

Challenges for global energy transition:

Based on the major findings from "IEEJ Outlook 2026"

Session 3

Long Term Perspectives on Aligning Energy Security with Transitions;
Energy Policy and Technology to Manage Megatrends and Disruptors

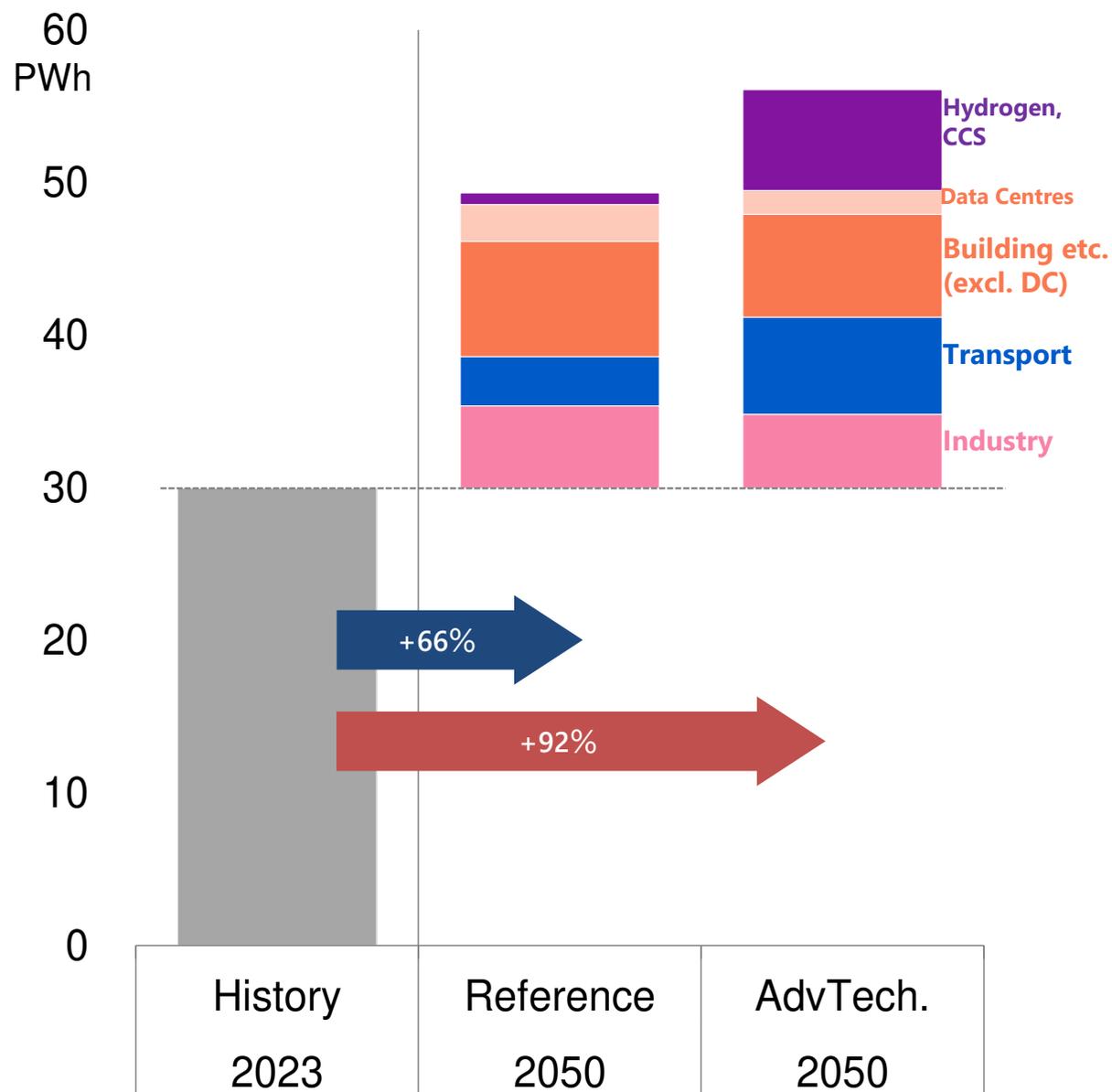
16th IEA-IEF-OPEC Symposium on Energy Outlooks

February 4th, 2026

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Power Demand leads Energy Demand Growth

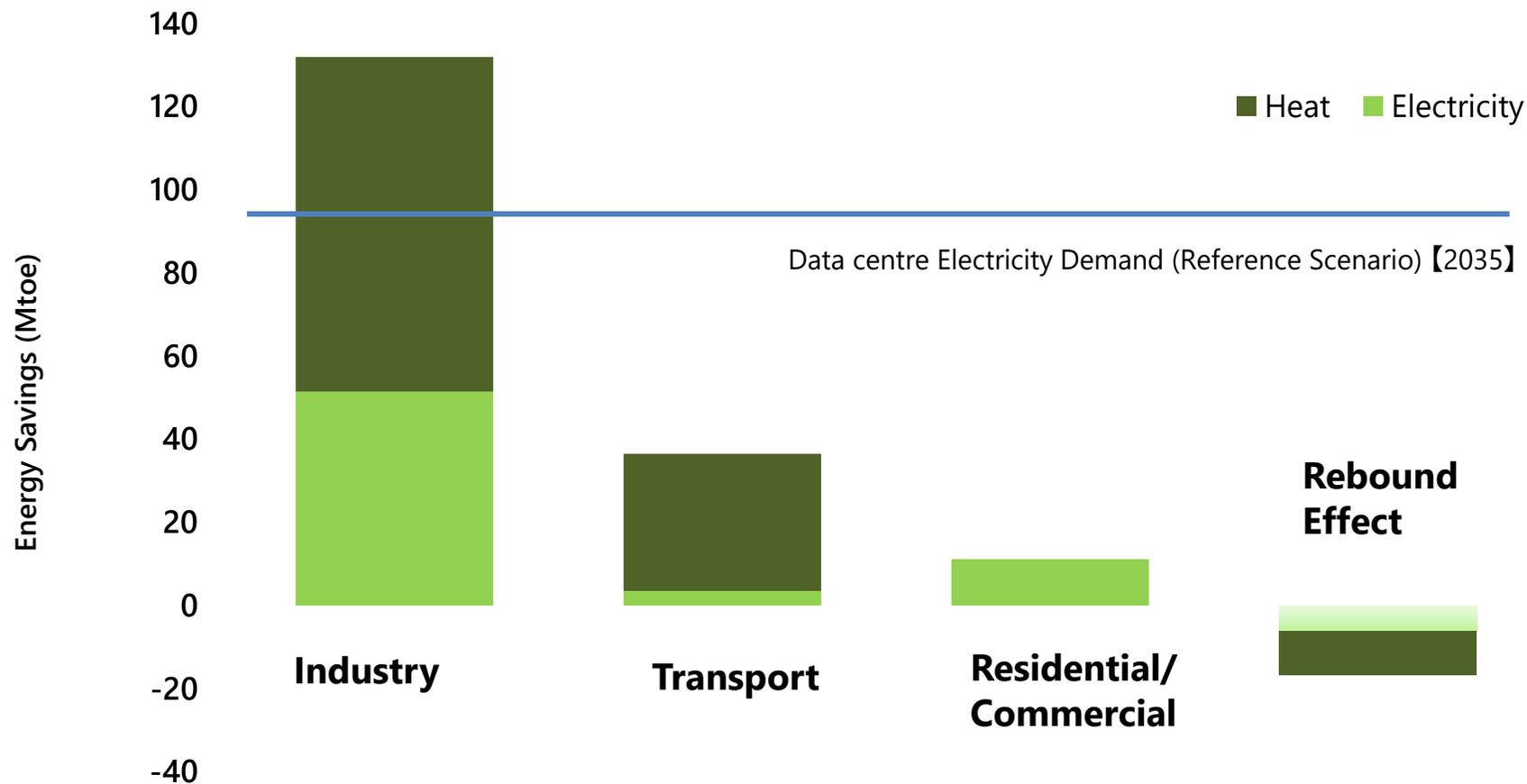


- Power generation strongly increases in both scenarios, mainly from;
- RS; industrial sectors and residential heating/cooling.
- **ATS: plus** electrification in transport, hydrogen/CCS..

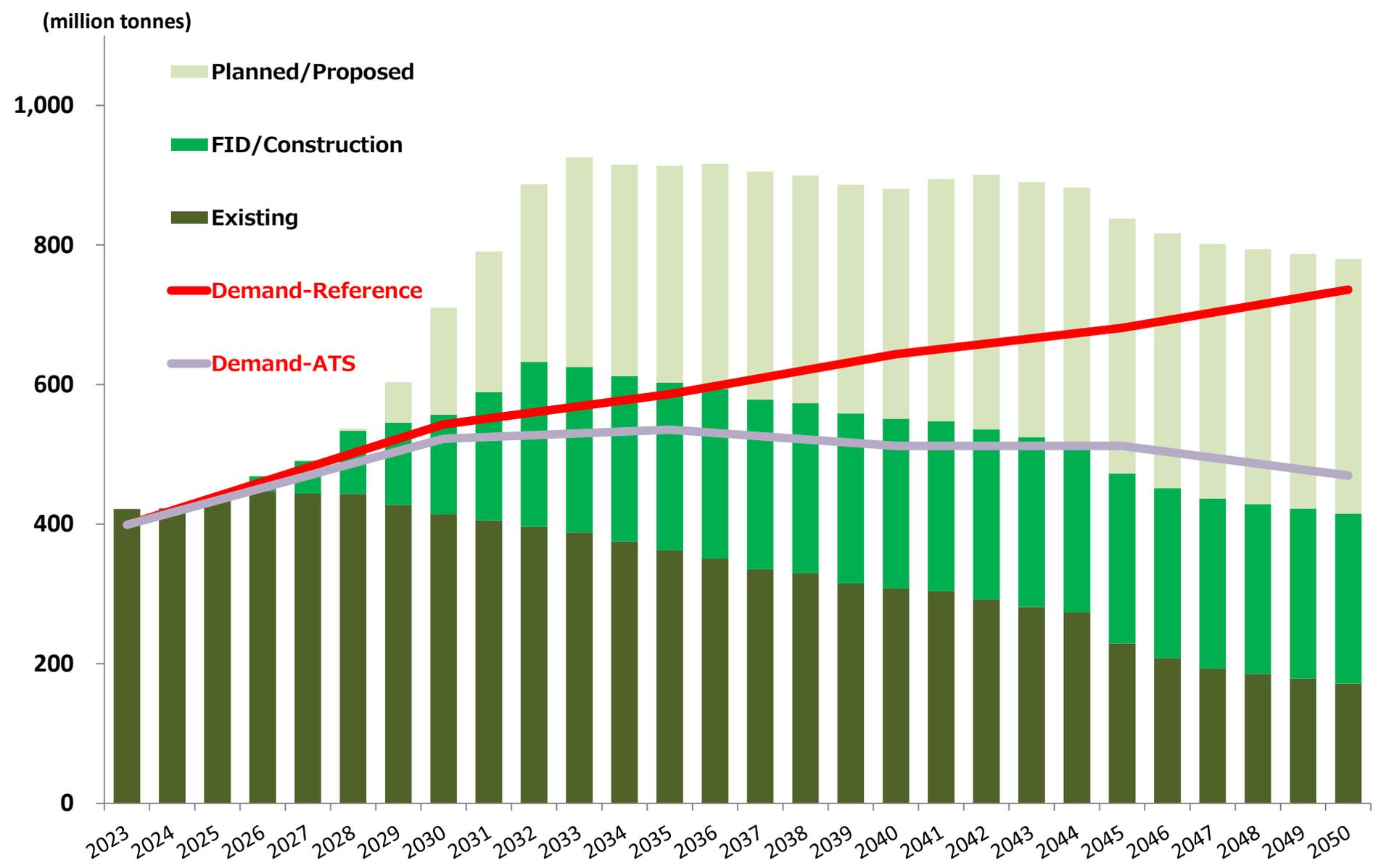
**Estimated by adding transmission and distribution losses to the electricity demand in each sector

Energy Savings Potential of AI at the Demand Side (2035)

- Demand-side energy savings using AI have the potential to reach 178 Mtoe (2,088 TWh) in 2035 in addition to ATS savings.
- By sector, the energy demand reduction effect is greatest in the industrial sector.



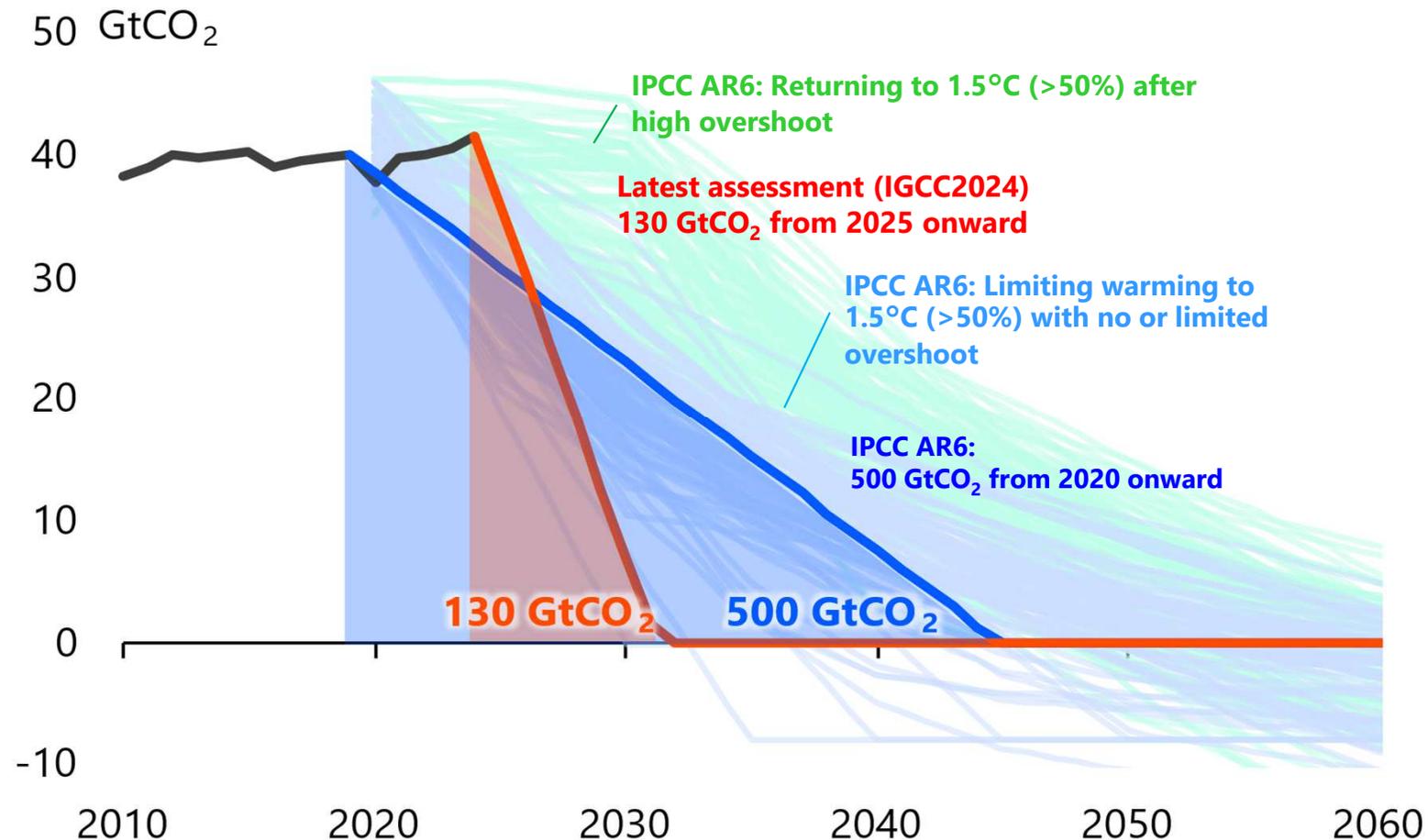
LNG supply-demand outlook (RS & ATS)



1.5°C Target Effectively Unattainable?

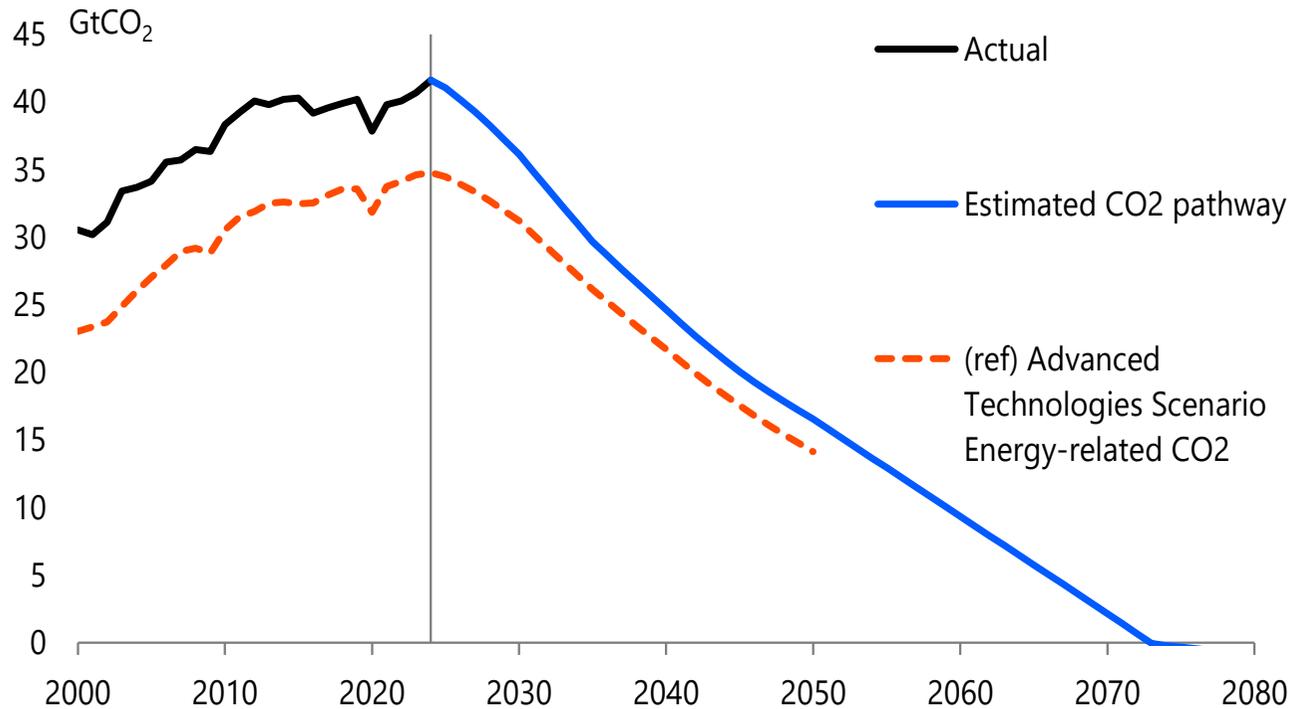
- Remaining carbon budget (CB) toward 1.5°C with a 50% probability is rapidly decreasing.
- The latest assessment of CB is 130 GtCO₂ from 2025 onward, less than four years' worth of current emissions

CO₂ emissions pathway consistent with the 1.5°C target

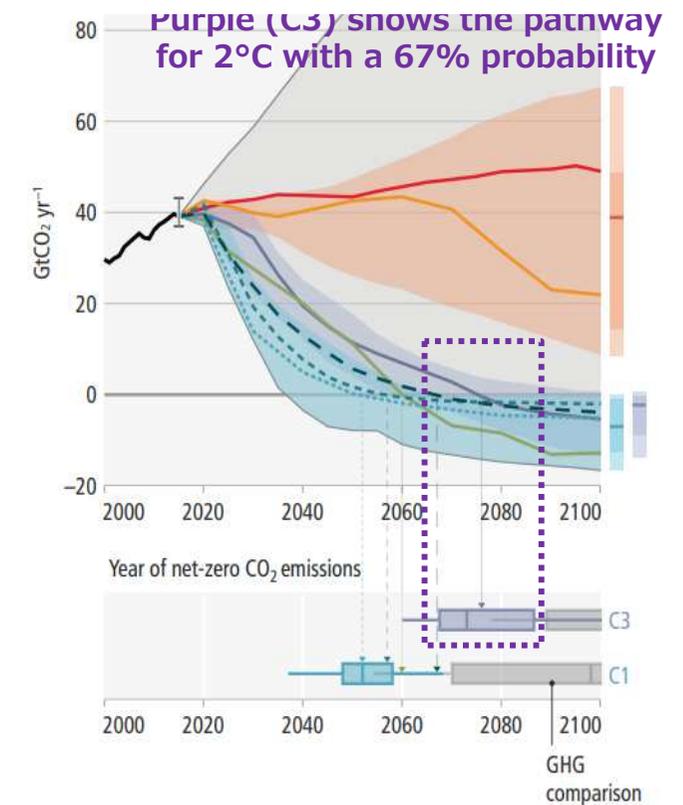


Emission Pathways of ATS and the 2°C target

Estimated CO₂ emissions pathway based on the Advanced Technologies Scenario



CO₂ emissions pathways in IPCC AR6 WG3

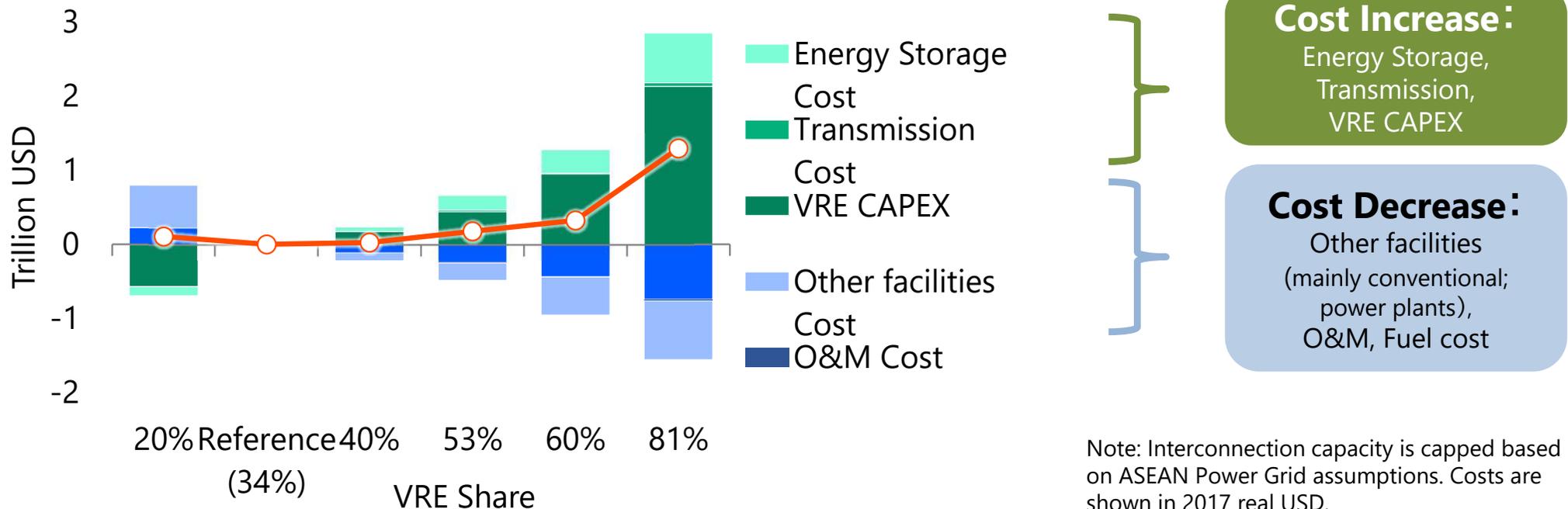


- Note: (Left) The estimated CO₂ pathway shows total CO₂ while ATS emission shows energy-related CO₂.
- (Right) IPCC AR6 WG3 SPM p.26
- **The estimated CO₂ emissions pathway by ATS achieves net-zero in 2073. The IPCC AR6 report states that the CO₂ emissions pathway for 2°C with a 67% probability (C₃) achieves net-zero around 2070 to 2080**

VRE and Changes in System Cost in ASEAN

- In ASEAN, the least-cost VRE share in 2060 is estimated to be around 30% — used here as the reference.
- Increasing VRE beyond the reference reduces CAPEX and OPEX for conventional power sources while raising VRE installation cost and integration costs such as storage and dispatchable power.
- At 81% VRE, cumulative cost rises by USD 1.3 trillion over 2030–2060 from the reference.

Cumulative System Cost Change in ASEAN (2030–2060, vs. reference)



Impact of Deepening Global Fragmentation

- **Deepening US-China conflicts and global fragmentation**
- **Oil-gas dominance vs clean energy dominance**
- **China's dominance in clean energy supply chain**
- **Concern for “weaponization” of strategic commodities**
- **New element of energy and economic security**
- **Energy transition challenge to be more complicated**

Reference Materials

Scenarios of IEEJ Outlook 2026

■ Regular scenarios

- Reference Scenario (RS): Business-as-usual future
- Advanced Technology Scenario (ATS): Maximum introduction of energy related technologies (Bottom-up approach)

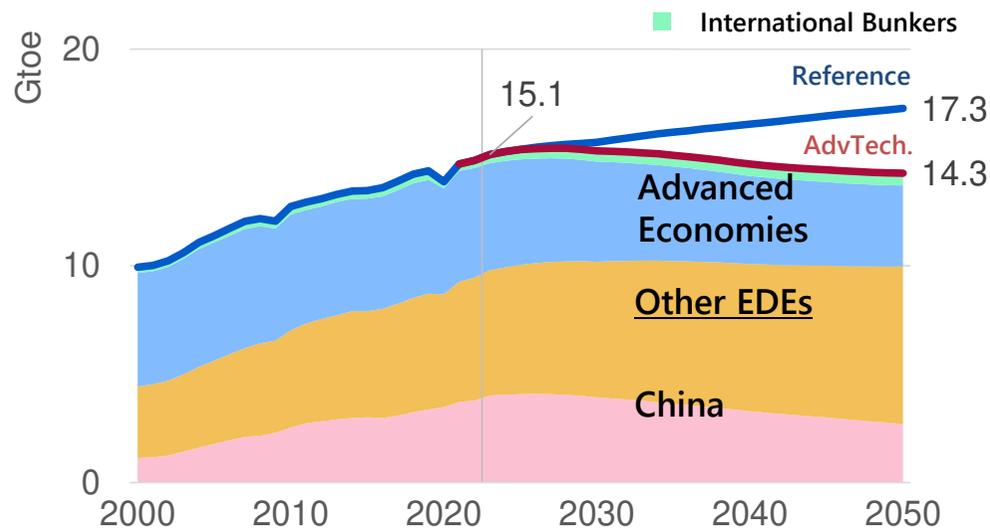
■ Highlights of this year

1. Analysis of integration cost of VRE
2. Impact of AI/DC expansion on energy demand
3. Carbon Budget and the issues relayed to “1.5°C” target

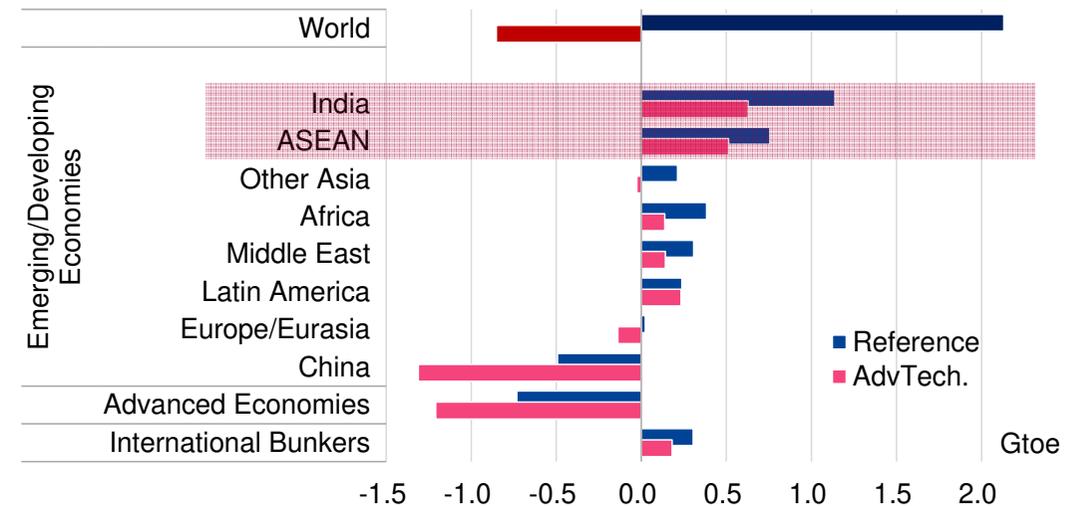
India and ASEAN Drive Global Energy Demand

- **RS:** primary consumption increases by 14% (2050 vs. 2023).
- **ATS:** peaks around 2030, due to efficiency improvement.
 - Growth concentrates in **India and ASEAN**, while demand in OECD and China declines.

Primary Energy Consumption



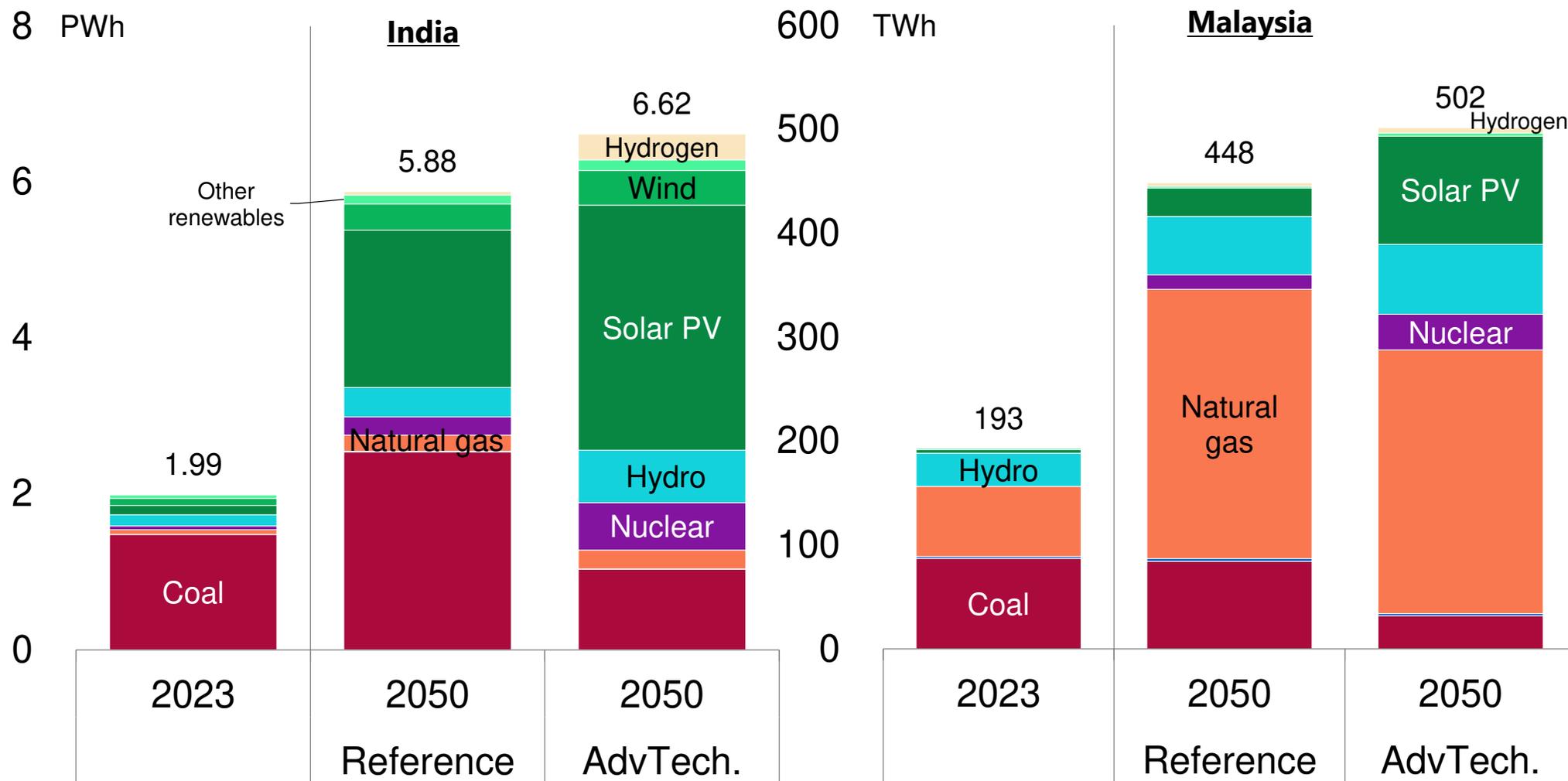
Regional Changes (2023-2050)



India and ASEAN: Rapid Increase in Power Demand

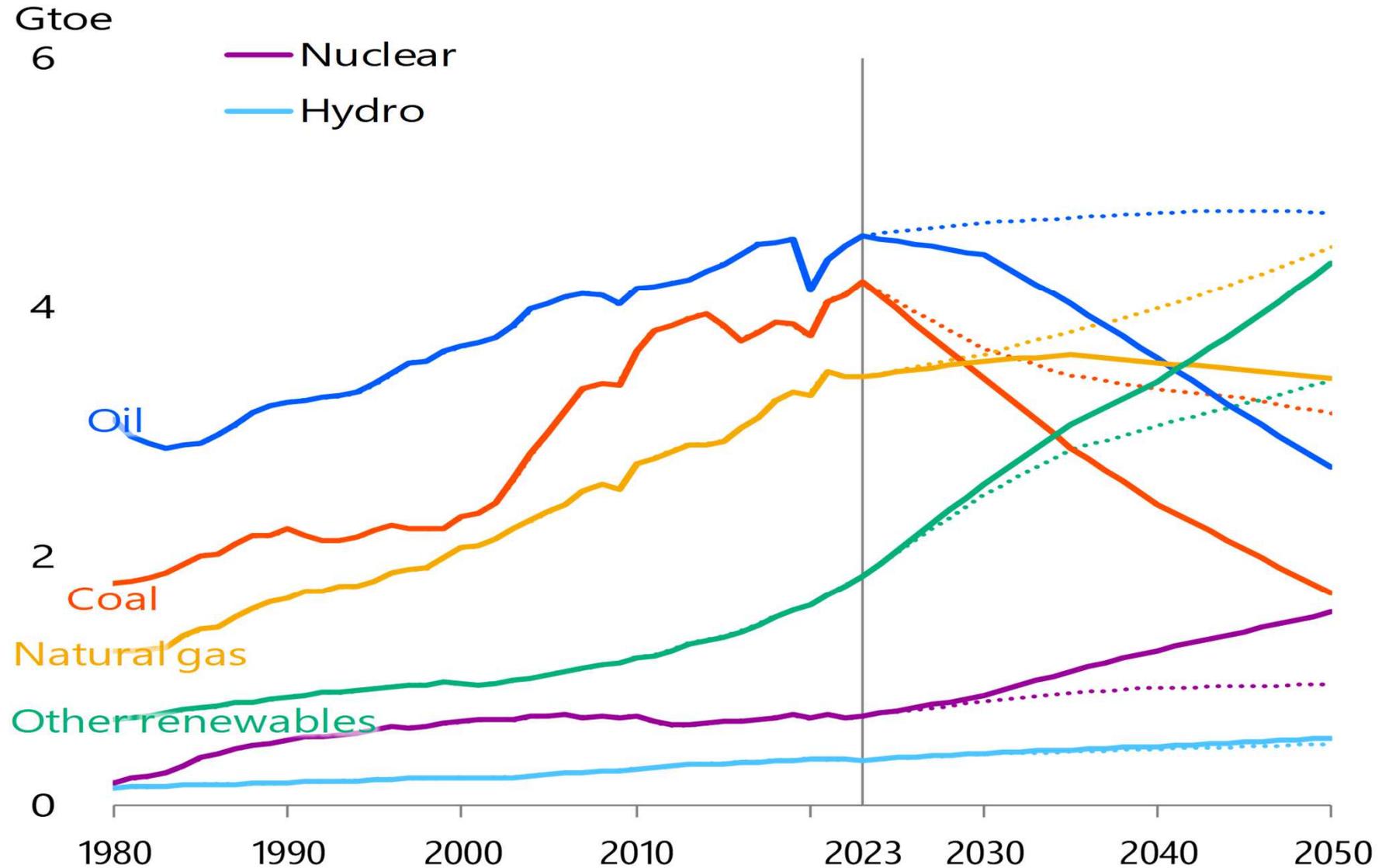
- Power generation will expand significantly in both regions.
- Rapid infrastructure development is essential, especially for both thermal power and renewables.

| Power Generation



Primary energy demand outlook (RS & ATS)

- Global fossil fuel consumption shows significant differences between scenarios.
- Even in **ATS**, fossil fuels account for 54% of TPES in 2050.

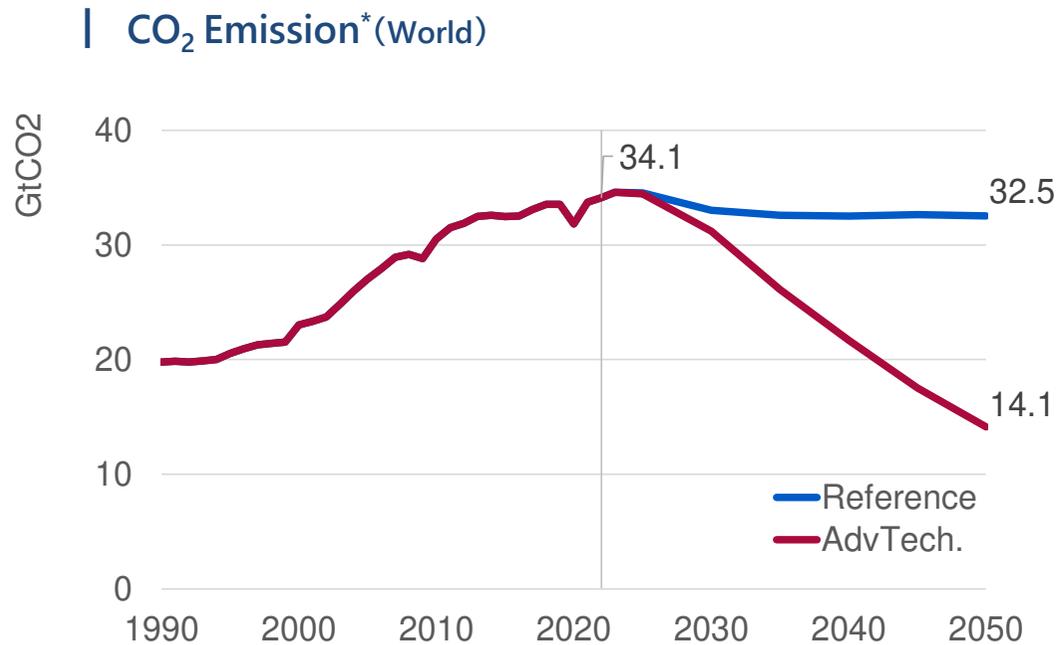


Note: Solid lines stand for Advanced Technologies Scenario and dotted lines stand for Reference Scenario.

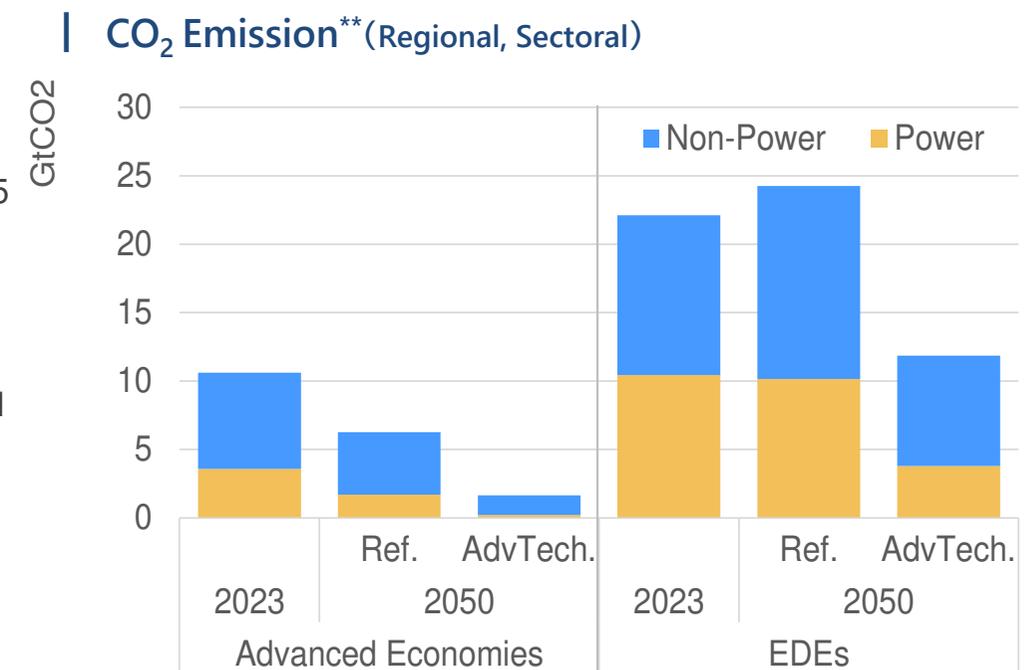
Source: IEEJ Outlook 2026 (IEEJ, October 2025)

Outlook for CO₂ Emissions Pathways

- **RS:** Global CO₂ emission remains at around current levels in 2050.
- **ATS.:** Global CO₂ emission will be reduced by 60% in 2050.
- Power sector decarbonizes first. Non-power sectors lag, especially in emerging economies.



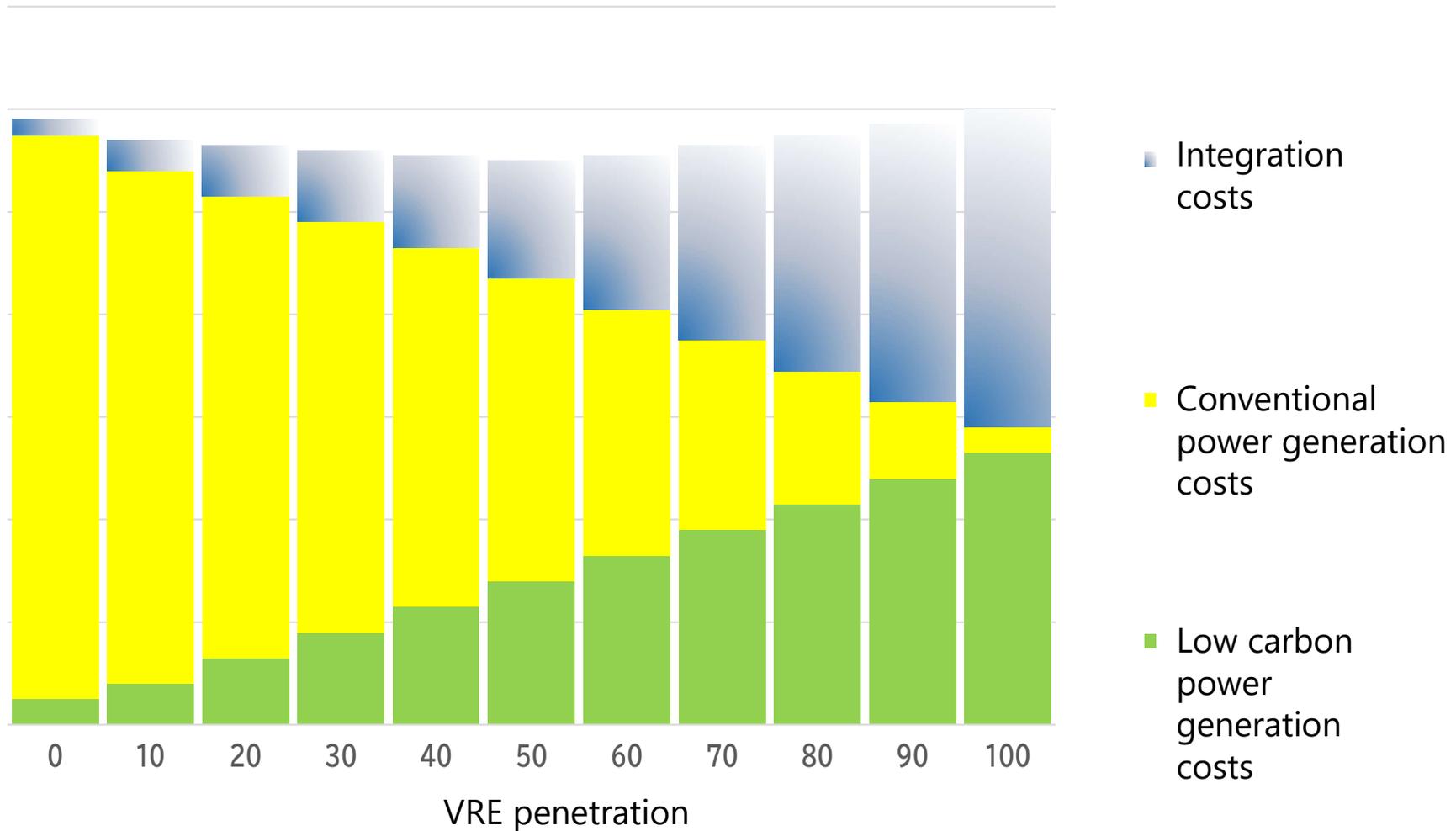
*Energy-related emissions minus offsets from CDR (BECCS/DACCS)



**EDEs: Emerging and Developing Economies

VRE and Total System Cost Including Integration Costs

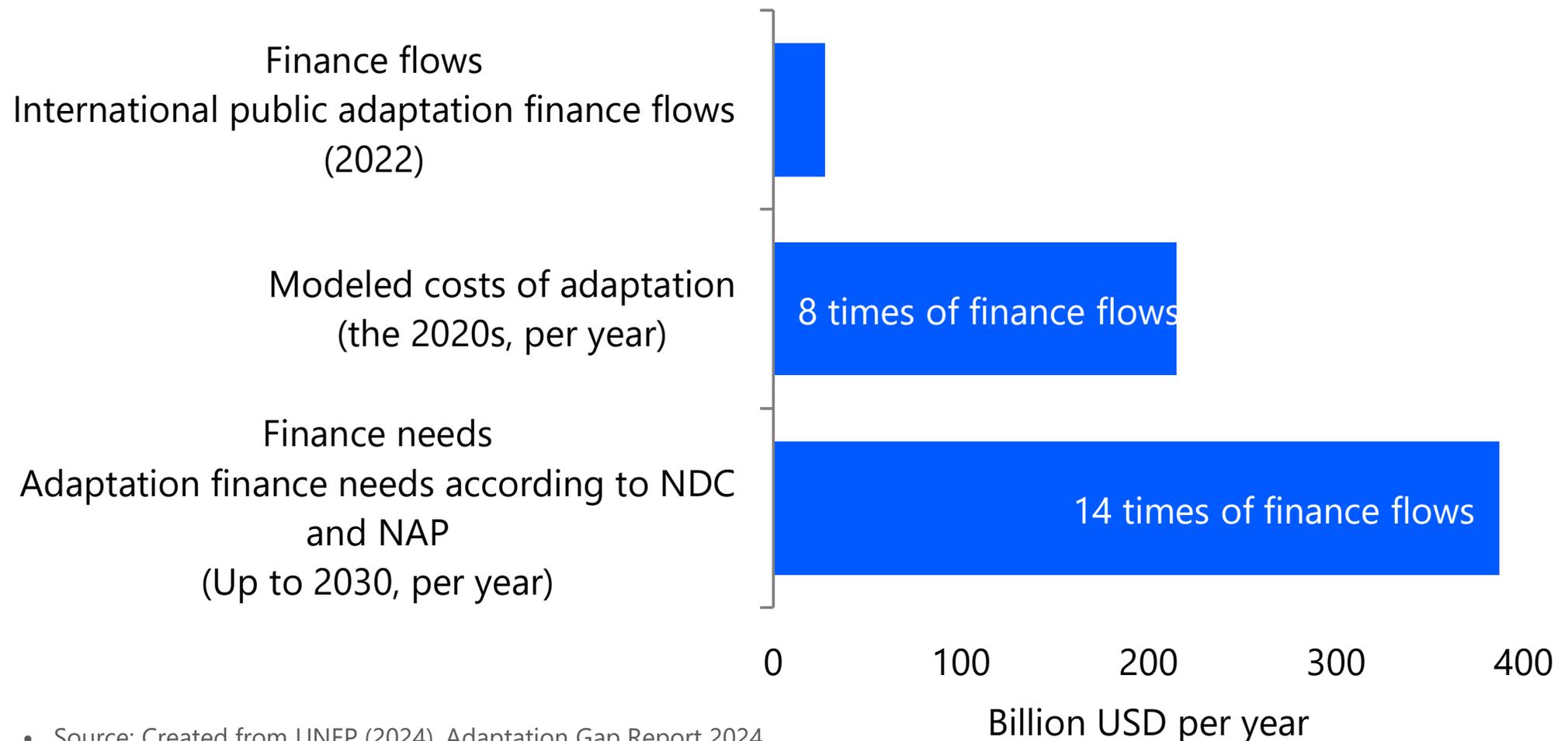
Illustrative image: Growth in VRE deployment vs. system cost trajectory



Source: Author, based on Matsuo (2021) and The Working Group on Power Generation Cost Verification (2025)

Need and Reality in Adaptation Finance

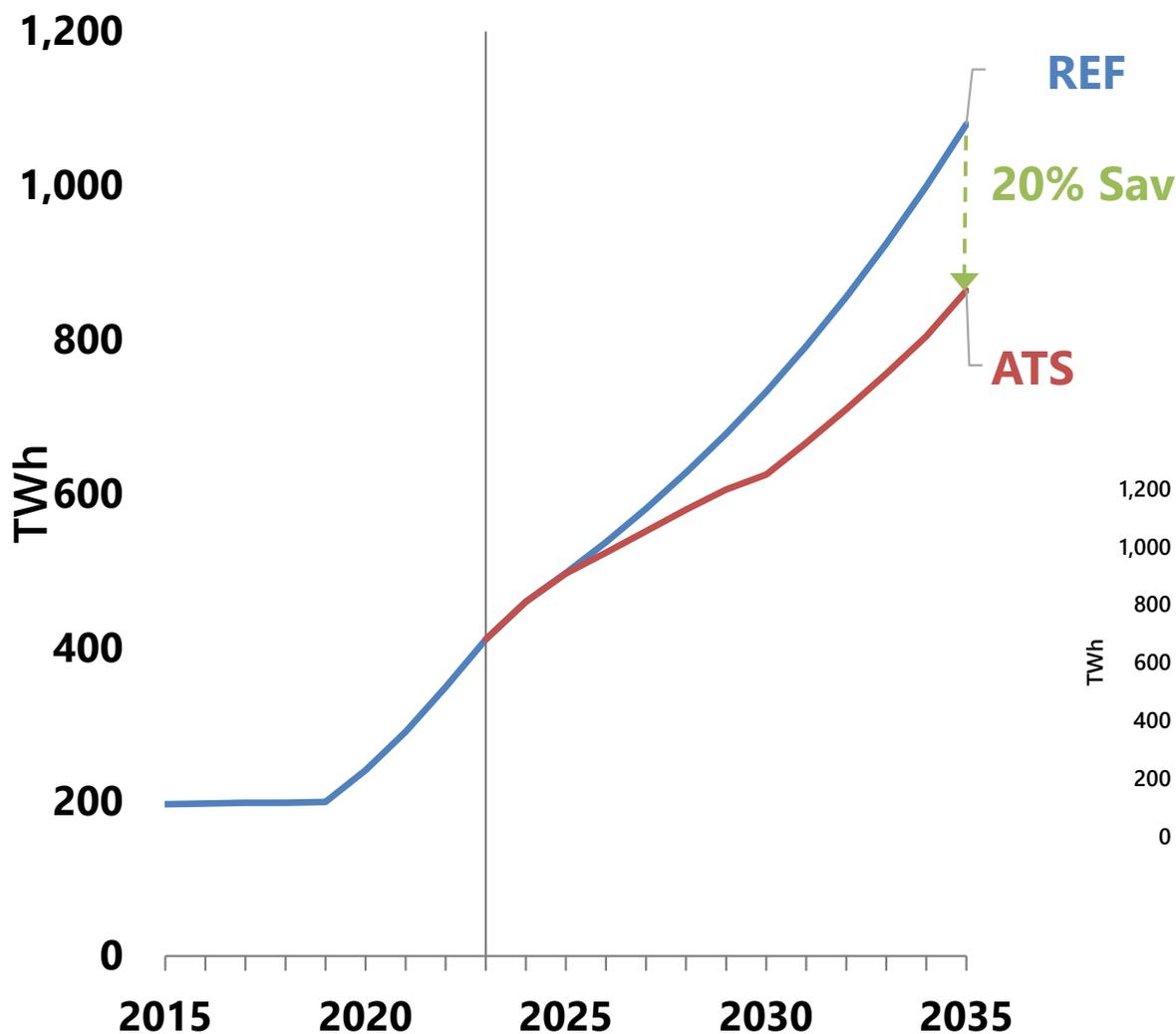
- UNEP shows that the modeled costs of adaptation is \$215 Bil. and the finance needs are \$387 Bil PA.
- International public adaptation finance for developing countries were \$28 Bil. in 2022.



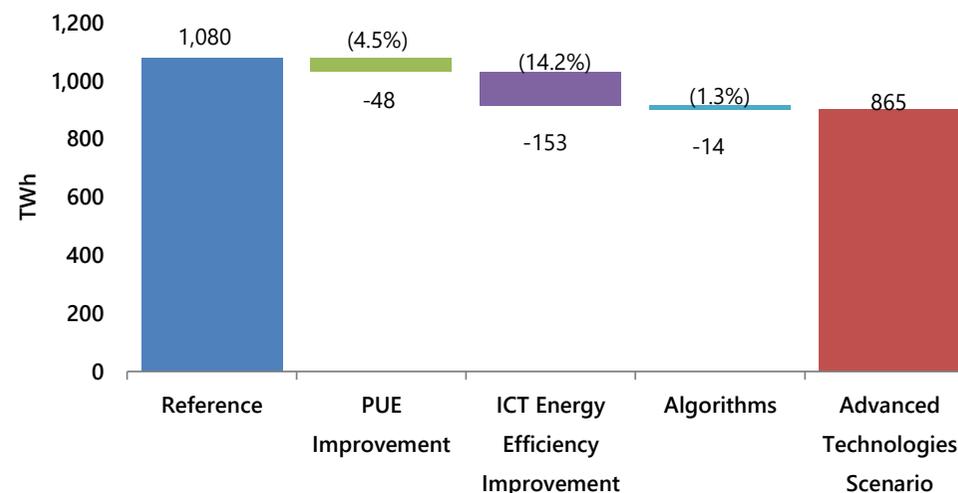
• Source: Created from UNEP (2024), Adaptation Gap Report 2024.

Data Center Electricity Demand Outlook (2035)

- Global DC power demand will increase from the current 497 TWh to 1,080 TWh by 2035.
- IEEJ analysis indicates the potential to save DC electricity demand by 20% by 2035.



DC Electricity Savings Potential (2035)



Source : IEEJ (2025).

Source: IEEJ Outlook 2026 (IEEJ, October 2025)