

# Assessment of climate mitigation goals with AIM/CGE

Diego SILVA HERRAN

NIES

AIM International Workshop, Nov 19<sup>th</sup> 2019



**Asia-Pacific Integrated Model**

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



# Outline

- Research on assessment of climate mitigation policies with AIM/CGE
- International projects
  - COMMIT, EMF36, ENGAGE
- National projects
  - JMIP/EMF35
  - Assessment of Japan's long-term mitigation goal.
- Future works

# Outline

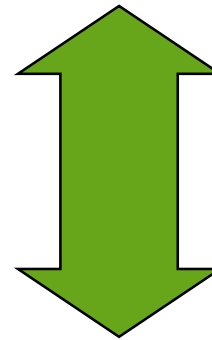
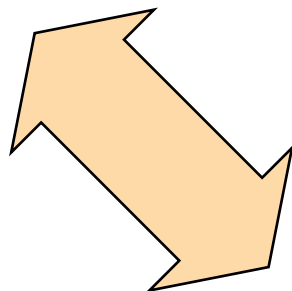
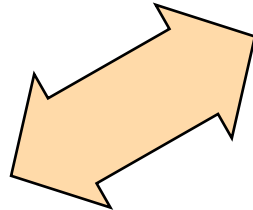
## Long term climate change mitigation scenarios considering sustainability aspects and national circumstances

Climate mitigation scenarios including sustainability aspects

Long term climate change mitigation scenarios

*Global· National targets*

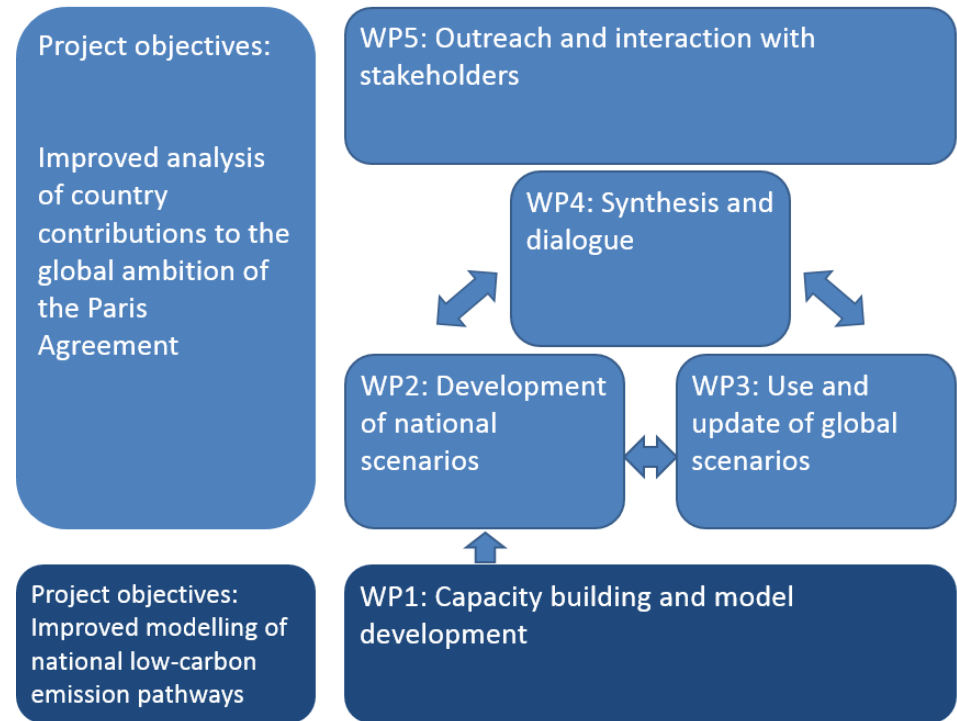
Transformations considering national circumstances in line with global climate targets



# COMMIT



- Climate policy assessment and Mitigation Modeling to Integrate national and global Transition pathways”
- Improved modelling and analysis of national low-carbon emission pathways and contributions the Paris Agreement (NDC, LTS).
- grant from European Commission DG CLIMA.
- Consortium institutes from 11 countries (NIES, IGES, some Asian AIM partners)
- Project outcomes: country factsheets, policy brief, scenario database, events for stakeholder involvement, papers.



<https://themasites.pbl.nl/commit/about-commit>

**URL:**

<https://themasites.pbl.nl/commit/>

# COMMIT outcomes

- Brief description of climate mitigation policy for each country in the project (11).
- Based on Talanoa Dialogue questions + national issue:
  - Where are we?
  - Where do we want to go?
  - How do we get there?
  - Country specific issue
- Combined factsheet of 5 countries submitted to Talanoa Dialogue (incl. Japan).

## Long-term, Low-emission Pathways in Brazil, Canada, EU, India and Japan

Contribution to the Talanoa Dialogue by the COMMIT project  
October, 2018



Environment and  
Climate Change Canada



<https://themasites.pbl.nl/commit/wp-content/uploads/COMMIT-Long-term-Low-emission-pathways-in-Brazil-Canada-EU-India-Japan.pdf>

# COMMIT outcomes

- Policy brief

## Contents

Executive summary .....  
 Where are we? .....  
 Where do we want to go? .....  
 How do we get there? .....  
 Chapter 1: Where do we want to go? .....  
 Paris Agreement requires rapid reduction of global greenhouse gas emissions  
 Operational targets: emission reductions, peak years, and phase-out years ....  
 Energy supply sector could be a major contributor to emission reductions .....  
 References .....  
 Chapter 2: Where are we going? .....  
 Implementation and ambition gaps .....  
 Benefits of early action and risks of delayed action .....  
 Success stories .....  
 References .....  
 Chapter 3: How do get from where we are going to where we want to go? ....  
 Dynamics of the transformation .....  
 Energy investments required for the transformation .....  
 Policy needs to incentivise the transformation .....  
 Benefits of deep decarbonisation efforts for other sustainability objectives ....  
 References .....

<https://themasites.pbl.nl/commit/wp-content/uploads/Opportunities-for-Enhanced-Action-to-Keep-Paris-Goals-within-Reach-COMMITCD-LINKS-policy-brief.pdf>



## Opportunities for Enhanced Action to Keep Paris Goals in Reach

Contribution to the Talanoa Dialogue by the COMMIT and CD-LINKS projects  
 October, 2018



# COMMIT Scenario database

- Existing global scenarios
- Existing national scenarios
- New scenarios
- Public release planned

**(1.) Regions:**

- Compare
  - Global
    - World
  - 5 regions
    - OECD90 and EU (and EU cand
    - Countries from the Reforming
    - Asian countries except Japan
    - Countries of the Middle East a
    - Latin American countries
    - Rest of the World
  - Individual G20 countries

**(2.) Model/Scenarios:**

- AIM V2.1
- AIM/CGE
- AIM/Enduse[Japan]
- BLUES
- COPPE-COFFEE 1.0
- GCAM-USA\_CDLINKS
- GCAM4
- GCAM\_LAMP
- GEM-E3
- GEM-E3\_IPTS\_World
- IMAGE 3.0
- IPAC-AIM/technology V1.0
- MESSAGE-GLOBIOM\_1.0
- MESSAGEix-GLOBIOM\_1.0
- REMIND 1.7
- REMIND-MAGPIE
- REMIND-MagPIE 1.7-3.0
- WITCH-GLOBIOM
- WITCH2013
- WITCH2016

**(3.) Variable:** data

- Agricultural Demand
- Agricultural Production
- Capacity Additions
- Capacity
- Capital Cost
- Capital Formation
- Capital Stock
- Carbon Sequestration
- Concentration
- Consumption
- Cumulative Capacity
- Debt Service
- Direct Risk
- Efficiency
- Emissions
- Employment
- Energy Service
- Expenditure
- Export
- Fertilizer Use
- Fertilizer
- Final Energy
- Fiscal Gap

**Query Results:**

Region	Model - Scenario	Variable	Unit	2005	2010
World	AIM V2.1 - CD-LINKS-NPi_V4	Emissions CO2	Mt CO2/yr	32974.899	33926.8

© COMMIT Database (Version 0.0.1)  
generated: 2018-09-10 12:29:41

# COMMIT scenario analysis

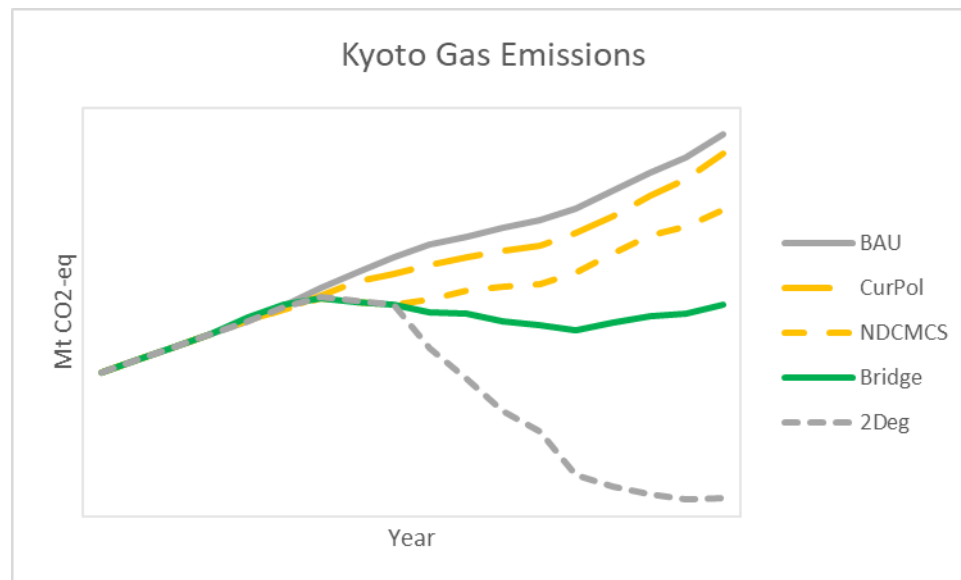


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- more realistic scenarios than the national '2 °C' pathways based on cost-optimal
- Not stylised but based on policy
- Distinguishing country groups
- With both global and national models
- Policies considered: final energy by sectors (transport, industry, buildings), renewable promotion, phase out non-CCS coal power, non-CO2 mitigation (N2O, CH4, F-gas).





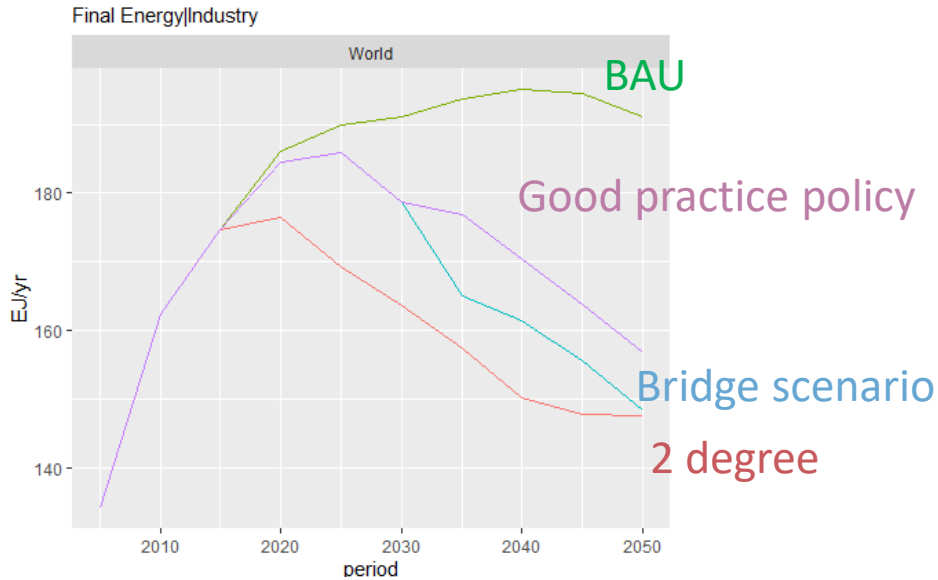
# COMMIT scenario analysis



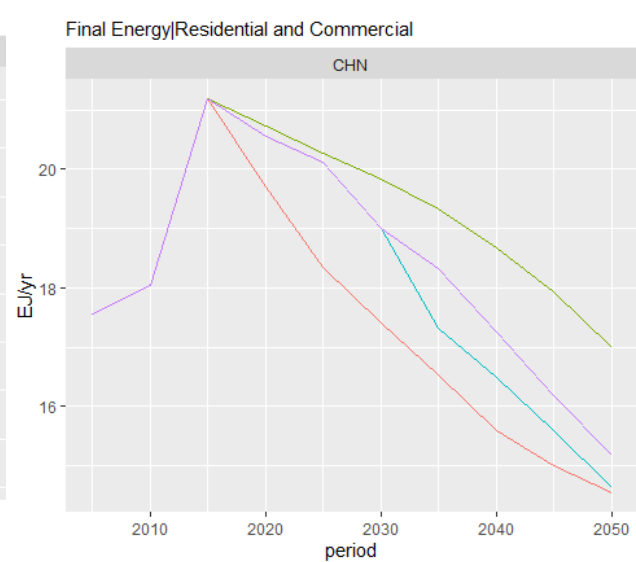
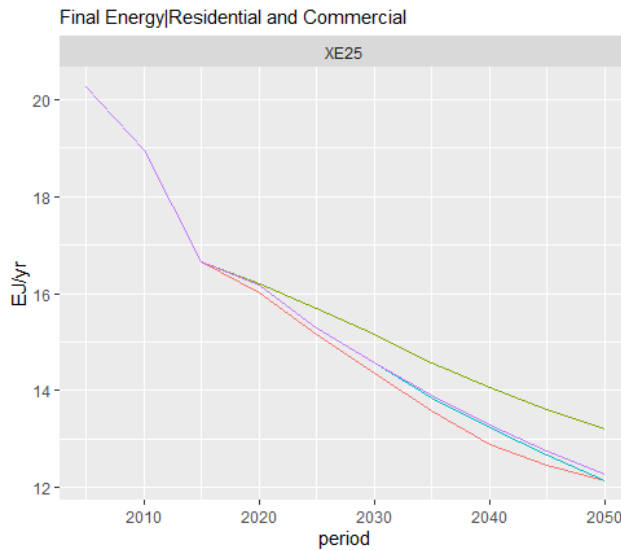
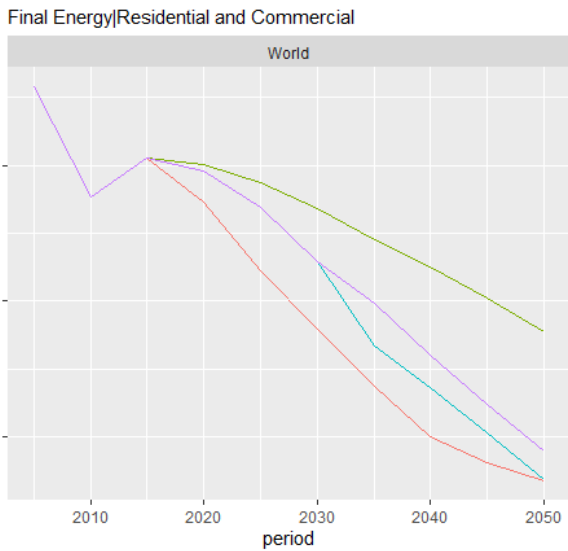
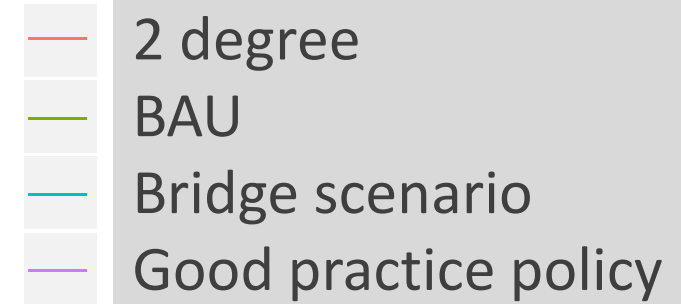
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scenario



# National analysis: JMIP/EMF35

- Assessment of Japan's long-term mitigation goal.
- Model inter-comparison of Japan national models
- Model and policy uncertainties.

Collaboration with EMF, IIASA.

- Special issue planned.

CLIMATE POLICY  
<https://doi.org/10.1080/14693062.2019.1634507>



RESEARCH ARTICLE



## Implications of Japan's long term climate mitigation target and the relevance of uncertain nuclear policy

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<sup>a</sup>Institute for Global Environmental Strategies (IGES), Hayama, Japan; <sup>b</sup>Graduate School of Engineering, Kyoto University, Kyoto-city, Japan; <sup>c</sup>National Institute for Environmental Studies (NIES), Tsukuba, Japan; <sup>d</sup>International Institute for Applied Systems Analysis (IIASA) Laxenburg, Austria

### ABSTRACT

Achieving long-term climate mitigation goals in Japan faces several challenges, starting with the uncertain nuclear power policy after the 2011 earthquake, the uncertain availability and progress of energy technologies, as well as energy security concerns in light of a high dependency on fuel imports. The combined weight of these challenges needs to be clarified in terms of the energy system and macroeconomic impacts. We applied a general equilibrium energy economic model to assess these impacts on an 80% emission reduction target by 2050 considering several alternative scenarios for nuclear power deployment, technology availability, end use energy efficiency, and the price of fossil fuels. We found that achieving the mitigation target was feasible for all scenarios, with considerable reductions in total energy consumption (39%–50%), higher shares of low-carbon sources (43%–72% compared to 15%), and larger shares of electricity in the final energy supply (51%–58% compared to 42%). The economic impacts of limiting nuclear power by 2050 (3.5% GDP loss) were small compared to the lack of carbon capture and storage (CCS) (6.4% GDP loss). Mitigation scenarios led to an improvement in energy security indicators (trade dependency and diversity of primary energy sources) even in the absence of nuclear power. Moreover, preliminary analysis indicates that expanding the range of renewable energy resources can lower the macroeconomic impacts of the long term target considerably, and thus further in depth analysis is needed on this aspect.

### Key policy insights

- For Japan, an emissions reduction target of 80% by 2050 is feasible without nuclear power or CCS.
- The macroeconomic impact of such a 2050 target was largest without CCS, and smallest without nuclear power.
- Energy security indicators improved in mitigation scenarios compared to the baseline.

### ARTICLE HISTORY

Received 5 September 2018  
Accepted 14 June 2019

### KEYWORDS

Climate mitigation targets;  
macroeconomic impact;  
Japan; scenario

Silva Herran et al., Climate Policy, 2019.

# JMIP/EMF35

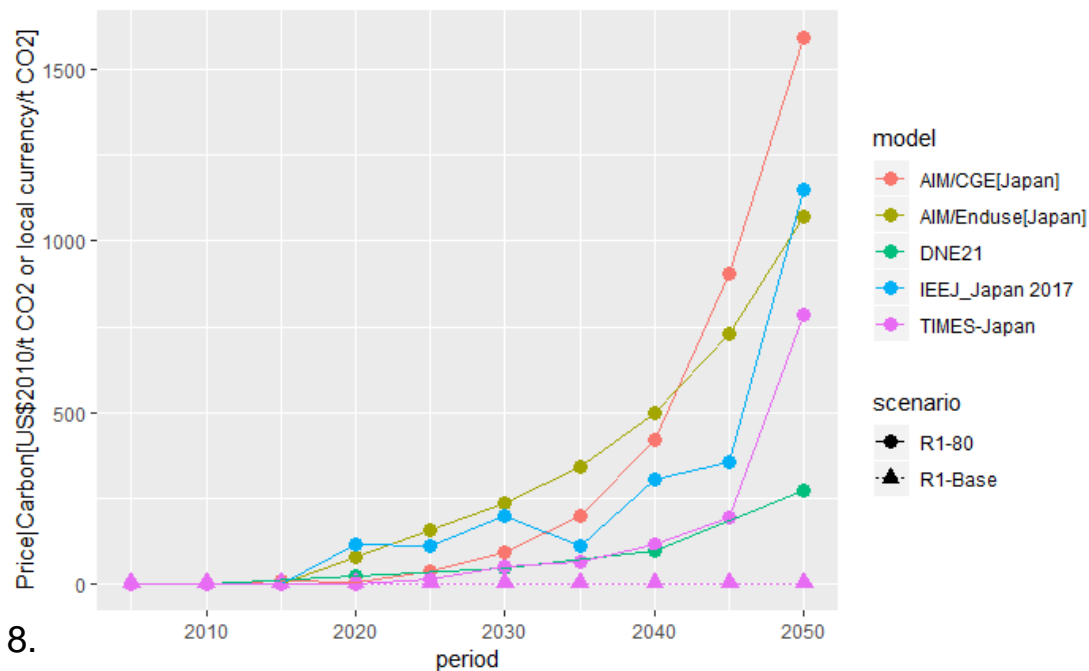


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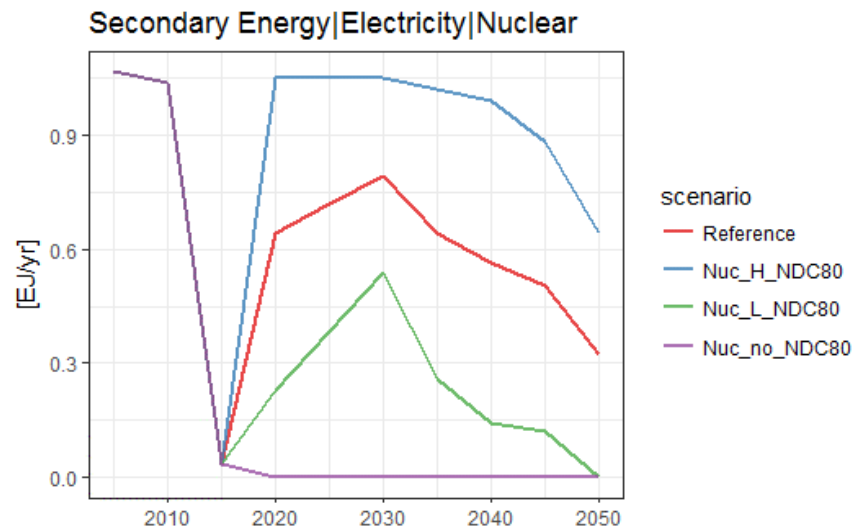
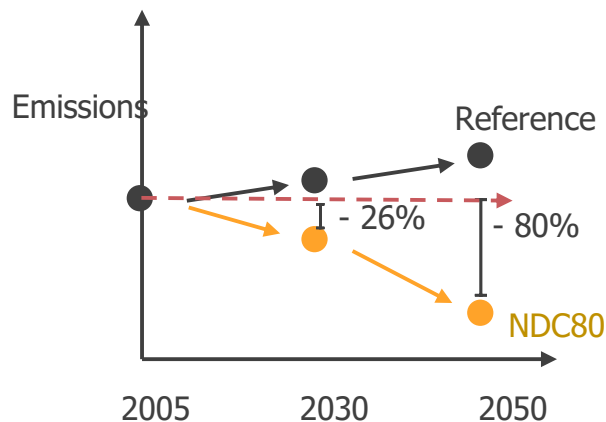
Model	Institute	Solution concept	Intertemporal treatment	Regional coverage
AIM/CGE	NIES	General equilibrium	Myopic	Japan
AIM/Enduse [Japan]	NIES	Partial equilibrium	Myopic	Japan
DNE21	UTokyo	Partial equilibrium	Intertemporal	Global
IEEJ (based on MARKAL)	IEEJ	Partial equilibrium	Intertemporal	Japan
TIMES-Japan	IAE	Partial equilibrium	Intertemporal	Japan



Slide from Sugiyama et al., IAMC 2018.

# Assessment of Japan's long-term mitigation goal

Scenario	Mitigation target	Technology constraint
<i>Reference</i>	No mitigation	Nuclear 2030 NDC share and 2050 intermediate supply
<i>Default_NDC80</i>	NDC target 80% reduction by 2050.	Nuclear 2030 NDC share and 2050 intermediate supply
<i>Nuc_L_NDC80</i>		Nuclear 2030 NDC share and 2050 phase out
<i>NoCCS_NDC80</i>		Default without CCS.
<i>RE_CostRed_L_NDC80</i>		Default with 50% lower rate of cost reductions in renewables.



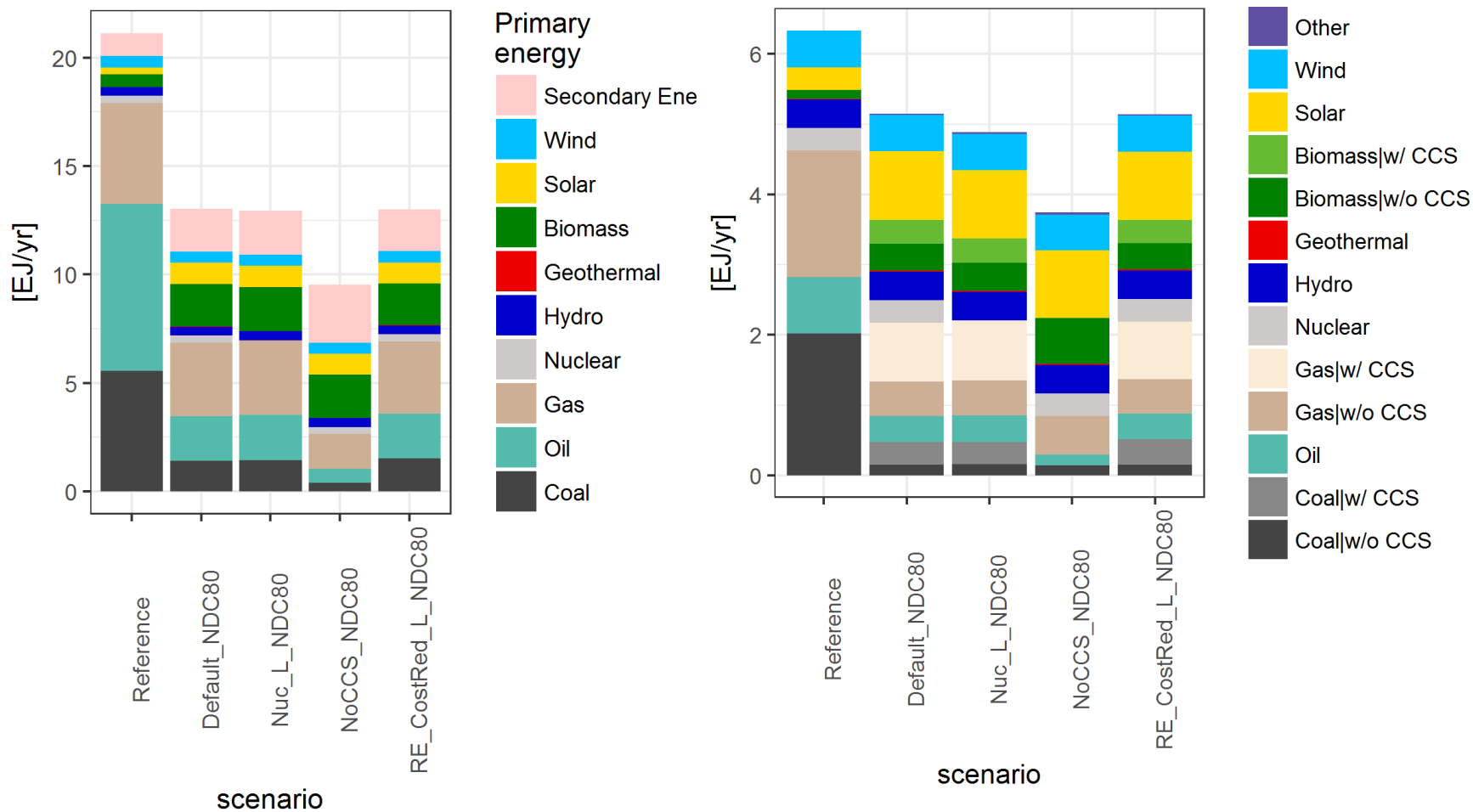
Silva Herran et al., Climate Policy, 2019.

Policy: BaU , NDC80 = NDC target by 2030 + 80% reduction vs 2005

Technology: nuclear power share in electricity = NDC target (20-22% by 2030) + 2050.

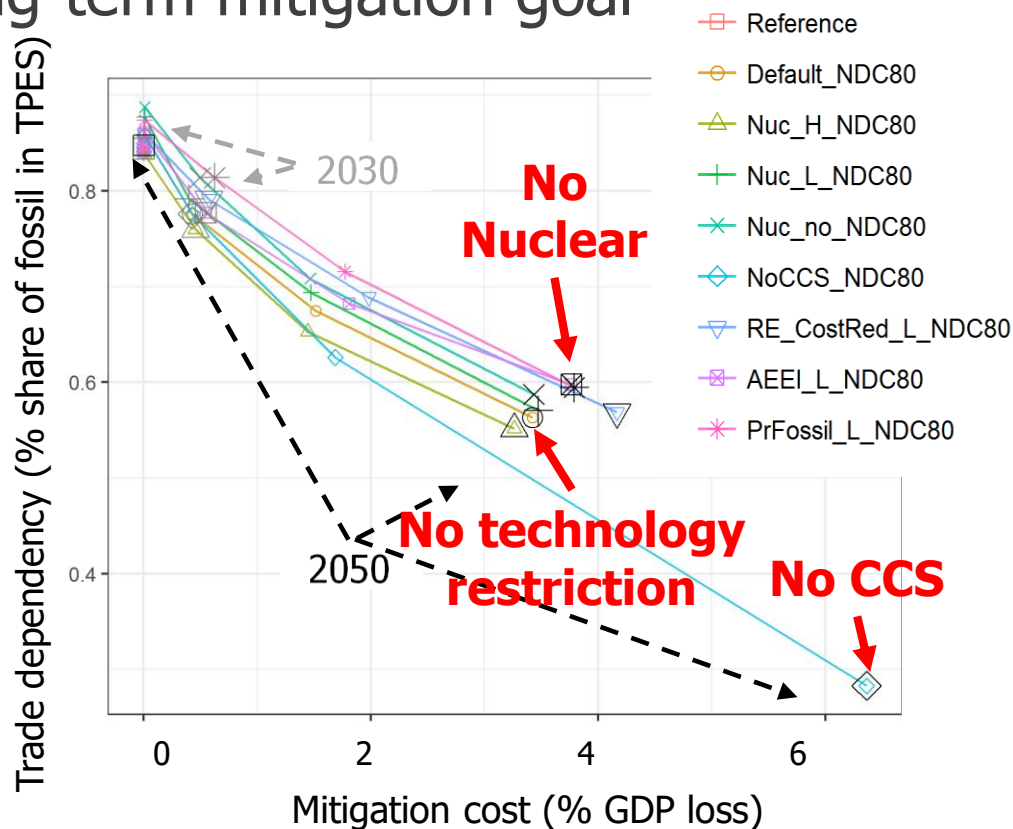
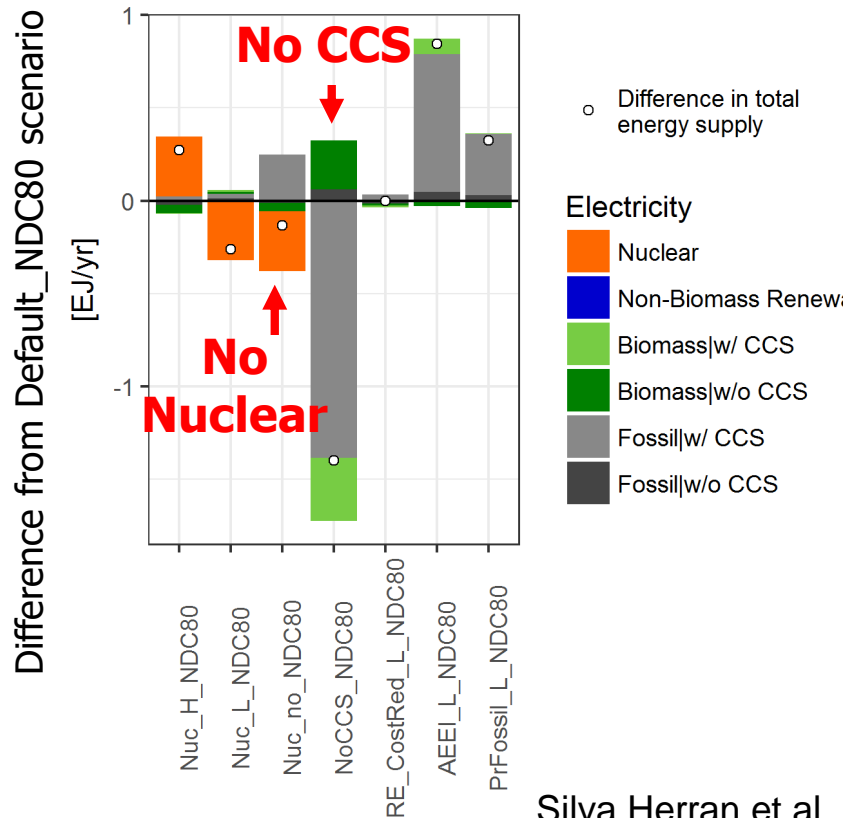
\*Default = NDC target (22%) + 0.5x extended plant life (60 years) with 3 new installations.

# Assessment of Japan's long-term mitigation goal



Silva Herran et al., Climate Policy, 2019.

# Assessment of Japan's long-term mitigation goal



Silva Herran et al., Climate Policy, 2019.

- Assessed 2030 (NDC) and 2050 (80%) mitigation goals of Japan considering uncertainty in technology (nuclear, CCS, RE) and energy security.
- Effect of lack of CCS is largest, lack of nuclear is relatively small.

# Assessment of Japan's long-term mitigation goal

Japan climate mitigation target (NDC + 80% 2050) feasible with constrained supply of nuclear power? → yes

If role of nuclear in mitigation decreases... what are the impacts?

→ nuclear decrease compensated mainly by natural gas and overall decrease in energy consumption.

→ Electricity prices increases driven by mitigation, and only slightly by nuclear power deficit.

Other technological constraints (CCS availability, renewable energy costs).

→ Impact of mitigation and CCS availability considerably larger than nuclear availability.

→ Cost reductions of renewables had small impact: small resource potential.

Considerations on the role of nuclear power in Japan.

→ Relevance of nuclear power in other contexts in addition to climate mitigation: energy security, social acceptability

# Future works

- International projects
  - COMMIT next stage, EMF36, ENGAGE
- National projects
  - JMIP/EMF35
- Sustainable development aspects and climate mitigation
- Collaboration with Asian partners.



Thank you very much!

