Integrated Energy Management Plan

Loudoun County, Virginia

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Prepared by:

Halcrow

with

Levidy**Adams** | HOK | BBP, LLC

Executive Summary

Loudoun County and the Claude Moore Charitable Foundation have a unique opportunity to make a significant, positive impact at Moorefield Station and throughout the county by:

- Delivering renewable energy for more than 3,250 homes
- Reducing Moorefield Station's projected GHG emissions by 28%
- Avoiding $40 million in county capital costs
- Diverting 87,000 tons of solid waste annually
- Marketing Moorefield Station as a unique, sustainable development

The energy and power market is changing like at no other time in the past 50 years. Advancements and developments in clean energy, distributed generation, smart appliances, smart grid, electric vehicles, power generation, data centers and utility programs are all beginning to converge and drive significant change in the electric grid, utilities and consumer desires. Energy is now viewed as integrated with multiple resource and infrastructure areas such as transportation, water and waste.

Loudoun County and future county development is further impacted by these energy issues due to the prevalence of data centers, proximity of Washington D.C. and expected growth in the area. To navigate and optimize these energy related issues, the county is using a unique partnership between the county government and the Claude Moore Charitable Foundation (Claude Moore Foundation) to lead the development of an Integrated Energy Management Plan (IEMP or Plan). Both the county and the Claude Moore Foundation are committed to sustainable development with a positive social impact.

The IEMP provides an energy and sustainable infrastructure framework to guide future development within the county. Initially, the IEMP will be applied to the Moorefield Station development located at the terminus of the "Dulles Silver Line" Metro rail station. The county intends to use the IEMP as a model for future developments and integrate the recommendations with the county's policies, economic development and community outreach efforts, where applicable.

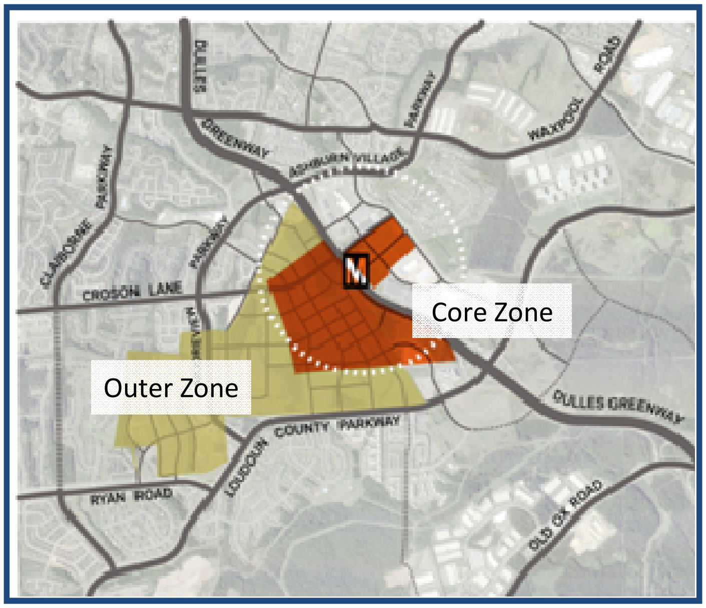
As a result of developing the IEMP, Loudoun County has a tremendous and unique opportunity to implement multiple, impactful projects, enhance economic development and create a market leading program within Moorefield Station. The key outcomes and recommendations of the IEMP include:

- A 10MW renewable energy power plant
- A non-potable water system to reduce water consumption and peak demands
- The zero energy/water/waste (ZEW^2) district and long -term business partnership program for Moorefield Station
- An opportunity to install 500kW or more of solar photovoltaic (PV) panels at Moorefield Station
- Dramatic reduction in Greenhouse Gas (GHG) emissions
- Significant reduction in county capital and operational expenses
- Ongoing stakeholder engagement in the community
- A more energy efficient and sustainable Moorefield Station

The major components of this unique and impactful opportunity for Loudoun County and Moorefield Station are summarized in the following pages with further detail provided in the full IEMP Report.

Moorefield Station

The IEMP will initially apply and be tailored to the Moorefield Station development. In the future, the county will apply the IEMP to other developments with the lessons learned at Moorefield Station. The Claude Moore Foundation currently owns the property and is managing the development processes. The zoning plans for the development are completed with the Claude Moore Foundation selling parcels of land for development as market conditions permit. Because the Claude Moore Foundation is a non-profit organization, it can also be more selective and patient in how and when the property is developed. This provides a unique opportunity to ensure a more sustainably developed Moorefield Station.



Moorefield Station is a 600-acre greenfield development that is just entering the initial stages of construction and development. Significant development at the site is not expected until approximately 2015 to 2017 depending on economic conditions and the extension of the Washington D.C. area light rail commuter train system. The Moorefield Station master plan is a transit- oriented, mixed- use development designed to be flexible with varying densities dependent on the type of public transportation service available and specific area of the development. Moorefield Station sits in a unique location, bordering the Dulles Greenway, near a power and natural gas infrastructure, and adjacent to Dulles Airport, data centers, Ashburn Technical Park, a Verizon campus and a Loudoun Water waste water treatment plant.

The development can be described as containing two distinctly different areas: the Core Zone and Outer Zone. The Core Zone is a higher density development, mixed-use, pedestrian centric or 'pedestrian shed' intended to be a true town center that happens to have excellent connections to the Metro system and other parts of the region. The Outer Zone is a transit supporting area with less dense development including residential development connected to the Core via bicycle and pedestrian linkages in addition to more traditional transit options.

IEMP Framework

A robust stakeholder engagement program was woven throughout the development, implementation and monitoring of the IEMP to ensure the success and wider adoption of the IEMP. This engagement plan included three key components:

- Internal IEMP Team to build county capacity and expertise
- External Advisory Panel to provide community feedback on the Plan
- Ongoing communication and reporting tools to monitor and communicate progress

The internal IEMP Team included key county subject matter experts and served as the core team for the creation of the IEMP components. The IEMP Team is comprised of a cross functional team made up of county staff and the Claude Moore Foundation. Outreach to external stakeholders started early in the planning process, with a team composed of the representatives from the following organizations:

- Claude Moore Foundation
- Comstock Partners
- Digital Realty Trust
- Dominion Virginia Power
- Dulles Greenway
- Loudoun Water
- Loudoun Chamber of Commerce
- Loudoun Public Schools
- MWAA
- Virginia Department of Transportation
- Verizon
- Washington Gas

The external Advisory Panel provided critical and periodic feedback on the IEMP, identified initial partnership opportunities and helped to build endorsement of the plan. As the project ends, the intent is for the Advisory Panel to continue its role and remain engaged in the project, longer-term implementation and public / private partnership opportunities.

In developing the key elements of the IEMP, the team took a broader approach and view of the IEMP and energy, rather than solely focusing on power or electricity industry specific opportunities. This approach allowed the identification of more potential projects and initiatives that led to a greater sustainability impact. For example, the IEMP identified unique opportunities for Loudoun County and Moorefield Station to make a difference in energy, waste and water performance due to potential partnerships between the Claude Moore foundation, Dominion Power, Loudoun Water and the County.

IEMP Key Elements: Mission

There are four key elements to the IEMP. The first is the overarching mission of the IEMP which guides and acts as a filter for decision making. The remaining elements include the project or programmatic related elements where the Plan is implemented and managed: the Focus Areas, Nexus Projects and Flagship Program.

The IEMP integrates and aligns with the broader County Energy Strategy (CES) which includes a vision for the county to *have reliable and affordable energy, be energy efficient and reduce greenhouse gas emissions*. As developed as a part of the Plan, the IEMP mission reflects this alignment with the CES and focuses directly on developments within the county. The IEMP Mission seeks to leverage the unique aspects of Loudoun County to drive economic development and more sustainable communities.

IEMP Mission:

Moorefield Station – harnessing the power of human creativity, economic prosperity and energy innovation to be ***The Nexus of the World's 21st Century Community.***

In the mission, there are two key terms which were carefully selected as key talking points to expand: Nexus and Prosperity. Nexus captures key differentiating components of Moorefield Station:

- Moorefield Station is a hub, impacting, influencing and facilitating interaction between people, infrastructure, markets and information
- Moorefield Station is the information technology, fiber optic and data hub of the US and world
- Moorefield Station will optimize the nexus of energy – water – transportation – waste – land use

Prosperity represents the triple bottom line basis of the approach to the IEMP, and encompasses the following aspects:

- People – Social/human components including education
- Planet – Environment
- Profit – Economic development

IEMP Key Elements: Focus Areas, Nexus Projects and Flagship Program

The remaining three elements of the Plan include the project or programmatic related components where the Plan is implemented and managed:

- Nexus Projects: Scale or large capital alternative energy / sustainable project(s) that cuts across and supports multiple Focus Areas and goals
- Flagship Program: A flexible community and business partnership program to pilot innovative programs, technologies or projects that cut across and support multiple Focus Areas and goals
- Focus Areas: Water, Energy, Transportation, Land Use and Waste

Once the mission was developed, it was then divided into five specific Focus Areas to effectively manage the implementation and monitoring of progress. Each Focus Area contains specific goals and programs to support the IEMP mission. While the mission acts as the overall guide for decision making, the Plan's most tactical programs are physically managed within the five specific Focus Areas of the Plan. A full list of the programs prioritized in each Focus Area is included in the full IEMP report.

One of the vital components targeted in the IEMP was some type of scale or large capital alternative energy or sustainable project and program that acts as a 'beacon' or sets a new standard for future national and international developments. These scale or large capital projects were dubbed the Nexus Projects to offer the proof of the Nexus component of the mission and leverage the energy – water – waste – transportation – land use nexus opportunities in the county or Moorefield Station.

In addition, a Flagship Program was developed to act as the beacon for other communities to follow in pursuit of more innovative and sustainable partnerships and developments. The Flagship program is structured as a flexible partnership with community organizations, local businesses and Moorefield Station that leads to innovative programs and projects that are piloted at Moorefield Station. Both the Nexus Projects and Flagship Program were elevated from the individual Focus Areas, as they are cross-cutting in nature, supporting multiple Focus Areas and goals. The Nexus Projects and Flagship Program help to directly prove the mission and should act as the marquee symbols of the IEMP.

IEMP Key Findings and Recommendations

In order to fully evaluate, prioritize and refine the project and program options available and recommend projects for the IEMP, several quantitative and qualitative tools were used. These included a business as usual (BAU) GHG emission model, program screening tool, financial and environmental pro forma model and three risk assessment frameworks. These tools integrated the overall goals of the IEMP and CES of reduced GHG emissions, renewable energy generation, energy efficiency and innovative nexus opportunities.

The first step in the detailed evaluation included the creation of the BAU GHG model. This created a baseline projection for Moorefield Station's building related GHG emission over a period of 30 years. This baseline provides a benchmark to compare GHG emission reducing projects and their potential reduction to Moorefield Station's currently projected emissions.

The next step included the program scoring tool to prioritize and evaluate the full project inventory and identify five Nexus Project opportunities and the Flagship Program. These five Nexus Projects were further evaluated using the financial and environmental pro forma model to recommend two of the five projects for implementation. Finally, additional risk assessments were performed on each of the Nexus Projects to further identify any potential gaps or risks to implementation and develop mitigation strategies to include in the implementation plan.

Throughout the evaluation process, the results were presented to the Advisory Panel for feedback and suggested partnership opportunities. This feedback and suggested partnerships were further evaluated and eventually included in the recommended implementation plan. A summary of the Nexus Project and Flagship Program recommendations is included below followed by a complete list of key findings and recommendations from the IEMP.

Nexus Projects

The results of screening and prioritizing the full inventory of project and program options resulted in the identification of five Nexus Projects for further evaluation.

- 25 MW conventional, natural gas fired combined heat and power plant
- 10 MW biomass power plant
- 10 MW refuse derived fuel power plant
- Non-potable water system integrated with Moorefield Station stormwater ponds
- Improved energy and sustainable building code for Moorefield Station

Each of the five projects was evaluated using the financial and environmental pro forma model. This created a projection of financial and environmental performance to compare the Nexus Projects and allow for scenario analysis. The pro forma calculated key metrics for comparison including: average cost of energy generated, annual emissions reductions, renewable energy generated and value of solid waste diversion.

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The results of the pro forma model were used to recommend the highest performing Nexus Projects for implementation:

Recommended Nexus Projects

Project	Avg. Cost of Electricity ($/kWh)[1]	Current Cost of Electricity ($/kWh)[2]	Avg. Cost of Delivered Water ($/1,000gal)	Current Cost of Delivered Water ($/1,000gal)	GHG Emission Reductions (mT CO_2e/Yr)
10MW RDF Power Plant	$0.037	$0.07	N/A	N/A	38,648
Non-potable Water System	N/A	N/A	$3.68	$5.31 - $7.12[3]	NA[4]

1. Costs do not include transmission and distribution costs from Dominion Power of approximately $0.03 per kWh.
2. Approximate cost of transmission and distribution ($0.03 per kWh) removed from average rates of $0.10 per kWh.
3. Loudoun Water currently has three tiers to their residential rates: the 2nd and 3rd tiers are similar to the non-potable water system usage. $5.31/000gal for 25,000-50,000gal per quarter and $7.12/000gal for 50,000gal+
4. GHG emission reductions related to energy consumption for water treatment are unavailable at this time.

The RDF power plant addresses a nexus of energy, waste and land use issues and offers multiple environmental and financial benefits including:

- Inexpensive source of renewable energy at an estimated $0.037 per kWh generated
- 87,000 tons per year of municipal solid waste diverted from the landfill for beneficial use
- Seven year extension of the life of the landfill
- $40 million net present value (NPV) avoided capital costs related to the landfill expansion
- 28 percent reduction in the total annual Moorefield Station GHG emissions

Refuse Derived Power Plant

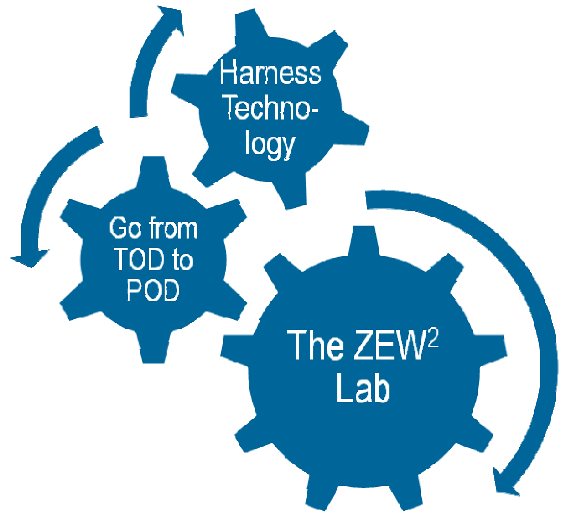
The RDF plant utilizes the county landfill and waste generated in the county as a biomass fuel in a plasma arc gasification power plant. The plasma arc vaporizes refuse material in an enclosed vessel to create steam and a syngas that are combusted and used to generate electrical power in turbine generators. Plasma arc technology was chosen for its projected financial and environmental performance including minimal emissions. In addition to plasma arc, there are alternative RDF power plant technologies proven to deliver much cleaner and lower emission power than past conventional RDF facilities, and the potential to increase recycling rates in the county.

Non-potable Water System

The non-potable water system harvests and treats water collected in the Moorefield Station stormwater ponds to provide local, low cost non-potable water for localized irrigation or building mechanical cooling needs. The system addresses the nexus of water and energy. By reducing the potable water demand of Moorefield Station, it reduces peak water demands, operating costs, chemical use and energy consumption by Loudoun Water and Moorefield Station.

As the recommended implementation plans for the RDF power plant and non-potable water system were developed, initial partners for the projects were identified. These preliminary partnership and implementation discussions further reinforced the benefits and financial feasibility presented by the projects.

ZEW^2 Lab Flagship Program



Through the course of the Plan development and confirmed by Advisory Panel feedback, it became clear a compelling community engagement and innovative technology testing program was needed for Moorefield Station. The program scoring and prioritization tool initially identified several more tactical programs that were combined to create this innovative program. This combined program became known as the zero energy, water and waste (ZEW^2) Lab Flagship Program.

The ZEW^2 Lab Flagship Program provides the mechanisms to engage partners and apply innovative technologies that support zero energy/waste/water in the Core Zone of Moorefield Station. The ZEW^2 Lab will act as a beacon for other communities and developments to follow and serve to prove the mission statement. There are two hallmarks used to coordinate and manage the supporting components, partnerships and programs for the ZEW^2 Lab.

- Hallmark 1 includes technology and infrastructure related components such as piloting new technologies or partnerships, smart grid and reclaimed water supply / re-use.
- Hallmark 2 includes components and projects to move beyond transit-oriented development to people oriented development or "TOD" to "POD." Elements include: Innovative parking solutions and new strategies, neighborhood distribution point and urban agriculture.

One of the keys of the ZEW^2 Lab is to provide the main framework to engage, manage and implement innovative infrastructure and technology partnerships at Moorefield Station. Through the development of the IEMP and the Advisory Panel meetings, several initial partnership opportunities for the ZEW^2 Lab were identified and initially developed as a part of the implementation plan.

The Nexus Projects and ZEW^2 Flagship Program Result in:

- Developing a 10MW renewable, RDF power plant generating low cost electricity
- Delivering enough renewable energy to power more than 3,250 homes in Loudoun County
- Reducing 38,700 metric tons of GHG emission annually; offsetting 28% of projected Moorefield Station annual emissions
- Diverting 87,300 tons of solid waste annually from the county landfill
- Avoiding more than $40,500,000 (net present value) of costs for the county landfill
- Developing a non-potable water system in Moorefield Station to reduce treated water consumption and costs
- Increasing local and sustainable economic development opportunities
- Creating a zero energy, water and waste district (ZEW^2) program for innovative technologies and long term partnerships

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Focus Area Programs

The most tactical programs were included and managed within the individual Focus Areas. These programs support their respective Focus Area goals. The Focus Area programs also include opportunities to integrate the Plan into county policies, services and procedures. Furthermore, specific goal achievement levels were developed for countywide application and for Moorefield Station. The figures below show the general goals of the Focus Areas and related projects or programs.

Energy:

Goals:

Clean Energy | Reduced GHG Emissions | Energy Efficiency | Building Energy Performance Labels

Programs:

- Solar Water Heating Rebates
- Geothermal Heat Pump Rebates
- Energy Efficient Building Code
- Rooftop PV Incentives
- LED Street Lighting
- Energy Use Web Dashboard

Water:

Goals:

Conservation | Reclaimed Water Use | Non-potable Irrigation | Reduced Demand

Programs:

- Reclaimed Water Rebates
- County Reuse Program
- Green Roofs / Stormwater Collection / Local Gardens
- Pilot Loudoun Water Programs
- Surface Wells for Non-potable Irrigation

Transportation:

Goals:

Alternative Fueling | Reduced Vehicle Miles Traveled per Person | Mass Transit Use | Walkscore & Bikescore

Programs:

- Smart Phone App
- Bike Sharing Program
- Bulk Transit Pass Purchase
- Food Store in Moorefield Core
- Permit Review for Bike/Ped Infrastructure

Land Use:

Goals:

Adhere to Land Use Guidelines | Protect Habitat | Minimize Parking | Sustainable Building Certifications

Programs:

- Parking Services (e.g. Meters)
- Integrate Stormwater Infrastructure with Open Space
- Maximum Parking Limits/Shared Parking
- Prescriptive Sustainable Design Options

Waste:

Goals:

100% Access to Recycling | Participation in Recycling | Recycle Social Goods | Divert Solid Waste | Use of Recycled Materials

Programs:

- Pay-as-you-throw Waste Collection
- 'Freecycle' Social Goods Recycle Sites
- Construction &Demolition Diversion Plans for Construction Requirements and Incentives
- Sustainable Building Code Incentives

Additional Key Findings and Recommendations

Below is a summary of additional key findings, recommendations and outcomes of the IEMP.

Findings

- The Advisory Panel feedback on the IEMP and initial contributions and interest in partnerships for the IEMP suggest solid business and community support for the IEMP. The county should consider maintaining the Advisory Panel involvement with the eventual implementation of the IEMP and Moorefield Station.
- Moorefield Station's annual GHG emissions at full build-out are estimated to be 137,700 metric tons of CO_2 equivalent ($mTCO_2e$). Full build-out of Moorefield Station is currently estimated to occur by 2040.
- A natural gas fired combined heat and power (CHP) plant is not financially viable or environmentally beneficial for Moorefield Station. Due to Dominion Power's current and projected GHG emissions rates, a natural gas CHP plant would result in increased GHG emissions, not a reduction. The projected average cost of electricity for a CHP plant is not competitive with current electricity rates. In addition, Virginia legislation and State Corporation Commission (SCC) regulations would likely require the county or Moorefield Station to become a regulated utility, operating within Dominion Power's service territory, to sell the heating and power to multiple end users.
- The RDF power plant offers several financial and environmental benefits including:
    - $0.037 to $0.055 per kWh average cost of electricity generated at the plant (current average costs are approximately $0.07 per kWh of electricity generated)
    - 38,648 $mTCO_2e$ per year of avoided GHG emissions (equivalent to a 28 percent annual reduction in Moorefield Station full build-out GHG emissions)
    - 80,592 MWh per year of renewable energy generated, equivalent to providing power to 3,250 homes in Loudoun County
    - 87,308 tons per year of waste diverted from the landfill
    - Seven year extension of the life of the county landfill
    - Net present value (NPV) benefit to the county of $40,591,000 for avoided landfill capital costs
- The Federal Production Tax Credit (PTC) was not included in the evaluation of the renewable energy projects due to their likely expiration in 2012. If the PTCs are extended, the RDF power plant average cost of electricity delivered would be further reduced by $0.011 per kWh if developed by a third party or tax-paying entity.
- The non-potable water system addresses peak day water demand which is a significant issue for the local utility, Loudoun Water. The non-potable water utility is cost competitive and reduces the environmental impact of treating and conveying water.

- Preliminary discussions with Dominion have identified an opportunity for Moorefield Station and potentially the county to participate in the proposed Community Solar Program. Initial discussions include participation in the Solar PV Leasing program to locate a large (e.g. 500kW+) solar PV array on Moorefield Station property in the near term. The Community Solar program is currently being reviewed and awaiting approval of the SCC.
- As a result of the IEMP, the county is continuing preliminary collaboration discussions with Dominion to participate in the Community Solar program and leverage current Dominion energy efficiency programs in the county through current county engagement programs.
- Renewable energy projects can have an important impact on the community's tax base including:
  - Providing important, early activity on the site
  - Leveraged properly, costs for infrastructure improvements for additional sites/projects can be covered within the context of these projects
  - The direct and indirect earnings impact to Loudoun County from the recommended Nexus Projects was estimated to be $25,600,000. The two Nexus Projects also result in additional fiscal and economic benefits of nearly $1.5 million in annual tax revenues.
- The Zofnass program for sustainable infrastructure at the Harvard Graduate School of Design provided a sustainable infrastructure risk assessment for Moorefield Station and the application of the IEMP. Moorefield Station and the IEMP received a high, favorable rating for sustainability performance in the areas of resource allocation, climate change, natural world and quality of life.

Recommendations

- The two selected Nexus Projects (non-potable water system and RDF power plant), ZEW^{2}Lab Flagship Program and Focus Areas are recommended for implementation by the county and Moorefield Station. A suggested implementation framework is included in the full report.
- A targeted and proactive RDF stakeholder engagement and communication plan is recommended to educate county residents and stakeholders on the newer RDF technologies and the environmental and financial benefits to the county. This engagement plan should coincide with further evaluation and be presented prior to the final decision to implement.
- In addition, due to the RDF technologies recommended, there is an excellent opportunity to support local economic development and sources of biomass and crop by-product feedstocks. The local farmers and vineyards have shown an initial interest in providing crop by-products, vineyard wastes and potentially new biomass crops (e.g. switchgrass) to fuel a renewable energy facility in the county. These additional sources of fuel feedstocks would further augment and diversify the waste fuel feedstocks and potentially allow for increasing the facility size in the future. Biomass is also identified as a locational advantage for Loudoun County.

- To further leverage the IEMP and Nexus Projects to make a broader county and regional economic impact, the county can focus efforts in targeted industries. In a down economy, the best approach is to build off the existing industry base within the county. The economic development assessment identified the following renewable energy sectors as suggeseted targets: wind, solar, geothermal and biomass. These sectors and supporting industries / markets were identified as a locational advantage for Loudoun County.
- The recommended implementation plan for the RDF power plant includes utilizing a partnership with Dominion Power or a third party developer to design, build, own and operate the RDF plant. This structure allows for the RDF plant to be constructed without the county providing or issuing bonds to finance the capital for the project. The financial and environmental benefits of the plant would be included in a purchase power or similar contractual agreement between the parties.
- The recommended implementation plan for the non-potable water system is for the Moorefield Station home owner's association (HOA) to design, build, own and operate the system within Moorefield Station. This is similar to other non-potable water systems in the county. The HOA would provide the capital and annual operating funds for the system and recover the costs through the HOA fees. The fees would be lower than purchasing potable water for their irrigation purposes, thus saving the HOA money. The county would support the project as needed; however, would not contribute capital or operating funds to the project.
- ZEW^2 Lab Flagship Program will act as energy and sustainability laboratory in the Core Zone of Moorefield Station. It will influence many residents and visitors to Moorefield Station to become more sustainable, act locally and contribute to the IEMP goals and sustainability in their home and the region.
- The Focus Area programs provide an opportunity for the county to integrate specific programs and process into county procedures, policies and incentives. One of the common low cost recommendations for the Focus Area implementation is modifying county procedures (such as permitting) to incentivize more sustainable and clean energy development and construction. The implementation plan provides greater detail regarding the specific opportunities.
- The recommended Implementation Plan aligns available and optimal funding strategies with the RDF power plant, non-potable water system and Focus Area programs. Funding strategies were identified and recommended for the RDF power plant and non-potable water system that would not require Loudoun County capital funds or bond issues.
- A short, mid and long term implementation plan was developed for the county to consider in the implementation of the IEMP. This framework divides the critical implementation elements of the IEMP (Focus Area programs, Nexus Projects and ZEW^2 Flagship Program) into manageable components with suggested timelines and schedules.

Conclusion

The unique partnership between Loudoun County and the Claude Moore Foundation provide a tremendous opportunity to deliver significant and impactful sustainable energy projects at Moorefield Station and throughout the county. The IEMP recommendations result in financial, economic and social benefits to

Moorefield Station and the county. Due to this partnership, location of Moorefield Station and county-related assets, the IEMP identified opportunities to:

- Develop a 10MW RDF renewable power plant without using county capital or bond funding
- Deliver renewable energy that could power more than 3,250 homes annually
- Support local farmers and vineyards through biomass economic development
- Reduce the projected GHG emissions related to Moorefield Station by 28 percent
- Implement a large solar PV project at Moorefield Station in the near term
- Avoid more than $40 million (NPV) in county capital costs at the landfill
- Divert 87,000 tons of solid waste annually for beneficial reuse
- Market Moorefield Station as a unique, sustainable development
- Engage the community and stakeholders in the IEMP

The implementation plan included in the full report identifies a path to implementing the Plan that is optimized with funding options to minimize the direct financial costs to the county. In addition, the implementation plan outlines the short, mid and long-term aspects of the Plan including near term 'wins' to quickly demonstrate the benefits and impact of the Plan. When implemented, the IEMP represents a market leading plan for the county and Moorefield Station.

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Section 1: Introduction

The energy and power market is changing like at no other time in the past 50 years. Advancements and developments in clean energy, distributed generation, smart appliances, smart grid, electric vehicles, power generation, data centers and utility programs are all beginning to converge and drive significant change in the electric grid, utilities and consumer desires. Loudoun County and future county development is further impacted by these energy issues due to the prevalence of data centers, proximity of Washington D.C. and expected growth in the area. To navigate and optimize these energy related issues, the county is using a unique partnership between the local county government and the Claude Moore Charitable Foundation (Claude Moore Foundation) to lead the development of an Integrated Energy Management Plan (IEMP or Plan). Both the county and the Claude Moore Foundation are committed to sustainable development with a positive social impact.

The IEMP provides an energy and sustainability framework to guide future development within the county. Initially, the IEMP will be applied to the transit-oriented Moorefield Station development located at the terminus of the “Dulles Silver Line” Metro rail station. However, the county intends to use the IEMP as a model for all future developments and integrate the programs throughout the county’s policy, economic development and community incentive efforts. Loudoun County is leading the development of the IEMP by using American Recovery and Reinvestment Act (ARRA) funds directly allocated to the county from the Department of Energy (DOE) with additional support from the Claude Moore Charitable Foundation.

The IEMP integrates and aligns with the broader county Energy Strategy (CES) which includes a vision for the county to *have reliable and affordable energy, be energy efficient and reduce greenhouse gas emissions*. The IEMP provides the framework and programs required to realize and implement specific aspects of the CES and achieve the related goals. Developed as a part of the Plan, the IEMP mission reflects this alignment with the CES and focuses directly on developments within the county.

IEMP Mission:

Moorefield Station – harnessing the power of human creativity, economic prosperity and energy innovation to be ***The Nexus of the World’s 21st Century Community.***

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- Internal IEMP Team to build county capacity and expertise
- External Advisory Panel to provide community feedback on the Plan
- Ongoing communication and reporting tools to monitor and communicate progress

Guided by the CES, and developing an IEMP, places Loudoun County in a sustainable energy leadership position. The IEMP Mission seeks to leverage the unique aspects of Loudoun County to drive economic development and more sustainable communities.

Integrated Energy Management Plan

This report provides a summary of the IEMP development process, application to Moorefield Station and a detailed discussion of several of the critical elements. Supporting analysis and calculations are also included in the Appendices for further detail and information. The report includes nine major sections as noted below.

- Section 1: Introduction
- Section 2: Moorefield Station Overview
- Section 3: Stakeholder Engagement Framework
- Section 4: Energy Supply Alternatives
- Section 5: Sources and Uses of Funds
- Section 6: Economic Development Assessment
- Section 7: Risk Analysis
- Section 8: Implementation Plan
- Section 9: Reporting to the Community

These sections align with the actual IEMP process and development utilized by the internal IEMP team and consultants. In general, the first portion of the report provides an overview of Moorefield Station, the structure and components of the Plan and the energy opportunities for the county to consider. These sections help to provide a foundation and context for the evaluation of the energy alternatives and management of the IEMP implementation.

The second portion of the report provides more detailed analytics, evaluations and recommendations for the county to consider when implementing the Plan. These sections include the creation of the baseline energy consumption and emissions for Moorefield Station, evaluation and results of county energy options, risk assessments and recommendations to implement the IEMP and realize the benefits.

The graphic shown in Figure 1 (following page) was developed to show the structure and key elements of the IEMP. This figure shows how the IEMP mission is realized through the five tactical Focus Areas, the larger capital investment related Nexus Projects and the eventual zero energy, water and waste (ZEW^2) program for ongoing county partnerships at Moorefield Station. Additional information and discussion of Figure 1 and the Plan elements are included in Section 3: Stakeholder Engagement. This section also includes a summary of the stakeholders, internal IEMP team and Advisory Panel which were integral to the development and eventual implementation of the IEMP.

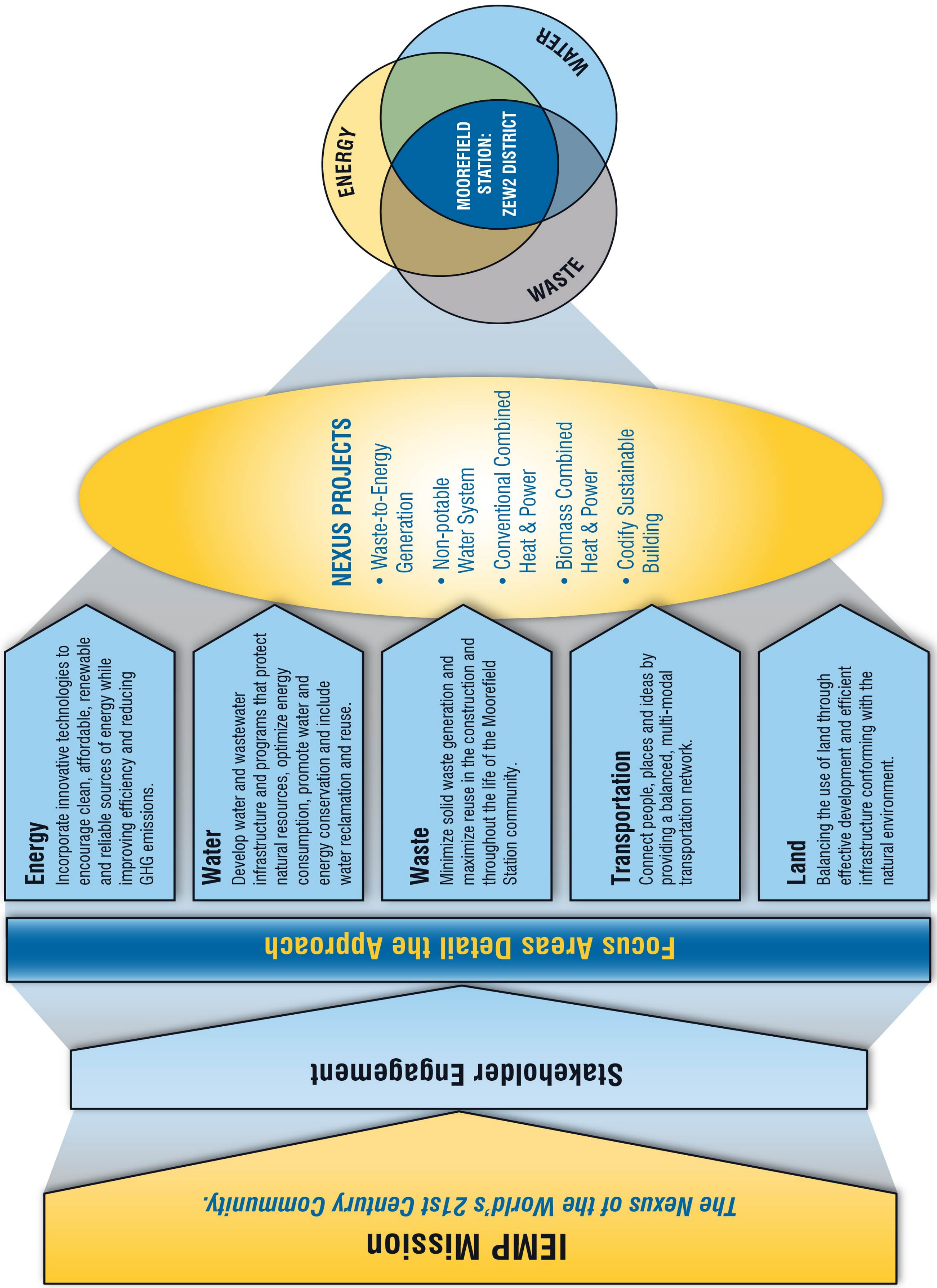


Figure 1: IEMP Plan Elements and Framework

Section 4: Energy Supply Alternatives provides the majority of the energy analytics and project evaluations. It includes the development of the business as usual (BAU) energy consumption and GHG emissions projections for Moorefield Station. This acts as a benchmark to compare energy options and alternatives and their respective reduction to the expected BAU emissions for the next 30 years. In addition, this section begins the detailed evaluation of the energy alternatives and prioritization of the five capital related Nexus Projects and Focus Area programs. Section 4 concludes by recommending two Nexus Projects for implementation and prioritizing programs for each Focus Area.

Sections 5, 6 and 7 provide a scan of funding options available for the IEMP, economic development opportunities and potential risks related to the IEMP implementation. These sections include a scan of the current and likely available funding mechanisms for the county to pursue in the implementation of the Plan. While funding and grant sources are becoming more limited, there is viable and low risk funding structures for the county to consider. The economic development assessment provides an overview of the current state of Loudoun County with respect to clean energy opportunities, economic impacts of the Nexus Projects as well as best practices for the county to consider in clean energy economic pursuits. The risk assessment provides broad sustainability (e.g. triple bottom line - economic, environmental and social) and conventional risk evaluations of Moorefield Station and the Nexus Projects.

The final two sections, build on the final project evaluations, prioritizations and risk assessments to recommend an implementation plan and summarize the conclusions and recommendations of the IEMP. Section 8 includes an implementation plan organized by short, mid and long term components for the county to consider. Finally, Section 9 provides a summary of the IEMP conclusions and recommendations including a draft of the public-facing IEMP brochure to summarize, communicate and publicize Moorefield Station and the IEMP in the county and region.

Section 2: Moorefield Station Overview

This section provides a general overview of the planned and approved Moorefield Station development and master plan. As mentioned previously, the IEMP will initially apply and be tailored to the Moorefield Station development. In the future, the county will apply the IEMP to other developments with the lessons learned at Moorefield Station. Moorefield Station is a 600 acre greenfield development that is just beginning the initial stages of construction and development. Significant development at the site is not expected until approximately 2015 to 2017 depending on economic conditions and the extension of the Washington D.C. area light rail commuter train system. Due to the initial stages of development, Moorefield Station provides an excellent opportunity to implement the IEMP with fewer barriers, lower costs and increased benefits.

The Moorefield Station master plan is a transit-oriented, mixed-use development designed to be flexible with varying densities dependent on the type of public transportation service and specific area of the development. The main driver for the greenfield development is the extension of the Washington Metropolitan Area Transit Authority's (Metro) light rail commuter system to Dulles Airport and on to Moorefield Station, which was approved by voters in the 2011. The extension of the Metro Silver line is currently planned to terminate at Moorefield Station. Adjacent and across the Dulles Greenway from the Metro train station lies Loudoun Station, a smaller (40 acre) TOD of mixed uses that will complete with

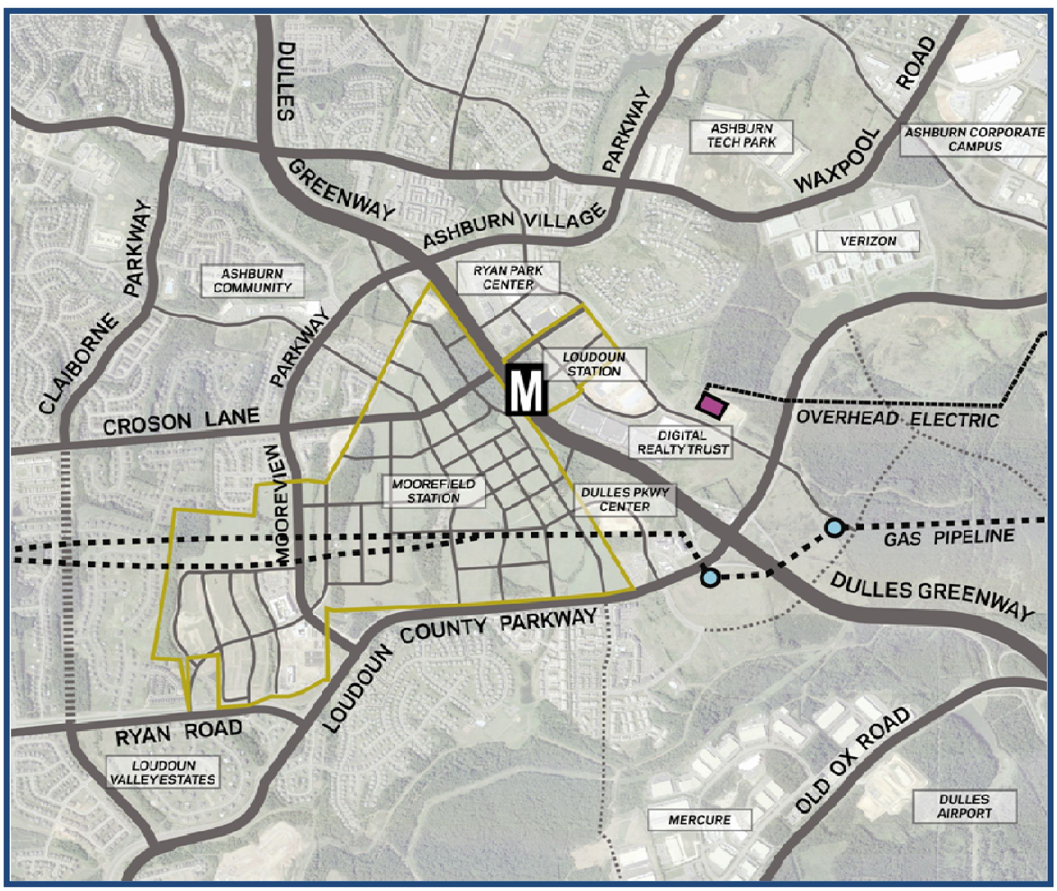


Figure 2: Moorefield Station Conditions

Moorefield Station.

As Loudoun County has grown and evolved over time, so have the local economy and demographics. The county is transitioning and blending a more rural and agriculture history with recent growth in high tech industries, data centers, Dulles Airport and Fortune 500 businesses. Moorefield Station sits in a unique location, bordering the Dulles Greenway, near large power and natural gas infrastructure, and adjacent to Dulles Airport, data centers, Ashburn Technical Park, a Verizon campus and a Loudoun Water waste water treatment plant. Figure 2 on the previous page illustrates Moorefield Station's location at the hub or nexus of the surrounding infrastructure and economic development.

The development can be described as containing two distinctly different areas as seen in Figure 3: the Core Zone and Outer Zone. The Core Zone is a higher density development, mixed-use, 'pedestrian shed' intended to be a true town center that happens to have excellent connections to the Metro system and other parts of the region.

The remaining area, the Outer Zone, of Moorefield is a transit supporting area with less dense development with residential development connected to the Core via bicycle and pedestrian linkages in addition to more traditional transit options.

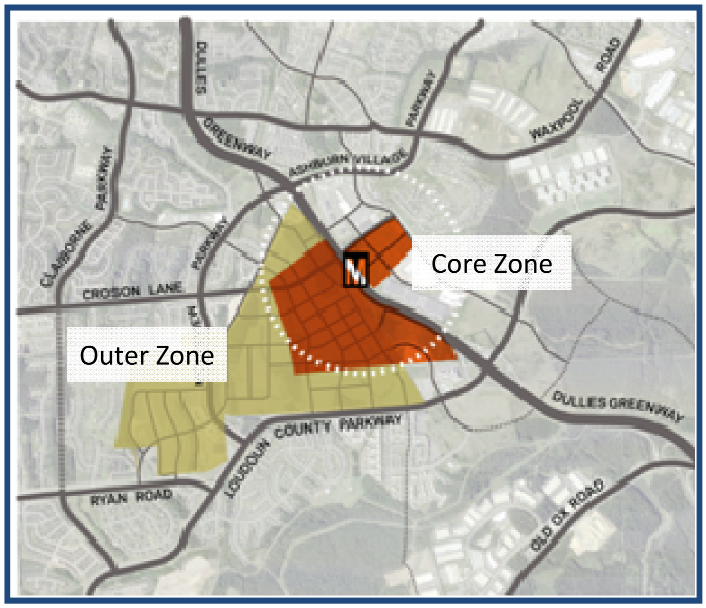


Figure 3: Moorefield Station Development Zones

Pedestrian Scale

Placing a multitude of uses and daily needs within a short walking distance from one another reduces automobile dependence and can create a healthier environment. Arranging those uses on a thoroughfare and block structure as well as integrating uses vertically (in the same building, and including parking) also promotes walking as an alternative to personal vehicles. All of these strategies are hallmarks of quality urban environments.

The Zoning classification (PD-TRC) requires the most intense mix of uses within its Inner and Outer Cores – which correspond directly with walkability paradigms. The Inner and Outer Cores (for the purposes of this exercise, combined) fit within a ½ mile radius pedestrian shed. The Master plan has considered the importance of pedestrian scale by ensuring that areas that are intentionally higher density occur in the most pedestrian accessible parts of the development – those nearest the transit platform.

The physical plan also reflects a clear understanding of pedestrian scale. The thoroughfare network – a regular grid, and the block sizes – generally not exceeding 800 feet in length, have been laid out to provide a comfortable and intuitive urban pattern that are easily navigable and provide a multitude of pathways from destination to destination.

Design guidelines have also been developed that prescribe an excellent pedestrian experience. High-quality streetscapes, shade in abundance, building disposition, and treating streets as a critical component of the public realm are all in evidence in the study area's new developments. Even as density increases, these developments can ensure a high quality pedestrian experience.

Intensity of Development Balanced with Degree of Modality

The PD-TRC Zoning also takes into consideration the possibility of incremental density increases over an extended period of time. Within the different areas of the development, different density caps are available depending on the type of public transportation service brought to the site. Density limits begin without additional transportation service, and increase with the arrival of bus, and then increase again with the arrival of rail as seen in Table 1 below. The figures included in the table represent the total allowable development at Moorefield Station, not necessarily the actual forecasted development.

Table 1: Moorefield Station Development Density

		Car (1)		Bus (2)		Rail(3)	
Precinct	Acres For Density	Total Units	Non-Res Sq. Ft.	Total Units	Not-Res Sq. Ft.	Total Units	Non-Res Sq. Ft.
Outer TDSA	200.71	1,000	250,000	1,000	250,000	1,000	250,000
Inner TDSA	246.05	1,000	2,000,000	1,500	2,500,000	1.750	3,000,000
Total TDSA	446.76	2,000	2,250,000	2,500	2,750,000	2,750	3,250,000
Outer Core	80.17	650	2,000,000	950	2,750,000	2,000	4,000,000
Inner Core	70.12	650	1,750,000	850	2,500,000	2,000	3,500,000
Total Core	150.29	1,300	3,750,000	1,800	5,250,000	4,000	7,500,000
TOTAL	**597.05**	**3,300**	**6,000,000**	**4,300**	**8,000,000**	**6,750**	**10,750,000**

1. At Car phase, total development is capped at 2,500 residential units and 5,500,000 SF commercial
2. At Bus phase, total development is capped at 3,750 residential units and 7,000,000 SF commercial
3. At Rail phase, total development is capped at 6,000 residential units and 9,500,000 SF commercial

The Master Plans for Moorefield and Loudoun Stations have both been designed to be flexible in their accommodation of different densities – by adjusting from surface parking to structured parking within the same block configuration. This allows the developments to move forward without relying completely on the arrival of a specific modal type, as well as allowing development to be somewhat flexible according to market demand.

Pedestrian and Bike Linkages

A key benefit of the PD-TRC Zone is that it reflects a much more inclusive attitude toward transportation and mobility. Real mobility should include all forms of transportation, including bicycles and foot traffic. This Zoning classification requires developments to consider quality bicycle and pedestrian linkages within a specific development and to adjacent neighborhoods.

The developments within the Study Area do a good job of ensuring pedestrian and bicycle access within their boundaries – by virtue of the street network, dedicated bike lanes and ample sidewalks, and their gridded thoroughfare system. Additionally, specific bike transportation elements such as bike storage, racks and transit facilities will help ensure that bike-to-rail options are available. The Moorefield Station linkages with the surrounding areas are shown below in Figure 4.

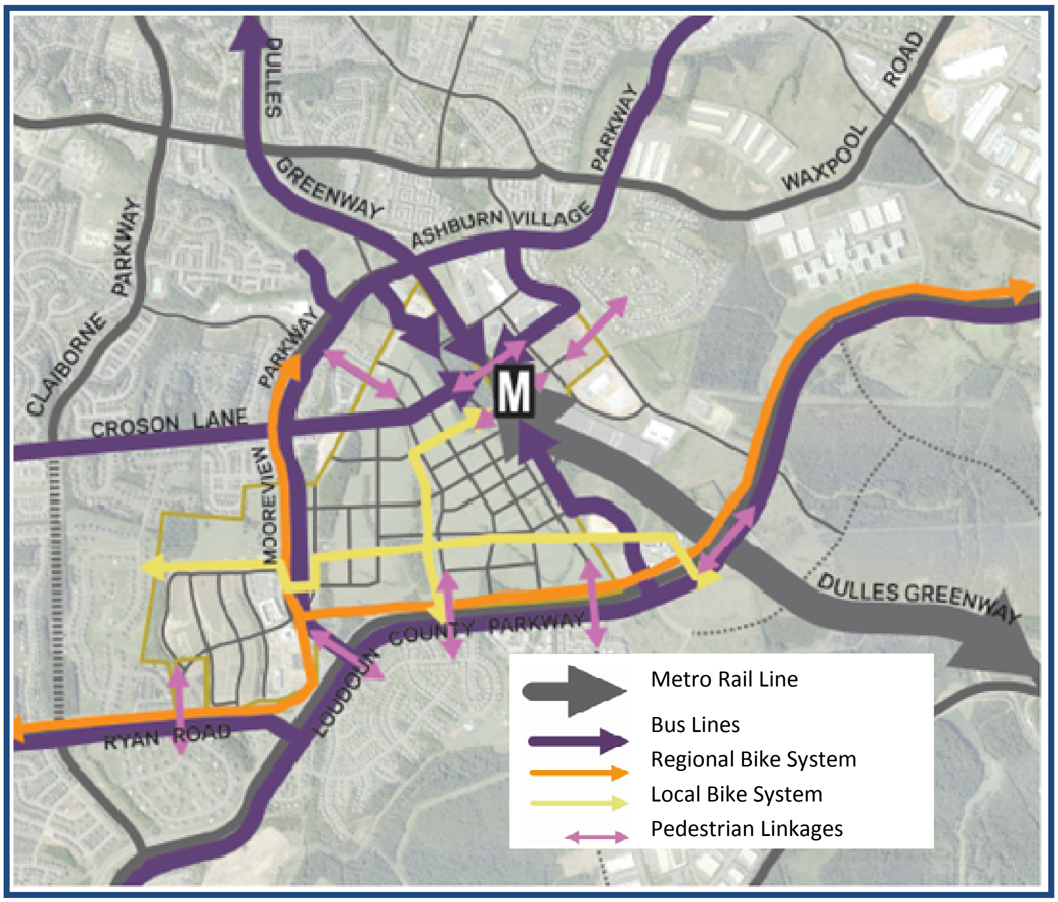


Figure 4: Moorefield Station Linkages

Beyond the project boundaries of Moorefield Station and Loudoun Station, it is less clear how bicycles will be able to safely cross highways and large arterials. By addressing these crossings, the 'bicycle shed' or area in which a person can use their bicycle to access transit and services can expand outward from the development (e.g. a one-mile radius). Clearly, more people riding bicycles and walking from surrounding neighborhoods to the Core Zone will further increase ridership and could extend the amount of Transit-Design Supportive areas.

Transit to Reduce Auto Dependency and Trip Generation

The arrival of Transit (Metro) to the Study Area should greatly and positively impact the amount of vehicle trips generated in the study area. Mixed-Use developments like those prescribed by the PD-TRC Zone have proven effective in reducing the number of peak hour vehicle trips when compared to single-use districts. Three key factors reduce the adverse traffic impacts:

- Diverse on-site activities can capture a large share of trips internally. Moorefield Station, especially in its Core, includes a very wide range of uses – including Civic, Retail, Office and Residential uses.
- Placement of development within highly walkable areas with good transit access. Trips generated in these areas (a TOD for instance) register more walk trips and transit trips and not just personal vehicle trips. Locating the highest density in the Core with access from both sides to the Metro Station will ensure that some people will give up driving to the station and opt for walking or biking.
- Central Locations that reduce trip lengths. By having the multitude of uses consolidated in the same development area, more daily needs can be met in the same location. The plans for the study area and the regulations in the PD-TRC significantly reduce the need to drive long distances from home to shopping or working.

It has also been shown around the country that the experience around the Metro Station can greatly impact ridership. Often, Metro Stations that are removed from high-quality and high-intensity places can lose ridership because the experience is completely auto-dependent. This area promises to be much more than a commuter-driven Metro Station. It is intended to be a true town center, thriving and vibrant, that happens to have excellent connections to the Metro System and to other parts of the Region.

High Quality Design

Design guidelines can ensure that a place will be beautiful, and the future developments promise to be as well-designed as any in the region. Guidelines are being included for streetscape, building typology, commercial frontage and signage, ensuring a standard of design excellence throughout the new developments.

In addition to conventional design guidelines, which typically regulate architecture and even style, other standards may prove useful in future developments to ensure energy-efficiency and sustainable building practices.

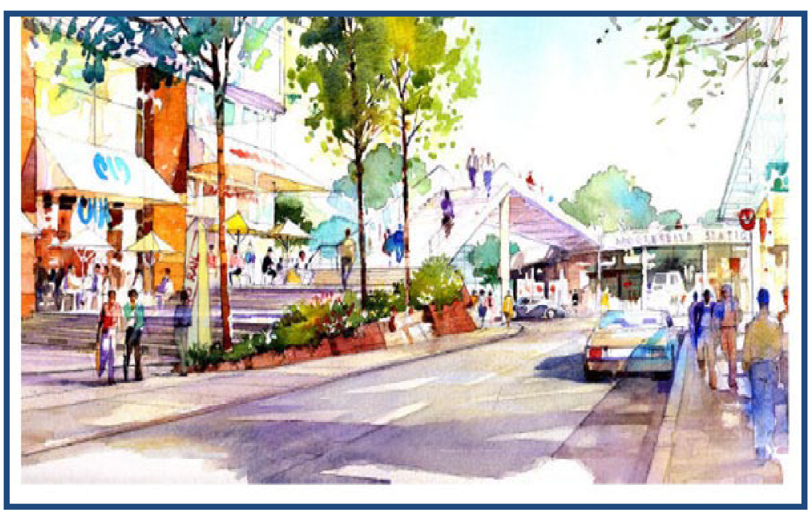


Figure 5: Design Guidelines

Well-designed and Accessible Public Spaces

It is imperative that urban spaces offer a healthy degree of publicly accessible open space. The PD-TRC encourages the development of a variety of open spaces to be used for social activity, recreation and visual enjoyment.

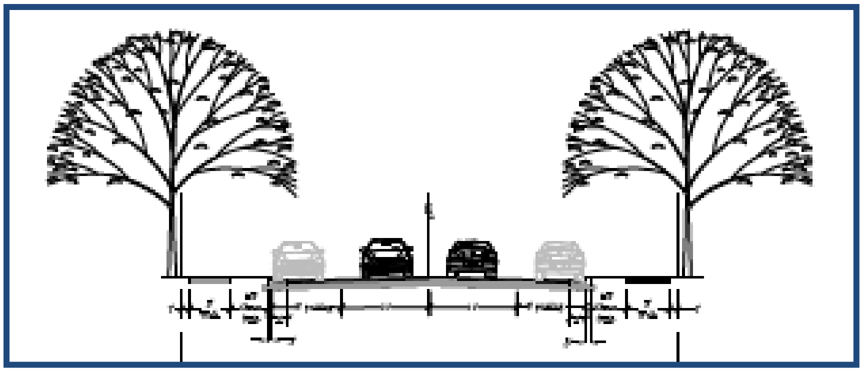


Figure 6: Design Guidelines

The Moorefield Station guidelines include prescriptive standards for high-quality spaces to be built throughout the development. Clearly, at the densities expected in the Core of the development, these spaces will more likely be smaller, more formal spaces. They will be balanced with the existing natural corridors that exist (along with some that are to be enhanced) throughout and beyond the boundaries of the development. The combination of intimate public space surrounded by buildings and large corridors that are part of a much larger system, or watershed, are an excellent way to accomplish the goals of the Zone and to provide urban and rural conditions within a single development project.

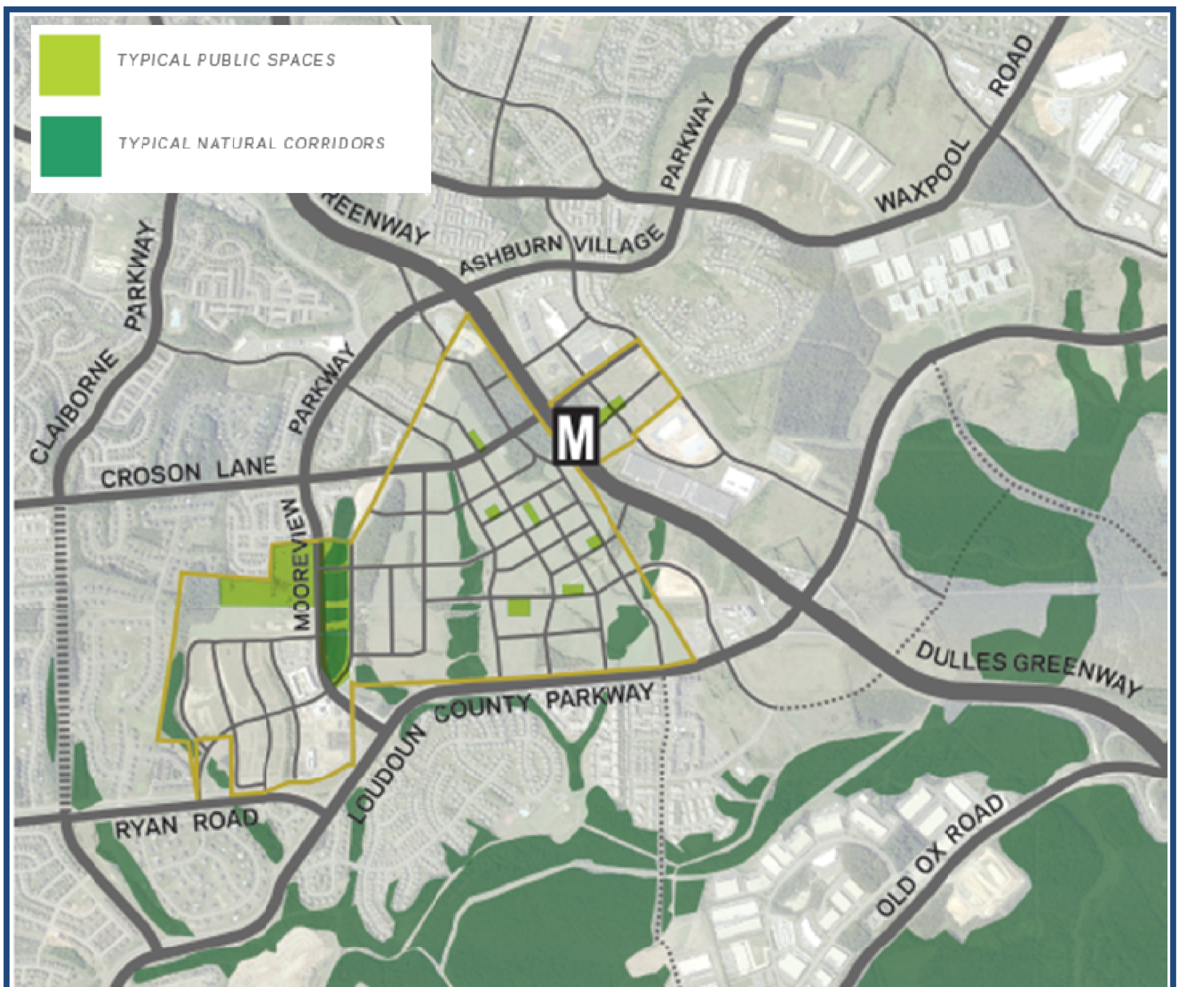


Figure 7: Moorefield Station Open Space

Zoning and Planned Development Areas

There is a very broad spectrum of land use categories and zoning designations currently present in the Study Area. Figure 8 shows the 18 different land use zones that are present in and around the Loudoun Station Metro site and Moorefield Station. Many of these land use categories are actually very similar. Few (like the PDTRC) permit the type of mixed-use development that will become the hallmark of future transit centers here and in other locations throughout the county, but all perform a valuable function in their ability to supply a multitude of uses in a small area of land.

Figure 8: Moorefield Station Land Use Zones

The array of land use categories is intended to ensure that there is enough space throughout the county to accommodate projected growth in industry, employment and housing. The map included in Figure 9 is a much more generalized version of the county's land use for the study area. Its purpose is to simplify the map above and highlight predominant uses in each area – predominantly residential, predominantly retail, predominantly commercial (combining industrial, office and research) or mixed.

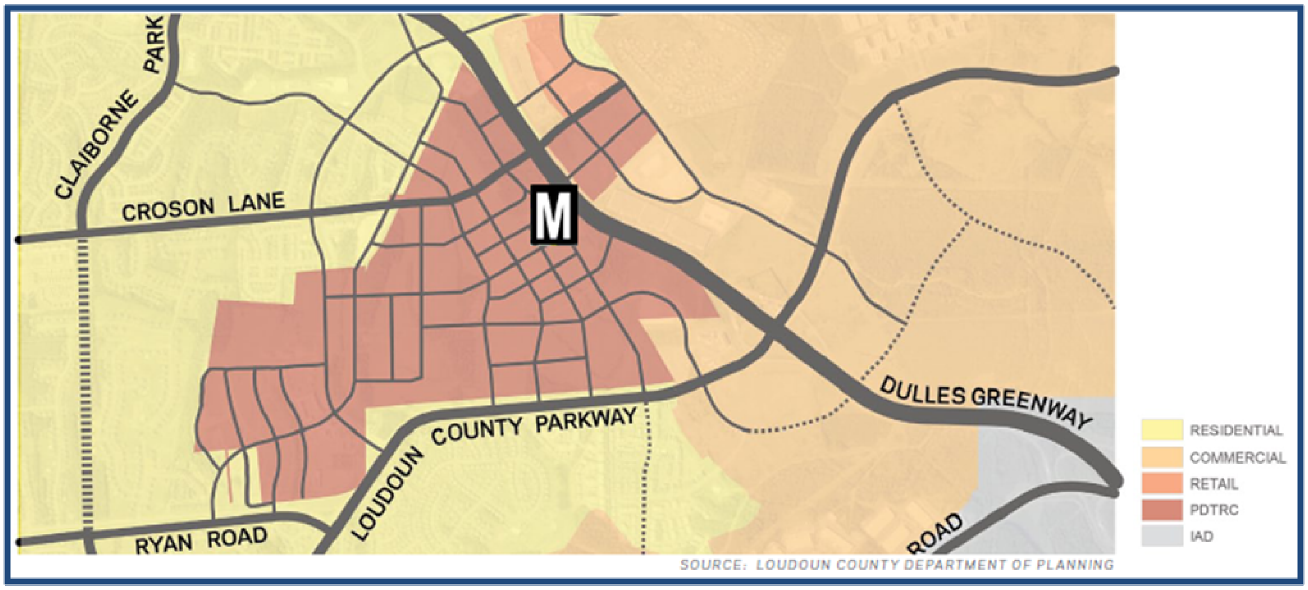


Figure 9: Moorefield Station General Land Use Areas

This map highlights the fact that projects like Moorefield Station can often serve as a link between predominantly residential areas and commercial areas and can serve as a way to buffer some of the incompatibilities that residential and other uses often face. The opportunity at Moorefield Station, through utilizing the PDTRC zone, makes it possible to supply the area for multiple uses in a configuration that promotes economic development and livability at the same time and in the same place. Combining land uses ultimately conserves more land and can more effectively leverage large investments in infrastructure.

The transit-oriented zoning and related density linkages to transit service levels allow the development to be somewhat flexible according to market demand. Due to this flexibility and projected market demand, Moorefield Station will likely develop from the outside areas first, then towards the more dense core area (e.g. from the Outer Zone to the Core Zone). Moorefield Station, Loudoun Station and other transit-related developments are a smart choice to help Loudoun County balance growth with livability.

Population and Employment Growth

Loudoun County, as a whole, continues to grow in both population and employment. Figures 10 and 11 show how and where this growth is expected to occur over a 15-year period. There are two basic observations with respect to county population and employment:

- Population growth tends to be highest in the edges surrounding already urbanized areas. [Areas shown in red are expected to grow most rapidly, and areas in blue are the most slow-growing.]
- Employment growth is projected to be most intense along an east-west corridor that includes major infrastructure.

The IEMP Study Area, including Moorefield Station, is poised to help Loudoun County achieve these growth projections in a more livable manner, and to achieve them in places where major infrastructure investments are being considered.

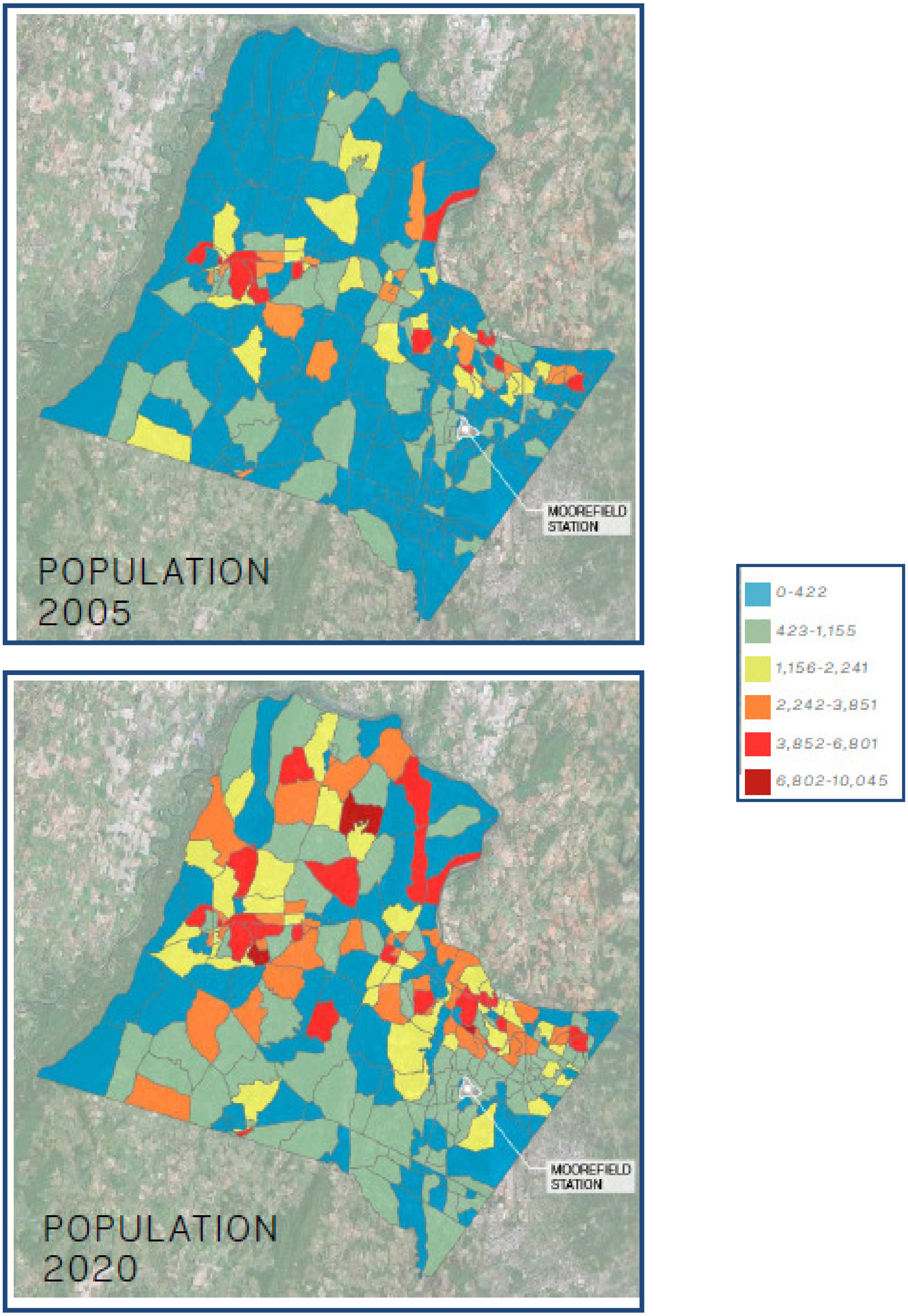


Figure 10: Loudoun County Population Growth 2005 to 2020

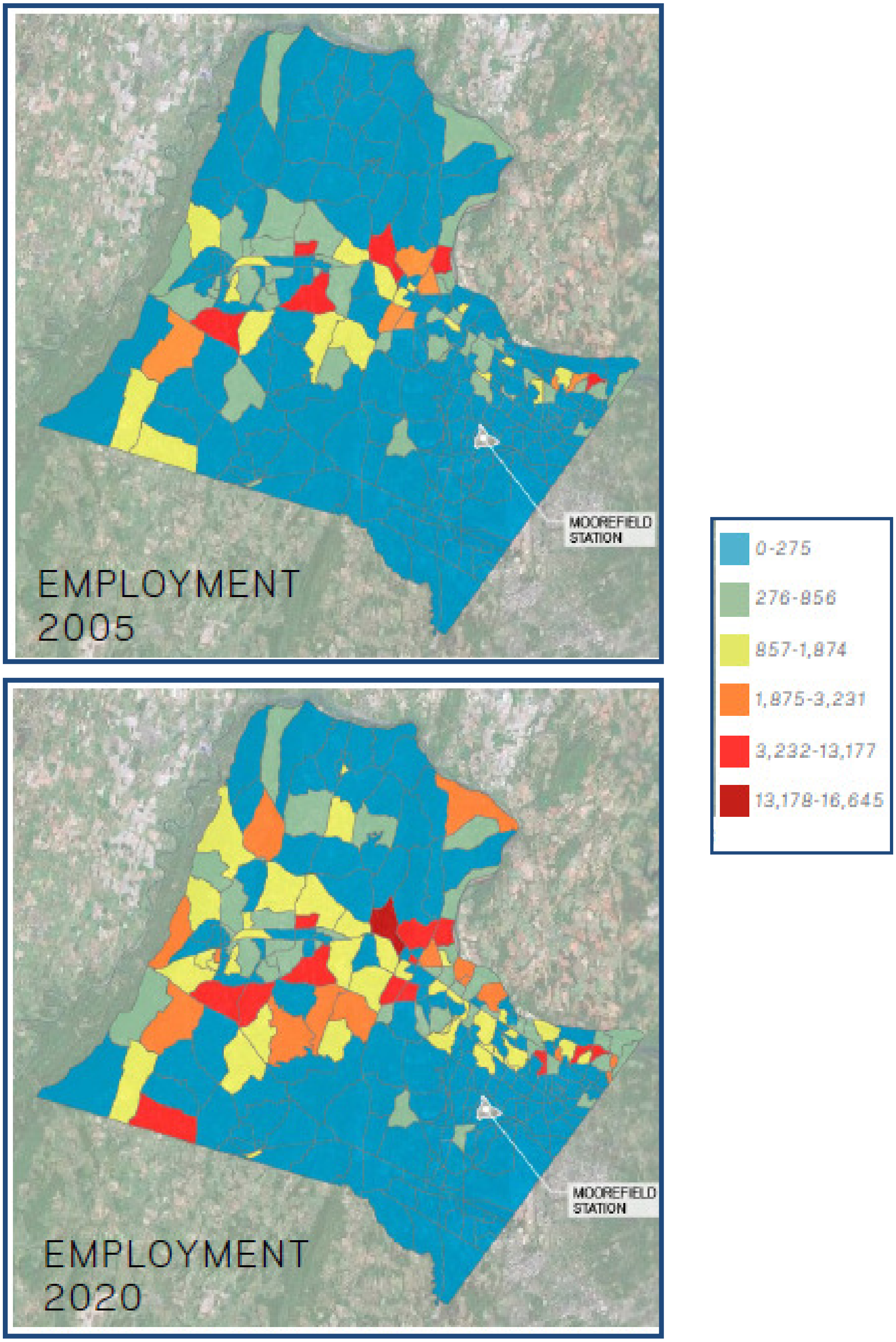


Figure 11: Loudoun County Employment 2005 to 2020

Building Energy Systems

In alignment with the overall high quality design and sustainable development intent of Moorefield Station, the supporting building energy systems and construction are expected to meet and / or exceed the current state of Virginia building codes. To properly identify building related energy efficiency and energy alternatives for the IEMP energy alternative evaluations, an inventory of the expected building systems was created for each type of building construction projected for Moorefield Station. A summary of the building construction and building energy system technologies is included below. These system inventories for commercial, multifamily and town homes/single family homes were used to develop the energy models used for the Business as Usual (BAU) GHG Emissions discussed in Section 4: Energy Supply Alternatives. These models and the BAU GHG Emissions project energy consumption and GHG emissions for the future build-out of Moorefield Station. The systems and building construction meet the current building codes and subsequent ASHRAE 90.1 (2007) energy code. These are the currently adopted codes for the state and Moorefield Station. For a more detailed inventory of all systems and construction types, please see Appendix A.

Commercial Buildings

The commercial buildings modeled for the IEMP meet current building and energy codes. The building envelope construction includes R-20[1] wall and roof insulation and approximately 70 percent of the walls are glazing (i.e. windows). Each commercial building is assumed to be a mid-rise type of office building of approximately 225,000 square feet each. The major building systems that consume energy include heating, ventilation and air conditioning (HVAC) and lighting systems. The heating system for the commercial building was assumed to be a central hot water heating plant consisting of two, equality sized gas-fired hot water boilers for space heating. Variable speed pumps were included to distribute the heating water to air handlers and variable air volume (VAV) coils and boxes located around the building perimeter.

Air conditioning is provided by a central refrigeration plant consisting of two equality sized electric motor driven refrigeration machines or chillers. The chillers are water-cooled with an open loop cooling tower. Variable speed pumps were also included to distribute the chilled water to air handlers and VAV coils. The air handlers delivering the heating and cooling air to the commercial spaces are VAV systems. The lighting for the commercial spaces is assumed to be code compliant T-8 fixtures.

Multifamily

Based on current codes, the multifamily (i.e. apartments) building envelope construction consists of R-15 insulated walls and R-20 insulated roofs. Each apartment or unit was assumed to be 1,200 square feet, with 12 units per floor and a total of eight floors per complex. The HVAC systems include a central gas-fired boiler for hot water heating with variable volume pumping. Air conditioning is provided by a refrigeration direct expansion (DX) split system with a cooling coil and separate condensing unit for each apartment likely located on the ground or the roof. The heating and cooling coils are located in the high efficiency packaged terminal air conditioners (PTAC) located in each unit.

[1] R-value is the measure of thermal resistance of materials. Higher R-value equates to higher resistance and insulating properties of the material. Typical wall and roof insulation comes in R-15 through R-40 depending on the use.

Townhouse

A single family attached home or townhouse was modelled to project energy consumption for the remaining residential construction units in Moorefield Station. The townhouse is more representative of the expected single family construction due to the higher density intent of the development. Each townhouse is assumed to be 2,200 square feet. Based on the current building code the townhouse construction includes R-15 wall and R-30 roof insulation. The heating and cooling is provided by a constant volume electric heat pump with electric reheat when needed. The heat pump system includes a centralized air handling unit in the home with a heating/cooling coil connected to a separate refrigerant condensing unit. Heat pumps are typical residential heating and cooling units. The refrigerant provides the cooling and heating depending on the need or season.

Energy Opportunities at Moorefield Station

As seen previously in Figure 1, Moorefield Station is located at a nexus of surrounding infrastructure with significant energy related opportunities. As a part of the IEMP, these energy and nexus strategies will be evaluated and analyzed to identify the best opportunities for the county and Moorefield Station to pursue and implement ,in support of achieving the CES goals as economically as possible. A preliminary list of these energy related opportunities located near Moorefield Station is included below.

- Waste heat from cooling towers from data centers (e.g. Digital Realty Trust)
- Dominion Virginia Power transmission lines
- Loudoun County Landfill
- Columbia Natural Gas transmission pipelines
- Loudoun Water treatment facility
- Geothermal exchange heating and cooling

Two of the primary goals identified in the original IEMP scope of work were to evaluate the opportunities to reuse waste heat and the applicability of a combined heat and power (CHP) facility to serve the 600 acre development. Due to the number of data centers in Loudoun County and their significant use of electricity and generation of waste heat, the intent was to use the waste heat generated as a resource to reduce overall energy consumption. A CHP plant was also initially identified in an effort to reduce costs and GHG emissions in serving the local energy loads in the county and Moorefield Station.

Waste Heat

In an effort to reduce energy consumption and develop a more energy efficient Moorefield Station, waste heat was targeted for use as a resource rather than waste or a by-product. Waste heat from power plants or industrial processes is commonly used to provide space heating or cooling, additional power or to pretreat water or air for use in space heating or cooling. Equipment typically used to harness the waste heat beneficially includes: heat recovery steam generators (power), absorption chillers (space cooling), heat exchangers (space heating and preheating) and heat pumps. Typically, waste heat is useful or economically viable at higher temperatures (e.g. steam at 220˚F +; water at 120˚F +) for larger applications.

The waste heat generated by the data centers is related to cooling towers rejecting the heat from water cooled chillers used for space cooling. The water used to cool the refrigeration chillers is circulated in a cooling tower to reject heat to the ambient air, typically creating large steam plumes from the cooling towers. These open loop cooling towers typically cool water from approximately 95˚F to 85˚F / 80˚F. Reuse of this temperature water is likely only economically viable in unique applications such as preheating air for space heating applications in buildings located very close to a data center or cooling tower. This low temperature waste heat is not likely viable for significant space heating or cooling needs in Moorefield Station.

Combined Heat and Power

CHP plants typically generate power by combusting natural gas in reciprocating engines or combustion turbines which generates significant amounts of exhaust waste heat. This high temperature exhaust is collected by a heat exchanger to generate steam or hot water for district heating applications. In general, CHP plants are most effective in a single owner campus or large industrial development where there is a significant demand for industrial process steam or district heating.

These plants are also interconnected to the larger electric grid serving the community and region. In the case of Moorefield Station, a CHP plant must be interconnected to Dominion Virginia Power’s (Dominion Power) existing electrical grid. Typically, the local or regional electric utility restricts the interconnection of a CHP plant to their electrical grids due to the potential risks and management issues the utility may face. In some cases, if the fuel used in the CHP plant is considered renewable (e.g. biomass) there may be fewer barriers to interconnection due to state or federal requirements for access.

Unless there is a unique industrial process steam requirement or dense, single owner development (e.g. college campus) natural gas fueled CHP plants are not typically cost effective. In addition, within the Commonwealth of Virginia, state legislation and State Corporation Commission (SCC) regulations are prohibitive of CHP plants, especially if operating for multiple end users as a district heating utility and connected to the grid. More detailed evaluation and discussions of a CHP plant alternative in Moorefield Station are included in Section 4 Energy Supply Alternatives.

Geothermal Exchange Heating and Cooling

Geothermal exchange heating and cooling is a commonly used high efficiency residential and commercial HVAC system called ground source heat pumps (GSHP). The GSHPs use the ground as a heat sink to either heat or cool a closed water loop which transfers heat to a refrigerant heat pump to condition a space. These systems use a special geothermal heat pump connected to a series of vertical geothermal exchange wells or horizontal coils buried in the ground. The ground is used to reject or absorb heat as needed to provide heating and cooling to the space.

High level secondary research was performed to verify the potential of geothermal exchange at Moorefield Station. The results of the research and subsequent discussions with local contractors showed GSHP and geothermal exchange systems are viable in Loudoun County. The soil conductivity levels meet the required levels for economically viable GSHP systems. The approximate return on investment for a GSHP system is approximately 10 percent, or a payback period of 10 years. There are multiple contractors and existing ground source heat pump systems in Loudoun County and throughout the state. The most significant costs related to a GSHP system are drilling costs related to the wells which can be 150 to 250 feet deep each.

Section 3: Stakeholder Engagement and IEMP Framework

The most effective strategic plans are both comprehensive and integrated, weaving together multiple elements. The diagram shown on the following page in Figure 12 illustrates the comprehensive nature of the IEMP. This diagram shows the relationship and integration of the IEMP Mission Statement, Focus Areas, Nexus Projects, Flagship Program and stakeholder engagement throughout the life of the IEMP. Each of the Plan elements is discussed in detail below including the internal and external stakeholder engagement efforts.

An integrated stakeholder engagement plan was used in the creation, development and eventual implementation of the IEMP. There were two critical stakeholder groups integral to the creation of the IEMP framework and elements:

- Internal County IEMP team (IEMP Team)
- External Community Advisory Panel (Advisory Panel)

In developing the Plan with the internal IEMP Team, the county builds the internal capacity and knowledge base to ensure the implementation of the plan and efficiently apply the process and results to future developments. The external Advisory Panel provides critical and periodic community feedback on the IEMP elements, endorses the plan and acts as broader advocates in the community. However, as the plan nears completion, the intent is for the Advisory Panel to remain engaged in the longer-term implementation and partnership aspects of the IEMP.

Engaging all stakeholder segments (e.g. businesses, county staff, customers and regulatory bodies) using all communications channels is vital to the ultimate endorsement and success of the plan over the long term. In order to lay the appropriate foundation during plan development, we worked with both staff and external business/community members during plan development. Additional broad-scale stakeholder engagement will be required for successful plan implementation. For example, a broad-scale stakeholder engagement plan is recommended to support the development of the refuse-derived fuel (RDF) power plant Nexus Project, as discussed in the Energy Supply Alternatives section of this report.

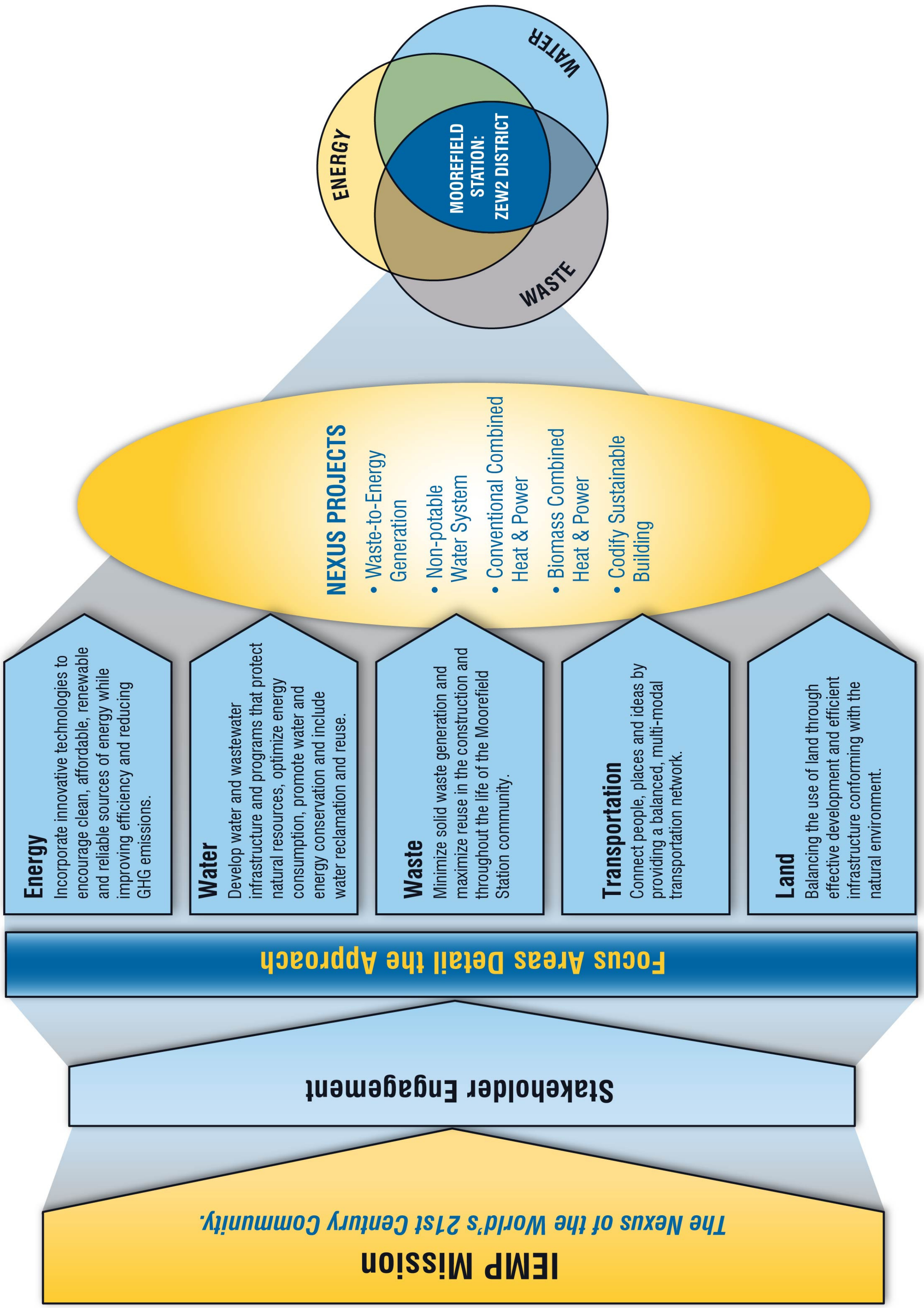


Figure 12: IEMP Plan Elements and Framework

IEMP Team

The IEMP Team includes key county subject matter experts and serves as the core team for the creation and implementation of the IEMP components. The IEMP Team is comprised of a cross functional staff team including:

- Department Leaders
- County Administrators Office
- Subject Matter Experts
- Claude Moore Foundation

The IEMP Team met regularly throughout plan development in workshop format. This team was responsible for contributing to the following plan elements:

- Mission Statement
- Focus Area Definition
- Strategic Goals
- Input to Energy Alternatives Analysis

As the plan moves into implementation, this same team will be responsible for the following:

- Leadership of Implementation
- Continuous Monitoring & Improvement

The primary work product of the IEMP Team is the planning document itself.

Advisory Panel

Outreach to external stakeholders started early in the planning process, with a team composed of representatives from the following organizations:

- Claude Moore Foundation
- Comstock Partners
- Digital Realty Trust
- Dominion Power
- Dulles Greenway
- Loudoun Water
- Loudoun Chamber
- Loudoun Schools
- Metropolitan Washington Airport Authority
- Virginia Department of Transportation
- Verizon
- Washington Gas

Figure 13: Advisory Panel Representatives

Integrated Energy Management Plan

Loudoun County would like to extend its appreciation to the Advisory Panel members for their valuable insights and looks forward to their continued involvement as the Plan comes to life.

This team met three times during plan development for the following primary purposes:

- Review and discuss directional elements developed by IEMP Team
- Offer feedback and insights for IEMP Team consideration
- Identify strategic risk and opportunities and develop subsequent recommendations
- Define partnership opportunities

As implementation of the plan proceeds, an ongoing role for the Advisory Panel is recommended. This offers continued insight and community alignment. Expansion of the membership to include broader and/or additional representation of interest groups as listed below is also recommended:

- Business and Industry
- Developers
- Neighborhood Associations
- Chambers of Commerce
- Non-Government Organizations
- Conservation Groups
- Citizens
- Local Utilities
- School Board

Input & Perspectives

To illustrate the high quality of the input received from the Advisory Panel, summaries of the two meetings held prior to the report completion are highlighted below.

The initial meeting of the Advisory Panel was held on August 3, 2011, for the purpose of reviewing the initial direction and providing an external perspective. In general, the overall message from the Advisory Panel was very clear: "Go big or go home." In other words, there was a clear desire to do something with high impact and high visibility that would truly make a difference in both Moorefield Station and the broader Loudoun County community.

In addition, the IEMP made the following specific plan revisions as a result of Advisory Panel input:

- Revised the Mission to enhance leadership and be more consistent with Loudoun County's overall direction
- Redrafted Focus Area definitions based on input of the Advisory Panel
- Revisited goal statements to ensure consistency and clarity
- Started discussion of specific energy programs that will leverage the potential of Moorefield Station

During the second meeting of the Advisory Panel, which was held on October 6, 2011, similar clear direction emerged. The focus of this meeting was to preview the technical analysis for specific projects under consideration, provide an opportunity for dialog and gather input on the zero energy/water/waste (ZEW^2) program concept of the plan (discussed in detail later in this report).

Based on this second Advisory Panel meeting, the IEMP made the following refinements to the IEMP:

- Brought partnership strategies into clearer focus
- Outlined follow up with specific organizations
- Reviewed economic development strategies
- Discussed and refined five Nexus Projects for further development
- Originated ideas for further development of the ZEW^2 concept

After each Advisory Panel meeting, a one-sheet summary of their input and the associated plan modifications was published. In addition, many off-line conversations and meetings have been held to develop further details of implementation and enhance working relationships. This closes the loop and respects the time and perspectives of the Panel members.

Long-term Partnerships Launched

Most significantly, engaging the Advisory Panel provided valuable insights on potential partners and synergy. Many of the Panel members expressed interest in long-term partnerships to create win-win opportunities. Those partnerships have created a solid foundation for the two recommended mid-term Nexus Projects (discussed later in this report):

- Refuse derived fuel plant in potential partnership with Dominion Power
- Non-potable water system in potential partnership with Loudoun Water

Other partnerships are certain to evolve over time as Moorefield Station build-out gets underway. Such collaborations are likely to include Washington Gas, Verizon and Digital Realty Trust, to name only a few indicated by early discussions. Additional exploration and development of partnership opportunities is a critical success factor for the IEMP; continued engagement and attention to these relationships is well worth the effort.

Mission and Plan Framework

The IEMP is structured with an overarching mission for county development, and then divided into five specific Focus Areas to effectively manage the implementation and monitoring of progress. The Focus Areas include: Water, Energy, Transportation, Land Use and Waste. Each of the Focus Areas contains specific goals and programs to support the IEMP mission. As stated previously, the IEMP Mission focuses on leveraging the unique aspects of Loudoun County to drive economic development and more sustainable communities.

Moorefield Station – harnessing the power of human creativity, economic prosperity and energy innovation to be ***The Nexus of the World's 21st Century Community***

In the mission, there are two key terms which were carefully selected as key talking points to expand: Nexus and Prosperity. Nexus captures key differentiating components of Moorefield Station:

- Moorefield Station is a hub, impacting, influencing and facilitating interaction between people, infrastructure, markets and information
- Moorefield Station is the information technology, fiber optic and data hub of the US and world
- Moorefield Station will optimize the nexus of energy – water – transportation – waste – land use programs

Prosperity represents the triple bottom line basis of the approach to the IEMP, and encompasses the following aspects:

- People – Social/human components including education
- Planet – Environment
- Profit - Economic development

One of the vital components desired by the county in the IEMP was some type of scale or large capital alternative energy or sustainable project(s) and programs that acts as a 'beacon' or set a new standard for future national and international developments. These scale or large capital projects were dubbed the Nexus projects to offer the proof of the Nexus component of the mission and leverage the energy – water – waste – transportation – land use nexus opportunities in the county. In addition, a Flagship program was developed to act as the beacon for other communities to follow in pursuit of more innovative and sustainable developments. Both the Nexus projects and Flagship program are cross-cutting in nature, supporting multiple Focus Areas and goals.

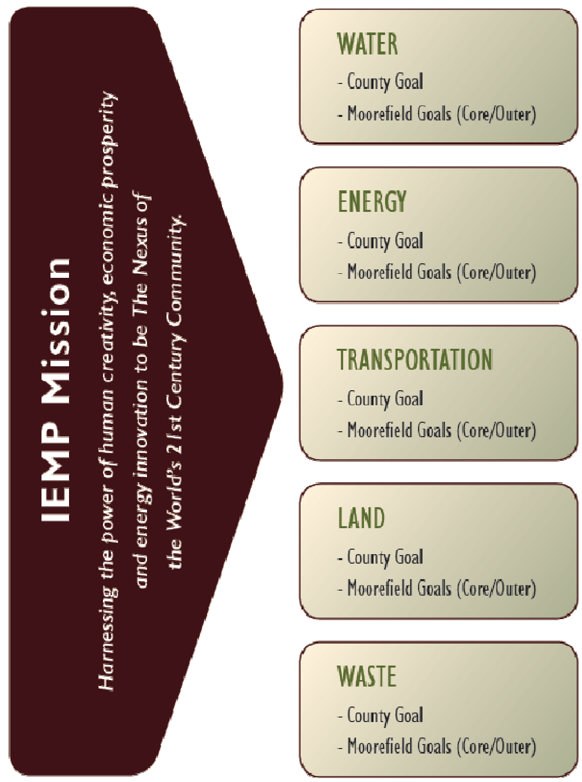


Figure 14: IEMP Structure

The Nexus projects are capital investments (e.g. bond financing, third-party financing agreement or contract) that result in some type of hard asset. The Flagship program is structured as a flexible partnership with community organizations, local businesses and Moorefield Station that leads to innovative programs and projects that are piloted at Moorefield Station. The Nexus projects and Flagship program are discussed in greater detail later in the report.

The mission highlights Loudoun County's innovative culture and educated demographic which supports economic development and more sustainable communities. Through the development, implementation and life of the Plan, the mission statement acts as the overall guiding direction and filter for decision making. However, the Plan and more tactical programs are physically managed within specific Focus Areas of the Plan as shown in Figure 14.

Focus Areas

The IEMP provides a model for both countywide development and individual developments, such as Moorefield Station. As such, two categories of goals were created to improve the relevance and effectiveness of the Plan and annual progress reporting. These two suggested categories include (1) broader countywide goals and (2) goals specific to the Moorefield Station development, which could be expanded to other developments as well.

In addition, due to the transit-oriented nature of Moorefield Station and similar intent for future developments, the suggested Moorefield Station goals were separated into two zones: Core and Outer Zones. These zones align with and reflect the significant differences in how the two zones will develop, proposed densities, types of buildings, construction and uses. In transit-oriented developments, such as Moorefield Station, the outer and less densely populated areas typically develop first (e.g. Outer Zone). In the mid to later stages of the development, the more densely populated inner core will be developed (e.g. Core Zone). The boundaries of the Core and Outer Zones are shown previously in Figure 3 in the Moorefield Station Overview Section of the report.

Each of the five Focus Areas is described in detail below with the suggested goal structure and includes the following:

- Definition: the Focus Area purpose and description
- Countywide Goals : potential overall goals for the entire county to pursue
- Moorefield Station Goals: potential goals targeted at the Moorefield Station development
  - Core Zone – the core planning area; central area near the station (approximately 150 acres)
  - Outer Zone – the outer Transit Design Supported Areas (TDSA); beyond the Core (approximately 400 acres)

Water

Definition: Develop water and wastewater infrastructure and programs that protect natural resources, optimize energy consumption, promote water and energy conservation and include water reclamation and reuse.

Countywide Goals:

1. Achieve 15 percent reduction in water consumption from current baseline of 100 gallons per capita per day (gpcd) by 2020.
2. Achieve two million gallons per day of reclaimed water by 2020.
3. Reduce maximum daily water demand by 20 percent from 2010 baseline by 2020.

Moorefield Station Goals (Core and Outer Zone)

1. Reclaim 30 percent of development's water supply in Core and 20 percent of Outer Zone.
2. Use non-potable water for 100 percent of landscape irrigation needs in Core and Outer Zones.
3. Implement a total of five reclaimed water programs or projects in the Core and Outer Zones.

Energy

Definition: Incorporate innovative technologies to encourage clean, affordable, renewable and reliable sources of energy while improving efficiency and reducing GHG emissions.

Countywide Goals:

1. Supply 10 percent of total county power from locally generated clean or alternative energy by 2030.
2. Reduce Greenhouse Gas (GHG) emissions from energy consumption by 22 percent from 2007 baseline by 2040.
3. Partner with businesses and utilities to implement 10 pilot programs in the county by 2020.

Moorefield Station Goals (Core / Outer Zones):

1. Supply 25 percent of Moorefield Station total electricity from renewable energy.
2. Building-related energy consumption will be 40 percent / 50 percent more efficient than current code in Outer / Core Zones.
3. All buildings will have an Energy Performance Label (EPL)[2].

Transportation

Definition: Connect people, places and ideas by providing a balanced, multi-modal transportation network.

Countywide Goals:

1. Promote energy efficient vehicles by expanding alternative fueling opportunities to 20 stations by 2020[3].
2. Provide transportation options that reduce vehicle miles traveled per person.

Moorefield Station Goals (Core / Outer Zone):

1. Achieve alterative transit level of 70 percent Core and 60 percent Outer Zone as primary commuting mode. [4]
2. Demonstrate 75 percent Core and 45 percent Outer Zone use of integrated bike/pedestrian infrastructure (usage as defined as at least once per week).
3. Achieve a walkscore/bikescore of 90+ in the Core Zone and 50+ in the Outer Zone

[2] EPL goal aligned with CES initiative 11.2

[3] EV charging station goal aligned with CES initiative 11.3

[4] Goal supports CES initiative 11.3; noted in appendix G expected 50% mass transit commuting

Land

Definition: Balancing the use of land through effective development and efficient infrastructure conforming with the natural environment.

Countywide Goals:

1. Ensure 90 percent of developments adhere to Loudoun County's planned land use guidelines and are compatible with surrounding areas.
2. Protect specified acres per development for natural habitat or open space consistent with the county's land use plan.
3. Minimize parking standards based on type and size of land use consistent with the Zoning Ordinance.

Moorefield Station Goals (Core / Outer Zone):

1. Implement Core / Outer Zone planning strategy to achieve a 2.0 Floor Area Ratio (Core) and 0.4 Floor Area Ratio (Outer) densities with a minimum of 15 percent of public parks, civic and open space.
2. Achieve Living Building Challenge third party certification for 50 percent of buildings (square footage) in the Core and 30 percent in the Outer Zone (square footage).
3. Minimize need to park through approved parking reductions up to 20 percent based on the availability of bus service and up to 50 percent based on the availability of rail service.

Waste

Definition: Minimize solid waste generation and maximize reuse in the construction and throughout the life of the Moorefield Station community.

Countywide Goals:

1. Ensure 100 percent of residents have access to single stream curbside recycling by 2015.
2. Achieve 50 percent participation rate in recycling programs for commercial businesses by 2020.
3. Achieve 80 percent residential participation rate in recycling of 'social goods' (e.g. Goodwill, Freecycle goods/clothing donations).

Moorefield Station Goals (Core / Outer Zone):

1. Use 20 percent (as measured by material costs) local, highly renewable or recyclable materials in construction of Core Zone buildings and 15 percent in Outer Zone.
2. Reuse / recycle (divert) 45 percent of the solid waste generated (by weight) from ongoing use in the Core Zone and 35 percent in the Outer Zone.
3. Reuse / recycle (divert) 50 percent of the construction and demolition (C&D) waste generated during Core Zone construction and 30 percent for Outer Zone.

Economic Development and Stakeholder Engagement

In addition to the five Focus Areas which are used to manage the key components of the IEMP, there are two other integrated and essential elements required to guide and implement the IEMP. Economic development is an overall guiding force for the IEMP and future developments within Loudoun County. Furthermore, an integrated and lasting stakeholder engagement plan is essential to the successful completion, adoption and implementation of the IEMP and achievement of the Focus Area goals. Definitions and a single goal were developed for economic development and stakeholder engagement to ensure their integration and implementation with the plan.

Economic Development

Definition: Contribute to the world's economy by attracting new businesses and innovative technologies, products and services while improving our community's triple bottom line.

Countywide Goal:

- 50 percent of Loudoun County businesses support the CES and adopt the IEMP to enhance their triple bottom line.

The county intends to coordinate and align all economic development and engagement aspects of the IEMP with the Loudoun County economic development department. In addition, the county intends to review the economic development aspects and assessments included in the IEMP with the recently created Energy Advisory Task Force. Feedback from the task force would be included and integrated with the eventual implementation of the Plan.

Stakeholder Engagement

Definition: Engage the citizens and businesses of Loudoun County in creation of highly sustainable developments and their use to eventually act as engagement opportunities influencing behavior throughout the development and beyond; including their own lives.

Countywide Goal

- By 2015, 80 percent of residents/businesses surveyed demonstrate knowledge of sustainability programs, alignment with its objectives and practical application in daily decisions/activities as demonstrated through responses to online surveys.

Effective stakeholder engagement is essential to successful completion, adoption and implementation of the IEMP. General elements to consider and address in an effective stakeholder engagement effort are included below. More specific stakeholder engagement for large capital projects is included in Section 8: Implementation.

In measuring the percentage of residents and businesses demonstrating knowledge of sustainability and the IEMP, the county can monitor and track the performance of the engagement efforts and programs. As specific engagement efforts are developed and implemented, Loudoun County must address different stakeholder groups, market segmentation and associated messaging. As shown in the accompanying diagram, the IEMP stakeholder engagement element involves comprehensive engagement across sectors.

Market Segmentation

Communications are most effective when needs of the audience are well understood and thoroughly addressed. As such, it is useful to divide the audience into logical segments to provide a basis for messaging and engagement methodologies. The following diagram captures potential market segments for the IEMP. Underlying all stakeholder communication it is critical to answer "what's in it for me (WIIFM)?" for each group.

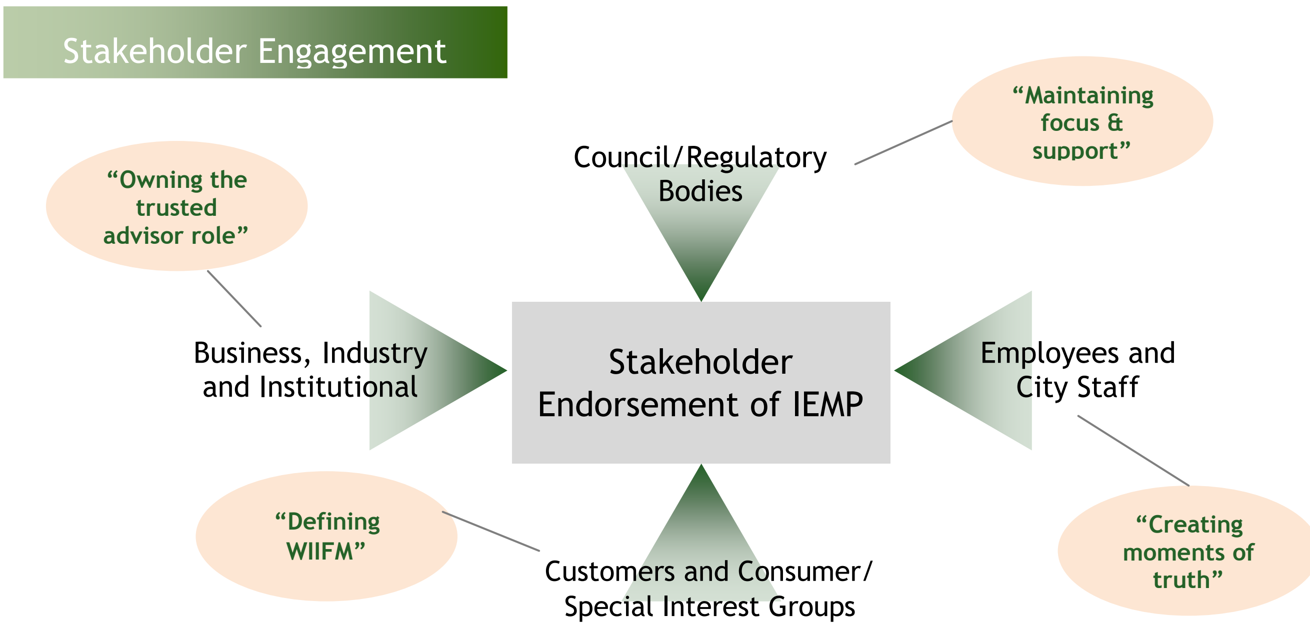


Figure 15: Stakeholder Groups and Objectives

Based on the segments defined, there would be variance in offerings and expected adoption rates for specific programs. For example, programs requiring active engagement and behavior modification, mass transit use or recycling would be most suited to the "count me in" segment; those programs that are more automatic and maybe require only a minor financial commitment, such as purchasing renewable energy credits, would appeal more to the "too busy to care" segment. Experience across industry sectors also shows variance in underlying motivations ranging from those who adopt sustainable behaviors for somewhat altruistic reasons, to others who are most significantly motivated by potential financial savings.

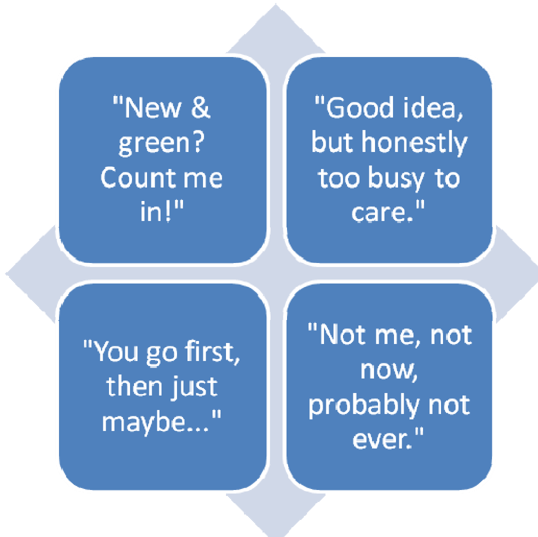


Figure 16: Market Segmentation

Message Development and Engagement Methodologies

Clearly defined messages aid in stakeholders' ability to understand, support and take the desired actions. For the IEMP, time spent defining those messages for the IEMP's selected programs and initiatives will be worthwhile in the long term. Message clarity accomplishes the following:

- Provides a consistent, intentional basis for communications with a clear, single message for all stakeholders: 'home base' for all discussions
- Includes features, benefits and proofs that are then tailored for specific uses: defining "what's in it for me?" from the consumer point of view

Specific stakeholder engagement methodologies were used during development of the IEMP, which will continue throughout the life of the IEMP and implementation. As mentioned previously, the IEMP Team and Advisory Panel are the two core engagement methodologies used to create the IEMP. In addition to the elements included in the plan development phase, ongoing stakeholder engagement in support of specific programs or elements of the plan will need to employ an array of methodologies to augment existing county efforts, such as the following:

- Stakeholder workshops/forums including the Advisory Panel
- Business & Industry Program (e.g. the Green Business Challenge)
- Residential Program (e.g. Residential Energy Conservation Outreach)
- Special Events
- School Programs (K-12 and higher education)
- Electronic Media
- Written communications
- Media Outreach/Public Relations
- Advertising/promotion using existing platforms
- Speakers bureau (e.g. Kiwanis, Rotary, includes talking points, presentations)
- Special Projects (public art, traveling exhibit, displays)

Section 4: Energy Supply Alternatives

After developing the IEMP framework elements including the mission statement and Focus Areas, the IEMP work transitioned to the more analytical and tactical components of the plan. This included the identification and evaluation of energy and energy related projects and programs to support the IEMP goals such as reduced GHG emissions, renewable energy generation, reduced waste and innovation. These projects and programs were organized into Nexus Projects, Flagship Program and Focus Area projects. The Nexus Projects and Flagship program combine to prove the nexus, innovative and world-leading elements of the IEMP mission statement. While the more focused, tactical projects support the respective Focus Area's goals.

To support program and project evaluation, prioritization and selection, several quantitative and qualitative tools and models were used. These tools developed as a part of the IEMP are shown below with a brief description of their use.

- Business as Usual (BAU) GHG Emissions: Projects baseline energy and GHG emissions for Moorefield Station
- Program Inventory and Screening: Screens and prioritizes program options for the Nexus projects, Flagship Program and the Focus Area programs
- Financial and Environmental Model: Evaluates the financial and environmental performance of the Nexus scale projects including scenario analysis

To properly evaluate the impacts and potential benefits of the IEMP and related projects, the BAU GHG emission inventory was created for Moorefield Station as projected over a 30 year period. The BAU GHG emissions provide the required benchmark to compare each project's GHG emission performance. The total GHG emissions for Moorefield Station are estimated to reach 137,700 metric tons CO_2 equivalent ($mTCO_2e$) annually by full build-out of the development.

The program inventory was developed by combining existing county programs related to the IEMP, with new programs and projects identified that support the IEMP. This provided an inventory to screen and identify five Nexus Projects and the Flagship Program. The programs and projects that remained in the inventory were further evaluated to identify and prioritize the tactical Focus Area Programs.

The financial and environmental model was used to perform a detailed cost and benefit evaluation of the five Nexus Projects. This evaluation led to the final recommendations of the 10MW Refuse Derived Fuel (RDF) power plant and the non-potable water system for irrigation. The RDF power plant and non-potable water system each support the IEMP mission and goals, and were determined to be financially and environmentally beneficial. The RDF power plant offers several financial and environmental benefits including:

- $0.037 to $0.055 per kWh average cost of electricity generated (current average costs are approximately $0.07 per kWh of electricity generated)
- 38,648 $mTCO_2e$ per year of avoided GHG emissions (equivalent to a 28 percent annual reduction in Moorefield Station full build-out GHG emissions)
- 80,592 MWh per year of renewable energy generated
- 87,308 tons per year of waste diverted from the landfill

- Seven year extension of the life of the county landfill
- Net present value (NPV) benefit to the county of $40,591,000 for avoided landfill capital costs

The tools and analysis used to generate the above results are discussed in more detail below. Including the creation of the baseline GHG emissions, initial project prioritization and the model used to quantify the direct financial and environmental costs and benefits under several scenarios.

Business as Usual Greenhouse Gas Emissions

In support of evaluating renewable energy and power generation alternatives for Loudoun County and Moorefield Station, a baseline of building related energy consumption and GHG emissions was developed to create a business as usual (BAU) base case. The scope of these baseline GHG emissions for Moorefield Station included the direct emissions from natural gas consumption and indirect emissions from electricity consumption. The BAU case will provide the benchmark to compare energy alternative's financial and environmental benefits. The GHG emissions for the BAU case were developed by utilizing three key sources of information:

- Energy models developed using the Trane Tracer program, similar to eQUEST/DOE2 model, to represent average commercial, residential and institutional building energy consumption and energy use intensity metrics
- Moorefield Station Zoning Plan for maximum allowable development (e.g. number of single family homes and commercial square footage)
- Forecasted Moorefield Station build-out timeline provided by a previous Loudoun County Economic Development study

In addition to the three key inputs listed above, other supporting assumptions and variables incorporated into the BAU forecast include: Commonwealth of Virginia building code, energy efficiency code, equipment performance characteristics, marginal electric GHG CO_2e emission rates and natural gas combustion emission rates. To develop the BAU forecast, the energy use intensity metrics and CO_2e emission rates were applied to the projected build-out of Moorefield Station over time.

The resulting natural gas and electricity related GHG emissions from buildings at Moorefield Station are shown below in Figure 17. The detailed energy modeling, electricity use and natural gas consumption calculations are included in Appendix A.

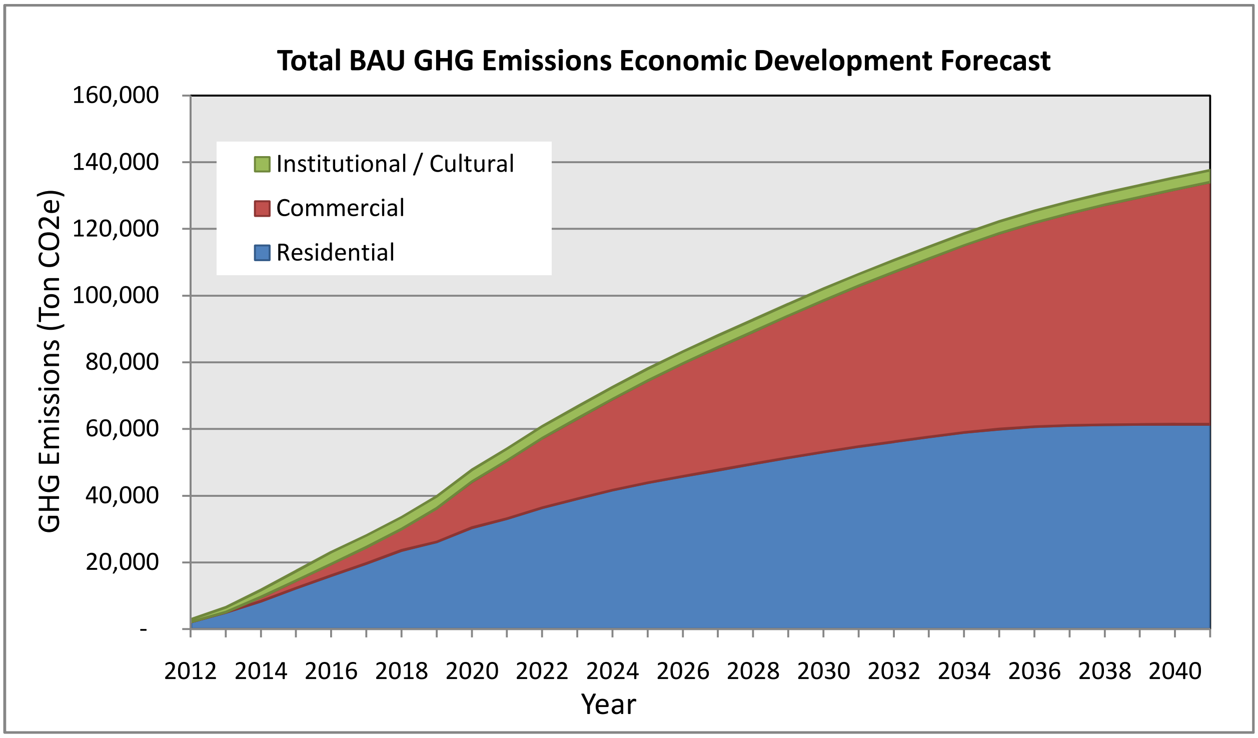


Figure 17: BAU GHG Emissions from Buildings at Moorefield Station

As seen in Figure 17 the GHG emissions are almost solely driven by commercial and residential development over time. The institutional and community related buildings represent a small portion of the overall emissions.

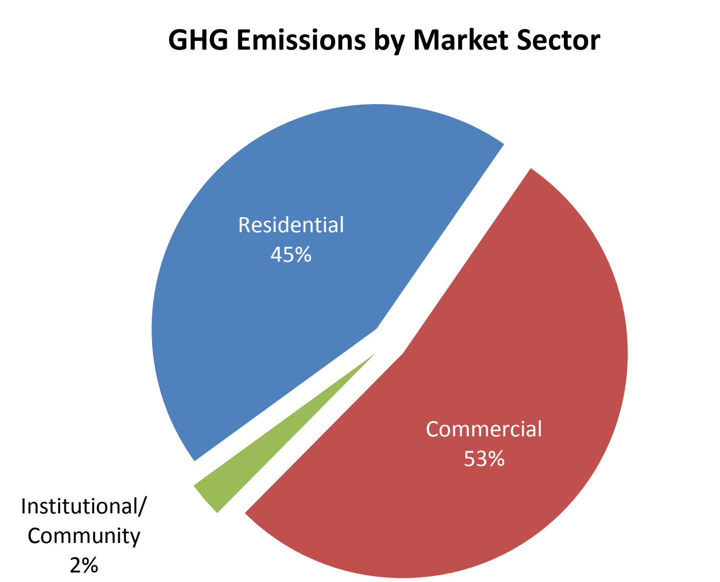


Figure 18: BAU GHG Emissions by Sector

As with many developments of this type and size, the residential or outer areas of Moorefield Station are likely to be developed first. This residential development primarily drives the GHG emissions in the early years (2012 through 2020). As Moorefield Station begins to transition from residential to commercial development in the years after 2020, the number and square footage of commercial buildings increases dramatically, and becomes the primary driver of GHG emissions. Figure 18 shows the breakdown of the GHG emissions at full build-out by market sector with commercial development accounting for a slightly larger share.

Using the maximum potential build out of Moorefield Station as provided in the zoning documents and previously seen in Table 1, the projected GHG emissions reach 137,700 metric tons per year by 2040. This amount of development results in a total estimated peak power demand of approximately 50 to 55 megawatts (MW) and approximately 252,000 megawatt-hours (MWh) of electricity per year at full Moorefield Station build-out. The electricity consumption at Moorefield Station will be the dominant source of the GHG emissions resulting in 90 percent of the total GHG emissions, as shown in Figure 19.

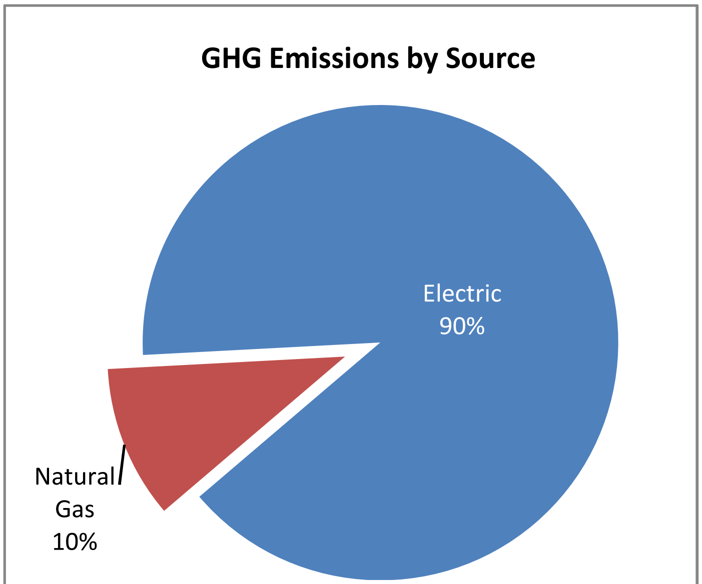


Figure 19: BAU GHG Emissions by Source

Electric System and Renewable Energy Overview

The major electricity providers in Virginia are Dominion Power and Northern Virginia Electric Cooperative (NOV EC). Each utility is a fully integrated electric utility including power generation, transmission and distribution assets and services. Moorefield Station is located in Dominion Power's service territory and will be served by Dominion Power.

The electric load and hourly demand created by Moorefield Station is expected to be similar to the surrounding areas and a typical city or county load. This includes a mix of commercial, residential and institutional electric loads. Figure 20 is a general representation of a typical summer-peaking electric system demand load curve for a city over a full year.

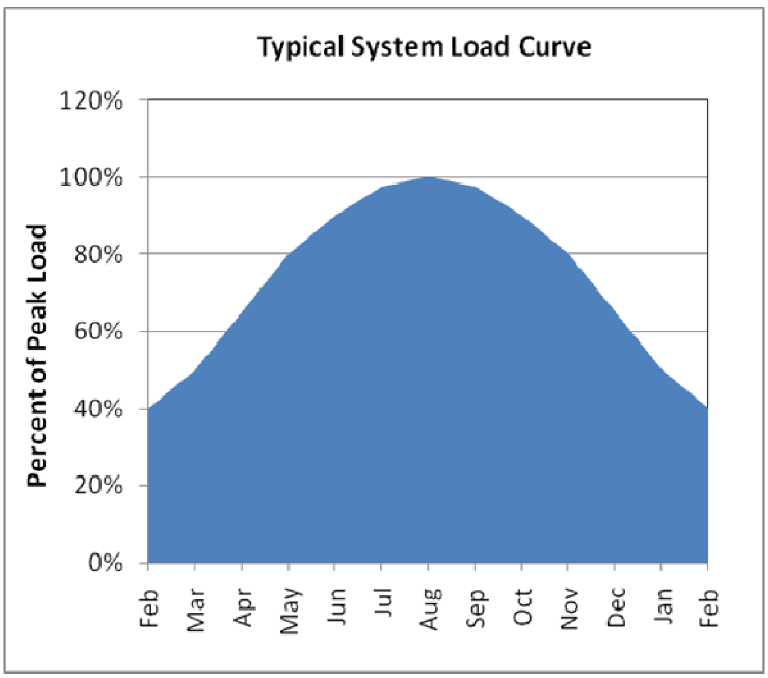


Figure 20: Electric System Demand Curve

As seen in Figure 20, the annual system peaks in the summer months due to the higher summer temperatures requiring increased air conditioning and electric loads. In the winter months the load is lower with reduced electricity demand, and more heating provided by natural gas. System demand curves can also be evaluated to identify base, intermediate and peak loads. Figure 21, shows the system demand with the expected base, intermediate and peak load contributions. A daily system load curve is similar to the annual system load curve in Figure 20. Daily peak demands typically occur between 4:00 and 7:00PM each day depending on the season with lower system load levels at night.

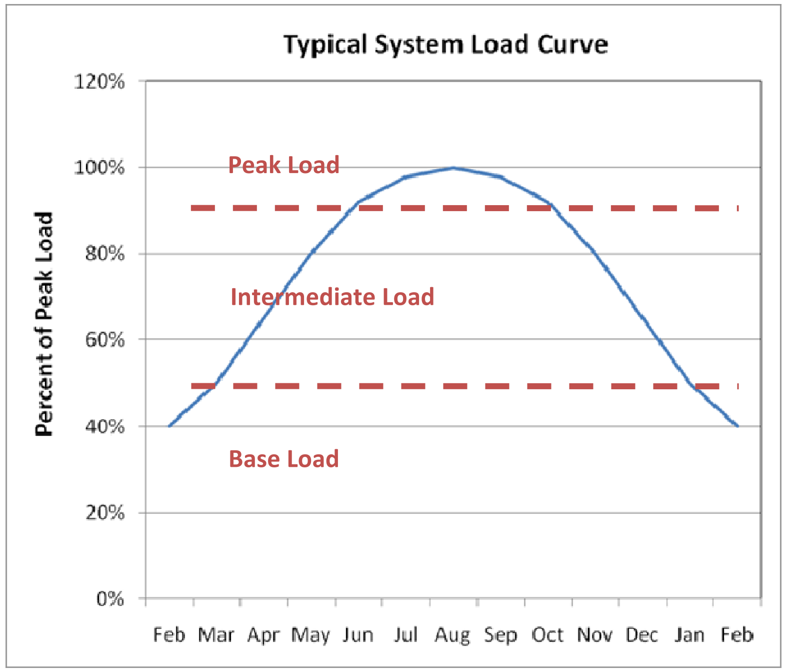


Figure 21: Electric System Demand Curve

In the electric utility industry, power plant resources can be classified into these three categories to serve the system load: base, intermediate and peak. The utility then dispatches or 'turns on' its individual power plants to meet these system loads. Typically, conventional (e.g. fossil) power plant technologies are aligned with and often organized according to these three categories.

These categories also provide some insight on the general costs to generate electricity. As one would expect, base load power typically includes the least expensive power generation technologies (e.g. $ per kWh) because it is expected to operate at all times. However, the most expensive technologies are only intermittently utilized to provide peak load power in limited situations such as a hot summer day with increased air conditioning loads.

Renewable and clean energy technologies can also be aligned with these three categories of the system load. However, some renewable energy technologies cannot be 'turned on' or dispatched as they are reliant on wind or sunlight to produce power. While wind and solar power are intermittent, they can still be classified as a base, intermediate or peaking power technology as dictated by historical data on wind and sunlight. A brief description of the most common renewable energy technologies and their ability to serve system loads is included below.

Wind Power

Wind power converts kinetic wind energy using large (e.g. 1MW or larger) wind turbines where wind flows over the blades of the turbine which turns a rotor and through a gear box, rotates a generator to produce electricity. Wind power is an intermittent source of power and electricity. Capacity factors[5] for wind

[5] Capacity factors are a measure of power plant operation. Capacity factor is a ratio or percentage equal to the net electricity generated over a period of time, divided by the total potential electricity that could have been generated over the same period of time.

turbines are typically 20 to 30 percent. For comparison purposes, conventional base load power plants such as coal plants have capacity factors of 90 percent or higher. In addition to the renewable energy generated, one of the key benefits of wind power is it requires no fuel and has no fuel costs.

Due to the times at which wind power is generated (evenings and night), wind power typically contributes to a system's base load. Conventional wind power in Loudoun County is not likely financially viable due to the lower quality wind resources in the county (e.g. low sustained wind speeds). This is reinforced by the National Renewable Energy Lab's (NREL) wind resource map, available at http://www.nrel.gov/gis/pdfs/windsmodel4pub1-1-9base200904enh.pdf.

Solar PV

Sunlight and solar radiation is converted to direct current electricity when photons strike PV semiconductor cells which creates an electrical current that is stored or converted to alternating current and delivered to the electrical grid. PV capacity factors are typically 10 to 25 percent. PV peak power production does not typically coincide with daily peak demands. However, PV does contribute some portion of its total potential power output at peak periods as the system peak is usually within a few hours of peak PV output.

As with wind, solar PV utilizes a sustainable and renewable fuel source and has no fuel costs. Solar PV is aligned with intermediate power generation. Solar capital costs have been dramatically decreasing over the past several years. Solar PV is applicable in Loudoun County; however, the financial viability is highly dependent on local and national rebates and tax credits.

Biomass

Biomass power generation utilizes a vegetative or biofuel feedstocks such as wood, grasses, crop wastes or municipal solid waste. The biomass feedstocks are combusted to generate steam in a boiler to operate a steam turbine to generate electricity. Since biomass power plants operate with high capacity factors, similar to conventional fossil fuel plants, they are considered a base to intermediate load power resource.

The financial viability of biomass plants is primarily dependent on fuel feedstock prices, availability and transportation costs. Biomass power plants are financially viable in Loudoun County; however, the cost effectiveness is dependent on local feedstock availability and prices. Four larger (approximately 50MW each) biomass power plants have recently been announced in Virginia.

Geothermal

Geothermal power is generated by geothermal energy from heat and steam below the Earth's surface. Geothermal plants either directly utilize the steam from geothermal features or use a heat exchanger to transfer the geothermal energy and heat an alternative fluid to create steam. The steam then rotates a steam turbine to generate electricity. Geothermal power plants typically have high capacity factors of 90 percent or more and are considered a base load technology. The viability and application of geothermal power is highly dependent on the access to steam and geothermal features relatively close to the surface. Recently, enhanced binary systems using much lower temperature water and heat exchangers have shown promise. There are no conventional geothermal resources for power generation within Loudoun County.

Based on this general understanding of the renewable energy options in Loudoun County, the BAU GHG emissions and the overall operation of electric utility systems, the IEMP Team and Consultant began to inventory and identify energy alternatives for Moorefield Station and the county. This process led to the development and selection of the Nexus Programs, Flagship Program and tactical Focus Area programs.

Project Inventory and Screening

As shown previously in Figure 1, the IEMP is structured with an overarching mission statement, with specific Focus Areas, Nexus Projects and a Flagship Program for supporting and achieving the IEMP goals and proving the mission. The IEMP Team, Consultant and county staff developed an inventory of the existing programs, policies or projects currently in use at the county that could prove the mission and support the Focus Area goals. An internal IEMP team brainstorming session and subject matter experts from the Consultant then identified potential new programs that were added to the existing list.

A screening tool was then developed and applied to the full new and existing program inventory to begin prioritizing the options to identify the Nexus Projects, Flagship Program and more tactical Focus Area programs. The screening tool scored and ranked the programs and projects with respect to four criteria:

- Nexus: contributes and cuts across multiple Focus Area goals
- Innovation: unique, leading edge concept; considered an example for other communities
- Energy impact: contributes to key county Energy Strategy goals of reduced GHG emissions and renewable energy generation
- Individual Focus Area Goals (e.g. specific to water, energy, transportation, land use and waste)

Projects and programs which resulted in high scores for the first three criteria (nexus, innovation and energy impact) were screened and selected for further evaluation and became the Nexus Projects and Flagship Program. The Nexus Projects and Flagship Program directly support and prove the IEMP mission. The Nexus Projects and Flagship Program form the trademarks of the IEMP while the remaining projects and programs are more tactical in nature for each Focus Area.

Nexus Projects include larger assets or more capital intensive projects while the Flagship Program is intended as more programmatic mechanism to manage ongoing and evolving partnerships and programs. The projects and programs remaining after identifying the Nexus Projects and Flagship Program were then prioritized with respect to the applicable Focus Area goals. The results of the Nexus and Flagship screening are shown below in Table 2.

Table 2: Nexus Project and Flagship Program Screening

Program	Nexus	Energy Impact	Innovation	Total
1. Combined Heat and Power (Biomass or Conventional Fuel)	5	5	5	15
2. Living Building Challenge	5	5	5	15
3. Zero Energy District	4	5	5	14
4. Finance EV Charging Stations at Residential and Multi-Family	4	4	5	13
5. Waste-to-Energy	4	5	3	12
6. Non-Potable Water System for Data Center Cooling Towers and Irrigation	4	4	3	11
7. Neighborhood Distribution Centers (Recycling, Local Markets, Freecycle)	4	3	4	11
8. Codify/Incentivize Sustainable Building Codes	4	4	2	10

Based on the screening, five Nexus Project alternatives were selected for further financial, technical and environmental analysis:

- Combined Heat and Power – Conventional Fuel (Natural Gas)
- Combined Heat and Power – Biomass Fuel
- Refuse-derived Fuel – Plasma Arc Gasification Technology
- Non-potable Water System
- Improved Energy Building Code

The remaining programs (Living Building Challenge, Zero Energy District and Neighborhood Distribution Centers) were consolidated to create an overarching zero energy, water and waste laboratory which became the Flagship Program. The Flagship Program was initially branded as the ZEW^2 Lab with a targeted implementation in the Core Zone of Moorefield Station. The remaining project and program inventory was further scored and prioritized based on each program's support of their respective Focus Area goals. A detailed description and evaluation of the Nexus Projects, Flagship Program and Focus Area programs is included below. The full program inventory and screening tool is also included in Appendix C.

Nexus Projects

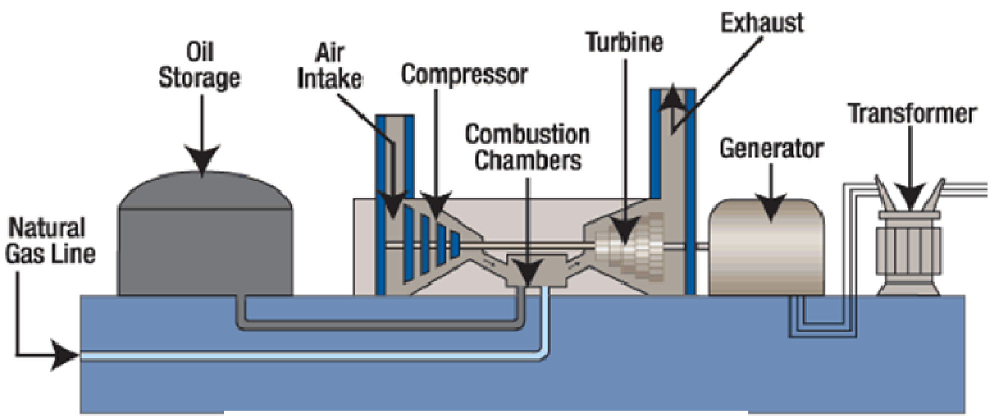
All of the Nexus Projects discussed below were evaluated for technical, financial and environmental feasibility through a financial and environmental model developed for the IEMP. The model was used to develop an average cost of energy delivered and to quantify the environmental costs or benefits. The model results and scenario analysis were used to perform a final prioritization and recommendation for project implementation.

Natural Gas Fired Combined Heat and Power Plant

The natural gas CHP plant features a combustion turbine generator, electrical generator and a heat recovery steam generator and requires approximately one to two acres of land. A conventional CHP plant generates power by combusting natural gas in a turbine, which then rotates an electrical generator to create power and electricity. After the combustion, the heat from the exhaust gas is passed through a heat recovery steam generator (HRSG) which produces steam that can be used for district heating or industrial processes. The steam from the HRSG passes through a heat exchanger to generate heating hot water which is pumped throughout the campus or district to individual buildings for heating.

The CHP project evaluated for the IEMP was a 25MW power plant that could provide enough power to meet the needs of approximately 6,500 to 7,000 residential homes. The natural gas would be contracted from and provided by the local natural gas pipeline company. As natural gas CHP is the most conventional alternative, having a long history of commercial operation and success, it will serve as somewhat of a benchmark or baseline for the other power alternatives. Figures 22 and 23 include a combustion turbine power plant diagram and a photo of a similarly sized natural gas power plant to the one evaluated in the IEMP.

Biomass Fired Power Plant



Courtesy of Tennessee Valley Authority Website

Figure 22: Combustion Turbine Diagram

Courtesy of International Energy Systems website

Figure 23: Combustion Turbine Power Plant

The IEMP evaluated a 10MW power plant capable of providing enough power for the needs of 3,000 to 3,500 residential homes. Biomass power generation is considered to be a renewable energy source and a carbon neutral technology since it uses renewable fuel feedstocks such as wood, bagasse, or grasses instead of fossil fuels. The feedstocks can be harvested and provided locally (e.g. woody, vegetative or C&D wastes) or purchased on the market through biomass suppliers on the East Coast. The biomass fuel can be stored in a covered storage area to keep it dry, then feed into a stoker furnace or fluidized bed, where it is combusted to generate heat and produce steam through a boiler. The superheated steam is then used to drive a steam turbine and generator to generate electricity. A biomass CHP plant would address a nexus of energy, waste and potentially land use issues in the county.

Figure 24: Biomass Feedstock and 60MW Power

Figure 25: Example Biomass

Alternative technologies gasify the biomass in an enclosed vessel and produce a syngas that is then combusted to generate the heat required for the production of the superheated steam. After the biomass or syngas is combusted, the exhaust gas then flows through a baghouse to remove any particulates from the stream before it is scrubbed to remove nitrogen and vented to the atmosphere through a stack. A typical biomass power plant of this size can require a space of 15 acres. Figures 24 and 25 are examples of larger biomass power plants.

In addition, other technologies and equipment can be added to the biomass plant described to increase the number and types of biomass feedstocks available. For example, an autoclave can be added to allow a greater diversity of feedstocks such as a municipal solid waste derived biomass feedstock. An autoclave applies high pressure saturated steam to municipal solid waste in order to convert the waste to an organic fiber or 'fluff'. By utilizing an autoclave, the resulting organic material or waste is sterilized and considered non-volatile and uncontaminated.

The organic fiber can then be processed into pellets or briquettes and combined with other biomass feedstock streams and used in the fluidized bed or other combustion chamber of a boiler. If the waste stream has a significant amount of plastics, metals and/or glass included, the autoclave will soften and flatten the plastics and it will clean metals and glass objects. The plastics, glass and metals can then be separated from the fiber by screens or other recovery systems to further increase recycling rates while still delivering the fiber feedstock. The autoclave can be located within the existing space required for a biomass power plant. An example of an autoclave is shown in Figure 26.

Courtesy Waste Technologies Website

Figure 26: Autoclave Technology

Refuse-derived Fuel Power Generation

At this point in time, generating electricity from refuse-derived fuel is an established and conventional power generation option. Moreover, in the last several years, new technology options for the processing of municipal solid waste have improved the emissions and operations of such plants. The IEMP evaluated a 10MW plasma arc gasification technology that has been growing in use and acceptance for RDF plant facilities due to its reduced emissions and improved performance. The 10MW facility would be enough power to provide the annual electricity needs for 3,000 to 3,500 residential homes. WPP Energy Corporation currently utilizes the plasma arc technology in their EPOD generation units. There are additional vendors and developers currently pursuing plasma arch technology projects in North America. Plasma arc technologies have primarily been used in Japan and Europe, with several smaller applications in the U.S. and Canada such as Westinghouse Plasma Corporation, a division of Alter NRG Corporation. Similar to biomass CHP, a refuse-derived power plant would address a nexus of waste, energy and potentially land use issues.

Figure 27: Utashinai Waste to Energy

Plasma arc technology vaporizes solid waste material in an enclosed vessel, creating steam and a syngas that are combusted and used to generate electrical power in turbine generators. The waste streams that can be used include: biomass, MSW, MSW hazardous wastes and medical wastes. The land space required for the EPOD technology design is approximately 15 acres. Plasma arc technology is a proven technology that has been used in smaller hazardous and municipal waste management scenarios and refuse-derived power plant facilities (e.g. less than 20MW). A few larger projects (e.g. greater than 25MW) have been developed on a commercial and demonstration scale. The largest plasma arc gasification refuse-derived power plant facility in the U.S. was recently permitted in July of 2010. It is expected to be approximately 160MW and the design and construction is just beginning. Figure 27 shows a larger plasma arc refuse-derived power plant facility designed to provide 300MW of power in Japan which began operation in 2002.

Non-Potable Water System

Establishing a non-potable water system at Moorefield Station would provide local, minimally treated water for appropriate uses such as make-up water for building cooling towers or localized irrigation needs. A non-potable water system at Moorefield Station includes leveraging the currently planned and approved stormwater control ponds to provide a water supply for the non-potable system. Sump pumps, piping and related equipment would be used to pump and deliver the water from the ponds to specific distribution points for open space/common area irrigation and make-up water for cooling towers (e.g. cooling towers for data centers near Moorefield Station).

The non-potable system was initially sized to provide the irrigation needs for the large community and open space near the planned school in the western portion of Moorefield Station, as well as the make-up water needs equivalent to the cooling tower evaporation needs of cooling approximately 500,000sf of commercial space[6]. This equates to almost nine acre-feet of water over the course of 15 days.

A non-potable water system addresses the nexus of water and energy. Typically the two largest costs for a water treatment utility are energy and chemicals. By reducing the amount of water needed at Moorefield Station, it will reduce the energy consumed in treating and delivering the water from the water utility (Loudoun Water) and reduce the peak day water requirements which drive infrastructure sizes and investments. Creating a non-potable water system for these treated water applications reduces peak demand, operating costs, chemical use and energy consumption by Loudoun Water.

Improved Energy Building Code

Annual Green Building Conference focuses on mitigating impacts of built environment.

Current data shows that the built environment has a substantial impact on energy consumption. The state of Virginia has jurisdiction and establishes the building and energy codes used throughout the state and all communities and counties in commercial and residential building construction. In some cases, specific developments with local covenants, such as home owners associations, can set more stringent or localized codes. The current energy code for Virginia is the ASHRAE 90.1 2007 energy code which is widely considered an efficient code and a best practice for building energy efficiency. As a separate

[6] The amount of make-up water available for a cooling tower is approximately 15,000gal per day, or equivalent to the evaporation losses for a 1,000ton water cooled chiller system. This amount of air conditioning is equivalent to the approximate needs of 500,000sf of commercial building space.

development with jurisdiction to adopt a more stringent code, Moorefield Station can require an improved energy code on the buildings constructed within the boundaries of Moorefield Station.

While there is the authority to adopt a broader, more sustainable building code (e.g. including recycled products, water conservation measures and building orientation), the quantitative evaluation of a more stringent code was limited to energy specific items. This included heating, ventilation and air conditioning (HVAC) and lighting equipment, while the broader architectural issues such as building orientation to the south and window to wall ratios were removed. These broader architectural and building orientation issues are less controllable through a code and would begin constraining the development and architectural flexibility necessary to develop Moorefield Station. As Moorefield Station is developed, orientation and southern exposure will be incentivized and coordinated. However, it cannot be directly controlled on each building, and thus was not included in the modeling.

Implementing or codifying a more stringent energy code for HVAC and lighting would result in greater energy savings and reduced GHG emissions for the development. This improved energy code would require, on average, 15 percent more efficient HVAC or lighting equipment. Examples of the more efficient equipment include: upgrading from T-8 to T-5 lighting systems and upgrading from an 80 percent to 95 percent efficient boiler or water heater.

Flagship Program: Zero Energy, Waste and Water District

Through the course of the Plan development and confirmed by Advisory Panel feedback, it became clear a compelling community engagement and innovative technology testing program was needed for Moorefield Station. The results of the program screening identified the core components of the Flagship Program: the Living Building Challenge, Zero Energy District and Neighborhood Distribution Centers. These components were consolidated to become the basis for the Zero Energy, Water and Waste lab or ZEW^2 Lab Flagship Program. The ZEW^2 Lab is the initial name developed by the IEMP Team for the program; however, future discussions within the county are expected and required to finalize the name and public/economic development brand for the Flagship Program.

The ZEW^2 Lab has two program hallmarks:

1. Harness technology and infrastructure in partnership with other global leaders
2. Move beyond <u>transit</u> orientation to <u>people</u> orientation

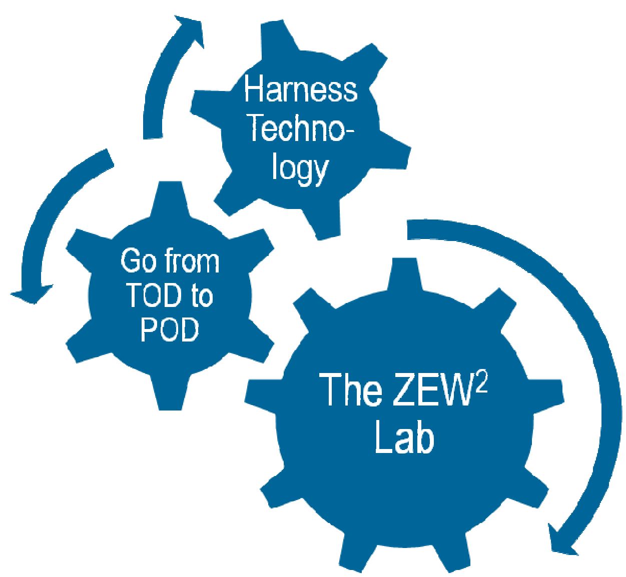


Figure 28: ZEW^2 Lab Diagram

The ZEW^2 Lab provides the mechanisms to engage partners and apply innovative technologies that support zero energy/waste/water in the Core Zone of Moorefield Station. The ZEW^2 Lab will act as a beacon for other communities and developments to follow and serve to prove the mission statement.

Moving to a true nexus and people centric approach creates synergy and provides global leadership; creating a lab environment harnesses human creativity.

The two hallmarks are used to coordinate and manage the supporting components, partnerships and programs for the ZEW^2 Lab. Hallmark 1 includes technology and infrastructure related components such as:

- Develop and implement Nexus Projects
- Pilot new technologies and partnerships
- Implement smart grid with progressive customer interface
- Develop non-potable/reclaimed water supply and re-use

Hallmark 2 includes components and projects to move beyond transit-oriented development to people oriented development or "TOD" to "POD." Elements include:

- Customer engagement / consumer behavior change partnerships
- Innovative parking solutions and new strategies
- Neighborhood distribution point, community engagement and learning opportunity
- Urban agriculture
- Social media
- Living building challenge

One of the key elements of the ZEW^2 Lab is to provide the main framework to engage, manage and implement innovative infrastructure and technology partnerships at Moorefield Station. Through the development of the IEMP and the Advisory Panel meetings, several initial partnership opportunities for the ZEW^2 Lab have been identified and initially developed. The initial partnership opportunities are listed below.

- Dominion Power
- EV Charging Pilot (750 participants) ends 11/2014; TOU Rate
- Smart Grid Pilot / Implementation
- PV incentive rates, PV pilot lease program and alternative distributed generation rate structures (net meter, future tariffs)
- NREL
- Communities of the Future (likely requires funding/grants)
- Emerging technology implementation
- Clean Cities Partnerships (100 partners, VA Clean Cities: transportation / alt. fuels and vehicles: **http://www.hrccc.org/about-the-program/about-us/**)
- Private Waste Haulers
- Recycling / Neighborhood distribution point
- Loudoun Water
- High efficiency fixtures, reclaimed water
- Verizon
- Communications / Smart Grid portal / App

Technical, Financial and Environmental Evaluation of Nexus Projects

To further evaluate and analyze the five Nexus Projects, a financial and environmental pro forma[7] tool was developed and provided to the IEMP team. It is important to note that where applicable, conservative estimates were used for Nexus Project financial and performance inputs to insure project recommendations included contingencies and were based on worst-case scenarios. The objective was to under promise and perhaps over deliver, rather than vice versa. As more detailed evaluations and engineering studies are developed for the recommended projects, the overall performance of the projects should remain the same or improve as compared to the pro forma calculations.

The pro forma tool models the Nexus projects and calculates key project performance metrics (based on the project) including:

- Average cost of energy delivered
- GHG emission reductions
- Renewable energy generated
- Average cost of water delivered
- Water demand reduction
- Value of landfill life extension
- Amount of waste diverted from landfill

The model also includes the ability to perform scenario analysis to evaluate specific inputs or assumptions and their subsequent affects on the results and performance. Using the initial results of the model, the county's and IEMP goals and the scenario analysis, a final prioritization of the five Nexus projects was completed. Several technical and project-specific assumptions are embedded in the pro forma and are used to calculate the performance and run scenarios. These technical assumptions include: power equipment heat rates, fuel costs, fuel consumption, capital costs, operating costs, water availability and marginal GHG emission rates.

In each Nexus project evaluation, the potential financial benefit associated with renewable energy credits (REC) was not included in the base case results. In addition, any potential cap and trade or federal climate change regulatory impact was not included to reflect the unlikely passage or adoption of comprehensive federal regulation in the short and midterm (i.e. next five to ten years). If federal climate change legislation were to pass and be implemented, the financial benefits related to renewable energy would be realized in carbon offsets or credits and eliminate RECs. Furthermore, the energy efficiency financial benefits did not include the potential for increased energy costs resulting from a federal cap and trade regime or regulatory framework. This was a conservative estimate and assumption to ensure the projects would be financially feasible without additional REC support. As the REC market is a mix of voluntary and regulatory requirements, and somewhat unreliable, any REC related revenues were considered "below the line" benefits. In addition, due to the lower prices for RECs, it is unlikely to materially impact the results; however, any REC financial benefits would be in addition to what is included in the base case evaluations and further

[7] A pro forma is a financial model that projects and anticipates the performance of a transaction, business operation or capital investment based on current information and inputs.

reduce the cost to deliver electricity. A full list of the assumptions and results, including REC impacts, is included in the Appendix E in addition to the full pro forma results.

As a result of the pro forma tool and related scenario analysis, two of the five projects appear financially and environmentally feasible under current conditions and assumptions. Other projects are likely to become more attractive as Moorefield Station development increases over time. As a result of the IEMP process and pro forma tool, the following projects are recommended for more detailed analysis and implementation:

- RDF Power Plant (with option to augment fuel with local biomass)
- Non-Potable Water System

The RDF alternative provides base load power generation capabilities, results in the lowest average cost of electricity and is less than current electricity costs in Loudoun County. In addition to the lower cost of electricity, RDF technology and power generation provides multiple other financial and environmental benefits to the county. RDF power is classified as renewable energy in the Commonwealth of Virginia and by the DOE, thus resulting in significant GHG emissions reductions. The 80,592MWhs of renewable energy generated by the RDF plant provide 38,648mTCO_2e GHG reductions per year. The GHG emission reductions are equivalent to reducing Moorefield Station electric and natural GHG emissions by 28 percent at maximum projected build-out. The RDF power plant also extends the life of the landfill and avoids future landfill capital expenditures of up to $40 million.

The non-potable water system addresses peak day water demand which is a significant issue for the local utility, Loudoun Water. The non-potable water utility is cost competitive and reduces the environmental impact of treating and conveying water.

A summary of the two highest priority Nexus projects are shown in Table 3 with the full results and scenario analysis of each Nexus project included below.

Table 3: Highest Priority Nexus Project Results

Project	Avg. Cost of Electricity ($/kWh)[1]	Current Cost of Electricity ($/kWh)[2]	Avg. Cost of Delivered Water ($/1,000gal)	Current Cost of Delivered Water ($/1,000gal)	GHG Emission Reductions (mT CO_2e/Yr)
10MW RDF Power Plant	$0.037	$0.07	N/A	N/A	38,648
Non-potable Water System	N/A	N/A	$3.68	$5.31 - $7.12[3]	NA[4]

1. Costs do not include transmission and distribution costs from Dominion Power of approximately $0.03 per kWh.
2. Approximate cost of transmission and distribution ($0.03 per kWh) has been removed from current VEPGA average rates of approximately $0.10 per kWh.
3. Loudoun Water currently has three tiers to their residential rates: the 2nd and 3rd tiers are similar to the non-potable water system usage. $5.31/000gal for 25,000-50,000gal per quarter and $7.12/000gal for 50,000gal+ per quarter
4. GHG emission reductions are unclear, as energy consumption for water treatment is unavailable at this time.

Natural Gas Combined Heat and Power (CHP)

The natural gas fired CHP plant was evaluated as a benchmark and conventional technology application for Loudoun County and Moorefield Station. As a conventional technology with smaller land use footprints than the other alternatives, the CHP size was increased to 25MW to provide a larger proportion of the total Moorefield Station power consumption. Five (5) MW combustion turbines were used in a modular fashion to align with and grow with the forecasted loads at Moorefield Station. As there are no immediate needs for centralized heating systems in Moorefield currently, in seven to 10 years there appears to be a large enough need to utilize the power and central heating capacity. The size of a natural gas fired CHP plant is not constrained by the fuel supply and availability as much as the other alternatives.

Natural gas is a much lower GHG emission fuel source for power than coal, and can be used for base, intermediate and peaking power loads. Due to the lower emission rates, ease of construction and currently low commodity prices, natural gas-fired power generation plant construction is expected to increase significantly in the short and mid-terms. While current commodity prices are lower than in the past (approximately $4.00/MMBtu), natural gas is historically a volatile commodity market as seen in Figure 29.

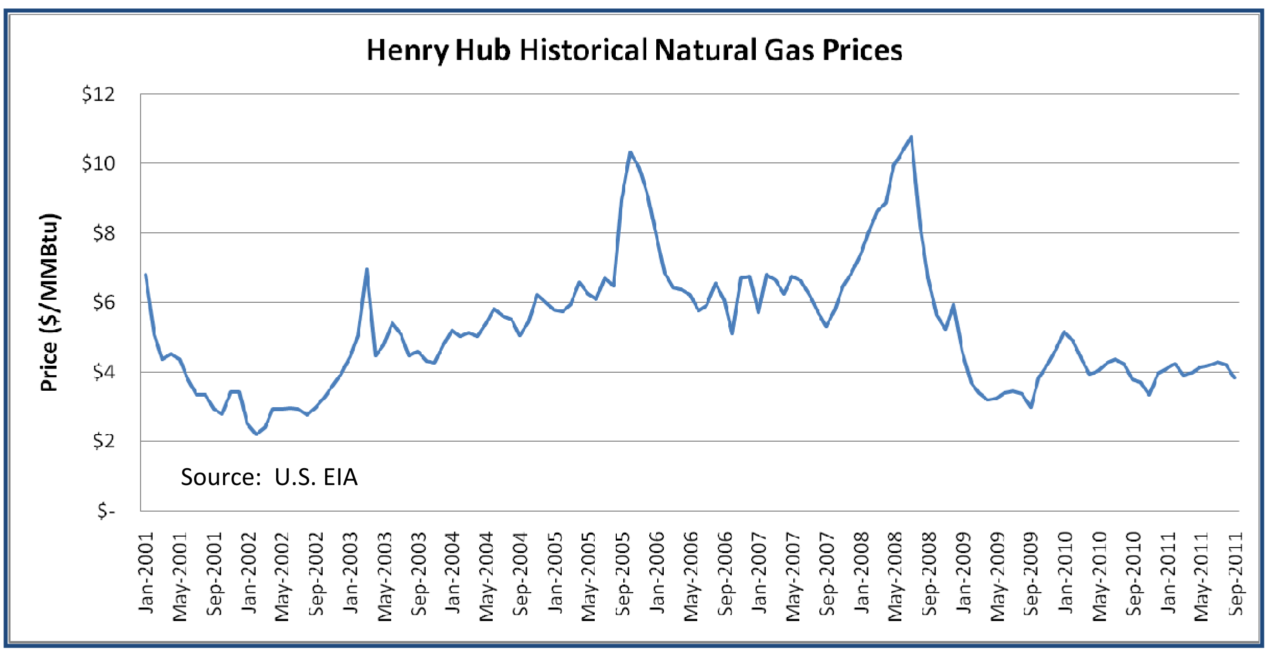


Figure 29: Historical Henry Hub Spot Prices for Natural Gas

The recent natural gas shale supplies in Pennsylvania and Texas, in addition to added transmission capacity from the Western U.S. to the Midwest have stabilized the market. Most natural gas forecasts show prices remaining stable with a steady escalation over time similar to an inflationary escalation as seen in Figure 30.

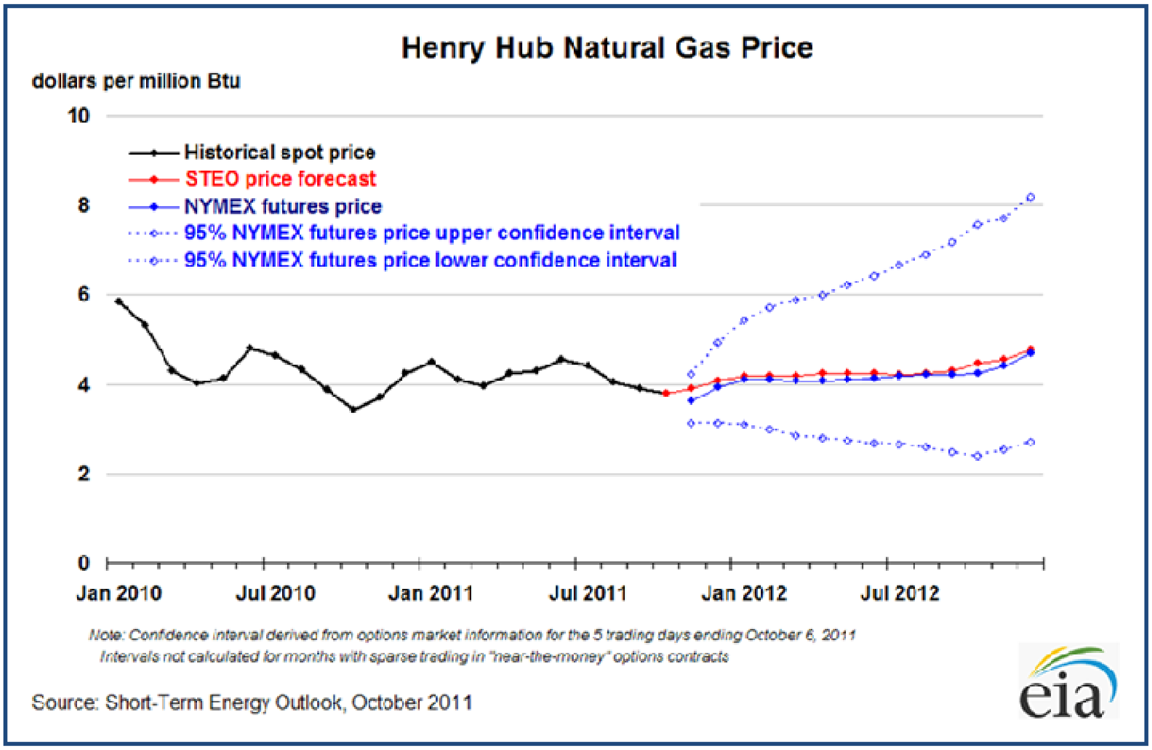


Figure 30: Forecasted Henry Hub Spot Prices for Natural Gas

A base case for the natural gas CHP plant included several technical inputs and assumptions. A list of the key assumptions impacting the performance and results of the natural gas CHP plant is included below.

- Combustion turbine heat rate: 11,500 btu/kWh
- Marginal CO_2e emission rate: 0.61 mTons CO_2e /MWh
- Capital costs: $32,500,000 (Gas turbine power plant) / $12,350,000 (District heating)
- Natural gas commodity prices: approximately $4.00/MMBtu in 2011; EIA natural gas commodity pricing forecast used for future years

The largest impact to the financial performance of the natural gas CHP plant is the annual fuel cost or annual commodity prices. To understand the impact on overall average costs of electricity and the financial performance, a scenario was run in the pro forma to reflect a higher natural gas commodity price.. The financial and environmental results of the base case and scenario for the natural gas CHP plant are shown below.

Table 4: Natural Gas Combined Heat and Power Results

Performance Metric	Base Case	Scenario 1
GHG Emissions ($mTCO_2e$/Yr)		
Moorefield Station BAU	137,665	137,665
GHG Reduction (Increase) [% of BAU] [1]	(19,182) [-14%]	(19,812) [-14%]
Renewable Energy Generated (MWh)	0	0
All-in Average Cost of Electricity ($/kWh) [2]		
Power Costs Only	$0.090	$0.108
Apply Heating Revenues/Profits	$0.089	$0.106
Heating Costs [3]		
Current Cost of Delivered Heat ($/MMBtu)	$10.13	$12.15
Average Cost of CHP Delivered Heat ($/MMBtu) [4]	$6.11	$6.11

1. GHG reductions include possible reductions from power generation and reductions from CHP avoided natural gas heating emissions
2. Results represent a 20 year average present value of electricity costs. Costs do not include transmission and distribution costs from Dominion Power of approximately $0.03/kWh.
3. Current heating costs and CHP results represent a 20 year average present value of heating / natural gas costs.
4. Heating costs recovered include district heating capital and O&M costs only. All fuel (NG) costs are embedded in the power generation costs; steam and hot water are the byproducts.

Due to Dominion Power's current marginal GHG emission rate for their power generation assets (0.49mT CO_2e/MWh), a natural gas CHP plant with the above assumptions does not generate power at a lower marginal GHG emission rate than Dominion Power's current generation asset mix. The project would actually result in increased GHG Emissions rather than a reduction. The reduction in heating related natural gas combustion emissions avoided by the CHP plant are included in the GHG emission calculations.

Alternative modular CHP natural gas technologies are available such as internal combustion engines or 'gen sets' with slightly more efficient heat rates. However, these slightly more efficient units still result in a net GHG emission increase from the BAU case and higher average costs of electricity than current prices. A more efficient power generation technology would also result in decreased steam and potential heating capacity for the CHP plant. Furthermore, the average cost of generating electricity for a natural gas CHP plant as evaluated would be higher than current Dominion Power electricity rates of approximately $0.07 per kWh not including transmission and distribution costs.

While the electricity costs are higher than current prices, the heating generated by the CHP plant would be delivered at a substantial decrease from current natural gas heating costs. Current heating costs are estimated at $10.13 per MMBtu at current natural gas market prices. The CHP plant is able to provide heating at $6.11 per MMBtu to cover the district heating capital and O&M costs. However, even with this savings applied to the overall price of electricity generated by the CHP plant, the levelized cost of electricity is marginally reduced to $0.089 from $0.090.

Biomass Power Plant

The second Nexus project evaluated by the pro forma tool was a 10MW biomass fired power plant. In Loudoun County, there are current and future municipal solid waste streams such as vegetative waste, woody waste and debris and C&D waste that can be used as a biomass feedstock. These readily available, local feedstocks are augmented with regionally supplied and processed biomass feedstocks such as pelletized vegetative waste or lumber mill by-products, to deliver the full fuel needs of a plant. One potential advantage of such a plant is the economic development associated with the local feedstocks such as leveraging local farmers to provide biomass feedstocks such as switchgrass or crop waste products.

Due to the operations, local waste fuel sources and land required to develop a biomass power plant, the plant was initially located at Loudoun County landfill. While heat recovery from the power generation process is an option for a biomass power plant, to remain conservative in the evaluation of the plant benefits, the centralized heat benefits were not included. In addition, there are currently no industrial processes or dense developments close to the landfill that would require the heat generated. The benefits of a biomass power plant include: renewable energy generation, reduced GHG emissions, municipal solid waste diversion and avoided capital costs associated with extending the life of the landfill. The key assumptions used in the biomass power plant base case impacting the final results and performance are included below.

- Biomass boiler and steam generator heat rate: 14,000 btu/kWh
- Heat content of feedstocks (average): 5,900 btu/lb
- Material handling costs: $5 per ton
- Tipping fees allocated to biomass plant: $30 per ton (50 percent of current tip fees for each ton of waste utilized as biomass feedstock)
- Locally available municipal solid waste biomass: 15,016 tons per year
- Fuel costs (in addition to local waste, if needed): $40 per ton
- Capital costs: $43,000,000

Production tax credits (PTC) and / or tax equity investments were not included in the financial evaluation for any of the Nexus Projects evaluated. Federal production tax credits for renewable energy projects are currently scheduled to expire at the end of 2013. Any renewable energy project utilizing production tax credits of $0.011 to $0.022 per kWh must be in commercial operation by December 31, 2013 to receive the credits. It is unlikely Loudoun County will be able to develop a biomass power plant in time to meet the required in-service date and receive the credits. If congress extends the PTC legislation, and the county were to use a third party to develop the project and take advantage of the credits, the average cost of electricity would be reduced further by $0.011 per kWh.

The largest impacts to the financial performance of the biomass power plant are the amount of locally available municipal waste biomass, portion of current tipping fees allocated to the plant and the purchased fuel costs. Several scenarios involving the above variables were evaluated in the pro forma to better understand the impact to the cost of delivered electricity. The financial and environmental results of the base case are shown below in Table 5.

Table 5: Biomass Power Plant Base Case Results

Performance Metric	Result	Units
GHG Emissions ($mTCO_2e$/Yr)		
Moorefield Station BAU	137,665	$mTCO_2e$ per Yr
GHG Reduction (Increase) [% of BAU]	38,684 [28%]	$mTCO_2e$ per Yr
Renewable Energy Generated	80,592	MWh per Yr
Waste Reduction / Diversion	15,016	Tons per Yr
All-in Average Cost of Electricity[1]	$0.083	Per kWh
Extension of Landfill Life [% of Life]	1.1 (11%)	Years
Net Present Value of Avoided Landfill Capital Expenditures	$6,980,000	

1. Costs do not include transmission and distribution costs from Dominion Power of approximately $0.03/kWh.

Biomass power generation is financially feasible and results in significant environmental benefits. Biomass is classified as renewable energy within Virginia and throughout the U.S. resulting in GHG emission reductions of 38,684 $mTCO_2e$ or 28 percent of the total Moorefield Station GHG emissions at full build-out. In addition, by using local waste feedstocks, biomass power diverts an additional 15,016 tons of waste from the landfill for beneficial uses and extends the life of the Loudoun County Landfill by a year or more, saving the equivalent of almost $7 million in capital expenditures.

Table 6 compares the average cost to generate electricity for the base case and each scenario. Each of the scenarios adjusts one of the variables or assumptions from the base case (i.e. each of the scenarios is independent from the others; the adjustments are not cumulative).

Table 6: Biomass Power Plant Scenario Results

Scenario:	Average Cost of Electricity ($/kWh)[1]
Current Dominion Power Rates	$0.070
Base Case	$0.083
1. Reduced Tip Fee Revenue Allocation ($0/Ton)	$0.087
2. Increase in MSW Available for Biomass (200% of Base Case)	$0.071
3. Reduced Biomass Fuel Costs ($20/Ton)	$0.062
4. No MSW Used for Biomass (100% Purchased Fuel)	$0.094
5. RECs Included at $5 per MWh	$0.078

1. Costs do not include transmission and distribution costs from Dominion Power of approximately $0.03/kWh.

The results of the scenario analysis show the price of fuel and local solid waste/biomass availability significantly impact the average cost of electricity generated. It is important to note many of the base case inputs and assumptions were conservatively calculated. The amount of solid waste utilized in the biomass feedstock was purposefully limited by using historical waste generation and characterization data. The price and availability of biomass feedstock fuels in Virginia was set conservatively and a recent study shows ample supply of feedstocks in the region at lower prices ($30 per ton) than used in the base case.[8]

As Scenario 4 shows, if no local municipal solid waste streams or biomass feedstocks are utilized (i.e. all fuel must be purchased), the cost of electricity generated increases to $0.094 per kWh, which is higher than current Dominion Power rates. Scenario 2 shows that if more local biomass waste feedstocks are available, the cost to generate electricity will decrease from $0.083 to $0.071 per kWh or lower. The base case utilizes 15,016 tons per year of local biomass waste feedstocks such as woody debris, C&D waste and vegetative wastes. This amount is approximately 16 percent of the total biomass fuel needs for the 10MW plant. If a more directed effort or program is developed to harvest local farm and vineyard crop wastes or cultivate new low impact crops such as switchgrass, the local feedstock supply could dramatically increase and further reduce the cost to generate electricity. A local biomass feedstock effort also supports the local farms and vineyards in Loudoun and surrounding counties while diverting additional waste for beneficial uses. In effect, any increase in the availability of local solid waste biomass feedstock streams further reduces the cost of electricity from $0.083 per kWh and likely near the current Dominion Power rates.

[8] Brian A. Kittler, Christopher M. Beauvais, 'The Potential for Sustainable Wood-Based Bioenergy in Maryland', *Pinchot Institute for Conservation,* 2010, p. 52-54

Refuse-derived Fuel (RDF) Power Plant

An RDF power plant offers several benefits to the county including:

- Inexpensive source of renewable energy
- Extension of the life of the landfill
- Avoided capital costs associated with the landfill expansion
- Reduced GHG emissions

The county's landfill and municipal solid waste operations offer a steady source of fuel for a RDF power plant facility and the land available to develop the plant. The plasma arc gasification technology also accepts all of the solid waste streams currently delivered to the Loudoun County Landfill.

In an effort to remain conservative with the project assumptions and to recognize county and community preferences, the amount of solid waste used to fuel the RDF facility was limited. Limiting the amount of waste means that the county and landfill should not have to import or seek additional Municipal Solid Waste (MSW) to operate the plant. With a plant size of 10MW, the fuel needed for the plant is kept below current waste levels delivered to the landfill. The other key assumptions related to the feasibility and performance of the RDF power plant are included below.

- Fuel requirements: 260 tons per day (87,300 tons per year)
- Capital costs: $49,000,000
- Heat rate: 12,800 btu/kWh
- Heat content of waste: 5,900 btu/lb
- Landfill tipping fees allocated to refuse-derived power plant: $30 per ton (~50 percent of tip fee for each ton of waste used as fuel)
- Solid waste delivered to landfill: 100,000 tons per year

The most significant impact to the financial performance of the RDF power plant is the allocation of tipping fees to offset costs and availability of solid waste. As is typical of all such plants, as the plant consumes solid waste as fuel it is diverted from the landfill. Since the waste stream is reduced to the landfill, the tipping fees and related revenues required for landfill operations could be significantly reduced. The remaining portion of the tipping fees would be allocated to the RDF power plant. Using the above assumptions and inputs, a base case was developed; results are show in Table 7. Table 8 shows the scenario analysis average cost of electricity, as compared to the base case and current Dominion Power rates.

Table 7: RDF Power Plant Base Case Results

Performance Metric	Result	Units
GHG Emissions ($mTCO_2e$/Yr)		
Moorefield Station BAU	137,665	$mTCO_2e$ per Yr
GHG Reduction (Increase) [% of BAU]	38,684 [28%]	$mTCO_2e$ per Yr
Renewable Energy Generated	80,592	MWh per Yr
Waste Reduction / Diversion	87,308	Tons per Yr
All-in Average Cost of Electricity[1]	$0.037	Per kWh
Extension of Landfill Life [% of Life]	7 (65%)	Years
Net Present Value of Avoided Landfill Capital Expenditures	$40,591,000	

1. Costs do not include transmission and distribution costs from Dominion Virginia Power of approximately $0.03/kWh.

RDF power generation is financially feasible and results in significant environmental benefits. RDF is classified as renewable energy within Virginia and throughout the U.S. resulting in GHG emission reductions of 38,684 $mTCO_2e$ or 28 percent of the total Moorefield Station GHG emissions at full build-out. In addition, by using local waste feedstocks, biomass power diverts an additional 15,016 tons of waste from the landfill for beneficial uses and extends the life of the Loudoun County Landfill by a year or more, saving the equivalent of almost $7 million in capital expenditures.

Table 8: RDF Power Plant Scenario Results

Scenario:	Average Cost of Electricity ($/kWh)[1]
Current Dominion Power Rates	$0.070
Base Case	$0.037
1. Reduced Tip Fee Revenue Allocation ($10/Ton)	$0.055
2. No Tip Fee Revenues Included ($0/Ton)	$0.064
3. RECs Included at $5/MWh	$0.033

1. Costs do not include transmission and distribution costs from Dominion Virginia Power of approximately $0.03/kWh.

The results of the scenario analysis show the RDF power plant to be the most cost effective Nexus project alternative for providing competitive renewable energy and reducing GHG emissions for Loudoun County and Moorefield Station. By locating the plant at the landfill it further reduces costs and barriers to development.

As with the biomass power plant, PTCs were not included in the evaluation due to their likely expiration in 2012. If the PTCs were extended, the RDF power plant average cost of electricity delivered would be reduced by $0.011 per kWh if developed by a third party or tax-paying entity.

RDF Power Generation and Biomass Optional Technology:

There are additional options for RDF power plants that the county could consider if the community or risk assessment identifies issues with implementation of the newer plasma arc technology. In addition, one option may further increase recycling rates and allow for a more conventional steam boiler technology. If an autoclave system, as described previously, is used to further process the municipal solid waste at the landfill, additional recyclable materials may be recovered prior to the waste being processed to fuel. An autoclave system screens some recyclable waste streams prior to and after the treatment process. Plastics, glass and metals can be removed from the stream and recycled, while the remaining waste is processed to become organic fiber and fuel pellets to be used in a boiler and steam turbine system.

The autoclave-derived solid waste fiber fuel could be combined with additional, locally available, biomass feedstocks similar to those discussed in the biomass power plant alternative (e.g. vineyard and crop wastes). This would provide an opportunity to diversify the fuel sources, augment solid waste with local biomass feedstocks and address potential concerns with the historical image and reputation of refuse-derived power plants. In addition, it would support economic development on local farms and possibly lead to new renewable crops such as switchgrass. While there is likely not enough farm waste or renewable crop availability in Loudoun County to fuel the full needs of a 10MW biomass or refuse-derived power plant immediately, it could provide 30 percent or more of the fuel needs in the near future.

Non-Potable Water System

A non-potable water system located in Moorefield Station provides financial and environmental benefits such as:

- Reduced water treatment costs and associated energy usage
- Reduced peak demand from Loudoun Water
- Reduced chemical use
- Potential for reducing costs for irrigation and mechanical cooling

In comparison to the larger power plant and CHP alternatives, the non-potable water system is more straightforward in nature with much lower capital costs. The key inputs and assumptions impacting the non-potable water system performance are included below.

- Capital costs: $550,000
- Fixed operations and maintenance costs: $75,000 per year
- Water consumption estimates: 189,000 gallons per day
- Stormwater retention ponds average volume and water storage

The most significant impact to the financial feasibility of the non-potable water system is the availability of the stormwater runoff or the water levels in the planned stormwater retention ponds. If there is an extraordinarily dry summer season or drought, the amount of stormwater available may be significantly reduced, thus increasing the average cost per 1,000 gallons delivered for irrigation or cooling purposes.

Table 9 below shows the base case and reduced water availability results for the non-potable water system.

Table 9: Non-potable Water System Results

Performance Metric	Base Case	Scenario 1: 50% Reduction in Water Availability
Water conserved (1,000gal / Yr)	28,794	14,487
Peak Day Demand Reduction for Loudoun Water (1,000 gal)	203	102
Average Cost of Water Delivered ($ / 1,000 gal)	$3.68	$7.37

Current Loudoun Water rates for residential customers include three tiers for quarterly billing (every three months):

- Tier 1: 0-25,000 gallons = $1.90 per 1,000 gal
- Tier 2: 25,001 – 50,000 gallons = $5.31 per 1,000 gal
- Tier 3: 50,000+ gallons = $7.12 per 1,000 gal

Typically irrigation water consumption is related to peak water system demands and the higher two tiers for Loudoun Water. The base case average cost of delivered water for the non-potable water system at $3.68 per 1,000 gallons is competitive and less than the equivalent Loudoun Water rates of tiers two and three. If more irrigation and mechanical cooling needs are added to the system (i.e. increase in the gallons delivered), the average cost of water delivered would decrease further and offset additional treated water needs.

The two large stormwater ponds are intended to serve as a year-round water feature for the development. Thus, the total non-potable system consumption should be balanced with maintaining a minimum volume of water in the ponds. A review of the original hydraulic analysis shows a total of 40 acre-feet of stormwater runoff (under average conditions and rainfall) should be available in the stormwater ponds every 15 days. The non-potable water system alternative utilizes approximately nine acre-feet every 15 days, or 22.5 percent of the total water available from runoff. Additional hydraulic and water consumption analyses can be completed to further optimize stormwater collection and consumption; however, the evaluation shows the system is financially and environmentally beneficial to the county, Loudoun Water and Moorefield Station.

Improved Energy Code

As with the non-potable water system, the improved energy code alternative is a more straightforward and less capital intensive effort than the energy generation projects. Due to the unique aspects of Moorefield Station and related authority over the building codes, a more stringent energy code could be incentivized and/or implemented. The improved energy code focuses primarily on HVAC and lighting equipment and products. The key assumptions and inputs that impacted the performance of the improved energy code are included below.

- Lights upgraded from T-8 to T-5 lighting fixtures
- Chiller efficiency improved from 0.717kW/ton to 0.468kW/ton
- Boiler efficiency increased from 80 to 86 percent
- Water heater efficiency improved from 80 to 96 percent
- Increased residential air conditioning efficiency from SEER 11 to SEER 13

In analyzing the effectiveness, feasibility and performance of the optional code, the marginal increase in costs of the HVAC and lighting upgrades listed above were compared to the resulting energy savings and GHG emission reductions. By evaluating the full cost of the upgrades and resulting energy reductions, an average cost per kWh or natural gas therm was calculated. Using the resulting costs per unit of energy, an incentive or capital contribution to improving the building efficiency could be developed. The DOE2, eQUEST building energy models used for the GHG BAU emissions were also utilized to model resulting energy impacts of the improved energy code. The financial and environmental results of the improved energy code are included below in Table 10.

Table 10: Improved Energy Code Results

Performance Metric	Base Case	Improved Energy Code
Electricity Consumption (MWh)[1]	251,724	222,618 (-12%)
Natural Gas Consumption (therms)[1]	2,864,047	2,376,022 (-17%)
Average Cost of Electricity Savings ($/kWh)[2]	N/A	$0.23 - $0.47
Average Cost of Natural Gas Savings ($/therm)[2]	N/A	$0.12 - $13.40
GHG Emissions ($mTCO_2e$)	137,665	120,963 (-12%)

1. Electric and natural gas savings are estimated at the full build out of Moorefield Station (e.g. energy use at full commercial and residential development)
2. Range of average cost of savings represents range of construction types (e.g. residential, multi-family and commercial)

The improved energy code results in a 12 percent reduction of electricity consumption and a 17 percent reduction in natural gas consumption. The resulting GHG emission reduction is 12 percent less than the original BAU emissions. The annualized marginal cost of the more efficient HVAC and lighting equipment ranges from $0.23 per kWh to $0.47 per kWh for electricity. The range in the costs for the energy saved is related to the type of construction (e.g. Commercial, Multi-family or Residential). Due to the current Dominion Power electricity rates of approximately $0.06-$0.10 per kWh, the cost of the electric efficiency improvements are not currently financially competitive unless additional grants or outside rebates are included.

The annualized cost for the natural gas savings ranges from $0.12 per therm to $13.40 per therm based on the type of construction. The natural gas efficiency improvements are financially viable and are competitive with or less than current natural gas delivery rates. However, the GHG emission rates related to natural gas consumption for heating and water heating are minimal compared to the electricity related GHG emissions. As seen previously in Figure 18, natural gas results in only 10 percent of the total GHG emissions. Figure 31 shows the reduction in GHG emissions over the build out of Moorefield Station as compared to the BAU emissions.

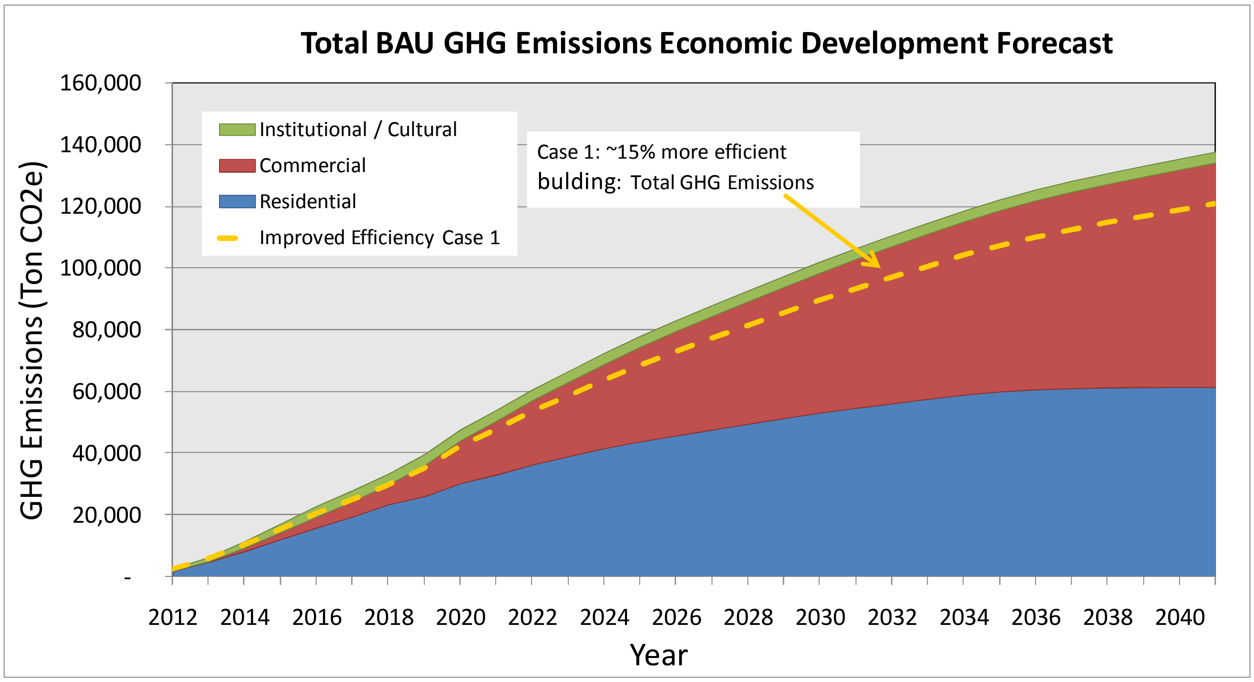


Figure 31: Reduced GHG Emissions from Improved Energy Code

Summary of Nexus Project Results

Of the five Nexus projects evaluated with the financial and environmental pro forma, two projects are recommended for more detailed engineering analysis and implementation for the county. The RDF power plant and non-potable water system each support the IEMP mission and goals, and were determined to be financially and environmentally beneficial. The RDF plant offers several financial and environmental benefits:

- $0.037 to $0.055 per kWh average cost of electricity
- 38,648 $mTCO_2e$ per Yr of avoided GHG emissions (28 percent reduction in Moorefield Station full build-out GHG emissions)
- 80,592 MWh per Yr of renewable energy
- 87,308 tons per Yr of waste diverted from the landfill
- 7 year extension of the life of the landfill
- NPV benefit of $40,591,000 for avoided landfill capital costs

In addition, due to the RDF technologies evaluated, there is an excellent opportunity to support local economic development and local sources of biomass and crop by-product feedstocks. The local farmers and vineyards have shown a strong interest in providing crop by-products, vineyard wastes and potentially new biomass crops (e.g. switchgrass) to fuel a renewable energy facility in the county. These additional sources of fuel feedstocks would further augment and diversify the waste fuel feedstocks and potentially allow for increasing the facility size in the future. Finally, similar to each of the power plant options discussed, the RDF power plant can contribute to improved reliability of the local electric grid by locating a distributed, 10MW generation facility in the county.

The second Nexus project recommended, the non-potable water system, also supports the IEMP mission and goals. The environmental and financial benefits include: $3.68 per 1,000 gallons average cost of delivered water, reduced water treatment chemical and energy use, reduced peak water demand and avoided infrastructure costs.

Focus Area Program Prioritization Results

The remaining targeted and tactical programs from the program inventory were prioritized within the respective Focus Areas. The programs were prioritized based on their contribution to the specific Focus Area Goals. For example, Energy Focus Area programs were prioritized based on their ability to supply local, clean energy, to reduce GHG emissions, and to reduce building related energy consumption. The highest priority programs for each Focus Area are included below in Tables 11 through 15.

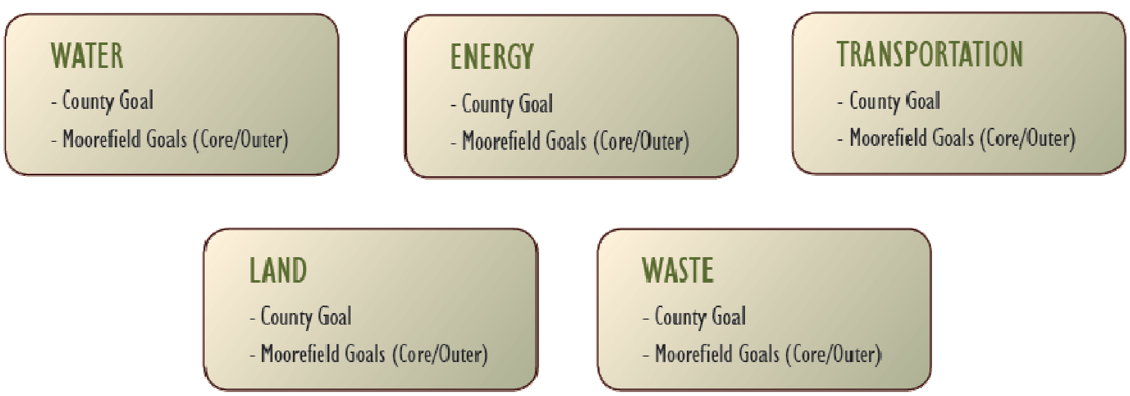


Figure 32: Focus Areas

Table 11: Water Focus Area Programs

1. Incentivize reclaimed water systems for all commercial buildings greater than 20,000sf
2. Develop water reuse program for the county
3. Pilot and leverage Loudoun Water conservation programs
4. Implement integrated green roofs, onsite water collection, local gardens and gardening outreach
5. Utilize waste water treatment plant effluent for data center cooling tower water make up
6. Augment potable water demand needs with wells for peak demand reduction

Table 12: Energy Focus Area Programs

1. Partner with banking industry to create revolving energy efficiency and renewable energy loan fund
2. Adopt ASHRAE standard green building code for Moorefield Station
3. Incentive/rebate program for distributed rooftop solar photovoltaic
4. Expand current LED solar lighted, electric vehicle charging program
5. Continue/expand current residential education and outreach energy campaign
6. Energy use web dashboard and O Power program
7. Incentive/rebate program for solar water heating
8. Incentive/rebate program for geothermal exchange for commercial and residential homes

Table 13: Transportation Focus Area Programs

1. Develop smart phone app (energy-water-transit) to show bike and pedestrian paths, zip car locations, parking availability, rapid transit
2. Require food store / small grocery store in Core Zone of Moorefield Station
3. Implement neighborhood distribution points for community gathering, recycling, local markets, delivery, mail, bike share program, etc. in Moorefield Station
4. Implement bike sharing program throughout county, initially targeting Moorefield Station
5. Include review of land development applications for inclusion of bicycle and pedestrian facilities along Countywide Transportation Plan roads
6. Incentivize bulk purchases for transit passes, coordinate with Metro
7. Leverage and target current employer transit outreach at Moorefield Station as it develops

Table 14: Land Use Focus Area Programs

1. Develop county prescriptive sustainable design options checklist with incentives providing reduced permit time, approval process or other county regulatory incentive
2. Adopt ASHRAE standard green building code for Moorefield Station
3. Create maximum parking limits, not a minimum requirement
4. Develop demand parking services (e.g. meters, variable rate parking, shared parking use)
5. Integrate and leverage the stormwater infrastructure and areas with open space and interpretive areas
6. Leverage parking diversities to reduce total amount of parking (e.g. shared lots)

Table 15: Waste Focus Area Programs

1. Adopt ASHRAE standard green building code for Moorefield Station (material diversion, reuse and recycled content)
2. Provide county permitting and regulatory incentives for C&D diversion plans and use of recycled content materials (e.g. reduce permit time, approval process or other county regulatory incentive)
3. Implement 'pay as you throw' solid waste and recycling plans in Moorefield Station (e.g. larger recycling bins are free, with increase prices for larger sizes of waste bins)
4. Require a C&D diversion plan for all Moorefield Station Core and Outer Zone development
5. Install 'Freecycle' stations at neighborhood distribution points (e.g. social good recycling)

The results of the energy alternatives evaluations and analyses resulted in:

- A recommendation for two large, capital related Nexus Projects (RDF power plant and non-potable water system)
- The creation of the ZEW^2 Lab Flagship Program to manage the ongoing and evolving partnerships at Moorefield Station
- The prioritization of the more tactical Focus Area programs and projects for future implementation.

While these analyses identified and prioritized programs and projects to support and achieve the IEMP goals, many of the projects and programs will require significant financial and county resource commitments to implement. To further support and ensure the success of the IEMP, funding strategies and options were researched to align and optimize projects with specific financing opportunities. The results of the funding research are included in the next section.

Section 5: Sources and Uses of Funds

In order to implement the projects and programs included in the IEMP, clear identification of capital and operational funding strategies is required. These funding strategies are applicable to the larger capital Nexus Projects and the programmatic Focus Area programs. The information presented here is based on a scan of external funding options conducted during the third quarter of 2011. While direct county capital funding (e.g. bond issuance) is an option to fund the projects, the intent of the assessment was to identify alternative and new funding mechanisms for the county. Thus, county or municipal bonds were excluded from the assessment. Over time, various other opportunities will certainly surface and require ongoing monitoring and pursuit.

Typically, ambitious energy management plans incorporate a variety of funding sources, which can be generally categorized as follows:

- Grants
- Revolving loan funds
- Low-interest financing
- Tax incentives and rebates
- Public/private partnerships
- Bonds

This funding strategy is based on balancing Loudoun County's clear desire to achieve their stated mission and make an impact in today's economic and funding realities. Two to three years ago there were many opportunities at the federal, state and local levels; however, those sources have diminished significantly. Therefore, the IEMP funding strategy relies more heavily on defining the necessary win-win partnerships and moving forward with them.

Specific research was conducted into the various funding sources available and their alignment with the two near-term Nexus Projects – refuse-derived power plant non-potable water system – and the Focus Area programs. The results of the research are summarized below, and Appendix F contains more detailed descriptions of the findings. Overall, our research and discussions with industry experts revealed federal and most state grant funds will be extremely limited in the immediate and near future. This trend was confirmed by a direct discussion with a U.S. Senator familiar with energy related federal funds.

Funding Strategy

Based on the research summarized below and the target projects and programs, we recommend an initial three-prong funding strategy as illustrated in the diagram below.

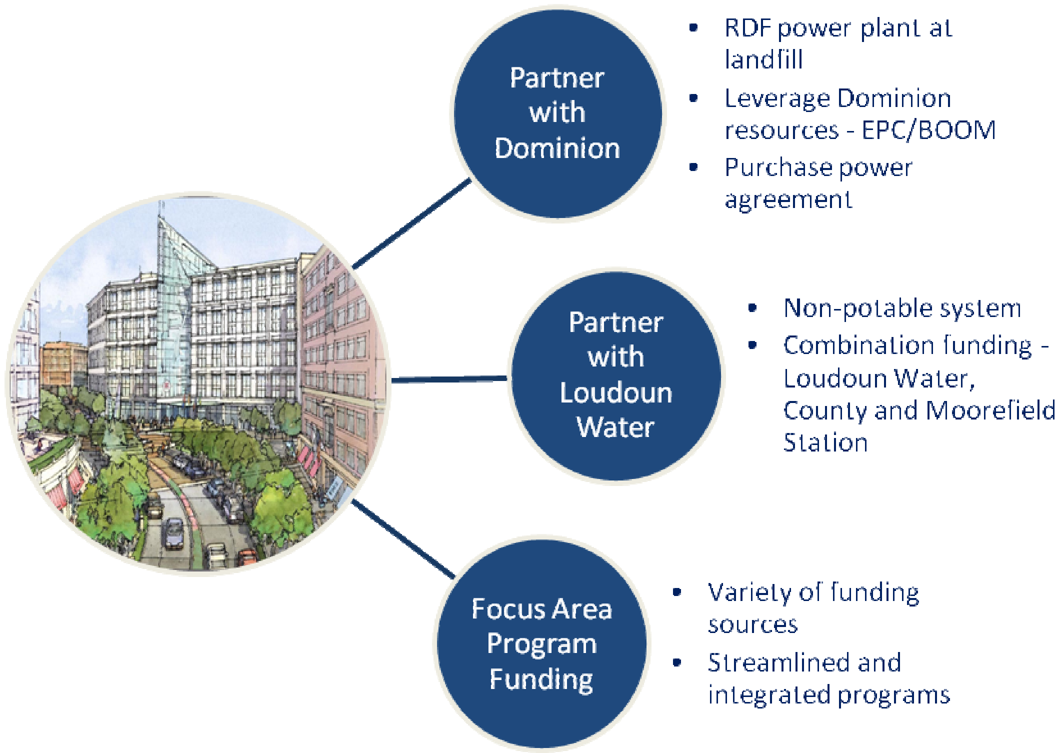


Figure 33: County and Moorefield Station IEMP Funding Strategy

This approach incorporates some flexibility which facilitates near-term development even while market conditions are not conducive to immediate build out at Moorefield Station. Additional information on the three-prong funding strategy and alignment of specific funding tactics to capital projects and programs is included in the Implementation section of this report.

Funding Options: Capital Projects and Public / Private Partnerships

There are many examples within Virginia and across the country that illustrate the viability of public/private partnerships. Such partnerships can take a variety of forms and generally feature a mix of the following aspects:

- Design
- Build
- Finance
- Own
- Operate
- Manage
- Transfer

The alternative project deliver methodology varies depending on the amount of risk that the county wants to assume and their ability to actively participate in development and/or ongoing management of a given facility.

At this point, we strongly recommend this approach as the best method for pursuing the targeted nexus projects. In order to jump start plan implementation, we have already had significant conversations with partners and outlined the following possibilities.

RDF Power Plant

Dominion Power has expressed interest in and support for the RDF power plant concept detailed previously in this report. This is a partnering opportunity that defines the classic "win-win" situation for both the county/Moorefield Station and Dominion Power that leverages this project to support the goals and/or fulfill requirements for both parties. Based on initial discussions with Dominion Power, two partnership structures were proposed to potentially fund the project: Dominion Power partnership with the county to build, own and operate the plant or a county partnership with a third party to build, own and operate the plant. In both cases, Dominion Power would own or purchase the power generated by the plant.

Public/Private Partnerships and Third Party Ownership

A key element of a successful energy project hinges on a purchase power or similar agreement between the county and Dominion Power or a third party and Dominion Power. This agreement forms a long term bilateral contract for the owner of a power plant to sell the electricity at an agreed price to the county and/or Dominion Power. The agreement forms a guarantee of sorts to the third party or Dominion Power equity investors that the project will have viable revenues and sustainable cash flow during its projected life and therefore meet its financing and debt obligations. In that way, the purchase power agreement is a pivotal funding strategy. Based on the analysis of the favorable rates (average cost per kWh generated) for the RDF power plant, we anticipate that Dominion Power, third party developers or others will be interested in such long-term agreements.

If the partnership with Dominion Power or a third party is pursued and implemented, then the RDF power plant would not likely require capital funding or bond issuances by the county. This funding mechanism and structure supports the county's stated goals of utilizing outside or third party capital financing (rather than direct county bond issuances) for project implementation. Much more detail regarding purchase power agreements and third party ownership is included in Section 8: Implementation.

Federal Production and Investment Tax Credits

One of the key drivers for financing a renewable energy project is the federal PTC or investment tax credit (ITC). These credits target private or commercial tax paying organizations. The PTC results in a tax credit of $0.011 to $0.022 per kWh (based on technology) of renewable energy generated for the first 10 years of the project's operation. The ITC provides a tax credit calculated as a percentage of the total capital investment of a renewable energy project. These credits are also utilized as a one-time tax grant or lump sum credit to corporate income taxes. This has led to a new market for 'tax equity' investors who are not typical power or renewable energy developers. These investors provide capital funding for projects in return for a direct credit to their current corporate tax obligation. To receive the PTCs, an approved renewable technology project must be commercially operating by Dec 31, 2013.

Public entities such as Loudoun County cannot directly take advantage of these credits; however, many public entities contract with a third party to develop a renewable energy project which is eligible for the tax benefits. These benefits received by the third party are then passed on to the public entity in the form of lower cost renewable electricity.

As mentioned previously, the PTC tax incentive is currently scheduled to expire at the end of 2012 and congress has not shown progress in renewing the incentives. However, Loudoun County should track federal legislation related to renewable and clean energy as the past legislation for the PTCs has been expanded multiple times. Most recently, it was extended to the December 31, 2013 in service deadline in 2009 by the ARRA legislation.

NOVEC recently announced federal grant funding for a biomass power plant through the RUS/USDA program that focuses on rural electric cooperatives. However, larger federal grant opportunities from USDA, DOE/NREL and others will be extremely limited in the short term. In addition, annual REAP funding for weatherization and upgrades is likely to be reduced by 75 percent in 2012.

Halcrow staff has discussed and reviewed potential funding options in biomass and renewable energy markets with industry experts and a current U.S. Senator. The results of the conversations included limited funding options at the federal level with DOE/NREL funding likely reduced significantly in the near and short terms. It appears the Department of Defense (DOD) and military funding are the only practical options for federal energy research, development and funding.

Non-potable Water System

Similarly, several conversations with Loudoun Water have indicated a high degree of interest in partnering to support the non-potable water system detailed previously. Based on initial discussions with Loudoun Water, they recommend implementing the non-potable water system for Moorefield Station in a similar manner as other non-potable systems in the county. Loudoun Water suggested utilizing a third party, the Moorefield Station HOA, to own and operate the non-potable water system. Loudoun Water would provide the potable water to the development and backup the non-potable system, if or when needed.

Public/Private Partnerships and Third Party Ownership

Due to regulatory and SCC issues, the non-potable water cannot be sold to multiple customers (e.g. Moorefield Station commercial building owners). However, the water can be used by a single customer to meet their potable or non-potable water needs. If the non-potable water system were operated to deliver and sell water to multiple parties, the system would be considered a utility and be in conflict with the current Loudoun Water utility system. Additional details regarding regulatory and SCC utility issues is included in Section 7: Risk Analysis.

To address the regulatory issues, the Moorefield Station HOA would develop the non-potable water system for local development irrigation needs, offsetting the costs of purchasing potable water from Loudoun Water to serve the same purpose. The HOA would finance the capital investment required for the system and mange the annual operating costs. The annualized costs of the system (capital and operating) would be recovered through the HOA's dues or payment system from Moorefield Station residents/developers. As shown in Section 4: Energy Supply Alternatives, the delivered water costs for the non-potable system are competitive with and lower than current Loudoun Water rates for the same purpose. Thus, the HOA's total costs to recover in dues for the non-potable water system would be lower than utilizing Loudoun Water potable water.

Due to the small scope and scale of the non-potable water system, Moorefield Station or Claude Moore Charitable Foundation capital funds may be required for the non-potable water system and stormwater pond integration. The construction cost of the actual stormwater ponds is already included in the future development fees or land costs paid by Moorefield Station developers. These capital costs are not included in the non-potable water system capital or operating related costs. The county would not likely contribute any funding to this non-potable water system; however, the county may provide staff or other resources for coordination purposes.

Virginia Clean Water Revolving Loan Fund

The Virginia Clean Water Revolving Loan Fund[9] offers a limited opportunity to support or reduce the capital costs associated with the non-potable water system. The fund reduces interest rates for local governments for projects to improve water quality or prevent future problems. The fund offers below-market interest rates, no bond issuance costs, and a payment waiver during construction in five categories. The Stormwater Loan Program category appears to be the most applicable opportunity; however, it currently has no funding appropriated. The Stormwater Loan Program is only funded when the wastewater revolving loan allocations are not fully utilized.

Pooled Financing Program

Virginia Resources Authority[10] issues bonds at least twice annually (fall and spring). The program has financed more than $1.5 Billion in projects by more than 100 local governments since 2003. The minimum recommended loan is $750,000 at an AAA/AA interest rate for up to 30 years, based on useful life of the project. This funding source may also be applicable to large-scale green building projects. The initial review and evaluation of the Virginia Resources Authority funding applicability to the IEMP projects and programs did not reveal any immediate opportunities for the IEMP or Loudoun County. However, the county should continue to monitor the funds as programs and projects evolve, as new projects may present an opportunity to leverage the funding support.

Funding Options: Focus Areas

There are myriad potential funding opportunities to support the Focus Area programs included in the plan. The built environment is a key contributor to greenhouse gas emissions and an underlying aspect of all Focus Area programs. Attention to identifying and streamlining access to these funds for Focus Areas will further support the near term action and benefits of the Plan. By aligning the development community and attracting businesses and residents, there is also a multiplying economic affect.

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[9] http://www.deq.state.ca.us/cap/ or Walter Gillis at 804.698.4133 and http://www.deq.state.va.us/cap/Stormwater.html

[10] http://www.virginiaresources.org/pooledfinancing.shtml

It is important to package both commercial and residential funding approaches into comprehensive offerings for a portfolio and programmatic approach. This is similar to what the county has started with the Green Business Challenge and Residential Outreach programs. A key feature of such programs is streamlining access and overall ease of use for customers.

The built environment, and specifically buildings, represents an area that is anticipated to evolve and continue receiving funding opportunities. One such example is a recent announcement by industrial and commercial market leaders, along with the Obama administration, of almost $4 billion in federal and private sector energy upgrades to buildings over the next two years. While this commitment is not a direct grant or funding source for Focus Area programs, it shows the opportunities growing with many large companies in the sustainability market. The commitment includes investing nearly $2 billion of private capital to upgrade energy performance by at least 20 percent by 2020 in 1.6 billion square feet of office, industrial, municipal, hospital, college and school buildings as part of the federal Better Buildings Challenge[11]. These privately driven efficiency and sustainability initiatives may offer an indirect funding opportunity for county programs; however, they offer an excellent opportunity to target companies that align with the goals of the IEMP and Moorefield Station.

Table 16 below summarizes funding sources for Focus Areas, green building and other residential/commercial incentives. Additional detail on specific programs and reference links by funding source are provided below, while full details can be found in Appendix F. Many of these funding sources also offer the flexibility and opportunity for future initiatives and programs developed as a part of the IEMP and the Focus Areas.

[11] http://www.environmentalleader.com/2011/12/02/firms-commit-2bn-to-energy-efficiency-white-house-plugs-in-2bn-more/

Table 16: Summary of Programmatic Funding Options

Category	Program Examples	Comments
Tax Lien Financing	PACE	Commercial; Residential pending
Revolving Loan Funds	"Green" funds administered by government or not-for-profits	NASEO/State Energy Loan Fund database
Leasing Programs	Energy Leasing Program Master Equipment Leasing Program	Covers services & equipment Administered by Treasury Dept.
Community Development Partnerships	Enterprise Green Communities Better Building Challenge	Direct lending to qualifying projects
Community Green Lending	New Generation Energy	Connects investors with projects
Residential Incentives	Tax Incentives/Exemptions (property/income) State Rebate Program Dominion Power Rebate Program Multi-state Collaboration	Incentivizes consumer behavior change; various sponsors
Commercial Incentives	Development Bonuses Green Building Funds	Stimulates aligned business practices
Green Jobs Creation	Jobs Creation Incentive Green Jobs Tax Credit	Incentives for green jobs and industry

PACE (Property Assessed Clean Energy) / Tax-Lien Financing

PACE financing allows repayment of qualifying expenses for energy efficiency (in some cases water efficiency and renewable energy) through lien-protected assessments on property tax statements. Repayment is generally over a period of 20 years and not accelerated with a sale or foreclosure, thereby transferring to the new property owner. This financing strategy ties the energy upgrades and benefits to the asset (i.e. property), thus tying and aligning the costs over time to the direct benefits over time. This is currently an option for commercial properties. However, applicability to residential properties is pending a federal legislative decision of a Fannie Mae/Freddie Mac ruling on PACE lien holder position in foreclosure situations. The Fannie Mae/Freddie Mac issue will likely not be resolved in the near future.

The State of Virginia passed PACE enabling legislation in 2009 that authorizes local governments to establish a loan program to provide financing for clean energy improvements to property owners via local ordinance. However, research indicated that no Virginia municipalities yet offer PACE financing programs.

Information Links

- http://leg1.state.va.us/cgi-bin/legp504.exe?000+cod+15.2-958.3
- http://leg1.state.va.us/cgi-bin/legp504.exe?101+ful+SB110ER+hil
- http://www.dsireusa.org/incentives/incentive.cfm?Incentive_Code=VA20F&re=1&ee=1

Revolving Loan Funds

Revolving loan programs take a dedicated funding allocation to finance specific types of projects. Loan repayment (with interest) replenishes the fund for sponsoring future projects creating a revolving source of capital for financing. In the case of "Green Revolving Loan Programs" approved loan recipients would use the financing to install renewable energy sources, upgrade heating and cooling equipment or upgrade / weatherize a home. Energy audits may be required as a prerequisite of the project to properly identify and prioritize efficiency and renewable projects. There appear to be few energy-specific revolving loan funds currently operating in Virginia. However, there are a number of similar state-operated revolving loan funds operated by the Virginia Resources Authority that focus on clean water, drinking water and storm water.

The National Association of State Energy Officials (NASEO), an organization of governor-designated energy officials from each state and territory, has established a State Energy Loan Fund database to track revolving loan programs run by state energy offices. There are reportedly 66 funds available in 34 states currently. The State of Virginia received $3,000,000 from the ARRA Energy Efficiency and Conservation Block Grant (EECBG) to fund a Building Retrofit Program.

Another potential avenue, though one not believed to be in practice in Virginia at present, relies on not-for-profit or foundations to administer revolving loans for sustainability efforts within specific regions. Examples include the Cascadia Loan Fund which serves small businesses and nonprofit organizations in Washington and Oregon, the Access Energy Cooperative in Iowa, and the Reinvestment Fund supporting community redevelopment in Pennsylvania, New Jersey, Delaware, Maryland, and Washington, DC.

Information Links

- http://www.naseo.org/resources/selfs/state.aspx?State=VA
- www.dmme.virginia.gov/divisionenergy.shtml
- http://www.cascadiafund.org
- http://www.accessenergycoop.com/Content/Community/Economic-Development/Revolving-Loan-Fund-Available.aspx
- http://www.trfund.com

Energy Leasing Program (VA)

Administered by the Department of Treasury, the energy leasing program provides funding for energy efficiency projects in facilities operated by state agencies, authorities and institutions of the Commonwealth of Virginia. The Energy Leasing Program allows for the purchase of services and equipment required to develop, design, and install an energy efficiency project. Agencies can finance energy projects at a minimum of $100,000 and will make repayments over 12 or 15 year terms.

Eligible projects must feature energy efficient technology, such as lighting and motor efficiency upgrades, building envelope enhancements, distribution system improvements, and energy management controls. Other covered projects are pending approval. The leasing program is a targeted funding opportunity if or when state facilities are located within Loudoun County or Moorefield Station.

Information Links

- http://www.trs.virginia.gov/documents/debt/MELP/EnergyDescription.pdf

Master Equipment Leasing Program (VA)

Similar to the Energy Leasing program, administered by the Department of Treasury, the Master Equipment Leasing program helps Commonwealth agencies, authorities and institutions obtain consistent and competitive credit terms for financing equipment and energy efficiency projects. The program is available in various loan repayment terms; however, the term may not exceed the useful life of the equipment.

Qualifying projects must have a minimum cost of $10,000 and may include: personal property, the installation or modification of an installation in a building, professional management, and other special services which are primarily intended to reduce energy consumption and demand or allow the use of an alternative energy source. Examples include lighting and motor efficiency upgrades, building envelope enhancements, distribution system improvements, energy management controls. Similar to the Energy Leasing Program, this funding source is targeted at State facilities.

Information Links

- http://www.trs.virginia.gov/documents/debt/MELP/MELP%20Description.pdf

Community Development Partnerships

There are a variety of community development organizations that fund energy efficiency and renewable energy projects as part of broader affordable housing / community development activities. One such example is Enterprise Green Communities launched in 2009 with a $4 Billion commitment to green affordable housing. By engaging multiple lending partners, they have developed projects in Virginia, including Richmond and Blacksburg. Offers include low-interest loans for project development while also operating a building retrofit and audit program. This presents an opportunity for the county to enhance affordable housing at a low or no cost if developed within Loudoun County.

Information Link

- www.greencommunitiesonline.org

Community Lending / Green Investments

There are a growing number of organizations that connect investors with projects that support a specific program or policy objective. For example, Boston-based New Generation Energy connects interested investors with organizations (small businesses, nonprofits, libraries, youth groups, health centers, schools and community centers) in need of funds for green development. Interested investors can sponsor a project by purchasing Renewable Energy Investment Notes in denominations of $1,000 to $100,000 for terms ranging between one and seven years that are paid back at an interest rate between 1.25 percent and 2.5 percent through the Community Lending Program. The previously cited Better Building Challenge is an example of a community lending program. If implementing a community lending program, the county would likely partner or reach an agreement with a third party community lending firm to administer the program in the county.

Information Link

- http://newgenerationenergy.org/

Residential / Commercial Incentives

There are several incentives that could stimulate consumer behavior that align with accomplishing the IEMP mission. Some of the programs represent options for the county to directly implement/adopt, in addition to programs the county would simply re-publicize or re-communicate to county residents to increase adoption. The county and Moorefield Station could package these into a broader market offering, streamlining citizens' ability to use as a basis for purchase and behavioral decisions. Highlights of these programs are included below with details included in the appendix. Options discussed below include:

- Property Tax Incentives
- Property Tax Exemption for Solar
- Income Tax Deduction
- State Rebate Program
- Dominion Power Rebate Program
- Multi-state Collaboration on Residential Retrofits

Property Tax Incentives

Virginia enacted legislation that allows local jurisdictions to assess the property tax of energy efficient buildings at a reduced rate. Under this law, eligible energy-efficient buildings, not including the real property on which they are located, may be considered a separate class of property for local taxation purposes. Accordingly, the governing body of any county, city or town may, by ordinance, allow a special assessment of the property taxes for this class of property. Further information at:

- http://leg1.state.va.us/cgi-bin/legp504.exe?000+cod+58.1-3221.2
- http://library.municode.com/index.aspx?clientID=12078&stateID=46&statename=Virginia
- http://www.countyofspotsylvania.us/emplibrary/ORDINANCE_NO_21_63.pdf
- http://www.vbgov.com/government/offices/green/energy/pages/energy-efficient-buildings.aspx
- http://www.vbgov.com/government/offices/green/energy/Documents/energy-efficientbldg-faq.pdf

Property Tax Exemption for Solar

Virginia allows any county, city or town to exempt or partially exempt solar energy or recycling equipment from local property taxes. Residential, commercial or industrial property is eligible for the exemption. The statute broadly defines solar energy equipment as any that is *"designed and used primarily for the purpose of providing for the collection and use of incident solar energy for water heating, space heating or cooling or other application which would otherwise require a conventional source of energy."* Recycling equipment is defined as equipment which *is "integral to the recycling process and for use primarily for the purpose of* *abating or preventing pollution of the atmosphere or waters."* Loudoun County currently offers this incentive as do several other cities and counties across the state.

Income Tax Deduction

Various residential appliances that meet federal Energy Star requirements are eligible for a personal deduction of 20 percent of the sales tax paid by an individual up to $500 maximum. However, this program expires July 1, 2012. The county would not directly implement the income tax deduction program; however, it could support and communicate the program for wider adoption in the county.

State Rebate Program

Virginia has applied some ARRA funds to offer rebates for geothermal heat pumps, energy efficiency upgrades and energy efficient appliances. With a program that opened June 20, 2011, Virginia is offering rebates to homeowners who replace their heat pumps, central heating, or central air conditioning systems with a geothermal heat pump. Further information is provided at: http://www.dmme.virginia.gov/DE/ARRA-Public/GeothermalHeatPump.shtml

The Home Efficiency Rebate Program, also began June 20, 2011 provides for homeowners to receive funds for rebates for up to 20 percent of the costs of qualifying energy products and services, for up to $595. The application process opened on June 20, 2011. Energy efficient equipment purchased and installed on or after March 26, 2010 is eligible for rebates. Further information is provided at:
http://www.dmme.virginia.gov/DE/ARRA-Public/HomeEfficiency.shtml

Through residential energy-efficient appliance rebates, Virginia is offering rebates to homeowners who purchase and install ENERGY STAR-rated furnaces, heat pumps, clothes washers, gas water heaters, and refrigerators purchased and installed on or after April 28, 2010. Homeowners who purchase and install ENERGY STAR-rated heat pump water heaters on or after May 28, 2010 are also eligible for rebate, as are those who purchase ENERGY STAR-rated dishwashers and room air conditioners on or after September 1, 2010. Central air conditioners must be purchased on or after March 1, 2011 in order to be eligible. Further information is available at: http://www.dmme.virginia.gov/DE/ARRA-Public/ARRA.shtml

Similar to the income tax deduction, the county would not take a direct role in adopting one of the above programs. However, the county should include these programs and incentives in public communications and targeted IEMP literature and communications.

Dominion Virginia Power Rebate Program

The SCC approved five residential demand-side management programs for customers of Dominion Power. In addition, the Commercial Heating/Air Conditioning Upgrade Program and the Commercial Lighting Program request upgrades to more efficient systems for the commercial sector in exchange for an incentive. The Air Conditioner Cycling Program will allow a company to control the central air-conditioner or heat pumps, cycling the unit off and on for short periods of time during peak periods in return for incentive payments. Further information is provided at: http://www.dom.com/dominion-virginia-power/customer-service/energy-conservation/ec-programs.jsp

Integrated Energy Management Plan

Multi-state Collaboration on Residential Retrofits

NASEO is currently participating in a four-state collaborative with the State Energy Offices in Alabama, Massachusetts, Virginia, and Washington, in a program funded by the State Energy Program and awarded through a competitive process. The objective is to establish residential retrofit programs in select communities in those states utilizing an innovative asset label, similar to a miles-per-gallon rating for the home, to increase information to the homeowner and drive decisions to invest in energy efficiency. The program will incorporate workforce training, financing, and streamlined customer service, and each state will adapt the program concepts to meet the direct needs of participating communities in their state. NASEO's role is to work with State Energy Offices and other project partners to provide coordination and facilitation among common program elements and share state experiences, best practices and lessons learned in order to inform the development of residential retrofit programs and markets in other states.

Development Bonuses

An example of development-focused programs is the Arlington, VA Green Building Incentive Program. Density and height bonuses are considered for developers who achieve the full range of LEED certifications. Achieving the LEED Certified level does not guarantee a density bonus, but will be considered on a case-by-case basis, and can potentially earn a prescribed floor area ratio (FAR) bonus.

In December 2003, the county also established a Green Building Fund. Developers who participate in the site plan process (meaning their projects are special exceptions to the Zoning Ordinance) and do not achieve official LEED certification are required to contribute to the fund. The Green Building Fund is then used to provide education and outreach to developers and the community on green building issues. If the building later receives LEED certification, the fee will be refunded. Those projects that achieve LEED certification do not have to contribute. Further information is provided at: http://www.arlingtonva.us/Departments/EnvironmentalServices/epo/EnvironmentalServicesEpoIncentiveProgram.aspx

Jobs Creation Incentive

With a focus on jobs creation, Virginia created the Clean Energy Manufacturing Incentive Grant Program to start July 1, 2012. The program replaces two other grant programs, which will be phased out. Money is appropriated to the fund at the discretion of the General Assembly.

"Clean energy manufacturer" is defined as a biofuel producer, a manufacturer of renewable energy or nuclear equipment/products, or "products used for energy conservation, storage, or grid efficiency purposes." Renewable energy includes solar, wind, hydro, biomass, waste energy, municipal solid waste, wave, tidal, and geothermal. It may also include thermal or electric energy from biomass co-firing facilities. Public service corporations are not eligible for the grants. Further information is provided at: http://www.dsireusa.org/incentives/incentive.cfm?Incentive_Code=VA46F&re=1&ee=1

Green Jobs Tax Credit

In April 2010, Virginia enacted the green jobs tax credit. For every green job created with an annual salary of $50,000 or more, the company will earn a $500 income tax credit for five years. The Office of Commerce and Trade will develop a full list of jobs eligible to qualify for the tax credit. Companies will be allowed tax credits for up to 350 green jobs created. If the taxpayer does not have enough tax liability to take the full credit, it may be carried forward for up to five years.

Section 6: Economic Development Assessment

As local government sustainability and energy plans are implemented across the country, the most successful plans integrate and support economic development activities. As such, the IEMP evaluated the possibilities for economic diversity and local employment opportunities resulting from the Plan. In addition, a best practice assessment was performed to better understand how similar communities are implementing and supporting energy plans and related programs or capital projects. A three-step process was included to evaluate and directly assess the economic development opportunities and impacts.

- ***Industry Evaluation:*** the industry evaluation assesses the county's current position in supporting renewable energy technologies and identifies potential target industries and opportunities
- ***Best Practices:*** the best practice assessment profiles how peer public sector entities are working to comprehensively grow renewable energy and sustainability in their communities. Based on the selection criteria discussed later in this section, BBP LLC identified Douglas County, Colorado; Fairfax County, Virginia; Frederick County, Maryland; City of Cambridge (in Middlesex County, Massachusetts); Ramsey County, Minnesota; Suffolk County, New York as communities to be analyzed.
- ***Economic Impact:*** The economic impacts resulting from commercial operations are related to the ongoing operations of the Nexus Project recommendations. The two main areas of economic impacts analyzed are: 1) ongoing operations and 2) impacts from the construction period. For each category, employment and earnings are estimated including income and retail taxes and spin off effects through the local and state economy.

Industry Evaluation

As the Loudoun County, Virginia and national economies continue to struggle with, and recover from, the economic downturn; economic development strategic planning will continue to grow in importance. When the economy is in such a downturn, business attraction and relocation is curtailed significantly and typically limited to regional companies. To create economic development opportunities under these conditions, it becomes critical to support and grow the companies that are in the community currently, and to seek out and attract those with a locational reason to expand in Loudoun County.

Due to these current economic conditions and related opportunities, the economic development assessment focused on identifying and leveraging existing Loudoun County industry strengths related to the IEMP and CES. An industry evaluation comprised of location quotient analysis was completed to identify and determine existing Loudoun County industry and market segment strengths. One of the key targets of IEMP and CES is renewable energy and related market sectors, thus these market sectors were used in the targeted economic development assessment and analysis.

The location quotient analysis provides an important look at the industry sectors that are currently in the county and region, and thus provide the initial foundation for expansion and regional attraction of similar companies. This section also profiles federal funding sources relevant to building and supporting these renewable energy industries within the county.

Industry Definition

Renewable energy is energy which comes from natural resources, such as wind, solar, geothermal and biomass, which are naturally replenished. As these forms of alternative energy have been further researched and developed over the years, the renewable energy industries and capacities are growing rapidly and have become less expensive.

Four major renewable energy industries were examined for Loudoun County as well as the major supporting components that make up each system: wind, solar, geothermal, and biomass. Each industry was further defined by utilizing predetermined industry sector definitions for major component parts. The definitions include Standard Industrial Classification (SIC) codes by industry sector as formulated by Renewable Energy Policy Research (REPR), a leader in renewable energy research. Though many renewable energy manufacturing companies conduct in-house research and development, the research and development industry was evaluated separately to include firms devoted solely to research and development and testing of renewable technologies. The industries examined include the following, described in terms of their definition, energy production and component parts (where applicable), and industry subsectors by SIC codes.

Wind

- Definition: The extraction of kinetic energy from the wind and conversion of it into a useful type of energy including thermal, mechanical, or electrical.
- Energy Production: In utility scale modern wind turbines, wind flows over three large composite blades mounted on a rotor, causing them to produce rotational energy which is transferred through a gearbox to a generator, where it is converted to electricity.
- Component Parts: Rotor (blades, hub, pitch drive), nacelle and machinery, gearbox and drivetrain, generator systems, tower and foundation

Wind

- Plastic Products (SIC 3089)
- Gray and Ductile Iron Foundries (SIC 3321)
- Fabricated Structural Metal (SIC 3441)
- Ball and Roller Bearings (SIC 3562)
- Blowers and Fans (SIC 3564)
- Speed Changers, Drives, and Gears (SIC 3566)
- Power Transmission Equipment (SIC 3568)
- Motors and Generators (SIC 3621)
- Electronic Components (SIC 3679)
- Electrical Equipment and Supplies (SIC 3699)
- Measuring and Controlling Devices (SIC 3829)

Solar

- Definition: Energy from the sun (radiant light and heat) that is converted into thermal or electrical energy.
- Energy Production: PV solar systems convert the energy from photons striking the cells into electrical current, which is then either stored in a battery for later use or converted into AC power by an inverter which can then be transferred to the electric grid.
- Component Parts: Batteries, blocking diode, charge controller, circuit breaker and fuses, inverter, meter, switch gear, and wiring

Solar

- Plastic Materials and Resins (SIC 2821)
- Unsupported Plastic Film and Sheet (SIC 3081)
- Sheet Metalwork (SIC 3444)
- Switchgear and Switchboard Apparatus (SIC 3613)
- Current-carrying Wiring Devices (SIC 3643)
- Semiconductors and Related Devices (SIC 3674)
- Storage Batteries (SIC 3691)
- Electrical Equipment and Supplies (SIC 3699)
- Instruments to Measure Electricity (SIC 3825)

Geothermal

- Definition: Energy derived from the heat in the interior of the earth used to heat water and make steam to turn generator turbines and make electricity.
- Energy Production: For geothermal power generation, flash steam plants operate by expanding hot geothermal fluid to make steam, which is then passed through a steam turbine-generator set to make electricity. In binary plants, a fluid with a low boiling point is circulated in a closed loop, receiving heat from a geothermal fluid through a heat exchanger, vaporizing, being expanded through a turbine-generator. Major components include various pumps and heat exchangers and piping.
- Component Parts: Heat exchangers, piping, pumps and compressors, turbine-generator, and wiring

Geothermal

- Steel Pipe and Tubes (SIC 3317)
- Fabricated Plate Work (SIC 3443)
- Construction Machinery (SIC 3531)
- Pumps and Pumping Equipment (SIC 3561)
- Air and Gas Compressors (SIC 3563)
- Blowers and Fans (SIC 3564)
- Refrigeration and Heating Equipment (SIC 3585)

Biomass

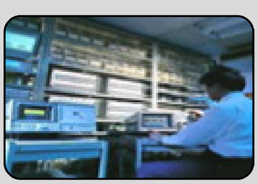
- Definition: Energy produced by the conversion of biomass directly to heat or to a liquid or gas that can be converted to energy
- Energy Production: For biomass power generation, biomass plants burn in a boiler which generates steam that is then passed through a steam turbine-generator which generates electricity. To convert the biomass into a chemical form, several processes are used such as combustion, gasification and pyrolysis.
- Component Parts: Piping, turbine-generator, pumps and compressors, transformers, batteries and heating and cooling equipment

Biomass

- Mineral Wood (SIC 3296)
- Steel Pipe and Tubes (SIC 3317)
- Fabricated Plate Work (SIC 3443)
- Industrial Valves (SIC 3491)
- Construction Machinery (SIC 3531)
- Conveyors and Conveying Equipment (SIC 3535)
- Special Dies, Tools, Jigs and Fixtures (SIC 3544)
- Pumps and Pumping Stations (SIC 3561)
- Air and Gas Compressors (SIC 3563)
- Blowers and Fans (SIC 3564)
- Refrigeration and Heating Equipment (SIC 3585)
- Fluid Power Cylinders and Actuators (SIC 3593)
- Industrial Machinery (SIC 3599)
- Transformers (SIC 3612)
- Switchgear and Switchboard Apparatus (SIC 3613)
- Storage Batteries (SIC 3691)
- Process Control Instruments (SIC 3823)

Research & Development

- Defined as an industry which represents the research, development, commercialization and deployment of renewable energy and energy efficiency technologies.



Research & Development

- Commercial Physical Research (SIC 8731)
- Testing Laboratories (SIC8734)

Location Quotient Analysis

A location quotient analysis was used to identify and determine what renewable energy industry sectors currently possess a locational competitive advantage in Loudoun County. The Location Quotient (LQ) for a given industry sector is a measure of its concentration relative to the concentration of that sector in a larger geography (the region and the nation). The LQ compares the local economy to the larger geographic economy to identify specializations in the local economy. Any employment over and above the expected percentage is therefore considered to consist of basic sector jobs because these workers are assumed to be exporting their goods and services to non-local areas.

Utilizing Dunn and Bradstreet, the total employment for each renewable energy industry sector was developed and the industries analyzed to determine location quotients. If the percentages are identical or if the local percentage is less than the reference percentage, then the local area has no basic sector employment for that industry as the area can only, at best, meet their local demand and not export these goods and services.

Below is a brief description of how to interpret the location quotient figures.

- LQ < 1.0: Local employment is less than the regional or national average for a given industry
- LQ > 1.0: Local employment is greater than the regional or national average, thus there is a location advantage for industries of this type to locate in the community

As seen in the supporting tables, the wind, geothermal, and biomass renewable energy industries in Loudoun County have a competitive locational advantage when compared to the DC Metropolitan Region, but not when compared to the nation. Conversely, the solar and research and development industries do not have a competitive location advantage when compared to the DC Metropolitan Region or four-state region of Virginia, Maryland, Delaware and the District of Columbia.

Table 17: Location Quotient Summary

Industry	LQ: Loudoun County vs. DC Metro	LQ: Loudoun County vs. States
Wind	1.54	0.97
Solar	0.50	0.29
Geothermal	1.17	0.18
Biomass	1.32	0.18
Research & Development	0.66	0.91

An estimated 736 individuals are employed in the wind industry and its respective sub-sectors in Loudoun County. Of the five renewable energy industries examined, the wind industry employs the second highest number of people after research and development. Several wind sub-sectors have high location quotients, suggesting there is a local competitive advantage in Loudoun County relative to the Washington DC

Metropolitan Region and the nation and include the following: fabricated structural metal; power transmission equipment; motors and generators; and, electrical equipment and supplies. In addition, several sub-sector industries offer a local competitive advantage in Loudoun County compared to the Washington DC Metropolitan Region but not to the nation and include plastic products and blowers and fans. Conversely, the sub-sector industry of electronic components offers a local competitive advantage in Loudoun County compared to the nation but not to the Washington DC Metropolitan Region. Overall, the wind industry employment sector in Loudoun County has location quotient of 1.54 when compared to the Washington DC Metropolitan Region and a location quotient of 0.97 when compared to the four-state region.

Table 18: Location Quotient - Wind Industry

Industry As Selected	Loudoun County	DC Metro	States	LQ: Loudoun vs. DC Metro	LQ: Loudoun vs. States
3089 Plastics Products	40	659	9,757	1.35	0.21
3321 Gray and Ductile Iron Foundries	-	105	653	-	-
3441 Fabricated Structural Metal	225	1,966	8,500	2.54	1.38
3562 Ball and Roller Bearings	-	-	788	-	-
3564 Blowers and Fans	25	73	1,760	7.61	0.74
3566 Speed Changers, Drives, and Gears	-	3	55	-	-
3568 Power Transmission Equipment	62	251	2,483	5.49	1.30
3621 Motors and Generators	32	165	1,355	4.31	1.23
3679 Electronic Components	195	4,504	7,547	0.96	1.34
3699 Electrical Equipment and Supplies	119	1,918	4,041	1.38	1.53
3829 Measuring and Controlling Devices	38	977	2,538	0.86	0.78
Subtotal (Wind Industry)	736	10,621	39,477	1.54	0.97
Total Employment (All Industries)	128,171	2,847,525	6,668,426	-	-

An estimated 256 individuals are employed in the solar industry and its respective sub-sectors in Loudoun County. Of the five renewable energy industries examined, the solar industry employs the second lowest number of people. One solar sub-sector, electrical equipment and supplies, has a high location quotient, suggesting there is a local competitive advantage in Loudoun County relative to the Washington DC Metropolitan Region and the four-state region. In addition, the sub-sector industry of instruments to measure electricity offers a local competitive advantage in Loudoun County compared to the four-state region but not the Washington DC Metropolitan Region. Overall, the solar industry employment sector in Loudoun County has location quotient of 0.50 when compared to the Washington DC Metropolitan Region and a location quotient of 0.29 when compared to the four-state region.

Table 19: Location Quotient - Solar Industry

Industry As Selected	Loudoun County	DC Metro	States	LQ: Loudoun vs. DC Metro	LQ: Loudoun vs. States
2821 Plastics Materials and Resins	-	55	9,925	-	-
3081 Unsupported Plastics Film and Sheet	-	184	7,259	-	-
3444 Sheet Metalwork	60	2,093	8,338	0.64	0.37
3613 Switchgear and Switchboard Apparatus	5	1,233	2,436	0.09	0.11
3643 Current-carrying Wiring Devices	-	292	929	-	-
3674 Semiconductors and Related Devices	19	4,833	9,781	0.09	0.10
3691 Storage Batteries	-	11	583	-	-
3699 Electrical Equipment and Supplies	119	1,680	3,603	1.57	1.72
3825 Instruments To Measure Electricity	53	1,100	3,034	1.07	0.91
Subtotal (Solar Industry)	256	11,481	45,888	0.50	0.29
Total Employment (All Industries)	128,171	2,847,525	6,668,426	-	-

An estimated 50 individuals are employed in the geothermal industry and its respective sub-sectors in Loudoun County. Of the five renewable energy industries examined, the geothermal industry employs the lowest number of people. One geothermal sub-sector, blowers and fans, has a high location quotient suggesting there is a local competitive advantage in Loudoun County relative to the Washington DC Metropolitan Region and the four-state region. In addition, the sub-sector industry of refrigeration and heating equipment offers a local competitive advantage in Loudoun County compared to the four-state region but not the Washington DC Metropolitan Region. Overall, the geothermal industry employment sector in Loudoun County has location quotient of 1.17 when compared to the Washington DC Metropolitan Region and a location quotient of 0.18 when compared to the four-state region.

Table 20: Location Quotient - Geothermal Industry

Industry As Selected	Loudoun County	DC Metro	States	LQ: Loudoun vs. DC Metro	LQ: Loudoun vs. States
3317 Steel Pipe and Tubes	-	78	732	-	-
3443 Fabricated Plate Work (Boiler Shop)	-	167	3,491	-	-
3531 Construction Machinery	3	311	2,937	0.21	0.05
3561 Pumps and Pumping Equipment	-	60	1,977	-	-
3563 Air and Gas Compressors	-	13	460	-	-
3564 Blowers and Fans	25	73	1,283	7.61	1.01
3585 Refrigeration and Heating Equipment	22	248	3,449	1.97	0.33
Subtotal (Geothermal Industry)	50	950	14,329	1.17	0.18
Total Employment (All Industries)	128,171	2,847,525	6,668,426	-	-

An estimated 355 individuals are employed in the biomass industry and its respective sub-sectors in Loudoun County. Of the five renewable energy industries examined, the biomass industry employs the third highest number of people, after research & development and wind. Several biomass sub-sectors have high location quotients, suggesting there is a local competitive advantage in Loudoun County relative to the Washington DC Metropolitan Region and the four-state region and include the following: special dies, tools, jigs, and fixtures; blowers and fans; and, process control instruments. In addition, refrigeration and heating equipment along with industrial machinery sub-sectors offers a local competitive advantage in Loudoun County compared to the four-state region but not the Washington DC Metropolitan Region. Overall, the biomass industry employment sector in Loudoun County has location quotient of 1.32 when compared to the Washington DC Metropolitan Region and a location quotient of 0.52 when compared to the four-state region.

Table 21: Location Quotient - Biomass Industry

Industry As Selected	Loudoun County	DC Metro	States	LQ: Loudoun vs. DC Metro	LQ: Loudoun vs. States
3296 Mineral Wool	-	140	387	-	-
3317 Steel Pipe and Tubes	-	78	732	-	-
3443 Fabricated Plate Work (boiler Shop)	-	167	3,275	-	-
3491 Industrial Valves	-	4	722	-	-
3531 Construction Machinery	3	311	2,797	0.21	0.06
3535 Conveyors and Conveying Equipment	-	7	2,366	-	-
3544 Special Dies, Tools, Jigs, and Fixtures	32	185	1,339	3.84	1.24
3561 Pumps and Pumping Equipment	-	60	1,351	-	-
3563 Air and Gas Compressors	-	13	450	-	-
3564 Blowers and Fans	25	73	1,283	7.61	1.01
3585 Refrigeration and Heating Equipment	22	248	3,199	1.97	0.36
3593 Fluid Power Cylinders and Actuators	-	8	604	-	-
3599 Industrial Machinery	48	893	7,626	1.19	0.33
3612 Transformers, Except Electric	5	290	2,884	0.38	0.09
3613 Switchgear and Switchboard Apparatus	-	1,188	2,526	-	-
3691 Storage Batteries	-	11	583	-	-
3823 Process Control Instruments	220	2,291	3,365	2.13	3.40
Subtotal (Biomass Industry)	355	5,967	35,489	1.32	0.52
Total Employment (All Industries)	128,171	2,847,525	6,668,426	-	-

An estimated 787 individuals are employed by the research and development industry and its respective sub-sectors in Loudoun County. Of the five renewable energy industries examined, the research and development industry employs the highest number of people. While the commercial physical research sub-sector does not exhibit a competitive advantage in Loudoun County compared to the Washington DC Metropolitan Region, it does offer a competitive advantage relative to the four-state region. Overall, the research and development industry employment sector in Loudoun County has location quotient of 0.66 when compared to the Washington DC Metropolitan Region and a location quotient of 0.91 when compared to the four-state region.

Table 22: Location Quotient - R&D Industry

Industry As Selected	Loudoun County	DC Metro	States	LQ: Loudoun vs. DC Metro	LQ: Loudoun vs. States
8731 Commercial Physical Research	702	22,642	35,042	0.69	1.04
8734 Testing Laboratories	85	3,787	9,755	0.50	0.45
Subtotal (Geothermal Industry)	787	26,429	44,797	0.66	0.91
Total Employment (All Industries)	128,171	2,847,525	6,668,426	-	-

Recommended Primary Industry Targets

To further identify and classify recommended target industry sectors for Loudoun County, BPP LCC implemented the following screening process to identify key target renewable energy industry sectors, which are organized into the following two categories:

- Tier 1: Defined as an industry sector that ranks among the top five highest sectors for employment within the respective industry in Loudoun County and has a location quotient greater than 1.0
- Tier 2: Defined as an industry sector that ranks among the top five highest sectors for employment within the respective industry in Loudoun or has a location quotient greater than 1.0 (excluding Tier 1 industry sectors)

Based on the data and findings derived from the location quotient analysis, BBP LLC defined the following renewable energy industry sectors as Tier 1 & 2 recommendations:

Table 23: Recommended Target Industries

Industry	Tier 1	Tier 2
Wind	Fabricated Structural Metal; Power Transmission Equipment; Electronic Components; Electrical Equipment and Supplies	Plastic Products; Blowers and Fans; Motors and Generators; Measuring and Controlling Devices
Solar	Electrical Equipment and Supplies; Instruments to Measure Electricity	Sheet Metalwork; Switchgear and Switchboard Apparatus; Semiconductors and Related Devices
Geothermal	Blowers and Fans; Refrigeration and Heating Equipment	Construction Machinery
Biomass	Special Dies, Tools, Jigs, and Fixtures; Blowers and Fans; Refrigeration and Heating Equipment; Industrial Machinery; Process Control Instruments	-
Research & Development	Commercial Physical Research	Testing Laboratories

Emerging Target Industries

To take the analysis one step further and look to emerging industry sectors, the location quotient for each industry in 2007 was compared to the location quotient in 2011. Those industries that showed an increase in LQ are growing relative to the rest of the Metro area or four-state region and thus emerging industry sectors to be considered. These emerging sectors are presented in the table below.

Sector	SIC 4 Code/Industry Description	
Biomass	3531	Construction Machinery
Biomass	3544	Special dies, tools, jigs, and fixtures
Biomass	3585	Refrigeration and heating equipment
Geo	3564	Blowers and fans
Geo	3585	Refrigeration and heating equipment
Solar	3444	Sheet metalwork
Solar	3613	Switchgear and switchboard apparatus
Wind	3564	Blowers and fans
Wind	3621	Motors and generators
Wind	3679	Electronic components, nec

Federal Funding

Multiple federal departments provide a variety of funding sources to encourage research, development and use of renewable energy resources including the Internal Revenue Service, the Department of Treasury, the Department of Agriculture, and the Department of Energy. Many of these incentives offer either a tax credit or a financing program.

Table 24: Funding Sources – Federal

Provider	Program
IRS	Business Energy Investment Tax Credit
IRS	Renewable Electricity Production Tax Credit
Department of Treasury	Renewable Energy Grants
USDA	Rural Energy for American Program (REAP) Grants
IRS	Clean Renewable Energy Bonds (CREB's)
IRS	Qualified Energy Conservation Bonds (QECB's)
Department of Energy	Loan Guarantee Program
USDA	Rural Energy for America Program (REAP) Loan Guarantee
Department of Energy	Renewable Energy Production Incentive (REPI)

Many of these and other funding sources are discussed in greater detail in Section 5: Sources and Uses of Funds.

Best Practices

While the industry evaluation provided an expectation of the types of green energy industries Loudoun County may target, and the supportive networks description offered a snapshot of private venture capital firms that may support the growth of these industries, the best practice assessment profiles how peer public sector entities are working to comprehensively grow renewable energy and sustainability in their communities.

Best practices in renewable energy projects, initiatives, and other developments are profiled with an emphasis on energy sectors identified in the early stages of the IEMP. In order to identify peer communities similar to Loudoun County, Virginia, BBP LLC selected best practice communities based primarily on the answers to the following screening questions and selection criteria:

- Does a formal energy plan exist for the municipality?
- Does the municipality have an active energy policy / initiatives?
- Does a high-technology business base exist in the municipality?
- Does the municipality offer energy / green job creation incentives?
- Does the municipality promote LEED buildings and offer green building incentives?

- Does the municipality receive national recognition for innovative alternative / green energy initiatives?
- Suggested municipalities from the Loudoun County Economic Development staff
- Other (Various other selection criteria)

Based on the input and selection criteria above, Douglas County, Colorado; Fairfax County, Virginia; Frederick County, Maryland; City of Cambridge (in Middlesex County, Massachusetts); Ramsey County, Minnesota; Suffolk County, New York were identified as communities for further analysis.

The best practice descriptions addressed the following key questions:

- What financing strategies were utilized?
- Who were the key participants?
- What marketing strategies were implemented?
- What key issues and constraints were exhibited, and how were they overcome?

Key findings from the community evaluations are grouped by question below. More detailed profiles of the best practice communities are provided in Appendix G**.**

Financing Strategies Utilized

- Combination of financing sources are used (federal, state, local and nonprofit) in addition to private funding sources
- US DOE Energy Efficiency Conservation Block Grant (EECBG) acts as the key funding source for projects that reduce energy consumption
- Commonwealth of Virginia offers several financing incentives related to renewable energy and sustainability. These include:
    - Green jobs tax credit
    - Rebates and tax credits for efficiency
        - Sales tax exemption for energy efficient products
        - Property tax exemption for solar systems
        - Residential energy efficient appliance rebates
        - Income tax deduction for energy efficient products
        - Geothermal heat pump rebate program
    - Green building and landscapes
        - Virginia Department of Conservation and Recreation provides funding for storm water management features (rain gardens, green roofs, etc.)
- Local government purchasing is often used as a means for the public sector to directly support green energy and sustainability
    - County purchasing preferences
    - Fleet of vehicles
    - New facility construction
    - Facility retrofit
- Nonprofit Sector plays a role in supporting emerging renewable energy companies
    - Technology incubators

Key Participants

- Local government
    - Leads by example, addressing multiple facets of energy and sustainability through government operations and capital projects:
    - Employee LEED accreditation
    - New facility construction to LEED standards
    - Existing facility energy audits and retrofits
    - Vehicle fleet transition to hybrid and electric power
    - Reforestation of built areas
    - Greening of events on government land and facilities
- General public
    - Engaged through multiple outreach techniques, including:
        - Government website
        - Newsletter
        - Social media
        - Online blog
        - Postcards
        - Calendars
        - Advertising at recycling facilities and programs
        - Public television
        - Open house/'Energy Fair'
        - Press releases, print advertisements, and other publications
        - Listening and Recruitment tour
- Special groups
    - Educational institutions
    - Workforce development providers
    - Technology community
- Local utilities and green energy providers
- Alternative/green energy advisory committees – multiple groups may be formed focused on different initiatives or audiences (and may or may not be mutually exclusive):
    - Sustainability Initiative Advisory Committee
        - Provide vision and guidance to implement and monitor sustainable energy
    - Environmental Coordination Committee
        - Ensure coordination of government policies and initiatives (across agencies)
    - Energy Efficiency and Conservation Committee
        - Coordinate energy efficiency and conservation across educational institutions, workforce development, technology community, and other special groups
    - Environmental Quality Advisory Council
        - Act as a forum for citizen input and advisor on environmental matters to government officials
    - Green Job Leadership Council
        - Connect policy to job creation

Marketing Strategies

- Economic development efforts focused on strategic sectors based on understanding of green economy. In Loudoun, the following sectors hold promise, and some of the other case study communities are pursuing (based upon location quotient analysis and review of Sectors of Green Economy):
    - Cleantech manufacturing
    - Waste management and energy and utilities (Refuse Derived Fuel)
    - Green buildings
    - Retail and organic gardening (to cater to growing and affluent population)
- Communities targeted green industries and clean energy companies (including existing businesses that could transition to green products)
- Green purchasing preferences and local government facility retrofits/LEED new construction activities stimulated green economy and green reputation
- Promotion of green development
    - Development targeted to sustainable locations (growth areas with infrastructure)
    - New private residential and commercial development encouraged to meet LEED standards
    - Facility retrofits of existing residential and commercial development promoted to achieve greater energy efficiency
- Integrated and efficient transportation systems planned and built, including those with transit and vehicle charging stations. Such a system would further enhance Loudoun's reputation as a green and progressive place to do business
- Growth of green economy before training the workers (to avoid training another community's future workforce)

Key Issues and Constraints and How to Overcome

- The key issues and constraints faced by communities vary by the local context
- Public opposition was a key issue in Colorado, and addressed through an extensive, multi-pronged public outreach effort
- Limited County control over planning and zoning matters was a key issue in New York, and prompted strategic collaboration between Suffolk County and local municipality community development officials, who ultimately have planning and zoning power
- Training workers in green industries and growing green jobs can be a chicken and egg situation (without the jobs, training the workers could result in training of a neighboring community or state's workforce); situation addressed through making training programs employer-driven, with partnerships to community businesses to connect trained participants to green-industry employment.
- Limited resources to hire new personnel, addressed by enhanced interdepartmental coordination, allowing efforts to be shared between working groups and commissions across departments. Expertise of existing employees bolstered through LEED accreditation program for all government employees.

Potential Initiatives

From the best practices analysis, BBP LLC developed a set of potential initiative topic areas for Loudoun County to consider. These initiative areas include:

- Initiative #1: Use Economic Development to Build 21st Century Economy
- Initiative #2: Government Leading by Example
- Initiative #3: Market Techniques to Promote Alternative / Green Energy Initiatives
- Initiative #4: Establish Alternative / Green Energy Advisory Committees
- Initiative #5: Create an Integrated /Efficient Transportation System
- Initiative #6: Promote Green Development
- Initiative #7: Build a 21st Century Urban Energy Infrastructure

The suggested sub-components of each initiative area are described below.

Initiative #1: Use Economic Development to Build 21st Century Economy

- Develop a green / clean economy by supporting renewable energy sectors, green building and energy efficient technology, energy-efficient infrastructure and transportation, and recycling and Refuse Derived Fuel
- Actively target green industries and clean energy companies
- Improve and coordinate energy efficiency throughout county and in county buildings
- Coordinate business attraction strategies
- Seek new energy partners to locate operations
- Achieve green economy by stimulating production or consumption in a broad range of sectors, from Cleantech R&D to green buildings and lifestyle-related retail and organic gardening. A listing of the variety of sectors that may be targeted is provided in the figure below.

Sectors of the Green Economy			
	Industries (Production)		Lifestyle (Consumption)
New	**Cleantech R&D** Research and product development for energy generation and storage, transport, nanotech, smart production, etc.	**Energy and Utilities** Electric, gas, water, etc.	**Eco-Tourism** Trip guides, hotels, etc.
	Cleantech Manufacturing Producing environmental, sensitive, low-emission, and/or energy efficiency products	**Green Buildings** On-site construction, solar panel installation, retrofits, HVAC, housing materials	**Organic Gardening** Pruning, yard work, landscaping, etc.
	Other Green Manufacturing Energy saving appliances, packaging green furniture, other manufacturing using green processes, etc.	**Waste Management** Recycling, composting, biomass, etc.	**Ecosystem / Park Management** Trail maintenance, erosion prevention, invasive species removal, etc.
	Sustainable Food Processing Baked goods, energy bars, teas and coffee, prepared foods, etc.	**Chemistry and Materials** Brownfields cleanup, less polluting / hazardous chemical process, etc.	**Retail** Restaurants, farmer's markets, groceries, cleaning products, clothing, appliances, cars and bikes, etc.
	Green Financial Services Venture capital, investment, and commercialization services for new green technologies	**Transportation** Vehicle and component manufacturing, biofuel stations, operations, maintenance, and repair, etc.	
Traditional	**Other "greened" Establishments** Traditional service firms that are greening operations	**Urban Goods Movement Systems** Freight, warehousing, etc.	
		Environmental Services Environmental impact reports, environmental law services, civil engineering, architecture, planning, etc.	

Source: Center for Community Innovation – Defining the Green Economy: A Primer on Green Economic Development

Figure 34: Green Economy Market Sectors

Integrated Energy Management Plan

Initiative #2: Government Leading by Example

- Sponsor and make available LEED accreditation course to all local government employees
- Retrofit county government facilities to become green and energy efficient
- Incorporate and adopt purchase of alternative fuels and efficient vehicles (hybrid and diesel)
- Systematically assess government owned facilities and identify energy efficient upgrades
- Create a tree planting program to maintain street and park trees to provide environmental benefits, including reduction of the urban heat island effect
- Require new construction and major renovations of government facilities to LEED certifications
- Create an energy alliance and offer free energy audits and free / subsidized energy efficiency measures to help residents and businesses save energy, water, and money by making their homes and buildings more efficient
- Adopt a 'Green Events' ordinance which mandates green standards for large capacity events and / or those that occur on county properties or facilities with the goal to reduce greenhouse gas and other harmful pollutant emissions, and to help maintain compliance with Federal Air Quality standards, promote waste reduction, reuse and recycling, promote water and energy conservation, and encourage use of transportation alternatives at events
- Engage employees as part of sustainability initiatives and provide ongoing green jobs training

Initiative #3: Market Techniques to Promote Alternative / Green Energy Initiatives

- Engage in an extensive public outreach effort that uses multiple methods of communication. Possible actions for consideration include:
    - Create a dedicated website for green initiatives and/or include on the County website
    - Publish a quarterly electronic newsletter
    - Utilize Facebook, Twitter, and other social media networks
    - Create an online 'blog' for residents and local business owners to share and voice comments and opinions
    - Distribute postcards to local businesses and participating jurisdictions
    - Utilize government television station
    - Host an 'Energy Fair' or open house
    - Create and publish press releases, advertisements, presentations, reports, fact sheets, and other resources
    - Market to educational institutions, workforce development agencies, and technology groups

Initiative #4: Establish Alternative / Green Energy Advisory Committees

- Establish committees including, but not limited to, the following:
    - Sustainability Initiative Advisory Committee to provide a vision and clear guidance to evaluate, adopt, integrate, facilitate, implement, and maintain programs, services, and policies to achieve the sustainability vision
    - Environmental Coordination Committee to ensure appropriate level of coordination and review of the county government's environmental policies and initiatives
    - Energy Efficiency and Conservation Coordination Committee to ensure coordination of energy efficiency and conservation across county agencies, schools, and authorities

    - Environmental Quality Advisory Council to advise on environmental matters and provide a forum for citizen input on environmental matters
    - Green Job Leadership Council to chart a course in the new green economy by connecting public policy to job creation
- Committees may be comprised of:
    - Local residents and business owners with experience related to the aspects of economic, environmental, and social sustainability appointed by the county government
    - County government staff members, including members from all departments

Initiative #5: Create an Integrated / Efficient Transportation System

- Reduce commuting by single-occupancy vehicles
- Improve facilities for walking and cycling
- Reduce motor vehicle travel through parking incentives and restrictions, car-sharing, promotion, and education
- Reduce motor vehicle emissions by electrification of transportation system, which utilizes the use of hybrid electric and all-electric vehicles instead of all-petroleum vehicles
- Promote local and regional transit improvements
- Provide vehicle charging stations throughout community to provide a supporting infrastructure and promote the use of electric vehicles

Initiative #6: Promote Green Development

- Promote design and construction of green buildings
- Build a green retrofit program which creates weatherization programs to green retrofit existing buildings
- Reduce heat island effect through design of the building environment
- Encourage investment in new sustainable residential and commercial development
- Provide broad based incentives to encourage urban (downtown & inner-city) development
- Adopt Green-Higher Performance building code and mandate energy savings over prior code

Initiative #7: Build a 21st Century Urban Energy Infrastructure

- Create a county-owned utility which creates and distributes renewable energy
- Engage in strategic business relationship / partnership with local utility and execute a ‘Power Purchase Agreement’
- Engage in agreement with green energy provider (wind, solar, biomass) to build green facilities
- Develop energy efficient program to create a green energy infrastructure
- Investigate a potential Refuse Derived Fuel facility

Economic and Fiscal Impacts and Projected Commonwealth Revenues

This section of the report presents the economic impact analysis including an economic impact analysis of commercial operations and project construction of a Refuse Derived Fuel facility and non-potable water facility. Economic analyses include estimates of the direct and indirect impacts of employment and earnings, as well as household spending in the local economy. The last section summarizes the economic impacts of the two IEMP projects at build-out and stabilization.

Economic Impacts of Commercial Operations

The economic impacts resulting from commercial operations are related to the ongoing operations of the Nexus Project recommendations. There are two main areas of economic impacts discussed below: ongoing operations and impacts from the construction period. For each category, employment and earnings are estimated, including income and retail taxes and spin off effects through the local and state economy.

Employment Estimates

Development of the IEMP projects will create and support permanent jobs, and generate wages and salaries that will, in turn, be re-spent throughout the local economy. The direct jobs and wages created and supported through this development are a key factor in assessing economic benefits of new commercial uses.

Because of the size and nature of these operations the direct employment impact will be relatively small. Table 25 shows estimated staffing levels for the proposed projects.

Table 25: Employment at Build-Out

Employees	Total Employment
Refuse Derived Fuel	9.0
Non-potable Water	1.5
TOTAL	**10.5**

Earnings

Total direct wages and salaries (earnings) are calculated based on total new jobs calculated for this project. The 10.5 FTE jobs supported by the development are projected to earn approximately $602,400 annually in 2011 dollars, at build-out and stabilization.

Table 26: Estimated Annual Earnings Impacts & Expenditures - Permanent Employment

	FTE's (Total Employees)	Average Earnings/Hr.	Total Annual Earnings
Refuse Derived Fuel	9.0	$28.97	$542,409
Non-potable Water	1.5	$19.23	$60,000
Total			$602,409

Direct and indirect Impacts

The U.S. Department of Commerce's *Regional Input-Output Modeling System* (RIMS II) estimates how much a one-time or sustained increase in economic activity in a particular region will be supplied by industries located in the region. The RIMS II model is utilized within this analysis to estimate direct and indirect economic impacts from commercial operations and construction activity. The RIMS II model employs regional input-output (I-O) multipliers which account for inter-industry relationships within regions.

Table 27: Total FTE Employment Impacts

	Total FTE Jobs	Employment Multiplier	Indirect Employment Impact	Total Employment Impact (5/)
Refuse Derived Fuel	9.0	1.493	4.4	13.4
Non-potable Water	1.5	1.890	1.3	2.8
Total	10.5		5.7	16.3

Based on the RIMS II model, employment at the two projects will support an additional 5.7 indirect FTE jobs, and wages earned by employees in new operations will generate indirect earnings of approximately $215,000 in the local economy.

Table 28: Total Earnings Impacts

	Total Annual Earnings	Earnings Multiplier (6/)	Earnings Impact	Total Earnings Impact (7/)
Refuse Derived Fuel	$542,409	1.350	$190,006	$732,415
Non-potable Water	$60,000	1.399	$23,952	$83,952
Total	$602,409		$213,958	$816,367

Total annual earnings for the employment of the RDF Power Plant and non-potable water (NPW) projects, including indirect earnings, are over $816,000.

Economic Impacts from Construction

Economic impacts from the construction of projects such as RDF and NPW can be important to the local and state economies. Based on total construction costs at build-out of approximately $50 million, including on- and off-site infrastructure, we estimate that approximately 430 FTE construction jobs would be sustained during the course of project development. Based on average earnings per hour of $22.16, BBP LLC projects that total annual earnings from construction will equal approximately $25.6 million, including direct and indirect earnings impacts.

Table 29: Economic Impacts from Construction

Direct Impacts	
Hard Construction Costs	$49,500,000
Labor Cost	40%
Total Labor Expenditure	$19,820,000
Average Earnings/Hr	$22.16
Total FTE Jobs	430
Indirect Impacts	
Output ($)	$45,500,000
Output Multiplier	1.8486
Indirect Economic Impact	$41,919,300
Total Economic Impact	$91,469,300
Total FTE Jobs	430
Employment Multiplier	1.3433
Indirect Employment Impact	148
Total Employment Impact	578
Total Annual Earnings	$19,820,000
Earnings Multiplier	1.2918
Indirect Earnings Impact	$5,783,476
Total Earnings Impact	$25,603,476

Various supplier and support industries will benefit from expenditures and employment associated with the construction of RDF and NPW projects. Of course, not all of this expenditure will occur in the local or even regional economy. Nonetheless, the value of this impact remains quite significant and of importance to local suppliers.

Construction Impacts: Materials Purchases and Sales Tax

Non-recurring sales taxes will be generated during the project construction phase, through the sale and purchase of building materials. BBP LLC estimates total sales taxes from construction to equal approximately $445,950.

Table 30: Material Purchases

Output Type (by component)	Total Construction Material Costs	% Regional Material Purchases	Total Regional Purchases	Total Regional Sales Tax
Refuse Derived Fuel	$29,400,000	30.0%	$8,820,000	$441,000
Non-potable Water	$330,000	30.0%	$99,000	$4,950
Totals	$29,730,000	30.5%	$9,067,650	$445,950

Income Taxes

Income taxes from new employment represent additional fiscal revenue to the state. BBP LLC estimates annual recurring income taxes generated from the RDF and NPW projects to equal approximately $26,457.

Additional non-recurring income taxes will accrue during the construction phase from construction jobs, as well as design and engineering work, legal services, marketing, promotion, etc. Income taxes generated from construction are estimated to equal approximately $870,634.

Table 31: Estimated Personal Income Taxes

Employee/ Household Category	Baseline Estimated Number of FTE Jobs	Estimated Annual Earnings Per Job	Estimated Individual Taxable Income	Total Taxable Income	Realized Personal State Income Taxes
Refuse Derived Fuel	9	$60,268	$48,455	$436,097	$23,822
Non-potable Water	1.5	$40,000	$32,160	$48,240	$2,635
Total	11	$602,409		$484,337	$26,457

Table 32: Estimated Construction Income Taxes

Construction Period	
Construction Jobs	430
Total Taxable Income	$15,938,3383
State Income Tax Rate	5.75%
Income Tax	$870,634

Conclusions

As the Loudoun, Virginia and national economies continue to struggle with, and recover from, the economic downturn; economic development strategic planning will continue to grow in importance. When the economy is in such a downturn, business attraction and relocation is curtailed significantly and typically limited to regional companies. To create economic development opportunities under these conditions, it becomes critical to support and grow the companies that are in the community currently, and to seek out and attract those with a locational reason to expand in Loudoun County.

Due to these current economic conditions and related opportunities, the economic development assessment focused on identifying and leveraging existing Loudoun County industry strengths related to the IEMP and/or CES. The location quotient analysis provides an important look at the industry sectors that are currently in the county and region, and thus provide the initial foundation for expansion and regional attraction of similar companies. The results of the analysis identified more than a dozen Tier 1 industry sector targets (see Table 23) in the Alternative Energy sectors of wind, solar, geothermal and biomass. The evaluation further focused on the supporting technology, R&D and manufacturing elements of these energy sectors for the greater employment, economic investment and growth impacts and opportunities.

The two Nexus Projects recommended in the IEMP are important catalytic projects for the county and the Moorefield Station development. The potential investment of public resources and monies in these two projects will be an important outward signal to the private sector that the county is invested in the Moorefield Station development and alternative energy. The direct and indirect earnings impact to Loudoun County from the recommended Nexus Projects was estimated to be $25,600,000, with additional economic benefits of nearly $1.5 million in annual tax revenues

Leveraging the Nexus Projects to provide infrastructure for additional sites will also be critical in assuring the private sector that investment in this project is sound. The economic and fiscal return from the Nexus Projects will further justify the public sector collaboration and participation in the remainder of the development. Furthermore, the best practice analysis reinforces this outcome as, in nearly all the case studies, public infrastructure and public monies led to catalytic projects.

Moorefield Station will and has already gained important momentum from early public collaboration and investment. The IEMP adds to this momentum through its investment and Nexus Projects, and further positions Moorefield Station and Loudoun County for the coming economic recovery.

Section 7: Risk Analysis

The final step in the IEMP evaluation of Nexus Projects and the IEMP was to assess the relative risks associated with the capital projects and performance of the IEMP when applied to Moorefield Station. This risk assessment builds on and utilizes the analyses completed in the prior sections of this report to identify any potential sustainability and project related risks or gaps which could impair the performance of the projects. Upon completion of the risk assessment, mitigation strategies were developed to fill the gaps or mitigate the material risks identified. Where applicable, the results of the risk analysis and mitigation strategies are included in the recommended IEMP implementation plan included in Section 8 of the report.

Due to the intent of the IEMP, IEMP mission and goals for Moorefield Station, the risk assessment went beyond the standard risk or due diligence frameworks. To address the broader sustainability attributes and the mission associated with the IEMP and Moorefield Station, additional sustainability-focused frameworks were applied.

Three separate risk frameworks and tools were utilized. Two of the frameworks focused on sustainability and sustainable development performance, while the conventional risk assessment focused on more standard project performance issues and risks.

- Zofnass Program for Sustainable Infrastructure (applied to Moorefield Station)
- HalSTAR Sustainability Assessment (applied to Moorefield Station and the five Nexus Projects)
- Conventional Risk Assessment (applied to the five Nexus Projects)

Applying the HalSTAR sustainability tool and the Zofnass Programs' sustainable infrastructure rating framework identifies broader, sustainability or triple bottom line (e.g. economic, environmental and social) related risks. This provides a more robust evaluation and leads to improved overall project and sustainability performance. The conventional risk assessment is more detailed in nature focusing on specific and standard project and asset related risks (e.g. financial, regulatory, operational and technological).

Overall, Moorefield Station and the Nexus Projects performed very well as evaluated by the sustainability risk frameworks. The conventional risk assessment of the Nexus Projects identified some specific areas of risk. However, the mitigation strategies identified should adequately address the risks, if needed, and support successful implementation.

Zofnass Program for Sustainable Infrastructure Assessment

The Zofnass program for sustainable infrastructure at the Harvard Graduate School of Design is currently developing and refining a sustainable rating system for infrastructure. Moorefield Station was used as a pilot project to support the development of the system and provide a targeted sustainability risk assessment for the development. The IEMP rated as highly favorable overall; key conclusions include:

- Overall score: 35 'Favorable' credits out of 42 applicable credits
- Excellent Resource Allocation performance due to integration and application of IEMP
- Good Natural World performance due to efforts to protect/preserve habitat and water quality
- Identified specific opportunity for building systems commissioning to improve performance; subsequently included in implementation plan

The Zofnass Program's mission is to promote the development, distribution and adoption of sustainable development methods and tools that define and quantify sustainability in the context of infrastructure and large scale developments. Recently, the Zofnass program and the Institute for Sustainable Infrastructure created a strategic partnership to collaborate in the development and implementation of the sustainable infrastructure rating system. This partnership further supports the eventual adoption and wider acceptance of the sustainable rating system. The Zofnass rating system evaluates 50 individual credits grouped into four categories as seen in Figure 34.

Figure 34: Zofnass Credit Categories

As the Zofnass rating system is under development, the first phase of the system includes the development of the credits and a checklist for a project. Eventually, the rating system will provide a performance based score, with the intent to rate an infrastructure project on its relative performance to similar types of projects. For example, a water treatment plant project would receive the highest scores if it performed in the top 10 percent of all the projects included in the Zofnass database for water treatment plants. In this first phase of the Zofnass rating system, each of the categories and individual criteria scores are qualitative in nature.

The Zofnass rating system was used as a sustainability-focused risk assessment for the infrastructure planned for the Moorefield Station development. As the assessment is completed, it will become a case study for the Graduate School of Design and provide critical information in the development of the Zofnass project database for scoring. Of the 50 total credits, 42 were applicable to Moorefield Station. At this stage of development, qualitative ratings of favorable, neutral and not favorable were applied to each credit. The IEMP and proposed Moorefield Station development scored very well, resulting in a 'favorable' rating in 35 of the 42 credits. A summary of the ratings for each category is shown below in Table 33.

Table 33: Summary Ratings for Zofnass Categories

	Favorable	Neutral	Not Favorable
RESOURCE ALLOCATION	12	0	0
NATURAL WORLD	7	1	2
CLIMATE CHANGE	6	0	3
QUALITY OF LIFE	10	1	0
Total	35	2	5

The IEMP and Moorefield Station's performance resulted in strong 'favorable' ratings in each of the four categories. Furthermore, Resource Allocation and Quality of Life aspects of Moorefield Station did not result in any 'not favorable' scores, while Natural World aspects of the development received only one 'not favorable' credit score. Climate Change was the only Zofnass category receiving more than one 'not favorable' credit score.

As the Zofnass rating system was used as a risk assessment tool, any credits resulting in 'neutral' or 'not favorable' were identified as potential areas of risk. Neither of the two 'neutral' credits identified a material risk or issue with Moorefield Station's development. These two credits relate to habitat connectivity and context sensitive design. A portion of each of these credits is outside the scope of Moorefield Station and will be managed as a part of the actual construction.

Of the five 'not favorable' credits, the Natural World credits related to maximizing use of developed sites and eliminating invasive species. As Moorefield Station is a TOD greenfield development, it is ineligible for the brownfield / maximized use of developed sites credit. Invasive species were addressed as a part of the original environmental studies for Moorefield Station. However, the Zofnass credit requires a much more comprehensive assessment than is currently required for Moorefield Station.

The three remaining 'not favorable' credits were all related to the Climate Change adaptability category. These three credits included assessing, designing and preparing for climate change threats. While Moorefield Station received six favorable ratings for climate change emissions, the IEMP and past Moorefield Station studies have not addressed or included climate change adaptability evaluations. While this is a potential area of risk for the development, past engineering and studies have addressed aspects of climate change adaptability issues such as flooding. To fully mitigate the potential risks of climate change threats, Moorefield Station and the future developers would need to specifically assess the individual climate change threats (e.g. flooding, food availability, extreme weather variability and sea rise) beyond current code and permitting requirements and their applicability or materiality to their specific portion of the development. As climate change adaptation and assessments were not included in the scope of the IEMP, no further studies or recommendations were pursued.

Overall, the Zofnass sustainable rating system's results for Moorefield Station reinforced the unique sustainable aspects of the development and the past work and collaboration by the county and the Claude Moore Foundation. The past zoning collaboration, TOD nature of the development, IEMP and commitment of the Claude Moore Foundation each contributed to the high score and expected sustainability performance. For a full listing of the Zofnass credits and resulting ratings, please see Appendix H.

HalSTAR

HalSTAR is a toolkit which leverages a global database of sustainability issues and practices to define sustainability and supports decision making on broad and specific sustainability issues, in any given context. In the case of Moorefield Station and the IEMP, HalSTAR acts as a comprehensive sustainability assessment tool used to identify sustainability related risks and mitigations strategies. For the IEMP, HalSTAR was applied to the overall Moorefield Station development and the five Nexus Projects to identify sustainability related risks. The evaluation resulted in a good to excellent rating across most categories for the development and the recommended Nexus Projects; key conclusions included:

- Strong sustainability performance for the Moorefield Station development with application of the IEMP recommendations
- Sustainability performance results for the five Nexus Projects further reinforced the original selections of the RDF power plant and non-potable water system
- The potential risk areas identified by the HalSTAR assessment for the two recommended Nexus Projects were known and addressed in the initial evaluation stages of the IEMP

Overview of HalSTAR

HalSTAR includes a global, comprehensive database of sustainable metrics, rating tools and indicators. The HalSTAR database currently contains almost 700 national and international sustainability related frameworks, documents and requirements and continues to grow with each new project. Some of the frameworks and documents contained in the database include LEED, BREEAM, CEEQUAL, the Global Reporting Initiative, Green Globes, the Dow Jones Sustainability Index and numerous industry or company specific sustainability guidelines.

After completing the IEMP assessment, the HalSTAR database now includes Loudoun County sustainability related guidelines such as the Energy Strategy, Green Building Challenge and transportation guidelines in addition to stakeholder documents such as Verizon's Corporate Responsibility Report and Loudoun Water's Statement of Policy.

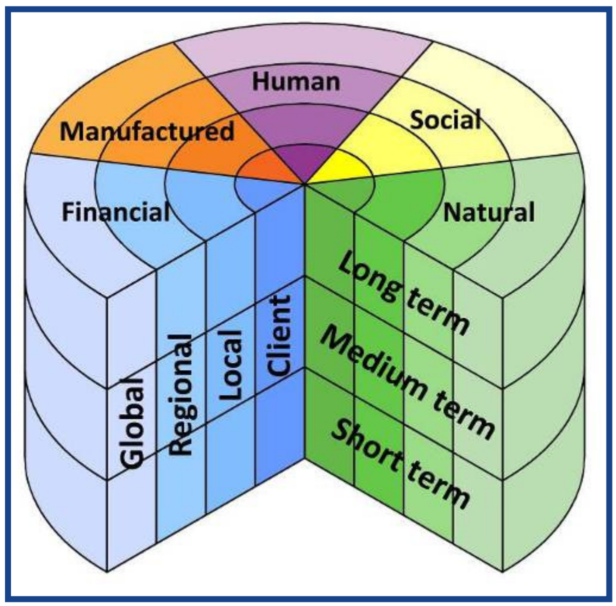


Figure 35: HalSTAR Systems Model of Capitals, Stakeholders and Timeline

While HalSTAR provides a holistic, generic framework, it must be adapted to any given context to ensure effective results. HalSTAR augments and tailors the global database with the requirements and positions of key stakeholders for a project or program.

This innovative approach ensures that time and energy is focused where it counts, resulting in a context-specific sustainable solution that reduces risks and highlights opportunities for innovation, efficiency and added value. The HalSTAR methodology is based on a cylindrical "systems model", which represents sustainable development as the balance between a range of needs (i.e. capitals – financial; human; natural), for a nested system of stakeholders (e.g. global, regional, local), throughout the lifecycle of a project or process (e.g. long, medium and short term). This generic model can be applied to describe the sustainability of any system.

The HalSTAR framework has been adapted from the Forum for the Future's five capital's model:

- Natural capital – the environment's capacity in terms of natural resources.
- Manufactured capital – assets which contribute to the development process.
- Human capital – people's health, knowledge, skills and motivation.
- Social capital – institutions that help maintain and develop human capital.
- Financial capital – enables natural, manufactured, human and social capitals to be owned and traded.

Using the five capitals to group the issues, the HalSTAR sustainability wheel is based on the definitions implicit in almost 700 existing approaches, including assessment methods, indicator sets, corporate responsibility strategies, policies and reports, legislation, planning policies, and the requirements and position statements of a range of stakeholder groups. The generic wheel covers every theme that has been identified relating to sustainability in all of the analyzed approaches. Figure 34 shows the HalSTAR five capitals, themes and areas organization.

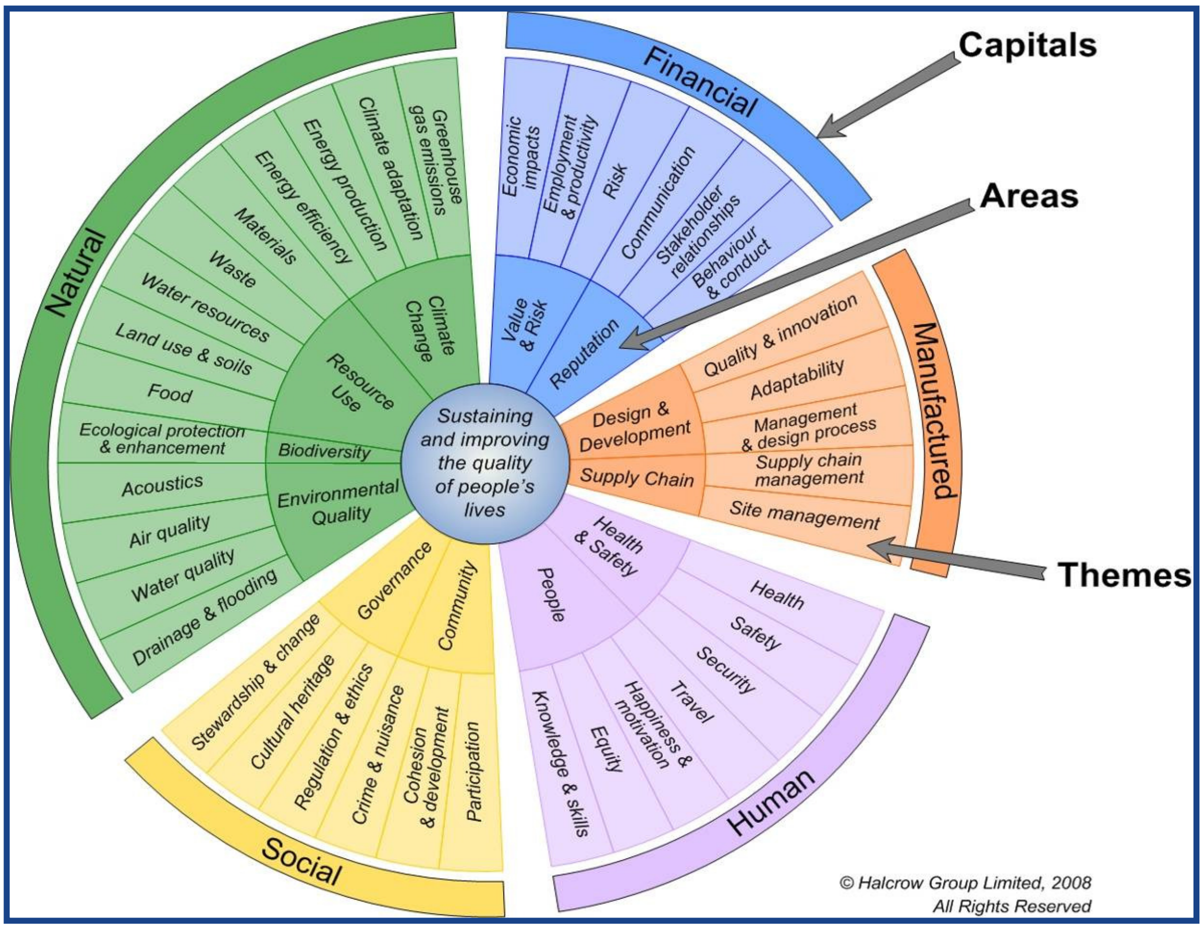


Figure 36: HalSTAR Sustainability Wheel – Capitals, Themes and Areas

The "issues framework" adds another dimension - issues in the diagram are associated with stakeholders on different scales (e.g. the client, project, end users, and local, regional, and global impacts). It can be used to identify, define and align the requirements of wide ranging groups associated with a particular project. Figure 37 shows some example indicators and criteria included in specific capital areas, themes and general stakeholder categories.

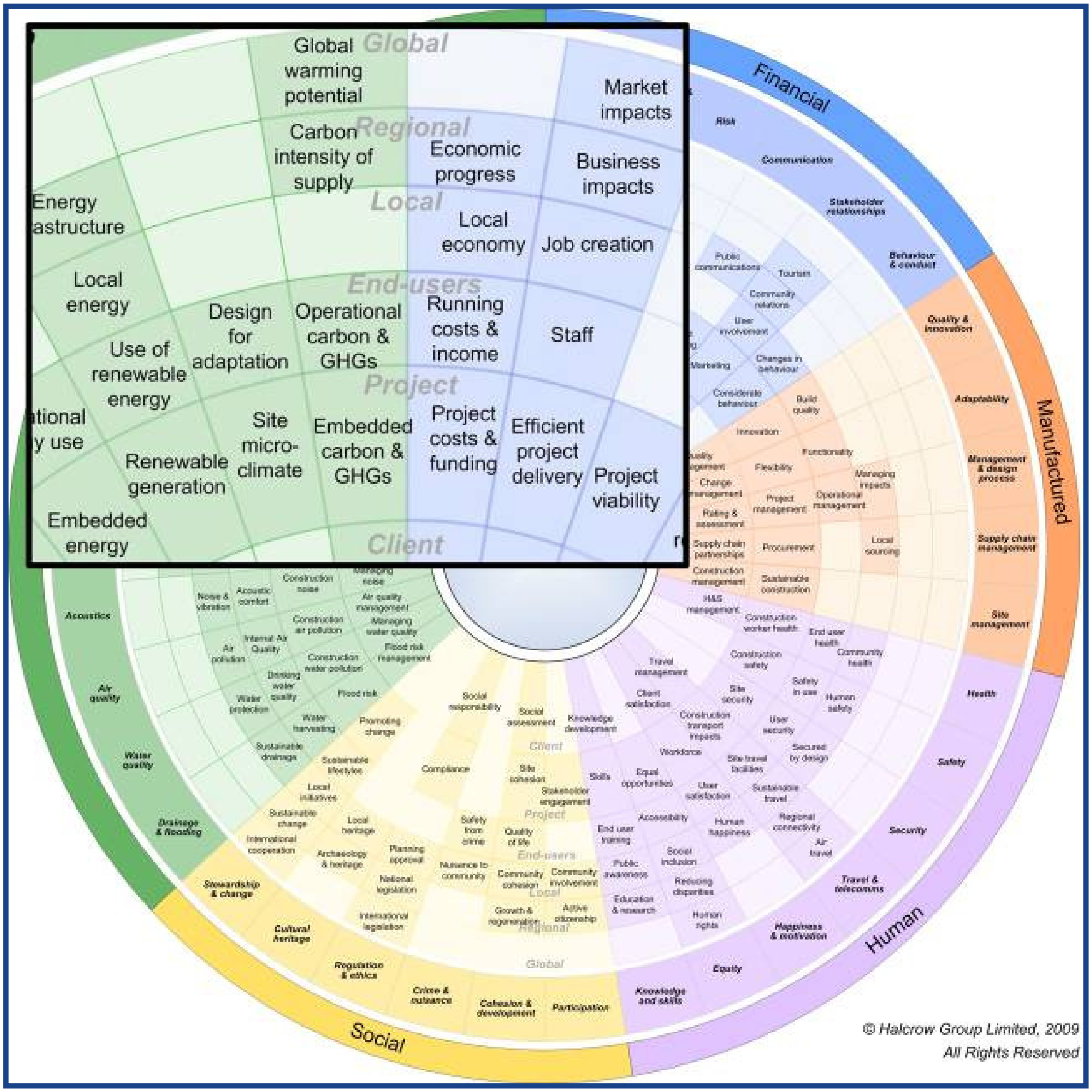


Figure 37: Example Sustainability Metrics and Indicators Included in the HalSTAR Tool

This initial comprehensive, holistic framework provides a worldwide 'shared view' of sustainable development that connects high level policy with project level practices. This initial framework is then adapted and tailored to the program or project, in addition to the applicable stakeholders' views and positions regarding the project. When completed, this tailored set of requirements is used to develop relevant criteria with which to evaluate projects and determine appropriate improvements.

Applying and Tailoring HalSTAR to Moorefield Station and the Nexus Projects

For Moorefield Station and the IEMP, the initial HalSTAR framework was tailored and augmented with the sustainability and businesses positions of the following list of stakeholders.

- Loudoun County
- Dominion Virginia Power
- Loudoun Water
- Digital Realty Trust
- Loudoun Public Schools
- Loudoun County Chamber of Commerce
- Verizon
- Washington Gas

The documents included in the stakeholder review, and later incorporated into the HalSTAR tool included items such as the Loudoun County Energy Strategy, Loudoun County Facilities Standards, Digital Realty Trust's Annual Summary Reports, Dominion Power's Sustainability Report and Verizon's Corporate Responsibility Report. A full list of the documents is included in Appendix I. A summary of the HalSTAR process from the full global database to the tailored set of Moorefield Station sustainability issues and criteria (including stakeholders and Loudoun County specific requirements) is shown in Figure 38.

The tailored set of issues and criteria is shown in the Moorefield Station combined documents HalSTAR wheel diagram in Figure 39. In order to develop this combined set of issues, a similar diagram was completed for each of the above stakeholders and integrated into the final diagram shown in Figure 40. The individual stakeholder diagrams and greater detail on the criteria, including a table of the Key Moorefield Station criteria is included in the Appendix I.

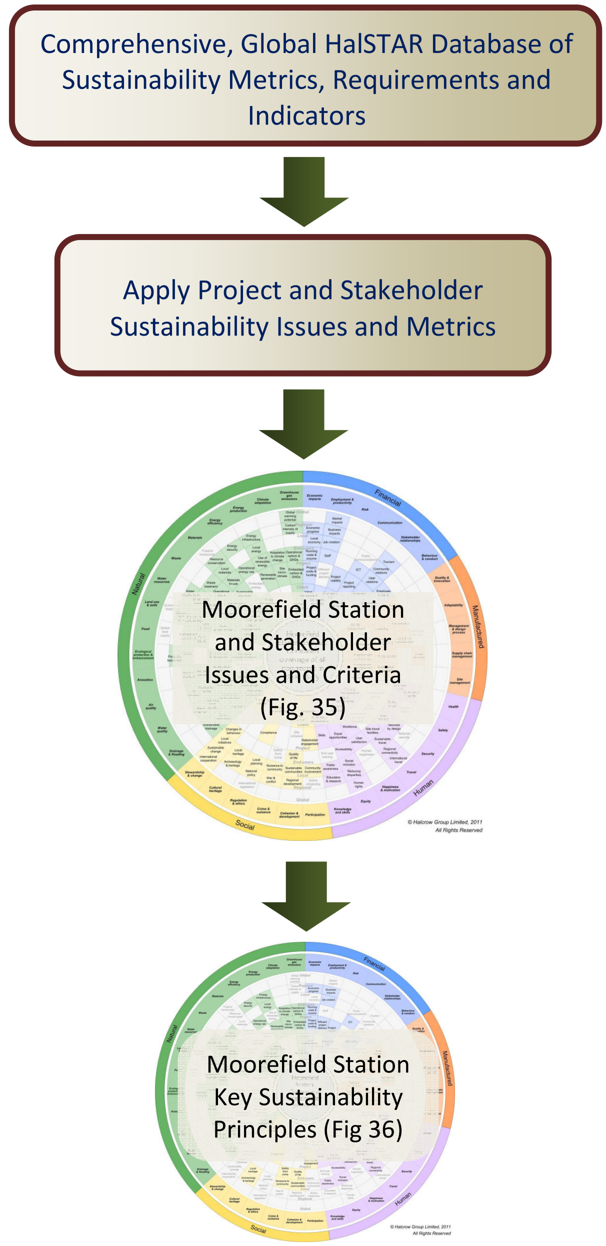


Figure 38: HalSTAR Process to Create a Combined and Tailored Set of Sustainability Criteria

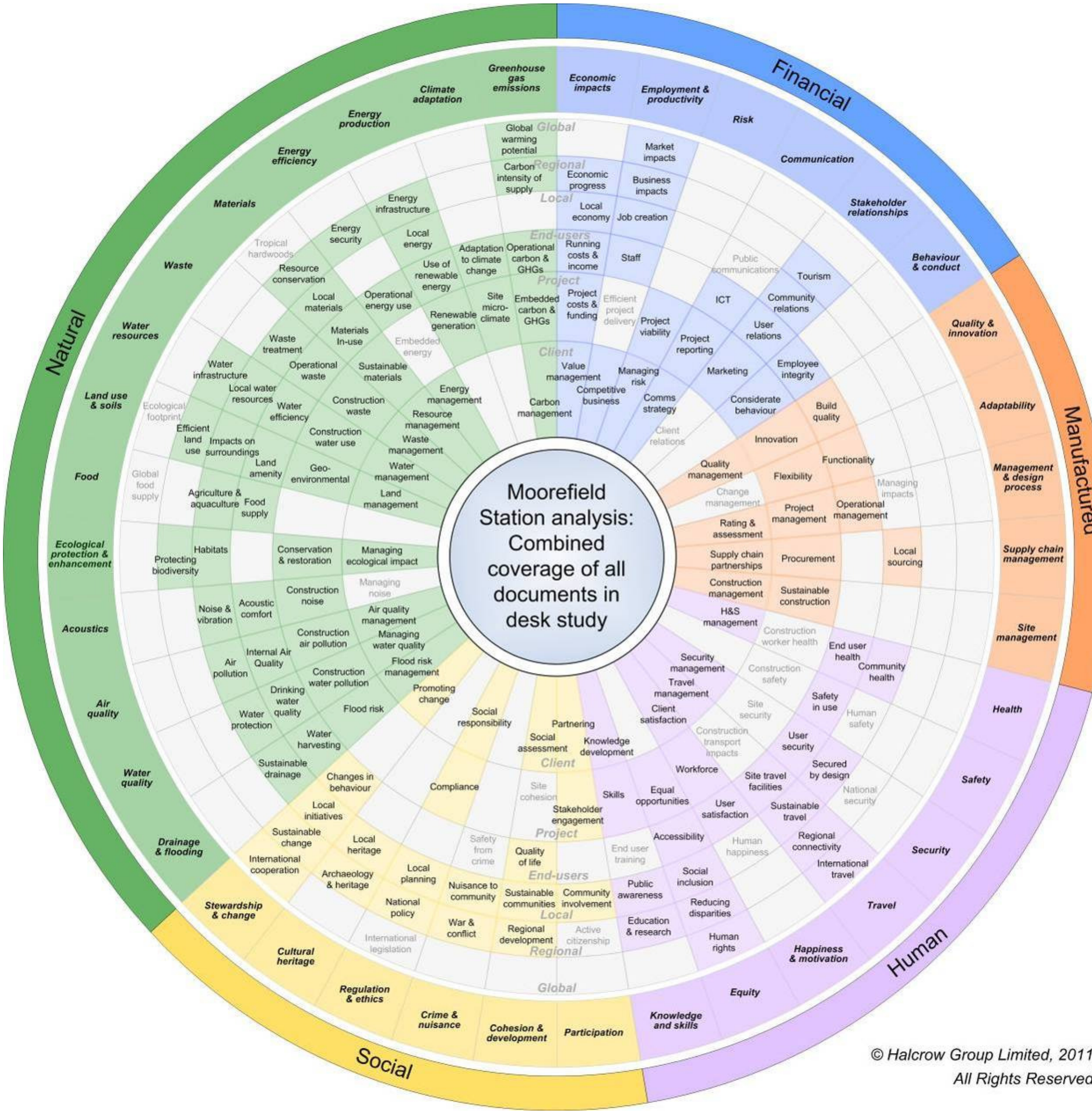


Figure 39: HalSTAR Wheel Diagram for Combined Moorefield Station Sustainability Issues

The final step in identifying the key sustainability related risk issues to apply in the Moorefield Station and Nexus Project assessment is to further adapt the combined Moorefield Station Sustainability Issues by selecting the key, applicable issues. In the combined analysis, it is likely that some of the issues in the framework, which have not been mentioned in previous documents and resources, may be relevant to the project (e.g. gaps in construction safety, change management, or end user training). It is also likely that some of the broader stakeholder issues and criteria included in Figure 35 or in the supporting documents are not

Figure 40: HalSTAR Wheel Diagram for Key Sustainability Issues and Principles

applicable or significant to the Moorefield Station project. By first considering all potential stakeholder concerns, then reviewing those concerns and removing those not applicable or significant, the key issues and risks are established. Figure 40 shows the HalSTAR Wheel diagram with the key sustainability issues and principles.

Figure 40 and the key set of sustainability issues were applied to the overall Moorefield Station Development and the five Nexus Projects. A summary of the results from the HalSTAR assessment is included below, while the full supporting details of the assessment, such as the individual issues, are included in the Appendix I.

HalSTAR Results for Moorefield Station Development

The set of key sustainability issues summarized in Figure 36 were assessed against the Moorefield Station Development to perform a gap and risk analysis. Moorefield Station's performance against each of the key issues was assessed using a 'traffic light' scoring system. Performance is rated on a scale from red to green. Green represents Moorefield Station exceeding compliance, regulations or excellent performance on an issue, while red represents poor performance. Moorefield Station was scored based on the planning and zoning already completed for the site, expected Metro rail station and application of the IEMP as described in this report. Figure 37 shows the summary results of the sustainability risk assessment for the Moorefield Station development by the key areas. The key issues identified in Figure 40 are grouped together and summarized within the areas. See Figure 36 for more information regarding the relationship between HalSTAR issues, themes and areas.

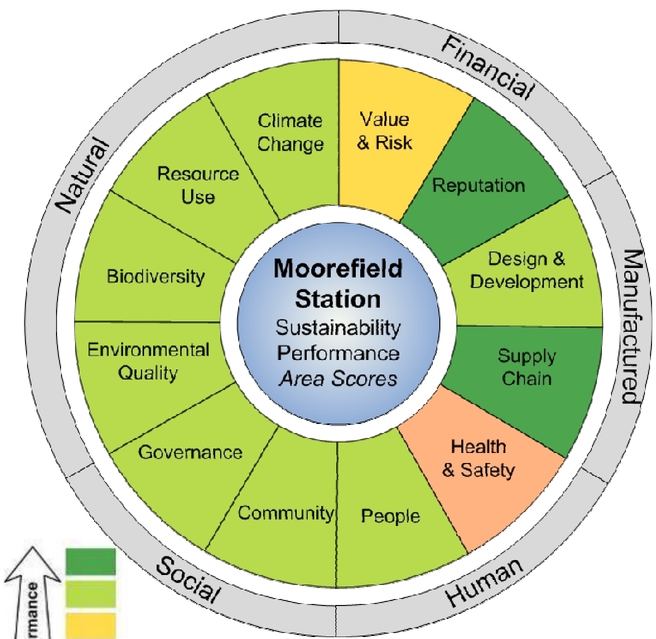


Figure 41: Moorefield Station HalSTAR Sustainability Performance Results

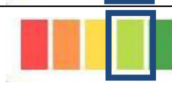
As seen in Figure 41, Moorefield Station's overall sustainability performance (with respect to the key issues) is good to excellent in most of the key areas (e.g. Resource Use, Reputation, Community and Biodiversity). However, Health and Safety and Value and Risk were two of the lower scoring areas. In performing the sustainable risk assessment, the lower performing areas were investigated further to identify potential gaps or risks for the development. Table 34 and 35 below show the supporting issues and details that led to the lower performance and scoring.

Table 34: Health and Safety Area Performance

Area	Issue	Principle (Definition)	Performance
Health & Safety	End User Health	Ensure and promote the health, safety and wellbeing of end-users throughout the lifetime of the proposal.	
	Safety in Use	Manage, mitigate, and review impacts on end user and public safety and create safe physical environments.	

Health and safety scored lower relative to the other areas because it was not a direct or high priority focus of the IEMP. Having a lower performance relative to the other areas for health and safety does not suggest that Moorefield Station will be an unsafe development. Moorefield Station will have the required health and safety elements, be compliant with applicable regulations and be an overall safe and healthy development. In fact, one of the first developments on the site is a new fire station. While the results of the IEMP may indirectly support improved health and safety, specific programs were not developed within the IEMP, identified as a higher priority issue or promoted in support of the development.

Table 35: Value and Risk Area Performance

Area	Issue	Principle (Definition)	Performance
Value and Risk	Project Costs and Funding	Ensure that capital costs are justifiable and affordable, and that adequate funding is available.	
	Running Costs	Minimize utilities costs and other operational costs.	
	Local Economy	Contribute towards a prosperous, diverse, competitive local economy.	
	Efficient Project Delivery	Ensure that the proposal is delivered efficiently and within appropriate timescales.	
	Employment Impacts	Create additional jobs and a more diverse range of employment opportunities.	
	Business Impacts	Deliver the conditions for successful, competitive businesses which are high-level economic contributors.	
	Risk Management	Systematically assess, manage and mitigate risks and uncertainties.	

The value and risk area scored adequately, just lower than the other higher performing HalSTAR sustainability areas for Moorefield Station. Value and Risk and Reputation are both areas contained within the Financial Capital for the HalSTAR tool. Value and Risk scored slightly lower due to some unknown or less controllable aspects of Moorefield Station. For example, the Claude Moore Foundation and the county have a smaller sphere of control regarding managing the risk and uncertainty related to Moorefield Station. The majority of the risk, after initial planning and sale of the property for development will be managed by the actual developer and owners of properties. In addition, while the IEMP and Moorefield Station will help diversify the overall economy (e.g. focus on clean and innovative energy opportunities), it may not directly result in a diverse range of employment impacts. Moorefield Station and the IEMP will likely result in more energy related jobs in the short and mid terms.

HalSTAR Results for Nexus Projects

In addition to the Moorefield Station assessment, the key sustainability issues from Figure 40 were applied to each of the five Nexus Projects to evaluate their sustainability performance and risks. The resulting 'traffic light' diagrams provide a rapid appraisal and comparison of each project while quickly highlighting potential gaps or risks. Figures 42 through 46 include the HalSTAR scoring results, with red indicating poor performance up to green indicating excellent performance.

Figure 42: Natural Gas CHP Nexus Project

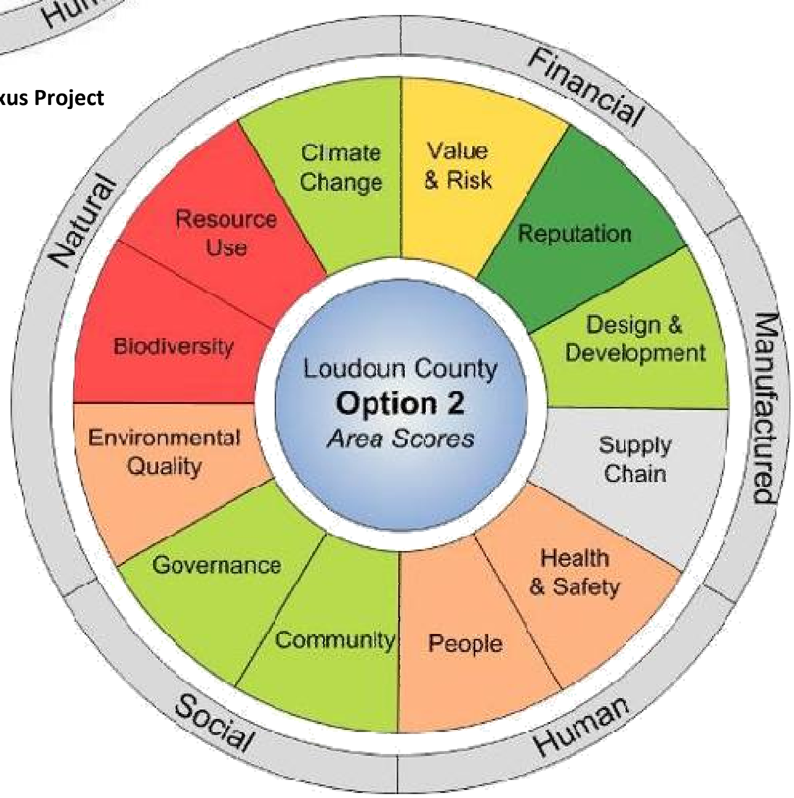


Figure 43: Biomass Power Plant Nexus Project

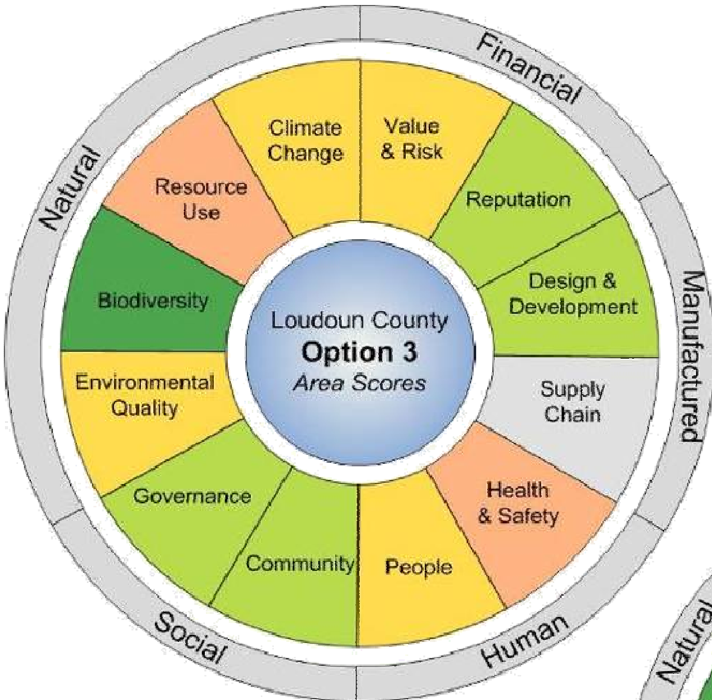


Figure 44: Waste to Energy Power Plant Nexus Project

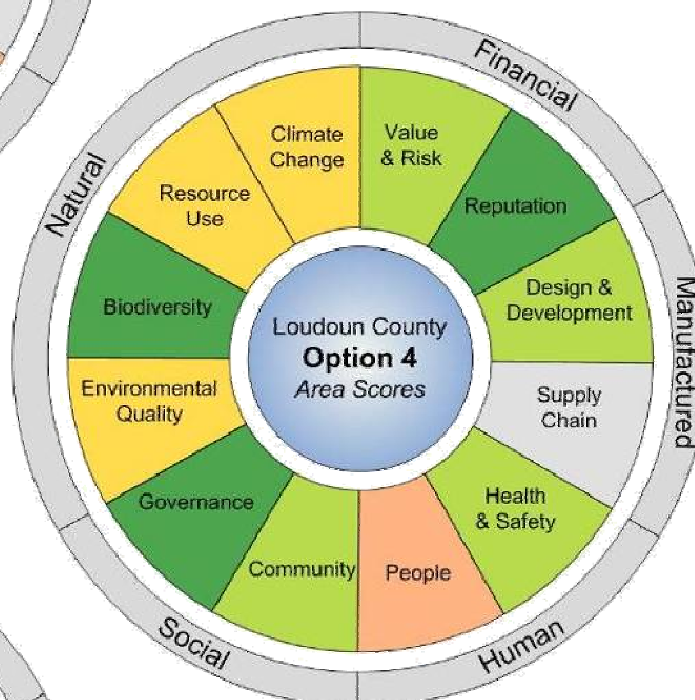


Figure 45: Non-potable Water System Nexus Project

Figure 46: Sustainable Building Code Nexus Project

Of the five Nexus projects, the sustainable building code (Figure 46) had the best sustainability performance according to the HalSTAR assessment. There were minimal risks identified or potential gaps. The only area that received a slightly lower score for performance was Value and Risk. This lower score was due to the limited job creation and diversity of jobs scores for the sustainable building code. The code itself would likely not result in new jobs or additional, positive economic impacts. Overall the sustainable code received high scores for reducing energy consumption and GHG emissions, water and resource efficiency, improved environmental quality and biodiversity.

The two Nexus Projects recommended for implementation by the financial and environmental evaluation received higher scores from the HalSTAR assessment. The refuse-derived power plant's sustainability performance was higher than the two similar Nexus Power projects: the natural gas CHP plant and the biomass power plant. The risks identified by HalSTAR included concerns of long term waste generation and potential impacts of source reduction and recycling efforts. If broad source reduction and recycling efforts become extremely successful, it may limit or greatly reduce the availability of the waste as a fuel to a power plant. This risk was identified and discussed in the evaluation, and the size of the plant was reduced to remain conservative and allow for greater waste diversion prior to the refuse-derived power plant facility. The sustainable benefits of the refuse-derived power plant facility include renewable energy, reduced emissions, avoided habitat destruction for the landfill expansion and reduced costs as compared to the other options.

The non-potable waste system also received high scores from the HalSTAR assessment. Overall, the assessment identified some minor gaps and potential risks related to reclaiming stormwater for non-potable uses. The risks identified focused on more natural resource impacts such as the potential for negative ground water quality impacts if the reclaimed water is not minimally treated. This should not become an issue, as best management practices for stormwater infrastructure and water quality on the Moorefield Station site are approved and will be used. This should mitigate any significant threat for increased pollution in the stormwater ponds and the reclaiming of that water for use at the site.

The two remaining Nexus Projects related to power generation, the natural gas CHP plant and biomass power plant had more significant risks identified by the assessment than the refuse-derived power plant alternative. These risks included the potential for negative biodiversity, resource and human impacts. The risks and gaps identified for the natural gas CHP plant included increasing GHG emissions, ongoing depletion of fossil fuel resources and lack of renewable energy generation. While these risks could be addressed to minimally reduce their impacts, they would never be significantly mitigated.

The most significant sustainability related risks identified for the biomass power plant include potential negative habitat, resource and biodiversity impacts. These risks are primarily associated with the sourcing of the biomass fuel or feedstocks. There is the potential for the sources of the biomass feedstock to deplete natural habitats, reduce biodiversity and come from unsustainable sources. To mitigate the potential negative impacts, a sustainable source strategy would be needed. This is initially addressed in the biomass power plant evaluation by utilizing local waste biomass (e.g. woody waste and debris) that would not deplete or impair local habitat. However, this only accounted for a portion of the fuel necessary (16 percent). The remaining 84 percent of the biomass feedstock is purchased from the market and requires additional analysis and a sustainable sourcing plan to mitigate the potential habitat and biodiversity risks.

HalSTAR Conclusions

Overall, the HalSTAR assessment for sustainability related risks for the Nexus Projects and Moorefield Station reinforced the previous prioritization, scenario analysis and recommendations.

Of the three power generation related Nexus Projects, the RDF power plant received the highest HalSTAR rating. The sustainability risks identified for this facility were known and included in the initial scenario analysis of the financial and environmental evaluation. The RDF project was reduced in size (e.g. MW) to mitigate any risks from the availability of solid waste and to act as a hedge against increasing recycling rates, reduced local solid waste availability and having to transport additional solid waste into the county.

The non-potable water system also received high sustainability performance scores and did not identify any significant risks or gaps for the project. The only concern identified related to the water quality on site and is addressed by the adoption of the best management practices for stormwater quality and treatment. There were two risk areas identified for the overall Moorefield Station development including value and risk and health and safety. For the most part, these risk areas are not material for Moorefield Station and are out of the direct control of the development, county and Claude Moore Foundation. These risks will be managed by the actual and eventual developers and owners of the buildings and facilities in Moorefield Station.

Conventional Risk Assessment

Following the Zofnass sustainable infrastructure and HalSTAR sustainability assessments, a conventional risk assessment was performed to address the more tactical and detailed implementation elements associated with the five Nexus Project options. Overall, the key conclusions regarding the Nexus Projects included:

- Regulatory issues and risks are common to four of the five Nexus Projects related to the county becoming a utility for heating, cooling, power and/or non-potable water
- The recommended RDF power plant faces technology, fuel feedstock and political risks; all of which were previously known, are manageable and include mitigation strategies
- The non-potable water system's only material risk is related to the previously discussed water supply availability
- The county's most significant and direct risk mitigation effort will likely be the proactive community engagement plan to support the RDF power plant.

Applying the conventional risk assessment to the five Nexus projects further supports, reinforces and enhances the prioritization and final project selections. The conventional risk assessment is separated into three areas:

- Project Risks
- Technology, operational, financial, regulatory, political, management
- Energy Supply and Market Risks
- Environmental, Health and Safety

Each of the risk areas was evaluated to determine the applicability and relative magnitude of the risks for each project. Risk mitigation strategies were developed to minimize and address the material risks identified for the two previously recommended Nexus Projects (refuse-derived power plant and non-potable water system).

Regulatory Issues and Risk

There is a common and significant regulatory risk shared between four of the five Nexus Projects. The natural gas CHP, biomass power plant, RDF power plant and the non-potable water system each share a risk related to the potential requirement of the county becoming a utility to implement each of the projects.

In Virginia, the SCC regulates all utilities (e.g. cable, electric, water and district heating/cooling) within the state including the exclusive service territories and franchises for each utility. For the three power generation related projects, the SCC regulations regarding power generation and sales limit the ability of public or private entities to develop a power plant project or operate a utility within existing franchise and service territories.

As with all states, a utility is granted a franchise with specific boundaries known as a service territory by the public utility commission (i.e. SCC) and/or the local government. The franchise provides the utility the exclusive right to sell its service (e.g. electricity or cable television) within the service territory, effectively becoming a regulated monopoly. Typically, no direct competition is allowed for that service within the territory. The most significant regulatory issues for a power generation or CHP project in Loudoun County are related to:

- Existing franchises and exclusive service territories granted by the SCC and the state
- Limits on selling heating or cooling services to more than one customer and/or multiple buildings
- Renewable power generation limits

Loudoun County is currently served by two electric utilities that have franchise rights in the county: Dominion Power and NOVEC. Due to these franchises, SCC and state statutes, it appears the county cannot develop any size of a conventional (e.g. coal, natural gas or fuel oil) power or CHP without becoming a regulated electric utility by the SCC. Virginia state statute 56-265.1 requires the electric service of a CHP plant to be regulated if the electricity is generated and sold to more than one customer.

The only general exception to local, conventional power generation limitations is for emergency backup power such as an emergency diesel generator. In addition, since franchises currently exist for electric utilities within the county and Moorefield Station, Loudoun County does not currently have the legal right to generate and sell electricity within those franchise service territories. The county would have to pursue legislative and regulatory paths such as applying for a certificate of public convenience and necessity (CPCN) for the power plant and the municipalization of existing assets and/or service territory to operate an electric or thermal utility and distribution assets. Becoming an electric utility would likely include SCC hearings, federal and state regulatory filings and litigation with existing franchise owners.

Furthermore, the statute places limitations on selling heat or district energy to multiple customers or the district energy system crossing any highway, street or road. District energy systems (heating or cooling) are allowable for a single property or a single, undivided tract of land with one owner providing heating or cooling services to the buildings on the premises (e.g. a college campus or cluster of county facilities). However, the statue requires the CHP owner and operator not charge separately or by meter for electric energy except as part of a rental charge. If the CHP owner charges fees for electric service, the service will be regulated as an electric utility. [12]

Since the market demand for distributed and mid size renewable power projects has increased, the State of Virginia and the SCC have granted permission to public and private entities to develop renewable energy projects up to 7.5MW without being regulated as a utility[13]. However, while the county can develop and own a renewable power generation facility up to 7.5MW without being a regulated utility, it must still obtain operating agreements or contracts with the local electric transmission and distribution utilities to deliver the power to the grid.

Similar regulations and limits on utility projects exist for combined heat and power. The SCC considers distribution of heating and cooling a utility, if sold to multiple end users or crosses boundaries such as streets or city/county lines. If the county pursued a CHP project, and developed a campus type distribution system in Moorefield Station to sell the heat and cooling, it would likely be regulated by the SCC and must become a utility. There is an exception for CHP for single users or multiple buildings owned and operated by a single entity such as a college campus or a county government site with multiple buildings.

While Loudoun County is limited in its ability to develop projects independently, it can enter into third party agreements or contracts with Dominion Power or other developers to build, own and operate a power plant facility greater than the 7.5MW limit. In fact, this is recommended path to implementation for the refuse-derived power plant for Loudoun County. A contractual agreement would likely include a third party to develop and operate the project, with Loudoun County and/or Moorefield Station entering into a purchase power agreement (PPA) to buy the power and electricity and receive the environmental benefits or RECs from the plant for a period of 10 to 20 years. The third party would also manage any contracts and interconnections with the local transmission and distribution electric utility provider (e.g. Dominion Power).

More detailed information on the recommended path to implementation is included in the implementation section of the report. While these regulatory risks are common to many of the Nexus Projects, the additional project, market and environmental, health and safety risks unique to each of the projects are discussed below.

Natural Gas Combined Heat and Power

Natural gas power and CHP plants carry relatively low project, environmental, health and safety risks. Natural gas plants have been in operation for more than 60 years while central heating and cooling plants have more than a 100-year operating history. Beyond the regulatory risks and issues facing each of the utility related projects, the largest risk facing a natural gas CHP plant is the volatility in the natural gas commodity market.

> The most significant risks identified for the natural gas CHP plant is volatility of the natural gas commodity markets. Historically, natural gas market prices have varied widely and are susceptible to major weather events such as hurricanes. However, recent shale gas reserves appear to have stabilized the market.

The key project related risk areas include operations and

[12] McGuire Woods Consulting "District Energy Systems: An Analysis of Virginia Law" prepared for the Northern Virginia Regional Commission, August 2011

[13] Code of Virginia Title 56, Chapter 10: 56-232 Public Utility and Schedules Defined

maintenance (O&M), management, engineering and technology. The minor O&M risks include the cost of combustion turbine overhaul (i.e. major maintenance) and availability of the proper replacement parts when the combustion turbine reaches 10 years of operation. Although the original equipment manufacturer (OEM) may have stopped making the replacement parts there are typically companies who provide aftermarket replacements; however, these parts would be higher in cost. Natural gas CHP and power plants typically require minimal direct on site management and can even be remotely operated and dispatched by the power generation company. If the county were to directly own and operate the plant (not recommended), there would be an increased risk as the county is not familiar with these types of assets and utility operations. However, this risk could easily be addressed by utilizing and contracting with a qualified third party to manage and operate the facility. This is a common tool used in the power generation and utility markets.

As natural gas power and CHP plants are common and widely utilized technologies, the engineering and technology risks related to this project are minimal. The CHP plant and related systems are common mechanical, electrical, civil, structural, piping and instrumentation and control systems. The technology and efficiencies have continued to improve in recent years beginning with the advent of dry low NO_X burners and higher grade turbine blade material that allows for increased combustion temperatures. There are no significant regulatory risks or issues beyond those previously discussed. All power generation facilities have a stringent permitting and regulatory process for construction and operation; however, this process should not significantly impact the project.

Energy supply and market risks represent the single largest risk for the natural gas CHP plant. Natural gas is a market traded commodity and can experience major swings in market prices and is dramatically affected by major weather events in the Gulf of Mexico such as hurricanes. Figure 47 shows historical natural gas prices for the past 10 years.

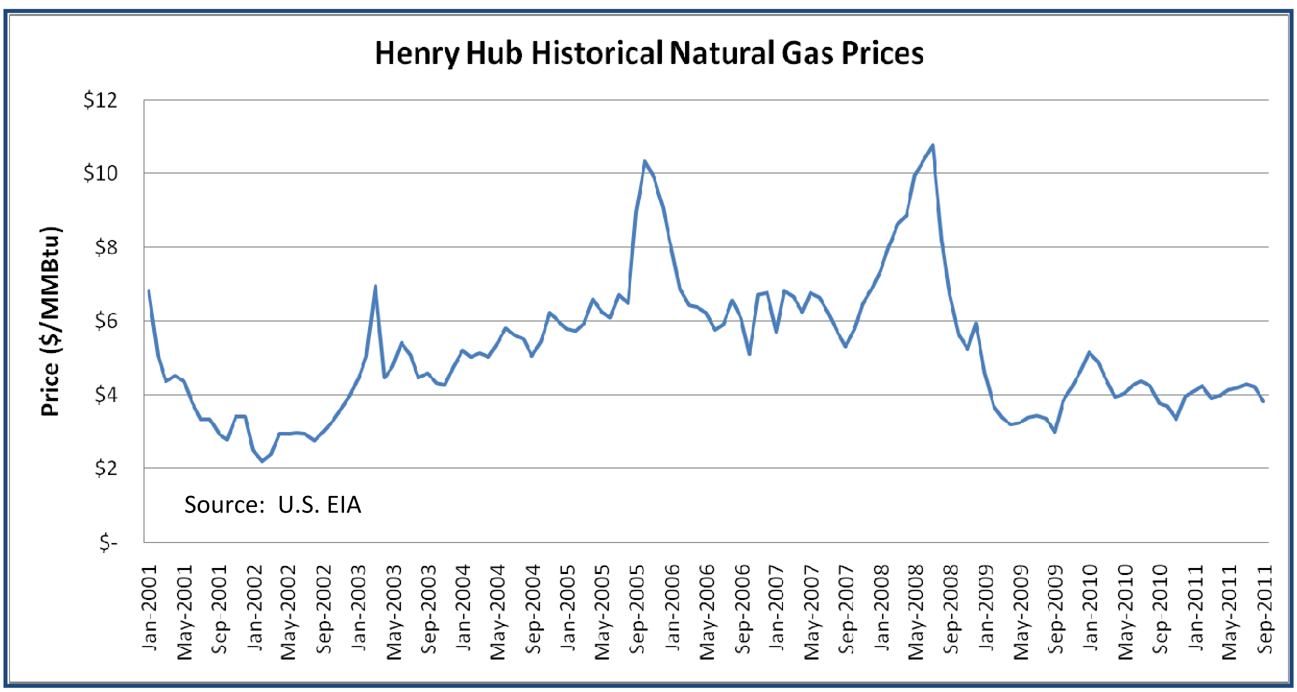


Figure 47: Historical Henry Hub Spot Prices for Natural Gas

The major spikes in natural gas prices occurring in September 2005 and September 2008 were related to hurricanes Katrina and Rita in 2005 and Gustav and Ike in 2008. Prices increased to more than $10 per MMBtu during those two events, 2.5 times higher than current natural gas prices. The recent shale gas deposits in Pennsylvania and Texas have added significant gas reserves to the market and stabilized prices, as seen previously in Figure 29. However, it will not remove the volatility. Electric utilities who use natural gas power plants typically adopt hedging strategies and fuel cost adjustments or 'pass-throughs' to address the market risks. All electric utilities in the U.S. utilize some type of a fuel/power cost adjustment which passes the direct fuel costs for power generation on to the end customer on a kWh basis. These mechanisms do not remove all risk, but they do reduce the volatility and impact of price swings.

Environmental, health and safety risks are also minimal and manageable for a natural gas CHP plant. The only emissions from a CHP plant are in the form of NO_X, CO and CO_2. Natural gas has overall lower emission rates as compared to other fossil fuel alternatives (e.g. coal and fuel oil). All emissions, except CO_2, can be controlled through the application of emissions control technologies such as low NO_X burners and selective catalytic reduction system and catalytic reduction to lower the CO emissions to meet regulations or desired limits. As in any use of flammable gaseous fuels, it requires precautions to ensure that explosions and fires are minimized. These precautions are regulated by the National Fire Protection Association and are updated annually. There are few health issues in a natural gas fired installation as long as typical good housekeeping practices are adopted and implemented.

Of the three power related Nexus Projects, the natural gas CHP plant would result in increased CO_2 and GHG emissions from the BAU base case. The biomass and refuse-derived power plants are considered CO_2 and GHG emission neutral. While GHG emissions would increase with the CHP plant, the direct financial and project risk related to the GHG emissions is negligible.

While CO_2 emissions can be further reduced and controlled by application of the best available control technologies, it is not currently required by federal regulations and air permits. As the U.S. does not currently have a federal GHG emission regulation or cap and trade regime adopted, there are no requirements to further control CO_2 emissions from a natural gas CHP plant. Furthermore, it is unlikely that a federal GHG emissions reduction legislation or a cap and trade regime will be passed and adopted in the next several years. If federal GHG emissions reduction legislation were passed in the future, the financial risk associated with the emission reductions and added technology costs would not materially impact the CHP plant. Any costs associated with GHG legislation or cap and trade for electric utilities will be passed on to the end customers similar to the fuel or power cost adjustment discussed for natural gas volatility. This pass through and shift of cap and trade and GHG reduction related costs has been confirmed by all 50 U.S. public utility commissions and Standard and Poor's (S&P) rating agency.

Biomass Power Plant

Biomass power plants have an operating history of more than 70 years and proven commercial operational history. Biomass also carries slightly more risk than conventional natural gas plants. However, this increase in risk for biomass power is minor and easily managed or mitigated. Overall, the most significant risk areas for a biomass power plant are potential fuel availability, fuel pricing, and increased O&M issues as compared to natural gas.

The key project related risks areas include O&M, management, engineering and technology. Biomass power plants include a greater scope of operations than natural gas CHP plants including material handling, fuel storage and material management. This increase in operations may require as many as 10 to 15 personnel to operate and maintain a 10 MW facility. This increase in personnel, operations and fuel handling increases the O&M related risks. However, the maintenance related O&M risks are lower as biomass technology, OEM replacement components, and equipment are smaller and less costly.

The most significant risks identified for the biomass power plant include: biomass feedstock availability, fuel pricing and broader operations and maintenance (O&M) and management issues. Each of the risks is manageable with recent studies supporting the availability of lower cost biomass feedstocks in and around Loudoun County.

The management related risks for a biomass plant are primarily associated with fuel supply, handling and sourcing issues. Procuring, using and managing a solid fuel stored on site requires specific biomass related expertise. There are multiple fuel feedstock sources utilized for the biomass power plant including local county vegetative/wood wastes and market purchased biomass pellets. Managing two or more feedstock sources, transportation costs and future fuel sourcing can significantly impact the plant performance. As in the natural gas CHP plant, a third party with biomass power experience should be used to operate and manage the facility to reduce and manage these risks.

The technologies used in biomass facilities in the past 30 years have seen little change, are low risk and commercially proven across multiple fuel sources including biomass. Fluidized bed combustion and boilers to generate steam are widely used and accepted for varying fuel sources and sizes of power plants. Varying fuel sources and combustion properties are the most significant risks related to the plant design and operation. Biomass feedstocks are a non-homogeneous fuel source and can vary widely in terms of ash and moisture content. The ash chemistry can also foul the heat transfer surfaces of the boiler requiring cleaning and unscheduled maintenance and downtime. The ash and feedstock heterogeneity risks are mitigated by selecting a qualified and experienced biomass engineer and the proper boiler manufacturer.

As with the natural gas CHP plant, the market risk related to fuel is the single largest risk to the biomass power plant. Fuel sourcing, transportation and market pricing all contribute to the price volatility and impact the financial feasibility of the biomass power plant. As evaluated in the Nexus Projects, the biomass power plant utilizes approximately 14 percent local MSW related biomass and purchases the remaining 86 percent on the market. The local biomass is effectively provided at no cost, while the market purchases will be approximately $40 per ton of biomass fuel. While there is risk related to market purchases of biomass, there is strong evidence that there are substantial sources and availability of biomass fuels in the areas surrounding Loudoun County which would support a competitive market and lower prices.

A recent study in Maryland showed significant availability of biomass feedstocks at competitive prices (e.g. less than $40 per ton). Mill residues or feedstocks are available at 46,600dry tons per year at a very low cost. If local woody waste streams are included (e.g. C&D debris and local wood waste / landowner debris), the total potential fuel supply at a price of $30 per dry ton is 784,000 to 870,000 tons per year.[14] In addition a local supplier (Envivia) was contacted in the Chesapeake Bay area, to confirm availability of biomass feedstocks at approximately $35 to $40 per ton, inclusive of transportation costs, delivered to Loudoun County. Envivia also recently announced an agreement with Dominion Power to provide biomass feedstocks to two of their proposed 50MW coal power plant retrofits located just south of Richmond, Virginia. The coal fired power plants are being modified and retrofitted to use biomass fuel.[15]

While there is likely adequate biomass feedstock supply; the supplier network may be in its nascent and early stages of development. With the growth of demand for biomass within Virginia and Loudoun County, a focused woody, vegetative and C&D debris recovery program could further mitigate supply issues and price volatility. In addition the supplier networks and local biomass crops offer additional economic development and job opportunities local to the county and state of Virginia.

Due to the likely need to transport biomass feedstocks to the biomass power plant site, transportation costs associated with the feedstock supply often become a prohibitive factor for biomass plant financial feasibility. While there appears adequate supply of feedstocks in the region, it is importation to note there will be GHG emissions associated with transporting feedstocks to a biomass power plant. While a biomass plant is considered ‘carbon neutral’ for power generation and renewable energy purposes, there will be some level of GHG emissions associated with feedstock delivery. The availability of local feedstocks not only mitigates feedstock supply issues, it also reduces these ancillary GHG emissions from transportation.

There is one specific regulatory issue to consider in pursuit of a biomass power plant related to Virginia state law. The State Code of Virginia Title 56, Chapter 23, commonly referred to as electricity re-regulation, places limitations on what feedstocks are classified as sustainable or renewable biomass feedstock. The approved biomass feedstocks are mostly limited to waste or by-product related biomass such as yard waste, vineyard wastes, right-of-way tree trimmings and certain mill residues. Direct harvesting of timber or logging is not included as a sustainable biomass feedstock[16]. This limitation would not impact the biomass power plant feedstocks as discussed and evaluated in this report.

While a biomass power plant is considered ‘carbon neutral’ and reduces GHG emissions for the county, there are additional environmental regulatory issues related to air permits. Emissions from biomass plants are generally fugitive dust from open fuel yards, NO_X and particulate matter from the combustion process. Additional environmental and emission controls are necessary to address the air permits and regulations. Additional controls include covered storage or water spray from the cooling tower blowdown for fugitive dust, Selective Non Catalytic Reaction (SNCR) device for NO_X and a fabric filter (baghouse) and electrostatic precipitator (ESP) for the particulate. Health and safety risks are minimal and generally addressed by health and safety manuals common to the industry. Personal protective equipment such as hard hats, steel toed safety shoes and hearing protection and dust masks are required at most facilities.

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[14] Brian A. Kittler, Christopher M. Beauvais, ‘The Potential for Sustainable Wood-Based Bioenergy in Maryland’, *Pinchot Institute for Conservation,* 2010*,* p. 52-54

[15] http://www.envivabiomass.com/press-releases/enviva-executes-agreement-with-dominion-virginia-power-for-biomass-supply/

[16] Code of Virginia Title 56, Chapter 23: 585.2 Sale of Electricity From Renewable Sources Through a Renewable Energy Portfolio Standard Program

Refuse Derived Power Plant

RDF power is similar to biomass and municipal solid waste is typically categorized as a biomass fuel for renewable energy requirements. The overall risk of a RDF plant is slightly higher than a biomass power plant, with slightly different risk issues. There are three specific issues that present a risk to the RDF power plant:

- Technology
- Public / political perception
- Feedstock availability

> The most significant risks identified for the refuse-derived power plant include: technology, public / political perception and fuel feedstock availability. Each of the risks is manageable with proven mitigation strategies.

The project related risks areas include O&M, management, engineering and technology. The O&M requirements and risks for a RDF power facility are similar in nature to the biomass facilities. The operations require 10 to 15 personnel due to the additional material handling, storage and preparation issues. Similar to biomass, general maintenance related risks are lower than natural gas CHP due to the smaller and less costly OEM replacement components and equipment. However, the plasma arc technology requires frequent replacement (e.g. two to three months) of the electrodes, which requires the owner and operator to keep an inventory of electrodes on site for replacement and to ensure continued uninterrupted operation.

Management risks are also similar to a biomass facility. Typically, securing a long term fuel supply, controlling transportation costs and managing the waste on site are essential to the success of the operation. However, the management risks related to the refuse-derived power plant evaluated in this report are minimal. The county currently operates a landfill and has significant experience managing solid waste and landfill operations. Combining this expertise with locating the power plant at the landfill removes much of the management related risks for the county.

The primary engineering and technology risk for the refuse-derived power project is associated with the initially selected technology and its relatively recent commercial adoption. While plasma arc technology has not been widely used in the U.S. for power generation purposes, it is a commercially proven technology with a proven record of more than 10 years in operation. However, in the power generation market, the 10-year record of operation is significantly less than other more conventional technologies such as fluidized bed combustion and steam turbines. While there are concerns about scaling the technology to larger applications (e.g. greater than 50MW), a 10MW plant should reduce the risk.

There are currently six to 10 companies that are providing plasma arc and gasification for biomass and other wastes. Westinghouse is the U.S. plasma arc technology provider and has created a joint venture with Alter NRG Corporation (NRG) to further develop and implement the technology. Plasma arc gasification has been in existence since the mid 1990s and there are multiple plants operating in Japan and North America for municipal solid waste. Westinghouse's plasma arc technology and torches have been in commercial operation for more than 20 years with more than 500,000 hours of commercial use. Westinghouse's technology has also been used commercially in Japan since 2002 for the gasification of MSW to generate power.

Recently the technology has been in high demand for studies and potential refuse-derived power plants. The largest, most recent application is in St. Lucie County, Florida for a refuse-derived power facility currently scheduled to be a 3,000 tons per day, 120MW plant. The plant is being developed by a third party developer, Geoplasma and has received its final environmental and air permits. Recent reports show Geoplasma is beginning final design and construction. A summary of some of the active plasma arc facilities around the world is included below in Table 36.

Table 36: Current and Proposed Plasma Arc Refuse Derived Power Facilities

Feed Stock	Feed Rate (tpd)	Owner	Location	Use	Comm. Operation Date
Currently Operating					
MSW/ASR	180	Hitachi Metals	Utashinai, Hokkaido, Japan	Power	2003
MSW	85	Plasco Energy Group	Ottawa, Canada	Power	2008
MSW	10.5	Air Force Special Operations Command	Hurlburt Field, FL	Power	2011
MSW/TDF	360	Sunbay Energy Corporation	Port Hope, Ontario, Canada	Power	2009
MSW	1000	Green Power Systems	Tallahassee, FL	Power	2010
Proposed Projects					
MSW	660	Geoplasma, LLC	St. Lucie County, FL	Power	2012
Biomass	250	CHO Power SAS / Europlasma	Multiple UK Port Sites	Power	2012
MSW	150	CHO Power SAS / Europlasma	Morcenx, France	Power	2012
MSW	2500	Sun Energy Group, LLC	New Orleans, LA	Power	NA
MSW/ Biomass	150	Koochiching Development Authority	Koochiching County, MN	Syngas	NA
Tire	NA	PR Power Company	Jackson, GA	Power	NA
MSW	NA	Eco NRG	Atlantic City, NJ	Power	NA

In addition to those listed in the table above, several other projects and developers are pursuing a similar refuse-derived power plant technology and syngas process with pyrolysis in Texas, North Carolina and other states. Overall the refuse-derived power market is growing, with newer, cleaner and more commercially viable technologies available.

The additional engineering required for a RDF power plant is similar to a biomass facility, with the exception of general care to remove any material (e.g. plastics) that can create HCl gas. If this cannot be accomplished then the boiler design must consider the production of HCl in the fuel and design the boiler accordingly. Since the gas resulting from the plasma arc process is high (3,000˚F), designs should also include high temperature materials for equipment fabrication.

As future and more detailed engineering studies are completed for the refuse-derived power plant, and plasma arc facilities under development or currently operating prove unsuccessful or not commercially viable, alternative refuse-derived power technologies are still available that delivery similar financial results but slightly higher overall emissions (e.g. CO and SO_2). The proposed mitigation strategy for plasma arc technology risks is an autoclave system with a conventional fluidized bed boiler and steam turbine. There are several recently announced refuse-derived power projects utilizing the autoclave technology and gasification process to fuel syngas fired refuse-derived power plant facilities with much lower emissions than the past waste direct combustion processes. In fact, a 25MW autoclave refuse-derived power project, larger than proposed in this report for Loudoun County, was recently announced in New York at the Port of Albany.

In addition to the State of Virginia Codes and SCC regulations limiting power generation and utilities discussed previously, refuse-derived power will face additional regulations due to the inclusion of MSW and the current Loudoun County Landfill. In addition to local county approvals for the landfill operations, regulations including federal and state air emission requirements, the National Fire Protection Association (NFPA) codes and water discharge requirements / permits will apply to the project. These are all common and frequently applied regulations and requirements for power generation facilities. There should be minimal risk associated with these regulatory approvals as the eventual developer or engineering, procurement and construction (EPC) contractor will be familiar with the permits and processes.

The most significant market related risks for refuse-derived power plants are related to public perceptions and acceptance of refuse derived power plants and potential MSW fuel availability. In the past, older refuse-derived power plant technologies have faced public concerns due to environmental emission issues and potential impact to recycling initiatives. The public perception risks should be addressed and mitigated by developing a proactive community and stakeholder engagement plan incorporating public meetings and involvement. More detail on a recommended stakeholder engagement framework for the RDF power plant was developed as a part of Section 8: Implementation Plan of this report.

The primary and alternate technologies recommended for the IEMP and refuse-derived power plant are more advanced, lower emission and more environmentally friendly than the older waste incinerators used in the past. In addition, if the alternative technology autoclave technology is selected, recycling rates would likely increase due to the sorting of glass, metal and plastics. The benefits and more environmentally friendly results of the recommended refuse-derived power technology should be communicated with stakeholders in a direct and managed method. This approach would help to ensure a more positive public perception of the project and eventual approval.

The risks identified with MSW and refuse-derived fuel availability are minimal and were addressed in the initial sizing and evaluation of the refuse-derived power plant. In fact, the access to local MSW as a feedstock, the county's current landfill operations and tipping fee revenues all contributed to the refuse-derived power plant having the best financial and environmental performance of the Nexus Projects. The sizing of the plant was optimized to utilize a lower level of MSW than what is currently accepted at the landfill and allow for additional recycling. Under current county recycling rates, the landfill receives approximately 100,000 tons of MSW per year. The refuse-derived power plant utilizes approximately 87,000 tons per year, providing an opportunity to increase recycling rates above current levels by 13,000 tons per year. By properly and conservatively sizing the plant, it should avoid any issues due to lack of MSW or refuse-derived fuels.

To further mitigate or hedge the potential market risk associated with MSW and RDF availability, local biomass sources such as new biomass crops grown in the county and local vineyard or vegetative wastes can further augment the MSW supply. Minimally augmenting (e.g. 10 to 15 percent) the MSW and refuse fuel supply with biomass does not materially affect the financial performance of the power plant.

The environmental, health and safety risks and issues of a refuse-derived power plant are similar, but slightly higher than a biomass plant. Refuse derived power is considered 'carbon neutral' and a renewable energy resource in Virginia and throughout the U.S. The environmental benefits of the refuse-derived power plant also include avoided risk and capital costs for the county by delaying and potentially avoiding all future landfill expansion and landfilling operations. Additional emissions from the refuse-derived power plant are similar to biomass and include CO, NO_X and PM. In addition, HCl and volatile organic compound (VOCs) are emitted which are unique to MSW and refuse-derived power plants. If the alternative autoclave technology is used, VOCs and HCl emissions are removed from the power plant through the autoclave's sterilization process. While the environmental performance is slightly better than a biomass power plant, there will be increased environmental regulatory issues as discussed previously.

Health and safety risks are the same or very similar to the other two power plant options. To address health and safety issues, full personnel protection is required for all plant personnel and any site visitors. There will be written guidelines for all safety and health issues with the plant personnel and in most cases employees are required to read and sign documentation that they have read and understand the rules and regulations. Since the dried waste is volatile, precautions must be taken to ensure all ignition sources are curtailed or minimized and automatic fire suppression should be installed at all handling and storage areas to further mitigate the risks.

Non-potable Water System

As the non- potable water system is a smaller project in scope and has a less complicated infrastructure, the risks are significantly lower than the larger power projects. The most significant risks to the non-potable system are related to performance and rainfall amounts leading to water storage in the ponds. The non-potable system was sized conservatively to utilize a smaller portion (22 percent) of the total stormwater ponds storage capacity during average rainfall amounts. By maintaining a conservative portion of the total storage available, it should ensure the availability of non-potable irrigation and cooling water. If extended drought periods reduce the amount of rainfall and stormwater runoff at Moorefield Station, it would limit the availability of non-potable water for irrigation and cooling. This would result in lost revenues and potable water likely serving the end irrigation and cooling uses as a backup system. However, the scenario analysis showed the resulting cost for providing non-potable water (with a significant 50 percent reduction in stormwater availability) remained cost competitive with local water rates.

There are minor O&M risks with the non-potable system including the pump and piping system maintenance and regulatory and health requirements for supplying and consuming non-potable water. Additional environmental, health and safety risks to the O&M staff should be negligible due to the basic nature of the system and if state DEQ and Department of Health policies, guidelines and regulations are followed.

Improved Energy Code

The improved energy code Nexus Project results in few direct risks to Loudoun County. As the project is less capital intensive for the county (e.g. an asset) and more incentive and regulatory in nature, the key risks are market related to the development of Moorefield Station. The improved energy code has few, if any, project related risks such as O&M, engineering or technology. As the State of Virginia sets the building and energy codes for state-wide adoption, the county cannot directly adopt or implement a more stringent building code. However, Moorefield Station can adopt and implement different codes through the development covenants, conditions of land sales and the home owners associations (HOA).

If adopting more stringent codes as a condition of development in Moorefield Station, the county and / or Moorefield Station may face minor management risks such as educating and coordinating building inspectors and developers in the improved code requirements to avoid confusion. This will also ensure their implementation with the buildings and proper inspection procedures. The most significant risk related to the improved code is market related with developers and the eventual development of Moorefield Station. If the improved code is perceived to be constraining or significantly more costly to the overall development (e.g. eventual leasing rates, construction costs), the developers and market dynamics may result in reduced demand for Moorefield Station.

As an improved energy code results in reduced long term operating costs and more efficient buildings, the overall impact to construction costs and eventual leasing costs should be minimal when compared to larger market dynamics such as the broader economy, local office space supply and demand and construction costs. The overall cost impacts of an improved code would likely result in total construction costs increasing less than one percent in aggregate. This market risk can be mitigated with targeted communication and education to define the code improvements and explain the overall cost and benefits to developers.

Conclusions and Recommendations from Risk Assessments

Overall, the three risk assessment frameworks reinforced the original Nexus Project recommendations and the unique sustainability related market opportunities for Moorefield Station. In any risk assessment, it is important to not only identify risks but also understand the magnitude of the risk. There were very few risks identified in the assessment that could result in a material or large magnitude impact on the two recommended Nexus Projects or Moorefield Station. Through the course of the implementation of the projects, additional project evaluation, analysis and design is recommended to thoroughly mitigate all risks. The list below summarizes the initial material risks to the Nexus Projects and Moorefield Station identified through the IEMP process.

- Moorefield Station
    - No material sustainability related risks identified

- Refuse Derived Power Plant:
  - Technology risk
  - Market / fuel feedstock risks
  - Political / public perception risk
- Non-potable Water System
  - Water availability / drought risk

From a sustainability perspective, the IEMP and Moorefield Station performed very well based on the Zofnass and HalSTAR sustainability risk assessments. In fact, no sustainability risks identified by Zofnass or HalSTAR were considered material or large enough to require mitigation strategies for the Moorefield Station development. These two sustainability risk and performance assessments helped to prove the partnership between Loudoun County and the Claude Moore Foundation was successful in establishing a path to a more sustainable and unique development.

The HalSTAR sustainability risk assessment results reinforced the Nexus Project recommendations and selection of the RDF power plant and non-potable water system. Each project received high sustainability performance ratings through the HalSTAR process. The conventional risk assessment did identify potential, specific material risks for the RDF power plant that required additional evaluations and initial development of mitigation strategies.

The most significant threats and risks related to the RDF power plant included technology risk, public/political perception and fuel feedstock availability. Plasma arc gasification was initially selected as the refuse conversion technology due to the low emissions, small footprint and its flexibility. While the technology is not widely adopted commercially in the U.S. for power generation purposes, it is a commercially proven technology with a proven track record of more than 10 years in operation. In addition, there are multiple plasma arc power facilities in operation in Japan and Europe with an increasing number of proposed RDF power projects adopting the technology in the U.S.

If future detailed engineering evaluations with county partners result in a higher than desired risk associated with the technology or several of the proposed projects prove unsuccessful, an alternative technology that delivers similar financial and environmental results is provided as a mitigation strategy. The alternative technology includes an autoclave and conventional boiler and steam turbine system. This system maintains environmental performance with lower emissions (e.g. GHG and SO_2), has a longer commercial operating history and delivers low-cost electricity.

To address the political / public perception risks associated with the RDF power plant, a proactive public stakeholder engagement framework is recommended to educate and engage the public prior to the project implementation. More information and details regarding the implementation of the engagement framework are included in the Implementation section of this report.

Finally, the risks identified related to the availability of MSW feedstocks and fuel were adequately addressed in the initial and conservative sizing of the plant (10MW). In addition, alternative, local biomass feedstocks were identified to augment MSW and support local agriculture business and economic development. This feedstock augmentation further mitigates risks related to MSW and fuel feedstock availability.

The non-potable water system risk assessment identified one substantial risk: water availability/drought. This risk was known during the initial development of the non-potable water system and was sized accordingly. The current non-potable water use results in approximately 22 percent of the total storage capacity of the stormwater ponds. This conservative sizing should mitigate drought and stormwater runoff water related issues. If additional irrigation water is needed, a potable water source could be integrated with the system to provide backup or emergency reserves.

Section 8: Implementation Plan

Integrating the results of the previous sections, including the energy supply alternatives and risk assessments provide the initial elements of the suggested IEMP implementation plan. The implementation plan is included below as the recommended path to integrate, execute and realize the projects and programs included in the IEMP. This includes the general steps, schedules and roles and responsibilities for the County and their potential partners to consider and further refine upon final approval of the Plan.

The implementation plan aligns the overall IEMP framework (specifically the tactical Focus Areas, Nexus Projects and ZEW^2 Lab Flagship Program) with short, mid and long term targets for implementation. Figure 48 shows the alignment of the Plan elements and general implementation timeline.

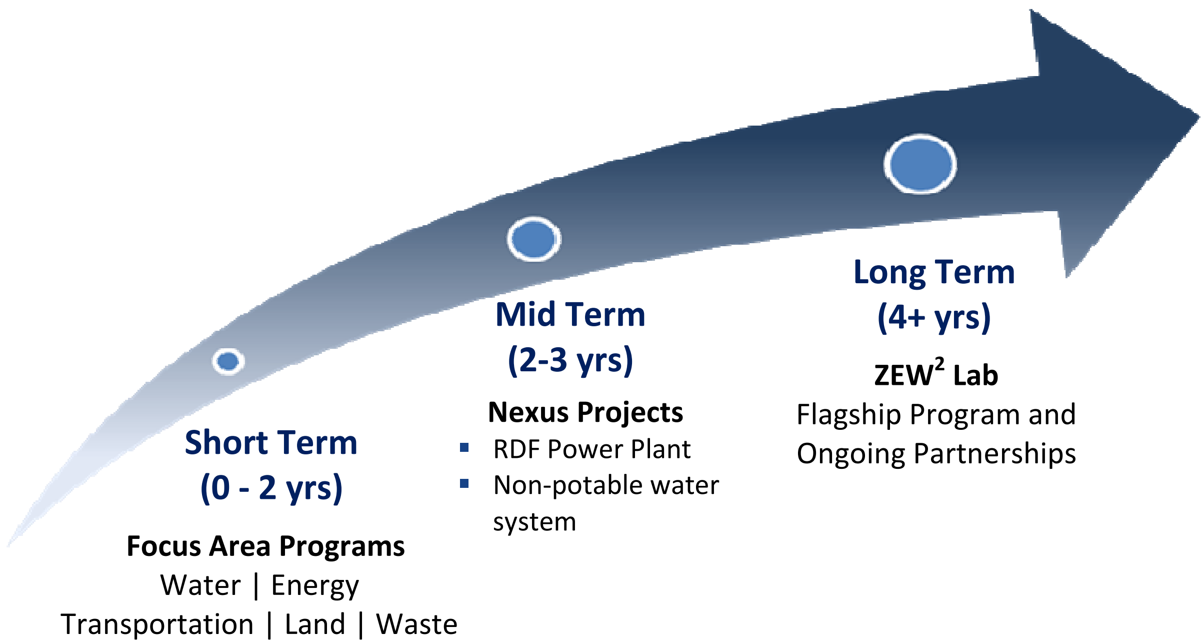


Figure 48: Short, Mid and Long Term Implementation of IEMP

The Focus Area programs and projects require smaller amounts of capital and county resources, allowing for the implementation in the zero to two year timeframe. However, the two recommended Nexus Projects require significant planning, permitting, capital, resources and engineering studies prior to full implementation and construction. These more capital and resource intensive Nexus Projects likely require a two to four year implementation schedule for the county. Finally, the ZEW^{2}Lab is intended as an ongoing mechanism for the county and Moorefield Station to engage partners throughout the life of the development in innovative technologies and initiatives that support the zero energy, water and waste goals of the program. The ongoing and evolving nature of the ZEW^2 Lab require a long term and continuous implementation schedule.

The implementation plans described below provide a recommended framework for the county to consider and tailor as needed in the future. High level implementation frameworks are included for the Focus Area programs and ZEW^2 Lab, as they require additional county, Board and staff input. Upon final county staff and Board review and/or eventual approval of the IEMP, the county can tailor and modify the plans as needed to align with the county strategy and available staff and capital resources. More detailed implementation plans are provided for the midterm implementation of the Nexus Projects. The RDF power plant and non-potable water system projects are more detailed and complex than the Focus Area programs and ZEW^2 Lab, requiring significantly more capital, resource, partner and county commitments.

Short Term Implementation

The recommended short term implementation plans include the five Focus Areas and related programs previously discussed and prioritized in Section 4. The Focus Area programs and projects not only apply to Moorefield Station, but have broader countywide opportunities as well. While Moorefield Station will take several years to begin significant development, the Focus Area programs could be implemented immediately throughout the county as resources are available. As Moorefield Station develops in future years, the Focus Area programs would be applied as applicable.

Most of the Focus Area implementation frameworks for Loudoun County leverage partner programs and funds in addition to potential internal county process or permitting incentives. High level implementation plans for each Focus Area are included below, encompassing a brief summary of the implementation, potential partnerships and program management. Each Focus Area implementation plan is broken down into two elements:

- Recommended Partners for Program Collaboration
- Management of Programs (e.g. direct county management / funded, partner collaboration or internal county process modifications)

Energy

There are eight energy specific programs focused on reducing energy consumption, increased clean energy use and reduced GHG emissions. These projects include energy efficiency rebates, renewable energy incentives, improvements to the current energy building code and two existing county programs: Energy Performance Labelling (EPL) for buildings and the Green Business Challenge. The management of the programs is organized into three groups: Loudoun County facilitated funding programs, existing county programs and Dominion Power collaboration.

Recommended Partners for Loudoun County and Moorefield Station:

- Washington Gas
- Dominion Power
- Local and national financial institutions
- Local HVAC, lighting and energy related contractors

Energy Program Management:

- New county Managed PACE and revolving loan funded programs:

  The county should consider partnering with financial institutions to implement commercial PACE and commercial / residential revolving loan funds to provide financial incentives and implement the following programs:

  - Solar water heating rebates
  - HVAC geothermal exchange rebates
  - ASHRAE improved energy code rebates

- Existing county energy programs

  Consider augmenting existing county outreach programs to target local county contractors for education on county initiatives, incentives and other available incentives (e.g. Dominion Power energy efficiency rebates). Contractors should act as additional outreach in the community for education and adoption of energy efficiency measures. In addition, consider continued support and expansion of the current Loudoun County energy programs including:

  - Expand residential outreach campaign and Green Business Challenge to include contractor outreach
  - Expand energy performance labelling (EPL) program; require EPL for all Moorefield Station buildings

- Dominion Power collaboration

  Consider partnering with and leveraging existing Dominion Power renewable energy and energy efficiency programs and rebates to support the following programs:

  - Commercial and residential distributed Solar PV and PV tariff programs
  - LED street lighting replacement program
  - Residential energy use web dashboard (e.g. OPower)

In support of early action on the IEMP and to ensure short term successes, further discussions with partners were completed to support two of the energy programs: AHSRAE improved energy code adoption for Moorefield Station and Dominion Power's Solar PV programs. In response to feedback from the IEMP participants, a prescriptive set of energy code recommendations was developed to implement in Moorefield Station. This will ensure and further support a more energy efficient development from the initial stages of construction. In addition, the Claude Moore Foundation and Moorefield Station are in a unique situation to offer a significant amount of currently undeveloped land for solar PV installations under Dominion Power's community solar program.

Moorefield station has an opportunity to adopt a more stringent energy code through the Moorefield Station HOA and development agreements. To ensure Moorefield Station is designed and constructed to be more energy efficient from the initial development stages, a prescriptive set of energy efficient measures and best practices should be considered for inclusion in the HOA requirements as shown below.

- T-5 high efficiency lighting
- Minimum 86 percent high efficiency heating boilers for all commercial buildings
- Minimum 96 percent efficient domestic water heaters for all residential and commercial buildings
- Maximum 0.5kW per ton of cooling for commercial chilled water systems
- Minimum SEER 13 and 82 percent efficient gas fired heat exchangers for packaged rooftop HVAC units
- SEER 15 residential air conditioning systems
- Minimum 90 percent efficient residential furnaces
- Systems commissioning for all commercial buildings
- Review opportunities for geothermal exchange or ground source heat pump systems for smaller commercial and all residential construction
- Require smart meters for all Moorefield Station construction

By adopting these measures, it would ensure the development is designed and constructed from the beginning to reduce energy use, improve reliability of the electric system and reduce GHG emissions by approximately 10 percent. Due to the unique relationship between the Claude Moore Foundation, the county and Moorefield Station, there is also a significant opportunity to implement a renewable energy project on the Moorefield Station property in the short term.

Dominion Power's Community Solar program includes a PV leasing program where Dominion Power leases land or rooftop space from a property owner to install larger solar PV systems (e.g. 500kW to 2MW). Dominion Power has submitted the program to the SCC for approval and is expected to be implemented by mid 2012. The Claude Moore Foundation has identified and is currently considering locations in Moorefield Station for larger PV installations and lease agreements with Dominion Power. This opportunity could result in a large solar PV array on Moorefield Station property generating renewable energy for Dominion Power and the county. Initial discussions between the county, the Claude Moore Foundation and Dominion Power have taken place, and further collaboration is recommended upon the SCC's expected approval of the program.

Water

The water focus area includes six water programs primarily focused on leveraging and expanding the use of non-potable water in the county and Moorefield Station. The management of the program is organized into two groups: county facilitated funding of projects and collaboration with Loudoun Water.

Recommended Partners for Loudoun County and Moorefield Station:

- Local and national financial institutions
- Virginia Clean Water Revolving Loan Fund
- Local plumbing and housing/building contractors
- Loudoun Water

Water Program Management:

- New county managed grant and revolving loan fund programs:

  Consider utilizing county or Virginia Clean Water Revolving Loan program funds and/or partnering with financial institutions to implement commercial / residential revolving loan programs to provide financial incentives and implement the following programs:

  - Reclaimed water system rebates for commercial buildings of 20,000 square feet or more
  - Develop county reuse program
  - Green roof, stormwater collection and local garden program incentives

- Loudoun Water collaboration:

  Partner with and leverage Loudoun Water conservation programs to jointly support and implement the following programs:

  - Pilot Loudoun Water outreach and education programs (irrigation, landscape tips and EPA watersense)
  - Effluent for cooling needs in Moorefield Station/reclaimed water system loop in Moorefield Station
  - Augment Loudoun Water supply with surface wells for irrigation/integrate with non-potable water system (stormwater ponds)

Transportation

The transportation focus area includes seven programs. These programs are focused on internal initiatives such as regulatory and permit approval incentives and outreach programs managed by the county.

Recommended Partners for Loudoun County and Moorefield Station:

- Washington Metropolitan Transit Authority
- Claude Moore Foundation (Moorefield Station)

Transportation Program Management:

- New County funded and managed programs:
  Consider utilizing and expanding current transit outreach efforts and develop new programs to integrate and include the programs below. The new transit programs should not require significant additional funds from current county funding levels.

  - Smart Phone Application for Moorefield Station and multi-modal transit options in Loudoun County
  - Bike sharing program, fee for service / self supporting (e.g. Denver B-cycle)
  - Coordinate with WMATA for bulk transit purchases by county companies and residents
  - Leverage current employer transit outreach to Moorefield Station as it develops

- County code and internal regulatory process incentives:
  Consider creating county process incentives (e.g. permit, code, development, fee rebates) to support the adoption of the following programs in Moorefield Station and the county.
  - Encourage smaller, appropriately sized food store in Core Zone of Moorefield Station (e.g. Sunflower Market, not large grocery store). Moorefield Station and Claude Moore Foundation have option of directly including food store in Core Zone.
  - Neighborhood distribution centers
  - Incentivize or incorporate bike / pedestrian facilities in land development review process

Land Use

The land use focus area includes six programs primarily focused on parking, improved / integrated land use and enhanced building design and construction. The identified programs should require minimal direct county funding.

Recommended Partners for Loudoun County and Moorefield Station:

- Claude Moore Foundation (Moorefield Station)
- HOAs and Developers
- Virginia Clean Water Revolving Loan Fund

Land Use Program Management:

- New county funded and managed programs:

  Consider county development and management of the following new programs. These new programs should require minimal direct county funding and/or be self supporting. An enterprise could be created for parking to collect fees to fund program and generate revenues. The Virginia Clean Water Revolving Loan program can be utilized to support open space.

  - Parking services for meters, variable rate parking and/or shared use
  - Incentives for integrating stormwater infrastructure with open space and interpretive areas

- County code and internal regulatory process incentives:

  Consider creating county process incentives (e.g. permit, code, development, fee rebates) to support the adoption of the following programs in Moorefield Station and the county.

  - Prescriptive sustainable design options (selected by county staff)
  - ASHRAE sustainable building code
  - Maximum parking limits
  - Shared lots; parking diversity

Waste

The waste focus area includes six programs primarily focused on reducing waste generation and reusing or recycling waste resources. The identified programs should require minimal direct county funding and rely more on county permitting/regulatory processes and smaller, manageable county funded projects.

Recommended Partners for Loudoun County and Moorefield Station:

- Claude Moore Foundation (Moorefield Station)
- HOAs
- Private Waste Haulers

Waste Program Management:

- New county funded and managed programs:

  Consider county development and management of the following new programs. These programs should require minimal county funding. Consider using county outreach to HOAs and private waste haulers to adjust or expand solid waste collection program options and a potential concession for 'freecycle' centers.

  - Incent, support Pay as You Throw programs for HOAs or through Private Hauler Program options
  - Locate/concession 'Freecycle' sites at neighborhood distribution point(s)

- County code and internal regulatory process incentives:

  Consider creating county process incentives (e.g. permit, code, development, fee rebates) to support the adoption of the following programs throughout the county. Moorefield Station specific programs would be adopted by the development and the applicable HOA.

  - ASHRAE sustainable building code
  - Construction and demolition waste diversion plans, use of recycled content materials in construction; require for Moorefield Station development

Mid Term Implementation

The two recommended Nexus Projects are the largest and most capital intensive components of the implementation plan. Due to the scope, scale, regulatory and capital elements related to the projects, it will likely require two to three years to fully implement the RDF power plant and non-potable water system. If the county chooses to implement the Nexus Projects, initial planning, partnering discussions and more detailed engineering studies should begin as soon as possible in support of their eventual construction and operation. The suggested detailed implementation plans, including project financing, permitting, partnerships, regulatory issues and timelines are included below for each of the Nexus Projects. Both projects include and likely require a significant partner and collaboration for the county to consider for successful implementation.

Integrated Energy Management Plan

Non-potable Water System

As described earlier, the non-potable water system utilizes the planned stormwater retention ponds near the southern boundary of Moorefield Station to provide non-potable water for irrigation and potentially mechanical cooling purposes (e.g. cooling tower makeup water). The project is estimated to deliver irrigation and mechanical cooling water at rates of $3.68 to $7.37 per 1,000 gallons which is competitive with and potentially lower than current Loudoun Water rates. The non-potable water system is considered as Level 1 Reclaimed Water by the Virginia DEQ and requires more treatment due to the potential for human contact.

Regulatory Issues

Due to the SCC and state statues regarding utility services, it is suggested that the non-potable water system serve the irrigation needs of the common areas of Moorefield Station. If the county or Moorefield Station were to sell the water to residential or commercial customers, the operation would be considered a utility service and the operator must become a regulated utility in competition with Loudoun Water.

Initial discussions with Loudoun Water indicated Loudoun Water would support the project; however, they would not directly manage or operate it. Loudoun Water would consider the project similar to other small, customer operated non-potable systems such as at golf courses. These systems augment Loudoun Water's system and are owned and operated by the customer. As a result of these discussions, it is suggested the Moorefield Station HOA become the owner and operator of the system. The HOA would finance the capital and operating costs through the fees collected from HOA dues. The non-potable water system contribution to HOA fees would be lower than the expected costs for Loudoun Water providing potable water for irrigation.

Estimated Timeline and Schedule

The timeline summarized below is directly linked to the site improvement, development of Moorefield Station and the construction of the stormwater ponds. The stormwater ponds collect and contain stormwater runoff from developed or impervious areas throughout Moorefield Station. As more areas are developed, the stormwater runoff will increase and maintain water levels in the ponds, providing the non-potable water source. The suggested timeline and implementation is divided into two phases. Phase 1 includes the additional engineering, design and permitting supporting the project. Phase 2 includes the actual construction and operation of the system.

- Phase 1: Zero to six months (prior to initial award of pond construction):
  - Stormwater ponds and infrastructure approved and permitted
  - Moorefield Station HOA completes detailed engineering plans for non-potable system
  - HOA to evaluate final capital and operational costs and include in HOA fee structure
  - Initiate permitting/regulatory process with Virginia and Department of Conservation and Recreation for the reuse of stormwater for non-potable, irrigation purposes
- Phase 2: Six months to four years (after award for construction of ponds):
  - Construct initial infrastructure with ponds as cost effective (e.g. pump inlets, pump house, piping connections)
  - As remaining areas of Moorefield Station develop and common areas are improved, construct and install the distribution piping and begin operation.

Refuse Derived Fuel Power Plant

The RDF power plant is the largest project included in the IEMP. The large scope, capital costs and complexity of the project include integration with the landfill, a third party owner and operator of the power plant, a power purchase agreement, agreements with waste haulers, selection of an engineering, procure and construct (EPC) contractor and significant permitting and regulatory elements. The overall development and implementation of the RDF power plant is estimated to take two to three years.

Regulatory Issues

Due to the previously discussed SCC and state legislation regarding utilities and the electric power industry in Virginia, the recommended implementation includes utilizing a third party to design, build, own and operate the plant. It is not recommended that the county pursue direct ownership and operation of the RDF power plant, as it would lead to significant regulatory and litigation issues.

Due to the current Virginia Energy Purchasing Governmental Association (VEPGA) contract for providing power at negotiated rates to the coalition of local governments in Virginia, Loudoun County cannot pursue a separate purchase power agreement (PPA) with Dominion Power or any third party power provider. Thus, Loudoun County cannot directly contract to receive the power and electricity generated at the facility. However, the county could potentially negotiate the allocation of the environmental benefits of the renewable power generated at the facility.

Due to SCC and state legislation, all renewable energy generated within Virginia by local electric utilities must be used by the utilities to contribute to the state renewable portfolio standard (RPS) goals, unless the REC can be sold for additional benefit (e.g. a higher price). The utilities are allowed to sell the RECs to private companies or other organizations (e.g. Loudoun County or Moorefield Station), if the sale prices for the RECs provide greater value than the current state REC market. For Loudoun County to directly receive the RECs and GHG reductions associated with the RDF power plant, the county must purchase them from Dominion Power in accordance with the SCC regulations. For example, the county could utilize a separate (non-PPA, non-VEPGA) agreement with Dominion Power to receive the RECs in lieu of other contributions such as land near the facility, or simply purchase the RECs directly according to SCC regulations.

Initial, high level discussions with Dominion Power have resulted in an interest in the project and preliminary collaboration and input on elements of the implementation plan summarized below. There are two suggested options for the ownership and development structure of the RDF power plant for the county to consider.

1. Dominion Power Ownership and Operation

   Dominion Power provides the capital financing for the RDF power plant portion of the project and becomes the owner, operator of the facility. The county partners with Dominion Power to provide land near the landfill and coordinate solid waste operations to provide the refuse derived fuel.

2. Third-party Ownership and Operation Through Dominion Power Schedule 19 Tariff

   Dominion Power's Schedule 19 Tariff provides a structure for smaller (less than 20MW) renewable energy power plant owners to sell power to Dominion Power. The county would competitively select and contract with a third part independent power developer to build, own and operate the RDF power plant near the landfill then sell the power to Dominion Power for resale in their system to end use customers. The county's contract with the third-party would be related to the operations of the landfill, leasing of land and related refuse derived fuel. The third-party would finance the RDF power plant and execute a long term (e.g. 20 year) PPA with Dominion Power. A copy of the Schedule 19 Tariff is included as Appendix K.

It is recommended the county continue discussions and collaboration with Dominion Power to jointly select the optimal ownership and operational structure for the project. Each of the two ownership options offer the county a direct path to implementing the RDF power plant, sharing in the environmental benefits and reducing risk without the use of county funds or issuing municipal bonds to finance the project.

Estimated Timeline and Schedule

The suggested timeline summarized below is separated into three phases. Phase 1 includes selecting and formalizing the ownership structure and agreements. Phase 2 includes the permitting process and approvals for the power plant and the potential landfill modifications. Phase 3 is the EPC and completion phase of the project. While portions of Phase 1 and 2 may be completed in parallel, the total project schedule is estimated at three to four years from initial project approval.

- Phase 1: Formalize ownership and operating structure (nine to 12 months)

  Phase 1 includes additional research and detailed engineering studies such as zoning research, finalizing partnerships, detailed landfill and RDF power plant engineering studies, soliciting bids for developer (if applicable) and executing contractual/operating agreements. The key participants in this phase include: Loudoun County, Dominion Power and third-party developer (if used). A breakdown of the steps in Phase 1 is included below:

    - County review of zoning at property at and near landfill for power plant
    - Continued discussions with Dominion Generation Development
    - Select partnering and financing strategy and solicit proposals: Dominion Power or third-party option
    - County to review land or other contribution options to project at landfill
    - County and/or other parties interested in environmental benefits (e.g. renewable energy credits (RECs)) enter memorandum of understanding with developer to complete final engineering studies
    - Begin broad stakeholder engagement and education on RDF power plant project, economic, environmental and social benefits (see below for more detail)
    - Review potential for including biomass fuel source: local farming if price competitive or subsidized to provide support (e.g. <$40 per ton of feedstock)
    - Begin landfill rezoning (if necessary), re-permitting, special exception for operations
    - Execute power purchase agreement between Dominion Power and County and/or Digital Realty Trust (rates, sharing RECs, term, etc.)

- Phase 2: Permitting and project approvals (12 to 18 months)

  Phase 2 includes the detailed permitting and approvals process. There will be local, state and federal permits and regulatory entities involved in the process. Loudoun County will play a significant role in the process due to the coordination and integration with the county landfill. It is recommended that Dominion Power or the third-party owner and operator manage the power plant and potentially the landfill related permitting process. Key participants include the owner/operator and Loudoun County.

    - Portions of Phase 1 and 2 should be completed parallel to one another where applicable.
    - Summary of likely power related permits and regulations: spill prevention, control and countermeasure (SPCC), Clean Water Act, environmental impact statement, qualifying facility, discharge/storm water, air permit, ash disposal, state building code and electrical interconnect
    - The state and federal agencies involved in the permitting process include: Department of Energy (DOE), Federal Energy Regulatory Commission (FERC), Environmental Protection Agency (EPA), county building department, Virginia Department of Environmental Quality (DEQ), SCC and U.S. Army Corps of Engineers

- Phase 3: Engineering, procure, construct (EPC) (12-18 months)

  Phase 3 includes the actual engineering design, construction and start up of the RDF power plant. The EPC contractor will manage the construction and start up process and navigate required final approvals. The county should consider the use of an owner's engineer or program manager to represent their interests and provide oversight throughout each phase of the project.

RDF Power Plant Stakeholder Engagement

As innovative energy projects, such as RDF power plant under consideration, are deployed across the U.S., it has become evident that they hold both great promise and potential pitfalls. The suggested RDF technologies fit largely within a power plant developer's core competencies and are therefore readily addressed by the organization's inherent skills and expertise. Technology, therefore, is often the least of the challenges. The softer elements of a successful project, however, create another set of challenges that are proving to be highly dynamic, subject to waves of public opinion and in need of much greater attention. This is particularly true for all aspects of engaging stakeholders in a dialog that leads to understanding, acceptance and the actions necessary to realize the promise of a RDF project.

Although the scope of this current effort does not include a stakeholder engagement plan for the RDF project, the following framework highlights essential elements for consideration as the project moves forward.

In today's technology-enabled world, it is more important than ever to engage stakeholders openly and control the fact-basis of messaging. As such, a filter for stakeholder engagement that aligns with the goals of being timely, truthful and transparent, as shown in Figure 49, is often the most effective.

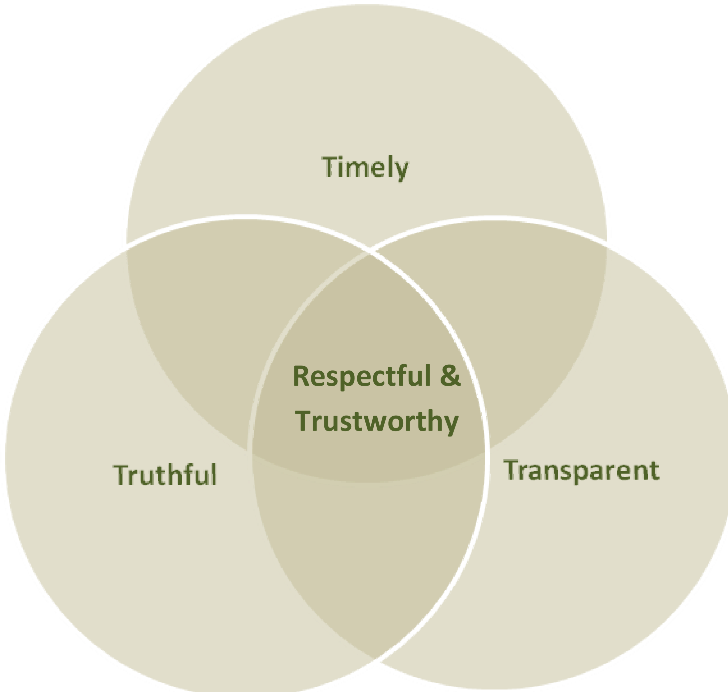


Figure 49: A Filter for Communication

There are four basic steps to engaging customers – all of which revolve around access to information and opportunities for dialog – as follows:

- Awareness
- Understanding
- Acceptance
- Action

One primary focus of stakeholder engagement is to take charge of the facts and provide the basic information necessary for people to make informed decisions. Fundamentally, the process of engaging customers is built around a core of defining "what's in it for me?" based on specific knowledge. Beyond that, attitudes and opinions/behaviors can begin to align, as shown in the Figure 50.

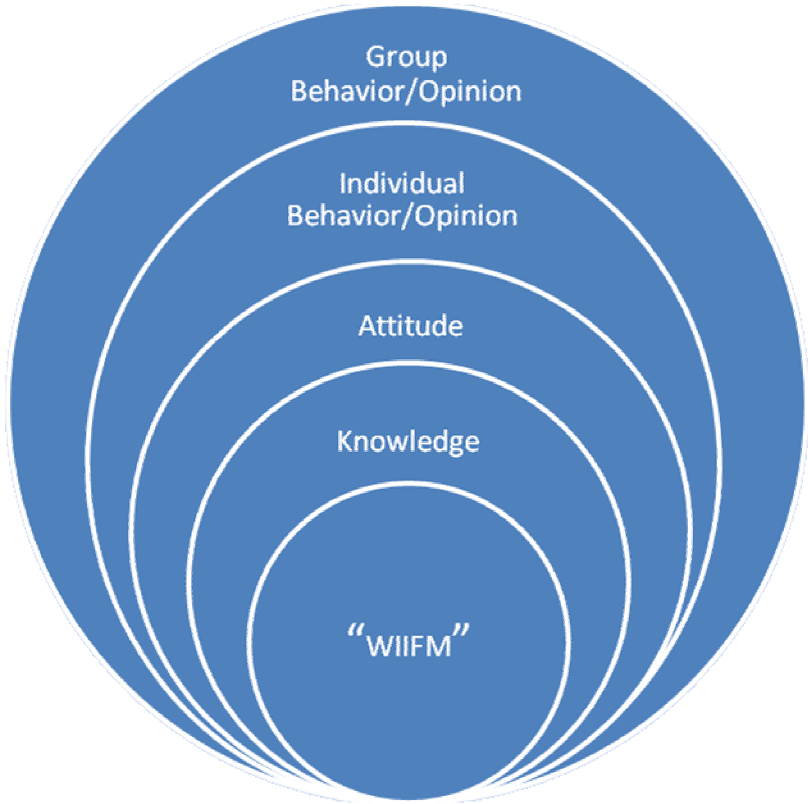


Figure 50: Effective Messaging

Customer Segments

Another aspect of communications planning is to consider likely attitudinal segments and how to communicate most effectively with each; this can be accomplished via customer segmentation. These segments form the basis for understanding the motivations and messaging for engagement materials and approach. Although specific research has not been conducted and is recommended, the following diagram illustrates four potential segments.

The task is to identify motivations and engage all customers while also realizing that some, represented in the lower right quadrant, are unlikely to opt in regardless. One of the goals is to influence the other three segments to become active, or at least passive, project supporters. Again, this is a conceptual framework for the RDF project that requires further development.

Figure 51: Potential Customer Segments

Message Map

A message map forms a "home base" for messaging and creates a foundation for clear, consistent and concise customer communications. As a starting place for the RDF project, the following draft message map addresses some key project aspects from the public's point of view. Messaging must also proactively address common concerns. Often with visible capital projects, there are a few key areas of citizen concern. For example, for an RDF plant, emissions and cost are very likely to be "hot buttons." Developing a fact-based response to those concerns is vital. Figure 52 shows an initial message map for the county to consider for further development.

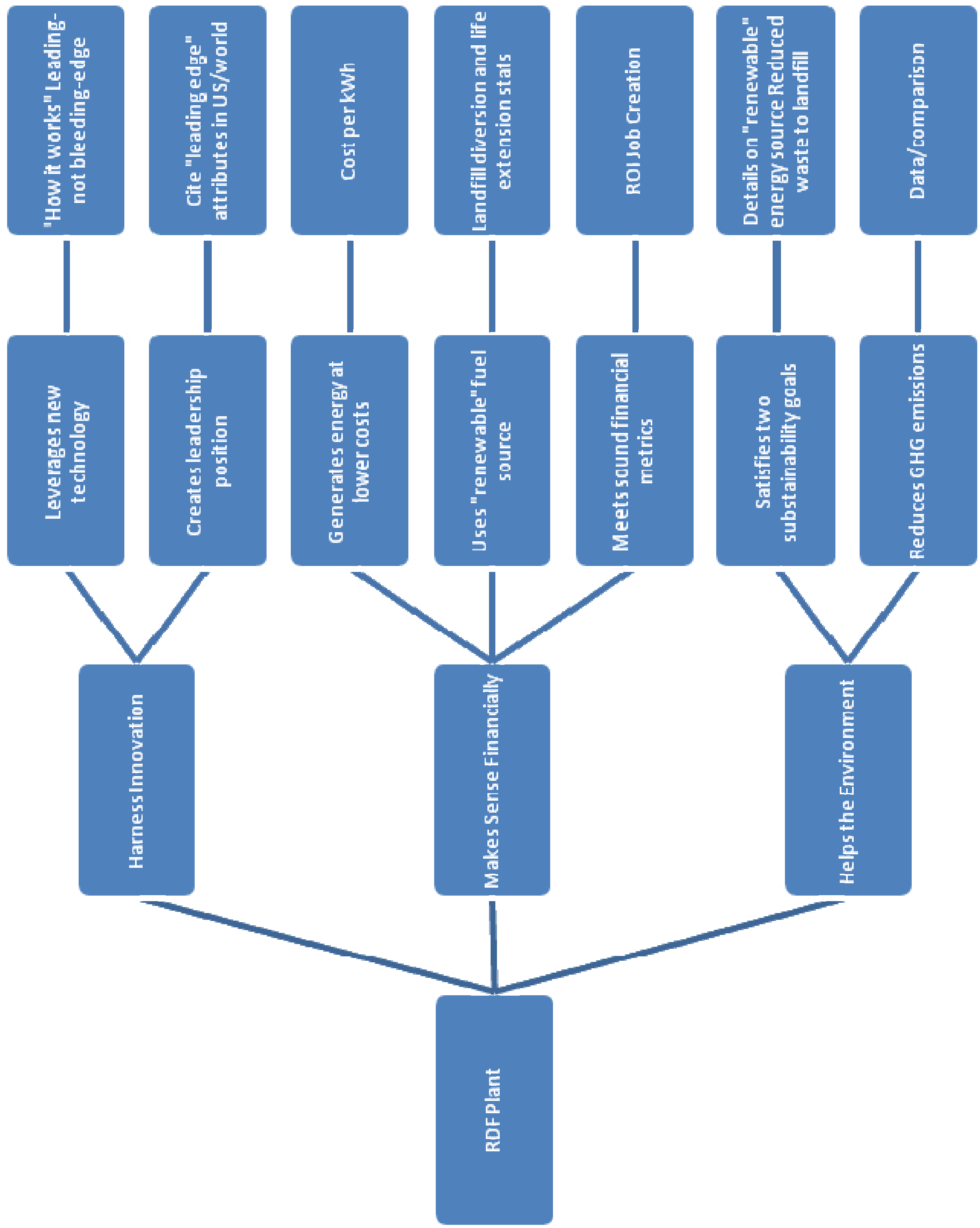


Figure 52: Draft Message Map for Further Development

Tactical Action Plan

Once the strategy and messaging is finalized, it must be reflected in all communications. For effective stakeholder engagement, it is important to leverage all channels, all methodologies, all the time. The following list summarizes the methods that could be considered as the customer engagement plan is finalized. On-point and consistent messaging would be used via all channels. Specific tools developed would include frequently asked questions (FAQs), fact sheets/briefs, presentations, brochure content, and so on. These methods would build from the county's existing communications approaches.

- Personal communication/appeal from county/Community Leadership
- Closed access cable TV
- Direct Mail
- Bill stuffers/other existing distribution channels
- Dedicated mailers
- Electronic Media
- Dedicated project web page
- Social media
- Stakeholder workshops/forums
- Environmental Groups
- Civic organizations: Chambers; Kiwanis, Rotary, etc.
- Non-governmental organizations (e.g., Sierra Club)
- Town hall/open house-style informational sessions
- Advisory Panel
- Expand and leverage group engaged for IEMP development
- Special Events
- Presence at community events (specify)
- Advertising
- For consideration; not an obvious fit
- Other methodologies

Another technique that aids in understanding communication effectiveness is the use of online research (e.g. Survey Monkey). This is a cost effective and timely way to gauge stakeholder awareness and support. Lastly, regular briefings to and engagement of the county's governing body is important for ongoing alignment and support.

Long Term Implementation

The long term implementation plans for the IEMP includes the ZEW^2 Lab for the Core Zone of Moorefield Station. As described previously, the ZEW^2 Lab is intended to provide a flexible framework for ongoing and evolving innovation and partnerships for the county and Moorefield Station. The suggested role for the county in the implementation of the ZEW^2 Lab is to facilitate and manage the initial partnerships and programs identified for the ZEW^2 Lab.

Overall, this portion of the implementation plan relies on community and private partnerships and does not require significant resources or capital funds from the county other than county staff time in facilitating the partnerships and programs. These partnerships and initial programs were developed as a part of the IEMP process through initial discussions with the Advisory Panel and other outreach efforts. As Moorefield Station and the Core Zone develop over the next four to seven years, the county can consider additional programs and partnerships in support of the goals of the ZEW^2 Lab.

It is recommended the county and Moorefield Station continue and potentially formalize the initial partnerships developed as a part of the IEMP where viable in the Core Zone or in other areas of the county. Due to the long term nature and flexibility of the ZEW^2 Lab and development at Moorefield Station, a high-level summary of the initial partnerships and innovative energy, water and waste programs for the county to consider is included below and organized by the two hallmarks of the program discussed previously: 1) harnessing technology and infrastructure in partnership with global leaders and 2) move beyond 'TOD' to 'POD'. The suggested implementation components with partners listed in parenthesis are included for the county's consideration.

ZEW^2 Lab: Harness Technology and Infrastructure in Partnership with Global Leaders

- Develop nexus project (non-potable water system with Moorefield Station HOA)
    - Leverage Loudoun Water past projects and experience; collaborate
    - Incorporate non-potable water system in Moorefield Station HOA roles and responsibilities
    - Align with development timeline with demand for irrigation
    - Moorefield Station HOA ownership; implementation with county support
- Pilot new technologies (Dominion Power, Verizon)
    - Collaborate with Dominion Power and Verizon Key Account Representatives for Loudoun County and Moorefield Station.
    - Pending Dominion Power community solar program: solar PV lease on County and/or Moorefield Station land
    - Smart Grid Pilot with Dominion Power and potentially others (Verizon, portal/demand response vendors)
    - Dominion Power LED outdoor lighting / street lighting program in Moorefield Station
- Additional Energy/Water/Waste Partnerships and Programs (waste haulers, National Renewable Energy Laboratory (NREL), Loudoun Water, Moorefield Station HOA)
    - Solid waste and private hauler partnerships for recycling and/or pay-as-you throw solid waste programs
    - Moorefield Station HOA guidelines, requirements for waste, recycling, energy and water use
    - NREL Communities of the Future program (currently requires funding), emerging technology implementation and Clean Cities Partnerships (100 partners, VA Clean Cities: transportation / alt. fuels and vehicles)
    - Loudoun Water EPA water budgeting tool implementation, apply water conservation programs
    - Living Building Challenge certifications for building energy, water, waste performance

ZEW^2 Lab: Move beyond "TOD" to "POD"

- Publicize previous work for Moorefield Station (Loudoun County and Claude Moore Foundation)
  - Densities, zoning, collaboration, process improvements
  - Transit / multimodal aspects integrated with Moorefield Station
- Innovative parking solutions (Claude Moore Foundation, VDOT)
  - New strategies, e.g., maximums on parking, car free zones; see Transportation Focus Area
- Neighborhood distribution point (Local farming community)
  - Engagement and learning opportunity; signage for RDF / Recycling, IEMP elements
  - Permanent local market
- Urban agriculture (Loudoun County Master Gardeners)
  - Local gardening plots for sale/rent
  - Community garden spaces
- Social media (no partners)
  - Public Relations and 'App' for smart phones to publicize multimodal options
- Living Building Challenge (International Living Future Institute)
  - Building certification based on actual performance – performance based standard
  - Integration of transit options and built environment/buildings

The suggested short, mid and long term implementation plans provide an initial and manageable framework for the county to realize the benefits and implement the projects and programs included in the IEMP. As the Board and county review the plan, it provides flexibility to tailor and modify the implementation as needed to align with available county resources. In addition, specific funding mechanisms and recommendations were aligned with the applicable Focus Area programs and Nexus Projects to further enhance the IEMP implementation and reduce the potential financial impacts on the county. The implantation plan framework provides guidance to realize significant benefits and contributions to the IEMP and County Energy Strategy goals along with a long term mechanism for ongoing partnerships in support of energy resource innovation, reduced GHG emissions and renewable energy.

Section 9: Conclusions and Recommendations

Loudoun County and the Claude Moore Charitable Foundation have a unique opportunity to make a significant, positive impact at Moorefield Station and throughout the county by:

- Delivering renewable energy for more than 3,250 homes
- Reducing Moorefield Station's projected GHG emissions by 28%
- Avoiding $40 million in county capital costs
- Diverting 87,000 tons of solid waste annually
- Marketing Moorefield Station as a unique, sustainable development

The IEMP provides an energy and sustainable infrastructure framework to guide future development within the county. Initially, the IEMP will be applied to Moorefield Station as it develops over the next 30 years. The IEMP will also be a model for future developments with the intent to integrate several of the recommendations with the county's policy, economic development and community outreach efforts where applicable.

As a result of developing the IEMP, Loudoun County has a tremendous and unique opportunity to implement multiple, impactful projects, enhance economic development and create a market leading program within Moorefield Station. The key outcomes and recommendations of the IEMP include:

- A 10MW renewable energy power plant
- A non-potable water system to reduce water consumption and peak demands
- The zero energy/water/waste (ZEW^2) district and long term business partnership program for Moorefield Station
- An opportunity to install 500kW or more of solar photovoltaic (PV) panels on current Moorefield Station land
- Dramatic reduction in GHG emissions
- Significant reduction in county capital and operational expenses
- Ongoing stakeholder engagement in the community
- A more energy efficient and sustainable Moorefield Station

IEMP Framework

A robust stakeholder engagement program was a key element in the creation of the Plan. Stakeholder engagement is woven throughout the development, implementation and monitoring of the IEMP to ensure the success and wider adoption of the IEMP. This engagement plan included the internal IEMP Team comprised of county staff members and subject matter experts and an external Advisory Panel of applicable community leaders that made significant contributions to the Plan. The core elements of the plan include the IEMP mission, Focus Areas, Nexus Projects and Flagship Program.

The IEMP mission aligns with the CES and focuses directly on developments within the county. The IEMP Mission seeks to leverage the unique aspects of Loudoun County to drive economic development and more sustainable communities.

IEMP Mission:

Moorefield Station – harnessing the power of human creativity, economic prosperity and energy innovation to be ***The Nexus of the World's 21st Century Community.***

Integrated Energy Management Plan

The remaining three elements developed for the Plan include the project or programmatic related components where the Plan is implemented and managed:

- Nexus Projects: Scale or large capital alternative energy / sustainable project(s) that cuts across and support multiple Focus Areas and goals
- Flagship Program: A flexible community and business partnership program to pilot innovative programs, technologies or projects that cut across and support multiple Focus Areas and goals
- Focus Areas: Water, Energy, Transportation, Land Use and Waste

After completing the mission, it was then divided into five specific Focus Areas (water, energy, land use, transportation and waste) to effectively manage the implementation and monitoring of progress. As shown in Sections 3 and 4, each of these Focus Areas contains specific goals and programs to tactically implement the IEMP. The Nexus Projects and Flagship Program were developed to address one of the key outcomes targeted in the IEMP: scale alternative energy / sustainable projects and programs that act as 'beacons' for future developments.

The Nexus Projects act to prove the Nexus component of the mission and leverage the energy – water – waste – transportation – land use nexus opportunities in the county or Moorefield Station. The ZEW^2 Lab Flagship Program was developed to act as flexible commercial and community partnership tool to pursue innovative and sustainable programs that are piloted at Moorefield Station. The Nexus Projects and Flagship Program help to directly prove the mission and should act as the marquee symbols of the IEMP.

IEMP Key Findings and Recommendations

Nexus Projects, Flagship Program and Focus Areas

The results of the BAU GHG model and project evaluation tools resulted in the eventual recommendation of two Nexus Projects (RDF power plant, non-potable water system), the ZEW^2 Lab Flagship Program and prioritized Focus Area programs. The RDF power plant and non-potable water Nexus Projects offer multiple environmental and financial benefits including: reduced county operating costs, reduced GHG emissions, extension of the landfill life, renewable power generation, reduced treated water demands and reduced energy consumption.

As the recommended implementation plans for the RDF power plant and non-potable water system were developed, initial partners for the projects were also identified. These preliminary partnership and implementation discussions further reinforced the benefits and financial feasibility presented by the projects.

The ZEW^2 Lab Flagship Program provides the mechanisms to engage partners and apply innovative technologies that support zero energy/waste/water in the Core Zone of Moorefield Station. There are two hallmarks are used to coordinate and manage the supporting components, partnerships and programs for the ZEW^2 Lab.

- Hallmark 1 includes technology and infrastructure related components such as piloting new technologies or partnerships, smart grid and reclaimed water supply / re-use.
- Hallmark 2 includes components and projects to move beyond transit-oriented development to people oriented development or "TOD" to "POD." Elements include: Innovative parking solutions and new strategies, neighborhood distribution point and urban agriculture.

The Nexus Projects and ZEW^2 Flagship Program Result in:

- Developing a 10MW renewable, RDF power plant generating low cost electricity at an estimated $0.037 per kWh
- Delivering enough renewable energy to power more than 3,250 homes in Loudoun County
- Reducing 38,700 metric tons of GHG emission annually; offsetting 28% of projected Moorefield Station annual emissions
- Diverting 87,300 tons of solid waste annually from the county landfill
- Avoiding more than $40,500,000 (net present value) of costs for the county landfill
- Developing a non-potable water system in Moorefield Station to deliver water at $3.68 per 1,000 gallons
- Reducing water consumption, peak demands, land use, energy consumption and costs at Moorefield Station
- Creating a zero energy, water and waste district (ZEW^2) program for innovative technologies and long term partnerships

The most tactical programs were included and managed within the individual Focus Areas. These programs support their respective Focus Area goals. The Focus Area programs also include opportunities to integrate the Plan into county policies, services and procedures. Furthermore, specific goal achievement levels were developed for countywide application and for Moorefield Station. Some of these specific Focus Area programs include:

- Geothermal heat pump incentives
- Energy efficient building codes
- County water reuse program
- Green roofs with stormwater collection and local gardens
- Smart phone application for trails, transit and multi-modal information
- Bike sharing program
- Creating maximum parking limits
- Integrating stormwater infrastructure with open spaces
- 'Freecycle' social goods recycling
- Construction and demolition waste diversion

Additional Key Findings and Recommendations

Below is a summary of additional key findings, recommendations and outcomes of the IEMP.

Findings

- The Advisory Panel feedback on the IEMP and initial contributions and interest in partnerships for the IEMP suggest solid business and community support for the IEMP. The county should consider maintaining the Advisory Panel involvement with the eventual implementation of the IEMP and Moorefield Station.
- Moorefield Station's annual GHG emissions at full build-out are estimated to be 137,700 metric tons of CO_2 e. Full build-out of Moorefield Station is currently estimated to occur by 2040.
- Currently, a natural gas fired CHP plant is not financially viable or environmentally beneficial for Moorefield Station. Due to Dominion Power's current and projected low GHG emissions rates, a

natural gas CHP plant would result in increased GHG emissions, not a reduction. The projected average cost of electricity for a CHP plant is less competitive than an RDF power plant. In addition, the potential CHP plant would be located and operate within Dominion Power and Columbia Gas's service territories. By locating within an existing service territory, Virginia legislation and SCC regulations would likely require the county or Moorefield Station to become a regulated electric and/or heating utility in order to sell the heating and power to multiple end users.

- The RDF power plant offers several financial and environmental benefits including:
  - $0.037 to $0.055 per kWh average cost of electricity generated at the plant (current average costs are approximately $0.07 per kWh of electricity generated)
  - 38,648 $mTCO_2e$ per year of avoided GHG emissions (equivalent to a 28 percent annual reduction in Moorefield Station full build-out GHG emissions)
  - 80,592 MWh per year of renewable energy generated, equivalent to providing power to 3,250 homes in Loudoun County
  - 87,308 tons per year of waste diverted from the landfill
  - Seven year extension of the life of the county landfill
  - Net present value (NPV) benefit to the county of $40,591,000 for avoided landfill capital costs
- Federal Production Tax Credits (PTCs) were not included in the evaluation of the renewable energy projects due to their likely expiration in 2012. If the PTCs are extended, the RDF power plant average cost of electricity delivered would be further reduced by $0.011 per kWh if developed by a third party or federal tax-paying entity.
- If the recommended plasma arc technology is determined to be a significant technology risk by the county or eventual third party developer, an alternative RDF power technology was provided and evaluated which results in similar financial and environmental performance.
- The non-potable water system addresses peak day water demand which is a significant issue for the local utility, Loudoun Water. The non-potable water utility is cost competitive and reduces the environmental impact of treating and conveying water.
- Preliminary discussions with Dominion have identified an opportunity for Moorefield Station and potentially the county to participate in the proposed Community Solar Program. Initial discussions include participation in the Solar PV Leasing program to locate a large (e.g. 500kW+) solar PV array on Moorefield Station property in the near term. The Community Solar program is currently being reviewed and awaiting approval of the SCC (expected in the spring of 2012).
- As a result of the IEMP, the county is continuing preliminary collaboration discussions with Dominion to participate in the Community Solar program and leverage current Dominion energy efficiency programs in the county through current county engagement programs.

- Renewable energy projects can have an important impact on the community's tax base including:
    - Providing important, early activity on the site
    - Leveraged properly, costs for infrastructure improvements for additional sites/projects can be covered within the context of these projects
    - The direct and indirect earnings impact to Loudoun County from the recommended Nexus Projects was estimated to be $25,600,000. The two Nexus Projects also result in additional fiscal and economic benefits of nearly $1.5 million in annual tax revenues.
- The economic development community benchmarking assessment provided important insight, including the following:
    - Public investment is typically followed by private investment and public/private partnerships
    - Collaboration is a key element in success; involving government, businesses, education, workforce and the community at large
    - "Green Energy" policies must be included at all levels of the county and project to effectively create the paradigm shift
- The Zofnass program for sustainable infrastructure provided a sustainable infrastructure risk assessment for the Moorefield Station development and the application of the IEMP. The results reinforced the unique, sustainable aspects and aspirations of the development, in addition to recognizing the past work and collaboration by the county and the Claude Moore Foundation.

Recommendations

- The two selected Nexus Projects (non-potable water system and RDF power plant), ZEW^2 Lab Flagship Program and Focus Areas are recommended for implementation by the county. A suggested implementation framework is included in the full report.
- A targeted and proactive RDF stakeholder engagement and communication plan is recommended to educate county residents and stakeholders on the newer RDF technologies and the environmental and financial benefits to the county. This engagement plan should coincide with further evaluation and prior to the final decision to implement.
- In addition, due to the RDF technologies recommended, there is an excellent opportunity to support local economic development and sources of biomass and crop by-product feedstocks. The local farmers and vineyards have shown an initial interest in providing crop by-products, vineyard wastes and potentially new biomass crops (e.g. switchgrass) to fuel a renewable energy facility in the county. These additional sources of fuel feedstocks would further augment and diversify the waste fuel feedstocks and potentially allow for increasing the facility size in the future. Biomass was also identified as a locational advantage for Loudoun County.
- To further leverage the IEMP and Nexus Projects to make a broader county and regional economic impact, the county can focus efforts in targeted industries. In a down economy, the best approach is to build off the existing industry base within the county. The economic development assessment identified the following renewable energy sectors as suggested targets: wind, solar, geothermal and biomass. These sectors and supporting industries / markets were identified as a locational advantage for Loudoun County.

- The recommended implementation plan for the RDF power plant includes utilizing a partnership with Dominion Power or a third party developer to design, build, own and operate the RDF plant. This structure allows for the RDF plant to be constructed without the county providing or issuing bonds to finance the capital for the project. The financial and environmental benefits of the plant would be included in a purchase power or similar contractual agreement between the parties.
- The recommended implementation plan for the non-potable water system is for the Moorefield Station home owner's association (HOA) to design, build, own and operate the system within Moorefield Station. This is similar to other non-potable water systems in the county. The HOA would provide the capital and annual operating funds for the system and recover the costs through the HOA fees. The fees would be lower than purchasing potable water for the irrigation purposes, thus saving the HOA money. The county would support the project as needed; however, would not contribute capital or operating funds to the project.
- The ZEW^2 Lab Flagship Program is recommended as energy and sustainability laboratory in the Core Zone of Moorefield Station. It has the potential to influence many residents and visitors to Moorefield Station to become more sustainable, act locally and contribute to the IEMP goals and sustainability in their home and the region.
- The Focus Area programs provide an opportunity for the county to integrate specific programs and process into county procedures, policies and incentives. One of the common low cost recommendations for the Focus Area implementation is modifying county procedures such as permitting to incentivize more sustainable and clean energy development and construction. The implementation plan provides greater detail regarding the specific opportunities recommended for the county.
- The recommended Implementation Plan aligns available and optimal funding strategies with the RDF power plant, non-potable water system and Focus Area programs. The funding strategies identified and recommended for the RDF power plant and non-potable water system would not require Loudoun County capital funds or bond issues.
- A short, mid and long term implementation plan was developed for the county to consider in the implementation of the IEMP. This framework divides the critical implementation elements of the IEMP (Focus Area programs, Nexus Projects and ZEW^2 Flagship Program) into manageable components with suggested timelines and schedules.

Reporting to the Community

In order to align with best practices in sustainability and energy strategy and in order for the IEMP to meet its commitment to citizens and demonstrate progress to plan, an initial summary brochure was developed and recommended for Loudoun County. This annual brochure serves the dual purposes of reporting to the broader Loudoun County community and marketing Moorefield Station. This report is more graphic and marketing in nature and act as the core external public communication document for the Plan and application at Moorefield Station. The format will also be available in an electronic form for placement on the Claude Moore Charitable Foundation and Loudoun County websites. However, hardcopy reports would be available for specific outreach and marketing efforts.

This brochure, included in Appendix J and shown in Figure 53, presents an overview of the IEMP with particular emphasis on the aspects with the highest visibility in terms of meeting the mission and engaging the public. Elements of the brochure include the mission, Focus Areas, Nexus Projects, ZEW^2 Lab Flagship Program and additional summary information about Moorefield Station.

Potential uses for this brochure include distribution to:

- Loudoun County Staff
- Community Members
- Various venues including events, speaking engagements, building lobbies, etc.
- Loudoun County Governing Body
- Moorefield Station Marketing
- Commercial ventures interested in Moorefield Station
- Potential Moorefield Station residents
- Non-profits/non-governmental organizations that have interest in Moorefield Station

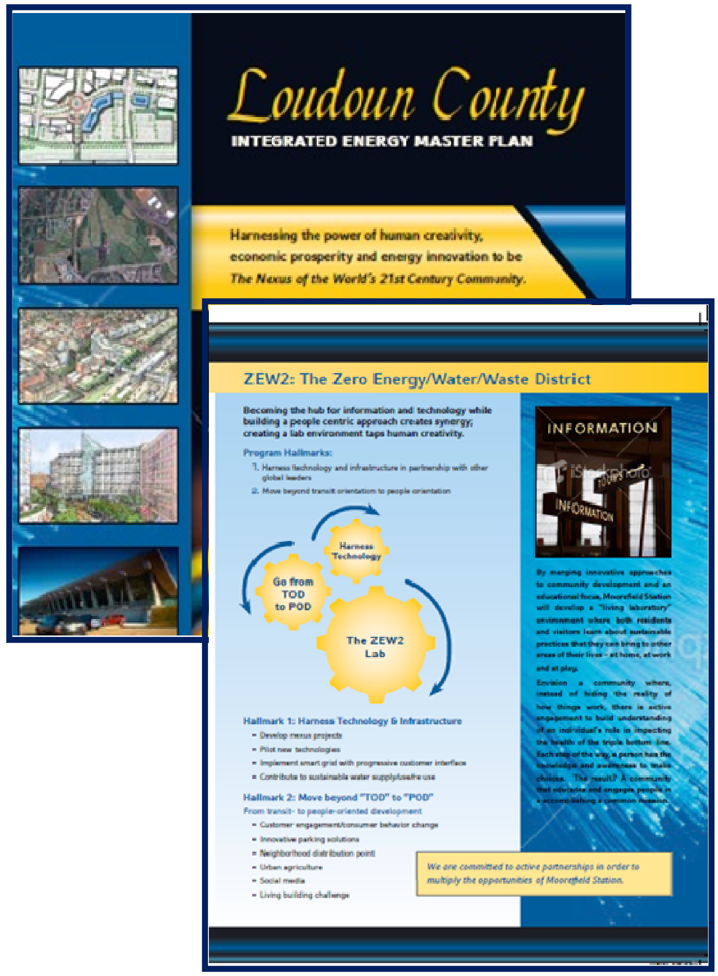


Figure 53: IEMP Public Brochure

In addition, to reporting on progress and the IEMP, the report will offer and highlight opportunities for the community and individuals to participate and support the IEMP's goals. As the plan evolves over time, an annual update of this brochure would be appropriate.

Conclusion

The unique partnership between Loudoun County and the Claude Moore Foundation provide a tremendous opportunity to deliver significant and impactful sustainable energy projects at Moorefield Station and throughout the county. Due to this partnership, location of Moorefield Station and county-related assets the IEMP identified opportunities to:

- Develop a 10MW RDF renewable power plant without using county capital or bond funding
- Deliver renewable energy that could power more than 3,250 homes annually
- Support local farmers and vineyards through biomass economic development
- Reduce the projected GHG emissions related to Moorefield Station by 28 percent
- Implement a large solar PV project in partnership with Dominion Power at Moorefield Station in the near term

- Avoid more than $40 million (NPV) in county capital costs at the landfill
- Divert 87,000 tons of solid waste annually for beneficial reuse
- Reduce peak water demands and energy consumption related to treated water
- Market Moorefield Station as a unique, sustainable development
- Engage the community and stakeholders in the IEMP

The IEMP recommendations result in financial, economic and social benefits to Moorefield Station and the county. The IEMP also provides an opportunity to set an example for other developments in the U.S. and throughout the world. When implemented, the IEMP represents a market leading plan for the county and Moorefield Station to become ***The Nexus of the World's 21st Century Community***.

Appendices

Appendices

Appendix A: Energy Modeling Data

Integrated Energy Management Plan

Energy Modeling Building System Descriptions

Efficient Case - Commercial

Heating hot water for the efficient office building was assumed as one central heating plant consisting of two equality sized, high efficiency gas fired hot water boilers for space heating. Variable primary pumping will be provided to serve the air handler and perimeter finned tubes.

Chilled water for the was assumed as one central refrigeration plant consisting of two equally sized, high efficiency electric motor driven refrigeration machines. Variable primary pumping will be provided to air handler and coils. Condenser water would be cooled by a packaged cooling tower assembly with two speed motors on the cooling tower fans. Condenser water is distributed by a constant volume pump.

Office areas would be served by a variable air volume air handling unit VAV boxes to supply interior zones and VAV boxes with interlock to finned tubes to supply perimeter zones. The air handler will be equipped with an air side economizer.

Electric lighting is assumed as T5 fluorescent fixtures.

Efficient Case - Multifamily

Heating hot water for the building would be provided by one central heating plant consisting of two equality sized, high efficiency gas fired hot water boilers for space heating. Variable primary pumping will be provided to serve the make up units and PTAC coils.

Dwelling units would be served by dedicated high efficiency, self contained, air cooled DX PTAC units.

100% preconditioned outside air would be supplied from a DX cooling, make up air units located on the roof. Air would be distributed via vertical duct risers discharging air into the common corridors. Dwelling units would have under cut doors enabling makeup air passage into the units.

Ground Source Heat Pumps Case – Multifamily

Heating and cooling was assumed as dedicated high efficiency ground source heat pumps. Vertical glycol water loop wells will be served by a constant volume pumps distributing the glycol water solution through the building feeding the individual ground source heat pumps and make up air units.

100% preconditioned outside air will be supplied from a ground source heat pump make up air units located on the roof. Air will be distributed via vertical duct risers discharging air into the common corridors. Dwelling units will have under cut doors enabling makeup air passage into the units.

Efficient Case - townhome

Heating and cooling will be provided by a high efficiency heat pump with electric reheat.

Ground Source Heat Pumps Case - Townhome

Heating and cooling would be provided by a high efficiency ground source heat pump. Vertical glycol water loop wells will be served by constant volume pumps distributing the glycol water solution to dedicated ground source heat pumps.

Loudoun County
Integrated Energy Master Plan

Halcrow

Building Energy Simulation
Systems Assumptions

COMMERCIAL BUILDING				
	Code	BAU	Most Efficient	
Dimensions of each floor		275 ft. x 104 ft. = 28,900 sf; 8 Floors	Same	
Glazing		70% distributed equally on all four sides	Same	
Envelope	ASHRAE 90.1-2007	Walls U-0.064 (R-20.5); Roof U-0.047 (R-20); Glass U 0.50; SC - 0.459	Same	
Schedules		Typical Office	Same	
Ventilation	ASHRAE 62.1-2007	5 cfm/person; 0.06 cfm/sq.ft.	Same	
Lighting Power Density	IECC 2006	1.0 w/sq.ft.	0.8 w/sq.ft.	
Plug Load		3 w/sq.ft.	Same	
System Type	ASHRAE 90.1-2007	VAV with reheat - Chilled Water and Hot Water	VAV with perimeter reheat - Chilled Water and Hot Water	
Economizer	ASHRAE 90.1-2007	Not required	Dry Bulb - ON point 65F	
Cooling System	ASHRAE 90.1-2007	2 equally sized Water Cooled Screw Chillers - 4.90 COP / 0.717 kW/ton	2 equally sized Water Cooled Screw Chillers - 0.468 kW/ton	
Heat Rejection	ASHRAE 90.1-2007	Cooling tower; 0.0637 kW/ton	Same	
Heating	ASHRAE 90.1-2007	Two equally sized boilers - 80%	Two equally sized boilers - 96%	
Pumps	ASHRAE 90.1-2007	Hot Water: 19 w/gpm; Chilled Water: 22 w/gpm	Same	
Miscelllaneous accessories:				
Water circulating pumps		4 kW	Same	
Base Utility:				
Parking Lot lights		34.3 kW	Same	
Toilet Exhaust Fans		2 kW	Same	
Domestic HW Heater	ASHRAE 90.1-2007	307 btuh/person x 857 = 263 MBh @ 80%	96%	
Elevators		26 kW for multiple (2)	Same	

MULTIFAMILY BUILDING					
	Code		BAU	Most Efficient	GSHP Over BAU
Dimensions of each floor			1200 sf x 12 units = 117,120 sf; 8 floors	Same	Same
Glazing			60% distributed equally on all four sides	Reduced to 50%	Same
Envelope	ASHRAE 90.1-2007		Walls U-0.064; Roof U-0.047; Glass U 0.50; SC - 0.459	Walls U - 0.050	Same
Schedules			Typical Multi Family	Same	Same
Ventilation	ASHRAE 62.1-2007		5 cfm/person; 0.06 cfm/sq.ft.	Same	Same
Lighting Power Density	ASHRAE 90.1-2007		0.7 w/sq.ft. - Lighting power density	0.52 w/sq.ft.	Same
Plug Load			0.5 w/sq.ft. - plug loads	Same	Same
System Type	ASHRAE 90.1-2007		Constant Volume PTAC and Hot Water	Same	Constant Volume- Non-mixing Water Source Heat Pump (WSHP)
Economizer	ASHRAE 90.1-2007		Not required	Same	Same
Cooling System			Direct Expansion - 9.305 EER	11.0 EER	16.2 Packaged EER WSHP; 143.9 gal/ton; 30% Glycol
Heat Rejection			Cooling tower; 0.0552 kW/ton	Same	Same
Heating	ASHRAE 90.1-2007		Two equally sized boilers - 80%	86%	Heat Pump: 0.0637 kW/Mbh Back up boiler with 80% efficiency
Pumps	ASHRAE 90.1-2007		Hot Water: 19 w/gpm; Chilled Water: 22 w/gpm	Same	Hot Water: 19 w/gpm; Condenser Water: 19 w/gpm
Miscelllaneous accessories:					
Water circulating pumps			2 kW	Same	100 ft head VFD pump for Vertical wells
Base Utility.					
Toilet Exhaust Fans			2 kW	Same	Same
Domestic HW Heater	ASHRAE 90.1-2007		1706 btuh/person x 182 = 310.5 MBh @ 80%	96%	Same
Elevators			26 kW for multiple (2)	Same	Same

Halcrow

Loudoun County
Integrated Energy Master Plan

Building Energy Simulation
Systems Assumptions

SINGLE FAMILY ATTACHED BUILDING				
	Code	BAU	Most Efficient	GSHP Over BAU
Dimensions of each floor		2200 sf x 2 units = 4400 sf	Same	Same
Glazing		40% distributed equally on all four sides	Same	Same
Envelope	IECC 2009	Walls U-0.082; Roof U-0.03; Glass U 0.35; SC - 0.459	Walls U-0.063	Same
Schedules		Typical Multi Family	Same	Same
Ventilation	ASHRAE 62.1-2007	5 cfm/person; 0.06 cfm/sq.ft.	Same	Same
Lighting Power Density		0.7 w/sq.ft. - Lighting power density	0.52 w/sq.ft.	Same
Plug Load		0.5 w/sq.ft. - plug loads	Same	Same
System Type		CV Heat Pump	Same	Constant Volume- Non-mixing Water Source Heat Pump (WSHP)
Economizer		Not Required	Same	Same
Cooling System		Heat Pump - 1.219 kW/ton	11.0 EER	16.2 Packaged EER WSHP; 143.9 gal/ton; 30% Glycol
Heat Rejection		Remote Condensor 0.12 kW/ton	Same	Same
Heating		Electric heat with supplementary boiler	Same	Supplementary electric heat
Pumps		Hot Water: 19 w/gpm	Same	Same
Miscelllaneous accessories:				
Water circulating pumps				100 ft head pump for Vertical wells
Base Utility:				
Parking Lot lights				
Toilet Exhaust Fans				
Domestic HW Heater		1706 btuh/person x 7 = 11.95 MBh @ 80%	96%	Same
Elevators				

Loudoun County
Integrated Energy Master Plan
Building Energy Simulation
System Assumptions

MULTIFAMILY BUILDING				
	Code	BAU	Most Efficient	GSHP Over BAU
Dimensions of each floor		1200 sf x 12 units = 117,120 sf; 8 floors	Same	Same
Glazing		60% distributed equally on all four sides	Reduced to 50%	Same
Envelope	ASHRAE 90.1-2007	Walls U-0.064; Roof U-0.047; Glass U 0.50; SC - 0.459	Walls U - 0.050	Same
Schedules		Typical Multi Family	Same	Same
Ventilation	ASHRAE 62.1-2007	5 cfm/person; 0.06 cfm/sq.ft.	Same	Same
Lighting Power Density	ASHRAE 90.1-2007	0.7 w/sq.ft. - Lighting power density	0.52 w/sq.ft.	Same
Plug Load		0.5 w/sq.ft. - plug loads	Same	Same
System Type	ASHRAE 90.1-2007	Constant Volume PTAC and Hot Water	Same	Constant Volume- Non-mixing Water Source Heat Pump (WSHP)
Economizer	ASHRAE 90.1-2007	Not required	Same	Same
Cooling System		Direct Expansion - 9.305 EER	11.0 EER	16.2 Packaged EER WSHP; 143.9 gal/ton; 30% Glycol
Heat Rejection		Cooling tower; 0.0552 kW/ton	Same	Same
Heating	ASHRAE 90.1-2007	Two equally sized boilers - 80%	86%	Heat Pump: 0.0637 kW/Mbh Back up boiler with 80% efficiency
Pumps	ASHRAE 90.1-2007	Hot Water: 19 w/gpm; Chilled Water: 22 w/gpm	Same	Hot Water: 19 w/gpm; Condensor Water: 19 w/gpm
Miscelllaneous accessories:				
Water circulating pumps		2 kW	Same	100 ft head VFD pump for Vertical wells
Base Utility:				
Toilet Exhaust Fans		2 kW	Same	Same
Domestic HW Heater	ASHRAE 90.1-2007	1706 btuh/person x 182 = 310.5 MBh @ 80	96%	Same
Elevators		26 kW for multiple (2)	Same	Same

Loudoun County
Integrated Energy Master Plan
Building Energy Simulation
System Assumptions

SINGLE FAMILY ATTACHED BUILDING				
	Code	BAU	Most Efficient	GSHP Over BAU
Dimensions of each floor		2200 sf x 2 units = 4400 sf	Same	Same
Glazing		40% distributed equally on all four sides	Same	Same
Envelope	IECC 2009	Walls U-0.082; Roof U-0.03; Glass U 0.35; SC - 0.459	Walls U-0.063	Same
Schedules		Typical Multi Family	Same	Same
Ventilation	ASHRAE 62.1-2007	5 cfm/person; 0.06 cfm/sq.ft.	Same	Same
Lighting Power Density		0.7 w/sq.ft. - Lighting power density	0.52 w/sq.ft.	Same
Plug Load		0.5 w/sq.ft. - plug loads	Same	Same
System Type		CV Heat Pump	Same	Constant Volume- Non-mixing Water Source Heat Pump (WSHP)
Economizer		Not Required	Same	Same
Cooling System		Heat Pump - 1.219 kW/ton	11.0 EER	16.2 Packaged EER WSHP; 143.9 gal/ton; 30% Glycol
Heat Rejection		Remote Condensor 0.12 kW/ton	Same	Same
Heating		Electric heat with supplementary boiler	Same	Supplementary electric heat
Pumps		Hot Water: 19 w/gpm	Same	Same
Miscelllaneous accessories:				
Water circulating pumps				100 ft head pump for Vertical wells
Base Utility:				
Parking Lot lights				
Toilet Exhaust Fans				
Domestic HW Heater		1706 btuh/person x 7 = 11.95 MBh @ 80%	96%	Same
Elevators				

Loudoun County
Integrated Energy Master Plan
Building Energy Simulation
System Assumptions

COMMERCIAL BUILDING				
	Code	BAU	Most Efficient	
Dimensions of each floor		275 ft. x 104 ft. = 28,900 sf; 8 Floors	Same	
Glazing		70% distributed equally on all four sides	Same	
Envelope	ASHRAE 90.1-2007	Walls U-0.064 (R-20.5); Roof U-0.047 (R-20); Glass U 0.50; SC - 0.459	Same	
Schedules		Typical Office	Same	
Ventilation	ASHRAE 62.1-2007	5 cfm/person; 0.06 cfm/sq.ft.	Same	
Lighting Power Density	IECC 2006	1.0 w/sq.ft.	0.8 w/sq.ft.	
Plug Load		3 w/sq.ft.	Same	
System Type	ASHRAE 90.1-2007	VAV with reheat - Chilled Water and Hot Water	VAV with perimeter reheat - Chilled Water and Hot Water	
Economizer	ASHRAE 90.1-2007	Not required	Dry Bulb - ON point 65F	
Cooling System	ASHRAE 90.1-2007	2 equally sized Water Cooled Screw Chillers - 4.90 COP / 0.717 kW/ton	2 equally sized Water Cooled Screw Chillers - 0.468 kW/ton	
Heat Rejection	ASHRAE 90.1-2007	Cooling tower; 0.0637 kW/ton	Same	
Heating	ASHRAE 90.1-2007	Two equally sized boilers - 80%	Two equally sized boilers - 86%	
Pumps	ASHRAE 90.1-2007	Hot Water: 19 w/gpm; Chilled Water: 22 w/gpm	Same	
Miscelllaneous accessories:				
Water circulating pumps		4 kW	Same	
Base Utility:				
Parking Lot lights		34.3 kW	Same	
Toilet Exhaust Fans		2 kW	Same	
Domestic HW Heater	ASHRAE 90.1-2007	307 btuh/person x 857 = 263 MBh @ 80%	96%	
Elevators		26 kW for multiple (2)	Same	

Energy Cost Budget / PRM Summary

By Halcrow

Project Name: Loudoun County Commercial Building		Date: December 19, 2011
City: Loudoun county Virginia	Weather Data: Washington, D.C.	

Note: The percentage displayed for the "Proposed/ Base %" column of the base case is actually the percentage of the total energy consumption.

* Denotes the base alternative for the ECB study.

		* Alt-1 Revised HWBoiler			Alt-2 Revised DHW Boiler		
		Energy 10^6 Btu/yr	Proposed / Base %	Peak kBtuh	Energy 10^6 Btu/yr	Proposed / Base %	Peak kBtuh
Lighting - Conditioned	Electricity	1,623.4	23	629	1,623.4	100	629
Space Heating	Electricity	8.6	0	6	8.6	100	6
	Gas	1,832.1	26	2,831	1,707.7	93	2,777
Space Cooling	Electricity	485.4	7	652	485.4	100	652
Pumps	Electricity	107.9	2	207	108.9	101	208
Heat Rejection	Electricity	97.7	1	97	97.7	100	97
Fans - Conditioned	Electricity	719.1	10	700	719.1	100	700
Receptacles - Conditioned	Electricity	1,357.8	19	590	1,357.8	100	590
Stand-alone Base Utilities	Electricity	950.5	13	213	950.5	100	213
Total Building Consumption		**7,182.6**			**7,059.2**		

		* Alt-1 Revised HWBoiler	Alt-2 Revised DHW Boiler
Total	**Number of hours heating load not met**	104	104
	Number of hours cooling load not met	5	5

	* Alt-1 Revised HWBoiler		Alt-2 Revised DHW Boiler	
	Energy 10^6 Btu/yr	Cost/yr $/yr	Energy 10^6 Btu/yr	Cost/yr $/yr
Electricity	5,350.5	0	5,351.5	0
Gas	1,832.1	0	1,707.7	0
Total	**7,183**	**0**	**7,059**	**0**

Energy Cost Budget / PRM Summary

By Halcrow

Project Name: Loudoun County Commercial Building	Date: December 19, 2011
City: Loudoun county Virginia	Weather Data: Washington, D.C.

Note: The percentage displayed for the "Proposed/ Base %" column of the base case is actually the percentage of the total energy consumption.

* Denotes the base alternative for the ECB study.

		* Alt-1 Commercial Building - M		
		Energy 10^6 Btu/yr	Proposed / Base %	Peak kBtuh
Lighting - Conditioned	Electricity	1,826.3	22	708
Space Heating	Electricity	8.7	0	6
	Gas	2,077.1	25	3,418
Space Cooling	Electricity	1,034.9	12	1,106
Pumps	Electricity	150.8	2	259
Heat Rejection	Electricity	125.0	1	124
Fans - Conditioned	Electricity	924.1	11	987
Receptacles - Conditioned	Electricity	1,357.8	16	590
Stand-alone Base Utilities	Electricity	950.5	11	213
Total Building Consumption		**8,455.4**		

		* Alt-1 Commercial Building - M
Total	Number of hours heating load not met Number of hours cooling load not met	60 0

	* Alt-1 Commercial Building - M	
	Energy 10^6 Btu/yr	Cost/yr $/yr
Electricity	6,378.2	0
Gas	2,077.1	0
Total	8,456	0

additional 1,093,754 KWh were adjusted manually to the report to compensate constant base load energy use not included in model

Energy Cost Budget / PRM Summary

By Halcrow

Project Name: MultiFamily Residential bldg		Date: December 14, 2011
City: Loudoun County	Weather Data: Washington, D.C.	

Note: The percentage displayed for the "Proposed/ Base %" column of the base case is actually the percentage of the total energy consumption.

* Denotes the base alternative for the ECB study.

		* Alt-1 Higher SEER			Alt-2 Revised HW boiler eff to 88			Alt-3 Revised DHW heater eff to		
		Energy 10^6 Btu/yr	Proposed / Base %	Peak kBtuh	Energy 10^6 Btu/yr	Proposed / Base %	Peak kBtuh	Energy 10^6 Btu/yr	Proposed / Base %	Peak kBtuh
Lighting - Conditioned	Electricity	371.8	5	187	371.8	100	187	371.8	100	187
Space Heating	Electricity	30.1	0	8	30.1	100	8	20.8	69	7
	Gas	2,843.8	38	1,094	2,789.8	98	1,039	2,422.6	85	986
Space Cooling	Electricity	328.3	4	228	328.3	100	228	328.3	100	228
Pumps	Electricity	8.9	0	4	8.9	100	4	4.9	55	4
Heat Rejection	Electricity	44.6	1	31	44.6	100	31	44.6	100	31
Fans - Conditioned	Electricity	2,767.8	37	316	2,767.8	100	316	2,767.8	100	316
Receptacles - Conditioned	Electricity	736.8	10	180	736.8	100	180	736.8	100	180
Stand-alone Base Utilities	Electricity	394.7	5	96	394.7	100	96	394.7	100	96
Total Building Consumption		**7,526.6**			**7,472.7**			**7,092.2**		

		* Alt-1 Higher SEER	Alt-2 Revised HW boiler eff to 88	Alt-3 Revised DHW heater eff to
Total	**Number of hours heating load not met**	0	0	0
	Number of hours cooling load not met	0	0	0

	* Alt-1 Higher SEER		Alt-2 Revised HW boiler eff to 88		Alt-3 Revised DHW heater eff to	
	Energy 10^6 Btu/yr	Cost/yr $/yr	Energy 10^6 Btu/yr	Cost/yr $/yr	Energy 10^6 Btu/yr	Cost/yr $/yr
Electricity	4,682.9	0	4,682.9	0	4,669.6	0
Gas	2,843.8	0	2,789.8	0	2,422.6	0
Total	**7,527**	**0**	**7,473**	**0**	**7,092**	**0**

Energy Cost Budget / PRM Summary

By Halcrow

Project Name: MultiFamily Residential bldg	Date: December 14, 2011
City: Loudoun County	Weather Data: Washington, D.C.

Note: The percentage displayed for the "Proposed/ Base %" column of the base case is actually the percentage of the total energy consumption.

* Denotes the base alternative for the ECB study.

		* Alt-1 Multi Family Buildings		
		Energy 10^6 Btu/yr	Proposed / Base %	Peak kBtuh
Lighting - Conditioned	Electricity	500.4	6	252
Space Heating	Electricity	30.0	0	8
	Gas	2,904.3	34	1,167
Space Cooling	Electricity	519.7	6	345
Pumps	Electricity	9.0	0	5
Heat Rejection	Electricity	54.0	1	36
Fans - Conditioned	Electricity	3,297.5	39	376
Receptacles - Conditioned	Electricity	736.8	9	180
Stand-alone Base Utilities	Electricity	394.7	5	96
Total Building Consumption		**8,446.5**		

		* Alt-1 Multi Family Buildings
Total	Number of hours heating load not met	0
	Number of hours cooling load not met	0

	* Alt-1 Multi Family Buildings	
	Energy 10^6 Btu/yr	Cost/yr $/yr
Electricity	5,542.2	0
Gas	2,904.3	0
Total	**8,446**	**0**

Project Name: MultiFamily Residential bldg
Dataset Name: MFAMILY-1b-BAU.TRC

Energy Cost Budget / PRM Summary

By Halcrow

Project Name: Town House		Date: December 14, 2011
City: Loudoun County Virginia	Weather Data: Washington, D.C.	

Note: The percentage displayed for the "Proposed/ Base %" column of the base case is actually the percentage of the total energy consumption.

* Denotes the base alternative for the ECB study.

		* Alt-1 Walls R 15			Alt-2 Reduced LPD 052 w/sqft			Alt-3 Improved SEER			Alt-4 Domestic HW Improved eff		
		Energy 10^6 Btu/yr	Proposed / Base %	Peak kBtuh	Energy 10^6 Btu/yr	Proposed / Base %	Peak kBtuh	Energy 10^6 Btu/yr	Proposed / Base %	Peak kBtuh	Energy 10^6 Btu/yr	Proposed / Base %	Peak kBtuh
Lighting - Conditioned	Electricity	18.8	8	9	14.0	74	7	14.0	74	7	14.0	74	7
Space Heating	Electricity	51.1	21	19	52.9	104	19	52.9	104	19	52.9	104	19
	Gas	78.6	32	12	78.6	100	12	78.6	100	12	65.5	83	10
Space Cooling	Electricity	40.8	17	28	39.9	98	28	36.4	89	25	36.4	89	25
Pumps	Electricity	0.1	0	0	0.1	100	0	0.1	100	0	0.1	100	0
Heat Rejection	Electricity	4.5	2	4	4.4	98	4	4.3	95	4	4.3	95	4
Fans - Conditioned	Electricity	22.2	9	3	22.2	100	3	22.2	100	3	22.2	100	3
Receptacles - Conditioned	Electricity	27.7	11	7	27.7	100	7	27.7	100	7	27.7	100	7
Total Building Consumption		243.9			239.8			236.2			223.1		

		* Alt-1 Walls R 15	Alt-2 Reduced LPD 052 w/sqft	Alt-3 Improved SEER	Alt-4 Domestic HW Improved ef
Total	Number of hours heating load not met Number of hours cooling load not met	976 0	1,035 0	1,035 0	1,035 0

	* Alt-1 Walls R 15		Alt-2 Reduced LPD 052 w/sqft		Alt-3 Improved SEER		Alt-4 Domestic HW Improved ef	
	Energy 10^6 Btu/yr	Cost/yr $/yr	Energy 10^6 Btu/yr	Cost/yr $/yr	Energy 10^6 Btu/yr	Cost/yr $/yr	Energy 10^6 Btu/yr	Cost/yr $/yr
Electricity	165.3	0	161.2	0	157.6	0	157.6	0
Gas	78.6	0	78.6	0	78.6	0	65.5	0
Total	244	0	240	0	236	0	223	0

Project Name: Town House
Dataset Name: THOUSE-1.TRC

TRACE® 700 v6.2.6.5 calculated at 02:49 PM on 10/03/2011
Energy Cost Budget Report Page 1 of 1

Energy Cost Budget / PRM Summary

By Halcrow

Project Name: Town House	Date: December 19, 2011
City: Loudoun County Virginia	Weather Data: Washington, D.C.

Note: The percentage displayed for the "Proposed/ Base %" column of the base case is actually the percentage of the total energy consumption.

* Denotes the base alternative for the ECB study.

		* Alt-1 Town Houses		
		Energy 10^6 Btu/yr	Proposed / Base %	Peak kBtuh
Lighting - Conditioned	Electricity	18.8	9	9
Space Heating	Electricity	24.8	12	7
	Gas	78.6	37	12
Space Cooling	Electricity	16.4	8	8
Pumps	Electricity	8.7	4	1
Heat Rejection	Electricity	5.0	2	2
Fans - Conditioned	Electricity	33.4	16	4
Receptacles - Conditioned	Electricity	27.7	13	7
Total Building Consumption		**213.6**		

		* Alt-1 Town Houses
Total	Number of hours heating load not met	0
	Number of hours cooling load not met	0

	* Alt-1 Town Houses	
	Energy 10^6 Btu/yr	Cost/yr $/yr
Electricity	135.0	0
Gas	78.6	0
Total	**214**	**0**

Project Name: Town House
Dataset Name: THOUSE-GSHP-2.TRC

Integrated Energy Management Plan

Appendix B: Advisory Panel Summary Sheets

Integrated Energy Management Plan

Integrated Energy Management Plan

Advisory Panel Input & Action Summary   August 2011

The initial meeting of the Integrated Energy Management Plan (IEMP) Advisory Panel was held on August 3, 2011 for the purpose of reviewing the initial direction and providing an external perspective.

The next day, the IEMP Team met to discuss the Advisory Panel inputs and take the next steps necessary to frame a compelling IEMP. Specific actions taken included:

- ✓ Revised the Mission to enhance leadership and be more consistent with Loudoun County's overall direction
- ✓ Redrafted Focus Area definitions based on input of the Advisory Panel
- ✓ Revisited goal statements to ensure consistency and clarity
- ✓ Started discussion of specific energy programs that will leverage the potential of Moorefield Station

The entire IEMP effort is grounded in the County Energy Strategy (CES). The CES vision states: ***Loudoun County will always have reliable and affordable energy, be energy efficient, and have reduced greenhouse gases.***

In alignment with the CES vision and the Advisory Panel's direction, the IEMP Team revised the mission as follows:

Moorefield Station – harnessing the power of human creativity, economic prosperity and energy innovation to be *The Nexus of the World's 21st Century Community.*

Two elements of the mission statement will become key talking points throughout the project. First, the word "nexus" captures to the following:

- ✓ Moorefield Station is the hub – impacting, influencing and facilitating interaction between people, infrastructure, markets and information
- ✓ Moorefield Station is the information technology, fiber optic and data hub of the US and world
- ✓ Moorefield Station will optimize the nexus of energy – water – transportation – waste – and land use programs

The second key element of the mission statement is the concept of "Economic Prosperity;" this encompasses:

- ✓ People: Social/human components, including the value of education and its alignment with the mission of the Claude Moore Foundation
- ✓ Planet: Environmental considerations
- ✓ Profit: Economic development

What we heard...

Inputs from the Advisory Panel were extremely valuable in providing clear direction to the IEMP Team to, "Go big or go home." There was also a clear sense of urgency in getting to the meat of the program analytics. We appreciate the Advisory Panel's clear direction and look forward to our next meeting.

Who we heard from...

Melissa Adams/Washington Gas
Chris Clemente/Comstock
Paul Elman/MWAA
Dale Hammes/Loudoun Water
Tony Howard/Chamber of Commerce
Bill Lebegern/MWAA
Todd Masters/Digital Realty
Garrett Moore/VDOT
Scott Morrow/Digital Realty
Maggie Parker/Comstock
Jeff Platenburg/Loudoun Schools
Phillip Sandino/Dominion
Tom Sines/Dulles Greenway
Randy Sutliff/Claude Moore Foundation

Throughout this project, please provide your ongoing feedback to Nicole Steele, Nicole.Steele@loudoun.gov (571) 258-3380

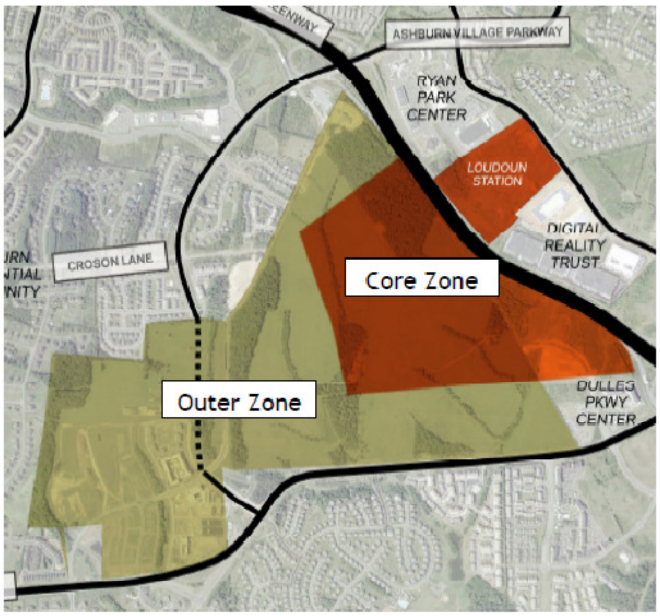
Again, our thanks for your interest and input.

Focus Areas & Goals

The IEMP Team revised focus area definitions based on Advisory Panel input, as highlighted in the sidebar. The goals are under careful review and redevelopment in order to align with the CES goals and provide clear metrics by which to measure progress to plan.

Moorefield Station Development Concept

The IEMP Team has developed a Core and Outer Zone concept that aligns with transit oriented development and enables the adoption of specific goals and programs in different areas of the development, as shown in the map below.



Focus Area Definitions

Energy: Leading the integration of innovative, clean, competitive and reliable energy resources to reduce GHG emissions and increase alternative energy use.

Water: Develop water and wastewater infrastructure and programs that protect natural resources, optimize energy consumption and promote water conservation, reclamation and reuse.

Transportation: Connect people, places and ideas by providing a balanced, multi-modal transportation network.

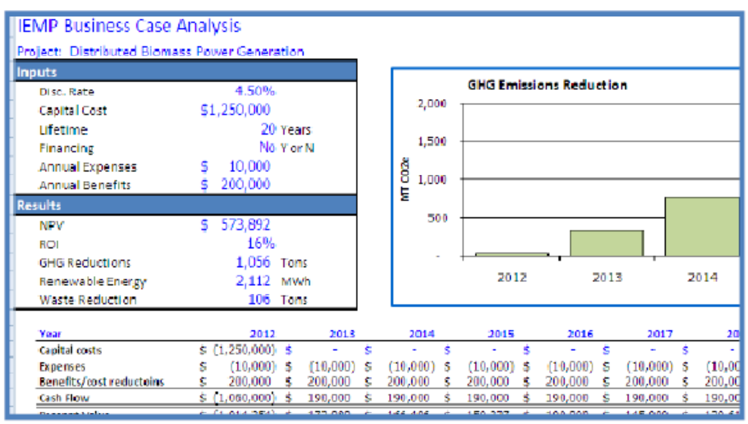
Waste: Minimize solid waste generation and maximize reuse in the construction and life of Moorefield Station.

Land: Maximize the use of land to benefit our community while balancing the need to preserve open space.

Program Identification & Analysis

Staff and consultants are now in the program development and analytics phase of the project, identifying and evaluating several projects for business case analysis. Potential nexus projects include Combined Heat & Power, Anaerobic Digestion, Waste Heat, Landfill Gas, Electric Vehicles, and Biomass to name only a few.

Analyzing the various existing and potential new programs is the focus of the work for the next several weeks. The following provides an example of the kind of output that will be developed for those programs prioritized for a deep dive.


IEMP Business Case Analysis

Project: Distributed Biomass Power Generation

Inputs		
Disc. Rate	4.50%	
Capital Cost	$1,250,000	
Lifetime	20	Years
Financing	No	Y or N
Annual Expenses	$ 10,000	
Annual Benefits	$ 200,000	
Results		
NPV	$ 573,892	
ROI	16%	
GHG Reductions	1,056	Tons
Renewable Energy	2,112	MWh
Waste Reduction	106	Tons

Year	2012	2013	2014	2015	2016	2017	20
Capital costs	$ (1,250,000)	$ -	$ -	$ -	$ -	$ -	$ -
Expenses	$ (10,000)	$ (10,000)	$ (10,000)	$ (10,000)	$ (10,000)	$ (10,000)	$ (10,00
Benefits/cost reductoins	$ 200,000	$ 200,000	$ 200,000	$ 200,000	$ 200,000	$ 200,000	$ 200,00
Cash Flow	$ (1,060,000)	$ 190,000	$ 190,000	$ 190,000	$ 190,000	$ 190,000	$ 190,00

Based on the analytical work that will be completed between now and the next Advisory Panel meeting, we will postpone the previously scheduled September session and **meet again on October 5 at 6:00pm at the Rust Library; 380 Old Waterford Rd. Leesburg, VA 20175.**

Integrated Energy Management Plan

Advisory Panel Input & Action Summary October 2011

The second meeting of the Integrated Energy Management Plan (IEMP) Advisory Panel was held on October 6, 2011. The focus of this meeting was to preview the technical analysis for specific projects under consideration, provide an opportunity for dialog and gather input on the zero energy/water/waste (ZEW^2) concept. Those present provided valuable perspectives and generally endorsed the direction of the plan.

The next day, the IEMP Team met to discuss the Advisory Panel inputs and take the steps necessary to integrate the specific feedback for the IEMP. Specific actions taken included:

- ✓ Brought partnership strategies into clearer focus; outlined follow up with specific organizations
- ✓ Reviewed economic development strategies
- ✓ Discussed and refined five "nexus" projects for further development
- ✓ Further developed the ZEW^2 concept

The entire IEMP effort is grounded in the County Energy Strategy (CES). The CES vision states: ***Loudoun County will always have reliable and affordable energy, be energy efficient, and have reduced greenhouse gases.***

Moorefield Station – harnessing the power of human creativity, economic prosperity and energy innovation to be *The Nexus of the World's 21st Century Community.*

What we heard...

In addition to learning more about the technical and business analysis behind the IEMP, the Advisory Panel provided insights on potential partners and synergy, as well as specific ideas to further develop the ZEW^2 – zero energy/ water/waste– concept. Many of the Panel members expressed interest in long-term partnerships to create a win-win opportunity.

We appreciate the Advisory Panel's input and look forward to our next meeting.

Who we heard from...

Mike Barancewicz/Loudoun Schools
Farid Bigdeli/VDOT
Kevin Dalton/Digital Realty
Dale Hammes/Loudoun Water
Catherine Hogan/Verizon
Phillip Sandino/Dominion
Colin Shay/Washington Gas
Randy Sutliff/Claude Moore Foundation
Gregg Wollard/MWAA

Throughout this project, please provide your ongoing feedback to Alan Brewer at **alan.brewer@loudoun.gov**

Again, our thanks for your interest and support.

Economic Development

A key element of the IEMP mission is "economic prosperity." As such, a part of the IEMP includes economic development based on a five-step analysis:

1. Industry Evaluation
2. Supportive Networks
3. Best Practices
4. Reuse Opportunities
5. Economic Impact

Tim George of BBP is leading a benchmark study that will highlight best practices in funding and marketing strategies, as well as common constraints encountered and how they were overcome. Further support of economic development will be accomplished by engaging various partners, such as those involved in the Advisory Panel, early in the Moorefield Station development cycle.

ZEW²: The Zero Energy/Water/Waste Lab

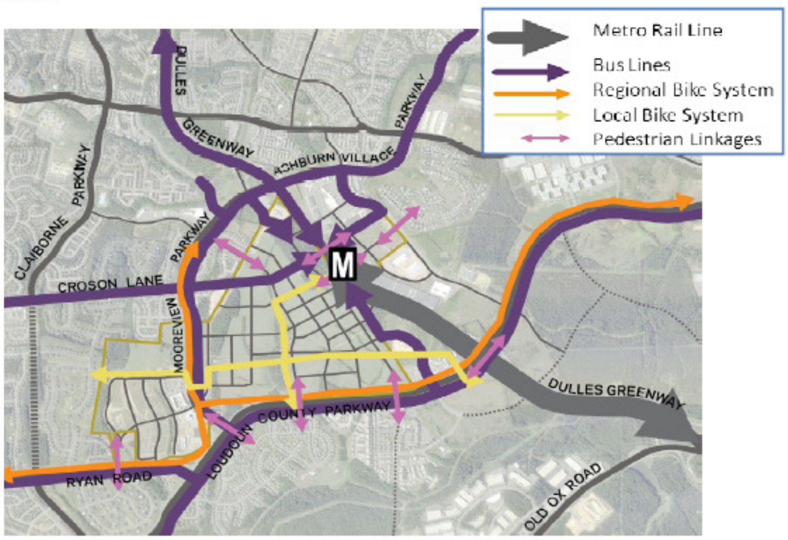
The team has developed the concept of Moorefield Station as a ZEW² Lab in order to move to a true nexus and people centric approach, create synergy and provide global leadership in the context of a lab environment. Program hallmarks include:

- ✓ Harnessing human creativity, technology and infrastructure
- ✓ Moving beyond *transit* orientation to *people* orientation

The Advisory Panel brainstormed a variety of ideas to augment the initial concept, including making technology, such as smart meters, a standard in the community. In addition, Panel members advocated creating a destination for "green" tourism and a true living laboratory with an overt educational focus including exhibits and signage throughout the community.

Moorefield Station Development Concept

With input from Colin Greene of HOK, the IEMP Team has developed a Core and Outer Zone concept that aligns with transit oriented development and enables the adoption of goals and programs specific to different areas of the development. In addition, there has been discussion of the value of the connectivity of Moorefield Station to surrounding areas via multi-modal transportation as shown in the map below.



Nexus Projects: Financial & Environmental Analysis

For the five nexus projects identified (sidebar), detailed financial and environmental analysis was conducted, as summarized in the table below.

Project	Approximate Cost	Change in GHG Emissions
Waste-to-Energy	$.04 -.06/kWh	-27%
Biomass	$0.08/kWh	-27%
Modular Gas Turbines	$0.09/kWh	+19%
Non-potable Water	$4/1,000 gallons	N/A
Codify Sustainable Bldg	$0.10 - $0.30	-11%

The next Advisory Panel meeting will be held in January; specifics to be determined.

Nexus Projects

Nexus projects are defined as those that have positive impact across multiple focus areas. Our analysis has identified five projects that will support the mission, perform competitively in terms of return on investment and reduce greenhouse gas emissions, as follows:

Conventional Combined Heat & Power: Combusts natural gas in a combustion turbine to rotate an electric generator to deliver electricity; a heat recovery steam generator can be added after combustion to produce steam for heating/cooling.

Biomass Combined Heat & Power: Uses natural or waste feedstocks such as wood or grasses instead of fossil fuel to generate steam which in turn, drives a steam turbine and generates power.

Waste-to-Energy: Plasma arc technology vaporizes waste in a sealed vessel to create a syngas and steam that are used to operate a turbine that in turn, generates electricity.

Non-potable Water System: Utilizes storm water collected in planned detention ponds as a non potable water supply for irrigation and mechanical cooling make-up water needs (e.g. cooling towers).

Codify Sustainable Building: Targets an average 15% improvement on HVAC and lighting equipment for all construction beyond current code.

Integrated Energy Management Plan

Progress Report and Update for Advisory Panel *February 2012*

Review of IEMP Progress to Date

Through the course of the IEMP development and feedback from the first two Advisory Panel Meetings, we have completed the IEMP mission, Focus Areas, evaluated five Nexus Projects and created the zero energy, water and waste (ZEW^2) Lab Flagship Program. The Nexus Project evaluation identified two larger, capital projects for the IEMP:

- 10 MW Refuse Derived Fuel Power Plant
- Non-potable water system for Moorefield Station

At the Advisory Panel's suggestion, the team further developed the concept of Moorefield Station as a ZEW^2 Lab in order to move to a true nexus and people centric approach, create synergy and provide global leadership in the context of a lab environment. Furthermore, Advisory Panel ideas such as incorporating technology, smart meters and creating a destination for "green" tourism were incorporated into the ZEW^2 Lab elements and partnering opportunities. The IEMP has now entered the final stages including risk assessments, economic development evaluations and implementation plans.

> **Moorefield Station – harnessing the power of human creativity, economic prosperity and energy innovation to be *The Nexus of the World's 21st Century Community*.**

This IEMP progress report and update for the Advisory Panel includes a summary of the results of an emerging and unique tool used to assess the sustainability of infrastructure and developments. The tool is the Zofnass Sustainable Infrastructure Rating System.

Zofnass Sustainable Rating System

The Zofnass program for sustainable infrastructure at the Harvard Graduate School of Design and the Institute for Sustainable Infrastructure (ISI) are collaborating to develop a sustainability rating system for infrastructure. This emerging rating system is envisioned as a set of guidelines to aid in optimizing the sustainability of a given infrastructure project during the planning and preliminary design phases, as well as a means to quantify the relative sustainability of the project. In support of the program the Zofnass Rating System is being developed.

The Zofnass sustainable infrastructure rating system was applied to Moorefield Station and the IEMP as a pilot project and will serve as a sustainability risk assessment for the development. As the assessment is completed, it will become a case study for the Graduate School of Design and provide critical information in the development of the Zofnass project database for scoring.

Zofnass Program for Sustainable Infrastructure

The Zofnass program's mission is to research, and promote methods, processes and tools that define and quantify sustainability for cities and infrastructures. The goal of the program is to better enable the adoption, utilization, and promotion of sustainable solutions for the design, delivery, and operations of large-scale urban developments and infrastructures. These tools include the all-inclusive Zofnass sustainable infrastructure rating system currently in development. The Zofnass rating system is a voluntary certification process that assesses environmental sustainability and quality of life issues for infrastructure projects.

If you would like more information or background on the Zofnass rating system, please see: http://www.gsd.harvard.edu/research/research_centers/zofnass/

Throughout this project, please provide your ongoing feedback to Alan Brewer at **alan.brewer@loudoun.gov**

Again, our thanks for your interest and support.

Results

The Zofnass Rating System includes four categories (Resource Allocation, Climate Change, Natural World and Quality of Life) and a total of 50 individual credits. Of the 50 total credits included in the Zofnass Rating System, 42 were applicable to Moorefield Station. At this stage of the rating system development, qualitative ratings of favorable, neutral and not favorable were applied to each credit.

The IEMP and proposed Moorefield Station development scored very well, resulting in a 'favorable' rating in 35 of the 42 credits. A summary of the ratings for each category is shown below.

Summary Ratings for Zofnass Categories

	Favorable	Neutral	Not Favorable
RESOURCE ALLOCATION	12	0	0
NATURAL WORLD	7	1	2
CLIMATE CHANGE	6	0	3
QUALITY OF LIFE	10	1	0
Total	35	2	5

Upcoming Advisory Panel Meeting #3

Please note the third Advisory Panel meeting for the IEMP is scheduled for late March.

Alan Brewer will be coordinating with the Advisory Panel participants and provide more detailed information including the date, time and location for the meeting.

The preliminary agenda for the meeting includes the following:

- IEMP Progress and Recap
- Risk and Economic Development Results
- Suggested Implementation Plans
- IEMP Reporting Brochure

The IEMP rated as highly favorable overall; key conclusions include:

- Overall score: 35 'Favorable' credits out of 42 applicable credits
- Excellent Resource Allocation performance due to integration and application of IEMP
- Excellent Quality of Life performance for stakeholder engagement, public spaces and sustainable design
- Good Natural World performance due to efforts to protect/preserve habitat and water quality
- The three Climate Change criteria rated 'non favorable' due to the limited climate adaptation analysis
- Identified specific opportunity for building systems commissioning to improve performance; subsequently included in implementation plan

Overall, the Zofnass sustainable rating system's results helped to prove the partnership between Loudoun County and the Claude Moore Foundation was successful in establishing a path to a more sustainable and unique development. The past zoning collaboration, TOD nature of the development, IEMP and commitment of the Claude Moore Foundation each contributed to the high score and expected sustainability performance.

For a full listing of the Zofnass criteria or the detailed scores and results of the IEMP and Moorefield Station performance please see http://www.gsd.harvard.edu/research/research_centers/zofnass/ or contact Alan Brewer.

Appendix C: Program Inventory and Screening Results

Integrated Energy Management Plan

Nexus Projects - Summary Prioritization

Program	Nexus	Energy Impact	Innovation	Total
Biomass (agriculture, C&D, solid waste) fired CHP	5	5	5	15
Living Building challenge	5	5	5	15
Anaerobic Digestion + FOG	5	5	4	14
Zero energy district	4	5	5	14
Finance EV charging stations at residences and multi-family	4	4	5	13
WTE	4	5	3	12
Dulles Corridor Metrorail Project	4	5	3	12
Data centers: free cooling, stormwater capture for cooling towers / effluent	4	4	3	11
Neighborhood distribution point (Deliveries, Farmers Market, Engagement, Recycle , Freecycle)	4	3	4	11
ASHRAE standard green building (codifies LEED)	4	4	2	10

Focus Areas - Summary Prioritization

Energy

Program	Energy Impact	Nexus	Innovation	Subtotal	Focus Area Goals
CHP (biomass/conventional)	5	5	5	15	5
Anaerobic Digestion + FOG	5	5	4	14	5
Living Building challenge	5	5	5	15	5
Zero energy district	5	4	5	14	5
Smart Grid Pilot	5	3	5	13	5
Partner w/banks revolving EE loan fund (not PACE)	3	3	4	10	5
ASHRAE standard green building (codifies LEED)	4	4	2	10	4
PV	3	1	2	6	4
LED Solar Lights Plus Electric Vehicle Charging Stations, EECBG Funded Project	5	3	4	12	4
Loudoun Green Business Challenge (LGBC), Energy Efficiency & Conservation Block Grant (EECBG) Funded Project	5	1	2	8	4
Residential Education & Outreach Campaign, EECBG Funded Project	5	1	2	8	4
Opower, Energy Dashboard	4	1	2	7	3
Solar Water Heating	4	1	1	6	3
Geo-exchange	4	1	2	7	3

Integrated Energy Management Plan

Water

Program	Energy Impact	Nexus	Innovation	Subtotal	Focus Area Goals
Living Building challenge	5	5	5	15	5
ASHRAE standard green building (codifies LEED) – fixtures/use	4	4	2	10	5
Gray water systems for all commercial >20,000sf or function (e.g. mixed use)	3	4	4	11	5
Onsite-local Stormwater collection	2	3	4	9	5
Re-Use Program	3	3	3	9	5
Pilot / leverage Loudoun Water conservation programs	3	3	2	8	4
Partner w/Bank for revolving EE/conservation loan fund	3	3	4	10	4
Green roofs / garden / outreach	3	3	3	9	4
Use WWTP effluent for data center cooling towers	1	4	3	8	4
Augment potable demand with wells for peak demand uses (e.g. cooling tower, irrigation, mix w/reuse)	1	2	2	5	4
Alt. non-potable water supply (use quarries as storage - near IAD) to meet peaking uses - e.g. irrigation, cooling towers, power plant, etc.	2	3	3	8	4

Transportation

Program	Energy Impact	Nexus	Innovation	Subtotal	Focus Area Goals
Smart Phone App (energy-water-transit) bike/path/zip car/pkg /rapid transit	2	3	4	9	5
Require Food Store in Core (key to walkable/bikeable)	3	2	2	7	5
Finance EV charging stations at residences and multi-family	4	4	5	13	4
Neighborhood distribution points (recycling, food delivery, mail, farmers market, bike storage,etc)*	3	4	4	11	4
Demand parking services (e.g. pay, variable rates, fees, shared parking)*	3	2	4	9	4
Bike sharing, secure bike storage and desirable rack locations	1	2	2	5	4
Review of land development applications for inclusion of bicycle/pedestrian facilities along Countywide Transportation Plan roads (in conjunction with Department of Planning)	2	2	1	5	4
Employer Outreach (fully grant funded)	3	1	2	6	4
Incentivize bulk purchase transit passes	2	1	2	5	4

Land

Program	Energy Impact	Nexus	Innovation	Subtotal	Focus Area Goals
County prescriptive sustainable design options checklist (5-10 specific land/sustainability elements to include in a Res or Commercial development or building) that provides reduced permit time or approval, county regulatory incentives, grant funds, etc.	2	4	3	9	5
ASHRAE standard green building (codifies LEED)	4	4	2	10	4
Maximum parking, not minimum*	3	2	3	8	4
Demand parking services (e.g. pay, variable rates, fees, shared parking)*	3	2	4	9	4
County permit incentives (e.g. reduced permit time for Certified Bldgs, reduce regulatory process, etc.)*	3	2	4	9	4
Integrate stormwater and urban space (open space / storage)	1	3	3	7	3
Leverage parking diversities (park and ride and retail/theater)*	1	2	2	5	3

Waste

Program	Energy Impact	Nexus	Innovation	Subtotal	Focus Area Goals
ASHRAE standard green building (codifies LEED)	4	4	2	10	5
County permit incentives (e.g. reduced permit time for C&D plan/material use, reduce regulatory process, etc.)	1	1	4	6	5
Neighborhood distribution point (recycle , freecycle + hazardous waste)	3	4	4	11	4
Pay as you throw (enlarge recycle bins, reduce and fees for waste)	1	1	3	5	4
Anaerobic digestion w/FOG	5	5	4	14	3
Biomass (agriculture, C&D, solid waste) fired CHP	5	5	5	15	3
Require/codify C&D plan and diversion	3	2	3	8	3
Freecycle stations	1	1	3	5	3

Water Focus Area

Develop water and wastewater infrastructure and programs that protect natural resources, optimize energy consumption, promote water and energy conservation and include water reclamation and reuse.

Goals

County - wide Goals
1. Achieve [15%] reduction in water consumption from current baseline of 100 GPCD by 2020.
2. Achieve 2 million gallons per day of reclaimed water by 2020.
3. Reduce maximum daily water demand by 20% from 2010 baseline by 2020
Moorefield Station Goals
1. Recycle and reuse 30% of development's water supply in Core Zone and 20% of Outer Zone
2. Use non-potable water for 100% of landscape irrigation needs.
3. Implement five greywater reuse programs or projects

Existing Program Inventory From Staff

Program	Energy Impact	Nexus	Innovation	Subtotal	(E) Program Score	Focus Area Goals
Re-Use Program	3	3	3	**9**	5	5
Demand Management Program (Awareness, tiered rates, AMI)	3	2	2	**7**	2 (Lack of data)	3
Others						

Potential New Programs

Program	Energy Impact	Nexus	Innovation	Subtotal	Focus Area Goals
Living Building challenge	5	5	5	**15**	5
Anaerobic Digestion	5	5	4	**14**	2
Gray water systems for all commercial >20,000sf or function (e.g. mixed use)	3	4	4	**11**	5
Incent net zero-water building	3	3	5	**11**	3
ASHRAE standard green building (codifies LEED) – fixtures/use	4	4	2	**10**	5
Partner w/Bank for revolving EE/conservation loan fund	3	3	4	**10**	4
Green roofs / garden / outreach	3	3	3	**9**	4
Onsite-local Stormwater collection	2	3	4	**9**	5
Pilot / leverage Loudoun Water conservation programs	3	3	2	**8**	4
Data centers: stormwater capture for cooling towers	1	4	3	**8**	3
Use WWTP effluent for data center cooling towers	1	4	3	**8**	4
Alt. non-potable water supply (use quarries as storage - near IAD) to meet peaking uses - e.g. irrigation, cooling towers, power plant, etc.	2	3	3	**8**	4
Incent or codify ULF toilets, comm spray heads (top water cons. measures)	2	2	2	**6**	2
Semi-permeable surfaces/parking/roads	1	2	2	**5**	2
Augment potable demand with wells for peak demand uses (e.g. cooling tower, irrigation, mix w/reuse)	1	2	2	**5**	4
Rainwater collection on parking structures (note need for traps, possible treatment)	1	1	2	**4**	3

Scoring: 1 - 5; 5 is best score / most effective

Energy Focus Area

Leading the integration of innovative, clean, competitive, reliable energy resources and energy efficiency to reduce GHG emissions and increase alternative energy use.

Goals

County - wide Goals
1. Supply 10% of county power from locally generated clean or alternative energy by 2020.
2. Reduce GHG emissions from energy consumption by 22% from 2007 baseline by 2040.
3. Partner with businesses and utilities to implement 10 pilot programs in the County by 2020.
Moorefield Station Goals
1. Supply 15% of Moorefield Station electricity from renewable energy.
2. Building related energy consumption will be 40%/50% more efficient than current code in Outer / Core Zones.
3. All buildings will have Energy Performance Label

Existing Program Inventory From Staff

Program	Energy Impact	Nexus	Innovation	Subtotal	(E) Program Score	Focus Area Goals
LED Solar Lights Plus Electric Vehicle Charging Stations, EECBG Funded Project	5	3	4	12	5	4
Loudoun Green Business Challenge (LGBC), Energy Efficiency & Conservation Block Grant (EECBG) Funded Project	5	1	2	8	5	4
Residential Education & Outreach Campaign, EECBG Funded Project	5	1	2	8	5	4
Government Support Center Integrated Energy Master Plan Feasibility Study, EECBG Funded Project	5	1	2	8	3	2
Server Virtualization, EECBG Funded Project	3	1	2	6	5	3
Youth Shelter Solar Panels, EECGB Project	3	1	2	6	2	3
Town of Purcellville LED Streetlights Retrofit, EECBG Funded Project	4	1	1	6	5	3
Energy Home Improvements Program, EECBG Funded Project	3	1	1	5	2	2
Energy Conservation Committee				0		Unknown

Potential New Programs

Program	Energy Impact	Nexus	Innovation	Subtotal	Focus Area Goals
CHP (biomass/conventional)	5	5	5	15	5
Living Building challenge	5	5	5	15	5
Anaerobic Digestion + FOG	5	5	4	14	5
Zero energy district	5	4	5	14	5
Smart Grid Pilot	5	3	5	13	5
WTE	5	4	3	12	2
Data centers: free cooling, stormwater capture for cooling towers	4	4	3	11	3
ASHRAE standard green building (codifies LEED)	4	4	2	10	4
Biomass	4	3	3	10	3
Partner w/banks revolving EE loan fund (not PACE)	3	3	4	10	5
Central Plant (heat and cool) ice storage	4	2	3	9	3
River Hydro	3	1	4	8	2
Geothermal exchange	4	1	2	7	3
OPower (all Res and/or Commercial over certain size)	4	1	2	7	3
Feed in Tariff	3	1	3	7	3
Solar water heating	4	1	1	6	3
PV	3	1	2	6	4
Wind	3	1	2	6	3
Demand Response (active and passive)	2	1	1	4	1

Scoring: 1 - 5; 5 is best score / most effective

Transportation Focus Area

Connect people, places and ideas by providing a balanced, multi-modal transportation network.

Goals

County - wide Goals
1. Promote energy efficient vehicles by expanding alternative fueling opportunities to 20 stations by 202(
2. Provide transportation options that reduce vehicle miles traveled per person to **[X/person/yr]** by 2020.
Moorefield Station Goals
1. Achieve alterative transit level of **[X%]** Core and **[Y%]** Outer Zone as primary community mode.
2. Demonstrate 75% Core and 45% Outer Zone use of integrated bike/pedestrian infrastructure (usage as defined as at least once per week).
3. Achieve a walkscore/bikescore of 90+ in the Core Zone and 50+ in the Outer Zone

Existing Program Inventory From Staff

Program	Energy Impact	Nexus	Innovation	Subtotal	(E) Program Score	Focus Area Goals
Dulles Corridor Metrorail Project*	5	4	3	12	5	5
Loudoun County Transit & Tysons Express Commuter Bus Service (Partially State grant and Fare Funded)	5	3	2	10	5	3
Completion of Sidewalk/Trail Missing Links (as identified by public/Board of Supervisors)	2	2	3	7	5	3
Employer Outreach (fully grant funded)	3	1	2	6	5	4
Review of land development applications for inclusion of bicycle/pedestrian facilities along Countywide Transportation Plan roads (in conjunction with Department of Planning)	2	2	1	5	5	4
Commuter Services (fully grant funded)	2	1	2	5	5	3
Commuter Park and Ride Lots (Component of Commuter Services, Loudoun County Transit, and VRT)	3	1	1	5	5	3
Virginia Regional Transit (Loudoun County provides a level of subsidy through gasoline tax)	2	1	1	4	N/A	2
Interchange Design	1	1	1	3	5	1

* not applicable as a program or project (regional transit project)

Potential New Programs

Program	Energy Impact	Nexus	Innovation	Subtotal	Focus Area Goals
Finance EV charging stations at residences and multi-family	4	4	5	13	4
Neighborhood distribution points (recycling, food delivery, mail, farmers market, bike storage,etc)*	3	4	4	11	4
Smart Phone App (energy-water-transit) bike/path/zip car/pkg /rapid transit	2	3	4	9	5
Demand parking services (e.g. pay, variable rates, fees, shared parking)*	3	2	4	9	4
County permit incentives (e.g. reduced permit time for car free, reduce regulatory process, etc.)*	3	2	4	9	3
Partner/Coop for EV zip car and EV stations	2	3	3	8	3
Require Food Store in Core (key to walkable/bikeable)	3	2	2	7	5
Target 2:1 jobs to resident ratios *	3	2	2	7	3
Car sharing (e.g. Zip car)	2	2	2	6	3
Optimization technology for parking garage (lead to space open)*	1	1	4	6	2
Bike sharing, secure bike storage and desirable rack locations	1	2	2	5	4
Incentivize bulk purchase transit passes	2	1	2	5	4
Priority parking for EV/alternate fuel vehicles or zip cars	1	1	2	4	2
Leverage "closest urban core" to Dulles*	2	1	1	4	2

* Applicable to other focus areas / e.g. land or all

Scoring: 1 - 5; 5 is best score / most effective

Land Focus Area

Balancing the use of land through effective development and efficient infrastructure conforming with the natural environment.

Goals

County - wide Goals
1. Ensure 90% of developments adhere to Loudoun County's planned land use guidelines and are compatible with surrounding areas.
2. Protect specified acres per development for natural habitat or open space consistent with the County's land use plan.
3. Minimize parking standards based on type and size of land use consistent with the Zoning Ordinance.
Moorefield Station Goals
1. Implement Core / Outer Zone planning strategy to achieve a 2.0 Floor Area Ratio (Core) and 0.4 Floor Area Ratio (Outer) densities with a minimum of 15% of public parks, civic and open space.
2. Achieve **[applicable third party certification]** for 50% of buildings (SF) in the Core and 30% in the Outer Zone.
3. Minimize need to park through approved parking reductions up to 20% based on the availability of bus service and up to 50% based on the availability of rail service.

Existing Program Inventory From Staff

Program	Energy Impact	Nexus	Innovation	Subtotal	(E) Program Score
See Transportation overlap (parking, land use permitting)					

Potential New Programs

Program	Energy Impact	Nexus	Innovation	Subtotal	Focus Area Goals
Neighborhood distribution point*	3	4	4	**11**	2
ASHRAE standard green building (codifies LEED)	4	4	2	**10**	4
Demand parking services (e.g. pay, variable rates, fees, shared parking)*	3	2	4	**9**	4
County permit incentives (e.g. reduced permit time for Certified Bldgs, reduce regulatory process, etc.)*	3	2	4	**9**	4
Maximum parking, not minimum*	3	2	3	**8**	4
Integrate stormwater and urban space (open space / storage)	1	3	3	**7**	3
Urban agriculture / local gardens	1	3	3	**7**	2
Optimization technology for parking garage (lead to space open)*	1	1	4	**6**	2
Leverage parking diversities (park and ride and retail/theater)*	1	2	2	**5**	3
County prescriptive sustainable design options checklist (5-10 specific land/sustainability elements to include in a Res or Commercial development or building) that provides reduced permit time or approval, county regulatory incentives, grant funds, etc.	3	4	3	**10**	5

* Applicable to other focus areas / e.g. transportation or all
Scoring: 1 - 5; 5 is best score / most effective

Integrated Energy Management Plan

Waste Focus Area

Minimize solid waste generation and maximize reuse in the construction and throughout the life of the Moorefield Station community.

Goals

County - wide Goals
1. Ensure 100% of residents have access to single stream curbside recycling by 2015.
2. Achieve 50% participation rate in recycling programs for commercial businesses by 2020.
3. Achieve [50%] residential participation rate in recycling of 'social goods' (e.g. Goodwill, Freecycle goods/clothing donations).
Moorefield Station Goals
1. Use 20% (as measured by material costs) local, highly renewable or recyclable materials in construction of Core Zone buildings and 15% in Outer Zone.
2. Reuse / recycle (divert) 45% of the solid waste generated (by weight) from ongoing use in the Core Zone and 35% Outer Zone.
3. Reuse / recycle (divert) 50% of the construction and demolition waste generated during Core Zone construction and 30% for Outer Zone.

Potential New Programs

Program	Energy Impact	Nexus	Innovation	Subtotal	(E) Program Score
County Ordinances (SW Mgmt Plan, Recycling, etc.)					NA
Outreach and Education (Res and Comm)					NA

Potential New Programs

Program	Energy Impact	Nexus	Innovation	Subtotal	Focus Area Goals
Biomass (agriculture, C&D, solid waste) fired CHP	5	5	5	**15**	3
Anaerobic digestion w/FOG	5	5	4	**14**	3
Neighborhood distribution point (recycle , freecycle + hazardous waste)	3	4	4	**11**	4
ASHRAE standard green building (codifies LEED)	4	4	2	**10**	5
Require/codify C&D plan and diversion	3	2	3	**8**	3
County permit incentives (e.g. reduced permit time for C&D plan/material use, reduce regulatory process, etc.)	1	1	4	**6**	5
Composting program, provide and brand mulch	1	1	4	**6**	2
Freecycle stations	1	1	3	**5**	3
Pay as you throw (enlarge recycle bins, reduce and fees for waste)	1	1	3	**5**	4
Public buildings adopt recycled material and diversion requirements	1	1	2	**4**	3
Single stream receptacles in all public and common spaces	1	1	2	**4**	3

Scoring: 1 5; 5 is best score / most effective

Appendix D: Business as Usual GHG Emissions

Integrated Energy Management Plan

Appendix D: Business as Usual GHG Emissions

Integrated Energy Management Plan

Electric GHG Emissions by Build-out Forecast (Cumulative metric tons)

Construction Type	Total SF	Total Units	2012	2013	2014	2015	2016	2017	2018	2019	2020	2021	2022	2023	2024	2025	2026	2027	2028	2029	2030	2031	2032	2033	2034	2035	2036	2037	2038	2039	2040	2041
Residential																																
Multi Family	5,580,000	4,650	588	1,432	2,513	3,774	5,060	6,367	8,010	9,995	12,261	14,497	16,733	19,020	21,175	23,070	24,718	26,291	27,869	29,432	30,889	32,241	33,482	34,683	35,823	36,683	37,276	37,597	37,798	37,879	37,919	37,919
Single Family Attached	2,440,600	1,300	1,069	2,586	4,314	6,229	8,032	9,722	11,326	11,475	12,781	12,855	13,390	13,390	13,390	13,390	13,390	13,390	13,390	13,390	13,390	13,390	13,390	13,390	13,390	13,390	13,390	13,390	13,390	13,390	13,390	13,390
Single Family Detached	160,000	50	95	204	327	458	580	690	788	850	878	878	878	878	878	878	878	878	878	878	878	878	878	878	878	878	878	878	878	878	878	878
Commercial																																
Office	10,600,000		-	-	925	1,896	2,993	4,218	5,579	8,951	12,398	15,700	18,849	21,826	24,836	27,869	30,779	33,564	36,215	38,867	41,514	44,090	46,596	49,027	51,441	53,836	56,148	58,377	60,521	62,641	64,733	66,797
Mixed Retail	150,000		62	124	187	249	311	368	426	483	541	598	638	678	718	758	798	821	844	867	890	914	934	954	973	993	1,013	1,019	1,024	1,029	1,034	1,040
Institutional / Cultural																																
Transit Support	2,700		4	7	11	15	19	19	19	19	19	19	19	19	19	19	19	19	19	19	19	19	19	19	19	19	19	19	19	19	19	19
Fire Station	13,500		21	42	64	85	106	106	106	106	106	106	106	106	106	106	106	106	106	106	106	106	106	106	106	106	106	106	106	106	106	106
School	435,000		639	1,279	1,918	2,558	3,197	3,197	3,197	3,197	3,197	3,197	3,197	3,197	3,197	3,197	3,197	3,197	3,197	3,197	3,197	3,197	3,197	3,197	3,197	3,197	3,197	3,197	3,197	3,197	3,197	3,197
TOTAL BAU (mTon CO2e)			2,479	5,676	10,257	15,263	20,297	24,686	29,451	35,077	42,180	47,850	53,810	59,113	64,319	69,286	73,885	78,265	82,517	86,755	90,882	94,834	98,601	102,253	105,828	109,102	112,027	114,582	116,933	119,138	121,276	123,345

Nexus Project 5: Improved Energy Efficiency - Electric GHG Emissions by Build-out Forecast (metric tons)

Construction Type	Total SF	Total Units	2012	2013	2014	2015	2016	2017	2018	2019	2020	2021	2022	2023	2024	2025	2026	2027	2028	2029	2030	2031	2032	2033	2034	2035	2036	2037	2038	2039	2040	2041
Residential																																
Multi Family	5,580,000	4,650	495	1,207	2,117	3,180	4,263	5,364	6,749	8,421	10,331	12,215	14,099	16,025	17,841	19,438	20,826	22,151	23,481	24,798	26,025	27,164	28,210	29,222	30,183	30,907	31,407	31,678	31,847	31,915	31,949	31,949
Single Family Attached	2,440,600	1,300	1,002	2,424	4,045	5,840	7,530	9,115	10,619	10,759	11,982	12,052	12,554	12,554	12,554	12,554	12,554	12,554	12,554	12,554	12,554	12,554	12,554	12,554	12,554	12,554	12,554	12,554	12,554	12,554	12,554	12,554
Single Family Detached	160,000	50	89	192	306	430	544	646	739	797	823	823	823	823	823	823	823	823	823	823	823	823	823	823	823	823	823	823	823	823	823	823
Commercial																																
Office	10,600,000		-	-	831	1,703	2,689	3,790	5,013	8,042	11,139	14,106	16,935	19,609	22,314	25,039	27,654	30,155	32,537	34,920	37,298	39,613	41,864	44,048	46,218	48,369	50,446	52,449	54,375	56,280	58,159	60,013
Mixed Retail	150,000		56	112	168	223	279	331	382	434	486	537	573	609	645	681	717	738	758	779	800	821	839	857	875	893	911	915	920	925	929	934
Institutional / Cultural																																
Transit Support	2,700		3	7	10	13	17	17	17	17	17	17	17	17	17	17	17	17	17	17	17	17	17	17	17	17	17	17	17	17	17	17
Fire Station	13,500		17	34	50	67	84	84	84	84	84	84	84	84	84	84	84	84	84	84	84	84	84	84	84	84	84	84	84	84	84	84
School	435,000		542	1,084	1,625	2,167	2,709	2,709	2,709	2,709	2,709	2,709	2,709	2,709	2,709	2,709	2,709	2,709	2,709	2,709	2,709	2,709	2,709	2,709	2,709	2,709	2,709	2,709	2,709	2,709	2,709	2,709
TOTAL BAU (mTon CO2e)			2,205	5,059	9,152	13,624	18,115	22,056	26,312	31,263	37,570	42,543	47,793	52,430	56,987	61,344	65,383	69,231	72,963	76,683	80,310	83,785	87,099	90,313	93,462	96,356	98,950	101,228	103,329	105,306	107,224	109,083
Reductions																																
Aggregate (mTons CO2e)			274	617	1,105	1,639	2,182	2,630	3,139	3,813	4,609	5,307	6,017	6,683	7,332	7,942	8,502	9,034	9,554	10,072	10,573	11,049	11,501	11,939	12,366	12,747	13,077	13,354	13,604	13,833	14,052	14,262
Percent Reduction			-11.1%	-10.9%	-10.8%	-10.7%	-10.7%	-10.7%	-10.7%	-10.9%	-10.9%	-11.1%	-11.2%	-11.3%	-11.4%	-11.5%	-11.5%	-11.5%	-11.6%	-11.6%	-11.6%	-11.7%	-11.7%	-11.7%	-11.7%	-11.7%	-11.7%	-11.7%	-11.6%	-11.6%	-11.6%	-11.6%

Natural Gas GHG Emissions by Build-out Forecast (Cumulative metric tons)

Construction Type	Total SF	Total Units	2012	2013	2014	2015	2016	2017	2018	2019	2020	2021	2022	2023	2024	2025	2026	2027	2028	2029	2030	2031	2032	2033	2034	2035	2036	2037	2038	2039	2040	2041
Residential																																
Multi Family	5,580,000	4,650	107	261	458	689	923	1,162	1,461	1,824	2,237	2,645	3,053	3,470	3,864	4,209	4,510	4,797	5,085	5,370	5,636	5,883	6,109	6,328	6,536	6,693	6,801	6,860	6,897	6,911	6,919	6,919
Single Family Attached	2,440,600	1,300	174	421	702	1,014	1,308	1,583	1,844	1,868	2,081	2,093	2,180	2,180	2,180	2,180	2,180	2,180	2,180	2,180	2,180	2,180	2,180	2,180	2,180	2,180	2,180	2,180	2,180	2,180	2,180	2,180
Single Family Detached	160,000	50	16	34	54	75	95	113	129	139	144	144	144	144	144	144	144	144	144	144	144	144	144	144	144	144	144	144	144	144	144	144
Commercial																																
Office	10,600,000		-	-	66	136	214	302	399	640	887	1,123	1,348	1,561	1,776	1,993	2,202	2,401	2,590	2,780	2,969	3,154	3,333	3,507	3,680	3,851	4,016	4,176	4,329	4,481	4,630	4,778
Mixed Retail	150,000		4	9	13	18	22	26	30	35	39	43	46	48	51	54	57	59	60	62	64	65	67	68	70	71	72	73	73	74	74	74
Institutional / Cultural																																
Transit Support	2,700		0	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1
Fire Station	13,500		1	3	4	5	7	7	7	7	7	7	7	7	7	7	7	7	7	7	7	7	7	7	7	7	7	7	7	7	7	7
School	435,000		44	87	131	174	218	218	218	218	218	218	218	218	218	218	218	218	218	218	218	218	218	218	218	218	218	218	218	218	218	218
TOTAL BAU (mTon CO2e)			347	815	1,429	2,112	2,788	3,411	4,090	4,732	5,613	6,273	6,996	7,629	8,241	8,806	9,318	9,806	10,285	10,762	11,218	11,651	12,058	12,453	12,835	13,164	13,439	13,658	13,848	14,015	14,172	14,320

Nexus Project 5: Improved Energy Efficiency - Natural Gas GHG Emissions by Build-out Forecast (metric tons)

Construction Type	Total SF	Total Units	2012	2013	2014	2015	2016	2017	2018	2019	2020	2021	2022	2023	2024	2025	2026	2027	2028	2029	2030	2031	2032	2033	2034	2035	2036	2037	2038	2039	2040	2041
Residential																																
Multi Family	5,580,000	4,650	89	218	382	574	770	969	1,219	1,521	1,866	2,206	2,547	2,895	3,223	3,511	3,762	4,001	4,241	4,479	4,701	4,907	5,096	5,279	5,452	5,583	5,673	5,722	5,753	5,765	5,771	5,771
Single Family Attached	2,440,600	1,300	145	351	585	845	1,090	1,319	1,537	1,557	1,734	1,744	1,817	1,817	1,817	1,817	1,817	1,817	1,817	1,817	1,817	1,817	1,817	1,817	1,817	1,817	1,817	1,817	1,817	1,817	1,817	1,817
Single Family Detached	160,000	50	13	28	44	62	79	94	107	115	119	119	119	119	119	119	119	119	119	119	119	119	119	119	119	119	119	119	119	119	119	119
Commercial																																
Office	10,600,000		-	-	54	112	176	248	328	526	729	923	1,108	1,284	1,461	1,639	1,810	1,974	2,130	2,286	2,441	2,593	2,740	2,883	3,025	3,166	3,302	3,433	3,559	3,684	3,807	3,928
Mixed Retail	150,000		4	7	11	15	18	22	25	28	32	35	38	40	42	45	47	48	50	51	52	54	55	56	57	58	60	60	60	61	61	61
Institutional / Cultural																																
Transit Support	2,700		0	0	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1
Fire Station	13,500		1	2	3	4	6	6	6	6	6	6	6	6	6	6	6	6	6	6	6	6	6	6	6	6	6	6	6	6	6	6
School	435,000		35	71	106	142	177	177	177	177	177	177	177	177	177	177	177	177	177	177	177	177	177	177	177	177	177	177	177	177	177	177
TOTAL BAU (mTon CO2e)			288	677	1,188	1,755	2,317	2,835	3,400	3,932	4,664	5,212	5,812	6,338	6,845	7,314	7,739	8,143	8,541	8,936	9,315	9,673	10,011	10,337	10,654	10,927	11,154	11,335	11,492	11,629	11,758	11,880
Reductions																																
Aggregate (mTons CO2e)			59	138	241	357	471	576	690	800	949	1,061	1,184	1,292	1,396	1,492	1,580	1,663	1,745	1,826	1,904	1,978	2,048	2,115	2,181	2,237	2,285	2,323	2,356	2,386	2,414	2,440
Percent Reduction			-16.9%	-16.9%	-16.9%	-16.9%	-16.9%	-16.9%	-16.9%	-16.9%	-16.9%	-16.9%	-16.9%	-16.9%	-16.9%	-16.9%	-17.0%	-17.0%	-17.0%	-17.0%	-17.0%	-17.0%	-17.0%	-17.0%	-17.0%	-17.0%	-17.0%	-17.0%	-17.0%	-17.0%	-17.0%	-17.0%

BAU Total GHG Emissions by Build-out Forecast (Cumulative metric tons)

Construction Type	Total SF	Total Units	2012	2013	2014	2015	2016	2017	2018	2019	2020	2021	2022	2023	2024	2025	2026	2027	2028	2029	2030	2031	2032	2033	2034	2035	2036	2037	2038	2039	2040	2041
Residential																																
Multi Family	5,580,000	4,650	695	1,693	2,971	4,462	5,983	7,528	9,471	11,818	14,498	17,142	19,786	22,490	25,039	27,279	29,228	31,088	32,954	34,802	36,525	38,123	39,591	41,011	42,360	43,376	44,077	44,457	44,695	44,790	44,837	44,837
Multi Family	2,440,600	1,300	1,243	3,007	5,016	7,243	9,339	11,305	13,170	13,344	14,862	14,948	15,570	15,570	15,570	15,570	15,570	15,570	15,570	15,570	15,570	15,570	15,570	15,570	15,570	15,570	15,570	15,570	15,570	15,570	15,570	15,570
Single Family Detached	160,000	50	111	238	380	534	675	803	918	990	1,022	1,022	1,022	1,022	1,022	1,022	1,022	1,022	1,022	1,022	1,022	1,022	1,022	1,022	1,022	1,022	1,022	1,022	1,022	1,022	1,022	1,022
Subtotal	**8,180,600**	**6,000**	**2,050**	**4,938**	**8,368**	**12,239**	**15,998**	**19,636**	**23,559**	**26,152**	**30,382**	**33,113**	**36,378**	**39,082**	**41,631**	**43,871**	**45,820**	**47,680**	**49,546**	**51,393**	**53,117**	**54,715**	**56,183**	**57,603**	**58,952**	**59,968**	**60,669**	**61,049**	**61,287**	**61,382**	**61,429**	**61,429**
Commercial																																
Office	10,600,000		-	-	991	2,032	3,207	4,520	5,978	9,592	13,284	16,823	20,197	23,387	26,613	29,862	32,981	35,965	38,805	41,647	44,483	47,244	49,929	52,534	55,121	57,687	60,164	62,552	64,850	67,121	69,363	71,574
Mixed Retai	150,000		67	133	200	267	333	395	456	518	579	641	684	726	769	812	855	880	904	929	954	979	1,000	1,022	1,043	1,065	1,086	1,092	1,097	1,103	1,108	1,114
Subtotal	**10,750,000**		**67**	**133**	**1,191**	**2,298**	**3,540**	**4,914**	**6,434**	**10,109**	**13,864**	**17,464**	**20,880**	**24,113**	**27,382**	**30,674**	**33,836**	**36,844**	**39,710**	**42,576**	**45,437**	**48,223**	**50,929**	**53,555**	**56,164**	**58,752**	**61,250**	**63,644**	**65,948**	**68,224**	**70,472**	**72,689**
Institutional / Cultura																																
Transit Support	2,700		4	8	12	16	20	20	20	20	20	20	20	20	20	20	20	20	20	20	20	20	20	20	20	20	20	20	20	20	20	20
Fire Station	13,500		23	45	68	90	113	113	113	113	113	113	113	113	113	113	113	113	113	113	113	113	113	113	113	113	113	113	113	113	113	113
School	435,000		683	1,366	2,049	2,732	3,415	3,415	3,415	3,415	3,415	3,415	3,415	3,415	3,415	3,415	3,415	3,415	3,415	3,415	3,415	3,415	3,415	3,415	3,415	3,415	3,415	3,415	3,415	3,415	3,415	3,415
	451,200		**709**	**1,419**	**2,128**	**2,838**	**3,547**	**3,547**	**3,547**	**3,547**	**3,547**	**3,547**	**3,547**	**3,547**	**3,547**	**3,547**	**3,547**	**3,547**	**3,547**	**3,547**	**3,547**	**3,547**	**3,547**	**3,547**	**3,547**	**3,547**	**3,547**	**3,547**	**3,547**	**3,547**	**3,547**	**3,547**
TOTAL BAU (mTon CO2e)			**2,826**	**6,491**	**11,687**	**17,375**	**23,085**	**28,098**	**33,541**	**39,808**	**47,793**	**54,124**	**60,806**	**66,742**	**72,560**	**78,093**	**83,203**	**88,071**	**92,802**	**97,517**	**102,101**	**106,485**	**110,659**	**114,705**	**118,663**	**122,267**	**125,466**	**128,240**	**130,782**	**133,153**	**135,448**	**137,665**

Total GHG Emissions by Source (metric tons)

Construction Type	Electric	Natural Gas	Total
Residential	52,187	9,242	61,429
Commercial	67,836	4,852	72,689
Institutional	3,322	226	3,547
Total BAU (mTon CO2e)	123,345	14,320	137,665

Nexus Project 5: Improved Energy Efficiency - Total GHG Emissions by Build-out Forecast (metric tons)

Construction Type	Total SF	Total Units	2012	2013	2014	2015	2016	2017	2018	2019	2020	2021	2022	2023	2024	2025	2026	2027	2028	2029	2030	2031	2032	2033	2034	2035	2036	2037	2038	2039	2040	2041
Residential																																
Multi Family	5,580,000	4,650	585	1,425	2,499	3,754	5,034	6,333	7,968	9,942	12,197	14,421	16,645	18,920	21,064	22,949	24,588	26,153	27,722	29,277	30,727	32,071	33,306	34,501	35,635	36,490	37,080	37,400	37,600	37,680	37,720	37,720
Multi Family	2,440,600	1,300	1,147	2,775	4,630	6,685	8,619	10,434	12,155	12,315	13,716	13,796	14,370	14,370	14,370	14,370	14,370	14,370	14,370	14,370	14,370	14,370	14,370	14,370	14,370	14,370	14,370	14,370	14,370	14,370	14,370	14,370
Single Family Detached	160,000	50	102	219	350	492	622	740	846	912	942	942	942	942	942	942	942	942	942	942	942	942	942	942	942	942	942	942	942	942	942	942
Subtotal	**8,180,600**	**6,000**	**1,835**	**4,419**	**7,480**	**10,931**	**14,275**	**17,507**	**20,969**	**23,170**	**26,855**	**29,160**	**31,958**	**34,232**	**36,377**	**38,261**	**39,901**	**41,465**	**43,035**	**44,589**	**46,039**	**47,383**	**48,618**	**49,813**	**50,948**	**51,802**	**52,392**	**52,712**	**52,912**	**52,992**	**53,032**	**53,032**
Commercial																																
Office	10,600,000		-	-	885	1,815	2,865	4,038	5,341	8,569	11,868	15,029	18,043	20,893	23,775	26,678	29,464	32,129	34,667	37,206	39,739	42,206	44,604	46,931	49,243	51,535	53,748	55,882	57,935	59,963	61,966	63,942
Mixed Retai	150,000		60	119	179	238	298	353	408	462	517	572	611	649	687	725	764	786	808	830	852	874	894	913	932	951	970	975	980	985	990	995
Subtotal	**10,750,000**		**60**	**119**	**1,064**	**2,053**	**3,162**	**4,390**	**5,748**	**9,031**	**12,385**	**15,601**	**18,654**	**21,542**	**24,462**	**27,403**	**30,228**	**32,915**	**35,475**	**38,036**	**40,592**	**43,080**	**45,498**	**47,844**	**50,175**	**52,486**	**54,719**	**56,857**	**58,915**	**60,949**	**62,956**	**64,937**
Institutional / Cultura																																
Transit Support	2,700		4	7	11	14	18	18	18	18	18	18	18	18	18	18	18	18	18	18	18	18	18	18	18	18	18	18	18	18	18	18
Fire Station	13,500		18	36	54	72	90	90	90	90	90	90	90	90	90	90	90	90	90	90	90	90	90	90	90	90	90	90	90	90	90	90
School	435,000		577	1,155	1,732	2,309	2,886	2,886	2,886	2,886	2,886	2,886	2,886	2,886	2,886	2,886	2,886	2,886	2,886	2,886	2,886	2,886	2,886	2,886	2,886	2,886	2,886	2,886	2,886	2,886	2,886	2,886
	451,200		**599**	**1,198**	**1,796**	**2,395**	**2,994**	**2,994**	**2,994**	**2,994**	**2,994**	**2,994**	**2,994**	**2,994**	**2,994**	**2,994**	**2,994**	**2,994**	**2,994**	**2,994**	**2,994**	**2,994**	**2,994**	**2,994**	**2,994**	**2,994**	**2,994**	**2,994**	**2,994**	**2,994**	**2,994**	**2,994**
TOTAL BAU (mTon CO2e)			**2,493**	**5,736**	**10,340**	**15,379**	**20,432**	**24,891**	**29,711**	**35,195**	**42,234**	**47,755**	**53,605**	**58,768**	**63,832**	**68,658**	**73,122**	**77,374**	**81,504**	**85,619**	**89,624**	**93,458**	**97,110**	**100,651**	**104,116**	**107,283**	**110,105**	**112,563**	**114,821**	**116,935**	**118,982**	**120,963**
Reductions																																
Aggregate (mTons)			333	755	1,347	1,996	2,653	3,206	3,830	4,613	5,558	6,369	7,201	7,975	8,728	9,435	10,081	10,697	11,299	11,898	12,477	13,027	13,549	14,054	14,547	14,984	15,362	15,677	15,961	16,219	16,466	16,702
Percent Reduction			-11.8%	-11.6%	-11.5%	-11.5%	-11.5%	-11.4%	-11.4%	-11.6%	-11.6%	-11.8%	-11.8%	-11.9%	-12.0%	-12.1%	-12.1%	-12.1%	-12.2%	-12.2%	-12.2%	-12.2%	-12.2%	-12.3%	-12.3%	-12.3%	-12.2%	-12.2%	-12.2%	-12.2%	-12.2%	-12.1%

Build-out Forecast per Loudoun County Economic Development Forecast (Cumulative square feet)

Construction Type	Total SF	Total Units	2012	2013	2014	2015	2016	2017	2018	2019	2020	2021	2022	2023	2024	2025	2026	2027	2028	2029	2030	2031	2032	2033	2034	2035	2036	2037	2038	2039	2040	2041
Residential																																
Multi Family	5,580,000	4,650	86,517	210,747	369,732	555,338	744,641	936,902	1,178,707	1,470,795	1,804,294	2,133,355	2,462,417	2,798,874	3,116,104	3,394,882	3,637,426	3,868,879	4,101,071	4,331,044	4,545,489	4,744,405	4,927,053	5,103,785	5,271,643	5,398,092	5,485,349	5,532,674	5,562,253	5,574,084	5,580,000	5,580,000
Single Family Attached	2,440,600	1,300	194,885	471,351	786,340	1,135,321	1,463,907	1,772,098	2,064,426	2,091,619	2,329,561	2,343,157	2,440,600	2,440,600	2,440,600	2,440,600	2,440,600	2,440,600	2,440,600	2,440,600	2,440,600	2,440,600	2,440,600	2,440,600	2,440,600	2,440,600	2,440,600	2,440,600	2,440,600	2,440,600	2,440,600	2,440,600
Single Family Detached	160,000	50	17,395	37,263	59,514	83,532	105,695	125,651	143,664	154,967	160,000	160,000	160,000	160,000	160,000	160,000	160,000	160,000	160,000	160,000	160,000	160,000	160,000	160,000	160,000	160,000	160,000	160,000	160,000	160,000	160,000	160,000
Commercial																																
Office	10,600,000	-	-	-	146,731	300,877	474,901	669,335	885,368	1,420,505	1,967,378	2,491,461	2,991,113	3,463,540	3,941,312	4,422,547	4,884,416	5,326,272	5,746,969	6,167,839	6,587,829	6,996,748	7,394,316	7,780,101	8,163,287	8,543,347	8,910,214	9,263,873	9,604,192	9,940,520	10,272,515	10,600,000
Mixed Retai	150,000	-	8,971	17,941	26,912	35,882	44,853	53,135	61,418	69,700	77,983	86,265	92,030	97,794	103,558	109,322	115,086	118,427	121,768	125,108	128,449	131,790	134,673	137,556	140,439	143,323	146,206	146,965	147,723	148,482	149,241	150,000
Institutional / Cultura																																
Transit Support	2,700	-	540	1,080	1,620	2,160	2,700	2,700	2,700	2,700	2,700	2,700	2,700	2,700	2,700	2,700	2,700	2,700	2,700	2,700	2,700	2,700	2,700	2,700	2,700	2,700	2,700	2,700	2,700	2,700	2,700	2,700
Fire Station	13,500	-	2,700	5,400	8,100	10,800	13,500	13,500	13,500	13,500	13,500	13,500	13,500	13,500	13,500	13,500	13,500	13,500	13,500	13,500	13,500	13,500	13,500	13,500	13,500	13,500	13,500	13,500	13,500	13,500	13,500	13,500
School	435,000	-	87,000	174,000	261,000	348,000	435,000	435,000	435,000	435,000	435,000	435,000	435,000	435,000	435,000	435,000	435,000	435,000	435,000	435,000	435,000	435,000	435,000	435,000	435,000	435,000	435,000	435,000	435,000	435,000	435,000	435,000
TOTAL BAU (SF)	19,381,800	6,000	398,008	917,782	1,659,949	2,471,910	3,285,197	4,008,321	4,784,783	5,658,787	6,790,415	7,665,439	8,597,360	9,412,007	10,212,774	10,978,551	11,688,729	12,365,378	13,021,608	13,675,792	14,313,567	14,924,743	15,507,842	16,073,242	16,627,169	17,136,561	17,593,569	17,995,312	18,365,969	18,714,887	19,053,556	19,381,800

Appendix E: Financial and Environmental Model

Integrated Energy Management Plan

Assumptions and Inputs

Item	Value	Units	Comments
1 Moorefield Station Projected Energy Consumption (at full buildout)			
Electric			All electric and natural gas consumption projections are linked to BAU Model and the economic development report provided by Loudoun County.
Residential	80,150	MWh	
Commercial	170,288	MWh	
Institutional / Public Buildings	6,779	MWh	
Total	257,217	MWh	
Natural Gas			
Residential	263,923	btuh	
Commercial	95,492	btuh	
Institutional / Public Buildings	4,512	btuh	
Total	363,927	btuh	
Estimated MWhs			
2015	31,149	MWhs	
2020	86,081	MWhs	
2025	141,401	MWhs	
2041	251,724	MWhs	
Heating Demand			
Moorefield Station			
Core Zone Peak Demand	128,404	mbtu/hr	
Core Zone Heating Consumption	110,598,153	mbtu/yr	
Average HVAC Heating Equip. Efficiency	90%		Average; general efficiency of boilers, furnaces, etc. for heating at Moorefield Station Core.
Annual Heating Available			
Heating available CHP (peak demand)	98,100,000	btu/hr	90% efficiency of heat exchanger for steam generated - to hot water.
Availability	92%		linked to natural gas availability
CHP Heating potential delivered/yr	790,607,520	mbtu/yr	
Heating Delivered by CHP Plant	108,877,814	mbtu/yr	
Estimated distribution / delivered Natural gas prices			
2011 Retail (LDC) Price	$ 7.00	per MMBtu	Commodity, transmission, distribution/LDC, profit costs
	$ 0.70	per Therm	
Margin added to HH Spot Prices	$ 2.23	per MMBtu	Rule of thumb for retail gas prices is adding approximately $3 per MMBtu to Spot Prices.
2 Estimated power plant size to provide all power			
Load Factor:	55%		55% is appropriate for mixed use; near end of development may approach 60%+
Estimated Peak Demand by Year of Development			
2015	6	MWs	
2020	18	MWs	
2025	29	MWs	
2041	52	MWs	
Power plant size (incl. T&D losses)	55	MW	Size to provide 100% of Moorefield Station Requirements
Estimated transmission and distribution losses	4%	total	Estimated Dominion T&D losses; confirmed with PPT presentation sent by Philip at Dominion for GS -4 Customer Class (3.73%)

3 Gas Fired Turbine Generators

Capacity / Size	25	MW	(5) 5 MW turbines to achieve 25MW; Modular approach to grow with Moorefield Station as there is no current need for heat.
Capital Costs	$32,500,000		TIC at $1300/kW (HRSG, CTs, Bal of Plant, etc.)
Fixed Operating Costs	$1,242,600	per yr	Total O&M approximately $2.25M; VOM removed to calculate fixed component
Variable O&M	$0.005	per kWh	Halcrow data, NREL supported at $0.005/kWh
Heat Rate	11,500	Btu/kWh	Note: option to include a single combustion turbine, at 8,775 Heat Rate. Impact to cost of energy is reduction ~$0.015/kWh
Land Space	1	acre	Includes space for GTGs, HRSG, stack, and operations building
Natural Gas Emission Combustion Rate	53.06	kg CO2 / MMBtu	EIA data
Emission Rates			
GHG Marginal Emissions Rate	0.61	Mtons/MWh	calculate at btuh/kwh and heat content of NG lbs/MWh
NOx marginal emission rate	5	lbs/MWh	
S02 marginal emission rate	0	lbs/MWh	
CO marginal emission rate	0.045	lb/MMBtu	Range of .01 to .08 lb/MMBtu; Average rate used for assumption
PM10 marginal emission rate	0.0065	lb/MMBtu	Range of .005 to .008 lb/MMBtu; Average rate used for assumption
CHP Plant data			
Steam Generated from HRSG	109,000,000	btu/hr	Heat Recovery Steam Generator from Turbines
Capital Costs	$ 12,350,000		Includes pumps, heat exchanger, buried insulated piping, valves, etc. Heat exchangers/connections for consumers are not included (cost covered by consumer/buildings)
O&M	$ 100,000	per year	Minimal O&M needs; 1-1.5FTEs, minor parts and equipment/maintenance

Natural Gas price forecast from EIA	2012	2013	2014
Real 2009 Year Dollars	$ 4.50	$ 4.56	$ 4.57
Escalated to Nominal Year Dollars by inflation	$ 4.77	$ 4.94	$ 5.05

Source: EIA Annual Energy Outlook Report; http://www.neo.ne.gov/statshtml/124.htm ; Table 133, line 975

Annual Inflation Rate 2% Per US Bureau of Labor Statistics; past 12 month

Equipment included are five 5-MW GTGs, HRSG, gas pipeline, and BOP

4 Biomass Fired Power Generation

Capacity / Size	10	MW	
Capital Costs	$43,000,000		TIC at $4,300/kW
Fixed O&M	$362,664	per yr	per year for non fuel operating costs at 1.5 cents/kWh (70% Variable/30% fixed)
Variable O&M	$0.011	per kWh	Halcrow data, NREL supported at ~$0.01/kWh
Heat Rate	14,000	Btu/kWh	Btu/kWh typical for biomass power plant
Land Space	15	acres	Fuel storage and power equipment and operations building
Fuel Processing Costs	$ 5.00	per ton	cost to sort, prep fuel in addition to landfill operations. Biomass only accepts small portion of current MSW stream, additional costs necessary as full landfill operations will be required in addition to the new fuel handling for biomass.
Heat content of biomass fuel	5,900	btu/lb	assumed (msw/biomass)
Emission Rates			
NOx emissions rate	6	lbs per MWh	
S02 marginal emission rate	0.055	lbs/MWh	Range of .04 to .07 lb/MMBtu; Average rate used for assumption
CO marginal emission rate	0.035	lb/MMBtu	Range of .02 to .05 lb/MMBtu; Average rate used for assumption
PM total marginal emission rate	0.35	lb/MMBtu	Range of .2 to .5 lb/MMBtu; Average rate used for assumption

Equipment includes all fuel handling, furnace, boiler, generator, and remaining BOP

5 WPP's EPOD Power Plant

Capacity / Size	10	MW	
Capital Costs	$49,000,000		turnkey project cost is $4.9 million per 1 MW; higher costs related to compact size of plant, lower overall emissions, increased environmental benefits.
Fixed O&M	$725,328	per yr	per year ($0.03/kwh for fixed and variable O&M per EPOD - 70% variable/30% fixed)
Variable O&M	$0.02	per kWh	
MSW Feed Rate	260	tons per day	Per EPOD
Heat Rate	12,783	btu/kWh	Estimated / calculated on heat content and Tons per day fuel
Heat Content of Fuel	5,900	btu/lb	
Land Space	15	acres	height 13m x width 45m x length 120m; majority of 15 acres would be provided by landfill
Fuel Processing Costs	$ -	per ton	cost to sort, prep fuel in addition to landfill operations (current tip fee for WTE or WTE alternative would cover fuel handling costs as almost all MSW is directed to WTE plant)
Emission Rates			NOTE: EPOD claims no to near zero emissions, the emissions included here are for general plasma arc technology and derived from the St. Lucie, FL Air Permit
NOx emissions rate	6	lb/MWh	
S02 marginal emission rate	-	lb/ton	negligible SO2 for Plasma Arc
CO marginal emission rate	0.40	lb/ton	per ton MSW
PM total marginal emission rate	0.50	lb/ton	per ton MSW
HCl marginal emission rate	0.30	lb/ton	per ton MSW
VOC marginal emission rate	0.35	lb/ton	per ton MSW

This is a plasma arc biomass power plant with zero pollution and handles all biomass, MSW toxic waste, and medical waste but not nuclear waste. All separation of materials occurs with their design

WTE Alternative (Autoclave)

Capacity / Size	10	MW	
Capital Costs	$29,784,000		TIC at $2,500/kW plus autoclave at $20,000 per tpd
Fixed O&M	$967,104	per yr	
Variable O&M	$0.0280	per kWh	
Heat Rate	14,000	Btu/kWh	
Land Space	15	acres	5 acres for power equipment, remaining would likely be provided by landfill area.
Fuel Processing Costs	$ -	per ton	cost to sort, prep fuel in addition to landfill operations (current tip fee for WTE or WTE alternative would cover fuel handling costs as almost all MSW is directed to WTE plant)
Heat content of biomass fuel	5,900	btu/lb	
Water Supply for Steam (autoclave)			
Assumed Fuel Heating Value HHV	5,250	Btu/lb	
Required Heat From Boiler	140,000,000	Btu/hr	
Fuel Input Rate Tons/hr	13.33	Tons/hr	
8 lb Steam per lb MSW	213,333	lbs	
$0.18/1,000/lb steam treatment costs	$38.40	per 1,000lbs of s	$0.18/1,000lbs of steam is industry assumption; could be impacted by Loudoun Water costs.
Annual Cost of Steam to Autoclave	$309,473		
Emissions			Note: all emission rates below are estimated and assumed as 'uncontrolled' with no additional emission control technologies. Rates could decline if additional controls and capital costs were added.
NOx emissions rate	6	lbs per MWh	
S02 marginal emission rate	1.1	lb/ton	
CO marginal emission rate	2.06	lb/ton	
PM total marginal emission rate	0.05	lb/ton	
NMOC marginal emission rate	0.12	lb/ton	

Equipment includes all fuel handling, furnace, boiler, generator, and remaining BOP

6 Financing Assumptions

Power Projects

Term	30	years	tied to asset life
Rate	5%		Assumes municipal bonds, tax exempt

Non Potable Water System

Term	10	years	tied to asset life (mix of pipe and pump lives)
Rate	5%		Assumes municipal bonds, tax exempt

7 Marginal Dominion Emission Rates

GHG Emission Rate	0.48	MT/MWh	Note: this will change over time; however, current IRP has combined cycle natural gas displacing coal and 3 biomass plant conversions. Thus rate should remain steady to decline. Emission rate from previous CES was 2009 rate (.49) and Dominion Environmental Report 2010 (.48).
NOx Emission Rate	0.0005	MT/MWh	Dominion Environmental Report 2010 rate
SO2 Emission Rate	0.00125	MT/MWh	Dominion Environmental Report 2010 rate

8 **Moorefield Station GHG Emissions and Electricity Consumption Forecasts**

Total GHG Emissions by Build-out Forecast (metric tons)

Construction Type		2012	2013	2014
Residential				
Multi Family		695	1,693	2,971
Multi Family		1,243	3,007	5,016
Single Family Detachec		111	238	380
	Subtotal	2,050	4,938	8,368
Commercial				
Office		-	-	991
Mixed Retail		67	133	200
	Subtotal	67	133	1,191
Institutional / Cultura				
Transit Support		4	8	12
Fire Station		23	45	68
School		683	1,366	2,049
	Subtotal	709	1,419	2,128
Total GHG Emissions mTCO2e:		2,826	6,491	11,687

Total GHG Emissions by Source (metric tons)

Construction Type	Electric	Natural Gas	Total
Residential	52,187	9,242	61,429
Commercial	67,836	4,852	72,689
Institutional	3,322	226	3,547
Total GHG Emissions mTCO2e:	123,345	14,320	137,665

Electric Consumption by Build-out Forecast (MWh) Note: See BAU GHG and Energy BAU Case.xls

Construction Type		2012	2013	2014
Residential				
Multi Family		1,200	2,923	5,128
Multi Family		2,182	5,278	8,804
Single Family Detachec		195	417	667
	Subtotal	3,577	8,618	14,599
Commercial				
Office		-	-	1,887
Mixed Retail		127	254	381
	Subtotal	127	254	2,268
Institutional / Cultura				
Transit Support		8	15	23
Fire Station		43	86	130
School		1,305	2,610	3,915
	Subtotal	1,356	2,712	4,067
		5,059	11,583	20,933

9 Solid Waste Characterization

Current Tip Fees

Contracted portion of SW (~59% per yr)	$43	per ton	
Gate Tip Fees (remaining ~41% per yr)	$60	per ton	
Diversion Rate (% recycled)	32%	of MSW	Per Loudoun Solid Waste Management Plan

<u>MSW Characterization</u>

MSW	57%	Per Loudoun Solid Waste Management Plan Ch.2
C&D	34%	
Vegetative Waste	9%	

Waste Generation Forecast for Entire County

MSW				
	2010	397,800	Tons per year	
	2015	464,800	Tons per year	
	2020	519,900	Tons per year	
	2025	562,100	Tons per year	
C&D Waste Generated				
	2010	152,600	Tons per year	
	2015	178,300	Tons per year	
	2020	199,400	Tons per year	
	2025	215,600	Tons per year	
Yard Waste / Vegetative				
	2010	35,300	Tons per year	
	2015	41,200	Tons per year	
	2020	46,100	Tons per year	
	2025	49,800	Tons per year	
Debris Waste (land clearing)				
	2010	45,000	Tons per year	
	2015	45,000	Tons per year	
	2020	45,000	Tons per year	
	2025	45,000	Tons per year	
Assumption of amount of waste usable for Biomass				
MSW		0%		
C&D Waste		10%		Assumption
Vegetative / Debris		80%		Assumption
Total waste for biomass by year for				
	2010	79,500	Tons per year	
	2015	86,790	Tons per year	
	2020	92,820	Tons per year	
	2025	97,400	Tons per year	

10 Landfill Life and Cell Forecast

Annual SW Accepted and Landfilled at LC Landfill 100,000 Tons per year

Estimated Annual SW Growth Rate 2.6% per year (per County, growth is similar to population growth)

Current LF Cells:	Size (Acres)	Volume (CY)
LCLF Unit Cell IIIB	10.3	763,476
LCLF Unit Cell IIIC	7	1,124,800

Weight Accepted per Cell	Size (Acres)	Tons	
LCLF Unit Cell IIIB	10.3	199,829	Expected to last 2005-2014
LCLF Unit Cell IIIC	7	235,750	Expected to last 2014-2021

End date of current expansion: 2021 year LF will be at capacity for LCLF Unit Cell IIIC

Years of capacity 10 years

Future LF Cells	Acres	Volume (CY)
Woods Road (WR) Phase 1	36.2	3,690,000
WR Phase 2	29.8	3,290,000
WR Phase 3	30.9	2,940,000
WR Phase 4	23.8	3,440,000
WR Phase 5	0	8,420,000
	120.7	21,780,000

Woods Road Future cells:

WR Site Development	$	11,655,000	FY 07-09	Assumed cost for full landfill / all cells - 120 Acres 21.78M CY
Cell 1A construction	$	7,216,000	FY 09	Construction of Cell 1A - Unknown size (estimated ~15-20acres)
Cell 1B construction	$	7,150,000	FY16	Construction of Cell 1B - 15.5 Acres, ~1.6M CY, ~475,000-500,000Tons

Estimated Landfill Cost per acre / CY / Ton

Cost per Acre (based on cell 1B)	$	558,415	per Acre	Assumes and allocates development cost equally to all 120 Acres, plus construction costs
Estimated Tons of Waste per CY		0.24	Tons per CY	Broad assumption based on existing cells
Estimated CY per Acre WRLF		101,934	CY per Acre	Calculated for Phase 1 only.
Cost per Ton of Waste Phase 1 WRLF	$	23.25	per ton	Calculated for Phase 1 only.

11 Non Potable Water System

Total Capital Cost for non potable system	$	550,000		3 distribution points, 2 ponds, multiple sump pumps, piping for irrigation and cooling tower water. See Figure to side.
Incl. Pumps, pipe, connections, install, etc.				
Annual Operating Costs				
Fixed O&M	$	75,000	per yr	Incl: 1.5 FTEs @ $40k/yr and System O&M
Electric Consumption		17,384	kWh/yr	
Water Consumption Estimates				
Point 1				
Cooling Water		15,000	gal/day	Roughly 1,000T AC capacity ~ 500,000SF Commercial Space; assumes 10hr operation (off at night)
Irrigation		53,000	gal/day	Estimate - projected to irrigate ~20-30acres
Total		68,000	gal/day	
Point 2				
Cooling Water		15,000	gal/hr	Roughly 1,000T AC capacity ~ 500,000SF Commercial Space; assumes 10hr operation (off at night)
Irrigation		53,000	gal/day	Estimate - projected to irrigate ~20-30acres
Total		68,000	gal/day	
Point 3				
Irrigation		53,000	gal/day	
Required Pond Volume Estimates				
Pond 1 (serves Point 1)		1,020,000	gallons	15 day reserve / supply
		3.13	AF	
		16%		Percent of total runoff over 15 days
Pond 2 (Serves Points 2 and 3)		1,815,000	gallons	15 day reserve / supply
		5.57	AF	
		28%		Percent of total runoff over 15 days
Conversion:				
	1 AF =	325,850	gallons	
	1hp	0.75	kw	
Pump Requirements:				
Size:				
Pump Station 1:		2.5	hp	(1+1) 1.3 hp for irrigation; (1+1) 1.2 hp for cooling
Pump Station 2:		3.8	hp	(2+1) 1.3 hp for irrigation; (1+1) 1.2 hp for cooling
Operating Hours / Yr		3,679	hours	assumes ~ 5/12 months = 42%

Stormwater Drainage estimates / water availability

Drainage area and CN are taken from stormwater plans provided by Mark Thomas
Data source for average monthly rainfall data for Washington DC is http://dc.about.com/od/weather/a/WashWeather.htm

East Pond - Average runoff generated over 15 day period

Month	Runoff Volume (ac-ft) for 182 ac	
May	20.84	AF
June	16.34	AF
July	20.29	AF
Aug	18.17	AF
Sept	19.40	AF
Average	19.01	AF
		0.222770141

West Pond - Average runoff generated over 15 day period

Month	Runoff Volume (ac-ft) for 182 ac	
May	22.18	AF
June	16.97	AF
July	21.53	AF
Aug	19.07	AF
Sept	20.49	AF
Average	20.05	AF

Loudoun Water Data

Max Day

	2009	41	MGD	Per Dale Hammes Interview 9/2/11
	2010	43	MGD	Per Dale Hammes Interview 9/2/11
	2011	38.6	MGD	Per Dale Hammes Interview 9/2/11

Estimated Losses from distribution/pipes: 7% Estimated / avg losses for water distribution utility

Current Rates

Quarterly

0-25,000gal	$	1.90	per 1,000gal
25,000 - 50,000gal	$	5.31	per 1,000gal
50,000gal +	$	7.12	per 1,000gal

Monthly

0-8,333gal	$	1.90	per 1,000gal
8,333 - 16,667 gal	$	5.31	per 1,000gal
16,667 gal +	$	7.12	per 1,000gal

Financial and Environmental Model and Forecast

Natural Gas Fired Combined Heat and Power

Project Description

A natural gas fired, combustion turbine power generation facility combusts natural gas in the turbine to rotate an electric generator, to generate electrical power. The heat from the exhaust gas is utilized in a heat recovery steam generator which will produces steam for heating purposes. A heat exchanger for the steam is used to produce high temperature hot water to pump and distribute to the Core Zone as a central heating plant. Infrastructure for the central heating plant includes buried, insulated piping, pumps, valves and control equipment. Natural gas fired combustion turbine generation is a widely used and commercially accepted technology. Dominion Power and other local power providers utilize this type of technology, but on a larger scale for their systems. The natural gas would be contracted and supplied from the local natural gas transmission and distribution company. The space required for the five 5-MW gas turbine generators is approximately 1 acre. This option serves as a benchmark to the other projects, as it is the most commercially and widely accepted technology.

Results

GHG Emissions				
BAU at Full Buildout		137,665	MTCO2e Annually	
Decrease (Increase) from Option		(19,812)	MTCO2e Annually	
Percent Emissions Reduction (Increase)		-14%	MTCO2e Annually	
Renewable Energy Produced		-	MWh Annually	
NOx Decrease (Increase) in Emissions		(356)	MTons Annually	
SO2 Decrease (Increase) in Emissions		252	MTons Annually	
Electric Costs / Rates				
All-in Average Cost of Energy	$	0.090	per kWh	Note: this does not include transmission, distribution, customer and franchise fee costs from local utility (LDC
Average Cost of Energy to MS (net meter)	$	0.116	per kWh	Not including first 5 years of minimal MS occupancy
All-in Average Cost of Energy w/heating revenues	$	0.089	per kWh	Applies the potential profit from heating to offset the costs of electricity productior
Heating Costs / Rates				
Average Cost to Deliver Heat	$	6.11	per MMBtu	
Current Cost to Deliver Heat	$	10.13	per MMBtu	
Difference	$	(4.02)	per MMBtu	

Assumes CHP is nonprofit (municipal utility); if partnering with Dominion a rate of recovery would be added (i.e. profit)

Scenario Results		Avg. Cost of Energy	
Base Case	$	0.090	per kWh
Incr. Fuel Cost (NG escalation 2% more than forecast)	$	0.108	per kWh
Apply heating savings to electricity costs	$	0.089	per kWh

	Units	Base Case Inputs	2012 User Inputs	2013	2014	2015	2016	2017	2018	2019	2020	2021	2022	2023	2024	2025	2026	2027	2028	2029	2030	2031	2032
Escalation Factors																							
Inflation	%	2%	2%	2%	2%	2%	2%	2%	2%	2%	2%	2%	2%	2%	2%	2%	2%	2%	2%	2%	2%	2%	2%
Natural Gas Price Escalation in Addition to Forecast	%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%
Power Purchase Escalation Cost	%	2%	2%	2%	2%	2%	2%	2%	2%	2%	2%	2%	2%	2%	2%	2%	2%	2%	2%	2%	2%	2%	2%
Drivers and Inputs		Base Case Inputs	**Inputs**																				
Size of Facility	MW	Assumptions & Input	25																				
Capacity Factor	%	92%	92%																				
Estimated T&D Losses	%	Assumptions & Input	4%																				
Electricity Generated	MWh	Calculated	201,480	201,480	201,480	201,480	201,480	201,480	201,480	201,480	201,480	201,480	201,480	201,480	201,480	201,480	201,480	201,480	201,480	201,480	201,480	201,480	201,480
Electricity Delivered	MWh	Calculated	193,965	193,965	193,965	193,965	193,965	193,965	193,965	193,965	193,965	193,965	193,965	193,965	193,965	193,965	193,965	193,965	193,965	193,965	193,965	193,965	193,965
Moorefield Consumption Forecast	MWh	Assumptions & Input	5,059	11,583	20,933	31,149	41,422	50,380	60,104	71,585	86,081	97,654	109,816	120,639	131,264	141,401	150,786	159,725	168,403	177,052	185,474	193,539	201,226
Steam Generated	mbtu/yr	Assumptions & Input	790,607,520	790,607,520	790,607,520	790,607,520	790,607,520	790,607,520	790,607,520	790,607,520	790,607,520	790,607,520	790,607,520	790,607,520	790,607,520	790,607,520	790,607,520	790,607,520	790,607,520	790,607,520	790,607,520	790,607,520	790,607,520
Moorefield Station Natural Gas Avoided	mbtu/yr	Assumptions & Input	120,975,349	120,975,349	120,975,349	120,975,349	120,975,349	120,975,349	120,975,349	120,975,349	120,975,349	120,975,349	120,975,349	120,975,349	120,975,349	120,975,349	120,975,349	120,975,349	120,975,349	120,975,349	120,975,349	120,975,349	120,975,349
Fuel Consumption	MMBtu	Calculated	2,317,020	2,317,020	2,317,020	2,317,020	2,317,020	2,317,020	2,317,020	2,317,020	2,317,020	2,317,020	2,317,020	2,317,020	2,317,020	2,317,020	2,317,020	2,317,020	2,317,020	2,317,020	2,317,020	2,317,020	2,317,020
Wholesale Natural Gas Prices	$/MMBtu	Assumptions & Input	$ 4.77	$ 4.94	$ 5.05	$ 5.25	$ 5.44	$ 5.58	$ 5.75	$ 5.94	$ 6.28	$ 6.64	$ 6.97	$ 7.36	$ 7.80	$ 8.20	$ 8.54	$ 8.91	$ 9.19	$ 9.43	$ 9.70	$ 10.04	$ 10.44
Retail Natural Gas Prices	$/MMBtu	Assumptions & Input	$ 7.00	$ 7.21	$ 7.37	$ 7.62	$ 7.85	$ 8.04	$ 8.25	$ 8.50	$ 8.89	$ 9.30	$ 9.69	$ 10.13	$ 10.62	$ 11.08	$ 11.48	$ 11.91	$ 12.25	$ 12.55	$ 12.88	$ 13.28	$ 13.74
Power Purchase Agreement (Net Meter)	$/MWh	$ 50.00	$ 50.00	$ 51.00	$ 52.02	$ 53.06	$ 54.12	$ 55.20	$ 56.31	$ 57.43	$ 58.58	$ 59.75	$ 60.95	$ 62.17	$ 63.41	$ 64.68	$ 65.97	$ 67.29	$ 68.64	$ 70.01	$ 71.41	$ 72.84	$ 74.30
Expenses																							
Debt Service (P&I)			0	2,093,604	2,093,604	2,093,604	2,093,604	2,093,604	2,093,604	2,093,604	2,093,604	2,093,604	2,093,604	2,093,604	2,093,604	2,093,604	2,093,604	2,093,604	2,093,604	2,093,604	2,093,604	2,093,604	2,093,604
Fixed O&M				1,267,452	1,292,801	1,318,657	1,345,030	1,371,931	1,399,369	1,427,357	1,455,904	1,485,022	1,514,722	1,545,017	1,575,917	1,607,436	1,639,584	1,672,376	1,705,824	1,739,940	1,774,739	1,810,234	1,846,438
Variable O&M				1,027,548	1,048,099	1,069,061	1,090,442	1,112,251	1,134,496	1,157,186	1,180,330	1,203,936	1,228,015	1,252,575	1,277,627	1,303,179	1,329,243	1,355,828	1,382,944	1,410,603	1,438,815	1,467,592	1,496,943
CHP O&M				100,000	102,000	104,040	106,121	108,243	110,408	112,616	114,869	117,166	119,509	121,899	124,337	126,824	129,361	131,948	134,587	137,279	140,024	142,825	145,681
Fuel				11,442,627	11,698,215	12,170,798	12,609,738	12,933,860	13,315,439	13,759,515	14,553,179	15,389,163	16,159,515	17,047,559	18,073,695	18,997,997	19,788,992	20,643,728	21,297,415	21,850,636	22,469,533	23,260,248	24,178,955
Subtotal				$ 15,931,231	$ 16,234,719	$ 16,756,160	$ 17,244,935	$ 17,619,889	$ 18,053,317	$ 18,550,278	$ 19,397,886	$ 20,288,891	$ 21,115,366	$ 22,060,655	$ 23,145,181	$ 24,129,040	$ 24,980,784	$ 25,897,484	$ 26,614,374	$ 27,232,062	$ 27,916,716	$ 28,774,502	$ 29,761,622
Central Heating Plant Revenue and Expenses																							
Heating Costs Avoided (NG) / Revenues				$ 872,203	$ 891,043	$ 921,323	$ 949,958	$ 972,712	$ 998,584	$ 1,027,837	$ 1,075,464	$ 1,125,424	$ 1,172,084	$ 1,225,018	$ 1,285,293	$ 1,340,385	$ 1,388,653	$ 1,440,389	$ 1,481,770	$ 1,518,051	$ 1,557,908	$ 1,606,887	$ 1,662,703
Heating Plant Debt Service Expense				$ 617,500	$ 617,500	$ 617,500	$ 617,500	$ 617,500	$ 617,500	$ 617,500	$ 617,500	$ 617,500	$ 617,500	$ 617,500	$ 617,500	$ 617,500	$ 617,500	$ 617,500	$ 617,500	$ 617,500	$ 617,500	$ 617,500	$ 617,500
Subtotal Potential Heating Savings				$ 254,703	$ 273,543	$ 303,823	$ 332,458	$ 355,212	$ 381,084	$ 410,337	$ 457,964	$ 507,924	$ 554,584	$ 607,518	$ 667,793	$ 722,885	$ 771,153	$ 822,889	$ 864,270	$ 900,551	$ 940,408	$ 989,387	$ 1,045,203
Forecasted Rate for Heating ($/MMBtu)				$ 7.21	$ 7.37	$ 7.62	$ 7.85	$ 8.04	$ 8.25	$ 8.50	$ 8.89	$ 9.30	$ 9.69	$ 10.13	$ 10.62	$ 11.08	$ 11.48	$ 11.91	$ 12.25	$ 12.55	$ 12.88	$ 13.28	$ 13.74
Price of Central Heating ($/MMBtu)				$ 5.93	$ 5.95	$ 5.96	$ 5.98	$ 6.00	$ 6.02	$ 6.04	$ 6.05	$ 6.07	$ 6.09	$ 6.11	$ 6.13	$ 6.15	$ 6.17	$ 6.20	$ 6.22	$ 6.24	$ 6.26	$ 6.28	$ 6.31
Other Revenues																							
Off System Sales (net to grid)				9,301,475	9,001,089	8,639,073	8,255,848	7,926,436	7,537,442	7,028,785	6,320,159	5,755,032	5,128,874	4,558,588	3,975,986	3,399,870	2,848,701	2,304,103	1,754,556	1,184,103	606,318	31,005	-
Subtotal				$ 9,301,475	$ 9,001,089	$ 8,639,073	$ 8,255,848	$ 7,926,436	$ 7,537,442	$ 7,028,785	$ 6,320,159	$ 5,755,032	$ 5,128,874	$ 4,558,588	$ 3,975,986	$ 3,399,870	$ 2,848,701	$ 2,304,103	$ 1,754,556	$ 1,184,103	$ 606,318	$ 31,005	$ -
Average Cost of Electricity ($/kWh)[1]																							
Nominal Year Dollars				$ 0.08	$ 0.08	$ 0.09	$ 0.09	$ 0.09	$ 0.09	$ 0.10	$ 0.10	$ 0.10	$ 0.11	$ 0.11	$ 0.12	$ 0.12	$ 0.13	$ 0.13	$ 0.14	$ 0.14	$ 0.14	$ 0.15	$ 0.15
Present Value (Discounted to 2012 Dollars)				$ 0.08	$ 0.08	$ 0.08	$ 0.08	$ 0.08	$ 0.08	$ 0.08	$ 0.08	$ 0.09	$ 0.09	$ 0.09	$ 0.09	$ 0.10	$ 0.10	$ 0.10	$ 0.10	$ 0.10	$ 0.10	$ 0.10	$ 0.10
Apply Potential Central Heating Gross Profit as Offset to Power Costs																							
Central heating sold at 10% discount from current year natural gas rates			10%																				
Nominal Year Dollars				$ 0.08	$ 0.08	$ 0.08	$ 0.09	$ 0.09	$ 0.09	$ 0.09	$ 0.10	$ 0.10	$ 0.11	$ 0.11	$ 0.12	$ 0.12	$ 0.12	$ 0.13	$ 0.13	$ 0.14	$ 0.14	$ 0.14	$ 0.15
Present Value (Discounted to 2012 Dollars)				$ 0.08	$ 0.08	$ 0.08	$ 0.08	$ 0.08	$ 0.08	$ 0.08	$ 0.08	$ 0.09	$ 0.09	$ 0.09	$ 0.09	$ 0.09	$ 0.09	$ 0.10	$ 0.10	$ 0.10	$ 0.10	$ 0.10	$ 0.10
Costs to Recover at Moorefield (Net Meter)				$ 6,529,756	$ 7,131,631	$ 8,013,048	$ 8,882,967	$ 9,585,210	$ 10,405,467	$ 11,408,877	$ 12,962,858	$ 14,416,694	$ 15,866,983	$ 17,380,168	$ 19,044,857	$ 20,602,346	$ 22,002,722	$ 23,461,433	$ 24,725,231	$ 25,910,680	$ 27,170,374	$ 28,600,672	$ 29,615,941
Cost of Energy to Moorefield ($/kWh)[2]																							
Nominal Year Dollars				$ 0.56	$ 0.34	$ 0.26	$ 0.21	$ 0.19	$ 0.17	$ 0.16	$ 0.15	$ 0.15	$ 0.14	$ 0.14	$ 0.15	$ 0.15	$ 0.15	$ 0.15	$ 0.15	$ 0.15	$ 0.15	$ 0.15	$ 0.15
Present Value (Discounted to 2012 Dollars)				$ 0.55	$ 0.33	$ 0.24	$ 0.20	$ 0.17	$ 0.15	$ 0.14	$ 0.13	$ 0.12	$ 0.12	$ 0.12	$ 0.11	$ 0.11	$ 0.11	$ 0.11	$ 0.11	$ 0.10	$ 0.10	$ 0.10	$ 0.10

Notes

1 Average cost of electricity (at Generator) assuming fully connected to Dominion Grid, all power delivered to Dominion (no net metering) and heating revenues (i.e. avoided NG heating costs) reduce costs. Does NOT include transmission, distribution, customer, franchise fee costs from Dominion.

2 Average cost of electricity assuming 'net metering' for electricity consumed by Moorefield Station, excess is sent to Dominion Grid. Recover costs through Moorefield Station tenants and a PPA with Dominion for the excess electricity available each year. Additional Heating revenues offset power costs.

Financial and Environmental Model and Forecast

Biomass Combined Heat and Power

Project Description
Biomass power generation is considered to be a renewable energy resource and carbon neutral power generation technology since it uses natural or waste feedstocks such as wood, bagasse, or grasses instead of fossil fuels. The biomass material or fuel is stored in a covered storage area to keep it dry and is then feed into a furnace or fluidized bed, where it combusted to generate heat to produce steam. The superheated steam is then used to drive a steam turbine to generate electrical power. Alternative biomass technologies gasify the biomass and produce a syngas that is then combusted to generate the heat required for the production of the superheated steam. The exhaust gas then flows through a baghouse to remove any particulates from the exhaust stream before it is scrubbed to remove nitrogen and vented to the atmosphere through a stack. A typical biomass power plant can require a space of 15 acres. For a combined heat and power facility, the boiler or fluidized bed is increased in size to provide additional steam for heating.

Base Case Results			
GHG Emissions			
BAU at Full Buildout		137,665	MTCO2e Annually
Reductions from Option		38,684	MTCO2e Annually
Percent Emissions Reduction		28%	
NOx Decrease (Increase) in Emissions		(179)	MTons Annually
SO2 Decrease (Increase) in Emissions		99	MTons Annually
Renewable Energy Produced		80,592	MWh Annually
Waste Reduction		15,016	Tons Annually
All-in Average Cost of Energy (Present Value)			
Without RECs	$	0.083	per kWh
With RECs	$	0.078	per kWh[1]
Average Cost of Energy to MS (net meter)			
Without RECs	$	0.082	per kWh
With RECs	$	0.079	per kWh[2]
Impact to Landfill Life (e.g. addt'l diversion)			
Percent Life Extension		11%	
Years Extended		1.08	Years
NPV of Deferred Costs	$	6,981,002	Equates to approx. $23/T of tip fee for capital costs of LF.

Note: Does not include transmission, distribution, customer and franchise fee costs from local utility (LDC) ~ $0.02-$0.04/kWh

Not including first 5 years of minimal MS occupancy

1. Assumes owner/operator (e.g. Dominion) receives all REC revenues.
2. Assumes Moorefield Station / Loudoun County Receive ALL REC revenues

Assumes CHP is nonprofit (municipal utility); if partnering with Dominion a rate of recovery would be added (i.e. profit)

Scenario Results		Avg. Cost of Energy	
Base Case	$	0.083	per kWh
Reduced Tip Fees ($0/Ton)	$	0.087	per kWh
Incl. RECs at High Price $5/MWh	$	0.078	per kWh
Additional MSW Available (2X current amount)	$	0.071	per kWh
Low Fuel Cost $20/T	$	0.062	per kWh
No MSW /All Purchased Fuel	$	0.094	per kWh

	Units	Base Case Inputs Input	2012 Inputs	2013	2014	2015	2016	2017	2018	2019	2020	2021
Escalation Factors												
Inflation	%	2%	2%	2%	2%	2%	2%	2%	2%	2%	2%	2%
Fuel Cost Escalation	%	2%	2%	2%	2%	2%	2%	2%	2%	2%	2%	2%
Power Purchase Escalation Cost	%	2%	2%	2%	2%	2%	2%	2%	2%	2%	2%	2%
Tip Fee Escalation	%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%
Increased MSW Available Locally	%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%
Drivers and Inputs	**Units**	Base Case Inputs	**Inputs**									
Size of Facility	MW	Assumptions & Input	10									
Capacity Factor	%	92%	92%									
Estimated T&D Losses	%	Assumptions & Input	4%									
Energy Generated	MWh	Calculated	80,592	80,592	80,592	80,592	80,592	80,592	80,592	80,592	80,592	80,592
Electricity Delivered	MWh	Calculated	77,586	77,586	77,586	77,586	77,586	77,586	77,586	77,586	77,586	77,586
Moorefield Consumption Forecast	MWh	Assumptions & Input	5,059	11,583	20,933	31,149	41,422	50,380	60,104	71,585	86,081	97,654
Fuel Consumption	Tons / Yr	Calculated	95,618	95,618	95,618	95,618	95,618	95,618	95,618	95,618	95,618	95,618
Desired Portion of County C&D MSW Diverted to Plant	%	50%	50%									
Amount of Loudoun County MSW/C&D Utilized	Tons / Yr	Calculated	13,067	13,299	13,530	13,761	13,952	14,143	14,335	14,526	14,717	14,862
Fuel Cost	$/Ton	$ 40.00	$40	$ 40.80	$ 41.62	$ 42.45	$ 43.30	$ 44.16	$ 45.05	$ 45.95	$ 46.87	$ 47.80
Tip Fee	per ton	$ 30.00	$ 30.00	$ 30.00	$ 30.00	$ 30.00	$ 30.00	$ 30.00	$ 30.00	$ 30.00	$ 30.00	$ 30.00
Power Purchase Agreement (Net Meter)	$/MWh	$ 50.00	$ 50.00	$ 51.00	$ 52.02	$ 53.06	$ 54.12	$ 55.20	$ 56.31	$ 57.43	$ 58.58	$ 59.75
Renewable Energy Credit Pricing	$/MWh	$ 5.00	$ 5.00	$ 5.00	$ 5.00	$ 5.00	$ 5.00	$ 5.00	$ 5.00	$ 5.00	$ 5.00	$ 5.00
Expenses												
Debt Service (P&I)				2,770,000	2,770,000	2,770,000	2,770,000	2,770,000	2,770,000	2,770,000	2,770,000	2,770,000
Fixed O&M				369,917	377,316	384,862	392,559	400,410	408,419	416,587	424,919	433,417
Variable O&M				863,140	880,403	898,011	915,971	934,291	952,977	972,036	991,477	1,011,306
Fuel				3,358,618	3,416,170	3,474,681	3,535,895	3,598,168	3,661,518	3,725,962	3,791,520	3,860,408
Fuel Processing Costs (MSW related only)				67,823	70,382	73,016	75,511	78,077	80,715	83,428	86,216	88,809
Subtotal				$ 7,429,498	$ 7,514,270	$ 7,600,569	$ 7,689,936	$ 7,780,946	$ 7,873,628	$ 7,968,013	$ 8,064,132	$ 8,163,939
Other Revenues												
Tip Fees				398,957	405,892	412,827	418,564	424,300	430,036	435,773	441,509	445,866
Off System Sales (net to grid)				3,366,153	2,947,059	2,463,963	1,957,236	1,501,852	984,366	344,647	-	-
Subtotal				$ 3,765,109	$ 3,352,951	$ 2,876,790	$ 2,375,799	$ 1,926,152	$ 1,414,402	$ 780,420	$ 441,509	$ 445,866
Average Cost of Electricity ($/kWh)[1]												
Nominal Year Dollars				**$ 0.09**	**$ 0.09**	**$ 0.09**	**$ 0.09**	**$ 0.09**	**$ 0.10**	**$ 0.10**	**$ 0.10**	**$ 0.10**
Present Value (Discounted to 2012 Dollars)				**$ 0.09**	**$ 0.09**	**$ 0.09**	**$ 0.09**	**$ 0.09**	**$ 0.09**	**$ 0.08**	**$ 0.08**	**$ 0.08**
Costs to Recover at Moorefield (Net Meter)				$ 3,664,389	$ 4,161,319	$ 4,723,779	$ 5,314,137	$ 5,854,794	$ 6,459,226	$ 7,187,593	$ 7,622,622	$ 7,718,073
Cost of Energy to Moorefield ($/kWh)[2]												
Nominal Year Dollars				**$ 0.32**	**$ 0.20**	**$ 0.15**	**$ 0.13**	**$ 0.12**	**$ 0.11**	**$ 0.10**	**$ 0.10**	**$ 0.10**
Present Value (Discounted to 2012 Dollars)				**$ 0.31**	**$ 0.19**	**$ 0.14**	**$ 0.12**	**$ 0.11**	**$ 0.10**	**$ 0.09**	**$ 0.08**	**$ 0.08**
Potential REC Revenue (Reduces Cost of Energy)				$ 402,960	$ 402,960	$ 402,960	$ 402,960	$ 402,960	$ 402,960	$ 402,960	$ 402,960	$ 402,960
Revised Average Cost of Electricity with RECS ($/kWh)												
Nominal Year Dollars				**$ 0.09**	**$ 0.09**	**$ 0.09**	**$ 0.09**	**$ 0.09**	**$ 0.09**	**$ 0.09**	**$ 0.09**	**$ 0.09**
Present Value (Discounted to 2012 Dollars)				**$ 0.08**	**$ 0.08**	**$ 0.08**	**$ 0.08**	**$ 0.08**	**$ 0.08**	**$ 0.08**	**$ 0.08**	**$ 0.08**
Revised Cost of Energy to Moorefield with RECs($/kWh)												
Nominal Year Dollars				**$ 0.28**	**$ 0.18**	**$ 0.14**	**$ 0.12**	**$ 0.11**	**$ 0.10**	**$ 0.09**	**$ 0.09**	**$ 0.10**
Present Value (Discounted to 2012 Dollars)				**$ 0.28**	**$ 0.17**	**$ 0.13**	**$ 0.11**	**$ 0.10**	**$ 0.09**	**$ 0.08**	**$ 0.08**	**$ 0.08**
Avoided Cost Estimate for Extension of Landfill Life												
Avoided Tons of Waste				13,299	13,530	13,761	13,952	14,143	14,335	14,526	14,717	14,862
Cost Avoided Per Ton of Waste[3]				$ 23.71	$ 24.18	$ 24.67	$ 25.16	$ 25.67	$ 26.18	$ 26.70	$ 27.24	$ 27.78
Nominal Year Value of Avoided Cost				$ 315,319	$ 327,216	$ 339,464	$ 351,064	$ 362,993	$ 375,259	$ 387,870	$ 400,835	$ 412,887
Present Value (Discounted to 2012 Dollars)				$ 309,136	$ 314,510	$ 319,884	$ 324,329	$ 328,774	$ 333,219	$ 337,664	$ 342,109	$ 345,485

	2022	2023	2024	2025	2026	2027	2028	2029	2030	2031	2032
Escalation Factors											
Inflation	2%	2%	2%	2%	2%	2%	2%	2%	2%	2%	2%
Fuel Cost Escalation	2%	2%	2%	2%	2%	2%	2%	2%	2%	2%	2%
Power Purchase Escalation Cost	2%	2%	2%	2%	2%	2%	2%	2%	2%	2%	2%
Tip Fee Escalation	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%
Increased MSW Available Locally	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%
Drivers and Inputs											
Size of Facility											
Capacity Factor											
Estimated T&D Losses											
Energy Generated	80,592	80,592	80,592	80,592	80,592	80,592	80,592	80,592	80,592	80,592	80,592
Electricity Delivered	77,586	77,586	77,586	77,586	77,586	77,586	77,586	77,586	77,586	77,586	77,586
Moorefield Consumption Forecast	109,816	120,639	131,264	141,401	150,786	159,725	168,403	177,052	185,474	193,539	201,226
Fuel Consumption	95,618	95,618	95,618	95,618	95,618	95,618	95,618	95,618	95,618	95,618	95,618
Desired Portion of County C&D MSW Diverted to Plant											
Amount of Loudoun County MSW/C&D Utilized	15,007	15,153	15,298	15,443	15,590	15,738	15,887	16,038	16,190	16,344	16,499
Fuel Cost	$ 48.76	$ 49.73	$ 50.73	$ 51.74	$ 52.78	$ 53.83	$ 54.91	$ 56.01	$ 57.13	$ 58.27	$ 59.44
Tip Fee	$ 30.00	$ 30.00	$ 30.00	$ 30.00	$ 30.00	$ 30.00	$ 30.00	$ 30.00	$ 30.00	$ 30.00	$ 30.00
Power Purchase Agreement (Net Meter)	$ 60.95	$ 62.17	$ 63.41	$ 64.68	$ 65.97	$ 67.29	$ 68.64	$ 70.01	$ 71.41	$ 72.84	$ 74.30
Renewable Energy Credit Pricing	$ 5.00	$ 5.00	$ 5.00	$ 5.00	$ 5.00	$ 5.00	$ 5.00	$ 5.00	$ 5.00	$ 5.00	$ 5.00
Expenses											
Debt Service (P&I)	2,770,000	2,770,000	2,770,000	2,770,000	2,770,000	2,770,000	2,770,000	2,770,000	2,770,000	2,770,000	2,770,000
Fixed O&M	442,085	450,927	459,946	469,145	478,527	488,098	497,860	507,817	517,973	528,333	538,900
Variable O&M	1,031,533	1,052,163	1,073,206	1,094,671	1,116,564	1,138,895	1,161,673	1,184,907	1,208,605	1,232,777	1,257,432
Fuel	3,930,534	4,001,922	4,074,592	4,148,569	4,223,802	4,300,310	4,378,112	4,457,226	4,537,672	4,619,469	4,702,635
Fuel Processing Costs (MSW related only)	91,470	94,202	97,007	99,887	102,852	105,905	109,049	112,286	115,619	119,051	122,584
Subtotal	$ 8,265,622	$ 8,369,214	$ 8,474,751	$ 8,582,271	$ 8,691,745	$ 8,803,208	$ 8,916,693	$ 9,032,235	$ 9,149,869	$ 9,269,629	$ 9,391,552
Other Revenues											
Tip Fees	450,224	454,581	458,938	463,295	467,693	472,133	476,616	481,141	485,708	490,320	494,975
Off System Sales (net to grid)	-	-	-	-	-	-	-	-	-	-	-
Subtotal	$ 450,224	$ 454,581	$ 458,938	$ 463,295	$ 467,693	$ 472,133	$ 476,616	$ 481,141	$ 485,708	$ 490,320	$ 494,975
Average Cost of Electricity ($/kWh)[1]											
Nominal Year Dollars	**$ 0.10**	**$ 0.10**	**$ 0.10**	**$ 0.10**	**$ 0.11**	**$ 0.11**	**$ 0.11**	**$ 0.11**	**$ 0.11**	**$ 0.11**	**0.11**
Present Value (Discounted to 2012 Dollars)	**$ 0.08**	**$ 0.08**	**$ 0.08**	**$ 0.08**	**$ 0.08**	**$ 0.08**	**$ 0.08**	**$ 0.08**	**$ 0.08**	**$ 0.08**	**0.08**
Costs to Recover at Moorefield (Net Meter)	$ 7,815,398	$ 7,914,633	$ 8,015,814	$ 8,118,976	$ 8,224,052	$ 8,331,075	$ 8,440,078	$ 8,551,095	$ 8,664,160	$ 8,779,309	$ 8,896,577
Cost of Energy to Moorefield ($/kWh)[2]											
Nominal Year Dollars	**$ 0.10**	**$ 0.10**	**$ 0.10**	**$ 0.10**	**$ 0.11**	**$ 0.11**	**$ 0.11**	**$ 0.11**	**$ 0.11**	**$ 0.11**	**0.11**
Present Value (Discounted to 2012 Dollars)	**$ 0.08**	**$ 0.08**	**$ 0.08**	**$ 0.08**	**$ 0.08**	**$ 0.08**	**$ 0.08**	**$ 0.08**	**$ 0.08**	**$ 0.08**	**0.08**
Potential REC Revenue (Reduces Cost of Energy)	$ 402,960	$ 402,960	$ 402,960	$ 402,960	$ 402,960	$ 402,960	$ 402,960	$ 402,960	$ 402,960	$ 402,960	402,960
Revised Average Cost of Electricity with RECS ($/kWh)											
Nominal Year Dollars	**$ 0.10**	**$ 0.10**	**$ 0.10**	**$ 0.10**	**$ 0.10**	**$ 0.10**	**$ 0.10**	**$ 0.11**	**$ 0.11**	**$ 0.11**	**0.11**
Present Value (Discounted to 2012 Dollars)	**$ 0.08**	**$ 0.08**	**$ 0.08**	**$ 0.08**	**$ 0.08**	**$ 0.08**	**$ 0.08**	**$ 0.08**	**$ 0.07**	**$ 0.07**	**0.07**
Revised Cost of Energy to Moorefield with RECs($/kWh)											
Nominal Year Dollars	**$ 0.10**	**$ 0.10**	**$ 0.10**	**$ 0.10**	**$ 0.10**	**$ 0.10**	**$ 0.11**	**$ 0.11**	**$ 0.11**	**$ 0.11**	**0.11**
Present Value (Discounted to 2012 Dollars)	**$ 0.08**	**$ 0.08**	**$ 0.08**	**$ 0.08**	**$ 0.08**	**$ 0.08**	**$ 0.08**	**$ 0.08**	**$ 0.08**	**$ 0.08**	**0.08**
Avoided Cost Estimate for Extension of Landfill Life											
Avoided Tons of Waste	15,007	15,153	15,298	15,443	15,590	15,738	15,887	16,038	16,190	16,344	16,499
Cost Avoided Per Ton of Waste[3]	$ 28.34	$ 28.90	$ 29.48	$ 30.07	$ 30.67	$ 31.29	$ 31.91	$ 32.55	$ 33.20	$ 33.86	$ 34.54
Nominal Year Value of Avoided Cost	$ 425,260	$ 437,963	$ 451,004	$ 464,391	$ 478,176	$ 492,370	$ 506,986	$ 522,035	$ 537,531	$ 553,487	$ 569,916
Present Value (Discounted to 2012 Dollars)	$ 348,861	$ 352,237	$ 355,613	$ 358,990	$ 362,398	$ 365,838	$ 369,311	$ 372,818	$ 376,357	$ 379,930	$ 383,537

Notes

1 Average cost of electricity (at Generator) assuming fully connected to Dominion Grid, all power delivered to Dominion (no net metering). Does NOT include transmission, distribution, customer, franchise fee costs from Dominion.

2 Average cost of electricity assuming 'net metering' for CHP; electricity consumed by Moorefield Station, excess is sent to Dominion Grid. Recover costs through Moorefield Station tenants and a PPA with Dominion for the excess electricity available each year.

3 Avoided Landfill costs are capital costs only for landfill construction. The avoided cost calculation does not include any changes to O&M costs or personnel.

Financial and Environmental Model and Forecast

Waste to Energy Combined Heat and Power (EPOD Technology)

Project Description

Waste to energy involves utilizing municipal solid waste streams as a fuel source for generating power. Waste to energy is considered renewable energy in Virginia. Multiple technology options exist; however, the option summarized below involves plasma arc technology from a specific vendor and developer: WPP Energy Corporation and their EPOD generation units. Plasma arc technology utilizes an electric arc within a reactor or enclosed vessel to vaporize the fuel or material in the reactor. This process results in steam and syngas which are then used to generate electrical power in turbine generators. For the EPOD technology, the waste material or fuel can be biomass, MSW, MSW toxic waste, and medical waste (but not nuclear waste). All separation of materials occurs within the EPOD design, and the vendor claims it has no chimney or stack waste emissions resulting in zero pollution. The land space required for the EPOD technology design is approximately 1.5 acres.

Base Case Results				
GHG Emissions				
BAU at Full Buildout		137,665	MTCO2e Annually	
Reductions from Option		38,684	MTCO2e Annually	
Percent Emissions Reduction		28%		
NOx Decrease (Increase) in Emissions		(179)	MTons Annually	
SO2 Decrease (Increase) in Emissions		101	MTons Annually	
Renewable Energy Produced		80,592	MWh Annually	
Waste Reduction				
Annual Reduction		87,308	Tons Annually	
Portion of Avg. Annual Waste Reduced		65%	of total LCLF waste	
All-in Average Cost of Energy				
Without RECs	$	0.037	per kWh	Note: Does not include transmission, distribution, customer and franchise fee costs from local utility (LDC) ~ $0.02-$0.04/kWh
With RECs	$	0.033	per kWh[1]	
Average Cost of Energy to MS (net meter)				
Without RECs	$	0.036	per kWh	Not including first 5 years of minimal MS occupancy
With RECs	$	0.034	per kWh[2]	
Impact to Landfill Life (e.g. addt'l diversion)				
Percent Life Extension		65%	Extension to Landfill Life	
Years Extended		7	years beyond 2021	
NPV of Deferred Costs		$ 40,591,000		
			Equates to approx. $23/T of tip fee for capital costs of LF.	

1. Assumes owner/operator (e.g. Dominion) receives all REC revenues.
2. Assumes Moorefield Station / Loudoun County Receive ALL REC revenues

Assumes CHP is nonprofit (municipal utility); if partnering with Dominion a rate of recovery would be added (i.e. profit)

Scenario Results		Avg. Cost of Energy	
Base Case	$	0.037	per kWh
Reduced Tip Fees ($10/Ton)	$	0.055	per kWh
No Tip Fees Included	$	0.064	per kWh
Incl. RECs at High Price $5/MWh	$	0.033	per kWh

	Units	Base Case Inputs / Input	Inputs 2012	2013	2014	2015	2016	2017	2018	2019	2020	2021	2022
Escalation Factors													
Inflation		2%	2%	2%	2%	2%	2%	2%	2%	2%	2%	2%	2%
Fuel Cost Escalation		2%	2%	2%	2%	2%	2%	2%	2%	2%	2%	2%	2%
Power Purchase Escalation Cost	%	2%	2%	2%	2%	2%	2%	2%	2%	2%	2%	2%	2%
Tip Fee Escalation	%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%
Drivers and Inputs	**Units**	Base Case Inputs	**Inputs**										
Size of Facility	MW	Assumptions & Input	10										
Capacity Factor	%	92%	92%										
Estimated T&D Losses	%	Assumptions & Input	4%										
Electricity Generated	MWh	Calculated	80,592	80,592	80,592	80,592	80,592	80,592	80,592	80,592	80,592	80,592	80,592
Electricity Delivered	MWh	Calculated	77,586	77,586	77,586	77,586	77,586	77,586	77,586	77,586	77,586	77,586	77,586
Moorefield Consumption Forecast	MWh	Assumptions & Input	5,059	11,583	20,933	31,149	41,422	50,380	60,104	71,585	86,081	97,654	109,816
Fuel Consumption	Tons / Yr	Calculated	87,308	87,308	87,308	87,308	87,308	87,308	87,308	87,308	87,308	87,308	87,308
Desired Portion of MSW Diverted to RDF Power Plant	%	100%	100%										
Amount of Loudoun County MSW utilized	Tons / Yr	Calculated	87,308	87,308	87,308	87,308	87,308	87,308	87,308	87,308	87,308	87,308	87,308
Loudoun County MSW Available Enough for WTE?		Calculated	YES										
Additional Fuel Source (if Needed)	Ton	Calculated	-	-	-	-	-	-	-	-	-	-	-
Fuel Cost	$/Ton	$40	$40	$ 40.80	$ 41.62	$ 42.45	$ 43.30	$ 44.16	$ 45.05	$ 45.95	$ 46.87	$ 47.80	$ 48.76
Tip Fee for WTE Facility (or Portion of Current Fee)	$/Ton	$30	$30	$ 30.00	$ 30.00	$ 30.00	$ 30.00	$ 30.00	$ 30.00	$ 30.00	$ 30.00	$ 30.00	$ 30.00
Power Purchase Agreement (Net Meter)	$/MWh	$ 50.00	$ 50.00	$ 51.00	$ 52.02	$ 53.06	$ 54.12	$ 55.20	$ 56.31	$ 57.43	$ 58.58	$ 59.75	$ 60.95
Renewable Energy Credit Pricing	$/MWh	$ 5.00	$ 5.00	$ 5.00	$ 5.00	$ 5.00	$ 5.00	$ 5.00	$ 5.00	$ 5.00	$ 5.00	$ 5.00	$ 5.00
Expenses													
Debt Service (P&I)				3,156,511	3,156,511	3,156,511	3,156,511	3,156,511	3,156,511	3,156,511	3,156,511	3,156,511	3,156,511
Fixed O&M				739,835	754,631	769,724	785,118	800,821	816,837	833,174	849,837	866,834	884,171
Variable O&M				1,726,281	1,760,806	1,796,022	1,831,943	1,868,582	1,905,953	1,944,072	1,982,954	2,022,613	2,063,065
Fuel				-	-	-	-	-	-	-	-	-	-
Fuel Processing Costs (MSW related only)				-	-	-	-	-	-	-	-	-	-
Subtotal				$ 5,622,626	$ 5,671,949	$ 5,722,257	$ 5,773,572	$ 5,825,914	$ 5,879,302	$ 5,933,757	$ 5,989,302	$ 6,045,958	$ 6,103,747
Other Revenues													
Tip Fees				2,619,240	2,619,240	2,619,240	2,619,240	2,619,240	2,619,240	2,619,240	2,619,240	2,619,240	2,619,240
Off System Sales (net to grid)				3,366,153	2,947,059	2,463,963	1,957,236	1,501,852	984,366	344,647	-	-	-
Subtotal				$ 5,985,393	$ 5,566,299	$ 5,083,203	$ 4,576,476	$ 4,121,092	$ 3,603,606	$ 2,963,887	$ 2,619,240	$ 2,619,240	$ 2,619,240
Average Cost of Electricity ($/kWh)[1]													
Nominal Year Dollars				**$ 0.039**	**$ 0.039**	**$ 0.040**	**$ 0.041**	**$ 0.041**	**$ 0.042**	**$ 0.043**	**$ 0.043**	**$ 0.044**	**$ 0.045**
Present Value (Discounted to 2012 Dollars)				**$ 0.038**	**$ 0.038**	**$ 0.038**	**$ 0.038**	**$ 0.037**	**$ 0.037**	**$ 0.037**	**$ 0.037**	**$ 0.037**	**$ 0.037**
Costs to Recover at Moorefield (Net Meter)				$ (362,766)	$ 105,649	$ 639,054	$ 1,197,097	$ 1,704,822	$ 2,275,696	$ 2,969,870	$ 3,370,062	$ 3,426,718	$ 3,484,507
Cost of Energy to Moorefield ($/kWh)[2]													
Nominal Year Dollars				**$ (0.031)**	**$ 0.005**	**$ 0.021**	**$ 0.029**	**$ 0.034**	**$ 0.038**	**$ 0.041**	**$ 0.043**	**$ 0.044**	**$ 0.045**
Present Value (Discounted to 2012 Dollars)				**$ (0.031)**	**$ 0.005**	**$ 0.019**	**$ 0.027**	**$ 0.031**	**$ 0.034**	**$ 0.036**	**$ 0.037**	**$ 0.037**	**$ 0.037**
Potential REC Revenue (Reduces Cost of Energy)				$ 402,960	$ 402,960	$ 402,960	$ 402,960	$ 402,960	$ 402,960	$ 402,960	$ 402,960	$ 402,960	$ 402,960
Revised Average Cost of Electricity with RECS ($/kWh)													
Nominal Year Dollars				**$ 0.034**	**$ 0.034**	**$ 0.035**	**$ 0.035**	**$ 0.036**	**$ 0.037**	**$ 0.038**	**$ 0.038**	**$ 0.039**	**$ 0.040**
Present Value (Discounted to 2012 Dollars)				**$ 0.033**	**$ 0.033**	**$ 0.033**	**$ 0.033**	**$ 0.033**	**$ 0.033**	**$ 0.033**	**$ 0.033**	**$ 0.033**	**$ 0.033**
Revised Cost of Energy to Moorefield with RECs($/kWh)													
Nominal Year Dollars				**$ (0.066)**	**$ (0.014)**	**$ 0.008**	**$ 0.019**	**$ 0.026**	**$ 0.031**	**$ 0.036**	**$ 0.039**	**$ 0.040**	**$ 0.041**
Present Value (Discounted to 2012 Dollars)				**$ (0.065)**	**$ (0.014)**	**$ 0.007**	**$ 0.018**	**$ 0.023**	**$ 0.028**	**$ 0.031**	**$ 0.033**	**$ 0.034**	**$ 0.034**
Avoided Cost Estimate for Extension of Landfill Life													
Avoided Tons of Waste				87,308	87,308	87,308	87,308	87,308	87,308	87,308	87,308	87,308	87,308
Cost Avoided Per Ton of Waste[3]				$ 23.71	$ 24.18	$ 24.67	$ 25.16	$ 25.67	$ 26.18	$ 26.70	$ 27.24	$ 27.78	$ 28.34
Nominal Year Value of Avoided Cost				$ 2,070,141	$ 2,111,544	$ 2,153,775	$ 2,196,850	$ 2,240,787	$ 2,285,603	$ 2,331,315	$ 2,377,941	$ 2,425,500	$ 2,474,010
Present Value (Discounted to 2012 Dollars)				$ 2,029,550	$ 2,029,550	$ 2,029,550	$ 2,029,550	$ 2,029,550	$ 2,029,550	$ 2,029,550	$ 2,029,550	$ 2,029,550	$ 2,029,550

	2023	2024	2025	2026	2027	2028	2029	2030	2031	2032
Escalation Factors										
Inflation	2%	2%	2%	2%	2%	2%	2%	2%	2%	2%
Fuel Cost Escalation	2%	2%	2%	2%	2%	2%	2%	2%	2%	2%
Power Purchase Escalation Cost	2%	2%	2%	2%	2%	2%	2%	2%	2%	2%
Tip Fee Escalation	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%
Drivers and Inputs										
Electricity Generated	80,592	80,592	80,592	80,592	80,592	80,592	80,592	80,592	80,592	80,592
Electricity Delivered	77,586	77,586	77,586	77,586	77,586	77,586	77,586	77,586	77,586	77,586
Moorefield Consumption Forecast	120,639	131,264	141,401	150,786	159,725	168,403	177,052	185,474	193,539	201,226
Fuel Consumption	87,308	87,308	87,308	87,308	87,308	87,308	87,308	87,308	87,308	87,308
Amount of Loudoun County MSW utilized	87,308	87,308	87,308	87,308	87,308	87,308	87,308	87,308	87,308	87,308
Additional Fuel Source (if Needed)	-	-	-	-	-	-	-	-	-	-
Fuel Cost	$ 49.73	$ 50.73	$ 51.74	$ 52.78	$ 53.83	$ 54.91	$ 56.01	$ 57.13	$ 58.27	$ 59.44
Tip Fee for WTE Facility (or Portion of Current Fee)	$ 30.00	$ 30.00	$ 30.00	$ 30.00	$ 30.00	$ 30.00	$ 30.00	$ 30.00	$ 30.00	$ 30.00
Power Purchase Agreement (Net Meter)	$ 62.17	$ 63.41	$ 64.68	$ 65.97	$ 67.29	$ 68.64	$ 70.01	$ 71.41	$ 72.84	$ 74.30
Renewable Energy Credit Pricing	$ 5.00	$ 5.00	$ 5.00	$ 5.00	$ 5.00	$ 5.00	$ 5.00	$ 5.00	$ 5.00	$ 5.00
Expenses										
Debt Service (P&I)	3,156,511	3,156,511	3,156,511	3,156,511	3,156,511	3,156,511	3,156,511	3,156,511	3,156,511	3,156,511
Fixed O&M	901,854	919,891	938,289	957,055	976,196	995,720	1,015,634	1,035,947	1,056,666	1,077,799
Variable O&M	2,104,326	2,146,413	2,189,341	2,233,128	2,277,791	2,323,346	2,369,813	2,417,210	2,465,554	2,514,865
Fuel	-	-	-	-	-	-	-	-	-	-
Fuel Processing Costs (MSW related only)	-	-	-	-	-	-	-	-	-	-
Subtotal	$ 6,162,692	$ 6,222,815	$ 6,284,142	$ 6,346,694	$6,410,498	$ 6,475,578	$ 6,541,959	$ 6,609,668	$ 6,678,731	$ 6,749,175
Other Revenues										
Tip Fees	2,619,240	2,619,240	2,619,240	2,619,240	2,619,240	2,619,240	2,619,240	2,619,240	2,619,240	2,619,240
Off System Sales (net to grid)	-	-	-	-	-	-	-	-	-	-
Subtotal	$ 2,619,240	$ 2,619,240	$ 2,619,240	$ 2,619,240	$2,619,240	$ 2,619,240	$ 2,619,240	$ 2,619,240	$ 2,619,240	$ 2,619,240
Average Cost of Electricity ($/kWh)[1]										
Nominal Year Dollars	**$ 0.046**	**$ 0.046**	**$ 0.047**	**$ 0.048**	**$ 0.049**	**$ 0.050**	**$ 0.051**	**$ 0.051**	**$ 0.052**	**$ 0.053**
Present Value (Discounted to 2012 Dollars)	**$ 0.037**	**$ 0.037**	**$ 0.037**	**$ 0.036**	**$ 0.036**	**$ 0.036**	**$ 0.036**	**$ 0.036**	**$ 0.036**	**$ 0.036**
Costs to Recover at Moorefield (Net Meter)	$ 3,543,452	$ 3,603,575	$ 3,664,902	$ 3,727,454	$3,791,258	$ 3,856,338	$ 3,922,719	$ 3,990,428	$ 4,059,491	$ 4,129,935
Cost of Energy to Moorefield ($/kWh)[2]										
Nominal Year Dollars	**$ 0.046**	**$ 0.046**	**$ 0.047**	**$ 0.048**	**$ 0.049**	**$ 0.050**	**$ 0.051**	**$ 0.051**	**$ 0.052**	**$ 0.053**
Present Value (Discounted to 2012 Dollars)	**$ 0.037**	**$ 0.037**	**$ 0.037**	**$ 0.036**	**$ 0.036**	**$ 0.036**	**$ 0.036**	**$ 0.036**	**$ 0.036**	**$ 0.036**
Potential REC Revenue (Reduces Cost of Energy)	$ 402,960	$ 402,960	$ 402,960	$ 402,960	$ 402,960	$ 402,960	$ 402,960	$ 402,960	$ 402,960	$ 402,960
Revised Average Cost of Electricity with RECS ($/kWh)										
Nominal Year Dollars	**$ 0.040**	**$ 0.041**	**$ 0.042**	**$ 0.043**	**$ 0.044**	**$ 0.045**	**$ 0.045**	**$ 0.046**	**$ 0.047**	**$ 0.048**
Present Value (Discounted to 2012 Dollars)	**$ 0.033**	**$ 0.033**	**$ 0.033**	**$ 0.032**	**$ 0.032**	**$ 0.032**	**$ 0.032**	**$ 0.032**	**$ 0.032**	**$ 0.032**
Revised Cost of Energy to Moorefield with RECs($/kWh)										
Nominal Year Dollars	**$ 0.042**	**$ 0.043**	**$ 0.044**	**$ 0.045**	**$ 0.046**	**$ 0.047**	**$ 0.048**	**$ 0.049**	**$ 0.050**	**$ 0.051**
Present Value (Discounted to 2012 Dollars)	**$ 0.034**	**$ 0.034**	**$ 0.034**	**$ 0.034**	**$ 0.034**	**$ 0.034**	**$ 0.034**	**$ 0.034**	**$ 0.034**	**$ 0.034**
Avoided Cost Estimate for Extension of Landfill Life										
Avoided Tons of Waste	87,308	87,308	87,308	87,308	87,308	87,308	87,308	87,308	87,308	87,308
Cost Avoided Per Ton of Waste[3]	$ 28.90	$ 29.48	$ 30.07	$ 30.67	$ 31.29	$ 31.91	$ 32.55	$ 33.20	$ 33.86	$ 34.54
Nominal Year Value of Avoided Cost	$ 2,523,490	$ 2,573,960	$ 2,625,439	$ 2,677,948	$2,731,507	$ 2,786,137	$ 2,841,860	$ 2,898,697	$ 2,956,671	$ 3,015,805
Present Value (Discounted to 2012 Dollars)	$ 2,029,550	$ 2,029,550	$ 2,029,550	$ 2,029,550	$2,029,550	$ 2,029,550	$ 2,029,550	$ 2,029,550	$ 2,029,550	$ 2,029,550

Notes

1 Average cost of electricity (at Generator) assuming fully connected to Dominion Grid, all power delivered to Dominion (no net metering). Does NOT include transmission, distribution, customer, franchise fee costs from Dominion.

2 Average cost of electricity assuming 'net metering' for CHP; electricity consumed by Moorefield Station, excess is sent to Dominion Grid. Recover costs through Moorefield Station tenants and a PPA with Dominion for the excess electricity available each year.

3 Avoided Landfill costs are capital costs only for landfill construction. The avoided cost calculation does not include any changes to O&M costs or personnel.

Financial and Environmental Model and Forecast

Waste to Energy Power (Autoclave and conventional boilers system)

Project Description

Waste to energy or refuse derived power is considered to be a renewable energy source in Virginia and carbon neutral. As an alternative to the EPOD plasma arc technology, a conventional refuse derived power plant with an autoclave could be used. In this alternative, the current municipal solid waste (MSW) stream is diverted from the landfill, processed and sterilized to provide a fuel feedstock to be used in a furnace or fluidized bed where it is combusted to generate heat and produce steam through a boiler. The steam is used to drive a steam turbine generator to generated electricity and power. An autoclave is used to pretreat MSW and remove / divert glass, metal and plastics from the waste stream to be recycled. An autoclave applies high pressure saturated steam to municipal solid waste in a pressure vessel in order to convert the waste to an organic fiber while the plastics, glass and metals are sterilized and separated from the fiber feedstock with screens so they can be recycled. The autoclave process improves the quality of the MSW feedstock by sterilizing and removing plastics which can negatively impact boiler performance while further increasing county diversion and recycling rates. The steam for the autoclave is provided by a heat recovery steam generator (HRSG) which uses the exhaust heat from the power generation process to generate steam for the autoclave. As the autoclave steam is unrecoverable, significant make up or supply water must be provided to the autoclave.

Base Case Results			
GHG Emissions			
BAU at Full Buildout	137,665	MTCO2e Annually	
Reductions from Option	38,684	MTCO2e Annually	
Percent Emissions Reduction	28%		
NOx Decrease (Increase) in Emissions	(179)	MTons Annually	
SO2 Decrease (Increase) in Emissions	57	MTons Annually	
Renewable Energy Produced	80,592	MWh Annually	
Waste Reduction			
Annual Reduction	87,308	Tons Annually	
Portion of Avg. Annual Waste Reduced	65%	of total LCLF waste	
All-in Average Cost of Energy			
Without RECs	$ 0.038	per kWh	Note: Does not include transmission, distribution, customer and franchise fee costs from local utility (LDC) ~ $0.02-$0.04/kWh
With RECs	$ 0.034	per kWh[1]	
Average Cost of Energy to MS (net meter)			
Without RECs	$ 0.038	per kWh	Not including first 5 years of minimal MS occupancy
With RECs	$ 0.036	per kWh[2]	
Impact to Landfill Life (e.g. addt'l diversion)			
Percent Life Extension	65%	Extension to Landfill Life	
Years Extended	7	years beyond 2021	
NPV of Deferred Costs	$ 40,591,000	Equates to approx. $23/T of tip fee for capital costs of LF.	

1. Assumes owner/operator (e.g. Dominion) receives all REC revenues.
2. Assumes Moorefield Station / Loudoun County Receive ALL REC revenues

Assumes CHP is nonprofit (municipal utility); if partnering with Dominion a rate of recovery would be added (i.e. profit)

Scenario Results	Avg. Cost of Energy	
Base Case	$ 0.038	per kWh
Reduced Tip Fees ($10/Ton)	$ 0.057	per kWh
No Tip Fees Included	$ 0.066	per kWh
Incl. RECs at High Price $5/MWh	$ 0.034	per kWh

	Units	Base Case Inputs / Input	2012 Inputs	2013	2014	2015	2016	2017	2018	2019	2020	2021	2022	2023	2024	2025	2026	2027	2028	2029	2030	2031	2032
Escalation Factors																							
Inflation		2%	2%	2%	2%	2%	2%	2%	2%	2%	2%	2%	2%	2%	2%	2%	2%	2%	2%	2%	2%	2%	2%
Fuel Cost Escalation		2%	2%	2%	2%	2%	2%	2%	2%	2%	2%	2%	2%	2%	2%	2%	2%	2%	2%	2%	2%	2%	2%
Power Purchase Escalation Cost	%	2%	2%	2%	2%	2%	2%	2%	2%	2%	2%	2%	2%	2%	2%	2%	2%	2%	2%	2%	2%	2%	2%
Tip Fee Escalation	%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%
Drivers and Inputs	**Units**	Base Case Inputs	**Inputs**																				
Size of Facility	MW	Assumptions & Input	10																				
Capacity Factor	%	92%	92%																				
Estimated T&D Losses	%	Assumptions & Input	4%																				
Electricity Generated	MWh	Calculated	80,592	80,592	80,592	80,592	80,592	80,592	80,592	80,592	80,592	80,592	80,592	80,592	80,592	80,592	80,592	80,592	80,592	80,592	80,592	80,592	80,592
Electricity Delivered	MWh	Calculated	77,586	77,586	77,586	77,586	77,586	77,586	77,586	77,586	77,586	77,586	77,586	77,586	77,586	77,586	77,586	77,586	77,586	77,586	77,586	77,586	77,586
Moorefield Consumption Forecast	MWh	Assumptions & Input	5,059	11,583	20,933	31,149	41,422	50,380	60,104	71,585	86,081	97,654	109,816	120,639	131,264	141,401	150,786	159,725	168,403	177,052	185,474	193,539	201,226
Fuel Consumption	Tons / Yr	Calculated	87,308	87,308	87,308	87,308	87,308	87,308	87,308	87,308	87,308	87,308	87,308	87,308	87,308	87,308	87,308	87,308	87,308	87,308	87,308	87,308	87,308
Desired Portion of MSW Diverted to RDF Power Plant	%	100%	100%																				
Amount of Loudoun County MSW utilized	Tons / Yr	Calculated	87,308	87,308	87,308	87,308	87,308	87,308	87,308	87,308	87,308	87,308	87,308	87,308	87,308	87,308	87,308	87,308	87,308	87,308	87,308	87,308	87,308
Loudoun County MSW Enough for WTE?		Calculated	YES																				
Additional Fuel Source (if Needed)	Ton	Calculated	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Fuel Cost	$/Ton	$40	$40	$ 40.80	$ 41.62	$ 42.45	$ 43.30	$ 44.16	$ 45.05	$ 45.95	$ 46.87	$ 47.80	$ 48.76	$ 49.73	$ 50.73	$ 51.74	$ 52.78	$ 53.83	$ 54.91	$ 56.01	$ 57.13	$ 58.27	$ 59.44
Tip Fee for WTE Facility (or Portion of Current Fee)	$/Ton	$30	$30	$ 30.00	$ 30.00	$ 30.00	$ 30.00	$ 30.00	$ 30.00	$ 30.00	$ 30.00	$ 30.00	$ 30.00	$ 30.00	$ 30.00	$ 30.00	$ 30.00	$ 30.00	$ 30.00	$ 30.00	$ 30.00	$ 30.00	$ 30.00
Power Purchase Agreement (Net Meter)	$/MWh	$ 50.00	$ 50.00	$ 51.00	$ 52.02	$ 53.06	$ 54.12	$ 55.20	$ 56.31	$ 57.43	$ 58.58	$ 59.75	$ 60.95	$ 62.17	$ 63.41	$ 64.68	$ 65.97	$ 67.29	$ 68.64	$ 70.01	$ 71.41	$ 72.84	$ 74.30
Renewable Energy Credit Pricing	$/MWh	$ 5.00	$ 5.00	$ 5.00	$ 5.00	$ 5.00	$ 5.00	$ 5.00	$ 5.00	$ 5.00	$ 5.00	$ 5.00	$ 5.00	$ 5.00	$ 5.00	$ 5.00	$ 5.00	$ 5.00	$ 5.00	$ 5.00	$ 5.00	$ 5.00	$ 5.00
Expenses																							
Debt Service (P&I)				1,918,643	1,918,643	1,918,643	1,918,643	1,918,643	1,918,643	1,918,643	1,918,643	1,918,643	1,918,643	1,918,643	1,918,643	1,918,643	1,918,643	1,918,643	1,918,643	1,918,643	1,918,643	1,918,643	1,918,643
Fixed O&M				986,446	1,006,175	1,026,299	1,046,824	1,067,761	1,089,116	1,110,899	1,133,116	1,155,779	1,178,894	1,202,472	1,226,522	1,251,052	1,276,073	1,301,595	1,327,627	1,354,179	1,381,263	1,408,888	1,437,066
Variable O&M				2,301,708	2,347,742	2,394,697	2,442,590	2,491,442	2,541,271	2,592,097	2,643,938	2,696,817	2,750,754	2,805,769	2,861,884	2,919,122	2,977,504	3,037,054	3,097,795	3,159,751	3,222,946	3,287,405	3,353,153
Make up water for autoclave				315,663	321,976	328,416	334,984	341,684	348,517	355,488	362,597	369,849	377,246	384,791	392,487	400,337	408,343	416,510	424,840	433,337	442,004	450,844	459,861
Fuel				-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Fuel Processing Costs (MSW related only)				-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Subtotal				$ 5,522,460	$ 5,594,536	$ 5,668,054	$ 5,743,042	$ 5,819,530	$ 5,897,548	$ 5,977,126	$ 6,058,296	$ 6,141,089	$ 6,225,538	$ 6,311,675	$ 6,399,536	$ 6,489,154	$ 6,580,564	$ 6,673,803	$ 6,768,906	$ 6,865,911	$ 6,964,856	$ 7,065,781	$ 7,168,723
Other Revenues																							
Tip Fees				2,619,240	2,619,240	2,619,240	2,619,240	2,619,240	2,619,240	2,619,240	2,619,240	2,619,240	2,619,240	2,619,240	2,619,240	2,619,240	2,619,240	2,619,240	2,619,240	2,619,240	2,619,240	2,619,240	2,619,240
Off System Sales (net to grid)				3,366,153	2,947,059	2,463,963	1,957,236	1,501,852	984,366	344,647	-	-	-	-	-	-	-	-	-	-	-	-	-
Subtotal				$ 5,985,393	$ 5,566,299	$ 5,083,203	$ 4,576,476	$ 4,121,092	$ 3,603,606	$ 2,963,887	$ 2,619,240	$ 2,619,240	$ 2,619,240	$ 2,619,240	$ 2,619,240	$ 2,619,240	$ 2,619,240	$ 2,619,240	$ 2,619,240	$ 2,619,240	$ 2,619,240	$ 2,619,240	$ 2,619,240
Average Cost of Electricity ($/kWh)[1]																							
Nominal Year Dollars				$ 0.037	$ 0.038	$ 0.039	$ 0.040	$ 0.041	$ 0.042	$ 0.043	$ 0.044	$ 0.045	$ 0.046	$ 0.048	$ 0.049	$ 0.050	$ 0.051	$ 0.052	$ 0.053	$ 0.055	$ 0.056	$ 0.057	$ 0.059
Present Value (Discounted to 2012 Dollars)				$ 0.037	$ 0.037	$ 0.037	$ 0.037	$ 0.037	$ 0.038	$ 0.038	$ 0.038	$ 0.038	$ 0.038	$ 0.038	$ 0.038	$ 0.039	$ 0.039	$ 0.039	$ 0.039	$ 0.039	$ 0.039	$ 0.039	$ 0.039
Costs to Recover at Moorefield (Net Meter)				$ (462,933)	$ 28,237	$ 584,851	$ 1,166,566	$ 1,698,438	$ 2,293,942	$ 3,013,239	$ 3,439,056	$ 3,521,849	$ 3,606,298	$ 3,692,435	$ 3,780,296	$ 3,869,914	$ 3,961,324	$ 4,054,563	$ 4,149,666	$ 4,246,671	$ 4,345,616	$ 4,446,541	$ 4,549,483
Cost of Energy to Moorefield ($/kWh)[2]																							
Nominal Year Dollars				$ (0.040)	$ 0.001	$ 0.019	$ 0.028	$ 0.034	$ 0.038	$ 0.042	$ 0.044	$ 0.045	$ 0.046	$ 0.048	$ 0.049	$ 0.050	$ 0.051	$ 0.052	$ 0.053	$ 0.055	$ 0.056	$ 0.057	$ 0.059
Present Value (Discounted to 2012 Dollars)				$ (0.039)	$ 0.001	$ 0.018	$ 0.026	$ 0.031	$ 0.034	$ 0.037	$ 0.038	$ 0.038	$ 0.038	$ 0.038	$ 0.038	$ 0.039	$ 0.039	$ 0.039	$ 0.039	$ 0.039	$ 0.039	$ 0.039	$ 0.039
Potential REC Revenue (Reduces Cost of Energy)				$ 402,960	$ 402,960	$ 402,960	$ 402,960	$ 402,960	$ 402,960	$ 402,960	$ 402,960	$ 402,960	$ 402,960	$ 402,960	$ 402,960	$ 402,960	$ 402,960	$ 402,960	$ 402,960	$ 402,960	$ 402,960	$ 402,960	$ 402,960
Revised Average Cost of Electricity with RECS ($/kWh)																							
Nominal Year Dollars				$ 0.032	$ 0.033	$ 0.034	$ 0.035	$ 0.036	$ 0.037	$ 0.038	$ 0.039	$ 0.040	$ 0.041	$ 0.042	$ 0.044	$ 0.045	$ 0.046	$ 0.047	$ 0.048	$ 0.050	$ 0.051	$ 0.052	$ 0.053
Present Value (Discounted to 2012 Dollars)				$ 0.032	$ 0.032	$ 0.032	$ 0.032	$ 0.033	$ 0.033	$ 0.033	$ 0.033	$ 0.034	$ 0.034	$ 0.034	$ 0.034	$ 0.035	$ 0.035	$ 0.035	$ 0.035	$ 0.035	$ 0.036	$ 0.036	$ 0.036
Revised Cost of Energy to Moorefield with RECs($/kWh)																							
Nominal Year Dollars				$ (0.075)	$ (0.018)	$ 0.006	$ 0.018	$ 0.026	$ 0.031	$ 0.036	$ 0.040	$ 0.041	$ 0.043	$ 0.044	$ 0.046	$ 0.047	$ 0.048	$ 0.050	$ 0.051	$ 0.052	$ 0.054	$ 0.055	$ 0.057
Present Value (Discounted to 2012 Dollars)				$ (0.073)	$ (0.017)	$ 0.006	$ 0.017	$ 0.023	$ 0.028	$ 0.032	$ 0.034	$ 0.035	$ 0.035	$ 0.036	$ 0.036	$ 0.036	$ 0.037	$ 0.037	$ 0.037	$ 0.037	$ 0.038	$ 0.038	$ 0.038
Avoided Cost Estimate for Extension of Landfill Life																							
Avoided Tons of Waste				87,308	87,308	87,308	87,308	87,308	87,308	87,308	87,308	87,308	87,308	87,308	87,308	87,308	87,308	87,308	87,308	87,308	87,308	87,308	87,308
Cost Avoided Per Ton of Waste[3]				$ 23.71	$ 24.18	$ 24.67	$ 25.16	$ 25.67	$ 26.18	$ 26.70	$ 27.24	$ 27.78	$ 28.34	$ 28.90	$ 29.48	$ 30.07	$ 30.67	$ 31.29	$ 31.91	$ 32.55	$ 33.20	$ 33.86	$ 34.54
Nominal Year Value of Avoided Cost				$ 2,070,141	$ 2,111,544	$ 2,153,775	$ 2,196,850	$ 2,240,787	$ 2,285,603	$ 2,331,315	$ 2,377,941	$ 2,425,500	$ 2,474,010	$ 2,523,490	$ 2,573,960	$ 2,625,439	$ 2,677,948	$ 2,731,507	$ 2,786,137	$ 2,841,860	$ 2,898,697	$ 2,956,671	$ 3,015,805
Present Value (Discounted to 2012 Dollars)				$ 2,029,550	$ 2,029,550	$ 2,029,550	$ 2,029,550	$ 2,029,550	$ 2,029,550	$ 2,029,550	$ 2,029,550	$ 2,029,550	$ 2,029,550	$ 2,029,550	$ 2,029,550	$ 2,029,550	$ 2,029,550	$ 2,029,550	$ 2,029,550	$ 2,029,550	$ 2,029,550	$ 2,029,550	$ 2,029,550

Notes

1 Average cost of electricity (at Generator) assuming fully connected to Dominion Grid, all power delivered to Dominion (no net metering). Does NOT include transmission, distribution, customer, franchise fee costs from Dominion.

2 Average cost of electricity assuming 'net metering' for CHP; electricity consumed by Moorefield Station, excess is sent to Dominion Grid. Recover costs through Moorefield Station tenants and a PPA with Dominion for the excess electricity available each year.

3 Avoided Landfill costs are capital costs only for landfill construction. The avoided cost calculation does not include any changes to O&M costs or personnel.

Financial and Environmental Model and Forecast

Non Potable Water System

Project Description
Using alternative sources (non potable) of water to reduce peak / peak day treated water demand from Loudoun Water provides an opportunity to reduce treated water peak demands, conserve water and reduce costs. The existing Moorefield Station plans include stormwater detention ponds and additional features to manage stormwater quantity and quality on the site. The two stormwater detention ponds would be utilized and likely modified to provide non potable water storage for local irrigation and mechanical (HVAC) cooling needs. The non potable water system includes pumps, piping, minimal treatment to deliver water to three delivery points as shown in the picture below. Any additional treatment for cooling applications or localized irrigation is implemented at the point of consumption (i.e. not included).

Case Results				
GHG Emissions				
BAU at Full Buildout		137,665	MTCO2e Annually	
Reductions from Option		-	MTCO2e Annually	
Percent Emissions Reduction		0%		
Water Conserved				
Conservation		28,974	000s Gal / Year	
Potential Peak Reduction at Consumer		189	000s Gal/day	
Avg. Cost of Water Delivered	$	3.68	per 1,000 gallons	Current Loudoun Water ~$2-$5 per 1,000gal (tiers)
Peak Day Reduction for Loudoun Water				
Non Potable System Reduction:		203	000s Gal/day	
Portion of Loudoun Peak Day:		0.5%	LW 38.6 MGD Peak	

Scenario Results	Avg. Cost of Water Delivered		
Base Case	$	3.68	per 1,000 gallons
50% reduction in water storage/availability	$	7.37	per 1,000 gallons

	Units	Base Case Inputs	2012	2013	2014	2015	2016	2017	2018	2019	2020	2021	2022
	Units	Input	Inputs										
Escalation Factors													
Inflation	%	2%	2%	2%	2%	2%	2%	2%	2%	2%	2%	2%	2%
Electric Rate Escalation	%	3%	3%	3%	3%	3%	3%	3%	3%	3%	3%	3%	3%
	%			0%	0%	0%	0%	0%	0%	0%	0%	0%	0%
	%			0%	0%	0%	0%	0%	0%	0%	0%	0%	0%
Drivers and Inputs	**Units**	Base Case Inputs	**Inputs**										
Electric Rates	$/kWh	$0.090	$0.090	$ 0.093	$ 0.095	$ 0.098	$ 0.101	$ 0.104	$ 0.107	$ 0.111	$ 0.114	$ 0.117	$ 0.121
Electric Consumption	kWh	Assumptions and Inputs	17,384	17,384	17,384	17,384	17,384	17,384	17,384	17,384	17,384	17,384	17,384
Water Supplied for Irrigation	Gal / Day	Assumptions and Inputs	159,000	159,000	159,000	159,000	159,000	159,000	159,000	159,000	159,000	159,000	159,000
Water Supplied for Cooling (HVAC Cooling Towers)	Gal / Day	Assumptions and Inputs	30,000	30,000	30,000	30,000	30,000	30,000	30,000	30,000	30,000	30,000	30,000
Adjusted Water Supply Available (avg/yr)	%	100%	100%										
Total Water Supplied to Development	Gal / Day	Calculated	189,000	189,000	189,000	189,000	189,000	189,000	189,000	189,000	189,000	189,000	189,000
Expenses													
Debt Service (P&I)				70,003	70,003	70,003	70,003	70,003	70,003	70,003	70,003	70,003	70,003
Fixed O&M				75,000	76,500	78,030	79,591	81,182	82,806	84,462	86,151	87,874	89,632
Electric O&M				1,612	1,660	1,710	1,761	1,814	1,868	1,924	1,982	2,041	2,103
Total				$ 146,615	$ 148,163	$ 149,743	$ 151,355	$ 152,999	$ 154,677	$ 156,390	$ 158,137	$ 159,919	$ 161,738
Average Cost of Water Delivered ($/1,000gal)													
Nominal Year Dollars				**$ 5.06**	**$ 5.11**	**$ 5.17**	**$ 5.22**	**$ 5.28**	**$ 5.34**	**$ 5.40**	**$ 5.46**	**$ 5.52**	**$ 5.58**
Present Value (Discounted to 2012 Dollars)				**$ 4.96**	**$ 4.92**	**$ 4.87**	**$ 4.83**	**$ 4.78**	**$ 4.74**	**$ 4.70**	**$ 4.66**	**$ 4.62**	**$ 4.58**

	2023	2024	2025	2026	2027	2028	2029	2030	2031	2032
Escalation Factors										
Inflation	2%	2%	2%	2%	2%	2%	2%	2%	2%	2%
Electric Rate Escalation	3%	3%	3%	3%	3%	3%	3%	3%	3%	3%
	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%
	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%
Drivers and Inputs										
Electric Rates	$ 0.125	$ 0.128	$ 0.132	$ 0.136	$ 0.140	$ 0.144	$ 0.149	$ 0.153	$ 0.158	$ 0.163
Electric Consumption	17,384	17,384	17,384	17,384	17,384	17,384	17,384	17,384	17,384	17,384
Water Supplied for Irrigation	159,000	159,000	159,000	159,000	159,000	159,000	159,000	159,000	159,000	159,000
Water Supplied for Cooling (HVAC Cooling Towers)	30,000	30,000	30,000	30,000	30,000	30,000	30,000	30,000	30,000	30,000
Adjusted Water Supply Available (avg/yr)										
Total Water Supplied to Development	189,000	189,000	189,000	189,000	189,000	189,000	189,000	189,000	189,000	189,000
Expenses										
Debt Service (P&I)	-	-	-	-	-	-	-	-	-	-
Fixed O&M	91,425	93,253	95,118	97,020	98,961	100,940	102,959	105,018	107,118	109,261
Electric O&M	2,166	2,231	2,298	2,367	2,438	2,511	2,586	2,664	2,744	2,826
Total	$ 93,590	$ 95,484	$ 97,416	$ 99,387	$ 101,398	$ 103,451	$ 105,545	$ 107,682	$ 109,862	$ 112,087
Average Cost of Water Delivered ($/1,000gal)										
Nominal Year Dollars	**$ 3.23**	**$ 3.30**	**$ 3.36**	**$ 3.43**	**$ 3.50**	**$ 3.57**	**$ 3.64**	**$ 3.72**	**$ 3.79**	**$ 3.87**
Present Value (Discounted to 2012 Dollars)	**$ 2.60**	**$ 2.60**	**$ 2.60**	**$ 2.60**	**$ 2.60**	**$ 2.60**	**$ 2.60**	**$ 2.60**	**$ 2.60**	**$ 2.60**

Financial and Environmental Model and Forecast

Improved Energy Code

Results of Improved Energy Code (BAU - Improved Code)			
Energy Use	**BAU**	**Improved Code**	**Difference**
Electricity (MWhs)	251,724	222,618	-12%
Natural Gas (Therms)	2,864,047	2,376,022	-17%
Emission Reductions	**Electric**	**Natural Gas**	**Total**
GHG (mTons)	13,971	2,589	16,560
Nox (mTons)	15	NA	15
SO2 (mTons)	36		36
Energy Unit Costs			
Electric	**Approximate Current Rates ($/kWh)**	**Cost per Unit for Reductions ($/kWh)**	**Difference**
Commercial	$ 0.09	$ 0.37	408%
Multi Family	$ 0.09	$ 0.23	256%
Single Family Attached	$ 0.09	$ 0.47	527%
Natural Gas	**Approximate Current Rates ($/therm)**	**Cost per Unit for Reductions ($/therm)**	**Difference**
Commercial	$ 0.08	$ 13.42	16774%
Multi Family	$ 0.08	$ 0.12	150%
Single Family Attached	$ 0.08	$ 1.25	1563%

Trane Tracer Energy Model Simulations:

Commercial High Rise ECM	Business As Usual (BAU Case) System	Annual Electricity Consumption	Annual Gas Consumption	Total Building Energy	Estimated Cost ($) of	Case 2: System	Annual Electricity	Annual Gas Consumption	Total Building Energy	Cost ($)	Cost Difference ($)
ECM-1:10% LPD reduction - 0.8 w/sq.ft.	T8 Fixtures				1,872,000	T5 Fixtures				2,601,600	729,600
ECM-2: VAV with perimeter heat instead of reheat	VAV with Reheat				4,685,000	VAV with perimeter heat				4,824,000	139,000
ECM-3: Economizer (On when outside air is 65F)	No Economizer				4,685,000	Economizer				4,824,000	139,000
ECM-4: Revised chiller kW/ton reduced from 0.717 to 0.468	Screw chiller				4,685,000	Screw chiller				4,824,000	139,000
ECM-4: Revised HW Boiler % increased from 80 to 86	Natural gas fired boiler				4,685,000	Natural gas fired boiler				4,939,200	254,200
ECM-5: Revised Domestic HW Boiler % increased from 80 to 96	Natural gas fired heater				4,697,000	Natural gas fired heater				4,957,200	260,200
		2,963,020	2,077	3,567,157	25,309,000		2,662,124	1,708	3,162,601	26,970,000	1,661,000
Multi Family Residential (1 building)											
ECM-1: Reduction in glass to wall ratio to 50%	60%				1,797,512	50%				1,643,656	(153,856)
ECM-2: Improved walls; R-19	R-15				28,820	R-19				36,357	7,537
ECM-3: 20% LPD reduction - 0.52 w/sq.ft.	Incandescent				879,936	Compact Fluorescent				1,275,904	395,968
ECM-4: Revised HVAC system	DX System				2,079,800	Higher Efficiency PTAC				2,296,140	216,340
ECM-5: Revised Domestic HW Boiler % from 80 to 96	80% Efficient				12,000	96% Efficient				18,000	6,000
		1,624,259	2,904	2,475,425	4,798,068		1,368,525	2,423	2,078,519	5,270,057	471,989
Townhouses (2 units)											
ECM-1: Improved walls; R-15	R-12				1,530	R-15				1,740	210
ECM-2: 20% LPD reduction - 0.52 w/sq.ft.	Incandescent				32,340	Compact Fluorescent				46,288	13,948
ECM-3: Revised SEER 13 (EER-11)	SEER 11				21,500	SEER 13				22,700	1,200
ECM-4: Revised Domestic HW Boiler % from 80 to 96	80% Efficiency				22,200	96% Efficiency				23,900	1,700
		49,265	79	72,301	77,570		46,188	66	65,384	94,628	17,058

Rate 5% Avg. Discount Rate (commercial and residential)
Term (life of improvements) 15 yrs

Year:	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**13**	**14**	**15**	**16**	**17**
Annualized Cost - Electric																	
Commercial	$110,466	$110,466	$110,466	$110,466	$110,466	$110,466	$110,466	$110,466	$110,466	$110,466	$110,466	$110,466	$110,466	$110,466	$110,466	$0	$0
MF	$58,991	$38,148	$38,148	$38,148	$38,148	$38,148	$38,148	$38,148	$38,148	$38,148	$38,148	$38,148	$38,148	$38,148	$38,148	$0	$0
Townhomes	$1,459	$1,459	$1,459	$1,459	$1,459	$1,459	$1,459	$1,459	$1,459	$1,459	$1,459	$1,459	$1,459	$1,459	$1,459	$0	$0
Annualized Cost - Natural Gas																	
Commercial	$49,558	$49,558	$49,558	$49,558	$49,558	$49,558	$49,558	$49,558	$49,558	$49,558	$49,558	$49,558	$49,558	$49,558	$49,558	$0	$0
MF	$578	$578	$578	$578	$578	$578	$578	$578	$578	$578	$578	$578	$578	$578	$578	$0	$0
Townhomes	$164	$164	$164	$164	$164	$164	$164	$164	$164	$164	$164	$164	$164	$164	$164	$0	$0
Electric Savings (kWh)																	
Commercial	300,896	300,896	300,896	300,896	300,896	300,896	300,896	300,896	300,896	300,896	300,896	300,896	300,896	300,896	300,896	300,896	300,896
MF	255,734	255,734	255,734	255,734	255,734	255,734	255,734	255,734	255,734	255,734	255,734	255,734	255,734	255,734	255,734	255,734	255,734
Townhomes	3,077	3,077	3,077	3,077	3,077	3,077	3,077	3,077	3,077	3,077	3,077	3,077	3,077	3,077	3,077	3,077	3,077
	559,707																
Total energy consumption		251,724 MWh		Percent of total		0.22%											
Natural Gas Savings (mmbtu)																	
Commercial	369	369	369	369	369	369	369	369	369	369	369	369	369	369	369	369	369
MF	482	482	482	482	482	482	482	482	482	482	482	482	482	482	482	482	482
Townhomes	13	13	13	13	13	13	13	13	13	13	13	13	13	13	13	13	13
Cost per kWh Saved																	
Commercial	$ 0.37	$ 0.37	$ 0.37	$ 0.37	$ 0.37	$ 0.37	$ 0.37	$ 0.37	$ 0.37	$ 0.37	$ 0.37	$ 0.37	$ 0.37	$ 0.37	$ 0.37	$ -	$ -
MF	$ 0.23	$ 0.15	$ 0.15	$ 0.15	$ 0.15	$ 0.15	$ 0.15	$ 0.15	$ 0.15	$ 0.15	$ 0.15	$ 0.15	$ 0.15	$ 0.15	$ 0.15	$ -	$ -
Townhomes	$ 0.47	$ 0.47	$ 0.47	$ 0.47	$ 0.47	$ 0.47	$ 0.47	$ 0.47	$ 0.47	$ 0.47	$ 0.47	$ 0.47	$ 0.47	$ 0.47	$ 0.47	$ -	$ -
Cost per Therm Saved (10 therms = 1MMBtu)																	
Commercial	$ 13.42	$ 13.42	$ 13.42	$ 13.42	$ 13.42	$ 13.42	$ 13.42	$ 13.42	$ 13.42	$ 13.42	$ 13.42	$ 13.42	$ 13.42	$ 13.42	$ 13.42	$ -	$ -
MF	$ 0.12	$ 0.12	$ 0.12	$ 0.12	$ 0.12	$ 0.12	$ 0.12	$ 0.12	$ 0.12	$ 0.12	$ 0.12	$ 0.12	$ 0.12	$ 0.12	$ 0.12	$ -	$ -
Townhomes	$ 1.25	$ 1.25	$ 1.25	$ 1.25	$ 1.25	$ 1.25	$ 1.25	$ 1.25	$ 1.25	$ 1.25	$ 1.25	$ 1.25	$ 1.25	$ 1.25	$ 1.25	$ -	$ -

Price of NG delivered ~$0.07-$0.10/therm.

Appendix F: Funding Options Screening

Integrated Energy Management Plan

Loudoun County Energy and Sustainability Plan: Funding Opportunities and Strategies

This memo outlines a variety of funding opportunities or strategies for the energy and sustainability strategies under consideration by Loudoun County. An overview is presented for each option that explains how it works, potential application to the strategies being considered. In some cases, examples are provided where a mechanism appears to not be in practice within Virginia at this time.

Funding Strategy	Discussion	Potential Application
REVOLVING LOAN FUNDS and LOW-INTEREST FINANCING		
PACE (Property-Assessed Clean Energy) / Tax-Lien Financing	PACE financing allows repayment of qualifying expenses for energy efficiency (in some cases water efficiency) through lien-protected assessments on property tax statements. Repayment is generally over a period of 20 years and not accelerated with a sale or foreclosure, thereby transferring to the new property owner. The State of Virginia has the enabling legislation, passed in 2009, that authorizes local governments to establish a loan program to provide financing for clean energy improvements to property owners via local ordinance. Each local government must determine the improvements (distributed generation renewable energy sources or energy efficiency improvements) to be covered by the program, funding sources, interest rates and loan terms, and the repayment method, e.g., water or sewer bill, real property tax assessments, or other. Private lenders may be included in the program. Legislation passed in 2010 (SB 110) clarified that the local government is authorized to place a lien on the property for the amount of the loan and that a local government is able to bundle loans and transfer them to a private financial institution, without impacting the lien. http://leg1.state.va.us/cgi-bin/legp504.exe?000+cod+15.2-958.3 http://leg1.state.va.us/cgi-bin/legp504.exe?101+ful+SB110ER+hil To date, it is understood that no municipalities yet offer PACE financing programs. http://www.dsireusa.org/incentives/incentive.cfm?Incentive_Code=VA20F&re=1&ee=1	*Larger county-wide applications. Might look at a third-party operator to administer program.* *If Developers /new-build have design guidelines and requirements, this more applicable to existing building stock*

<table>
<tr><th>Funding Strategy</th><th>Discussion</th><th>Potential Application</th></tr>
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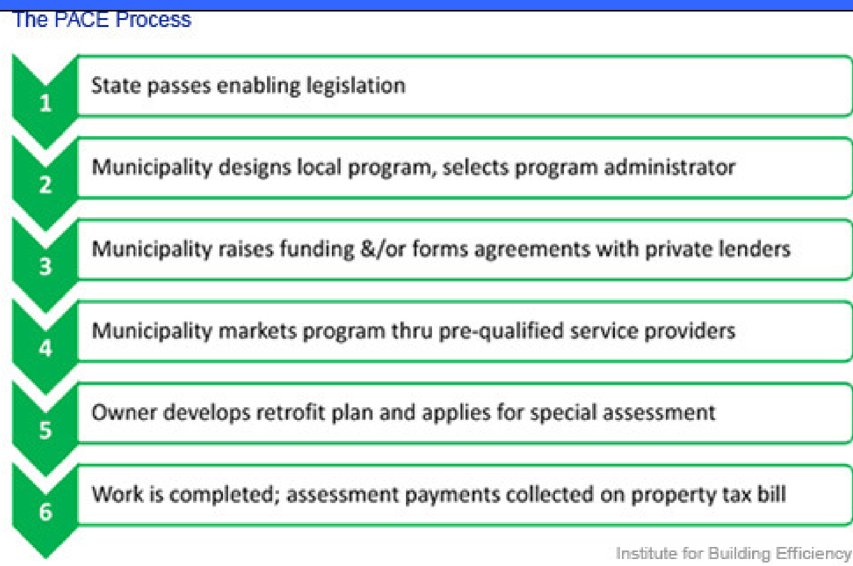

http://www.institutebe.com/clean-energy-finance/pace-finance.aspx

PACE models being implemented are continuing to evolve in response to market conditions. At the most basic level, there are two models that have been employed to-date: public agency-driven and owner-arranged. PACE models have been applied to both the residential and commercial sectors.

Under the initial PACE model, public agencies would provide funding upfront to program participants for approved retrofit improvements. Property owners would apply for inclusion of their project in special assessment districts. The PACE repayment obligations would then be pooled into bond issuances in order to free up additional lending capacity. Many of the initial residential programs used this model. However, since mid-2010, when the Federal Housing Finance Agency (FHFA), the regulator of Fannie Mae and Freddie Mac, ruled that PACE bond repayments would be subordinate to the mortgages, residential programs have stalled. The State of California and a number of municipalities have filed a suit against FHFA claiming FHFA violated the Administrative Procedures Act and the National Environmental Policy Act, and in August 2011. The suit is advancing following a federal judge's decision in August 2011 that the case could proceed. At the same time, a bi-partisan bill, the PACE Assessment Protection Act 2011 was introduced to the House Committee on Financial Services in July 2011. It has been in the Subcommittee on Insurance, Housing and Community

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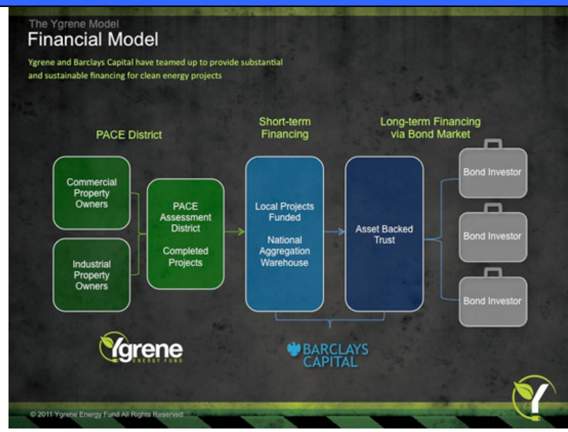
Funding Strategy	Discussion	Potential Application
	Opportunity since August. The bill would require Fannie and Freddie to accept residential retrofits and support growing interest and expansion of PACE programs. As PACE has evolved, a newer owner-arranged model has developed, focusing primarily on the commercial sector. [This appears to be the area that has been advancing since the FHFA ruling]. The transaction is similar to the public model, but relies on private capital, rather than public, taxpayer funding. The property owner finds a private lender group to invest funds in the energy project. The investment is paid with interest through the property-tax assessment. The investors acquire privately-placed bonds secured by the PACE assessment. Energy benchmarking mandates that many cities are adopting may support expansion of PACE commercial programs as better data (and track-records for energy/cost savings) is established. A recently announced example of the private model is the PACE Commercial Consortium, which has received support from Richard Branson's Carbon War Room. Ygrene Energy Fund, based in Santa Rosa, CA, is the finance administrator, partnering with Barclays Capital, Lockheed Martin, Energi and Hannover Re. [*Note, remains to be seen how successful the program will work out. Some locations require lender consent for commercial loans so there may still be pushback from banking regulators.]* The Consortium's pilot programs will be with Miami-Dade County, FL ($550 million) and Sacramento, CA ($100M). The Consortium has exclusive rights for 5-years to offer energy upgrades. Property owners will have no upfront capital outlay, but then pay back at ~7% interest in their assessments. Barclays Capital will offer short-term loans, and then package completed projects into long-term bonds they market. Lockhead Martin, as engineering partner, will provide guarantees on any technology installed. Contractors (to be screened and monitored by the Consortium) will provide performance warranties for utility savings, which Energi, an insurance underwriter, will back. IN turn, Hannover Re will back the insurance contracts.	

Funding Strategy	Discussion	Potential Application
	 	
Revolving Loan Funds	Revolving loan programs take a dedicated funding allocation to loan towards specific types of projects. Loan repayment (with interest) replenishes the fund for sponsoring future projects. In the case of "Green Revolving Loan Programs" approved loan recipients would use the money to install renewable energy sources, or upgrade / weatherize existing equipment. Energy audits may be required as part of the project. There appear to be few energy-specific revolving loan funds currently operating in Virginia. There are however, a number of state-operated revolving loan funds operated by the Virginia Resources Authority that focus on clean water, drinking water and storm water. These are profiled below. The National Association of State Energy Officials (NASEO), an organization of governor-designated energy officials from each state and territory, has established a State Energy Loan Fund database to track revolving loan programs run by state energy offices. There are reportedly 66 funds available in 34 states. The State of Virginia received $3,000,000 from the American Recovery and Investment Act Energy Efficiency and Conservation Block Grant (EECBG) to fund a Building Retrofit Program. http://www.naseo.org/resources/selfs/state.aspx?State=VA www.dmme.virginia.gov/divisionenergy.shtml Alexandria, Virginia is understood to be considering the creation of a Green Revolving Loan Program.	*They might consider establishing one – doesn't seem to really have a large one, but as per comment below – I want to better understand what their block grants have been allocated to already.*

Funding Strategy	Discussion	Potential Application
	It was included in the strategies assessed in their Energy and Climate Change Action Plan 2012 – 2020 report published in April 2011.	

Action Name:	Green Revolving Loan Program					
Action ID:	C.1.5					
Sector:	Community Residential					
Action Origin:	EAP, Energy Principle, Goal 2. EECBG Project #2.					
Energy Savings:	2012	152 MWh	**CO2e Reductions:**	2012	116	tonnes
	2020	2,050 MWh		2020	1,561	tonnes
Capital Costs:	2010-2012	46,200	**Operating Costs:**	2012	($21,677)	Cost Savings
	2013-2020	624,024		2020	($292,792)	Cost Savings
Payback Period:	2.1	years				

DRAFT

Action Description:

Revolving loan programs provide sources of money from which loans are made for installation of green technologies such as energy efficient windows, weatherization, or solar panels. Energy audits may also be a component of this program. A revolving energy fund is a sum of money dedicated to energy efficiency, clean energy, or other energy reduction measures, that is loaned out to qualified applicants. Money borrowed from the fund is replenished via loan and interest (if relevant) repayments for a predetermined set of time. Revolving energy funds (REFs) can be structured in a variety of ways with an array of overarching objectives. Regardless of their structure, REFs provide a unique opportunity for municipalities to guarantee a continual stream of funds for energy efficiency, conservation, and clean energy work without tapping into existing capital cycles.

Energy Assumptions and Calculations:

In 2006, there are 21,754 single family housing unit and 17,039 condominium apartments in Alexandria. EPA estimates that average household energy consumption in the South can be reduced by about 4,600 kWh of electricity and 200 therms of natural gas at an average cost per participant of about $6,000. With $200,000 available in the revolving loan fund, it is estimated that 33 homes (0.08% of all Alexandria single family homes and condos) can be retrofitted. Retrofitting 33 units will result in energy savings of 151,800 KWh and 6,600 therms.

Year	# of Single Family Homes	Cumul. Participation Rate	Cumul. Participants	Per Participant Energy Savings (KWh)	Total Electric Savings (MWh)	Per Participant Gas Savings (MMBtu)	Total Gas Savings (MMBtu)
FY2006	38,793						
Projected 2012	39,530	0.08%	33	4,600	152	20	660
Projected 2020	44,573	1.0%	446	4,600	2,050	20	8,915

GHG Emission Reduction Calculations:

ICLEI's *Local Government Operations Protocol*, Table G.7 shows that to CO2e emission factor for electricity generated in Virginia is 0.5285 tonnes per MWh; Table G.1 shows the factor for natural gas combustion is 0.0534 tonnes per MMBtu.

Saving 152 MWh of electricity and 669 MMBtu of gas in 2012 will reduce CO2e emissions by 116 tonnes.
Saving 20,504 MWh of electricity and 89,146 MMBtu of gas in 2020 will reduce CO2e emissions by 15,606 tonnes.

Cost Assumptions and Calculations:

The RDEE estimates that the average cost per participant will be $5,850 for retrofitting residences with energy efficient windows, HVAC systems, appliances, insulation, etc. This cost will be offset by the energy savings realized. The City's average cost for electricity was $0.0928 per KWh in FY2006. (Reference: Budget Memo #113: Green Energy; dated April 22, 2008; from James K. Hartman, City Manager, to the Mayor and Members of City Council). Each household will save $557 annually for reduced energy costs, for a payback period of 10.5 years. Operating costs to administer the program is estimated to be $50,000 per year.

Capital costs in 2010-2012 will be $46,800 with annual savings in energy costs of $22,000 per year.
Capital costs in 2013-2020 will be $0.624 million with annual savings in energy costs of $0.29 million per year.

Source: City of Alexandria Energy and Climate Change Action Plan 2012 – 2020

As another potential avenue, though one not believed to be in practice in Virginia at present, Throughout the US, a number of not-for-profit or foundations that administer revolving loans for sustainability efforts within specific regions. Examples are the Cascadia Loan Fund (http://www.cascadiafund.org/) which serves small businesses and nonprofit organizations in Washington and Oregon; the Access Energy Cooperative (http://www.accessenergycoop.com/Content/Community/Economic-Development/Revolving-Loan-Fund-

Funding Strategy	Discussion	Potential Application
	Available.aspx), which is active in Iowa, and the Reinvestment Fund (http://www.trfund.com), which supports community redevelopment in Pennsylvania, New Jersey, Delaware, Maryland, and Washington, DC.	
	Virginia Clean Water Revolving Loan Fund (CWRLF) http://www.deq.state.va.us/cap/ - Reduces interest rates for local governments for projects to improve water quality or prevent future problems. The fund offers: below-market interest rates [1% below prevailing rates, 0% loans for some localities meeting eligibility criteria], no bond issuance costs, and a payment waiver during construction. Has 5 programs administered under the fund: Wastewater Loan Program, Agricultural BMP Loam Program, Brownfield Loan Program, Land Conservation Loan Program, and Stormwater Loan Program [http://www.deq.state.va.us/cap/Stormwater.html. This latter category is new as of 2011, and has no funding appropriated, so gets funds only where the wastewater allocations are not fully drawn down]. State administration: Department of Environmental Quality – Program and policy administrator on behalf of the State Water Control Board (SWCB). Virginia Resources Authority: Fund manager, e.g., underwriting loans, issuing bonds, investing monies, closing loans, making disbursements, and maximizing economic benefits. Applicable project types: publicly owned wastewater treatment facilities, brownfield remediation, and open space preservation related to water quality issues.	*Might be able to look at grey-water/non-potable system?.*
	Virginia Drinking Water State Revolving Fund (DWSRF) - Provides low interest loans, as well as some grants, for drinking water projects to local governments and privately organized water suppliers. The fund receives U.S. EPA grants and state matching and is permanent and perpetual, similar to the Virginia Clean Water Revolving Loan Fund. Virginia Department of Health administers the program, while VRA acts as financial administrator and services the loans.	
Commonwealth's Energy Leasing Program	Administered by the Department of Treasury, the program provides funding for energy efficiency projects in state facilities operated by state agencies, authorities and institutions of the Commonwealth of Virginia who receive appropriate from the General Assembly of the Commonwealth. The Energy Leasing Program allows for the purchase of services and equipment required to develop, design, and install an energy efficiency project. Agencies can finance energy projects at a minimum of $100,000 and will make repayments over 12 or 15 year terms. http://www.trs.virginia.gov/documents/debt/MELP/EnergyDescription.pdf Qualifying projects: Minimum cost of $100,000. May include projects with relevant energy efficient technology, such as lighting and motor efficiency upgrades, building envelope enhancements, distribution system improvements, and energy management controls. Equipment Insulation, Lighting, Energy Mgmt. Systems/Building Controls, Caulking/Weather-stripping, Duct/Air sealing, Building Insulation, Windows,	*Application or some larger project aspects if county can bring down overall cost of funding?*

Funding Strategy	Discussion	Potential Application
	Doors, Siding, Motors, Custom/Others pending approval	
Commonwealth's Master Equipment Leasing Program	Administered by the Department of Treasury, the program helps Commonwealth agencies, authorities and institutions obtain consistent and competitive credit terms for financing equipment and energy efficiency projects. Available in 3, 5, 7 and 10 year loan repayment terms The term may not exceed the useful life of the equipment http://www.trs.virginia.gov/documents/debt/MELP/MELP%20Description.pdf Qualifying Energy Projects: Minimum cost of $10,000. May include: personal property, the installation or modification of an installation in a building, professional management, and other special services which are primarily intended to reduce energy consumption and demand or allow the use of an alternative energy source. Personal property is defined as new or reconditioned tangible personal property that includes personal property to be affixed to realty and must be used for governmental purposes. MELP financed energy projects with relevant energy efficient technology include lighting and motor efficiency upgrades, building envelope enhancements, distribution system improvements, energy management controls.	*Application or some larger project aspects if county can bring down overall cost of funding?*
Virginia Pooled Financing Program	Virginia Resources Authority issues bonds at least twice annually (fall and spring). The program has financed more than $1.5 Billion in projects by > 100 local governments since 2003. http://www.virginiaresources.org/pooledfinancing.shtml Minimum recommended loan: $750,000 Interest rate: "AAA/AA' Term: Up to 30 years, based on useful life of project	*Application or some larger project aspects if county can bring down overall cost of funding?*
Private-Financed Energy-Efficiency and Renewable Lending/Rebate Programs	There are a number of private lenders offering loans to homeowners to install energy efficiency measures. An example: AFC First Financial Corporation, EnergyLoan® www.energyloan.net program. It works in partnership with states, utilities, manufacturers and municipalities. Programs are offered through a network of over 2,000 Approved Contractors who sell, install, and service high efficiency heating, air conditioning, weatherization and "whole house" remodeling and alternative energy related home improvements. AFC First is one of three approved Fannie Mae Energy lenders in the U.S. It is the administrator for Pennsylvania's Keystone HELP Energy Efficiency Loan and Rebate Program www.keystonehelp.com, the state's official ENERGY STAR® and energy efficiency program, in cooperation with the Pennsylvania Treasury, DEP and PHFA. AFC First worked with DEP to create the rebate program which accompanied the expansion of Keystone HELP in 2009. AFC is also the creator and administrator the state of Connecticut's Solar Lease program, ctsolarlease.com, the nation's first rate payer supported residential PV financing plan in cooperation with the Connecticut Clean Energy Fund. The program also combines rebates and financing in an innovative fashion and has exceeded volume expectations by more than 50%. [For residents in the three states where it is partnered, residents get lowered rates]	*Related to revolving fund – they might want to initiate or work with a 3rd party lender to manage programs?*
Community Development	There are a variety of community development organizations that fund energy efficiency and renewable energy projects as part of broader affordable housing / community development activities.	*More project-based for specific items or developemtns.*

Funding Strategy	Discussion	Potential Application
Partnerships	An example: Enterprise Green Communities. Launched October 2009 with a $4Billion commitment to green affordable housing. Partners include: AIA, APA, BoA, Blue Moon Fund, BP, Citi Foundation, Fannie Mae, Freddie Mac, Greater Minnesota Housing Fund, JPMorgan Chase, M&T Bank, Merrill Lynch Community, NASEO, Mizuho Corporate Bank amongst others. Have developed projects in Virginia, including Richmond and Blacksburg. They offer low-interest loans for project development but also operate a Building Retrofit Program and audits. www.greencommunitiesonline.org	
Community Lending / Green Investment	There are a growing number of organizations that connect investors with projects that support a specific program or policy objective. Example: Boston-based New Generation Energy, http://newgenerationenergy.org/, connects interested investors with organizations (small businesses, nonprofits, libraries, youth groups, health centers, schools and community centers) in need of funds for green development. Interested investors can sponsor a project by purchasing Renewable Energy Investment Notes in denominations of $1K - $100K for terms ranging between 1 and 7 years that are paid back at an interest rate between 1.25% and 2.5% through the Community Lending Program.	*Might be something in the new green development that residents could participate in – part of outreach / local community involvement*
PUBLIC – PRIVATE PARTNERSHIPS		
PPP / DBFOM	Virginia DOT is already pursuing PPP projects to fund managed lanes, tunnels and other large-scale infrastructure projects. Opportunities to look at innovative projects within the energy/water nexus. Examples: Envision: Charlotee – academic, finance, technology, and business community working together on the project to look at energy management devices, energy meters, the electric utility and the display monitors to communicate with one other fast enough to provide the streaming data on energy use. http://www.envisioncharlotte.com/ Morris County NJ – Pilot renewable energy program. Tioga Energy and SunDurance Energy to install solar panels on public schools and county government facilities. Bond-financing by Morris County Improvement Authority while solar installer designs, installs, operates and maintains. Private operator takes advantage of existing federal tax and state utility advantages.	*Larger-scale energy installations, 3rd-party operated bike share programs. Also the whole TOD site with transit/real estate. Also – some of the business/behavior challenges?*
TAX INCENTIVES/ REBATES		
Property Tax Incentives	Virginia enacted legislation that allows local jurisdictions to assess the property tax of energy efficient buildings at a reduced rate. Under this law, eligible energy-efficient buildings, not including the real property on which they are located, may be considered a separate class of property for local taxation purposes. Accordingly, the governing body of any county, city or town may, by ordinance, allow a special assessment of the property taxes for this class of property.	

<table>
<tr><th>Funding Strategy</th><th>Discussion</th><th>Potential Application</th></tr>
<tr><td></td><td>An energy efficient building is any building that exceeds the energy efficiency standards of the Virginia Uniform Statewide Building Code by 30%; meets performance standards of the Green Globes Green Building Rating System, the Leadership in Energy and Environmental Design System, or the EarthCraft House Program; or qualifies as an Energy Star home under federal Energy Star criteria.

Applicable Sectors: Commercial, Industrial, Residential, Multi-Family Residential, Low-Income Residential, Agricultural, Institutional

http://leg1.state.va.us/cgi-bin/legp504.exe?000+cod+58.1-3221.2
• Charlottesville – Owners of real estate in which the energy efficient building is constructed shall pay tax on the building at a rate levied by city council for this class of property as defined in section 58.1-3221.2 of the Code of Virginia. Eligibility for the tax rate is to be effective the first day of the tax year succeeding the certification and the buildings are eligible for the tax rate for one year total.
http://library.municode.com/index.aspx?clientID=12078&stateID=46&statename=Virginia
• Spotsylvania County – Energy efficient buildings, as defined in section 58.1-3221.2 of the Code of Virginia, shall constitute a separate class of property and is to be exempt from county taxes on real property and tangible personal property for a period of 5 years.
http://www.countyofspotsylvania.us/emplibrary/ORDINANCE_NO_21_63.pdf
• Virginia Beach – A special tax rate program provides an opportunity for Virginia Beach property owners to reduce the tax rate on qualified residential and commercial energy-efficient buildings, not including the land on which they are located. The tax savings amount varies for each building and depends on the assessment each tax year. The exemption only applies to the building, not the land.
http://www.vbgov.com/government/offices/green/energy/pages/energy-efficient-buildings.aspx
http://www.vbgov.com/government/offices/green/energy/Documents/energy-efficientbldg-faq.pdf</td><td></td></tr>
<tr><td>Property Tax Exemption for Solar</td><td>Virginia allows any county, city or town to exempt or partially exempt solar energy equipment or recycling equipment from local property taxes. Residential, commercial or industrial property is eligible. The statute broadly defines solar energy equipment as any that is "designed and used primarily for the purpose of providing for the collection and use of incident solar energy for water heating, space heating or cooling or other application which would otherwise require a conventional source of energy." Recycling equipment is defined as equipment which is "integral to the recycling process and for use primarily for the purpose of abating or preventing pollution of the atmosphere or waters."

Cities and counties currently offering an exemption include: Albemarle, Alexandria, Charlottesville, Chesterfield, Hampton, Hanover, Henrico, Isle of Wight, King and Queen, Loudoun, Lynchburg, Prince</td><td></td></tr>
</table>

Funding Strategy	Discussion	Potential Application
	William, Pulaski, Spotsylvania, Warren, Wichester and Wise.	
Local Rebate Program	City of Fredericksburg - Home Performance with Energy Star (GW-HELP) [Note: expires Dec 31, 2011. Was a 6-month program commencing Jul 1, 2011 for residential owner-occupied homes built before 2001. Rebate linked to income level. Eligible Efficiency Technologies: Equipment Insulation, Water Heaters, Lighting, Furnaces , Boilers, Heat pumps, Central Air conditioners, Programmable Thermostats, Caulking/Weather-stripping, Duct/Air sealing, Building Insulation, Windows, Doors Maximum Incentive: 50% - 75% AMI - $2,350 75% - 100% AMI - $3,850 100% - 120% AMI - $5,850 120%+ AMI - $500	
Income Tax Deduction	Personal deduction for residential sector: 20% of the sales tax paid by an individual up to $500 max. Eligible Efficiency Technologies: Clothes Washers, Dishwasher, Refrigerators, Dehumidifiers, Ceiling Fan, Water Heaters, Lighting, Boilers, Heat pumps, Central Air conditioners, Programmable Thermostats Must meet federal Energy Star efficiency requirements Expires Jul 1, 2012	
State Rebate Programs	**Geothermal Heat Pump Rebate Program**: Opened June 20, 2011. Virginia is now offering rebates to homeowners who replace their heat pumps, central heating, or central air conditioning systems with a geothermal heat pump. A 20% rebate is available, with a limit of $2,000 per residential property address (ARRA funds) http://www.dmme.virginia.gov/DE/ARRA-Public/GeothermalHeatPump.shtml **Home Efficiency Rebate Program**: Opened June 20, 2011. Homeowners can receive funds for rebates for up to 20% of the costs of qualifying energy products and services, for up to $595. The application process opened on June 20, 2011. Energy efficient equipment purchased and installed on or after March 26, 2010 are eligible for rebates. Maximum incentive of $595, and a $5M program budget. (ARRA funds) http://www.dmme.virginia.gov/DE/ARRA-Public/HomeEfficiency.shtml **Residential Energy-Efficient Appliance Rebates:** Virginia is offering rebates to Virginia homeowners (single-family) who purchase and install ENERGY STAR-rated furnaces, heat pumps, clothes washers, gas water heaters (storage and tankless), and refrigerators purchased and installed on or after April 28, 2010. Rebates will not be retroactive, so consumers must abide by the April 28, 2010 start-date to be eligible. Homeowners who purchase and install ENERGY STAR-rated heat pump water heaters on or after May 28, 2010 are also eligible for rebate, as are those who purchase ENERGY STAR-rated dishwashers and room air conditioners on or after September 1, 2010. Central air conditioners must be purchased on or after March 1,	

Funding Strategy	Discussion	Potential Application
	2011 in order to be eligible. (ARRA FUNDS) Heat Pump, Air Source: $300 Natural Gas or Propane Furnace: $250 Heat Pump Water Heater (Purchased on or after May 28, 2010): $250 Tankless Gas Water Heater: $225 Storage Gas Water Heater: $35 Clothes Washer: $75 Refrigerator: $60 Dishwasher: (Purchased on or after September 1, 2010): $50 Room Air Conditioner (Purchased on or after September 1, 2010): $40 Central Air Conditioner (Purchased on or after March 1, 2011): $500 http://www.dmme.virginia.gov/DE/ARRA-Public/ARRA.shtml	
Utility Rebate Program	The Virginia State Corporation Commission approved five demand-side management programs for customers of Dominion Virginia Power. The costs of the programs, estimated at $28.1 million, will be recovered through two rate adjustments that result in an increase of approximately 52 cents per month on a typical residential customer's bill. The Commercial Heating/Air Conditioning Upgrade Program and the Commercial Lighting Program request upgrades to more efficient systems for the commercial sector in exchange for an incentive. In addition, the Air Conditioner Cycling Program will allow a company to control the central air-conditioner or heat pumps, cycling the unit off and on for short periods of time during peak periods in return for incentive payments. Packaged Terminal A/C and Heat Pumps: $30/ton Unitary or Split A/C and Air Source Heat Pumps: $40/ton Water Cooled Chillers: $10 - $35/ton Air Cooled Chillers: $17/ton Geothermal Heat Pump: $51/ton HVAC VFDs: $37/hp T8 Fluorescents: $2 - $13/fixture T8 High Bay: $43 - $138 High Performance T8: $2 - $20 T5 Fluorescents: $3 - $100/fixture CFL Bulb: $1.50 - $2 CFL Hard Wired Fixture: $24 - $62 Metal Halide: $30 LEDs: $14 - $111 Exterior Bi-Level Lighting Control: $51 Occupancy Sensors: $27 - $69 Lighting Controls: $552 - $794 Delamping: $5.50 - $7	
OTHER PROJECTS / INCENTIVES		
Multi-State	NASEO is currently participating in a four-state collaborative with the State Energy Offices in Alabama,	

Funding Strategy	Discussion	Potential Application
Collaboration on Residential Retrofits	Massachusetts, Virginia, and Washington, in a program funded by the State Energy Program and awarded through a competitive process. The objective is to establish residential retrofit programs in select communities in those states utilizing an innovative asset label, similar to a miles-per-gallon rating for the home, to increase information to the homeowner and drive decisions to invest in energy efficiency. The program will incorporate workforce training, financing, and streamlined customer service, and each state will adapt the program concepts to meet the direct needs of participating communities in their state. NASEO's role is to work with State Energy Offices and other project partners to provide coordination and facilitation among common program elements and share state experiences, best practices and lessons learned in order to inform the development of residential retrofit programs and markets in other states.	
Development Bonuses	Given the density and profile of Loudoun County, such programs may not be as relevant, but Arlington, VA has a Green Building Incentive Program. Density and height bonuses are considered for developers who achieve the full range of LEED certifications, Certified, Silver, Gold and Platinum. Achieving the LEED Certified level does not guarantee a density bonus, but will be considered on a case-by-case basis, and can potentially earn a bonus of .05 floor area ratio (FAR) for office buildings (.10 FAR for residential). Office buildings achieving LEED Silver can be eligible for up to .15 FAR (residential .20 FAR). Office buildings achieving LEED Gold can be considered for .35 FAR (residential .40 FAR) and office buildings achieving LEED Platinum can be considered for .45 FAR (residential .50 FAR). In December 2003, the County also established a Green Building Fund. Developers who participate in the site plan process (meaning their projects are special exceptions to the Zoning Ordinance) and do not achieve official LEED certification are required to contribute $0.045/sq ft. The Green Building Fund is used to provide education and outreach to developers and the community on green building issues. If the building later receives LEED certification, the fee will be refunded. Those projects that achieve LEED certification do not have to contribute. http://www.arlingtonva.us/Departments/EnvironmentalServices/epo/EnvironmentalServicesEpoIncentiveProgram.aspx	
Jobs Creation Incentives	Clean Energy Manufacturing Incentive Grant Program ; $36M In April 2011, Virginia created the Clean Energy Manufacturing Incentive Grant Program. The program is meant to replace the Solar Photovoltaic Manufacturing Incentive Grant Program and the Biofuels Production Incentive Grant Program, which will be phased out by 2013 and 2017, respectively. Money is appropriated to the fund at the discretion of the General Assembly. "Clean energy manufacturer" is defined as a biofuel producer, a manufacturer of renewable energy or nuclear equipment/products, or "products used for energy conservation, storage, or grid efficiency purposes." Renewable energy is defined in the statutes (§ 56-576) to include solar, wind, hydro, biomass, waste energy, municipal solid waste, wave, tidal, and geothermal. It may also include thermal or electric energy from	

Funding Strategy	Discussion	Potential Application
	biomass co-firing facilities. Public service corporations are not eligible for the grants. A clean energy manufacturer can receive a grant for up to six years if it: • Begins or expands its operations in Virginia on or after July 1, 2011 • Makes a capital investment of more than $50 million in Virginia on or after July 1, 2011 • Creates 200 or more new full-time jobs on or after July 1, 2011 • Enters a memorandum of understanding setting forth the requirements for capital investmen and the creation of new full-time jobs The governor may reduce the capital investment and full-time job minimums if the manufacturer is located in an area with an unemployment rate of 1.25 times the statewide average unemployment rate of the previous year. For wind manufacturers, the capital investment minimum is $10 million and the job minimum is 30. The state will begin awarding grants on July 1, 2012. http://www.dsireusa.org/incentives/incentive.cfm?Incentive_Code=VA46F&re=1&ee=1 Green Jobs Tax Credit In April 2010, Virginia enacted the green jobs tax credit. For every green job created with a yearly salary of $50,000 or more, the company will earn a $500 income tax credit for five years. The Office of Commerce and Trade will develop a full list of jobs eligible to qualify for the tax credit. Companies will be allowed tax credits for up to 350 green jobs created. If the taxpayer does not have enough tax liability to take the full credit, it may be carried forward for up to 5 years. **Definitions** ***Green Jobs*** Defined as jobs in the manufacturing and operation of renewable or alternative energy products and technologies used to generate electricity and energy. ***Alternative Energy Sources*** Eligible alternative energy sources are defined as "hydrogen and fuel cell technology, landfill gas, geothermal heating systems, solar heating systems, hydropower systems, wind systems, and biomass and biofuel systems."	

Integrated Energy Management Plan

Appendix G: Economic Development Community Evaluations and Best Practices

Integrated Energy Management Plan

Best Practice Profiles

The following profiles describe the six (6) best practice communities evaluated by BBP LLC. Communities are described in terms of population/context, energy-related planning efforts, why each was selected, examples of current initiatives, efforts to grow green jobs, and incentive programs, as applicable to each community.

Suffolk County, NY

Suburban County (Long Island, NY) with population of 1,493,350 outside a major city (New York)

Clean Energy Plan Summary

Topic areas include:

- Analyze data for energy conservation & efficiencies;
- Perform energy audits;
- Undertake energy efficiency projects;
- Adopt easily implemented technologies;
- Develop policy on alternative fuel vehicles;
- Install solar panels;
- Purchase energy star office equipment;
- Use green building practices; and
- Participate in the Clean Energy Leadership Task Force.

Why Selected

In 2011, EPA announced Suffolk part of top 50 largest green power purchasers in the U.S. Suffolk obtains 90 percent of electricity from green sources – outranking all but six other municipalities in the U.S. in amount of green energy used.

Examples of Awards and Current Initiatives

- Environmental Leader Award – Greater Long Island Clean Cities Coalition
- Solar Achievement Award – Renewable Energy Long Island
- Hosted Energy Infrastructure Summit to create a regional roadmap for sound energy infrastructure to diversify our energy supply and meet increasing demand while advancing energy efficiency and clean energy goals
- Biodiesel Pilot Programs – Bergen Point and Indian Island Facilities; and Suffolk County Dredging Projects
- Power Purchase Agreement – engaged in a strategic business relationship/partnership with a local utility
- Collaboration with Local Municipalities – because Suffolk County lacks zoning and planning powers (all powers held by local municipalities), and because the majority of energy-related federal funds ‘pass-through’ the County to local municipalities, the County strategies and collaborates with local municipality community development officials on green energy projects.
- LEED Accreditation for Employees – Suffolk County sponsored and made available LEED accreditation to all Suffolk County government employees

Green Jobs

In 2009, the state of New York signed the Green Jobs/Green New York Act to create green jobs, and stimulate commercial and residential efficiency improvement investments. Suffolk County was awarded $600,000 out of this program, the second highest amount across New York (second to New York City). Through this Act, Suffolk County utilized the funding in part to provide training and education to Department of Social Services recipients seeking employment in energy-related home improvement and energy conservation, during a six-week training class. Participants who partook in the class earned green certifications in their particular area of interest/study. In addition to the Green Jobs/Green New York Act, more than $1 million from OTDA was awarded to both Nassau and Suffolk counties to fund workforce development programs in green technologies.

In September 2011, a fuel blending and distribution facility was opened at Calverton Enterprise Park in Suffolk County, which will advance the statewide biodiesel industry. This marks a significant example of working towards producing cleaner and greener fuel options. Additionally, this facility will create demand for 40 green jobs, thus spearheading the beginning of clean energy for the region.

Green Building Incentives

The Suffolk County Legislature enacted Resolution No. 126-2006 in 2006, which created the Leadership in Energy and Environment Design (LEED) Program for county construction projects. Revisions to program requirements were made in 2008 (Resolution No. 551-2008), and 2011 (Resolution No. 458-2011). The program requires the County's public works department to apply LEED Building Rating System 2.2 principles to new construction projects or renovation projects (limited to projects with a cost of $1,000,000 or more), and to the planning of new built-to-suit construction and renovation projects for long term lease by the County.

Marketing

The County uses various methods to market green incentive programs, including brochures, programs on the municipally-owned television station, advertising through recycling programs and facilities, calendars, and an energy fair.

Ramsey County, Minnesota

County with 508,640, 2010 population; metropolitan region within the County (Minneapolis-St. Paul)

Energy Management and Stewardship Plan (March 2011)

Key elements of the planning process and focus of plan include:

- Proactive planning process to anticipate change in available energy sources
- Builds upon and collaborates with other government entities for each energy program
- Seeks to achieve economic benefits to the County and further public resources
- Can be applied "universally"– vehicles, ice rinks, adult day care facilities, schools, homes, etc.
- Focus Areas: general management (policies/leadership), buildings owned by the county (energy management), internal systems (fleet, purchasing, information services, etc.), employees (education, engagement, actions)

Why Selected

Ramsey County has been integrating energy-efficiency measures for over twenty years. The County offers a clear guide that provides comprehensive approach to County-wide decisions related to energy consumption, efficiency, savings and worker productivity. Various home energy reporting programs have been developed in the county that have lowered residential energy costs. As an urban county with a large population, energy and "green" needs are high, which has resulted in a strong and proactive program.

Examples of Recognition and Current Initiatives

- Minnesota is leading state in U.S. in embracing and driving measurable savings through information-based energy efficiency
- Combination of technology innovation and energy efficiency by businesses located in Ramsey, MN (i.e.: Connexus Energy)
- "Roofs to Roads" Partnership
- Sustainable Businesses
- Green Alternatives Newsletters to the public

Green Jobs

Renewable Energy Network Empowering Workers (RENEW) is a green job training program through a partnership between the City of Minneapolis Employment and Training Program and Ramsey County Workforce Solution. This is a workforce-training program for qualified residents for career training in green industries. Participants are able to select from over 40 training options in Renewable Energy, Building Systems, Manufacturing and Construction. There are at least ten training locations where qualified residents may attend and obtain certifications. This program maintains partnerships with community businesses to connect the trained participants with available green-industry employment. Within two years, this program has trained over 500 participants in over 40 career tracks.

ISEEK is a Minnesota statewide program that links workers to career tools, such as training, higher education, certification programs, apprenticeships and job openings according to their interests and training backgrounds. A green jobs resource section also allows navigation by area throughout the state. Local to the Ramsey County area partners include Anoka Technical College, Hennepin Technical College, Minneapolis Community & Technical College and St. Paul College for workforce training places.

Minnesota Clean Energy Resource Teams (CERTS) is a statewide and regional initiative that focuses on clean energy within local communities. The state is broken into regions, of which Ramsey is located in the "Metro" region. Each region has a team, a coordinator and a steering committee, and a "Regional Strategic Clean Energy Plan" including how clean energy efforts can be applied to community projects.

Fairfax County, Virginia

Considered a competitor to Loudoun County; a Suburban County in the Washington DC metro area with a population of 1,081,726

Fairfax County Energy Efforts

Energy Initiatives and Action Areas:

- Energy Efficiency (Facilities Management, Waste Management, parks, LED Lighting, LEED, Vehicle Services, Schools);
- EECBG Program ($9.6 million allocated to Fairfax County in 2009; funded 15 projects in multiple areas: information technology; facilities improvements; hybrid and electric

vehicles; greenhouse gas emissions inventory; and residential energy education and outreach) ;
- Greenhouse Gas Inventory;
- Air Quality & Transportation;
- Other Environmental Initiatives (Growth and Land Use, Air Quality and Transportation, Tree Canopy, Water Quality, Parks/Trails/Open Space); and
- Education & Outreach (conducted through: website; social media including Facebook and Twitter; and Channel 16 productions)

Energy Leadership:
- Environmental Coordinating Committee - established to ensure an appropriate level of coordination and review of the County's environmental policies and initiatives
- Energy Efficiency and Conservation Coordinating Committee - – established to ensure coordination of energy efficiency and conservation across county agencies, schools, and authorities
- Environmental Quality Advisory Council - appointed 14-member citizen group advises the Board on environmental matters and provides a forum for citizen input on environmental issues
- Regional Coordination

Virginia Rebates/Tax Credits
- Sales Tax Exemption for Energy Efficiency products – energy star washers, refrigerators, dehumidifiers, fans, lighting, air conditioners ($2,500 of less per product)
- Property Tax Exemption for Solar – solar water, space heaters, solar thermal electric, solar panel systems
- Residential Energy Efficient Appliance Rebates – up to $660 for furnaces, heat pumps, water heaters, clothes washers and refrigerators
- Income Tax Deduction for Energy-Efficient Products – up to 20% up to $500 for water saving Energy star appliances including dishwashers, clothe washers, air conditioners, ceiling fans, etc
- Geothermal Heat Pump Rebate Program – up to $2,000 for installing geothermal heat pumps

Why Selected

Fairfax is a neighboring county to Loudoun, and has numerous national recognitions for green, environmental and efficiency efforts from 2002 to present. In addition, the energy efforts, policies, and initiatives cover all aspects of county implementation that have had great success including school improvements, TOD planning, tree planting, water quality improvements and a comprehensive education and outreach program. There are a variety of committees that have been formed to spearhead efforts on specific areas of green and environmental concerns.

Examples of Current Initiatives

- Environmental Improvement Program
- Cool Counties Initiative

- Board's Energy Policy
- Solid Waste Management Plan
- Fairfax County's Fairfax Water hosted a delegation of six Israeli companies that presented technologies they have developed at the "Water Management for a Growing Urban Community – Challenges and Solution" – evidences a presence with international businesses interested in doing business in Fairfax County that is relevant to green and environmental energy initiatives.
- 2011: Governor's Environmental Excellence award for storm water outreach
- Energy Resource Recovery Facility – privately owned and operated "one of the largest waste-to-energy facilities in the country" under contract with Fairfax County

Green Jobs

The state of VA has a policy for Green jobs tax credit for companies that create up to 350 green jobs in the state, which allows a $500 income tax credit for the creation of each "green" job with a salary of at least $50,000 for taxable years beginning on and after January 1, 2010.

Fairfax County has been successful in attracting high-technology companies, such as Oracle (database software vendor), and Andersen Consulting (management and technology consulting firm), which has delineated Fairfax County as a high-technology market.

The Private Sector Energy Task Force established for Fairfax County will also create "a transformational vision and its goals will be met through the identification and implementation of scalable, community-wide energy efficiency projects focused on producing measurable results for businesses" as well as attract companies that will create green jobs throughout the County.

Green Building Initiatives

Green Roof technology has gained momentum in Fairfax County. The Virginia Department of Conservation and Recreation and the National Fish and Wildlife Foundation have provided grants to pay for storm water management features including rain gardens, cisterns and green roofs in communities throughout Fairfax County. The non-profit EcoStewards Alliance has been helping communities throughout the County retrofit their buildings and landscapes into a greener and more sustainable manner, through Green Building techniques.

Energy Efficiency Initiative

Fairfax County's multi-pronged energy efficiency initiative covers the followings areas:

- Facilities management – installation of energy management control; right-zing of HVAC equipment; efficient lighting and lighting controls; installation of more efficient system types
- Waste management – landfill gas recovery and utilization; energy / resource recovery facility; recycling; effluent reuse
- Parks – Indoor lighting upgrades; outdoor lighting upgrades; control installation; geothermal system
- LED lighting – lighting pilot programs; County participation on Dominion Virginia Power LED street light task force
- LEED

- Vehicle services – fleet hybrids, hydraulic hybrid refuse collection truck; electric vehicles and charging
- Schools – Designs to conform to collaboration for high performance schools

City of Cambridge, MA (in Middlesex County)

Within Middlesex County, much of the green energy-related activities have occurred in the City of Cambridge, which has a population of 105,162 (compared to Middlesex County's population of 6,547,629).

City of Cambridge Initiatives

Energy Reduction Plan

Formal plan designed for the reduction of energy across the City of Cambridge, including:

- City buildings (new and existing);
- Employees (reduce use of energy in offices);
- Purchases (green vehicles); and
- Programs and initiatives to encourage energy reduction by businesses and residents.

Climate Protection Plan

- Energy
- Improve energy efficiency
- Promote cleaner and greener electricity
- Increase use of East Cambridge District steam
- Transportation
- Reduce commuting by single-occupancy vehicles
- Improve facilities for walking and cycling
- Reduce motor vehicle travel through parking incentives and restrictions, car-sharing, promotion and education
- Reduce motor vehicle emissions
- Promote local and regional transit improvements
- Land Use, Buildings & Vegetation Management
- Foster mixed-use, transit-oriented development and redevelopment, and public open space through zoning and incentives
- Optimize use of vegetation to shade buildings and reduce urban heat island effect
- Reduce heat island effect through design of the built environment
- Promote design and construction of green buildings
- Work for transit-oriented regional land use planning
- Waste Management
- Prevent waste
- Increase recycling
- Implement environmentally preferable purchasing

Climate Initiatives

- Alternative fuel and vehicles – working to incorporate alternative fuels and vehicles into the municipal fleet. Municipally-owned diesel vehicles are now fueled by B20 biodiesel;

- Energy management – established to systematically assess municipally-owned facilities and identify energy efficiency upgrade projects;
- Green buildings/LEED – all municipal new construction and major renovation building projects will be LEED/green buildings;
- Transportation demand management – offers a variety of infrastructure enhancements, employee programs, annual events, and other programs highlighting and encouraging use of transportation options;
- Urban forestry program – actively plants and maintains street and park trees to provide environmental benefits, including reduction of the urban heat island effect; and
- Waste management and recycling – all municipal facilities recycle.

Community Initiatives

- Residents (greenhouse gas calculators, energy efficiency programs);
- Businesses and Organizations (energy audits, business energy efficiency programs, services to religious facilities to assess energy use, efficiency and renewable energy);
- University Sustainability Activities (Harvard Green Campus Initiative, MIT Environmental Programs);
- Cambridge Energy Alliance (non-profit energy initiative providing services and financing to upgrade buildings of all types throughout the city. Helps residents and businesses save energy, water, and money by making their homes and buildings more efficient. Helps people make use of free energy audits and free or subsidized efficiency measures);
- Climate Protection Case Studies;
- Green Buildings (LEED certified buildings, efforts across the city); and
- Renewable Energy (installations across the city)

Why Selected

There are 33 solar PV systems in the City of Cambridge that contribute to clean, renewable energy. Cambridge is the leader in Massachusetts for commercial use of clean energy, and saves 300 tons of CO_2 emissions and $55,000 in electricity costs each year from solar PV systems. There are sixteen “Clean Energy” companies located in the City of Cambridge, evidencing that Cambridge values and facilitates the business atmosphere for the innovation of clean renewable energy.

Examples of Recognition and Current Initiatives

- High-tech corridor between Harvard and MIT with numerous green and clean energy high tech businesses
- Massachusetts designated Cambridge a “Green Community”
- Interdepartmental coordination within the City results in efforts that are not centralized in one department, but rather shared between working groups and commissions.

Green Jobs

- North Shore InnoVentures – A Technology Incubator Network
- Cleantech InnoVenture Center - CIVC provides companies with access to a wide array of high tech, cleantech and biotech companies, to grow young, dynamic clean technology companies
- Cambridge, MA – Fraunhofer Center for Sustainable Energy Systems (CSE) is a non-profit applied research and development laboratory dedicated to the commercialization of clean energy technologies: Photovoltaic (PV) Modules, Building Energy Efficiency, and the TechBridge commercialization

Frederick County, MD

Suburban county to Washington DC; with a population of 233,385; very similar to Loudon in that it is "one county removed" from the border of Washington DC, with strong energy policy and management/conservation plans, and high-technology incubators.

County Energy Conservation Planning

Sustainable Action Plan for County Operations, 2010

This Plan sets out guiding principles, goals and actionable steps to protect the environment, conserve energy and live sustainably across the County, specifically within County governments and programs/initiatives. The following are 7 categories of areas this Plan examined to guide sustainability efforts. The Plan was written by a 32-member team of Frederick County employees.

1. Leading By Example
2. Conserving Energy and Reducing Emissions
3. Implementing Green Building Practices
4. Making Green Purchasing Decisions
5. Protecting Green Infrastructure
6. Recycling and Reducing Waste
7. Choosing Transportation Alternatives
8. The Sustainable Action plan was written by employees from the following departments and offices: Animal Control, Citizen Care & Rehab, Citizen Services, County Attorney's Office, County Manager's Office, Economic Development, Emergency Management, Finance, Fire & Rescue Services, Public Libraries, Health Services, Human Resources, IT, Management Services, Montevue Home, Public Schools, Parks & Recreation, Permitting & Development Review, Planning, Public Works, Transit Services, UMD Extension, and Utilities and Waste.

Comprehensive Energy Plan, 2010

This Plan defines annual goals to reduce the County's use of non-renewable energy over a 15-year period by 50 percent or more. The Plan included a combination of recommendations focusing on: Energy Conservation, Conversion to Renewable Fuel Sources, and Generating Renewable Energy. Specific recommendations for meeting set goals are listed below:

1. Organizational Commitment – led by the Office of Environmental Sustainability, included adopting a written energy conservation expectation, providing annual reports, obtaining commitment from county leaders, and educating county staff.
2. Buildings – led by Management Division Services, included (among others) adopting Energy Management Program, conducting energy audits, implementing recommendations from energy audits, installing control systems in County buildings, and using Energy Star software to monitor use and use roofing materials that minimize heat absorption.

3. Fleet – led by Fuel Conservation Committee, included seeking fuel reduction, converting diesel fuel to bio-diesel fuel, purchasing hybrid vehicles/buses, downsizing vehicles to be more fuel efficient, and utilizing teleconferencing/webinars.
4. Utilities and Solid Waste Facilities – led by the Division of Utilities and Solid Waste Management, included landfill gas recovery and electricity generation producing 2 megawatts of renewable energy, pursuing construction of regional municipal waste-to-energy project providing 45 megawatts of renewable electricity, and re-evaluating the option for installation of photovoltaic solar technology projects within five years.

Frederick's Renewable/Sustainable Programs & Initiatives

- Frederick County Office of Sustainability
- Frederick County Commercial Recycling Program
- Frederick County Economic Development Agriculture Programs
- Frederick County Workforce Services (frederickworks.com)
- Focus Forward on Green: The Great Frederick Fair

Frederick County Renewable/Sustainable (Green) Industries

- More than 20 green companies including BP Solar, US Department of Agriculture, Focus Forward on Green
- Low tax structure, fast track permitting assistance, lower development costs
- Start-up companies have access to the two high-tech incubators at the Frederick Innovative Technology Center, Inc.

High-Technology Incubator: Frederick Innovative Technology Center, Inc.

- Encourages technological innovation
- Accelerating development of commercially viable technology-based entities
- Range of services provided are provided, including business development, financing, manufacturing assistance, marketing, networking, research assistance and technical assistance.

Funding Sources

Frederick County utilized Energy Efficiency Conservation Block Grant (EECBG) funds from the Department of Energy to support projects that reduce energy use, including:

- Installation of a solar thermal pre-heating system at the Adult Detention Center
- Energy audits for county buildings
- Retrofits to lighting and mechanical equipment at various county buildings
- A greenhouse gas emissions inventory
- A community based home energy audit project

Marketing

Frederick County uses several methods to get the word out about its energy programs, including:

- Sustainability Newsletter – quarterly electronic newsletter
- Website announcements
- Webcasts

- Presentations, reports, fact sheets and other resources for interested citizens (topic areas include sustainability; climate and greenhouse gas emissions; greener lifestyle practices; composting; native plants; natural household cleaners; natural lawn care; rain barrels; rain gardens; water resources; renewable energy and conservation; agriculture and food; waste and recycling; and environmental awareness).

Douglas County, CO

Douglas County has a population of 288,465, is adjacent to the Denver metro area.

Why Selected

Douglas County is considered a competitor to Loudoun County. While it does not have a specific Energy Management Plan, Douglas County has a variety of energy-related initiatives, programs and advisory committees that facilitate environmentally and economically sustainable efforts.

Douglas County Community Planning & Sustainability Department

Douglas County offers development review and permitting for new and expanding businesses and existing infrastructure to facilitate business start-up and expansion. While the Community Planning & Sustainability Department considers Sustainable Development an element of its work, the main focus of the department is on creating an inviting business environment. One key issue Douglas County faced was public opposition to green energy efforts; members of the public felt that government was trying to force them to make energy changes. In response, Douglas County implemented a multi-pronged public outreach effort to obtain public feedback and get residents involved in planning for green energy.

Sustainability Initiative Advisory Committee

Douglas County established the Sustainability Initiative Advisory Committee (SIAC) consisting of: three appointees made by the Partnership of Douglas County governments; six county residents with experience related to the aspects of economic, environmental, and social sustainability appointed by the County manager; three county business owners appointed by the County manager; and three County staff members. This committee was coordinated to do the following:

- Gather public information;
- Recruit residents and business owners to engage in future sustainability-related activities and programs;
- Develop a vision statement on sustainability in the county;
- Develop a series of objectives supporting the vision;
- Meet semi-annually with the Sustainability Working Group; and
- Make suggestions regarding programs and efforts with the Sustainable Working Group.

Marketing

Because public opposition was an issue in Douglas County, an extensive public outreach effort was undertaken to obtain public input. County staff attended 14 countywide meetings and events, held an open house, and created a blog for citizens to share comments. As part of this effort, the public was asked to review and rank the main categories of initiatives that the county's funds for green energy and efficiency (through the EECBG program) could be applied to:

- Pilot programs, studies and analysis
- Public education and outreach
- Rebate and incentive programs

To promote incentive programs, a website was created, postcards were disbursed throughout local businesses and partnering jurisdictions, and a press release and advertisements were created. The County also held a Listening and Recruitment Tour to obtain feedback to assist in writing the Vision Statement and Objectives.

Holistic Approach to Sustainable Water Management in Northwest Douglas County, 2007

Water management is another key issue in Douglas County. The 2007 study identified two water management techniques to "offer an overlooked renewable water supply alternative for Colorado: precipitation management through rainwater and snow melt harvesting and outdoor water demand management through use of water efficient landscaping and irrigation practices."

Funding Sources

Douglas County uses the Department of Energy's Energy Efficiency Conservation Block Grant (EECBG) funds to support projects that reduce energy use. This funding source is the only source of funding dedicated to energy efficiency and green energy projects.

Other Case Studies Evaluated

Prince William County, Virginia

Considered a competitor to Loudon County, as a neighboring jurisdiction. A suburban county in close proximity to the Washington DC metropolitan area, and great successes in environmental efforts

Prince William County Energy Policies

Green Guiding Principles for the County – These principles overlap at times, but are a framework for all initiatives throughout the county to begin efforts, motivate the public and begin to make immediate changes to the environment.

Why Selected

Prince William County has numerous programs and initiatives underway that are successful that address county government practices, residential homes, and businesses. The policies and plans they have established provide tangible actions to reduce impact on the environment. The county has a long list of accomplishments that speak to their guiding principles, policies and goals.

Examples

- Twelve rebate and tax programs in Prince William County for residents and businesses (see selection above) Rebates/Tax Credits
    - Columbia Gas of VA – rebates on energy efficient appliances including water heaters, furnaces, windows, insulation and duct sealing
- Solid Waste Management Plan
- Extraordinary Environmental Enterprise (E4) certification by VA Environmental Excellence program, for the County landfill and composting facility
- Exemplary Environmental Enterprise (E3) certification by the VA Department of Environmental Quality Environmental Excellence Program, for the landfill, fleet operations, compost facility, operations buildings, print shop and supply warehouse

- Energy Star certification for Fairfax County's government center and development services building
- Methane gas captured from the landfill operations and used to generate electricity

Somerset County, New Jersey

Somerset County Renewable Energy Program

Combined effort between Somerset County and Somerset County Improvement Authority allowing entities to take advantage of clean energy initiatives without debt impacts; Combines public financing (regional), allowing local municipalities to benefit from state renewable energy; $500,000 initiative offered to all municipalities, public school districts, and local authorities within Somerset County; consisting of renewable energy sources (solar panels, installed on buildings or grounds); Somerset County is one of four counties in New Jersey that are pursuing a wide-scale public solar power project such as this, in order to meet the statewide goal of reducing energy by 20% by 2020

Somerset County High Performance Public Buildings Program and Green Building Design Task Force

Goals: create new public buildings that generate taxpayer savings by reducing building operating costs and increase user productivity, and to demystify the process of reviewing the design of a high performance building, so that Somerset County and its local municipalities would have a tool that planning and building departments could readily use

Deliverables: Policy and Implementation Model (guide through adopting a green building model), Building Program Toolkit (guide through implementation), Program Requirements (serves as a summary of performance goals)

Somerset County Energy Council

Energy Efficiency & Conservation (goals)

1. Continue to turn the County Energy Audit Program results into tangible projects
2. Measure and report the results of the Audit Program Master Plan
3. Develop "white papers" to provide technical advice to the County and local jurisdictions regarding energy products and efficiency improvements

- Home energy conservation improvements
- Residential and small commercial retail energy offerings including renewable energy options

Alternative & Renewable Energy (goals)

1. Evaluate emerging alternative and renewable energy policies, programs and technologies
2. Identify specific energy projects that can be successfully applied in Somerset County
3. Support the growth of the renewable and alternative energy industries

Education & Awareness (goals)

1. Build awareness of behavioral changes that achieve energy sustainability
2. Disseminate sustainable energy policies and best practices at the state, regional and local levels
3. Encourage energy awareness and education programs
4. Enhance utilization of the SCEC website and other outreach venues

Denton County, Texas

Denton County does not have a Green Energy Management Plan or any sort of plan that is related. Denton County does have energy management systems installed in some county facilities, and has identified additional buildings over the past 10 years for updates including power corrections, rooftop unit replacements, among others.

Incentive Programs

- GreenSense Energy Efficiency Rebate Program – rebates for heat pumps, air conditioners, programmable thermostats, insulation, windows and solar panels (through Denton Municipal Electric)
- GreenSense Solar Rebate Program – rebates for solar panels and solar water heaters (for Denton Municipal customers)
- Home Energy Efficiency – incentives for dishwashers/clothes, dryers, refrigerators, water heaters, heat pumps, furnaces, air conditioners, weather-stripping, duct/air sealing, insulation, solar panels, etc.
- Solar Water Heating Incentive Program – rebates for solar water heaters that supplement electric water heaters from $600 to $1,500

Texas Incentive Programs

- Renewable Energy Systems Property Tax Exemption – property tax exemptions for installation and distribution of solar, wind, thermal, mechanical, electrical, biomass or anaerobic energy systems
- Solar PV Pilot Program – rebates for solar panels at $2/watt DC up to $20,000
- Residential and Small Commercial Energy Efficiency Programs – incentives for refrigerators, water heaters, lighting, heat pumps, air conditions, furnaces, insulation and others

Green Job/Business Incentives

There were no green business or green job incentives listed on the Denton County

Integrated Energy Management Plan

Appendix H: Zofnass Power Point Rating Results

Integrated Energy Management Plan

THE ZOFNASS PROGRAM FOR SUSTAINABLE INFRASTRUCTURE
Harvard University Graduate School of Design

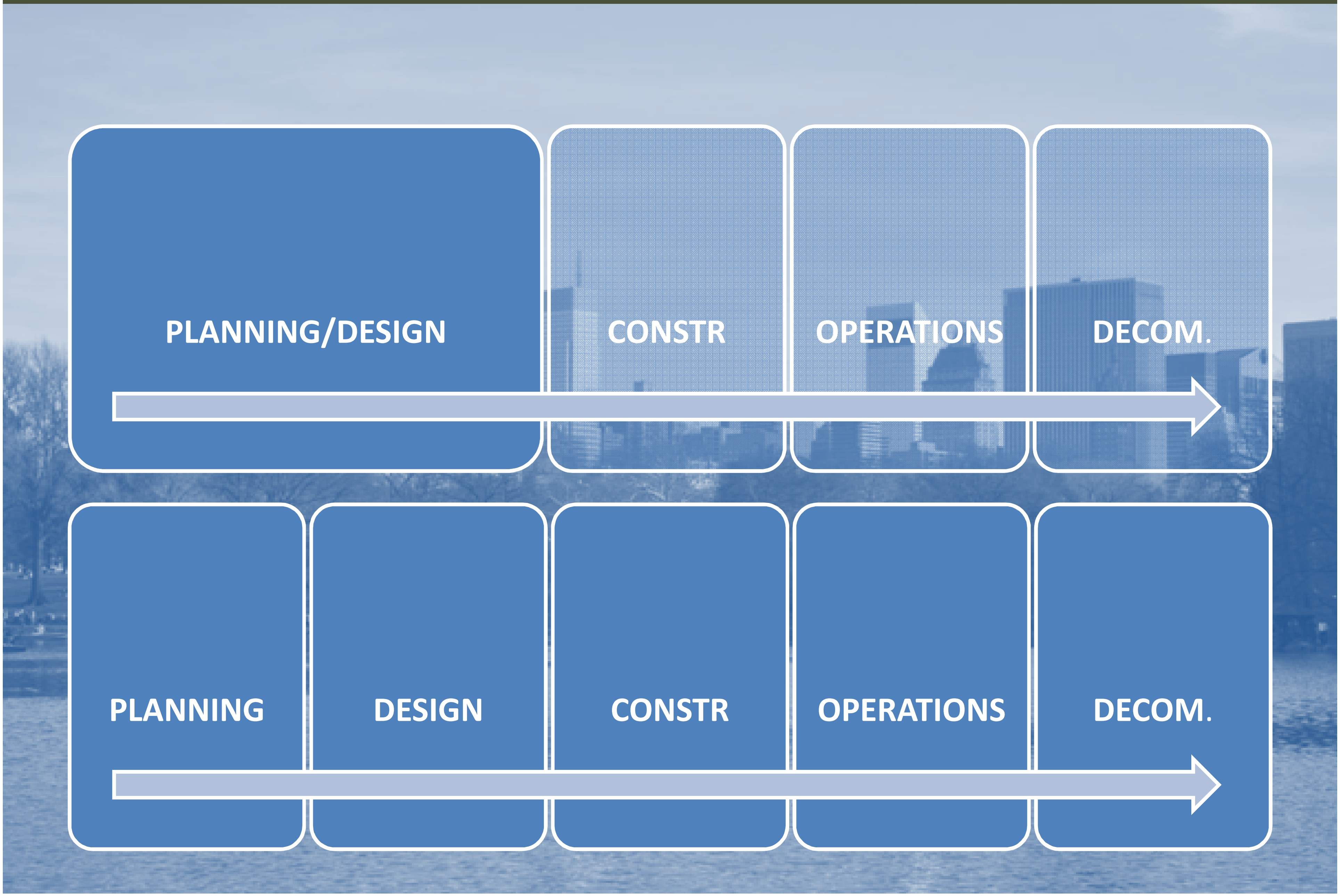
Loudoun County – Moorefield Station Project

THE ZOFNASS PROGRAM FOR SUSTAINABLE INFRASTRUCTURE
Harvard University Graduate School of Design

The goal of the Zofnass Program is to better enable the design industry to promote and utilize sustainable options for the design and delivery of large scale development and infrastructure projects.

The mission of the Zofnass Program is to promote the development, distribution and adoption of sustainable development methods and tools that define and quantify sustainability in the context of infrastructure and large scale developments.

THE ZOFNASS PROGRAM FOR SUSTAINABLE INFRASTRUCTURE
Harvard University Graduate School of Design



Recent Case Studies

•Seyour-Capilano Water Filtration Plant
Guan C., L. Farley, A. Kane (under development)

•Cape Cod Nitrogen Pollution
Burke W., A. Kane (under development)

•Evaluating the US high-speed rail projects
Georgoulias A., J. Chapman, D. Kim, M. Lo

•EPA's storm water management strategies for the Charles river.
Georgoulias A., A. Cawrse, D. Pal, B. Porcar, Y. Xiao

http://www.gsd.harvard.edu/research/research_centers/zofnass/

CREDIT CATEGORIES

RESOURCE ALLOCATION

CLIMATE CHANGE

NATURAL WORLD

QUALITY OF LIFE

CREDIT LIST

RESOURCE ALLOCATION 12 Credits

1 MATERIALS

- ☐ R1.1 Use Materials Efficiently
- ☐ R1.2 Use Recycled + Reused Materials
- ☐ R1.3 Use Regional Materials
- ☐ R1.4 Innovate or Exceed Credit Requirements

2 ENERGY

- ☐ R2.1 Reduce Energy Use
- ☐ R2.2 Use Renewable Energy
- ☐ R2.3 Commission + Monitor Electrical Systems
- ☐ R2.4 Innovate or Exceed Credit Requirements

3 WATER

- ☐ R3.1 Reduce Water Use
- ☐ R3.2 Utilize Water Efficient Landscaping
- ☐ R3.3 Commission + Monitor Water Systems
- ☐ R3.4 Innovate or Exceed Credit Requirements

NATURAL WORLD 12 Credits

1 SITE SELECTION

- ☐ NW1.1 Prepare Site + Impact Assessment
- ☐ NW1.2 Protect Wetlands and Water Bodies
- ☐ NW1.3 Conserve Prime Habitat
- ☐ NW1.4 Maximize Use of Developed Sites
- ☐ NW1.5 Maximize Use of Contaminated Sites
- ☐ NW1.6 Innovate or Exceed Credit Requirements

2 HABITAT

- ☐ NW2.1 Preserve/Protect Habitat Connectivity
- ☐ NW2.2 Eliminate Invasive Species
- ☐ NW2.3 Reduce Stormwater Runoff
- ☐ NW2.4 Treat Stormwater
- ☐ NW2.5 Treat Effluent
- ☐ NW2.6 Balance Earthwork
- ☐ NW2.7 Innovate or Exceed Credit Requirements

CLIMATE CHANGE 10 Credits

1 EMISSIONS

- ☐ CC1.1 Reduce Greenhouse Gas Emissions
- ☐ CC1.2 Protect Air Quality
- ☐ CC1.3 Enhance Public Transport
- ☐ CC1.4 Enhance Pedestrian/Bicycle Routes
- ☐ CC1.5 Mitigate Heat Island Effect
- ☐ CC1.6 Innovate or Exceed Credit Requirements

2 CLIMATE ADAPTABILITY

- ☐ CC2.1 Assess Climate Change Threat
- ☐ CC2.2 Design for Long Term Climate Change
- ☐ CC2.3 Prepare for Extreme Weather Events
- ☐ CC2.4 Innovate or Exceed Credit Requirements

QUALITY OF LIFE 16 Credits

1 COMMUNITY

- ☐ QL1.1 Preserve Cultural Sites
- ☐ QL1.2 Implement Context Sensitive Design
- ☐ QL1.3 Enhance Site/Neighborhood Safety
- ☐ QL1.4 Enhance Public Space
- ☐ QL1.5 Minimize Light Pollution
- ☐ QL1.6 Innovate or Exceed Credit Requirements

2 EDUCATION

- ☐ QL2.1 Promote Sustainability Awareness
- ☐ QL2.2 Implement Sustainable Practices Training
- ☐ QL2.3 Solicit Community Feedback
- ☐ QL2.4 Innovate or Exceed Credit Requirements

3 VALUES

- ☐ QL3.1 Plan for Growth Impacts
- ☐ QL3.2 Reduce Demand
- ☐ QL3.3 Implement Integrated Project Approach
- ☐ QL3.4 Encourage Local Employment
- ☐ QL3.5 Innovate or Exceed Credit Requirements

☐/12 **TOTAL RESOURCE** + ☐/12 **TOTAL NATURAL WORLD** + ☐/10 **TOTAL CLIMATE CHANGE** + ☐/15 **TOTAL QUALITY OF LIFE**

NW2.3 REDUCE STORMWATER RUNOFF

INTENT:
Reduce stormwater runoff caused by new development

METRIC:
Comparison of pre- and post-development stormwater runoff.

DESCRIPTION:

Development causes a change to the natural flow of runoff on a site. Increasing the quantity of impervious surface on a site tends to reduce the amount of stormwater that infiltrates into the ground, decrease the amount absorbed and expired by plants (evapotranspiration), and increase the amount of surface runoff.

Impervious Surfaces (percentages of total site)	% of Stormwater that becomes runoff
0 (Undeveloped Site)	10%
10-20	20%
35-50	30%
75-100 (Urban Area)	55%

Increased runoff typically leads to erosion, which pollutes waterways with sediment. It also increases the quantity of water draining into waterbodies, which can cause channel erosion in streams. Changes in flow and increased sedimentation have detrimental impacts on aquatic life. Down-stream flooding is also more likely.

Structural and non-structural stormwater management strategies can be incorporated into the design in order to reduce these negative impacts associated with increased runoff. Detention basins, infiltration basins, porous pavement, retention ponds, wetland basins, filter strips, and bioswales are examples of non-structural stormwater management elements that can help retain stormwater on-site. Many of these features also provide some level of treatment of the runoff, filtering pollutants from reaching waterbodies.

CREDIT REQUIREMENTS:

Work with an environmental or civil engineer to incorporate stormwater management strategies into the design to ensure peak stormwater runoff quantity from a 2 year, 24 hour design storm does not increase post-development. Requirements for post-development runoff vary by the initial condition and are outlined in the following table:

Site Condition	Quantity Requirements	Rationale
Undeveloped	Post development runoff must not exceed pre-development runoff	Undeveloped sites have low rates of runoff, so development should seek to match pre-development conditions.
Developed, not Brownfield	Post development runoff must be at least 25% less than pre-development runoff	Developed sites tend to have much higher rates of runoff than undeveloped sites; redeveloping a site, therefore, offers significant potential to decrease stormwater runoff compared to existing conditions
Developed, Brownfield	Post development runoff must be at least 10% less than pre-development runoff	Contamination may limit potential for stormwater infiltration, so brownfields have lower requirements than other developed sites

CREDIT DOCUMENTATION:

- Demonstrate that development will not increase the quantity of stormwater runoff off-site for up to 2 year storm events by providing the following:
  - calculation* of pre-development stormwater runoff for a 2 year, 24 hour design storm
  - calculation* of post-development stormwater runoff for 2 year, 24 hour design storm
  - indicate whether site is undeveloped, developed (non-brownfield), or a developed brownfield
- Provide a site plan and narrative explaining what stormwater management measurers were incorporated into the design to reduce the quantity of stormwater runoff
- Include CV of engineer who assisted with this credit

The Rational Method or other similar methods are acceptable techniques for calculating stormwater runoff quantities. (for more information about the Rational Method, a useful resource is a handout from the Iowa Stormwater Manual - http://www.ctre.iastate.edu/pubs/stormwater/documents/2C-4RationalMethod.pdf)

RELATED CREDITS/STANDARDS

- LEED ND 2009 GIB Credit 8: Stormwater Management, p.93
- LEED BD+C 2009 SS Credit 6.1: Stormwater Design—Quantity Control, p.91
- LEED BD+C 2009 SS Credit 6.1: Stormwater Design—Quality Control, p. 101
- SSI Guidelines and Performance Benchmarks 2009 Site Design—Water Credit 3.6, p.78
- SSI Guidelines and Performance Benchmarks 2009 Site Design—Water Credit 3.7, p.82
- Pearl Community Rating System PW-2: Stormwater Management, p. 104

RESOURCES + TOOLS:

- Protecting Water Quality from Urban Runoff [EPA] - http://www.epa.gov/owow/NPS/urban_facts.html
- Nonpoint Source (NPS) Outreach Toolbox [EPA] (includes tools and resources to help agencies and organizations craft effective outreach campaigns for non-point pollution and runoff) - http://cfpub.epa.gov/npstbx/index.html
- STORMWATER TOOLS (EPA) - http://cfpub.epa.gov/npdes/greeninfrastructure/technology.cfm - Types, Applications, and Design Approaches to Manage Wet Weather; very good list of many techniques with links to pages for additional information; following topics are included:
  - Site: Green Roofs, Rain Harvesting, Downspout Disconnection, Planter Boxes, Rain Gardens, Permeable Pavements, Vegetated Swales, Brownfield Redevelopment, Infill and Redevelopment
  - Neighborhood: Green Parking, Green Streets & Highways, Pocket Wetlands, Trees & Urban Forestry
  - Watershed: Riparian Buffers, Approaches for Green Infrastructure Design
- Stormwater sizing worksheet.xls (downloaded) – (EPA) [http://www.epa.gov/smartgrowth/emeryville.htm] – spreadsheet to calculate sizing of different stormwater management techniques
- Stormwater BMP Modeling Concepts and Simulations (EPA) – good overview http://www.epa.gov/nrmrl/pubs/600r06033/epa600r06033toc.pdf
- Plants Not Pipes: Promoting Green Infrastructure and its Side Benefits in Region VI [west Virginia] http://www.downstreamstrategies.com/documents/reports_publication/GreenInfrastructureInRegionVI-Final.pdf - covers wide variety of topics related to stormwater management including funding sources, examples, tools, and existing policies (state and federal)
- SAN FRANCISCO: STORMWATER MANAGEMENT DESIGN GUIDELINES guidelines: http://sfwater.org/mto_main.cfm/MC_ID/14/MSC_ID/361/MTO_ID/543; resources page of their website: http://sfwater.org/mto_main.cfm/MC_ID/14/MSC_ID/361/MTO_ID/565 Summary: Very helpful document – includes science and regulatory context behind stormwater management as well as series of guidelines; includes detailed information about variety of stormwater management tools (effectiveness in reduce quantities of stormwater, effectiveness improving stormwater quality, diagrams of construction, techniques to calculate sizes needed, etc.)
  - Really good decision tree, and other summary matrixes (pollutants vs. land use; pollutants vs. BMPs) to help select appropriate BMP – PDF pg 93-95 (doc pg 85)
  - (also, separate PDF doc. and excel spreadsheet workbook provides resource for calculations);
  - Appendix A includes detailed look at each technology
  - Sizing help PDF pg 100; includes procedures to calculate – 101 - 104
- RIVERSIDE COUNTY:STORMWATER QUALITY BEST MANAGEMENT PRACTICE - DESIGN HANDBOOK - Riverside CA - BMP Handbook.pdf - http://www.floodcontrol.co.riverside.ca.us/downloads/Planning/BMP%20Handbook%20(draft%208).pdf useful document that gives a bit of science with overviews about each type of BMP; includes information about how to design (and size) each as well as how well the BMPs perform; includes table of contaminants expected with different land uses
- Innovative Approaches for Urban Watershed Wet-Weather Flow Management and Control: State-of-the-Technology INTERIM REPORT . http://www.epa.gov/nrmrl/pubs/600r09128/600r09128.pdf has good data/research summaries/case studies on variety of techniques

Loudoun County – Moorefield Station Project
Zofnass Category Rating

RESOURCE ALLOCATION

Favorable

CLIMATE CHANGE

Favorable

NATURAL WORLD

Neutral

QUALITY OF LIFE

Favorable

RESOURCE ALLOCATION

- 12 Credits
- Promotes the use of resources which:
  - minimizes impacts on the current environment
  - does not compromise the ability of future generations to have access to the resources the will need

RESOURCE ALLOCATION

◆ MATERIALS

- ❑ R1.1 Use Materials Efficiently
  - Favorable
- ❑ R1.2 Use Recycled + Reused Materials
  - Favorable
- ❑ R1.3 Use Regional Materials
  - Favorable
- ❑ R1.4 Innovate or Exceed Credit Requirements
  - Favorable

RESOURCE ALLOCATION

1 MATERIALS

☐ **R1.1 Use Materials Efficiently - Favorable**

The IEMP states specific benchmarks for reusing and recycling solid waste, construction waste, and demolition waste. (Reference Document IEMP-(D)-2011) This shows a faithful attempt to manage materials efficiently throughout the development and construction process.

☐ **R1.2 Use Recycled + Reused Materials – Favorable**

The IEMP states specific benchmarks for reusing and recycling solid waste, construction waste, and demolition waste. (Reference Document IEMP-(D)-2011)

☐ **R1.3 Use Regional Materials - Favorable**

Specific benchmarks are stated in the IEMP for the using local materials. Every reasonable attempt should be made to use local materials throughout the entire process. (Reference Document IEMP-(D)-2011)

☐ **R1.4 Innovate or Exceed Credit Requirements - Favorable**

There are several benchmarks in the IEMP that address the efficient use of materials. We do recommend that these benchmarks be carefully followed and increased if able.

RESOURCE ALLOCATION

ENERGY

- R2.1 Reduce Energy Use
  - Favorable
- R2.2 Use Renewable Energy
  - Favorable
- R2.3 Commission + Monitor Electrical/Mechanical Systems
  - Neutral
- R2.4 Innovate or Exceed Credit Requirement
  - Favorable

RESOURCE ALLOCATION

2 ENERGY

☐ **R2.1 Reduce Energy Use – Favorable**

The IEMP creates a thorough guide for the development to maximize the potential reduction in energy consumption and production. (Reference Document IEMP-(D)-2011)

☐ **R2.2 Use Renewable Energy - Favorable**

The IEMP states its intention to include PV systems into the development of the site and to review alternative power generation methods. (Reference Document IEMP-(D)-2011) Proper documentation of the final configuration will be required to achieve this Zofnass credit.

☐ **R2.3 Commission + Monitor Electrical/Mechanical Systems - Neutral**

There is mention of monitoring these systems in the IEMP, but the plan needs to be further developed in order to provide a favorable rating. A more developed plan with specific information into how the systems will be monitored and how adjustments will be made when problems arise.

☐ **R2.4 Innovate or Exceed Credit Requirements – Favorable**

The IEMP places its greatest emphasis on creating and managing energy in an efficient manner. Yet more details are still necessary into how energy will ultimately be provided and managed on the site when it is developed.

RESOURCE ALLOCATION

WATER

- R3.1 Reduce Water Use
  - Favorable
- R3.2 Utilize Water Efficient Landscaping
  - Favorable
- R3.3 Commission + Monitor Water Systems
  - Favorable
- R3.4 Innovate or Exceed Credit Requirements
  - Favorable

RESOURCE ALLOCATION

3 WATER

☐ **R3.1 Reduce Water Use - Favorable**

The IEMP states its intentions of collecting runoff water and reusing it onsite, implementing water efficient equipment, and encouraging those on site to be mindful of their water use. (Reference Document IEMP-(D)-2011)

☐ **R3.2 Utilize Water Efficient Landscape – Favorable**

The IEMP states its intentions of collecting runoff water and reusing all grey water for landscape spaces. (Reference Document IEMP-(D)-2011) Proper documentation of the final configuration will be required to achieve this Zofnass credit.

☐ **R3.3 Commission + Monitor Water Systems – Favorable**

The IEMP includes an overarching water usage plan for use during the operational phase of the site. (Reference Document IEMP-(D)-2011)

☐ **R3.4 Innovate or Exceed Credit Requirements - Favorable**

There is an extensive attempt made by the IEMP to plan for the needs and uses of water across the entire site.

NATURAL WORLD

- 13 Credits

- Minimizes the negative impacts of infrastructure on local and regional ecosystems by:
  - promoting the rejuvenation of degraded ecosystems
  - minimizing fragmentation and disruptions to ecosystems
  - mitigating problems caused by its construction or operations

NATURAL WORLD

◆ SITE SELECTION

- ❑ NW1.1 Prepare Site + Impact Assessment
  - Favorable
- ❑ NW1.2 Protect Wetlands and Water Bodies
  - Favorable
- ❑ NW1.3 Conserve Prime Habitat
  - Favorable
- ❑ NW1.4 Maximize Use of Developed Sites
  - Not Favorable
- ❑ NW1.5 Maximize Use of Contaminated Sites
  - Neutral
- ❑ NW1.6 Innovate or Exceed Credit Requirements
  - Neutral

NATURAL WORLD

1 SITE SELECTION

☐ **NW1.1 Prepare Site + Impact Assessment - Favorable**

100 Year Floodplain Assessment Complete, Soil Delineation Complete, Wetland Delineation Complete, Mature Tree Delineation Complete, Phase I Archeological Report Complete, Phase I Environmental Report Complete, Preliminary Mapping of Wildlife Corridors Complete. The Environmental and Archeological Reports have been accepted by Loudoun County. (Reference Document MS-ZCPA-2007) The completion of an Environmental Impact Statement according to State or Federal requirements will satisfy this requirement.

☐ **NW1.2 Protect Wetlands and Water Bodies - Favorable**

There is a conceptual Wetland Mitigation Planting Plan that includes planting list and the creation of a Palustine Forestland. Roads appear to be laid out to minimize impact to existing wetlands. A stated mission of the IEMP is to "Develop water and wastewater infrastructure and programs that protect natural resources." (Reference Documents MS-ZCPA-2007 and LC-IEMP-B) To be eligible for a Zofnass rating in this area Zofnass has specific requirements regarding impact and minimum buffer zones to protect natural wetlands and water sources. A comparison of the wetland delineation and the final construction documents will need to be complete.

☐ **NW1.3 Conserve Prime Habitat - Favorable**

Conducted a Wetland delineation of prime habitat and a Threatened and Endangered Species inventory. (WI and ETSHE).

☐ **NW1.4 Maximize Use of Developed Sites - Not Favorable**

The proposed development is in greenfield site and would be ineligible for this credit. To be eligible for this credit a site would need to demonstrate that at least 60% of the site had been previously developed.

☐ **NW1.5 Maximize Use of Contaminated Sites - Neutral**

The proposed development is in greenfield site and would be ineligible for this credit. To be eligible for this credit documentation would need to be provided of brownfield status. This could be done via a local, state, or federal designation or results form a Phase II Environmental Assessment.

☐ **NW1.6 Innovate or Exceed Credit Requirements - Neutral**

At this point in the project planning it is difficult to assess any innovative features that would offset or mitigate some of the Not Favorable ratings above. The Innovation credit is based upon exceeding the credit requirements listed above. Zofnass views sustainability as a evolving field and aims to reward innovative and exemplary performance.

NATURAL WORLD

◆ HABITAT

- NW2.1 Preserve/Protect Habitat Connectivity
  - Neutral
- NW2.2 Eliminate Invasive Species
  - Not Favorable
- NW2.3 Reduce Storm-water Runoff
  - Favorable
- NW2.4 Treat Storm-water
  - Favorable
- NW2.5 Treat Effluent
  - Favorable
- NW2.6 Balance Earthwork
  - Favorable
- NW2.7 Innovate or Exceed Credit Requirements
  - Neutral

NATURAL WORLD

2 HABITAT

☐ **NW2.1 Preserve/Protect Habitat Connectivity – Neutral** The Wetland Delineation and the Environmental Report delineates some of this information and along with one of the maps in the Base Maps file but additional work needs to be done during the project planning process to insure connectivity with surrounding Greenfields. (Reference Document MS-ZCPA-2007, WI and ETSHE) To be eligible for this credit a mapping of at least 4 focal species and there important habitats and the travel corridors would need to be completed.

☐ **NW2.2 Eliminate Invasive Species - Not Favorable** There is no documentation to evaluate regarding an invasive species strategy during the construction or the operation phase. To be eligible for this credit a "comprehensive site assessment that documents existing conditions, analyzes environmental impacts of alternatives, and lists possible mitigation measures" would be required.

☐ **NW2.3 Reduce Storm Water Runoff – Favorable** A stated mission of the IEMP is to "Develop Water and Wastewater infrastructure and programs that protect natural resources." As the project planning stage continues this goal will need to be further evaluated against the actual plans and work put in place. (Reference Documents MS-ZCPA-2007 and LC-IEMP-B) To be eligible for this credit the minimum submission would include a site plan and narrative explaining storm water management measures; the calculations would be based the quantity of run-off for a 2 year storm event.

☐ **NW2.4 Treat Storm Water – Favorable** A stated mission of the IEMP is to "Develop Water and Wastewater infrastructure and programs that protect natural resources." As the project planning stage continues this goal will need to be further evaluated against the actual plans and work put in place. (Reference Documents MS-ZCPA-2007 and LC-IEMP-B) To be eligible for this credit documentation of the estimated storm water treatment would be required. A listing of the treatment methods and the percent treated would be included. The creation of a monitoring and maintenance plan is vital for a successful on-going program.

☐ **NW2.5 Treat Effluent – Favorable** A stated mission of the IEMP is to "Develop Water and Wastewater infrastructure and programs that protect natural resources." As the project planning stage continues this goal will need to be further evaluated against the actual plans and work put in place. (Reference Documents MS-ZCPA-2007 and LC-IEMP-B) To be eligible for this credit a table of the expected hazards associated with the effluent form the project infrastructure will need to be created along with a plan for the proposed treatment. A management and monitoring plan to insure enforcement will be critical to the success of effluent treatment.

☐ **NW2.6 Balance Earthwork – Favorable** A rudimentary review of the proposed grading plan reveals a quick assessment of a balanced earthwork plan. (Reference Document MS-ZCPA-2007) Calculation of the final grading plan with quantities of earth imported and exported from the site for the infrastructure construction would need to be submitted for evaluation of this credit. A blanked site, pertaining to earthwork, reduces resource consumption and pollution.

☐ **NW2.7 Innovate or Exceed Credit Requirements - Neutral** At this point in the project planning it is difficult to assess any innovative features that would offset or mitigate some of the Not Favorable ratings above. The Innovation credit is based upon exceeding the credit requirements listed above. Zofnass views sustainability as a evolving field and aims to reward innovative and exemplary performance.

CLIMATE CHANGE

- 10 Credits

- Reduce Greenhouse Gas Emissions
- Promote climate change adaptability

CLIMATE CHANGE

- **EMISSIONS**
  - CC1.1 Reduce Greenhouse Gas Emissions
    - Favorable
  - CC1.2 Protect Air Quality
    - Favorable
  - CC1.3 Enhance Public Transport
    - Favorable
  - CC1.4 Enhance Pedestrian/Bicycle Routes
    - Favorable
  - CC1.5 Mitigate Heat Island Effect
    - Favorable
  - CC1.6 Innovate or Exceed Credit Requirements
    - Favorable

CLIMATE CHANGE

1 EMISSIONS

☐ **CC1.1 Reduce Greenhouse Gas Emission** - **Favorable** A stated mission of the IEMP is the stated reduction of greenhouse gas emissions including specific targets regarding renewable energy and efficiency improvements. (Reference Document IEMP-(D)-2011) To be eligible for the Zofnass credits the Zofnass Valuator Tool (ZTC) will need to be employed during the design phase in reference to the entire infrastructure project.

☐ **CC1.2 Protect Air Quality** - **Favorable** The combined goals of the IEMP will improve overall air quality. (Reference Document IEMP-(D)-2011) The use of the ZTC during the design phase and appropriate documentation of air quality components will need to be submitted to be eligible for the Zofnass credit.

☐ **CC1.3 Enhance Public Transport** - **Favorable** Moorefield Station is being developed as a supporting development to the expansion of a public rail transportation system, the rail system along with the narrative in the IEMP regarding the appropriate development in relation to the amount of transpiration serves required is highly favorable in the Zofnass system. (Reference Document IEMP-(D)-2011) Proper documentation of the final configuration will be required to achieve this Zofnass credit.

☐ **CC1.4 Enhance Pedestrian/Bicycle Routes** - **Favorable** The IEMP recognizes the necessity and inclusion of pedestrian and bicycle transpiration systems as part of a fully integrated transportation system. (Reference Document IEMP-(D)-2011) Proper documentation of the final configuration will be required to achieve this Zofnass credit.

☐ **CC1.5 Mitigate Heat Island Effect** - **Favorable** The supplied documents are silent on this requirement, though much of what is being planned will have some mitigation of the Heat Island Effect. Enhancement of the mitigation of the Heat Island Effect should be included as the design progresses in particular in the final construction requirements of the buildings. Items to consider is plantings of trees shading through conventional and non-conventional means, white roofing materials and roof top gardens.

☐ **CC1.6 Innovate or Exceed Credit Requirements** - **Neutral** While the proposed project will develop a green-field site the project is taking extraordinary measures in the planning process to incorporate as many sustainable design features as possible along the goal of extending these features to the surrounding county and should be recognized for the efforts in this area. The Innovation credit is based upon exceeding the credit requirements listed above. Zofnass views sustainability as a evolving field and aims to reward innovative and exemplary performance.

CLIMATE CHANGE

CLIMATE ADAPTIBILITY

- CC2.1 Assess Climate Change Threat
  - Not Favorable
- CC2.2 Design for Long Term Climate Change
  - Not Favorable
- CC2.3 Prepare for Extreme Weather Events
  - Not Favorable
- CC2.4 Innovate or Exceed Credit Requirements
  - Neutral

CLIMATE CHANGE

2 CLIMATE ADAPTABILITY

☐ **CC2.1 Assess Climate Change Threat** - **Not Favorable**

There was no information in the submitted documents to assess this requirement. Future impacts on infrastructure projects due to change in the climate as a result of global warming should be considered in the design and construction of projects. An initial plan should include a vulnerability assessment, a risk assessment and an adaption assessment.

☐ **CC2.2 Design for Long term Climate Change** - **Not Favorable**

There was no information in the submitted documents to assess this requirement. Infrastructure systems should be designed for resiliency to changes in the global climate and the long term potential impacts on projects.

☐ **CC2.3 Prepare for Extreme Weather Events** - **Not Favorable**

There was no information in the submitted documents to assess this requirement. Consideration should be given to the types of long term climate changes that may impact the project and design should allow for adaptation of the project to changes in the climate.

☐ **CC2.4 Innovate or Exceed Credit Requirements** - **Neutral**

There was no information in the submitted documents to assess this requirement.

QUALITY OF LIFE

- 15 Credits

- Maximize the quality of life of those who use, or are affected by infrastructure projects by:

  - minimizing environmental health impacts and promoting safety and security
  - engaging the local community in decision-making
  - employing and training local workers

QUALITY OF LIFE

- **COMMUNITY**
  - QL1.1 Preserve Cultural Sites
    - Favorable
  - QL1.2 Implement Context Sensitive Design
    - Neutral
  - QL1.3 Enhance Site/Neighborhood Safety
    - Favorable
  - QL1.4 Enhance Public Space
    - Favorable
  - QL1.5 Minimize Light Pollution
    - Favorable
  - QL1.6 Innovate or Exceed Credit Requirements
    - Neutral

QUALITY OF LIFE

1 COMMUNITY

☐ **QL1.1 Preserve Cultural Sites – Neutral**

A Phase I Archaeological Investigation has been completed and no significant sites were located. (PI-AI).

☐ **QL1.2 Implement Context Sensitive Design - Neutral**

While the IEMP does states some favorable design intentions with regard to scale, sunlight, and open space, there is little mention of the immediate neighborhood of the site. (Reference Document IEMP-(D)-2011) And given this site has significant density benchmarks, we are concerned about how sensitive the development will be. To be eligible for this credit the development should further develop their intentions toward the immediate surrounding neighborhood.

☐ **QL1.3 Enhance Site/Neighborhood Safety - Favorable**

The IEMP states favorable design intentions with regard to scale, sunlight, zoning, and open spaces. (Reference Document IEMP-(D)-2011)

☐ **QL1.4 Enhance Public Space - Favorable**

With IEMP intending to preserve "existing natural corridors" and provide "typical public space" are an excellent balance of open space necessary in such a dense development. (Reference Document IEMP-(D)-2011)

☐ **QL1.5 Minimize Light Pollution - Favorable**

IEMP’s intentions to limit automobile trips and provide mixed-use developments, in combination with numerous pedestrian pathways are great characteristics to implement. (Reference Document IEMP-(D)-2011)

☐ **QL1.6 Innovate or Exceed Credit Requirements - Neutral**

There is not enough information provided to adequately assess this requirement. More information would need to be provided.

QUALITY OF LIFE

EDUCATION

- QL2.1 Promote Sustainability Awareness
  - Favorable
- QL2.2 Implement Sustainable Practices Training
  - Neutral
- QL2.3 Solicit Community Feedback
  - Favorable
- QL2.4 Innovate or Exceed Credit Requirements
  - Neutral

QUALITY OF LIFE

2 EDUCATION

☐ **QL2.1 Promote Sustainability Awareness - Favorable**

The IEMP intends to engage the community with a well developed "Stakeholder Engagement" Plan is very beneficial. (Reference Document IEMP-(D)-2011)

☐ **QL2.2 Implement Sustainable Practices Training - Neutral**

There was no information in the submitted documents to assess this requirement.

☐ **QL2.3 Solicit Community Feedback - Favorable**

The great detail provided in the IEMP about the "Stakeholder Engagement" Plan is well informed and thorough in its neighborhood approach. (Reference Document IEMP-(D)-2011)

☐ **QL2.4 Innovate or Exceed Credit Requirements - Neutral**

While the IEMP make a faithful attempt to engage the neighborhood, but not enough to exceed this requirement.

QUALITY OF LIFE

- **VALUES**
  - QL3.1 Plan for Growth Impacts
    - Favorable
  - QL3.2 Reduce Demand
    - Neutral
  - QL3.3 Implement an Integrated Project Approach
    - Favorable
  - QL3.4 Encourage Local Employment
    - Favorable
  - QL3.5 Innovate or Exceed Credit Requirements
    - Favorable

QUALITY OF LIFE

3 VALUES

☐ **QL3.1 Plan for Growth Impacts - Favorable**

The IEMP provides research and projects into how the site will mostly likely grow and develop over time. (Reference Document IEMP-(D)-2011)

☐ **QL3.2 Reduce Demand – Neutral**

This is not a stated goal of the IEMP, rather the project is attempting to grow the site over time.

☐ **QL3.3 Implement an Integrated Project Approach- Favorable**

The IEMP is detailed in its approach of how to implement the 5 "focus areas." The details into execution are particularly strong and provide good insight into how the site will be developed. (Reference Document IEMP-(D)-2011)

☐ **QL3.4 Encourage Local Employment – Favorable**

This is one of the primary goals of the IEMP and the subsequent goals reinforce this primary goal. (Reference Document IEMP-(D)-2011)

☐ **QL3.5 Innovate or Exceed Credit Requirements - Favorable**

The IEMP is a successful document in articling the primary goals and intentions of the development. As the project progress, it is expected the IEMP to provide more detail into how each phase and characteristic will be developed going forward.

Appendix I: HalSTAR Data and Results

Integrated Energy Management Plan

HalSTAR project and stakeholder related scoping documents used to develop and the tailor HalSTAR tool for Moorefield station.

Group	Document	Issue Date
Project specific	Zofnass Loudoun County – Moorefield Station Project Summary	20 September 2011
	Loudoun County Energy Strategy Project F: Moorefield Station and Digital Realty Trust data centers	16 June 2010
Loudoun County	Loudoun County Energy Strategy	16 June 2010
	Loudoun County Environmental Policy and Program Assessment	19 June 2008
	Loudoun County Facilities Standards Manual	15 December 2007
	Loudoun County Overarching and Environmental Sustainability	03 February 2011
	Loudoun Countywide Transportation Plan *(sections on "Transportation Goals and Strategies" and "Protection of the Environment")*	04 February 2011
Digital Realty Trust	Digital Realty Trust - Code of Business Conduct and Ethics	25 February 2011
	What is Driving the US Market? 2011, Digital Realty Trust	15 April 2011
Dominion Virginia Power	Dominion Citizenship & Sustainability Report 2010/2011	06 September 2011
Loudoun County Chamber of Commerce	Loudoun County Chamber of Commerce - 2011 Public Policy Positions	04 January 2011
	Loudoun Green Business Challenge 2011	01 January 2011
Loudoun County Public Schools	Loudoun County Public Schools - Policies and Regulations manual *(policies on "High Performance Design and Construciton" and "Energy and Water Management")*	01 December 2010
Loudoun Water	Loudoun Water Statement of Policy	15 July 2011
Washington Gas	WGL Holdings 2010 Corporate Performance Report	10 January 2011
Verizon	Verizon Communications Corporate Responsibility Report	20 April 2011
Rating schemes	LEED 2009 for Existing Buildings: Operations & Maintenance Rating System	01 October 2010
	LEED 2009 for New Construction and Major Renovations Rating System	01 October 2010
	BREEAM Bespoke 2008	01 January 2008
	BREEAM Communities 2009	01 January 2009

Moorefield Station Key Issue and Principle Performance Scoring (Table of the criteria used in Figure 40.)

	Area	Issue	Sustainability Principle	
Financial Capital	Value & risk	Value management	Ensure optimum value throughout the project lifecycle.	
		Project costs and funding	Ensure that capital costs are justifiable and affordable, and that adequate funding is available.	
		Running costs	Minimize utilities costs and other operational costs.	
		Local economy	Contribute towards a prosperous, diverse, competitive local economy.	
		Efficient project delivery	Ensure that the proposal is delivered efficiently and within appropriate timescales.	
		Employment impacts	Create additional jobs and a more diverse range of employment opportunities.	
		Business impacts	Deliver the conditions for successful, competitive businesses which are high-level economic contributors.	
		Risk management	Systematically assess, manage and mitigate risks and uncertainties.	
		Project viability	Ensure that the proposal is economically viable and feasible in terms of cost, timescale and deliverability.	
	Reputation	ICT	Ensure adequate communications infrastructure and maximize the take-up and exploitation of ICT and e-services.	
		Marketing	Develop and promote the brand of the development in the context of a coherent marketing framework.	
Manufactured Capital	Design & development	High Quality Environments	Deliver a high quality built environment, ensuring that buildings, infrastructure, public spaces and places are buildable, fit for purpose, resource efficient, sustainable, resilient, adaptable and attractive.	
		Innovation	Encourage new ideas and innovation to develop comparative advantages.	
		Flexibility	Future proof the development for change over its anticipated lifecycle, ensuring it resilience.	
		Rating and assessment	Establish systematic evaluation and benchmarking of the performance and effectiveness of proposals.	
		Operational management	Ensure high standards for the sustainable commissioning, management, maintenance and future adaptation of the proposal.	
	Sup ply Chai	Supply chain partnerships	Work in partnership with suppliers and contractors, developing supply chain capability to deliver value.	

		Sustainable procurement	Establish procurement policies and processes to ensure the sustainability of procured goods and services.	
		Sustainable construction	Apply sustainable construction principles to minimize whole life costs and mitigate negative impacts on the surrounding community and environment.	
Human Capital	**Health & safety**	End user health	Ensure and promote the health, safety and wellbeing of end-users throughout the lifetime of the proposal.	
		Safety in use	Manage, mitigate, and review impacts on end user and public safety and create safe physical environments.	
		User security	Assess and manage impacts on the security of users to ensure that a secure environment is provided to all users during operations without inconveniencing them.	
	People	Site travel facilities	Minimize vehicle journeys associated with the project and ensure site accessibility by a choice of travel modes.	
		Sustainable travel	Enable more sustainable transport choices for both passenger and freight movements.	
		Regional connectivity	Ensure an efficient, safe, integrated transport network.	
		User satisfaction	Assess the needs of occupants, users and visitors and incorporate measures into the design to accommodate these needs and ensure user satisfaction.	
		Equal opportunities	Foster diversity and ensure equal opportunities.	
		Accessibility	Meets the access requirements of different user groups.	
		Social inclusion	Prevent social inequalities and foster a socially inclusive community, ensuring equitable impacts on different groups.	
		Skills	Identify and address training gap to ensure that people have the right skills.	
		Public awareness	Develop the skills, knowledge and confidence of the community, and raise awareness of important issues.	
Social Capital	**Community**	Stakeholder engagement	Use appropriate, inclusive methods to identify, communicate, consult and engage stakeholders throughout the process, building consensus and minimizing potential future areas of objection.	
		Quality of life	Contribute to the quality of life in communities, considering how the daily needs of users will be met.	
		Sustainable communities	Promote and develop fair, cohesive, prosperous and sustainable communities, with adequate housing and facilities to meet local needs.	
		Safety from crime	Help to reduce crime, and create spaces where people feel safe and secure.	

		Nuisance to community	Manage and minimize adverse effects on the local area.	
	Governance	Compliance	Ensure compliance with the letter and intent of all relevant regulations, legislation, and standards as the minimum.	
		Local heritage	Protect and enhance the built environment, including cultural and historical assets.	
		Archaeology	Ensure appropriate management and protection of archaeological sites and features.	
		Promoting change	Foster a shared sense of purpose and responsibility toward sustainable development, and steer positive change.	
Natural Capital	Environmental Quality	Flood risk management	Adopt sustainable flood management policies and strategies, in order to identify necessary adaptation and mitigation measures designed to avoid the risk of harm from flooding.	
		Sustainable drainage	Develop and implement a sustainable drainage strategy to manage stormwater in order to limit disruption of natural water hydrology and minimize risks of flooding and water pollution on- and off-site.	
		Water pollution	Protect, enhance and restore the quality of water, including inland and coastal surface water and groundwater.	
		Drinking water quality	Manage, monitor and improve drinking water quality to ensure adequate provision of clean, safe drinking water for all users, in compliance with relevant standards.	
		Air pollution	Minimize emissions of air pollutants and implement strategies to improve air quality.	
		Noise and vibration	Minimize and mitigate noise and vibration resulting from the proposal, ensuring that levels do not exceed critical limits.	
	Biodiversity	Habitats	Conserve, restore and enhance the natural environment by sustaining, and where possible improving, the quality and extent of natural habitats.	
		Biodiversity	Help to conserve and enhance the diversity of species, as part of healthy functioning ecosystems.	
	Resource Use	Food supply	Ensure access to affordable, healthy, locally produced food.	
		Agricultural land	Promote and enable competitive, sustainable farming and agricultural practices which contribute to the production of healthy, nutritious food and other crops without damaging wildlife or human health.	
		Geoenvironmental	Manage and protect the quality of soils, minimizing soil loss, disturbance and contamination, and remediating previously degraded land.	

		Land amenity	Ensure the conservation and wise use of land, improving the capability and amenity of land resources.	
		Impacts on surroundings	Protect and enhance the character and appeal of landscapes, avoiding negative impacts on the site and adjacent areas.	
		Water management	Establish appropriate systems to monitor and record water consumption at regular intervals.	
		Water efficiency	Ensure and increase the efficient use of water resources and minimize water demand.	
		Local water resources	Apply water sensitive design to protect local resources and enhance local amenity.	
		Water infrastructure	Manage and maintain an efficient water infrastructure.	
		Waste management	Establish and implement sustainable waste management plans and procedures to minimize waste, and recover and recycle resources efficiently.	
		Waste treatment	Reduce waste quantities and ensure sustainable treatment and disposal, contributing to the move away from landfill.	
		Resource management	Manage and monitor resource use, ensuring the prudent, sustainable use of natural resources and material assets.	
	Climate Change	Energy management	Adopt appropriate energy management measures in line with the energy consumption hierarchy.	
		Operational energy use	Ensure the efficient, effective use of energy during operation.	
		Energy security	Ensure sustainable use, and maintain the reliability, of energy supplies, balancing supply and gross energy consumption.	
		Renewable generation	Increase the generation of renewable energy.	
		Local energy	Maximize the production and use of locally generated energy in order to reduce transmission losses.	
		Energy infrastructure	Ensure that effective, efficient, resilient energy infrastructure exists.	
		Site microclimate	Consider and respond to the local climatic conditions, exploiting the potential resultant contribution to performance.	
		Adaptation to climate change	Ensure resilience and enable effective adaptation for current and potential future impacts of climate change.	
		Carbon management	Develop and implement appropriate strategies, plans and policies to reduce greenhouse gas emissions.	

		Embedded carbon	Minimize carbon dioxide emissions arising from the manufacture of materials, their transportation, installation and construction.	
		Operational carbon and greenhouse gases	Minimize net carbon dioxide and other greenhouse gas emissions due to transport and operations.	

Appendix J: IEMP Brochure

Integrated Energy Management Plan

Background and Perspectives

Why an Energy Master Plan?

The way we think about and use energy is changing like at no other time since kites and lightning bolts. Advancements in clean energy, distributed generation, technology-enabled devices, smart grid, electric vehicles and power generation are converging. Consumer expectations are increasing. Loudoun County is particularly impacted by such issues due to its demographics, location, industry and expected growth. To navigate and optimize their approach, the County has created a unique partnership between county government and the Claude Moore Charitable Foundation to lead the development of an Integrated Energy Management Plan (IEMP). Both are committed to sustainable development based on delivering to a triple bottom line that considers people, the planet and profit.

"We at the Claude Moore Charitable Foundation are enthusiastic about being a Loudoun County showcase for the wise use of resources as we develop Moorefield Station into a global destination. As we partner with the County and others, we welcome the opportunity to engage in dialog and create the community of the future that balances the needs of people, planet and profit every step of the way."

- **Randy Sutliff**, *Claude Moore Charitable Foundation*

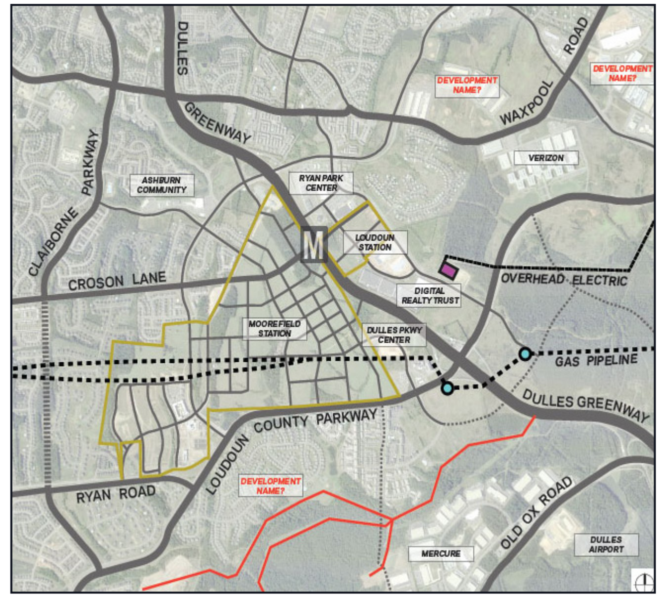
Claude Moore Charitable Foundation

MOOREFIELD STATION

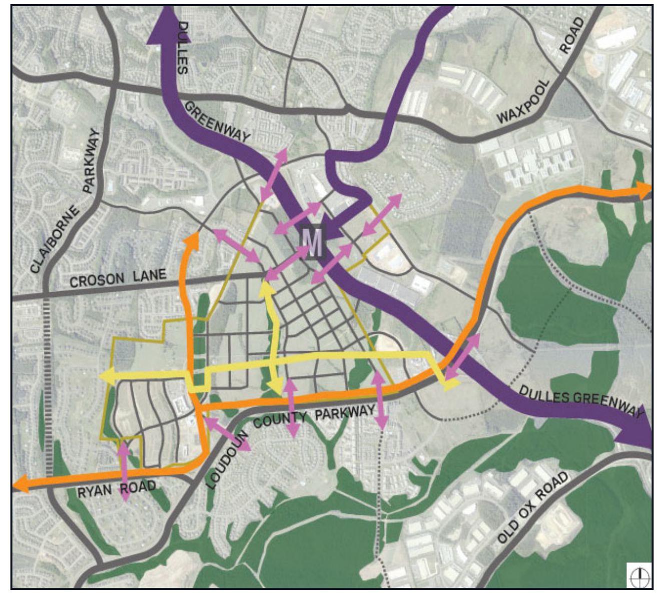
A CLAUDE MOORE CHARITABLE FOUNDATION COMMUNITY

Moorefield Station is planned as a transit oriented, mixed use development with variable density. It features a unique location at the terminus of the planned Metro Silver line, borders the Dulles Greenway, near large power and natural gas infrastructure, a waste water treatment plant and Dulles Airport, and includes important industrial and commercial develop nearby.

Moorefield Station: Regional Hub



Interconectivity Map



A great benefit of Moorefield Station is its inclusive approach to mobility featuring all forms of transportation, both within the development and connected to adjacent neighborhoods. The map shows various ways to connect, including Metro (gray); bus (purple); regional/local bike lanes (orange and yellow); and pedestrian links (light purple)

Economic Development

Driving economic development through a comprehensive energy plan represents a best practice that fuels a vibrant community.

Results / Opportunities

- Job Creation
- Financial impact and available funding
- Supporting technology and clean energy growth
- Moorefield Station opportunity (Why MS?)

5 Step Process

Industry Evaluation

With focus on the renewable energy industry sectors and those most suitable for Loudoun County, the industry evaluation will identify the state and level of support for existing, emerging, and future major technologies and industries in the region. Funding programs available for energy-related activities will be identified and profiled.

Supportive Networks

Using interview results, third party data and other analyses, supportive networks will be screened for entrepreneurs, funding sources and workers (including review of skill levels, research/institutional linkages and training programs for workers in applicable fields). This work will include profiling employment in key renewable energy and related industries.

Best Practices

Best practices in renewable energy projects, initiatives and other developments will be profiled with an emphasis on energy sectors identified by the Consultant Team in early stages of this project. The best practice descriptions will address key questions including: what financing strategies did they use? Who were the key participants? What was their marketing strategy? What were the key issues and constraints? How were these issues and constraints overcome?

Reuse Opportunities

Based on environmental, transportation/access, community, and other potential issues, a roster of reuse opportunities will be developed for the short-term and interim periods. A qualitative assessment of economic development reuse opportunities resulting from the IEMP process and implementation will be selected to be further evaluated.

Economic Impact

Of the selected reuse opportunities, an economic and fiscal impact overview analysis will be conducted to include direct and indirect/spinoff benefits (overall jobs and payroll) to the local and Loudoun regional economy, and to the Commonwealth of Virginia economy and associated selected tax revenue impacts (local government, Loudoun County, and Virginia.

Getting involved means we all succeed.

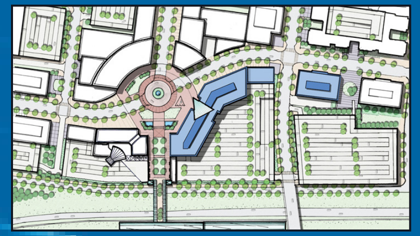
We are committed to active partnerships in order to multiply the opportunities of Moorefield Station.

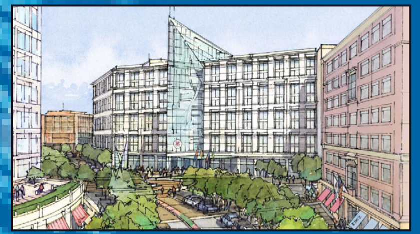
Partners in Plan Development:

- Claude Moore Foundation
- Comstock Partners
- Digital Realty Trust
- Dominion Energy
- Dulles Greenway
- Loudoun Water
- Loudoun Chamber
- Loudoun Schools
- MWAA
- Virginia Dept. of Transportation
- Verizon
- Washington Gas

For more information:

www.Loudoun.gov



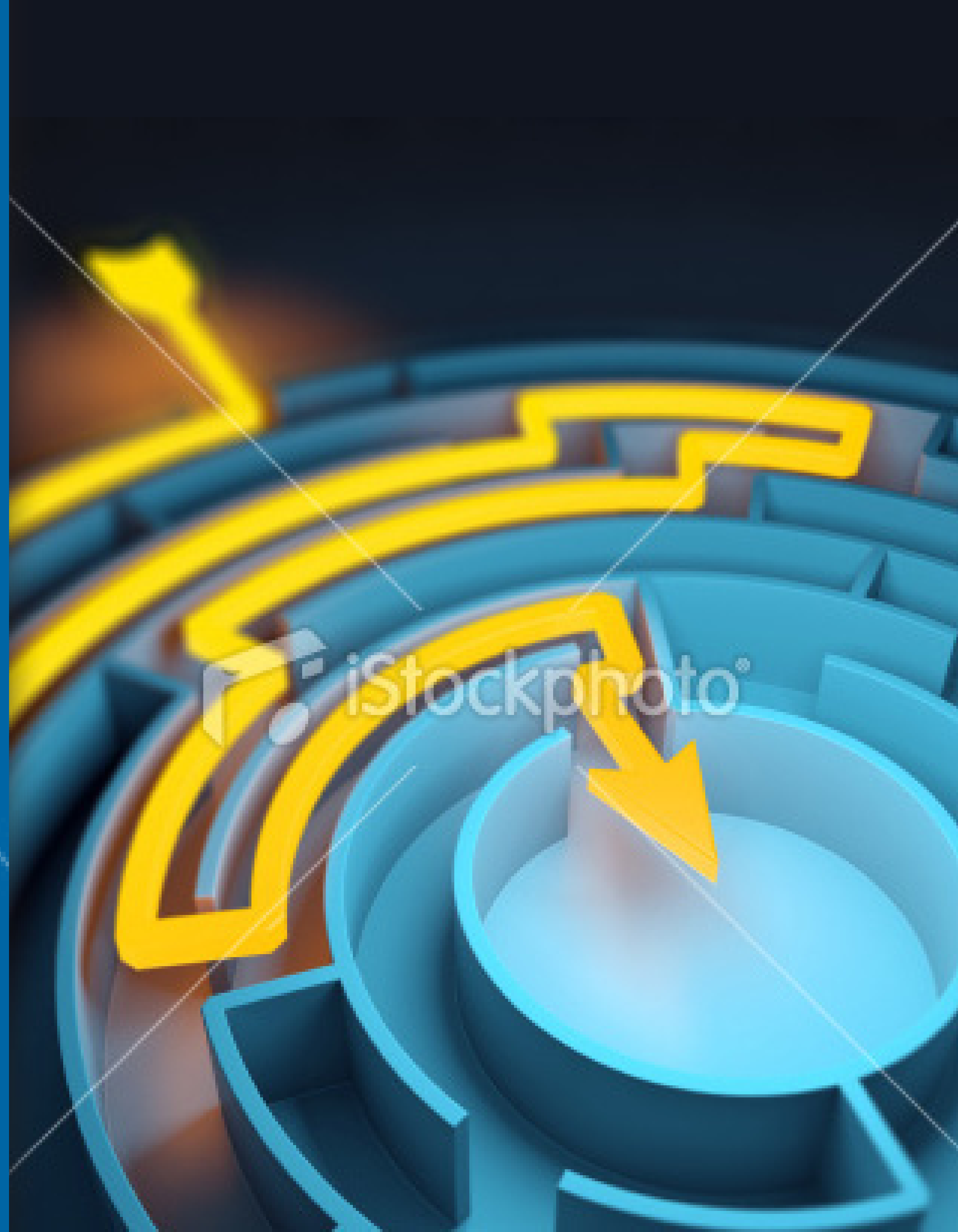


A partnership of Loudoun County and the Claude Moore Charitable Foundation for Moorefield Station.

Loudoun County

INTEGRATED ENERGY MASTER PLAN

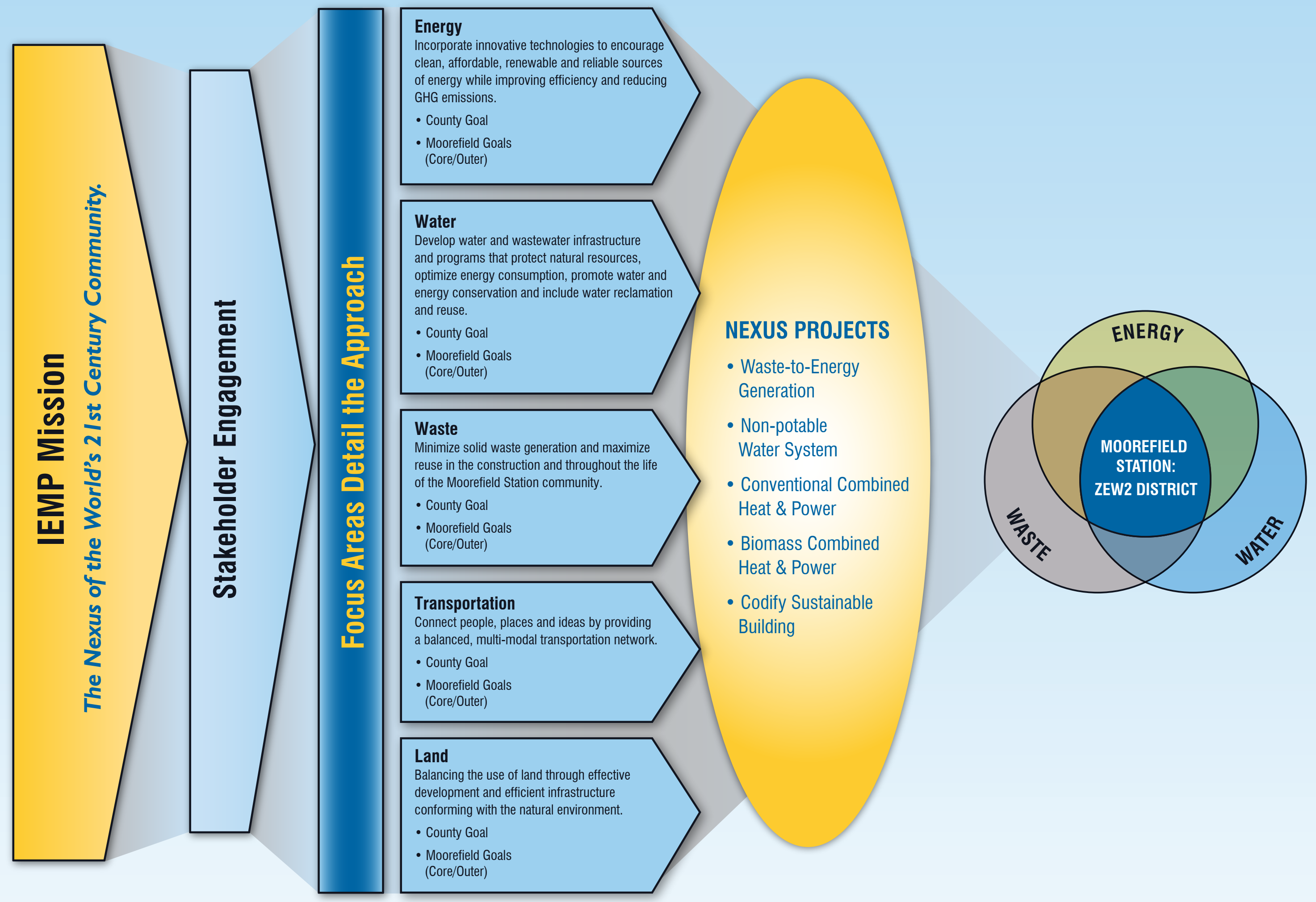
Harnessing the power of human creativity, economic prosperity and energy innovation to be *The Nexus of the World's 21st Century Community.*



An Integrated Approach

Spanning from overall strategy to identification of specific projects results in a high impact and durable plan.

Being The Nexus of the World's 21st Century Community – as called for in the mission statement – requires an integrated and robust approach that optimizes programs in a broader and long-term strategy. Starting with the mission, we achieve focus through the details of the five focus areas – energy, water, waste, transportation and land. To tap potential synergy, we then evaluated possible projects for those that optimized positive impacts and use of resources. The resulting "Nexus Projects" represent capital investments and directly contribute to achieving goals. Finally, a flagship program, called the Zero Energy/Water/Waste District (ZEW2) has been developed to act as the beacon for more innovative and sustainable developments throughout the world.



Nexus Projects

Nexus projects form the centerpiece of the entire strategy and create real progress to plan goals.

A key component of the IEMP is alternative energy or sustainable projects that act as a 'beacon' to set a new standard for regional, national and global development. First, a screening was conducted to prioritize various options by ranking with respect to (1) ability to accomplish individual focus area goals; (2) ability to meet multiple goals with a single project; (3) degree of innovation; (4) contribution to County Energy Strategy goals of reduced GHG emissions and renewable energy generation. This was followed by a deeper dive into the business performance of each option.

Five projects were identified as meeting the criteria established:

1. Waste-to-Energy Generation
2. Non-Potable Water System
3. Conventional Combined Heat & Power
4. Biomass Combined Heat & Power
5. Codify Sustainable Building

Two projects emerged as having the highest near-term potential; other projects will be incorporated over time.

1

Refuse Derived Fuel Power Plant technologies are well established and sustainable power generation options. Recent technological advances have improved emissions and overall performance. A 10MW plasma arc gasification or an alternative conventional autoclave technology would provide enough power to provide the annual electricity needs for more than 3,250 homes in Loudoun County. In addition, an RDF power plant could divert almost 90% of the waste delivereed to the landfill, reduce landfill costs and avoid future expansion of the landfill. This project addresses the nexus of waste, energy and land use issues.

2

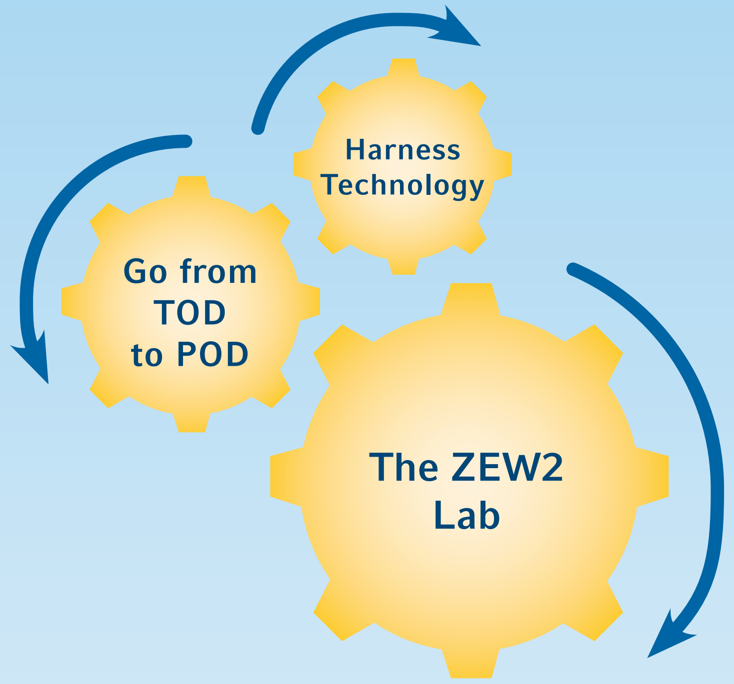
A Non-Potable Water System would provide local, minimally treated water for uses such as make-up water for building cooling towers or localized irrigation. Planned stormwater control ponds will supply water to the system. A non- potable water system addresses the nexus of water, energy and land use by reducing the energy consumed in treating and delivering water while lowering peak day requirements which drive infrastructure investments.

ZEW2: The Zero Energy/Water/Waste District

Becoming the hub for information and technology while building a people centric approach creates synergy; creating a lab environment taps human creativity.

Program Hallmarks:

1. Harness technology and infrastructure in partnership with other global leaders
2. Move beyond transit orientation to people orientation



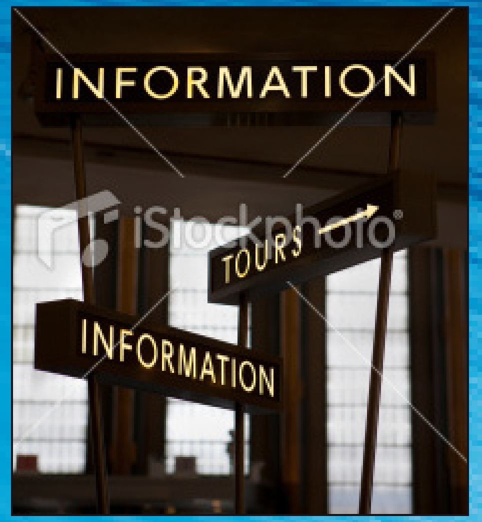
Hallmark 1: Harness Technology & Infrastructure

- Develop nexus projects
- Pilot new technologies
- Implement smart grid with progressive customer interface
- Contribute to sustainable water supply/use/re-use

Hallmark 2: Move beyond "TOD" to "POD"

From transit- to people-oriented development

- Customer engagement/consumer behavior change
- Innovative parking solutions
- Neighborhood distribution point
- Urban agriculture
- Social media
- Living building challenge



By merging innovative approaches to community development and an educational focus, Moorefield Station will develop a "living laboratory" environment where both residents and visitors learn about sustainable practices that they can bring to other areas of their lives – at home, at work and at play.

Envision a community where, instead of hiding the reality of how things work, there is active engagement to build understanding of an individual's role in impacting the health of the triple bottom line. Each step of the way, a person has the knowledge and awareness to make choices. The result? A community that educates and engages people in accomplishing a common mission.

We are committed to active partnerships in order to multiply the opportunities of Moorefield Station.

Appendix K: Dominion Virginia Power Schedule 19

Integrated Energy Management Plan

Schedule 19
POWER PURCHASES FROM
COGENERATION AND SMALL POWER PRODUCTION
QUALIFYING FACILITIES

I. APPLICABILITY & AVAILABILITY

This Schedule is applicable to any Cogenerator or Small Power Producer (Qualifying Facility), as defined in the Public Utility Regulatory Policies Act of 1978 (PURPA), which desires to provide all or part of its electrical output to the Company on an energy and capacity or on an energy only basis, and which has a net capacity of 20,000 kW or less, and enters into an agreement for the sale of electrical output to Virginia Electric and Power Company (Agreement).

No developer, or any affiliate of a developer, shall be permitted to locate a Schedule 19 facility within one-half mile of any other Schedule 19 facility owned or operated by such developer or any affiliate of such developer unless:

a. Such facilities provide thermal energy to different, unaffiliated hosts; or
b. Such facilities provide thermal energy to the same host, and the host has multiple operations with distinctly different or separate thermal needs; or
c. Such facilities utilize a renewable resource that may be subject to geographic siting limitations, such as hydroelectric, solar or wind power facilities.

This Schedule is available to a Qualifying Facility (QF) which enters into an Agreement with the Company during the effective period of this Schedule, and which achieves Commercial Operation in accordance with the provisions of its Agreement (Commercial Operations) on or after January 1, 2006.

II. MONTHLY BILLING TO THE QF

The provision of Electric Service from the Company to the QF will be in accordance with any applicable filed rate schedule. A QF that elects to sell electrical output from its generation facility will be billed a monthly charge as follows to cover the cost of meter reading and processing:

1. For QFs requiring only one non-time differentiated meter: $5.56.
2. For QFs requiring only one time differentiated meter: $65.09.
3. For QFs requiring two time differentiated meters: $102.62.

(Continued)

Schedule 19

POWER PURCHASES FROM
COGENERATION AND SMALL POWER PRODUCTION
QUALIFYING FACILITIES

(Continued)

III. CONTRACT OPTIONS

QFs with a net capacity of 10 kW or less shall elect, from the following two options, the manner in which the QF shall operate and provide its electrical output to the Company. This election shall be contracted for and made a part of the QF's Agreement. QFs with a net capacity greater than 10 kW but less than or equal to 20,000 kW must contract for the supply of both energy and capacity to the Company, in accordance with Paragraph III. A., below. Purchase payments, if any, to the QF for the supply of energy and/or capacity to the Company shall be based on this contractual designation.

A. Supply of Energy and Capacity: A QF shall contract for the supply of both energy and capacity to the Company, except as may be permitted pursuant to Paragraph III. B., below. The level of capacity that the QF contracts for shall not exceed 20,000 kW. The supply of both energy and capacity shall require the installation of one (or two, if necessary) time differentiated meter(s) to measure the hourly output of the QF's generation facility.

B. Supply of Energy Only: A QF with a net capacity of 10 kW or less may elect to contract for the supply of only energy to the Company. A QF electing this option will not be eligible for capacity payments. Election of this option shall require the installation of a non-time differentiated meter to measure the monthly output of the QF's generation facility.

IV. PAYMENT FOR COMPANY PURCHASES OF ENERGY AND CAPACITY

A QF that supplies both energy and capacity to the Company, in accordance with Paragraph III. A., above, shall receive purchase payments as follows:

A. Energy Purchase Payments

1. Purchase payments for the supply of energy by the QF to the Company will be based on an hourly energy purchase price (cents per kWh) that is calculated using the hourly $/MWh PJM Interconnection, LLC (PJM) Dom Zone Day Ahead Locational Marginal Price (DA LMP) divided by 10, and multiplied by the hourly net generation as recorded on the Company's time differentiated meter.

(Continued)

Schedule 19

POWER PURCHASES FROM
COGENERATION AND SMALL POWER PRODUCTION
QUALIFYING FACILITIES

(Continued)

IV. PAYMENT FOR COMPANY PURCHASES OF ENERGY AND CAPACITY (Continued)

2. All energy purchase prices per kWh will be increased by 2.8% to account for line losses avoided by the Company. This line loss percentage will be fixed for the term of the contract between the QF and the Company.

3. In lieu of the line loss percentage in Paragraph IV. A.2., a QF may request that the percentage be derived by a line loss study calculated to the location the QF interconnects with the Company. To receive this site specific line loss percentage, the QF must be willing to bear the cost of such a study.

B. Capacity Purchase Payments

Purchase payments for the supply of capacity by the QF to the Company will be made based upon the QF's daily net on-peak generation multiplied by that corresponding day's on-peak capacity purchase price, as calculated, below. If applicable, the purchase payment for capacity may be modified by application of the Summer Peak Performance Factor (SPPF), as described, below. The on-peak hours for every day are from 7 AM to 11 PM. Off-peak hours are defined as all other hours.

Beginning June 1, 2007, and for each June 1, thereafter, PJM will establish the Reliability Pricing Model capacity resource clearing price for each PJM zone, shown as a $/MW/day price, that will be applicable through the following May 31. Such prices will be the clearing results from PJM's Base Residual Auction. Using the price for the Dom Zone (initially identified on the PJM website as "Dom_PZonal"), the Company will calculate an on-peak capacity purchase price (cents per kWh) for each day by dividing the Dom Zone $/MW/day price by 16 hours, and further dividing the result by 10, rounded to the nearest one-thousandth cent. The resulting cents per kWh on-peak capacity purchase price will be applied to the QF's net on-peak generation for the corresponding day, to provide for the daily capacity purchase amount. The sum of the daily capacity purchase amounts for the billing month will constitute the monthly capacity purchase payment to the QF, unless modified by application of the SPPF, below.

(Continued)

IV. PAYMENT FOR COMPANY PURCHASES OF ENERGY AND CAPACITY (Continued)

Initially, a QF's SPPF will be 1. Once a QF has achieved Commercial Operations and such operation encompasses at least a full Summer (defined by PJM as June 1 through September 30, inclusive), the following January billing month, and for each January billing month thereafter, an SPPF will be calculated that is based on the QF's operation during the five (5) PJM coincident peak hours ("CP Hours"), as posted by PJM, during the Summer of the previous calendar year. The QF's SPPF is equal to the number of CP Hours in which the QF generated at or greater than 75% of its net capacity, divided by 5. Therefore, the SPPF could be 0, .2, .4, .6, .8, or 1. The QF's SPPF will be applied to the monthly capacity purchase payment for each billing month of the current calendar year.

V. PAYMENT OF COMPANY PURCHASES OF ENERGY ONLY

A QF that supplies only energy to the Company, in accordance with its election in Paragraph III. B., above, shall receive purchase payments as follows:

A. Purchase payments for the supply of only energy by the QF to the Company will be based on an energy purchase price (cents per kWh) that is calculated using the average of the hourly $/MWh Dom Zone DA LMP for the QF's billing month divided by 10, and multiplied by the net generation as recorded on the Company's non-time differentiated meter.

B. All energy purchase prices per kWh will be increased by 2.8% to account for line losses avoided by the Company. This line loss percentage will be fixed for the term of the contract between the QF and the Company.

C. In lieu of the line loss percentage in Paragraph V. B., a QF may request that the percentage be derived by a line loss study calculated to the location the QF interconnects with the Company. To receive this site specific line loss percentage, the QF must be willing to bear the cost of such a study.

(Continued)

Schedule 19

POWER PURCHASES FROM
COGENERATION AND SMALL POWER PRODUCTION
QUALIFYING FACILITIES

(Continued)

VI. PROVISIONS FOR COMPANY PURCHASE OF THE QF GENERATION

A. The QF shall own and be fully responsible for the costs and performance of the QF's:

1. Generating facility in accordance with all applicable laws and governmental agencies having jurisdiction;

2. Control and protective devices as required by the Company on the QF's side of the meter.

B. The Company shall own and install any interconnection facilities on the Company side of the meter required for the QF to sell energy to the Company. The costs associated with these facilities will be borne by the QF. These costs include, but are not limited to, the costs of connection, switching, metering, transmission, distribution, safety provisions, telephone lines, and administrative costs incurred by the Company which are directly related to the installation and maintenance of the facilities necessary to permit interconnected operations with the QF. The QF shall pay for these interconnection costs by either of the following methods:

1. A one-time lump-sum payment equal to the estimated new installed cost of all interconnection facilities provided by the Company multiplied by the appropriate tax effect recovery factor (if applicable), plus the appropriate monthly charge as described in Section IV.E. of the Company's Terms and Conditions on file with the Virginia State Corporation Commission.

2. A continuous monthly charge as described in Section IV.E. of the Company's Terms and Conditions on file with the Virginia State Corporation Commission which is designed to recover over time the estimated new installed cost of all interconnection facilities and their related operating expenses.

The QF will also be responsible for payment to the Company for the cost of removing the interconnection facilities at the conclusion of the QF's Agreement. Payment for these costs shall be in the same manner as the Company charges its other customers for similar work.

(Continued)

Schedule 19

POWER PURCHASES FROM
COGENERATION AND SMALL POWER PRODUCTION
QUALIFYING FACILITIES

(Continued)

VI. PROVISIONS FOR COMPANY PURCHASE OF THE QF GENERATION (Continued)

C. In addition to the costs in Paragraph VI.B., above, the actual costs associated with relocating and/or rearranging existing facilities to allow interconnected operation will also be borne by the QF. A monthly charge shall not apply to these costs. Payment for these costs shall be in the same manner as the Company charges its other customers for similar work.

D. The QF shall have equipment specifications and plans for control devices interconnection facilities, and protective devices approved by the Company in advance of energizing the facility.

E. The relays and protective equipment shall be subject, at all reasonable times, to inspection by the Company's authorized representative.

F. Upon request by the Company, the Cogenerator or Small Power Producer must demonstrate that the facility is a Qualifying Facility as defined by PURPA.

G. The Company shall have the right to reduce the energy received from a QF during periods when a minimum load condition exists on the Company's system. These reductions will be within the design limits of each QF’s equipment and will be limited to 1,000 off-peak hours in any calendar year.

VII. MODIFICATION OF RATES AND OTHER PROVISIONS HEREUNDER

The provisions of this schedule, including the rates for purchase of electricity by the Company, are subject to modification at any time in the manner prescribed by law, and when so modified, shall supersede the rates and provisions hereof. However, payments to QFs with contracts for a specified term at payments established at the time the obligation is incurred shall remain at the payment levels established in their contract.

VIII. TERM OF CONTRACT

The term of contract shall be mutually agreed upon, but not less than one year.