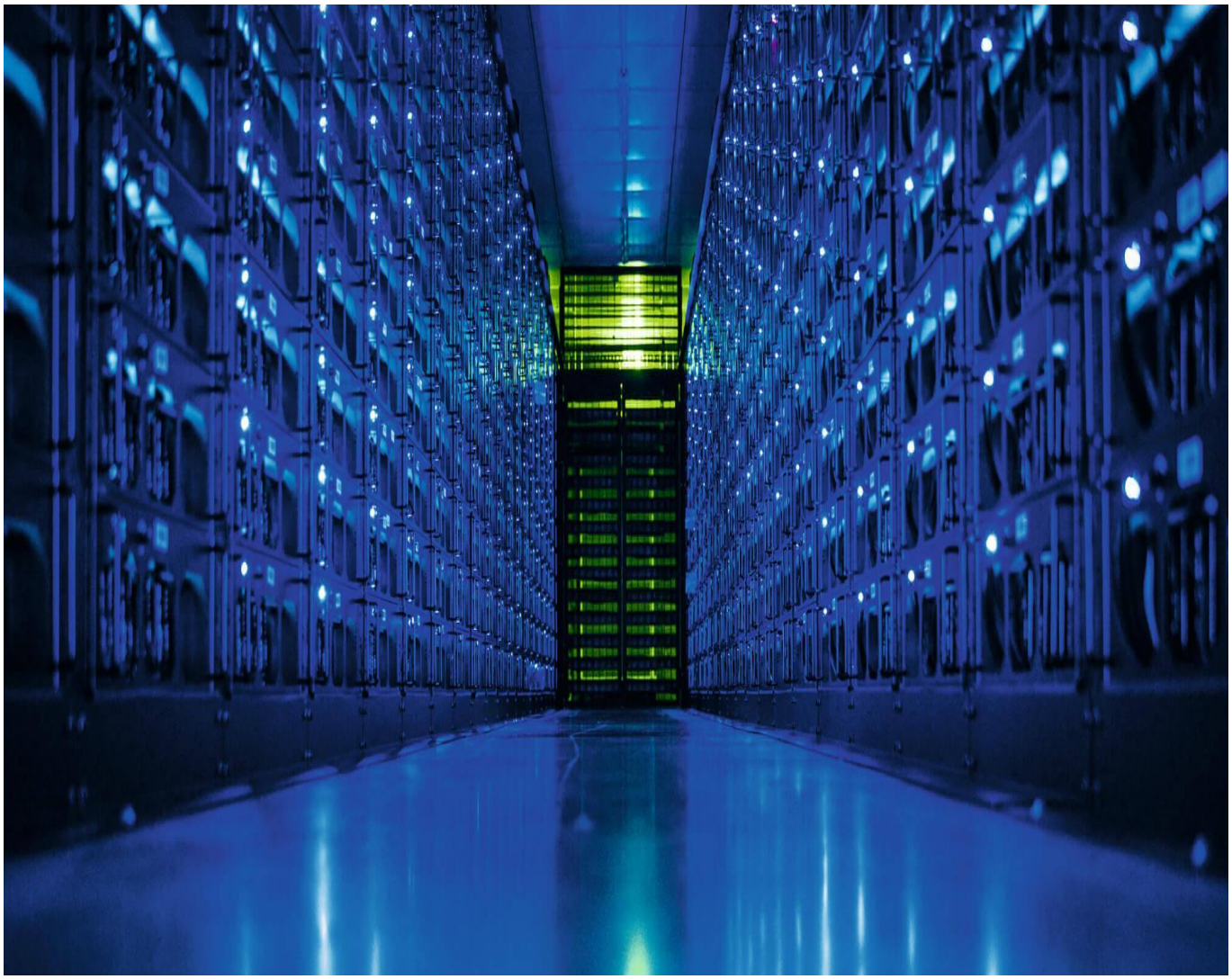
Community Choice Aggregation to Decarbonize the Data Center Capital of the World



Applied Policy Project

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Disclaimer

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Client

This report was prepared for Virginia Clean Energy (VCE), a nonprofit organization fiscally sponsored by LEAN Energy US. VCE has a mission to accelerate the expansion of clean and renewable energy via Community Choice Aggregation (CCA) in the Commonwealth of Virginia. Their work includes education, outreach, policy research, advocacy, organization, and development as a way to facilitate the creation of CCAs in Virginia.

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Executive Summary

Data centers are the backbone of the modern internet age and are critical to processing, storing, and disseminating large-scale data. Nicknamed "Data Center Alley", Loudoun County, Virginia has the world's largest concentration of data centers.[1] It harbors the grid for some of the largest international companies and 70% of the world's internet usage traffic passes through these data centers.[2] As cloud technology advances, more data centers are going to be needed to keep up with this demand. Dominion Energy, the incumbent investor-owned utility (IOU) in Loudoun County, supplies the electricity that these data centers consume, however only 4% of their energy mix comes from renewables.[3] Dominion has proposed to meet the local energy demands by building eight more natural gas power plants that emit greenhouse gas (GHG) emissions and other pollutants.

The client for this report, Virginia Clean Energy (VCE), sees Community Choice Aggregation (CCA) as an alternative for the energy procurement of the region's municipalities. CCA is a policy option that lets local communities vote on their power mix for power generation. CCA allows a local government to negotiate lower rates and choose a greater percentage of renewable energy. Furthermore, it is more efficient for CCA to implement renewable energy supply management collectively than for each data center to do it individually. The report seeks to answer the question:

What would be the impact of Community Choice Aggregation (CCA) in Loudoun County for decarbonizing data center energy usage?

To answer this question, the team gathers data from interviews with local stakeholders and experts, such as successful CCAs in California, trade associations, competitive service providers (CSP), and data center groups. Furthermore, the report ascertains the impact of CCA in Virginia through feasibility study evaluations and predictive estimations for GHG emissions and energy prices. A major benefit towards the eventual adoption of CCA in Virginia is the legal status of CCA in the state. Virginia's Code § 56-589 allows for: "Any municipality or other political subdivision of the Commonwealth to aggregate the electric energy load of residential, commercial, and industrial retail customers within its boundaries on an opt-in or

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[1] Klein, B. (2019, May 29). Data Center Alley: Why 70% of Internet Traffic Flows Through Ashburn Virginia. DigitalTech. Retrieved March 9, 2022, from https://digitaltech.com/data-center-alley-why-70-of-internet-traffic-flows-through-ashburn-virginia/.

[2] Schweitzer, A. (2021, March 26). *The pandemic is driving a data center boom in Northern Virginia*. NPR. Retrieved January 26, 2022, from https://www.npr.org/local/305/2021/03/26/981557613/the-pandemic-is-driving-a-data-center-boom-in-northern-virginiat

[3] Starks, L. (2020, August 4). *Why I sold Dominion Energy (NYSE:D)*. SeekingAlpha. Retrieved March 7, 2022, from https://seekingalpha.com/article/4364041-why-i-sold-dominion-energy

opt-out basis".[4] The opt-out model basis allows for the highest participation rates while maintaining consumer choice.

This report compares and evaluates three policy options in regards to energy procurement for Loudoun County: 1) implementing CCA, 2) maintaining Dominion Energy's status quo, and 3) raising state renewable portfolio standards (RPS). These three policy options are evaluated based on the criteria of 1) **GHG emission rates**, 2) **financial feasibility**, 3) **administrative feasibility**, and 4) **political feasibility**. For the qualitative analysis, this report examines the risk factors (or perceived risk) inherent in each policy option and the logic of the data center's renewable energy procurement behavior by interviewing experts and analyzing case studies. As a basis for these analyses, this report also researches the relevant literature, including government energy releases, academic publications, data center ESG reports, CCA reports, and press articles. These efforts lead to a variety of significant findings, chiefly that the implementation of a CCA to decarbonize data centers is financially feasible and will pass those benefits onto its customers. Additionally, CCA as a policy option has the highest GHG reduction estimates of the three policy options. The projected GHG reduction with the implementation of a CCA best aligns with state legislation requirements and would be the best option for Loudoun County to be on track to meet its energy goals. States where CCAs exist have more competition to bring down the price for renewable energy and give easier access to data centers. This policy option would allow the county to have their choice of renewables when procuring the massive amounts of energy required to maintain the growing data centers. CCA implementation receives the best score based on the aforementioned criteria while simultaneously serving the Commonwealth of Virginia's clean energy goals.

[4] § 56-589. Municipal and State Aggregation

Glossary

Ancillary Services – Those services necessary to support the transmission of electric power from seller to purchaser given the obligations of control areas and transmitting utilities within those control areas to maintain reliable operations of the interconnected transmission system.

CalCCA – California Community Choice Association; the California's trade association for community choice aggregators.

Carbon-free – resources used for electricity generation that include renewable energy resources such as solar, wind, geothermal, small-scale hydroelectric, and biomass, but can also include resources that do not emit greenhouse gasses when used, such as large hydroelectric and nuclear.

Community Choice Aggregation (CCA) – a local, public electricity provider that makes energy procurement decisions, while the affiliate investor-owned utility continues to provide transmission and distribution services. Usually a city, county, or group of cities and counties.

California Public Utilities Commission (CPUC) – the regulatory agency overseeing services in California including electric, telecommunications, water, railroad, and more.

California Independent System Operator (CAISO) – a nonprofit that is responsible for ensuring reliability of the electrical grid that covers much of California and for operating a wholesale electricity market for electricity providers.

Competitive Service Provider – companies licensed by the Virginia's State Corporation Commission to supply or aggregate energy services throughout Virginia.

Direct Access – Large power consumers which have opted to procure their wholesale supply independently of the IOUs through an Electricity Service Provider.

Electric Service Providers (ESP) – An alternative to traditional utilities. They provide electric services to retail customers in electricity markets that have opened their retail electricity markets to competition in California.

Gigawatt hour (GWh) – a unit of electricity consumption. Equal to 1,000 megawatt hours.

Greenhouse Gas (GHG) – refers mainly to carbon dioxide.

Integrated Resource Plan – A utility's plan for future generation supply needs.

Investor-Owned Utility (IOU) – a private, for-profit electricity provider. For example, IOUs within Virginia are Appalachian Electric Power and Virginia Electric Power Company (Dominion).

Joint Powers Authority (JPA): A legal entity comprising two or more public entities. The JPA provides a separation of financial and legal responsibility from its member entities.

Kilowatt hour (kWh) – a unit of electricity that is equivalent to 1,000 watts in one hour

Megawatt hour (MWh) – a unit of electricity consumption. Equal to 1,000 kilowatt hours.

Metric Tons (MT) – 2,000 lbs.

Opt-down – when a customer chooses to enroll in a lower-cost electricity option or an electricity option with a smaller proportion of carbon-free energy.

Opt-in – when a customer chooses to enroll in a CCA program.

Opt-out – when a customer chooses to leave a CCA program.

Opt-up – when a customer chooses to enroll in a more expensive electricity option or an electricity option with greater amounts of carbon-free energy.

Power Purchase Agreement (PPA) – The standard term for bilateral supply contracts in the electricity industry.

PJM (Pennsylvania New Jersey Maryland Interconnection LLC) –As a regional transmission organization, PJM operates a wholesale electricity market that spans all or part of the District of Columbia and 13 states including Virginia, Illinois, and New Jersey.

Renewable energy – resources used for electricity generation that do not diminish with use and are naturally replenishing, such as solar, wind, geothermal, small-scale hydroelectric, and biomass.

Retail electricity provider – After electricity is bought by resell or "supply" entities in the wholesale market, it can be sold to end-users in the retail market. It can be a local utility or a number of competitive retailers.

Renewable Portfolio Standard (RPS) – State policy requiring that utilities and other electricity generation service providers procure a minimum percentage of generation from renewable energy.

Renewable Energy Credits (REC) – Unbundled RECs are those that have been disassociated from the electricity production originally represented and are sold separately from energy. Bundled RECs are delivered with the associated energy.

Reliability Pricing Model (RPM) - PJM's capacity market meant to ensure long-term grid reliability by securing the appropriate amount of power supply resources needed to meet predicted energy demand in the future.

State Corporation Commission (SCC) – A state agency with regulatory authority over many business and economic interests in Virginia. It regulates public utilities in Virginia and relevant mandates by Virginia Clean Economy Act.

Virginia Clean Economy Act (VCEA) – Passed in 2020, the Act aimed to modernize the Commonwealth's clean energy portfolio, combat climate change and create green energy jobs for future generations.

Wholesale Power – Large amounts of electricity that are bought and sold by utilities and other electric companies in bulk at specific trading hubs. Quantities are measured in MWs, and a standard wholesale contract is for 25 MW for a month during heavy-load or peak hours (7 am to 10 pm, Mon-Sat), or light-load or off-peak hours (all the other hours).

I. Introduction

A. Data Center Electricity Demand

Online usage is soaring with no signs of slowing down, and electricity consumption continues to increase, specifically with huge impacts in Loudoun County, Virginia. Loudoun County has the world's highest concentration of data centers, with 70% of the world's internet traffic passing through its borders.[5] Nicknamed "Data Center Alley", Loudoun County data centers include global companies such as Facebook, Amazon, Google, and Apple. Loudoun County is home to the most data centers in the world due to its existing infrastructure, cost of land, and fiber-optic rich connections. Additionally, Ashburn, a city in Loudoun County, has 20% cheaper electricity than the national average. Cheaper electricity, stable power, and an educated population make Loudoun County the perfect place for data centers.[6] Data centers are the backbone of nearly every business and are critical to processing, storing, and disseminating large-scale data. These tech giants continue to grow each year, demanding more and larger sized data centers. As cloud technology advances, more data centers are going to be utilized and more energy consumed to keep up with this demand.

Data centers consume massive amounts of energy; one report shows the entire data center industry uses over 90 billion kilowatt-hours of electricity annually.[7] Globally, 3% of all electricity used in the world goes to data centers.[8] In fact, electricity generated by independent generators in Loudoun county produces 5,006,874 megawatt hours of electricity annually, but utility customers consume 19.41% more than is being produced each year.[9] For reference, each megawatt can power enough electricity for 400 to 900 homes annually. According to Loudoun County's 2009 energy strategy report, electricity accounts for 52% of all greenhouse gas (GHG) emissions and data centers consume 1 gigawatts monthly, or the same amount of electricity that can power 250,000 homes.[10]

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[5] Schweitzer, A. (2021, March 26). *The pandemic is driving a data center boom in Northern Virginia*. NPR. Retrieved January 26, 2022, from https://www.npr.org/local/305/2021/03/26/981557613/the-pandemic-is-driving-a-data-center-boom-in-northern-virginiat

[6] *Why is Ashburn the data center capital of the world?* Enterprise IT Made Easy. Colocation Data Centers, Cloud and Network. (n.d.). Retrieved March 24, 2022, from https://www.datacenters.com/news/why-is-ashburn-the-data-center-capital-of-the-world

[7] Data Center Power Design and features. Digital Realty. (n.d.). Retrieved January 26, 2022, from https://www.digitalrealty.com/data-center-power#:~:text=In%20order%20to%20keep%20data,34%20coal%2Dpowered%20power%20plants.

[8] Data Center Power Design and features. Digital Realty. (n.d.). Retrieved January 26, 2022, from https://www.digitalrealty.com/data-center-power#:~:text=In%20order%20to%20keep%20data,34%20coal%2Dpowered%20power%20plants.

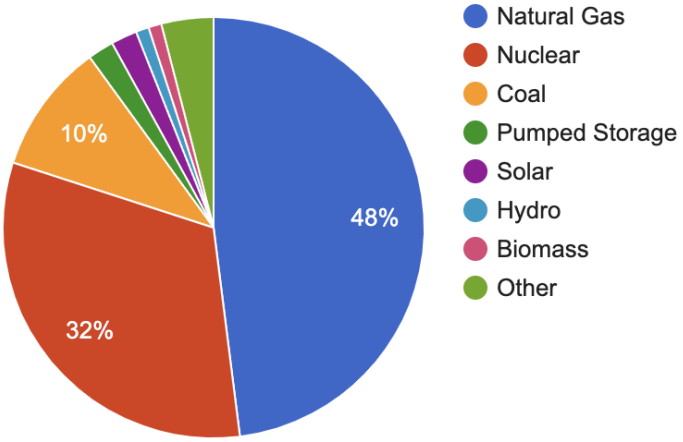
[9] Reese, N. (2022, January 26). *Loudoun County, VA: Electricity rates, providers & more*. Find Energy. Retrieved March 5, 2022, from https://findenergy.com/va/loudoun-county-electricity/

[10] Northern Virginia Regional Commission. (n.d.). *Loudoun County Energy Strategy*. loudouncounty.gov. Retrieved March 5, 2022.

B. Energy Power Mix

Dominion Energy, the incumbent investor-owned utility (IOU) in Loudoun County supplies the electricity that data centers consume. However, only 4% of Dominion Energy's fuel mix is renewable, see Figure 1-1.[11]

Figure 1-1: Dominion Energy Electric Generation Fuel Mix in 2020[12]



Since the passage of the Virginia Clean Economy Act (VCEA) in 2020, Dominion Energy is working on its goal of "net-zero carbon emissions by 2050", but is behind compared to its neighboring states when it comes to using renewable energy. One of the reasons they are behind so far, is because Virginia puts its state subsidies towards fossil fuels rather than renewable energy.[13] It is projected that the demand for energy is expected to increase by 15% in the next 15 years, therefore there will be a capacity gap that must be filled to meet this demand.[14] Dominion Energy has proposed to close this gap by building eight more natural gas power plants that emit GHG and other pollutants. Additionally, they've also proposed to build two natural gas pipelines to bring in fracked natural gas from Pennsylvania and West Virginia. These pipelines are called the Atlantic Coast pipeline, which has been abandoned, and the Mountain Valley Pipeline that goes through the Appalachian Trail, an important wildlife and

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[11] Starks, L. (2020, August 4). *Why I sold Dominion Energy (NYSE:D)*. SeekingAlpha. Retrieved March 7, 2022, from https://seekingalpha.com/article/4364041-why-i-sold-dominion-energy

[12] Dominion Energy. 2021. Integrated Resource Plan 2021 Update. Retrieved March 9, 2022, from https://cdn-dominionenergy-prd-001.azureedge.net/-/media/pdfs/global/company/desc-2021-integrated-resource-plan.pdf?la=en&rev=e13351d019f7452483757099fa254707

[13] GRRR.nl. (2021, December 9). *Climate and energy benchmark - electric utilities*. World Benchmarking Alliance. Retrieved February 11, 2022, from https://www.worldbenchmarkingalliance.org/publication/electric-utilities/

[14] Editor, L. to the. (2019, January 14). *Zero carbon virginia: A call for renewable energy and greater efficiency*. LoudounTimes.com. Retrieved January 26, 2022, from https://www.loudountimes.com/opinion/zero-carbon-virginia-a-call-for-renewable-energy-and-greater-efficiency/article_ff81ad7c-f89e-11e8-99ff-4f2ed32f96a2.html

recreation area.[15] However, this solution becomes even more problematic, as power plants have a life expectancy of 40 years that would essentially lock Virginia into decades of more unsustainable emissions.

C. Recent Policy Efforts

The VCEA passed in 2020 established its first ever mandatory renewable portfolio standards (RPS) for Virginia, which are policies designed to increase the use of renewable energy sources for electricity generation.[16] The VCEA requires Dominion Energy to use 100% clean energy by 2045, with a benchmark of 75% renewable energy coming from the Commonwealth by 2025 and beyond. Renewable energy is defined as electricity from solar, wind, falling water (hydroelectric), some types of biomass and other in-state resources.

The VCEA is the only bill in the south with a mandatory RPS of 100% clean energy and one of the stronger versions of the law compared to any state in the country. If the RPS standards are met, this would put Virginia within close distance of clean-energy leading states like Maryland. [17]

D. GHG Emission Goals and Strategies

Using clean energy can reduce GHGs and is known as an effective way to slow climate change. As a result, slowing climate change may prevent deaths from air pollution, earthquakes, floods, droughts, and other climate disasters.[18] Renewable energy is extracted from resources that are naturally replenished and do not produce air pollution or heat-trapping gasses during the production of the electricity.[19] However, it is important to note there may be emissions associated with embodied energy in the panels or turbines.

Currently, Loudoun County is in the process of updating its 2009 energy strategy, which originally set a long-term goal of reducing GHG emissions from 3.85 to 3.0 million metric tons of carbon dioxide (CO_2) by 2040, and will define an updated local emission reduction target. In the meantime, the County has adopted the Metropolitan Washington Council of Governments (MWCOG) climate mitigation goal of 50 percent greenhouse gas emission reductions below 2005 levels by 2030. In 2005, Loudoun County's GHG emissions were 3.8 million metric tons,

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[15] Niina H. Farah, C. A. (2022, January 31). *Court deals major blow to Mountain Valley Pipeline*. E&E News. Retrieved March 25, 2022, from https://www.eenews.net/articles/court-deals-major-blow-to-mountain-valley-pipeline/

[16] Virginia's Legislative Information System, 2020 Session.

[17] *The Virginia Clean Economy Act (HB1526 ... - CCAN action fund*. (n.d.). Retrieved March 25, 2022, from https://ccanactionfund.org/media/Virginia-Clean-Economy-Act-update-factsheet.pdf

[18] Hayes, R. (2021, November 4). 7 key benefits of greenhouse gas emission reduction. Benchmark ESG | Gensuite. Retrieved January 26, 2022, from https://benchmarkdigitalesg.com/news/7-key-benefits-of-greenhouse-gas-emission-reduction/

[19] Editor, L. to the. (2019, January 14). *Zero carbon virginia: A call for renewable energy and greater efficiency*. LoudounTimes.com. Retrieved January 26, 2022, from https://www.loudountimes.com/opinion/zero-carbon-virginia-a-call-for-renewable-energy-and-greater-efficiency/article_ff81ad7c-f89e-11e8-99ff-4f2ed32f96a2.html

so in order to reach the MWCOG goal, they must reduce their emissions to 1.9 million metric tons. At the State level, the Commonwealth of Virginia requires Dominion Energy Virginia to be 100 percent carbon-free by 2045 and Appalachian Power, another large energy provider in Virginia, to be 100 percent carbon-free by 2050 and requires nearly all coal-fired plants to close by the end of 2024.

However, recently, the Loudoun County Board of Supervisors held an Energy Strategies Workshop showing GHG emissions grew from around 3.8 million metric tons of CO_2 to almost 6.3 million metric tons in 2018 (September 29, 2021).[20] This increase is driven mostly by an increase in size and energy demands of data centers.[21]

E. CCA as a Policy Option

The client of the report, Virginia Clean Energy (VCE), is a nonprofit organization promoting the policy option of Community Choice Aggregation (CCA) as an effective tool for municipalities to significantly reduce their GHG emissions from electricity procurement at the local level. Virginia Code §56-589 of the Virginia Electric Utility Restructuring Act (VEUR) of 1999, reenacted in 2007, allows for CCA formation, however no CCA programs for residential and businesses exist in Virginia to date.[22]

CCA as a policy option in Loudoun County would give communities a tool to combine their energy load to purchase competitive and clean power on an "open power market".[23] Moreover, CCA would let its communities vote on their power mix for generation, which aligns with standards set by the political subdivision. Letting communities vote on their desired power mix, would allow CCA to purchase power from renewable energy projects locally and create even more local jobs to build energy generation.

F. CCA Feasibility Study

Loudoun County has since hired GDS Associates, Inc, an engineering consultant firm, to prepare a feasibility study evaluating CCA. The feasibility study was finalized in December of 2021 and concludes:[24]

1. Forming a CCA would serve lower electricity bills for county customers.

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[20] Bos business meetings, public hearings and special meetings. BOS Business Meetings, Public Hearings and Special Meetings | Loudoun County, VA - Official Website. (n.d.). Retrieved January 26, 2022, from https://www.loudoun.gov/3426/Board-of-Supervisors-Meetings-Packets

[21] Siddik1, M. A. B., Shehabi2, A., Marston3, L., https://orcid.org/0000-0002-1735-6973, A. S., & https://orcid.org/0000-0001-9116-1691, L. M. (2021, May 21). *IOPscience*. Environmental Research Letters. Retrieved February 4, 2022, from https://iopscience.iop.org/article/10.1088/1748-9326/abfba1

[22] § 56-589. Municipal and State Aggregation

[23] Blue Virginia. (2018, January 10). *Vote your power: Community choice energy in Virginia*. Blue Virginia. Retrieved March 5, 2022, from https://bluevirginia.us/2018/01/vote-your-power-community-choice-energy-in-virginia

[24] GDS Associates Inc. (n.d.). *Loudoun County Municipal Aggregation Technical Feasibility Study*. Retrieved March 5, 2022.

2. CCA customers should see no changes in service except lower rates and increased renewable power procurement.
3. Customers would pay generation charges set by the CCA and no longer pay Dominion Energy's costs for electricity generation, but would still pay the costs of Dominion services or wire rates.

However, even though the feasibility study concludes that a CCA may have several positive impacts on its consumers and the environment, it does not indicate any conclusions about its impact on data centers, which is the purpose of this report and what the applied policy project seeks to answer.

G. Policy Question

To help Loudoun County reach its energy strategy plan by reducing GHG emissions, increasing renewable energy usage, and adding value to organizations and the community, this report aims to answer the following policy question:

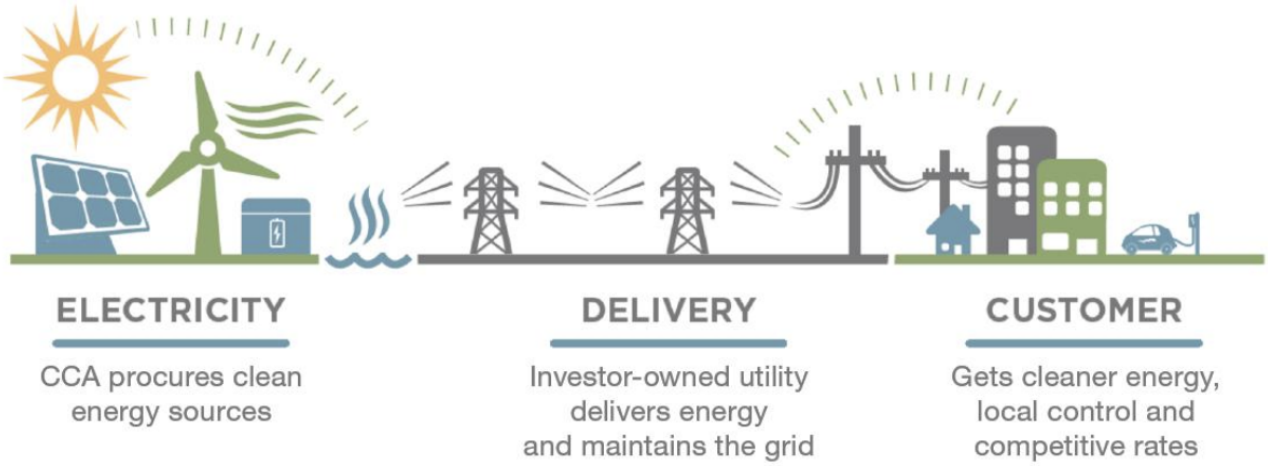
What would be the impact of Community Choice Aggregation (CCA) in Loudoun County for decarbonizing data center energy usage?

II. Background

A. Community Choice Aggregation

CCA is an alternative energy procurement model that allows counties, cities, and municipalities to aggregate electricity production within their boundaries.[25] Through this model, the local government can negotiate lower rates and choose a greater percentage of renewable energy.[26] As Figure 2-1 shows, the CCA program procures the energy with their preferred ratio of renewables, the local IOU delivers said energy and the customers maintain local control over their energy mix with more competitive rates. Local governments manage the community's electric power supply while the IOU continues to provide distribution and billing. CCAs are currently active in 7 states; California, Illinois, Massachusetts, New York, Ohio, New Jersey, and Rhode Island. They are authorized in 2 more states, New Hampshire and Virginia, and currently under consideration in 5; Arizona, Colorado, Connecticut, Maryland, and Oregon.[27] The benefits of a CCA program may include cleaner energy sources, local retail market competition, more stable electricity rates, and reduced GHG emissions.

Figure 2-1: Community Choice Aggregation[28]



1. CCA Program History

Massachusetts was the first state to legalize CCA in 1997, making Cape Light Compact the first CCA program in the nation.[29] California authorized theirs in 2002 under Assembly Bill

[25] What is CCA? Virginia Clean Energy. (n.d.). Retrieved February 15, 2022, from https://www.virginiacleanenergy.org/what-is-cca.html#:~:text=Community%20Choice%20Aggregation%20(CCA)%20is,retail%20customers%20within%20their%20boundaries.?

[26] Ibid.

[27] Ibid.

[28] Ibid.

[29] Andover CCA FAQ. Retrieved February 20, 2022 from https://www.andovercca.org/?page=faq.

117 and Senate Bill 790.[30] In May of 2010, Marin Clean Energy (MCE) was formed, becoming California's first CCA and in 2015; Lancaster became the first California city to create a stand-alone CCA.[31] In 2018, California's energy consumption was second-highest among all states, but its per capita energy consumption was the fourth-lowest due in part to its mild climate and its energy efficiency programs.[32] California has joint power authorities run programs on behalf of multiple jurisdictions with 33% or 100% green power options in CCAs like in Sonoma County and 50% or 100% from MCE.[33] These options are noticeably higher than their respective incumbent utility offers and higher than the state RPS requirements with similar prices. MCE has supported 5,000 green jobs, saved over $68M since 2010 and committed over $2.1B to build new CA renewable projects, with 49 megawatts (MW) of new renewable projects built in their service area.[34] The CCA has also eliminated over 700,000 metric tons of GHGs from 2010 to 2016.[35] Meanwhile, in 2014, Sonoma Clean Power saved customers $14M while reducing GHG emissions by 54,000 metric tons.[36] New York's pilot CCA program in Westchester has saved residents nearly $8M and is responsible for the largest purchase of renewable energy in New York history.[37] In 2016, community choice aggregations sold about 8.7 billion kilowatt-hours of green power to about 3.3 million customers.

The expansion of CCAs into more states would increase demand for renewable energy by as much as 53 million MWh per year.[38] These CCA programs could be emulated in Loudoun, or in other municipalities in Virginia, with their own CCA. The Loudoun program can mitigate risk and ensure best practices by learning from the experiences of out of state CCA programs. Surrounding Virginia communities investigating CCAs may be able to avoid problems and identify opportunities by understanding the business strategies and lessons learned from the first state program.[39]

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[30] Bill Number: AB 117. Retrieved February 22, 2022 from http://www.leginfo.ca.gov/pub/01-02/bill/asm/ab_0101-0150/ab_117_bill_20020924_chaptered.html.
[31] Cal Choice. CCA History. Retrieved February 24, 2022 from https://californiachoiceenergyauthority.com/cca-history/.
[32] U.S. Energy Information Administration, California. Retrieved February 24, 2022 from https://www.eia.gov/state/?sid=CA.
[33] CCA by State. LEAN Energy US. (n.d.). Retrieved March 6, 2022, from https://www.leanenergyus.org/cca-by-state
[34] What is CCA? Virginia Clean Energy. (n.d.). Retrieved February 15, 2022, from https://www.virginiacleanenergy.org/what-is-cca.html#:~:text=Community%20Choice%20Aggregation%20(CCA)%20is,retail%20customers%20within%20their%20boundaries.?
[35] Ibid.
[36] Ibid.
[37] Ibid.
[38] O'Shaughnessy, Eric. Community Choice Aggregation: Challenges, Opportunities, and Impacts on Renewable Energy Markets. NREL. 2019.
[39] Starting a New CCA. CalCCA. (n.d.). Retrieved February 24, 2022, from https://cal-cca.org/resources/#toggle-id-1.

2. CCA in Virginia

a) Overview

While the legal framework for CCAs in Virginia is laid out in Virginia State Code, municipalities in the state have yet to establish a first program. Without a CCA program, renewable energy mixes have been historically low in the state. In 2020, natural gas accounted for 61% of Virginia's utility-scale electricity net generation, nuclear supplied 29%, renewables (mostly biomass) provided 6%, and coal fueled less than 4%.[40] It is important to note that nuclear energy has ambiguity in its status as far as being considered green energy. It is the prevailing political wisdom to consider it nonrenewable and the report assumes as such. Considering the volume of data centers in Loudoun, establishing a CCA can go a long way towards reducing the state's GHG emissions. Furthermore, CCAs have the ability to attract large companies such as Facebook, Apple, and Google to invest in renewable energy sources while creating local green jobs. Since there are no CCA programs formed in the state, Loudoun County can lead the transition towards more sustainable energy and help meet state energy GHG emission reduction goals. CCA programs typically consist of higher mixes of renewables but they do not come at the price of operating at a loss. These CCAs can be profitable for the community in which they operate while simultaneously increasing local green energy efforts. Should a CCA program be successful in Loudoun County, net income from procuring and selling clean electricity can be reinvested locally to support the development of more renewable energy and promotion of energy efficiency.[41]

b) Legal Setting

Virginia's code § 56-589 allows for the formation of CCA programs, based on the vote of Loudoun County's governing body.[42] The code allows for the CCA to include municipal, residential, and commercial customers, including data centers. The Environmental and Regulatory Law Clinic at the University of Virginia School of Law confirmed the legal framework available for the establishment of a CCA in Virginia.[43] The legal report suggests that existing Virginia law allows for the development of a CCA program by right, with three options and under certain restrictions. The three options under Virginia Code § 56-589 allow designing a CCA: "(1) on behalf of customers within its jurisdiction; (2) on behalf of itself for its governmental buildings and facilities; and (3) on behalf of itself and other municipalities for their governmental buildings and facilities".[44] Code §56-589 introduces the restrictions written in law, chiefly among them the demand of at least 5 MW of use in the previous calendar year to qualify.[45] The megawatt use demand may be easy for the large counties such as Arlington

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[40] U.S. Energy Information Administration, Virginia. Retrieved February 24, 2022 from https://www.eia.gov/state/?sid=VA.

[41] Municipal Aggregation Technical Feasibility Study. December 2, 2021. GDS Associates, Inc.

[42] Municipal Aggregation Technical Feasibility Study. December 2, 2021. GDS Associates, Inc.

[43] Legal Options for Community Choice Aggregation in Virginia. University of Virginia, School of Law. December 2019.

[44] Ibid.

[45] Ibid.

and Loudoun to meet but challenging for the smaller Virginia municipalities. In addition, the law requires that a customer cannot have had a peak demand exceeding one percent of the incumbent utility's peak load during the previous calendar year. The limit is also designed to eliminate many smaller municipalities. Lastly, there is a five-year written notice requirement before a customer may return to the incumbent utility for any reason.[46] This notice is designed to deter leaving incumbents such as Dominion. So, while the legal framework for a CCA is present and is written law, there are caveats and obstacles to overcome.

c) Recent Efforts

Municipal aggregation was established by statute in 1999 as part of deregulation under the VEUR. In 2003, the City of Fairfax applied to the State Corporation Commission (SCC), for an aggregation pilot program license, however, they did not move forward with their program and let the license expire in 2009.[47] In 2007, Virginia re-regulated the electric utility industry under the Electric Utility Regulation Act, imposing new laws on the State's two largest IOUs, Dominion and Appalachian Power Company.[48] VCE also conducted a feasibility study for a potential CCA in Arlington County, Virginia. In October 2018, VCE submitted the project to AGU's Thriving Earth Exchange program, and was selected in December 2018. Although not an official partner of this effort, Arlington County was chosen in part due to its transformative Community Energy Plan (CEP), which includes commitments to 100% electricity from renewable sources by 2035 and achieving carbon neutrality by 2050.[49] In the written Virginia code, customer enrollment is allowed on either an opt-in or opt-out basis. In some states' aggregation programs, the customer of the municipal aggregator pays a monthly charge for the costs remaining to the incumbent utility for power purchased, otherwise known as "exit fees".[50] These are established to protect the remaining incumbent customers from paying for the costs of the departing load.

d) State Level Policies

California and Virginia are the only states with regulated retail electricity markets that allow CCAs.[51] No other regulated market states have implemented CCA-enabling legislation. The lack of legislative implementation is indicative of the considerable challenges facing CCAs in regulated markets, including but not limited to significant opposition from IOUs.[52] Virginia's SCC regulates its IOUs and electric cooperatives. Suppliers and aggregators must be approved for licensure by the SCC. In the event of a CCA program proposal, the governing body with jurisdiction (which may be the SCC) would also need to approve the plan before it proceeds

[46] Ibid.
[47] Municipal Aggregation Technical Feasibility Study. December 2, 2021. GDS Associates, Inc.
[48] Ibid.
[49] Feasibility Study for a Potential Community Choice Aggregation in Arlington County. Virginia Clean Energy. March 2020.
[50] Municipal Aggregation Technical Feasibility Study. December 2, 2021. GDS Associates, Inc.
[51] O'Shaughnessy, Eric. Community Choice Aggregation: Challenges, Opportunities, and Impacts on Renewable Energy Markets. NREL. 2019.
[52] Ibid.

further. The election of Republican Governor Youngkin in November 2021 caused clean energy advocates to question if there is the potential for a backlash to clean energy in the state due to growing fears of "turning Virginia into California".[53]

e) Non-CCA Electricity Procurement Methods

Dominion Energy, the largest IOU in Virginia, provides electricity to more than 2.5 million homes and businesses in Virginia including over 12 million square feet of commissioned data center space.[54] Another option for procuring energy comes from Power Purchase Agreement (PPA), which are long-term contracts in which commercial entities form an agreement with an energy generating unit to procure renewable energy certificates (RECs) from a specific project.[55] RECs are the "environmental attributes of electricity generated from renewable resources" with 1 REC equaling 1 MWh.[56] Lastly, Competitive Service Providers (CSP) are companies licensed by the SCC to supply or aggregate energy services throughout Virginia. For more detail in regards to these entities, see Appendix B.

B. Data Centers

1. Overview

Data centers house computer systems and other associated components to allow users to use online services such as telecommunication, video streaming, etc. The demand for data centers is continuously growing and is expected to grow exponentially in the foreseeable future. Some companies using data centers build their own data centers, such as Google and Meta. However, most data center users lease space in a data center facility. Generally, the leasing activity can take place on either a retail or wholesale basis.

If a data center user chooses to lease a data center on a retail basis, the landlord can provide services down to the computer rack level and will keep different devices from different tenants away by installing physical separations such as cages. If a data center user chooses to lease a data center on a wholesale basis, the provider can lease the space directly to the tenant and the landlord will be responsible for the power distribution units.

The lease for data centers is often long and can be as long as ten years or more. It can be costly for a data center user to move their data in and out of a data center, thus that a user can often choose the renewal option when a lease is over. The rent of the lease is often decided by the space used and the amount of power allocated to this space. Some data center companies provide green leases, also referred to as "energy-aligned" leases, which use standard lease

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[53] Spector, Julian. *What does Glenn Youngkin's win in Virginia mean for clean energy?* Canary Media. November, 2021.

[54] Dominion Energy, "Northern Virginia ranks as the largest data center market in the world", accessed 2022-03-08, https://economicdevelopment.dominionenergy.com/va/key-industries/data-centers/

[55] EPA, Green Power Partnership. Introduction to Virtual Power Purchase Agreements. 2016.

[56] Ibid.

clauses that provide for the management and improvement of the environmental performance of a building to align financial incentives and sustainability goals between a landlord and a tenant.

The power requirements for a data center can be massive. A typical 100,000 square foot data center will be serviced by 15-20 MW. The power is consumed by two main usages: the power to run the equipment and the power to cool the equipment. While some of the data centers are seeking electricity from renewable sources, most of the energy provisions come from IOUs that have a low proportion of renewable energy in the portfolio. In Loudoun County specifically, the ratio of renewable energy percentage provided from Dominion's portfolio, is only as low as 4%[57].

2. Data Center Market in the US

The top five data center companies in the US are Equinix, Digital Realty, CyrusOne, CoreSite, and QTS Realty Trust.[58] Table 2-1 shows the number of data centers, customer, power capacity, square feet and interconnections of each company.

Table 2-1: Top Five Data Center Companies

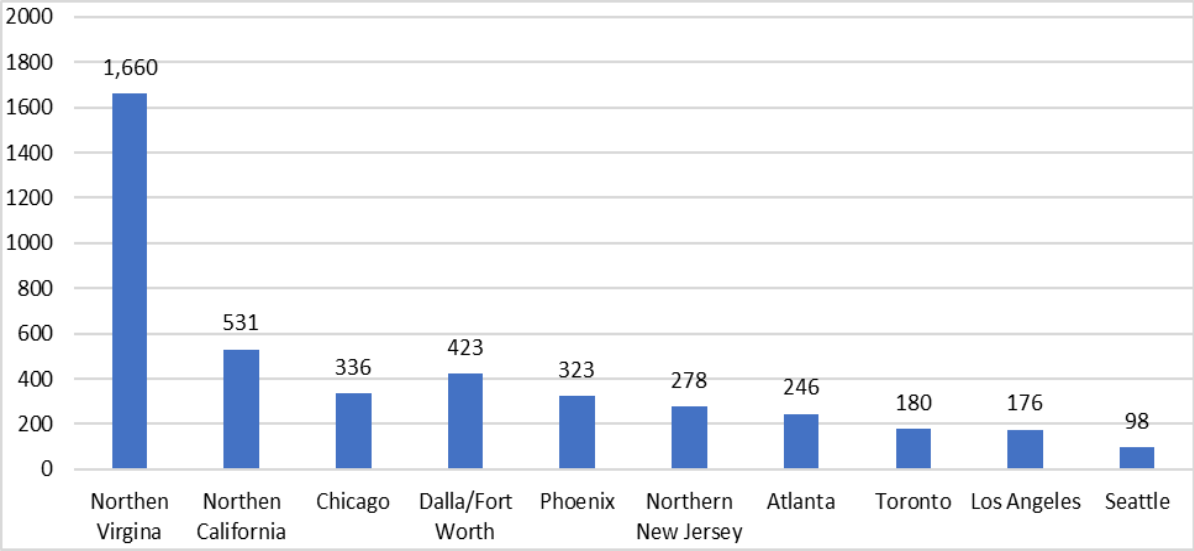
Company	Data Centers	Customers	Power Capacity	Square Feet	Interconnections
Digital Realty	284	4,000+	1,800MW	35.4m	162k
Equinix	227	10,000+	1,300MW	26.2m	387k
CyrusOne	53	1,000+	836MW	7.7m	23k
CoreSite	24	1,370+	250MW	3.2m	32k+
QTS	27	1,000+	294MW	3.9m	13k

As Figure 2-2 shows, the top 10 data center markets in North America are Northern Virginia, Northern California, Chicago, Dallas, Phoenix, Northern New Jersey, Atlanta, Toronto, Los Angeles, and Seattle.[59] Among these 10 largest markets, Northern Virginia is also the largest market in the world. The total power of data centers in Northern Virginia is 1660 MW, more than three times the capacity of the second largest market in North America, Northern

[57] Starks, L. (2020, August 4). *Why I sold Dominion Energy (NYSE:D)*. SeekingAlpha. Retrieved March 7, 2022, from https://seekingalpha.com/article/4364041-why-i-sold-dominion-energy
[58] Zhang, M. (2021, April 15). *Top 5 Data Center Companies & 7 U.S. markets*. Dgtl Infra. Retrieved March 11, 2022, from https://dgtlinfra.com/top-5-data-center-companies-markets/
[59] Pure-play Data Centre S-REIT sponsored by largest global owner, operator, developer and acquirer of Data Centres. (n.d.). Retrieved March 11, 2022, from https://www.Digitalcorereit. com/overview/default.aspx

California. Following figure shows the commissioned power of data centers in each area from the top 10 data center market.

Figure 2-2: Top 10 North America Data Center Markets



Northern Virginia also has the highest inventory growth rate of 257% in the primary market, the highest net absorption, and the most data center capacity under construction (see Appendix A Figure 1&2). The positive net absorption in Northern Virginia indicates that there was more capacity rented than the capacity that became available during the period, showing there is a significantly high demand for data centers in Loudoun County.

3. Loudoun County's Popularity

Loudoun County, and specifically the Ashburn area, is known as the Data Center Capital of the World. When the internet first became available to the public in 1991, Ashburn and its surrounding region of Northern Virginia was immediately identified as the ideal location for the physical location for networked computer servers in data centers.[60]

Data Centers in Loudoun County are estimated to contribute to approximately 70 percent of the internet traffic flows in the world. As for the total data center capacity, the data center market around Ashburn has become the first in the world to surpass 1 gigawatt, which is almost twice as much as the second largest data center concentrated area in the world[61]. Table 2-2 lists the key factors that make Northern Virginia the ideal place for data centers.

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[60] St.Germain, J. (2019, August 29). *Why is Ashburn the Data Center Capital of the World?* Datacenters.com. Retrieved March 9, 2022, from https://www.datacenters.com/news/why-is-ashburn-the-data-center-capital-of-the-world

[61] Ibid.

Table 2-2: Key Factors Contributing to Loudoun County's Popularity

Factor	Description
Power	Dominion Virginia Power provides most of the energy consumed by data centers in Northern Virginia with a rate 20% lower than the national average.
Water	Data Center Alley has abundant municipal access to water for cooling needs due to its proximity to the Potomac River.
Fiber Access	Metropolitan Area Exchange, East (MAE-East), later Equinix brought one of the earliest Internet Exchange Points to the Eastern seaboard, transforming Northern Virginia into the powerhouse of connectivity.
Competent Workforce	Government contractors and tech experts from every area of specialization congregate in Northern Virginia for proximity to Washington D.C, giving data centers access to an elite and highly skilled workforce.
Resources	Surrounded by a high concentration of other businesses providing equipment, parts, and labor, the area is rich in competitively priced resources for running a data center.
Space to Build	In the past decade, 75 data centers have been opened in Loudon County alone, encompassing 10 million square feet of operating space. While the real estate market is competitive, there's still plenty of room for expansion.

According to the report and the interview with a data center expert from Digital Infra, there is a trend that the number of data centers, capacity, and consumption are all headed upward. From 2012 to 2021, data center space has increased more than four-fold in Loudoun County, from 5 million square feet of building space to over 26 million square feet. And in 2021, there is still an additional 4 million square feet of data centers under development.[62] Northern Virginia has been the most sought after area for the investors to invest in space. Figure 3 in Appendix A shows the power capacity also continued to increase while vacancy rate is below 10% all the time. The vacancy rate is a measurement expressed as a percentage of the total amount of physically vacant space divided by the total amount of existing inventory of data centers. The increasing inventory and low vacancy rate indicates the growing market and large demand for data centers.

[62] Zhang, M. (2022, February 18). *Loudoun County Mulls Route 7 Data Center Prohibition, Nixes 'Dulles Cloud South'*. Dgtl Infra. Retrieved March 9, 2022, from https://dgtlinfra.com/loudoun-county-route-7-data-centers/

III. Methodology & Data

This report aims to assess the impact of CCA on data center decarbonization in Loudoun County. CCA impact is examined and compared to other policy options that could be considered to promote data center decarbonization. CCA has not yet been implemented in Virginia, although a law passed in 1999 to allow for its implementation. Therefore, there is also an analysis of the feasibility of implementing each policy from the perspective of the Loudoun County government. Finally, based on the evaluation of these policies, a final recommendation is made regarding policies that Loudoun County should implement.

A. Data sources and methodology

Table 3-1: Summary of Data Sources and Methodology

Method	Data Source	Rationale for Analysis
Market Analysis about data center	• The Loudoun County Office of Mapping & Geographic Information • Data platform that consolidates information on the data center market	To understand the data center market structure in Loudoun County To estimate the total energy consumption of data centers in Loudoun County
Trend Analysis about GHG	• Total Power Data of Each Data Center in Northern Virginia • Data on projected power demand for data centers in the U.S.	To estimate GHG emissions for each policy option
Trend Analysis about Rates	• The prospect of CCA rates analyzed by Loudoun County Feasibility Study • Electricity rate information from U.S. Environment Information Administration (EIA)	To estimate rates for each policy option
Interviews	• Data Center Providers • Loudoun County Staff • Arlington County Staff • CCA staff • CCA Research Expert • Data Center Market Research Expert	To understand data center markets and each stakeholders' view To understand research methodology on CCA

As Table 3-1 summarizes, this research examines relevant quantitative and qualitative data to evaluate each policy option to promote data center decarbonization. This report organizes

information on data centers located in Loudoun County for quantitative analysis. It uses that information to estimate the projected future GHG emissions and electricity prices when each policy option is implemented. The period for the analysis ranges from 2024 to 2033 to be compared consistently with the Loudoun County feasibility study period.

For the qualitative analysis, the inherent risk factors in each policy option and the logic of the data center's renewable energy procurement behavior is analyzed through expert interviews and case studies. As a basis for these analyses, this report also researches relevant documents, including government documents, academic publications, data center's ESG reports, press articles, and CCA's reports.

B. Data Center Location and Energy Consumption Analysis

The location information, space and capacity of individual data centers is retrieved from Loudoun County Office of Mapping & Geographic Information and individual data center's website. The aggregated data about total capacity for each data center provider is found from the Greenpeace report.

Due to limited resources of data, the electricity consumption data for Loudoun County's data centers specifically is not available. The electricity consumption used in this report is based on an estimation calculated from the total capacity. The total electricity consumption for data centers in Loudoun County is estimated by the following formula:

$$Total\ Electricity\ Consumption = Total\ Capacity \times Total\ Consumption\ Estimate \times Total\ Operation\ Hour$$

The value of the actual consumption estimate is taken to be 0.6 as the estimated percentage range for actual electricity usage according to the interview with Digital Infra falls between 50% to 75%. It is assumed that the actual consumption rate for the data center on average will be 60% on average. The total operation hour is calculated as every hour in a year.

C. GHG Emission Analysis

The basic formula to estimate annual GHG emissions for all data centers in Loudoun County is as follows:

$$GHG_i = Total\ Consumption_i \times Share\ of\ Resource_i \times Emissions\ Factor$$

This report estimates GHG emissions for each policy option by modifying this basic formula to fit each policy option. The share of resource and emissions factors are explained below.

Share of Resource refers to the percentage of sources of electricity supplied to each data center. This report uses the information on the energy mix published by each electricity supplier.
Emissions Factor is an indicator of how much CO_2 is emitted by each source of electricity. The total life cycle emissions factor published by the National Renewable Energy Laboratory

(NREL) is also included.[63] Life Cycle Assessment (LCA) is a method of calculating the impact of energy consumption on the environment, taking into account all processes from energy generation to energy consumption. For example, photovoltaic power generation produces no CO_2 during electricity production. However, CO_2 is produced during the equipment's manufacture and disposal. Therefore, the emissions factor is not zero, even for solar power. In addition, since there is no data available for the Other and Unspecified categories, emission factor values by the UCLA Luskin Innovation Center are used in its place.[64] These emission factors are summarized in Table 3-2.

Table 3-2: LCA Emissions Factors for Electricity Generation Technologies

Generation Technology	Emissions Factor (MTCO2e/MWh)	Generation Technology	Emissions Factor (MTCO2e/MWh)
Biomass	0.052	Nuclear	0.013
Photovoltaic	0.043	Natural gas	0.486
Geothermal	0.037	Coal	1.001
Hydropower	0.021	Other	0.428
Wind	0.013	Unspecified	0.428

GHG emissions in 2033 calculated by the above formula are compared with a baseline to determine the GHG reductions for each policy option. The baseline is set as the case where Dominion continues to supply electricity until 2033, maintaining the current power mix as of 2020.

In estimating GHG emissions, unbundled RECs and Virtual PPAs are not considered due to the difficulty of linking them to each data center. While these methods are effective as a means of offsetting GHGs, electricity is procured from non-renewable resources. As a result, the use of unbundled RECs has been declining in California CCAs, and seven CCAs have never relied on them.[65]

D. Rates Analysis

When calculating rates for data centers by each policy option, the unit of analysis is dollars per

[63] NREL. (n.d.). Life Cycle Greenhouse Gas Emissions from Electricity Generation: Update. Retrieved March 27, 2022, from https://www.nrel.gov/docs/fy21osti/80580.pdf

[64] Trumbull, K. & DeShazo, J. (2021). Southern California Regional Energy Needs Assessment. UCLA Luskin Center for Innovation.

[65] Trumbull, K., DeShazo, J., Gattaciecca, J., Callahan, C., & Einstein, M. (2019). The Rapid Growth in Community Choice Energy and its Acceleration of Renewable Energy: A California Case Study. UCLA Luskin Center for Innovation.

kilo-watt hour ($/kWh). A kilo-watt hour measures the amount of energy used per hour. As data centers will be applied to commercial rates, this section analyzes commercial rates specifically or its proxy figure.

For CCA rates, methods and base figures from the Loudoun County feasibility study are used to forecast the rates. When forecasting the rates of Dominion Energy and PPA deals, the base figures from the EIA are utilized while the yearly increase rate (2%) refers to the assumption used in the Loudoun County feasibility study. In case of RPS target increase, the rate will be calculated based on the RPS target increase ratio and the proportion of RPS compliance costs in the total bill.

E. Expert Interviews

The main stakeholders regarding the policy questions set in the report are CCAs, electric utilities as suppliers of electricity, and data centers as consumers of electricity. Conducting interviews with these stakeholders makes the policy evaluations and proposals more realistic and meaningful. There are also interviews with experts in the field of academia and media to understand the policy analysis methodology and the structure of the data center market for the report. Table 3-3 summarizes the interviewees in this report. The details of the interview process and a list of interviewees are described in Appendix C.

Table 3-3: Summary of Interviewees in this report

Interviewee	Rationale for Interview
VCE	VCE, the client for the report, has in-depth knowledge on the subject and a vast network of CCAs in the country. Therefore, while VCE was the client in this study, it also served as the critical point of contact and expert on Virginia's electricity market structure.
Loudoun County Department of General Services	The general services department is responsible for reviewing CCA implementation in Loudoun County. The department reported to the Board of Supervisors in January of 2022 on a feasibility study of CCA in Loudoun County. This report is expected to be used as reference material to consider CCA implementation. Therefore, the policy recommendations are summarized, considering their outlook and concerns about CCA implementation.
Arlington County Department of Environmental Management	Should Loudoun County decide to implement CCA, it will need to consider how to design its governance model. That consideration may involve coordination with other counties in Virginia. Arlington County was the first County to initiate discussion around CCA and the status of the County's consideration of CCA is essential information for Loudoun County.
Data Centers	The data centers' approach to power procurement and actual business operations are crucial elements of this report. Since the data published by data centers in their ESG reports may provide a superficial analysis of these elements, the authors decided to conduct an interview survey. Digital Realty, QTS, and CoreSite cooperated with our interview survey.
CCAs	As a case study, this report examines the treatment of data centers and other corporate clients in CCAs in the Northern California area, where data centers are concentrated. Silicon Valley Clean Energy (SVCE) and San Jose Clean Energy (SJCE) contributed to the interview section. These interviews allowed for more accurate predictions of what business decisions data centers will make when Loudoun County implements CCA.
CCA Policy and Research Experts	The UCLA Luskin Innovation Center has conducted several studies and published reports on CCA. Their high level of expertise in renewable energy procurement schemes, including CCA, aided the policy evaluation process.
Media with Expertise in the Data Center Business	Dgtl Infra is a media that summarizes market trends related to the four facilities essential to deliver bandwidth: data centers, towers, fiber, and small cells. The interviews with them provided in-depth insight into the data center market that they have accumulated over the years.

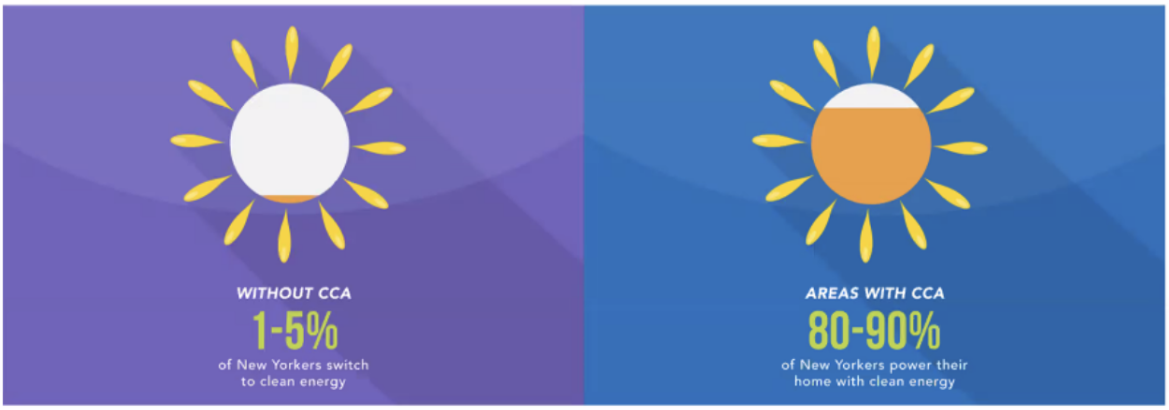
IV. Key Findings

A. Effective Design of CCA

1. Opt-out Setting

One key finding of a CCA model is found in the state of Virginia's Code § 56-589. Section 56-589 reads as follows: "Any municipality or other political subdivision of the Commonwealth may aggregate the electric energy load of residential, commercial, and industrial retail customers within its boundaries on an opt-in or opt-out basis".[66] Hence, a CCA model is required to exist on an opt-in or opt-out model basis, meaning that customers do not have to participate if they do not want to. Findings from this study show that a CCA with an opt-out model shows to be beneficial for increasing clean energy usage. In fact Joule Community Power, a clean energy advocate company, has noted this impact of a CCA opt-out model in New York as shown in Figure 4-1.[67]

Figure 4-1: Impact of Opt-Out Model



This figure is consistent with the interview findings from SJCE and SVCE. Their opt-out rates are extremely low, about 3% and 4% respectively. It is important to note that in California when a CCA is established, it is required by law for the CCA to send out notification to all customers about CCA's value proposition and information on how to opt-out.

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[66] GDS Associates Inc. (n.d.). *Loudoun County Municipal Aggregation Technical Feasibility Study*. Retrieved March 5, 2022.

[67] Facebook.com/solarpowerworld. (2021, February 11). *Joule Community Power Testing 'opt-out' community solar program in New York*. Solar Power World. Retrieved March 27, 2022, from https://www.solarpowerworldonline.com/2020/09/joule-community-power-testing-opt-out-community-solar-program-in-new-york/#:~:text=Residents%20can%20opt%2Dout%20of,benefits%20to%20solar%20project%20developers.

2. Types of CCAs

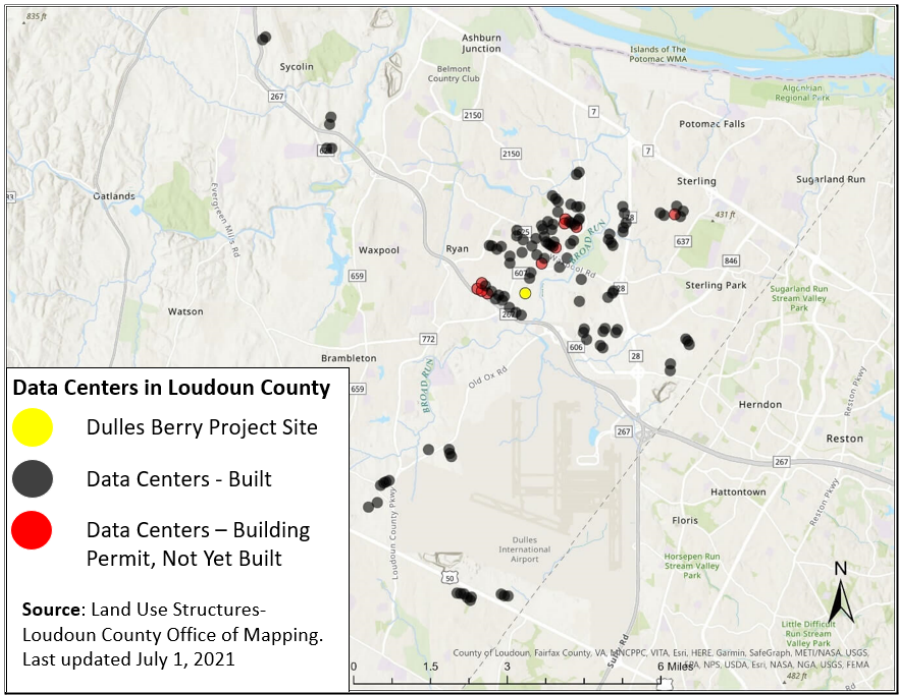
There are a few different types of CCAs governance to consider with key differences between each of them. First, there is a single-jurisdiction. A single-jurisdiction establishes and operates its own CCA program. Of course, there are some benefits to this type, such as full control over policy decisions regarding power content mix, local programs, and revenues. However, because this type of CCA has full control, the jurisdiction will also take on all the risks and liabilities. Next, there is a multi-jurisdiction CCA, also known as joint powers authority (JPA). This type of CCA includes multiple jurisdictions that make an intergovernmental agreement (IGA), which is a type of contractual agreement that assigns jurisdictions to provide a particular service and a board that provides oversight. Lastly, there is a relatively new governance type named hybrid CCA (hybrid JPA of CCAs). A hybrid CCA shares costs such as power procurement, technical analysis, scheduling forecasting, and other related costs. Each member of this kind of CCA has local control over power content, rate structure, program development, and operational revenue. There is a board that oversees hybrid CCA that is responsible for contracting and budgeting with third-party vendors.

B. Data Centers' Electricity Consumption in Loudoun County

1. Number of Data Centers and Their Capacity

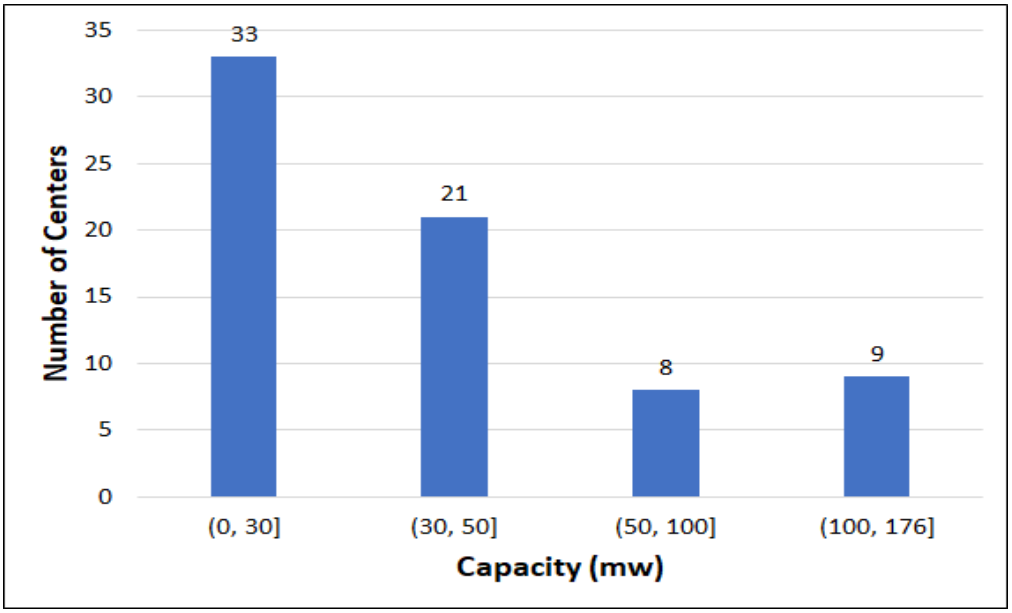
The Loudoun County Office of Mapping & Geographic Information provides spatial information about all the data centers in Loudoun County. According to the data, there are 112 data centers in Loudoun County and 10 data centers with building permission and still in construction. Figure 4-2 shows the location of all data centers in Loudoun County.

Figure 4-2: Map of Data Centers in Loudoun County



As Figure 4-3 shows, the data centers in Loudoun have a capacity range from 2 MW to 176 MW. The data center with the largest capacity is one of the hyperscale data centers from Amazon AWS. Most data centers have capacities under 50 MW and there are 9 of them exceeding 100 MW. By summing the capacity for each data center, the resulting total capacity for data centers in Loudoun county is 3,041.7 MW.

Figure 4-3: Number of Data Centers in Each Capacity Range



About half of the data centers from Amazon AWS have a high capacity above 50MW. Additionally, Amazon AWS owns the data center facility with the hyperscale power capacity in the County, which has a capacity of 176MW. Table 4-1 shows the top ten data center providers with the highest capacity in Loudoun County.

Table 4-1: Number and Capacity of Data Centers in Loudoun County

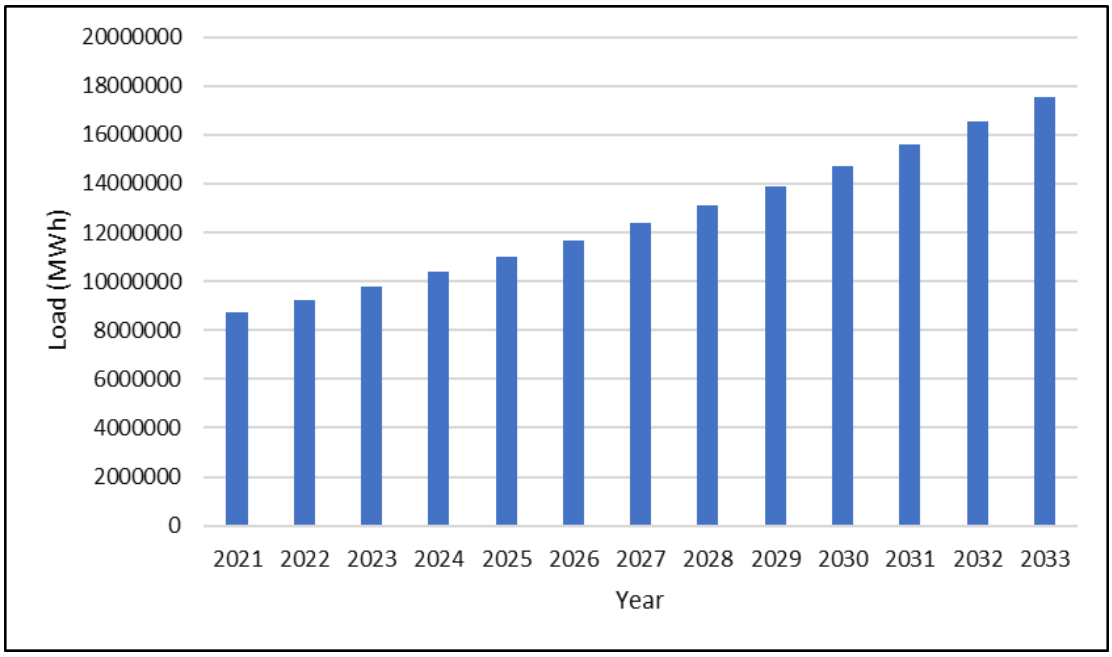
Provider	Total Capacity (MW)	Number of Data Centers
Amazon AWS	865	19
Digital Realty	612	16
CyrusOne	324	5
Aligned Energy	180	2
QTS	162	4
Vantage Data Centers	146	1
Cyxtera	141	3
Equinix	121	11
NTT Global Data Centers	108	5
Anexio	86	3

The forecast of the load from 2023 to 2033 and the proportion of the energy consumption in each sector is shown in Figure 4 in Appendix A. The commercial sector consumes a large portion of the total electricity consumption compared to all sectors combined[68]. It is important to note the load growth of the commercial sector was significant for the past five years from the historic data acquired from Dominion's annual retail sales. This trend is likely to continue in the future and grow at the same rate.

There are over 140,000 registered accounts in total and most of the accounts are residential (see Figure 5 in Appendix A). The second largest component of the accounts are in the commercial sector, and the number of commercial accounts is nearly a quarter of the residential.

The forecast of annual load for Loudoun county's data centers is based on a 10-year time span (2024-2033), the annual growth rate for data centers' total electricity consumption is derived from the Loudoun County CCA Feasibility Study. According to the study, the forecasted load follows a linear trend as it is assumed that the growth rate of electricity consumption for the commercial sector will remain constant and projected load factor data centers will stay the same, within the range from 65% to 70%[69]. Figure 4-4 shows the forecast load of data centers for 10 years.

Figure 4-4: Forecast Load of Data Centers in Loudoun County[70]



[68] Municipal Aggregation Technical Feasibility Study. December 2, 2021. GDS Associates, Inc
[69] "Municipal Aggregation Technical Feasibility Study" (Virginia Clean Energy, n.d., #12)
[70] (Note: this figure does not include single-tenant data centers)

2. Current Energy Procurement Behavior of Data Centers

a) Analysis of PPA market

Virginia is primarily a regulated electricity market, and there is limited choice for residential and commercial customers, including data centers, to choose where their electricity is sourced from. Most data centers in Virginia procure the energy from Dominion Energy, the largest electricity provider and the primary electricity utility for "Data Center Alley". However, the percentage of renewable sources in Dominion's portfolio is still lower than 5%.

Figure 6 in Appendix A shows the proportion of renewable projects in the data center capacity. Among the 15 data centers companies listed, there are 6 IT companies that have a portion of renewable energy in the total electricity procurement. Apple is the only company that has achieved 100% renewable energy goal for data center's energy procurement and the renewable project proportions in other data centers' are still less than a half of their total capacity.

In Loudoun County, a few information technology (IT) companies that have their own energy goals are exploring PPA as a tool for renewable energy procurement as shown in Table 4-2.

Table 4-2: Examples of PPA Signed by IT Companies

Company	PPA Signing Details
Google	• Signed a 10-year 500MW renewable energy deal last May with Applied Energy Services (AES), a CSP accredited by the State.[71] • Two data centers in the County will be powered by 90% carbon-free energy on an hourly basis. • AES assembled a 500MW portfolio from its own projects and third parties adding up to $600 million of investment, which will gather wind, solar, hydro, and battery storage resource[72]
Microsoft	• Signed a renewable energy deal with AES last November. • Microsoft's commitment to use 100% renewable energy by 2025.[73] • AES will supply the energy of a 576MW of renewable energy portfolio, including wind, solar, and battery storage projects in the Pennsylvania, New Jersey, Maryland Interconnection LLC (PJM) region

[71] Swinhoe, D. (2021, May 5). AES and Google sign 500MW renewable energy deal for Northern Virginia data centers. *Datacenter Dynamics.* https://www.datacenterdynamics.com/en/news/aes-and-google-sign-500mw-renewable-energy -deal-for-northern-virginia-data-centers/

[72] Ibid.

[73] Swinhoe, D. (2021, November 3). Microsoft signs renewable energy deal with AES to power Virginia data centers. *Datacenter Dynamics.* https://www.datacenterdynamics.com/en/news/microsoft-signs-renewable-energy-deal-with-aes-to-power-virginia-data-centers/

It is important to note, however, only a small number of IT companies are utilizing the U.S. renewable PPA market. According to a 2019 study by the Renewable Energy Buyers Alliance (REBA), five companies such as Amazon, Meta, Verizon, Google, and Microsoft account for almost 60% of reported renewable energy purchases.[74] There are three main factors that contribute to these tech giants' dominance of the renewable PPA market as shown in Table 4-3.[75]

Table 4-3: Three Hurdles in Signing a PPA

Factor	Description
Scale Requirements	Relative contracts with renewable energy providers basically determine PPA prices. Therefore, the larger the contract, the greater the economies of scale and the better the terms of the PPA contract. Conversely, it is challenging to procure renewable energy through PPAs unless there is a great demand for electricity, such as a giant tech company. According to a Columbia University Center on Global Energy Policy study, without at least 75-100 GWh of geographically concentrated power load, it is unlikely that a practical renewable PPA can be signed.[76]
Price Volatility Risk	When a company enters into a PPA, it compares the fixed price of the PPA that it will pay over the long term with the wholesale power price that would be the variable cost if the PPA were not implemented. It closely examines whether the former is likely to be less than the latter. If wholesale electricity prices are unexpectedly low for an extended period, the company will be financially disadvantaged. It will be difficult for a company to conclude a large-scale PPA unless it is economically strong enough to take such price fluctuation risks.
High Level of Expertise and Long-Term Negotiations	The signing of a PPA involves financial risks, as just described, as well as long-term negotiations with the renewable energy provider. This feature of PPAs requires significant human and time resources. Unless a company can secure legal and financial experts and personnel familiar with the wholesale electricity market, it will face hurdles concluding PPAs.

These characteristics of PPAs were mentioned in the authors' interviews with data centers and CCAs. As shown in Table 4-1, most of the data centers in Loudoun County, except for

[74] Clean Energy Buyers Association. (n.d.). CEBA Deal Tracker. Retrieved March 27, 2022, from https://rebuyers.org/deal-tracker/.
[75] Kobus, J, Nasrallah, A, & Guidera, J. (2021). The Role of Corporate Renewable Power Purchase Agreements in Supporting US Wind and Solar Deployment. Columbia University Center on Global Energy Policy
[76] Ibid.

Amazon, are leasing data centers and are not part of the group that dominates PPAs. Therefore, while the amount of renewable energy procured through the signing of PPAs is on the rise, it is not necessarily reasonable to assume that this trend applies to Loudoun County.

b) Concrete Efforts by Data Centers to Secure Renewable Energy

This section conducts a case analysis of renewable energy procurement behavior by several data centers and reveals the four findings. Since information about the procurement behavior is corporate information, there are limitations in comprehensively collecting and analyzing the data. However, these cases are significant facts that cannot be ignored when examining the impact of CCA on the decarbonization of data centers in Loudoun County.

First, each data center has set its renewable energy ratio target and makes efforts to accomplish it. Since it is unrealistic to expect all data centers to be powered by renewable energy sources in the short term, data center providers whose data centers are located in multiple regions need to decide which region to prioritize in terms of decarbonization.

Some data centers have disclosed their renewable energy procurement policies in their ESG reports. For example, CyrusOne has published a Renewable Energy Procurement Hierarchy, stating that regional and bundled renewable energy procurement is the most desirable.[77] The hierarchy consists of Physical PPA, Virtual PPA (same region), Virtual PPA (different region), and RECs, in that order.[78] Digital Realty also states that it prioritizes the use of renewable energy supplied by the grid in the same region where the data center is located in its ESG report.[79] Given these facts, data centers will give priority for decarbonization to data centers located in regions where it is possible to conclude physical PPAs under relatively better conditions. QTS also publishes in its ESG report which regions' data centers are powered by renewable energy.[80] As of 2020, 8 out of 18 regional data centers are powered by renewable energy, while Loudoun County's data centers have not been decarbonized.[81] One reason for this, QTS notes, is that the cost of signing PPAs in Virginia is higher than in other regions.[82] While it is difficult to get an accurate figure on the price of PPAs because they are relative contracts, a study by Lawrence Berkeley National Laboratory in 2021 found that PJM's average PPA prices as of 2019 were more than 1.5 times as much as the country as a whole.[83] Given the data centers' strategy for decarbonizing their data centers, the electricity market of

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[77] CyrusOne. (2021). *2021 Sustainability Report*, https://cyrusone.com/app/uploads/2021/11/2021-Sustainabilty-Report_Final.pdf. p 44.
[78] Ibid.
[79] Digital Realty. (2021). *2020 Environmental, Social and Governance Report,* https://go2.digitalrealty.com/rs/087-YZJ-646/images/Report_Digital_Realty_2106_2020_ESG_Report.pdf. p 32.
[80] QTS. (2021). *2020 ESG Initiatives Report*, https://www.qtsdatacenters.com/company/corporate-sustainability/esg. p 16.
[81] Ibid.
[82] Wright, Travis. QTS. March 7, 2022. Interview.
[83] Lawrence Berkeley National Laboratory. (2021). *Utility - Scale Solar, 2021 Edition*, https://emp.lbl.gov/sites/default/files/utility_scale_solar_2021_edition_slides.pdf

Northern Virginia is not attractive. This analysis means that the decarbonization of data centers in Loudoun County may fall behind those in other regions without proper policy intervention .

Figure 4-5: The Cases about Electricity Procurement Behaviors by Data Centers[84]

Data Center Provider	Area	Transition History of Power Procurement	Main Factor for Transitions or Stay
Digital Realty	Northern Virginia	Case 1 Utility with Default Plan (Dominion)	Dominion plan's limitation[*1]
	Northern California	Case 2 Utility (PG&E) → CCA (East Bay Community Energy) → CSP	Cleaner energy source at the same or cheaper cost
CoreSite	Northern Virginia (Peak demand ≧ 5 MW[*2])	Case 3 Utility with Default Plan (Dominion) → CSP	Cleaner energy source with cheaper cost
	Northern Virginia (Other than the above[*2])	Case 4 Utility with Default Plan (Dominion) → Utility with 100% Renewable Plan (Dominion)	Cleaner energy source with premium of 0.398¢/kWh[85]
	Northern California	Case 5 Utility with Default Plan (PG&E) → CCA (Silicon Valley Clean Energy)	Cleaner energy source at the same or cheaper cost
QTS	Northern Virginia	Case 6 Utility with Default Plan (Dominion)	Dominion plan's limitation[*1]
	Northern California	(No data centers in CCA Area)	-

*1: Dominion's 100% Renewable Energy Plan is only available to customers with peak demand of 5 MW or less[86]
*2: CSPs' service is only available to customers whose peak demand is at least 5 MW

[84] Binkley, Aaron, Digital Realty, personal interview, February 15, 2022, Wright, Travis, QTS, personal interview, March 7, 2022 Interview, Muñoz, Mauricio, CoreSite, personal interview, March 22, 2022, created by authors
[85] Dominion Energy. (n.d.). *Renewable Energy Programs.* Retrieved March 31, 2022 from https://www.dominionenergy.com/virginia/renewable-energy-programs/renewable-energy-101
[86] Ibid.

Second, Figure 4-5 shows concrete cases of electricity procurement behavior by Digital Realty, CoreSite, and QTS in Northern Virginia and Northern California. As noted in the Background section, Northern California is the second-largest data center market in the United States. At the same time, the region is a leading region in the adoption of CCA. An analysis of data center behavior in these two regions reveals the following points:

1. Data centers located in regions where CCA has been implemented, such as Northern California, have easy access to cheaper and cleaner energy (Case 2 and 5). On the other hand, in Northern Virginia, there are cases where data centers pay additional costs to gain access to clean energy (Case 4) and where they are forced to give up access to clean energy and choose Dominion's default plan (Case 1 and 6).
2. In Northern California, there is market competition between CCAs and CSPs, allowing data centers to procure renewable energy on better terms (Case 2).

Third, CCAs often offer special rate discounts to heavy electricity users like data centers. To maintain price competitiveness over IOU and PPA, it is imperative for CCAs to keep large customers from opting out of CCAs and to enjoy economies of scale. According to the interview with SJCE, rate is the primary reason for commercial customers when deciding to opt-out. Therefore, SJCE has to contact large customers individually and offer cheaper options, such as "Green Tariff" which provide discounted rates from original commercial rates when the customers sign up for long-term contracts.[87]

Similarly, SVCE also had a special setting enabling rate discounts for big customers. SVCE adopted a resolution for "Non-standard Pricing Agreement Policy" in 2019, delegating to the CEO the authority to negotiate and execute non-standard pricing agreements with large commercial and industrial customers whose loads are greater than or equal to 10 GWh annually.[88] It aimed to prevent large commercial and industrial loads from moving to a minimally compliant electricity product, vastly increasing CO2 emissions.[89] Moreover, such a policy gave more latitude to SVCE to cope with the rate changes of PG&E, the IOU in the region, and other electricity service providers.

Last but not least, a few data center providers tried to develop their own renewable energy procurement schemes in order to fill in the void of CCA. QTS, for example, has developed a "Green Power Procurement Model", which is quite similar to the concept of CCA.[90] The model starts QTS partnering with an investment bank as it is preparing to fund a new renewable energy project. Then, QTS purchases a portion of the energy and bundled REC's that the

[87] Ziemba, K. (2022, February 25). Interview with SJCE. personal.
[88] SVCE Board of Directors. (2019, June 12). *August 2019 Rate Update*. https://www.svcleanenergy.org/wp-content/uploads /2019/06/2019-0612-Presentations-Combined-Items-3-4-5.pdf
[89] Ibid.
[90] Wright, T. (2022, March 7). Interview with QTS. personal.

project produces for 10+ years, which is sleeved through a retailer.[91] In this case, an investment held the risk of the total project management while QTS had to negotiate with the bank and retailers in terms of rate and terms all of which can be done by CCA if CCA were available (See Figure 7 in Appendix A).[92]

C. Grid Reliability

1. Perceived Risks

During interviews with local data centers, risk management is a huge topic of discussion. A Loudoun County data center operator for example voiced concerns over CCA being able to deliver huge amounts of electricity without failure. Dominion is able to provide standard, cheap, and reliable electricity to Northern Virginia data centers as they have the necessary blueprint and framework in place. Sophisticated commercial users like data centers wish to use the most cost effective energy strategies rather than being motivated by impacting GHG emissions. Loudoun County staff are also concerned about managing the risk of mismatched supply and demand. For example, in California, if a CCA is not able to provide the necessary energy required, the California Independent System Operator (CAISO) will intervene and then bill the CCA later. As a result, Virginia would also need a similar intervention plan from PJM with the necessary capacity in place to intervene in the event of failure. There is also the concern of excess electricity waste if the CCA is unable to properly channel the correct amounts for data centers. Although additional administrative costs will be required, it is more efficient for CCA to implement 24/7 renewable energy supply management collectively than for each data center to do it individually.

2. Market Capacity

There exists an inflated perception of risk and unreliability for CCA. It is unfounded as grid reliability depends on wholesale market capacity, not the reliability of CCA itself. For example, in the hours of the day when renewable energy is not as readily available, the data center will buy from the market to cover the consumer. However, it would be easier to get this energy from a CCA when the management is done by the power provider and not by the data center. PJM's capacity market, called the Reliability Pricing Model (RPM), exists to ensure long-term grid reliability by securing the appropriate amount of power supply resources needed to meet predicted energy demand in the future.[93] Their pay-for-performance model serves as an insurance policy under which resources must deliver on demand during system emergencies or owe a significant payment for non-performance.[94] The three essential elements of this market capacity are the stipulations that procurement must occur three years before it is needed

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[91] QTS. (2021). *2020 ESG Initiatives Report*, https://www.qtsdatacenters.com/company/corporate-sustainability/esg. p 19.
[92] QTS. (2020). *Sustainability: What is it?*, https://www.epa.gov/sites/default/files/2020-11/documents/gppwebinar_ 11-12-20_ wright.pdf. p 8.
[93] PJM Learning Center. Capacity Market (RPM) Retrieved March 5 from https://learn.pjm.com/three-priorities/buying-and-selling-energy/capacity-markets.aspx.
[94] Ibid.

through a competitive auction, locational pricing for capacity must vary to reflect limitations on the transmission system, and there must be a demand formula used to set the price paid to market participants for capacity and the amount of capacity.[95]

3. Design, Composition, and Advantages

CCA resource composition consists of short, medium, and long-term PPAs plus market purchases. While exact percentages are kept confidential for competitive reasons, most of the agreement load in California can be covered by short, medium, and long-term PPAs.[96] Long-term PPA market purchases are usually provided at a lower rate as they are providing large amounts of energy, but can go for as long as 12-15 years. PPAs, however, may not be able to handle the entire energy load, so larger users typically prefer CCA. Furthermore, unlike PPAs, CCA can handle 24/7 renewable energy supply management. Short and medium-term PPAs are used to mitigate fines when developers have a minimum threshold that they have to meet and when they wish to avoid the penalty for missing it. The CCA power resource compositions are designed in this fashion to increase reliability and mitigate risks. The different length options lower grid maintenance risks by addressing any supply and matching issues.

[95] Ibid.
[96] Ziemba, Kate. San Jose Clean Energy. February 25, 2022. Interview.

V. Policy Options

A. Introduce CCA

To decarbonize data center energy procurement, Loudoun County can consider introducing a CCA for the first time in Virginia as a primary policy option. As previously identified in the key findings section, an opt-out setting of CCA is an important nudge to have customers remain in the relatively higher renewable energy mix program, which in turn will be a great source for Loudoun County to meet their MWCOG energy goal. Considering the cases of other CCAs in California, the participation rate of Loudoun County CCA is expected to range from 90% to 95% (= *1 – opt-out rate*).

When setting up a CCA, the Board of Supervisors in Loudoun County can choose from various governance options to meet its unique needs. In terms of governance options, this report assumes that Loudoun County will start with a single-jurisdiction CCA for a few reasons. First, Loudoun County has a large enough population and electricity consumption that it alone can reach enough economies of scale. As discussed in the key findings section, the total capacity for data centers in Loudoun County is 3,041.7 MW from 112 data centers. In addition, Loudoun County has a total population of 413,538, making it the fourth largest County in Virginia.[97] The case of SVCE's launch in 2017, consisting of 13 cities and towns, it was expected to serve between 233,406 to 259,559 in its 5 years of launch (See Figure 8 in Appendix A).[98] Since then, it has provided lower rates than PG&E.

Second, considering the heavy electricity consumption by data centers, Loudoun County will need a wide latitude in making decisions on the rate schedule for commercial sectors, discount policy, etc. With a multi-jurisdiction CCA, Loudoun County will have to share the decision-making authority with other municipalities. A hybrid JPA can be another option for Loudoun County to secure its full control of CCA operation within its jurisdiction. However, few neighboring counties are actively exploring the CCA at this point; a hybrid JPA can be adopted after Loudoun County establishes the CCA.

B. Maintain the Status Quo

If Loudoun County chooses to maintain the status quo, it means data centers would keep sourcing their power either by Dominion Energy or other CSPs via PPAs. Considering Dominion's long history as a dominant player in the electricity market in the region, they have credibility for providing electricity and utility services as well as political status in renewable

[97] Data Common. *Ranking by population: Top 100 Counties in Virginia*, Retrieved March 5, 2022, from https://datacommons.org/ranking/Count_Person/County/geoId/51?h=geoId%2F51107

[98] Silicon Valley Clean Energy. (2017, December). *Addendum No.1 to the Community Choice Aggregation Implementation plan and statement of intent*. https://www.svcleanenergy.org/files/managed/Document/1059/SVCE%20Addendum%20No.%201%20Milpitas%20Expansion%20%28F%29.pdf.

energy policymaking. Therefore, Loudoun County may consider maintaining the business-as-usual approach as a convenient option.

Dominion is exerting its own efforts to raise the renewable energy mix mandated by the VCEA passed in 2020. Mandatory RPS Program was established by the VCEA, which requires Dominion Energy to be 100% renewable by 2045. This goal will be achieved through a transition to more renewable energy generation in the portfolio by promoting solar and wind-power electricity generation. Dominion's integrated resource plan (IRP) started from 2020, set a goal to have 16 gigawatts of solar, more than 5 gigawatts of offshore wind, and 2.7 gigawatts of energy storage over the 15 years. As it takes time to plan and build new facilities to generate renewable electricity on its own, most of Dominion's RPS requirement will be filled with purchase of virtual RECs.

When it comes to PPA, as discussed earlier in the background and key findings section of this report, some big IT companies that have their own energy goals are exploring this option to support their needs. Google, for example, signed a 10-year 500MW renewable energy deal last year with AES, a CSP accredited by the state.[99] Google has two data centers in Loudoun County and this deal aims to ensure that the data centers will be powered by 90% carbon-free energy on an hourly basis.[100] The findings show Google, Microsoft, Visa, and Amazon have clean energy PPAs to partly support their power capacity. However, this report could not find any other data centers that signed PPAs in Loudoun County. As discussed in the Key Findings section, negotiating and signing PPAs requires several administrative burdens and risks that only hyperscale data centers can bear. Small and medium sized tenants and data center providers may not benefit directly from PPAs.

C. Raise RPS Target

Loudoun County can advocate for the higher RPS target as another policy option, even though RPS is a state-level policy intervention tool. The core of the VCEA was to mandate the Renewable Energy Portfolio Standard Program under which utilities must meet annual requirements for the sale of renewable energy based on a percentage of non-nuclear electric energy sold to retail customers.[101] The target of RPS started from 14% in 2021 and gradually increased to 100% renewable energy by 2045 and thereafter (See Figure 5-1).

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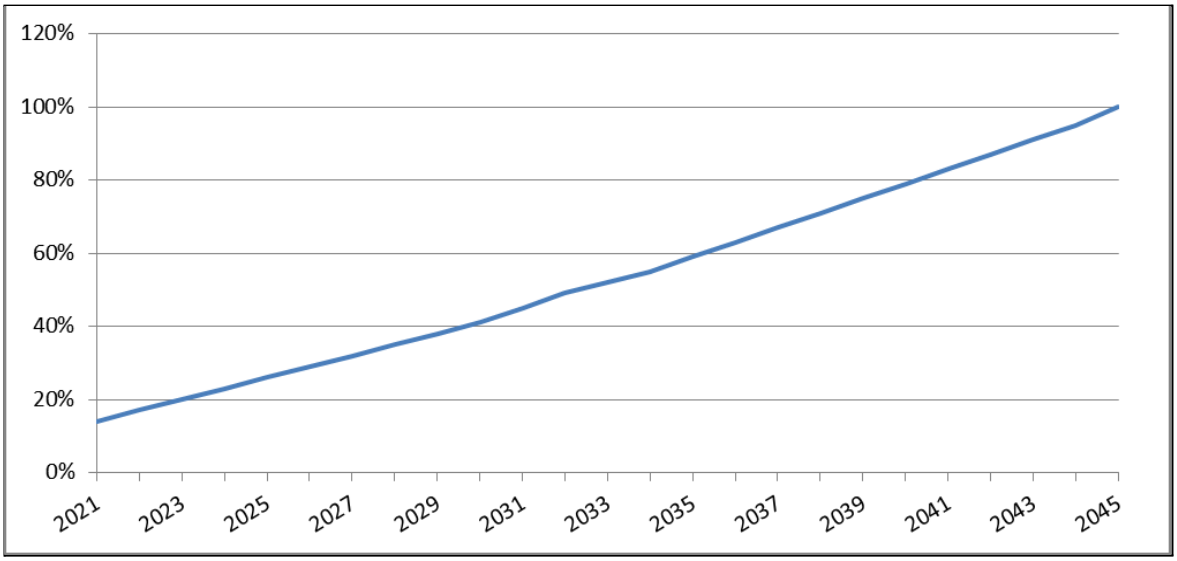
[99] Swinhoe, D. (2021, May 5). AES and Google sign 500MW renewable energy deal for Northern Virginia data centers. *Datacenter Dynamics.* https://www.datacenterdynamics.com/en/news/aes-and-google-sign-500mw-renewable-energy -deal-for-northern-virginia-data-centers/

[100] Ibid

[101] § 56-585.5. (Effective until October 1, 2021). *Generation of electricity from renewable and zero carbon sources*. https://law.lis.virginia.gov/vacode/56-585.5/

Figure 5-1: RPS target for Virginia



From 2021 to 2024, utilities may use RECs from any renewable energy facility that are located in the State or within the PJM Interconnection, LLC (PJM) region. However, starting from 2025, at least 75% of RECs should be provided by "RPS eligible sources", which are (a) solar or wind energy, (b) hydro energy, (c) waste-to-energy or landfill gas-fired generating resources, (d) biomass-fired energy.[102] If the utilities fail to meet the RPS program compliance obligations, or if the cost of RECs necessary to comply exceeds $45/MWh, the utility must pay a deficiency payment equal to $45/MWh shortfall.[103] The deficiency payment for any shortfall in procuring RECs for solar, wind, or anaerobic digesters located in Virginia shall be $75/MWh for resources one MW and lower.

Even though RPS operates via IOUs, it can still be considered as an alternative to CCA if it is raised to the point similar to the average RPS of the States with CCA implemented. As of September 2020, 38 states and the District of Columbia have established an RPS or renewable goal.[104] When compared with other states, Virginia's RPS program was launched the latest, however, its targets are lower than other states where CCAs are implemented (See Figure 5-2). For example, in California, the RPS goal is expected to be 44% and in New York 44.8% by 2024, while in Virginia that number is only 22%.[105] Virginia's target is 10% lower than the average RPS target (32.8%) of those with CCA implemented and active RPS goal from 2024 to 2033.

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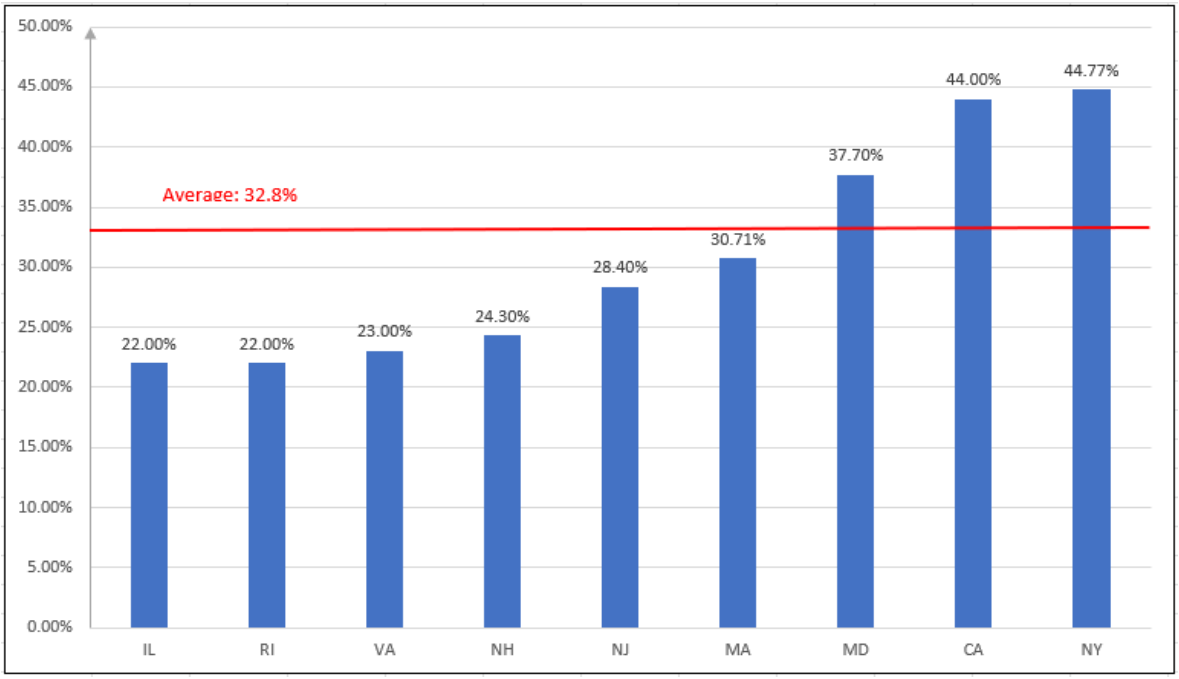
[102] PJM. *Program Information: Virginia*. Retrieved March 10, 2022, from https://www.pjm-eis.com/program-information/virginia

[103] § 56-585.5. (Effective until October 1, 2021) *Generation of electricity from renewable and zero carbon sources*. https://law.lis.virginia.gov/vacode/56-585.5/

[104] U.S. Energy Information Administration. *Renewable energy explained: Portfolio standards*. Retrieved March 10, 2022, from https://www.eia.gov/energyexplained/renewable-sources/

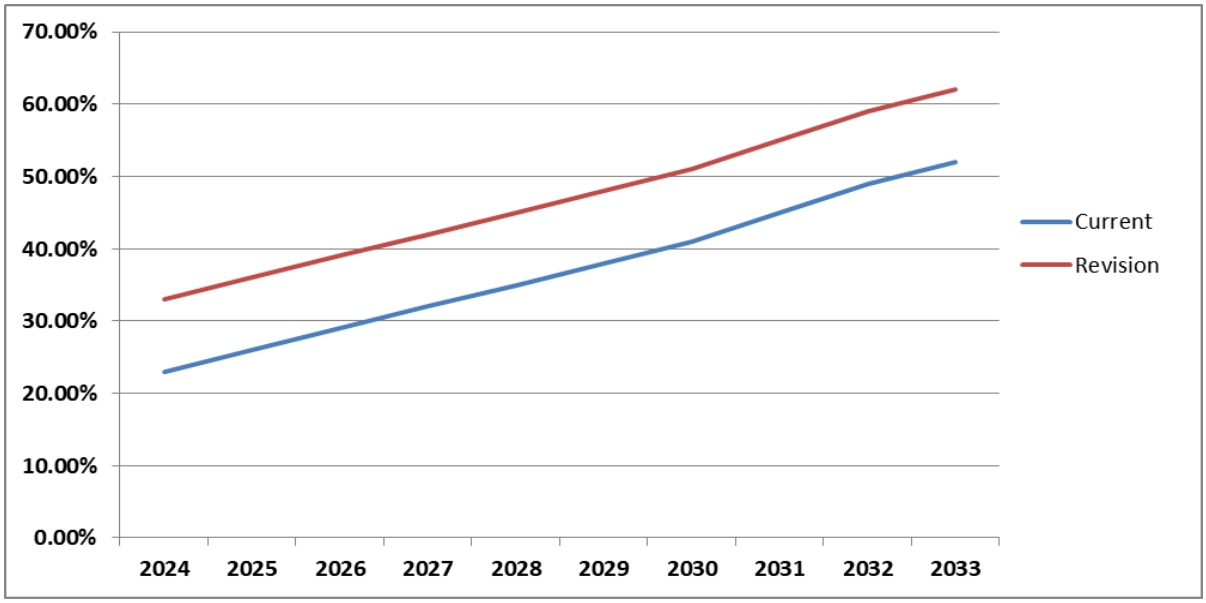
[105] Barbose, G. (2021). (rep.). U.S. Renewables Portfolio Standards 2021 Status Update. Berkeley Lab. Retrieved March 10, 2022, from https://eta-publications.lbl.gov/sites/default/files/rps_status_update-2021_early_release.pdf.

Figure 5-2: RPS target by state in 2024



For the analysis, this report assumes the RPS rate will be raised by 10% points starting from 2024 so that it matches the average RPS rate of states with CCA implemented (See Figure 5-3). As it is a tight schedule, IOU will not have enough time to develop its own renewable energy projects and physically supply renewable energy in the region; Dominion Energy is assumed to fulfill its additional RPS mandate by purchasing RECs between 2024 to 2033.

Figure 5-3: Raising RPS target in Virginia



VI. Criteria and Methods of Evaluation

A. Criteria Defined

The proposed policy options are evaluated based on the following criteria: **GHG emissions**, **financial feasibility**, **administrative feasibility,** and **political feasibility**. These criteria determine which policy options serve Loudoun County's best environmental energy procurement interests, along with potential drawbacks and obstacles. The evaluation of policy options is based on the status quo's baseline and how the other policy options compare. These criteria determine which policy options serve Loudoun County community's

The policy option evaluation consists of two steps- first evaluating each option based on its impact on GHG emission rates, and secondly, evaluating the financial, administrative, and political feasibility. The primary goal is to make policy recommendations that will reduce the most GHG emissions and be the most feasible to implement while providing additional value to consumers and data centers. Therefore, it is important to consider Loudoun County's future energy goals and make sure the policy aligns with them through the evaluative criteria of *financial feasibility, administrative feasibility,* and *political feasibility,*

B. Evaluation Rating Scale

1. GHG Emission Rates: *How will the policy affect GHG emission rates?*

	Low	**Medium**	**High**
GHG Emission Rates	Policy option has an unknown or relatively low impact on reducing GHG emissions. A low ranking would fall in the reduction rate's range of less than 40%.	Policy option has a relatively moderate impact at reducing GHG emissions. A medium ranking would fall into the range of 40% - 60%.	Policy option has a relatively high impact on reducing GHG emissions. A high ranking would fall into the range of more than 60%.

Greenhouse gas emission rates serve as a considerable criteria for its effectiveness to measure how effective the policy option is in its environmental impact. The metrics used to gauge reduction rates are the reduction rates from a base line, where all total consumption from 2024 to 2033 is supplied by the current power mix of Dominion. This number is calculated by each policy option over the time span of ten years as noted in the methodology. Since Loudoun County has a long term energy target to reduce GHG emissions to 50% below 2005 levels by 2030, this number is used as a baseline to evaluate each policy option.

2. **Financial Feasibility:** ***Does the policy provide cheaper energy to data centers?***

	Low	Medium	High
Financial Feasibility	Policy option would encumber higher costs per kilowatt hour than the baseline.	Policy option would encumber 0-9% lower costs per kilowatt hour than the baseline.	Policy option would encumber 10% or cheaper costs per kilowatt hour than the baseline.

Financial feasibility also plays a pivotal role in the process, as a policy option will introduce competition to the IOU, Dominion Energy. The financial feasibility criteria is cost per kilowatt-hour for data centers. The financial feasibility is evaluated by comparing it to a baseline rate. The baseline in 2020 is $0.0763/kWh, which is the average commercial rate of the total electricity industry in Virginia.[106] As the rates in 2024 to 2033 are to be compared, this report assumes the baseline will increase by 2% annually during the analysis period. The baseline in 2024 is $0.0826/kWh.

3. **Administrative Feasibility:** ***Will the policy require additional administrative procedures to implement the policy option?***

	Low	Medium	High
Administrative Feasibility	Policy requires a considerable amount of additional staff, infrastructure, and administrative procedures to implement. Policy is beyond reach for the County to implement.	Policy may require some additional staff, infrastructure, or administrative procedures to implement. Policy is within reach for the County to implement.	Policy may be implemented with relatively low to no amounts of additional staff, infrastructure, or administrative procedures. Policy is within reach for the County to implement.

Administrative feasibility measures the likelihood that a department of agency has the budget, ability, and capacity to successfully implement a recommended policy. Administrative feasibility for this policy is determined by how much Loudoun County needs to invest in new resources to implement the policy. Consideration is also given to the quality of the resources needed (e.g., high level of expertise). It will take into account the perspectives of various

[106] U.S. Energy Information Administration. Average Price (Cents/kilowatt hour) by State by Provider, 1990-2020. Retrieved March 10, 2022, from https://www.eia.gov/electricity/data.php#sales

stakeholders, including the general population, energy companies, data center operators, and renewable energy providers. Since administrative feasibility can be subjective, the criteria considers hiring a new department, implementing completely new procedures, and building costly infrastructure as low. Medium is if two or more of these are required, and high is one or none are required.

4. **Political Feasibility:** ***How difficult will the policy be to implement with various stakeholders?***

	Low	**Medium**	**High**
Political Feasibility	Policy requires support from two or more political stakeholders and does not provide community reinvestment programs.	Policy requires support from two or more political stakeholders and provides community reinvestment programs.	Policy requires support from only one political stakeholder and provides community reinvestment programs.

It is important to consider that each policy option involves various stakeholders with conflicting perspectives. For example, Virginia's current governor has been very vocal and holds a strong stance on not supporting programs that reduce GHG gas emissions because he believes the cost is passed onto taxpayers. Additionally, in order for the CCA policy option to be implemented, it must garner support from the Board of Supervisors. Other stakeholders include the general public, ratepayers such as residents and businesses, external political groups, and other environmentally friendly organizations that have similar interests as the client. The support from stakeholders is dependent on risk or their perception of risk. Lastly, the program's community reinvestment plans are important to consider as they affect the general population's interest and buy in. Thus, political feasibility is defined as the difficulty of buy-in from influential stakeholders and government entities that can determine whether a policy option will be implemented or not.

C. Methodology for Evaluating Policy Options

VCE promotes CCA as a way to accelerate expansion of clean and renewable energy while taking in various stakeholders input. As a result, their goals guide the evaluation process for the criteria using a few steps. The policy option is judged using a three point scale followed by a detailed description of the rationale used and the methodology that contributes to the criteria.

Figure 6-1 shows the methodology flow chart for evaluating policy options. GHG emission rates are evaluated with a very straightforward approach. GHG emission impact is low, medium, or high when compared to the baseline. Combined feasibility is evaluated by using

the average percentage of administrative and financial feasibility and comparing it to the baseline. Lastly, each policy option's political feasibility is compared back on its ranking of “low”, “medium” or “high” to see which policy option has the highest political feasibility. Based on these evaluations, this report is able to make the best policy recommendation concerning the GHG emission impacts and feasibility to implement.

Figure 6-1: Methodology for Evaluating Policy Options

VII. Evaluation

Using our four criteria, the policy options are summarized in Table 7-1 below. In addition, following the chart, the rationale for each criteria is explained.

Table 7-1: Policy Recommendation Evaluation Chart

Criteria	Policy Option 1: CCA	Policy Option 2: Status Quo	Policy Option 3: Raising RPS
GHG Emission Rate	High	Low	Low
Financial Feasibility	High	Medium	Low
Administrative Feasibility	Medium	High	Low
Political Feasibility	Medium	High	Low

▸ Policy Option 1: CCA

A. GHG emission

1. Methodology

When Loudoun County implements CCA, data centers have two options: (1) use CCA, or (2) opt-out of CCA and use other means of electricity supply. In this estimation formula, GHG emissions are estimated by adding up the GHG emissions generated in these two cases. Thus, the basic formula described in the Methodology & Data section is modified to fit this policy option as follows:

$$\begin{aligned} &GHG_i \\ &= Total\ Consumption_i \times Opt\ out\ rate \times Share\ of\ Resource\ for\ CCA_i \times Emissions\ Factor \\ &+ Total\ Consumption_i \times (1 - Opt\ out\ rate) \times Share\ of\ Resource\ for\ PPA_i \times Emissions\ Factor \end{aligned}$$

This report set the following assumptions in this estimation. In the case of CCA use, *Total Consumption* is the total capacity multiplied by the consumption rate. *Opt_out_rate* is the out-out rate (3.6%) of SVCE, which, like Loudoun County, has many data centers in its territory. SVCE offers two plans, Green Start, which has a renewable rate of 42.5%, and Green Prime, which has a renewable rate of 100%. This report runs estimates under two scenarios based on these two plans. The estimates are based on the assumption that the opt-out rate and share of resources will remain unchanged. In addition, in the case of CCA opt-out, it is

assumed that data centers that opt-out of CCA individually sign solar-powered PPAs in this estimation. Table 7-2 shows the emissions factor and share of electricity resources used in this estimation.

Table 7-2: LCA Emissions Factor and Share of Electricity Resources

Resource	Emissions Factor (MTCO2e /mWh)	Base Case (Utility)[107]	CCA[108]		PPA
			Scenario1 (42.5 % renewable)	Scenario2 (100 % renewable)	
Biomass	0.052	1.0%	2.8%	0.0%	0.0%
Geothermal	0.037	0.0%	1.9%	0.0%	0.0%
Small Hydroelectric	0.021	1.0%	5.2%	0.0%	0.0%
Photovoltaic	0.043	2.0%	18.3%	25.0%	100.0%
Wind	0.013	0.0%	14.3%	75.0%	0.0%
Coal	1.001	10.0%	0.0%	0.0%	0.0%
Large Hydroelectric	0.021	0.0%	47.5%	0.0%	0.0%
Natural Gas	0.486	48.0%	0.0%	0.0%	0.0%
Nuclear	0.013	32.0%	9.5%	0.0%	0.0%
Other	0.428	4.0%	0.3%	0.0%	0.0%
Unspecified	0.428	0.0%	0.2%	0.0%	0.0%
TOTAL	-	100.0%	100.0%	100.0%	100.0%

[107] Dominion Energy. Product Content Label. Retrieved March 9, 2022, from https://cdn-dominionenergy-prd-001.azureedge.net/-/media/pdfs/virginia/save-energy/gp-product-content-label.pdf?la=en&rev=f716ef1f27404586be33c3cda43678b1&hash=BE5D8E853AC4052DA7080CE68F889DF7

[108] California Energy Commission. 2020 Power Content Label Silicon Valley Clean Energy. Retrieved March 9, 2022, from https://www.energy.ca.gov/filebrowser/download/3899

2. Results

Based on these processes, the criteria of GHG emission is high, because the estimated GHG reduction rate in 2033 compared to the baseline will be higher than 60%. As Table 7-3 shows, scenarios 1 and 2 have 92.9% and 94% reduction rate, respectively. For reference, the reduction can be expressed as the number of cars, assuming the EPA-estimated 4.6 metric tons of CO2 per year emitted by passenger cars averaging 22 miles per gallon (mpg) and 11,500 miles per year. In this case, it is 1,259,000 and 1,274,000, respectively.

Table 7-3: GHG Emissions Comparison

	Baseline (Utility)	Policy Option 1 (42.5 % renewable)	Policy Option 1 (100 % renewable)
Projected GHG Emissions in 2033 (metric tons CO2)	6,231,000	440,000	373,000
Reduction rate	-	92.9%	94.0%
Reduction in Emissions expressed as annual number of cars *	-	5,791,000	5,858,000

* Assumption: the EPA-estimated 4.6 metric tons of CO2 per year emitted by passenger cars averaging 22 miles per gallon (mpg) and 11,500 miles per year[109]

B. Financial Feasibility

1. Methodology

The generation rate of a CCA in Loudoun County is composed of power supply costs, non-power supply costs, and pass-through charges from Dominion. The components of each category will follow the way that the Loudoun County feasibility study adopted (See Figure 9 in Appendix A). Based on the feasibility study's annual power supply costs($/MWh) of CCA with 4 possible scenarios which assumes 25%, 50%, 75%, and 100% renewables respectively in the power mix (See Figure 10 in Appendix A), this report will derive average power supply costs ($/kWh) of each scenario. The power supply cost is a weighted average of all major rate schedules – residential, commercial and industrial sectors. Considering the load of the commercial sector comprising more than 88% of total load in 2023 and 92% in 2033, the average power supply costs will be almost the same as that of the commercial sector.[110] In addition, estimated exit fee and operational costs will be added to the power supply costs. The exit fee and operational costs derive from the estimation of the feasibility study. (See Figure 11 and 12 in Appendix A)

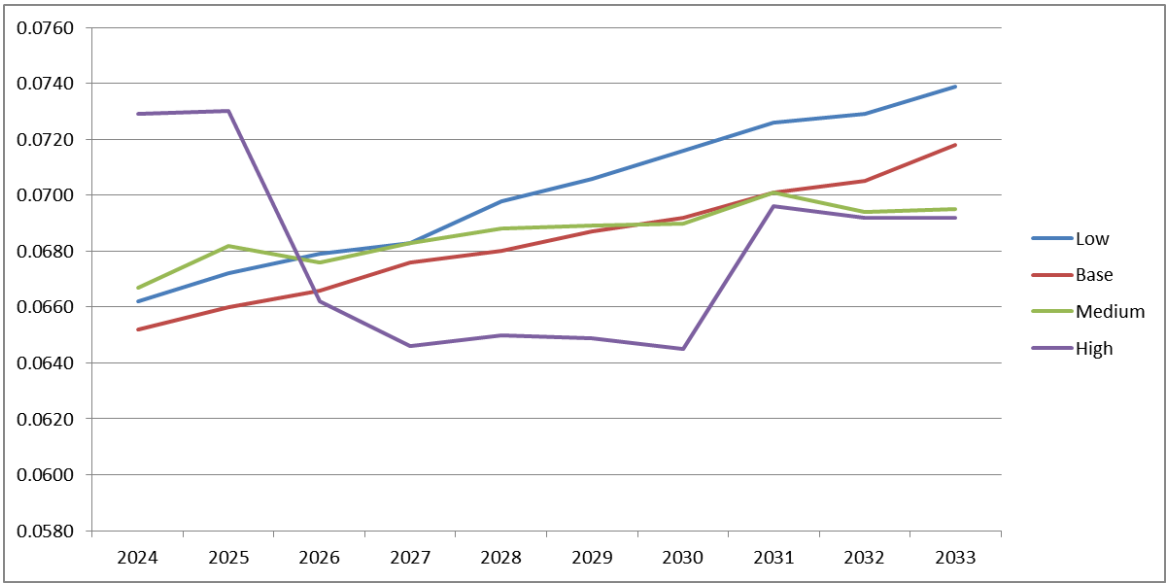
[109] U.S. Environmental Protection Agency. Greenhouse Gas Emissions from a Typical Passenger Vehicle. Retrieved March 31, 2022, from https://nepis.epa.gov/Exe/ZyPDF.cgi?Dockey=P100U8YT.pdf.
[110] GDS Associates Inc. (n.d.). Loudoun County Municipal Aggregation Technical Feasibility Study. Retrieved March 5, 2022. p 12.

2. Results

From 2023 to 2033, the commercial rate of Loudoun County CCA is projected as Figure 7-1. In case of the base power mix, it is expected to increase from $0.0516/KWh in 2024 to $0.0621/KWh in 2033. Compared to the baseline $0.0826/KWh, the expected average commercial rate of the total energy industry in Virginia in 2024, CCA base case rate is approximately 21% cheaper. Based on these figures this report assesses a CCA in Loudoun County will be a price-competitive option for data centers, therefore, this report ranks the criteria of financial feasibility for CCA option as high. The result clearly shows data centers will benefit from CCA in terms of energy bills, which is the primary advantage of a CCA.

Figure 7-1: Forecast of CCA Commercial Rate

(unit: $/kWh)



C. Administrative Feasibility

There are multiple steps that Loudoun County has to complete to introduce a CCA. The general steps are as follows:

1. Municipality must agree to the formation of a CCA through appropriate political means that includes receiving approval from the appropriate governing body (ie: Board of Supervisors).
2. An official declaration must be sent to the service area IOU and in the event of a CCA program proposal, the governing body with jurisdiction (which may be the SCC) would also need to approve the plan before it proceeds.
3. The local government must decide the manner in which it will aggregate electric energy and manage opt-in/opt-out requirements.
4. Must register as an aggregator since the CCA will be serving data centers under VA Code § 56-588.

5. Other steps include, entering into a service agreement with the IOU, securing an energy supply, and notifying customers.[111]

In Virginia, there is no set of guidelines that govern specific steps like in California; however, it will still need to be approved by the Board of Supervisors, acknowledged by the Virginia SCC and enabled by an agreement with Dominion Energy. Formation of a CCA is estimated to have a total start of capital cost of $3.7 million with the cost projected to be offset with the operating revenue in 3 years.[112] $1.1 million of that total cost is estimated for staffing and administrative costs.[113]

A majority of states that have already introduced CCA have started with minimal staff requirements and then slowly introduced additional in-house staff over time. For example, there would only be one staff member that would be in charge to operate the CCA. That staff member would be responsible to hire and oversee consultants that would perform all necessary technical tasks.[114] There are some procurement risks, however with conservative power procurement strategies, these risks can be mitigated.

There are other administrative benefits that are covered by implementing a CCA over the other policy options. First, a CCA is considered a "public service" that will absorb most legal and administrative risks from data centers. Secondly, when compared to other policy options, CCA's don't require large credit requirements like small businesses do for signing a PPA or have large legal teams, where it's common to have more than 20 employees for procurement. Lastly, it is harder for small businesses to put down the required credit deposit, since it is difficult to predict what will happen when contracting a 10-year renewable project. It is not worth the risk for smaller businesses to take on and even more so when they may not have the appropriate risk management resources.

Based on these processes, the criteria of administrative feasibility is evaluated as medium, this is because this report considers the significant administrative costs, but also considers that cost is recouped after three years of existence of the CCA. Additionally, this rating considers that the administrative framework for a CCA already exists in other states.

D. Political Feasibility

1. Elected Officials

A potential roadblock in the implementation of the CCA is the current governor's history of anti-renewable rhetoric. Although the administration is supporting an offshore wind project,

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[111] Cal-CCA, "What are some of the steps to forming a CCA?", https://cal-cca.org/resources/#toggle-id-2 (accessed on Feb. 25th, 2022)
[112] Municipal Aggregation Technical Feasibility Study. December 2, 2021. GDS Associates, Inc.
[113] Municipal Aggregation Technical Feasibility Study. December 2, 2021. GDS Associates, Inc.
[114] Ibid

that is more due to Dominion's lobbying efforts. He has previously expressed concerns over the Commonwealth becoming too similar to California.[115] He has also gone on to criticize the VCEA as "unworkable", in hopes of rolling back 100% clean energy goals[116]. He has further advocated to pull Virginia out of the Regional Greenhouse Gas Initiative (RGGI), further compromising the state's clean energy future. It is difficult to gain complete support because even if the Board of Supervisors for the state of Virginia is in favor of a CCA, but their staffers have concerns, it is still very arduous to implement the program. Despite Virginia code allowing CCA for jurisdictions "by right", the Governor may slow the process down. Although the governor's capacity to implement anti-CCA actions has been limited, they are still worth noting in the larger framing of the state energy policy. CCAs are not affected directly through these measures, but they are significant roadblocks placed in front of clean energy program implementation.

2. Dominion Lobbying

Dominion is infamous in the Virginia state legislature for its lobbying power. In the Capitol, Dominion "doled out millions in campaign contributions and employed an army of lobbyists who helped write energy policy for decades. The result was soaring electricity bills and an energy grid heavily reliant on fossil fuels".[117] In 2020, the VCEA established a schedule by which Dominion is required to retire non renewable electric generating units in the Commonwealth and enter into solar and wind powered sources.[118] The VCEA also made the RPS program mandatory, which would force the IOU to switch to 100% renewables by 2045. Dominion fought back and won, increasing its influence by doubling the size of its lobbying corps and using its long-standing relationships with legislative leaders and former Governor Ralph Northam.[119] Dominion has a monopoly on its territory, providing power to two-thirds of customers in Virginia, in exchange for convincing the SCC that it isn't overcharging customers. The precedent set by the IOU means facing staunch opposition in regards to lobbying in the Capitol.

3. Exit Fees

Exit fees are in place for the customer of the municipal aggregator to pay a monthly charge for the costs remaining to the incumbent utility for power purchased.[120] The fee is meant to protect the remaining incumbent customers from paying for the costs of the departing load.[121]

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[115] Spector, Julian. *What does Glenn Youngkin's win in Virginia mean for clean energy?* Canary Media. November, 2021.
[116] Ibid.
[117] Wilson, Patrick. *Inside the Utility Company Lobbying Blitz That Will Hike Electric Bills*, Pro Publica. October, 2020.
[118] Virginia's Legislative Information System, 2020 Session. Retrieved March 8, 2022 from https://lis.virginia.gov/
[119] Wilson, Patrick. "Inside the Utility Company Lobbying Blitz That Will Hike Electric Bills". Pro Publica. October, 2020.
[120] Municipal Aggregation Technical Feasibility Study. December 2, 2021. GDS Associates, Inc.
[121] Ibid.

Although the legality of the exit fee is held in question, the report assumes that the fee would be applied. The CCA total generation cost plus exit fee must be lower than Dominion's generation rates in order for the transaction to be profitable.[122] The exit fee is intended to hold any lost revenues for Dominion, however the Loudoun county feasibility study still maintains that even with the paid fee, the program is still feasible.[123] Furthermore, exit fees would get lower the longer the CCA was established further increasing the likelihood that they would not be a significant deterrent in program implementation. Therefore, despite exit fees being subject to change, following the previously mentioned assumptions means they are not a significant roadblock in the political field.

4. Community Reinvestment

While Virginia has yet to establish a CCA, prior CCAs in other states have shown a history of community reinvestment programs that help out local citizens and mitigate environmental risks. California CCAs for example have established low-income solar storages for electricity, provided EV and infrastructure incentives, feed-in-tariffs, and net energy metering (NEM).[124] These CCAs have established electric vehicle infrastructures in Santa Barbara, Silicon Valley, East Bay, and Sonoma.[125] Furthermore, these CCA have advanced state resiliency initiatives via microgrids in communities such as Lancaster, Monterey, Santa Cruz, and Los Angeles.[126] California CCAs have also added 6,117 MW of solar panels, 1,044 MW of wind turbines, and 14 MW of geothermals.[127] Furthermore, they participate in community programs such as giving grants to organizations for projects that advance electrification in Central Coast, providing local financial support through the Community Benefits Program in Clean Power Alliance, and working with local nonprofits to educate underrepresented communities in energy awareness and education in Silicon Valley.[128] These efforts all help the state convert energy more towards renewables and educate their local communities on clean energy benefits.

Implementing CCA is legal in code, but Dominion and the Governor have the ability to influence the process negatively. Despite facing opposition, municipalities still have the legal standing to launch a CCA. Therefore, implementation earns a medium rating for its political feasibility as it requires gaining support or bypassing two political stakeholders (the Governor and Dominion), in addition to the established history of adequate community reinvestment programs.

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[122] Ibid.
[123] Ibid.
[124] Community Impact. CalCCA. (n.d.). Retrieved March 10, 2022, from https://cal-cca.org/resources/#toggle-id-1.
[125] CCA Programs. CalCCA. (n.d.). Retrieved March 10, 2022, from https://cal-cca.org/resources/#toggle-id-1.
[126] CCA Resiliency Initiatives. CalCCA. April, 2021.
[127] Community Impact. CalCCA. (n.d.). Retrieved March 10, 2022, from https://cal-cca.org/resources/#toggle-id-1.
[128] Community/Outreach/Innovation Grants. CalCCA. (n.d.). Retrieved March 10, 2022, from https://cal-cca.org/resources/#toggle-id-

▸ Policy Option 2: Maintaining Status Quo

A. GHG emission

1. Methodology

If Loudoun County does not implement CCA, data centers have two options: (1) use utility, or (2) sign a PPA and receive electricity supply from a renewable energy provider other than utility. Therefore, the basic formula described in the Methodology & Data section is modified to fit this policy option as follows:

$$GHG_i = (Total\ Consumption_i - PPA_i) \times Share\ of\ Resource\ for\ Utility_i \times Emissions\ Factor + PPA_i \times Share\ of\ Resource\ for\ PPA_i \times Emissions\ Factor$$

The assumptions used in this estimation are as follows:

In the case of procured by the utility, this report uses the Dominion value for the *Share of Resource_Utility.* Dominion has designed three plans for renewable energy procurement in the 2021 IRP.[129] This report uses Plan A, a least-cost strategy that could achieve the RPS imposed by the VCEA. In this plan, the share of renewable energy sources in Dominion's power mix will not increase substantially, and the RPS will be achieved through RECs (See Figure 13, 14 and 15 in Appendix A). Therefore, this estimation assumes that the power mix as of 2020 will be maintained. Although Dominion offsets GHG emissions by using RECs, GHGs are physically emitted from the electricity supplied by Dominion, so this estimation does not consider the offsetting effect of GHG emissions by RECs.

In the case of using PPAs, based on this research, there are no data centers in Loudoun County that are powered by solar or wind PPAs. On the other hand, the use of PPAs in the U.S. is expanding, and there is a possibility that PPAs will power data centers in Loudoun County.[130] Therefore, the amount of electricity secured by PPAs is estimated under this assumption in this estimation. Power supply from solar-powered PPAs increases by 100 MW each year starting in 2024. The capacity factor is 24.6% for solar photovoltaic in 2021.[131] According to Dominion's 2021 IRP, the reasonable build constraint for PV power generation is 1,200 MW/year.[132] Therefore, the estimation in this section is consistent with the Dominion's assumption in its 2021 IRP.

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[129] Dominion Energy. 2021. Integrated Resource Plan 2021 Update. Retrieved March 9, 2022, from https://cdn-dominionenergy-prd-001.azureedge.net/-/media/pdfs/global/company/desc-2021-integrated-resource-plan.pdf?la=en&rev=e13351d019f7452483757099fa254707

[130] National Renewable Energy Laboratory. (n.d.). Voluntary Green Power Procurement. Retrieved March 9, 2022, from https://www.nrel.gov/analysis/green-power.html

[131] U.S.Energy Information Administration. Electric Power Monthly. Retrieved March 9, 2022, from https://www.eia.gov/electricity/monthly/

[132] Dominion Energy. 2021. Integrated Resource Plan 2021 Update. Retrieved March 9, 2022, from https://cdn-dominionenergy-prd-001.azureedge.net/-/media/pdfs/global/company/desc-2021-integrated-resource-plan.pdf?la=en&rev=e13351d019f7452483757099fa254707

2. Results

Based on these processes, this report ranks the criteria of GHG emission as low because the estimated GHG reduction rate in 2033 compared to the baseline will be lower than 40%. Table 7-4 shows that this policy option has a 10.8% reduction rate.

Table 7-4: GHG Emissions Comparison

	Baseline (Utility)	Policy Option 2
Projected GHG Emissions in 2033 (metric tons CO2)	6,231,000	5,555,800
Reduction rate	-	10.8%
Reduction in Emissions expressed as annual number of cars	-	147,000

B. Financial Feasibility

1. Methodology

For the average commercial rate of Dominion Energy, this report uses the average commercial rate of Dominion Energy in 2020, published by the EIA as a base figure. Then a 2% increase rate from the Loudoun County feasibility study assumption will be applied to forecast the rate in 2024 to 2033. The feasibility study projected Dominion Energy's generation rates to increase on average by 2% per year over the next 10 years based on the projected market prices, Dominion's current resource mix and future requirements.[133]

For PPA rates, this report could not identify the PPA rates specific to data centers as the information was confidential. Instead, this report utilizes the average commercial rate of Virginia's restructured retail service providers in 2020, published by the EIA as a base figure. Then the 2% increase rate is also applied to project the rate for 2024 to 2033.

2. Results

As shown in Figure 7-2, Dominion's average commercial rate ranges from $0.08/kWh to $0.095/kWh in 2024 through 2033. Compared to the baseline in 2024, $0.0826/kWh, Dominion's rate is slightly cheaper by 3%.[134] It is, however, approximately 20% more expensive than that of CCA. Dominion Energy's relatively high rate is primarily due to its monopolistic status in the Virginia market and guaranteed return on equity (ROE) rate of

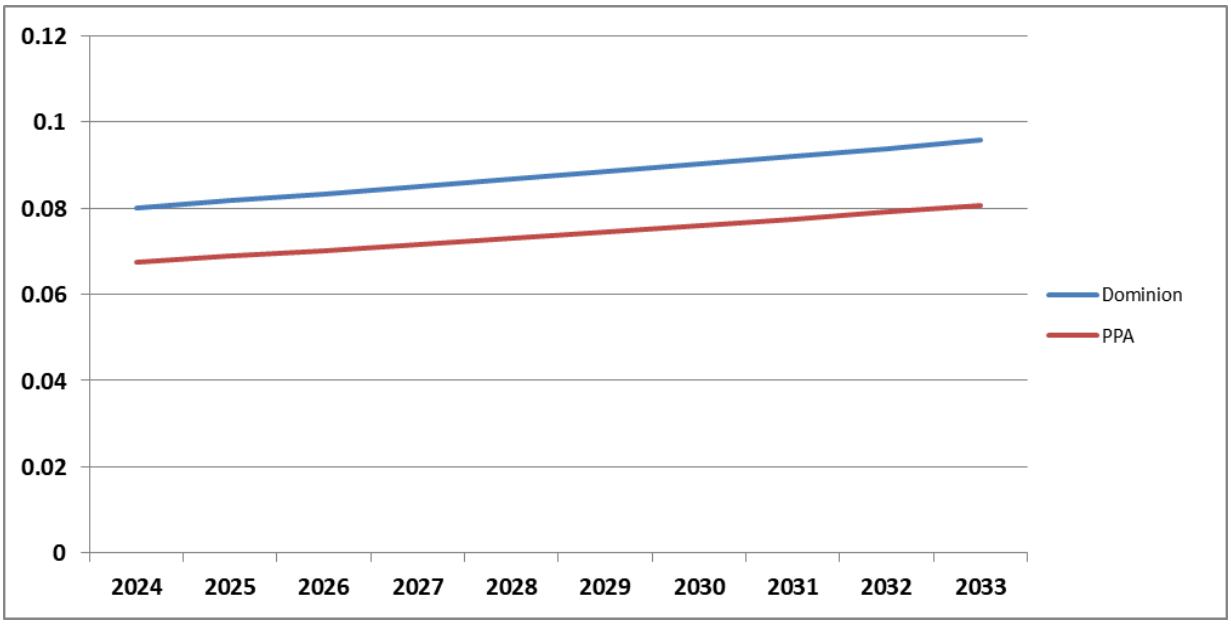
[133] GDS Associates Inc. (n.d.). *Loudoun County Municipal Aggregation Technical Feasibility Study*. Retrieved March 5, 2022. p 34.
[134] U.S. Energy Information Administration. Average Price (Cents/kilowatt hour) by State by Provider, 1990-2020. Retrieved March 10, 2022, from https://www.eia.gov/electricity/data.php#sales

9.35%.[135] What is worse is that Dominion Energy has recently attempted to raise the ROE rate to 10.8%.[136] If SCC approves the ROE increase, the rate can go even higher.

For PPAs, the commercial rate ranges from $0.067/kWh to $0.080/kWh (See Figure 7-2). Compared to the baseline in 2024, the PPA rate is 19% cheaper. To note, this rate can be largely underestimated as the PPAs that are popular from IT companies are 100% renewable deals, which will require the most expensive premium. Yet, it is still lower than the rate of Dominion. The reasons behind this could include: aggressive rate discount led by long-term deals and ancillary purchases. Data centers usually conclude a PPA for 10 to 20 years which provides a stable cash flow for energy suppliers, in turn, the suppliers can provide higher discount rates to compete with IOU.

Considering the possibility of underestimated PPA rates for data centers and the vast majority of data centers relying on Dominion's programs, the composite rate for this policy option is computed by giving weight 9:1 (Dominion:PPA). The composite rate is $0.0788/kWh which is 4.5% cheaper than the 2024 baseline. Therefore, this report assesses the financial feasibility of maintaining the status quo as medium.

Figure 7-2: Forecast of Average Commercial Rate for Dominion and PPAs ($/kWh)



[135] SCC. (2021, November 18). *SCC Approves Settlement in Financial Review of Dominion Energy Virginia Rates.* https://scc.virginia.gov/newsreleases/release/SCC-Approves-Settlement-in-Dominion-Financial-Revi
[136] Daily Press. (2021, April 1), *Dominion Energy not planning customer rebates after collecting $26 million above its 4-year target*, https://www.dailypress.com/business/consumer/dp-nw-dominion-review-20210401-7qnh3gddg5cuvb4xgmmy2fh6gy-story.html

C. Administrative Feasibility

Maintaining the status quo will not require additional administrative action from the County, therefore, it has the highest administrative feasibility among all policy options in this report. However, what seems to be "remaining in the safe zone" may incur higher political costs in the future. If Dominion's monopoly continues and the electricity bill remains to be one of the highest in the region, the residents and data centers in the jurisdiction may raise concern and criticize the County for not taking any effective actions. In addition, if this status is left unchecked it is unclear if Loudoun County can meet its MWCOG energy goal, considering that most of the data centers are relying on Dominion's highly carbonized energy mix.

If data centers in Loudoun County choose to go with a PPA, there are a few steps they must follow to obtain one. Data centers are generally able to acquire a PPA under a few conditions. First, a project must be located in a state or area where third-party ownership of energy generation equipment is allowed.[137] It is important to note that some states have limits or restrictions in regulated markets on non-utility providers to sell electricity. Next, under a PPA, the customer will sign a contract with the third-party to purchase power generated on the facility's property or a nearby location. The PPA will lay out the terms of sale, price, delivery schedule, payment terms, termination, and billing between both partiesThe electricity that is generated is then purchased by the data center at a rate that is typically lower than the utility's retail rate.

Data centers will see immediate cost savings by purchasing power through a CCA, but must take into account the PPA contract rate increasing annually by 1-5%. This increase is to capture gradual decreases in system deficiency, maintenance and operating costs, and increases in the retail rate of electricity. The other caveat is that PPAs are generally long-term contracts between 10-25 years. Lastly, when the PPA ends, the data center may be able to purchase the system from the developer, extend the term, or have the third-party remove their equipment from the property.

Based on these considerations, administrative feasibility is ranked high since maintaining the status quo should require 25% or less additional administrative costs.

D. Political Feasibility

The feasibility of maintaining the status quo increases the longer it takes to implement a CCA. As data centers acquire their own PPAs, the financial feasibility of future CCA will further shrink as the opt-out rate will increase. Furthermore, the larger the opt-out rate, the less financially effective the CCA becomes as a 90% remaining rate assumption maintains the price point benefits of a CCA over Dominion. Over the long term, this trend becomes less likely as data center energy usage rates increase and renewables rates remain very low. The

[137] *Power purchase agreement*. Power Purchase Agreement | Better Buildings Initiative. (n.d.). Retrieved March 6, 2022, from https://betterbuildingssolutioncenter.energy.gov/financing-navigator/option/power-purchase-agreement

Commonwealth constituents will also grow increasingly less satisfied seeing the county's inaction over a tremendous environmental issue. So in the short term, political feasibility of maintaining the status quo remains high, however over time it gets increasingly more difficult to justify inaction. This is combated through Dominion's own reinvestment programs. While CCA reinvestment remains an exercise of projection, Dominion has established programs such as funding local STEM education initiatives through the Dominion Energy Charitable Foundation ($30 million since 1985), Environmental Education and Stewardship Grants (annual grant of up to $1 million), and School and Job-Readiness Programs aimed at aiding children prepare for post-secondary programs in STEM.[138] Furthermore, through 2035, Dominion has reported plans to expand offshore wind, solar, and energy storage by roughly 24,000 MW.[139] The IOU also has a Grid Transformation Plan (GTP) that includes over 15,000 MW of new solar and onshore wind, up to 5,200 MW of offshore wind, and 2,700 MW of storage along with plans for net metering.[140]

Due to the local elected body's support of Dominion Energy and their heavy lobbying influences, in addition to their reinvestment programs, the political feasibility of maintaining Dominion as the status quo energy provider remains high.

[138] Educational Programs: Dominion Energy. (n.d.). Retrieved March 10, 2022, from https://www.dominionenergy.com/our-company/customers-and-community/educational-program
[139] Climate Report. Dominion Energy. 2021. Retrieved March 10, 2022 from https://www.dominionenergy.com/-/media/pdfs/global/company/esg/2021-climate-report.pdf
[140] Ibid.

▸ Policy Option 3: Raising RPS

A. GHG emission

1. Methodology

The methodology and assumptions for estimating GHG emissions in Policy Option 3 is the same as that used in Policy Option 2. When estimating GHG emission in Policy Option 2, this report assumed that the Dominion would choose the least-cost strategy that achieves the RPS mainly through RECs and its power mix as of 2020 would be maintained (See Figure 13, 14 and 15 in Appendix A). Even if the Virginia State raises its RPS, it does not have a direct impact on improving Dominion's power mix because Dominion can choose to offset GHGs by purchasing more RECs to meet the increased RPS. As a result, the policy effect in reducing GHG emissions is the same as Policy Option 2.

2. Results

Based on these processes, this report ranks the criteria of GHG emission as low because the estimated GHG reduction rate in 2033 compared to the baseline will be lower than 40%. Table 7-5 shows that this policy option has a 10.8% reduction rate.

Table 7-5: GHG Emissions Comparison

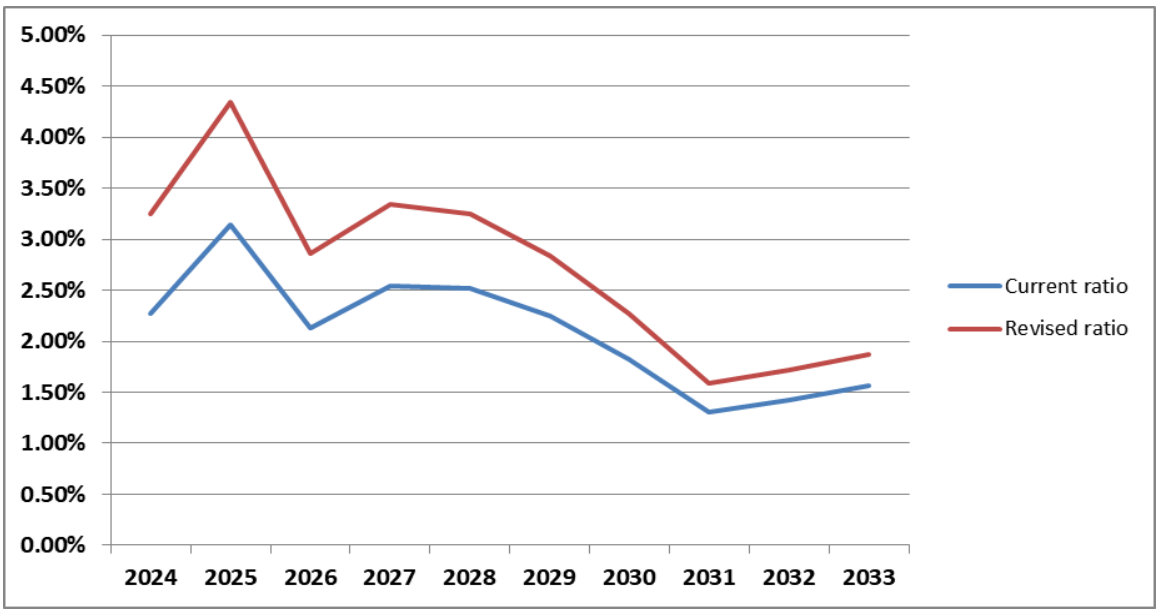
	Baseline (Utility)	Policy Option 3
Projected GHG Emissions in 2033 (metric tons CO2)	6,231,000	5,555,800
Reduction rate	-	10.8%
Reduction in Emissions expressed as annual number of cars	-	147,000

B. Financial feasibility

1. Methodology

Based on Dominion's IRP report in 2021, the current prospect on proportion of RPS compliance cost out of the total bill is derived. To specify, the RPS program-related resources is divided by the total cost of delivering electricity to "Large General Service" customers in the commercial sector (See Figure 16 in Appendix A). This report assumes the rise of the RPS target will lead to proportional increase of the proportion of RPS compliance cost. In order to project the average commercial rate, each case of RPS compliance cost ratio is applied to the current projection of Dominion's average commercial rate. The percentage of RPS compliance cost to the total Dominion commercial bill is shown in Figure 7-3.

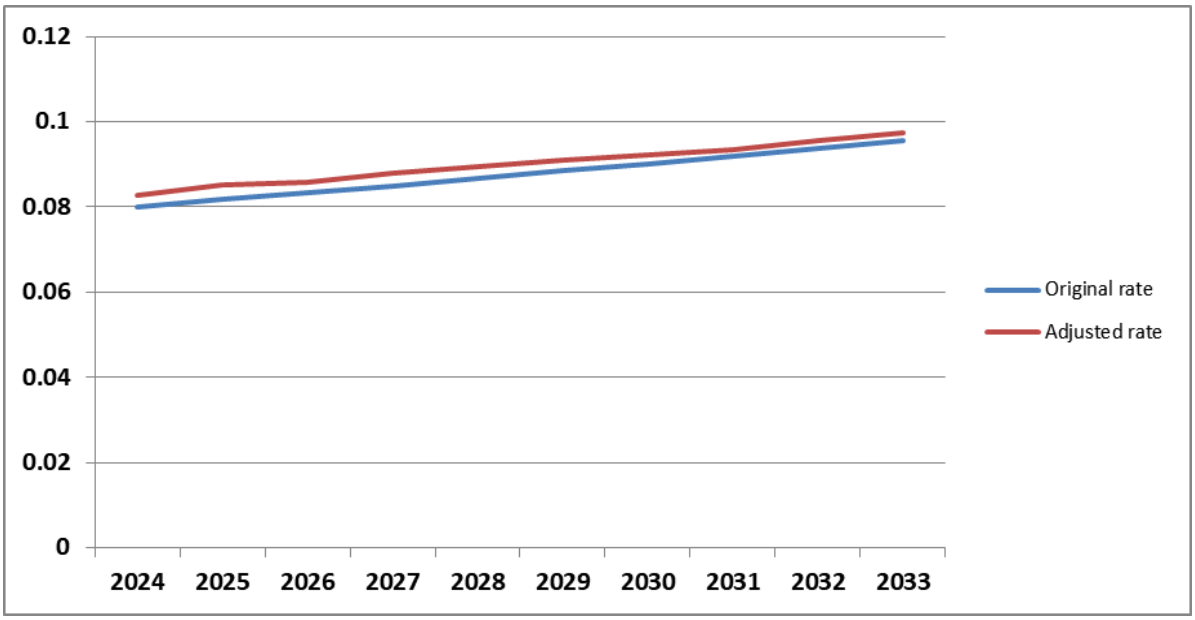
Figure 7-3: Percentage of RPS Compliance Cost to the Total Bill



2. Results

As RPS requirement strengthens, the proportion of RPS compliance costs increases. This trend led to an increase in total bill, in this case the average commercial rate for Dominion customers. Now the rate ranges from $0.082kWh to $0.097kWh (See figure 7-4). Compared to the 2024 baseline, it is higher by 0.1%. The higher rates will be discouraging to data centers; this report assesses the financial feasibility of this policy option as low.

Figure 7-4: Forecast of Average Commercial Rate for Dominion (unit: $/kWh)



C. Administrative Feasibility

In 2020, the VCEA that created the RPS was introduced to the VA State House by Representative Rip Sullivan and the VA State Senate by Senator Jennifer McClellan.[141] The bill ended up passing with a Democratic majority, and Democratic Governor Ralph Northam signed it into law. With this being said, in order for the Commonwealth of Virginia to raise its RPS, a bill that has higher standards must be proposed to the VA Legislature by a Member of the House of Representatives or State Senate, pass through several legislative committees, and be signed into law by the Governor. There would most likely have to be a Democratic majority in the House of Delegates and a Democratic Governor, like it did for the VCEA of 2020, to pass. However, as of 2022 there is a Republican majority in the House of Delegates and a Republican Governor, so it would likely not pass.

The administrative cost of enhancing the VCEA and raising the RPS should be minimal. However due to higher RPS, it is likely that there will be a higher amount of deficiency payment to the department. The payments will be deposited into the account administered by the Virginia Energy Department, formerly called the Department of Mines, Minerals and Energy, which is directed to distribute a portion of the money to job training and renewable energy programs, energy efficiency measures, and administrative costs.[142]

Since the administrative costs for raising the RPS for Loudoun County should be minimal, however, this report considers the likelihood that a RPS bill with higher standards will pass is low. Based on the criteria scale, administrative feasibility is scored as low.

D. Political Feasibility

Roughly half of the growth in U.S. renewable energy generation since the beginning of the 2000s is due to RPS requirements.[143] For example, in 2022 California had RPS increases, which required the state's utilities to generate 73% of energy from renewables by 2032 and 100% by 2045.[144] 10 states have set a RPS of 100% but the standard policies vary across the board nationwide. Additionally, while these RPS increases are helpful, they do not provide any direct community reinvestment initiatives. Virginia specifically will have a difficult time as the Virginia RPS was recently enacted and it may be too soon to attempt raising it. The fact that RPS is a state-level policy intervention tool only complicates matters as it begins to involve more variables in the equation. Reinforcing the VCEA and raising the RPS will be politically

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[141] Wikimedia Foundation. (2021, December 23). *Virginia Clean Economy Act*. Wikipedia. Retrieved March 10, 2022, from https://en.wikipedia.org/wiki/Virginia_Clean_Economy_Act

[142] HB 1526 Electric utility regulation; environmental goals, https://lis.virginia.gov/cgi-bin/legp604.exe?201+sum+HB1526

[143] National Conference of State Legislatures (NCSL). *State Renewable Portfolio Standards and Goals.* 2021.

[144] Kennedy, Ryan. "California lifts renewable energy target to 73% by 2032". PV Magazine. Retrieved March 10, 2022 from https://pv-magazine-usa.com/2022/02/14/california-lifts-renewable-energy-target-to-73-by-2032/#:~:text=The%20California%20Public%20Utilities%20Commission,and%20includes%20increased%20reliability%20provisions

challenging due to the opposition from IOUs and parties of different interest. There is also the deficiency payment to consider, which will be highly unpopular. Due to the dominance in the utility market, Dominion has the financial and political power to campaign and lobby against this proposal. Elected officials in the county are also expected to fight against these kinds of proposals as they have shown a proclivity towards these anti-renewable legislation standards. With all of these elements being considered, the tremendous opposition towards RPS standards in Virginia, its relative infancy, and lack of community reinvestment programs, puts it in the low feasibility tier.

VIII. Recommendation and Conclusion

A. Recommendation

To answer the policy question "**What would be the impact of CCA in Loudoun County for decarbonizing data center energy usage?**", the report demonstrates that CCA is an effective policy option expected to achieve higher GHG emissions reductions and competitive pricing when compared to other policy options. In particular, the report identifies the need to focus on the power mix of the electricity providers to drive actual GHG emission reductions for data centers in Loudoun County. Since Loudoun County is home to the most data centers in the world, implementation of a CCA would allow data centers to purchase large amounts of clean energy that is price-competitive that would ultimately lead to decarbonization.

This report analyzes specific renewable energy procurement behaviors of data centers in Northern Virginia and Northern California. Through these analyses, this report also identifies CCA as a means to democratize access to renewable energy for data centers. Some of these data centers are categorized as "hyperscale" and consume more than 100 MW, and since Dominion Energy is the IOU in the region, the data centers procure energy through them by default. This default option conflicts with individual data centers' own energy goals as a majority of the energy mix that Dominion uses is not from renewable sources. It is important to note that only a few data centers use PPAs.

This report reveals that CCA implementation has a low opt-out rate which would substantially decrease clean energy usage. If CCAs are implemented in Virginia, discounted rates should be applied specifically for customers with high energy usage, such as data centers. Discounted rates can be used to incentivize customers with massive energy usage to stay with CCA. Having a majority of customers that use large amounts of energy, such as data centers, will help achieve economies of scale.

Furthermore, the report reveals that grid reliability is an important factor for data centers, but may not always be properly understood in terms of CCAs grid reliability. Based on the analysis of this report, Loudoun County should inform stakeholders and data centers that the CCAs grid reliability will be the same as Dominions. With the caveat of additional administrative costs, it is more efficient for a CCA to implement a 24/7 renewable energy supply management collectively than for each data center to do it individually.

However, there are challenges with political and administrative feasibility. The main challenges are:

1. CCA's administrative feasibility is estimated to be "medium", since start up costs are projected to be recouped by year 3 and revenues can be used for rainy day funds, community reinvestment programs, and further reduced rates.
2. CCA's political feasbility is estimated to be "medium" since there has been political opposition by influential stakeholders, however, municipalities still have the legal authority to launch a CCA.

B. Conclusion

Considering the evaluative criteria of GHG emissions rates, financial, administrative, and political feasibility, this report makes the final policy recommendation to implement CCA in Loudoun County, Virginia.

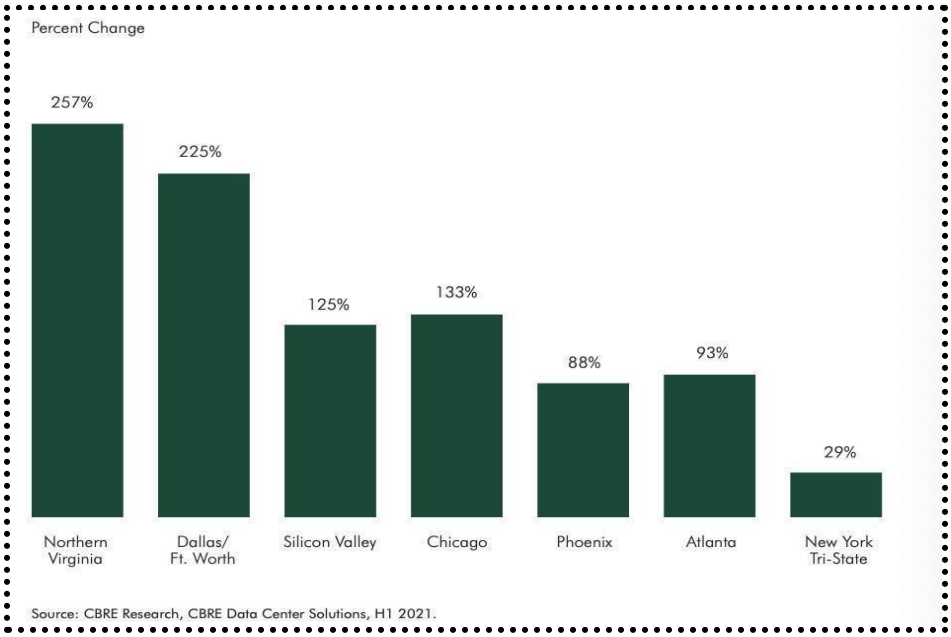
Loudoun County has adopted MWCOG's climate mitigation goals and aims to reduce their GHG emission to 1.9 million metric tons by 2030. As of 2022, Loudoun County is behind in reaching those goals when compared to jurisdictions in neighboring states. One of the challenges is the increase in size and energy demands of data centers. The projected GHG reduction with the implementation of a CCA best aligns with the VCEA requirements and would be the best policy option for Loudoun County to be on track to meet its energy goals by 2033.

CCA is cost competitive with the default service and is projected to have lower energy costs per kilowatt hour than Dominion Energy. Even though CCA will have high startup costs, those costs will be recovered rather quickly. The implementation of CCA's projected rates show that data centers will benefit immensely, which is a primary advantage of a CCA considering the amount of energy data centers consume.

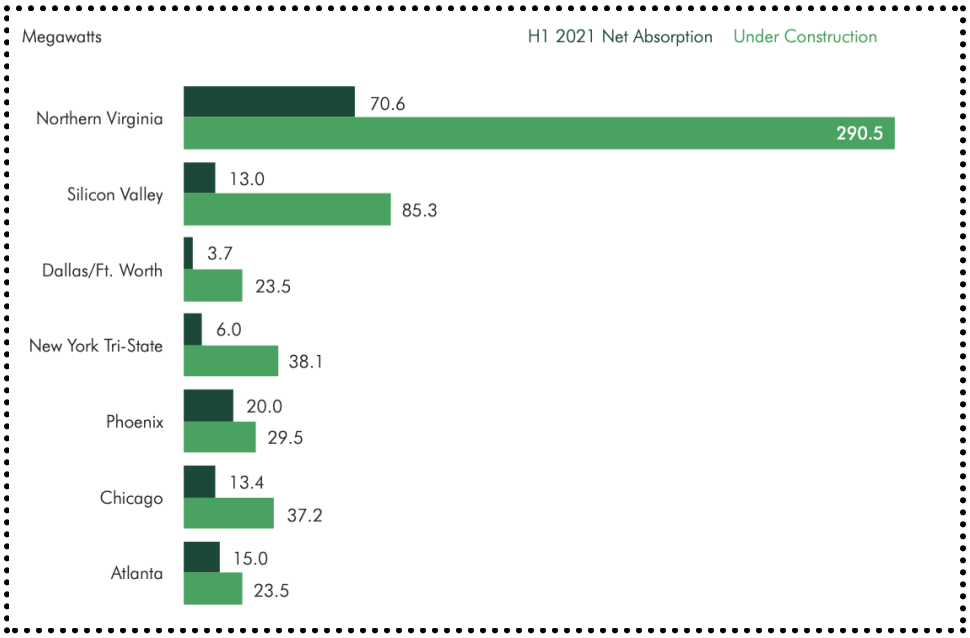
IX. Appendices

Appendix A: Supplementary Data

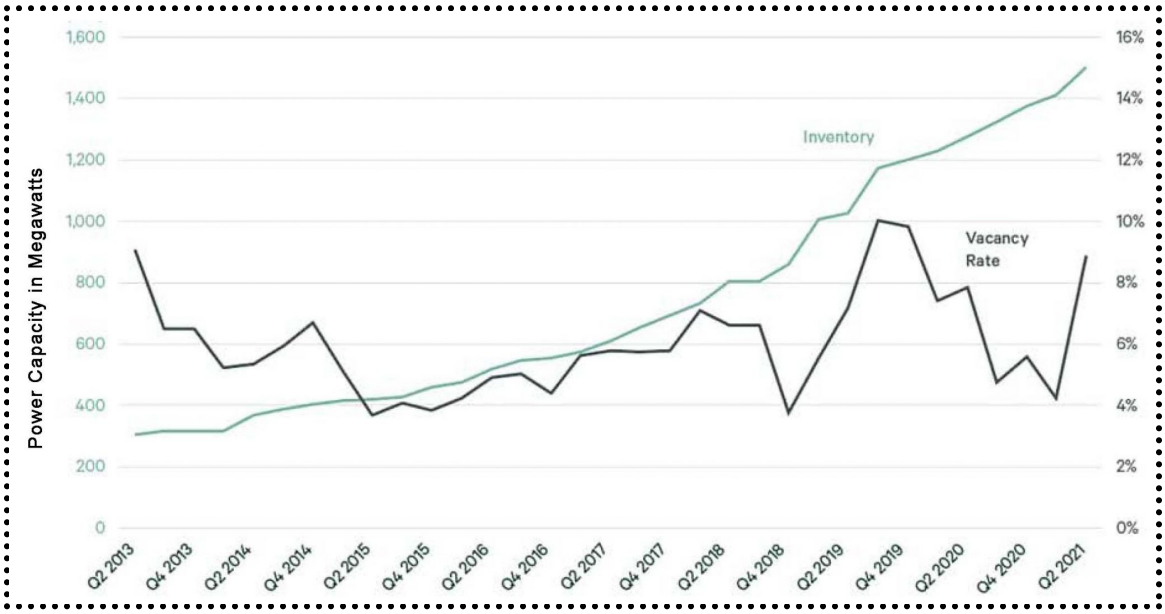
1: 2021 Data Centers Inventory Growth



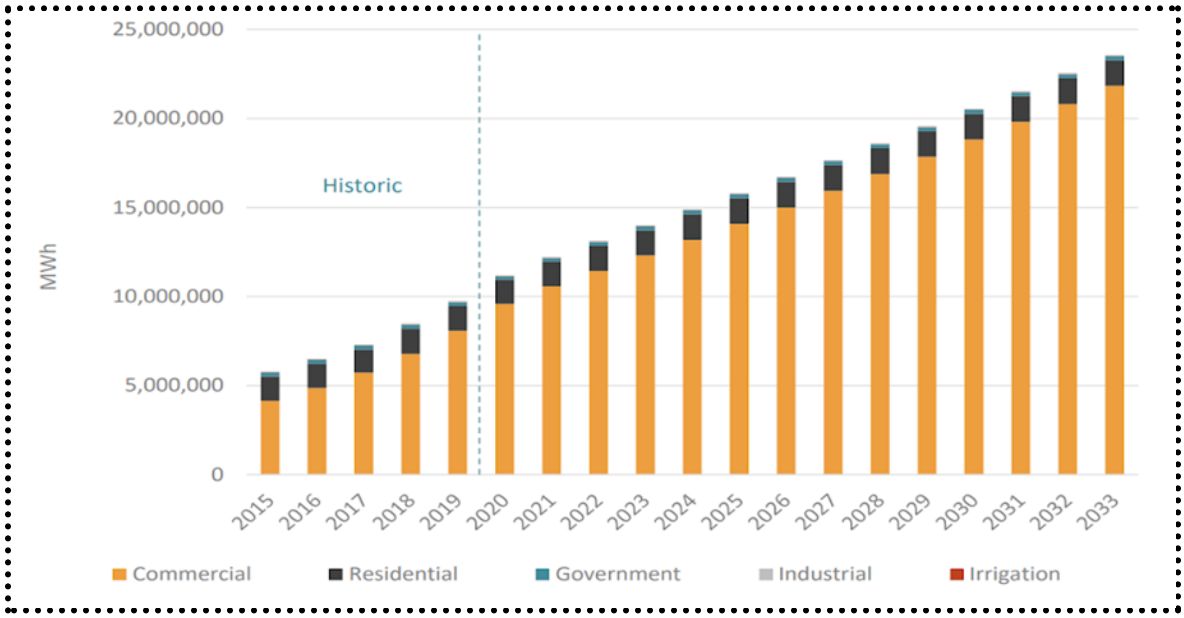
2: 2021 Data Centers Net Absorption



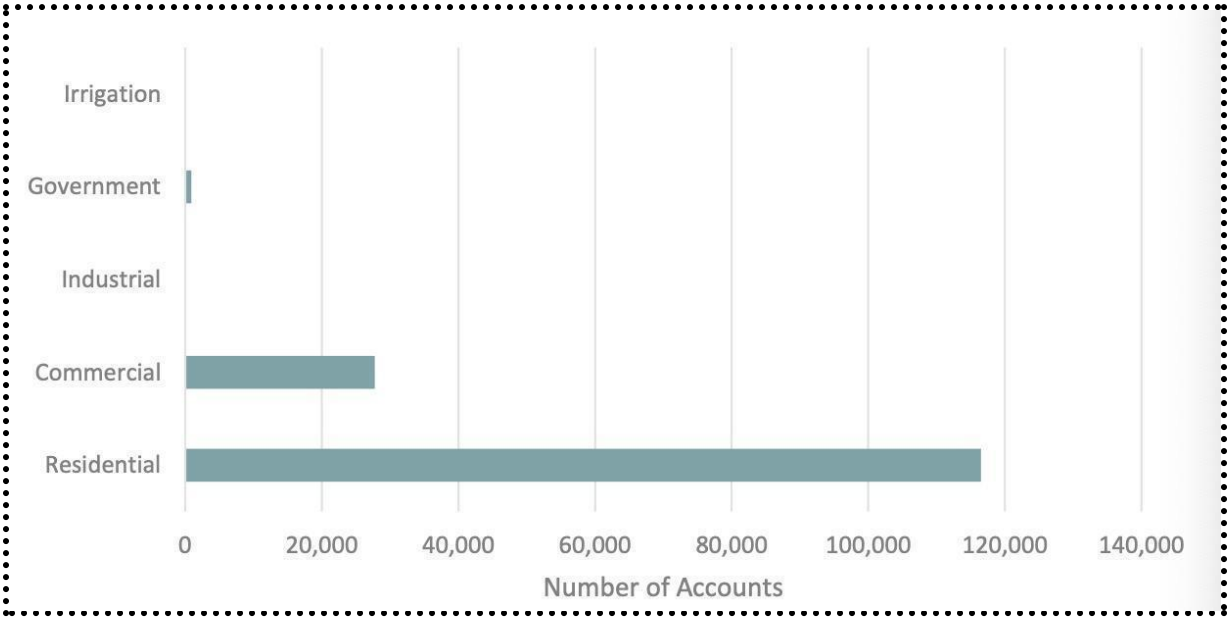
3: Inventory vs Vacancy Rate



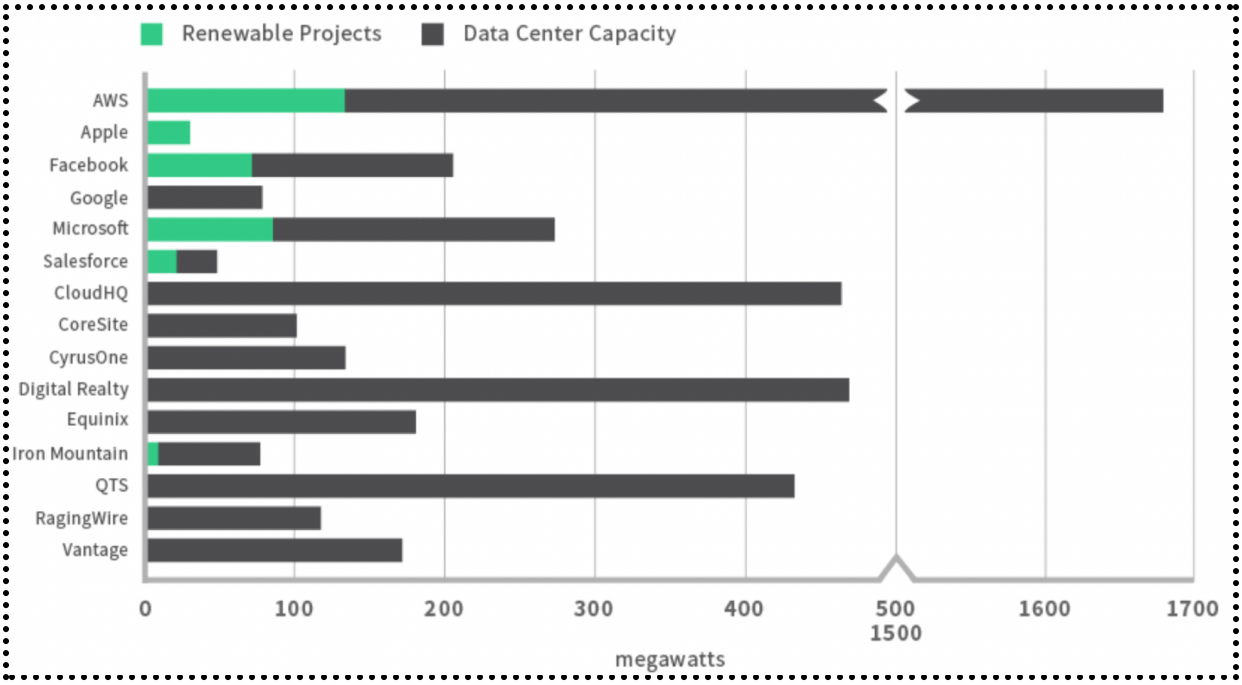
4: Forecast Municipal Aggregation Service Area Load



5: Forecast Service Accounts



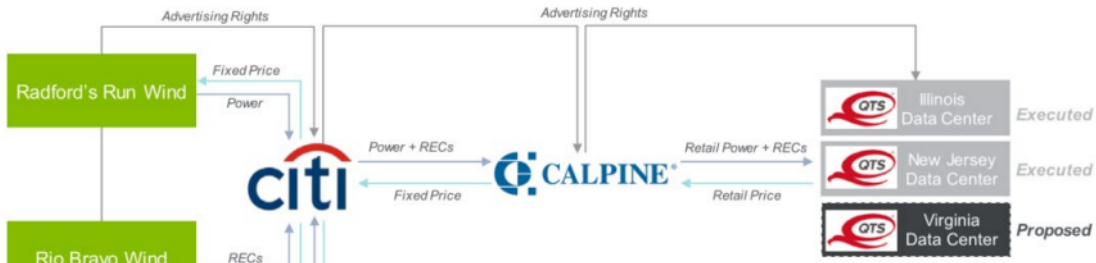
6: Energy Consumption Composition for Data Centers in Virginia



7: Green Power Procurement Model (QTS)

Project Specific Commodity Hedge Renewables

Recently Recognized by EPA for Leadership Award



- Citi finances project and offtakes power & REC's
  - Significant leverage on the project owner
  - Citi sells wholesale output of the project to 5-20 customers
- Calpine sits between Citi and QTS to retail the power & REC's
- Even with markups, the low basis allows for lower cost power to QTS

QTS Customers Get:

- 10 year energy price certainty
- Specific source, local project renewables
- No Basis risk – power settles at major hubs
- Flexible volumes
- Pricing that is on par or lower than conventional brown power

QTSGREEN 8

8: SVCE account forecast

Extraordinarily Sensitive Information Redacted

Rate Outlook 2020 to 2035

LARGE GENERAL SERVICES BILL PROJECTION - PLAN A, COMPANY METHODOLOGY

Rate projections are not final. Rates are subject to regulatory approval.
Certain line items potentially eligible for customer credit reinvestment offset under Va. Code.
Rate projections assume return on equity of 9.20%.

LARGE GENERAL SERVICE Schedule GS-4 (6,000,000 kWh - 10,000 kW)	2019 DEC 2019	2020 MAY 1, 2020	2020 DEC 2020	2021 DEC 2021	2022 DEC 2022	2023 DEC 2023	2024 DEC 2024	2025 DEC 2025	2026 DEC 2026	2027 DEC 2027	2028 DEC 2028	2029 DEC 2029	2030 DEC 2030	2031 DEC 2031	2032 DEC 2032	2033 DEC 2033	2034 DEC 2034	2035 DEC 2035
DISTRIBUTION & GENERATION (BASE) [1]	$ 131,196.69	$ 131,196.69	$ 131,196.69	$ 131,196.69	$ 119,032.15	$ 119,032.15	$ 119,032.15	$ 119,032.15	$ 119,032.15	$ 119,032.15	$ 119,032.15	$ 119,032.15	$ 119,032.15	$ 119,032.15	$ 119,032.15	$ 119,032.15	$ 119,032.15	$ 119,032.15
TRANSMISSION - RIDER T	$ 37,760.00	$ 37,760.00	$ 42,270.00	$ 45,260.00														
FUEL (MARKET FORECAST)	$ 139,524.00	$ 104,142.00	$ 102,126.00	$ 122,688.00														
DSM (APPROVED & PROPOSED)	$ 150.00	$ 150.00	$ 6.49	$ 54.00														
RIDER PIPP - UNIVERSAL SERVICE FEE [2]	$ -	$ -	$ -	$ 162.00														
Generation Infrastructure																		
EXISTING GENERATION RIDERS [3]	$ 36,670.00	$ 34,070.00	$ 33,750.00	$ 34,650.00														
RIDER SNA - NUCLEAR SUBSEQUENT LICENSE RENEWAL	$ -	$ -	$ -	$ -														
Distribution Infrastructure																		
GT PLAN (APPROVED PHASE 1)	$ -	$ -	$ -	$ -														
STRATEGIC UNDERGROUND PLAN	$ -	$ -	$ -	$ -														
RURAL BROADBAND	$ -	$ -	$ -	$ 20.00														
A5 Environmental																		
RIDER E	$ 5,560.00	$ 5,560.00	$ 7.48	$ 3,140.00														
RIDER RGGI	$ -	$ -	$ -	$ 14,358.00														
RIDER CCR	$ -	$ -	$ -	$ 17,670.00														
Additional Resources in Plan A																		
GAS CT (2026 & 2027)	$ -	$ -	$ -	$ -														
BIOMASS - 2023 RETIREMENT	$ -	$ -	$ -	$ -	$ 2,030.00	$ 1,690.00	$ (1,300.00)	$ (1,590.00)	$ (1,630.00)	$ (1,660.00)	$ (2,120.00)	$ (250.00)	$ -	$ -	$ -	$ -	$ -	$ -
VCHEC - 2023 RETIREMENT	$ -	$ -	$ -	$ -	$ 1,280.00	$ 29,380.00	$ (7,870.00)	$ (7,500.00)	$ (7,340.00)	$ (7,160.00)	$ (6,920.00)	$ (6,670.00)	$ (6,520.00)	$ (6,390.00)	$ (6,060.00)	$ (5,930.00)	$ (5,800.00)	$ (6,040.00)
RPS Program-Related Resources Plan A																		
RIDER RPS [4]	$ -	$ -	$ -	$ 1,092.00	$ 2,916.00	$ 7,386.00	$ 8,328.00	$ 11,538.00	$ 11,394.00	$ 11,382.00	$ 10,806.00	$ 9,516.00	$ 7,686.00	$ 5,556.00	$ 6,228.00	$ 7,020.00	$ 8,052.00	$ 9,048.00
RIDER CE [5]	$ -	$ -	$ -	$ 480.00	$ 560.00	$ 790.00	$ 730.00	$ 690.00	$ 660.00	$ 620.00	$ 590.00	$ 560.00	$ 540.00	$ 520.00	$ 490.00	$ 480.00	$ 460.00	$ 440.00
RIDER CE - FUEL BENEFIT	$ -	$ -	$ -	$ -	$ (258.00)	$ (402.00)	$ (366.00)	$ (354.00)	$ (348.00)	$ (336.00)	$ (342.00)	$ (348.00)	$ (348.00)	$ (354.00)	$ (366.00)	$ (372.00)	$ (378.00)	$ (384.00)
RIDER CE - REC PROXY VALUE	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ (318.00)	$ (228.00)	$ (120.00)	$ (84.00)	$ (60.00)	$ (36.00)	$ (36.00)	$ (42.00)	$ (42.00)	$ (42.00)
RIDER CE - CAPACITY OFFSET	$ -	$ -	$ -	$ -	$ -	$ (40.00)	$ (60.00)	$ (60.00)	$ (60.00)	$ (60.00)	$ (60.00)	$ (60.00)	$ (60.00)	$ (60.00)	$ (60.00)	$ (60.00)	$ (60.00)	$ (70.00)
TOTAL RIDER CE	**$ -**	**$ -**	**$ -**	**$ 480.00**	**$ 302.00**	**$ 348.00**	**$ 304.00**	**$ 276.00**	**$ (66.00)**	**$ (4.00)**	**$ 68.00**	**$ 68.00**	**$ 72.00**	**$ 70.00**	**$ 28.00**	**$ 6.00**	**$ (20.00)**	**$ (56.00)**
RIDER PPA [3]	$ -	$ -	$ -	$ -	$ 1,350.00	$ 1,938.00	$ 3,172.00	$ 3,194.00	$ 3,198.00	$ 3,174.00	$ 3,166.00	$ 3,148.00	$ 3,148.00	$ 3,142.00	$ 3,154.00	$ 3,164.00	$ 3,176.00	$ 3,194.00
RIDER PPA - FUEL BENEFIT	$ -	$ -	$ -	$ -	$ -	$ -	$ (3,210.00)	$ (3,108.00)	$ (3,054.00)	$ (2,982.00)	$ (3,030.00)	$ (3,090.00)	$ (3,090.00)	$ (3,126.00)	$ (3,228.00)	$ (3,306.00)	$ (3,354.00)	$ (3,378.00)
RIDER PPA - REC PROXY	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ (3,204.00)	$ (1,662.00)	$ (948.00)	$ (750.00)	$ (540.00)	$ (348.00)	$ (360.00)	$ (372.00)	$ (390.00)	$ (408.00)
RIDER PPA - CAPACITY OFFSET	$ -	$ -	$ -	$ -	$ -	$ -	$ (220.00)	$ (220.00)	$ (230.00)	$ (230.00)	$ (230.00)	$ (230.00)	$ (230.00)	$ (240.00)	$ (240.00)	$ (240.00)	$ (240.00)	$ (250.00)
TOTAL RIDER PPA	**$ -**	**$ -**	**$ -**	**$ -**	**$ 1,350.00**	**$ 1,938.00**	**$ (258.00)**	**$ (134.00)**	**$ (3,290.00)**	**$ (1,700.00)**	**$ (1,042.00)**	**$ (922.00)**	**$ (712.00)**	**$ (572.00)**	**$ (674.00)**	**$ (754.00)**	**$ (808.00)**	**$ (842.00)**
RPS PROGRAM-RELATED RESOURCES SUBTOTAL	$ -	$ -	$ -	$ 1,572.00	$ 4,568.00	$ 9,672.00	$ 8,374.00	$ 11,680.00	$ 8,038.00	$ 9,678.00	$ 9,832.00	$ 8,662.00	$ 7,046.00	$ 5,054.00	$ 5,582.00	$ 6,272.00	$ 7,224.00	$ 8,150.00
PLAN A TOTAL	**$ 350,860.69**	**$ 312,878.69**	**$ 309,356.66**	**$ 370,770.69**	**$ 372,472.15**	**$ 412,806.15**	**$ 369,656.15**	**$ 372,278.15**	**$ 377,862.15**	**$ 380,248.15**	**$ 389,910.15**	**$ 385,774.15**	**$ 385,788.15**	**$ 388,352.15**	**$ 390,728.15**	**$ 399,794.15**	**$ 401,530.15**	**$ 403,720.15**
CAGR PLAN A (2019 BASE)													0.9%					0.9%
CAGR PLAN A (MAY 2020 BASE)													2.0%					1.6%

[1] Publicly available, annualized tariff rates consistent with filing in Case No. PUR-2021-00058. No future change modeled.
[2] No assumptions modeled for exemptions to Rider PIPP.
[3] Riders B, R, S, W, BW, GV, US-2, US-3 and US-4.
[4] Includes the cost of purchases plus the cost of the REC proxy value from Company-owned facilities.

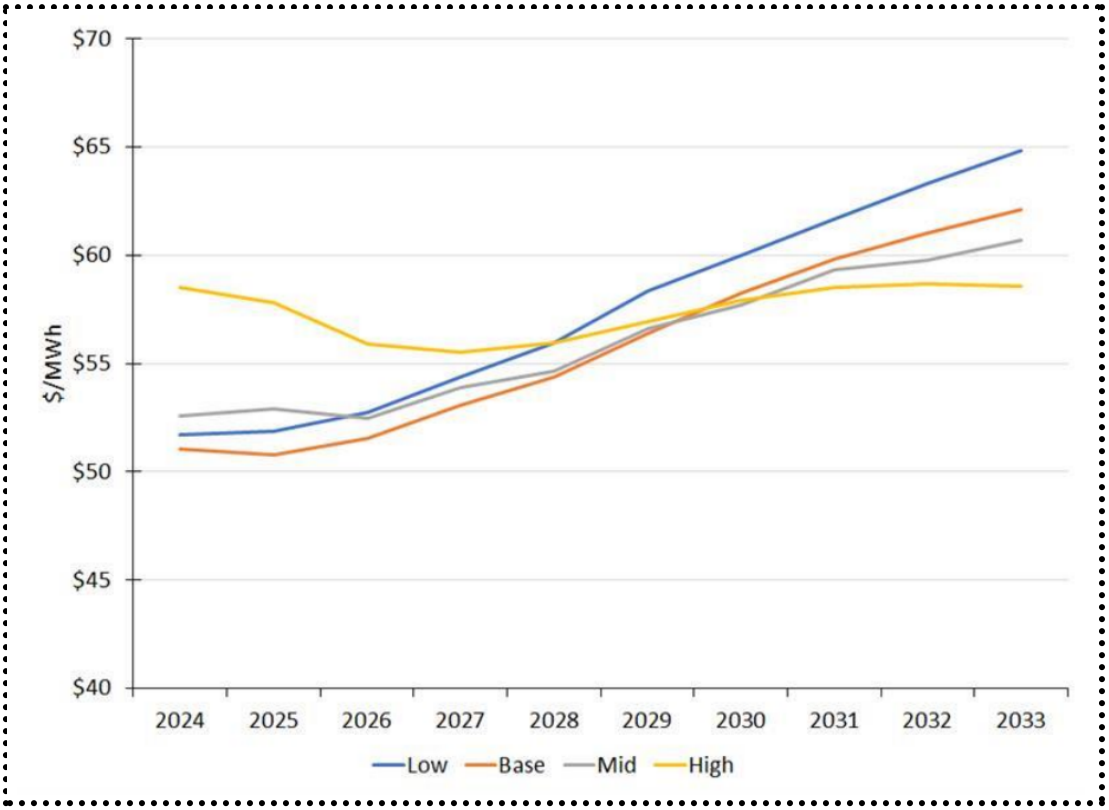
9: Cost components for financial analysis in Loudoun County Feasibility Study

- Power Supply Costs:
  - Wholesale Purchases
  - Renewable Purchases
  - Local and Regional Solar
  - Battery Storage
  - Procurement of Reliability Pricing Model (RPM) or "Performance" Capacity
  - Ancillary Services
- Non-Power Supply Costs:
  - Start-Up Costs
  - Municipal Aggregation Staffing and Administration Costs
  - Consulting Support
  - Dominion billing and Regulatory Charges
  - Financing Costs
- Pass-Through Charges from Dominion:
  - Transmission and Delivery Charges
  - Potential Stranded Generation Costs/Exit Fee

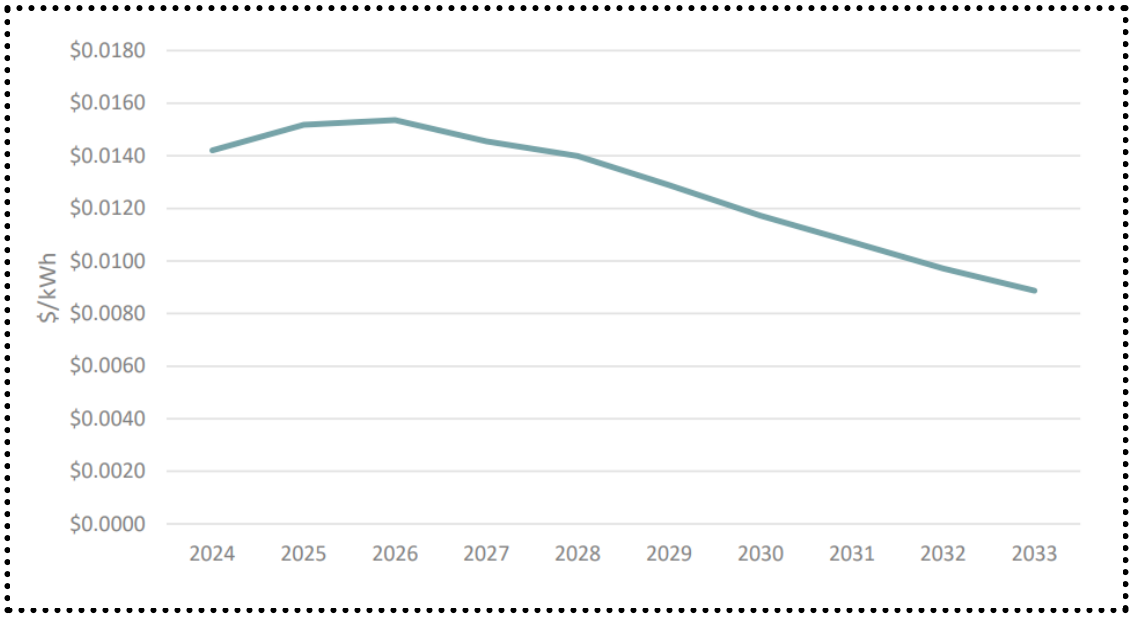
10: Power Portfolio for Loudoun County Feasibility Study

Scenario 1 *25% Renewable by 2033 Portfolio (Low Case)*: Renewable Portfolio increases linearly from 10% in 2024 to 25% in 2033, recognizing that the municipal aggregation will not be bound by the Virginia Clean Economy Act (VCEA) and may be able to provide a discounted rate compared to Dominion IOU by balancing an optimized portfolio and a renewable option.
Scenario 2 *52% Renewable by 2033 Portfolio (Base Case)*: Following VCEA's renewable timeline for Dominion IOU, Renewable Portfolio will increase from 23% in 2024 to 52% by 2033.
Scenario 3 *75% Renewable by 2033 Portfolio (Mid Case)*: Renewable goal increases linearly from 50% in 2024 to 75% in 2033, providing a higher renewable standard than the VCEA for Dominion.
Scenario 4 *100% Renewable by 2033 Portfolio (High Case)*: 100% of retail loads are served with RPS-qualifying renewable resources or Renewable Energy Credits in all years.

11: Annual Power Supply Costs from Loudoun County Feasibility Study



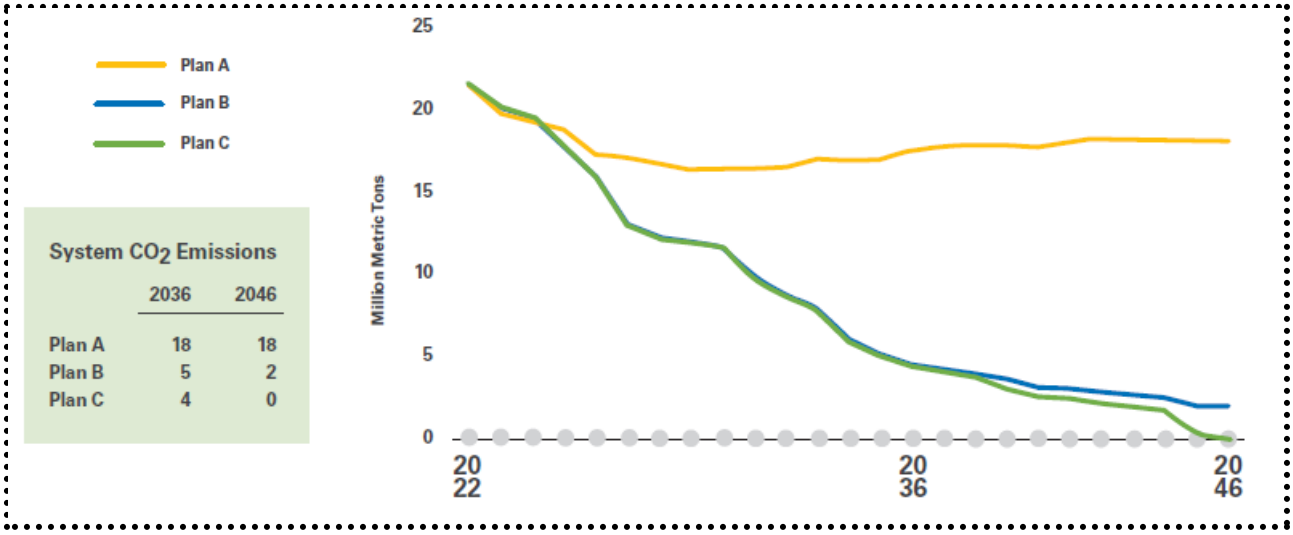
12: Exit Fee Forecast from Loudoun County Feasibility Study



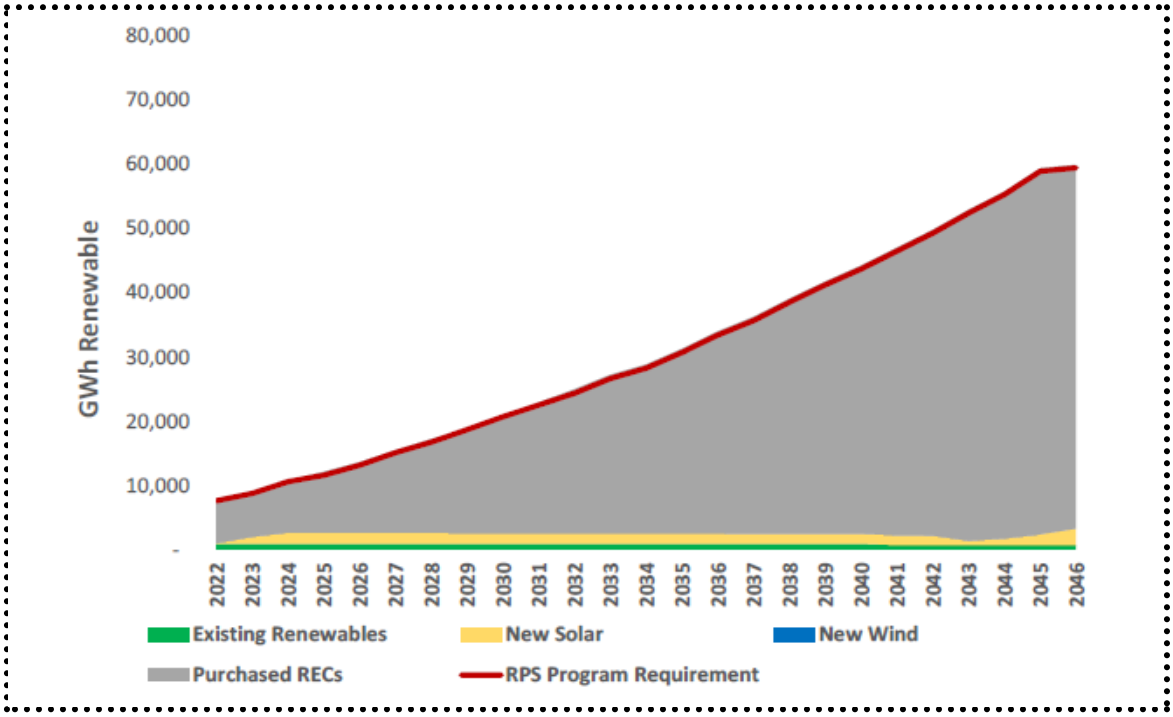
13: Three alternative plans regarding GHG emissions - Dominion IRP (2021 Update to the 2020 Integrated Resource Plan)

	Plan A	Plan B	Plan C
NPV Total ($B)	$46.0	$67.9	$70.7
Approximate CO_2 Emissions from Company in 2046 (Metric Tons)	18 M	2 M	0
Solar (MW)	820 15 yr. 2,140 25 yr.	14,310 15 yr. 17,790 25 yr.	14,310 15 yr. 20,550 25 yr.
Wind (MW)	— 15 yr. — 25 yr.	5,174 15 yr. 5,174 25 yr.	5,174 15 yr. 5,614 25 yr.
Storage (MW)	— 15 yr. — 25 yr.	2,713 15 yr. 2,713 25 yr.	3,793 15 yr. 12,043 25 yr.
Natural Gas-Fired (MW)	970 15 yr. 970 25 yr.	— 15 yr. — 25 yr.	— 15 yr. — 25 yr.
Retirements (MW)	2,567 15 yr. 2,567 25 yr.	2,561 15 yr. 4,792 25 yr.	2,561 15 yr. 13,356 25 yr.

14: Projected CO_2 enussuibs from Dominion's fleet from 2022 to 2046 - Dominion IRP (2021 Update to the 2020 Integrated Resource Plan)



15: Means of procuring renewable energy in the case of Plan A - Dominion IRP (2021 Update to the 2020 Integrated Resource Plan)



16: Large General Services Bill Projection - Dominion IRP (2021 Update to the 2020 Integrated Resource Plan)

Extraordinarily Sensitive Information Redacted

Rate Outlook 2020 to 2035

LARGE GENERAL SERVICES BILL PROJECTION - PLAN A, COMPANY METHODOLOGY

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TRANSMISSION - RIDER T	$ 37,760.00	$ 37,760.00	$ 42,270.00	$ 45,260.00														
FUEL (MARKET FORECAST)	$ 139,524.00	$ 104,142.00	$ 102,126.00	$ 122,688.00														
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Distribution Infrastructure																		
GT PLAN (APPROVED PHASE 1)	$ -	$ -	$ -	$ -														
STRATEGIC UNDERGROUND PLAN	$ -	$ -	$ -	$ -														
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BIOMASS - 2023 RETIREMENT	$ -	$ -	$ -	$ -	$ 2,030.00	$ 1,690.00	$ (1,300.00)	$ (1,590.00)	$ (1,630.00)	$ (1,660.00)	$ (2,120.00)	$ (250.00)	$ -	$ -	$ -	$ -	$ -	$ -
VCHEC - 2023 RETIREMENT	$ -	$ -	$ -	$ -	$ 1,280.00	$ 29,380.00	$ (7,870.00)	$ (7,500.00)	$ (7,340.00)	$ (7,160.00)	$ (6,920.00)	$ (6,670.00)	$ (6,520.00)	$ (6,390.00)	$ (6,060.00)	$ (5,930.00)	$ (5,800.00)	$ (6,040.00)
RPS Program-Related Resources Plan A																		
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RIDER CE [5]	$ -	$ -	$ -	$ 480.00	$ 560.00	$ 790.00	$ 730.00	$ 690.00	$ 660.00	$ 620.00	$ 590.00	$ 560.00	$ 540.00	$ 520.00	$ 490.00	$ 480.00	$ 460.00	$ 440.00
RIDER CE - FUEL BENEFIT	$ -	$ -	$ -	$ -	$ (258.00)	$ (402.00)	$ (366.00)	$ (354.00)	$ (348.00)	$ (336.00)	$ (342.00)	$ (348.00)	$ (348.00)	$ (354.00)	$ (366.00)	$ (372.00)	$ (378.00)	$ (384.00)
RIDER CE - REC PROXY VALUE	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ (318.00)	$ (228.00)	$ (120.00)	$ (84.00)	$ (60.00)	$ (36.00)	$ (36.00)	$ (42.00)	$ (42.00)	$ (42.00)
RIDER CE - CAPACITY OFFSET	$ -	$ -	$ -	$ -	$ -	$ (40.00)	$ (60.00)	$ (60.00)	$ (60.00)	$ (60.00)	$ (60.00)	$ (60.00)	$ (60.00)	$ (60.00)	$ (60.00)	$ (60.00)	$ (60.00)	$ (70.00)
TOTAL RIDER CE	**$ -**	**$ -**	**$ -**	**$ 480.00**	**$ 302.00**	**$ 348.00**	**$ 304.00**	**$ 276.00**	**$ (66.00)**	**$ (4.00)**	**$ 68.00**	**$ 68.00**	**$ 72.00**	**$ 70.00**	**$ 28.00**	**$ 6.00**	**$ (20.00)**	**$ (56.00)**
RIDER PPA [5]	$ -	$ -	$ -	$ -	$ 1,350.00	$ 1,938.00	$ 3,172.00	$ 3,194.00	$ 3,198.00	$ 3,174.00	$ 3,166.00	$ 3,148.00	$ 3,148.00	$ 3,142.00	$ 3,154.00	$ 3,164.00	$ 3,176.00	$ 3,194.00
RIDER PPA - FUEL BENEFIT	$ -	$ -	$ -	$ -	$ -	$ -	$ (3,210.00)	$ (3,108.00)	$ (3,054.00)	$ (2,982.00)	$ (3,030.00)	$ (3,090.00)	$ (3,090.00)	$ (3,126.00)	$ (3,228.00)	$ (3,306.00)	$ (3,354.00)	$ (3,378.00)
RIDER PPA - REC PROXY	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ (3,204.00)	$ (1,662.00)	$ (948.00)	$ (750.00)	$ (540.00)	$ (348.00)	$ (360.00)	$ (372.00)	$ (390.00)	$ (408.00)
RIDER PPA - CAPACITY OFFSET	$ -	$ -	$ -	$ -	$ -	$ -	$ (220.00)	$ (220.00)	$ (230.00)	$ (230.00)	$ (230.00)	$ (230.00)	$ (230.00)	$ (240.00)	$ (240.00)	$ (240.00)	$ (240.00)	$ (250.00)
TOTAL RIDER PPA	**$ -**	**$ -**	**$ -**	**$ -**	**$ 1,350.00**	**$ 1,938.00**	**$ (258.00)**	**$ (134.00)**	**$ (3,290.00)**	**$ (1,700.00)**	**$ (1,042.00)**	**$ (922.00)**	**$ (712.00)**	**$ (572.00)**	**$ (674.00)**	**$ (754.00)**	**$ (808.00)**	**$ (842.00)**
RPS PROGRAM-RELATED RESOURCES SUBTOTAL	$ -	$ -	$ -	$ 1,572.00	$ 4,568.00	$ 9,672.00	$ 8,374.00	$ 11,680.00	$ 8,038.00	$ 9,678.00	$ 9,832.00	$ 8,662.00	$ 7,046.00	$ 5,054.00	$ 5,582.00	$ 6,272.00	$ 7,224.00	$ 8,150.00
PLAN A TOTAL	**$ 350,860.69**	**$ 312,878.69**	**$ 309,356.66**	**$ 370,770.69**	**$ 372,472.15**	**$ 412,806.15**	**$ 369,656.15**	**$ 372,278.15**	**$ 377,862.15**	**$ 380,248.15**	**$ 389,910.15**	**$ 385,774.15**	**$ 385,788.15**	**$ 388,352.15**	**$ 390,728.15**	**$ 399,794.15**	**$ 401,530.15**	**$ 403,720.15**
CAGR PLAN A (2019 BASE)													0.9%					0.9%
CAGR PLAN A (MAY 2020 BASE)													2.0%					1.6%

[1] Publicly available, annualized tariff rates consistent with filing in Case No. PUR-2021-00058. No future change modeled.
[2] No assumptions modeled for exemptions to Rider PIPP.
[3] Riders B, R, S, W, BW, GV, US-2, US-3 and US-4.
[4] Includes the cost of purchases plus the cost of the REC proxy value from Company-owned facilities.

Appendix B: Non-CCA Energy Procurement Options

1. Dominion (IOU)

Dominion Energy, the largest IOU in Virginia, provides electricity to more than 2.5 million homes and businesses in Virginia including over 12 million square feet of commissioned data center space.[145] Dominion has a long history as a dominant player in the local electricity market. Their long-term efforts in the region grant them the credibility for providing electricity and utility services as well as a strong political arm in renewable energy policymaking. In the event of the establishment of CCA in Virginia, Dominion would still participate in delivering the electricity and maintaining the grid.

2. PPAs and RECs

Another option for procuring energy comes from PPA. PPAs are long-term contracts in which commercial entities form an agreement with an energy generating unit to procure RECs from a specific project.[146] RECs are the "environmental attributes of electricity generated from renewable resources" with 1 REC equaling 1 MWh.[147] PPAs typically come in two mechanisms, physical and virtual. In physical PPA transactions, energy projects and buyers must be located in the same grid as the power is physically delivered. In a virtual PPA, the projects and buyers do not need to be in the same grid and buyers own the RECs. Virtual PPAs are the fastest growing financial transaction structure currently as they allow for smaller buyers to participate without energy trading expertise.[148]

3. Competitive Service Providers

CSP are companies licensed by the SCC to supply or aggregate energy services throughout Virginia. To be licensed as a CSP, the company must demonstrate to the SCC that it has the technical and financial capability of providing competitive energy services to Virginia consumers.[149] Effective January 1, 2009, electricity customers with annual demands of more than 5 MW acquired the option to shop for competitive electricity supply.[150] Those with 2 or more nonresidential retail customers that aggregate to reach 5 MW of load qualified to purchase electric energy from a CSP by petition and approval from the SCC.[151]

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[145] Dominion Energy, "Northern Virginia ranks as the largest data center market in the world", accessed 2022-03-08, https://economicdevelopment.dominionenergy.com/va/key-industries/data-centers/
[146] EPA, Green Power Partnership. Introduction to Virtual Power Purchase Agreements. 2016.
[147] Ibid.
[148] Kansal, Rachit. *Virtual Power Purchase Agreement.* RMI, 2019.
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[149] Competitive Service Providers. Retrieved February 22 from
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[150] Dominion Energy. Competitive Service Providers.
[151] Ibid.

Appendix C: Interview Guides

Category	Entity	Name	Associated Role
Public Agency in Virginia	Loudoun County	Marc T. Aveni	Assistant Director, Department of General Services
Public Entity in Virginia	Arlington County	Demetra J. McBride	Bureau Chief, Office of Sustainability and Environmental Management, Department of Environmental Services
Data center	Digital Realty	Aaron Binkley	Senior Director, Sustainability
Data center	QTS	Travis Wright	Vice President, Energy and Sustainability
Data center	CoreSite	Mauricio Muñoz	Manager, Product Management
CCA	San Jose Clean Energy	Kate Ziemba	Public Information Manager
CCA	Silicon Valley Clean Energy	Don Bray	Director, Account Services and Community Relations
CCA	Lean Energy U.S.	Alison Elliott	Interim Executive Director
Experts on CCA	UCLA Luskin Center for Innovation	Kelly Trumbull	Senior Project Manager
Experts on CCAs	UCLA Luskin Center for Innovation	J.R. DeShazo	Founding Director (Dean of the LBJ School of Public Affairs)
Experts on Data Center Markets	Dgtl Infra	Adam Simmons	Founder & CEO

This report has been prepared in cooperation with the above entities. Before conducting the interviews, the authors of this report reviewed the public information available. They then conducted interviews about the background circumstances of the information and the experiences and ideas of the respective entities. After the interviews, the results were summarized, and any additional questions were sent via email. The purpose of the interviews with each subject and the main questions asked are as follows.

Interview Guide for Public Agency Staff

1. Purpose
    a. To assess how Loudoun County and Arlington County policymaking staff plan to implement policies to decarbonize data centers
    b. To understand how they are thinking about implementing CCAs
2. Main Questions
    a. Data Center decarbonization initiatives
    b. Status of consideration of CCA implementation
    c. Thoughts on governance structure if CCA were to be implemented

Interview Guide for Data Center Providers

1. Purpose
    a. To analyze efforts by data center operators to increase the percentage of renewable energy. In particular, to investigate how different power procurement methods - Utilities, PPAs (Virtual/Physical), and CCAs - are being used.
    b. To analyze what barriers exist to current renewable energy procurement methods.
2. Main Questions
    a. Status of current efforts to increase the share of renewable energy based on data published by ESG report and EPA Green Power Partnership
    b. Advantages and disadvantages of procuring renewable energy through Utility, PPAs (Virtual/Physical), and CCAs

Interview Guide for CCAs

1. Purpose
    a. To understand how renewable energy procurement works through PPAs in CCAs
    b. To investigate the treatment of business customers in CCAs in order to encourage more data center operators to participate in the CCA framework if CCAs were implemented in Loudoun County.
    c. To assess CCA's efforts to ensure the reliability of the power supply
2. Main Questions
    a. Trends in CCA opt-outs by business customers
    b. Human and time costs of concluding a PPA
    c. Mechanisms to maintain the same level of power supply reliability as the IOU

Interview Guide for Experts

1. Purpose
    a. To obtain knowledge and resources on CCA and other renewable energy procurement methods as well as data center markets
    b. To receive technical advice on how to set policy options and evaluate them in this report
2. Main Questions
    a. Questions on various matters pertaining to the stage of preparation of this report

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