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# Long-term carbon neutral goal and near-term actions

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Thematic Track 13: The Pathway Towards Decarbonisation  
Message from Scientists Towards Green Recovery  
ISAP2020, Online  
November 13, 2020



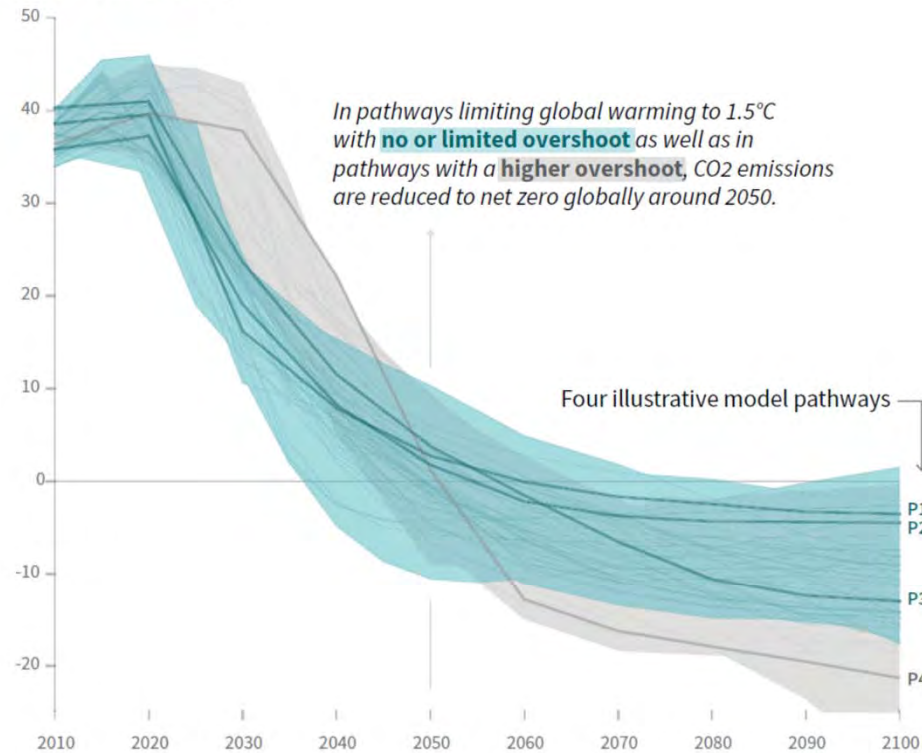
**Asia-Pacific Integrated Model**  
<http://www-iam.nies.go.jp/aim/index.html>



# From IPCC SR1.5: **To achieve 1.5 degree target, immediate GHG reduction and net zero CO2 emissions in 2050 are needed.**

Global total net CO<sub>2</sub> emissions

Billion tonnes of CO<sub>2</sub>/yr



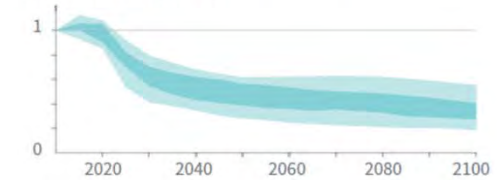
In pathways limiting global warming to 1.5°C with **no or limited overshoot** as well as in pathways with a **higher overshoot**, CO<sub>2</sub> emissions are reduced to net zero globally around 2050.

Four illustrative model pathways

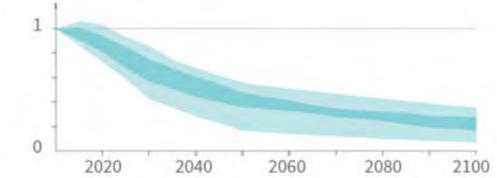
Non-CO<sub>2</sub> emissions relative to 2010

Emissions of non-CO<sub>2</sub> forcers are also reduced or limited in pathways limiting global warming to 1.5°C with **no or limited overshoot**, but they do not reach zero globally.

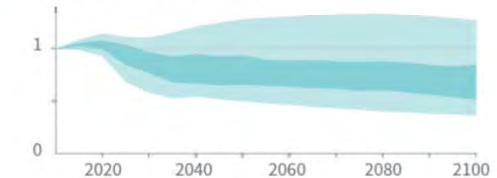
Methane emissions



Black carbon emissions

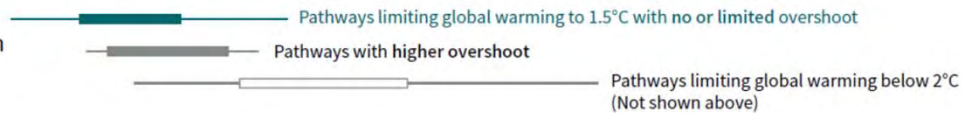


Nitrous oxide emissions



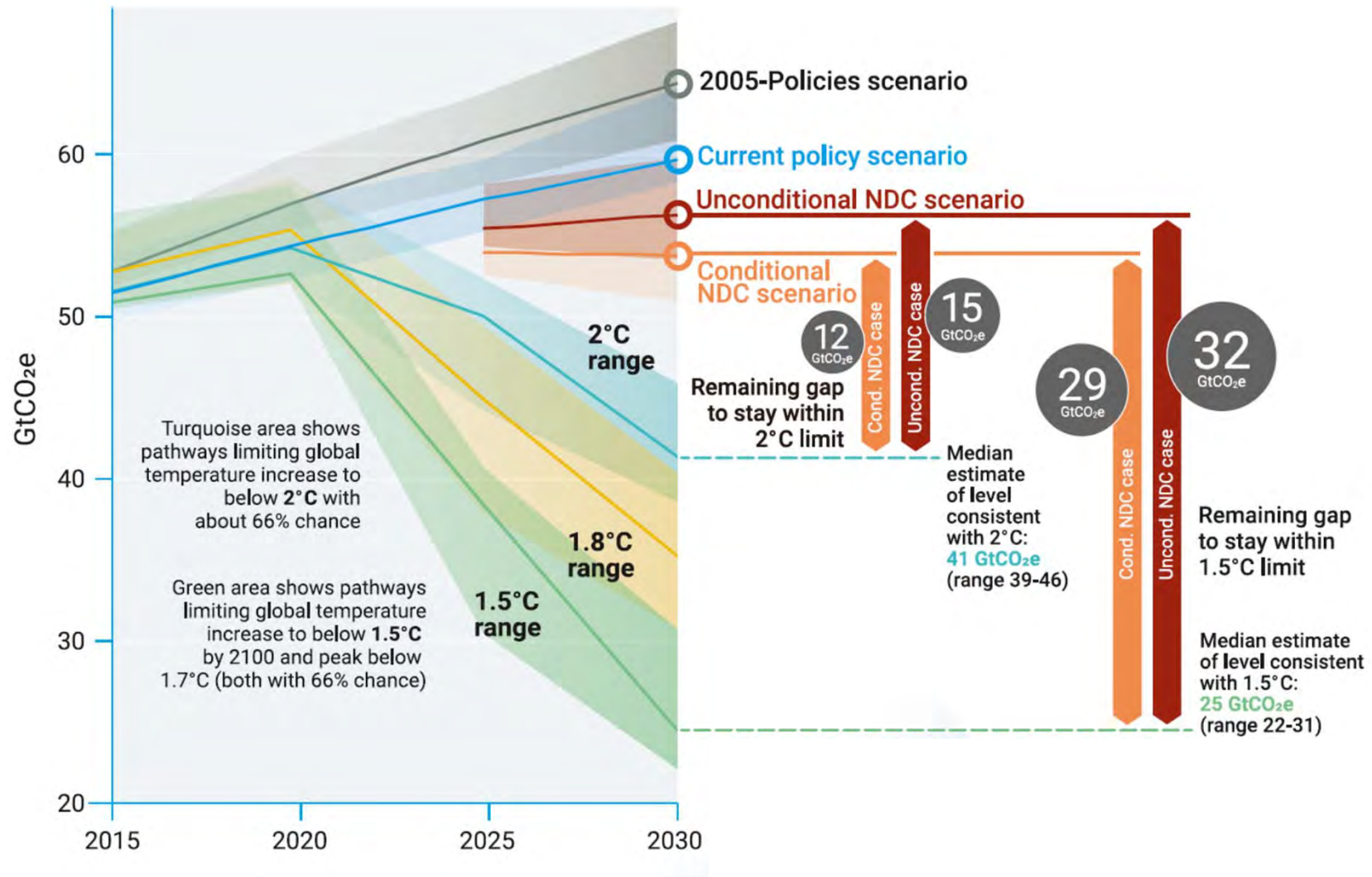
Timing of net zero CO<sub>2</sub>

Line widths depict the 5-95th percentile and the 25-75th percentile of scenarios



[https://www.ipcc.ch/site/assets/uploads/sites/2/2019/05/SR15\\_SPM\\_version\\_report\\_LR.pdf](https://www.ipcc.ch/site/assets/uploads/sites/2/2019/05/SR15_SPM_version_report_LR.pdf)

# Present NDC can achieve the 1.5/2 degree target?



UNEP (2019) Emissions Gap Report 2019, Fig. 3.1  
<https://www.unenvironment.org/resources/emissions-gap-report-2019>

# Why 1.5 degree?

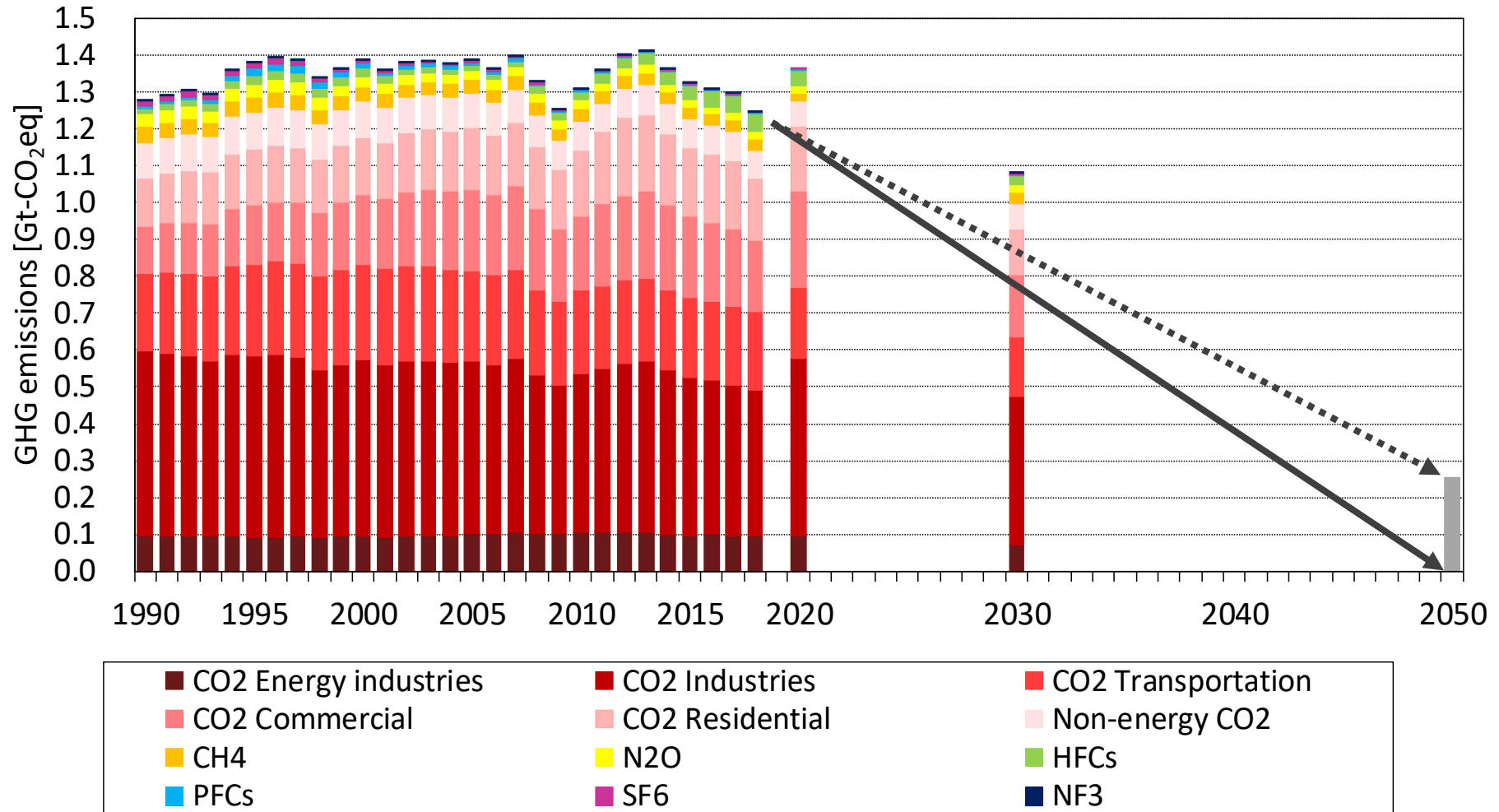
- Paris Agreement

- Article 2: 1. (a) **Holding the increase in the global average temperature to well below 2 °C above pre-industrial levels and to pursue efforts to limit the temperature increase to 1.5 °C above pre-industrial levels**, recognizing that this would significantly reduce the risks and impacts of climate change;
- Article 4: 19. All Parties should strive to formulate and communicate **long-term low greenhouse gas emission development strategies**, mindful of Article 2 taking into account their common but differentiated responsibilities and respective capabilities, in the light of different national circumstances.

# Japan Long-Term Strategy under the Paris Agreement as A Growth Strategy (June 2019) → Now Net-Zero (Oct 2020)

Outlines of Japan's Long-term Strategy under the Paris Agreement (Cabinet decision, June 11, 2019)	
<b>Chapter 1: Basic Concepts</b>	Provisional Translation
<p>➤ <b>Proclaiming a “decarbonized society” as the ultimate goal and aiming to accomplish it ambitiously as early as possible in the second half of this century</b>, while boldly taking measures towards the reduction of GHGs emissions by 80% by 2050  <small>* an unconventional vision of an “ideal future model” * contributing to the achievement of the long-term goals of the Paris Agreement, including efforts to limit the temperature increase to 1.5°C</small></p> <p>➤ <b>Realizing “a virtuous cycle of environment and growth”</b> towards the vision with business-led disruptive innovation, Swift implementation of actions from now, contributing to the world, <b>Action Towards a bright Society with Hope for the Future</b>  <small>[Factors: Achievement of SDGs; “Co-innovation”, Society 5.0; the “Circulating and Ecological Economy”; and leading country in solving problems]</small></p>	
<b>Chapter 2: The Vision of Each Sector and the Direction of Measures</b>	<b>Chapter 3: Cross-sectoral Measures for Achieving a Virtuous Cycle of Environment and Growth</b>
<p><b>Section 1: Measures for Emissions Reductions</b></p> <p><b>1. Energy: For energy transition/decarbonization, pursuing every option</b></p> <ul style="list-style-type: none"> <li>Utilizing renewable energy as the major power source</li> <li>Reducing CO<sub>2</sub> emissions from the thermal power in line with the long-term goals of the Paris Agreement</li> <li>Promoting CCS&amp;CCU/Carbon Recycling</li> <li>Realizing a “Hydrogen Society”/battery/nuclear/energy efficiency</li> </ul> <p><b>2. Industry: Decarbonized manufacturing</b></p> <ul style="list-style-type: none"> <li>Use of CO<sub>2</sub>-free hydrogen (e.g. a challenge towards “zero-carbon steel”)</li> <li>Feedstock change (e.g. CCU including artificial photosynthesis and biomass utilization)</li> <li>Achieving drastic energy efficiency, and complete transition from fluorocarbons in mid-long term</li> </ul> <p><b>3. Transport: the challenge of “Well-to-Wheel Zero Emission”</b></p> <ul style="list-style-type: none"> <li>Achieving the highest level of environmental performance of Japanese vehicles supplied worldwide by 2050</li> <li>Road/transport systems using big data and IoT</li> </ul> <p><b>4. Community and Living: Achieving carbon neutral, resilient and comfortable communities and living by 2050/ creating the “Circulating and Ecological Economy”</b></p> <ul style="list-style-type: none"> <li>Capable communities and corporations to achieve carbon neutrality even before 2050</li> <li>Shift to carbon neutral living (encouraging technology development and dissemination to achieve net Zero Energy Buildings, equivalency in stock average of housing and office buildings/ shift of lifestyles)</li> <li>Carbon-neutral community building (urban city building, farming/forestry/fishing villages building, and development of distributed energy systems)</li> </ul> <p><b>Section 2: Measures for Carbon Sinks</b></p>	<p><b>Section 1: Promotion of Innovation</b></p> <ul style="list-style-type: none"> <li>Promoting innovation for practical application and wide usage of cross-sectoral decarbonization technologies leading to drastic reduction of GHG, achieving cost that allows commercialization for social application</li> </ul> <p><b>(1) Progressive Environment Innovation Strategy</b></p> <ul style="list-style-type: none"> <li>Setting clear goals such as costs, maximizing investment of public and private resources, discovering and creating technological seeds in and outside Japan, setting issues from demands, strengthening support that leads to commercialization</li> <li>Challenging R&amp;D, and enhancing alliances among R&amp;D institutes with facilitation of international joint R&amp;D activities [Research and Development 20 for clean energy technologies(RD20)]</li> <li>Target setting and visualizing challenges for the practical use <ul style="list-style-type: none"> <li>Realizing hydrogen cost equivalent to existing energy: e.g. lowering manufacturing cost of CO<sub>2</sub>-free hydrogen to 1/10</li> <li>CCU/carbon recycled products to be provided with costs equivalent to existing products, nuclear power(such as Reactor, Fusion)</li> </ul> </li> </ul> <p><b>(2) Innovation in Economic and Social Systems/lifestyle</b></p> <p><b>Section 2: Promotion of Green Finance</b></p> <ul style="list-style-type: none"> <li>Appropriately “visualizing” corporate efforts in innovation etc. and mobilizing finance for innovation by financial institutions</li> </ul> <p><b>(1) Mobilizing green finance through TCFD<sup>®</sup> disclosures and dialogues</b> ※Task Force on Climate-related Financial Disclosures</p> <ul style="list-style-type: none"> <li>Industry: improving TCFD Guidance &amp; Scenario Analysis Guide / Financial sector: Formulating a guidance on green investment</li> <li>Facilitating dialogue between industry and financial sector (TCFD Consortium)</li> <li>Promoting discussion and share the above initiatives with the world (TCFD Summit)</li> </ul> <p><b>(2) Promoting initiatives to expand ESG finance</b></p> <ul style="list-style-type: none"> <li>Initiatives for ESG finance (Support to the issuance of green bonds, encouraging local ESG finance), development of ESG Dialogue Platform, enhancing ESG finance literacy, ESG Finance High-Level Panel</li> </ul> <p><b>Section 3: Business-led Promotion of International Application, and International Cooperation</b></p> <ul style="list-style-type: none"> <li>Promoting competitive technologies and products with high environmental performance/ promoting co-innovation benefiting participants from both countries</li> </ul> <p><b>(1) Promoting international application of decarbonization technologies together with policy/institutional development and international rule-making</b></p> <ul style="list-style-type: none"> <li>Promoting international application of decarbonization technologies and reductions of GHG emissions through development of business environment by improving business environment including working for institutional development in partner countries leading international rule-making cooperating in building policy and institutional framework in partner countries and by international rule-making (e.g. establishing public and private-sector initiatives in ASEAN, and developing appropriate international frameworks for utilizing market-based mechanisms)</li> </ul> <p><b>(2) Strengthening Development and Investment of infrastructure that contributes to CO<sub>2</sub> emission reductions</b></p> <ul style="list-style-type: none"> <li>Development and investment of energy and city/transport infrastructure that contributes to CO<sub>2</sub> emission reductions in line with the long-term goals of the Paris Agreement (e.g. renewable energy such as offshore wind power and geothermal power, hydrogen, CCS&amp;CCU/Carbon Recycling, smart cities)</li> </ul> <p><b>(3) Creating platforms for global scale decarbonized society building</b></p> <ul style="list-style-type: none"> <li>Supporting partner countries in the formulation of NDCs and mitigation measures, enhancing transparency in the overall supply chains</li> </ul>
<b>Chapter 4: Other Measures</b>	<b>Chapter 5: Review and Implementation of the Long Term Strategy</b>
<ul style="list-style-type: none"> <li>Human Resource Development</li> <li>Government-led initiatives</li> <li>Integrating climate change adaptation with development of a resilient society</li> <li>Carbon Pricing (Expert/technical level discussions)</li> </ul>	<ul style="list-style-type: none"> <li><b>Review:</b> Re-examining policies and measures flexibly every about 6 years with reference to situations, and improving the Long-term strategy if necessary</li> <li><b>Implementation:</b> Analysing relevant factors responding to future changes in the situations / collaborating and having dialogues with stakeholders including the youth</li> </ul>

# GHG emissions in Japan; trend and future targets



Source: GIO, NIES <http://www-gio.nies.go.jp/aboutghg/nir/nir-j.html>

# What is needed to realize net-zero GHG emission in Japan?

"Transition" is needed.

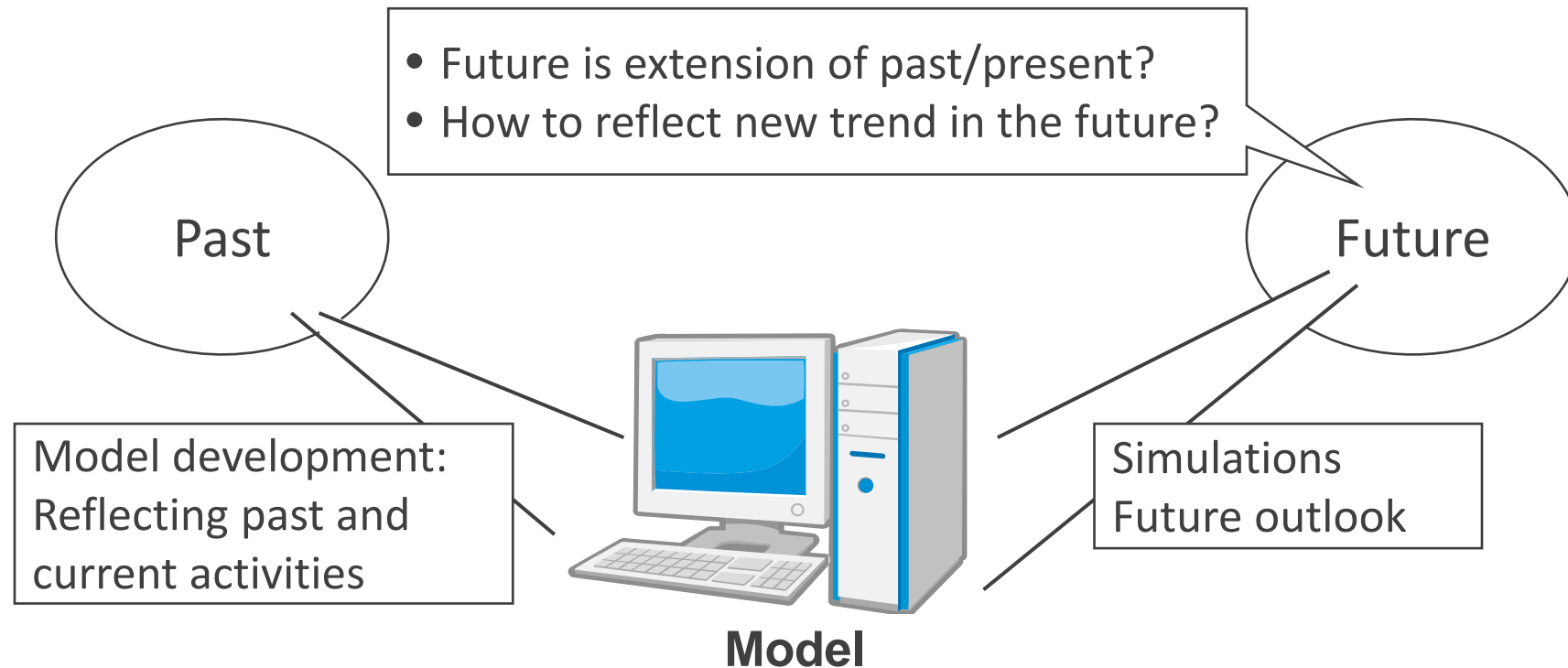
- Energy efficiency improvement
- Decarbonize power generation
- Electrification
- Carbon sink
- Countermeasures to reduce non-CO2
  
- Behavior change (Demand side)
  - Digitalization
  - Dematerialization
  - Reduction of wastes including food loss -"Mottainai"
  
- Support to developing countries

# How to achieve net-zero GHG emission in Japan?

- Immediate actions!
  - Considering long-term viewpoint.
    - Consistent and robust long-term goal
    - Carbon pricing
    - Inefficient equipment will be replaced to efficient one.
    - Education
  - Socio-economic condition change
- In order to quantify effectiveness of countermeasures, model and scenario development (simulation) are useful.

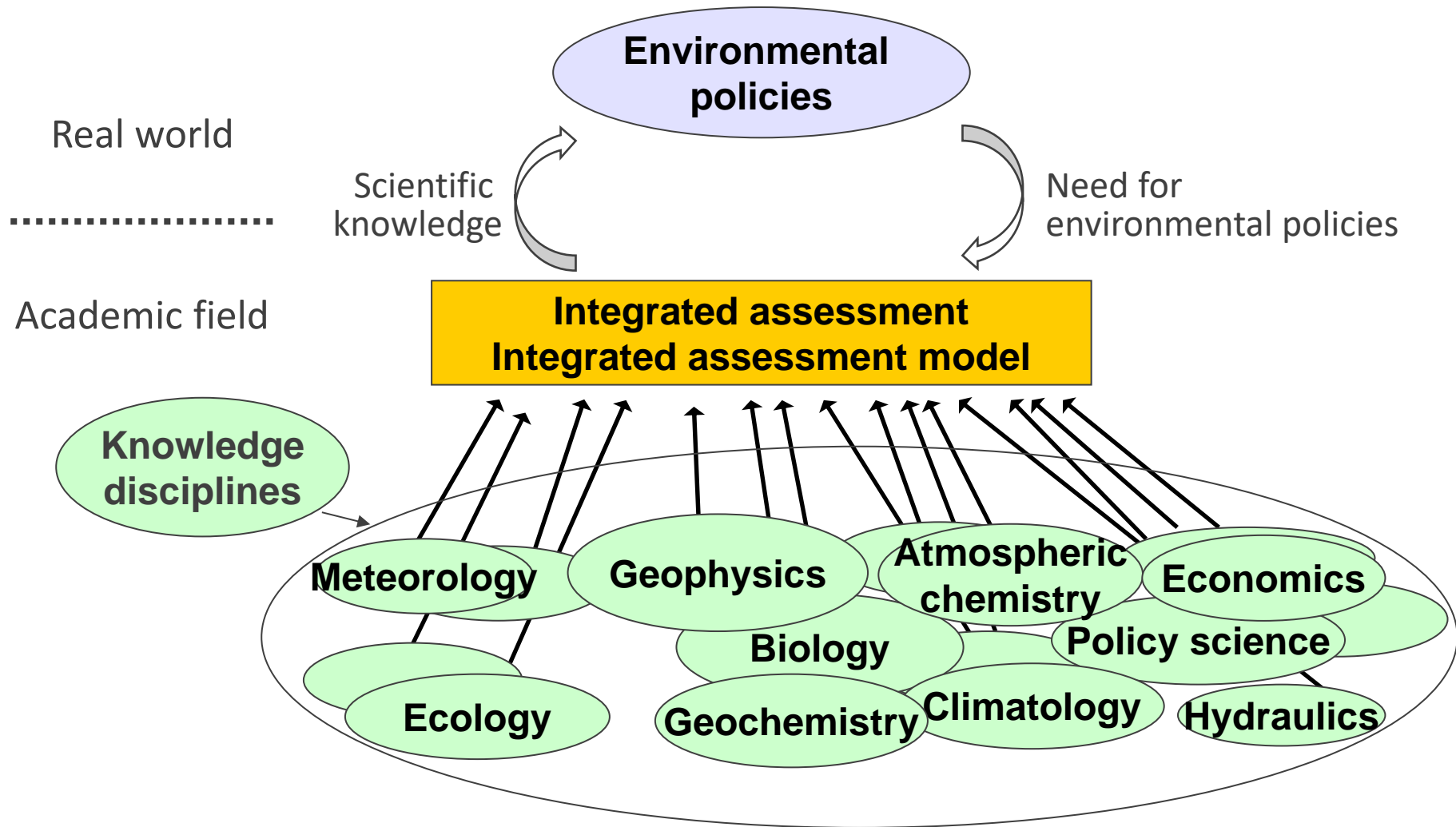


# Roles of model



- Model cannot predict future, but only shows a result corresponding to a set of inputs.
  - Model has both subjective and objective aspects.
  - Model has both advantages and disadvantages.
- We will have to use model to meet purpose.

# Integrated Assessment Model as a tool to bridge between environmental policies and scientific knowledges



By using model. we can make experiments.

# Zero-emission pathway by 2050 in Japan

- According to the previous studies on global 1.5°C pathways, CO<sub>2</sub> emissions needs to be net-zero around 2050 globally (Rogelj et al. (2015)).
- Assessing national net-zero emission pathways by 2050 using AIM/Enduse [Japan], mainly focusing on:
  - difference of energy system transformation with the 2°C scenario (80% reduction by 2050)
  - the role of technologies, such as negative emission and nuclear
- BECCS is added to the technology options in AIM/Enduse[Japan]
- Oshiro, K., Kainuma, M., & Masui, T. (2018). Transformation of Japan's energy system to attain net-zero emission by 2050. Carbon management 9(5), <https://doi.org/10.1080/17583004.2017.1396842>,

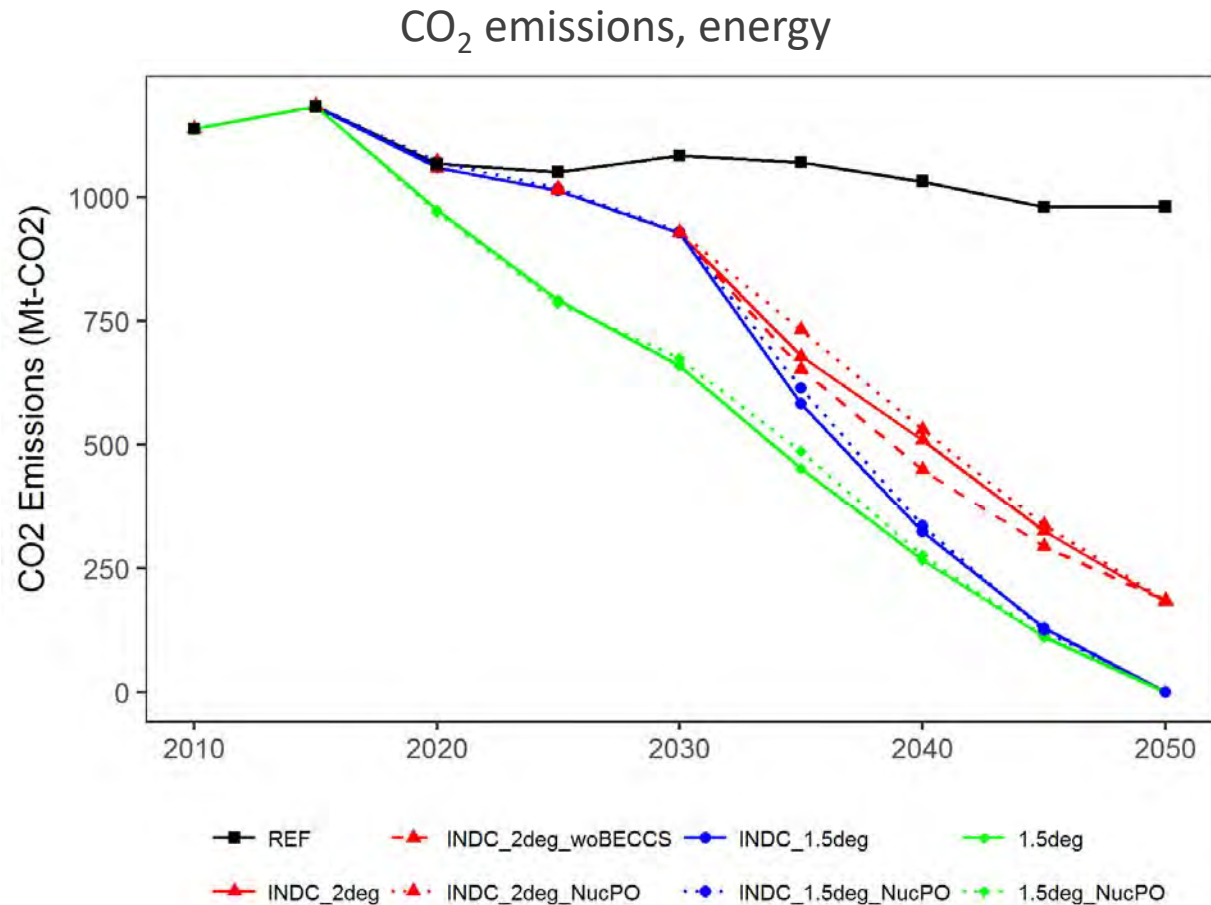


## Transformation of Japan's energy system to attain net-zero emission by 2050

Ken Oshiro, Toshihiko Masui & Mikiko Kainuma

# Net-zero emission pathways in Japan

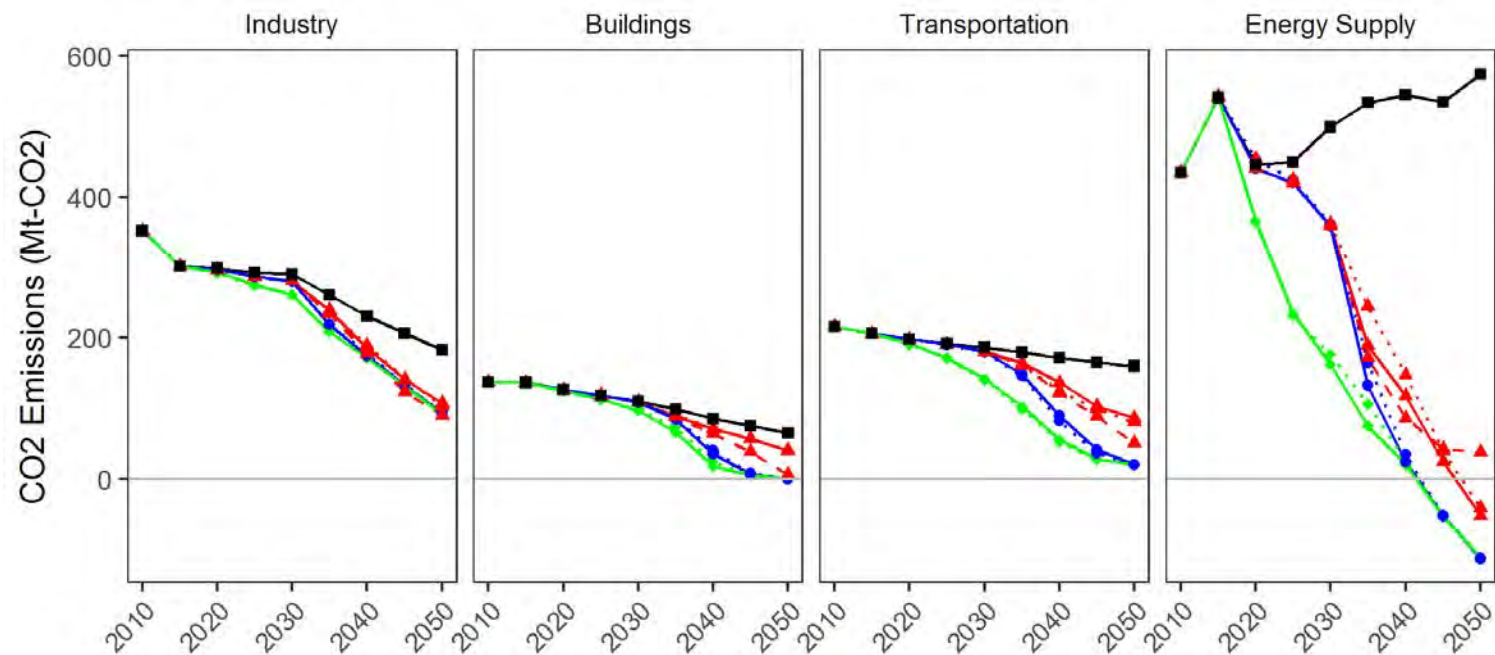
- BECCS is required in zero-emission. 80% reduction is achievable without BECCS
- Phase-out of nuclear power would not compromise zero-emission
- If following the NDC, drastic emission reduction is required after 2030



# Sectoral strategies to zero emission in Japan

- Power sector needs to be largely transformed, including net-negative.
- Difference between net-zero and 80% reduction is moderate in the buildings and industry sector.
- Buildings sector needs to be almost decarbonized even in 80% reduction.

Sectoral direct CO<sub>2</sub> emissions



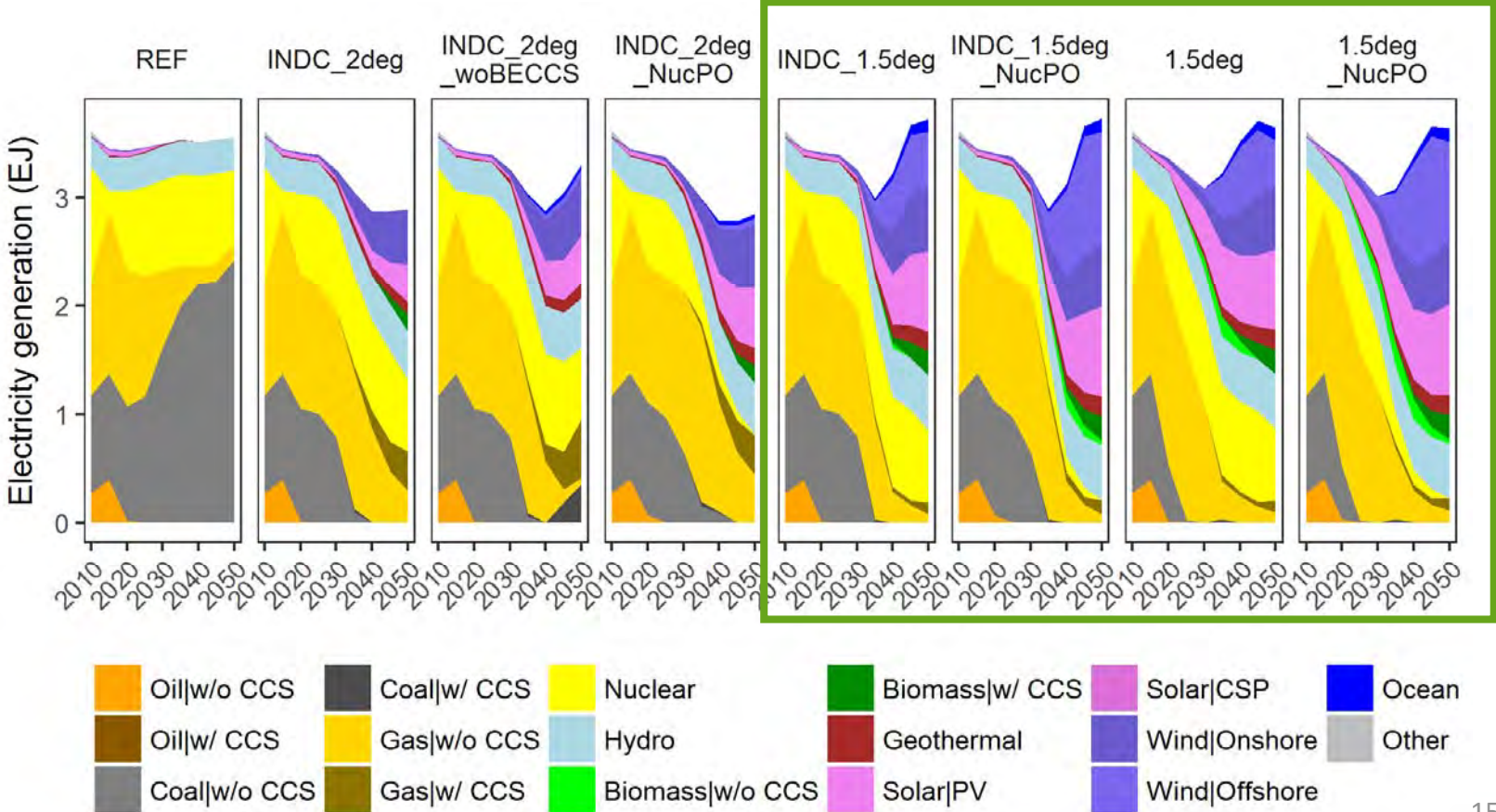
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# Energy system transformation in power sector

- Dependence on VREs, such as solar and wind, as well as BECCS.
- Given phase-out of nuclear, challenges to integrate VREs are exacerbated.

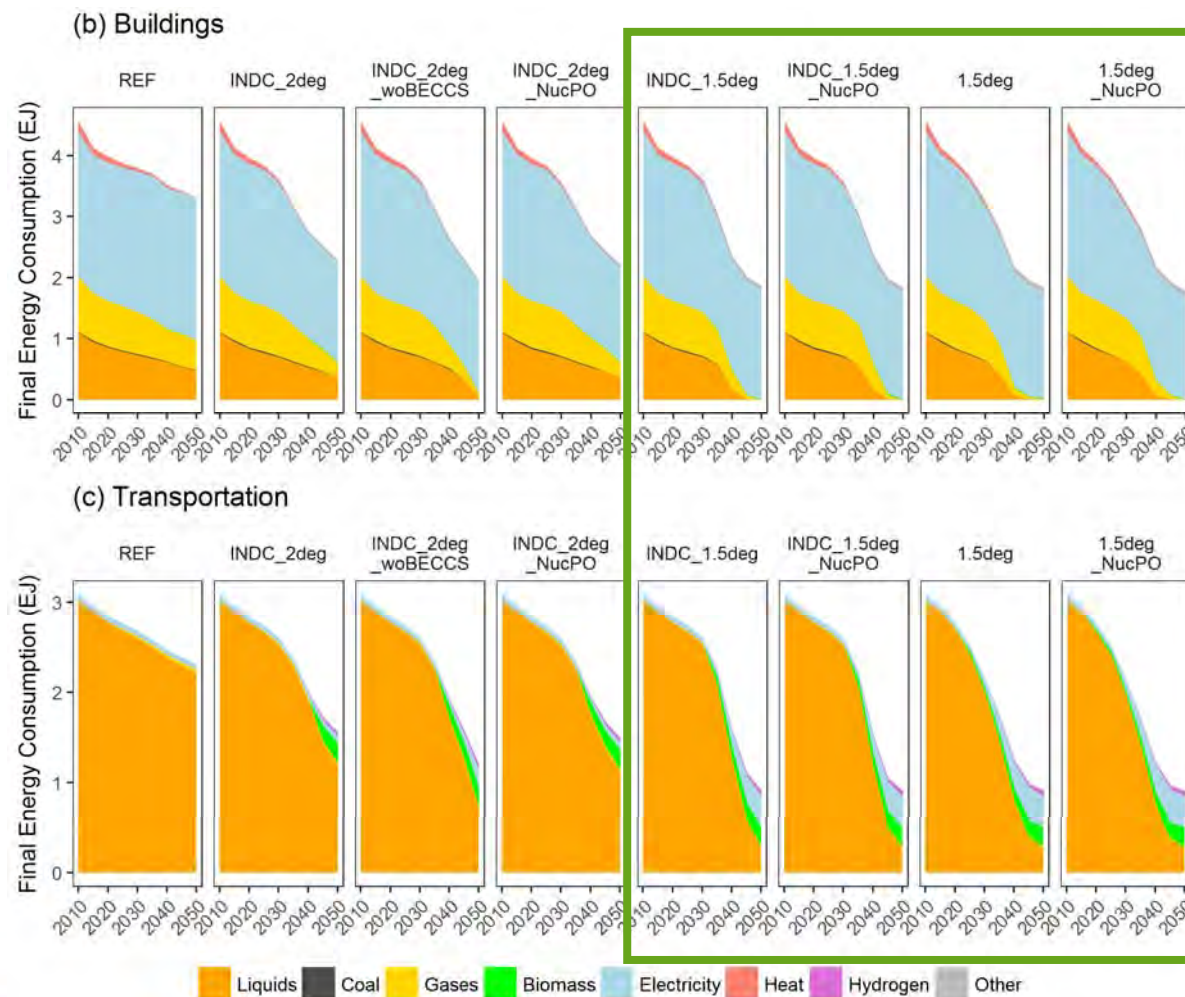
Electricity generation



# Energy system transformation in energy demand sectors

- Buildings sector: completely electrified by 2050 even in the 80% reduction
- Transport sector: switch to BEV and FCEV

Final energy demand by sources in the buildings and transportation sectors



# How to overcome COVID-19

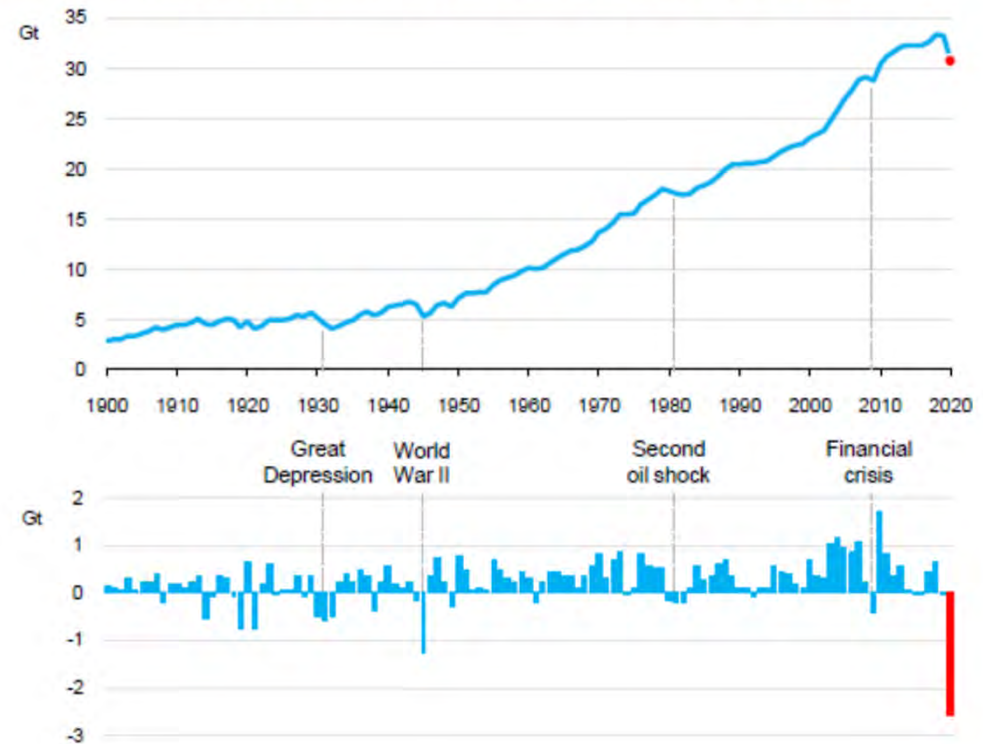
- Drastic changes in socio-economic activities can reduce GHG, but reduced GHG is very small compared to those to achieve net-zero emission.
  - If the structure of our society does not change, rebound effects may happen.
- We must consider
  - How to recover from short-term drastic changes.
  - Present activities will lead to 2050.
- In order to satisfy both short-term target and long-term target,
  - Change ourselves (action and mind).
  - Keep new experiences.
    - Green recovery
    - Digitalization



# How to consider Covid-19



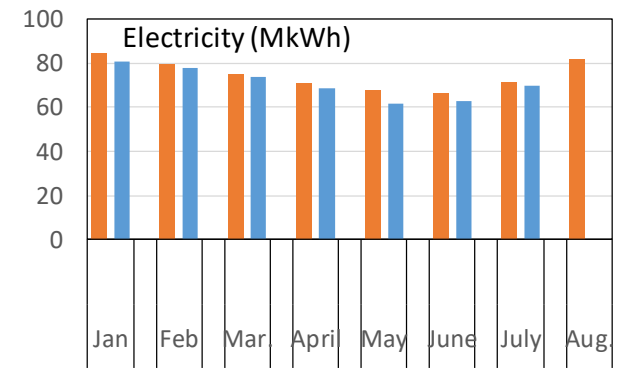
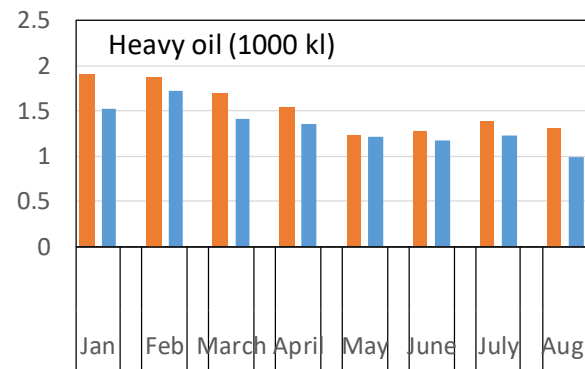
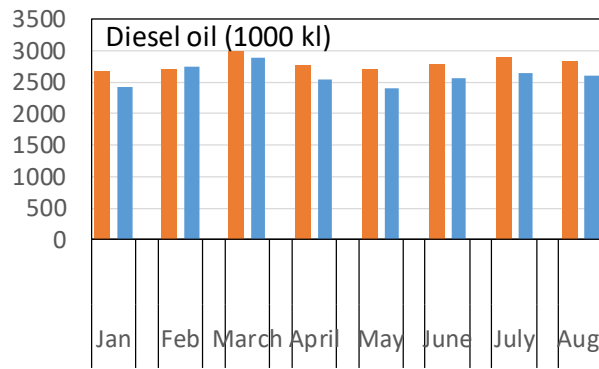
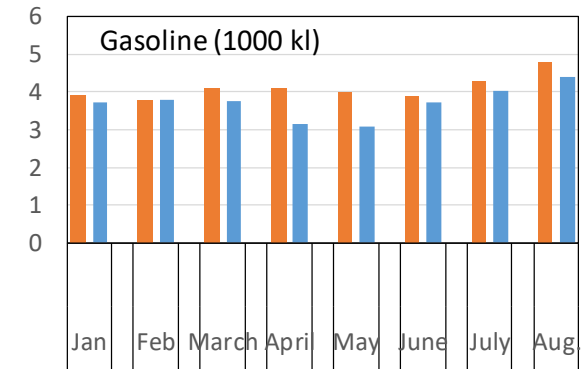
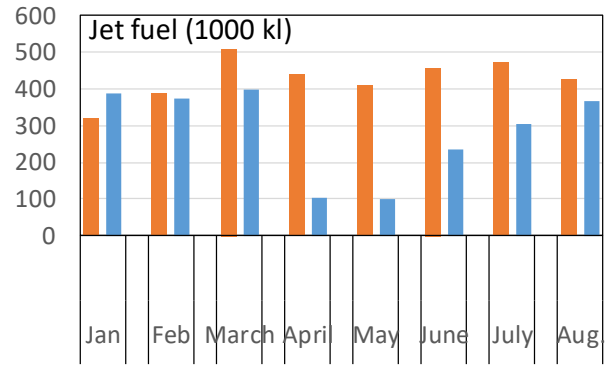
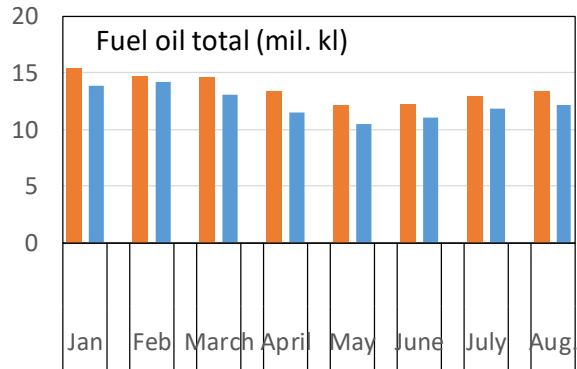
Global energy-related CO2 emissions and annual change, 1900-2020



## IEA forecasts

- Global primary energy will decrease by 6% between 2019 and 2020, and
- Global energy CO2 will decrease by 8% between 2019 and 2020.

# Change of monthly energy demand in Japan



2019

2020

Data: METI and ANRE

Covid-19 mentions that severe economic damage will happen to achieve net-zero GHG society if our society does not change.