**System Synergies between Waste Heat and Food Production, a case study at the European Spallation Source**

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At present food production depends almost exclusively on direct use of stored energy sources, may they be nuclear-, petroleum- or bio-based. This paper will point towards surplus heat as a way to bridge the gap between today’s food systems and truly sustainable ones, suitable to be implemented in urban and peri-urban areas. Considering that arable land and fresh water resources are the base for our present food systems, but are limited, in combination with continued urbanisation, such solutions are urgently needed. By combining the use of surplus energy with harvest of society’s organic side flows, like e.g. food waste and aquatic based cash crops, truly sustainable and urban close food systems are possible at a level of significance also for global food security.

The European Spallation Source (ESS) will require approximately 270 GWh of power per year to operate, power that ultimately is converted to heat. With innovative cooling solutions, a third of the captured heat will be high-temperature and can be sold as district heating, supplying a significant portion of the heating needs in the City of Lund. Further innovation is required for the remaining two thirds of the heat produced. This heat could be augmented with heat pumps and thereby recycled as district heating, but at the price of a significantly increased use of electricity. ESS is located in the middle of Scandinavia's most expansive urbanisation and its most productive bread basket area is a most interesting place to also host a demonstration of the interconnection between surplus energy and nutrient recycling.

This paper will bring forward an alternative food production cooling chain, involving fermentation, aquaculture and greenhouse horticulture including both use of low-grade surplus heat and recycling of society’s organic waste that is converted to animal feed and fertilizer. The development of such a system will demand trans-disciplinary collaboration. The paper will show both the cooling processes and the biological processes involved.