UCSB Automotive Energy & GHG Model Version 5

WorldAutoSteel

Introduction

The University of California at Santa Barbara (UCSB) Automotive Energy & Greenhouse Gas (GHG) Model ("UCSB Model") was developed under the leadership of Dr. Roland Geyer of UCSB's Bren School for Environmental Science and Management as a part of a comparative study on material GHG emissions[1]. The methodology and model have been validated by an ISO Critical Review Panel[2] and offers a way to accurately estimate the impact of various design choices, such as light-weighting, on the vehicle's overall carbon footprint in an easy-to-use Excel worksheet format.

Purpose of the Model

The main goal of the UCSB Model is to **quantify the energy and GHG impacts of automotive material substitution** under a broad range of conditions and in a completely transparent fashion. Users are able to review all calculations, and parameters are changeable at user discretion. The functional unit of all studied product systems is defined as transportation services of passenger vehicles of equivalent size, utility, equipment, and powertrain configuration over their total vehicle life. The model uses attributional life cycle assessment (ALCA) methodology, even though consequential system expansion is used to account for the GHG and energy implications of scrap inputs to and outputs from the vehicle life cycle.

Version 4 of the model expanded the system boundaries of Version 3 in order to include most of the significant GHG-emitting processes in a vehicle life cycle. It is estimated that Version 4 captures 98-99% of the life cycle impacts of the studied vehicle life cycles. More importantly, it is estimated that Version 4 captured at least 99% of the energy and GHG impacts of the studied automotive material substitutions, i.e. the difference in impact between the alternative vehicles of equivalent size, utility, equipment, and power train configuration.

Version 5 Model Functionality

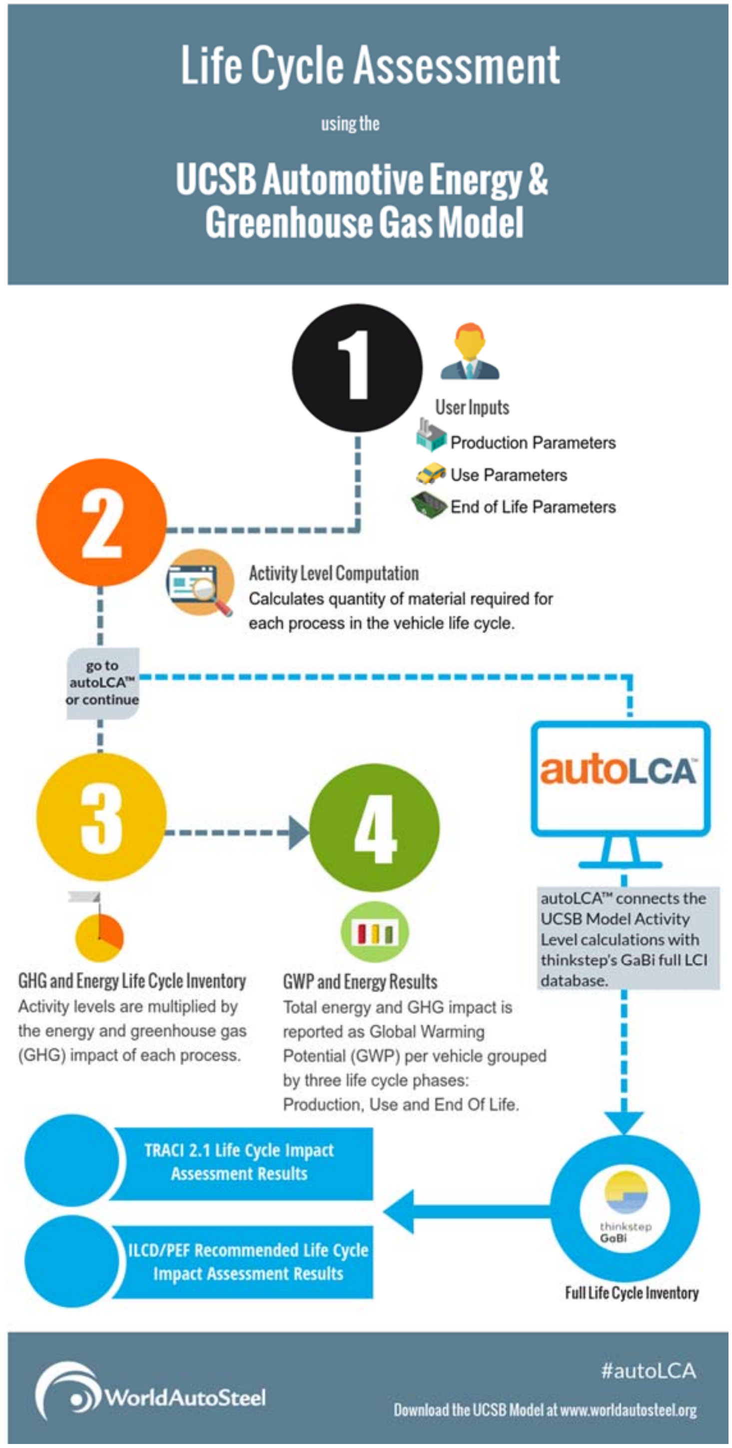
The new UCSB Model Version 5 has the same goal and scope as Version 4. The fundamental calculations, i.e. the conversion of input data into GHG and energy results are identical between the two versions. However, the way the computations are implemented on the spreadsheets of Version 5 is very different from Version 4. This was for the following reasons:

- Version 5 can now be used in conjunction with the autoLCA model, which, in turn, enables the user to obtain results for a wide range of impact indicators. Version 5 has a feature that allows the user to transfer the selected input data to autoLCA.
- Strictly separating the calculation of the activity levels for each unit process from their multiplication with the unit process inventories (and implicitly, the global warming potentials of the GHG emissions) dramatically simplifies the computational structure of the spreadsheet model.
- The new, simplified computational structure of Version 5 simplifies maintenance and further development of the spreadsheet model.
- Using the spreadsheet model to populate the autoLCA model radically simplifies the computational structure of autoLCA.
- The new computational structure facilitates detailed contribution analysis

What is different Version 5 Compared to Version 4:

1. Data input has been separated into two parts, data input required by all model users (*Data Input* spreadsheet), and data input that should only be changed from the default setting by expert users (*Expert Data Input* spreadsheet). This makes the Version 5 more user-friendly and avoids that non-expert users inadvertently change default expert input data.
2. To the extent possible, Version 5 uses process inventory data from autoLCA, i.e. the GaBi life cycle inventory database from thinkstep. The sources of all inventory data are listed in column R of the *LCA Calculations* spreadsheet.
3. To the extent possible, Version 5 uses driving energy demand, ED, and energy savings, ES, data generated with the WorldAutoSteel Power Train Model. The only power train types currently not supported by the WorldAutoSteel Power Train Model are HEV and FCV. For those two, the original Version 4 data from fka is used.
4. The use of the WorldAutoSteel Power Train Model made it possible to add ED and ES data for the WLTP 3b driving cycle for ICEV-G, ICEV-D, PHEV20, PHEV40, and BEV.
5. Scrap inputs to and outputs from the vehicle life cycle are accounted for through consequential system expansion only, i.e. multistep recycling (MSR) methodology has been removed. It recently emerged that MSR methods are based on a flawed assumption and should thus be avoided.
6. The scrap market response parameter was changed from α to $(\alpha - 1)$, in order to improve intuition and align it with the way it is used in more recent models and publications.

Users can download the UCSB Model (and User Guide) free for use in conducting his/her own evaluations at http://www.worldautosteel.org/life-cycle-thinking/ucsb-energy-ghg-model/



[1] Geyer, Dr. Roland, The Impact of Material Choice in Vehicle Design on Life Cycle Greenhouse Gas (GHG) emissions, 2007, available at http://www.worldautosteel.org/projects/vehicle-lca-study/assessments-of-automotive- material/.

[2] Geyer, Dr. Roland, Methodology Report, The Impact of Material Choice in Vehicle Design on Life Cycle Greenhouse Gas (GHG) emissions, 2007, available at http://www.worldautosteel.org/projects/vehicle-lca- study/assessments-of-automotive-material/.