Green chemistry, cradle to grave, or circular economy

Level: Master
Start: Anytime
Project duration: 6-9 months
Project form: Case study – collecting data, determining environmental impacts, and analyzing/comparing model outcomes
Supervision: Rosalie van Zelm

Background and short content of the project
This project is about performing a full **environmental life cycle assessment** of a product or service. Manufacture and consumption of products and services by humans leads to resource extraction (depletion) and land use, and causes emissions of environmentally hazardous substances (pollution). To address the environmental impact of a product or service, environmental life cycle assessment (LCA) can be used as a methodology. An LCA includes the step-wise calculation of environmental impacts of a product or service during its full life-cycle: from resource extraction to waste disposal. In the goal and scope definition, the subject and the purpose of an LCA study are determined. During the inventory phase for each of the product systems or services considered, data are gathered for all the relevant processes involved in the life cycle. The outcome of the inventory analysis is a list of resource extractions, land use occupations, and emissions. In the life cycle impact assessment phase the inventory data are valued concerning their environmental burden. First, it is decided which impact categories will be included in the LCA (selection), such as global warming, acidification, land occupation, and fossil fuel use. Second, the data obtained in the inventory phase are linked to the impact categories (classification). For example: the emission of ammonia contributes to acidification, eutrophication, and respiratory impacts, and the extraction of natural gas attributes to resource scarcity. Third, the impacts are quantified (characterization). Predefined characterization factors are used for this purpose. The last step in the LCA is the interpretation of the results from the previous three steps, to draw conclusions, and to provide recommendations for decision makers.

The **goal** of this master internship is to perform an LCA case study applying the characterization factors developed at the department of environmental science to test the applicability of derived factors.
There are a variety of interesting cases, from **green chemistry** – i.e. investigating a new chemical or chemical process, to investigating the **circularity of a process**, e.g. recycling metals from wastewater streams.

In this project, possibilities to cooperate with other groups, institutes, or companies are possibility. You can think of working on a novel chemical process together with synthetic organic chemistry, working with or at TNO on a question they received or are interested in, or we can try to make a connection with a company working e.g. on their wastewater treatment process.

Subgoals can for example be to compare outcomes with outcomes applying a different set of characterization factors, to see for the relevance of spatial variability (grid, country or ecoregion specific) in our characterization factors, to include uncertainties, to improve LCA methods related to the novel process looked at, or to make recommendations on how to quantify a circular economy.

More information:
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