Updates on AIM global modeling and relevant international activities

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AIMWS

July, 2025

International activities

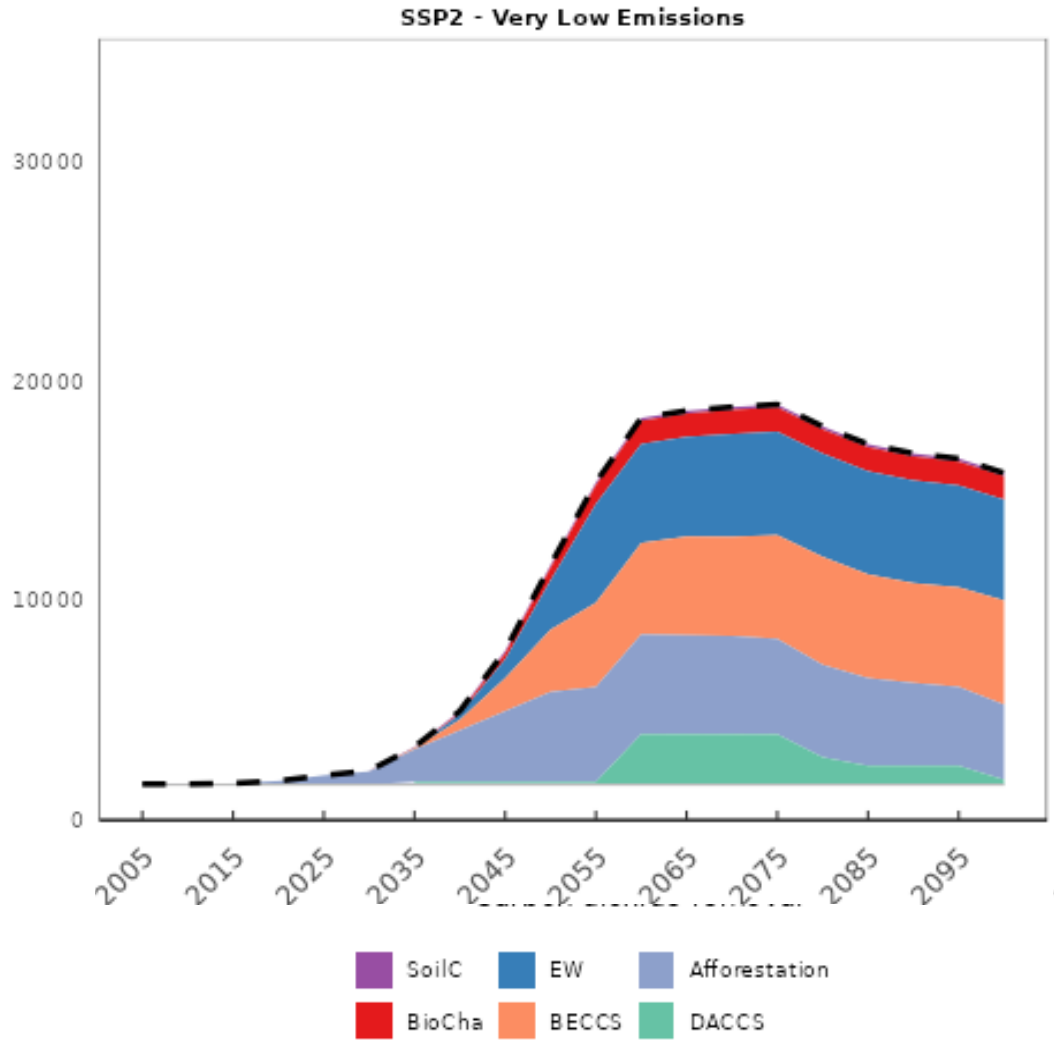
- IAMC
  - ✓ SWG on national scenarios will be practically activated this year — Saritha Vishwanathan
- IAM MIPs:
  - ✓ ELEVATE (International policy, European Horizon) — Osamu Nishiura
  - ✓ NEWPATHWAYS (Inequality, European Horizon) — Zhao Shiya
  - ✓ JMIP (Japanese policy, MOEJ) — Osamu Nishiura
- ScenarioMIP (CMIP)
  - ✓ New climate community scenarios — Shinichiro Fujimori and many others
- GEO (Global Environmental Outlook) 7
  - ✓ Contribution to providing illustrative scenarios for solution pathways — Shinichiro Fujimori
  - ✓ 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

Model overview in 2024-2025

Covered area	Models	Spatial resolution	Major updates	Publication status
Economy	AIM-Hub (CGE)	17 regions	NDC updates Synthetic fuel CDR and inequality CDR comprehensive investigation	Tsutsui et al. (2025) Nishiura et al. (in prep) Fujimori et al. (under review) Thanakon et al. (in prep)
Energy	AIM-Technology (Energy system)	31 regions	Defossil fuel	Oshiro et al. (2024) Mori et al. (2024) Mori et al. (in review)
Development	AIM-PHI (Household)	180 countries	With MESSAGEix Carbon pricing	Zhao et al. (accepted) Zhao et al. (in review)
Land-use	AIM-PLUM (allocation) AIM-AFOLU (Tech)	0.5° ~~17 regions~~ 180 countries	Forest management National modeling Afforestation, soil carbon AgMIP Ozone impact	Hasegawa et al. (2024) Hasegawa et al. (2025) Farhana et al. (under review1 ,2) Xia et al. (under review)
Atmospheric	GEOSCHEM	4x5°	Dietary change Spatial resolution Ammonia economy Aging effects	Jansakoo et al. (2024) Jansakoo et al. (2024) Jansakoo et al. (in review) Uchida et al.(in review)
Biodiversity	AIM-BIO	0.5°	-	Hirata et al. (2024)
Fire	CLM	0.5°	Model comparison	Park et al.(2024)
System integration	Hub-Tech model linkage	17 regions	Consistent scenarios in energy and economy	Fujimori et al. (2024) Nishiura et al. (2024)

CDR representation in AIM-Hub

- BECCS
- Afforestation
- DACCS
- Soil carbon
- Biochar
- Enhanced weathering



AIM 3.0 – Full integration mode used in scenarioMIP

Shinichiro Fujimori
(Kyoto Univ. Prof.)

Osamu Nishiura
(NIES Res.)

Tomoko Hasegawa
(Ritsumeikan Univ. Prof.)

DICE

CO2 emissions pathways

AIM-Hub

- Final energy
- Power generation
- Additional investment
- DACCS
- Carbon price

- CO2 emissions sequestration from LU

- GDP changes
- FFI emissions pathways

- Land use
- Ag price

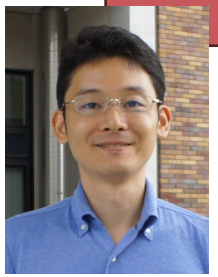
AIM-Technology

AIM-PLUM

Koga Yamazaki
(Kyoto Univ. PhD St.)

Land use map

Fire



Ken Oshiro
(Hokkaido Univ. Asso.Prof.)

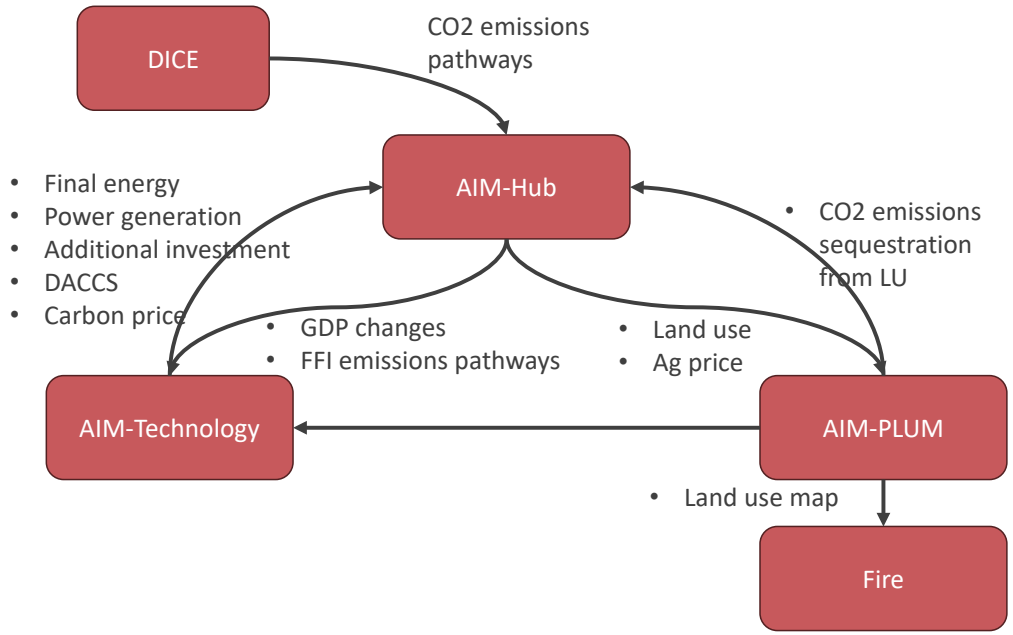
Shotaro Mori
(Kyoto Univ. Ass. Prof.)

Chaeyeon Park
(AIST Res.)

Model run sequence

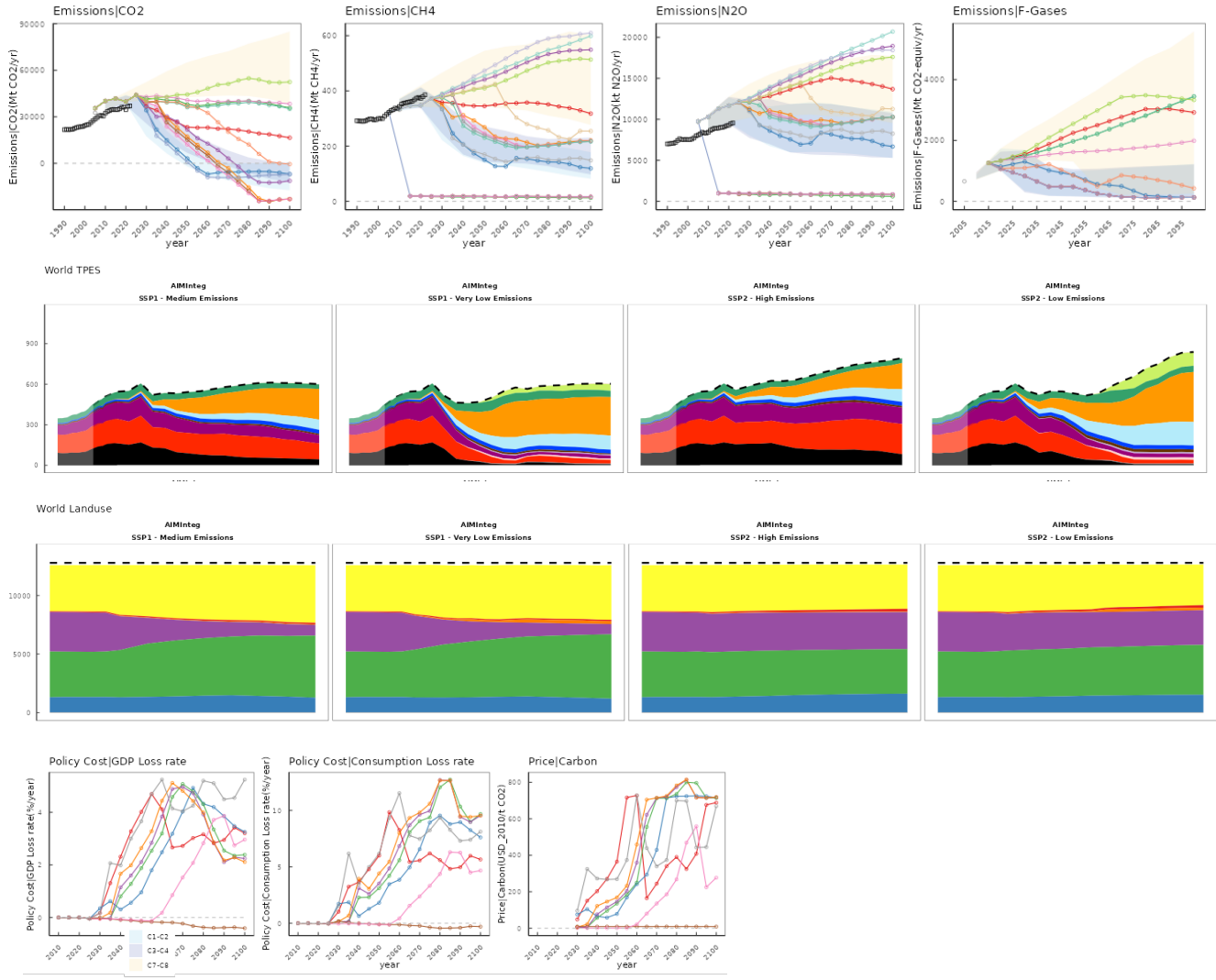
- DICE
- AIMHub 1
- AIMPLUM 1
- AIMTech 1
- AIMHub 2
- AIMPLUM 2
- AIMTech 2
- AIMHub 3
- AIMPLUM 3
- Fire

How we report the model outputs



- Most variables are taken from AIM-Hub which is consistent with AIM-Tech and AIM-PLUM
- Land cover, emissions associated with land and land-use changes are taken from AIM-PLUM
- Fire (grassland and forest fire) emissions (air pollutant and non-CO2) are from fire model

Fully consistent, energy, economy, land, CDR and emissions



ASIA-PACIFIC INTEGRATED MODEL

Towards open and transparent model intercomparison platform for scenarios generated by Integrated Assessment Models

Shinichiro Fujimori, Volker Krey, Keywan Riahi, Masahiro Sugiyama, Tomoko Hasegawa, James Edmonds, Celine Guivarch, Sergey Paltsev, Steven Rose, Roberto Schaeffer, Massimo Tavoni, Saritha Sudharmma Vishwanathan, Detlef van Vuuren, Matthias Weitzel

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Background: IAM scenarios and classification

- Play an important role in climate research and real decision-making
- Contributing to international reports such as IPCC, NGFS, UNEP gap report etc.
- There are three kinds of scenarios
  - ✓ Community scenarios (e.g. RCPs, SSPs, etc)
    - ➢ Shared among climate research communities across IPCC WGs which becomes an basement for the entire IPCC report
  - ✓ Model Inter-comparison Project (MIP) scenarios
    - ➢ Multi-models join each study with specific research topic and compare their results each other.
  - ✓ Individual study's scenarios

MIP role in IAM community

- MIPs are comparing multiple model results and derive implications from them
- Four main roles
  - ✓ Robustness of findings using multi-model results agree on a specific aspect
  - ✓ Identification of uncertainty or certainty
  - ✓ Giving opportunities to review model representations and improve
  - ✓ Giving chances to learn each other

History of IAM MIP for global study

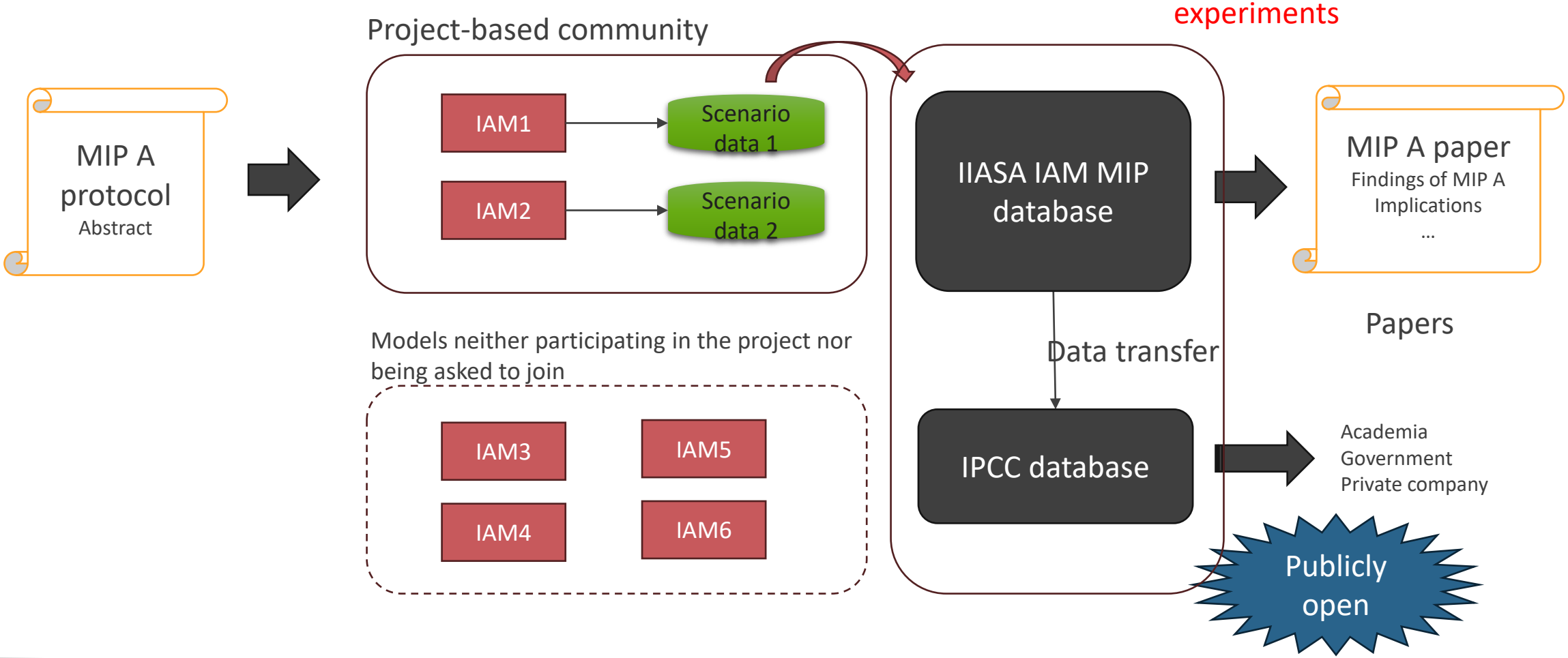
Year	Organizer	Title	Journal	Number of models
2021	EU	ENGAGE: Exploring National and Global Actions to reduce Greenhouse gas Emissions	Nature Climate Change, Nature Sustainability	9
2020	EU	COMMIT: Climate pOlicy assessment and Mitigation Modeling to Integrate national and global Transition pathways	Nature Communications	9
2018	EU	CDLINKS: Linking Climate and Development Policies – Leveraging International Networks and Knowledge Sharing	Nature Energy, Nature Sustainability	6
2017	US	EMF 33: Bio-Energy and Land Use	Climatic Change	12
2017	US	EMF 30: Short Lived Climate Forcers / Air Quality	Climatic Change	9
2017	EU	ADVANCE: Advanced Model Development and Validation for the Improved Analysis of Costs and Impacts of Mitigation Policies	Nature Climate Change, Energy Economics	7
2014	EU	AMPERE: Assessment of Climate Change Mitigation Pathways and Evaluation of the Robustness of Mitigation Cost Estimates	Technological Forecasting and Social changes	11
2014	EU	LIMITS: Low climate IMpact scenarios and the Implications of required Tight emission control Strategies	Nature Climate Change, Climate Change Economics	6
2013	US	EMF 27: Global Model Comparison Exercise	Climatic Change	18
2013	EU	ROSE: Roadmaps toward Sustainable Energy futures	Climatic Change	3
2012	EU	RECIPE: Report on Energy and Climate Policy in Europe	Climatic Change	3
2012	US	AME: Asian Modeling Exercise	Energy Economics	19
2010	Japan	MAC study	Sustainability Science	3
2011	US	EMF 25: Energy Efficiency and Climate Change Mitigation	-	10
2010	EU	ADAM: The Economics of Low Stabilization Project	Energy Journal	5
2009	US	EMF 22: Climate Change Control Scenarios	Energy Economics	10
2006	EU	IMCP: The Innovation Modeling Comparison Project	The Energy journal	11
2006	US	EMF 21: Multi-Gas Mitigation and Climate Change	The Energy journal	19
2004	US	EMF 19: Climate Change: Technology Strategies and International Trade	Energy Economics	14
1999	US	EMF 16: The Costs of the Kyoto Protocol	The Energy journal	13
1996	US	EMF 14: Integrated Assessment of Climate Change	-	4
1993	US	EMF 12: Controlling Global Carbon Emissions - Cost and Policy Options	American Economic Review	10

Current MIP system

1) Make MIP protocol

2) Share and implement MIP protocol

3) Publish papers based on MIP experiments



Scenario sources in AR6 WG3 scenario database

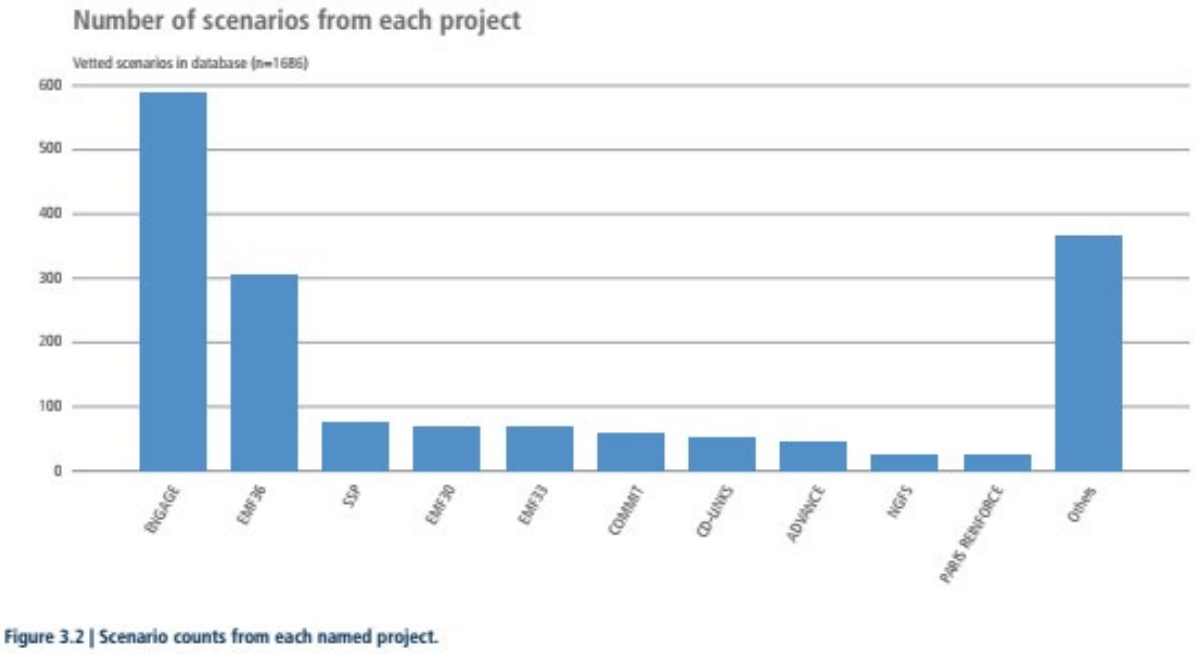


Figure 3.2 | Scenario counts from each named project.

- EU project based scenarios are dominant (ENGAGE, EMF36, COMMIT, CD-LINKS and ADVANCE)
- Interpretations
  - ✓ Considering the capacity to do MIP, Europe has sufficient resources and this is natural
  - ✓ There could be bias

- Scenarios generated by IAMs are based on assumptions and "model", and both cannot completely be independent from modeler's sense of value → risk to be biased
- IPCC should avoid bias or the situation which can include bias as much as possible.
- At IPCC workshop on the Use of Scenarios in 2023, diversification of the participation of the scenario development was also frequently mentioned.

Invention and restructuring in a way of organizing IAM MIP is needed

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The need for new MIP platform

- Inclusive MIP system should be established
- The MIP should be open to anybody in the world who handles IAMs and the process from the protocol development, the scenario provision, to the scenario assessment should become openly and transparently carried out.
- CMIP is the great ancestor for IAM community

Proposal MIP system

1) Make MIP protocol and submit to coordinating organization and endorsed

MIP A protocol
Abstract

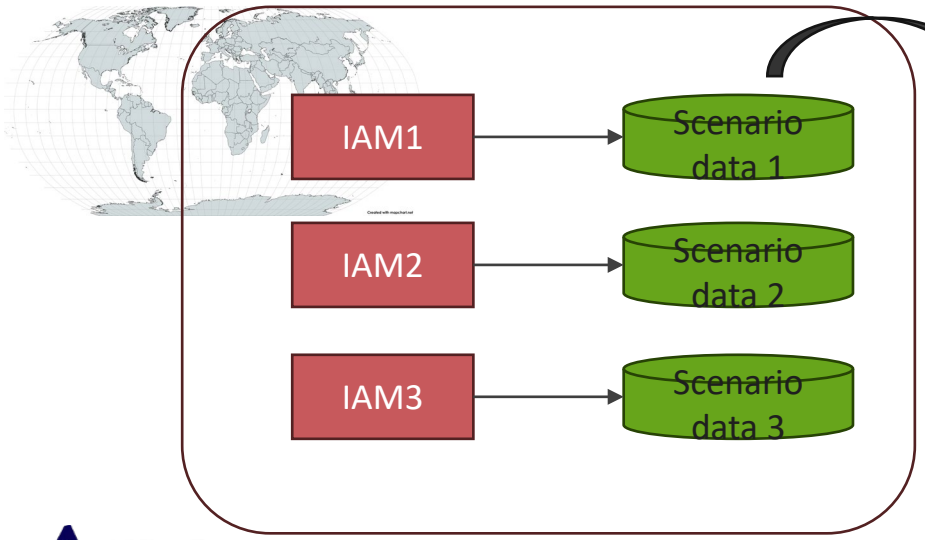
IAM MIP coordinating organization (e.g. IAMC)

2) Open the protocol and revise

MIP A protocol paper
Scope
Experiment
Variables…

Publicly open

3) Implement MIP protocols and submit scenarios



IAM database infrastructure (e.g. IIASA database)

IPCC database

4) Publish papers based on MIP experiments

MIP A paper
Findings of MIP A
Implications
…

Assessment by coordination team

Publicly open

Academia
Government
Private company
NGO (IPCC etc)

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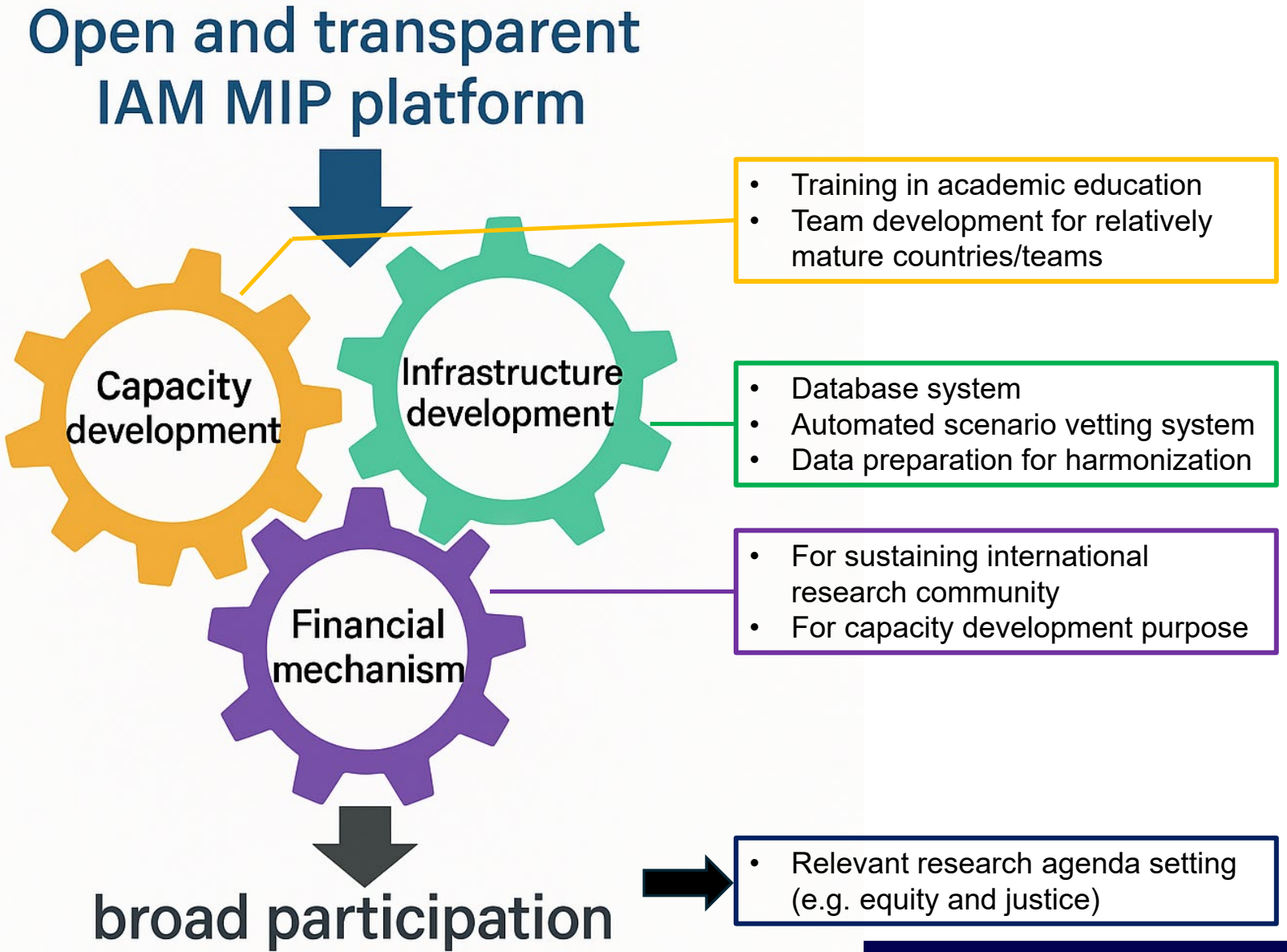
Procedure

- A coordination team submit MIP draft protocol to a central organization (maybe IAMC)
- The central organization endorses the MIP proposal based on some criteria (e.g. research question, policy relevance, etc.)
- The MIP protocol is disclosed with the call for scenario submissions (e.g. published as an article in GMD)
- Scenarios need to pass a specific vetting procedure so that the quality of the model outcomes is maintained.
- The scenarios are assessed by the coordination team.
- The scenario data is in public
  - ✓ Within one year after releasing the first paper, if somebody wants to assess data, the scenario providers must be acknowledged as co-authors. → Give credits as co-authorship to model participants
  - ✓ After that, the data is fully open and anybody can use it with proper citation.

Challenges

- There are limited teams from under-represented countries.
  - ✓ In the long-term, this open and inclusive IAM MIP organization should give chances for capacity development
- Most advanced IAMs are complex which can be a barrier for newcomers
  - ✓ Multi-level MIPs can be formulated from conventional (relatively easy) to most-advanced
- More works for quality control would be needed
  - ✓ Vetting procedure might need to be transparent
  - ✓ A specific organization needs to manage whole things in IAM MIPs (e.g. IAMC)
  - ✓ Sustaining funding and more resources would be needed to organize MIPs more systematically

Broader issues



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This presentation is supported by the Environment Research and Technology Development Fund (JPMEERF1-2401) of the Environmental Restoration and Conservation Agency of Japan, JST ASPIRE and financially supported by The Sumitomo Electric Industries Group CSR Foundation.

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Thank you for your attention