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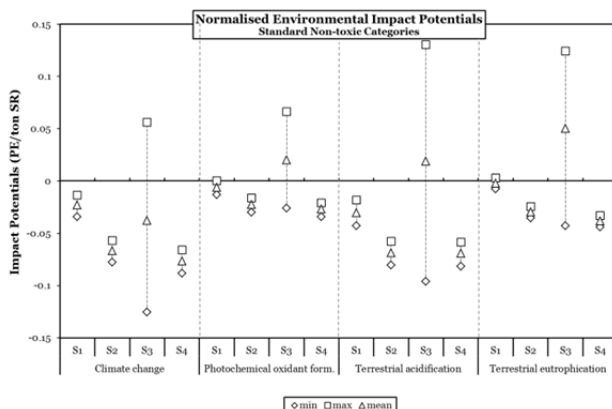
Life cycle assessment modelling of new technologies considering uncertainty

Anders Damgaard^{1*}, Line Brogaard¹, Thomas Astrup¹, Alessio Boldrin¹

1: DTU Environment; *Corresponding author email: adam@env.dtu.dk

Life cycle assessment (LCA) is commonly used for assessing the sustainability of new environmental technologies. Even though material handled in many environmental technologies is heterogeneous, many LCA studies only consider the uncertainty to a limited degree focusing on sensitivity of process choices or not even assessing the uncertainty of the system at all. The study investigated what new knowledge would be gained if the modelling considered the uncertainty of all parameters used in the modelling of the technologies assessed, and how this could support the decision of technology to apply. To carry out the modelling we used the LCA model EASETECH (Clavreul et al., 2014) developed by DTU Environment and DTU Compute. EASETECH allows both single values, as well as distributions of values. This allows us to consider the aleatoric variability and epistemic uncertainty of data.

As a case study we investigated the handling of shredder residue (SR) in Denmark. The assessment compared the potential environmental impacts and depletion of abiotic resources in relation to four alternative scenarios: S1) landfilling; S2) co-combustion at a waste incineration (WI) plant; S3) pyrolysis; S4) co-combustion at a cement kiln. Distributions (normal, lognormal and triangular) were assigned to process parameters and emissions for all of the treatment technologies. Besides the distributions mean values were also assigned so conventional life cycle impact assessment values could be calculated for comparison.



Normalized environmental impact potentials for non-toxic categories are presented in the figure. The results show that for all impact categories were the emerging technology, Pyrolysis, considerably more uncertain than the mature technologies (landfill, WI, Cement Kiln). The reason for these results is that where pyrolysis is still under development and very uncertain, most of the other technologies are more mature, and good inventory data could be employed in the study. Including the uncertainty in the LCA modelling allowed us recognizing that a lot more

data about pyrolysis of SR is needed before a robust decision can be made whether or not to use pyrolysis as a viable treatment technology. This stresses the fact that, when modelling emerging technologies, it is important to consider the full uncertainty for the technology when compared to more mature technologies which are associated with a smaller degree of uncertainty.

References:

Clavreul, J., Baumeister, H., Christensen, T.H., Damgaard, A. 2014. An environmental assessment system for environmental technologies. *Environmental Modelling & Software* 60: 18–30