Emissions scenario analysis for consideration of Japan's reduction target using the AIM model

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AIM International Workshop

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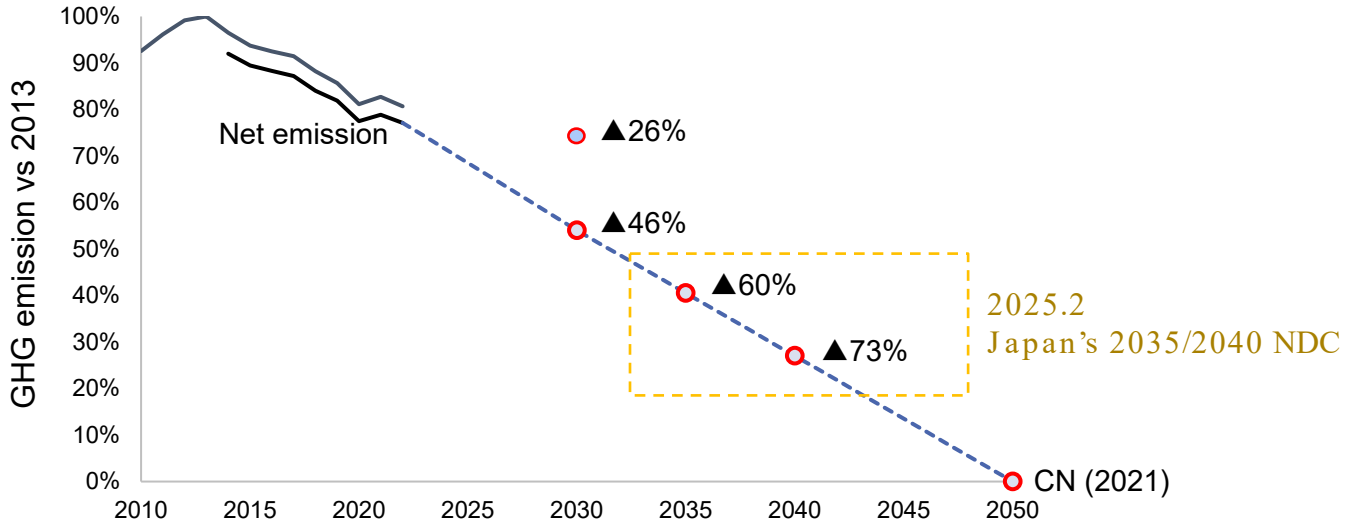
Japan's New Reduction Targets

Japan's GHG reduction target

	GHG reduction target (NDC, Plan for Global Warming Countermeasures)	Energy Basic Plan
2015～16	• INDC GHG（vs 2013） 2030FY ▲26%　(2050FY ▲80%)	• TFC 2030FY 326 billion *l* • ELE 2030FY RE22~24%、NUC22~20%, Thermal 56%
2021.10	• NDC GHG（vs 2013） 2030FY ▲46%　2050FY CN	• TFC 2030FY 280 billion *l* • ELE 2030FY RE36~38%, NUC20~22%, Thermal 42%
2025.2	• NDC GHG（vs 2013） 2030FY ▲46%　2035FY ▲60% 2040FY ▲73%　2050FY Net Zero	• TFC 2040FY 260~270 billion *l* • ELE 2040FY RE40~50%, NUC20%, Thermal 30~40%



AIM ASIA-PACIFIC INTEGRATED MODEL

Process for determining new target

2025.2 Cabinet decisions

Plan for Global Warming Countermeasures
NDC (Nationally Determined Contributions)

Energy Basic Plan

Joint meeting of
the subcommittee of the Central Environment Council
and the subcommittee of the Industrial Structure
Council (2024.6～2024.12)

Basic Policy Subcommittee of the Advisory
Committee for Natural Resources and
Energy (2024.5～2024.12)

Model analysis
by NIES, RITE
(2024.12)

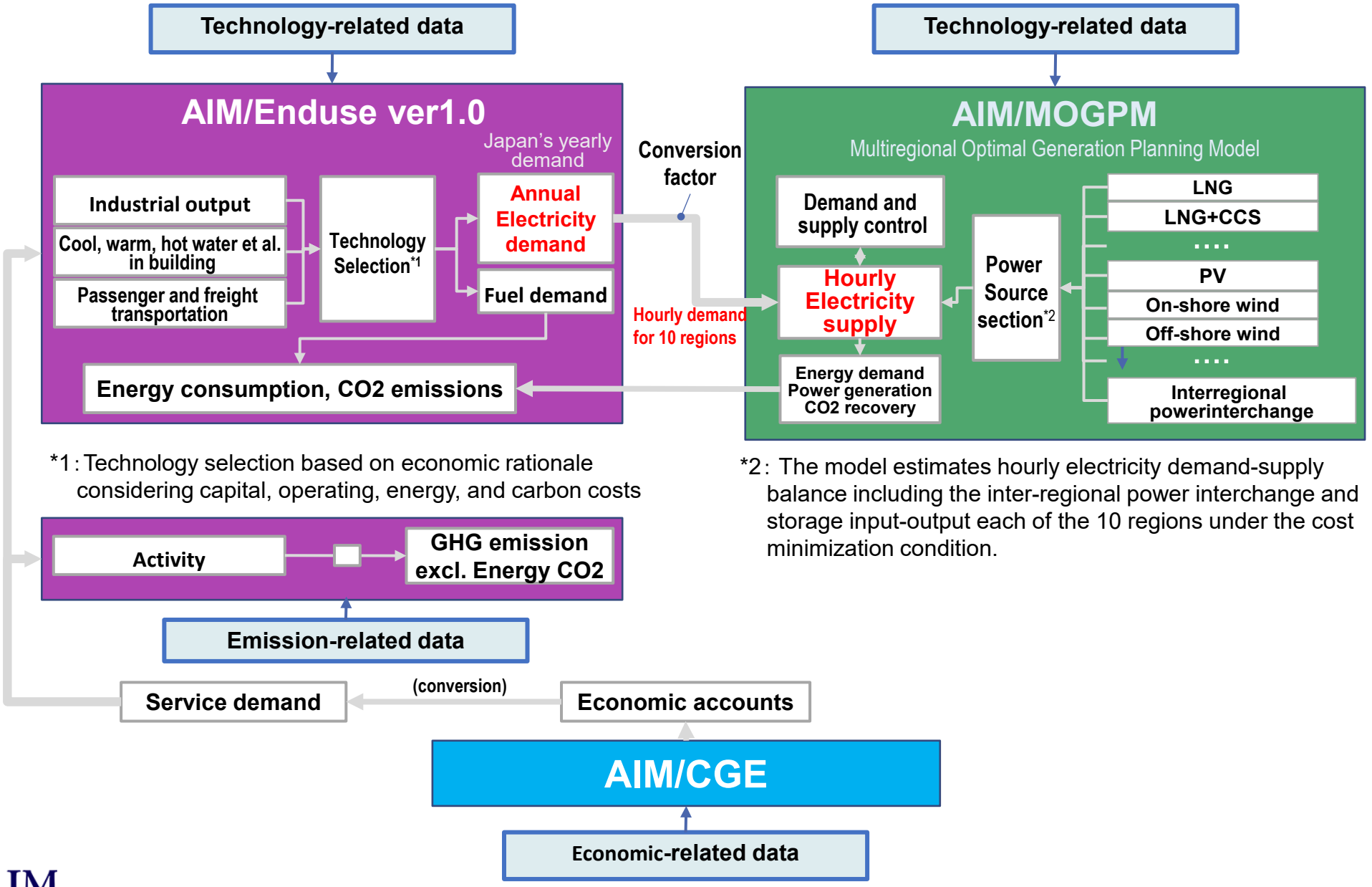
GHG emission pathways from 2030 to 2050
（≈ GHG reduction rate by 2035 and 2040）

Model analysis
by NIES, RITE, IGES, Deloitte, IEEJ, McKinsey
(2024.12 / 2025.1）

Energy mix in 2040 and 2050

AIM
ASIA-PACIFIC INTEGRATED MODEL

Three AIM models used in the analysis



*1 : Technology selection based on economic rationale considering capital, operating, energy, and carbon costs

*2 : The model estimates hourly electricity demand-supply balance including the inter-regional power interchange and storage input-output each of the 10 regions under the cost minimization condition.

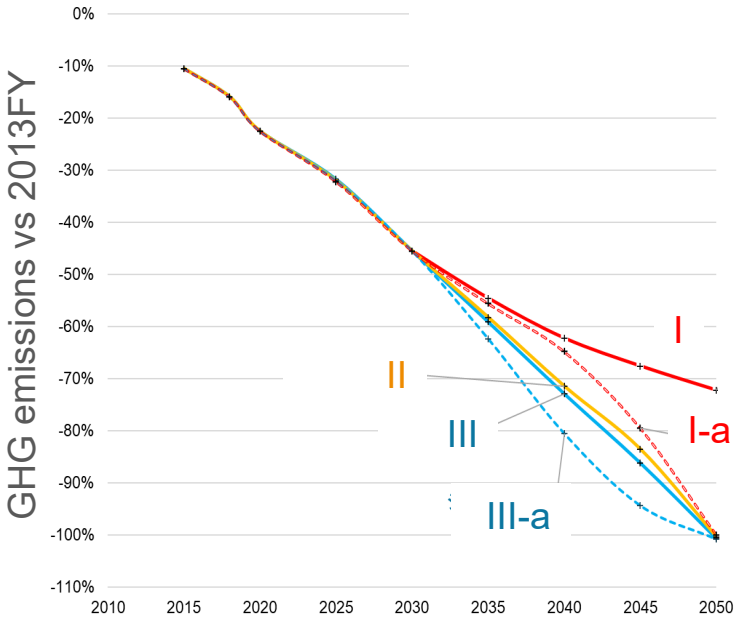
Modelling studies of early / late deployment of low carbon measures

Scenario

Technology Progress { Scenario I : without innovative technologies
Scenario I-a : late deployment of innovative low carbon technologies

Innovative Technology ... Scenario II : moderately timed deployment of innovative technologies

Social Transformation { Scenario III : Scenario II + Social transformation
Scenario III-a : early deployment of innovative low carbon technologies



		Technology Progress Scenario		Innovative Technology Scenario	Social Transformation Scenario	
		I	I-a	II	III	III-a
Overview			Innovative Tech. Late deployment	RE - low CCUS - low	RE - low CCUS - low	Innovative Tech. Early deployment
Innovative Technology		—	△	○		
Social transformation		—	—	—	○	
Electrification		BaU	Acceleration after 2040	Acceleration after 2030		
Efficient energy		Low	High after 2040	High		
RE max	PV	160 / 209 GW	160 / 209 GW	160 / 209 GW	160 / 209 GW	185/209 GW
	Offshore wind	15 / 45 GW	15 / 45 GW	15 / 45 GW	15 / 45 GW	15 / 45 GW
H2, NH3, Synfuel	vs total fuel demand	0%/0%	0%/100%	25%/100%	25%/100%	25%/100%
	self-sufficiency	—	≒10%	≒10%	≒10%	≒10%
Nuclear		140 TWh				
GHG Emission in 2050		≒ ▲70%	GHG net zero			
GHG Emission pathway			Convexity above	Linear	Linear	convexity below
Carbon price（1,000 JPY/tCO_2）		0	10 / 40	10 / 40	10 / 40	20 / 40
CO_2 storage (Max)($MtCO_2$)		0	6 / 120	27 / 120	27 / 120	82 / 120

AIM ASIA-PACIFIC INTEGRATED MODEL

Deployment of low carbon technologies

► PV installed capacity

	Stock Capacity (GW)				Installed capacity during the period (Equivalent to the number of house) （1,000/10yrs）	
	2022	2030	2040	2050	’31-’40	’41-’50
I-a (Late)	71	111	160	209	9,800	9,800
III			160	209	9,800	9,800
III-a (Early)			184	209	14,800	5,000

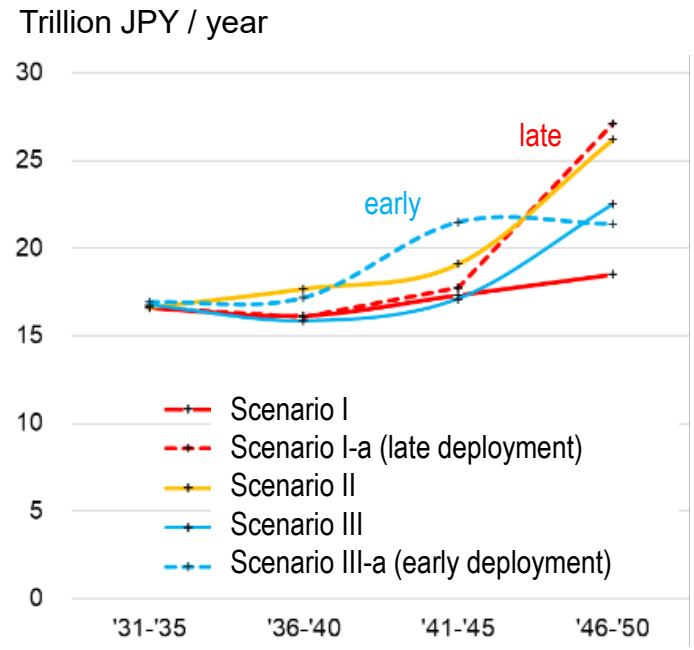
Number of detached houses in Japan = 29,329 (1,000) in 2023

► Hydrogen-based fuel

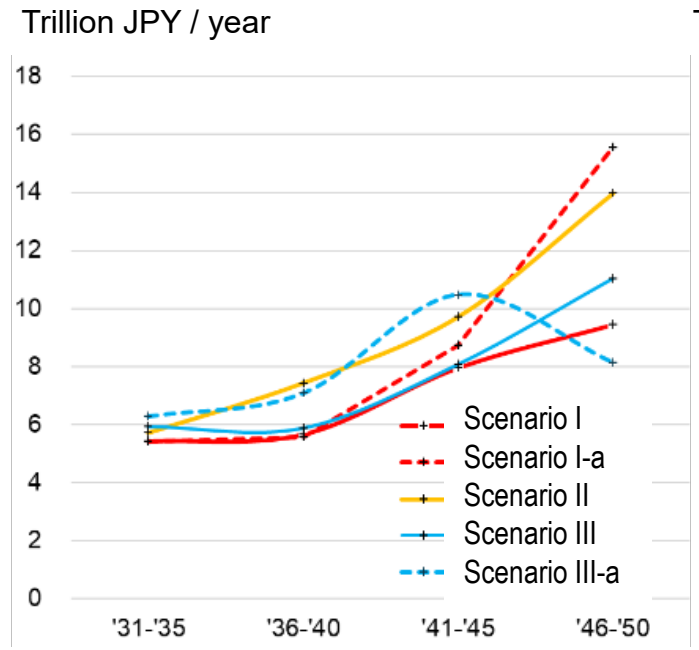
	Increase of demand (Mtoe/10yrs)		Increase of demand (vs present natural gas demand(=100))	
	’31-’40	’41-’50	’31-’40	’41-’50
I-a (Late)	0	109	0	116
III	7	71	6	76
III-a (Early)	21	56	22	60

Cost of energy device

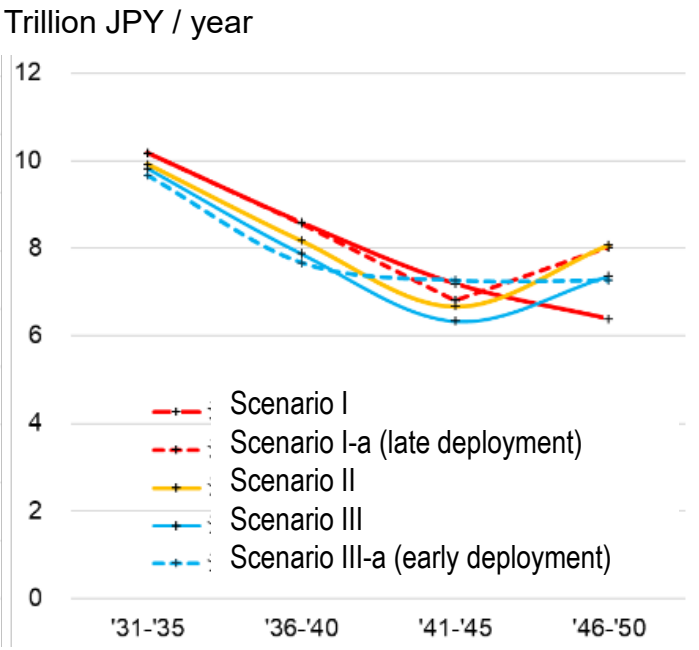
► Fixed cost + O&M + Import of energy



► Fixed cost



► Import of energy

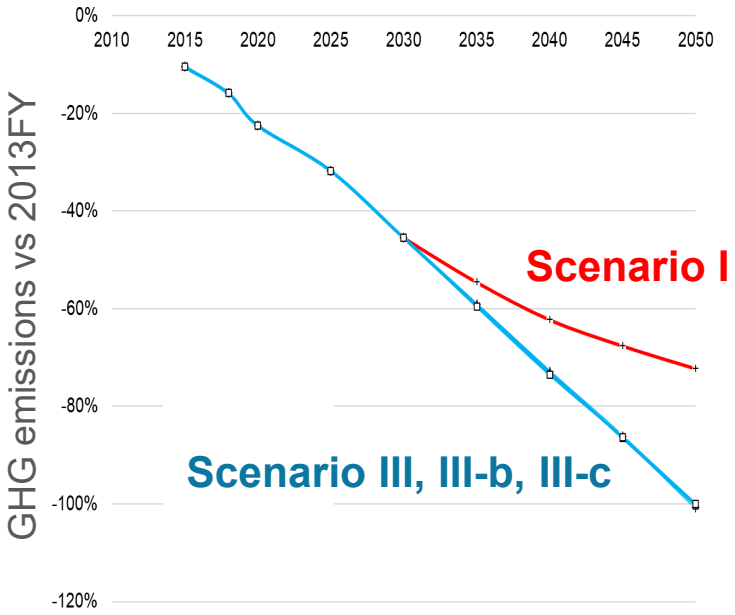


Modelling studies of energy mix

Scenario

Technology Progress ・・・ Scenario I

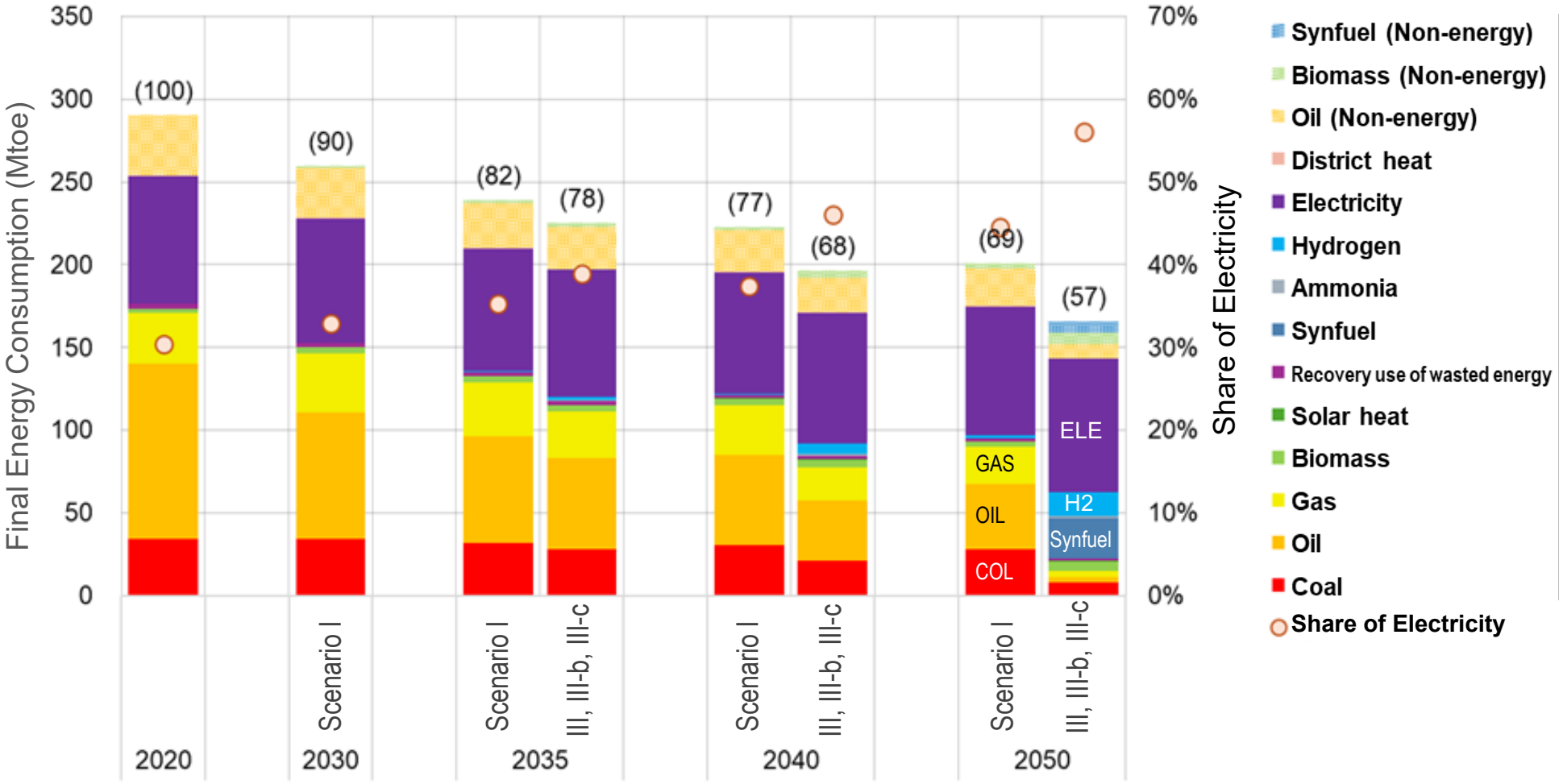
Social Transformation
- Scenario III : Hydrogen's share is larger than other scenarios
- Scenario III-b : CCUS's share is larger than other scenarios
- Scenario III-c : Renewable's share is larger than other scenarios



		Technology Progress Scenario	Social Transformation Scenario		
		Scenario I	Scenario III	Scenario III-b	Scenario III-c
Overview			RE - low CCUS - low	RE - low CCUS - high	RE - high CCUS - low
Innovative Technology		—	○		
Social transformation		—	○		
Electrification		BaU	Acceleration after 2030		
Efficient energy		Low	High		
RE max	PV	160 / 209 GW	160 / 209 GW	160/209 GW	201/384 GW
	Offshore wind	15 / 45 GW	15 / 45 GW	15 / 45 GW	45 / 179 GW
H2, NH3, Synfuel	vs total fuel demand	0%/0%	25%/100%	25%/100%	25%/100%
	self-sufficiency	—	≒10%	≒10%	≒30%
Nuclear		140 TWh			
GHG Emission in 2050		≒ ▲70%	GHG net zero		
GHG Emission pathway			Linear		
Carbon price（thousand JPY/tCO_2）		0	10 / 40	10 / 40	10 / 40
CO_2 storage (Max)($MtCO_2$)		0	27 / 120	27 / 200	27 / 120

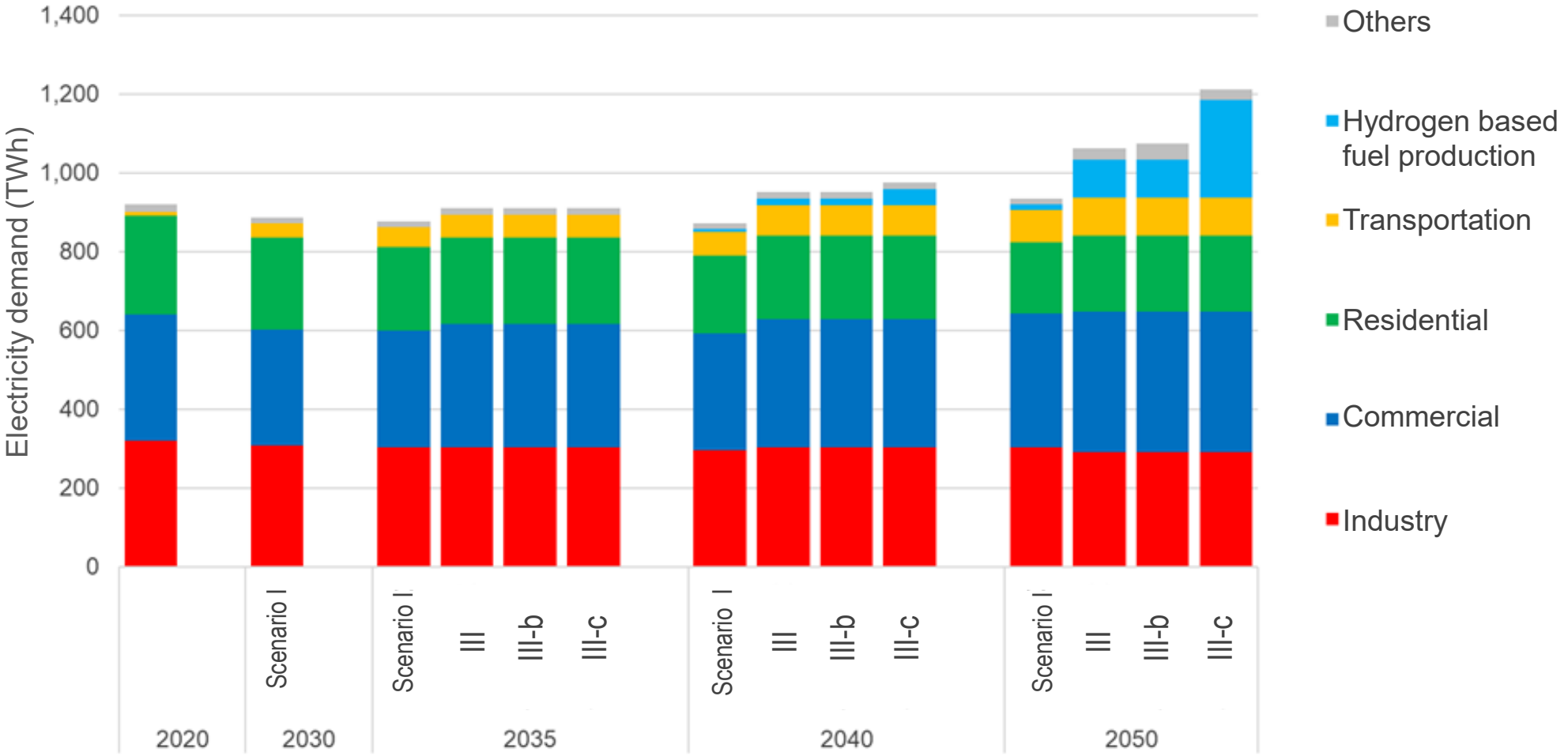
Final energy consumption

- Improving energy consumption efficiency, shifting from fuel to electricity use, and switching from fossil fuels to hydrogen-based fuels are essential to achieve net zero emission.



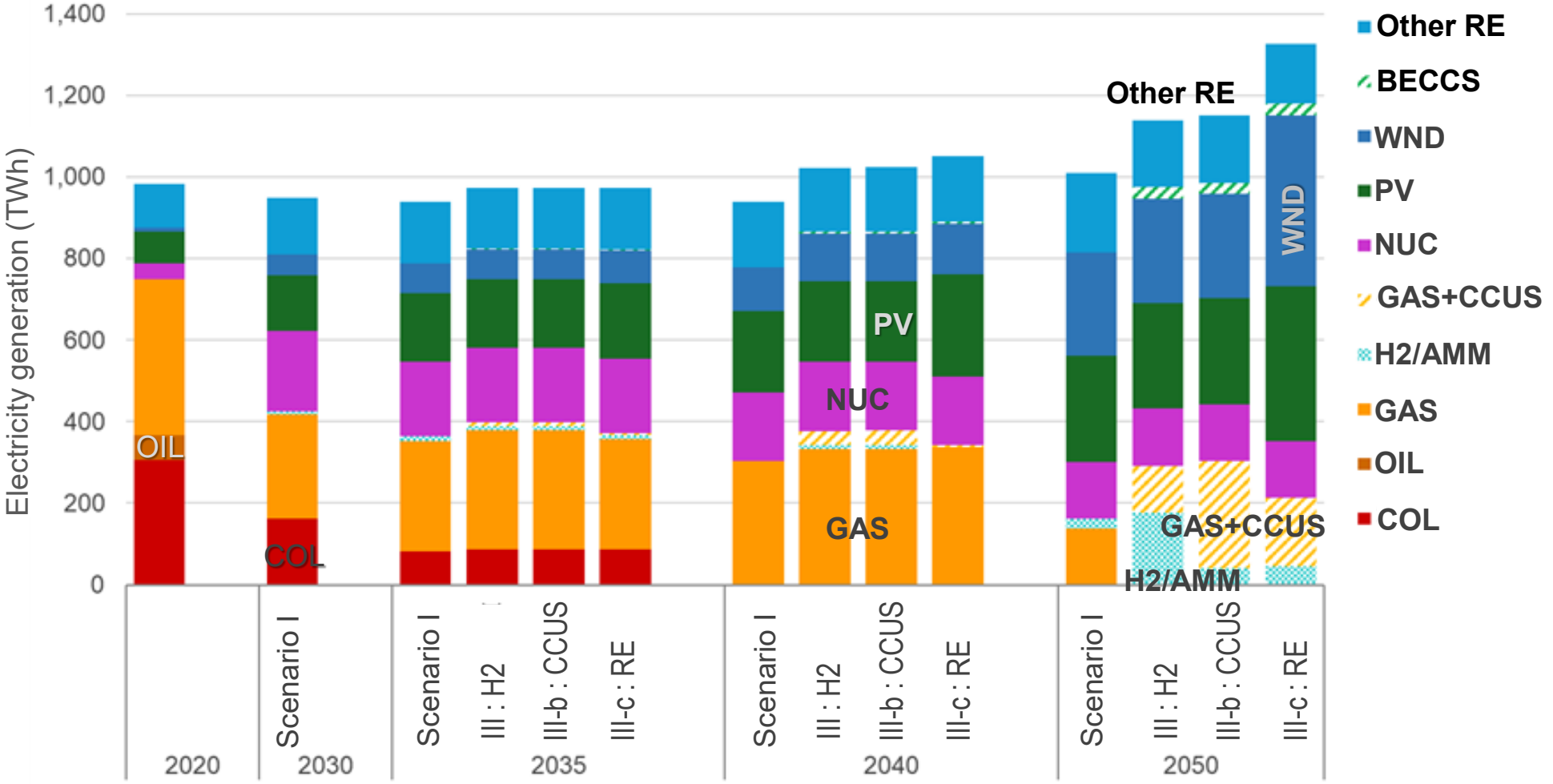
Electricity demand

- Electricity demand in final consumption sector has remained roughly stable.
- Electricity demand for the domestic production of hydrogen-based fuels increase in future.



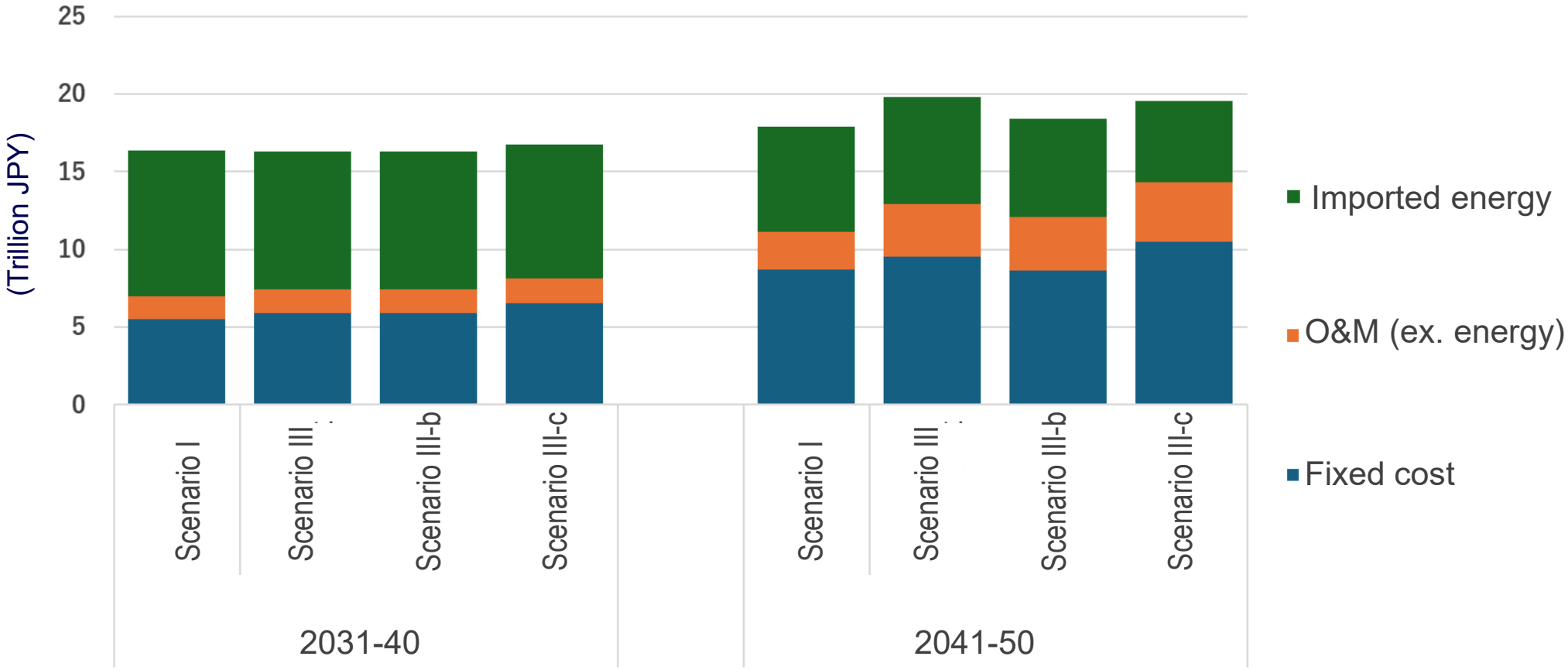
Electricity Generation

- Renewable energy increases steadily, and coal-fired plants are phased out by 2040. The difference between scenarios is not significant by 2040.
- After 2040, along with further increases in renewable energy, the introduction of CCUS-equipped power plants and hydrogen or ammonia power plants also increase.



Cost

- Differences arise between scenarios from 2041 onwards, but these differences cannot be said to be significant given the uncertainty in technology costs.



Energy saving and electrification

Rapid deployment is difficult within just a few years due to the timing of equipment renewal and replacement cycles. Therefore, steady and continuous efforts must begin immediately.

Power generation

Achieve 100% decarbonized power generation by 2050 to reach net-zero emissions. After 2040, further expand renewable power generation and promote large-scale deployment of thermal power with CCUS and power generation using new fuels.

Amount of investment

The future cost of innovative technologies over a 20-year horizon is highly uncertain. Therefore, it is important to prepare for a wide range of options and update assumptions regularly.