JLARC
JOINT LEGISLATIVE AUDIT AND REVIEW COMMISSION

December 9, 2024

Data Centers in Virginia

Commission Briefing

Study resolution

- Directs JLARC to review the impacts of data centers in Virginia and state and local policies regarding data centers
  - Projected growth of the data center industry in Virginia
  - Impact on energy consumption and infrastructure and customer costs
  - Impact on residents and natural and historic resources
  - State and local regulation of siting and construction
  - Impact on economy and tax revenues
  - State policies and incentives for data centers

Commission resolution (December 11, 2023)

Primary research activities

- Over 300 interviews, including data center companies, utilities, local governments, state agencies, Virginia residents, and other stakeholders and experts
- Reviews of reports, state and local regulations, and other relevant documentation
- Analyses of data related to the size and distribution of data centers, environmental impacts, and economic and revenue impacts
- Forecast of future energy demand and modeling of energy infrastructure needs, costs, and rate impacts (Completed with assistance of consultants)

In brief

- Data centers provide economic benefits and can generate substantial local tax revenues for localities that have them.
- Data center industry is driving immense increase in energy demand, and building enough new generation and transmission infrastructure to address demand will be difficult.
- Data centers are currently paying full cost of service, but growing energy demand will likely increase costs for other customers and create additional financial risks for utilities.

In brief

- Data center backup generators emit pollutants, but their use is minimal, and existing regulations largely curb adverse impacts.
- Data center water use is currently sustainable, and state ensures future sustainability through regulation.
- Increasing number of data centers are being built close to residential areas and can negatively impact residents; some localities have taken steps to address this concern, but noise impacts can be difficult to resolve.

In brief

- Virginia's sales tax exemption for data centers could be (1) extended to maintain data center growth and economic benefits, (2) allowed to expire to slow growth and reduce energy impacts, or (3) modified to balance these priorities.
- Sales tax exemption could also be changed to address policy concerns related to energy efficiency, natural and historic resources, and local residential impacts, but changes could make the exemption a less effective economic development tool.

In this presentation

Background

Economic and Fiscal Impacts

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Natural and Historic Resource Impacts

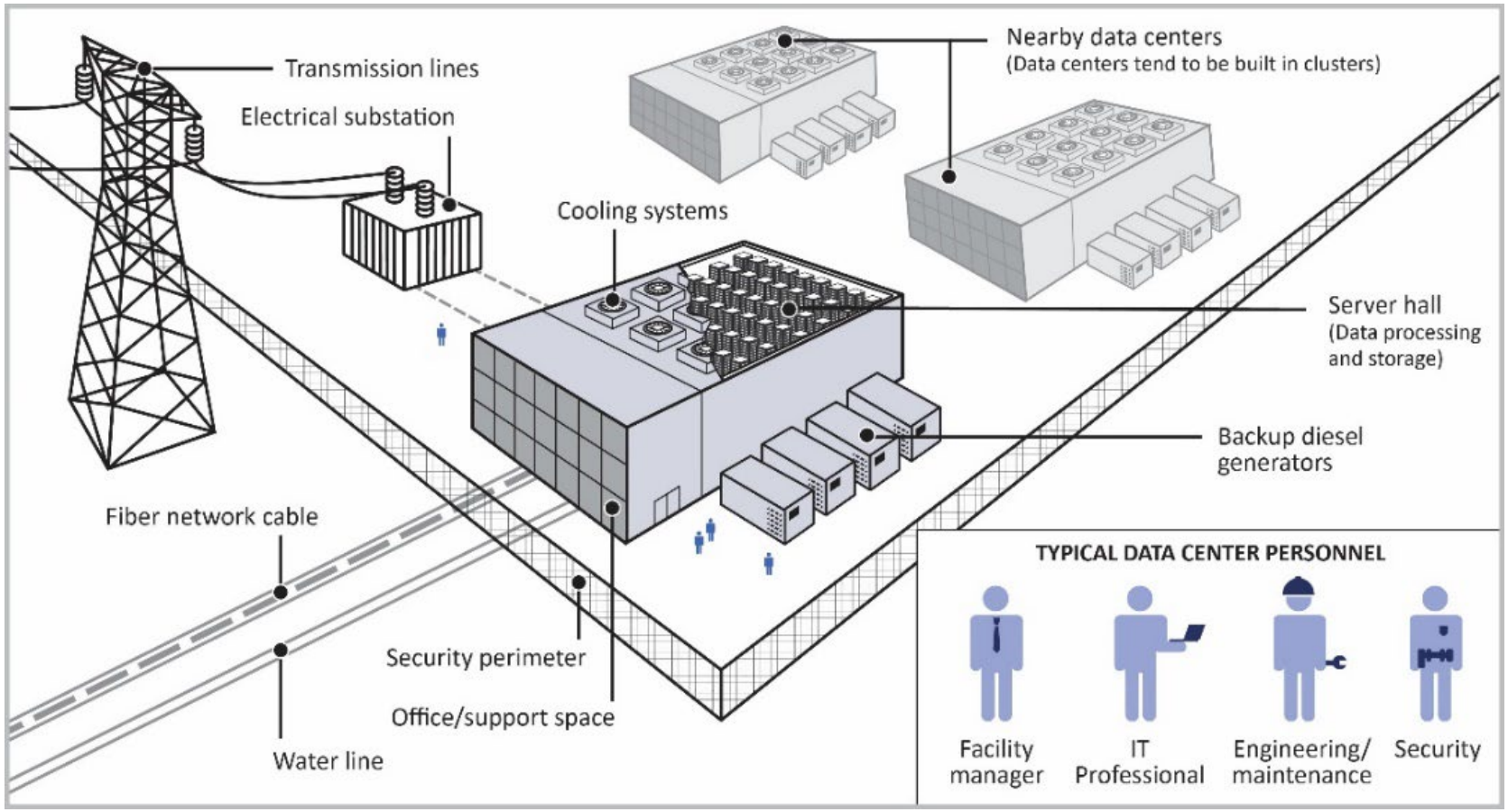
Local Residential Impacts

Using Data Center Exemption to Address Policy Concerns

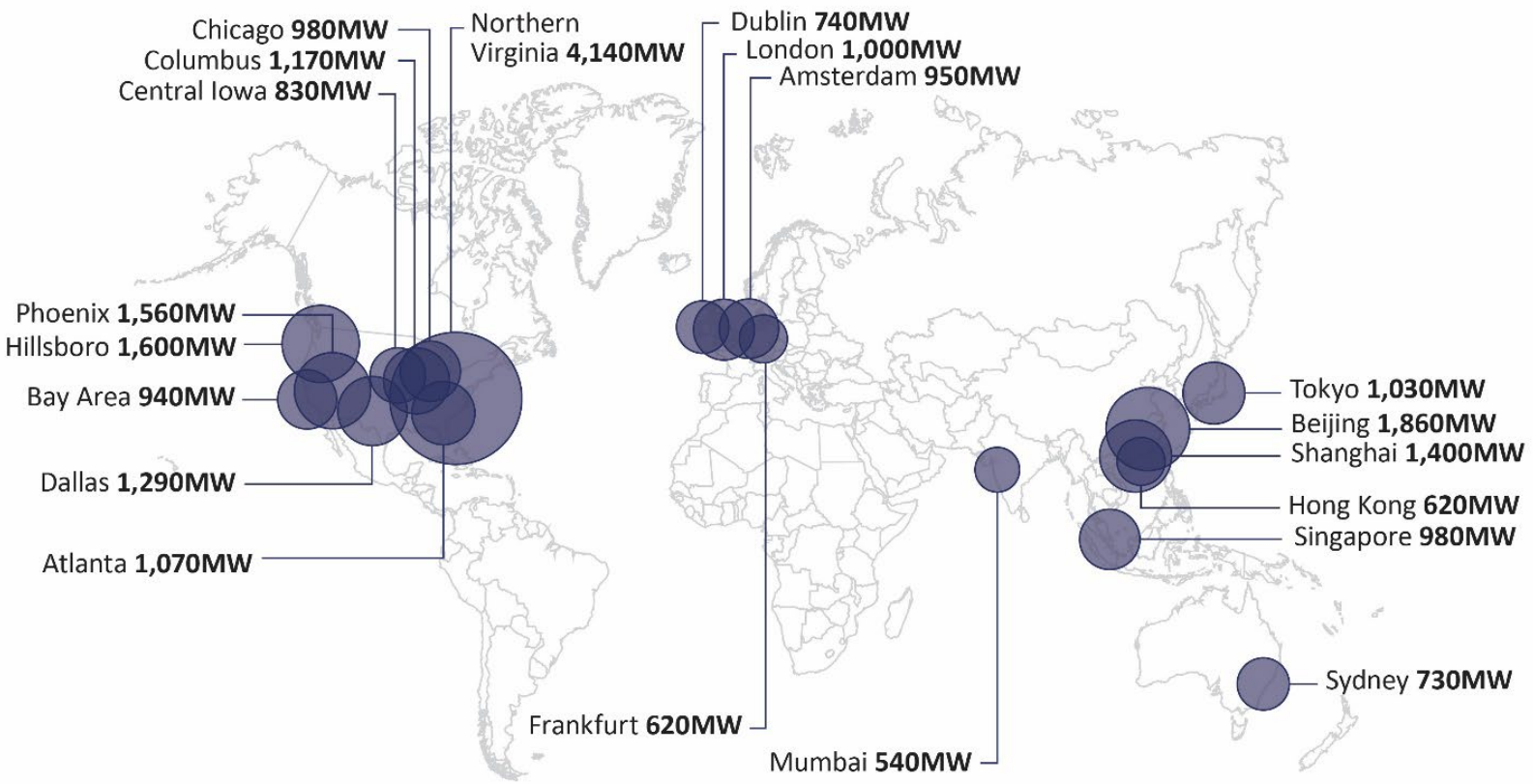
Data centers are key hubs of world's digital infrastructure

- Enable modern digital services and economy
  - Internet, cloud services (business, personal), media streaming, apps, financial transactions
- Industry is growing rapidly, driven by a combination of established and emerging trends
  - Existing uses accelerated by COVID-19 pandemic
  - Emergence of artificial intelligence
- Dominated by a few large companies
  - Amazon Web Services, Google, Meta, Microsoft

Modern data centers are large industrial buildings, increasingly located together on “campuses”

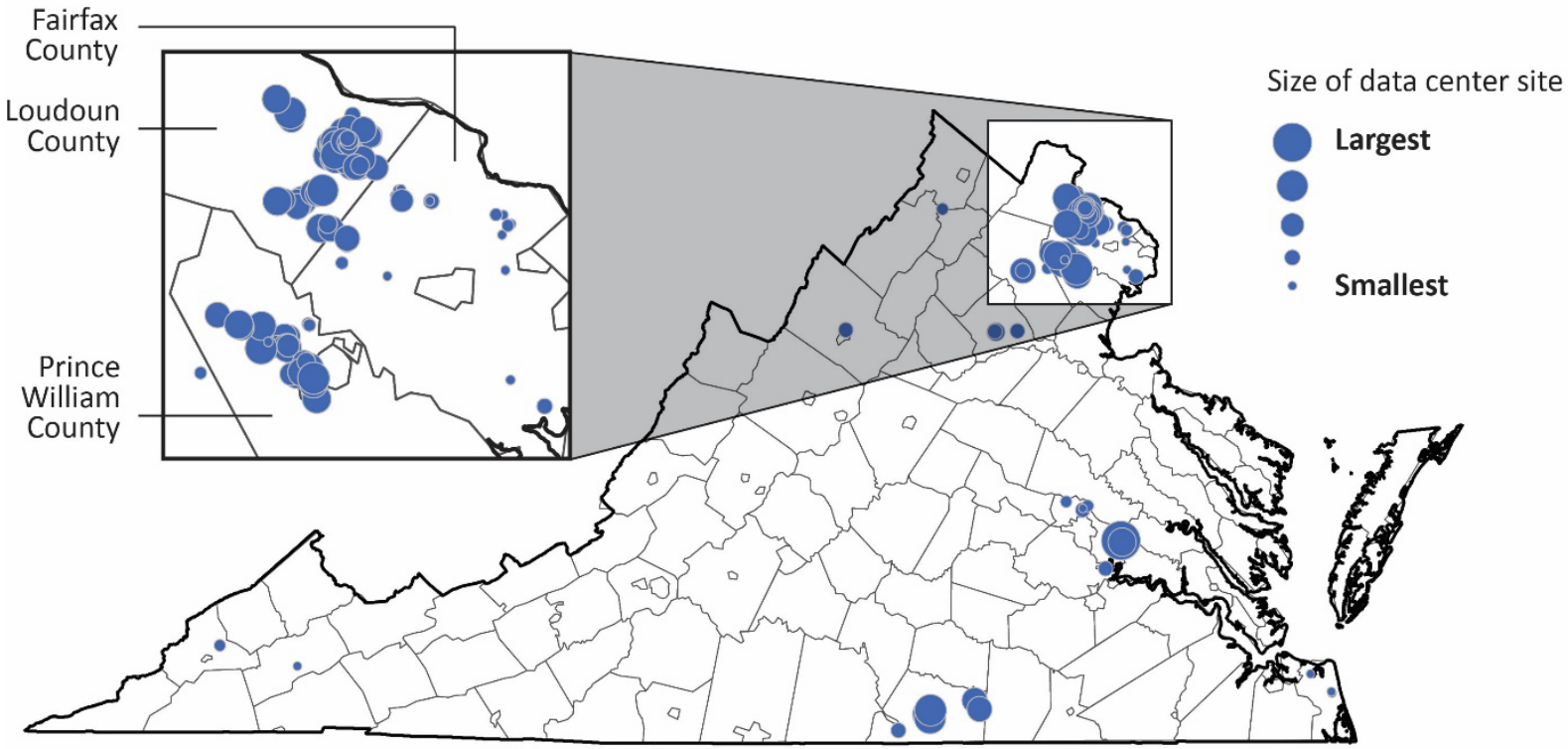


Northern Virginia is the largest data center market in the world



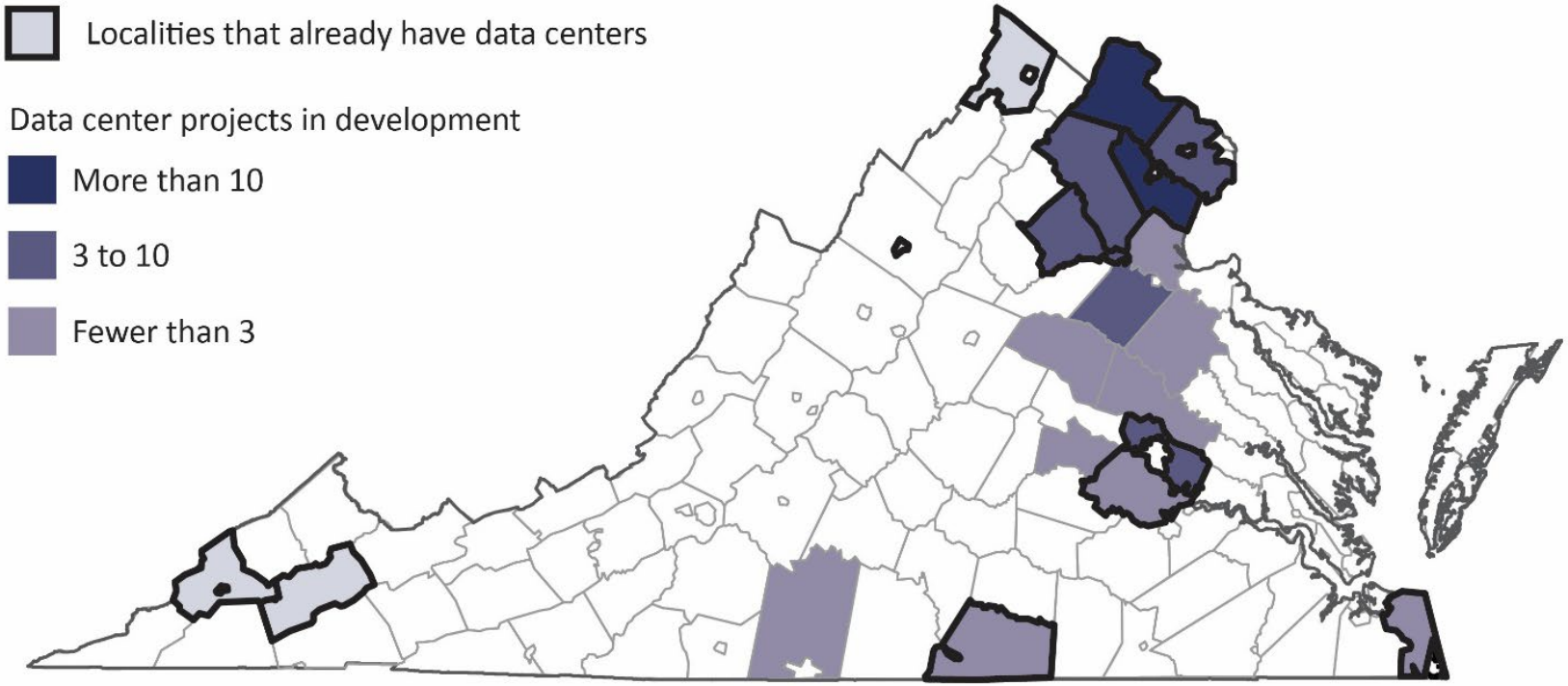
JLARC analysis of Cushman & Wakefield 2024 Global Data Center Market Comparison

Most of Virginia's data center industry concentrated in Northern Virginia



Data center size is measured using operational capacity, given in megawatts of power.

Virginia's data center industry is starting to expand into new localities, mostly along I-95 corridor



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Using Data Center Exemption to Address Policy Concerns

Finding

Data centers provide economic benefits, mostly during their initial construction.

Data center industry has economic benefits, with most benefits occurring during construction

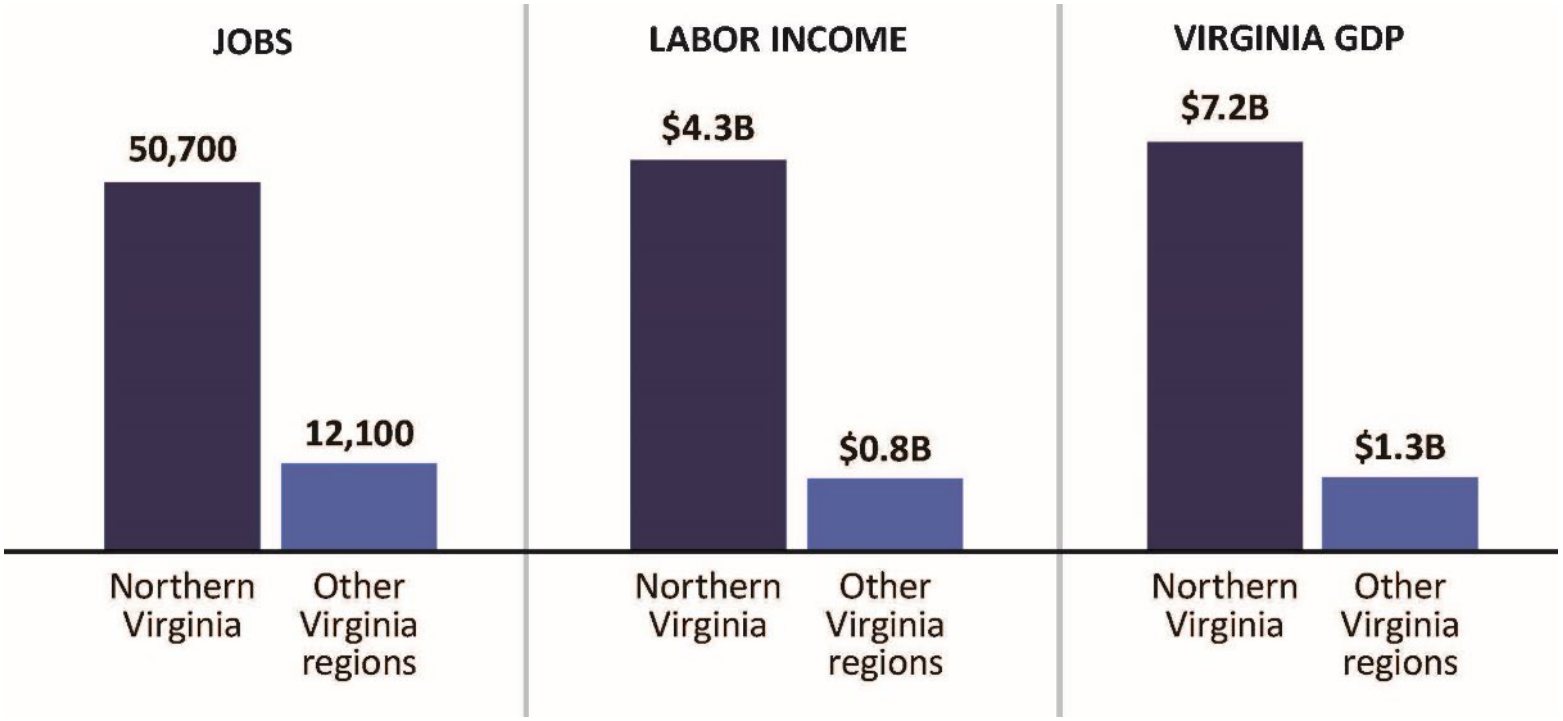
Economic impact	Annual average*		
	Construction	Operations	Total impact
Jobs	59,000 jobs	15,000 jobs	74,000 jobs
Labor income	$4.3B	$1.2B	$5.5B
Virginia GDP	$6.4B	$2.7B	$9.1B

*Direct and indirect economic effects, based on capital investment and related operation spending

Data center industry creates jobs and is a significant source of capital investment in Virginia

- During construction, a data center site can employ up to 1,500 workers, including skilled construction and trades
- During operations, typically employ small number of workers relative to facility size (~50)
  - Facilities, engineers, IT, trades, security
  - Most jobs are relatively high-paying
- Significant source of capital investment ($24B in FY23)
  - ~20% for construction, much of which stays in-state
  - Most computer & equipment investment to out-of-state companies

Economic impact is concentrated in Northern Virginia



Totals for Northern Virginia and other Virginia regions do not sum to statewide totals shown in previous slide because the regional method of analysis does not account for impacts from activity in Northern Virginia occurring in other Virginia regions and vice versa.

Finding

Data centers can generate substantial local tax revenues for localities that have them.

Localities with data centers can collect substantial tax revenues from the industry

- Local tax revenues primarily from business personal property and real property (real estate) taxes
- Amount of local revenue depends on several factors, such as size of data center market and local tax rates
  - Some localities have greatly reduced rates to try and attract data centers, which greatly reduces potential revenue
- For localities with relatively mature data center markets, revenues ranged from <1% to 31% of total revenues
  - Loudoun $733M (31%), Prince William $110M (7%)*

*Cannot report totals for counties with small number of data centers to protect taxpayer confidentiality

Localities in economically distressed areas could have difficulty attracting the industry

- To attract data centers, a locality must have access to transmission lines and large, flat areas of land
- Localities that are close to data center customers and population centers have historically had an advantage
  - Rural localities may be better able to compete for new data centers running artificial intelligence (AI) workloads
- Localities are more attractive if they have "shovel-ready" industrial sites suitable for data centers
  - VEDP's Virginia Business Ready Sites Program provides grants for site development

VEDP = Virginia Economic Development Partnership

Recommendation

VEDP should clarify that potential data center sites are eligible for grants under the Virginia Business Ready Sites Program.

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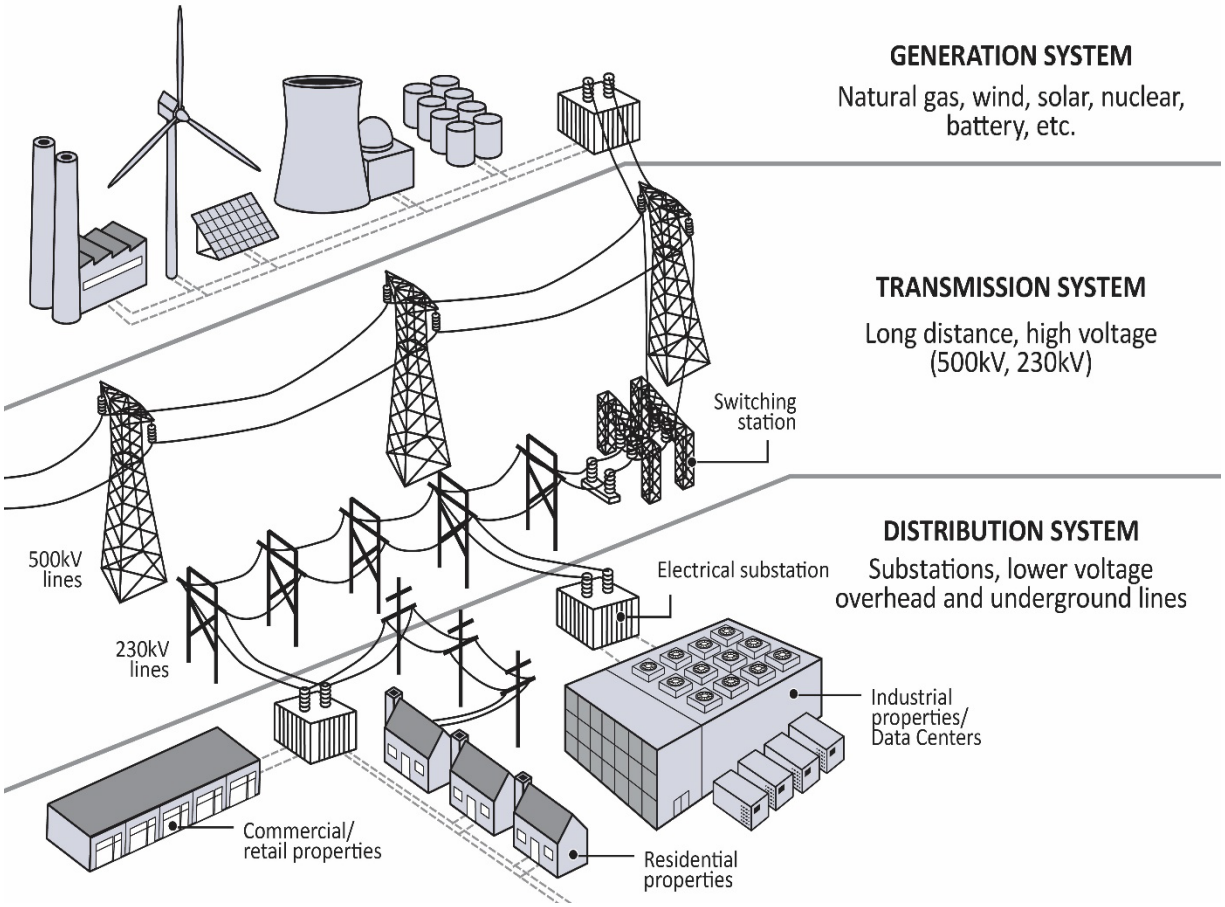
Using Data Center Exemption to Address Policy Concerns

Modern data centers use substantially more energy than other commercial or industrial operations

- Small 18 MW data center power capacity is roughly equivalent to a mid-sized automobile assembly plant, 60 large commercial office buildings, or 4,500 homes
- Largest new data centers draw from 100 to over 200 MW, more than most industrial consumers
- Planned data center campuses are expected to consume well over 1,000 MW
  - More than the 950 MW generation capacity of Virginia's largest nuclear reactor

MW = megawatts of power used in an instant, which is the common metric for measuring data center size

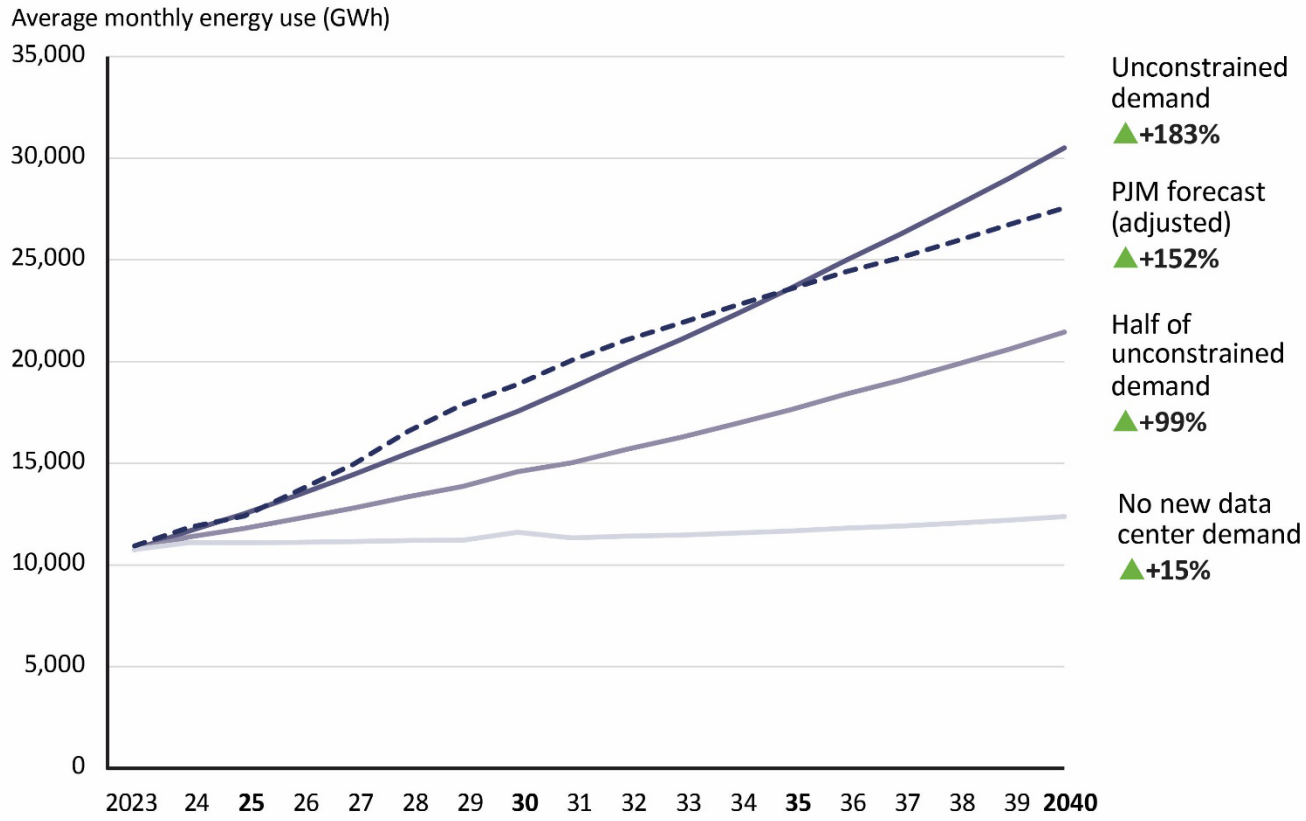
Energy comes from a complex grid composed of generation, transmission, and distribution systems



Finding

Data center industry is driving immense increase in energy demand, and building enough new generation and transmission infrastructure to address demand will be difficult.

Data center industry is forecast to drive immense increase in Virginia's energy demand



PJM is the regional organization responsible for coordinating generation and transmission for Virginia and several other eastern and midwestern states

New generation and transmission infrastructure will need to be built to help address energy demand

- New generation infrastructure needed includes
  - Renewable solar and wind facilities
  - Natural gas plants
  - Nuclear plants
  - Battery storage and “demand response” resources
- New transmission needed includes
  - “Interzonal” lines to bring power into and across Virginia
  - “Intrazonal” lines to disperse power to local distribution points
  - Transmission substations

Addressing energy demand would require substantially increasing current system capacity and energy imports

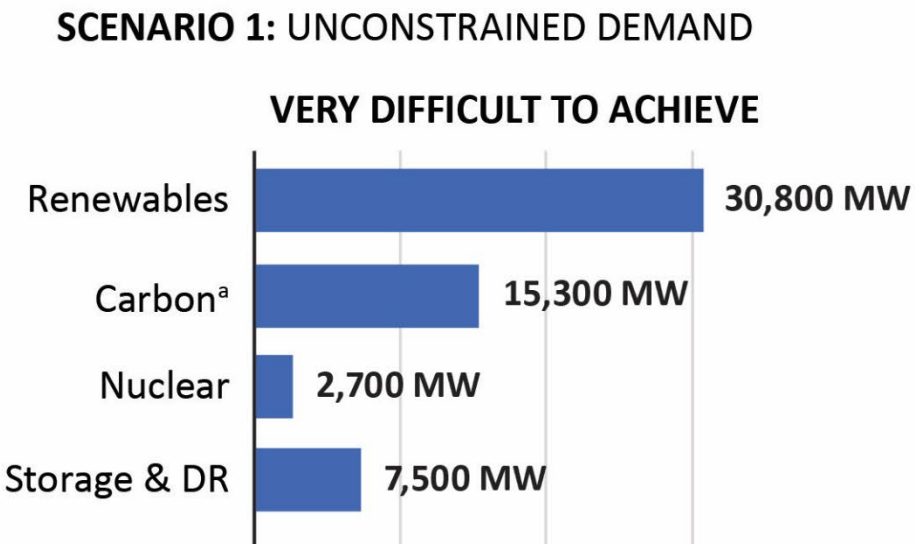
	Change from 2025 to 2040	
	Scenario 1: Unconstrained demand	Scenario 2: Half unconstrained demand
Generation (in-state)	+150%	+90%
Transmission (Interzonal)*	+40%	+35%
Imported energy (net)	+150%	+55%

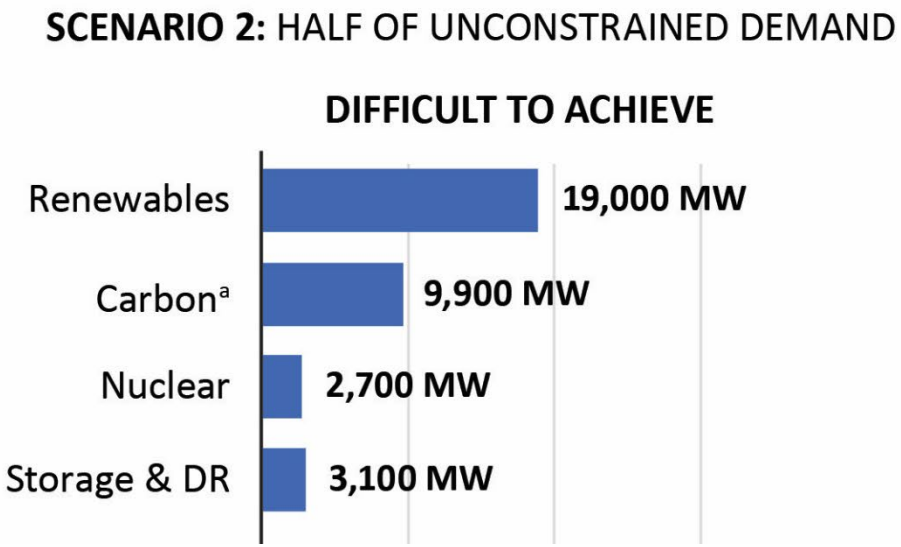
Scenarios shown assume that Virginia Clean Economy Act (VCEA) renewable requirements are met.
*Transmission capacity is only interzonal lines to and from the Dominion transmission zone, where most data centers are located and most growth is expected to occur.

Building enough infrastructure to meet growing data center demand will be difficult

- Scenario 1: Unconstrained demand very difficult to achieve
  - Solar added each year at 2x rate added in 2024
  - Large natural gas plant added almost every 1.5 years
  - Wind capacity exceeding all secured offshore capabilities
  - New nuclear plants using technologies not yet proven viable
- Scenario 2: Half of constrained demand difficult to achieve
  - Less new solar and natural gas, similar wind and nuclear
- Both scenarios would require many new transmission lines, especially in and around Northern Virginia, and could require new gas pipeline capacity

Breakdown of generation capacity that would need to be added (2025 to 2040)





Scenarios shown assume that Virginia Clean Economy Act (VCEA) renewable requirements are met.
[a] Carbon generation is from natural gas baseload and peaker plants. However, starting in 2045 (not shown), grid model assumes natural gas plants would be converted to hydrogen fuel.

Finding

Demand growth raises concerns about system capacity and reliability, but existing utility requirements and processes limit risks.

Demand growth raises grid reliability concerns, and utilities are responsible for ensuring reliability

- Unprecedented pace of energy demand growth raises concerns
  - Availability of sufficient generation capacity
  - Ability of transmission system to reliably deliver power
- Utilities have obligation to serve new data center customers, but **foremost responsibility is to ensure grid reliability**
- Regulated by federal agency and international standards

The Federal Energy Regulatory Commission (FERC) oversees the nation's electrical grid.
The North American Electrical Reliability Corporation (NERC) sets reliability standards for the grid.

Regulatory requirements and planning reduce reliability risks from growing energy demand

- **Transmission** reliability concerns appear to be effectively addressed through existing planning processes
- **Generation** capacity concerns partially addressed through existing requirements, but some risk remains
  - Addition of new generation to regional grid not centrally planned
  - Demand could increase faster than new generation is added, regional *reserve* capacity projected to be insufficient by 2030
  - Issue must be addressed at federal & regional level
- Delaying addition of new data centers, as needed, would address risks

Recommendation

The General Assembly may wish to consider clarifying that electric utilities have the authority to delay, but not deny, service to customers when the addition of customer load cannot be supported by the transmission system or available generation capacity.

Finding

State could encourage or require data centers to take actions to help address their energy impacts, but actions would have small effect on demand.

Data centers could take actions to help address energy impacts

- Data centers could invest more in renewable and other energy generation to help meet generation needs
  - Would not lower energy demand
  - Unclear if on-site generation would substantially reduce need for new grid infrastructure
- Participation in demand response programs could offset some energy demand and reduce infrastructure needs
- Improving data center efficiency (e.g., PUE) makes better use of energy but has marginal impact on total energy use

PUE = Power Usage Effectiveness ratio, which measures efficiency of cooling and other building systems, but not computing activity that makes up most data center energy use

Recommendation

The General Assembly may wish to consider expanding Virginia's statutory Accelerated Renewable Buyers program, which effectively encourages large utility customers to invest in solar and wind projects, to include battery storage.

The General Assembly may wish to consider requiring utilities to establish demand response programs for large data center customers and requiring that these customers participate in those programs.

Policy option

The General Assembly could consider requiring that, as a condition of receiving the sales tax exemption, data center companies meet and certify to an energy management standard.

Virginia's sales tax exemption for data centers is discussed in more detail in the last section of this presentation.

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Using Data Center Exemption to Address Policy Concerns

Finding

Data centers are currently paying full cost of service, but growing energy demand is likely to increase costs for other customers.

Data centers are currently paying full cost of service

- Independent review of utility rate structures and cost allocations found costs incurred by data centers are currently being fully recovered from them
- **Generation and transmission** costs are either passed through to individual data center customers or allocated to customer classes that largely consist of data centers
- **Distribution** costs are directly charged to data center customers or collected through contractually obligated minimum payments

Review of current rates focused on three utilities that currently have large data centers: Dominion Energy, Mecklenburg Electric Cooperative (MEC), and Northern Virginia Electric Cooperative (NOVEC)

Growing data center energy demand is likely to increase costs, including for other customers

- Generation and transmission costs could increase $10B to $18B by 2040, mostly because of data center demand
- Portion of “fixed costs” associated with new infrastructure would be billed to non-data center customers
- It would be difficult to provide enough energy supply to keep pace with growing demand, so energy prices would increase for all customers
- Utilities would need to import more power and could be more susceptible to spikes in energy market prices

Cost increases are for the unconstrained and half of unconstrained demand scenarios, assuming that Virginia Clean Economy Act (VCEA) renewable requirements are met.

Example: projected increase in generation and transmission charges for residential customer

Typical monthly residential generation and transmission charges (Dominion Energy)

	2023	2030	2040
Scenario 1: Unconstrained demand	$90	+$23	+$37
Scenario 2: Half unconstrained demand	$90	+$7	+$14

Typical monthly residential charges are the sum of the amount billed to Dominion Energy residential customers assuming typical use of 1,000 kWh. Dominion Energy is Virginia's largest electric utility and is responsible for providing generation and transmission to much of the state, including areas where most of the state's data center industry is concentrated. Charges shown assume that Virginia Clean Economy Act (VCEA) renewable requirements are met. Constant 2024 dollars.

Utilities, under SCC regulation, could help insulate customers from systemwide cost increases

- Utility rates not designed to account for rapid cost increases to serve a small number of very large customers
- Utilities could help insulate non-data center customers by
  - Creating a separate data center customer class
  - Adopting new cost allocation methods
  - Adjusting rates more frequently
- Utility cost allocation and rate design are highly technical; practicality & legality of changes require detailed analysis
- SCC is in best position to address and has scheduled a technical conference on cost concerns for December 2024

SCC = Virginia State Corporation Commission, which regulates state electric utilities

Finding

Data center growth creates additional financial risks to utilities and their customers.

Data center growth creates additional financial risks to utilities due to sheer size of energy use

- Data center demand could drive infrastructure to be overbuilt, stranding costs with existing customers
- Data centers pose particular risks to electric co-ops
  - Could account for 80 percent or more of energy sales for some co-ops by 2030
  - Delayed or disputed payments from a single large customer could create substantial financial liabilities
- Data center company participation in retail choice program could shift generation costs to other customers

Electric cooperatives (co-ops) are not-for-profit electric utilities.
Retail choice is a statutorily established program that allows large electric customers to purchase energy through third-parties instead of their incumbent utility.

Recommendation

The General Assembly may wish to consider directing Dominion Energy to develop a plan for addressing the risk of generation and transmission infrastructure costs being stranded with existing customers and file it with the SCC.

Dominion Energy is Virginia's largest electric utility and is responsible for providing generation and transmission to much of the state, including areas where most of the state's data center industry is concentrated.

Policy options

The General Assembly could consider amending the Code of Virginia to allow electric cooperatives to create for-profit subsidiary companies to provide energy services to customers with load capacity of over 90 MW.

The General Assembly could consider amending the Code of Virginia to require that electric utilities establish caps on participation in retail choice, and that such caps be approved by the SCC.

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Using Data Center Exemption to Address Policy Concerns

Study examined data center industry impacts on natural and historic resources

- Impacts examined include
  - **Air emissions from backup generators**
  - **Water use**
  - Water quality
  - Land conservation
  - Electronic waste
  - Historic resource preservation
- Regulations are in place to help protect these resources

Water quality (stormwater runoff, protection of streams and wetlands, wastewater discharge), land conservation, electronic waste disposal, and historic resource preservation are discussed in the full JLARC report but are not included in this presentation.

Finding

Data center backup generators emit pollutants, but their use is minimal, and existing regulations largely curb adverse impacts.

Data centers rely on large number of diesel generators for backup power (average 54 per site)

- Emit several harmful air pollutants, such as nitrogen oxides, carbon monoxide, and particulate matter
- Regulated by DEQ using state and national standards
  - All backup generators permitted and monitored by DEQ
  - Limits use and allowable emissions to protect air quality
- Backup generators rarely run for prolonged periods
  - Routine maintenance (10-30 minutes per month)
  - Few actual power outages (operators reported 0 to 2 outages at their facilities in last two years, lasting from 1 to 5 hours)

DEQ = Virginia Department of Environmental Quality

Backup generator emissions unlikely to harm regional air quality; localized effects under study

- Backup generators <4% of regional nitrogen oxides emissions and 0.1% of carbon monoxide and particulate matter
  - Emissions only 7 percent of what permits allowed (2023)
  - Regional air quality has improved while industry has grown
- A “worst-case” prolonged, large-scale *regional* outage could contribute to temporary air quality issues
  - Such outages are rare, and air quality would return to normal after the event
- To identify any *localized* concerns, DEQ launched study to monitor data center generator emissions in Northern Virginia

Policy option

The General Assembly could consider requiring that, as a condition of receiving the sales tax exemption, all new data center developments in the Northern Virginia Ozone Nonattainment Area use only Tier 4 generators, Tier 2 generators with selective catalytic reduction systems, or generators with equivalent or lower emission rates.

Virginia's sales tax exemption for data centers is discussed in more detail in the last section of this presentation.

Finding

Data center water use is currently sustainable, and state ensures future sustainability through regulation.

Most data centers use the same amount of water (or less) as an average large office building

- Most data centers (83 percent) used the same amount of water as, or less than, an average large office building (2023)
- Water use varies depending on cooling system
- Data center water use accounted for
  - 2% to 21% of total water use at six water utilities
  - <0.5% of total state withdrawals

State regulates sustainability of water withdrawals, but some localities should consider local impacts

- DEQ regulates water withdrawals and requires permits for large scale withdrawals (surface, groundwater)
  - DEQ models withdrawal impacts on water availability, flora, and fauna when permits are issued and renewed
- Virginia is relatively water rich, but some localities have limited water resources (e.g., lack direct access to surface waters or are in groundwater management areas)
- Localities should consider whether data center projects could affect ability to meet future residential demand or pursue other development opportunities

Recommendation

The General Assembly may wish to consider expressly authorizing local governments to (i) require proposed data center developments to submit water use estimates and (ii) consider water use when making rezoning and special use permit decisions related to data center development

Policy option

The General Assembly could consider requiring that, as a condition of receiving the sales tax exemption, data center companies meet and certify to an environmental management standard.

Virginia's sales tax exemption for data centers is discussed in more detail in the last section of this presentation.

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Using Data Center Exemption to Address Policy Concerns

Local governments are responsible for managing land development in their jurisdictions

- Establish zoning ordinances for residential, commercial, and industrial development
- Approve development projects and exceptions or changes to zoning
  - By-right (staff)
  - Special permit (elected officials)
  - Rezoning (elected officials)

Finding

Growing number of data centers are being built close to residential areas, impacting nearby residents, and some localities have taken steps to minimize impacts.

Data centers are industrial facilities that are largely incompatible with residential uses

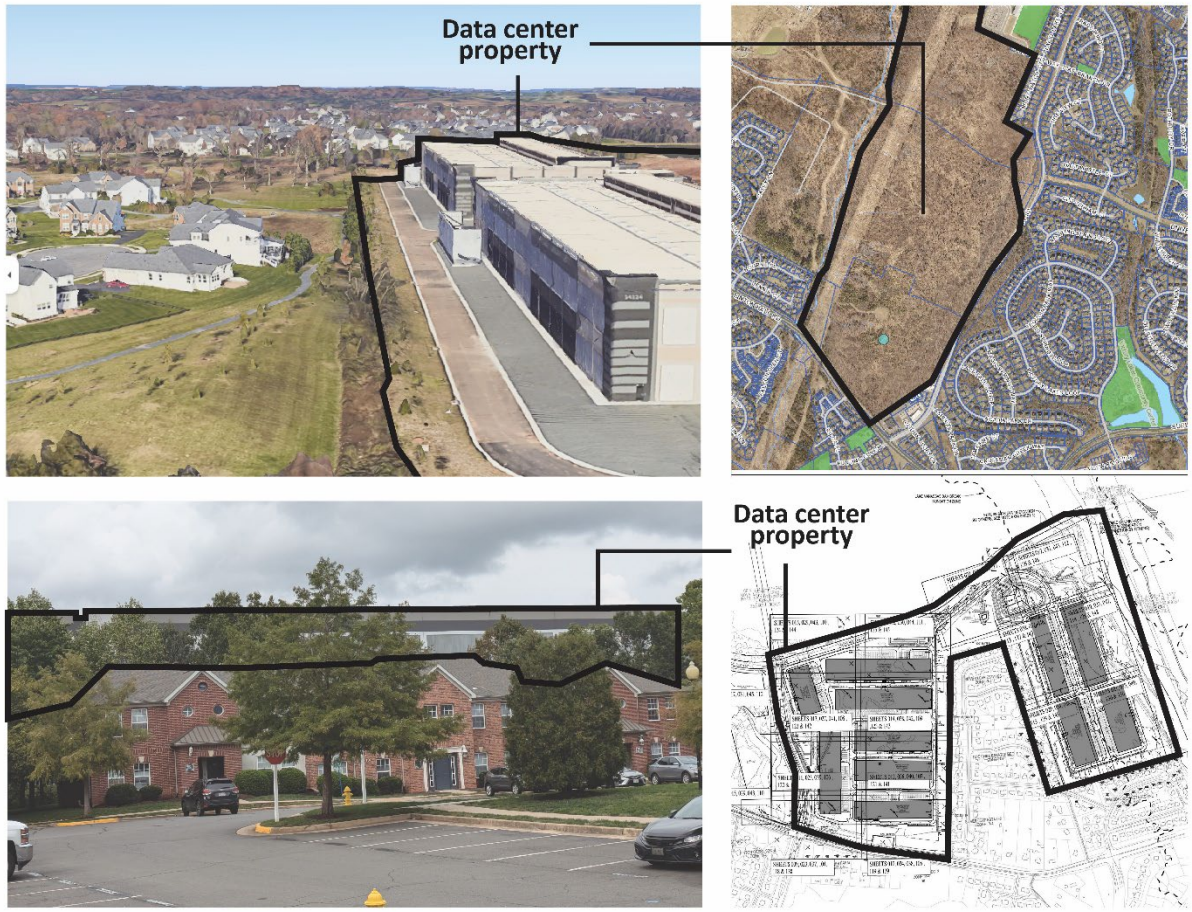
Generators

Cooling equipment

Electric substation

Transmission line

One-third of data centers are near residential areas, and industry trends make future impacts more likely



Some localities have allowed data centers near neighborhoods but are now taking steps to minimize future impacts

- Some localities have allowed data centers next to residential areas because of
  - Inadequate planning and zoning
  - Elected officials changing or granting exceptions to zoning requirements designed to reduce residential impacts
- Several Virginia localities have made or are considering zoning ordinance changes to reduce risk of residential impacts
- Effectiveness ultimately depends on elected officials

Localities should implement several practices to minimize residential impacts

- Classify data centers as industrial use
- Revise zoning maps to prevent by-right data centers next to residential
- Ensure sufficient minimum requirements for data center developments are sufficient (setbacks, building heights)
- Designate optimal locations for data center development (away from residential, close to transmission)
- Require pre-development sound modeling and revise ordinances to better prevent and address noise conflicts

Finding

In a few cases, noise from data centers has negatively affected nearby residents, and noise impacts can be difficult to resolve.

Noise has been an issue for a minority of data centers but can negatively affect nearby residents

- Only some data centers audible past property line, and noise has only been a problem when close to residential
  - Noise is typically a low-frequency “drone” or “hum” and is not loud enough to damage hearing
- In a few cases, noise has been significant enough to affect well-being of nearby residents
- Resolution has been difficult because noise ordinances are ineffective at addressing complaints
- Localities can take steps to mitigate data center noise, but some are unsure of their authority to do so

Recommendation

The General Assembly may wish to consider expressly authorizing local governments to require sound modeling studies for data center projects prior to approval.

The General Assembly may wish to consider authorizing local governments to establish and enforce maximum allowable sound levels for data center facilities, including (i) using alternative low frequency noise metrics and (ii) setting noise rules and enforcement mechanisms in their zoning ordinances, separate from existing noise ordinances.

Policy option

The General Assembly could consider requiring that, as a condition of receiving the sales tax exemption, data center companies conduct a sound modeling study prior to the development of a proposed data center that is to be located within a certain distance of a residential area.

Virginia's sales tax exemption for data centers is discussed in more detail in the last section of this presentation.

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Using Data Center Exemption to Address Policy Concerns

Since 2010, Virginia has offered a sales tax exemption to attract large-scale data centers

- Qualifying data centers and tenants can purchase computers and other equipment without paying sales tax
- Exemption considered valuable by the industry
  - Provided $928.6M savings in FY23 (by far Virginia's largest economic development incentive)
  - Used by 90% of industry (as measured in MW of power)
  - Industry indicates exemption is a key factor in location and expansion decisions
- Main policy lever state has for addressing concerns about data center industry

Findings

Exemption could be (1) extended to maintain data center growth and economic benefits, (2) allowed to expire to slow growth and reduce energy impacts, or (3) modified to balance these priorities.

Policy Options

General Assembly could change data center sales tax exemption in one of the following ways

- **Maintain industry growth and economic benefits** by extending exemption expiration date from 2035 to 2050
- **Slow industry growth and reduce future energy impacts** by allowing exemption to expire in 2035 (current statutory date)
- **Balance competing priorities** by extending a *partial* exemption from 2035 to 2050

Note: If a change is made, the General Assembly would need to determine how to treat the large subset of data centers that qualify for the special 2040 or 2050 extension. Extension currently pertains only to Amazon Web Services, but other companies may be interested in qualifying.

Findings

Exemption could be changed to address policy concerns related to energy efficiency, natural and historic resources, and local residential impacts, but changes could make the exemption a less effective economic development tool.

Policy Options

General Assembly could make eligibility for data center tax exemption contingent upon one or more of the following:

- Adopting energy and/or environmental management standards (*all* data centers)
- Using lower emission generators (*new* data centers in Northern Virginia)
- Conducting Phase 1 historic resource and viewshed studies (*new* data centers)
- Conducting sound modeling studies to identify potential noise issues (*new* data centers)

SCR = Selective Catalytic Reduction system

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Consulting support provided for this report

Energy + Environmental Economics -- grid modeling and rate analysis

Weldon Cooper Center for Public Service -- energy demand modeling and economic impact analysis