EDRC
Energy Demand Research Centre

The Energy Demand Research Centre – an introduction

Photo by Geoffroy Hauwen on Unsplash

09.09.2025

Imperial College London

Prof Sara Walker

Co-Director, EDRC
University of Birmingham

Energy Demand Research Centre (EDRC)

- UKRI's current main investment in energy demand
  - £15m from EPSRC and ESRC, incl. £1.85m Flexible Fund
- 5-year centre from July 2023
- Led by Prof Mari Martiskainen and Prof Sara Walker
- Team of 85 people in 14 universities
- External partners in various projects

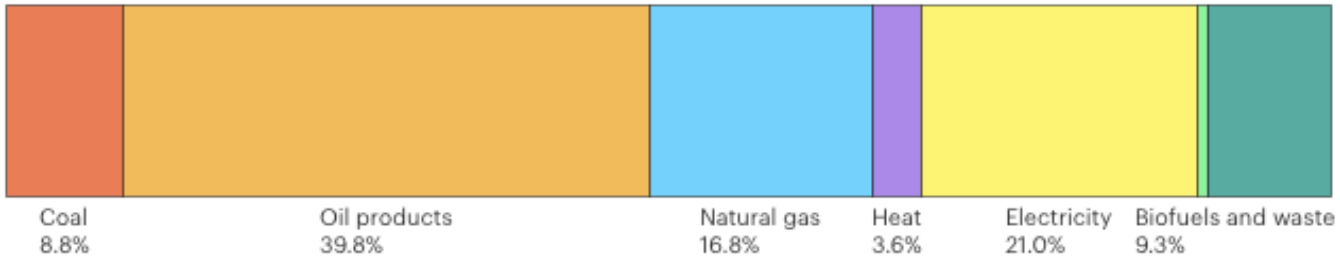
EDRC team at a meeting at Sussex, September 2024, Photo by Stuart Robinson

Why we need to focus on energy demand

Energy mix

Total final consumption, World, 2022

Total energy supply | Production | Electricity | Consumption



Emissions

Energy-related CO2 emissions, World, 2022

34117 Mt CO2

↑47%

change since 2000

Source: https://www.iea.org/data-and-statistics

Urgent need to address climate change

World Meteorological Association:

“The past ten years 2015-2024 are the ten warmest years on record 2024”

“Long-term temperature goal of the Paris Agreement not yet dead but in grave danger”

Other negative impacts of fossil fuels

- Air and land pollution
- Geopolitical tensions
- Global market volatility
- Energy insecurity
- Climate and energy justice

Photo by Tania Malréchauffé on Unsplash

Our vision in EDRC

Our work will **inform and inspire** energy demand reductions that support an affordable, comfortable and secure Net Zero society.

We will make energy demand reduction the **foundation for a fair, fast and flexible transition** to Net Zero, championing research on cross-sectoral energy demand solutions that can be applied at speed and scale for significant impact.

5 main interdisciplinary research themes

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Futures: Insights from a Citizens' Panel with quantitative energy demand modelling to understand conditions required for a lower energy future.

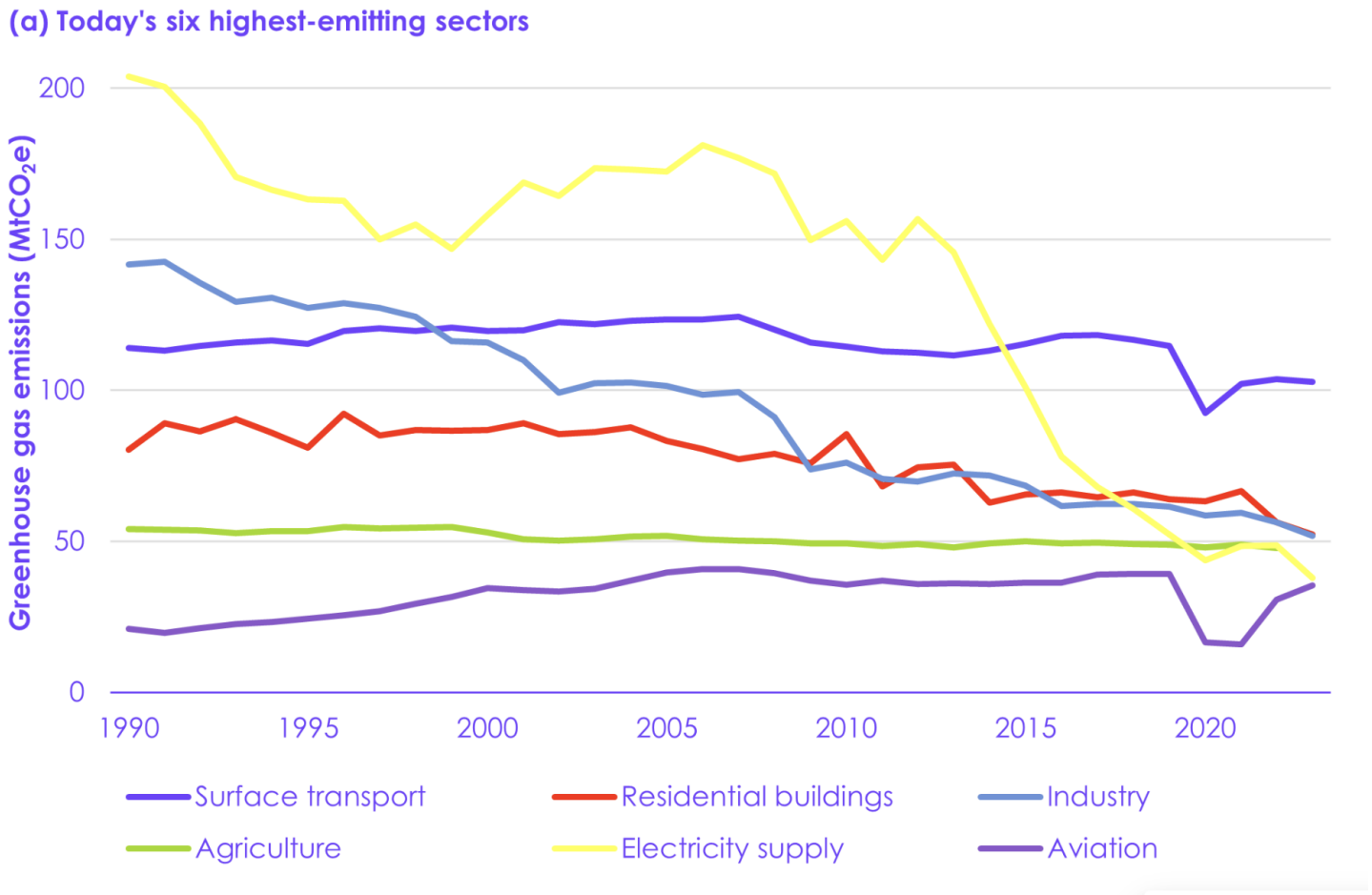
Flexibility: Technology change and social change with energy demand flexibility to change how we use energy and improve our lifestyles.

Place: Local differences in transport and building energy use to develop tools for a place-based approach for faster decarbonisation with greater co-benefits.

Governance: The balancing of powers and resources between national and sub-national actors, institutes and locations.

Equity: Affordability and accessibility of energy demand solutions, whilst realising opportunities to secure sustainable economic benefits such as new jobs and skills.

Figure 1.4 UK emissions by sector since 1990



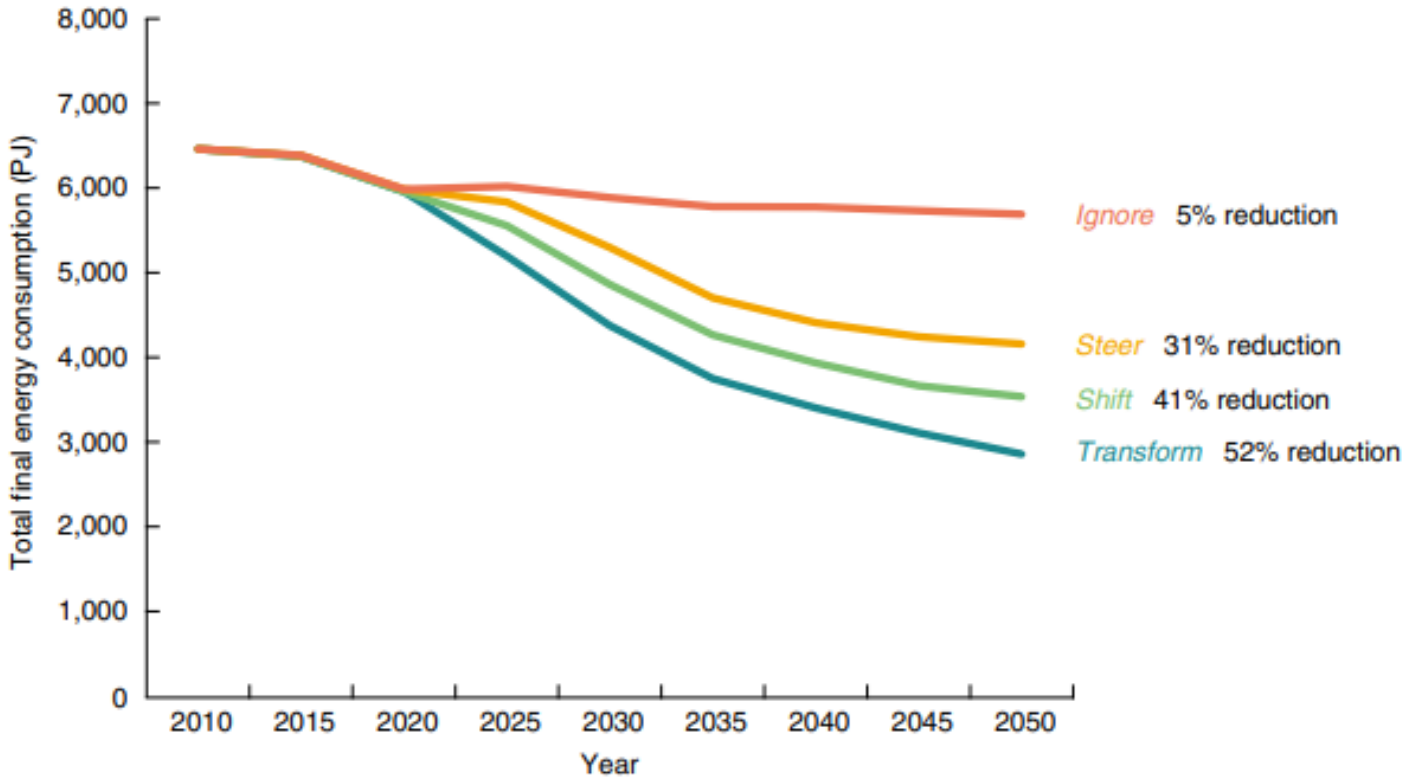
Six largest emitting sectors in the UK:

- Surface transport
- Residential buildings
- Industry
- Agriculture
- Electricity supply
- Aviation

Source: Climate Change Committee, 7th Carbon Budget report: https://www.theccc.org.uk/publication/the-seventh-carbon-budget/

Energy demand reduction as the ‘first fuel’

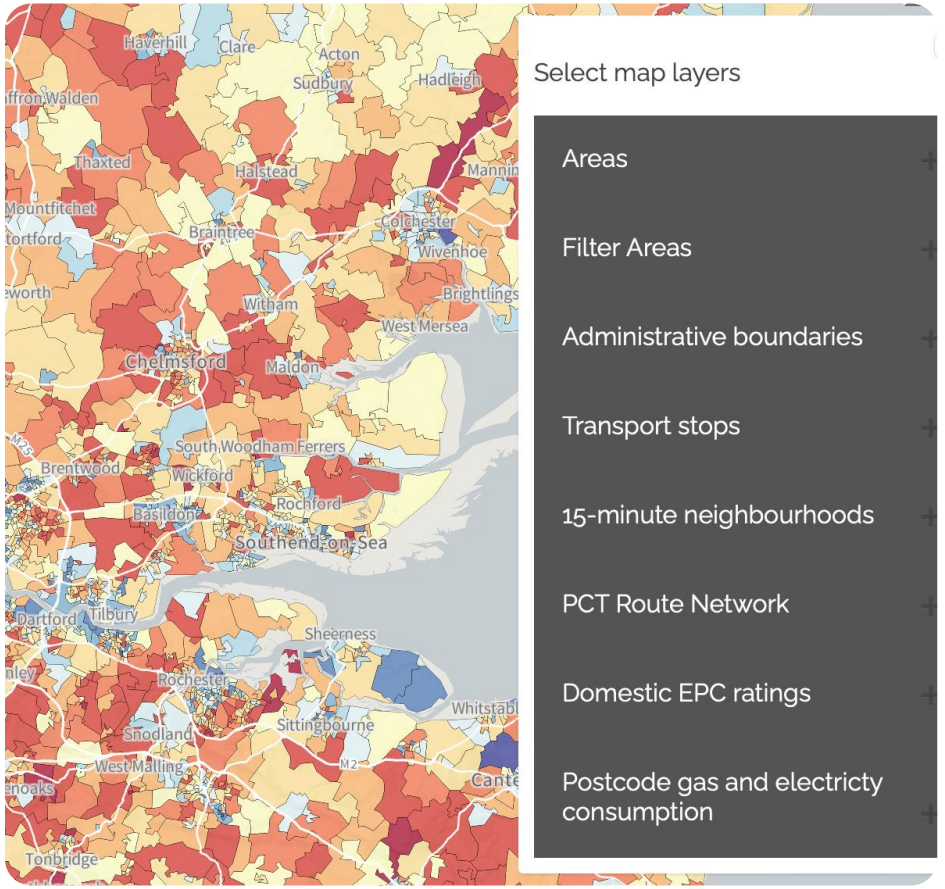
- Demand reduction key part of transition to Net Zero by 2050
- UK could reduce energy demand by 50% by 2050, whilst enabling improvements in quality of life (Barrett et al. 2021)
- Requires consideration for technical, social, cultural and issues
- We have a strong track record in the UK on energy demand research & analysis



Source: Barrett et al. (2022). Energy demand reduction options for meeting national zero-emission targets in the United Kingdom. Nature Energy, 7, 726-735.

Example project: Carbon & Place tool

- Placed-based carbon calculator (PBCC) tool developed during previous centre CREDS by Dr Malcolm Morgan
- Provides detailed local information about energy and carbon emissions
- EDRC develops this further
  - E.g. downscaling national scenarios by utilising and expanding with regionally representative data on energy demand interventions
  - Using PBCC to select case studies
  - Retrofit potential of areas



Source: https://www.carbon.place

Example project: Energy Flexibility Certificate

The EFC framework aims to demonstrate the existing and future potential flexibility capacity of properties by gathering and processing cross-vector data and making it accessible.

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Similar to how the Energy Performance Certificates (EPC) provide buildings' energy efficiency ratings**, EFCs will summarise the existing and future potential flexibility capacity of properties through a dual rating:**

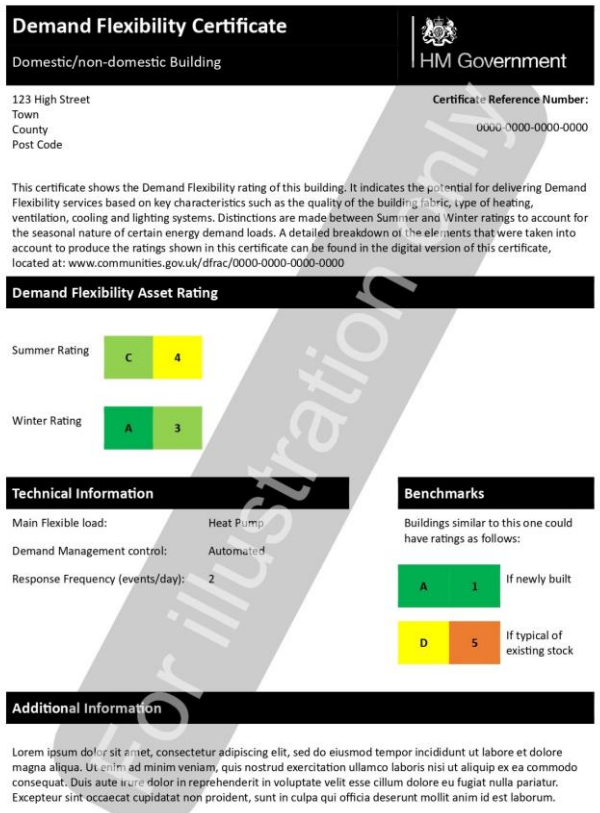
- **Nominal rating:** The range within which the overall Demand Flexibility potential falls into (i.e. Magnitude of demand increase/decrease [kW]).
- **Quality rating:** Provides an indication of how easily the flexibility can be harnessed and is a function of how often, how fast, and for how long the flexible demand responses can be delivered (i.e. response rate [kW/second], frequency [events/day], and duration [minutes]).

The **static certificate** provides the energy consumers / flexibility providers with:

- An **estimate of the flexibility capability of their property** based on its current characteristics and installed technologies;
- The **maximum potential flexibility rating** the property can achieve;
- **Recommendations for the property owners** to achieve the maximum flexibility rating

- The **dynamic digital** portal will be accessible by DNO / NESO to have an **aggregated and individual dashboard of live data to inform decisions on balancing and operating the system and network planning activities.**

Static Certificate



Demand Flexibility Certificate

Domestic/non-domestic Building

HM Government

123 High Street
Town
County
Post Code

Certificate Reference Number:
0000-0000-0000-0000

This certificate shows the Demand Flexibility rating of this building. It indicates the potential for delivering Demand Flexibility services based on key characteristics such as the quality of the building fabric, type of heating, ventilation, cooling and lighting systems. Distinctions are made between Summer and Winter ratings to account for the seasonal nature of certain energy demand loads. A detailed breakdown of the elements that were taken into account to produce the ratings shown in this certificate can be found in the digital version of this certificate, located at: www.communities.gov.uk/dfrac/0000-0000-0000-0000

Demand Flexibility Asset Rating

Summer Rating C 4

Winter Rating A 3

Technical Information

Main Flexible load: Heat Pump
Demand Management control: Automated
Response Frequency (events/day): 2

Benchmarks

Buildings similar to this one could have ratings as follows:

A 1 If newly built

D 5 If typical of existing stock

Additional Information

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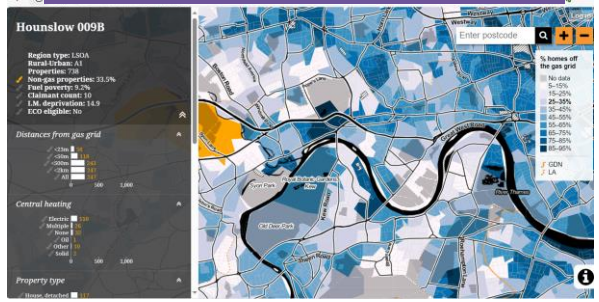
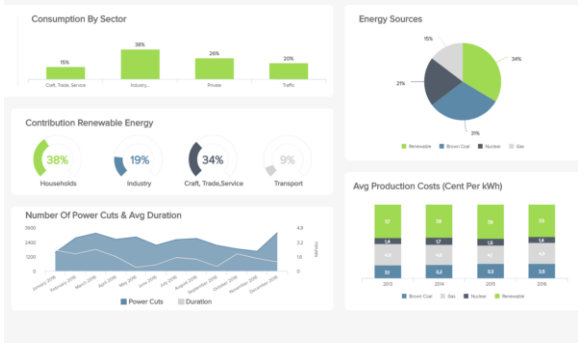
Dynamic EFC Information

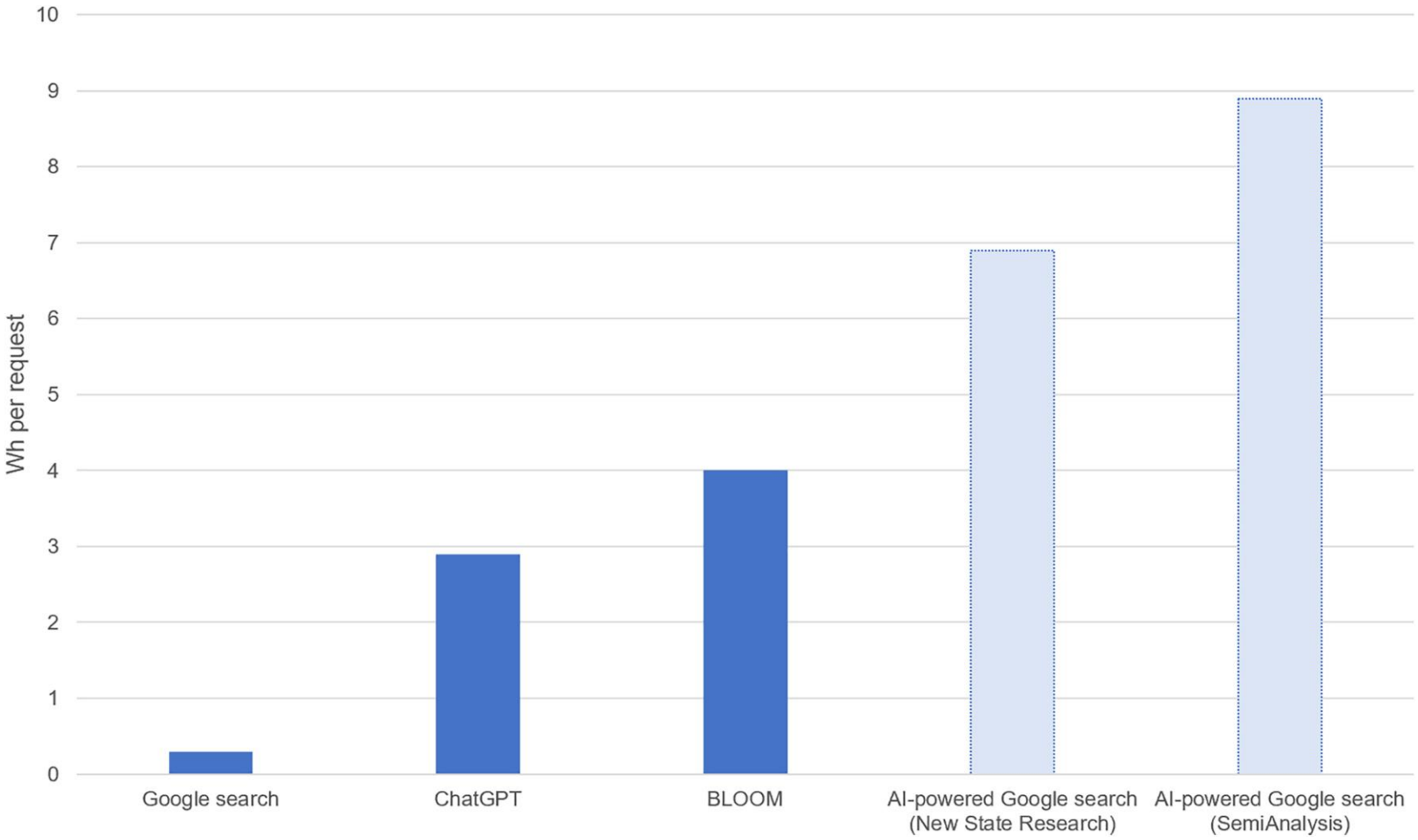
Example of aggregated view



Example of individual dashboard

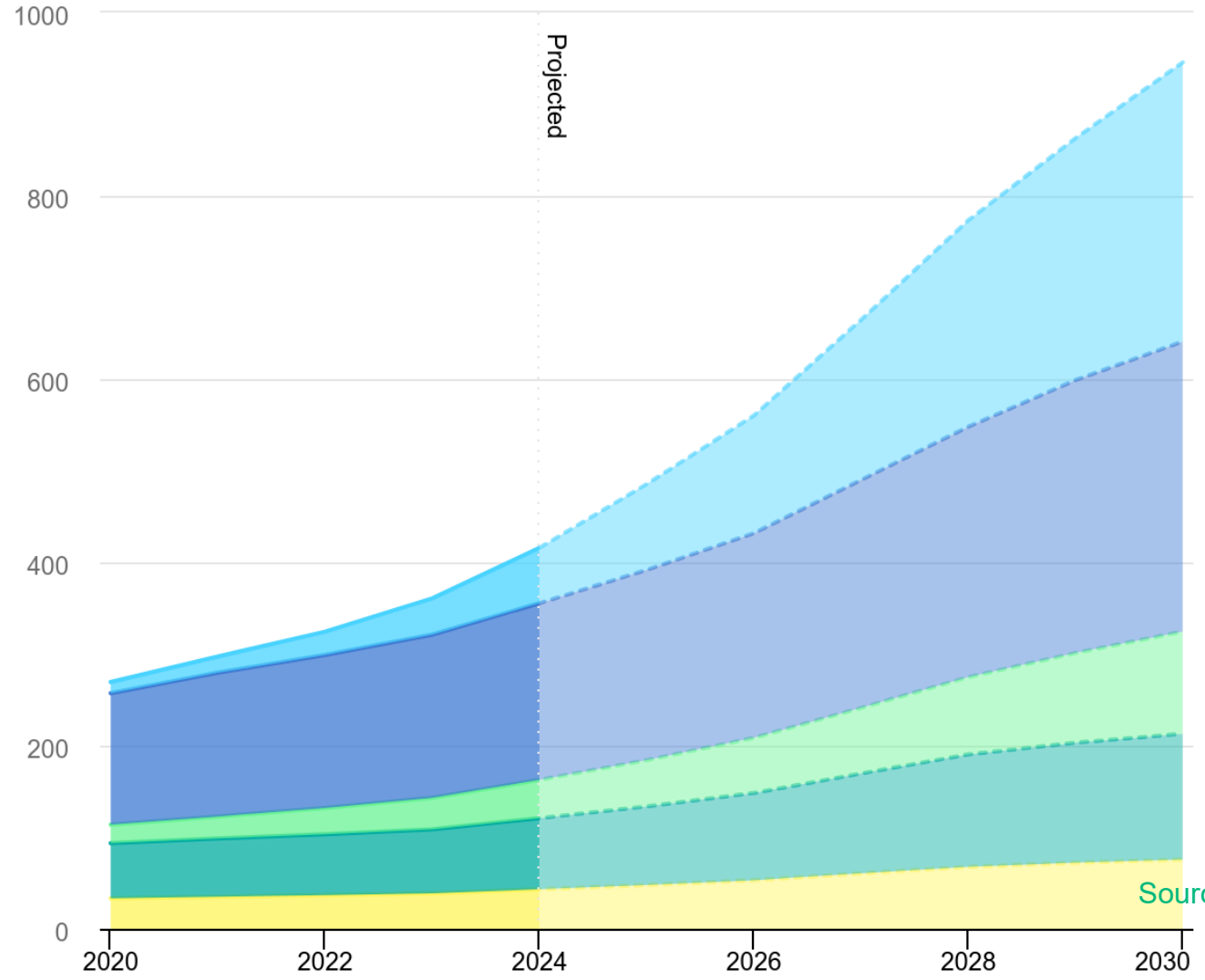


The growing energy footprint of AI



Source: de Vries (2023)

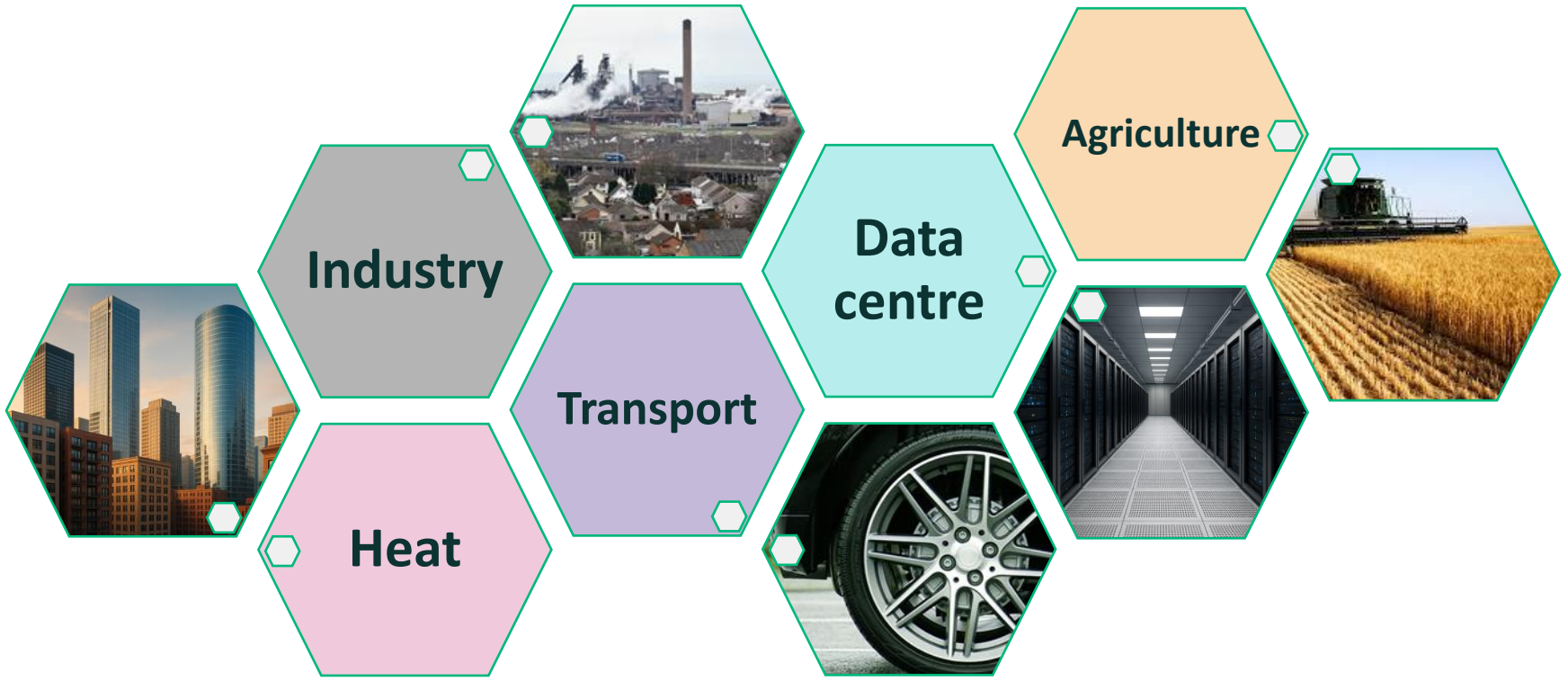
Global data centre electricity consumption, by equipment, IEA base case 2020-2030



Source: International Energy Agency

Flexibility from demand sectors

One of the key focuses of EDRC is assessing alternative flexibility from across demand sectors including industries, heating, transport, and data centres.



Energy and Flexibility in Data Centres

- DCs are responsible for **2.5% of the UK's** electricity consumption. This rate is expected to be **6% by 2050.**
- Global energy consumption of DCs was **450 TWh in 2022**, accounting for around **1.7% of global energy demand.**

Energy Consumption Breakdown of a typical Data Centre

Flexibility Assets

- Backup Generators
- Uninterruptible Power Supply (UPS)
- Thermal Energy Storage Tanks.
- IT Servers

Operation Flexibility

Load Shifting

IT workload could be shifted from peak to off-peak times or migrated between geographically distributed DCs.

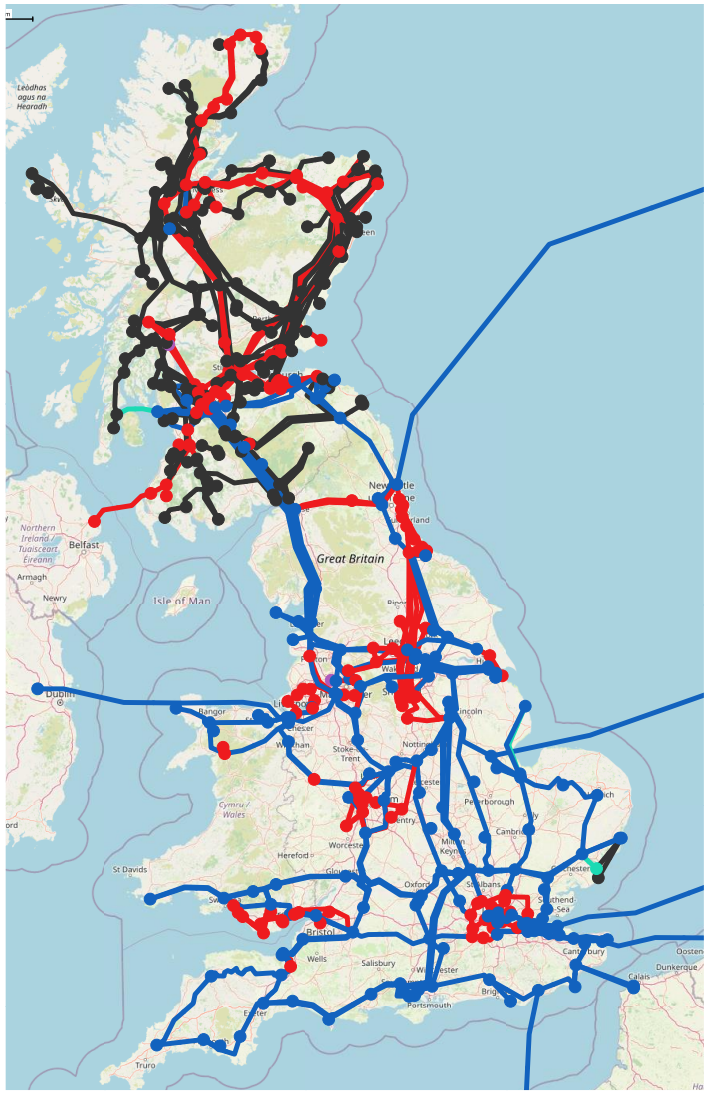
Utilisation of DCs as Virtual Energy Storage System

DCs equipped with renewable energy sources, energy storage units can operate as VESSs to provide a range of grid services.

On-going research on DC flexibility in EDRC

- DC level
  - Characterising aggregate flexibility from DC
  - Optimal operation strategy of a DC in electricity and ancillary services markets

- Electricity system level
  - Assessing the impacts and value of DC to the local and national electricity network.



Summary

- Climate change requires urgent action
- Potential for further energy demand reduction
- Multiple benefits of lower energy demand - good for the economy, people, wellbeing and the planet
- AI and the associated energy consumption is an area of concern and whilst currently small (globally), can be significant at the local level

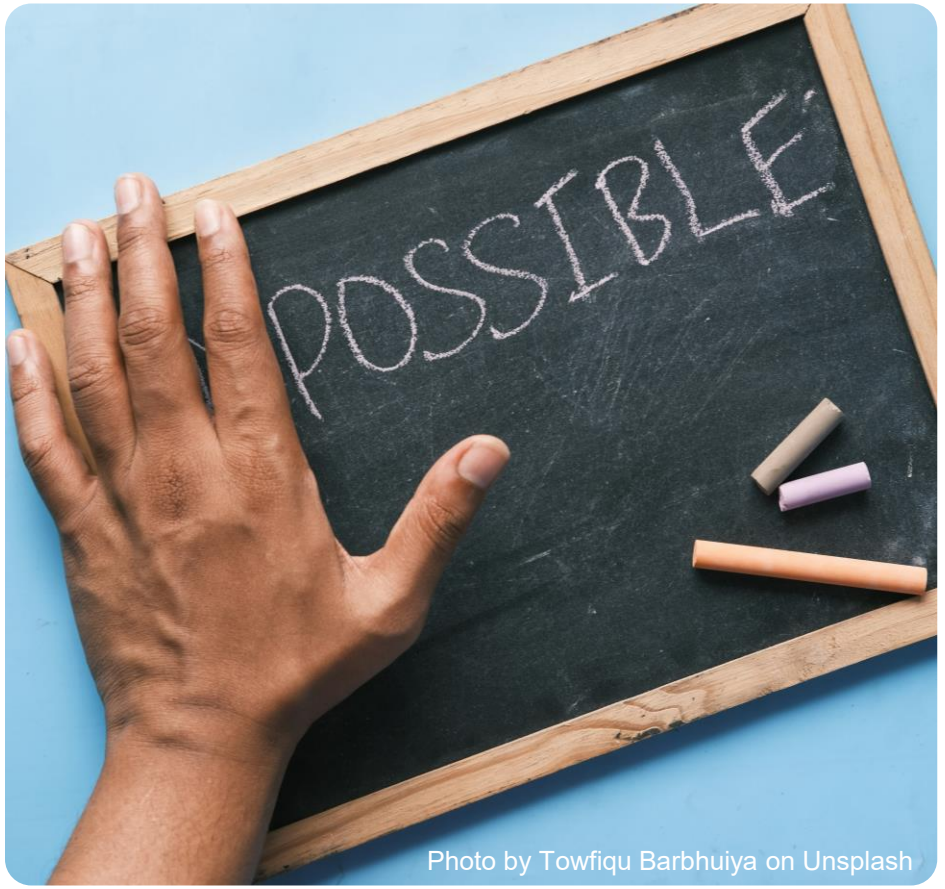


Photo by Towfiqu Barbhuiya on Unsplash

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Funded by:

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Engineering and Physical Sciences Research Council

In Partnership:

University of Sussex

Newcastle University

Cardiff University / Prifysgol Caerdydd

The University of Edinburgh

Imperial College London

Lancaster University

UCL

University of Exeter

University of Leeds

Manchester 1824 The University of Manchester

University of Reading

University of Strathclyde Glasgow

University of Surrey

University of Birmingham

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Thank you!

Director Prof Mari Martiskainen & Co-Director Prof Sara Walker

on behalf of the whole EDRC team

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