Capacity Area B2 Topic 2.1 Deliverable 1

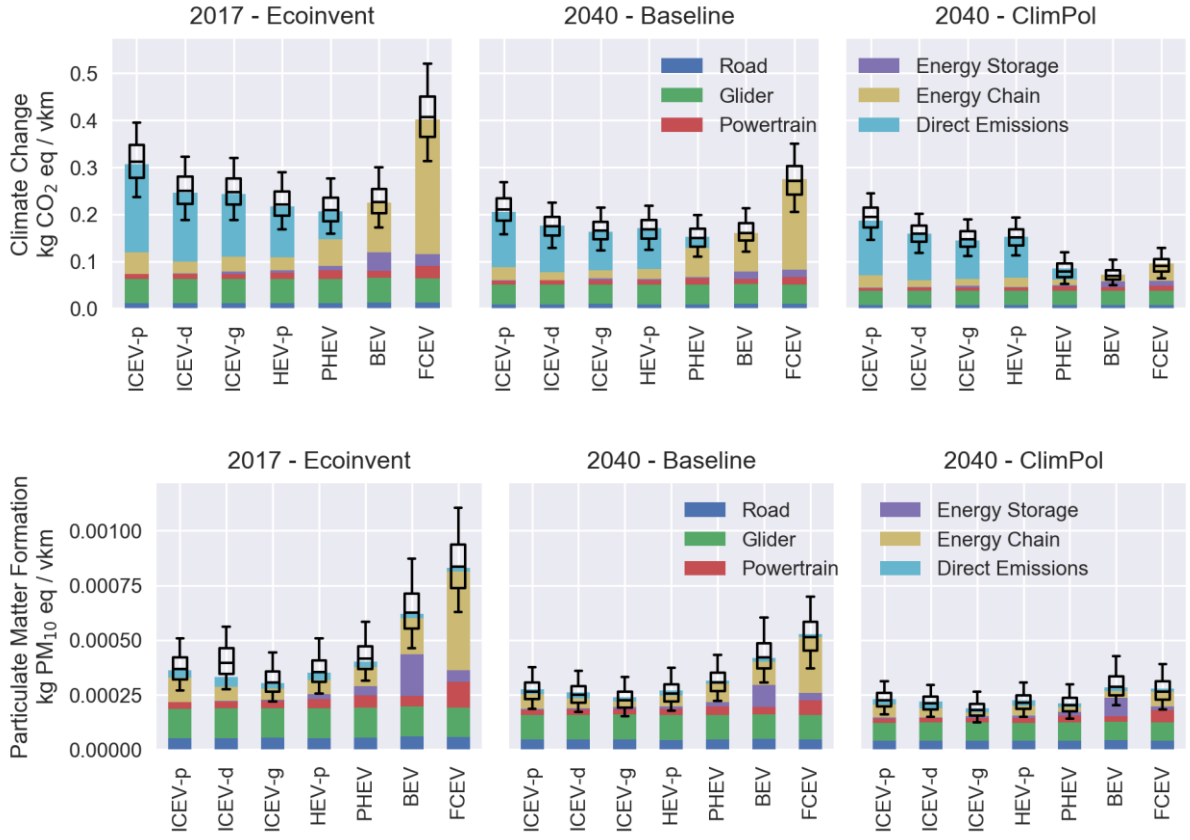
Extension of mobility datasets to include future technology development

Life cycle assessment (LCA) models have been developed for passenger cars [1, 2], motorcycles [3], urban buses [4] and aircraft [5] that reflect both current and future (2050) technology levels. Furthermore, total ownership costs have been added to the LCA models for passenger cars, motorcycles and urban buses, though results are unpublished.

A calculation model has been constructed to reflect uncertainty in input parameter assumptions and the sensitivity of results to variability in these input values [1, 2].

A methodology [6] and software package [7] have been developed to modify LCA databases using results from integrated assessment models to reflect future electricity scenarios. This allows us to much more accurately model the upstream vehicle and infrastructure impacts of future passenger transport and represents a significant improvement on the current best practice in prospective LCA.

The accompanying figures will be included in an upcoming journal publication. They show the climate change and particulate matter formation impacts of current and future passenger cars with a variety of different powertrains operating in Western Europe[1]. Two future global electricity scenarios are considered to modify the LCA database. Uncertainty bars represent variable sizes and performance of passenger cars and not uncertainty in the background database or life cycle assessment impact assessment methodology. The boxes contain 50% of the results, while the whiskers show the 5% and 95% bounds.



[1] We select Western Europe instead of Switzerland in this case for its broader applicability for the journal readership. If results were to be calculated for Swiss operating conditions, the energy chain bar would be reduce by roughly half for BEV and FCEV in the 2017 and 2040 – Baseline scenarios. 2040 – ClimPol scenario results are very similar for Swiss and Western European operating conditions.

References:

1. Cox, B., et al., Uncertain Environmental Footprint of Current and Future Battery Electric Vehicles. Environ Sci Technol, 2018. 52(8): p. 4989-4995.

2. Cox, B. and C. Bauer, The environmental burdens of passenger cars: today and tomorrow. 2018, Paul Scherrer Institut, Swiss Federal Office for Energy: PSI Villigen.

3. Cox, B.L. and C.L. Mutel, The environmental and cost performance of current and future motorcycles. Applied Energy, 2018. 212: p. 1013-1024.

4. Cox, B., A. Castillo, and C. Mutel, Environmental assessment of current and future urban buses with different energy sources, in The 30th International Electric Vehicle Symposium & Exhibition. 2017: Stuttgart.

5. Cox, B., W. Jemiolo, and C. Mutel, Life cycle assessment of air transportation and the Swiss commercial air transport fleet. Transportation Research Part D: Transport and Environment, 2018. 58: p. 1-13.

6. Mendoza Beltran, A., et al., When the background matters Using scenarios from Integrated Assessment Models (IAMs) in Prospective LCA. Journal of Industrial Ecology, 2018. Submitted.

7. Mutel, C. and B. Cox. Wurst python package. 2017; Available from: https://wurst.readthedocs.io/.