Advances in transport modeling

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Four key messages

Transport systems play a critical role in future energy transitions

New trends and disruptive innovation bring opportunities and challenges

Policies are the game changer

Data is the new oil

Three building blocks for modelng the future

Transitions

Transport systems play a critical role in achieving a sustainable future

- Several emerging trends may lead to a transition in transport sustainability
- But the future is highly uncertain, depending on the development of **demand**, **consumer choice** and **technology**

Policies

Policies can create the conditions that favor these transitions

- Must be carefully designed with a good understanding of the drivers of behaviors
- New trends and disruptive innovation bring opportunities and challenges

Data

is the new oil

New research frontier: Big Data, Machine learning and AI

- Many challenges in using Big Data effectively
- But, the potentials for drastically improving understanding and management of future systems are limitless!

Developing future scenarios is anticipating

Global trends

Policy & tech change

Markets and geopolotics

Three Revolutions

1. Electric vehicles, trucks, ships, airplanes

- Emissions, efficiency benefits
- Range, cost concerns

2. Mobility as a service (MaaS)

- Car/ride/bike/scooter sharing

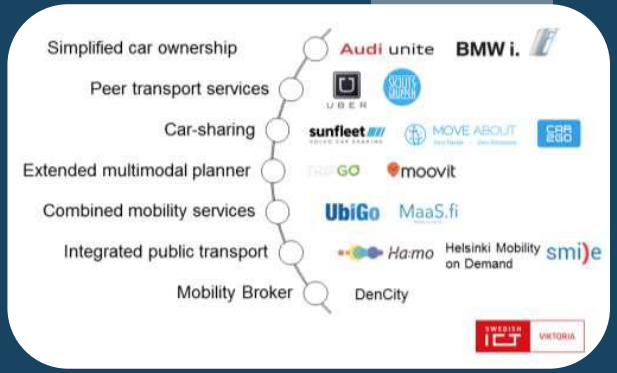
3. Autonomous vehicles

- Safety, traffic benefits
- Unknown impact on total travel demand
- The end of private vehicles?
- More parking space?
- Shared or not shared?

Policy led transition

Consumer led transition

Industry led transition



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- Safety, traffic benefits
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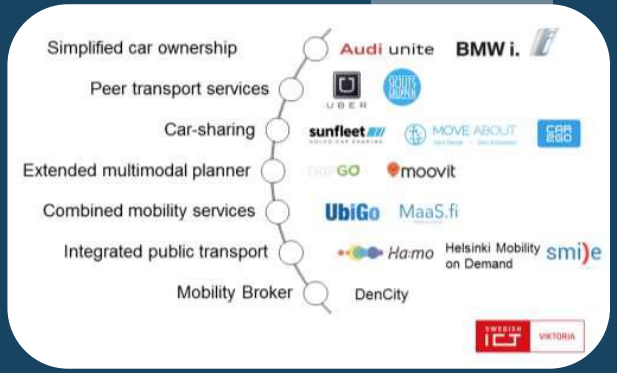
4. Artificial intelligence (AI)
- Efficiency, new usages, new *technology* /*service*

Industry led transition

Policy led transition

Consumer led transition

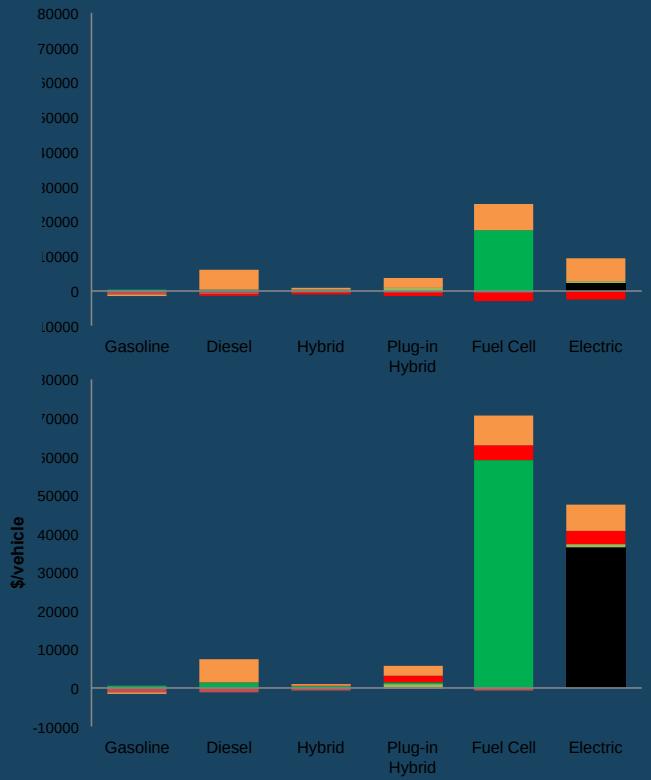


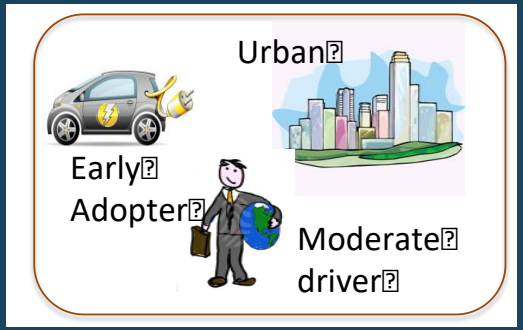
Major Uncertainty: Consumer Choices

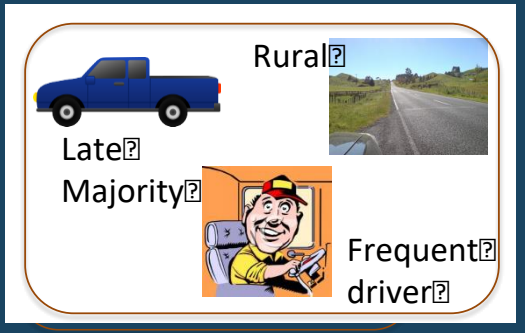
- Vehicle cost
- Fuel cost
- Refueling station availability
- Range Anxiety cost
- Model availability
- New technology risk premium
- Towing capability
- Supply chain logistics
- Willingness to pay

Barriers translate to real and perceived costs for consumers

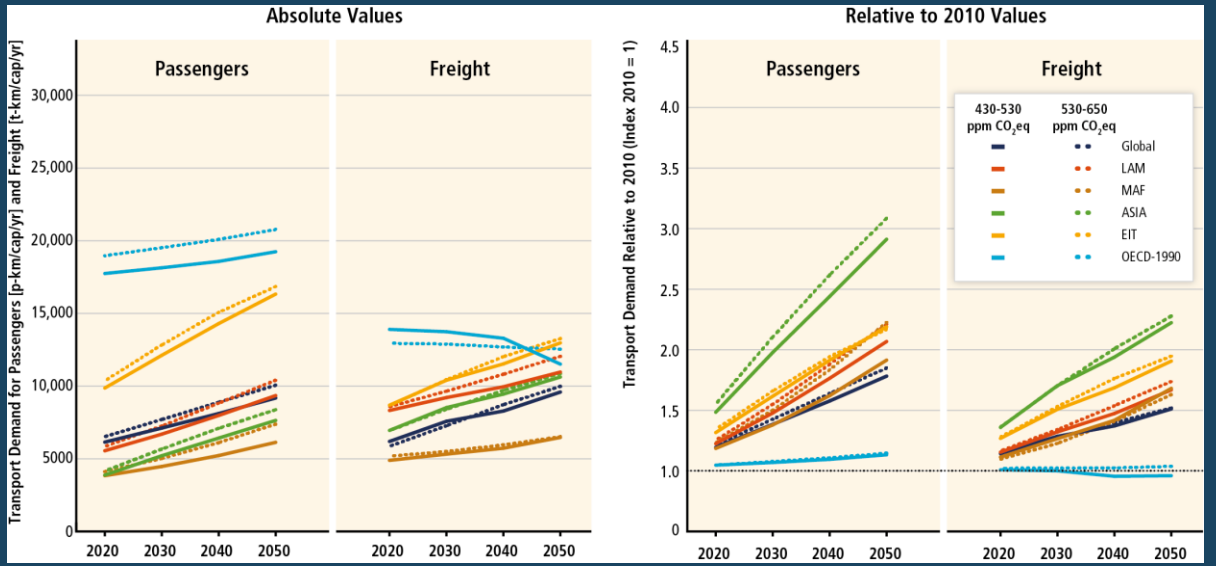
- Model Availability cost
- Risk Premium
- Refueling inconvenience Cost
- Charging Refueling Cost
- Towing Cost
- Range Anxiety Cost





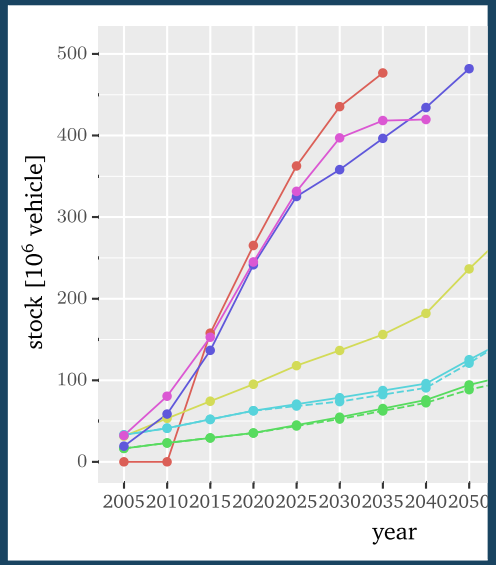


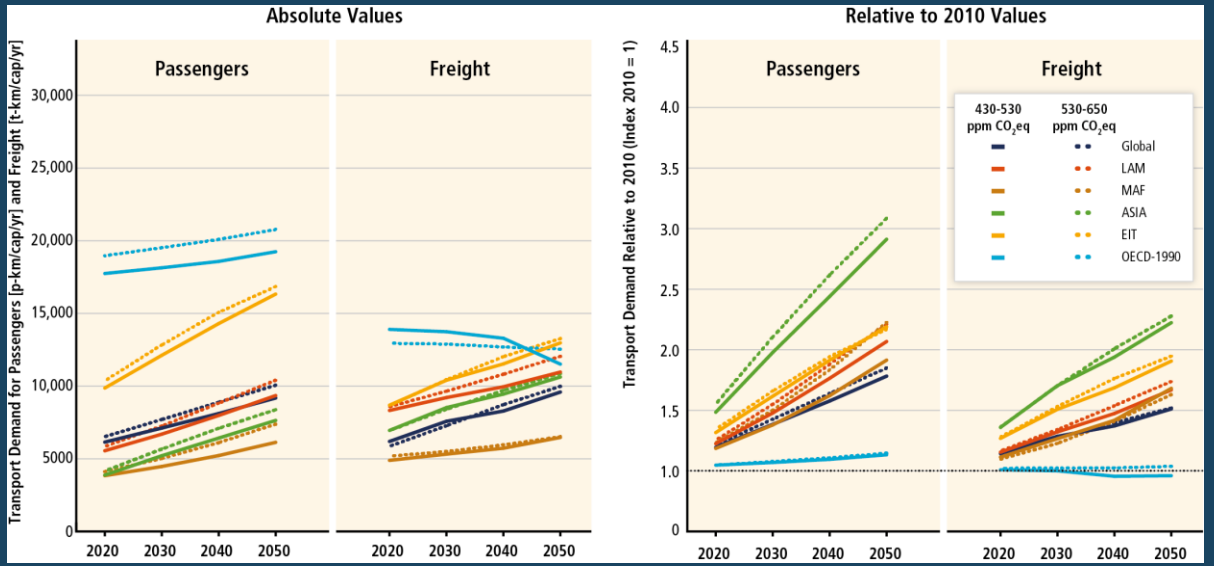
Major Uncertainty: Demand growth



Major Uncertainty: Demand growth

- Huge uncertainty about China: China's LDV stock
- Will there be 90 million cars or 500 million cars in China by 2050?





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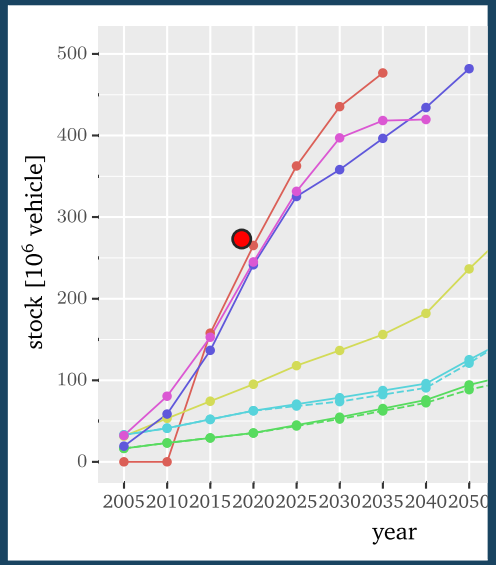

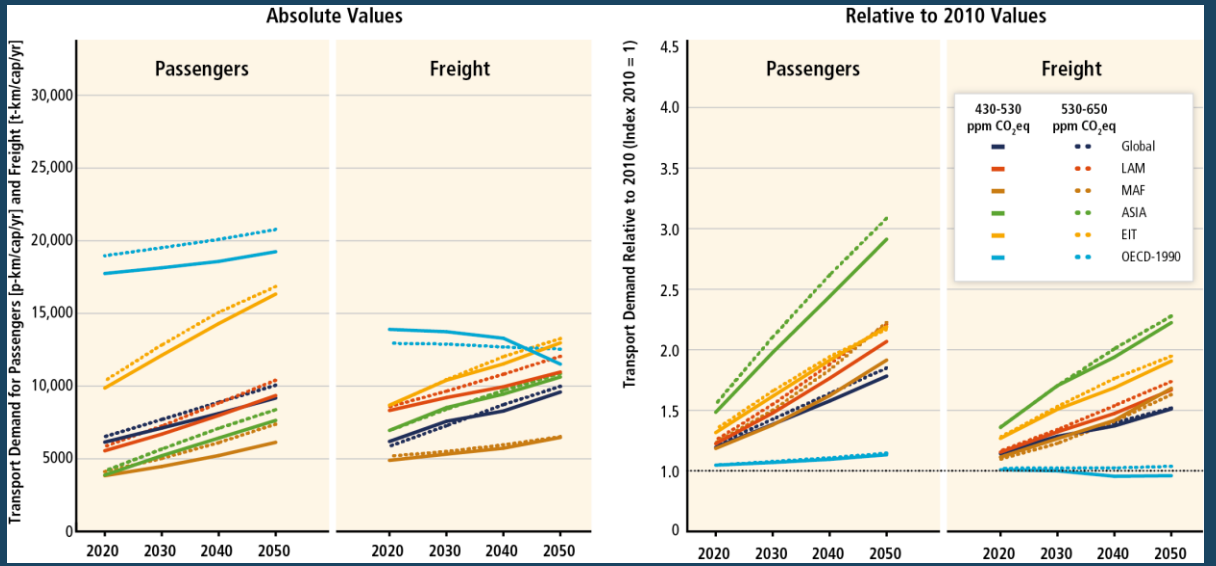

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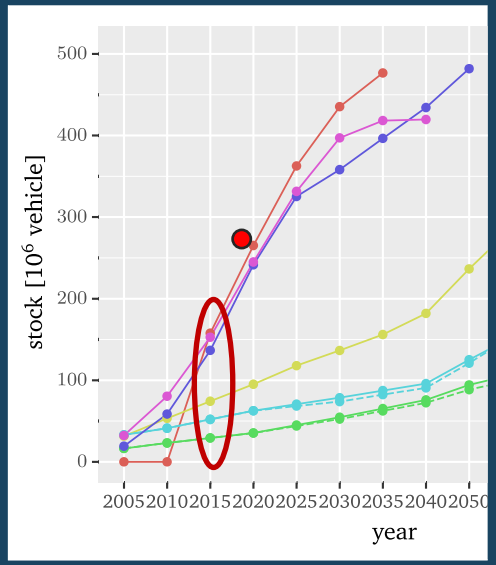

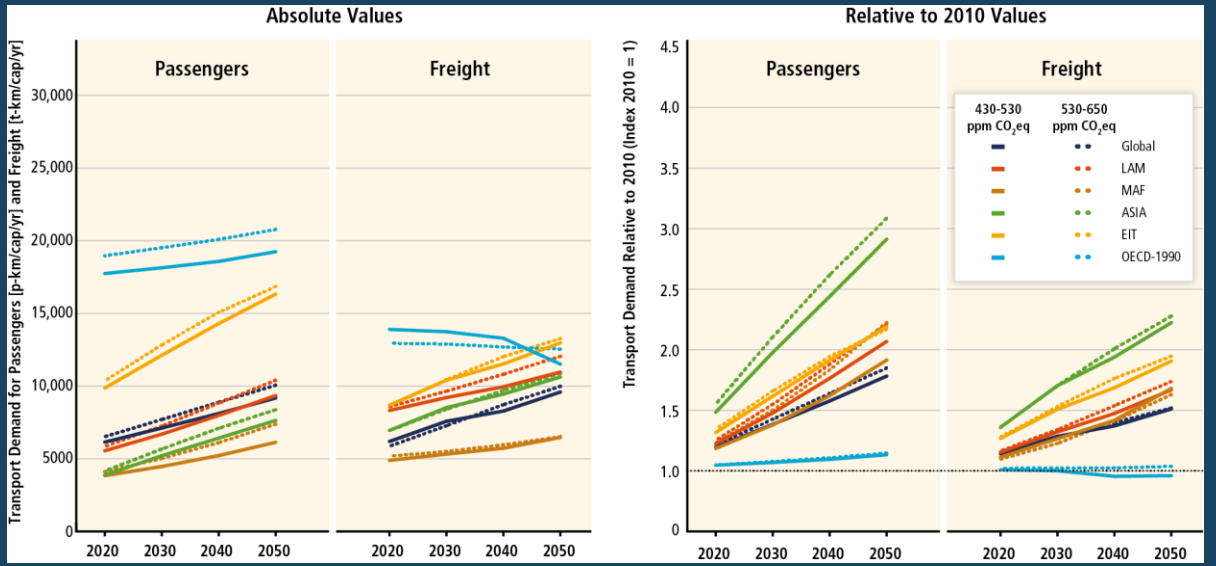

How much did people travel? How certain are we?

International Transport Energy Modeling (iTEM) comparison, thousand PKM/capital/yr, all modes, 2015

	Australia	Brazil	China	U.S.
BP	26.2	5.4	5.0	23.1
PNNL-GCAM	21.7	8.3	8.4	26.6
ITF-OECD	33.7	6.9		15.2
IIASA-MESSAGE	43.5	5.4	4.5	27.7
IEA-MoMo		4.2	6.3	19.7
ICCT-Roadmap	17.5	8.4	6.5	26.8

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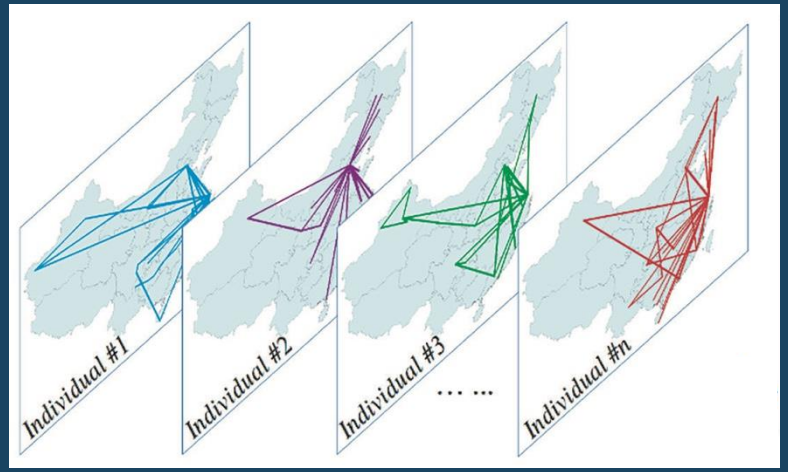
"To realistically model individual mobility in cities at both micro- and macrolevel, it is necessary to understand the essential features of a population distribution in space at different times."

Jiang, S., et al. (2016). "The TimeGeo modeling framework for urban motility without travel surveys." Proc Natl Acad Sci USA **113**(37): E5370-5378.

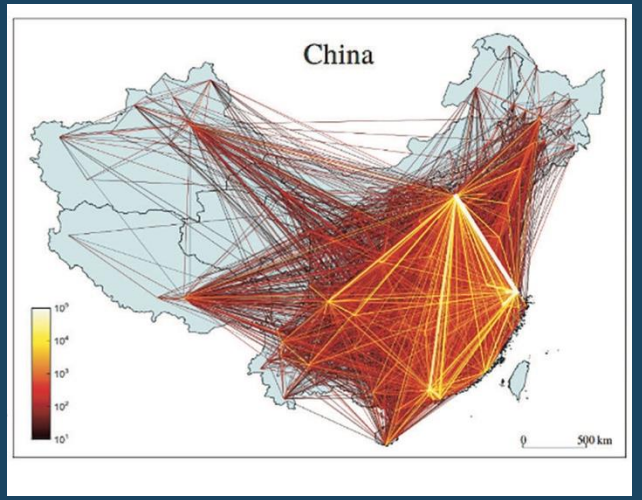
What is human mobility?

The geographic displacement of human beings in space and time, seen as individuals or groups.

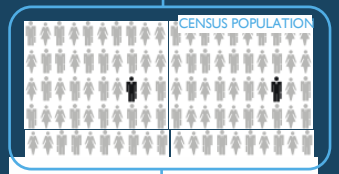
Individual mobility

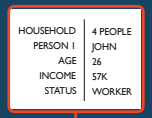


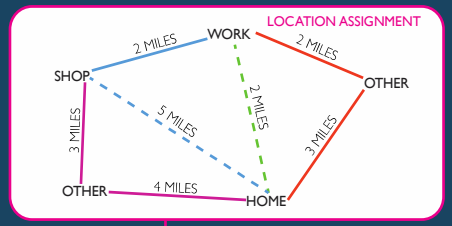
Population mobility

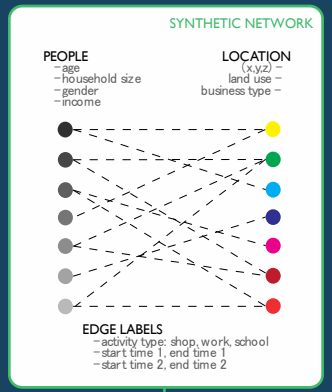


Source: Yan et al, 2017









DISAGGREGATED POPULATION GENERATOR

DISAGGREGATED SYNTHETIC POPULATION

ACTIVITY, LOCATIONS, & ROUTE ASSIGNMENT

SYNTHETIC SOCIAL CONTACT NETWORK

Sonia Yeh, Department of Space, Earth and Environment, Chalmers Univ.

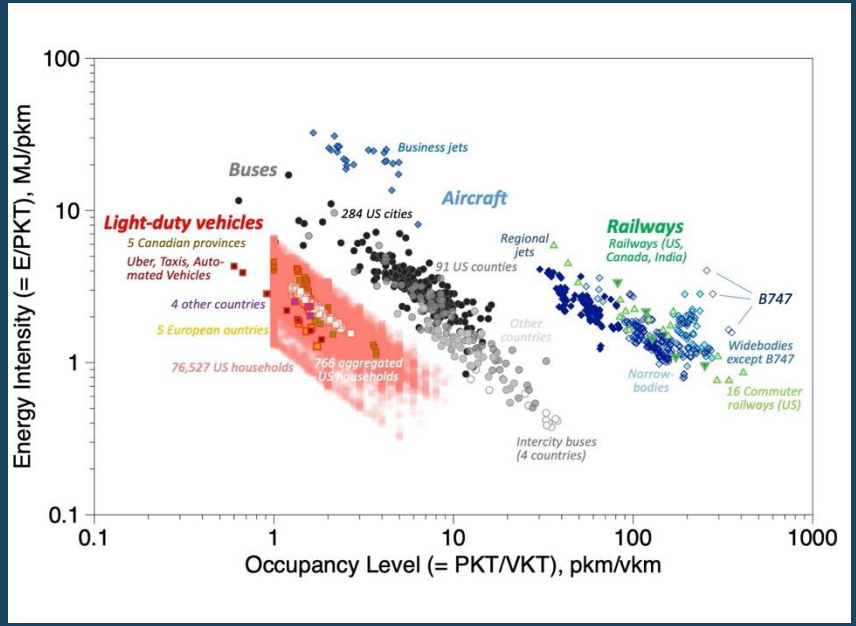
A Holistic Perspective on Passenger Travel Energy and Greenhouse Gas-Intensities

Passenger ransport emissions are mostly explained by

- Occupancy
- Travel distance

Reduce emissions from travel:

- **Sharing**
- **Electrification**
- Reduce demand
- Emission fees



Source: Schäfer and Yeh (2020)

Advances in Transport Modeling

Understand how we move from today to the future

- Describing, predicting and simulating emerging trends and patterns of **mobility** at various scales: city, region, country and global.

Identify effective policy solutions to get us from where we are today to where we want to be in the future

- Developing quantitative tools to evaluate policy options that support energy transitions

Making projections is hard!

Prescribing solutions is even harder!!

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