Existing Power Plants Sharing Grid Access with New Resources Can Double Virginia's Generation Capacity Faster and at Lower Cost

Umed Paliwal, Amol Phadke

umed@berkeley.edu repowervirginia.com

Working Paper 2025

Suggested citation: Paliwal, Umed and Phadke, Amol (2025). "Existing power plants sharing grid access with new resources can double Virginia's generation capacity faster and at lower cost", Center for Environmental Public Policy, Goldman School of Public Policy, University of California, Berkeley.

This working paper is circulated for discussion and comments. The paper has not been peer-reviewed or been subject to review by any editorial board.

Data Center Drive massive load growth in Virginia

The Challenge

- Data centers drive 87% of Dominion's projected load growth, with demand expected to double by 2039. Northern Virginia is the world's largest data center market, but extended interconnection timelines (6+ years average) limit competitiveness for these high-value investments seeking speed-to-power.
- Virginia has ~8 GW of projects in PJM interconnection queue (Dominion zone), with average wait times exceeding 6 years—Active projects average 6.2 years in queue, while projects Under Construction have waited 7.4 years on average.
- Capacity market prices have surged dramatically: PJM Dominion Zone hit $444.26/MW-day for 2025/26 (65% above RTO average), and 2026/27 reached the price cap at $329.17/MW-day (11.4× increase from 2024/25 baseline of $28.92/MW-day).
- New gas plants ordered today won't come online until 2030-2031 at earliest, with capital costs surging from $1,116-1,427/kW to over $2,000/kW for recent combined-cycle projects (GridLab, 2025).

The Solution

- 10.7 GW of Virginia's thermal capacity (61%) operates at less than 15% capacity factor, with 68% operating below 30% CF. Similarly, solar plants (16.6% CF) severely underutilize their interconnections, leaving expensive grid infrastructure idle most of the time.
- Deployment of new generation at these existing underutilized plants can provide cost-effective energy and capacity without building new transmission infrastructure, bypassing lengthy interconnection queues.
- Virginia can add 21 GW of clean energy capacity through surplus interconnection: 12.4 GW solar + 4.1 GW wind + 4.5 GW storage. This includes 8 GW at thermal plants and 13 GW at existing renewable plants through co-location of complementary resources.
- Surplus interconnection can save $1.8 billion in interconnection costs, equivalent to ~$529 per Virginia household. Projects can be completed in 12-18 months compared to 6+ years for standard queue projects.

Policy Recommendations

- Require the Virginia SCC and utilities to evaluate surplus interconnection potential in Integrated Resource Plans—identifying which existing plants offer the best opportunities for co-location of solar, wind, and storage resources.
- Develop procurement mechanisms for surplus interconnection projects, including RFPs for specific plant sites and Purchase and Sale Agreement structures to enable third-party development at utility-owned facilities.
- Streamline land permitting near existing thermal sites. Projects co-located at existing generation facilities have inherently lower land-use and environmental impacts and should qualify for expedited approval pathways.
- Require evaluation of surplus interconnection opportunities before approving new greenfield generation capacity. Co-location at existing sites saves transmission costs and accelerates deployment compared to building new infrastructure.

Data Center Drive massive load growth in Virginia

Virginia: The Data Center Capital of the World

87% of Projected Load Growth
Data centers are the **dominant driver** of Dominion's electricity demand growth, responsible for 87% of all projected load increases.

Data Center Alley
Northern Virginia (Loudoun, Fairfax, Prince William counties) is the **world's largest data center market** — larger than the next 5 US markets combined. Growth is expanding to surrounding counties.

~5% Annual Load Growth
Dominion's 2025 IRP forecasts **~5% annual demand growth** over the next 20 years, with total demand expected to **double by 2039**.

Tax Incentives
Virginia was among the **first states to offer data center tax incentives**, including sales tax exemptions on equipment, which spurred early growth and established market dominance.

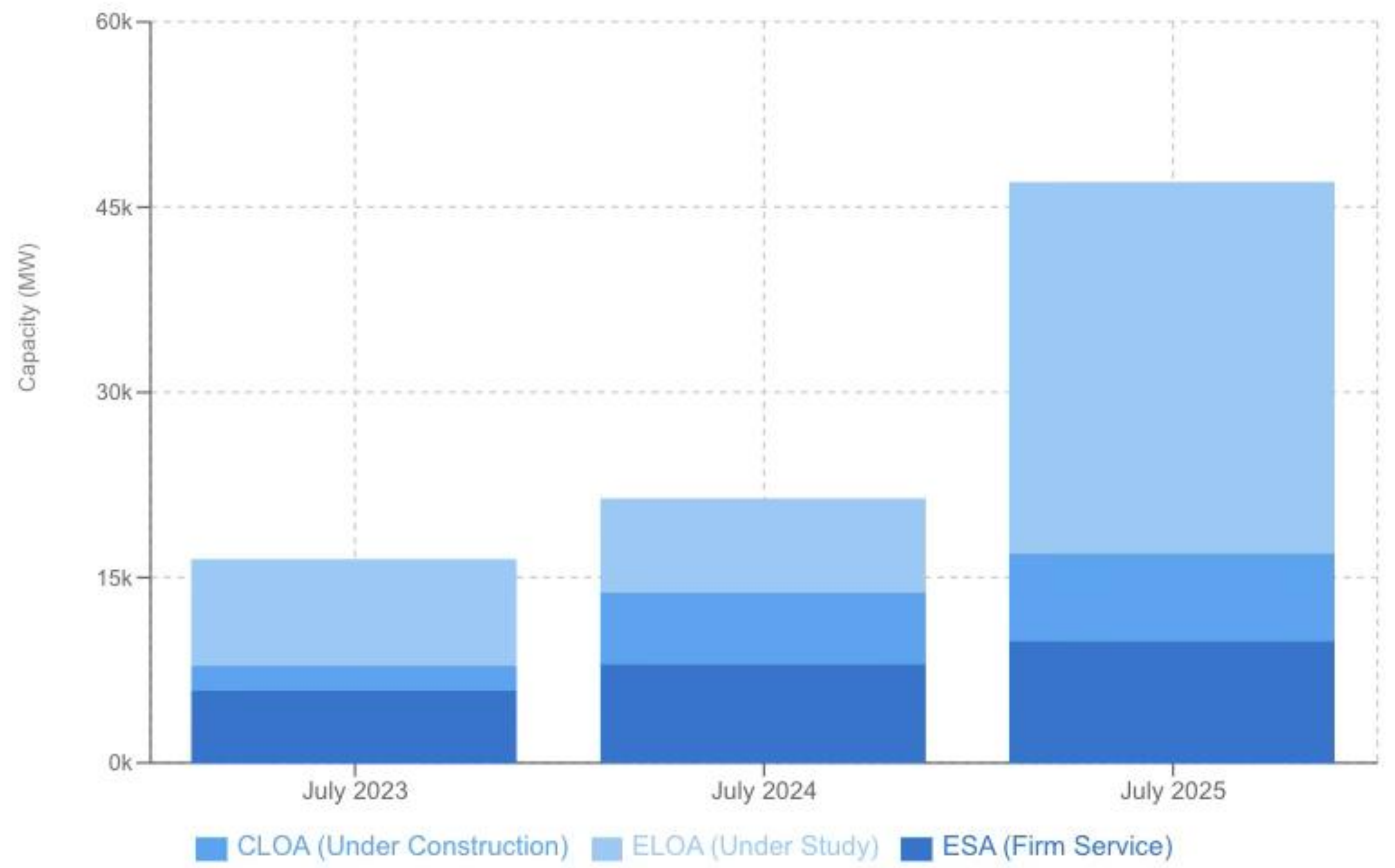
Share of Dominion's Electricity Demand

24%	26%	27%	40%
2023	2024	2025	2035 (proj.)

Sources: Dominion Energy 2025 IRP, JLL North America Data Center Report 2024

Data Center Contract Growth (2023-2025)

Capacity in MW by contract type — Total contracts grew 185% in 2 years



ESA
Electric Service Agreement — Firm contracts

CLOA
Construction Letter — Under construction

ELOA
Engineering Letter — Being studied

Source: Dominion Energy 2025 IRP Update (October 2025), Figure 2.1.15

Solar dominates the 8 GW of capacity in pipeline in Virginia

Project Pipeline

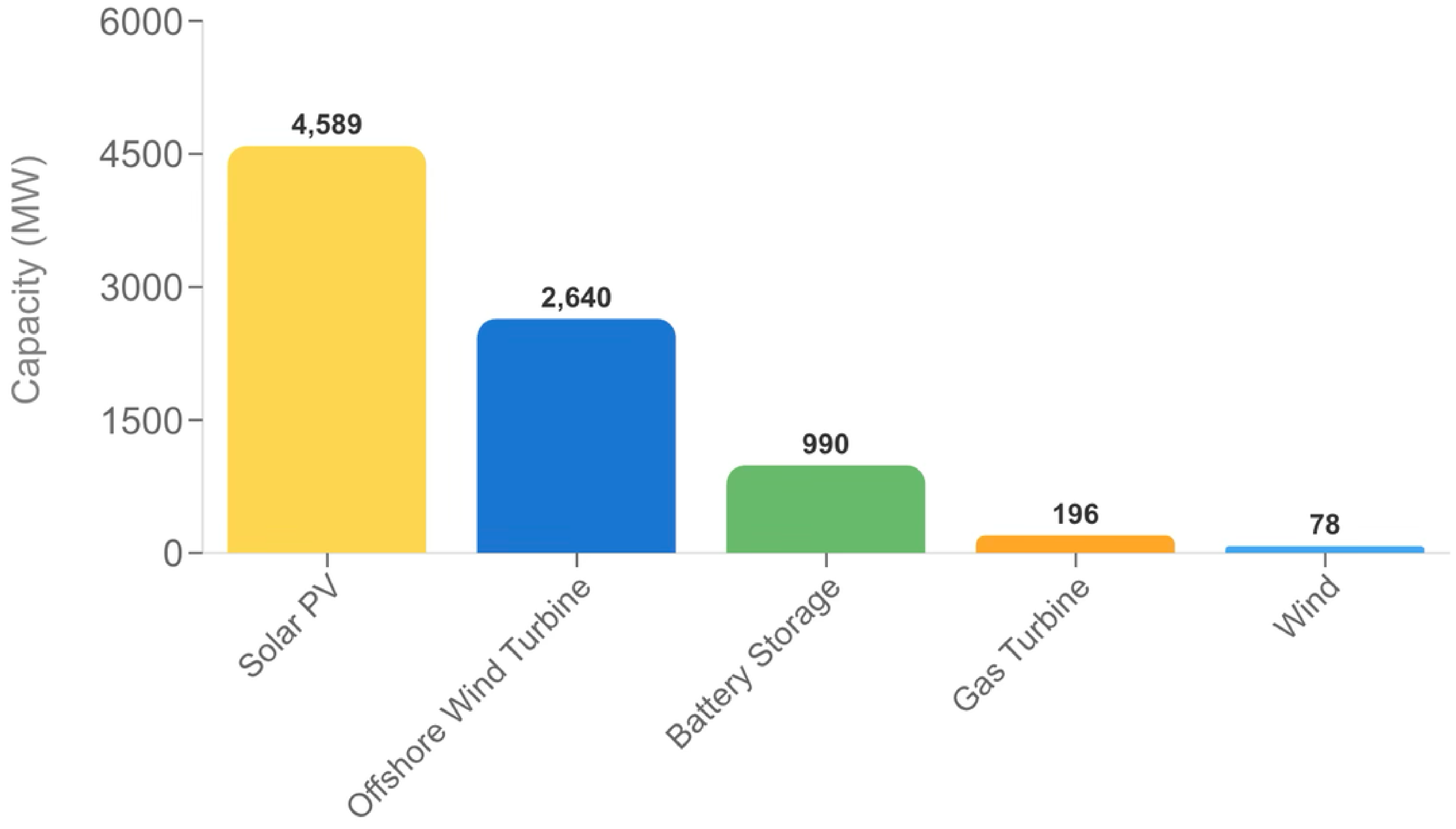
Pipeline Summary:

- Total Projects: 77
- Total Capacity: 8,502 MW
- 31% increase from current capacity

Key Highlights:

- **Coastal Virginia Offshore Wind (CVOW)**: 2,640 MW single project — 176 turbines, under construction, expected completion late 2026
- **Solar**: 4,589 MW across 55 projects — dominates the pipeline at 54%
- **Battery Storage**: 990 MW across 11 projects (avg 90 MW) — 7 of 11 are co-located with solar
- **Natural Gas**: 196 MW — Marsh Run Generating (ODEC peaker expansion in Fauquier County)

Upcoming Capacity by Technology Type (MW)

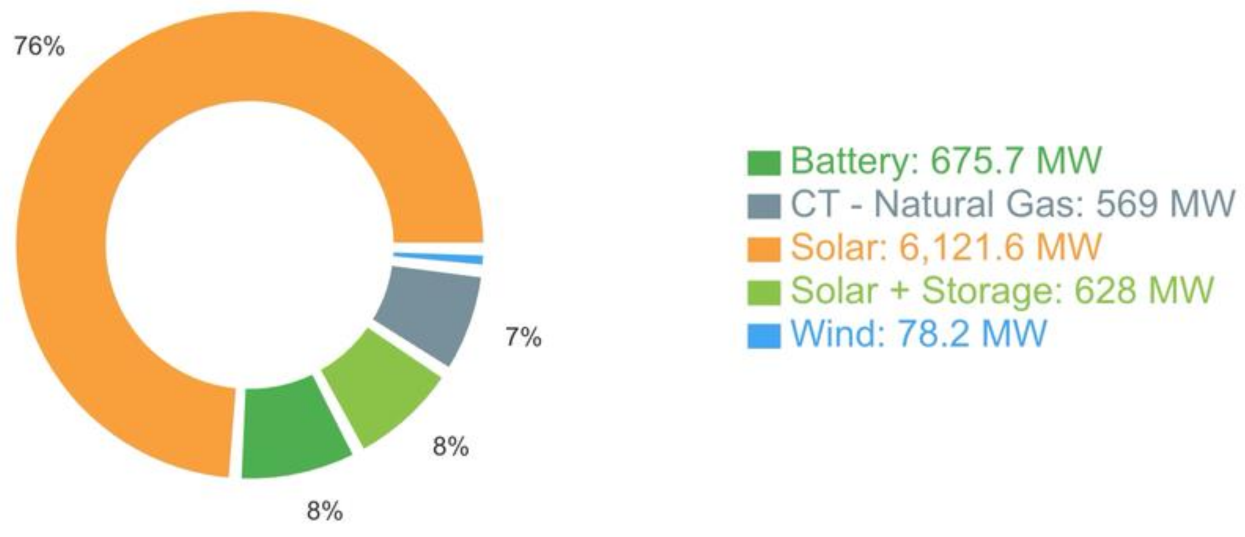


Total pipeline represents 31% of Virginia's existing capacity

Projects in interconnection queue takes 5+ years

Domination Queue by Technology

Total: **8,072.5 MW** in queue (Active, Suspended, Under Construction)



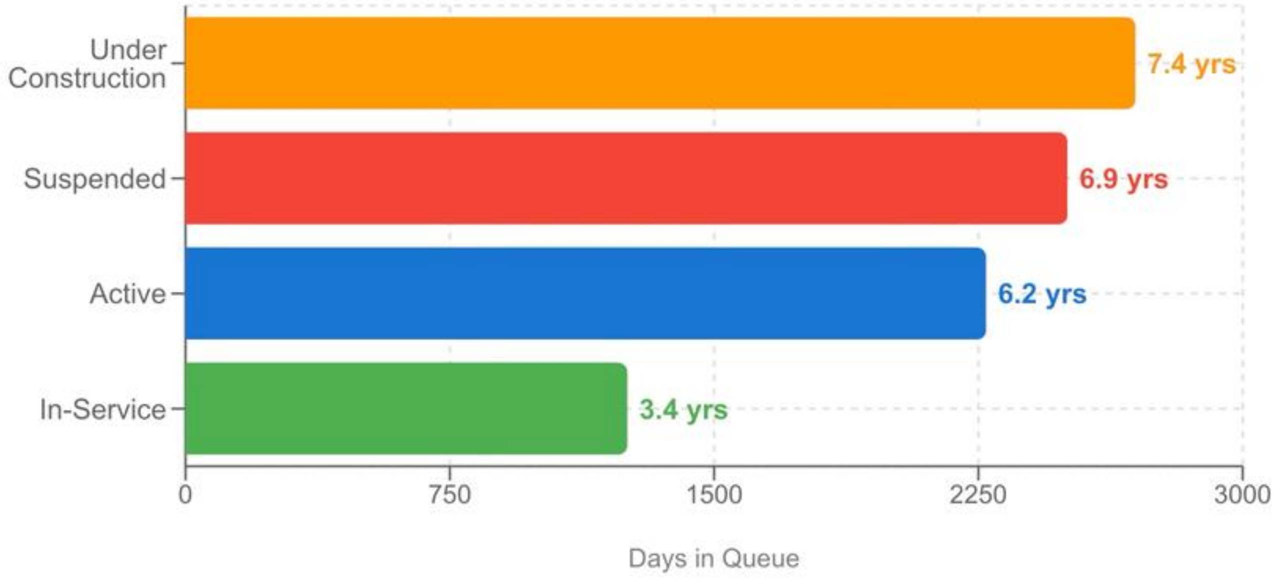
Solar Dominates the Queue

76% of Dominion's queue capacity (6,121.6 MW) is solar projects, reflecting strong developer interest but facing years of delays

Source: PJM 2025 Q3 State of the Market Report — Data as of September 30, 2025

Time Spent in PJM Queue by Project Status

This chart shows the **average time projects have already spent** in the queue based on their current status. For projects still in progress (Active, Under Construction, Suspended), this represents waiting time so far — they are still not complete.



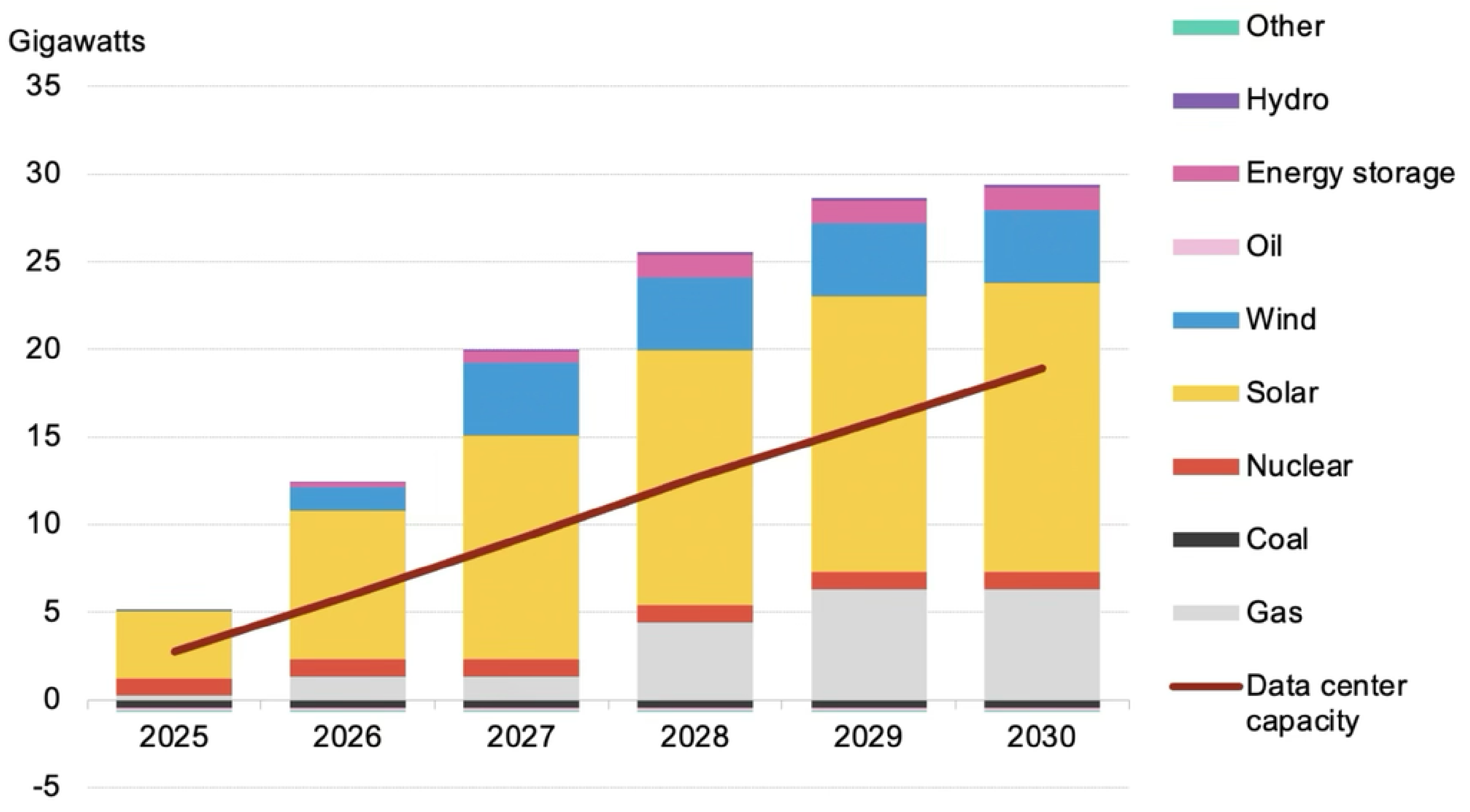
What Each Status Means:

- **Active:** Projects currently undergoing PJM studies (Feasibility, System Impact, or Facilities Study) — still waiting for approvals
- **Under Construction:** Projects that completed studies and signed agreements — now being physically built
- **Suspended:** Projects paused by developers (financing, permitting issues) — holding queue position but not progressing
- **In-Service:** Completed projects now operational — this shows *total time* from queue entry to generating power

PJM Faces a 9.5 GW Effective Capacity Shortfall by 2030 - BNEF

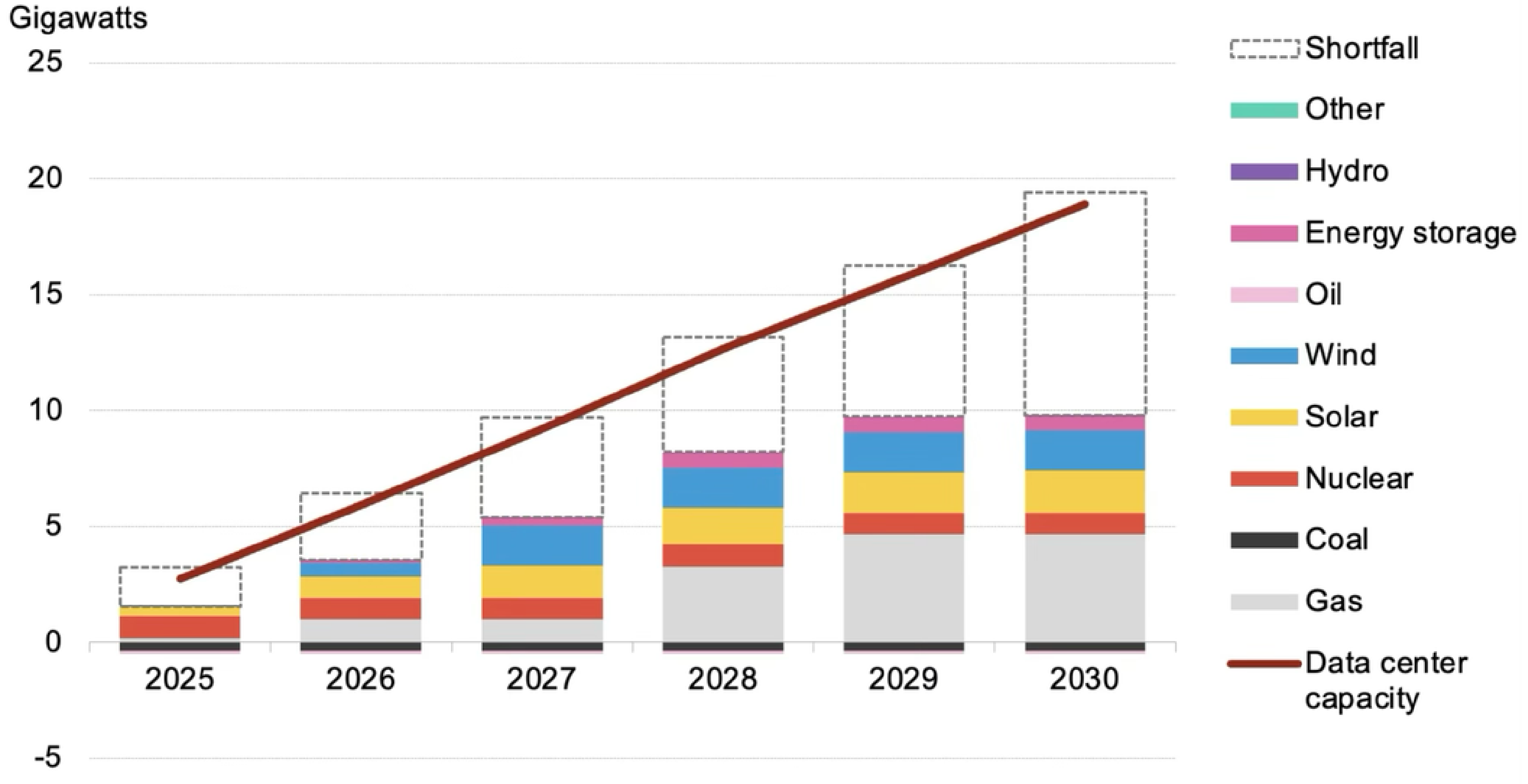
⚠ **Supply vs. Demand Mismatch:** BNEF forecasts PJM data center load reaching **31 GW by 2030**. EIA projects **28.7 GW** of new supply additions — barely keeping pace with data center growth alone. When adjusted for effective load carrying capacity (ELCC), PJM faces a **9.5 GW shortfall** by 2030. [BNEF]

Supply by Nameplate Capacity



New supply additions (57% solar, 22% gas, 14% wind) appear sufficient on nameplate basis

Supply by Effective Load Carrying Capacity (ELCC)



When adjusted for reliability contribution, a **9.5 GW shortfall** emerges by 2030

Capacity Market Prices Increasing Signaling Capacity Crunch

$ Capacity Market Dynamics

PJM divides its footprint into ~27 **Locational Deliverability Areas (LDAs)** based on utility territories to account for transmission constraints. While a base RTO-wide price exists, zones with local capacity shortfalls clear at higher prices to incentivize local generation.

The **Dominion Zone** covers Virginia's Dominion Energy territory. Massive data center demand growth in Northern Virginia is outpacing local transmission and generation, causing severe locational scarcity and significantly higher capacity prices.

PJM Dominion Zone (Virginia)

- 2023/24: $9.25/MW-day (baseline)
- 2024/25: $28.92/MW-day (aligned with RTO)
- 2025/26: $444.26/MW-day (65% above RTO!)
- 2026/27: $329.17/MW-day (hit price cap)

48× increase from baseline - Virginia locational scarcity

PJM RTO-Wide Average

- 2024/25: $28.92/MW-day
- 2025/26: $269.92/MW-day (+833%)
- 2026/27: $329.17/MW-day (at cap)

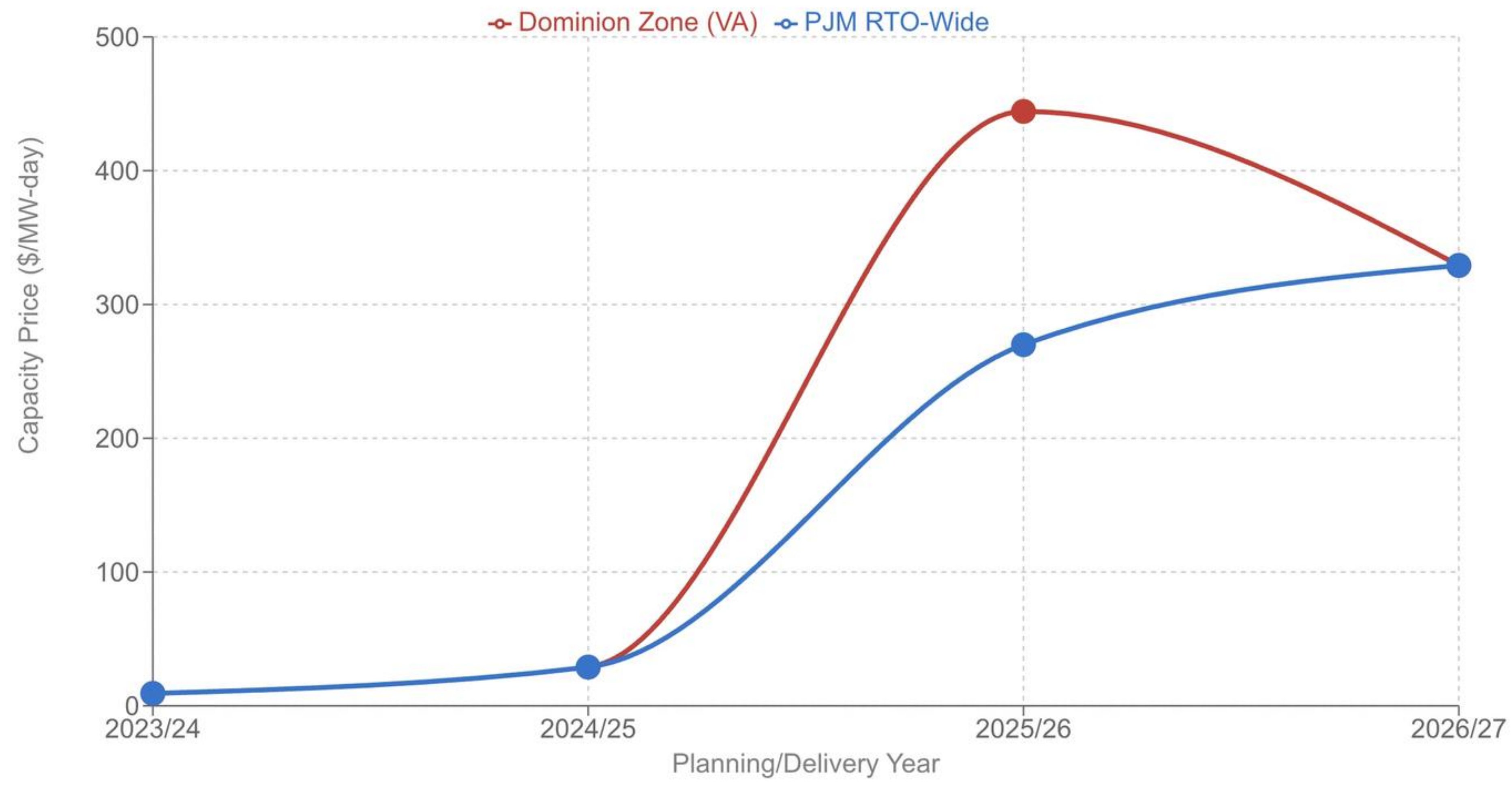
11.4× increase, hitting price cap

Virginia Locational Scarcity Premium

- 2025/26: Dominion $444 vs RTO $270 = $174/MW-day gap
- 65% premium shows severe local capacity constraints

Projects IN Virginia worth significantly more to grid

Annualized Capacity Market Prices ($/MW-day)



Virginia retail electricity prices are rising

The Cost Shift Problem

Data Center Dominance

- **24%** of Dominion's electricity sales (2023) [JLARC]
- **87%** of projected load growth [E3]
- **11 GW** new data center load by 2030 [E3]

Residential Bill Impact

- 2021: ~**$122**/month [SCC RD384]
- 2026: ~**$165**/month (+35%) [SCC RD716]
- **JLARC warns: +$23-37/month by 2040 [E3]**

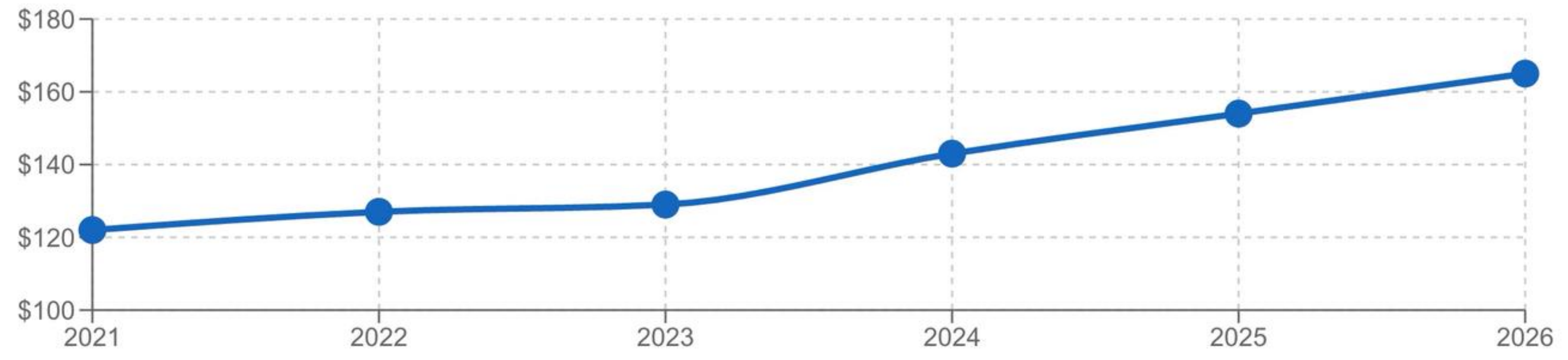
Capacity Market Shock

- Dominion Zone 2025/26: **$444**/MW-day [PJM]
- vs 2024/25: $29/MW-day (**15× increase!**) [PJM]
- 65% premium over RTO average [PJM]

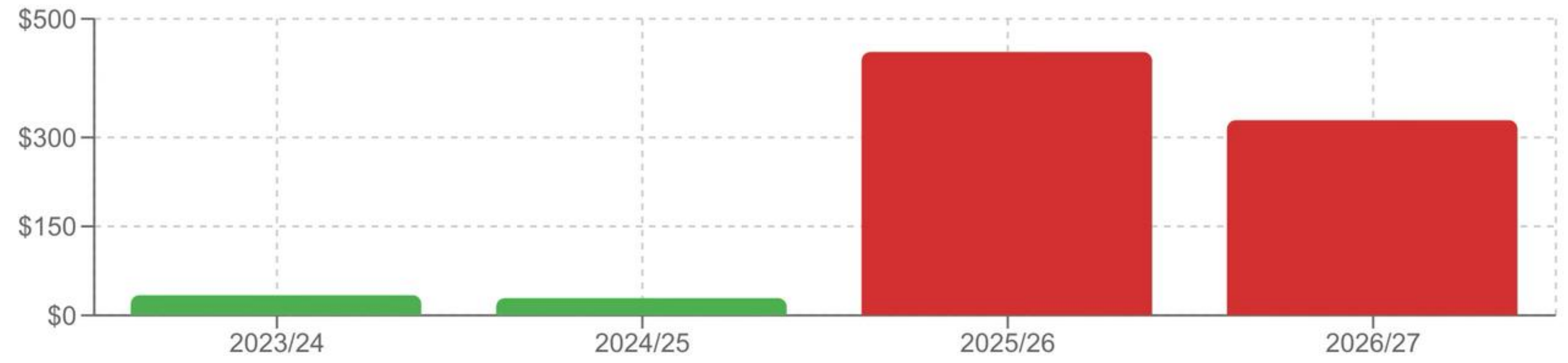
New Protections (2027)

- **GS-5 Rate Class** for >25 MW customers [SCC]
- 14-year contracts with minimum demand charges [SCC]
- Data centers pay 85% of T&D costs [SCC]

Average Residential Monthly Bill [SCC Status Reports]



Dominion Zone Capacity Price ($/MW-day) [PJM BRA]

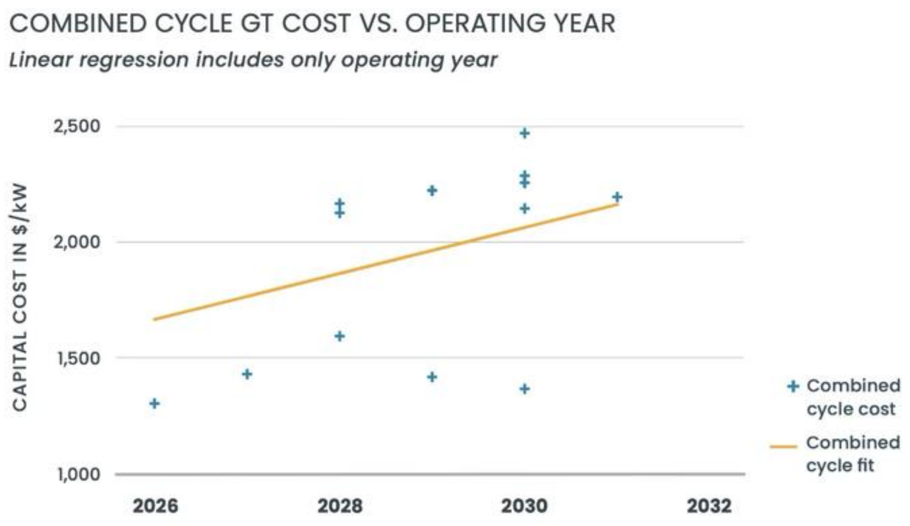


$50-100 billion infrastructure investment needed by 2039 to serve data center growth. [E3] Without surplus interconnection, residential ratepayers bear disproportionate costs.

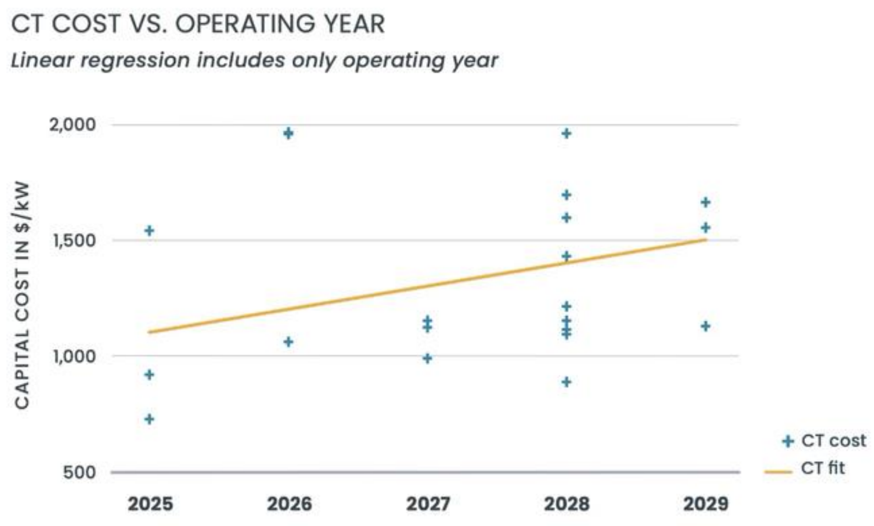
New Gas Would Not Come Online Before 2030 — At Double the Cost

Gas Turbine Capital Costs Have Doubled

Combined Cycle (CCGT)



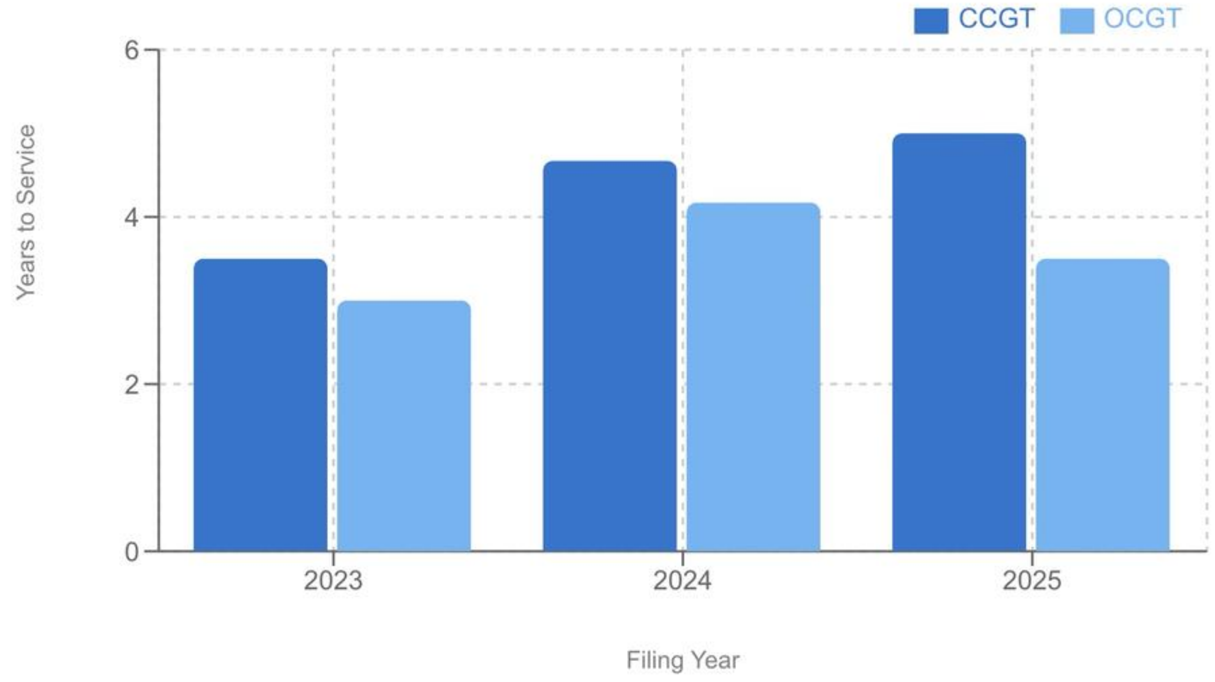
Simple Cycle (CT)



Source: GridLab "The New Reality of Power Generation" Report, September 2025

Gas Lead Times Are Growing

Gas Project Lead Times by Filing Year



A gas project filed today would not be operational until 2030-2032

CCGT Lead Times:

- 2023: **3.5 yrs**
- 2024: **4.7 yrs**
- **2025: 5.0 yrs**

Why Increasing:

- Supply chain constraints
- Queue backlogs (6+ yrs)
- Permitting delays
- Labor shortages

Source: BloombergNEF Gas Plant Tracker

Thermal plants are underutilizing their interconnection capacity

Interconnection Underutilization

Thermal plants like peaker gas plants and oil/gas steamers operate at extremely low capacity factors. In Virginia, peaker gas plants operate at 9% capacity factor and oil/gas steamers operate at 1% capacity factor, meaning for 91% of the time and 99% of the time, respectively, the interconnection capacity sits idle.

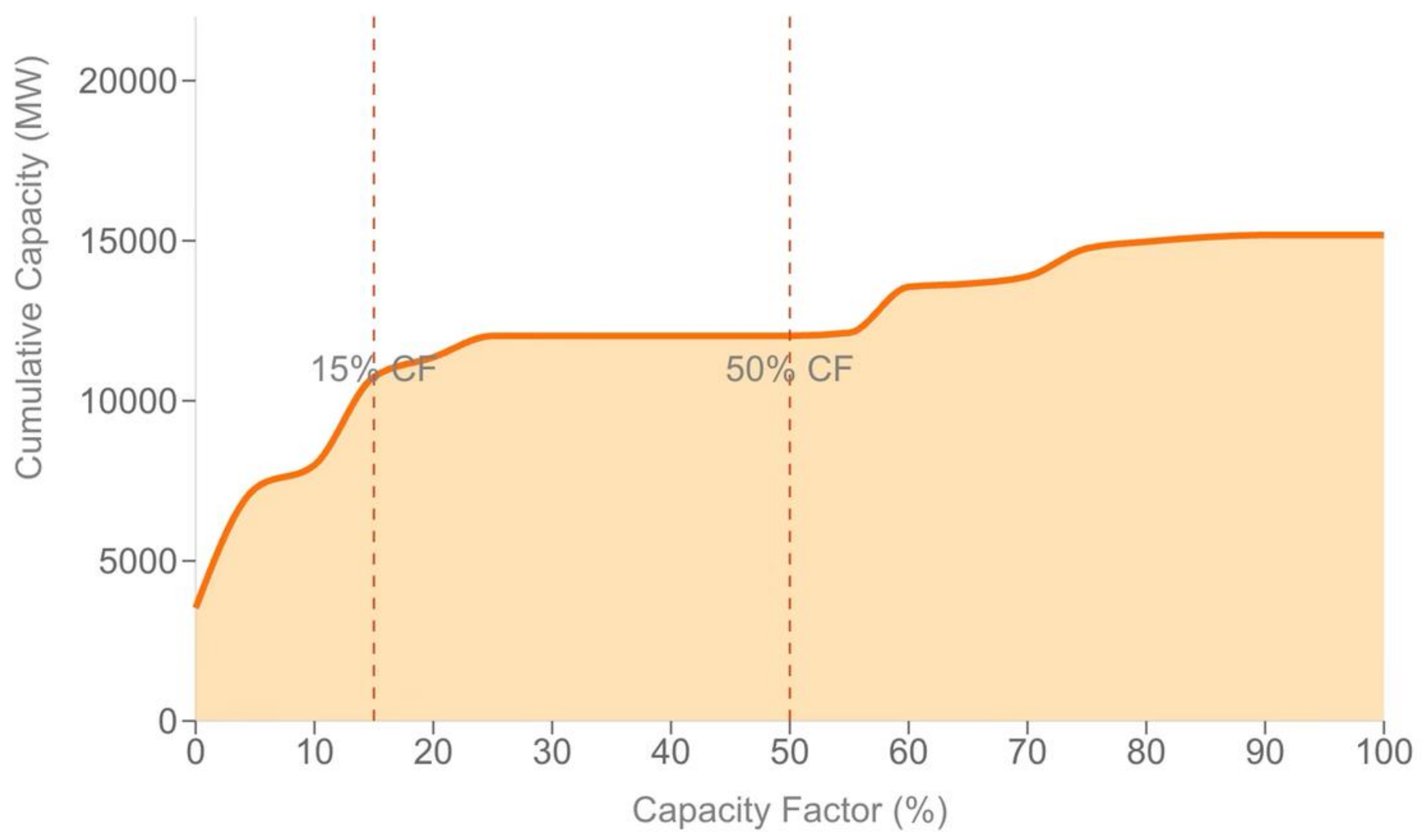
2024 Thermal Capacity Factors

- Gas CCGT: 67%
- Oil/Gas Steam: 1%
- Coal: 9%
- Gas CT: 9%

Underutilized Interconnection Capacity

- **10.7 GW (61.2%)** operates at <15% capacity factor
- **12.0 GW (68.5%)** operates below 30% CF

Cumulative Thermal Capacity by Capacity Factor



Steep rise shows majority of capacity concentrated in low-utilization plants

Renewables are underutilizing their interconnection capacity

Two Dimensions of Underutilization

Virginia renewables underutilizing interconnection capacity from both firm capacity and energy perspectives

RE Energy Production Gap

Solar operates at just 16.6% capacity factor, leaving 83.4% of interconnection capacity idle

Solar Intermittency Limits Firm Capacity

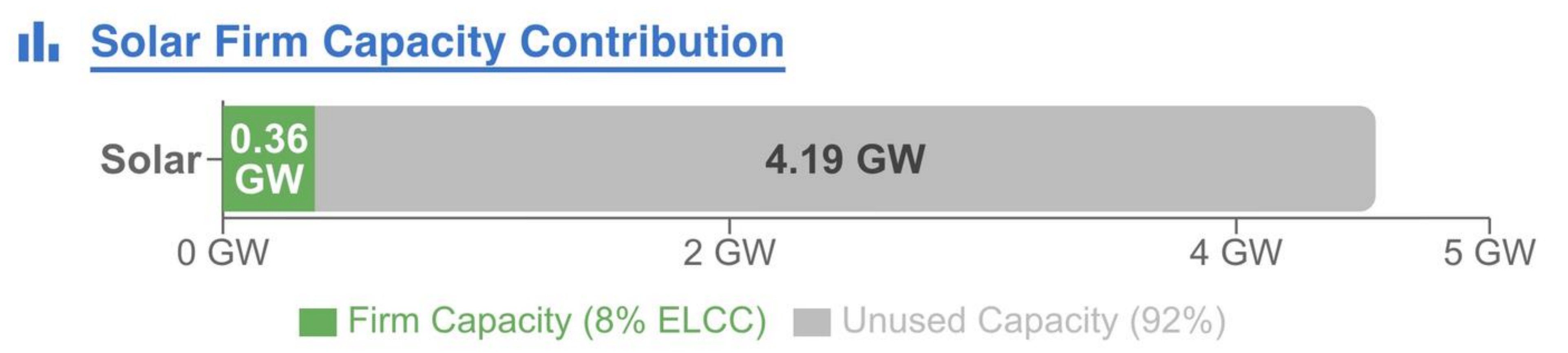
PJM assigns only 8% ELCC for solar, meaning only 8% of installed capacity counts toward peak reliability

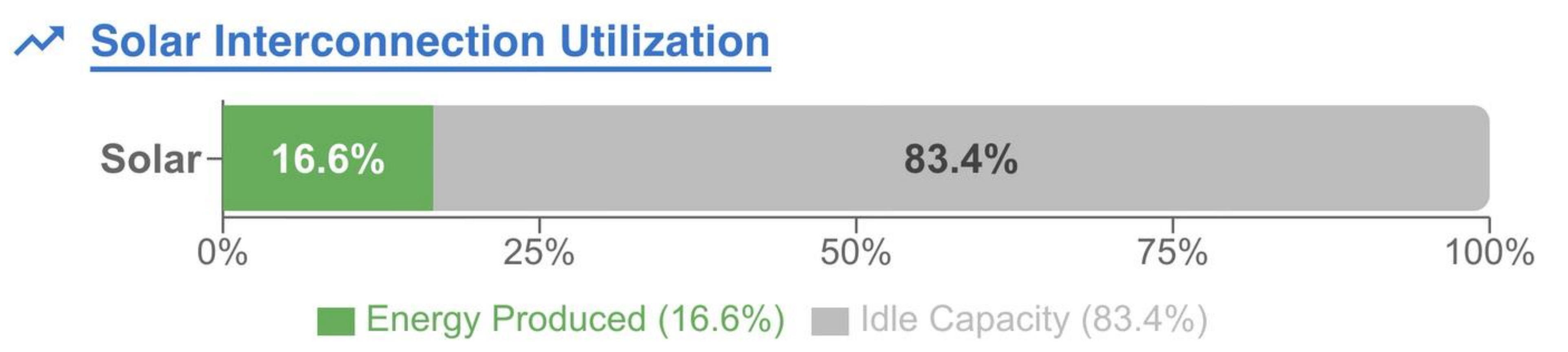
Firm Capacity Shortfall

4.5 GW of installed renewable capacity provides only 0.4 GW of firm capacity — just 8% of nameplate capacity

Storage as the Solution

4-hour storage receives 58% ELCC (PJM 2027/2028 BRA) — significantly higher than standalone solar

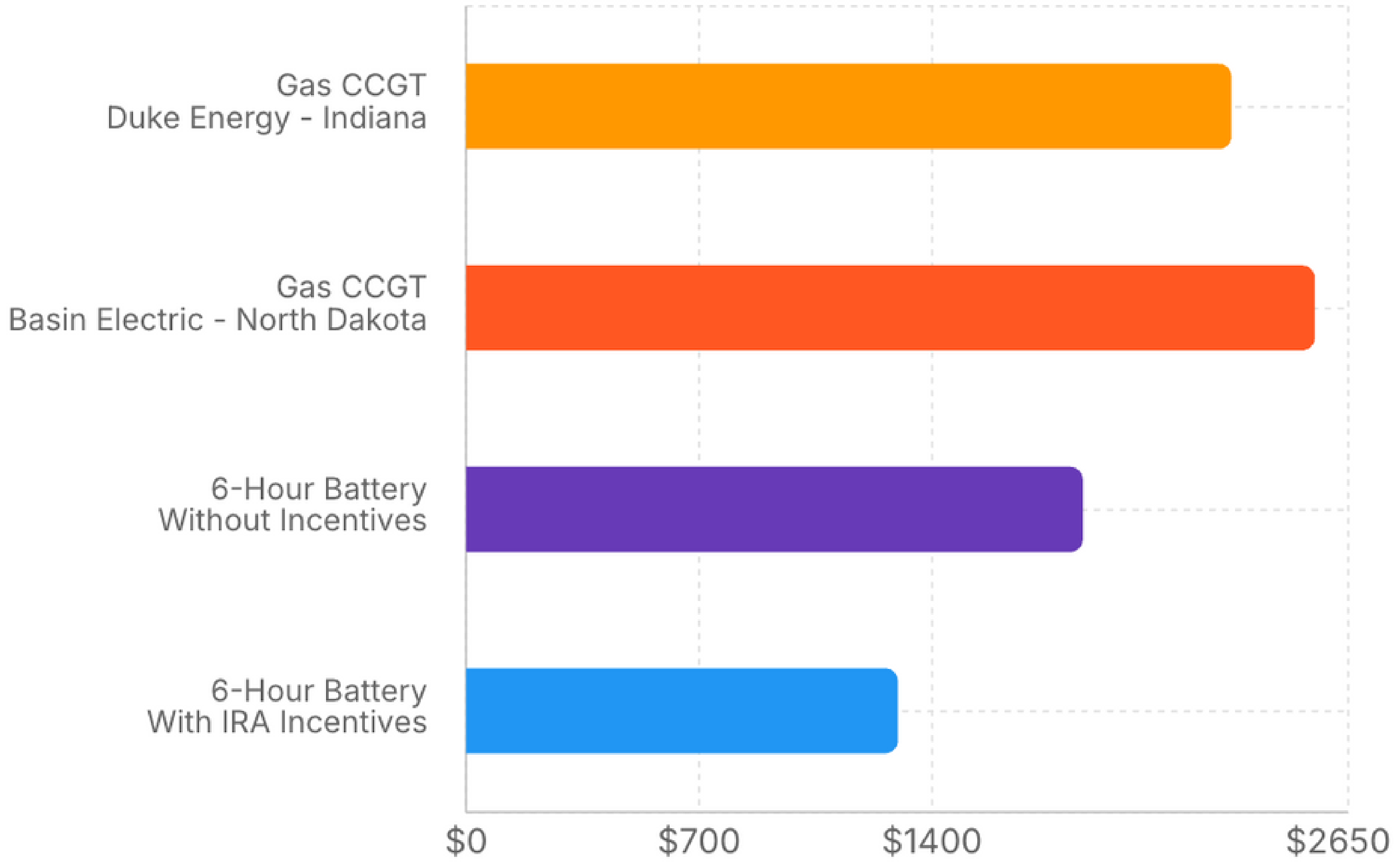




Storage capital costs are cheaper than gas

Capital Cost Comparison ($/kW)

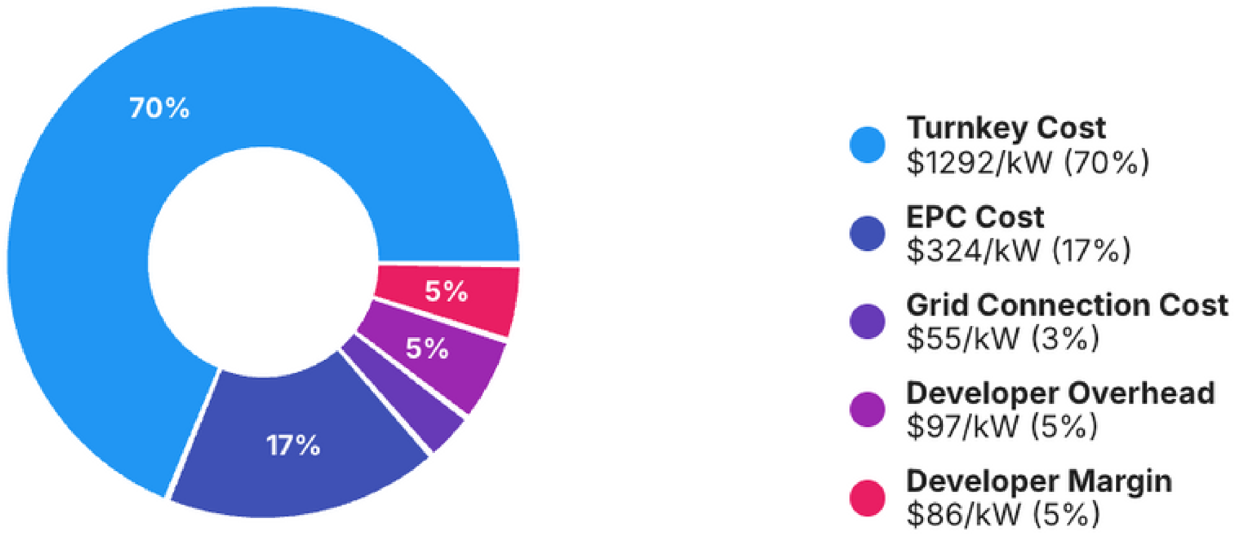
6H Battery with IRA: $1297/kW



Source: BNEF 2025 and PUC Filings

6H Battery Cost Components (wo Incentives)

Total: $1853/kW



Source: BNEF 2025

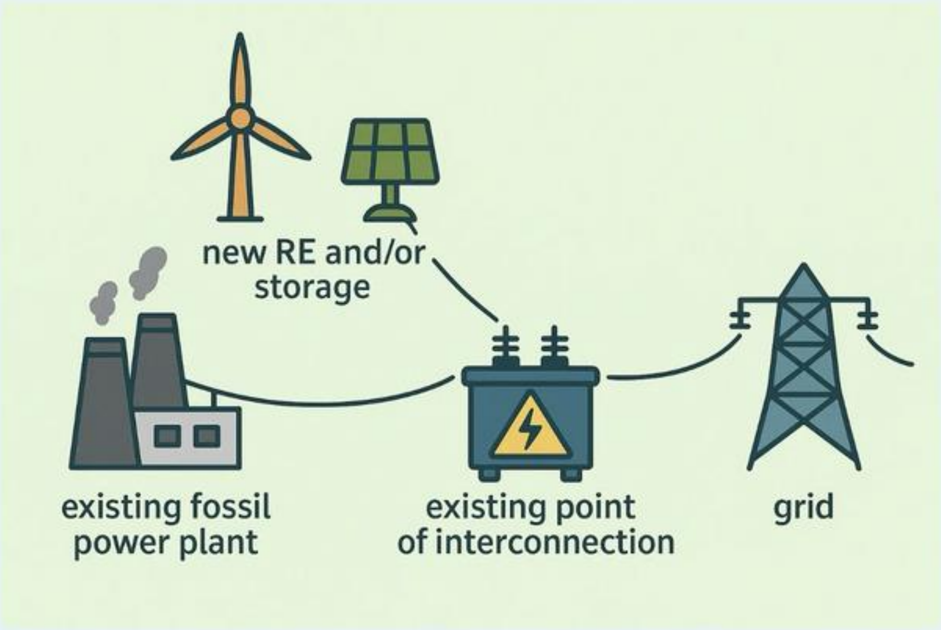
Battery Storage Outperforms Gas Plants

- Gas costs rising ($2,300-2,550/kW)
- Battery costs dropping every year
- Battery supply chain advantages over gas

- 2018: 2,000 cycles (6-year life)
- 2024: 10,000-15,000 cycles (20+ years)

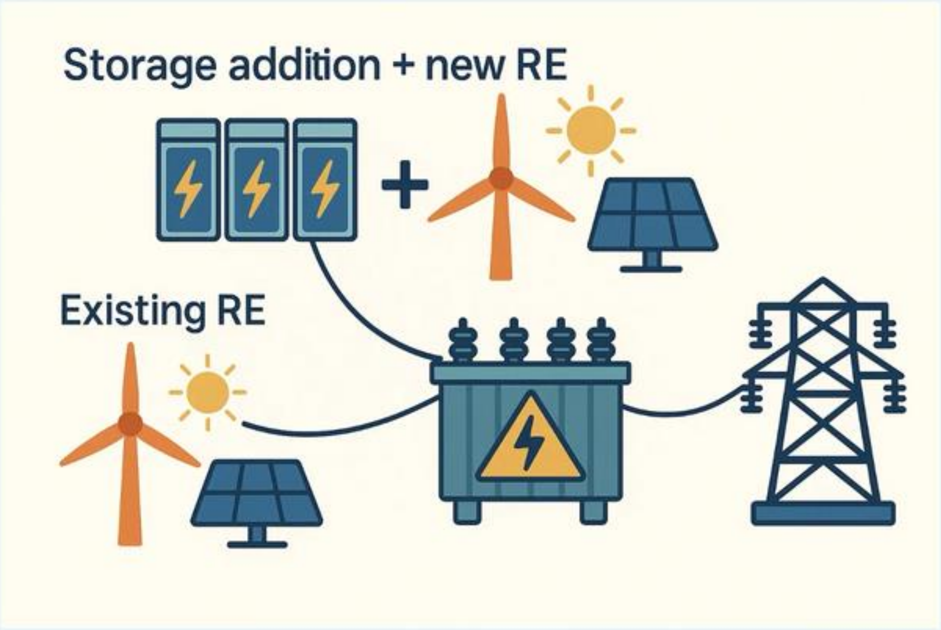
Maximizing efficiency of existing assets: Surplus Interconnection

Renewables at Thermal Plants



- Thermal plants (especially peakers) significantly underutilize their interconnection capacity
- Cheaper solar and wind resources can be added at underutilized thermal plants using surplus interconnection service (SIS)
- FERC Order 845 provides regulatory pathway for surplus interconnection service
- Bypasses lengthy interconnection queues for faster deployment
- Reduced costs through shared infrastructure and site development
- Creates transition pathway beyond fossil generation assets

Storage at Renewable Plants



- Batteries can be added to existing renewable sites using spare grid capacity (SIS)
- They store excess clean energy that would otherwise go to waste
- Energy dispatched even when renewables aren't generating, smoothing output
- Batteries enable adding more renewable capacity at the same location
- This maximizes the value and efficiency of existing grid connections
- FERC Order 845 provides the regulatory pathway for this approach

Surplus Interconnection Projects

🏭 Thermal

Crete Energy Venture

🏢 Earthrise Energy
📍 Will County, IL - PJM

🏭 Original Capacity	➕ Added Capacity
301MW Gas	**250MW Solar (2 projects)**
Online: Operating	Online: In Development

Source: Earthrise Portfolio

Gibson City

🏢 Earthrise Energy
📍 Ford County, IL - MISO

🏭 Original Capacity	➕ Added Capacity
237MW Gas	**270MW Solar (2 projects)**
Online: Operating	Online: In Development

Source: Earthrise Portfolio

Shelby County

🏢 Earthrise Energy
📍 Shelby County, IL - MISO

🏭 Original Capacity	➕ Added Capacity
352MW Gas	**360MW Solar (2 projects)**
Online: Operating	Online: In Development

Source: Earthrise Portfolio

☀️ RE

Polaris Solar

🏢 DTE Energy
📍 Michigan - MISO

Original Capacity	➕ Added Capacity
168MW Wind	**100MW Solar**
Online: Operating	Online: 2025

Source: DTE Solar

Pine River Solar

🏢 DTE Energy
📍 Michigan - MISO

Original Capacity	➕ Added Capacity
161.4MW Wind	**80MW Solar**
Online: Operating	Online: April 2025

Source: DTE Announcement

Scott Solar + Storage

🏢 Dominion Energy + RES
📍 Powhatan County, VA

☀️ Original Capacity	➕ Added Capacity
12MW Solar	**12MW/48MWh Storage**
Online: 2019	Online: May 2022

Source: Scott Solar

Maximizing efficiency of existing assets: Surplus Interconnection

Resource Assessment

- Assessed RE resource availability within a 6 mile buffer zone around each thermal and renewable plant in Virginia
- Applied 50+ exclusion criteria including physical constraints (land cover, slope, etc.), environmental protections (protected areas, national parks, etc.), and local ordinances
- Estimated local solar and wind potential using suitable area and average solar and wind generation density

Economic Analysis

- Estimated local hourly solar and wind generation near each power plant in Virginia using meteorological data from ERA5
- Estimated local solar and wind LCOE using capaital cost data from BNEF and compared with the variable costs of thermal plants to identify economic crossover points
- Applied relevant IRA incentives including energy community bonus tax credits at power plant locations

Portfolio Optimization

- Estimated optimal mix of soalr, wind and storage which maximizes interconnection use while limiting curtailment below 5%
- For thermal plants, estimated optimal solar and wind capacity that can be added, and for renewable plants, estimated additional solar and wind capacity that can be enabled by adding 6-hour storage.
- Selected high-quality resources with capacity factors above 30% for wind and 20% for solar to ensure economic viability

Load Growth Analysis

- Compared surplus interconnection potential with Virginia's peak and energy load growth projections for 2030
- Estimated interconnection utilization increase for renewable plants through battery storage and renewable additions
- Quantified avoided interconnection and network upgrade costs based on historical cost data from Virginia

500 GW of solar and wind potential near existing interconnection points

Thermal Plants

117
Units
29 Plants

17.6
GW Capacity

Plants in Urban Areas

0
Facilities
0% of Total

0
MW Capacity
0% of Total

RE Potential Near Thermal Plants

73.8
GW
Solar Potential

8.9
GW
Wind Potential

Total Potential: 82.7 GW

Renewable Plants

85
Units
82 Plants

4.5
GW Capacity

Plants in Urban Areas

2
Facilities
2% of Total

205
MW Capacity
5% of Total

Additional RE Potential Near Renewable Plants

387.4
GW
Solar Potential

46.5
GW
Wind Potential

Total Potential: 433.9 GW

By 2030 All Thermal Capacity Expensive Compared to Local RE LCOE

Economic Crossover

Crossover occurs when renewable LCOE becomes lower than thermal plant variable costs. At this point, it becomes cheaper to build new renewables than to operate existing thermal plants.

Solar Crossover

GW of thermal capacity with variable costs higher than local solar LCOE

2024	2030
With IRA: **17.6 GW**	With IRA: **17.6 GW**
Without: **9.9 GW**	Without: **17.6 GW**

Wind Crossover

GW of thermal capacity with variable costs higher than local wind LCOE

2024	2030
With IRA: **7.2 GW**	With IRA: **8.8 GW**
Without: **2.7 GW**	Without: **4.4 GW**

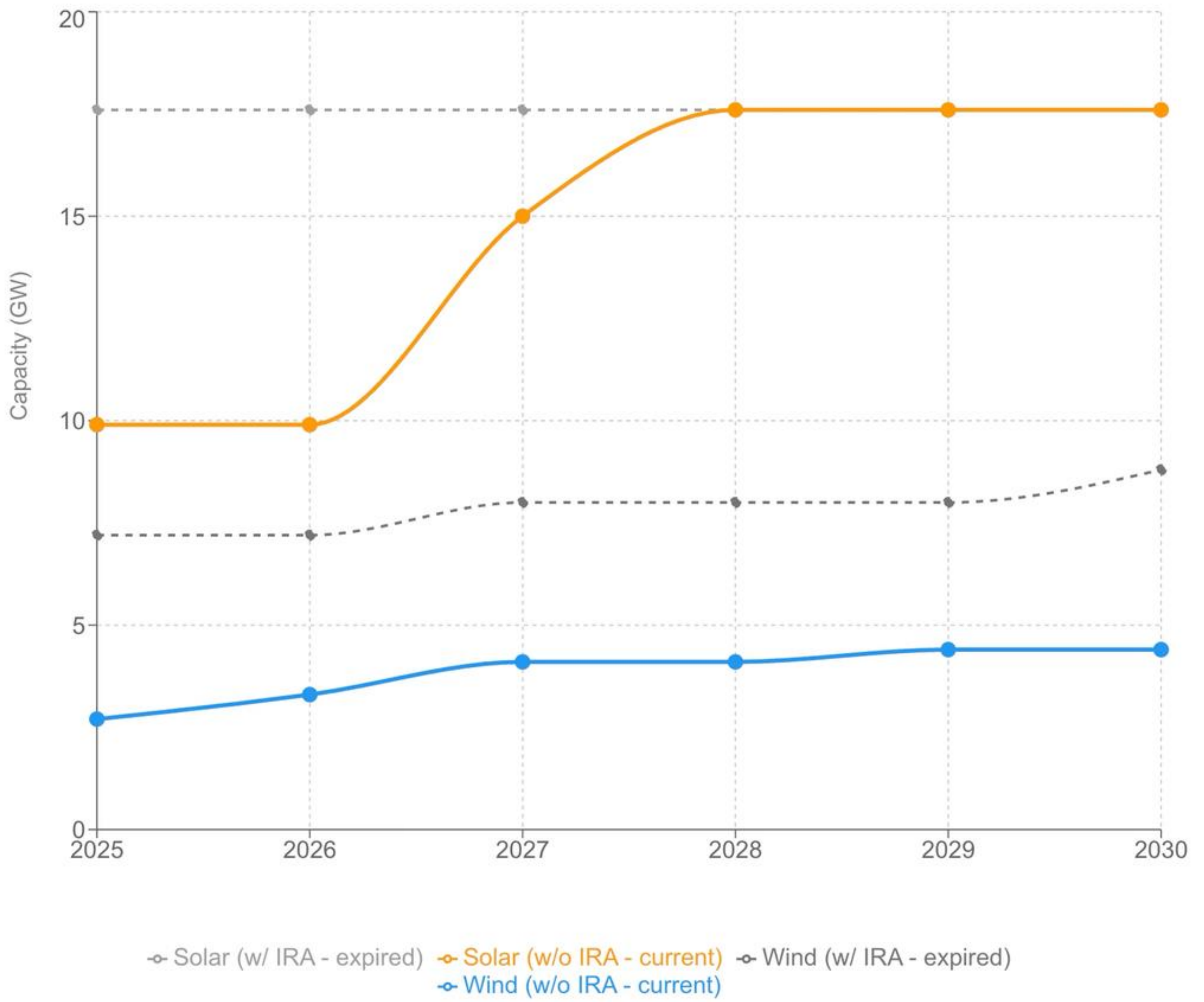
Impact of IRA Tax Credits

The Inflation Reduction Act (IRA) tax credits significantly reduced renewable LCOE and accelerated economic crossover. These credits are no longer in effect.

With IRA credits, solar already competes with 17.6 GW of thermal capacity (100% of Virginia's thermal fleet). Without credits, this would drop to 9.9 GW—a 7.7 GW difference.

Wind shows similar impact: competing with 7.2 GW with credits versus 2.7 GW without—a 4.5 GW difference.

Renewable Capacity Below Thermal Variable Costs



Solid lines: Without IRA (current) | Dashed lines: With IRA (expired)

8 GW of RE can be added at Virginia thermal plants

RE Integration Potential Results

8 GW of renewable energy capacity can be integrated near existing thermal plants in Virginia by 2030

- Solar integration potential: 8 GW
- Wind integration potential: 0 GW

Sensitivity Analysis:

Fuel prices (natural gas, coal) directly impact thermal plant variable costs. We varied fuel costs by ±1 standard deviation from historical averages to test how fuel price uncertainty affects RE integration potential:

○ **Low fuel prices** (1σ below avg): Thermal plants become cheaper to operate, reducing RE competitiveness → 0.1 GW (2025) → 3.8 GW (2030)

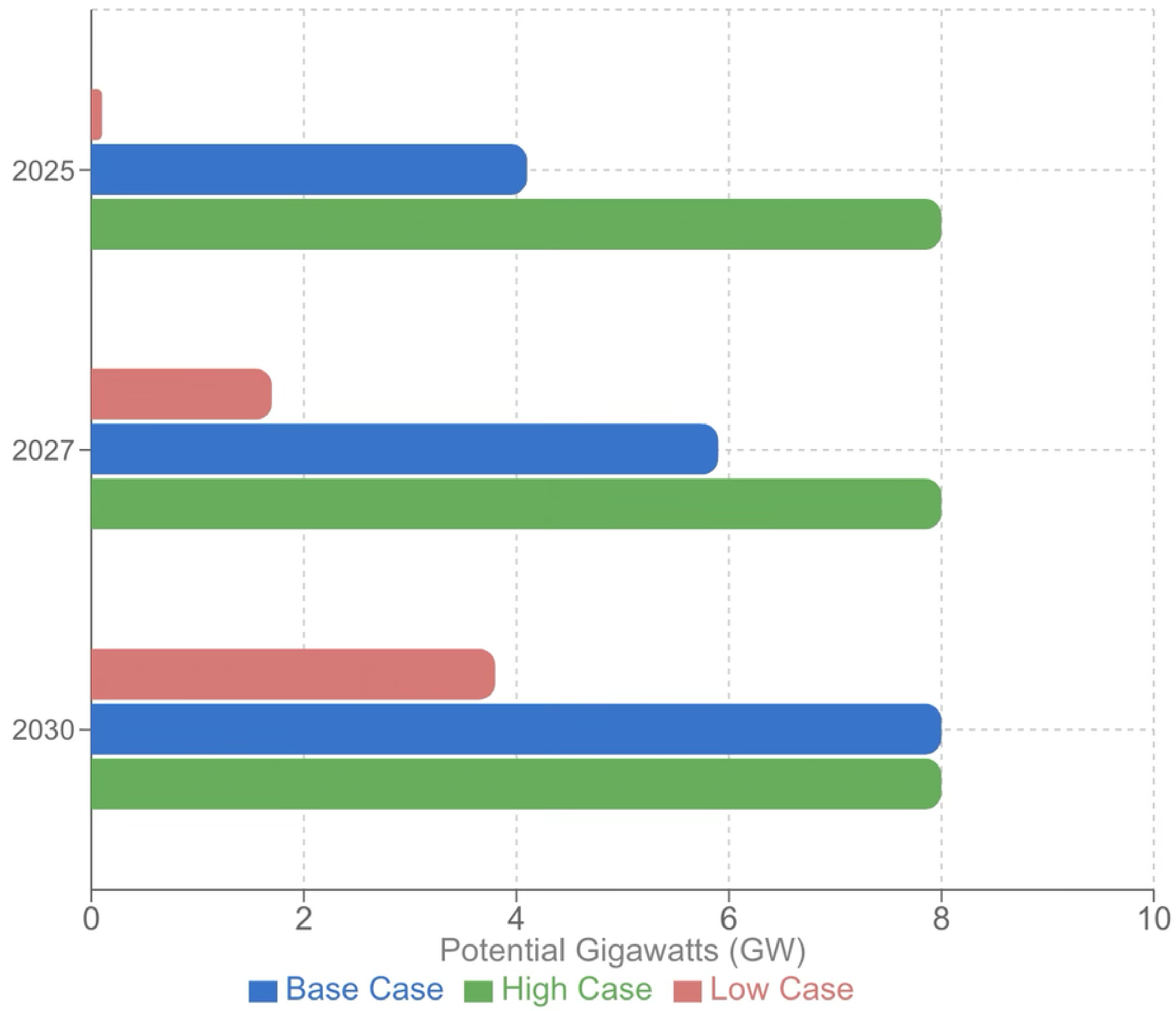
○ **High fuel prices** (1σ above avg): Thermal plants become more expensive, making RE more attractive → 8 GW (2025) → 8 GW (2030)

Trajectory:

Integration potential grows from 4.1 GW in 2025 to 5.9 GW in 2027, reaching 8 GW by 2030 as renewable technology costs continue to decline.

Total RE Integration Potential by Year

RE capacity that can be economically integrated at existing thermal plant sites



8 GW of RE enabled by 4 GW of storage can be added at existing RE plants

Enhancing Virginia's Existing Renewable Fleet

We analyzed optimal solar and wind capacity additions at each renewable site when paired with 6-hour battery storage. Battery storage increases interconnection utilization by capturing excess generation during peak production, enabling significantly more renewable capacity without infrastructure upgrades.

The optimization algorithm estimates the solar and wind capacity that maximizes the interconnection utilization while limiting curtailment to below 5%. We analyzed 85 renewable plants (≥10 MW) in Virginia.

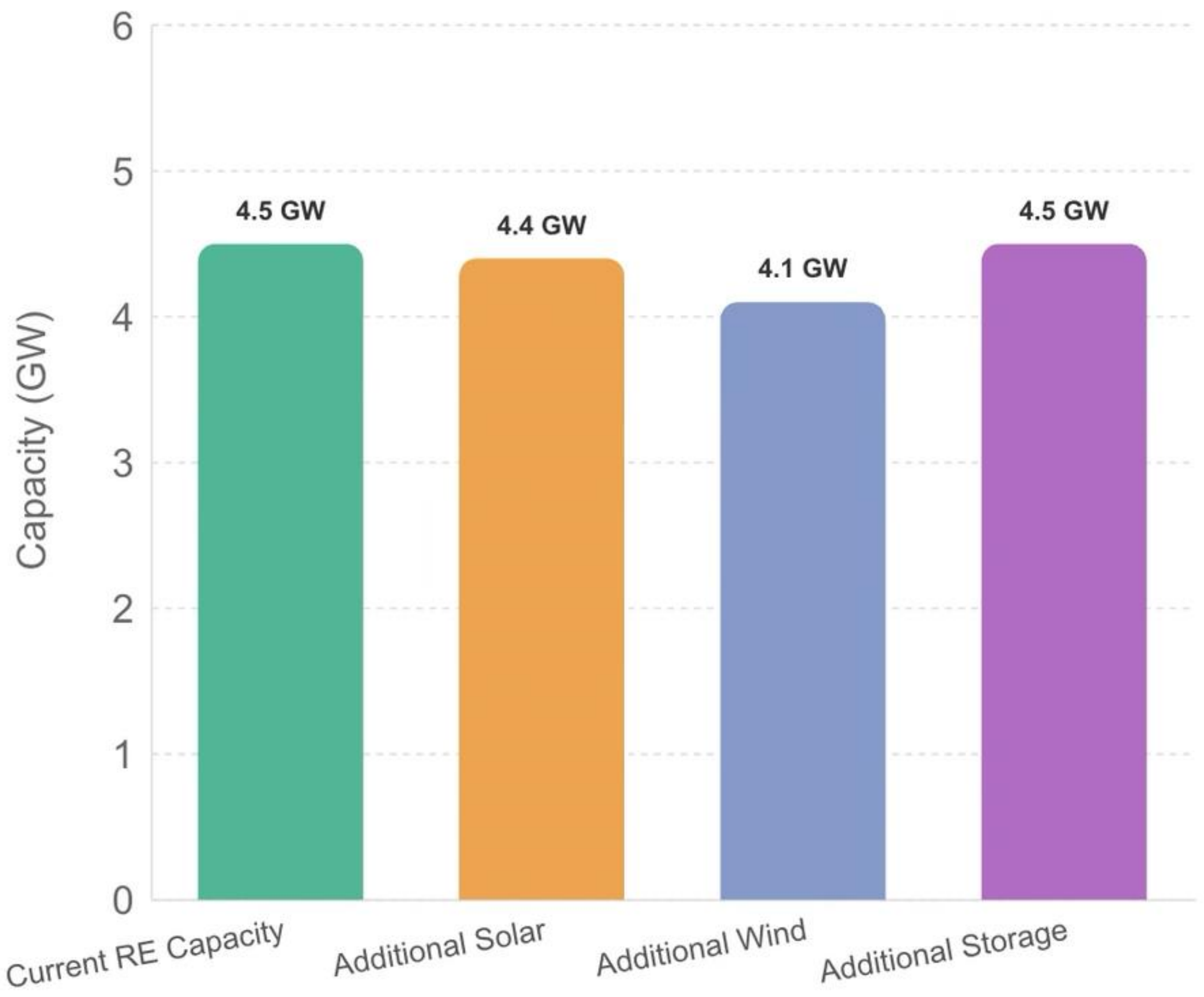
Solar Capacity	Wind Capacity	Storage Capacity
+4.4 GW	**+4.1 GW**	**+4.5 GW**

Current RE Capacity: 4.5 GW

Total After Enhancement: 4.5 + 8.6 = 13.1 GW

188% Overall Increase

Additional Capacity at Existing RE Sites (GW)



Additional capacity potential: 4.4 GW solar + 4.1 GW wind + 4.5 GW storage

PJM 6H Storage ELCC comparable with Gas

PJM ELCC Values

Effective Load Carrying Capability measures a resource's contribution to meeting peak demand. Higher ELCC means more reliable capacity during critical grid hours.

PJM's Methodology: Uses probabilistic analysis to assess resource performance during system stress, considering:

- Output during peak demand periods
- Weather-correlated performance
- Marginal value as more units are added

Why Solar Has Low ELCC

Solar receives only 8% ELCC because it doesn't generate during **evening peak periods** when the grid needs power most. Solar produces energy midday, but peak demand occurs after sunset.

Battery Storage = Firm Capacity Solution

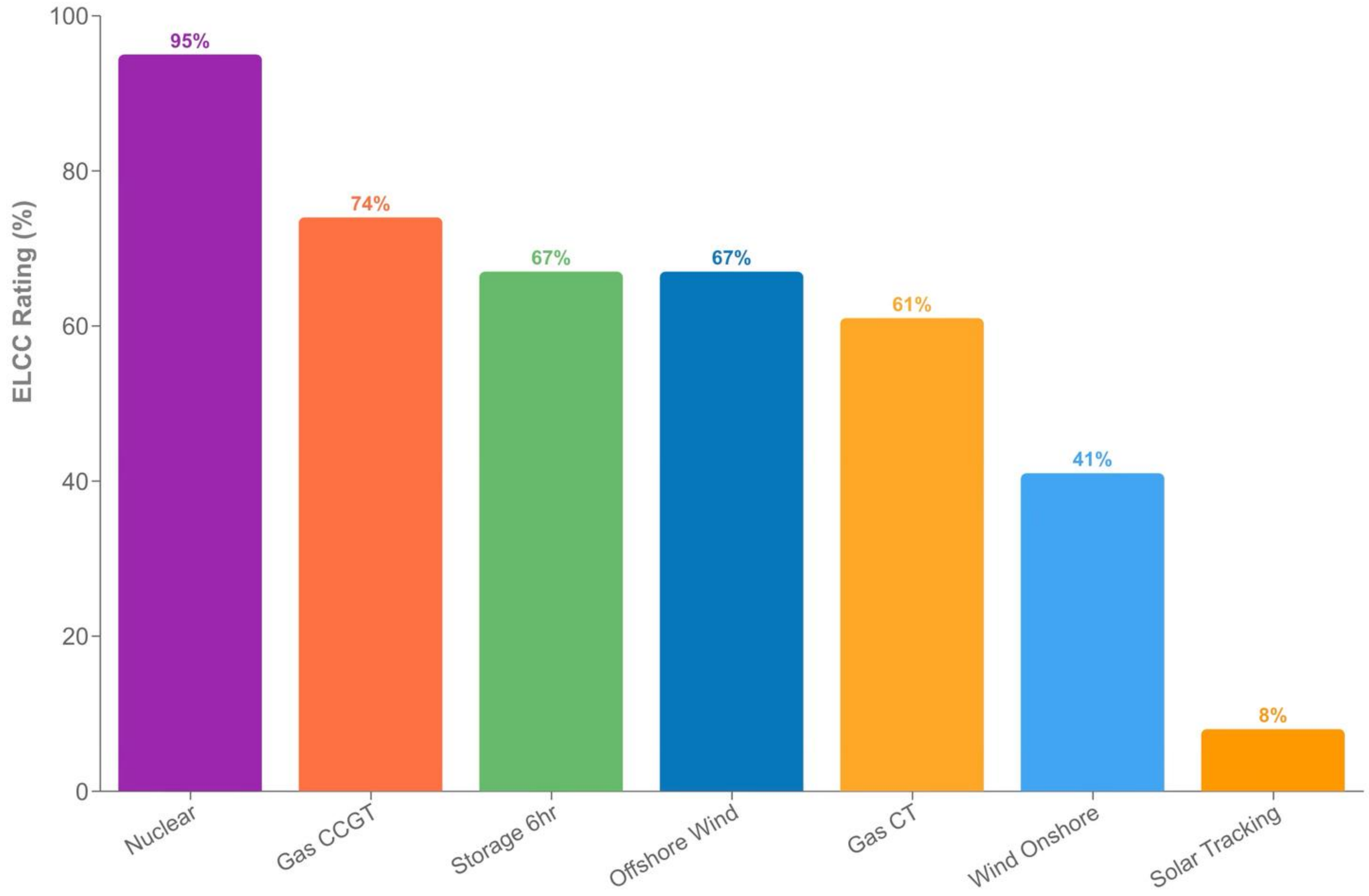
6-hour battery storage receives **67% ELCC** — comparable to Gas CT (61%). Adding storage at existing renewable plants converts them into **firm capacity resources**.

Data Centers Need Firm Capacity

Virginia's 24/7 data center growth requires **firm capacity**. Surplus interconnection enables adding battery storage at existing sites to meet this demand faster than building new gas plants.

Source: PJM RPM Base Residual Auction 2027/28 ELCC Class Ratings

ELCC by Technology Type



Solar + Wind + Storage: Firm Capacity Comparable to Gas Plants

Enhanced Capacity Factor

Converting intermittent renewables to firm capacity: By adding 6-hour battery storage and combining solar with wind, this hybrid portfolio achieves capacity factors of ~70%, comparable to combined cycle gas turbines (CCGT) which typically operate at 50-85% capacity factor.

Hybrid Portfolio Components:

- 8.9 GW Solar
- 4.1 GW Wind
- 4.5 GW Storage

Solar Capacity Factor

Current — 27.3%

With Hybrid Enhancement — 69.8%

+156% Improvement

Firm Capacity Contribution

PJM 2027/2028 ELCC Values

Solar	Wind	6-hr Storage
8%	41%	67%

Standalone Firm Capacity (if separate)

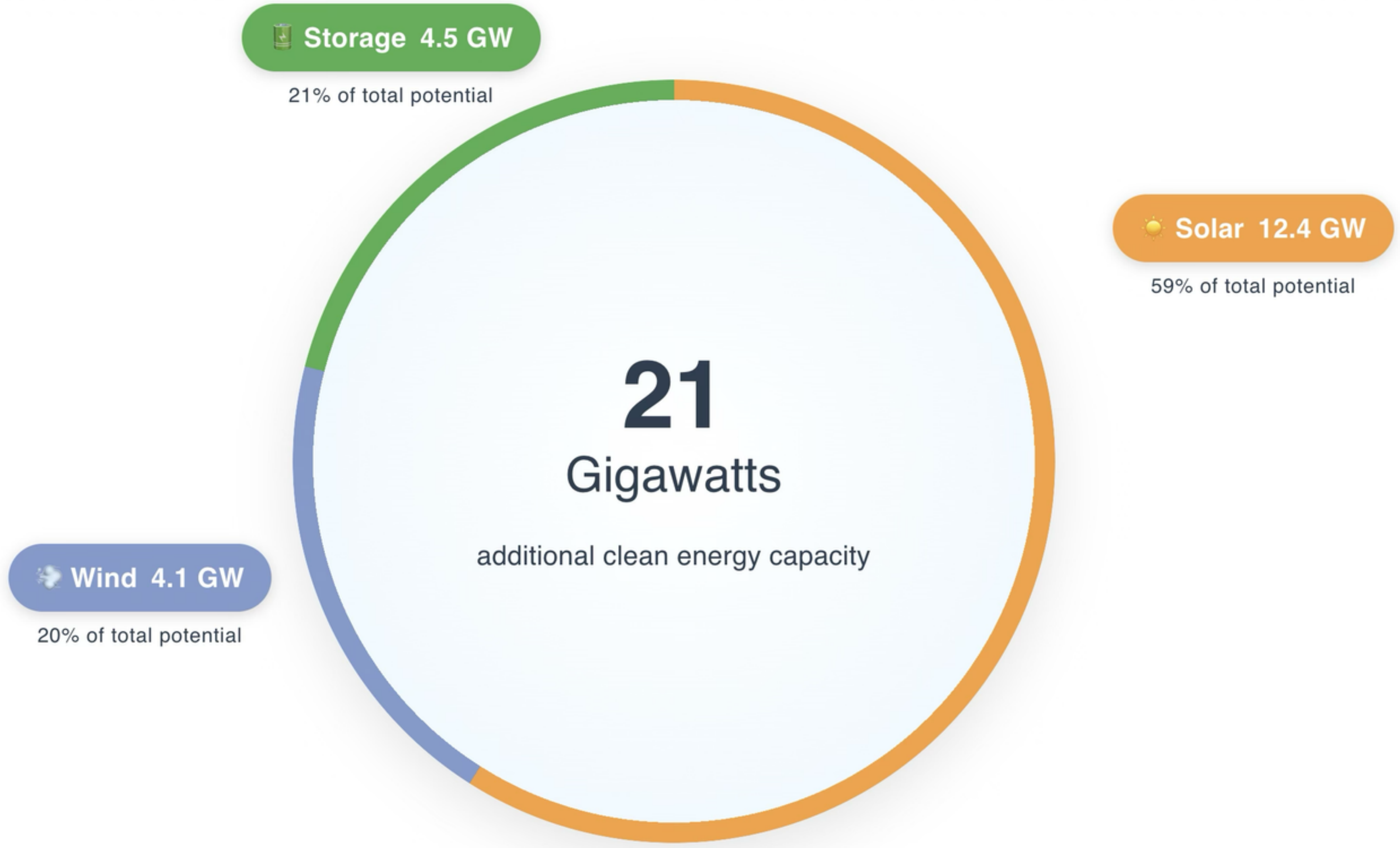
8.9 GW × 8%	4.1 GW × 41%	4.5 GW × 67%
0.71 GW	1.68 GW	3.02 GW

Hybrid Portfolio Firm Capacity

Simple Sum 5.41 GW → Hybrid Estimate ~4 GW

PJM Hybrid Rule: Co-located resources receive a combined ELCC rating (not simple sum). The hybrid ELCC accounts for integrated operation where storage charges from solar/wind during off-peak and discharges during peak demand. Diversity benefits from complementary solar/wind profiles are captured in the combined rating.

21 GW of RE + Storage can be added at existing power plants in Virginia



12.4 GW of additional solar capacity near existing renewable and thermal plants

4.1 GW of additional wind capacity through interconnection sharing

4.5 GW of storage enables higher penetration of renewables

Surplus Interconnection: Meeting VCEA targets faster and cheaper

Virginia Clean Economy Act (VCEA)

Signed into law in 2020, the VCEA establishes Virginia as a national leader in clean energy, mandating a transition to 100% carbon-free electricity.

Key Mandates by 2035:

- **16,100 MW** of solar and onshore wind capacity
- **5,200 MW** of offshore wind capacity
- **3,100 MW** of energy storage
- **59%** renewable energy for Dominion

Timeline:

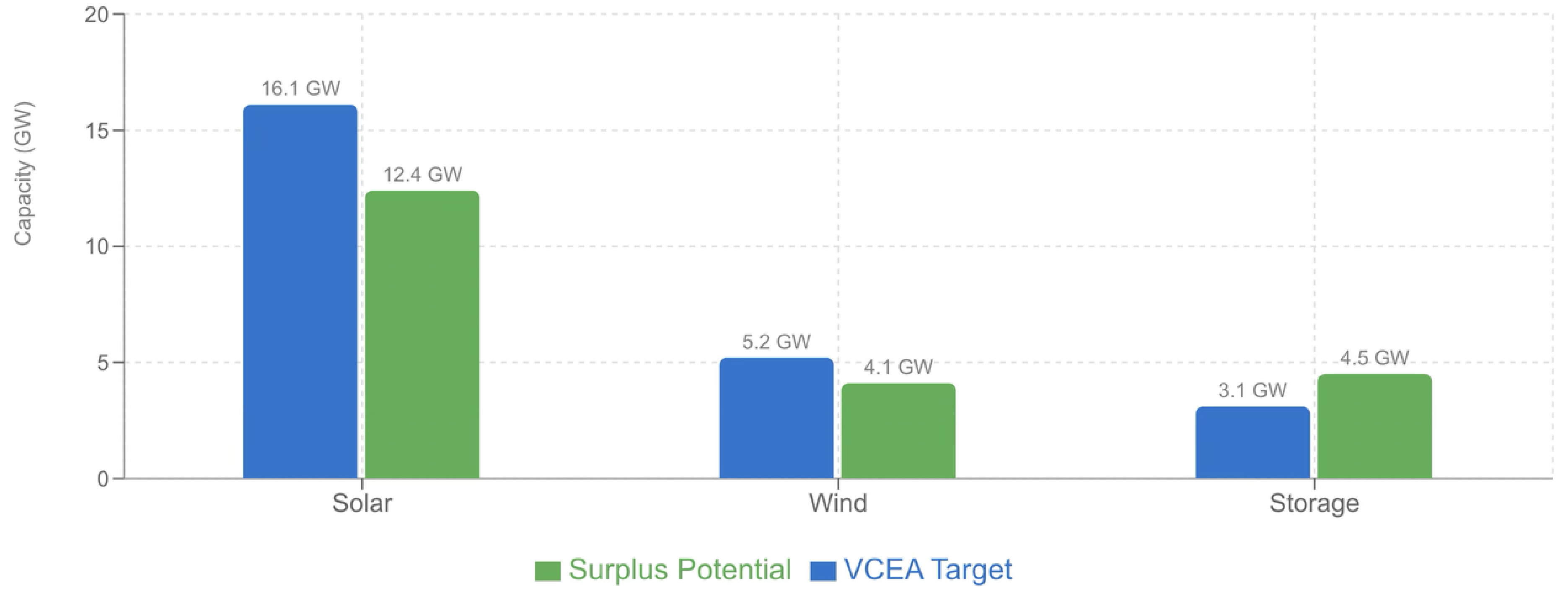
2030:	41% renewable (Dominion)
2035:	59% renewable (Dominion)
2045:	100% clean (Dominion)

Why Surplus Interconnection?

- **12-18 months** vs 4-6 year queue
- $ **Lower cost** — no new transmission
- ✓ Uses existing grid infrastructure
- ✓ Proven deployment pathway

VCEA Targets vs Surplus Interconnection Potential

Capacity comparison in GW — Surplus can meet significant portion of VCEA requirements



Solar: 77% of Target
12.4 GW surplus can meet majority of 16.1 GW solar/wind target

Wind: Onshore Complement
4.1 GW onshore potential complements offshore wind mandate

Storage: Exceeds Target
4.5 GW surplus exceeds 3.1 GW VCEA storage mandate by 45%

Surplus interconnection can deliver 21 GW of clean energy capacity — faster, cheaper, and without new transmission infrastructure

Sources: Virginia Clean Economy Act (2020), EIA 2024 Data, 1000GW Analysis

$1.8B of savings in interconnection costs

$ Total Potential Savings

$1.8B

By leveraging existing infrastructure

$529
Savings per Virginia household

- ✓ Reduces interconnection costs
- ✓ Reduces new transmission infrastructure requirements
- ✓ Cost savings from faster deployment of cheaper clean energy and replacing generation from expensive thermal plants

ⓘ This $1.8B is a conservative estimate that only accounts for interconnection cost savings for 21 GW of renewable capacity using a median cost of $85/kW (LBNL Queued Up 2024). Additional benefits from co-location of solar, wind, and batteries, and increased utilization of bulk transmission would significantly increase the total value of savings, but are not included in this figure.

Shared Benefits Across Stakeholders

Surplus interconnection creates benefits for all stakeholders:

RE Developer	Reduced Interconnection Costs	Faster Development	
Existing Plant Owner	Additional Revenue Streams	Diverse Portfolio	
Consumer	Low Cost Electricity	Tax Revenue	Less Pollution
Power System	Reliability	Higher Tx Utilization	Low Capacity Prices
Economy	Reliable Supply	Faster Supply	Low Cost Power

Finding best candidates for surplus interconnection

Thermal Plants Ranking

Weighted scoring to identify best thermal plants for surplus interconnection service

- **25% — Economic Arbitrage**
  Differential between plant variable cost and renewable LCOE
- **30% — Renewable Resource Potential**
  Combined solar and wind capacity within 6-mile radius
- **15% — Underutilization Factor**
  Inverse of capacity factor (lower utilization = higher score)
- **15% — Technical Resource Quality**
  Maximum renewable capacity factor achievable at site
- **10% — Plant Interconnection Capacity**
  Existing thermal plant megawatt capacity
- **5% — Site Development Suitability**
  Percentage of non-urbanized land area

Renewable Plants Ranking

Weighted scoring to identify best expansion candidates

- **30% — Resource Quality Performance**
  Current operating capacity factor of renewable facility
- **30% — Expansion Potential**
  Additional renewable capacity within 6-mile radius
- **20% — Economic Optimization**
  Ratio of optimal to current capacity factor
- **10% — Site Development Viability**
  Percentage of non-urbanized surrounding area
- **10% — Existing Plant Scale**
  Current installed capacity demonstrating viability

Top thermal plants for surplus interconnection

Top Ranked Plants

#1 Warren County
Warren County • 1472 MW • Gas CCGT
SIS RE Potential: 1829 MW

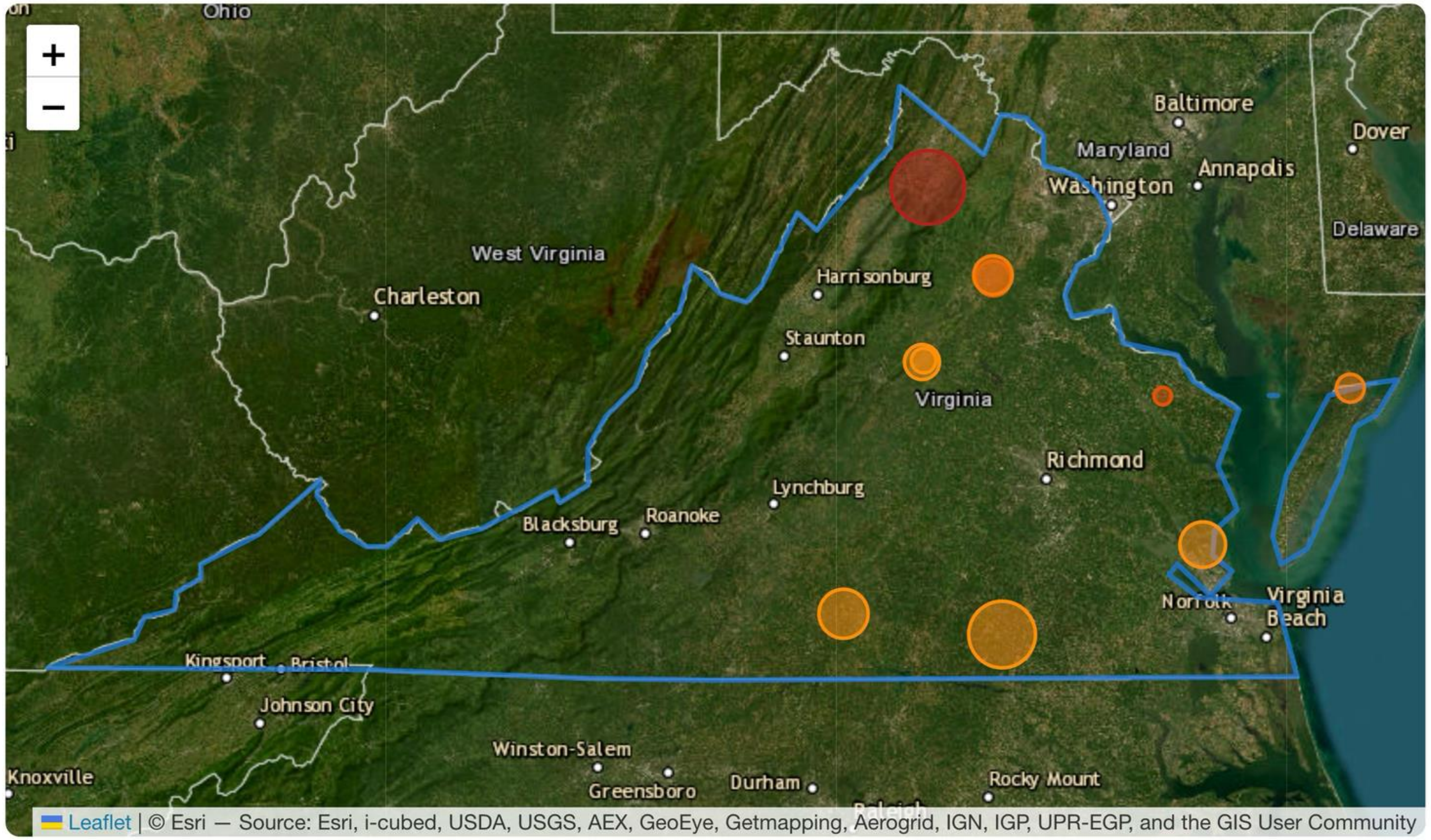
#2 Northern Neck
Richmond County • 47 MW • ogs
SIS RE Potential: 58 MW

#3 Marsh Run Generation
Fauquier County • 481 MW • Gas CT
SIS RE Potential: 598 MW

#4 Commonwealth Chesape
Accomack County • 318 MW • ogs
SIS RE Potential: 390 MW

#5 Remington
Fauquier County • 608 MW • Gas CT
SIS RE Potential: 755 MW

Geographic Distribution



● Rank #1 ● Top 3 ● Top 5 ● 6-10 *Circle size = Plant capacity*

Top renewable plants for surplus interconnection

Top Ranked Plants

#1 ☀ **Cavalier Solar**
Isle of Wight County • 156 MW • Solar
SIS RE Potential: 316 MW

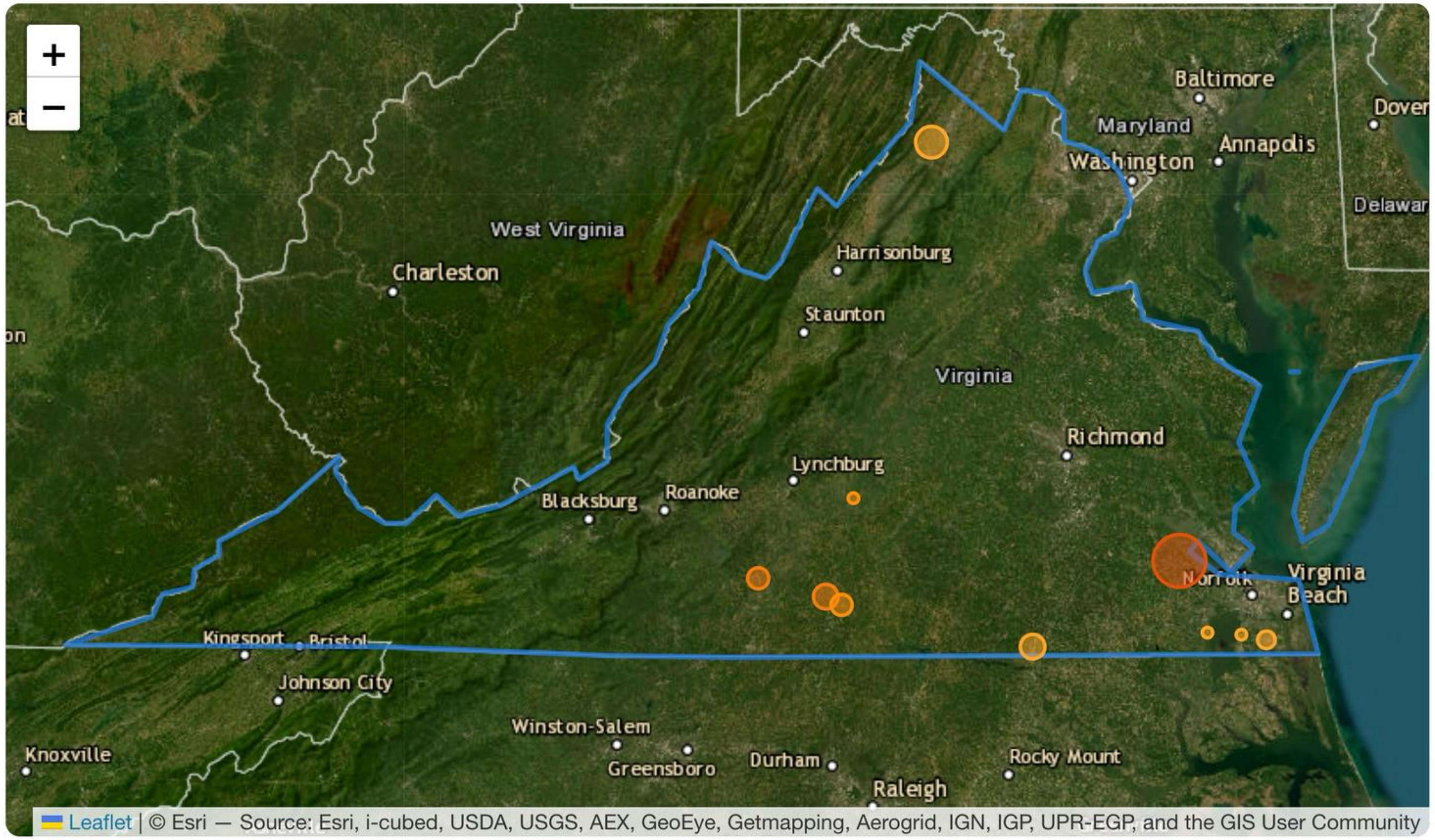
#2 ☀ **Crystal Hill Solar**
Halifax County • 65 MW • Solar
SIS RE Potential: 143 MW

#3 ☀ **Whitehorn Solar**
Pittsylvania County • 50 MW • Solar
SIS RE Potential: 101 MW

#4 ☀ **Sunnybrook Solar Project - Hybrid**
Halifax County • 51 MW • Solar
SIS RE Potential: 113 MW

#5 ☀ **Caden Energix Pamplin LLC**
Appomattox County • 16 MW • Solar
SIS RE Potential: 33 MW

Geographic Distribution



☀ **Solar:** #1 Top 3 Others 🌬 **Wind:** #1 Top 3 Others *Circle size = Plant capacity*

Quick deployment and incremental scaling reduce stranded asset risk

Uncertain Demand Growth Drivers

AI & Data Centers
Explosive growth with unpredictable timing - some facilities need 1GW+

Manufacturing Reshoring
Policy-driven industrial expansion with uncertain location and scale

Transportation Electrification
EV adoption varies 10x between forecasts - massive grid impact uncertainty

Grid planners face unprecedented uncertainty in timing, location, and magnitude of new loads - traditional planning breaks down

Deployment Strategy Comparison

Traditional New Generation

- 5-7 year development timeline
- Large upfront commitment (500MW+)
- High stranded asset risk
- Requires accurate long-term forecasts

SIS + Battery Storage

- 12-18 month deployment
- Modular additions (50-200MW blocks)
- Deploy capacity as demand materializes
- Leverages existing interconnection

The "Build As You Need" Advantage with SIS

Surplus Interconnection Service transforms how utilities can respond to uncertain demand growth by enabling incremental, just-in-time capacity additions:

Risk Mitigation Benefits:

- Match CAPEX deployment to actual load growth
- Avoid overbuilding in uncertain markets
- Preserve optionality as forecasts evolve
- Minimize stranded asset exposure

Operational Flexibility:

- Start with 100MW, scale to 500MW+ over time
- Respond to surprise data center announcements
- Adjust to actual EV adoption rates
- Redeploy assets if local demand shifts

SIS enables utilities to transform stranded asset risk into strategic flexibility - critical for navigating the unprecedented uncertainty of the energy transition

FERC Approves PJM Surplus Interconnection Service Reforms

Four Key Changes Approved by FERC

PJM filed tariff revisions on December 20, 2024 to remove restrictions and expand surplus interconnection service access

1. Additional Interconnection Facilities

Explicitly allows construction of new physical interconnection facilities where needed. Enables parallel operation of surplus unit with existing generator - critical for solar+storage configurations. Previously unclear if additional facilities were permitted.

2. Removes "Material Impact" Restrictions

Strikes language that terminated requests for ANY impact on queue determinations or material impacts on system limits. Now only blocked if new network upgrades required. This "materiality review" previously killed most surplus requests.

3. Earlier Access to Surplus Service

Expands eligibility to projects with executed ISA/GIA but not yet built. Previously only operational facilities could offer surplus. Allows requests during construction phase - aligns with FERC Order 2023 requirements.

4. Energy Storage Eligibility

Clarifies that resources "seeking to receive electric energy from the grid and store it for later injection" can use surplus service. Removes ambiguity about storage eligibility that existed in prior tariff language.

Previous Restrictions Removed

PJM would automatically terminate surplus requests if:

- Any impact on network upgrade determinations for queued projects
- Material impacts on short circuit capability limits
- Material impacts on steady-state thermal and voltage limits
- Material impacts on dynamic system stability

Result: "Materiality review" effectively blocked most surplus requests

Expected Benefits

- Faster deployment of new capacity without queue delays
- Existing solar can add batteries using surplus service
- Better utilization of existing interconnection capacity
- May help reduce capacity prices
- Aligns PJM with MISO's more flexible approach

Behind-the-Meter Data Centers: Leveraging Surplus Interconnection

Innovative Behind-the-Meter Solution

Configuration Setup

Data center is located behind-the-meter of an existing gas peaker plant, with new oversized solar arrays + 16-hour battery storage added on-site

How It Works

95% of the time: Data center receives power from solar + battery storage.
5% of the time: When solar/battery unavailable, gas plant provides backup power

Gas Plant Dual Role

1) Provides electricity to grid during peak demand when needed
2) Acts as backup power source for data center (5% of time)

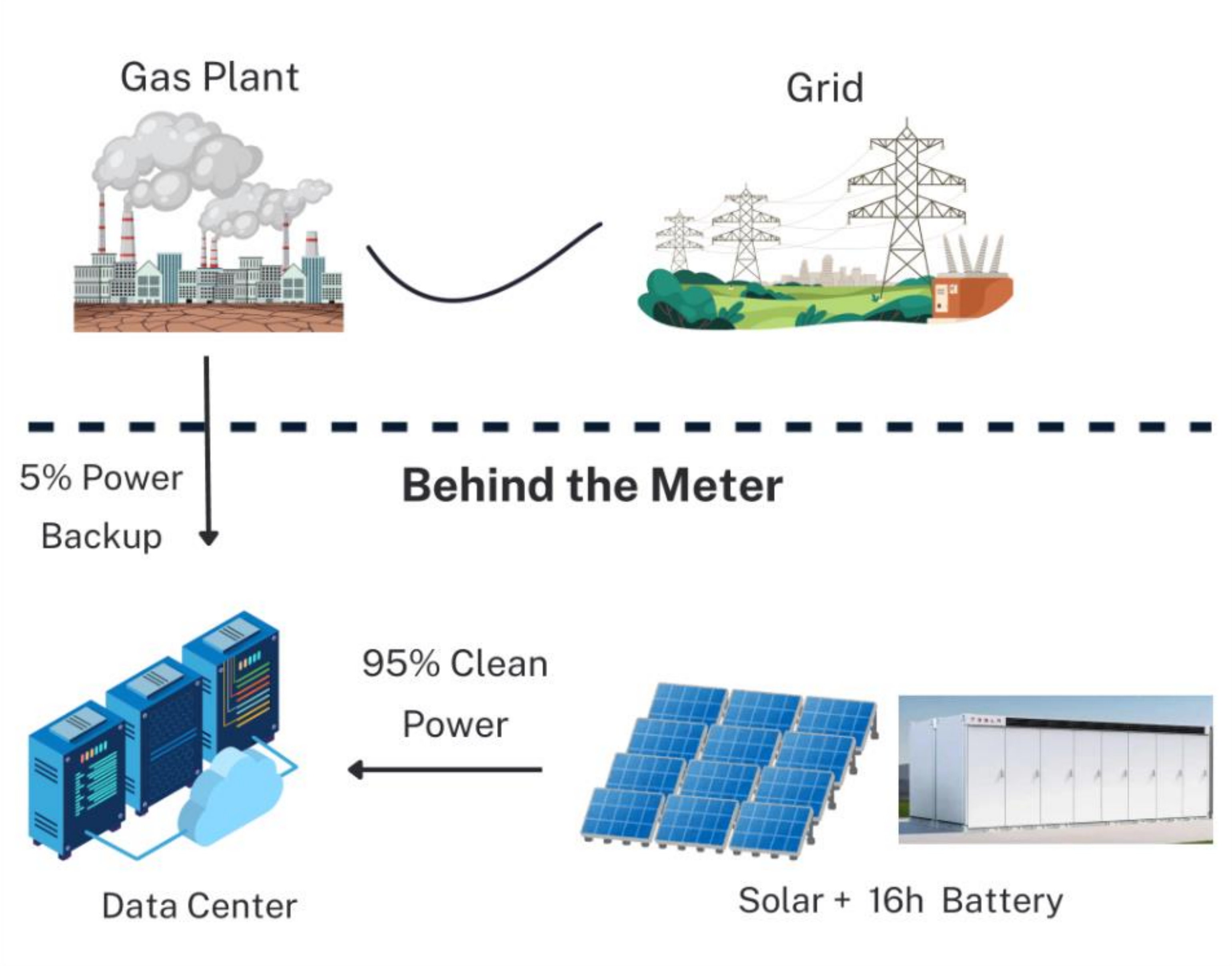
Fast Implementation

Complete build in 1-2 years (vs 5-6 years for new gas plant or grid connection)

Key Benefits

- Uses existing gas plant interconnection (no new transmission)
- 95% carbon-free operation with solar + battery
- Gas plant remains available for grid emergencies

Surplus Interconnection to Power Data Centers



Thank you!

Thermal Plants constitute 80% of Virginia’s installed capacity

Capacity Breakdown

Thermal capacity dominates at 79% of total installed capacity, with Gas CCGT being the largest single source at 41% of total capacity.

Total Capacity: 22,112 MW

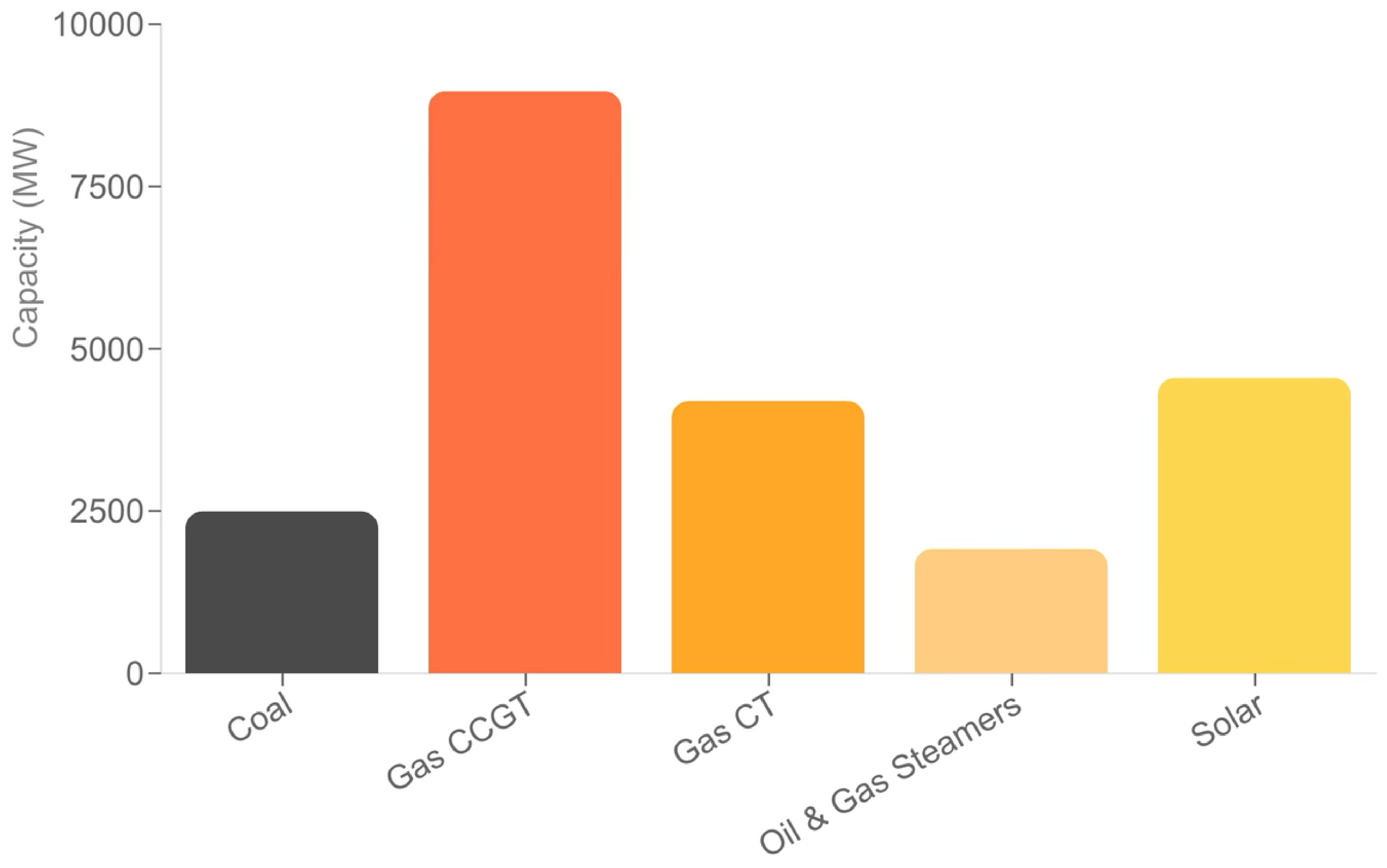
Thermal: 17,562 MW

- Coal: 2,493 MW (14%)
- Gas CCGT: 8,965 MW (51%)
- Gas CT: 4,192 MW (24%)
- Oil & Gas Steamers: 1,912 MW (11%)

Renewable: 4,550 MW

- Solar: 4,550 MW (100%)

Installed Capacity by Technology (MW)



Thermal technologies account for 79% of installed capacity, while renewables represent 21%

Marginal Cost of Thermal Generation

$ Thermal Generation Economics

Virginia's 17.6 GW installed thermal capacity shows clear variable cost stratification by technology. Gas CCGT (9.0 GW) dominates the low-cost range at ~$31/MWh, while Coal (2.5 GW) operates around $41/MWh. Gas CT peakers (4.2 GW) are in the $46/MWh range, and Oil & Gas Steamers (1.9 GW) are the most expensive at ~$51/MWh. This cost structure determines dispatch order—higher variable cost units remain idle unless market prices justify their operation.

Capacity-Weighted Average Variable Costs

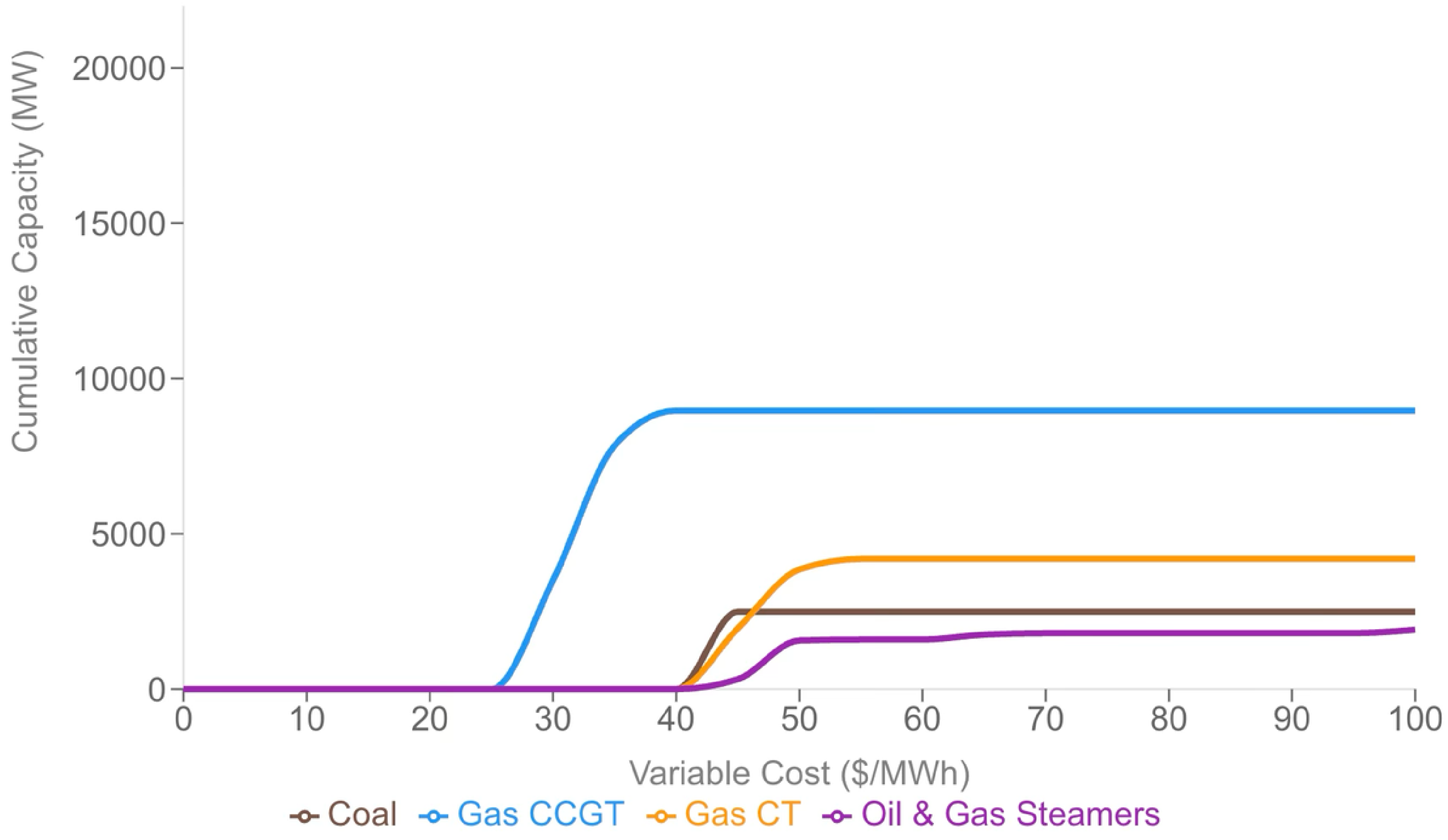
Variable costs include fuel and variable O&M—the marginal cost to generate each MWh

- Gas CCGT: $31.10/MWh (9.0 GW installed)
- Gas CT: $45.91/MWh (4.2 GW installed)
- Coal: $40.93/MWh (2.5 GW installed)
- Oil & Gas Steamers: $51.28/MWh (1.9 GW installed)

Economic Dispatch Impact

- Total Thermal Capacity: 17.6 GW
- Weighted Average VC: $44.51/MWh
- 19.9% of capacity competes economically at <$30/MWh

Cumulative Thermal Capacity by Technology & Variable Cost



Gas CCGT dominates the low-cost range ($30-40/MWh), while Coal, Gas CT, and Oil & Gas Steamers cluster in the $40-55/MWh range

Renewables are underutilizing their interconnection capacity

Renewable Interconnection Underutilization

Because of intermittency, solar plants utilize their interconnection only when the sun is shining. The average capacity factor in Virginia for solar is 16.6%. This means solar plant interconnection is idle 83.4% of the time. Virginia currently has minimal operational wind capacity (12 MW pilot project offshore).

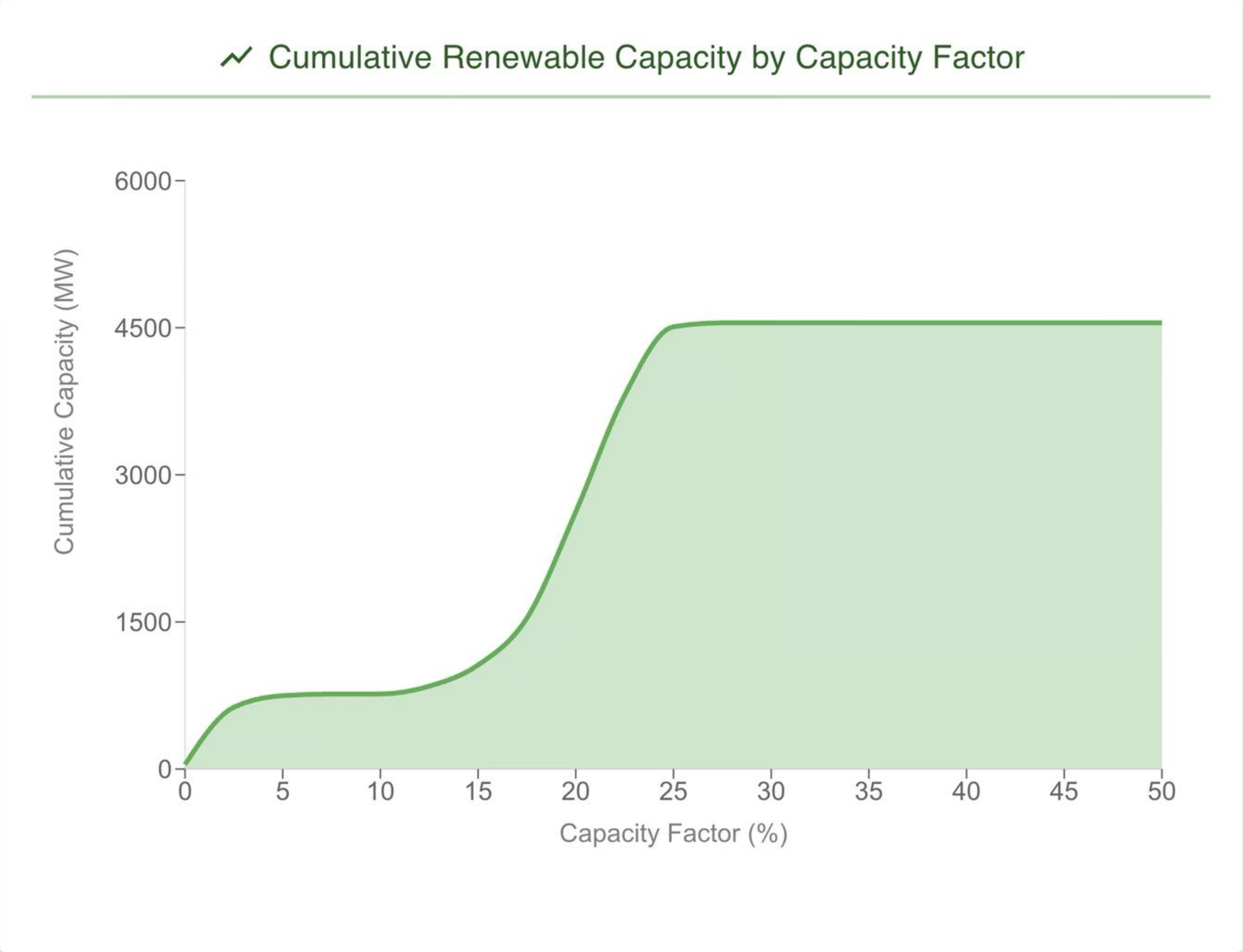
Technology Capacity Factors

- Solar: 16.6% (4,549.9 MW)

Note: Virginia's renewable fleet is currently 100% solar

Underutilized Interconnection Opportunity

Solar plants can only utilize their interconnection during daytime when the sun is available. During nighttime and cloudy periods, this valuable grid interconnection capacity sits completely idle — not being utilized by anybody. This represents a significant opportunity to co-locate complementary resources like battery storage to maximize the value of existing grid connections.



Cost of Renewable generation

Renewable Generation Economics

Virginia's 4.5 GW of solar capacity shows unsubsidized LCOE averaging $33.86/MWh — which is **lower than thermal generation variable costs** ($44.51/MWh average). This means new solar generation is cost-competitive with the marginal cost of running existing thermal plants, even without IRA tax credits.

Why Solar LCOE is Consistent Across Virginia

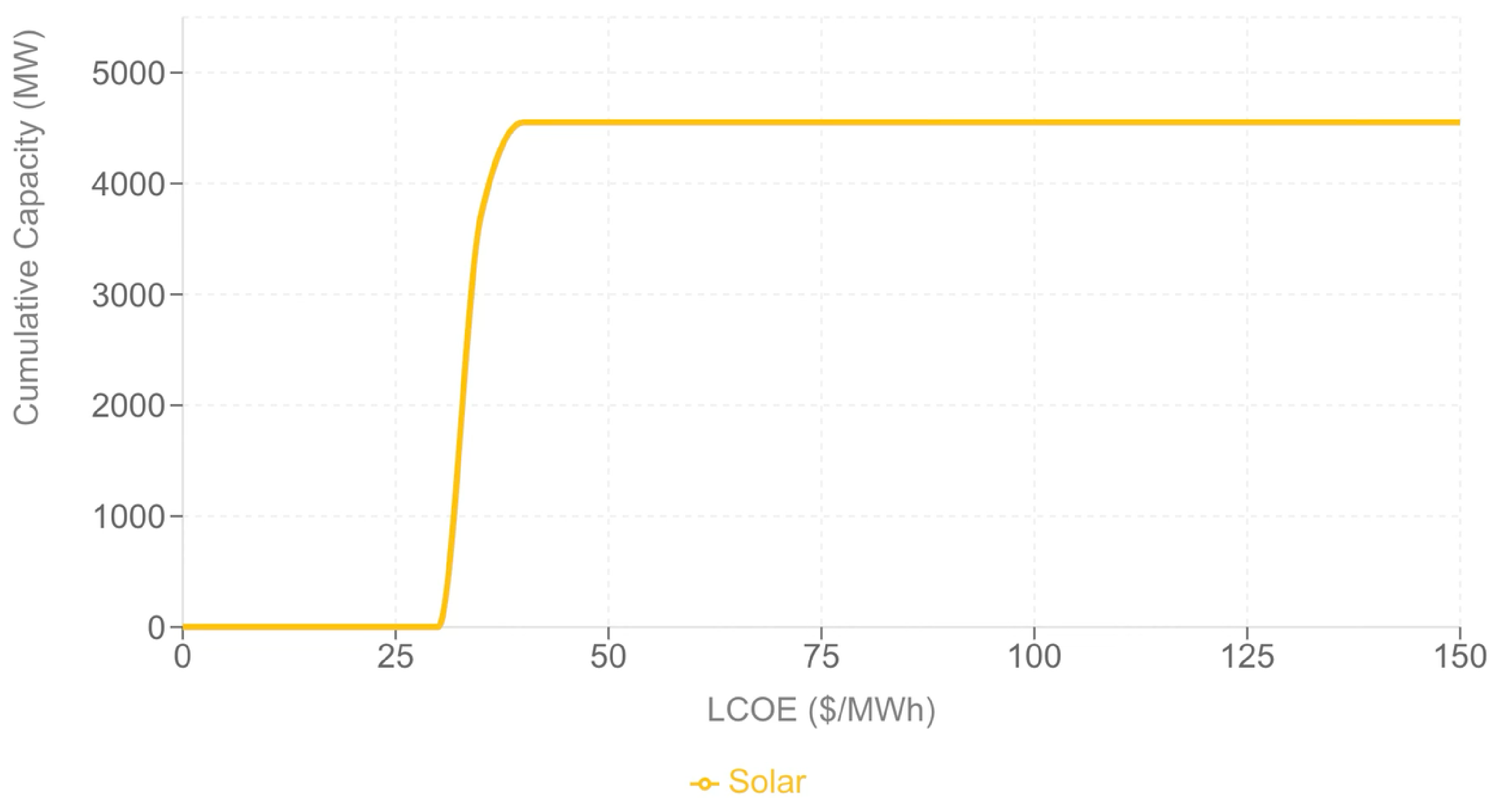
Solar resource quality (irradiance) is relatively uniform across Virginia, so capacity factors don't vary dramatically by location. Additionally, solar panel costs have dropped so significantly that minor differences in capacity factor have minimal impact on final LCOE.

Developers can also optimize economics by adjusting the inverter loading ratio (ILR/DC:AC ratio) to achieve higher capacity factors, further narrowing LCOE differences across sites.

Solar Economics Summary

- Total Solar Capacity: 4.5 GW
- Average LCOE (unsubsidized): $33.86/MWh
- Thermal Avg Variable Cost: $44.51/MWh

Cumulative Renewable Capacity by Unsubsidized LCOE



New Gas would not come online before 2030

Gas Project Lead Times Growing

BNEF tracked **16.8 GW** of gas capacity planned to come online between 2026-2031. [BNEF]

Critical Timeline Gap

A gas project filed **today** won't be operational until **2030-2032**. Virginia's capacity crisis is **now**.

Combined Cycle (CCGT) Lead Times

- 2023 filings: **3.5 years** avg
- 2024 filings: **4.7 years** avg
- **2025 filings: 5.0 years avg**

Why Lead Times Are Increasing

- Supply chain constraints for turbines
- Interconnection queue backlogs
- Permitting delays
- Labor & material shortages

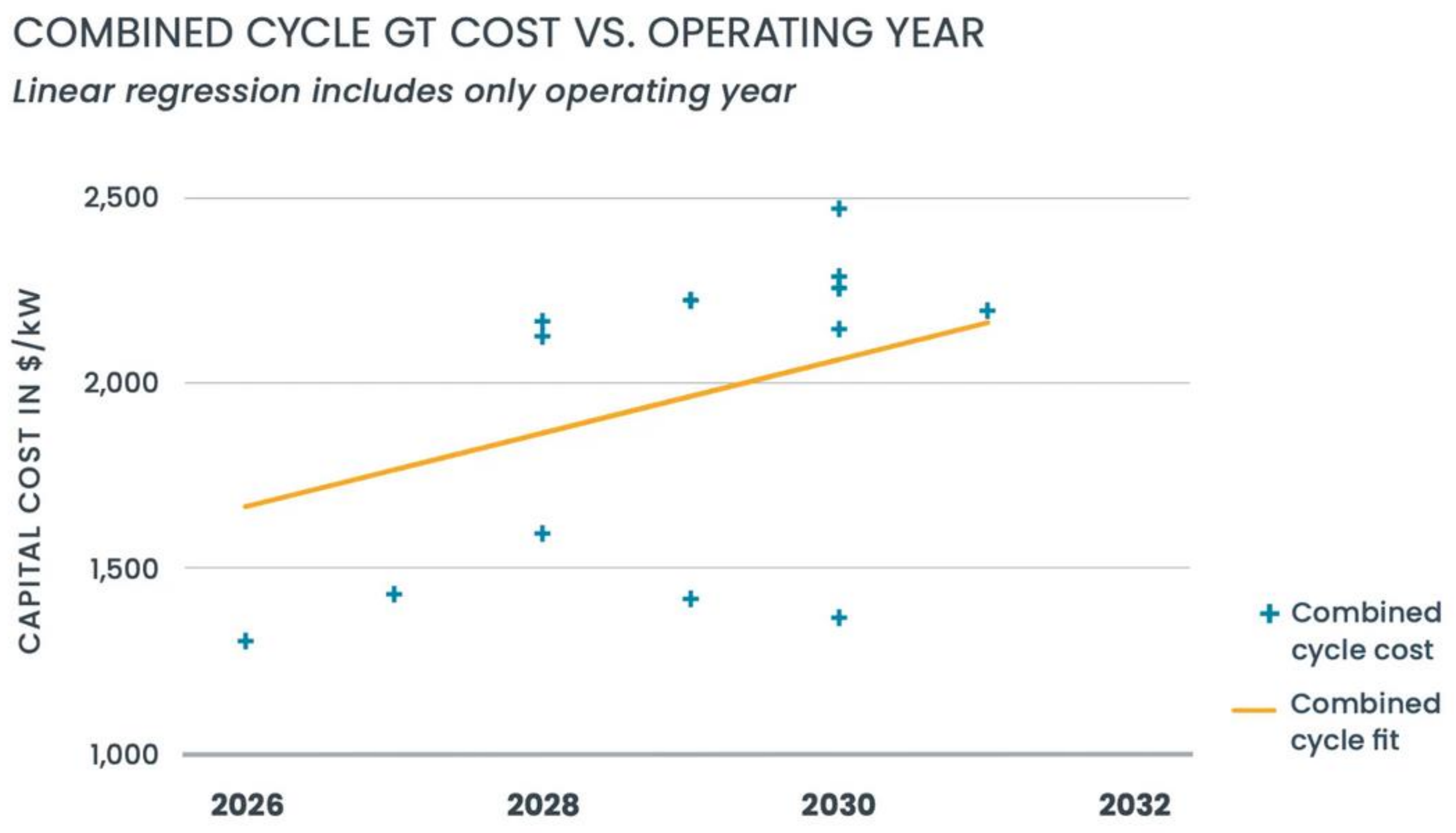
Gas Project Lead Times by Filing Year (Years to Service) [BloombergNEF]

When Will New Gas Actually Come Online?

Filing Year	Lead Time	In-Service
2023	3-4 years	2026-2027
2024	3-6 years	2027-2030
2025	4-6 years	2029-2031
2026 (Today)	4-6 years	**2030-2032**

Gas Capital Costs and Timelines have increased significantly

Combined Cycle (CCGT) Capital Costs



Simple Cycle (CT) Capital Costs