7th Thermal-Mechanical-Chemical Energy Storage Workshop
July 2025

DATA CENTERS – CAN LDES SOLUTIONS FIT THE CURRENT NEED

STRATEGIC ASSESSMENT: DATA CENTER

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Datacenter

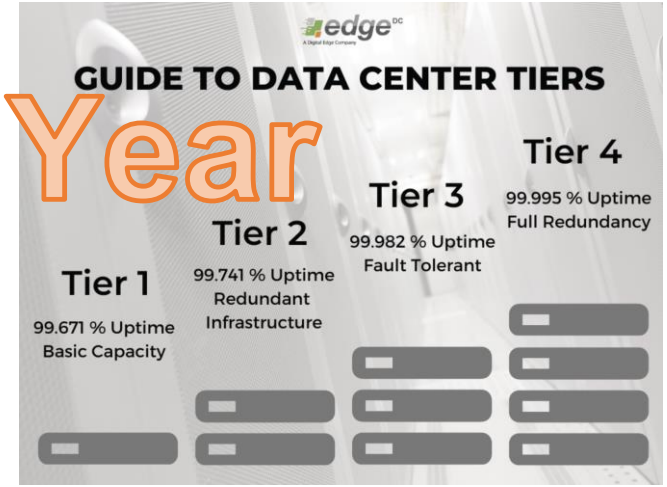
Tier 1 – 28.8 Hours Downtime per year

Tier 2 – 22 Hours Downtime per year

Tier 3 – 1.6 Hours Downtime per year

Tier 4 – 26.3 Minutes Downtime per year

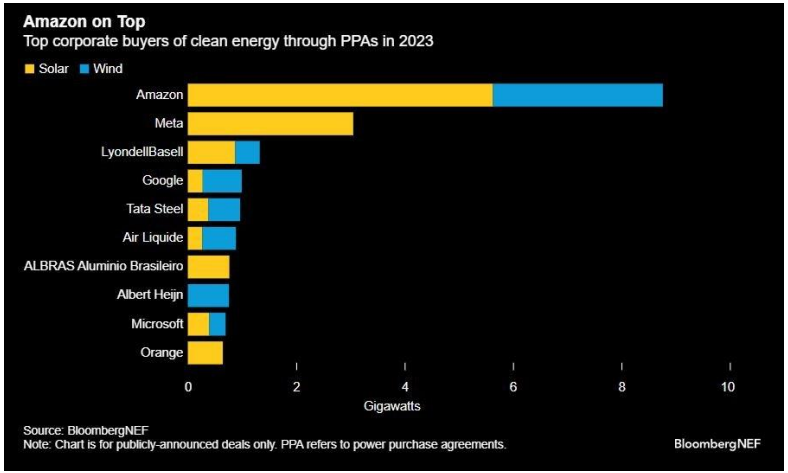
Last Year



Lead times for backup diesel generators 18mth+

Economics of Datacenter is not that complicated and yes it can be very lucrative .

10 MW Build				
Datacenter Build	$ 360,000,000			
H100	7840	Unit		
Utilization of Datacenter	75%			
Power Price Cases $/MWh	100	1000	2000	3000
Cost of Power	$ 9,385,714	$ 93,857,143	$187,714,286	$ 281,571,429
H100 Rental	5	$/Hr		
Potential Annual Revenue	$ 257,544,000			
Power %of Revenue	4%	36%	73%	109%



The PRICE is right!

They are paying north of $150/MWh!

($240Million/(200 MW x 8760 x 0.9) = $152/MWh!

Helios Value Creation Opportunity

The value creation opportunity at Helios is enormous; every 200MW gross (133MW Critical IT load assuming 1.5 PUE) leased results in:

- **$240MM of revenue** ($1.8MM of revenue per MW of critical IT load per CoreWeave lease)
- **$216MM of EBITDA** (90% EBITDA margin, per mgmt. guidance as lease is structured as Triple Net)
- **$4.9MM of enterprise value** (assuming 22.5x EBITDA multiple, which represents discount to public and M&A data center comps at ~25x+)
- **$3.4B of equity value** (assumes 80% LTC construction financing, per mgmt. guidance; 12% rate assumed for purposes of conservatism)

Note: The required equity investment is limited beyond amounts funded for the first 600MW at Helios. At stabilization, the construction loan will be refinanced out with lower cost debt, and refinancing proceeds will exceed the construction loan principal, with excess proceeds "recycled" as equity into new development

CapEx & Financing Assumptions ($MMs) (per 200MW Gross)		
MW (Gross)		200
PUE		1.5
MW (Critical IT)		133
CapEx $ per MW (Critical IT Load)	$	12
Total CapEx	**$**	**1,600**
Loan to Cost ("LTC")		80.0%
Construction Loan ($)	**$**	**1,280**
Required Equity from GLXY (per 200MW Gross)	**$**	**320**

Stabilized EBITDA, Valuation, and Returns		
Rev. per MW - Critical IT Load (Year. 1)	$	1.8
Revenue (Year 1)	**$**	**240**
EBITDA Margin		90.0%
EBITDA (Year 1)	**$**	**216**
Assumed EBITDA Multiple		22.5x
Enterprise Value	**$**	**4,860**
Less: Construction Loan Principal		(1,280)
Less: Construction Loan Interest (1-yr., 12% All-In)		(154)
GLXY Equity Value (per 200MW Gross)	**$**	**3,426**

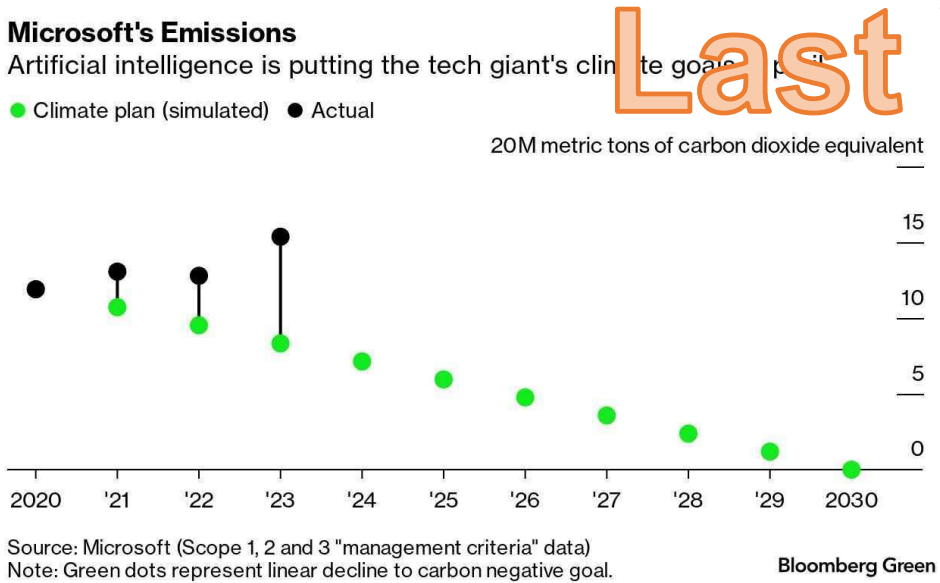
Galaxy has already signed up 600MW gross MW capacity on these terms, which results in ~$650MM of expected EBITDA; Assuming a 22.5x EV / EBITDA multiple and 80% construction LTV, **the existing 600MW leased implies $10.3B of equity value**

Total Equity Value Helios (USD)

EBITDA ($MMs)	Gross MW	Critical IT	Estimated EBITDA Multiple										
			17.5x	18.5x	19.5x	20.5x	21.5x	22.5x	23.5x	24.5x	25.5x	26.5x	27.5x
$ 216	200	133	$ 2,346	$ 2,562	$ 2,778	$ 2,994	$ 3,210	$ 3,426	$ 3,642	$ 3,858	$ 4,074	$ 4,290	$ 4,506
432	400	267	4,693	5,125	5,557	5,989	6,421	6,853	7,285	7,717	8,149	8,581	9,013
648	**600**	**400**	**7,039**	**7,687**	**8,335**	**8,983**	**9,631**	**10,279**	**10,927**	**11,575**	**12,223**	**12,871**	**13,519**
864	**800**	**533**	**9,386**	**10,250**	**11,114**	**11,978**	**12,842**	**13,706**	**14,570**	**15,434**	**16,298**	**17,162**	**18,026**
1,080	1,000	667	11,732	12,812	13,892	14,972	16,052	17,132	18,212	19,292	20,372	21,452	22,532
1,296	1,200	800	14,078	15,374	16,670	17,966	19,262	20,558	21,854	23,150	24,446	25,742	27,038
1,512	1,400	933	16,425	17,937	19,449	20,961	22,473	23,985	25,497	27,009	28,521	30,033	31,545
1,728	**1,600**	**1,067**	**18,771**	**20,499**	**22,227**	**23,955**	**25,683**	**27,411**	**29,139**	**30,867**	**32,595**	**34,323**	**36,051**
1,944	1,800	1,200	21,118	23,062	25,006	26,950	28,894	30,838	32,782	34,726	36,670	38,614	40,558
2,160	2,000	1,333	23,464	25,624	27,784	29,944	32,104	34,264	36,424	38,584	40,744	42,904	45,064
2,376	2,200	1,467	25,810	28,186	30,562	32,938	35,314	37,690	40,066	42,442	44,818	47,194	49,570
2,592	2,400	1,600	28,157	30,749	33,341	35,933	38,525	41,117	43,709	46,301	48,893	51,485	54,077
2,700	**2,500**	**1,667**	**29,330**	**32,030**	**34,730**	**37,430**	**40,130**	**42,830**	**45,530**	**48,230**	**50,930**	**53,630**	**56,330**

800MW Gross / 533MW Critical IT Load: Total currently approved capacity at Helios; **$13.7B** of equity value at 22.5x EBITDA multiple
1,600MW Gross / 1,067MW Critical IT Load: Includes 800MW of incremental capacity expected to be approved in "single digit months"; **$27.4B** of equity value at 22.5x EBITDA multiple
2,500MW Gross / 1,667MW Critical IT Load: Total potential capacity at Helios (800MW approved today plus full 1,700MW under load study approval); **$42.8B** of equity value at 22.5x EBITDA multiple midpoint

Datacenters want to be green AND want ATC reliability



Last Year

Google Sustainability Report

ENERGY		2023		
Energy consumption	**Unit**	**Renewable sources**	**Non-renewable sources**	**Total**
Fuel	MWh	68,300	232,900	301,200
Purchased electricity[7]	MWh	15,672,000	9,580,600	25,252,600
Purchased heat[8]	MWh	0	278,500	278,500
Purchased steam	MWh	0	14,500	14,500
Purchased cooling	MWh	0	53,000	53,000
On-site renewable electricity	MWh	10,700	0	10,700
Total energy consumption	**MWh**	**15,750,900**	**10,159,600**	**25,910,500**

Is it possible to develop a cost-effective long-duration energy storage system that can address both short-term and long-term energy needs?

Such a system could be a game-changer if enabling facilities to achieve sustainability goals while simultaneously providing backup power capabilities.

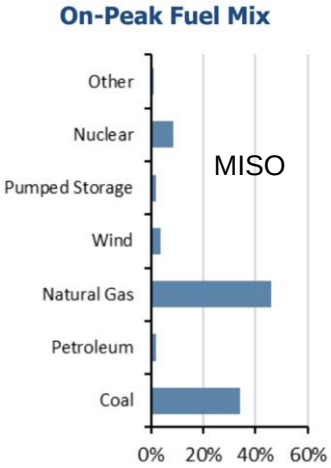
Being Green Requires More Work

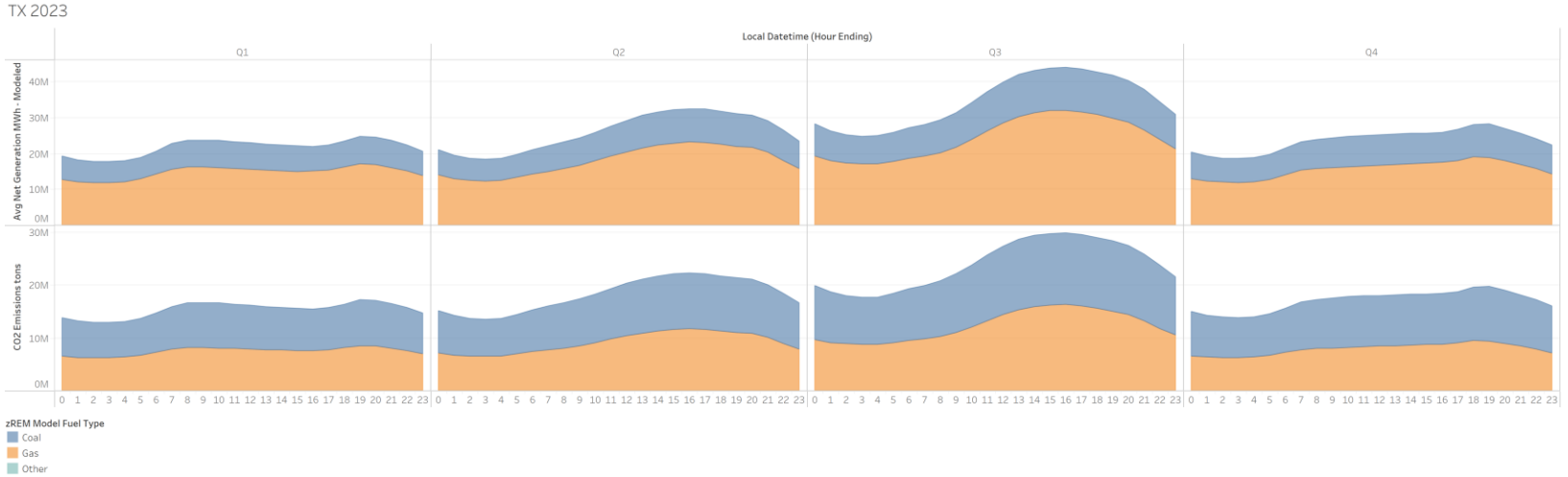
Last Year

Energy storage can play a crucial role in minimizing CO2 emissions from data centers. Data centers connected to the grid can utilize on-site storage to significantly reduce their carbon footprint and contribute to a cleaner grid.

For facilities prioritizing CO2 reduction, strategically deploying battery storage with a capacity of approximately 12 hours a day can minimize carbon emissions.

In this scenario, the primary driver for storage adoption is not cost reduction, but rather CO2 emissions reduction.



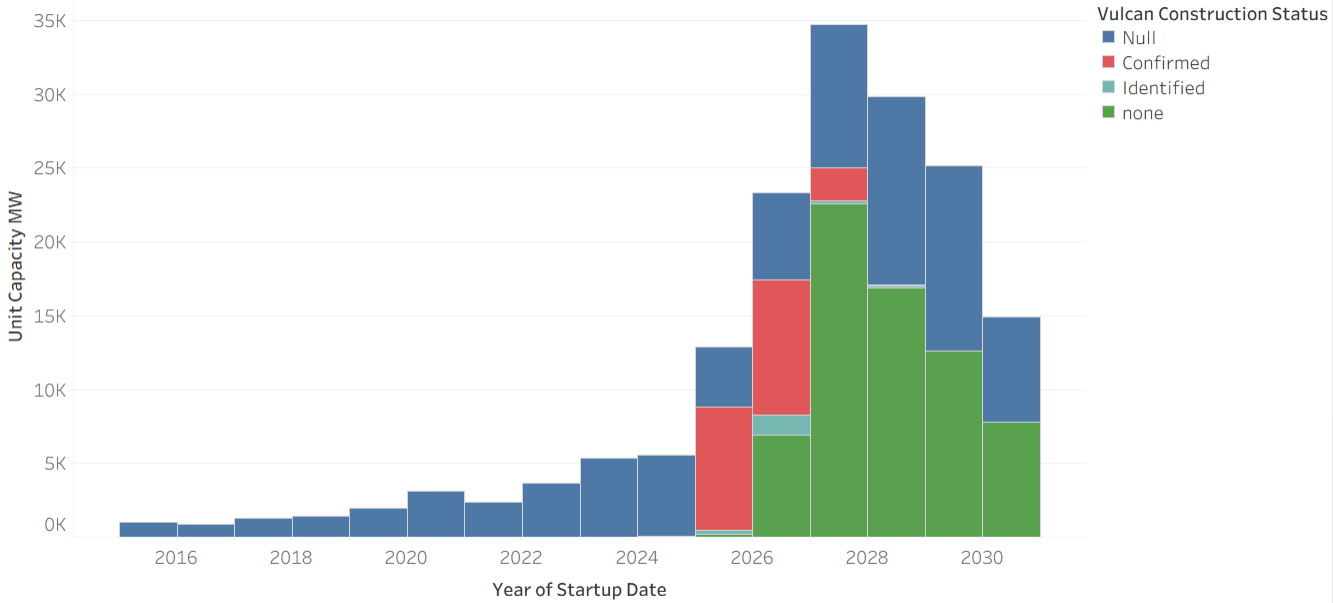


Datacenter Coverage

Datacenter Map 2030

Datacenter Coverage

Datacenter Capacity Additions Overtime & SynMax Vulcan Coverage



Capacity and Year Online from IIR. Null represents the currently non-Vulcan covered project. Confirm notes the first satellite image shows construction signs. None notes the project does not show any construction signs - no land clearing or structure at the site.

SYNMAX INTELLIGENCE
VULCAN

When is new data center load expected?

Pryor Data Center DC 12 (Oklahoma, US)

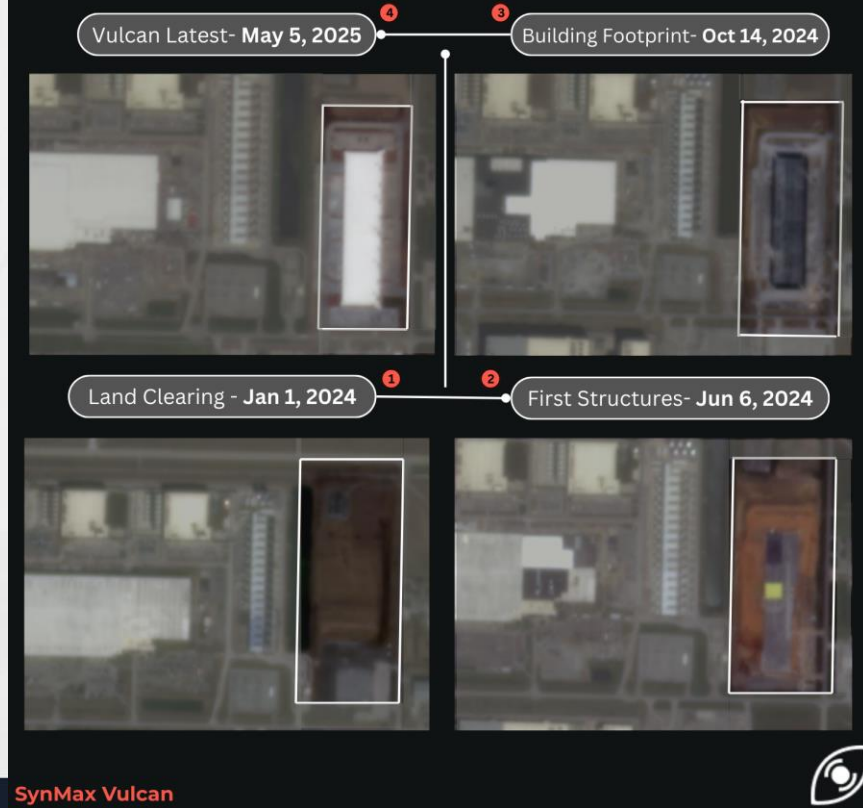
Vulcan latest capture on **May 5, 2025**

ISO: SPP
Owner: Google, Inc.
Unit Capacity: 70 MW (DC 12), **Total site capacity**: 436 MW
Plant/ Unit Status: Operational
IIR Start Date: 31ST December 2024

<300 MW
<250 MW
<200 MW
<150 MW
<100 MW
<50 MW

SynMax Vulcan

Evolution Of Pryor DC 12 (Oklahoma, US)



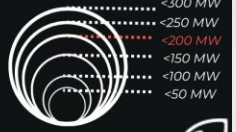
SynMax Vulcan

When will new power generation be online?

Oriana Solar Plant (Victoria County, Texas, US)

Vulcan latest capture on **Apr 13, 2025**

ISO: ERCOT
Owner: Oriana Solar LLC
Capacity: 180 MW
Expected Online: June 2025



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Evolution Of Oriana Solar Plant (Victoria County, Texas)

3 Vulcan Latest- **Apr 13, 2025**

1 Land Clearing - **July 15, 2024**

2 First Structures- **Sept 27, 2024**

SynMax Vulcan

Datacenter Bubble

The potential for a "winner-take-all" outcome is a significant driver behind the current build-out.

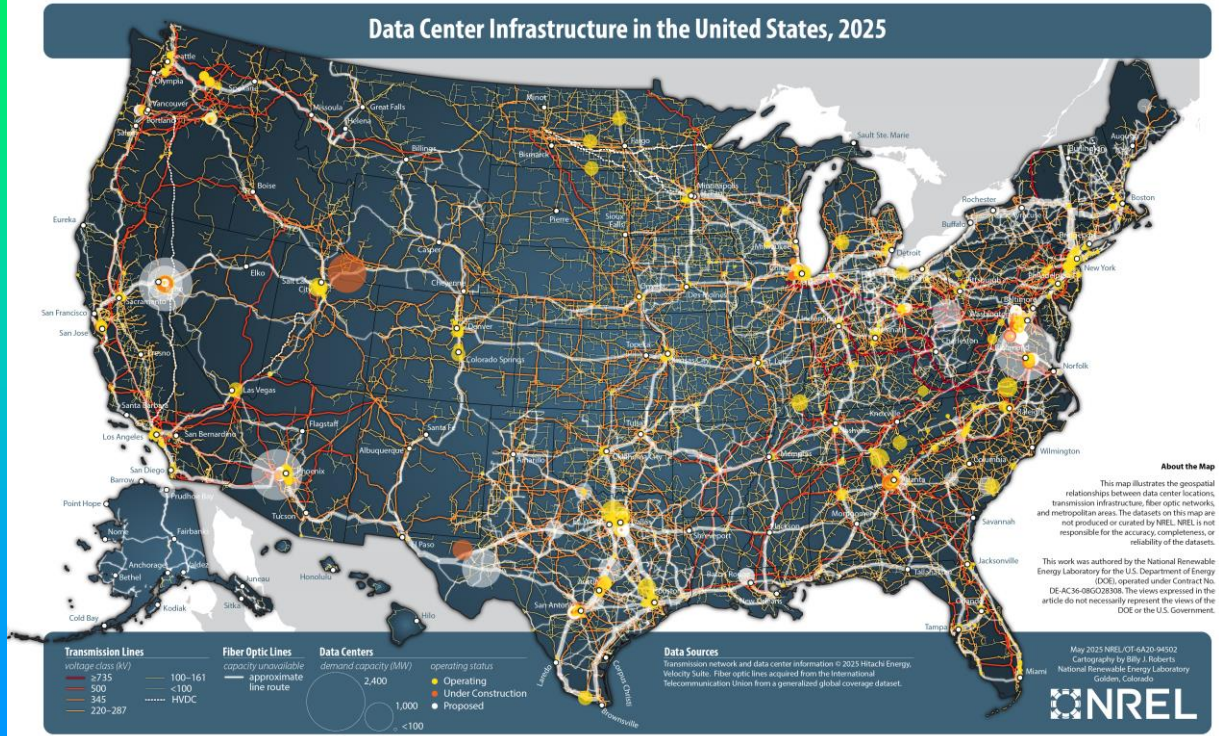
Annual advertising revenue for Google, Meta, and Amazon collectively stands at approximately $460 billion.

A projected investment of $2 trillion could potentially yield a return approaching 20% over 10 years, assuming a strategy to capture a substantial share of this market.

Current spending by publicly traded companies is around $300 billion annually, translating to an estimated 10-15 GW of capacity per year. If this accounts for 60% of total spending, the overall market could be between 16-25 GW annually.

Infrastructure for Datacenter

Sites are being picked away – optimal site offers reliable power, fiber, and workforce.



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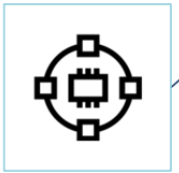
Why AI/ML?

Case study showing the value AI/ML can bring to society:

T-PULSE assures OSHA compliance with AI/ML – 400+ Models

T-Pulse connects with Sensors on site



Less than **1%** False Positive VS Human's **4%** False positive

T-Pulse applies AI & Machine Vision algorithm to detect unsafe conditions, security risks, operational choke points, etc.

T-Pulse alerts individuals via dashboard, mobile alerts and other channels

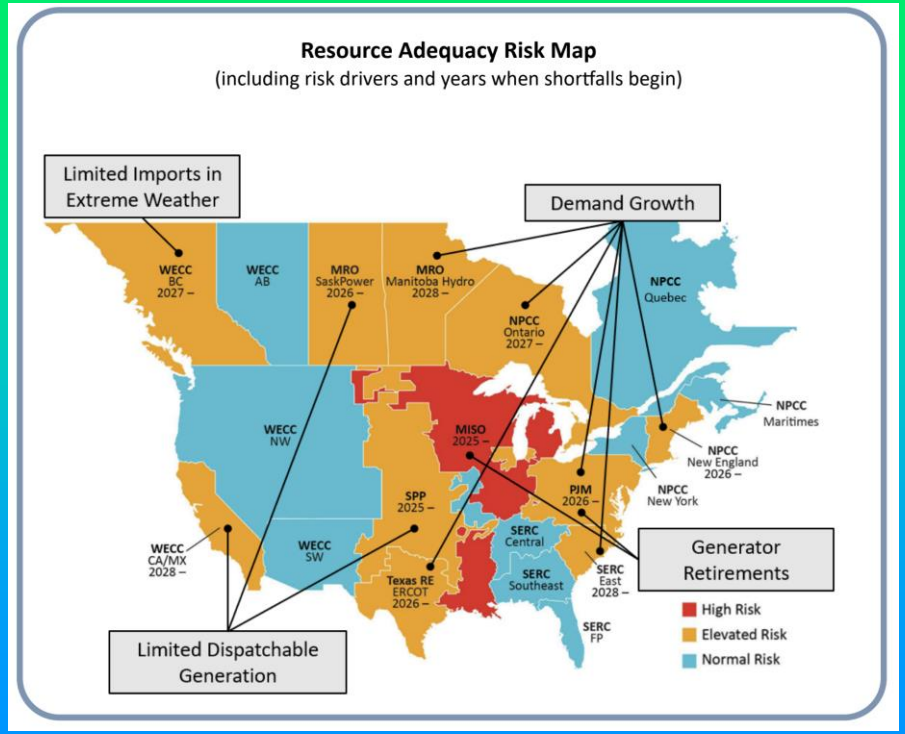
People take actions to prevent incidents from happening

Copyright of Detect Technologies

NERC Longterm Reliability Assessment 2024

Error in MISO found a few weeks ago.

NERC now notes MISO is not in the high risk category but elevated.



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NERC Summer Assesment 2025

Summer highlights current issues are overall in the range for typical outages.

Extreme conditions cause the West and TX and parts of MISO in the negatives.

Table 2: Seasonal Risk Scenario On-Peak Reserve Margins

Assessment Area	Anticipated Reserve Margin	Anticipated Reserve Margin with Typical Outages	Anticipated Reserve Margin with Higher Demand, Outages, Derates in Extreme Conditions
MISO	24.7%	9.3%	-1.9%
MRO-Manitoba	14.6%	11.2%	3.8%
MRO-SaskPower	33.5%	28.3%	22.4%
MRO-SPP	28.5%	18.2%	3.4%
NPCC-Maritimes	42.2%	31.7%	18.6%
NPCC-New England	14.1%	3.9%	4.0%
NPCC-New York	31.6%	12.5%	5.2%
NPCC-Ontario	23.4%	23.4%	3.7%
NPCC-Québec	32.7%	28.2%	19.1%
PJM	24.7%	15.0%	5.3%
SERC-C	19.6%	12.7%	3.2%
SERC-E	29.1%	21.8%	13.0%
SERC-FP	20.2%	14.0%	11.8%
SERC-SE	41.3%	37.7%	12.5%
TRE-ERCOT	43.2%	33.0%	-5.1%
WECC-AB	42.6%	40.3%	20.5%
WECC-Basin	24.3%	15.9%	-27.2%
WECC-BC	24.3%	24.2%	-6.6%
WECC-CA	56.9%	51.0%	4.7%
WECC-Mex	14.1%	1.6%	-16.8%
WECC-NW	32.1%	29.4%	-13.0%
WECC-RM	25.7%	18.2%	-18.9%
WECC-SW	22.3%	14.0%	-13.0%

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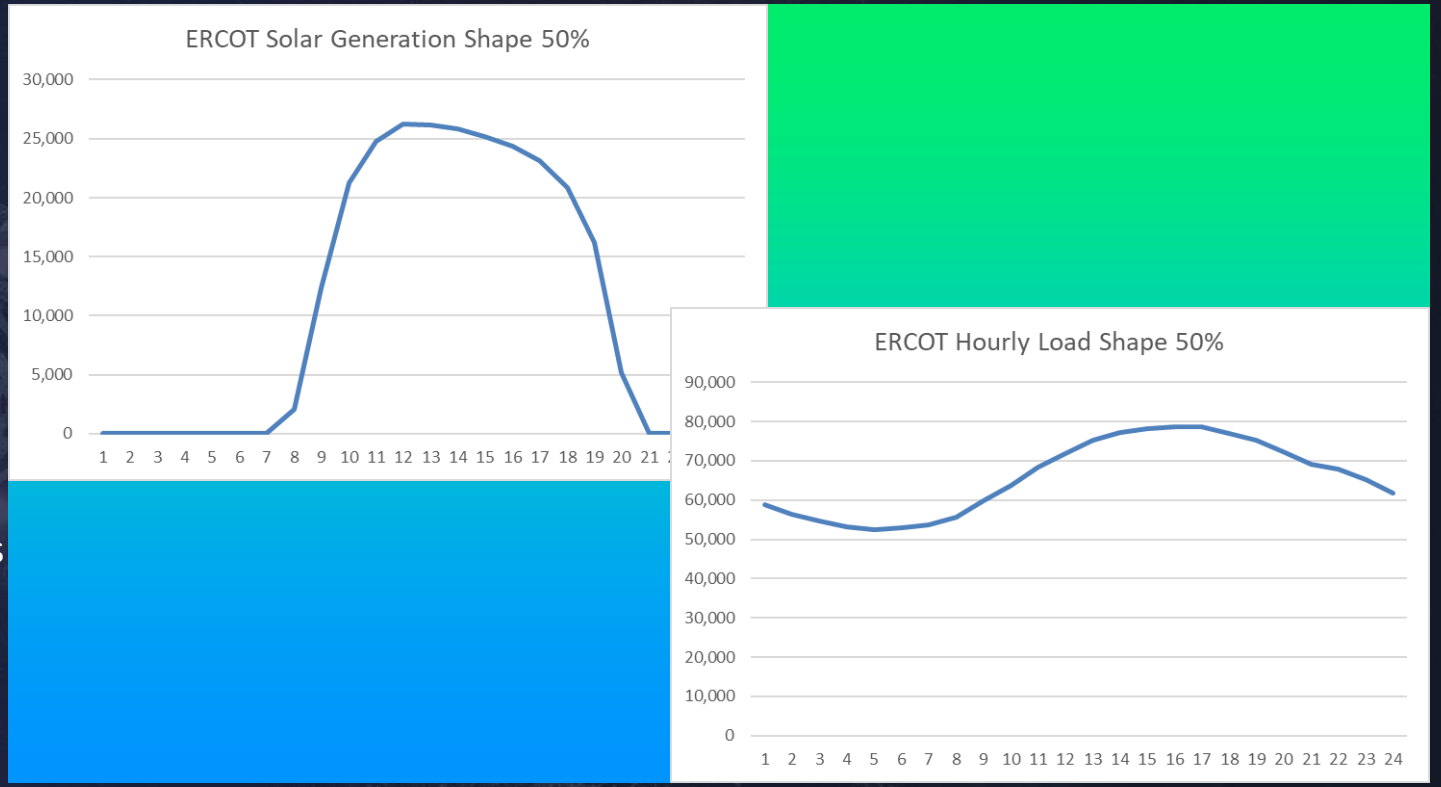
Peak Demand?

With solar the impact of peak demand is not as obvious.

By 9pm the solar is gone but load has also dropped off by nearly 13%.

Coincidently the winter vs. summer peak is around 14%.

Therefore if solar exceeds 13% of total generation in peak other generation is needed by 9 pm.



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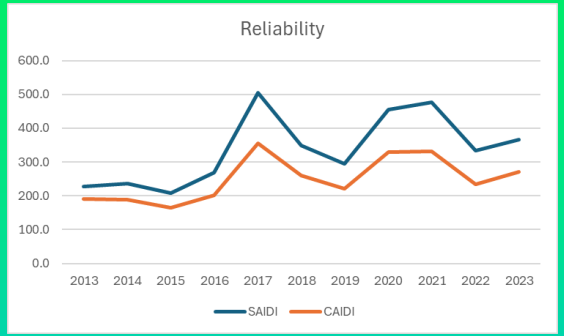
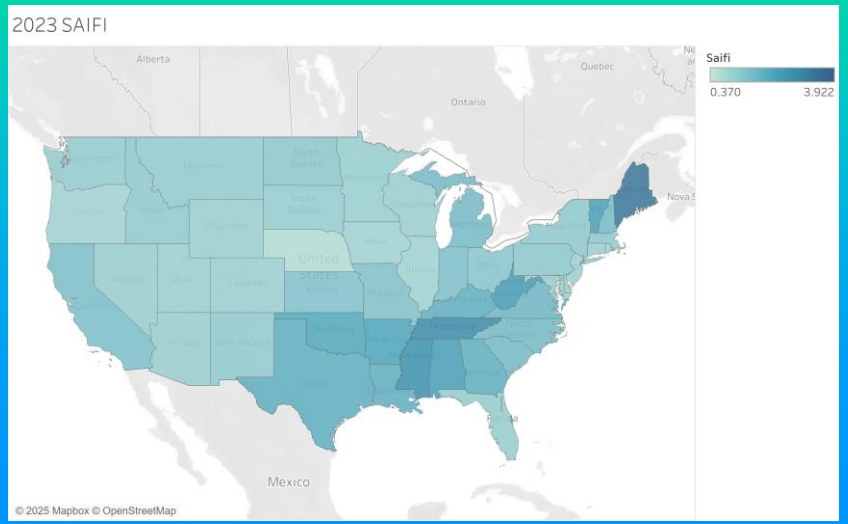
Reliability

SAIDI = System Average Interruption Duration Index. It is the minutes of non-momentary electric interruptions, per year, the average customer experienced.

CAIDI = Customer Average Interruption Duration Index. It is average number of minutes it takes to restore non-momentary electric interruptions.

SAIFI = System Average Interruption Frequency Index. It is the number of non-momentary electric interruptions, per year, the average customer experienced.

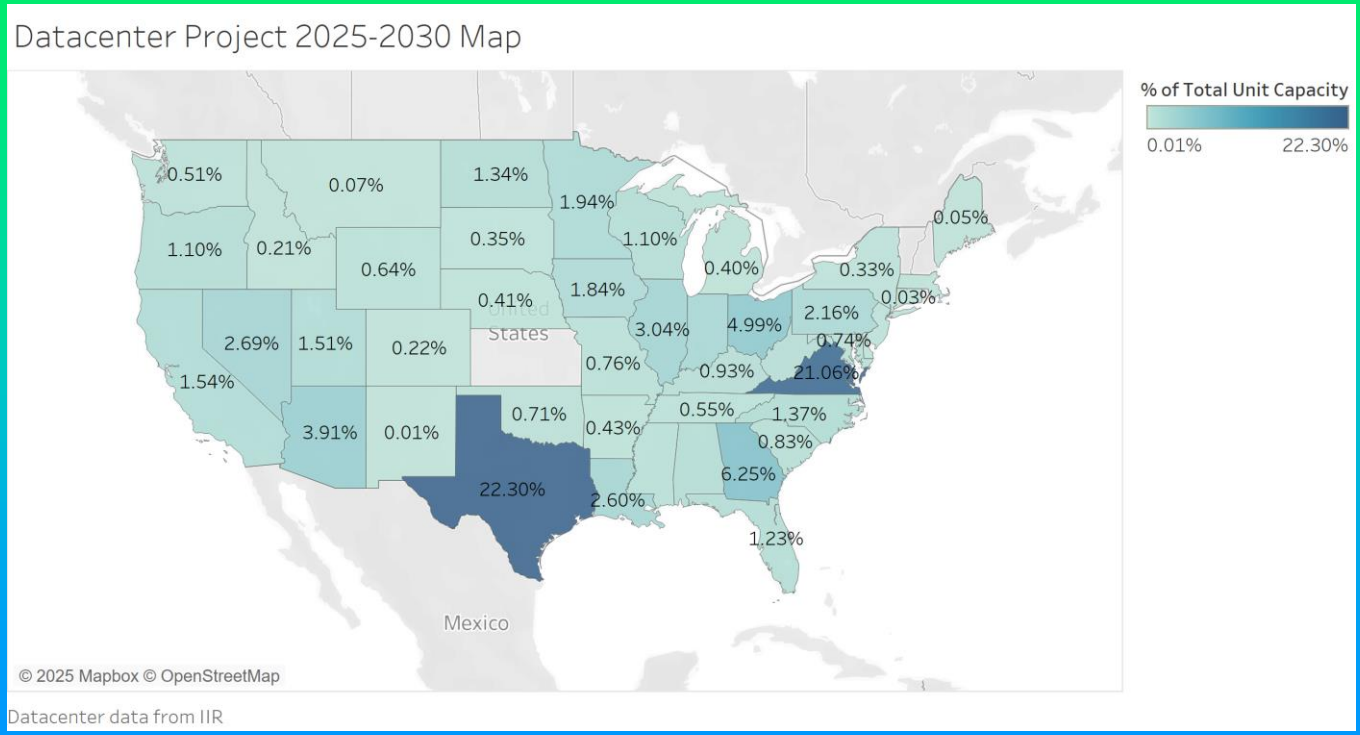




SYNMAX Vulcan

Datacenter Projects by State

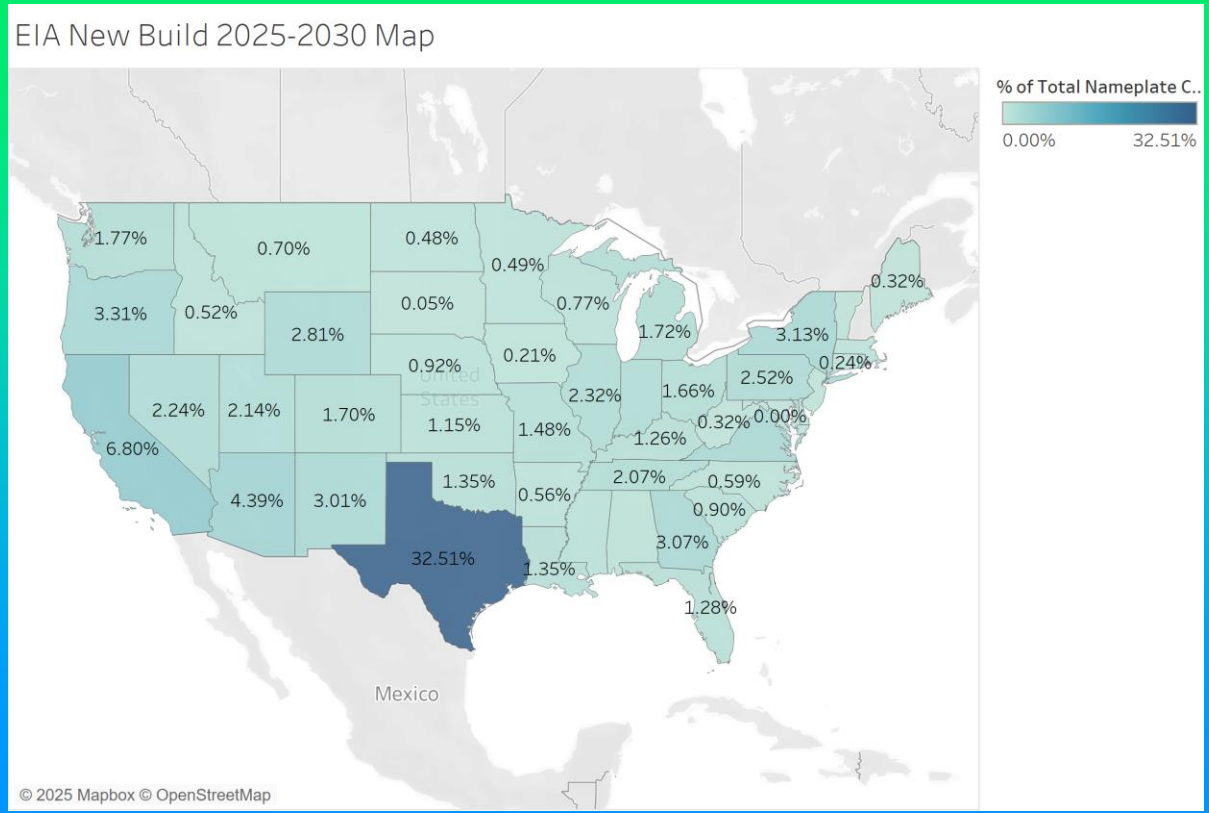
Largest growth for datacenters seen in TX and VA



Power Plant Projects by State

A clear leader in generation projects is ERCOT.

ERCOT is more likely to be able to meet the datacenter load growth.

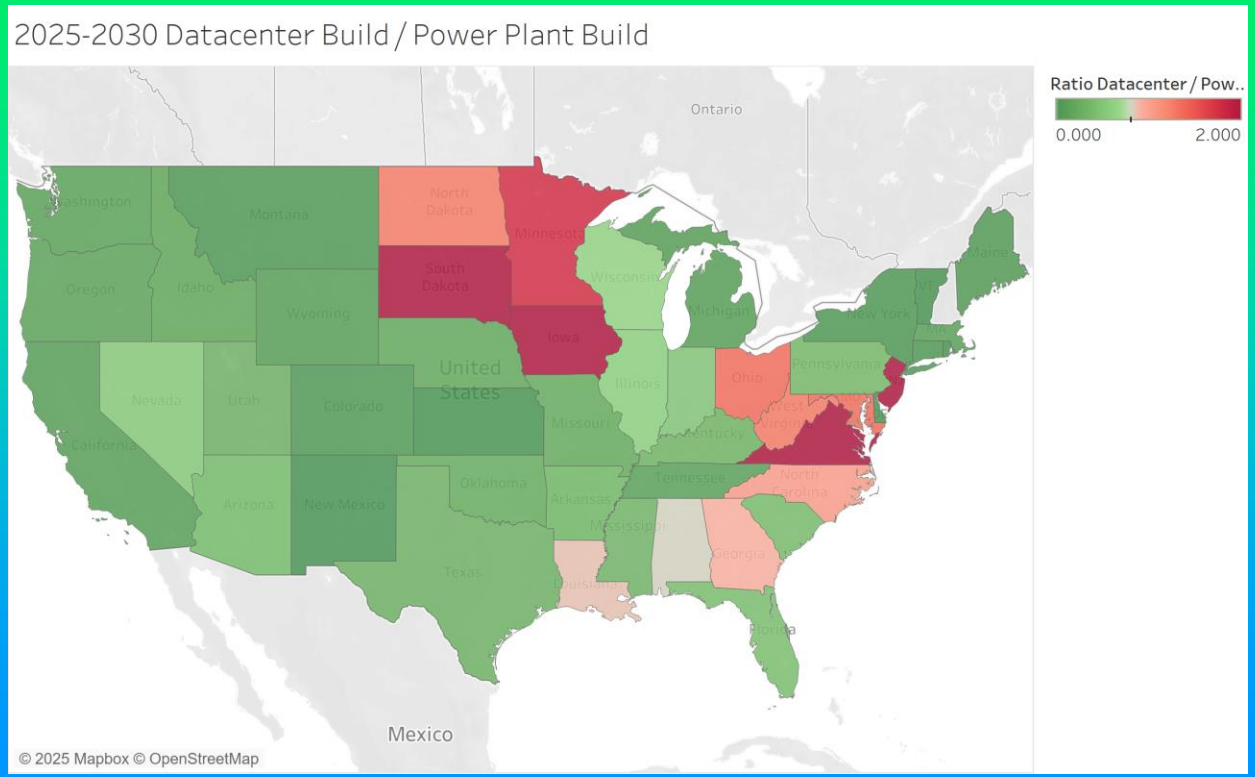


Datacenter Additions / Power Plant Additions

Certain states are depending on transmissions e.g. NJ and VA.

LA, GA, AL, SD, IA are using up their surplus.

However, the distribution system will also be stressed.

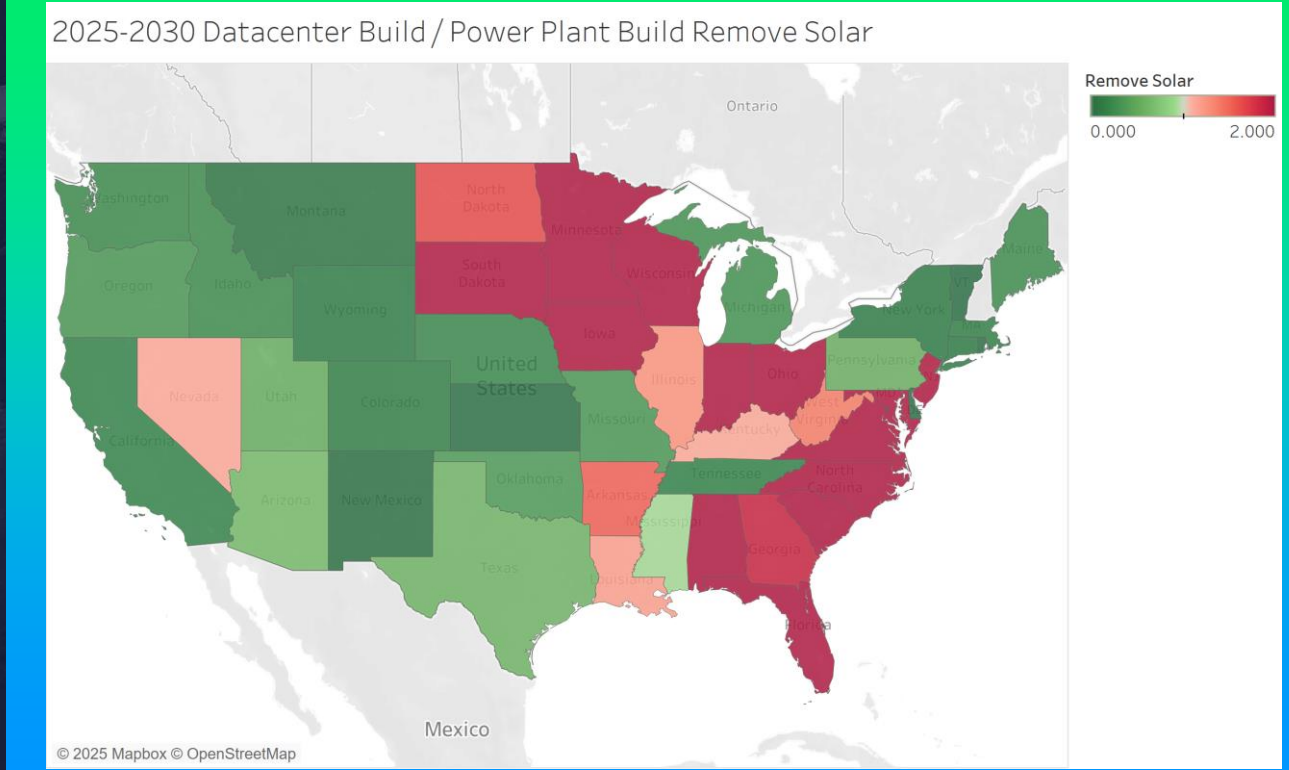


Datacenter Additions / Power Plant Additions Removing Solar

The AI datacenters are not going to shut off at night and the load drop is not enough to make up for the loss of solar in many states.

Solar builds are 47% percent of the builds till 2030.

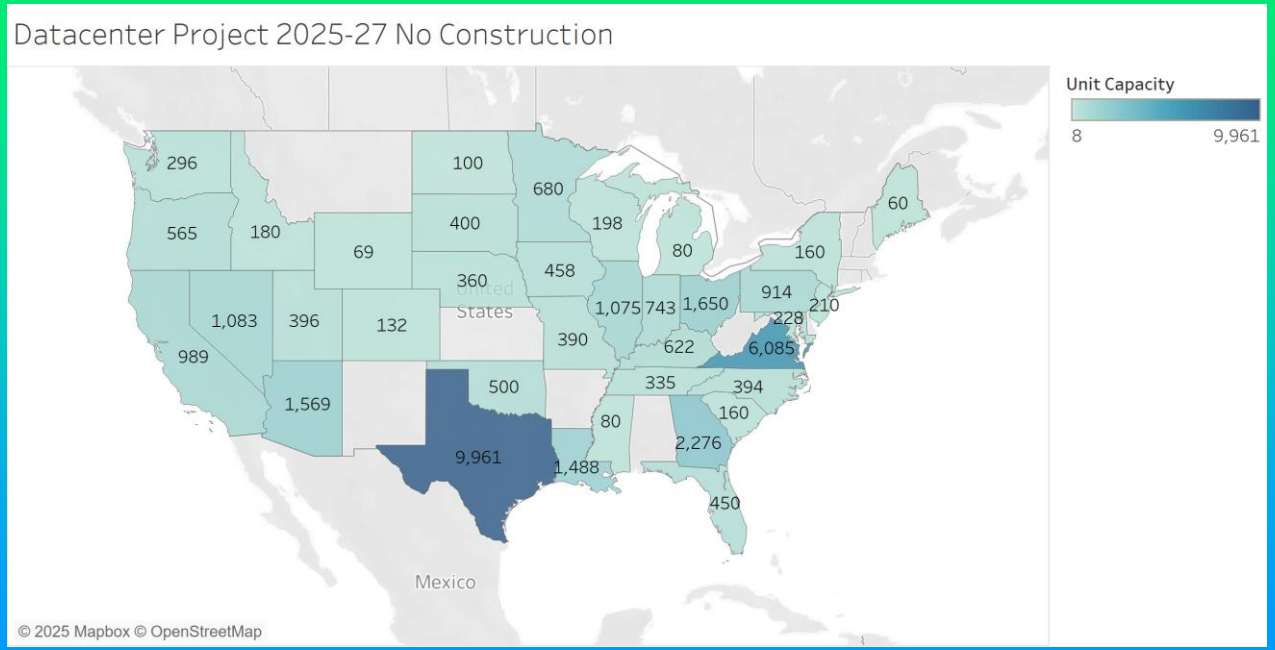
Resource planners need to go back to the dispatch models and refine the loss of load cases.



Datacenters without signs of Construction

With datacenter constructions averaging around 2 years, we have over 36 GW not in construction yet but with an online date sooner than 2027.

VA projects likely at risk given timing and limited expansion.



Enough supply with the amount of load?

Gas supply chain is tight.

McKinsey notes 150 GW additional data center demand coming by 2030.

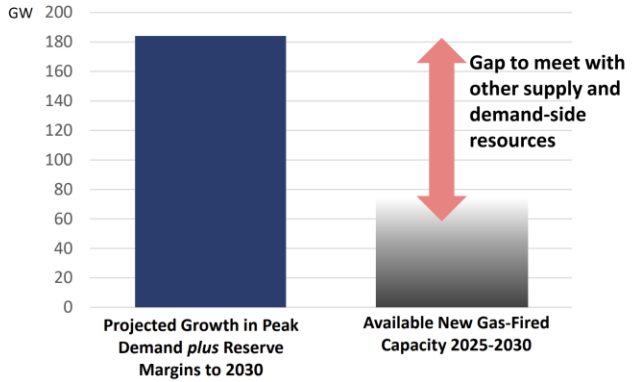
Solutions still coming from policy side - In Texas Senate Bill 6 allows utilities to curtail loads greater than 75 MW during firm load sheds.

Resource Adequacy Challenge: Gas-Fired Alone Will Not Meet the Need

Next 5 years will need new capacity for 160 GW peak growth *plus* reserve margin and replacing retirements

- Retention is important where needed and cost effective
- All new supply resources have lead times for development, equipment, construction, and interconnection
- New gas-fired generation will be limited by supply chains:
  - <80 GW in interconnection queues[1] and not all will be built[2]
  - Supply chains may limit development to closer to 50 GW by 2030
  - Lead times for turbines mean 50 months to build a CC, 44 for CT[3]
- Many more resources will be needed to meet the gap:
  - BESS, wind and solar
    - >2 TW ICAP in queues is vast, even if resource adequacy value is derated
    - 2025 has 18 GW BESS, 33 GW utility-scale PV, 8 GW wind planned[4]
    - Loss of tax credits will reduce builds dramatically
  - Demand side: DR/VPPs, energy efficiency… more cost effective now
  - Uprates and restarts (though these are limited)
- Tx interconnection must be further expedited, and behind-the meter resource additions

New Gas-Fired Plants Insufficient to Meet Projected Demand



Notes: Available new gas-fired capacity does not include uprates to existing plants; projected peak demand growth calculated from compilation of RTO and utility load forecasts; does not account for the need to replace planned retirements.

Sources: 1. LBNL, "Queued Up: 2024 Edition," April 2024
2. Rough estimate based on statements from turbine manufacturers
3. Brattle 2025 CONE Study for PJM Quadrennial Review
4. EIA: Solar, battery storage to lead new U.S. generating capacity additions in 2025

Combined Cycle Economics not Aligned with Natural Gas & Power Futures

As of 6/26/25

Cal 2027:

Henry: **$4/mmbtu**

PJM W On-Peak:

$62.95/MWh

ERCOT-N On-Peak:
$60.72/MWh

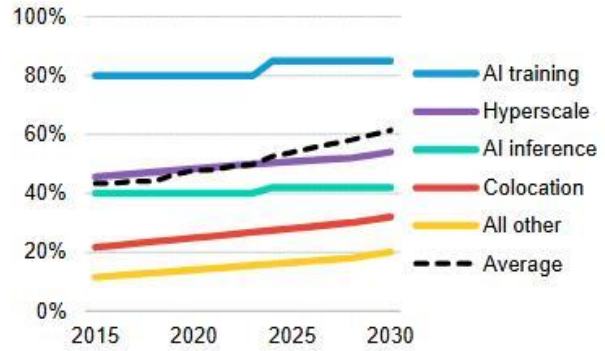
CC LCOE Analysis					
Capital Cost $/kW	1000	**2000**	2000	2000	2000
Discount Rate	8	8	8	8	**12**
Period Year	20	20	20	20	20
Capacity Factor	65	65	**50**	50	50
FOM $/kW-yr	25	25	25	25	25
VOM $/MWh	3	3	3	3	3
Heat Rate mmbtu/MW	7	7	7	7	7
Fuel Cost $/mmbtu	4	4	4	**5**	5
LCOE $/MWh	53	71	83	90	105

Variable Impact on LCOE	$/MWh
2X Capital Cost	18
Reduce Capacity Factor by 15%	12
Gas Price Up by $1/mmbtu	7
Discount Rate Increase 50%	15

Data center demand vary by type

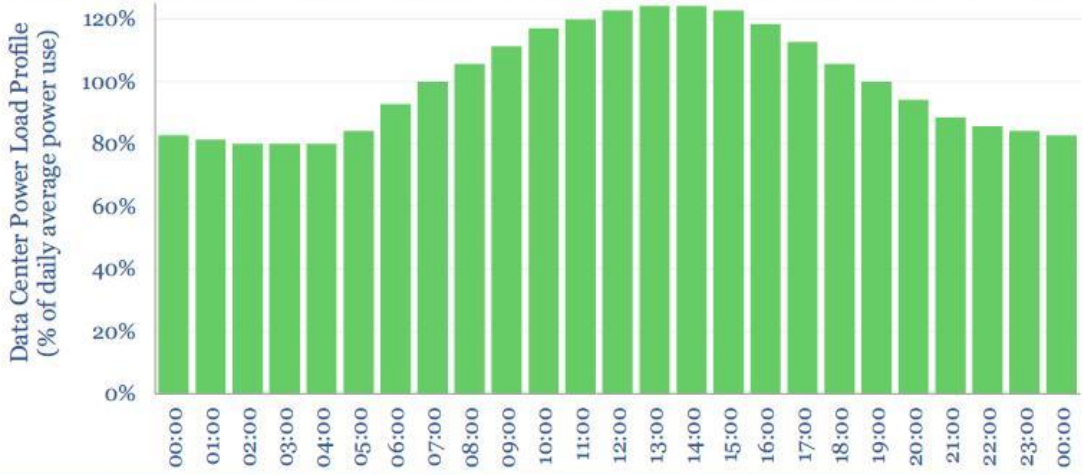
AI Training highest utilization rates but still vary usage during the day

Figure 9: Server utilization rate by date center type



Source: BloombergNEF, Lawrence Berkeley National Lab. Note: Average utilization rate is capacity weighted.

***Fig 2.** Data-center energy use typically ranges from 80-125% of its daily average?*



Source: Technical Papers, Company Reports, TSE

Download the data?

Volatility Solutions Needed

AI workloads are different
Even off-grid solutions still must deal with the intra-day/intra-hour volatility.

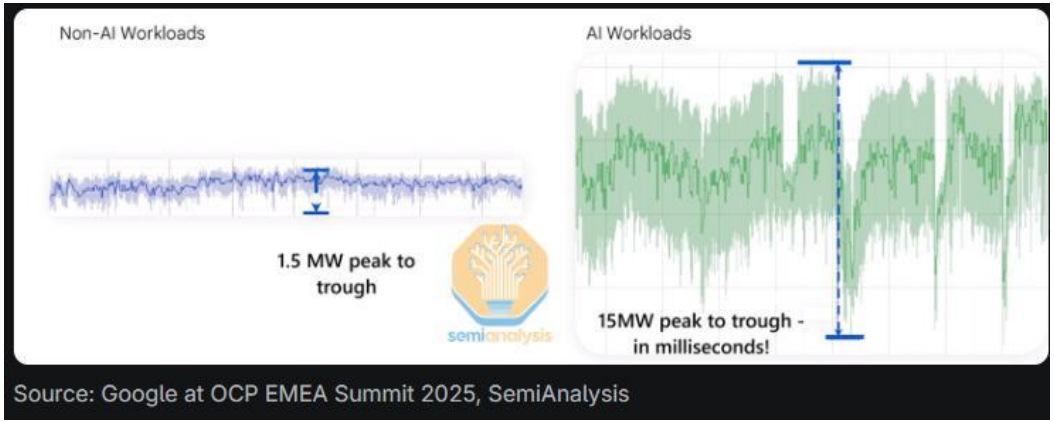


Figure 3: Real-time power consumption from two US hyperscale data centres (MW)

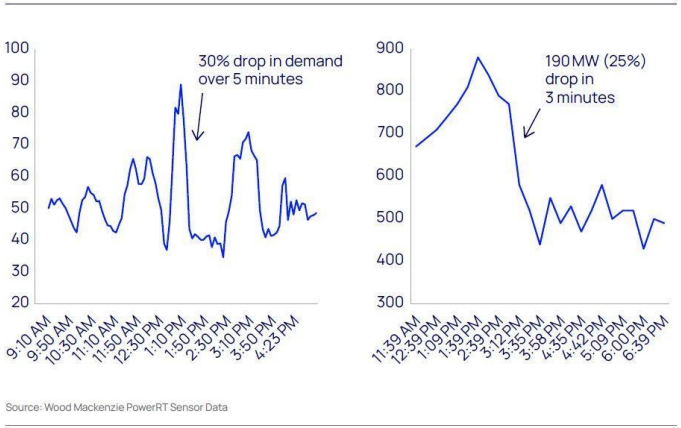
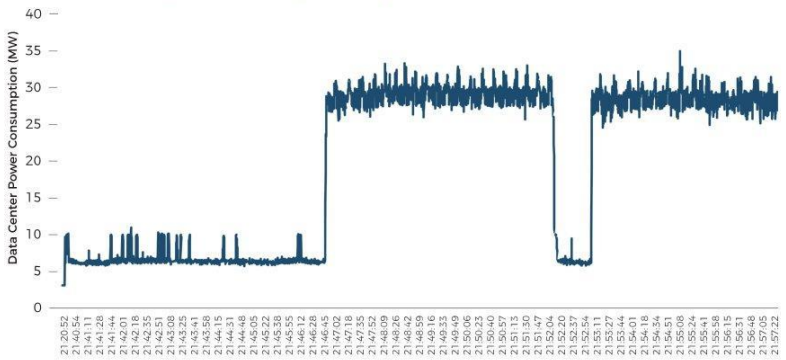


FIGURE 2.3. **AI Training Power Consumption Example**



New and challenging load consumption patterns have been observed particularly for AI data centers, which can pose potential grid stability and reliability risks and thus must be effectively modeled, studied, and mitigated.. SOURCE: EDGETUNEPOWER, INC.

Data center energy needs

1. Time to market – its an arms race they need it now!
    - Good news: Policies are pushing for Data Center coming online fast – e.g. SPP “flexibility rule”- 90-day interconnection along as data center agrees to cut demand or transfer to back up generation when the grid is strained. ERCOT is also on track to offer something similar.
2. Energy must be there all the time when they need it! LOTS of redundancy! Outages beyond 4 hr exist!
3. Their load can go up and down intra-hour so they need power sources that can handle that!
4. If the above can be done they would *like* it to be green….

Can your LDES technology fill this need?