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Contribution of AIM to update NDC and LTS in Japan

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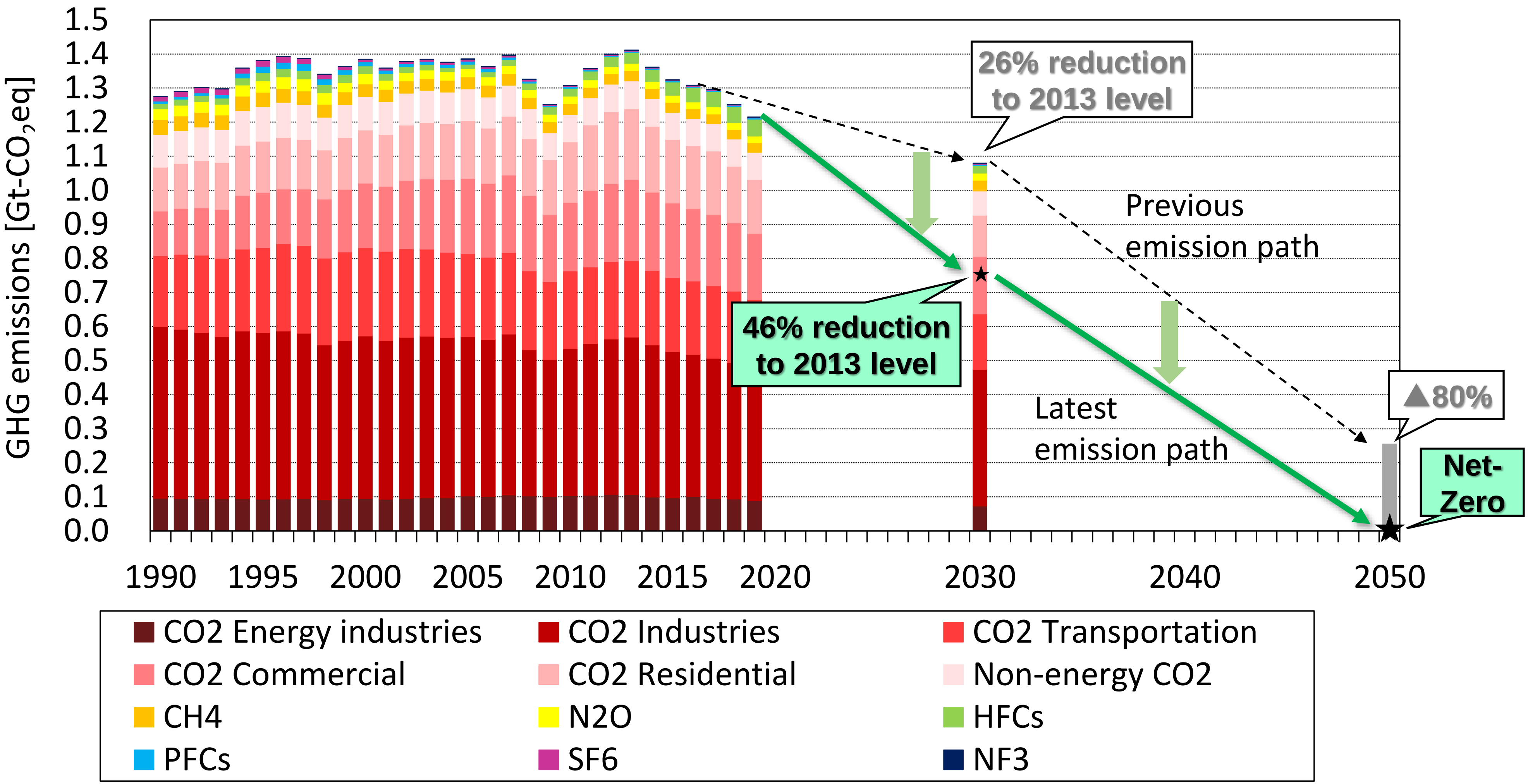
AIM ASIA-PACIFIC INTEGRATED MODEL Asia-Pacific Integrated Model

http://www-iam.nies.go.jp/aim/index.html

NIES JAPAN

Past trend and future targets of GHG emissions in Japan

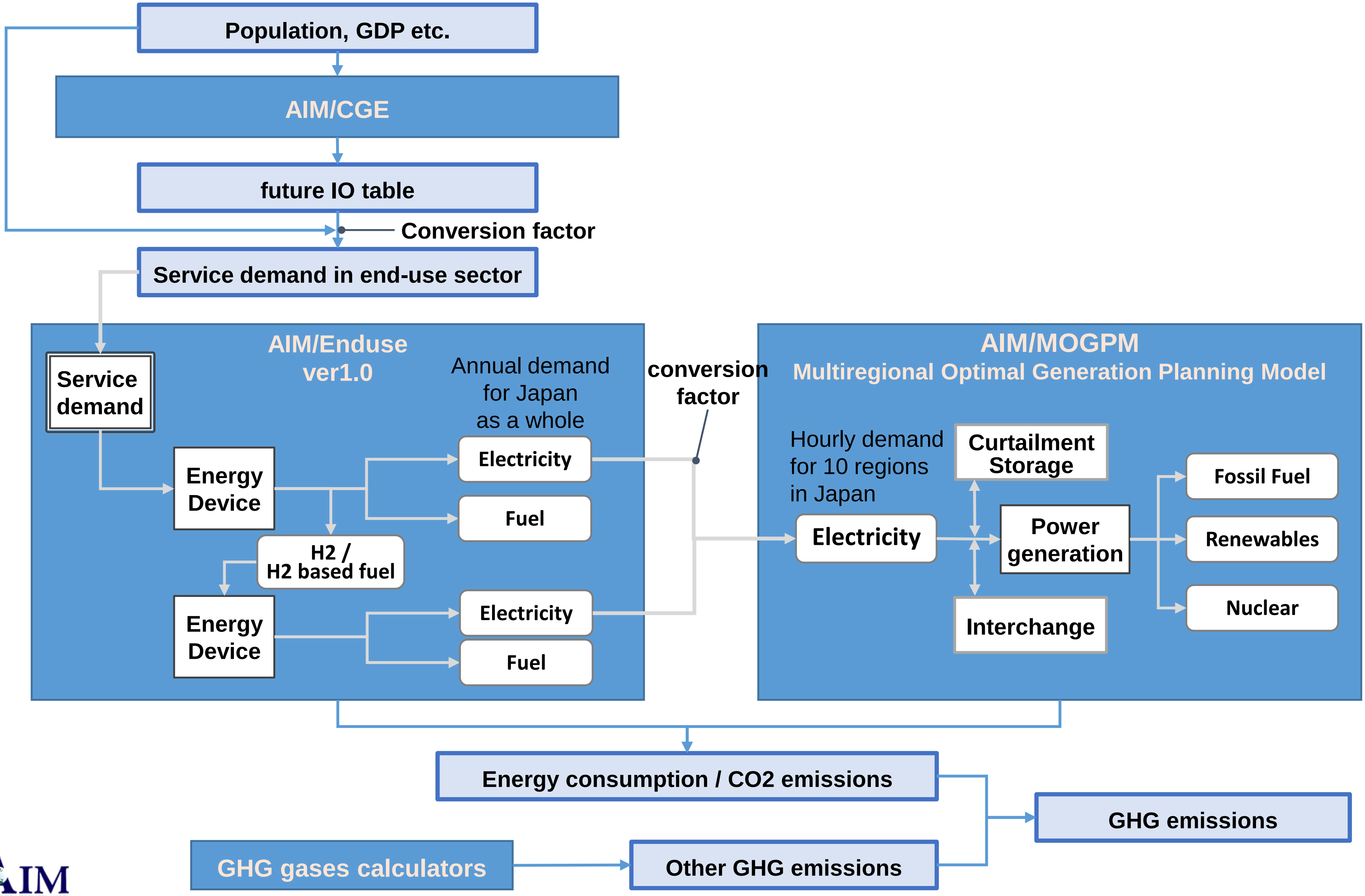


Data source:

Greenhouse Gas Inventory Office of Japan, NIES, https://www.nies.go.jp/gio/en/index.html

Japan's NDC, https://www.env.go.jp/press/files/en/828.pdf

Past trend and future targets of GHG emissions in Japan



Population, GDP, Service demand in 2050

	Future outlook	Notes
Population	126.440 (2018) → 101.923 (2050) mil. people	National Institute of Population and Social Security Research
Number of households	53.889(2018) → 47/241(2050) mil. households	National Institute of Population and Social Security Research and estimated based on its outlook
GDP growth rate	1.7%/year (2020-2030) 0.5%/year (2031-2050)	2020-2030: Estimated by Cabinet Office 2031-2050: SSP2
Crude steel production	102.89 (2018)→ 85.70 (2050) mil. ton	Estimated based on the future I/O table from AIM/CGE.
Cement production	60.23 (2018)→ 60.39 (2050) mil. ton	
Ethylene production	6.18 (2018)→ 5.41 (2050) mil. ton	
Paper & paperboard production	26.03 (2018)→ 23.48 (2050) mil. ton	
Machinery production	100 (2015)→ 141 (2050) index	
Business floor space	1903 (2018) → 1671 (2018) mil. m2	Estimated based on the future I/O table from AIM/CGE.
Passenger transport	1,459 (2018) → 1,179 (2050) bil. person-km	Estimated from population trend
Freight transport	411 (2018) → 419 (2050) bil. ton-km	Estimated based on the future I/O table from AIM/CGE.

AIM
ASIA-PACIFIC INTEGRATED MODEL

Four pillars of CO_2 reduction measures

1) Reduction of energy service demand

- Industry：Lifetime extension, Structural optimization, Reuse, Recycling etc.
- Buildings：Insulation, Energy management system
- Transport：Passenger transportation reduction and improvement of logistics efficiency through digitalization

2) Improvement in energy efficiency

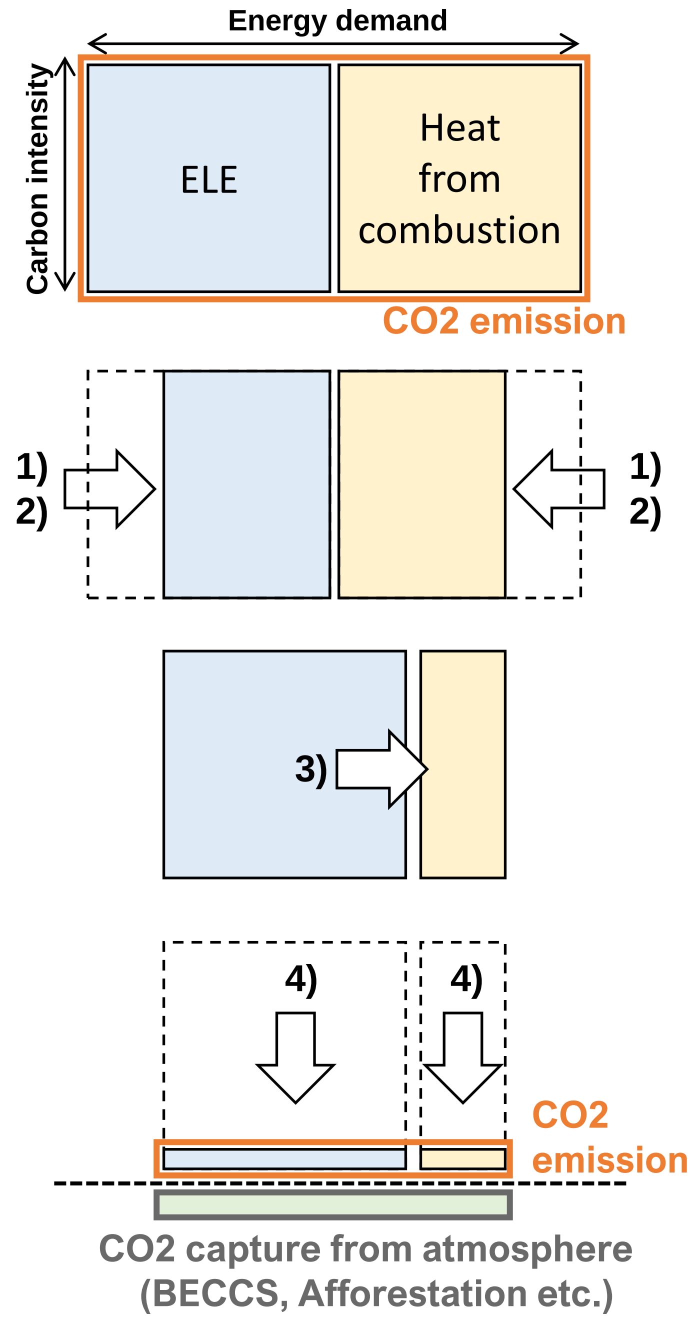
- Energy efficient device in all sectors

3) Electrification

- Industry：Heat pump as an alternative to boilers in low to medium temperature
- Buildings：Heat pump as an alternative to stove and boiler for heating and hot water
- Transport：BEV, FCV

4) Decarbonization of Energy

- Renewables
- Hydrogen and hydrogen-based fuels
- CCUS



Scenarios

- "Technology" scenario: net-zero emissions are achieved through deploying a wide range of the low-carbon technologies.
- "Technology + social transformation" scenario: In addition to the "Technology" scenario, the social transformation is assumed. The social transformation reduces the energy service demand with the help of the progress of digitalization and circular economy.

Technology × **Social transformation**

Technology

○ Energy efficient technology

○ Renewable energy

○ Electrification (electric cars, heat pumps, etc.)

○ Hydrogen / Hydrogen-based fuel (hydrogen, synthetic fuels, ammonia, etc.)

○ CCUS

○ Negative emission technology

Social transformation

○ Efficient use of materials

- Lifetime extension, Structural optimization, Reuse, Recycling etc.

⇒ Industrial productions in 2050: -15%

○ Passenger transportation reduction through digitalization

○ Logistics efficiency improvement through digitalization

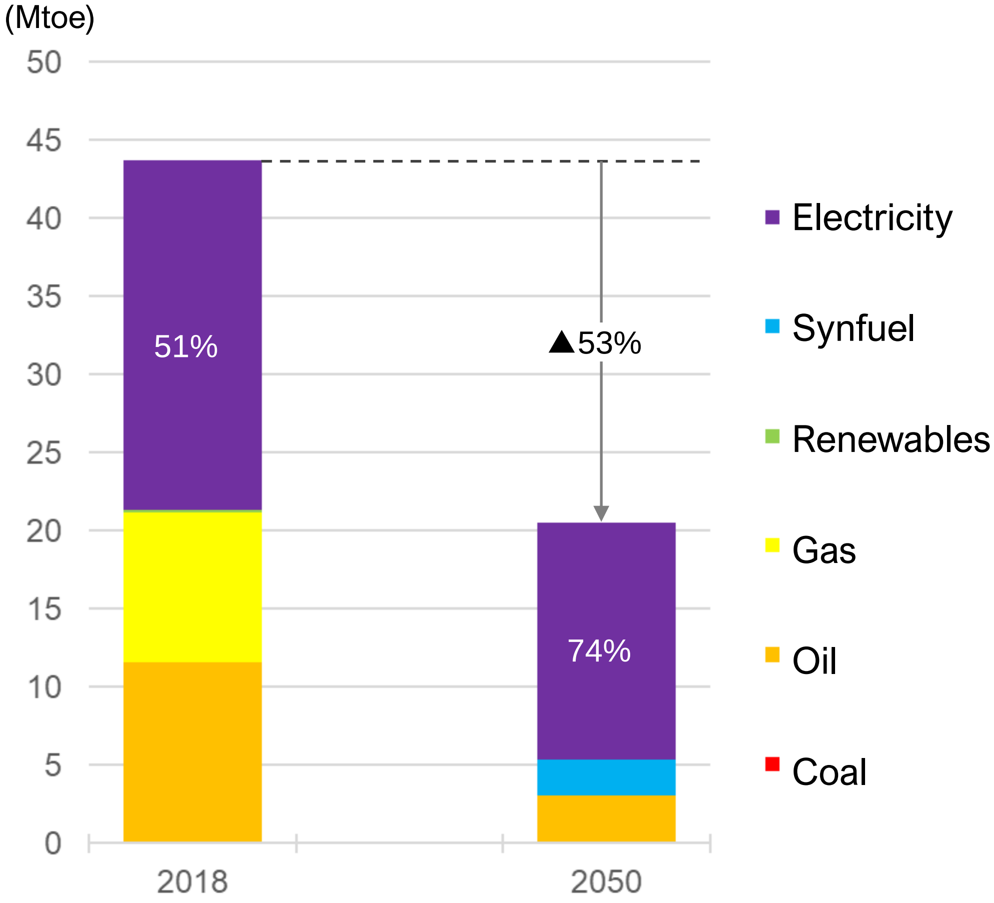
⇒ Passenger & freight transport volumes in 2050: -20%

AIM ASIA-PACIFIC INTEGRATED MODEL

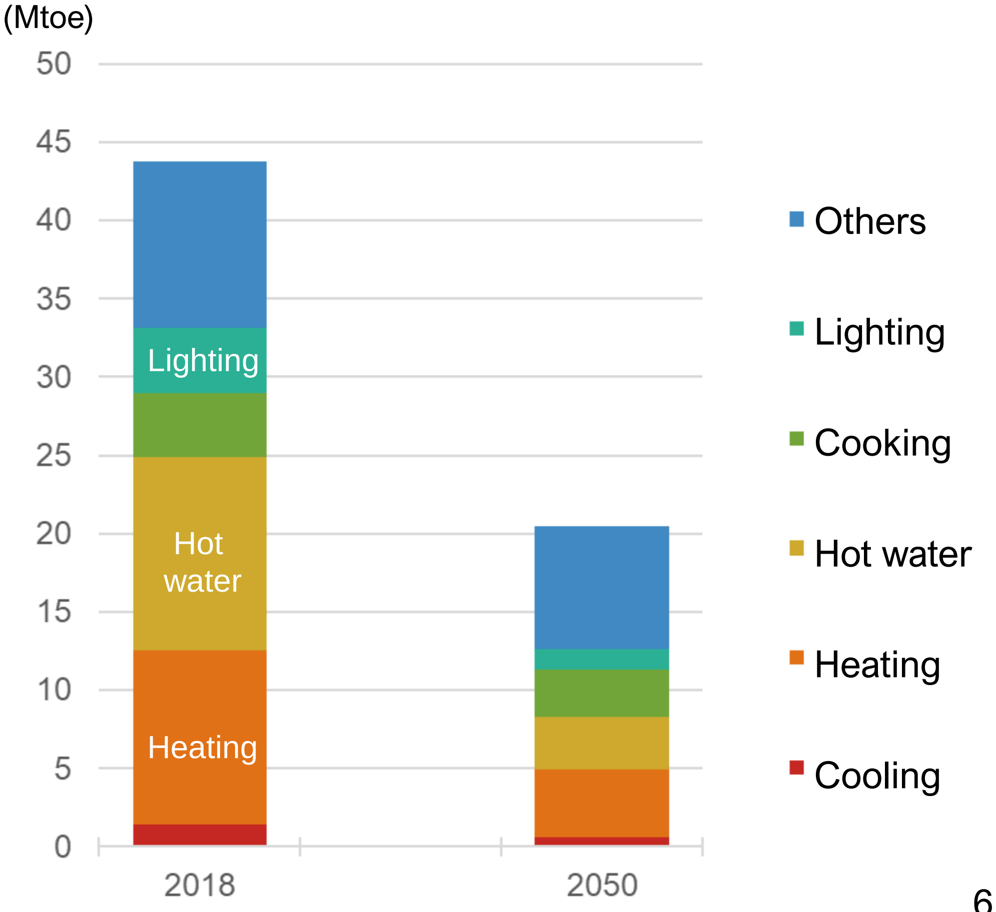
Energy consumption in residential sector

- Energy consumption in residential sector in 2050 decreases by 53% compared to 2018.
- The share of electricity increases from 51% in 2018 to 74% in 2050 due to the promotion of electrification of heating and hot water supply.
- Energy consumption for heating, hot water supply, and lighting is significantly reduced by insulations in building and efficient energy devices.

＜Energy consumption by fuel＞



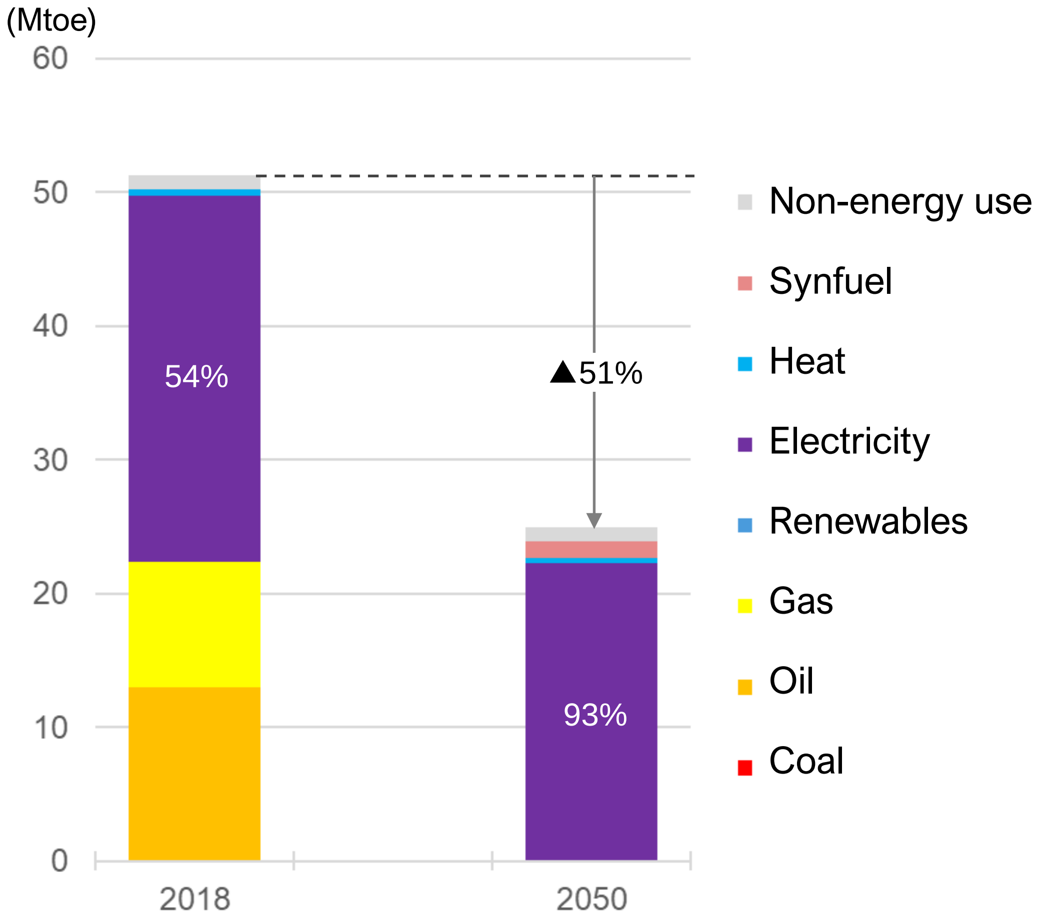
＜Energy consumption by service＞



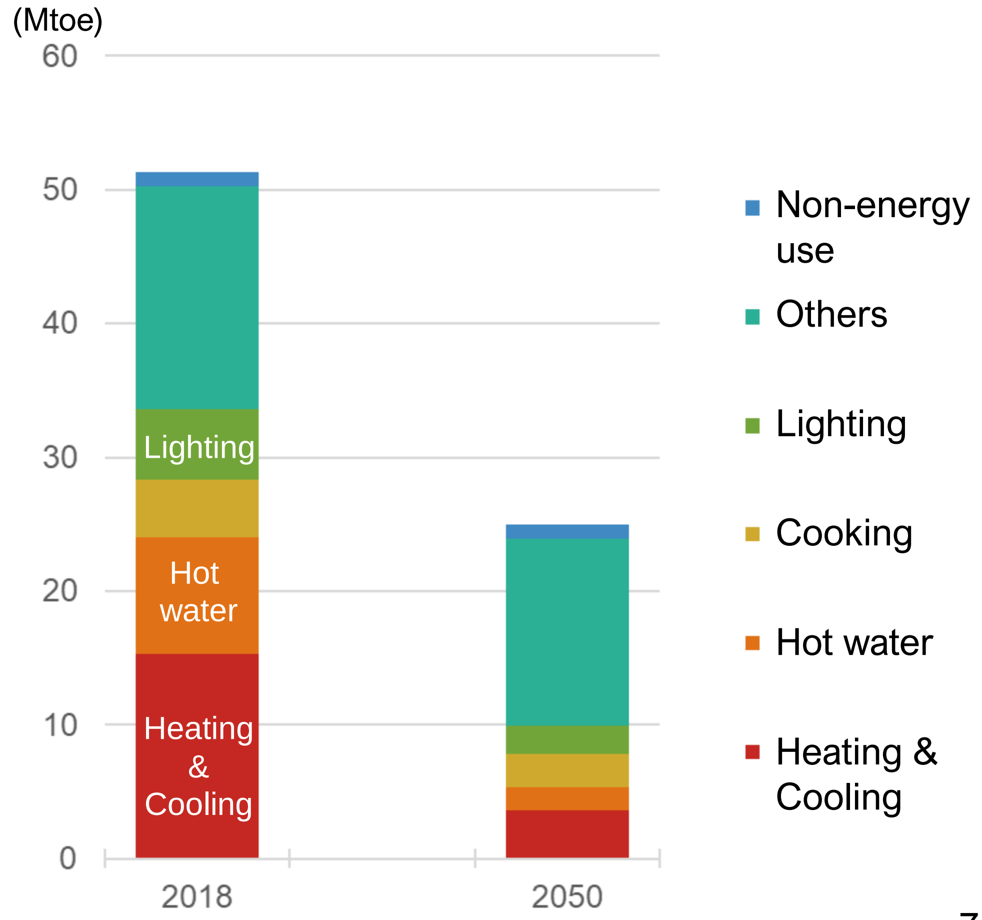
Energy consumption in commercial sector

- Energy consumption in commercial sector in 2050 decreases by 51% compared to 2018.
- The share of electricity increases from 54% in 2018 to 93% in 2050 due to the promotion of electrification of heating and hot water supply.
- Energy consumption for heating, hot water supply, and lighting is significantly reduced by insulations in building and efficient energy devices.

＜Energy consumption **by fuel**＞



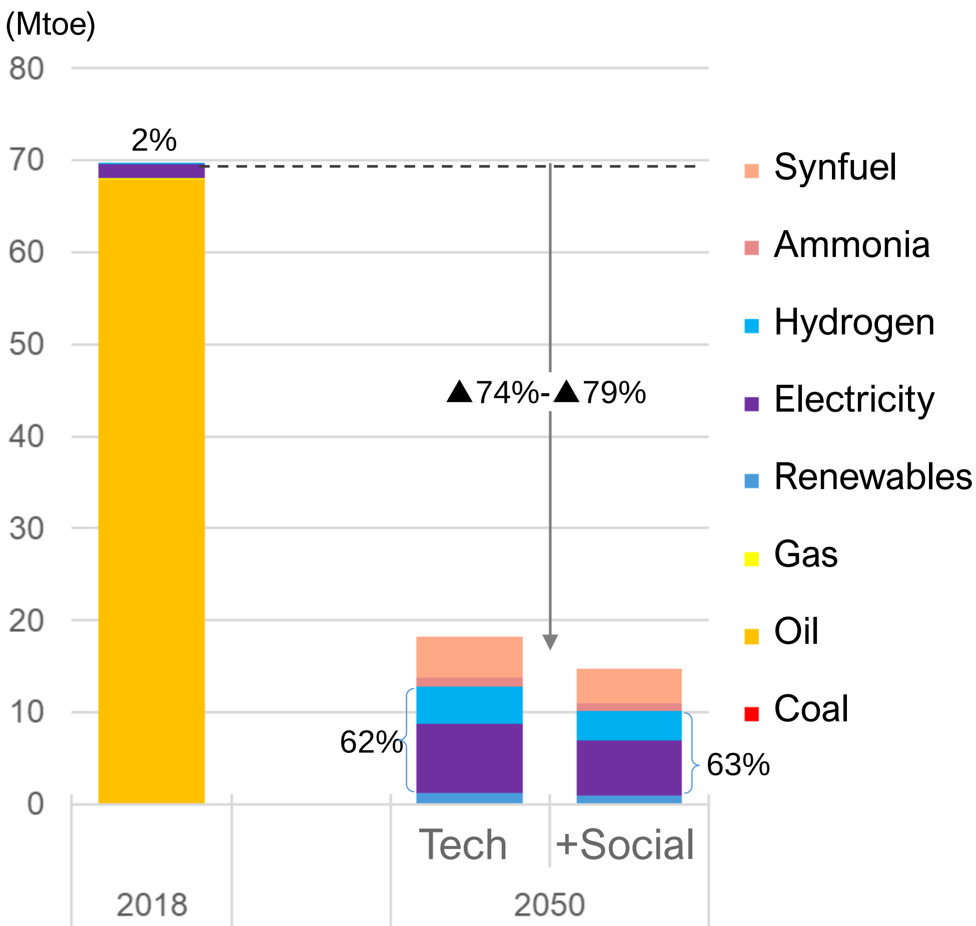
＜Energy consumption **by service**＞



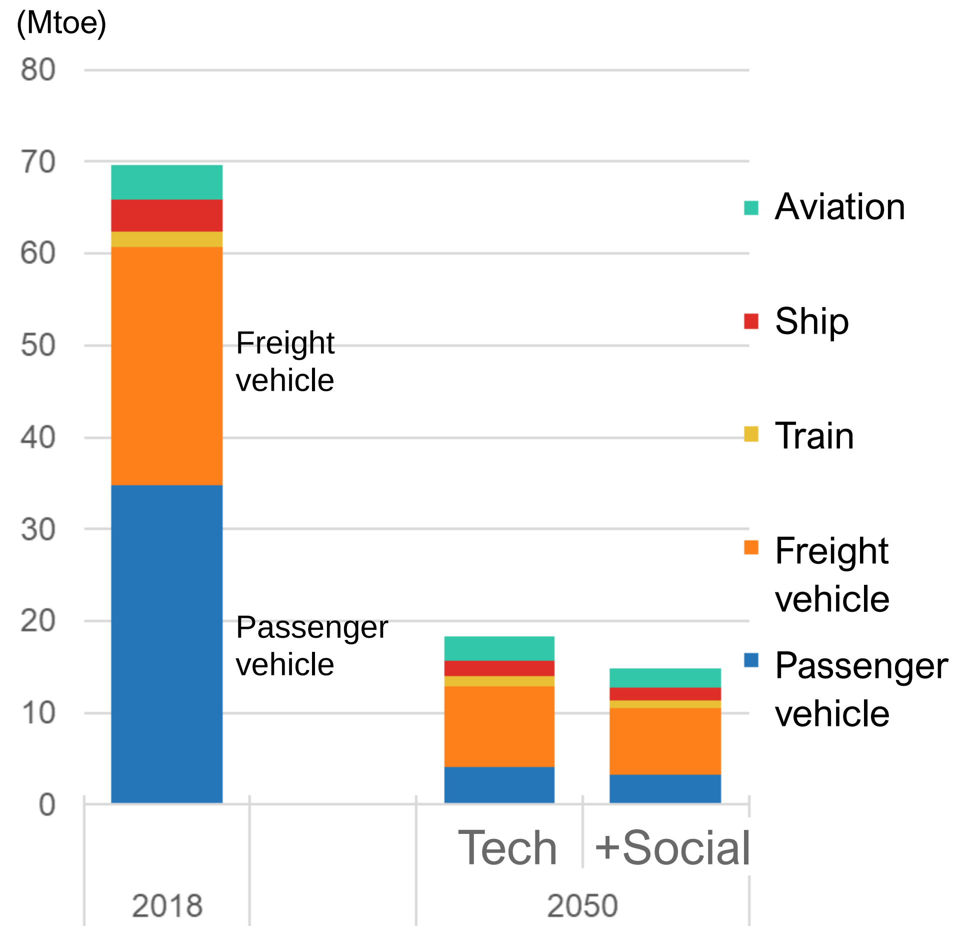
Energy consumption in transportation sector

- Energy consumptions in transportation sector in 2050 decrease by 74-79% compared to 2018.
- The share of sum of electricity and hydrogen increases from 2% in 2018 to 62-63% in 2050 and energy consumptions by vehicle decrease significantly due to the promotion of electric vehicles and fuel cell vehicles.

＜Energy consumption by fuel＞



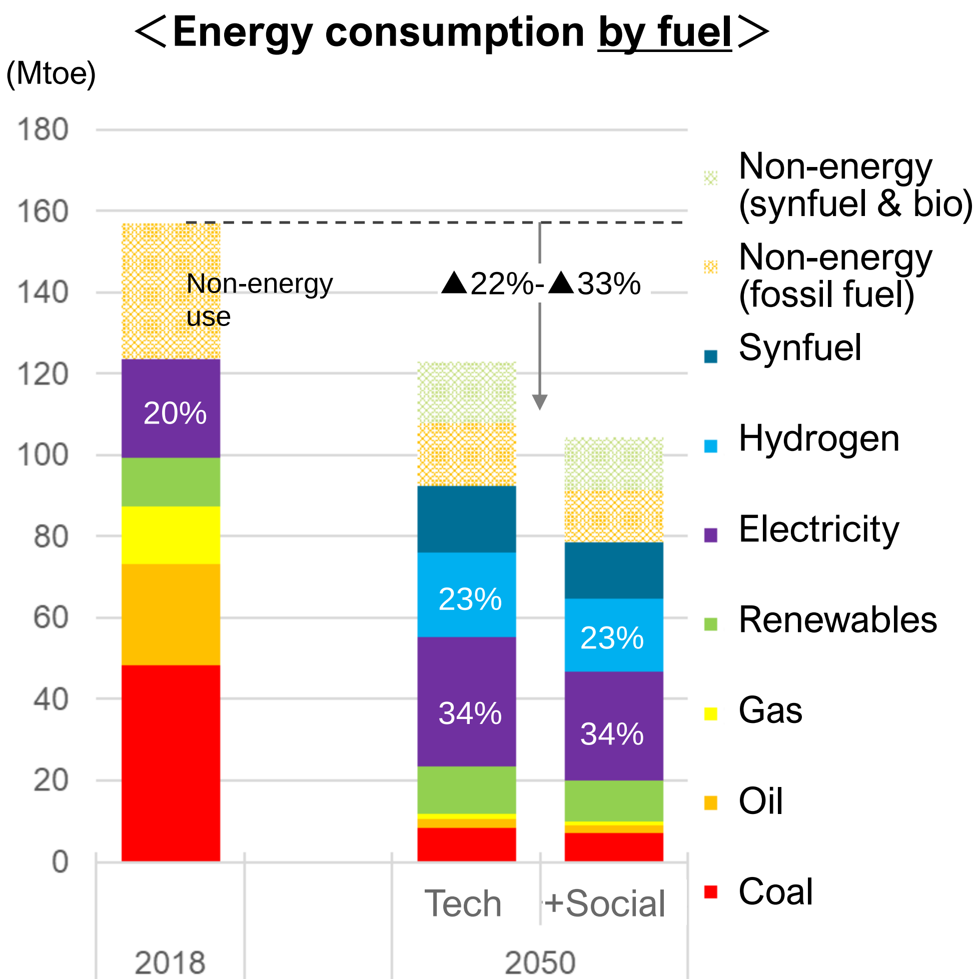
＜Energy consumption by service＞

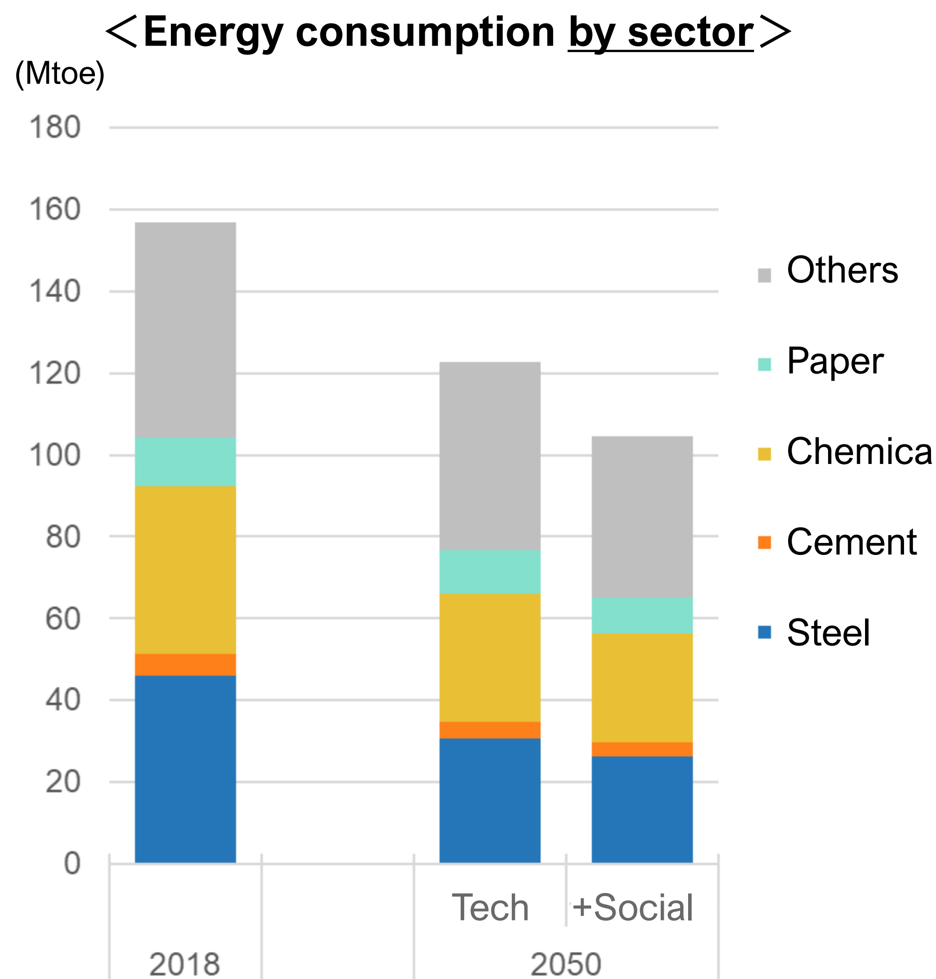


Energy consumption in industrial sector

- Energy consumptions in industrial sector in 2050 decrease by 22-33% compared to 2018.
- The share of electricity increases from 20% in 2018 to 34%* in 2050 due to the promotion of heat pump for heating. The share of hydrogen increases from 0% in 2018 to 23%* in 2050 due to the promotion of H2 burner for high temperature heat process and hydrogen reduction ironmaking.

* The ratio of electricity and hydrogen for energy use excluding non-energy use.



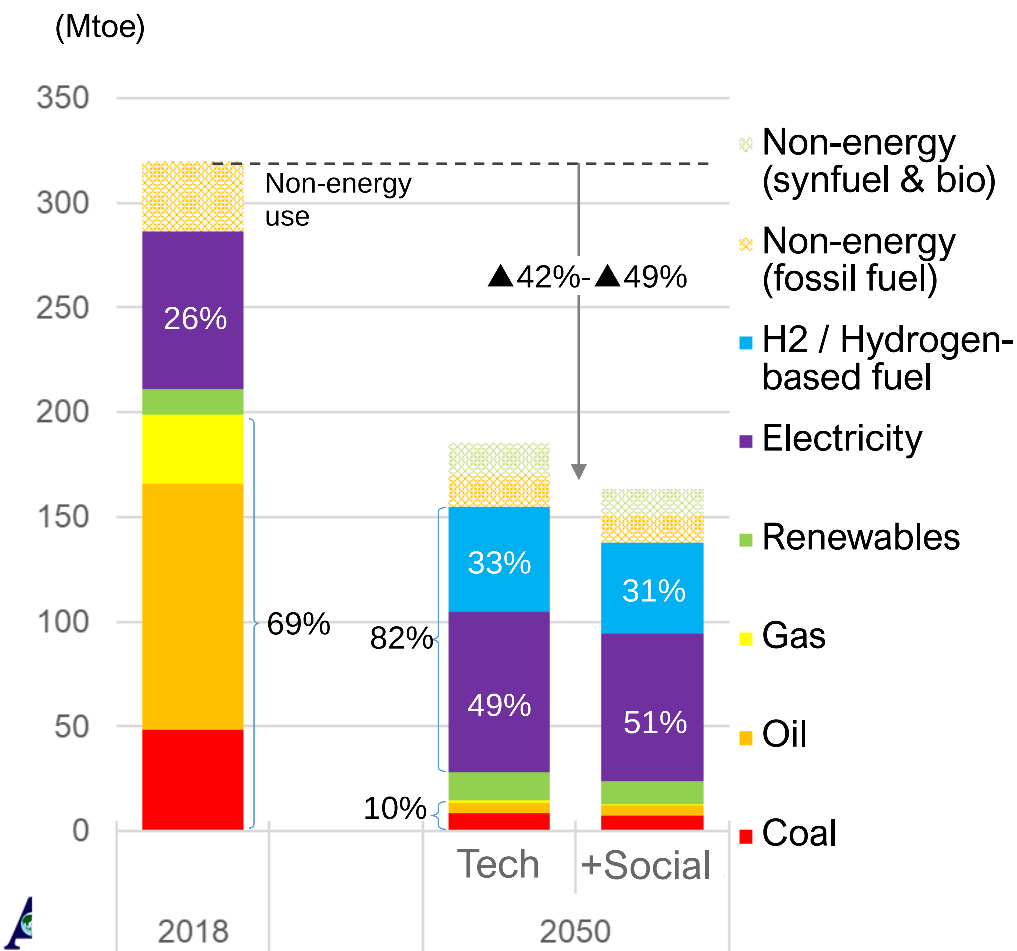


Final Energy Consumption (=sum of IND, RES, COM, TRA)

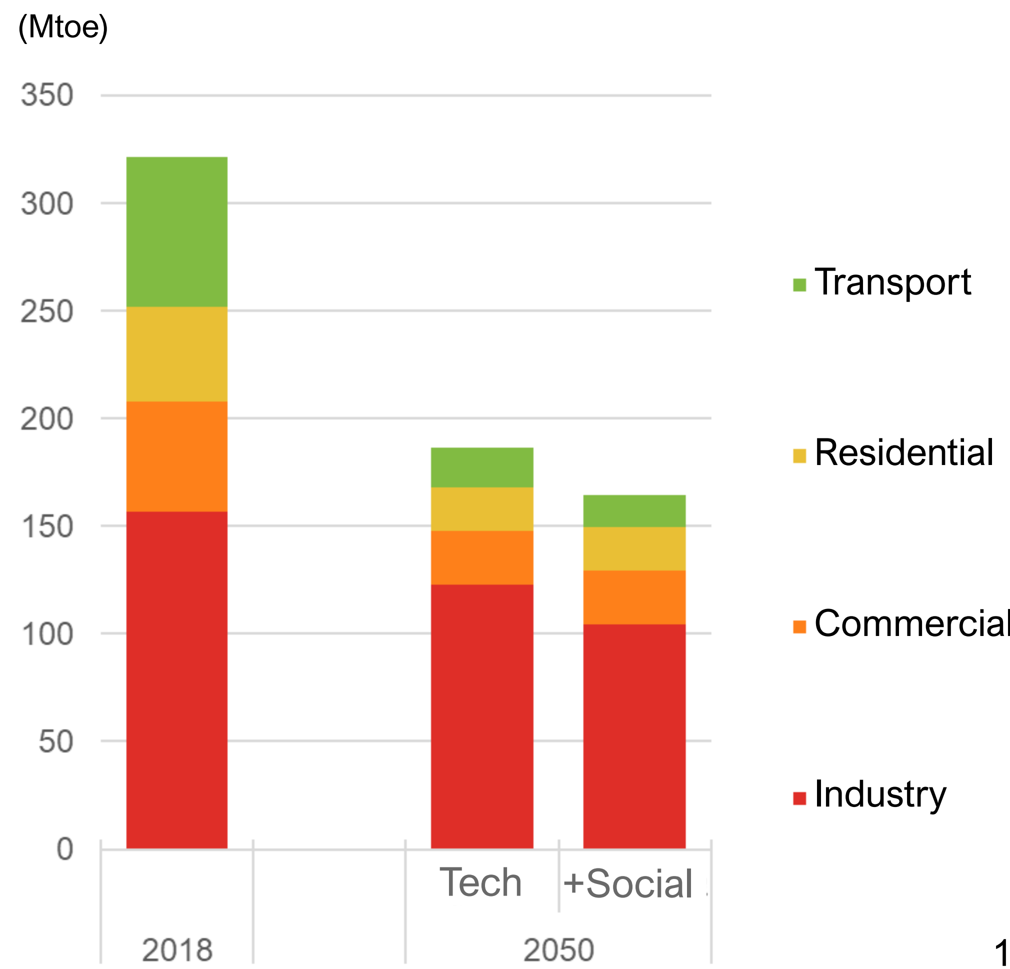
- Final energy consumption in 2050 decrease by 42-49% compared to 2018.
- The share of fossil fuel decreases from 69% in 2018 to 10%* in 2050, while that of sum of electricity and hydrogen increase from 26% to 82%*.

* The ratio of electricity and hydrogen for energy use excluding non-energy use.

＜Energy consumption **by fuel**＞

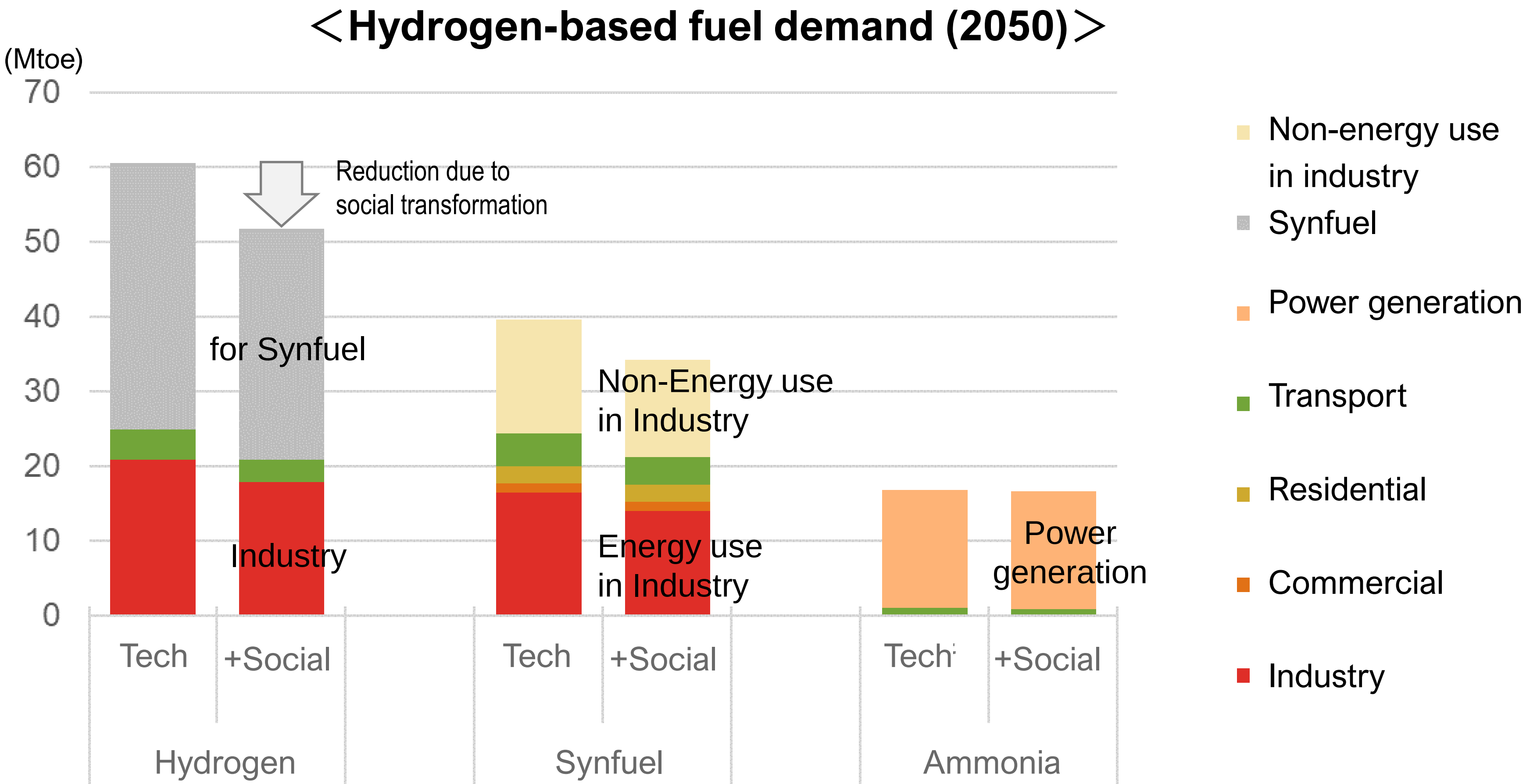


＜Energy consumption **by sector**＞



Hydrogen-based fuel demand

- Hydrogen demand is 52-61 Mtoe in 2050, and the demand for synthetic fuel production accounts for more than 50%.
- Synthetic fuel demand is 34-40 Mtoe in 2050, and the demand in industrial sector including energy and non-energy use accounts for about 80%.
- The demand for ammonia is 17 Mtoe, most of which is for power generation.

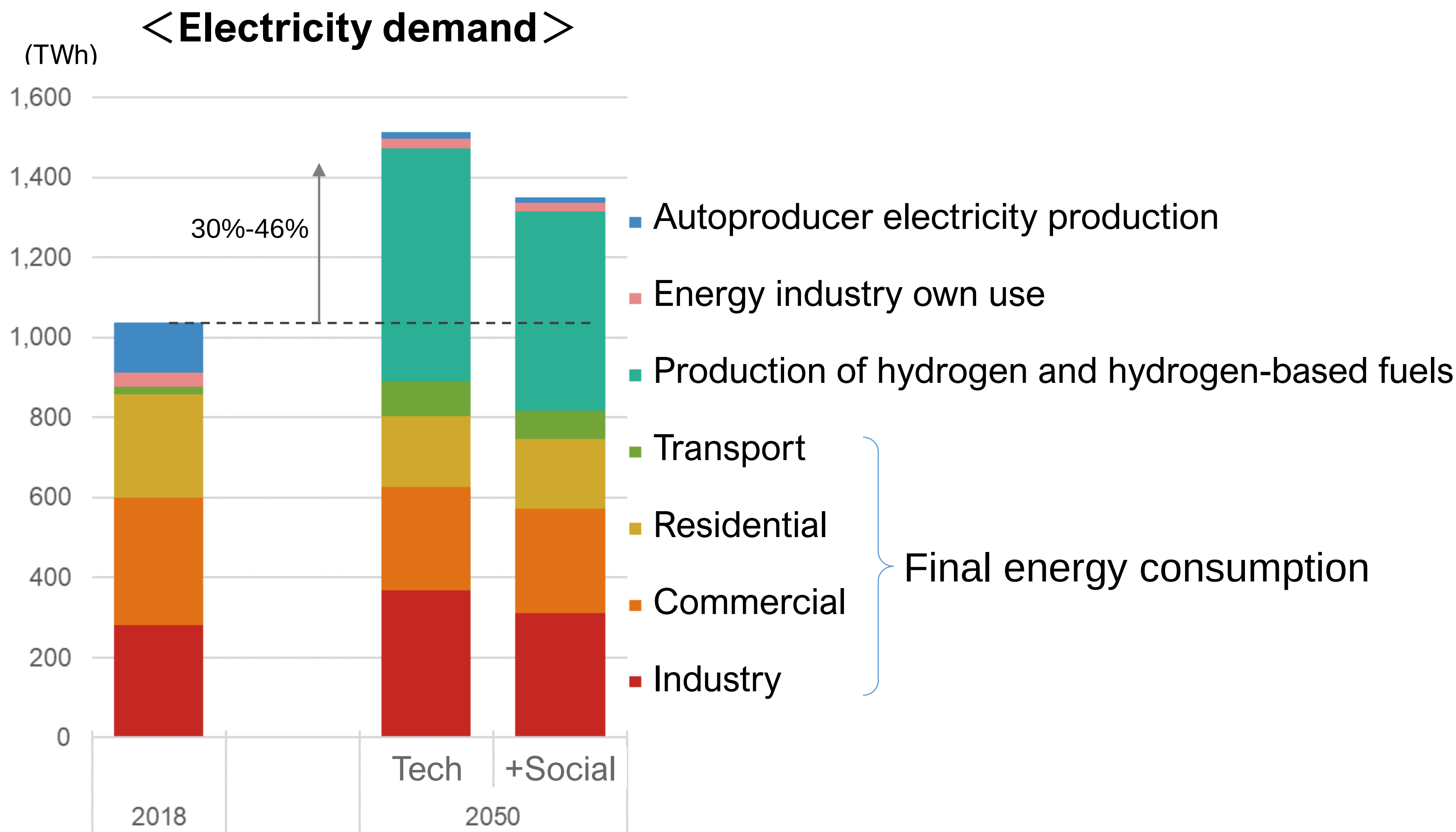


・Assumption of Import rate: Hydrogen and synfuel 30%, Ammonia 100%

AIM ASIA-PACIFIC INTEGRATED MODEL

Electricity demand

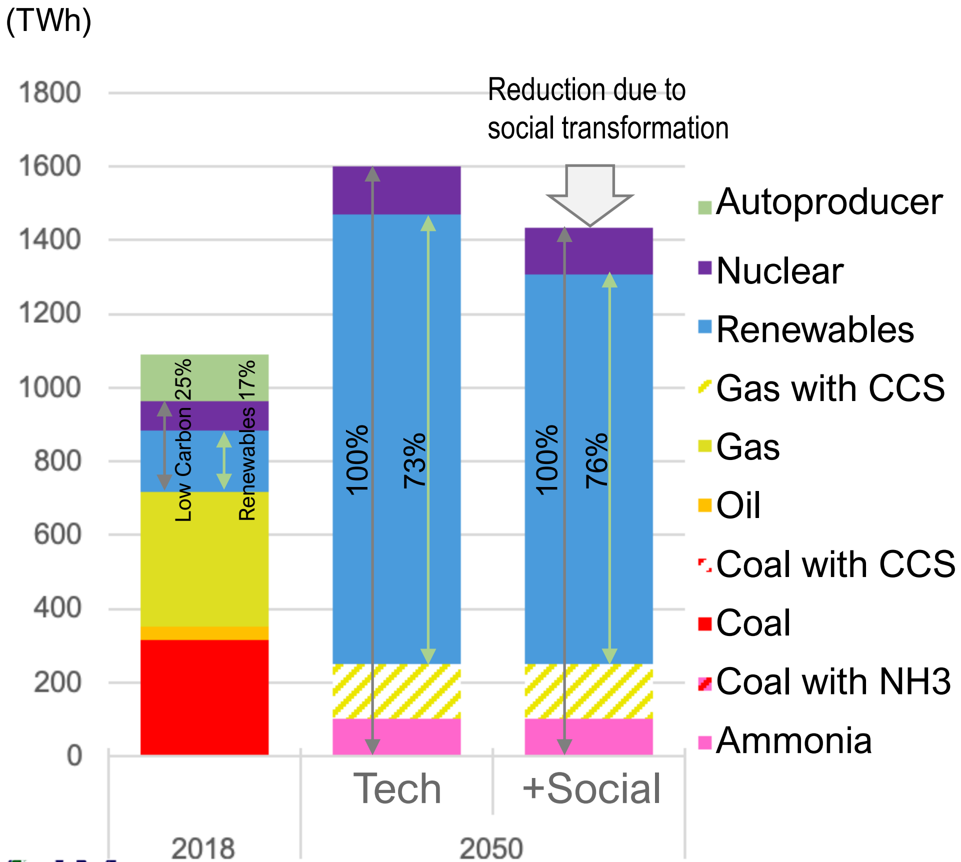
- Electricity demand increases substantially from 2030 onward, rising 30-46% in 2050 compared to that in 2018.
- Demand in the final consumption sector remains flat or decreases, but demand for new fuel production (mainly for electrolysis to produce hydrogen) increases considerably.



Electricity generation

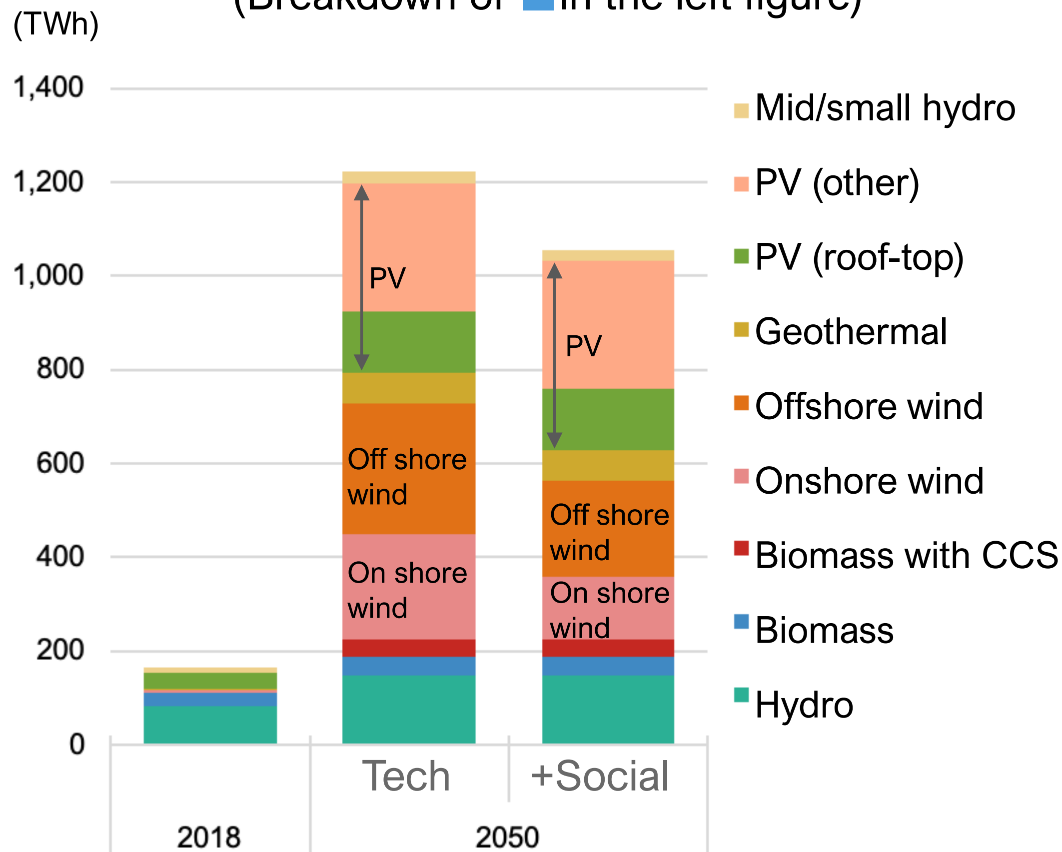
- Share of low-carbon power changes from 25% in 2018 to 100% in 2050.
- Share of renewable energy sources increases from 17% in 2018 to 73-76% in 2050. PV and wind power account for a large share of electricity generation, with PV at 403-405 TWh in 2050, onshore wind power at 133-226 TWh in 2050, and offshore wind power at 205-276 TWh in 2050.

＜Total electricity generation＞



＜Renewable electricity generation＞

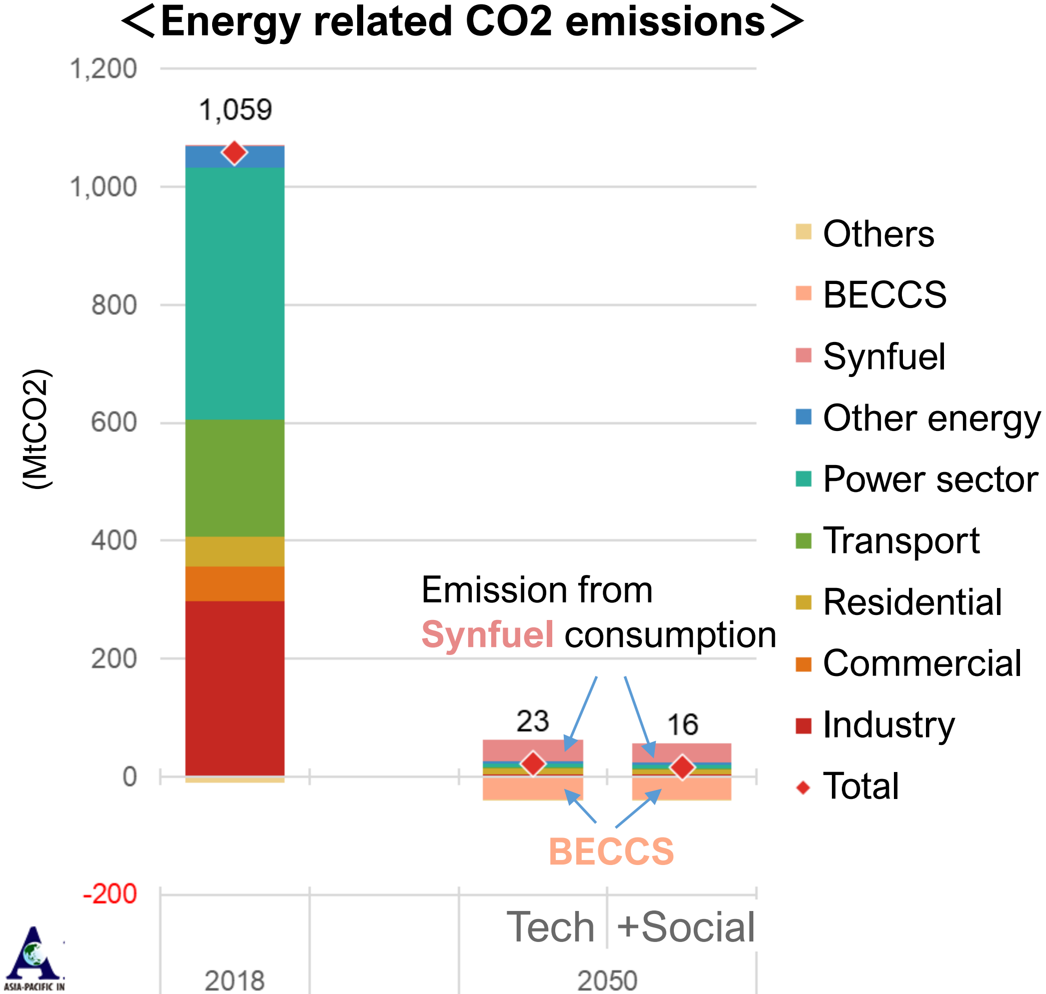
(Breakdown of ■ in the left figure)

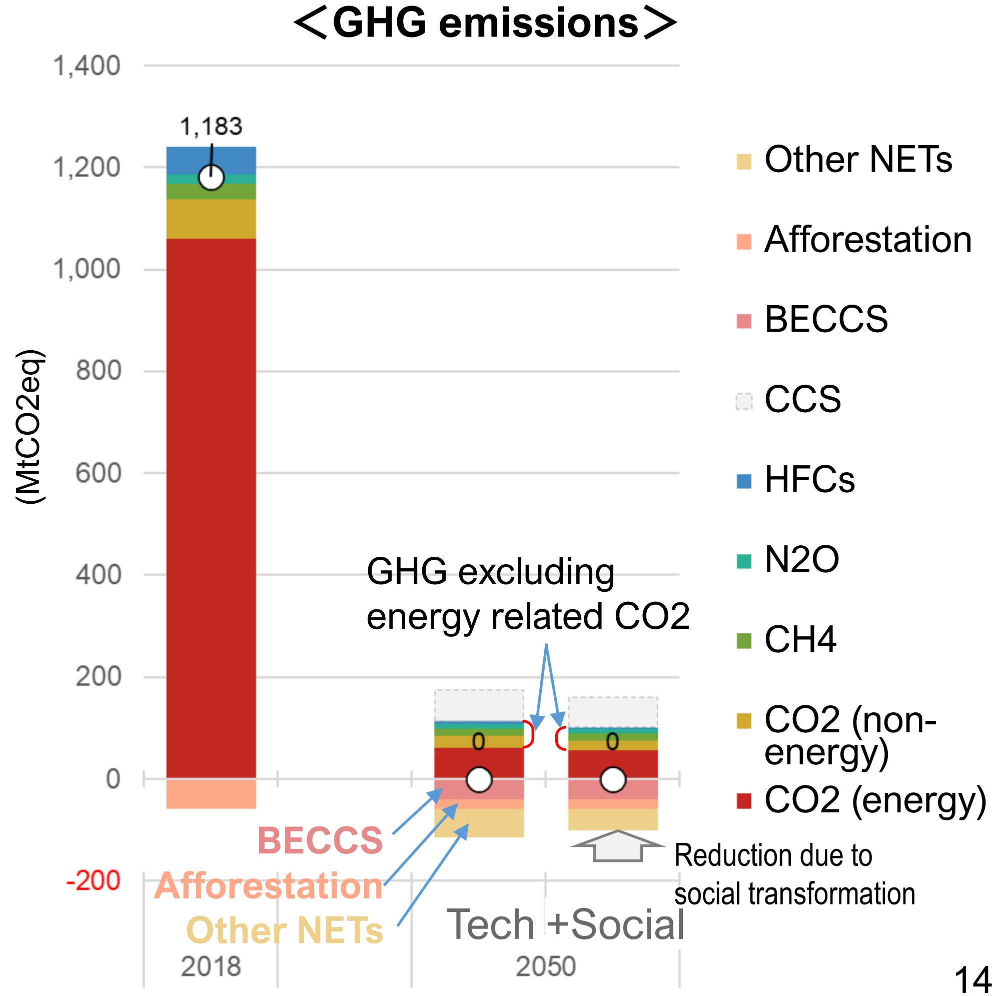


AIM ASIA-PACIFIC INTEGRATED MODEL

Energy related CO2 and GHG emissions

- Regarding energy related CO2 emissions in 2050, direct emissions from fossil fuels decrease to almost zero, and emissions from synthetic fuels remain. Due to offset by BECCS, net CO2 emissions is achieved.
- Regarding GHG emission in 2050, CH4 and N2O emission also remain. In order to achieve GHG neutral, almost 100MtCO2 negative emissions including BECCS, afforestation and other measures is needed.

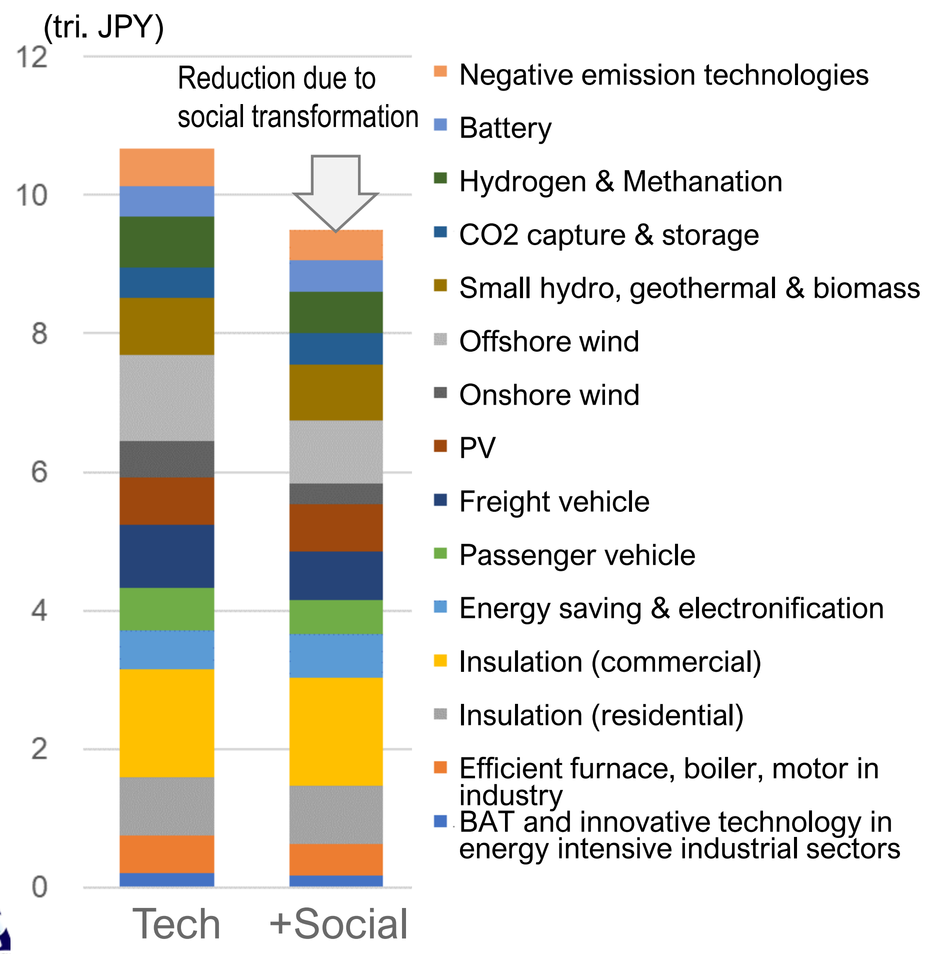




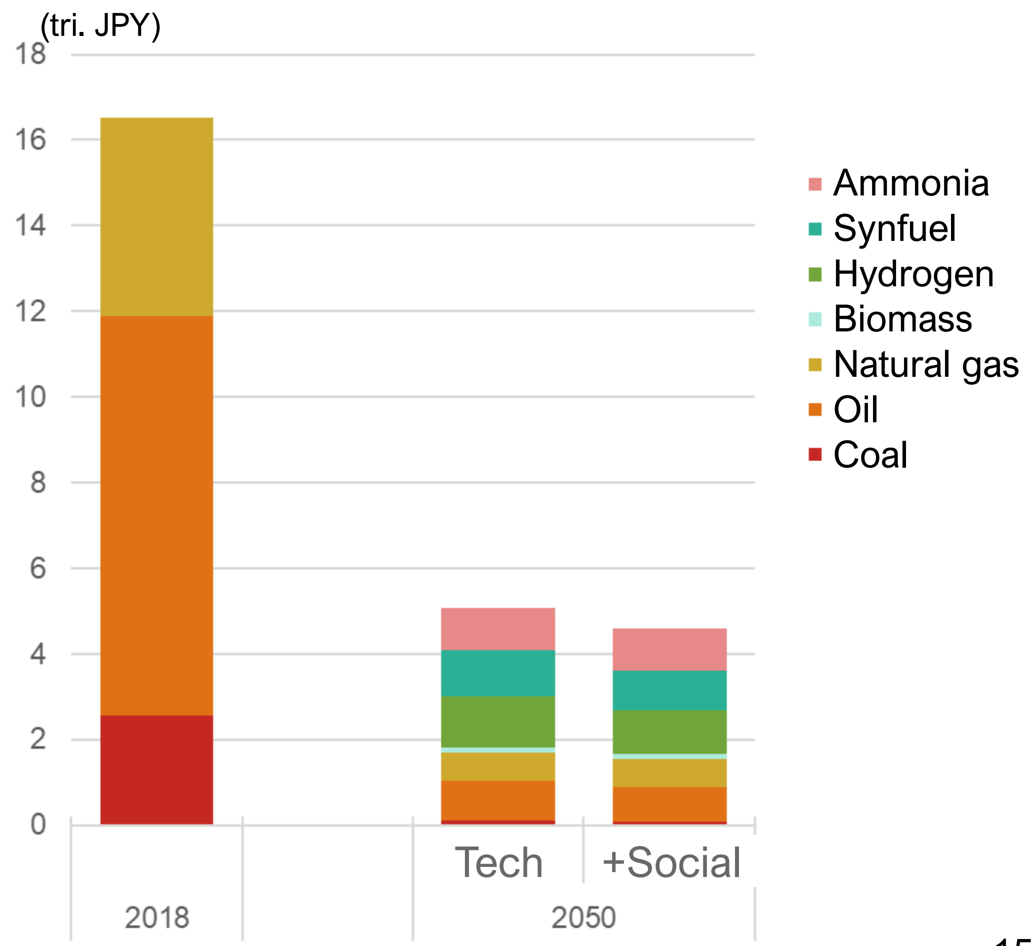
Additional investment

- In terms of the amount of additional investment needed to achieve net-zero, investment in insulation of buildings and renewable energy accounts for a large share.
- Net energy imports in 2018 were about 16 trillion yen, but imports will fall by about 12 trillion yen in 2050 due to reduced dependence on fossil fuels.

＜Additional investment (average 2041-50)＞



＜Net import value of energy in 2050＞



Implications

(1) Social transformation could increase certainty of achieving net-zero.

There is much uncertainty regarding the development and dissemination of low-carbon technologies. In order to enhance the feasibility of net-zero GHG emissions, it is important to make efforts to social transformation into a society where service demand can be decoupled with energy demand by promoting digitalization and circular economy.

(2) Electrification and maximum utilization of renewable energy power generation potential

While the potential of photovoltaic and wind power is much higher than other renewables, both are highly variable power sources. To address variability, it is necessary to ensure flexibility by combining various power sources, storing electricity and implementing interregional interchange.

(3) Early maximum introduction of low carbon technology

In order to disseminate 100% low carbon technology on a stock basis in 2050, it is necessary to achieve 100% dissemination on a flow basis at an early stage. In the next 10 to 15 years, it will be necessary to increase the acceptance of society toward the mass dissemination of low carbon technology in terms of both hardware and software.

(4) Acceleration of the development of innovative technologies

It is difficult to completely eliminate GHG emissions. Therefore, it is also necessary to take measures to capture and store atmospheric CO_2 to offset the emitted GHG. We must accelerate the development of these innovational technologies with a view to utilizing overseas resources.