TotalEnergies

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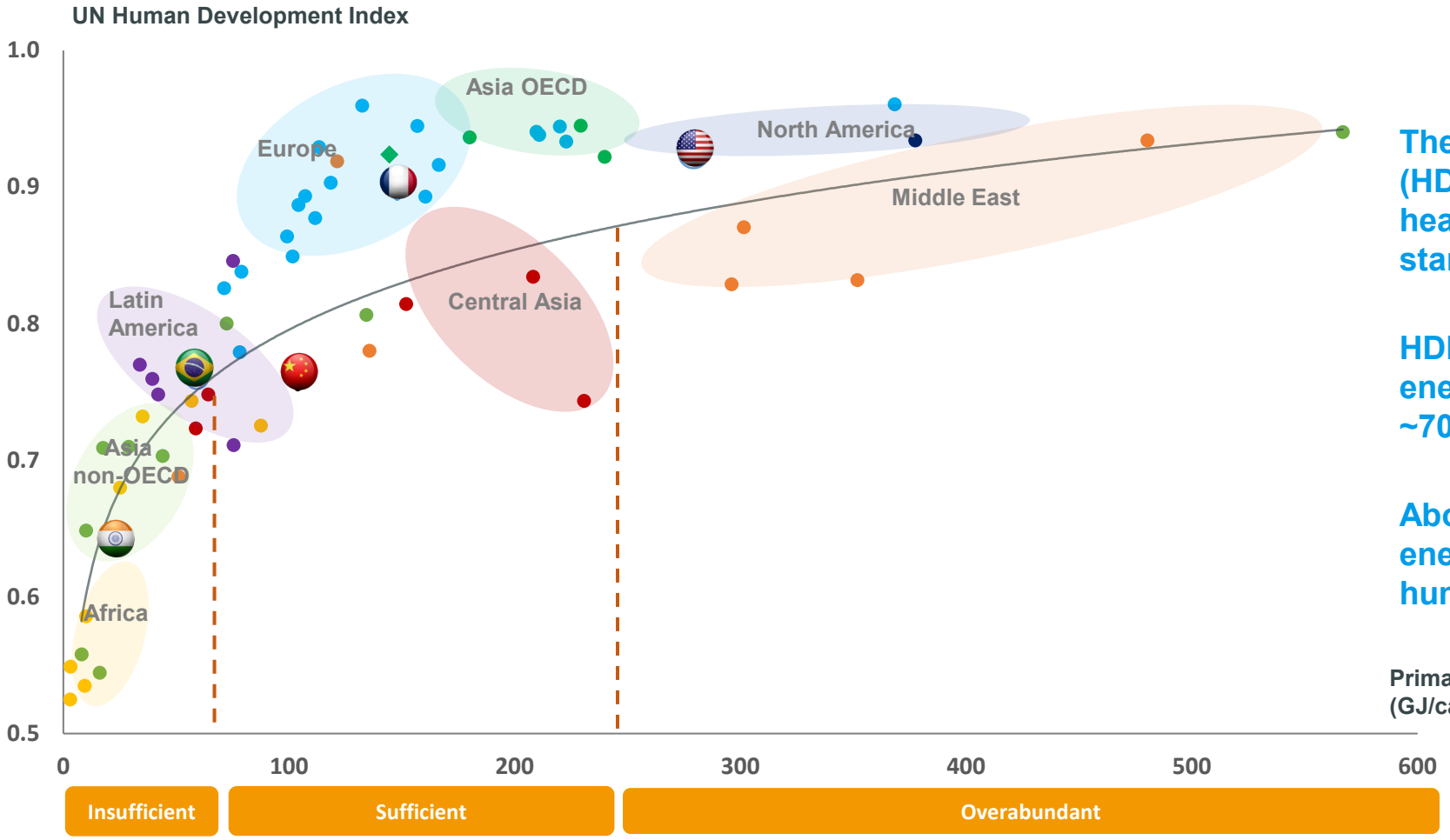
Energy Outlook 2024

Riyadh, February 19, 2025

Energy access is essential to human development



The UN Human Development Index (HDI) measures well-being in terms of health, education and living standards (GDP)

HDI increases dramatically with energy access for low levels (below ~70 GJ/cap)

Above ~240 GJ/cap incremental energy does not significantly improve human development

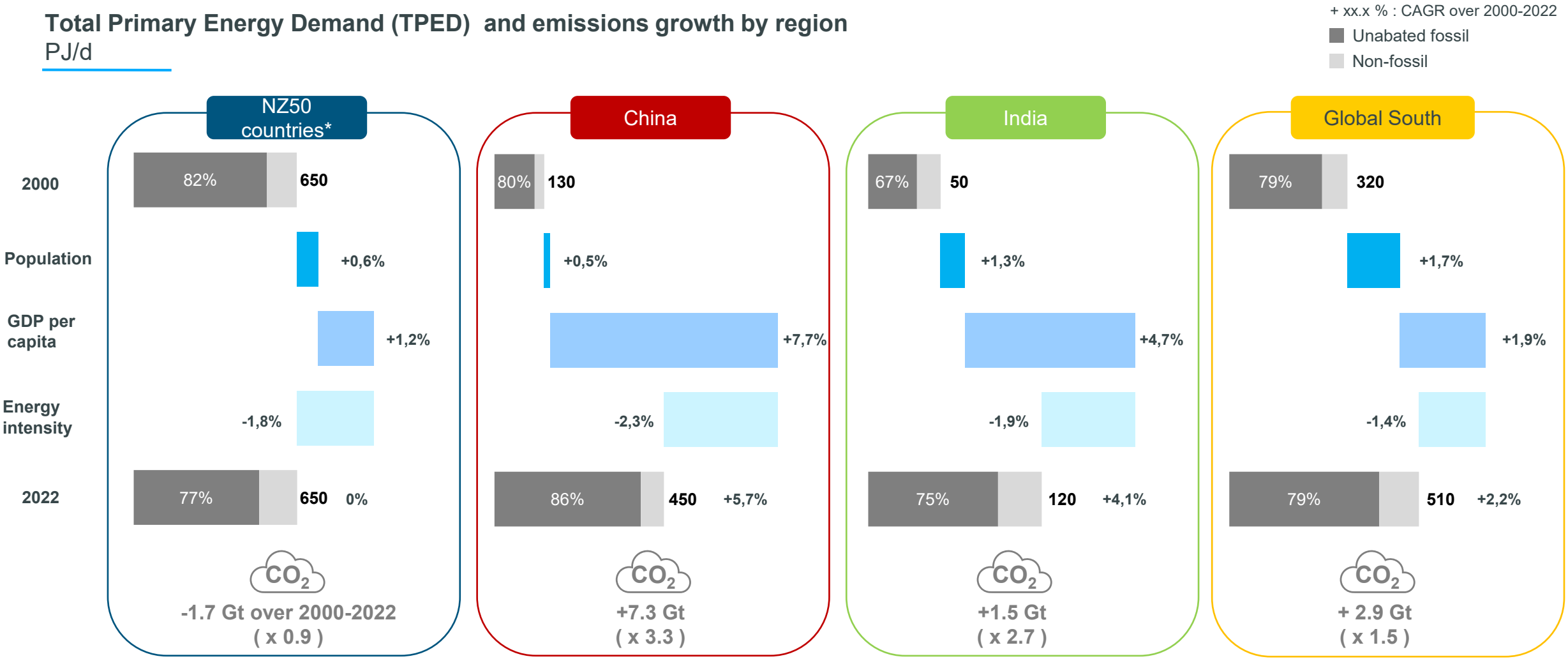
Today ~4.5 bn people have insufficient access to energy (below ~70 GJ/capita)

Sources. HDI: UN data, TPED: Energy Institute & Enerdata, Population: Oxford Economics, graph adapted from Smil (2017)

Energy demand growth primarily driven by improved living standards

Total Primary Energy Demand (TPED) and emissions growth by region

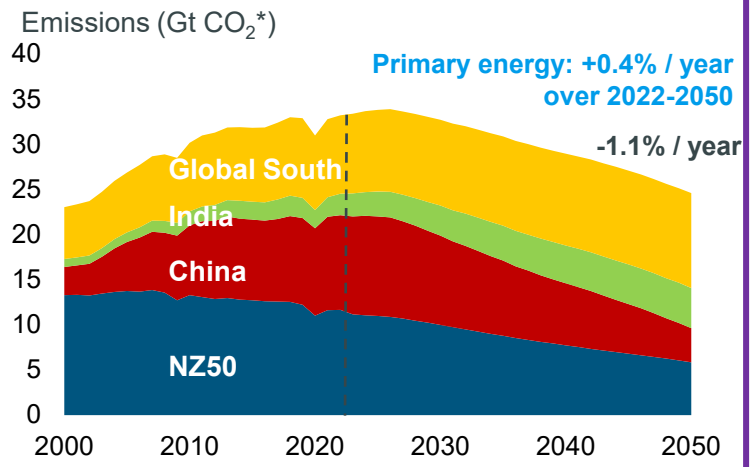
PJ/d



* *The 44 countries, mainly OECD countries, that have committed to net carbon neutrality by 2050*

Three possible scenarios to 2050

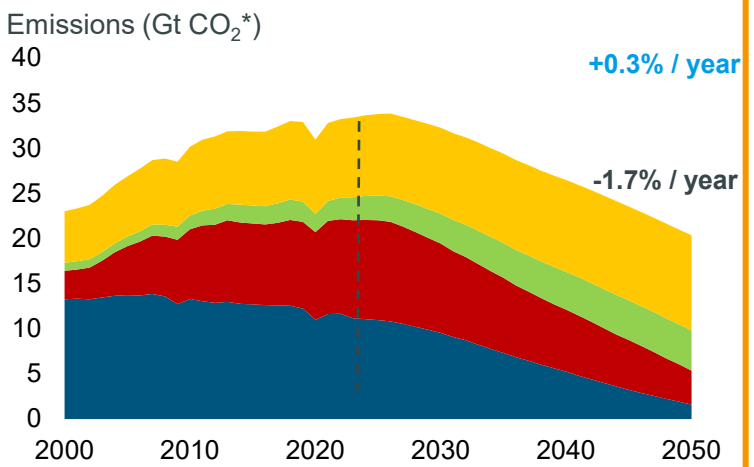
Trends



- Based on current trends, NZ50 countries fail to reach their long-term objectives, while China makes progress to NZ60
- India and Global South are developing without decarbonizing

~ +2.6-2.7°C by 2100**

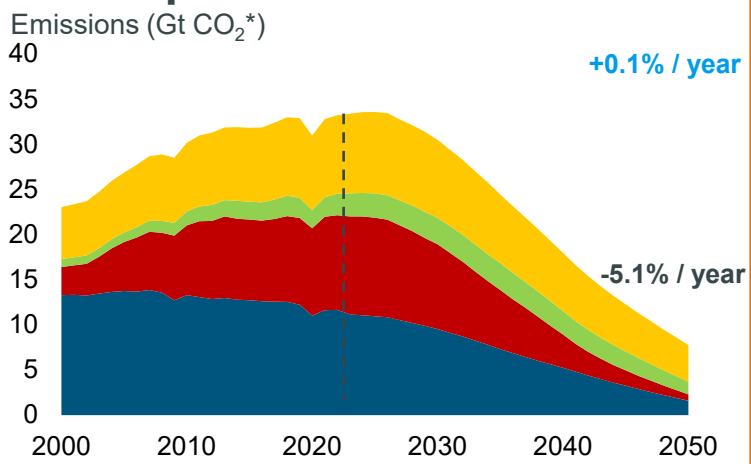
Momentum



- NZ50 countries and China reach their 2050/2060 targets
- In India and Global South, around half of the growth in energy demand is met by low-carbon energies

~ +2.2-2.3°C by 2100**

Rupture



- Global cooperation enables India and Global South to join in the race to Net Zero
- Demand growth is addressed with low-carbon energies and efficiency gains

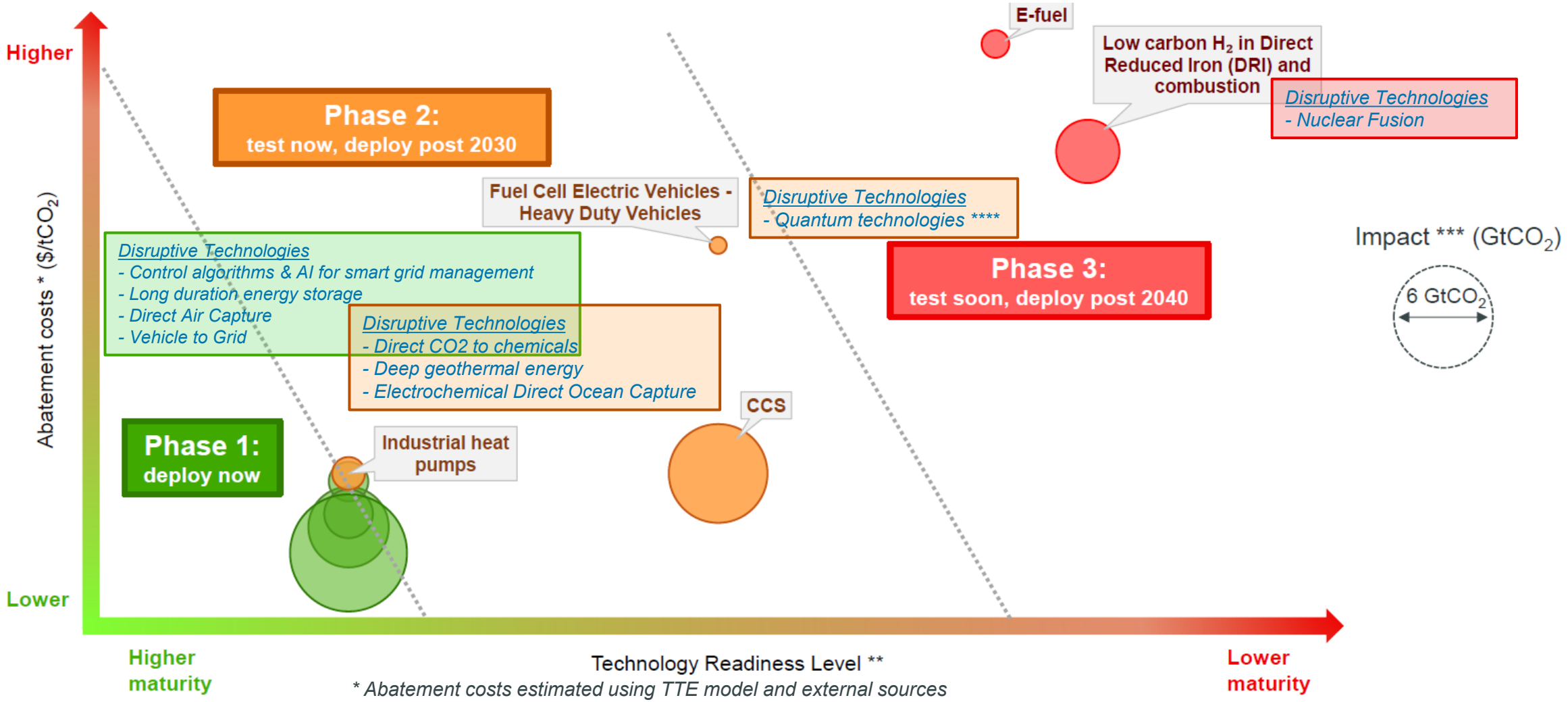
~ +1.7-1.8°C by 2100**

Our collective challenge: move away from the “Trends" scenario without compromising growth in emerging countries

** CO_2 emissions related to energy combustion*
*** Temperature increases estimated at P66-P83, evaluation conducted by MIT*

From Trends to Momentum and Rupture

Deploying decarbonation technologies following cost and technology merit curve

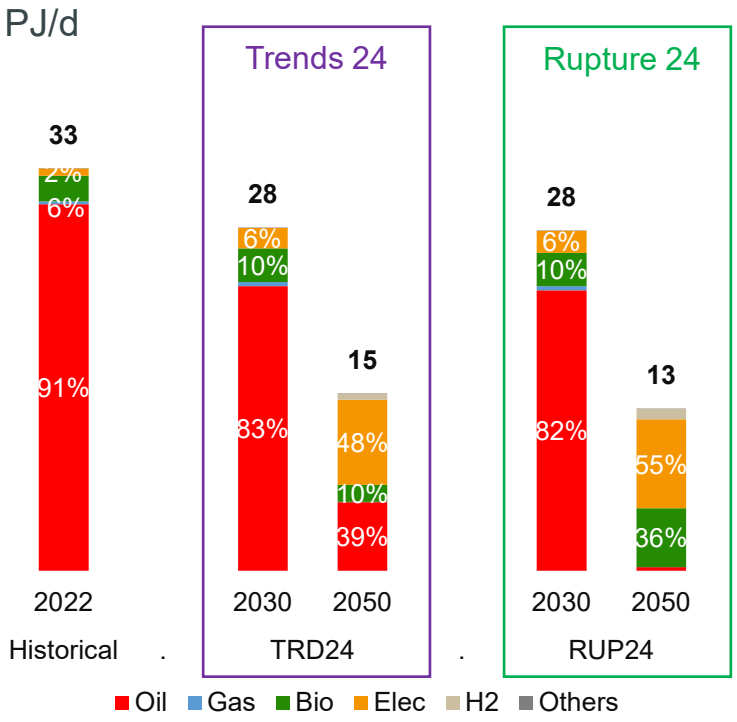


** Abatement costs estimated using TTE model and external sources*
*** TRL: sourced from the IEA Clean Energy Technology Guide*
**** Impact: estimated using 2023 CO2 emissions*
***** Quantum technologies may be used in batteries and solar panels to improve their efficiency²*

Decarbonization technologies deployed in all sectors

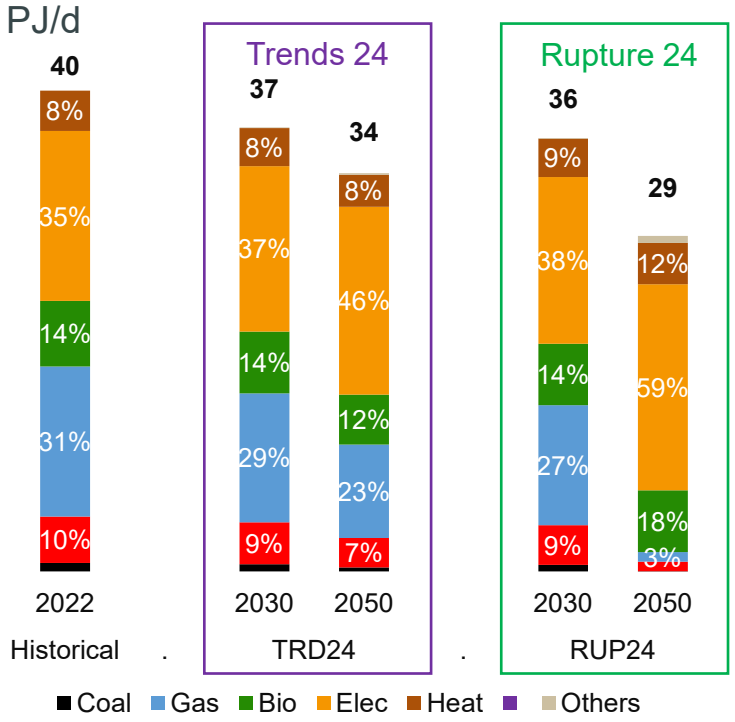
Electrification is a key driver of energy efficiency gains

Energy Demand in transportation



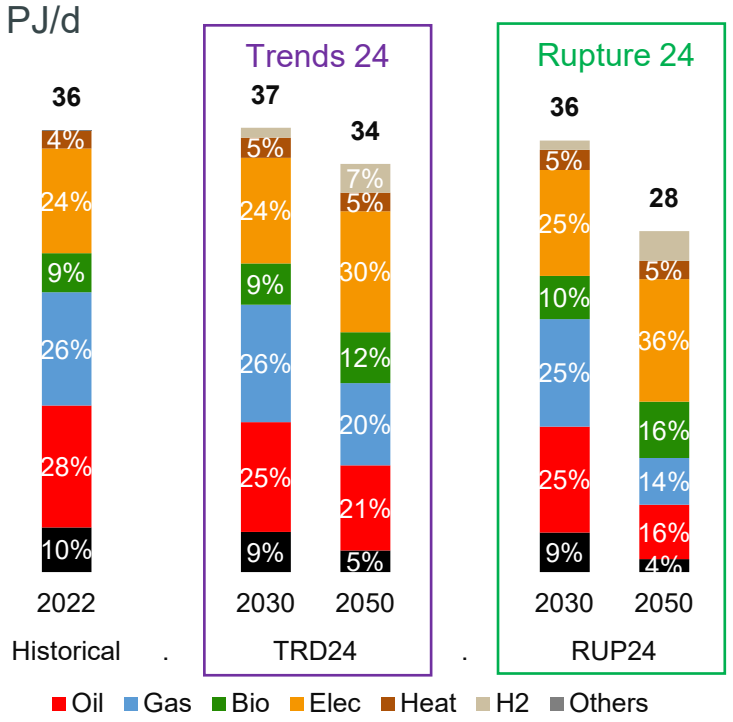
Electrification boosts energy efficiency, (notably road transport and heat in industry & buildings) from -1.7% pa over 2000-2022 to -2.3% pa over 2022-2050 in TRD, but fleet inertia slows achieving 2030 targets.

Energy Demand in buildings



Heat pumps and energy renovations encourage efficiency and fossil fuel phase outs, with a higher adoption rate in RUP24 than TRD24

Energy Demand in industry



Heat pumps, low-carbon hydrogen and CCS all contribute to industry decarbonization. However, transition is slow due to significant investment required and long asset lives

TotalEnergies Energy Outlook 2024: key messages

- Access to energy is essential to human development and rising living standards, but remains highly uneven from one country to another, against a backdrop of demographic growth.
- The global energy transition is underway. The pace is being set by the United States in particular.
- Three scenarios have been developed for 2050: Trends, Momentum and Rupture. They differ in terms of their decarbonization trajectories, and lead to different temperature rises by 2100.
- Amongst many decarbonization drivers, low-carbon electrification is key to energy transition.
- Decarbonization technologies must be introduced according to their cost and maturity curve.
- To overcome the obstacles to energy transition and reduce inertia, public policies need to be implemented and international cooperation stepped up.

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