



Loudoun County Energy Strategy

2023



Loudoun County
VIRGINIA



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Acknowledgments

This 2023 Loudoun County Energy Strategy is a comprehensive update to the 2009 Strategy and is the result of a year-long process led by the Loudoun County Department of General Services (DGS). Throughout the development of this 2023 Strategy, DGS sought input from other County departments, the Board of Supervisors, the Environmental Commission (EC), and the Loudoun County community. Thank you to the following parties and individuals for supporting and contributing to the establishment of the 2023 Strategy, all of whom will also be key Strategy implementation partners in the coming years.

Loudoun County Board of Supervisors

The 2020 – 2023 Board of Supervisors held Loudoun County’s first Environment Summit in 2022 and established the Environmental Commission in 2020. The Board’s vision and direction in the areas of the environment and energy are captured in this 2023 Loudoun County Energy Strategy.

- Phyllis J. Randall, Chair At-Large
- Koran T. Saines, Vice Chairman
Sterling District
- Juli E. Briskman, Algonkian District
- Michael R. Turner, Ashburn District
- Tony R. Buffington, Blue Ridge District
- Sylvia R. Glass, Broad Run District
- Caleb A. Kershner, Catoctin District
- Matthew F. Letourneau, Dulles District
- Kristen C. Umstattd, Leesburg District

Loudoun County Environmental Commission

The Loudoun County Board of Supervisors appointed the following members to advise and make recommendations to the Board on policies and practices dealing with the County’s environment, sustainability, and the management of energy. These inaugural members of the EC contributed to the development of this plan.

- Jeffrey Hanson, Data Center Coalition
- William Marsh, Subject Matter Expert (SME):
Engineer with LEED AP and/or CEM
- Morris Meyer, SME: Sustainable Energy
- Molly Bercher, Loudoun County High School
Junior/Senior
- Michael Myers, Member of an
Environmental Conservation Organization
- Eric Deaver, Natural Resources/Water Quality
- Chris Tandy, Member of an Environmental
Organization that Represents/Supports
Underrepresented Populations
- Gem Bingol, SME: Environmental Planner
- Miriam Westervelt, at-large Citizen
Representative
- Scott Emery, at-large Citizen Representative
- Carrie-Anne Mosley, at-large Citizen
Representative
- Brendon Shaw, Public Utility - Electric
- Scott Mcgeary, Public Utility - Gas
- Mark Peterson, Public Utility - Water
- Don Treanor, Loudoun County Public
Schools Energy and Environmental Team
Manager
- Emily Southgate, Member of Collegiate
Faculty Specializing in Environmental Issues

Loudoun County Departments and Offices

The development of the 2023 Energy Strategy was undertaken by staff in DGS, led by project manager Marc Aveni, Assistant Director General Services, with assistance from the following County departments:

- DGS, including
 - Energy Management
 - Facilities Maintenance
 - Fleet Management
 - Parking Operations
 - Public Works
 - Transit Operations
 - Water and Environmental Services
 - Waste Management
- County Attorney
- County Administration
- Public Affairs and Communications Division of the Office of the County Administrator
- Department of Building and Development
- Department of Economic Development
- Department of Family Services
- Department of Finance and Budget (DFB)
- Department of Housing and Community Development
- Department of Information Technology
- Department of Parks, Recreation and Community Services (PRCS)
- Department of Planning and Zoning (DPZ)
- Department of Transportation and Capital Infrastructure (DTCI)
- Office of Equity and Inclusion
- Office of Mapping and Geographic Information (OMAGI)

Other Partners

In addition to the individuals noted above, this Strategy would not have been possible without support from:

- The Metropolitan Washington Council of Governments (MWCOC), who provided support, data, and guidance throughout the Energy Strategy development process.
- The Northern Virginia Regional Commission (NVRC), who provided data to support the residential solar potential analysis from the Northern Virginia (NOVA) Solar Map for Loudoun County.
- The Loudoun Chamber of Commerce, the Loudoun County Coalition of Homeowners and Condominium Associations, the Data Center Coalition, and the public who all provided input throughout the development of the Strategy and will continue to be key partners in its implementation.

ICF Incorporated, LLC supported DGS during the development process.

Please contact the Department of General Services at 703-771-5552 or dgs@loudoun.gov for more information about this plan or for any questions regarding the Energy Strategy.



Executive Summary

Purpose

The 2023 Loudoun County Energy Strategy (the Strategy) is a blueprint for realizing the County's vision to contribute to achieving Virginia's goals of net zero greenhouse gas (GHG) emissions by 2045 and a carbon-free grid by 2050 while ensuring energy is clean, reliable, and affordable for all residents and businesses in Loudoun County. The Strategy recognizes the community's position as a regional leader in economic development, purchasing power, and quality of life. It builds upon the County's existing energy and environmental programs and sets new goals for the County government to lead by example through strategies and actions that reduce energy consumption, increase energy efficiency and the use of clean energy, and reduce GHG emissions of its own operations. The Strategy also outlines strategies and actions that can be taken by the County, key partners, and the public that will support meeting state GHG emission reduction goals and provide benefits for County residents and businesses by ensuring equitable access to low-cost, reliable energy.

Background

The 2023 Energy Strategy builds on the 2009 Loudoun County Energy Strategy and existing efforts to promote energy efficiency and clean energy solutions within the County. The 2023 Strategy is the result of a transparent process that involved frequent meetings with the Loudoun County Board of Supervisors, the Loudoun County Environmental Commission (EC), and the public.

This 2023 Energy Strategy was developed by the Department of General Services (DGS) at the direction of the Loudoun County Board of Supervisors. It reflects input from several stakeholders, including the Metropolitan Washington Council of Governments (MWCOC), County government departments, the EC, the Northern Virginia Regional Commission (NVRC), the Loudoun Chamber of Commerce, the Loudoun County Coalition of Homeowners and Condominium Associations, the Data Center Coalition, and the public.

As a first step in developing the 2023 Energy Strategy, DGS drafted a goal framework, drawing on ideas from the Board of Supervisors, feedback from the EC, public comments, and discussions with County departments. Based on stakeholder input, DGS created the final goal framework, which includes ten strategies to help the County achieve the vision for this Strategy. The Board of Supervisors approved the goal framework in July 2022.

Following goal framework approval, modeling of most of the ten strategies was done to understand the potential energy changes and GHG emission reductions for the County government and the Loudoun County community resulting from implementing the 2023 Strategy. Specific implementation actions were developed for each of the ten strategies in collaboration with multiple stakeholders. Finally, the completed Strategy was adopted by the Board of Supervisors in February 2023.

Loudoun County Context

Efforts are already underway at the county level to move toward cleaner and more reliable energy resources, use less energy, and reduce GHG emissions. The County is promoting public transportation and the opening of three Metro line stations in the County at the end of 2022 provides additional transit options. The County pledged to procure zero emissions vehicles for its own fleet – the County aims to replace 23% of its fleet with electric vehicles and plug-in hybrid electric vehicles. To reduce emissions and energy costs from its own facilities, the County has installed solar arrays at several facilities, enacted programs to promote employee education and leadership in energy conservation, and is a U.S. Environmental Protection Agency ENERGY STAR partner.

Energy use and energy resources are tracked by the County for its own operations and this information was used to develop an energy profile and GHG emissions inventory for 2021. As shown in Figure ES1, about three quarters of the County government's GHG emissions in 2021 came from the County operated landfill. This landfill accepts waste from the broader community and does not represent only the waste generated from County operations. Other GHG emissions shown in Figure ES1 are a result of energy consumed in County-owned or operated buildings, cars, and trucks.

GHG emissions from government operations comprise 2% of total community GHG emissions. In 2020 community GHG emissions were 6.2 million metric tons of carbon dioxide equivalent (CO₂e), a 58% increase from 2005. From 2005 to 2020 GHG emissions from commercial buildings have quadrupled, driven by increased commercial energy use and growth in commercial square footage. Residential building GHG emissions increased 7%, driven by population growth, and transportation sector emissions decreased more than 20%¹.

Figure ES-1. County Government Operations and Landfill GHG Emissions, 2021

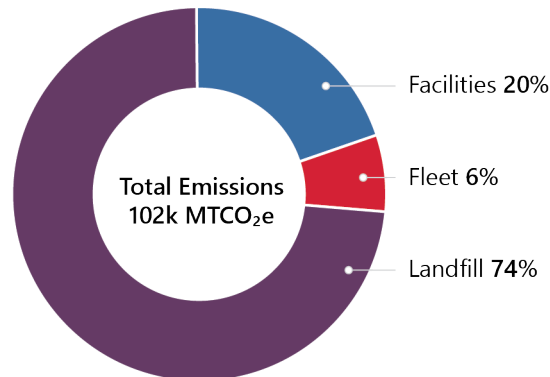
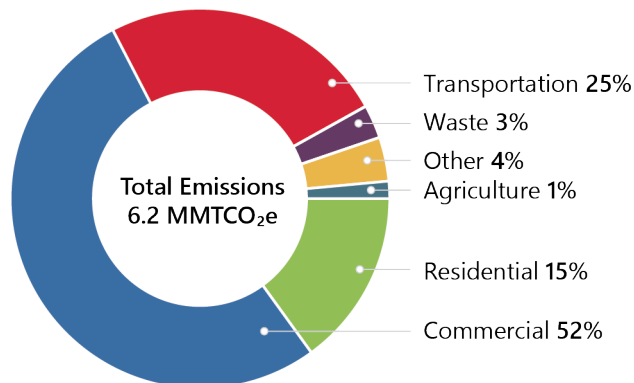


Figure ES-2. Community GHG Emissions by Sector, 2020



Goals, Strategies, and Actions

The backbone of this 2023 Energy Strategy is the goal framework, which is guided by the County's long-term vision for a community that uses less energy and cleaner energy, has lower GHG emissions, and provides equitable benefits and solutions. The goal framework includes three goal areas that cover both County municipal operations and the larger community: **Goal Area 1.** Leading by Example in County Government Operations; **Goal Area 2.** Supporting Clean Energy Development in the County; and **Goal Area 3.** Stimulating Community-Wide Action (see Figure ES3). Each goal area includes strategies that address energy and GHG emissions. The third goal area

¹ This includes impacts of COVID-19 on the transportation sector. From 2005-2018, there was a 3% reduction in transportation emissions due to improved fuel economy and reduced off road and aviation activity.

also includes strategies that address equity, communication, and transparency.

The goal framework includes ten strategies and for each strategy, multiple actions are identified and include opportunities to engage stakeholders such as government departments and employees, the Board of Supervisors, state organizations, and Loudoun County businesses, industries, and community members. Actions relate to County and community investments, infrastructure updates, policy changes, program development, and behavioral shifts. These actions are designed to capture ongoing and new efforts, provide clear next steps to implement the Energy Strategy, and adapt to changes. Table ES1 summarizes the goal areas, strategies, and actions of this 2023 Strategy.

If all the strategies and actions included in this plan are implemented, total GHG emissions for the county are projected to decrease 56% from 2018 levels by 2050. That is equivalent to taking 742,500 gasoline cars off the road annually by 2050.

Goal Area 1. Leading by Example in County Government Operations

This goal area focuses on programs, policies, and technologies the County can adopt to reduce emissions from government operations. Strategies and actions within this goal area aim to increase clean energy deployment, improve energy efficiency, and reduce GHG emissions from County facilities; reduce County fleet and employee travel emissions; reduce emissions from the County landfill; and improve communication regarding County progress on implementing the Energy Strategy. Through Goal Area 1 the County will set an example and lead Loudoun toward a more energy efficient and cleaner future for all.

Goal Area 2. Supporting Clean Energy Development in the County

This goal area overlaps both County and community-wide efforts. The sole strategy of this goal area is to facilitate access to and development of clean energy in the county. The actions within this strategy encourage the County to explore low carbon fuels; promote onsite renewables; and explore power purchase agreements (PPAs), net metering, and other opportunities for increasing clean energy supply and use in the community. Through Goal Area 2, the County will support the development and use of clean energy in municipal operations and the greater community to lower emissions and provide benefits for all of Loudoun County.

Goal Area 3. Stimulating Community-Wide Action

The primary focus of Goal Area 3 is to encourage community members to take action to reduce their GHG emissions. This goal area builds upon the County's example set in Goal Area 1 and the clean energy deployment established in Goal Area 2. Goal Area 3 strategies and actions will promote reductions in transportation and building emissions, establish energy-focused community education programs, and develop a community-supported plan to ensure the Energy Strategy is enacted equitably. Goal Area 3 bolsters the efforts of the other goal areas through stimulating community-wide action to ensure the vision of this Energy Strategy is achieved.

Figure ES3. The three goal areas of the County's Goal Framework

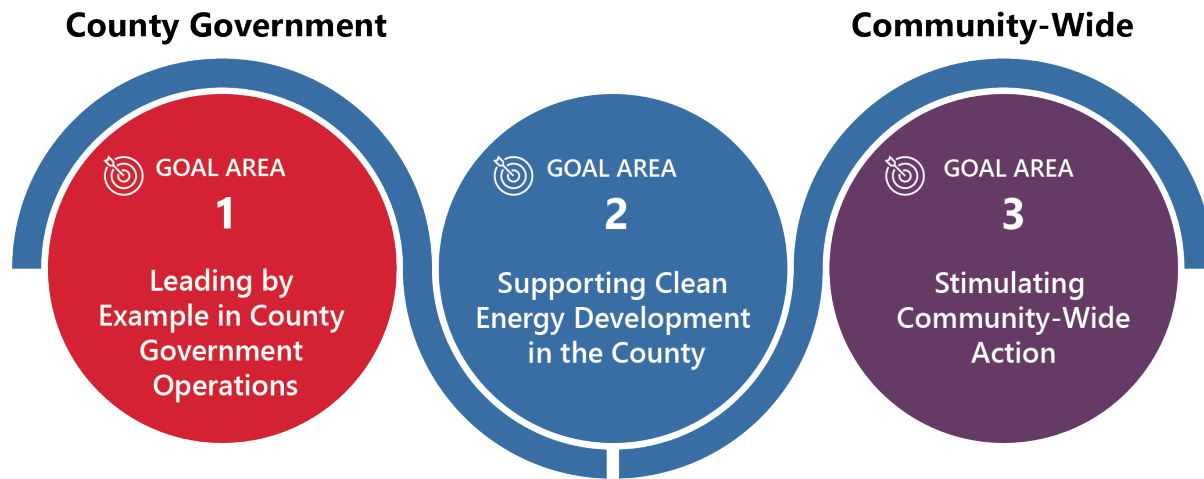


Table ES1. An overview of the Loudoun County Energy Strategy Goal Framework

Strategy		Action
Goal Area 1. Leading by Example in County Government Operations		
1. Increase County clean energy use	1.1	Install onsite solar at select facilities.
	1.2	Use geothermal exchange systems or other clean fuel sources at select facilities for heating/cooling.
	1.3	Explore large-scale offsite PPAs to offset electricity use.
2. Reduce energy use from new and existing County facilities and increase efficiency	2.1	Update energy efficiency measures for the design of new facilities.
	2.2	Implement or expand automated building energy management systems.
	2.3	Develop strategic building retrofit plans for all facilities, with a focus on resiliency for critical facilities.
	2.4	Develop County employee energy committee to encourage more energy conservation.
	2.5	Establish a County energy policy.
3. Reduce County fleet and employee travel emissions	3.1	Implement Board-approved fleet changes focused on zero-emission and plug-in hybrid vehicles and explore low or zero-emission landscaping and public works equipment.
	3.2	Implement procurement focused on low- or zero-emission transit buses.
	3.3	Install EV chargers at County buildings for County and employee vehicles.
	3.4	Reduce County employee vehicle miles traveled.
4. Reduce GHG emissions from County landfill	4.1	Participate in Virginia Environmental Excellence Program.
	4.2	Divert municipal solid waste from landfill disposal.
	4.3	Mitigate GHG emissions via flaring or beneficial use of landfill gas.
5. Provide transparent and accessible communications about County progress for the Energy Strategy	5.1	Establish a public-facing progress reporting dashboard or progress report.
	5.2	Provide regular public progress updates.

Strategy

Goal Area 2. Supporting Clean Energy Development in the County

- | | |
|---|---|
| 6. Facilitate access to and development of clean energy in the county | 6.1 Explore PPAs, expanded net metering opportunities, and other tools to encourage community clean energy use. |
| | 6.2 Assess the potential for low carbon fuels within the county. |
| | 6.3 Accelerate community adoption of onsite renewables. |

Goal Area 3. Stimulating Community-wide Action

- | | |
|---|---|
| 7. Reduce transportation emissions | 7.1 Support the adoption of ZEVs within the county. |
| | 7.2 Support electric vehicle charging infrastructure development across the county. |
| | 7.3 Reduce the number of car trips and vehicle miles traveled within and in and out of the county. |
| 8. Reduce GHG emissions from residential and commercial buildings and increase efficiency | 8.1 Pursue funding opportunities and partnerships for energy efficiency and electrification. |
| | 8.2 Explore programs such as green home certifications for residents and a pilot program with data centers. |
| 9. Provide education and technical assistance to county residents, businesses, and institutions | 9.1 Provide technical assistance, community events, or training programs for electric vehicles, energy efficiency and weatherization upgrades, buildings efficiency and electrification technologies, and clean energy. |
| | 9.2 Provide a clearinghouse of information to facilitate access to individual funding, tax credits, and incentives (utility, state, and federal programs). |
| | 9.3 Establish transparent process to help guide Energy Strategy implementation. |
| 10. Develop a community supported and influenced energy equity work plan | 10.1 Ensure equity across all populations in access to financing, equipment, and programs for ZEVs, energy efficiency retrofit for buildings, and clean energy. |
| | 10.2 Track the benefits of the Energy Strategy for disadvantaged communities as a part of regular progress tracking and public reporting. |
| | 10.3 Conduct targeted outreach and education through non-traditional partnerships and channels to access and educate the diverse community in Loudoun. |

Energy Strategy Implementation

The 2023 Loudoun County Energy Strategy was adopted by the Board of Supervisors in February 2023. Implementing this multi-year, multi-stakeholder plan will require support and action from the County government, businesses, and residents to maintain the County's position as a regional and national leader in the energy sector and beyond.

DGS is already starting the implementation process for this Strategy and will be working with stakeholders including the Board of Supervisors, the EC, County departments, residents, business owners, MWCOG, NVRC, the Loudoun Chamber of Commerce, the Data Center Coalition, utilities, and other community partners to implement the strategies and actions.

To support the implementation of the strategies and actions, DGS will look to secure funding, including opportunities available through the 2022 Inflation Reduction Act (IRA) and 2021 Infrastructure Investment and Jobs Act (IIJA). As committed to within this Strategy, and to ensure accountability, the County will annually track progress on Energy Strategy implementation and share information publicly about this progress. Over time, as implementation progresses and technologies and policies evolve, the County will also update this 2023 Energy Strategy to reflect accomplishments and new opportunities.

Through adopting and implementing this Energy Strategy, Loudoun County is on a path to realizing its long-term vision to contribute to achieving Virginia's goals of net zero GHG emissions by 2045 and a carbon-free grid by 2050 while ensuring energy is clean, reliable, and affordable for all residents and businesses in Loudoun County.



Loudoun County Government Center building.



Background and Purpose

Over the past decade, Loudoun County (the County) has seen substantial economic and community growth. The County is one of the fastest growing areas in the metropolitan Washington D.C. region – the population has increased more than 70% since 2005 and 15% since 2015 to reach 424,000 in 2020. The County is also home to 11,028 businesses, including many of Virginia’s wineries, breweries, and farms, and has the largest concentration of data centers in the world. As a result, the Loudoun County community is a leader in the region and the country in economic development, purchasing power, and quality of life for residents.²

Recognizing the importance of Loudoun County’s leadership and the ever-increasing shift in policy, regulations, and science toward a cleaner and more resilient future for all, in December 2020 the County Board of Supervisors unanimously voted to direct the Loudoun County Department of General Services (DGS) to update the County’s 2009 Energy Strategy. At the same meeting, the Board of Supervisors directed staff to establish the County’s Environment Commission (EC), which was formally adopted on February 2, 2021. In September 2021, to kick off the process for updating the Energy Strategy, the MWCOG and DGS facilitated a Board of Supervisors Energy Strategy workshop.

This workshop focused on the context in Loudoun County and initial discussion around how to incorporate clean energy and climate-friendly technology, policy, and solutions that have rapidly evolved since 2009. The County has already been working to take advantage of these opportunities, such as transitioning its own fleet to zero-emission vehicles (ZEVs). This 2023 Loudoun County Energy Strategy (the Energy Strategy, or the Strategy) captures these trends and existing work, placing them in the context of an updated and comprehensive energy plan for the County government and broader community in a three-part framework.

This Energy Strategy lays out a series of strategies and supporting actions that, when taken together, will support the County’s vision: **to contribute to achieving Virginia’s goals of net zero greenhouse gas (GHG) emissions by 2045 and a carbon-free grid by 2050 while ensuring energy is clean, reliable, and affordable for all residents and businesses in Loudoun County.** The 2023 Energy Strategy is an overall blueprint to achieve this long-term vision. Implementation of the Strategy will occur over several years and be led by Loudoun County DGS with support from the entire County government, the EC, the Board of Supervisors, and county residents, business, and organizations. This phased approach will help prioritize and use County and community resources effectively and in a way that benefits all residents and businesses while retaining the County’s position as a regional and national leader.

²Loudoun Virginia Economic Development. (n.d). “Top Ways Loudoun County, Virginia, is No. 1”. Available at <https://biz.loudoun.gov/site-selection/loudoun-number-1/>

Energy Strategy Vision, Goals, and Framework

Loudoun County has established a long-term vision to contribute to achieving Virginia's goals of net zero GHG emissions by 2045 and a carbon-free grid by 2050 while ensuring energy is clean, reliable, and affordable for all residents and businesses in Loudoun County.

This vision will be implemented, and success measured by using a goal framework that covers both County government operations (i.e., County buildings, vehicles, and the County landfill) and the larger community (see Figure 1). Ten strategies and several supporting actions are defined within each goal area (see Table 1). If successfully implemented, this framework will put the county on a path to achieve a cleaner, lower carbon, more resilient, and equitable future.

Goal Area 1, Leading by Example in County Government Operations, focuses on what the County government can do to reduce energy use, use cleaner energy, and reduce GHG emissions from its operations. The government will lead the broader community by demonstrating changes in its own buildings, landfill, cars and trucks, and daily operations. Within this goal area the County has outlined strategies that will result in powering County operations with 100% clean electricity by 2030, reaching net zero GHG emissions from the County fleet and facilities by 2045 (in line with the state's net zero GHG emissions goal), and diverting 70% of municipal solid waste (MSW) from being landfilled by working with the community. The final strategy in this goal area is dedicated to providing the community with a transparent understanding of County emissions, energy use, and progress on actions being taken as a result of this Energy Strategy.

Energy Strategy Terms

- **Vision** – A guiding statement that describes the County's imagined future and provides objectives for the County to strive to achieve.
- **Goal framework** – A structure in which goal areas, strategies, and actions fit within to form the backbone of the Energy Strategy.
- **Goal area** – The Energy Strategy focuses on three distinct areas for advancement: County government leadership, clean energy development within the county, and action across the community. Goals are defined and strategies and actions are provided for each.
- **Strategy** – Within each goal area, the County has defined overarching strategies that address energy and GHG emissions for different sectors (e.g., buildings, transportation). Strategies also include important considerations that are not specific to a sector and address equity, communication, and transparency.
- **Action** – Each strategy includes multiple actions, or initial steps the County may take to begin implementing the Energy Strategy.

Goal Area 2, Supporting Clean Energy

Development in the County, includes strategies and actions to increase the supply of clean energy in the county. This goal area includes both onsite and offsite clean electricity resources (e.g., solar, geothermal exchange systems) and low- or zero-emission gas resources. The development of clean energy resources within the county will support both County efforts in Goal Area 1 and statewide utility efforts to meet Virginia Clean Economy Act (VCEA) requirements of 100% clean electricity by 2045 and 2050, respectively. VCEA achievement is critical to meeting the County's Energy Strategy vision, as clean electricity enables more GHG reductions in homes, businesses, schools, places of gathering, and in how County residents move around (see Goal Area 3).

Goal Area 3, Stimulating Community-wide

Action, sets forth actions the County government can take to facilitate actions by residents and businesses to achieve GHG emission reductions in the broader community. This goal area contains two strategies focused on reducing GHG emissions from residential and commercial buildings and transportation within the county. It also includes two strategies focused on how the County is working toward these GHG reductions in a transparent and equitable way. The implementation of the strategies would lead to GHG emission reductions across the community and support a future that aligns with the County's Energy Strategy vision.

Leading by Example Through Changes in County Operations

GHG emissions from government operations are 2% of overall county emissions. While this is a small portion, the actions the County is taking to address its own emissions set an example for the broader community. They also provide demonstration projects that can be used as models for implementation and help identify and address challenges the community may face in pursuing the strategies and actions to achieve the vision outlined in this Energy Strategy.

Current actions the County is taking include:

- Procuring zero-emission vehicles;
- Composting and expanded recycling opportunities at the landfill; and
- Utilizing clean fuel sources, such as geothermal and onsite solar for new building construction.

Figure 1. The three goal areas of the County's Goal Framework

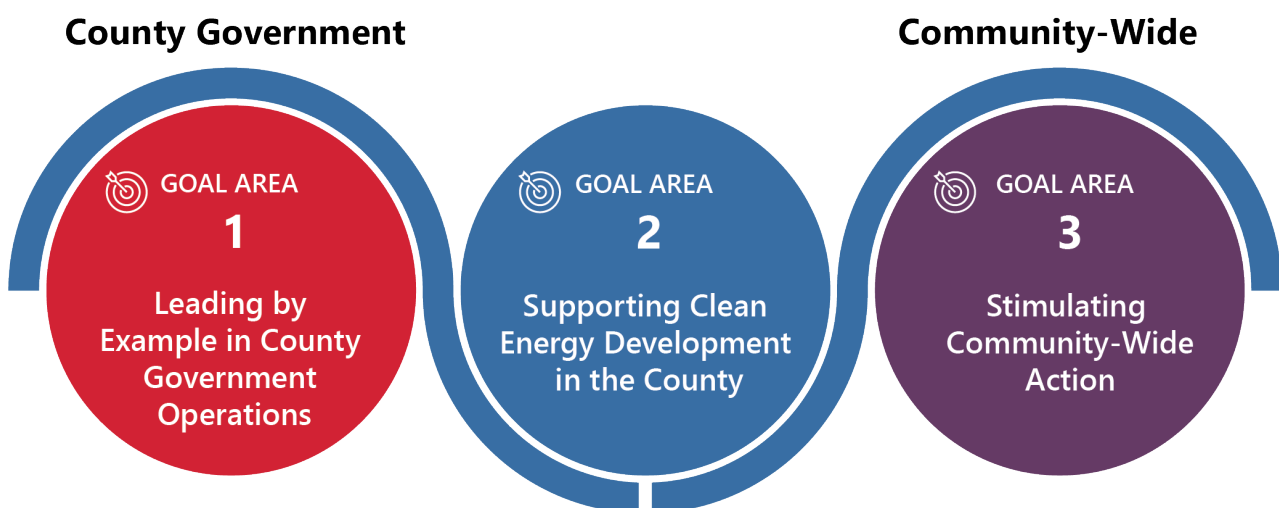


Table 1. An overview of the Loudoun County Energy Strategy Goal Framework

Goal Area	Strategy
1. Leading by Example in County Government Operations	1. Increase County clean energy use
	2. Reduce GHG emissions from new and existing County facilities and increase efficiency
	3. Reduce County fleet and employee travel emissions
	4. Reduce GHG emissions from County landfill
	5. Provide transparent and accessible communications about County progress for the Energy Strategy
2. Supporting Clean Energy Development in the County	6. Facilitate access to and development of clean energy in the county
3. Stimulating Community-wide Action	7. Reduce transportation emissions
	8. Reduce GHG emissions from residential and commercial buildings and increase efficiency
	9. Provide education and technical assistance to county residents, businesses, and institutions
	10. Develop a community supported and influenced energy equity work plan

2023 Energy Strategy Development Process

To develop this Strategy DGS led a multi-phase process that included technical work, stakeholder and public engagement, and close coordination with the EC and the Board of Supervisors (see Figure 2).

After the September 2021 Energy Strategy Workshop, DGS began the process of drafting the Strategy goal framework. As part of this process, DGS engaged with several key stakeholders, including the EC, Loudoun Chamber of Commerce, Data Center Coalition, Loudoun County Coalition of Homeowners and Condominium Associations, many non-profit groups such as Habitat for Humanity and the local chapter of the National Association for the Advancement of Colored People (NAACP), and different County departments and offices. The County met with the EC in March 2022 to provide an overview of the project and solicit feedback on the direction of the Energy Strategy. Those conversations informed the goal framework, which was presented to the EC on April 27, 2022, and discussed again on May 11, 2022. After integrating feedback from the

EC and County departments, the County held a public input session on June 29, 2022 and solicited feedback on goals, strategies, and supporting actions for the Energy Strategy in person and through an online comment form.

The EC feedback, public comments, and discussions with County departments all informed the final goal framework that the Board of Supervisors voted to approve at an Environmental Summit on July 27, 2022. This framework set the foundation for developing more specifics for strategies and actions throughout 2022. The development of these strategies and actions also involved working closely with the community and stakeholders to understand how the County can prioritize energy equity, provide education and public outreach in support of the Energy Strategy and create a culture of shared responsibility for Energy Strategy implementation.

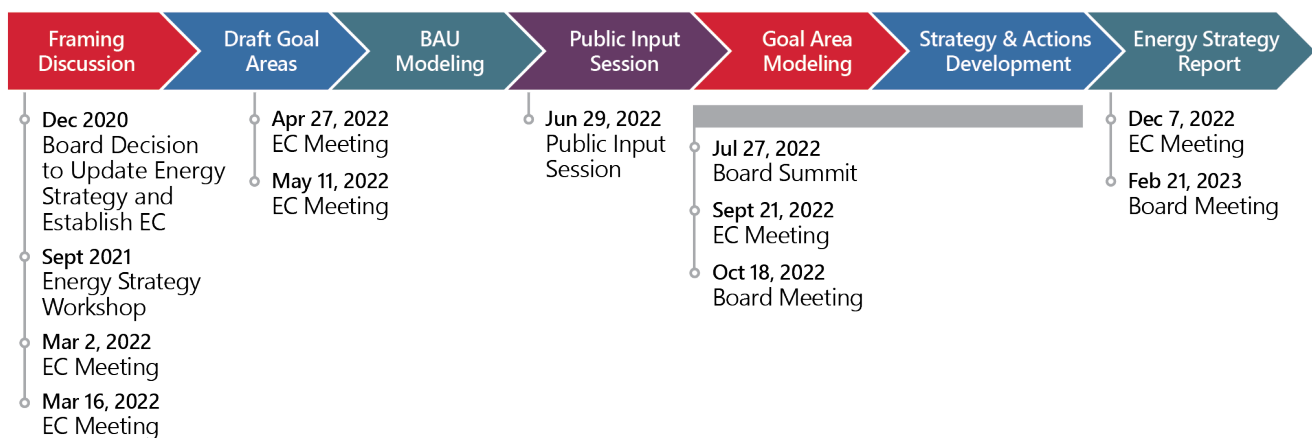
Following the goal framework development, two types of scenarios were designed and modeled to understand the order of magnitude changes in energy use and GHG emissions that could result from implementing the Energy Strategy. The scenarios include business-as-usual (BAU) projections and strategy scenarios that reflect

many of the strategies included in the goal framework for both County operations and the community. Draft BAU scenarios were completed in August 2022, followed by draft strategy scenarios in October 2022. These scenarios were presented to the EC and the Board of Supervisors. DGS also solicited input, and feedback on the scenarios from County departments and MWCOC. All modeling was finalized by the end of 2022, prior to the final presentation to the Board of Supervisors about the content of this Energy Strategy in February 2023. At this meeting, the Board voted to

approve the 2023 Energy Strategy presented in this report.

Ultimately, these steps led to the development of this Energy Strategy, which the Board voted to approve in the February 2023 meeting. Moving forward DGS and government and community stakeholders will work collaboratively to implement the actions outlined in this strategy that call for more specific project and program plans, using new technologies, securing funding and resources, and regularly reporting on progress.

Figure 2. The Loudoun County Energy Strategy Development Process





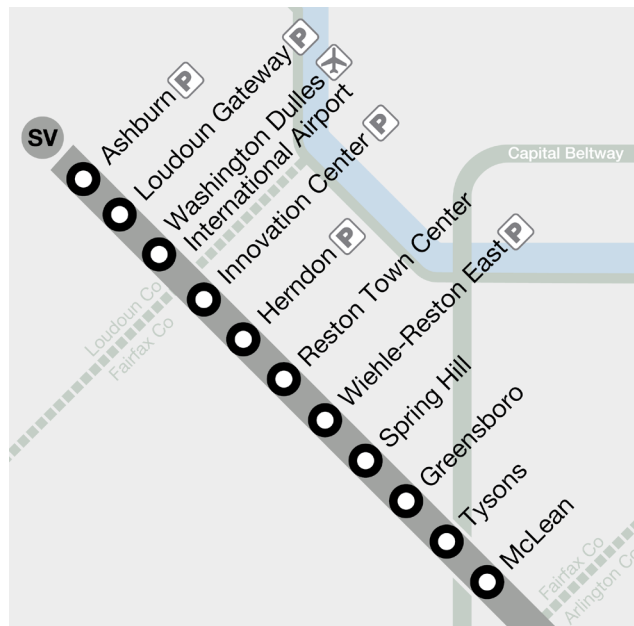
Loudoun County Context

Existing Energy Policies and Programs

Efforts are already underway at the county, state, and regional levels to move toward cleaner and more reliable energy resources, use less energy, and reduce GHG emissions. The 2023 Loudoun County Energy Strategy works in cooperation with these established efforts to advance and amplify opportunities to achieve the County's vision.

Since the 2009 Loudoun County Energy Strategy, the County has enacted policies and programs that aim to reduce GHG emissions and improve energy efficiency in the transportation and buildings sectors and encourage clean energy use and development.

Supporting transportation GHG emissions reductions: To reduce GHG emissions and improve efficiency in the transportation sector, the County promotes public transportation and pledged to procure ZEVs for the County fleet. In November 2022, the Washington Metropolitan Area Transit Authority (WMATA) extended Metrorail service and opened three new stops in Loudoun County, along with an extended bus route. By collaborating with WMATA to build out this multimodal transportation network, the County has provided citizens an efficient, accessible way to reduce their GHG emissions by reducing miles traveled in personal vehicles. This development is complemented by the County's ZEV plan, adopted in December 2022, which aims to reduce government vehicle fleet emissions by replacing 23% of its fleet with ZEVs, both all-electric vehicles and plug-in hybrid electric vehicles (PHEV).



Caption: Silver Line Metro stations in Loudoun County.
Photo Credit: WMATA

Supporting building GHG emission reductions through clean energy development and greater energy efficiency: The County has installed solar photovoltaic (PV) arrays at several facilities, including the Youth Shelter Buildings, the Homeless Shelter building, and the Harmony Park & Ride. The County has enacted programs to promote employee education and leadership in energy conservation and has been an U.S. Environmental Protection Agency (EPA) ENERGY STAR partner since 2008, using ENERGY STAR rated efficient appliances to lower energy demand from its facilities. A newly revamped Employee Energy Conservation Committee (E2C2) will teach employees ways to improve energy efficiency and reduce energy and water consumption as well as provide a means for employees to suggest energy-saving ideas in

the workplace. In the past this group has conducted a popular energy awareness pledge campaign which will likely continue. In the broader community, County financing programs like Commercial Property Assessed Clean Energy (C-PACE) provide help to mitigate upfront costs for businesses that want to invest in clean energy, energy efficiency improvements or water conservation measures.

Aligning with regional and federal goals and incentives. MWCOG set goals to reduce GHG emissions 50% below 2005 levels by 2030 and 80% by 2050 for the metropolitan Washington D.C. region, as outlined in its 2030 Climate and Energy Plan.³ At the state level, through the VCEA, Virginia has an established target of reaching economy-wide net zero GHG emissions by 2045.⁴ The legislation also mandates a net zero power sector by 2045 and 2050 for utilities Dominion Energy and Appalachian Power Company, respectively. At the national level, the Infrastructure Investment and Jobs Act (IIJA) of 2021 and the Inflation Reduction Act (IRA) of 2022 provide significant federal funding and assistance opportunities to accelerate the development of clean and reliable energy resources, use energy more efficiently, and significantly reduce GHG emissions. The County is already actively working to evaluate and secure funding from these new opportunities, such as through the Energy Efficiency and Conservation Block Grant Program.⁵

County Energy and Emissions Profiles

Energy profiles and the GHG inventories they support give insights into opportunities for County and community action. These tools provide historical trends and a base year from which to compare future year emissions against

Energy Uses and GHG Emission Sources in County Operations

- **Transportation** – Energy consumption and GHG emissions from the County's on-road vehicle fleet. Vehicles the County owns and operates include public service cars, emergency and public safety vehicles, trucks, buses, vans, and motorcycles.
- **Buildings** – Energy consumption and GHG emissions from the County's 100+ facilities, which include administrative buildings, community centers, libraries, public safety facilities, parks, animal shelters, fire and rescue buildings, and group homes.
- **Waste** – Methane emissions from the County owned and operated landfill. Landfills emit methane (a potent GHG) as waste decomposes.

and measure progress toward goals. For the 2023 Energy Strategy, the County used its energy profile and GHG inventory for the community, developed by MWCOG, for select years from 2005 to 2020. The County developed a separate energy profile and inventory for its government operations for 2021.⁶ The GHG inventories cover Scope 1 and Scope 2 emissions.⁷

These inventories served as the starting points for projecting energy and emissions data through 2050 for BAU scenarios for the County and community. The BAU scenarios provide a picture of what energy and GHG emissions could look like over time. They also serve as comparisons for the strategy scenarios, which reflect the potential implementation of key

³ Metropolitan Washington Council of Governments. 2020. "Metropolitan Washington 2030 Climate and Energy Action Plan". Available at <https://www.mwcog.org/documents/2020/11/18/metropolitan-washington-2030-climate-and-energy-action-plan/>

⁴ Virginia Clean Economy Act. VA HB 1526. 2020 Regular Session. Available at <https://lis.virginia.gov/cgi-bin/legp604.exe?201+sum+HB1526>

⁵ U.S. Department of Energy. (n.d.). "Energy Efficiency and Conservation Block Grant Program." Available at <https://www.energy.gov/scep/energy-efficiency-and-conservation-block-grant-program>

⁶ 2021 was selected as a recent year with a return to more normal operations post-COVID and to ensure data accuracy and availability.

⁷ Scope 1 emissions are GHG emissions produced directly from sources an organization owns or controls. Scope 2 emissions are GHG emissions produced indirectly from generating the electricity that an organization uses. See the Glossary for examples.

strategies within the Strategy goal framework. The BAU scenarios assume no additional energy conservation, clean energy, or GHG-reducing actions are taken and no new policies are implemented beyond those already in place. Notably, the BAU scenarios presented do not account for meeting the VCEA state clean electricity goal, while the strategy scenarios do. This is because significant work still needs to be done by Dominion Energy, in collaboration with the county and state, to achieve the VCEA goal of net zero electricity by 2045.

County Operations

GHG emissions from government operations come from the County buildings, fleet, and the landfill and comprise 2% of total community GHG emissions. While the GHG emissions in Figure 3 are a result of energy consumed in County-owned or operated buildings, cars, and trucks, the landfill accepts waste from the broader community and does not represent only the waste generated from County operations.

Figure 4 shows approximately one-quarter of the County government's energy consumption in 2021 came from using vehicles. The County's vehicle fleet mainly uses gasoline, but there are plans to transition the light-duty vehicle fleet to a mix of all-electric vehicles and PHEVs in the near-term. The remaining three-quarters of energy consumed is used in County facilities. Electricity and natural gas are the main types of energy consumed in the facilities, with small amounts of propane also used.

Under a BAU scenario, County government emissions are projected to increase nearly 20% from 2021 to 2050, driven by the development of new County facilities. GHG emissions from the vehicle fleet are projected to decrease by about 40% due to improvements in fuel economy; the County's ZEV purchase plan is not included in the BAU modeling. GHG emissions from the County-owned landfill are more than double the GHG emissions from County vehicles and facilities combined and are projected to increase nearly 30% from 2021 to 2050 due to expected population growth leading to increased

Figure 3. County Government Operations and Landfill GHG Emissions, 2021

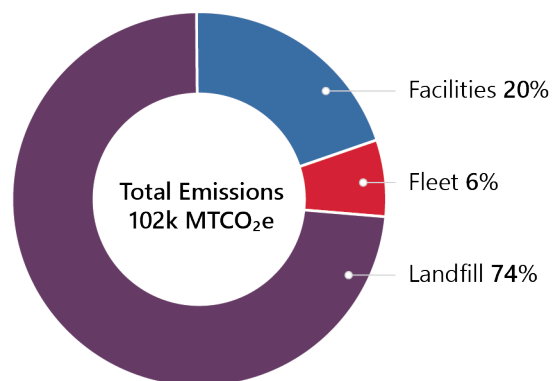
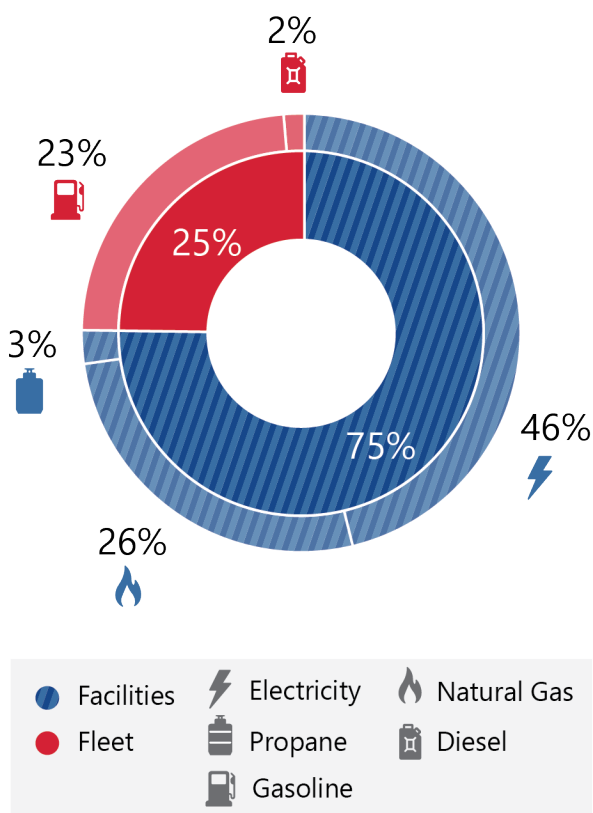


Figure 4. County Government Operations Energy Consumption by Source and Fuel Type, 2021



municipal solid waste being landfilled (see Appendix Figure A1 for more information).

Community

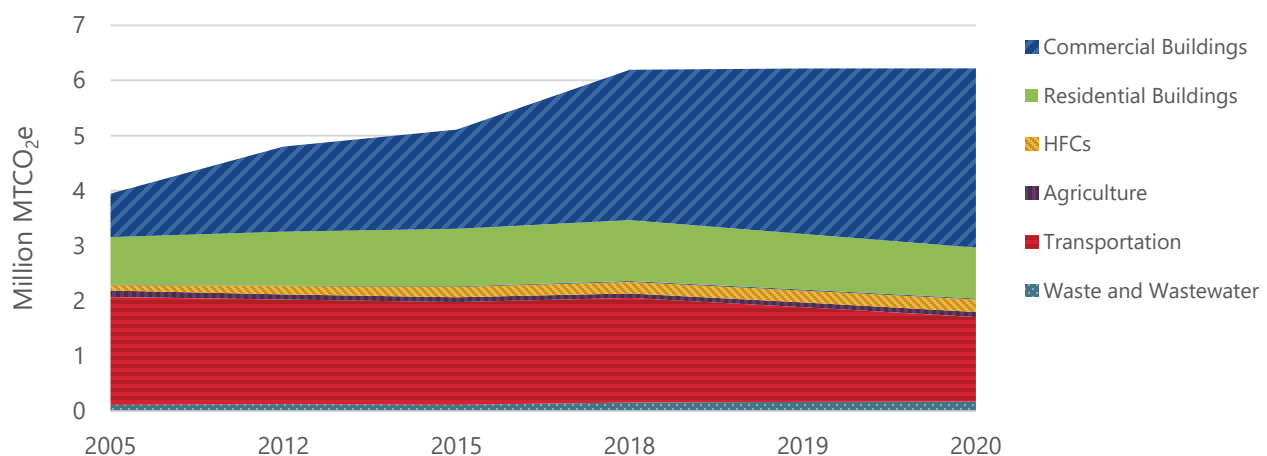
From 2005 to 2020, GHG emissions in Loudoun County increased 58%. This change is shown in Figure 5, which depicts county-wide GHG emissions in metric tons of CO₂-equivalent (MTCO₂e) from 2005 to 2020 (CO₂ stands for carbon dioxide). Since 2005, GHG emissions from commercial buildings have quadrupled, driven by increased commercial energy use and growth in commercial square footage. Residential building emissions have increased by 7%, driven by population growth, while transportation sector emissions decreased more than 20%.⁸ The reduction in transportation emissions was largely driven by a decrease in vehicle miles traveled (VMT).

In 2020, over 90% of emissions came from the energy used in buildings and transportation, two-thirds, and a quarter, respectively. The remaining county GHG emissions were from agricultural sources and waste (including the County landfill). From 2018 to 2020, total county emissions remained relatively flat at 6.2 million MTCO₂e (see Figure 6). GHG emissions

decreased from transportation and residential buildings due to COVID-19, but those declines were offset by increased emissions from commercial buildings as more office and retail space along with data centers were added in the county. Data center energy usage was not lessened by COVID-19, but rather was key to enabling the national virtual environment needed for the many workers and students during the pandemic.

As shown in Figure 7, over half of the energy consumed across the county is in the form of purchased electricity, most of which was used by the commercial sector. Within the commercial sector, energy consumption is believed to be largely driven by data centers, which have power-intensive operations. Data center square footage doubled from 2018 to 2022 and is expected to continue growing from 28 million square feet today⁹ to nearly 40 million square feet by 2030.¹⁰ Buildings, primarily residential ones, also consumed natural gas, fuel oil, and propane. Most of the fuel oil and propane consumption was from rural homes and businesses not connected to natural gas pipelines.

Figure 5. Community Historical GHG Emissions, 2005-2020



Note: Natural gas fugitive emissions are too small to be visualized at this scale.

⁸ This includes impacts of COVID-19 on the transportation sector in 2020. From 2005-2018, there was a 3% reduction in transportation emissions due to improved fuel economy and reduced off road and aviation activity.

⁹ Loudoun Virginia Economic Development. 2022. "Annual Report FY22: Loudoun's Economic Evolution". Available at <https://simplebooklet.com/publish.php?wpKey=c61047aZ7Y7uuXSgGppwJD&source=forum#page=7>

¹⁰ Board of Supervisors. 2020. "2020 Fiscal Impact Committee Guidelines". Available at https://loudoun.granicus.com/MetaViewer.php?view_id=77&clip_id=6482&meta_id=186112

Transportation made up roughly a quarter of total energy consumption in the county. Over half of this energy used was in the form of gasoline in personal vehicles and commercial trucks. Buses, larger trucks, and off-road transportation (e.g., tractors) primarily used diesel. Other fuels, such as E-85 and compressed natural gas (CNG), made up less than 1% of fuel consumed for transportation. Lastly, jet fuel used for aviation accounted for 3% of energy consumed by the county.

Under the BAU scenario, GHG emissions in the county are projected to rise 56% by 2050 from 2020 levels, driven in large part by increased energy used to support a growing commercial buildings sector (see Appendix Figure A2). The share of GHG emissions from buildings in 2050 is expected to rise from 67% in 2020 to nearly 75%, while transportation's share will fall from about 25% to 20%. Although the share of emissions from the transportation sector is projected to decline, the absolute emissions are projected to increase about 20% due to increases in VMT, off-road activity, and aviation activity.

Consistent with the approach to calculate emissions from all purchased electricity, data center GHG emissions were calculated using the average annual grid emissions factor for the region.¹¹ Individual corporate sustainability actions, such as the purchase of offsite clean energy to offset more carbon intensive onsite energy usage, were not included due to lack of data availability. The growing use and better accounting of such off-site clean energy and how it impacts local GHG emissions is an area of interest that needs further exploration.

Non-CO₂ GHG emissions (including methane (CH₄) and nitrous oxide (N₂O)) come from solid waste, wastewater treatment, agriculture, and natural gas emissions leaked from pipelines, known as fugitive emissions. Another type of GHG emissions, hydrofluorocarbons (HFCs), are commonly used as refrigerants and are emitted

Figure 6. Community GHG Emissions by Sector, 2020

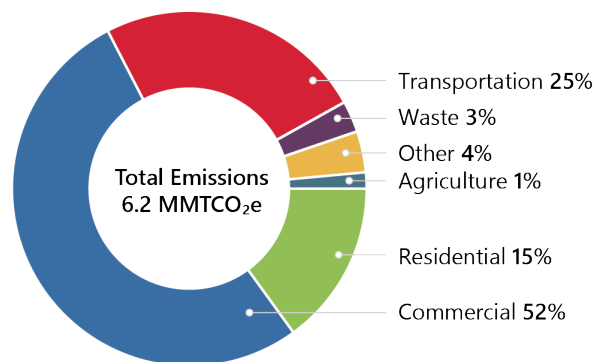
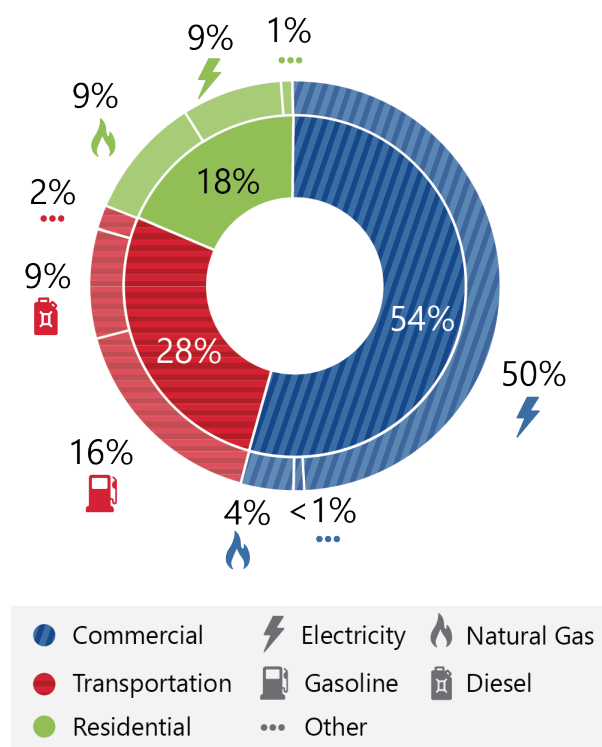


Figure 7. Community Energy Consumption by Sector and Fuel Type, 2020



¹¹ The grid emissions factor is the amount of GHGs emitted per MWh of electricity consumed. GHGs are emitted when electricity is generated from burning fossil fuels, such as coal or natural gas through the larger regional generation, transmission, and distribution system.

through equipment leakage (e.g., from refrigerators and air conditioning units).

Under the BAU scenario, most non-CO₂ GHG emissions are expected to increase due to Loudoun County's increasing population. However, agricultural emissions, which have declined since 2005, are expected to continue to decline nearly 40% by 2050 from 2020 levels.

Without intervention, Loudoun County's energy use and GHG emissions will grow in the coming decades. Coordinated and comprehensive strategies are needed to alter the county's energy and emissions pathways to realize change by 2050. By implementing this Energy Strategy, Loudoun County can change course and ultimately fulfill its vision for a cleaner, lower carbon future.



2023 ENVIRONMENTAL EXCELLENCE AWARDS ★★★★★

Nominations are being accepted to recognize leadership on environmental issues in Loudoun. Activities should have occurred between January 2022 and February 2023, with the exception of the Lifetime Achievement award, in the following categories:

- Citizen or Community Group (examples: Nonprofit organization, club, faith-based group, etc.)
- Educator – Teacher or School employee
- Government Employee or Program/Team
- Large Business (over 100 employees)
- Lifetime Achievement (Individual)
- Small Business (under 100 employees)
- Student – Individual or Group

Learn more & submit your nominations at loudoun.gov/EnvironmentalAwards

The deadline to submit is February 28, 2023. Winners will be notified in March with presentation of the awards scheduled for April.

LOUDOUN COUNTY VIRGINIA

SCAN HERE TO NOMINATE

Loudoun County Environmental Excellence Awards Flyer.

Energy Uses and GHG Emissions Sources in Loudoun County

- **Buildings** – Energy consumption and GHG emissions from residential and commercial buildings. Energy in residential buildings is primarily used for heating and cooling, lighting, water heating, and appliances. Commercial energy consumption in the community is mostly in the form of electricity for data centers, but also includes the same end uses as residential buildings.
- **Transportation** – Energy consumption and GHG emissions from on-road vehicles (passenger vehicles, buses, and trucks), off-road vehicles (e.g., construction equipment), and aviation (passengers leaving from IAD, DCA, and BWI).
- **Waste** – GHG emissions from solid waste generated by the community. Some is disposed of in the County landfill, while the rest is exported to other landfills. Also includes GHG emissions from wastewater treatment. These emissions are primarily methane.
- **Fugitive Natural Gas**– Methane that leaks from the natural gas distribution system, associated with the amount of natural gas used in the County.
- **HFCs** – Refrigerants that leak from cooling and refrigeration systems. These chemicals are hundreds or thousands of times more potent GHGs than CO₂.
- **Agriculture** – GHG emissions from enteric fermentation, manure management, and soils.



Goals, Strategies, and Actions

The vision for the 2023 Energy Strategy will be implemented, and success will be measured, by using a goal framework that spans three areas:

1. Leading by Example in County Government Operations,
2. Supporting Clean Energy Development in the County, and
3. Stimulating Community-Wide Action.

This section includes details for each goal area and associated strategies and actions that together make up a blueprint for the County. By design, the goal framework is adaptable for modifications in the future and serves as a starting point for follow-on implementation steps by the County. The strategies and actions were designed as modular, so the County can act on various components over the next few years as resources become available for implementation.

This section also presents modeling results for projected changes in energy and GHG emissions for each goal area and specific strategies. While modeling is a useful tool to help understand and communicate the potential environmental benefits of these strategies, it is indicative and not meant to set

specific outcomes for this Energy Strategy. Going forward, the County will be developing performance measures and metrics for accountability and progress tracking for this Energy Strategy (see Strategies 9 and 10, pages 46 and 49).

Table 2 below summarizes the GHG emission reductions estimated for modeled strategies. The percentage reductions in Table 2 show how the emission reductions in 2030 and 2050 compared to emissions in the base year (2021 for Goal Area 1 and 2018 for Goal Areas 2 and 3) for each strategy. The numbers in parentheses show the absolute change in GHG emissions in 2030 and 2050 compared to the base year. For Goal Area 1, ambitious quantitative targets are included within the strategies and reflected in the modeled government operations strategy scenario. The strategies and actions included for Goal Areas 2 and 3 focus on the role of the County government to facilitate community-wide GHG emission reductions. **As a result of this Energy Strategy total GHG emissions for the county are projected to decrease 56% from 2018 levels by 2050. That is equivalent to taking 742,500 gasoline cars off the road annually by 2050.**

Table 2. Summary of Strategies and Potential GHG Emission Reductions

Strategy	Changes in GHG Emissions by 2030 Compared to Base Year	Changes in GHG Emissions by 2050 Compared to Base Year	Equivalent Number of Gasoline Cars off the Road Annually by 2050 ¹²
Goal Area 1. Leading by Example in County Government Operations (<i>Reductions presented for Goal Area 1 assume electricity is supplied by 100% clean energy sources by 2030, in line with Strategy 1</i>)			
1. Increase County clean energy use	100% reduction in emissions from renewable electricity use (14,000 MTCO ₂ e)	100% reduction in emissions from renewable electricity use (14,000 MTCO ₂ e)	3,000
2. Reduce GHG emissions from new and existing County facilities and increase efficiency	9% reduction (500 MTCO ₂ e) in GHG emissions from improving efficiency and fuel-switching	100% reduction (6,000 MTCO ₂ e) in GHG emissions from improving efficiency and fuel-switching	1,300
3. Reduce County fleet and employee travel emissions	43% reduction (3,000 MTCO ₂ e) in GHG emissions from fewer internal combustion engine vehicles (ICEVs) in the fleet	100% reduction (7,000 MTCO ₂ e) in GHG emissions from moving to a ZEV fleet	1,500
4. Reduce GHG emissions from County landfill	7% increase (5,000 MTCO ₂ e) in GHG emissions due to county population growth outpacing diversion rate of MSW	60% reduction (45,000 MTCO ₂ e) in GHG emissions from MSW diversion	9,700
Goal Area 2. Supporting Clean Energy Development in the County (<i>Reductions presented for Goal Area 2 are associated only with Action 6.3 and reflect the state VCEA clean electricity mandate</i>)			
6. Facilitate access to and development of clean energy in the County	10% reduction (64,000 MTCO ₂ e) in GHG emissions from installing residential rooftop solar	4% reduction (24,000 MTCO ₂ e) in GHG emissions from installing residential rooftop solar	5,200
Goal Area 3. Stimulating Community-wide Action (<i>Reductions presented for Goal Area 3 reflect the state VCEA clean electricity mandate</i>)			
7. Reduce transportation emissions	19% reduction (282,000 MTCO ₂ e) in GHGs from on-road transportation by reducing VMT and phasing in EVs	67% reduction (1 MMTCO ₂ e) in GHGs from on-road transportation by reducing VMT and phasing in EVs	215,500
8. Reduce residential and commercial building emissions and increase energy efficiency	27% reduction (295,000 MTCO ₂ e) in residential GHG emissions from improving efficiency and electrification	52% reduction (574,000 MTCO ₂ e) in residential GHG emissions from improving efficiency and electrification	123,700
	16% increase (441,000 MTCO ₂ e) in commercial GHG emissions due to data center growth outpacing reductions from efficiency and electrification in other commercial buildings	70% reduction (2 MMTCO ₂ e) in commercial GHG emissions due to improving efficiency and electrification	430,900

Note: MTCO₂e (Metric Tons Carbon Dioxide Equivalent); MMTCO₂e (Million Metric Tons Carbon Dioxide Equivalent)

¹² U.S. Environmental Protection Agency. 2022. "Greenhouse Gas Equivalencies Calculator". Available at <https://www.epa.gov/energy/greenhouse-gas-equivalencies-calculator#results>. Assumes 2019 averages of 22.2 mpg gasoline passenger vehicles driving 11,250 miles annually.

Goal Area 1: Leading by Example in County Government Operations

Goal Area 1 covers opportunities where the County has direct operational control to make changes to reduce GHG emissions through increasing clean energy use, increasing energy efficiency and the use of efficient electrification, and reducing GHG emissions from the County on-road vehicle fleet. In addition to these strategies there are also opportunities for the County-owned and operated landfill, which accepts waste from the broader community to take action to reduce GHG emissions. Since the County does not have control over the amount

of waste generated by the community, this is an aspirational recommendation to help guide County waste management practices to prioritize waste diversion and emission reductions in its planning. The final strategy in Goal Area 1 is to provide transparent and accessible communication about progress on the Energy Strategy. This strategy is part of a comprehensive effort to prioritize community education and awareness of County actions. Table 3 below shows the strategies and associated actions for Goal Area 1. The actions are designed to fit a modular approach to implementation of this Strategy; the County will work to implement aspects of these actions as resources become available.

Table 3. Goal Area 1 Strategies and Actions

Strategy		
Goal Area: Leading by Example in County Government Operations		
1. Increase County clean energy use	1.1	Install onsite solar at select facilities.
	1.2	Use geothermal exchange systems or other clean fuel sources at select facilities for heating/cooling.
	1.3	Explore large-scale offsite PPAs to offset electricity use.
2. Reduce GHG emissions from new and existing County facilities and increase efficiency	2.1	Update energy efficiency measures for the design of new facilities.
	2.2	Implement or expand automated building energy management systems.
	2.3	Develop strategic building retrofit plans for all facilities, with a focus on resiliency for critical facilities.
	2.4	Develop County employee energy committee to encourage more energy conservation.
	2.5	Establish a County energy policy.
3. Reduce County fleet and employee travel emissions	3.1	Implement Board-approved fleet changes focused on zero-emission and plug-in hybrid vehicles and explore low or zero-emission landscaping and public works equipment.
	3.2	Implement procurement focused on low- or zero-emission transit buses.
	3.3	Install EV chargers at County buildings for County and employee vehicles
	3.4	Reduce County employee vehicle miles traveled.
4. Reduce GHG emissions from County landfill	4.1	Participate in Virginia Environmental Excellence Program.
	4.2	Divert municipal solid waste from landfill disposal.
	4.3	Mitigate GHG emissions via flaring or beneficial use of landfill gas.
5. Provide transparent and accessible communications about County progress for the Energy Strategy	5.1	Establish a public-facing progress reporting dashboard or progress report.
	5.2	Provide regular public progress updates.

The County undertook a strategy scenario modeling effort to understand the potential impact of the Goal Area 1 strategies on energy and GHG emissions from government operations. The modeling was informed by quantitative goals set for most strategies (see Table 4). These goals are designed to be ambitious and were selected to present an example to the rest of the community and provide opportunities for partnerships and education. The County also established a target for Goal Area 1 overall to reach net zero GHG emissions from County operations by 2050.

The goal for Strategy 1 is to achieve 100% clean electricity by 2030 for government operations. For Strategy 2, the goal is to achieve net zero GHG emissions from County facilities by 2050, which will be accomplished through various measures, including energy efficiency, electrification, and the use of clean fuels. For Strategy 3, the goal is to have the County fleet be comprised entirely of zero-emissions vehicles by 2050. Finally, Strategy 4 has a goal to move toward a zero waste-to-landfill county, with support from the community, targeting a 70% municipal solid waste diversion rate from BAU levels in 2050.

The modeling for the Goal Area 1 Energy Strategy scenario is based off the 2021 County government operations GHG inventory and BAU scenario, adding in the above quantitative goals as well as a range of assumptions to meet them.

For the County fleet, ZEV sales over time were assumed for different vehicle types, prioritizing the electrification of cars and personal vehicles in the near-term and delaying significant action for medium- and heavy-duty vehicles (e.g., semi-trucks) until the 2030s due to cost and availability. By 2040, all vehicles added to the fleet will be ZEVs.

For County facilities, buildings upgrades modeled included LED lighting, HVAC (heating, ventilation, and air conditioning) changes and additional HVAC controls to increase efficiency, the electrification of gas or propane equipment (e.g., water heating) and appliances (e.g., stovetops), and building envelope retrofits to increase efficiency (e.g., insulation). Rough order of magnitude estimates were calculated for different strategies to provide an initial view of potential County costs and savings. These are presented in the Appendix. Any critical facilities identified by the County were designated to be electrified later than other facilities (to allow for battery systems and other clean resiliency solutions to mature), and renewable natural gas (RNG) was assumed to supply any remaining natural gas and propane consumption, starting at 10% in 2030 and phasing in to provide 100% of the remaining gas supply by 2050.

The strategy to electrify facilities and vehicles is paired with a goal to supply county electricity needs with 100% clean energy by 2030. This ensures GHG emissions are not being transferred from one sector to another.

Table 4. Key Goals and Milestones for Goal Area 1

Key Goals and Milestones	2030	2040	2050
Clean Electricity Supply (% coming from clean energy)	100%	100%	100%
Buildings: Reduction in energy consumption (% reduction in energy consumption from 2021)	8%	20%	32%
Buildings: Decarbonized building fuels (% RNG in gas supply)	10%	70%	100%
Transportation: Fleet Electrification (% of on-road fleet that has been electrified)	10%	76%	100%
Waste: Landfill Waste Diversion (% diverted from BAU levels)	10%	35%	70%

Figures 8 and 9 show the GHG emission reductions attributable to each of the strategies compared to the BAU projections for County operations. Figure 8 shows the projected emissions from County operations under the Goal Area 1 Energy Strategy scenario including the County landfill. When the County landfill is included, County emissions decline 71% by 2050 from 2021 levels. This leaves about 30,000 MTCO₂e remaining in 2050 that the County

would need to offset or address in the future to meet its net zero goal.

However, since the County does not have direct control over waste generated by the community, Figure 9 removes the County landfill to highlight how the County reaches net zero GHG emissions from areas where it has direct control.

Figure 8. County Government Operations GHG Emission Reductions by Strategy

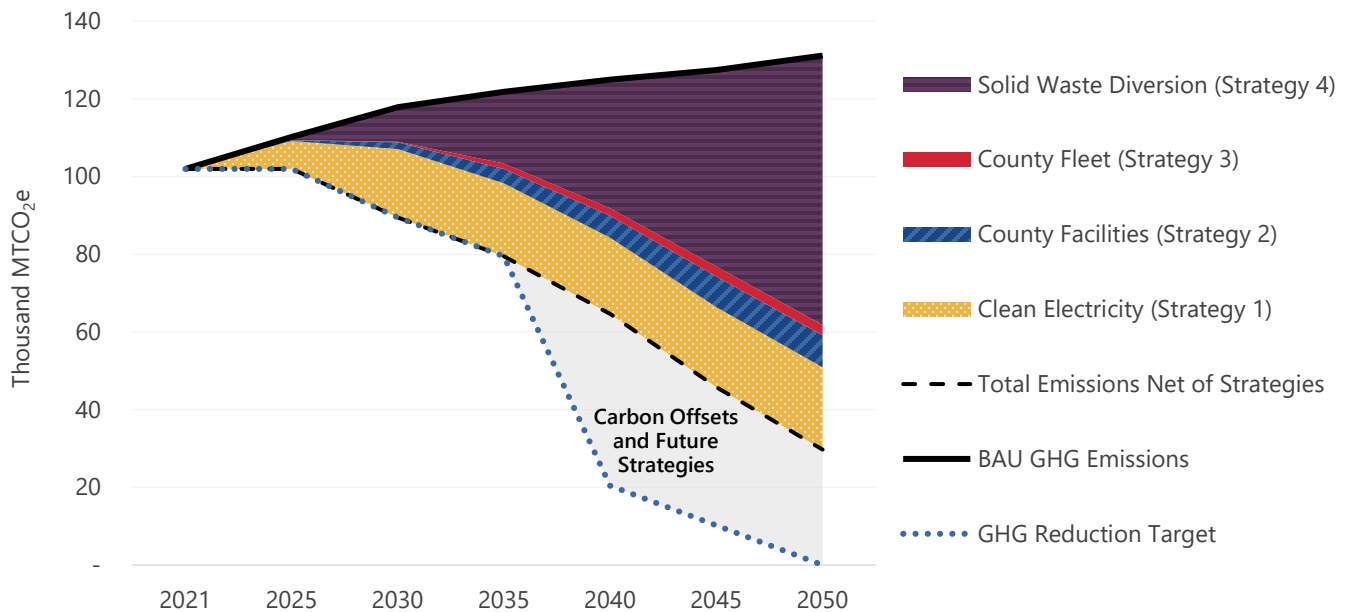
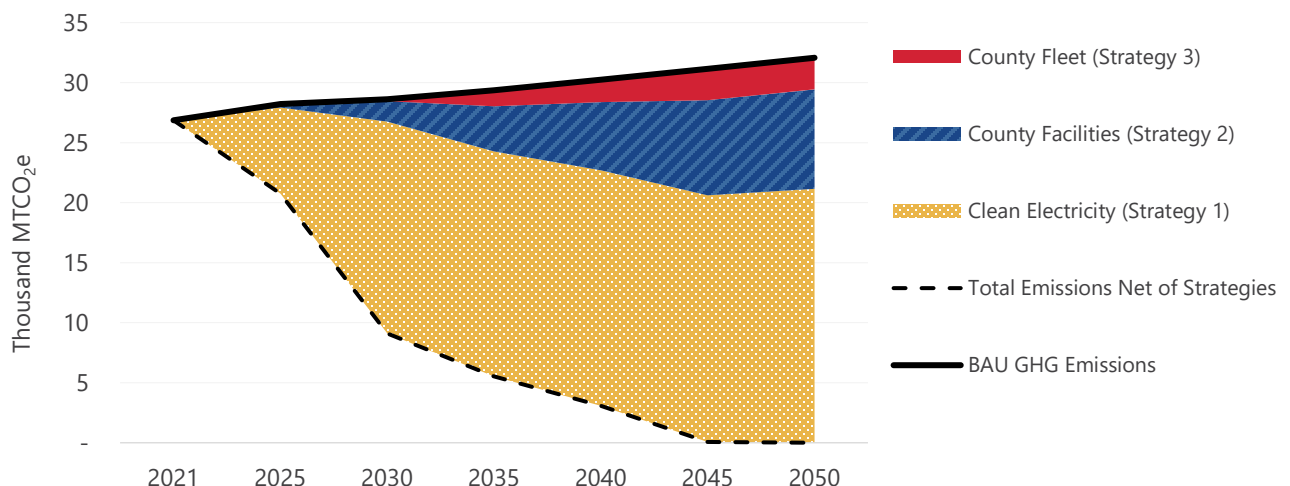


Figure 9. County Government Operations GHG Emission Reductions by Strategy without Landfill



Strategy 1, using clean electricity to power government operations, accounts for the majority of GHG emission reductions for the County government. This strategy includes the benefit of supplying clean power to both electric vehicles and facilities, while Strategies 2 and 3 reflect the impact of the change in energy use in the City fleet and facilities. Strategy 2, which captures energy efficiency improvements and electrification in facilities shows the impact of the change in energy consumed. Strategy 3, which captures fleet electrification, reflects the reduction in emissions from the removal of internal combustion engine vehicles. These three strategies underscore the importance of a coordinated plan to reduce emissions through electrification while also ensuring a clean power supply to meet increased electricity use without increasing emissions in the power sector.

The modeling was designed to help guide the County in outlining a path toward achieving its GHG reduction goals. Using the modeling results, the County considered relative potential changes in GHG emissions along with real world examples or constraints (e.g., current policy drivers or regulations, legal and acting authority) to help prioritize overall investments and make decisions about how to allocate and request resources now and in the future.

The following sections detail each of the five strategies in Goal Area 1 and outline recommended actions and next steps for the County to take to move toward implementing the Energy Strategy for Goal Area 1. To implement the strategies for Goal Area 1, the County will collaborate with internal government departments including DGS, DTCL, PRCS, DFB, DPZ, Department of Economic Development, the Public Affairs and Communications Division, and external partners like the EC, utilities, and MWCOG.

Strategy 1: Increase County clean energy use

- **Action 1.1:** Install onsite solar at select facilities.
- **Action 1.2:** Use geothermal exchange systems or other clean fuel sources at select facilities for heating/cooling.
- **Action 1.3:** Explore large-scale offsite PPAs to offset electricity use.



100% reduction in GHG emissions from purchased electricity for County operations by 2030

Milestones

100% clean electricity for County operations by 2030

The pathway to net zero GHG emissions requires increasing the County's consumption of clean energy. This will have amplifying benefits for emission reductions in County buildings, vehicles, and other equipment. As an interim goal, the County will aim to meet its electricity needs with 100% clean energy sources by 2030.

There are multiple actions the County could take to support this strategy. Actions 1.1 and 1.2 focus on areas where the County could utilize onsite resources, such as solar and geothermal exchange systems, while Action 1.3 looks at procuring renewable power offsite through a virtual power purchase agreement (PPA)¹³ in cases where onsite resources are insufficient to meet the electric and reliability needs of a facility. While each of these actions is complementary, energy choices must consider the specific needs and characteristics of each County facility. Supplying the government's electricity with locally sourced clean energy is preferable, but

¹³ In these arrangements, an energy user signs a contract to buy the energy output from solar and/or wind installation(s) on remote site(s). These projects deliver the electric power to the wholesale market on the electric grid, and the transaction is settled through a financial contract.

offsite PPAs provide an option for cases where this is infeasible.

Action 1.1: Install onsite solar at select facilities.

Installing onsite solar is a key supporting action to increase the County's use of clean energy. Solar panels could either be installed on County buildings or ground-mounted on County land where feasible. Not only would this generate direct power for County facilities, but it would also reduce electricity costs. To date, the County has successfully installed 49 kW of solar capacity at multiple locations (see Spotlight).

Furthermore, five new buildings are planned to have solar panels, including the Lovettsville, Aldie, Leesburg South, and Round Hill Fire and Rescue Stations as well as the Fire and Rescue Basic Training Facility.

Implementers. DGS working in tandem with stakeholders including DTCL (new facilities and transit), DPZ (zoning ordinances), and occupants of affected buildings.

Potential Barriers: Compliance with local zoning ordinances and limitations regarding existing structures and electrical wiring.

Next Steps

- Release and evaluate requests for proposal (RFP) for a master onsite PPA contract. When selected, master PPA provider will develop proposals for individual PPA contracts and installations at appropriate County facilities.
- As appropriate and feasible, include solar panels in the design for new facilities.
- Review opportunities associated with onsite battery storage paired with solar.
- Review ongoing Zoning Ordinance Rewrite and any future amendments intended to overcome any existing zoning barriers.
- Review State Code solar energy provisions and monitor General Assembly actions pertaining to solar energy. Consider as part of the County's legislative agenda.



Spotlight

The County has a total of 49 kW of solar capacity at the following locations:

- Cascades Bus Shelter solar lights
- Harmony Park & Ride, 32 LED lights with 11 kW of solar
- New Youth Shelter Building, 14 kW solar array
- Old Youth Shelter Building, 14 kW solar array
- Homeless Shelter Building, 10 kW solar array

Also, the New Youth Shelter, Leesburg Bus Garage, New Animal Shelter, Neersville Fire Station, Brambleton Fire Station, Lucketts Community Center, Kirkpatrick Fire Station, Sterling Community Center, Bluemont Community Center, and Loudoun Heights Fire Station # 26 all have geothermal exchange systems. An eleventh facility, the Ashburn Recreation Center, is under construction and will also use geothermal.





Rooftop solar panels on a Youth Shelter Building.

Action 1.2: Use geothermal exchange or other clean fuel sources as energy at select facilities for heating/cooling.

The County will study the feasibility of adding additional geothermal exchange heating and cooling systems in select County buildings. Geothermal exchange is already in place at 10 facilities and will also be used at the Ashburn Recreation Center, which is under construction. Benefits of a geothermal exchange system include lower maintenance costs, higher efficiency, longer life than a traditional natural gas-powered heating system, and a smaller mechanical room footprint. Given the County's experience with geothermal exchange systems, lessons learned will be applied to the design and operation of future systems.

Implementers: DTCL (facilities and transit), working with DGS (operations and maintenance) and third-party engineering and installation companies.

Potential Barriers: The negative perception of geothermal system performance must be overcome through education and by ensuring proper design of geothermal exchange systems to be consistent with building operation requirements (e.g., humidity and temperature requirements).

Next Steps

- Develop a County-wide geothermal feasibility assessment, and then develop site-specific plans for facilities that are good candidates for geothermal exchange systems.
- As a part of the capital improvement process (CIP), require that geothermal exchange be considered for use on all new facilities and implemented if conditions and facility program determine it is feasible.
- Continue to review operational performance of all new buildings prior to commissioning. For buildings with geothermal exchange systems, particular attention will be paid to the performance of the systems in reviewing performance before commissioning.
- Leverage lessons from geothermal exchange systems currently installed at County transit maintenance and operations facility and apply those to a second transit maintenance facility where systems may be installed.



A geothermal exchange system at the Animal Shelter.

Action 1.3: Explore large-scale offsite PPAs to offset electricity use.

Another way the County can increase clean energy supply, particularly for facilities where onsite solar or geothermal is infeasible from a cost or technical perspective, is by using offsite PPAs. Preference should be placed on renewable electricity generated within the county or sourced locally within the region or state. These

agreements can ensure the County's clean energy goal is met.

Implementers. DGS and the Department of Finance and Budget (DFB), working in partnership with electric utility companies, the Data Center Coalition, and other regional jurisdictions.

Potential Barriers. Contract structures and rates.

Next Step

Explore options for large-scale offsite PPA for County operations, including considering and discussing potential partnerships, for example with the data center community, to make the offsite PPA more attractive.

The County is already in the process of developing an RFP for a master PPA contract. The scope of the RFP includes an evaluation of facilities and the potential to engage in site-specific third party PPAs. The master PPA provider will also develop proposals for individual PPA contracts and installations at appropriate County facilities. The RFP will be released in 2023, and the contract is expected to be in place by the end of FY 2024.

Strategy 2: Reduce GHG emissions from new and existing County facilities and increase efficiency

- **Action 2.1:** Update energy efficiency measures for the design of new facilities.
- **Action 2.2:** Implement or expand automated building energy management systems.
- **Action 2.3:** Develop strategic building retrofit plans for all facilities, with a focus on resiliency for critical facilities.
- **Action 2.4:** Develop County employee energy committee to encourage more energy conservation.
- **Action 2.5:** Establish a County energy policy.



9% reduction in GHG emissions by 2030 and 100% by 2050 from 2021 levels

Milestones

32% reduction in energy use in County facilities by 2050

Reducing energy consumption through energy efficiency lowers both emissions and operating costs. To improve building efficiency, the County can address efficiency measures in the design of new facilities, while also focusing on implementing efficiency improvements at existing facilities. Other actions include implementing and expanding automated building energy management systems to monitor real-time energy use and developing a County energy team and committee to promote further energy conservation. All these potential measures can be supported by an energy policy to standardize and demonstrate efficiency actions.

Action 2.1: Update energy efficiency measures for the design of new facilities.

New County buildings are a significant source of projected future building emissions. Currently, new County buildings are designed to meet LEED Silver requirements where feasible, which incorporates a certain level of energy performance improvement, yet more action can be taken to reduce new building emissions.

Implementers. DTCL, with the help of DGS.

Potential Barriers. Some facilities have limited opportunity for energy performance improvement, such as park restrooms and storage buildings.

Next Steps

- Maintain the policy minimum of LEED Silver certification or building to ENERGY STAR standards on new facilities and for buildings undergoing major renovations where feasible.
- As possible, design new facilities with a 25% improvement in energy performance below the baseline standard per the current 90.1 Commercial Building Energy Modeling Guidelines and Procedures from the American Society of Heating, Refrigerating and Air-Conditioning Engineers (ASHRAE).

The County is looking to expand an existing employee-focused education and conservation programs, including an employee energy conservation awareness program through monthly energy conservation pledge and a dedicated employee energy conservation ideas mailbox where employees share their energy conservation ideas.

Action 2.2: Implement or expand automated building energy management systems.

Another way the County can improve energy efficiency in buildings is by installing and operating automated building energy management systems (BEMS) in facilities. BEMS can help facility managers schedule operations such as lighting and climate control, ensuring that buildings are consuming minimal energy when not in use. These systems can be paired with internet-connected devices, thereby deepening automatic control of building operations (e.g., smart thermostats).

Implementers. DGS in partnership with DTCL.

Potential Barriers. Lack of staff capacity, standardized energy policy, and education on BEMS could be barriers to full implementation. Success of this action requires dedicated staff to operate the BEMS. Furthermore, the County lacks a Board-approved Energy Policy to define temperature ranges or other standardizations for BEMS operations, which contributes to difficulties in operating and educating staff on BEMS.



A County employee is awarded LED light bulbs as a prize for winning the monthly energy challenge.

Next Steps

- Evaluate existing BEMS and identify areas for improved operations and potential gaps where an automated system could be implemented.
- Continue to implement the ongoing plan to upgrade remaining BEMS.
- Conduct more staff training and education.
- Dedicate an expert to monitor and operate BEMS.

Action 2.3: Develop strategic building retrofit plans for all facilities, with a focus on resiliency for critical facilities.

To address GHG emissions from existing facilities, the County can draft building retrofits plans to improve energy efficiency and build resilience where needed. Strategic building retrofit plans will address lighting efficiency, building envelope retrofits, HVAC controls and retrofits, and fuel-switching (e.g., electrification). These plans will be informed by an ongoing County project to perform an energy audit on select representative County facilities. This action includes the development of an overall plan to guide investment and timing for facility retrofit plans, including regular and consistent building energy audits. Plans for critical facilities (e.g., sheriff and fire stations) will focus on resilience and energy efficiency, which often go together. In addition, the County will look at collaborating with property owners for efficiency improvements in leased spaces, which could leverage the

Loudoun County C-PACE financing program (Commercial Property Assessed Clean Energy).

Implementers. DGS.

Potential Barriers. A lack of data, though ongoing building audits should begin to fill this gap.

Next Steps

- Perform audits (e.g., ASHRAE Level 2 audits) for top energy using facilities and gather information needed to create the strategic retrofit plans.
- Use data from the audits to inform development and implementation of building-specific plans.
- Conduct regular and consistent building energy audits of existing buildings.
- Discuss potential efficiency improvements and funding sources with property owners of leased buildings space.

Action 2.4: Develop County employee energy committee to encourage more energy conservation.

To promote employee support, an Employee Energy Conservation Committee (E2C2) will help raise awareness and initiate engagement among employees around energy-saving best practices in the workplace. The committee will build a culture of conservation through an ongoing employee program that recognizes and encourages specific actions that employees can take at the office to save energy.

Implementers. DGS is leading the development of the committee, which will include representatives of all departments, including the County Administration.

Potential Barriers. Finding energy champions in all County departments, ensuring active participation, monitoring conservation efforts, and securing resources needed to celebrate energy conservation events.

Next Steps

- Present this concept to the County Administration and the County Leadership Team for their input and approval in 2023.
- Present to all County staff in 2023, after approval.

Action 2.5: Establish a County energy policy.

Another cost-effective method of reducing building emissions is to set a County energy policy that will be adhered to within County buildings. The policy will provide guidance on energy standards for occupied versus unoccupied buildings, which can aid in planning for holiday, weekend, and hybrid work settings. It can address energy-saving methods, including installation of motion sensor lighting systems and set temperature ranges for thermostats. Establishing a County energy policy will improve building energy efficiency and requires cohesion with the County Board, staff, and BEMS.

Implementers. Implementation of this action will be led by DGS with the support of DTIC and County staff.

Potential Barriers. Staff pushback or lack of buy-in, as individuals may have their own temperature preferences.

Next Steps

- Design and implement a County Energy Policy (necessary for full use of BEMS). To include set points for heating/cooling and occupied versus unoccupied building settings (planning for holiday/weekend/hybrid work settings).
- Seek Board approval of the Energy Policy.
- Provide education and outreach with building occupants (e.g., how the motion sensors work).

Strategy 3: Reduce County fleet and employee travel emissions.

- **Action 3.1:** Implement Board-approved fleet changes focused on zero-emission and plug-in hybrid vehicles and explore zero-emission landscaping and public works equipment.
- **Action 3.2:** Implement procurement focused on low- or zero-emission transit buses.
- **Action 3.3:** Install EV chargers at County buildings for County and employee vehicles.
- **Action 3.4:** Reduce County employee vehicle miles traveled.



43% reduction in GHG emissions from County fleet electrification by 2030 and 100% by 2050 from 2021 levels

Milestones

100% ZEVs on the road by 2050

Reducing County fleet emissions by transitioning to ZEVs is a visible way for the County government to lead the community by example. A successful transition to 100% ZEVs by 2050 will require a gradual, but continuous, phase-in of ZEVs across all types of vehicles. Since ZEV options are not widely available yet for medium- and heavy-duty vehicles, the County will prepare for their adoption once they are available. The County will also look at

adopting less emissive off-road equipment like landscaping and public works equipment (e.g., tractors and lawn and garden equipment).

To begin the phaseout of vehicle emissions, the County can start by implementing a policy that promotes procurement of EVs. The County can also install electric vehicle chargers in County buildings and employ tactics to reduce County employee's VMT, such as using or expanding public shuttles or working and meeting remotely. By taking these actions, the County can lower emissions related to fleet and commuter transportation, a large step on the pathway to net zero GHG emissions. Reducing County fleet emissions depends, in large part, on the carbon intensity of the electricity used to charge the electric vehicles. As such, increases in clean energy supply as outlined in Strategy 1 are imperative for the success of Strategy 3.



Loudoun County promotes flexible work environments that help reduce vehicle miles traveled by employees through alternate worksites, such as employees' homes, and through the use of virtual meetings.



Spotlight

The County has already made progress toward ZEV adoption. The FY 2023 CIP budget provides funding for the EV Charging Stations for County Facilities project. This project consists of the planning, design, and construction of EV charging stations at existing County facilities. Furthermore, the County has contracted aid in the development of a Zero Emission Fleet Feasibility Plan to align with the EV Charging Stations project. The Board of Supervisors has also adopted a ZEV/Plug-in Hybrid Fleet Conversion strategy for the County fleet administrative vehicles.

Action 3.1: Implement Board-approved fleet changes focused on zero-emission and plug-in hybrid vehicles and explore zero-emission landscaping and public works equipment.

One way the County can reduce fleet and employee vehicle emissions is by establishing a policy that promotes acquiring EVs and other low- and zero-emissions equipment. The County will consider revising their procurement policy to establish a rate of ZEV adoption that leads the County to a 100% ZEV fleet by 2050. This ambitious but attainable goal is another way the County can lead the community by example and promote adoption of ZEVs throughout the county.

Implementers. The lead implementor will be DGS, in partnership with DTCI and PRCS.

Potential Barriers. Negative perception of ZEVs among employees, limited choice for cost-effective electric industrial landscaping equipment options, limited availability of heavy-duty ZEV model options (e.g., trucks), supply chain issues limiting ZEV supply, and the cost of ZEVs.

Next Steps

- Present this concept to the County Administration and the County Leadership Team for their input and approval in early 2023.
- Present to all County staff in 2023, after approval.
- Collaborate with regional partners on EV and ZEV fleet and charging market development, including best practice policies and procedures, infrastructure development, cooperative procurement, and installation.

Action 3.2: Implement procurement focused on low- or zero-emission transit buses.

In addition to buying ZEVs and low-emissions equipment, the County can also set an example for reducing emissions by procuring low- or zero-emissions transit buses. In recent years, the County has been monitoring the development

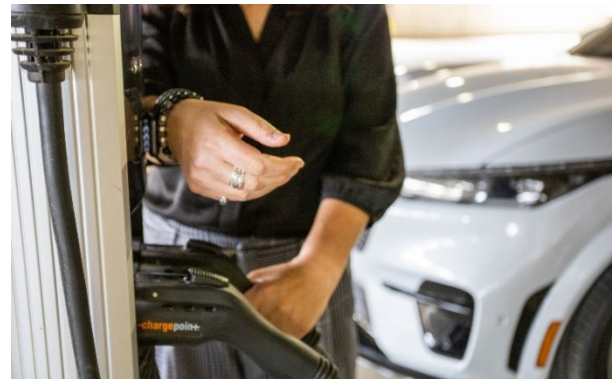
of alternative clean fuel solutions for the transit fleet, evaluating financial costs and environmental benefits in making transit decisions. To date, this has led to a pilot project and successful grant for purchasing both electric and Compressed Natural Gas (CNG) buses. At the Board Business Meeting on December 6, 2022, the County Board of Supervisors directed that future commuter buses procurements should consider CNG buses along with alternatives as the technology matures.

Implementers. Led by DGS in partnership with consultants and third-party suppliers.

Potential Barriers. Vehicle costs, CNG fuel costs, and infrastructure costs.

Next Steps

- Continue buying CNG replacement buses in accordance with the County Fleet Replacement Plan beginning in FY 2024.
- Continue to closely monitor the development of alternative clean fuel solutions for the transit fleet.



A resident uses a public EV charger located in a County parking garage.

Action 3.3: Install EV chargers at County buildings for County and employee vehicles.

To promote the procurement and use of ZEVs, the County should install EV chargers to provide a designated space for County vehicles to charge while not in use. EV charger access for employee vehicles incentivizes employee EV purchases by providing convenient workplace

charging. The County should also establish a networked system for tracking EV electricity use to understand charging patterns.

The County has already made progress toward expanding EV charging access at County buildings. The adopted FY 2023 CIP budget provides funding for the Electric Vehicle Charging Stations for County Facilities project. This project consists of the planning, design, and construction of electric vehicle charging stations at existing County facilities. The County is working to develop a Zero Emission Fleet Feasibility Plan to align with the Vehicle Charging Stations project. To date, the County has installed seven EV charging stations at Harmony Park & Ride in Hamilton, 32 stations at the Ashburn South Metro Garage, and 40 stations at the Gateway Metro Garage.

Implementers. DGS and DTCL.

Potential Barriers. Permitting requirements, potential electrical upgrades or host site capacity, and limited contractor selection.

Next Steps

- Implement the charging site assessment plan.
- Explore funding opportunities to fully implement an expanded charging plan.
- Provide operator training for proper use of charging equipment and maintenance.

Action 3.4: Reduce County employee vehicle miles traveled.

Another low-risk way the County can set an energy efficiency example for the community is by reducing employee VMT. Limiting VMT of employee travel reduces the emissions the County government generates. Options such as meeting virtually instead of in person (when possible) and public transit incentives to encourage use of the county's commuter buses and new Silver Line metro stations can reduce VMT.

Implementers. Department of Community and Human Services and DTCL, with the support of the County Administration and County employees.

Potential Barriers. Shortage of existing shuttles from public transit stops to County buildings; the need for an updated and more flexible telework policy and home office equipment for County staff; and a need for County staff to be present at government facilities in some cases.

Next Steps

- Improve connection between County buildings and transit (e.g., to the metro and commuter buses).
- Consider County telework policy updates and public or carpooling transit incentives.



All Loudoun County employees can ride for free on the Loudoun County Transit System, which now includes a bus route from the new Ashburn Silver Line metro station to the Government Center.

Strategy 4: Reduce GHG emissions from County landfill.

- **Action 4.1:** Participate in Virginia Environmental Excellence Program.
- **Action 4.2:** Divert municipal solid waste from landfill disposal.
- **Action 4.3:** Mitigate GHG emissions via flaring or beneficial use of landfill gas.



Spotlight

Loudoun County recently adopted a 5-cent plastic bag tax and is expanding the yard waste composting and recycling program in the county to divert solid waste from the landfill.

The County is also considering options for the beneficial use of landfill gas as opposed to flaring via a recently released Request For Information on renewable clean energy options.



Landfill gases (LFGs), mainly GHGs like methane and carbon dioxide, are emitted as MSW decomposes. There are multiple strategies the County can undertake to reduce LFG emissions, including burning off or flaring methane, by using LFG as fuel, or by preventing LFG emissions by reducing the amount of MSW landfilled. The County's efforts to reduce LFG emissions must be supported by community action to reduce waste via methods like recycling or composting, state programs that incentivize LFG tracking and reporting, and nationwide advancements in LFG flaring and recycling technologies.

Reducing landfill emissions will require the County to take actions that promote waste reduction and beneficial alternative uses for LFGs. For one, the County can participate in the state's Virginia Environmental Excellence Program (VEEP) that encourages and assists facilities in using environmental management systems to limit pollution. VEEP can provide grants to help County facilities exceed their emissions reductions targets. Additionally, the County can divert MSW from the landfill by promoting alternative disposal methods like recycling or composting. The County can also discourage the use of single-use products like plastics that add to the MSW supply. Finally, the County can mitigate GHG emissions from LFG by flaring or finding alternative, more beneficial uses for LFG as a fuel for vehicles or electricity generation.

Action 4.1: Participate in Virginia Environmental Excellence Program.

VEEP is a voluntary state program managed by the Department of Environmental Quality that encourages and assists facilities and organizations that have strong environmental records to go beyond their legal requirements. Participants set their own goals and report regularly to the state. The County can participate in VEEP to limit pollution, including LFG, and receive VEEP grants to support facilities emissions reductions. Currently, the County sits at the E2 level of VEEP.

Implementers. DGS.

Potential Barriers. Staffing shortages and constraints to conduct the work.

Next Steps

- Consider addition of new energy-related goals to next application for E2 renewal.
- Investigate the criteria to elevate from current E2 status to E3 status.
- Define County goals for E3 and evaluate costs and benefits.

Action 4.2: Divert municipal solid waste from landfill disposal.

To reduce LFG, the County can limit the amount of MSW that is disposed into the landfill. Waste can be diverted from landfill disposal by

increasing and improving effectiveness of composting and recycling of vegetative and food waste, paper, and glass products, etc. Policy, infrastructure, and public education will support this effort. To date, the County has taken steps toward this action by implementing a program to collect glass at drop off centers for recycling, expand composting of certain wastes at the landfill and by implementing a disposable plastic bag tax.

Implementers. DGS will lead in partnership with haulers, residents, and businesses.

Potential Barriers. Resource constraints (staff, consultants, equipment, infrastructure). County does not provide curbside trash collection, which limits capability to implement change. May require ordinance or legislative changes. Success depends on active participation of residents and businesses.

Next Steps

- Expand the existing Category I Composting Program as approved by the Board.
- Create a residential food waste drop off center pilot project as approved by the Board.
- Consider expansion of food waste recovery to more public drop off sites and via residential and commercial curbside collection.
- Explore improvements in the glass recycling program and increase efficiencies including the establishment of a locally centralized aggregation depot and direct haul to glass recycling processors.
- Expand public outreach to increase voluntary recycling and composting as much as possible with existing facilities.
- Identify resources needed to complete a comprehensive alternative disposal study to evaluate medium and long-term recycling and / or waste diversion options.
- Consider expansion of public recycling and / or waste diversion opportunities at the Loudoun County Solid Waste Management Facility including cardboard recycling for businesses, and a permanent facility to

collect household hazardous waste and consumer electronics.

- Consider changes to the County's codified ordinances to ban specific items from disposal in the county's landfill including but not limited to cardboard, consumer electronics, and household hazardous wastes.
- Consider expanding recycling of disposable bottles and cans to include all County-operated public facilities.



Loudoun County landfill.

Action 4.3: Mitigate GHG emissions via flaring or beneficial use of landfill gas.

To mitigate GHG emissions from LFG, the County can flare LFG or find alternative uses for LFG as a fuel. The County has taken steps to initiate LFG flaring, and currently flare nearly all LFG. They have also made an effort to innovate other beneficial uses for LFG. They have released a Request for Information (RFI) for alternative energy sources and are currently evaluating responses.

Implementers. DGS will lead, along with businesses interested in beneficial use projects.

Potential Barriers. Reducing gas through composting, as proposed in Action 4.2, conflicts with the goal of producing beneficial gas. Expectation of decreasing the LFG resource as composting goes up would limit economic benefits and reduce interest in developing beneficial projects.

Next Steps

- Complete RFI that includes options for beneficial use of LFG.
- Monitor, upgrade, and increase LFG wellfields and flare capacity in balance with LFG generation.
- Further study on the beneficial use of LFG, including effect of reducing waste as proposed in Action 4.2.

Strategy 5: Provide transparent and accessible communications about County progress for the Energy Strategy.

- **Action 5.1:** Establish a public-facing progress reporting dashboard or progress report.
- **Action 5.2:** Provide regular public progress updates.

Actions 5.1 and 5.2 focus on providing access to information regarding the County's progress toward energy efficiency. Dashboards, reports, or public progress updates can all provide accessible information. Transparent and accessible communications with county residents and businesses is a key component of leading by example. This helps establish trust in the County's operations, holds the County accountable to its goals, and provides a way for the public to learn about how these strategies can be implemented.

Action 5.1: Establish a public-facing progress reporting dashboard or progress report.

To provide transparent and accessible information to the community, the County will establish a public-facing progress reporting dashboard or report. Providing a landing page with data and metrics will help both the County government and residents track the County's progress.

Implementers. This action will be led by DGS, OMAGI, Department of Information Technology, and the Public Affairs and Communications Division, with input from the public and the EC.

Potential Barriers. Lack of data availability.

Next Steps

- Establish key metrics to track publicly.
- Review available data and tracking systems to support key metrics or develop systems to collect needed data.
- Design and develop dashboard or report template.
- Set up and publish dashboard or report on public website and promote it via the EC.

Action 5.2: Provide regular public progress updates.

In addition to establishing a dashboard or report for tracking progress, the County will share progress updates with the community through meetings with the EC and Board of Supervisors. Committing to providing regular progress updates will help promote transparency on government operations and hold the County accountable to meeting its goals.

Implementers. This action will be led by DGS, in partnership with DTCL, the Public Affairs and Communications Division, and the EC.

Potential Barriers. Current lack of staff resources and data availability.

Next Steps

- As outlined within this Strategy, commit to providing at least an annual update on progress to the Board, with more frequent updates to the EC.



A County employee is awarded LED light bulbs as a prize for winning the monthly energy challenge.

Goal Area 2: Supporting Clean Energy Development in the County

The vision for this Energy Strategy is to contribute to Virginia’s goal for net zero GHG emissions by 2045 and for net zero emissions from the power sector by 2050. Goal Area 2 focuses on what can occur within Loudoun County to support those goals by developing and using clean energy resources. Goal Area 2 intersects with both Goal Areas 1 and 3 by focusing on the foundational element of clean energy supply, which is a key driver for emission reductions from fuel-switching via electrification or the use of low-carbon fuels. As such, Goal Area 2 encompasses both what the County has direct operational control over (e.g., facilitates Strategy 1 under Goal Area 1) and where the County can play a role in supporting VCEA goals to decarbonize the electricity supply to amplify the benefits of electrification strategies in Goal Area 3. Goal Area 2 includes one strategy and three actions, shown in Table 5.

As shown in Figure 10, a clean electricity supply comprises the majority of GHG emission reductions in the community. Absent a clean electricity supply, the increased use of electricity to supply electric vehicles would shift GHG emissions from the transportation sector to the power sector, and the expected growth in data center electricity consumption would continue to drive emissions from purchased power.

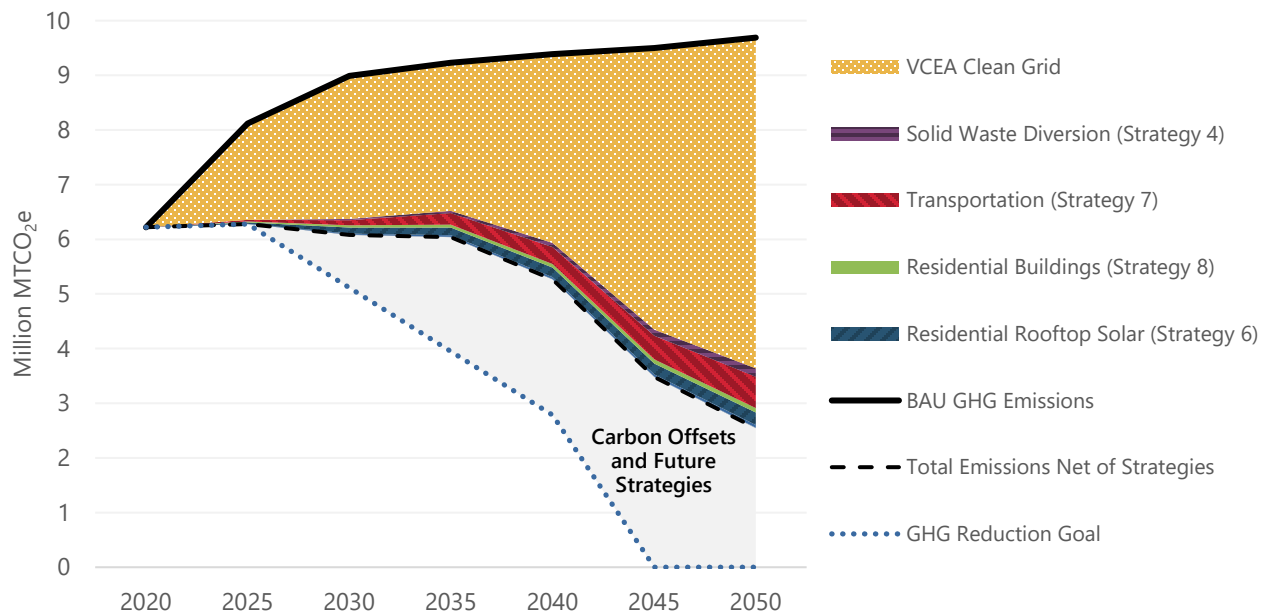
Figure 10 also shows a category called Carbon Offsets and Future Strategies. The emission reductions represented by this category are equal to the remaining GHG emissions after all identified strategies are included. In 2050, total remaining emissions are 2.7 million MTCO_{2e} across all sectors. Nearly half of the remaining emissions come from buildings, while a third come from transportation, and the rest from the other sectors. The Carbon Offsets and Future Strategies category acknowledges that additional action will need to be taken to reach net zero emissions in the long-run. These actions will likely be supported by new technologies and policies that will be developed in the future.

The following section details Strategy 6 and the associated recommended actions and next steps for the County to move toward implementing the Energy Strategy for Goal Area 2. To implement the strategy and recommended actions for Goal Area 2, the County will have to collaborate with internal government departments and external partners like the DGS, DTCL, DFB, the Public Affairs and Communications Division, Loudoun Chamber of Commerce, Department of Economic Development, DPZ, the EC, utility companies, the Data Center Coalition, HOAs, the Northern Virginia Regional Commission (NVRC), Virginia State Energy Office, and federal agencies and organizations such as the U.S. Environmental Protection Agency and U.S. Department of Energy research laboratories.

Table 5. Goal Area 2 Strategies and Actions

Strategy	Action
Goal Area: Supporting Clean Energy Development in the County	
6. Facilitate access to and development of clean energy in the county	6.1 Explore PPAs, expanded net metering opportunities, and other tools to encourage community clean energy use.
	6.2 Assess the potential for low carbon fuels within the county.
	6.3 Accelerate community adoption of onsite renewables.

Figure 10. Community GHG Emission Reduction by Strategy: VCEA breakout



Note: Commercial and natural gas fugitive emissions are too small to visualize at this scale.

Strategy 6: Facilitate access to and development of clean energy in the county.

- **Action 6.1:** Explore PPAs, expanded net metering opportunities, and other tools to encourage community clean energy use.
- **Action 6.2:** Assess the potential for low carbon fuels within the county.
- **Action 6.3:** Accelerate community adoption of onsite renewables.

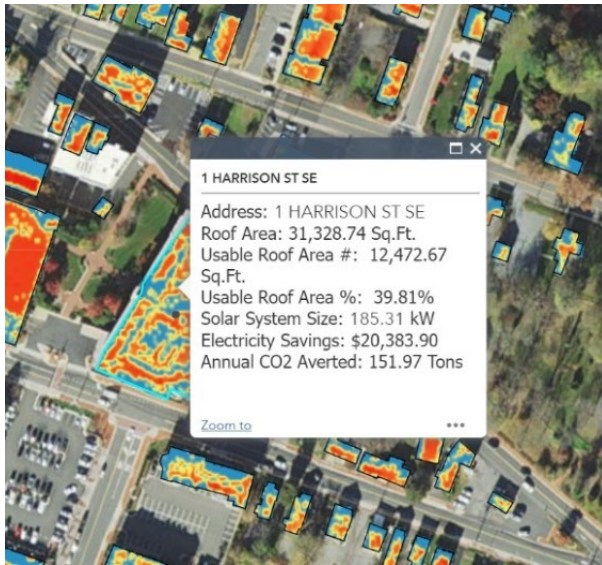
Milestone
By 2050, 40% of residential electricity consumption met by rooftop solar

The County must facilitate access to and the development of clean energy in the county to ensure electrification strategies realize the greatest possible reduction in GHG emissions.

Of the actions that comprise this strategy, Action 6.1 focuses on making clean electricity more directly accessible for the community while Actions 6.2 and 6.3 focus on decarbonizing the county's energy profile through accelerated use of low carbon fuels and onsite renewables.

The County leveraged data provided by the NVRC to analyze the potential for residential rooftop solar in the county. Based on data from both OMAGI and NVRC's Northern Virginia (NOVA) Solar Map, an adoption rate of 10% would offset about 40% of projected residential electricity consumption in the county in 2050. NVRC's Solar Map estimates the potential size of a solar PV array that can be placed on the building rooftop and its potential output. Figure 11 shows the type of information the Solar Map provides for a building.

Figure 11. NVRC's NOVA Solar Map Sample



Action 6.1: Explore PPAs, expanded net metering opportunities, and other tools to encourage community clean energy use.

Action 6.1 recommends that the County facilitate opportunities for residents and businesses to have more cost-effective access to clean energy. As such, the County will consider the feasibility of a PPA for clean energy on behalf of the community (potentially in collaboration with large energy users in the county) and other tools to encourage community clean energy use. The County will also consider expanding its PPA for government operations (see Action 1.3). Other tools the County may consider include flexible green zones or innovative districts.

Implementers. DGS will take the lead on this action with necessary engagement from homeowner's associations (HOAs), the Loudoun Chamber of Commerce, Department of Economic Development, and the Data Center Coalition.

Potential Barriers. Possible Zoning Ordinance conflicts, lack of enabling authority in the state code, local permitting difficulties, staff resources.

Next Steps

- Have conversations with stakeholders and develop a plan to consider the expansion of the PPA.
- Assess the process to expand PPAs and understand and confront any barriers.
- Explore barriers to net metering and consider possible changes.

Action 6.2: Assess the potential for low carbon fuels within the County.

Not all appliances and equipment will be electrified in the county, leading to a need for low carbon fuels to reduce the GHG emissions from the current use of natural gas, propane, and oil. Where possible, using lower carbon content fuels (e.g., renewable natural gas, hydrogen) reduces emissions, especially when the fuel sources are developed within the county or region. To facilitate the use of low carbon fuels, the County will assess the potential to develop and use low carbon fuels within the county. In 2022, the County released an RFI soliciting information on potential alternative energy projects to reduce GHG emissions in the county. As of early 2023, the County is currently reviewing responses to determine if any projects should be pursued.

Implementers. DGS will take the lead on this action and will engage utilities, regional organizations (e.g., MWCOC), and the Data Center Coalition.

Potential Barriers. New and unproven technology concerns, funding to study.

Next Steps

- Evaluate RFI responses for potential partnerships and opportunities and go to the Board of Supervisors in 2023 with a recommendation on next steps based on the responses received.
- Work with regional partners on hydrogen hub development to learn about the technology, use cases, and implementation options.
- Review funding opportunities to support clean fuels development and use in the county (e.g., IIJA and IRA).
- Collaborate on new state and regional climate planning grant programs, including the US DOT's Carbon Reduction Program and the US EPA's Carbon Pollution Reduction Grant Program.
- Begin discussions with Economic Development, the Data Center Coalition, electric companies and other commercial facilities on a pilot program to study cleaner alternative fuel sources for County and data center backup diesel generators. Explore grant opportunities and possible partnership with the Department of Energy National Renewable Energy Laboratory (NREL) or universities on such a program.

Action 6.3: Accelerate community adoption of onsite renewables.

Through education, outreach and stakeholder partnerships, the County can educate residents and businesses about onsite clean energy options and funding sources available to them. The County can also help facilitate community solar projects (i.e., local solar facilities shared by multiple community members). Community solar has been discussed by the EC, been mentioned during public input sessions, and considered in the Zoning Ordinance Rewrite process. Increased onsite clean energy adoption not only lowers GHG emissions throughout the county, but also provides decentralized low-cost energy, increasing household resilience and agency in their power supply options.

Implementers. DGS will take the lead on this action and work with multiple stakeholders, including: the EC, Loudoun Chamber of Commerce, Economic Development Authority, DPZ, HOAs, the NVRC, Virginia State Energy Office, and federal agencies.

Potential Barriers. Possible Zoning Ordinance conflicts, lack of enabling authority in the state code, local permitting difficulties, and staff resources.

Next Steps

- Review opportunities for funding and incentive programs, including promoting C-PACE.
- Develop a stakeholder engagement/community outreach initiative in partnership with the EC, Chamber of Commerce, and Equity Officer.
- Review ongoing Zoning Ordinance Rewrite and any future amendments intended to overcome any existing zoning barriers.
- Review State Code solar energy provisions and monitor General Assembly actions pertaining to solar energy. Consider as part of the County's legislative agenda.

Goal Area 3: Stimulating Community-wide Action

Goal Area 3 focuses on what the County can do to support the community in reducing GHG emissions through effective electrification and efficiency measures while prioritizing equity and transparency. This goal area builds from leading actions taken by the County in Goal Area 1, as well as the clean energy development and deployment included in Goal

Area 2. For this goal area in particular, the County will coordinate with the Virginia State Energy Office and work to track, understand, and pursue emerging and ongoing federal funding opportunities (e.g., through the IRA). The Goal Area 3 Energy Strategy modeling shows a potential reduction in community GHG emissions to 2.7 million metric tons CO₂e by 2050, a 56% drop from 2018 levels, or a 30% reduction from 2005 levels. The strategies and actions for Goal Area 3 are shown in Table 6 below.

Table 6. Goal Area 3 Strategies and Actions

Strategy	Action
Goal Area: Stimulating Community-wide Action	
7. Reduce transportation emissions	7.1 Support the adoption of ZEVs within the county.
	7.2 Support electric vehicle charging infrastructure development across the county.
	7.3 Reduce the number of car trips and vehicle miles traveled within and in and out of the county.
8. Reduce GHG emissions from residential and commercial buildings and increase efficiency	8.1 Pursue funding opportunities and partnerships for energy efficiency and electrification.
	8.2 Explore programs such as green home certifications for residents and a pilot program with data centers.
9. Provide education and technical assistance to county residents, businesses, and institutions	9.1 Provide technical assistance, community events, or training programs for electric vehicles, energy efficiency and weatherization upgrades, buildings efficiency and electrification technologies, and clean energy.
	9.2 Provide a clearinghouse of information to facilitate access to individual funding, tax credits, and incentives (utility, state, and federal programs).
	9.3 Establish transparent process to help guide Energy Strategy implementation.
10. Develop a community supported and influenced energy equity work plan	10.1 Ensure equity across all populations in access to financing, equipment, and programs for ZEVs, energy efficiency retrofit for buildings, and clean energy.
	10.2 Track the benefits of the Energy Strategy for disadvantaged communities as a part of regular progress tracking and public reporting.
	10.3 Conduct targeted outreach and education through non-traditional partnerships and channels to access and educate the diverse community in Loudoun.

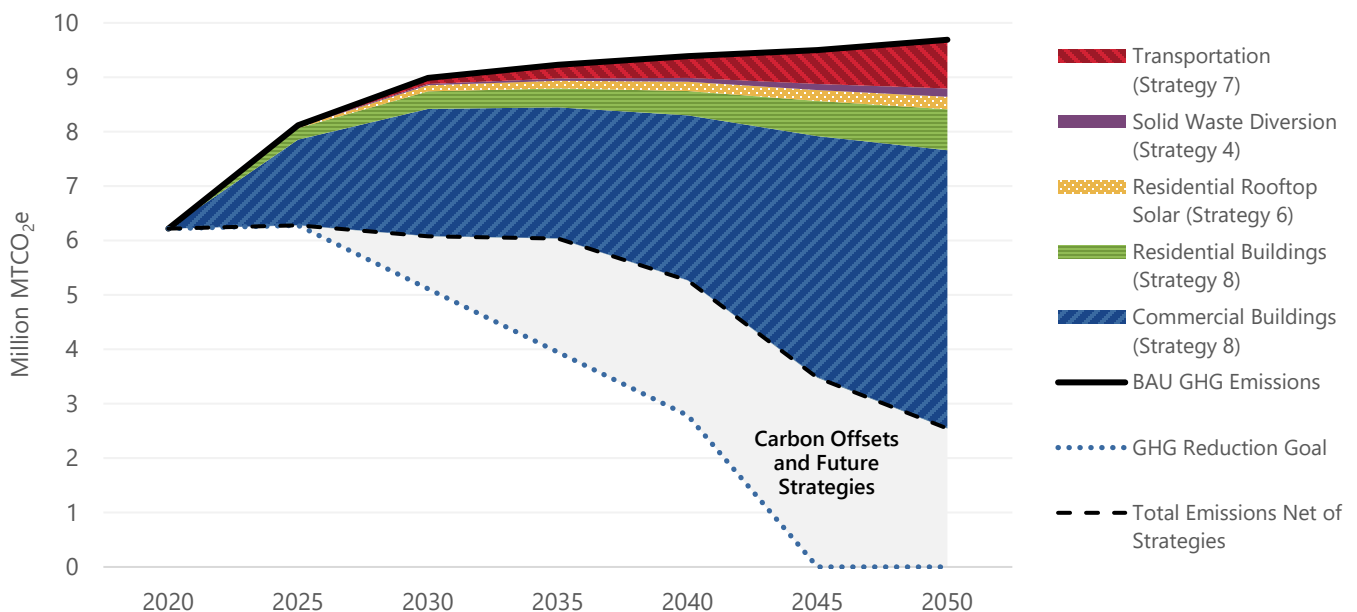
The County undertook a modeling effort to understand the potential impact of the Goal Area 3 strategies on energy and GHG emissions from the county. The modeling was informed by goals set for the strategies. The overall goal for Goal Area 3 is to meet the state goal of net zero emissions by 2045, with additional aspirational goals for the transportation and building sectors.

The modeling includes targets for Strategy 7 to have 100% ZEV vehicle sales by 2050 and a 14% reduction in VMT for passenger vehicles by 2050. For the Strategy 8, modeling analyzed the change in building energy use and emissions that results from a moderate adoption rate of various technologies and retrofits, including electrification, HVAC retrofits and controls, hot water/cooking, building envelope and lighting. No specific strategies were modeled to reduce energy consumption at data centers although efforts and pilot programs are included as action items in the Energy Strategy and likely to occur. Finally, a 70% MSW diversion rate was assumed for all MSW generated by the community, consistent with Strategy 4.

Figure 12 shows the GHG emission reduction attributable to each of the strategies compared to the BAU projections for the community. This chart

presumes that the VCEA targets for clean electricity supply are met in 2045, and the benefits of clean electricity are integrated with the transportation and building sector chart categories. Under this Energy Strategy scenario, county GHG emissions decline 56% by 2050 from 2018 levels. The majority of emission reductions come from commercial buildings, which is due to cleaning the electricity supply for data centers. GHG emissions from buildings decline 66% from 2018 levels by 2050, and emissions from on-road transportation fall 67%. Emissions from municipal solid waste decline nearly 60% from 2018 levels. About 2.7 million metric tons of emissions remain in 2050, which consist of remaining natural gas consumption in buildings, natural gas fugitive emissions, remaining ICEVs on the road, and emissions from landfilled MSW. GHG emissions from off-road transportation, aviation, wastewater treatment, agriculture, and HFCs remain at BAU and are not addressed in this Energy Strategy. The sectors with the largest portion of remaining emissions are buildings and transportation, making up 48% and 36%, respectively, of the total remaining emissions. To meet the goal of net zero emissions by 2045, the county would need to take additional actions or purchase carbon offsets.

Figure 12. Community GHG Emission Reductions by Strategy



These modeling results are indicative and meant to illustrate a potential reduction in county GHG emissions. The focus of Goal Area 3 is on developing partnerships and creating education and outreach programs in the community (Strategies 9 and 10) to facilitate the recommended actions in Strategies 7 and 8.

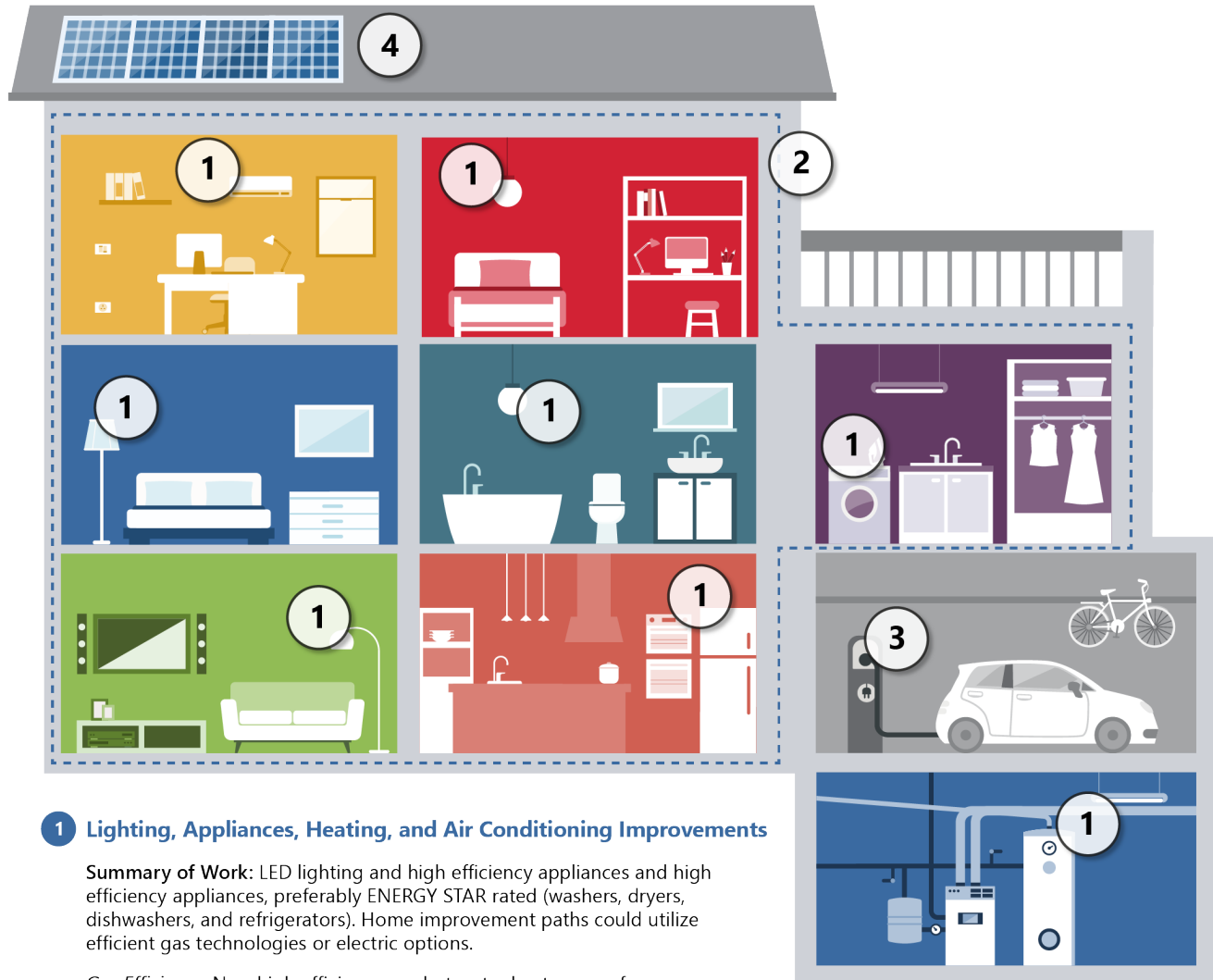
The actions in this goal area will require the participation of the entire community, particularly homeowners and businesses which will need to drive change in county homes, buildings, and ways to move around. Figure 13 below illustrates upgrades for a single-family house that may be completed to improve energy efficiency and use cleaner energy. The graphic also shows the range of investments that might be needed for a household to reduce its GHG emissions in alignment with this Energy Strategy. Since many of the investments included in Figure 13 will be needed anyway throughout regular home and vehicle maintenance (equipment and appliances break, vehicles reach the end of their useful life, etc.), the information in Figure 13 is designed to focus decisions on how to replace the equipment or appliance when it reaches the end of its useful life such that it can contribute to meeting County goals. The investments presented would be made over a timespan as opposed to all at once and for many of the changes (e.g., in the cases of home weatherization or rooftop solar) savings from lower energy bills will likely exceed

the financed cost of the improvements, leading to a net cost-savings for homeowners. All of the cost estimates shown below include the impact of available federal tax credits and rebates. The County may help promote such efforts with homeowner workshops and other public information meetings. See the Appendix for more information on these estimates.

The following sections detail each of the four strategies in Goal Area 3 and outline recommended actions and next steps for the County to take to move toward implementing the Energy Strategy for Goal Area 3. The final two strategies, Strategies 9 and 10, focus on establishing a transparent process to help guide Energy Strategy implementation and ensuring implementation actions consider equity from all angles, including outreach and metrics tracking.

To implement the recommended strategies for Goal Area 3, the County will have to collaborate with internal government departments and external partners like the Department of Housing and Community Development (DHCD), DTCL, Department of Economic Development, the County Equity Officer, the EC, HOAs, Loudoun Chamber of Commerce, the Commonwealth of Virginia, NVRC, MWCOG and various community-based organizations.

Figure 13. How the Energy Strategy Could Apply to a Typical Single Family Home in Loudoun



1 Lighting, Appliances, Heating, and Air Conditioning Improvements

Summary of Work: LED lighting and high efficiency appliances and high efficiency appliances, preferably ENERGY STAR rated (washers, dryers, dishwashers, and refrigerators). Home improvement paths could utilize efficient gas technologies or electric options.

Gas Efficiency: New high efficiency gas hot water heaters, gas furnaces, and boilers

Electrification: New heat pump water heaters and central heat pump systems (replacing existing gas equipment)

Cost Range: \$3,230-\$12,890

Annual Savings Range: \$360-\$1,000/year

2 Home Weatherization

Summary of Work: Improvements to home comfort and energy performance through the sealing of air leaks, and added insulation to doors, windows, roofs, and walls.

Cost Range: \$2,630-\$5,400

Annual Savings Range:
\$1,070-\$1450/year

3 Electric Vehicle and Charger

Summary of Work: Electric vehicles and associated charging equipment.

Cost Range: \$34,500-\$48,500

Annual Savings Range:
\$1,330-\$1,800/year

4 Rooftop Solar

Summary of Work: New solar photovoltaic systems that produce onsite electricity

Cost Range: \$8,580-\$17,150

Annual Savings Range:
\$1,000-\$2,000/year

Note: IRA tax credits are incorporated into the cost estimates, and the lower total costs are associated with rebates and incentives targeted at LMI homeowners.

Strategy 7: Reduce transportation emissions.

- **Action 7.1:** Support the adoption of ZEVs within the county.
- **Action 7.2:** Support electric vehicle charging infrastructure development across the county.
- **Action 7.3:** Reduce the number of car trips and vehicle miles traveled within and in and out of the county.



67% reduction in GHG emissions by 2050 from 2018 from fewer ICEVs on the road and reduced VMT

Milestones

100% sales of ZEVs by 2050

On-road transportation comprised nearly a quarter of total GHG emissions for the county in 2018 and represents an important sector. Reducing on-road transportation emissions is necessary for the County to achieve its vision of contributing to net zero GHG emissions and will benefit from the VCEA mandate for a carbon-free grid, which the County will support under Goal Area 2. The County will act on this strategy by promoting the adoption of ZEVs, expanding EV charging infrastructure, and reducing VMT from passenger vehicles by promoting alternative forms of transport (transit buses, Silver Line metro) and community planning to enhance biking and walkability, particularly around transit centers. With the recent opening of the Silver Line metro and the existing County-run commuter bus system, the County will be considering how to best utilize these assets to reduce VMT. Open land near the metro stations presents opportunities for walkable and bikeable communities and town centers to get residents to not rely as much on their personal vehicles.



In 2023, three Silver Line metro stations opened in Loudoun County.

Helping promote expanded EV charging throughout the County as well as in rural and multi-family, low- and moderate-income housing areas of the community will help ensure equity.

Action 7.1: Support the adoption of ZEVs within the county.

To reduce county GHG emissions, improve local air quality and reduce noise pollution, the County should support the increased sales of ZEVs through education and outreach to residents and businesses about vehicle model availability and federal funding opportunities (e.g., IRA tax credits).

Implementers. DGS will take the lead on this action, working with the EC, local car dealerships, HOAs, and regional partners.

Potential Barriers. EV cost and availability and perception that EVs are only for those with higher incomes.

Next Steps

- Conduct community outreach/education (e.g., ride and drive events).
- Pilot ZEV program or purchases within the county.
- Provide information to the public about tax credits and link to other information sources or clearinghouses (e.g., MWCOG).
- Prioritize parking for ZEVs at Park and Ride Lots and metro garages.

Action 7.2: Support EV charging infrastructure development across the county.

The County will support charging infrastructure development for EVs by pursuing funding opportunities to support public, residential, and workplace charging infrastructure and creating a pilot program for public chargers. This will make chargers more accessible to drivers and help increase EV adoption throughout the county. The County will consider working with the private sector EV supply equipment vendor community to facilitate private sector investment in EV infrastructure.

Implementers. DGS and DTCL, in partnership with HOAs, the Loudoun Chamber of Commerce, Department of Economic Development, electric utilities, local and regional non-profits, and MWCOG (Regional EV Infrastructure Deployment Plan).

Potential Barriers. Lack of accessible EV chargers, especially in rural and multi-family, low- and moderate-income housing areas of the community

Next Steps

- Develop a plan to evaluate potential for public charging access/installation in the county.
- Focus on access for rural areas, multi-family, and low- and moderate-income housing.
- Review funding opportunities to pursue (e.g., IIJA or IRA) Mid-Atlantic EV Partnership grant, U.S. DOT Infrastructure grants, and possibility of a community grant program to fund community EV chargers.



A Loudoun County commuter bus makes it possible for residents to take public transit to work, reducing VMT for personal vehicles.

Action 7.3: Reduce the number of car trips and VMT within and in and out of the county.

The County will consider expanded public transit options, including metro, commuter shuttles, and buses to reduce reliance on personal vehicle travel. Currently, DGS Transit implements and supports commuter and employer options including carpool, vanpool, Employer Smart Benefits, Bike Share, Guaranteed Ride Home program, CarpoolNow, incenTrip, Pool Rewards, Flextime Rewards, and incentives for transit fares through the Commuter Assistance Program. The County will continue these activities and expand them where possible.

Implementers. DTCL and the Department of Economic Development will take the lead on this action with DGS as a supporting partner.

Potential Barriers. Metro and bus schedules that do not align with work and family obligations, lack of flexible scheduling in workplaces, and the critical mass of people needed to make commuting feasible.

Next Steps

- Consider shuttle/connections around the county (e.g., wineries, breweries, farm tours, town centers and metro stations).
- Explore options to expand or optimize Loudoun County Commuter Bus.
- Consider expanded incentives for public transit.

Strategy 8: Reduce residential and commercial building emissions and increase energy efficiency.

- **Action 8.1:** Pursue funding opportunities and partnerships for energy efficiency and electrification.
- **Action 8.2:** Explore programs such as green home certifications for residents and a pilot program with data centers.



52% reduction in GHG emissions from residential buildings and 70% from commercial buildings by 2050 from 2018 levels

Another strategy for reducing GHG emissions in the county is to address residential and commercial buildings. Buildings were responsible for nearly two-thirds of GHG emissions in the county in 2018, over 70% of which was from commercial buildings. Electricity is the largest contributor to the county's energy consumption and GHG emissions, largely due to data center electricity consumption. Residential electricity use and heating fuel also contribute to the county's energy use and emissions. The County can support GHG emission reductions in non-data center commercial buildings and in residential buildings by focusing on improvements in energy efficiency, electrification, and rooftop solar adoption.

The County can take steps to reduce residential and commercial building emissions through Action 8.1, pursuing funding and partnerships for energy efficiency (EE) and electrification. This will provide residents and businesses with the means to lower their building energy use and switch to cleaner fuel sources. Action 8.2 builds upon this by exploring incentive programs, like green home certifications, and pilot programs to implement energy efficient building strategies and test their efficacy. Residents and businesses will not only benefit from the health and environmental impacts of lower emissions, but they will also save money on their energy bills by reducing their energy use.

Action 8.1: Pursue funding opportunities and partnerships for energy efficiency and electrification.

To reduce overall GHG emissions, the County will evaluate and pursue funding opportunities for energy efficiency and electrification in residential and commercial buildings. These financing efforts could include a feasibility study for a green bank and evaluation of available IRA program funds.

Implementers. DGS in collaborating with the Department of Economic Development, the DHCD, and applicable non-profits.

Potential Barriers. Staff time and resources. Consumer awareness,



Spotlight

Since data centers are as visible and important part of the Loudoun County landscape, discussions with Economic Development, the Data Center Coalition, and other commercial facilities on a pilot program to study cleaner alternative fuel sources for County and data center backup diesel generators to reduce GHG emissions from those sources is in its early stages. Furthermore, the county is looking to explore grant opportunities and possible partnerships, for example with the Department of Energy National Renewable Energy Laboratory (NREL) and technology companies.

Next Steps

- Consider green bank feasibility study and learn from regional localities who already have green banks or have studied them.
- Prioritize and pursue IRA funding; develop an aggressive strategy to pursue funding to distribute to the community.
- Continue to access programs to support efficiency and electrification such as the Home Repair Program, Low Income Home Energy Assistance Program, and the Weatherization Assistance Program.

Action 8.2: Explore programs such as green home certifications for residents and a pilot program with data centers.

To reduce building emissions from the residential and commercial sectors, the County can investigate programs that promote green building incentives for homes and commercial buildings, particularly data centers. This effort includes the promotion of and education about sustainable building design and operations to increase energy efficiency. Incentives such as green home certifications can be employed to reward home and building owners for their actions in the form of symbolic and financial benefits.

Implementers. DGS will take the lead on this action with the help of the Department of Economic Development and the Public Affairs and Communications Division. The Data Center



A data center utilizing small-scale distributed solar energy.

Coalition and utilities will also be important stakeholders and partners.

Potential Barriers. Staff time and resources and concerns about sharing proprietary data center operations data.



A typical data center in Loudoun County.

Next Steps

- Explore options to encourage energy efficiency in residential buildings through programs such as green home certifications.
- Continue conversations with Data Center Coalition about opportunities to reduce emissions and understand the impact of current sustainability actions to purchase offsite clean energy.
- Explore partnership with NREL on an innovative study on potential alternative fuels for backup generators.

Strategy 9: Provide education and technical assistance to county residents, businesses, and institutions.

- **Action 9.1:** Provide technical assistance, community events, or training programs for electric vehicles, energy efficiency and weatherization upgrades, building efficiency and electrification technologies, and clean energy.
- **Action 9.2:** Provide a clearinghouse of information to facilitate access to individual funding, tax credits, and incentives (utility, state, and federal programs)
- **Action 9.3:** Establish transparent process to help guide Energy Strategy implementation.

Education is important for county residents, businesses, and institutions to fully realize the vision of this Energy Strategy. Through community outreach, education, and technical assistance, the County will help facilitate reductions in energy usage and GHG emissions from the transportation and building sectors. Widespread understanding of energy efficiency upgrades and electrification retrofit options in the community – and associated funding sources – can result in greater adoption of sustainable technologies and clean energy resources, as well as help residents to lower their energy bills and reduce their emissions footprint. If residents, businesses, and institutions know what they can implement and how, they are more likely to take that step and help the County reach their emissions goals.

To provide these educational and technical assistance tools, Action 9.1 focuses on reaching out to the community to spread knowledge about efficient or electric technologies, equipment, and appliances, as well as opportunities for onsite use of clean energy. Action 9.2 focuses on dissemination of information regarding funding opportunities for these technologies. Finally, Action 9.3 establishes a process to communicate progress on the implementation of the Energy Strategy.



An Environmental Commission meeting.



Spotlight

The Board appointed Environmental Commission plays a key role in community outreach, education, and engagement. The EC has an annual environment and energy awards program and will also hold the first Environment and Energy Public Forum in May 2023.

Action 9.1: Provide technical assistance, community events, or training programs for electric vehicles, energy efficiency and weatherization upgrades, buildings efficiency and electrification technologies, and clean energy.

Reaching out to the community through education and training is a key way to encourage residents and businesses to adopt new behaviors and use new energy efficient equipment and appliances. This action includes hosting roundtables and discussions with key stakeholders, holding webinars for residents focused on funding sources, and hosting trainings on operation and maintenance of EVs and charging stations. These efforts also include expanding marketing for all County transit services and providing specialized public outreach sessions to promote energy efficient habits. The County will work closely with stakeholders and key partners to help design and implement these education and training sessions.

Implementers. DGS will take the lead on this action with help from the EC. Other stakeholders and partners include: DTCl; EC; the Public Affairs and Communications Division; HOAs; Department of Economic Development; Loudoun Chamber of Commerce; non-profits; community organizations and centers; libraries; faith-based organizations; NVRC, and MWCOG.

Potential Barriers. Reaching and engaging a busy public.

Next Steps

- Develop a coordinated community education and outreach plan to support the Energy Strategy.
- Coordinate with the EC for annual public forum to share work of the EC as well as solicit ideas from the public on potential future energy efforts.
- Explore collaboration with a local or regional clean energy market accelerator (e.g., a green bank).
- Review and pursue IRA funding and federal grant options to support technical assistance.
- Expand marketing of transit services and provide a specialized webinar to support sharing of this information.
- Conduct annual environmental excellence awards to celebrate and promote grassroots and business successes in partnership with the EC.
- Conduct annual public forum to solicit public input and engagement on possible energy issues for further consideration by staff and Board in partnership with the EC.

Action 9.2: Provide a clearinghouse of information to facilitate access to individual funding, tax credits, and incentives (utility, state, and federal programs).

The County can promote energy efficient practices by increasing access to funding and incentive opportunities and educating the community about these available resources. As such, the County can develop and maintain a clearinghouse of information, or link to other clearinghouses, to support public outreach and education for stimulating community clean energy action.

Implementers. DGS and the Public Affairs and Communications Division will take the lead on this action. Other stakeholders and partners include the EC; Loudoun Chamber of Commerce, HOAs; Department of Economic Development; non-profits; community organizations; faith-based organizations; NVRC, MWCOG; and utilities.

Potential Barriers. Knowledge of federal funding sources, grant writing assistance, need for fiscal agent other than the County, staff time.

Next Steps

- Develop a website to connect residents and businesses to available tools and data for state and federal funding.
- Include specific information on how to access the IRA funding and incentives.

Action 9.3: Establish transparent process to help guide Energy Strategy implementation.

Another important aspect of community education and awareness in relation to this Energy Strategy is clear and accessible updates from the County that help the community stay up to date and hold officials accountable to emissions reduction goals. Therefore, the County should develop and implement an annual progress report process, conduct regular updates of the public dashboard, create opportunities for public touchpoints and feedback, and develop a steering committee to guide the implementation of the Energy Strategy.

Implementers. DGS, OMAGI, and the Department of Information Technology will take the lead on this action in partnership with the EC and the Public Affairs and Communications Division.

Potential Barriers. Funding for website development, staff to provide oversight, assistance, and updates.

Next Steps

- Establish a steering committee for the Energy Strategy and develop its annual work plan.
- Develop performance measures and metrics for accountability and incorporate Energy Strategy actions into the annual budget process.
- Conduct annual progress reporting on the Energy Strategy.
- Develop a public dashboard and Energy Strategy website.

Strategy 10: Develop a community supported and influenced energy equity work plan.

- **Action 10.1:** Ensure equity across all populations in access to financing, equipment, and programs for ZEVs, energy efficiency retrofit for buildings, and clean energy.
- **Action 10.2:** Track the benefits of the Energy Strategy for disadvantaged communities as a part of regular progress tracking and public reporting.
- **Action 10.3:** Conduct targeted outreach and education through non-traditional partnerships and channels to access and educate the diverse community in Loudoun.

Equity is a key aspect of a successful work plan, as it ensures efficient, widespread execution of actions for the benefit of the entire community, especially underserved and low-income populations. The County will ensure equity is incorporated into their Energy Strategy by following through on Action 10.1, which pertains to access to resources, including funding opportunities. Making these tools readily available will lead into Action 10.2, which focuses on tracking and reporting on the impact of programs on disadvantaged communities. This will help the County monitor progress and maintain accountability. Finally, the County can encourage equitable engagement in this Energy Strategy through Action 10.3, conducting targeted outreach and education. The County can approach communities in a way that communicates knowledge, builds trust, and strengthens equity and the overall impact of this Energy Strategy throughout the county.



Spotlight

The County has a new Office of Equity and Inclusion and recently passed an Equity Resolution. Coordination with the Equity Officer is expected as part of the Energy Strategy.

Action 10.1: Ensure equity across all populations in access to financing, equipment, and programs for ZEVs, efficiency retrofit for buildings, and clean energy.

County resources must be equitably accessible across the entire community for the County to make significant progress toward its goals. By ensuring open, equitable access to financial, physical, and logistical resources, the County can implement this Energy Strategy throughout the region. While this action does not include development or administration of the County equity policy, it does ensure that equity is kept in mind, especially to ensure underserved and low-income communities reap the many benefits of increased energy efficiency and funding opportunities for home retrofits and EVs.

Implementers. DGS and DTIC will take the lead on this action. Other partners and stakeholders include: DHCD; Office of Equity and Inclusion; DFB; the Public Affairs and Communications Division, Department of Economic Development; non-profits; faith-based orgs; community groups; HOAs; and the EC.

Potential Barriers. Assistance with outreach and engagement, staff resources to conduct and manage, funding to conduct actual projects.

Next Steps

- Develop draft energy equity plan with input from County staff and the EC as approved in Environment and Energy Work Plan.
- Meet with stakeholders to understand unmet needs and where funding is most needed, adjust plan as needed.
- Review guidelines for federal definitions of energy equity, identify these populations in the County, and pursue IRA funding.
- Coordinate with development of overall County equity plan.
- Support and partner with existing programs to assist with Low-to-Moderate Income (LMI) housing retrofits (e.g., Habitat for Humanity).
- Promote C-Pace program locally with targeted outreach event to the commercial sector.

Action 10.2: Track the benefits of the Energy Strategy for disadvantaged communities as a part of regular progress tracking and public reporting.

With equity in mind, this Energy Strategy aims to support all members of the Loudoun County community. As such, it is important that the County track the benefits of these various strategies and actions to ensure that they benefit and serve the needs of disadvantaged communities. In accordance with this action, the County will set metrics to reflect data such as the portion of County-supported EV chargers or solar installations that occur in disadvantaged communities. Other metrics may be developed.

Implementers. DGS will take the lead on this action. Other partners and stakeholders include: DHCD; Office of Equity and Inclusion; DFB; the Public Affairs and Communications Division; Department of Economic Development; non-profits; faith-based orgs; community groups; HOAs; and the EC.

Potential Barriers. Need to establish definitions for disadvantaged communities and metrics by which to measure success.



Community hubs like the Brambleton Library are places where Loudoun families meet and can be used as centers for community education and outreach.

Next Steps

- Work with Equity Officer to develop metrics in consultation with community organizations and the general public.
- Develop a plan to collect and convey information per agreed upon metrics.

Action 10.3: Conduct targeted outreach and education through non-traditional partnerships and channels to access and educate the diverse community in Loudoun.

To ensure that all community members benefit equitably from emissions reductions and energy efficiency programs, it is necessary to meet and educate communities where they live and learn. Therefore, the County can approach community stakeholders via faith groups, community organizations, non-profits, and other non-traditional strategies. Not only will this help the County pass critical knowledge to these communities, but it will also build trust and accountability between community stakeholders and the government.

Implementers. DGS and the Public Affairs and Communications Division will take the lead on this action. Other partners and stakeholders include: DHCD; Office of Equity and Inclusion; DFB; Department of Economic Development; non-profits; faith-based orgs; community groups; HOAs; and the EC.

Potential Barriers. Staff time and resources.

Next Steps

- Based on results from actions 10.1 and 10.2, DGS will work with Public Affairs and the County Equity Officer to create an inclusive outreach planning guide.
- Consider the use of partnerships and diverse locations for outreach with faith-based groups as part of their established events.
- Explore the use of non-traditional “pop up” outreach events at farmers markets and other casual community events.



Energy Strategy Implementation

Implementation of this multi-year, multi-stakeholder plan will require support and action from County government, businesses, and residents. The Strategy is written to include actionable information for strategies and their supporting actions, such as key implementers, barriers, and next steps. It is also designed to be used as a blueprint for more detailed planning and eventual implementation. Many of the recommended actions will require additional funding and staff resources. The County must be prepared to lead by example and collaborate with internal and external stakeholders to contribute to achieving Virginia's vision of net zero emissions by 2045 and a carbon-free grid by 2050.

While these efforts will be, and are already starting to be, driven primarily by the DGS, successful execution requires partnership with all County departments, the EC, and the Board of Supervisors. It also requires support from citizens, businesses, institutions, and outside organizations like the Data Center Coalition, utilities, MWCOG, HOAs, and the Chamber of Commerce. Working with these partners, the County must continue to prioritize resources and secure funding, including IJJA and IRA grants, to grow their energy management program and fulfill needs like hiring staff to oversee and implement the Energy Strategy.

As committed to within this Strategy, and to ensure accountability, the County will regularly track progress on implementing the Energy Strategy and publicly share updates on progress.

Over time, as implementation progresses and technologies and policies evolve, the County will also update this 2023 Energy Strategy to reflect accomplishments and new opportunities.

With the support of stakeholders, funding, and a comprehensive Energy Strategy, the County will begin implementing actions and strategies to achieve the goal areas. The County will take immediate next steps to lead by example in government operations, support clean energy development, and stimulate community actions. Initial steps already underway include conducting building energy audits as part of renovation plans, developing specific green building and engineering plans or feasibility assessments, implementing a Board-approved EV charging plan, developing RFPs for various clean energy efforts, beginning discussions on an overall energy equity plan, and developing an energy dashboard for public transparency. After that, next steps will be to build and expand community networks, as well as securing funding. As the County takes these initial steps to enact plans and attract stakeholders, it will continue to engage the community, track, and report progress in partnership with MWCOG, and regularly report progress to the EC and the Board to ensure accountability.

By enacting the Energy Strategy, the County can successfully achieve its emissions reduction goals in an equitable, informed, and cost-effective manner that solidifies the County's position as a regional and national leader in the energy sector and beyond.



Glossary

Action: Each strategy includes multiple actions, or initial steps the County may take to begin implementing the Energy Strategy.

Automated building energy management systems: Building systems where basic operations like lighting and climate control can be automated and programed to consume minimal energy when not in use.

Building energy audit: An assessment that evaluates a building's energy efficiency.

Business as usual: A future scenario in which no additional GHG-reducing actions or policies are implemented beyond those already in place.

Carbon offsets: A purchase made to compensate for, or offset, one's GHG emissions through the reduction or removal of carbon dioxide from the atmosphere.

Electric vehicles: A vehicle that uses an electric motor and draws power from a battery that can be externally charged. Electric vehicles include both plug-in hybrid electric vehicles and all-electric vehicles.

Electrification: The process of using vehicles and appliances powered by electricity instead of those that rely on combustion of fuels to operate. Examples include driving an electric vehicle instead of a gasoline vehicle or using an electric heat pump rather than natural gas furnace for space heating.

Energy efficiency: The process of using less energy to provide the same product or service.

Energy profile: An assessment that quantifies the energy consumption of each sector within a given time period.

ENERGY STAR: An EPA program that distinguishes products, homes, commercial buildings, and industrial plants that meet certain energy efficiency specifications. Those meeting the specifications can display the ENERGY STAR logo.

Geothermal exchange systems: A building climate control system that takes advantage of the relatively constant temperature of the ground to help regulate the temperature inside a building. These systems exchange heat between the building and the ground.

Goal area: The Energy Strategy focuses on three distinct areas for advancement: County government leadership, clean energy development within the county, and action across the community. Goals are defined for each of these areas and strategies and actions are provided for each.

Goal framework: A structure in which the goal areas, strategies, and actions fit within that form the backbone of the Energy Strategy.

Green bank: Banks or other financial entities that use their investments to fund environmental or clean energy projects.

Greenhouse gas: A gas that, when present in the atmosphere, causes the planet to retain heat.

Greenhouse gas inventory: An assessment that quantifies the GHG emissions from each sector within a given time period.

Inflation Reduction Act: A national bill passed in 2022 that provides significant federal funding opportunities for clean energy production, electric vehicles, and GHG-reducing home appliances, among other things.

Infrastructure Investment and Jobs Act: A national bill passed in 2021 that provides significant federal funding opportunities for clean energy and other infrastructure development.

Landfill gases: Gases, mostly methane and carbon dioxide, produced as a result of organic matter breaking down in landfills.

LEED: The U.S. Green Building Council's certification program that rates buildings on their energy efficiency, materials, and other environmental and climate measures. Buildings must meet certain standards to be certified. There are four tiers of certification, listed here from lowest to highest: Certified, Silver, Gold, and Platinum

Net metering: An electricity billing system in which a building's excess rooftop solar is returned to the grid, generating credits that can be applied to the building's electricity bill.

Net zero greenhouse gas emissions: A state where there are no remaining GHG emissions, or where any GHG emissions are completely offset by removal of GHG emissions from the air.

Onsite clean energy resources: Clean energy production at the place where the energy is used. Examples include residential rooftop solar and geothermal exchange systems.

Offsite clean energy resources: Clean energy production that occurs away from the place where the energy is used. Examples include utility-scale solar farms and wind farms.

Power purchase agreement: An arrangement where an energy user signs a contract to buy the energy output from solar and/or wind installation(s) on remote site(s). These projects deliver the electric power to the wholesale market on the electric grid, and the transaction is settled through a financial contract.

Renewable natural gas: A substitute for fossil natural gas. While fossil natural gas is extracted from underground sources, renewable natural gas can come from a variety of sources, including landfill gas, wastewater treatment plants, livestock farms, food production facilities, and organic waste management operations.

Scope 1 emissions: GHG emissions produced directly from sources an organization owns or controls. Examples for the County government include emissions from combusting natural gas for facilities space heating or burning gasoline in the vehicle fleet.

Scope 2 emissions: GHG emissions produced indirectly from generating the electricity that an organization uses. An example for the County government is emissions from coal combustion to produce the electricity that power County facilities.

Strategy: within each goal area, the County has defined overarching strategies that address energy and GHG emissions for different sectors (e.g., buildings, transportation). Strategies also include important considerations that are not specific to a sector and address equity, communication, and transparency.

Virginia Clean Economy Act: A Virginia bill passed in 2020 that established a target of net zero economy-wide GHG emissions by 2045 and requires Virginia's electricity to be 100% clean by 2050.

Virginia Environmental Excellence Program: A voluntary state program managed by the Department of Environmental Quality that encourages and assists facilities and organizations that have strong environmental records to go beyond their legal requirements.

Vision: A guiding statement that describes the County's imagined future and provides objectives for the County to strive to achieve.

Zero-emission vehicles: Vehicles that do not produce any direct exhaust or tailpipe emissions.



Acronyms

AFLEET – Alternative Fuel Life-Cycle Environmental and Economic Transportation

BAU – Business as usual

BEMS – Building energy management system

CIP – Capital improvement program

CNG – Compressed natural gas

DFB – Department of Finance and Budget

DGS – Department of General Services

DHCD – Department of Housing and Community Development

DTCI – Department of Transportation and Capital Infrastructure

EC – Loudoun County Environmental Commission

EPA – Environmental Protection Agency

EUI – Energy use intensity

EV – Electric vehicle, including all-electric vehicles and plug-in hybrid electric vehicles

EVSE – Electric vehicle supply equipment, includes charging infrastructure

GHG – Greenhouse gas

HFC – Hydrofluorocarbon

HOA – Homeowners association

HVAC – Heating, ventilation, and air conditioning

ICEV – Internal combustion engine vehicle

IIJA – Infrastructure Investment and Jobs Act

IRA – Inflation Reduction Act

LEED – Leadership in Energy and Environmental Design

LFG – Landfill gas

LMI – Low to moderate-income

MSW – Municipal solid waste

MWCOG – Metropolitan Washington Council of Governments

NREL – National Renewable Energy Laboratory

NOVA – Northern Virginia

NVRC – Northern Virginia Regional Commission

OMAGI – Office of Mapping and Geographic Information

PHEV – Plug-in hybrid electric vehicle

PPA – Power purchase agreement

PRCS – Parks, Recreation and Community Services

PV – Photovoltaic

RFI – Request for Information

RFP – Request for proposal

RNG – Renewable natural gas

SME – Subject matter expert

VCEA – Virginia Clean Economy Act

VEEP – Virginia Environmental Excellence Program

VMT – Vehicle miles traveled

WMATA – Washington Metropolitan Area Transit Authority

ZEV – Zero-emission vehicle



Technical Appendix

Household Costs

The household costs and savings presented in Section 3.3 estimate what it would cost a homeowner to install equipment that would reduce GHG emissions from their household. The costs are compared to “conventional” equipment, which includes gas-powered and standard-efficiency appliances, incandescent lighting, gas space heating, existing building envelopes with leaks and gaps, and gasoline vehicles. Households can upgrade their homes by installing efficient or electrified appliances, LED lighting, and heat pump space cooling and heating, weatherizing their homes, installing rooftop solar panels, or purchasing an electric vehicle and home charger. In general ENERGY STAR equipment replacements, where applicable,

were considered for all upgrades outlined below. Equipment upgrade options are listed in Table A1.

The upfront costs of conventional equipment are typically lower than those of upgraded equipment. However, the IRA will offer homeowners rebates and tax credits for many of the upgraded equipment items. Utilities may also have rebate programs that offer incentives for purchasing upgraded equipment. Table A2 lists incentives that are currently available or will become available soon. Note that many of the rebate and tax credit programs from the IRA are not yet established, but they are expected to become available in 2023. Values for those programs were estimated in this Appendix.

Table A1. Equipment upgrade options to replace conventional equipment

Conventional Equipment	Upgraded Replacement
Gas furnace	Efficient electric heat pump or efficient gas furnace
Air conditioner	Efficient electric heat pump
Gas water heater	Heat pump water heater or efficient gas water heater
Gas stove	Electric (or induction) stove or efficient gas stove
Clothes washer	Efficient clothes washer
Gas clothes dryer	Heat pump dryer or efficient gas dryer
Refrigerator	Efficient refrigerator
Dishwasher	Efficient dishwasher
Incandescent lighting	LED lighting
Existing building envelope	Weatherized building envelope
No rooftop solar	Rooftop solar
Gasoline vehicle	Electric vehicle (with home charger)

Table A2. Incentive availability and sources for various home energy improvements

Equipment Type	Rebate Available	Tax Credit Available	Funding Source
Gas Furnace	✓		Utility Rebate Program
Air Conditioner			
Heat Pump	✓*	✓	IRA, Utility Rebate Program
Gas Water Heater	✓		Utility Rebate Program
Heat Pump Water Heater	✓*	✓	IRA, Utility Rebate Program
Gas Stove			
Electric/Induction Stoves	✓*		IRA
Clothes Washer			
Gas Clothes Dryer			
Heat Pump Clothes Dryer	✓*		IRA
Refrigerator			
Dish Washer			
LED Lighting	✓		Utility Rebate Program
Weatherization	✓*	✓	IRA, Utility Rebate Program
Residential Rooftop Solar		✓	IRA
Electric Vehicle		✓*	IRA
EV Charger		✓	IRA

*Rebate is income dependent.

After the incentives are applied, the upfront costs of upgraded equipment can be lower than that of conventional equipment, depending on the combination of upgraded items the homeowner purchases and the homeowner's income level.

The upgraded equipment is divided into five categories: efficiency improvements, electrification improvements, weatherization, rooftop solar, and EV charger and new EV. The categories include the following equipment:

- **Efficiency Improvements:** More efficient versions of conventional lighting, appliances, and HVAC. These items use the same fuel sources as conventional lighting, appliances, and HVAC.

- **Electrification Improvements:** Electrified versions of appliances, and HVAC, or more efficient versions if the equipment is already electric.
- **Weatherization:** Improvements to the efficiency of the building envelope through insulation, weatherization, and sealing.
- **Rooftop Solar:** Rooftop solar panels.
- **EV Charger and New EV:** At-home EV charger and new EV.

Table A3 compares the upfront cost ranges of conventional equipment to upgraded equipment, with incentives included.

Table A3. Capital cost ranges for various improvement categories, with incentives included

Conventional Equipment					
	Lighting, Appliances, and HVAC		Gasoline Vehicle		
Cost Range	\$7,710-\$9,660		\$24,000-\$29,750		
Upgraded Equipment					
	Efficiency Improvements	Electrification Improvements	Weatherization	Rooftop Solar	EV Charger and New EV
LMI Cost Range	\$9,530-\$12,890	\$3,230-\$7,970	\$2,630-\$3,560	\$8,580-\$17,150	\$34,500-\$53,850
Total Cost Range	\$9,530-\$12,890	\$3,230-\$10,360	\$2,630-\$5,400	\$8,580-\$17,150	\$34,500-\$53,850

Costs may reflect national averages or may vary based on equipment specifications. Costs include maximum incentives.

Independent of upfront cost, upgraded equipment leads to annual savings in energy because it is more efficient than conventional equipment. Improvement in efficiency means the upgraded equipment can provide the same services as conventional equipment but use less energy to do so. Lower natural gas, electricity, and gasoline consumption each year leads to lower natural gas and electric bills each year and less spent at the pump. These savings can eventually pay off any increase in upfront costs to purchase upgraded equipment. Table A4 lists the estimated annual savings each improvement category would generate.

Savings are realized in the following ways:

- **Efficiency Improvements:** Improvement in efficiency means the upgraded equipment can provide the same services as conventional equipment but use less energy to do so. Lower natural gas and electricity consumption each year leads to lower natural gas and electricity bills each year.
- **Electrification Improvements:** Electrifying equipment gets rid of natural gas consumption and the entire natural gas bill. Although this does increase a homeowner's

electric bills, savings from natural gas reductions offset that increase. This is because electrified equipment is also more efficient than gas-powered equipment.

- **Weatherization:** Upgrading the building envelope keeps thermal energy inside the household and helps reduce the need for HVAC equipment to operate. A more efficient building envelope will do a better job preventing warm air in the winter and cold air in the summer from escaping outside, reducing the natural gas and electricity needed to maintain temperature and keep the space comfortable.
- **Rooftop solar:** Installing rooftop solar reduces the amount of electricity purchased from the utility, reducing the homeowner's electric bill.
- **EV Charger and New EV:** Electric vehicles are more efficient than gasoline-powered vehicles, requiring less energy to drive the same distance. They also generally require less maintenance each year. As a result, switching from a gasoline-powered vehicle to an electric vehicle saves money each year.

Table A4. Annual savings ranges for each improvement category

Efficiency Improvements	Electrification Improvements	Weatherization	Rooftop Solar	EV Charger and New EV
Without weatherization: \$360-\$840/year With weatherization: \$740-\$1,000/year	Without weatherization: \$680-\$920/year With weatherization: \$740-\$1,000/year	Without efficiency or electrification improvements: \$1,050-\$1,430	\$843-\$1,685/year	EV only: \$1,340-\$1,820/year

Top Ten County Facilities Costs

The ten County-owned facilities that consumed the most energy in 2021 are the following:

1. Loudoun Adult Detention Center
2. Claude Moore Recreation & Community Center
3. Dulles South Recreation and Community Center
4. Loudoun County Department of General Services Administrative Office
5. Loudoun General District Court
6. Loudoun County Sheriff's Office Administration Building
7. Loudoun County Government Center
8. Loudoun County Info Technology Office
9. Shenandoah Building
10. Loudoun County Parks, Recreation, & Community Services Administration Office

There are several energy efficiency measures the County can implement to reduce the energy consumption of these facilities. These energy efficiency measures include, but are not limited to, LED lighting, heating, and cooling retrofits, installing HVAC controls, electrification, and building envelope retrofits. The County has already begun implementing some of these measures on select facilities.

Total cost estimates to complete the implementation across all the top ten facilities are listed in Table A5. Once implemented, these measures will lead to savings that were not calculated as a part of this study. The costs listed in Table A5 are broad estimates based on the

square footage of each facility and are intended to function as starting estimates. The costs were determined by applying dollar per square footage estimates for the conservation measures from the National Renewable Energy Laboratory, U.S. Department of Energy, Lawrence Berkeley National Laboratory, Pacific Northwest National Laboratory, and Center for Energy and Environment. The costs do not reflect any incentives that may be available. The LED lighting, electrification, and building envelope retrofit measures may be impacted by incentives available through the IRA and other funding sources. These costs are representative of today's dollars and do not consider declines in cost over time. They are not indicative of the County's budget to implement the retrofits. Energy audits of these facilities will reflect more specific and accurate needs, costs, and potential savings for the County.

Table A5. Total implementation costs by conservation measure for the top ten County facilities

Conservation Measure	Estimated Implementation Cost (\$)
LED lighting	\$1,600,000
Heating retrofit	\$260,000
Cooling retrofit	\$440,000
HVAC controls	\$2,700,000
Electrification	\$2,500,000
Building envelope retrofit	\$190,000
Total	\$7,700,000

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GHG Emissions Modeling Methodology

This section provides an overview of the methodology for modeling BAU and strategy scenario energy consumption and emissions for the community and County government operations. The methodology will be described for each sector that was modeled. For the community and County, modeling began by compiling a GHG inventory as a baseline for the projections. The County and MWCOG provided base year data. BAU projections were based on forecasted growth in population, construction, and other activity. Strategy projections incorporated several ways to reduce energy consumption and/or emissions compared to the BAU.

Community BAU

Community BAU modeling was conducted starting from GHG inventories completed by MWCOG for historical years, including 2005, 2018 and 2020. The underlying activity, energy consumption and emissions data provided by MWCOG formed the foundation for the projection analysis through 2050. For the BAU scenario, each sector was projected based on either MWCOG forecasts, expected growth in key metrics such as population or building square footage, or based on historical trends in emissions. The following section outlines the projection methodology for each sector.

Transportation

Transportation BAU projections were based off modeling previously completed by MWCOG out through 2045 using the EPA MOVES model. MWCOG provided estimates of VMT and vehicle population by vehicle category for 2018, 2030, and 2045, and GHG estimates for 2018, 2020, 2030, and 2045. 2020 estimates for VMT and population by vehicle category were derived using 2020 totals provided by MWCOG. Energy consumption by vehicle and fuel type was estimated using implied fuel economies from the EPA MOVES3 model.

GHG emissions from the off-road and aviation subsections were projected by applying the county's forecasted population growth rate through 2050 (provided by MWCOG) to the MWCOG 2020 inventory data.

Buildings

Changes in building energy consumption were projected based on data for new residential households and commercial square footage provided by MWCOG. Energy consumption in existing buildings was held flat, and calculated energy consumption from new facilities were added to it. Energy consumption for new residential and commercial buildings was calculated based on the 2018 annual energy consumption per household or commercial square foot, known as energy use intensity (EUI), with efficiency savings layered on top based on an assumption of 85% of new construction following stricter energy codes. No heating oil or propane consumption was assumed in new construction.

Waste

MWCOG provided emission estimates from wastewater and landfilled municipal solid waste for the 2020 GHG inventory year. Emissions

through 2050 based on the county's population growth rate for 2020-2050.

Agriculture

GHG emissions from agriculture were projected using the historical annual average rate of change in emissions based on MWCOG inventory data from 2005 to 2020. Emission projections were extrapolated to 2050 based on annual growth rates of -2.1%, -1.9%, and -1.1% for enteric fermentation, manure management, and agricultural soils emissions, respectively.

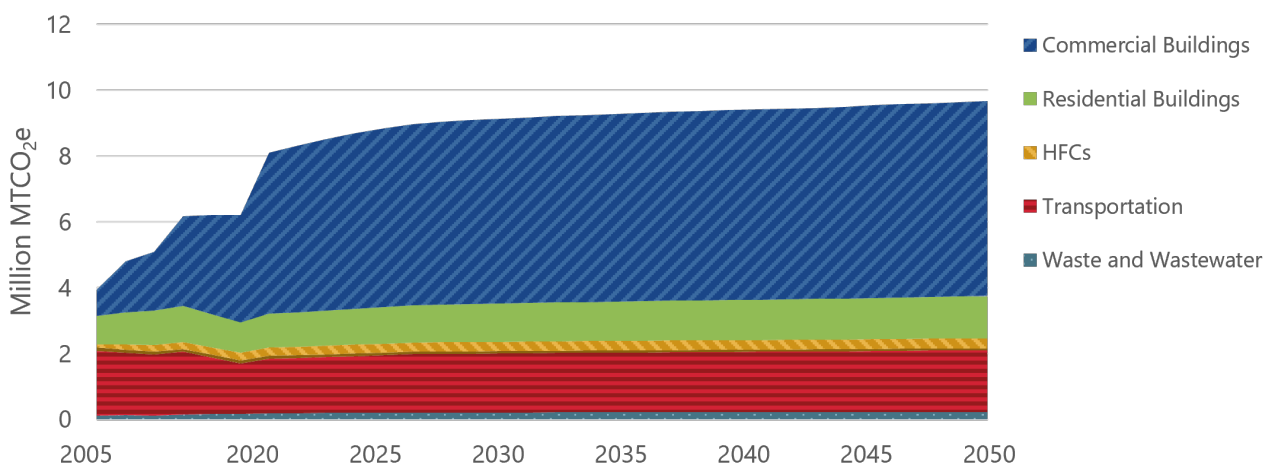
HFCs

HFC emissions in 2020 were derived as a proportion of total HFC usage found in EPA's Inventory of U.S. GHG Emissions and Sinks¹⁴ and Loudoun's population in relation to the total U.S. population. They were projected through 2050 using population forecasts.

Natural Gas Fugitive

Natural gas fugitive emissions were calculated by applying a natural gas leakage rate to the natural gas consumption in the buildings and transportation sectors. The leakage rate was derived from 2020 natural gas fugitive emissions estimates from MWCOG and natural gas consumption in those years.

Figure A1. Community BAU Scenario GHG Emissions, 2005-2050



Note: Agriculture and natural gas fugitive emissions are too small to visualize at this scale.

¹⁴ U.S. Environmental Protection Agency. 2022. "Inventory of U.S. GHG Emissions and Sinks – 1990-2021". Available at <https://www.epa.gov/system/files/documents/2022-04/us-ghg-inventory-2022-main-text.pdf>

Electricity

Electricity emission factors were sourced from EPA's Emissions & Generation Resource Integrated Database (eGRID)¹⁵ database for the Virginia region and then held constant at the 2020 rate to demonstrate emissions growth without changes to the generation supply (e.g., no incremental clean energy additions).

Community Strategy Scenarios

Community strategy scenarios applied various emission reduction strategies such as building energy efficiency and electrification, vehicle electrification and reduction in miles driven, and solid waste reduction to the BAU projections. The following section outlines the projection methodology for each sector.

Transportation

For Strategy 7, EVs were modeled to be phased in such that 100% of vehicle sales are electric in 2050. On-road VMT, population, energy consumption, and emissions were modeled using CO₂Sight. The impacts of passenger vehicle VMT reduction of 10% by 2030 and 14% by 2050 were also modeled.

Buildings

Strategy 8 modeling included both existing and new buildings. Energy efficiency and electrification in existing residential and commercial (non-data center) buildings were modeled through 2050 using CO₂Sight, ICF's decarbonization platform. Fuel oil and propane in existing buildings were modeled to be electrified at a rate of 10% by 2030 and 100% by 2045. Residential rooftop solar installations were modeled to reach 5% and 10% of technical potential in 2030 and 2050, respectively. The technical potential was found using GIS mapping of residential rooftops.

New buildings were assumed to be 5% more efficient than existing buildings in the BAU scenario due to stricter building codes through

2050. In addition, new construction was assumed to be 95% electric starting in 2022.

Waste

Goals of 10% and 70% solid waste reduction by 2030 and 2050, respectively, were applied to the BAU solid waste estimates.

Natural Gas Fugitive

Natural gas fugitive emissions were again calculated by applying a natural gas leakage rate to the natural gas consumption in the buildings and transportation sectors after strategies were modeled.

Electricity

The strategy scenario electricity emission factor includes VCEA power sector decarbonization requirements.

Government Operations BAU

Government operations BAU modeling was conducted starting from the County's 2021 energy consumption and waste disposal data, which formed the foundation for the projection analysis through 2050. For the BAU scenario, each sector was projected based on expected growth in key metrics such as population or facility square footage or based on expected technology improvements. The following section outlines the projection methodology for each sector.

Electricity

Electricity emission factors were sourced from EPA's Emissions & Generation Resource Integrated Database (eGRID)¹⁶ database for the Virginia region and then held constant at the 2020 rate to demonstrate emissions growth without changes to the generation supply (e.g., no incremental clean energy additions).

¹⁵ U.S. Environmental Protection Agency. 2022. "Historical eGRID Data". Available at <https://www.epa.gov/egrid/historical-egrid-data>

¹⁶ U.S. Environmental Protection Agency. 2022. "Historical eGRID Data". Available at <https://www.epa.gov/egrid/historical-egrid-data>

County Facilities

The County provided 2021 electricity, natural gas, and propane consumption for its facilities and its plans for construction of facilities through 2029. Energy consumption in existing facilities was held flat, and calculated energy consumption from new construction was based on the EUI for Virginia buildings from the ASHRAE 90.1 2016¹⁷ building code. No propane consumption was assumed in new construction. New construction after 2029 was based on population growth.

County Fleet

The County provided VMT, fuel consumption, and vehicle types for its 2021 fleet. Annual fleet VMT was held flat through 2050, and fuel economy was assumed to improve over time. The BAU did not account for any near-term EV procurement plans for administrative vehicles.

County Landfill

The County provided data for quantity of solid waste buried in its landfill. The tonnage of waste

buried in the landfill was assumed to increase based on population growth.

Government Operations Strategy Scenarios

Strategy modeling for government operations applied various emission reduction strategies such as building energy efficiency and electrification, vehicle electrification, and solid waste reduction to the BAU projections. The following section outlines the projection methodology for each sector.

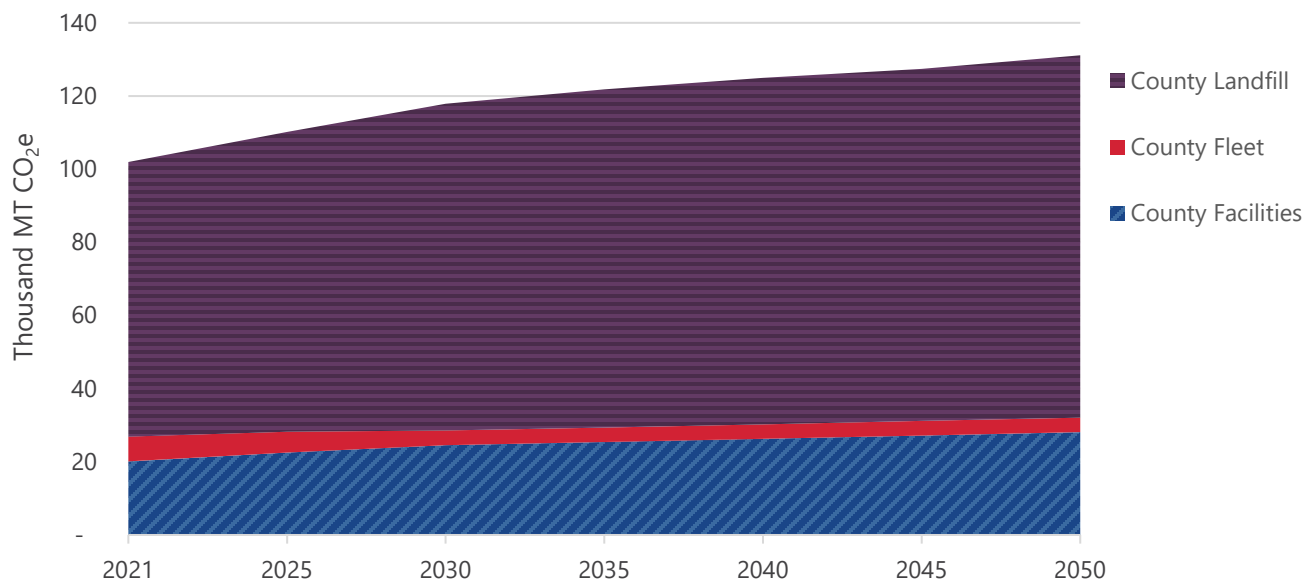
Electricity

The mitigation scenario electricity emission factor reduces electricity emissions to zero by 2030, aligning with Strategy 1.

County Facilities

For Strategy 2 modeling, the 2021 energy consumption in County facilities was broken down to different end-uses (e.g., heating, air conditioning, lighting, etc.) using the proportions given in the EIA Commercial Buildings Energy Consumption Survey

Figure A2. County Government Operations BAU Scenario GHG Emissions, 2021-2050



¹⁷ U.S. Department of Energy. (n.d.). Building Energy Codes Program ANSI/ASHRAE/IES Standard 90.1. Available at <https://www.energycodes.gov/prototype-building-models>

(CBECS)¹⁸. Facilities were determined to be eligible for LED lighting, HVAC retrofits and controls, and/or electrification based on services provided and fuels consumed. HVAC retrofits and controls, and electrification were modeled to occur after building envelope retrofits. Roughly one-third of natural gas and propane use was switched to RNG at a rate of 10% in 2030 and 100% in 2045, rather than electrified.

County Fleet

As part of Strategy 3, EVs were modeled to be phased in from 2025 through 2050, with EVs replacing internal combustion engine (ICE)

vehicles at the time of purchase. The number of EVs replacing conventional vehicles was determined by sales targets to arrive at a 100% EV fleet by 2050 following the County's normal vehicle purchase schedule. Fuel economy of remaining ICE vehicles was assumed to increase over time. EV fuel economies were retrieved from the AFLEET 2020 Tool¹⁹.

County Landfill

For Strategy 4, goals of 10% and 70% solid waste reduction by 2030 and 2050, respectively, were applied to the BAU solid waste estimates.



A rendering of the LEED Gold certified Loudoun County Youth Shelter, which is an energy efficient building powered by a geothermal exchange system and on-site solar panels.

¹⁸ U.S. Energy Information Administration (EIA). 2016. "Commercial Buildings Energy Consumption Survey (CBECS) 2012 Survey Data, Tables E5 and E7". Available at <https://www.eia.gov/consumption/commercial/data/2012/index.php?view=consumption>

¹⁹ Argonne National Laboratory (ANL). 2021. *Alternative Fuel Life-Cycle Environmental and Economic Transportation (AFLEET) Tool 2020*. Available at https://greet.es.anl.gov/afleet_tool