International Energy Agency

Energy and AI

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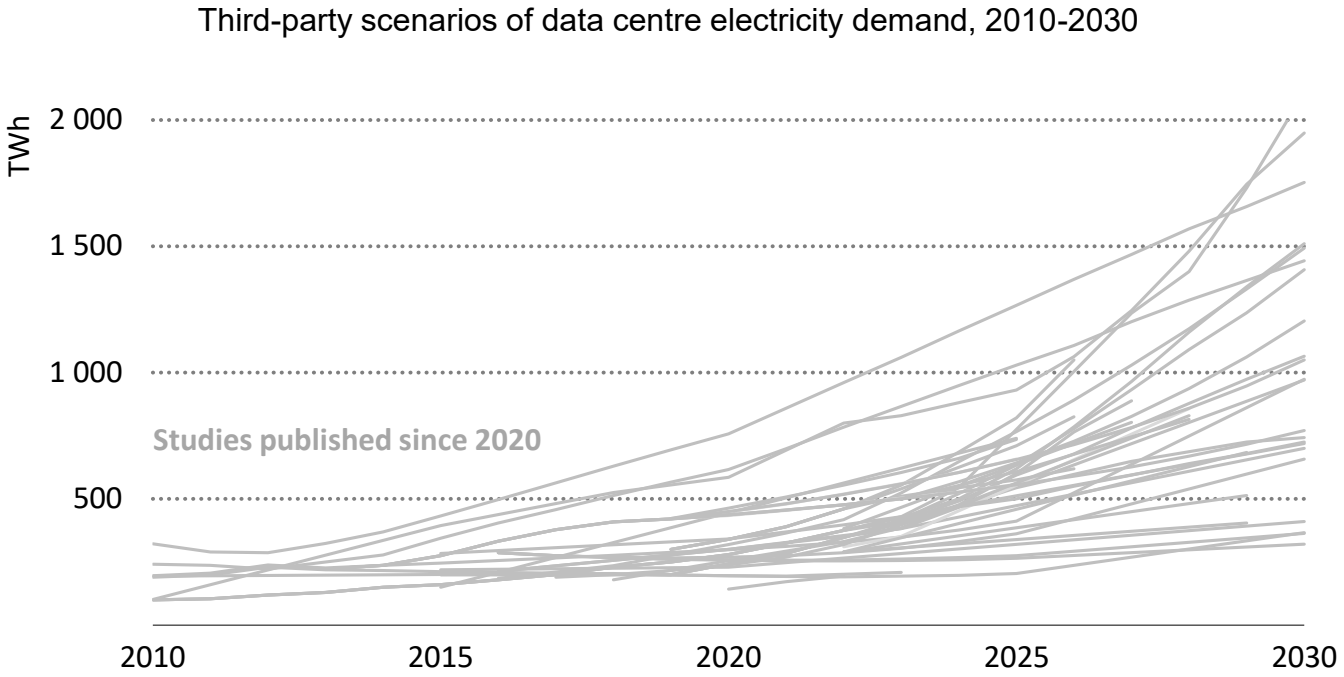
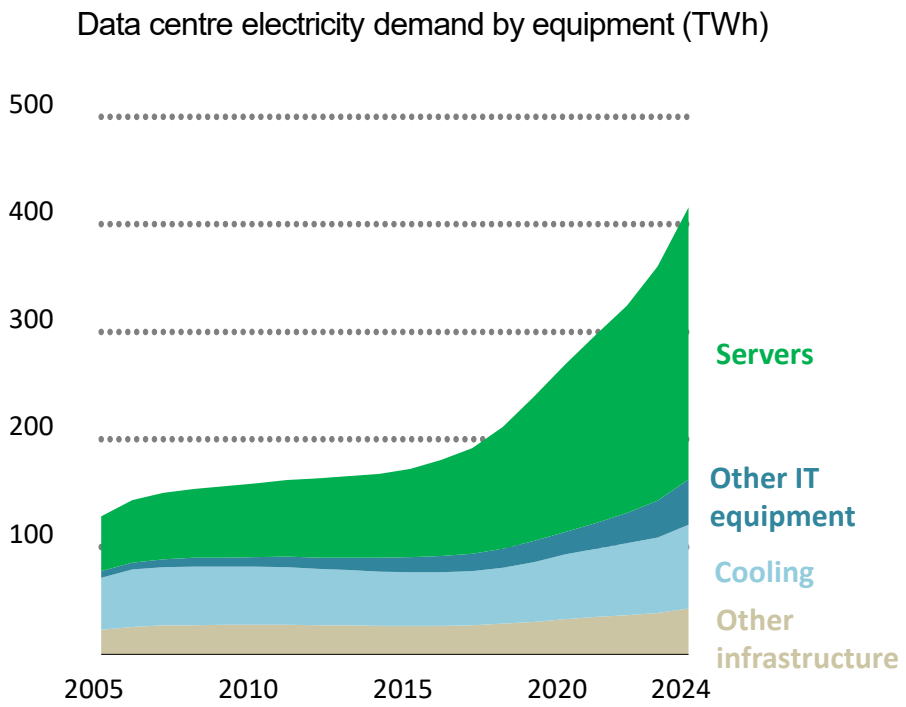
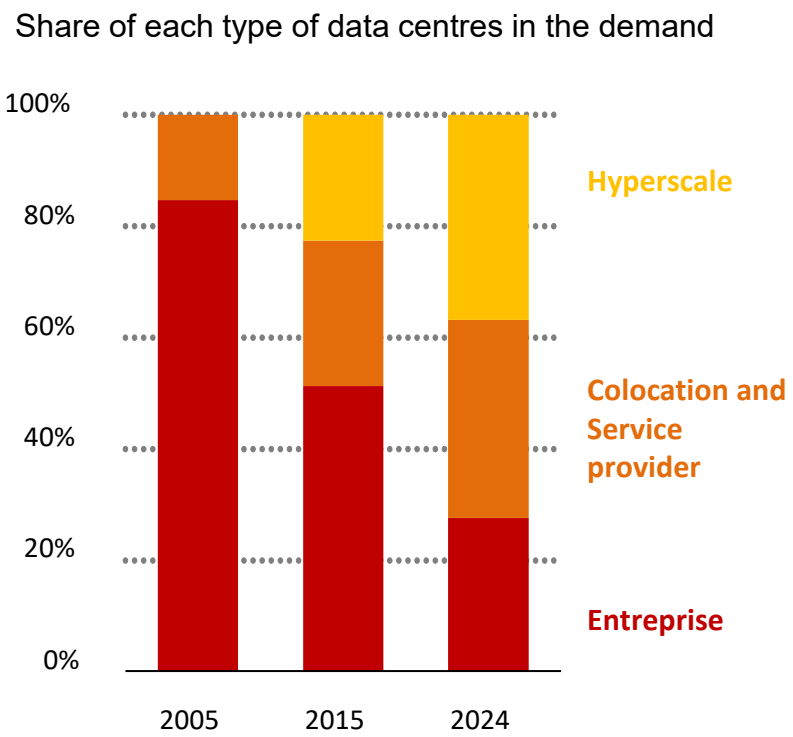
Electricity demand projections for data centres are highly uncertain



There is a sevenfold difference between the highest and lowest projection of energy demand from data centres for 2030.

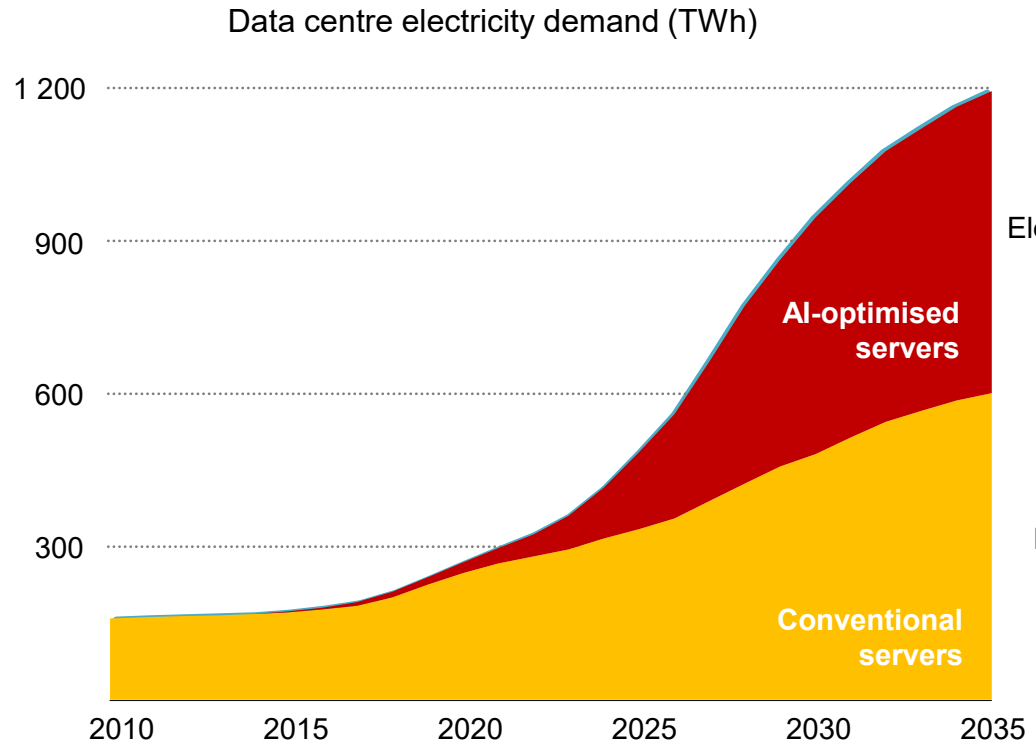
Energy efficiency has limited demand growth

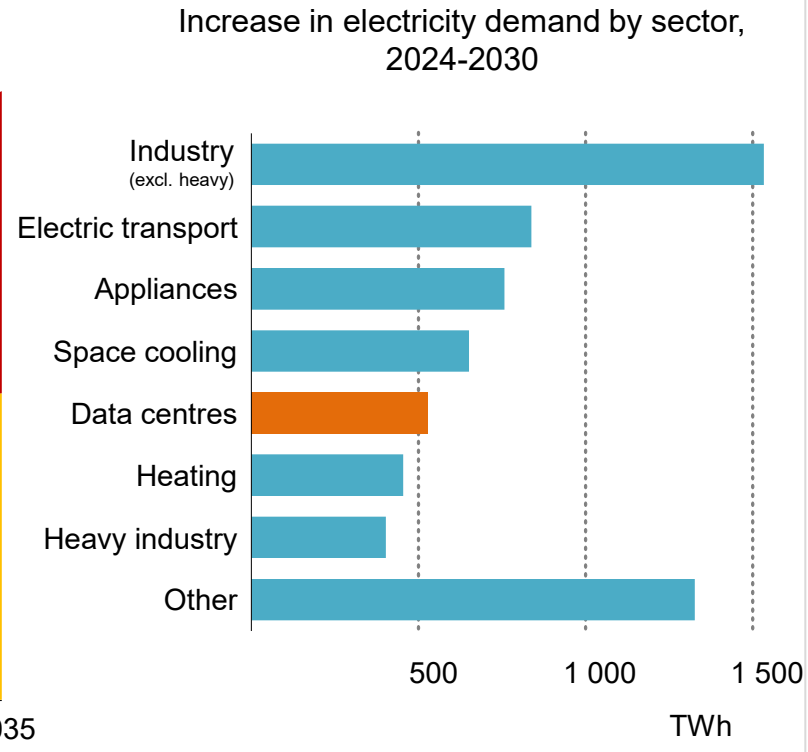




After a decade of very limited growth thanks to hardware and software efficiency improvement, in addition to a shift from small data centres to bigger and more efficient facilities, data centre electricity demand started to grow again in 2016-17.

Data centre electricity demand surges

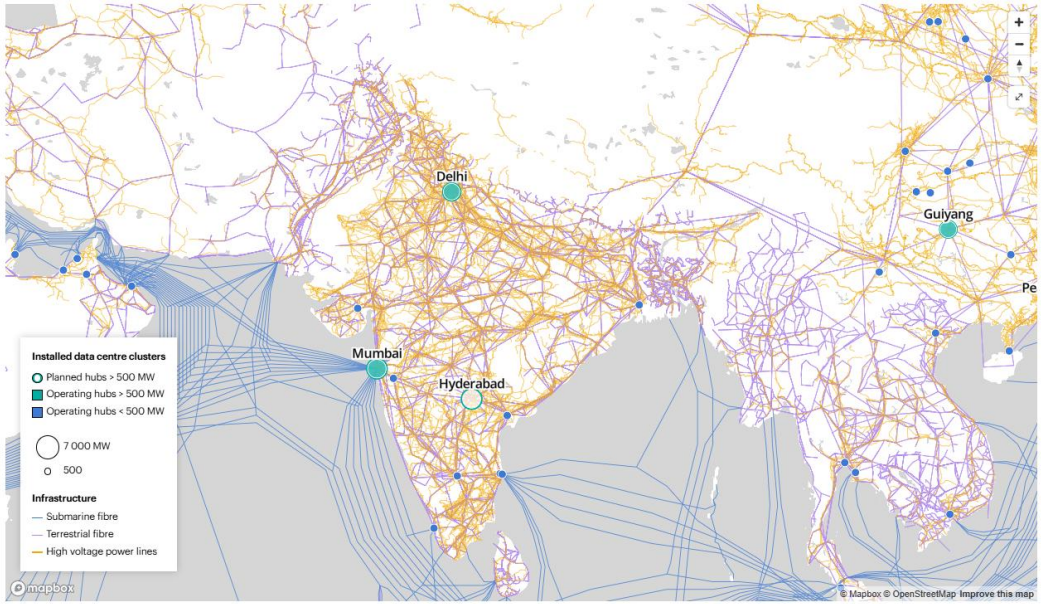




Data centre electricity demand more than doubles to 2030 and almost triples by 2035, driven by AI. Data centres are among the key contributors to electricity demand growth.

Regional data centre hubs in India

Interactive map of data centre hubs alongside associated power and digital infrastructure



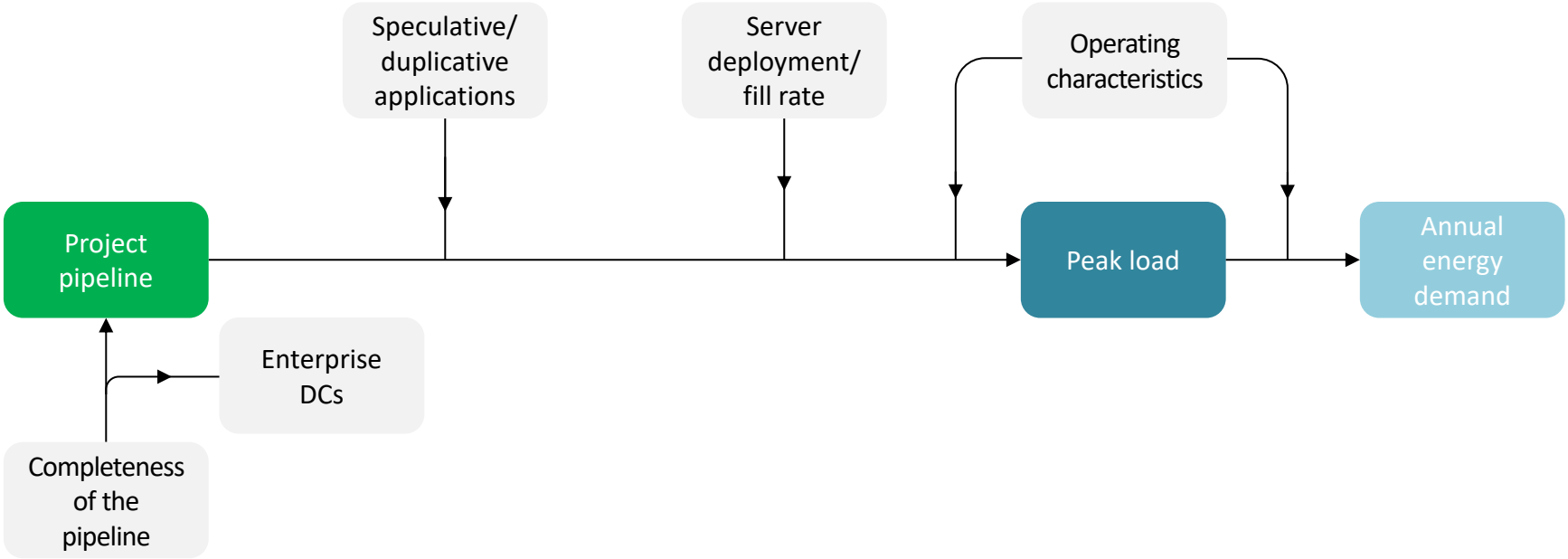
Note: The data centre hubs shown above represent the capacity-weighted centroid of a cluster of data centres within 100 km of each other and totalling over 500 MW of installed capacity. The Pearl River Delta encompasses the combined capacity of Guangzhou, Shenzhen and Hong Kong (China). The high voltage power lines shown reflect the extent of the high voltage powerlines available from the OpenStreetMap server as of the date of export and is provided as is.

Source: IEA analysis of data centre location data from Omdia's Data Center Building Tracker – 2H24 and Data Centre Map (2025), powerline data from OpenStreetMaps (2024), and communications infrastructure data from the ITU Broadband Mapping programme (2025) and submarine fibre optic network from TeleGeography (2021).

Source: IEA Energy and AI Observatory

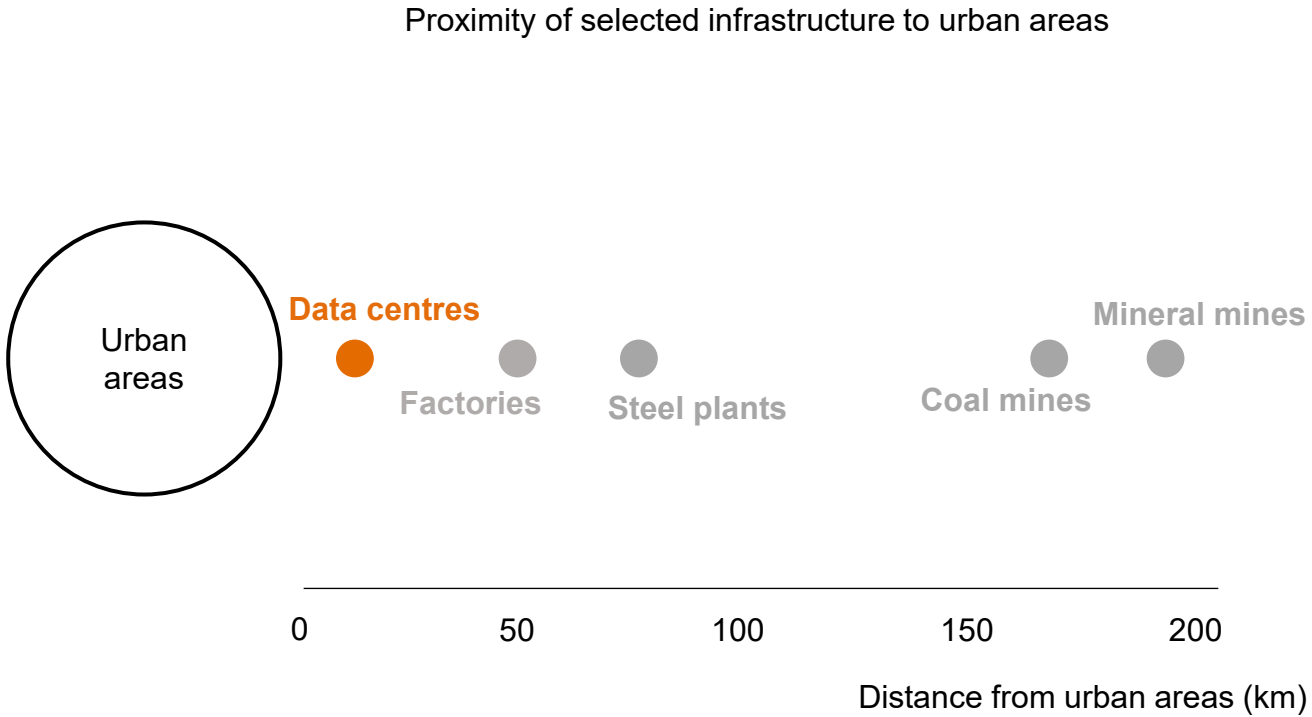
Project pipeline can help better understand local market dynamics and inform electricity demand projections. However, accurate information on the project pipeline is challenging to gather.

Challenges going from pipeline to peak/annual electricity demand



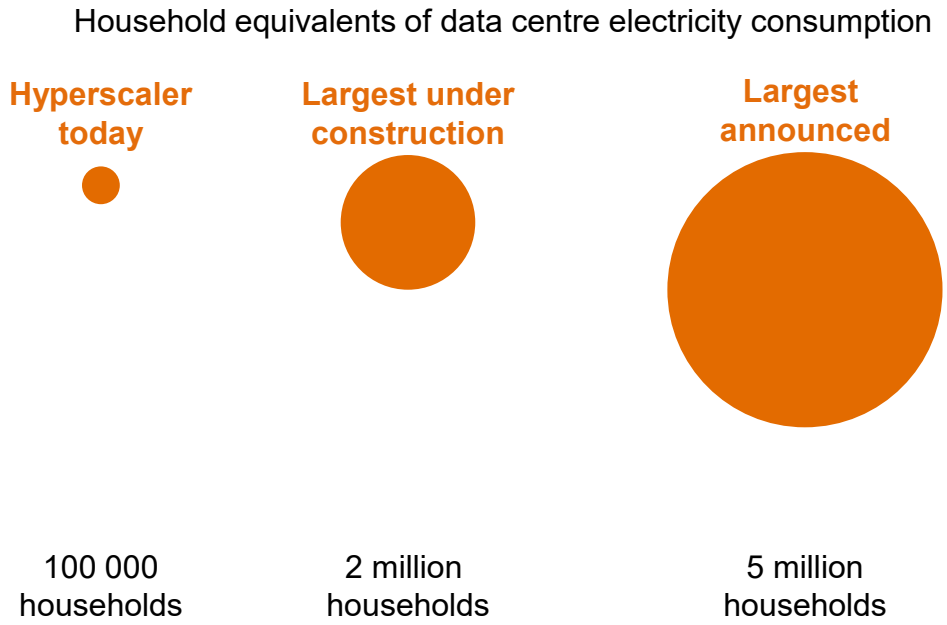
Project pipeline strengthens understanding of market trends and local dynamics, improving demand projections. However, key uncertainties remain.

Data centres cluster together



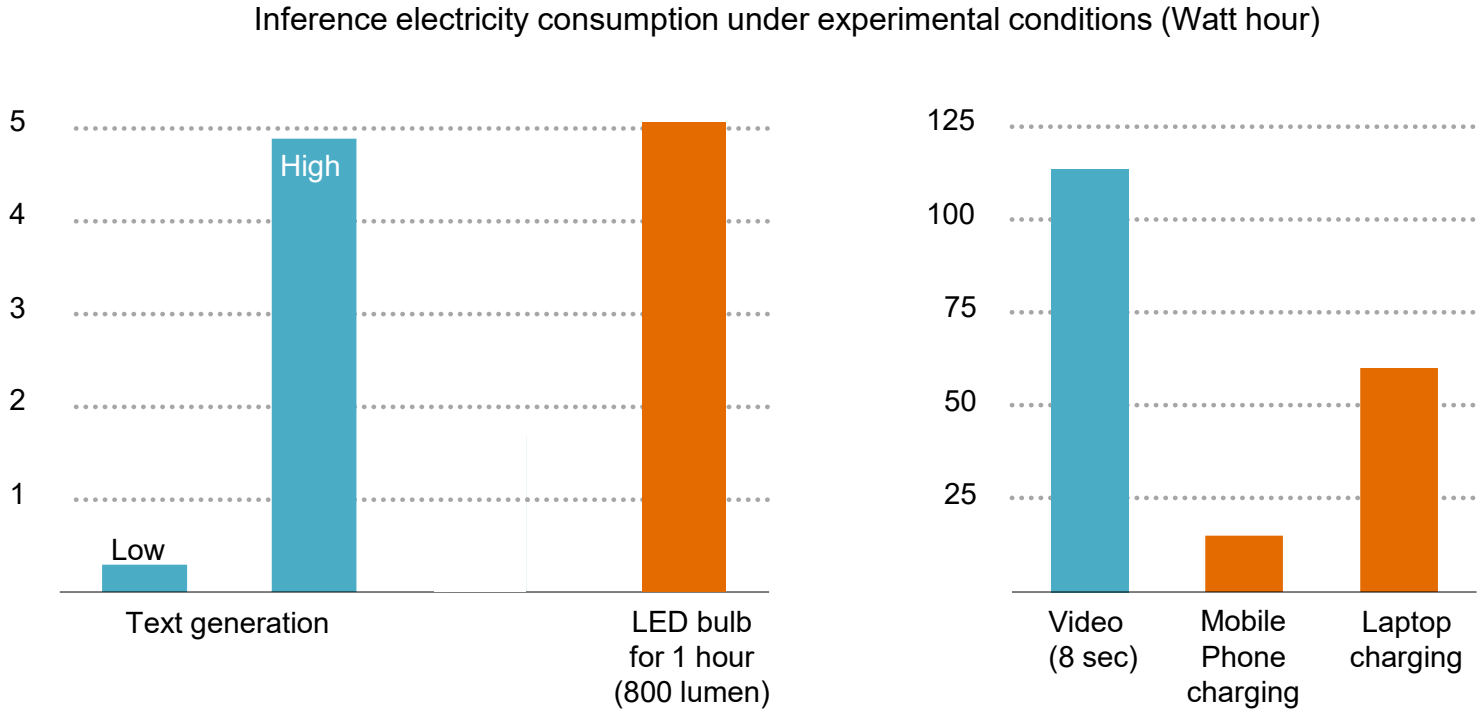
Data centres are both power intensive and tend to cluster together, creating challenges for local grids.

Data centres cluster together – and are growing in size



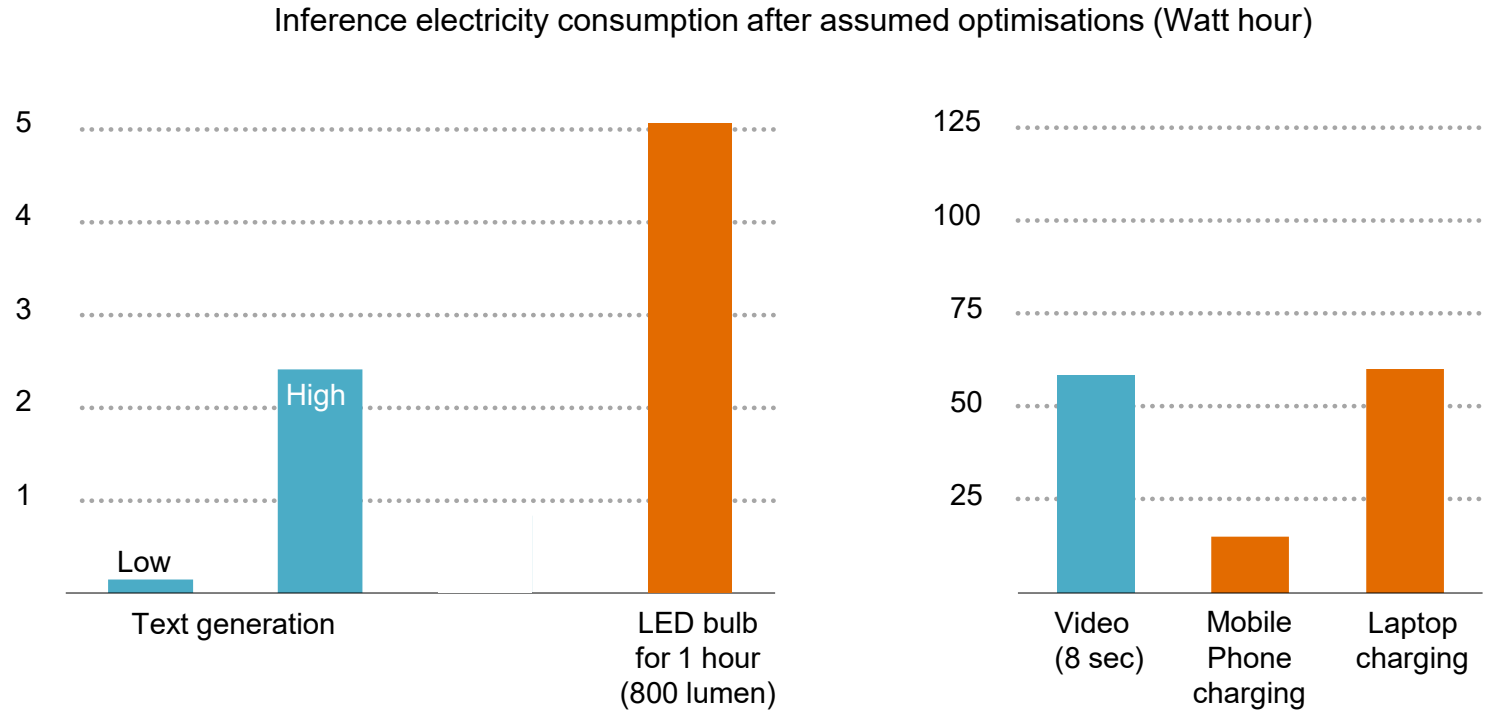
Data centres are both power intensive and tend to cluster together, creating challenges for local grids. They are also increasing in size, with the largest under construction 20 times larger than a typical hyperscaler today

How much electricity does generative AI consume?



Generating large amounts of text in experimental conditions can consume as much electricity as an LED bulb.

How much electricity does generative AI consume?



However, real-world efficiency measures for inference such as batching can as much as halve the consumption.

What about the longer-term?

- The longer-term outlook for AI-related electricity consumption is clouded by very high levels of uncertainty:
  - **Uptake** both in terms of scale and nature
  - Innovation and capability of **the core AI technology** itself
  - Extremely rapid innovation driving **efficiency improvements** in both hardware and models
  - Spillovers on GDP and productivity
- Traditional approaches of activity * intensity do not work:
  - AI is not a homogenous good
  - We do not have comprehensive data on activity
  - Both are subject to the uncertainties outlined above

Conclusion

- There are **two main approaches** to understanding **electricity demand and peak load growth** in the data centre sector:
  - **Server shipment bottom-up modelling:** robust at the aggregate level, but weaker in capturing local trends.
  - **Project pipeline analysis:** strong at reflecting local dynamics, but with blind spots on some market segments and persistent uncertainties.
- Both approaches require work to standardise definitions and metrics, improve data sources, and validate key assumptions.
- Dialogue between government, the tech sector, and the energy industry remains crucial
- **Even with a perfect understanding of demand, grid integration would remain a key challenge**:
  - Deployment continues to **concentrate** in already dense areas.
  - Facilities are **increasing in scale**, amplifying system impacts.