

Impediments and potentials of water heat recycling for building heating – technical, economical, planning and legal aspects

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Subject of research project

In Germany, the theoretical potential of wastewater heat amounts to about 29.2 terawatt hours per year – in relation to the resource “public sewage system”, wastewater cooling of two degrees Kelvin and a yearly working figures (electric heat pump) of four. There are 40 million apartments in Germany that need heating. The total amount of thermal energy required for all apartments is about 626 terawatt hours per year, if the average thermal energy demand is defined as 15,645 kilowatt hour per year per apartment.

Based on its theoretical potential, water heat recycling could therefore be used for heating 5 percent, i.e. 2 million, of all apartments in Germany. There is also a large number of heated non-residential buildings whose thermal energy demand is specified with 42.6% of that of the entire building stock.

It can be noted that the potential of water heat recycling has not been used to its fullest extent yet – even though sophisticated technologies are available. Thus, the key questions that need to be examined is, which impediments and incentives play a role in the recycling of wastewater heat, and which strategies can be developed to overcome technical, economical, planning and legal barriers to integrate wastewater recycling in the heat market.

For this purpose, the stakeholders of the real-estate industry and the building construction sector in general need to be identified that play a part in developing, designing, constructing and maintaining buildings. An online-survey, ordered thematically, was designed to make use of their experiences and views. To achieve a high degree of acceptance a maximum level of data privacy protection was ensured.

It has been verified that there are deficits concerning experiences, information procurement and knowledge regarding investment costs and cost efficiency.

From these findings following strategies and action fields have been derived which then lead to recommendations for action in order to increase the amount of use cases for water heat recycling.

1. Knowledge transfer

This topic should be integrated in diverse education programs, and it should be part of the standard canon of knowledge and information in the construction industry, as well as the real estate industry and public administration, to generate a broader range of use cases.

Upon the dissemination of basic knowledge, in a second step, all involved parties can rely on significantly improved knowledge and experience. It is especially helpful when already realized projects are published as examples whereby a wide readership and awareness-building can be achieved.

2. Willingness of stakeholders

At the start of planning, all parties involved should be made aware of the possibility of water heat recycling in the form of a cooperative communication and cooperative project management in order to harness the stakeholders' willingness to increase cases of application.

3. Available tools

Available tools (e.g. sewage register) should be used for increasing cases of application; for example, more wastewater heat cadasters should be compiled and used to determine the heat demand.

Only then can the wastewater heat supply be compared with the heat demand which allows for a concrete assessment of possible locations or areas. On the basis of this comparison relevant property locations can be identified, and discussions with stakeholders can be conducted effectively.

4. Knowledge dissemination

To achieve fast knowledge dissemination among planners, craftsmen, general contractors, real-estate economists, urban planners, system operators etc. information events at engineer's and architectural associations, chambers of crafts, and real estate congresses should be carried out. Through the aforementioned institutions infomails, newsletters, whitepapers and flyers could be distributed to their members.

5. Convincing decision-makers

To convince the decision-makers – building clients and their representatives – an awareness for the application of wastewater heat needs to be created; provided that the technical background presents no problem. By addressing cost-efficiency and sustainability, as well as activities for reducing legal barriers, the contribution to climate and environmental protection and benefits for real-estate marketing – aspects most relevant for decision-makers – are presented.

6. Cost-efficiency assessment

As approaches for cost-efficiency – in consideration of the investor-user dilemma – a suitable assessment of life-cycle costs and sustainability would be that of additional considerations of operating costs and annual costs for different technical options.

This, in turn, will support the use of economic comparisons in view of different heating technologies and requirements for the building envelope which can increase the number of uses cases.

7. Funding

An increase of application cases through a simple and therefore fast extension of funding programs for research and technological development would entail investment subsidies or fiscal incentives. For example, KfW programs for water heat recycling could be established or the use of this technology could be integrated into existing funding programs. The KfW program 494 could, for example, be quickly expanded accordingly. Additionally, competing topics such as construction in existing contexts, fire protection and accessibility need to be taken into consideration as these lead to investments which then need to be compensated through cost savings elsewhere.

8. Buildings Energy Act (GEG) / Renewable Energy Heating Act (EEWärmeG)

Since wastewater heat utilization in public / private sewers has not been categorized as renewable thermal energy in the Renewable Energy Heating Act (EEWärmeG), wastewater heat utilization has not yet gained acceptance whenever renewable energies are required to be used in new buildings. This should be revised in the forthcoming Buildings Energy Act (GEG).

9. Legal framework

A right to use wastewater heat should be formulated. This can be done by considering different contract models based on the specific stakeholder groups. If required, sample contracts can be created for the public and private sector. Contract terms that need to be defined serve as a reciprocal balance of risks. The provider is awarded with the profit whereas the user, in return, can rely on a calculable basis. The liability for founders/users/investors should be limited since waste heat recovery serves the general good

and allocations of liability can be regarded as impediments. Contractual forms and formulations should be nationally standardized and made freely available.

10. Role of wastewater institutions

Sewage operators and stakeholders (e.g. environmental engineers) are knowledge holders with regard to wastewater technology. This is why they are key partners in disseminating knowledge and building acceptance regarding the reuse of wastewater heat. The sewage operators could facilitate an interdisciplinary cooperation for all involved in the process. And based on their public infrastructure task an involvement in covering the heat requirement for buildings could be initiated. Sewage operators are heard or are even involved in master plan and building application processes. In particular in building application processes sewage carriers can then address builders and the planners involved and discuss water heat recycling, as long as the location makes it reasonable for the specific project. In case of project-based developments plans, an active promotion of the reuse of wastewater heat can be realized through conversations with decisive stakeholders. In this case, contact can be made at an early stage in the project, even before applying for building permission.

11. Cooling of buildings

In general, the application of cooling of buildings rises. This can, for example, be ascribed to the increased comfort requirements, legal requirements for summer heat insulation and the application of heat-pump technology. In the summer, water heat recycling can transfer the derived waste heat to a relatively stable medium which has a lower temperature level as the outside air. Accordingly, cooling of building with water heat recycling is a much more efficient and therefore climate friendlier technology. Furthermore, it also comes with a better cost efficiency.

12. Requirements for decreasing costs

Regarding the investment costs it should be pointed out that the costs are reduced by an increased number of applications.

Until now the use of wastewater heat has been exclusively reserved to the acquisition of suppliers. In the future, costs for acquisition and development could drop if use cases increase, and if the technology is demanded by stakeholders.

13. Networker role

Since the increase of use cases of wastewater heat requires an interdisciplinary cooperation between many participants, and therefore a network structure, an active leadership of the network connections seems critical for the successful work of the network. Therefore, it needs to be determined who assumes the group leadership within the network. The need for a network can be derived from the fact that the technology and reference projects exist, as well as a general interest according to the survey. Nevertheless, a link between all those involved in the construction process is missing to assure more use cases and a sustainable use of resources. A cooperation of all industrial partners alone cannot raise the applications to the full extent of its potential. Therefore the network needs to be widened.

Conclusion

As long as planners, the real-estate sector and municipalities do not have empirical values this requires higher planning and coordination efforts which reduces the economic efficiency of water heat recycling.

The transfer of knowledge and further information on the topic of "water heat recycling" in the areas of technology, efficiency, planning and legal aspects is therefore very important for eliminating impediments.

The willingness particularly of planners but also of municipalities and real-estate sector to engage in the technology should be increased by means of different procedures of visualization of stakeholders and the technology itself.

Short title:

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