Energy supply/demand up to 2050

With Circular Carbon Economy Analysis

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Energy Outlook toward 2050

Two Basic Scenarios:

Reference (RS)

Advanced Technologies (ATS)

One Other Scenario:

Post Corona Transformation (PCS)

Circular Carbon Economy (CCE)

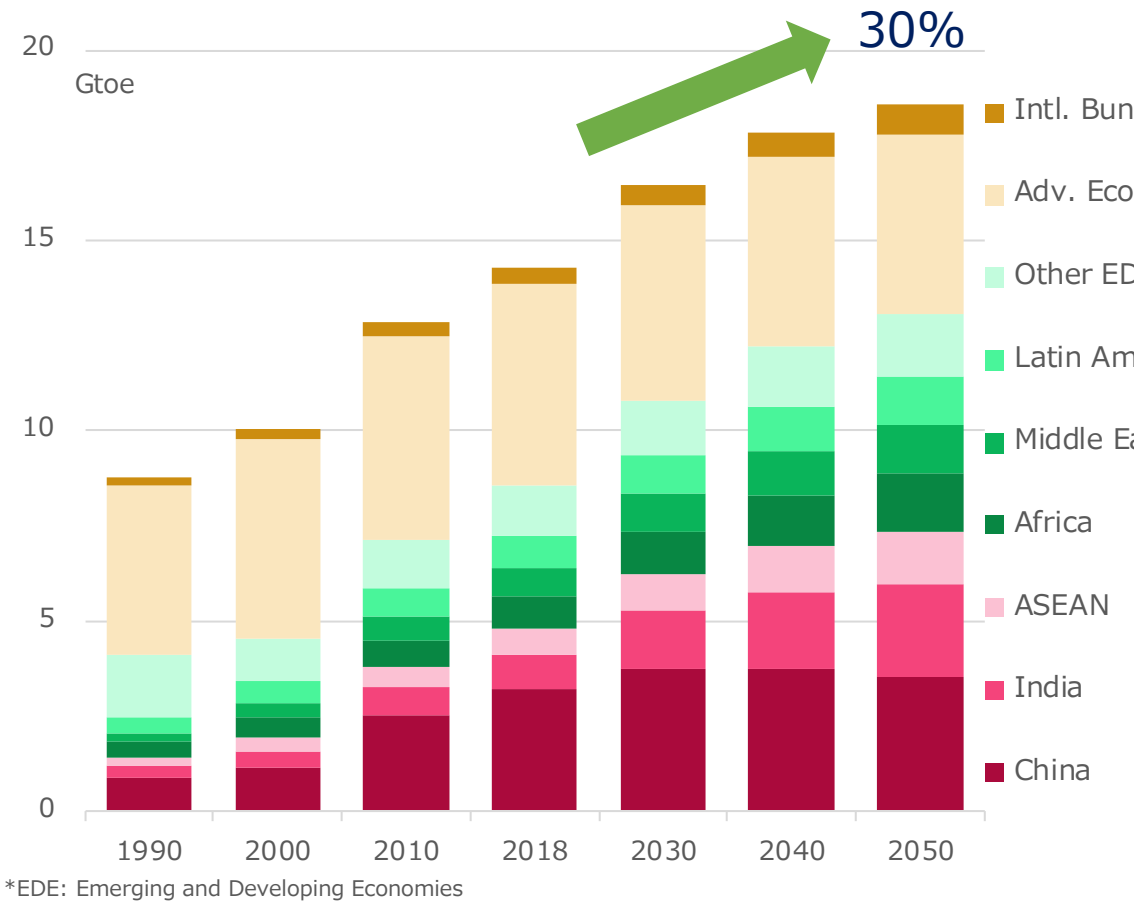
Two base scenarios of IEEJ Outlook

	Reference Scenario	Advanced Technologies Scenario
	Reflects past trends with technology progress and current energy policies,	**Assumes introduction of powerful policies** to address energy security and climate change issues
Social-economy structure	After a drop of 5% this year, GDP growth will be strong for the next 4-5 years, for an annual average of 2.6%/year by 2050. Growth is led by developing economies. Population increases by 0.8% from 7.6 to 9.7 billion. Due to higher income, appliances and vehicles are rapidly diffused.	
International energy price	**Oil** supply cost **increases** along with demand growth. **Gas** price **convergences** among Europe, N. America and Asia markets. **Coal unchanged** at today's level.	**Slower price increase** due to lower demand growth (coal price decreases).
Energy policies	**Gradual reinforcement** of low-carbon policies with past pace.	**Further reinforcement** of domestic policies along with international collaboration.
Energy technologies	Improving efficiency and declining cost of existing technology with past pace.	Further declining cost of existing and promising technology.

Reference

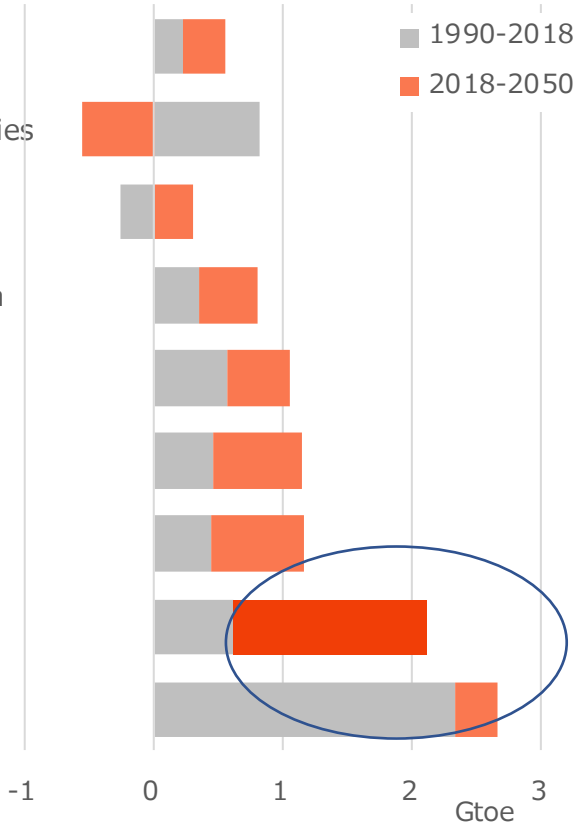
Demand growth shifts from China to India

❖ Primary Energy Demand



*EDE: Emerging and Developing Economies

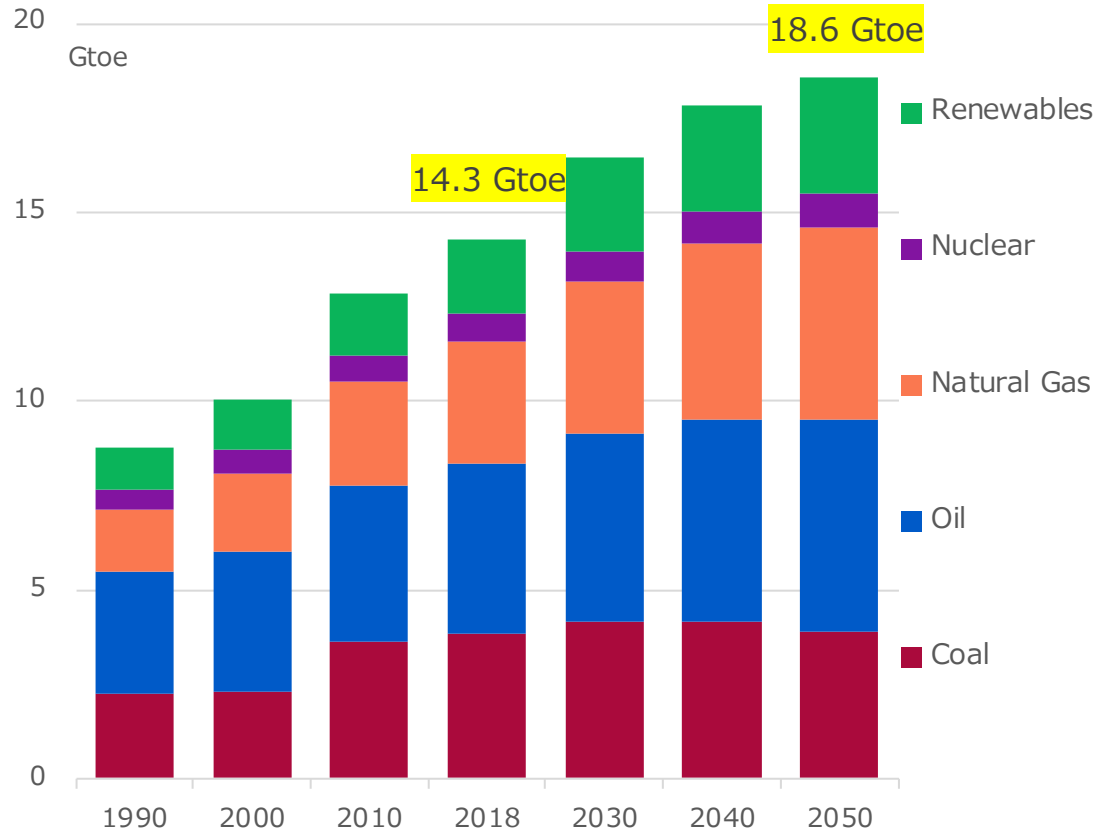
❖ Growth (1990-2050)



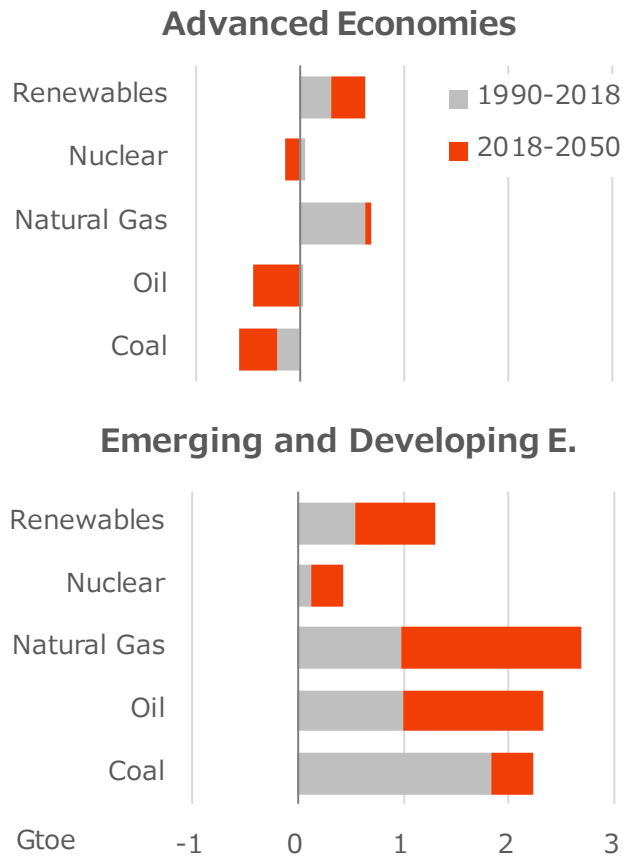
Reference

Coal peaks out, NG increases significantly, Oil continues to increase

❖ Primary Energy Demand

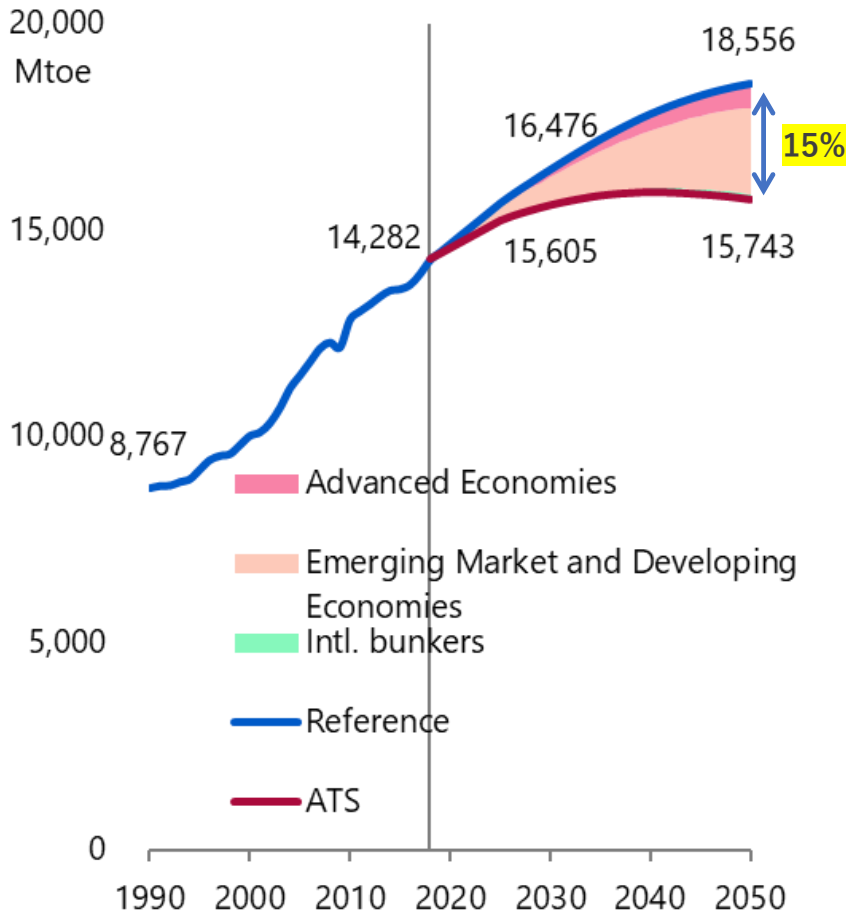


❖ Growth (1990-2050)

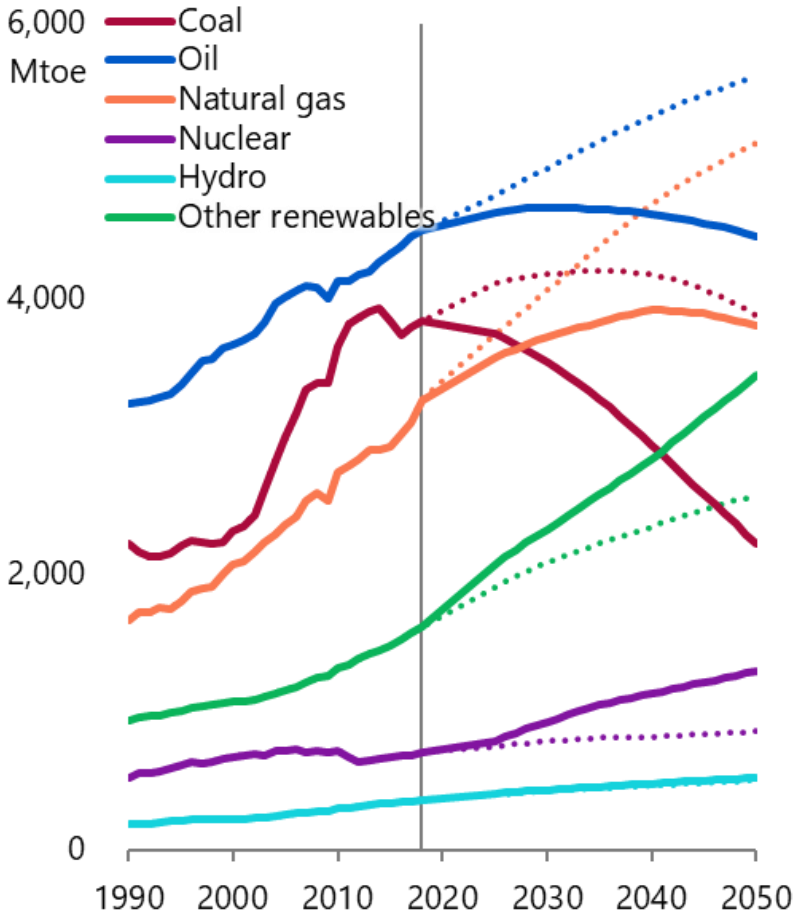


Total Primary Energy demand

❖ By Region

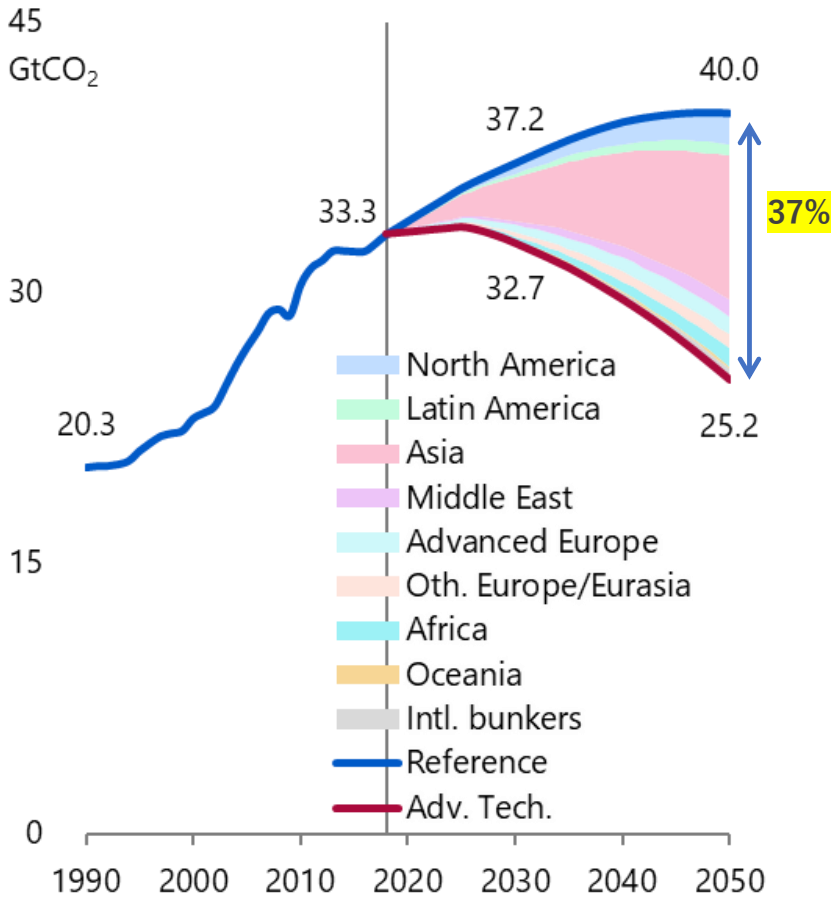


❖ By Source

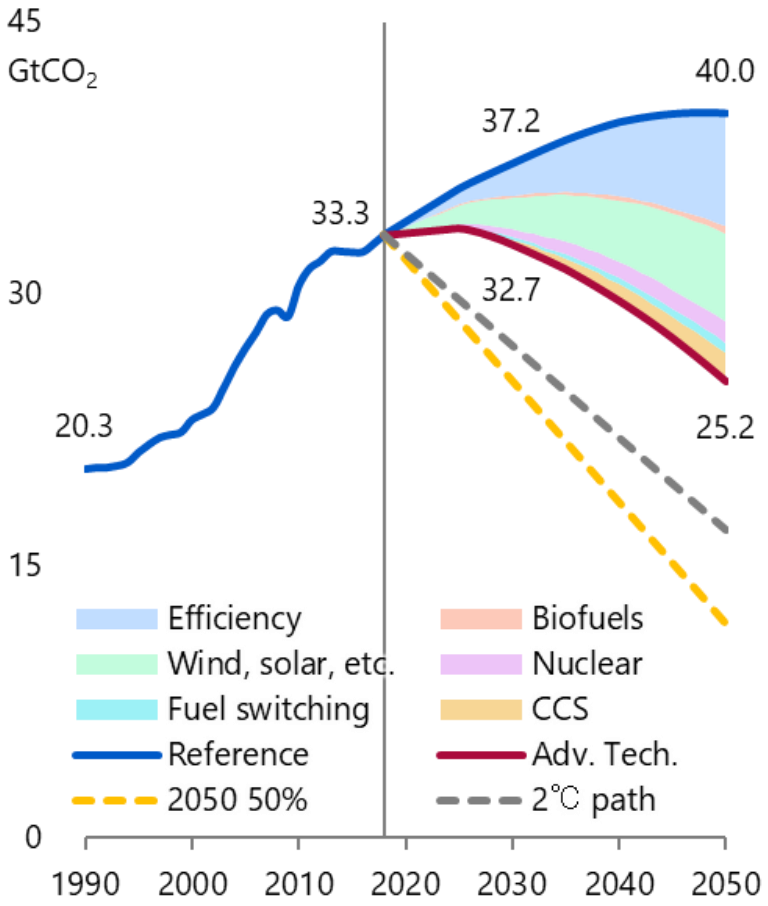


CO_2 Emissions

❖ By country / region



❖ By technology

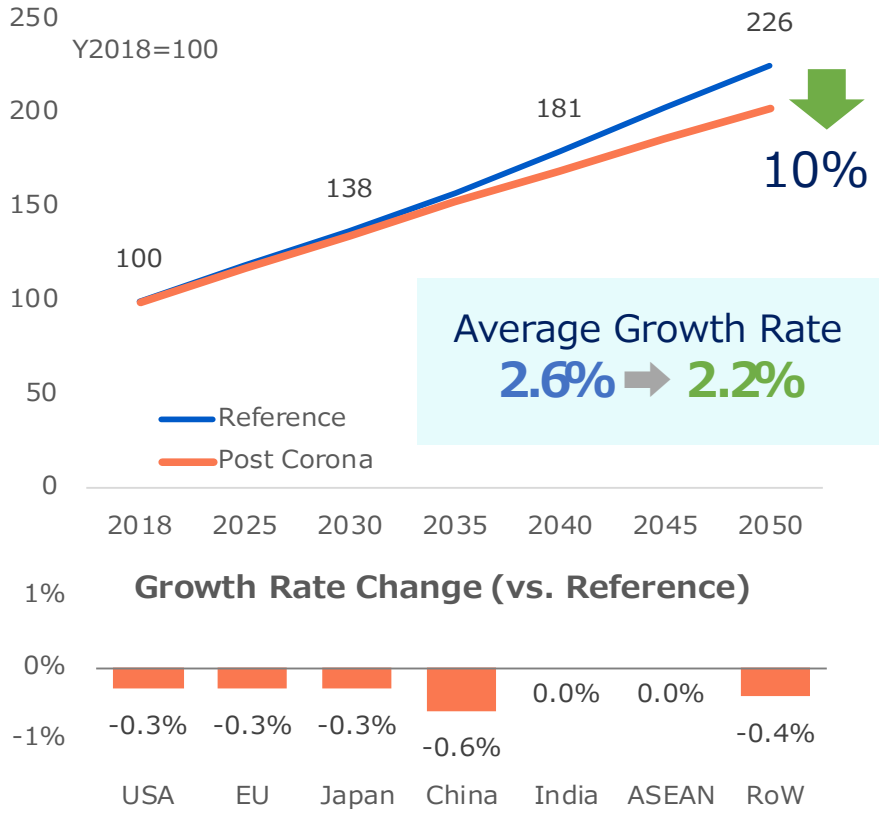


Qualitative assessment of a "Post Corona World Transformation Scenario"

Reference Scenario	Reflects past trends with technology progress and current energy policies.	
Post Corona World Transformation Scenario	A world that adopts digitization and emphasizes security causing transformation and changes in politics, economy and society. The extent of efforts to strengthening climate change measures differs in each country.	
	Emphasis on security	**Progress of digitization**
Changes in consciousness and behavior	・Reviewing supply chains, including the extent of **self-sufficiency**.	・Increasing remote activities ・**Migration from large cities to rural areas is emerging**.
Changes are accelerating	・Nationalism is leading to **withdraws from a free trade system**.	・Transportation demand stagnates. **Significant drop in oil demand**
Consequences of the changes	・**Global economy slowing down**. Manufacturing shifts from China to India /ASEAN. ・Strengthening efforts to **diversify energy supply** and improve self-sufficiency.	・**Electricity demand increases**.

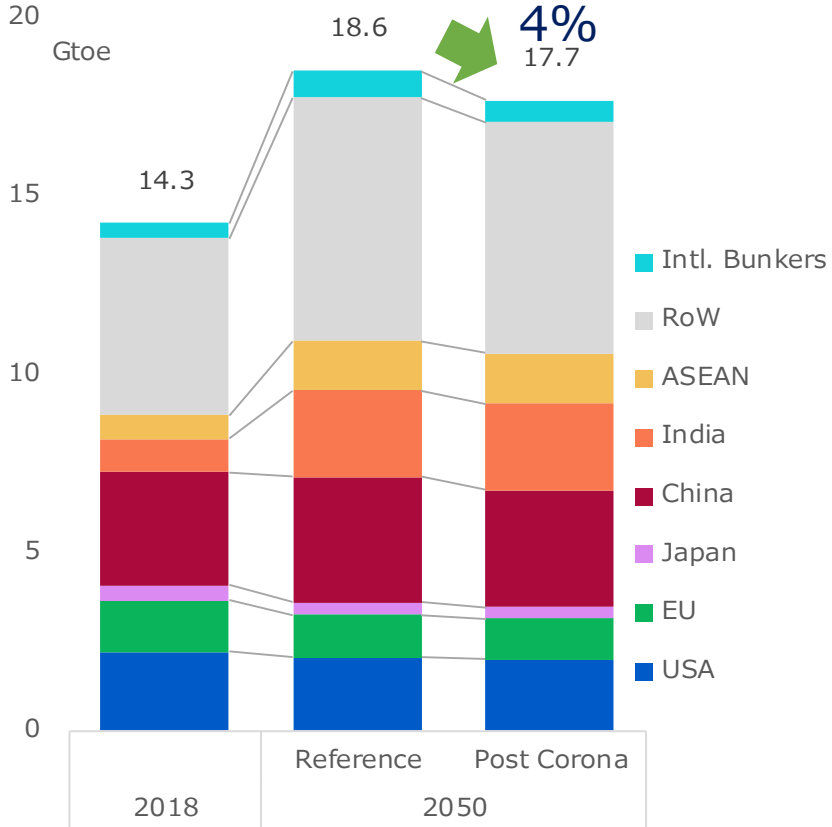
Economic growth slows and energy demand curtails

❖ GDP



Ref.) During the Great Depression of 1929, about 10% of GDP was lost in three years.

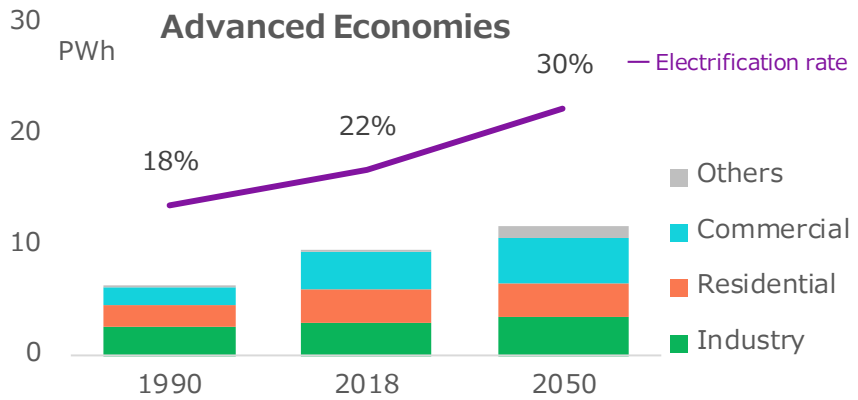
❖ Primary Energy Demand

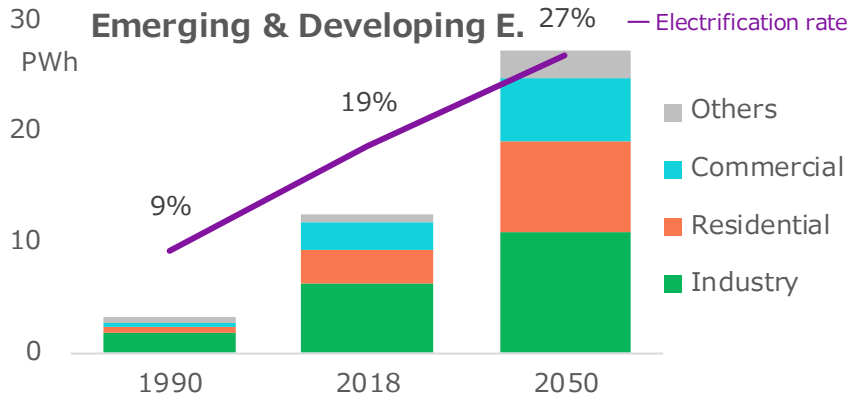


Note) The EU (European Union) does not include the United Kingdom. The same shall apply hereafter. RoW: Rest of the world

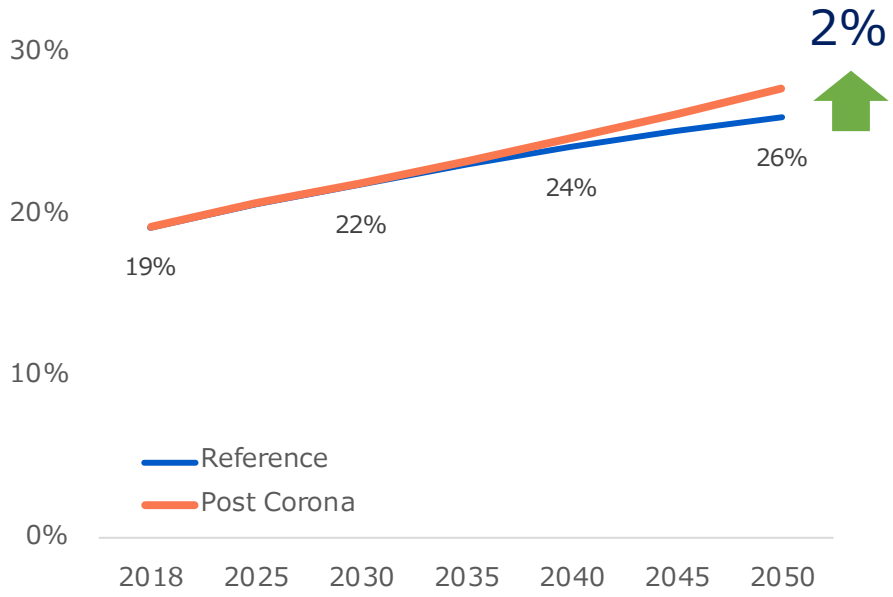
Digital transformation(DX) raises electrification rate

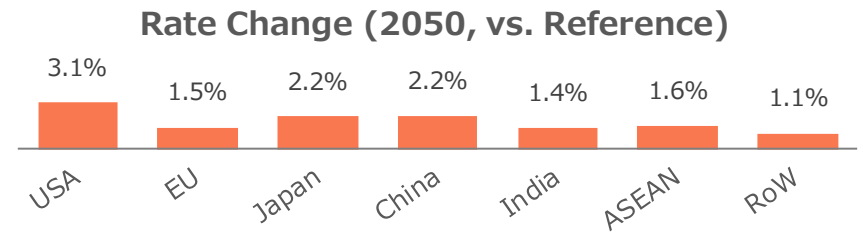
❖ Final Electricity Demand (Reference)





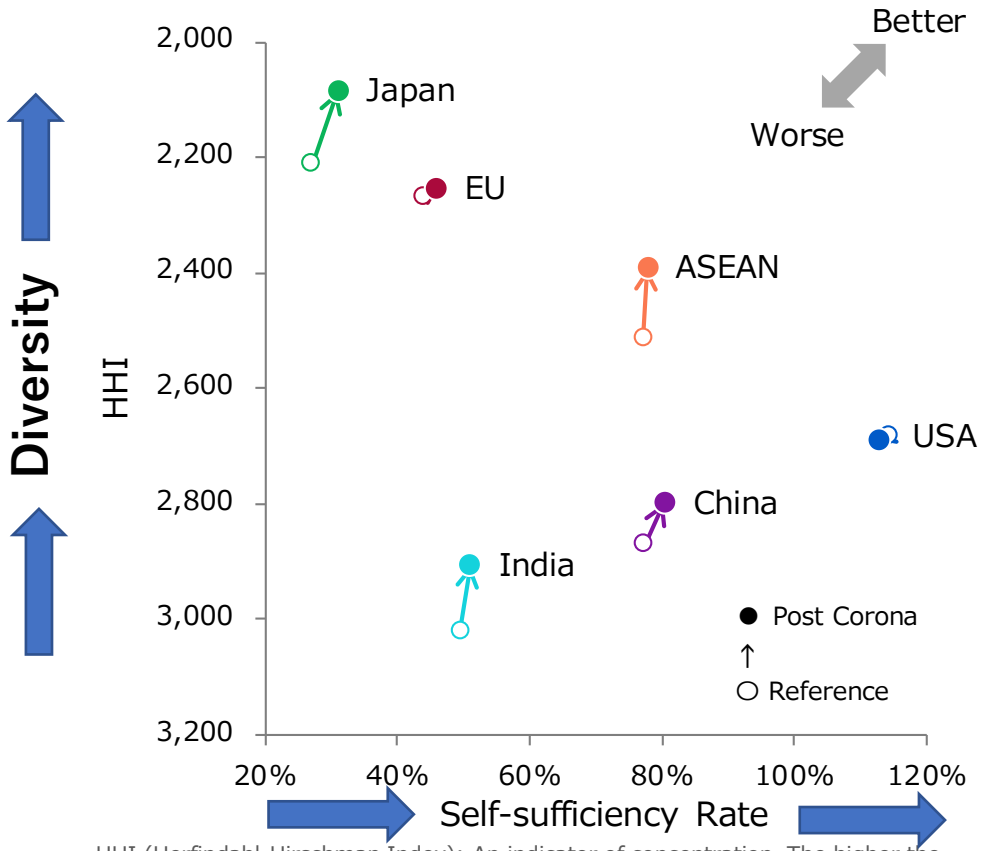
❖ Electrification Rate in Post-Corona





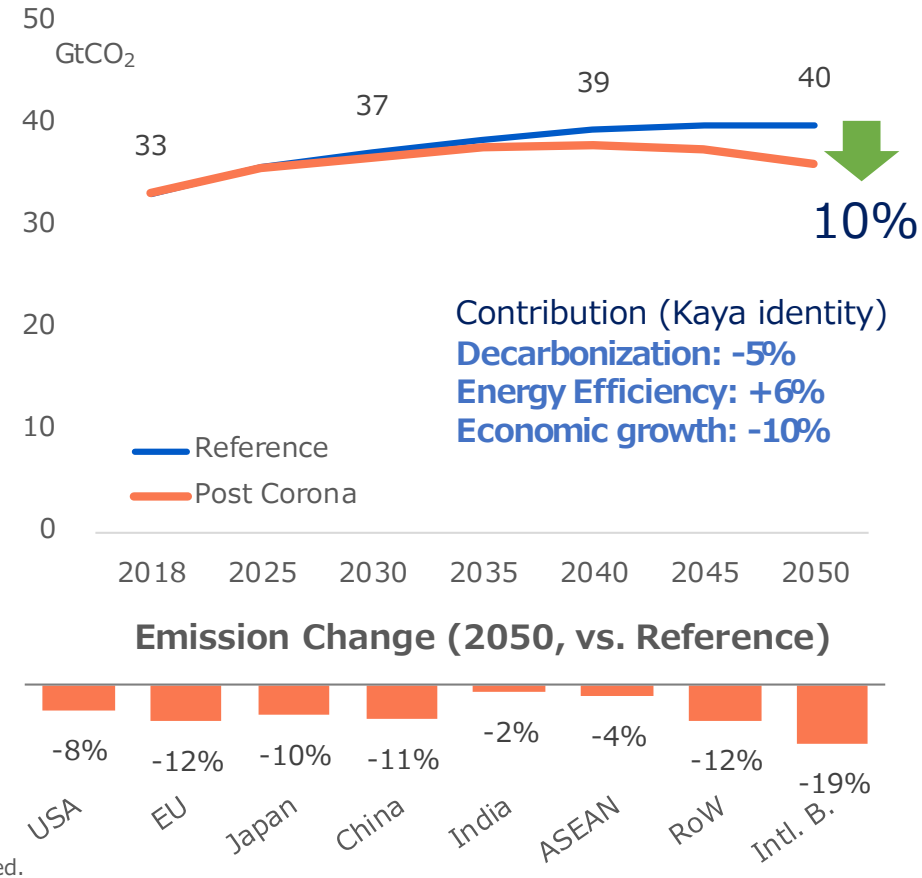
Self-sufficiency / diversity improves and CO_2 peaks earlier

❖ Energy Self-sufficiency/Diversity (2050)



HHI (Herfindahl-Hirschman Index): An indicator of concentration. The higher the number, the higher the concentration, and the lower the number, the more diversified.

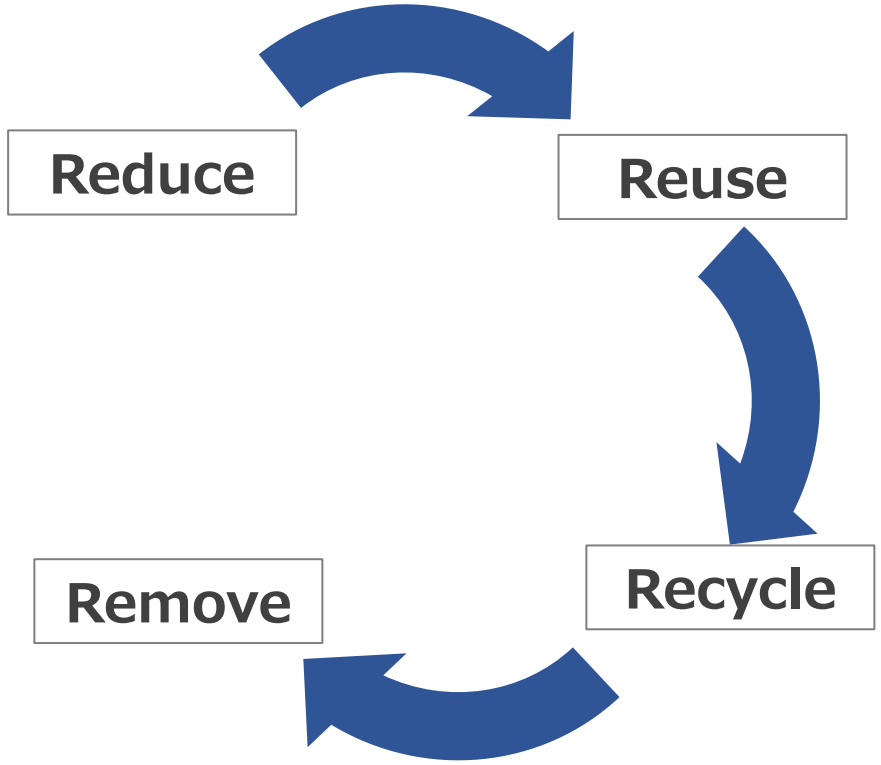
❖ Energy-related CO_2 Emissions



Circular Carbon Economy / 4R Scenario (CCE)

Circular Carbon Economy: CCE

Reducing the amount of carbon entering the system



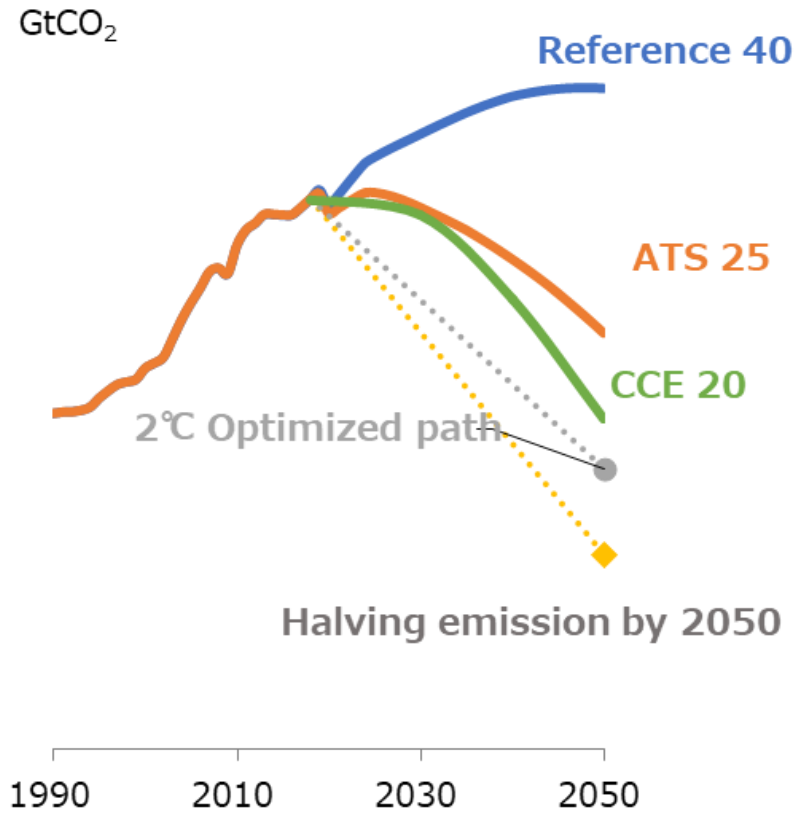
Reusing carbon without chemical conversion

Recycling carbon with chemical conversion

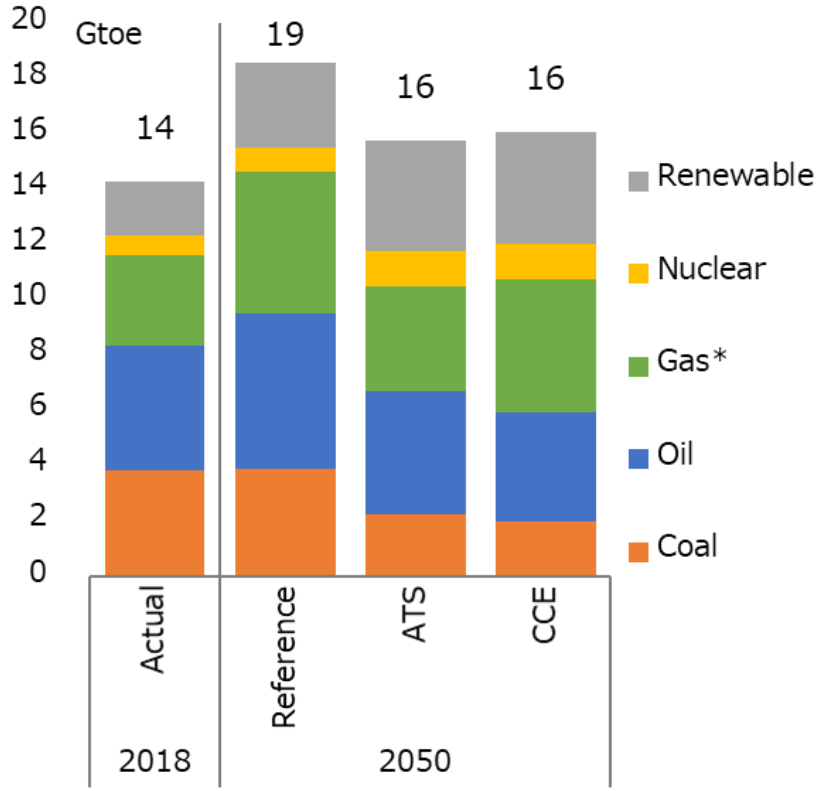
Removing carbon from the system

Emissions reduced while using fossil fuels

❖ World CO_2 Emissions



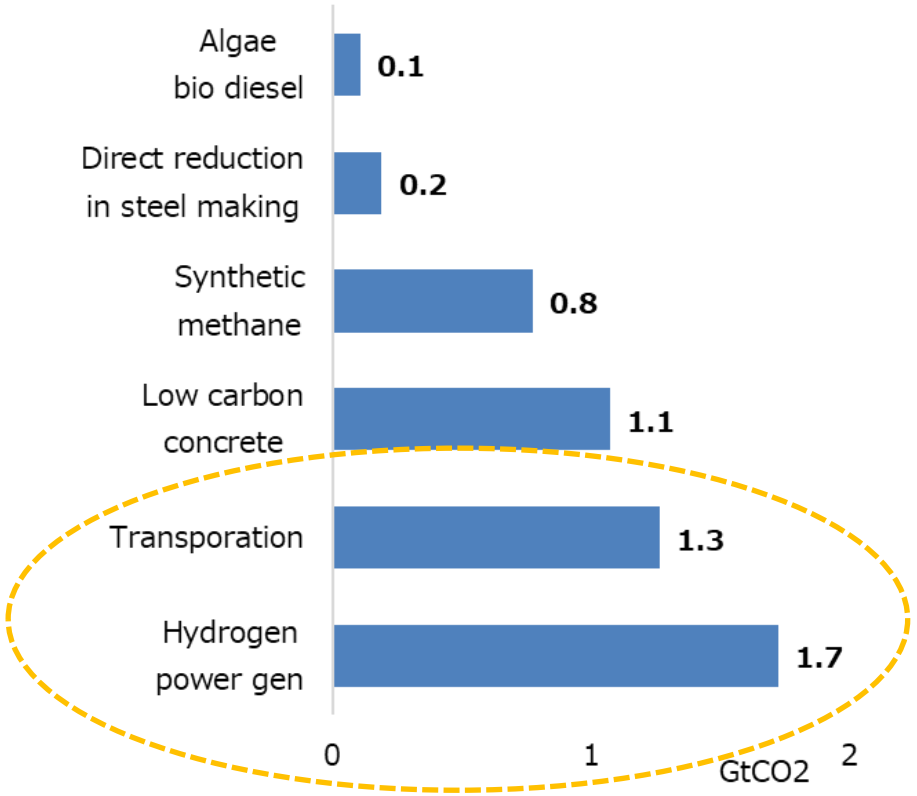
❖ Total Primary Energy Demand of the World



*Gas in CCE scenario includes synthetic methane

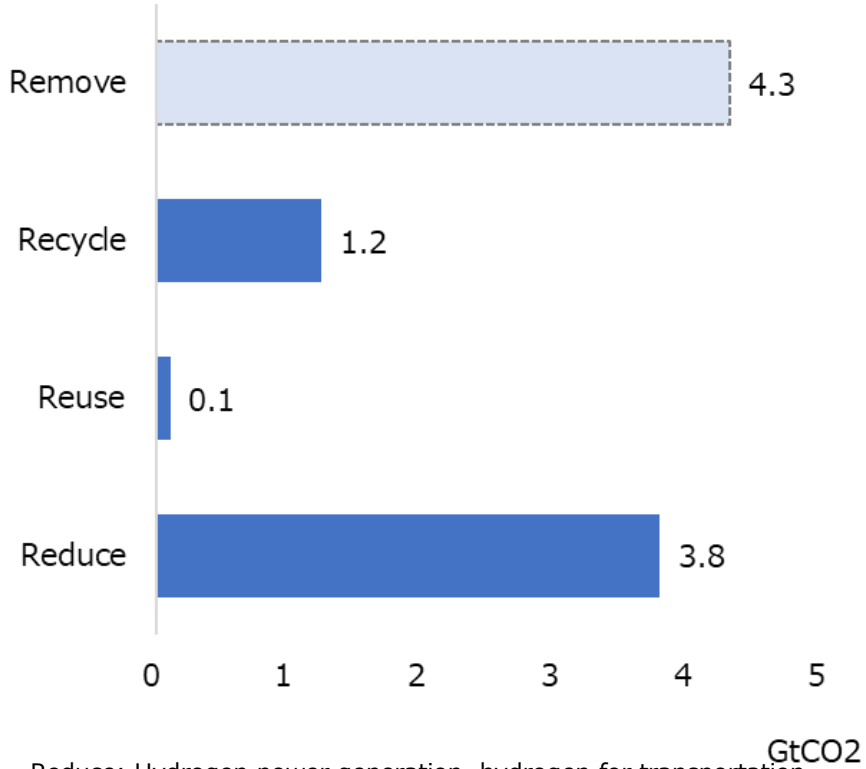
Power and transport have large reduction potential.

❖ CO_2 emissions reduction by technology



* The amount of Low carbon concrete is the sum of reduced volume of cement production reduction and concrete curing absorbing CO_2.

❖ CO_2 emissions reduction by 4R



Reduce: Hydrogen power generation, hydrogen for transportation, cement production reduction, direct reduction of steel making
Reuse : Algae biodiesel
Recycle : CO_2 absorbing concrete, synthetic methane
Remove: CCS (also counted in Reduce and Recycle technologies)

In conclusion,

- Regardless of the scenario, the **reliance on fossil fuels remains high** in 2050 and we are **still far from a zero-carbon economy**. (RS 79%, ATS 67%, PCS 77%, and CCE 67%)
- In the Advanced Technologies Scenario, it is possible to achieve significant demand reductions, but possible changes in attitudes due to the **pandemic could significantly alter the future.**
- **High expectations** that **blue hydrogen** could play a key role even to pave the way for **green hydrogen**. **Production cost reductions** and **infrastructure developments** required.
- **Definition of Carbon Circular Economy (CCE)** needs additional refinements before the concept of CCE could be further publicized and accepted.
- CCE is not the only solution. We need **a variety of technologies** and **carbon free energy** to tackle climate change challenge, taking into consideration national circumstances. Government support and international collaboration are always essential, especially at **the early stage of R&D**.
- How to supply cleaner energy solution for the **additional energy requirements of future generation** should be part of the global solution.

Thank you
for your attention!

https://eneken.ieej.or.jp/en/whatsnew/436.html

Panel Discussion

Panelists

- **Dr. Arij van Berkel**, Research Director, Lux Research
- **Mr. Yoshikazu Kobayashi**

  Senior Researcher, Institute of Energy Economics, Japan (IEEJ)
- **Mr. James Laybourn**

  Regional Business Development Manager, DNV GL Oil & Gas
- **Mr. Vipul Tuli,** Head, India Business, Sembcorp

Questions for the Panelists

1. Which of the 4Rs (Reduce, Reuse, Recycle, Remove) is more applicable in your country? And why?

2. For companies in energy business, a rapid change towards decarbonization is a huge challenge. What do you think is most needed to meet this challenge. From your company's perspective, which of the 4Rs is most applicable?

3. Large-scale decarbonization requires huge potential in CCS, what are the pros and cons of such expectations towards CCS?

4. Many countries have declared to become carbon-neutral by 2050 or before 2100, creating rising pressures towards decarbonization from the financial sector on the private sectors. On the other hand, UN estimates that there will be 2 billion more population by 2050. Can the "Carbon Circular Economy" address both the decarbonization and the sustainable development challenges?

5. Is the "Carbon Circular Economy" a concept which is suitable for growing Asia?