Life cycle assessment of the Danish electricity distribution network

Purpose
This article provides life cycle inventory data for electricity distribution networks and a life cycle assessment (LCA) of the Danish transmission and distribution networks. The aim of the study was to evaluate the potential importance of environmental impacts associated with distribution, in current and future electricity systems.

Methods
The functional unit was delivery of 1 kWh of electricity in Denmark. The focus of the assessment was distribution of electricity, and the related impacts were compared to the generation and transmission of electricity, in order to evaluate the importance of electricity distribution in Denmark. The 2010 Danish electricity distribution network was modeled, including power lines (50, 10, 0.4 kV), transformers (50/10 and 10/0.4 kV), and relevant auxiliary infrastructure (e.g., cable ditches, poles, and substations). Two types of 50 kV power lines (underground and overhead) and 0.4 kV (copper and aluminum) were modeled.

Results and discussion
Electricity transmission and distribution provided nonnegligible impacts, related mainly to power losses. Impacts from electricity distribution were larger than those from transmission because of higher losses and higher complexity and material consumption. Infrastructure provided important contributions to metal depletion and freshwater eutrophication (copper and aluminum for manufacturing of the cables and associated recycling being the most important). Underground 50-kV lines had larger impacts than overhead lines, and 0.4-kV aluminum lines had lower impacts than comparable copper lines.

Conclusions
A new specific dataset for infrastructure in the distribution network was provided and used to evaluate the role of electricity distribution in Denmark. Both transmission and distribution provided nonnegligible impacts. It was argued that the impacts from electricity distribution are likely to increase in the future, owing to more renewables and decentralized electricity generation, and that impacts from infrastructure may become significant compared to electricity generation itself. It was recommended that impacts from electricity distribution and related infrastructure are included in relevant LCA studies. The data provided here make this possible.