

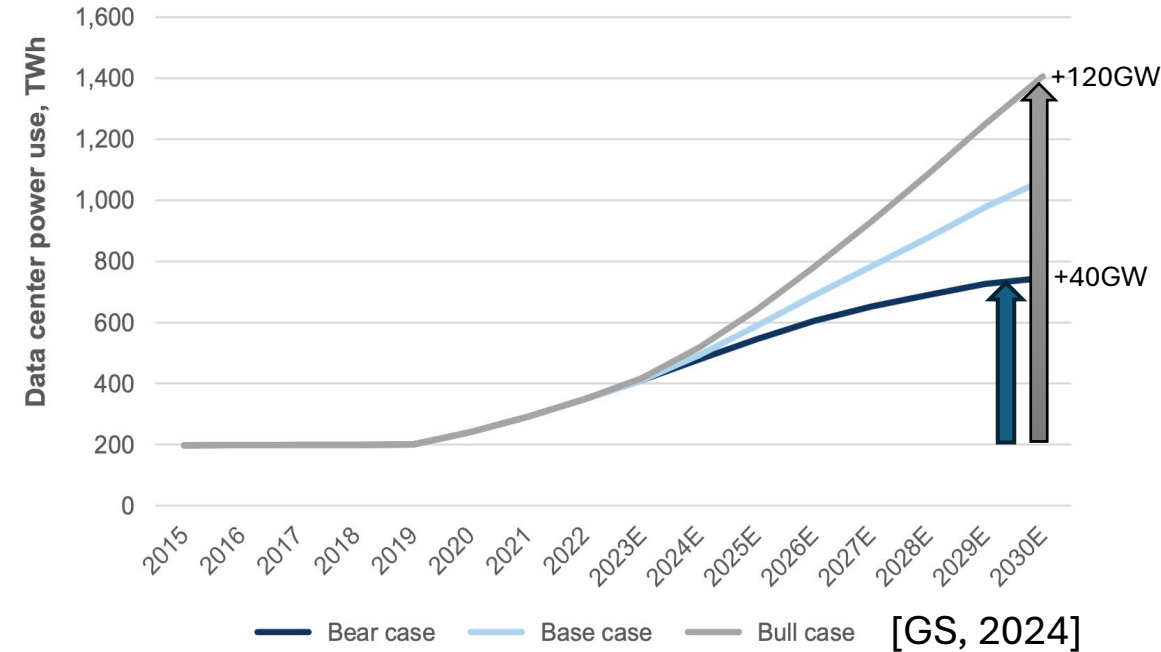
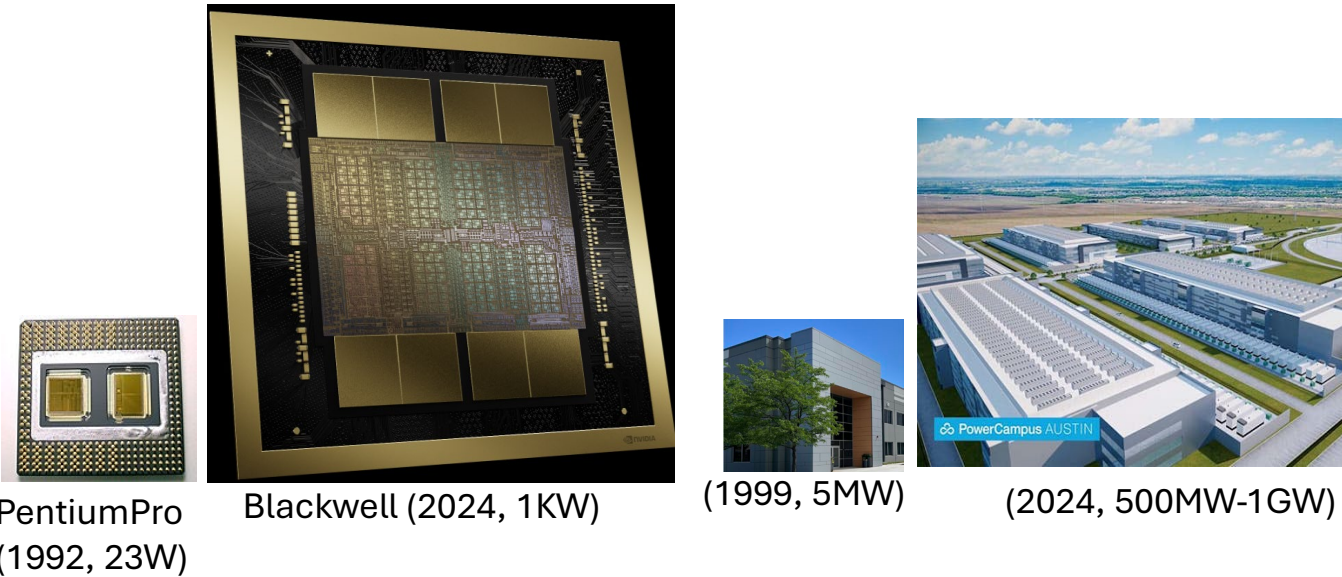
Datacenters should be Dynamic and Cooperate with the Grid

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November 12, 2024

Computing power is BIG, despite Energy Efficiency improvements



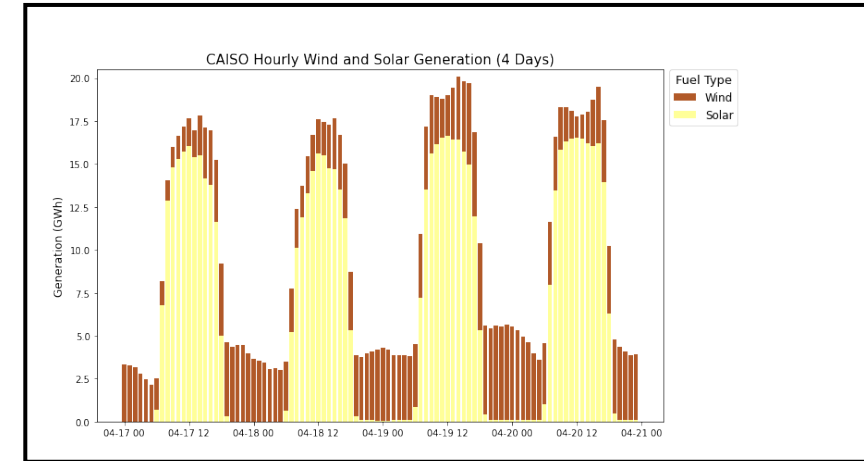
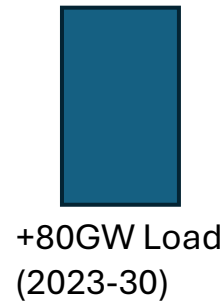
- Chips, Datacenters 50x higher power
- 2023-30: Projected growth 1.8-3.4x => 40-120GW
 - 8-11% of US Power Demand in 2030
- Consequences of BIG
 - Datacenter Power, Grid Stability (high frequency)
 - 8MW (Supercomputer, 2016), 15MW? (AI datacenter, 2024)
 - Grid Adequacy: Generation, Seasonal, Daily Variation

More Consequences of BIG

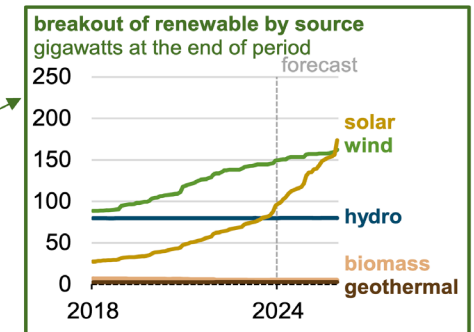
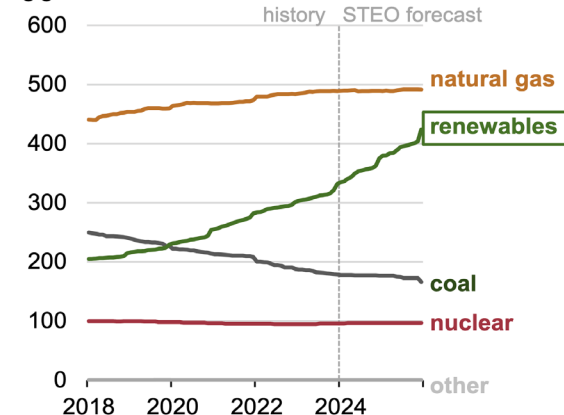
- 2024: NoVa 25% Grid, 25% CAGR => 5% growth
- Today's Cloud+AI is ~40% CAGR?
- 2030: 8% of USA grid 25% CAGR => 2% growth

Datacenter Flexibility is essential to Match Renewable Variation

- Balancing is difficult: Flat load vs. fluctuating Generation Mix
- Nominal case is +80GW, (240GW wind and solar capacity)
 - 2018-23: +23GW capacity/year
 - Must accelerate 1.5-2x
- Incremental problem is Flat load vs. new Wind and Solar
 - Datacenter growth is a Grid renewable integration problem



U.S. annual electric generating capacity (2018–2025)
gigawatts at end of December



EIA, 1/2024



Dynamic Datacenters can increase Grid Capacity, Efficiency and Reduce Cost

- Benefits

- Up to 50% more DC growth (EirGrid, Dominion) [see Lin, E-energy '24]
- Greater Efficiency (cheaper power)
- => Other benefits as well!

- Flexible and...

- Cost-effective?
- Meet compute SLO?
- Cooperate with Grid to avoid “Thundering Herd”?
 - All dive for Green; Differing Self-interest
- Treat All customers big and small fairly?
- Incentivize flexibility?
 - (load, shape, commitments)

