Planning for the Infrastructure of the Digital Age

Christopher Miller

President, Piedmont Environmental Council

Mission

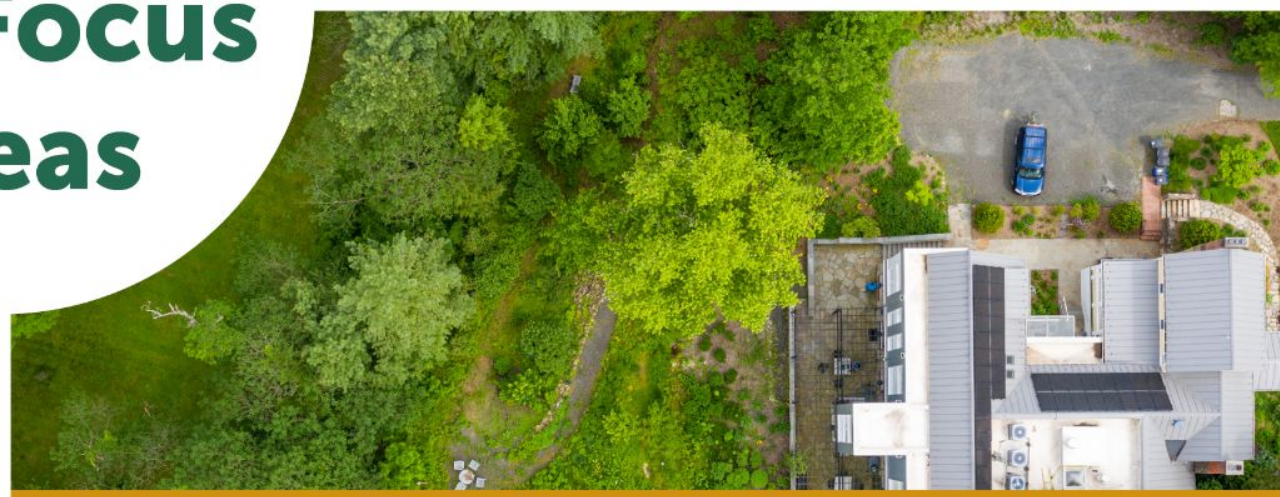
Protect and restore the lands and waters of the Virginia Piedmont, while building stronger, more sustainable communities.

Conserving and Restoring the Piedmont's Lands and Waters

Creating Stronger, More Sustainable Communities

PEC Strategic Plan
Key Focus Areas

Shaping and Advancing Virginia's Clean Energy Future



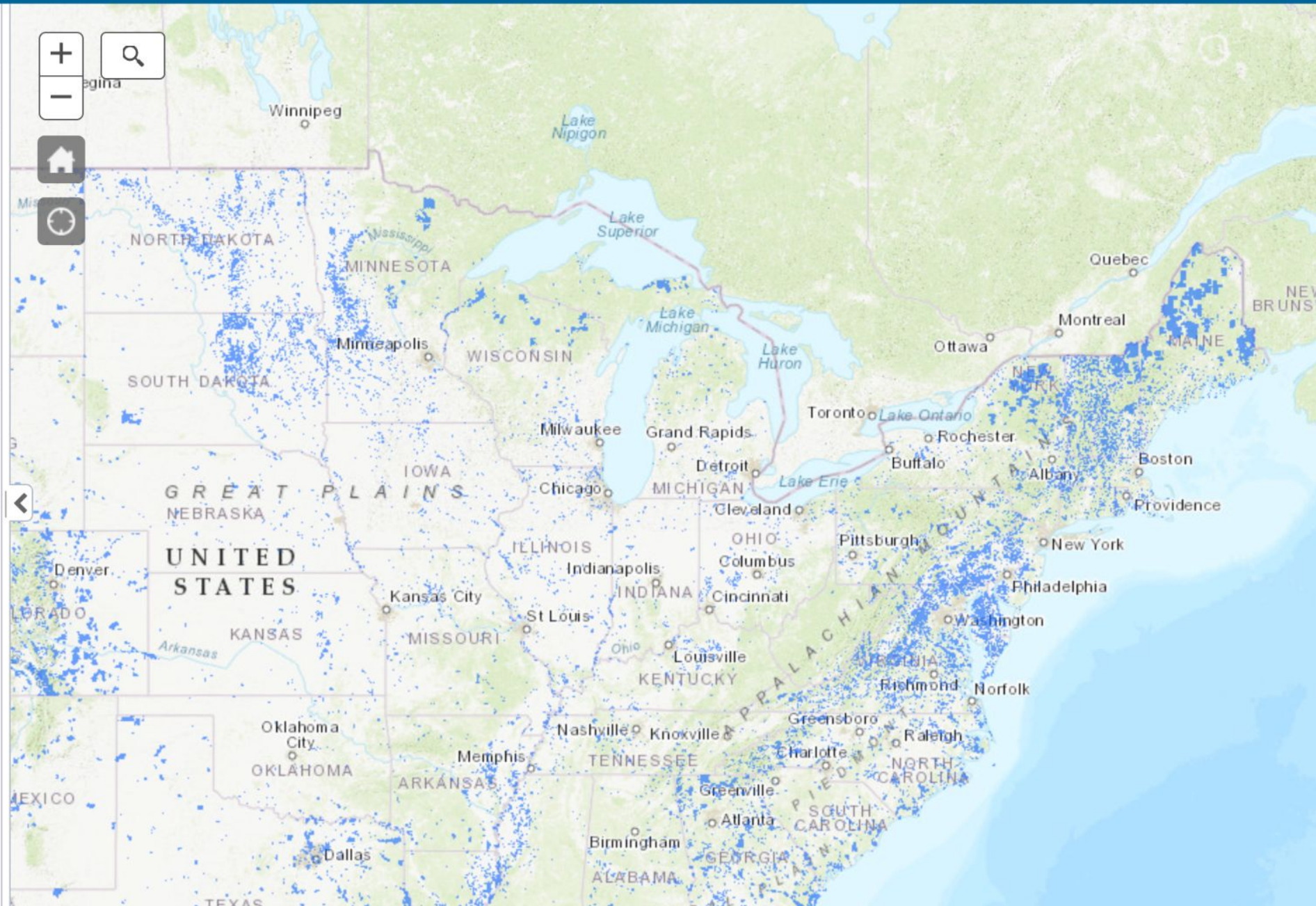
Setting an Example Through Land Ownership

Shenandoah River


This property is
forever protected with a
CONSERVATION EASEMENT
Piedmont
Environmental
Council

NCED Planning Application

National Conservation Easement Database



- Group Easement Selection
- Query Data
- Layers
  - Conservation Easements
    - Conservation Easements
    - Conservation Easements View
  - Overlays
- Bookmarks
- Draw
- Print
- Google Street View

NCED Planning Application

National Conservation Easement Database

- Group Easement Selection
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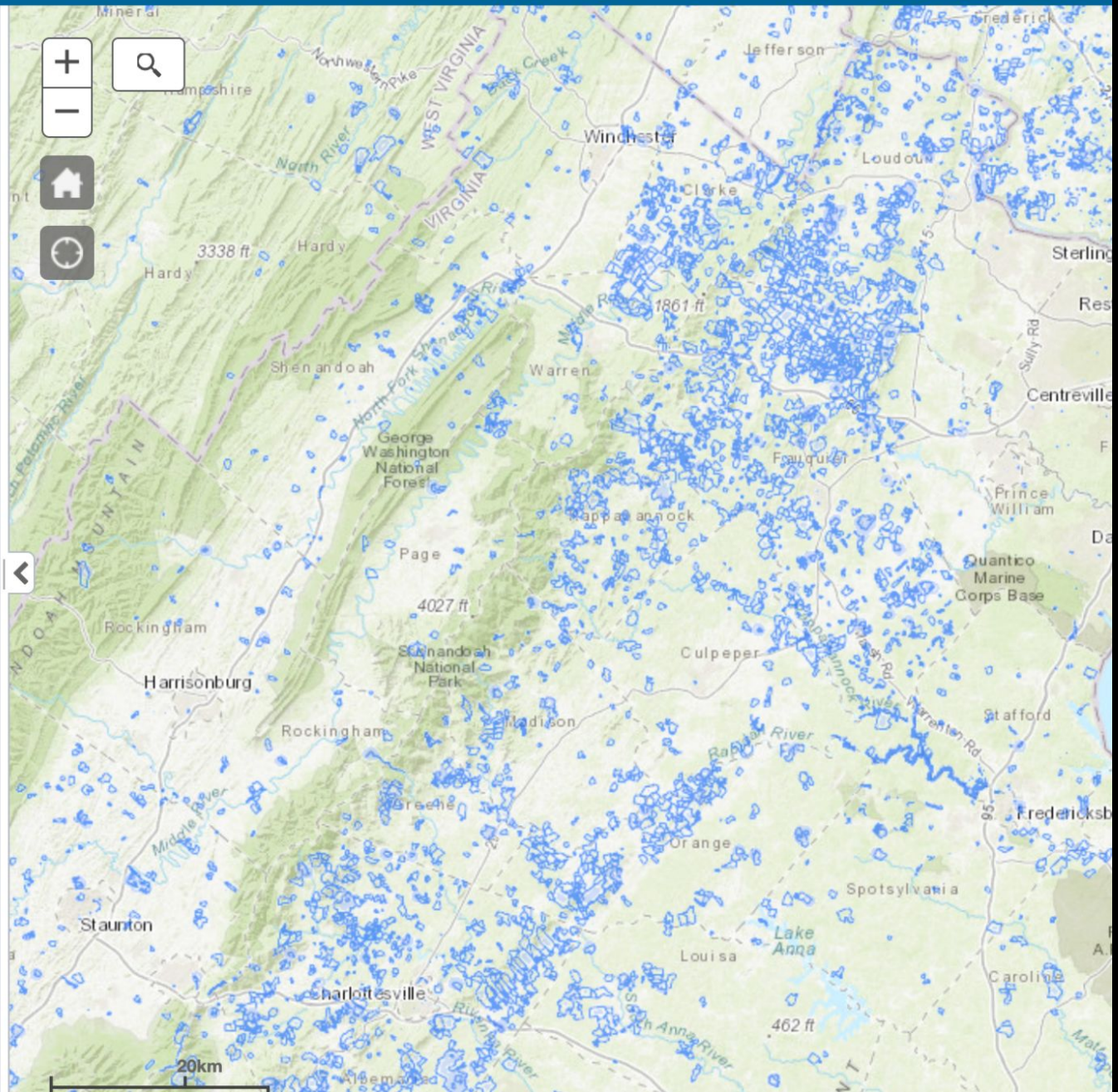

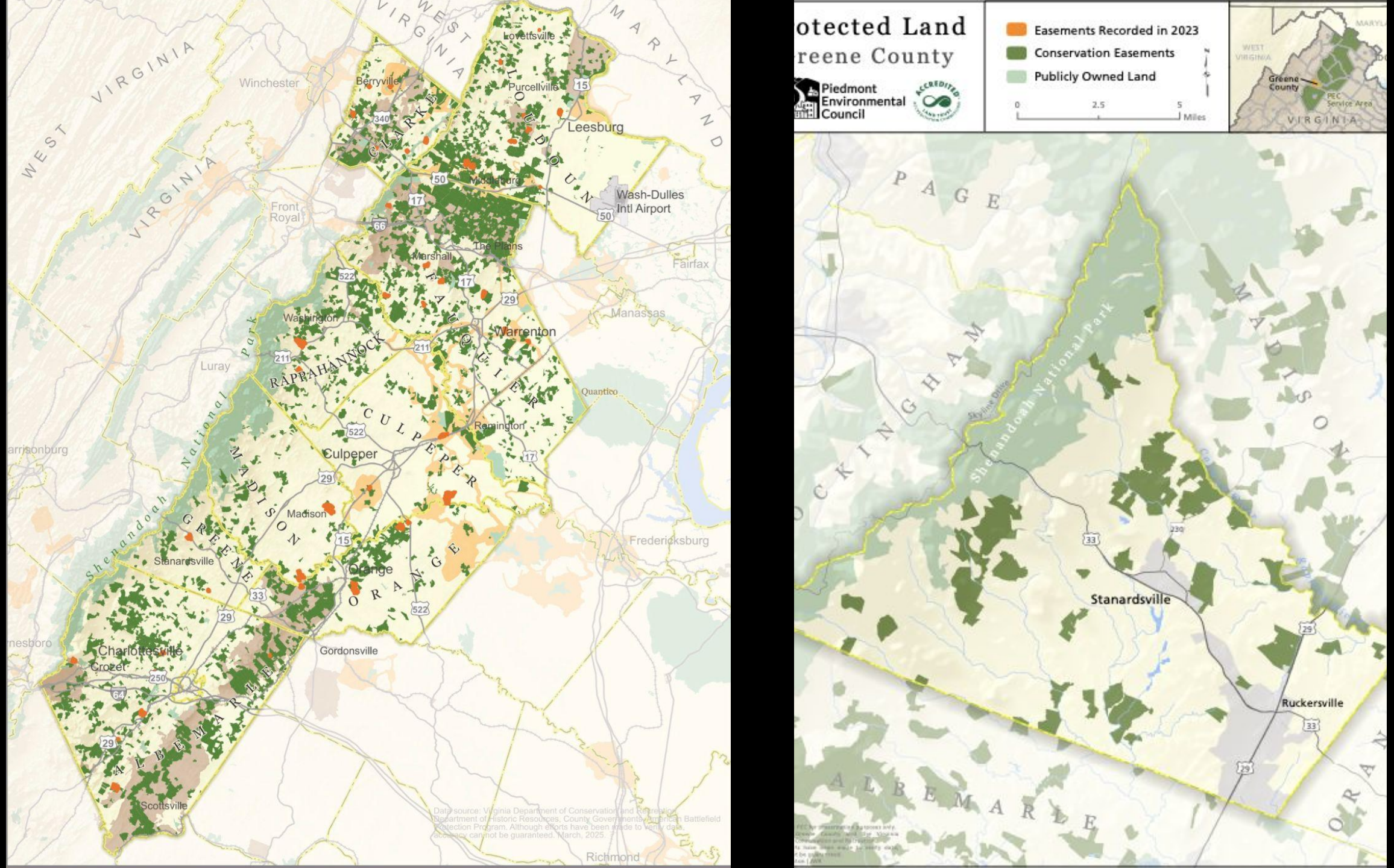
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Piedmont Environmental Council
Easements Recorded in 2023
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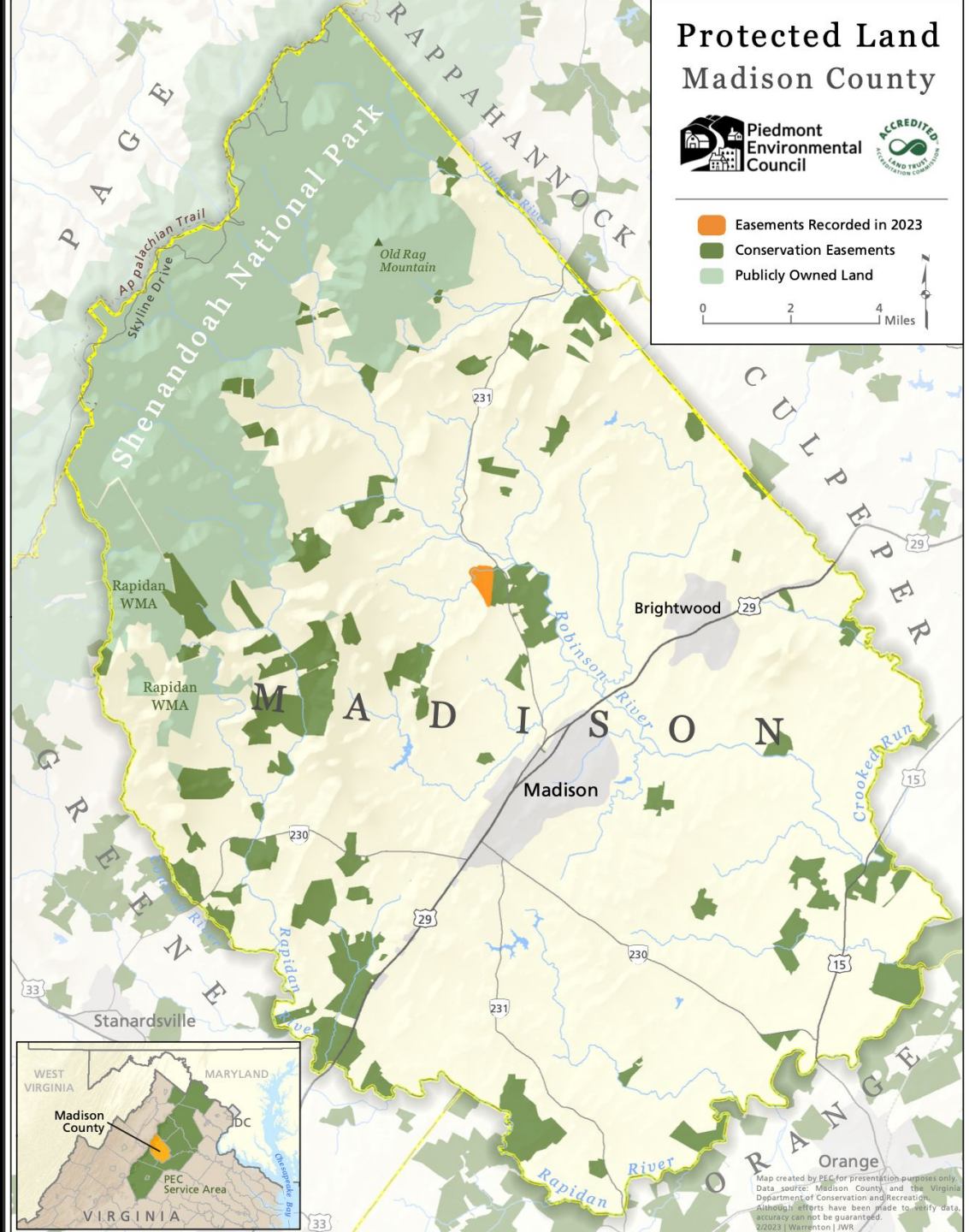
Lovettsville
Purcellville
Leesburg
Middleburg
Wash-Dulles Intl Airport
Front Royal
The Plains
Marshall
Fairfax
Manassas
Warrenton
Washington
Luray
Remington
Quantico
Culpeper
Madison
Stanardsville
Orange
Gordonsville
Fredericksburg
Charlottesville
Crozet
Scottsville
Richmond
Shenandoah National Park
CLARKE
LOUDOUN
FAUQUIER
RAPPAHANNOCK
CULPEPER
MADISON
GREENE
ORANGE
ALBEMARLE
PAGE
ROCKINGHAM
Skyline Drive
Ruckersville


Protected Land
Madison County
Piedmont Environmental Council
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Easements Recorded in 2023
Conservation Easements
Publicly Owned Land
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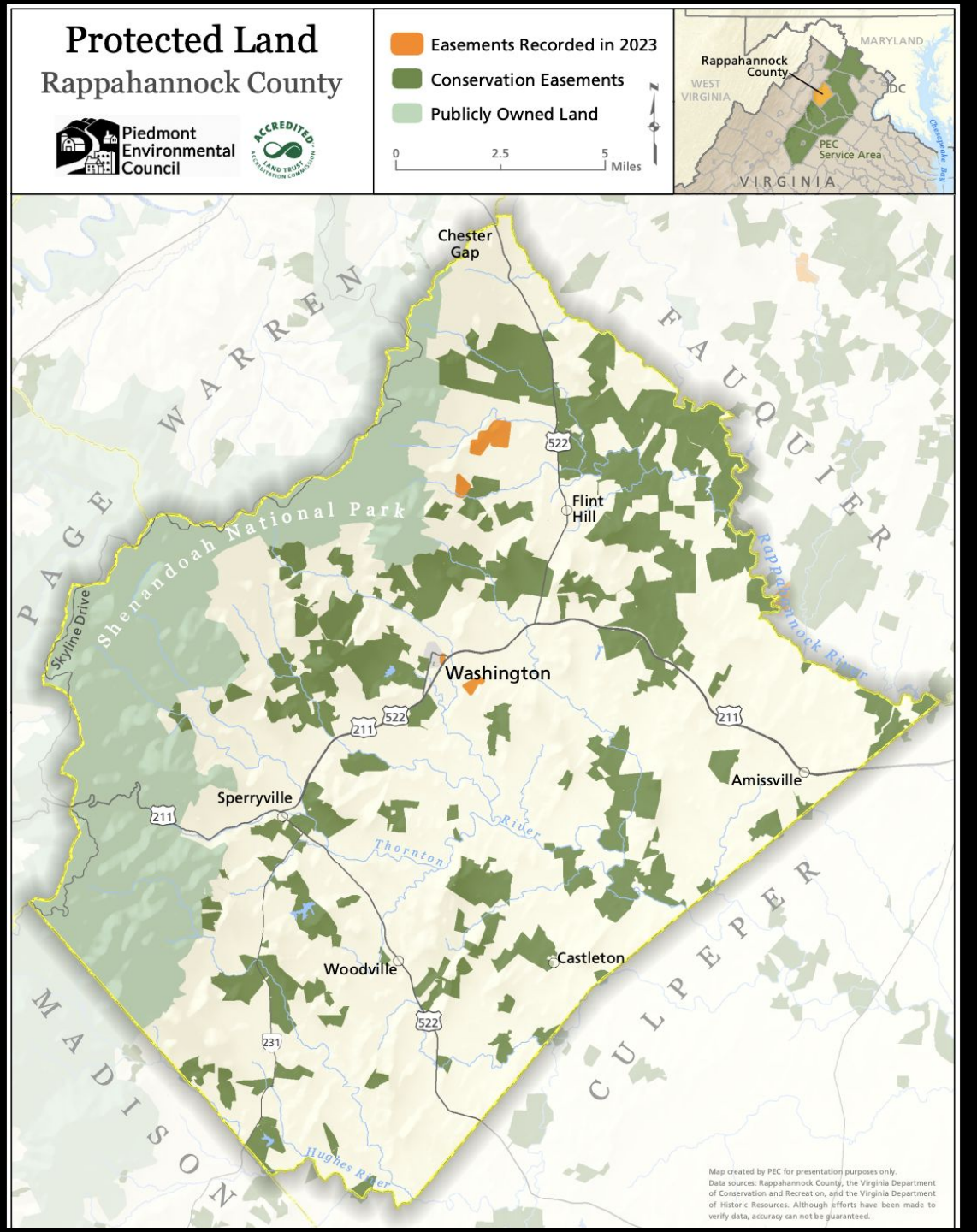
CULPEPER
GREENE
ORANGE
MADISON
Shenandoah National Park
Appalachian Trail
Skyline Drive
Old Rag Mountain
Hughes River
Rapidan WMA
Rapidan WMA
Robinson River
Brightwood
Madison
Crooked Run
Rapidan River
Stanardsville
231
29
230
15
33
WEST VIRGINIA
MARYLAND
DC
Madison County
PEC Service Area
VIRGINIA
Chesapeake Bay
Orange
Map created by PEC for presentation purposes only.
Data source: Madison County and the Virginia Department of Conservation and Recreation.
Although efforts have been made to verify data, accuracy can not be guaranteed.
2/2023 | Warrenton | JWR


Protected Land
Rappahannock County
Piedmont Environmental Council
ACCREDITED
Easements Recorded in 2023
Conservation Easements
Publicly Owned Land
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WEST VIRGINIA
MARYLAND
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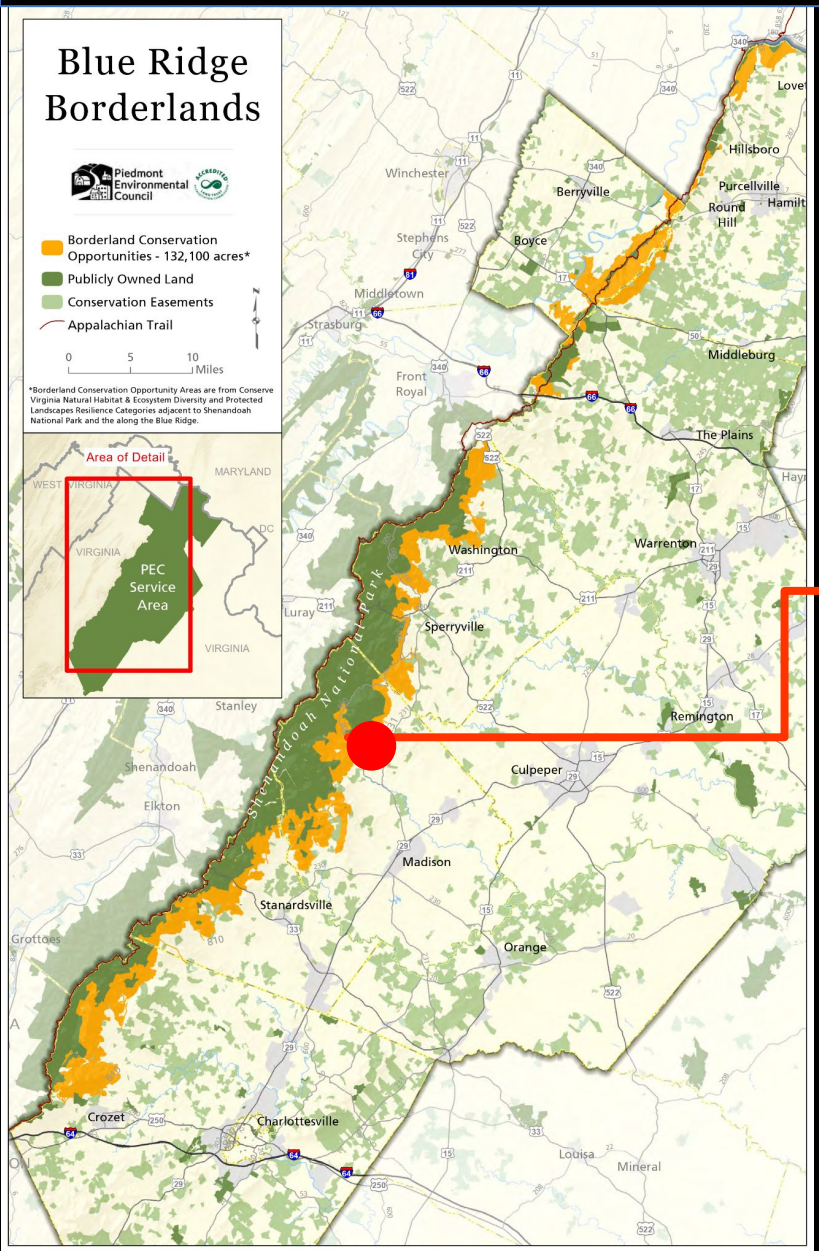
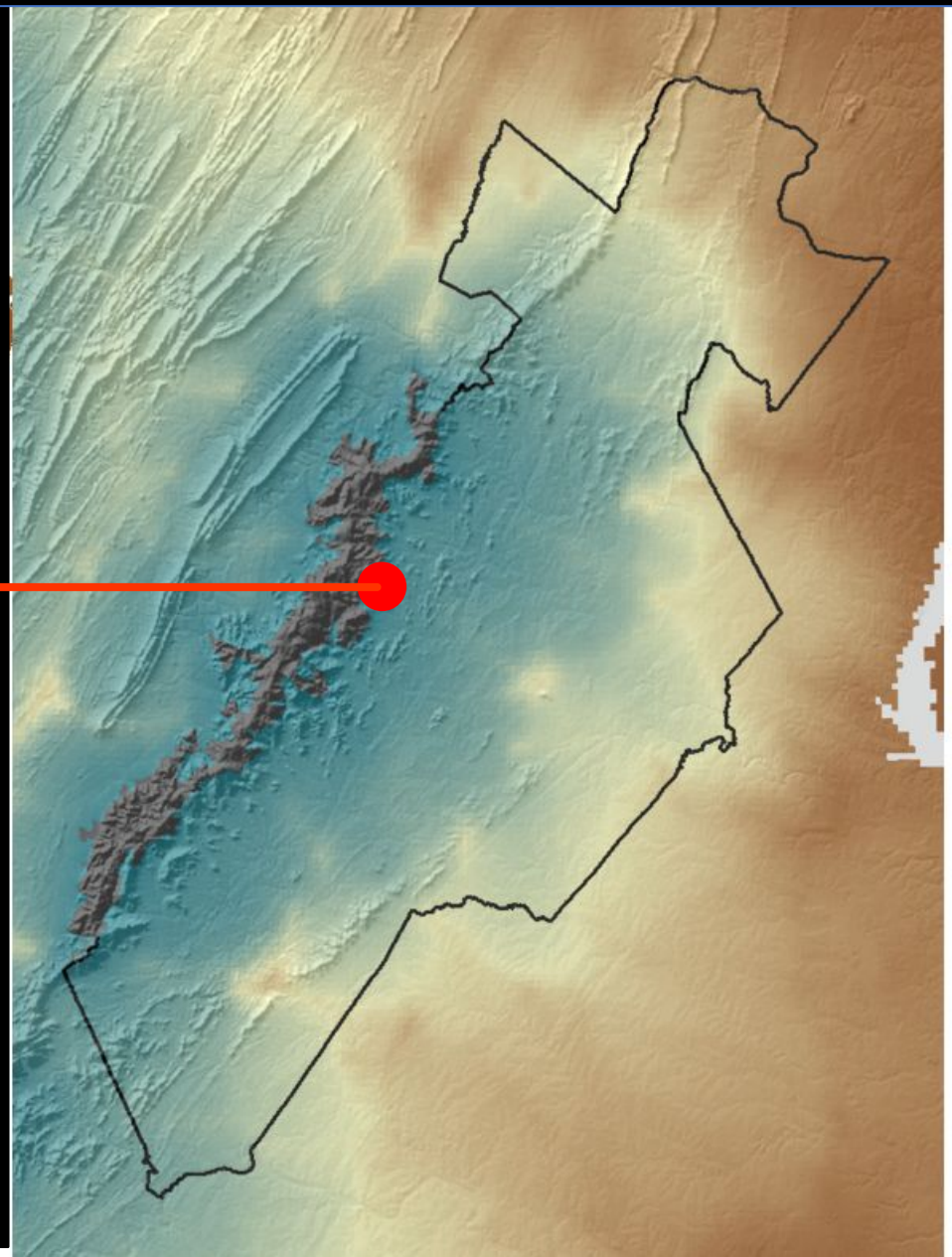
FAUQUIER
CULPEPER
MADISON
Shenandoah National Park
Skyline Drive
Chester Gap
Flint Hill
Washington
Sperryville
Amissville
Woodville
Castleton
Rappahannock River
Thornton River
Hughes River
522
211
231
Map created by PEC for presentation purposes only.
Data sources: Rappahannock County, the Virginia Department of Conservation and Recreation, and the Virginia Department of Historic Resources. Although efforts have been made to verify data, accuracy can not be guaranteed.

Building Momentum Around Blue Ridge Borderlands…



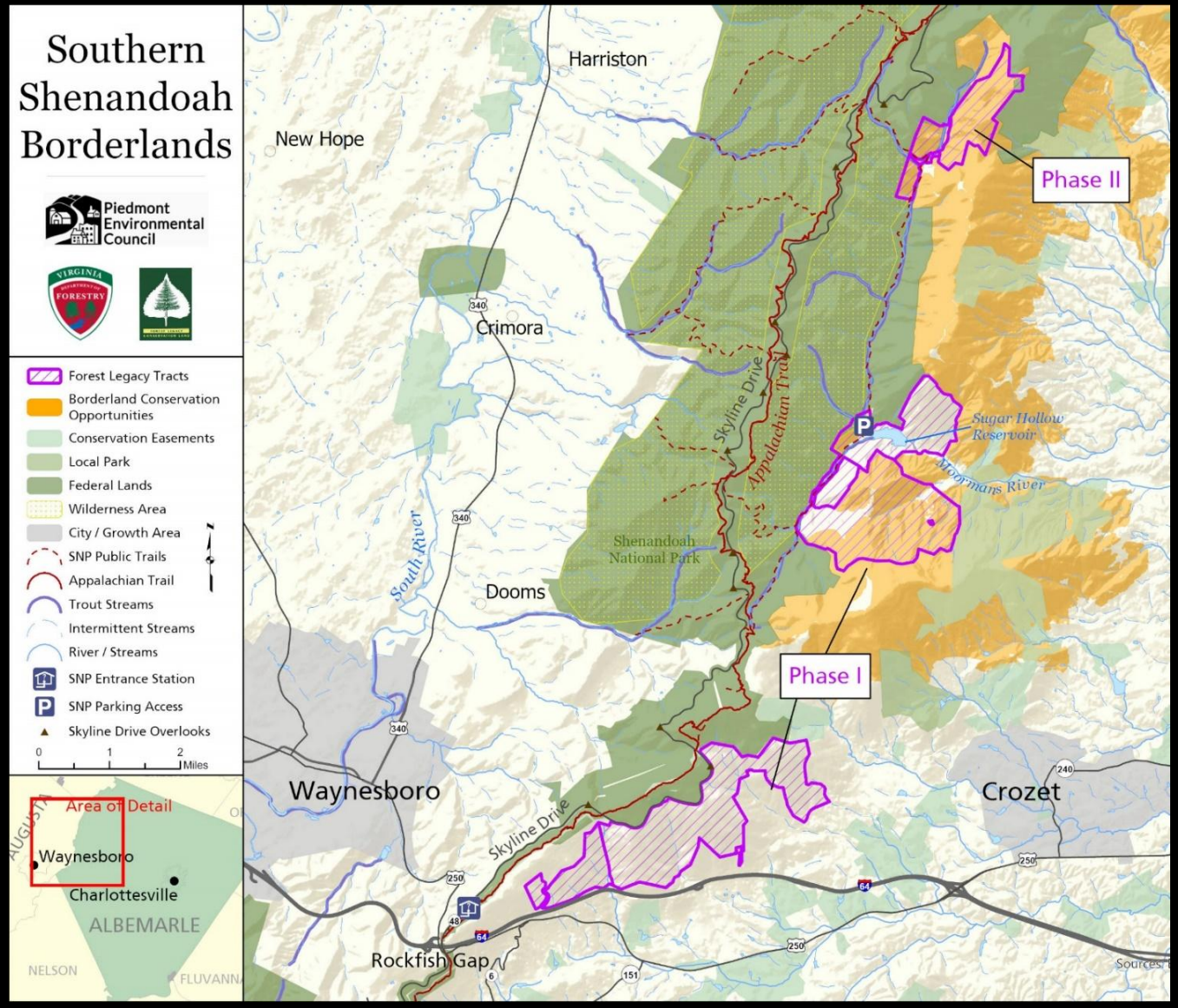
Prioritize protection of 132,000+ acres adjacent to public lands along the Blue Ridge



- AT Landscape Partnership (Strategic Conservation Cmte)
- Shenandoah National Park Regional Conservation Partnership (emerging)

Conserving the Southern Shenandoah Borderlands

Forest Legacy Projects



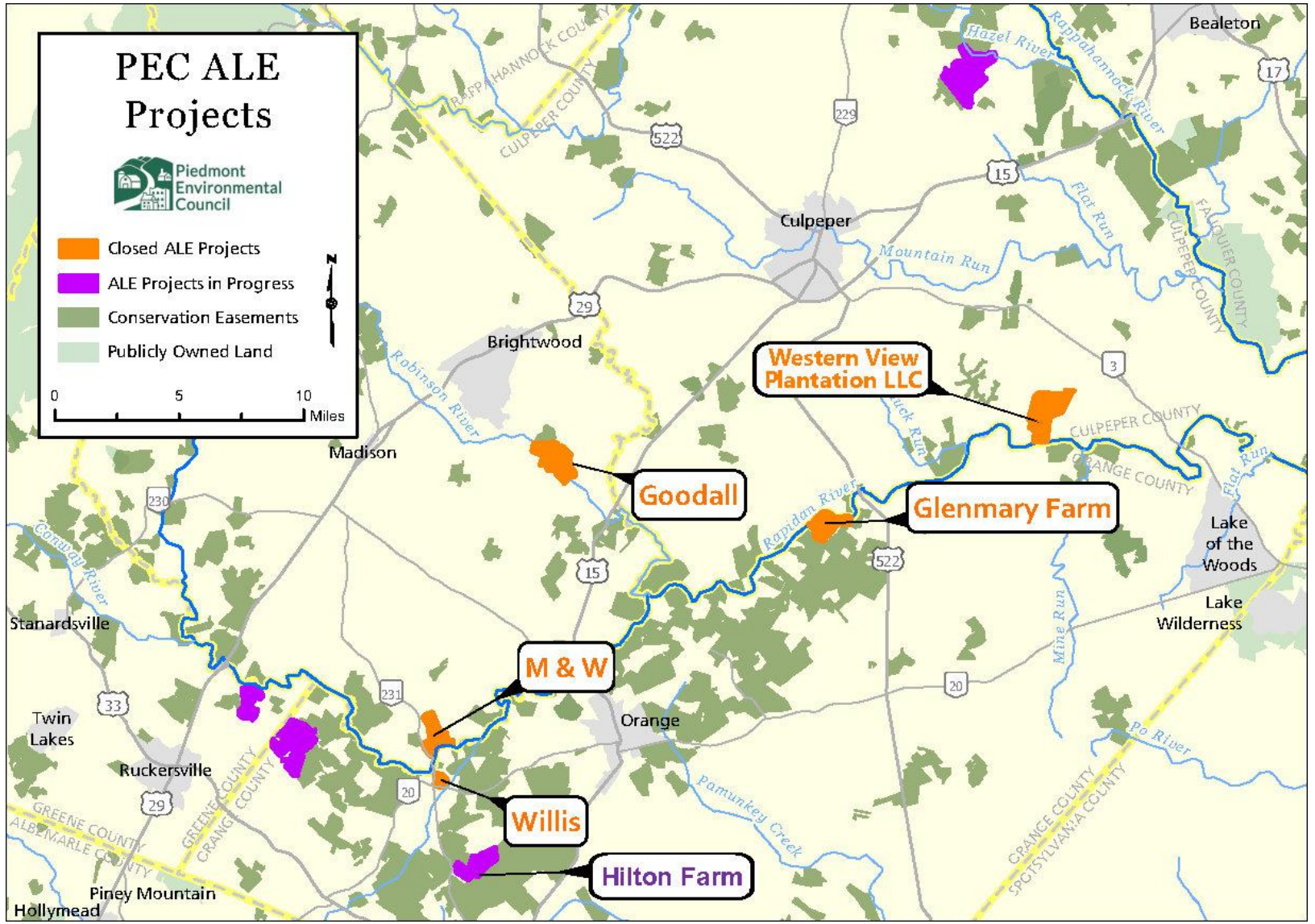
Cedar Mountain is PHASE II of a larger Forest Legacy project, with PHASE I conserving up to 4,300 acres forestland in Albemarle County.

In total, over **5,000** acres of privately owned forest land adjacent to Shenandoah will be permanently protected.

Accelerating conservation in the Rappahannock-Rapidan watershed from the Blue Ridge to the Bay

Piedmont Environmental Council

PEC's Pipeline of ALE Projects



Since 2018, PEC has secured over $6 million through the ALE program to match other public and private funding for the purchase of conservation easements on 10 farms totaling almost 4,300 acres.

In 2024, PEC completed four easements, totaling 1,743 acres within the Upper Rappahannock watershed of Madison, Orange and Culpeper counties.

In 2025, farms in Orange and Greenes are scheduled to be completed

Goodall Farm:

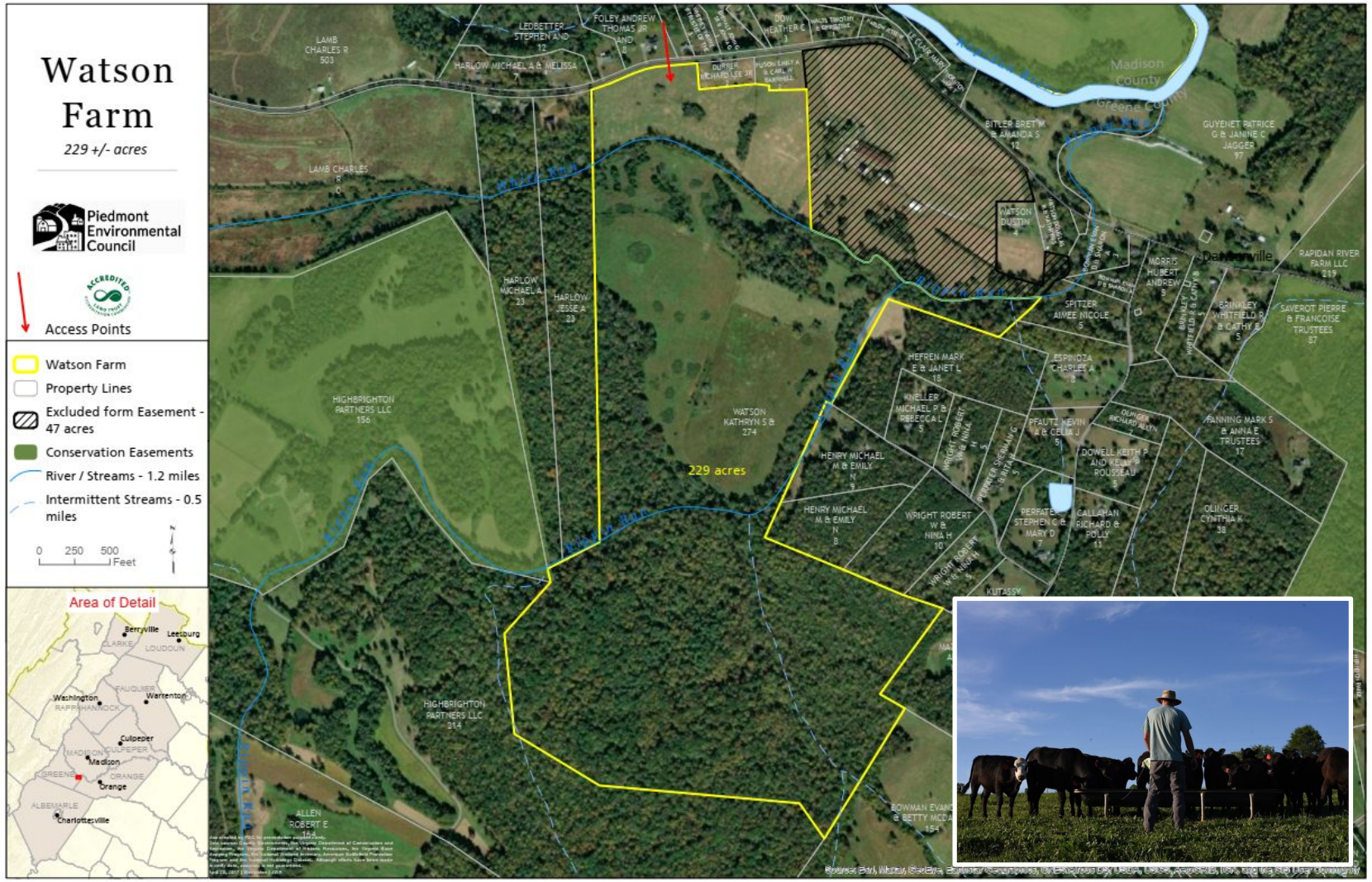
596 acre Century Farm along the Robinson River in Madison County, VA

Goodall Farm:
Over 4 miles of Rivers and Streams

The farm has more than **2.25 miles of frontage along Robinson River** and an additional 2.26 miles of intermittent stream tributaries.

Like most of the Robinson River, Conserve Virginia – a mapping tool created by the Department of Conservation–designates the riparian areas along the farm's streams as "**highest priority lands for conservation in the interest of water quality improvement** in general".

“Loan, Protect, Save” with AFT – Long Acre ALE (Greene County)

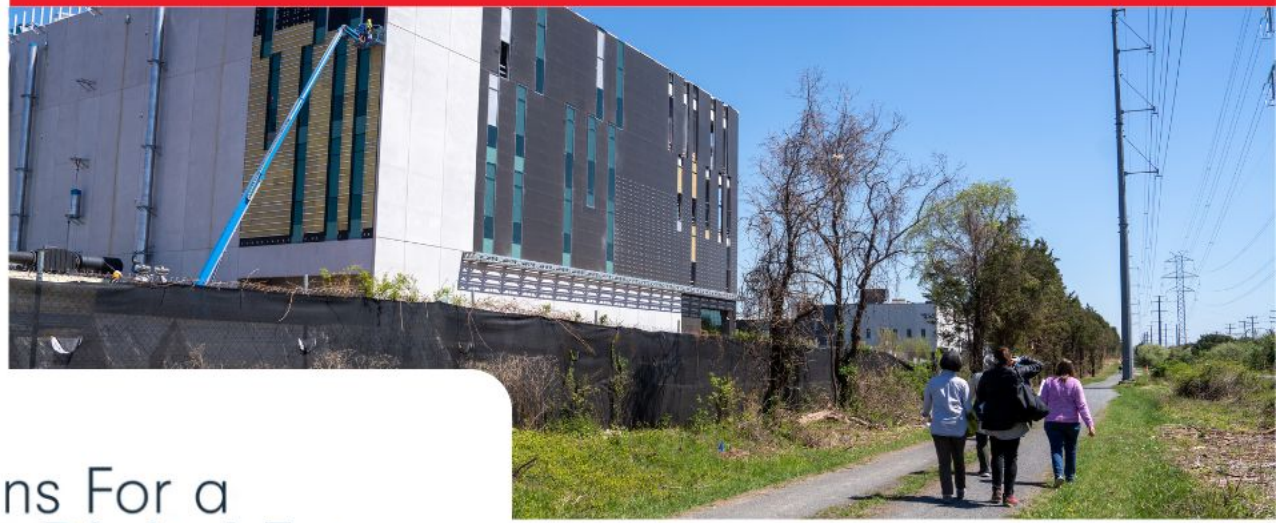


- **Location**: Greene County
- **225 acre Multi-Generational,** Working Cattle Farm
- Farm at-risk due to diverse financial situations of family members
- PEC secured $485K in ALE & $242K in VLCF in 2023
- AFT extended $750K loan to Dustin Watson to buy-out other family members


W&OD Trail

Enhanced Transparency

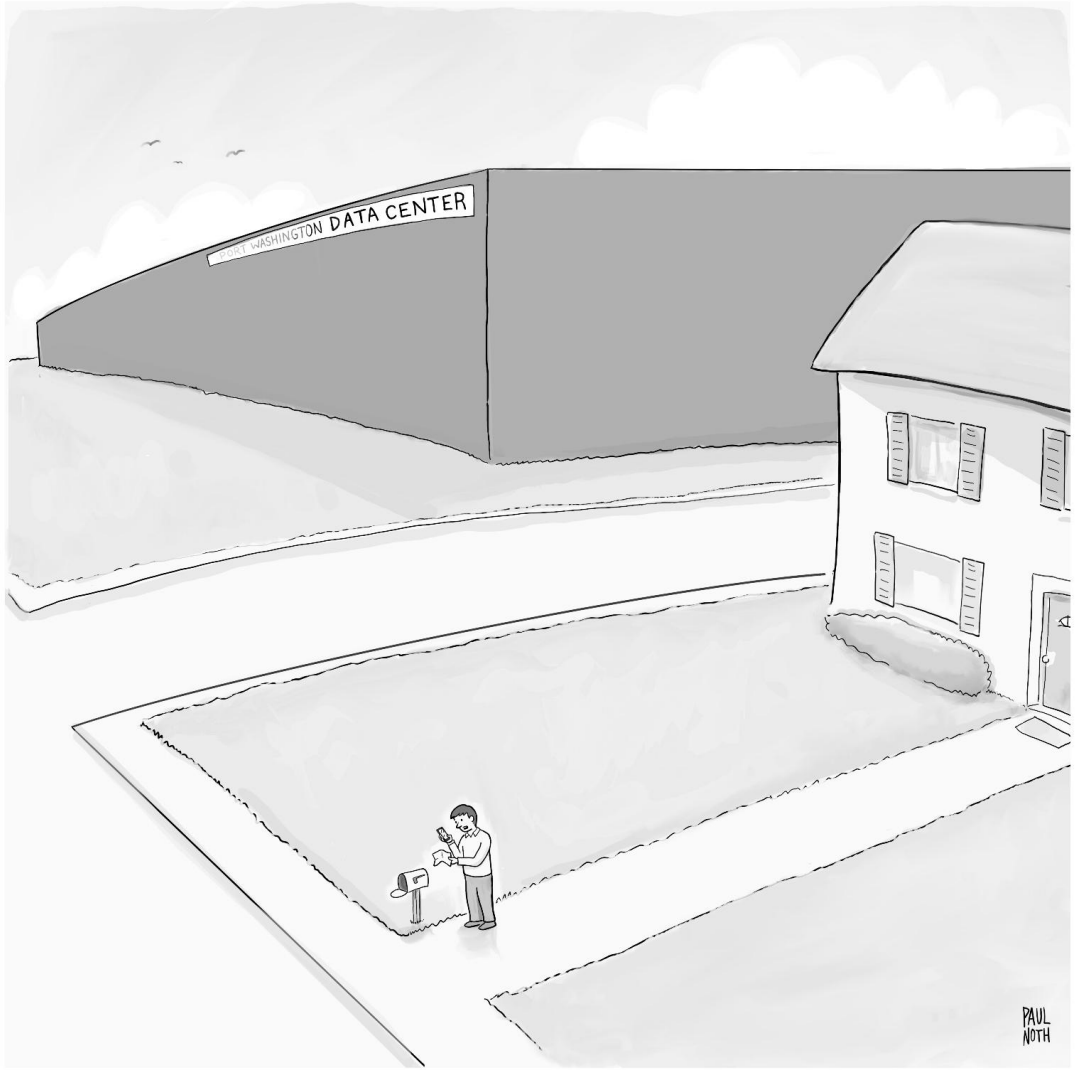
Protections for Familes and Businesses



Virginians For a
Smarter Digital Future

State Oversight

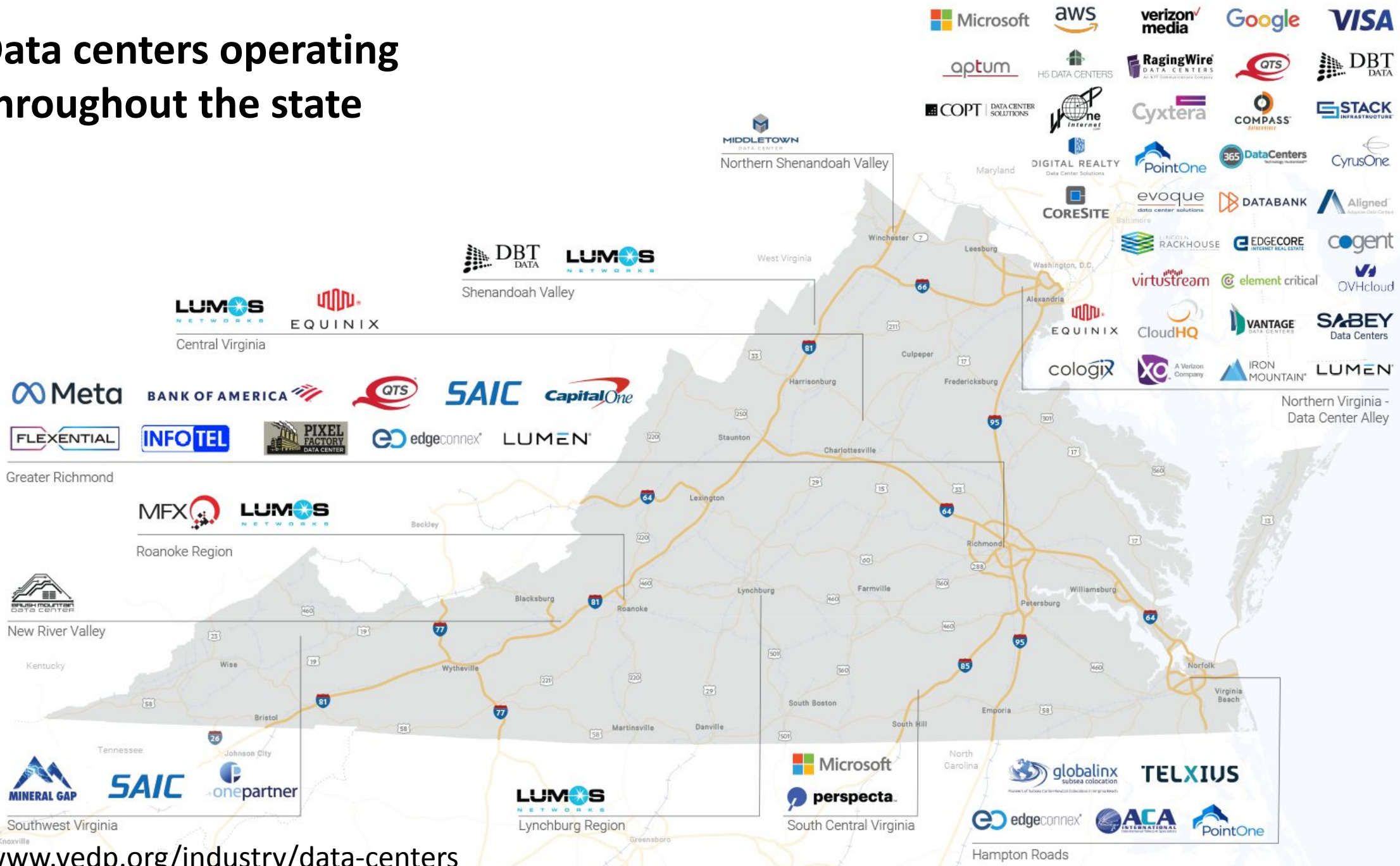
Incentives for Sustainability & Mitigation of Impacts



"ChatGPT, why is my electric bill so high?"

"One day, son, this farmland will be yours to sell to a tech company building a data center."

Data centers operating throughout the state



Source: www.vedp.org/industry/data-centers

The Digital Age

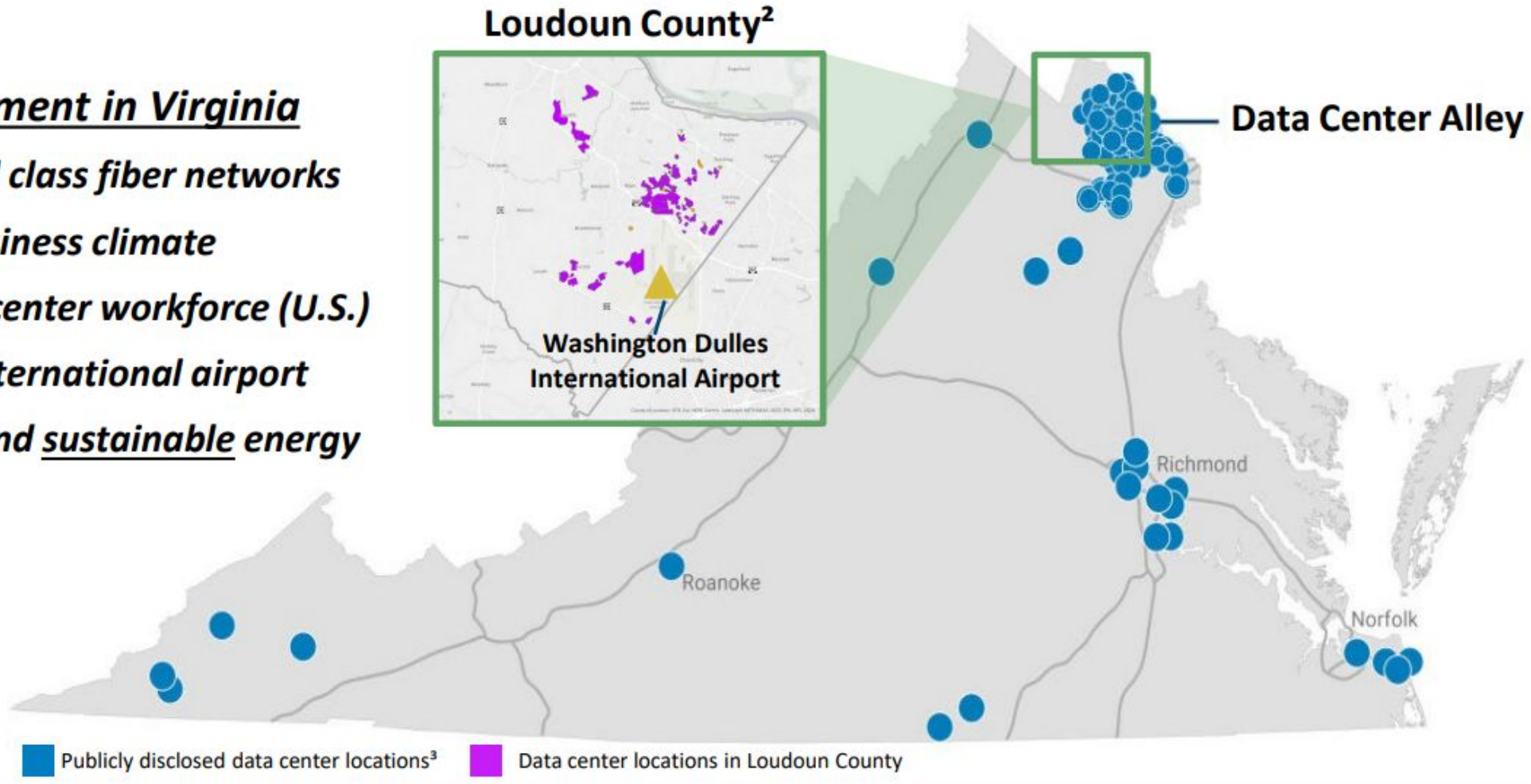
- Outsourcing of information technology functions
- Advancing smartphone technology and apps (5G)
- Roll out of rural broadband
- Digitalization and data storage
- Internet of things
- Self driving vehicles
- Artificial intelligence and machine learning

Dominion Energy Virginia

Northern Virginia boasts the largest data center market in the world[1]

Data center development in Virginia

- ✓ ***Connectivity to world class fiber networks***
- ✓ ***Attractive business climate***
- ✓ ***Access to largest data center workforce (U.S.)***
- ✓ ***Access to nearby international airport***
- ✓ ***Access to affordable and sustainable energy***



Committed to deliver safe, reliable, affordable and sustainable energy to our customers

[1] https://www.vedp.org/industry/data-centers [2] February 2022 Loudoun County Data Center Land Study [3] Data Center locations provided by Data Center Hawk

Data Centers: Connected by Fiber and Powered by Electricity

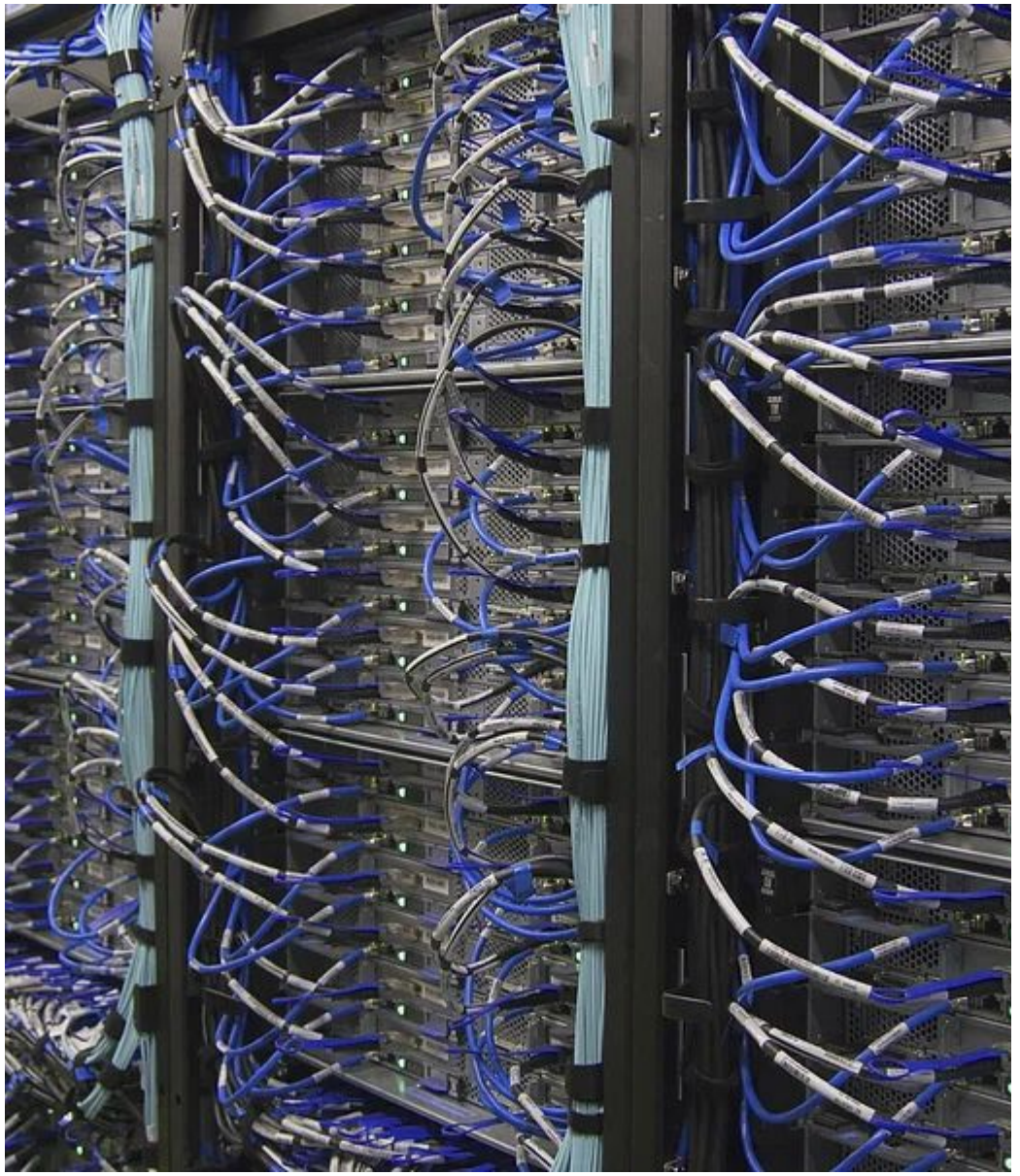
Loudoun Now - August 17, 2023

Outgoing Deputy County Administrator Charles Yudd said he thinks Loudoun's next big planning challenge won't be land use, as it has been for the past three decades, but infrastructure, especially energy infrastructure.

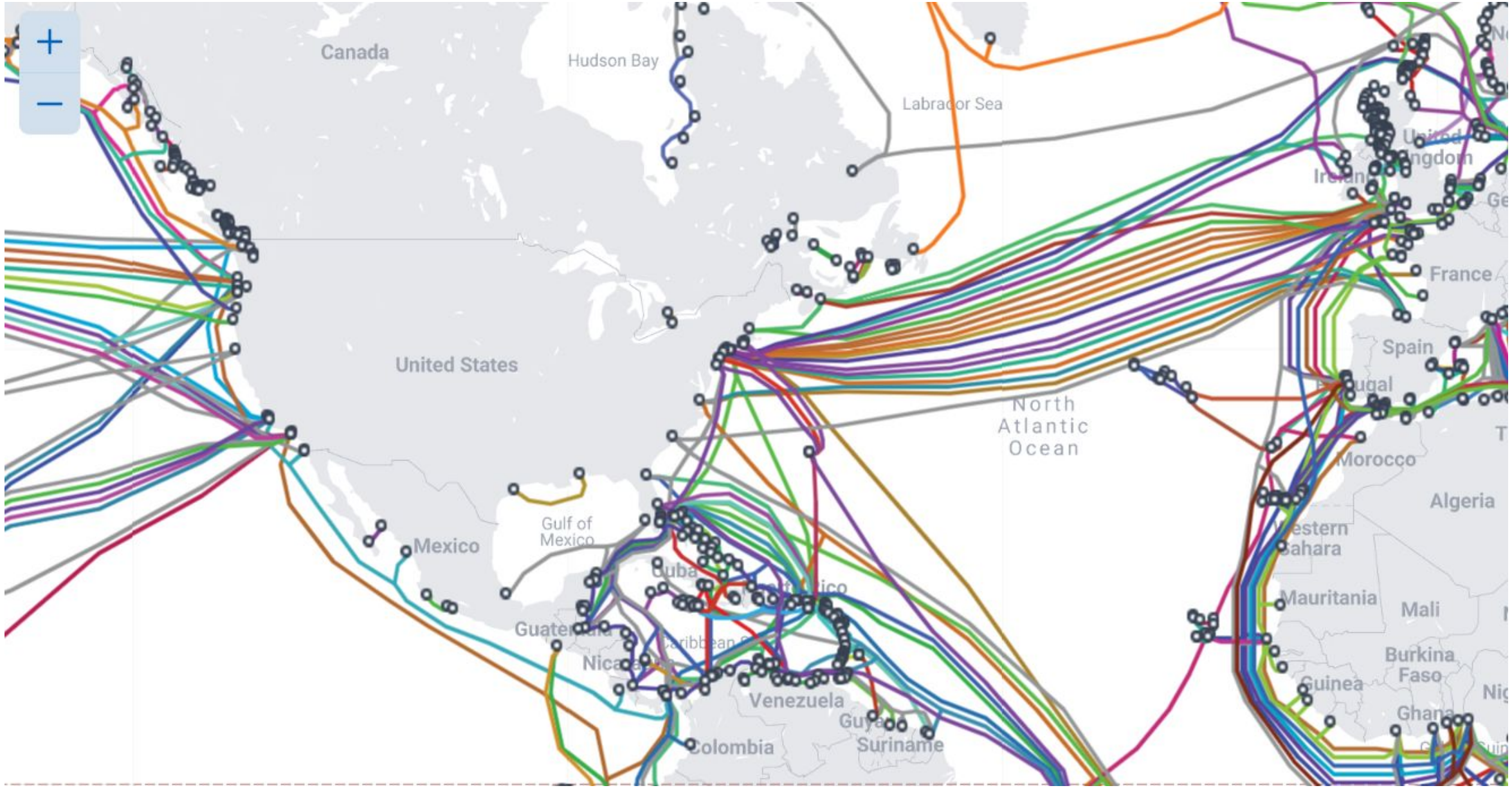
Fiber Connects Everything

Dark/Lit Terrestrial Fiber:

- **Internet Content Providers** (e.g. Google, Facebook, Microsoft, Akami and Alibaba)
- **Service Providers** – Typically telecommunications or cable companies (e.g. Verizon, AT&T, Cox, or Comcast)
- **Dark Fiber Providers** – Fiber available for lease from owners (e.g. Crown and Castle, Lumen, and Zayo)



Submarine Cable Map:

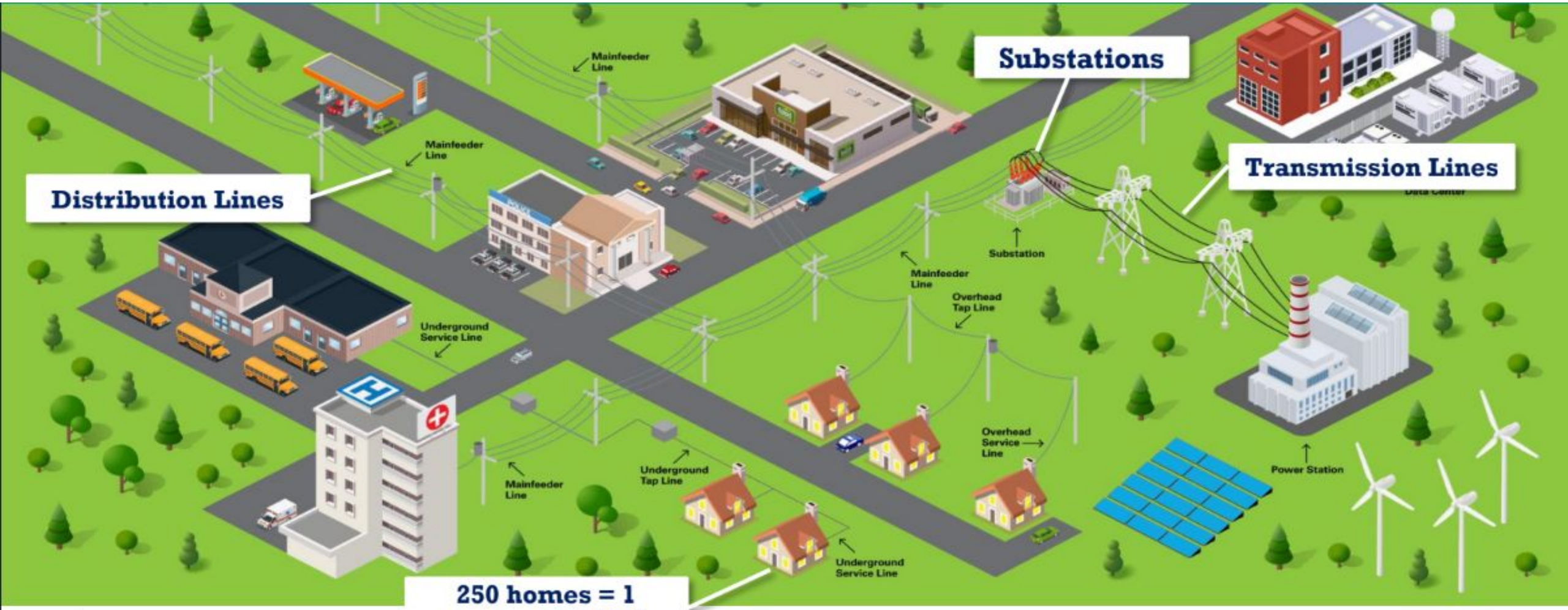


Virginia Beach is the landing point for four transoceanic fiber connection cables.

Source: www.vedp.org/industry/data-centers

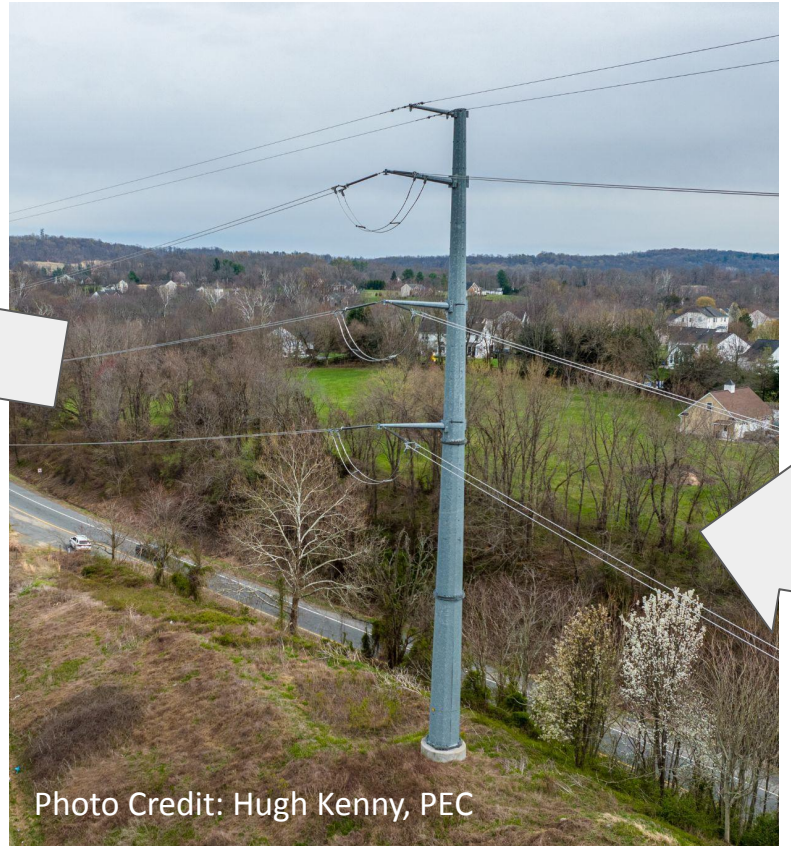
The Electric Grid

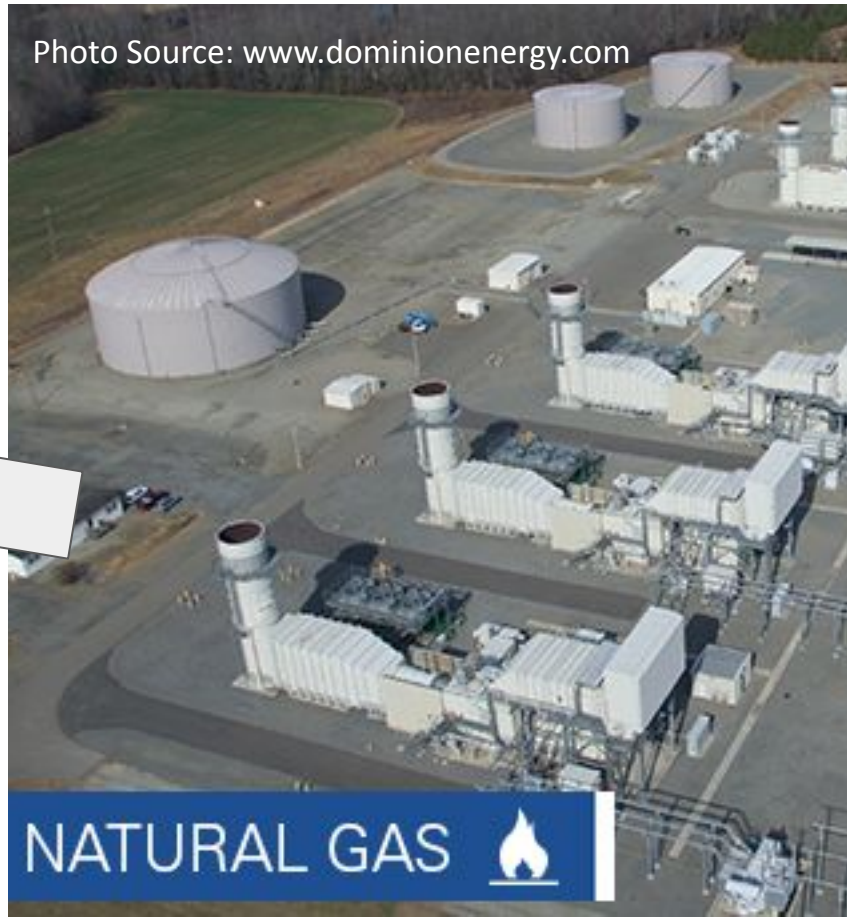
1000 watts = 1 kilowatt
1000 kW = 1 megawatt
1000 MW = 1 gigawatt



Dominion Energy

Data Centers Consume a Huge Amount of Electricity





PENN TODAY

The hidden costs of AI: Impending energy and resource strain

Deep Jariwala and Benjamin C. Lee on the energy and resource problems AI computing could bring.

By Nathi Magubane

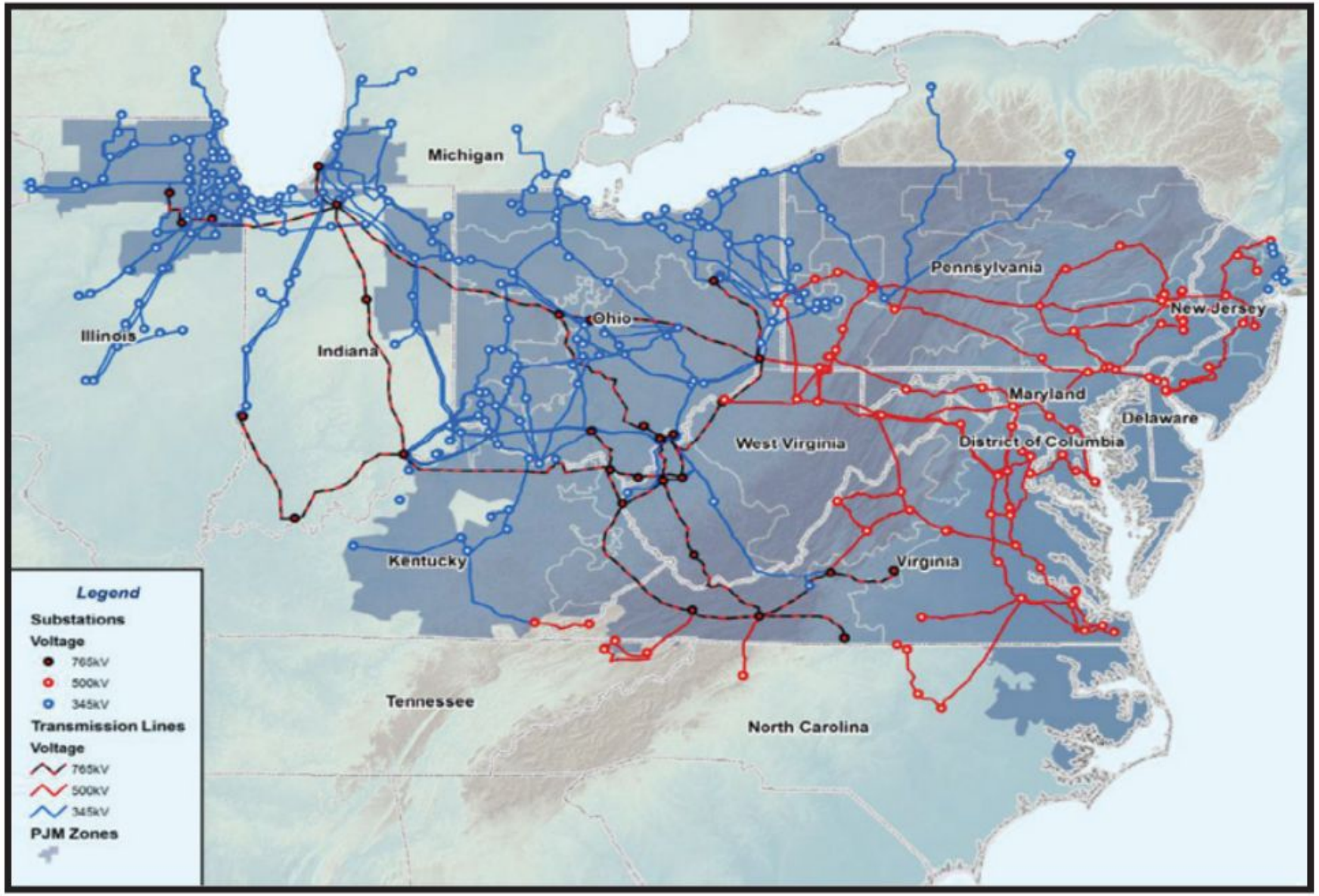
March 08, 2023

https://environment.upenn.edu/events-insights/news/hidden-costs-ai-impending-energy-and-resource-strain

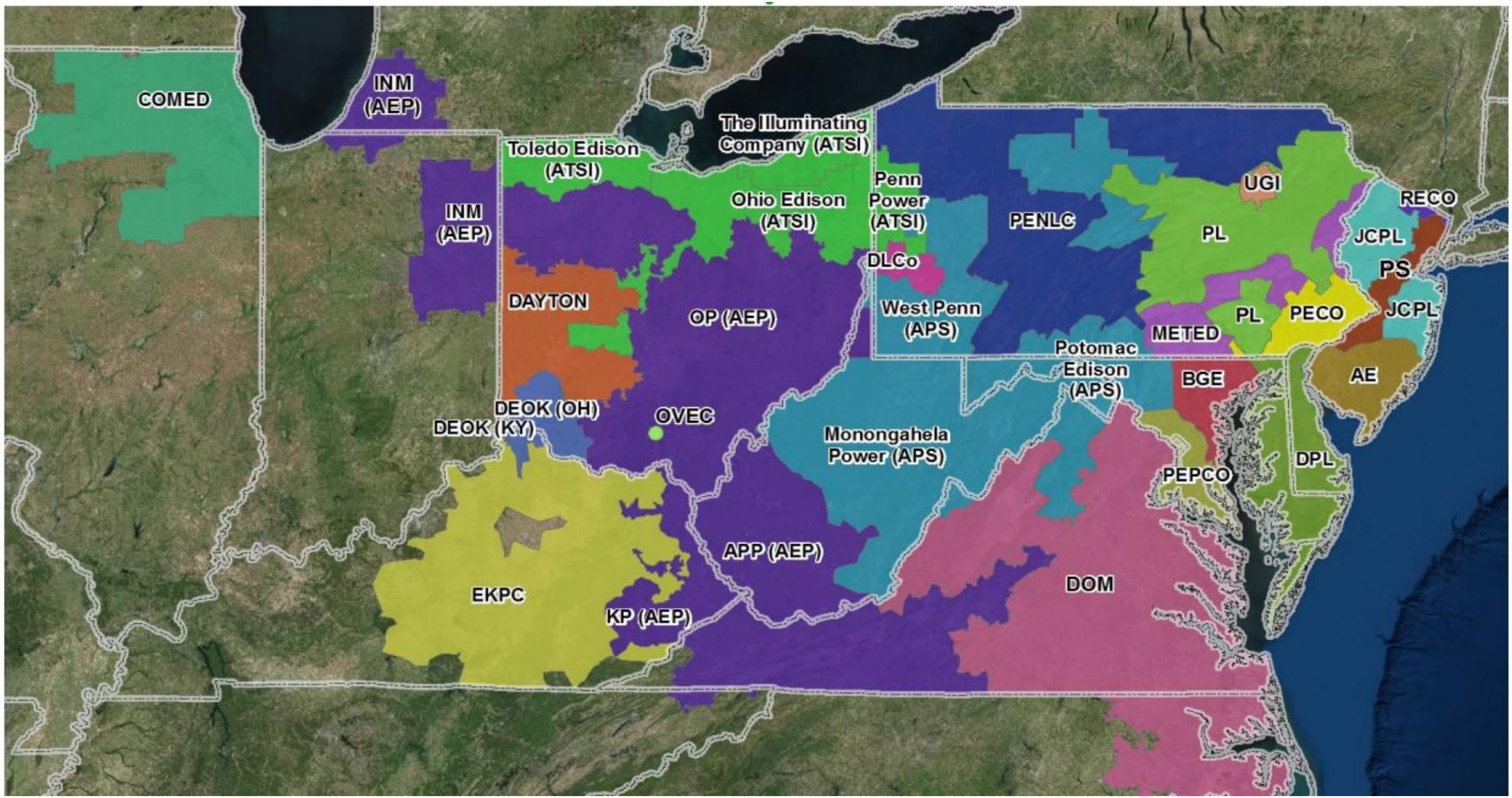
“We take it for granted, but all the tasks our machines perform are transactions between memory and processors, and each of these transactions requires energy. As these tasks become more elaborate and data-intensive, two things begin to scale up exponentially: the need for more memory storage and the need for more energy… If we continue at this rate, by 2030, it's projected to rise between 8-21%, further exacerbating the current energy crisis.” – Jariwala

Role of RTO

Acting as a neutral, independent party, PJM operates a competitive wholesale electricity market and manages the high-voltage electricity grid to ensure reliability for more than 65 million people.



PJM Interconnection


COMED
INM (AEP)
INM (AEP)
The Illuminating Company (ATSI)
Toledo Edison (ATSI)
Ohio Edison (ATSI)
Penn Power (ATSI)
PENLC
UGI
RECO
PL
JCPL
DLCo
PS
DAYTON
OP (AEP)
West Penn (APS)
PL
PECO
JCPL
METED
Potomac Edison (APS)
BGE
AE
DEOK (OH)
DEOK (KY)
OVEC
Monongahela Power (APS)
DPL
PEPCO
APP (AEP)
DOM
EKPC
KP (AEP)

Transmission Planning Standards (varies by utility, this is Dominion Energy Standards)

- Direct-connect load at any substation is limited to 300 MW (due to reliability criteria)
- Generally only 230kV and below are used to serve local load requests. Tapping into 500kV with a new substation is typically only done to resolve system level issues.
- The State Corporation Commission provides regulation of electric facilities; however, it requires a CPCN (certificate of convenience and public necessity) for most lines over most 138kV or those placed underground or including structures in a navigable waterway.
- Local government regulates permitting (siting, zoning, and site plan) of substations.
- Rough estimates of what lines can carry (varies based on conductor and conditions):
  - 230 kV line around 1 to 1.6 GW
  - 500 kV line around 4.3 to 5.2 GW
- Single source radial transmission line load is generally limited to 100MW
- Dominion requires reinforcements when load exceeds 300MW (N-1-1 contingency; simultaneous loss of 2 major units); applies to both line loss and substation loss

What is a Data Center?

North Fork of Broad Run

Fuel Storage

Diesel Generators

Photo Credit: Hugh Kenny, PEC

Photo Source: www.globalpwr.com

Photo Credit: Christopher Bowns, Wikimedia Commons

Types of Data Centers

- **Cloud** - hosted off-premises (ex: Amazon (AWS), Microsoft (Azure), Google
- **Colocation -** companies rent space (ex: Digital Realty and QTS)
- **Enterprise -** built, owned, and operated by companies (ex: Meta)
- **Bitcoin Miner -** dedicated to cryptocurrency (ex: TeraWulf)

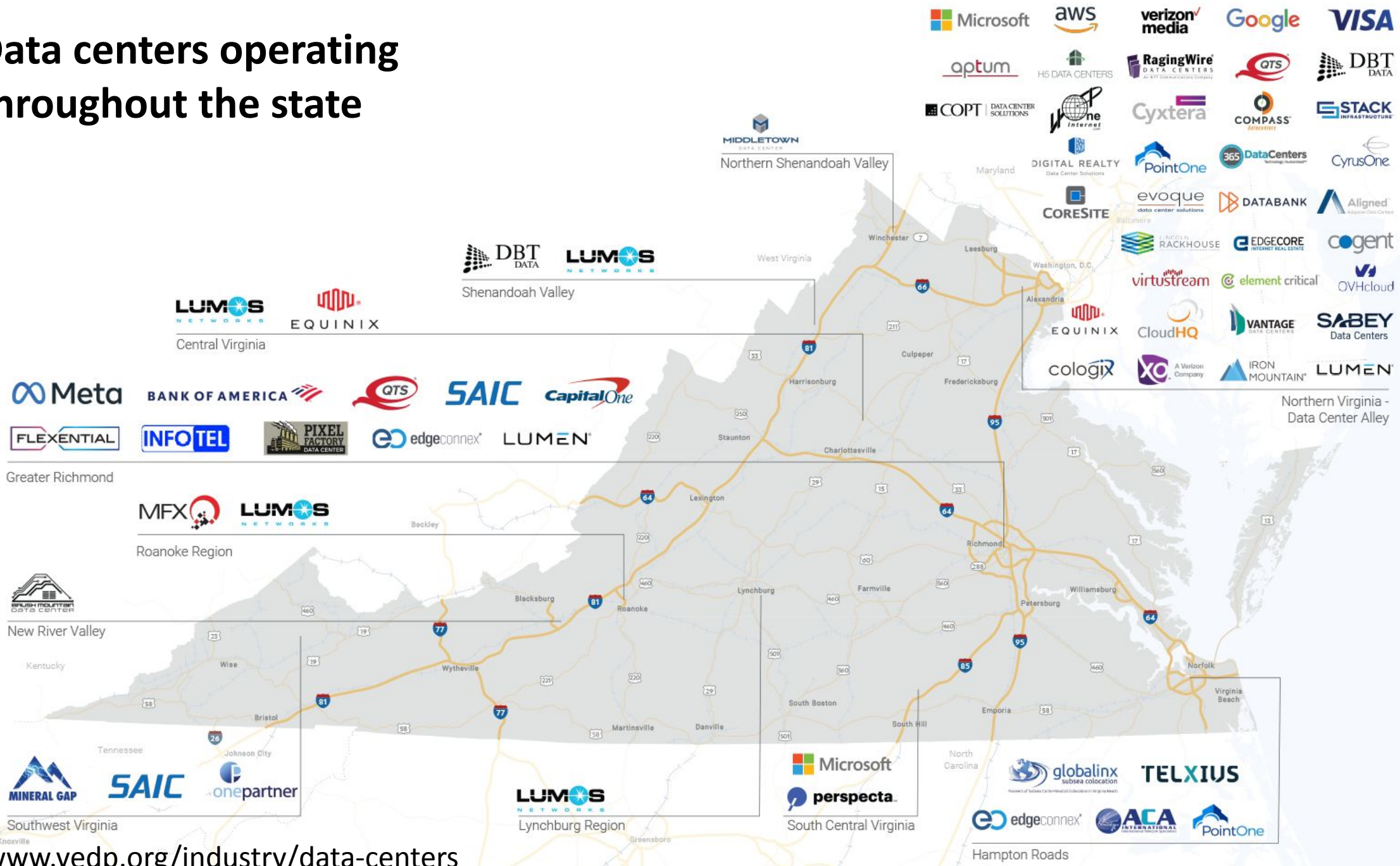
What is a Hyperscale data center?

What about Edge data centers?

An edge data center is a small data center that is located close to the edge of a network, closer to end users and devices. They deliver cached content and cloud computing closer to consumers so that the applications and services they use perform faster and are more secure. They are usually tied into a large network of data centers with a large core data center campus.

Edge data centers are all the buzz but not that much of the market yet…

Data centers operating throughout the state



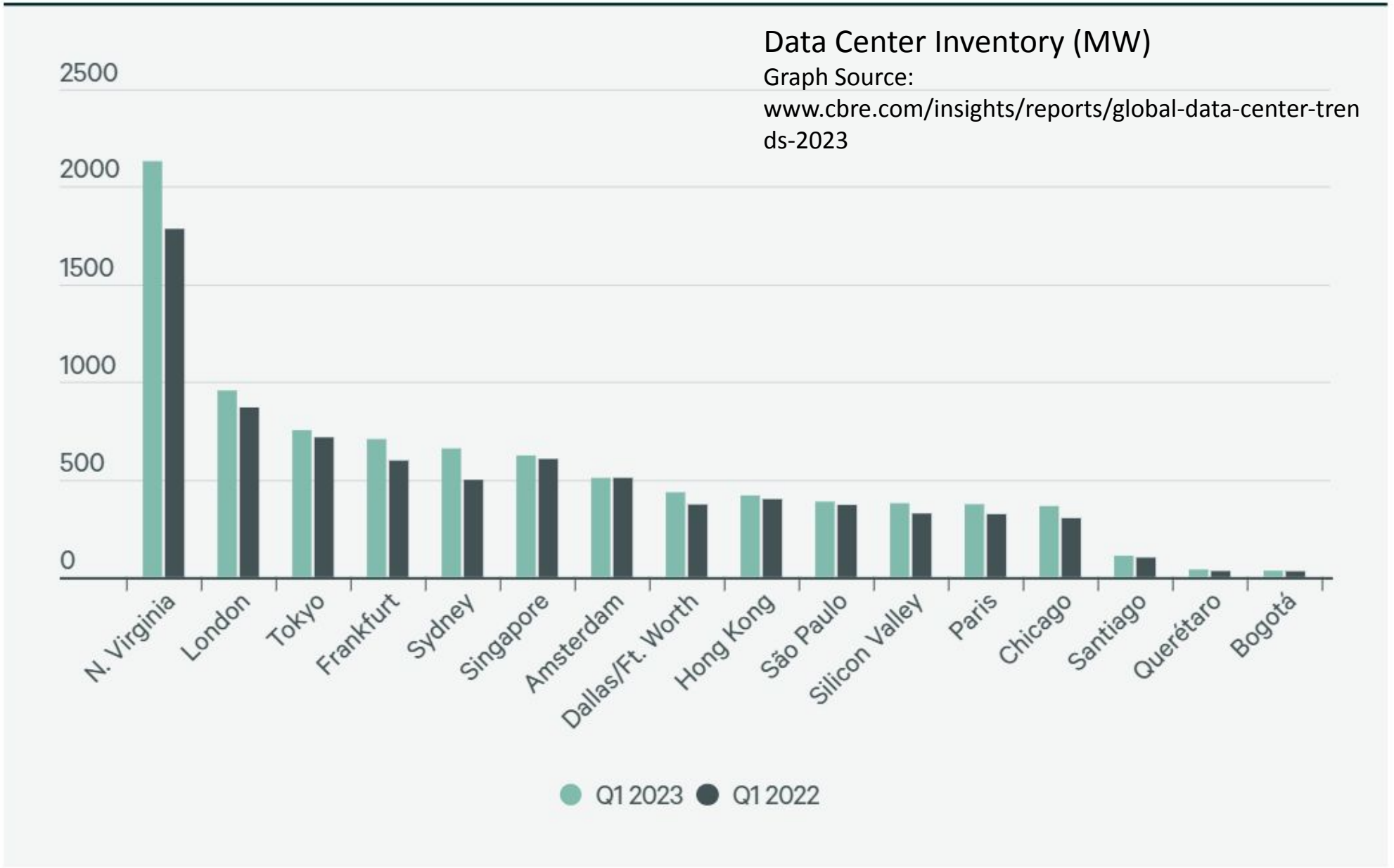
Source: www.vedp.org/industry/data-centers

Major Data Center Markets

Image Source: www.cbre.com/insights/reports/global-data-center-trends-2023

Data Center Inventory (MW)

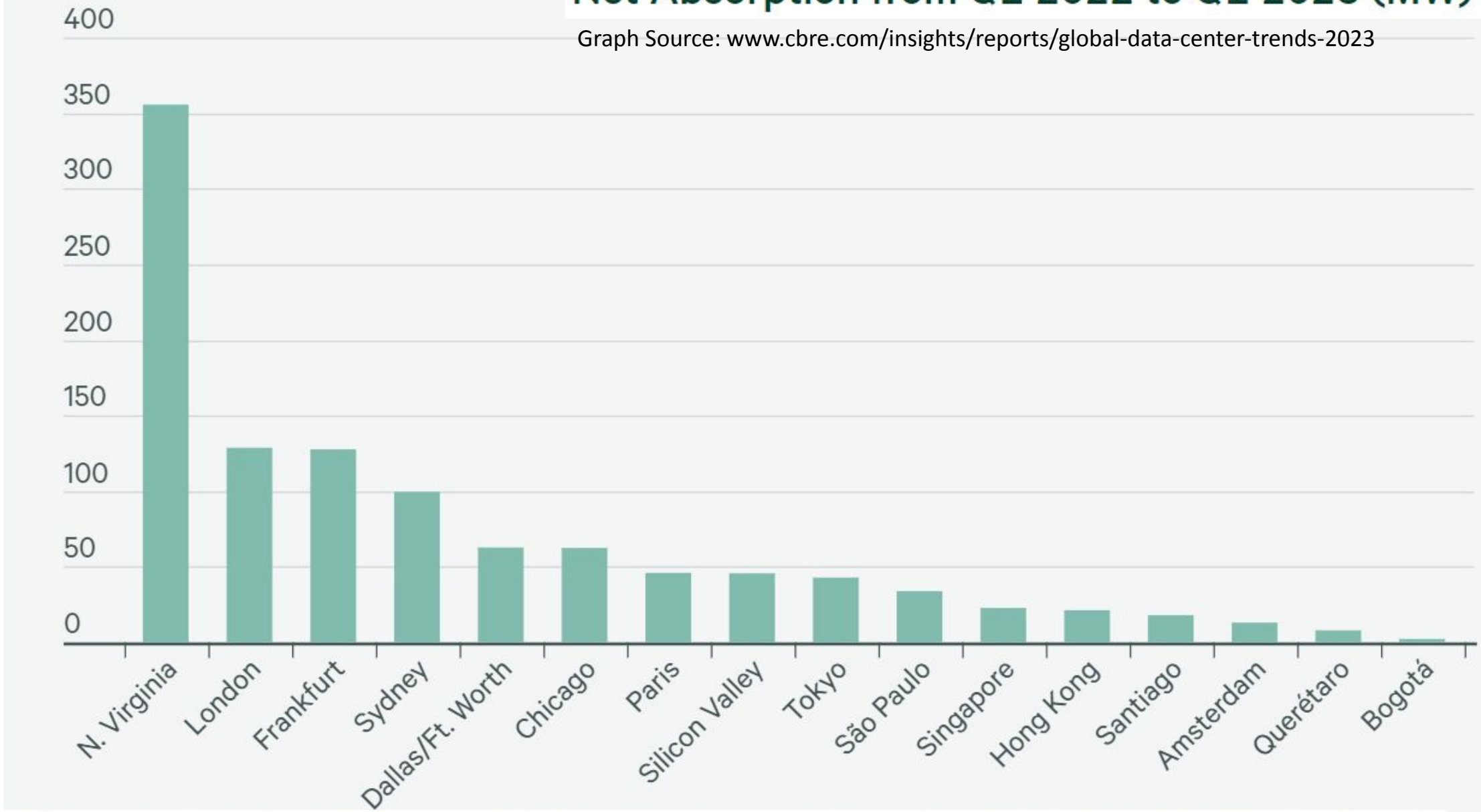
Graph Source:
www.cbre.com/insights/reports/global-data-center-trends-2023



Source: CBRE Research, Q1 2022 & Q1 2023. Figures and data for North American markets include only wholesale colocation facilities. In Europe, Latin America, and Asia-Pacific, total inventory includes both wholesale and retail colocation facilities.

Net Absorption from Q1 2022 to Q1 2023 (MW)

Graph Source: www.cbre.com/insights/reports/global-data-center-trends-2023



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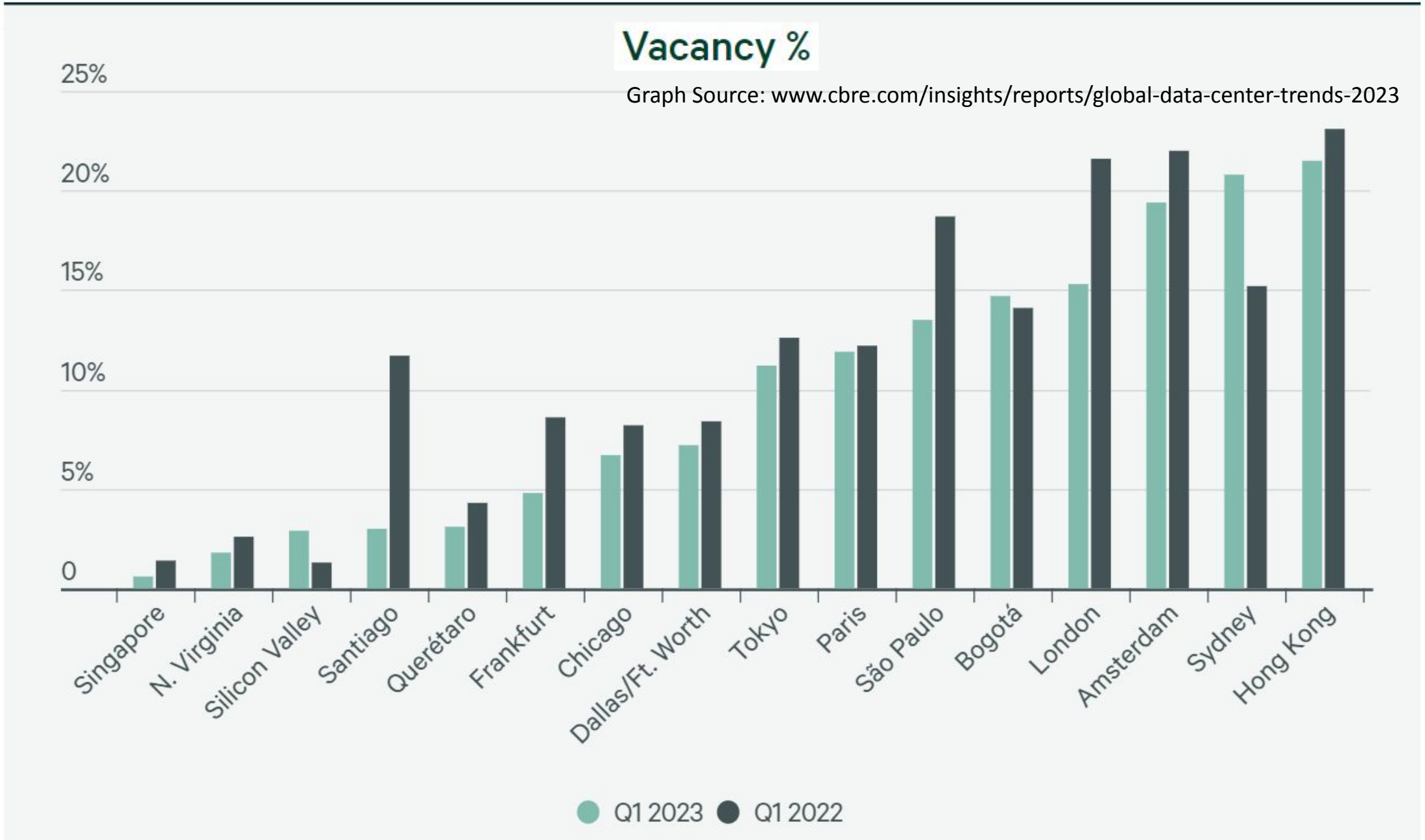
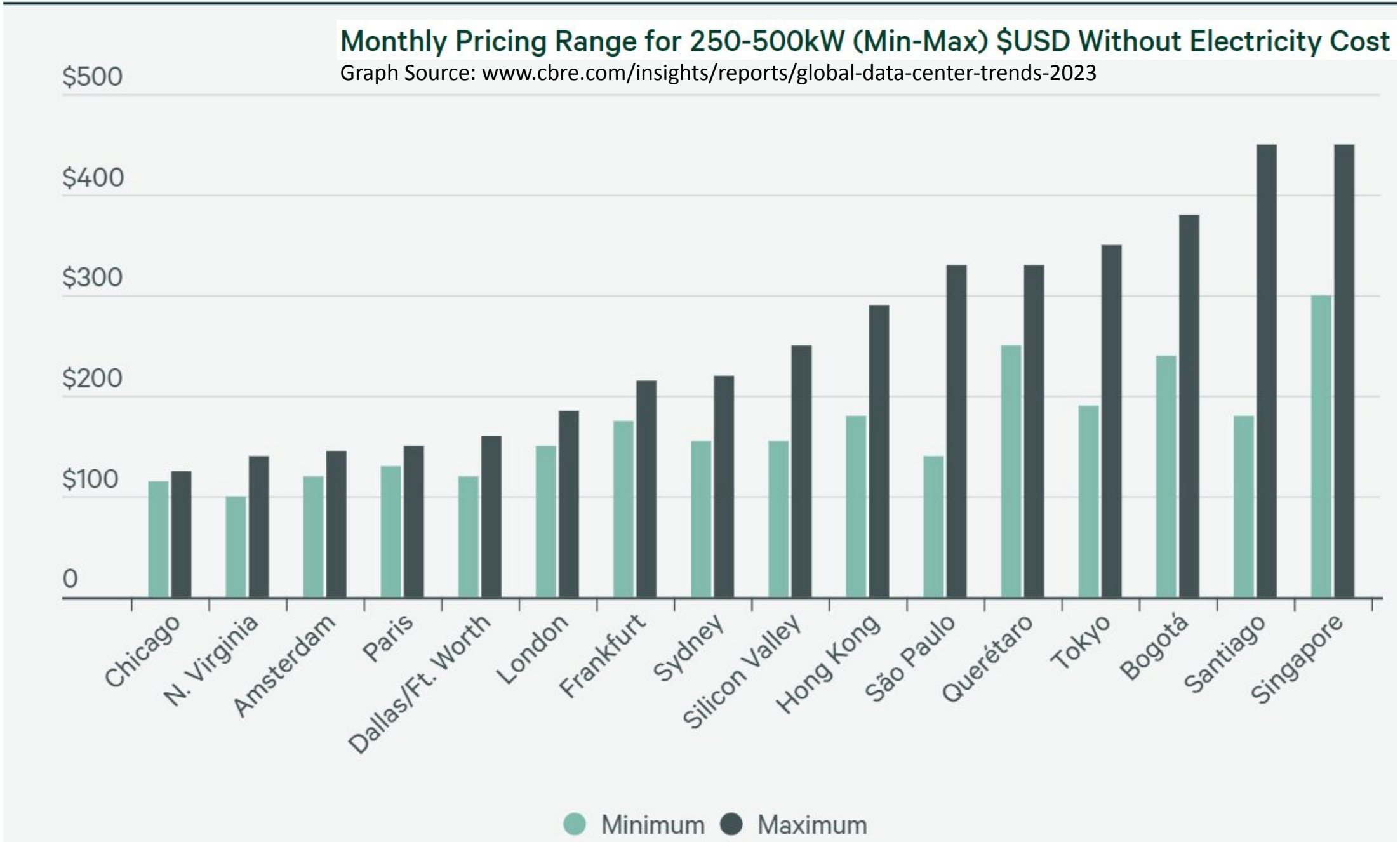
Graph Source: www.cbre.com/insights/reports/global-data-center-trends-2023



Source: CBRE Research, Q1 2022 & Q1 2023. Figures and data for North American markets include only wholesale colocation facilities. In Europe, Latin America, and Asia-Pacific, total inventory includes both wholesale and retail colocation facilities.

Monthly Pricing Range for 250-500kW (Min-Max) $USD Without Electricity Cost

Graph Source: www.cbre.com/insights/reports/global-data-center-trends-2023



Source: CBRE Research, Q1 2022 & Q1 2023. Figures and data for North American markets include only wholesale colocation facilities. In Europe, Latin America, and Asia-Pacific, total inventory includes both wholesale and retail colocation facilities.

Approved and Applications Filed with Localities…

County	Status	Development Sqft	Estimated Power Range
Loudoun	Approved	12,286,529	1,843MW – 5,529MW
	Applications	10,938,449	1,641MW – 4,922MW
Prince William	Approved	10,719,984	1,608MW – 4,824MW
	Applications	42,510,328	6,377MW – 19,130MW
Fauquier	Approved	2,901,000	435MW – 1,305MW
Culpeper	Approved	4,630,000	695MW – 2,083MW
	Applications	1,990,000	299MW - 896MW
Stafford	Applications	6,010,000	902MW – 2,705MW
Spotsylvania/Caroline	Applications	6,600,000	990MW – 2,970MW
King George	Applications	7,500,000	1,125MW – 3,375MW

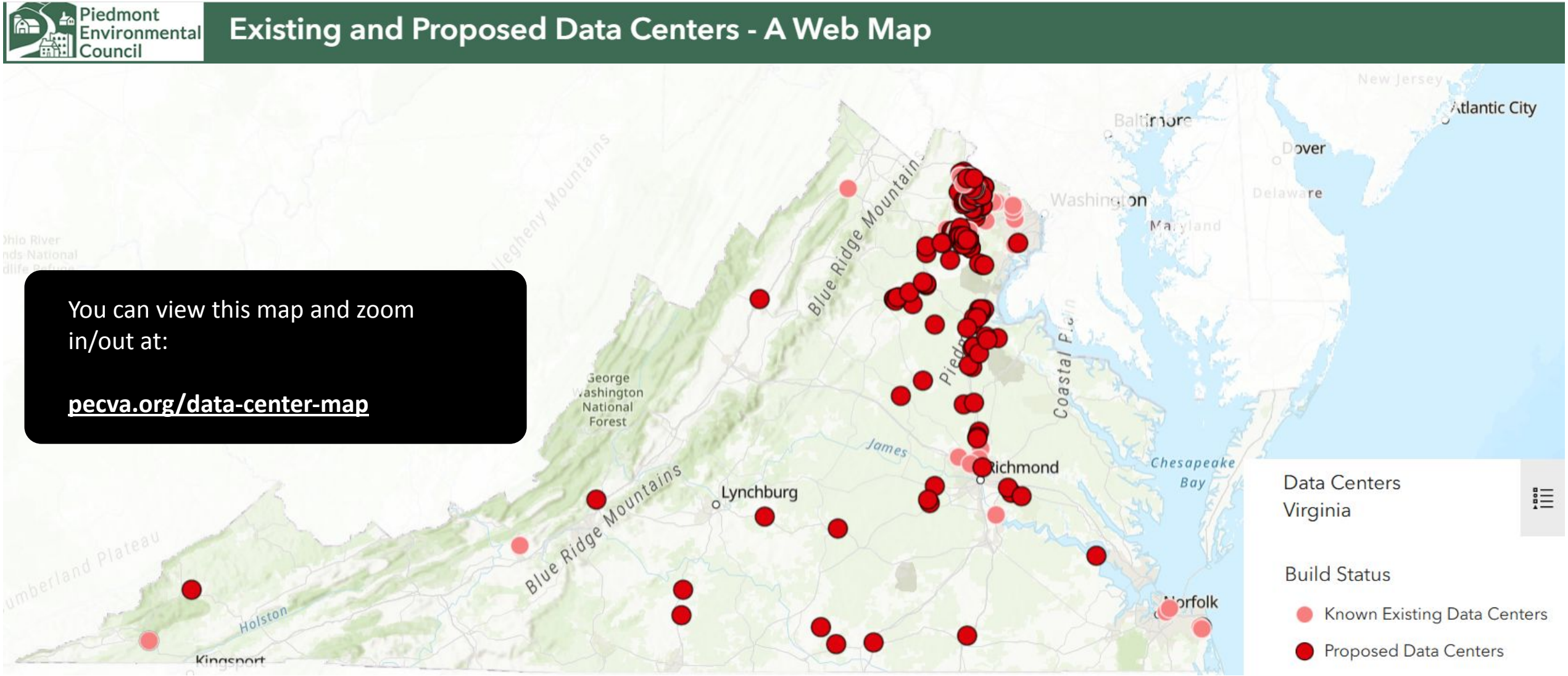
Approved and Applications Filed with Localities…

County	Status	Development square feet	Estimated Power Range
[illegible]	[illegible]	[illegible]	1,843MW – 5,529MW
			1,641MW – 4,922MW
			1,608MW – 4,824MW
			6,377MW – 19,130MW
			435MW – 1,305MW
[illegible]	[illegible]		695MW – 2,083MW
	Applications		
Stafford	Applications		
Spotsylvania/Caroline	Applications		
King George	Applications		

Total Approved:
30,537,513 square feet
4,611MW – 13,742MW

Total With Applications:
106,086,290 square feet
15,915MW – 47,739MW

Data Center Projects In Virginia

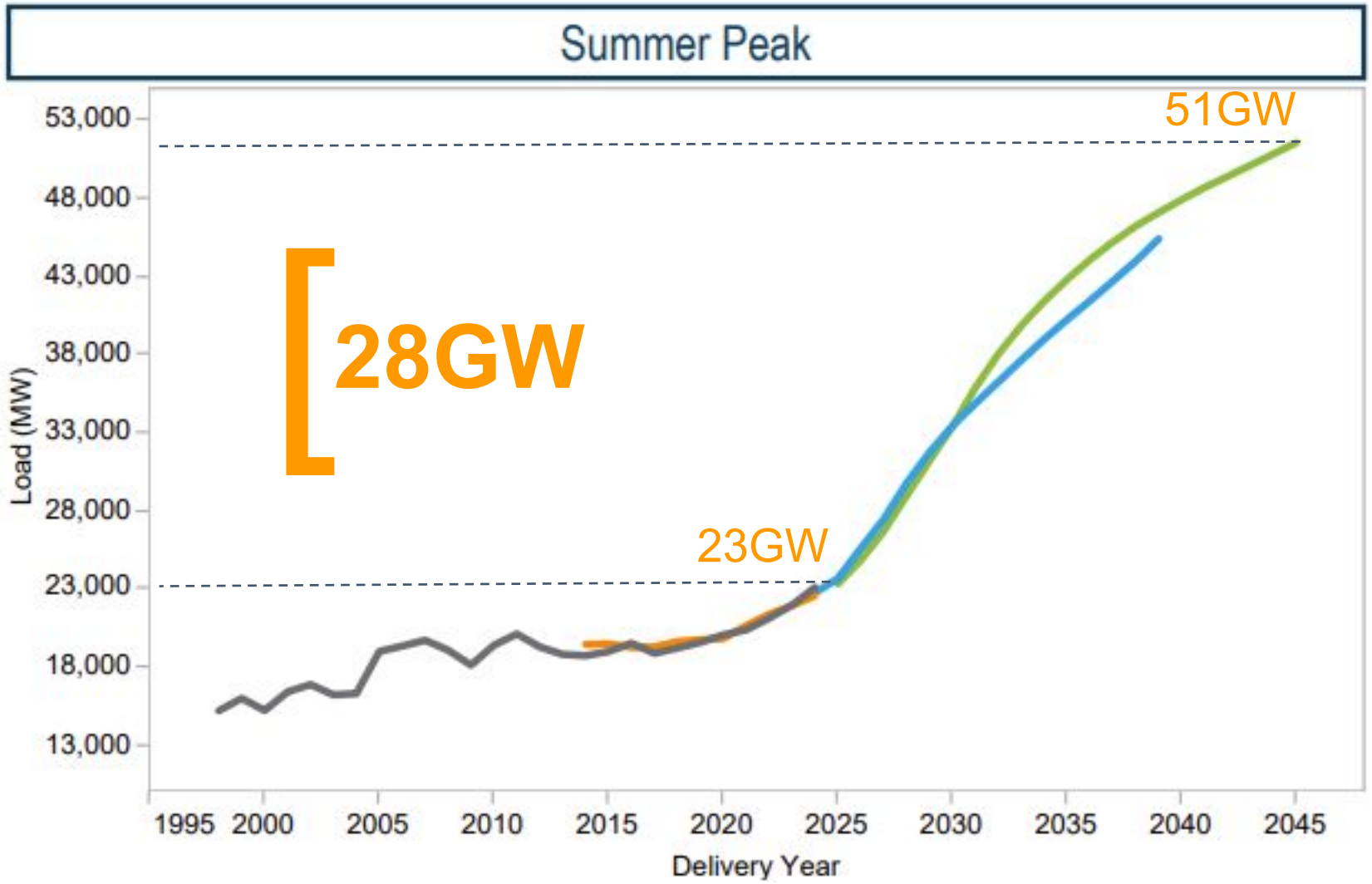


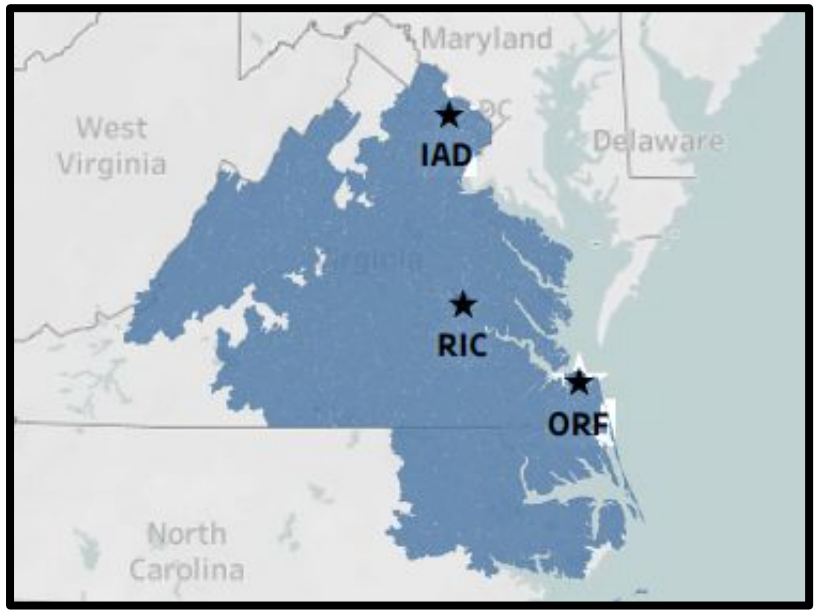
Currently about 60 million square feet existing or being constructed in the state

There's another 350 million square feet approved or in the pipeline

Skyrocketing Load Demand

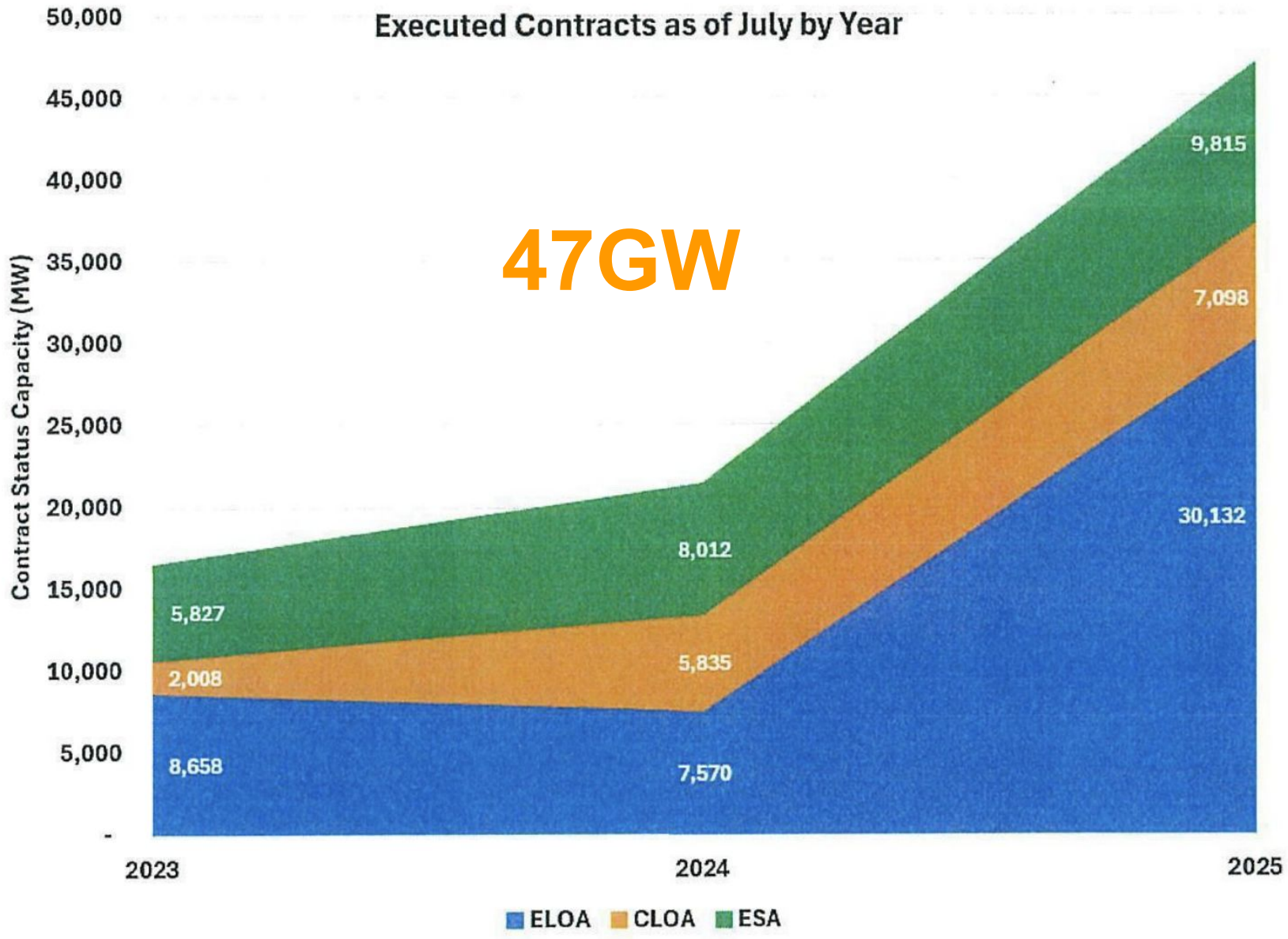
Dominion Energy's 20 Year Forecast





Green = 2025 projection
Blue = 2024 projection

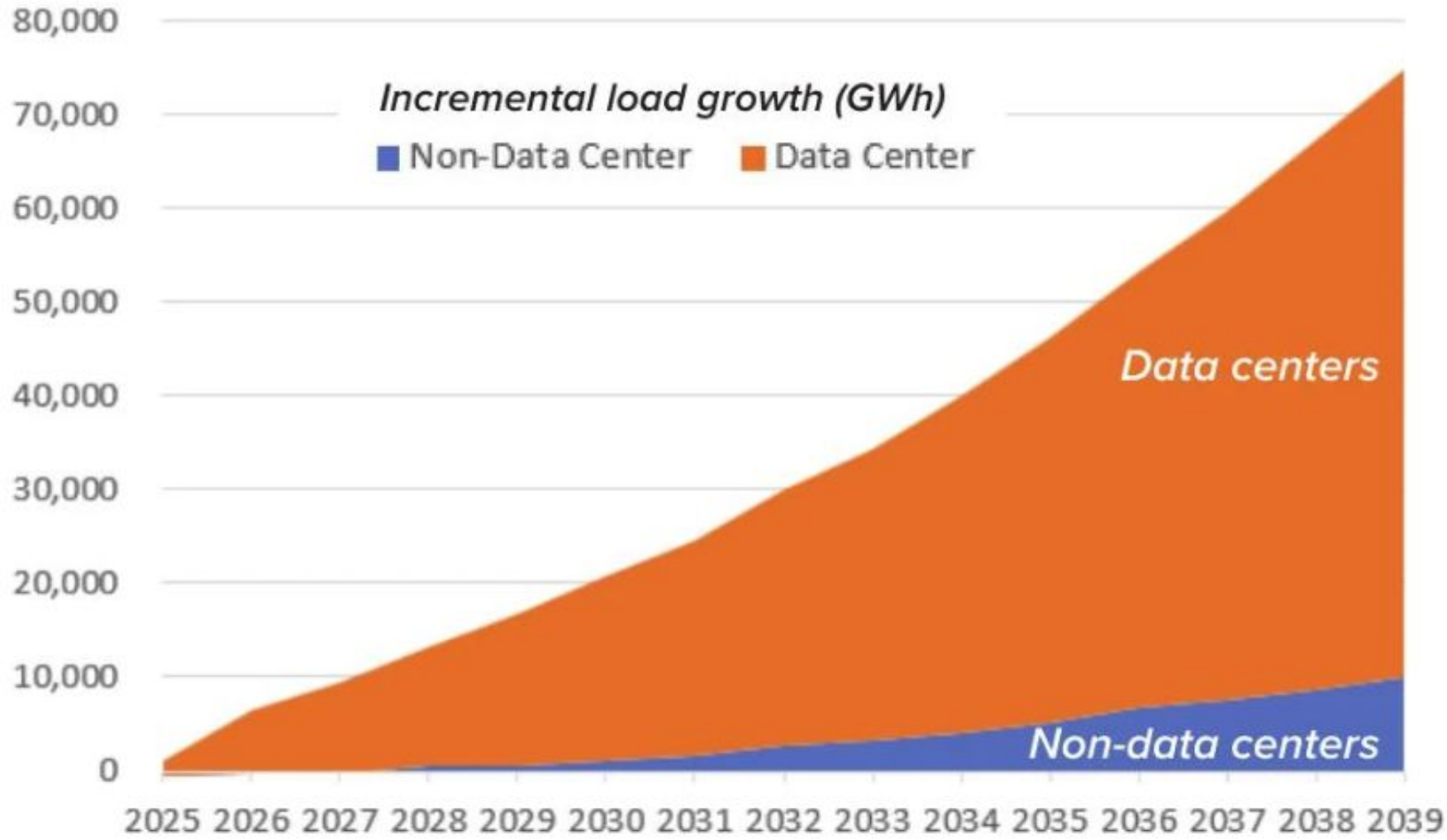
Dominion's Contracts with Data Center Customers



That's more than a doubling of Virginia's peak load!

Feeding the beast

PEC analysis of regulatory filings shows how data centers are expected to drive steep growth in Virginia's power demands.



SOURCE: PEC from Dominion Energy data

Crisis by Contract

Utilities have an obligation to serve all load requests for land uses approved by localities and have authority to request use of eminent domain from the state through a Certificate of Public Convenience and Necessity (CPCN)

Code of Virginia

Table of Contents » Title 56. Public Service Companies » Chapter 10. Heat, Light, Power, Water and Other Utility Companies Generally » Article 2. Services, Rates, Charges, Etc. » § 56-234. Duty to furnish adequate service at reasonable and uniform rates

§ 56-234. Duty to furnish adequate service at reasonable and uniform rates.

A. It shall be the duty of every public utility to furnish reasonably adequate service and facilities at reasonable and just rates to any person, firm or corporation along its lines desiring same. Notwithstanding any other provision of law:

Dominion Energy Virginia

Data center request process

Typical data center request process from contact to connection

1 High level assessment

- Identify infrastructure requirements

2 Substation Engineering Letter of Authorization

- Detailed engineering plan
- Costs reimbursed to Dominion Energy

3 Construction Letter of Authorization

- Authorizes construction
- Customer must reimburse Dominion Energy for all spent costs should they walk away

4 Install infrastructure

- Substation(s)
- High voltage transmission lines
- Distribution lines

5 Electric Service Agreement

- Defines how the customer will take service and structure to recover costs
- Includes revenue requirement whether customer takes service or not

What is the “Crisis by Contract”?

An energy “*crisis*” that’s been artificially created through Dominion’s unquestioning acceptance of these contracts and their rushed in-service dates.

PJM fast-tracks 11.8 GW, mainly gas, to bolster power supplies

Natural gas-fired generation accounts for 69% of selected Reliability Resource Initiative capacity, followed by batteries at 19% and nuclear at 12%.

Published May 5, 2025

Ethan Howland
Senior Reporter

PJM selects 11.8 GW in Resource Reliability Initiative

Gas-fired generation accounts for two-thirds of selected capacity.

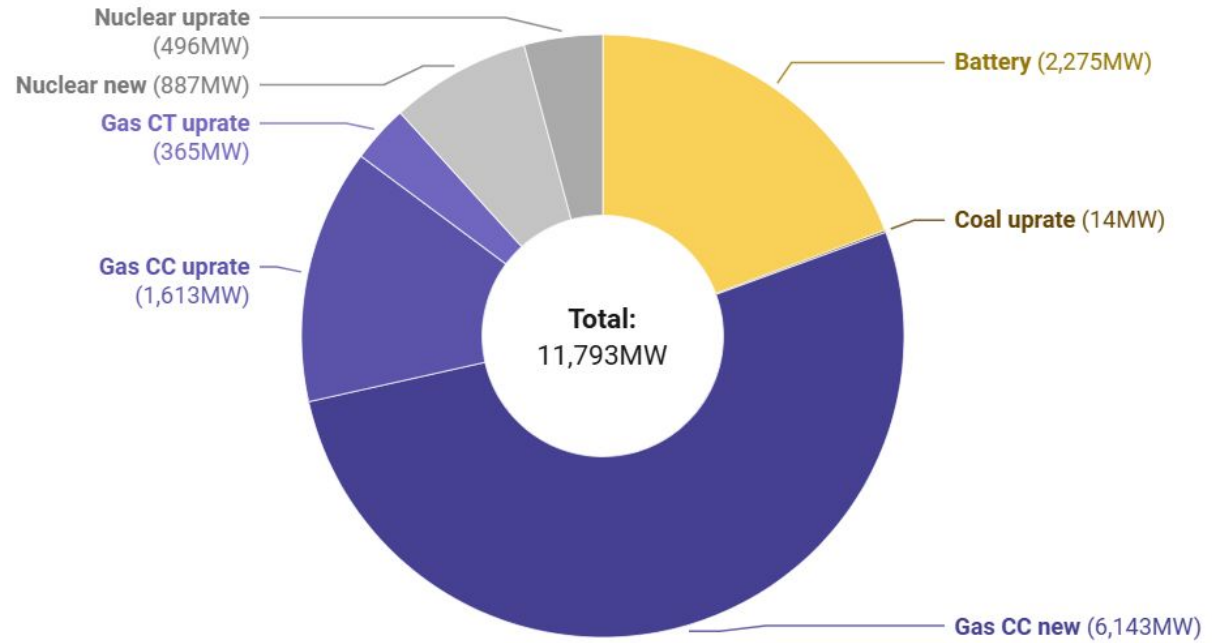
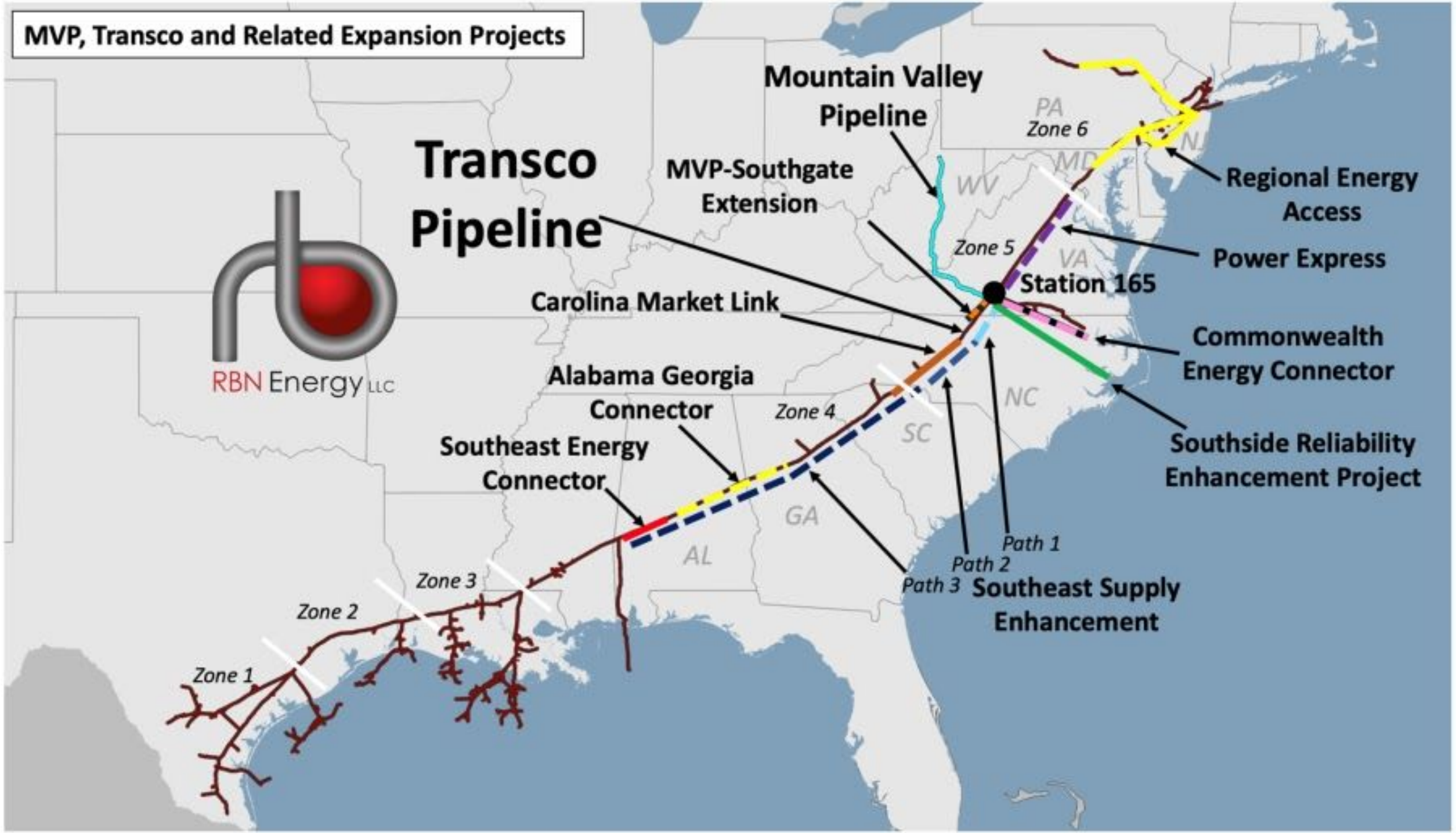
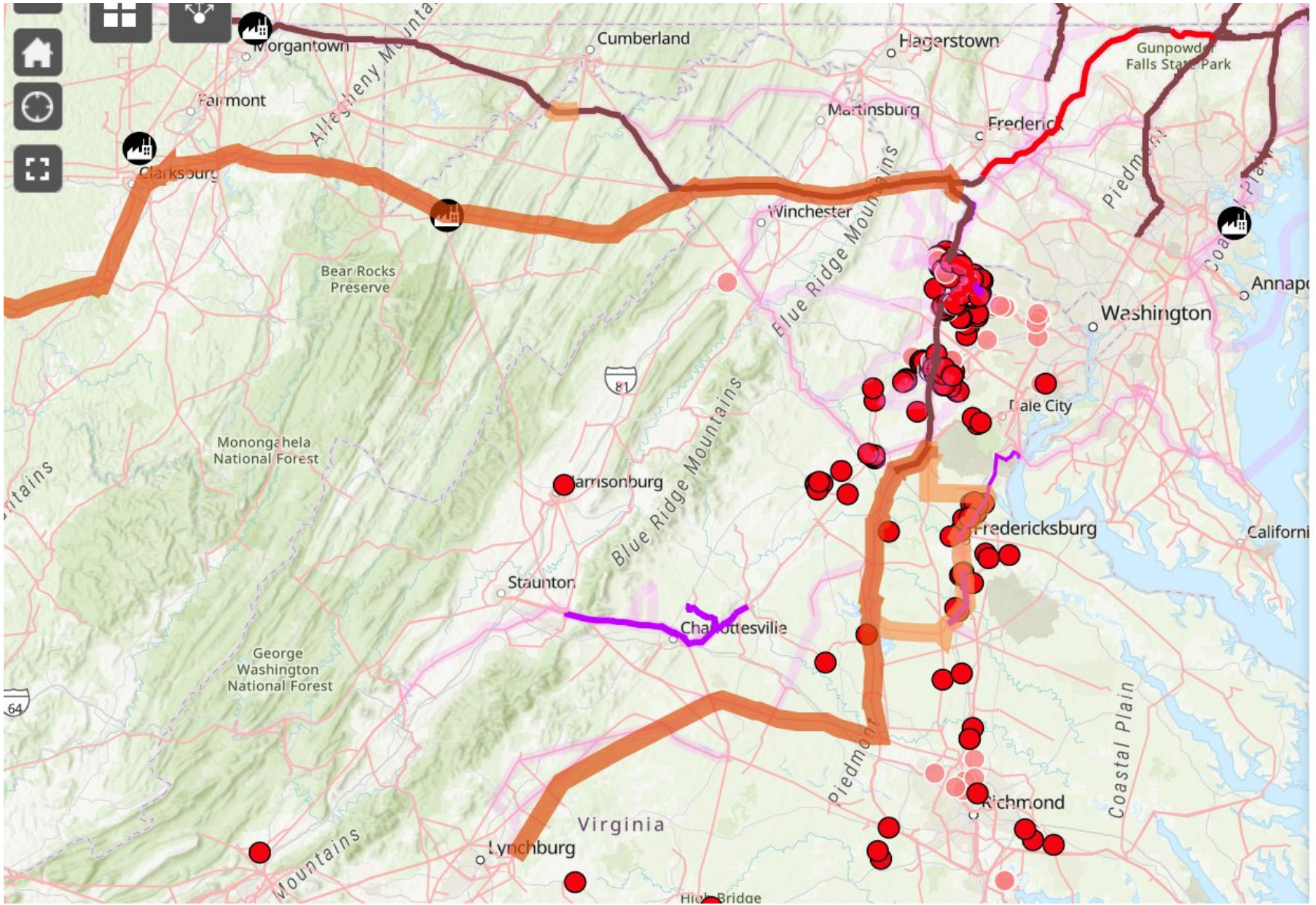


Chart: Ethan Howland/Utility Dive • Source: PJM Interconnection • Get the data • Created with Datawrapper


MVP, Transco and Related Expansion Projects
Transco Pipeline
Mountain Valley Pipeline
MVP-Southgate Extension
Carolina Market Link
Alabama Georgia Connector
Southeast Energy Connector
Regional Energy Access
Power Express
Station 165
Commonwealth Energy Connector
Southside Reliability Enhancement Project
Southeast Supply Enhancement
Zone 1
Zone 2
Zone 3
Zone 4
Zone 5
Zone 6
Path 1
Path 2
Path 3
PA
WV
MD
VA
NC
SC
GA
AL
RBN Energy LLC

$12 Billion in Regional Transmission Lines Being Planned



PJM 2024 Window 1: Selected Transmission Proposals (from 12/2024)

- 500 kV
- 765 kV

Coal Power Plants with Maximum Output over 1,000 MW

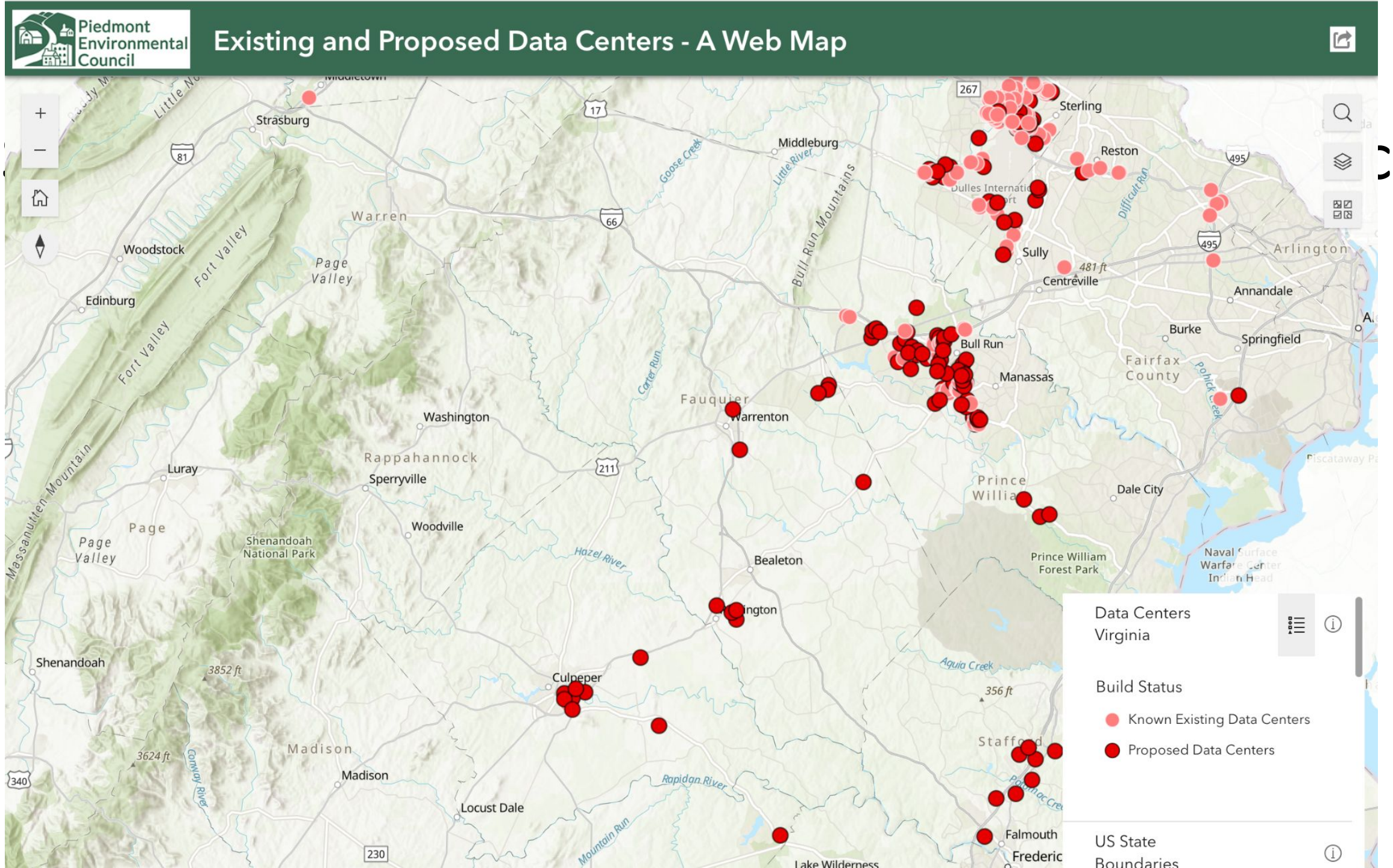
PJM 2022 Window 3: Selected Transmission Proposals (from 10/31/23)

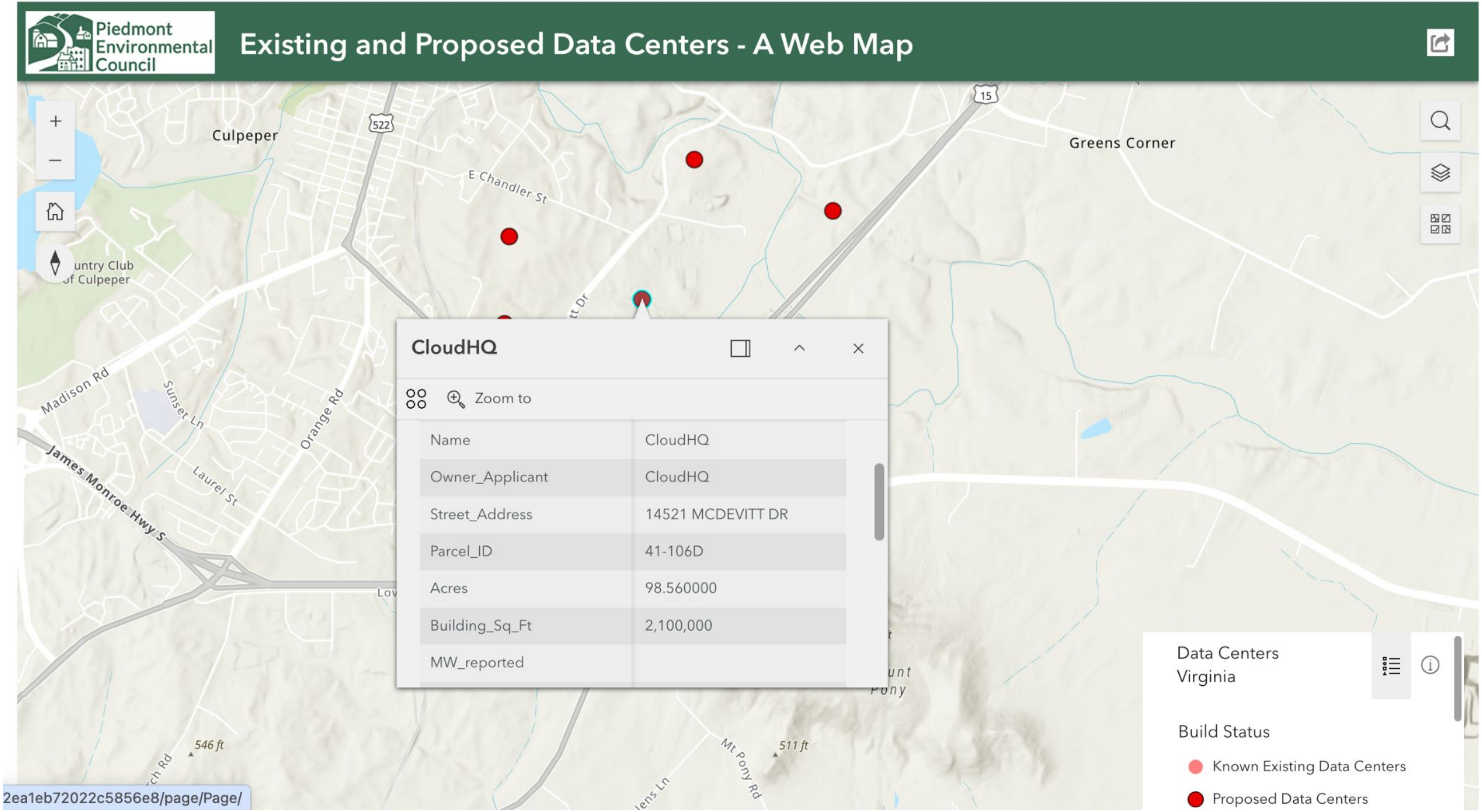
- New Transmission Line (Route to be determined by utility)
- Expand Existing Right of Way
- Rebuild in Existing Right of Way

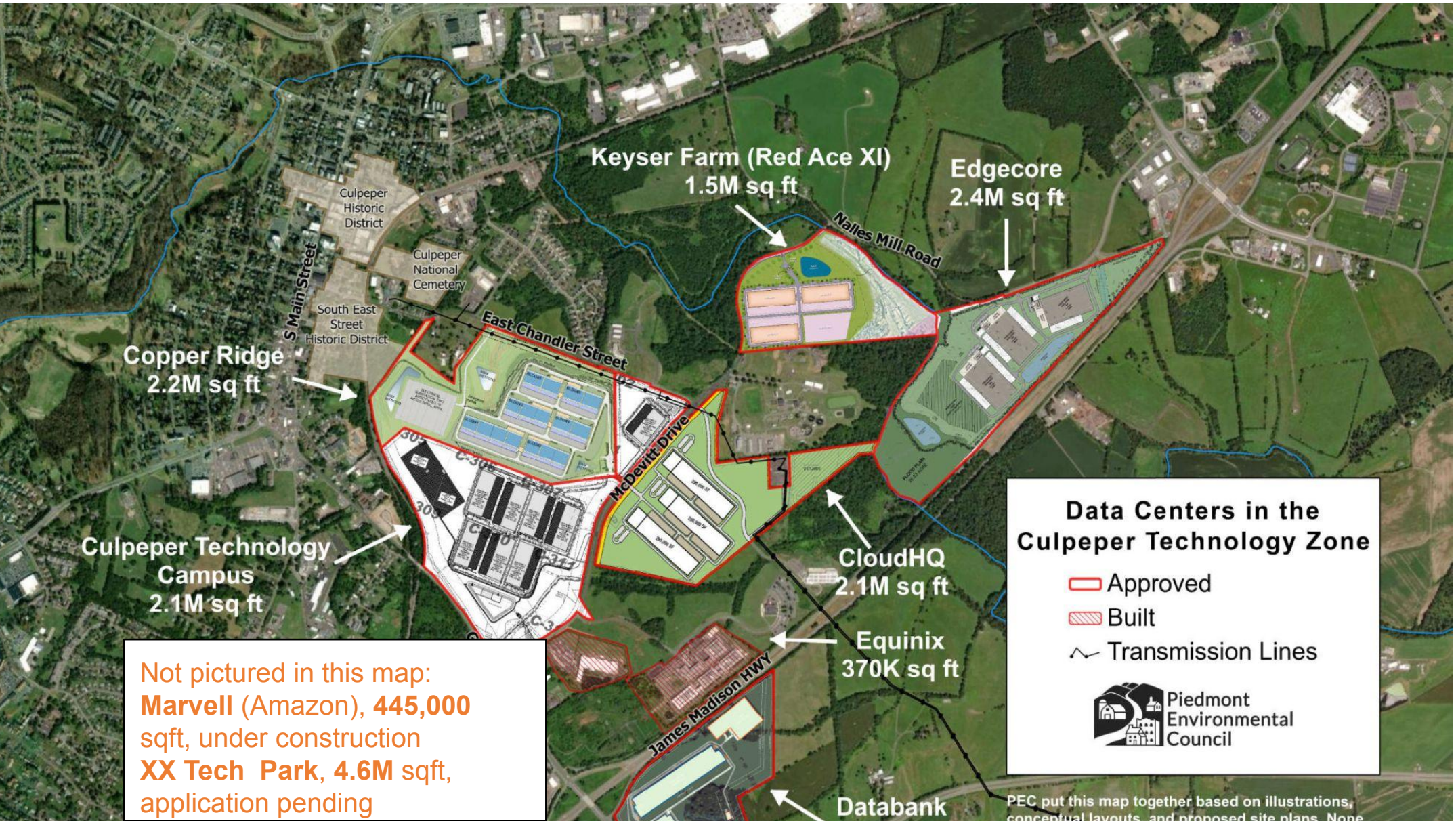
PJM 2022 Window 3: Original Transmission Proposals from 9/5/23

Data Centers in Virginia

- Existing
- Proposed


Piedmont Environmental Council
Existing and Proposed Data Centers - A Web Map
Data Centers Virginia
Build Status
Known Existing Data Centers
Proposed Data Centers
US State Boundaries
Strasburg
Middleburg
Sterling
Reston
Woodstock
Edinburg
Warren
Page Valley
Fort Valley
Sully
Centreville
Arlington
Annandale
Burke
Springfield
Bull Run
Manassas
Fairfax County
Fauquier
Warrenton
Washington
Rappahannock
Sperryville
Luray
Woodville
Shenandoah National Park
Bealeton
Culpeper
Prince William Forest Park
Dale City
Shenandoah
Madison
Locust Dale
Falmouth
Goose Creek
Little River
Bull Run Mountains
Difficult Run
Hazel River
Rapidan River
Aquia Creek
Massanutten Mountain
Conway River
Mountain Run
3852 ft
3624 ft
481 ft
356 ft




Keyser Farm (Red Ace XI)
1.5M sq ft
Edgecore
2.4M sq ft
Nalles Mill Road
Culpeper Historic District
Culpeper National Cemetery
S Main Street
South East Street Historic District
East Chandler Street
Copper Ridge
2.2M sq ft
McDevitt Drive
Culpeper Technology Campus
2.1M sq ft
CloudHQ
2.1M sq ft
Equinix
370K sq ft
James Madison HWY
Databank
Data Centers in the Culpeper Technology Zone
Approved
Built
Transmission Lines
Piedmont Environmental Council
PEC put this map together based on illustrations, conceptual layouts, and proposed site plans. None
Not pictured in this map:
Marvell (Amazon), 445,000 sqft, under construction
XX Tech Park, 4.6M sqft, application pending

Rappahannock County Transmission Lines

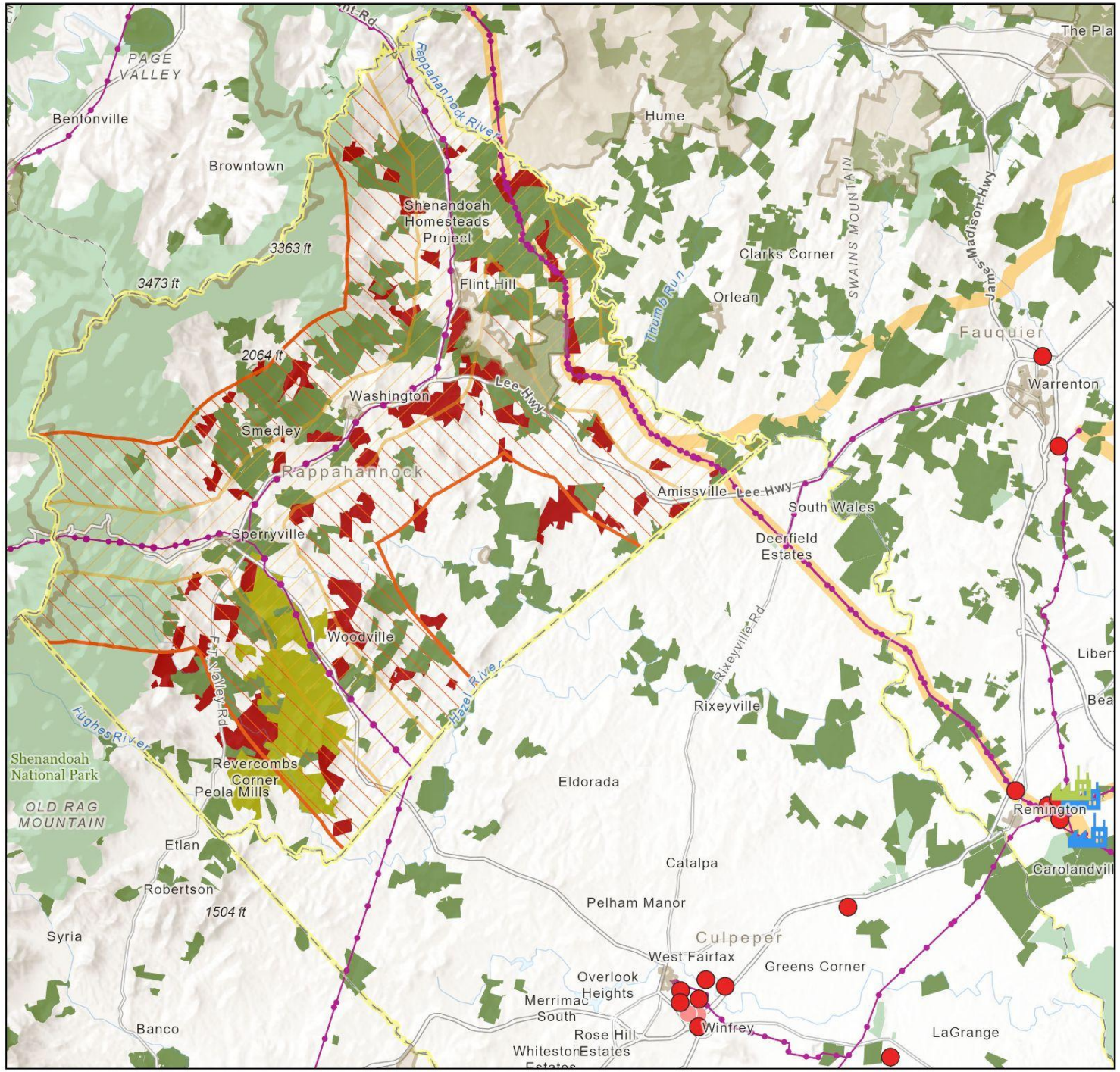
Piedmont Environmental Council

ACCREDITED LAND TRUST ACCREDITATION COMMISSION

- Existing Data Center
- Proposed Data Center
- Natural Gas Powerplant
- Solar Powerplant
- Current Transmission Lines
- Parcels with 100 or More Acres within 3 Miles of a Transmission Line
- 1 Mile Buffer
- 3 Mile Buffer
- Historic Districts
- Eldon Farm
- Conservation Easements
- Publicly Owned Land
- PJM 2022 Window 3: Initial Transmission Proposals (from 9/5/23)

Map created by PEC for presentation purposes only. Although efforts have been made to verify data, accuracy can not be guaranteed.
07/29/2025

0 5 Miles




Loudoun County, Virginia


Fairfax, Virginia


Loudoun County, Virginia

Proposed Substations, Transmission Lines, Loudoun, VA

Piedmont Environmental Council

Substations
- Existing
- Appears Constructed
- Proposed

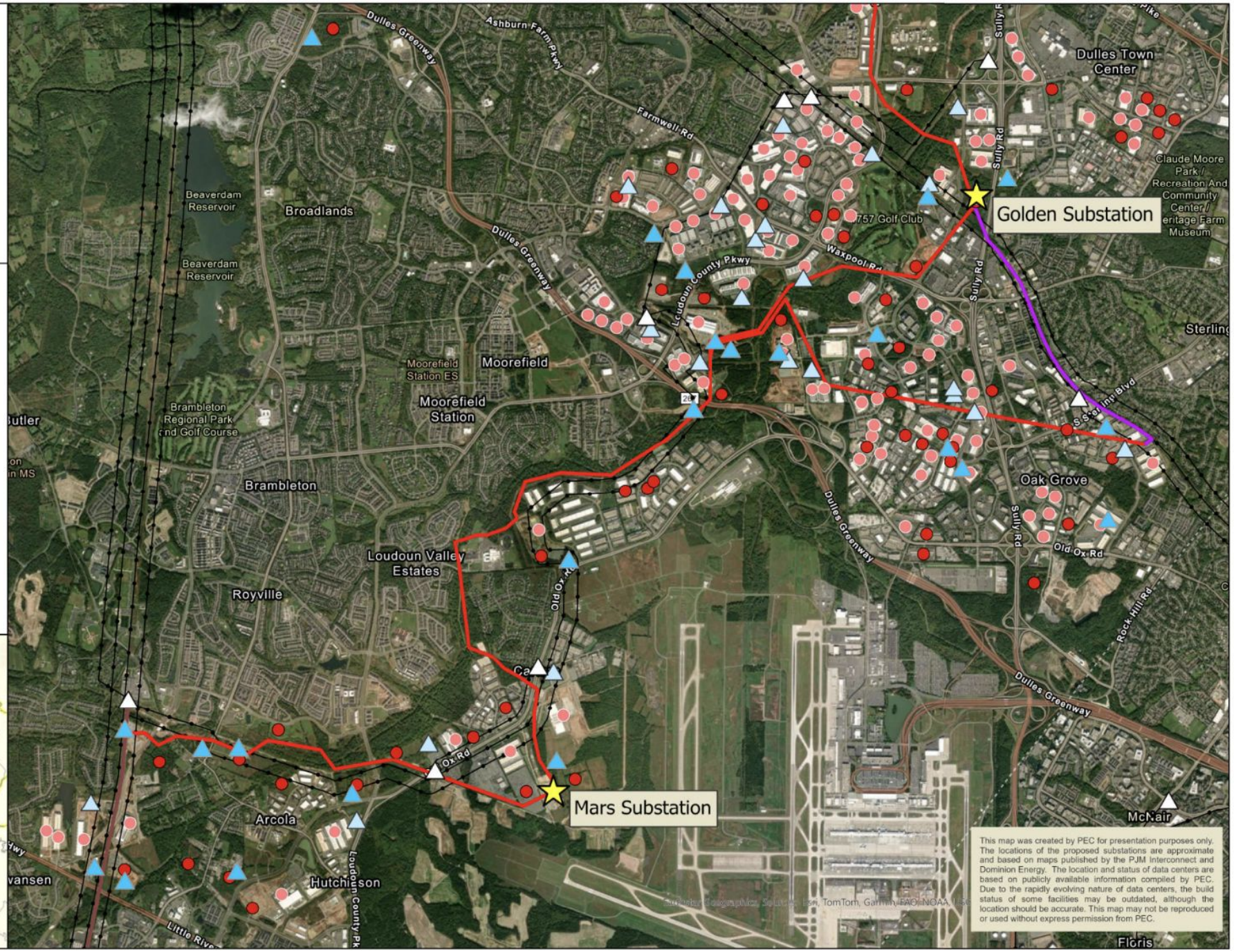
Transmission Lines
- Existing

RTEP 2022 Window 3
- New
- Expansion
- Rebuild

Data Centers in Virginia
- Existing
- Proposed

0 1 Miles

N



Who will pay?

FAST COMPANY

PREMIUM DESIGN TECH WORK LIFE NEWS IMPACT PODCASTS VIDEO INNOVA

11-15-2024 | IMPACT

AI data centers could make your electric bill go up by 70%

A new report quantifies just how much artificial intelligence might cost you.

THE WALL STREET JOURNAL.

World Business U.S. Politics Economy Tech **Markets & Finance** Opinion Arts Lifestyle

BUSINESS | ENERGY & OIL | HEARD ON THE STREET Follow

AI Is About to Boost Power Bills—Who'll Take Heat for That?

High prices are a windfall for power-plant owners but are starting to raise difficult questions

By Jinjoo Lee Follow

Aug. 12, 2024 7:00 am ET

Share Resize 155 Listen (3 min)

BUSINESS | ENERGY & OIL Follow

Who Pays? AI Boom Sparks Fight Over Soaring Power Costs

Utilities and technology companies are at odds over who should pay for electricity costs in unprecedented data-center build-out

By Katherine Blunt Following

July 29, 2025 5:30 am ET

An Amazon Web Services data center in Manassas, Va. PHOTO: NATHAN HOWARD/BLOOMBERG NEWS

“Dominion estimated that it will have to invest more than $40 billion in the state over the next five years to serve data-center demand, meet clean-energy targets and complete other necessary work. That is roughly equal to the value of its entire system there.

“We think this is the most important decision that’s being made in America about who pays for energy,” said Chris Miller, president of the Piedmont Environmental Council, which advocates to protect smaller utility customers. “How do you make sure residential users aren’t being asked to subsidize these giant global corporations?””

Who Pays? AI Boom Sparks Fight over Soaring Power Costs | Wall Street Journal

Harvard Law Research Paper

Extracting Profits from the Public: How Utility Ratepayers Are Paying for Big Tech's Power

New paper from the Harvard Electricity Law Initiative uncovers how utilities are forcing ratepayers to fund discounted rates for data centers

March 5, 2025

Ari Peskoe , Eliza Martin

Download paper (PDF)

A new paper by Legal Fellow Eliza Martin and Electricity Law Initiative Director Ari Peskoe explores how the public is paying the energy bills of some of the largest companies in the world. Amazon, Google, Meta, Microsoft, and other technology

The State Corporation Commission Has Scheduled a Hearing of Dominion Energy Virginia's 2025 Biennial Review of Rates

The SCC has scheduled a public witness hearing to begin at noon on September 2, 2025, followed by an evidentiary hearing. Public witnesses intending to provide oral testimony must pre-register with the SCC by 5 p.m. on August 26, 2025. Both the evidentiary hearing and the public witness hearing will be webcast.

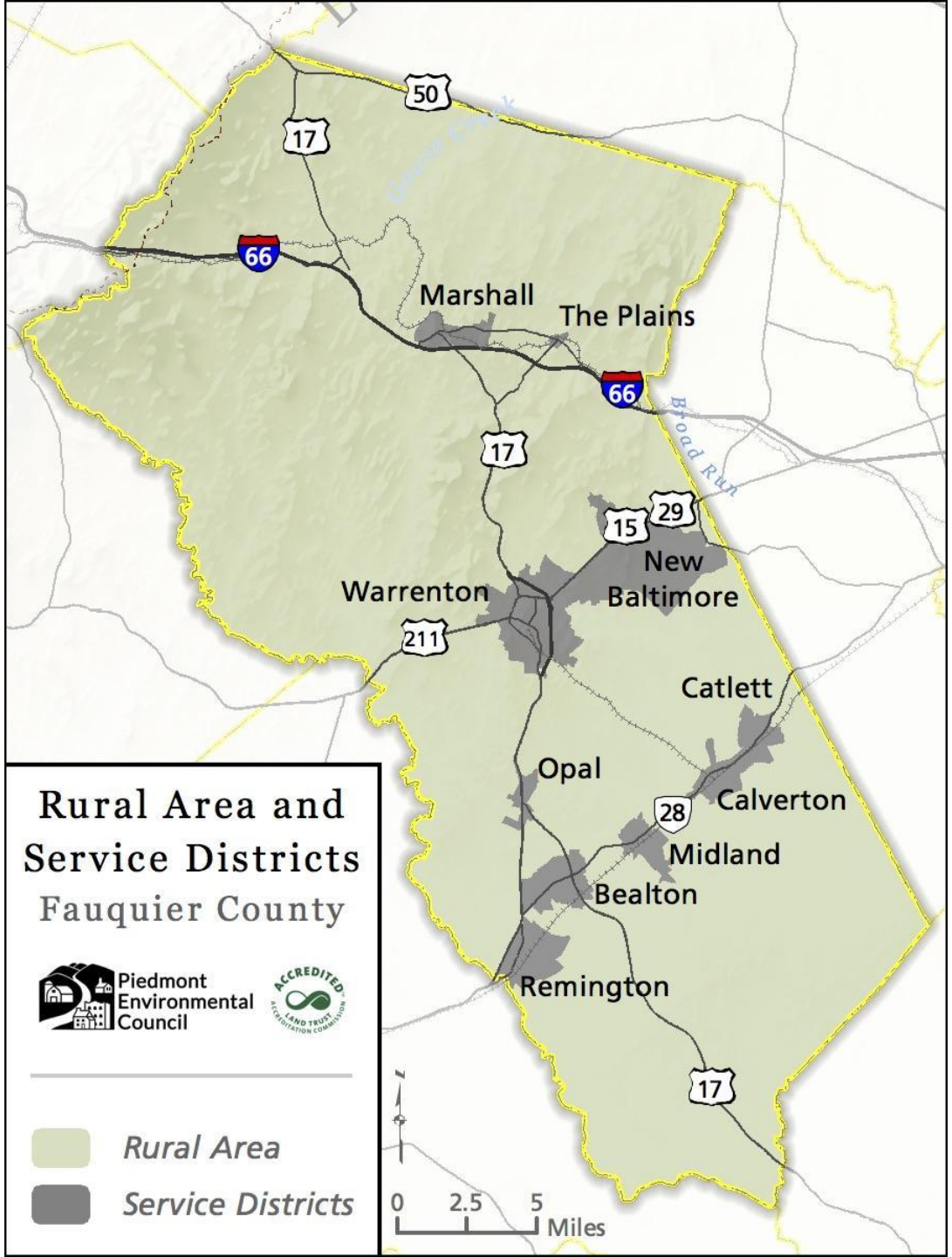
Public witnesses wishing to provide oral testimony may pre-register in one of two ways:

- Completing a public witness form for case number PUR-2025-00058 on the SCC's website.
- Calling the SCC at 804-371-9141 during normal business hours (8:15 a.m.-5 p.m.) and providing your name and the phone number you wish the Commission to call to reach you during the hearing.

To promote fairness for all public witnesses, each witness will be allotted five minutes to provide testimony.

Web link for more info:
https://www.scc.virginia.gov/about-the-scc/newsreleases/release/scc-schedules-hearing-on-dominion-2025-biennial-review/scc-schedules-hearing-on-dominion-2025-biennial-review.html

Let’s zoom in on local impacts…



A Local Example for Scale:

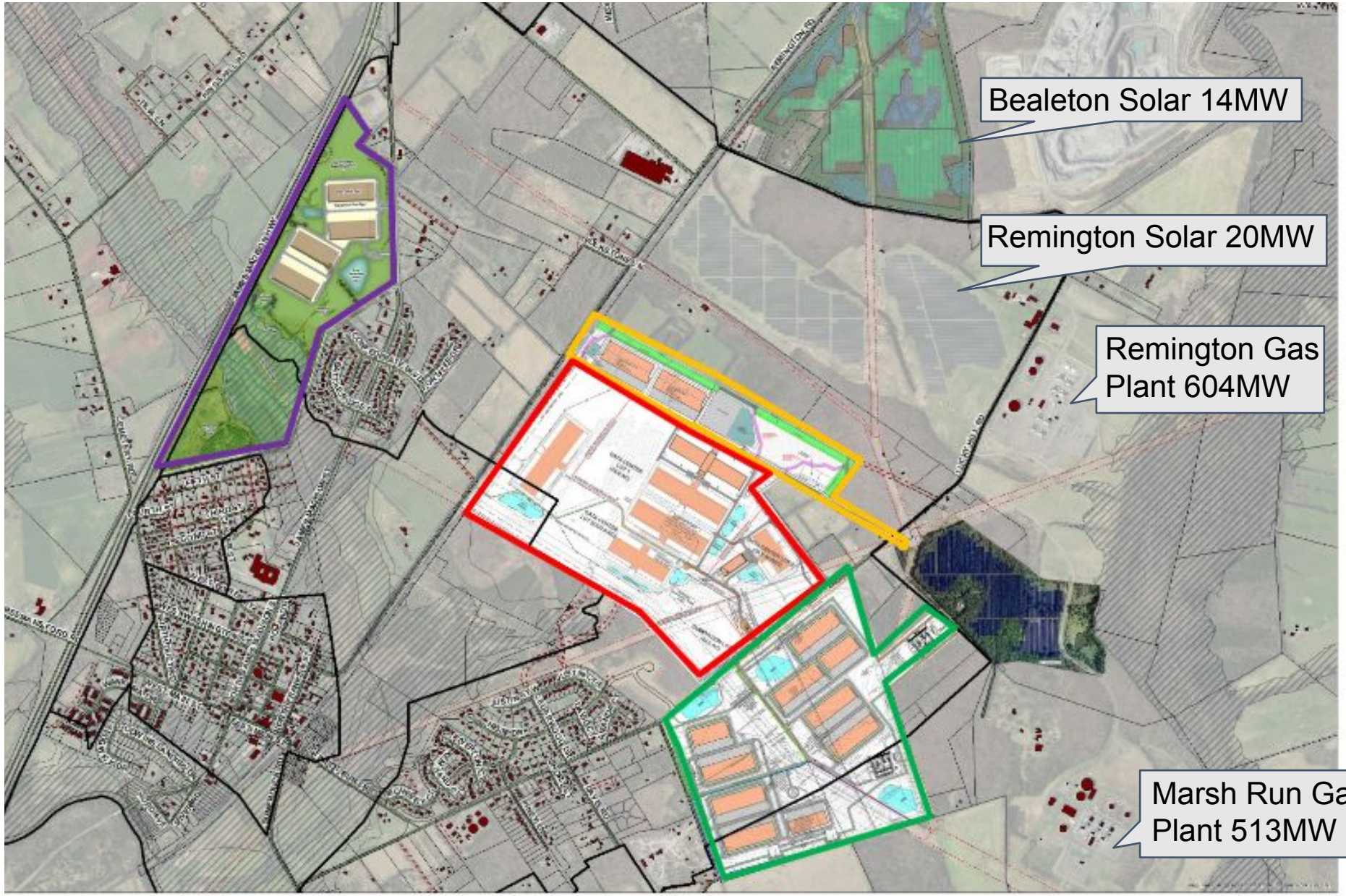
Fauquier Data Center Proposals and Energy Infrastructure

Residential Consumption:

Fauquier ≈ 26,000 homes

26,000 homes ≈ 60–100 MW

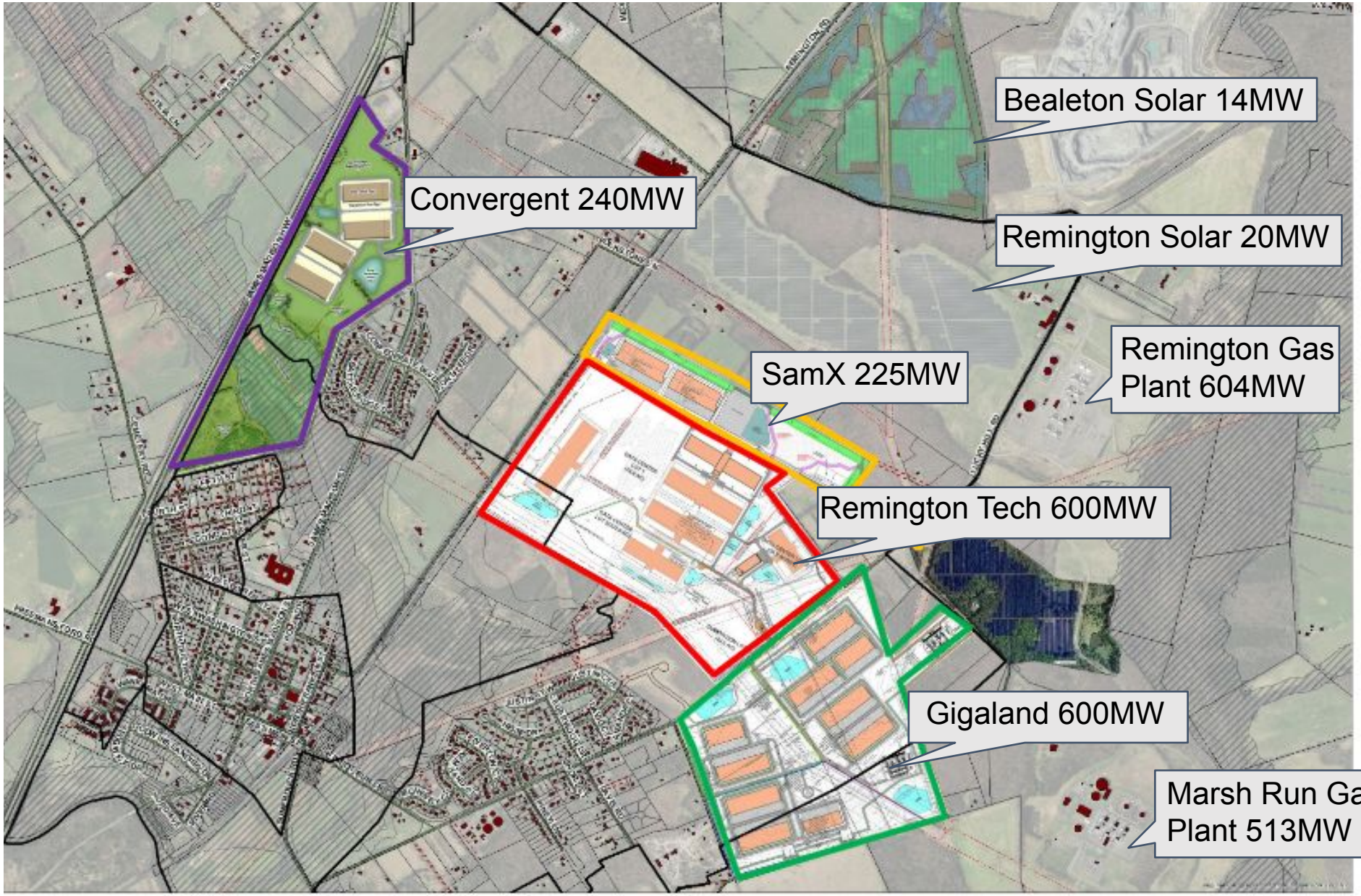
Fauquier Data Center Proposals and Energy Infrastructure



Residential Consumption:
Fauquier ≈ 26,000 homes
60-100 MW ≈ 26,000 homes

Energy Production:
Solar = 34 MW
Gas = 1,117 MW
Total – 1,151 MW

Fauquier Data Center Proposals and Energy Infrastructure



Residential Consumption:
Fauquier ≈ 26,000 homes
60-100 MW ≈ 26,000 homes

Energy Production:
Solar = 34 MW
Gas = 1,117 MW
Total – 1,151 MW

Data Center Consumption:
Approved – 600 MW
Proposed – 1,065 MW
Total – 1,665 MW

Who pays and who bears the risk?

Utility Ratepayers (You and Me) Subsidizing Data Center Power Demand

- **Discounted rates**, private negotiations, and stronger leverage and influence as largest customer class
- **Flawed rate structure** that does not match the new paradigm of 24/7 large load consumers driving increase
- **High demand causing higher capacity costs** and fuel prices that are born by all users
- **Transmission lines** to solely serve a data center are unfairly subsidized by all users
- **Huge risk** borne by the rest of the customers if data centers don’t consume as much energy as expected

Community Impacts Experienced in Northern Virginia

Parks and Trails

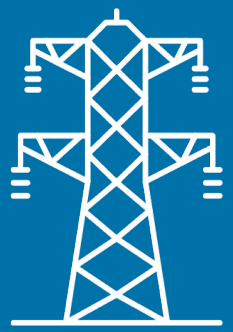
Noise

Water

Air Quality

Wildlife Habitat

Design



Energy Infrastructure

Data center development is unprecedented

- **Explosive growth** and lots of speculation due to the boom in AI
- **Much more energy**; a campus can use as much as a city
- **More generators** are used for onsite backup power requirements than any other use including hospitals and factories
- **Consumptive water use**; much of the water is lost to evaporative cooling
- Facilities **tend to cluster**, leading to cumulative impacts on air and water quality, water consumption, and energy infrastructure.

Why do Localities Find Data Center Attractive?

- They generally don't usually create a lot of traffic
- They don't require school seats
- They create some jobs (although not as much as many other forms of economic development)
- **They offer a lot of tax revenue**
  - **Personal Property Tax (IT Equipment)**
  - **Real Estate Tax**

Loudoun Now August 15, 2023
Town Vice Mayor of Leesburg Neil Steinberg said on Leesburg's recent decision on data centers, *"in the end, it is all about the money, and it is a lot of money..."*

Local Land Use Impacts of Data Centers Vary…

- Traffic
- Effect on Adjacent Uses
- Lighting
- Building Design
- Energy Usage
- Air Quality
- Noise
- Water Usage and Wastewater
- Water Vapor Plumes
- Fire Protection and Fuel Storage

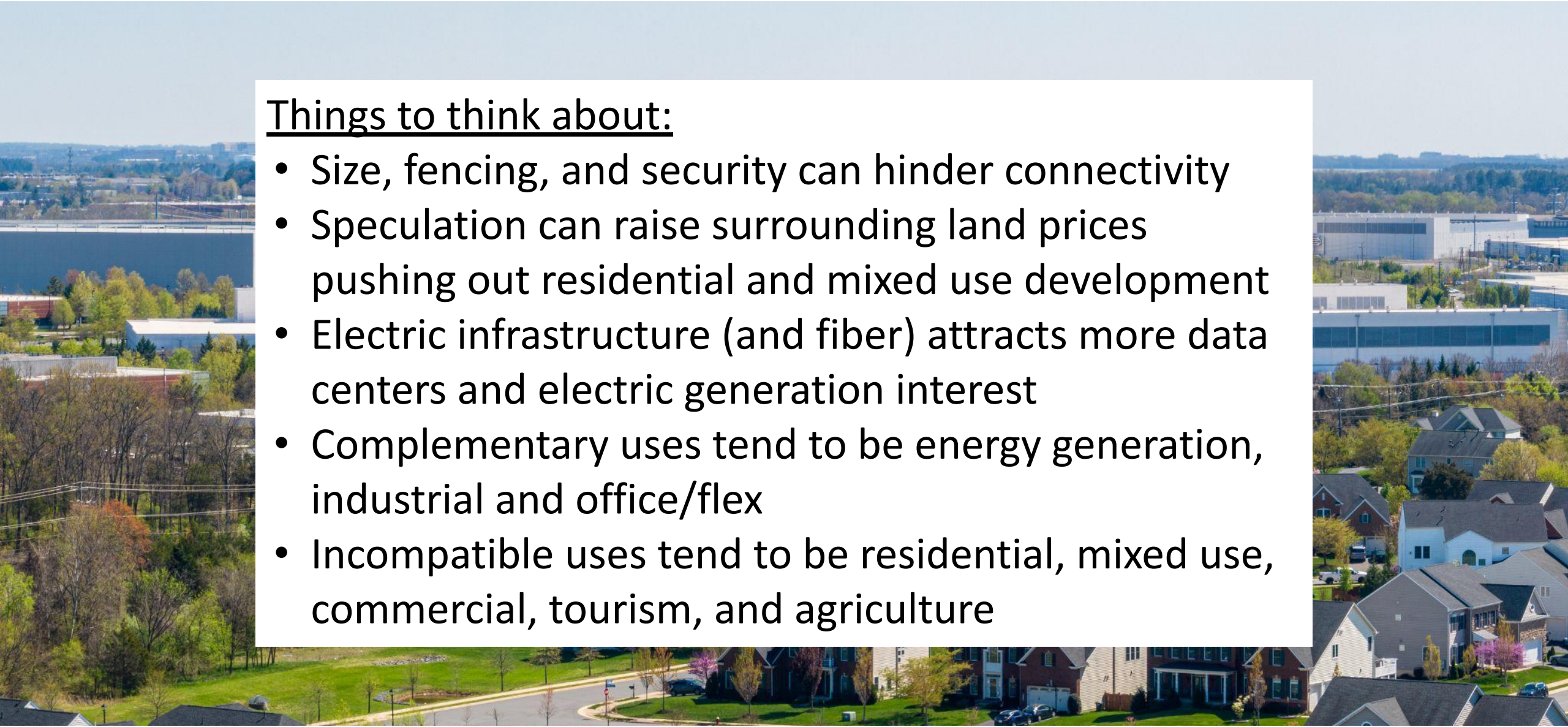
Traffic

Digital Reality colocation data center with conference and work space

Amazon cloud data center

Effect on Adjacent Uses

Effect on Adjacent Uses



Things to think about:

- Size, fencing, and security can hinder connectivity
- Speculation can raise surrounding land prices pushing out residential and mixed use development
- Electric infrastructure (and fiber) attracts more data centers and electric generation interest
- Complementary uses tend to be energy generation, industrial and office/flex
- Incompatible uses tend to be residential, mixed use, commercial, tourism, and agriculture

Lighting

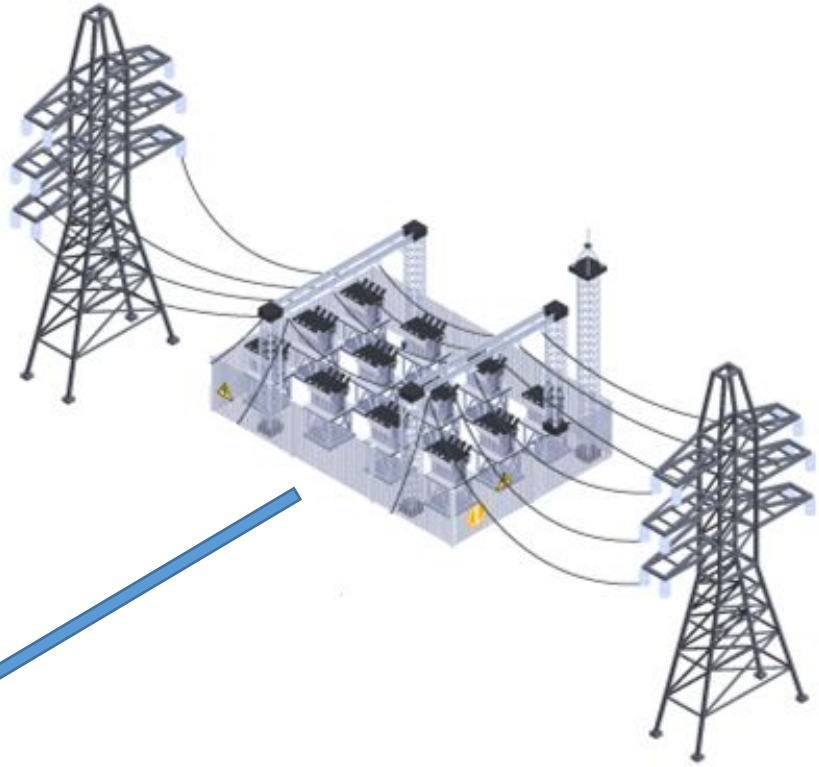
Good data center lighting example; Amazon data centers in Ashburn

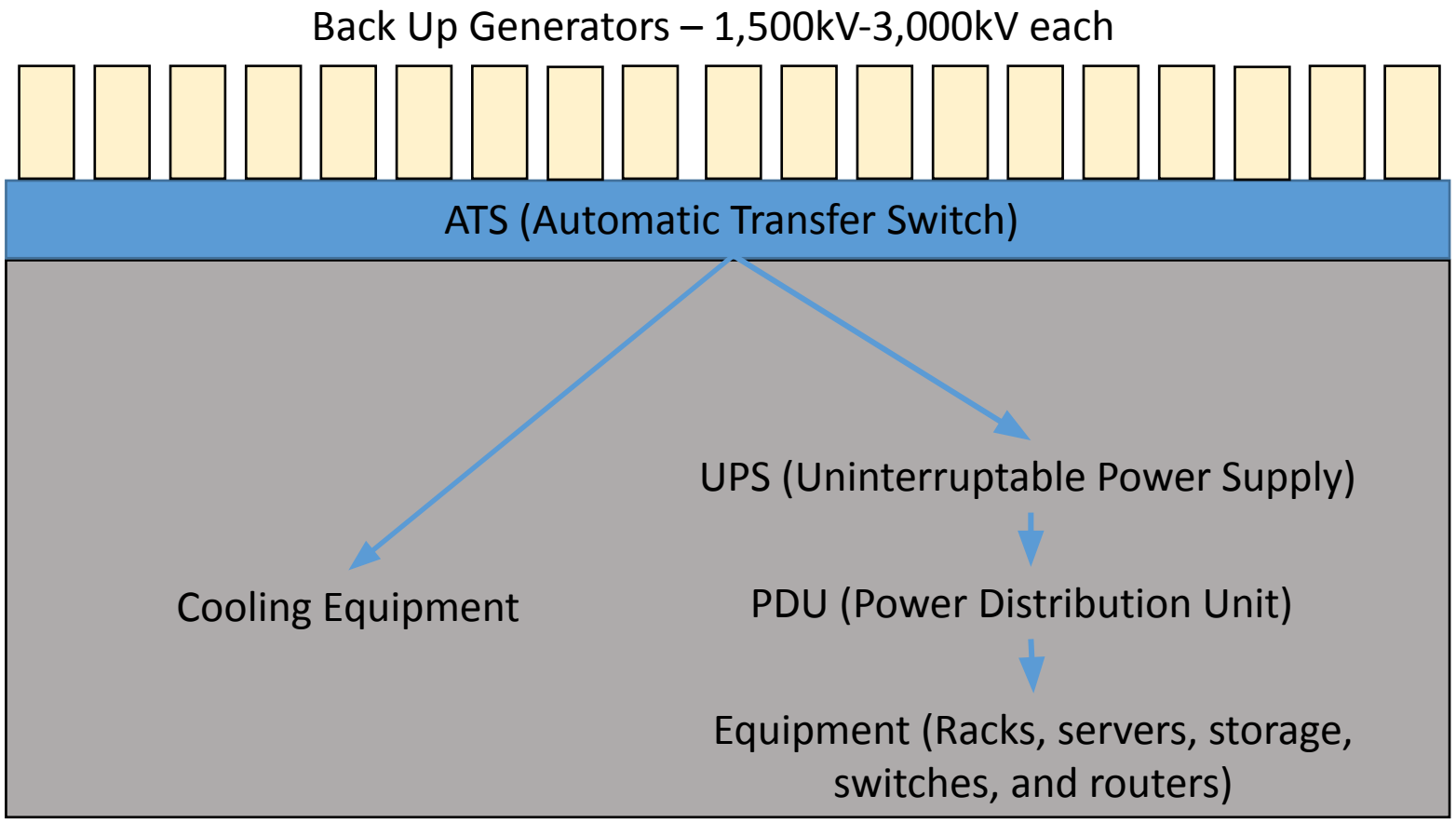
Building Design and Massing

Things to think about:

- Height limits/FAR/building footprint limits (affects power usage as well)
- Encourage different architectural treatments to break up the monolithic appearance of the primary façade (such as building step-backs, projections, recesses, fenestration (or simulated windows), differentiated surfaces and materials)
- Use screening and site layout to ensure mechanical and storage facilities are not visible from the primary façade.
- Roof parapets, equipment penthouse, or other visually solid screen should be used to screen roof top equipment (this may help some with noise as well).

Power Path for Typical Data Center





Note about energy efficiency:
Industry often uses: PUE

$$PUE = \frac{\text{Total Facility Power}}{\text{IT Equipment Power}}$$

Backup Generators

Whole House Generators are from 7.5 to 26kW

Commercial Generators run from 1500kW to 3500kW

Generator Regulations

EPA Generator Tiers:

Tier I - first set of emission standards covering all new non-road mobile diesel engines

Tier II - Adopted 1999. Addressed NOx, carbon monoxide, unburned hydrocarbons and particulate matter (PM)

Tier III - Implemented between 2006 and 2008. Restricting exhaust emissions further.

Tier IV – Implemented 2008 to 2015. Mandated reduction of sulfur content and 90 percent reduction of PM and NOx emissions. Uses the best emissions-reduction technology available

Virginia DEQ Emergency vs. Non Emergency Standards

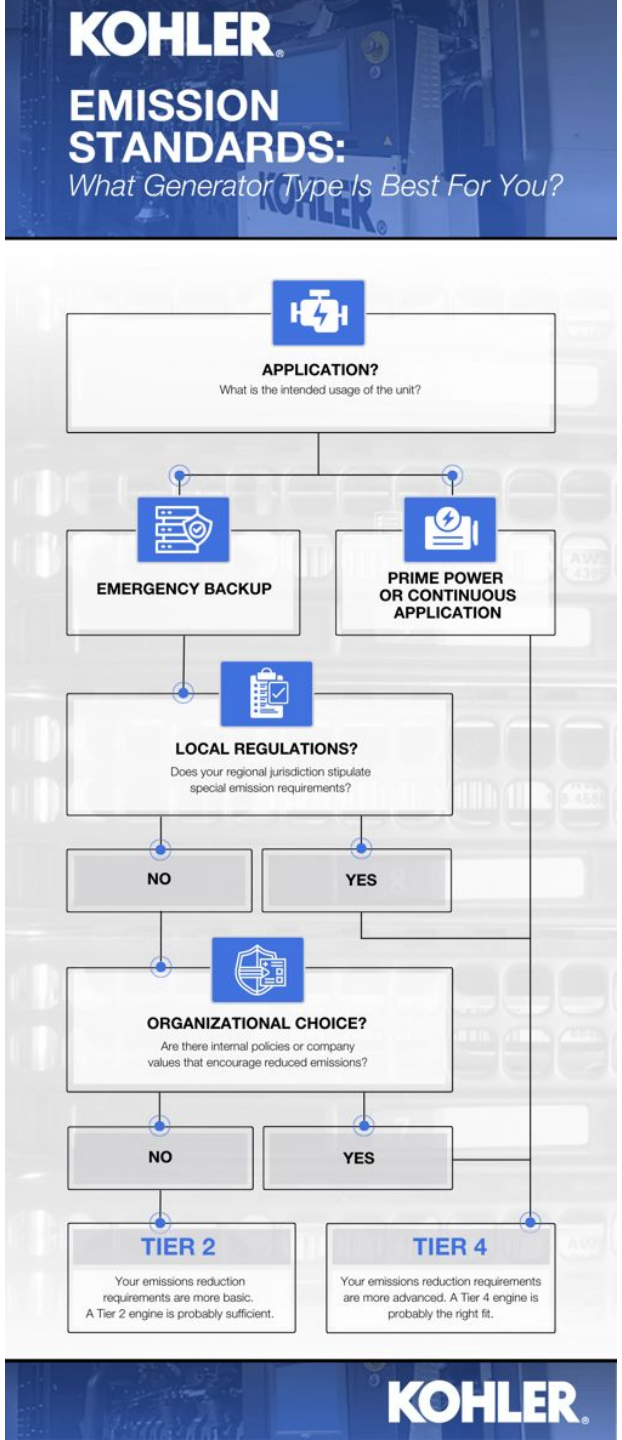
Emergency Generators (Tiers 1-3, most are 2)

- Use of low sulfur diesel fuel oil
- Must use good operating practices and perform appropriate maintenance
- Emission limit = 6.0 g/hp-hr

Non-Emergency Generators (Tier 4)

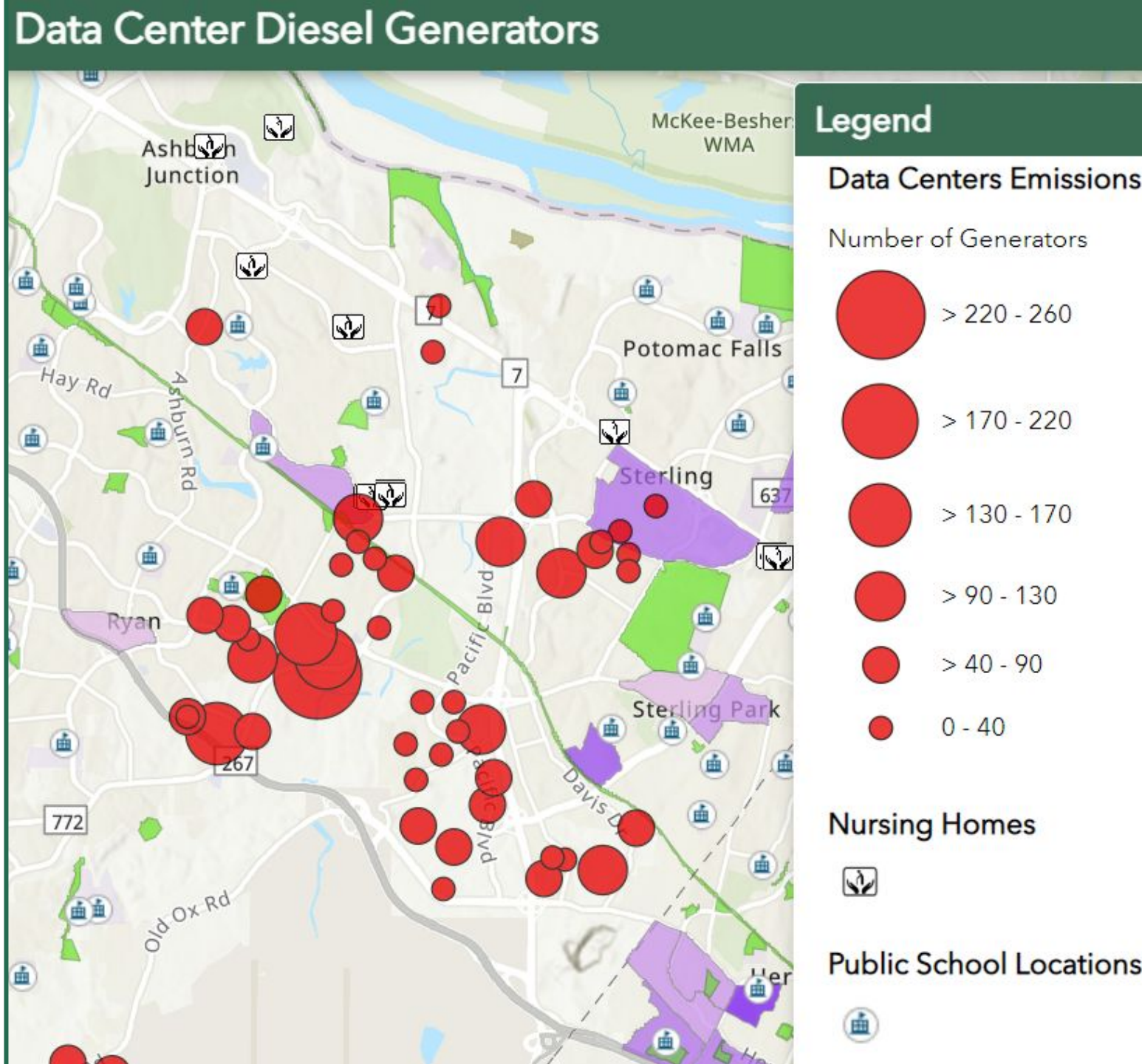
- Use of low sulfur diesel fuel oil
- Emission limit = 0.60 g/hp-hr
- Requires diesel particulate filters (DPF)
- Requires diesel oxidation catalyst (DOC)
- Requires open or closed loop SCR (Selective Catalytic Reduction) systems

How companies decide what generator type to use:



Source: https://insights-datacenters.kohlerpower.com/emission-standards-for-data-centers-a-decision-making-guide

There are over 4000 data center diesel generators permitted in Loudoun, the vast majority are Tier II

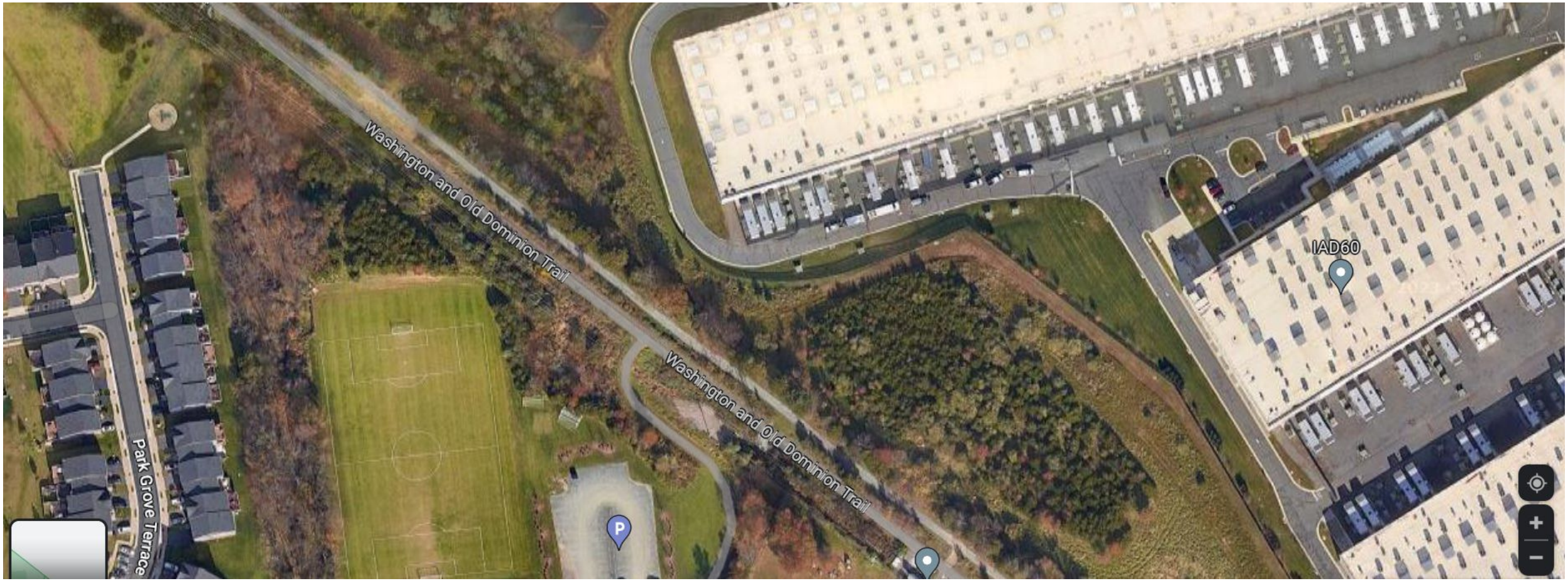


www.pecva.org/work/energy-work/data-centers-diesel-generators-and-air-quality-pec-web-map/

Hidden Danger of Generators

W&OD Trail, Loudoun County

Amazon Datacenters in Ashburn, VA



Noise Issues

- Cooling (air conditioning compressors and chiller fans)
- Generators (run for maintenance and emergencies)
- Cyptocurrency (noisier than other data centers but don’t need to run 24/7 the same way as other data centers, may be able to cut them off…)

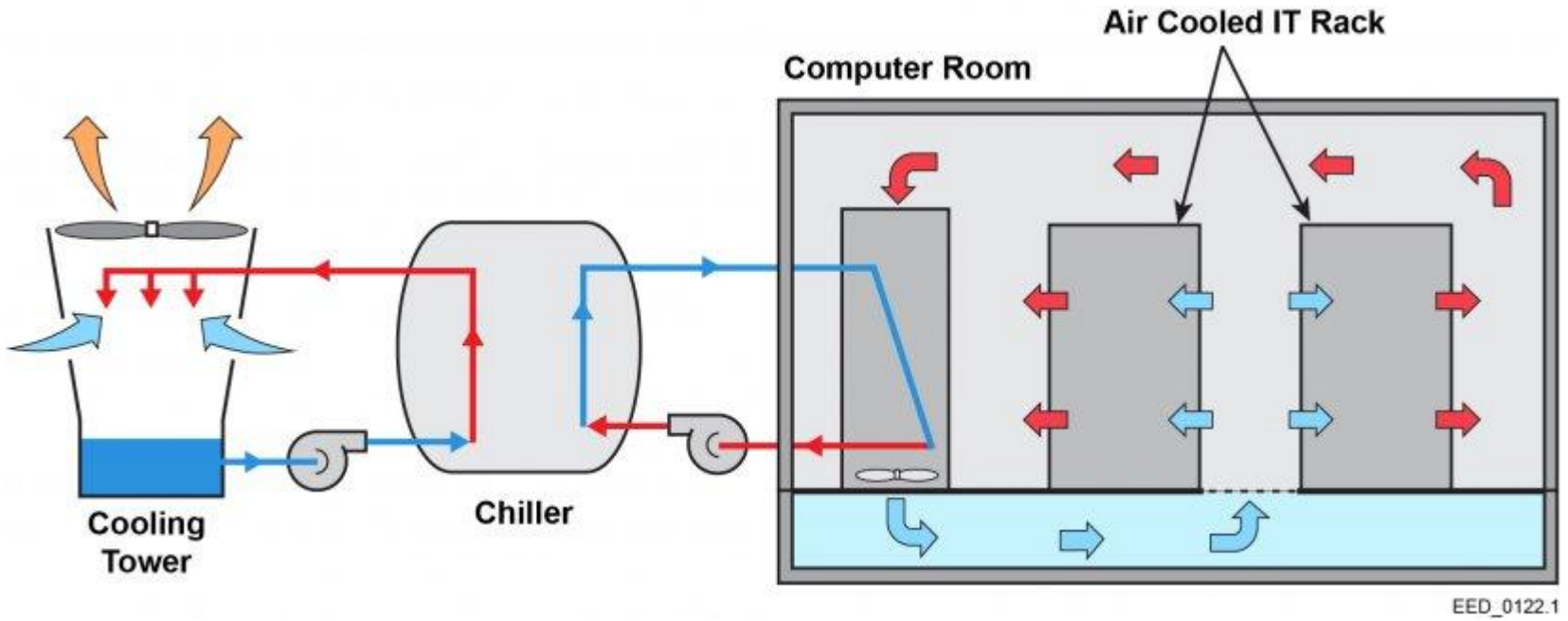
Roof of 2-story data center in Ashburn, VA

Bitfury Mines, Georgia

Thoughts for addressing noise issues

- Avoid allowing data centers in close proximity to residential development
- Require noise study upfront rather than going through costly battle to enforce noise ordinance after construction
- Some cooling systems are quieter than others. Liquid cooling is not only more energy efficient it is also much quieter because it eliminates fans.
- Require generator maintenance to be done during waking hours and not on weekends.
- Consider only allowing cryptocurrency data centers to run during daytime hours

Typical cooling at data center



This is a simplified schematic of a typical data center that relies on evaporation from a cooling tower as the last stage of heat removal from the facility.

Source:
www.energy.gov/femp/cooling-water-efficiency-opportunities-federal-data-centers

Cooling Techniques (often combination of several)

Air Cooling - CRAC systems (computer room air conditioner) which provides traditional air cooling or CRAH (computer room air handler) systems which use cooling coils and a chiller system to remove heat.

Closed loop cooling design:

- Air-cooled chiller (no water loss)
- Adiabatic cooling has no cooling tower (much less water loss)

Liquid Cooling - liquid Immersion or direct-to-chip (uses less energy and less water)

Hybrid Cooling – In row cooling unit or rear-door heat exchangers (uses less energy and less water)

Other industry solutions to reduce water consumption:

- Free cooling or air- or water-side economizers (utilizing naturally cool air or water)
- Rainwater harvesting and treatment for use in cooling
- Bleed recovery using reverse osmosis units to treat water blown down from evaporative cooling system
- Trigeneration using absorption chillers (onsite power generations using natural gas)

Design Configurations: Room, Row, Rack, or Hybrid; raised floor; hot/cold aisles; blanking panels

Things to think about

- **Water Usage** – Evaporative cooling towers can use a lot of water and are often only are a sustainable choice when there is gray water available
- **Energy Usage** – Air cooling without evaporative cooling uses more energy
- **Noise** – Use and location of HVAC equipment (fans, condensers, compressors, and cooling towers); require noise study up front
- **Blowdown** – The capacity of wastewater treatment facility to handle amount and concentration of projected blowdown from evaporative cooling systems
- **Water Vapor Plumes** – Cooling tower plumes are harmless but can be unsightly and create public concern
- **Trigeneration** - Additional Community Impact of a Trigeneration facility (basically an onsite natural gas power plant)

Fire Protection

- Locality will likely need additional training for first responders to fires at data centers (see Loudoun's ER manual)
  - Lithium-ion batteries thermal runaway
  - Physical access can be challenge
  - Entry gates (may restrict longer vehicles)
  - Security policies can delay response
  - Facility size and lack of markings
- Locality may need additional equipment such as trucks with taller ladders
- Local inspectors may need additional training if first data center in locality
- Ensure proper fire protection and fighting system in place for data center and fuel storage yard

Fuel Storage

- Above ground storage is safer than underground storage tanks for preventing leaks
- Bulk fuel storage should be separated from generators and buildings
- Fuel storage containers must have secondary containment and overfill protections
- Insure there are no storm drains near fueling stations that could end up polluting nearby wells, rivers, ponds and water reservoirs if there was an overflow

Onsite Power Generation

Loudoun Now - August 17, 2023
Outgoing Deputy County Administrator Charles Yudd said he thinks Loudoun's next big planning challenge won't be land use, as it has been for the past three decades, but infrastructure, especially energy infrastructure.

"We see high-demand users contemplating small nuclear reactors, things that might need to be incorporated into business systems," he said.

SMR Nuclear to Hydrogen On-Site Power Generation Plan Proceeds In Surry County, Virginia

An illustration of Green Energy Partners' and IP3's jointly planned data center and energy campus near the Surry Nuclear Power Station in Southeastern Virginia.

Natural Gas to Hydrogen Plan Emerges for On-Site Data Center Power Generation In West Virginia

Rendering of the proposed Mountaineer GigaSystem by Fidelis New Energy, LLC, including hyperscale, carbon neutral data centers providing for both production and consumption of lifecycle net zero hydrogen. Credit: Fidelis New Energy, LLC

DuPont Fabros NJ1 data center in Piscataway, New Jersey (now owned by QTS)

What Should Your County Do?

- Define data centers/cryptocurrency (possibly separately) and any type of onsite power generation allowed
- Adopt use-specific standards (require basic information on data center type and cooling system, projected energy and water usage, building design, site layout with substation, generators, fuel storage and containment area, noise study, etc)
- No perfect model ordinance to point to but take a look at:
  - Loudoun County (building design standards, screening of mechanical equipment, etc.)
  - Prince William County (Data Center Opportunity Zone Overlay District)
  - Prince George County, VA (building design standards, require noise study, etc)
  - Town of Leesburg (building design standards, sustainability recommendations, etc)
  - Niagara Falls, NY (High Energy Usage Overlay District)
  - Frederick County, MD (building design, landscaping, screening, noise standards, etc)
  - Pitt County, NC (separation from sensitive uses, requires noise study and underground wiring)
  - Chandler, AZ (preconstruction noise baseline study, annual noise study during peak operation, requires sound mitigation measures, establishes generator maintenance time limitations, etc)

What Should Your County Do

- Don’t sign NDA’s and review FOIA regulations and what is considered proprietary information (a general concept plan with building locations, anticipated power usage, generator yard, fuel storage, substation, etc and basic description of type of data center and cooling is not proprietary info)
- Meet with your utility to discuss electrical infrastructure required during review not after approval! This requires full information such as projected MW of data center and planned location of substation.
- DEQ oversees the air permitting of generators but to protect the public health safety and welfare localities could adopt local regulations number or location of diesel generators in proximity to sensitive uses such as schools, parks, trails, elderly living facilities, hospitals, etc.

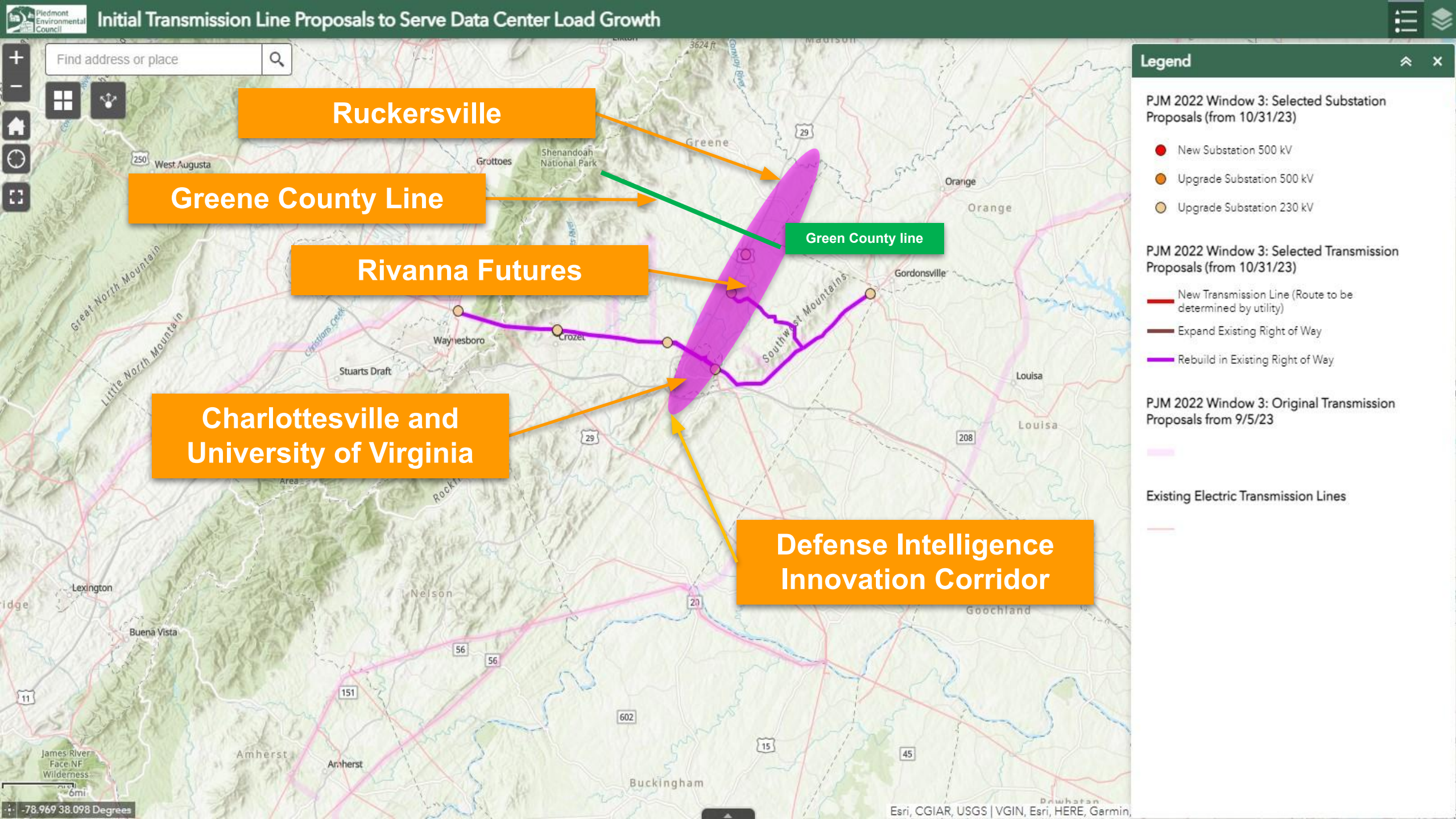
More information

- UpTime Institute - IT advisory organization tracking industry trends and providing guidance
- CBRE – commercial real estate services and investments research and provide insights
- Data Center Dynamics (DCD) - Articles, white papers, training, webinars, magazine
- Data Center Frontier – Articles, white papers, projections/trends, webinars, videos
- Podcasts – The Data Center Frontier Show, DCD Zero Downtime, Not Your Father's Data Center Podcast (less technical and more local focus)
- APA Illinois Chapter On-Demand Education Course on Crypto Mining & Data Centers (David Morley, AICP, Stewart Weiss, and Tom Thunder) CM 1.25
- PJM Transmission Expansion Advisory Committee (TEAC) – determining transmission line routes to deliver power to northern Virginia and other small data center hubs in the state
- Take a tour of Loudoun's Data Center Alley and schedule tour of inside of colocation data center with Iron Mountain or QTS
- **Visit PEC's website**

www.pecva.org/our-work/energy-matters/data-centers-energy-demand/

Albemarle has a few small data centers but PEC is concerned about the County opening the door to many large data centers without community input and review by the Planning Commission and Board of Supervisors.

This unprecedented level of development could have significant consequences - but we can act to ensure we have a more sustainable future.

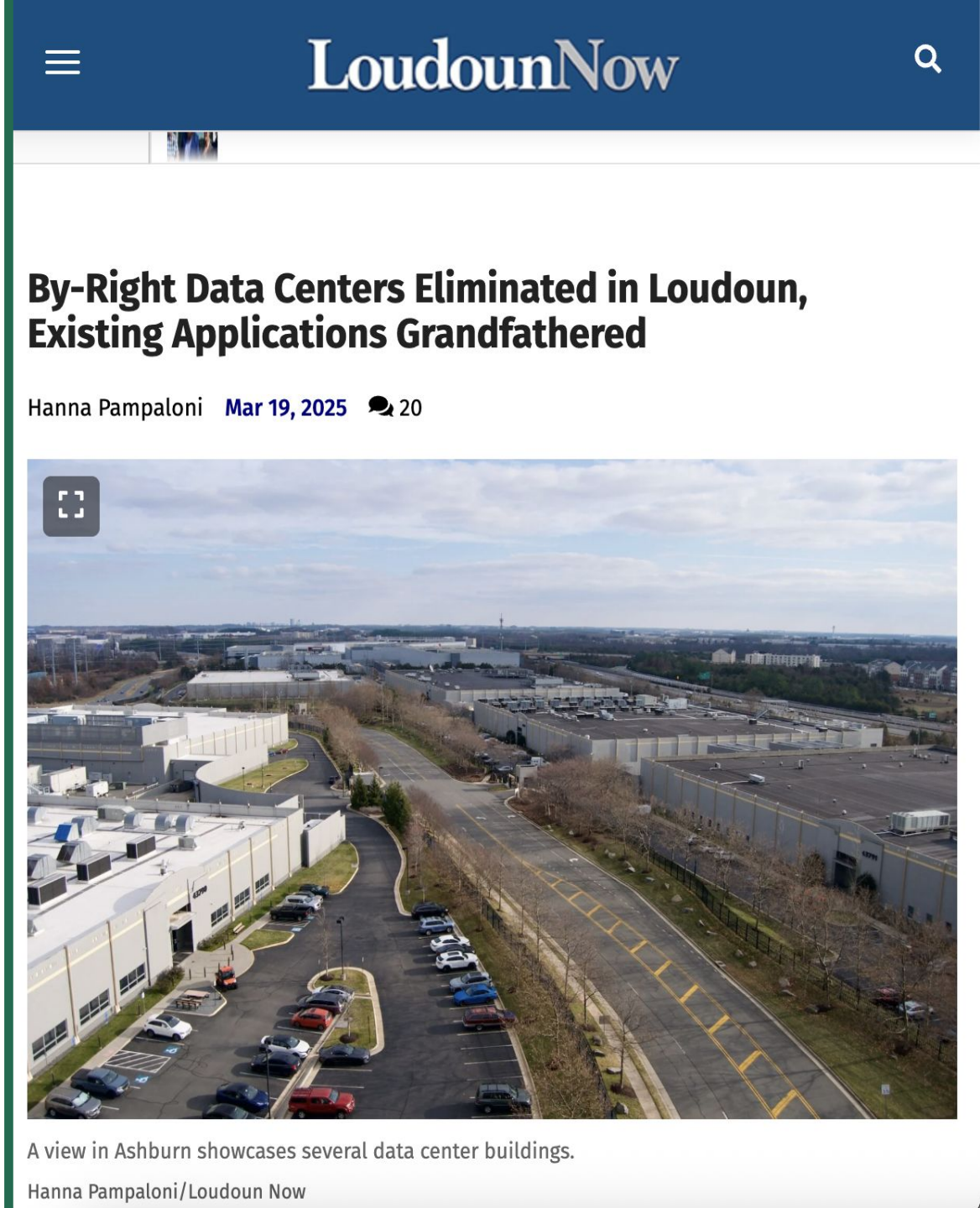

Initial Transmission Line Proposals to Serve Data Center Load Growth
Find address or place
Ruckersville
Greene County Line
Rivanna Futures
Charlottesville and University of Virginia
Defense Intelligence Innovation Corridor
Green County line
Legend
PJM 2022 Window 3: Selected Substation Proposals (from 10/31/23)
New Substation 500 kV
Upgrade Substation 500 kV
Upgrade Substation 230 kV
PJM 2022 Window 3: Selected Transmission Proposals (from 10/31/23)
New Transmission Line (Route to be determined by utility)
Expand Existing Right of Way
Rebuild in Existing Right of Way
PJM 2022 Window 3: Original Transmission Proposals from 9/5/23
Existing Electric Transmission Lines
Greene
Orange
Louisa
Gordonsville
Waynesboro
Crozet
Stuarts Draft
Shenandoah National Park
Grottoes
West Augusta
Great North Mountain
Little North Mountain
Southwest Mountains
Lexington
Buena Vista
Nelson
Amherst
Buckingham
Goochland
James River Face NF Wilderness
-78.969 38.098 Degrees
Esri, CGIAR, USGS | VGIN, Esri, HERE, Garmin,

Albemarle County's
Proposed Updated Data Center Ordinance

PEC is advocating that Albemarle County:

- Heed the warnings from Loudoun, Louisa and Culpeper Counties
  - **continue requiring special use permits for all data centers larger than 40,000 square feet.**

- Allow the public and elected officials to have a voice in data center proposals that would compromise the county's ability to make informed, community-centered decisions



LoudounNow

By-Right Data Centers Eliminated in Loudoun, Existing Applications Grandfathered

Hanna Pampaloni Mar 19, 2025 20

A view in Ashburn showcases several data center buildings.

Hanna Pampaloni/Loudoun Now

How Did We Get Here?

Current Data Center Ordinance

- With some performance requirements, the county allows data centers:
  - up to 40,000 sq. ft in industrial zoned areas

- On property with commercial zoning (regardless of size), with a special use permit

- On industrially-zoned property for data centers exceeding 40,000 square feet, with a special use permit

Proposed change: By-right with performance requirements in overlay districts up to 500,000 sq. ft

Fifth Street Station

Ashburn, Va

Energy of approx. 10-20,000 homes!

What's Driving Albemarle's Data Center Demand?

2) Desire to increase tax revenue from nonresidential sources…

3 STRATEGIC DIRECTION

The goals and initiatives are summarized below, and specific actions related to each initiative are detailed in the following pages.

GOAL 1 Expand economic opportunities in the Food and Beverage industry

A. Provide specialized training, peers, and mentors to reach young people, recruit talent for specialized positions, and assist businesses with start-up, expansion, and access to new consumer markets.

B. Leverage and overcome resistance to new technologies for agricultural biotechnology advances in animal and crop sciences and environmental resilience; promote greenhouses and controlled environment agriculture ("CEA") and continue to expand rural infrastructure.

C. Monitor land competition and conditions and support climate change research and investments in resilient infrastructure.

GOAL 2 Leverage Virginia's clean technology assets to establish an expanded hub for innovation and Advanced Manufacturing

A. Develop a clean energy technology sector plan in Region 9 that focuses on R&D, innovation, and product manufacturing.

B. Focus on building support for Clean Energy R&D and small-scale manufacturing initiatives.

C. Support university-based collaboratives to advance R&D in next-generation commercial applications.

D. Evaluate and build out the Clean Energy supply chain.

GOAL 3 Designate a Defense and Intelligence industry corridor

A. Market corridor (Rtes. 15 and 29) expanding from Fauquier to Orange, Greene, Culpeper, Albemarle counties and Charlottesville.

B. Promote incentives such as a defense production zoning overlay.

C. Focus on infrastructure investments to ready sites with necessary security precautions.

D. Partner with existing employers to meet needs and provide job training and recruitment for specialized roles.

RIVANNA FUTURES

INTELLIGENCE & NATIONAL SECURITY
INNOVATION ACCELERATION CAMPUS

Accelerating innovation technology through partnerships today, for tomorrow's challenges.

Rivanna Station Futures

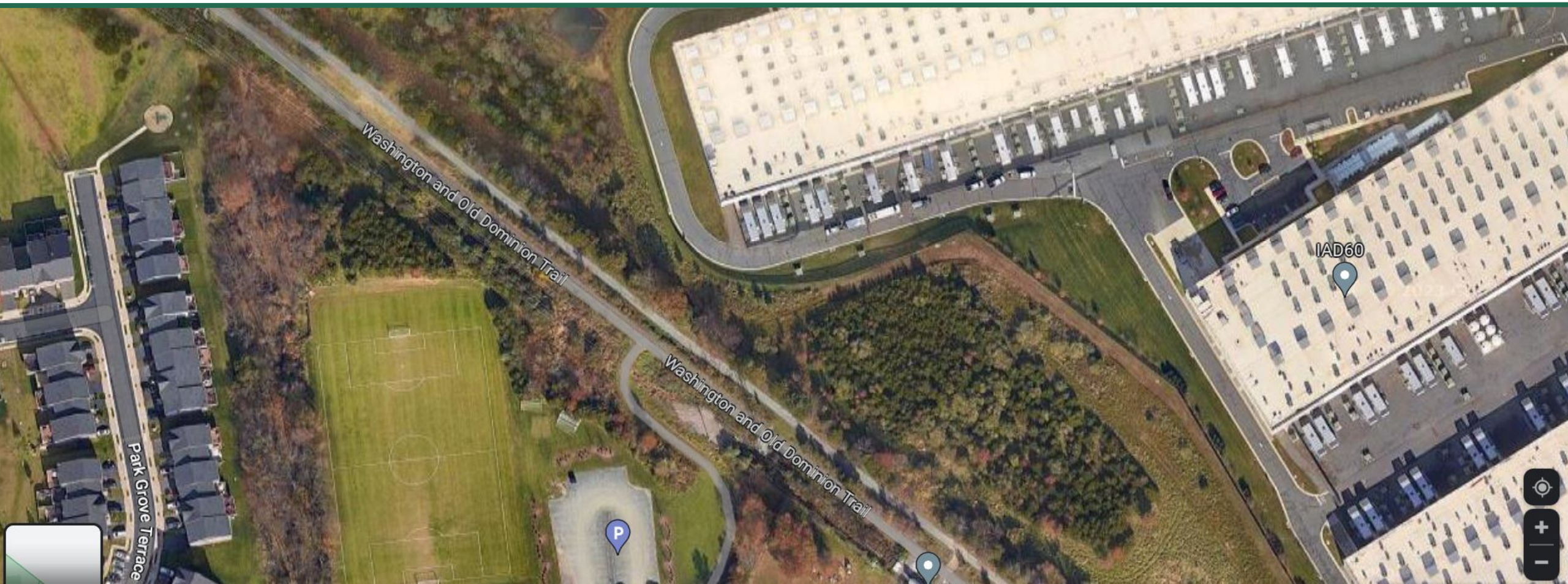
"...potential for development from North Fork [of the Rivanna River] all the way up to Greene County, approximately eight miles, with the possibility of realizing a **level of potential similar to Silicon Valley at its onset.**

He said that they believed the **Rivanna Station Futures projects would help anchor that work**. He said there was an ecosystem in their community that supported it."

- Deputy County Executive, Albemarle County

Albemarle County Planning Commission Work Session Meeting Record, October 24, 2023

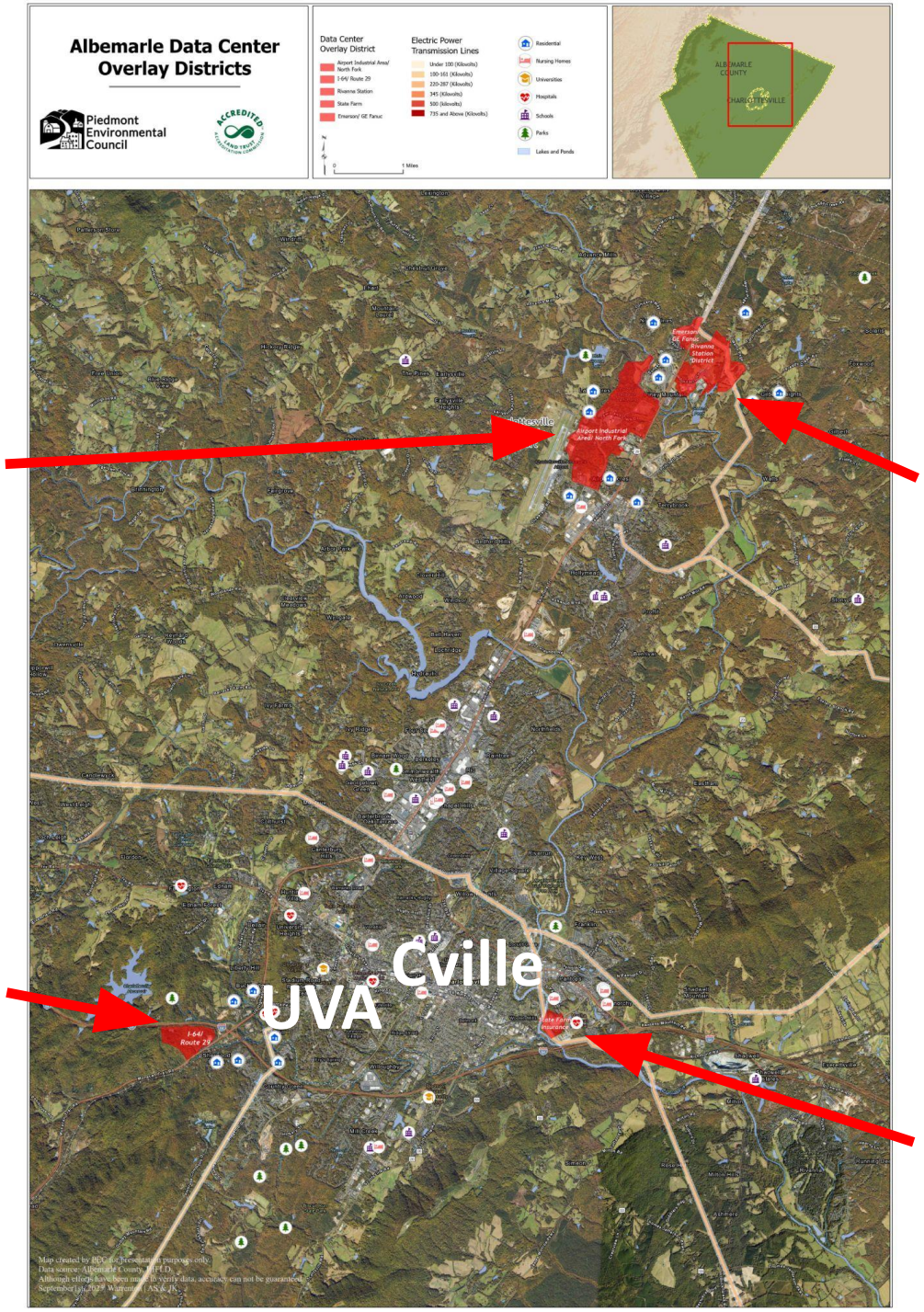
Proximity to sensitive receptors such as parks, trails, schools, hospitals, assisted living facilities, or low-income neighborhoods…




W&OD Trail, Ashburn, Virginia


Haymarket, Virginia

Haymarket, Virginia



Airport Industrial Area

I-64/I-29 Interchange

Emerson & Rivanna Futures Campus

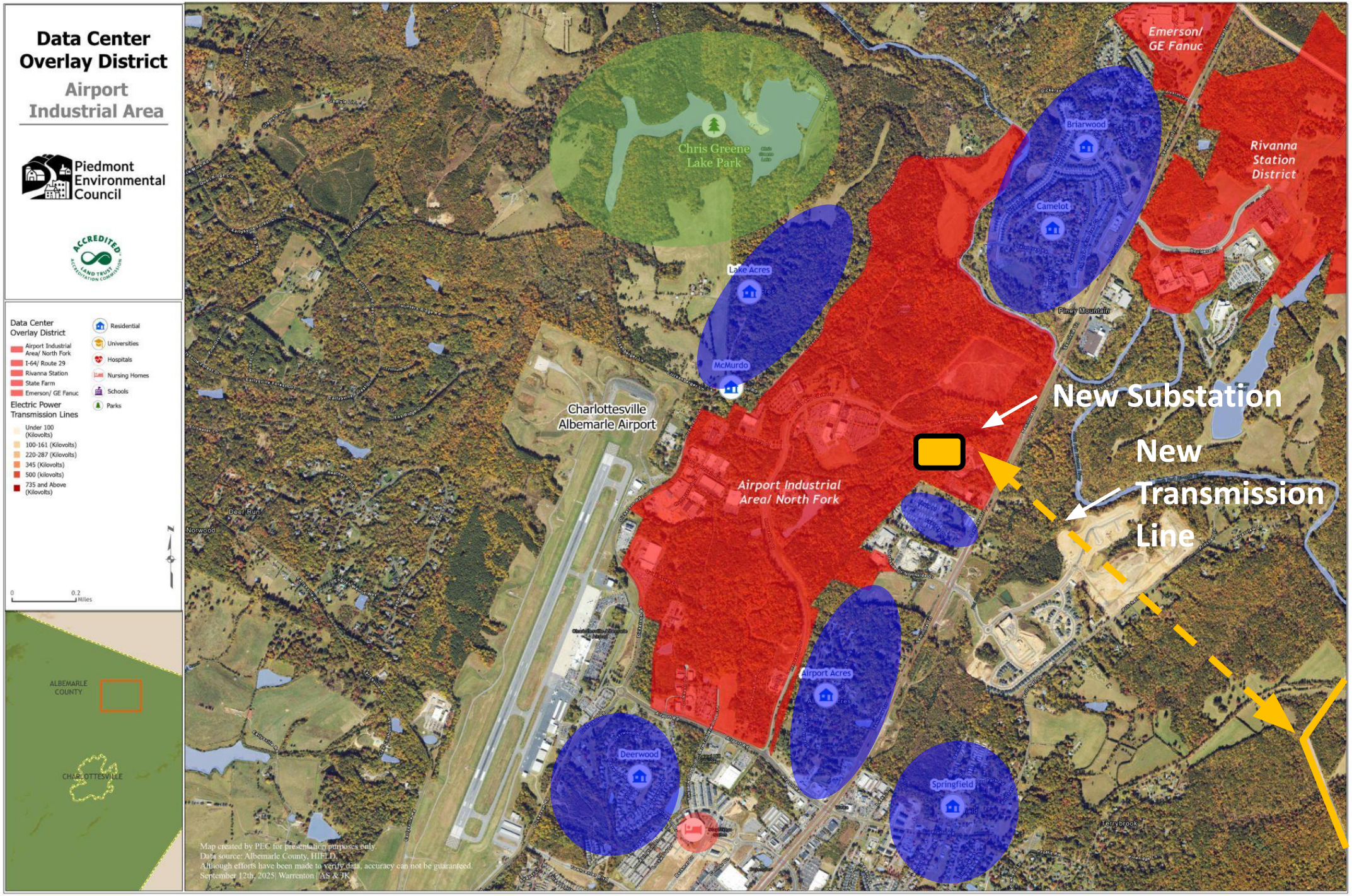
Former State Farm - Pantops

Data Center Overlay District

Airport Industrial Area

Piedmont Environmental Council

ACCREDITED LAND TRUST ACCREDITATION COMMISSION

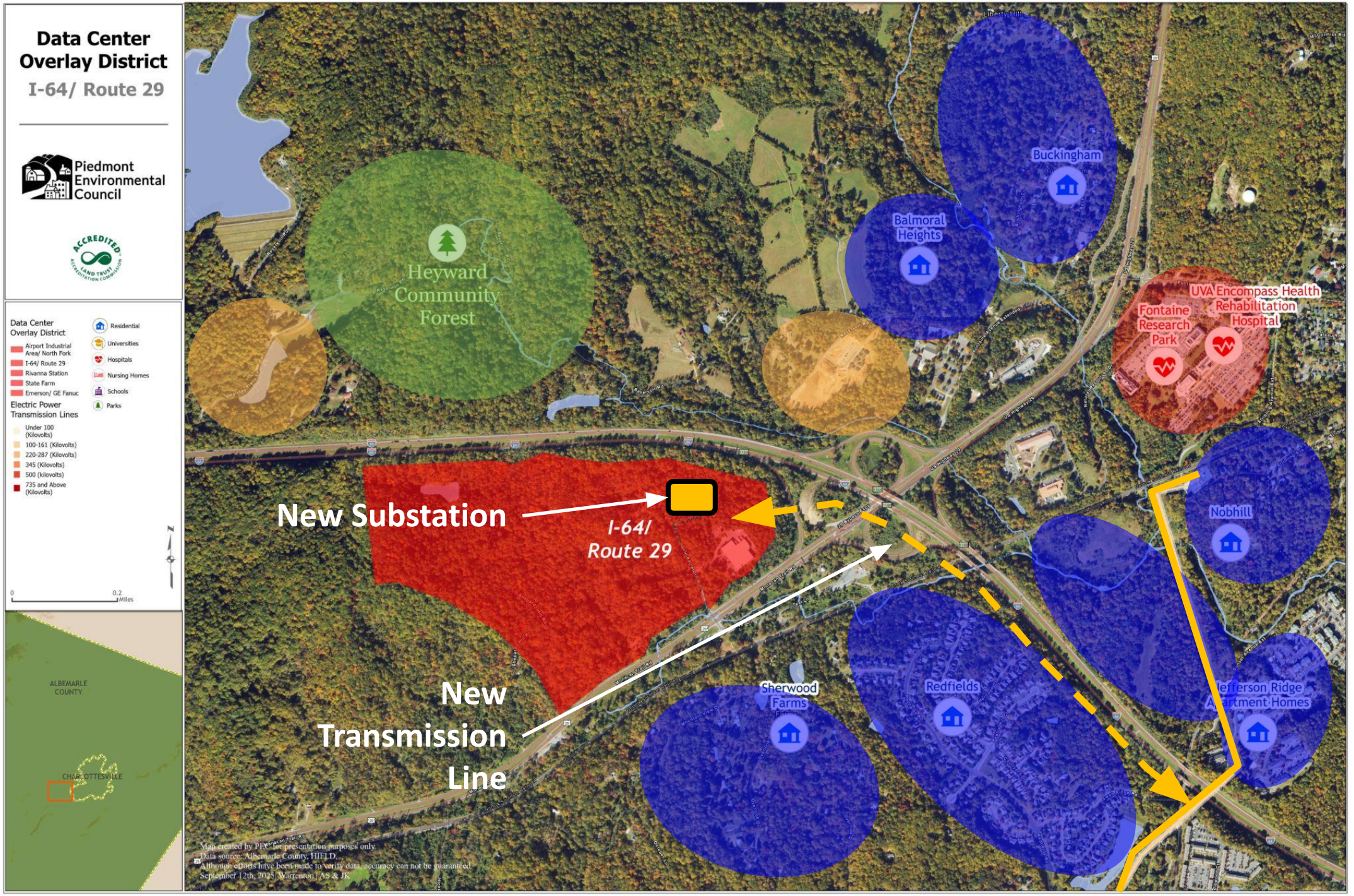


Data Center Overlay District

I-64/ Route 29

Piedmont Environmental Council

ACCREDITED LAND TRUST ACCREDITATION COMMISSION



Data Center Overlay District

State Farm

Piedmont Environmental Council

ACCREDITED LAND TRUST ACCREDITATION COMMISSION

Data Center Overlay District
- Airport Industrial Area/ North Fork
- I-64/ Route 29
- Rivanna Station
- State Farm
- Emerson/ GE Fanuc

Electric Power Transmission Lines
- Under 100 (Kilovolts)
- 100-161 (Kilovolts)
- 220-287 (Kilovolts)
- 345 (Kilovolts)
- 500 (kilovolts)
- 735 and Above (Kilovolts)

- Residential
- Universities
- Hospitals
- Nursing Homes
- Schools
- Parks

N

0 0.2 Miles

ALBEMARLE COUNTY

CHARLOTTESVILLE

Pantops

Glenorchy

Woolen Mills

State Farm Insurance

SENTARA MARTHA JEFFERSON HOSPITAL

New Substation

Prepared by PEC for presentation purposes only
Data source: Albemarle County, IIFLD
Although efforts have been made to verify data, accuracy can not be guaranteed
September 12th, 2025, Warrenton, VA & JK

Data Center Overlay District

Emerson Rivana

Piedmont Environmental Council

ACCREDITED LAND TRUST ACCREDITATION COMMISSION

Data Center Overlay District
- Airport Industrial Area/ North Fork
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- Residential
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N

0 0.2 Miles

ALBEMARLE COUNTY

CHARLOTTESVILLE

Expanded Substation

New Substation

North Pines

Mclane Ridge

Emerson/ GE Fanuc

Briarwood

Rivanna Station District

Camelot

Piney Mountain

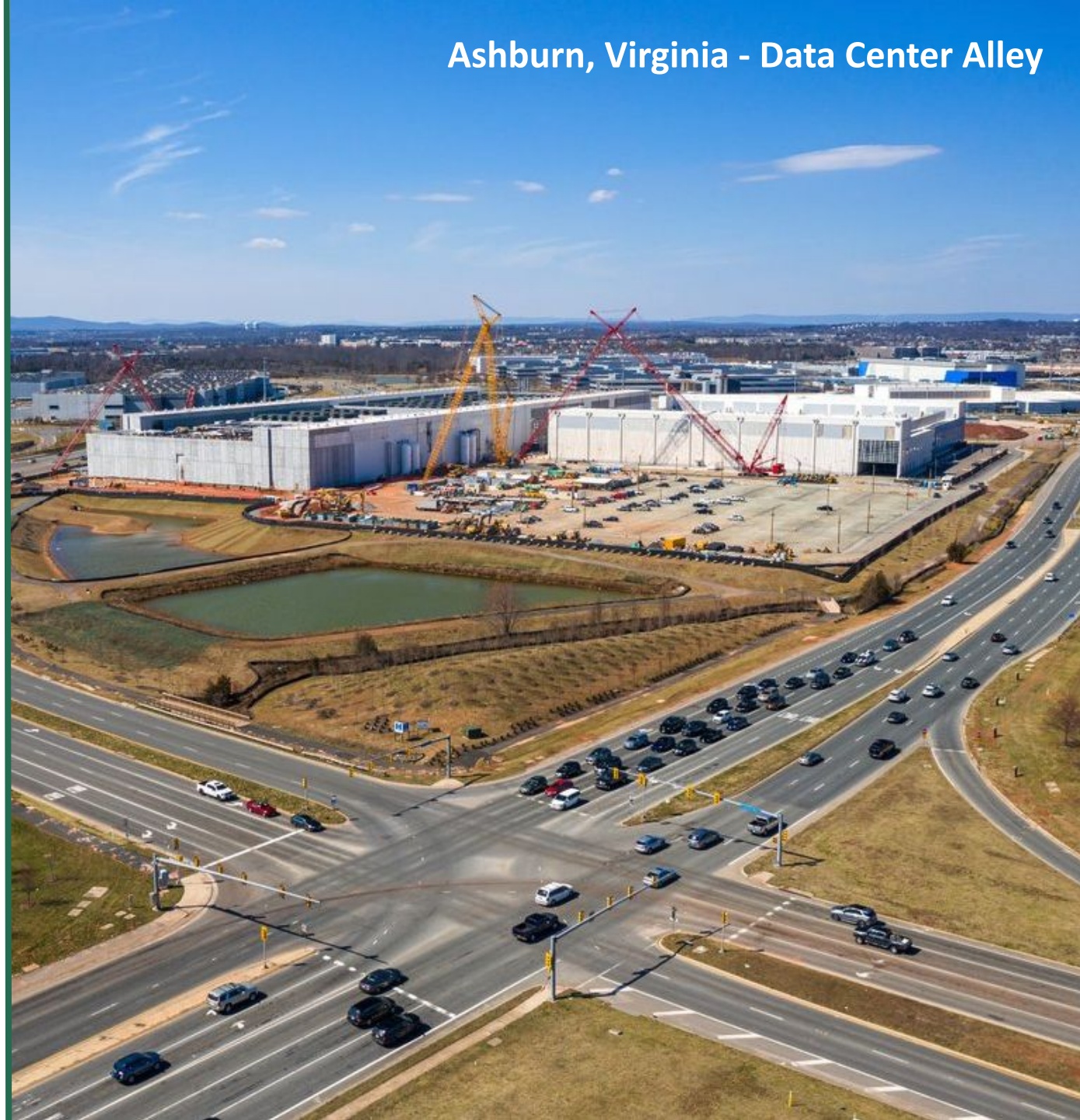
Northwood

Airport Industrial Area/ North Fork

Map created by PEC for presentation purposes only.
Although efforts have been made to verify data, accuracy can not be guaranteed.
September 12th, 2025| Warrenton | AS & JK

Local Land Use Impacts

- Energy Usage
- Water Usage and Wastewater
- Water Vapor Plumes
- Air Quality
- Noise
- Fire Protection and Fuel Storage
- Compatibility w/Adjacent Uses
- Lighting
- Building Design
- Parks and Trails
- Wildlife Habitat

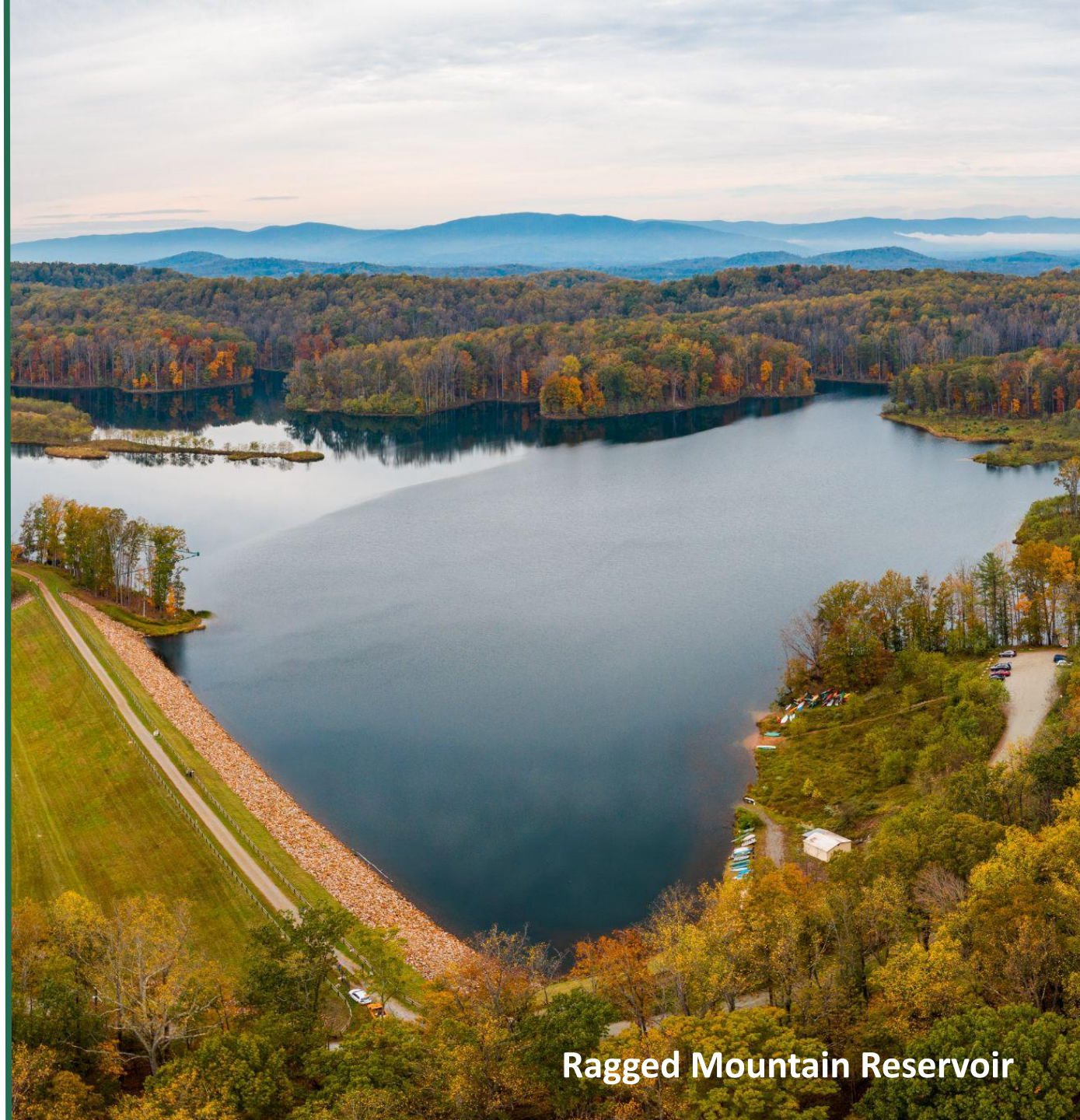


Water Impacts

The county is proposing requiring the use of “closed loop cooling” and/or “recycled” water systems.

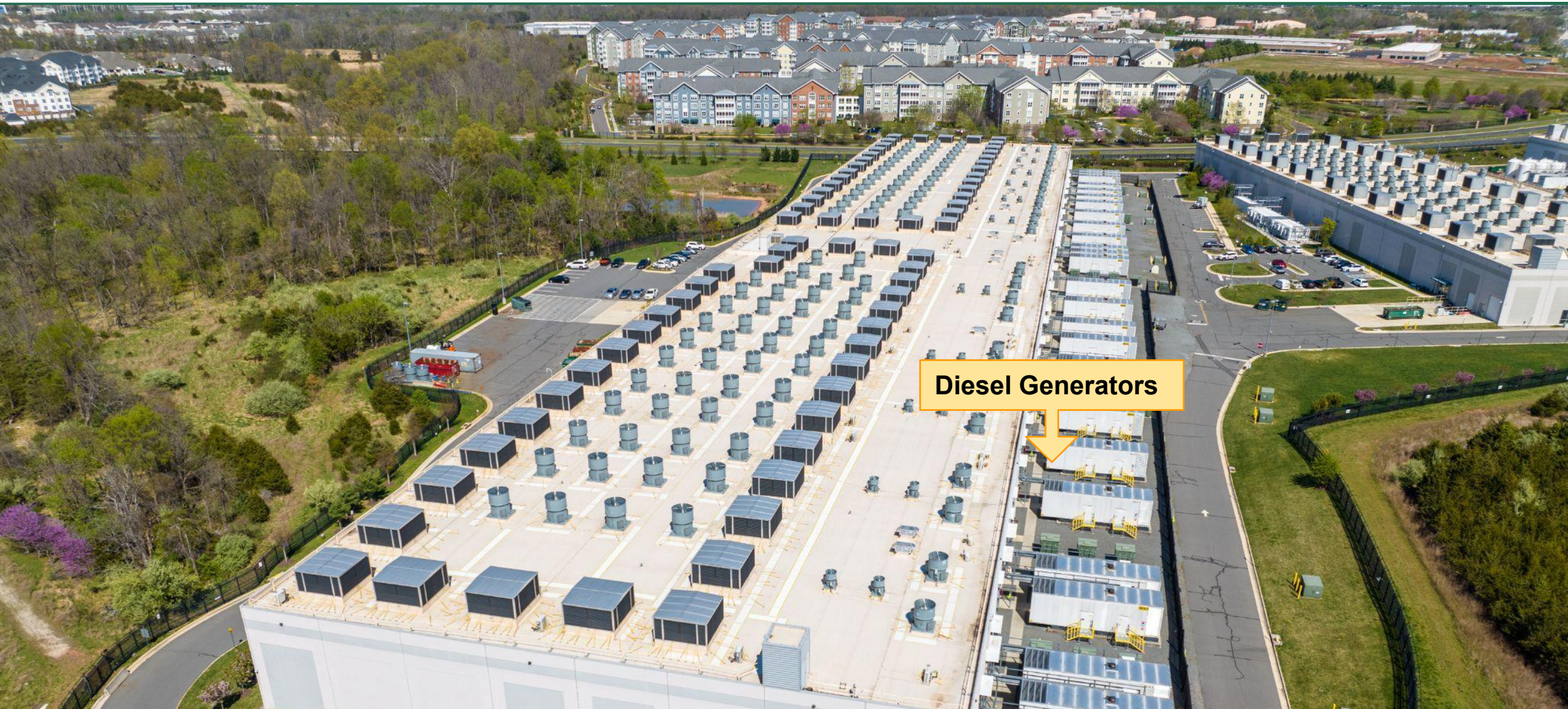
While a good step, this doesn’t eliminate water concerns:

- **Water loss**
- **Replenishment**
- **Infrastructure costs**
- **Increased contaminant discharge**



Ragged Mountain Reservoir

Air Impacts - Data Centers & their Power Plants



Noise Impacts - Constant low-level hum

Monopolization of Industrial & Commercial Land

Land Use Impacts: Electrical Grid

Climate Impacts

Dominion’s Mt. Storm Power Station - West Virginia

Cumulative Environmental Impacts

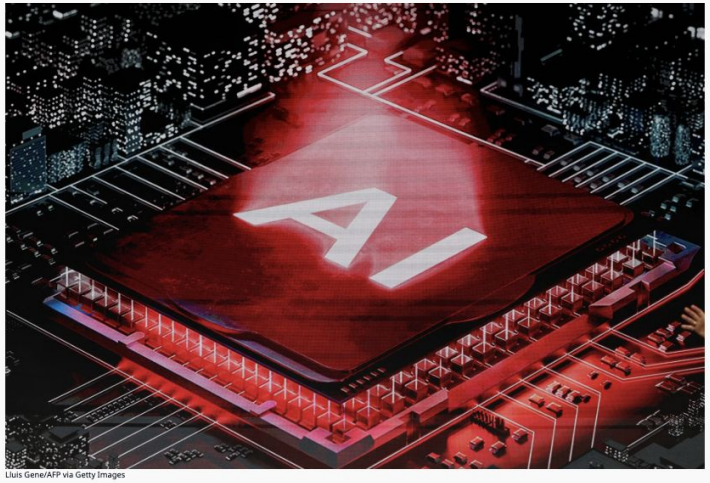
- Combined off-site energy use of multiple data centers leading to additional transmission lines and substations in Albemarle
- Combined on-site energy and air quality impacts of multiple data centers running their generators for testing and during peak energy demand periods
- Combined impacts of data centers on potable and recycled/reclaimed water usage
- Albemarle will not meet its climate action goals owing to massive amount of electricity required to power data centers from fossil fuels

A.I.

Has the tide finally turned on AI's trillion-dollar boom?

For over a year, AI was gospel. Now, Wall Street, Silicon Valley, and regulators are asking the same question: What if it's not?

By **Shannon Carroll** Updated August 28, 2025



Lluis Gene/AFP via Getty Images

AI Bubble

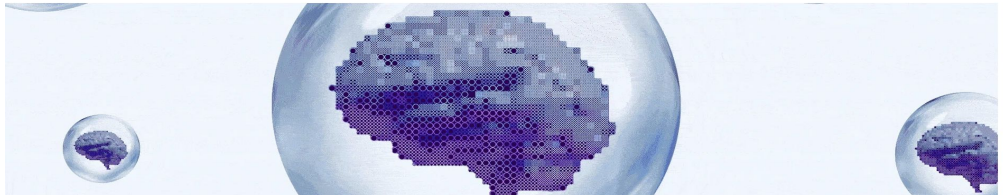
Popular Latest Newsletters *The Atlantic* Sign In Su

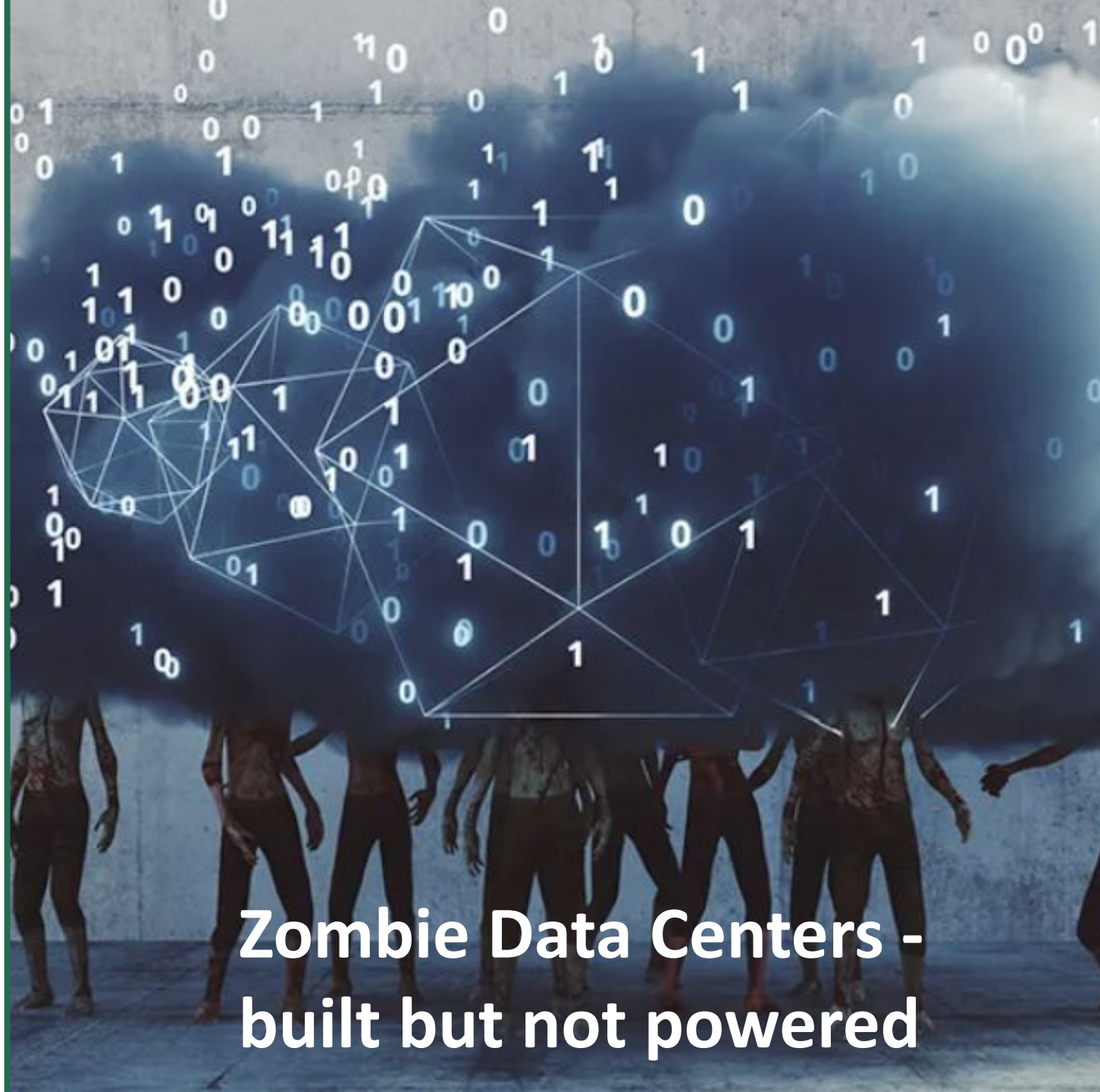
WORK IN PROGRESS

Just How Bad Would an AI Bubble Be?

The entire U.S. economy is being propped up by the promise of productivity gains that seem very far from materializing.

By Rogé Karma





Zombie Data Centers - built but not powered

Large data centers are unlike any other large building in Albemarle

Home Depot
Albemarle County

PEC is advocating that Albemarle County:

- Heed the warnings from Loudoun, Louisa, and other counties, and to continue requiring special use permits for all data centers larger than 40,000 square feet.
- Allow the public and elected officials to have a voice on data center proposals over 40,000 sf so the county can make informed, community-centered decisions.

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Hanna Pampaloni Mar 19, 2025 20

A view in Ashburn showcases several data center buildings.

Hanna Pampaloni/Loudoun Now

Responsible regulation
&
transparency are needed

Especially at the local level

Next Steps

- **Write the Board of Supervisors at BOS@albemarle.org**
  - Ask that all data centers above 40,000 Sq. Ft. be required to have a Special Use Permit

- **Speak at a Public Hearing**
  - **Oct. 14:** Planning Commission
  - **Nov. 19:** Board of Supervisors

Our Data Center Reform Agenda

- Transparency
- Reasonable oversight and regulation of impacts
- Planning to avoid and mitigate impacts
- Fair and equitable allocation of costs focused on getting data centers to pay

Ongoing initiatives

- **Legal Work**
  - Rate case before the State Corporation Commission
  - Challenges to Wilderness Crossing / Digital Gateway
- **Local and State Advocacy**
  - transmission lines
  - data center proposals
  - changes to land use plans
- **Coalitions and Partnerships**
  - Virginia Data Center Reform Coalition & Virginia Conservation Network
- **Media**
  - earned
  - digital

Questions

Key Takeaways

- **Data center growth is unprecedented** with massive impacts to land, water, air and climate

- We need **state AND local action**

    - Write the Board of Supervisors

    - Speak at a Public Hearing
        - Oct. 14: Planning Commission
        - Nov. 19: Board of Supervisors

- **Get involved with PEC** during State Corporation Commission Hearings & the upcoming Virginia General Assembly


Cedar Mountain - Shenandoah