

Agora
Energiewende



Emerging technologies for the energy transition

Input for CASE discussions

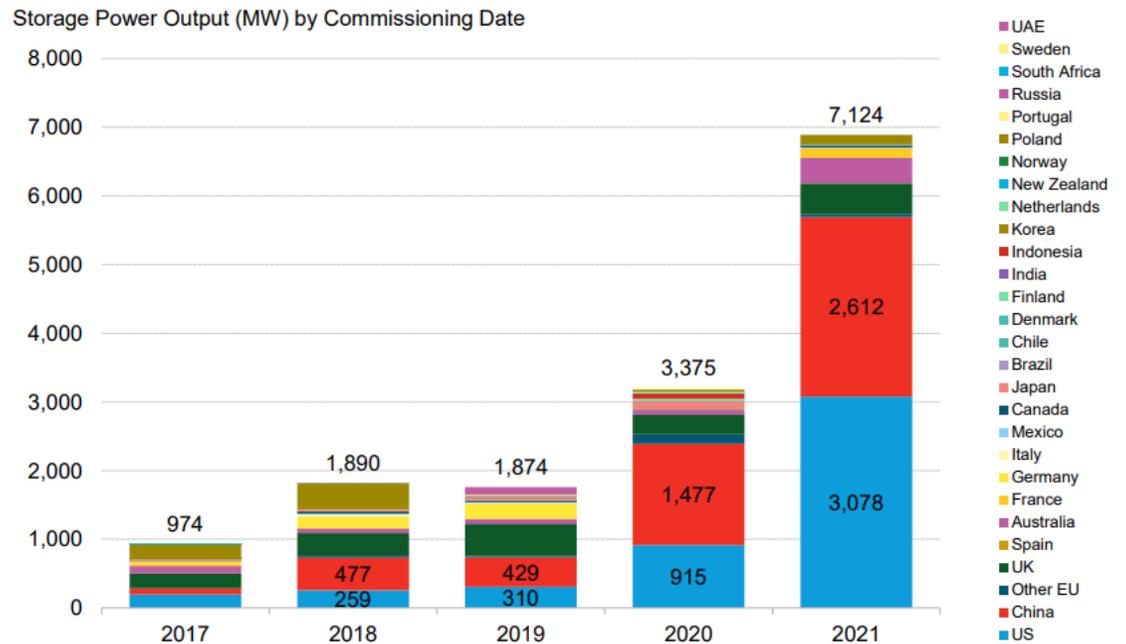
Mentari Pujantoro

MARCH 2023

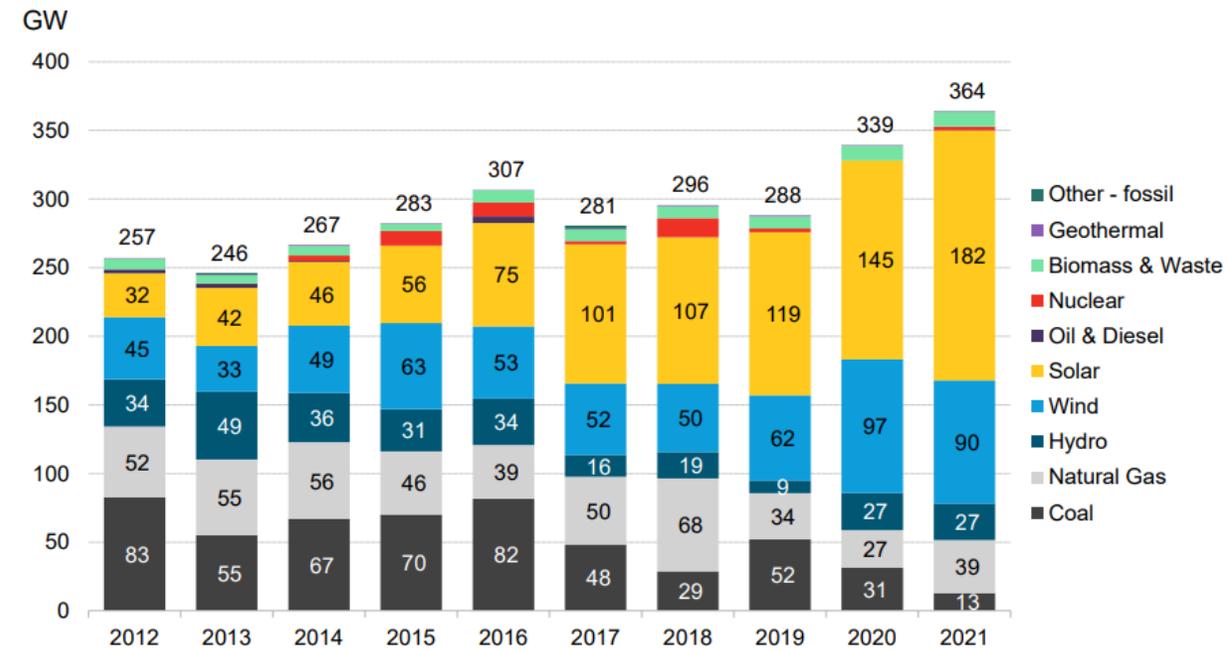


The world enters the age of clean technology manufacturing

Annual newly commissioned utility-scale battery storage capacity in CEM nations



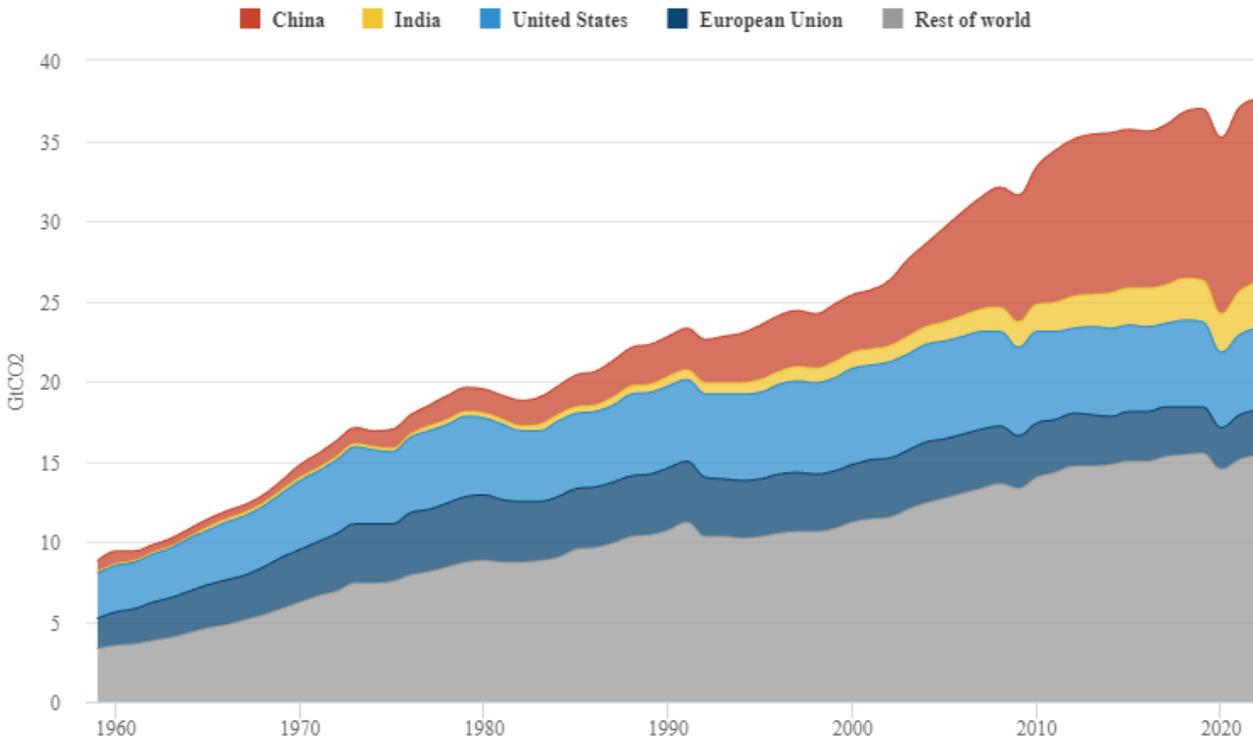
Annual new power-generating capacity additions, global



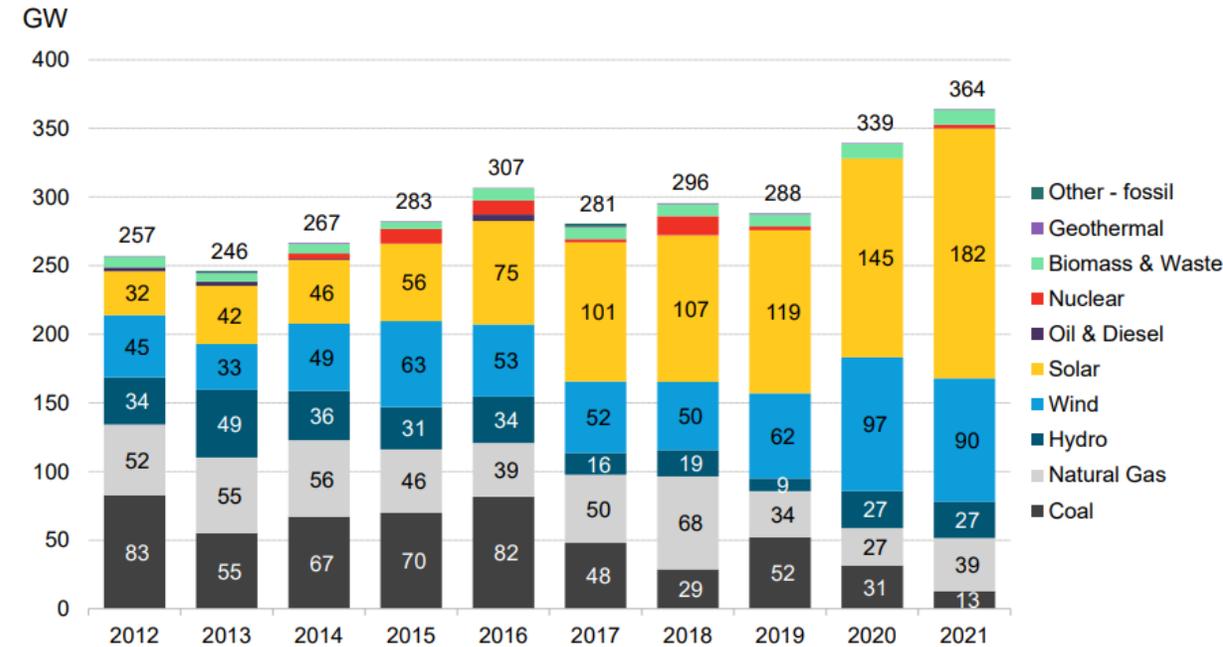
Source: Bloomberg (2022)

Global CO2 emissions reached a new peak in 2022, driven by growing energy demand and increasing fossil fuel consumption.

Global CO2 emissions from fossil fuels by region (1959-2022)



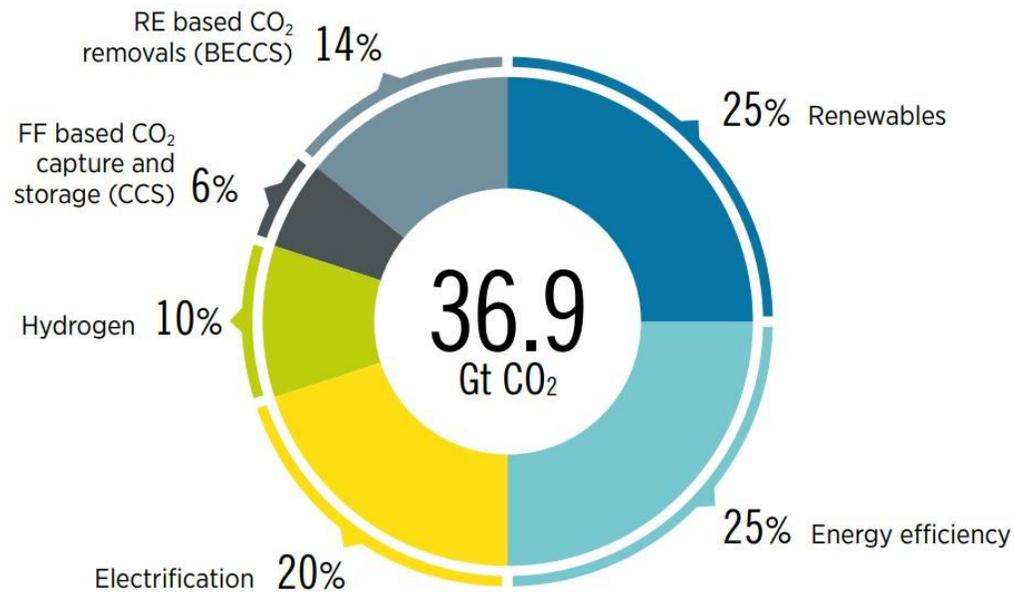
Annual new power-generating capacity additions, global



Source: Global Carbon Project (2022), World Economic Forum (2022), Bloomberg (2022)

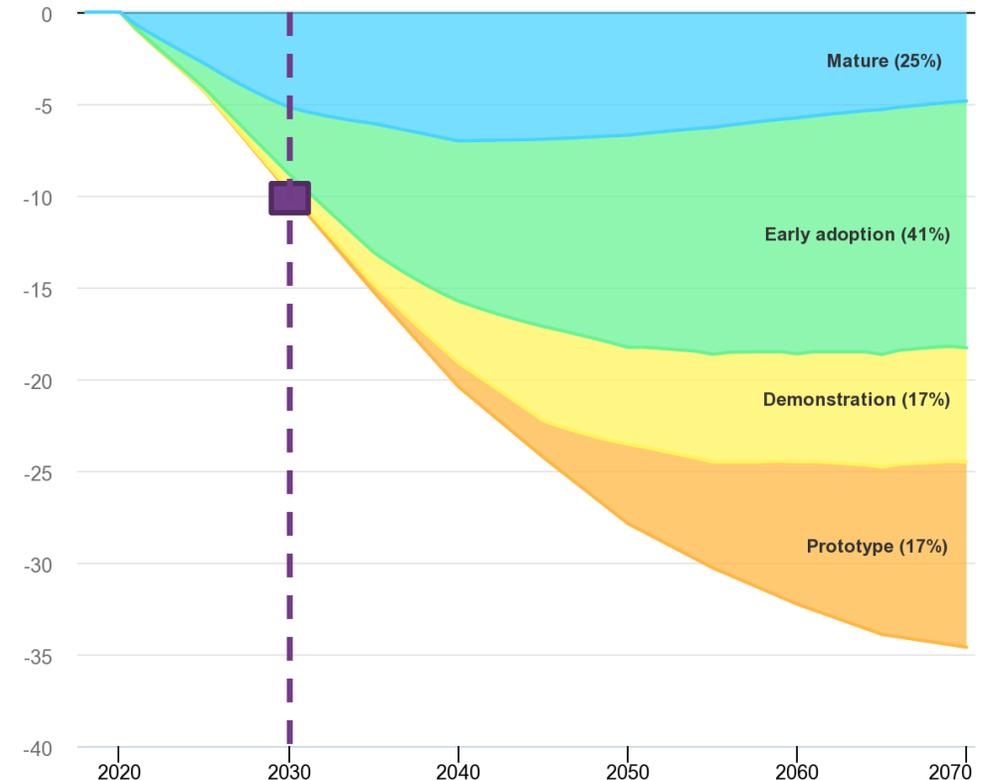
Renewables, efficiency and renewables-based electrification provide 70% of worldwide emission reductions needed to reach net-zero

Share of emission reduction measures to reach net zero



Source: IRENA, 2021

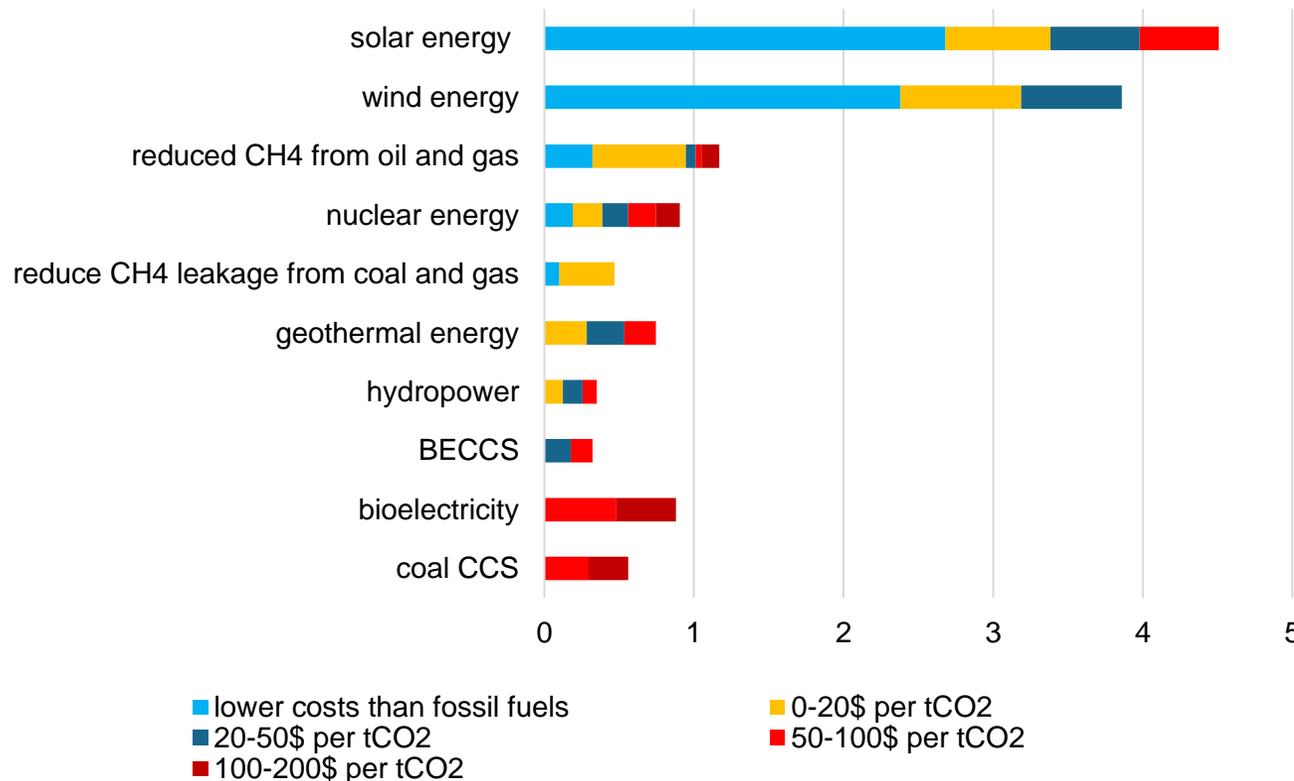
Technology diffusion based on their maturity level



Source: IEA, 2021

Beware of false promises! Some low-carbon power generation technologies (nuclear, coal co-firing, CCS) are uncertain (economically, technologically and sustainably)

Global abatement potential in the energy sector (GtCO₂eq) by 2030 of various energy transition technology



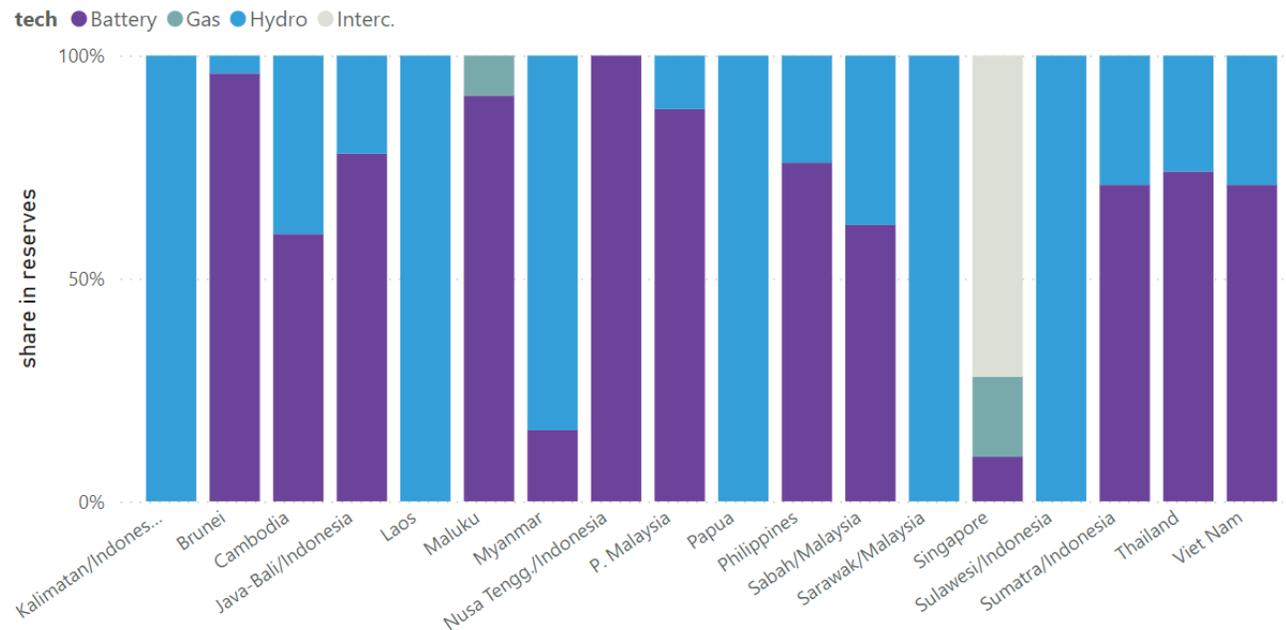
Issues to consider:

- Nuclear: waste management, safety and security risk, complex institutional framework, sourcing of uranium doesn't contribute to energy security, long lead time (>10 years), not flexible
- CCS: not net zero compatible, doesn't capture all emissions, need to solve CO₂ storage issue
- Ammonia cofiring: fuel sourcing, 100% emission reduction require 100% blending

Identifying reasonable roles for emerging technologies in a renewables-driven system.

Investing in flexible technologies are key!

Hydropower and batteries are sufficient to provide operating reserves in most countries by 2050



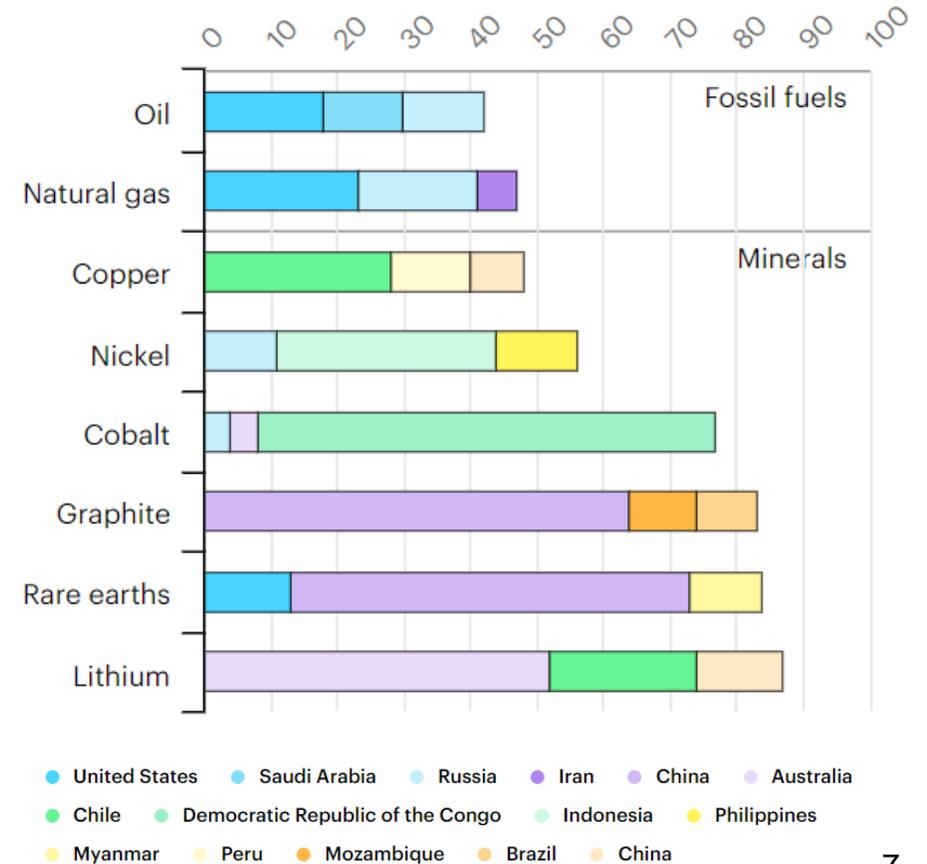
- Several RES integration and electrification technologies are already mature or under development, including flexible grids, storage and green fuels.
- As of 2030, battery will likely be a cost-effective option in a few countries and achieve large scale maturity in 2040.
- Investing in CCS or H2 should consider flexible operation principles (e.g., inertia provider).
- Each country should develop its vision toward modernising and building grid infrastructure with a trade-off between central infrastructures (transmission grids) and decentralized solutions. (Distribution grids lead time 2 years vs transmission line 10 years)

International partnership: Every country should define its role and participation in the value chain of clean energy technologies

Announced projects for clean energy technologies are concentrated in several countries



Share of top producing countries in extraction of selected minerals and fossil fuels



Key messages

- The world enters the age of clean energy technology manufacturing: Ramping up clean energy technologies contribute to both energy security, competitiveness in the global economy, and net zero transition.
- Renewables, efficiency, and electrification (fuel switch) provide the majority of emission reduction to net-zero. Several options are already mature, but others (H2, advanced grid integration concepts) are still in emerging and prototyping phase.
- Identifying reasonable roles for emerging technologies in a renewables-driven system. Investing in flexible technologies are key - battery storage (and hydropower), grid integration technologies, H2/clean gas for adequacy and inertia.
- A country like Indonesia can play a key role in the value chain of some energy transition technologies (such as batteries and EV). Participating in the global value chain should consider resource availability, human capacity and industrial priorities (technology transfer vs technology leadership).

Thank you





- **Think Tank and Policy Lab**
- **>100 energy transition experts**
- **Independent** and non-partisan with diverse financing structure
- **Our vision:** a prosperous and **carbon-neutral global economy** by 2050
- **Science-based solutions and policy advise** to deliver **clean power, heat, industries, and agriculture** – in Germany, Europe, and globally
- **Programs in ~20 countries**, with offices in Berlin, Brussels, Beijing and Bangkok
- Partner of the **CASE project** (Clean, Affordable and Secure Energy System for Southeast Asia)

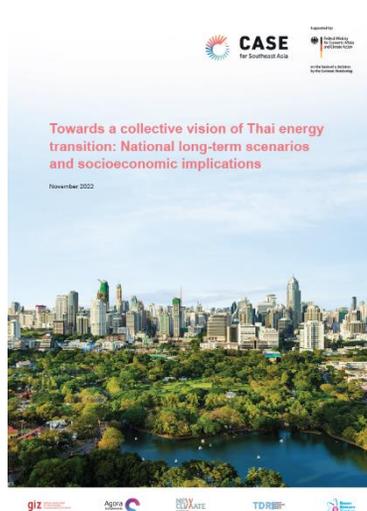
Together with its partners around the globe, Agora has developed several long-term technology and policy roadmaps to reach net-zero.



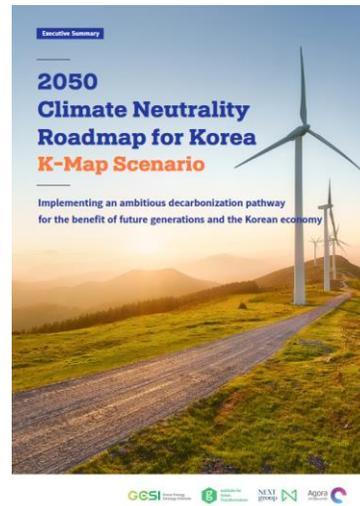
Turkey



Thailand



South Korea



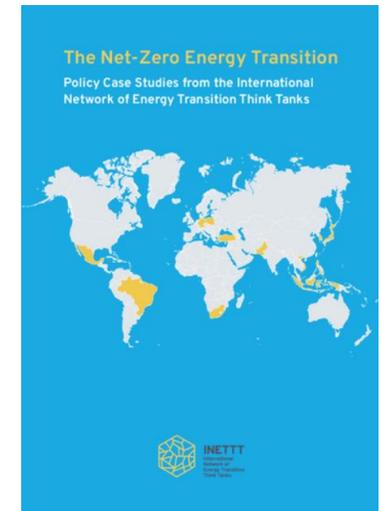
Japan



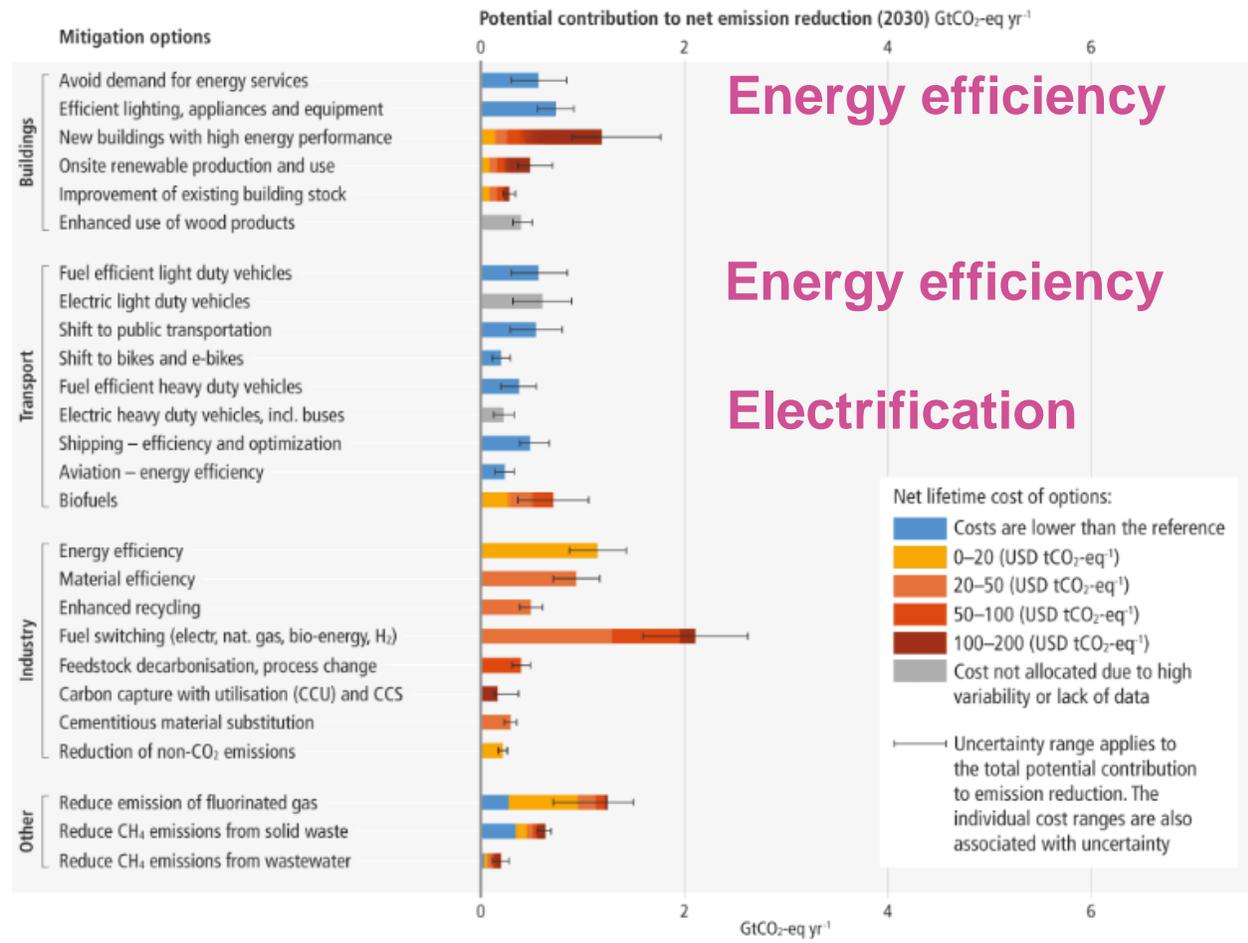
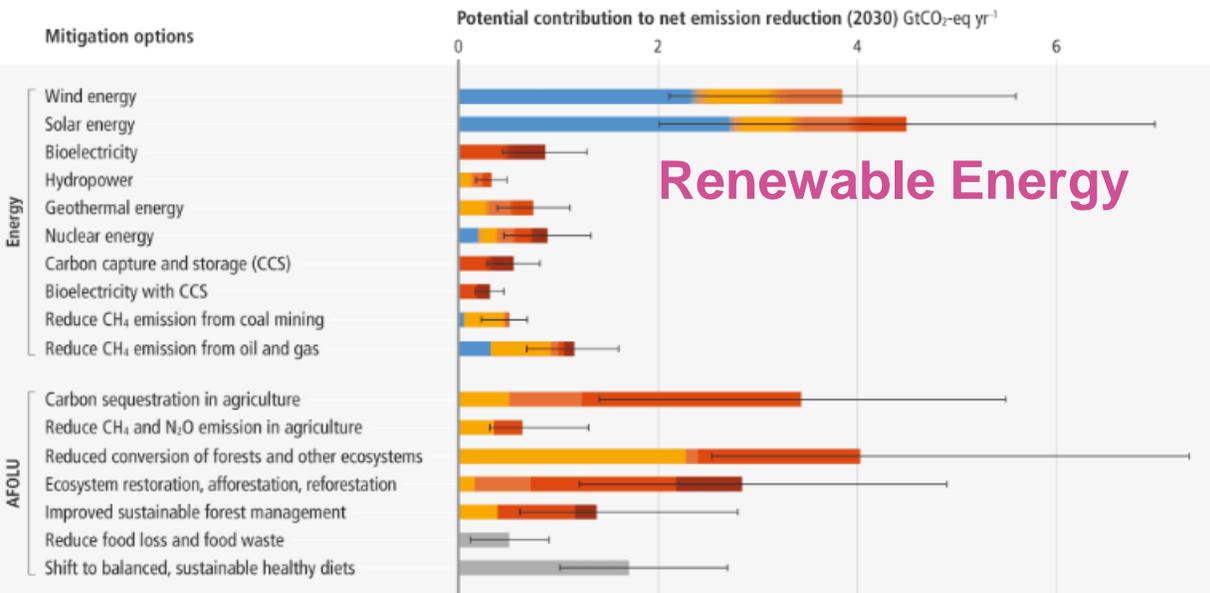
Indonesia



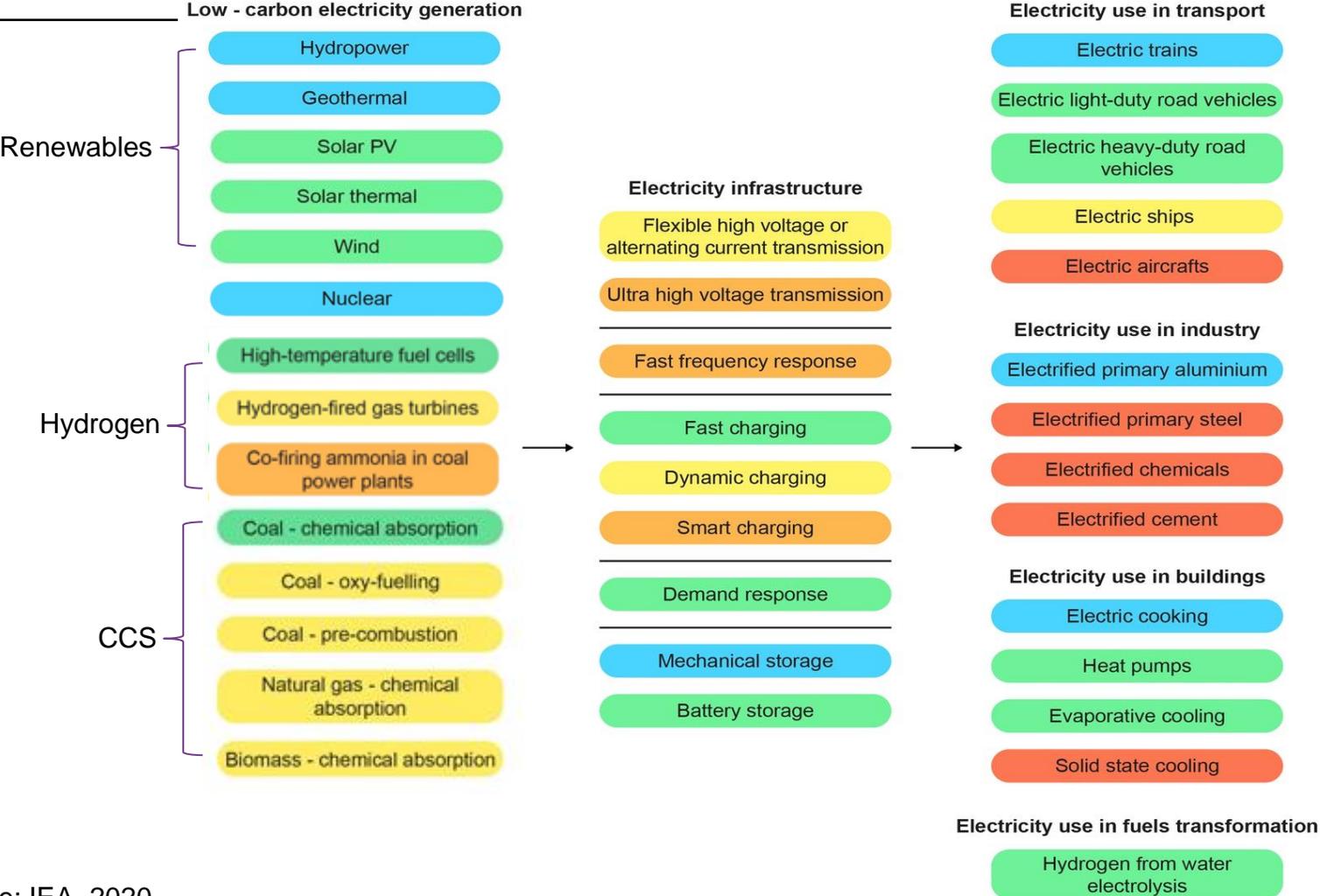
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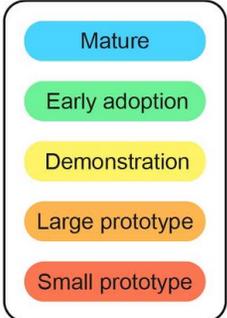
Near-term mitigation strategy with low cost and high potential: RE, EE, Electrification



Renewable energy as key priority in mitigating power sector emission



- Various low-carbon technologies are already at mature stage and commercially available, showing some low-hanging fruit opportunities based on electrification for emission reduction.
- Readiness of low-carbon technologies in the electricity value chain drives the energy transition towards net-zero emissions (focus in electricity)

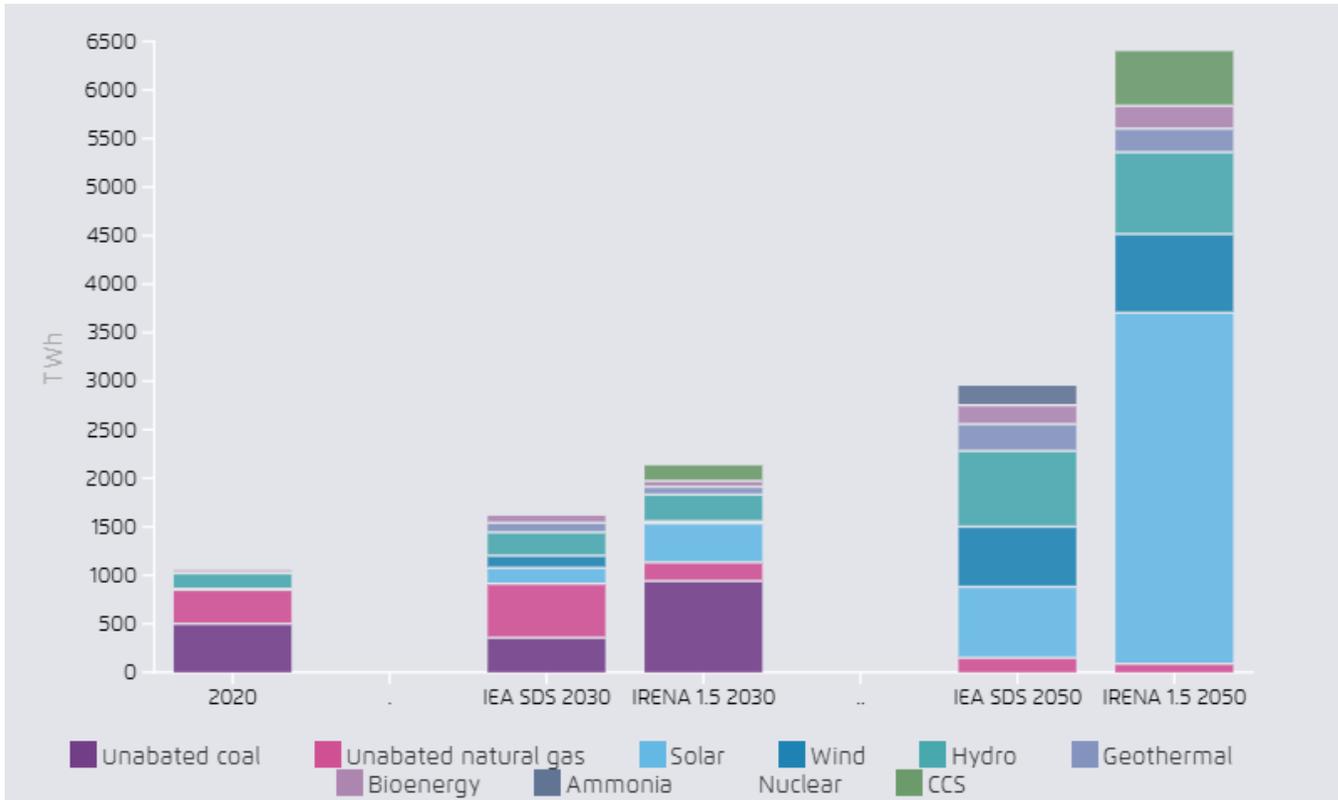


Source: IEA, 2020

How we supply electricity? Clear direction on Ramp up RE.

However, complex outlook on the size of nuclear, CCS, and cofiring.

Regional energy scenarios (2030 and 2050)



Regional climate scenarios (2050 and 2070)

