Electricity trade in East, Southeast, and South Asia under the 1.5°C goal

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1. Background

- The role of power interconnections has become significant in decarbonized power systems.
- Previous studies examined interconnections in East, Southeast, and South Asia, but faced several limitations.
  - ✓ Lack of consideration for recent ambitious climate targets (e.g., 1.5°C goal), emerging technologies (e.g., CCS and offshore wind) and comprehensive evaluations covering all these regions.
- This study evaluates the role of international interconnections and their impacts on national power systems in these regions under 1.5°C scenarios.

2. Methods

- We employed a power system model covering 74 regions in East, Southeast, and South Asia (Fig. 1)
  - ✓ Estimate technology deployment and operational status to minimize total system costs.
  - ✓ Consider the power supply and demand balance over 2,720 hours per year (365 days x 8 hours)
  - ✓ The energy demand and emission pathways were derived from the outputs of the AIM-Technology model.

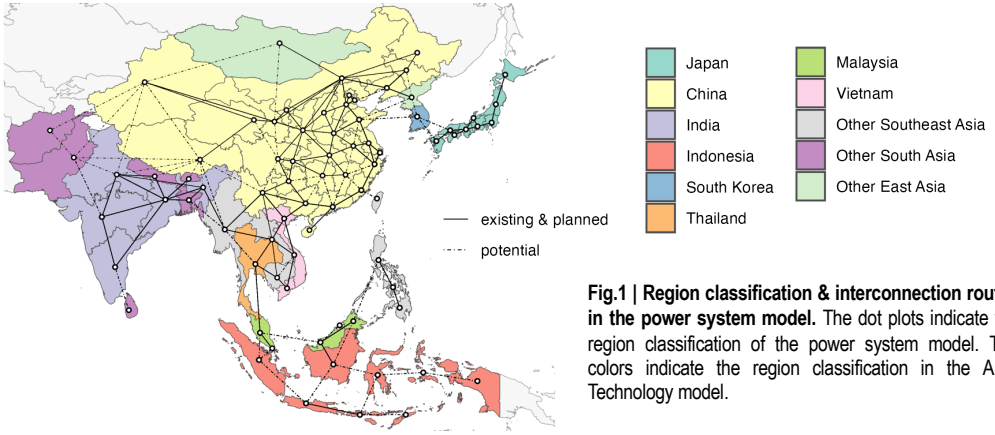

Fig.1 | Region classification & interconnection routes in the power system model. The dot plots indicate the region classification of the power system model. The colors indicate the region classification in the AIM-Technology model.

- We assessed a two-dimensional scenario matrix
  1. emission pathways: 1.5°C scenario (300C) vs. 2°C scenario (700C)
  2. international power interconnection expansion: existing & planned routes vs. existing & planned + potential routes

Table 1 | Scenario descriptions

Scenario	Emission pathway	Power interconnection
1.5C	1.5°C	existing & planned
1.5C+	1.5°C	existing & planned + potential
2C	2°C	existing & planned
2C+	2°C	existing & planned + potential

1.5C, 2C:

only the reinforcement of existing & planned international power interconnection routes

1.5C+, 2C+:

allowed for the development of potential new routes

3. Results

- The total power generation in the entire region did not change significantly , however, the locations of solar and wind power generation shifted across countries and regions.

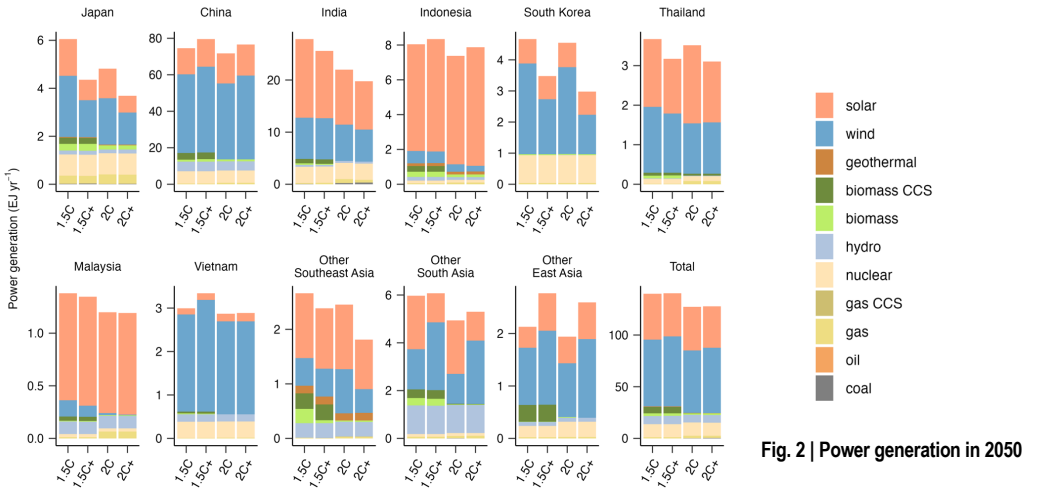

Fig. 2 | Power generation in 2050

- Substantial electricity were traded, particularly in countries such as Japan, South Korea, Malaysia and Vietnam
- The total mitigation cost across the region by 2050 was reduced by 4.7% (1.5°C) and 8.8% (2°C)

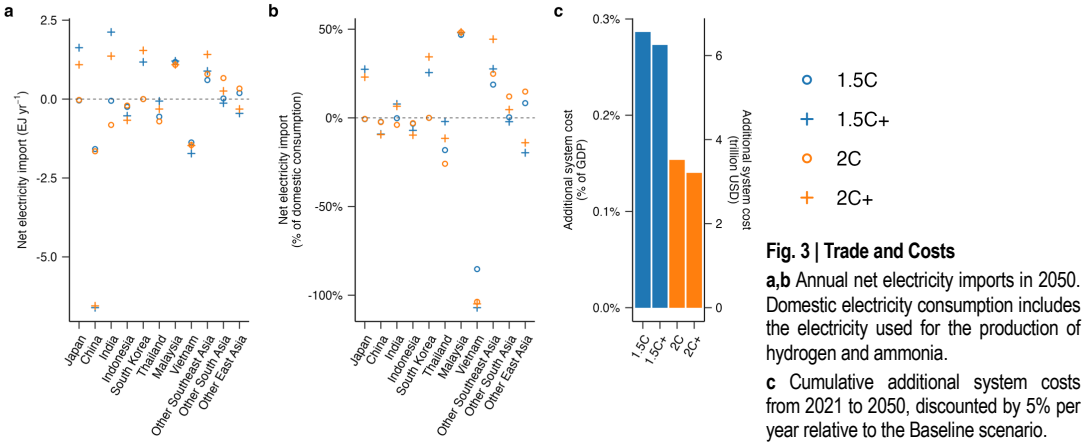

Fig. 3 | Trade and Costs

a,b Annual net electricity imports in 2050. Domestic electricity consumption includes the electricity used for the production of hydrogen and ammonia.

c Cumulative additional system costs from 2021 to 2050, discounted by 5% per year relative to the Baseline scenario.

4. Discussion & Conclusions

- It is noteworthy that despite the strengthening of emission reduction efforts, The rate of additional system cost reduction from 1.5C to 1.5C+ did not reach the level achieved from 2C to 2C+.
  - ➢ In the 1.5°C scenarios, the production of green hydrogen-based energy carriers absorbed surplus electricity and functioned as a balancing technology, which relatively weakened the role of interconnections.
- Our finding serves as a reminder of the benefits brought by open international electricity trade.
  - It was revealed that the development of potential interconnection routes, which currently lack an explicit start year, was expected to reduce the cumulative system costs by 305–310 billion USD in both the 2°C and 1.5°C scenarios.

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