東京大学未来ビジョン研究センター
Institute for Future Initiatives

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GTAP

EMF 35 JMIP study: preliminary results and implications for Japan's climate change mitigation

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Policy background and motivation

Policy background

- Nationally Determined Contribution NDC)
  - 26% reduction by 2030
  - Assumes fast economic growth
    (~1.7%/y in contrast to recent growth of ~ 1.0%/y)
  - Featuring a significant deployment of nuclear (20-22%)
  - Increases the share of industry in emissions/final energy

- Mid-Century Strategy (MCS)
  - 80% reduction by 2050
  - Mostly qualitative, not backed by modeling analysis yet

Motivation

- No MIP with sensitivity analysis on technology, etc.
  (Oshiro et al. 2019 addressed sensitivity on emissions constraints with a multi-model framework)

Major model intercomparison studies (MIPs) for national / regional climate policy analysis: no academic study from Japan so far

Policy events	Study	Country/ region	Type of work	Outcome and note
COP15 (2009)	Committee on mid-term target	Japan	Part of policymaking process (with townhall meetings and surveys)	Documents for expert committee Book (Fukui 2009 (ed.)) (in Japanese) Individual papers
	EMF 22 (US)	USA	Academic	*Energy Economics* special issue (Fawcett et al. 2009)
	EMF 22 (EU)	Europe	Academic	*Energy Economics* special issue (Böhringer et al. 2009)
COP21 (2015)	N/A	Japan	(no MIP)	Analysis by individual modeling groups
	EMF 24	USA	Academic	*Energy Journal* special issue (Fawcett et al. 2014; Clarke et al. 2014)
	EMF 28	Europe	Academic	*Climate Change Economics* special issue (Weyant et al. 2013; Knopf et al. 2013)

No academic work from Japan (aside from some individual contributions)

=> Not reference to Japan's modeling effort from abroad or IPCC

Stanford Energy Modeling Forum (EMF) 35
Japan Model Intercomparison Project (JMIP)

Objective:

To analyze long-term climate policy **(NDC, MCS)** of Japan

- with a multi-model framework
- **In light of unique plights:**
  less RE resource endowments,
  large share of industry final energy, &
  dependence on energy imports

Steering Committee:
Masa Sugiyama (UTokyo),
Shinichiro Fujimori (Kyoto U&NIES),
Ken Wada (RITE),
John Weyant (Stanford)

Core funding:
MOEJ 2-1704
(Apr 2017-Mar 2020)

Models:
AIM/CGE
AIM/Enduse
DNE21
IEEJ
TIMES-Japan

Output: IPCC AR6 (Ch4)

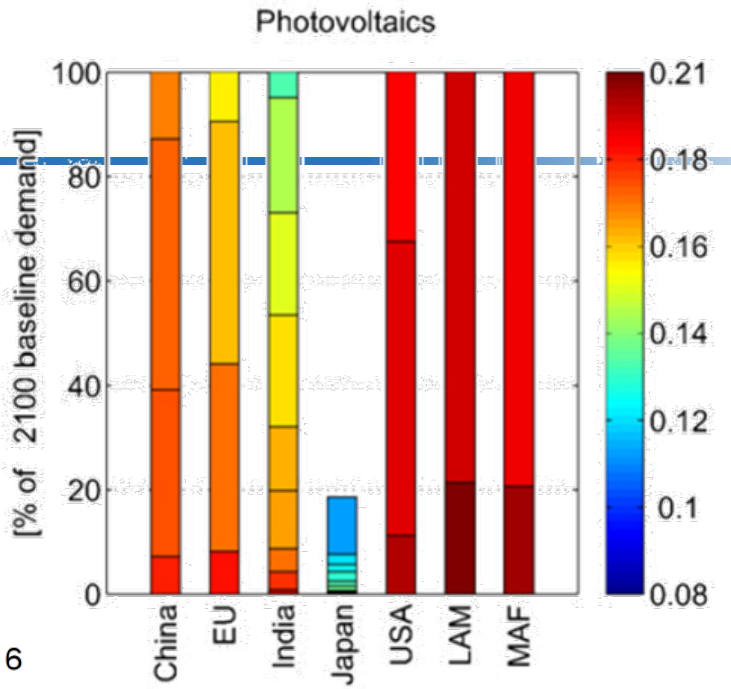
Special issue expected in Mar 2021 in *Sustainability Science*

- Policy & technology
- Renewables
- Industrial decarbonization
- Electrification

Submission: April 2020

Japan's unique situation

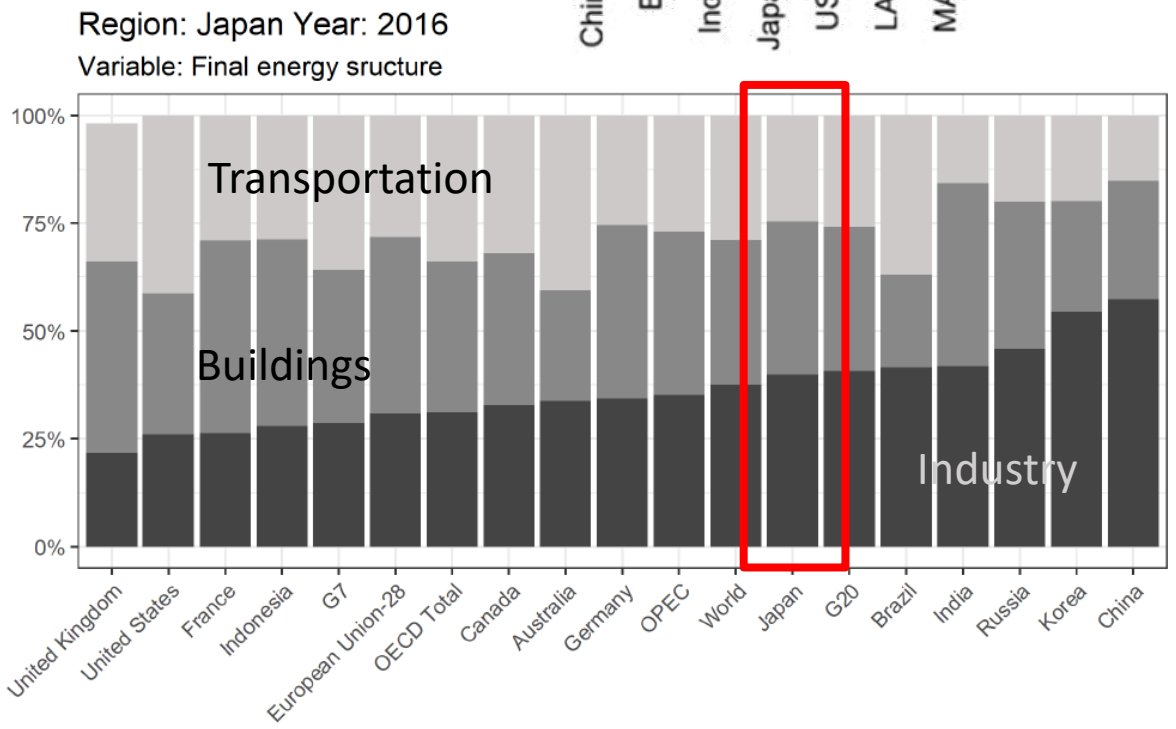
- Renewable energy:
  Less endowments, higher costs



Color: Capacity factor

Luderer et al. (2017)

- High share of industry emissions (not agriculture)



Models

Model and input assumptions

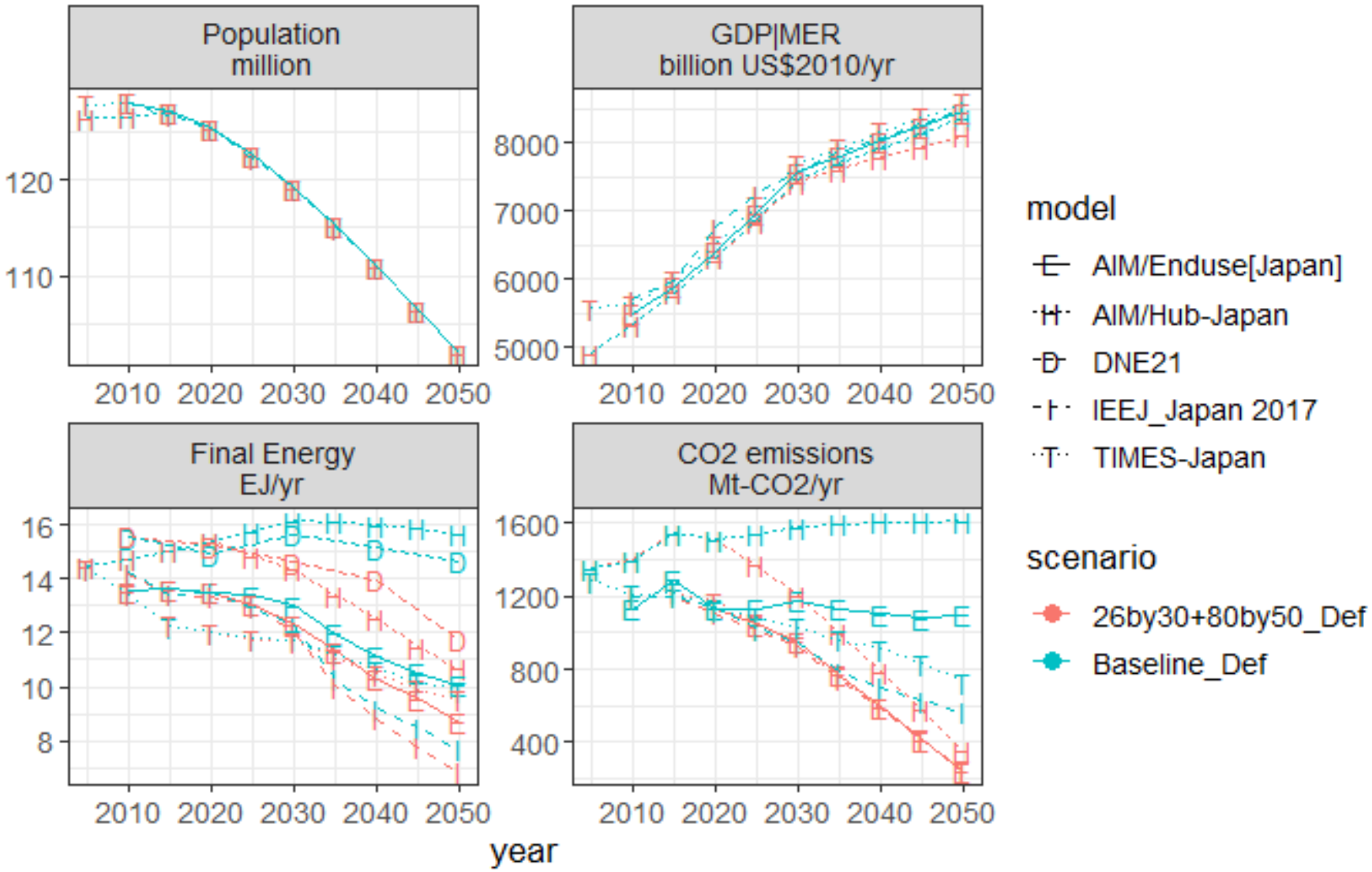
Model	Institute	Equilibrium concept	Region	Temporal treatment
AIM/Hub-Japan	Kyoto U / NIES	General	Japan	Myopic
AIM/Enduse[Japan]	Kyoto U / NIES	Partial	Japan	Myopic
DNE21	U Tokyo	Partial	World	Intertemporal
IEEJ	Institute of Energy Economics Japan	Partial	Japan	Intertemporal
TIMES-Japan	Institute of Applied Energy	Partial	Japan	Intertemporal

Some input parameters harmonized

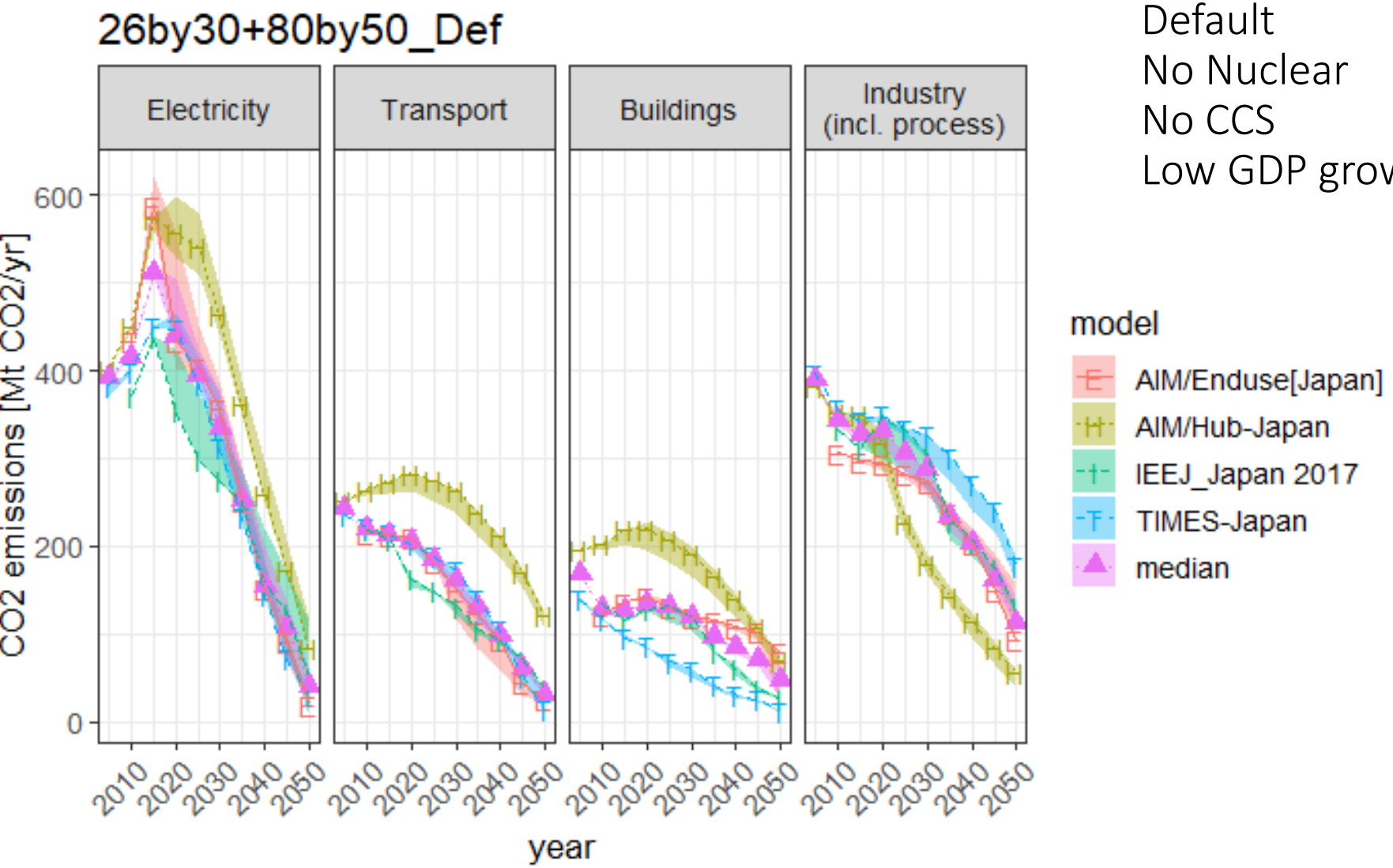
- Population
- GDP growth rates

Results

Drivers, final energy, and CO_2 emissions

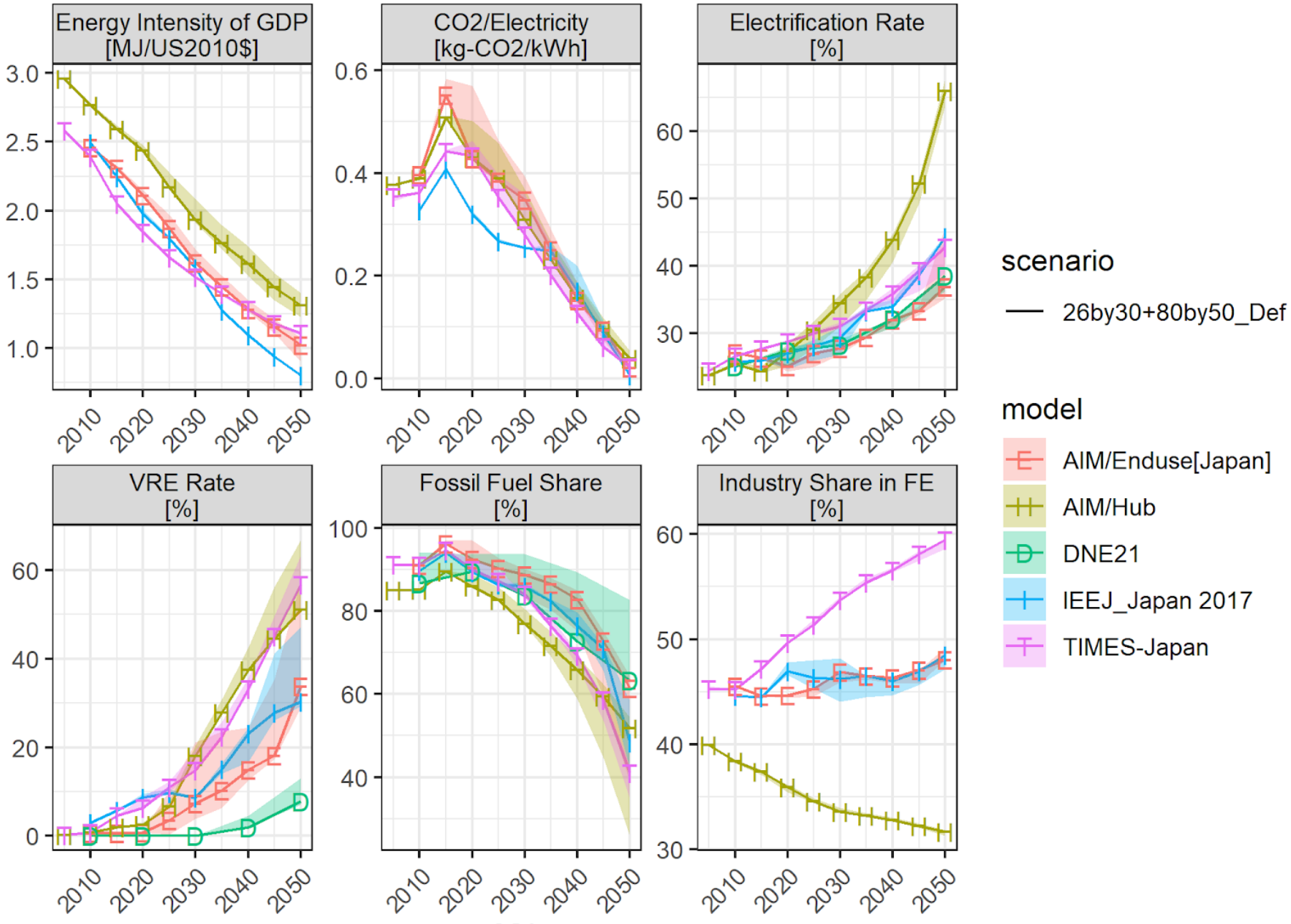


CO_2 emissions by sector: all sectors contribute to deep mitigation

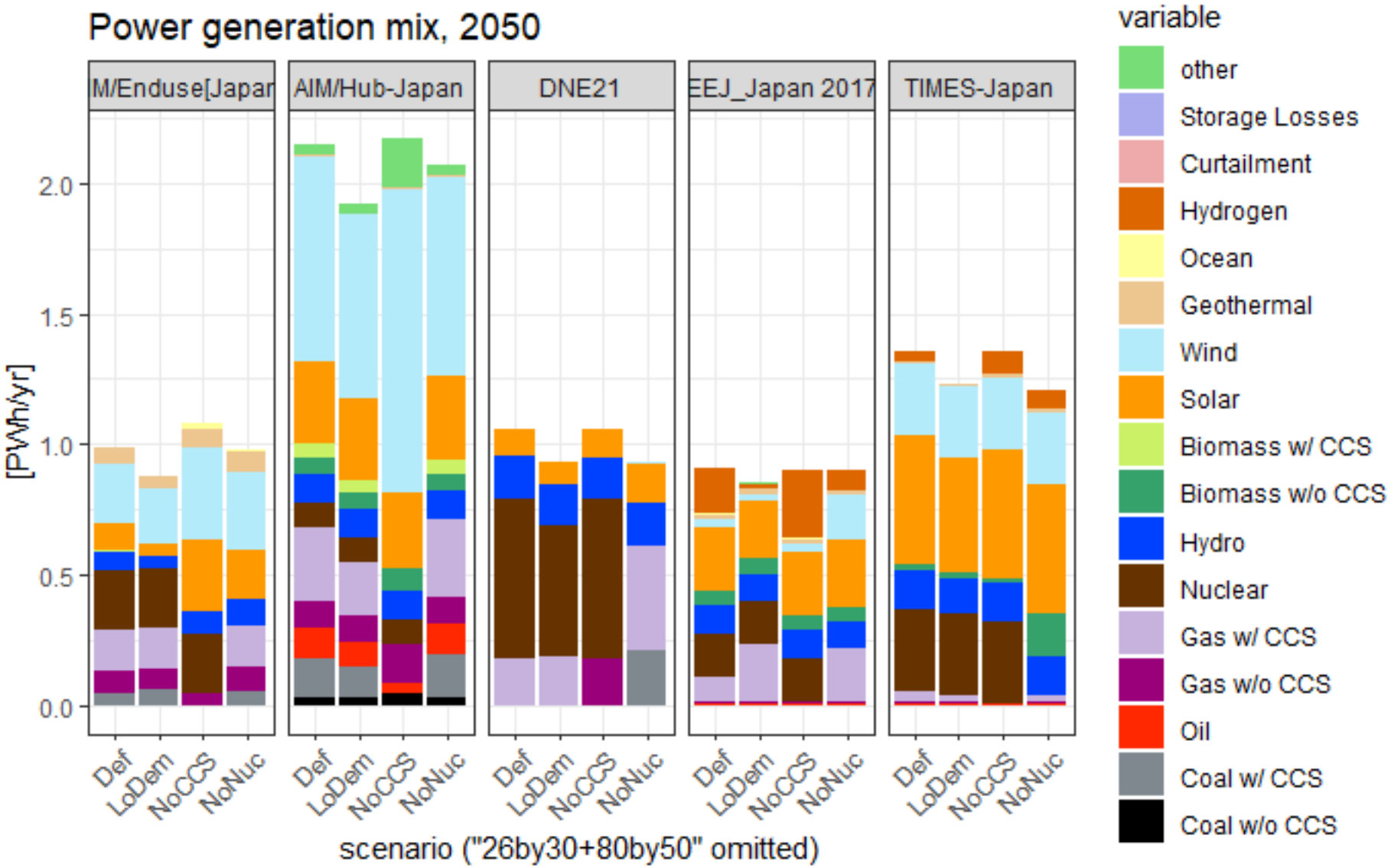


Ribbon: range of
Default
No Nuclear
No CCS
Low GDP growth

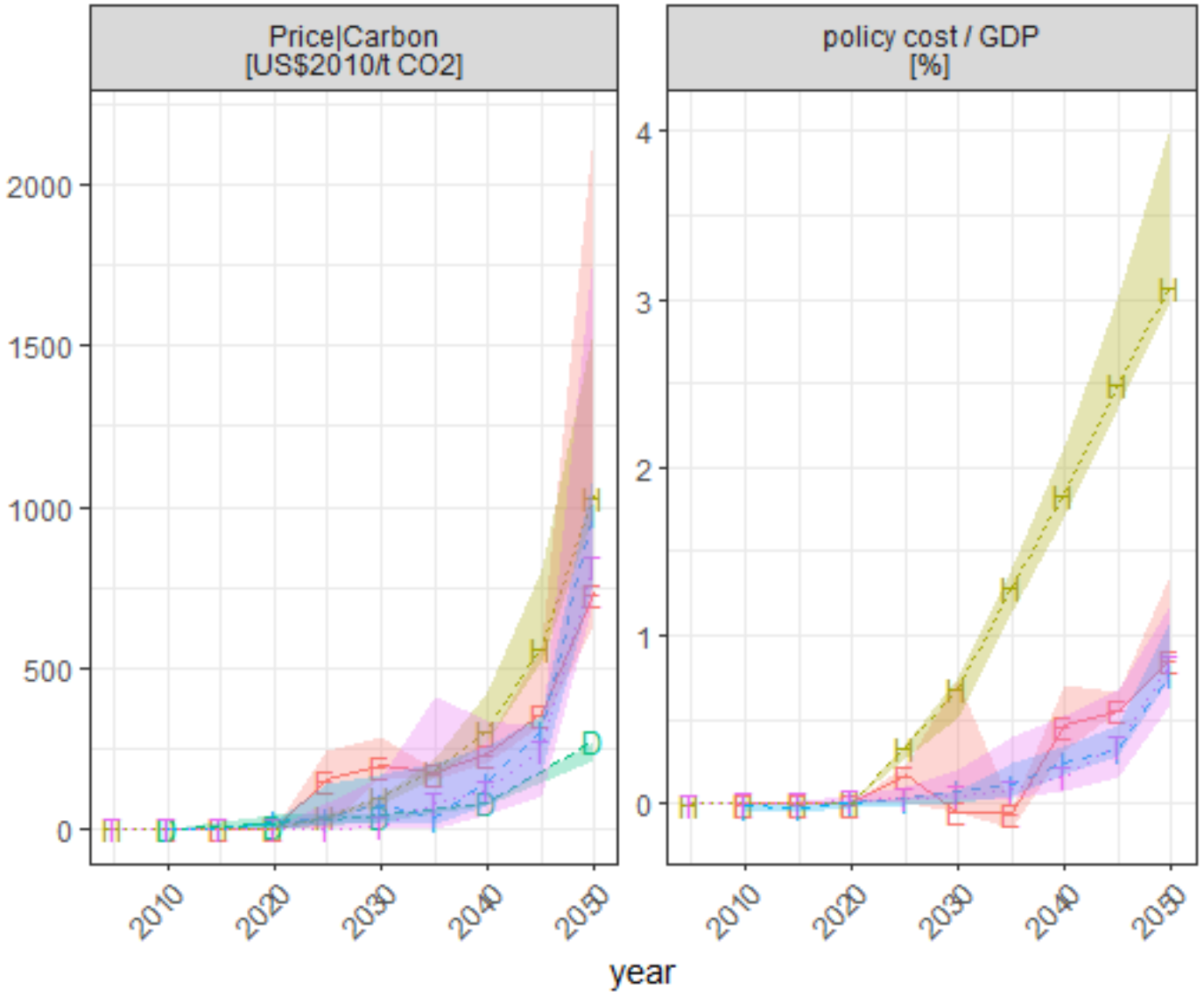
Mitigation strategies effective in the global context also work in Japan



Uncertainty: energy and power mix



Cost metrics
marginal costs are comparable or higher than Europe / US



Ribbon: range of
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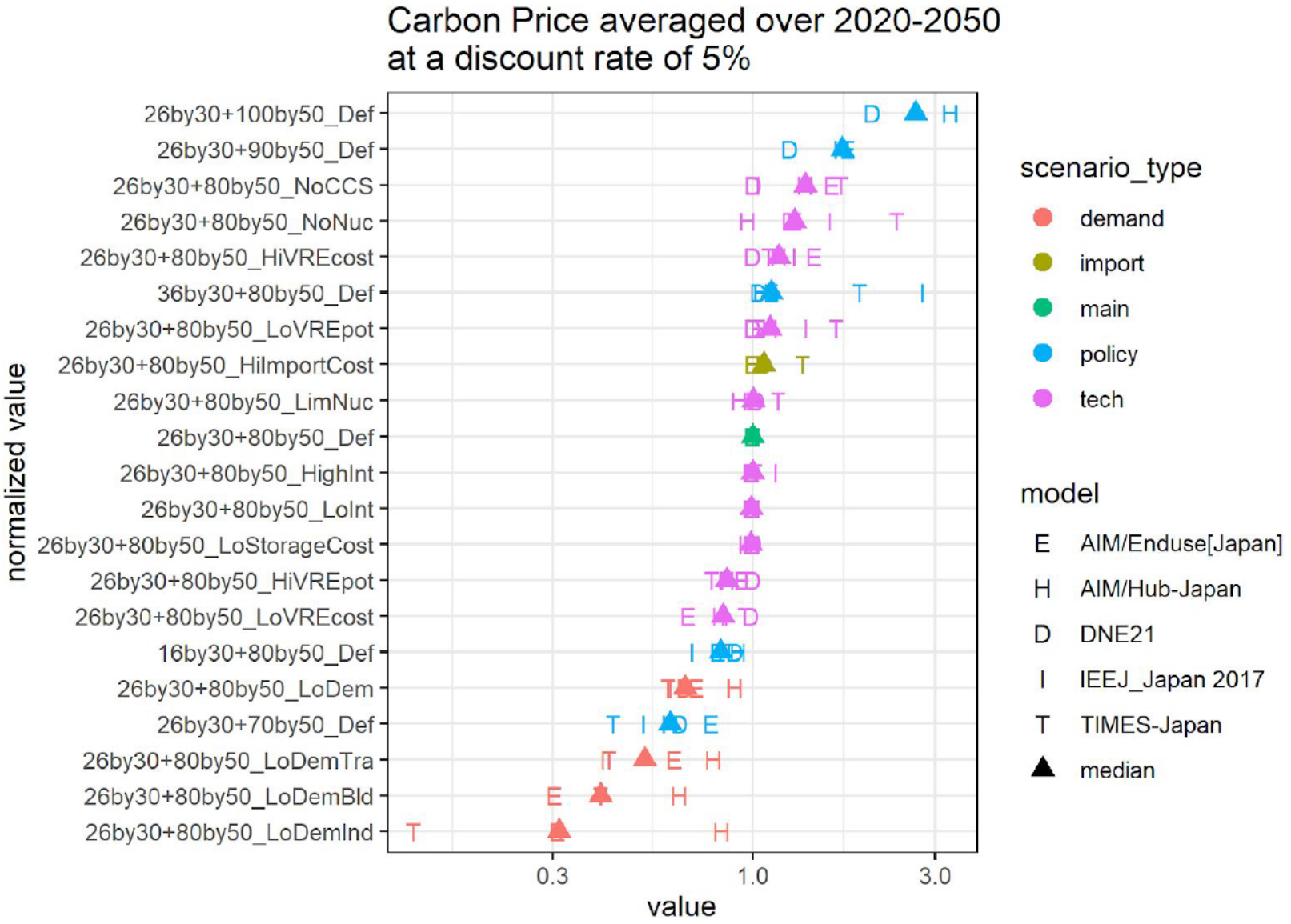
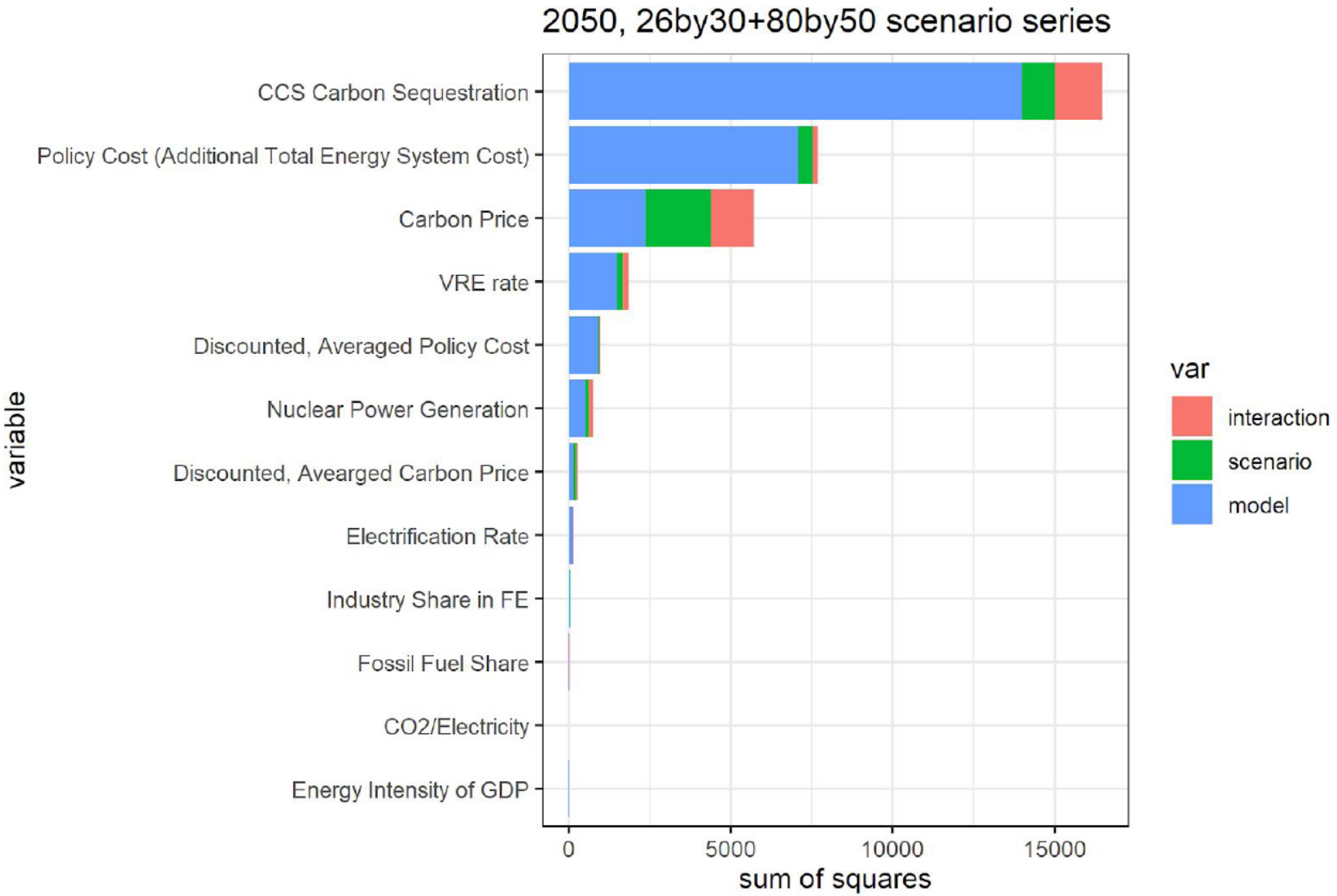
model
- AIM/Enduse[Japan]
- AIM/Hub-Japan
- DNE21
- IEEJ_Japan 2017
- TIMES-Japan

Costs are sensitive to various assumptions



Which parameter is most uncertain? ANOVA decomposition of sum of squares

- Each value normalized by its value in its own average value



Conclusions

- Robust mitigation strategies have been identified despite different models and scenario assumptions
  - Economy-wide efficiency, power-sector decarbonization, electrification
- Uncertainties have been identified
  - Energy and power generation mixes
  - Costs
  - Adaptative management policy framework is necessary
- Large innovation challenges