

Life Cycle Accounting: Towards Life Cycle Design

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Goal and Scope. It has been highlighted in the paper that, due to their inherent limitations, standard or traditional accounting practices are incapable of capturing the fact that 'Pollution Prevention Pays', i.e. reducing the environmental impacts can also lower costs of a product while meeting all other critical requirements. As such, environmentally preferable design often may not be the lowest-cost option when measured by standard accounting systems and methods.

Total Cost Assessment (TCA), which provides the foundation for life cycle accounting, is discussed. Full Cost Assessment (FCA), conducted by adding hidden, liability and less tangible costs to the usual costs, is also discussed. Benefits of the TCA and FCA models for accounting over their traditional counterpart, i.e. standard accounting, are also discussed.

Methods. It has become apparent that economic assessments typically used for investment analysis by corporations are not adequate for environmental projects because the standard accounting systems and methods have the following inherent problems. Firstly, they do not adequately address the fact that pollution prevention measures would benefit a number of production areas at a facility than most other kinds of capital investment. Secondly, they do not usually account for the full range of environmental expenses companies often incur. Thirdly, they usually do not accommodate a sufficiently long time horizon to allow full evaluation of the benefits of many environmental projects. Finally, they do not provide a mechanism for dealing with the probabilistic nature of environmental benefits, many of which cannot be estimated with a high degree of certainty.

The revised accounting systems and methods need to comprehensively address these pitfalls.

Results and Conclusions. A product can be successful in the marketplace only if it can be offered at an attractive price. Actual costs of product development get distorted when measured through the standard accounting methods, because current capital budgeting evaluations often do not include all environmental costs, savings and revenues.

TCA and FCA models for accounting have distinct benefits to capture actual costs of product development over standard accounting practices. For a comprehensive product cost analysis by corporations, environmental costs and benefits must be routinely gathered and utilized for management and financial accounting to paint an accurate picture.

Recommendations and Outlook. Prevailing accounting practices need drastic revisions to reflect the actual costs of product development. This would be the first and the most critical step for corporations aspiring towards life cycle design.

Evaluating environmental projects on a basis equal to that of other investments (i.e. using a life cycle approach) will only allow environmental projects to justly compete for investments at an organizational level.

Both opportunities and barriers exist for the improved accounting system which include the life cycle costs.

Keywords: Life cycle accounting; total cost assessment (TCA); full cost assessment (FCA); environmental accounting

Streamlined Life-Cycle Assessment of Production of a Chemical Intermediate from Petroleum Feedstock vs Bio-Derived Feedstock

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Goal and Scope. As a part of a cooperative agreement among the U.S. Department of Energy, the EPA and an industry partner, the project evaluated the application of the Life Cycle Design (LCD) framework to an analysis of a Research and Development investment for manufacturing a chemical intermediate from two different starting materials. The compound investigated is 1,4-butanediol (BDO), which is an important synthesis platform for a range of interesting compounds including monomers for biodegradable polyester plastic. In addition to the specific qualitative and quantitative results of the case study, the objectives were: (1) to help DOE managers identify environmental concerns early in the technology development process when they can be most cost effectively addressed; (2) to support Research and Development project selection through an additional set of environmentally-oriented screening criteria; (3) to develop and apply an LCA-based method to allow comprehensive evaluation of the potential environmental aspects of developmental technologies and better target Research and Development resources toward projects with the greatest life cycle benefits; and (4) support alternative feedstocks program cost-benefit analysis in relation to agency goals and objectives.

Methods. The purpose of this study was to identify critical areas in technology development at an early stage in the development process. During such early stages of technology development, data availability is limited because of proprietary concerns and inventory estimates have to be derived from modeled data, bench-scale results or process engineering estimates. This led to a use of streamlined LCA where only those environmental aspects that had significant differences due to the use of technology were evaluated. From a decision support perspective, an Environmental Impact Factors (EIF) Method was proposed and used for the streamlined LCA. The EIF method significantly reduces the information needs and time involved in applying the LCA approach. EIFs are designed to quantify the differences between the environmental impact categories of the technologies being compared for a certain criteria.

Results and Conclusions. The overall conclusions of the project were; (1) An LCA-based method is able to provide program managers with a tool for identification of the environmental profile of alternative technology projects, although its use in a rapid screening mode is limited by the time and effort necessary to conduct the analysis, (2) Interactions between the LCD analyst, the process developer, and the program manager should be encouraged as the ability to realize the benefits of the approach are not realized if the program manager does not provide incentives for the process developer to iterate on and revise the designs to take into account the LCA learnings, and (3) Processes that are based on renewable resource derived feedstocks are not intrinsically lower in environmental burdens than their fossil resource based counterparts.

Recommendations and Outlook. On the LCA methodology the work showed that judicious use of streamlining approaches can minimize the effort to compare technological options. Recommendations to apply the method iteratively as future generations of designs are developed will ensure that the program manager's choices are accurate. On the results the elements of the technology envelope needing the most improvement were identified (hot spots analysis) and recommendations made for changes with the most beneficial impact on the life cycle profile.

Keywords: Bio-based feedstocks; renewable resources; streamlined LCA; technology alternative assessment