

Decarbonization Challenge And Energy Security

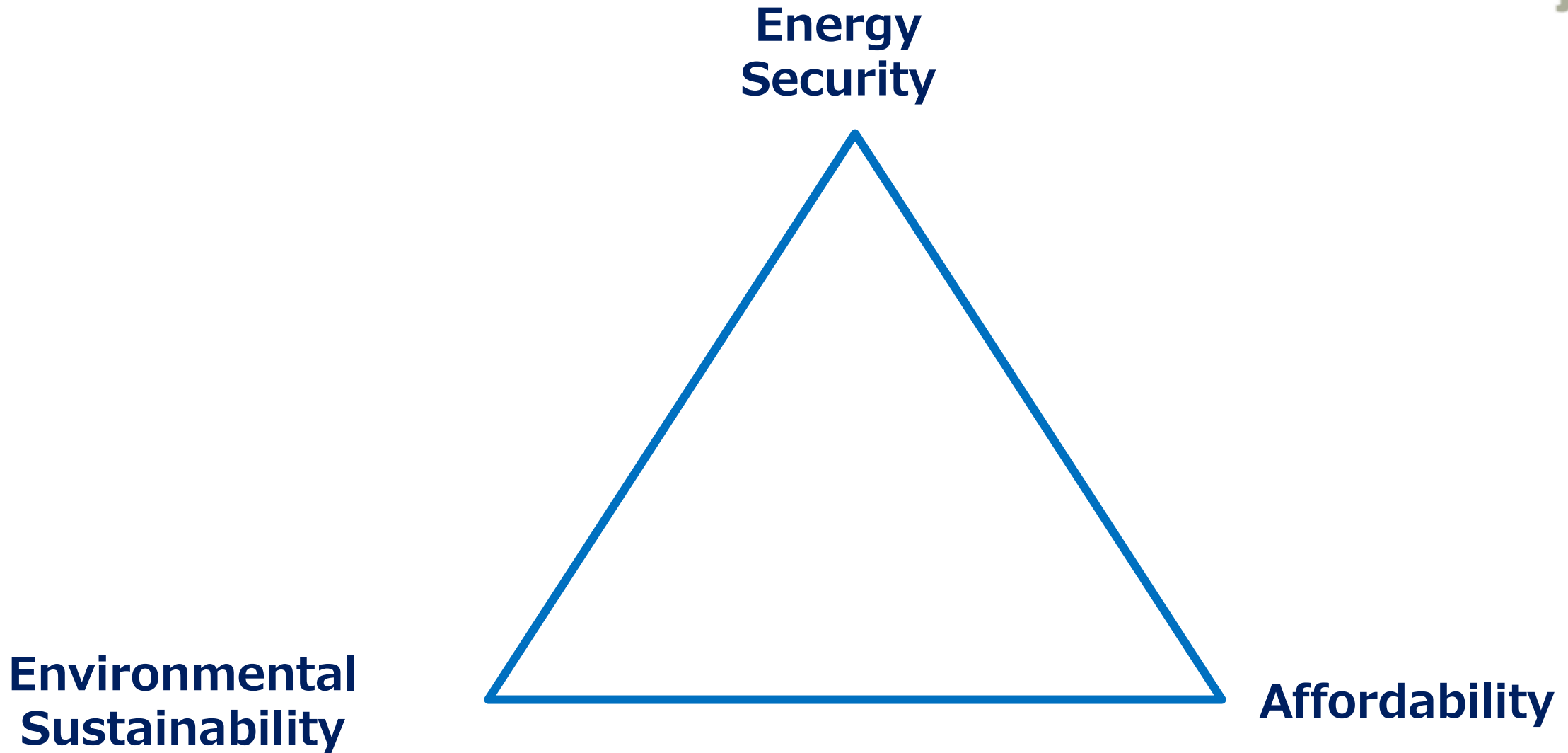
6 September 2023

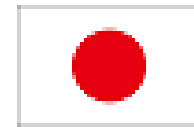
Yukari Yamashita

Managing Director

The Institute of Energy Economics, Japan

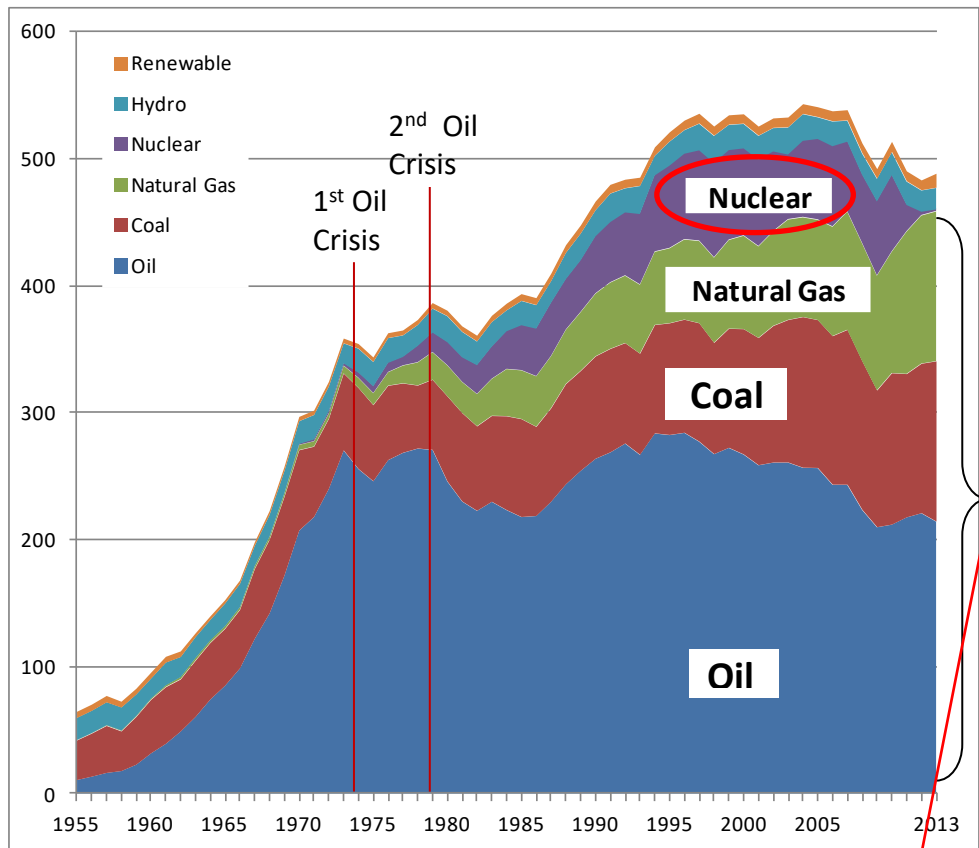
The Energy Trilemma or 3E





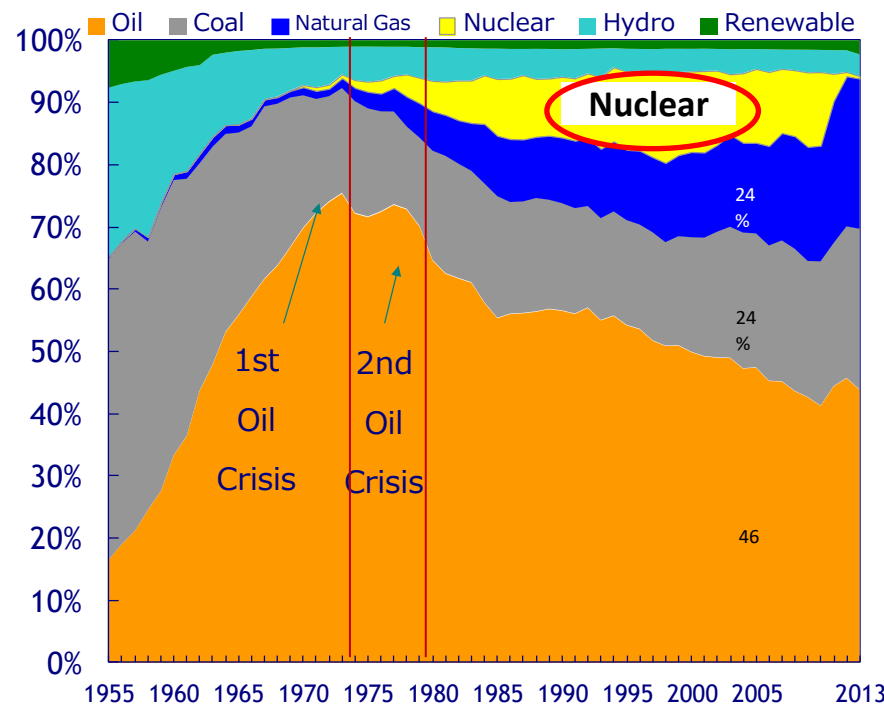
Diversification of Energy Supply Became Important after Oil Crises

Primary Energy Supply Trend of Japan (1955-2013)



High dependence on imports

	1955	1973	2011	2013
				(%)
Oil	17%	75%	44%	44%
Coal	48%	17%	23%	26%
Gas	0%	2%	23%	24%
Nuclear	0%	1%	4%	0%
Hydro	27%	4%	4%	3%
Renewables	8%	1%	2%	2%



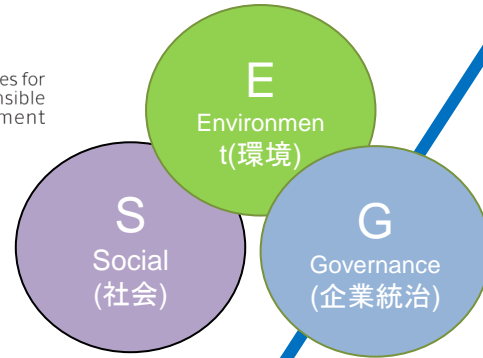
50 years later, We are Facing the Energy Trilemma again

Energy Security



PRI Principles for Responsible Investment

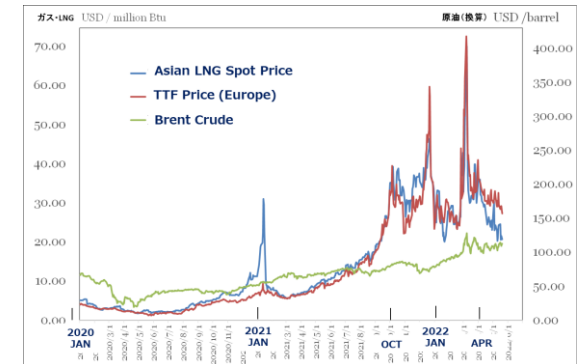
TCFD TASK FORCE ON CLIMATE-RELATED FINANCIAL DISCLOSURES



Environmental Sustainability



Affordability



5

Crude Oil Price, Natural Gas / LNG Spot Price

Gas Price in Europe Hit over 400 USD/BBL. Asian LNG Spot Price Hiked.

ガス・LNG USD / million Btu

原油(換算) USD /barrel

- Asian LNG Spot Price
- TTF Price (Europe)
- Brent Crude

Date	Asian LNG Spot Price (USD / million Btu)	TTF Price (Europe) (USD / barrel)	Brent Crude (USD / barrel)
2020 JAN	~5.00	~20.00	~12.00
2020 JUN	~5.00	~2.00	~7.00
2020 NOV	~10.00	~5.00	~8.00
2021 FEB	~32.00	~10.00	~10.00
2021 JUN	~15.00	~10.00	~12.00
2021 OCT	~35.00	~25.00	~15.00
2022 JAN	~45.00	~35.00	~18.00
2022 APR	~25.00	~30.00	~20.00

(出所) 各種資料等よりエネ研作成

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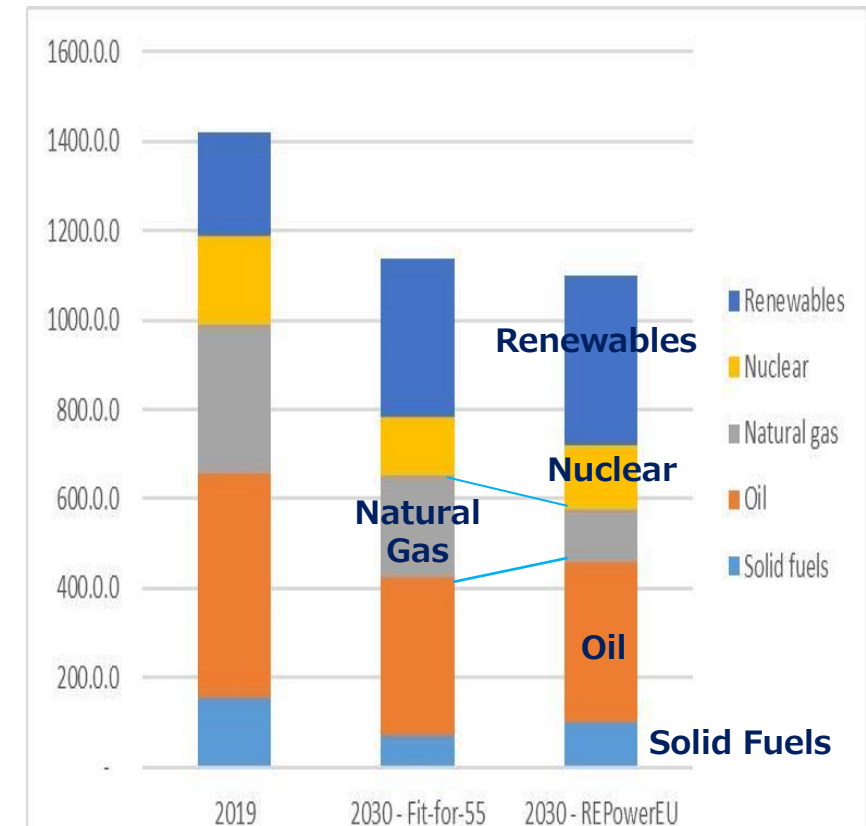
G7: Energy Self-Sufficiency & Dependency on Russian Energy

- Dependency on Russia is high for Germany and Italy.
- Europe is important importer for Russia (Oil: 53%, Gas:78%, Coal:35%)

国名	Energy Self Sufficiency (2020)	Dependency on Russia		
		Oil	Natural Gas	Coal
Japan	11% (石油:0% ガス:3% 石炭0%)	4% (シニア5位)	9% (シニア5位)	11% (シニア3位)
USA	106% (石油:103% ガス:110% 石炭:115%)	1%	0%	0%
Canada	179% (石油:276% ガス:13% 石炭:232%)	0%	0%	0%
UK	75% (石油:101% ガス:53% 石炭:20%)	11% (シニア3位)	5% (シニア4位)	36% (シニア1位)
France	55% (石油:1% ガス:0% 石炭:5%)	0%	27% (シニア2位)	29% (シニア2位)
Germany	35% (石油:3% ガス:5% 石炭:54%)	34% (シニア1位)	43% (シニア1位)	48% (シニア1位)
Italy	25% (石油:13% ガス:6% 石炭:0%)	11% (シニア4位)	31% (シニア1位)	56% (シニア1位)

REPowerEU

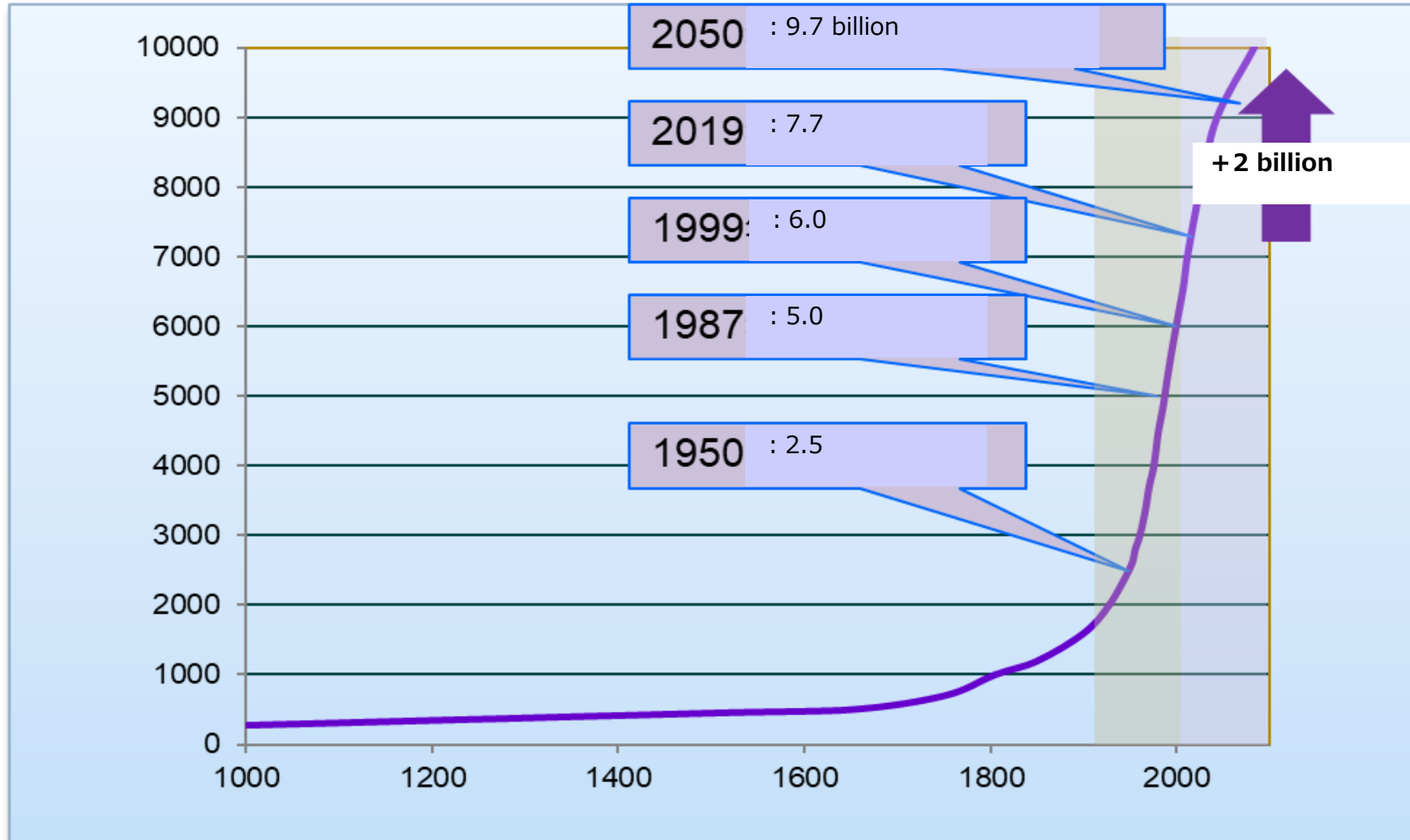
- Natural Gas Reduction: Less import from Russia. More coal use in power generation.



(Source) European Commission, SWD(2022)

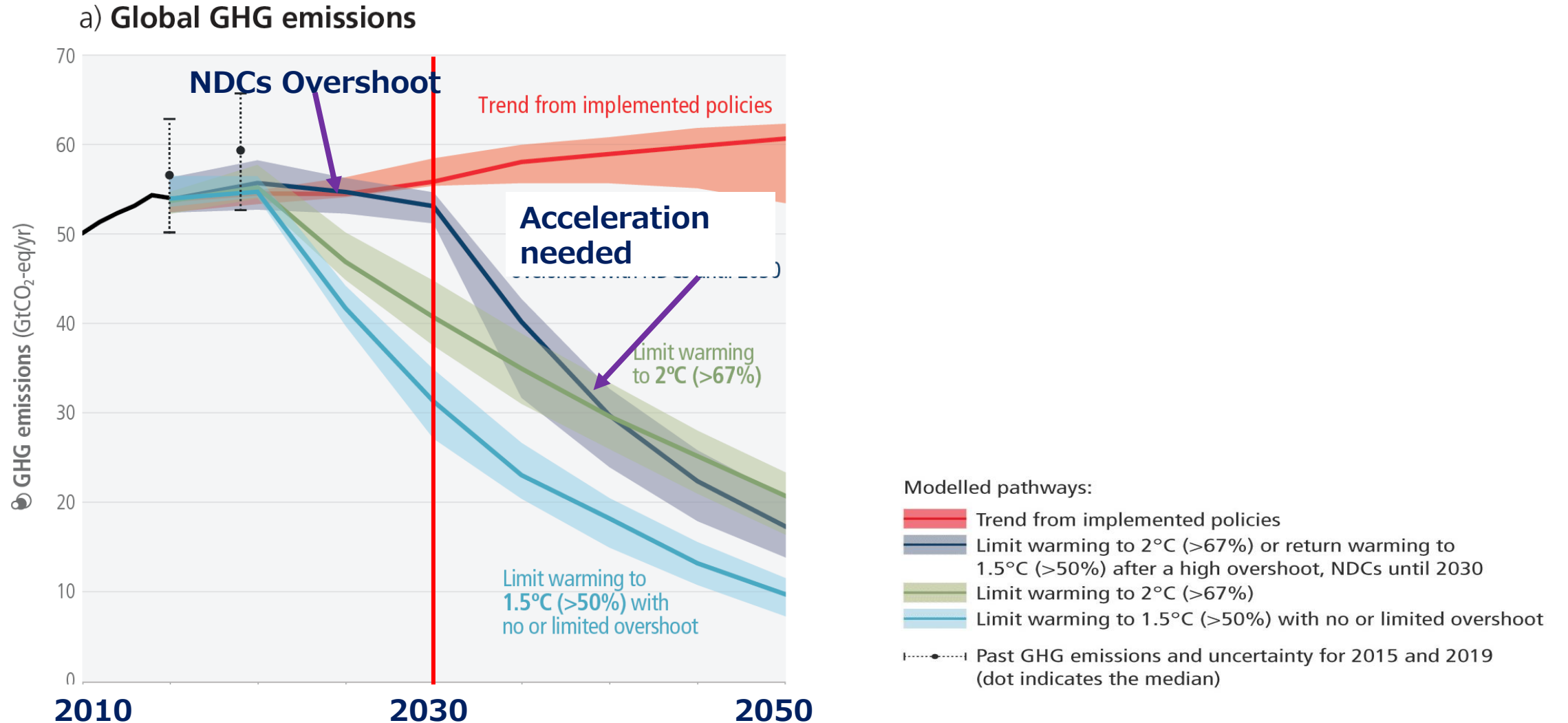
3 Billion More People Need Access to Energy

Rapid World Population Increase since 20th Century



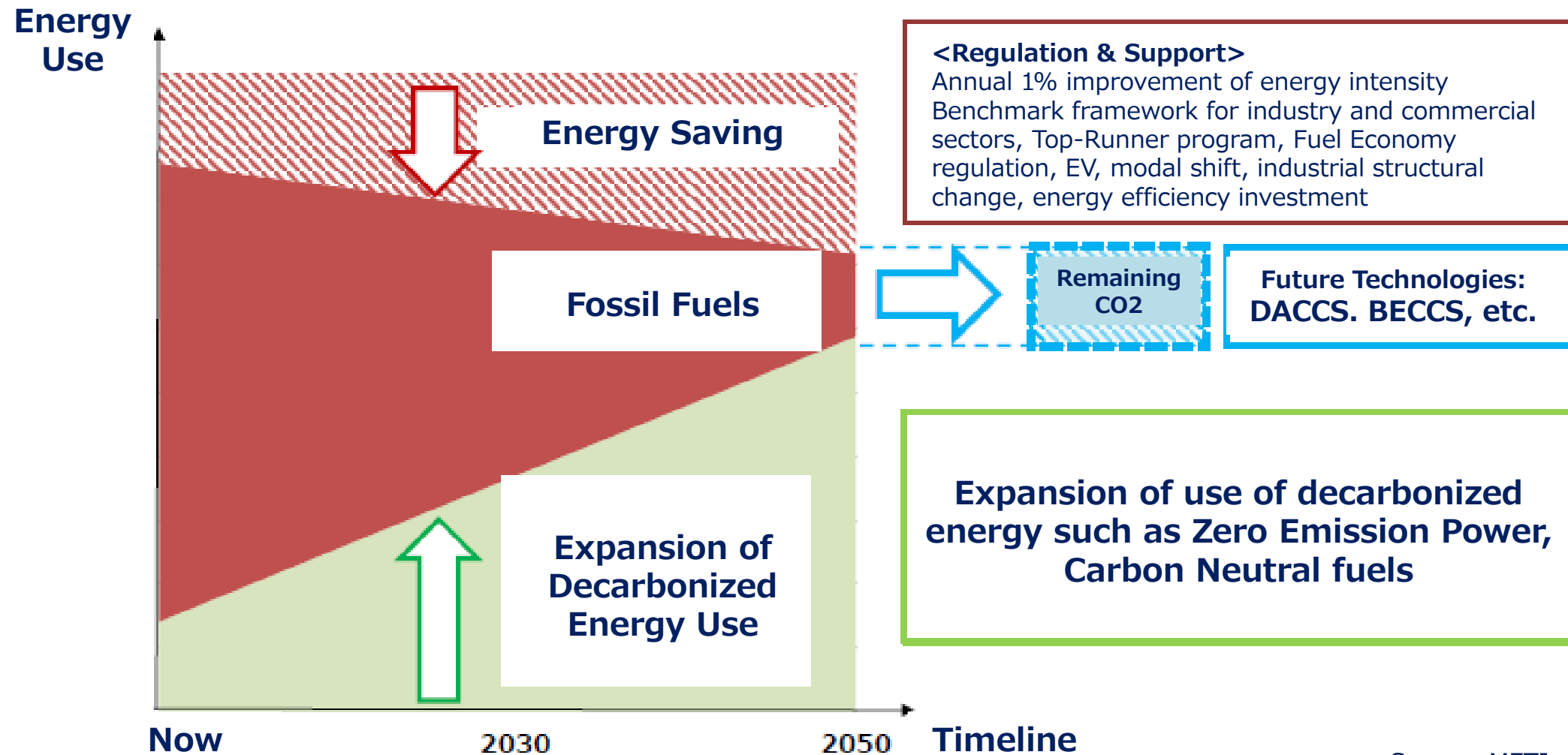
Source: UN

Accelerated Reduction Needed even before 2030



Source: AR6 WG3 Figure SPM 4

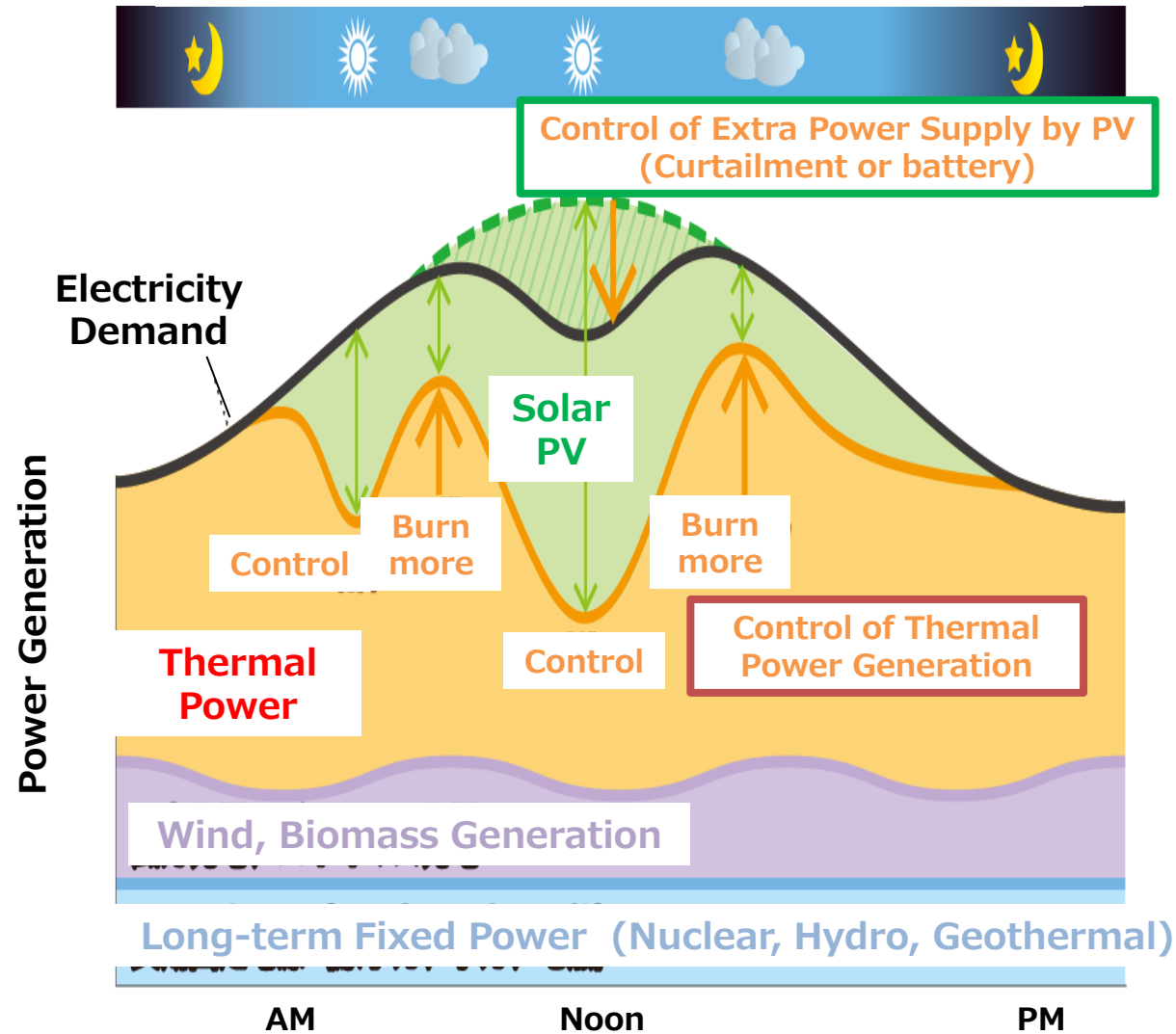
Basic Concept for Achieving the CN Target



Source: METI

Keep an Eye on Electricity Security

Image of Power Generation Mix

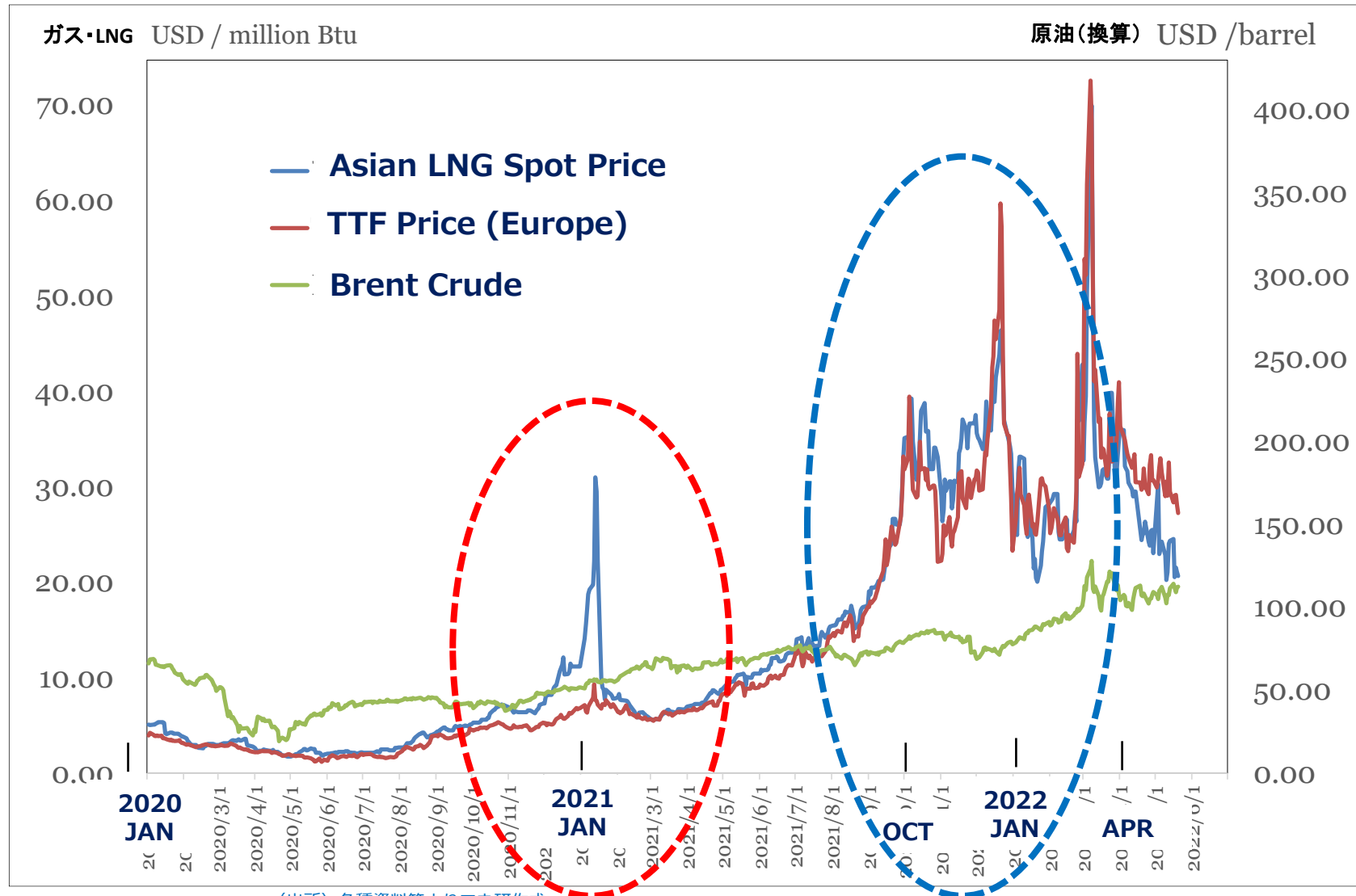


Electricity supply and demand must always be balanced.

Urgent subjects are technical study on frequency, voltage, transient stability, etc. under massive introduction of variable power sources.

Crude Oil Price, Natural Gas / LNG Spot Price

Gas Price in Europe Hit over 400 USD/BBL. Asian LNG Spot Price Hiked.



Promotion of Nuclear Power & Renewable Power

25 countries

To Use in the Future

- | | | |
|--|--|--|
| <ul style="list-style-type: none"> USA (93) France (56) China (54) Russia (38) India (23) Canada (19) Ukraine (15) UK (11) Sweden (8) Check Republic (6) | <ul style="list-style-type: none"> Pakistan (5) Slovakia (4) Finland (4) Hungary (4) Argentina (3) South Africa (2) Brazil (2) Bulgaria (2) Mexico (2) Netherlands (1) | <ul style="list-style-type: none"> Alemannia (1) Iran (1) UAE (2) Belarus (1) Japan |
|--|--|--|

5 countries

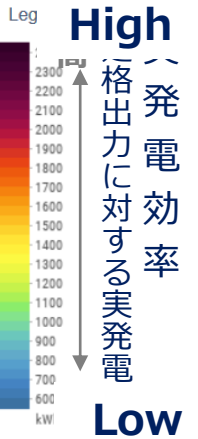
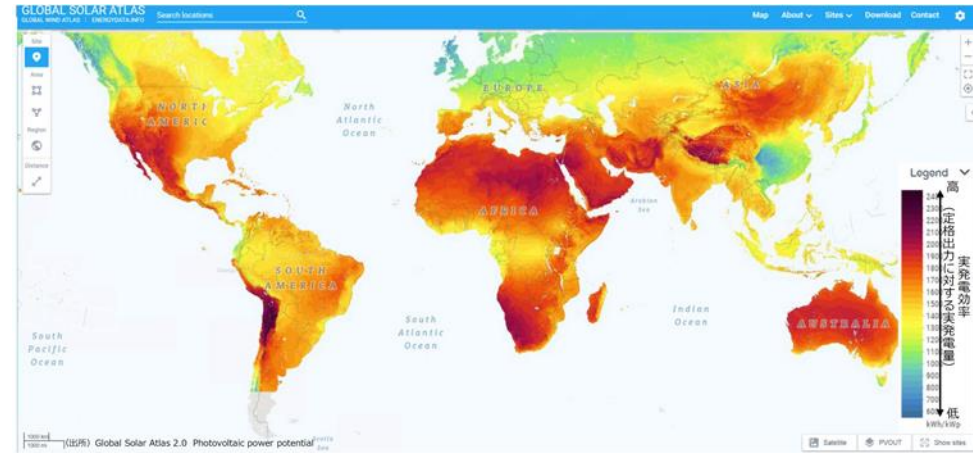
Currently in Use

- | | |
|--|---|
| <ul style="list-style-type: none"> Korea (24) Germany (3) Belgium (7) Chinese Taipei (4) Switzerland (4) | <p>To be closed past 2080</p> <p>Closed by 2025</p> <p>Closed by 2025 → by 2035 or later</p> <p>Not specified</p> <p>Not specified</p> |
|--|---|

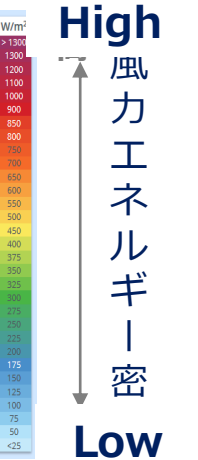
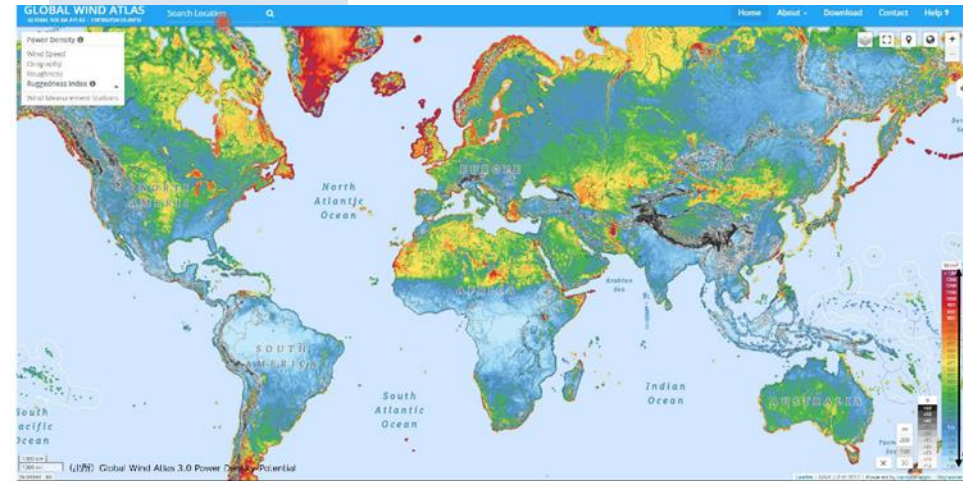
Korea continues to construct 4 new reactors

Not To Use In the Future

PV Potential



Wind Potential

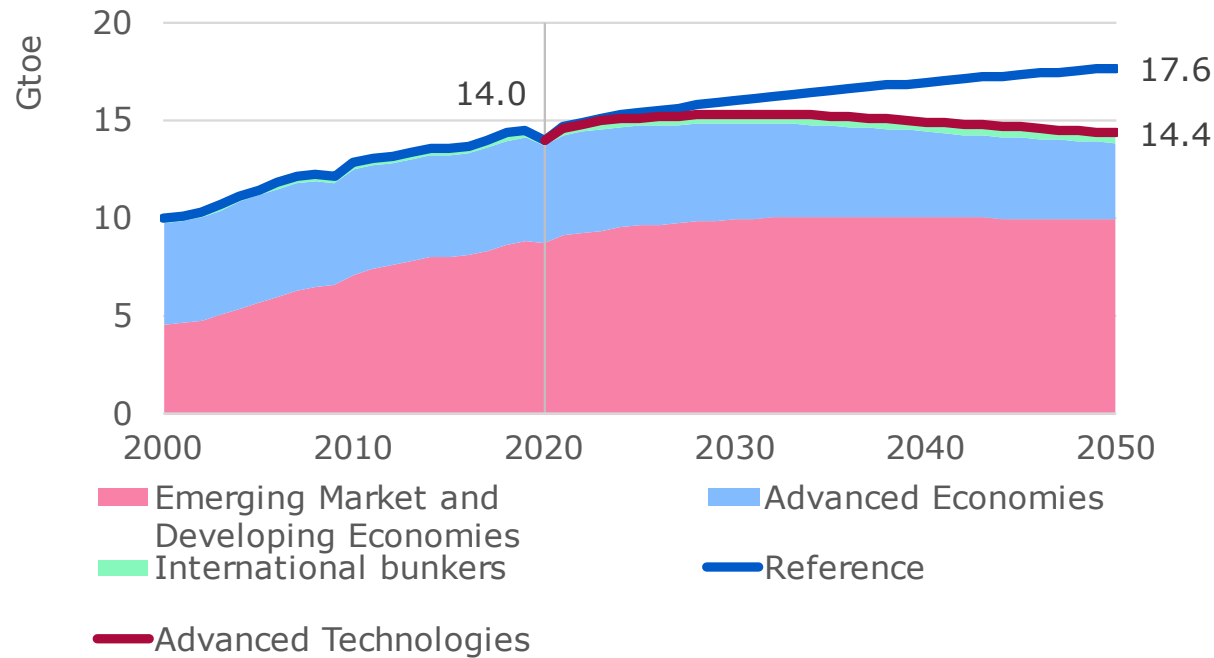


(出所) 経済産業省 貿易経済協力局「～エネルギー・電力～事務局資料」(資料2) 第1回インフラ海外展開懇談会、2020年4月24日

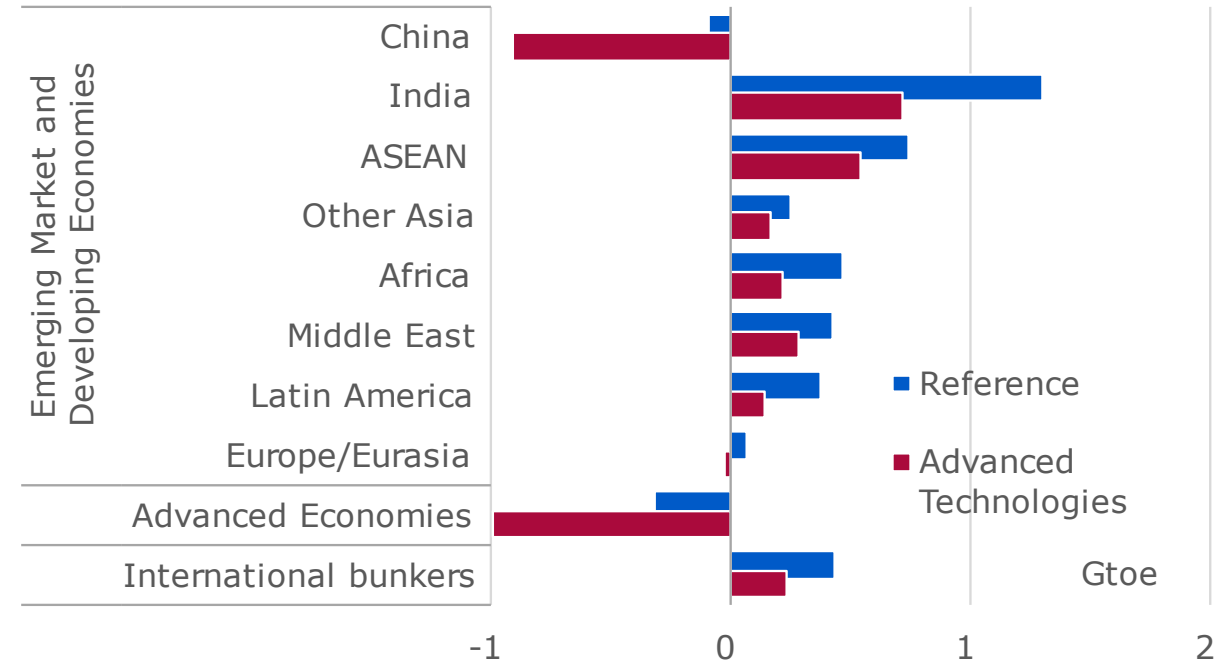
Source : IAEA Power Reactor Information System, etc. (16 February 2022)

Increase in energy demand centring on India and ASEAN

Primary energy demand outlook



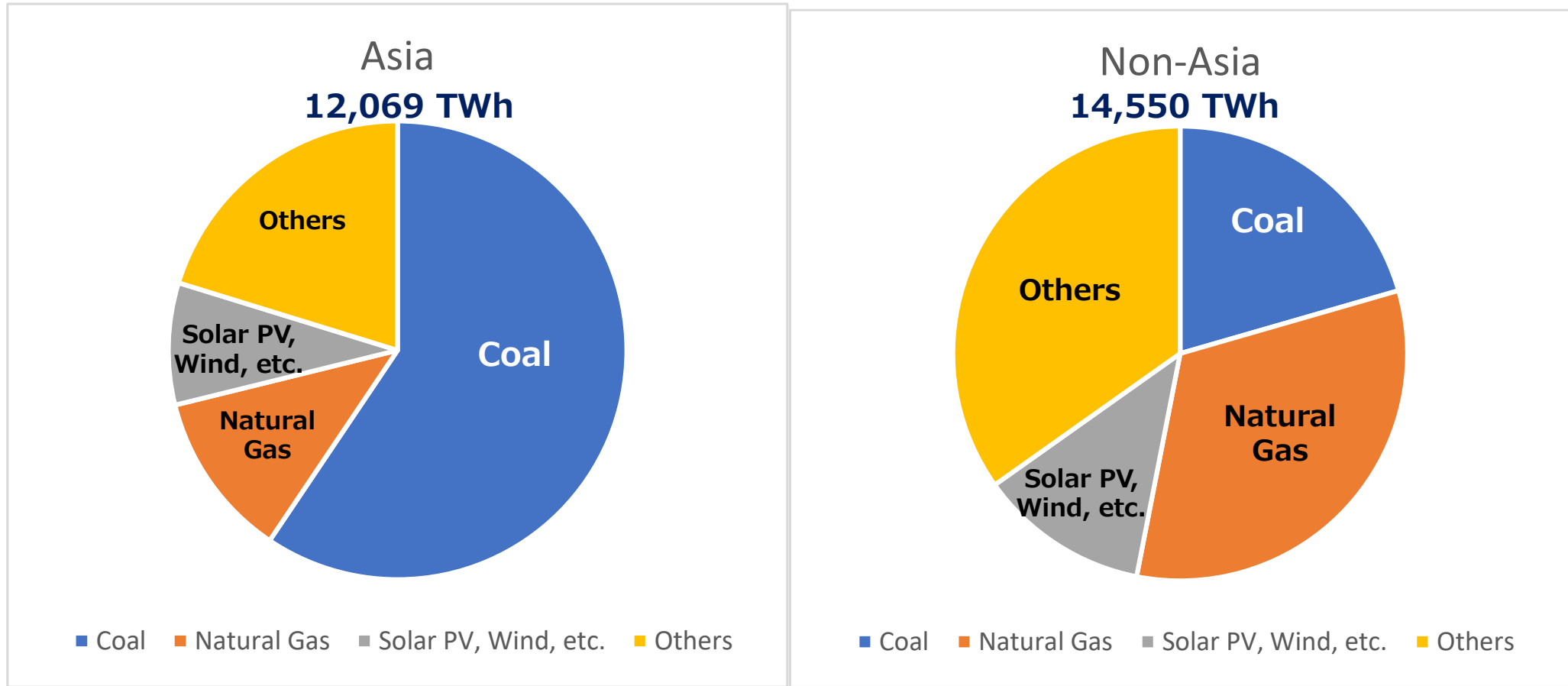
Changes in primary energy demand (2020-2050)



Source: IEEJ Outlook 2022

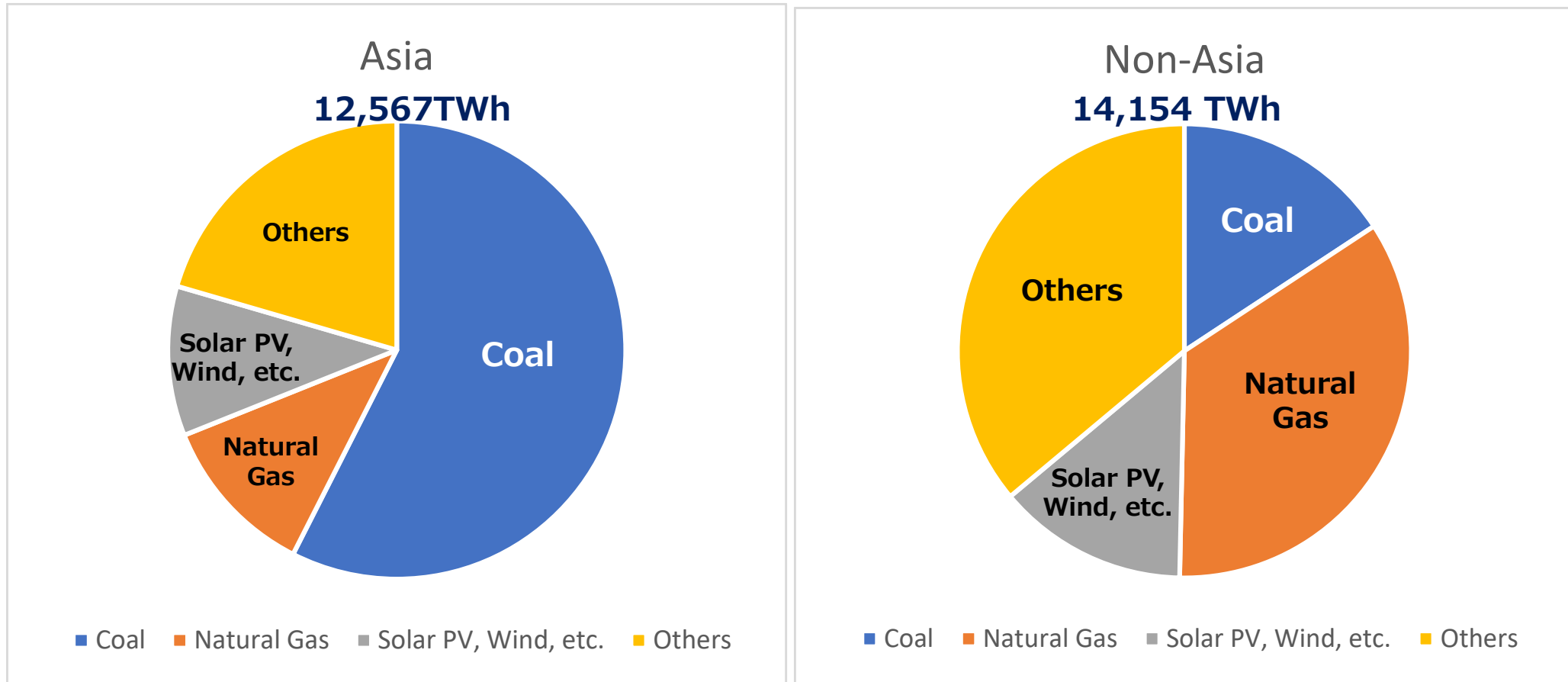
Coal still plays a major role in power generation, especially in Asia

❖ Power generation mix (2018)

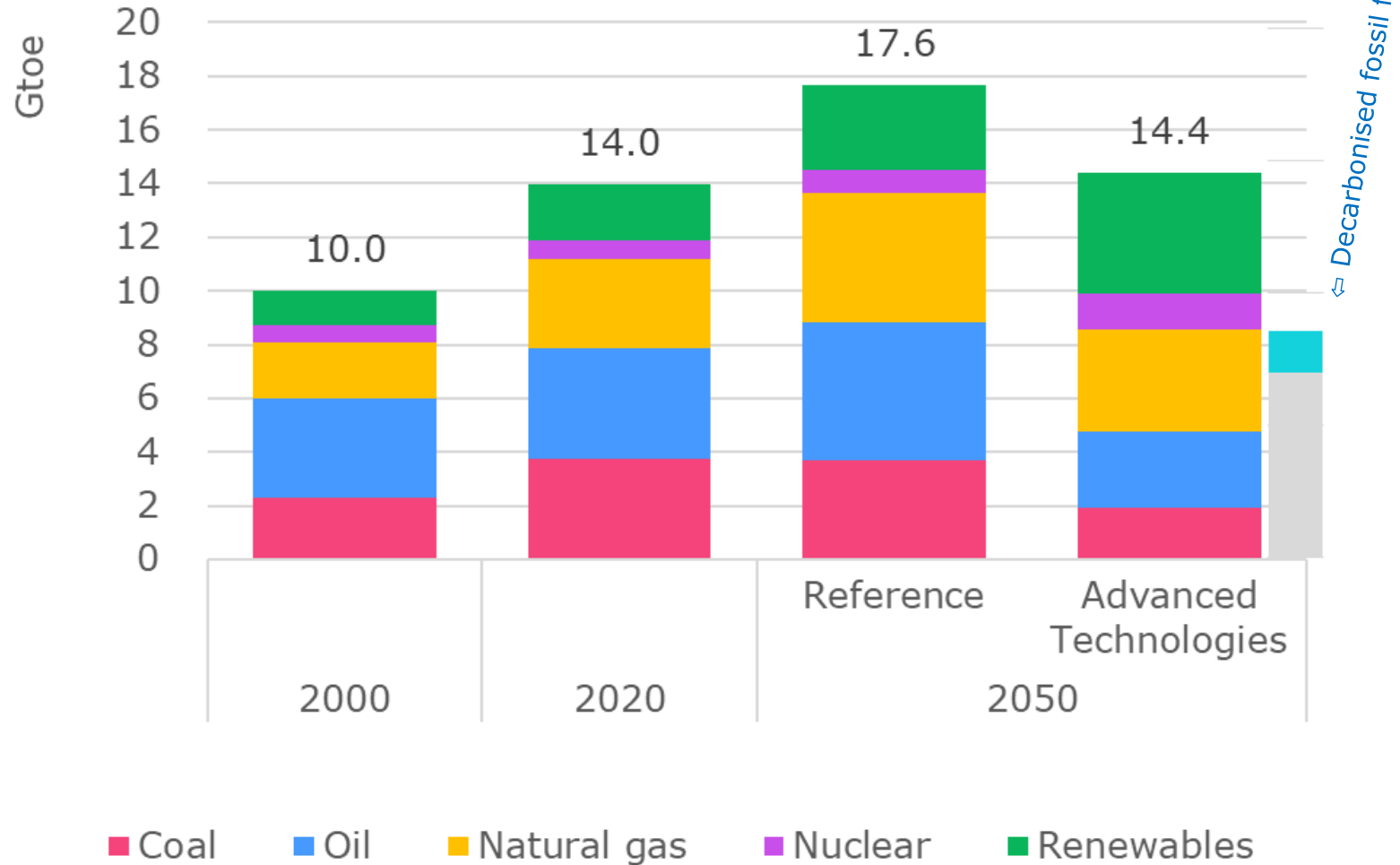


Coal in Asia Increased while Coal in Non-Asia Decreased

❖ Power generation mix (2020)



Primary energy demand outlook

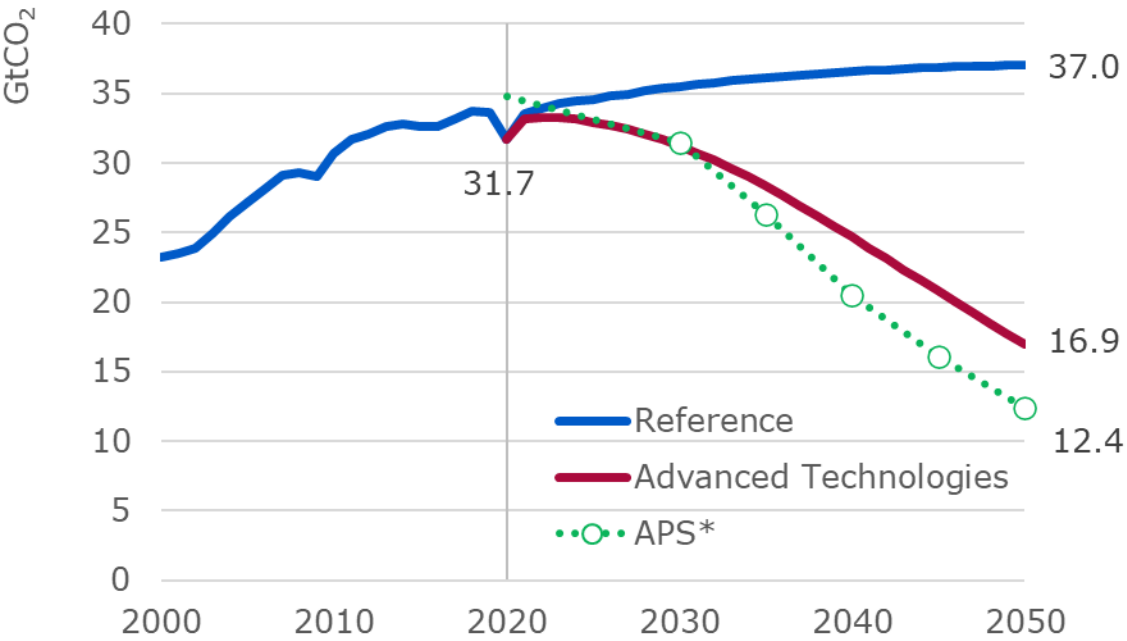


Source: IEEJ Outlook 2022

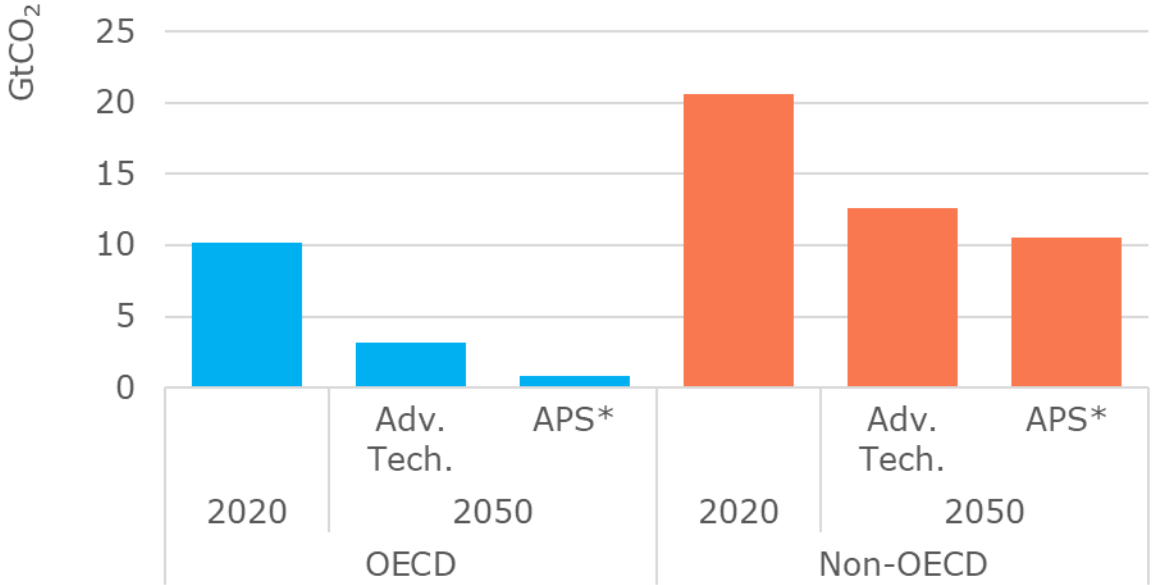


Emerging Market and Developing Economies key to achieving NZ

Energy-related CO₂ emissions outlook



CO₂ emissions outlook by region

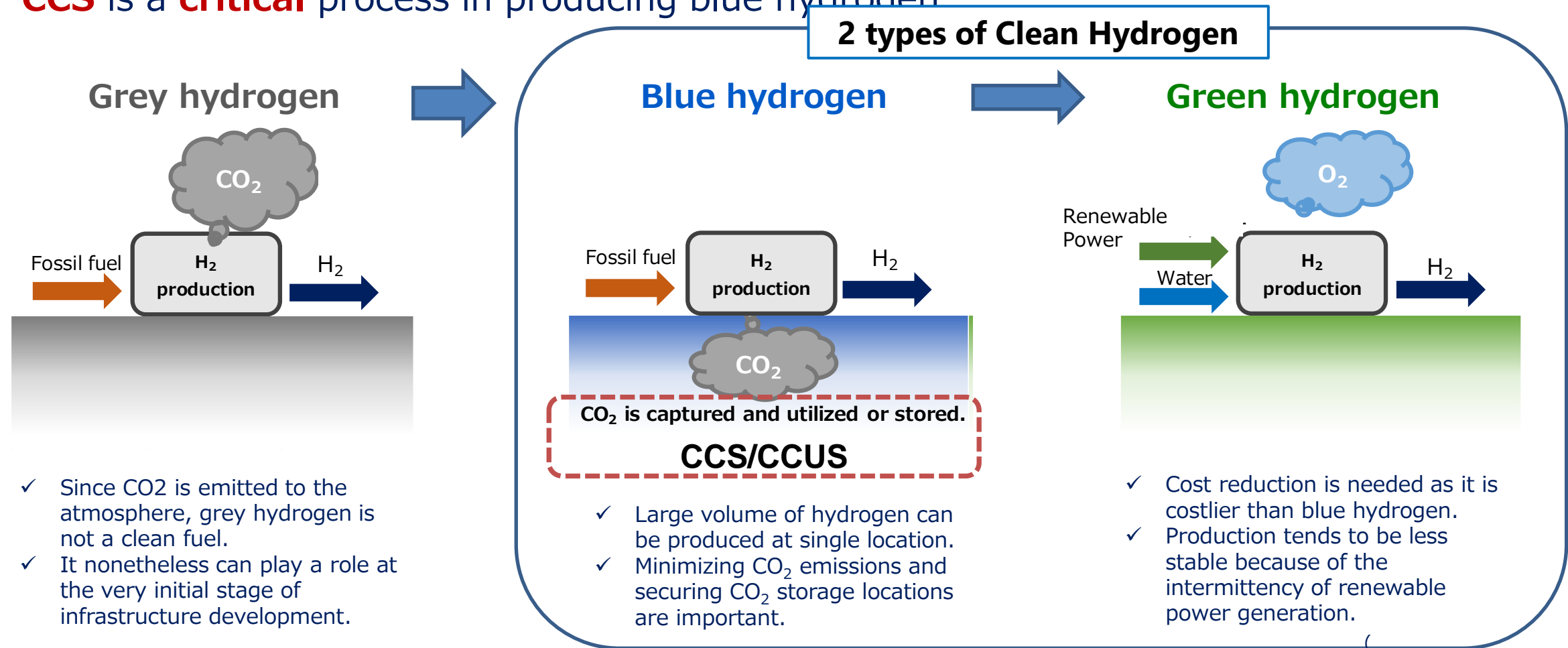


*APS: Announced Pledges Scenario, estimates when countries' stated policy goals are realised. Includes industrial processes. IEA "World Energy Outlook 2022" (October 2022).

Source: IEEJ Outlook 2022

Expectation towards Clean Hydrogen

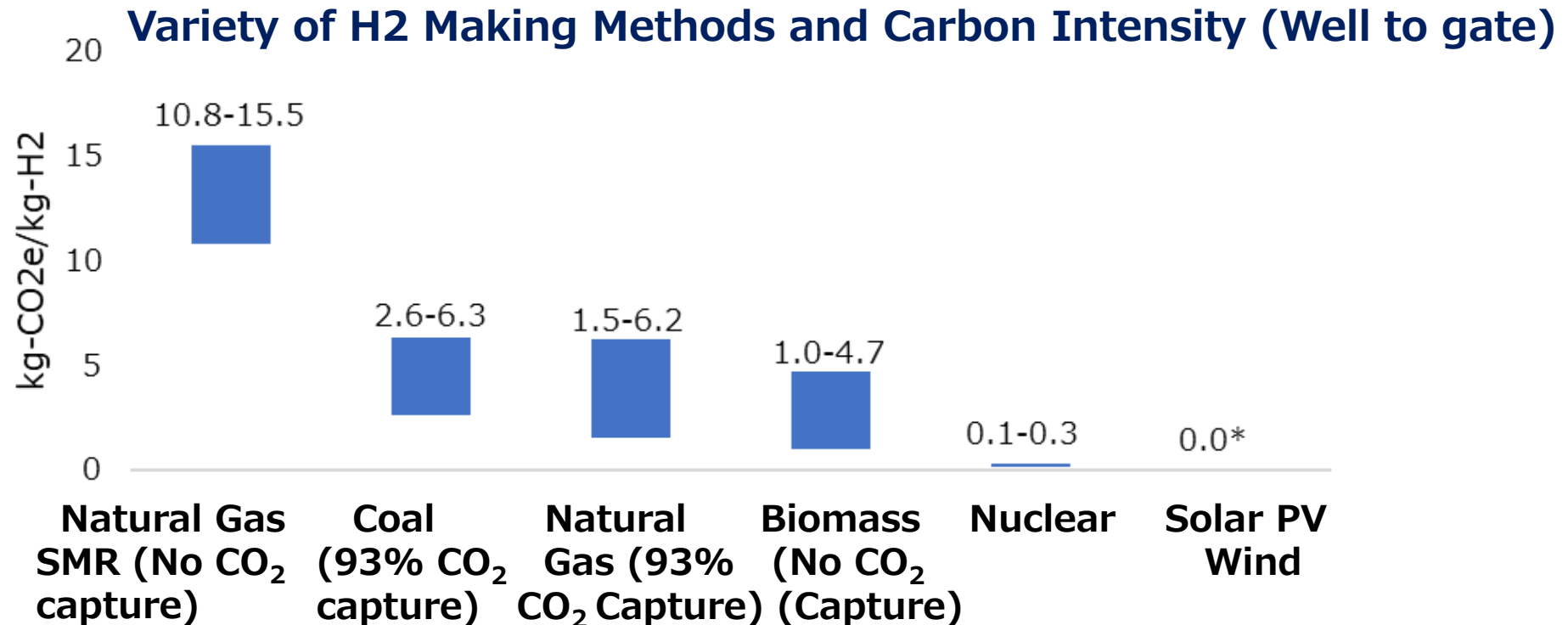
- **Clean hydrogen** can be produced from both fossil fuel (with CCS, blue hydrogen) and renewable energy (**green hydrogen**)
- **CCS** is a **critical** process in producing blue hydrogen



Hydrogen: Important is “Carbon Intensity” not Colors

Hiroshima Leaders’ Communiqué

- ◆ We affirm the importance of developing international standards and certification including for a GHG calculation methodology for hydrogen production and mutual recognition mechanism for carbon intensity-based tradability, transparency, trustworthiness and sustainability.



Source : Prepared by Yoshikazu Kobayashi based on IEA (2023), Towards Hydrogen Definitions based on Their Emissions Intensity, pp39-43 (444th Research Meeting, 25 July 2023)

1. **Climate Change** has been the top priority in the world up to COP26 with **CN declarations**.
2. **In 2021**, many countries around the world had **difficulties meeting electricity demand** with sufficient power supply. **Natural gas demand surged in Europe** to fill in the supply shortage and resulted in **gas price hike around the world**. With Ukrainian Crisis **in 2022**, the world come to recognize long forgotten **geopolitical risks** and importance of **energy security**.
3. **NDCs for 2030 are not sufficient** to meet the **2050 CN target** unless harder efforts are to be realized beyond 2030.
4. The world needs to find **a balance among 3Es** or **Energy Trilemma** going back to **the basic**. Each country needs to find own **portfolio** rather than just depends on one energy or on one country. Adding nuclear as a clean option has become more relevant to many countries. Challenges for developing countries to achieve **energy transition** to reach CN need to be recognized and be addressed.
5. With challenges in changing energy systems, fossil fuels still have some role during transition. More efficient use of materials as well as energy, creation and strengthening of **recycling** systems, **acceleration of technology innovation** such as use of **hydrogen, ammonia, CCUS** and **CDR**, and **cost reduction** are essential for **energy transition**.