Titel1: Benchmarking local network topology of sustainable heat supply: An open-source approach downscaling integrated assessment model results

Aiming towards sustainable heat supply for residential/commercial buildings implies the necessity of decarbonizing heat production portfolios. Most decarbonization studies examine net-zero scenarios on a highly aggregated level using integrated assessment models (IAMs) with global coverage. To translate these high-level transformation pathways to policy measures at a local resolution, it is necessary to downscale results from an aggregated level to a higher granularity. This work's core objective is to examine the local network topology of sustainable heat supply and to identify the trade-offs for heat supply companies between low-carbon energy carriers, a significant heat demand reduction by building renovation, and a heat network expansion integrating renewable technologies such as geothermal and green gas high-efficiently. A two-stage analysis is proposed, including a downscaling algorithm for using IAM results for obtaining high spatial granularity using a novel downscaling technique accounting for the infrastructure requirements of centralized heat supply options and population density as criteria, and a benchmarking assessing network-based heat supply topologies. Using Austria as a case study, we downscale values projected by different decarbonization storylines from the H2020 *openENTRANCE* project. Results indicate that sustainable heat networks achieve only lower heat densities compared to existing networks, thus reducing infrastructure to supply ratio efficiency.