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Global-regional water and land impacts of local energy transformations

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To meet the Paris Agreement and SDG 13 on climate change, nations, sectors, and cities need to decarbonize their economies in the next couple of decades. Such energy system transformations will impact water and land resources to varying extents, depending on current state and the transformation strategy chosen. This paper explores the water- and land- resource impacts, and their geographical extent, of local energy transformations with ambitious targets for becoming carbon neutral and fossil free. The impacts are quantified for a set of energy futures in a concrete case example of a Swedish municipality (Oskarshamn) that recently adopted such targets to be met by the year 2030.

An energy systems model is set up for the concrete case example of Oskarshamn, based on current energy use and five projected future development scenarios up to year 2040. The geographical origins of all used energy carriers (fuels, heat and electricity) are mapped, and associated water and land use are estimated based on relevant available data reported in the literature and open databases.

Results show that most of the water consumption for the local energy use occurs outside the Oskarshamn municipality borders, with a large part of that consumption also occurring outside of Sweden. Scenarios with aggressive shifts to biofuel use exhibit the largest increases in water consumption in regions outside of Sweden, and predominantly in regions with less water availability than Sweden. Land-use impacts follow similar geographical patterns. Overall, these results imply that attempts to locally accelerate mitigation of climate change may significantly affect water and land resources outside that locality. Both water and food security, as well as climate adaptation capacity, may thus be compromised in other regions and localities within geographically large water & land influence zones of local energy transformations.