Report Summary: Wastewater Heat Recovery UK Feasibility

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Overview: Wastewater heat recovery (WWHR) was evaluated for physical performance and institutional acceptance within the UK based on University of Cambridge case studies and industry surveys.

Aims: By investigating the technical and social factors potentially affecting WWHR's adoption or lack of adoption in the UK, this research aims to understand whether the UK provides a suitable environment to utilise WWHR.

Process/methodology: A review of literature provided an integrated technical and social framework to assess the usability of the technology. Then, case studies at Wolfson College and at the Northwest Cambridge Development (NWCD) combined with WWHR industry interviews tested technological viability while discovering potential social factors influencing WWHR's adoption. Finally, a questionnaire for UK wastewater companies investigated social viability by testing the previously discovered social factors.

Results: Through literature, site data, and interviews, WWHR (in combination with heat pumps) was found to use 56% less energy with 67% less emissions (CO_{2e}) than conventional boiler heating system[1, 2]. Both case study sites, Wolfson and NWCD, proved viable for WWHR installations but showed potential challenges. These challenges include a lack of data, especially wastewater temperature and flow; integration into existing/planned infrastructure; and required cooperation with outside organisations. The numerical results are summarised in Table 1.

Table 1: Case study findings

Case Study	Sewage Flow (l/s)	Heat Output (kW/day)	Heating Demand (kW/day)	Heat Pump Size (kW)	GHG Savings ($kgCO_2e$/day)
Wolfson	25.0	837	1,588	286	184
NWCD	25.1	841	23,838	314	204

The literature, interviews, and surveys suggest the potential for acceptance of WWHR by the UK wastewater industry. The surveyed wastewater industry shows significant existing knowledge of the technology but also heavy uncertainty in its performance. The data also indicated a lack of existing UK wastewater data but indicated a general acceptance of coordination between sites and wastewater companies. Finally, the data provided some understanding in how wastewater company structures may influence coordination potential.

[1] DECC, 2016. Greenhouse gas reporting - Conversion factors 2016. Available at: https://www.gov.uk/government/publications/ greenhouse-gas-reporting-conversion-factors-2016 [Accessed June 17, 2016]. [2] Gelhaus, C., Innovative System for Heat Recovery from Wastewater - Huber Technology UK - Rotamat Ltd. *Huber Technolgoies Website*. Available at: http://www.huber.co.uk/global/huber-report/ablage-berichte/energy-from-wastewater/innovative-system-for-heat-recovery-from-wastewater.html?L=0 [Accessed March 10, 2016].

Recommendations: The University should build relationships with the local wastewater treatment provider and begin planning for the potential use of WWHR. New developments should be considered for the technology beginning at infrastructure planning, therefore simplifying the implementation process. It is suggested that sites begin monitoring wastewater temperature and flow, if existing sites are considering implementation.

Conclusions: The mixed-method research with triangulation of quantitative and qualitative analyses allowed the following conclusions to be drawn:

- UK wastewater patterns and infrastructure should allow for WWHR applications.
- Wolfson College and Northwest Cambridge Development both provide potential for WWHR applications, although implementation at both sites is fully reliant upon coordination with multiple non-University organisations.
- Locating sites with both sufficient wastewater flow and organisational support may be challenging.
- WWHR is ideal for new development sites, but can be integrated into existing sites.
- A lack of existing wastewater data hinders WWHR applications.
- Confidence in the technology is limited by existing gaps in understanding WWHR's effect on other systems.
- Further education on WWHR's operational abilities is critical to future applications.
- Cooperation with between organisations will be necessary for WWHR applications.
- UK wastewater companies may be willing to allow WWHR applications within their infrastructure.

Next steps: Further work should focus on proving the technology's operational abilities as well as understanding how to make the installation environment more conducive to wastewater company/end user partnerships. Studying the single UK application in Scotland and properly communicating the results may reduce associated risk with UK WWHR. Research on performance limiting effects may help better understand product performance. Additionally, research into other potential technology benefits may help to show an increased need for the product. Finally, as this research only addressed a few of the discovered social factors, additional research investigating the necessary partnerships and interactions may be beneficial.

Photo(s)/graphics related to the project:

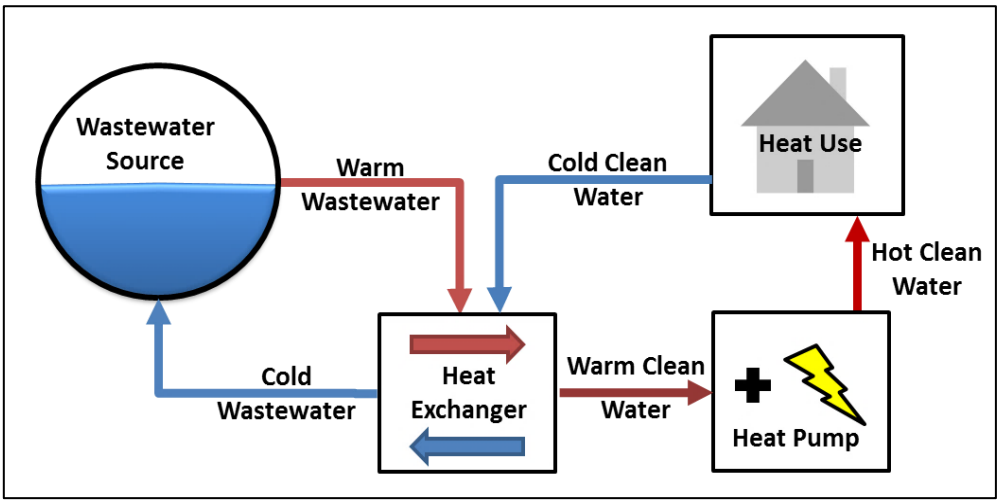

Figure: Simplified WWHR process

About you: *Stephanie Drenten, Engineering for Sustainable Development, MPhil.*

Motivation: *I found it important to research a topic for my thesis that stretched my existing knowledge and skills while providing insight into ways to operate facilities sustainably.*

Personal outcomes from project: *The project allowed me to gain experience as a consultant coordinating directly with clients, product suppliers, and infrastructure operators. It also allowed me to investigate the factors that influence a technology's uptake and market spread. Additionally, this was the first time I have conducted social research.*

Vision: *WWHR is a technology, which on the correct scale, can be extremely beneficial for multi-use developments. In the future, the technology should be reviewed for use on University properties, especially new developments or major infrastructure changes. Overall, I hope the research will be used to further communication between end-users, infrastructure owners, and product developers to increase installation viability.*

What's next?: *With my MPhil completed, I'm headed to Cleveland, Ohio, USA to work as an Energy Program Engineer for Forest City Reality. My work will focus on instituting and tracking energy efficiency programs across the company's portfolio of properties around the USA.*

On a scale of 1-5 how motivated are you to do further work on environmental sustainability?: *5-Very motivated, I believe it is extremely important that we find and implement ways to conduct our daily lives which are environmentally sustainable.*