Mid century strategies in Japan: challenges in long-term decarbonization scenarios

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International Forum for Sustainable Asia and the Pacific

Strategic Partnerships to Implement the Paris Agreement (SPIPA)

The SPIPA programme encourages and assists EU and non-European major economies in making their best efforts towards the goals of the Paris Agreement, harnessing international economic and political relations to move more quickly together towards its full implementation.

SPIPA is jointly commissioned by the European Union as a Foreign Policy Instrument Action and the German Federal Ministry for the Environment, Nature Conservation, and Nuclear Safety (BMU) in the context of the International Climate Initiative (IKI).

Purpose

How much change it is needed to realise Japan's mid-century strategy (MCS)?

- 80% GHG emission reduction by 2050
- Macro-economic indicators historical trends and long-term scenarios.

Why quantitative scenarios are important:

- to understand the challenges for decarbonization in the long-term, and
- to support the formulation of MCS by highlighting the aspects requiring further discussion.

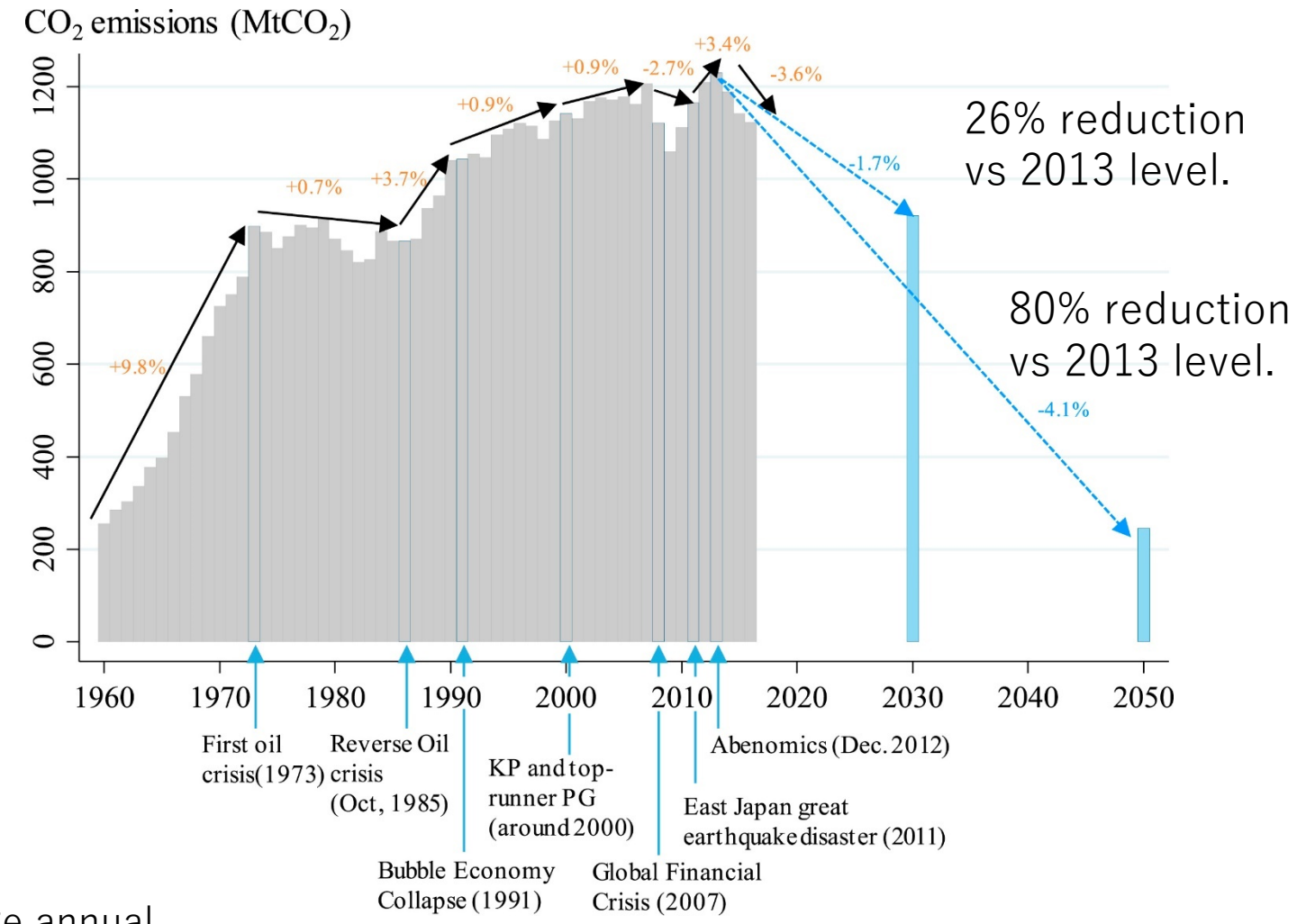
How to interpret the challenges for Japan's MCS

Japan's MCS

- 80% GHG emission reduction by 2050

Challenge

- Speed of change in major drivers of emissions
- Annual change rate
- Population, GDP, energy use, carbon content.



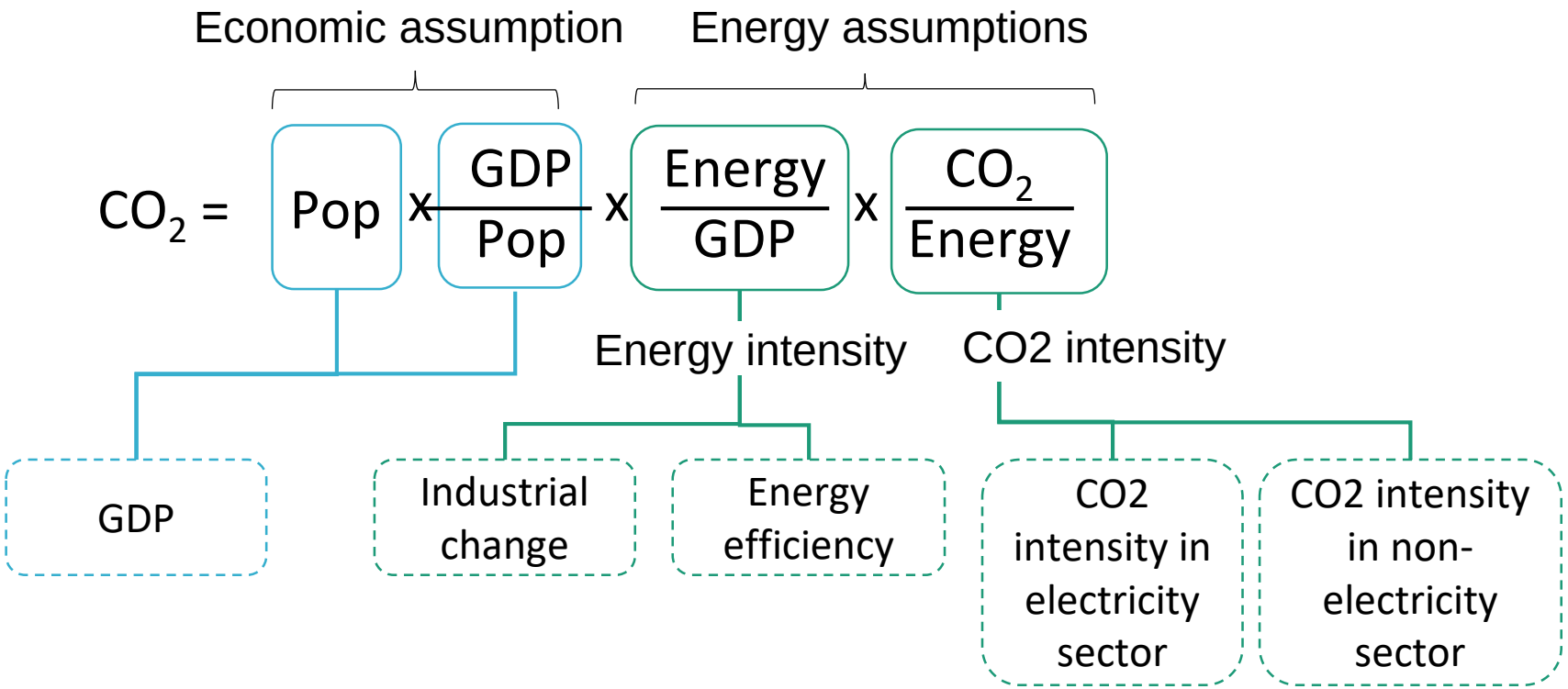
Japan's energy-related CO2 emissions.

Numbers of arrows are the compound average annual rate of change in the period indicated by the arrows.
Kuriyama et al. (Energy Policy 2019).

How to interpret the challenges for Japan's MCS

Major drivers of emissions

- Population, GDP, energy use, carbon content
- Kaya identity



Description of long-term scenarios

Scenario = image of possible future to inform decision making NOT prediction

- Inform policy making to address climate change issues.
- Storyline/narrative to describe = qualitative = vision, assumptions.
- Model to quantify = quantitative = defined with mathematic equations, solved with computer, several methods/tools/assumptions.

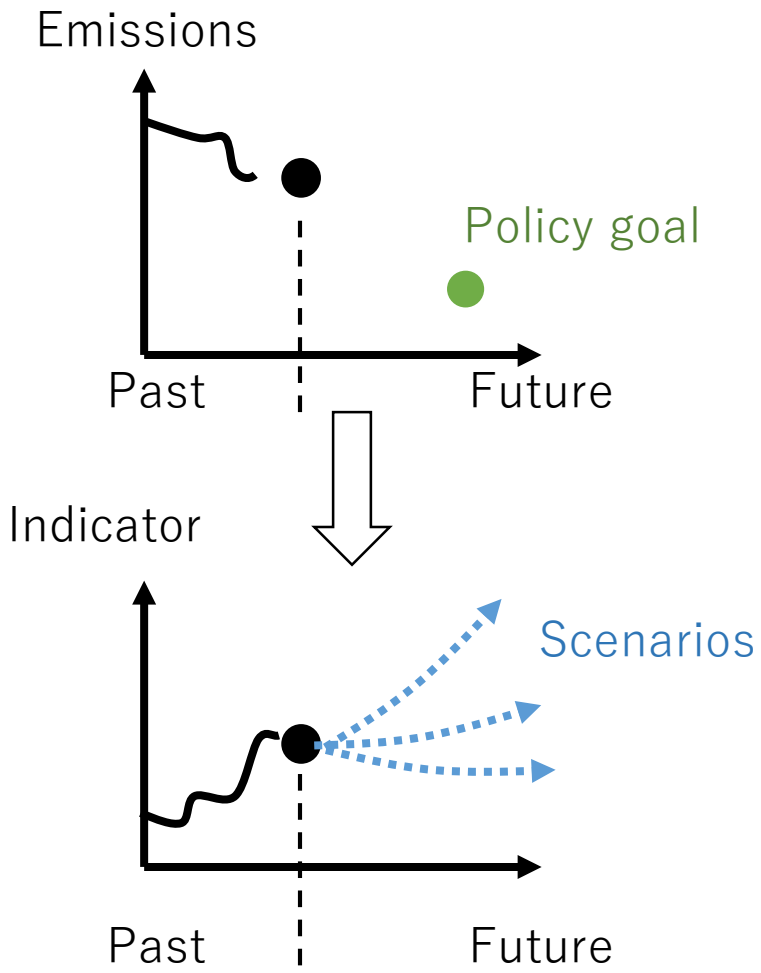
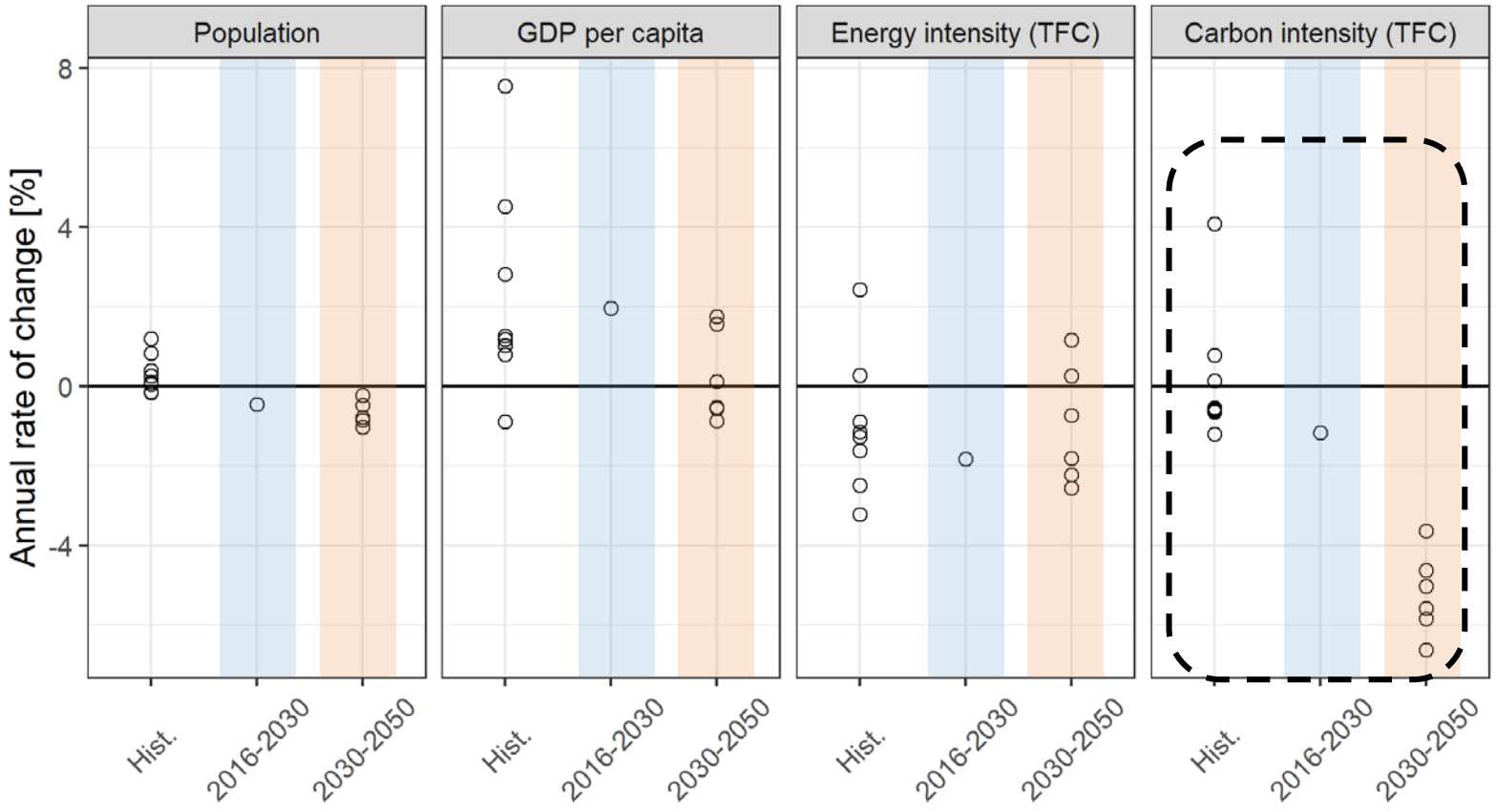


Image of long-term scenarios in climate policy making

Results – Macro indicators (Kaya ID)

Reducing 80% emissions will need to balance economic growth and decreasing population with lower energy use and transition to low carbon energy.

- Unprecedent decrease in carbon intensity.
- Positive expectations on GDP per capita with decreasing population.
- Scenarios where energy use increases (mainly due to electrification) require deeper decarbonisation.



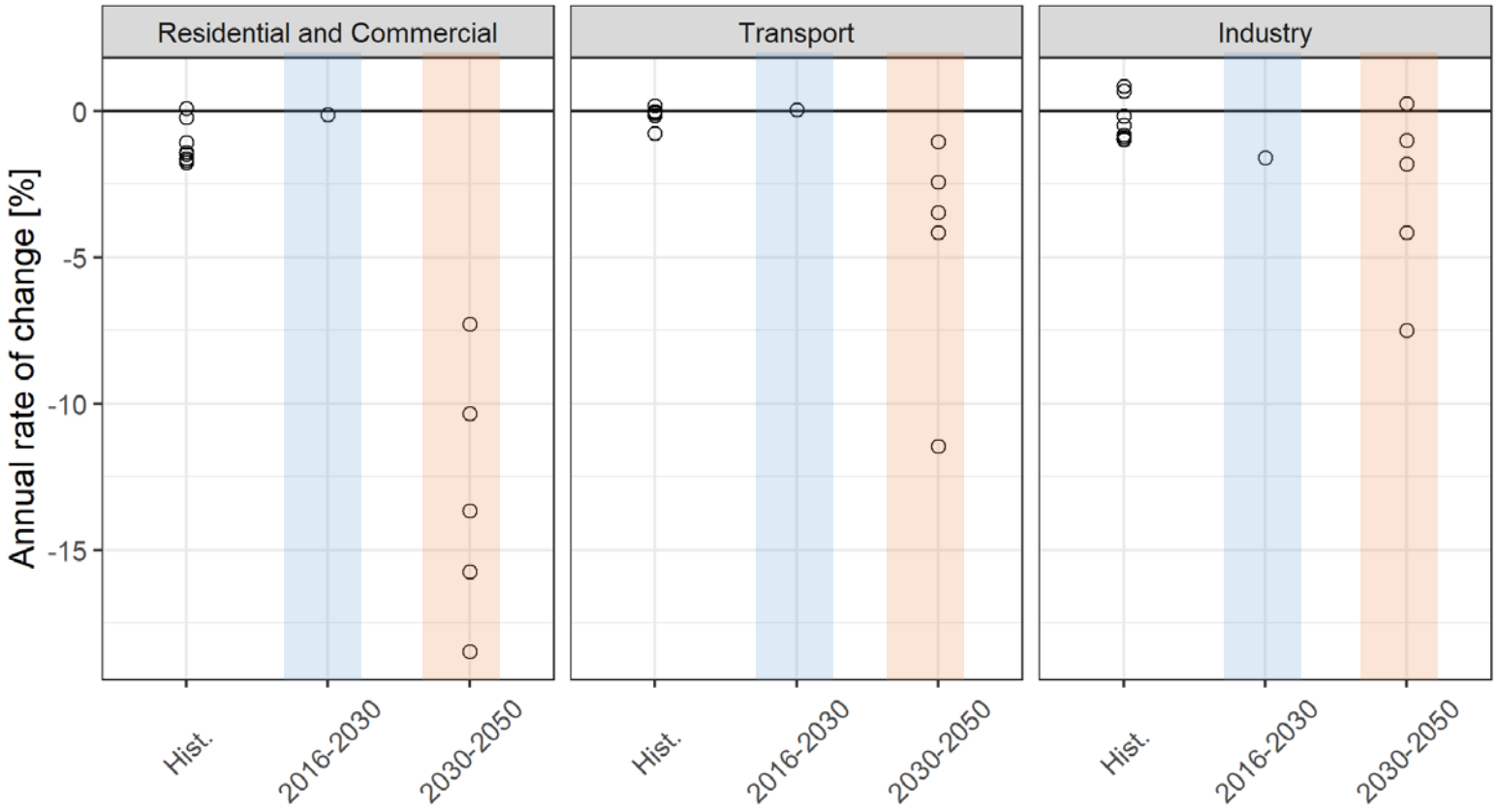
Based on data from Kuriyama et al. (Energy Policy 2019) and Sugiyama et al. (Energy 2019)

"Hist" are values for selected timeframes between 1960-2016.
"2016-2030" are based on NDC assumptions.
"2030-2050" are values for Japan 80% emission reduction scenario from different models.

Results – Carbon intensity by economic sector

Carbon intensities by sectors considerably lower than experienced (Historical)or committed (NDC).

- Fast reductions in buildings (residential and commercial).
- Slower decarbonisation in transport and industry.
- Scenarios with little or no improvement in carbon intensity in some sectors emphasize the need for CCS and carbon-free carriers (electricity, hydrogen).



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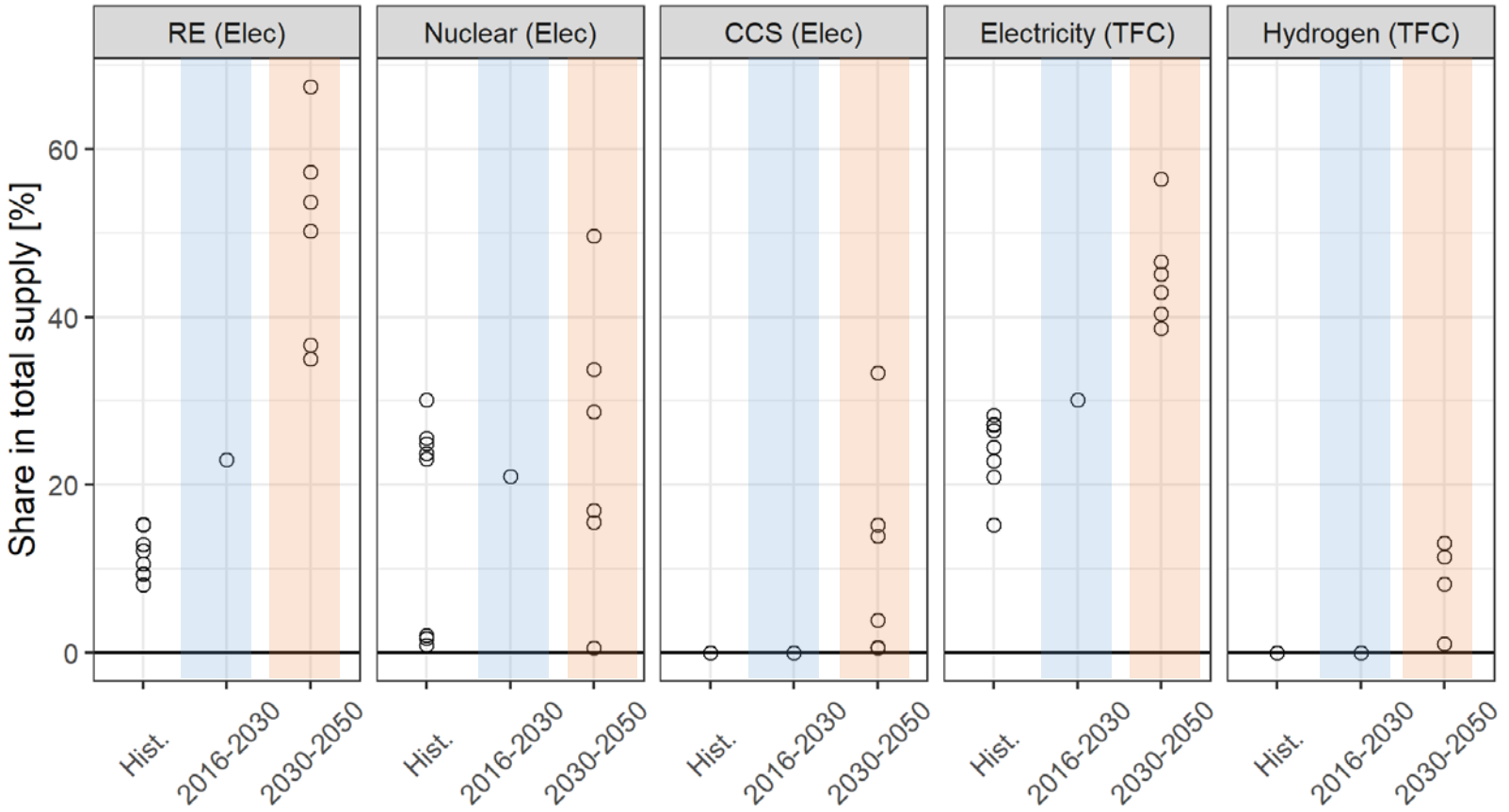
Results – Energy technologies and carriers

Share of low carbon technologies and carriers needs to be significantly boosted across scenarios.

- Boosting renewables is a must.
- Scenarios show multiple possibilities for nuclear and CCS, and reflect diverse views on their feasibility (technical, political, social).
- Substitution of fuels with electricity.
- Hydrogen can play a complementary role if produced from carbon-free sources, infrastructure required.



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Implication and suggestions from this study

- Achieving 80% reduction target in 2050 requires a substantial change that is completely different from the change during the period between the 2016-2030.
- The nature (indicator) and size of changes vary depending on the scenario.
- The current Japan's MCS can be enhanced with information from multiple scenarios to promote action towards concrete measures in specific sectors.
- The process of MCS formulation should include a forum for policy makers and researchers that incorporates policy development and scenario analysis.

ご清聴ありがとうございました。

Thank you for your attention.

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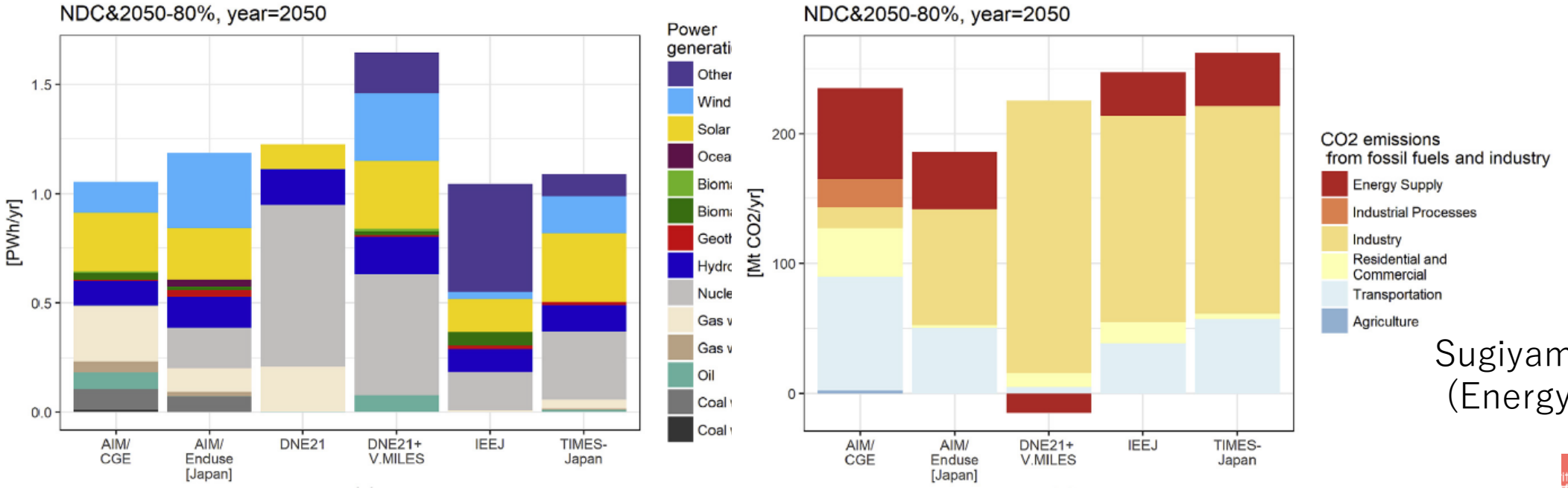
Insights from long term scenarios

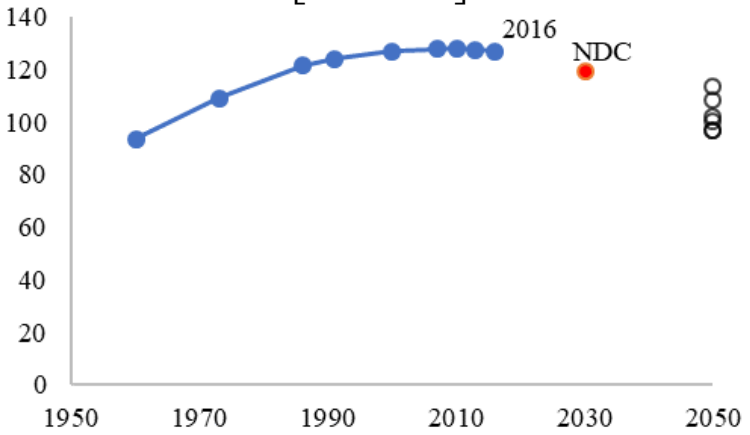
Table 1
Models participating in this study. The abbreviations for organizations are as follows. NIES: National Institute for Environmental Studies; UTokyo: The University of Tokyo; RITE: Research Institute of Innovative Technology for the Earth; IEEJ: Institute of Energy Economics, Japan; and IAE: Institute of Applied Energy. DNE21+ (MILES version) is abbreviated as DNE21 + V. MILES hereinafter.

Model	Institute	Solution concept	Intertemporal treatment	Regional coverage	Characteristics
AIM/CGE [global]	NIES	General equilibrium	Myopic	Global	Multiple economic sectors represented. Strong at analyzing macroeconomic implications.
AIM/Enduse [Japan]	NIES	Partial equilibrium	Myopic	Japan	Regional breakdown for better power sector representation
DNE21	UTokyo	Partial equilibrium	Intertemporal	Global	Detailed representation of global energy transportation and power generation dispatch
DNE21+ (MILES version)	RITE	Partial equilibrium	Intertemporal	Global	Detailed representation of energy technologies
IEEJ	IEEJ	Partial equilibrium	Intertemporal	Japan	Various hydrogen technologies incorporated. Soft-linked to a macroeconomic model.
TIMES-Japan	IAE	Partial equilibrium	Intertemporal	Japan	Various hydrogen technologies incorporated. Soft-linked to detailed sector models (buildings and power)

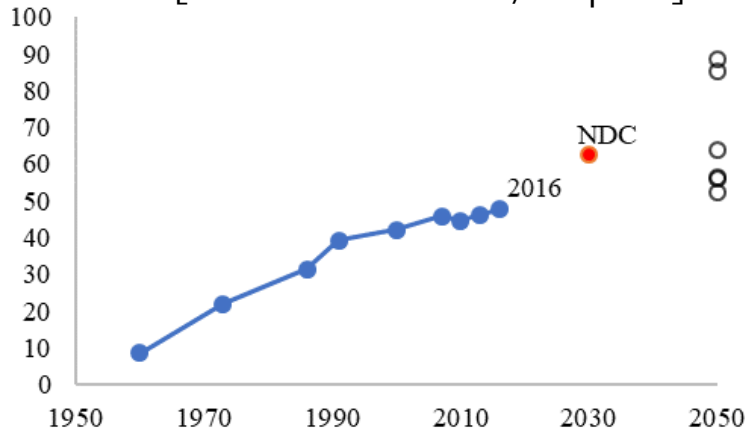


Sugiyama et al. (Energy 2019)

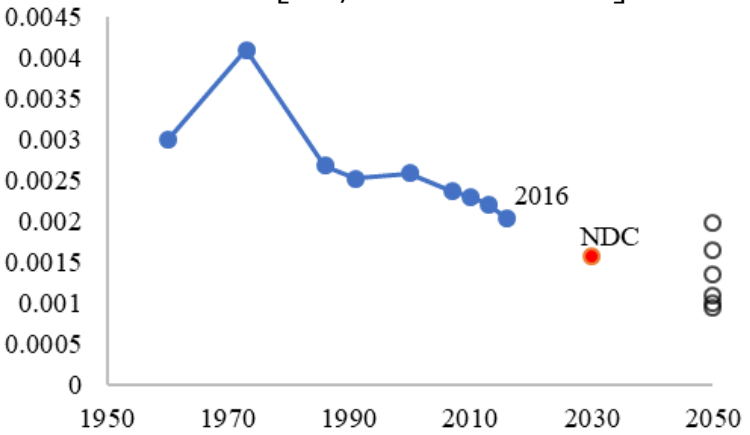
Population
[million]



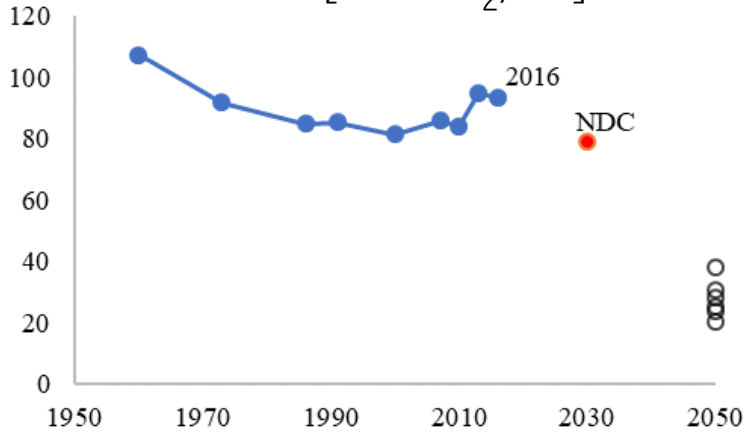
GDP per capita
[thousand USD/capita]



Energy intensity (Final energy/GDP)
[EJ/billion USD]



Carbon intensity (CO_2/Final energy)
[Mt CO_2/EJ]



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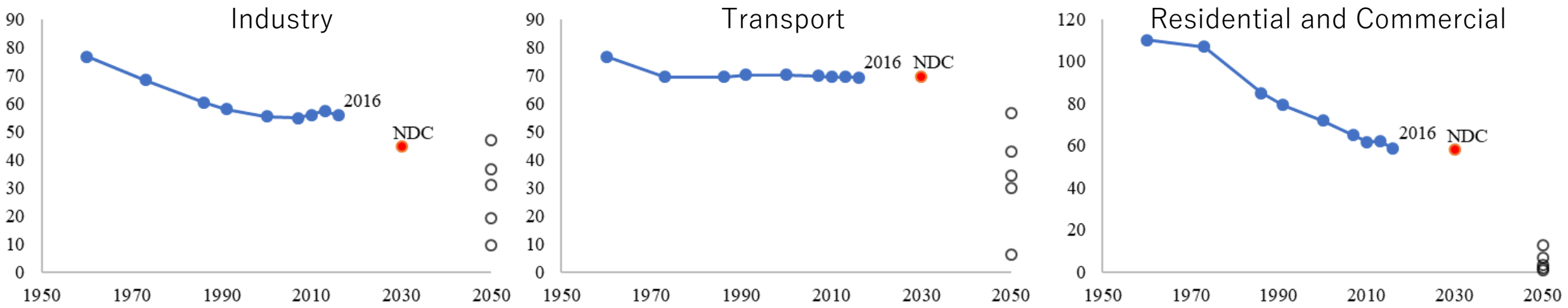
Carbon intensity (CO_2/Final energy)
[Mt CO_2/EJ]



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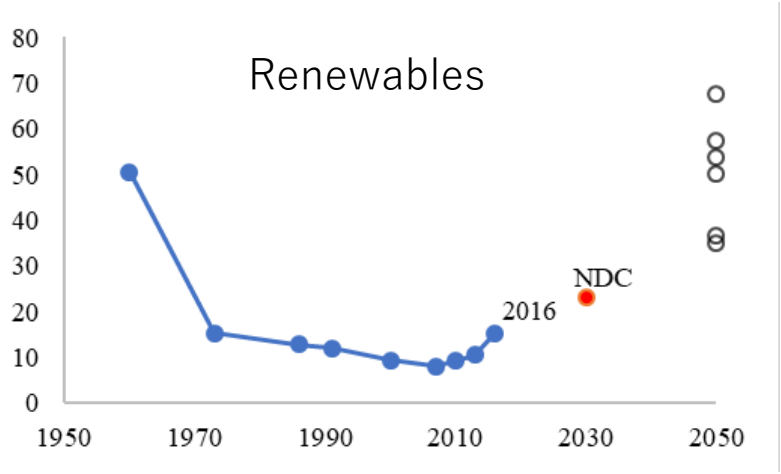
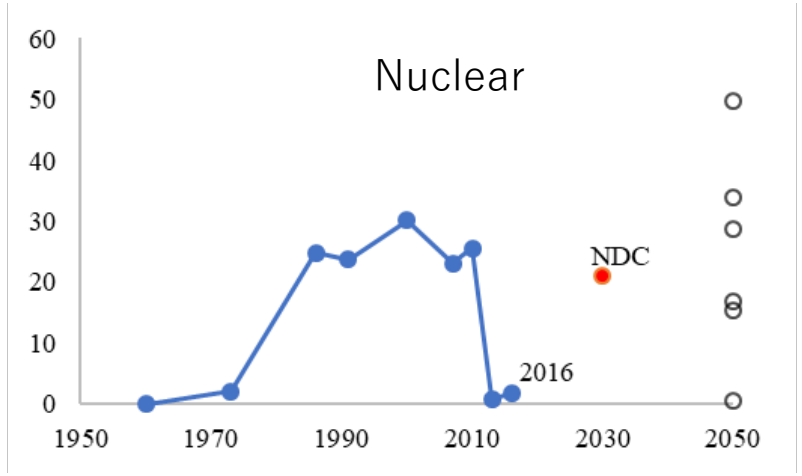
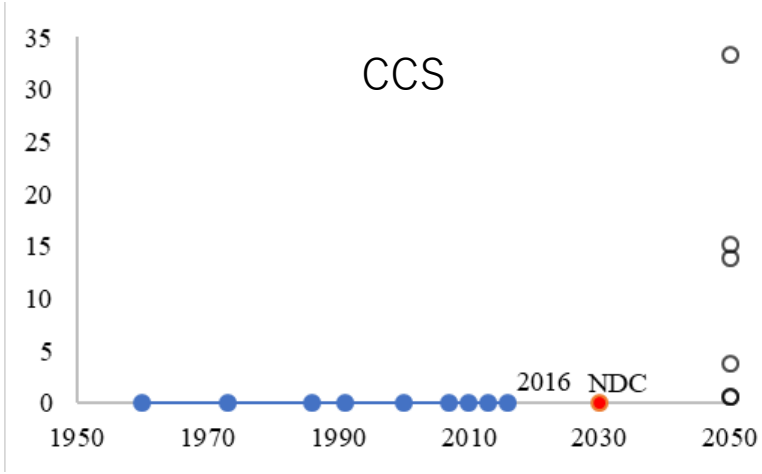
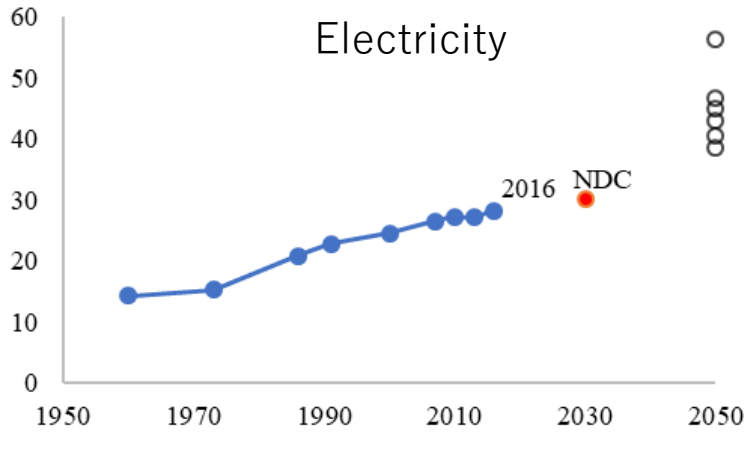
Share in electricity supply [%]

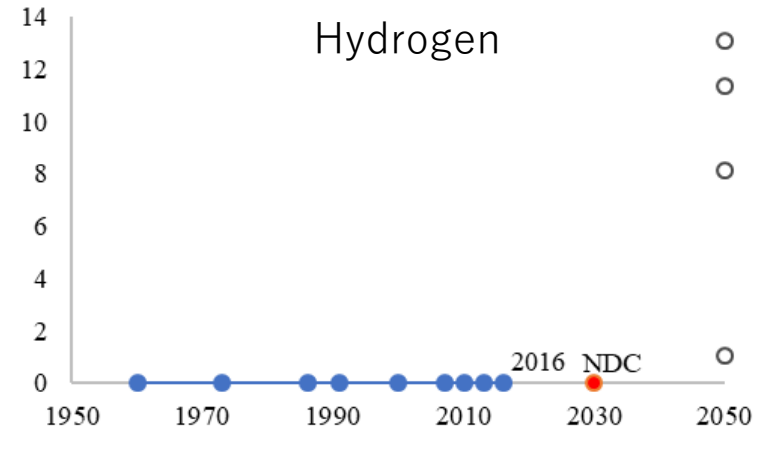






Share in final energy consumption [%]





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