Waste heat recovery – Considerations for the management of thermally polluted urban groundwater resources

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Abstract

Heating and cooling using groundwater is often performed without consid-ering potential effects on subsurface resources and the multiple interactions of different subsurface utilizations. As a result, significantly increased subsur-face temperatures have been observed in many urban areas. The current un-coordinated use of subsurface resources can lead to conflicts among different users and, specifically thermal pollution may lead to large-scale thermal im-pacts and impairments of groundwater quality.
Alternatively, current and future heat-demand in urban areas could be sup-plemented by recovering "waste heat" from the subsurface. Technologies for using this renewable energy resource would be particularly suitable in new buildings and infrastructures and in centers of economic growth.
We show that quantitative modeling approaches can serve as the scientific basis for thermal management strategies to better understand how thermal states of urban groundwater resources develop. On the one hand, we illustrate how to derive the potential for recovering waste heat from urban groundwater resources. On the other hand we demonstrate the applicability of the ''inte-grated relaxation factor" (IRF) concept which facilitates optimizing and locat-ing auspicious urban settings for developing thermal management strategies.
To our opinion, such strategies and advancements of practical solutions are indispensable in the debate on climate change and energy transition, as well as for reaching formulated development goals in different public initiatives such as the 2000-Watt-Society or the Europe 2020 Strategy.