Electric Grid – Data Center Interactions

How do we achieve sustainable, low cost electricity?

Workshop on Artificial Intelligence-Related Data Center Electricity Use and Emissions,
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What can a data center do if it wants to contribute to a greener grid?

Grid focused:
Let's help the grid!
Demand response
Market participation

Consumer focused:
By (more directly)
aiming to use electricity
when it is "low carbon"

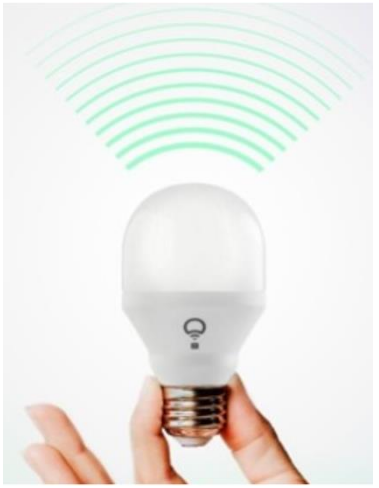


Photo: National Grid

Challenges of Carbon intensity signals

There are **different ways** of defining the carbon intensity of electricity

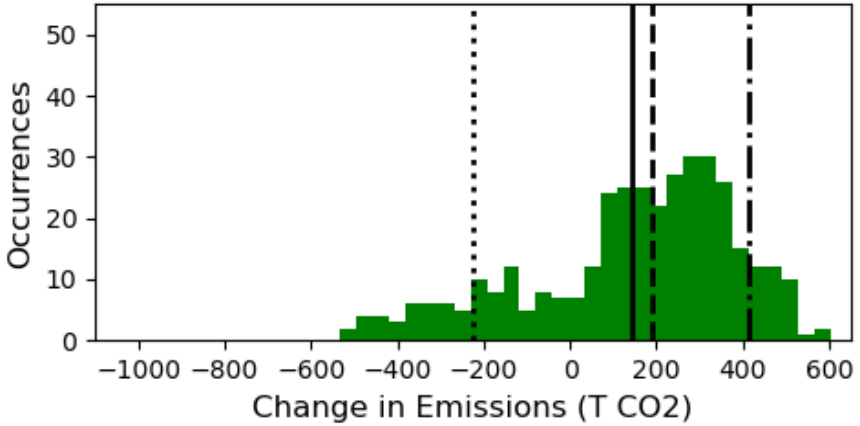
Average carbon emissions $= \frac{\text{Total emissions}}{\text{Total consumption}}$

Locational marginal carbon emissions $= \frac{\Delta \text{ emissions}}{\Delta \text{ consumption}}$

Shifting electricity use to minimize emissions can **reduce** the (perceived) emissions of a data center, but may **increase** total emissions

We need better methods for carbon accounting!

Impact of data center load shifting, using average carbon emissions



Change across the whole year:

Data center emissions: - 3.7%

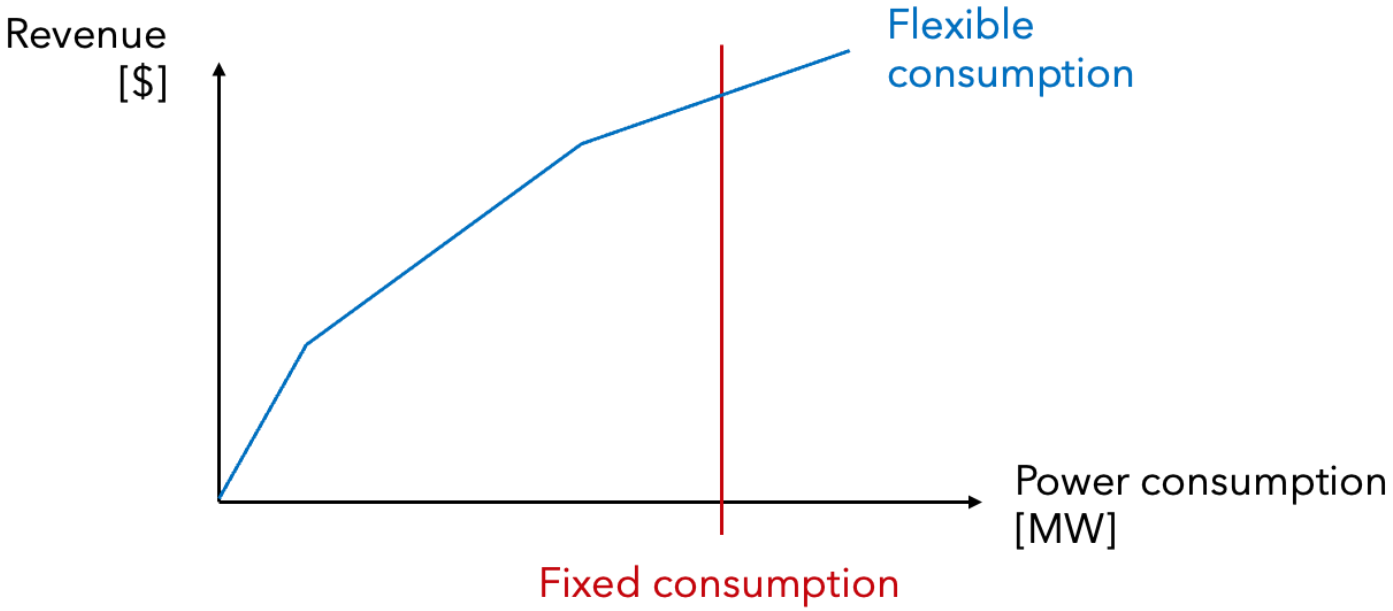
Total grid emissions: + 0.33%

J. Gorka, N. Rhodes and L. Roald, ElectricityEmissions.jl: A Framework for the Comparison of Carbon Intensity Signals, under review.

Better Alternative: Market participation

Large electric loads can bid in the electricity market:

- Allows loads to access cheaper (and typically cleaner!) electricity
- Helps the grid operate more efficiently



For a data center doing bitcoin mining, the relationship between revenue and cost is based on bitcoin value.

What is this relationship for an AI-related data center?

How can the electricity market be more welcoming to data centers?