Imperial College London

Centre for Process Systems Engineering

UCL

2018 Seminar Series: New Frontiers in Systems Engineering

Prof. Stefanie Hellweg (ETH Zurich, Institute of Environmental Engineering)

Environmental optimization of wood resource use

Abstract:

Wood is one of the most important renewable resources. It can be used as material and as energy source. The versatility of wood raises the question, how wood resources should be used in order to achieve an optimal environmental benefit. In the presentation, this question will be answered based on an analysis of the complete value chain of wood, including forestry and wood harvesting, processing and production, transport, (cascade) use of wooden products and energy recovery or disposal. Value chains were analyzed with material flow assessment and life cycle assessment, combined with mathematical optimization. The focus of the study was wood consumption in Switzerland, but international supply chains were also included. Methods for the impact assessment of forestry and wood use were developed and applied, along with existing impact assessment methods. The results show that the use of wood has often less long-term impacts on climate change than other materials. However, the environmental performance of various wood uses spreads largely and demands a careful management of wood resources. Wood use is especially beneficial, when high-impact products (e.g. steel) are substituted, and if the energetic use at the end of the life cycle is warranted, substituting e.g. heating oil. Furthermore, products with a long lifetime store and thereby delay the emissions of carbon to the atmosphere, which reduces climate change impacts. Environmental drawbacks of wood application, like the potentially high particulate matter emissions during combustion, should be addressed, e.g. through particle filters and automated systems. Cascade use of wood, e.g. a first use as construction material and a second use as energy source, can increase the efficiency and the environmental benefit of wood, especially when more wood products are used and substitute other materials and energy sources. A comparison of functionally equivalent wooden and massive buildings (the latter constructed of brick or concrete) shows that the use of wood in construction pays off environmentally. Although wooden buildings tend to have a slightly increased space heat demand, due to less thermal mass, their overall impacts are smaller than those of massive buildings. This is due to the environmental benefits of the material (carbon storage capabilities and less embodied energy). This result is valid for impacts of climate change, but also for many other environmental indicators. When specifically looking at the forestry sector, biodiversity impacts in terms of species extinction is several orders of magnitudes higher in tropical regions than in Europe. It is recommended to source wood only from certified, extensively managed forests and avoid imports from high-impact regions.

Overall, it can be concluded that an increasing use of wood products will help mitigate climate change in the long-term. However, the environmental benefits of each use need to be assessed carefully, considering substitution effects, cascade use and temporary carbon storage, to make optimal use of the limited resource wood.

Biography:

Stefanie Hellweg is full professor for ecological systems design at the Institute of Environmental Engineering of ETH Zurich (Switzerland). After completing her Ph.D. on the environmental assessment of thermal waste treatment processes she worked as a post-doc and senior scientist at the Institute for Chemical and Bioengineering at ETH Zurich. Between 2004 and 2005 she was a visiting scientist at Lawrence Berkeley National Laboratory and in 2014 at Yale University. Since 2006 she holds the Chair for Ecological Systems Design at ETH Zurich. Her research goals are to model, analyze, evaluate and improve the resource efficiency and environmental impacts of products and processes, new technologies and consumption patterns. Her main research interests include the development of new methods for Life Cycle Assessment (LCA), the development and application of environmental decision support tools for Industrial, and prospective environmental assessment of new technologies and products. She is a member of the Swiss National Research Council and the UN environment International Resource Panel.

3 May 2018, 11am, RODH 333

Organisers & Contacts: Dr. Gonzalo Guillen Gosalbez (g.guillen05@imperial.ac.uk), Dr. Alex Kiparissides (alex.kiparissides@ucl.ac.uk), Ms. Cristina Romano (c.romano@imperial.ac.uk)