The contribution of new mobility technologies and services to climate change mitigation and economic welfare

TÉCNICO LISBOA

CENTER for INNOVATION, TECHNOLOGY and POLICY RESEARCH

Authors: Tatiana Bruce da Silva[1], Patrícia Baptista[2], Carlos Santos Silva[1], Luan Santos[3]

[1] IN+ Center for Innovation, Technology and Policy Research, LARSys, Instituto Superior Técnico, Universidade de Lisboa
[2] IN+ Center for Innovation, Technology and Policy Research, LARSys, Associação para o desenv. do Instituto Superior Técnico, Universidade de Lisboa
[3] Production Engineering Program (PEP/COPPE/UFRJ)

IAEE Online Conference, 08/06/2021

Outline

1- Motivation, Background and Objective

2- Results of the analysis

3- Conclusion and next steps

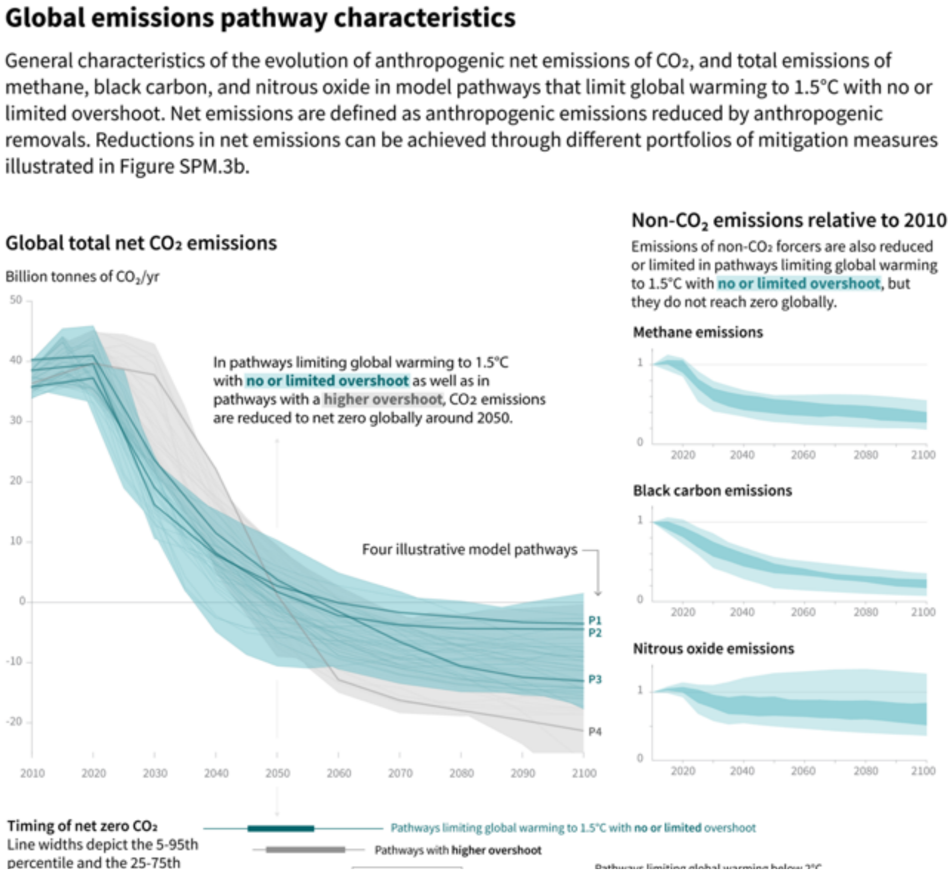
CENTER for INNOVATION, TECHNOLOGY and POLICY RESEARCH

Motivation, Background and Objective

CENTER for INNOVATION, TECHNOLOGY and POLICY RESEARCH

IN+
CENTER for INNOVATION, TECHNOLOGY and POLICY RESEARCH

In order to limit global warming to 1.5 degrees Celsius until the end of the century, and avoid catastrophic climate change, the world must attain zero GHG emissions around 2050, that is, “reach carbon neutrality”, while having negative emissions from 2050 onwards. (IPCC, 2018)



Transportation is a difficult sector to decarbonize

Options:

- Renewable fuels (e.g.: hydrogen, biofuels)
- More efficient technologies (e.g.: electric vehicles)
- More sustainable mobility (e.g.: public transportation, active modes)
- Behavioral changes

CENTER for INNOVATION, TECHNOLOGY and POLICY RESEARCH

Behavioral changes: actions from the demand side to induce change in transportation consumption

- Shifting from ownership to service consumption
- Matching capacity to use

Technologies and services to promote that

- Carsharing
- Ride-hailing
- Autonomous vehicles

CENTER for INNOVATION, TECHNOLOGY and POLICY RESEARCH

Objective

Analyze the current literature on new mobility technologies and services to assess how they may contribute to changes in vehicle use and ownership, as well as adoption of alternative services, with the consequent impacts in terms of energy use, its associated emissions, transportation decisions, and overall economic welfare of the population.

CENTER for INNOVATION, TECHNOLOGY and POLICY RESEARCH

Results of the analysis

CENTER for INNOVATION, TECHNOLOGY and POLICY RESEARCH

Overall, direction of effects is fairly the same across studies, but their magnitude is influenced by assumptions made

Vehicle Ownership	VKT/VMT	CO_2 emissions	Other transit modes	Economic welfare
Carsharing				
Lower vehicle ownership across studies (range: 3 – 80% reduction)	**Lower** VKT/VMT across studies (range: 2 – 83% reduction)	**Lower** emissions across studies (range: 4 – 67% reduction)	- **Increases** public transit and active modes' use - **Complements** transit (fills gaps) - **Substitutes** private/rented cars	**Increases** welfare: more access to households, fills mobility gaps, cheaper than vehicle ownership
Ride-hailing				
Inconclusive, but there is a negative trend among users (either reduced car ownership or intention to shed a vehicle)	**Higher** VKT/VMT across studies (range: 8 – 157% increase), mostly due to deadheading	**Lower** emissions, which are mostly due to the modelling of shared/pooled services and EVs across studies	Mostly **substitutes** modes. Results across studies: - Public transit: 17 – 31% - Public transit and active modes: 34 – 58% - Private cars and taxis: 19 – 83%	**Increases** utility for users and grants positive externalities, but also **increases** congestion and **reduces** traffic speed, which may negatively impact welfare
Autonomous vehicles				
Not much studied. Some papers show that shared autonomous vehicles (SAVs) decrease ownership	**Higher** VKT/VMT across studies (range: 2 – 47% increase). SAVs mitigate impacts	**Lower** emissions across studies (range: 3 – 87% reduction) when performance is optimized, increased fuel efficiency, etc.	**Substitute** public transit and active modes	**Increase** welfare for users and reduce system's operating costs. May increase congestion, but impact is mitigated with SAVs

IN+ CENTER for INNOVATION, TECHNOLOGY and POLICY RESEARCH

Carsharing

- Impacts vary across studies due to several factors: region; density; built environment; public transit accessibility; and carsharing service and business model
- Overall, carsharing leads to:
  - Reduced vehicle ownership
  - Reduced vehicle kilometers traveled (VKT)/vehicle miles traveled (VMT)
  - Reduced emissions
- Fuel efficiency is improved if the carsharing fleet is comprised of energy efficient vehicles
- Interaction with other transit modes: impacts are mixed and depend on type of carsharing service
- Finally, carsharing is providing utility to customers

Ride-hailing

- Mostly substitutes other transit modes and increase VKT/VMT, especially due to deadheading
- Energy impacts are not ideal, but welfare impacts are:
  - In Brazil, used as an alternative to unsafe transportation modes
  - In Cape Town, counters for insufficient mobility services
  - In São Paulo, positively impact accessibility of workers in the job market
- Therefore, the design of an effective sustainable transportation system must account not only for its energy impacts, but also for the benefits it brings to society

CENTER for INNOVATION, TECHNOLOGY and POLICY RESEARCH

Autonomous vehicles

- Benefits:
  - Provide mobility to underserved populations (the disabled, elderly, and children)
  - Reduce the opportunity cost of travelling (multitasking on board)
  - Improve security and efficiency of travel
  - Reduce overall number of vehicles and parking spaces
  - Lead to population clustering in urban areas
- Drawbacks:
  - Increase VKT/VMT, energy use and emissions
  - Contribute to urban sprawl, job displacement and unemployment
- Overall, impacts are still unclear: benefits at the vehicle level may be offset by greater vehicle utilization and shifts in travel patterns at the society level

Conclusion

Conclusion

- Impacts of new mobility technologies and services on energy consumption and emissions have been fairly studied
- While the promotion of these services may be policy driven, there is no approach, however, that considers the two perspectives of energy use and economic welfare
- By impacting the welfare of agents, new mobility technologies and services that are employed as policy solutions to improve energy consumption may further affect productivity and the economy
- Such outcomes have yet to be measured and are under development by the authors

CENTER for INNOVATION, TECHNOLOGY and POLICY RESEARCH

NEXT STEPS:
The contribution of new mobility technologies and services to climate change mitigation and economic welfare in Rio de Janeiro state, Brazil

TENTATIVE SCHEDULE

Use OSeMOSYS to develop a model of Rio de Janeiro's energy system

Fall 2020 ✓

Model new mobility technologies and services into OSeMOSYS

Spring 2021 ✓

Develop a general equilibrium model and link it to the energy system/mobility model to assess welfare implications

Fall 2021

Propose policy solutions to achieve different outcomes

Spring 2022

CENTER for INNOVATION, TECHNOLOGY and POLICY RESEARCH

Thank you!

E-mail: tatiana.silva@tecnico.ulisboa.pt

TÉCNICO LISBOA

IN+ CENTER for INNOVATION, TECHNOLOGY and POLICY RESEARCH