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The materiality of mobility
A case study for the City of Vienna, Austria

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Speaker video

Structure and abstract

Methodology

We present a stock-driven or bottom-up material stock analysis, combined with a stock-flow-service nexus approach.

Results

99 Mt of mobility stocks in Vienna, 3.5 Mt/yr of material flows for expansion and maintenance, 16 PJ/yr of primary energy, 1.2 Mt/yr of CO_2-equ and 1,700 million trips/yr

Stock-flow-service indicators of four mobility modes – pedestrian, bicycle, public transport and motorized individual traffic.

Conclusion

high resource intensity of MIT, also regarding material stock and flow intensity; trips vs. distances as a proxy for services

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The socio-ecological relevance of urban mobility stocks

- Cities are important for sustainable development
- Medium-sized cities incorporate larger shares of the global population than megacities and their size allows more flexibility of urban development
- Mobility stocks need substantial amounts of resources and persist for a long time → path dependencies / lock-in effects

Vienna

- traffic-related GHG-emissions increased by 59% (1990-2014) and population is growing
- The City of Vienna aims for a CO_2-neutral transport sector until 2050 and for a reduction of the related per-capita final energy consumption by 70%

Speaker video

Sources: Krausmann et al. 2018, Haberl et al. 2017, , IRP 2018, MA23

Aim and methodology

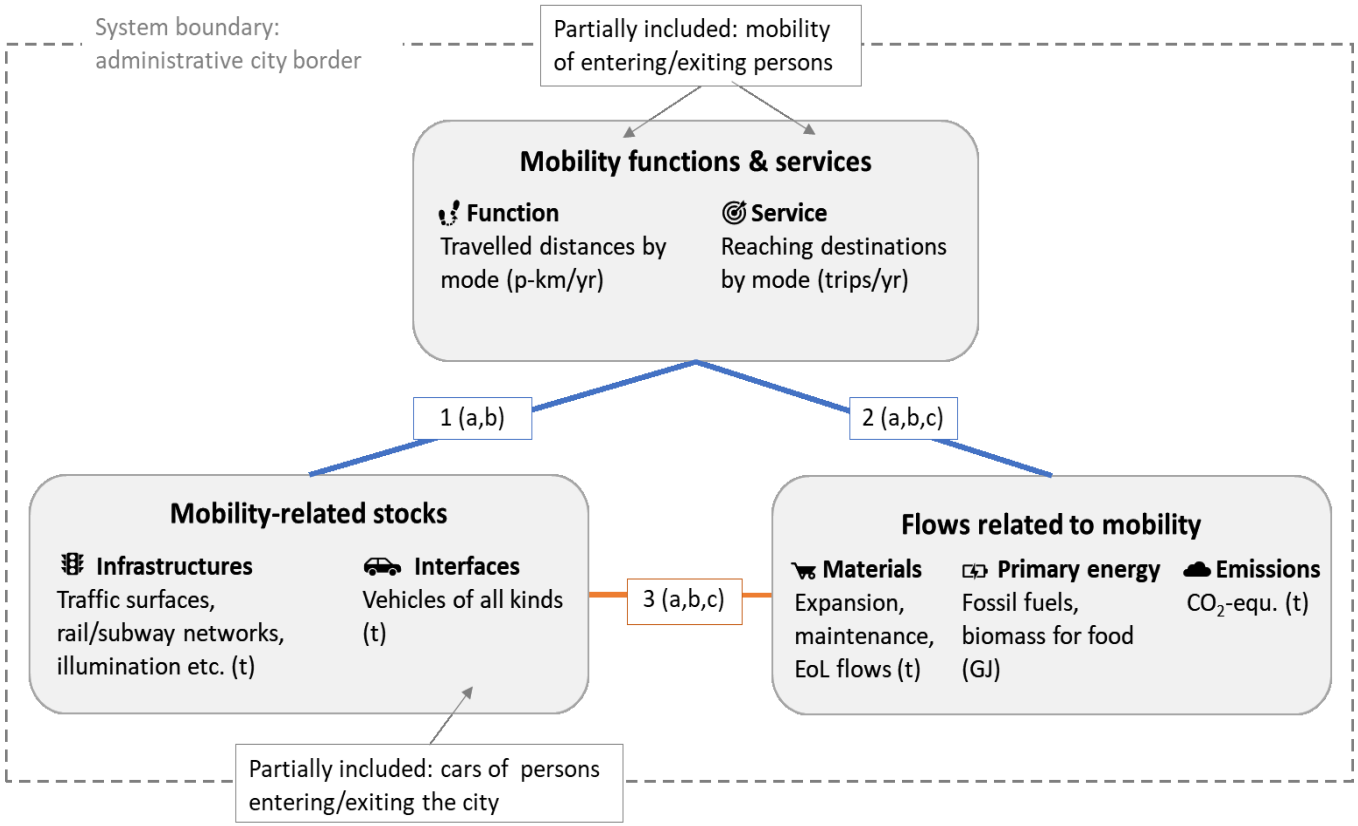
- Mass-balanced approach building on the concept of social metabolism: material and energy flow analysis
- Stock-driven / bottom up analysis of material stocks
- Quantification of material stocks for mobility within city territory:
  - roads, rail, subway and tram infrastructure and
  - interfaces or vehicles such as cars, bicycles, trains, trams and busses
- Quantification of material flows for maintenance, expansion, primary energy use and emissions linked to personal mobility
- Stock-flow-service indicators for four different mobility modes:
  - pedestrian mobility
  - bicycle mobility
  - public transport
  - motorized individual traffic

Data sources: statistical inventory (city of Vienna), material intensities from literature, providers of technical products and expert estimations

Speaker video

Sources: Fischer-Kowalski & Haberl 1998, Pauliuk & Hertwich, 2015, Krausmann et al. 2017

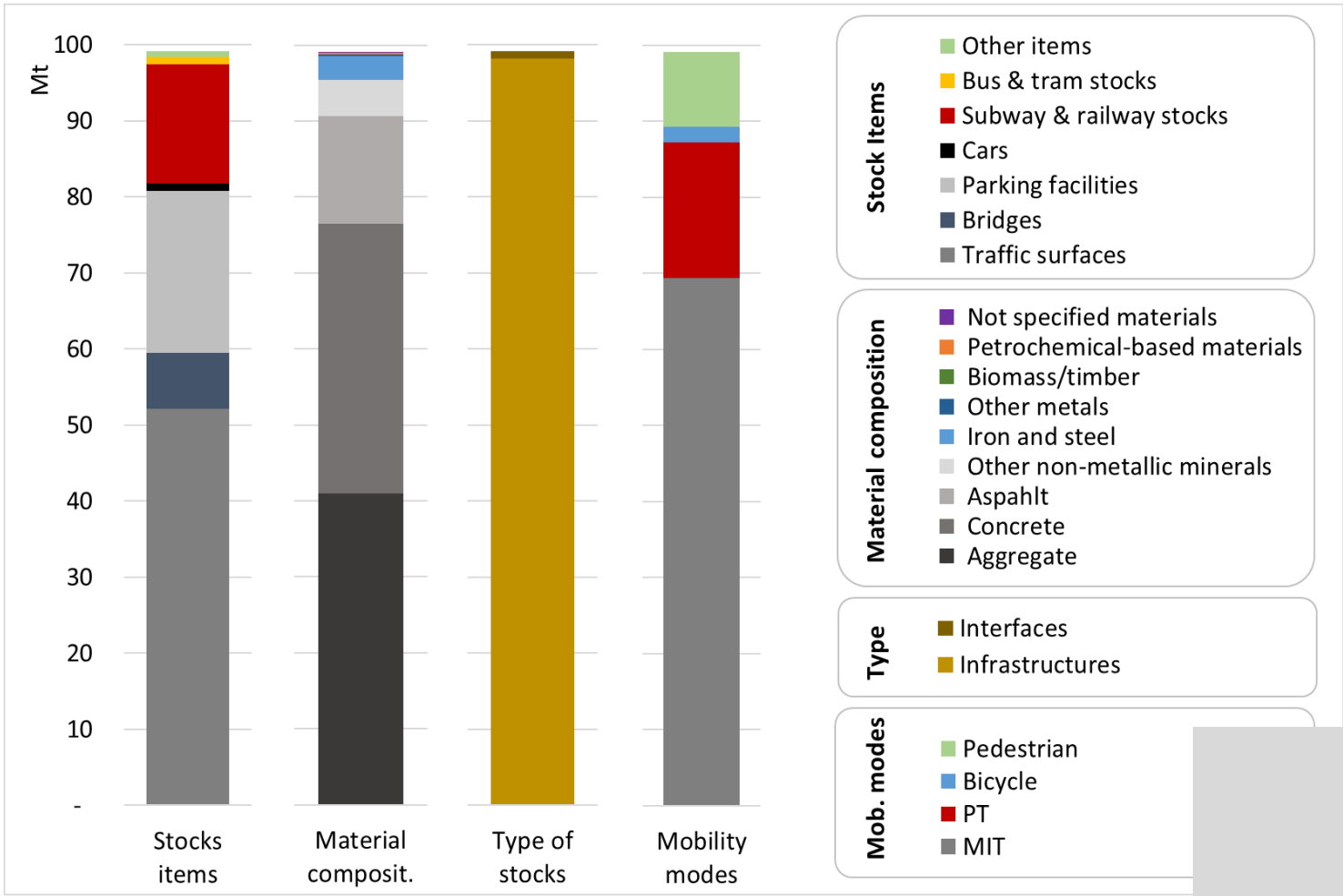
Methodological approach



Own illustration; Sources: Carmona et al. 2020, Haberl et al. 2017

Speaker video

Results: the mass of mobility stocks



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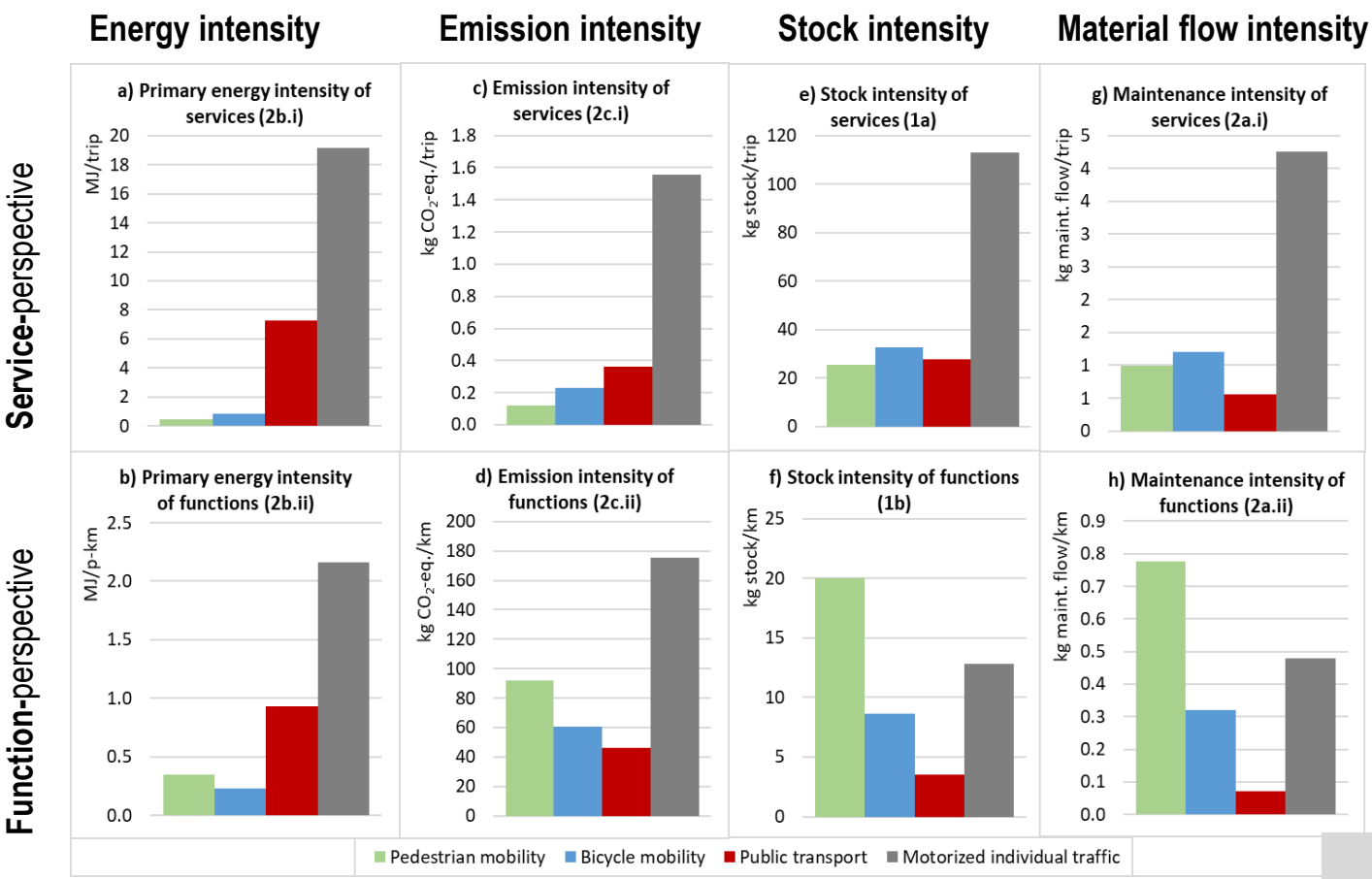
Own illustration

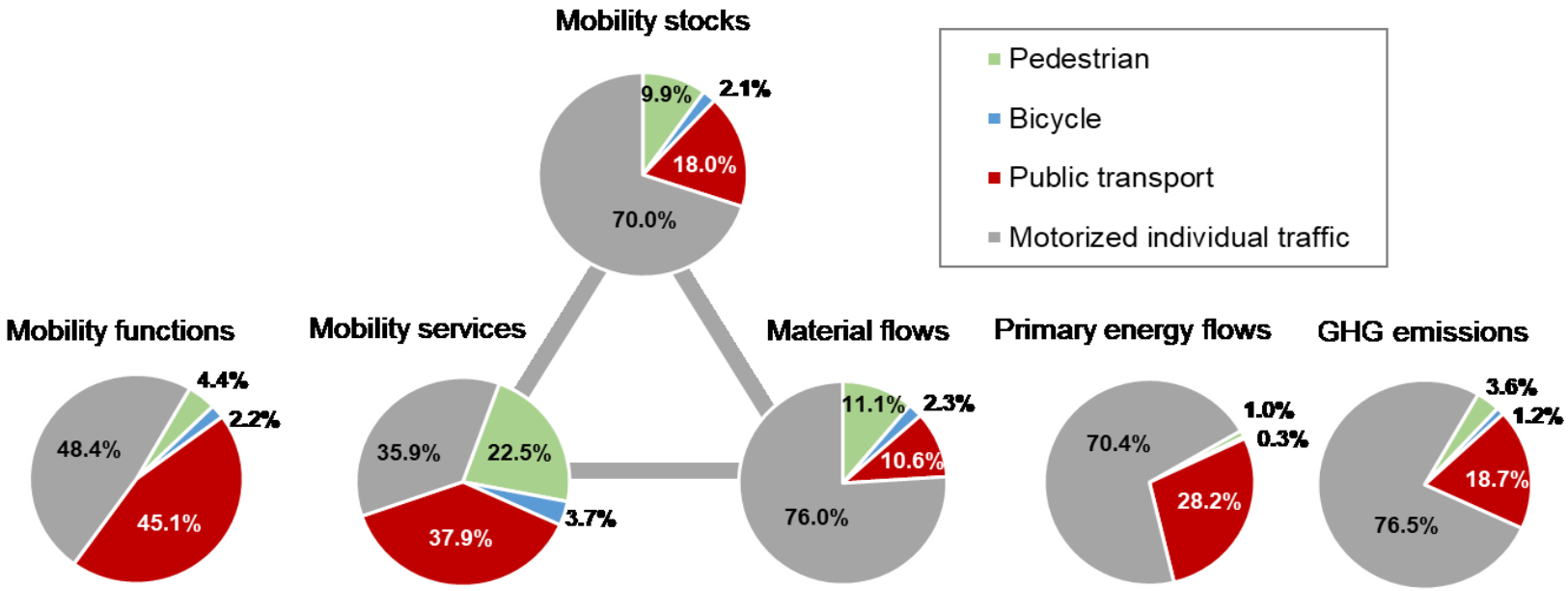
Results: stock-flow-service indicators



Own illustration

Speaker video

Results: stock-flow-service relations of four mobility modes



Own illustration

Speaker video

Discussion and limitations

- The novel perspective on resource requirements of mobility emphasizes the high resource intensity of MIT, not only in terms of fuel demand and GHG emissions but also regarding material stock and flow intensity.
- The number of trips as a proxy for mobility services is a first step in overcoming the widespread focus on km travelled - (longer) distances are rarely what 'people actually want' nor a significant contribution to wellbeing.
- Further promising extensions:
  exergy analysis of material stocks, the quantification of upstream material demands for building up material stocks and providing material flows, assessment of benefits such as dis-/pleasure of travelling, time savings, health effects or environmental impacts, spatially-explicit analysis

Speaker video

Policy implications

Insights of this analysis relevant to policy making:

1. Prioritization: Infrastructure-based measures have been the most successful in the past and are promising to reduce lock-in effects; traffic surfaces are of special importance
2. Stock-flow-service-relations are a helpful perspective for urban planning to gain a broader view on resource efficiency
3. Absolute reductions of distances travelled is necessary.
   Our analysis shows that especially trips to and from workplaces are long and MIT-intensive
4. Integrated planning with the greater region around the city – commuting activity into and out of the city plays an important role in determining urban mobility levels
5. Relevant monitoring has to be improved, especially of mobility

Speaker video

Sources: Magistrat der Stadt Wien, 2019, MA 18, 2014, Buehler et al. 2017, Alarfaj et al. 2020, Serrenho et al. 2017, de Blas et al. 2020

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