County of Fairfax, Virginia

MEMORANDUM

DATE: December 13, 2021

TO: Board of Supervisors

FROM: Bryan J. Hill
County Executive

SUBJECT: The Role of Off-Site Renewable Energy in Achieving Renewable Energy Goals

Introduction
This memorandum addresses the renewable energy goals of the Operational Energy Strategy (OES) and outlines opportunities for meeting the challenges ahead. A large off-site solar or wind power purchase agreement (PPA) is essential to meet the county's OES renewable energy goals. A significant purchase of off-site renewable electricity would complement the use of on-site renewables and the growing share of renewable power on the electric grid, allowing the county to achieve its goals in a cost-effective manner.

Off-site PPAs could make 100 percent renewable electricity for operations possible by 2030, exceeding OES goals and demonstrating leadership in the Commonwealth. OES will allow for carbon neutrality for county operations by 2040.

Background
Attachment A presents greater detail on electricity use in our county operations, describing how electrification of the fleet and building systems will largely offset the gains in energy efficiency also prescribed in OES.

Options to Increase Renewable Energy for County Operations
We have found additional ways to obtain clean renewable energy (RE) for county operations. These options and brief explanations of each are included in the list below. Two of the options are focused on renewable energy credits (RECs). RECs embody the environmental attributes associated with electricity from renewable sources and are an important element of all RE transactions. Attachment B addresses the factors that influence the financial and intrinsic value of RECs, including project location, project age, degree of customer involvement, and type of renewable resource. Attachment B also discusses the concept of "additionality," which is the recognition that a REC customer can play in creating new renewable electricity.

1. *On-site RE installations designed, financed, and owned by a PPA vendor*. Pay for renewable electricity generated by that system with no upfront or on-going costs
2. *On-site RE installations designed, financed, and owned by the county*. The county has not yet completed any projects using this approach, however, we may in the coming months.

3. *Off-site virtual PPA for large RE purchase via renewable energy credits (RECs).* This option involves the purchase of RECs through a PPA with one or more specific off-site renewable energy generation sites.
4. *Generic REC purchases*. This option involves the purchase of RECs from a utility or other party – often a broker.
5. *RE distributed by the power grid.* This option requires no special action on the part of the customer. The amount of RE as a percentage of overall Virginia grid power is small today (six percent in 2020). It is expected to grow quickly as the result of mandates in the 2020 Virginia Clean Economy Act (VCEA). By 2045 Dominion Energy (Dominion) is required to generate 100 percent of the electricity with interim goals of 41 and 79 percent of renewable electricity by 2030 and 2040, respectively.

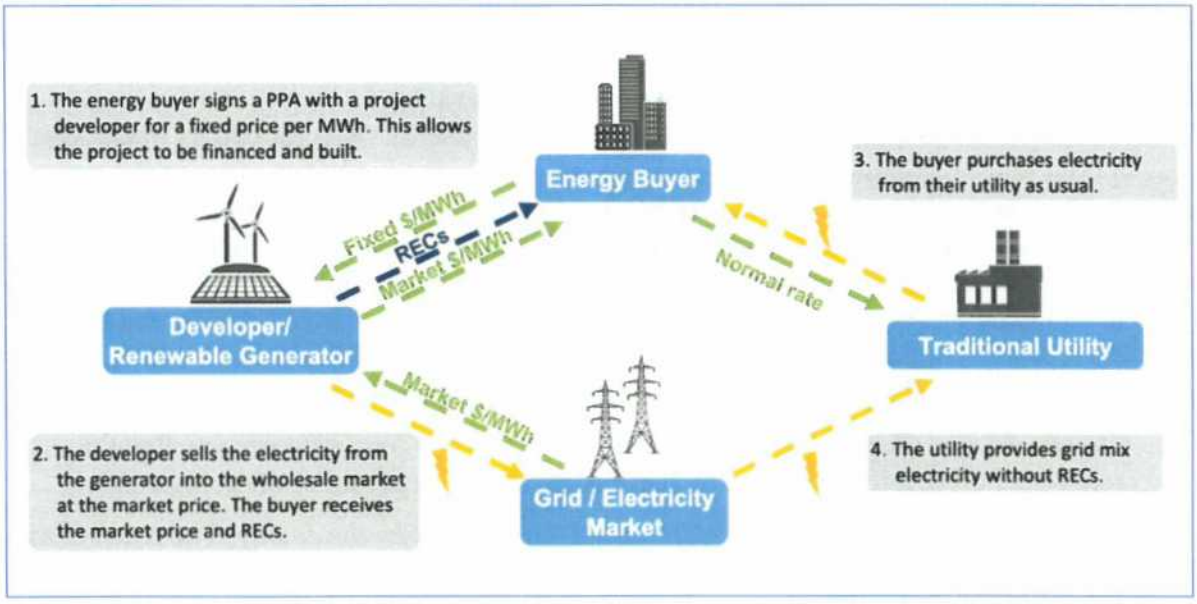
Alternatives to On-Site Renewable Energy Systems

Given the limitations of on-site renewable energy opportunities relative to the scale of the county's present and future electricity needs, it is unlikely that on-site solar projects will provide more than 10 percent of the electricity needed for county operations (see Attachment A).

Off-Site Virtual PPA

Virtual off-site PPA is illustrated in Figure 1, below. In this type of arrangement, the customer makes a "virtual" purchase of electricity from a large renewable solar or wind energy farm. The electricity generated is sold into the electric grid at prevailing wholesale rates. The customer makes a financial commitment to the vendor to pay a fixed rate for the power generated. In Figure 1, green arrows represent the flow of money, while yellow arrows represent the flow of electricity. The transfer of RECs is shown with a black arrow.

Figure 1. *Schematic of a Virtual Power Purchase Agreement*[1]



[1] See American Cities Climate Challenge, Renewables Accelerator, at https://cityrenewables.org/vppa/.

As noted on the previous page, this type of transaction is sometimes referred to as a variable-priced REC contract because the result is simply a purchase of RECs at a price that fluctuates over time, depending upon the wholesale price of electricity. If the wholesale price of power is high when the renewable farm is generating power, the customer receives a credit (income). If the wholesale price of power is low during a generation period, the RE project will owe the project developer money. Over the course of a year, the RE project will have a mix of credits and debits surrounding the customer's fixed rate, and an annual true-up is performed to reconcile payments. It is possible to negotiate price floors and ceilings to limit volatility, but agreements with these restrictions usually result in a higher fixed rate for the customer.

In 2020, Arlington County entered an agreement with Dominion for an off-site PPA.[2] Dominion acted as the project developer of a 120 MW solar farm to be built in Pittsylvania County, VA. Amazon and Arlington County were the two customers for the entire output of this project; Arlington's share – about one-third of the total – will provide about 80 million kilowatt hours per year, enough to cover nearly all of Arlington County's operational electricity needs. The project is under construction and expected to begin producing electricity in 2022. This agreement will generate high-quality RECs for Arlington and also promotes "additionality," as Dominion was not going to build the solar farm until it had customers for the output.

Generic REC Purchases: Utility or Broker

Like many other electric utilities, the county's primary electric service provider, Dominion offers customers different options for purchasing renewable energy credits. In all cases, these options are an additional cost to the customer. Fairfax County Government (Fairfax County) could purchase RECs from Dominion at a rate of 0.45 cents per kWh. At current rates, purchasing enough RECs to cover all electricity used by government operations would cost over $1.1 million per year.

Rather than purchase RECs from Dominion, Fairfax County could purchase RECs from any number of individual or bundled renewable energy sources. In fact, one of the options that Dominion offers is the resale of RECs from a national mix of sources, with Dominion functionally a broker for certificates generated by other parties. However, those RECs are often from older wind and biomass sources and considered lower quality than RECs from new sources located in Virginia or within the grid network serving Virginia and nearby states. inexpensive.

Renewables on the Power Grid

Dominion is fast developing RE projects across the Commonwealth to meet new statutory requirements contained in the VCEA. Under the VCEA, Dominion is required to generate electricity from 100 percent renewable sources by 2045. The VCEA also imposes interim goals of 41 percent RE by 2030 and 79 percent RE by 2040. On its face, it appears that the VCEA is more than adequate to meet the Fairfax OES goal of 50 percent RE for electricity by 2040.

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[2] See Washington Post, "New Amazon-Arlington Solar Farm to fulfill most of county's renewable pledges" (1/28/2020) athttps://www.washingtonpost.com/local/virginia-politics/amazon-arlington-solar-farm/2020/01/28/c44baf76-41e2-11ea-b503-2b077c436617_story.html.

Nonetheless, there is some concern about Dominion's ability to meet these goals. Dominion's clean energy portfolio is currently very modest, accounting only for about six percent of its 2020 electricity supply – and much of this reflects existing hydroelectric and biomass sources. The company is only at the beginning of its massive investment in solar and wind energy. Moreover, electric utility regulations have changed dramatically in the past five years, and further changes are expected. Given the uncertainty of VCEA implementation, we assume that Dominion achieves 35 percent renewable electricity by 2030, not the 41 percent required by the VCEA.

A summary of the advantages, disadvantages, and cost considerations of the five options for procuring renewable electricity are presented in Attachment C.

Recommendation and Next Steps

Based on the foregoing, including limitations of on-site RE opportunities relative to the scale of the county's present and future electricity needs, staff recommends that the county pursue an off-site virtual power purchase agreement resulting in a mix of sources to meet 100 percent of the county's operational electricity use with renewables by 2030, as outlined in Item 3.

Figure 2 shows one possible mix of RE sources for the county in 2030. This mix allows the county to procure 100 percent of its electricity as RE, exceeding the goal of 50 percent by 2040.

Figure 2. *Possible Mix of Renewable Energy Sources to Meet 100% of Fairfax County Needs in 2030*

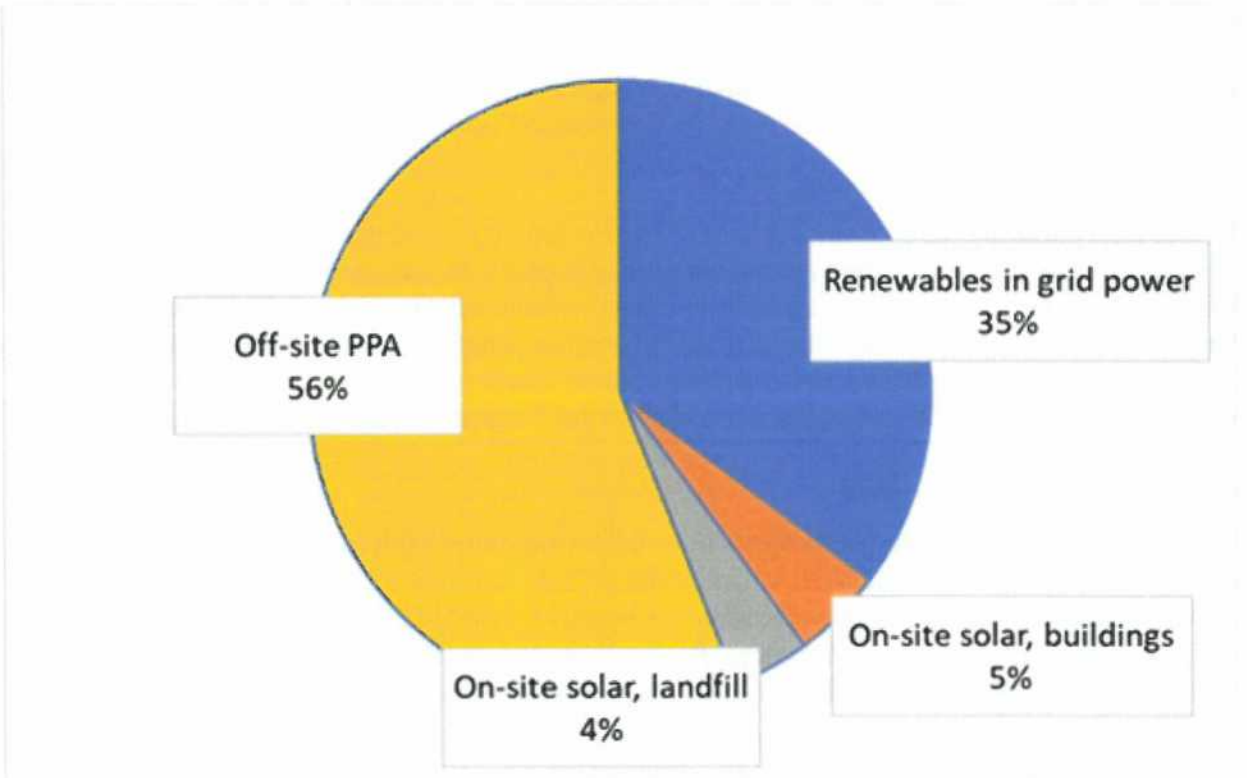


Figure 3 illustrates this mix of renewable electricity in 2030 in tabular form, assuming the county continues to consume about 250 million kWh per year (where decreases through efficiency are offset by increases due to fuel switching in buildings and the electrification of transportation). One hundred percent renewable electricity is feasible at a modest premium above current costs, largely due to the premium to be embedded in utility rates and any consultant fees needed for an off-site PPA.

Figure 3. *Achieving 100 Percent Renewable Electricity for Operations in 2030*[3]

Source of Energy/RECs	Estimated 2030 volume (MWh)	Cost Implications
On-site solar PPA at landfill	10,000	Neutral – PPA rates near utility rates
On-site solar PPA on facilities	12,000	Neutral – PPA rates near utility rates
Utility generation (grid mix)	88,000	Slight premium over today – unavoidable RE costs are embedded in utility rates
Off-site PPA	140,000	Neutral – PPA rates near utility rates
Total	**250,000**	

There are two primary options for Fairfax to pursue an off-site PPA. Staff recommends that the county proceed with both simultaneously:

1. Negotiate with Dominion for a transaction similar to the Arlington-Dominion deal in 2020, and

2. Develop and issue a Request for Proposals for a competitive procurement of variable-priced RECs in the form of an off-site PPA.

Obtaining Dominion's agreement to a transaction similar to that made with Arlington County and Amazon may be difficult to achieve, as the Renewable Portfolio Standard mandated by the VCEA compels Dominion to develop RE projects and keep or retire the RECs the projects generate. However, it is possible Dominion and Fairfax County could agree to some joint stake in the RECs from a new RE site, and Fairfax County could arbitrage (trade) its new RECs for a larger quantity of lower value RECs. This is a topic for exploration with consideration of broader county objectives. If a transaction with Dominion is not feasible, staff can pivot with emphasis on the second option.

Staff also recommends hiring experienced utility and legal consultants to assist in identifying and evaluating criteria for an off-site PPA and addressing the complex issues these arrangements raise. For example:

- **How important is it to Fairfax County that the RE project(s) be located in Virginia?** A Virginia-based renewables project is desirable, but there may be new solar or wind

[3] Although the VCEA calls for Dominion to provide 41% renewable electricity in 2030, some slippage is assumed in Figure 4, with Dominion achieving only 35 percent renewable energy by 2030. The estimates for on-site solar PPA contributions are based on this analysis and discussions with a vendor regarding the I-95 landfill site.

projects ready for development in nearby states with more carbon-intensive electricity generation than Virginia. It is most important that the RE project(s) be located within the PJM Interconnection, the grid network serving Virginia and nearby states. Procuring RECs from solar or wind located in Kentucky, Ohio, or Pennsylvania – also part of PJM –would accelerate global carbon reduction more rapidly than buying only from a Virginia site. Geographic flexibility to maximize carbon reduction is an emerging best practice among corporate buyers and policymakers.

- **What minimum environmental criteria should be applied to any prospective RE site?** The county could set limits on the amount of forest removal from a potential site (e.g. as a percentage of the total acreage).
- **Could a diversity of RE supply sources reduce financial risk or optimize financial outcomes?** Geographic diversity provides exposure to multiple wholesale power markets, possibly at different times of day. Wind farms tend to produce more energy at night than during the day, while solar farms naturally produce energy during the day.

This effort, combined with on-going installations of solar PV on county facilities, can provide 100 percent renewable electricity for county government operations by 2030. Achieving 100 percent renewable electricity will contribute substantially to the goal of carbon neutrality by 2040, establishing Fairfax County as a leader in the Commonwealth and set an example for the community to follow as we address the global climate crisis.

If you have comments or questions on this memorandum, please contact Kambiz Agazi, Director, Office of Environmental and Energy Coordination, at (703)-324-1788 or at Kambiz.Agazi@fairfaxcounty.gov.

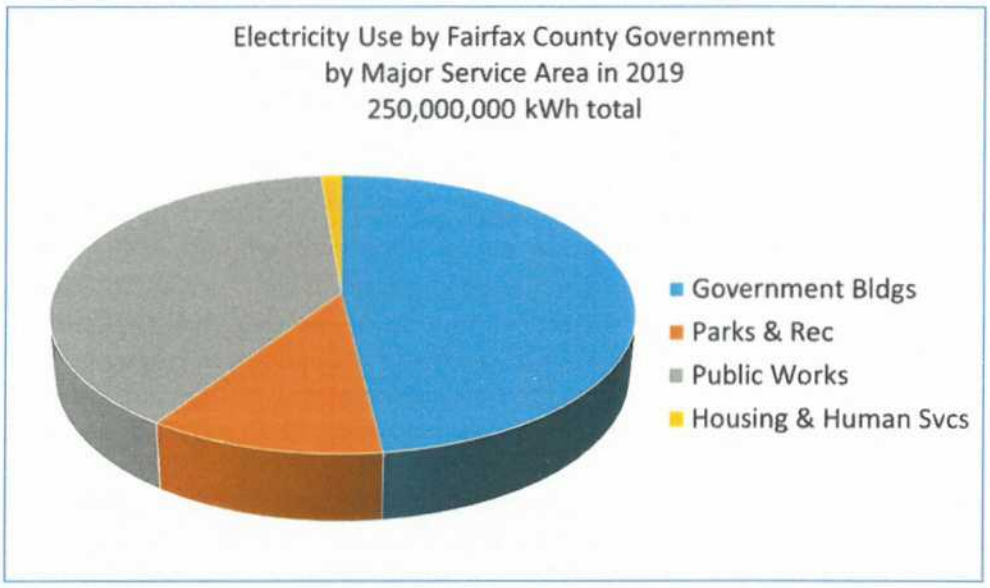
Attachments: Attachment A, Limitations of On-Site Renewable Energy Systems to Power County Operations
Attachment B, Renewable Energy Certificates
Attachment C, Comparative Summary of Renewable Energy Procurement Options

cc: Rachel O'Dwyer Flynn, Deputy County Executive
Ellicia Seard-McCormick, Deputy County Executive
Christina Jackson, Chief Financial Officer
Kambiz Agazi, Director, Office of Environmental and Energy Coordination

ATTACHMENT A
Limitations of On-Site Renewable Energy Systems to Power County Operations

County Electricity Use
Fairfax County government uses a lot of electricity – about 250 million kWh each year. This power is used for a wide variety of services to the public, including general government, human services, public works, libraries, public safety, the Park Authority, and housing programs. If an average home uses 1,000 kWh a month (12,000 kWh a year), then county government uses the equivalent of nearly 21,000 homes per year. Figure A1 illustrates how the county operation's use of electricity is distributed across major program areas.

Figure A1



Limitations of On-Site Renewables
Fairfax has contracts in place allowing vendors to install solar PV systems on county properties and the county would buy the electricity those systems generate through power purchase agreements (PPAs). The PPAs are designed to be cost-neutral to the county, with no upfront costs and the annual cost to the PPA provider equivalent to rates paid to Dominion.

However, the area available for solar PV on county property is limited in proportion to the total building area. Although the county has over 12 million square feet of occupied building area, plus another 1 million ft^2 of above-ground garages, much of that area is in multistory construction, with exposed roof areas a small fraction of the total building area. Furthermore, much of the roof area is unsuitable for solar PV due to the presence of mechanical and elevator penthouses, exhaust fans, and other rooftop equipment. Those rooftop building elements and nearby trees often cast shade on otherwise suitable roof area, diminishing the solar PV potential. Roofs on smaller buildings where the installed PV would total under 100 kW are generally uneconomical for the PPA vendors.

Overall, Fairfax has only about 500,000 sq ft. (about 12 acres) of suitable roof area for solar PV. This roof area could accommodate solar PV capable of generating about 12 million kWh per year, or only about five percent of the county's total annual consumption for operations.

Covering parking lots with solar canopies offers another opportunity for significant PV installations, as do open spaces adjacent to county properties. However, the structural supports for canopy systems add substantial costs to those installations and canopy PV is therefore priced much higher than conventional rooftop solar. Solar PV on open ground space is lower in cost than canopies, but ground-mounted PV removes valuable green space from community use.

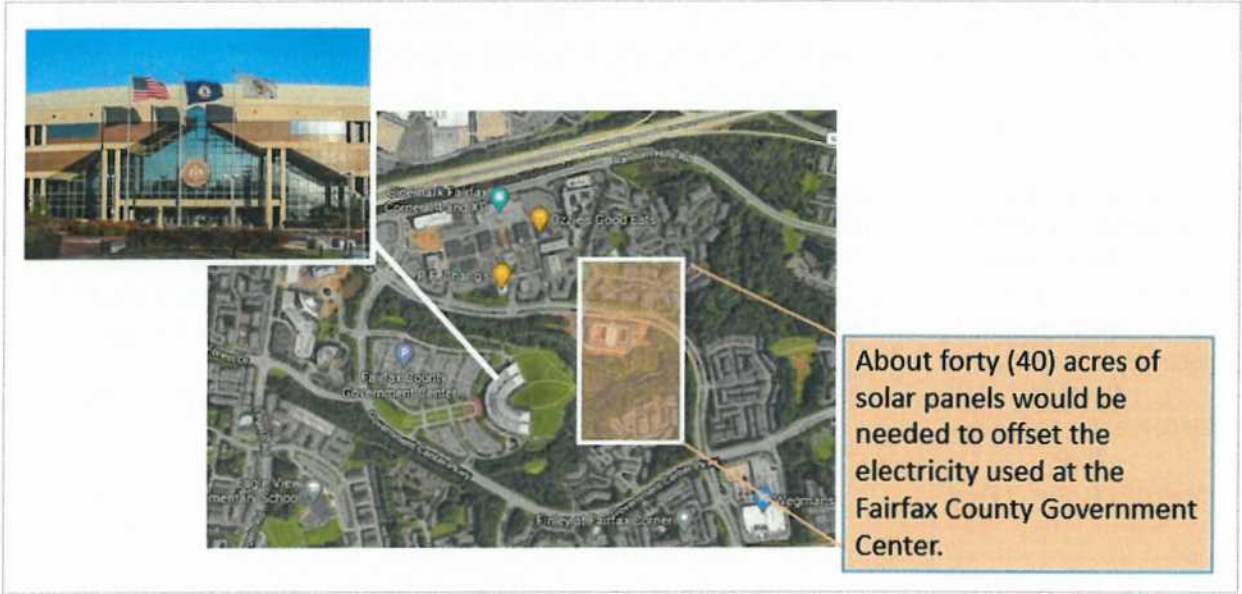
Another factor limiting the portion of total electricity use that can be directly offset by on-site solar is the energy intensity of some county facilities and the nature of other electricity uses. Wastewater treatment is generally out-of-sight and not thought of by most people. However, to clean 40 million gallons of sewer water per day to meet strict Chesapeake Bay clean water standards, the Noman Cole Plant in Lorton consumes over 42 million kWh each year, or about 17 percent of the county's total. That industrial facility has limited conventional roof area and limited area for ground-mounted solar.

Aquatic centers are another energy-intensive building use, and the Fairfax County Park Authority operates nine facilities with swimming pools, all open long hours. Aquatic centers generally have high energy burdens because heating and pumping water are energy-intensive processes, and the indoor air must be constantly dehumidified – another energy-intensive process – for user comfort and prevention of condensation and mold. Aquatic centers are important amenities for the health and well-being of Fairfax residents, and while efficiency improvements are being made in these facilities, there are practical limitations to their reduced energy use.

In contrast to the high intensity of electricity per unit area of structures, solar radiation is diffuse. In Northern Virginia, the sun provides about 4.5 kWh/m^2 (about .41 kWh/ft^2) per day. Despite recent improvements in photovoltaic panel efficiency, solar PV only captures and converts to electricity 15 to 20 percent of available power from the sun. Thus, even 12 acres of solar PV would only put a small dent in county government's electricity use.

To illustrate the energy intensity of multi-story building energy use in relation to diffuse solar radiation, Figure A2 contrasts the footprint of the Government Center with the approximate land area needed for solar photovoltaics to satisfy the electricity use at the Government Center. This is after energy efficiency improvements have cut electricity by about 20 percent over the past ten years at the Government Center.

Figure A2. The Dilemma of High Energy Intensity and Diffuse Solar Energy



Improving energy efficiency is necessary but not sufficient

If increasing the supply of on-site renewable energy is difficult, how about reducing demand? The county's Operational Energy Strategy sets ambitious targets for improving energy efficiency in county operations, including a 25% reduction in energy use by 2030 and a 50% reduction in energy use by 2040. Achieving such massive reductions will require substantial investments in new technologies and renovations of existing buildings and facilities, a process already underway. Cutting the amount of electricity used in half would seem to double (to ten percent) the portion of electric energy provided by renewables if 12 acres of county property were covered with solar PV.

However, another element of the county's carbon reduction plan in the OES is the transition to all-electric buildings, including replacement of aging natural gas equipment (for space heating and water heating) with electric technologies. About 2 million therms of natural gas are used in county buildings each year, and another 1.6 million therms are used by public works in their facilities. If half of this natural gas use were replaced by electricity by 2040, county power use would rise by about 52 million kWh per year.

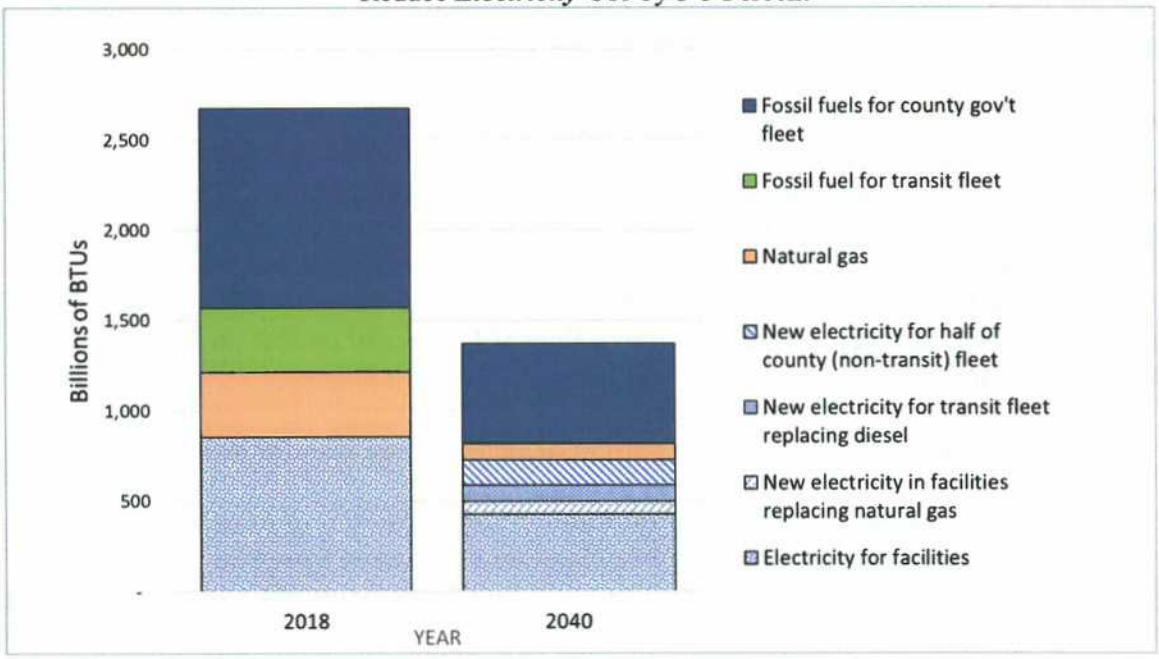
Furthermore, decarbonization of the county fleet necessitates electrification of vehicles. OES recommends ambitious targets for electrification of all vehicles, and particularly Connector buses, calling for 99 percent of all Connector vehicle-miles to be via electric buses by 2035. The Fairfax Connector fleet used over 2.5 million gallons of diesel fuel in 2019. Assuming no growth in the fleet or miles traveled, replacing this with an equivalent amount of EV bus service would require about 26 million kWh of electricity each year, even after accounting for the substantial improvement in fuel efficiency provided by electric buses compared to diesels. Other government fleet vehicles (police, fire, public works, etc.) consume over 8 million gallons of

petroleum fuels. Conversion of half of that fleet to electrics would add about 40 million kWh of use per year, again allowing for the tremendous efficiency gain by EVs. Figure A3 summarizes these changes in energy use, and Figure A4 presents this information in graphical form using British Thermal Units (BTUs) as a consistent unit of energy across the different energy sources.

Figure A3. Effect of Efficiency and Electrification of County Operations

Energy Activity	Energy Use in 2018	Change by 2040	Est. Energy Use in 2040
Electricity in facilities	250 million kWh	Cut in half through efficiency	125 million kWh
Natural Gas in facilities	3.6 million therms	Cut in half through efficiency	1.8 million therms
Connector Fleet Fuel	2.5 million gallons	Conversion to 99% EVs	0.25 million gallons
Government Fleet fuel	8.5 million gallons	Conversion to 50% EVs	4.2 million gallons
Electricity substitution for natural gas	0	25% of natural gas use converted to electric	52 million kWh
Electricity for Connector Fleet	0	99% EVs	26 million kWh
Electricity for Gov't Fleet	0	50% EVs	40 million kWh
		New Electricity Use:	*118 million kWh*

Figure A4. The Operational Energy Strategy Will Cut Total County ***Energy*** Use in Half, But Only Reduce ***Electricity*** Use by 3-5 Percent



In summary, most of the reduction in electricity use expected from increased efficiency will be replaced by increasing use of electricity for activities for which the county had relied on fossil fuels. This discussion does not account for growth in county services. While Fairfax is pursuing net zero energy new construction, the growing population in the county means the pipeline for new and expanded facilities continues. Not all construction will meet net zero energy levels of performance due to site or facility constraints.

ATTACHMENT B
Renewable Energy Certificates

Renewable Energy Certificates (RECs) have become a vital component of clean energy development. RECs are tradable non-tangible commodities that represent proof that one megawatt-hour (MWh) of renewable electricity was generated. RECs are market-based instruments that represents the property rights to the environmental, social and other non-power attributes of renewable electricity generation. They are the accepted legal instrument through which renewable energy generation and use are substantiated in the market. The use of RECs is supported by multiple levels of government, regional electricity transmission authorities, non-profit organizations and trade associations, as well as U.S. case law.

Established protocols for corporate and governmental greenhouse gas emission inventories address RECs carefully. The protocols recognize the purchase of RECs as a legitimate market response and instrument by which energy-consuming institutions can reduce their GHG emissions from electricity purchases.

RECs vary in financial value and perceived quality. The financial value of a REC is usually driven by state renewable portfolio standards (RPS), but the financial value also varies by the source of renewable energy and the age of the renewable energy generation site. For example, RECs from a new solar farm in a state with a mandatory RPS will command a higher market value than an existing wind farm that has been operating for many years in a state that has no RPS (or has already attained its RPS goal).

The intrinsic quality of RECs is usually driven by the relationship between the renewable energy generation and the customer. For example, rooftop solar panels on a Fairfax County building (or canopy) are literally connected to the county's direct use of electricity, and the panels may be visible to the public. The RECs associated with these solar installations have high intrinsic value to the county because the county is directly responsible for the creation of new renewable electricity ("additionality"), and there is a clear link between the renewable electricity generated and the county's physical location.

This concept of *additionality* is the recognition that a REC customer can play a role in the creation of new renewable electricity. Through direct installation on a customer site, or through a contractual agreement to buy power from a new renewable energy site, a customer can legitimately claim to have been responsible for the creation of new renewable power and therefore the avoidance of pollution from other generation sources in the utility grid mix.

On the other hand, the purchase of RECs from an existing wind farm in the Midwest (where wind power is prevalent) has lower intrinsic value to Fairfax due to: (a) the lack of a connection to Fairfax County, (b) the RECs are from an already-existing wind farm, and (c) the purchase of those RECs does little to stimulate the growth of additional renewable electricity.

The county should weigh the financial value (cost) and intrinsic value of RECs when making decisions, as some trade-offs may be desirable.

ATTACHMENT C
Comparative Summary of Renewable Energy Procurement Options

Favorable Attributes	Unfavorable Attributes	Cost Considerations
On-site RE installation(s) owned by 3rd party (PPA)		
No upfront capital if roof is immediately suitable. High quality RECs with additionality. No maintenance cost.	Requires suitable site (new roof, etc.). Neutral impact on utility costs. Site resource is limited.	On-going energy cost expense generally the same as pre-RE.
On-site RE installation(s) owned by the county		
Reduces utility bills. High quality RECs with additionality.	Initial capital cost and project management; modest on-going maintenance costs. Requires suitable site (new roof, etc.). Site resource is limited.	Project management. Capital investment needed, but ROI may be attractive through reduced utility expense.
Off-site virtual PPA (variable-priced RECs)		
No upfront capital requirement. High quality RECs with additionality. Very large purchases possible.	Complex legal and financial transaction. Risk of long-term contracts with market pricing.	Procurement and transaction costs, including legal and analytical. Contract intent is cost-neutral (at worst) or to realize cost savings.
Generic REC purchases		
Little effort needed by county. Purchase from the utility allows for on-bill payment.	Questionable quality of renewables. Added cost to utility bills.	A recurring added cost without return.
RE distributed by the electric grid		
No action required on customer part, other than to pay utility bill.	Customer is not entitled to RECs associated with RE.	Electric utility costs expected to increase over time but largely outside customer control.