Loudoun County
VIRGINIA
WHERE TRADITION MEETS INNOVATION

White Paper

Ashburn, Loudoun County, VA
Data Center Growth and Energy Constraints

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Data Centers: Key Milestones

- 1993 Update of 1972 Zoning Ordinance: No mention of data centers
- 1990's (latter half): Metro Area Exchange-East established in Loudoun County; AOL HQ fiber laid
- 2000 Zoning Administrator determination: Data Centers are viewed similar as office buildings in the 1993 Zoning Ordinance. Office parks hot trend.
- 2001: General Plan (land use) updated
- 2003: Revised 1993 Zoning Ordinance aligns with General 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.
- 2014: ZOAM addressing data center sight, setback, sound
- 2019: General Plan (Comprehensive Plan) Updated

Data Centers: Key Milestones (Cont.)

- 2022 May-Aug: Loudoun TLUC holds meetings to map/manage data center growth through CPAM/ZOAM; Dominion announces Wishing Star/Mars
- 2022 Jul: PJM informs Dominion it has underestimated power need; Dominion constrains "data center alley until new lines in 2027[1, 2]
- 2023: Dominion announces new 500/230 Kv line along Rte. 7 in Loudoun[3] and a new 500 KV line from Doubs-Aspen.[4]
- 2023 Dec: Zoning Ordinance updated to 2019 Comp Plan; SPEX for RDP and OP parcels
- 2023 Dec: PJM accepts NextEra proposal to build 500Kv line as part of the Mid Atlantic Resiliency Link (portion through western Loudoun); significant public resistance[5]
- 2024: Loudoun BOS denies a 2.9 mil. sq. ft./600 Mw data center; finally agrees to the "by right" size of 1.3 mil. sq. ft. and about 100 Mw

Three Converging, Co-dependent, Conflicting Trends



Demand for data will increase exponentially

= More data centers; denser racks within existing data centers; Leads to…



Demand for energy will increase exponentially

Reduced somewhat by increased efficiency

= More transmission lines; delay in decarbonization; Leads to…



Community resistance will increase exponentially

= Pressure on local elected officials to curtail growth, impose stricter performance standards, stop power lines or face election consequences

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 (actual)[12]
  - 2023: 3.4 Gw (2022 forecast)[13]

2018-2023 =240%
(or 3.4X) Increase

- Same Linear Progression Over the Next 5 Years = 11.56 Gw by 2028
- BUT…Artificial Intelligence (AI) Will Increase Existing Data Rack Power Consumption from 10-14 Kw/rack to 60-80 Kw/rack = 20.4-27.2 Gw by 2028

Exponential Growth in Power Demand (cont.):

- Same Linear Progression Over the Next 5 Years = **11.56 Gw by 2028**
- BUT…Artificial Intelligence (AI) Will Increase Existing Data Rack Power Consumption from 10-14 Kw/rack to 60-80 Kw/rack = 20.4-27.2 Gw by 2028

- Kimley Horn Report to Loudoun County: "Power Transmission Evaluation of Loudoun County, Virginia. Due Diligence Report"[14]
- Approximately 200 Data Centers (buildings) now in Loudoun County
  - 148 parcels with new applications; 72 with site plans = 84 new buildings
  - 76 parcels have no site plan, but Kimley Horn est. is 33 more buildings
  - 117 new buildings @ avg. 70 Mw/building = 8.19 Gw needed by 2028
  - 2023 PJM Projected Use: 3.4 Gw + 8.19 Gw = **11.59 Gw by 2028**

Loudoun County Current and Planned Transmission Lines[16]

- Utility companies are required, by law, to provide power to all customers
- Transmission lines require 100'-150' of easement
- *500 Kv line = 2.1 Gw; 230 Kv line = 750 Mw (distance dependent; est.)[17]
- Current transmission lines bringing power into Loudoun County:
  - From the north: (1) 500 Kv line = 2.1 Gw; (2) 230 Kv lines = 1.5 Gw
  - From the south: (2) 500 Kv line = 4.2 Gw; (2) 230 Kv line = 1.5 Gw
  - Total currently coming into Loudoun: 9.3 Gw, but not to "Data Center Alley"
  - Data center loop (Aspen/Golden/Mars/Wishing Star)
- Planned new lines bringing more power by 2028 (earliest):
  - New Doubs-Aspen line: (1) 500 Kv line = 2.1 Gw
  - Mid-Atlantic Resiliency Link: (1) 500 Kv line = 2.1 Gw
  - New Morrisville-Wishing Star line: (1) 500 Kv line = 2.1 Gw
  - Total planned: 15.6 Gw by 2028 (but only 2.85 Gw thru loop added to current 3.4 Gw = 6.25 Gw to Data Center Alley)

*Peak capacity about double avg. load

Capacity Factor: Choosing a Microgrid Power Source

- Capacity Factor Definition[31]
  - 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 2023 of Various Power Sources[32]

2023	Geothermal	Hydroelectric	Nuclear	Biomass	Gas	Solar	Wind
Capacity Factor	70%	34.2%	93.1%	50.6%	61.7%	23.3%	33.5%

Choosing a Microgrid Power Source

Power Source Type	Baseload Capacity	Carbon Net Zero	NOX, PM2.5 Free
Diesel Backup Generators w/SCR		Tier IV	Tier IV
Battery Energy Storage Systems		✓	✓
Natural Gas Turbines w/SCR	✓	Tier IV	Tier IV
Green Hydrogen		✓	✓
Blue Hydrogen			
Small Modular Reactor	✓	✓	✓

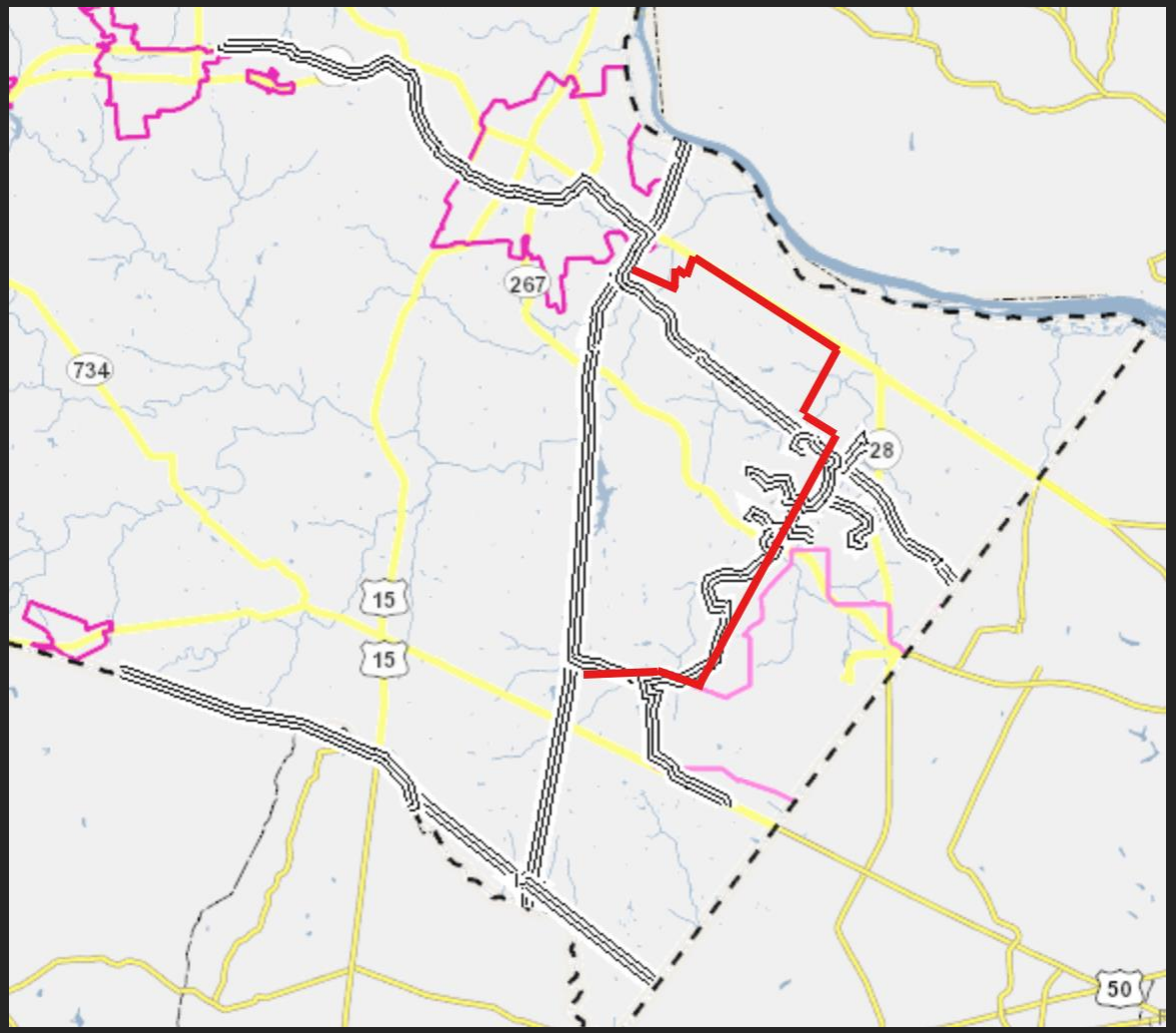
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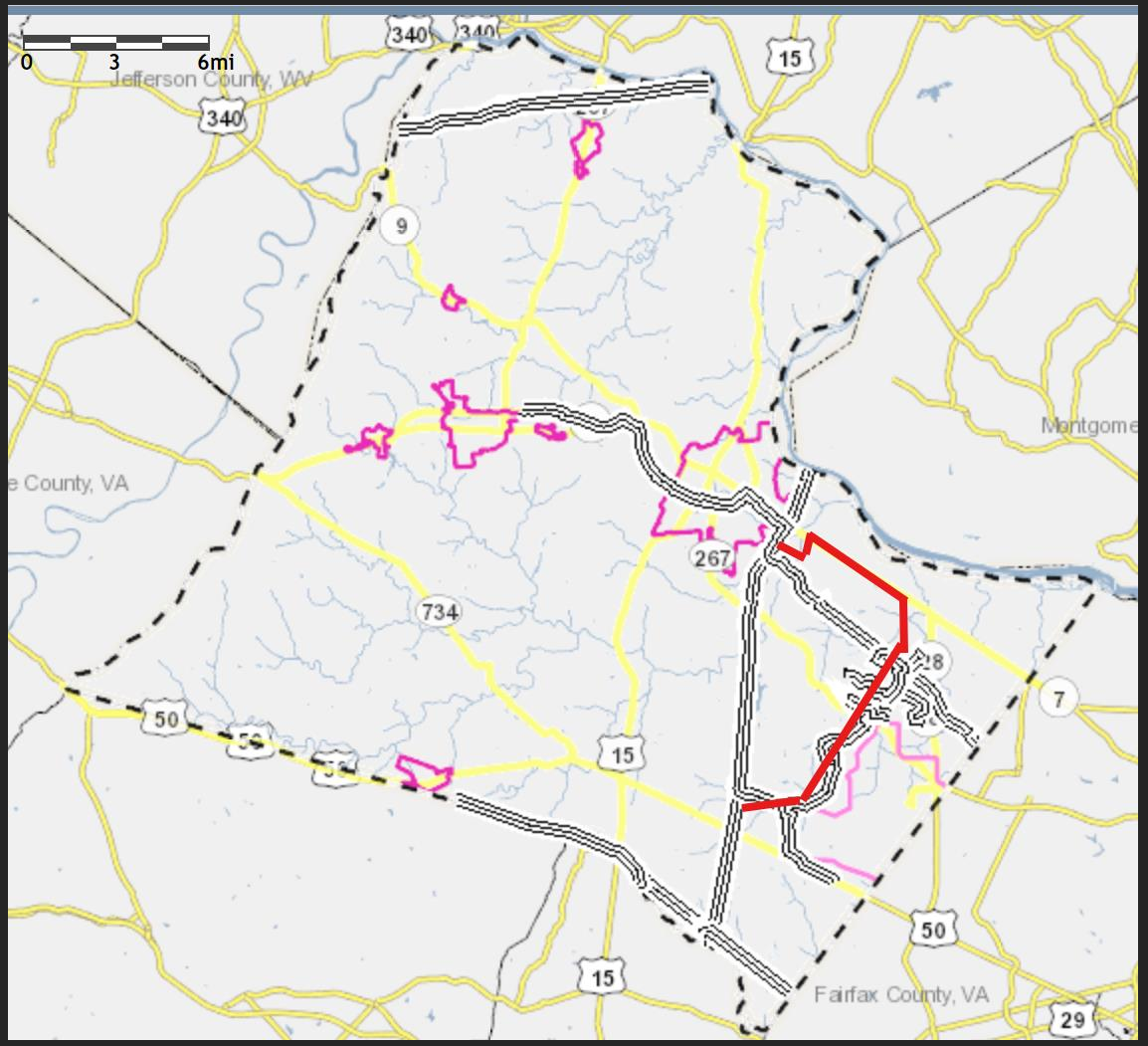
Questions?

Endnotes

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