

Advancing efficient heating and cooling energy supply in Southern Europe: the potentialities of aquifer thermal energy storage

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Scientific research has highlighted the potential of aquifer thermal energy storage (ATES) in heating-dominated countries. However, ATES may also play a significant role in advancing the decarbonization of cities in Southern Europe by enabling energy-efficient heating and cooling in buildings. Based on this premise, two alternative configurations for activating a small-scale district heating and cooling network in Rome (Central Italy) are investigated. The first employs a conventional air-to-water heat pump, while the second integrates a water-to-water heat pump with an ATES system. The dynamic behaviour of the aquifer is modelled using GeoSIAM, whereas the energy conversion systems and user heating and cooling loads are simulated in TRNSYS 18. The integration of geological and energy system models through an iterative approach lays the foundation for a comparative energy and environmental assessment. The results highlight the advantages of the ATES-based configuration, which is characterised by primary energy savings and carbon dioxide emissions avoided compared to the reference case, thereby underscoring the relevance of ATES in contributing to broader climate and energy targets.