The contribution of transport policies to the mitigation potential and cost of 2 °C and 1.5 °C goals

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INTRODUCTION

- ***Background***: The transport sector represents a quarter of global CO_2 emissions and is known as one of the main causes of global warming. Reduction of global transport-related CO_2 emissions to achieve the goal of limiting warming to below 2℃ and 1.5℃ will be challenging.
- ***Question***: There is limited information on whether and how transport policies affect the mitigation cost and whether these policies are conducive to achieving the stringent global temperature limits of below 2℃ and 1.5℃.
- ***Difficulties***: On one hand, existing IAMs (e.g. AIM/CGE) represent transport at a highly aggregated level, but technological details and behavioral determinants are not incorporated. On the other hand, transport mode choice decision models fail to capture the dynamic interaction between transport sector and macro-economic system.

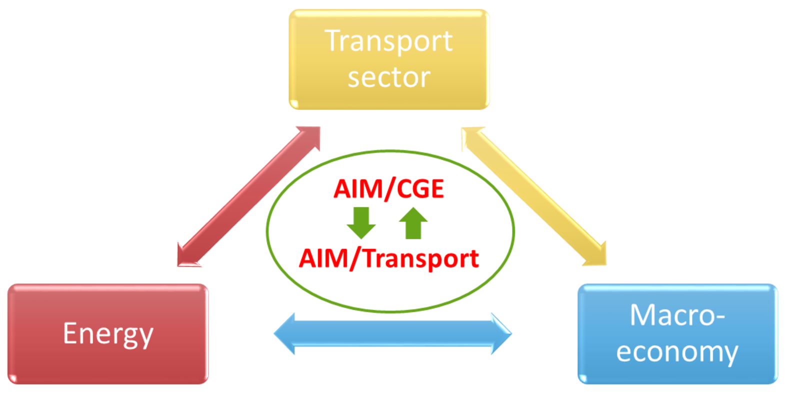

Figure 1. Research framework

- ***Objective***: To achieve a better understanding of the role of transport policies for climate change targets, the main purpose of this research was to assess the impacts of transport policies on mitigation potential and cost for the goal of limiting warming to below 2℃ and 1.5℃.

METHODOLOGY

- A transport model, AIM/Transport, is developed to project the global passenger and freight transport demand for different modes and technologies and transport-related energy use, incorporating transport mode choice and technological details.
- AIM/Transport is coupled with a global computable general equilibrium model AIM/CGE to capture the interactive mechanism between the transport sector and the macroeconomy.
- An iterative method was used to integrate AIM/CGE and AIM/Transport. The transport volume, transport-related energy consumption, and capital cost for transport device feedback from AIM/Transport is passed to AIM/CGE for parameter re-estimations of the transport sector in AIM/CGE.

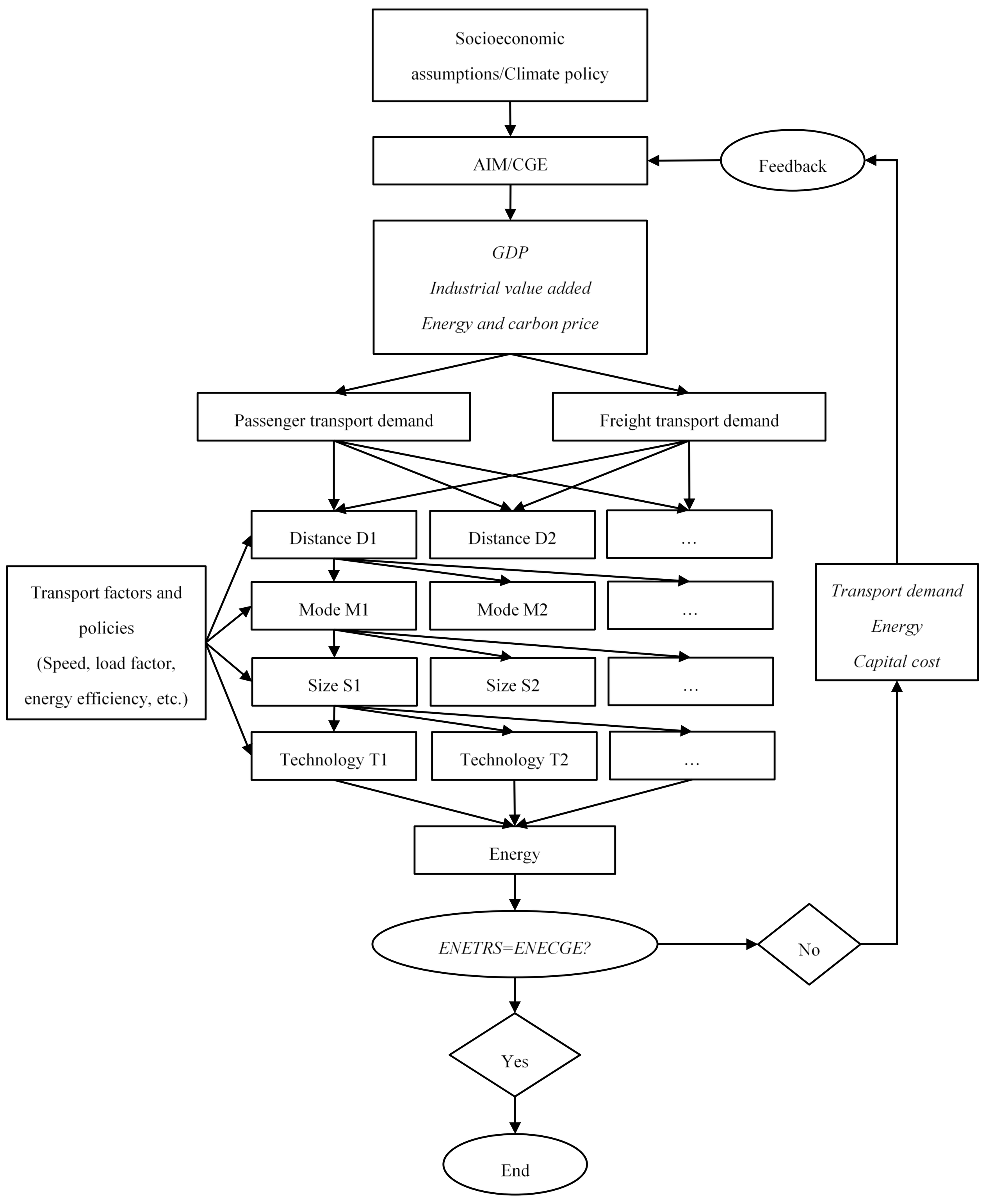

Figure 2. Model structure

Table 1. Scenario framework

Scenario	Description
Ei_High	50% improvement in LDV vehicle energy efficiency from baseline level will be achieved by 2050
Tech_Innovation	Higher preference factor is given to advanced technology vehicles compared to the conventional ICE-driven cars
Mass_Transit	The modal preference factors of Japan are employed as a proxy to reflect the preferences in mass transit-oriented development. Developing countries will gradually converge to Japan's preference factors in 2005 by 2100
Occu_High	The occupancy factor of a car will converge to two people per car by 2100
Low_Carbon	The combination of technological transformation and behavioral change

RESULTS

- ***Reference Scenario:***

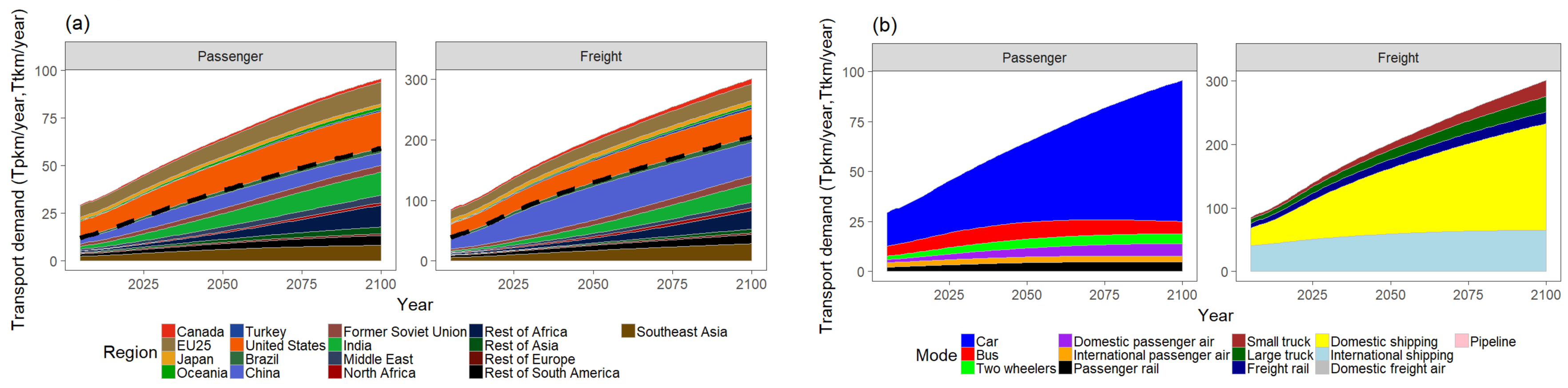

Figure 3. Region-wise (a) and mode-wise (b) transport demand from 2005 to 2100

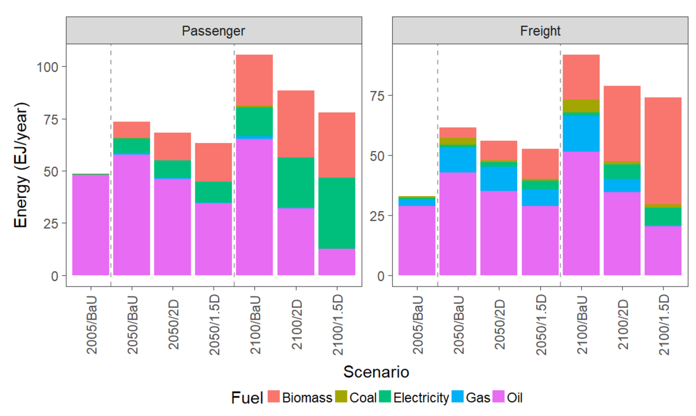

Figure 4. Energy consumption

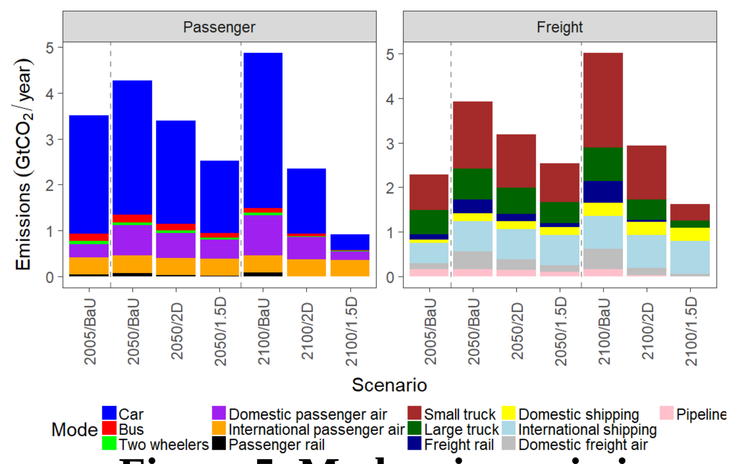

Figure 5. Mode-wise emissions

- For passenger transport, the European Union, the United States, and India account for a considerable proportion of travel demand in the world, while China plays the most dominant role in freight transport.
- The private travel mode plays an increasing role in passenger transport, while navigation maintained large shares in freight sector.
- Car and small and large trucks are the major transport modes contributing to CO_2 emissions, implying that road transportation is the primary emission source.

- ***Impacts of Transport Policies: Emissions***

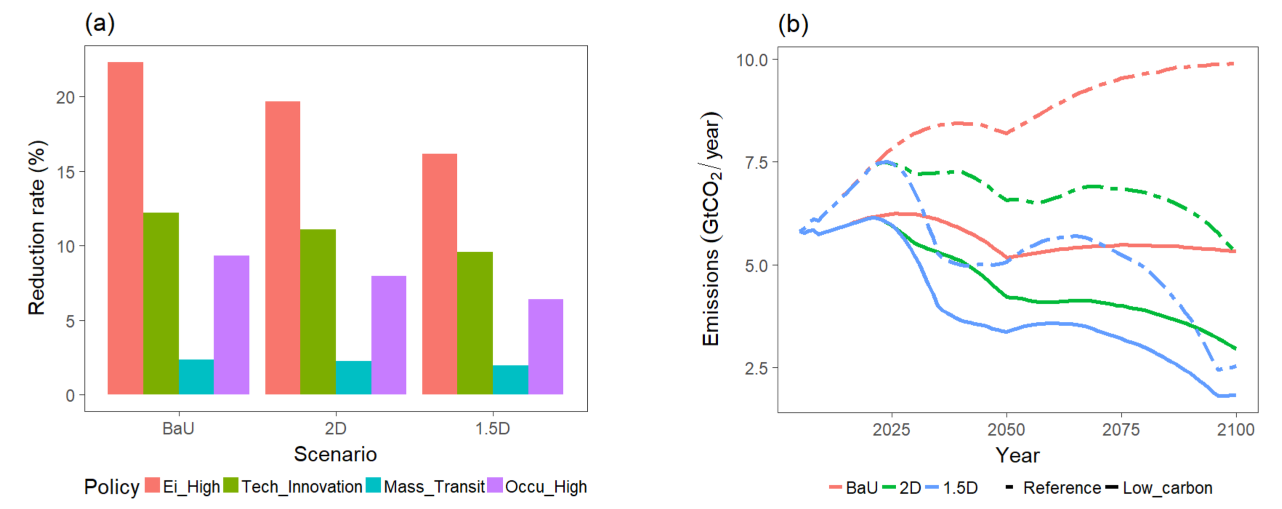

Figure 6. reduction potential (a) and emission trajectories (b) during 2005–2100

- Technological policies such as Ei_High and Tech_Innovation have significant impacts on emission reduction.
- Maximum emission reduction can be achieved with low-carbon transport strategies combining both technological and behavioral policies.

- ***Impacts of Transport Policies: Mitigation Cost***

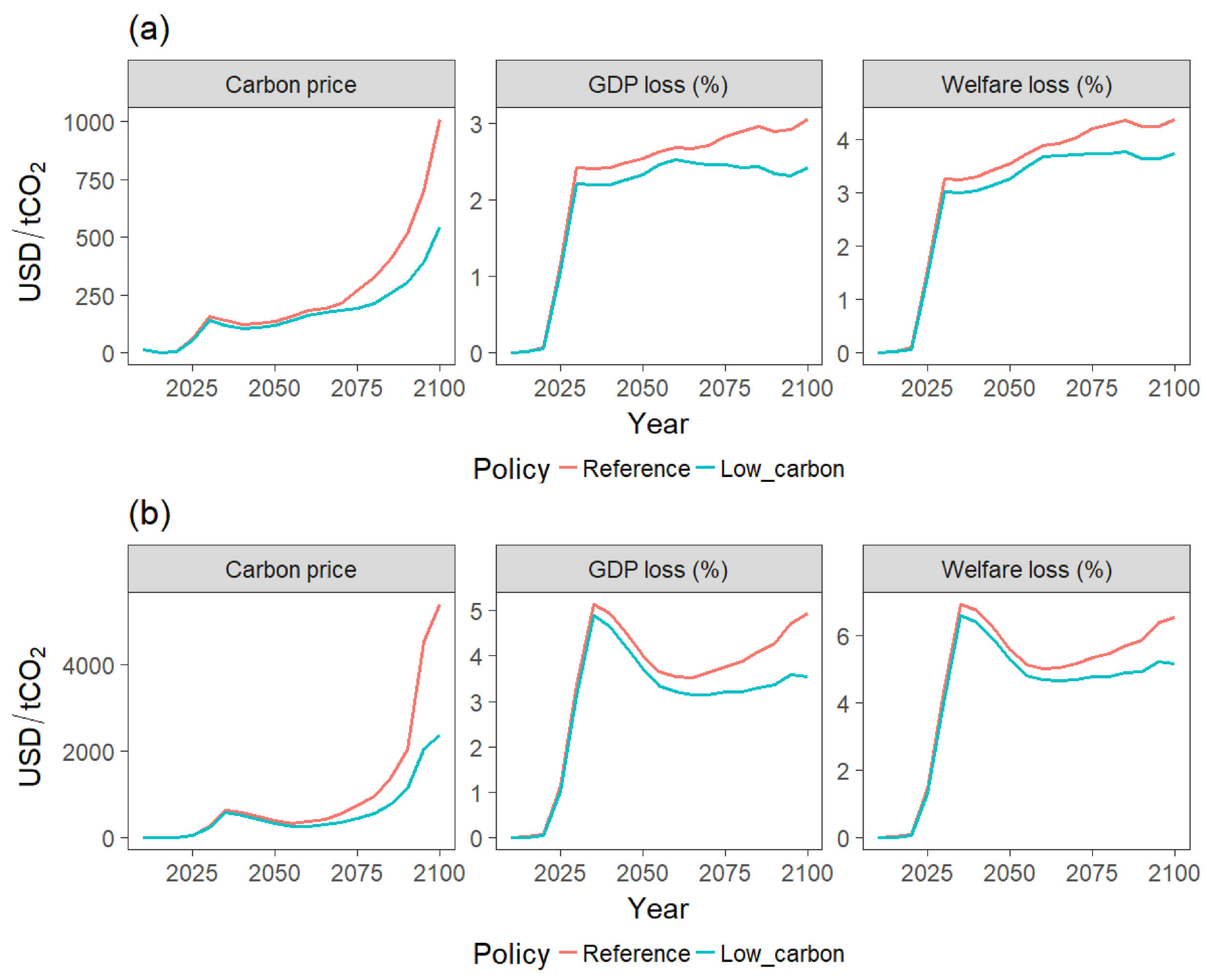

Figure 7. Mitigation cost metrics for 2°C (a) and 1.5°C (b) targets

- The carbon price, GDP loss rate, and welfare loss rate can be reduced in the Low_Carbon scenario.
- The degree of contribution of transport policies is more effective for stringent climate change targets.

DISCUSSIONS & CONCLUSIONS

- The integration of the transport model and CGE model can enrich transport representation in an integrated assessment model and capture mode and technological factors.
- Transport policy interventions such as energy efficiency improvements, vehicle technology innovations, public transport development, and increasing the vehicle occupancy rate alter global transport-related energy consumption composition and emission trajectories.
- Transport policies provide an effective contribution to modifying the mitigation cost, and the transport sector deserves more attention for achieving stringent climate change mitigation targets.

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