LOUDOUN COUNTY ENERGY STRATEGY

As Approved by the
Loudoun County Board of Supervisors
On December 15th, 2009

Prepared by
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This Loudoun County Energy Strategy was produced by the Northern Virginia Regional Commission in collaboration with a team of industry experts drawn from local, national and international organizations. This project has also benefited from the generous contributions of time and expertise of many Loudoun county staff members who provided data and information, as well as valuable advice. The following individuals are specifically acknowledged for their contributions to this report:

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1 CES Process - Background

Loudoun County is taking the lead to develop a comprehensive County Energy Strategy (CES) that will support the County's economic competitiveness, attract high-quality employment and investments, and respond to the impact that Loudoun's energy use has on the environment. There is also specific emphasis on reducing peak demand on the existing electricity grid in efforts to reduce the need for significant future investments.

In May 2009, the County staff participated in a full-day workshop on successful community energy planning. The workshop evaluated experiences from other communities in the US, Canada and Europe, and compared and contrasted them to northern Virginia and the Washington Metropolitan region.

The development of the CES started in July 2009 with support from funds from the US Department of Energy's "Energy Efficiency and Conservation Block Grant" (EECBG) program. The CES used pre-existing planning and economic development structures from the County as the basis for evaluating the energy impacts and opportunities. The goal is for the CES to serve the community's energy needs in a rational way within the current planning frameworks.

This Loudoun County Energy Strategy Report outlines a 30-year roadmap including goals for energy use, distribution, and supply for the County as a whole. Both short- and medium-term implementation approaches are recommended. Among these are recommendations to ensure the efficient construction, renovation and operation of homes and buildings. The CES also addresses ways to incorporate clean and renewable energy generation, distributed in clean and economical ways. The CES highlights the energy opportunities presented by higher density mixed-use developments that are likely to be built around the planned Metro stops, and other large-scale compact developments. It also addresses the use of energy in all forms of transportation.

To develop the baseline and core recommendations, the CES Team assessed large amounts of information from multiple sources. A strong message received at the public input sessions, held during the week of September 7-14, 2009, was to have this background included and referenced as completely as possible. To satisfy this request, while still retaining acceptable readability of the report, the CES has been structured with multiple Appendices. These are available from the County as separate supporting documents. Extensive footnotes and references are used throughout the CES Report, Appendices, and a Glossary of Terms is provided at the end to assist the reader.

The development of a CES was a condition for the approval for the use of the balance of 2009 EECBG funds on immediate projects, and recommendations are included that are consistent with the overall directions of the CES. However, the CES is a framework that goes far beyond these initial projects. The overall results of the Loudoun County Energy Strategy will be a consequence of adopting an integrated approach to efficiency in use, efficiency in energy distribution, and a mix of conventional and alternative energy sources. The individual measures interact with each other, and are recommended in their entirety as an integrated strategy. An approach that attempts to pick and choose between them will change the ultimate outcomes for the County.

2 Executive Summary

This section is available as a stand alone document, representing a comprehensive summary of the full CES Report.

2.1. Executive Summary Part I – County Energy Strategy

Note that for ease of readability, references supporting any statistical data or declarative statements in the Executive Summary have not been used. References are provided where the information is included in the wider report.

CES Background

There are rapidly growing trends changing the face of the energy markets worldwide creating high-value market opportunities and employment. Globally, energy use has increased more than five times in the last 50 years. Energy use could double again in the next twenty years, creating uncertainties over future pricing, supply security, environmental impacts and possible energy-related legislation.

Businesses and organizations of all types are making unprecedented investments in reducing energy usage and greenhouse gas emissions, aimed at controlling both costs and future risks. They are finding this is improving the competitiveness of their activities. This is driving major growth in new businesses aimed at supporting energy efficient homes, buildings and industrial processes, along with efficient, comfortable, competitive individual and mass transportation. Efforts are being made to restructure the summer peak demand on the existing electricity grid, which would reduce the need to increase the generation and transmission capacity and would have significant impacts on large scale power plant or transmission investments. The need for reliable, cleaner and renewable energy supplies distributed more efficiently is a further factor in the transformation of the energy market.

Loudoun County is well positioned to become recognized for successfully serving the changing energy needs of both the community and current and future businesses. Recognizing the potential opportunities, Loudoun County took the lead in developing a comprehensive County Energy Strategy (CES) reaching to 2040 to achieve measurable reductions, using 2007 as the baseline year.

The CES Vision underlines the importance of energy to Loudoun County's overall economic development goals:

"Loudoun County will always have reliable and affordable energy, be energy efficient, and have reduced greenhouse gases."

Success will be measured in many ways summarized in the five key Goals of the CES:

- Loudoun County will be recognized as a location of choice for investment in part because of its innovative energy strategy.
- Loudoun County will strive to have consistently lower energy costs relative to surrounding areas.
- Loudoun County will have greenhouse gas emissions among the lowest in the country.
- Loudoun County will be recognized as a regional, state, and national role model of

effective energy and climate management.
- All major investments will visibly contribute to meeting the CES goals.

The CES for Loudoun County has been developed with these Goals clearly in mind. The recommendations made, if adopted, will ensure they are achieved. The County has been one of the most successful regions in the US in attracting new jobs, a trend expected to continue. By 2040, local employment is expected to grow to 305,000 jobs from 140,000 in 2007. Population is expected to grow to 458,000 from 270,000 over the same time. This will require adding 75,000 homes to the current 100,000 and adding 73 million square feet of non-residential buildings to the existing 69 million. Most development will be to the east in the County. Some of this development will be clustered in new mixed-use residential and commercial neighborhoods around the Metrorail stations, which are due to open in 2016.

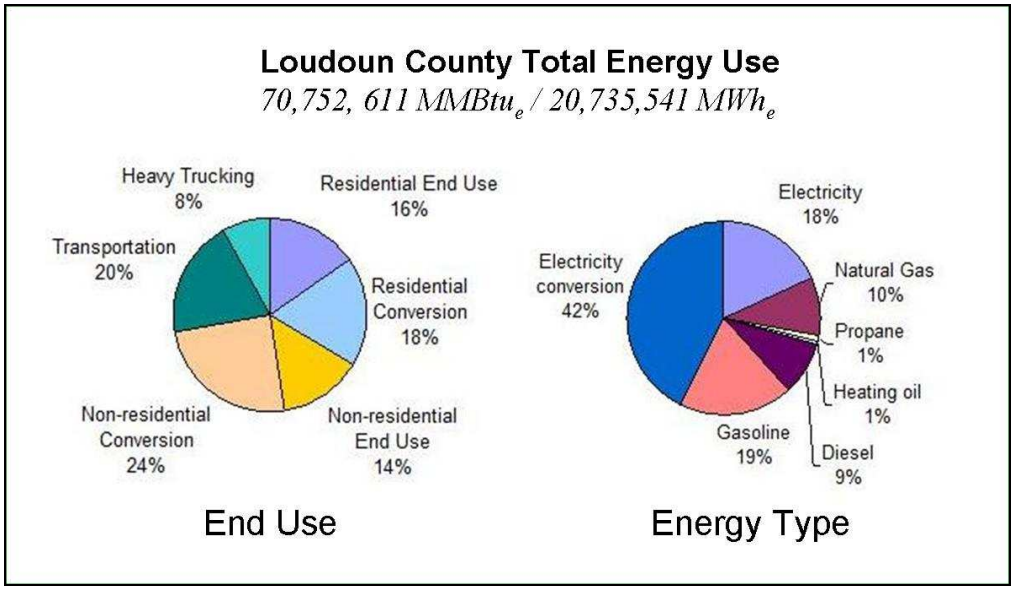
All electricity for the County is generated outside of the County resulting in about 70% conversion and transmission inefficiencies. These are included in the total energy and emissions figures for the County.

Loudoun County is home to a number of Data Centers, which continue to be major consumers of electricity, and are constantly seeking new ways to be both more energy efficient and to create lower emissions. Data Centers and the other technology businesses are expected to be a continuing strategic source of investment and employment in the County.

Transportation will remain a challenge for the County, with about 2.3 billion vehicle miles of travel causing congestion of the existing roads at peak traffic times. The two new Metrorail stations and planned bus services will offer some new travel options beginning in 2016, but will not fundamentally change the overall dominance of the individual vehicle as the preferred means of transportation.

The 2007 local energy use in Loudoun County was distributed as 34% in homes, 38% in commercial and public buildings of all types, and about 28% in transportation. Of the total energy supplied 60% is related to the use, distribution and generation of electricity, 28% is from gasoline and diesel fuel, and the balance from natural gas, propane, and oil for heating and hot water for homes buildings. In total, the County uses 70,753,000 Million Btu of energy of all types.

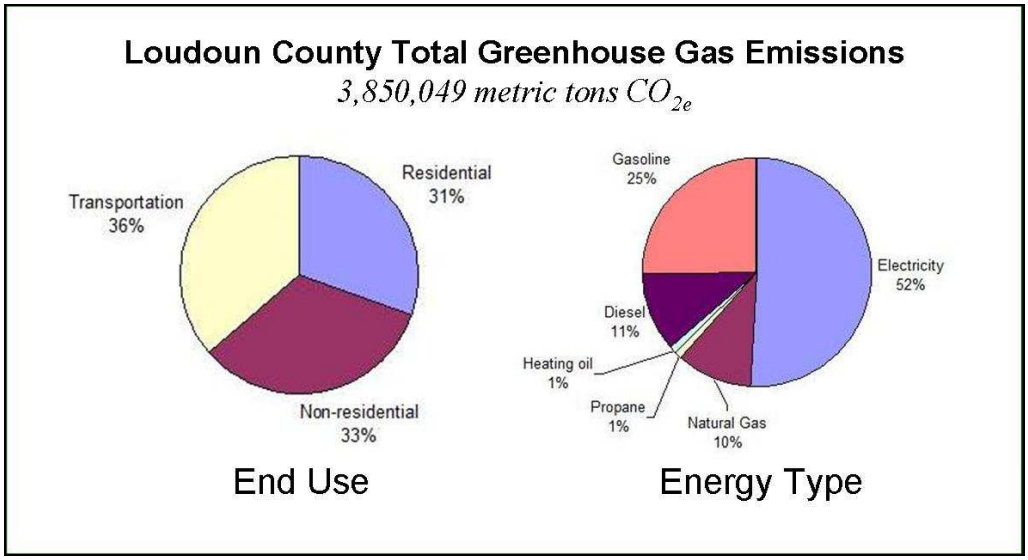
Loudoun County Energy Use in 2007



Prices for natural gas and electricity in Northern Virginia have historically been among the lowest in the country, a situation that is by no means certain to continue.

Energy use is the major human cause of greenhouse gases. Greenhouse gas emissions for Loudoun County were split into 31% from home energy use, 33% from buildings and 36% from transportation. By energy type, electricity accounts for 52% of all emissions, gasoline and diesel fuels for 36%, with the remaining 12% from natural gas and other heating fuels. In total, the County creates 3.85 Million metric tons of energy related greenhouse gases. Legislation currently being debated in Congress is calling for greenhouse emissions reductions of between 60% and 70% over the period used for the CES.

Loudoun County Greenhouse Gas Emissions in 2007



On the basis of local energy use and greenhouse gas emissions per resident, Loudoun County is towards the upper end of US urban averages. Taking into account its rural and urban mix, the County as a whole is typical for the US. On a global comparison, the energy use and greenhouse gas per capita for the US is more than twice that of Japan and the European Union.

CES Recommendations

On a business-as-usual track, by 2040 Loudoun County would require 46% more energy to manage the expected growth. This is even allowing for some expected improvements in the efficiency of both existing structures and new construction. Over the same period, total greenhouse gas emissions would increase by 50%.

The CES addressed three main areas of energy opportunity – homes and buildings, transportation and clean and renewable energy supplies.

Homes and Buildings

The energy needs of the growth in both employment and housing for the County can be provided through efficiency of both new construction and existing homes and buildings. This will be achieved by:

- Encouraging all new construction to meet Energy Star levels from 2011, or about 30% more efficient than current code.
- Encouraging all major retrofits to be at least 25% more efficient than the current County average.
- Incrementally increasing these targets every four years by about 4%.

These are levels that are readily achievable at modest incremental construction costs of

between 2% and 5%, and are increasingly becoming market norms.

To both educate the market and to raise the market transparency of the actual energy performance of homes and buildings, voluntary Energy Performance Labeling (EPL) is recommended. A current EPL would be available anytime a building is sold or leased. Wherever this approach has been adopted, a steady improvement in energy efficiency occurs over and above the expected gains from changes in construction codes. The US Department of Energy is looking into implementing this on a national basis. These labels are expected to be similar to Energy Star labeling for appliances or MPG statements on vehicles.

Since building codes are a State jurisdiction, these would be voluntary measures to be adopted by the County, supported by a variety of outreach and incentive initiatives. Virginia is a Dillon rule state, so the voluntary nature of these recommendations is underlined.

These recommendations result in 7% less total energy use in homes and buildings while serving a 70% increase in population and more than a 100% increase in jobs

Transportation

The transportation energy needs of the expanded population can be more than met through a range of efficiency measures. Some, such as weight reduction from advanced materials, more efficient diesel, gasoline and hybrid drive trains and a general market trend to smaller vehicles are beyond the County's direct control. Others would be a result of successful implementation of local initiatives, including the following:

- Reduction in outbound commuting through the successful growth of local employment.
- Development of mixed-use neighborhoods to encourage shorter commutes, walking and cycling.
- Development of transit-oriented mixed-use neighborhoods encouraging the use of mass-transit and local walking and cycling or short drives to the two new Metrorail stations.
- Encouragement of smaller vehicle use through urban design and parking strategies.

While including some impacts from urban redesign and mass transit, the CES recognized that individual vehicles would remain the dominant form of transportation for the entire period to 2040.

These combinations of wider trends and local recommendations result in 18% less energy use in transportation, again serving the needs of a 70% higher population. The per capita greenhouse gas emissions caused by transportation will be less than half today's levels.

A significant deployment of all-electric vehicles was not assumed, despite obvious early signs that this could happen earlier than previously thought. To be successful, this requires investment for readily available recharging and battery replacement infrastructure on a regional basis, and is beyond the scope of the CES. This does not rule out small scale pilots to raise awareness and to familiarize the community with the benefits and practicalities of all-electric vehicles.

Clean and Renewable Energy

By generating a significant percentage of its electricity and heat locally, the County can greatly

reduce the peak demands on the electric grid and the fuel waste inherent in distant electricity generation.

The CES is recommending two major clean and renewable energy supply approaches.

The first is to implement about 100 Megawatts of natural gas-fired Combined Heat and Power (CHP) by 2040. By simultaneously generating heat and electricity, fuel efficiency is doubled and emissions are greatly reduced. This could be distributed over a number of developments.

The use of medium-sized CHP would be encouraged in the following kinds of developments:

- In higher density developments, such as anticipated around the transit hubs, district energy could be used to distribute heating and cooling, avoiding the need for individual chillers and boilers in every home and building. This recommended approach was modeled on two typical projects and showed good economics for homeowners, building occupants, developers, the district energy service provider and potentially the County.
- In single large developments of about 100,000 square feet or larger. These would include commercial or retail complexes, sport centers, large healthcare facilities, etc.

The second recommendation is to install about 25Megawatts of Solar electricity by 2016, rising to 100 Megawatts by 2040, aimed primarily at reducing the summer cooling peaks, and reducing the need for increased transmission capacity. The final configuration of installations will be a mix of individual residential and commercial installations, and probably one or two dedicated solar farms.

The combination of efficiency and the selective deployment of CHP and solar electricity would reduce the summer electricity peaks by as much as 35% compared to business-as usual.

In much of the County, property densities are very low and will remain so. A wide and growing market of clean and renewable energy supply options is available, ranging from micro-CHP units to geothermal heating and cooling units, and the CES strongly supports their deployment where justified by costs and available incentives.

Loudoun County has a strong rural nature, with a substantial supply of agricultural and forestry waste. These have significant potential to be converted to various gas, liquid, or solid biofuels. Depending on the relative costs of energy and the need to further reduce greenhouse gases, about 10% of new construction could use biofuels for heating, and up to 20% of all natural gas could be substituted with biogas.

Supporting Successful Implementation

The CES lays out a framework of recommendations that touches on many different aspects of the County over the coming decades. Over time, the basic recommendations need to be incorporated in multiple County outreach meetings, planning, and reporting activities. These include:

- Public Education and Outreach should be employed, with an immediate focus on homes and buildings emphasizing the benefits of efficient construction and operation for homeowners, building users, and builders, and encouraging owners to invest in energy audits and retrofits. An additional focus should be to familiarize the community

with the benefits of the various clean and renewable energy supply and distribution strategies recommended including Solar PV, district energy, CHP, geothermal and others.

- Implementation of Large Scale Pilot Projects (Scale Projects) will form a key part of the implementation recommendations of the CES. These are projects large enough to capture the combined value of efficient use, efficient distribution, and clean and renewable energy, but are bounded such that benefits can be clearly identified and risks fully understood. They can range from entire mixed-use neighborhoods to single large commercial or institutional developments.
- Planning and Land Use procedures and requirements will need to be adjusted over time to incorporate the CES recommendations on energy efficiency and energy sourcing and distribution. These will generally be voluntary in nature, given the Dillon rule constraints, or will apply to specific Scale Projects where Special Exception Zoning by the County is possible.
- District Energy Services Ownership and Operation will need guidelines developed relative to service quality, zoning and planning, and relationships with the current gas and electricity utilities. Initially, these can be developed for one or two Scale Projects.
- Grants and Other Support from a range of Federal, State and other sources are increasingly available as the drive for green jobs and climate change mitigation accelerates. The CES is recommending that the County deepens its expertise to help identify and capture these various incentives for public and private clients.
- The Systematic Gathering and Regular Reporting of results will be crucial to tracking the Goals of the CES. The successful outcome will be the result of years of consistent implementation practice. Progress should be continually monitored and publicly reported.
- Updating Targets is important. Over time, the Goals in the CES will need to be revisited and adapted to meet the as yet unanticipated future needs of the County, as well as the changing face of the US and global energy and climate markets. Although the Goals set forth in the CES are challenging, they are still less than global best practice. They should be regularly reviewed and adjusted to keep pace with best practice trends.

CES Results

The CES provided for the total energy needs of the 271,000 existing residents and the anticipated 186,000 new residents to be met with 21% less total energy than today. Clean and renewable distributed energy sources for both heat and electricity will enhance supply security, reduce fuel waste, improve environmental performance and create new energy related business opportunities in the County.

When implemented, the CES will reduce the greenhouse gas emissions of the County from today's 3.85 Million metric tons by 22% to about 3.00 Million metric tons (mt), at the same time supporting a population growth of 70%. On a per resident basis this is a reduction from today's 14.2 mt to 6.6 mt.

Adopting a fully integrated approach to energy management will make Loudoun County attractive to investors from many parts of Europe and Japan who are increasingly seeing the US and Canada as an attractive energy related market.

By implementing Scale Projects which may include CHP, renewable energy and possibly district energy, new local businesses will be seeded with substantial growth potential throughout the US and Canada.

The combination of the economic, supply security and environmental aspects of Loudoun County's CES will make the County's academic institutions natural locations for research and new curricula focused on advanced energy planning and implementation.

2.2. Executive Summary Part 2 - 2009 Energy Efficiency Conservation Block Grant

Under the auspices of the American Recovery and Reinvestment Act, Loudoun County is eligible for a formula based grant amount of $2,215,600 for energy efficiency projects, with $250,000 encumbered to date. The following projects are being recommended for consideration for use of the remaining $1,965,600 in funds. They are not listed in any priority order.

	Project	Task Description	Estimated Project Cost	Potential Matching Funds	Jobs Created	Benefits	Energy and Environmental Impact
A	Temporary Position to Support Energy Efficiency Programs	Employ staff to implement CES and grant projects and provide reporting.	$196,560	None	1 job for duration of the grant	Necessary to meet the requirements of the grant.	High
B	Loudoun County Youth Shelter Expansion	Implement renewable energy solutions through solar and geothermal solutions.	$500,000	None	36 jobs for project duration	Provides 60% reduction for both energy and pollution, reduces peak demand on the grid, and provides an educational platform.	Medium
C	Scott Jenkins Memorial Park Solar Lights & Charging Stations	Implement renewable energy solutions for parking facilities by using 210 kW of solar powered lighting.	$300,000	None	4 jobs for project duration	Provides affordable public option for charging electric vehicles. Potential source of income for the County with excess electricity being sold to grid.	High
D	Education and Outreach to Business Community	Educate and promote efficient building standards and practices to the business sector.	$100,000	Chamber of Commerce / Private Sector	2.5 to 3 jobs for project duration	Provides potential 40% increased energy efficiency gains in commercial buildings.	High

E	Education and Outreach to Residents	Provide outreach and education to homeowners to promote home efficiency measures.	$240,000	Department of Energy/ Joint Regional Efforts	2.5 to 3 jobs for project duration	Can deliver 20% residential energy efficiency gains with minimal 5% increase in construction costs.	High
F	Energy Solution for Moorefield Station Scale Project and Digital Realty Trust data center cluster	Develop Integrated Energy Master Plan for Mixed-use Transit Neighborhood combined with a major Data Center cluster	$300,000	Private Sector	6 to 9 jobs for 6 to 9 months	Provides potential multi-sector energy savings of 40% to 50%.	High
G	Energy solution including Gas-Fired CHP cluster of 8 County Buildings Scale Project	Create plan for effective investments in efficient energy use and clean supply by implementing smaller scale integrated solution.	$150,000 – $200,000 **Not Chosen by Board for EECBG Applic.	None	1.5 to 2 jobs for project duration	Provides 40% reduction in energy requirement, reduces peak demand on the grid, and provides an educational platform.	Medium
H	Implementation of Energy Audits Recommendations	Implement the second phase of an existing County building energy audit program.	$1,100,000 - $1,250,000 **Not Chosen by Board for EECBG Applic.	None	11 to 12 jobs for project duration	Reduces annual costs to the County by $124,000, as well as reduces peak demand on the grid.	Medium
I	Building standards and Energy Performance Labeling (EPL)	Educate and promote efficiency to key stakeholders in residential and commercial buildings.	$200,000	None	1 to 1.5 jobs for project duration	Ensures code compliance with an increased 5% efficiency gain over current code.	High
J	Fund energy improvements as part of Loudoun County Home Improvement Program (LCHIP) (EPL)	Enhances existing home improvement program with ability to provide energy audits and retrofits.	$140,000 **Project activity added by the Board	None	2 jobs for project duration	Provides potential 20% energy savings to low or moderate income residents.	High

These projects are a conscious mix that supports the successful launch of the CES in three distinct ways. The strong recommendation is to implement at least one from each group.

1. ***Immediate and visible energy saving projects that have both educational and proliferation potentials.***
    - *B: Loudoun County Youth Shelter Expansion*
    - *C: Scott Jenkins Memorial Solar Lights and Charging Stations*
    - *H: Implementation of Energy Audit Recommendations in County Buildings*
2. ***Stakeholder engagement and awareness of benefits of a community approach to energy productivity***
    - *D: Education and Outreach to Business Community*
    - *E: Education and Outreach to Residents*
    - *I: Building Standards and Energy Performance Labeling*
    - *J: Loudoun County Home Improvement Program – Energy Improvements*

3. ***Pre-planning for successful implementation of Integrated Large Scale Projects with potential to pilot various policy and institutional aspects of the CES.***
    - *F: Moorefield Station and Digital Realty Trust Data Centers*
    - *G: Energy Solution for County Buildings Cluster*

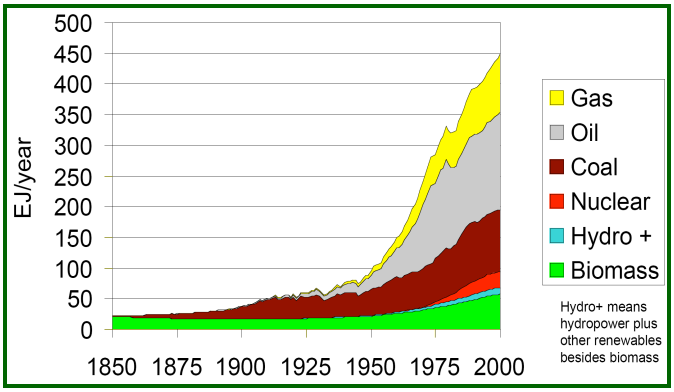
3 Energy and Climate Overview

There are accelerating global trends changing the face of the energy markets worldwide, creating high value market opportunities and employment. Loudoun County is well-positioned, along with its neighbors in Northern Virginia to become a globally recognized region, successfully serving the needs of the growing green economy and the wider environment.

Since the early 1800s, plentiful availability of low cost energy enabled the US and the world's other industrialized countries to achieve high levels of well-being and prosperity.

Over the past fifty years, energy demand has increased fivefold, with the expectation that it will double yet again within the next twenty years. In the last decade, there have been increases in energy costs, accompanied by extreme volatility.

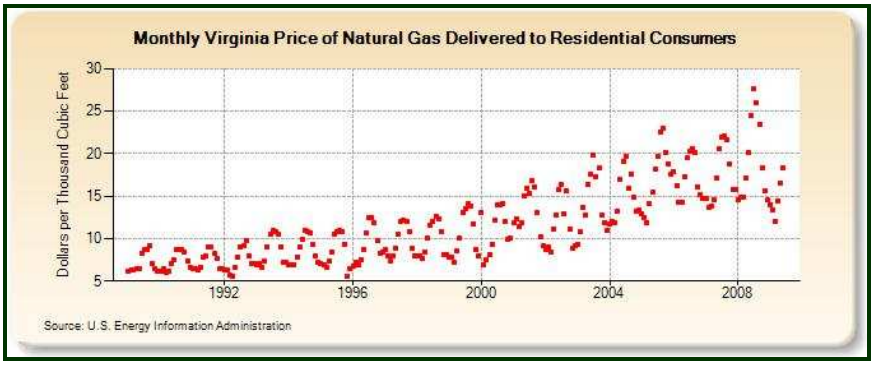
Figure 3.1: Worldwide Use of Energy from 1850 to 2000[1]



As imports of energy grow, the nation is increasingly exposed to the full force of global energy market pressures with the likelihood that energy costs will continue to press higher accompanied by high levels of uncertainty.

This trend is well exemplified by the steady increase in both volatility and the average price of natural gas charged to homeowners in Virginia. Since 1990, prices have tripled along with a substantial increase in uncertainty. At the time of writing, gas prices were again at low levels, underlying the basic volatility and unpredictability.

Figure 3.2: Residential Natural Gas Prices in Virginia



[1] IIASA plus updates from BP, IEA, EIA et al

The US uses substantially more energy than many other major regions of the world; relative to the European Union it uses more than twice the energy per person. More importantly, the US uses 40% more energy for every dollar of GDP, which has a clear impact on global competitiveness. With national energy costs of at least $1 Trillion annually, this provides a significant opportunity for national, state, and local economies to improve their efficient use of energy.

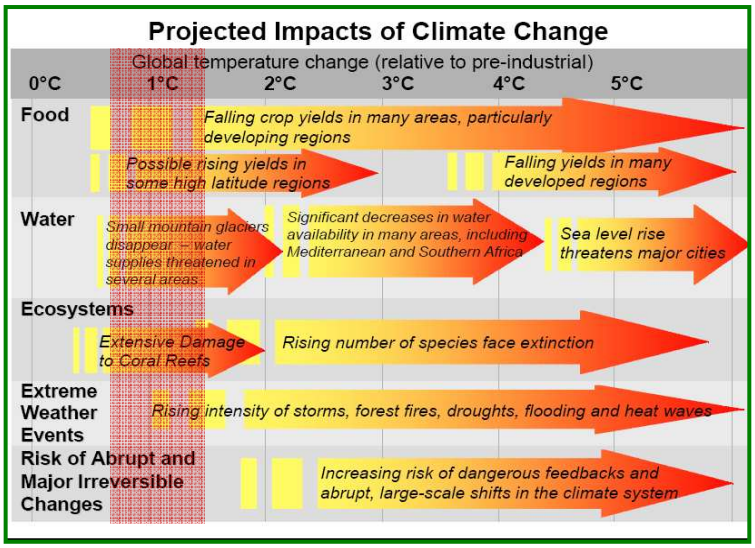
Figure 3.3: 2007 Energy Use by Major Regions[2]

Region	Population	GDP	Energy	Energy /Capita	Energy /GDP
USA	4.6%	18.9%	19.5%	100	100
EU	7.5%	25.1%	14.8%	47	57
Japan	1.9%	8.8%	4.3%	52	47
China	20.0%	4.5%	16.3%	19	355
India	17.0%	1.5%	4.9%	7	317
World	100%	100%	100%	23	97

The probable contribution of human activity to the creation of greenhouse gas emissions and their effect on climate change is becoming reflected in international, federal, and state legislation and in broader policies and market changes.

About 70 percent of greenhouse gases caused by humans come from the use of energy, the balance coming from industrial processes and land-use. At 23.6 metric tons[4] per inhabitant, the US has the second highest level per capita greenhouse gas emissions in the world presenting both environmental challenges and opportunities. (See Appendix A for more background.) At a local level both Virginia and the Washington Metropolitan Area have developed plans aimed at enhancing the region's competitiveness and reducing its environmental impact through the way energy is sourced or used.

Figure 3.4: Possible Impacts of Climate Change on Natural Systems[3]



The US has responded to the 2008 recession by targeting stimulus budgets at creating green jobs and new businesses aimed at increasing energy productivity and mitigating climate impacts. This is creating a unique window of opportunity for Loudoun County to optimize the opportunities around this emerging market.

[2] IEA 2007 World Energy Statistics adjusted for 2007 exchange rates
[3] http://www.treasury.gov.uk/independent_reviews/stern_review_economics_climate_change/sternreview_index.cfm
[4] See Glossary of Units and Terms at the end of this document – this footnote will not be repeated in the CES.

4 Energy Challenges for Communities

The competitiveness of communities will increasingly be defined by how effectively they use energy, water, and other natural resources.

Economic and population growth, such as is expected in Loudoun County, strains both fuel supply and the available capacity and costs of electrical transmission grids and natural gas networks delivering energy to urban communities, while remaining cost effective for surrounding rural areas. A local example of this is the proposed high-voltage transmission line across Loudoun needed to serve the anticipated demand of cities well beyond the County itself.

The Commonwealth of Virginia and its electrical utilities, including Dominion Power[5], recognize the need to reduce peak demands and move generation closer to communities and their final end use. Gas companies also recognize the need to rethink their business models under multiple financial and environmental pressures[6].

In the US, about 80% of the population lives in urban centers. Loudoun presents an interesting challenge in that it has both distinctly urban and rural profiles. Well over half of all of the energy is used in the US for the homes and buildings, combined with transportation within and between urban centers. Homes and buildings alone account for about 40% of all energy used and consume 70% of all electricity. Transportation accounts for about 30% of energy nationally, with the largest portion from road vehicles[7].

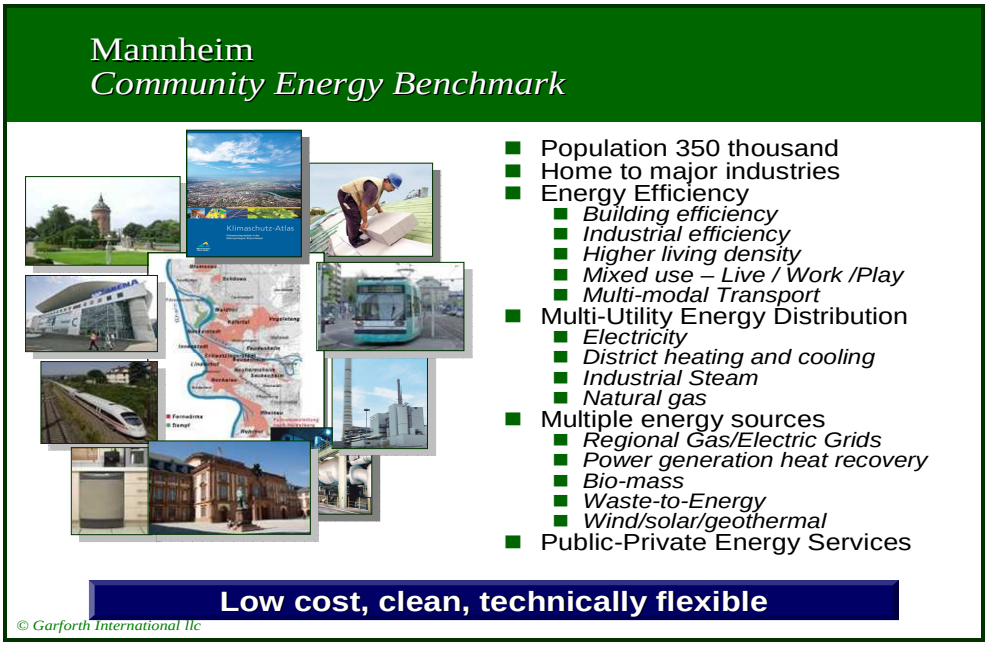
Energy is a major part of the cost to treat and distribute water, and as such should be included within the scope of the County Energy Strategy. The US is by far the largest water user in the Organization for Economic Cooperation and Development (OECD)[8] countries at 61,000 cubic feet (cf) per capita and rising. The OECD average is 32,000 cf, with some countries much less, such as German at 16,000 cf.[9] A large percentage of water use is for landscaping, an application where water reuse, rain-water harvesting, and urban redesign can have major impacts.

In developing the CES, the Team compared the performance of Loudoun County against communities globally recognized for their high quality and competitively priced energy, combined with low greenhouse emissions[10]. The use of global benchmarks looked at comparing the interplay of various energy strategies and particular technologies.

Mannheim, a highly industrialized city in southern Germany with a slightly larger population than Loudoun County, has per capita greenhouse gas emissions of about one third those of the Washington DC Metro Area, despite a heavy reliance on coal fired electricity.

[5] CES Team Member inputs from Dominion plus multiple consulting team experiences
[6] CES Team Discussions with Washington Gas plus multiple consulting team experiences
[7] US DOE Energy Information Administration http://www.eia.doe.gov
[8] OECD-Organization for Economic Cooperation and Development www.oecd.org
[9] http://www.oecd.org/dataoecd/42/27/34416097.pdf
[10] See Appendix C for some Best Practice examples from USA, Canada and Europe.

Figure 4.1: Summary of Mannheim, Germany



In another example, the per capita emissions in the benchmark city of Copenhagen, Denmark are less than 3 metric tons, compared to those in the Washington DC Metro Area at above 19 metric tons per person[11]. This is a substantial difference even allowing for lifestyle and climate differences. In 2009, Copenhagen was rated to be the second most livable city in the world with a thriving, innovative economy combined with an attractive competitive lifestyle, underlining the fact that energy productivity and competiveness can go hand in hand.

Both Mannheim and Copenhagen have highly reliable, technically flexible, competitively priced energy. These cities have succeeded in seamlessly integrating efficient buildings, served by a mix of utilities including district energy networks for both heating and cooling in addition to electricity and gas, with energy supplies sourced from a wide mix of clean, renewable and traditional energy sources. Transport energy use is reduced through efficient urban design combined with multi-modal transport options including the efficient use of the private car. Copenhagen in particular is now investing in the community wide infrastructure needed to support widespread use of electric vehicles, as much to take advantage of the nighttime production of wind generated electricity as to avoid fossil fuel emissions.

Communities are increasingly recognizing that their quality of life and competitiveness will be significantly influenced by how effectively they manage their energy and water needs if they are to grow and thrive long into the future. Many are also realizing that the goods and services needed to support this transition to higher levels of energy productivity will be a key to creating

[11] http://www.iied.org/climate-change/media/cities-produce-surprisingly-low-carbon-emissions-capita

and retaining high quality employment. This is especially true in the rapidly growing demand for qualified employees in various energy and environmental areas – the so-called “green jobs”.

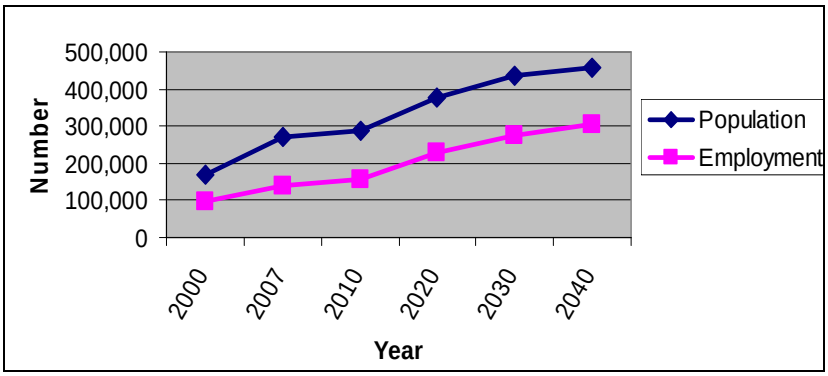
5 Loudoun County Growth to 2040

Loudoun County's planned growth potentially creates opportunities for innovative and effective energy solutions both reducing costs and environmental impacts.

The specific data found in this section was sourced from multiple pre-existing Loudoun County reports.

Loudoun County currently has approximately 270,000 inhabitants and about 140,000 local jobs. It is a part of the Washington DC Metropolitan Area and includes a large part of Washington Dulles International Airport within its boundaries. It is one of the most successful regions of the US in attracting new business, with employment having grown by over 75% between 2000 and 2008.

Figure 5.1: Anticipated Population and Employment Trends 2000 to 2040



The County has a mix of rural areas and small towns with historic neighborhoods covering most of the region, combined with rapid suburban growth mostly concentrated in the east and along Highway 7. The County is committed to preserving its attractive rural and historic features while providing a thriving environment for the anticipated business and population growth. A more detailed profile of Loudoun County is contained in Appendix B.

The population is expected to grow by 69% to approximately 458,000 by 2040. The County has a highly professional and successful economic development process with a proven track record. Going forward, local employment will grow by 116% to a total of about 305,000 by 2040. A major focus is to ensure that new jobs will be of a level that supports a thriving, growing local population. To support this growth, the County will add over 75,000 housing units to the existing base of about 100,000, and over 73 million square feet to the existing 69 million square feet of residential space.

Denser neighborhoods clustered around local employment are intrinsically more energy efficient, even without changes in building codes and energy supply strategies. Average journey lengths for both commuting and local travel will be shorter, reducing the energy requirements.

In 2000, 45% of Loudoun residents worked in the County. About 39% traveled from Loudoun to Fairfax County and 21% traveled from Fairfax to Loudoun to work. The balance traveled to more distant employment. In the current strategy, the residents per job ratio changes from 1.93

residents to each job in 2007 to 1.5 residents to each job in 2040.

In terms of traffic volume, Loudoun County's roads had a daily total of about 6.3 million vehicle miles in 2007, in many cases on roads beginning to approach congestion levels. In addition to planned highway developments, the Silver Line extension of the Washington Metro will add three stations in Loudoun County by 2016 reducing the reliance on individual vehicle traffic along the critical Dulles Corridor.

6 Developing the Loudoun County Energy Strategy

Success results from long-term consistent community engagement and leadership committed to deliver breakthrough energy results supported by sound local practices.

The County's rapid growth presents unique opportunities around energy as well as some potential risks. Both opportunities and risks are present as they apply to the increasing density of population, increasing local employment, and changing transportation patterns.

Recognizing this, starting in July 2009, Loudoun County committed to develop an Energy Strategy that will ensure its long-term competitiveness and environmental performance. To avoid the risk of the CES becoming a purely visionary exercise, it has been developed with effective implementation in mind. Specific short-term "next step" projects and broader policy recommendations are included, and are of sufficient reach and scale to ensure they are prototypical for the County as a whole.

The CES Team evaluated municipal success stories in Canada, Europe and the US to adopt and adapt best practices. The common threads in all these success stories was the importance of taking a multi-decade view; having community leadership in place that ensured consistent implementation of basic strategies year-after-year; and viewing the energy supply to the community as a single integrated whole. (See Appendix C for Community Energy Planning Global Best Practice).

Recognizing the need for a long-term commitment built on tangible and immediate next steps, the CES has a planning horizon from a baseline year of 2007 to 2040. The CES builds on a number of existing land use and economic development plans and should be seen as a complimentary layer to existing planning. Wherever possible, the CES used existing assumptions around growth and land planning. Where adjustments could bring clear energy or climate benefits, these are recommended.

Underlining the need for long-term engagement that extends well beyond the political leadership of the day, the CES Team has also enlisted the assistance of a Business Input Group comprised of senior leaders from commercial, academic, and non-governmental organizations of the County.

7 Leadership by the Community

Loudoun County has a wealth of community, academic, and business expertise and enthusiasm already committed to transforming the energy performance of the region.

Successful implementation of the County Energy Strategy will ultimately depend on the motivation and support of the community. There are many Loudoun-based and regional organizations already making improvements that can potentially impact the entire community. The County is fortunate to have this expertise and the enthusiasm that these organizations can bring to ensure the CES delivers on its commitments.

As part of gathering the existing data at the start of the energy planning process, the CES Team made an effort to identify what resources and programs were already available within the County as a whole. It was impressive to see the local government initiatives on sustainability and especially on energy and water conservation aspects. A summary of these is in Appendix D – Governmental Leadership.

In addition, a growing number of local businesses, schools, universities and colleges, non-governmental organizations and interested individual are actively engaged in developing new capabilities aimed at reducing the environmental impacts of unnecessary energy waste and finding profitable opportunities in the rapidly changing energy market.

The role of local government at all levels cannot be underestimated. The continuing and ongoing statements and demonstration of commitment by elected representatives and senior staff set the tone for the entire community. All publicly funded investments and activities should be consistent with the overall expectations of the CES.

A community with a successfully implemented energy strategy gains economic, environmental and social benefits. A common feature of communities that have achieved exceptional results has been their ability to maintain directional consistency across the political spectrum. This does not, and should not; inhibit healthy debate as to the most effective ways to deliver the overall CES results.

Loudoun County is showing exceptional leadership in the North Virginia and Capital regions through taking the first steps in implementing a comprehensive energy strategy. If similar steps were put in place by neighboring jurisdictions, the region as a whole would become more competitive, and the relative benefits for each locality would grow. Loudoun's example is already having impacts on the long term energy planning in neighboring counties. Regional teaming will accelerate the process and is to be actively encouraged.

8 Energy Vision Supporting Economic Development

CES Vision

"Loudoun County will always have reliable and affordable energy, be energy efficient, and have reduced greenhouse gases."

This proposed CES Vision is straightforward and addresses the three critical dimensions of a world class energy strategy:

- Reliability
- Affordability
- Environmental Impact

This clearly supports the Economic Development Vision of Loudoun County:

"Our Vision is to be an innovative, globally competitive economy known for its favorable business environment, exceptional quality of place and strong sense of community"

A world-class energy strategy goes hand in hand with all the other competitive values of the County. The CES Team is proposing that the energy commitment be added to the competitive elements used to attract investors and residents to Loudoun County:

- Recognized Center for Innovation
- Prosperous Business Environment
- High Quality of Place
- Sound Fiscal Health
- Favored Visitor Destination
- World-class Energy Strategy

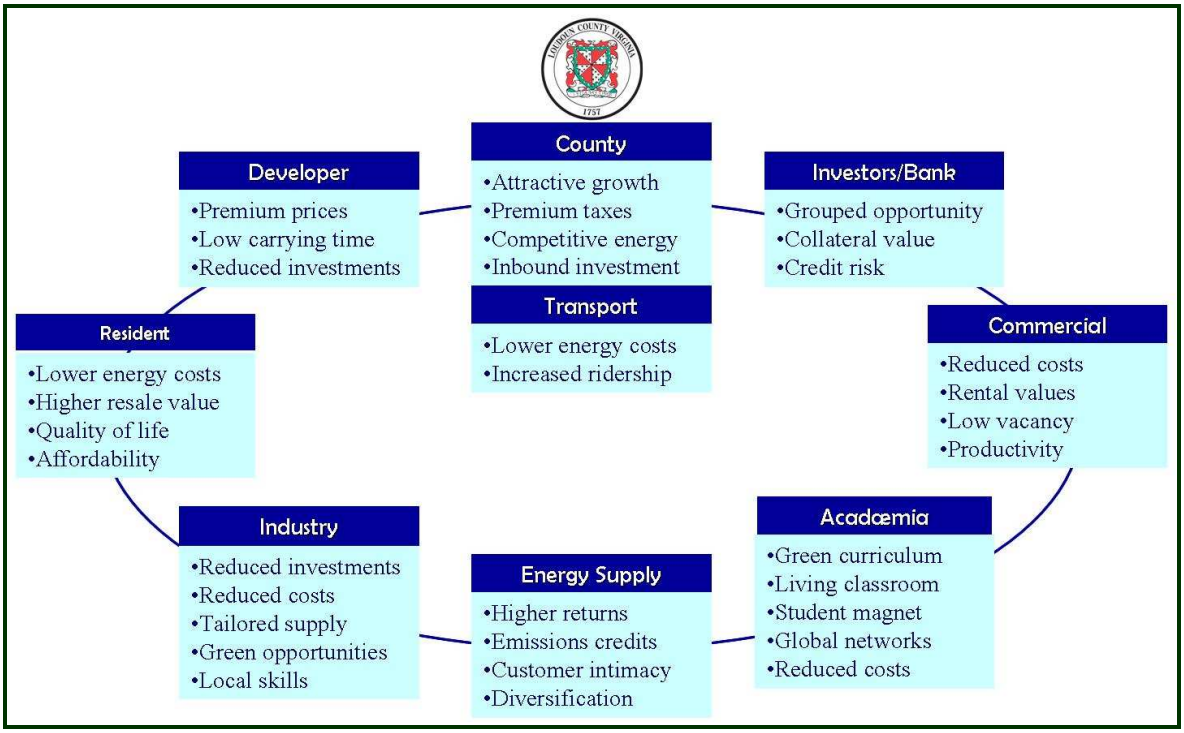
The CES Team sought input and opinions from many community sources before finalizing the recommended wording for the CES Vision.

9 CES Goals

1. **Loudoun County will be recognized as a location of choice for investment in part because of its innovative energy strategy.**
2. **Loudoun County will strive to have consistently lower energy costs relative to surrounding areas.**
3. **Loudoun County's greenhouse gas emissions will be among the lowest in the country.**
4. **Loudoun County will be recognized as a regional-state-national role model of effective energy and climate management.**
5. **All major investments will visibly contribute to meeting the CES goals.**

Each goal will have long-term measurements that will be consistently tracked relative to a 2007 baseline with regular formal and informal reporting to the local community at large, to the investment community worldwide, and to the local political, business, and academic leadership.

Figure 9.1: Benefits of Community Energy Approach



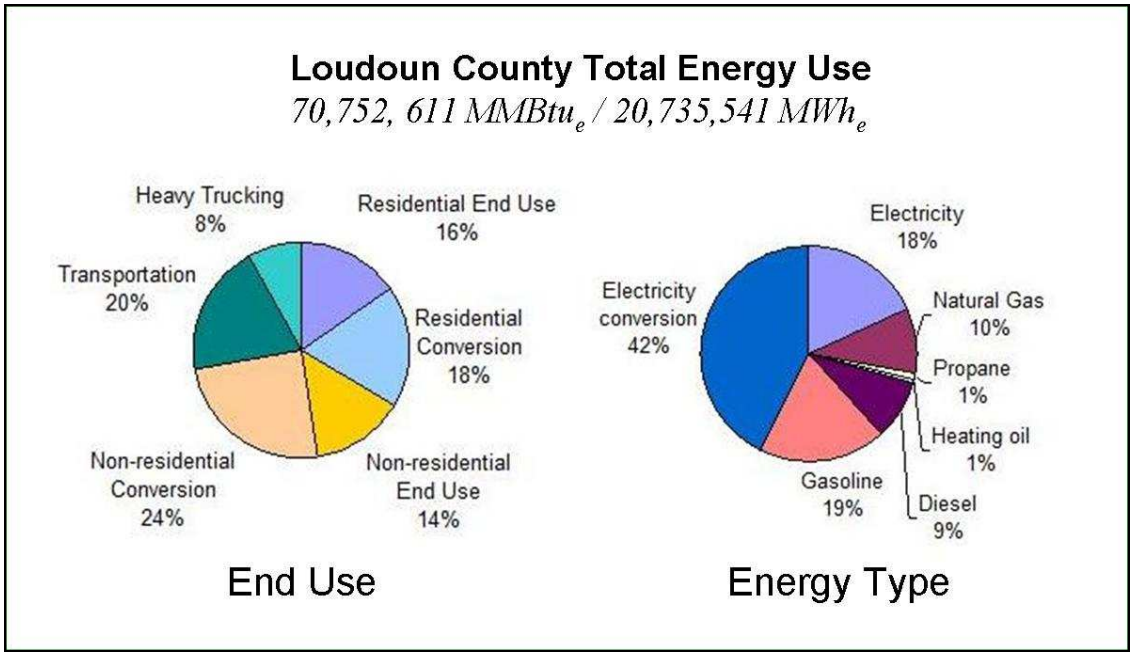
Successfully achieving these goals brings tangible financial, social, and environmental benefits to residents, businesses, academic institutions, transport services, developers and builders, banks, investors, energy suppliers, the individual Towns, and to the County as a whole.

10 Loudoun County Energy and Greenhouse Gas Baseline

10.1. Energy Use and Supply

For 2007, the approximately 270,000 inhabitants of Loudoun County used a total of 20,736 gigawatt-hours (GWh) of energy of all types for homes, work, and vehicles. (1,000 MWh = 1 GWh) Using the more familiar US measures[12], this translates to 70,752 Billion British Thermal Units (Btu). (1,000 MMBtu = 1 Billion Btu) This estimate is based on metered data from the regional gas and electric utilities, combined with various transportation studies and assumptions.

Figure 10.1: Loudoun County Energy Use in 2007



The energy types used by the County break into two distinct parts. About 50% is used within the County as electricity, transportation fuels, and natural gas and other heating fuels. The remaining 50% is consumed outside yet is a direct result of the County's activities. Nearly 42% of this second part is the energy consumed as heat and line losses to make the County's electricity. The remaining 8% is an estimate of the portion of the diesel fuel used by long-haul trucking to serve the needs of the County.

[12] The CES will generally use American units, except where International Units (ISO) have become the norm or where their use will simplify comparisons with global best practices.

Including the electricity conversion losses is relatively uncommon in many community plans, and is sometimes seen as controversial. However, these losses represent valuable fuel that has been paid for in one way or another by the County. The CES specifically addresses measures to reduce some of these conversion losses through the use of clean and renewable energy sources with the associated reductions in pollution and improved economics.

The County's 101,359 homes account for 34% of all energy used by Loudoun County. A further 38% serves the 69 million square feet of other buildings including offices, data centers, shops, hospitals and public buildings. The remaining, 28% is for local and trucking transportation. There is no significant industrial use of energy within the County. Collectively homes and buildings account for over 70% of all types of energy used and nearly 100% of all electricity.

A common index for community energy use is to look at the total usage on a per resident basis. An average of about 260,900,000 Btu or 76,000 kilowatt-hours (kWh) of all kinds of energy for each resident are used every year in Loudoun County. This is relatively typical for the US, edging towards the upper end of the national range. On a worldwide comparison this represents at least twice the energy used by the average European Union (EU) resident.

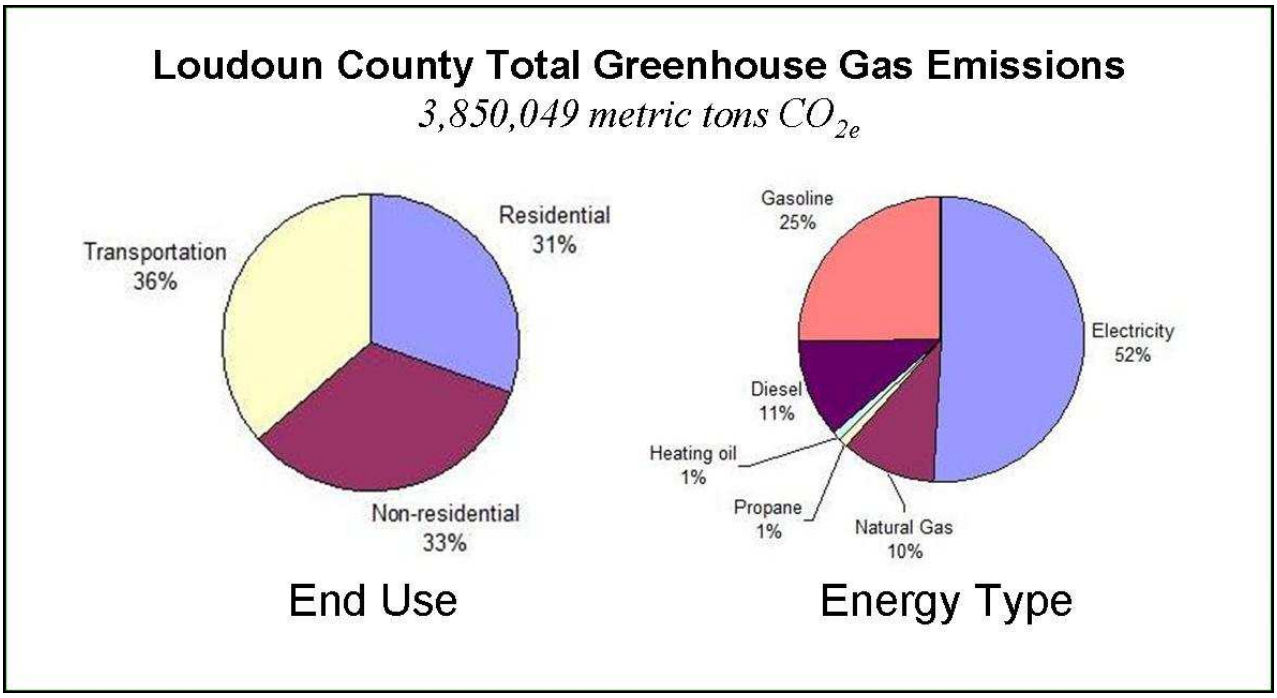
This is not the whole picture as there is about 30% more energy consumed by national industries, defense, shipping and airlines on behalf of each US resident on average. The CES does not include these latter energy uses as there is little that can be done at a local level to affect them.

10.2. Greenhouse Gas Emissions

In 2007, the County's use of energy emitted about 3.9 million metric tons (Mmt) carbon-dioxide equivalent of greenhouse gases, creating a "carbon-footprint" for each resident of 14.2 Metric tons.[13]

[13] GIL estimation derived from Dominion, Washington Gas, and NOVEC data and County transportation studies.

Figure 10.2: Loudoun County Greenhouse Gas Emissions in 2007



Homes in Loudoun County account for 31% of these emissions while other buildings, including the extensive data center businesses, account for 33%. The balance of 36% is created from vehicle use. Light vehicles (cars, SUV's, and light trucks) account for approximately 70% of all transportation emissions and the balance comes from commercial trucks and buses.

Loudoun County has a relatively high carbon footprint per resident when compared with many US metropolitan areas, with the notable exception of Washington DC itself. It has a fairly typical carbon footprint when the mix of rural and urban neighborhoods that typify the county are considered.

There are currently no regulatory constraints on the creation of greenhouse gases.

10.3. Energy Pricing

The County, along with the rest of Virginia, has enjoyed some of the lowest electricity prices in the US, which has helped to discourage strategic investments in both reducing capacity and improving efficiency. The demands of growth combined with investment constraints could put upward pressure on electricity pricing in the future. Both Dominion and NOVEC deliver electricity to the County under the pricing and service regulations set by the State.

Virginia has a voluntary target to have at least 12% electricity generation from renewable

sources by 2022. The Virginia Energy Plan is targeting 20%. Indicative national targets from the Obama Administration are 25% by 2025. As a non-US reference point, the European Union achieved 16% renewable electricity in 2006, with a target to reach 21% by 2010, and 30% by 2020.

Washington Gas and Light delivers natural gas to the County. Prices have been on a steady upward trend, though currently (late 2009) they are relatively low. The future outlook is for prices to continue to climb accompanied by significant short term unpredictability.

10.4 Electrical Infrastructure

The County's electricity is currently supplied via the regional grid from power plants outside the County. The growth of population and increase in business activity, the data center businesses in particular, is significantly increasing demand on the grid, especially during the peak cooling hours in the summer months. This growth in demand is also prevalent in neighboring areas. Combined, this regional growth is putting strains on the transmission capacity, which is exemplified by the proposed high-voltage transmission line that will stretch across the County. The line will serve the anticipated demand of cities well beyond the County itself.

In light of the current strain on transmission capacity, it is increasingly challenging to gain approval for new large scale projects and applications that would require major increases in generation. At the same time the utility companies and customers are faced with uncertainties over possible greenhouse gas legislation.

The combination of these stresses is resulting in a growing focus on distributing generation across the grid, reducing the total demand through efficiency, and finding ways to effectively transmit energy throughout the system.

10.5 Homes and Buildings Energy Efficiency

Loudoun's overall energy use has a high potential for reduction. Loudoun County's homes use about 69,200 Btu of energy each year per square foot or 220 kWh for each square meter (about 10 square feet) of finished space.[14] Current US best practice or EU normal practice would be between 125 and 175 kWh in a comparable climate. These numbers do not include the electrical conversion energy as referenced earlier in the report. They do include all the electricity used for plug loads, which include entertainment systems, home computers and appliances. This is typically about 14% of all the energy used in homes. This percentage is holding constant, even though the equipment is becoming significantly more efficient, and practice that is likely to continue. However, the trend is to use more equipment with second and third TV's, computers, etc. Plug load efficiencies could be significantly improved by the use of deep stand-by modes. This legislative requirement is likely to come in force in California soon, and there is a possibility this could become a national norm.

In the non-residential sector, the CES Team was unable to get sufficient metered data to separate the energy use of the large data center business from the rest of the non-residential buildings to get valid performance indexes. Overall, the non-residential sector indexes are 142,000 Btu per square foot or 448 kWh per square meter, again substantially higher than

[14] GIL calculation from multiple data sources

comparable EU practice or US best practice, even when considering the impact of the data center usage. The Loudoun County assessment of their 145 County buildings gives an index of about 116,000 Btu per square foot per year or 365 kWh per square meter.

Currently Virginia has energy-related building codes based on the 2006 IECC Residential and 2004 ASHRAE Commercial recommendations for new construction. When compared to the rest of the US, these are mid-range standards. Some updating to these codes is expected in 2010 and a 10% overall efficiency improvement is anticipated, if Virginia adopts the next version. It is uncertain how the building codes will develop over the 30 years of the Strategy, but both ASHRAE and the Federal Government are aiming to set targets of 30 to 50% reductions in the decades to come. This would bring Virginia in the range of the current California codes, which represents US best practice.

Under the present market expectations, renovation could be expected to result in homes and buildings being about 15% more efficient that they were before renovation. This is assumed to be typical in the Base Case for the CES target period. Compliance is also a major factor and further inefficiencies of at least 5% have been assumed.

The preceding paragraphs represent the “Base Case” used in the CES for future construction and operations of homes and buildings.

Further information on the applicable energy codes, their evolution, the market compliance, and the assumptions used in the CES is included in Appendix F.

10.6 Transportation Energy Efficiency

Loudoun County’s light vehicle traffic travels 2.28 Billion vehicle miles a year and is the overwhelming majority of the 2.5 Billion miles travelled by all vehicles including heavy trucks, buses and motorcycles. Transportation greenhouse gas emissions per mile are very tightly related to the fuel efficiency of vehicles.

The available data for Loudoun County indicates that the light vehicle GHG emissions are about 430 grams CO2 per vehicle mile (g/m). This is very close to the US average of about 450 g/m. It is a little lower because there are more miles driven in cars as opposed to SUV’s and light trucks than is found nationally.

The recently passed US fuel efficiency standards[15] will set a standard of about 360g/m for new vehicles by 2016. By comparison the current EU average is 290 g/m and the 2015 target for new vehicles is 210 g/m on average. This is 40% less than the US target for 2016. The EU long-range target is an average of 190 g/m, with a handful of vehicles already available that achieve about 150 g/m.

Transportation produces 36% of all of Loudoun’s GHG emissions while consuming 28% of its energy. There are a number of programs in the County aimed at encouraging more efficient use of vehicles and using alternatives such as buses, Metrorail, bikes, and walking. These are gaining supporters, though currently these represent a very small minority of total journeys.

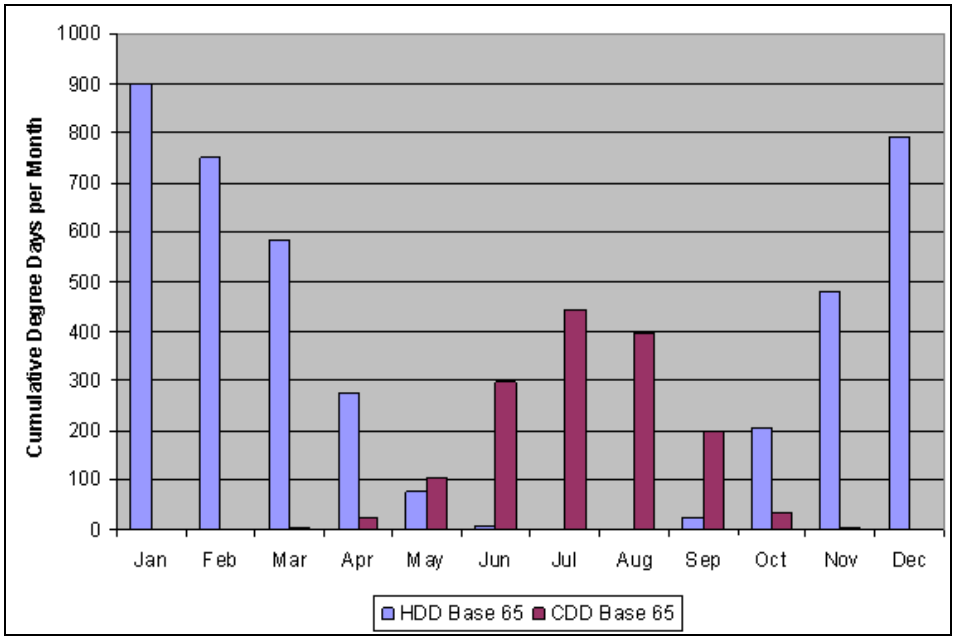
[15] http://www.epa.gov/fueleconomy/

Because of the many variables that may affect the County's transportation energy use in the future, defining the transportation "Base Case" was challenging. It was agreed that the dominant use of individual vehicles for personal and commercial transportation would be the consideration of the Base Case.

10.7 Climate

Loudoun County's climate has 5,010 heating degree days (HDD) and 940 cooling degree days (CDD) per year referenced to a 65 degree F outside temperature. Figure 10.3 indicates the heating and cooling needs over a full year.

Figure 10.3: Heating and Cooling Degree Days in Loudoun County Area



The climate is somewhat challenging with significant winter heating needs, along with substantial summer cooling needs, with relatively high humidity. The CES closely examines how the heating and cooling needs of homes and building can be met both more economically and in an environmentally cleaner way.

10.8 Neighborhood Developments

The planned pattern of growth of much of the County is an important part of the baseline assessment. Much of the new development will be creating denser, walkable neighborhoods, many served by a variety of transportation choices. This kind of "Smart Growth"[17] blends a range of housing choices with local shops, places of work, and entertainment.

Figure 10.4: Typical North American Smart Growth Development[16]

This is an accelerating trend in the US. Loudoun County with its clustered growth patterns and growing access to the Metro transportation system is well placed to benefit. These kinds of neighborhoods also have a great potential to be highly innovative when it comes to energy sourcing distribution and efficiency. When included in the early planning, the energy needs of these developments can easily be up to 40 to 50% less than normal, with even higher greenhouse reductions, with good economics and reliability[18].

In current planning requests with the County, there is no evidence of systematic integrated energy planning, nor is there anticipation of the much higher density neighborhoods that appear to be gathering market appeal elsewhere in the US.

10.9 Renewable Energy Sources

Currently there is a negligible amount of renewable energy being generated or used in the County.

The solar potential to generate electricity is reasonably good and will be a valuable part of the overall CES. This has the added benefit of reducing the summer peak demand on the electrical grid.

The rural nature of much of the County makes it a candidate for converting agricultural waste into various forms of biofuel for both heat and electricity generation. Currently there is very limited biofuel use.

With current technology, the potential for wind generation is poor based on wind resource mapping from NREL.

The CES "Base Case" will assume no additional renewable energy being deployed in the County. All recommendations that include the addition of renewable energy are included in the CES Future Case scenarios to different degrees. The CES will make recommendations to

[16] Terra Sol
[17] http://www.smartgrowth.org/about/principles/default.asp?res=1024
[18] Marina District-Toledo – The Navy Yard at Noisette – Assessments by GIL

expand these options based on their viability in the region as well as their potential educational applications.

11 Loudoun County Energy Strategy

11.1 CES Framework

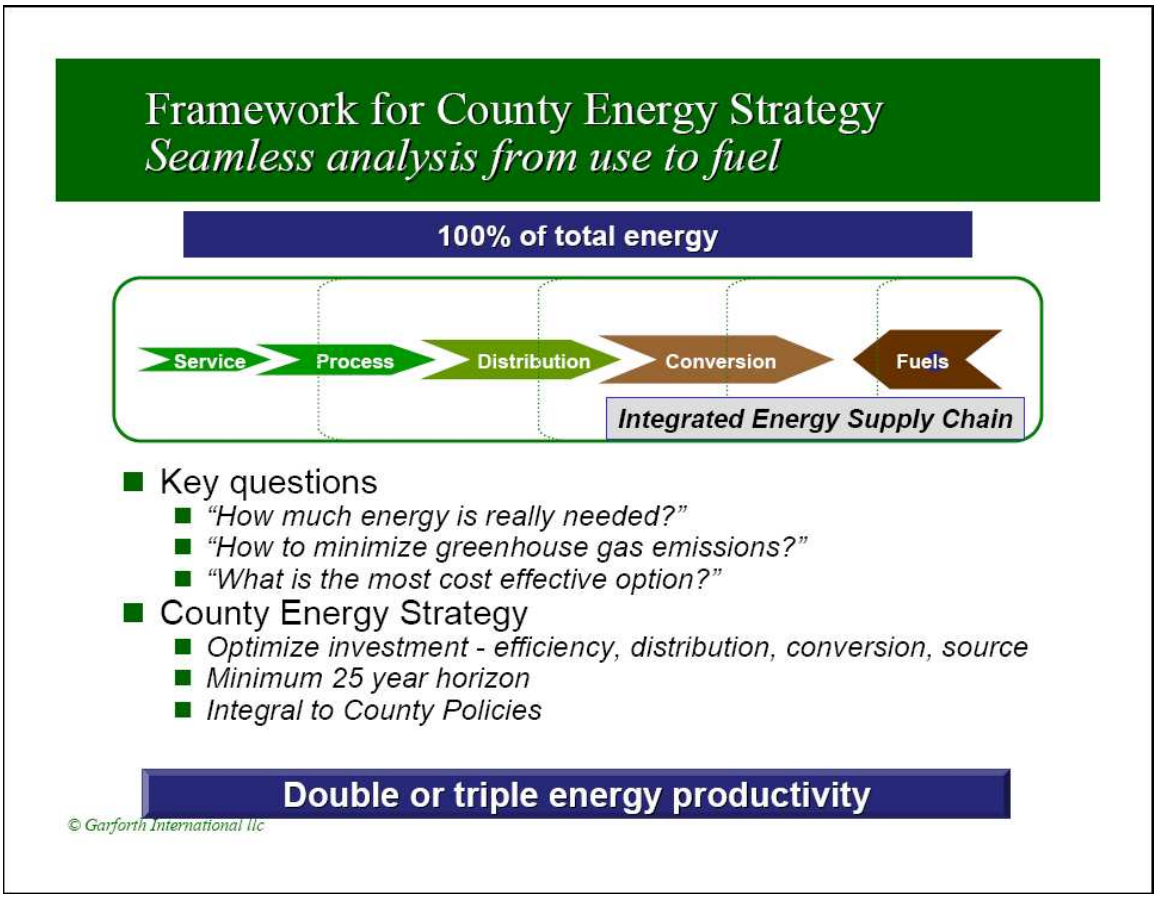
The conclusions from the baseline assessment and associated benchmarking are that substantial opportunities exist to systematically reduce the energy and greenhouse gas footprint of the County, while enhancing the competitiveness and livability.

The CES was finalized using the following priorities:

- Maximize the energy efficiency in homes and buildings
- Maximize the energy efficiency of transportation
- Maximize the use of clean combined heat and power
- Maximize the use of economically viable renewable energy sources
- Minimize the peak and average load increases to the existing electricity grid

These priorities are intended to be viewed as an integrated strategy, implemented over many years.

Figure 11.1: Holistic View of Energy Use and Supply Planning



The rationale behind this priority order comes from a demand driven approach. It is important to ask these questions sequentially, working upstream in the energy conversion chain towards the primary fuel source. Along this path there are usually choices to provide the same energy quality from different sources. Criteria for these choices should include availability, reliability, cost, sustainability and environmental aspects, finding balance between them. At the end of the optimized path, it is usually much easier to meet the now decreased remaining demand by cost-efficient, reliable, and clean primary energy sources.

In the past, the tendency has been to view energy use in a fragmented way, rather than looking at the whole chain. At the level of an individual building or vehicle this is understandable. At the level of a region, far greater benefits can be gained by viewing the entire chain from end use to the choice of fuel as a single seamless total. Communities that approach this seamless integration will typically double or triple the overall effectiveness in the way they use energy. It is never a straight line, but as long as these basic priorities are understood and respected by the community, the overall outcomes are achieved.

The CES includes recommendations summarizing not only the recommended technical

measures, but also the community engagement, policy, business and institutional changes that will be the keys to success.

The results shown in the following paragraphs are supported by detailed modeling of the CES found which can be found in the Appendices.

11.2 Maximize the Energy Efficiency in Homes and Buildings

Efficiency has the potential to meet all of the energy needs of the planned residential and non-residential growth in Loudoun County from 2010 to 2040.

The CES is recommending that the County support voluntary and regulatory efficiency measures that would allow the planned population and employment growth to occur with no net addition of energy for these sectors for the coming thirty years.

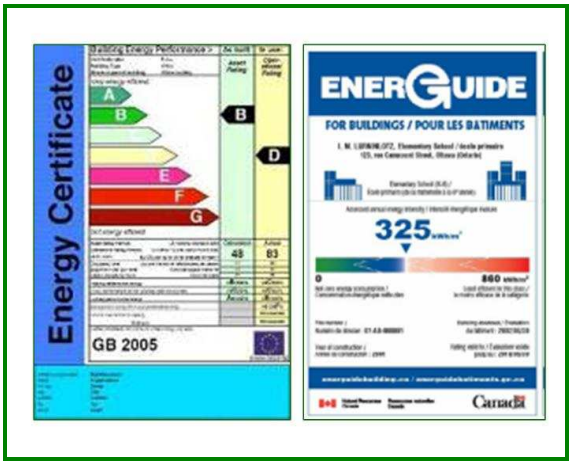
This seemingly impossible outcome could be achieved by the following measures:

- Encourage new construction to be 30% more efficient than the State Energy Code from 2011, a level approaching California today.
- Encourage all major renovation to be at least 25% more efficient than the current County average from 2011.
- Increase these efficiency targets incrementally by an average of 1% per year, cumulated together every four years at 4%.

These levels are already being proposed in pending Federal guidelines and are similar to those used in the voluntary energy efficiency construction programs such as Energy Star (Homes and Buildings). They are increasingly being seen as expected levels by customers, in some ways putting the market expectations ahead of the current building codes. To meet these increased efficiency requirements, the construction costs are typically 2% to 5% higher, levels that are lower than often perceived.

In addition to raising the efficiency of construction, the CES is recommending creating a program where all homes and buildings will have a current Energy Performance Label (EPL) whenever sold or rented. This would provide transparency to the actual consumption of both new and existing structures.

Figure 11.2: Energy Performance Labels- EU and Canadian Examples



Examples of similar labels from both the EU and Canada are shown in Figure 11.2. The EPL offers the buyer or renter information to support their decision by providing 1) a guarantee that the property meets the promised energy efficiency levels and/or 2) shows the actual recent energy performance of the structure. The CES is recommending this as a voluntary program for all significant real-estate transactions.

In Virginia, Building Codes and future mandatory Energy Performance Labeling requirements are within State jurisdiction, so achieving these results will result from visible leadership from all levels of local government using a combination of the following approaches:

- Provide education and outreach to residents, realtors, mortgage lenders, developers and builders to raise the awareness of the benefits in terms of operating costs, resale values, comfort, environmental impact and reduced future risks.
- Share success stories from residents, developers and builders
- Ensure clarity of expectations through issuing County recommended guidelines, recognizing these are not mandatory
- Create Special Exception Zones where allowed, for larger developments with above code efficiency requirements, probably associated with a clean and renewable energy supply approach and teamed with the master developer and Town authorities
- Include appropriate questions for information in planning applications that stimulate awareness of the County's interest and expectation in above code levels of efficiency
- Post EPL's on all public buildings with explanatory notes for the public, and actively encourage voluntary labelling of local business, especially with high public traffic
- Seek out "early adopters" from the development and building community
- Use available Federal and State funds for efficient construction training and retrofitting of existing homes and buildings
- Team with providers of construction financing and mortgages to offer premium financing when the energy performance of a building is high and is backed by a valid EPL.
- Offer selected projects in the County as State/National prototypes of successful neighborhood energy efficiency or EPL implementation to attract both special incentives

and to gain possible regulatory exemptions.

11.3 Maximize the Energy Efficiency of Transportation

The County has the potential to meet all of the community's transportation needs and to halve the per capita greenhouse gas emissions from 2010 to 2040.

The CES has analyzed the complex influences of transportation energy use in Loudoun County, and the resulting GHG emissions. Some are beyond the County's control, including weight reduction through advanced materials, new drive train technologies such as hybrids and clean diesel, and a general market trend to a mix of smaller vehicles.

Outside of the impact of these, the CES is recommending the following local measures, some of which are already recognized in the County's Revised General Plan:

- Reduce outbound commuting by the successful growth of local employment from 1.93 residents per local job to 1.5, thereby reducing average journey distances.
- Develop some mixed-use neighborhoods to encourage shorter commutes, walking and cycling.
- Develop transit oriented mixed-use neighborhoods encouraging use of mass-transit and local walking and cycling or short drives to transit hubs.
- Encourage smaller vehicles through urban design and parking strategies.
- Encourage clean diesel, diesel/gas hybrid vehicles or all electric vehicles (EVs) through provisions such as fuel availability and recharging stations.

Transportation is a major challenge for Loudoun County, both in terms of the economic and environmental costs, but also to the perception of livability in the eastern growth areas. The above recommendations combined with the broader automotive industry trends will reduce the transportation energy use and resulting GHG creation by 50% per person by 2040. However, over the plan period, the total population will grow by 69%. When this is factored in, the total transportation related energy use of the County will be reduced by 15%.

One option to further reduce GHG emissions would be the wide scale deployment of electric vehicles (EVs) in the County. This would require the County to provide supporting infrastructure including the widespread availability of electric recharging stations as well as battery replacement services. This initiative could also be combined with customer incentives to switch to 100% electric vehicles. This scenario was not fully modeled in the CES, and is expected to require planning at a regional or State level.

Further details of the transportation assessment and recommendations are included in Appendices G.

11.4 Maximize Use of Clean Combined Heat and Power (CHP)

The County has the potential to obtain a high percentage of its heat and electricity needs, as well as reduce the peak electricity demand on the grid, through the implementation of clean, distributed combined heat and power (CHP) generation.

With today's technology, small- to medium-scale natural gas or biogas fired cogeneration is a reliable and economically viable option to supply heat and electricity at a local level. Thousands of these units are in use around the world, with well documented reliability levels. The commercially viable technologies include micro turbines for small scale applications, larger turbines, and reciprocating engines. This recommendation can be achieved through a combination of a number of measures:

District Energy

- Construct district energy networks to supply heating, domestic hot water and cooling to higher density new developments. The district energy networks enable the efficient and economic distribution of the heat generated by CHP. The simultaneous generation of electricity and heat roughly doubles the fuel efficiency.
- Make district energy available in medium- to high-density neighborhoods targeted for revitalization thereby creating suitable neighborhoods for viable CHP deployment.

District Energy (DE) delivers heating and cooling to homes and buildings via a reliable network of highly insulated pipes. The heat for the system would typically come from CHP and one or two gas boilers depending on the particular project. The connection to the buildings is with a simple heat exchanger, a meter and some basic controls. The network would typically be owned and operated by a special purpose energy services company under multi-decade service agreements. Increasingly these are formed as a non-regulated affiliate of a traditional gas or electric utility. District energy can bring financial and other benefits to an appropriate development:

- Property Developer / Builder
    - Reduced construction costs as there is no need for chillers, furnaces and boilers in each building. This frees up sufficient funds for implementing standards of efficiency above applicable code levels. This roughly nets to a zero construction cost impact
    - Potential for premium pricing due to reduced energy costs. National Association of Homebuilders estimate about $10 on the sell price for every $1 annual energy saved. Builders willing to guarantee their work through voluntary Energy Performance Labeling have a better chance to gain premium prices.
    - Ease and low cost of implementing luxury features such as under-floor heating in garages and bathrooms, heated towel rails, etc. with premium pricing potential
- Resident
    - Increased usable space
    - Heating and cooling prices typically 5% to 10% lower than BAU, with overall energy costs being a further 30% or more less due to efficient construction
    - Availability of well-priced luxury features
- Energy Services Company
    - Low risk, proven technology with predictable investment and operating costs.
    - Long-term stable rates of return between 10 and 20%
- Local Government / Community
    - Potential contribution to public funds from Energy Service Company if structured as a Public-Private Partnership

District Energy with CHP and efficient construction, is a proven way to dramatically reduce total energy requirements, avoid high levels of electricity conversion losses, and provide lower cost, reliable heating and cooling services. In Loudoun County, in addition to the transit oriented mixed-use developments, it may be a viable solution for academic campuses, and some neighborhood renewal projects.

Large Single Structures

- Evaluate economic and environmental benefits of using distributed CHP on single developments larger than approximately 100,000 square feet.

Increasingly, it is economically viable to implement CHP in medium sized developments such as a shopping or commercial complex. There is a growing pool of investors and operators willing to invest in, and operate clean and renewable systems. The recommendation is for the County to request such an evaluation be completed as part of the planning request to gain transparency of the potential benefits and challenges for all parties.

Micro-CHP

- Monitor the emerging potential for economically viable micro-CHP for suitability of large scale deployment in lower density neighborhoods and to supply smaller single developments.

Currently (late 2009) micro-CHP technology is not economically viable for individual homes and buildings. However, if the overall market prices of gas and electricity increase and the technology gets cheaper this is likely to become viable during the plan period. When that happens, it will be a valuable contribution to energy efficiency and lower costs in most of the County's lower density areas.

Other Aspects of CHP

Implementing CHP needs to address a number of overlapping challenges from the standpoints of the developer, existing utilities, current public service regulation, land planning, and end-user perception.

From a regulatory standpoint, the interconnection of CHP with the existing electrical grid falls under the Commonwealth of Virginia State Corporation Commission rules governing connection costs and technical requirements. In the past, it is fair to say these rules have not always encouraged the use of CHP. This is changing, and the overall trend in the U.S. is for interconnection conditions to become more CHP friendly, a trend that is likely to accelerate.

The impact these interconnection rules have on projects must be individually evaluated on a project by project basis. Overall, CHP projects should be considered where their unsubsidized rate of return is better than 10% with reasonably conservative assumptions. This is increasingly typical. Investors are looking for suitable CHP projects in which to invest.

The CES is recommending the implementation of distributed CHP that in total has at least a 100 MW (electric) capacity by 2040. This would make a significant impact on reducing summer peaks, in turn reducing the pressures on the regional grid.

CHP is usually only viable where there is significant use of heat. From a regulatory standpoint, there are no known barriers to implementing district energy (heating or cooling) networks,

other than the provision of public rights of way for infrastructure. It is assumed this is a local County or Town jurisdiction.

Most natural gas CHP engines or turbines can be easily adapted to use of biogas, so this aspect of the CES also supports the renewable fuels strategy.

11.5 Maximize the Use of Economically Viable Renewable Energy Sources

The County has the potential to supply at least 25% of it summer peak cooling demand and a significant portion of its winter heat base load from renewable sources.

This can be achieved through a combination of the following measures:

- Establish a program to deploy about 25 million square feet of solar PV across the County by 2016, rising to about 100 million square feet by 2040.
- Complement the heat and power sources with biogas CHP or biomass boilers as district energy and CHP become more widely deployed.
- Defer any decisions on investing in wind energy, other than for educational awareness, until the technology becomes more cost effective. This could be by decreasing investment and operational cost, and/or by increasing the value of produced electricity, which are both likely to happen in the coming years.

To make a substantive and valuable contribution to reducing summer grid peak demand, PV needs to be deployed in large quantity.

Traditionally PV initiatives have supported small individual installations with large subsidies. The rapidly dropping costs of PV, down over 100% in the last 12 months alone, combined with the potential to reduce summer peaks is changing that equation.

Working with Dominion Power, it was recommended that the County develop a County wide large scale deployment plan which includes investment, ownership and operating aspects and includes a mix of:

- Individual residential and commercial rooftop installations
- Solar PV “farms” potentially associated with academic or commercial campuses
- Dedicated solar PV “farms”

Virginia has traditionally had limited incentives and supporting regulatory structures and incentive standpoint, for Solar PV. This is changing, with significant rebates now (2009) available. At the same time, prices for solar arrays are dropping fast as manufacturing capacity ramps up worldwide. There are no obvious regulatory barriers to implementing solar PV solutions.

Biomass is widely available in Loudoun County from agricultural and forestry waste, with reasonably attractive energy potential either as solid or gas fuel. It has not been included in detail in the energy models used in the CES due to time constraints, but can be explored in the future to determine if further benefits can be achieved from this source.

As the County grows, it will create larger quantities of municipal waste, which if appropriately separated for recycling and energy recovery could be a profitable and environmentally friendly asset within the County. A supplementary study of the viability of a modern waste-to-energy facility is recommended. This recommendation would be an even higher priority if the possible waste-to-energy facility could deliver heat to suitable neighborhood projects in addition to producing electricity.

11.6 Reduce Peak and Average Load to the Existing Electricity Grid

The combination of efficiency, district energy, CHP, and renewable energy outlined in the CES will ensure future demands on the regional grid will be less than today and still support growth plans.

In the CES, the use of electricity will continue to increase between 2010 and 2020, albeit more slowly than would have been the case under business-as-usual. If the CEP is implemented, by 2030, all the growth in population and jobs will be absorbed, and in subsequent years, the demands on the wider grid will actually decline.

Detailed time-interval electrical data was not available, but based on reasonable assumptions the estimate 2040 peak as well as the absolute demand for electricity was far below the BAU outlook.

This is a major benefit to the regional utility as it reduces both the need for increased generating and transmission capacity.

11.7 Critical CES Support – Greenhouse Gas Monetization

The combination of efficiency, district energy, CHP, and renewable energy outlined in the CES will create significant emissions reductions that have potential trading value.

The implementation of a County-wide multi-year integrated energy strategy could result in an annuity-like flow of tradable energy and environmental benefits. These benefits might include sales of excess energy, both renewable and conventional fuels; tradable emission reductions; emission reduction credits; energy efficiency credits; renewable energy credits; and tradable tax credits. The value of these potential benefits will only be dramatically greater if the US Federal Government passes legislation that creates a market value for qualified emissions reduction credits. The intent is not to offer an opinion on the probability of laws being passed, nor of the quality of any of the current proposals that are under debate in the US Congress. However, the recommendation is to have County data organized and validated such that the County could benefit if these laws do come into force.

The current greenhouse footprint of about 3.8 million metric tons could easily double in a business-as-usual scenario, as opposed to stabilizing and reducing in the CES recommended scenario.

To ensure the basic measures are in place to have a robust monetization strategy, the following steps should be considered:

- Form an Energy and Environmental Trading Committee, following approval of the CES. The role of this team would be to ensure the County was taking appropriate steps to be ready to monetize the emissions and efficiency credits from successful implementation of the CES. It would an ad-hoc committee, meeting as needed
- Develop a priority list of tradable GHG emission reductions and possibly other tradable environmental assets.
- Put in place systems to identify and track sustainability projects at a very early stage.
- Consider non-traditional ways to extract value from off-book environmental and energy assets including collaboration with other counties, NGOs, the private sector, or some combination.
- As the potential laws become clearer, consider contracting third party environmental trading services on a pay-for-performance basis

With the outlook for value of GHG emissions credits ranging anywhere from $10 to $100 per metric ton over the next decade, it is incumbent on the County to be prepared to gain maximum benefit from the successful implementation of the CES. Greenhouse gas monetization and other aspects are discussed in further detail in the Appendix J.

11.8 Critical CES Support – Other

Successful implementation of the CES will require County-wide engagement around education, commitment, policy, institutional, and business aspects related to energy.

To be successful, a comprehensive approach is recommended that would address the following aspects that are considered critical to implementation:

- ***Public Education and Engagement*** – This should start with the homes and buildings area. Three of the recommended DOE EEBCG projects specifically focus on this ongoing process. Beyond these additional projects will need to be put in place.
- ***Planning and Land-use*** - The concept of Scale Projects and the wide-scale efficiency recommendations, requires that many planning procedures and documents be adjusted to reflect energy efficiency practices and encouragement of renewable sources. In particular, the Revised General Plan, the Facilities Standards Manual, Zoning Ordinances and Transportation Plan.
- ***Multi-utility Energy Services Ownership and Operation*** – The recommendations around district energy require some guideline development around the formation of neighborhood district energy entities and their relationship to the incumbent utilities. There is an extensive amount of market experience from around the world focusing on this subject, but a detailed local set of guidelines will need to be established. This will initially be developed in the context of one or two specific Scale Projects.
- ***Accessing Grants and Other Support Mechanisms*** - It is likely that energy, green jobs, and climate change will remain the focus of public policy support in various informational and financial ways. However, these resources can be easily missed and usually have a complex application process. It is recommended that the County establish expertise and processes to maximize the opportunity from grants and other

incentives for both public and private clients.

- ***Collecting and Reporting Results -*** On the basis of "what gets measured gets managed" it is recommended that regular public reporting of the County energy and environmental results is provided at scheduled Board of Supervisors meetings, as well as being made accessible to the wider public.
- ***Updating Future Targets -*** With reference to the current baseline, the Goals set forth in the CES are challenging, yet they are still less than global best practice. They should be regularly reviewed and adjusted to keep pace with best practice trends.

These aspects and the various tools to support them are discussed in detail in the Appendices.

12 CES - Results

This section summarizes the CEP results in a series of graphs covering the period from 2007 to 2040. They show three cases. The Base Case is a business-as-usual future, where new buildings continue to be built following the likely State energy code evolution and existing buildings undergo deep renovation at an assumed 15% improvement level (see Appendix E for CES Assumptions).

Future Case 1 assumes new construction has a target of 30% better than the prevailing State Energy Code and a 1.0% annual improvement out to 2040. The existing building stock undergoes deep renovation at a higher 25% improvement, with the renovation efficiency increasing at 1.0% per year in subsequent years. All homes and buildings are assumed to have a current Energy Performance Label.

In addition to the elements of Future Case 1 described above, Future Case 2 assumes that:

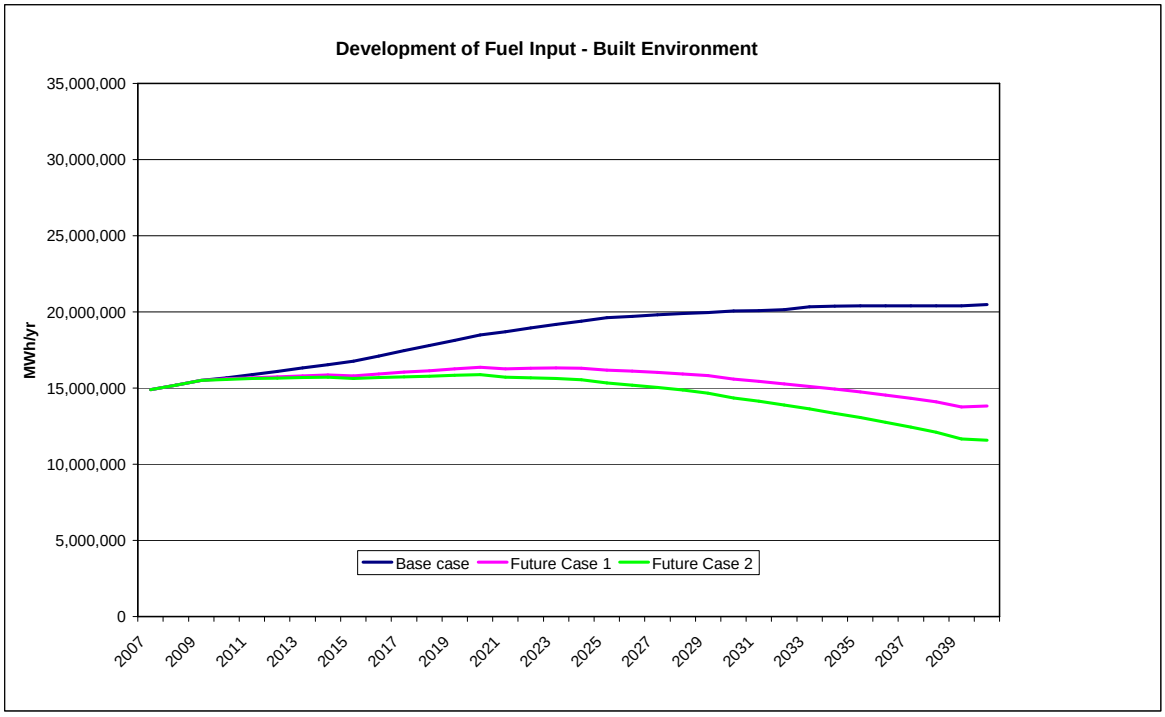
- 10% of new residential and non-residential buildings utilize biomass pellet fuels
- 10% of new residential buildings are using solar thermal
- An average 300 sq. ft. of solar PV is installed on each new building (about 100 MW of nominal generating capacity in total)
- 20% of natural gas is replaced by gas derived from biomass[19]

[19] Several sources are possible, in principle biological substances from waste to wood. For example 90% maize and 10% animal excrement would need an agricultural area of 24 mi² or 5% of County area.

12.1 Built Environment

Figure 12.1 shows the fuel input for the built environment under three scenarios.

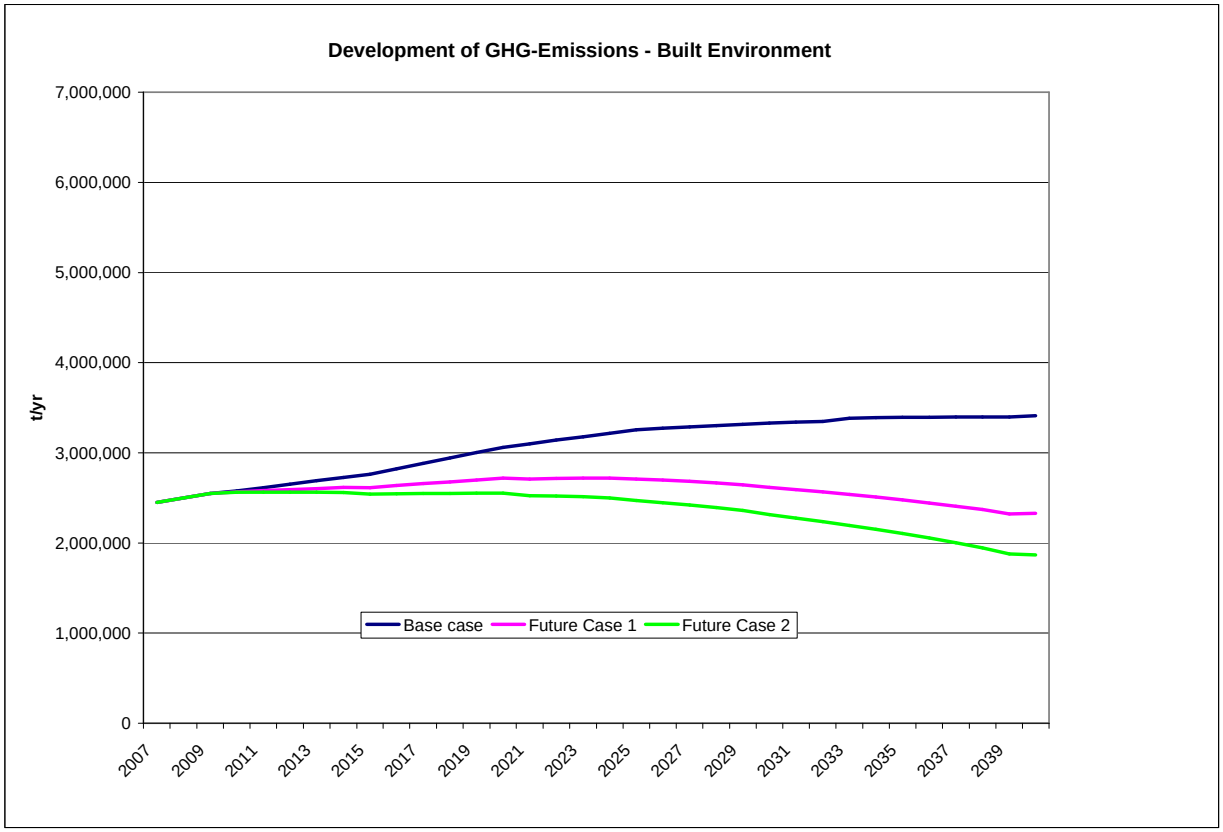
Figure 12.1: County Energy Use - Built Environment



The increased energy needs of housing and employment are more than met by the combined recommendations.

Figure 12.2 shows the GHG created by the built environment under three scenarios.

Figure 12.2: County GHG Emissions – Built Environment

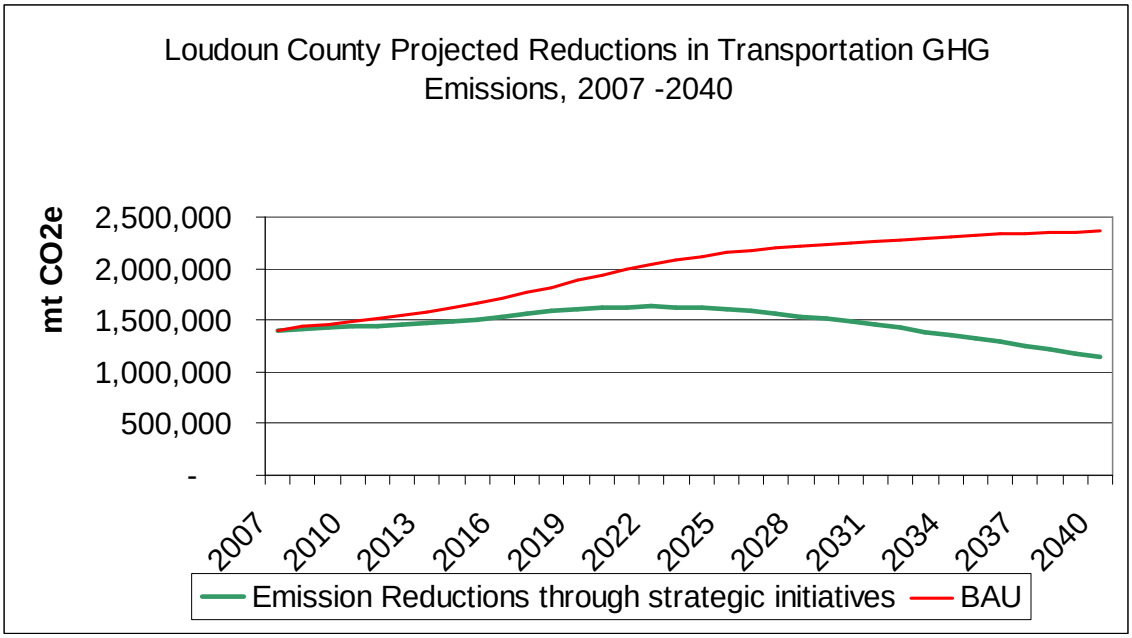


Despite the expected growth, the overall carbon footprint of the buildings in the County will declined by 25% from 2007 levels.

12.2 Transportation

Figure 12.3 shows the total greenhouse emissions from transportation.

Figure 12.3: County GHG Emissions – Transport

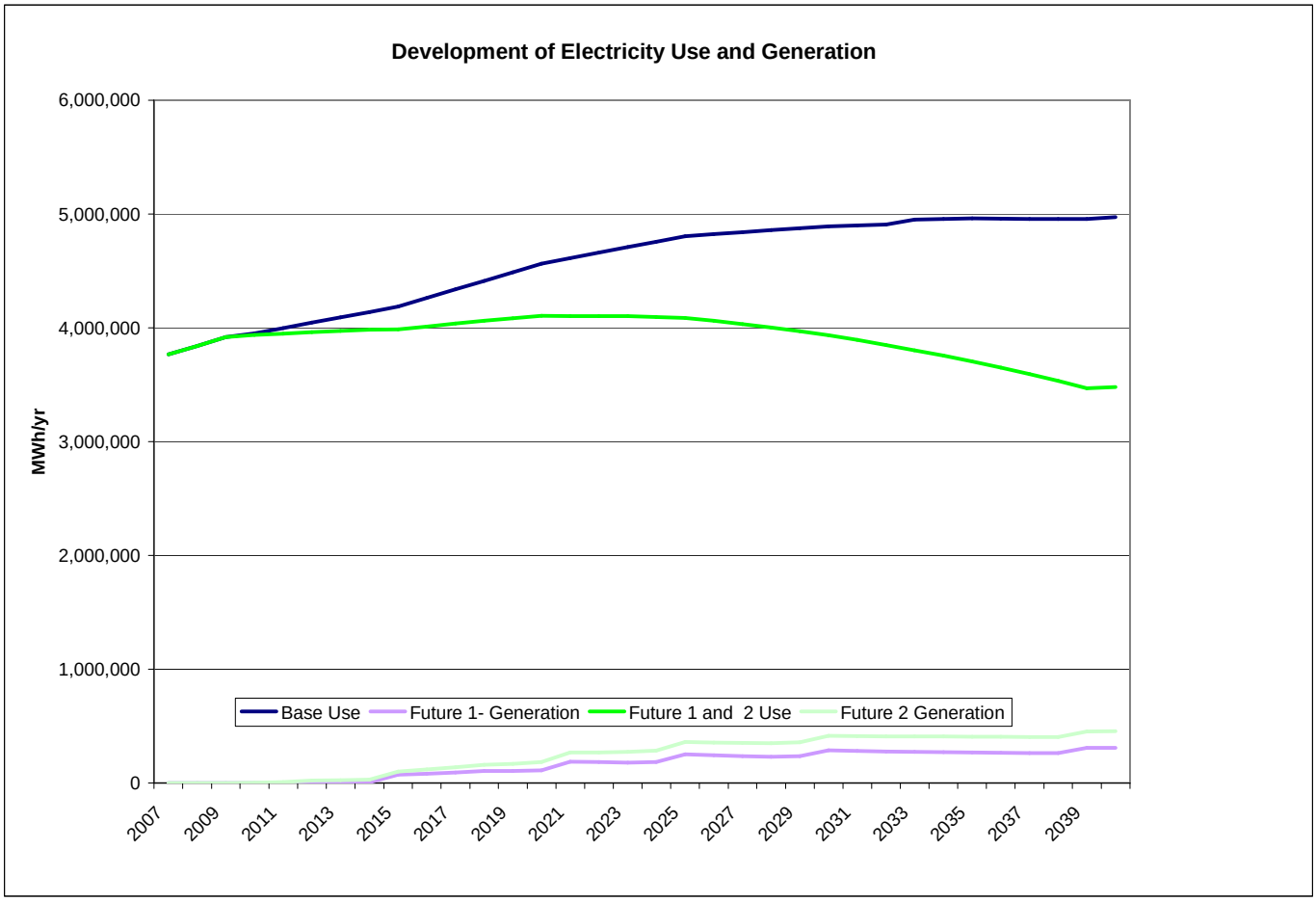


The CES recommendations have absorbed all of the growth in transportation needs of the larger population, while reducing total GHG emissions by about 15%. On a per capita basis they have been reduced by about 50% from 5 mt per capita to 2.5 mt.

12.3 Impact on Electricity

Figure 12.4 shows the total County Energy electricity balance.

Figure 12.4: County Electricity Profile

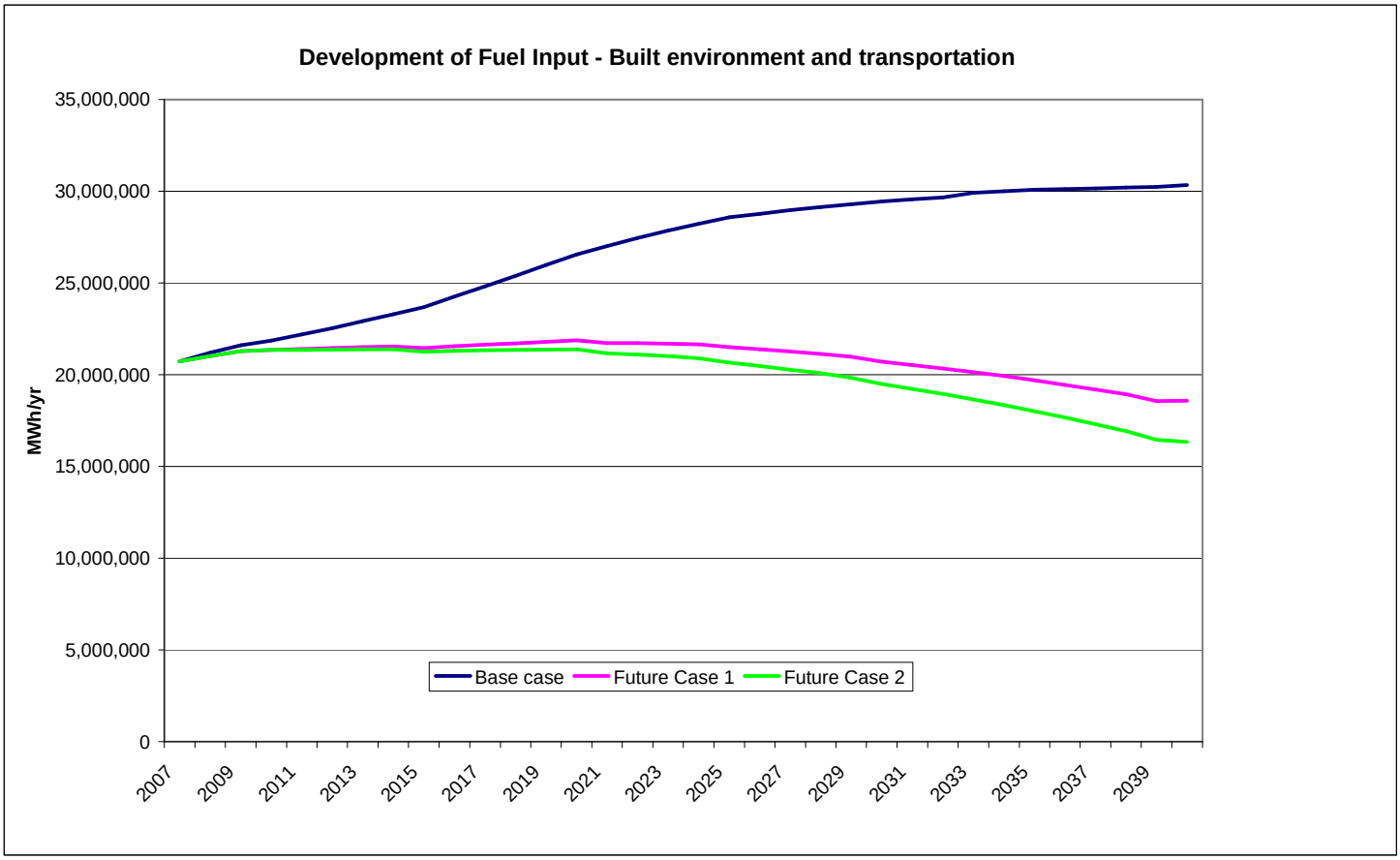


The CES has eliminated the need for additional regional electricity capacity to serve its anticipated population and economic growth. If similar results were achieved across the entire region, this would have a significant impact on the need for new transmission and generation capacity in the regional electricity grid.

12.4 Overall Results

Figure 12.5 shows the total County energy use from Buildings and Transport combined.

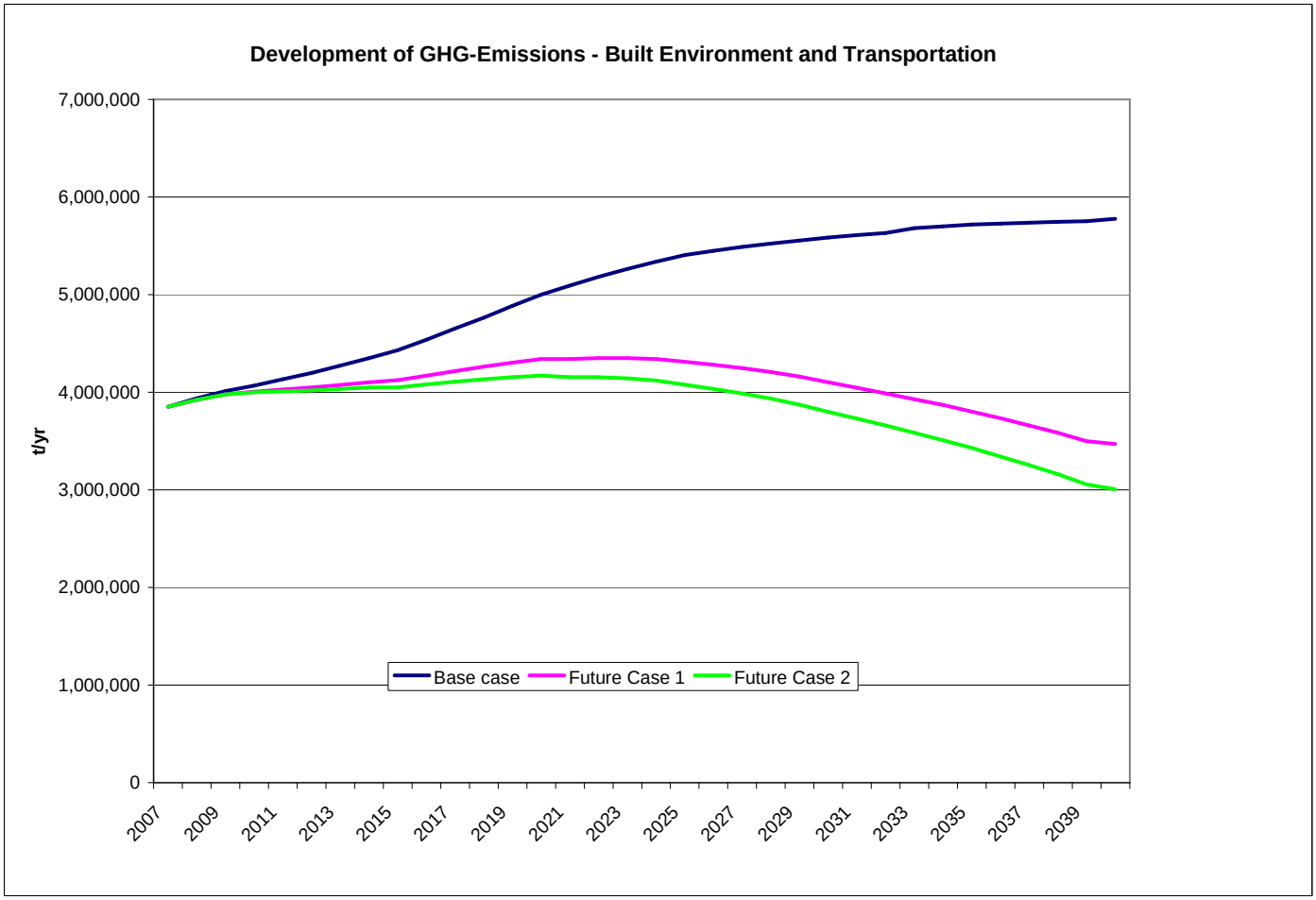
Figure 12.5: County Energy Use – All Uses



The CES allows the County to grow both its population and employment while significantly reducing its overall energy needs.

Figure 12.6 shows the total County GHG emissions from Buildings and Transport combined.

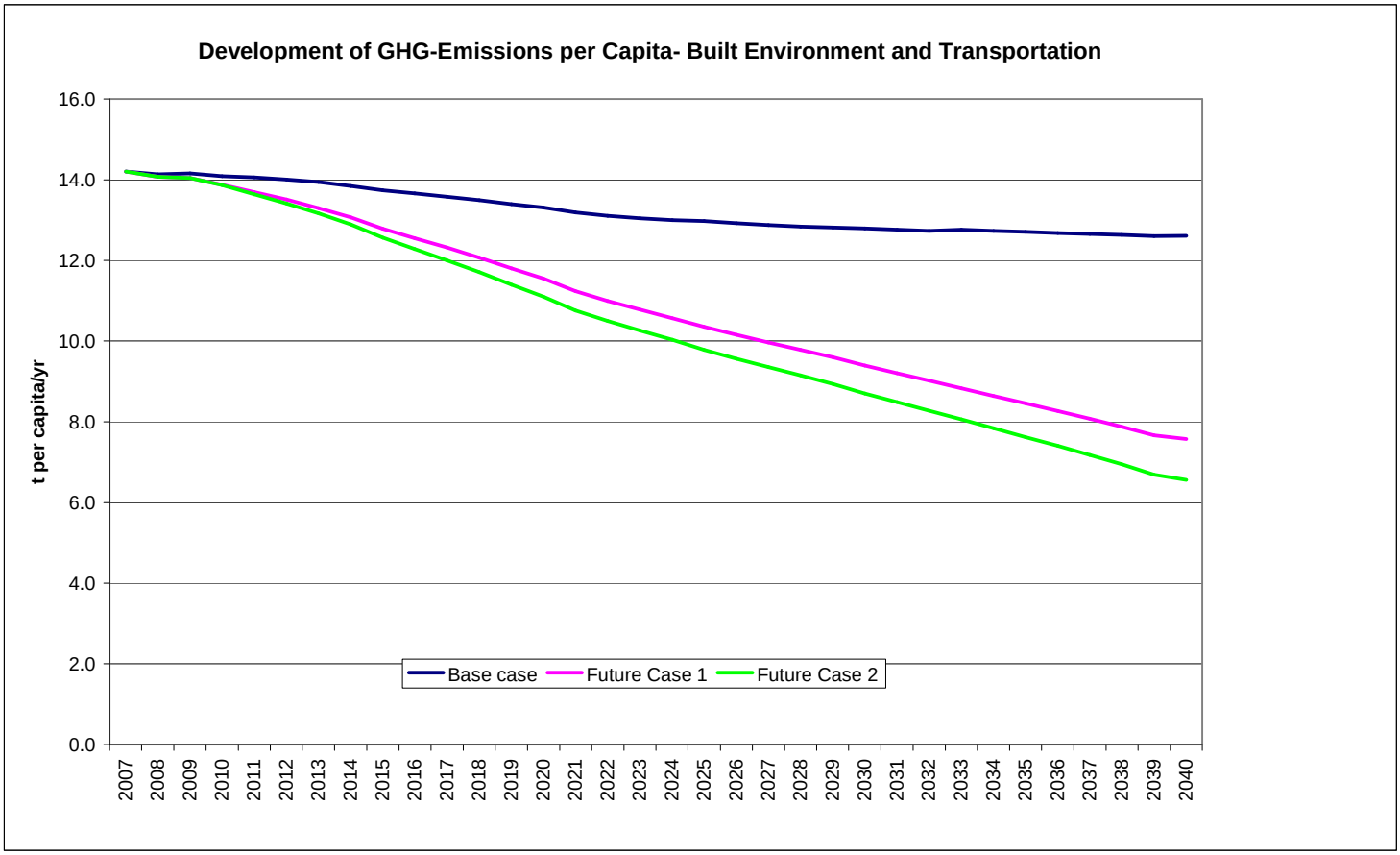
Figure 12.6: County GHG Emissions – All Uses



The CES has allowed the County to grow both its population and employment while significantly reducing its overall greenhouse gas emissions.

Figure 12.7 shows the total per capita emissions from Buildings and Transport combined.

Figure 12.7: Per Capita GHG Emissions – All Uses



Greenhouse gas emissions have been reduced from about 14 mt per resident to 6 mt. This is a level comparable to Stockholm today.

The table in Figure 12.8 summarizes all the energy needs in Terra Watt Hours (TWhe) for the three main sectors of Loudoun County activities in 2007 or the "Base Case", in comparison to 2040 "business-as-usual" (BAU), 2040 Future Case 1 (Case 1), and 2040 Future Case 2 (Case 2). (1 TWh = 1,000 GWh)

Figure 12.8: Loudoun Fuel Input by Sector, 2007 and 2040

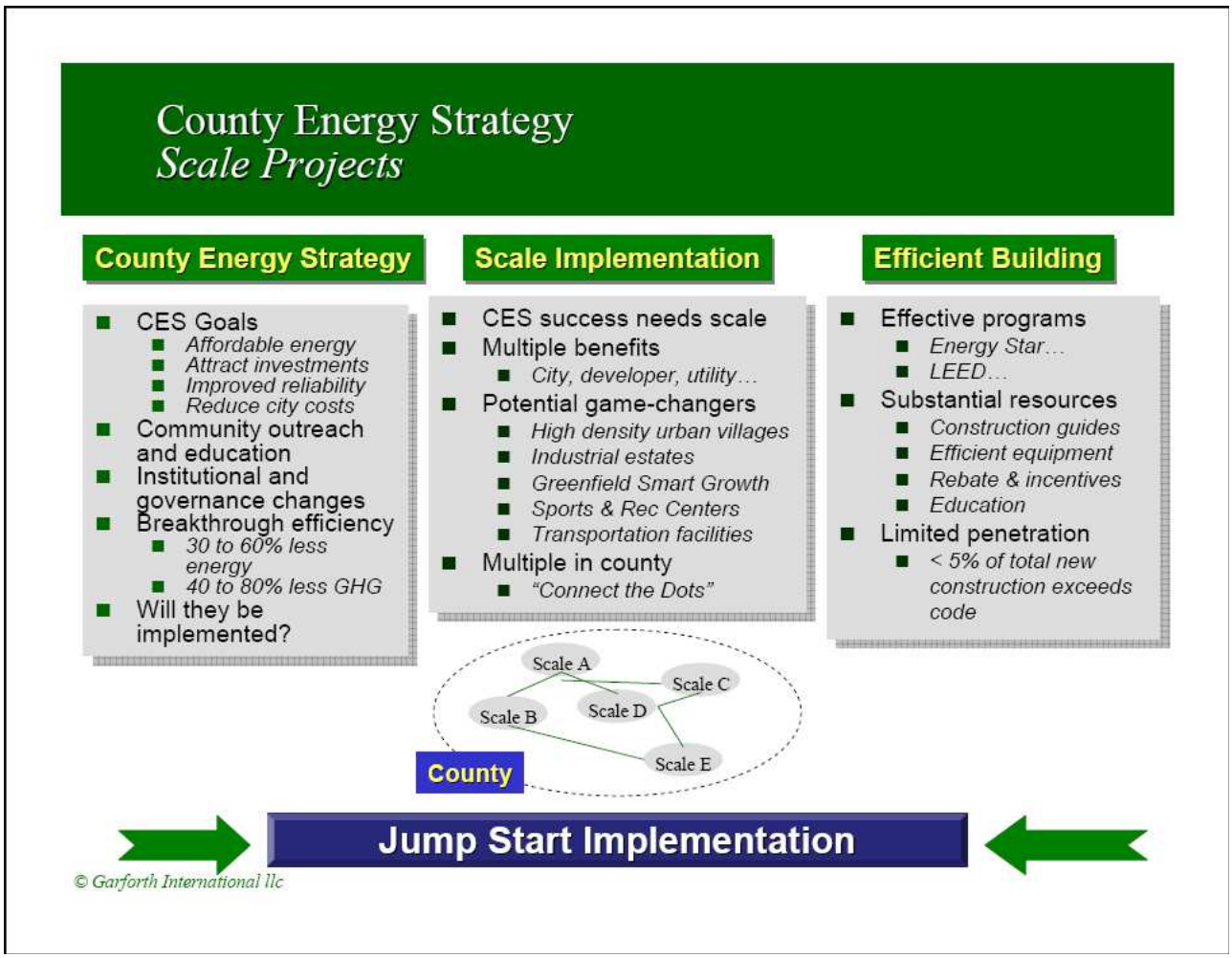
Sector	2007 TWhe/yr	2040 BAU TWhe/yr	2040 Case 1 TWhe/yr	2040 Case 2 TWhe/yr
Residential	7.0	10.4	7.0	5.0
Non-Residential	7.9	10.0	6.8	6.5
Transport	5.8	9.9	4.8	4.8
Total (Gross)	20.7	30.3	18.6	16.3

Future Case 2 Result: While the County's population grows by 69% by 2040, the total needs of 186,000 new residents will have been met while still achieving an overall reduction in total energy use of 21%.

13 Accelerating CES Implementation with Scale Projects

Successful long-term achievement of the breakthrough benefits from the Loudoun County Energy Strategy will depend in part on successfully kick-starting the energy structures through "Scale Projects".

Figure 13.1: Scale Projects Jump Start Effective Implementation



In the U.S., a growing number of counties and cities are developing energy and climate plans. A key question is the extent to which even the best of these will deliver on their targets. The CES has targets aimed at achieving breakthrough energy and greenhouse gas creation reductions delivering a world-class competitive and attractive community.

As outlined in the preceding paragraphs, delivering on these goals involves tackling the overall

efficiency of homes, buildings, transportation, and restructuring the shape and possibly even the institutions of energy supply and land planning. These are daunting tasks. All too often, once the scope of these challenges becomes apparent, CES plans stall and become little more than visionary statements of intent, with little implementation success.

At the same time many excellent programs encourage efficiency in individual homes and buildings, through raising awareness, providing implementation guidelines and various training and voluntary rating programs. Examples include Energy Star and the US Green Building Council. Many public utilities have energy saving guidelines for all users. These all offer excellent material and have done a great service in raising general awareness of the opportunities and solutions available. However, implementing the CES "one building at a time" will not successfully deliver the break-through results the County is envisioning.

Scale Projects bridge this gap. They are developments with the size and timing such that new guidelines implemented in accordance with the CES can be applied within relatively large, but contained boundaries. They are large enough to address both energy demand and supply within a single project. Over time, multiple Scale Projects blend together. This "connecting the dots" creates the County-wide results that are possible by full implementation of the CES.

In general, the expectation would be that these CES Scale Projects would use at least 30% to 50% less energy than would be the case with business-as-usual and would create 40% to 70% less greenhouse gas emissions, while delivering attractive economic performance for investors and other financial stakeholders. Returns on incremental investments typically range between 10% and 25%. Although these ranges are provided as reference, the energy and economic benefits should not be generalized, and would need to be assessed in a detailed Integrated Energy Master Plan specific to the project.

It is recommended that the County identify a list of potential Scale Projects beyond those explored in this Report. Each project should be evaluated as to how it can implement the combined integrated efficiency, energy distribution, and clean and renewable energy supply solutions that are recommended by the CES. Given the Dillon Rule constraints, wherever possible, the projects should be selected at least in the initial phases, where there is clear support from the key influencers. If, in addition, the County would be able to apply Special Exception Zoning around such things as above-code building efficiencies and non-traditional clean and renewable energy supplies, this will accelerate the process.

Specific projects are not contained in the CES. However, a range of possible opportunities was developed to help identify potential candidates. Scale projects are typically found in the following categories:

Transit-oriented Urban Villages

Covering some hundreds of acres, with a mix of medium to high density housing, retail, hotels, and offices clustered around transit hubs.

Employment-oriented Urban Villages

This would have a similar general profile, but clustered around concentrations of local employment often of a high-quality commercial or technical nature.

Retail and Entertainment Focused Urban Village

Again a similar general profile, but clustered around retail, entertainment and culturally focused concentration.

Retirement and Continuing Care Communities

Communities focused on the needs of individuals and families in later years, which include mixed-use and entertainment venues, combined with housing and support resources to meet different levels of mobility and medical care need.

Existing and New Academic Campuses

An integrated approach to energy reduces operating costs and environmental impacts. The growing need to provide technical, managerial, and business education and research for a range of energy and environmental disciplines fits naturally with the opportunity to improve the operational performance of the campus.

Data Centers – Expansion and New Development

Data centers are a major part of the economic development of Loudoun County, and are also major causes of rising electricity demand. The 24/7 nature of the energy needs create opportunities for innovative energy supply and the potential use of waste heat. A Scale Project to contain costs, reduce grid peaks and reduce greenhouse gas emissions can be an example for other data centers and communities in the County and beyond.

Sports, Retail and Commercial Mixed-use Neighborhood

Sports facilities combined when combined with other development are good candidates for innovative energy approaches. This includes ensuring that they have an appropriate approach to minimizing transportation energy and emissions.

Business Park

Business parks, maybe with research facilities and even some light industrial uses, can be opportunities for creative economic and clean energy solutions, including on-site renewable and CHP energy sources. They could become magnets for investors due to the competitive, clean and flexible energy services. Services offered may include a wider range of utilities than would normally be the case such as heating, cooling, electrify, natural gas, process steam, and compressed air.

Downtown Expansion and Renewal District

Typically these will cover multiple blocks of an existing urban neighborhood undergoing revitalization with attractive energy efficiency improvement opportunities. There are major challenges to redefining the energy performance of a neighborhood where there is a mix of new and existing development with multiple owners, and where development will take place over many years. These Scale Projects allow the consistent planning procedures to be addresses as well as the costs and technology.

14 Recommended Projects for Funding U.S. Department of Energy's "Energy Efficiency & Conservation Block Grant" Program

14.1 Background

Under the auspices of the American Recovery and Reinvestment Act, Loudoun County is eligible for a formula-based grant of $2,215,600. These funds will be used to support a variety of energy efficiency and conservation projects. From this, $250,000 was requested and encumbered for the preparation of this County Energy Strategy.

Subject to final approval by the US Department of Energy (DOE), the balance of $1,965,600 could be awarded to a variety of specific or County-wide energy efficiency and renewable energy projects. The funds must be spent within three years.

14.2 Project Summaries

Based on the initial findings of the CES Team, the following projects are recommended for consideration for funding using the Energy Efficiency and Conservation Block Grant (EECBG) monies. A brief narrative, estimated budget allocation and energy performance measures for the projects are included.

This list represents a mix of near-term projects that were selected to encourage comprehensive conservation measures throughout the County and to set the stage for the long-term implementation of the CES. There is no priority to the listing. Some projects on this list will yield quick and beneficial energy efficiency gains; others will demonstrate the more complex integrated recommendations and goals of the CES as it supports community scale projects and economic development.

The recommended projects are:

A) Temporary Position to Support Energy Efficiency Programs
B) Loudoun County Youth Shelter Expansion
C) Scott Jenkins Memorial Park Solar Lights & Electric Vehicle Charging Station
D) Energy Education and Outreach to Businesses
E) Energy Education and Outreach to Residents
F) Energy Solution for Moorefield Station and Data Centers Scale Project
G) Energy Solution including Gas-fired CHP cluster of 8 County Buildings Scale Project
H) Implementation of Energy Audit Recommendations for County Buildings
I) Building Codes and Energy Performance Labeling
J) Loudoun County Home Energy Improvement Program (added by the Board of Supervisors)

Project A: Temporary Position to Support Energy Efficiency Programs

Project Description

With funds from the US Department of Energy's Energy Efficiency and Conservation Block Grant Program, Loudoun County has developed a comprehensive County Energy Strategy (CES) that sets forth measurable goals and objectives for energy efficiency, energy conservation, and the reduction of greenhouse gas emissions related to all energy use in the County. To ensure effective implementation of the Strategy, especially in the critical first years, the County will appoint a full-time energy coordinator to provide planning, and regular reporting to the US Department of Energy, County Government, and the community at large. The duties of this coordinator will include:

- Coordination and integration of County-wide policies and programs that supports the CES
- Coordination and management of budget efforts related to the CES and related grant solicitations (particularly from the Department of Energy) and contract management
- Providing information to the community about sustainable energy management and overseeing the outreach activities related to the CES
- Managing multiple projects and priorities and providing expert advice on a wide-range of energy issues

It is our goal to implement and expand sustainable energy management over the long-term. Loudoun County can be a national model for demonstrating the linkages between sustainable energy management, economic development and greenhouse emissions reductions.

Proposed Number of Jobs Created: This effort requires a full-time County staff to manage, monitor and report on this program for the duration of the grant. Drawing from the suggested methodology from the US Department of Energy - $92,000 for every job - the number of jobs calculated from this project is approximately 1, over the course of the development of the project.

Proposed Energy Saved and/or Renewable Energy Generated: The most important goal of this position is to implement the recommendations of the County Energy Strategy. The County seeks to have excellent guidelines for energy conservation for the long-term and to promote a framework for solid implementation. Expected outcomes associated with this strategy include:

- Reduced operating costs due to the implementation of renewable energy
- A long-term (30 to 40 years) road map for energy conservation
- Reduced greenhouse gases
- Reduced maintenance costs for energy operations in the County
- Green collar job creation – especially in the renewable energy sector
- Education in the renewable energy field

Proposed Greenhouse Gas Emissions Reduced ($C0_2$ Equivalents):

Proposed Funds Leveraged:

Proposed EECBG Budget: $196,560

Project B: Loudoun County Youth Shelter Expansion

Project Description

Loudoun County has an existing 12-bed Youth Shelter built in the 1980s. The Shelter is a short-term, crisis intervention program that provides community-based, short-term residential services for youth between 12 and 17, who cannot live at home. It operates twenty-four hours a day, three hundred sixty-five days a year and provides group and individual counseling, medical and mental health services, substance assessment, recreation and physical fitness, community service opportunities, and family work. Counselors prepare youth to receive assistance from other community resources, as they move through this transitional period. The existing building has been operating at peak capacity since it opened.

There are plans to expand the current shelter by adding another 12-bed unit and support space. The design of the new staff-secured Youth Shelter is 90% complete. The design is a campus layout consisting of three buildings - the existing and new youth shelters and a shared dining/kitchen area.

The project will be bid in January 2010, with construction starting in April 2010. From the conception of this project, the architects and engineers have been tasked to create a passive solar, LEED Silver rated building that out-performs current code buildings in energy efficiency by 60%. Financially, the incremental energy investments could deliver economic returns 2% to 3% better than municipal bonds. Due to the short-term nature of the shelter's services, with the average stay for each youth at 27 days, the County has decided to make the new campus an educational facility teaching the youths about sustainability and energy conservation. Educational elements on campus will be highlighted with signage.

The energy solution in the new Youth Shelter and Dining/Kitchen buildings includes numerous energy saving architectural components and construction techniques. However, the majority of our energy goals will be met by a combination of two strategies:

1. By installing an estimated 10kW photovoltaic panel system on the Youth Shelter roof which is expected to provide 12.5% of the building's electricity needs; and

2. By implementing ground source geothermal heat pumps for heating and cooling the project. Geothermal is expected to reduce the demand for natural gas for heating both new buildings by 30% and electricity needed for cooling both buildings by 15%.

Proposed Number of Jobs Created: Drawing from the suggested methodology from the US Department of Energy - $92,000 for every job - the number of jobs calculated from this project is approximately 36 over the course of the development of the project. The overall budget is $2.84 million, of which $500,000 - $600,000 would emanate from the EECBG grant program.

Proposed Energy Saved and/or Renewable Energy Generated: The measurable goals and objectives of this activity include the development of a final investment-grade energy plan for the Youth Shelter to optimize the energy solution. The goals of this project are to reduce operating costs due to the implementation of renewable energy; reduce emissions of greenhouse gases; reduce maintenance costs; create jobs in the renewable energy sector; provide education in the clean and renewable energy field; and educate the youth who pass through the facility.

Proposed Greenhouse Gas Emissions Reduced ($C0_2$ Equivalents):

Proposed Funds Leveraged:

Proposed EECBG Budget: $500,000

Project C: Scott Jenkins Memorial Park Solar Lights & Electric Vehicle Charging Stations

Project Description:

The County is building the Scott Jenkins Memorial Park in Hamilton, Virginia. The project is scheduled to begin in spring of 2010. There is going to be a Park & Ride built as part of this park. The County is planning to install 21 parking lights at this Park & Ride to accommodate commuters and also to provide safety.

The County is proposing LED lights that would include the following features:

1. Powered by PV solar
2. Excessive energy will be sold back to the grid
3. Electrical Vehicle (EV) Charging Stations built into the poles
4. Credit card capability to sell power to EV commuters
5. Solar panels will have GPS track capability to maximize efficiency

Proposed Number of Jobs Created: Drawing from the suggested methodology from the U.S. Department of Energy - $92,000 for every job - the number of jobs calculated from this project is approximately 4 over the course of the development of the project.

Proposed Energy Saved and/or Renewable Energy Generated: There are a number of economic and environmental benefits related to this project. The lights will not only be powered by renewable energy but also the excess power will be sold back to the grid, providing a source of future income to the County. The specific proposal for this project is for 21 lights, each having two 5 kW solar panels. There will be cumulative 210 kW of renewable energy generated which can be sold to the grid during the peak times. Since the lights are LED, they will have extended life as well as low maintenance costs.

Proposed Greenhouse Gas Emissions Reduced (C02 Equivalents):

Traditional lighting design would include 21 150 watts sodium vapor lights. (150 X 21 = 31.5 kW X 365 days X 10 hours = 114975 kW annually)

CO2 Equivalents = 114975 kW X 2.096 (EPA number) = 240,988 lb of CO2 not generated. This is equivalent to taking 21 cars off the road or planting 32 acres of trees.

Assumption:

11,500 lbs of CO_2 = removing one car per year off the roads

7,530 lbs of CO_2 = planting one acre of trees

	Co_2 Reduction in pounds
Lights	240,988
	Total
Co_2 Reduction (lb)	**240,988**
Equivalents	
Number of cars removed from roads for a year	21
Acres of trees planted	32

Sources:
Energy comparisons estimated from:
http://www.smud.org/business/community-energy-awards.html
www.peterborough.gov.uk/page-12304

Proposed Funds Leveraged: None

Proposed EECBG Budget: $300,000

Project D: Education and Outreach to Businesses

Project Description

Loudoun County's efforts to meaningfully increase its competitiveness through reducing energy use and associated greenhouse gases will need active partnerships and cooperation with the County's business community. There are multiple examples of businesses saving money and reducing future risks through effective energy management, including developing and implementing green building solutions, reducing energy process demand and diversifying to include cleaner and renewable energy supplies, along with promoting transit options. Increasingly, businesses are finding new opportunities as a result of market shifts to green solutions, in turn creating new investment and green collar jobs. The County needs to further promote energy awareness by recognizing green businesses that serve as good models.

A series of outreach and communication efforts would be developed to promote good building design, energy efficiency habits, and opportunities for "green" commerce. Working cooperatively with the Loudoun County Chamber of Commerce, Loudoun County Small Business Center, and other business and professional organizations, a series of educational and incentive programs will be developed. One such program is the "Green Business Challenge" which was approved by the Loudoun County Board of Supervisors in September 2009. It encourages businesses to evaluate their operations and practices and identify and implement innovative ways to conserve energy. The Green Business Challenge is a friendly, voluntary competition among County commercial enterprises who want to demonstrate commitments to sustainability. Participating businesses earn points for specific company initiatives such as creating an internal "green" team, purchasing "green" power, installing renewable energy systems, and implementing building improvements to reduce energy demands. Judges evaluate candidate companies by considering their point achievements. Awards will be given in 2010. It is envisioned that the program will be renewed in subsequent years, with incentives or rewards provided to the winners if funds were allocated from the EECBG.

In the short-term, the County would organize public workshops around aspects contained in the Challenge, utilizing web-based tools to disseminate information about the Green Business Challenge and best practice case studies from the County's commercial sector.

Proposed Number of Jobs Created: Using the suggested US DOE methodology from the - $92,000 for every job - the number of jobs from this project will be between 2.5 to 3 over the course of the project, not including local employment from businesses investing in efficiency and clean and renewable energy.

Proposed Energy Saved and/or Renewable Energy Generated: This can be tracked and determined by individual businesses participating in the Green Business Challenge.

Proposed Greenhouse Gas Emissions Reduced ($C0_2$ Equivalents): By encouraging businesses to participate in the Green Business Challenge, there is a solid chance to significantly reduce greenhouse gases. Currently, the business and institutional emissions are 33% of the County total at 1.3 Million mt.

Proposed Funds Leveraged: Joint sponsorship and outreach efforts with the Loudoun County Chamber of Commerce.

Proposed EECBG Budget: $100,000

Project E: Education and Outreach to Residents

Project Description

Approximately 30% of Loudoun County's energy consumption is from its 110,000 homes. This is above 50% if use of personal vehicles were included. The County has made energy conservation a priority, through encouraging energy improvement measures in homes and the reduction of inefficient vehicle use. With funds from the grant, the County, teamed with local organizations and businesses, will provide public education and outreach to residents. The aim is to encourage home energy audits and energy retrofits, efficient appliance purchases, and energy efficient transportation habits.

Loudoun County will leverage its existing affiliation with the "Home-Performance with Energy Star" pilot program, sponsored by the US Department of Energy and the US Environmental Protection Agency. This program creates job opportunities, provides job training, and offers energy performance contracts to homeowners. The "Home-Performance with Energy Star" pilot begins in early 2010. It will train local contractors to offer home energy audits and retrofits in Loudoun County. The program also leverages the positive Energy Star brand recognition by endorsing audit and improvement standards. Through this program, a typical homeowner in Loudoun County can expect to achieve at least 20% savings in energy costs. Those who participate in the pilot will be asked to sign a utility bill consent form to be used for performance evaluation. A minimum target would be to engage at least 1% or 1,000 homes in the County.

The project will also include promotion of the US Department of Energy's Weatherization Program to low-income home owners in the County. Funded by the Federal Recovery Act, this is a free service available to qualified residents and is implemented by Community Housing Partners. The County will develop an outreach campaign to explain how to take advantage of this program, as well as promote the tools, resources, and technical assistance of Energy Star and similar organizations to expand the efficiency opportunities. Energy affordability is important since affordable housing is a local priority.

Although specifics of this outreach have not been planned at this point, however, some of the following outreach might be considered: advertisement over the internet, radio, television, public buss fleets and energy events. A parallel marketing campaign will be launched through homeowner associations. Finally, Loudoun County will develop a website specifically for energy efficiency information and connect residents to information and resources available through a single portal. The project will draw from a highly successful outreach program undertaken by the State of Maryland, which partnered with a private marketing firm to broadcast the energy conservation program.

Proposed Number of Jobs Created: Using the suggested US DOE methodology from the - $92,000 for every job - the number of jobs from this project will be between 2.5 to 3 full time equivalents over the course of the project. An efficiency project would invest between $1,500 and $3,000, so one new job also would be created for every 20 to 30 homes retrofitted.

Proposed Energy Saved and/or Renewable Energy Generated: Each home in Loudoun uses about 124 MM Btu_e/year, so a typical home retrofit would reduce this by about 25 MM Btu_e.

Proposed Greenhouse Gas Emissions Reduced ($C0_2$ Equivalents): Since every business and home is responsible for reducing its carbon footprint, an effective outreach campaign can have great effect in reducing greenhouse gas emissions. The project encourages the public to save energy, and each typical energy retrofit will reduce the GHG emissions by 3 metric tons.

Proposed Funds Leveraged: The funds potentially leveraged from this effort include the US DOEs "Home-Performance through Energy Star" pilot program, the US DOE's Weatherization Program for low-income homeowners, and other federal, state, and local incentive programs.

Proposed EECBG Budget: $240,000

Project F: Energy Solution for Moorefield Station and Digital Realty Trust data centers Scale Project

Project Description

The CES underlines that one key to successful implementation and attainment of the energy efficiency and greenhouse gas reductions is the planning and implementation of Scale Projects which offer the probability of early success. These are large enough to demonstrate the enhanced energy and environmental gains through combining efficient urban design, energy efficiencies, district energy, clean and renewable energy supplies, and adjusted business models, within large, but well defined boundaries. These are commonly referred to as "Neighborhood Energy Plans" in regions of North America and Europe.

The Moorefield Station project in southeastern Loudoun County has a strong mix of energy, land-use, transportation and economic attributes, which makes it suitable to serve as a Scale Project and demonstrate the benefits of integrated energy solutions. Moorefield Station, when completed, will be a 400-acre mixed-used development south of the Greenway between the 772 and 607 Interchanges. A critical focus of the development will be the concentration of density and pursuit of transit-oriented development around the terminus of the proposed "Dulles Silver Line" Rail Station.

There is a Data Center cluster, operated by Digital Realty Trust[20] in close proximity to Moorefield Station development. This will be expanded in the future. Data Centers use large amounts of energy to run their IT and the heating and cooling of the buildings. The 2007 Virginia Energy Plan estimated that 10% to 15% of Northern Virginia's electricity is used by Data Centers. They use 10 to 15 times more than a normal commercial building. They are a major and growing cause of greenhouse gas emissions in Virginia. High electricity usage exposes Data Centers to economic and environmental costs and risks. These include higher current operating costs and the risk of unacceptable future costs in a volatile, but generally rising, electricity market. Risks also include potential supply reliability and greenhouse gas impacts. Minimizing the energy usage and environmental impact, combined with very high degrees of reliability is a major focus of this industry.

No detailed energy study has been completed that could guide the construction and deployment of highly efficient, cost effective energy infrastructure for Moorefield development. This is needed before an investment-grade energy solution can be finalized. The proposed project will create an Integrated Energy Master Plan (IEMP) for Moorefield Station in sufficient detail to determine the energy savings, greenhouse gas mitigation and economic viability of implementing above code efficiencies, combined with non-standard sources of supply, distribution and uses of energy. It will include a detailed assessment of the energy opportunities for the Data Center cluster, both on a stand alone basis and as a potential integrated part of the wider neighborhood. This part of the IEMP will potentially serve as a regional and national role model for future Data Center investments and expansions.

The IEMP will evaluate the optimum combination of above code construction, heating and cooling and other energy demands, and how they can be served with a portfolio of local clean and renewable energy sources, and district energy (heating/cooling) systems. Initial indications

[20] http://www.digitalrealtytrust.com/

suggest that the size of the development is suitable for a local co-generation facility with high levels of fuel efficiency due to the potential to implement district energy solutions and to serve the current and future needs of the data centers. The close proximity between Moorefield Station and Data Centers may also facilitate waste heat recovery between the community and the data centers.

Proposed Number of Jobs Created: Using the suggested US DOE methodology - $92,000 for every job - the number of jobs from this project will be between 6 to 10 full time equivalents for the approximately 6 to 9 months needed to develop the IEMP.

Proposed Energy Saved and/or Renewable Energy Generated: Based on comparable assessments, site and source energy use of 40% to 50% less than BAU with good economics may be achieved for the Scale Project as a whole. .

Proposed Greenhouse Gas Emissions Reduced ($C0_2$ Equivalents): The overall direct and indirect greenhouse gas emissions avoidance could be between 50% and 70% less than BAU.

Proposed Funds Leveraged: From the preliminary estimates this project could leverage about 2% of the total construction costs in energy efficiency investments and about $32 million in clean and renewable energy system investments. The potential for leveraging Data Centers is not quantifiable at this stage, but is potentially significant.

Proposed EECBG Budget: The proposed budget is $300,000, with the possibility of a funding match from the Claude Moore Charitable Foundation, the land owner. Digital Realty Trust has also indicated the possibility of matching resources both with funding and with extensive in-kind resources.

Project G: Energy Solution for a Gas-Fired CHP Study That Includes 8 County Buildings

Project Description

Loudoun County has multiple County buildings that require a detailed feasibility study to implement energy efficiency upgrades combined with a clean and renewable energy supply - including solar photovoltaic and natural gas-fired cogeneration:

1) Youth Shelter Building, 6,000 square feet
2) Friendship House Building, 5,586 square feet
3) Transitional Housing Building, 17,486 square feet
4) Respite Center Building. 3,338 square feet
5) DIT Computer Center Building, 27,874 square feet

In addition, there are three planned County buildings totaling approximately 20,000 square feet that are to be in included in the study. These buildings will be located close to the existing buildings. The implementation will be configured to act as a teaching location on the implementation of small-scale integrated energy solutions. These buildings are located on a small part of a 700-acre County-owned site. The feasibility study will address potential future extensions of an efficient energy strategy.

This study will enable the County to make optimum investments in efficiency and clean and renewable energy sources under a range of price and greenhouse gas emissions scenarios. This study will provide the County with a clear roadmap to economically reduce energy and greenhouse gases at this particular property. This project also will act as a community example for accelerated proliferation of similar projects. The project performance will be monitored for at least three years after commissioning relative to its design goals by a team from the County and a local college.

Proposed Number of Jobs Created: This effort requires a full-time consultancy from the engineering field. The study phase will be six months and require three consulting and engineering staff financed from the Department of Energy EECBG grant. The implementation phase will last one year and require ten construction and engineering staff (to be financed by the County budget). Drawing from the suggested methodology from the U.S. Department of Energy – $92,000 for every job - the number of jobs calculated from this project is approximately 1.5 to 2, over the course of the development of the project. Perhaps as many as five comparable projects could evolve in the County from this project, with a similar employment level as the initial demonstration project.

Proposed Energy Saved and/or Renewable Energy Generated: The most important goals and objectives of this project are to: 1) Reduce operating costs due to implementation of clean and renewable energy; 2) Reduce greenhouse gases 60% when compared to business as usual; 3) Reduce energy needs for these buildings by at least 40% less than business as usual through the combination of efficiency, PV and cogeneration; 4) Reduce summer peak demand from the regional electricity grid.

Proposed Greenhouse Gas Emissions Reduced ($C0_2$ Equivalents): The reductions of greenhouse gas emissions are estimated to be 60% when compared to business as usual

Proposed Funds Leveraged:

Proposed EECBG Budget: $150,000 - $200,000

Project H: Implementation of Energy Audits Recommendations for County Buildings

Project Description:

Loudoun County started comprehensive energy audits of its own facilities in 2008. Six buildings were selected that were presumed to be the most energy-intensive. The first-phase, initiated under a Virginia State Energy Services Contract, developed a program of recommended energy conservation measure which the County began implementing in the fall of 2009. The County also commissioned the performance contractor, Custom Energy Services Inc., to perform a second phase of investment-grade audits on the remaining County-owned facilities. The criteria for inclusion on the list of recommended improvements is the potential for significant and measurable energy savings to the County, reduction of $C0_2$ emissions through reduction in energy and water usage and an average return on investment of about 12% or simple pay-back period of 10 years or less.

The 22 proposed energy conservation measures from the second phase audits are in buildings that range in size between 1,000 and 24,000 square feet. They include measures to be completed in libraries, animal shelters, garage and maintenance facilities, and senior citizens centers. The age of the buildings spans between 1 to 180 years.

The following retrofits fall into major categories of lighting (L), HVAC (H), building controls (C), weatherization, (W), and water conservation (WC).

Facility	ECMs Proposed	Proj.Energy Savings/yr	O&M Cost Savings/yr	Total Cost Savings/yr	Construction Investment
Animal Shelter	L,H,W,WC	$19,341	$18	$19,359	$180,440
Ashburn Library	L,H,C,W	$11,504	$105	$11,609	$106,097
Banshee Reeks	L,H	$ 1,077	$ 92	$ 1,169	$8,151
Carver Center	H,C	$ 8,033	$ 0	$ 8,033	$24,679
Cascades Library	L,H,W,WC	$ 3,060	$ 0	$ 3,060	$33,858
Cascades Sr.Ctr	H,C	$16,156	$ 0	$16,156	$82,968
Douglass Com Ctr	L,H	$1,270	$ 5	$ 1,275	$14,614
Dulles South CC	L,H,W	$10,392	$129	$11,677	$81,244
Dulles South PSC	L,W	$6,271	$279	$ 6,550	$77,272
F/R High Bay	L,H,W	$7,348	$ 64	$ 7,412	$83,514
Friendship House	L,H,WC,W	$3,783	$417	$ 4,200	$14,151
Gen Svc Shops	L,H	$5,287	$361	$ 5,648	$66,236
Farm Museum	L,H,W	$3,505	$139	$ 3,644	$41,430
Lovettsville Lib	L,H,W	$1,940	$ 70	$ 2,010	$19,472
Middleburg Lib.	L,H,WC	$1,823	$ 38	$ 1,861	$17,570
PRCS Shops	L,H	$149	$0	$149	$1,230
Purcellville Lib	L,H,WC	$ 4,775	$614	$ 5,389	$38,847
Respite Ctr	L,H	$793	$38	$ 831	$ 6,426
Sterling Lib/CC	H,W,WC	$6,369	$0	$ 6,369	$ 40,726
Trans. Housing	L,W,WC	$2,432	$100	$ 2,532	$ 21,884
Valley Bank	L,H,W	$2,659	$142	$ 2,801	$23,781
Youth Shelter	L,H,W,WC	$3,351	$ 79	$ 3,430	$26,205
Contingency & Miscellaneous @ 9.8%					*$ 99,207*
Total		**$121,318**	**$2,690**	**$124,008**	**$1,100,000**

Proposed Number of Jobs Created:

Drawing from the suggested methodology from the U.S. Department of Energy – $92,000 for

every job - the number of jobs calculated from this project is approximately 11 to 12, over the course of the development of the project.

Proposed Energy Saved and/or Renewable Energy Generated: The estimated kWh reductions per year are expected to be 1,516,438.

Proposed Greenhouse Gas Emissions Reduced ($C0_2$ Equivalents): The estimated $C0_2$ emissions reductions are expected to be 1,836,406 lbs / year (~ 835 metric tons)

Proposed Funds Leveraged:

Proposed EECBG Budget: $1,100,000 - $1,250,000

Project I: Building Codes and Energy Performance Labeling

Project Description

The CES calls for substantially more energy efficient new construction, significant efficiency upgrades in renovation projects and "Energy Performance Labeling" (EPL) for all residential units. Energy Performance Labeling (EPL) will be recommended on a voluntary basis for homes and buildings when they are sold, leased, or rented. This is a new process for real-estate agents, builders, energy oriented contractors, owners, and mortgage banks. In general they will be unaware of the significant potential economic and environmental benefits.

This project will be a structured outreach and education program for all stakeholders in the residential housing community. The goal will be to inform and encourage implementation of both individual and shared solutions in terms of viable efficient upgrades and construction, including EPL's. This could potentially provide significant results toward meeting the County's strategic energy and GHG reduction goals in the critical residential sector, which accounts for one third of the County's energy use.

Proposed Number of Jobs Created: Using the suggested US DOE methodology - $92,000 for every job - the number of jobs from this project will be between 1 to 1.5 full time equivalents over the course of the development of the project.

Proposed Energy Saved and/or Renewable Energy Generated: The CES is calling for at least 30% energy efficiency in the residential segment at the same time that the County is planning to double employment. Applying a voluntary energy labeling program along with raised awareness of efficiency opportunities will be a direct contributor energy efficiency. The CES estimates the EPL program alone will increase overall efficiency by 5% over time.

Proposed Greenhouse Gas Emissions Reduced ($C0_2$ Equivalents): 30% of all GHG emission in Loudoun County, or approximately 1.2 M mt per year, comes from the residential sector. Each percentage reduction represents 10,000 metric tons avoided.

Proposed Funds Leveraged: Approximately $250,000 should be assigned to this program, ideally including some matching money from either a real-estate lender or a suitable trust. This umbrella project should also leverage other incentives such as the various Federal Tax Credits for efficiency and renewable energy and Virginia's Homeowners' grant / rebate program aimed at supporting energy efficient investments. Given the long-term interest that the gas and electric utilities will have in restructured energy systems, especially in higher density residential areas, they are also ideal partners.

Proposed EECBG Budget: $200,000

Project J: Loudoun County Home Improvement Program – Energy Retrofits

The Loudoun County Home Improvement Program (LCHIP) is available countywide to low and moderate income homeowners who want to rehabilitate their primary residences. In 2008-2009, the Board of Supervisors supported using $229,330 in Community Development Block Grant (CBDG) funding to assist low- to moderate-income homeowners with renovations, including energy efficient renovations. After meeting program criteria, including completion of the pre-qualification form, the homeowner, a county construction technician and a contractor assess the renovation needs of the property. The homeowner then selects from a county checklist the types of renovations or rehabilitation items that are eligible. Loans are awarded based on credit-worthiness. The loans have a ten-year term and may be forgivable and/or interest free. The proposed use of the EECBG funds is for providing grants to the eligible LCHIP homeowners to pay specifically for energy efficient renovations. Grant funding would ease the economic burden on homeowners seeking energy efficient renovations, especially considering only loans are currently available for this purpose. This proposed project aims to enhance the current program, while maintaining the integrity of the voluntary nature. On average, 40 homeowners per year complete the pre-qualification process for the LCHIP. The project would also have the added educational benefit for homeowners to directly learn about energy efficient products for the home.

Proposed Number of Jobs Created: Using the suggested US DOE methodology from the $92,000 for every job – the number of jobs from this project would be at least 1 job over the course of the project. However, considering these funds would be used to pay contractors, local private sector contractor businesses would greatly benefit from this investment in energy efficient renovation projects. For example, for every energy efficiency project that expends $1,500 to $2,000, one new job also would be created for every 20 to 30 homes retrofitted.

Proposed Energy Saved and/or Renewable Energy Generated: This can be tracked by the energy efficient products paid for through grant funding. Each home in Loudoun uses about 124 MM Btu_e / year. A typical home retrofit would result in 25 MM Btu_e reduction.

Proposed Greenhouse Gas Emissions Reduced (CO_2 Equivalents): By enabling homeowners to install energy efficient products, reductions in greenhouse gas emissions are certain. Pairing this project with the education outreach, this LCHIP would actually assist homeowners with implementing projects that would directly reduce greenhouse gas emissions. Each typical energy retrofit will reduce GHG emissions by 3 metric tons. For older homes, the reduction would be even higher.

Proposed Funds Leveraged: In 2008-2009, $229,330 from CDBG funds were allocated to the Loudoun County Home Improvement Program. With CDBG funds planned each year, the opportunity for future allocation exists. Considering the CDBG funds are made as loans, private dollars are used to repay them, which also results in leveraging private dollars and sustain the program beyond the duration of the EECBG.

Proposed EECBG Budget: $140,000

Glossary of Terms

The following summary of selected terms and abbreviations used in the report is not exhaustive. In some cases, terms are defined in the body of the text and may not be repeated here.

Term	Definition
Air Pollutants	In addition to greenhouse gases, these include: Sulphur dioxide (SO_2), Nitrogen oxide (NOx), Hydrogen chloride (HCl), Hydrogen fluoride (HF), carbon monoxide (CO), and non-methane volatile organic compounds (NMVOC).
ASHRAE	The American Society of Heating, Refrigerating and Air-Conditioning Engineers, Inc.
Baseline or "Base Case"	Estimation of the present energy use, greenhouse gas emissions, and the prevailing conditions affecting them
BAU	Business as usual
Biomass	Vegetation such as wood, agricultural or animal waste, catering waste or landfill gas, etc with the potential to be used as a fuel. Suitably separated municipal waste may fall into this category.
Btu, M Btu, MM Btu	British thermal unit (BTU or Btu) is a unit of energy defined as the amount needed to heat one pound of water one degree Fahrenheit. For the purposes of this report, 1,000 Btus are labeled M Btu, while 1,000,000 Btus are labeled MM Btu.
Building Code	Legally required construction practices.
Building Standard	Voluntary construction practices, generally exceeding code requirements
Built Infrastructure	General term referring to all the homes, commercial and institutional buildings and industrial buildings in the Town.
CAFE	Corporate Average Fuel Economy. The sales weighted average fuel economy, expressed in miles per gallon (mpg), for a fleet of vehicles. This is a mandatory standard regulated by the EPA. The 2009 version includes greenhouse gas emissions per mile for the first time.
Carbon dioxide (CO_2)	The commonest form of greenhouse gas. Over 70% of man-made greenhouse gas emissions are from the use of energy.
Carbon dioxide equivalent (CO_2e)	Where "e" is used to denote the term "equivalent": Greenhouse effect of the other five greenhouse gases identified in the Kyoto Treaty expressed in equivalents of carbon dioxide. This unit of measure is used to allow the addition of or the comparison between gases that have different global warming potentials (GWPs). Since many greenhouse gases (GHGs) exist and their GWPs vary, the emissions are added in a common unit, CO_2e. To express GHG emissions in units of CO_2e, the quantity of a given GHG (expressed in units of mass) is multiplied by its GWP.
Certified Emission Reduction (CER)	Generic term used to describe metric ton of greenhouse gas reduction or avoidance that has independently validated certification and can be traded in a recognized regulated market. CERs come in many forms.

Clean and Renewable energy	This phrase is used in the CES to indicate some combination of renewable energy and cogeneration (CHP) energy sources.
Cogeneration	Generating electricity in such a way that most of the heat produced is usefully used. A common definition is that an average minimum overall fuel efficiency of 70% is expected. Peak efficiency would typically exceed 90%. Also known as CHP.
Combined Heat and Power (CHP)	See Cogeneration
Commercial Buildings	Nonresidential buildings generally owned or operated by for-profit entities
Community Energy Strategy (CES)	Plan to guide the long term efficiency of energy and water use in Loudoun County to 2040.
Cooling Degree Days	A measure of how hot a location was over a period, relative to a base temperature. In this report, the base temperature is 65℉ and the period is one year. If the daily average temperature exceeds the base temperature, the number of cooling degree-days for that day is the difference between the two temperatures. However, if the daily average is equal to or less than the base temperature, the number of cooling degree-days for that day is zero.
Daylighting	Designing buildings to maximize the use of natural daylight to reduce the need for electricity
District Cooling	Cooling services delivered via district energy systems
District Energy (DE)	Networks that deliver heating or cooling to energy consumers carried through the medium of chilled or hot water, or (in older systems) steam. Heating and cooling is transferred to the home or buildings via a heat-exchanger
District Heating	Heat services delivered via district energy systems
Electrical Conversion Losses	The difference between the energy value of the fuel used to make electricity and the energy value of the electricity itself.
Energy Performance Label	A guarantee that a property meets the promised energy or that its actual recent energy performance is available to the buyer or renter as information to support a purchase or rental decision.
ENERGY STAR	Joint Environmental Protection Agency and U.S. Department of Energy programs http://www.energystar.gov/ supporting energy efficiency as a cost effective way to reduce greenhouse gas emissions in home, buildings, industry and equipment.
EU	European Union
EV	Electric Vehicle
Fossil Fuels	Combustible material obtained from below ground and formed during a geological event.
Future Case	Estimation of future energy use and greenhouse gas emissions. and the assumptions and conditions affecting them
Geothermal systems (low temperature)	Systems that use the relatively constant temperature of the ground a few meters down to cool buildings in summer and heat them in winter.

Geothermal systems (high temperature)	Systems that use volcanic sources of heat either for direct use or generating electricity. Not applicable to Loudoun County.
Gigawatt-hour (GWh)	A unit of electrical energy equals the use of 1 thousand million watts of electrical energy in one hour.
Gigawatt-hour-equivalent (GWh_e)	A unit of energy from any source equivalent to one thousand million watts of electricity. Used to get a standard measurement for comparison of different forms of energy.
Global Warming Potential (GWP)	A relative measure of the warming effect that the emission of a GHG might have on the Earth's atmosphere. It is calculated as the ratio of the time-integrated radiative forcing (i.e. the amount of heat-trapping potential) (measured in units of power (watts) per unit of area (square meters) that would result from the emission of 1 kg of a given GHG to that from the emission of 1 kg of CO_2. For example, the GWP for nitrous oxide (N2O) is 310, which means that 1 kg of N_2O emissions is equivalent to 310 kg of CO_2 emissions.
g/m	grams CO2 per vehicle mile - term used to capture GHG emissions as they apply to transportation
Green Energy	Energy derived from conservation, renewable sources of energy and clean distributed energy. What energy forms are included varies depending on local jurisdictions and practices.
Greenhouse Gases (GHG)	A greenhouse gas absorbs and radiates heat in the lower atmosphere that otherwise would be lost in space. The main greenhouse gases are carbon dioxide (CO_2), methane (CH_4), chlorofluorocarbons (CFCs) and nitrous oxide (N_20), sulphur hexafluoride (SF_6), hydrofluorocarbons (HFC) and perfluorinated carbons (PFC). The most abundant greenhouse gas is carbon dioxide (CO_2).
GHG Monetization	Processes to convert tradable energy and environmental benefits into cash or cash equivalents
Gross Domestic Product (GDP)	The total value of goods and services produced by a country during a given time period, most commonly a year.
Gross Vehicle Weight Rating (GVWR)	The maximum allowable weight of a fully loaded vehicle, including liquids, passengers, cargo, and the tongue weight of any towed vehicle. This value is defined by the manufacturer and is based on vehicle design.
Heating Degree Days	A measure of how cold a location was over a period, relative to a base temperature. In this report, the base temperature is 65℉ and the period is one year. If the daily average temperature is below the base temperature, the number of heating degree-days for that day is the difference between the two temperatures.
Heavy-Duty Vehicles	Vehicles with gross weight of 4.5 tons or more (3900 kg) or designed to carry more than 12 persons at a time, including tractor-trailers, city and highway buses and utility vehicles (ambulances and fire trucks). This category also includes Light-Duty Trucks with GVWR greater than 3900 kg (such as some heavier full size pick-up trucks and work vans).

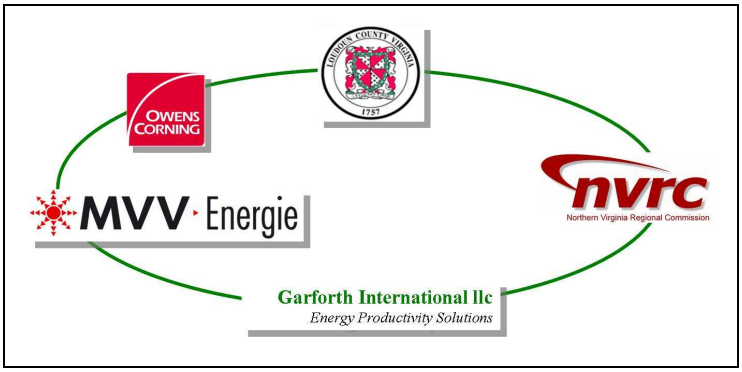
IECC	International Energy Conservation Code - a model energy building code produced by the International Code Council (ICC). The code contains minimum energy efficiency provisions for residential and commercial buildings, offering both prescriptive- and performance-based approaches. The code also contains building envelope requirements for thermal performance and air leakage. Primarily influences US and Latin American markets.
IEMP	Integrated Energy Master Plan – A comprehensive plan defining the energy efficiency of construction, energy distribution and energy supply to achieve agreed economic, environmental and other goals. Typically an IEMP would cover at least 15 years into the future and would apply to large developments.
Insolation	The amount of solar energy received on a surface over a period of time. It is usually expressed in units of kilowatts-hours per square meter (kWh/m^2), "peak sun hours", megajoules per square meter (MJ/m^2) or Langleys (L), for the given period such as a day or hour. $1kWh/m^2$ = 1 peak hour = 3.6 MJ/m^2 = 0.00116 L
Institutional Buildings	Nonresidential buildings generally owned by public administration, education, public or private healthcare facilities and other not-for-profit entities.
Kilowatt-hour (kWh)	A unit of electrical energy universally used as the basic billing unit and equals the use of 1 thousand watts of electrical energy in one hour. One kWh is about 3,412 Btu.
Kilowatt-hour-equivalent (kWhe)	A unit of energy from any source equivalent to one kilowatt-hour of electricity. Used to get a standard measurement for comparison of different forms of energy.
Kyoto Treaty	International Treaty aimed at reducing man-made greenhouse gases primarily through reduced use of fossil fuels. Signed in 1997 and ratified in 2005 by most industrialized countries accepting mandatory targets; and by many other countries .accepting mandatory reporting and voluntary goals.
Leadership in Energy and Environmental Design (LEED)	A voluntary system for rating existing and new homes, buildings and neighborhoods based on their overall environmental performance including energy and water use. Developed by US Green Buildings Council, a non-profit group.
Light-Duty Trucks:	This category includes pick-up trucks, mini-vans and SUVs with a GVWR of 4.5 US tons (4.1 metric tons) or less which are designated primarily for transportation of light-weight cargo or that are equipped with special features such as four-wheel drive for off-road operation. It includes both LDGT (Light-Duty Gasoline Trucks) and LDDT (Light-Duty Diesel Trucks).

Light-Duty Vehicle	Vehicles mainly used for passenger transportation with a weight less than 4.5 US tons (or 4.1 metric tons) that includes: "cars", motorcycles, SUV's and pickup trucks and those using alternative fuels. Includes LDGV (Light-Duty Gasoline vehicles) and LDDV (Light-Duty Diesel vehicles).
Megawatt-hour (MWh)	A unit of electrical energy equals the use of 1 million watts of electrical energy in one hour.
Megawatt-hour-equivalent (MWhe)	A unit of energy from any source equivalent to one megawatt-hour of electricity. Used to get a standard measurement for comparison of different forms of energy.
NGOs	Non-governmental organizations
NREL	National Renewable Energy Laboratory http://www.nrel.gov/
OECD	Organization for Economic Cooperation and Development http://www.oecd.org
Off-Road Vehicles	Off Road or non-road vehicles include heavy mobile equipment in the construction, mining and logging sectors, recreational vehicles such as snowmobiles, and lawn and garden devices including lawnmowers and trimmers. These vehicles may be gasoline powered (snowmobiles, all-terrain vehicles, etc.) or diesel powered (excavating, construction, generator sets, etc).
On-Road Vehicles	Light-Duty Gasoline Vehicles (LDGV) = Cars Light-Duty Diesel Vehicles (LDDV) Light-Duty Gasoline Trucks (LDGT) – includes SUVs Light-Duty Diesel Trucks (LDDT) Heavy-Duty Gasoline Vehicles (HDGV) Heavy-Duty Diesel Vehicles (HDDV) Motorcycles (MC) Alternative Fueled Vehicles (Alt Fuel)
Passenger Miles	The sum of the distances traveled by individual passengers (including the driver). If there are two passengers and one driver, who drive 10 miles, then passenger miles total 30m for this trip.
Per Capita or /capita	For each person in the total population being considered. In the Loudoun CES this generally referred to a legal resident.
Potable Water	Water that has been treated and delivered via public distribution and is considered safe for human consumption
PV	See Solar Photovoltaic Systems
Rainwater Harvesting	Systematically gathering rainwater to use for non-potable applications and to minimize the need to manage as storm water runoff
Renewable energy	Energy generated from sources other than fossil fuels, most commonly sun, wind, water and various animal and plant derived fuels. These create the least greenhouse gases in operation.
RES	Renewable electricity standard (RES) is a tool for developing a cleaner, more sustainable power supply. 35 US have some RES in place (2009). Virginia has a voluntary goal to have 12% renewable electricity by 2022.

Scale Projects	Scale Projects are developments with the size and timing such that new guidelines in line with the CES can be applied within relatively large, but contained boundaries. These are projects large enough to capture the combined value of efficient use, efficient distribution, and clean and renewable energy, but are bounded such that benefits can be clearly identified and risks fully understood. They can range from entire mixed-use neighborhoods to single large commercial or institutional developments. Over time, multiple Scale Projects blend together.
Smart Growth	Approach to developing areas of a cities to use minimum resources, to maximize social interactions with a balanced mix of demographics, usually associated with creating mixed-use walkable neighborhoods.
Smart Meters	Energy meters (heat/electricity/cooling, gas) capable of gathering energy use patterns, applying different tariffs depending on time of day and use level, and capable of being integrated into wider information and control systems
Solar Heating Systems	Systems that collect the heat of the sun to warm buildings or make domestic hot water.
Solar Radiation	Intensity of solar radiation received on a surface at a given time - usually expressed in Watts per square meter (m^2). Radiation varies from zero at sunrise to a maximum at solar noon.
Solar Photovoltaic Systems (PV)	Systems that directly convert sunlight into electricity either for use locally or for delivery to the wider grid
Sustainability	Meets the needs of the present generation without compromising the ability of future generations to meet their own needs.
Terawatt-hour (TWh)	Terawatt hours are often used for metering larger amounts of electrical energy to industrial customers and in power generation. It is equivalent to 10^{12} watts.
Terawatt-hour-equivalent (TWh_e)	A unit of energy from any source equivalent to 10^{12} watts of electricity. Used to get a standard measurement for comparison of different forms of energy.
Ton, Metric (mt)	Unit of weight equal to 1,000 kilograms – mostly used in this Report as a measure of greenhouse gas emissions. 1mt = 1.102 US ton.
Transit Oriented Design (TOD)	Land development that takes into account transportation choices as a means of reducing oil and other energy use. Typically it would combine rail systems, walkable mixed-use communities, and approaches to minimise the impact of individual vehicles and commuting.
UNFCC	United Nations Framework Convention on Climate Change
Vehicle-Miles	The distance traveled by vehicles on the road.
White Certificate	An independently validated document that certifies that a reduction in energy consumption has been attained. This may be a tradable asset under future State or Federal legislation.

CES Team

The development of the CES is being done by a Team that represents a mix of local, regional and global expertise, along with substantial community engagement.



CES Team – Local, Regional, and Global Expertise

In addition to Loudoun County Staff, the Core Team includes members that bring complimentary perspectives.

NVRC brings in-depth best practice benchmarking along with a local perspective as to how the Loudoun CES could be a catalyst for Northern Virginia as a whole.

Owens Corning has wide-ranging knowledge of North American energy efficient residential and commercial construction and renovation.

MVV decon GmbH, as the consulting arm of MVV Energie AG, applies its knowledge of highly-efficient municipal energy and water systems as the multi-utility service provider in its home town of Mannheim and six other German cities, and also as advisor to cities and countries globally.

Garforth International provides a global and local business view to the integrated CES recommendations.

John Palmisano, a founding partner in eTrios, brought twenty years of environmental assets trading to give perspectives on possible impacts of climate change legislation and credits.

Dianne Perkin from Terra Sol conducted the bulk of the research and analysis on the transportation aspects.

Dominion Virginia Power, NOVEC, and Washington Gas are also actively engaged with the CES Team providing utility and regulatory data, and providing a valuable utility perspective.

Appendices

The following appendices are available on request as supporting information to the CES Report.

A US Greenhouse Gas Emissions - Background
Appendix A includes the overall sources of US emissions of greenhouse gases, including some impacts on the region around Loudoun County.

B Profile of Loudoun County
Appendix B includes current demographics, growth patterns and expectations, commuting patterns, modes of public and private transportation, climate factors, renewable energy resources, and impacts on energy.

C Global Best Practice Examples
Appendix C provides a summary of critical factors that have delivered breakthrough energy performance, together with some examples from around the world.

D Government Leadership
Appendix D provides a synopsis of existing energy efficiency initiatives in Loudoun County supported by both Town and County governments.

E CES Project Assumptions
Appendix E lists the assumptions used for the Base Case (Business as Usual) and the two Future Case scenarios for energy efficiency of homes, buildings, and transportation.

F Energy Baseline at 2007 – Statistical Information
Appendix F gives a detailed explanation of the CES assessment of the current energy use and energy related greenhouse gas related emissions.

G Energy Use and Efficiency in Transportation
Appendix G gives detailed background of the CES assumptions in the assessment of the multiple influences on the future use of energy in transportation.

H Elements of Flexible Energy Supply
Appendix H provides commentary on flexible energy supply including district energy, combined heat and power, and renewable energy sources assessed in the County Energy Strategy.

I Regulation, Management, and Incentives
Appendix I provides a general evaluation of the current regulatory frameworks and possible management and incentive approaches towards the successful execution of the CES.

J GHG Emissions Reduction Trading
Appendix J is commentary on the potential monetization of greenhouse gas reductions under the auspices of possible U.S. Federal Climate Change legislation.

K Loudoun County Tracking System for Energy and Environmental Projects
Appendix K shows a sample framework for a County-wide tracking system that would both track progress against the CES energy targets and create an environmental database.

L 2007 Energy Baseline – Energy and Emissions Assumptions
Appendix L gives a summary of the underlying assumptions used to develop the greenhouse gas footprint of Loudoun County.

M CES Team
Appendix M provides a brief overview of the organizations involved in the development of the CES for Loudoun County.