Data Centers & Virginia's Clean Energy Future

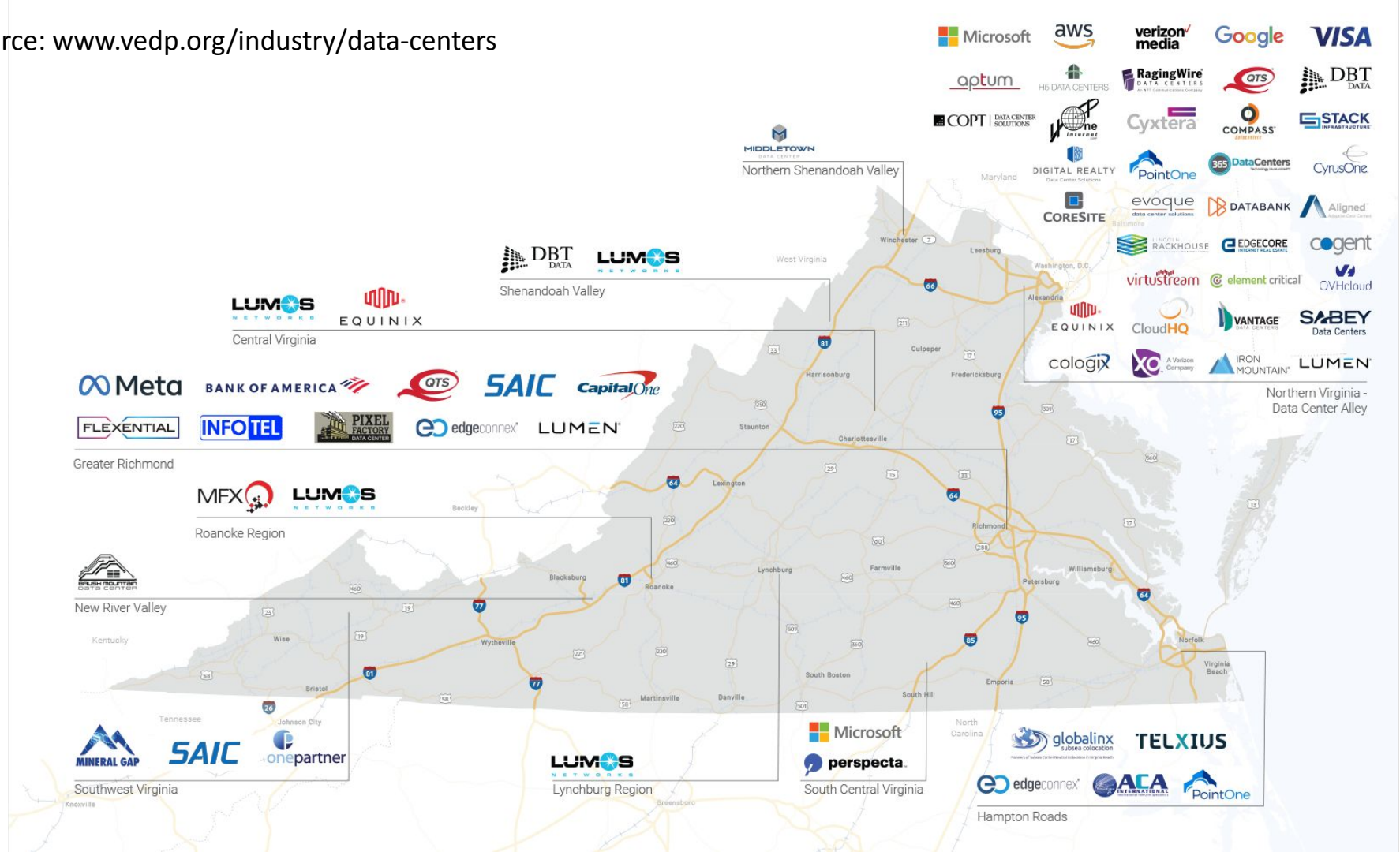
Piedmont Environmental Council

PEC Annual Meeting - June 8, 2025
Julie Bolthouse, Director of Land Use and
Ashish Kapoor, Senior Energy and Climate Advisor

Today's Presentation

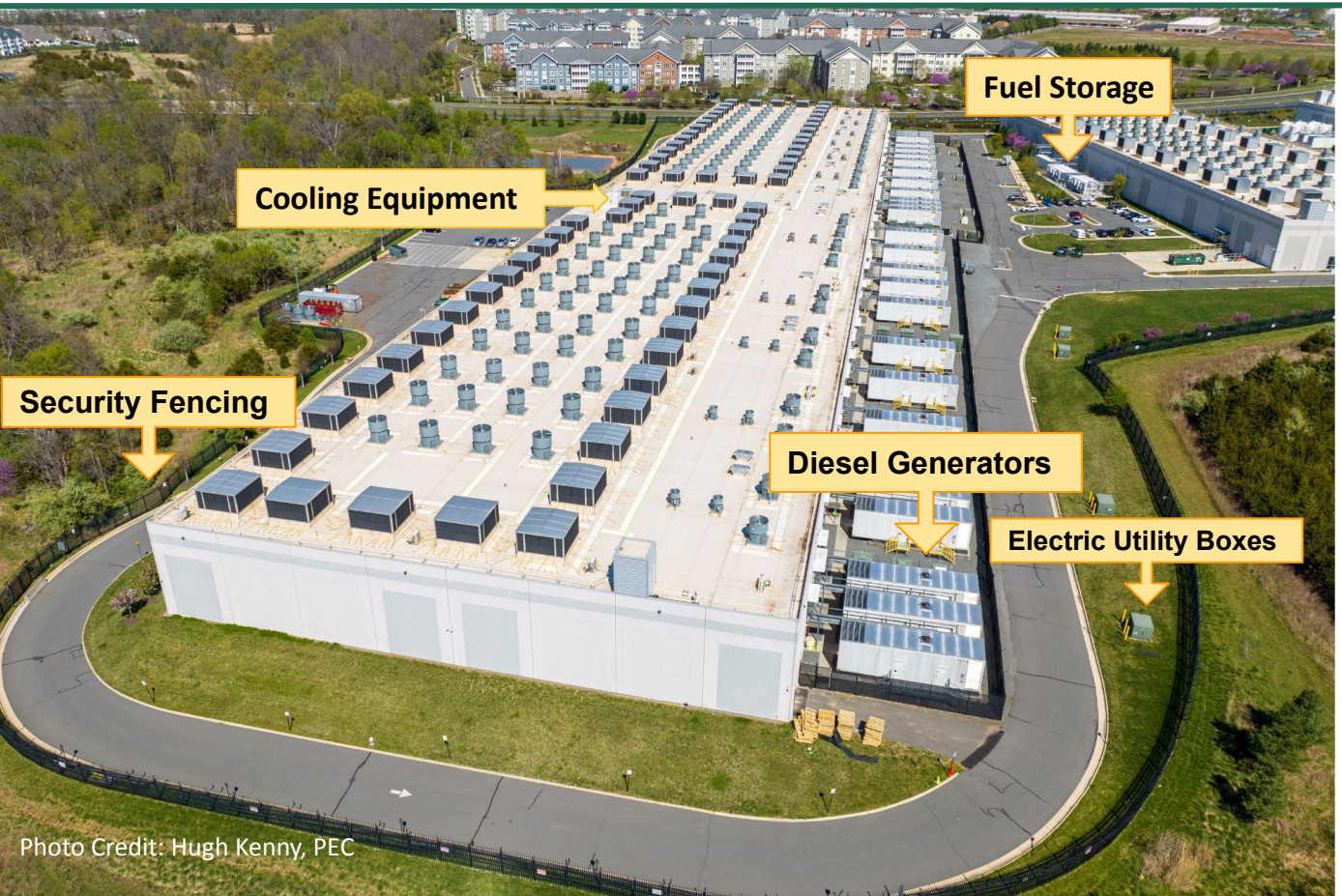
- Exploding Data Center Energy Demand
- Impact on Communities and the Environment
- Getting to Solutions
- Climate Action in the Face of These Challenges

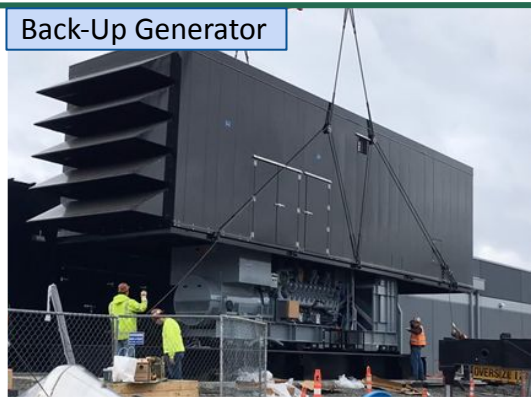
Source: www.vedp.org/industry/data-centers



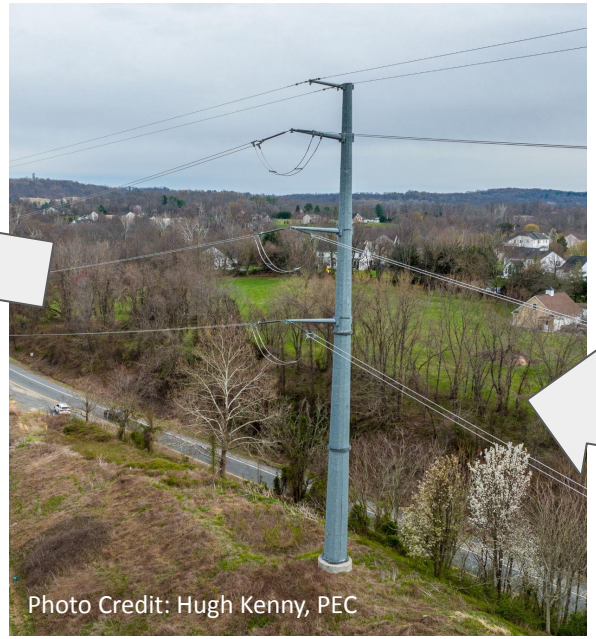
What is a Data Center?

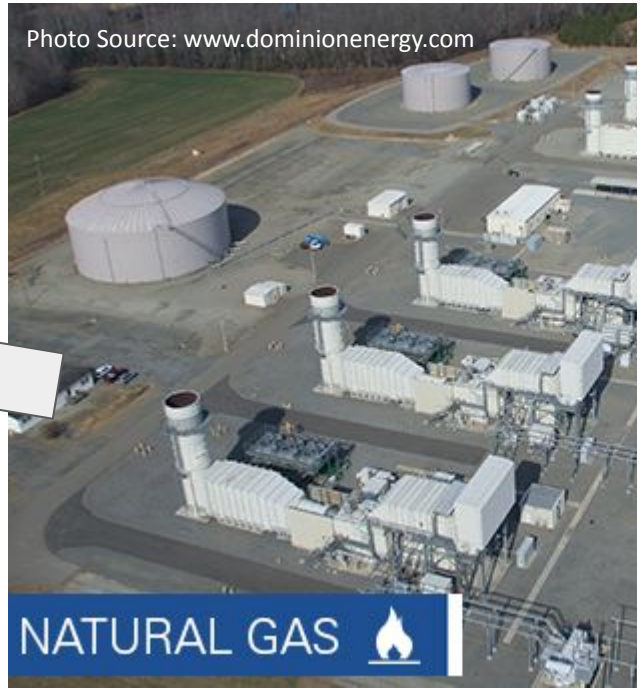
Top Photo Source: www.globalpwr.com
Bottom Photo: Christopher Bowns, Wikimedia Commons

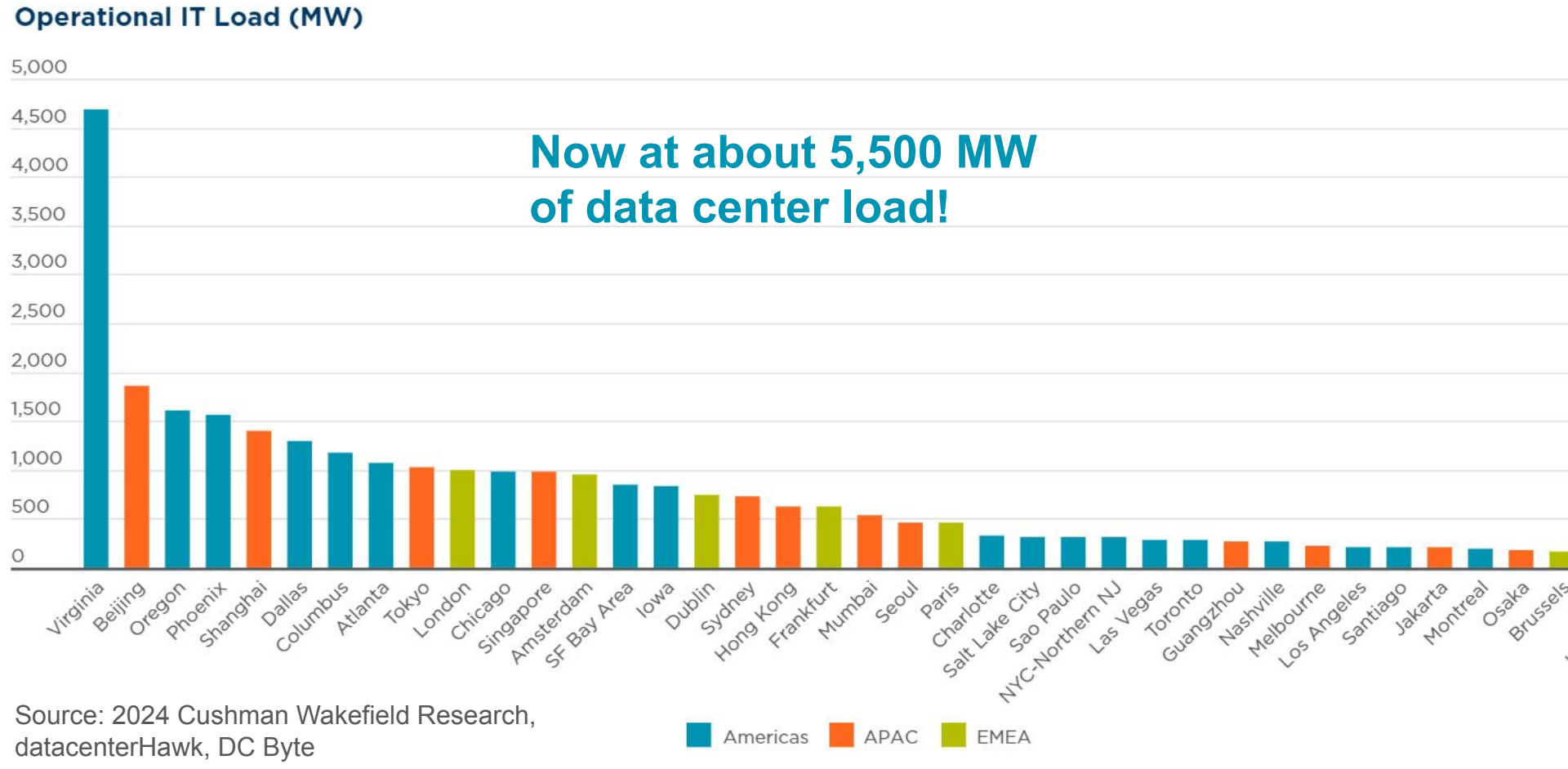




Data Centers Consume a Huge Amount of Electricity



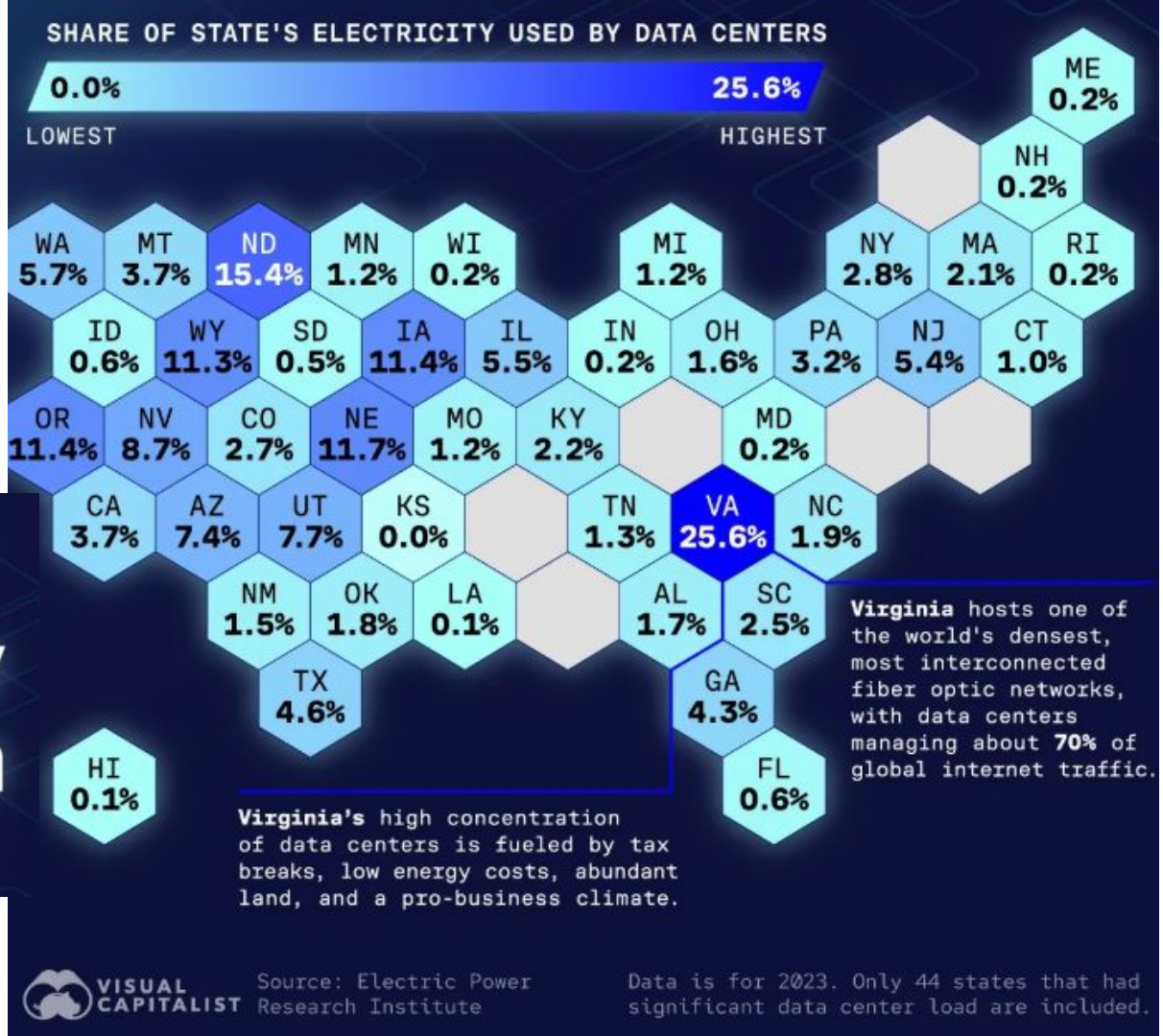




Source: 2024 Cushman Wakefield Research, datacenterHawk, DC Byte

Data Center Electricity Consumption

BY STATE



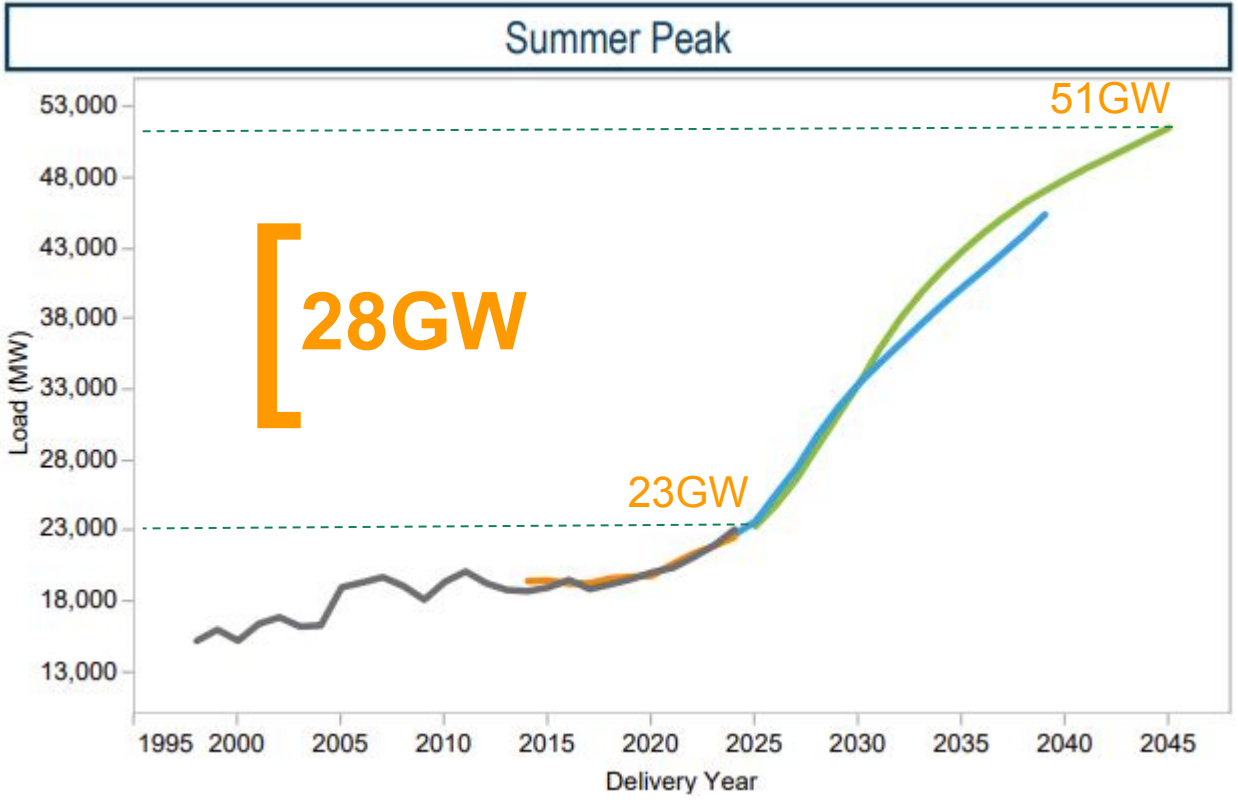
VISUAL CAPITALIST

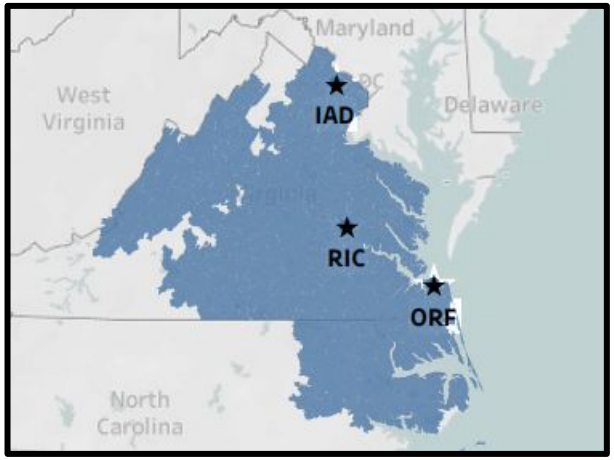
Source: Electric Power Research Institute

Data is for 2023. Only 44 states that had significant data center load are included.

Skyrocketing Load Demand

Dominion Energy's 20 Year Forecast





Green = 2025 projection
Blue = 2024 projection

Demand Driving Data Centers

- Outsourcing of information technology functions
- Advancing smartphone technology and apps (5G)
- Expansion of rural broadband
- Digitization and data storage
- Cloud computing
- GenAI such as large language models, and machine learning

What makes data center development different?

- Boom in AI has led to explosive growth and lots of speculation
- Buildings are bigger and taller than most other uses in suburban/rural area
- They use much more energy than other uses; a campus can use more than a manufacturing plant or a steel mill
- Onsite backup power requirements necessitate more generators than any other use including hospitals and factories
- Facilities tend to cluster, leading to cumulative impacts on air and water quality, water consumption, and energy infrastructure.

2 Dominion Energy Virginia

Data center request process

Typical data center request process from contact to connection

1 High level assessment

Local

- Identify infrastructure requirements

2 Substation Engineering Letter of Authorization

SCC

- 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

Development and infrastructure costs are incurred by the customer

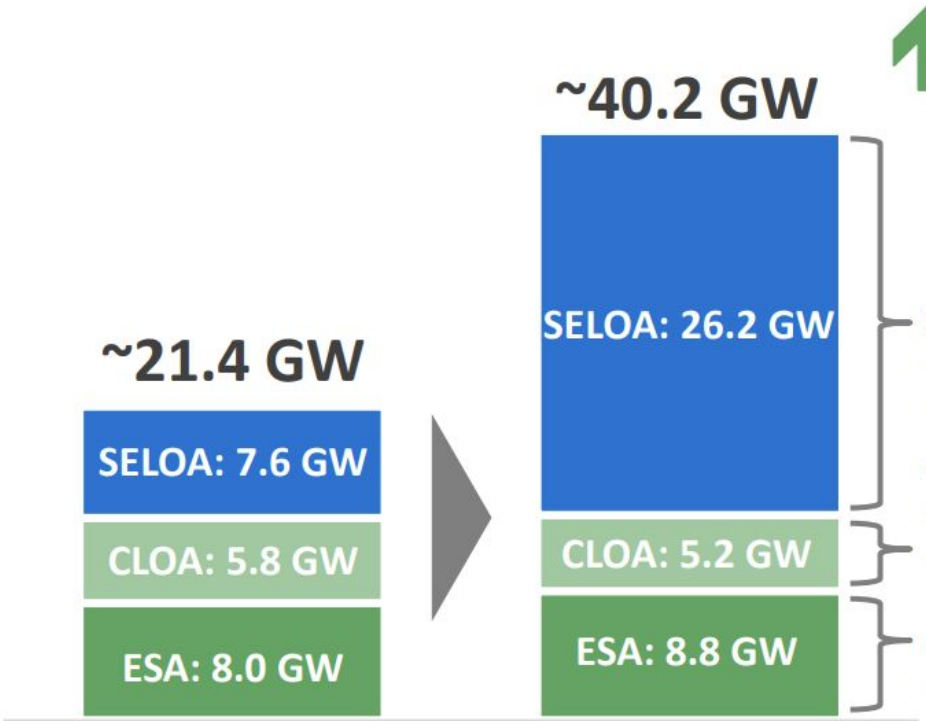
This has created a “Crisis by Contract”

1. Developer proposes project with localities and utility (often using NDA’s)
2. Localities approves project and construction begins
3. Utility and developer agree to engineering contract and utility shares substation proposals with PJM for review
4. Line routing discussions may begin in the community
5. Utility and developer agree to construction contract and utility summits route to SCC for approval (CPCN- Certificate of Public Convenience and Necessity)
6. Utility and developer agree to service agreement usually with a small amount of power initially with a planned ramp up for more over time.

In the background, all three types of contracts are used to establish their load forecast and justify new regional transmission line projects and generation facilities such as gas plants that also require a CPCN

Dominion Energy Virginia

Data center contracted capacity (updated)



~19GW/88% *vs. July 2024 data center contracted capacity*

Substation Engineering Letter of Authorization (SELOA)

- Detailed engineering plan
- Costs reimbursed to Dominion Energy

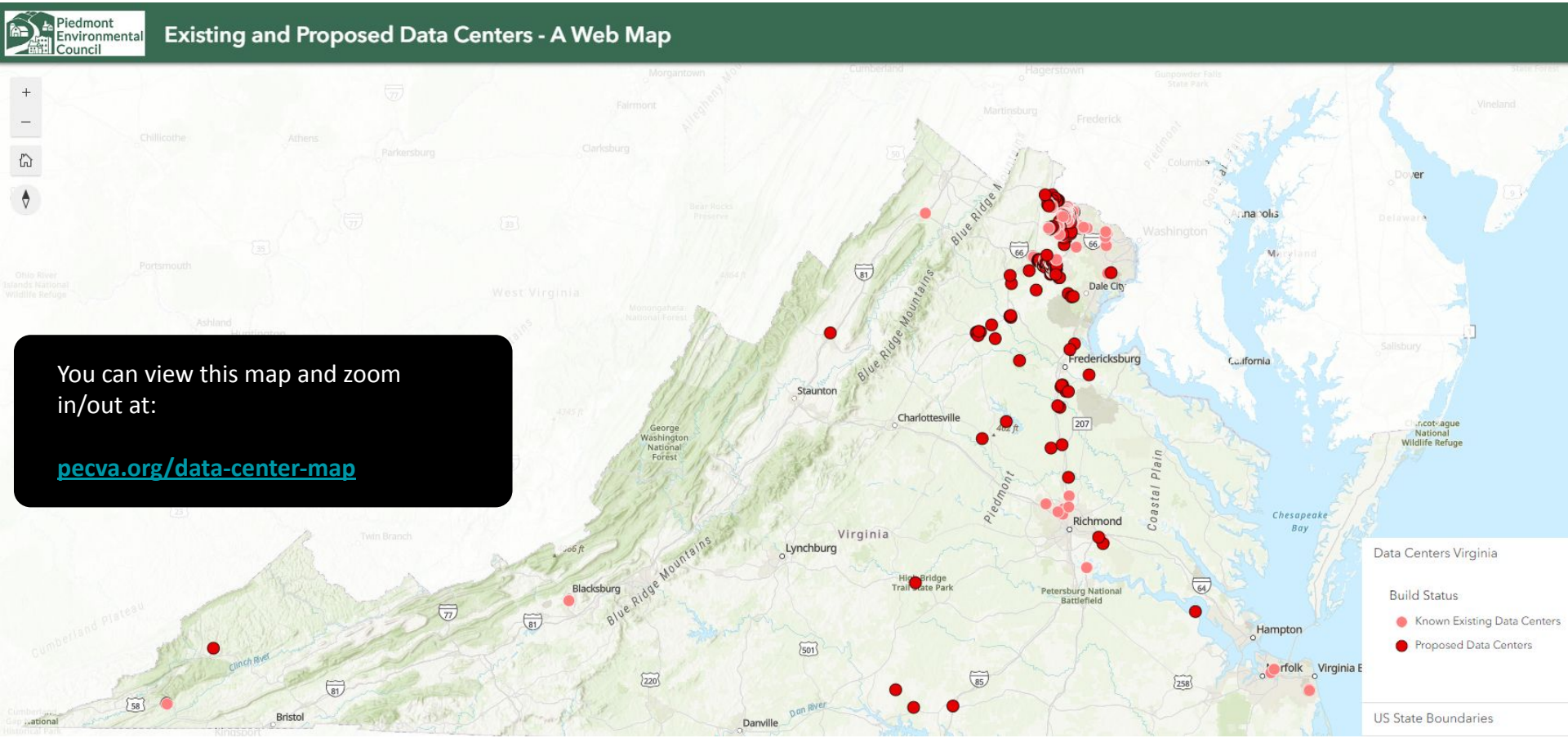
Construction Letter of Authorization (CLOA)

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

Electric Service Agreement (ESA)

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

Data Center Proposals In Virginia



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

There's another 200 million square feet approved or in the pipeline…

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

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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

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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

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.

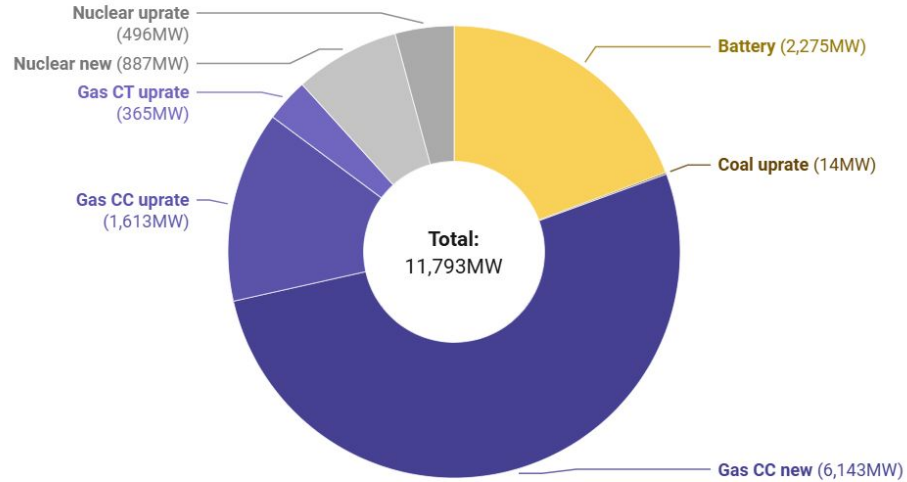
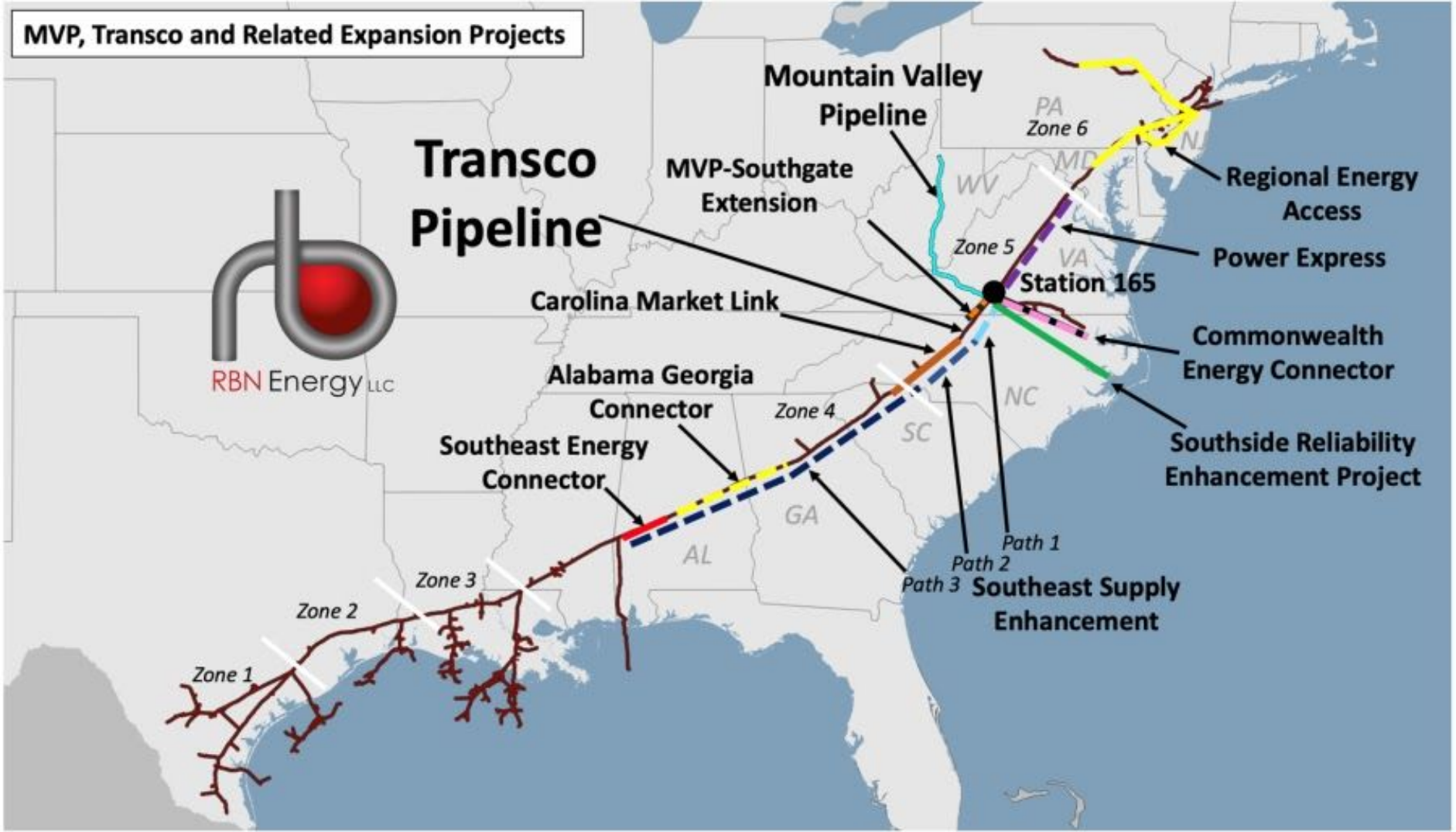


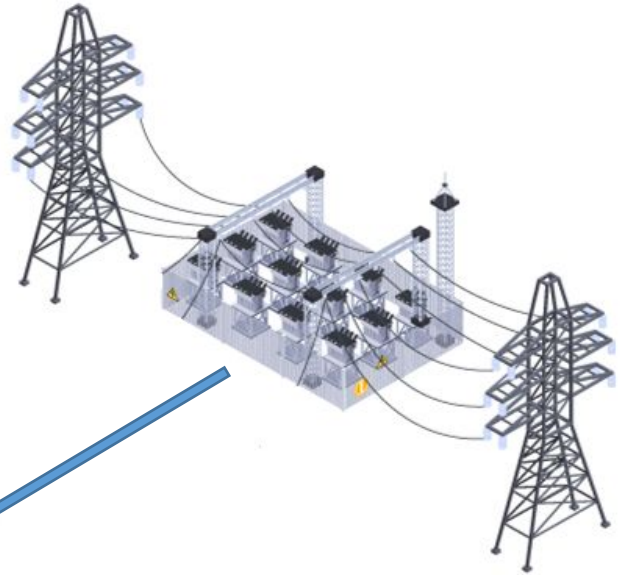
Chart: Ethan Howland/Utility Dive • Source: PJM Interconnection • Get the data • Created with Datawrapper

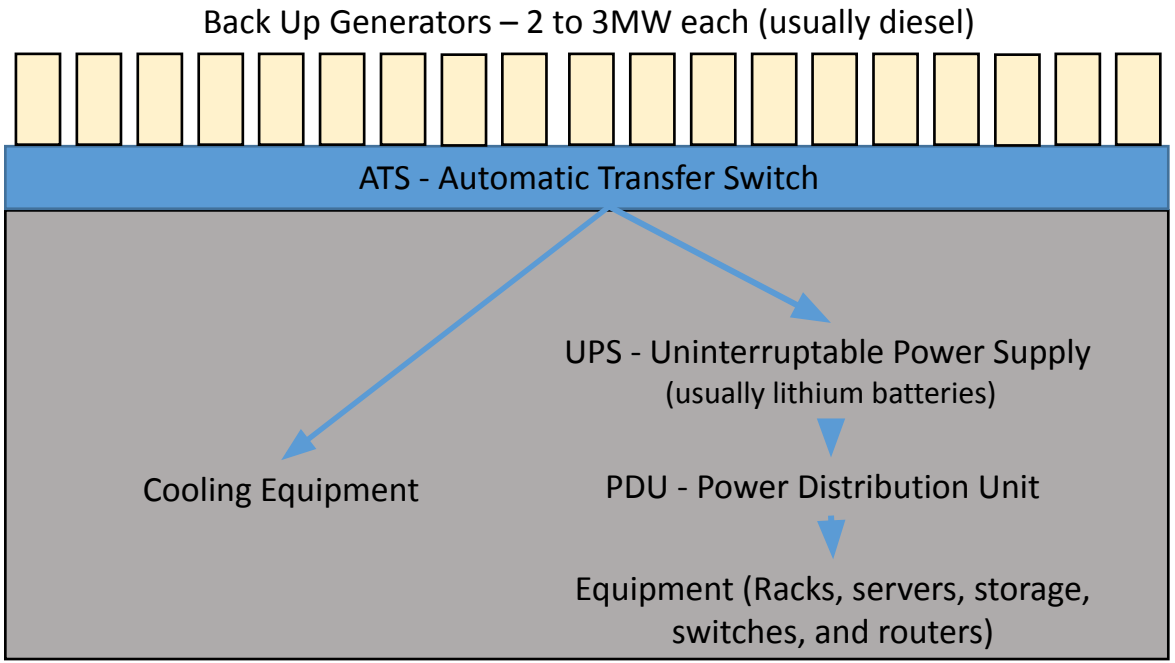

MVP, Transco and Related Expansion Projects
Mountain Valley Pipeline
Transco Pipeline
MVP-Southgate Extension
Carolina Market Link
Alabama Georgia Connector
Southeast Energy Connector
RBN Energy LLC
PA
Zone 6
WV
MD
NJ
Regional Energy Access
Zone 5
VA
Power Express
Station 165
Commonwealth Energy Connector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

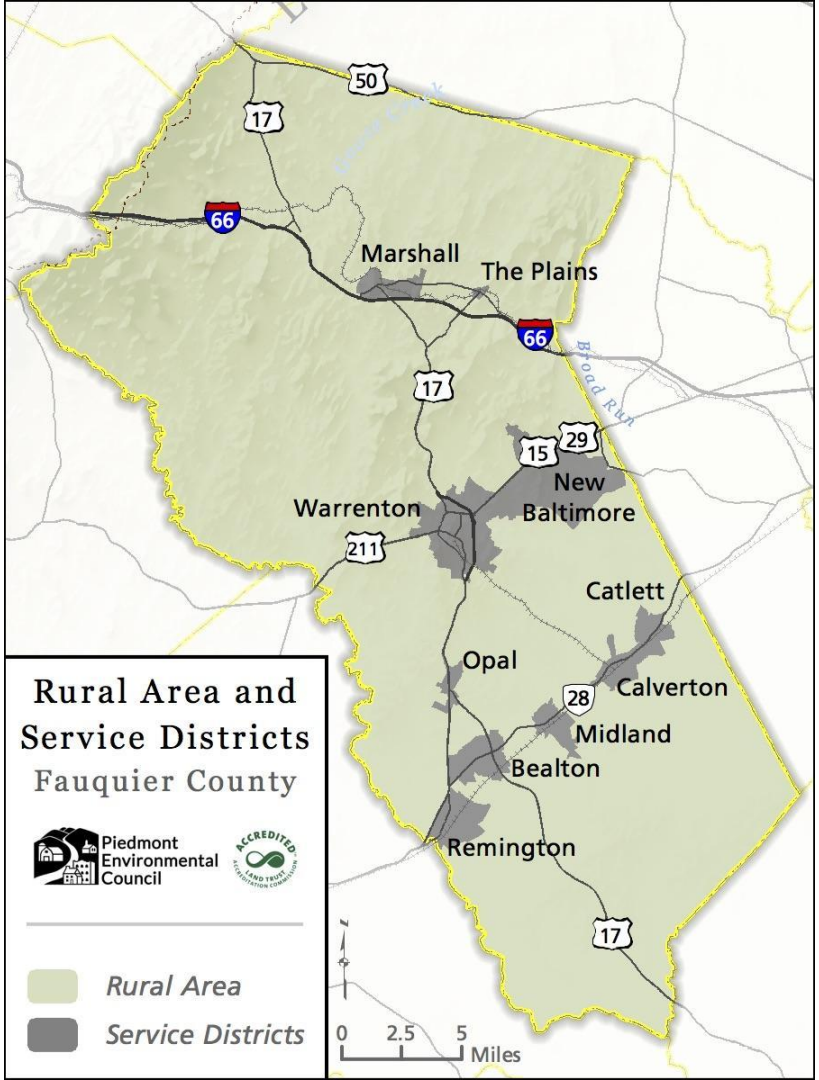
Let’s zoom in on local impacts…

Energy Usage by Data Center Building

60-90 MW (approximately 25,000 homes)







A Local Example for Scale:

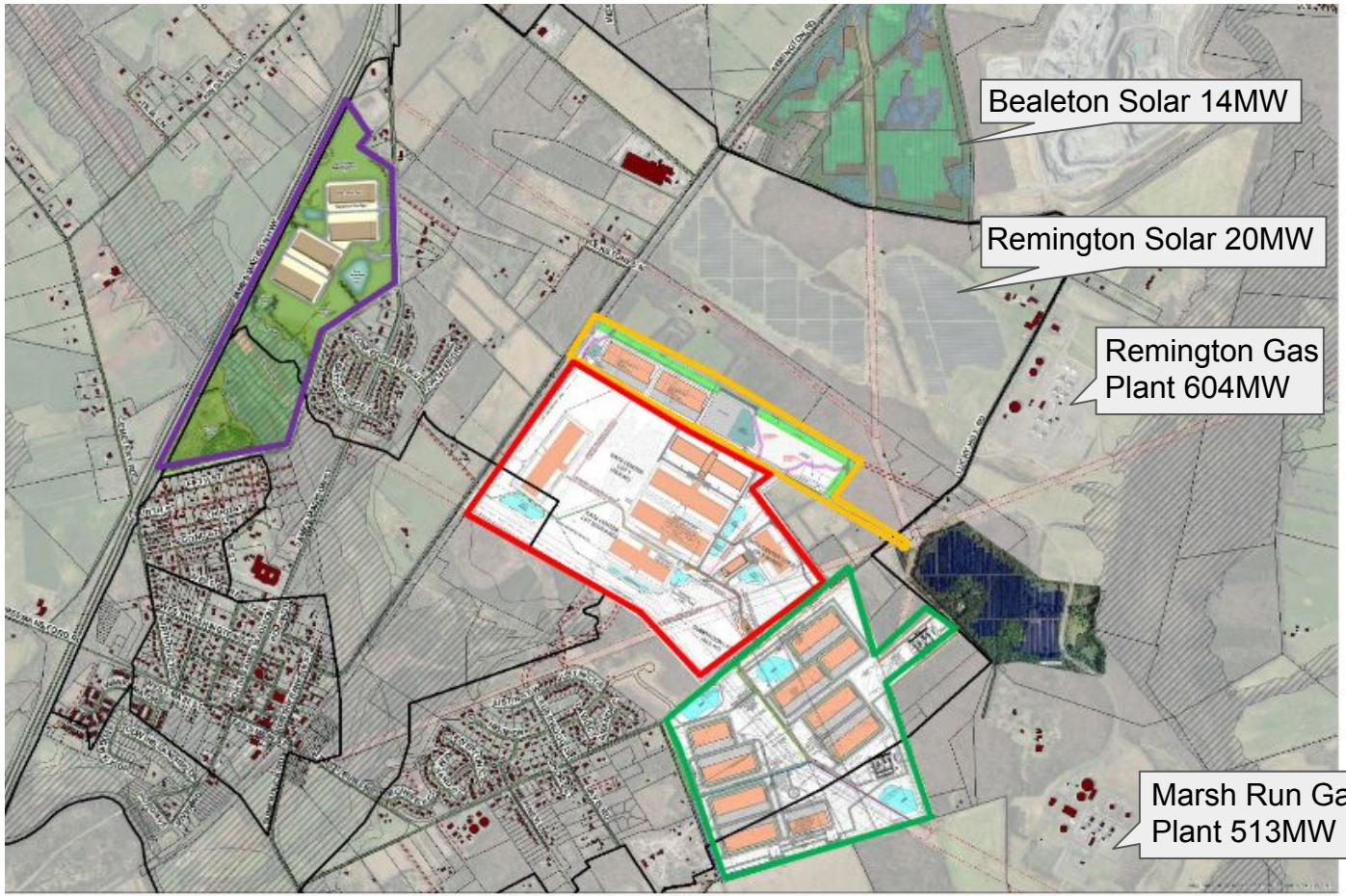
Fauquier Data Center Proposals and Energy Infrastructure

Residential Consumption:

Fauquier ≈ 26,000 homes

26,000 homes ≈ 60 MW – 100 MW

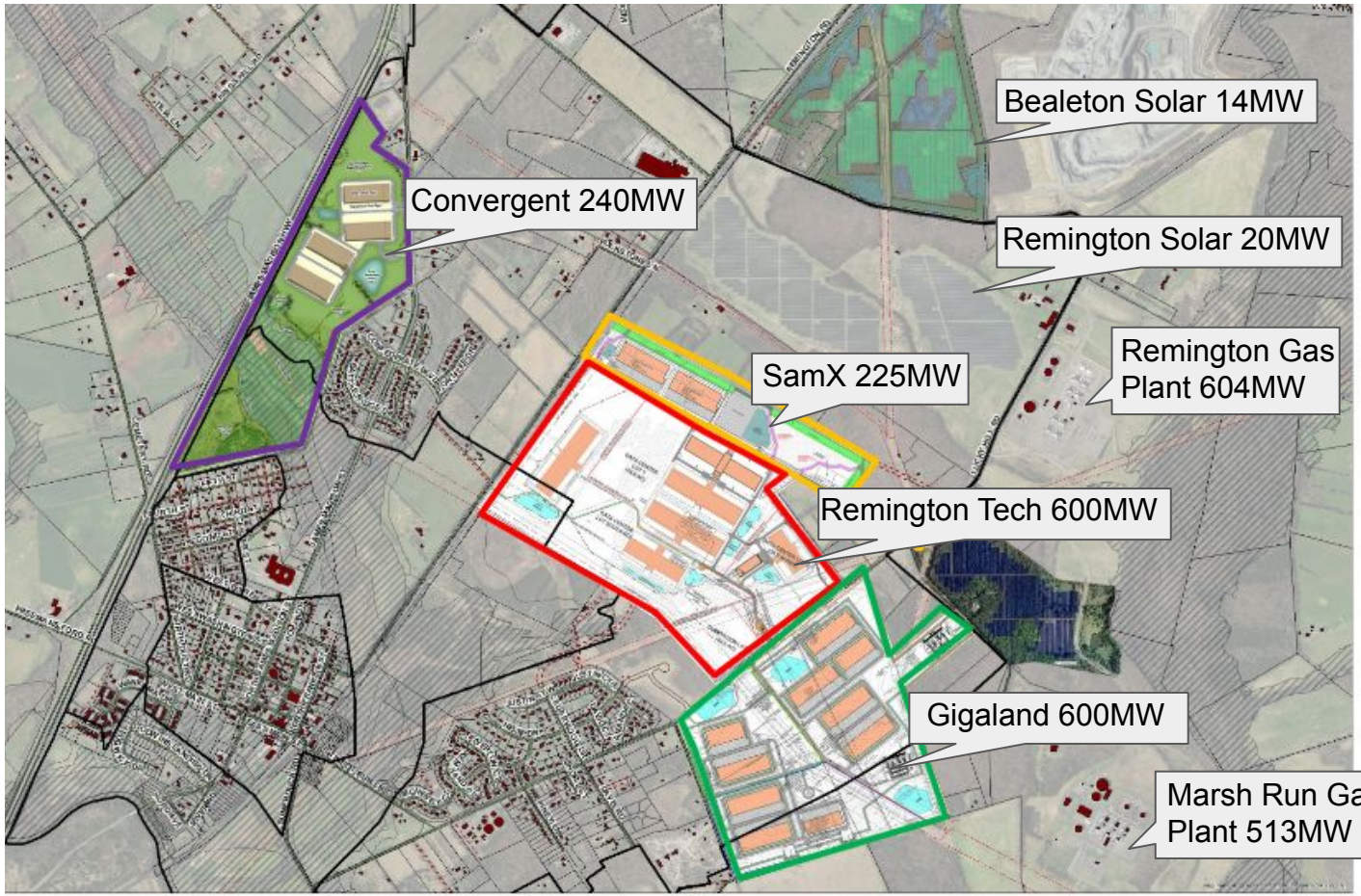
Fauquier Data Center Proposals and Energy Infrastructure



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

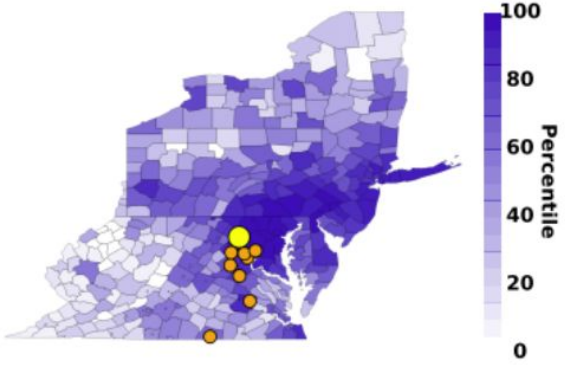
Energy Production:
Solar = 34 MW
Gas = 1,117 MW
Total – 1,151 MW

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

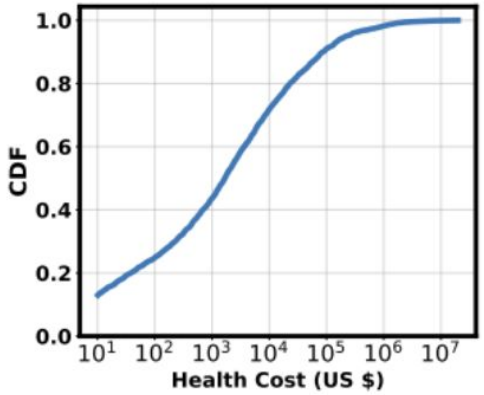
Air Quality - Generators


Photo credit: peo-acwa-flickr-cc

Air Pollution Modeling Using EPA modeling tool - COBRA



(a) Health cost map



(b) CDF of county-wide health cost

State	County	Health Cost (million $)
MD	Montgomery	**19.9** (17.3, 22.4)
VA	Fairfax	**18.9** (16.6, 21.2)
MD	Prince Georges	**8.9** (7.5, 10.4)
MD	Baltimore	**8.3** (7.0, 9.6)
DC	District of Columbia	**7.6** (6.2, 9.0)
MD	Anne Arundel	**6.3** (5.5, 7.2)
MD	Baltimore City	**6.0** (4.8, 7.1)
VA	Loudoun	**5.4** (4.7, 6.1)
VA	Prince William	**5.0** (4.4, 5.7)
MD	Frederick	**4.6** (3.9, 5.2)

(c) Top-10 counties by health cost

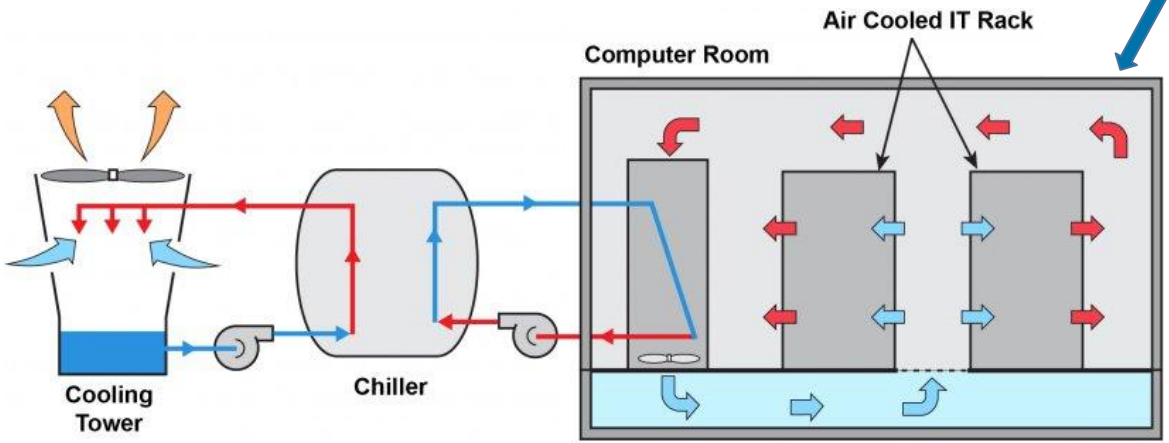
Figure 1: *The county-level total scope-1 health cost of data center backup generators operated in Virginia (mostly in Loudoun County, Fairfax County, and Prince William County) [57]. The backup generators are assumed to emit air pollutants at 10% of the permitted levels per year.*

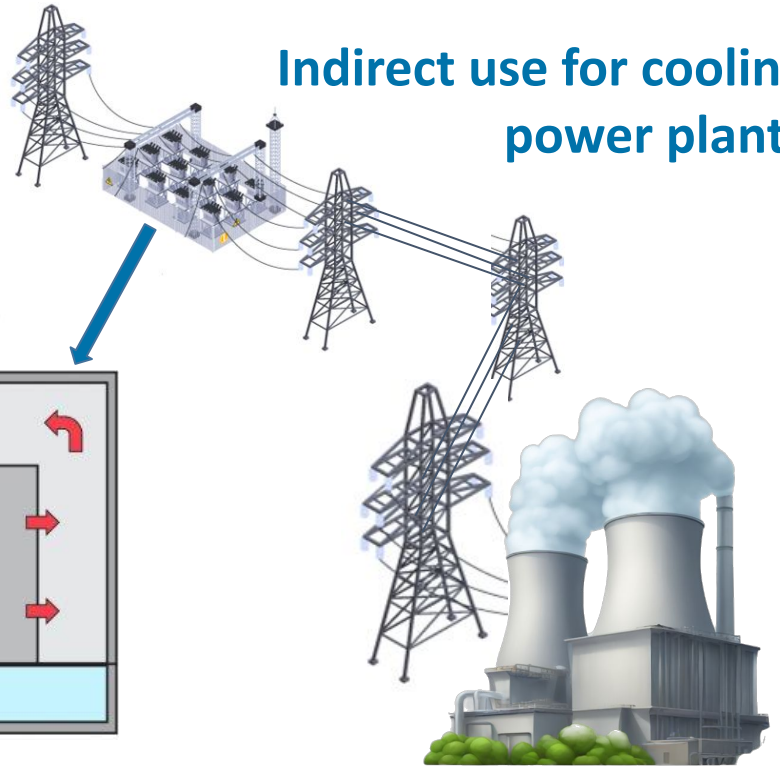
Source: The Unpaid Toll: Quantifying the Public Health Impact of AI - https://arxiv.org/abs/2412.06288

Water Consumption – Cooling and Power

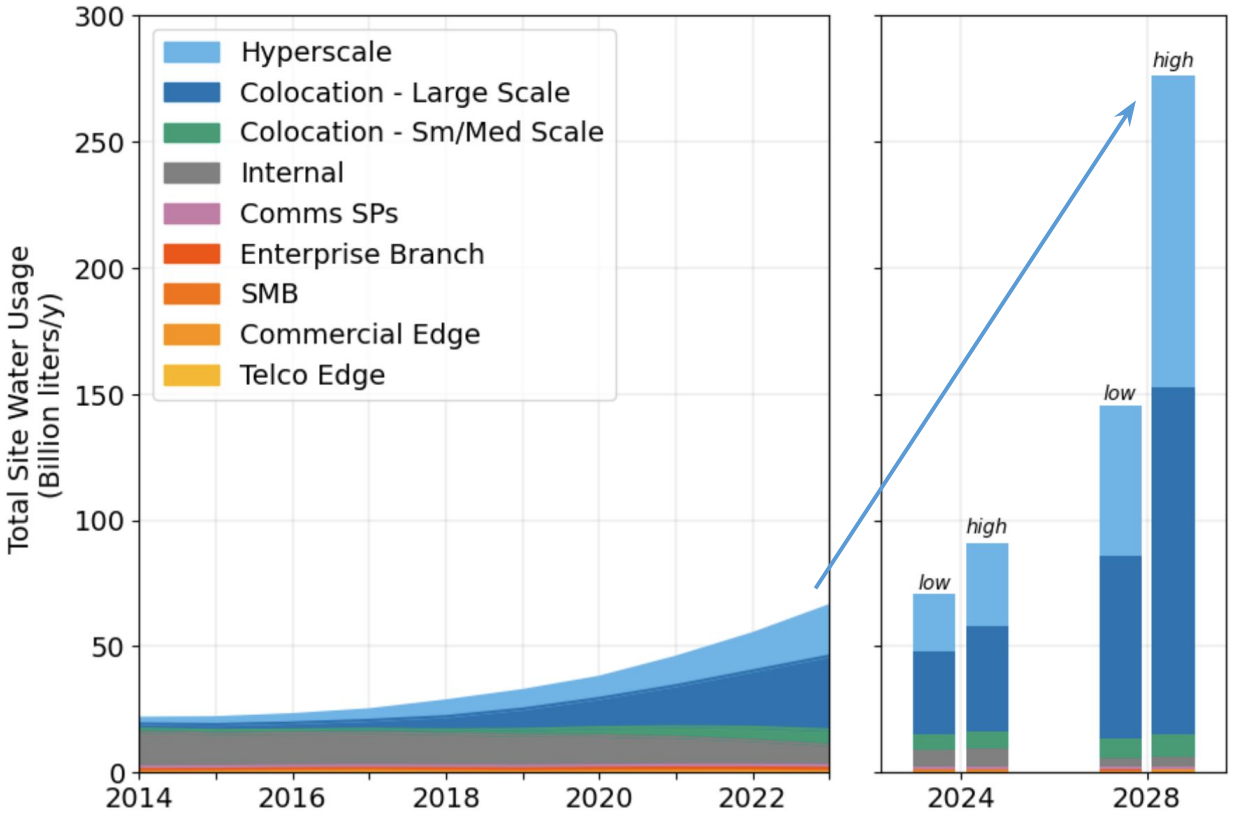
Indirect use for cooling power plants

Direct use for cooling IT





Water Consumption Projections



The U.S. data center water consumption in 2028, almost entirely driven by AI, will exceed **2 – 4x** the 2023 level

Source: 2024 United States Data Center Energy Usage Report and graph from Making AI Less "Thirsty": Uncovering and Addressing the Secret Water Footprint of AI Models https://arxiv.org/abs/2304.03271

In summary:

- Cost, risk, and impacts of massive amounts of energy infrastructure falling unfairly on other ratepayers
- Explosive growth pushes back Virginia's progress towards a clean energy future
- Communities are facing increasing air pollution, water supply constraints, and impacts to homes and public resources like parks

Are there solutions?

YES, but first we need to SLOW DOWN!

1. State Policy Change

- **State review** of data center proposals and oversight of regional and statewide impacts
- **Increased transparency** around energy, water, and emissions
- **Industry pays** for infrastructure through utility tariffs on large load users and fair allocation of costs
- **Incentivize sustainability** through the sales tax exemption or other means and **mitigate impacts**.

If the Virginia General Assembly fails to take action, **unchecked data center expansion will have a disastrous impact on ratepayers, our communities and the environment.**

Four Pillars of Data Center Reform

ENHANCED TRANSPARENCY	PROTECTIONS FOR FAMILIES AND BUSINESSES
STATE OVERSIGHT	INCENTIVES FOR EFFICIENCY

Virginia is already home to the world's largest concentration of data centers, with an IT power load believed to be nearly three times greater than the next largest market in Beijing. Many of these data centers individually draw as much power as small cities.

The rapid growth of data centers is creating an unprecedented demand for energy, land and water, and our communities are paying the costs. Without any public review or oversight by the state, Dominion Energy has already contracted with data centers for a startling 21 gigawatts (GW) of electricity, which nearly doubles its current peak energy capacity and is the equivalent of more than 11 North Anna nuclear power plants.

Without strong regulatory and legislative intervention, the risks and costs of the immense infrastructure supporting data centers is destined to be passed on to all ratepayers, including other businesses and residents.

Our electric companies are using these contracts to justify expensive and polluting energy infrastructure projects, including nuclear and gas power plants, and are delaying the retirement of coal plants. The Virginia Department of Environmental Quality has permitted thousands of diesel generators as back-up power for data centers, and it is now approving onsite gas turbines as primary power. **The continued use of fossil fuels by data centers exacerbates the environmental and climate risks already present throughout the state.**

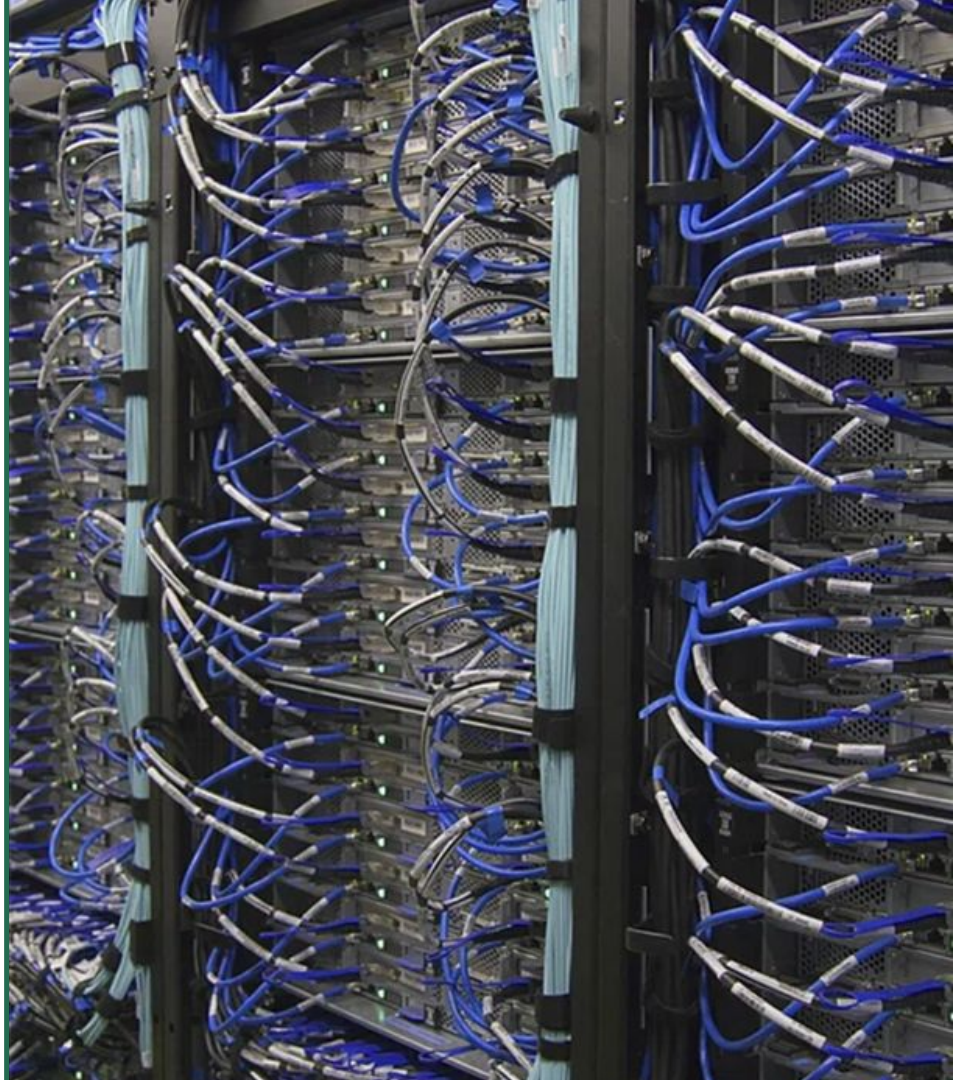
Water consumption by data centers, particularly in the Potomac and Rappahannock river watersheds, is increasing at an alarming rate — at the same time that much of the state is experiencing increased drought conditions. The cumulative impact of data centers on neighborhood air quality and individual watersheds is yet to be assessed.

From the **THE PIEDMONT ENVIRONMENTAL COUNCIL**

Learn more and get connected at **PECVA.ORG/DATACENTERS**

2. Market Push Towards Reducing Data Usage –

- Better data center monitoring tools, data management, and data reduction techniques
- Tools and resources to consumers to manage their data usage and make informed decisions
- Smaller AI models and more efficient software design
- Consumer pricing to reflect true cost that triggers price response and reduces waste



3. Required/Incentivized Sustainability Practices

- IT energy efficiency
- Cooling efficiency
- Water conservation practices
- Waste heat utilization
- Geothermal heating and cooling
- Onsite solar, wind, and advanced geothermal power generation
- Onsite battery storage utilized for backup and demand response replacing standard generators

4. State Commitment to Clean Energy and Smart Grid

- Well sited and designed utility scale solar
- Innovative grid solutions
  - Advanced conductors/Smart grid technology
  - More battery storage; longer-term storage pilot projects
  - Virtual Power Plants
- Retain Net Metering Rates
- More state incentives: parking lot, brownfield, agrivoltaics, rooftop

Photo Credit: Hugh Kenny, PEC

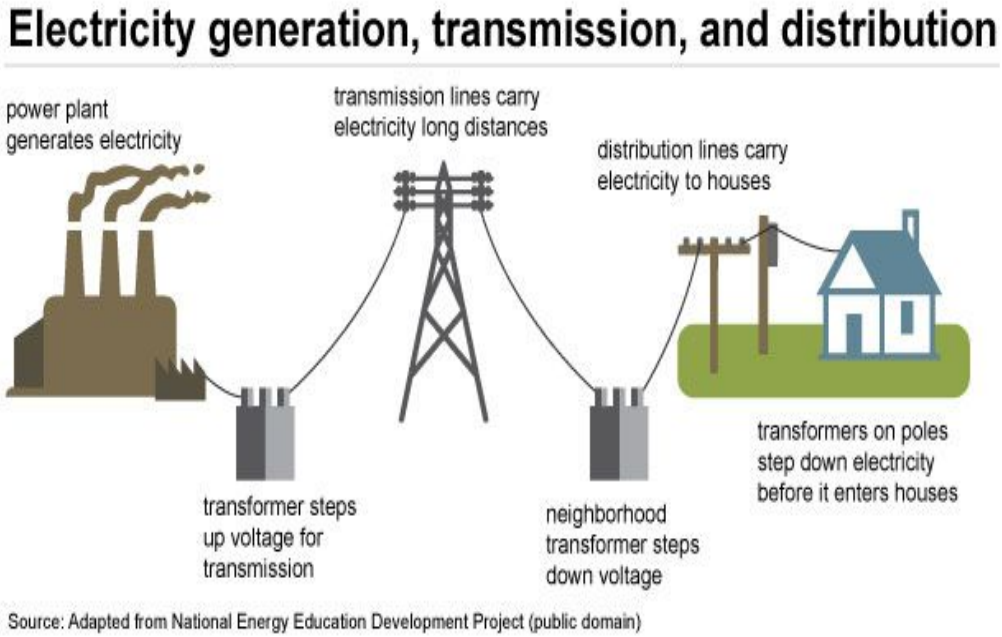
Energy Lay of the Land

- What is the Virginia Clean Economy Act and how is our progress
- Large Scale Solar Siting
- Advancing Distributed Generation, Storage, Agrivoltaics

Energy Talk

- **Definitions**
  - 1,000 KW=1 MW
  - 1,000 MW = 1 GW
  - kWh= electricity produced
  - Transmission/Distribution/ Substation

- **We are part of PJM**
  - A regional transmission operator that operates the grid essentially from IL to VA and NJ to NC



Virginia Clean Economy Act

- Mandatory Renewable Portfolio Standard
  - 100% renewable energy by 2045/2050 for Dominion/APCo
  - 16,100 MW solar by 2035

- Distributed Generation Cap → 6%

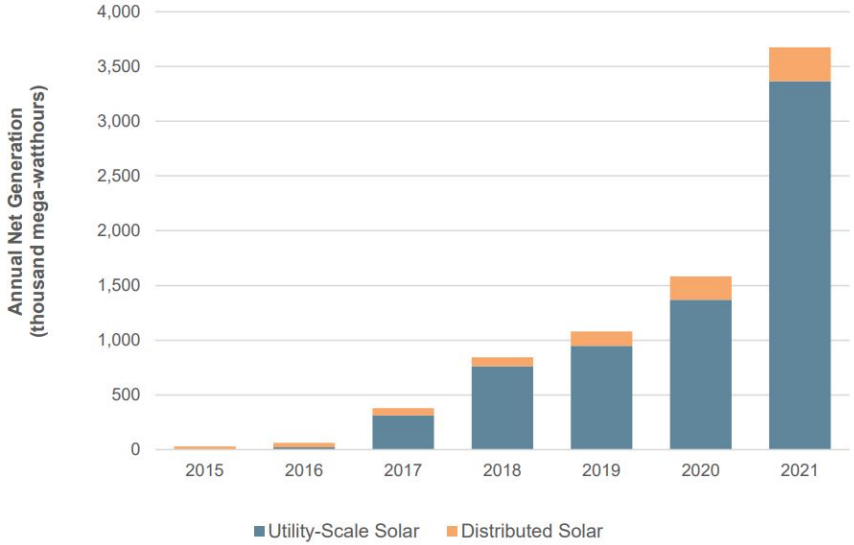
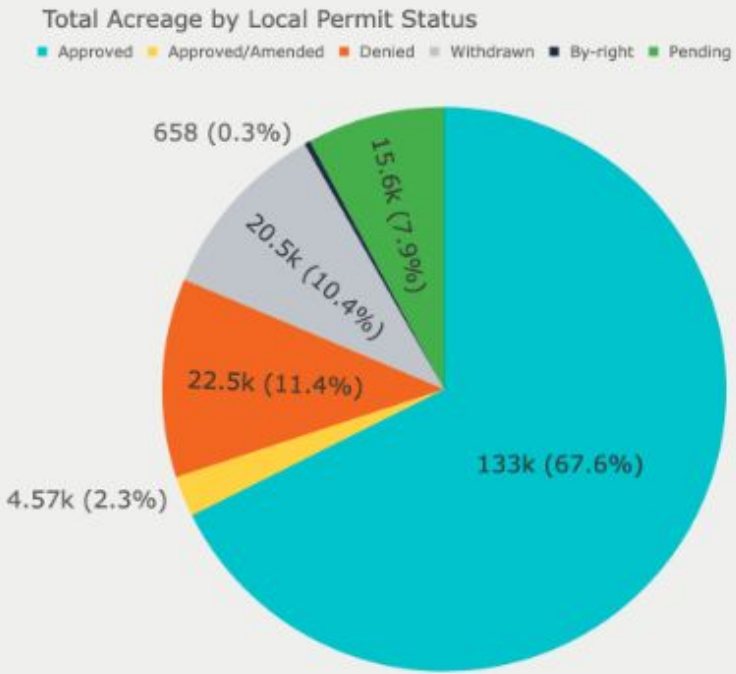
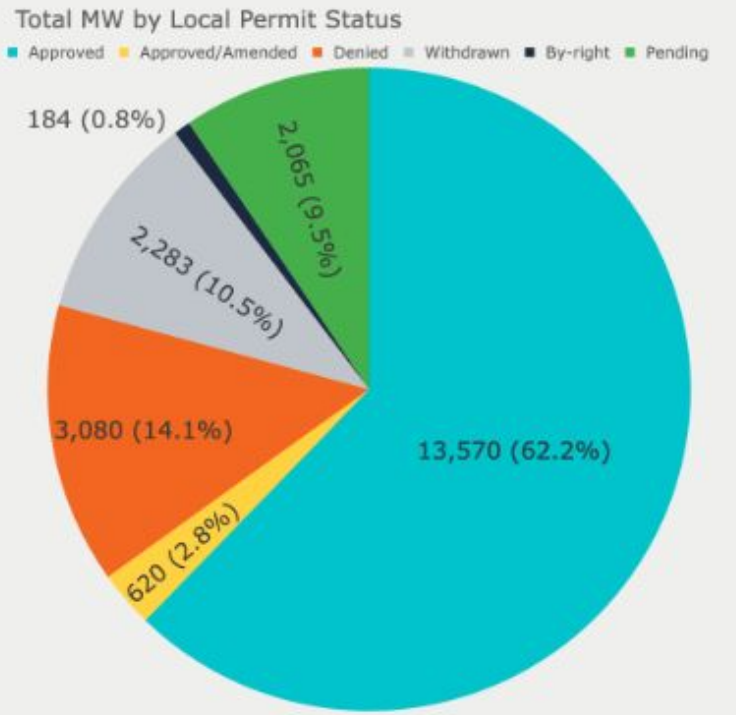


Figure 4. Annual Net Generation from Solar in Virginia
Source: U.S. EIA

Virginia Clean Economy Act Progress

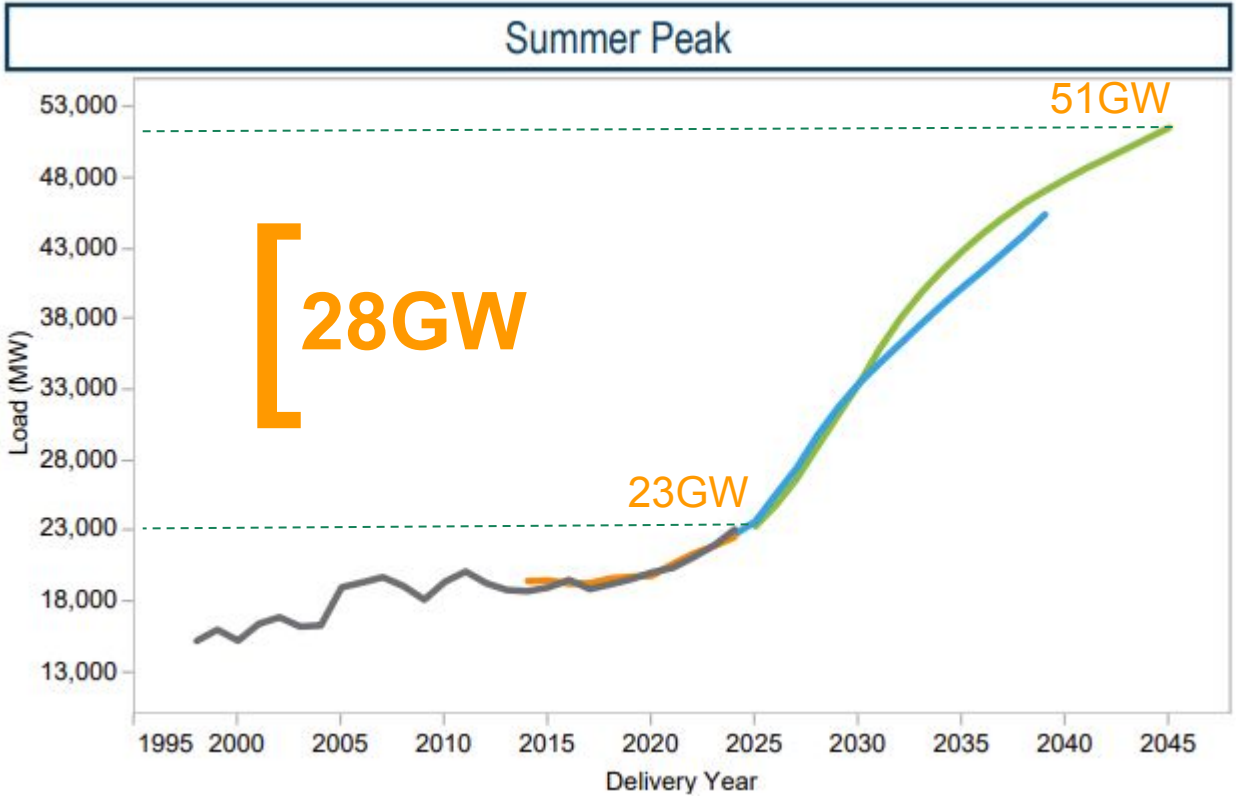


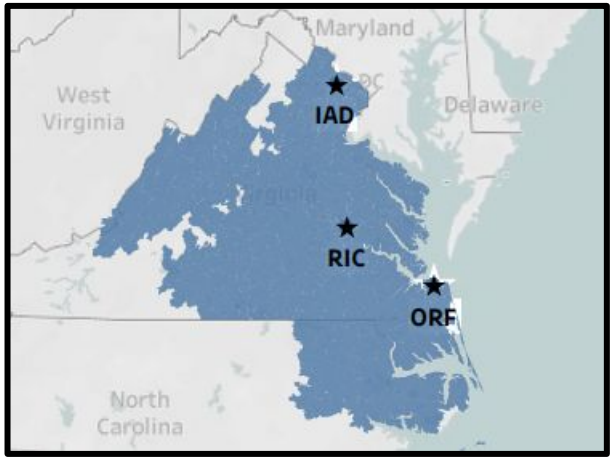


Approval Rates

Skyrocketing Load Demand in Virginia

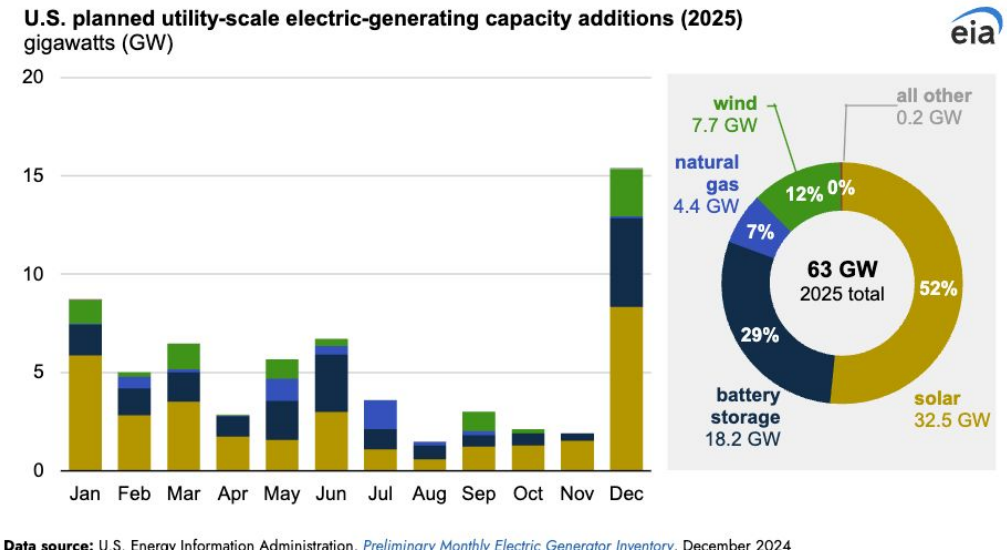
Dominion Energy's 20 Year Forecast



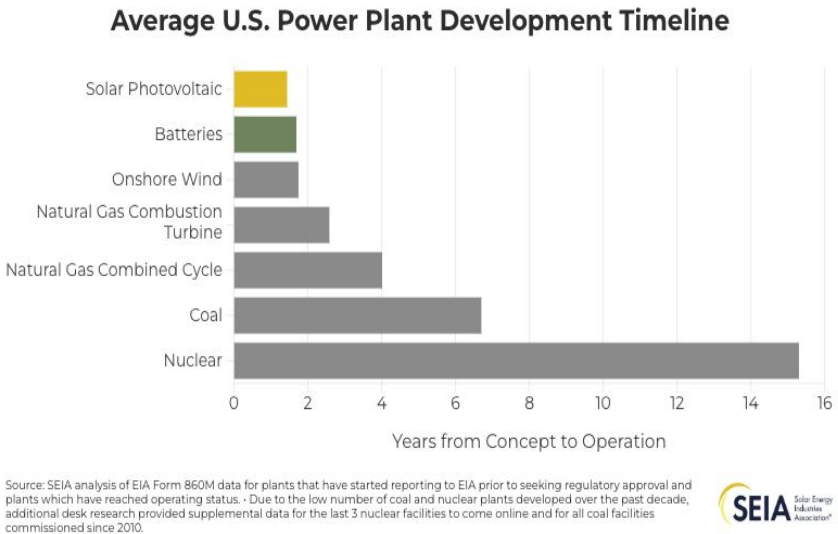


Green = 2025 projection
Blue = 2024 projection

National Perspective on Energy Mix and Development Timelines



Data source: U.S. Energy Information Administration, *Preliminary Monthly Electric Generator Inventory*, December 2024



Large Scale Best Practices

- PBR (5-150MW)
- Minimize impacts to:
  - Historical, cultural and scenic resources
  - Prime agricultural soils and forested land
  - Wildlife
  - Water Quality
- Minimal grading
- Soil testing
- Construction (acreage, machines, rain events)
- Decommissioning

Solar Siting/HB 206

- **Legislation**
  - HB206 draft regulations process update
  - Local authority issue

- **Related opportunities for best practices**
  - Dual Use
  - All Terrain Trackers (Nevados)

Summary of Utility Scale Solar in VA

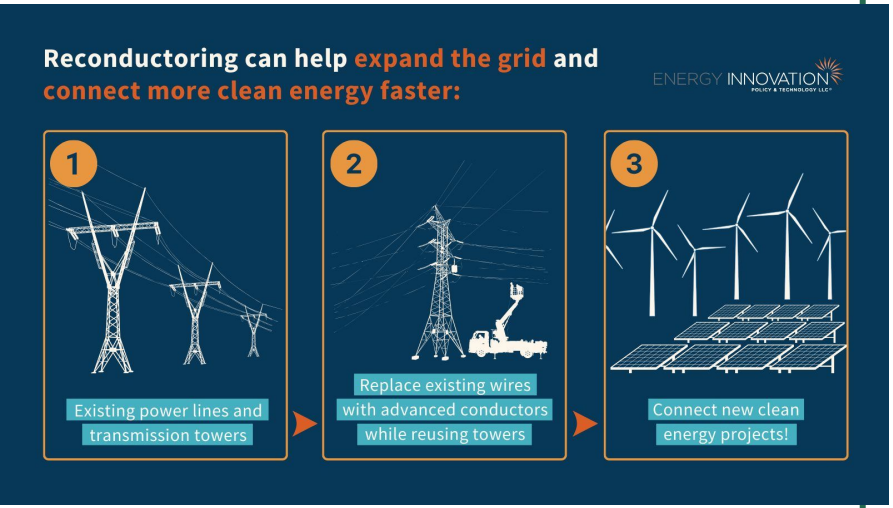
- Large part of solar future
- Best practices critical for present and future
- Data center demand = 100,000s acres of solar
- Increased local resistance/related legislation

Pieces of a Clean and Resilient Future

- Advanced Conductors/Smart Grid
- Data Center Sustainability
- Rooftop/Community Solar
- Brownfield Solar
- Parking Lot Solar
- Batteries/VPP’s/Microgrids
- Agrivoltaics

Reconductoring

- Using carbon fiber
- Decrease line temp/sag
- Significantly increase capacity on existing lines
- Faster to implement
- Less expensive



Smart Grids

- Traditional grid designed for centralized generation
- Smart tech more effective way to integrate intermittent and distributed energy
- Sensors and other technology to establish two-way communication.
- Improves load balancing and enhances distribution management

Data Center Sustainability Report: Case Study snippet

Iron Mountain Data Center – Edison, New Jersey

Iron Mountain's colocation data center in Edison, NJ, features a 7.2MW rooftop solar array–the largest of any data center in the US. This 7.2 MW installation generates over 9 million kWh of clean energy annually, offsetting a portion of the facility's reliance on grid electricity. The facility is certified to the BREEAM standard for sustainable building.

Innovative Practices

Rooftop Solar: A 7.2 MW rooftop solar installation generates over 9 million kWh of clean energy annually.

Efficient Cooling Infrastructure: Utilizes efficient cooling technologies, including optimized airflow management and water-side economizers, to minimize energy consumption.

Certifications: BREEAM standard for sustainable building.

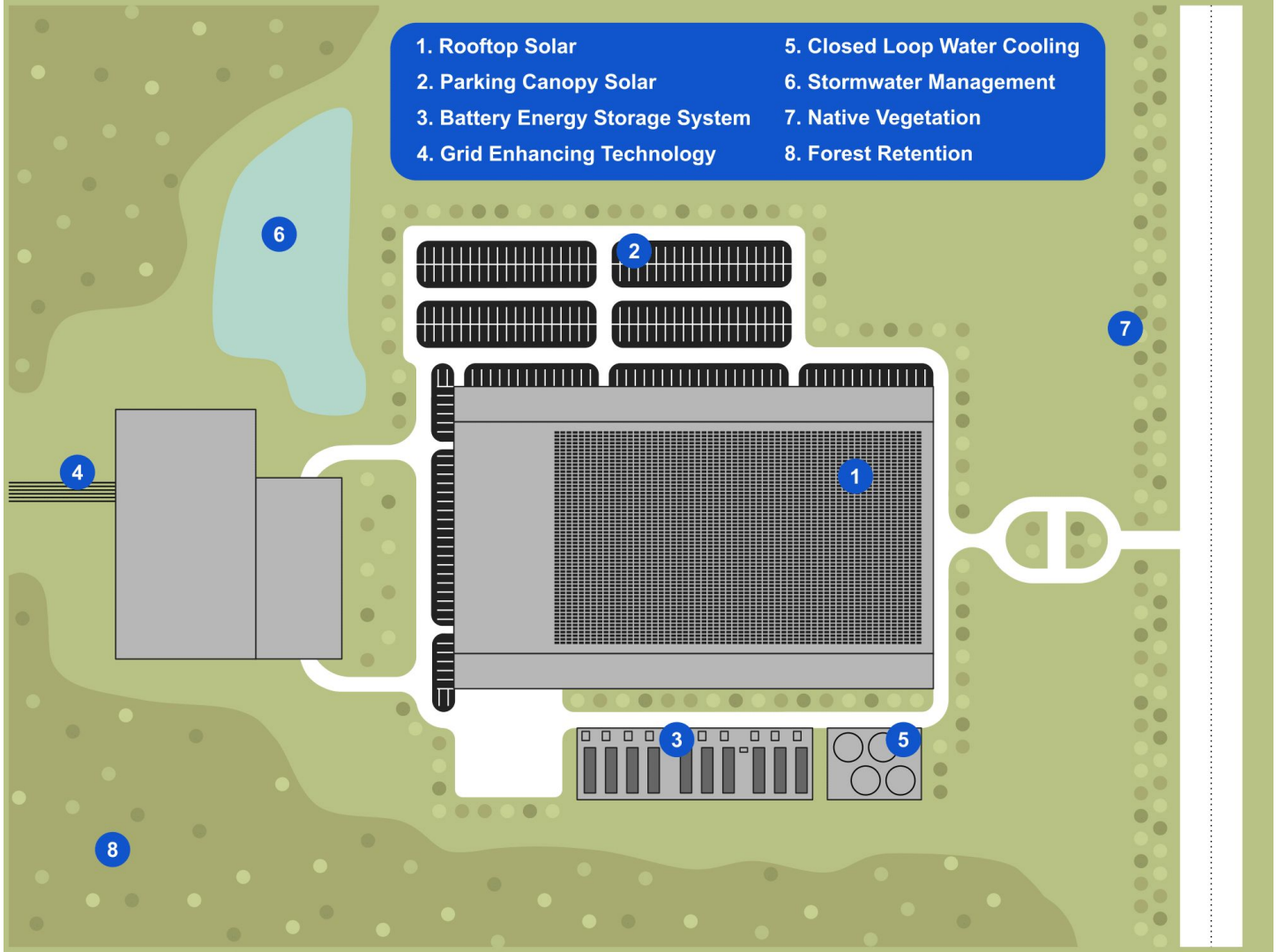


Image credit: Emily Johnson

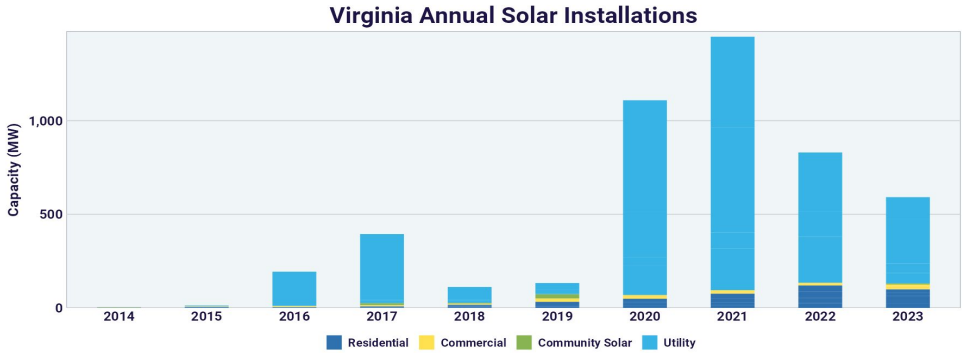
Benefits of Distributed Generation

- Benefits the consumer
- Less lost to inefficiency
- Protection against outages
  - Load shifting
  - Battery
- Faster interconnection
- Energy Independence
- Protection against rate increases
- Using Built environment
- Creates more local business

Hurdles to a More Distributed Grid

- Grids and RTO's set up to be centralized generation/transmission based
- Infrastructure yields high guaranteed rates of return for utility
- Biased modeling systems in IRPs
- "Value of Solar" pending in SCC with Dominion/App Power
  - **Value of Net Metering**
  - Base Charges
  - The 6% cap

- Cost prohibitive limits on larger distributed systems (250kW - 1 MW)
  - Businesses, schools, large ag
  - DTT Standards/Dark Fiber
  - Grid upgrade costs
- No State Incentives
- Risk of Federal Incentives
- Size Limits/Rural Limits



Battery Backup

Advantages:

- Grid resilience & independence
- Benefit to peak load
- Bi-directional EV’s
- Virtual power plant/Microgrid
- Federal incentives (30%)

Challenges:

- Cost
- Lack of state incentives

What PEC is Working on in Distributed Generation

- **Solarize Piedmont (annual)**
- **USDA Rural Energy for America**
  - Solar on the Farm event
  - Solar for Rural Businesses event
  - Solar in the Community
- **SolarApp+/SolSmart**
- **Virginia Department of Energy**
  - Solar for All Advisory Group
  - Shared Solar Advisory Group
- **DOE Voucher Recipient ($300k)**
- **Net Metering and Value of Solar**
  - Dunsky Report underway
  - SCC Case
- **Data Center Sustainability Report**

DG and Storage Legislation

- **Parking lot solar:**
  - PEC ran a parking lot solar bill last year that gained significant support from organizations such as Farm Bureau, Agribusiness and Cattlemen's Association.
  - This year's bill gave localities ability to mandate parking lot solar on certain new parking lot developments
- **Long Duration Energy Storage (HB 2537 / SB1394):**
  - Decreases impacts on our natural resources
  - Model ordinances, advisory and built with local consensus
- **HB 1883/SB1040, the Distributed Generation Expansion Act:**
  - *Triples* required solar development on parking lots, brownfields and coal mines.
  - This allows urban and suburban communities to do their part, making use of underutilized impacted sites
  - Meeting demand more efficiently than widely dispersed rural solar projects.

DG and Storage Legislation

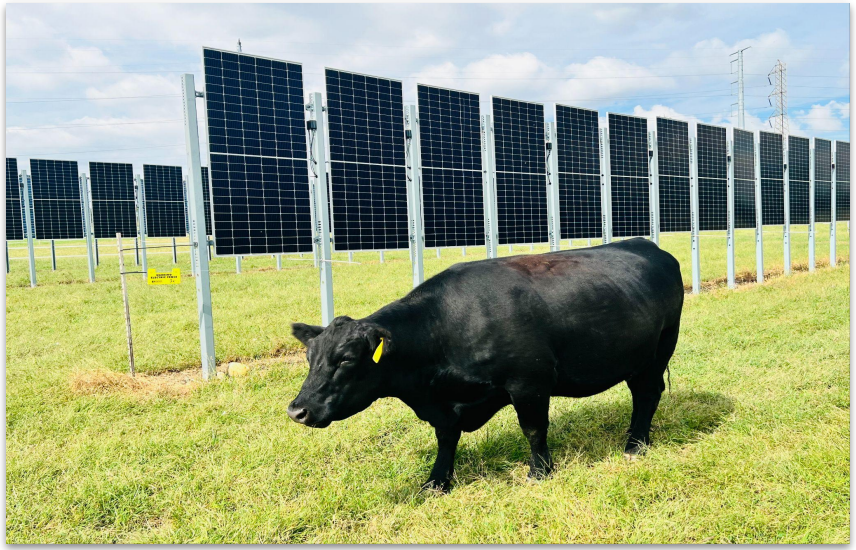
- **HB 2346/SB 1100, the Virtual Power Plant Program: PASSED**
  - Innovative, cutting edge program that *incentivizes home batteries*, along with other distributed energy resources, to discharge energy to the grid at those peak times when we need it most. Successful in states such as Texas.
  - For our rural communities, many of whom are end of line users, backup generation is quite common and *1 in 6 Americans* have some type of backup.
  - More natural resource and ratepayer friendly than building new generation.
- **HB 2266/SB 1058, Interconnection bill for distributed resources: PASSED**
  - Many schools and farms in communities across the Piedmont have explored solar. However, onerous grid upgrade costs can stretch into the hundreds of thousands of dollars, making many projects infeasible. Spreading these upgrade costs across a rate class will help take the pressure off of the installing party.
  - This fix encourages development, providing more business for local installers and contractors across the Commonwealth.
  - In addition to cost savings for schools and businesses, this bill will help facilitate projects that preserve our conservation resources.

What is Agrivoltaics

Working towards a consensus definition in Virginia. American Farmland Trust defines agrivoltaics as:

- **Production of marketable agricultural products throughout the full life of the solar array, and**

- **Intentional design of the solar array, done in consultation with farmers or other experts, to ensure that these systems are constructed, installed, and operated so that land within the array is suitable for agricultural production—with flexibility for the farmer to change what they produce in response to market demand throughout the 30-40 year+ life of the project.**



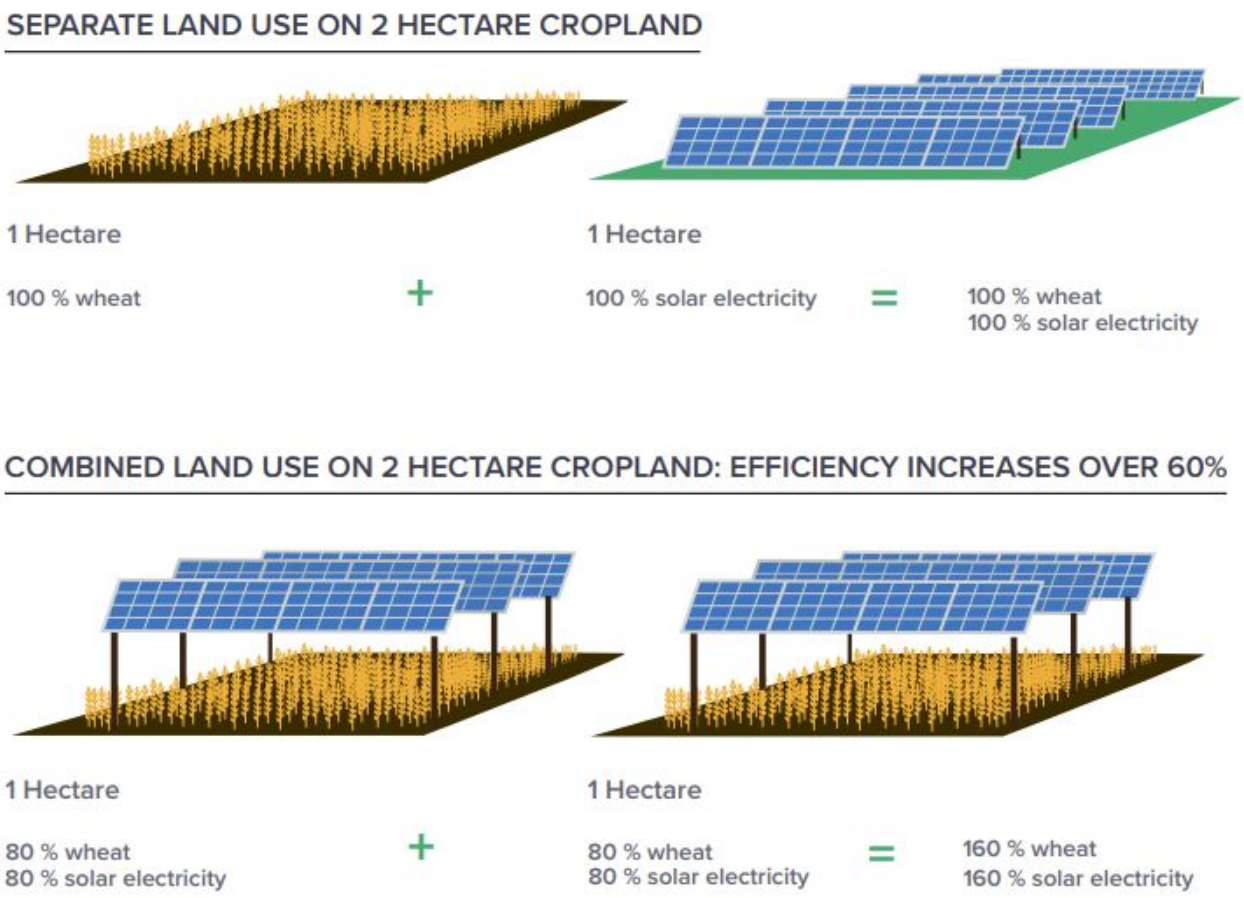


Figure 6: Product visualization under agrivoltaic systems.
Photo source—Fraunhofer Institute for Solar Energy Systems

Challenges of Agrivoltaics

- Need more studies for Virginia climate, soil and crops
- Comp plans are often not clear on agrivoltaics
- Incentives and retention of agricultural tax benefits
- “More expensive than utility scale”
- Ordinances that limit front of meter projects for rural/agricultural zoned properties
- Perception

Advantages of Agrivoltaics

- Farmers diversify income stream
- More positive view from farmers than standard solar
- Cost saving on vegetation management, decreased emissions
- Increased overall use of the land
- Increased efficiency for panels
- Increased moisture content can lead to higher biomass growth and/or nutrient rich content for grazing
- Shade for cows and sheep, mitigation of drought impacts
- Waste as fertilizer
- Cumulative impact/keeping land in ag

Large Scale Agrivoltaics Best Practices

- Thus far this is typically sheep grazing
- Limited grading/use of terrain trackers
- Grazing plan (seed mix, re-vegetation timeline)
- Community benefits to local ag economy
- Land ownership structure for grazer

About the PEC Community Farm at Roundabout Meadows

- **Demonstration farm in Loudoun**
- **Regenerative practices**
- **Certified Naturally Grown (CNG)**
- **About 50,000 pounds of produce per season**
- **All produce donated to local hunger relief organizations**
  - Loudoun Hunger
  - Christ Church Cares/FISH
- **Full time staff/Volunteer Days**
  - Fortune 500 companies, youth groups, church groups, etc.

Agrivoltaics Project at Roundabout Meadows

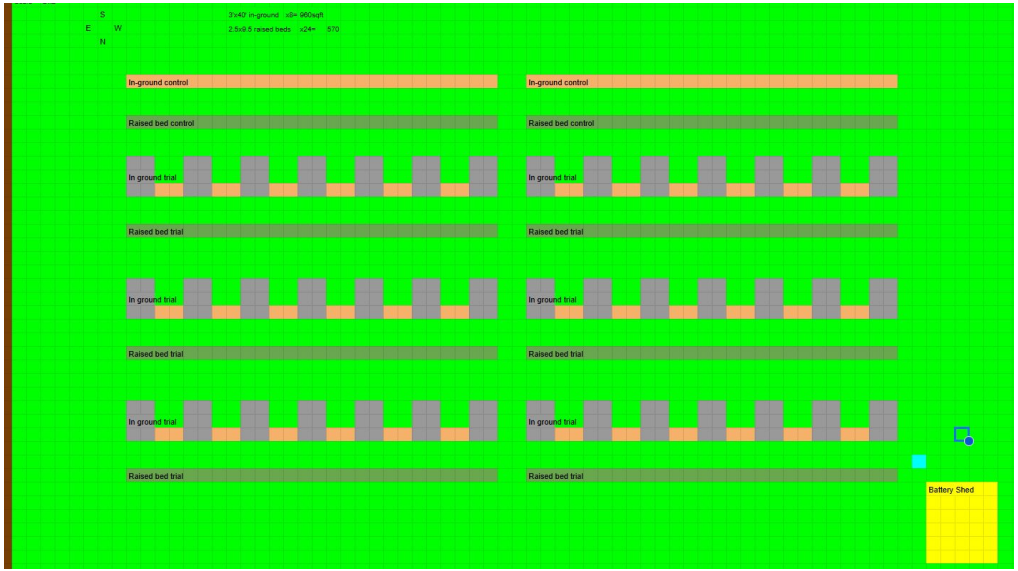
The Solar Setup

- **Technical Assistance from U.S. Department of Energy's National Renewable Energy Lab (NREL)**
- **17Kw Solar System**
- **42 panels/spaced**
- **130% Offset**
- **Full battery backup**
  - Off grid capabilities/resilience
- **6 foot racking**
- **Fixed tilt panels**

Agrivoltaics Project at Roundabout

The Ag Setup

- **1,530 sqft production space, will yield approximately 2,000 lbs, 1,667 meals**
- **Experimental Group/Control group**
- **In ground plantings and Raised beds**
- **Choosing crops and varieties that will likely work (cold weather, shade tolerant), under 4’ tall, non-vining**
- **Crops Include:**
  - Lettuce, Collards, Chard, Kale
  - Cauliflower
  - Turnips, Beets
  - Tomatoes, Peppers
- **Monitoring: Yield, Quality, Irrigation,Soil**



Agrivoltaics Project at Roundabout Meadows

What we expect:

- **Yield delta will be greater for hot-weather crops than cool-weather crops**
- **Trial crops delayed/variable maturity**
- **Trial crops will require less irrigation**
- **Disease pressure will be greater in trial**
- **Soil temperature will be lower in trial**
- **Fertility will be similar with no contamination**

Data we will share:

- **Gathering data points relevant to farmers**
- **Irrigation requirements (irrometer), yield per square foot/days, harvest timeline, biotic pressures (pests/diseases), phenotypic variation, soil temperature, soil fertility, soil contamination (heavy metals), vegetation management challenges**

Learning Lessons

- Racking procurement
- Permitting/Local Ordinances
- Grid upgrades
- Project timeline
- Bedrock/Geotech
- Supply Chain
- Insurance
- Scalability/Legislation
- Incentives (ITC, REAP, RECs)

Hammering Through Bedrock

Trenching: Laying the Infrastructure

Racks on Racks on Racks

Raise Up

Piedmont Environmental Council

Thank you!

PEC Annual Meeting - June 8, 2025
Julie Bolthouse, Director of Land Use and
Ashish Kapoor, Senior Energy and Climate Advisor