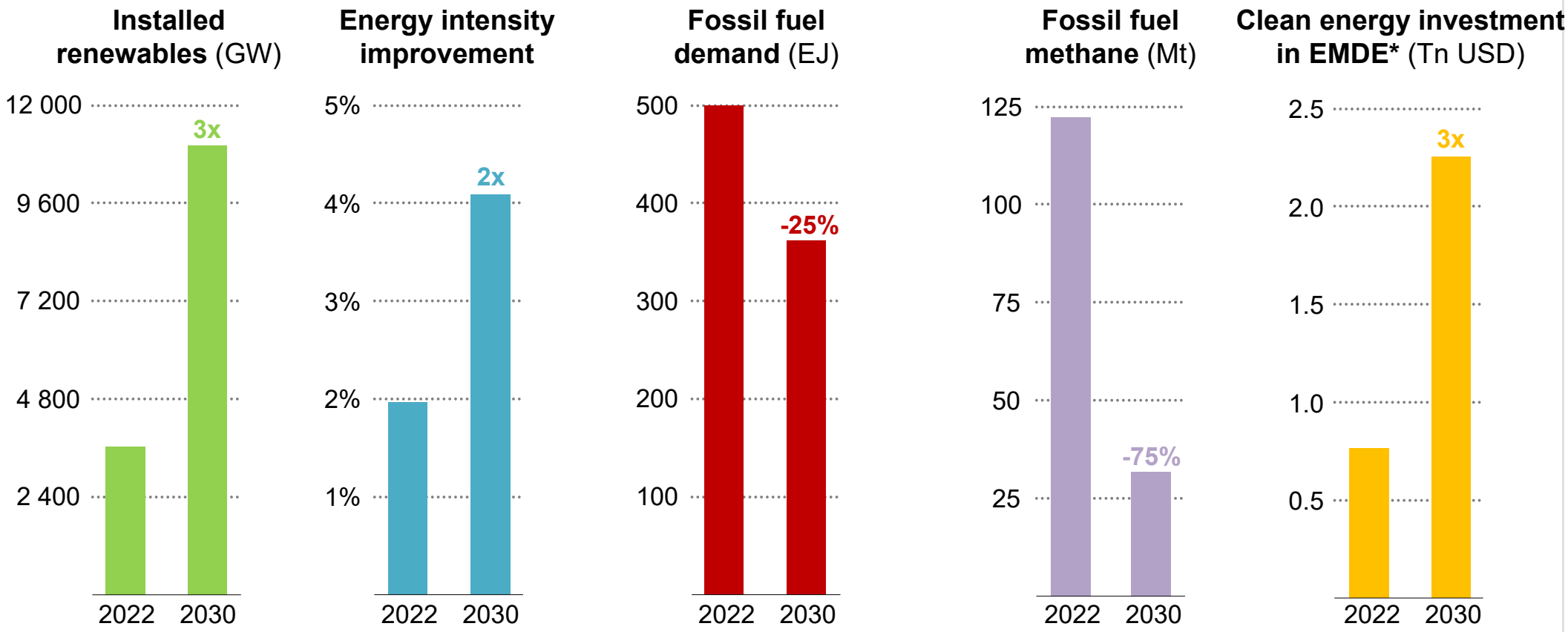
International Energy Agency

Clean energy technologies for net zero

Dr Timur Gül, Chief Energy Technology Officer, International Energy Agency

18 April 2024, APERC Annual Conference, Japan

Five pillars to keep 1.5 °C alive



A comprehensive energy package for COP28 needs to drive the growth in clean energy, support emerging and developing economies in the transition, and recognise the need to reduce fossil fuel demand

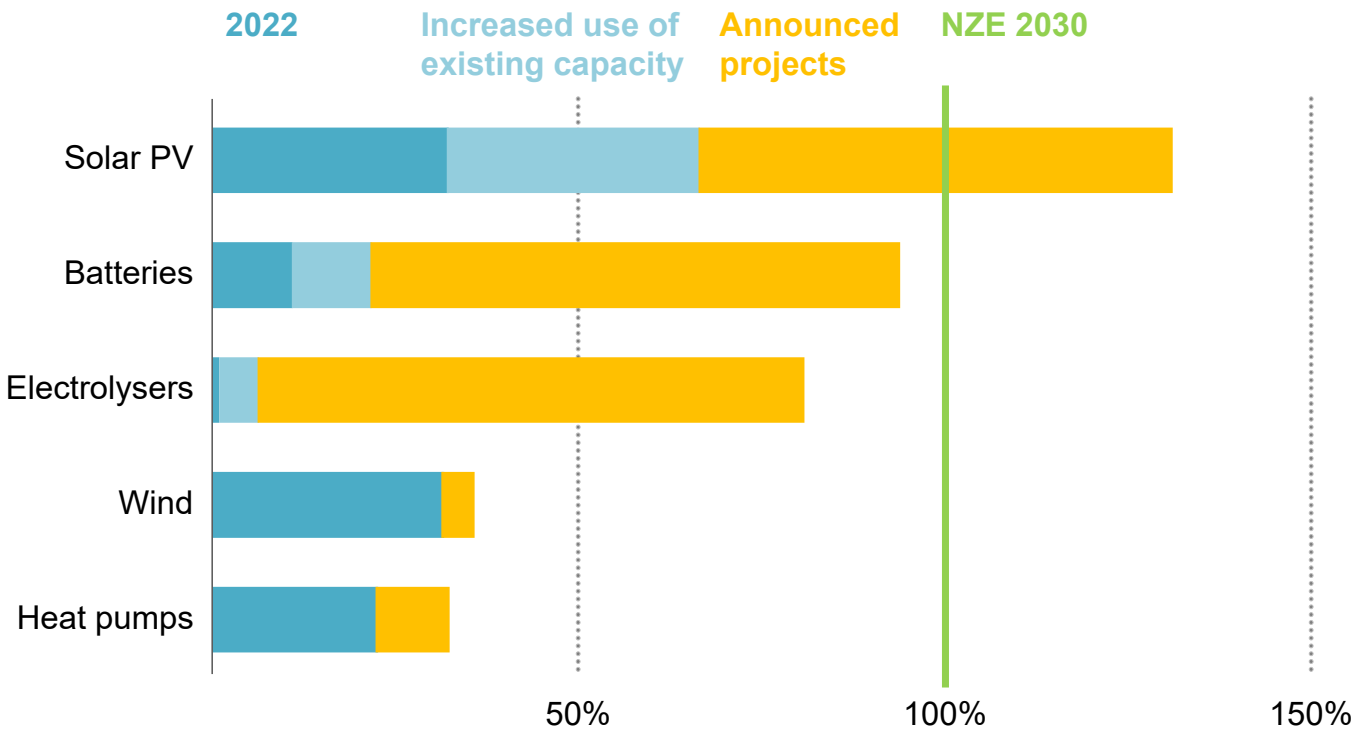
IEA 2024. CC BY 4.0.

Source: IEA (2023), World Energy Outlook 2023

* EMDE = emerging market and developing economies

Clean technology supply chains present an industrial opportunity

Announced manufacturing project throughput and deployment of key technologies in the NZE Scenario

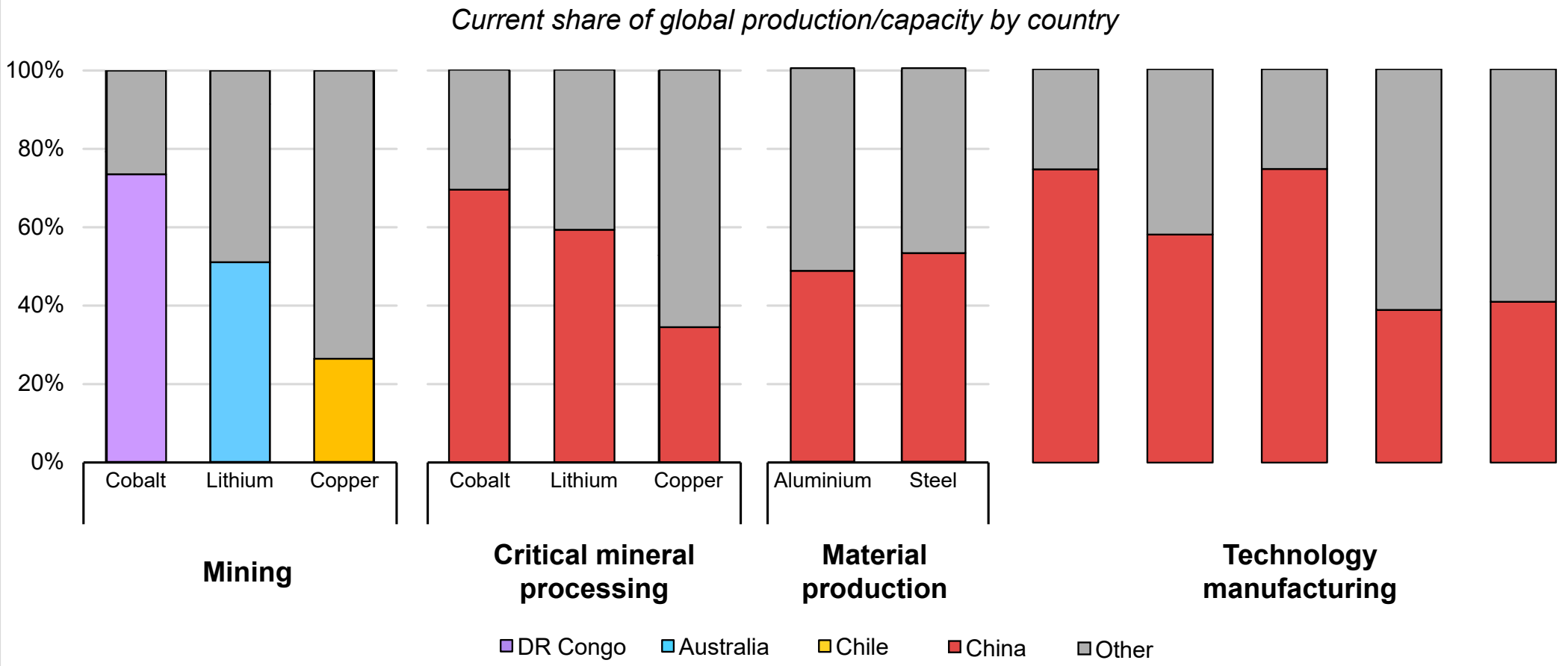


If all announced projects proceed, solar PV manufacturing will exceed the 2030 level needed in the NZE Scenario, and batteries manufacturing will get very close. Other technologies see larger gaps.

IEA 2024. CC BY 4.0.

Source: IEA (2023), Net Zero Roadmap: A Global Pathway to Keep the 1.5 °C Goal in Reach

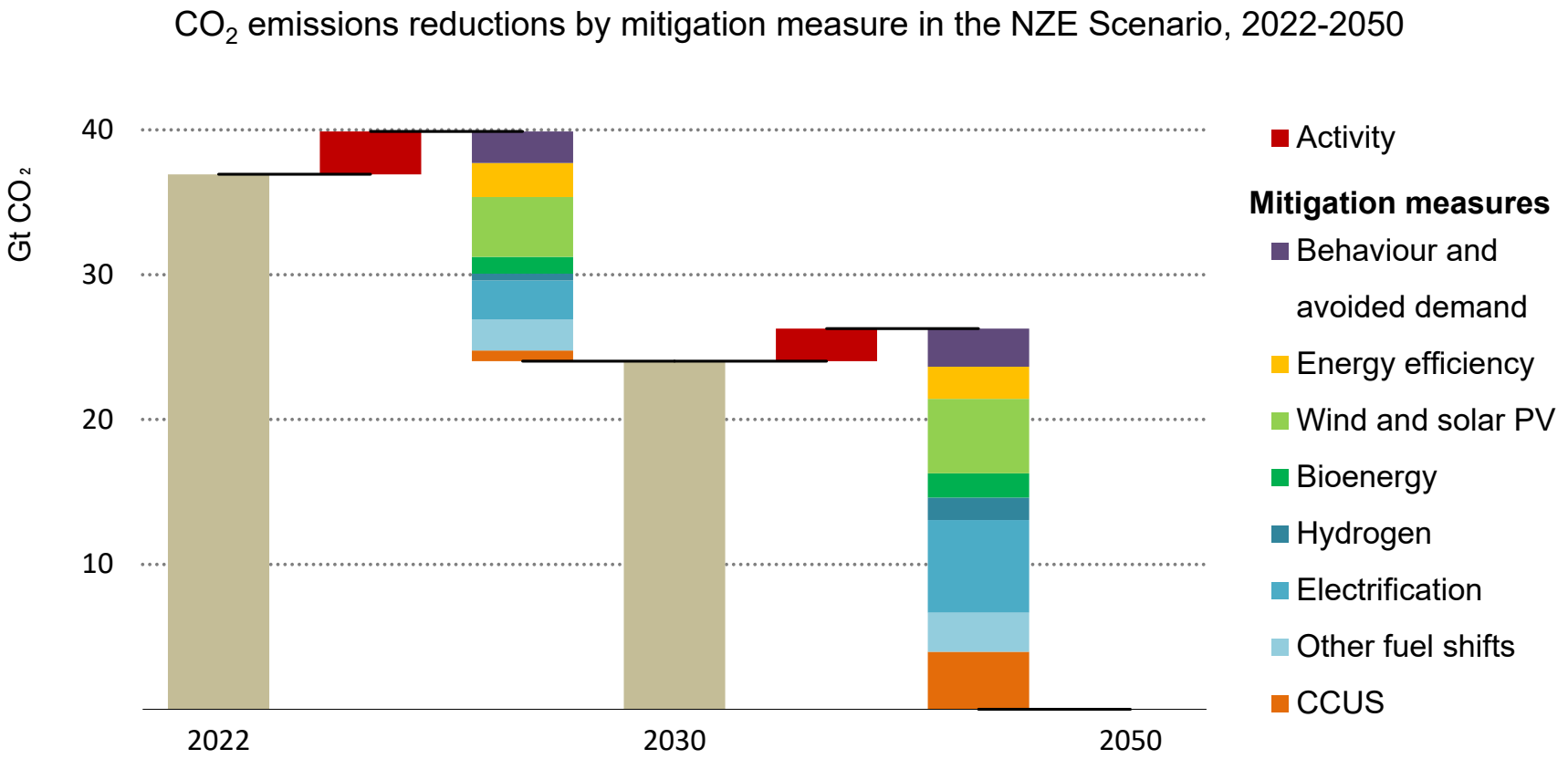
Clean technology supply chain concentration risks extend beyond mining



IEA 2024. CC BY 4.0.

Source: IEA (2023), Energy Technology Perspectives 2023

A broad range of clean energy technologies are needed



Renewables, energy efficiency and end-use electrification contribute 80% of reductions by 2030. The role of hydrogen and CCUS is more important between 2030 and 2050.

IEA 2024. CC BY 4.0.

Source: IEA (2023), Net Zero Roadmap: A Global Pathway to Keep the 1.5 °C Goal in Reach

Many clean energy technologies are not yet on track with net zero

Cross-cutting

Energy system overview

- Energy efficiency
- Behavioural changes
- Electrification
- Renewables
- Bioenergy
- Hydrogen
- Carbon capture & storage
- Innovation
- Digitalisation
- International collaboration

Technology deep dives

- Direct air capture
- Bioenergy with carbon capture & storage
- CO_2 capture & utilisation
- Electrolysers

Infrastructure deep dives

- CO_2 transport & storage
- Data centres & transmission networks
- District heating

Electricity

Technology deep dives

- Coal-fired electricity
- Gas-fired electricity
- Solar PV
- Wind
- Hydro
- Nuclear
- Demand response

Infrastructure deep dives

- Grid-scale storage
- Smart grids

Oil & natural gas supply

Subsectors

- Methane emissions from oil and gas operations
- Flaring

Low-emission fuel supply

Subsectors

- Biofuels supply

Transport

Subsectors

- Cars and vans
- Trucks and buses
- Rail
- Aviation
- International shipping

Technology deep dive

- Electric vehicles

Industry

Subsectors

- Steel
- Chemicals
- Cement
- Aluminium
- Paper
- Light industry

Buildings

Subsectors

- Heating
- Space cooling
- Lighting
- Appliance & equipment

Technology deep dives

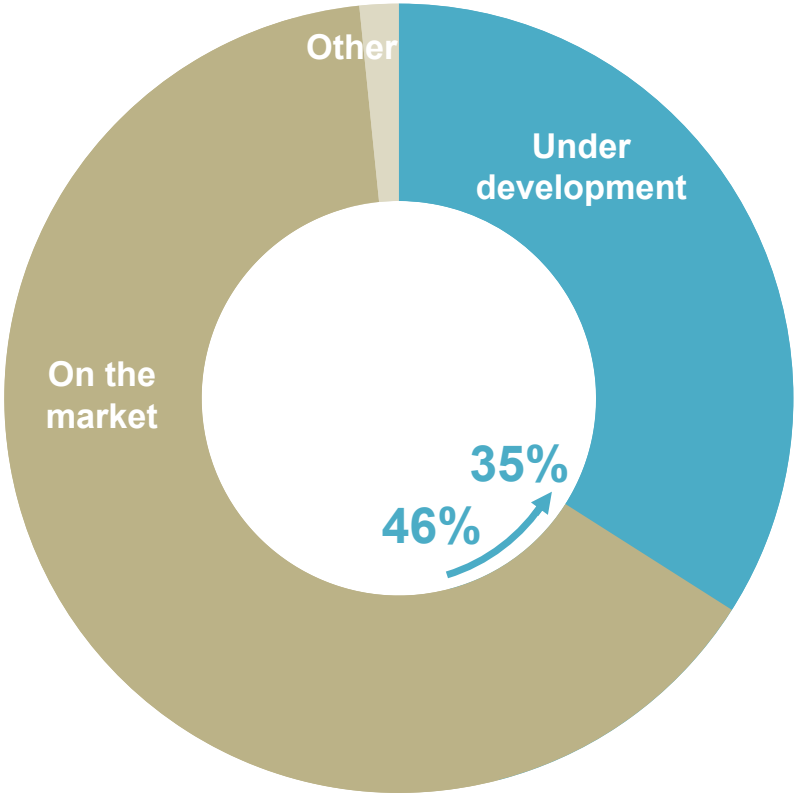
- Buildings envelope
- Heat pumps

IEA 2024. CC BY 4.0.

Source: IEA (2023), Tracking Clean Energy Progress 2023

Innovation is already delivering new tools and lowering their costs

CO_2 emission reductions by technology maturity in 2050 in the NZE Scenario of **2023**



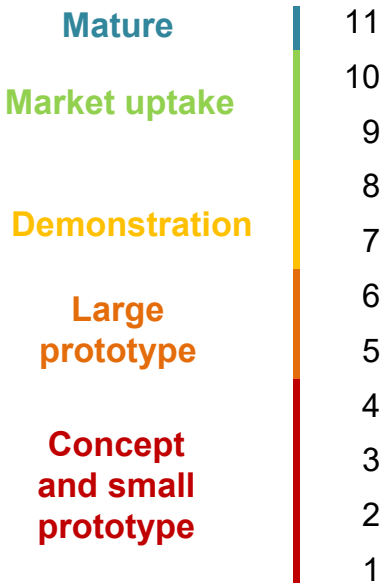
Clean energy innovation has been accelerating in the last few years, yet more RD&D is needed to unlock the next generation of low-emissions technologies.

IEA 2024. CC BY 4.0.

Source: IEA (2023), Net Zero Roadmap: A Global Pathway to Keep the 1.5 °C Goal in Reach

Tracking progress for 550+ concepts in the ETP Clean Tech Guide

Technology readiness level over time for selected clean energy technologies



Important innovations are taking place every year, but there remain significant opportunities for clean energy technology development to put the world on track with a net zero pathway.

IEA 2024. CC BY 4.0.

Source: IEA (2023), Net Zero Roadmap: A Global Pathway to Keep the 1.5 °C Goal in Reach