The climate footprint of imports of combustible waste in systems with high shares of district heating and variable renewable energy - DTU Orbit (17/08/2019)

This work addressed the role of waste-to-energy (WtE) within the growing paradigm of the circular economy (CE), by combining long-term co-optimization of waste management and energy systems, to determine possible economic and climate impact consequences of future WtE capacity utilization. Co-optimization was realized by integration of a network optimization model for the waste sector, OptiFlow, with the partial equilibrium energy systems model Balmorel. The modelling framework allows to determine the effects of waste-derived energy production within energy systems, including induced and avoided energy (production and long-term investments). The article documents the application of this framework to an analysis of waste trade for WtE between European countries in the base year 2014 and prospectively until 2035, taking Denmark as example for an importing country. Results indicating present and long-term economic benefits for waste trade, under socio-economic conditions, were documented in a concurrent publication. Here, a broader consequential LCA approach was employed to appraise climate change impact potential in a variety of foreground and background conditions. We find that in 2014, trade of residual combustible waste was mostly beneficial from a climate perspective, as the Danish energy system still relies partly on fossil fuels. Towards 2035, climate advantages are uncertain and dependent on avoidance of higher impact waste management (i.e. sanitary landfilling), the differences in the energy carbon-intensity of importing and exporting countries, impact of global biomass supply, and the type and quantity of traded waste. In general, benefits from waste-derived energy production will be offset by direct combustion emissions as background systems decarbonize. Waste transport played only a minor role in the outcome. The study showcases integration of ESA in waste LCA to better account for affected (often referred as marginal) energy production.