Life Cycle Design of Emerging Energy Generation Technologies

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Efforts to take advantage of LCA early in the design process have led to both general and product-specific design software tools. "General" tools (i.e., tools that assess a wide variety of products) include PRé's ECO-it, Boothroyd Dewhurst's DFE software, Granta Design's Materials EcoSelector, and Carnegie Mellon's Economic Input-Output LCA [1-3], and more. Example product-specific LCA tools include those from the buildings sector such as the BEES and BSLCA tools [4-5]. Although the general tools serve a much broader audience, product-specific tools are able to include very detailed results for the arguably smaller number of materials used in the products of interest, can be based on multi-material components for selection by the user, and can be based on terminology and the design-process characteristics of the sector.

Movement of emerging energy generation technologies from development to production provides an example of the importance of product-specific design tools. Because fuel cell system manufacturing and fuel delivery infrastructures are not yet in place, LCA design tools keyed to technology materials and fuels promise important contributions to decision making in the private and public sectors. Learning from LCA tools developed for use in building design and leveraging the growing body of LCA data available [6], an opportunity exists to develop fuel cell life cycle design tools that:

(1) Assess a wide variety of system hardware options, fuels, and fuel production scenarios,
(2) Base assessments on publicly available, highly peer reviewed quantitative LCA data that provide transparent results suitable for both internal decision-making and external communications, and
(3) Are able to produce results in a timeframe and format useful to the design process.

This presentation will describe modeling methods, key data issues, and design interface issues in the development of a set of life cycle design tools for PEM fuel cell stacks and fuel production systems. Finally, we generalize the tool development process to product-specific tool development beyond fuel cells.

Abstract References

1 PRé Consultants (2006) *ECO-it ecodesign software: screening tool for designers*, description at http://www.pre.nl/eco-it/default.htm

2 Granta Design (2004) *Materials EcoSelector*, description at http://www.grantadesign.com/products/ces/components/ecoselector.htm

3 Hendrickson, C., A. Horvath, S. Joshi, L.B. Lave (1998) "Economic Input-Output Models for Environmental LCA," *Environmental Science and Technology*, 184A-191A, tool at http://www.eiolca.net/

4 U.S. National Institute of Standards and Technology *Building for Environmental and Economic Sustainability (BEES)*, described at http://www.bfrl.nist.gov/oae/software/bees.html

5 Laine, T., E. Reinikainen, K. Liljeström, A. Karola (2001) Integrated LCA-Tool for Ecological Design, Olof Granlund Oy, Helsinki, Finland, available at http://www.ibpsa.org/proceedings/bs01/BS01_0739_746.pdf

6 Fava, J., J.S. Cooper (2004) "Life-Cycle Assessment in North America: An update on capacity building," *Journal of Industrial Ecology*, 8, 8-10