International Transport Forum | CPB Corporate Partnership Board

Workshop summary

Life-cycle assessment of urban transport options

Corporate Partnership Board of the ITF

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OECD

Discussion summary

Mode-replacement and comparison factors

Part of the LCA will require comparing alternatives and in that respect, it makes sense to compare like-to-like alternatives or plausible mode replacement behaviour with respect to the new mobility options that are the focus of this project.

- Evidence on mode-replacement is scarce and context-dependent.
- Dockless e-scooter sharing trips are mostly taking place over relatively short distances (4.7 km in Paris on average, generally less than 8 km). E-scooter trips have a greater tendency to displace movements by car in car-intensive cities of North America (30% of all e-scooter trips) than in France (8%), suggesting that car trip replacement depends on the broader context (e.g. with respect to modal choice/availability). Sizable shares of all e-scooter sharing trips replace walking (37% to 47% in surveys carried out in Portland and France, respectively) and public transport (10% to 30%). In France, e-scooters are often (1 out of 4 to 5 trips) used in combination with other modes, mostly (66% of all intermodal trips) with public transport. E-scooters also induced new trips (in particular for leisure, including in group rides) and have no or very small observed impact on reduced car ownership.
- Bike sharing is used for trips having similar distances to shared e-moped/motorscooters (5.25 km/trip, in France), displacing public transport in cities where it is widely available (France), and only marginally in more car-centric environments (United States), especially when it allows users to get to their destination more quickly and cheaply. Like other micro-mobility modes, bike sharing is used in roughly one trip out of 3 to 4 in conjunction with other modes (mostly public transport, in France).
- Car sharing tends to take place over relatively long distances (38 km in France) and displays . higher occupancy rates than private car travel. Thus it may reduce vehicle km travelled reduce car ownership due to and deferred vehicle sales.
- In France (and possibly in Europe) early evidence from the deployment of ride-sourcing indicates that it acts mainly as a substitute for traditional taxi services and public transport trips (typically for sub 15 km trips but longer airport access trips as well). It induces travel that would not have been taking place otherwise and has a very limited effect on replacing car trips.
- Despite the induced travel, ride sourcing also contributes to a reduction of car ownership, an observation that is consistent with the greater reliance on multi modal mobility options by users of ride sourcing services (in France, they have a higher rate of public transport subscriptions than the average). Changes on overall traffic activity are

small, as increased vehicle km on ride hailing services are compensated by reduced vehicle km travelled on personal cars.

- The offer and the adoption of different options are subject to the characteristics of the built environment (for example across urban centres, suburban areas, city edges, low-density residential areas at the urban fringe and rural areas) and the availability of other transport options. Impacts vary not only based on location, but also across different time slots (e.g. hour of the day and day of the week). Urban density and the quality of the alternative transportation options are important element to take into account, and so is the policy context (e.g. parking policy), especially for car sharing. Other aspects influencing adoption include convenience, cost and access to digital technology interfaces. For the development of the ITF CPB project, this variability suggests that it will be important to pick assumptions capable to represent cases with high relevance and contextualise the discussion of the results.

- The multimodal nature of micromobility trips, and in particular the joint use of e-scooters, shared bikes/e-bikes and e-mopeds/motorscooters with public transport in the case of France, suggest that micromobility solutions have the potential to reinforce public transport ridership by expanding the catchment areas, especially in the case of high capacity rail transport services.

Life-cycle assessment

- A large portion of the life cycle impacts from vehicle manufacturing (in particular energy use and GHG emissions) are imputable to the recovery of materials and their use for the fabrication of parts. Other relevant components relate mainly with fluids and the processes required for part assembly.

- Region-specific characteristics on the way materials are produced can have important impacts on the carbon intensities of steps like raw material recovery and material processing and fabrication. Some of these characteristics (e.g. the carbon intensity of the electricity used for aluminium production) have greater impacts than others. Instruments allowing to accounting for the main factors impacted by these major changes should be included in the work developed in this area by the ITF.

- Although there are differences in LCA methodologies (namely the use of the ‘recycled content’ (or ‘cut-off’) approach or the ‘marginal’ or ‘consequential’ approach), the impact of these differences on energy and GHG emissions for ICE vehicles using petroleum fuels and electrified vehicles are not leading to sizable discrepancies in results, especially if compared with other sensitivity parameters such as the conditions characterising raw material recovery, material processing and fabrication, the carbon intensity of the electricity used by the vehicles, variations in terms of vehicle mileage, vehicle lifetime, and, for battery electric vehicles, the frequency of replacement of battery

packs. Parameters influencing battery durability (e.g. the number of cycles for which different types of batteries have been designed for, but also the frequency of fast charging vs. slow charging practices) have been flagged as relevant to define the frequency of battery replacement.

- The life cycle impacts of battery manufacturing do not necessarily scale linearly with size, and the specific energy stored in batteries is a function of the type of application for which batteries are designed, with differing values for batteries focused on the delivery of power as opposed to batteries designed to maximize energy storage. These aspects are relevant when LCA methodologies (like GREET) which were developed primarily for the case of cars, are generalized to other transport vehicles.

- Although there is value in the consideration of second life of batteries, it is currently very difficult to assess and quantify the effect that this could have in terms of energy, GHG emissions and other impacts. This aspect is complicated further by different functional units for the grid (kWh) and the vehicle (km travelled). At this stage, using GREET as a basis for vehicle manufacturing emissions means that the accounting of the impact of second life of batteries would not be factored in the analysis.

- Life cycle impacts of transport infrastructure are most relevant for infrastructures that have a relatively low rate of utilization and/or a high amount of emissions per km of network built. This means, in practice, that they have the greatest relevance for high capacity rail projects. Given their higher material requirement per network km, elevated and underground solutions are more likely to be characterised by greater life cycle impacts.

- There is merit in considering both vehicle weight when looking at impacts of road infrastructure networks (e.g. because vehicle weight has direct effects on infrastructure deterioration). One way to handle this could be the use of weighting factors for different vehicle types, in conjunction with other factors accounting for their different occupancy rates (pkm/vkm). Given the likely small impact of road infrastructure emissions on the final results per pkm, though, this correction may not be a strict requirement for this specific project.

Key takeaways for the project design

Project-specific discussions focused on whether the use of a comparative approach focused on trip distance clusters would be appropriate (and which options would fall in which cluster), whether the methodology and preliminary data used for the development of the LCA tool shared with participants were appropriate, and which should be key sensitivity parameters to consider.

- The simplified LCA approach presented by the ITF at the workshop seems to be the correct approach.

- Regarding car sharing, it could be relevant to consider differences in trip length for different types of services. For example, one-way car sharing tends to be associated with shorter trip distances than round-trip, and peer-to-peer also tend to be mostly relevant for longer trips. In addition, some of these uses may not be relevant for the urban focus of the project. Regional differences may also matter for occupancy levels and trip distances.

- It is important to ensure that sharing for ride sourcing services is properly represented, since changes in occupancy have major implications for the abatement of impacts on a pkm basis.

- If car-pooling is represented, it is important to account that long distance services (e.g. BlaBlaCar) have different characteristics than short distance ones (Waze).

- Given the differences in lifetime and usage, e-scooters should not only be considered in the case of shared services, but also in the case of vehicle ownership/leasing.

- There could also be merit to represent separately on-demand transport services, but the project will need to balance between a broader coverage of options and a need to focus on the most relevant from a policy development perspective (prioritizing those with greater scope for wide adoption).

- It is understood that the project has a deliberate focus on energy and GHG emission impacts, but there is value in recognising explicitly the relevance of other aspects. These include in particular safety (which is the subject of another ITF CPB project), health and space occupation.

- Despite differences in occupancy rates for public transport across different times of the day and days of the week, the project should focus on *average* values when analysing environmental impacts of public transport. The basis for this is that some of the services with lower occupancy are a necessity to ensure accessibility and guarantee the reliable availability if public transport services in zones where occupancy is higher during times of high transport service demand.

- Vehicle lifetime has significant influence on LCA, especially for vehicles that tend to have relatively short useful life (e.g. shared e-scooters). The project will have to account for changes in the design and achieved lifetime of vehicles and/or components (esp. accounting for modular design and replaceable batteries).

- Empty running is an import factor to consider for ride-sourcing and similar services but it is not unique to these – individual car travel also displays some extent of “empty running” (e.g. for trips to pick up someone at an airport). This should be reflected in LCA accounting to the extent possible.

- Regarding vehicle technologies, there is merit in considering options such as small urban vehicles using small battery packs when looking at urban mobility. There is also merit in considering a wide range of alternative fuels for combustion engines. Nevertheless, increasing the number of options also comes with the risk of a loss of focus and the dilution of key messages and policy recommendations.
- Results should be shown not only in terms of impacts per pkm, but also per vkm.
- Categorizing modes and services based on trip distance bins improves LCA comparability of likely alternatives. Modes and services can also be compared accounting for different occupancy levels, giving visibility to the capacity of high occupancy options to reduce environmental impacts.
- The project should report on quantitative results for 2020, include indicative results for 2030 and provide insights for 2050.
- The project has a deliberate focus on passenger transport. Although combined passenger/goods delivery is certainly relevant, addressing the LCA of such hybrid services would complicate the present task and should be left out of the quantitative modelling effort.

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