



Resource Page



Loudoun County
VIRGINIA
WHERE TRADITION MEETS INNOVATION

Ashburn, Loudoun County, VA Data Center Growth: Our Changing Paradigm

Vice Chair and Ashburn Supervisor, Mike Turner
July 1, 2026

The opinions and recommendations in this presentation represent those of the author alone and in no way represent those of any other Board member, the Loudoun County Board of Supervisors or Loudoun County Staff. Furthermore, these opinions and recommendations have no legal authority nor are they in any way legally binding on any Loudoun County employee.

Loudoun County, VA Key Facts

- Overview: Loudoun County, VA

- Highest concentration of data centers in the world
- Home to “Data Center Alley”; construction every single day for 16 years
- 250+ data centers built; NOVA has 600+; TX 440; CA: 290
- 53 million sq. ft. built; 60 million in the pipeline

Data Centers: Key Milestones

- **2000:** Zoning Administrator determination: Data Centers are considered “office buildings” in the 1993 Zoning Ordinance; **(6) parcels allow “by right” data centers w/o BOS approval**
- **2003:** Zoning Ordinance aligned with **2001 Comprehensive Plan**; first Mention of Data Centers in Zoning Ordinance
- **2008:** Loudoun Economic Development initiates marketing strategy to recruit data centers on land designated for data centers due to underground fiber
- **2014:** Zoning Ordinance Amendment (ZOAM) addressing data center sight, setback, sound
- **2019*:** General Plan (Comprehensive Plan) Updated (*4-yr. plan/ordinance mismatch)
- **2022: Pivotal year! 1)** PJM informs Dominion its infrastructure plan is insufficient; **2)** Chat GPT launches; **3)** Post COVID demand for data explodes
- **2023*:** Zoning ordinance updated to match Comprehensive Plan; Dominion announces plan to build (6) new Loudoun transmission lines
- **2024:** JLARC study states it will be “very difficult” for Dominion to meet unconstrained demand
- **2025:** On March 18th, Loudoun BOS ends all “by right” data center development in Loudoun

Data Centers: Benefits

- **Revenue:** FY2027 Projected \$2.9 billion in Local Tax Funding; \$1.3 billion is data center tax revenue (1/3 real; 2/3 personal)
 - Lowest Real Property Tax Rate in DC Metro area; About 25% Lower Than Neighbors⁷
- **Expense:** A Data Center Costs the County \$0.04 per \$1 of Tax Revenue⁸
 - Most Businesses Cost About \$0.25 per \$1; Homes About Even⁸
- **Infrastructure:**
 - Put Few Cars on the Road
 - Very Few Kids in Schools

Exponential Growth in Data Demand

- Growth of Permitted data center floor space:¹⁰
 - 2016: 8.8 mil. sq. ft.
 - 2017: 10.1 mil. sq. ft. (14.7% increase)
 - 2018: 13.1 mil. sq. ft. (29.7% increase)
 - 2019: 18.3 mil. sq. ft. (39.7% increase)
 - 2020: 21.5 mil. sq. ft. (17.5% increase)
 - 2021: 26.4 mil. sq. ft. (22.8% increase)
 - 2022: 28.1 mil. sq. ft. (6.4% increase)
 - 2023: 31.9 mil. sq. ft. (13.5% increase)
 - 2024: 41.2 mil. sq. ft. (29.2% increase)
 - 2025: 53.0 mil. sq. ft. (14.0% increase)

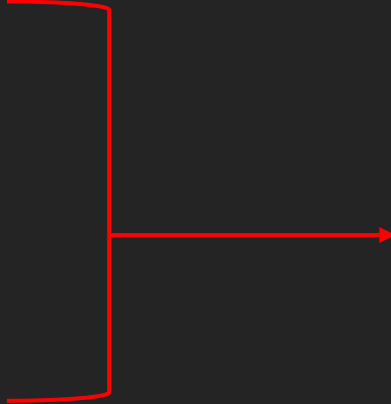
2016-2020 = 144% Increase

2021-2025 = 100% Increase

Exponential Growth in Power Demand:

- Power Consumption in Loudoun County:¹¹

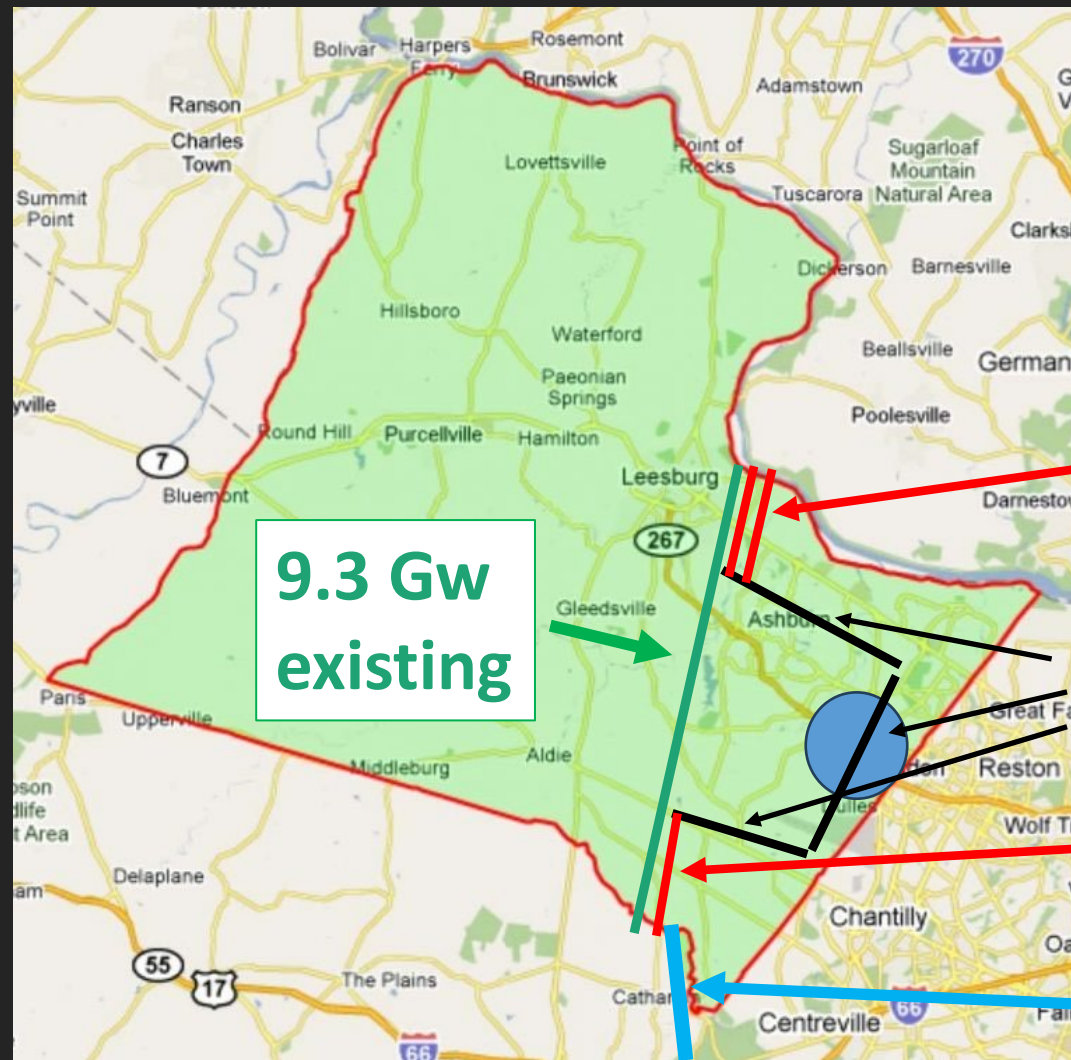
- 2018: 1 Gw (chart interpolation)
- 2019: 1.5 Gw (chart interpolation)
- 2020: 1.6 Gw (chart interpolation)
- 2021: 2.0 Gw (chart interpolation)
- 2022: 2.8 Gw (chart interpolation)
- 2023: 3.4 Gw (chart interpolation)
- 2024: 4.14 Gw (actual)
- 2025: 5.33 Gw (actual)



2020-2025 = 233%

- Same Linear Progression Over the Next 5 Years = **14.2 Gw by 2030**
- BUT...Artificial Intelligence (AI) Will Increase Existing Data Rack Power Consumption from 10-14 Kw/rack to 100+ Kw/rack = **20+ Gw by 2030**

Based on 5 yr. trend, total needed by 2030 is 14.2 Gw, but that does not count AI growth.



8.6 Gw new planned
= 17.9 Gw total
available by 2030

4.2 Gw new

2.85 Gw connection
(5.7 new to "DC Alley")

2.1 Gw new

2.3 Gw HVDC new

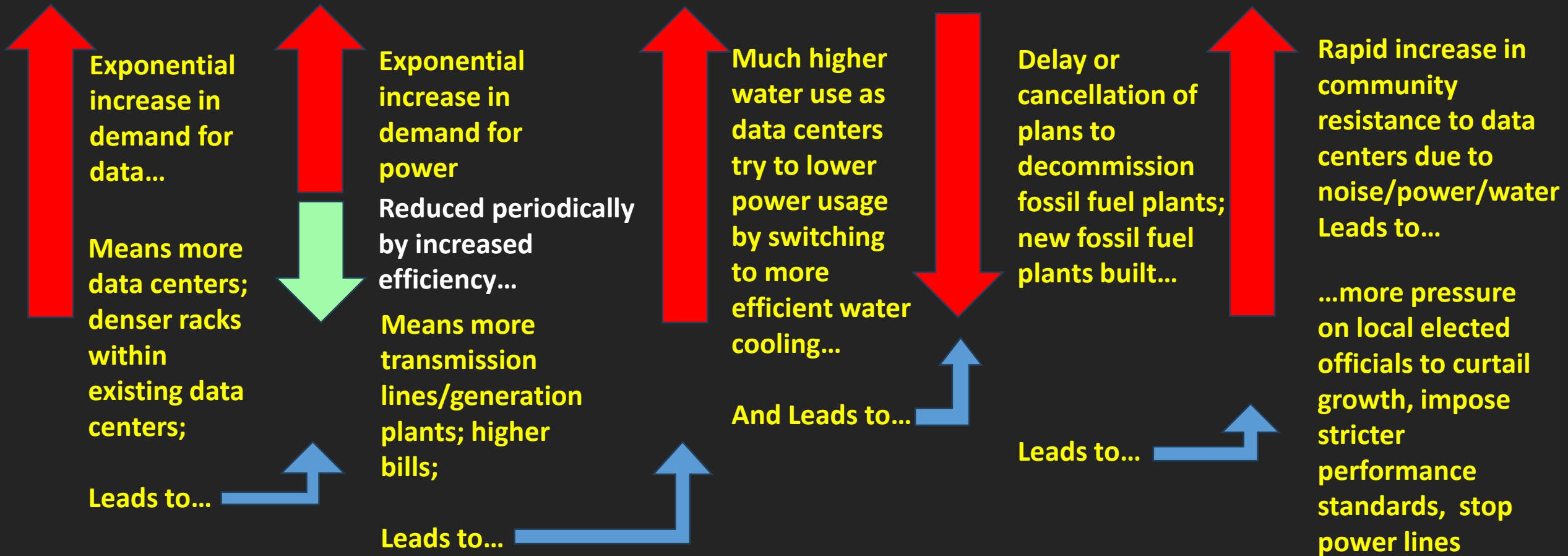
Bottom Line: These Won't Be Enough!

Loudoun County: Current Assessment

Our Realities (author's opinion)

1. Loudoun power grid is oversubscribed and will likely worsen; PJM/Dominion's planned infrastructure buildout will not keep up with demand; confirmed by JLARC study³²
2. With AI, halting new data center construction will slow but not solve our problem
3. Decommissioning/closing of fossil fuel plants throughout PJM service area will be slowed or reversed²⁰
4. Community resistance to power infrastructure expansion will grow rapidly
5. Solar and wind not viable (capacity factor)
- 6. The 135-yr. old paradigm of power generated by large remote power plants and transmitted across hundreds of miles of transmission lines will not work for Loudoun County**

National Assessment: Five, Community-Specific Developing Trends



The Most Likely Near Term Way Ahead

Three Possible Scenarios:

1. Scenario #1: Utilities or Government Artificially Constrain Demand

- A. Utilities delay or deny applications based on generation/transmission capacity limits (currently happening de facto)

2. Scenario #2: Technological Breakthrough

- A. New Nvidia chip uses 1000x less energy to process AI; 2,300% savings
- B. Jevon's paradox; more efficient use of a resource leads to more resource used

3. Scenario #3: Onsite Power Microgrids with Strict Performance Standards

- A. Onsite power is developing NOW!
- B. Local communities MUST enforce performance standards!

C. Immediate, transitional solutions: Fuel Cells or Gas Turbines

D. Long-term solutions: SMRs and HVDC underground regional network

Capacity Factor: Choosing an Onsite Baseload Power Source

- Capacity Factor Definition³⁰
 - Annual hours operated at max. capacity / (8,670 annual hours)
 - Examples:
 - 1 MW max. capacity averaging .5 MW every hour for a year / 8,670 hrs. = 50%
 - 1 MW max. capacity averaging 1 MW over 4,380 hours for a year / 8,670 hrs. = 50%
- Actual Capacity Factors in 2024 of Various Power Sources³¹

2024	Geothermal	Hydroelectric	Nuclear	Biomass	Gas	Solar	Wind
Capacity Factor	65%	34.5%	92.3%	59.0%	59.7% (90+%)	23.4%	34.3%

What Is a Microgrid?

Five Elements²⁴

- Large Power Consumer (existing)
- Power Grid Connection (existing)
- Onsite Baseload Power Source (24/7/365 maximum power source)(new)
- Onsite Backup Power Source (existing)
- Onsite Energy Storage System (new)

Possible Baseload Power Sources (current/new):

- Blue Hydrogen Fuel Cells (Noise-free; only emission is low level CO₂)
- Gas Turbines (Natural Gas; Biomass Gas)²⁵
 - Should always include Selective Catalytic Reduction (reduces NOX emissions by 95%; CO emissions by 85% (with ammonia); **still produces PM2.5 and CO₂**)
- Small Modular Reactors (new technology)
 - X-Energy/Oklo helium/sodium fast reactors 2-3 years from licensing

What Is a Microgrid?

Backup Power Sources

- Diesel Generators
 - Should be Tier IV; most are now Tier II
- Energy Storage Systems
 - Battery Energy Storage Systems (BESS; lithium ion; fire hazard; 4-hr. storage)
 - Long Duration Energy Storage Systems (LDES; 10+ hrs of storage)
- Hydrogen Fuel Cells
 - **Green:** Solar power strips Hydrogen and Oxygen from H₂O; combined at a catalyst; no noise/emissions
 - **Blue:** Natural gas from utility pipeline is reformed inside each fuel cell to produce hydrogen and oxygen and generate power; noise-free, only emission is low levels of CO₂

Choosing a Microgrid Power Source

Power Source Type	Baseload Capacity	Carbon Net Zero	NOX, CO, PM2.5, CO ₂
Tier IV Diesel Backup Generators or Tier II with SCR and DPF			No (CO ₂)
Energy Storage Systems (BESS; LDES)		✓	✓
Natural Gas Turbines w/SCR	✓		No (PM 2.5, CO ₂)
Green Hydrogen Fuel Cells		✓	✓
Blue Hydrogen Fuel Cells	✓		No (CO ₂)
Small Modular Reactor (*Future)	✓ *	✓	✓

15 Best Practices for Communities

Six Factors Communities Must Address When Considering Data Centers:

1. Noise 2. Power 3. Water 4. Emissions 5. Setback 6. Appearance

Basic Rules:

- Make sure your Comprehensive Plan lists performance standards and your Zoning Ordinance aligns with the plan; make sure both are current.
- Never allow “by right” data center development; require local jurisdiction approval.
- Never sign a Non-Disclosure Agreement.

Noise

1. Conduct a pre- and post-construction noise study (dBA and dBC). dBA is audible noise; dBC is Tonal/Narrow band low-frequency humming. dBC has the worst health effects and usually occurs in a single, narrow band.

15 Best Practices for Communities (cont.)

Noise (cont.)

2. Pass a noise ordinance/zoning ordinance that limits noise to a maximum of 50 dBA (audible sound) perceived noise at the sending property line and reduces dBC to background noise levels. (Option: Limit post-construction to a % of pre-constr.)

Power

3. Require utilities to specify, in writing, the maximum power requested by the data center; how the utility plans to deliver power (routing, overhead, substations, etc.); require Board approval to exceed.
4. Build data centers near existing power lines but no closer than 2x the ROW
5. Require substations to be onsite or adjacent and included in the application; never allow "by right" separate substation development or to call them "accessory use."
6. For energy storage, use long duration storage systems (10 hours of storage minimum), not lithium-ion batteries which are not long duration systems.

15 Best Practices for Communities (cont.)

Water

7. Require the data center and water utility to specify in writing how much water the data center will use annually.
8. Determine whether the data center will use air cooling, open loop water cooling or closed loop water cooling.
9. Determine whether the data center will use potable water or reclaimed water
10. Determine how the data center will purify its wastewater and whether the local water treatment facility can adequately process the wastewater.

Emissions

11. Require Tier IV backup generators or Tier II generators with Selective Catalytic Conversion (SCR) attached. If using natural gas turbines, require SCR using ammonia as the catalyst. **Require strict noise limits; require no PM2.5**

15 Best Practices for Communities (cont.)

Setback

12. 500' minimum setback from residential; 1,000' preferred.

Appearance

13. Require natural screening, berms, fenestration (windows) on principal facades.

14. Limit building height, Floor Area Ratio (FAR) to ensure compatibility with surrounding structures.

15. Encourage microgrid design within the data center campus for future use (Microgrid: large power consumer, baseload power source, backup power source, long-duration storage, grid connection).



Resource Page

Questions?

Endnotes

1. <https://www.rtoinsider.com/30472-pjm-orders-dominion-immediate-need-projects-load-jump-data-center-alley/>
2. <https://www.pjm.com/-/media/committees-groups/committees/teac/2023/20230110/item-04---data-center-load-planning.ashx>
3. https://www.loudountimes.com/news/lansdowne-residents-oppose-route-7-transmission-line-proposal/article_46190288-639f-11ee-9908-7722c63f7ffd.html
4. PJM. “Transmission Expansion Advisory Committee (TEAC) Recommendations to the PJM Board.” PJM. Dec. 11, 2023. Slide 44, last entry in table. <https://pjm.com/-/media/committees-groups/committees/teac/2023/20231205/20231205-pjm-teac-board-whitepaper-december-2023.ashx>
5. PJM advances proposal for transmission line in western Loudoun | 1local | loudountimes.com
6. Loudoun County FY2025 Appropriations Resolution; Commissioner of Revenue.
7. “City of Alexandria Revenues.” City of Alexandria. 2024. Pg. 7-19 table. <https://www.alexandriava.gov/sites/default/files/2023-02/Section%2007%20Revenues%20FY24.pdf>
8. Northern Virginia Technology Council. “The Impact of Data Centers on Virginia’s State and Local Economies 5th Biennial Report.” April, 2024. Pg. 7.
9. United States Data Centers: Top 10 Locations in the USA - Dgtl Infra. <https://dgtlinfra.com/united-states-data-centers/>
10. Loudoun County Commissioner of the Revenue, May 31, 2024.
11. Abdulsalam, Sami. “Dominion Northern Virginia Area Immediate Need.” Slide #2, “Data Center Alley Area Load Growth and Transmission System.” Slide #3, “Dominion 2022 Load Forecast.” Data interpolated from data center load forecast line (orange). June 7, 2022. <https://www.pjm.com/-/media/committees-groups/committees/teac/2022/20220712/item-08---dominion-northern-virginia---immediate-need.ashx>
12. Joint Legislative Audit Review Commission. “Data Centers in Virginia: 2024.” December 9, 2024. Chart on pg. 7. <https://jlarc.virginia.gov/pdfs/reports/Rpt598.pdf>
13. Kimley Horn. “Power Transmission Evaluation of Loudoun County, Virginia. Due Diligence Report.” September, 2024
14. Abdulsalam, Sami. “Dominion Northern Virginia Area Immediate Need.” Slides #8, #9. <https://www.pjm.com/-/media/committees-groups/committees/teac/2022/20220712/item-08---dominion-northern-virginia---immediate-need.ashx>
15. <https://openinframap.org/#11/38.941/-77.3388>
16. Power Engineers. “500 kV AC/DC Extra-High Voltage Transmission Project.” Power Engineers. 2024. <https://www.powereng.com/library/500-kv-acdc-extra-high-voltage-transmission-project>

17. Solar.com. “Solar Panel Efficiency - Pick the Most Efficient Solar Panels.” 2024. <https://www.solar.com/learn/solar-panel-efficiency/>
18. Community Solar Authority. “How Much Land For 1 Mw Solar Farm: A Quick Guide.” May 31, 2024. <https://communitysolarauthority.com/how-much-land-for-1-mw-solar-farm-a-quick-guide/>
19. Vineyard Wind. “Avangrid, CIP Announce First Power from Nation-Leading Vineyard Wind 1 Project.” Vineyard Wind. January 3, 2024. <https://www.vineyardwind.com/press-releases/2024/1/3/cip-avangrid-announce-first-power-from-nation-leading-vineyard-wind-1-project>
20. Plumer, Brad and Popovich, Nadja. “A New Surge in Power Use is Threatening U.S. Climate Goals.” The New York Times. March 14, 2024.
21. Plumer, Brad. “The U.S. Urgently Needs a Bigger Grid. Here’s a Fast Solution.” The New York Times. April 9, 2024. <https://www.nytimes.com/2024/04/09/climate/electric-grid-more-power.html>
22. Berthou, Andreas. “The Benefits of High-Voltage Direct Current (HVDC) Power.” EE Power. October 19, 2020. <https://eepower.com/technical-articles/the-difference-that-dc-makes/#>
23. 10 USC, Title 10, Section 2911. [https://uscode.house.gov/view.xhtml?req=\(title:10%20section:2911\(b\)%20edition:prelim\)](https://uscode.house.gov/view.xhtml?req=(title:10%20section:2911(b)%20edition:prelim))
24. NREL. “Microgrids.” <https://www.nrel.gov/grid/microgrids.html>
25. <https://enchantedrock.com/>
26. ABB. “What Are Battery Energy Storage Systems?” <https://electrification.us.abb.com/battery-energy-storage-systems-bess-basics>
27. <https://oklo.com/overview/default.aspx>
28. <https://www.energy.gov/eere/fuelcells/hydrogen-and-fuel-cell-technology-basics>
29. Inci, Mustafa. “Future vision of hydrogen fuel cells: A statistical review and research on applications, socio-economic impacts and forecasting prospects.” ScienceDirect. October, 2022. <https://www.sciencedirect.com/science/article/abs/pii/S2213138822007871#:~:text=HFC%20technologies%20have%20started%20to%20be%20used%20as,buildings%2C%20industry%20heat%3B%20and%20more%20futuristic%20trend%20implementations>
30. U.S. Energy Information Agency. “Glossary.” U.S. EIA. https://www.eia.gov/tools/glossary/index.php?id=Capacity_factor#:~:text=Capacity%20factor%3A%20The%20ratio%20of,operation%20during%20the%20same%20period
31. U.S. Energy Information Administration. “Table 6.07.B. Capacity Factors for Utility Scale Generators Primarily Using Non-Fossil Fuels” Electric Power Monthly. https://www.eia.gov/electricity/monthly/epm_table_grapher.php?t=epmt_6_07_b
32. Joint Legislative Audit and Review Commission. “Data Centers in Virginia.” Commission Draft. December 9, 2024. <https://jlarc.virginia.gov/pdfs/reports/Rpt598-2.pdf>

33. World Meteorological Organization, WMO-No. 1368. “State of the Global Climate, 2024.”
https://library.wmo.int/viewer/69455/download?file=WMO-1368-2024_en.pdf&type=pdf&navigator=1

Total needed power is 14.2 Gigawatts by 2030

Existing:

Blue = single 230Kv lines countywide

North combination lines:

Red = (1) 500Kv & (2) 230Kv

South combination lines

Red = (2) 500Kv & (2) 230Kv

New:

North Black Lines = (2) 500Kv

South Black Line = (1) 500 Kv

Red Dashed = 500/230Kv combined (3 segments)

Green = 525 HVDC undergrounded

Orange dot = 770 Mw Gas power plant

Not included are the new 230Kv lines

Across the northern portion (not pictured)

- Existing: (1) 500 Kv line
- New: (1) 500 Kv & (1) 765 Kv

