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Renewable energy application: sustainability techniques in Torino Urban City

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Italy is one of the top 10 countries for geothermal electricity generation and among the first 15 for heating and cooling applications. In 2021, there were 226 active installations in Italy for the exploitation of direct geothermal energy for the sole heat production purposes. These are, in most cases, individual heating and thermal plants.

For about 2 years, Torino has been among the 100 European cities and the 9 Italian cities that have the objective of achieving an 80% reduction in CO_2 emissions by 2030 compared to 2019 values. The journey started long ago when the European Union's Mission Smart and Climate-Neutral Cities was launched, with the aim of accelerating the transition towards climate neutrality in 100 selected European cities as a reference by 2030 (anticipating 2050 foreseen by the Green Deal) and opening a call aimed at all European cities. Torino was thus one of the selected Italian cities. The priority objective of Torino and the other selected cities was the preparation of the so-called Climate City Contracts (CCC) (Comunicato Stampa Comune di Torino, 2024), i.e. contracts which, although having no legal value, will serve to formalize a clear, transparent and well-defined political commitment towards the Commission and national/regional authorities, including citizens, research organizations and the private sector.

In this context, Groundwater Heat Pumps (GWHPs) are an efficient solution for reducing carbon emissions in heating and cooling systems in urban areas with favourable geological conditions (Taddia et al., 2019). These systems draw water from shallow aquifers, undergo heat exchange processes, and return water at a modified temperature. It is important to preserve the groundwater quality of aquifers, which serve as renewable energy sources, for urban sustainability. In order to promote the adoption of GWHP, urban planning should be carried out while ensuring the long-term protection of groundwater. Torino Urban City has an alluvial shallow aquifer that is a valuable source of low-enthalpy geothermal energy (Berta et al., 2024). However, it is essential to conduct a comprehensive site assessment to evaluate the environmental impacts, taking into account well characteristics, locations, pumping rates, and thermal effects on local groundwater resources. The thermal plumes, which are shaped by water extraction and reinjection rates, have an impact only on downstream neighbouring plants. Accurate hydrogeological characterization is crucial for constructing new facilities, as positive aquifer responses to long-term disturbances demonstrate. The proposed urban-scale model is a valuable tool for experts and authorities, enabling the assessment of thermal disruptions at both localized and urban levels. Using this tool ensures the sustainable use of aquifer resources in complex systems, promoting informed decision-making for urban heating and cooling strategies.

Berta A. et al. (2024) - The role of standards and regulations in the open-loop GWHPs development in Italy: The case study of the Lombardy and Piedmont regions. Renewable Energy, https://doi.org/10.1016/j.renene.2024.120016.

Comunicato Stampa Comune di Torino: https://comunicatistampa.comune.torino.it/2024/03/la-citta-di-torino-presenta-il-climate-city-contract-alla-commissione-europea/ (Accessed on April 2024)

Taddia G. et al. (2019) - Groundwater Heat Pump Systems Diffusion and Groundwater Resources Protection. Geoingegneria Ambientale e Mineraria, 156.