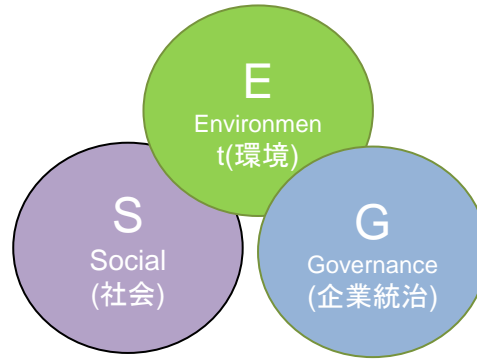
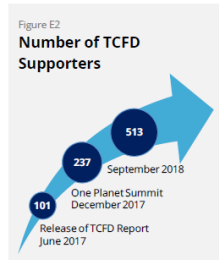


Challenges of the Global Energy Situation

September 5, 2022

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Managing Director

The Institute of Energy Economics, Japan



- ◆ Nov. 2021 at COP26 Global Coal to Clean Power Transition Statement
- ◆ Phase down of coal thermal power generation
- ◆ Inclusion of “acceleration of efforts to phase out of subsidies for fossil fuels” in Glasgow Climate Pact

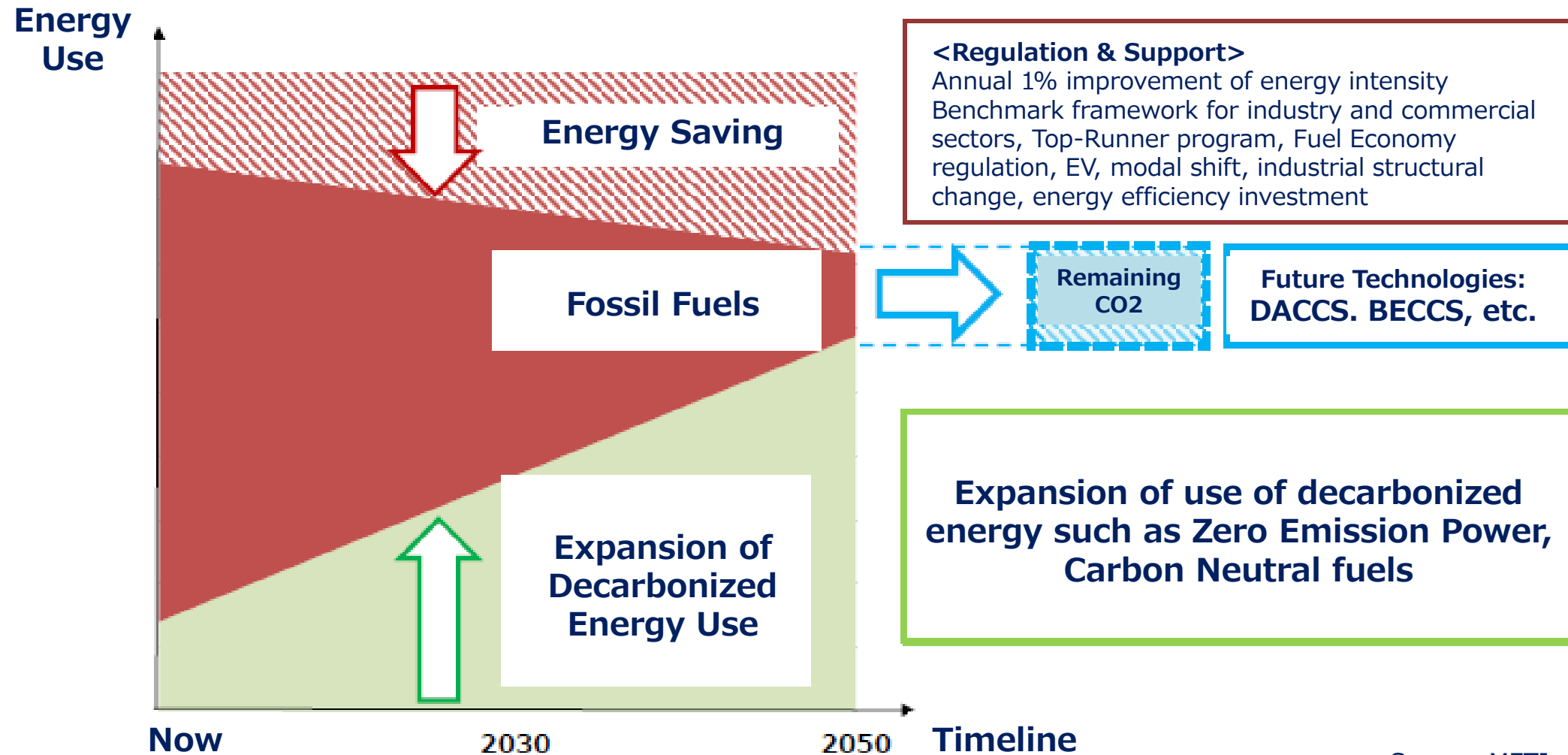
October 2018~

The REVOLT against energy taxes is worldwide.
Carbon taxes are inherently regressive and hurt the poor the most.

Protests from the youth (2018-2019)

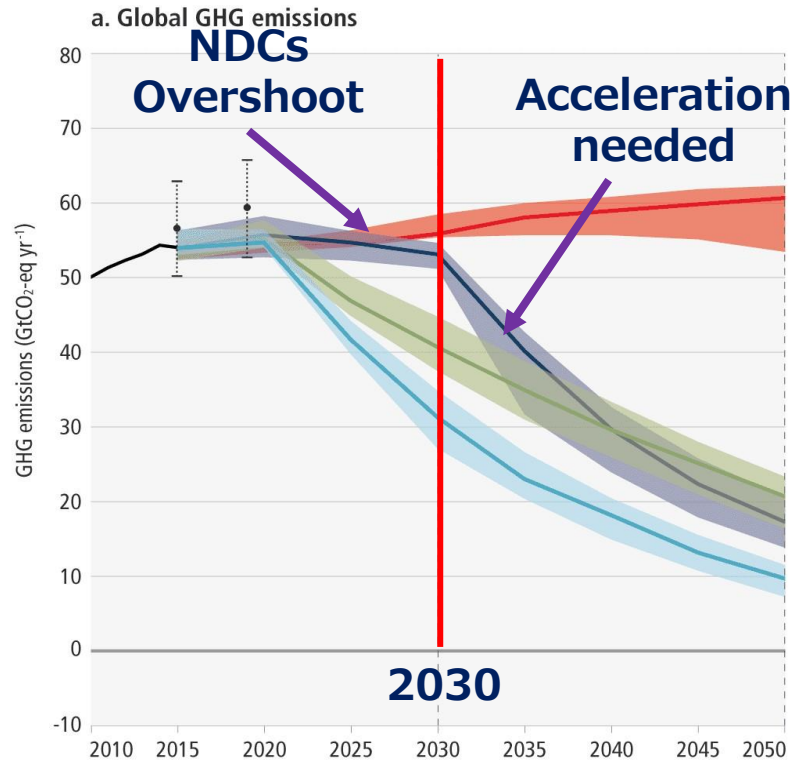


Basic Concept for Achieving the CN Target



Source: METI

Accelerated reduction needed after 2030



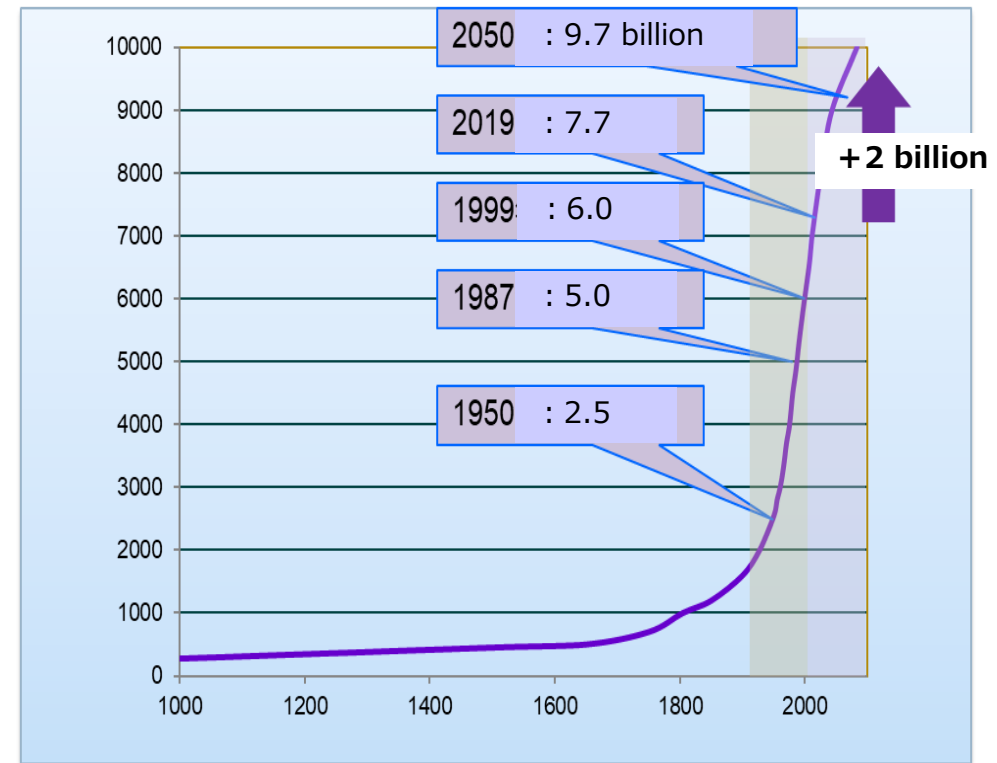
Modelled pathways:

- █ Trend from implemented policies
- █ Limit warming to 2°C (>67%) or return warming to 1.5°C (>50%) after a high overshoot, NDCs until 2030
- █ Limit warming to 2°C (>67%)
- █ Limit warming to 1.5°C (>50%) with no or limited overshoot

⋮ Past GHG emissions and uncertainty for 2015 and 2019 (dot indicates the median)

Source: AR6 WG3 Figure SPM 4

Rapid World Population Increase since 20th Century



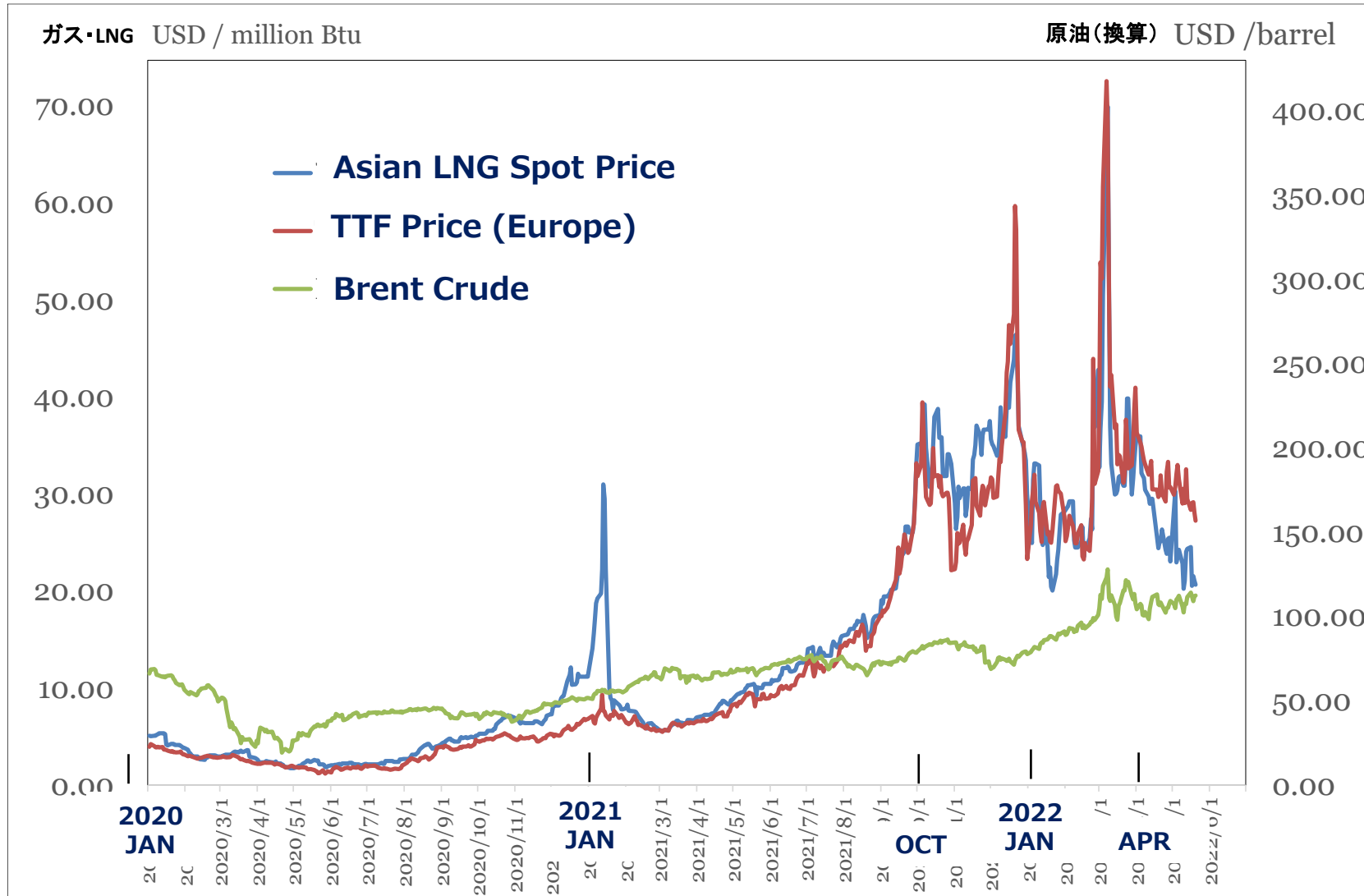
Source: UN

Many Challenges (2021~2022)

- **COVID** stays delaying full economic recovery
- **Climate change** remains an important issue to tackle
- **Power supply shortage** has become an issue around the world in 2021 caused by combination of **not enough VRE** and other factors including **bad weather** and **gas shortage** (Texas, East Asia, China, Spain, UK, Sydney)
- Several coalitions for CN were announced before/during/after Glasgow COP26
- **Ukrainian risk** since February 2022 brought **price hike** for **crude oil, natural gas, coal** and **electricity** around the world.
- **Gas supply shortage** in Europe and around the world pushed countries to bring back **nuclear** and/or **coal** options
- Issues caused by Ukrainian risks and influence of **economic sanction on Russia**
- Unusually **hot days in June** and **power supply shortage** (Western Europe, Japan). Higher natural gas price, **decreased coal thermal power plants** and higher than ceiling wholesale price caused power shortage in Sydney, Australia.

Crude Oil Price, Natural Gas / LNG Spot Price

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



(出所) 各種資料等よりエネ研作成

Ukrainian Crisis and International Energy Situation

- Russia's invasion to Ukraine : **Challenge** towards **international order**
- **Economic sanction on Russia** by US, Europe and Japan
- Concern for **stoppage of energy export from Russia**
 - Constraint on energy transaction
 - Damage and/or limited operation of energy export related infrastructure
 - Retaliation by Russia
- **Price hike** of crude oil, gas, LNG, coal and potential **market instability**
 - Oil: Reaction of **Saudi Arabia, Iran nuclear deal**, release of **stockpile**, role of **US shale**
 - Gas/ LNG: Impact of **shrank supply**; collaboration or competition over **substitutional supply** sources
 - Coal: **Import Sanction on Russia**, securing substitutional supply source with **tighter supply-demand balance**
 - Level of market insecurity depends on impact of **supply shortage**, duration and effectiveness of **countermeasures**
- Huge impact on Europe and potential **spread of negative impacts** to the rest of the world
- **Stable energy supply** and **energy security** becomes priority

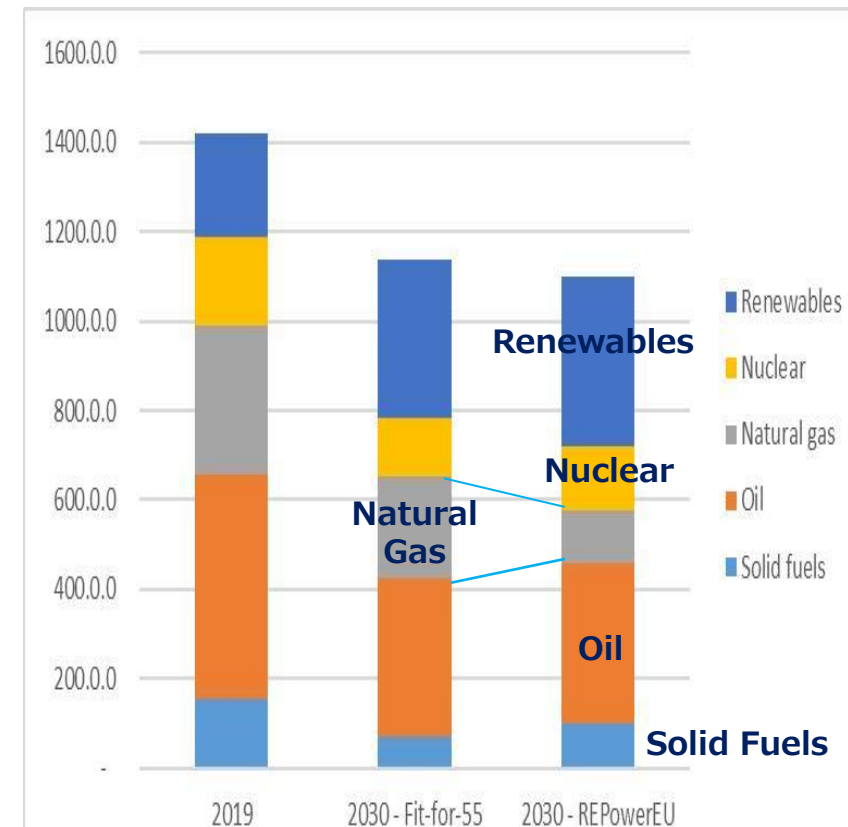
G7: Energy Self-Sufficiency & Dependency on Russian Energy

- 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)

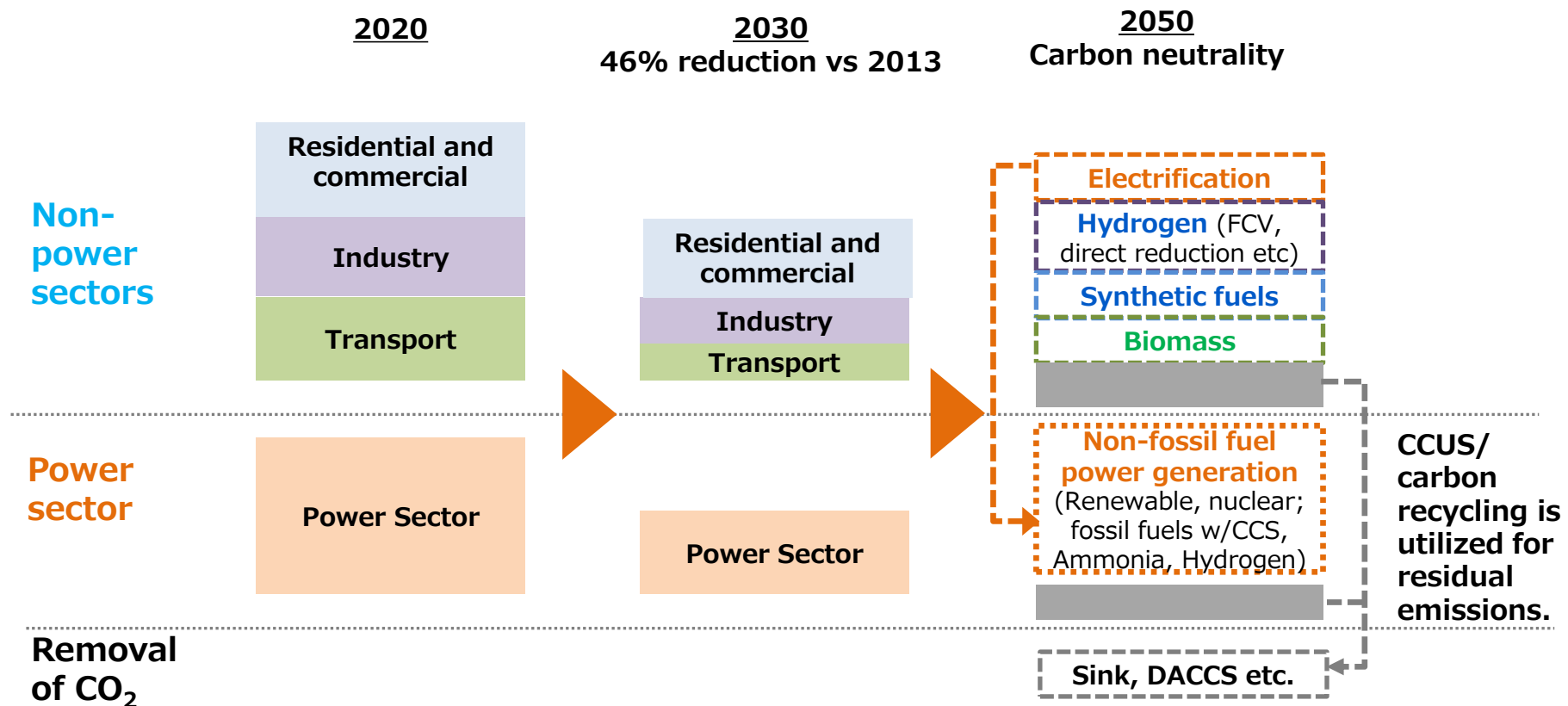
Energy Security has become Priority in face of Ukrainian Crisis

- **Decreasing dependency** on Russia
 - **Change in Energy Mix: renewables**, energy **efficiency**, use of **nuclear**
 - **Diversification** of oil and LNG **supply source**: USA, Qatar (LNG) and KSA (oil)
- Preparing and strengthening **emergency preparedness**
 - **Coordinated release of stockpile** (oil) by IEA
 - **Flexible destination of LNG** and emergency **sharing**
 - **Refurbishment** and **strengthening** of international **cooperation schemes** to stabilize international energy markets
- **Appropriate investment** to secure ample supply as well as supply surplus
- **Recognition** of value of **stable baseload power**
 - **Nuclear : New construction** plan (France). Inclusion to **EU Taxonomy**
 - Attack on nuclear power station in Ukraine. Rise of new risk on nuclear.

- G7 Energy and Environment Ministerial (27 May, 2022) :
 - ✓ Recognize that **LNG plays key role** and **continued investment** is essential. Specify role of **hydrogen and ammonia**.
 - ✓ Add **system flexibility and SMR** to recognize the role of **nuclear**
 - ✓ **Decarbonization of power system**, phase out of international **fossil fuel finance** (similar to the Global Coal to Clean Power Transition Statement) at COP26)
 - ✓ Task out of “**G7 Industrial Decarbonization Agenda**” to IEA
- **Joint Statement of the G7 Summit** (28 June) deals Climate Change first including inauguration of **Climate Club** but also considers importance of **stable energy supply** and **energy security**. **Price cap on Russian oil** to be considered.
- **Government of Japan** is promoting several **initiatives to support ASEAN and Asia** to accelerate **decarbonization of fossil fuels** (ASEAN-Japan Business Co-Creation Vision, ASIA-Japan Investing for the Future Initiative (AJIF), Asia Energy Transition Initiative (AETI))

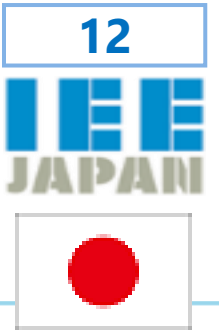
6th Basic Energy Strategy (Japan)

Image of CO₂ emissions reductions toward 2050 carbon neutrality



Source: METI

Expected Shortage of 2022 Winter Reserve Rate (Japan)

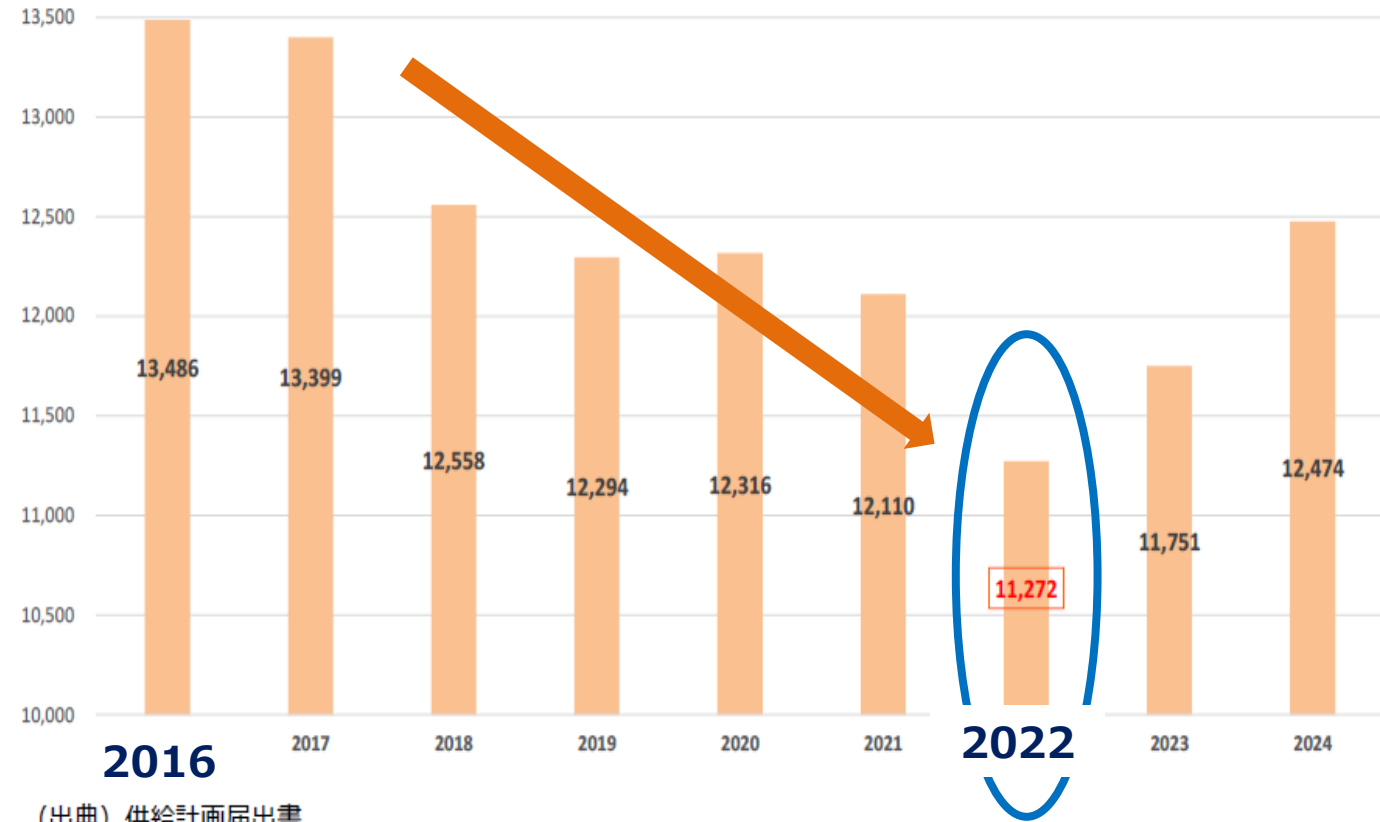


Estimated Winter Reserve Rate

	2022	2023		
	12	1	2	3
Hokkaido	12.6%	6.0%	6.1%	12.3%
Tohoku	7.8%	1.5%	1.6%	
Tokyo		1.5% (103)	1.6% (95)	
Chubu	5.5%	1.9% (99)	3.4%	10.1%
Hokuriku				
Kansai				
Chugoku				
Shikoku	45.4%	39.1%	40.8%	65.3%
Kyushu				
Okinawa				

※()内は3%に対する不足量 単位:【万kW】

Supply Capacity of Thermal Power Plants (10 MW)



(出典) 供給計画届出書

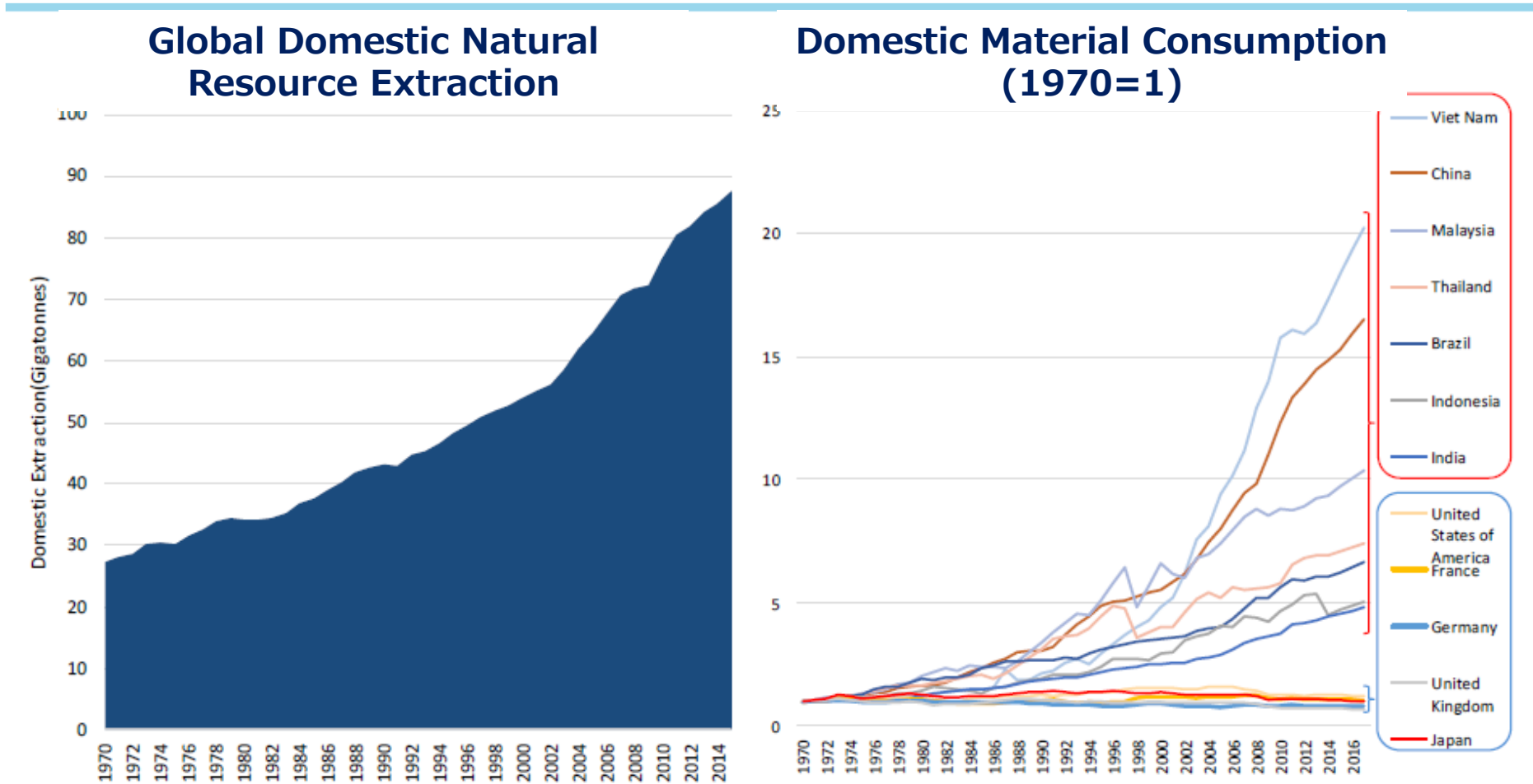
Source : METI, "Power Supply Demand Measures" (30 June 2022)

A light gray world map is visible in the background of the slide.

Way Forward and Potential Challenges

Concern on Material (minerals, metals, etc.) Shortage

- ✓ Rapid economic growth of developing countries and global increase in material use

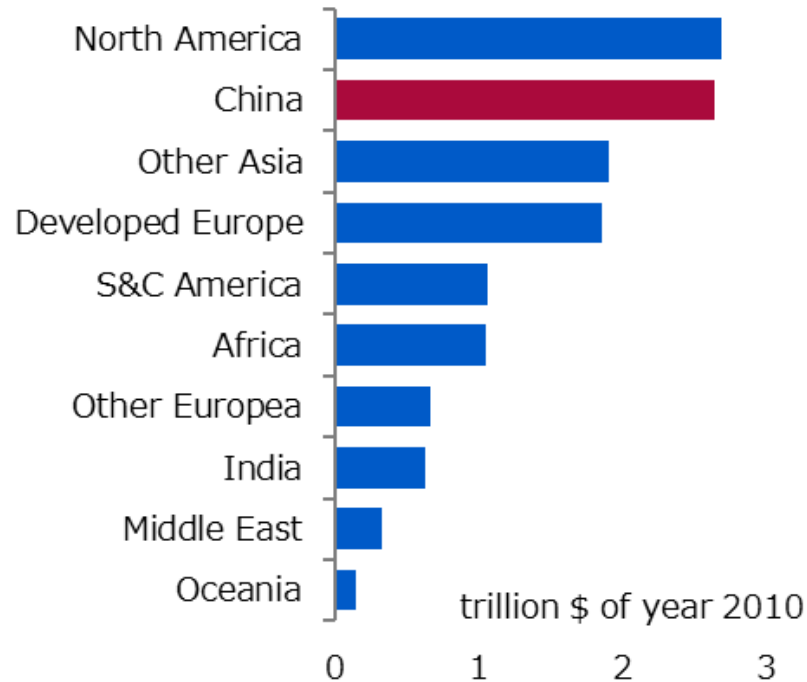


(注) Domestic Extractionは、各国国内で採掘される天然資源の総量

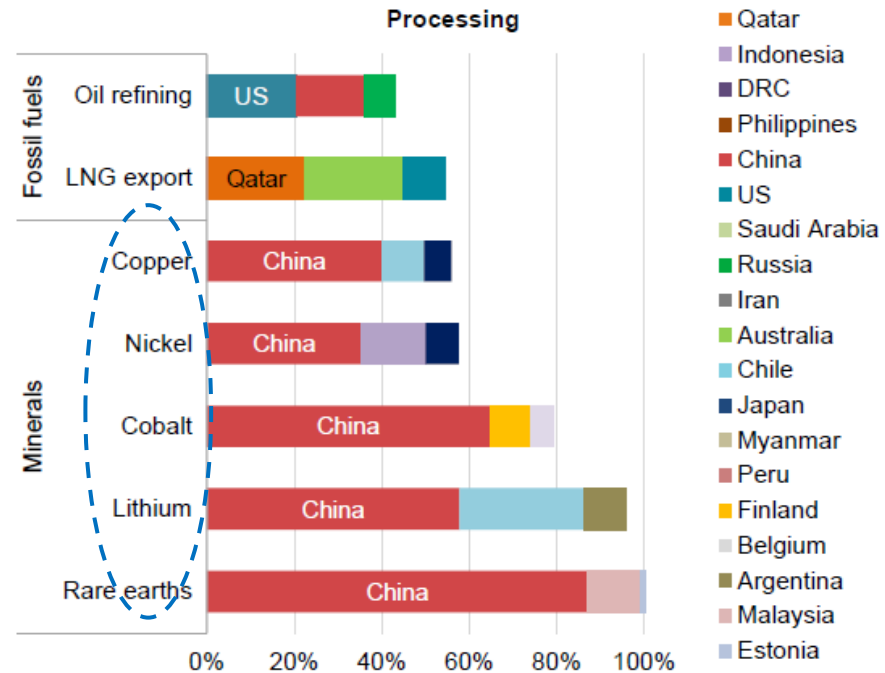
(出所) UNEP-IRP 「UN Environment International Resource Panel Global Material Flows Database」のデータをもとにMURC作成

- **China's presence** is likely **to expand** in a world heading toward CN.
- Its presence will grow in the field of **renewable energy, critical minerals**, as well as **fossil fuels**.
- A high level of competition with developed countries could lead to international divisions or conflicts.

❖ Investments in renewable power generation in Reference scenario



❖ Process capacity of fossil fuels and critical minerals



Source : IEA, The Role of Critical Minerals in Clean Energy Transitions



Circular Economy and Circular Carbon Economy: CCE

- EOR
- CO2 enhanced greenhouses for vegetable grow
- Biofuels from algae synthesis

- CCU
- Artificial photosynthesis
- Bioenergy recycle (Paper & Pulp)
- Coal ash concrete curing with CO2 absorption
- Synthetic liquid fuel from H2 & CO2
- Synthetic chemical feedstock from H2 & CO2

Reducing the amount of carbon before entering the system

Reduce

Reusing carbon without chemical conversion

Reuse

Recycle

Recycling carbon with chemical conversion

Remove

Removing carbon from the system

- **CCS**
- Direct Air Capture (DAC)
- SINK

- Efficiency (energy & material)
- Renewable & nuclear energy, including hybrid use with fossil fuel
- Advanced USC technologies for coal fired power plants
- **Hydrogen & ammonia (blue/green)**
- **Direct reduction in steel making with hydrogen (blue/green)**

Source: IEEJ Outlook 2021

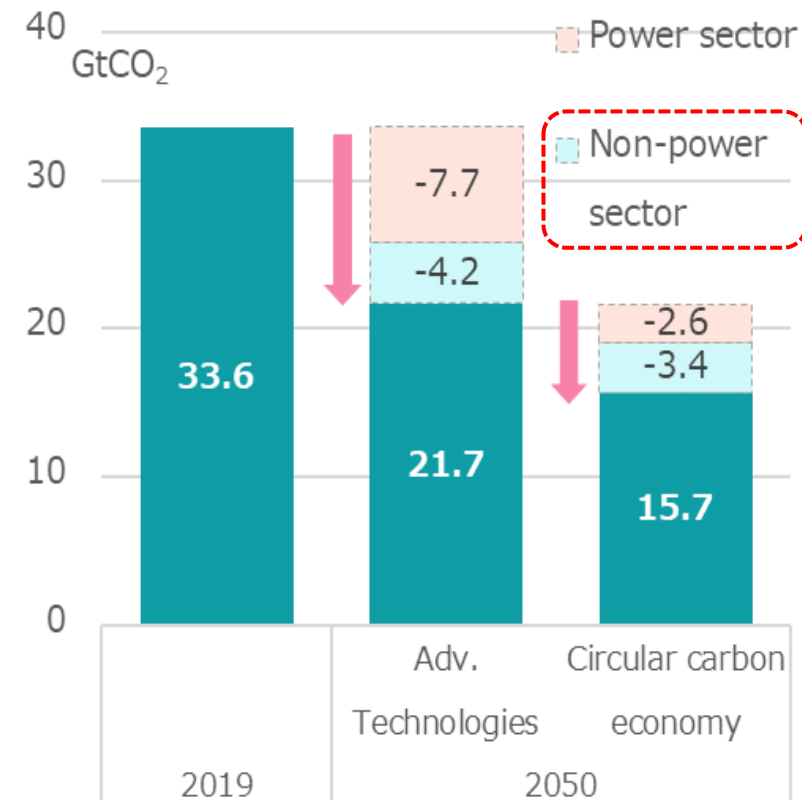
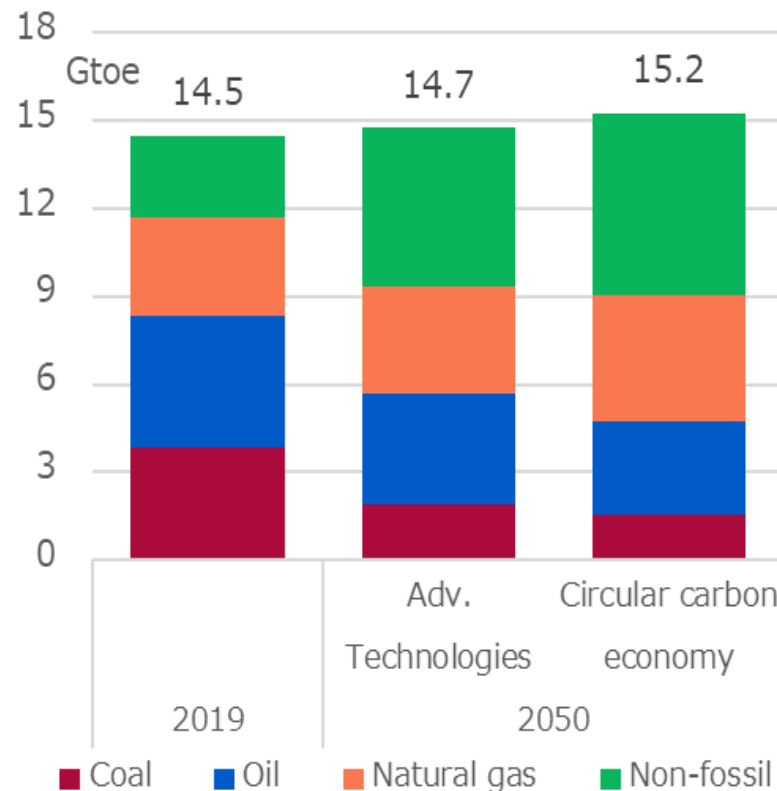
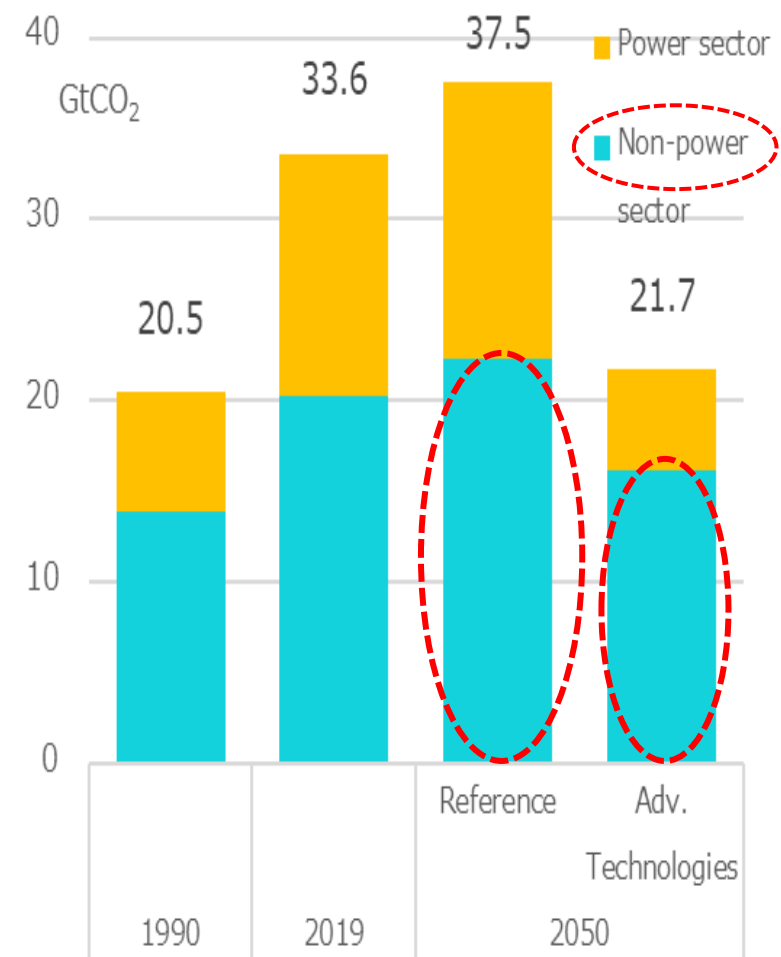
Decarbonization of non-power generation sector is difficult

❖ Energy-related CO₂ emissions

Using H₂ and CCUS will maximize use of decarbonized fossil fuels

❖ Primary energy demand

❖ Energy-related CO₂ emissions

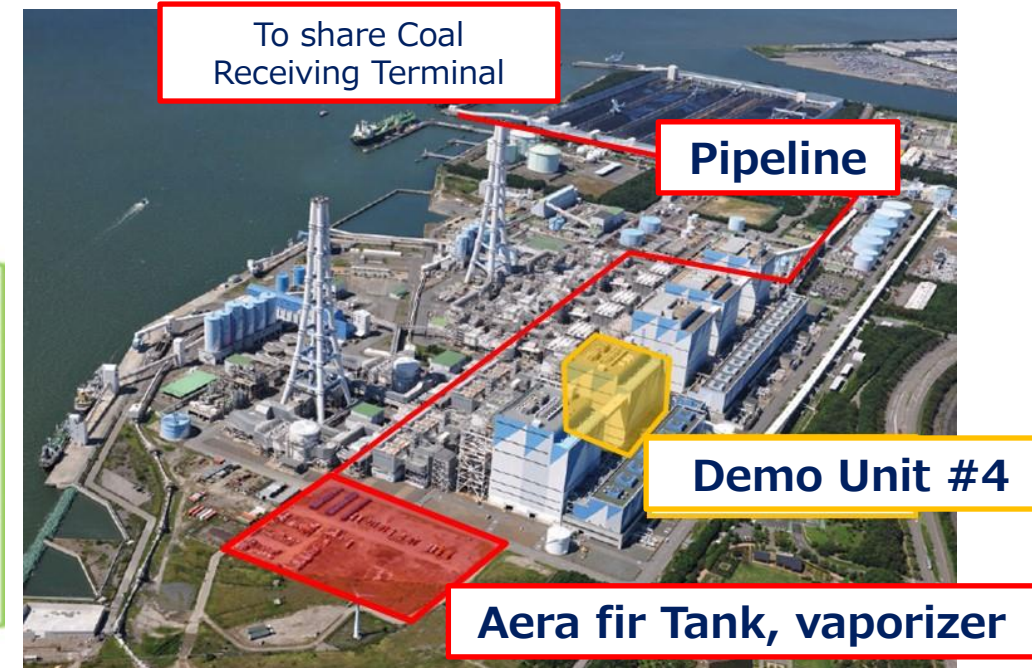
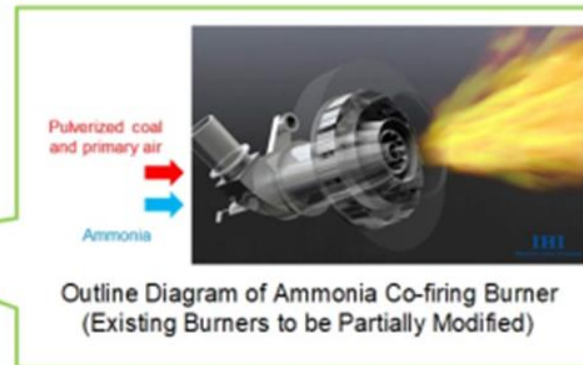
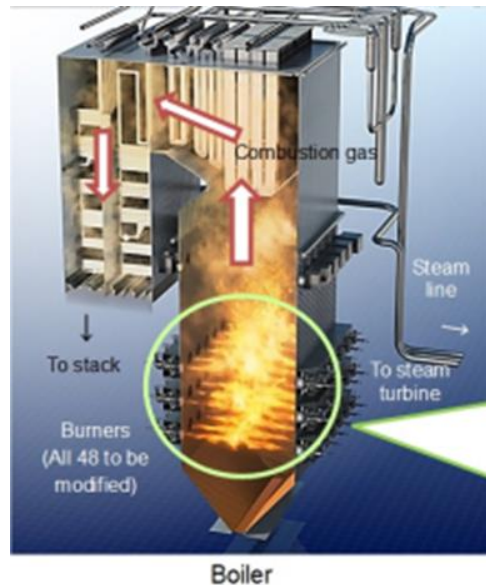


Source: IEEJ Outlook 2022

Demonstration : Fuel Ammonia for Power Generation

- Basic Energy Strategy Target (2030): 1% of Power Mix (ammonia: 3 million tons)
- **JERA Demonstration: 20% co-firing with coal** power plant → **up to 60%** is possible
- Estimated global supply potential (2030) : 15 million tons.
 - **KSA:** 10 Mton, **UAE:** 1 Mton, **Australia:** 3.5 Mton, **Indonesia:** 0.7 Mton, **USA:** 0.5 Mton
 - New projects under consideration **in Canada**, Russia, and Chile.
- Co-firing with coal thermal power → co-firing with gas power (up to 70%) and 100% gas turbine.
 - In the longer run, **industrial use** to be pursued.

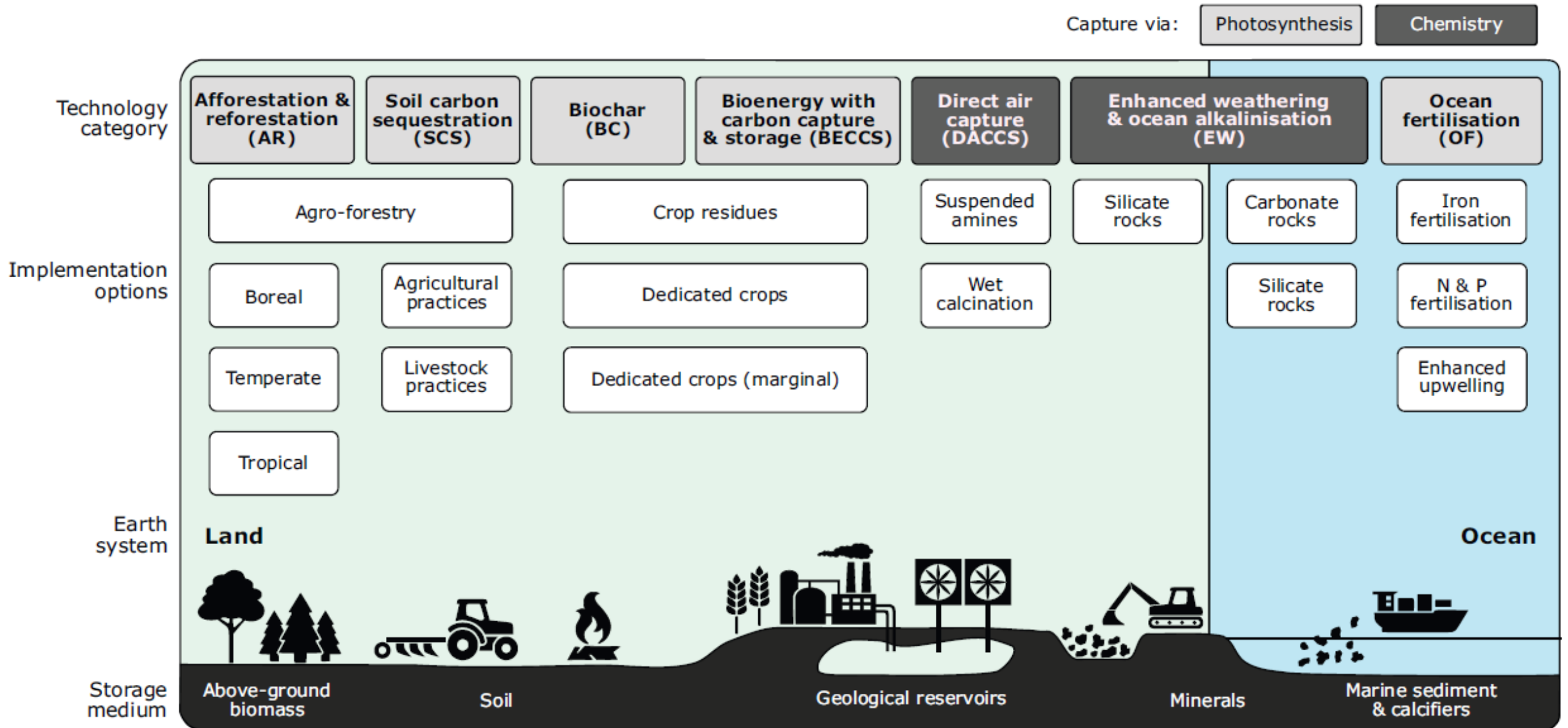
Blue Ammonia from KSA



Source: JERA

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 including Japan. Moreover, **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**. Importance of **energy transition** towards CN is also recognized.
3. **NDCs for 2030 are not sufficient** to meet the **2050 CN target** unless harder efforts are to be realized beyond 2030. There are several challenges.
4. The world needs to find **a balance among 3Es** going back to the basic. Each country needs to find own **portfolio** rather than just depends on renewable energy. Issues of future **shortage of critical minerals and materials** are rapidly recognized. More efficient use of materials as well as energy, creation and strengthening of **recycling** systems or **circular economy, acceleration of technology innovation** including use of **hydrogen, ammonia, CCUS** and **CDR**, and **cost reduction** are essential for **transition**.

CDR is Absolute Must for Net Zero – for your later search



Source: Jan C Minx, et.al "Negative Emissions Part 1: Research Landscape and Synthesis" 2018