Framework for hybrid life-cycle inventory databases: a case study on the Building for Environmental and Economic Sustainability (BEES) database

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In an effort to develop a whole building LCA tool, NIST is transforming new bottom-up BEES data into a hybrid database in which the strengths of both bottom-up and top-down approaches can be combined. The objective of this paper is to describe the framework and the process under which the hybrid BEES database is being built, with an emphasis on its accounting structure. This paper can support other efforts to build hybrid LCI databases.

The BEES hybridization utilizes the most detailed Supply and Use Tables (SUTs) —known as item-level data—focusing particularly on the construction sectors. First, the partial SUTs at the item level are constructed and connected to standard SUTs that describe the rest of the economy, which is then followed by balancing and 'redefinition.' Second, item-level environmental data are compiled and then also balanced and redefined, which completes the compilation of the bi-resolution SUTs with environmental data. Third, the bi-resolution SUTs are integrated with BEES data that has been converted into matrix form. Because the completely rolled out BEES technology matrix involves a significant number of products, the integration prioritizes the product groups that are potentially the most significant contributors to the LCIA results for buildings.

This step-by-step procedure will enable the creation of a hybridized BEES database, combining the strengths of both the bottom-up, process-based data and the top-down, input-output data with enhanced resolution. The benefit of hybridization at the database level—as opposed to at the individual LCA study level—is that whole-building LCA users can adopt the hybrid BEES approach, with its benefit of a more complete system definition, without the training or effort that would be required to construct a hybrid system from scratch. In addition, reformulation of new BEES data into a matrix structure better facilitates the parametric LCA application that is central to NIST's vision to develop a tool for assessing the sustainability performance of energy technologies and systems in an integrated building design context.

There are currently a number of initiatives being organized to implement a hybrid approach at the LCI database level. In laying out the methodological framework for efficiently transforming an existing LCI database into a hybrid database, this paper can support future development of hybrid LCI databases.