Rise of AI, impact over energy supply + demand

Microgrid and Demand Flexibility overview

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Agenda
1. Who’s talking here
2. AI in 3 slides
3. Energy impact
4. Centralized + Distributed
5. Demand flexibility
Electrical Engineer perspective
AI or ML?

Difference between machine learning and AI:
If it is written in Python, it's probably machine learning
If it is written in PowerPoint, it's probably AI

*Algorithms
*Machine Learning
*Maths

What the hell is this?
High-level View on AI/ML types

Artificial Intelligence  *Machine that mimics human intelligence & behaviour*

Machine Learning  *Machine that learns from the data automatically w.r.t a particular task and performance measure*

Deep Learning  *Subset of ML, learning happens via algorithms inspired by neural networks in human brain*

Generative AI  *Subset of DL, creating new content from existing ones using advanced algorithms*

Machine Learning

- **Supervised Machine Learning**
  - Training data includes known labels
  - Regression
    - Label is a numeric value
    - Predict the number of bike rentals based on day, season, and weather
  - Classification
    - Label is a categorization (or class)
    - Predict whether a patient is at-risk for diabetes based on clinical measurements

- **Unsupervised Machine Learning**
  - Training data is unlabeled
  - Clustering
    - Similar items are grouped together
    - Vehicles with similar emissions and fuel efficiency characteristics are separated into clusters
WHEN EVERYONE DIGS FOR GOLD

SELL SHOVELS
Power and compute
Exponentially hungrier
How Energy Intense?

ChatGPT Will Command More Than 30,000 Nvidia GPUs: Report

Quiz: Typical LLM takes ~1 month to train. How much energy consumed by GPU per training?

<table>
<thead>
<tr>
<th>Product</th>
<th>GPU Only Power Consumption</th>
<th>Model</th>
</tr>
</thead>
<tbody>
<tr>
<td>A-100</td>
<td>300-400 W</td>
<td>GPT 3.5</td>
</tr>
<tr>
<td>H-100</td>
<td>500-700W</td>
<td>GPT 4</td>
</tr>
</tbody>
</table>


https://www.cudocompute.com/blog/comparative-analysis-of-nvidia-a100-vs-h100-gpus/
Quiz: How much energy consumed per LLM training?

30,000 GPUs X 700 W/chip X 30 days X 24 hrs/day =

Typical Tesla: 1000 lifetime cycles, 70 kWh battery size

15 GWh / Training  →  200+ Tesla
Each runs from brand-new to 400k miles and retired.

(Not included)
How To...?

Meet future energy + compute demand...

AI Breakthrough Paves Way for Near-Limitless Clean Energy: Fusion Puzzle Solved!

Bottleneck?

(Hint: Not at the supply side)

Evidence of Problem 1: Increasing timelines

Evidence of Problem 2: Rising cost to interconnect
Queue exceeds Installed capacity

U.S. Installed vs. Active Interconnection Queues, rising demand

More than 95% of active capacity in interconnection queues is zero-carbon

Source: DOE, Lawrence Berkeley NL, 2023
Grid – Essential for energy transition

Centralized megatrends, but only part of solution

100+ years, 50 million miles, $300 B/year

- Interconnection – Resilience and reliability, Congest
- Digitization – Load Flow, Smart Grid, SCADA
- Decarbonization – Climate change, carbon intensity (lbs/MWh)
Distributed Energy and Microgrids

Distributed energy resources (DERs) are pivotal in helping the power grid smoothly transition to clean energy. Deployed at customer sites and in the distribution grid, DERs can be grid-connected assets or devices that consume, store or generate power and can respond to a signal.

**Reliability**

Up to 100%
- Power needs met with on-site energy resources

**Lead Times**

As low as 1 year
- From a signed contract to an operational facility

**Energy Costs**

Predictable
- Energy costs are defined in long-term contract

**Emissions**

Zero-carbon
- Achievable
Microgrids focus on demand
Centralized + Distributed, dance together

Local, onsite, AI-enabled, customer energy systems add tremendous flexibility, removes constraints
Demand flexibility makes grid smarter

Increase the **site** flexibility (all energy) to increase “demand flexibility”

1. **Make building loads more energy efficient**
2. **Enable building flexibility with a Microgrid**
3. **Utility/Regulator Controlled**
   - **Make the grid demand flexibility compensation worthwhile**
4. **Set a long-term performance-based contract**
5. **Grid Demand Flexibility**
6. **Energy-as-a-Service**
   - **Customer Controlled**
   - **Shape the demand flexibility**
Talk to you more in Seattle!

Future discussions and collaboration needed!
Questions?  Comments?

Thank you!

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