Challenges and Issues toward Carbon Neutrality

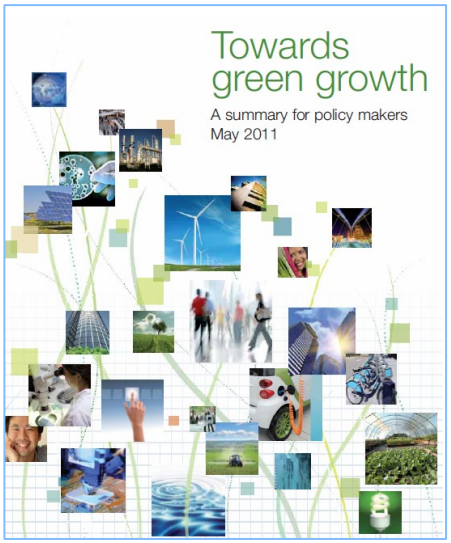
Growing interests in carbon neutrality

- An increasing number of countries announced reaching carbon neutrality (CN) as a target by mid-century. Interest in CN is growing globally.
- Climate actions are expected to not only achieve emissions reduction but should also provide multiple economic benefits.
- Given that the world depends on fossil fuels for over 80% of its energy requirements as of today, achieving CN will not be an easy task. Several challenges and issues lie ahead.
- The net balance between benefits and costs of climate actions can vary across country, organization, and individual.

- **Challenges and issues related to CN**
  - ✓ Positive and negative economic effects of climate actions
  - ✓ Disparity caused by climate actions
  - ✓ Energy security issues growing in complexity
  - ✓ Supply stability issue caused by restrained upstream investments
  - ✓ Geopolitical impacts

Economic benefits of climate actions

- Green growth and Green deal
  - "Green growth" is a condition where economic growth and carbon emissions are decoupled (OECD 2011; UNEP 2011; World Bank 2012).
  - "Green deal" is a government's policy that aims to simultaneously achieve economic stimulus, development of a clean energy industry with job creation, along with emissions reduction (Friedman 2019; European Commission 2021).

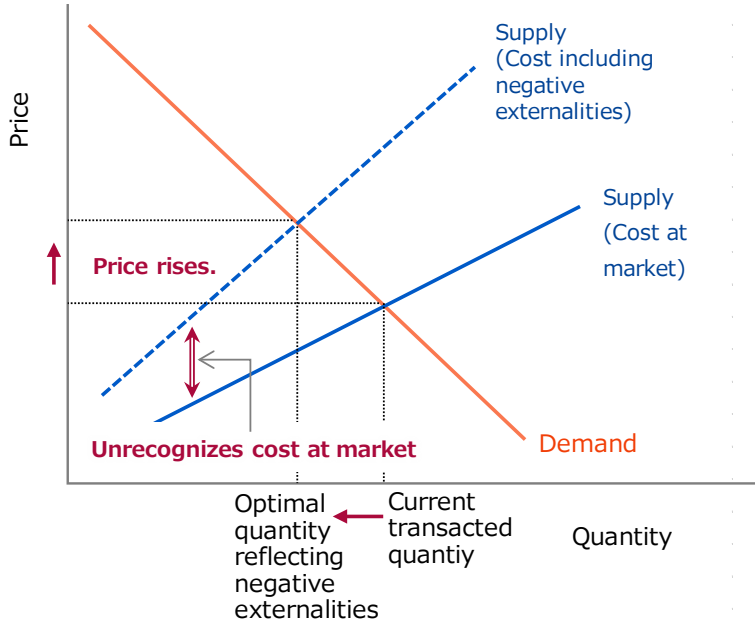


- Economic benefits of Green deal
  - EU estimates its Green deal will create over 160,000 jobs through the development of a clean energy market and products until 2030 (European Commission 2021).
  - IEA's Net Zero scenario is estimated to add 4% to the world's GDP and generate 25 million jobs through the development of clean energy industry by 2030 (IEA 2021).

Economic costs of climate actions

- Costs associated with negative externalities
  - Climate change is a typical case of negative externalities.
  - Addressing negative externalities means to account for unrecognized costs that could eventually raise prices and reduce the transacted volume of traded goods and services.
  - An increase in prices may result in leakage of national wealth.
- Costs associated with carbon lock-in
  - Carbon lock-in is the “inertia” caused by consumer behaviors and existing fossil fuel infrastructure. It inhibits or delays the adoption of emissions reduction technologies (Seto *et al.* 2016)
  - Realizing CN means overcoming the lock-in effect with significant investments in new infrastructures, the replacement of existing facilities while requiring job switching and vocational training.

❖ **Internalization of negative externalities**

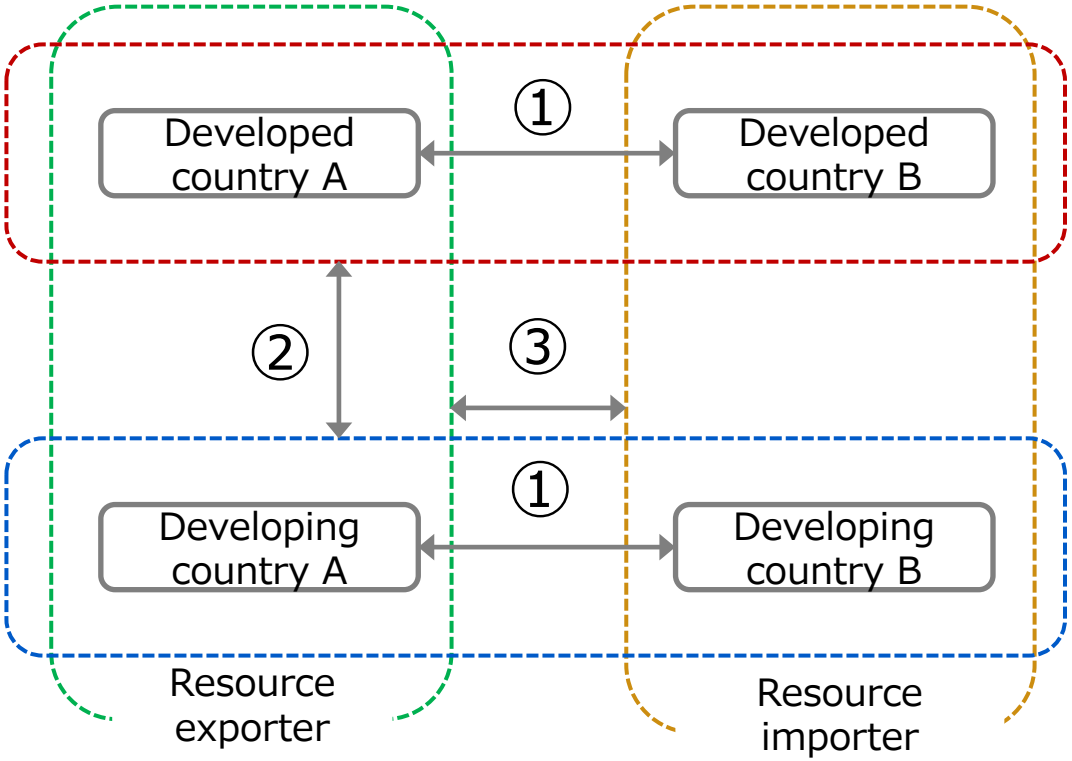


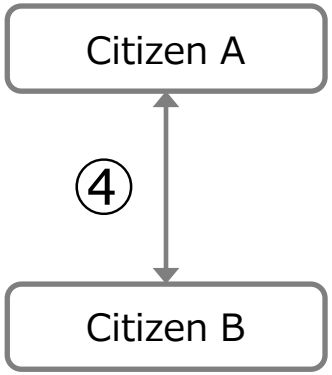
Balance of positive and negative effects

- The net balance between the positive and negative effects can vary for each country, organization, and individual depending on the following external and internal factors
  - External factors: Geographical factors, indigenous resources, renewable energy resources, etc.
  - Internal factors: Administrative capabilities and leadership of the government, technological capacity, financial capacity, entrepreneurship, industrial structure, liquidity in labor market, containment of COVID-19, etc.

Disparity caused by climate actions

- Climate actions can widen disparity of various kinds because of differed capacities and resource endowments of each actor.
  - ① Disparity among developed countries and among developing countries.
  - ② Disparity between developed and developing countries
  - ③ Disparity between resource exporting country and importing country
  - ④ Disparity between citizens within same country

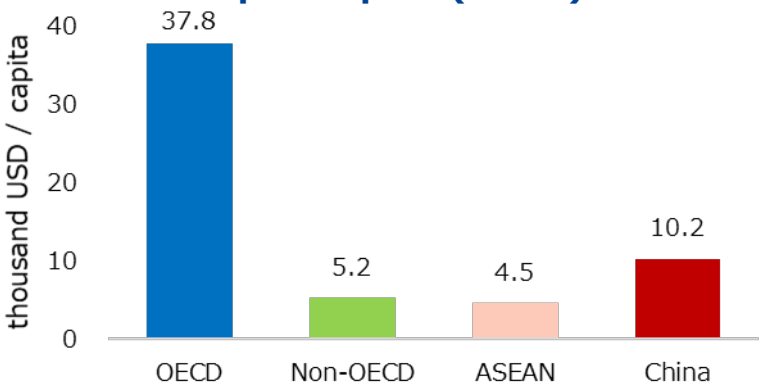




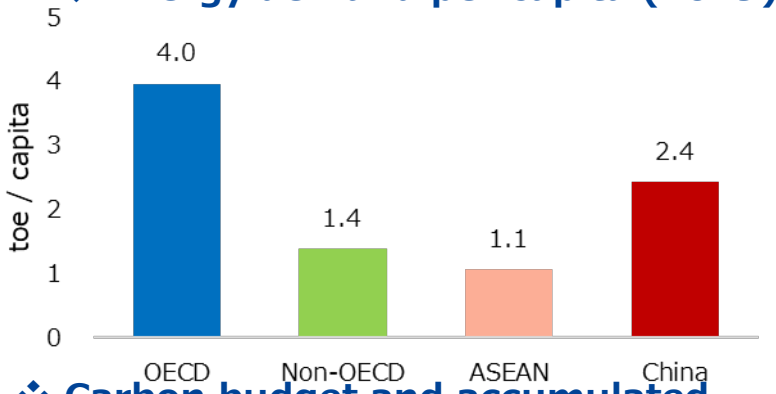
Comparison between developed and developing countries

- The existing differences are large.

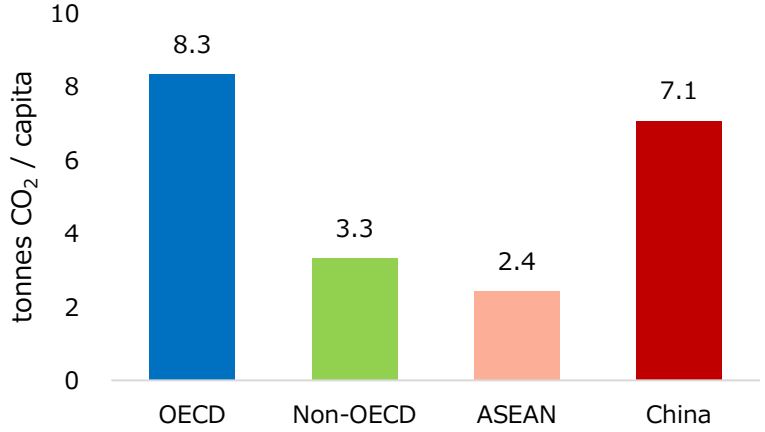
❖ GDP per capita (2019)



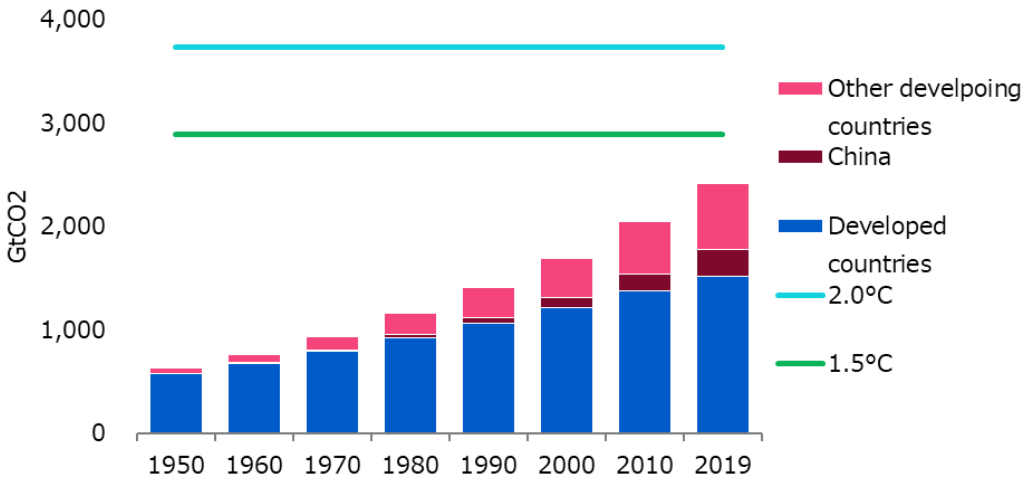
❖ Energy demand per capita (2019)



❖ CO_2 emissions per capita (2019)



❖ Carbon budget and accumulated emissions

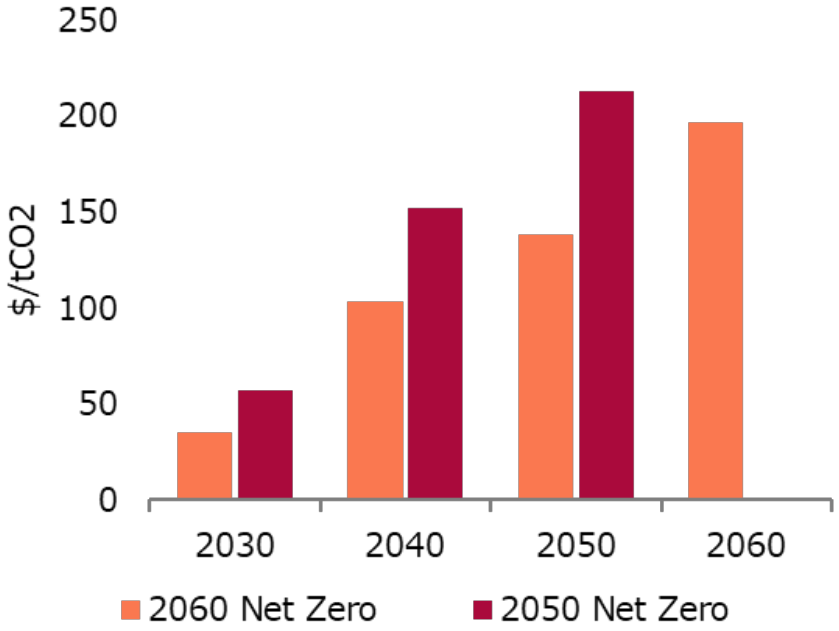


Note: Carbon budget figure are 50% expectation values
Source : IEA, IPCC, Global Carbon Budget 2020; Friedlingstein et al (2020); IEEJ estimate

Economic burden for the developing world (in the case of ASEAN)

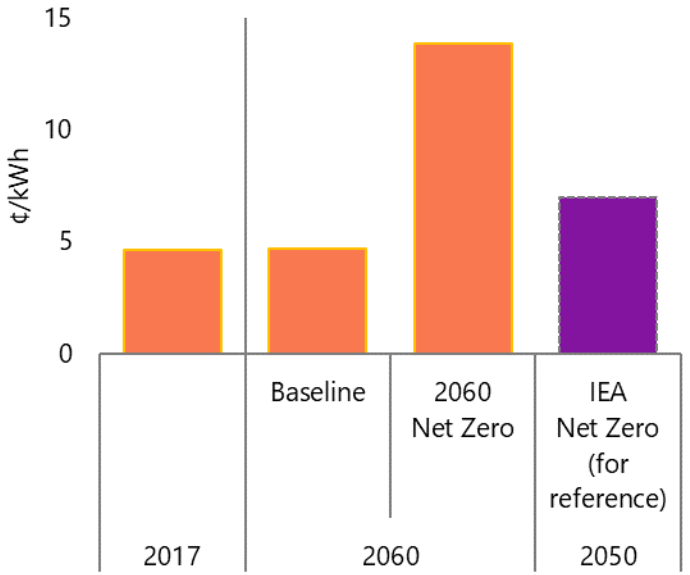
- Seeking for CN in a short period may cause a significant burden for ASEAN.
  - Average reduction cost for CN in 2050 or 2060 will be around \$200/t-CO_2.
  - Electricity price for CN in 2060 will triple from current levels.
  - Additional costs for CN in 2050 and 2060 will be equivalent to 2.9% and 2.5% of annual GDP, respectively.
- Supports to make a pragmatic roadmap toward CN are needed.

❖ Average CO_2 reduction cost in ASEAN



Source : IEEJ; IEA

❖ Electricity price in ASEAN

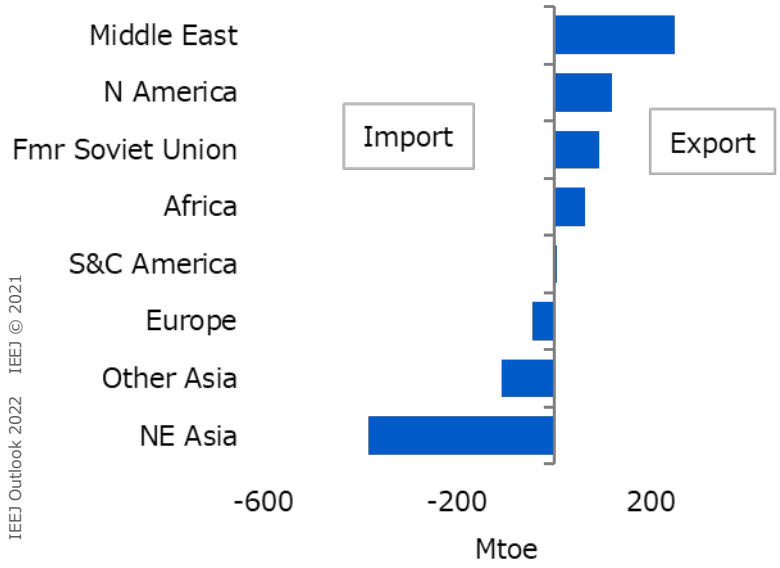


Note : Figure of IEA Net Zero is based on the estimated increased rate of electricity price in the world (+50%)
Source: IEEJ; IEA

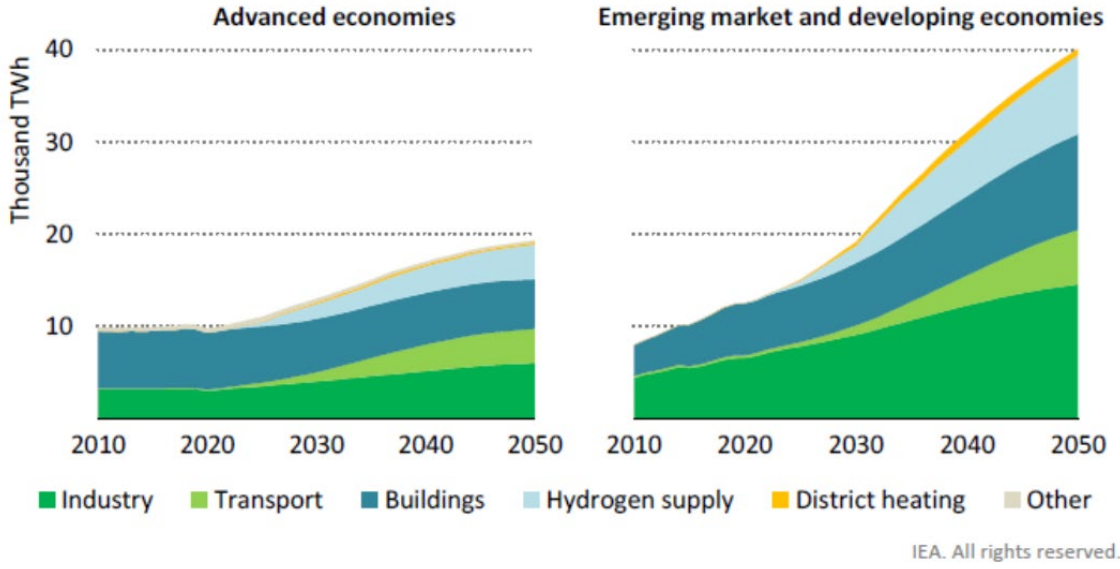
Energy security with increased complexity

- Energy security risks growing in significance
  - The world continues to depend on fossil fuels during the transition to CN.
  - Existing resource exporters may reinvent themselves as exporters of decarbonized fossil fuels, such as hydrogen and ammonia.
  - Electricity supply security becomes far more important while VRE's intermittency, system reform, cyber attacks remain important critical issues.
  - Supply security of critical minerals emerged as a new potential security issue.

❖ Hydrogen trade balance as of 2050 in CCE scenario



❖ Electricity demand in IEA Net Zero scenario

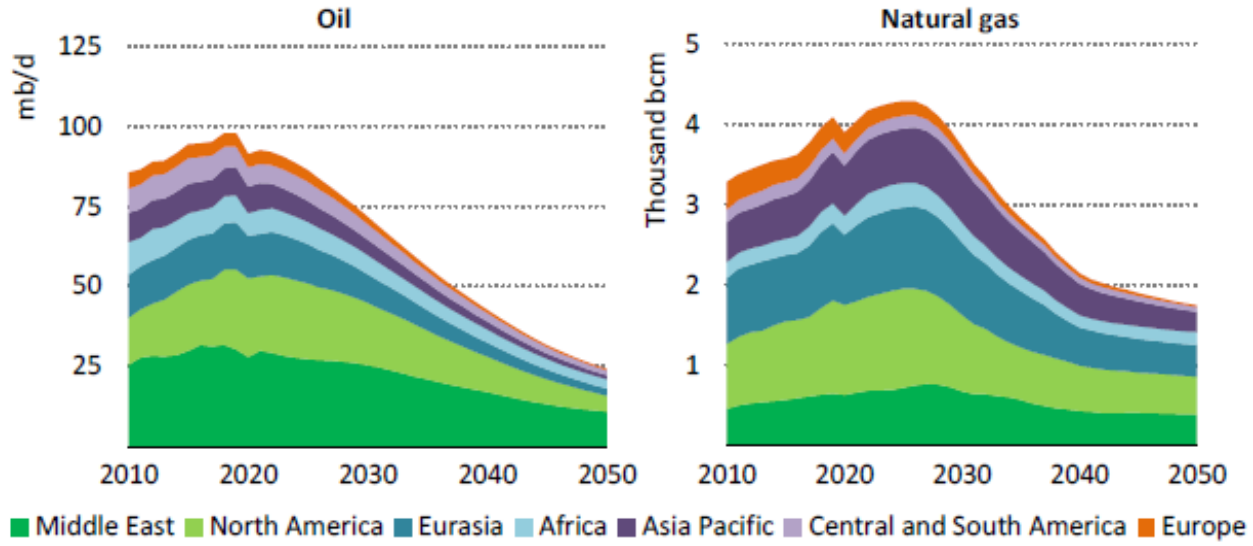


Source : IEA, Net Zero by 2050

No new upstream investment is needed to achieve CN by 2050?

- The “No new upstream investment” conclusion from IEA’s Net-zero scenario
  - IEA provided a back-casting scenario to achieve CN in 2050 and implied that there are no need for new oil and gas field to be approved for development and that no new coal mines or mine extensions are required.
  - IEA did not necessarily recommend no new upstream investments.
  - In the net zero scenario, the crude oil price will fall to $35/bbl in 2030 and $24/bbl in 2050..

Figure 3.3 ▷ Oil and natural gas production in the NZE

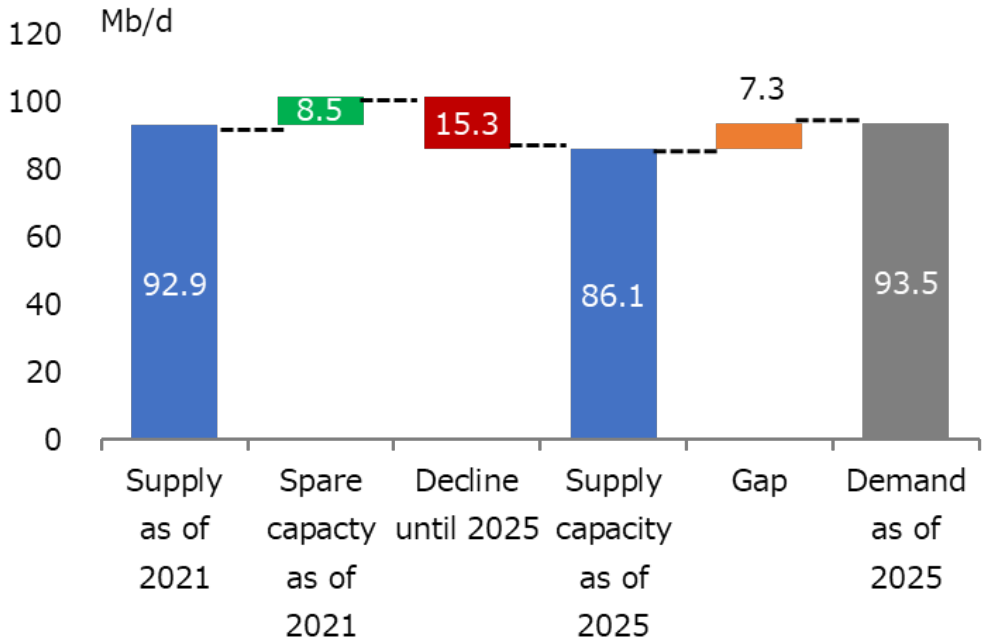


Source : IEA

What if investments in upstream oil stop?

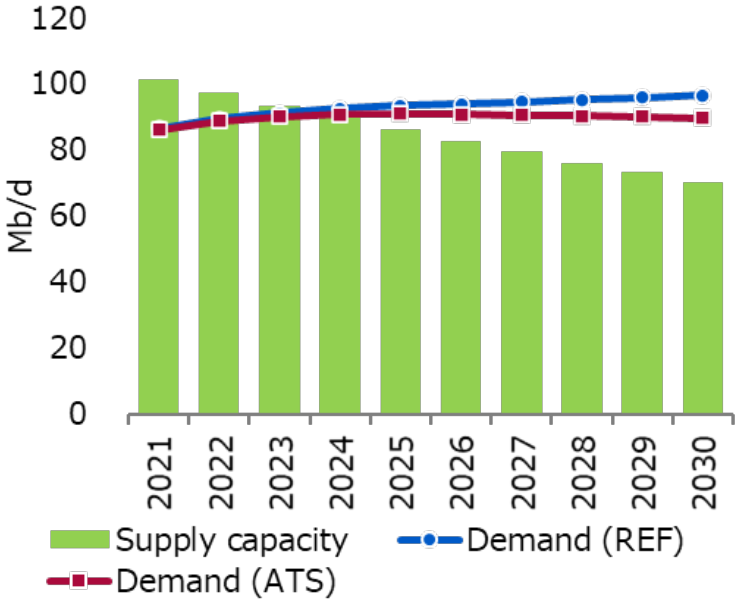
- If investment in new oil and gas field development stops, demand will surpass supply capacity by 2024.
  - World oil demand may return to a growing trend in the post-COVID world; the "No new upstream investment" conclusion may bring "chilling effect" on legitimate investments to meet such growing demand.

❖ World oil demand and supply capacity as of 2025 if investment stops



Note: Bio fuels are excluded. Supply capacity is assumed to decline by 4% annually.
Source : IEA; IEEJ estimate

❖ World oil demand and supply capacity if investment stops

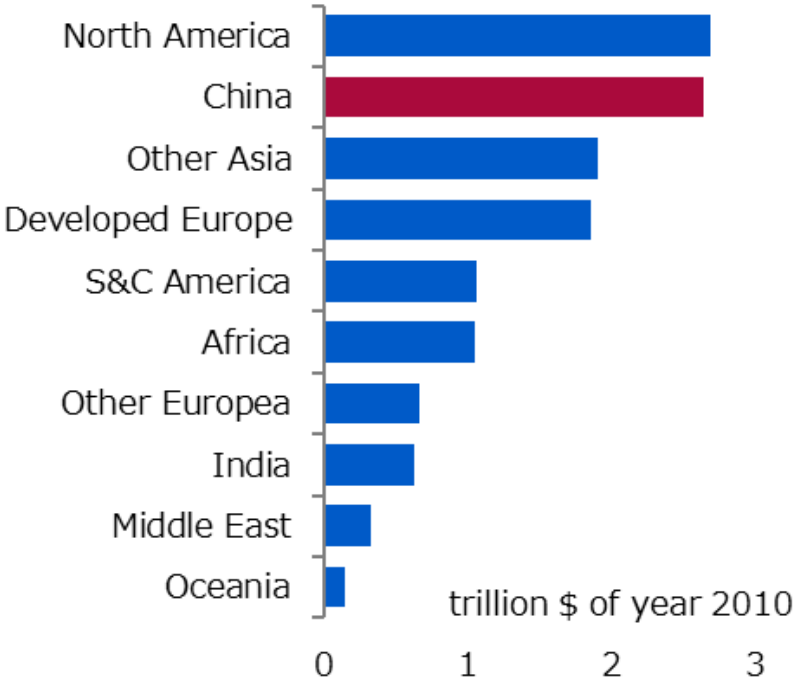


Note: Demand excludes biol fuels.
Sources: IEA, IEEJ estimates

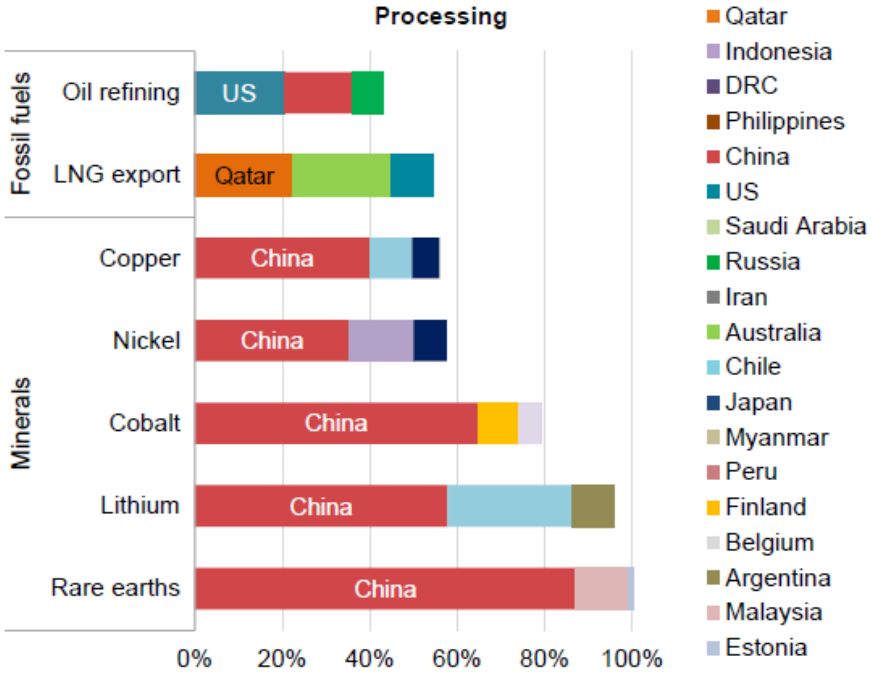
China's growing presence in a CN world

- 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

Summary

- The net effect of green deals and investments varies from country to country.

- The traditional energy security issues are becoming multidimensional and complex.

- The “no new upstream investment” conclusion cause chilling effects on the legitimate investments and can destabilize the future oil and gas supply.
  - .
- The transition to CN should proceed in an inclusive manner without forcing disproportionate economic burdens on developing countries.