SUPPORTING WASTE HEAT RECOVERY AND REUSE ACROSS EUROPEAN COUNTRIES: THE CONTRIBUTION OF THE EMB3Rs TOOL

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Overview

In Europe (EU) 27, heat still holds a residual share as a vector in final energy consumption. As for the demand-side, in 2015 heating and cooling accounted for half of EU's total energy demand (Fleiter et al. 2017), with only 23% being of renewable origin (Eurostat 2022). In spite of this outstanding mismatch between supply and demand, an increasing body of literature has identified a significant potential for waste heat recovery (WHR) and reuse across the EU (Agathokleous et al. 2019). Large and energy-intensive industrial facilities are often producers of waste heat as a by-product of their activities. The lack of appropriate assessment tools remains a key challenge to the wider adoption and deployment of waste heat recovery solutions (Connolly et al. 2014).

Methods

This paper introduces the EMB3Rs (User-driven Energy-Matching & Business Prospection Tool for Industrial Excess Heat/Cold Reduction, Recovery and Redistribution) platform, framing it in the context of other existing tools, and highlighting its innovative character and contribution to address the challenges stated above. The EMB3Rs platform integrates five analysis modules to allow for the exploration of the feasible technical routes to the recovery and use of the available excess thermal energy. It is applied to seven European case studies for validation purposes and to explore its future potential. The case studies considered included resource and energy intensive industries, others focused on district heating networks and a super-user application with a macro assessment aiming as testing suitability for guiding policies for energy efficiency and GHG emissions reductions.

Results

The EMB3Rs platform has been successfully applied and validated in all of the seven different European case studies. It has allowed to identify suitable solutions both for internal heat recovery (by performing pinch analysis and by implementing Organic Rankine Cycles for electricity production) as well as for converting heat for District Heating and Cooling (DHC) networks. The EMB3Rs platform allowed identifying the best DHC network design solutions, selecting the key technologies based on least-cost, and characterizing them extensively (e.g. capacities for sources and sinks, storage requirements, emissions, costs, etc), market prices, internal rate of return, and payback period.

This novel tool has been extensively validated by comparing the results with others from commercially available software and /or ad-hoc excel tools, and has proven to deliver feasible and trustable results within a reasonable confidence range. Scalability options for the EMB3Rs platform are currently being assessed, with a view at maximizing its deployment and use across the EU and beyond.

Conclusions

The EMB3Rs platform is a novel tool developed under the H2020 project EMB3Rs. It is a comprehensive, online and open-source tool allowing to assess waste heat recovery and reuse solutions with regards their technical, environmental and economic feasibility. This innovative tool has so far demonstrated to deliver feasible and encouraging results, which allow saving a significant amount of time in relation to traditional (mostly manual) methods, and / or expensive specialized manpower.

It's wider deployment and use at EU scale is expected to facilitate the assessment of WHR project easier and, contribute to their dissemination and adoption (e.g. by industries and local authorities, inter alia), especially in the current context of rising energy prices and imperative energy transitions.

References

Agathokleous, Rafaela, Giuseppe Bianchi, Gregoris Panayiotou, Lazaros Aresti, Maria C. Argyrou, Giorgos S. Georgiou, Savvas A. Tassou, et al. 2019. "Waste Heat Recovery in the EU Industry and Proposed New Technologies." Energy Procedia 161 (March): 489–96. https://doi.org/10.1016/j.egypro.2019.02.064.

Connolly, D., H. Lund, B. V. Mathiesen, S. Werner, B. Möller, U. Persson, T. Boermans, D. Trier, P. A. Østergaard, and S. Nielsen. 2014. "Heat Roadmap Europe: Combining District Heating with Heat Savings to Decarbonise the EU Energy System." Energy Policy 65 (February): 475–89.

Eurostat. 2022. "Renewables Steadily Increasing in Heating and Cooling." 2022. https://ec.europa.eu/eurostat/web/products-eurostat-news/-/edn-20220211-1.

Fleiter, Tobias, Rainer Elsland, M Rehfeldt, Jan Steinbach, U Reiter, G. Catennazzi, Martin Jakob, et al. 2017. "Profile of Heating and Cooling Demand in 2015." Heat Roadmap Europe (HRE) D 3.1. https://heatroadmap.eu/wp-content/uploads/2018/11/HRE4_D3.1.pdf.