

IEEJ Outlook 2026

Global Energy Supply and Demand Outlook to 2050

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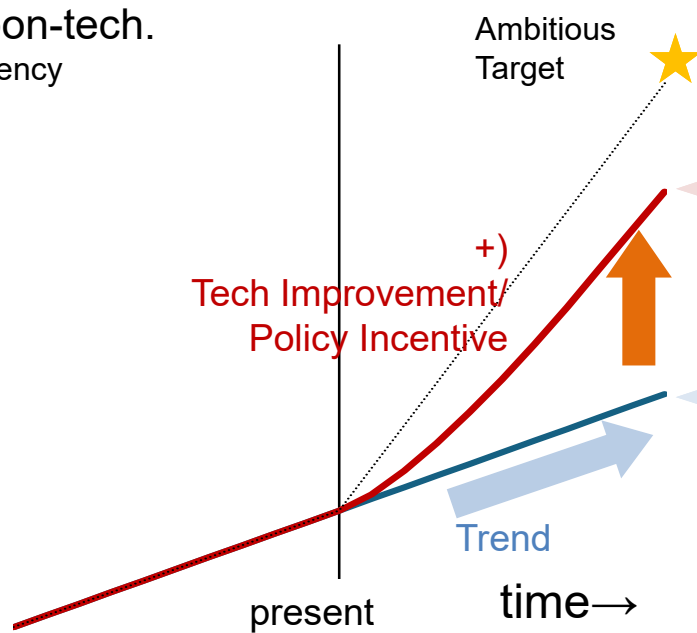
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What is IEEJ Outlook?

- Global long-term energy supply and demand projections to 2050.
- Two scenarios with different technology and policy development trajectories.
 - Both are "What if...?" based **forecasts**, not target-based **backcasts** ("What must be done?").

| Scenarios

↑Amount of low carbon-tech.
*e.g. Renewables, Efficiency



[Advanced Technologies] ("AdvTech.")
Maximum feasible efforts for energy security and climate goal.

[Reference] ("Ref")
Continuation of historical trends.

Global Power Demand Surges

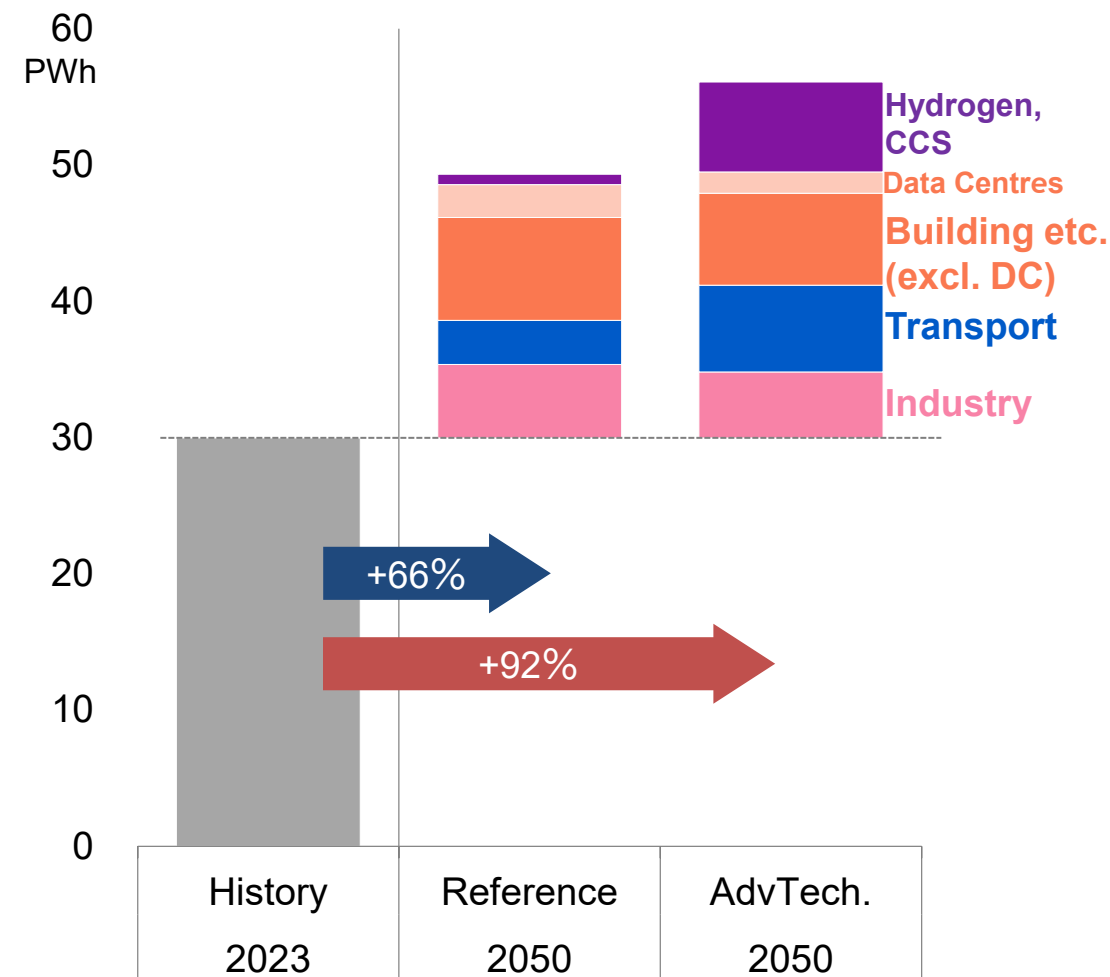
| Historical Data Trend [Global]

- 2024 generation increased +4.0% from 2023*
 - accelerating from 10-year average (2.6%/year).

| Outlook toward 2050

- Power generation strongly increases in both scenarios, mainly from;
 - **Reference:**
industrial sectors and residential heating/cooling.
 - **AdvTech.:**
(+) electrification in transport, hydrogen/CCS.
- Massive investments in grids and generation will be essential.

| Required Generation Increase (World)



*Energy Institute, Statistical Review of World Energy (2025)

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

Global Generation Mix; Growth centred on solar PV and wind

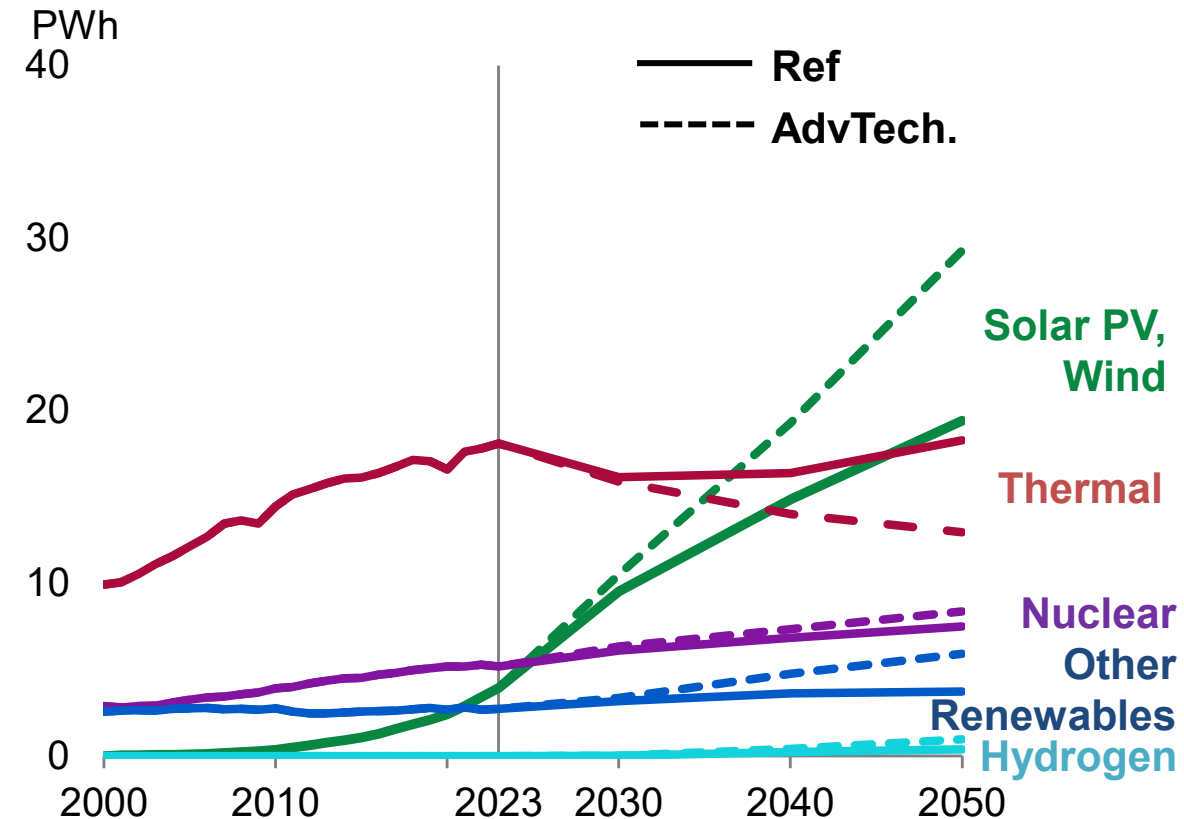
| Historical Data Trend [Global]

- Solar PV generation increases at the highest pace between 2022-2024.*
- Wind power also grows, but the pace is slowing.

| Outlook toward 2050

- **Ref.:** Solar and wind dominate expansion, but slow facing integration costs, land constraints.
- **AdvTech.:** mitigates these constraints by technology and policies.
- Other power sources (Thermal/ Nuclear/ Other Renew.) remain essential.

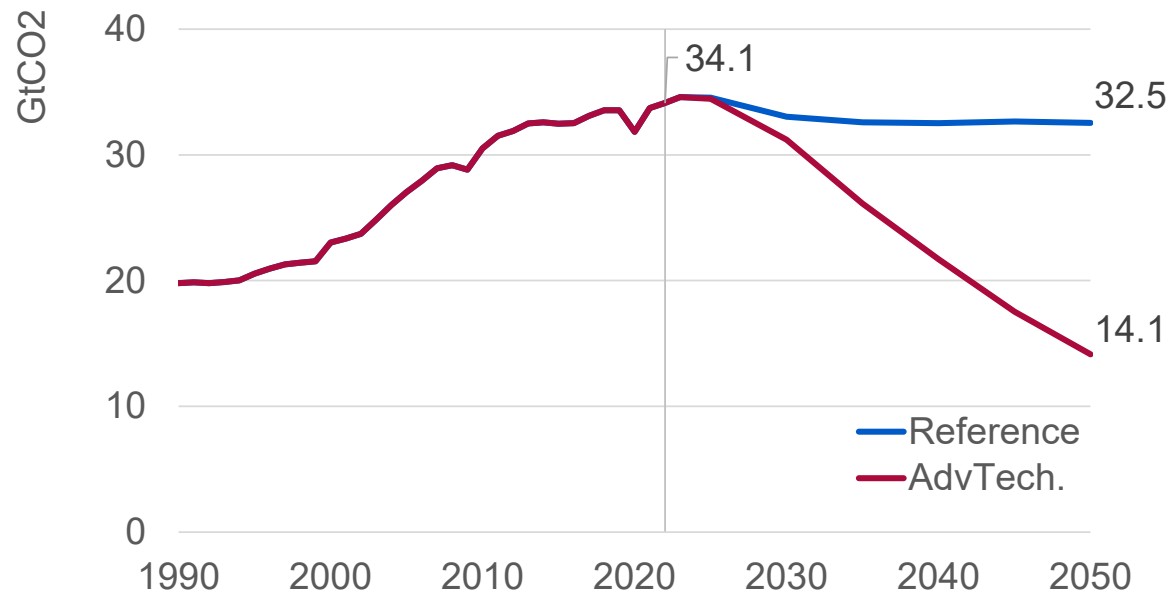
| Generation by Source (Global)



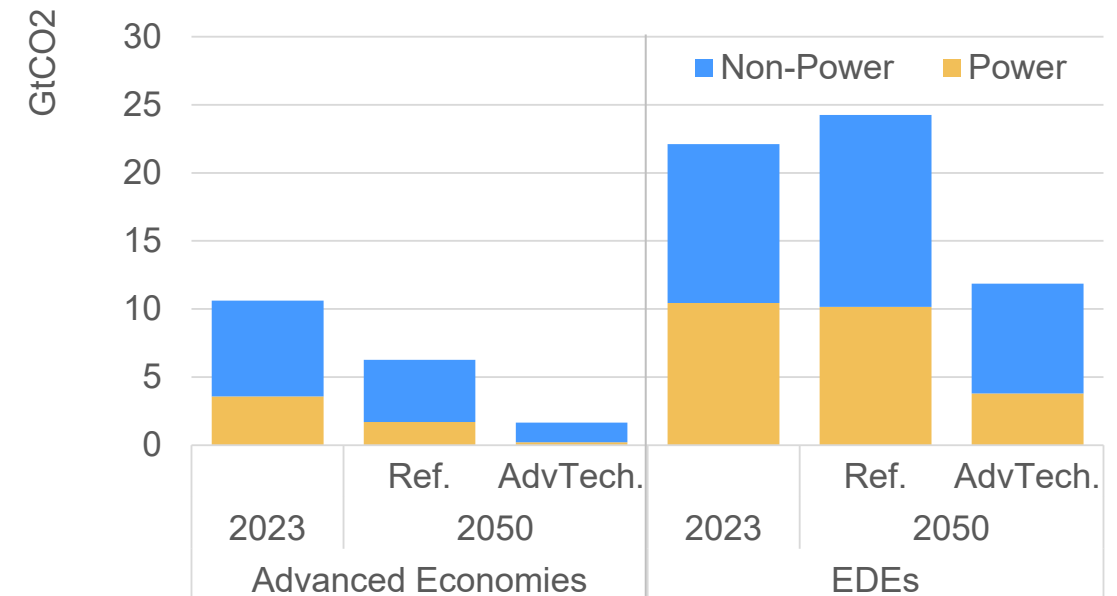
CO₂ Emissions Pathways

- **Reference:** Global emissions remain around current levels.
- **AdvTech.:** Reaching -59.3% vs 2023.
 - Power sector reduce emission first. Non-power sectors lag, especially in emerging economies.

| CO₂ Emission* (World)



| CO₂ Emission** (Regional, Sectoral)



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

**EDEs: Emerging and Developing Economies

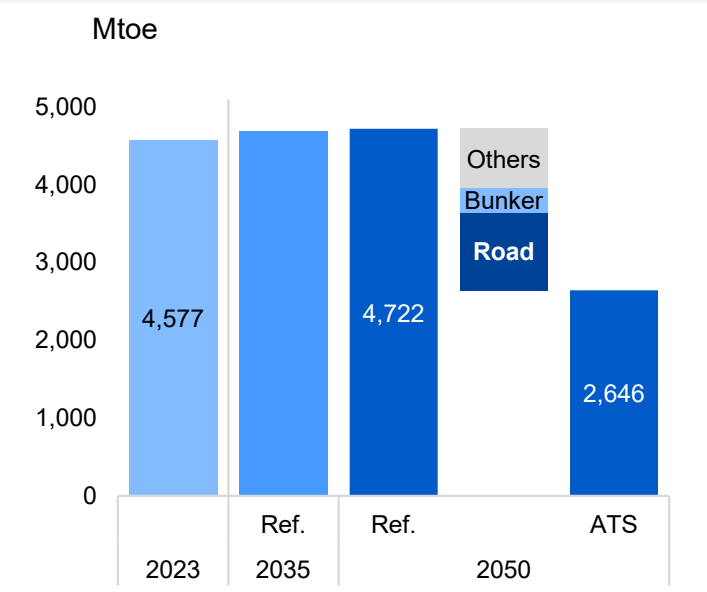
Fossil Fuels Demand Is Uncertain, Especially for Oil/Coal

- Global fossil fuel consumption shows significant differences between scenarios.
 - Even in **AdvTech.**, fossil fuels account for over half of primary energy consumption in 2050.

| Primary Energy Consumption(Global)

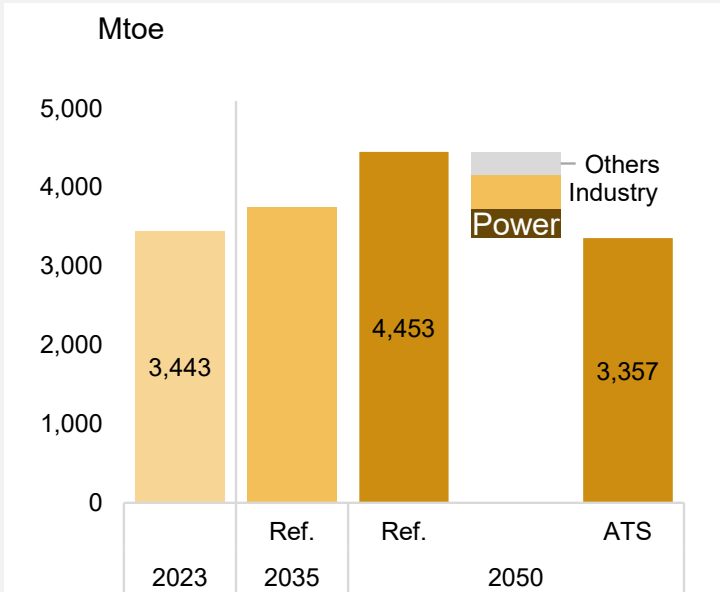
| Oil

- Largest uncertainty—depends on road transport trends.



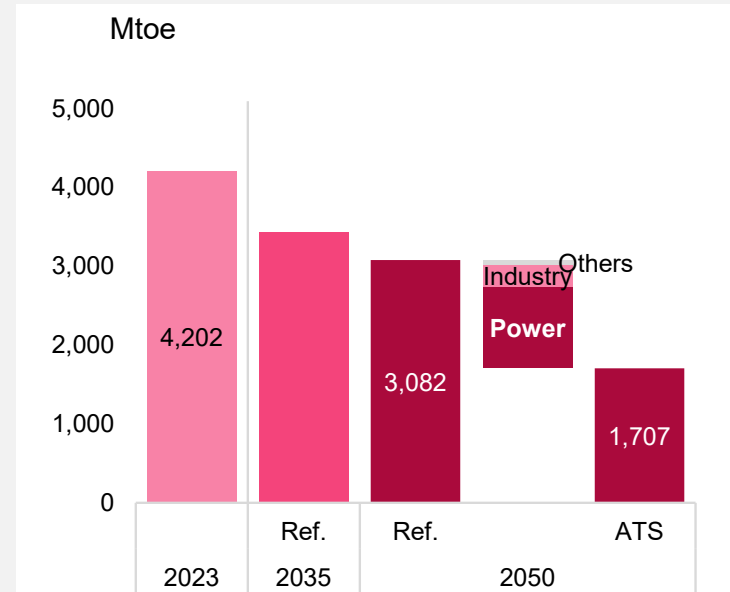
| Natural Gas

- Stable demand across both scenarios.



| Coal

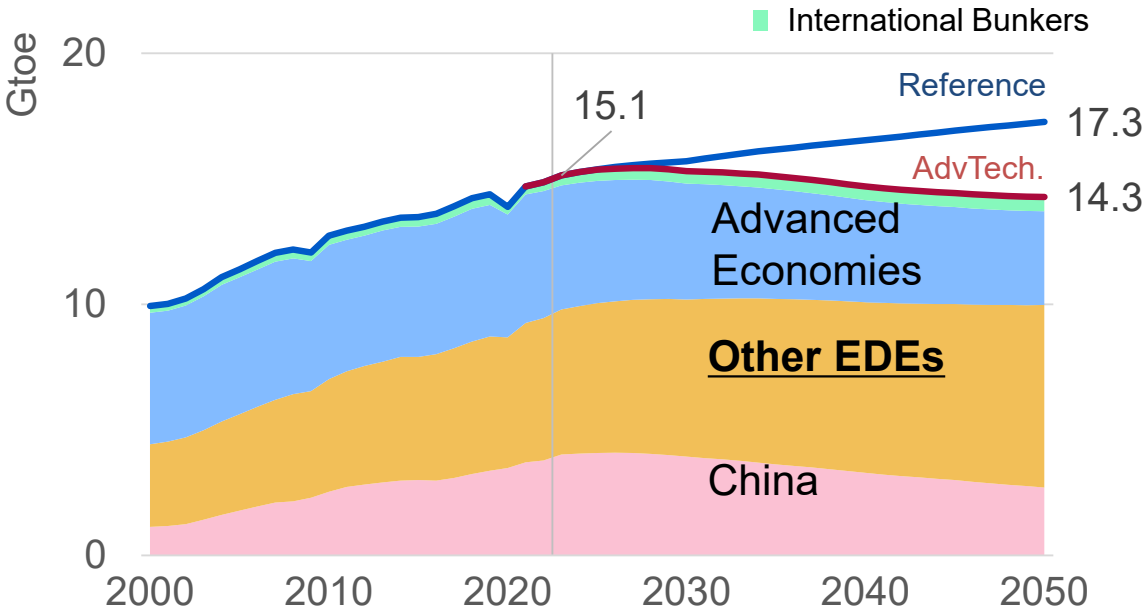
- Sharp decline under **AdvTech.** due to renewable substitution.



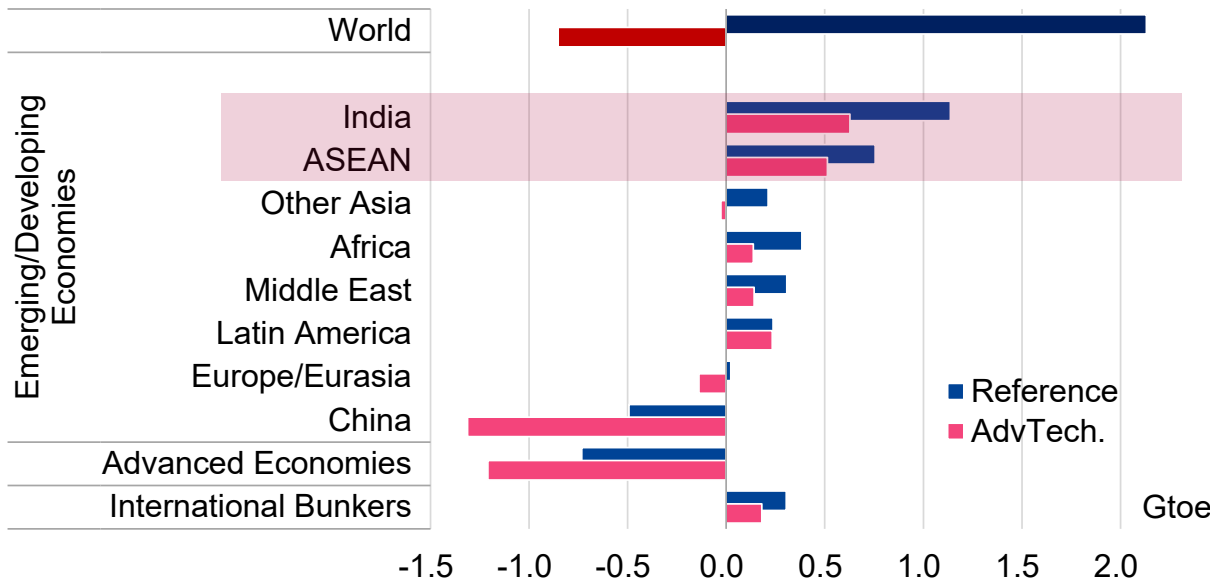
India and ASEAN Drive Energy Consumption Growth

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

| Primary Energy Consumption



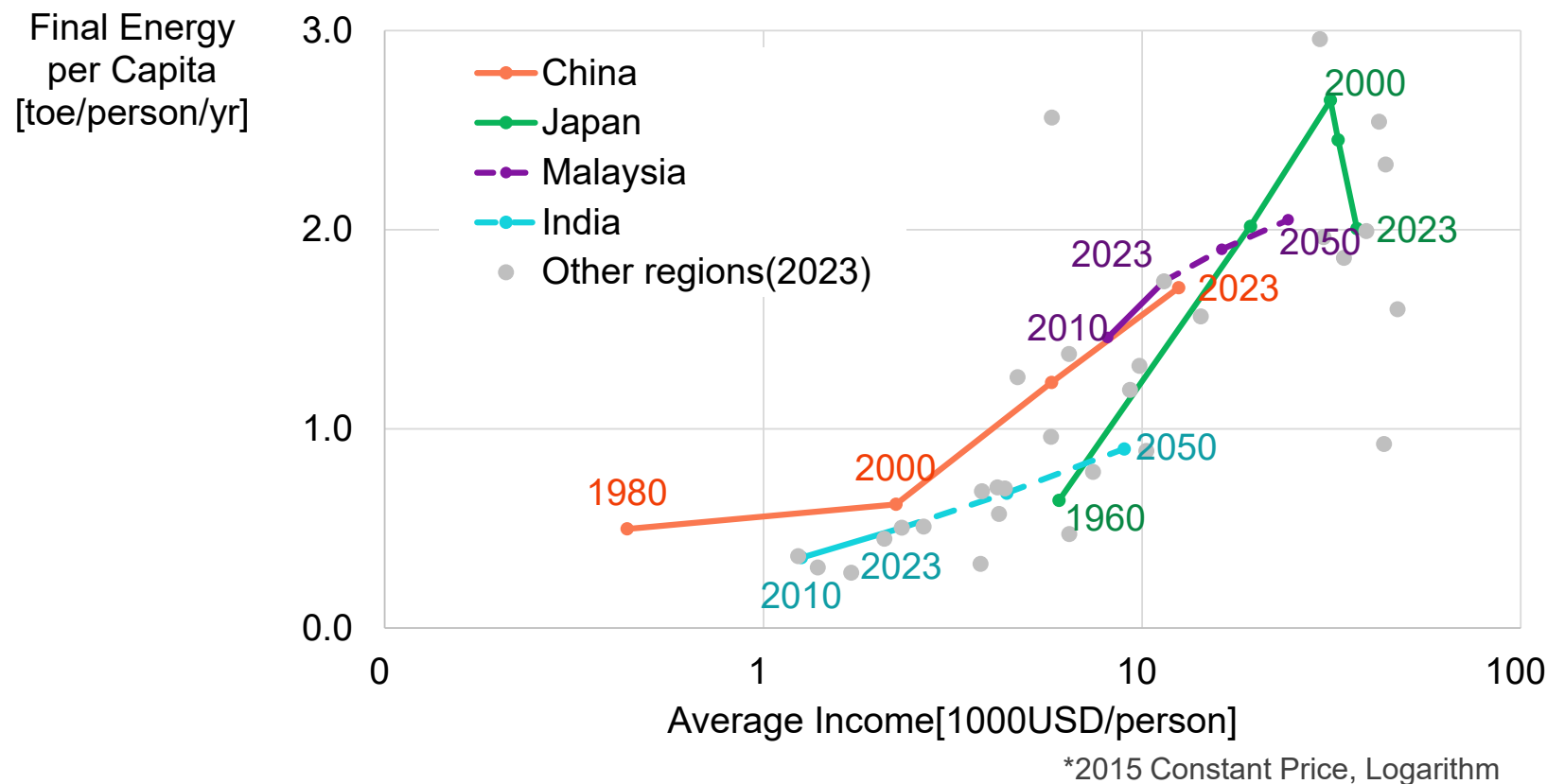
| Regional Changes (2023-2050)



Economic Growth Makes ASEAN and India Major Consumers

- Economic growth and industrialization drive energy demand.
- **India and ASEAN** follow the earlier path of Japan and China.

| Income and Final Energy Per Capita (Reference)



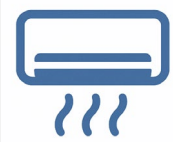
Source) History: IEA(2025), World Bank(2025), IEEJ(2025) . Future projections are from this outlook.

Expanding "3C" Stimulates Energy Consumption

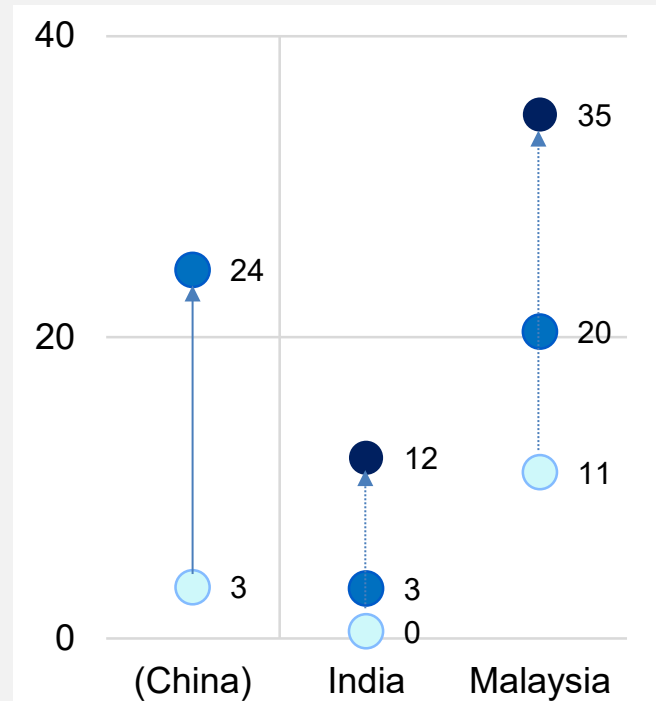
- Rising income leads to more use of **coolers, cars, and construction materials** (Steel, Cements) (e.g.) Penetration of "3C" in 1960s Japan, economic growth in 2000s China.

Buildings:

Cooler



Units per 100 people (residential)

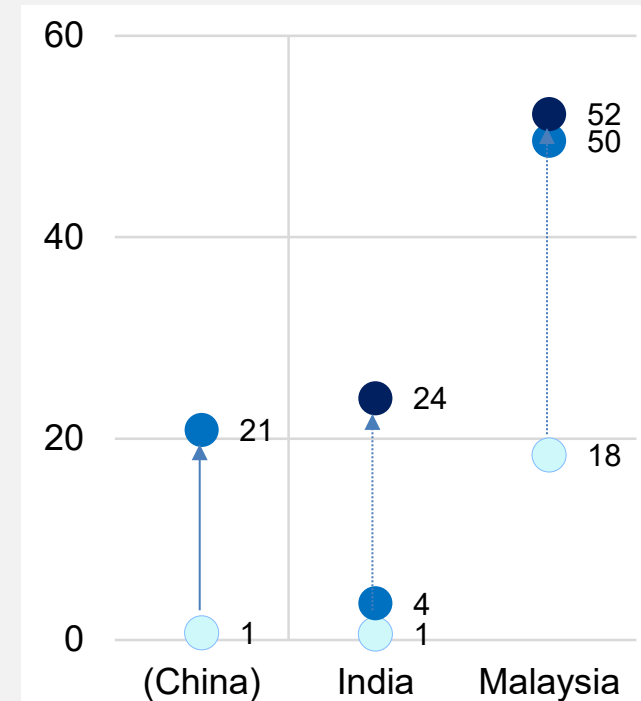


Transport:

Car



Passenger Vehicles per 100 people

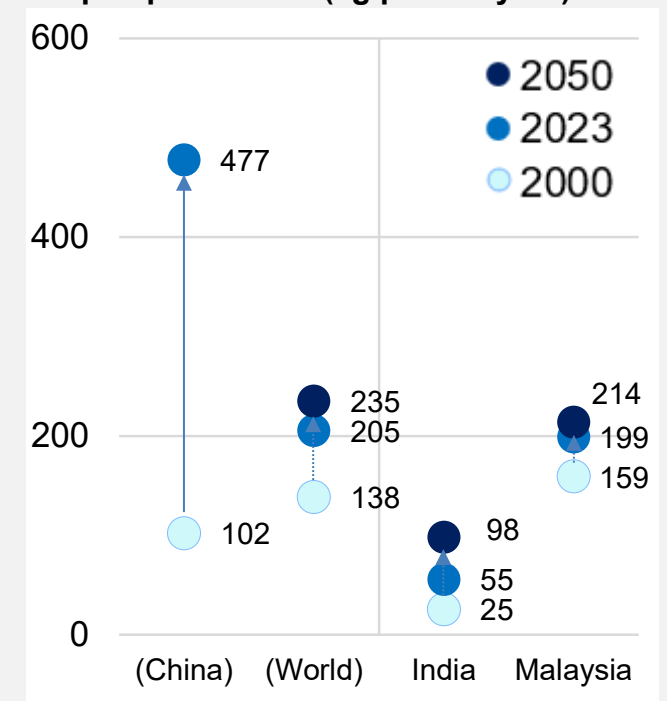


Industry:

Crude Steel



Per capita production (kg/person/year)

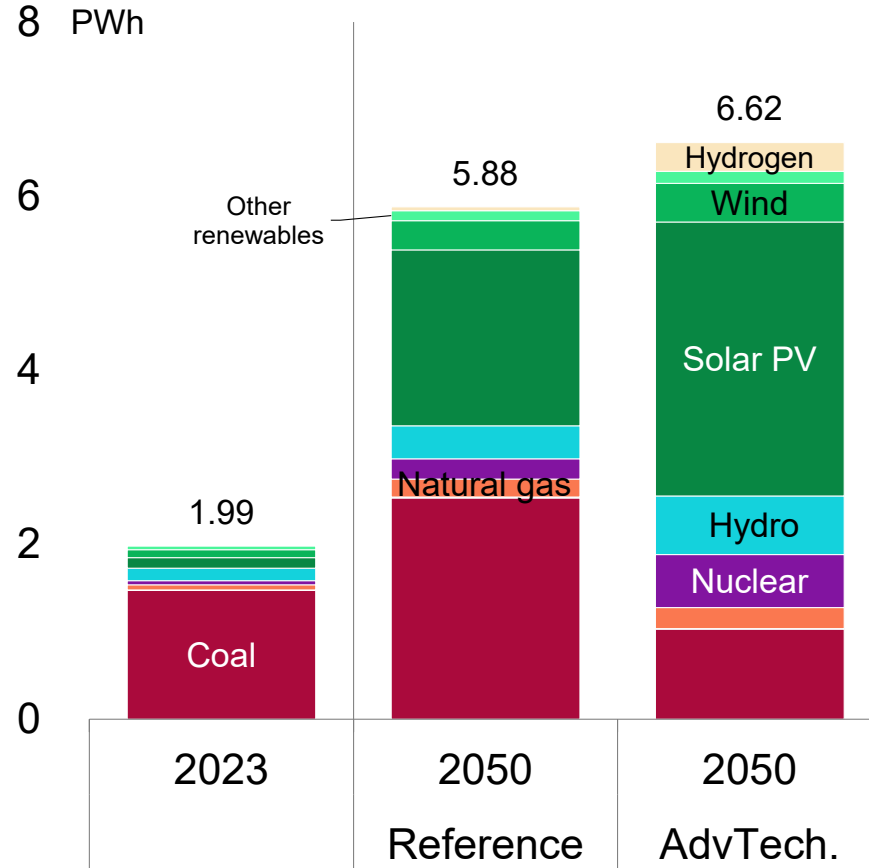


Challenges in Energy Supply and Demand Challenge (1): Rapid Increase in Power Demand

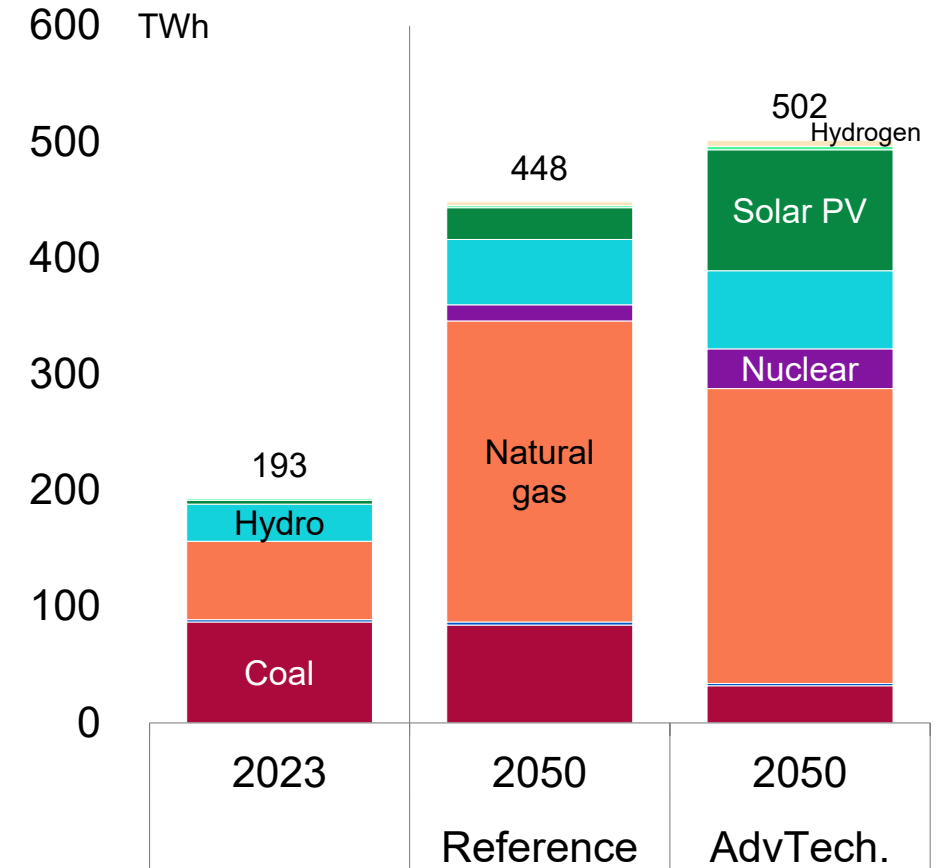
- Power generation will expand significantly in both regions.
- Rapid infrastructure development is essential, especially for both thermal power and renewables.

| Power Generation

India



Malaysia

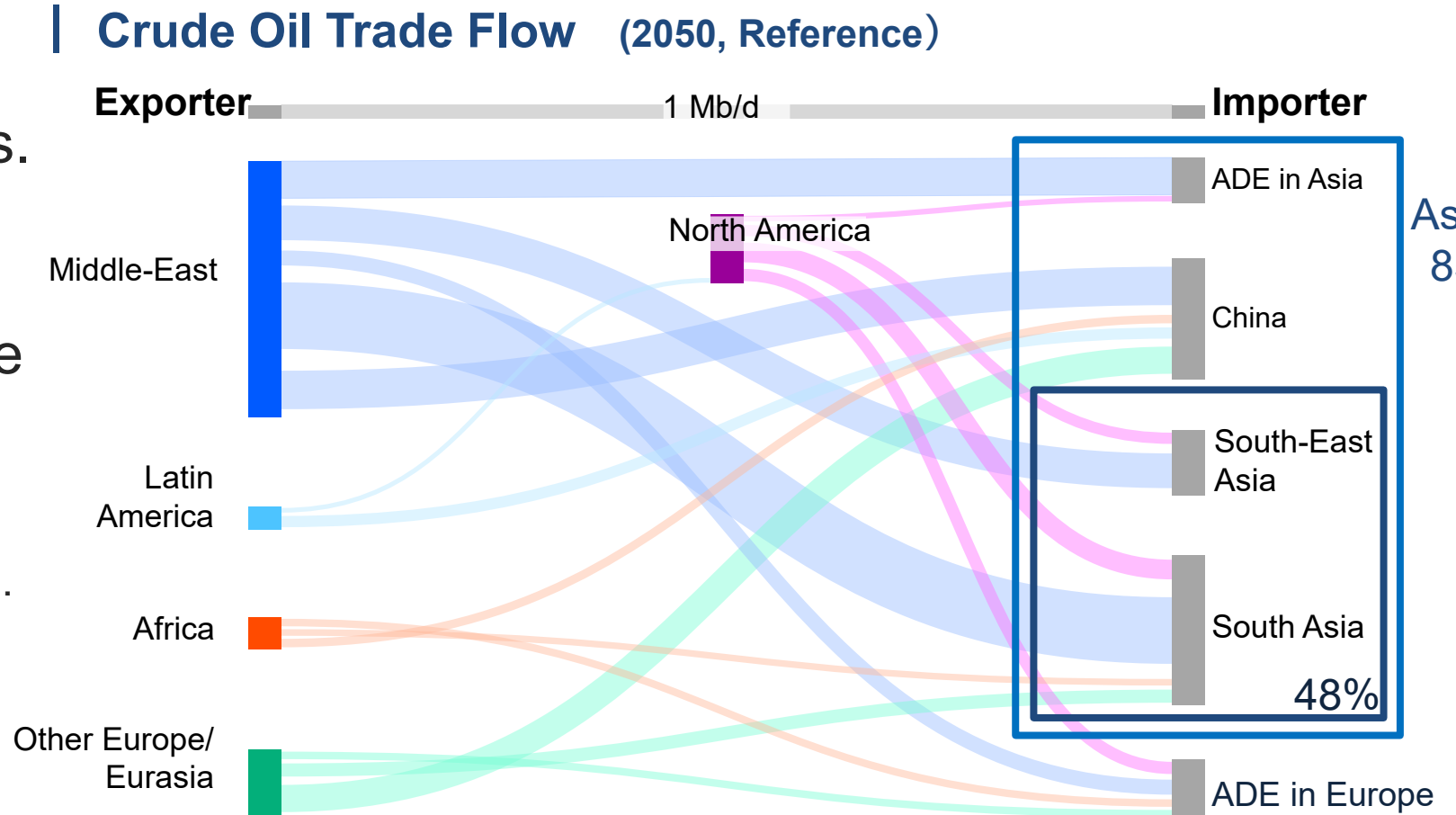


Challenges in Energy Supply and Demand (2): Rising Import Dependence on Fossil Fuel

■ Oil and gas demands increase, making ASEAN and India net fuel importers.

■ Asia's share of global crude trade rises sharply.

- **By 2050, 85% of interregional flows head to Asia,** over half to South/Southeast Asia.



Note: Shows flows of 0.5 Mb/d or greater.
Percentages represent the share of total inter-regional trade volume.

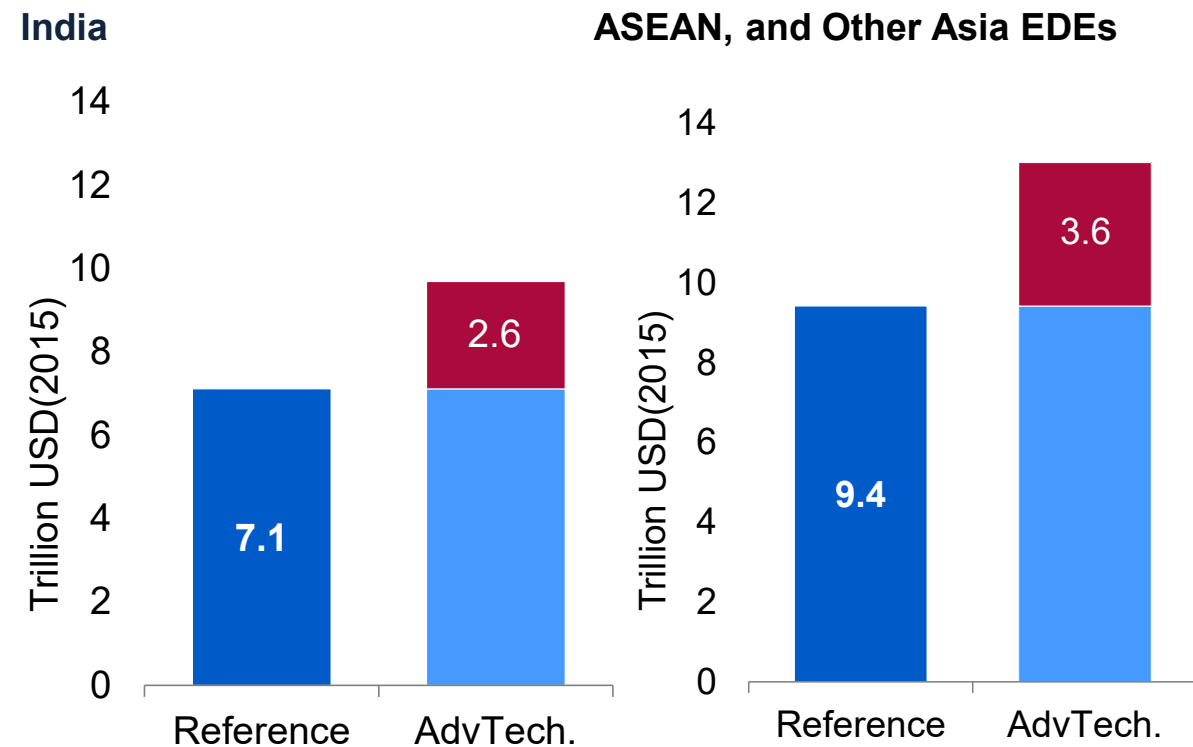
Challenges in Energy Supply and Demand (3): Investment for CO₂ Reduction

- ASEAN and India are key players for global decarbonization.
- On the other hand, substantial energy investment is required for **AdvTech**.

➤ **CO₂ Reduction Potential**
(gap between **Reference**.-**AdvTech**. in 2050)

- 1) India + ASEAN + Other Asia EDEs
- ≡ 2) All Advanced Economies
- ≡ 3) China
- ≡ 4) Rest of the World

| Energy Investments (Cumulative, 2024-2050)



- Global power demand surges through 2050, driven by economic growth, electrification, and expanding data centres.
 - **AdvTech.** sees +92% generation vs 2023 due to electrification, hydrogen, and CCS.
- Fossil fuel use, particularly oil, diverges widely across scenarios; ensuring fuel supply stability remains essential, even in energy transition pathway.
- India and ASEAN are the centres of future demand growth, facing three significant challenges:
 - 1. Managing rapidly rising power demand.
 - 2. Enhancing energy security in an import-dependent dependence on Fossil fuels.
 - 3. Securing investment for CO₂ reduction.

Thank you for your attention.

■ Further information of IEEJ Outlook 2026 is available on the [IEEJ website](https://www.iej.or.jp/en/outline).

Summary Report

Summary

Global energy supply and demand outlook to 2050

Energy demand will continue to rise until 2050 under current conditions.

This Outlook analyses global energy supply and demand projections through 2050 under two scenarios. Under the Reference Scenario, which assumes current policy and technological trends continue, global primary energy consumption will continue to grow steadily, primarily driven by Emerging and Developing Economies, increasing by 14% by 2050 compared to 2023 levels.

On the other hand, under the Advanced Technologies Scenario—which assumes the maximum deployment of various energy technologies to advance energy security and decarbonisation—emissions peak around 2030 before gradually declining, reaching a 6% reduction by 2050 compared to 2023 levels.

Under the Advanced Technologies Scenario, global CO₂ emissions will be reduced by 59% of current levels.

Projections for carbon dioxide (CO₂) emissions vary significantly between the scenarios. Under the Reference Scenario, global emissions remain largely unchanged from current levels until 2050. This is because emissions reductions in Advanced Economies are largely offset by increased emissions associated with economic growth in Emerging and Developing Economies.

Meanwhile, under the Advanced Technologies Scenario, global CO₂ emissions in 2050 would be reduced by 59% compared to 2023 levels. However, electrification remains challenging in non-power sectors, particularly industry (high-temperature heat) and transport (long-distance haulage), making decarbonisation in these sectors a major hurdle towards overall net-zero. Hydrogen and synthetic fuels represent promising alternatives, but high costs remain a challenge. Further technological advancement and cost reduction are essential going forward.

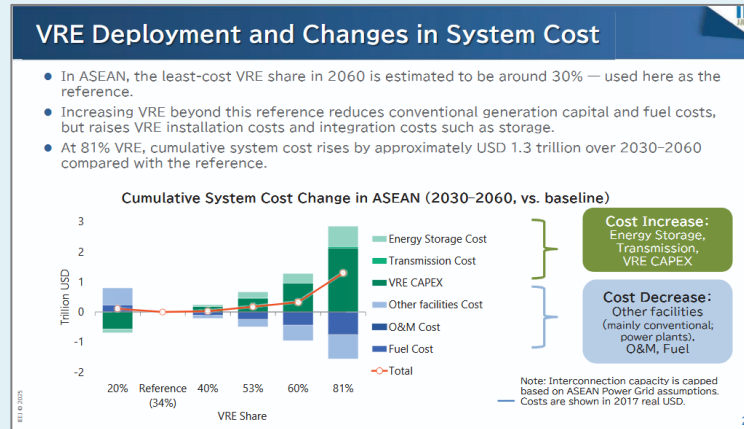
Significant increase in electricity demand and challenges to stable supply

Global electricity generation continues to increase substantially under both scenarios. The Reference Scenario projects a 66% increase compared to 2023 levels, while the Advanced Technologies Scenario anticipates nearly double the increase, driven by electrification and expanding demand for hydrogen and carbon capture and storage (CCS). This growth stems from the rapid expansion of data centres, currently attracting global attention, alongside industry sector growth centred on Emerging and Developing Economies and rising space heating and cooling demand in residential sector.

To meet this substantial increase in demand and ensure stable electricity supply, securing sufficient power generation capacity is essential. Solar photovoltaics and wind are expected to account for a large proportion of the overall increase in electricity generated. However, from around 2030, constraints such as a shortage of suitable sites and rising integration costs to manage supply fluctuations will become apparent. Consequently, investment in other

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Slide Materials



Global Energy Outlook:

- ✓ Key Points
- ✓ Reference Materials

Topics:

- ✓ VRE Integration Costs
- ✓ Climate Targets and Adaptation
- ✓ AI and Future of Energy Demand

Scenario Tables

Asia		Reference Scenario											
Primary energy consumption		(Million tonnes of oil equivalent (Mtoe))										CAGR (%)	
		1990	2000	2010	2023	2030	2035	2040	2045	2050	2023/1990	2030/1990	2050/1990
Total ¹⁾		2,073	2,839	4,758	6,869	7,301	7,595	7,865	8,137	8,340	3.7	0.8	0.6
Coal		785	1,033	2,400	3,422	3,081	2,915	2,829	2,771	2,650	4.6	-1.1	-0.7
Oil		618	918	1,171	1,576	1,702	1,750	1,810	1,863	1,903	2.9	0.8	0.5
Natural gas		116	234	454	739	884	983	1,089	1,206	1,325	5.8	2.3	2.0
Nuclear		77	132	152	206	282	313	344	371	403	3.0	3.1	1.6
Hydro		32	41	92	151	174	184	194	203	212	4.8	1.5	0.9
Geothermal		8.2	23	30	61	86	152	165	171	176	6.3	6.0	0.6
Solar, wind, etc.		1.3	2.1	16	195	533	715	830	932	1,036	16.4	8.9	2.2
Biomass and waste		435	456	444	518	558	580	597	609	620	0.5	0.8	0.4
Hydrogen		-	-	-	-	0.8	3.0	7.7	11	15	n.a.	n.a.	6.7
Renewables and waste		-	-	-	-	0.8	3.0	7.7	11	15	n.a.	n.a.	6.7
Shares (%)		100	100	100	100	100	100	100	100	100	100	100	100
Final energy consumption		(Mtoe)										CAGR (%)	
		1990	2000	2010	2023	2030	2035	2040	2045	2050	2023/1990	2030/1990	2050/1990
Total		1,515	1,952	3,128	4,280	4,774	4,996	5,179	5,350	5,488	3.2	1.1	0.6
Coal		423	372	885	746	757	729	702	678	654	1.7	-0.4	-0.7
Oil		465	743	992	1,405	1,524	1,569	1,625	1,675	1,714	3.4	0.9	0.5
Natural gas		46	90	201	414	483	517	540	555	561	6.9	1.6	0.4
Electricity		157	279	575	1,107	1,370	1,537	1,681	1,827	1,962	6.1	2.5	1.6
Heat		14	30	70	204	249	252	240	224	205	8.4	1.0	-1.6
Hydrogen		-	-	-	-	0.2	0.2	0.8	2.2	3.9	n.a.	n.a.	17.5
Renewables and waste		409	437	405	403	389	393	390	390	388	0.0	-0.2	-0.1
Shares (%)		100	100	100	100	100	100	100	100	100	100	100	100

- ✓ Primary Consumption
- ✓ Power Generation Mix
- ✓ CO₂ Emissions
- ✓ Key Assumptions
- etc.