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# What is needed to develop decarbonized society? -Findings from research side-

## 脱炭素社会を実現するために必要なことは？ -研究側からの考察-

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ISAP2025, Plenary 3

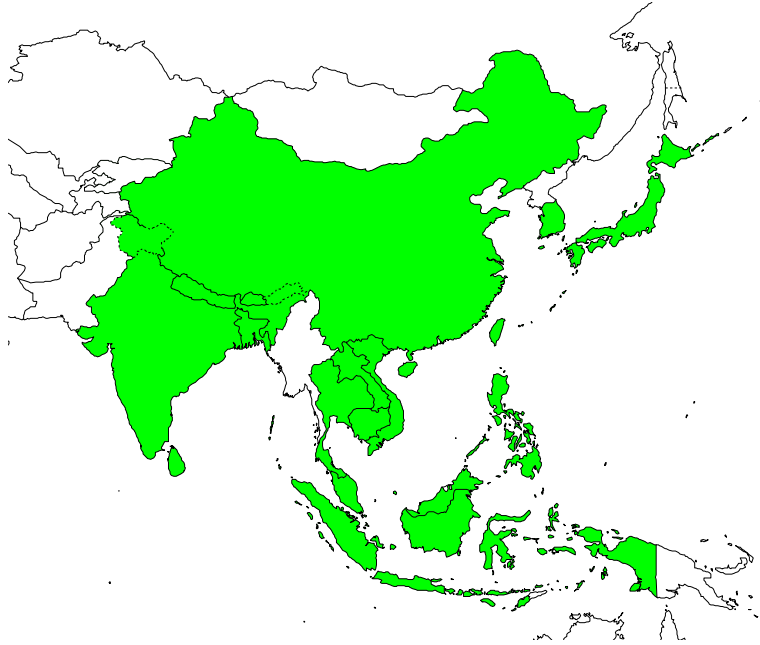
Just and Inclusive Transition towards Net-Zero and Resilient Societies in ASEAN

PACIFICO YOKOHAMA, Japan

29 July, 2025

# International Network of AIM (Asia-Pacific Integrated Model)

## AIM(アジア太平洋統合評価モデル)を通じた国際連携



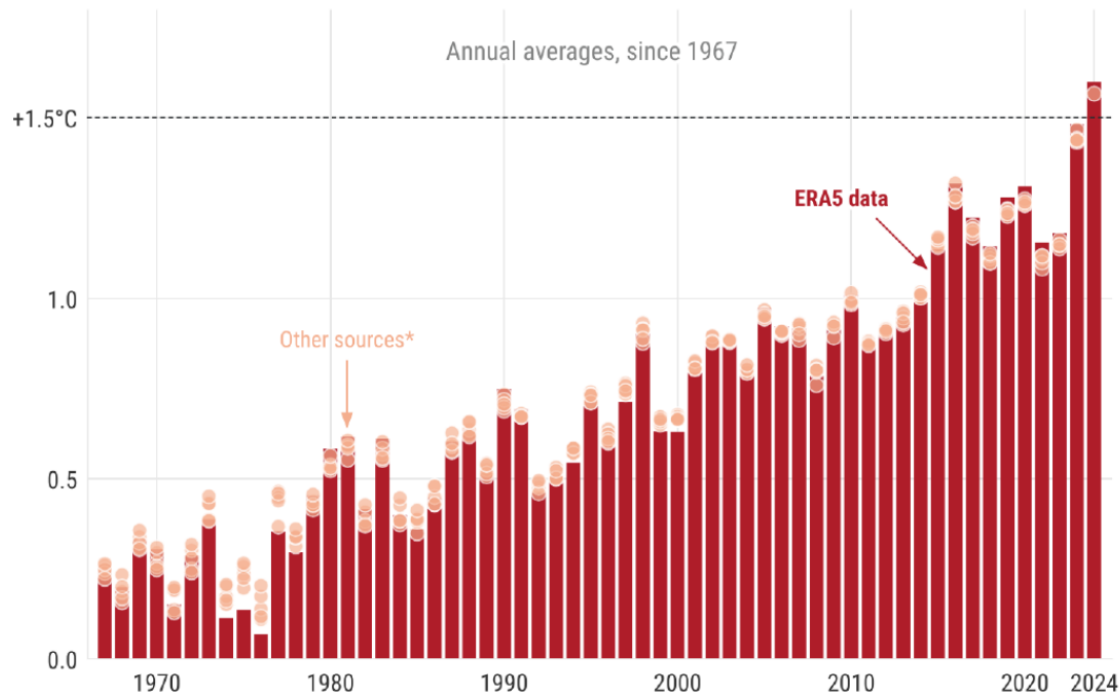
- AIM (Asia-Pacific Integrated Model) project started in 1990. 1990年にAIMプロジェクトを開始。
- Asian countries/regions will update their mitigation target and roadmap to achieve the 1.5/2 degree target reflecting their issues to be solved and the resources to be endowed. アジア諸国は、自国の課題や利用可能な資源を踏まえて1.5/2°C目標を実現するための緩和策を検討。
- Model can be a collaboration tool between science and decision making process. From the long-term viewpoint, each country/region will need the capacities to develop model and scenarios by itself. モデルは科学と政策決定をつなぐツールであり、長期的に各国は自らモデル・シナリオ開発を行う能力構築が必要。
- AIM has supported Asian countries/regions to develop the integrated assessment model (IAM) and their long-term low carbon/decarbonized scenarios. AIMは統合評価モデルや脱炭素シナリオ開発を支援。
- <https://www-iam.nies.go.jp/aim/index.html>

In 2024, global mean temperature exceeded 1.5 °C target...  
2024年に世界の平均気温は1.5°Cを超えてしまった...



### Global surface temperature: increase above pre-industrial

Reference period: pre-industrial (1850–1900) • Credit: C3S/ECMWF



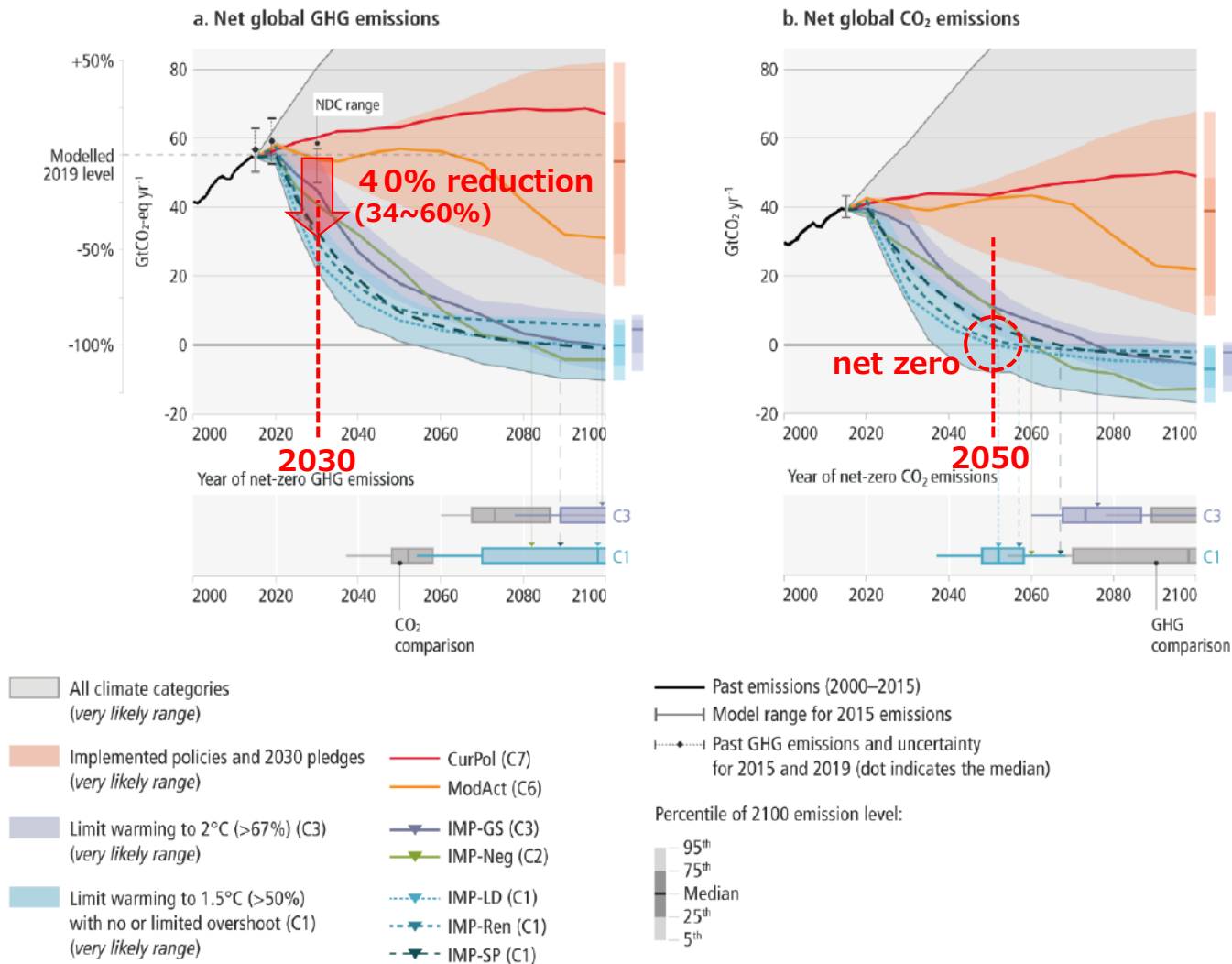
\*Other sources comprise JRA-3Q, GISTEMPv4, NOAA GlobalTempv6, Berkeley Earth, HadCRUT5.  
Estimate for 2024 is based on ERA5 and JRA-3Q data only.

Source: Copernicus Climate Change Service (2025) Global Climate Highlights 2024  
<https://climate.copernicus.eu/global-climate-highlights-2024>

# GHG and CO<sub>2</sub> emissions paths toward 1.5 °C

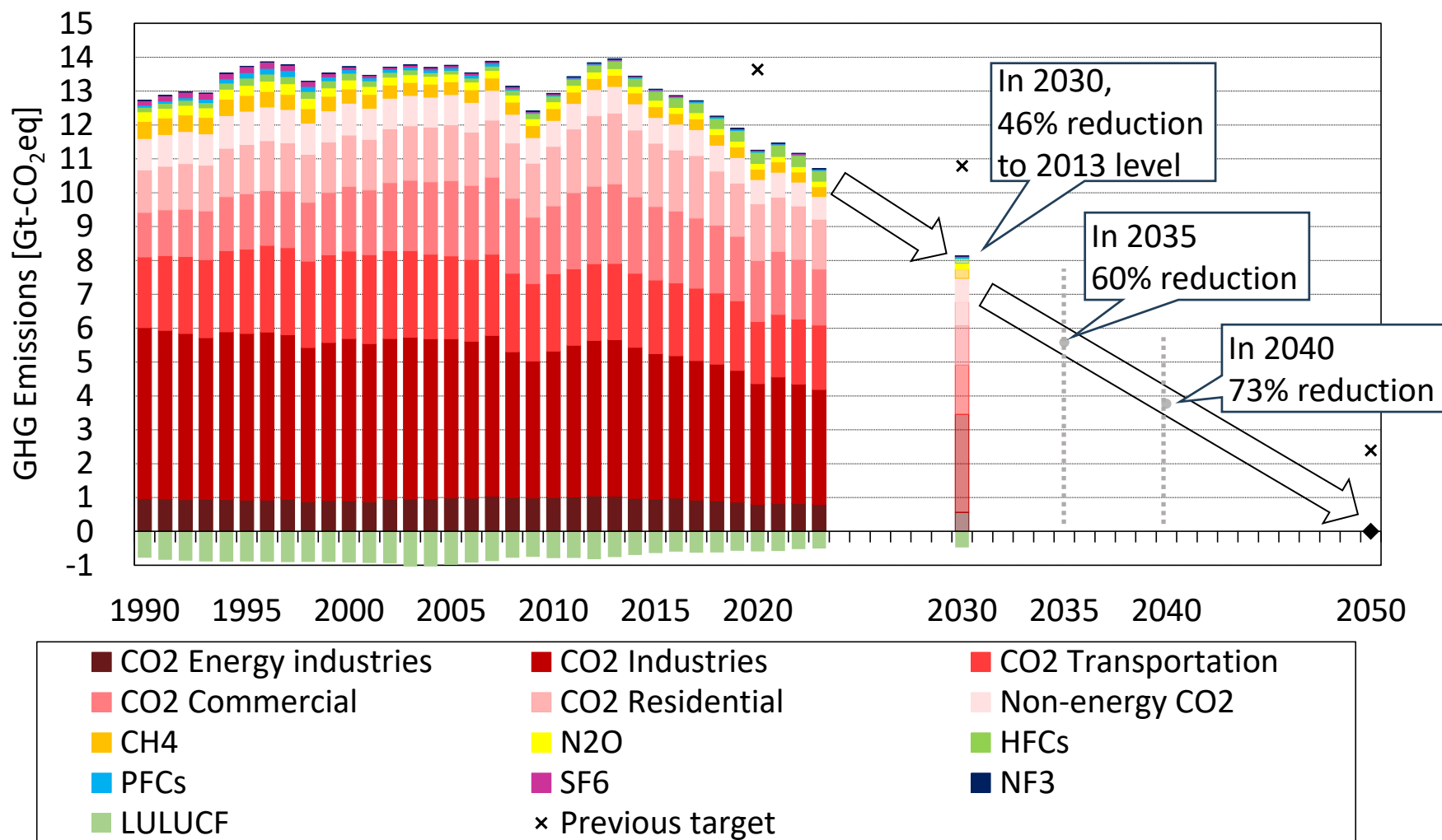
## 1.5°C目標の実現に必要なGHGとCO<sub>2</sub>の排出経路

Modelled mitigation pathways that limit warming to 1.5°C, and 2°C, involve deep, rapid and sustained emissions reductions.



# Past trend and future targets of GHG emissions in Japan

## 日本のGHG排出経路と将来目標



Source:

Historical data: Greenhouse Gas Inventory Office of Japan, Japan's National Greenhouse Gas Emissions

Target: Japan's Nationally Determined Contribution (NDC) and Long-Term Strategy under the Paris Agreement

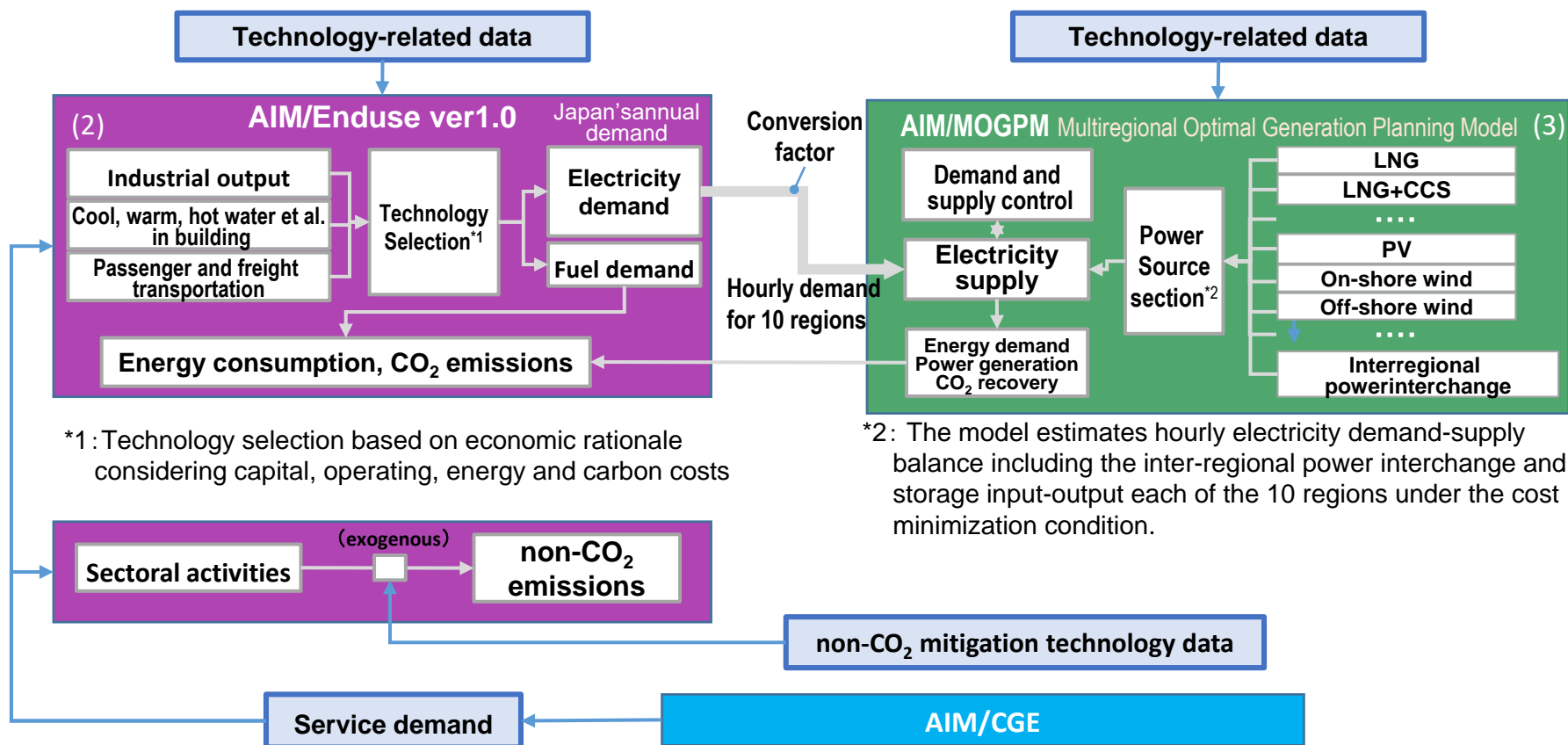


# Models used for Japan's GHG estimates:

## 日本のGHG推計に用いたモデル:

### AIM/CGE, AIM/Enduse and AIM/MOGPM

- An applied general equilibrium model is used to establish a macro-frame for the future, given the economic growth rate and population assumptions (1). Next, future energy demand is estimated using an energy demand model (2). The annual electricity demand estimated in (2) is expanded to hourly demand by region, and the generation facility configuration and supply configuration are estimated using a cost-optimized power supply model that can take into account coincidence constraints and inter-regional interconnection line constraints (3). The results are fed back into the energy demand model to calculate Japan's overall energy supply and demand and CO<sub>2</sub> emissions.

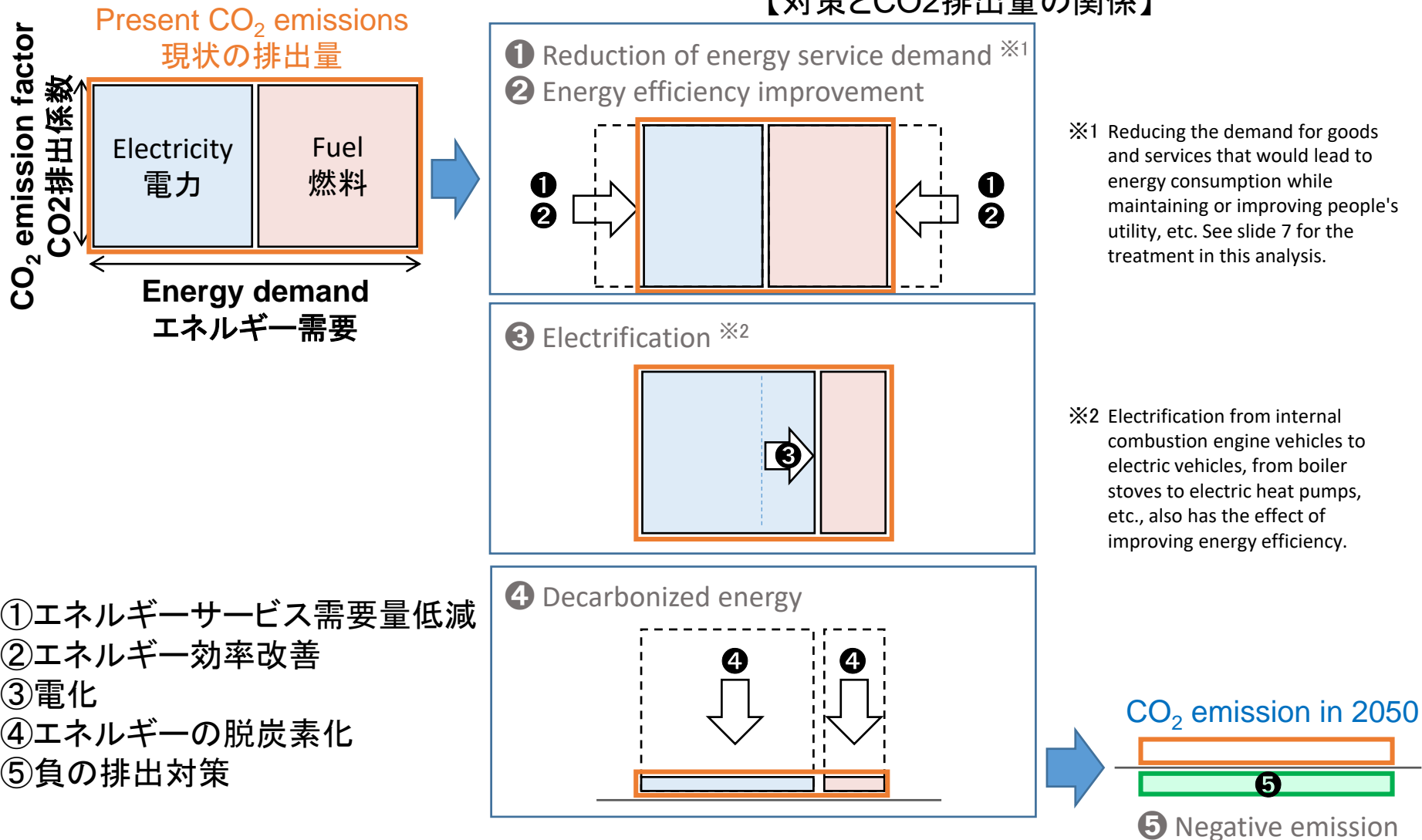


# Pillars of measures to achieve net-zero in 2050

## 2050年ネットゼロを実現する対策の柱

### 【Relation between Measures and CO<sub>2</sub> Emissions】

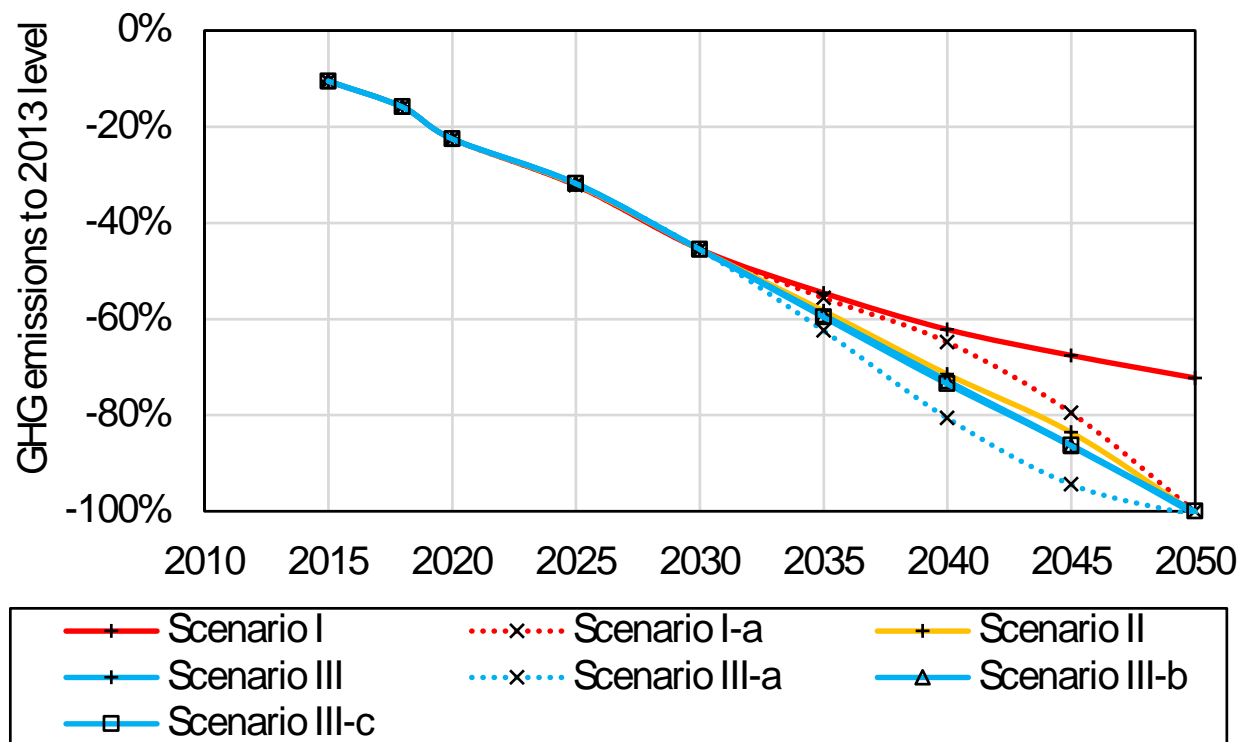
#### 【対策とCO2排出量の関係】



# GHG emission pathways in Japan using AIM

## AIMを用いた日本のGHG排出経路

- In Technology Progress Scenario (Scenario I), GHG emissions in 2050 are 70% reduction compared to those in 2013. It is possible to achieve net-zero in 2050 by mass adoption of innovative technologies starting in 2040 (Scenario I-a).
- In Innovative Technology Scenario (Scenario II), not only the decarbonization of electricity and energy efficiency and electrification in end-use sectors, but also various measures such as new fuels, BECCS and demand-side CCS contribute to emission reductions, and achieve the net-zero GHG emissions by 2050.
- In Social Transformation Scenario (Scenario III), social transformation can contribute to the net-zero GHG in addition to the innovative technologies. Introducing measures upfront can push the GHG reduction path down (Scenario III-a).



In detail, please see the following discussion paper although it is in Japanese.  
詳細な結果(日本語)は以下のディスカッションペーパーを参照のこと。

<https://www.nies.go.jp/social/publications/dp/pdf/2025-01.pdf>



# Contribution of AIM in Thailand タイにおけるAIMの貢献

Third & Fourth National Communication, Long-term Strategy and Biennial Transparency Report  
by Prof. Bundit Limmeechokchai (Thammasat University)



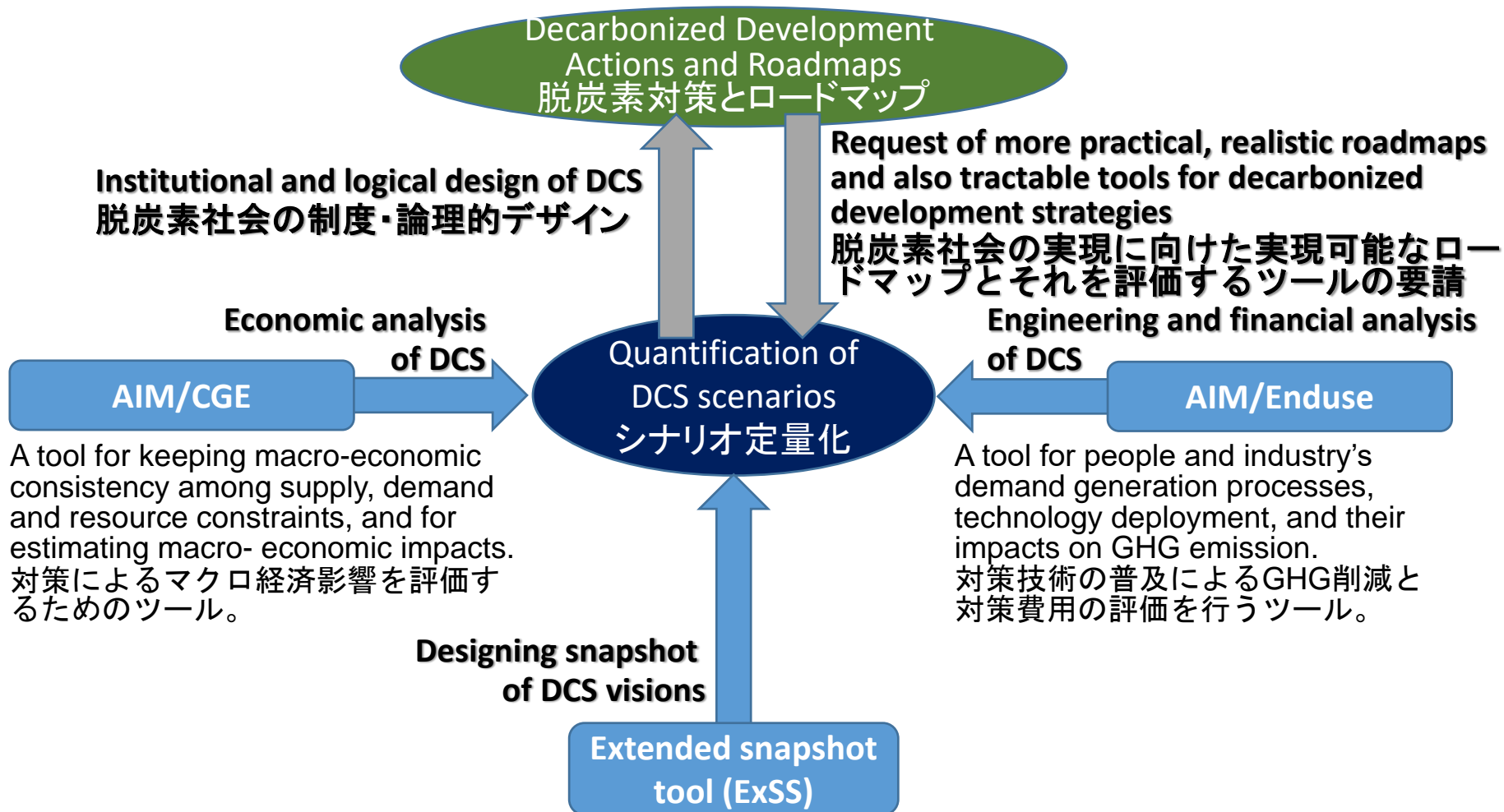
<https://unfccc.int/documents/181765>  
<https://unfccc.int/documents/624738>



[https://unfccc.int/sites/default/files/resource/Thailand%20LT-LEDS%20%28Revised%20Version%29\\_08Nov2022.pdf](https://unfccc.int/sites/default/files/resource/Thailand%20LT-LEDS%20%28Revised%20Version%29_08Nov2022.pdf)  
<https://unfccc.int/sites/default/files/resource/THAILAND%E2%80%99S%20BTR1.pdf>

# How to combine the tools in order to keep consistency and unity among socio-economic policies and DeCarbonized Society (DCS) actions

## 社会経済政策や脱炭素対策の整合的評価に向けたツール



An integrating tool of future economic, industrial, social and energy visions with mitigating options.

緩和策のオプションとともに、将来の経済、産業、社会、エネルギーに関するビジョンを示すツール。

# AIM and LoCARNet Peer-to-Peer Meeting for Sharing Experience and Lessons (July 24, 2025; @NIES)

## 各国間での経験・知見共有のためのAIM/LoCARNet会合

### Meeting Objectives 会合の目的

- Share plans and requests from each country to AIM.  
各国の計画やAIMチームへの要望の共有。
- Response to requests from each country and ways forward (short-, medium- and long-term).  
各国からの要望に対する回答や今後の予定(短期～長期)。
- Participating countries 参加国  
Thailand, Indonesia, Malaysia, Vietnam, Lao, Philippines, Bangladesh  
タイ、インドネシア、マレーシア、ベトナム、ラオス、フィリピン、バングラデシュ



# Toward decarbonized Asia アジアの脱炭素化に向けて

- Final goal is common among countries: sustainable decarbonized development  
最終目標は各国共通：持続可能な脱炭素社会へ

✓ But process/strategy may be different among countries;  
しかしながら道のりや戦略は各国で異なる。

✓ Viewpoint of economy and CO2

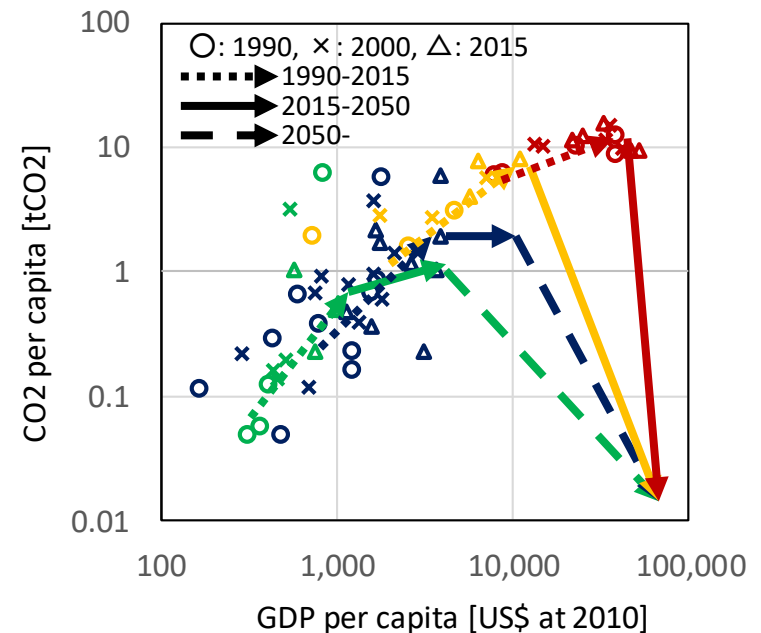
- **Japan, Korea**: immediate drastic CO2 reduction
- **China, Thailand, Malaysia**: strong decoupling between economic growth and CO2 reduction
- **Bhutan, India, Indonesia, Lao, Vietnam**: economic growth with maintaining CO2 emissions
- **Cambodia, Nepal**: economic growth

In developing countries: correction of disparities between urban and rural 都市と農村の格差など

✓ Other viewpoints

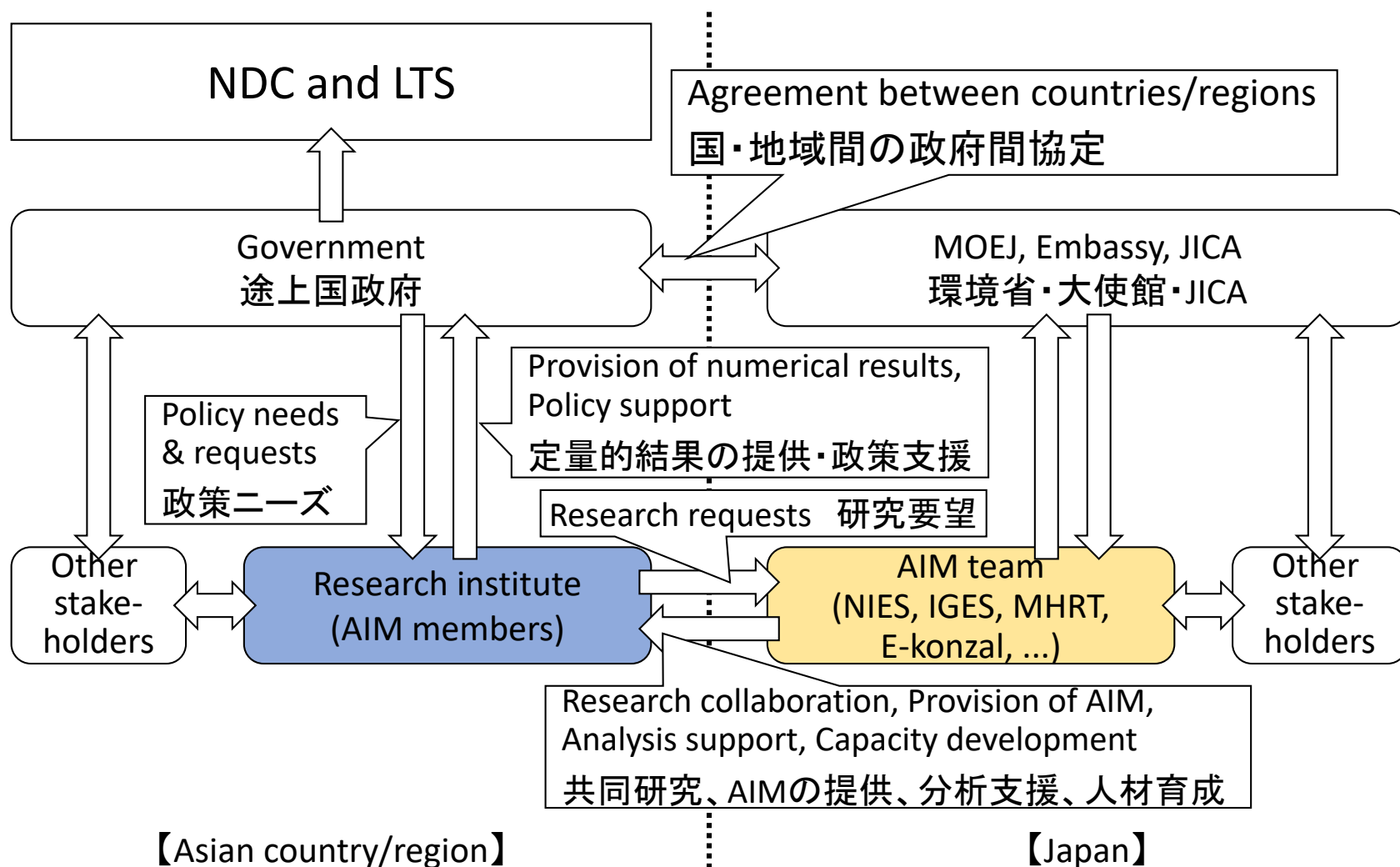
- Resource endowment 利用可能な資源
- Social conditions such as aging, available technology, etc 高齢化や技術水準などの社会状況

- Quantitative assessment based on AIM, which is customized to each country, is needed to show future scenarios and roadmaps toward the decarbonized society.  
脱炭素社会に向けたシナリオやロードマップを示すために、AIM等による定量評価が必要。





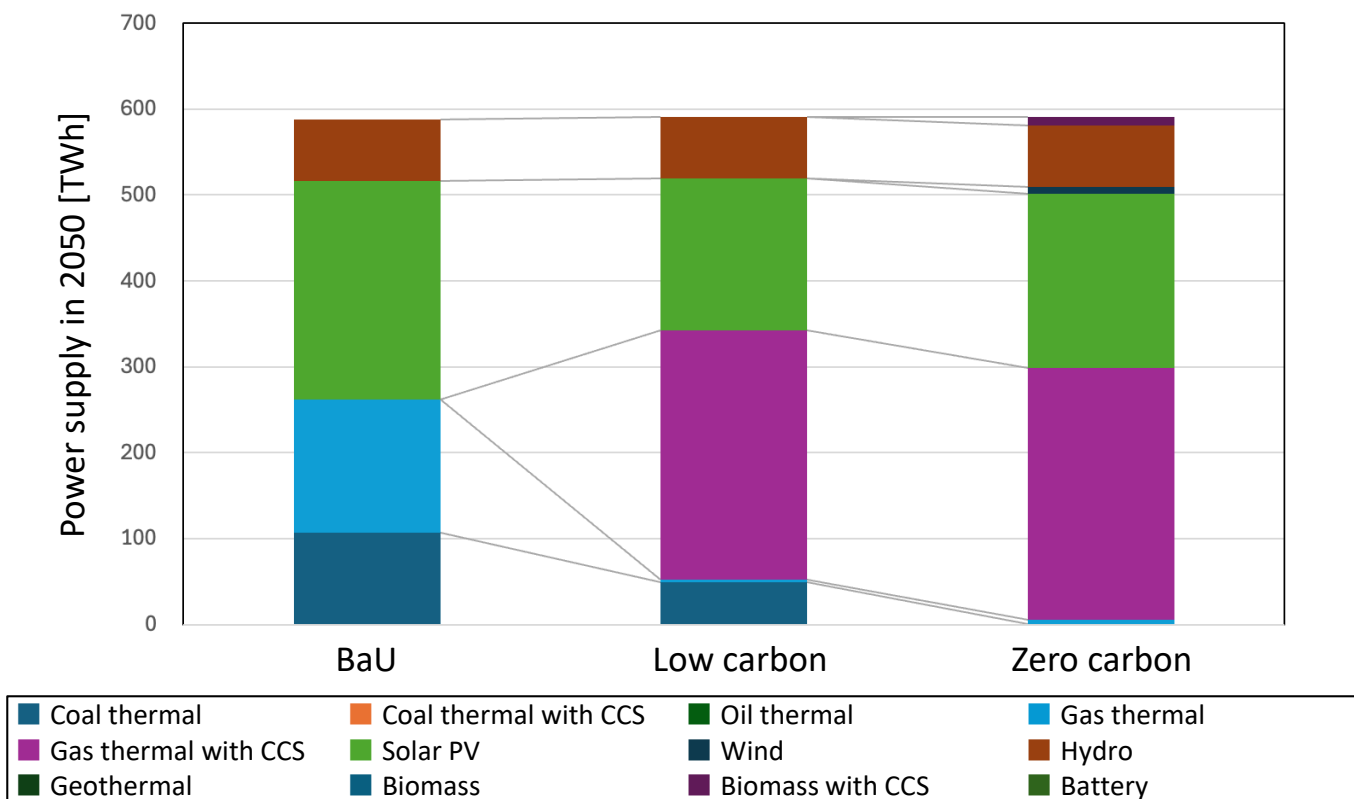
# Expected structure to support climate policy in Asian countries/regions アジアでの気候政策支援に向けて目指している関係



NIES: National Institute for Environmental Studies  
IGES: Institute for Global Environmental Strategies  
MHRT: Mizuho Research & Technologies

Using Power Plan Model, necessary power supply mix considering hourly electricity supply and demand is simulated.

電源計画モデルにより、時間単位の電力需給を考慮した電源構成を計算。



by Dr. Shuichi Ashina (NIES)

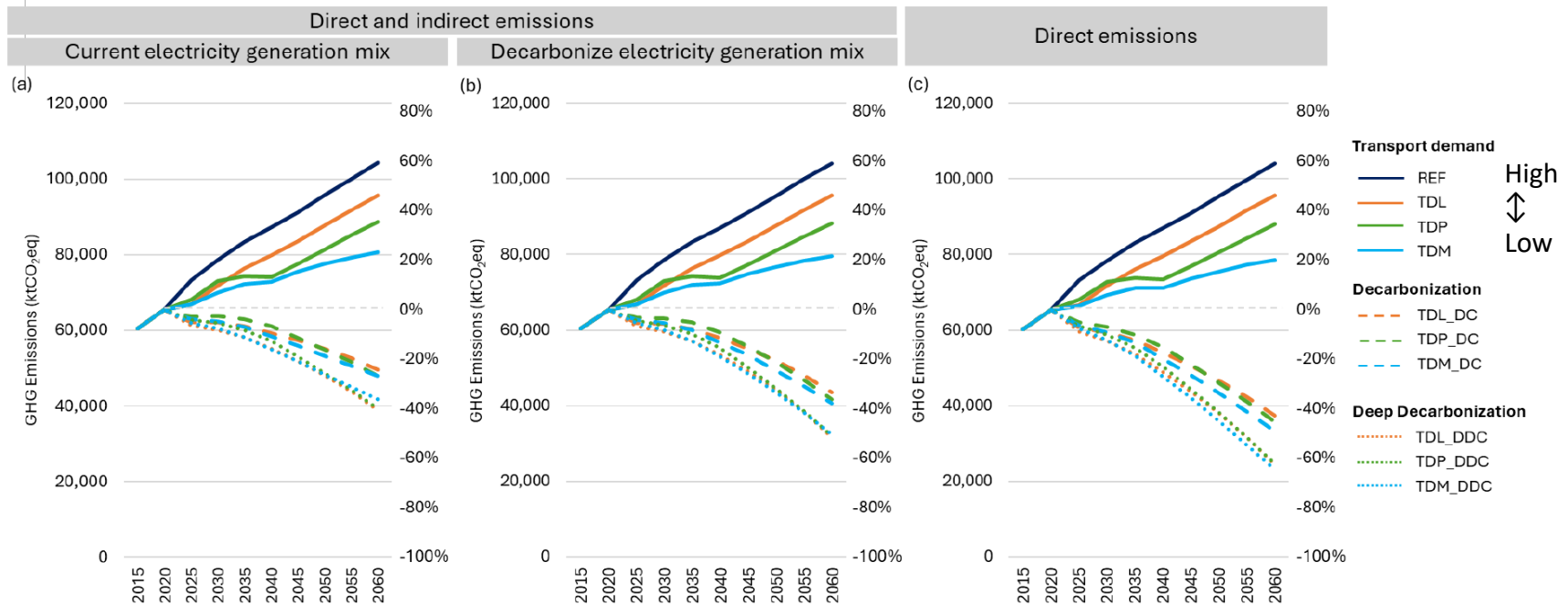
Power supply mix of Thailand in 2050: To achieve the CO2 zero in 2050, coal-fired should be phase-out, and PV and gas-fired with CCS will be a key.

タイにおける各ケースの2050年の電源構成: 2050年排出ゼロを実現するには石炭火力はゼロに。太陽光発電とCCS付ガス火力の推進が鍵に。



Using transport model and energy system model, direct and indirect CO2 emissions from transport sectors are estimated.

運輸モデルとエネルギーシステムモデルの統合により、運輸部門の直接・間接CO2排出量を計算。



by Dr. Tatsuya Hanaoka, Dr. Achiraya Chaichaloempreecha (NIES) and Prof. Runsen Zhang (U of Tokyo)

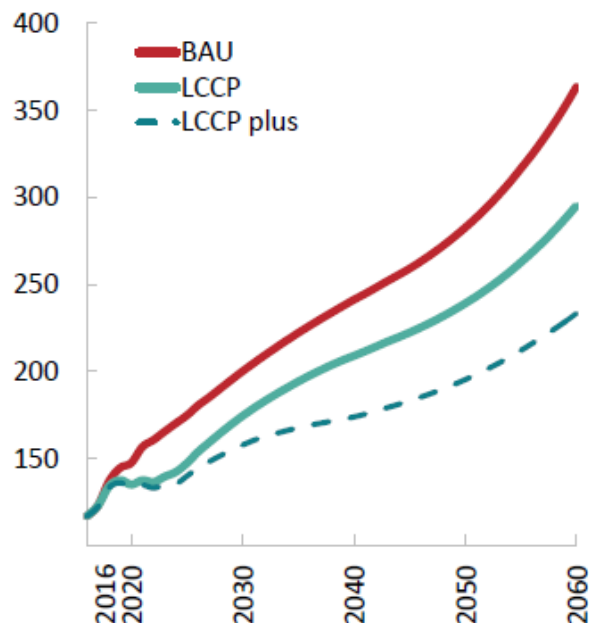
GHG emissions from transportation sector in Thailand: Measures to address demand in the transportation sector and diffusion of decarbonization technologies will have a significant impact on emissions. In addition, power supply mix will also have an impact.

タイの運輸部門におけるシナリオ別GHG排出量の推移: 運輸部門の需要対策と脱炭素技術の普及が排出量に大きく影響。最終的には電源構成も影響。

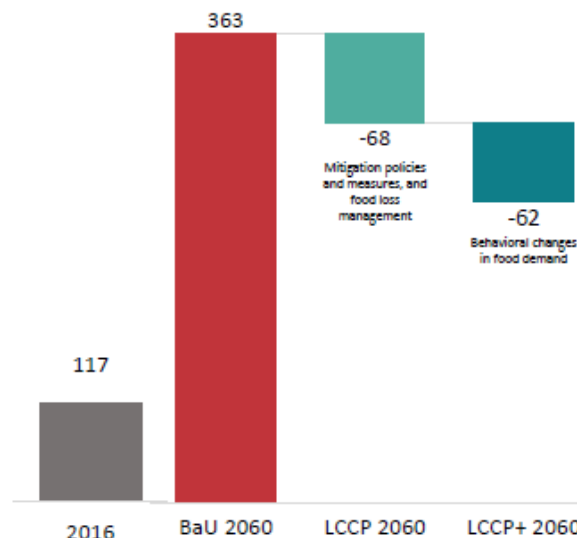
Food loss countermeasures and changes in food demand also affect GHG emissions.

フードロス対策や食料需要の変化も温室効果ガス排出量に影響を及ぼす。

a. Agriculture GHG Emissions  
(million tCO<sub>2</sub>e)



b. Emission reductions in 2060  
(million tCO<sub>2</sub>e)



LCCP: Low Carbon Compatible with Paris Target

LCCP+: LCCP + Sustainable and Healthy Diet

by Dr. Rossita Annuri (NIES)

GHG emissions from agricultural sector in Indonesia: With GHG mitigation measures and sustain food demand, increase of GHG emissions between now and 2050 will be halved.

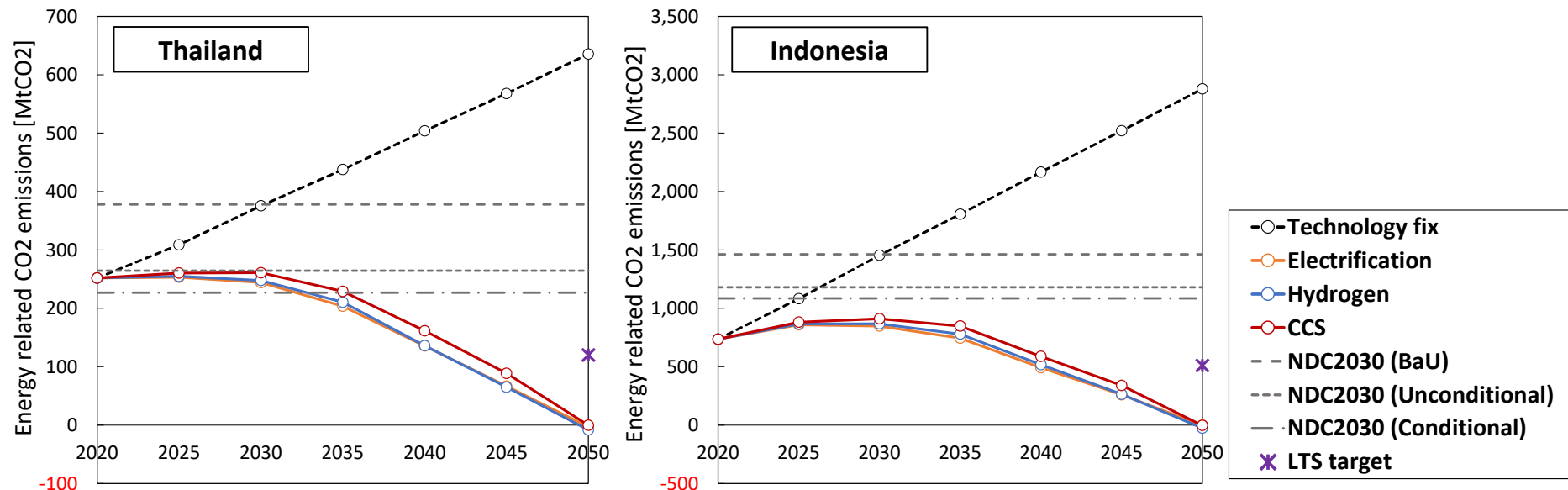
インドネシアにおける農業部門からの温室効果ガス排出量の推移: 温暖化対策とともに食料需要を持続的にすることで、現在から2050年までのGHG排出量の伸びは半減。

Using AIM/Enduse model, we explore net-zero CO2 emission pathways in some Asian countries.

## AIM/Enduseを使ったCO2排出量実質ゼロの経路の推計

AIM/Enduse model simulates the combination of technologies that minimizes the sum of initial and operating costs subject to future energy service demands.

AIM/Enduseは将来のエネルギーサービス需要を所与に初期費用と運転費用の合計を最小にする技術の組み合わせを計算。



by Mizuho Research & Technologies, Ltd.

To achieve net-zero CO2 emissions in Thailand and Indonesia, the CO2 emission factors for electricity and hydrogen should be negative values by utilizing BECCS.

タイとインドネシアで実質ゼロを実現するには、BECCSの活用により電力と水素の排出係数を負値にすることが必要。

# Messages from AIM simulations targeting ASEAN

## AIMによるASEANでのシミュレーションからのメッセージ

- Long-term measures are necessary. 長期的な視点の対策が必要。
  - ✓ It is possible to develop micro-level individual measures in each sector and integrate them into a macro-level long-term scenario that balances economic development and decarbonization.  
経済発展と脱炭素の両立に向けて、各分野のミクロな個別対策とそれらを融合したマクロな長期シナリオを描くことは可能。
  - ✓ New technologies are necessary. What is Japan's role in supporting them?  
新しい技術は必要。それを支える日本の役割とは？
  - ✓ Capacity development to create partnership between researchers and stakeholders including policymakers.  
研究者と政策決定者を含む関係者との連携構築に向けた人材育成。
  - ✓ In addition to initiatives in individual ASEAN countries, coordinated efforts across the entire ASEAN region are also necessary.  
ASEAN各国での取組に加えて、ASEAN全体の連携した姿も必要。
- From Japan's analysis 日本の分析結果から
  - ✓ Delaying measures could lead to an increase in stranded assets and rising costs.  
対策の先送りは、座礁資産の増加、費用の上昇を導く要因ともなりうる。
  - ✓ In addition to technology, the role of social transformation is also important.  
技術に加えて社会変容の役割も重要となる。