PHD DISSERTATION DEFENSE

CHARACTERIZING UNCERTAINTIES IN LIFE CYCLE ASSESSMENT

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ABSTRACT Life cycle assessment (LCA) aims to support corporate and public policy decisions by quantifying the environmental performance of a product. Understanding uncertainties in LCA results is therefore important for making informed decisions. Monte Carlo simulation (MCS) has been widely utilized to characterize uncertainties in LCA. However, as the size of an LCA database grows, running a full MCS is becoming increasingly challenging. Furthermore, uncertainty literature in LCA has focused on life cycle inventory (LCI), while the uncertainties from the remaining steps—including characterization, normalization, and weighting—have not been addressed, despite their perceived relevance in overall uncertainty characterization in LCA.

The objectives of my dissertation are: (1) to develop a new method to improve the computational efficiency of large-scale MCS in LCA, (2) to empirically test the reproducibility of comparative decisions obtained using the method, and (3) to develop and test an analytical method to decompose the overall uncertainty in LCA into its constituents. The new method for uncertainty characterization in LCA involves pre-calculating and storing the distribution profiles of the most widely used LCA database, ecoinvent. The pre-calculated uncertainty values can be used as a proxy for understanding the uncertainty and variability in a comparative LCA study without compromising the ability to reproduce the comparative results. Finally, I demonstrated a new method to decompose the overall uncertainties of an LCA result over the contributing factors, including those from LCI, characterization, normalization, and weighting. To do so, I adopted the logarithmic mean Divisia index (LMDI) decomposition method into MCS.

BIO Yuwei is a PhD Candidate in Environmental Science and Management at the Bren School of Environmental Science & Management at the University of California, Santa Barbara. She studies Life Cycle Assessment (LCA) with a focus on characterizing uncertainty of LCA results and improving reliability of LCA applications. She has published research in industrial ecology journals and frequently presented research at international conferences. She also received a Master's from the Bren School specializing in Economics and Politics of the Environment and Energy and Climate. She earned her undergraduate degree from Ohio State University, where she studied Environmental Policy and Management with an emphasis on Environmental Economics.

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