

Estimating the Energy Consumption of Data Centres in the European Union

Policy Implications for AI Deployment and Sustainability

Introduction

In recent years, the development and deployment of Artificial Intelligence (AI) technologies have increased the demand for digital services, raising concerns about the environmental impacts of data centres. **This research estimates the energy consumption and emissions of data centres across the 27 EU Member States**, providing insights to support the sustainable development of digital infrastructure in the region.



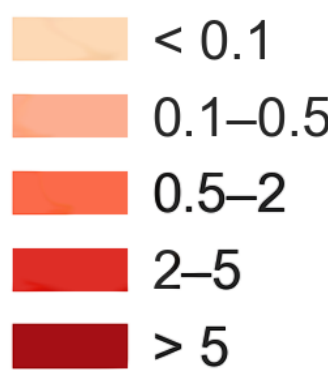
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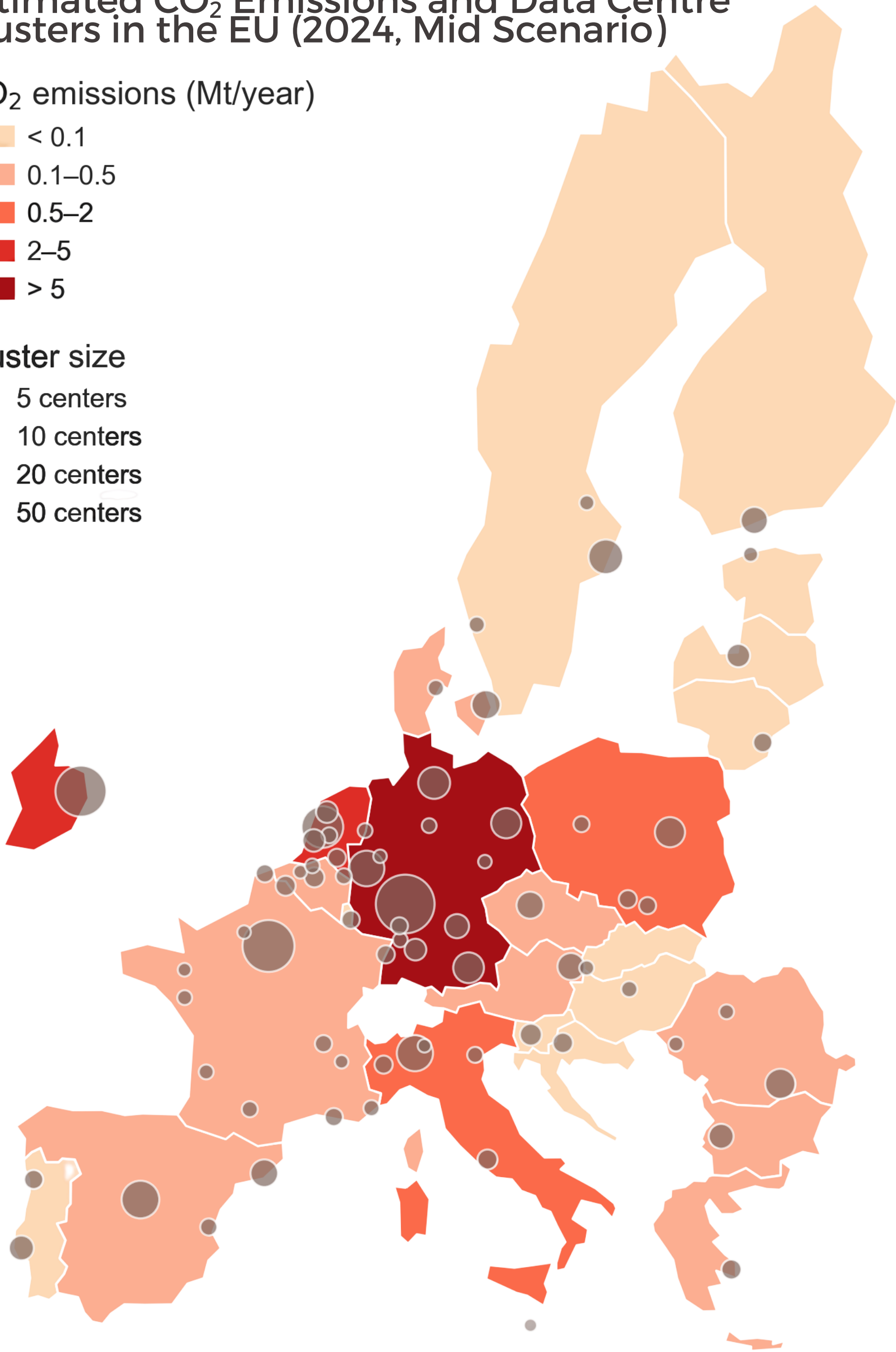
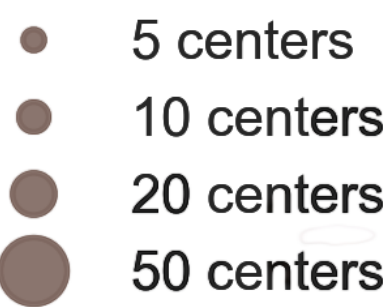
Data Centres Are Highly Clustered, but Emissions Are Not

Estimated CO₂ Emissions and Data Centre Clusters in the EU (2024, Mid Scenario)

CO₂ emissions (Mt/year)

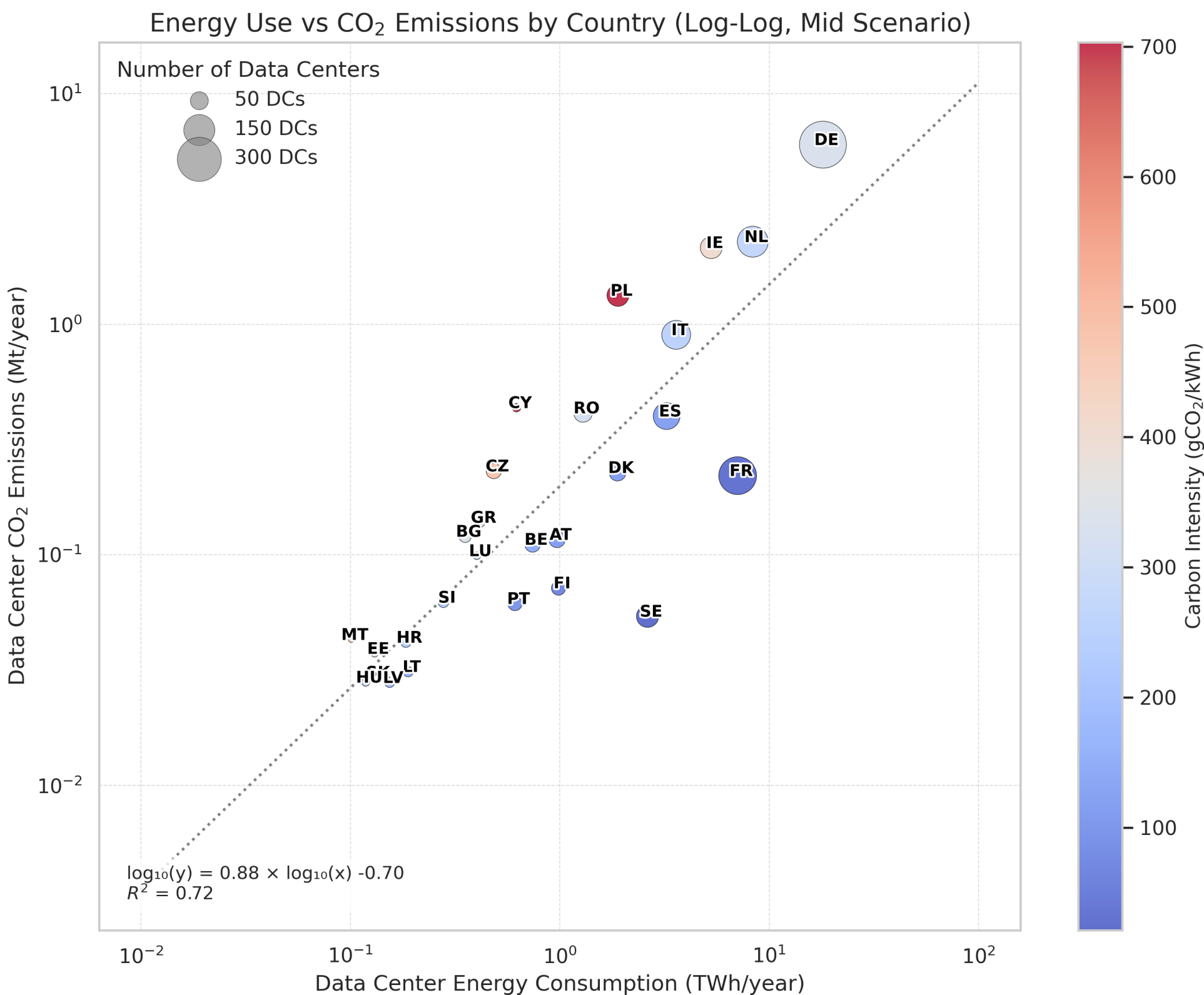


Cluster size



Emissions scale with energy use but vary by national carbon intensity.

Poland and Ireland emit more per TWh; Sweden and France emit less due to cleaner grids.



Methodology



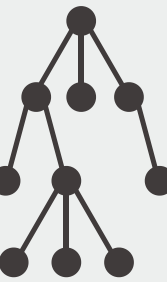
Data Gathering

Scraped data from datacentermap.com, a public listing of ~1,700 data centres across the EU-27.



Data Cleaning and Geocoding

Cleaned data and implemented an NLP and geocoding pipeline to extract information and located each data centre.



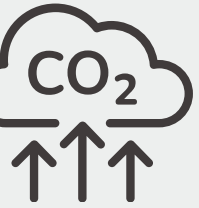
Classification and Imputation Strategy

Data centres were classified (hyperscale, colocation, enterprise) using a rule-based approach and a supervised ML model (Random Forest). Missing whitespace values were imputed based on type.



Energy Consumption Estimation

Estimated energy use with an area-based model using IT density and PUE benchmarks from Jerléus et al. (2024), under three scenarios (low, mid, high).



Emissions Modeling

Estimated annual CO₂e by combining data centres' electricity use with location-based carbon intensity factors from Electricity Maps (LCA-based)

Key results

Data Centres are clustered

- Frankfurt (95), Paris (74), Dublin (72), and Amsterdam (48), often referred to as the FLAP-D markets, concentrate a large share of Europe's infrastructure

Energy consumption

- Data centres in the EU consume from **54.5 to 60 TWh annually**, equivalent to 2.2%–2.6% of total demand in 2021.
- Germany (18 TWh) is the top consumer, followed by the Netherlands (8.3 TWh), France (7 TWh), and Ireland (5.3 TWh)

CO₂ emissions

- Emissions **range from 14.2 to 17.2 MtCO₂e/year**, with 15.7 Mt in the mid scenario.
- Germany leads with 6 Mt, followed by the Netherlands (2.3 Mt) and Ireland (2.1 Mt). Countries such as Sweden and France emit less due to cleaner energy mixes

Policy Implications

- The environmental footprint** of data centers is shaped not only by the amount of electricity they use, but also by **where they are located** and the carbon intensity of the local electricity grid.
- As the EU aims to position itself as a global leader in AI, the rising electricity demand from data centres **may place additional pressure on grid capacity**, energy security, and emissions targets. These findings highlight the need **better to integrate** digital infrastructure planning with energy and climate policy.
- New reporting obligations for data centres under the Energy Efficiency Directive (EED) will **improve access to energy and operational data**. This will enable more accurate estimations and more informed policymaking.