

Capacity Area B1 Topic 3.1 Deliverable 2

Analysis of causal relationships and trade-offs between mobility and other consumption areas

An analysis of relationships and trade-offs between mobility and other consumption areas was conducted mainly based on the model and sub-models developed in Deliverable 1. The insights gained do not only advance our understanding of mobility behavior of households, but can also be used for setting up future mobility scenarios. Furthermore, these analyses confirmed that the developed model is ready for application to assess highly resolved future mobility scenarios in the context of total household consumption. In addition, first investigations on the relationship between mobility impacts and population density could be conducted.

Further interesting insights are expected by comparing the conclusions of this deliverable with the findings of Deliverable 1. Most of the insights obtained from this deliverable are presented in two peer-reviewed scientific articles [1, 2]. However, additional research has been conducted for this deliverable, which is summarized in an internal report.

Summary (mainly based on the internal report)

In order to investigate the relationships and trade-offs between mobility and other consumption areas, various analyses were performed on different levels. On a household level basis, different feature importance techniques were applied to the Swiss household budget survey. Furthermore, the different archetypical consumption patterns found in [1] were scrutinized in the context of mobility behavior and an additional univariate prevalence-weighted correlation analysis was conducted. Furthermore, the overall model from Deliverable 1 was used for an in-depth investigation of potential drivers of carbon footprints on a municipality level. Finally, the estimates for individual households from the overall model were used for a spatially highly resolved analysis of the relationship between mobility greenhouse gas emissions and population density on a hectare-basis [2].

The most important conclusions from above analyses can be summarized as follows. Please note that the following bullet points describe observations by trend, which might not apply in all situations:

- Transport (together with housing) is the most important category of greenhouse gas emissions induced by household consumption.
- Mobility is also for all individual households the most important or the second most important contributor to environmental impacts (few exceptions).
- Car trips dominate mobility footprint.
- Higher income leads to higher mobility emissions (total and per-capita).
- Smaller households use cars more often, while families have higher impacts from "transport services" by trend.
- Older households have higher per-capita housing and health impacts but have clearly lower transport impacts (as well as communications impacts). Furthermore, younger households compensate lower food-impacts by higher restaurant-impacts.
- If households have high expenditures in one mobility-related consumption area, they tend to have high expenditures in other mobility-related areas. Therefore, if a household is mobile, it does not restrict itself to a single traffic mode. Furthermore, we observe correlation of higher than average mobility demand along with higher expenditures for restaurants, cultural, and sports services, revealing the importance of recreational activities for mobility behavior.
- Rural dwellers have higher mobility impacts due to larger emissions from car-driven distances. This is partly compensated by urban inhabitants' larger demand for air travels and taxi rides (as well as higher impacts in the category of restaurants and hotels).

- Increasing population density is associated with decreasing total/mobility environmental impacts (but this levels off at a certain density). Impacts from different density areas most often differ because of mobility and housing. Low density is associated with longer transport distances and poor public transport services).
- One of the most important factors influencing the municipal carbon footprints is the share of people in a municipality living in an area with poor access to public transport services.

References

- [1] A. Froemelt, D. J. Dürrenmatt, and S. Hellweg, *Using Data Mining To Assess Environmental Impacts of Household Consumption Behaviors*, *Environ. Sci. Technol.*, vol. 52, no. 15, pp. 8467–8478, 2018.
- [2] A. Froemelt, R. Buffat, S. Hellweg, *Machine Learning Based Modeling of Households: A Regionalized Bottom-Up Approach to Investigate Consumption-Induced Environmental Impacts*, accepted by *Journal of Industrial Ecology*, 2019.