

Mid-century low emission scenarios in Japan

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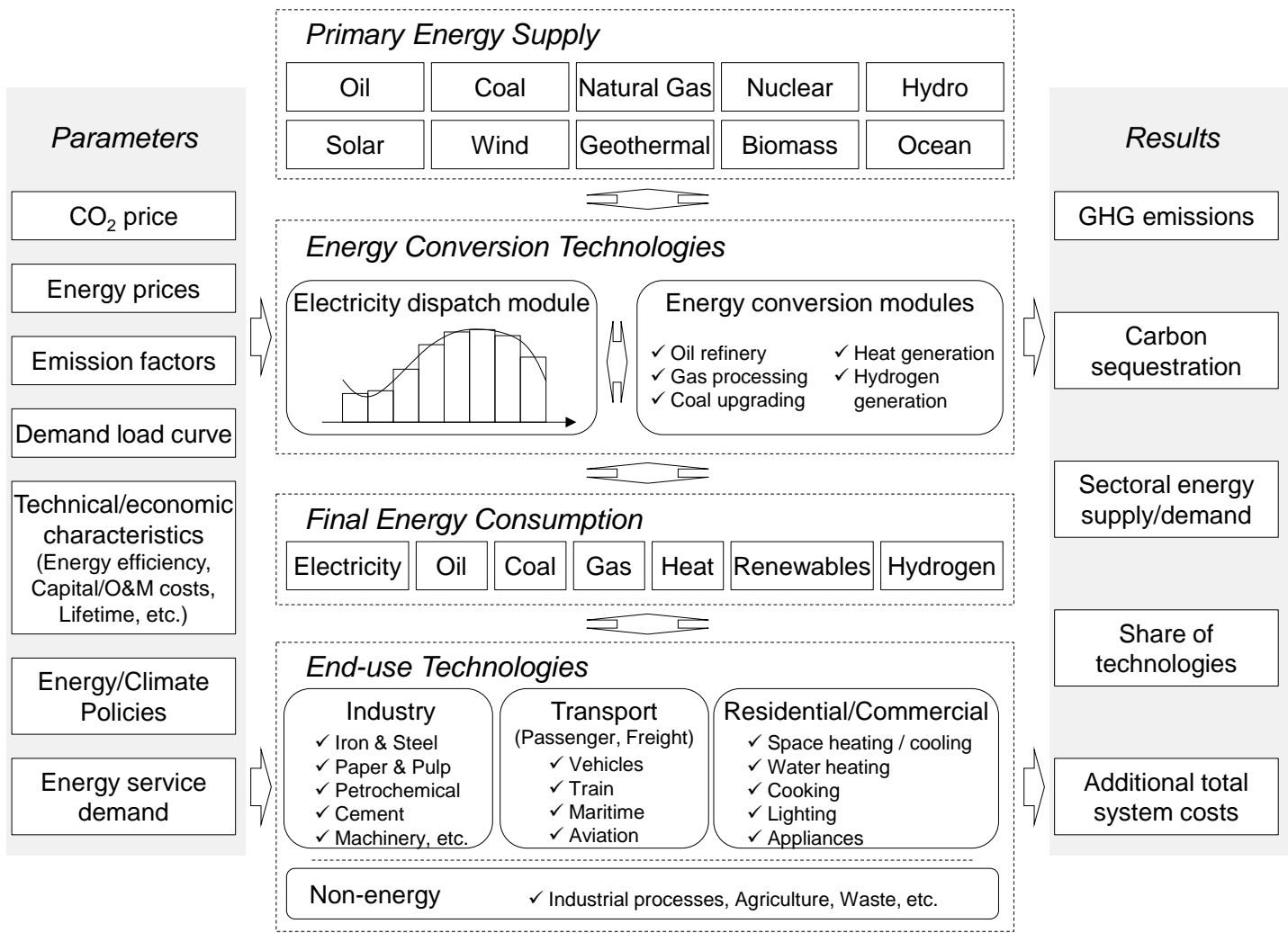
The 23rd AIM International Workshop
November 28, 2017. NIES, Tsukuba, Japan

Recent updates related to AIM/Enduse [Japan]

- NDC and Mid-century strategy in Japan
 - MILES: electrification report, completed this October
 - DDPP: national report on passenger transport
http://www.iddri.org/Publications/Rapports-and-briefing-papers/DDPPTR_JAP.pdf
 - **CD-LINKS**: National emission pathways assessment based on emission budget
 - JMIP (Japan model inter-comparison project):
 - 6 energy models from Japanese institutes, including AIM/CGE and AIM/Enduse [Japan]
- National pathways corresponding to the 1.5 °C goal
 - **Net-zero emission scenarios in Japan by 2050**

AIM/Enduse [Japan]

- Bottom-up of end-use sectors, hard-linked with energy supply sectors
- Recursive dynamic model
- Minimizing total system costs; capital, O&M, and emission costs



National zero-emission pathway by 2050 in Japan

- According to the previous studies on global 1.5°C pathways, CO₂ 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]
- Paper published by Carbon Management Special Issue Oshiro, K., Kainuma, M., & Masui, T. (2017). Transformation of Japan's energy system to attain net-zero emission by 2050. Carbon management, (in press)



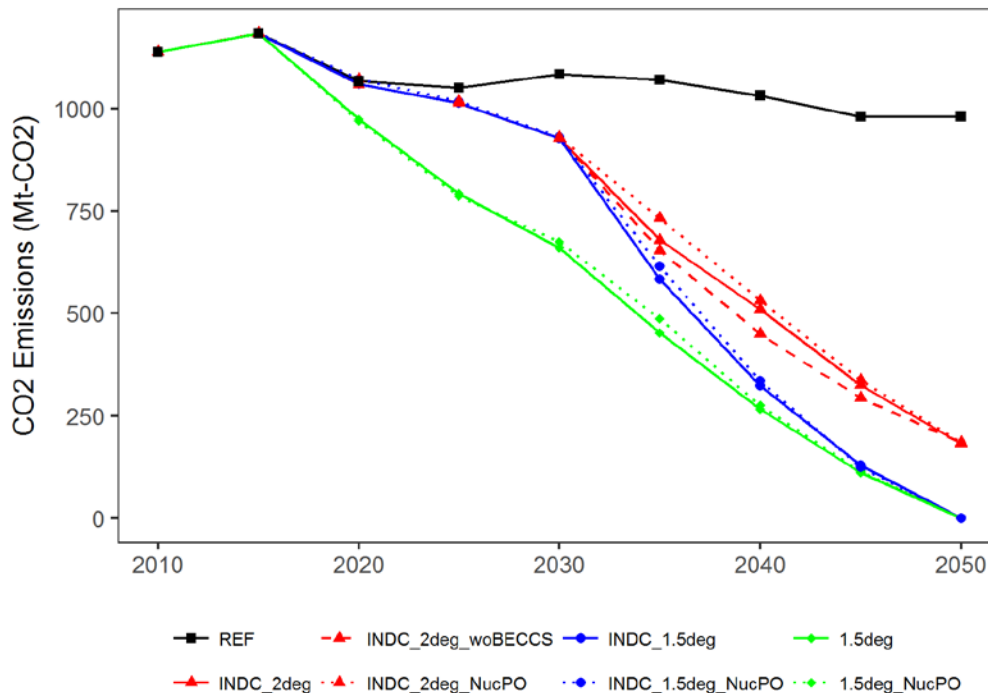
Transformation of Japan's energy system to attain net-zero emission by 2050

Ken Oshiro, Toshihiko Masui & Mikiko Kainuma

Results: 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
- Zero emission pathway results steep rise in CO₂ price, more than 2,000 US\$/t-CO₂ in 2050

CO₂ emissions, energy



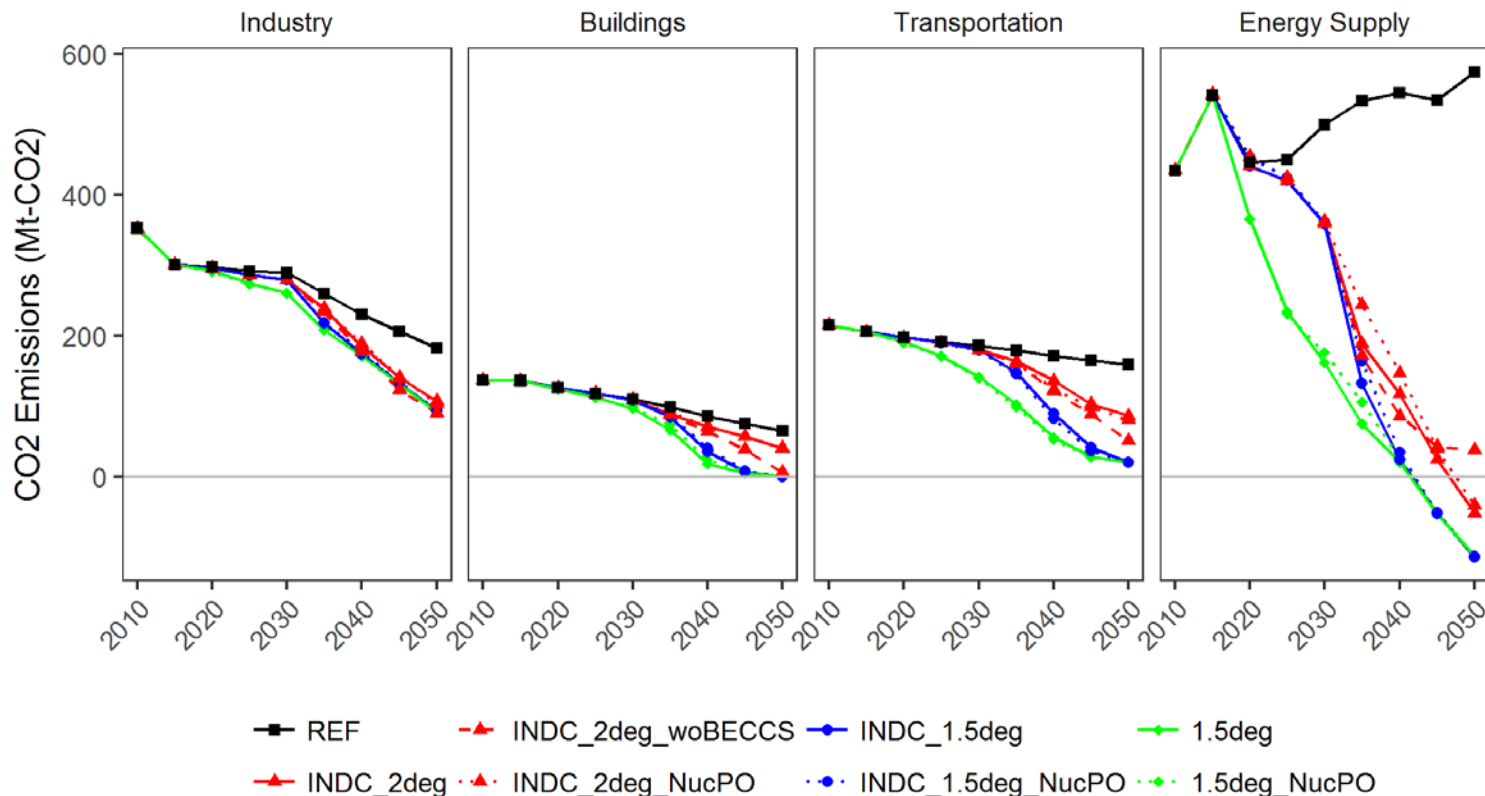
CO₂ price (US\$/t-CO₂)

Emission constraint	Technology availability		
	Full	w/o BECCS	Nuclear phase-out
Ref	0		
INDC-2deg	520	860	570
INDC-1.5deg	2,490	-	3,150
1.5deg	2,200	-	2,640

Sectoral strategies to zero emission

- 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.

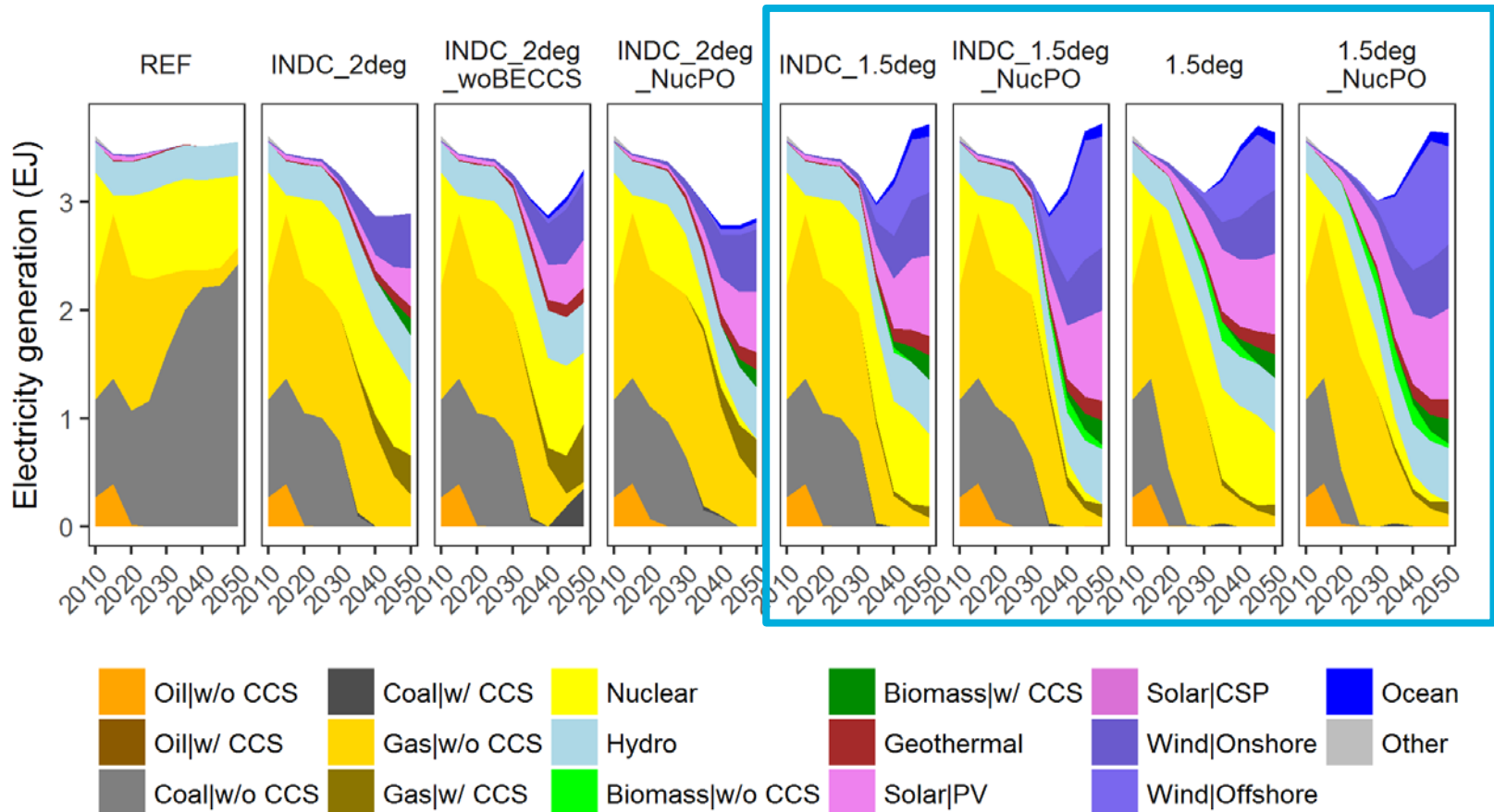
Sectoral direct CO₂ emissions



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.

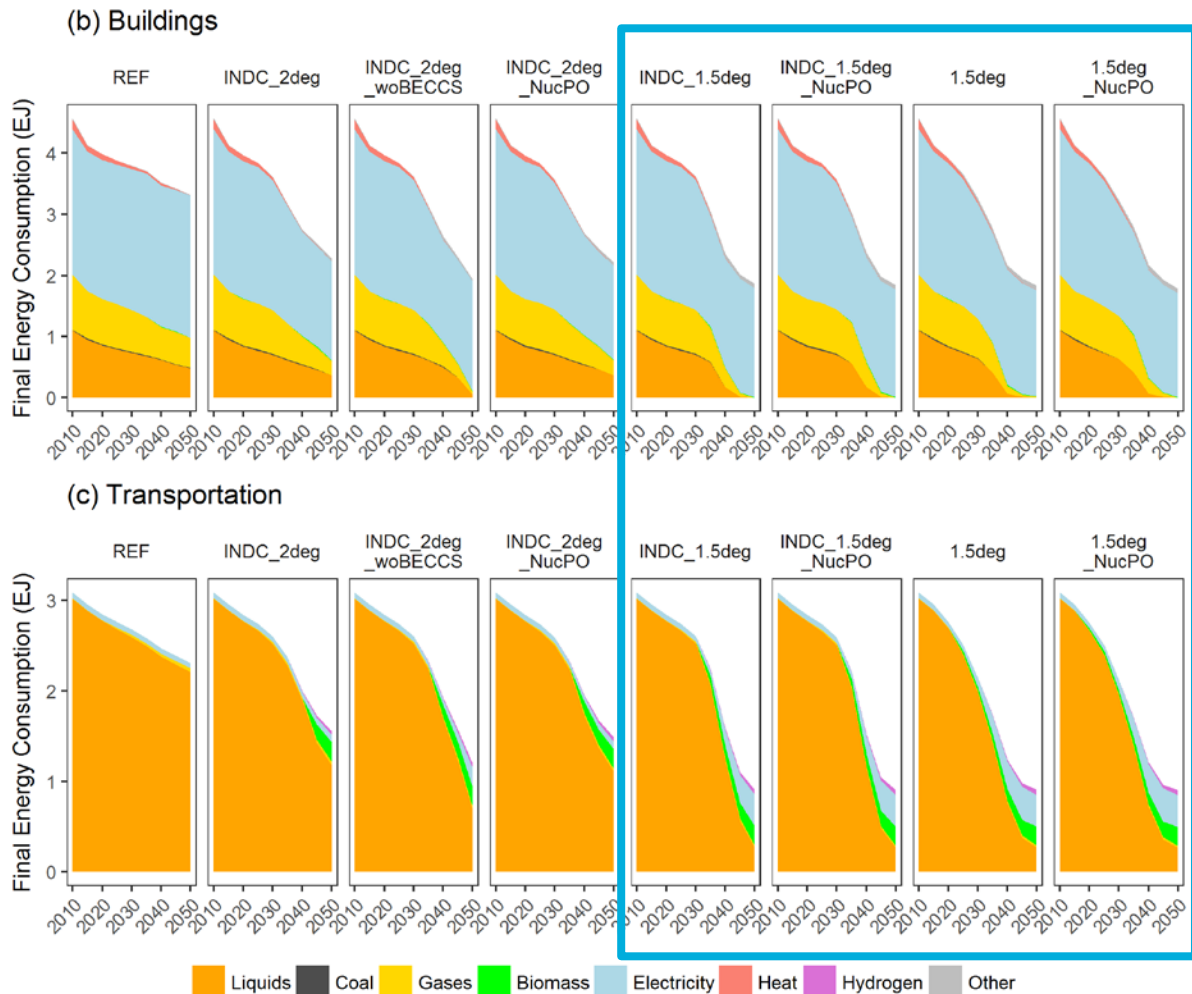
Electricity generation



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



Discussion and conclusion

- In Japan, net-zero emissions by 2050 requires drastic energy system transformation, especially in power and transport sector.
- Buildings sector needs to be decarbonized even in the 80% reduction scenario by large-scale electrification.
- Achieving net-zero emissions by 2050 would require substantial challenges, depending on only technological options.
As future works, assessing contribution of social and behavioral change would be effective.