Ph.D.project 13.


The project addresses external technical issues that traditionally are not included or sufficiently addressed in LCA-modelling of waste management systems. This can be the environmental significance of technical capital (construction, maintenance and decommissioning of buildings, equipment, trucks, etc), the robustness of data on recycling of scrap materials in industry, the importance of geographical limitations and data availability for example with respect to exchange with the energy system.

The student will work at the Department of Environmental Engineering, Technical University of Denmark with Professor Thomas H Christensen as supervisor.

Background

Life-cycle-assessment (LCA) methods are becoming more integrated to waste management research and decision making. The EU has introduced the concept in their Thematic Strategy on the prevention and recycling of waste (EC, 2005a), the Thematic Strategy on sustainable use of resources (EC, 2005) and more recently in the European Waste Framework Directive (EC, 2008). LCA-modelling is now used for decision support regarding waste management systems in several countries, including Denmark. Specific waste LCA-modelling tools are emerging, in particular the UK WRATE model, developed by the UK Environment and the Danish EASEWASTE, developed by DTU. The models are the latest generation of tools performing system analysis in terms of waste flows and providing standard modules for the main waste management technologies, but born with a range of limitations (Christensen et al., 2007). A recent international model comparison workshop hosted by DTU Environment in November 2008 under the auspices of the International Expert Group on Waste LCA-Modelling revealed major progress in waste LCA-modelling but also many unresolved issues. In order to move LCA-waste modelling to the next level, increasing its ability to better represent complex waste management issues as expected for future waste management problems and in order to improve their credibility, it is important to quantitatively address unresolved issues as for example:

- How important is capital in terms of the construction, maintenance and decommissioning of buildings, equipment, trucks etc. in assessing the overall environmental profile and resource consumption of waste management? This is basically not addressed in the literature.
- How well does existing data for industrial recycling of scrap materials (paper, metals, plastic, glass, etc.) represent current markets absorbing these materials in terms of recovered waste? Much of current data seems to originate from Nordic countries while the materials are sold on a global market.
- How well does existing data for industrial recycling of scrap materials (paper, metals, plastic, glass, etc.) represent the recycling industry in the near future as these are meeting high energy prices and increasing environmental constrains? Most current data are 5-15 years old and may not apply to current or future recycling markets under constraining energy prices and trends toward renewable energy. Maybe existing data can be adjusted for this development as part of technology forecast.
- As waste management becomes more effective in recovering energy and materials, the direct environmental load and use of virgin resources decreases. Simultaneously,
the energy recovered by waste management, as well as the energy issues in material recycling become more critical and addressing this correctly becomes imperative. This is a key issue in greenhouse gas accounting in waste management. Are decisions regarding increasing use of renewable energy in waste management a real question for waste management or is it a general policy issue? How far should the consequences be addressed?

**Content**

The PhD project can contain several activities addressing some of the important issues raised above. The goal is to be able to quantify the environmental aspects of the technical issues not currently accounted for in LCA. The actual activities must be chosen with due consideration of the qualifications of the PhD student and the integration with on-going projects within, as well as outside the 3R graduate school.

The work will involve scrutiny of existing databases as well as collection of new data in collaboration with industry and foreign partners identifying capital contributions, energy contributions to recycling processes and the role of geographical boundaries. The importance of the gained complexity is measured against traditional LCA-modelling failing to address these complex issues. A special effort will be made to improve existing technologies that could prove useful for modelling future alternatives.

The work is expected to lead to improved understanding of the importance of technical aspects, currently not included in the LCA-modelling of waste management systems, 3-4 manuscripts for international scientific journal, and 2 international conference contributions. The thesis is expected to consist of 30-50 pages describing the main achievement of the work, the 3-4 manuscripts for international journals and maybe one conference contribution.

**Qualifications**

The applicant should have a background in waste management and/or LCA. The applicant must have analytical skills, be interested in system analysis, be well-organised in planning, networking and collaboration, and be interested in aggregating complex issues into communicable terms. The applicant must be cooperative, since several PhD students will work on bordering topics within the same research group. The applicant must master the English language and preferably also Danish.


