Low Carbon Society Research Network
8th Annual Meeting

LCS-R Net

Modelling 1.5 °C scenarios: Scientific challenges and consequences for policy making

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6-7 September 2016

Bergische Universität Wuppertal, Germany

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GHG Scenarios analyzed for a 1.5 degree path

Scenario	Description
Reference	Shared Socio-Economic Pathway 2 (SSP2)
INDC forever	Copenhagen pledges in 2020, INDCs in 2030, followed by the same carbon price for INDC
2.6W_INDC	Copenhagen pledges in 2020, INDCs in 2030, and then implementation of mitigation policies so that cumulative GHG emissions during the 21st century will be the same as those in 2.6W_Copenhagen
2.6W_Copenhagen	Copenhagen pledges in 2020 followed by mitigation policies to meet 2.6W/m^2 radiative forcing target
1.5deg_Copenhagen	Copenhagen pledges in 2010 followed by mitigation policies to meet 1.5 ^{o}C target

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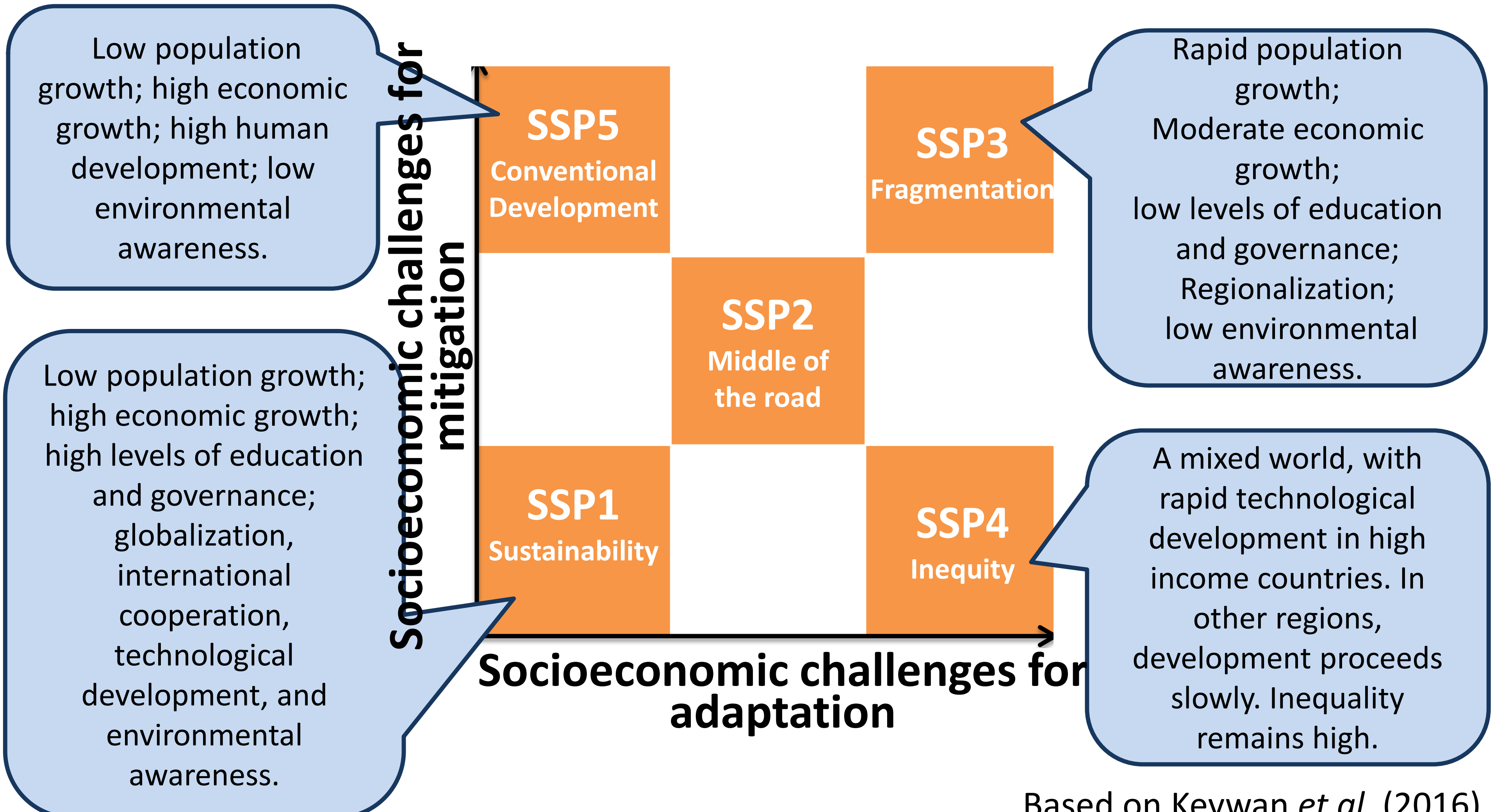
Source: S. Fujimori

What are Shared Socioeconomic Pathways (SSPs)?

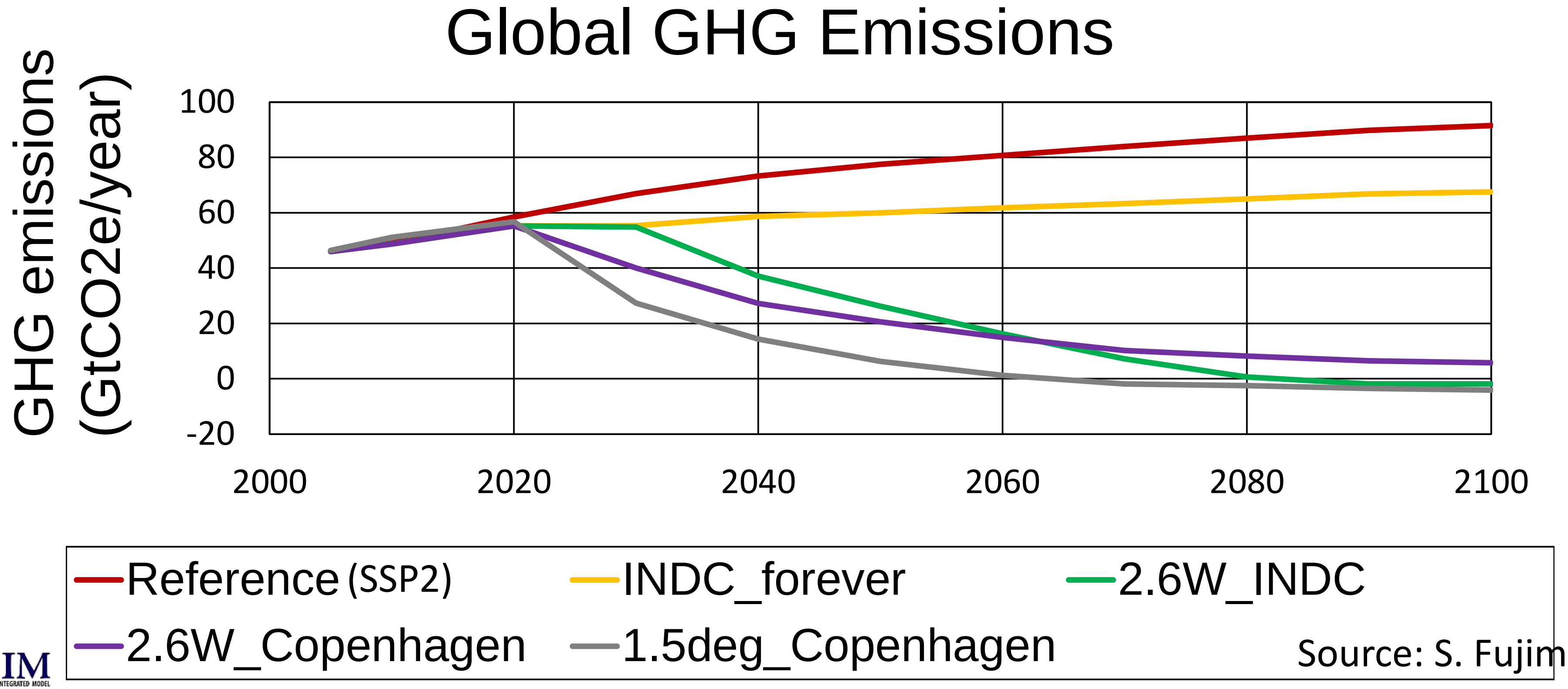
The SSPs are part of a new framework that the climate change research community has adopted to facilitate integrated analysis of future climate impacts, vulnerabilities, adaptation, and mitigation.



Based on Keywan *et al.* (2016)

There is a feasible path to limit the average temperature increase to 1.5 ^{o}C. Challenges are:

- Lower the GHG emissions earlier in order to keep low the total cumulative GHG emissions. We cannot expect much of minus emissions.
- Move the world towards increased share of renewables.
- The world needs to recognize how important it is to start reduction earlier.



Source: S. Fujimori

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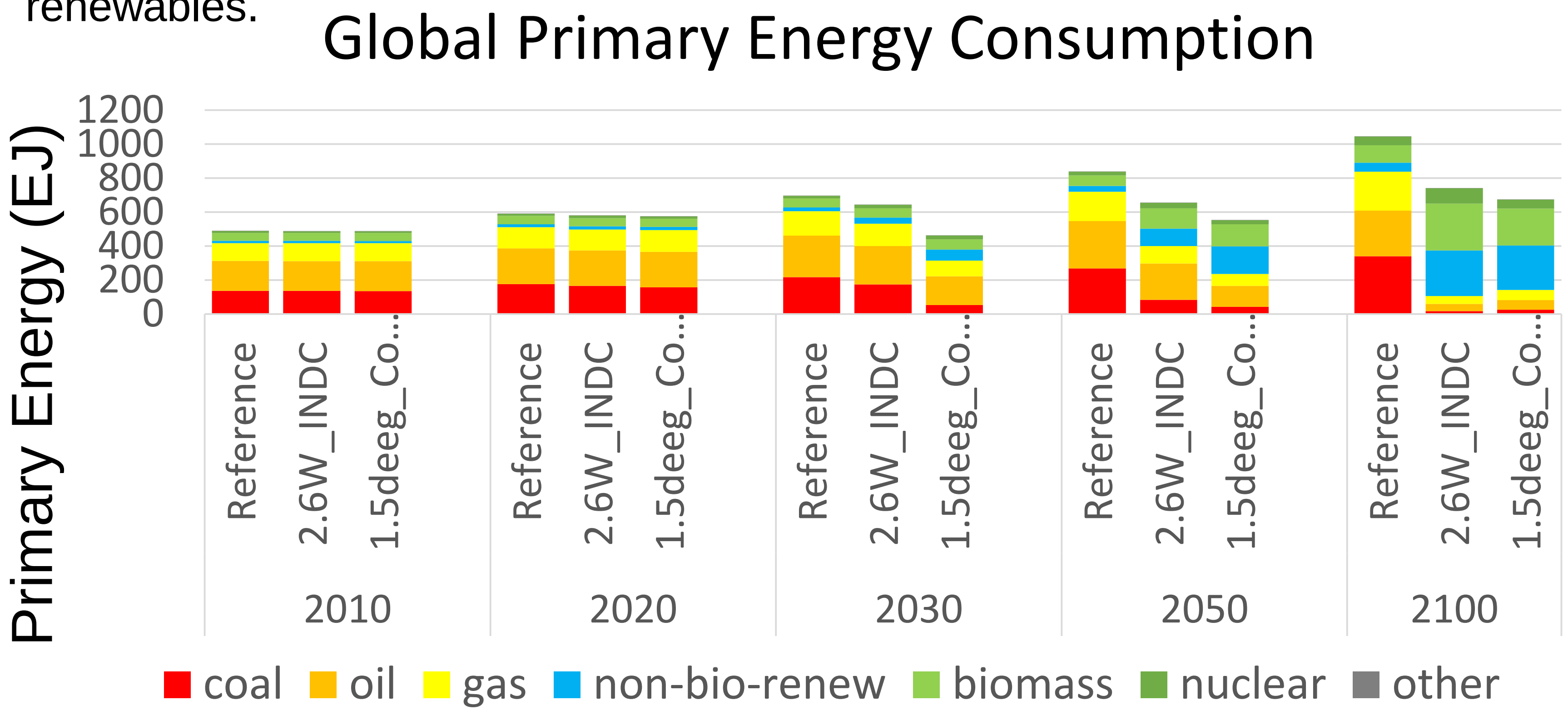
Increasing the capacity of renewables is a key in achieving 1.5 ºC target.

- As the availability of renewables in 2030 is limited, the amount of primary energy consumption in 2030 in 1.5deg_Copenhagen scenario becomes much lower than that in 2030 in 2.6W_INDC because of CO_2 constraint and renewable capacity.
- The amount of primary energy consumption in 2100 in 1.5 degree scenario is 65% of that in the reference. This is due to energy efficiency improvement and availability of renewables.



Source: S. Fujimori

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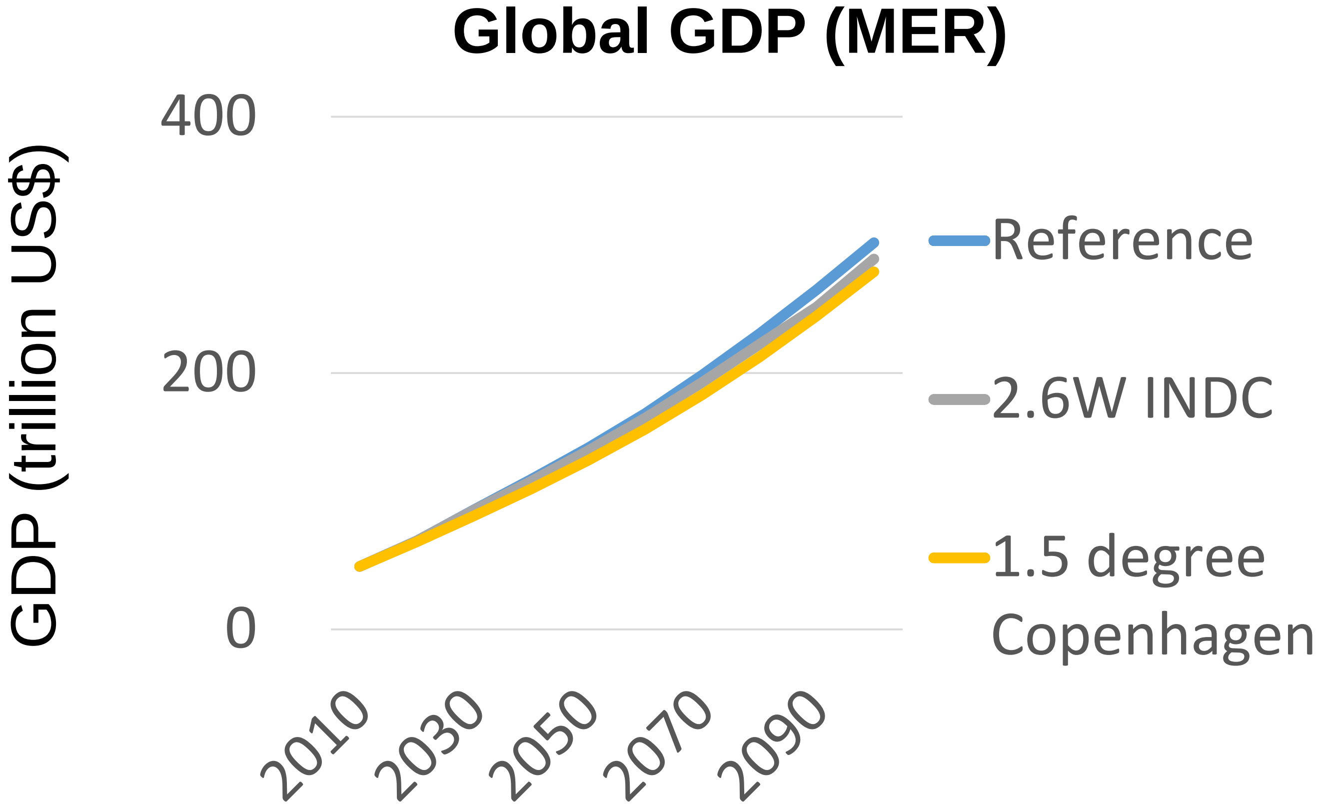
CO2 constraint may cause decrease in primary energy consumption around the year of 2030. It may cause decrease of GDP

- The world GDP in 2100 will be 6.15, 5.89 and 5.70 times that in 2010
- Compared to Reference case, the world GDP in 2100 will be 4.2% lower in 2.6W INDC and 7.5% lower in 1.5 degree Copenhagen scenarios.



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Source: S. Fujimori

Impacts of Climate Change

Scenarios under the ICA-RUS (Integrated Climate Assessment – Risks, Uncertainties and Society) project

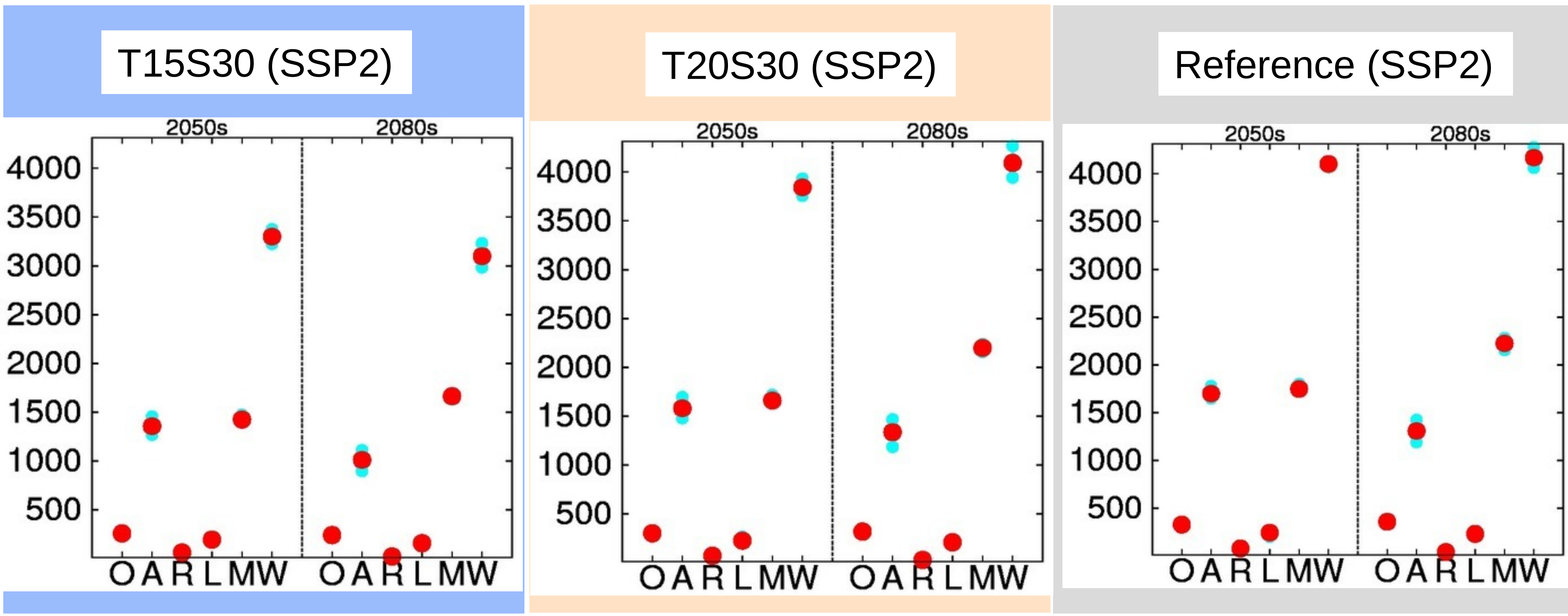
Strategies	Targeted temperature level relative to preindustrial [ºC]	Assumed climate sensitivity [ºC]	Probability of meeting the target
Reference (SSP2)	-	3.0	-
T15S30	1.5	3.0	~ 50%
T20S30	2.0	3.0	~ 50%

http://www.nies.go.jp/ica-rus/en/

Source: Takahashi @ AIM workshop

Change in water-stressed population (2050 & 2080) [million : Relative to 1981-2000]

- The impacts on Asia and Middle East and Africa are large because of their population and intensity of impacts.
- Under the 1.5 scenario, world water-stressed population is mitigated to a good extent.

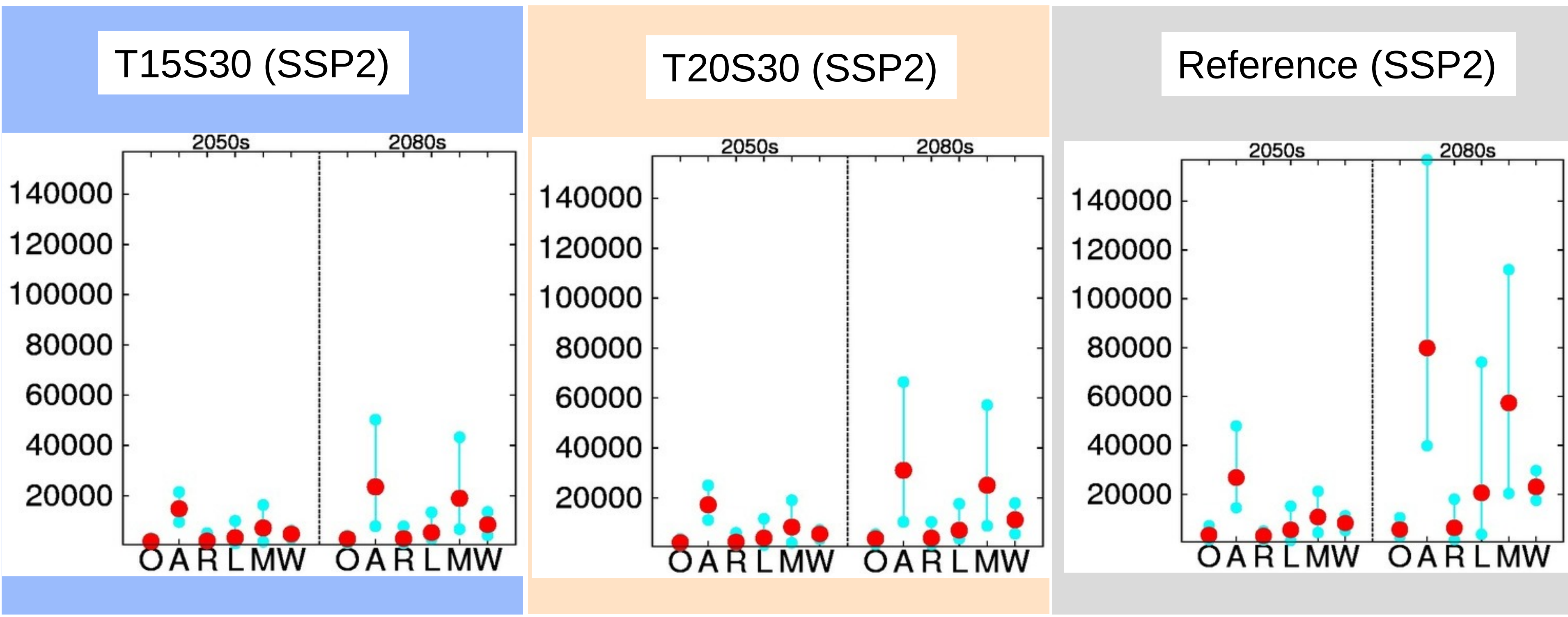


O: OECD90 ; **A**: Asia ; **R**: FSU and East Europe ; **L**: Latin America ;
M: Middle East and Africa ; **W**: World

Data from ICA-RUS project

Percent change in economic asset exposed to flooding [%] (2050 & 2080)

- The impact on asset exposed to flooding (% change) in Asia is the highest in all scenarios.
- GHG emission mitigation efforts lower the impacts, especially in the 1.5 scenario.



O: OECD90 ; **A**: Asia ; **R**: FSU and East Europe ; **L**: Latin America ;
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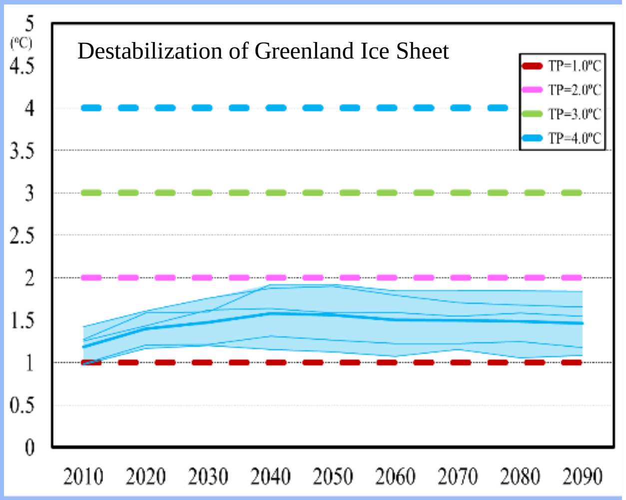
Data from ICA-RUS project

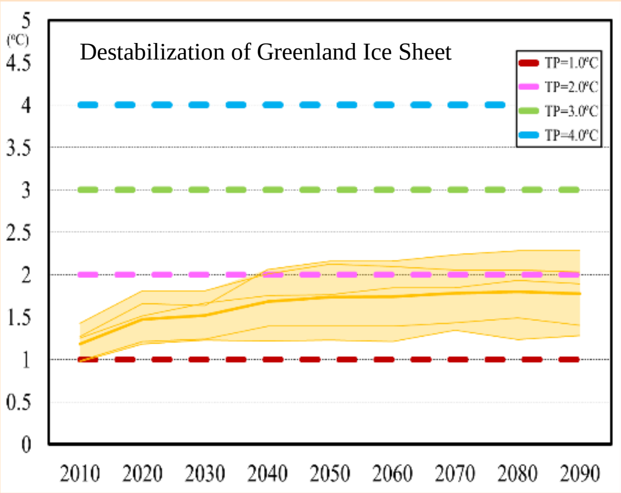
The tipping point temperature of Greenland Ice Sheet

- According to IPCC AR5, the tipping point for destabilization of the Greenland ice sheet can be crossed at a global temperature rise of between 1℃ and 4 ℃ from pre-industrial levels.
- Under T15S30, it would probably not be reached in this century if the tipping point temperature is 2 ºC.
- The tipping point of 2 ºC would be passed during the 2040s with T20S30 (depending on the climate model).

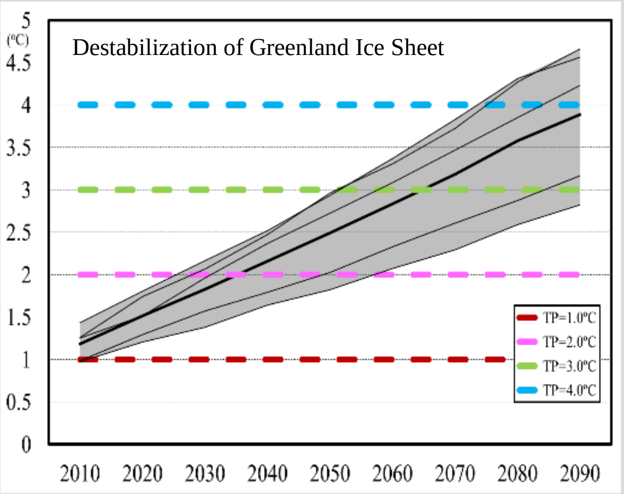
T15S30 (SSP2)



T20S30 (SSP2)



Reference (SSP2)



Data from ICA-RUS project

Japanese INDC analysis

Case

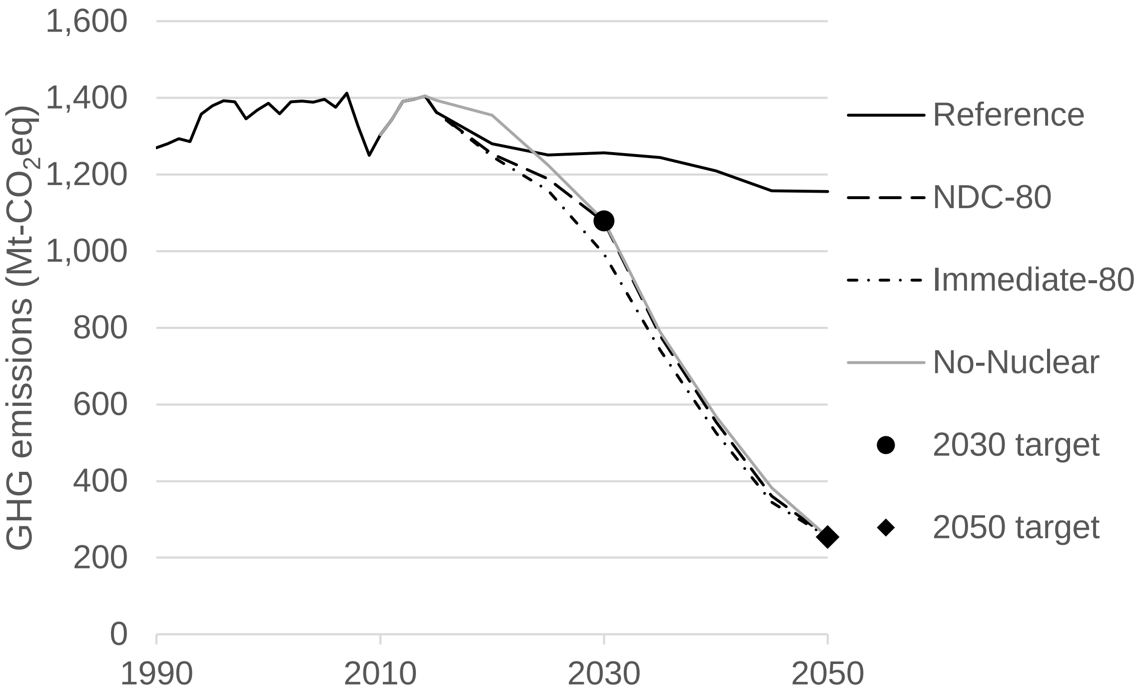
1. Reference
   No carbon price.
2. NDC-80
   Implicit carbon prices are implemented to meet the NDC by 2030, and strengthened thereafter toward the 80% reduction by 2050.
3. Immediate-80
   Compared with NDC-80, higher carbon prices are implemented by 2030 to the level of around a half of 2050.
4. No nuclear
   Without restart of nuclear power after 2015

- 2030 target: 25.4% reduction wrt. 2005 based on the NDC
- 2050 target: 80% reduction based on the national goal that considers the global 2 degrees goal

Results: GHG emissions

- Both 2030 and 2050 targets are technically feasible without nuclear power, however rapid reduction is required after 2030
- Immediate-80 case results 29% reduction in 2030 (wrt. 2005)
- Carbon prices range 600-740 US$/t-CO2 in 2050

GHG emissions pathways



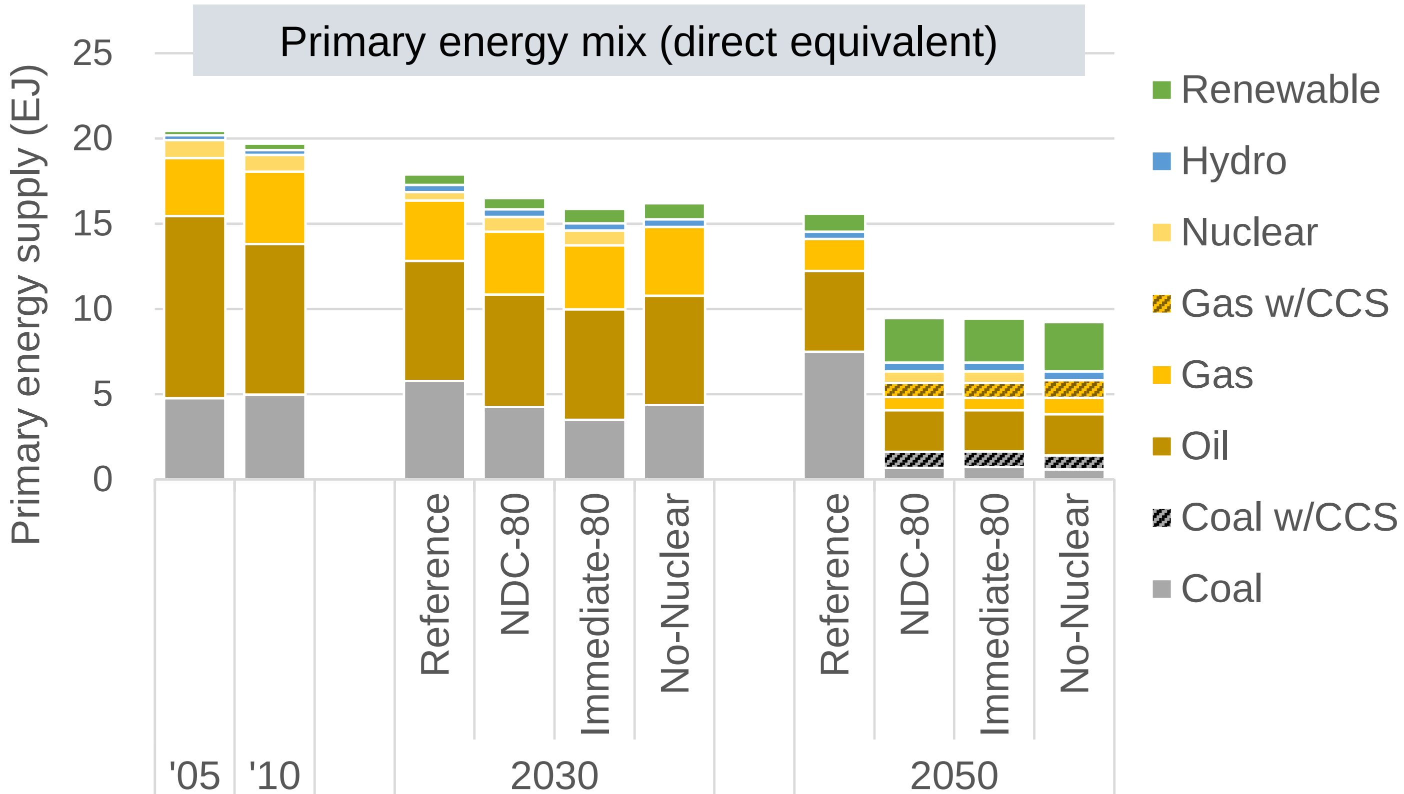
Carbon price

Case	2030	2050
Reference	0	0
NDC-80	165	654
Immediate-80	260	607
No-Nuclear	454	736

Unit: (US$/t-$CO_2$)

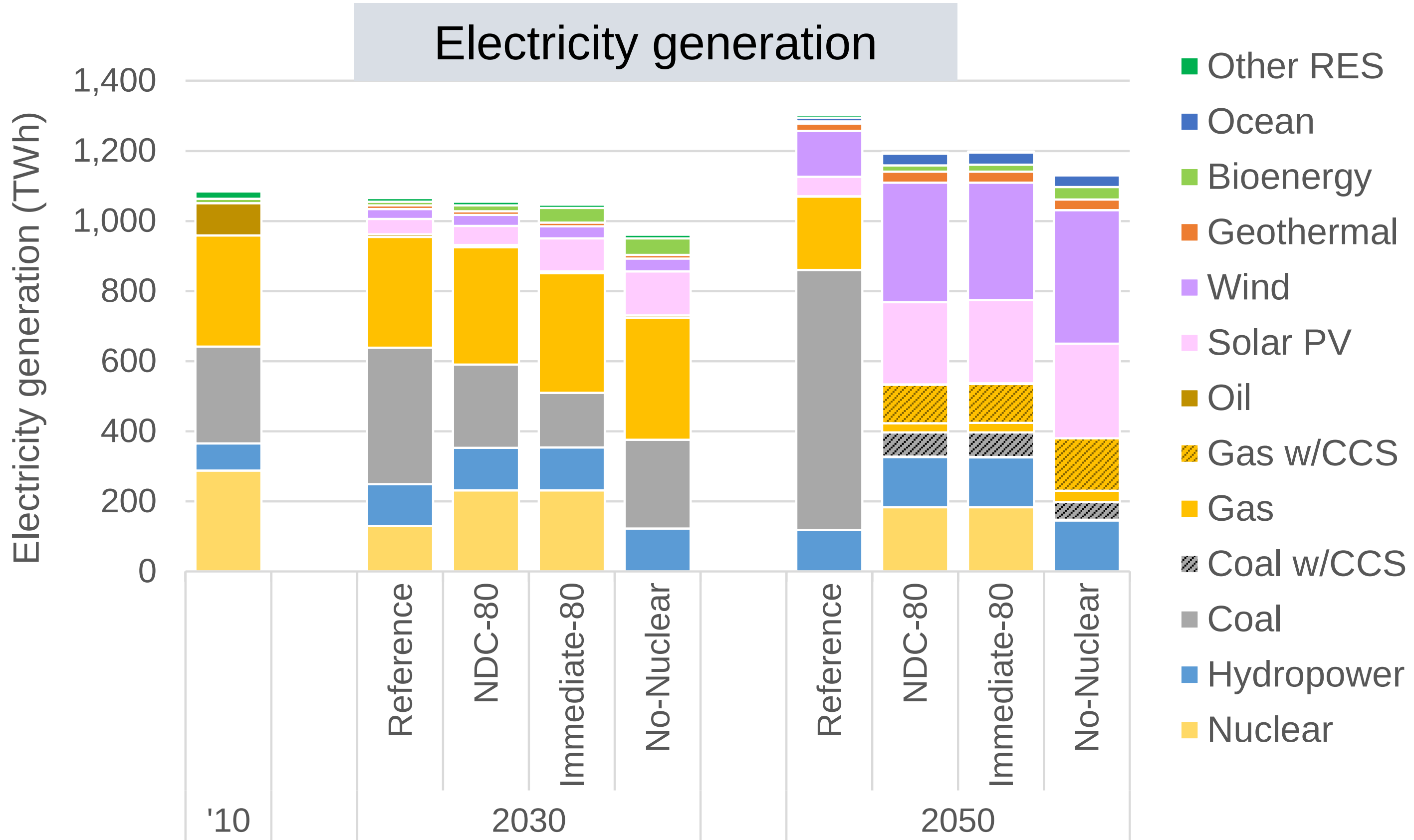
Results: Primary energy mix

- Energy efficiency and low-carbon energies are key options
- Share of low-carbon energies (NDC-80):
  - ➢ 12% in 2030, 59% in 2050
- Innovative technologies such as CCS could be important options by 2050



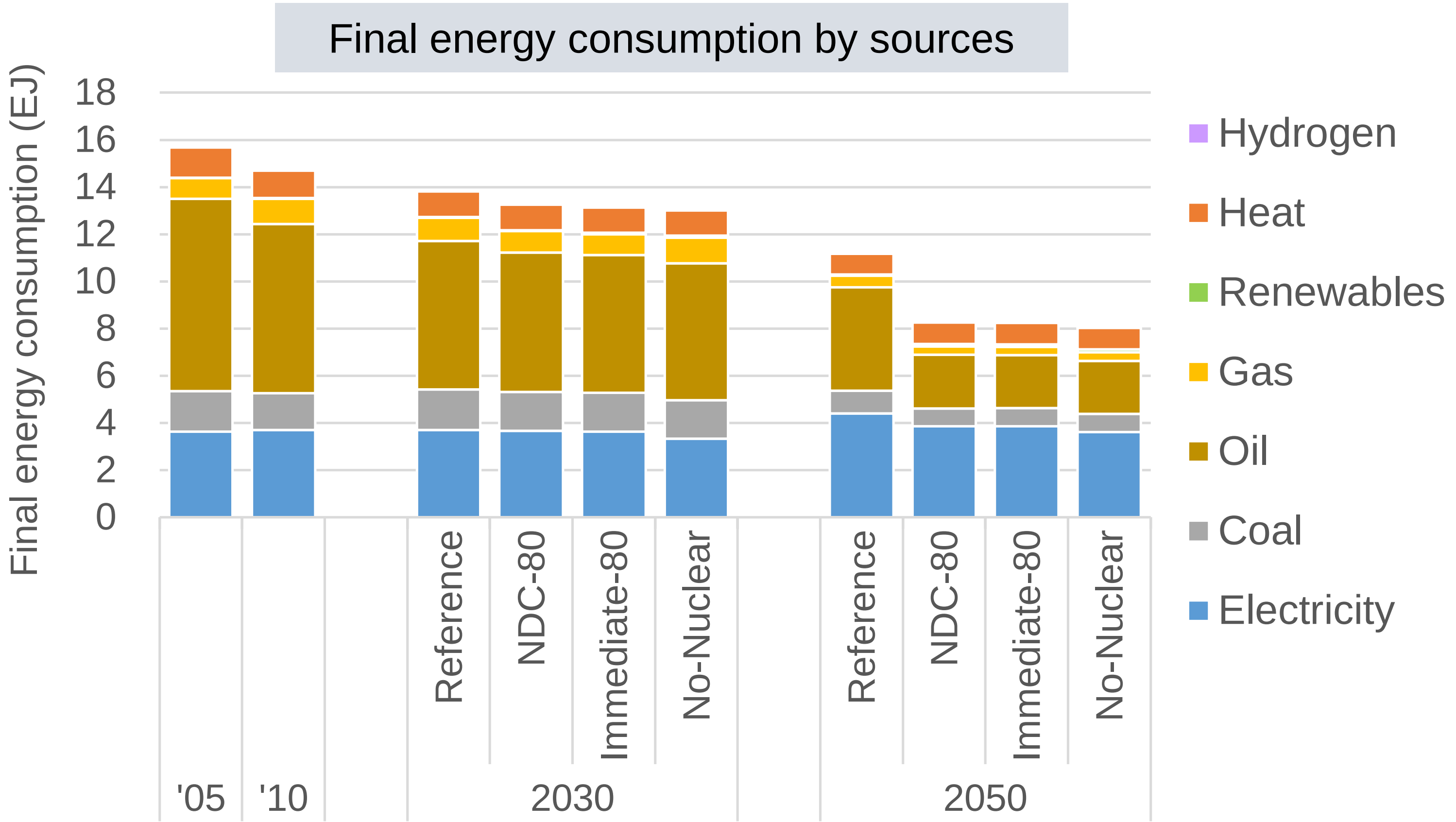
Results: Electricity supply

- Renewables account for 23% in NDC-80, 30% in Immediate-80 in 2030. In 2050, electricity is almost decarbonized.
- Integration of variable renewable energies (VREs) is challenge after 2030



Final energy consumption

- Energy efficiency continues to be a key option by 2050
  - ➢ Around 10-11% in 2030, 43% in 2050 (wrt. 2010)
- Electrification is another challenge, especially after 2030.
  - ➢ Around 28% in 2030, 46% in 2050



Results in the Japanese case study

- Japan’s NDC would be effective to consolidate a transition from the baseline trajectory, by improvement of energy efficiency and deployment of low-carbon electricity.

- The 80% target by 2050 requires significant electrification in end-use sectors as well as the acceleration of energy efficiency and decarbonization of electricity between 2030 and 2050.

- The implementation of NDC is meaningful, however, rapid transformation of energy systems would still be required to meet the national long-term goal.

Challenges to meet the 1.5 degrees C target

(1) Technologies for penetrating renewables

- Back-up energy system
- High efficient and large capacity battery
- Grid reliability

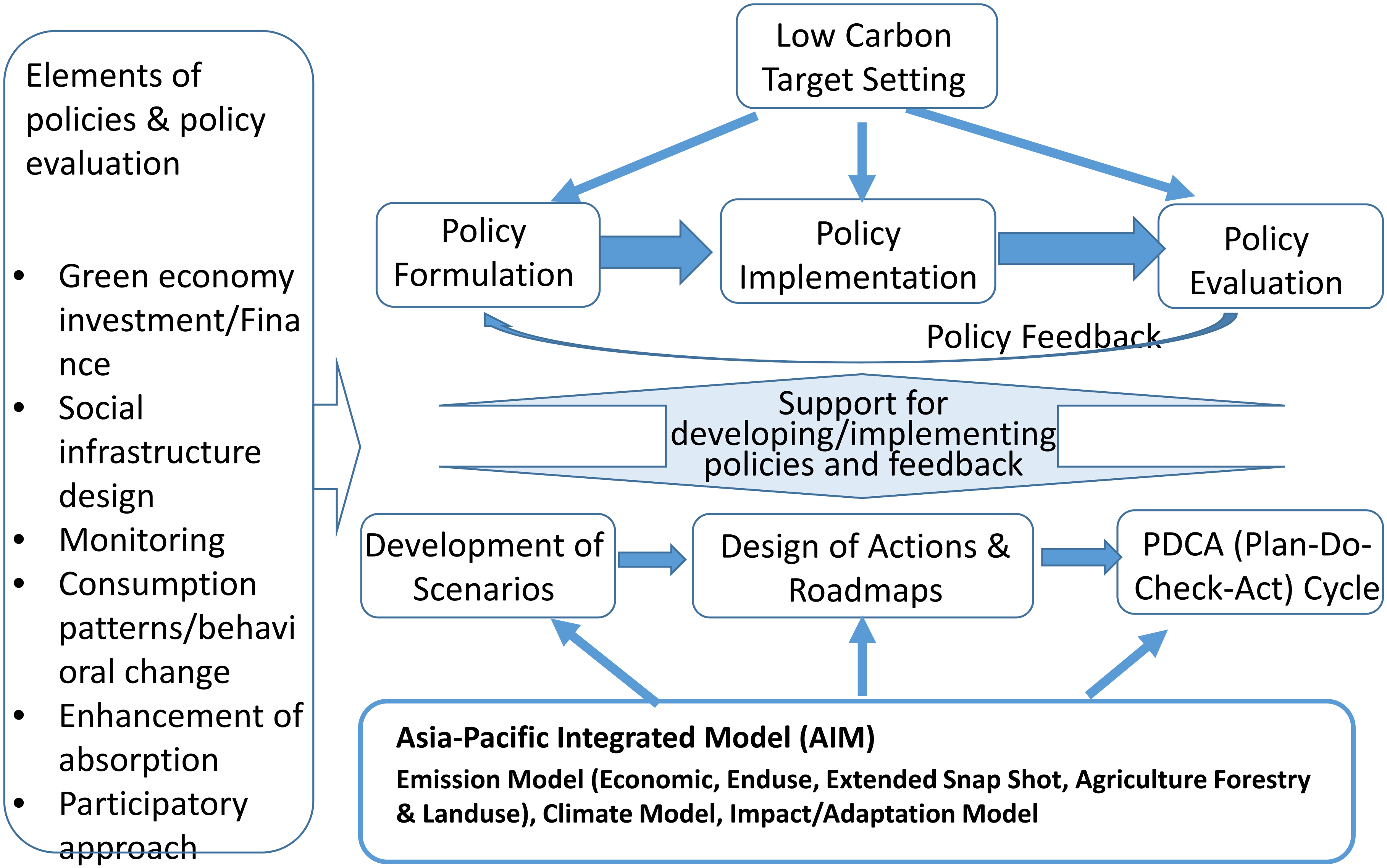
(2) Policies to increase a share of renewables

- Carbon price
- Feed in Tariff
- Emission trading
- Best Available Technologies
- Keep/increase employment

(3) Increase of the public awareness and participation

- Provide effective information to the public
- Increase dialogue among policy makers, citizens, business and scientists
- Increase international collaboration

Science-Policy linkages are necessary to stay below 1.5 degrees C



Urgent to-do-list toward Low Carbon Society (LCS)

While implementation of INDCs is a meaningful step toward reduction in global GHG emissions until 2030, it alone will not lead to further GHG cuts. In order to meet either 1.5 ^{o}C or 2 ^{o}C target, INDCs would have to be revised and additional long-term countermeasures have to be implemented. Therefore, a transition toward LCS demands many more and early efforts that are designed and implemented in a concerted and consistent manner.

Below are a do-list which requires an urgent movement.

- **Radical international agreements and monitoring mechanism under UNFCCC**.

In order to ensure the implementation of INDCs and verify them, countries need to set up processes in the form of their own legal systems and to gather reliable and transparent data. Accelerated negotiations are required to arrive at agreements on unresolved issues such as making countries commit to drastic emission reduction targets and designing and implementing more ambitious policies that meet the expectations of LCS.

Urgent to-do-list toward Low Carbon Society (LCS) (Cont'd)

- **Strong policy push, legal framework and financial incentives to ramp up investment in low-carbon technology.**

Direct governmental support for low carbon technology R&D is required to catch up with energy demands by renewables in 2030. If not, energy supply needs to be lowered in the 1.5 scenario which may cause decrease of GDP. While investments in low-carbon systems must be boosted through strong incentives, investments in high-carbon systems must be de-incentivized and legally challenged.

- **Establishment and scale-up of low-carbon infrastructures**.

Low-carbon infrastructures, such as public and efficient transportation systems for both long-distance and intra-city movements, facilities network for EV charging and supply of other low-carbon energy carriers, logistical chains for procurement and supply of equipment and spares for low-carbon technologies, smart grid systems and systems for recycling and sustainable waste management need to be urgently established. This will enable the majority of people to access such energies, technologies and systems at low marginal costs.

Urgent to-do-list toward Low Carbon Society (LCS) (Cont'd)

- **Networks to spread local-scale and city level decarbonisation through local governments and leaders**.

The world's cities account for 70% of global energy demands. Initiatives such as C40, WMCCC and ICLEI have demonstrated that networks and actions involving local level government leaders and civil society organizations have committed to implement low carbon policies. Spreading such networks can result in speedier mitigation implementation at local levels.

- **Inter-disciplinary climate modeling and research to estimate real costs and benefits.**

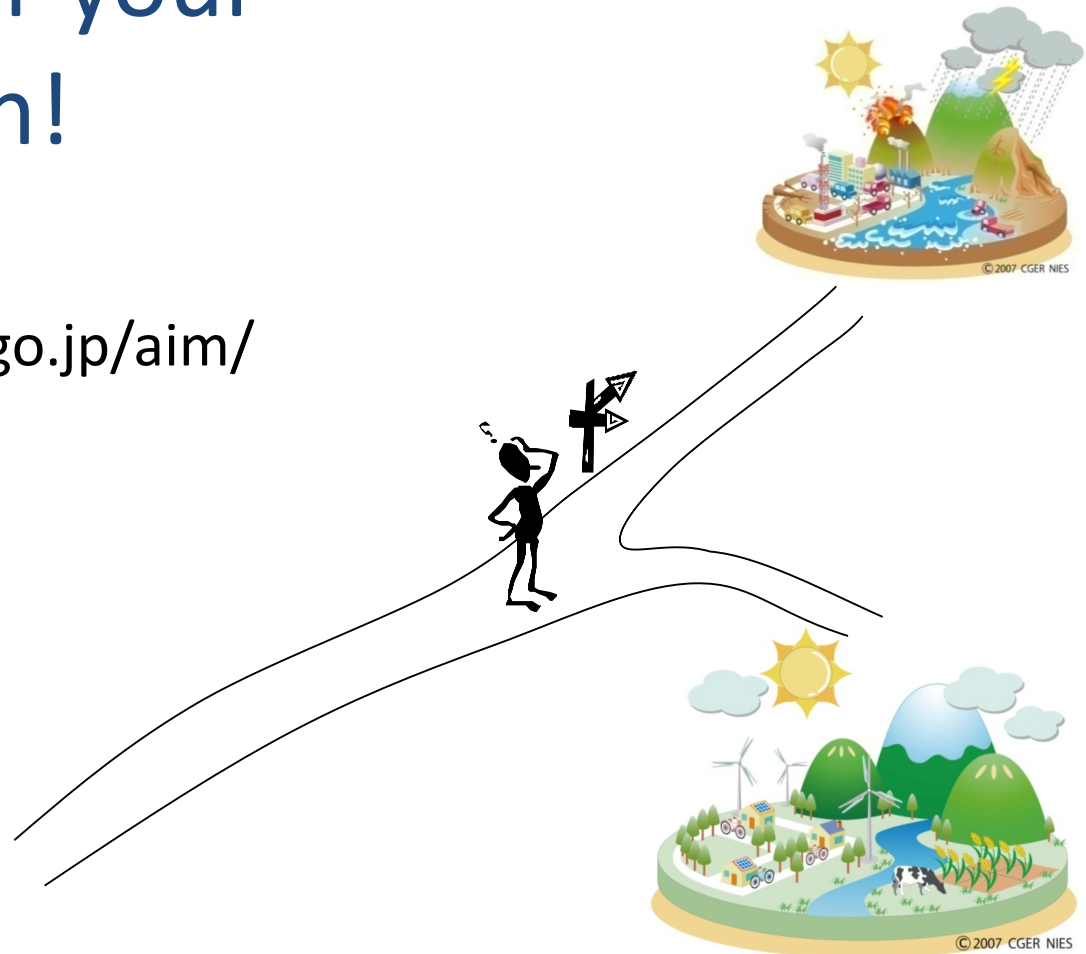
Science-based policy is a key to promote transition toward LCS. Although lots of climate studies have cautioned about serious and irreversible impacts, current policies cannot meet the target to prevent serious climate impacts. More researches are required to link science and policy communities. Inter-disciplinary climate research that combines natural sciences and engineering with economics and other social sciences would help to correctly emphasize the costs and benefits, and thereby communicate both the urgency and the desirability of reducing GHG emissions.

http://lcs-rnet.org/pdf/publications/lcs_Primer_on_Low_Carbon_Societies_e.pdf

Thank you for your attention!

http://www-iam.nies.go.jp/aim/

http://lcs-rnet.org/



You must be the change you wish to see in the world.

- Mahatma Gandhi

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