Mitigating Data Center-Driven Energy Demand Growth in Virginia

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For the **Virginia Conservation Network**

Virginia Conservation Network

University of Virginia | Frank Batten School of Leadership and Public Policy

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Abbreviations

C-PACE – Commercial Property Assisted Clean Energy
D.C. – Data Center
DCRSUT – Data Center Retail Sales & Use Tax Exemption
EUI – Energy Use Intensity
GWh – Gigawatt Hours
I.T. – Information Technology
kBtu/ft^2 – kilo-British Thermal Units per Square-Foot
MW – Megawatts
NPV – Net Present Value
O.C. – Opportunity Cost
PUE – Power Usage Effectiveness
U.S. – United States
V.A. – Virginia
VCN – Virginia Conservation Network

Executive Summary

This report assesses the policy options available to the Virginia Conservation Network (VCN) to address the rapidly growing energy demands of data centers in the Commonwealth. Data centers currently account for 20% of Virginia's electricity usage, and projections indicate their energy demands could increase by 100% or more by 2050, threatening the state's ability to meet its goal of achieving a 100% carbon-free electricity grid by that time.

The report examines three policy alternatives: 1) Mandatory energy benchmarking and reporting requirements, 2) Tying tax incentives for data centers to strict energy efficiency standards, and 3) Establishing a tradable permit system to cap data centers' total energy use. Each option is evaluated based on cost, effectiveness, administrative feasibility, and political feasibility.

The analysis concludes that the energy benchmarking approach (Alternative 1) represents the most viable and promising policy path forward. While not as directly impactful as a hard cap on energy use, benchmarking would provide critical data to inform future policymaking, raise public awareness, and leverage market forces to drive efficiency improvements. Importantly, this alternative also scores the highest in terms of administrative and political feasibility.

To implement the energy benchmarking recommendation, the report outlines a five-part strategy for VCN:

(1) Leverage the growing national attention on data center energy use to raise awareness in Virginia.
(2) Work with state legislators to introduce a benchmarking bill in the 2025 legislative session.
(3) Facilitate collaboration between state agencies, data center operators, and energy efficiency financing programs.
(4) Maintain a public spotlight on data centers' energy consumption and implications for Virginia.
(5) Engage with global IT brands to encourage voluntary action on improving energy efficiency and shifting to renewable energy.

By pursuing this multifaceted approach, VCN can position Virginia to obtain the critical data needed to guide future policymaking while also motivating the data center industry to take proactive steps to reduce its environmental footprint. This represents a pragmatic first step towards addressing a challenge that threatens the Commonwealth's clean energy transition.

Disclaimer

The author conducted this study as part of the program of professional education at the Frank Batten School of Leadership and Public Policy, University of Virginia. This paper is submitted in partial fulfillment of the course requirements for the Master of Public Policy degree. The judgments and conclusions are solely those of the author, and are not necessarily endorsed by the Batten School, by the University of Virginia, or by any other agency.

University of Virginia Honor Pledge

On my honor as a student, I have neither given nor received unauthorized aid on this assignment/examination.

Signed,

Nicholas D. Ruszkowski

Acknowledgments

Thank you to my faculty advisors for your guidance, encouragement, and support: to Professor Pennock for encouraging me to seek out and embrace 'intelligent confusion;' to Professor Myung for pushing me to dig deeply into the evidence, even when the answers were not immediately accessible.

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Thank you to all my Batten MPP 2024 cohorts for inspiring me to be curious and resilient throughout this process. Thanks especially to my friends, the *'Clemrades,'* Abby Cornwell, Anna Heetderks, and Elizabeth Link for tackling this project with me – you all are going to do big things.

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Introduction

Virginia has become a hub of rapid development for the growing data center industry in the United States. The industry uses an unprecedented amount of electricity around the clock and throughout the year to power massive computing systems for remote data storage and processing. As a result, Virginia's peak electricity demand is expected to nearly double within the next 25 years, making it impossible for the state to transition to fully zero-carbon energy as it committed to in the 2020 Virginia Clean Economy Act (PEC 2023). Virginia must act now to regulate data center energy use.

This report will explain the current policy environment, the politics of the issue, and thwarted attempts to pass regulations. It will discuss the root causes of the problem, map the ecosystem of vested interests, and provide an overview of existing literature and innovative international policies intended to address this novel issue. It will then analyze three potential alternatives to reel in data centers' energy demand and layout a plan for implementation.

Problem statement

By 2050, Virginia's data center industry will add 23,641 - 77,336GWh of annual electricity demand, accounting for 20-45% of the state's total electricity consumption, which is projected to nearly double from current rates (Shobe et al., 2021). This overconsumption by a single industry undermines Virginia's commitment to establishing an emissions-free economy by 2050 (The Virginia Clean Economy Act, 2020).

Figure 1: A Data Center and Energy Transmission Lines

Client Overview

The Virginia Conservation Network (VCN) is a coalition of over 160 partner organizations composed of the major conservation groups and researchers working in the Commonwealth. Partners include state chapters of national organizations such as the Sierra Club, Environmental Defense Fund, and EarthJustice, as well as state and local organizations such as the Chesapeake Bay Foundation. The Network's mission is to build "a powerful, diverse, and highly coordinated conservation movement focused on protecting our Commonwealth's natural resources today and for tomorrow."

VCN and its member organizations are interested in recommending policies to address data center-driven energy demand growth. In its 2024 Common Agenda, representing the policy agenda of its more than 160 member organizations across the Commonwealth, VCN endorsed three policy proposals:

1. Contract with an independent body like the National Academy of Sciences to study all costs and benefits of the data center industry.
2. Enable the Virginia Department of Energy and Department of Environmental Quality to assist local governments and implement a state review process for new development proposals.
3. Examine and consider changing the rules governing approval and allocation of costs for new transmission and energy generation infrastructure "to ensure that parties causing investments bear the costs of those investments [and] preventing residential energy customers from shouldering this burden."

The purpose of this report is to expand on these proposals.

Background

Information technology (IT) companies have identified Northern Virginia as a prime location for data centers, facilities that house massive computing hardware systems that store and process remote data (Kidd, 2023). Northern Virginia's low energy prices, affordable land, favorable regulatory environment, and robust existing fiber cable network earned it the nickname, 'Data Center Alley' (Kidd, 2023). Data centers have spread across the state, but due in part to the connectivity benefits of locating close together, 166 of Virginia's 186 data centers were concentrated in Loudoun, Fairfax, Prince William, and Fauquier counties as of 2019 (Baxtel, n.d.).

Governing Magazine reported that Loudoun County gains nearly $600 million in tax revenue annually from data centers (Kidd, 2023). The Northern Virginia Technology Council estimates that the area's data centers were responsible for nearly $174 million in state revenue and $1 billion in local tax revenue in 2021 (Kidd, 2023).

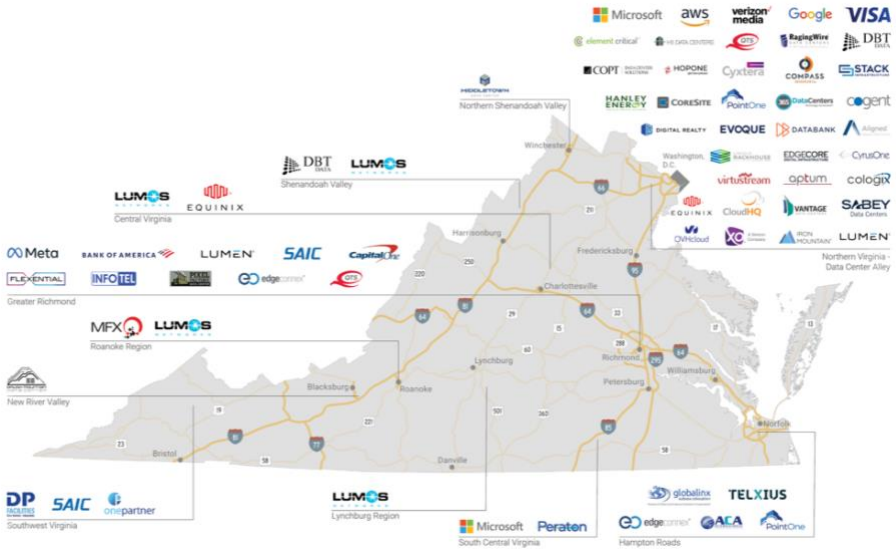


Figure 2: Virginia Data Centers by Owner (Burnette, n.d.)

Current Policy Environment

Local governments currently have unilateral authority over the development of new data centers. The state has taken no action to account for the growing strain on electrical, water, and land resources.

Virginia Clean Economy Act (VCEA) of 2020, which was intended to guide the state's transition to a carbon-free energy market by 2050, failed to foresee the explosive growth in energy demand driven by data centers according to Professor Bill Shobe, director of the Virginia Clean Energy Project and the Center for Economic and Policy Studies at the University of Virginia's Weldon Cooper Center for Public Service. Shobe suggested Dominion Energy, the utility monopoly serving most of Virginia, is planning to continue using fossil fuels even after the $50 per megawatt-hour deficiency credit, included in the VCEA to disincentivize non-renewable fuel sources, sets in. Shobe explained that energy demand is very inelastic, allowing utilities to pass off the fees to consumers.

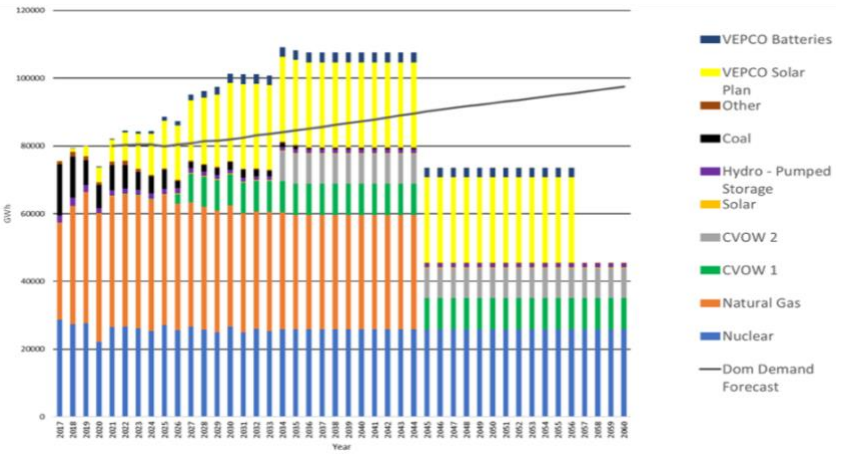


Figure 3: Dominion's Projected Customer Demand Compared to Generation Profile (Office of the Governor, 2022)

According to Professor Shobe, Virginia used to import energy via PJM Interconnection, the privately operated regional transmission organization it shares with 11 other states. Dominion transitioned to importing natural gas in recent decades, which it could use to produce energy at facilities in the state, thereby increasing revenue. Today, 57% of Virginia's energy is sourced from natural gas (*Dominion Energy 2023 Integrated Resource Plan*, 2023).

The State Corporations Commission, which approves utility rates and investment in new energy infrastructure (transmission lines and production plants), could reduce approval of coal and natural gas-powered plants, but without zero-carbon energy sources to fill in the capacity, this would lead to an energy shortage.

Professor Shobe also raised the concern that, if Virginia limits data center growth here, IT companies may move their investments to other states with cheap energy and looser emissions regulations, such as West Virginia. He explained that the environmental impact would be worse with data centers developing in states that are not committed to limiting emissions.

Data centers already account for 20% of Virginia's energy demand (Kidd, 2023). Dominion Energy, the state-regulated utility monopoly that serves most of Virginia, and PJM, the regional transmission organization (RTO) that coordinates the interstate movement of wholesale electricity, project data centers could drive Virginia's total energy demand up nearly 100% by 2050 (*Dominion Energy Integrated Resource Plan*, 2023). Meanwhile, all other sectors will only grow by 2.5% (Shobe, 2021). Without intervention, data center energy demand growth will likely undermine the state's commitment to sourcing all its electricity from zero-carbon energy resources, outlined in the Virginia Clean Economy Act of 2020 (The Virginia Clean Economy Act, 2020).

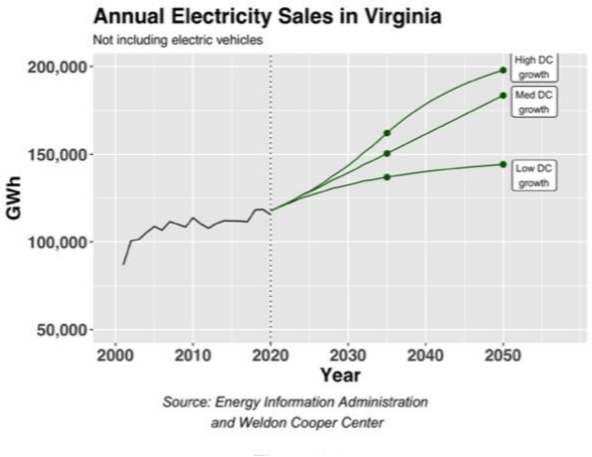


Figure 4 (Shobe, 2021)

Virginia's energy utilities must supply all energy requests within their regions. If data centers' energy usage goes unchecked, and the state's energy demand continues to grow as a result, Dominion will need to keep natural gas and coal-powered energy production facilities online. Even as it expands its investment in low-cost, zero-carbon energy sources such as wind, solar, and small modular nuclear reactors, the state would fail to divest from fossil fuel and would continue emitting greenhouse gasses at equivalent or increased levels to the present (*Dominion Energy Integrated Resource Plan*, 2023).

Politics of the Problem

Ivy Main, a lawyer, journalist, and data center policy advocate associated with the Sierra Club and National Beyond Coal Campaign, described a 'lag time' between technology changes (including improvements in zero-carbon energy and the growth of data centers) and public opinion. According to Main, many people still believe coal, one of the most expensive energy sources, is the cheapest. Main acknowledges that politics also plays a role: there is resistance to understanding the benefits of investing in renewables – some of which is influenced by private interests.

Main said political leaders and the public also are slow to understand the dangers of data centers. They do not perceive the imbalance of costs and benefits. The state and localities are drawn to the tax revenue data centers offer, but neither has fully considered the costs of undermining the ongoing clean energy transition or the increased costs to all Virginian electricity rate-payers due to a surge in demand. There seems to be a 'build first, assess impact later' mentality among data center advocates.

In 2023, Virginia's Republican Governor Glenn Younkin organized a $35 billion deal with Amazon Web Services to establish several new campuses and advance statewide industry expansion (Kidd, 2023). Main said the Governor was motivated by the construction jobs the development would create in addition to the tax revenue. According to Main, the Governor apparently did not care to consider how this development would affect Virginia's long-term energy goals. Even some environmentally conscious, Democrats signed onto the Amazon deal, though they are starting to "catch on that it was not fully thought through," Main explained.

Previous Attempts at Regulation

In 2023, State Senator Chap Petersen introduced two resolutions to study and constrain the growth of data centers in Virginia, SB 1078 and SJ 240. According to Sen. Petersen, data centers, on balance, 'do not add much to the economy.' Counties look to them as an economic savior, but they provide only short-term benefits that 'run dry' as their taxable value depreciates and negligible long-term job growth. The Senate unanimously passed Sen. Petersen's proposed resolutions, but the House of Delegates let them die in committee.

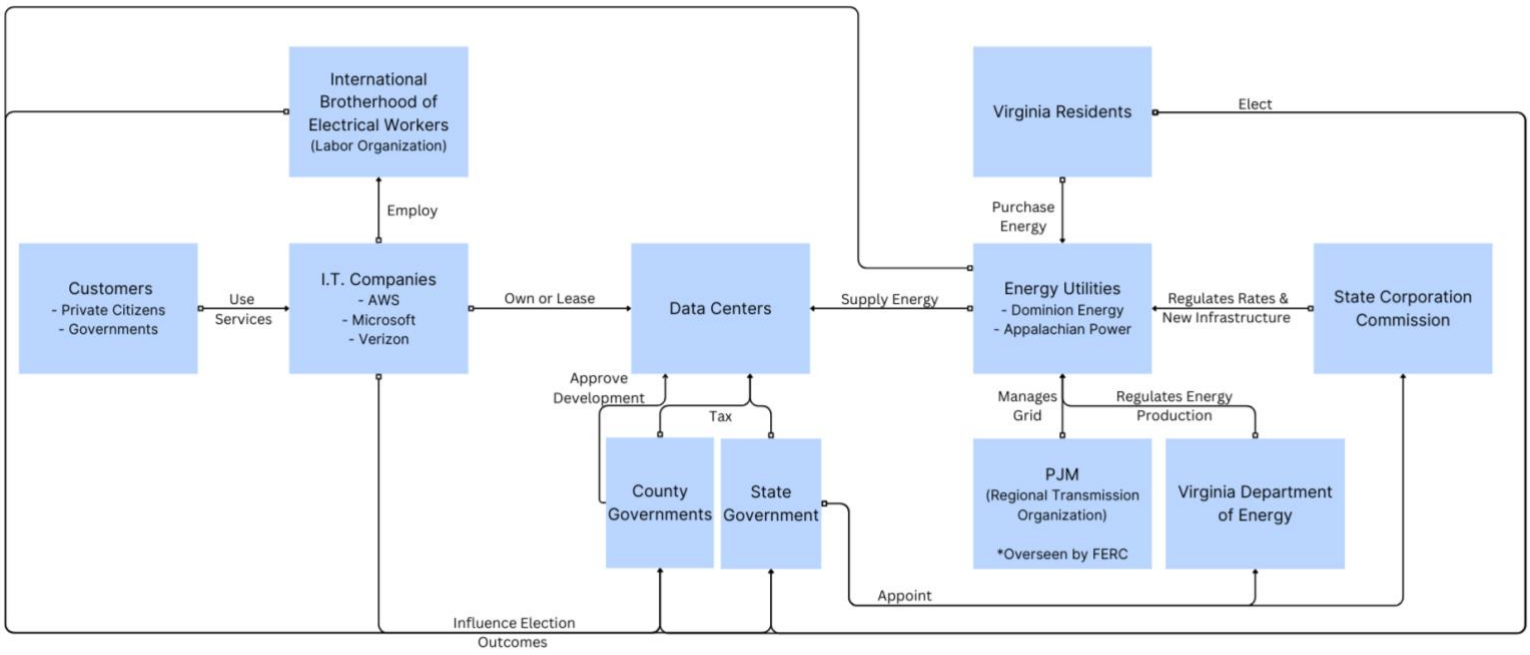
The policies Sen. Petersen proposed included expanded restrictions on where data centers could develop and a resolution to study the environmental and economic effects of unrestricted growth. Sen. Petersen noted that currently, there is no strategy to address the unprecedented development. The state government does not know how much energy the state-regulated monopolies will ultimately need to supply.

In proposing data center regulatory bills, Sen. Petersen recalled going up against the State Chamber of Commerce, local governments, organized labor (including the International

Brotherhood of Electrical Workers), and the Younkin administration, who, at the time, was motivated to settle the deal with Amazon. Petersen recalled encountering some county supervisors who supported regulations to protect their valuable land and water resources, but according to Sen. Petersen, the opposing stakeholders were pursuing the short-term economic gains of expanding the industry.

After Sen. Petersen proposed the two bills, he faced an electoral primary challenge backed by stakeholders who opposed the new regulations, including organized labor groups and the data center industry. He blamed a lack of support from conservation networks groups for his loss to a candidate that is more aligned with the data center industry.

Ecosystems Map (Figure 5)



A key takeaway from this map is that there is no organization directly overseeing the development and operation of data centers. The state has not granted either of the three regulatory bodies (the Regional Transmission Organization [PJM], the Virginia Department of Energy, or the State Corporation Commission) the authority to control or study the impacts of the growing industry.

Of the stakeholders that directly interact with data centers, the public institutions (state and local governments), private organizations (I.T. companies, labor organizations), and state-regulated monopolies (electrical utilities), all profit from data centers. Virginia residents must bear the external costs of the industry in the form of depleting water and land resources, increased electricity prices, and increased energy-related emissions.

Review of Existing Literature

Data-center-driven energy demand growth has become an issue of concern around the world. The Department of Energy/Berkeley Lab Center of Expertise for Energy Efficiency in Data Centers (CoE) published the *Data Center Energy Assessment Process Manual (Version 2.0)* in 2020. In the manual, the CoE explains that the data center electricity use grew rapidly from 2000 to 2006 but slowed significantly from 2006 to 2016 with energy efficiency improvements and less server installation (in part due to the 2008 Financial Crisis). According to the Center of Expertise, "the total energy savings potential in data centers is still large" (Herrlin & Traber, 2020). Researchers have published significant literature on techniques for increasing data centers' energy efficiency.

Two Methods for Measuring Data Center Energy Efficiency

Power Usage Effectiveness (PUE)

In 2007, The Green Grid, a non-profit organization of information technology researchers developed the Power Usage Effectiveness (PUE) metric, which it defined as the ratio of total 'facilities energy usage' to 'IT equipment energy usage' (Avelar et al., n.d.).
'IT equipment energy' is the energy dedicated to equipment that is used to manage, process, store, or route data (Avelar et al., n.d.). It includes supplemental equipment such as monitors and workstations used to control the data center. 'Total facility energy' is defined as all the energy that is solely used by the data center and includes IT equipment and all supportive equipment, such as cooling system components, lighting, and power delivery components (Avelar et al., n.d.).

According to the Green Grid's description of the metric, PUE helps with identifying opportunities to improve a data center's operational efficiency, allows researchers to compare data centers' relative efficiency scores, and could be a tool for design targets or efficiency standards for new data centers (Avelar et al., n.d.).

Data Center Performance per Energy (DPPE)

The Japanese Green IT Promotion Council created Datacenter Performance per Energy (DPPE) as a new data center efficiency metric. DPPE is a function of 'IT Equipment Energy Efficiency,' 'IT Equipment Utilization,' Power Usage Effectiveness (PUE), and a 'Green Energy Coefficient' (*Introduction of Datacenter Performance per Energy [DPPE]*, 2010).

DPPE = (IT Equipment Utilization × IT Equipment Energy Efficiency) /
(Power Usage Effectiveness – Green Energy Coefficient)

They described the purpose of the metric as factoring equipment efficiency and zero-carbon energy use into the evaluation of data center efficiency (*Introduction of Datacenter Performance per Energy [DPPE]*, 2010).

Two Approaches to Increasing Data Center Efficiency

In 2016, Rong et al. described approaches to increasing data center efficiency. Rong et al. concluded that these strategies should be integrated into data center design and operation to achieve "the maximum benefits of data centers and the minimum environmental impact" (Rong et al., 2016).

High-Performance Computing (HPC)

High-Performance Computing is a branch of computer engineering that studies alternative hardware architecture and computing systems to maximize efficiency (Rong et al., 2016). Rong et al. (2016) reviewed six HPC methods to increase data center energy efficiency and found effects ranging from 15-70% power savings across methods. Rong et al. (2016) noted that some of these techniques also created significant cost savings.

Before the recent proliferation of AI and large data analytics, most private IT firms did not need High-Performance Computing systems (Rong et al., 2016). Currently, most of Virginia's data centers are classified as 'Enterprise scale' or 'Hyperscale.' Hyperscale data centers support massive amounts of data that require continuous, uninterrupted operation, and network redundancy (*Hyperscale Data Centers*, n.d.).

As processing demand grows, High-Performance Computing systems allow IT enterprises to meet their performance needs with greater efficiency. A Corporate Vice President at microchip manufacturer AMD wrote that the efficiency gains brought by High-Performance Computing systems are "vital to enabling enterprises to achieve their data center performance goals, while also meeting business goals such as lowering energy costs and advancing broader corporate sustainability initiatives" (Kuppuswamy, 2023).

Computer-Room Design for Energy Conservation

Cooling systems account for 40-50% of data center energy consumption on average (Meijer, 2010). Researchers have developed systems to increase data center efficiency through strategic cooling techniques, ranging from taking advantage of natural cold air or water to the placement of HVAC ventilation in computer rooms (Rong et al., 2016). Applying best practices for cooling contributes to increased efficiency and reduced costs (Rong et al., 2016).

Policy Case Studies

European Union: Voluntary Agreement

In 2008, the E.U. created the 'Data Center Code of Conduct' (CoC), a voluntary initiative aimed at limiting the increase in data center energy overconsumption by informing data center operators on how to cost effectively increase energy efficiency (Brocklehurst, 2022). It is managed by the European Commission's scientific research service, the Joint Research Center (Brocklehurst, 2022).

Participants in the Data Center CoC reported a small but statistically significant reduction in PUE from 2009 to 2016, which they attributed in large part to the adoption of more efficient cooling technologies. Avgerinou et al. (2017) conclude the program is an example of successful a non-regulatory policy that has stimulated improved efficiency.

China: Efficiency Standards

China implemented national Minimum Energy Performance Standards for data centers in 2021 with a target PUE of 1.25 in the east and 1.2 in the west of the country. Certain cities have set requirement PUE caps for data centers (*Data Centres & Networks*, n.d.). Beyond that, Xu Bin, a deputy director at the National Development and Reform Commission said the country aims to increase the data center industry's green energy usage rate from 20% to about 80% by 2025 (Min & Erchi, 2022).

Virginia could follow China's example by implementing Minimum Energy Performance Standards and renewable energy usage requirements. It is too early to analyze the results from the Chinese policies, but the IEA report argues that PUE is a poor measure of efficiency as it does not reflect overall energy usage, productivity, or resource efficiency (Brocklehurst, 2022). The state could consider using the Japanese Green IT Promotion Council's 'Datacenter Performance per Energy' (DPPE) metric for efficiency as it accounts for clean energy use and equipment efficiency in addition to the standard PUE metric.

U.S. Energy Information Agency: Efficiency Reporting

In 2018, the U.S. Energy Information Agency conducted a pilot energy consumption survey of a random selection of data centers (Brocklehurst, 2022). The Energy Information Agency recorded a response rate of 26% and found that data center operators resisted sharing important information such as square footage, number of workers, number of servers, and power usage effectiveness (Brocklehurst, 2022). The EIA concluded that cooperation from the industry would be required to consider adding data centers to the Commercial Buildings Energy Consumption Survey (Brocklehurst, 2022).

Virginia should consider instituting mandatory reporting requirements for data centers to allow the state to monitor efficiency and statewide energy demand. This would supply the necessary background information for any further data center industry regulations. The IEA maintains that there are many likely benefits to a mandatory requirement for data centers to report energy usage information, including:

- Attracting greater attention to energy usage from data center operators
- Identifying the areas of highest impact to guide future policies
- Empowering governments to track efficiency and compliance with policies
- Driving competition between providers (if the information is public)

Analysis of Alternatives

I will analyze three alternatives using the following criteria: cost, effectiveness, administrative feasibility, and political feasibility.

Evaluative Criteria

Cost

For this analysis, I will quantify the **administrative costs** and **opportunity cost of future growth** for each proposal. Both costs will be weighted equally on a 'low-medium-high' scale. A low cost rating will indicate minimal added expenditures for the state government and low opportunity cost of reduced industry growth in the state. This assessment will not account for economic benefits associated with reduced energy consumption (such as reduced air pollution from fossil-fuel-powered energy generation or reduced energy infrastructure investments) as the second criterion, 'Effectiveness,' captures these benefits.

Effectiveness

I will assess each alternative based on its effectiveness in reducing total energy consumption (GWh/Year) by data centers in Virginia through 2050. In the next three decades, reducing energy consumption growth by data centers will ease Virginia's transition to a decarbonized energy grid, and policymakers should aim to facilitate this through the most cost-efficient means. A highly effective alternative would limit annual data center growth to only that which new clean energy sources can offset. Low effectiveness will reflect no reduction to the current data center energy demand growth projections published by Shobe et al..

Administrative Feasibility

I will estimate the relative administrative feasibility of each alternative on a scale of high, medium, and low based on the staff and expertise requirements to administer each policy (**Complexity**) and whether the policy calls for inter-agency cooperation (**Authority**). For complexity, I will assess each alternative's compatibility with ongoing programs and mandates in the relevant agencies. Because each alternative relies on a well-established tool of government, researchers have compiled keys to success and likely sticking points for implementation. Minimal additional staffing requirements and high ownership by a single agency will indicate high administrative feasibility.

Political Feasibility

I will estimate the political feasibility of each alternative on a scale of high, medium, and low. I will consider the expected support for of each alternative among three important stakeholders: **I.T. companies, the International Brotherhood of Electrical Workers, and the public**. I will predict the likely response from these stakeholders based on their public agendas, previous responses to similar regulation proposals, and the distribution of costs associated with each alternative.

I will employ the 'Wilson Matrix' framework for political feasibility analysis. The Wilson Matrix classifies a policy proposal based on the concentration vs. diffuseness of its supporters and opposition (see Figure 4). A highly feasible policy will avoid facing backlash from organized interest groups and would gain support from a concentrated political coalition.

		Support	
		Concentrated	Diffuse
Opposition	Concentrated	Interest Group Politics	Entrepreneur Politics
	Diffuse	Client Politics	Majoritarian Politics

Figure 4: The Wilson Matrix

Alternative 1: Energy Benchmarking

This alternative proposes instituting mandatory energy usage reporting requirements (referred to as 'energy benchmarking') for data centers and establishing an industry outreach initiative to encourage investments in energy efficiency. All data centers operating in Virginia would have to publicly disclose their energy usage and efficiency through the Energy Star Portfolio Manager program and report the share of electricity they procure from carbon-free energy resources. Virginia could promote efficiency measures (such as high-performance computing systems and computer-room design for energy conservation) through existing publicly backed financing programs.

Cost

Administrative Cost: Low

The proposal would require creating two full-time positions in the Virginia Department of Energy ('Virginia Energy'), Energy Efficiency Team to review and audit energy-use reports. In a program analysis for a similar policy proposal, the Virginia Department of Taxation projected the annual cost of two full-time employees would be $230,000 (Virginia Department of Taxation, 2024). The Energy Star Portfolio Manager tool is free.

Opportunity Cost of Future Growth: Low

This policy would likely not reduce future data center development in Virginia. Data center operators and clients have expressed a growing commitment to reducing their climate impacts through improved efficiency and increasing transparency about energy use (see political feasibility analysis for Alternative 1).

Effectiveness

This alternative scores 'Medium' for effectiveness. There is a mantra in business management that says, "You can't manage what you don't measure." Seven states and 44 localities in the United States have benchmarking requirements for commercial buildings' energy use (Institute for Market Transformation, 2017). Researchers with the Lawrence Berkeley National Laboratory studied benchmarking for data centers. They found that measuring energy use efficiency reveals opportunities for significant cutbacks to energy use and operating costs for data centers (Greenberg et al., 2006).

California started requiring all commercial buildings over 50,000 ft^2 to report energy use and efficiency in 2018, and California's Energy Commission recognizes data centers as a distinct building class. Since the start of the program, California's data centers' median weather-normalized site energy use intensity (kBtu/ft^2) dropped from 733 in 2018 to 616 in 2022 (California Energy Commission, n.d.). This 16% reduction in annual energy consumption appears to have leveled off after the first two years. In response to the policy, the U.S. EPA commented, "Benchmarking the energy use of commercial buildings is a critical first step on the path to superior energy efficiency, and the California Energy Commission is to be commended for identifying existing buildings as a major opportunity to reduce energy consumption and greenhouse gas emissions." (Cook, 2015)

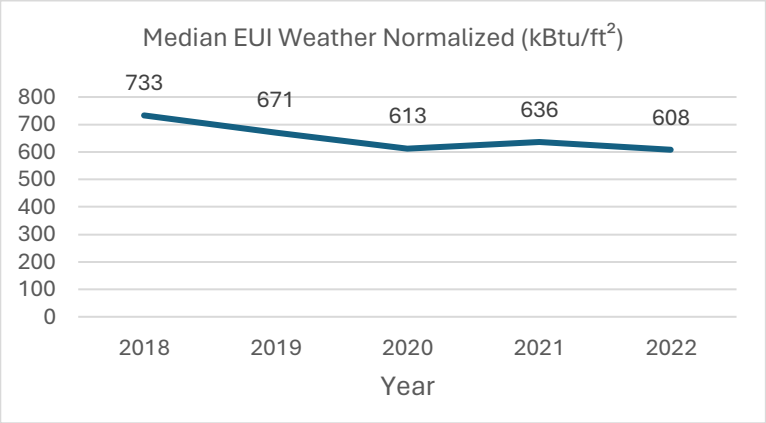


Figure 5: California Data Centers EUI After Benchmarking Requirement (California Energy Commission, n.d.)

New York City also adopted a building efficiency score program using Energy Star Portfolio Manager. The city created a letter grading scale and posts efficiency scores on buildings to improve public accountability for inefficient energy use. The program's success at increasing energy efficiency is debated. In a review of the program for New York Real Estate Magazine, Ginger Zhe Jin, a behavioral economist at the University of Maryland, observed that commercial building tenants are not as likely to consider building efficiency scores compared to restaurant customers, who have more options. "If they observe a D on the door of a restaurant, they probably want to go to the next restaurant where the grade is an A," said Zhe Jin. "Maybe as an individual employee you just don't have a choice of walking in or not walking in to that building." (White, 2021)

Peter Sabesan, a broker at a leading New York real estate firm, said a building's energy grade does not factor into a tenant's decision to rent office space. He told Real Estate Magazine that none of his clients have ever turned down a lease because of a poor efficiency grade. "At the end of the day, it's always about the rent," said Sabesan. "If it's an

equal deal, it's definitely a plus, but if it's not an equal deal, the tenants care about the rental package and the concession package more than the energy efficiency." (White, 2021)

This proposal's effectiveness rests on empowering activists and consumers through increased transparency. By making energy efficiency statistics public, this alternative would increase scrutiny on especially wasteful data centers. Virginians would be better informed about the industry's effects on the energy market, empowering future regulatory efforts. Some of data centers' largest customers, I.T. giants like Meta and Google, are making public commitments to reduce their climate impacts (Korolov, 2022). Thus, this alternative would support the market demand for greater data center efficiency. If Virginia's data centers demonstrate similar efficiency improvements to those observed in California following the establishment of benchmarking requirements, **this alternative could result in the abatement of 16% (46,895 to 165,282 GWh) of data center energy demand growth over the next 25 years.**

Administrative Feasibility

Authority: High

The U.S. Department of Energy recommends that states develop a verification process overseen by trained staff to ensure quality and accuracy of reporting and analysis of energy use data (Korolov, 2022). This process would involve reviewing reports for outliers, comparing the data with national averages and other state records, making periodic site visits, and conducting random sampling of utility meter data. This should be feasible with two new additional full-time staff embedded in the Virginia Energy, Energy Efficiency Team, which currently oversees the state's energy efficiency programs.

Complexity: Low

The Energy Star Portfolio Manager tool is already widely used across the country, including by the Government of Virginia to monitor public facilities. In 2020, Virginia passed 'lead by example' legislation, requiring each state agency head to designate an 'energy manager' who would implement energy efficiency and climate change resiliency improvements for state buildings (Plumer & Popovich, 2024). According to the ACEEE, "State and local governments can advance clean energy technologies and practices in the marketplace by promoting energy efficiency in their own operations." (Shoemaker, 2016) The 2020 energy efficiency policy for public buildings paves the way for future benchmarking programs by building the government's familiarity with the Energy Star Portfolio Manager system and developing the market for energy-efficient technology projects in Virginia.

The burden this policy places on data center operators is relatively low. According to the EPA, nearly a quarter of commercial building space in the United States is already actively benchmarking with Portfolio Manager (Energy Star, n.d.-a). Operators would need to register with Portfolio Manager and report energy use once each year. This information is available on monthly utility bills.

To complement the proposed reporting mandate, Virginia Energy could tap into the state's existing public-private partnerships, including the Virginia PACE Authority and Virginia Energy Efficiency Council, to incentivize and assist data centers in investing in more efficient systems. These organizations work to lower some of the barriers to energy efficiency by providing advice and financing solutions to reduce the upfront cost of energy-efficient upgrades.

Researchers at Bocconi University identified high upfront costs as the primary barrier to implementing energy-efficient systems for commercial buildings (Bagaini et al., 2020). Virginia's Commercial Property Assisted Clean Energy (C-PACE) program offers long-term financing for buildings to make energy efficiency investments, often at fixed rates. The program is backed by Virginia Energy and administered by the non-profit Virginia PACE Authority. By reducing upfront costs and administrative burdens, C-PACE could be instrumental to data center operators looking to make competitive upgrades to their energy efficiency under the proposed reporting requirements (Bagaini et al., 2020).

Bonus: Built-in water efficiency tracking capabilities
An additional benefit of this proposal is that the Energy Star Portfolio Manager can also track water use efficiency (Energy Star, n.d.-b). Data center water overconsumption is also a serious public policy concern (Sakry, 2022). If Virginia takes action to regulate data center water use in the future, this program will enable the state to easily integrate water efficiency reporting.

Political Feasibility

This alternative scores 'High' for political feasibility. This proposal would face 'Client Politics' with support from I.T. companies, the IBEW, and climate advocates. When a proposal faces 'Client Politics,' it has a high likelihood of success.

Organized Labor (Support) – One of the most significant interest groups that have lobbied against regulations on data center development, the International Brotherhood of Electrical Workers, could be brought on board to support this policy to the extent that it would create demand for energy efficacy retrofitting projects on existing data centers and would not limit development as much as other policy proposals.

IT Companies (Support) – Furthermore, hyperscale data center owners, such as Microsoft, Meta, Google, and Amazon Web Services, and more than 40 colocation data center operators have publicly committed to driving down the carbon emissions associated with data center operations (Butler, 2022). In 2016, these giants in the data center market formed the 'Infrastructure Masons' industry group ('iMasons') to collaborate on setting emissions reductions goals (Butler, 2022). In 2022, iMasons adopted the 'iMasons Climate Accord,' an informal agreement to reduce climate impacts of I.T. infrastructure, and their leaders have expressed growing awareness of the need to increase energy efficiency and transparency to meet corporate sustainability goals and protect their public image (iMasons Climate Accord, n.d.).

Joe Kava, the Vice President of Data Centers at Google, said, “We are excited to help create an open standard for reducing the embodied carbon in data centers, and work with equipment manufacturers to improve energy efficiency across the industry.” (Butler, 2022) Christian Belady, Vice President of Data Center Advanced Development at Microsoft, said, "We're delighted to support such a valuable initiative to help bring both measurement and transparency to the data center industry," referring to the group’s plan to establish an independent governing body to promote transparency and establish a standard metric for data center efficiency (Judge, 2022). "Day by day, we see more and more focus within global industry on limiting greenhouse gas emissions,” said iMasons Executive Director Jeff Omelchuck, "the public sentiment is largely swayed to support that and see that as an important element of brand credibility and brand value" (Judge, 2022).

The Public (Support) – The General Assembly failed to adopt a bill in 2022 that would have allowed localities to create benchmarking ordinances. However, public attention around the issue of data center energy use is growing (Boysko, 2022). The New York Times and Washington Post recently published articles on the topic (Halper, 2024) (Plumer & Popovich, 2024), and the 2024 Virginia Legislative session included multiple bills to address data center energy consumption (Virginia LIS, 2024).

Finally, the existence of the Virginia Energy Efficiency Council (VAEEC) will facilitate cooperation and support for this proposal. The VAEEC engages many critical stakeholders, including energy utility providers, private industries, localities, and government agencies. VAEEC’s goal is to “facilitate discussions and share resources to advance energy efficiency throughout the Commonwealth” by “[identifying] barriers to and opportunities for energy efficiency advancement, and to develop a strong, fact-based, and balanced industry voice before local, state, and national policymakers and regulators” (“About Us,” n.d.). VAEEC could act as an organized supporter of this proposal and alleviate concentrated resistance to a benchmarking requirement by connecting data center operators, labor organizations, and public financing programs.

Alternative 2: Selective Tax Incentives

This alternative proposes adding energy efficiency standards to the qualifications for the existing Data Center Retail Sale and Use Tax Exemption (DCRSUT), which currently incentivizes data centers to develop in Virginia and meet local investment and job creation requirements (JLARC, 2019). Changing this tax incentive would theoretically drive down the projected data center electricity demand growth without setting a firm cap on consumption. To implement this alternative, Virginia would set a minimum level of energy efficacy for all new and existing data centers to qualify for the DCRSUT using the industry standard Power Usage Effectiveness (PUE) metric, defined as the ratio of total ‘facilities energy usage’ to ‘I.T. equipment energy usage’ (Avelar et al., n.d.).

Virginia Delegate Suhas Subramanyam and State Senator Barbara Favola introduced joint bills to update eligibility standards for the DCRSUT exemption in the 2024 legislative

session. The bills propose requiring data centers to have a PUE score of no more than 1.2 and procure at least 90% of their electricity from carbon-free energy or renewable energy certificates to retain eligibility for the exemption (in addition to meeting all existing requirements) (Subramanyam & Favola, 2024).

Cost

Administrative Costs: Low

According to the fiscal impact statement prepared for the House and Senate finance committees regarding the proposal, "to the extent that data centers are unable to meet this bill's energy usage requirements, this bill could result in a substantial unknown positive revenue impact" (Virginia Department of Taxation, 2024). In 2023, Virginia's data centers received an estimated $750.4 million in tax breaks due to the DCRSUT, all of which could become new tax revenue if data centers fail to comply with the proposed amendment (Virginia Department of Taxation, 2024). The Virginia Economic Development Partnership estimates needing two additional full-time employees to monitor compliance with the new requirements (Virginia Department of Taxation, 2024). Two full-time employees would cost $230,000 (Virginia Department of Taxation, 2024).

Opportunity Cost of Future Growth*:* Medium

The DCRSUT is not the only factor that attracts data centers to Virginia. However, a 2019 report by the Joint Legislative Audit and Review Commission stated that the DCRSUT exemption "has a sizable influence on data center decisions to locate or expand in Virginia, and it is estimated to have a moderate economic benefit per $1 million in spending by the state" (JLARC, 2019). Thus, raising the qualification requirements would discourage some future development and erase the 'moderate economic benefit' to state and local tax revenues. This proposal would be especially damaging to future investments in economically disadvantaged regions of Southwest Virginia, where the DCRSUT currently provides special incentives for data center development.

Effectiveness

This alternative scores 'low' or 'medium' for effectiveness. The proposed PUE limit of 1.2 could reduce overall expected data center energy consumption by 14.28-25%, depending on counterfactual (1.4-1.6). However, this also depends on data centers deciding that it is worth the required investment to comply. According to Data Center Knowledge, average data center PUE has stalled around 1.5. Researchers from the Uptime Institute suggested that early reductions in PUE represented "low hanging fruit," and further improvements would require more costly investments (Robb, 2023).

The Department of Taxation report found that investments in efficiency technology necessary to continue qualifying for the credit would cost data centers $25 Billion over two years (Virginia Department of Taxation, 2024). This cost estimate was based on data self-reported by data centers, so it is likely an overestimate of actual up-front costs. Still, the tax credit alone would not offset the upfront cost of energy efficiency investments required to achieve PUE 1.2. Even when factoring in reduced energy costs from increased efficiency,

most data centers would not have a positive net present value of investing in the efficiency upgrades required to continue qualifying for the DCRSUT within a data centers' expected lifespan of 15-20 years (Judge, 2017). Depending on the counterfactual level of energy efficiency, most data centers would not see positive returns until 18-46 years from now (See Appendix for NPV calculations).

Assuming most data centers will not choose to comply with the proposed changes to the DCRSUT qualifications, this alternative could reduce data center energy demand growth over the next 25 years by removing the some of the incentive to develop in Virginia. The effect of the tax exemption on data centers' decision to develop in Virginia is debated. The Figure 5 shows the effect of this proposal on energy demand growth under four scenarios. Each scenario represents a different reduction in future data center industry growth, representing the uncertainty about the effect of the DCRSUT incentive.

Figure 6: Effect of Alternative 2 on D.C. energy demand growth

	DCRSUT Scenarios				
	0% Reduction	**1% Reduction**	**5% Reduction**	**20% Reduction**	**25% Reduction**
LOW					
Total Energy Demand Growth	293,096	291,291	284,073	257,004	247,981
Total Abated Energy Demand Growth	0	-1,805	-9,023	-36,092	-45,115
(%) Total Abated Energy Demand Growth	0.0%	-0.6%	-3.1%	-12.3%	-15.4%
HIGH					
Total Energy Demand Growth	1,033,013	1,026,191	998,903	896,573	862,463
Total Abated Energy Demand Growth	0	-6,822	-34,110	-136,440	-170,550
(%) Total Abated Energy Demand Growth	0.0%	-0.7%	-3.3%	-13.2%	-16.5%

Administrative Feasibility

Complexity: Low

House Bill 116 does not specify how data centers would report energy use, but the most straightforward system would be the Energy Star Portfolio Manager tool, as described in the first alternative. However, energy use would not necessarily need to be made public. Similarly to Alternative 1, this policy would require data monitoring and audits to ensure compliance. The Virginia Economic Development Partnership estimates it would need two new full-time employees to monitor data centers' compliance with the requirements established by this proposal, costing $230,000 annually (Virginia Department of Taxation, 2024). The Virginia Economic Development Partnership could connect data center operators with the Virginia PACE Authority for financing support. The Virginia Department of

Taxation considers implementation of the bill as routine and would not require additional funding or personnel.

Authority: Medium
This program requires some coordination between the Virginia Economic Development Partnership & Department of Taxation. The VEDP would be responsible for monitoring compliance and promoting energy efficiency opportunities to data center operators. The Virginia Department of Taxation would process tax exemption filings.

Political Feasibility

This alternative scores 'Low' for political feasibility. This proposal would face 'Entrepreneur Politics' with concentrated opposition from I.T. companies and the IBEW and diffuse support from climate advocates. When a proposal faces 'Entrepreneur Politics,' it has a low likelihood of success.

IT Companies & Organized Labor (Strong Opposition) – This proposal will most likely incur significant pushback from the data center industry and the electricians' union, both of whom are politically active in state and local elections and stand to lose significant financial benefits if the policy is adopted. Setting such a high efficiency standard would likely cause the data center industry as a whole would lose around $750.4 million in tax exemptions (Virginia Department of Taxation, 2024).

The Public (Weak Support) – Given that the proposal is not likely to generate the intended efficiency improvements (see effectiveness analysis above), it should not receive the support of environmental organizations either. This policy could more effectively incentivize energy abatement if the tax incentive was raised, but this is also not likely to be politically popular as more constituents are becoming concerned about that the is state subsidizing large IT companies.

Alternative 3: Tradable Permits for Energy Use

This alternative proposes that the Virginia Department of Energy establish a maximum quantity of electricity (GWh) to be made available to all data centers in the state. The Department of Environmental quality would sell permits guaranteeing access to a share of this energy pool to Virginia's data centers, which they could use, save, or exchange at competitive rates. Data centers would be fined for noncompliance if they exceed their allotted shares. This alternative treats Virginia's zero-carbon electricity as a limited resource and protects residents and small businesses from competing with data centers for access.

Implementing this policy would require the state to make yearly assessments of the total electricity capacity available as the state progressively decommissions fossil fuel power plants and brings more zero-carbon energy onto the grid. A new regulatory office in the Virginia Department of Energy would determine how many electricity permits to allocate to the data center industry each year and what price to auction them at. These decisions

would be informed by accounting for the availability of all energy resources and projecting the demand from all other sectors in the state.

Cost

Administrative Cost: Low

In addition to covering the program's costs, DEQ would be able to reinvest revenues from the sale of in Virginia's economy. New York's State Energy Research and Development Authority (NYSERDA), which manages proceeds from the sale of permits in the Regional Greenhouse Gas Initiative, provides a model for local reinvestment (NYSERDA, n.d.). NYSERDA uses RGGI proceeds to administer energy efficiency, carbon abatement, and renewable energy programs, invest in disadvantaged communities, and lower consumers' energy bills statewide (NYSERDA, n.d.).

Opportunity Cost of Future Growth: Very High

One concern associated with cap-and-trade policies is that they can generate high price volatility in the market for permits. This alternative would auction permits to data centers based on current energy consumption levels and allow for the creation of new permits if data centers invest in zero-carbon energy resources. Dominion's 2022 Integrated Resource Plan projected that the utility will be able to supply a quantity of clean energy without fossil fuel resources in 2050, which is roughly equal to the amount of electricity it produces today (*Dominion Energy 2023 Integrated Resource Plan,* 2023). Thus, the state should expect to limit energy allowances for data centers to levels that do not exceed the sector's current consumption rate, roughly 12,000 G.W./hours annually.

Limiting the growth of the data center industry would result in significant losses to future income for the state and localities. The Northern Virginia Technology Council reported that in 2021, the data center industry was "directly and indirectly" responsible for generating approximately 5,500 operational and over 10,000 construction and manufacturing jobs as well as $174 million in state tax revenue and over $1 billion in local tax revenue across the state (Richardson, 2023). With the industry expected to grow as much as 200%-660% by 2050, capping growth would result in a massive reduction in state income over the coming decades (Shobe et al., 2021).

Effectiveness

This alternative scores 'High' for effectiveness. This is the only alternative that guarantees Virginia meets its climate goals by limiting the growth of the data center industry to a size that can be reliably powered without increasing the state's consumption of fossil fuels. Conventionally, the market has treated energy as an infinite resource. Virginia law mandates energy utilities supply energy to meet all consumer requests (*Dominion Energy 2023 Integrated Resource Plan*, 2023). This premise conflicts with Virginia's goal of achieving a decarbonized energy market, given that clean energy development cannot keep pace with data centers' runaway demand for energy.

Publicly managed tradable permits (often referred to as 'cap-and-trade' permits) are a market-based strategy to manage scarce common resources (Center for Climate & Energy Solutions, n.d.). This approach differs from 'command-and-control' strategies of resource management (e.g. efficiency standards, pollution/extraction limits, etc.) such that permit exchange markets determine the price of a limited, common resource, driving innovation to use the resource with maximum efficiency (Center for Climate & Energy Solutions, n.d.). Relative to other market-based strategies, tradable permits allow for more certainty about the future use of limited resources as they set a cap on the amount of a resource that can be used. (Center for Climate & Energy Solutions, n.d.).

Data center businesses would be able to purchase, bank, and exchange permits, which researchers from Harvard and MIT say "provides a margin of intertemporal flexibility with positive economic and environmental consequences" (Schmalensee & Stavins, 2017). Lessons from previous implementations of cap-and-trade policies, such as program established under Title IV of the Clean Air Act Amendments of 1990, which regulated Sulfur Dioxide emissions from coal-fired power plants (larger than 100MW), and the E.U. Emissions Trading System (ETS), which focused on Carbon Dioxide from electricity generators and large industrial sources, indicate that accurate monitoring and significant violation penalties are key to successful programs (Schmalensee & Stavins, 2017).

Administrative Feasibility

Complexity: High
Virginia Energy could use the Energy Star Portfolio Manager tool to track energy use and establish the annual data center energy permits budget. The DEQ coordinated Virginia's auctioning and compliance with the Regional Greenhouse Gas Initiative, giving it some experience with cap-and-trade management (Virginia DEQ, n.d.). However, establishing and maintaining a market for permits would be arduous and complex.

Ownership: Low
The state would need to establish a partnership between the Department of Energy, which would be responsible for monitor the availability of clean energy resources and compliance with the permit program, and the Department of Environmental Quality to oversee the sale and exchange of data center energy permits. The need for cross-agency cooperation complicates this proposal.

Political Feasibility

This alternative scores 'low' for political feasibility. This proposal would face 'Interest Group Politics' with concentrated opposition from I.T. companies and the IBEW and concentrated support from climate advocates. When a proposal faces 'Interest Group Politics,' the stronger political coalition's interests tend to win. In this case, the economic and political capital of the opposition significantly outweighs that of the supporters.

IT Companies & Organized Labor (Strong Opposition)
It is the most restrictive alternative for data center growth in the coming decades. Data center operators and Virginia's electricians' unions would likely push back on this proposal as well as local governments that stand to gain significant tax revenue from the growing industry.

The Public (Strong Support)
Climate advocates and the public should support this alternative as it is among the feasible plans to fully comply with the Virginia Clean Economy Act, but the concentrated economic interests opposing it would most likely be insurmountable. Wyatt Gordon, Senior Policy & Campaigns Manager of Land Use & Transportation for the Virginia Conservation Network, told a reporter, "It's the biggest corporations in the entire world on one side, and then you have Virginia residents and a ragtag group of environmental folks on the other," Gordon said. "So, I think you know who won" (Richardson, 2023).

Outcomes Matrix

	Benchmarking	Tax Incentive	Cap & Trade
Cost Admin. Cost Low = 1 Med. = .5 High = 0 O.C. of Future Growth Low = 1 Med. = .5 High = 0	**Administrative Cost: Low (1)** 2 Full Time Employees (FTE) ($230,000 / year) Energy Star Portfolio Manager (Free) **O.C. of Future Growth: Low (1)** Due to the growing drive for efficiency & transparency among data companies, this alternative should not drive away future data center investment	**Administrative Costs: Low (1)** Increased tax revenue from data centers unable to meet new requirements (-$750.4 million in 2023) 2 Full Time Employees (FTE) ($230,000 / year) **O.C. of Future Growth: Medium (.5)** JLARC found the DCRSUT "has a sizable influence on data center decisions to locate or expand in Virginia" Especially costly to future investments in SWVA, where the DCRSUT provides special incentives for development	**Administrative Costs: Low (1)** DEQ would be able to reinvest permit revenues **O.C. of Future Growth: Very High (0)** In 2021, data centers generated >15,500 jobs, $174M in state tax revenue, and $1B+ in local tax revenue With the industry expected to grow 200%-660% by 2050, capping growth would result in a massive reduction in state income over the coming decades
Effectiveness Low = 0 Med. = 1.5 High = 3	**Medium (1.5)** 16% abatement (46,895-165,282 GWh) of D.C. energy demand growth over 25 years Better information about the D.C.s' effects on the energy market, empowering future regulation Supports growing demand for data center efficiency	**Low - Medium (0 - 1.5)** If successful, 1.2 PUE limit would reduce D.C. energy consumption 14.28-25%, *but based on negative NPV of investing in EE within 20 years, most data centers would opt not to comply.* Reduced tax incentives to locate in Virginia would drive 0-16.5% abatement (0-170,550 GWh) of D.C. energy demand growth over 25 years	**High (3)** This is the only alternative that guarantees Virginia meets its climate goals by limiting the growth of the data center industry to a size that can be reliably powered without increasing the state's consumption of fossil fuels 100% abatement (1,033,013 GWh) of D.C. energy demand growth over 25 years
Admin. Feasibility Complexity Low = 1 Med. = .5 High = 0 Ownership Low = 0 Med. = .5 High = 1	**Complexity: Low (1)** Compliance monitoring by 2 FTE Virginia already uses Portfolio Manager for government buildings; Existing programs to finance efficiency upgrades **Ownership: High (1)** Managed by 2 FTE embedded in the Virginia Energy, Energy Efficiency Team, which currently oversees the state's energy efficiency programs ***Bonus**: Built-in water efficiency tracking capabilities	**Complexity: Medium (.5)** Compliance monitoring by 2 FTE Va. DoT considers implementation 'routine' **Ownership: Medium (.5)** Requires minimal coordination between the VEDP & DoT	**Complexity: High (0)** Requires the establishment of a market for tradeable permits **Ownership: Low (0)** Requires a cooperation between the Virginia Energy (monitoring the availability of clean energy resources and compliance with the permit program) & DEQ (overseeing the sale and exchange of data center energy permits)
Political Feasibility Low = 0 Med. = 1 High = 2	**High (2)** *Client Politics* IBEW & D.C. Operators - Support The Public - Support	**Low (0)** *Entrepreneur Politics* IBEW & D.C. Operators - Strong Opposition The Public - Weak Support	**Low (0)** *Interest Group Politics* IBEW & D.C. Operators - Strong Opposition The Public - Strong Support
Total	7.5	2.5 - 4	4

Recommendation

I recommend advocating for Alternative 1, Energy Benchmarking. This policy would not solve the problem of energy overconsumption by the data centers in Virginia, but it would facilitate the sharing of important information for future policy decisions and investments. Benchmarking reveals points of inefficacy, enabling cost effective, energy-efficient design upgrades. As I.T. companies become more conscious of their climate impacts, public scrutiny over the data center energy use should drive further investments in efficiency. A similar program in California has coincided with an average reduction in data center energy use intensity of 16.0% in its first four years, and Virginia should expect similar benefits (California Energy Commission, n.d.). Energy benchmarking also imposes the lowest costs and has the highest political and administrative feasibility rating, which is critical given the powerful, organized forces representing data center operators, laborers, and energy utility providers in Virginia's politics.

Implementation

The Virginia Conservation Network (VCN) should take a five-pronged approach to implementing this recommendation.

1) **Take advantage of the growing national awareness of data center energy demand growth and spread awareness in Virginia about the need for more transparency and accountability.** The Virginia Conservation Network connects an influential and active coalition across the state. It should work with its member organizations to raise awareness of this issue among gross roots community organizers.
2) **Work with state legislators to introduce a state benchmarking bill in the 2025 legislative session.** The Virginia Conservation Network should call on its members to advocate for a statewide data center energy benchmarking policy.
    a. VCN included a call for the General Assembly to pass a law allowing local governments to create benchmarking ordinances for commercial buildings.
    b. In 2022, State Senator Jennifer Boysko introduced a bill that would have granted localities this authority; unfortunately, it failed in committee. Because data center energy overconsumption threatens Virginia's statewide climate goals, a benchmarking requirement should be adopted at the state level. VCN Should consider asking Sen. Boysko to patron a state-level data center benchmarking bill.
    c. Senator Danica Roem, Delegate Suhas Subramanyam, and Senator Barbara Favola have also introduced legislation to address data center energy overconsumption and may be willing to patron or co-patron the bill.
3) **Facilitate collaboration** between state agencies, data center operators, and energy efficiency financing programs such as the Virginia C-PACE Authority.

4) Continue to **shine a spotlight** on data centers' energy consumption and the implications for Virginia's ratepayers and climate goals.
5) Communicate with climate stakeholders beyond Virginia to **put pressure on global I.T. brands** like Google, Meta, and Amazon Web Services to reduce their climate impacts by investing in energy efficiency and zero-carbon energy sources. Reach out to the iMasons industry group with a request for comment on the data center industry's effects on the Virginia's climate goals.

Appendix

To view calculations, please visit: https://myuva-my.sharepoint.com/:x:/g/personal/ndr2wr_virginia_edu/EaGky0s0xZtGrVQ1u7BVA0gBbWFrCflQZUMc9n2P4ioEFQ?e=VSgceh

File Password: Batten2024

References

About Us. (n.d.). *Virginia Energy Efficiency Council*. Retrieved March 17, 2024, from https://vaeec.org/about/

Avelar, V., Azevedo, D., & French, A. (Eds.). (n.d.). *PUE: A Comprhensive Examination of the Metric*. The Green Grid.

Bagaini, A., Colelli, F., Croci, E., & Molteni, T. (2020). Assessing the relevance of barriers to energy efficiency implementation in the building and transport sectors in eight European countries. *The Electricity Journal*, *33*(8), 106820. https://doi.org/10.1016/j.tej.2020.106820

Baxtel. (n.d.). *Northern Virginia Data Center Market*. Retrieved November 5, 2023, from https://baxtel.com/data-center/northern-virginia

Boysko, J. B. (2022, January 11). *SB 452 Local governments; additional powers, energy efficiency of buildings*. Virginia Legislative Information Service. https://lis.virginia.gov/cgi-bin/legp604.exe?221+sum+SB452#

Brocklehurst, F. (2022). *International review of energy efficiency in Data Centres for IEA EBC Building Energy Codes Working Group*. International Energy Agency.

Burnette, S. (n.d.). *Data Centers | Virginia Economic Development Partnership*. Virginia Economic Development Partnership. Retrieved December 3, 2023, from https://www.vedp.org/industry/data-centers

Butler, R. (2022, April 27). *70 Data Center Companies Join the Infrastructure Masons Climate Accord*. Data Center Knowledge.

https://www.datacenterknowledge.com/sustainability/70-data-center-companies-join-infrastructure-masons-climate-accord

California Energy Commission. (n.d.). *Workbook: Energy Efficiency Benchmarking Dashboard*. Retrieved March 16, 2024, from https://tableau.cnra.ca.gov/t/CNRA_CEC_PUBLIC/views/EnergyEfficiencyBenchmarkingDashboard/BenchmarkingDashboard?%3AshowAppBanner=false&%3Adisplay_count=n&%3AshowVizHome=n&%3Aorigin=viz_share_link&%3AisGuestRedirectFromVizportal=y&%3Aembed=y

Center for Climate & Energy Solutions. (n.d.). Cap and Trade Basics. *Center for Climate and Energy Solutions*. Retrieved February 5, 2024, from https://www.c2es.org/content/cap-and-trade-basics/

Concept of New Metrics for Data Center Energy Efficiency Introduction of Datacenter Performance per Energy [DPPE]. (2010). Green IT Promotion Council.

Cook, L. (2015). *U.S Environmental Protection Agency Comments on Building Energy Use Benchmarking and Public Disclosure Program (AB 802)*. U.S. Environmental Protection Agency. https://efiling.energy.ca.gov/GetDocument.aspx?tn=207155&DocumentContentId=22449

Data centres & networks. (n.d.). IEA. Retrieved November 1, 2023, from https://www.iea.org/energy-system/buildings/data-centres-and-data-transmission-networks

Dominion Energy 2023 Integrated Resource Plan. (2023). Dominion Energy South Carolina Inc.

Energy Star. (n.d.-a). *Benchmark Your Building With Portfolio Manager*. Energystart.Gov. Retrieved March 16, 2024, from https://www.energystar.gov/buildings/benchmark

Energy Star. (n.d.-b). *DataTrends: Water Use Tracking*. Retrieved March 16, 2024, from https://www.energystar.gov/buildings/tools-and-resources/datatrends-water-use-tracking

Greenberg, S., Mills, E., Tschudi, B., Rumsey, P., Engineers, R., & Myatt, B. (2006). *Best Practices for Data Centers: Lessons Learned from Benchmarking 22 Data Centers*.

Halper, E. (2024, March 7). *Amid explosive demand, America is running out of power*. Washington Post. https://www.washingtonpost.com/business/2024/03/07/ai-data-centers-power/

Herrlin, M., & Traber, K. (2020). *Data Center Energy Assessment Process Manual*. Center of Expertise for Energy Efficiency in Data Centers.

Hyperscale Data Centers. (n.d.). U.S. Department of Energy Better Buildings Initiative. Retrieved November 5, 2023, from https://betterbuildingssolutioncenter.energy.gov/data-center-toolkit/hyperscale

iMasons Climate Accord. (n.d.). *Carbon neutrality in digital infrastructure*. iMasons Climate Accord. Retrieved March 17, 2024, from https://climateaccord.org/

Institute for Market Transformation. (2017, September 5). *Map: U.S. City, County, and State Policies for Existing Buildings: Benchmarking, Transparency and Beyond*. https://www.imt.org/resources/map-u-s-building-benchmarking-policies/

JLARC. (2019). *Data Center and Manufacturing Incentives*. Joint Legislative Audit and Review Commission. https://jlarc.virginia.gov/pdfs/reports/Rpt518-1.pdf

Judge, P. (2017, July 21). *The data center life story*. Data Center Dynamics. https://www.datacenterdynamics.com/en/analysis/the-data-center-life-story/

Judge, P. (2022, April 27). *iMasons proposes work on data centers' embodied carbon*. Data Center Dynamics. https://www.datacenterdynamics.com/en/news/imasons-proposes-work-on-data-centers-embodied-carbon/

Kidd, D. (2023, July 27). *The Data Center Capital of the World Is in Virginia*. Governing. https://www.governing.com/infrastructure/the-data-center-capital-of-the-world-is-in-virginia

Korolov, M. (2022, September 2). *iMasons Expands Into LATAM, Building Momentum for Climate Accord*. Data Center Knowledge | News and Analysis for the Data Center Industry. https://www.datacenterknowledge.com/sustainability/imasons-expands-latam-building-momentum-climate-accord

Kuppuswamy, R. (2023, July 20). Why—And how—High-performance computing technology is coming to your data center. *VentureBeat*. https://venturebeat.com/data-infrastructure/why-and-how-high-performance-computing-technology-is-coming-to-your-data-center/

Meijer, G. I. (2010). Cooling Energy-Hungry Data Centers. *Science*, *328*(5976), 318–319.

Min, C., & Erchi, Z. (2022, April 21). *Five things to know about China's mega east-west data center plan*. Nikkei Asia. https://asia.nikkei.com/Spotlight/Caixin/Five-things-to-know-about-China-s-mega-east-west-data-center-plan

NYSERDA. (n.d.). *Regional Greenhouse Gas Initiative*. NYSERDA. Retrieved February 5, 2024, from https://www.nyserda.ny.gov/About/Funding/Regional-Greenhouse-Gas-Initiative

Office of the Governor. (2022). *The Commonwealth of Virginia's 2022 Energy Plan*. https://energy.virginia.gov/energy-efficiency/documents/2022_Virginia_Energy_Plan.pdf

Plumer, B., & Popovich, N. (2024, March 14). *A New Surge in Power Use Is Threatening U.S. Climate Goals—The New York Times*. The New York Times. https://www.nytimes.com/interactive/2024/03/13/climate/electric-power-climate-change.html?searchResultPosition=1

Richardson, E. (2023, December 4). *Virginia is Banking on Data Centers, but Some Say Growth Should be More Deliberate*. Williamsburg Yorktown Daily. https://wydaily.com/latest-news/2023/12/04/virginia-is-banking-on-data-centers-but-some-say-growth-should-be-more-deliberate/

Robb, D. (2023, September 13). *Why has PUE Remained Flat for So Long After Years of Progress?* Upsite Technologies. https://www.upsite.com/blog/why-has-pue-remained-flat-for-so-long-after-years-of-progress/

Rong, H., Zhang, H., Xiao, S., Li, C., & Hu, C. (2016). Optimizing energy consumption for data centers. *Renewable and Sustainable Energy Reviews*, *58*, 674–691. https://doi.org/10.1016/j.rser.2015.12.283

Sakry, C. (2022, February 2). *Researcher explores how proliferating data centers affect water supply in the United States*. Virginia Tech News. https://news.vt.edu/content/news_vt_edu/en/articles/2022/01/Datacenters.html

Schmalensee, R., & Stavins, R. N. (2017). Lessons Learned from Three Decades of Experience with Cap and Trade. *Review of Environmental Economics and Policy*, *11*(1), 59–79. https://doi.org/10.1093/reep/rew017

Shobe, W. (2021). *Electricity Sales Forecast for Virginia: 2020-2050*. Energy Transition Initiative: University of Virginia, Weldon Cooper Center for Public Service.

Shobe, W., Watkins, A., & Forys, B. (2021, April 1). *Electricity Sales Forecast 2020-2050*. Weldon Cooper Center for Public Service. https://www.coopercenter.org/research/electricity-sales-forecast-2020-2050

Shoemaker, M. (2016). Best Practices in Developing State Lead-by-Example Programs and Considerations for Clean Power Plan Compliance. *American Council for an Energy-Efficient Economy*. https://www.aceee.org/sites/default/files/lbe-best-practices-022416.pdf

Subramanyam, S., & Favola, B. A. (2024, January 10). *A BILL to amend and reenact § 58.1-609.3 of the Code of Virginia, relating to sales and use tax exemption; data centers*. Virginia's Legislative Information System. https://lis.virginia.gov/cgi-bin/legp604.exe?241+ful+SB192

Virginia Clean Economy Act, 10.1-1308 Code of Virginia (2020). https://lis.virginia.gov/cgi-bin/legp604.exe?201+ful+HB1526ER

Virginia Department of Taxation. (2024). *Retail Sales and Use Tax; Data Center Exemption 2024 Fiscal Impact Statement*. Virginia Legislative Information System. https://lis.virginia.gov/cgi-bin/legp604.exe?241+oth+HB116F161+PDF

Virginia DEQ. (n.d.). *Carbon Trading*. Retrieved March 17, 2024, from https://www.deq.virginia.gov/our-programs/air/greenhouse-gases/carbon-trading

Virginia LIS. (2024). *Bills and Resolutions > 2024 session*. Virginia Legislative Information Service. https://lis.virginia.gov/cgi-bin/legp604.exe?241+lst+ALL+HB0080

Virginia PACE Authority. (n.d.). *Who is the Virginia PACE Authority?* [Virginia PACE]. Retrieved March 16, 2024, from https://virginiapace.com/

White, A. (2021, August 13). *NYC Landlords React to Building Energy Efficiency Grades*. The Real Deal. https://therealdeal.com/new-york/2021/08/13/energy-efficiency-grades-motivation-or-nuisance/