



Flexible Electricity Demand

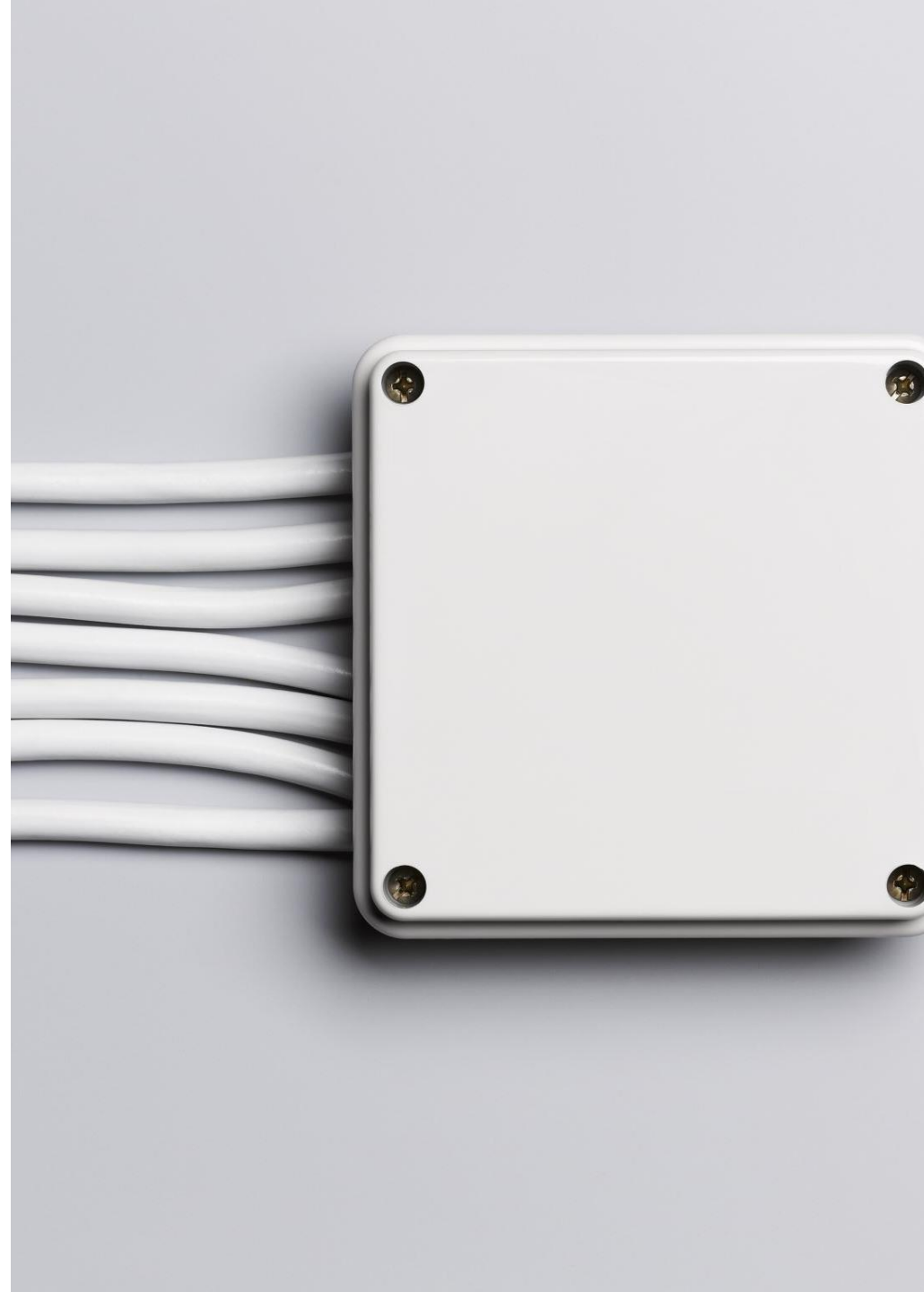
~~Nice to Have~~ **Need to Have**

Dr. Blake Shaffer
Oct 2025

Rethinking the role of demand

- *The electricity system of the past involved forecasting demand and dispatching supply; the grid of the future will increasingly involve forecasting supply and dispatching demand.*

- Jeff Nagle, Pacific Northwest National Lab



Why now?

1. The **need** for flexible demand is growing

- More variable supply (e.g. renewables)
- Larger residential loads (e.g. EVs, heat pumps, AC)
- MEGA industrial loads on the horizon (e.g. data centres)

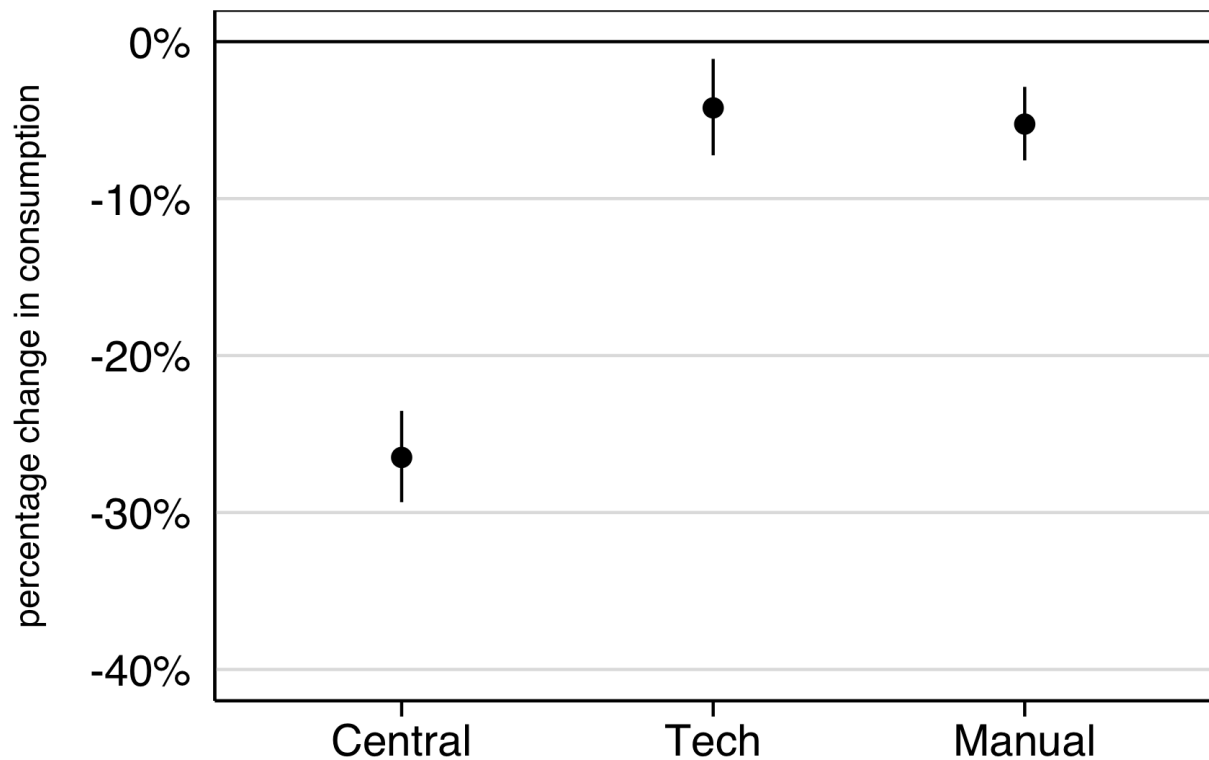
2. The **ability** to flex is also growing

- Control and telemetry technology is cheaper
- New flexible devices

What we know

Automation is key to boosting responsiveness

Demand response pilot results



- Ran a pilot on 2000 households
- 3-hour “peak events”
- Financial rewards based on kWh reduced

Results:

- 5% reduction for **Manual** group
- Also 5% reduction when augmented with **Tech (no improvement!)**
- **27% reduction** when Automated/**Central** control

What we know

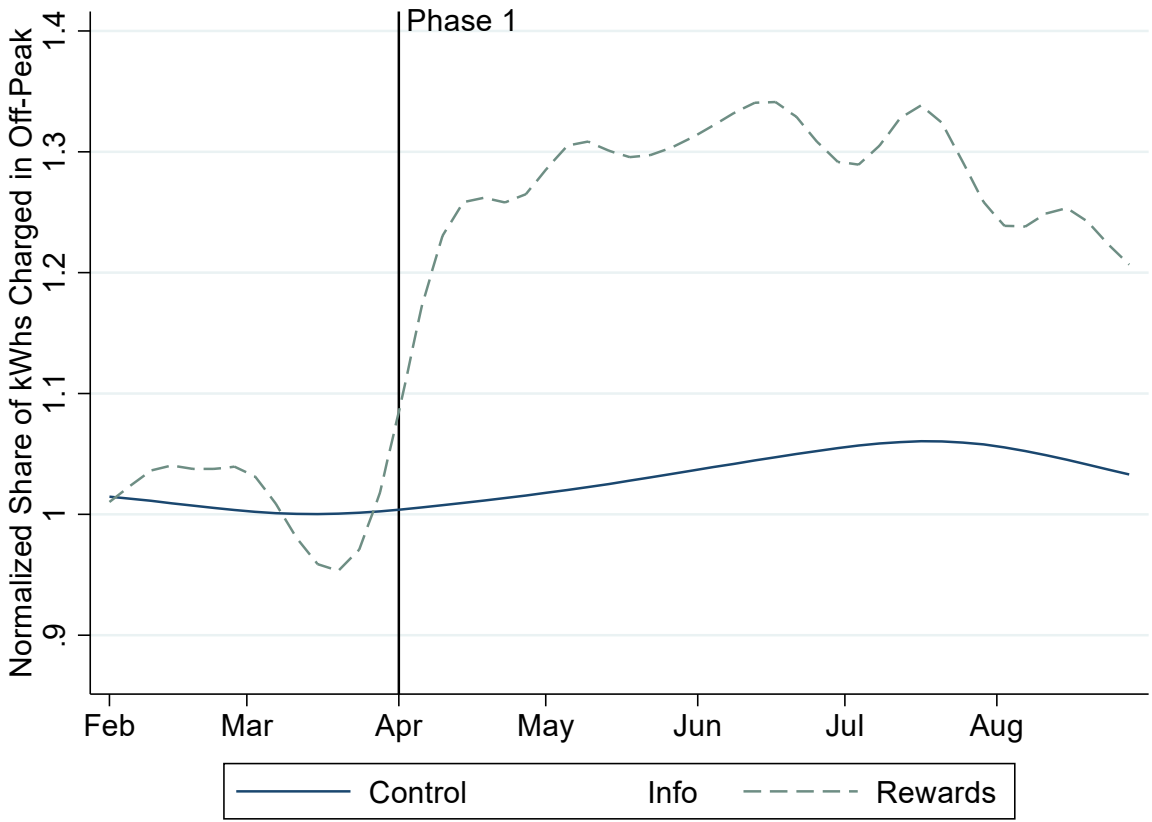
Some devices are *much* more flexible than others

EV charge timing
“elasticity” of -1.6

Compare to typical
residential load of -0.1

**EVs separate the service
from the *power draw***

Enmax TOU EV study results



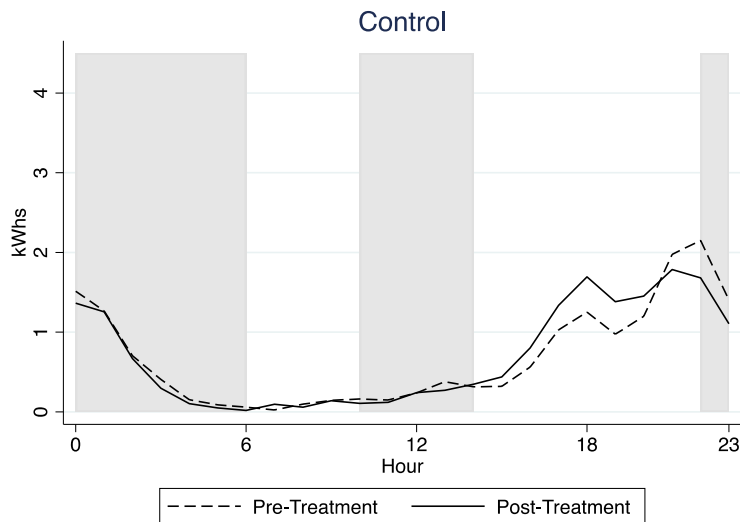
30% increase in off-peak charging
upon receipt of 3.5c/kWh **Reward**

No change to **Info** group

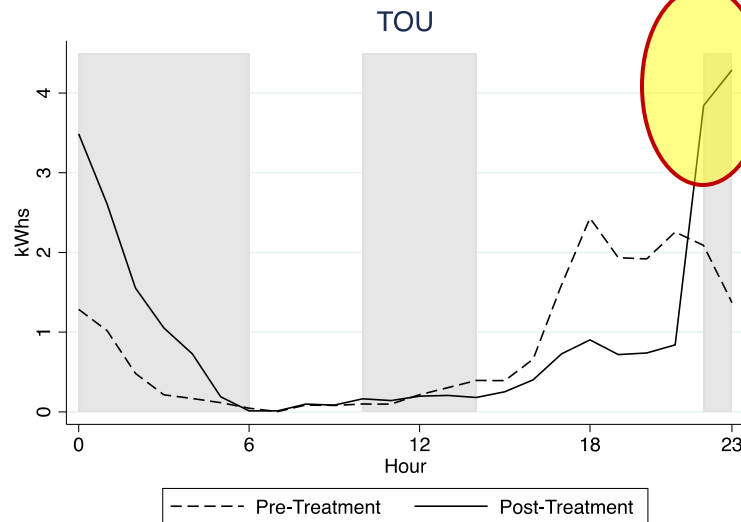
Too flexible? Transformer Violations

Unintended consequences of TOU rates with flexible EV charging

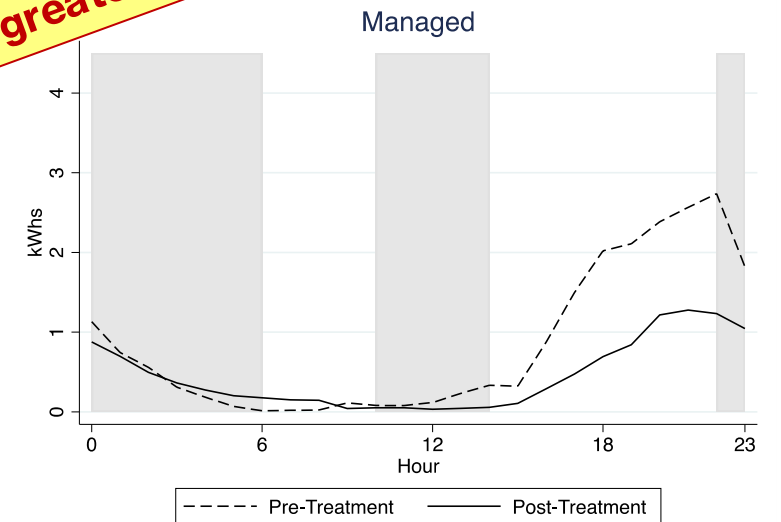
Fortis TOU/Managed Charging study results



No change to **Control**



Larger violations from **TOU**



Reduced violations from **Managed**

Key Takeaways of Fortis Study

1. Why is this “unintended consequence” more of an issue with EVs?

- **Big power draw** and **very flexible**
- Leads to greater **correlation** of household peak demand under TOU

2. Demand charges can help

- **\$ per kW** based on peak demand
- Encourages lower draw “**Level 1**” charging

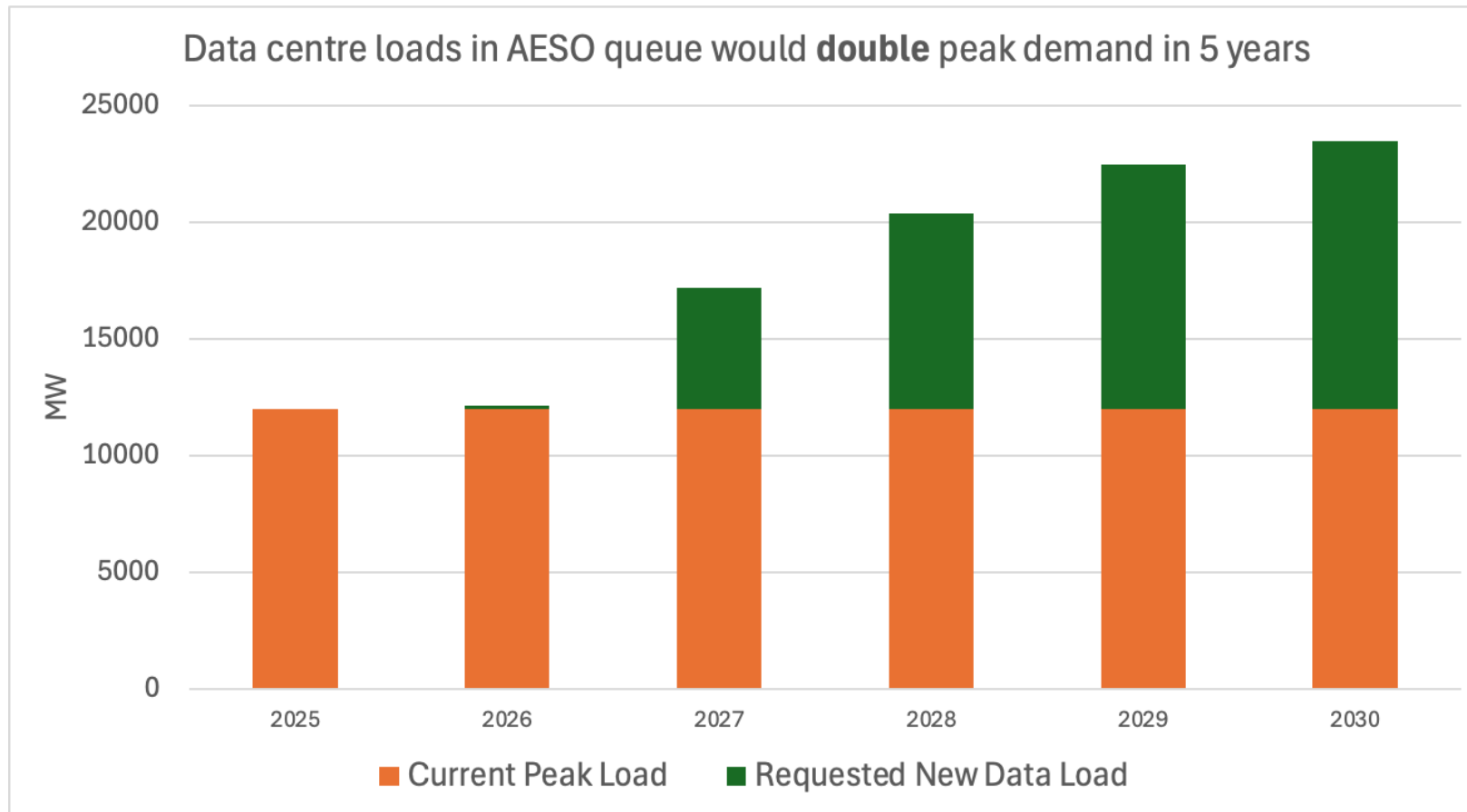
3. Managed charging can resolve the coordination challenge

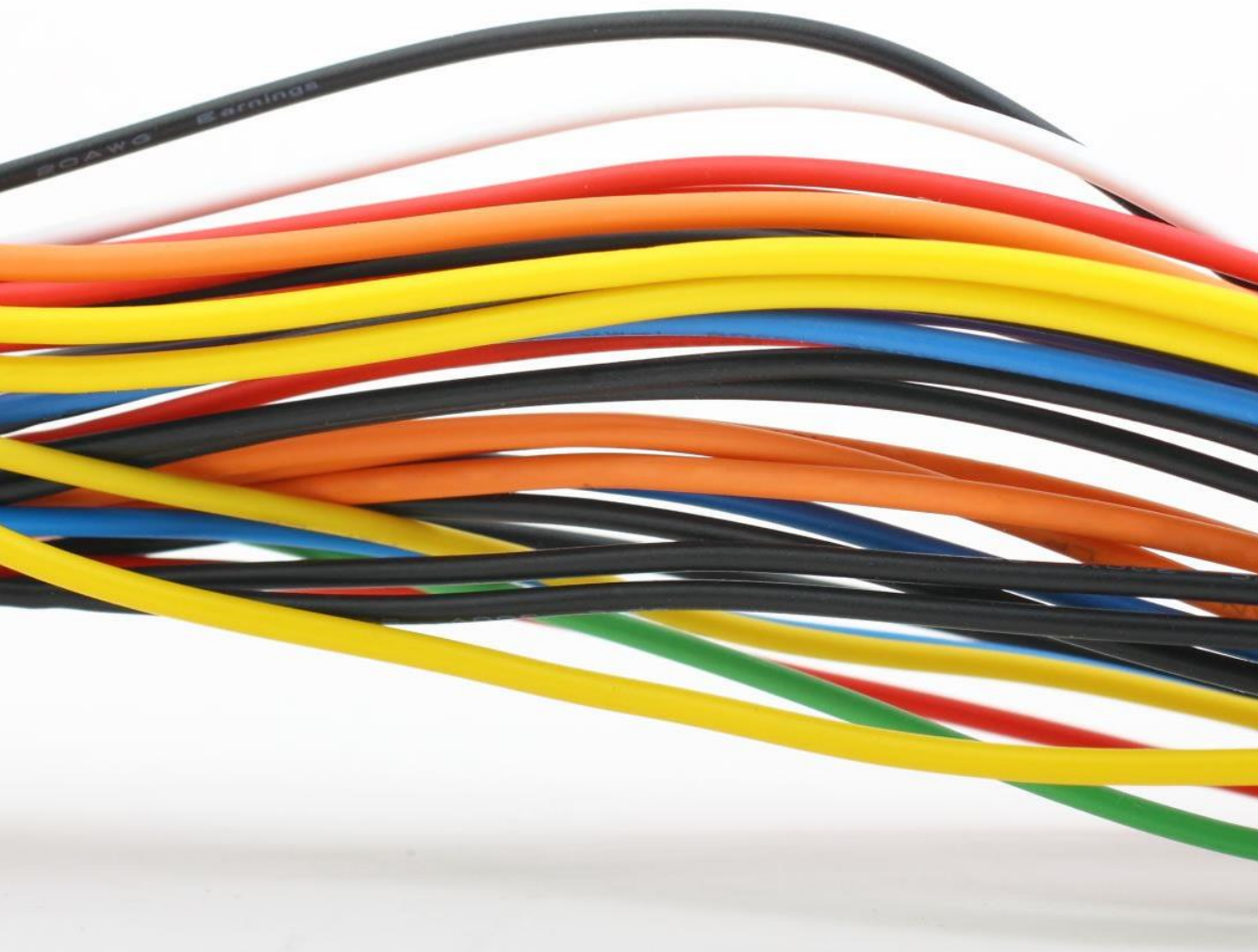
- ... but how to get people comfortable with it?
- More research needed on **take-up acceptance rates**

What about **BIG** loads?

How to integrate data centres without sacrificing affordability

There are a lot of “Data Load” requests in the queue...





Data Centres and Consumer Prices

How prices go **UP**:

- Mega loads compete for scarce supply
- Full-requirements contracts lead to system capacity (e.g. wires) upgrades

How prices go **DOWN**:

- Bigger kWh denominator over which to spread fixed costs
- Avoiding peak periods with a ***little bit of flexibility***

Duke paper on data center [sic] flexibility

- The US electricity system utilization rate is approx. 50%
- The system is *at capacity* in only a small number of hours
- A little bit of flexibility can allow for *a lot* of new data centre load without exceeding reserve margins
- **Curtailing 0.25% hours → +76 GW (10%) added**

Figure 2. Load Duration Curve for US RTO/ISOs, 2016–2024

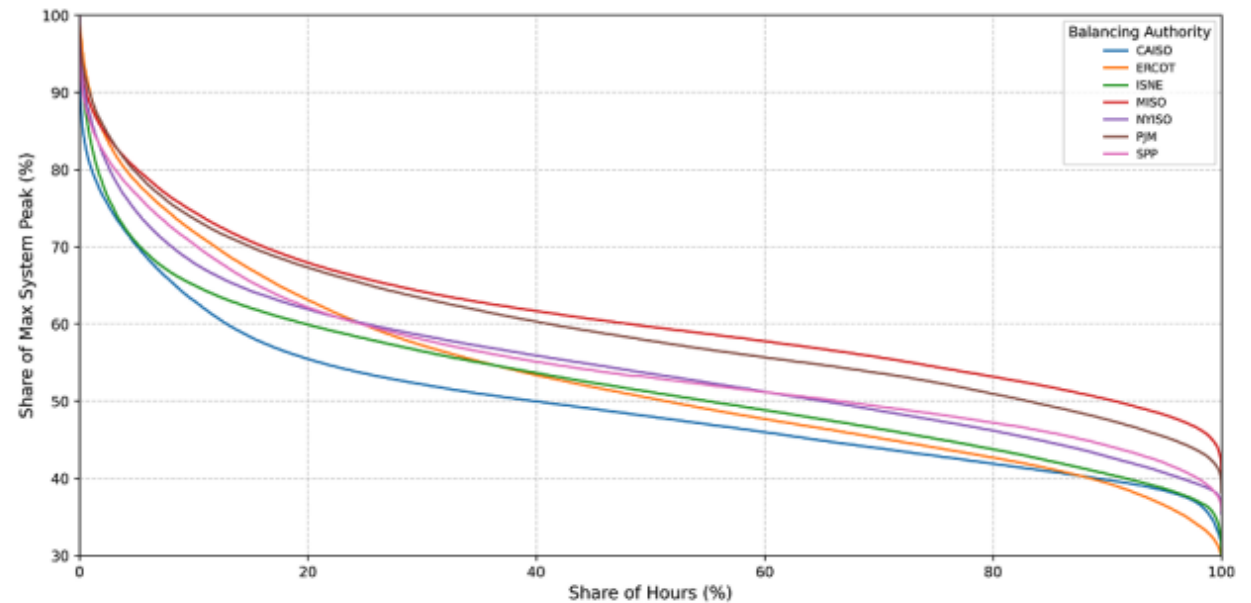
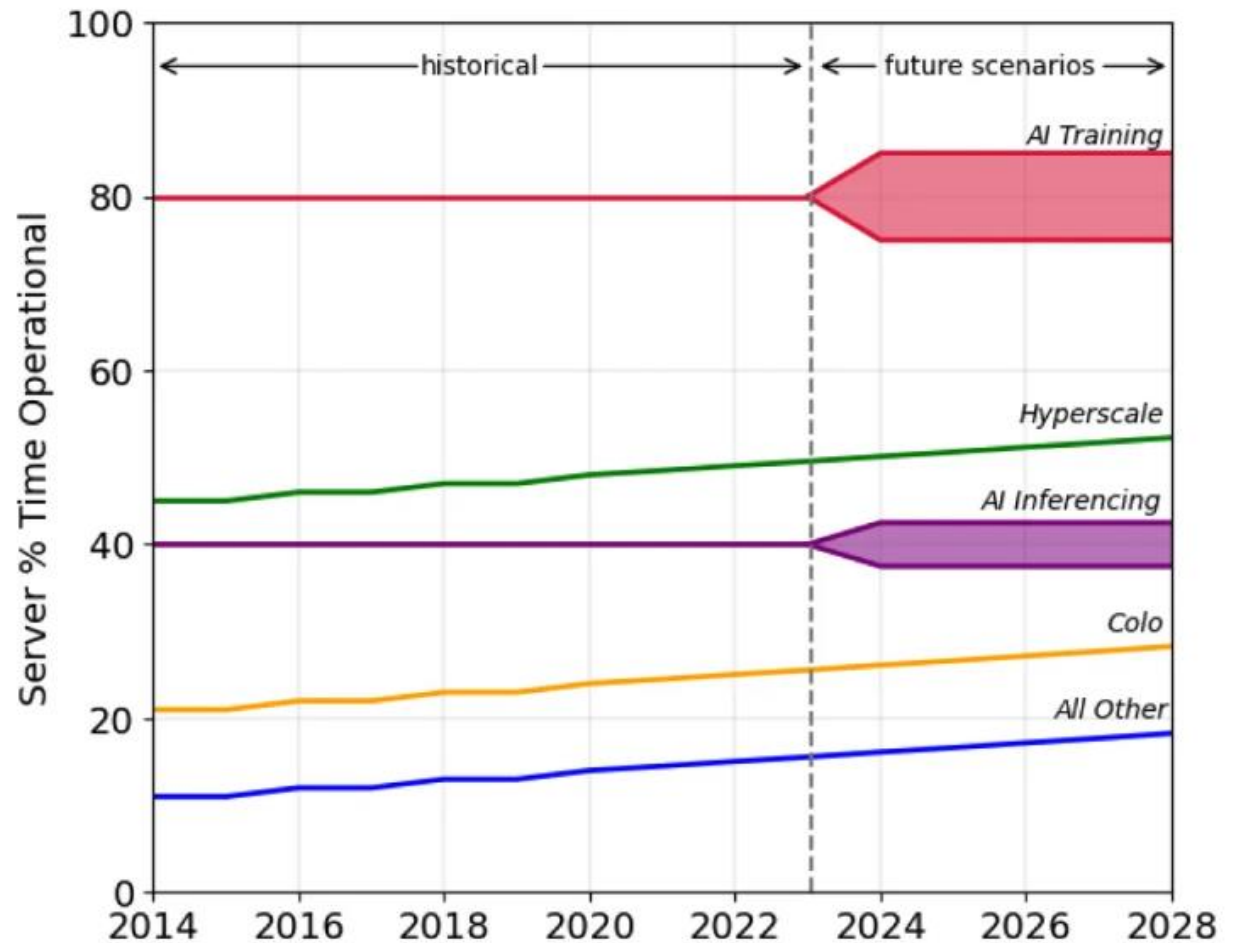


Figure from Norris et al. (2025)

Q: Do data centres need to run 24/7?

A: No.

Figure 1: Operational time of servers given data center type



Source: Shehabi, A., et al. 2024 United States Data Center Energy Usage Report. Lawrence Berkeley National Laboratory, Berkeley, California. LBNL-2001637

How can data centres *flex*?

- **Spatial flexibility**

- **Shift** compute to other data centre locations
- *“Arbitrage fibre optic lines instead of transmission lines”*

- **Temporal flexibility**

- **Reduce** compute during periods of strain
- **Delay** compute (e.g. batch processing) for some processes

- **Other flexibility**

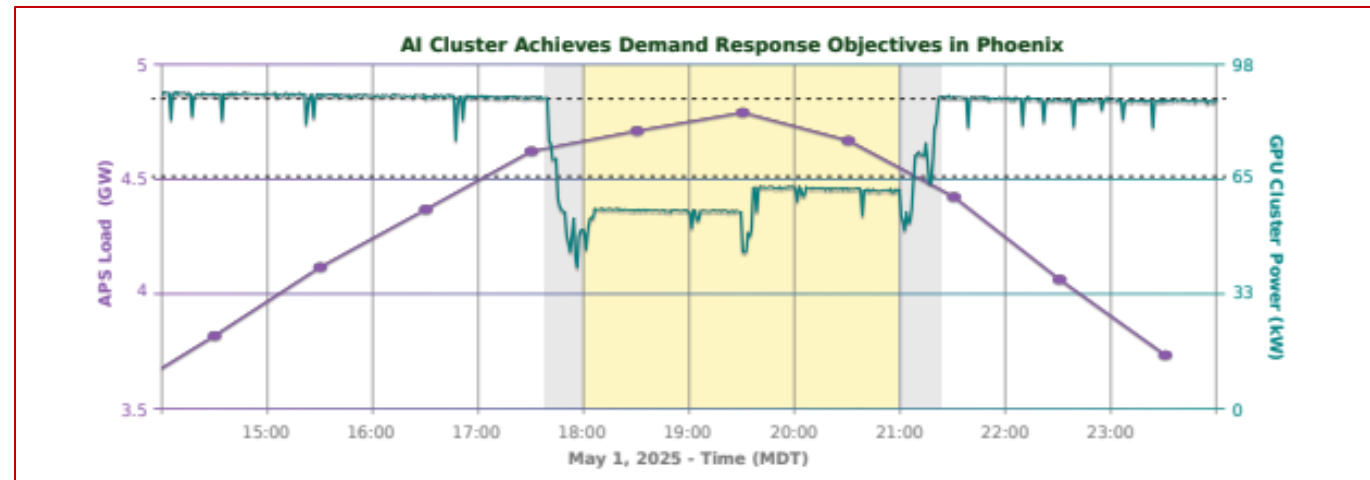
- Pre-cool or **alter set points** slightly (cooling accounts for 30-40% of data centre load)
- **Voltage adjustments** to slow processing speeds (slight delay on your ChatGPT query)
- **Server optimization** (shut idled or low-compute servers)

But will they flex?

Google agrees to curb power use for AI data centers to ease strain on US grid when demand surges

By Laila Kearney

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EmeraldAI/NVIDIA field demonstration results (Colengelo et al. 2025)

D. Voluntary Demand Response and Load Flexibility

DCC supports exploring well-structured, voluntary demand-response and load-flexibility programs for large load customers that allocates risk appropriately, provides clear incentives and compensation, and allows customers to meet their sustainability commitments. Data center participation depends on the exact nature of demand response, load resource, or emergency response programs.

Thank you!

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UNIVERSITY OF CALGARY
Electricity Centre