Updates on AIM global modeling and relevant international activities

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AIMWS

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International activities

- IAMC
  - ✓ SWG on national scenarios will be practically activated this year — Saritha Vishwanathan

- IAM MIPs:
  - ✓ ELEVATE (International policy, European Horizon) — Osamu Nishiura
  - ✓ NAVIGATE (Inequality, European Horizon) — Zhao Shiya
  - ✓ JMIP (Japanese policy, MOEJ) — Osamu Nishiura

- ScenarioMIP (CMIP)
  - ✓ Designing new climate community scenarios — Shinichiro Fujimori and many others

- GEO (Global Environmental Outlook) 7 — Shinichiro Fujimori
  - ✓ Contribution to providing illustrative scenarios for solution pathways
  - ✓ CLA contribution

- AgMIP
  - ✓ New exercise starts as EAT-Lancet framework — Kazuaki Tsuchiya, Xia Shujuan, Tomoko Hasegawa
  - ✓ AIM proposes a new study on Ozone impact on food security

- Bending the curve phase 2, BESCIM — Tomoko Hasegawa, Kazuaki Tsuchiya

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ASIA-PACIFIC INTEGRATED MODEL

Model overview in 2023

Covered area	Models	Spatial resolution	Major updates	Publication status
Economy	AIM-Hub (CGE)	17 regions	DAC introduction	Fujimori et al. (2023) Fujimori et al. (in review) Nishiura et al. (in review)
Energy	AIM-Technology (Energy system)	31 regions	Advanced technology (DAC, synfuel, ammonia etc) High temporal resolution	Oshiro et al. (2022) Oshiro et al. (2023) Oshiro et al. (in review)
Development	AIM-PHI (Household)	180 countries	National HHS data	Zhao et al. (2022) Fujimori et al. (2023)
Land-use	AIM-PLUM (allocation) AIM-AFOLU (Tech in agr)	0.5° 17 regions	Representation in forest management National modeling	Hasegawa et al. (in review)
Atmospheric	GEOSCHEM	4x5°	AIM own scenarios can be implemented	Jansakoo et al. (in review) Jansakoo et al. (in review)
Biodiversity	AIM-BIO	0.5°	-	Hirata et al. (in review)
System integration	Hub-Tech model linkage		Consistent scenarios in energy and economy	Fujimori et al. (in review) Nishiura et al. (in review)

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Model overview in 2024

| Covered area	Models	Spatial resolution	Major updates	Publication status
Economy	AIM-Hub (CGE)	17 regions	DAC introduction NDC updates Synthetic fuel	Fujimori et al. (2023) Nishiura et al. (in review) Nishiura et al. (in prep)
Energy	AIM-Technology (Energy system)	31 regions	Advanced technology High temporal resolution Stranded asset	Oshiro et al. (2023) Oshiro et al. (2024) Mori et al. (2024)
Development	AIM-PHI (Household)	180 countries	Adverse side effects With MESSAGEix Carbon pricing	Fujimori et al. (2023) Zhao et al. (in review) Zhao et al. (in prep)
Land-use	AIM-PLUM (allocation) AIM-AFOLU (Tech)	0.5° 17 regions	Forest management National modeling	Hasegawa et al. (2024) Hasegawa et al. (in prep)
Atmospheric	GEOSCHEM	4x5°	Dietary change Spatial resolution Ammonia economy	Jansakoo et al. (2024) Jansakoo et al. (in review) Jansakoo et al. (in prep)
Biodiversity	AIM-BIO	0.5°	-	Hirata et al. (2024)
System integration	Hub-Tech model linkage		Consistent scenarios in energy and economy	Fujimori et al. (2024) Nishiura et al. (2024)

# Role of hydrogen (NH3) co-firing on global power system decarbonization

Scenario

- Emission scenarios
  - ✓ 500-1400 Gt-CO_2 budget based on ENGAGE
  - ✓ The 500 scenario reaches net-zero CO_2 emission by 2050

- Technology scenario
  - ✓ <u>Default</u>: model default assumptions
  - ✓ <u>H2Opt</u>: Optimistic assumptions on hydrogen.
    - ➤ Drastic cost reduction for electrolyzer and renewable electricity.
  - ✓ <u>LimCCS</u>: CCS constraints
    - ➤ Generally promote hydrogen use.
  - ✓ <u>NoCOF</u>: No co-firing for the reference.

Results: Power generation

- Fossil fuel phase-out is observed across all mitigation scenarios.
  - Few difference between with and without hydrogen co-firing.
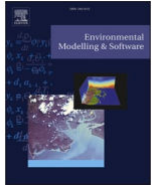 - Upscaling of solar and wind power is a major driver of power system decarbonization.
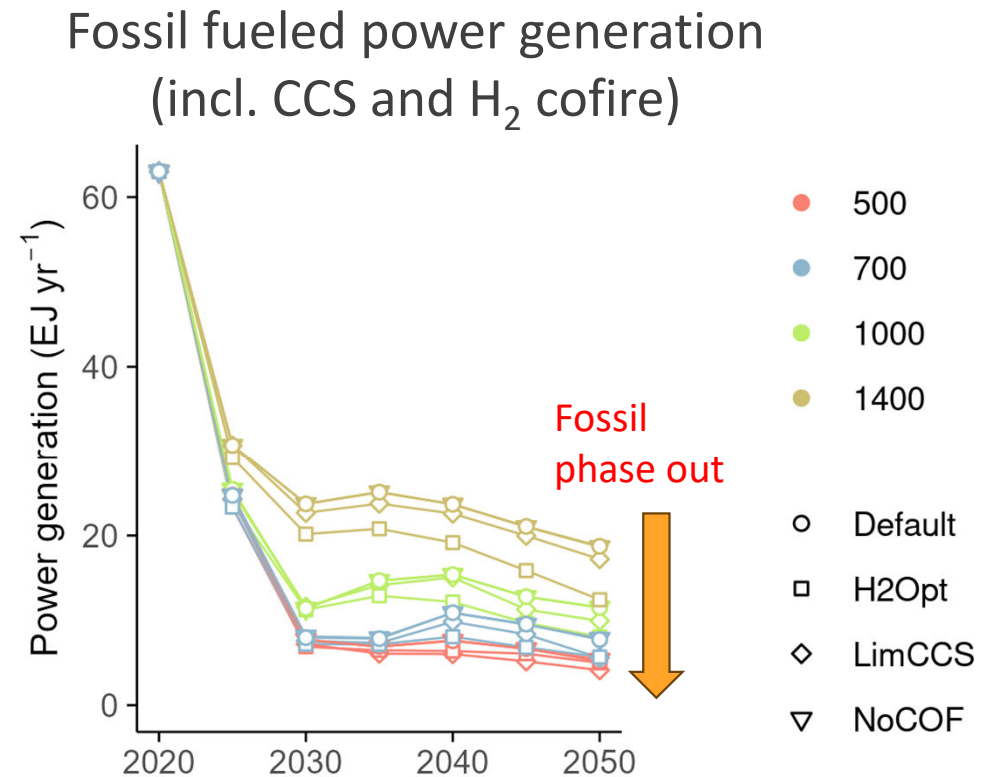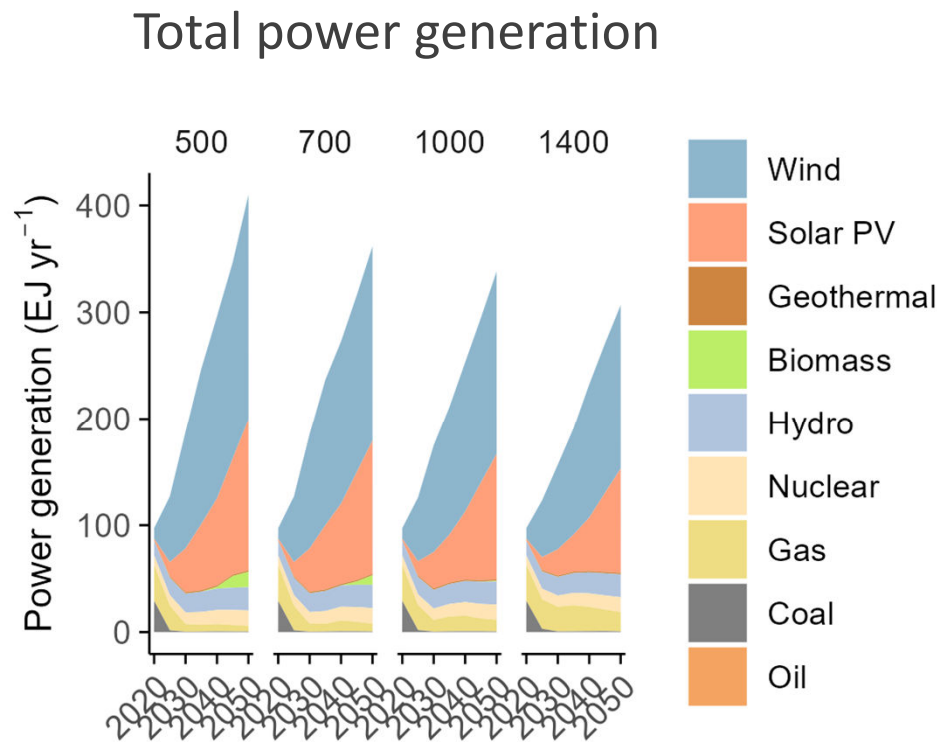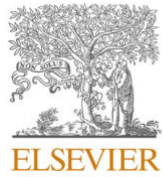
Total power generation

Fossil fueled power generation
(incl. CCS and H_2 cofire)

Integration of a computable general equilibrium model with an energy system model: Application of the AIM global model

Shinichiro Fujimori [a,b,c,*], Ken Oshiro [a], Osamu Nishiura [a], Tomoko Hasegawa [d,a,b], Hiroto Shiraki [e]

[a] Kyoto University, C1-3, Kyotodaigaku-Katsura, Nishikyo-ku, Kyoto, Japan
[b] National Institute for Environmental Studies, Tsukuba, Japan
[c] International Institute for Applied System Analysis (IIASA), Laxenburg, Austria
[d] Ritsumeikan University, Kusatsu, Japan
[e] Nagoya University, Nagoya, Japan

AIM-Hub AIM-Technology integration

Methodology

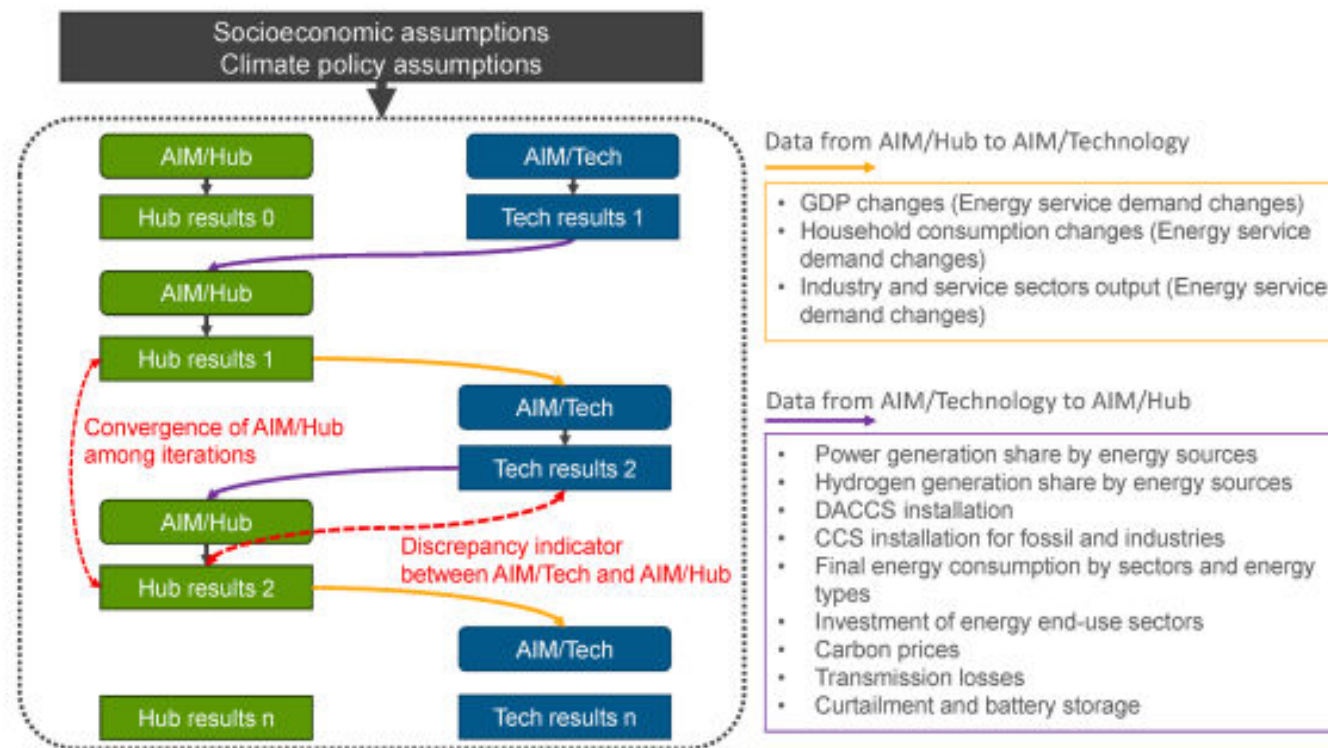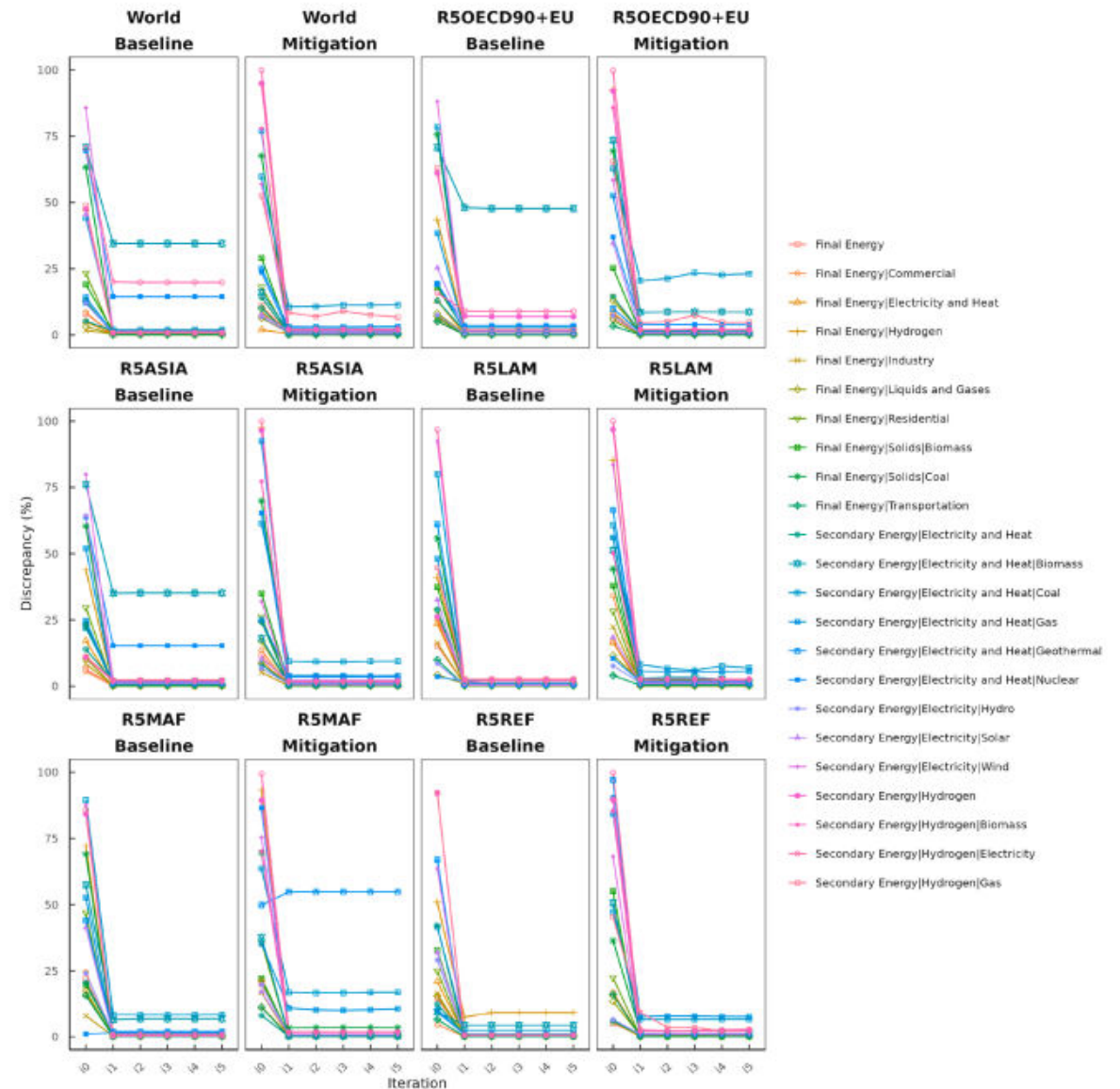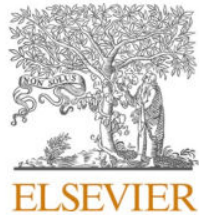- Iterate computation of AIM-Hub and AIM-Technology by exchanging the model results

Fig. 1. Overall framework of the models' interactions.

Convergence of the model results

- AIM-Hub endogenize the AEEI and logit share parameters by forcing AIM-Technology energy system information.

- Most important indicators are well converged at the second iteration

Integration of energy system and computable general equilibrium models: An approach complementing energy and economic representations for mitigation analysis

Osamu Nishiura [a,*], Volker Krey [b,c], Oliver Fricko [b], Bas van Ruijven [b], Shinichiro Fujimori [a]

[a] Kyoto University, C1-3, Kyotodaigaku-Katsura, Nishikyo-ku, Kyoto, Japan
[b] International Institute for Applied System Analysis, Schlossplatz 1, A-2361, Laxenburg, Austria
[c] Industrial Ecology Programme and Energy Transitions Initiative Norwegian University of Science and Technology, NO-7491, Trondheim, Norway

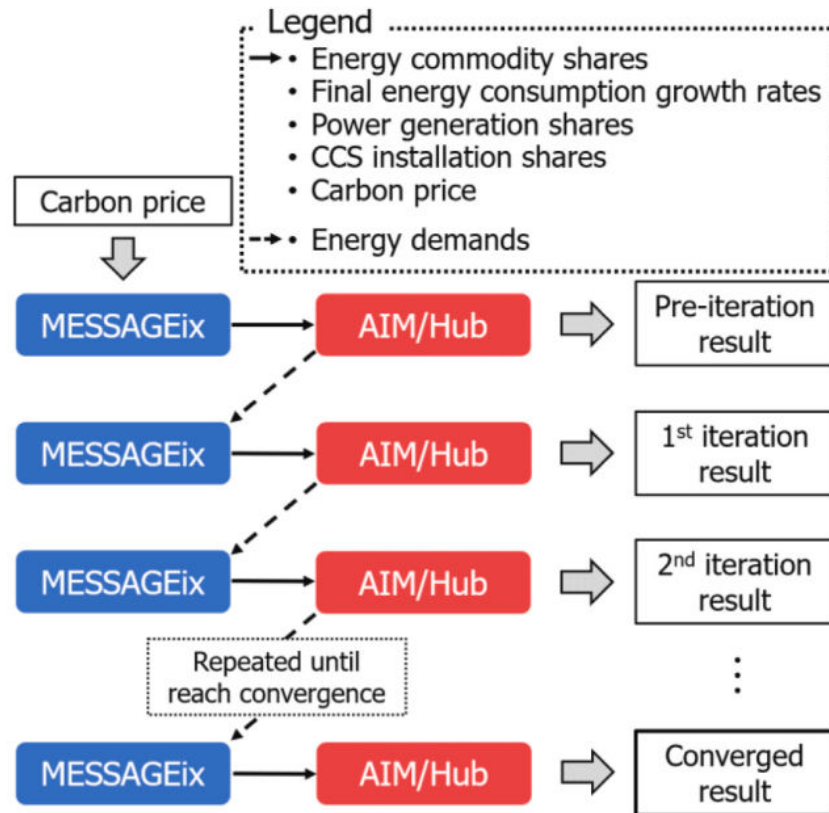AIM-Hub MESSAGEix integration

Iterative procedure and results

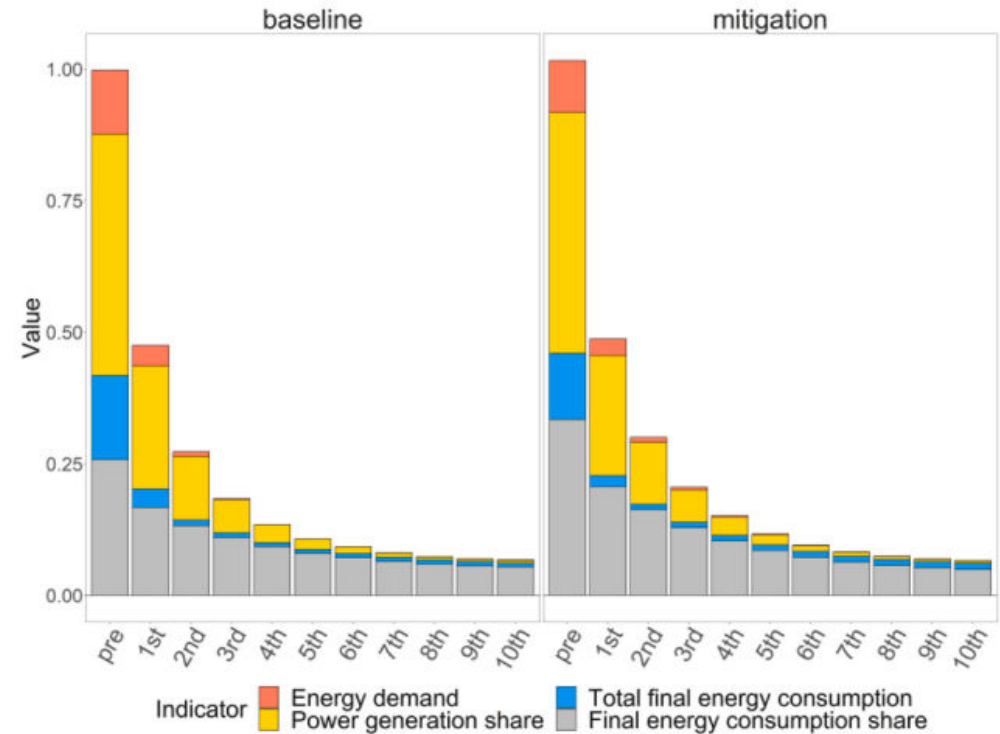Fig. 1. Overview of the method used to integrate the two models.

Fig. 8. Indicators for confirming convergence. On the x-axis, "pre" indicates the result obtained by calculating the indicator based on the results calculated before data exchange. The others show the results calculated based on the results after each of the data exchanges.

Future perspective of the modeling

- Better understanding on poor and low-income people. How to harmonize development and climate change mitigation?
  - ✓ Hunger [2014-]
  - ✓ Poverty and inequality [2019-]

- Expanding the representation in environmental system
  - ✓ Biodiversity [2015-]
  - ✓ Air quality [2018 -]
  - ✓ Nitrogen pollution [2023-]

- Finer resolution and better integration for the climate mitigation studies
  - ✓ Energy system (Hourly power dispatch, sub-national representation)
  - ✓ General mitigation scenarios: National scenarios
  - ✓ Broader topics: Harmonizing with gridded information

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ご清聴ありがとうございました

Thank you for your attention

Asia-Pacific Integrated Model
https://www.athehost.env.kyoto-u.ac.jp