



Data centre heat energy reuse opportunities



UK Research
and Innovation

EST 1892

LSBU

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LOT-NET The logo icon for LOT-NET consists of two circular arrows forming a loop. The top arrow is blue and points to the right, while the bottom arrow is red and points to the left.

Low Temperature Heat Recovery and Distribution Network Technologies

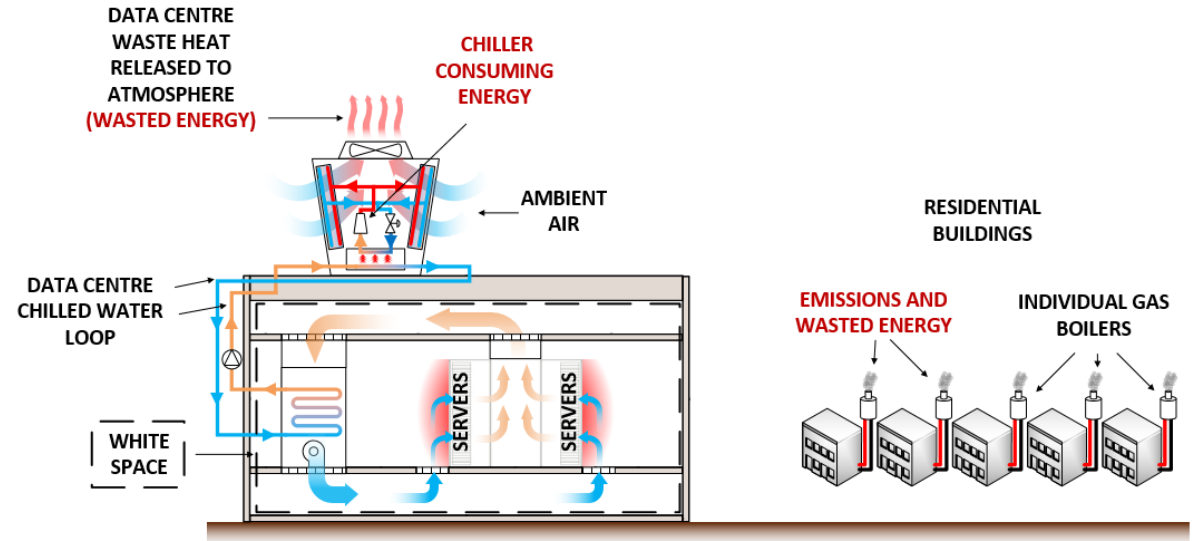
Research questions

1. How much waste heat is generated by data centres in the UK and how can it be captured?
2. What are the benefits?
3. How can we overcome the barriers to adoption of waste heat recovery?

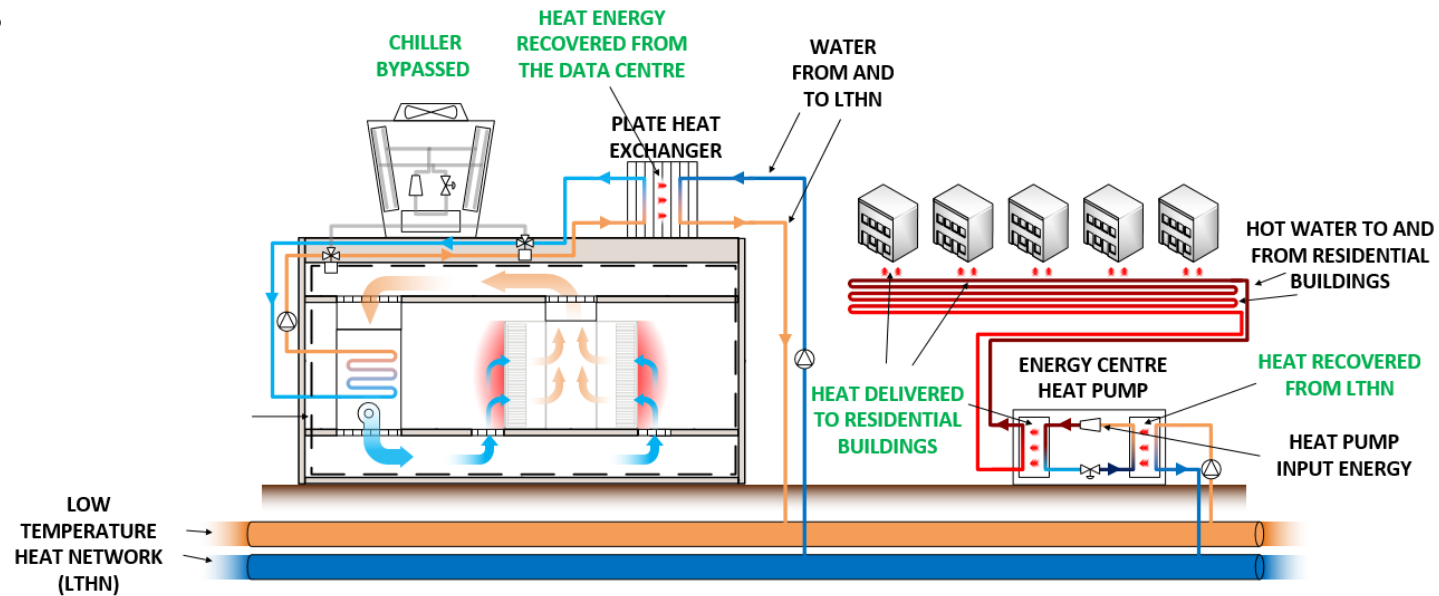
Business as usual:

Heat recovery in data centres

- In cities, heat energy can be recovered to a district heat network, and reused for hot water and space heating;
- Recovering the waste heat also satisfies the data centre's cooling requirements, while the existing equipment stays in place to ensure resilience.



Heat recovery:



Heat and buildings strategy



Heat and Buildings Strategy

Presented to Parliament by the Secretary of State for Business, Energy and Industrial Strategy by Command of Her Majesty

October 2021

Technology	Heat networks
Description	Heat networks use hot water in pipes to deliver heating (and in some cases cold water for cooling) to many consumers from a centralised heat source. As this pipe infrastructure can be used to deliver heating from a range of different heat sources, they can be decarbonised by switching to a low-carbon source of heat.
Types	<p>Low-carbon heat sources for heat networks can include:</p> <ul style="list-style-type: none"> • 'waste heat' sources (supported in some cases by large-scale heat pumps to upgrade the heat temperatures) <ul style="list-style-type: none"> • industrial processes • data centres • underground transportation • sewage



¹⁹⁷ BEIS internal analysis, using the 'National Household Model' (2017) (<https://data.gov.uk/dataset/957eadbe-43b6-4d8d-b931-8594cb346ecd/national-household-model>), based on consideration of thermal and electrical constraints at dwelling levels.

¹⁹⁸ Fluorinated gases (F-gases), such as HFCs, are man-made. Though they do not damage the atmospheric ozone layer, they are greenhouse gases with a far greater global warming potential than carbon dioxide.

¹⁹⁹ Guidance on current and upcoming bans on F-gases can be found at: <https://www.gov.uk/government/collections/fluorinated-gas-f-gas-guidance-for-users-producers-and-traders>.

Heat and buildings strategy

Heat and Buildings Strategy

setting a date to ensure that all homes meet a Net Zero minimum energy performance standard before 2050, where cost-effective, practical and affordable.

20. **Significantly reducing energy consumption of commercial, and industrial buildings by 2030:** This will deliver significant emissions reductions and deliver cost savings for businesses by: setting privately-rented commercial buildings a minimum efficiency standard of EPC band B by 2030 in England and Wales, introducing a new and innovative performance-based energy rating for large commercial and industrial buildings, over 1,000m² which use more energy than all other commercial and industrial buildings, while only accounting for about 7% of the stock²⁷ and can deliver significant energy and emission reductions, consulting on regulating the owner-occupier sector later this year
21. **Launch a new world-class policy framework for energy-related products:** We will continue to pursue and explore policies that increase use of energy efficient, smart and sustainable products and maximise their associated benefits, following our departure from the EU. We plan to launch our new Energy Related Products Policy Framework which will be published in due course and include illustrative proposals on a range of products including cookers, boilers (including consideration of hybrids), showers, taps and heat emitters. The introduction of this new framework will reduce consumer bills, reduce energy consumption, and reduce emissions by ensuring that when consumers invest in new products, they are buying products that have been made to high efficiency standards.
22. **Considering how to ensure flexible demand and supply (including through smart technologies and energy storage) is taken into account across the full range of energy performance, fuel poverty and heat policies, including regulation and subsidy schemes:** We will build on existing work to consider how to recognise technologies in the Standard Assessment Procedure (SAP) methodology, so that buildings are decarbonised in a way that works for the consumer and the wider energy system.
23. **Developing a workforce pipeline with the skills to meet the requirements of Net Zero transition:** Government is working closely with industry to ensure that installers have up-to-date, high-quality training and that they are not undercut by installers who offer cheaper, low-quality installations. This involves developing new core competencies and agreed training criteria for installing low-carbon heating systems and ensuring energy efficiency improvements are delivered to high standards, using quality and certification schemes, and specification standards.

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- Renewable electrical energy, whether purchased or generated, is not enough if heat is wasted
- Heat recovery allows to close the loop and become truly carbon neutral

²⁷ BEIS internal analysis of BEIS (2016), 'Building Energy Efficiency Survey' (<https://www.gov.uk/government/publications/building-energy-efficiency-survey-bees>). Private buildings only. Excluding energy used for manufacturing and refining.

Why is the survey important? It will:

- provide critical insight into how energy is used in data centres
- allow to develop generic factors which are instrumental to data centre categorisation
- enable a much more realistic extrapolation -> estimation of the size of the opportunity for waste heat recovery in the UK
- investigate the market's attitude towards heat recovery and allow to identify enablers to adoption

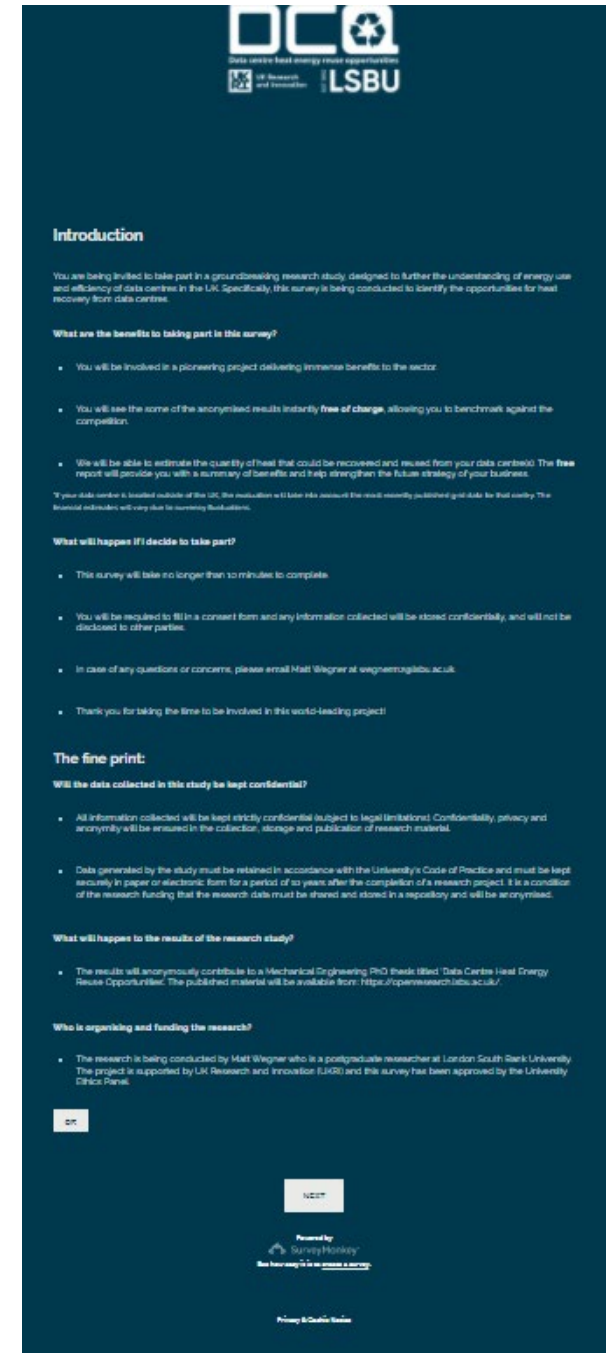
Case study

- Real-life data is critical to evaluation of benefits of heat recovery through energy modelling

Survey

Launched on November 16th 2021 during the data centre SIRACH event. It aims to:

- Overcome the lack of transparency within the sector
- Understand how data centres use energy
- Help establish generic factors between facilities for a more accurate estimate of heat available from the sector
- Invite data centre owners and operators to participate in the project (energy modelling)
- Investigate the industry's attitude towards waste heat recovery



DCA
Data centre heat energy reuse opportunities

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Introduction

You are being invited to take part in a groundbreaking research study designed to further the understanding of energy use and efficiency of data centres in the UK. Specifically, this survey is being conducted to identify the opportunities for heat recovery from data centres.

What are the benefits to taking part in this survey?

- You will be involved in a pioneering project delivering immense benefits to the sector.
- You will see the some of the anonymised results instantly **free of charge**, allowing you to benchmark against the competition.
- We will be able to estimate the quantity of heat that could be recovered and reused from your data centres! The free report will provide you with a summary of benefits and help strengthen the future strategy of your business.

*Your data centre is located outside of the UK, the motivation is to take this research the next step by publishing global data for that country. The financial outcomes will vary due to currency fluctuations.

What will happen if I decide to take part?

- This survey will take no longer than 10 minutes to complete.
- You will be required to fill in a consent form and any information collected will be stored confidentially, and will not be disclosed to other parties.
- In case of any questions or concerns, please email Matt Wegner at wegner@lsbu.ac.uk.
- Thank you for taking the time to be involved in this world-leading project!

The fine print:

Will the data collected in this study be kept confidential?

- All information collected will be kept strictly confidential (subject to legal limitations). Confidentiality, privacy and anonymity will be ensured in the collection, storage and publication of research material.
- Data generated by the study must be retained in accordance with the University's Code of Practice and must be kept securely in paper or electronic form for a period of 10 years after the completion of a research project. It is a condition of the research funding that the research data must be stored and stored in a repository and will be anonymised.

What will happen to the results of the research study?

- The results will anonymously contribute to a Mechanical Engineering PhD thesis titled 'Data Centre Heat Energy Reuse Opportunities'. The published material will be available from: <https://openresearch.lsbu.ac.uk/>.

Who is organising and funding the research?

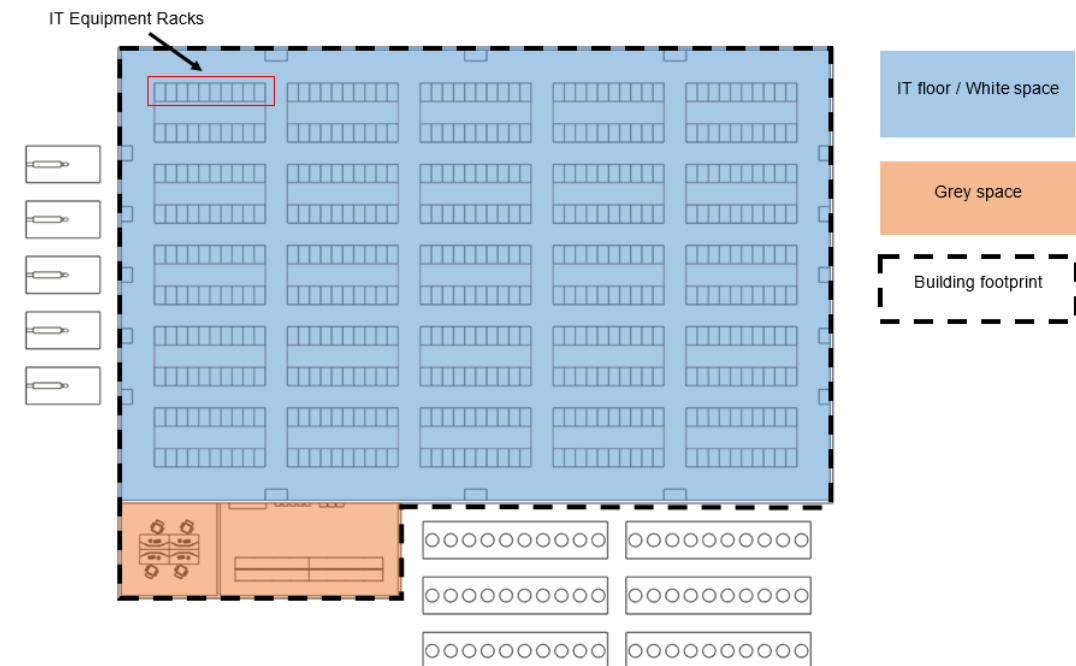
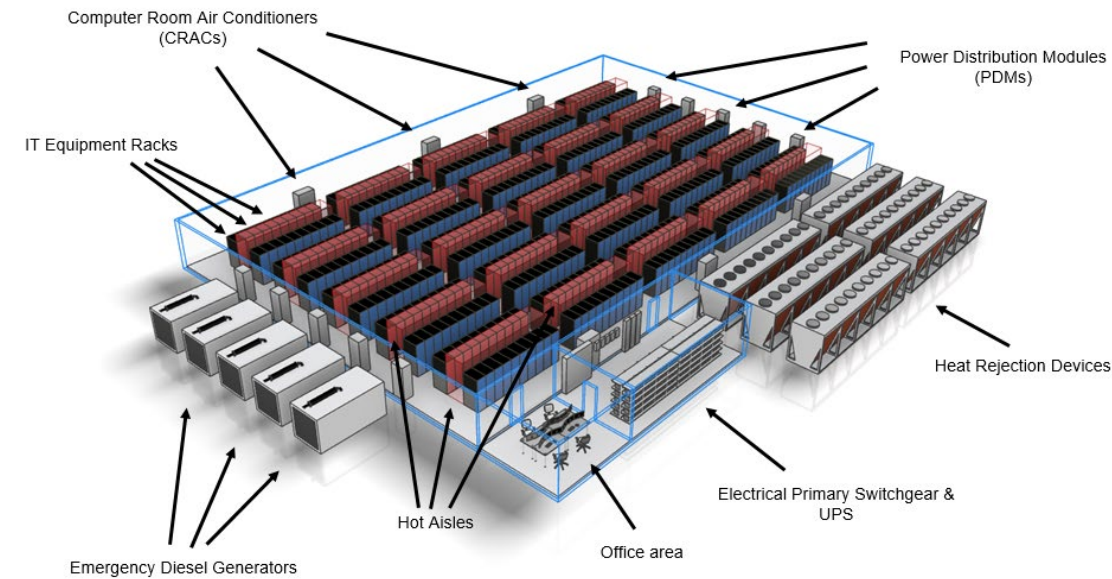
- The research is being conducted by Matt Wegner who is a postgraduate researcher at London South Bank University. The project is supported by UK Research and Innovation (UKRI) and this survey has been approved by the University Ethics Panel.

Powered by
SurveyMonkey
See how easy it is to create a survey.

Privacy & Cookie Notice

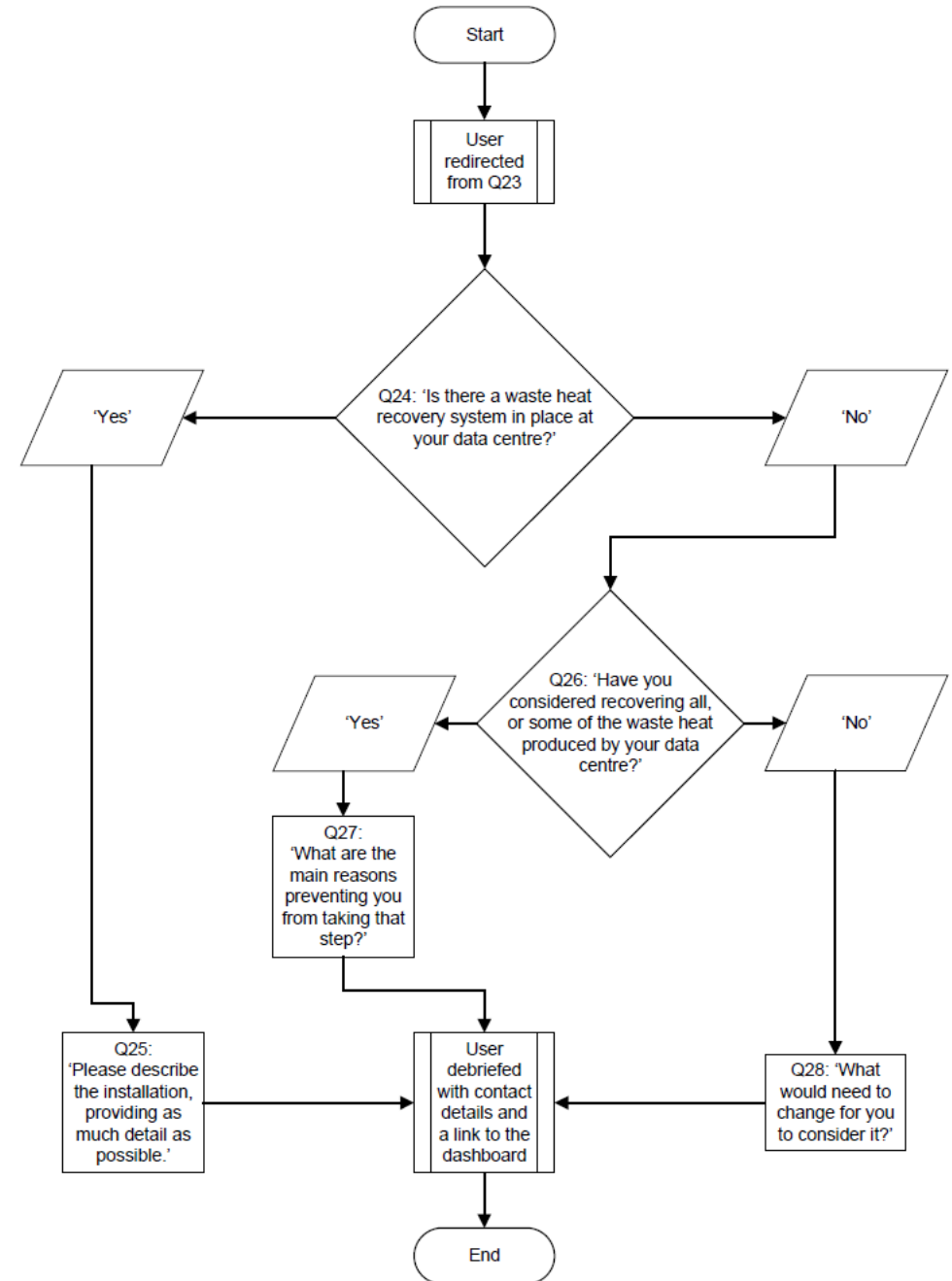
Features of the survey

- No less than 10 minutes to complete
- Total of 28 questions (maximum of 26 presented to the participants):
 - Consent form - 'Yes' statements (3)
 - Optional report request and contact preferences (3)
 - General & building information (4)
 - Server room & IT equipment information (9)
 - Cooling system information (4)
 - Appetite for waste heat recovery (2-3)






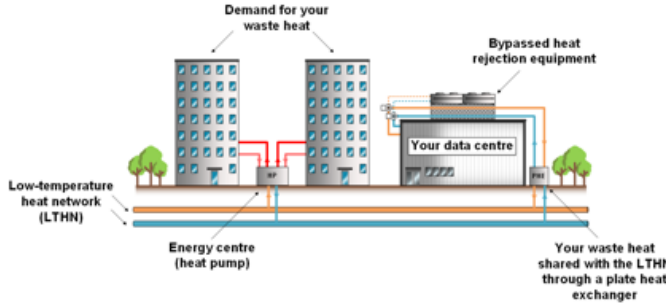
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Benefits

- Involvement in a ground breaking project
- Free evaluation
- Free benchmarking
- Energy modelling study – Benefits:
 - NDA, guaranteed full confidentiality
 - Opportunity to get ahead of the competition – leading the change
 - Opportunity for consulting work
 - Report at the end of investigation
 - Identified and evaluated opportunities for heat recovery for specific sites
 - Opportunity for co-authorship of a journal/conference publication

 Data centre heat energy reuse opportunities  UK Research and Innovation EST 1992 		Waste Heat Recovery Potential Report	
Prepared for:		Date issued:	
Robert Tozer		2021/11/30	
<p>Contents and aim of this report</p> <p>This document has been issued to you following completion of the 'Data centre heat energy opportunities' survey, where you supplied us with information relating to your facility. The report supplies core information regarding the opportunities presented by waste heat recovery and an estimate of the amount of energy potentially available for reuse at your data centre.</p>			
<p>Data centre sector waste heat potential</p> <p>It is estimated that data centres currently consume around 4% of electrical energy in the UK, eventually converting it into heat. In this form, traditionally considered as waste, the energy is typically discharged into the ambient air. Our research shows that waste heat produced by colocation data centres alone (in the order of 42 TWh) has the potential to satisfy 10% of the Nation's demand for hot water and space heating, while bringing numerous energy, carbon, and monetary savings to the sector.</p> <p>In face of the urgent need to eliminate emissions by year 2050, waste heat recovery will play a crucial role in decarbonising the UK's heating and cooling industry, which is currently responsible for around half of energy use and 1/3rd of overall carbon emissions. As a high volume heat energy producer, the data centre sector is an extremely valuable asset that could find its place at the heart of urban and sub-urban energy sharing.</p>			
<p>Your waste heat recovery potential</p> <p>According to the data you provided us with so far, we know that your facility is currently consuming approximately [xxx] MWh/p.a. of electrical energy in order to supply cooling to the entire data centre, including the crucial [xxx] MWh required by the average annual IT load. This process alone likely costs you in the order of £[xxx]k p.a.</p> <p>The waste heat generated in the process has a high potential for reuse due to the steady supply at predictable temperatures. It is estimated that your waste heat can satisfy the space and water heating demand of [xxx] typical households, while heat recovery could supply you with the full cooling load required by your business. An example of such arrangement is illustrated below:</p>		<p>Illustrated stats</p> <p>This could potentially save your business [xx] t of carbon emissions. This would drastically improve your PUE and allow to measure the efficiency of your data centre using ERF. The carbon savings are equivalent to displacing [xx] gas boilers from UK's households and...</p>	
			
<p>Recommended next steps</p> <p>It is recommended that a more detailed evaluation is conducted in order to explore the full scope of benefits available to you, including the potential for heat sharing via low-temperature district heat networks. This would involve us asking you for more data necessary for energy modelling and a visit to your data centre. If you would like to proceed, full confidentiality will be legally assured with a Non-Disclosure Agreement. Please email Matt Wegner at wegnerm2@lsbu.ac.uk to start this process and to set your business on course towards its truly carbon neutral future.</p>			

Survey update and next steps:

- >30 responses so far, working on many more in 2022
- Arranged participation of a number of telecoms data centres in Q1 2022
- Number of contacts in the industry sharing link to the survey with connections
- Confirmed feature in the January edition of ACR Journal
- Collaboration with Operational Intelligence – site visits, reporting



<https://www.surveymonkey.co.uk/r/dc-heat>

Response rate and location of data centres:

