RECOMMENDATION PAPER

From Data Centres to District Heating & Cooling: Boosting waste heat recovery to support decarbonisation

The climate emergency calls for a swift and radical transformation of the energy system. Delivering sustainable heating and cooling is fundamental to achieving Europe's climate neutrality ambition, as heating and cooling represent 50% of the final energy consumption in the EU.

The increasing reliance of our societies on digital infrastructures and data processing capacity will lead to increased demand in power and cooling. **Since 2010, the global internet traffic has grown 12-fold**. The resulting energy demand from data centres and data transmission networks was around 200 TWh and accounts for around **1% of global final electricity demand in 2019**[1]. This equals around 6% of the global district heating demand in 2014[2]. It can be expected that the total data produced will increase by a factor of 4 by 2025[3].

The EU Green Deal proposes a path towards sustainable societies and EU leaders agreed on more ambitious greenhouse gas (GHG) emission reduction targets for 2030 and carbon neutrality by 2050. In its recent publications, **the European Commission has put a strong emphasis on the decarbonisation, greater efficiency and circularity of the heating and cooling sector**. The EU Digital Strategy[28] announced a commitment to make data centres climate-neutral by 2030, with actions to be put in place in 2021 to 2022.

In this perspective, waste heat recovery from data centres (DC) is bound to play an important role, since **almost 100% of the electricity supply to the data centre is transformed into heat**. Its recovery fosters greater energy efficiency for DC and supports the decarbonisation of district heating and cooling (DHC). There is significant heat recovery potential from unconventional waste heat sources. Approximately 1.2 EJ (or 340 TWh) per year could be recovered from unconventional waste heat sources, including data centres, which corresponds to more than 10 % of the EU's total energy demand for heat and hot water[4].

The DHC and the data centre sectors acknowledge the convergence and synergies between their sectors with the recovery and use of the waste heat generated when cooling data centre facilities into DHC.

The present paper is a joint effort between Euroheat & Power (EHP), representing the district heating and cooling sector and stakeholders from the data centre value chain, all committed to delivering on climate targets.

EHP is committed to pursuing the **full decarbonisation of DHC networks** in Europe before 2050, to contribute to the goals set out in the Paris Agreement[5]. Data centre operators and trade associations agreed to take action to make data centres **climate neutral by 2030** and thus have the opportunity to provide carbon free thermal energy with the Climate Neutral Data Centre Pact (CNDP) [6]. The data centre sector is already on its way to be **powered by 75% renewable energy in 2025 and 100% by 2030.**

These sectors came together to propose recommendations on how to better support the uptake of DC waste heat recovery in the context of the European Commission's work on the "Fit for 55" legislative Package, as well as for the national implementation of EU rules and translation into local policies and planning.

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[1] IEA analysis based on Masanet, E. et al. (2020). Recalibrating global data center energy-use estimates, Science, 367(6481), 984-986, https://doi.org/10.1126/science.aba3758.

[2] Sven Werner, International review of district heating and cooling, Energy, https://doi.org/10.1016/j.energy.2017.04.045

[3] IDCs Data age 2025 study

[4] ReUseHeat project report "Accessible Urban Waste Heat" https://www.reuseheat.eu/project-documents-newsletter/

[5] See: https://www.euroheat.org/wp-content/uploads/2019/09/Our-DHC-Decarbonisation-Pledge.pdf

[6] See the Initiative: https://www.climateneutraldatacentre.net/self-regulatory-initiative/

1. Support District Heating development and modernisation

Without access to DHC grids, DC must rely on various types of cooling technologies to dissipate the heat generated by the IT equipment. This is an electricity intensive process, that results in excess heat being released - 'wasted' - into the environment. DHC is a proven solution for the decarbonisation of the energy system, connecting a wide range of low-carbon local sources of heat or cold (including waste heat) to the urban communities in which they are needed. However, there are still some barriers to an efficient and large-scale implementation of low temperature waste heat sources for the majority of DHC grids.

→ Investment policies and funding instruments enabling the EU Green Deal need to reflect the concept of energy system integration and fully address the development of new DHC networks and the modernisation of existing ones, to integrate waste heat/cold and renewable energy.

2. Better recognise waste heat from data centres in the EU framework

A stable and consistent framework is vital to promote waste heat across **EU legislation**.

→ Renewable Energy Directive (RED II): Treating waste heat (including DC waste heat) on par with renewable energy sources when it comes to achieving renewable targets in heating and cooling (REDII, article 23), district heating (REDII, article 24) or buildings, is key to ensure the development of waste heat recovery and the roll-out of projects. Systems that integrate waste heat generally provide a lower carbon heat source. If the objective is decarbonisation, this should be reflected in EU and national policies.

→ Energy Efficiency Directive (EED): Waste heat from large data centres should be explicitly covered in the EED Article 14 and Annex VIII on the National Comprehensive Heating and Cooling Assessment, as currently only industrial installations are considered for cost-benefit analysis.

→ Energy Performance of buildings (EPBD): The EPBD could have a role in supporting waste heat utilisation and heat planning as well as in highlighting the importance of sharing anonymised data to trusted research organisations.

3. Foster cooperation, planning and empower the different waste heat actors

Cities and buildings are at the heart of the decarbonisation challenge. While decisions on DHC infrastructure and implementation remain local, their crucial role in the broader energy system as a flexibility provider, makes a structured dialogue and planning to ensure the alignment and coherence between local, national and EU actors an absolute necessity. Better planning should also help overcome distance and technical challenges that are inherent to waste heat recovery from DC.

→ Member States do not systematically address the decarbonisation of heating and cooling in their National Climate and Energy Plans (NECPs). Furthermore, there is no EU obligation for them to draft heat plans or include a specific section on heating and cooling decarbonisation in their NEPCs.

Such plans should build on existing instruments such as the EED Article 14 on the National Comprehensive Heating and Cooling Assessment and the Long-term Building Renovation Strategies under Article 2a of the Energy Performance of Buildings Directive.

National decarbonisation of heating and cooling plans would guide urban planning, translating general objectives and targets into concrete roadmaps, solutions and projects.

There are a few key aspects to unlocking better heat planning at regional/local level:

→ Foster integrated urban energy planning: promote the cooperation between DC, DHC and planning companies on urban energy planning – highlight the importance of compact urban growth in planning. Waste heat actors have limited opportunities to meet and exchange with each other, they are focused on their core activities and do not necessarily have the knowledge to implement successful waste heat recovery projects. Some EU projects and initiatives already support cities in their decarbonisation efforts by providing networking opportunities, expert support, peer review, mapping and planning tools. More public funding needs to be committed to foster better communication, spread knowledge and create trust between three different waste heat actors. [7]

→ Ensure that maps of DHC zones (areas with high enough heat density to support DH) and existing grids in the city are created and available to encourage DC to establish within or close to those boundaries.

→ Foster access to information by creating urban registries of data centres, allowing the identification of waste heat potential and location when applying for permits or similar processes. These registries could be used for the matchmaking of DHC operators and DC. To ensure qualitative heat mapping, the registries could include characterisation of the waste heat (kW capacity, temperature, availability profile).

4. Improve the business case of waste heat recovery

Waste Heat recovery projects have rather high CAPEX and financial risks. On the one hand, they require long-term commitments with long pay-back periods, sometimes not compatible with the mid-term investment timeframes for DC. Some EU funded projects[8] already address these issues. **EU funding and support should continue to be provided for instance, to**:

→ Support faster and easier commercial negotiations with the development of standardised clauses and contracts that can serve as resources for stakeholders to kick-start WH recovery projects. For instance, the ReUseHeat project has designed a checklist with essential contractual aspects to cover[9].

→ Identify examples of business models derived from real projects.

→ Promote advanced risk management mechanisms to cover unscheduled DHC operational costs that result from the intermittency of heat from data centres or other specific unplanned incidents that are not within the control of either party.

Waste heat from DC projects bankability would also be improved by:

→ Including a carbon price and the avoided costs of carbon in business cases.

→ Adapting the electricity network charges and levies system, so that the use of electricity for energy system integration becomes competitive. DC waste heat is generally low grade and must be upgraded with heat pumps. In some countries, the cost of electricity (levies, network charges, etc.) worsens the business case with prohibitive costs, leading to a lack of attractiveness for waste heat projects.

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[7] See the projects listed in the Discussion Paper prepared by AIT, Part II, 6; https://www.euroheat.org/wp-content/uploads/2020/06/Discussion.pdf

[8] See: https://www.mdpi.com/2076-3417/9/15/3142

[9] ReUseHeat project report "D2.3 Contractual Forms" https://www.reuseheat.eu/project-documents-newsletter/

5. Boost skill training and capacity building

→ Build capacity and understanding of techno-economic analysis for DC waste heat in DH networks.

→ Train workforce to the specific needs of waste heat recovery, for instance heat pump technicians. Increasing awareness of professionals, e.g. installers and real estate developers can be done through education, as it was the case in 2018 with the "Green Deal on heat pumps" which set out to train 6000 heat pump technicians[10].

6. Integrate waste heat in standard and sectoral guidelines for data centres

→ Data Centre standards such as EN 50600 "Information technology - data centre facilities and infrastructures" (ISO TS 22237) and Uptime Institute standard on "Tier Classification System" that evaluate data centre facilities must be updated to include waste heat recovery/district cooling.

→ The revised European Standard CEN-EN 16325 on guarantees of origin (GOs) now includes a standard for GOs for heating and cooling, implementing the Renewable Energy Directive. This could support waste heat recovery from data centres, differentiating from fossil based generated thermal energy and as such increase the acceptance of data centre waste heat.

→ There are some very positive examples of industry initiatives and voluntary guidance document which have seen some uptake in the DC industry, that reflect the contribution of waste heat for DC energy efficiency, for instance:

- **The EU Code of Conduct on Data Centre Energy Efficiency[11] and its companion from the European Commission Joint Research Centre "2021 Best Practice Guidelines for the EU Code of Conduct on Data Centre Energy Efficiency"[12].**
- **The Climate Neutral Data Centre Pact[13].**
- **EU green public procurement criteria for data centres, server rooms and cloud service[14], includes a criterion on waste heat reuse readiness.**
- **These initiatives are good practices that should be continued and developed.**

[10] Renewable and Waste Heat Recovery for Competitive District Heating and Cooling Networks, REWARDHeat Project, PESTLE analysis for the Netherlands, IVL Swedish Environmental Research Institute, publication foreseen end of March 2021 (accessed draft version).
[11] See: https://ec.europa.eu/jrc/en/energy-efficiency/code-conduct/datacentres
[12] See: https://e3p.jrc.ec.europa.eu/sites/default/files/documents/publications/jrc123653_jrc119571_2021_best_practice_guidelines_final_v1_1.pdf
[13] See: https://www.climateneutraldatacentre.net/self-regulatory-initiative/
[14] See: https://ec.europa.eu/jrc/en/publication/eur-scientific-and-technical-research-reports/development-eu-green-public-procurement-gpp-criteria-data-centres-server-rooms-and-cloud

7. Selected case studies for reference and other resources

Projects examples (non-exhaustive list)

- Dalkia, Val d'Europe, France
- Funnen District Heating, Odense, Denmark
- GleSYS/Falkenberg Energi, Sweden
- NorthC data center/Aalsmeer Energy Hub, Aalsmeer (south of Amsterdam), the Netherlands
- Open District Heating, Stockholm, Sweden
- Tallaght District Heating Network, Dublin, Ireland
- Telia/Fortum, Helsinki, Finland
- Veolia/BS Energy, Braunschweig, Germany
- WarmteStad, Zernike Campus, Groningen, the Netherlands

Other resources

- European Commission/Tilia study: "Integrating renewable, waste heat & cold sources into DHC systems" (February 2021)
- ReUseHeat project
- Celsius Initiative Toolbox: Excess heat from datacentres: Let your Insta-selfies heat your home
- Interreg HeatNet NWE was focused on the development of 4th generation DHC across 6 countries in North-west Europe, an online platform was developed to provide guidance for other cities to develop 4DHC in their region.

The drafting of this paper was initiated and coordinated by:

Euroheat & Power (EHP) is a unique network of district energy organisations and professionals, connecting industry players, decision-makers and academia in a joint effort to drive forward sustainable heating and cooling. With its member organisations, EHP leads activities and fosters a dialogue with stakeholders involved in waste heat recovery. https://www.euroheat.org/ | For more information, contact Pauline Lucas, Policy Manager | pl@euroheat.org

Dutch Data Center Association (DDA) is the trade association for data centres in the Netherlands, the bedrock of the Dutch economy. The DDA unites leading data centers in The Netherlands in a common mission: to strengthen the economic growth and awareness of the data center sector to government, media and society. The DDA works from three focus areas: Energy & Sustainability, Education & Employment and Digital Economy & Mainport. We are committed to making the industry's power usage more sustainable and efficient, and we focus on reusing data center residual heat. Furthermore, in close cooperation with education institutions, we create data center courses and enthuse students to choose a career in the data centre industry. Lastly, we promote our industry and our position as a Digital Gateway to Europe. We also contribute to discussions about technical standards in the sector, and we actively facilitate our members and partners with information about relevant market developments during our (internal) events, publications and media channels. https://www.dutchdatacenters.nl/ | For more information contact Erik Barentsen, Senior Policy Officer | erik@dutchdatacenters.nl

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The Hamburg Institut is a consulting and research company with a focus on the energy and environmental sector. Since 2012, it has been supporting

ministries, municipalities, energy industry companies, associations and other national and international stakeholders in the successful implementation of the energy transition. The Hamburg Institut pools long-standing expertise from politics, administration, business, law and technology and offers interdisciplinary research work in addition to consulting and strategy development. Since 2019, the Hamburg Institut has been part of the Averdung Ingenieure & Berater GmbH company group. www.hamburg-institut.com

The ReUseHeat project, financed under the European H2020 framework, is generating knowledge on how excess heat from data centres, sewage water treatment, service sector buildings and metro stations can be reused in district heating systems. This kind of heat source is increasingly important to reach 2050 targets as fossil fuels are being phased out. The project features four technical demonstration sites but also emphasizes the importance of understanding the urban waste heat investment risks, business models and contracts. https://www.reuseheat.eu/