A Greenhouse Gas Emissions Inventory and Reduction Policy Options for College Park

Environmental Project Course
School of Public Policy
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PALS - Partnership for Action Learning in Sustainability
An initiative of the National Center for Smart Growth

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Preface

This report was prepared as part of the environmental project course at the School of Public Policy of the University of Maryland. The study team consisted of four masters level students in the School. It was also one of several courses focused on the City of College Park via the Partnership for Action Learning in Sustainability (PALS) run through the National Center for Smart Growth. New to the 2014-2015 academic year, the PALS program is a campus-wide initiative that enlists faculty and students to offer fresh solutions to the problems facing Maryland communities. The City of College Park has partnered with the University of Maryland as the second municipal "client" benefiting from the time, energy, and knowledge of University faculty and students. The report was prepared under the supervision of Professor Robert Nelson of the School of Public Policy and Sean Williamson of the Environmental Finance Center at the University of Maryland. The report is available at Professor Nelson's web site at http://faculty.publicpolicy.umd.edu/nelson/publications and also on the PALS website at www.smartgrowth.umd.edu/pals.

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Executive Summary

Attempts to organize a world allocation of binding greenhouse gas (GHG) total emission limits by nation, along the lines of the Kyoto Protocol as formulated in 1997, have thus far been unsuccessful. The distributional and other normative considerations that would underlie any such general world agreement on permissible national GHG limits simply do not exist today. Following the failure of the Copenhagen Conference of the Parties (COP) in 2009 to reach much agreement, a new approach has emerged to replace the Kyoto approach. GHG reductions will have to be made on a voluntary basis at the national or sub-national levels.

The next Conference of the Parties in Paris in December 2015 thus will have an underlying assumption that national GHG reduction strategies will have to be voluntarily agreed upon. While voluntary, there will be an effort to promote normative worldwide standards for GHG emissions by nations and other jurisdictions that will be widely accepted and reflected in national voluntary reduction agreements and subsequent monitoring of national efforts. Within nations, lower levels of government may also have to voluntarily undertake GHG emission reductions.

The United States has found it thus far impossible to agree on nationwide GHG emission goals or on a nationwide strategy for achieving such goals. In 2009, an attempt to pursue nationwide GHG limits and strategy was successful in the House of Representatives with the passage of the Waxman-Markey cap and trade legislation. Such a comprehensive nationwide approach, however, never made headway in the Senate.

Voluntary agreements to reduce GHG emissions need not be limited to national governments. In the U.S., the most aggressive program to limit future GHGs has been adopted at the state level in California, including a California GHG cap and trade system, which in 2014, was extended by voluntary agreement to include the Canadian Province of Quebec. The State of Maryland is part of another voluntary multi-jurisdictional agreement of Northeast states to reduce GHGs by means of a cap and trade system, the Regional Greenhouse Gas Initiative (RGGI), which began operating in 2008.

Voluntary efforts to limit GHGs can occur at the local government level as well. Indeed, a number of local governments around the U.S. have adopted GHG reduction measures, typically as part of their broader sustainability planning and implementation. In an April 2015 interview with the *Washington Post*, Secretary of State John Kerry stated, "a lot of mayors around the world are ahead of their national governments, and a lot of local citizens are well ahead of their elected leaders. I think we need to find a way to highlight that." The *Post* further noted, "acknowledging that governments may not be moving fast enough to avert a climate disaster, … Kerry is pushing for a bigger role for cities, universities and other institutions in achieving rapid cuts in greenhouse-gas emissions." As the *Post* reported, he suggested that the Paris COP in December 2015 should "include a forum in which non-state actors can commit to reducing carbon pollution blamed for the planet's warming. Kerry said that a groundswell of citizen support is needed to prod world leaders into making the difficult choices necessary to protect Earth's climate."

This report addresses the possibility that the City of College Park, Maryland, might join in local sustainability efforts relating to GHG mitigation. It includes an inventory of GHG gas emissions in College Park generated by the broader community of private residents and private commercial activities, by the City government, and by the University of Maryland. The inventory results are summarized in Chapter 1.

Chapter 2 explores nine policy options that the City could adopt to reduce GHG emissions. In Chapter 3, the GHG reduction efforts of local governments across the U.S. are identified as possible elements of College Park's future GHG and sustainability planning.

Key College Park GHG Inventory Findings

1. College Park's total 2013 GHG emissions were equivalent to 438,824 metric tons of CO_2 emissions (or 438,824 "$MTCO_2e$"), equal to 14.5 $MTCO_2e$ per capita in College Park, lower than the 17.6 $MTCO_2e$ per capita for the U.S. as a whole.
2. College Park's total GHG emissions decreased from 464,705 $MTCO_2e$ in 2007 to 438,824 $MTCO_2e$ in 2013, a decline of 5.5 percent.
3. In the City, the most significant GHG percentage declines from 2007 to 2013 were in the areas of residential electricity use (15.3 percent), residential natural gas use (27.2 percent), and commercial electricity use (12.1 percent).
4. The most significant GHG percentage increase from 2007 to 2013 in College Park resulted from greater consumption of gasoline (7.9 percent).
5. In 2013, UMD was responsible for 44 percent of the GHG emissions within the City.
6. Considering only emissions that can be allocated to the College Park community (i.e., *not* GHGs from UMD faculty and student air travel), the University's largest source of GHGs came from use of natural gas for heating and on-site power generation at the combined heat and power plant (68.6 percent of UMD GHG emissions), followed by GHG emissions from purchased electricity (26.7 percent).
7. Among the non-University College Park community, in 2013:
   - 9.5 percent of total GHG emissions came from residential electricity use
   - 6.7 percent from residential natural gas use
   - 29.0 percent from commercial electricity use
   - 7.1 percent from commercial natural gas use
   - 53.7 percent from gasoline and other petroleum products for transportation purposes
   - 1.2 percent from disposal of solid waste.
8. GHG emissions from the City of College Park government (directly or financially) are about 1 percent of total College Park GHG emissions.

Policy Options for Reducing GHG Emissions in College Park

Chapter 2 describes and analyzes nine policy options for reducing GHGs in College Park for the purposes of environmental sustainability, as follows.

1. Replace old HPS (high pressure sodium) Pepco streetlights with new LED (light emitting diode) streetlights.
2. Purchase College Park CO_2 offsets in the Regional Greenhouse Gas Initiative (RGGI) cap and trade allowance market.
3. Provide assistance to City residents in reducing the soft costs of installing PV (photovoltaic) solar systems.
4. Create an "energy coach" electricity energy efficiency-enhancing program.
5. Promote residential (=and commercial composting.
6. Promote building construction according to LEED standards.
7. Establish a property assessed clean energy (PACE) program.
8. Develop a community choice aggregation program for residents to purchase electricity less expensively.
9. Encourage City employees to work more from home.

Table ES.1 is a brief description and assessment of the impact on GHG emissions and an overview estimate of the administrative and economic feasibility of each of the nine policy options.

Table ES.1 Impact and Feasibility of Policy Options for Reducing GHG Emissions in College Park

NAME	DESCRIPTION	IMPACT AND FEASIBILITY
Retrofit streetlights	convert Pepco-owned streetlights to high efficiency LED bulbs	high impact, moderate feasibility
Purchase CO_2 allowances	Purchasing commodities similar to carbon offsets to reduce the City's carbon footprint	low impact, high feasibility
Reduce solar soft costs and encouraging solarization	Reduce the transaction costs associated with installing solar PV on residential roofs	high impact, high feasibility
Energy coach program	Through technical assistance and marketing, reduce the barriers to energy efficiency investments	high impact, high feasibility
Composting	Use the City's procurement agency to purchase composting units at a low- cost and sell to residents	low impact, high feasibility
LEED construction	Create incentives more LEED building construction in the City	moderate impact, moderate feasibility
Property Assessed Clean Energy (PACE)	An alternative financing mechanism for energy efficiency and renewable energy using property taxes	high impact, moderate feasibility
Community choice aggregation	Aggregate electricity demand and leverage the City's procurement to purchase clean energy for all residents	low feasibility
Work from home	Allow City employees to work from home more frequently	low impact, moderate feasibility

Chapter 1

Summary of Levels and Trends of Greenhouse Gas Emissions

The government of the City of College Park seeks to better understand and manage climate forcing greenhouse gases (GHGs) from both City operations and the larger College Park community. By making GHG mitigation a priority and implementing reduction strategies to achieve reductions, the City can lead by example, stand out among peers, and position itself as an attractive community for potential residents and businesses.

A key step toward mitigation is to conduct regular GHG inventories of both government operations and the College Park community. This chapter updates the City's previous GHG inventory completed in 2007. The new inventory includes greenhouse gas emissions for 2010 and 2013 for the entire community of College Park. It also includes a new GHG inventory for 2013 and 2014 measuring the activities of the City of College Park government.

Community-Scale GHG Inventory

The community-scale inventory is designed to capture all GHGs emitted within the City of College Park boundaries, including emissions from residents, businesses, through-traffic (e.g., vehicles along Route 1 or the Capital Beltway), and the University of Maryland. In 2010 and 2013 community-scale GHGs equaled 410,747 and 438,824 metric tons of carbon dioxide equivalents ($MTCO_2e$), respectively. Total community emissions in 2010 and 2013 were significantly lower than in 2007 when they totaled 464,715 $MTCO_2e$ (see Table 1.1).

The 5.6 percent reduction in GHG emissions between 2007 and 2013 was driven by decreased electricity use and a cleaner electricity-generating fuel mix. Excluding the University of Maryland, the College Park community electricity consumption declined over the period. This can be attributed to the economic recession, energy efficiency improvements, and very likely, the sale of the Washington Post building to the University (which shifted its emissions into the University category). At the community-wide level, another important factor was the University of Maryland's purchase of renewable energy credits from other non-University parties, which count as partial offsets to the GHG emissions physically coming from the University, thus resulting in fewer GHG emissions being assigned to the University GHG grand total.

Reduced GHG emissions from the electricity sector more than negated an increase in GHGs from greater vehicle activity within the City. Gasoline consumed by vehicles in College Park increased by an estimated 8 percent between 2007 and 2013—enough to result in a roughly 1 percent increase in the total amount of energy consumed in the City of College Park. The community-scale inventory reveals that the College Park community both increased energy consumption and decreased GHGs between 2007 and 2013. This resulted from the fact that a unit of energy from electricity (i.e., British thermal unit) is about twice as carbon-intensive compared to a unit of energy from gasoline, meaning the reduced electricity consumption had a greater GHG reduction impact than the estimated increase in energy used for vehicles (see Figure 1.1).

Table 1.1 Community-scale GHG Emissions, City of College Park

	2007	2010	2013	'07-'13%	'10-'13%
Residential Buildings					
Electricity	27,633	25,656	23,408	*-15.3%*	*-8.8%*
Natural Gas	22,531	16,115	16,400	*-27.2%*	*1.8%*
Commercial Buildings – UMD					
Electricity	53,945	52,019	51,613	*-4.3%*	*-0.8%*
Natural Gas	135,184	125,827	132,931	*-1.7%*	*5.6%*
Propane	416	323	587	*41.1%*	*81.7%*
Diesel fuel	78	144	37	*-52.6%*	*-74.3%*
Commercial Buildings (non-UMD)					
Electricity	85,698	79,725	71,172	*-17.0%*	*-10.7%*
Natural Gas	12,867	15,809	17,447	*35.6%*	*10.4%*
Transportation - UMD					
Gasoline	3,863	3,871	3,862	*0.0%*	*-0.22%*
Diesel	633	370	3,873	*511.8%*	*946.8%*
Natural Gas	2	1	0	*-100.0%*	*-100.0%*
E85	20	228	234	*1070.0%*	*2.6%*
B5	2,144	2,659	0	*-100.0%*	*-100.0%*
Transportation (non-UMD)					
Gasoline	114,878	121,371	124,279	*8.2%*	*2.4%*
Diesel	4,161	4,396	4,501	*8.2%*	*2.4%*
Aviation	453	150	157	*-65.3%*	*4.67%*
Solid Waste	2,471	3,441	2,902	*17.4%*	*-15.7%*
REC offsets	-2,262	-41,358	-14,579	*544.5%*	*-64.7%*
Total (including offsets)	**464,705**	**410,747**	**438,824**	***-5.6%***	***6.8%***
Total (excluding offsets)	466,967	452,105	453,403	*-2.9%*	*0.3%*
Population of College Park	27,225	30,463	31,274	*11.9%*	*14.9%*
Emissions per person ($MTCO_2e$/person)	17.15	14.84	14.50	*-13.5%*	*-15.5%*

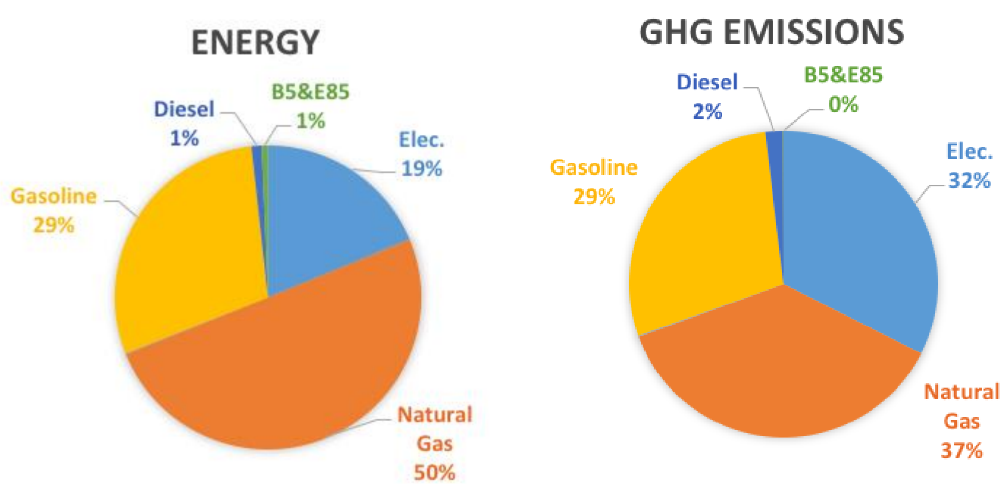
The high carbon intensity for College Park electricity reflects the 40 percent share of coal, which emits twice as much CO_2 per unit of power generated as natural gas, in the fuel mix for providing electricity in the PJM regional power system that includes Maryland. According to the EPA's eGRID report, the average output emission rate from electricity generation in Maryland was 1,007.04 lb/MWh in 2010. By comparison, the emission rate in California was 613.28 lb/MWh.

As shown in Table 1.1, in 2013, the University of Maryland was responsible for 68 percent of the GHG emissions from commercial buildings within College Park. The University's natural gas GHGs are far greater than the non-University portion of College Park – both residential and commercial – because the University uses natural gas to both heat buildings and generate power at its combined heat and power plant.

Also in 2013, transportation activities outside the University generated 94 percent of the total transportation related GHG emissions in College Park, reflecting the City's high traffic volumes, representative of metropolitan Washington, D.C.

As compared with the U.S. national average of 17.6 $MTCO_2e$ per capita, the College Park community emits 14.50 $MTCO_2e$ per capita.[1] However, the higher U.S. average includes large amounts of industrial and agricultural GHGs that don't exist in College Park. Given its new status as a Big Ten city, a more interesting comparison may be between College Park and other Big Ten cities such as State College, PA. In fact, State College and College Park have similar sized total carbon footprints, although State College, with about 10,000 more residents, has a lower per capita carbon footprint than College Park.

Figure 1.1 Energy and GHG Emissions by Fuel Type, City of College Park, 2013



The results shown in Table 1.1 and Figure 1.1 suggest a way to reduce GHGs in the College Park community. Because electricity is so much more carbon-intensive than other GHG sources per unit of energy, and because there are more proven ways of reducing electricity usage and shifting to cleaner sources, electricity should be the focal point for reducing community GHGs (perhaps by adopting some of the GHG policy options examined in Chapter 2).

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[1] World Bank, 2010. Available online: http://data.worldbank.org/indicator/EN.ATM.CO2E.PC

City Government GHG Inventory

The inventory of government operations includes GHG emissions associated with activities conducted (including financed) by the City. This includes some activities occurring outside City boundaries such as City-financed air travel. GHG emissions from the City's government operations are small compared to the total community-scale inventory – less than 1 percent. Nonetheless, government operations are important because, unlike community-scale GHGs, the City has direct control over its own government operations. The City government may be able to set an example that others in College Park will then follow, magnifying the potential City impact. In 2013, the City's operations used 20,433 MMBtu of energy and emitted 3,477 $MTCO_2e$; in 2014, the City used 20,686 MMBtu and emitted 3,457 $MTCO_2e$ (see Table 1.2).

Between 2007 and 2014 there was about a 29 percent increase in total GHGs attributed to from City government operations. However, this large increase was due primarily to a change in the way solid waste GHG emissions are attributed. In 2007, GHGs from solid waste decomposition, which creates methane, a highly potent GHG, were not included in the City's inventory. In 2013 and 2014, methane emissions from solid waste collection activities and subsequent decomposition were included. GHG emissions from solid waste now contribute more than 40 percent of City government emissions.

By excluding GHGs from solid waste and purchasing renewable energy credits (RECs), City operations decreased emissions by 212 $MTCO_2e$ or 6 percent between 2007 and 2014. This result was mainly a function of decreased City employee commuting and a cleaner electricity fuel mix and not necessarily more efficient government operations. Energy consumption in all categories of City operations, including energy used by buildings, streetlights, and vehicles, increased between 2007 and 2014.

Another important difference between 2007 and the 2013 and 2014 inventories is the City's means of obtaining electricity. In 2007, the City purchased less than 1 percent of its electricity from clean-powered wind. However, in 2013 and 2014 the City offset 100 percent of its electricity use by purchasing renewal electricity credits via wind, biomass, and low-impact hydro—a total of 1.850 million kWh.[2] By using REC offsets in 2013 and 2014, the City's effective GHG emissions from electricity use equaled zero.

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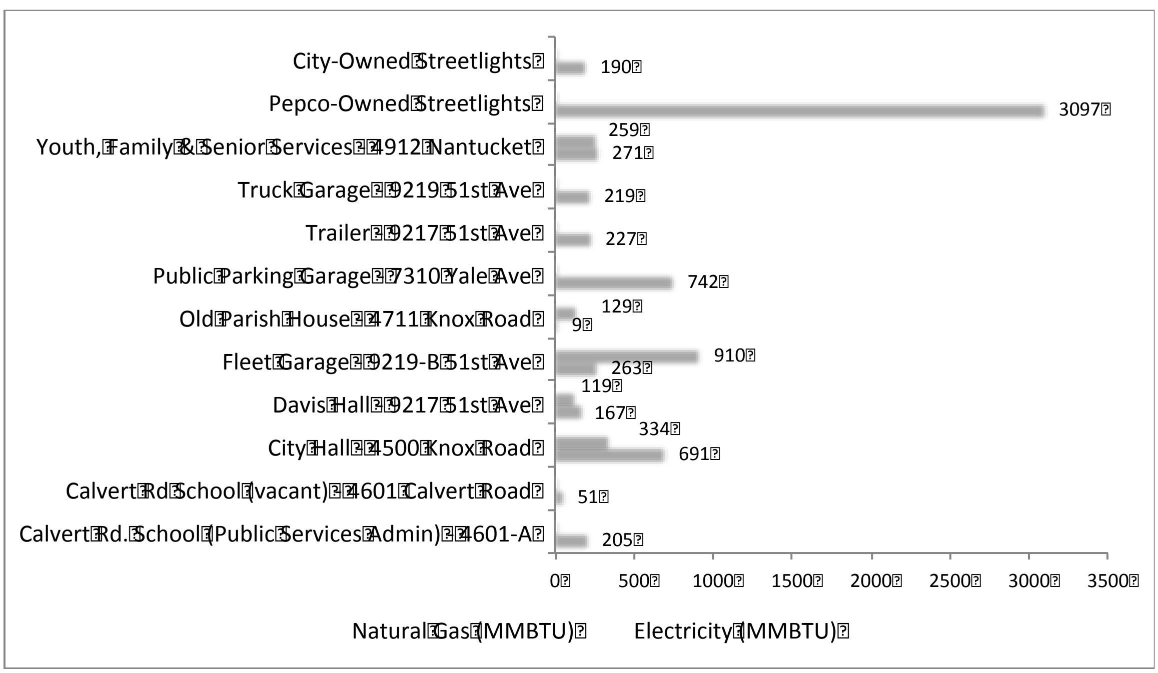
[2] From 1/22/2015 purchase agreement signed by City of College Park Finance Director and confirmation that similar agreement was made in 2013 and 2014.

Table 1.2 Government Operation GHGs, City of College Park

	2007	**2013**	**2014**	***07-14%***	***13-14%***
Building Gas	96	83	94	*-2.1%*	*13.3%*
City Fleet - Gasoline	511	122	126	*-75.3%*	*3.3%*
City Fleet - Diesel	19	379	376	*1878.9%*	*-0.8%*
Building Electricity	373	384	380	*1.9%*	*-1.0%*
PEPCO-owned Streetlights - Electricity	442	416	416	*-5.9%*	*0.0%*
City-owned Streetlights - Electricity	19	24	26	*36.8%*	*8.3%*
Air Travel	39	11	13	*-66.7%*	*18.2%*
Reimbursed Personal Vehicle*	11	N/A	N/A	*N/A*	*N/A*
Employee Commuting	541	410	410	*-24.2%*	*0.0%*
Solid Waste	N/A	1,648	1,616	*N/A*	*-1.9%*
Waste Water*	1	N/A	N/A	*N/A*	*N/A*
REC offsets	-6	-824	-822	*13600.0%*	*-0.2%*
Total (include offsets)	**2,047**	**2,653**	**2,635**	***28.8%***	***-0.7%***
Total (exclude offsets)	2,053	3,477	3,457	*68.4%*	*-0.6%*

* Data not available for 2013 and 2014 inventories

Figure 1.2 Energy Consumption in City Facilities and Streetlights, 2014



The City's streetlights, most of which are Pepco-owned, account for approximately 50 percent of all electricity used by the City and they use more electricity than all City buildings combined (see Figure 1.2). Moreover, many of the City's streetlights are low efficiency high-pressure sodium (HPS). Light emitting diode (LED) streetlights have dropped in price in the past decade; they are 50-70 percent more efficient than HPS and last much longer, thus minimizing replacement costs as bulbs burn out. As described in Chapter 2, retrofitting LED streetlights now would save both the City and Pepco significant amounts of money over a 20-year time frame, while emitting many fewer GHGs; a promising policy option.

It may be helpful to compare the City of College Park government operations GHG inventory with the City of Frederick, which was the subject of a Fall 2014 University of Maryland PALS study.[3] Related specifically to government operations, the Frederick emits about twice as many GHGs per resident compared to College Park and consumes about four times as much energy per resident. One major reason for the difference is the role of the University of Maryland, which takes a share of land and electricity "off-the-books" for the City. For example, the University's 35 percent of the City's land area doesn't include streetlights that would otherwise be part of the City's carbon footprint. In addition, College Park is a more densely populated and transit-connected municipality, which removes a significant share of GHGs from vehicle movements when compared to the City of Frederick.

Inventory Lessons Learned

This was College Park's second GHG inventory as well as the first student-led research project under the University's PALS program. As such, there were multiple challenges and many lessons learned.

First, energy and GHG tracking should be performed regularly and this report (including the methods discussion in the Appendix) should assist the City to replicate this effort. Moreover, carbon accounting is not as strictly accurate as some of the international GHG accounting protocols may suggest. The results of the City's GHG inventory are sensitive to available data and assumptions made to overcome data gaps. For example, it is hard to be certain about the actual number of vehicle miles traveled in College Park and thus the estimated transportation GHG emissions.

The City should consider the following recommendations for the conduct of future GHG inventories:

> *Data Availability and Quality* – The City should seek to broaden available data sources, particularly estimates of vehicle travel within the community, water and sewer consumption at City operations, and solid waste (e.g., what entities create the most solid waste within the City?). Likewise, higher resolution electricity data (e.g., electricity used at owner-occupied vs.

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[3] Students of URSP 688R, 2014. City of Frederick Carbon Footprint and Energy Profile. PALS 2014-15, UMD & City of Frederick.

renter-occupied housing) could help the City develop a more efficiently targeted plan for reducing electricity use.

Consistent Inventories – The City should aim to conduct inventories at regular intervals in a consistent and replicable fashion. Conducting an inventory every three years is reasonable, and all data should be collected and compiled often (i.e., not three years removed from the target inventory year). By institutionalizing the data collection and inventory procedure, the process will become increasingly efficient.

Consideration of Offsets – Other than renewable energy credits, the inventories did not include carbon sinks such as trees or composting. There may be data available that future inventories could integrate.

Communicating Results – To ensure that the inventory and the data collected as part of the process are put to the best use, the City should evaluate ways to creatively and effectively communicate results to the College Park community including metrics, infographics, marketing, and other public outreach strategies to ensure residents know the City's goals for energy use and GHG emissions.

For more detail from the community-scale and government operation inventories and supplemental analysis and detailed methods see Appendix A: College Park Community-Scale Greenhouse Gas Emissions Inventory (2010 and 2013) and Appendix B: College Park Government Operations Greenhouse Gas Emissions Inventory (2013 and 2014).

Chapter 2

Policy Options for Greenhouse Gas Reductions

College Park has the opportunity to assume leadership in Maryland for local government efforts to reduce greenhouse gas emissions within the entire community and from the operations of City government. By taking a leadership role, College Park would be able to gain recognition for its strong commitment to local sustainability, positioning itself as a more attractive location for new residential, commercial and other development.

In deciding where to live, millennials and earlier generations are increasingly influenced by the communal value statement made in choosing a residential location. A strong sustainability commitment by the City would complement the University's commitment to sustainability and its broader campaign to boost the attractions of College Park as a place for faculty and students from across the nation to work and study.

This chapter explains and analyzes nine policy options to reduce GHG emissions, drawn from precedents across the United States, which are covered in Chapter 3.

Policy Option 1 - Replace Pepco's HPS Streetlights in College Park with LED Streetlights

Of the 1,666 streetlights in College Park, 1,531 are owned by Pepco and 135 are owned by the City. As shown in Figure 1.2, the Pepco streetlights are the largest single source of energy consumption for which the City government is responsible. College Park's existing Pepco streetlights are mainly the older high pressure sodium (HPS) type. Newer, light-emitting diode (LED) lights, however, offer significant economic and environmental advantages over the older HPS streetlights.

LED lights use about half the electricity of HPS streetlights, and thus also emit half the amount of GHGs. LED lights have much longer lifespans, about 20 years as compared with four years for HPS, thus producing large savings in replacement costs. These costs include the price of the new bulb as well as labor and transportation costs to the site of the burned out bulb. LED streetlights also typically have around one sixth the maintenance costs per year as compared with HPS lights.

Many cities across the U.S. are turning to LED street lights. As of 2013, the City of Los Angeles, retrofitted over 141,000 streetlights with LEDs, reducing energy use by 63 percent for these lights and saving the city $7 million per year in electric power costs. In the longer run, Los Angeles' full conversion to LED streetlights is expected to reduce carbon emissions equal to 47,583 tons annually. This would be equivalent to removing about 10,000 cars from Los Angeles roads per year.

There have been rapid technological improvements in recent years in the quality of the light from LED bulbs. More complete information about LED street lights is available at the Department of Energy's

Municipal Solid-State Street Lighting Consortium website: http://energy.gov/eere/ssl/doe-municipal-solid-state-street-lighting-consortium

In response to questions submitted by the report authors to Pepco relating to LED light conversions, Pepco sent back the following answers.

1. What does Pepco do to burnt-out streetlights currently?
"Replace them with the same type of streetlights."

2. Does Pepco have any plan to retrofit the existing streetlights with more upgraded ones?
"Not unless there are requests from the jurisdiction. Pepco will not initiate a retrofitting program itself."

3. Is Pepco doing a LED converting program now?
"Yes. A state highway program on Route 193 (in Lanham)."

4. Do you think that the ongoing program received any financial assistance?
"Can't tell. It's about the third party."

5. Is Pepco responsible for the costs of retrofitting?
"Negative."

If College Park wants to convert streetlights from HPS to LED, it must take the initiative with Pepco. College Park would approach Pepco with a request for conversion and a proposed division of the costs. The best negotiating stance might be to propose to Pepco that LED bulbs be installed in the process of replacing burned out HPS bulbs that Pepco already pays for doing itself. College Park could agree to pay the incremental costs of substituting an LED bulb for the HPS bulb that would otherwise be installed. These incremental costs would include the higher costs of the LED bulb and some extra costs for the altered bulb fixture required to handle LED. Since LED bulbs last much longer (about 20 years) than HPS bulbs (about four years), the conversion process to all LED bulbs would not take long.

Such an agreement would yield substantial financial gains both for the City of College Park (reduced costs of electricity for streetlights and for streetlight maintenance) and for Pepco (reduced costs of replacing burned out HPS bulbs with new LED bulbs that last much longer), as examined below.

<u>Financial Benefits for College Park</u>

At present, College Park's existing streetlights cost the City $146,971 in total every year. This includes street light maintenance costs of $123,301 per year, the use of 966,877 kWh of electric power per year which costs the City $20,111 per year, and other miscellaneous expenses. The existing streetlights in College Park are the source of an estimated 442 tons of CO_2 equivalent GHG emissions per year

If the 1,481 Pepco-owned HPS streetlights in College Park were LED, the amount of electric power consumed would decrease to 435,127 kWh per year with a cost to the City of $9,051 per year, yielding a savings of $11,060 per year. The City also pays maintenance fees for Pepco to operate and manage the streetlights. The current annual maintenance cost for College Park per HPS bulb is $79.81. Based on the relative maintenance costs of HPS and LED provided by Pepco, the City would save $20,616 per year on streetlights maintenance with the installation of LED lights.

The City's total cost savings from reduced electricity-consumption and maintenance savings were calculated over a 20-year time horizon, under different discounted rates (0 percent, 3 percent, 5 percent and 10 percent). The City's total cost savings of an LED conversion over 20 years is estimated to range from $1 million to $2 million, depending on the discount rate (Table 2.1). At a 5 percent discount rate, total 20-year costs savings for College Park would equal $1.4 million, or $70,000 per year.

Table 2.1. City of College Park Street Light Costs and Savings over 20 years (2015-2034)

Discount Rate	Status Quo (HPS)	LED All	Cost Savings
0%	$2,726,050	$593,323	$2,132,726
3%	$2,088,672	$454,598	$1,634,074
5%	$1,783,562	$388,191	$1,395,371
10%	$1,276,462	$277,821	$998,641

<u>Financial Benefits for Pepco</u>

Pepco is responsible for installing new streetlights and the replacement of burnt-out streetlights. The same two strategies studied in College Park were used to estimate Pepco's cost savings: replace all existing streetlights with LEDs as soon as possible or replace the HPS lights continuously over four years as they burn out.

Table 2.2 shows the total discounted costs to Pepco over 20 years if the old HPS bulbs were used for the entire 20 years: the "status quo." Replacement costs for burnt-out HPS bulbs would be incurred on average every four years. At a 5 percent discount rate, the total cost to Pepco over twenty years for this strategy would be $968,968, or $48,488 per year.

An alternative strategy would be to replace all HPS lights with LED lights immediately. Table 2.2 compares the costs of this immediate replacement strategy with the "status quo" strategy, again discounted at four different rates (0 percent-10 percent).

The comparison uses two estimates of labor, transportation, and bulb replacement costs: the cost data provided by Pepco, and the average contracted cost ("market cost") based on six case studies (San Francisco, Ann Arbor, Minnesota, New York, Seattle, and Sunnyvale). For LED replacements, the total costs include the price for a new LED streetlight (lamp, ballast, globe, light-sensitive switch, and bracket), and installation costs, which depend on the labor hours needed to remove the old streetlights and install new LED lights and the hourly wage rate. Generally, Pepco's costs for bulb replacement are higher than market costs. The initial cost and installation cost for Pepco are $523/LED bulb and $135/LED bulb, as compared with $370/LED bulb and $133/LED bulb for the market average for contracted replacement.

As shown in Table 2.2, Pepco achieves large cost savings at the discounted rates of rates of 0 and 3 percent. Using Pepco's cost figures, these saving are $506,132 and $159,859, respectively (as the discount rate becomes higher, future replacement costs for burned out lights are more highly discounted, thus lowering the overall savings). Using market prices instead of Pepco figures, the savings of switching to LED lights at a 0 percent and 3 percent discount rate are $735,583 and $389,310, respectively. Using a discount rate of 5 percent, a negative cost saving of $-5,900 results with Pepco figures, but equals a positive $223,551 at market contracted costs. If the costs are discounted at an even higher rate of 10 percent, LED replacement will not lead to positive savings for Pepco over the 20 years.

Table 2.2 Total 20-Year Discounted Pepco Costs and Savings

		LED All		Cost Savings	
Discounted Rate		Pepco Costs	Market Costs	Pepco Costs	Market Costs
0	$1,481,000	$974,868	$745,417	$506,132	$735,583
3%	$1,134,727	$974,868	$745,417	$159,859	$389,310
5%	$968,968	$974,868	$745,417	$-5,900	$223,551
10%	$693,472	$974,868	$745,417	$-281,396	$-51,945

A third scenario would be to retrofit the Pepco-owned HPS streetlights with LEDs as old lights burn out. Since HPS streetlights have an average life expectancy of four years, this would mean that 25 percent of the HPS lights would be replaced by LEDs each year over the first four years (2015-2018).

As shown in Table 2.3, the undiscounted sum of the costs (0 percent) over the 20 years will be the same as the costs of the immediate LED replacement scenario, because Pepco is only accountable for the one-time replacement costs. If the LED replacement costs are discounted according to the year in which they occur, savings are discounted, and the cost savings of switching to LED will be modestly higher than with immediate replacement. Using Pepco's estimates for LED installation, the cost savings would be $506,132, $201,629 and $61,549 at 0 percent, 3 percent and 5 percent, respectively. Using market contractor prices, the cost savings would be $735,583; $421,249; $275,125 and $43,683 at 0 percent, 3 percent, 5 percent and 10 percent, respectively.

Table 2.3. Pepco's Costs and Savings over 20 Years of Retrofitting HPS over Four Years

		LED Burn Out		Cost Savings	
Discounted Rate	Status Quo (HPS)	Pepco Costs	Market Costs	Pepco Costs	Market Costs
0	$1,481,000	$974,868	$745,417	$506,132	$735,583
3%	$1,134,727	$933,098	$713,478	$201,629	$421,249
5%	$968,968	$907,419	$693,843	$61,549	$275,125
10%	$693,472	$849,805	$649,790	-$156,333	$43,683

To better compare the feasibility of the two strategies, payback years are presented by calculating the difference between the cumulative costs of using HPS for 20 years and adopting one of the strategies from 2015 to 2034. The payback years will be the period during which the differences are negative. A positive net value occurs when Pepco starts to achieve overall cost savings from the LED switching strategy.

Thus, the payback years closely reflect the cost savings. The greater the Pepco cost savings are from switching to LED, the shorter the payback years will be. A negative saving means a payback period longer than 20 years, indicating that Pepco will not save any costs for 20 years under this scenario. As Table 2.4 shows, the payback years of both LED installation options—immediate as old bulbs burn out—ranges from 10 to 17 years. As the discount rate increases, the length of the payback period increases.

Table 2.4. Pepco's Payback Years

	LED All		LED Burn Out	
Discounted Rate	**Pepco Prices**	**Market Prices**	**Pepco Prices**	**Market Prices**
0%	13	10	13	10
3%	16	11	15	11
5%	20+	13	17	12
10%	20+	20+	20+	16

<u>Summary</u>

By switching to LED lights, over 20 years, the City of College Park would save about $1 million to $2 million in electricity and maintenance costs, or $50,000 to $100,000 per year, depending on the discount rate. In addition, there would be social benefits from reduced GHG emissions of $7,596 per year, based on the reductions in College Park GHGs resulting from LED lights, and the current federal government estimate of the social costs of CO_2 emissions of about $40 per year.

Pepco would also save substantial amounts of money in labor, transportation, the bulb costs and other replacement expenses for HPS lights since the HPS lights last only about four years before burning out, and the LED lights last 20 years. These savings would be more than $500,000 over a 20-year period, or more than $25,000 per year for the Pepco-owned streetlights in College Park.

Thus, both the City of College Park and Pepco would benefit from switching to LEDs under plausible discount rate assumptions. College Park would also gain environmental benefits of reduced GHGs, and should work with Pepco to develop a mutually agreed-upon program to convert its HPS lights to LEDs as soon as possible. Since Pepco owns the lights, Pepco would have to be an active participant in any such effort.

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Policy Option 2 - Purchase CO_2 Offsets in the Regional Greenhouse Gas Initiative (RGGI) Cap and Trade Allowance Market

The City of College Park purchases Renewable Energy Credits (RECs) as a way of using renewable power for its government electric power purchases. Since all electric power sources are blended in Pepco electric power distribution, College Park does not actually receive electricity from wind, solar, or any other specific power sources (it is impossible to say which electron goes to any one power consumer). Rather, the regional power coordinator, PJM, assigns a number of RECs to each renewable power source that are then bought and sold in a market as a way of purchasing power from renewable sources.

Purchasers of a solar REC obtain this amount of power from a solar source, offsetting their GHG emissions from routine electricity consumption that typically comes from fossil fuel and other sources. In 2014, the City purchased 1.850 million kWh worth of RECs, an amount equal to the total electric power consumption of the City government. Thus, in 2014, all electric power consumed by City government came from a renewable source.

The City could also obtain credits as offsets for GHG emissions by purchase allowances in Regional Greenhouse Gas Initiative (RGGI) auctions and then not use these allowances for the purpose of electric power generation.

In 2008, RGGI became the first operating cap and trade system for GHGs in the U.S. The total number of CO_2 allowances offered for sale each year is determined by RGGI. Electric power companies, and other entities that may choose to bid, compete against one another to purchase the RGGI allowances. Specifically, each electric power producer in the nine RGGI states must hold CO_2 allowances equal to its actual CO_2 emissions each year (allowances can be "banked" and thus might have been purchased in a prior year). These allowances are bought and sold in auctions that are run by RGGI several times a year.

If College Park participated in an RGGI auction and successfully purchased allowances, the practical effect would be to reduce future total CO_2 emissions from all electric power plants within the RGGI region by the amount of the City's purchases. In other words, if College Park bought some allowances and held them, there would be fewer allowances available to the electric power companies, and the total RGGI cap for the electric power sector of participating states would be reduced by this amount. In this manner, any RGGI allowance purchases by College Park would offset any GHG emissions occurring within College Park.

The City should consider its various options in the number of RGGI allowances it might purchase. The City might decide, for example, to purchase only allowances equal to the GHG emissions generated by air travel on City business (13 $MTCO_2e$ in 2014 -- see Table 1.2). It might purchase allowances equal to the emissions generated by the City's car fleet such as police patrol cars (126 $MTCO_2e$ in 2014). Most ambitiously, it might purchase allowances equal to all the emissions generated by City government (2,635 $MTCO_2e$ in 2014). This last case would make the City of College Park government "greenhouse gas free," that is, taking RGGI offsets into account, the net impact of City government activities would add no GHGs to the atmosphere.

Compared with other ways of reducing CO_2 emission within the City, purchasing RGGI allowances is inexpensive. In the March 2015 RGGI auction, allowances sold for $5.41 per ton of CO_2. At that price, the costs of offsetting all City air travel by purchasing RGGI allowances would be $70 per year, the cost of offsetting all City car fleet GHG emissions would be $682 per year, and the cost of offsetting all City government greenhouse emissions would be $14,255 per year. Of course, in the future these costs would vary with the actual auction prices. (The City could bid and not end up with any purchases if the allowance price rose too high.)

More ambitious would be purchasing sufficient RGGI allowances to offset all the GHG emissions in College Park—residential, commercial and governmental (excluding the University of Maryland). As shown in Table 1.1, total College Park community-wide emissions equaled 291,687 $MTCO_2e$ in 2013. The costs of offsetting this level of GHG emissions by purchasing RGGI allowances would be $1.6 million per year. In that case, College Park would be one of the few cities in the United States that would be able to say that its entire community is "GHG free."

If the City adopted this strategy, it would be the first municipality in the nine-state RGGI region to purchase allowances for this purpose. The City of Dover, Delaware purchased CO_2 allowances in an RGGI auction but Dover has its own local power plant, and had to purchase RGGI allowances equal to its CO_2 emissions from the plant.

<u>RGGI Basics</u>

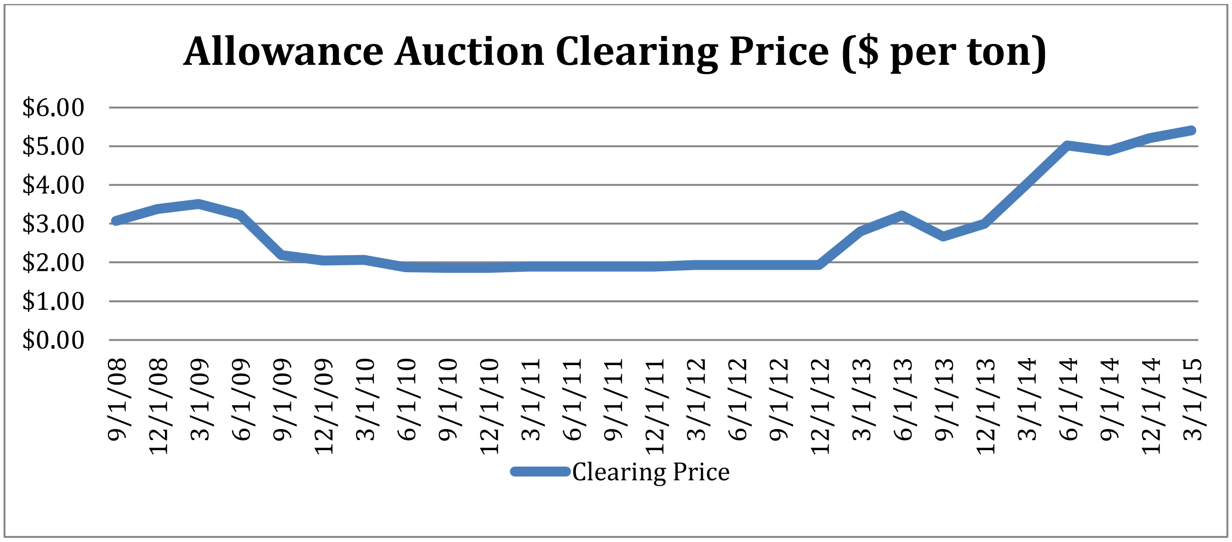
The Regional Greenhouse Gas Initiative includes nine northeast and mid-Atlantic states (CT, DE, ME, MD, MA, NH, NY, RI, and VT). It was the first cap and trade program in the U.S. to reduce greenhouse gas emissions, CO_2 specifically.[1] Each state receives a total amount of RGGI allowances at each auction, based on various factors. The allowances are sold in one overall RGGI auction and the proceeds are distributed to the states according to their relative shares of allowances. Any party is eligible to participate in an RGGI auction.

From 2013 to 2014, due to an allowance surplus (more allowances than electric power company demand for them), the RGGI emission cap was lowered significantly, eliminating the surplus, and resulting in a bidding competition in auctions since then. The new RGGI emission cap was set at 91 million tons of CO_2 in 2014, set to decrease by 2.5 percent annually to around 78.2 million tons in 2020.[2]

Figure 2.1 shows the clearing prices for allowance auctions since September 2008. As noted above, when the CO_2 emission cap was lowered in 2013 to eliminate the surplus, the sales price of RGGI allowances increased significantly. The clearing price for the March 2015 auction was $5.41 per ton, the highest since RGGI began holding auctions in 2008. The total RGGI revenues from the 2015 sale were $82.5 million.

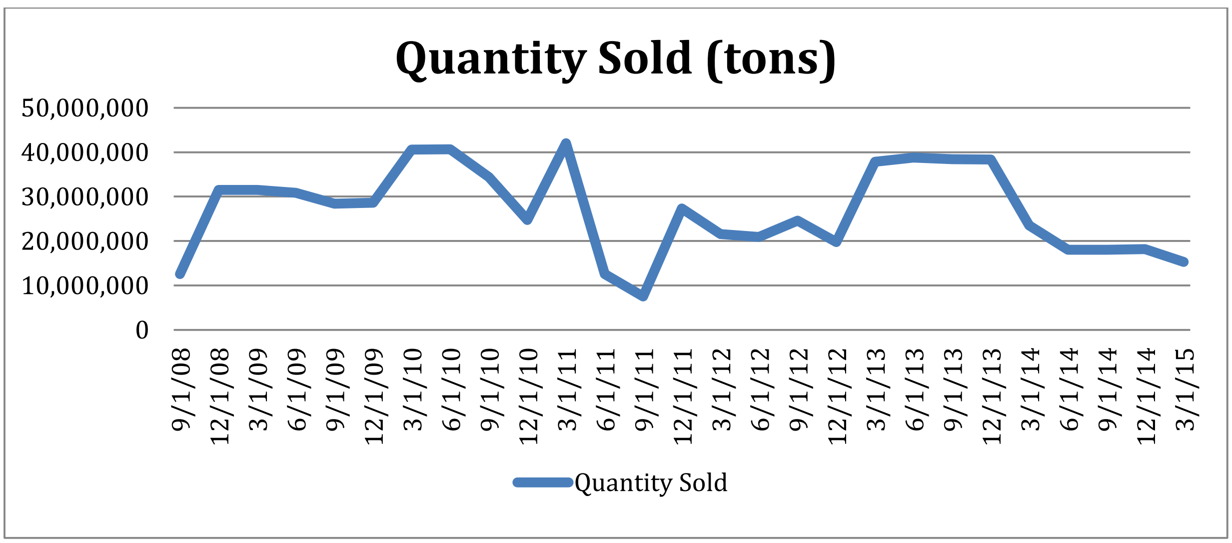
Since 2008, the cumulative value of CO_2 auction allowances is $2.1 billion and the State of Maryland has received a cumulative total of $435.2 million from RGGI auctions.

Figure 2.1 Allowance Auction Clearing Price (dollar per short ton)



Data source: Allowances Offered and Sold (by auction), RGGI

Figure 2.2 Quantity Sold (tons)



Data source: Allowances Offered and Sold (by auction), RGGI

Policy Option 3 - Provide Assistance to City Residents to Reduce the Soft Costs of Installing PV Solar Systems

The cost of solar panels for home use has dropped by 33 percent since 2011, leading to rapidly growing home use of PV solar systems in the U.S. (SEIA, 2015). However, other costs associated with the installation of solar systems—the soft costs—haven't declined as rapidly. The City could provide various forms of assistance to its residents who are in the process of or are considering installing solar systems, helping to reduce those costs and advance the use of solar power by College Park residents.

One form of assistance would be to give relief from any increases in property assessments that might result from the installation of residential solar power. The average homeowner cost of a solar installation (net of government rebates) is $22,500 for a 5kW system, potentially increasing the home property assessment by a similar amount—under College Park's 1.3 percent tax rate, the homeowner property tax could increase by $284.40. Given the public benefits of solar power, and the City's goal to encourage solar power, it might be reasonable to provide homeowners with such tax relief.

Another form of assistance would be to provide information and guidance for residents about the process to install solar systems, including sample economies of residential solar. The City could distribute the information in mass mailings to City residents and could establish a solar advice line or other form of advisory service.

Small PV systems (≤10kW) can benefit significantly from a streamlined process partly because they have many similarities and common features (Edmund, 2012). A streamlined process could reduce waiting times and unnecessary delays caused by lack of knowledge. Also, an accessible, organized, and comprehensive list of "what to do" would encourage a more mature solar market for potential customers and thus wider solar installation. The following steps could reduce costs and time spent on the permit and inspection processes[4]:

1) Create a detailed brochure for installing solar PV, clearly describing each step of the process, including financial options, permit applications, system installation, and maintenance. For maximum benefit, this outreach should be specifically developed for College Park (or Prince George's County) residents and include State- and County-specific grants and incentives (see below). Along with printed forms, this material should be available on City and County websites.

2) Provide checklists for the solar PV permitting and inspection processes for solar installations within the City. The checklists should include all documents or standards required for application. The checklists should be informative (based on consultations with the Department of Permitting, Inspections and Enforcement, solar installers, and Pepco) and

[4] For detailed steps to simplify permitting process, please refer to the IREC guideline (2013a).

easy to understand (assuming that readers know very little about PV installation and operation). Again, the checklists should be printed and online.

3) The City should work collaboratively with technicians from Pepco, solar installers, and the Prince George's County Department of Permitting, Inspections and Enforcement (DPIE) to find the most efficient way to complete the inspection and permitting process.

4) Allow parts of permit application and issuance to be completed online, whether it is for the permit or financial incentives. Set a timeline for reviewing each application and encourage making reservations. Several states have already provided online application processes, including Arizona (Solar One Stop) and California (San Jose and Berkeley).

5) Encourage solar story sharing among City residents. Successful solar installation stories or case studies will reduce unfamiliarity and misunderstanding among residents. Create public forums and information exchanges where homeowners who have recently installed solar systems can meet with residents considering solar installations. The Baltimore Sun has posted several solar stories written by homeowners in Rockville and Frederick on their website. These experiences include the full installation process and some of the barriers to solar installation[5].

6) Communicate to residents all sources of potential financial and other support such as:
   - Federal and State tax credits and other tax advantages offered for installation of home solar systems.

   - Residential Clean Energy Grants: The Maryland Energy Administration (MEA) provides grants for solar PV, solar water heating, and geothermal systems for primary Maryland residences. The award is $1,000 for each solar PV system. MEA has also tried to reduce the soft costs during grant application by launching an online application process for its residential clean energy grants. It has established a one-stop portal that combines the three elements of the application process (grants, SREC, and County property tax credit) into one (StateStat, 2014).

   - Solar bulk purchasing: When a group of people want to install solar systems, they can bargain for lower prices from suppliers and reduce soft costs. In 2014, the City of College Park and the University of Maryland formed a group of residents who were interested in purchasing solar power (Community Power Network, 2014). The group chose Astrum solar company as the single service provider and got a bulk purchase discount of 30 percent on the original cost. After deducting other incentives, the cost of a 5kW solar PV system was about 30 percent of its original cost (about $8,000). A total of 145

[5] For representative cases in other states, IREC (2013b) has provided some in its report.

households signed up for the group but it is not clear how many people signed contracts with Astrum.

7) The City should use the Metropolitan Washington Council of Governments (MWCOG) Solar Bulk Purchasing Process (Solarize), and encourage residents to do so as well. MWCOG's Climate, Energy and Environment Policy Committee (CEEPC) recommends that communities "develop criteria for an expedited permit process, adopt a permit checklist, and establish fixed fees for residential permits." The recommendation also includes a checklist for permitting and inspections created by Maryland/DC/Virginia Solar Energy Industries Association (MDV-SEIA), the local solar industry association (NARC, 2015). However, the checklist is not posted on either the City or County website.

   To develop City policies that encourage solar installations, MWCOG has created a template for local governments and encouraged them to add a "solar" page on their website with relevant information sources about solar PV (NARC, 2015). However, the current template looks overwhelming and unorganized. To improve public awareness and access to information, MWCOG also listed City of College Park on the Solar Roadmap, a website providing residential solar potential and local progress in permitting, planning and zoning, financing options, and solar market development.

Further Solar Background

The potential for reducing solar costs is illustrated by the fact that the cost of PV solar installation in Germany is much lower than in the U.S. In 2010, the average soft cost of a residential PV system was $0.62/w in Germany, compared with $3.34/w in the U.S. (LBNL, 2013).

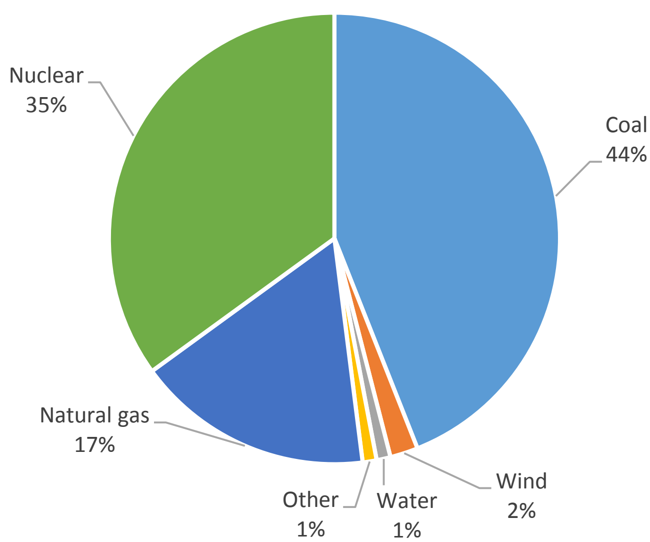
This gap reflects several factors. First, in Germany, almost all the residential PV system is customer-owned and the market size is larger and more concentrated than in the U.S., reducing transactions costs generally. Related to this, U.S. installers have lower customer success rates, which contributes to higher costs for marketing and advertising. Then, in the U.S., the time required for permitting, interconnection, and inspection is greater than in Germany. Higher U.S. labor costs are another contributing factor at every step of the process. Finally, the U.S. frequently has higher sales taxes on PV systems than Germany.

According to estimates by SEIA (2014), U.S. installers will spend an average of $3,000 in sales or marketing to acquire a new customer. A more organized market could significantly reduce solar soft costs. The Massachusetts Clean Energy Center has offered solar bulk programs in Massachusetts since 2011. Through the end of 2013, 46 communities had participated the program with 2,428 contracts signed and 15,955 kW of solar PV capacity installed (MDV-SEIA, 2014). Although the City of College Park adopted a "Solarize" program in 2014, the results of the program are unclear and there has been little follow up since then. Studies in Arizona, California, and New Jersey show that households with an income between $40,000 and $90,000 have accounted for about 70 percent of new solar PV system installations (Hernandez, 2013). A bulk purchasing program could concentrate on assisting such middle class residents.

Solar PV installations would contribute to carbon emission reductions from residential homes in the City of College Park. As shown in Figure 2.3, more than half of the electricity provided to College Park residences still comes from fossil fuels (Ethical Electric, 2014) and every megawatt hour (MWh) of electricity generated will create 1079.57 lbs. of GHG emissions (Environmental Protection Agency, 2014). If PV solar provided 5 percent of community-wide electricity in College Park, it would create 12,725 kW of solar capacity with a positive economic impact of $23.5 million and 122 jobs in a year. The carbon emission reduction would be equal to planting 5,876 acres of trees or taking 1,494 cars off the road (Solar roadmap, 2015). Also, more PV solar in College Park would help the State of Maryland to achieve its Renewable Portfolio Standard (RPS)—20 percent of Maryland's electricity needs from renewable sources by 2020.

During the past few years, the price of PV solar has decreased significantly in the U.S. Residential costs have fallen from $6.6/w in 2010 to $5.02/w in 2012. However, the price reduction has been mainly in hardware. At the same time, the non-hardware (soft) costs of PV solar systems have stayed almost the same, as a result, a larger portion of the total cost comes from soft costs—an increase from 50 percent of the total cost in 2010 to 64 percent in 2012 (Friedman et al., 2013).

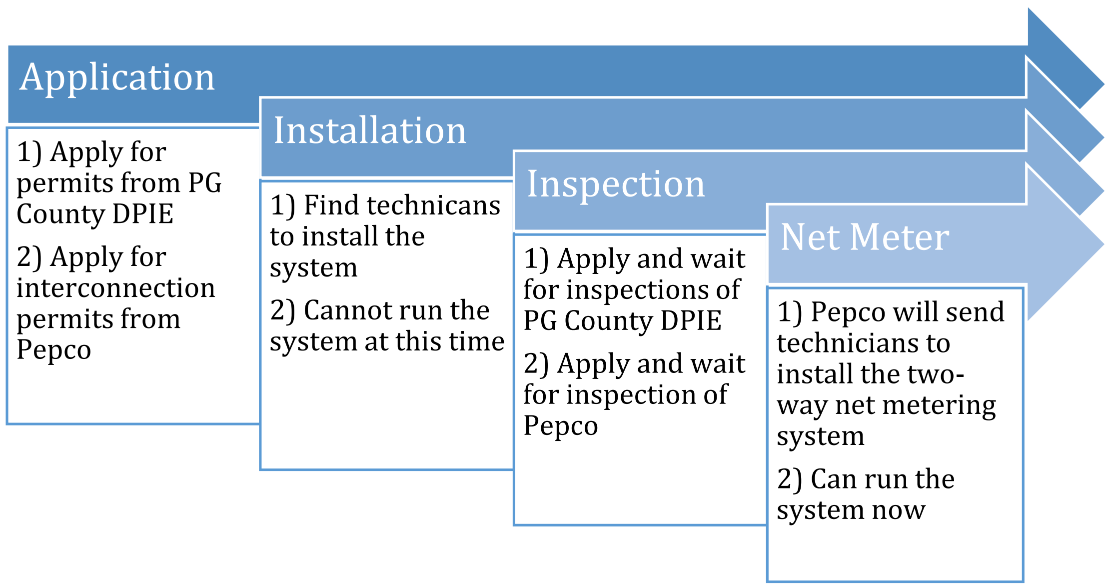
Fig 2.3 Electricity Sources, October 2013-September 2014



<u>PV Solar installation in College Park</u>

Figure 2.4 describes the four steps to install PV solar in College Park. All applicants can submit electronic application forms to the Department of Permitting, Inspections and Enforcement of Prince George's County. The fee for permitting of solar panels equals 0.6 percent of the construction cost plus $20. The minimum fee is $55 for residential and $75 for commercial (DPIE, 2014). The interconnection application fee to Pepco is zero if the capacity is not larger than 10kW (Pepco, 2015). In the last step, a two-way net metering will record both the electricity use from the grid and excess kilowatts generated by the home PV system.

Fig 2.4 Application Process for PV Solar in College Park



<u>Financing Options for Installing PV Solar in College Park</u>

Table 2.5 shows several major financing options for installing a PV solar system. In 2012, 68 percent of the residential PV solar systems in the U.S. were installed through third-party contracts. Solar Power Purchasing Agreements SPPA are gaining a larger market share in Maryland as well; 70 percent of residential PV solar installation in the first half of 2012 were through SPPA, increasing from 50 percent in 2010 (Ardani et al., 2013).

SPPA providers, or solar service providers, will purchase from the equipment manufacturer, ask installers to design and maintain the system, and find investors to finance the whole process. Some SPPA providers can provide the funding or installation themselves (EPA, 2014). Thus homeowners only need sign the contract and then can enjoy cleaner electricity, usually at a lower price.

The City of College Park has many PV solar installations through SPPA as well. One of the biggest projects is a 631 kW PV solar installed at the University of Maryland in 2010. A 20-year Power Purchasing Agreement (PPA) is provided with Washington Gas Energy Services (WGES). More than 2,600 PV solar panels have been installed on the roof, generating 7,920 MWh annually, with an estimated annual utility savings of $88,150.

Table 2.5 Common PV Solar Financing Options

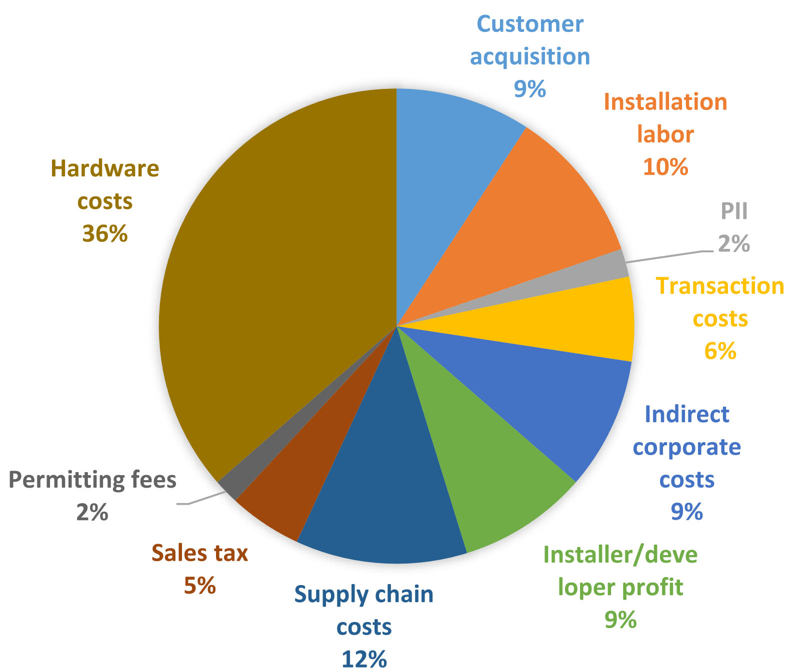
Name	Upfront Cost	Term	Advantages	Disadvantages
Cash Purchase	pay full upfront cost directly with cash	none	avoid financing cost and third party participation homeowners enjoy all rebates, incentives, and SRECs[6].	large one-time investment (avg. $20,000 for a 4kW system) homeowner responsible for system maintenance
Home Equity Loan	borrow upfront cost against home value	5 to 30 years	interest rate can be favorable and tax deductible homeowner enjoys all rebates, incentives, and, SRECs	interest rate may increase homeowner responsible for system maintenance
Other Loan Products	borrow upfront cost from bank, credit union, or against PV solar itself	up to 10 years	interest rate may increase homeowner responsible for system maintenance	interest rate often not tax deductible homeowner responsible for system maintenance
SPPA	third party pays upfront cost and owns the system; homeowners lease the system, purchase power	15 to 20 years	no direct upfront cost third party usually responsible for maintenance	third party owns the system and enjoys the rebates, tax incentives, and SRECs Ongoing savings are lower than direct cash payment
Property Assessed Clean Energy	most upfront cost covered by local government secured with a property lien	10 to 20 years	low upfront cost (about $100) homeowner owns system interest tax deductible	mortgage lien may be problematic homeowner responsible for system maintenance

Note: Information in the table has referred to fact sheet of DOE

[6] For more information about solar PV rebates, tax incentives, and RECs, please refer to NREL report (Coughlin & Cory, 2009).

As the commonest financial choice for solar installation in U.S., third-party financing has multiple benefits. First, it provides additional services for customers, such as maintaining O&M and receiving incentives. Second, the transactional costs for third parties will lower the price of electricity by cooperating with tax-equity provider, which makes solar more attractive to customers (Feldman et al., 2013). However, third parties will process all the incentives and complicated the soft costs of solar installation, which increases the soft cost. According to the reports of NREL (Ardani et al., 2013), costs of PV solar system installation are divided as shown in Figure 2.5.

Figure 2.5 Residential PV Solar Systems: Soft Costs Components



Among all the cost components, transaction costs mainly come from the negotiation between third parties. Indirect corporate costs and installer/developer profits will also be much higher when the contracts involve multiple parties. Lack of organized and comprehensive information will increase costs for customer acquisition. And the information asymmetries among homeowners, solar installers, third parties, and government will result in a longer time period and more disqualifications, which will lead to a larger cost in installation labor and PII costs.

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Policy Option 4 - Create an Energy Coach Program

People frequently say they want to be involved in projects that help protect the environment, or say that they care about the environment, but are not aware of actual steps that they can take to reduce their carbon footprint. Everyone wants to save money on their electricity bill, but they often don't have the tools or knowledge about how to make energy efficiency improvements to their homes. Making this information easily accessible and understandable for residents is a strategy that some municipalities have taken to reduce the community's cumulative carbon footprint.

Some cities have used an "energy coach" program to provide specific recommendations about how households could reduce their carbon footprint. An energy coach, working for the city, makes site visits, walks the resident through an energy audit to build trust between the residents and potential contractors, and recommends ways to improve energy efficiency such as improved insulation, energy efficient appliances, composting, etc. Residents are given a payback time estimate for the cost savings resulting from the improvements and then can make some or all of the upgrades suggested.

Incentives for participation could include a raffle for participating residents to have some or all of the renovations paid for by the city or neighborhood competitions to see who can reduce their carbon footprint the most. Such incentives require additional funding and organization, but may be worth the investment.

The potential costs and benefits of an energy coach program in College Park are estimated based on results in University Park of a similar program. The College Park estimates are adjusted to reflect the fact that University Park has about 15 percent of the population and 8 percent of the households of College Park. It is possible that College Park could start with a small pilot project that covers an area and population similar to that of University Park.

<u>University Park Case Study</u>

University Park, a small town next to the City of College Park, successfully implemented a STEP Energy Coach Program through the DOE's Better Buildings Neighborhood Program. The program started at the end of 2010 and data has been gathered through the third quarter of 2013.

There were significant costs to University Park during this three-year period. To inform citizens about this program, the town used several different outreach strategies, including business organization outreach, direct mail, door-to-door canvassing, school/church/library outreach, neighborhood meetings, and webinars. Labor costs, including the costs of the energy coach staff person, are shown in Table 2.6. The costs were highly subsidized by federal funds, although the exact subsidy amount is unclear.

Table 2.6 University Park Energy Coach Program Costs (over 3 years)

Marketing and Outreach	$191,753
Labor and Materials	$685,377
Other Program Expenses	$511,242
Total Expenditure	$1,388,372

University Park has a total of 877 households. Tables 2.7 and 2.8 show the implementation and energy metrics tracked during the program's three-year period. It is important to note that only single-family residences were targeted. In three years, the program upgraded nearly a quarter of all University Park households for energy efficiency.

Table 2.7 Single-Family Home Visits and Upgrades

Time Period	Consultations	Upgrades	Success Rate*	Engagement Rate**
Year 1	114	50	43.85%	5.70%
Year 2	42	42	100%	4.79%
Year 3	112	112	100%	12.71%
Total	268	204	76.12%	23.26%

*Number of homes that received a consultation **and** chose to receive some or all recommended efficiency upgrades

** Number of homes upgraded **compared** with the total number of homes within University Park

As a result of the upgrades, annual energy use was reduced in all areas: electricity, natural gas, and heating oil. Homes that received upgrades saw a significant reduction in their energy bills (Table 2.8).

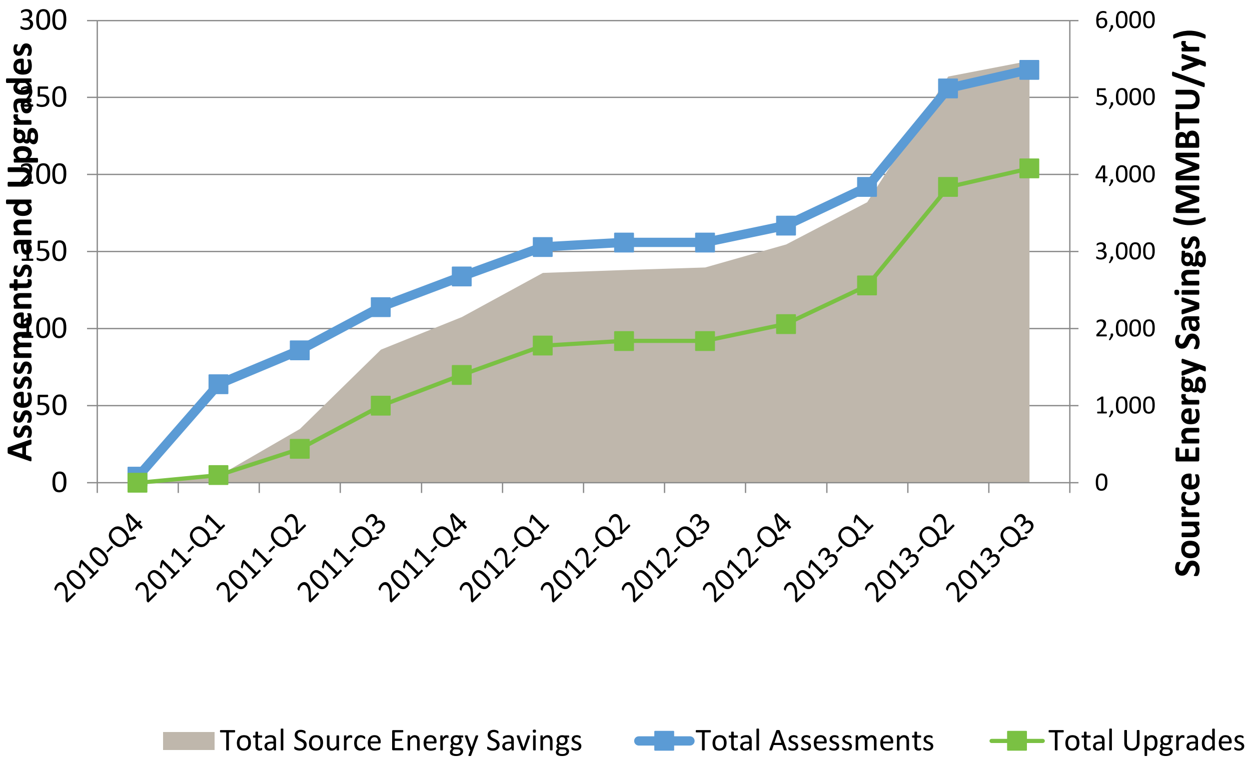
Table 2.8 Energy Savings by Year

Time Period	Electricity (kWh)	Natural Gas (MMBtu)*	Cost Savings ($)
Year 1	69,072	845.26	$12,19
Year 2	40,224	549.16	$13,19
Year 3	95,111	1443.53	$32,17
Total	204,407	2837.96	$57,56

*Heating oil is not a separate energy consumption category within the College Park GHG inventory, and so the heating oil savings total has been added into the natural gas energy savings for comparison later.

Figure 2.6 shows the amount of energy saved compared with the number of assessments and upgrades, on a quarterly basis.

Figure 2.6 Cumulative Assessments, Upgrades, and Energy Savings



On an individual household level, there were significant energy and fiscal savings for those who upgraded their energy efficiency in University Park, as shown in Table 2.9. On average, each upgraded household could expect a savings of $282.17 or $94.06/year, which should hold true in College Park, as well. These are averages, so the figures don't show the benefit of upgrading a home earlier or later—the earlier a home is upgraded the more savings will be accrued over time.

Table 2.9 Average Savings Per Upgraded Household

Electricity (kWh/home)	Natural Gas (MMBtu/home)	Savings ($/home)
1001.99	13.91	$282.17

Policy Financing and Implementation in College Park

If this program were scaled up to serve the entire City of College Park, and if its costs were proportionally the same as for University Park, the College Park's energy coach program would exceed $10 million. However, University Park, facilitated by a large federal grant, undertook a more ambitious and expensive program than College Park would be likely to pursue.

Moreover, the exact policy employed in University Park might not work as well in College Park. University Park is a smaller and more tightly knit community where more residents own their houses. In College Park, a majority of residents stay in the area for fewer than five years. Since so many City residents don't plan to establish roots, and since so many do not have the authority to make alterations to their home, it makes more sense to target property owners, and to encourage renovations that will increase the property's value. The best approach in College Park would be to design a similar, lower-budget program that can work on a similar scale to the University Park program but designed for the circumstances of College Park.

First, the City would need to gauge the interest of current homeowners in an energy coach program. The City could contact individuals who own homes with a few questions about their interest in participating in free energy coaching assessments to help reduce utility bills. This might also involve outreach to landlords, not necessarily the residents who are currently living in the homes.

If there is not enough interest, there might be no need for the program, but if there is some interest, then a part-time or even full-time energy coach could be hired for a temporary appointment to help with homeowners who express interest in the service.

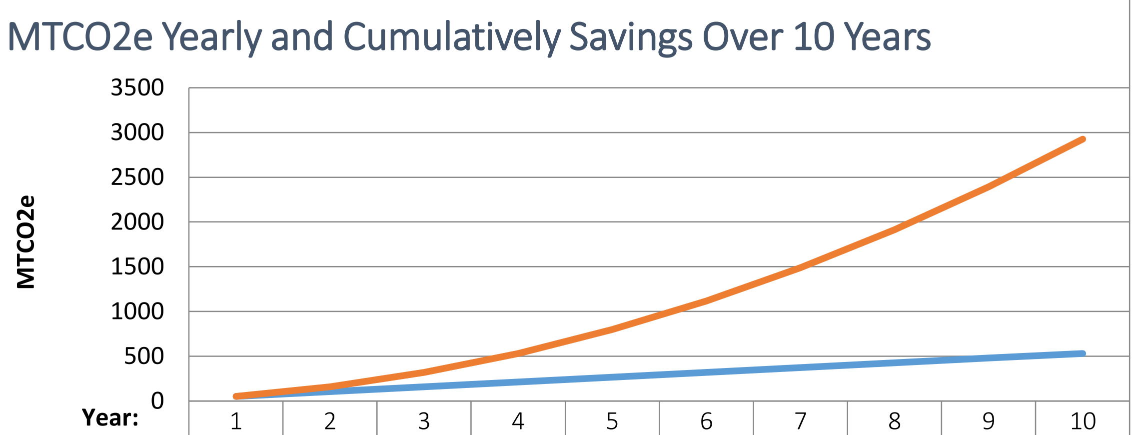
Estimated Cost

We estimate a 3-year energy coach program in College Park, expected to have similar impacts to the University Park experience, would cost approximately $39,000, or $13,000 per year. This budget is designed to move slowly but steadily from neighborhood to neighborhood in College Park. It is estimated that the energy coach program would have one coach going through 50 audits a year. This energy coach would be paid $50/hour, and each house would require about four hours worth of time.

This comes out to $10,000 for the coach per year. There would also be an estimated added materials cost of $3,000 per year for outreach and publications.

As seen in University Park, not every homeowner that goes through the energy coach process chooses to upgrade the home. Assuming a 76 percent success rate, 114 homes would be upgraded over a three-year program. Based on a rate of 1.4 $MTCO_2$/year per house, the total GHG reductions would be about 319.2 $MTCO_2e$—and this amount grows cumulatively by 53.2 $MTCO_2e$/year.

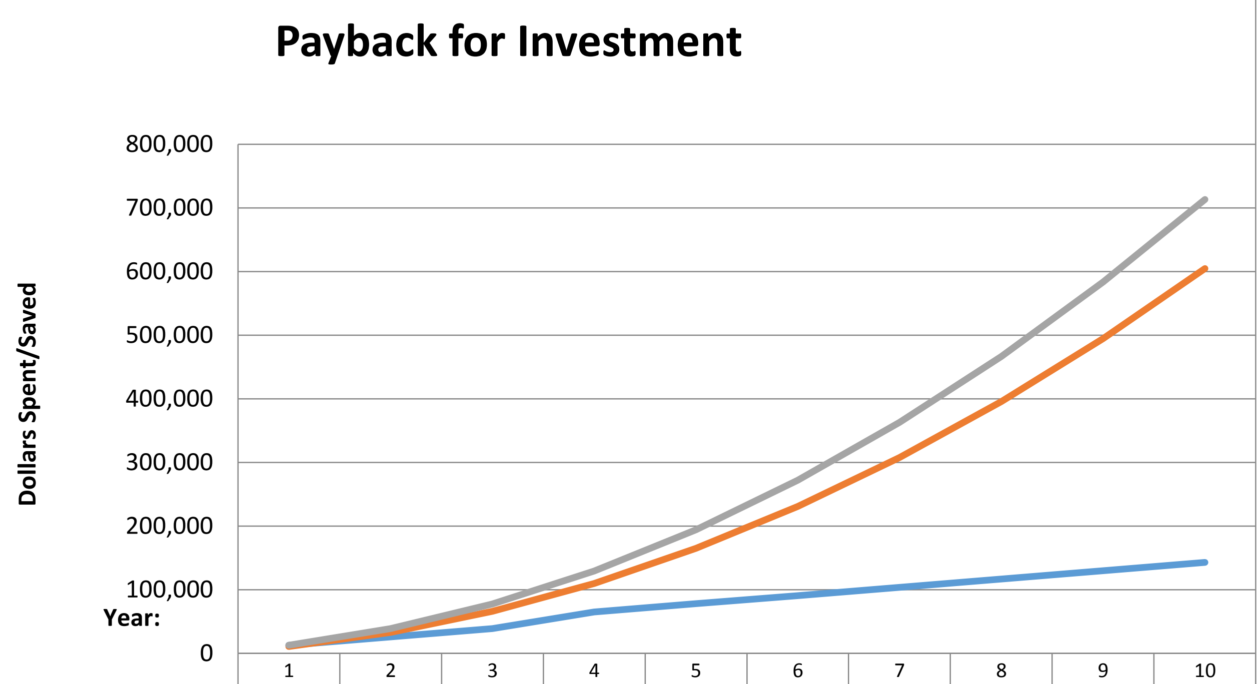
Figure 2.7 $MTCO_2e$ Yearly and Cumulative Savings (over 10 years)



Year:	1	2	3	4	5	6	7	8	9	10
MTCO2e Yearly	53.2	106.4	159.6	212.8	266	319.2	372.4	425.6	478.8	532
MTCO2e Cumulative	53.2	159.6	319.2	532	798	1117.2	1489.6	1915.2	2394	2926

Each homeowner can expect to save approximately $282 per home every year. Figure 2.8 shows the cumulative amount of money College Park would spend on the program, cumulative home savings, and cumulative savings including the savings based on the social cost of carbon (SSC) (kept at a flat rate of $37/$MTCO_2e$).

Figure 2.8 Payback for Investment (over 10 years)



Year:	1	2	3	4	5	6	7	8	9	10
Cumulative Spending	13,000	26,000	39,000	65,000	78,000	91,000	104,000	117,000	130,000	143,000
Cumulative Homeowner Savings	10,998	32,994	65,988	109,980	164,970	230,958	307,944	395,928	494,910	604,890
Cumulative Savings (including SSC)	12,966	38,899	77,798	129,664	194,496	272,294	363,059	466,790	583,488	713,152

The estimated payback time on the investments for this program would happen between Years 1 and 2 of the program, and would fall short of paying for itself by only $34 (when including the SSC) within the first year.

Based on these calculations, the City of College Park could significantly reduce its residents' utility bills and the community's carbon footprint for a relatively low investment cost of $13,000/year. Also, the assumption of a 76 percent success rate is likely a low estimate, as the coaching program in University Park rose to 100 percent by the end of the third year—meaning that these estimates are probably low for the number of houses and therefore the money and $MTCO_3e$ saved cumulatively.

Policy Option 5 - Promote Residential and Commercial Composting

To reduce greenhouse gases, composting is the best method disposing of organic waste. It allows organic compounds to degrade at a normal rate, producing CO_2 over a longer period, instead of methane created by compressing organic waste in a landfill. Methane is a much more potent greenhouse gas than CO_2 so there would be significant greenhouse gas benefits if compost disposal reached the atmosphere in the form of CO_2 emissions rather than methane emissions. At present, College Park's solid waste is sent to a county-owned landfill where the methane is siphoned off, but there are still leaks. Through a voluntary composting program, residents could reduce the tonnage of organic waste sent to the landfill and create rich soil that could then be used for home gardening or other purposes.

The levels of methane and CO_2 emissions from organic waste generated in College Park are not large. Nonetheless, the City could facilitate composting at a minimal cost. The main cost would be the purchase of a composter—around $40 per unit—that would be borne by the homeowner. Many City residents might be willing to pay this price, to contribution to addressing climate change problems. But there are several actions the City could take to encourage wider use of composters by City residents.

<u>Community Outreach and Education</u>

A first step in a City-facilitated composting program would be to inform residents of the new program and how it would work. Outreach efforts should target City areas with more individually owned homes than renters and students. Homeowners are more likely to participate in a composting program, both as a source of individual satisfaction in using the composted material for home gardening and as a long-term method that might increase the value of their homes.

Community outreach might involve several steps to get the message out to as many residents as possible. Three effective methods of outreach are:

- distributing fliers at community events
- door-to-door canvassing and distribution of information
- maintaining an active website with a program description and sign-up instructions.

The information distributed would describe the program and the most effective composting methods, allowing residents could gauge whether or not to make the commitment of buying and maintaining a compost bin.

As a part of this effort, it would be helpful to maintain a database of the interested residents' names, mailing addresses, emails, and phone numbers. Gathering names at the local farmers market could be one effective method, as well as distributing materials at locations like MOM's Organic Market, and street-level canvassing. The website should link to an online survey that automatically adds contact information to a database.

Bulk Purchase of Composting Units

Purchased individually, composters range from $70 to $200, making a purchase burdensome for some residents (Home Depot website). Bulk purchasing would reduce the prices, inviting wider resident interest.

Home Depot and other retail stores offer volume pricing programs in which a bid is created for bulk purchases based on the location of the purchase, transportation, advertisement, co-op moneys, etc. (Source: George Plaza, email). These arrangements are usually set up through a contracting agreement and occur more frequently than the City would likely require.

For example, Home Depot offers bulk purchasing of compost units. In an interview, George Plaza, a Home Depot Bid Specialist and System Administrator, stated that the local store would need to receive and submit a specific order from the City to know the actual savings of bulk purchasing, but generally buying in bulk can save consumers between 40 and 80 percent (http://www.cbn.com/finance/SMI_buyinbulk.aspx).

It may be easier to work directly through the manufacturers of units. If the City is interested in pursuing bulk purchases, it should shop around at the time of purchase to find the best deal possible.

If the City is initially successful, as more people sign up over time, the City could say that it will make a new bulk purchase for every 50-100 individuals signed up for the program. Under this rolling sign-up, residents would be contacted to confirm their interest and with final billing information. The City would likely require a storage space for any unsold bins, but hopefully, most composting bins would be distributed soon after they arrive.

Baltimore County and Similar Programs

Baltimore County has a yearly sale of compost bins and rain barrels. In April 2015 sale the county sold 767 compost bins[7] for $39 each, which is a little over half-price, based on the current retail price of composting bins. People who wanted the bins were on an email list, which is still active, so orders for next year will be based on the number of people who add their names to the list.

Similar programs exist across Maryland, and while Prince George's County has a program like this, College Park is excluded from it. College Park currently has a composting program that enables residents to request curbside composting, but no program to help people compost at home.

Expected GHG Reductions from Residential Composting Promotion

[7] http://www.baltimorecountymd.gov/Agencies/publicworks/recycling/composting/binsale.html

Table 2.10 shows the estimated GHG reductions (in CO_2 equivalents) as more homes participate in the composting program. It assumes that the College Park municipal solid waste (MSW) has approximately the same composition as the U.S. average. “Recent waste composition studies estimate that approximately 72 percent of the municipal waste stream going to landfills is organic (6 percent wood, 7 percent textiles/leather, 13 percent yard debris, 12 percent food scraps, 34 percent paper)”[8]

According to 2013 census data, there are 7,155 housing units in College park, 4,155 of which are detached homes. Assuming that these homes can all have individual composting bins, the estimated reductions in CO_2 equivalents are shown as more households participate.

If 25 percent of College Park households participated, the expected GHG reductions would equal 995 tons of CO_2 emissions per year. This would be about equal to the total CO_2 emissions of 212 cars per year. Assuming two cars per household, it would be enough to offset the annual CO_2 emissions of about 1.5 percent of the resident-owned cars in College Park.

Table 2.10 Curbside Trash and GHG Reductions from Home Composting

Percentage of Participating Homes	Reduction in Curbside Trash Totals (tons)	Expected GHG Reductions (Metric Tons/Year CO_2e)
5%	102.08	199.08
10%	204.15	398.04
25%	510.38	995.16
50%	1020.76	1,990.44
75%	1531.13	2,985.60
100%	2041.51	3,981.00

The possible City program described above is only designed for individual homes; a composting program for apartment complexes would need to be coordinated between the City and apartment management. If all City waste were included, however, the resulting GHG reduction would be larger. If, hypothetically, the overall percentage of participating facilities of all kinds in the City were 25 percent, the expected GHG reductions would be equivalent to 1,714 tons of CO_2 emissions. This would be enough to offset the emissions of about 3 percent of resident-owned cars in College Park.

[8] http://compostingcouncil.org/admin/wp-content/uploads/2011/11/Keeping-Organics-Out-of-Landfills-Position-Paper.pdf

Table 2.11 - Curbside Trash and GHG Reductions for all Residential and Commercial Buildings

Percentage of Participating Facilities	Reduction in Curbside Trash Totals (tons)	Expected GHG Reductions (tons CO_2e/year)
5%	244.13	475.92
10%	351.55	685.56
25%	878.88	1,713.84
50%	1,757.77	3,427.68
75%	2,636.65	5,141.40
100%	3,515.53	6,855.24

<u>Cost to the City</u>

As noted, the absolute magnitude of GHG emissions reductions is not large. But for many, there might be significant emotional satisfaction in the act of participating. Moreover, the City's costs of a voluntary composting program would be quite low, since bin purchasers would pay for them in full (at the reduced bulk rate). The only costs would be a small amount of time from a City employee and the costs of communication materials.

As a rough estimate, the annual costs of a composting promotional program, plus organizing bulk purchases for City residents, would be less than $6,000, assuming $75 per hour for a City employee, at an annual employee cost about $4,000.

These costs would generate about 1,000 tons of CO_2 reduction, or thus about $6 per ton. In comparison, the price of an allowance in the most recent RGGI auction was $5.4 per ton, about the same. The federal government now uses a net social benefit for a ton of CO_2 reduction of about $40. So by this standard, a composing program easily passes a City cost-benefit test.

Of course, another cost, as noted above, is the privately born expense of purchasing the composters. But this is a cost only incurred once, so should be less than $10 per year per homeowner when averaged out over more than 10 years. The largest actual costs would be the time and effort to use the composter, but this might be comparable to traditional recycling. It would be a cost born voluntarily, suggesting that the homeowners' satisfaction in doing their part for the environment is sufficient to compensate them for their efforts.

Table 2.12 Estimated City Composting Program Budget

Item	Cost
Creating and maintaining website	$500 - $1,000/year
Fliers/printed material	$1,000/year
Organizing	1 person hour/week (on average)

PALS Team: "Improving Solid Waste Practices in the City of College Park"

The City of College Park also received a composting recommendation from another PALS program this year. This document was created by four undergraduate students and is titled, "Improving Solid Waste Practices in the City of College Park." The goal of this project was to create a short-term action plan for the City that would contribute to the long-term goal of becoming a zero-waste city—a worthwhile and ambitious long-term goal. According to the PALS report, the City should aim to reduce waste by 7 to 8 percent in the coming three years, and increase recycling by the same percentage.

The PALS program created a three-year strategic plan to help the City improve education, outreach, and composting. This short-term plan includes, but is not limited to, providing bins to City residents to increase backyard composting. Since this project created a strategic plan and not an action plan, there are no details provided about the costs to the City or the potential benefits of implementation. The above analysis gives the City a general idea of the implementation costs of creating a bulk-bin purchase program as a way to start moving toward the goals outlined in the Zero-Waste Strategic plan provided by the PALS team.

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http://www.epa.gov/epawaste/nonhaz/municipal/pubs/msw_2010_rev_factsheet.pdf

George Plaza. Email. 5/4/2015

http://www.epa.gov/epawaste/nonhaz/municipal/

Waste calculator: http://www.stopwaste.us/partnership/calculator/

Policy Option 6 - Promote Construction According to LEED Standards

LEED (Leadership in Energy & Environmental Design) is a green building certification program that, as EPA explains, "recognizes best-in-class building strategies and practices." To achieve certification, projects should include green or cool roofs, motion sensor lighting, low emitting water conservation, and sustainable waste disposal, among other environmentally friendly practices.

In 2008, the U.S. Green Building Council (USGBC) compared the average commercial building in the U.S. and those that were LEED certified. It found that LEED certification leads to, on average, a 25 to 30 percent decrease in energy consumption versus the national average. Given the close correlation between energy consumption and GHG emissions, LEED-certified buildings will also typically have lower GHG emissions.

The University of Maryland campus has seven LEED-certified buildings; the City of College Park has only two LEED-certified buildings. The City could develop programs and incentives to encourage a higher rate of LEED certification on new and renovated buildings.

The City has no direct regulatory ability to require LEED certification for new projects—that authority belongs to Prince George's County through its administration of zoning throughout the County. Because the City can't require LEED certification through land-use permitting requirements, it should pursue less direct, "soft power" means of influencing development decisions.

For example, the University is planning to expand into the surrounding College Park area by purchasing buildings off-campus and renting them to businesses that will help turn College Park into a more picturesque college town. This expanded development strategy offers an opportunity for College Park to create a greener identity, advanced by increasing the number of LEED-certified buildings. The University is likely to be among the main sources of new construction of buildings in College Park beyond its current campus area.

Another indirect method of encouraging LEED certification is asking developers and other commercial establishments in College Park to notify the City in advance of plans for new buildings or major renovations. The City could consult on their plans for LEED certification and encourage them to pursue it. The City might work with developers and with the EPA to clarify the requirements for LEED certification and to address any problem areas. The City might be able to offer non-regulatory incentives that encourage LEED certification. For example, it might offer more favorable treatment in the delivery of some City services where appropriate.

Another way to promote LEED certification is to work with Prince George's County to use its zoning power to create new College Park commercial zones that require LEED certification. This is a larger effort, but framed properly, with the expected energy savings explained, and set in the context of an overall College Park sustainability campaign, Prince George's County might be open to the suggestion.

Prince George's County is committed to the adoption of environmentally sustainable policies within its boundaries.

GHG Reduction Potential in the Commercial Sector

The commercial sector contributed 117,408,004 kWh in 2013 to College Park's total energy usage. When compared to the City's total energy consumption , excluding the contribution of the University, commercial establishments made up 44.2 percent of the total energy consumption. However, the ability to influence LEED certification will mainly apply to newly constructed and renovated buildings.

Implementing a LEED certification strategy will involve advance close communication between the City and the University about the intention for LEED certification in the planned expansion. The City could express its strong interest in LEED certification within its jurisdiction, and the University could include LEED guidelines in renovation, or new development.

All this would take planning and dissemination of information to local developers and business/commercial building owners. It might also involve the creation of a data-gathering center that would distribute certification information. LEED-related activities would probably require a substantial commitment from at least one City staff member but the GHG payoff could be high.

Policy Option 7 - Establish a Property Assessed Clean Energy (PACE) Program

A Property Assessed Clean Energy (PACE) program is an innovative financing model that makes energy efficiency retrofits and renewable energy investments easier for property owners. PACE financing reduces the initial costs and spreads remaining costs over the life of the investment. Any municipal government can implement a PACE program as long as it collects the real property taxes of its residents. The City of College Park could establish such a program to assist in financing energy improvements for its commercial property owners, which will help to fulfill its GHG sustainability goals.

In special energy financing areas (also known as clean energy assessment districts), which must be designated by the local government, lenders provide funds (partial or total of the upfront cost, depending on the project) to property owners to improve energy efficiency or to install small-scale renewable energy systems. Over the ten to twenty years following the investment, a City property tax supplement is added to the existing property tax. This surcharge on the property tax bill is collected by the local government and disbursed to lenders as loan payments. PACE is different from other loan programs since the tax stays with the property instead of the owner.

Most PACE programs allow projects like energy efficiency (EE) improvements or renewable energy installation. Some also have a separate category for water efficiency (WE) improvements. According to Maryland's Clean Energy Loan Program Act, both EE projects and WE projects with installed capacity of less than 100 kW are qualified. Generally, EE projects include improving energy management systems, upgraded insulation, HVAC systems, boilers and furnaces, lighting, energy recovery and redistribution systems, and motors and drives. WE improvements include PV solar or solar hot water projects.

Extended non-payment of a PACE tax surcharge will result in a lien being placed on the property, the same as failing to pay any other portion of the property tax bill. A property lien gives a local government authority to sell the taxpayer's property through foreclosure or the lien must be satisfied before the property can be sold.

<u>Background</u>

In 2008, California became the first state to pass PACE legislation. Since then, thirty more states and the District of Columbia have authorized PACE under state laws. Any local government in these states can sponsor a program as long as it has authority for taxing and placing liens. County government is the most common local level for administering PACE programs since their larger scale helps reduce the costs. A municipality such as College Park, however, can have its own PACE program.

Originally, both residential and commercial properties could participate in PACE. But, in 2010, the Federal Housing Finance Agency (FHFA) prohibited residential PACE programs for "safety and soundness concerns." It's not clear when or whether FHFA will revoke the residential restriction and whether there will be new requirements for residential PACE projects, such as a reserve in case of property owners' delinquencies. Most residential projects have been suspended since then, though a few programs continue in California (e.g. HERO program in Sonoma County) where PACE-associated mortgages are not involved with FHFA on the secondary market (Harcourt Brown & Carey, 2014). Meanwhile, none of the commercial PACE loans are affected. Commercial properties do not usually use home equity loans and thus the PACE loans are particularly helpful.

<u>Benefits of PACE</u>

PACE programs can benefit all parties. From the property owners' perspective, PACE deals with two major concerns during the decision-making about energy efficiency improvements. First is the large upfront cost, which are covered with a longer repayment period than other loans for small projects. Second, the loan obligation is tied to the property instead of the property owner. Thus, the property owner does not need to worry about paying off the full loan if the property is sold.

From a local government perspective, PACE can boost the local economy and create job opportunities, especially in energy efficiency and retrofit projects. One of the reasons is that energy efficiency information provided by government instead of contractors is usually considered more trustworthy by loan recipients. Also, PACE will help local governments make carbon emission reductions and achieve a higher percentage of renewable electric power (helping to meet the Maryland Renewable Portfolio Standard). With financing from a third party, a local government takes less credit or obligation risk and will not compete with other programs for funds.

From the lenders' perspective, PACE provides a more secure opportunity to make loan investments without affecting the balance sheet. The PACE tax lien has a senior priority relative to other property taxes, which reduces the risk of non-payment. Additionally, an energy audit before approving a project should establish that the cost savings will be larger than repayment obligations each year. Finally, PACE participation can increase the Corporate Social Responsibility (CSR) reputation of a company since its properties have fewer negative environmental impacts.

<u>Implementation</u>

The first step in establishing a PACE program is state passage of a law that allows local governments to set special tax assessment areas. In 2014, Maryland enacted legislation that authorized local governments to pass local laws to allow commercial PACE programs. The bill clearly defines commercial property: property not intended for human habitation or property for human habitation including more than four single-family units.

After state legislation, a locality would pass an ordinance to create a "Clean Energy Program" that enables lien creation and project financing. Recently, Montgomery County passed a PACE financing ordinance and the program is now under development. The political will to support clean energy has been important in establishing the Montgomery County program.

To implement a PACE program, to the locality should issue a Request for Proposal (RFP) inviting a PACE expert to study the local situation. The study must address:

1) the locality's financial status, including bond ratings, interest rate levels, risk tolerance, and types of third parties

2) the size of the proposed program based on how much a lender can provide relative to project size and what kind of changes are included. When the estimated costs are too large, the PACE program will usually provide funding less than 10 or 20 percent of the property value

3) the financing options. Three types of bonds are available: pooled bonds where PACE applications are aggregated, stand-alone bonds designed for large projects, and owner-arranged bond contracts with a lender who accepts the PACE financial mechanism. The study should make sure the financing structure will provide enough revenue to cover possible delinquencies

4) the role of the local government. Local governments need to set a policy for repayment. The surcharge on the tax bill can only include expenses for bonds repayment and administering process.

Barriers

PACE is a voluntary program with an uncertain participation rate. Thus, education and marketing would are important for a successful PACE program in the City. Workshops for installers, contractors, and consumers could promote the projects. Also, a streamlined application process, a comprehensive information website, and case studies are valuable. The Arkansas Advanced Energy Equity Program (A2E2) and Vermont Efficient programs provide examples.

To reduce concerns about property sales, College Park should provide information about increased property values and reduced electricity bills. For apartment owners around the campus, it is especially important to inform them fully about costs and benefits. A pilot program might be a good way to start.

Another possible barrier is internal administration. A PACE program requires knowledge and experience in both the energy and financing fields. Cooperation between the financial, energy, and legal departments is essential for an efficient and successful PACE implementation.

Yet, as shown below, there are a growing number of states and localities that have established successful PACE programs.

Location	Program	Project	Cost	Savings	Term	Major improvements
San Luis Obispo, CA	California FIRST	The CaliPaso Winery	$811,419	$79,214	20	Solar PV
Sacramento, CA	Clean Energy Sacramento	Capital Mall Building	$513,000	$47,000	25	HVAC installation
Los Angeles, CA	Los Angeles County PACE	Hilton Los Angeles/Universal City	$7,000,000	$800,000	20	Energy efficiency glass, LED lighting, low-flow shower heads and bathtubs, new elevators
Los Angeles, CA	Los Angeles County PACE	Historic Constance Pasadena Hotel	$6,860,000	$68,280	20	Power saving, water saving
Los Angeles, CA	Los Angeles County PACE	Teamsters' meeting hall	$236,350	$30,000	20	Solar array, cool roof, lighting
Los Angeles, CA	Green Finance San Francisco	Prologis historic Pier 1 building	$1,400,000	$350,000	20	Daylight utilization, solar PV, LED light, energy system control
San Francisco, CA	Figtree PACE Financing	Cascade Orthopedic Supply	$139,255	$22,732	25	Solar PV
Butte, CA	Me2 PACE	University Club building	$662,000	$75,000	18	HVAC installation, repair and replace windows, balance airflow, LED light
Milwaukee, WI	C-PACE	Westport Avenue Building	$170,000	$17,500	13	LED Lighting
Lucas, OH	Toledo-Lucas Port Authority	One Maritime Plaza	$1,400,000	$75,040	15	HVAC, lighting, water pump, building envelope
Washtenaw, MI	Ann Arbor's PACE program	Big Boy restaurant	$88,488	$8,300	10	HVAC, cooking, control system, lighting
Ramsey, MN	Edina Emerald Energy PACE program	Salut Bar American restaurant	$39,308	$15,296	10	LED Lighting, control system
District of Columbia	DC PACE program	Multifamily housing property	$340,000	$40,000	10	Solar array, lighting, control system

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Policy Option 8 - Develop a Community Choice Aggregation Program for Residential Electricity Purchases

Pioneered in California, a Community Choice Aggregation (CCA) program allows local governments to become purchasing agents for residential, commercial and municipal electricity consumers within its jurisdiction.

If College Park adopted this program, the City would purchase power directly from electric power producers, much as some independent private aggregators already now do. PEPCO (soon to become Exelon) would distribute the power within its distribution network and handle all operations and maintenance.

One advantage of such a program is that independent power aggregators can typically purchase and offer electricity at prices lower than offered by distributors such as PEPCO. Many current purchasers of electric power are unaware of the option to obtain their power from independent aggregators, and so pay unnecessarily high electric power bills to PEPCO. Most existing independent aggregators are private but in a Community Choice Aggregation program, the aggregation is performed by a public entity, such as the City of College Park.

A City program would operate on an opt-in or opt-out basis. Most CCAs are "opt-out" entities, meaning that the customer is, by default, part of the aggregation (Community Choice Aggregation, 2015) and each customer is given an opportunity to opt-out of the program. If a customer opts out, or has no community choice program available, that customer has the right to switch back to utility service at any time. Opt-out aggregation achieves the necessary market scale for effective group purchasing, while opt-in approach is voluntary but participation rates are traditionally low.

Currently, states that have passed CCA laws providing for community aggregation are California (2002), Illinois (2009), Massachusetts (1997), New Jersey (2003), Ohio (1999), and Rhode Island (1997) (Community Choice Aggregation, 2015). For this option to be adopted in College Park, the state of Maryland would have to pass a new law authorizing community aggregation.

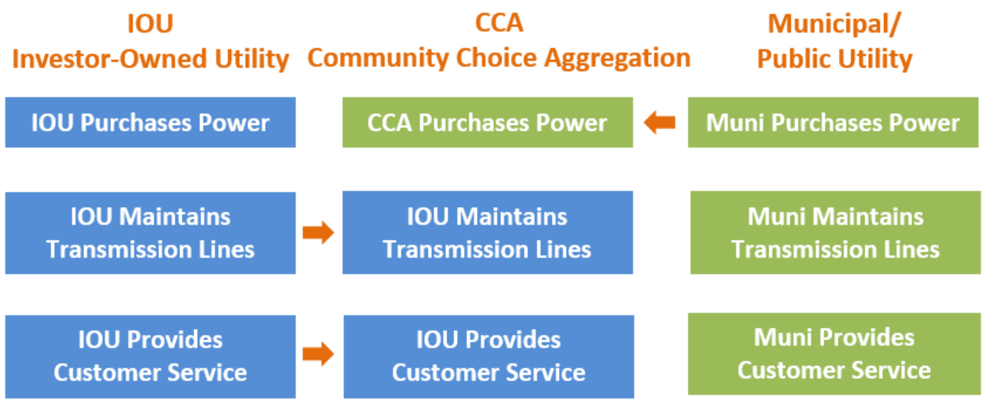
<u>Other Benefits</u>

Besides lower cost electric power, benefits can include reducing greenhouse gas emissions from electric power suppliers, providing more choices for customers to meet their needs, and stimulating local employment and the economy.

- Secure energy supply and price stability

The cost savings for CCA customers are generated by the lower rates offered by publicly-owned municipal utilities. Roughly 70 percent of U.S. electricity is supplied by vertically integrated investor-owned utilities (IOUs). Maryland's IOU is Pepco. By developing a hybrid access between an IOU and a municipal or member co-op utility, CCA reaps the benefits of controlling power supply and generation without the financial drag of covering the costs of operating and maintaining sometimes antiquated utility infrastructure (What is CCA, 2015). Generally speaking, CCAs save 15 to 20 percent off the power rates offered by traditional IOUs.

Figure 2.9 How CCA Works



Source: US EPA, 2012

- Reduce greenhouse gas emissions

The City currently purchases RECs for its own electric power but private electricity users in the City do not. Hence, by organizing these private users, CCAs create opportunities to purchase additional RECs and develop greater regional renewable power capacity (Lantz, 2006). There are six CCAs in the U.S. providing green power products (Table 2.14) serving communities in Illinois, Sonoma County (CA), Lowell (MA), Cleveland (OH), Lancaster (MA), and Marin County (CA) (Community Choice Aggregation, 2015). With the development of more renewable power generation, more green jobs will be created and more investors will be attracted, resulting in the boost in the local economy.

Table 2.14 CCAs with Renewable Capacity

Location	Program Name	Renewable Offer	Start Date	Premium
Communities in Illinois	Municipal Aggregation	Typically 100% green power option	2010-2014	varies
Sonoma County, CA	Sonoma Clean Power	33% or 100% green power	2014	33% product has 4-5% savings; 100% product is 3.5¢ /kWh premium over 33% product
Lowell, MA	Community Choice Power Supply Program	100% green power	2014	8-10% savings
Cleveland, OH	Municipal Aggregation Program	100% green power	2013	21% savings
Lancaster, MA	Municipal Aggregation Program	Local PV incorporated into product mix	2013	10% savings
Marin County, CA	Marin Energy	50% or 100% green power	2010	100% is 1¢/kWh extra

Source: U.S. Department of Energy

Case Study: Clean Energy in Marin County, California

California was the first state to enact CCA legislation with clean energy as a goal. California's CCA legislation, AB 117, was passed in 2002 and amended by SB 790 in 2011. The Marin Energy Authority (MEA) is a local government agency formed in 2008 to act as a community choice electric power public aggregator in Marin County to implement the CCA program. The CCA, Marin Clean Energy (MCE), currently serves approximately 95,000 customers, and at full implementation could serve as many as 129,000 customers who would obtain their electric power throughout Marin County and the City of Richmond (MEA, 2012).

One of MCE's goals is to reduce greenhouse gas emissions from the electric power sector through increased use of renewable energy resources and reduced reliance on fossil-fueled resources. MEA's current fuel mix includes the highest proportion of renewable energy (51 percent) of any California utility (Figure 2.10). The program is now reducing 39,027 MTCO2e annually and carbon-free powered generation accounts for more than 50 percent of the total capacity.

MCE's customers can choose from two renewable energy products: Light Green with 50 percent renewables, or Deep Green with 100 percent renewables. MEA's renewable energy requirements are met with a combination of RPS[9]-eligible contracts and Green-e Energy certified REC purchases (Berkeley, 2013). MEA has also established net energy metering and feed-in-tariff programs and its long-term PPAs have spurred the development of nearly 60MW of new solar, wind and landfill gas in California. By increasing the use of renewable energy resources and reducing the reliance on fossil-fueled resources, MEA hopes to achieve its long-term goal of 100 percent renewable energy supply by 2022 (Figure 2.11).

[9] California Renewables Portfolio Standard

Figure 2.10 MCE Fuel Mix, 2013

Source: Integrated Resource Plan Annual Update (MEA, 2013)

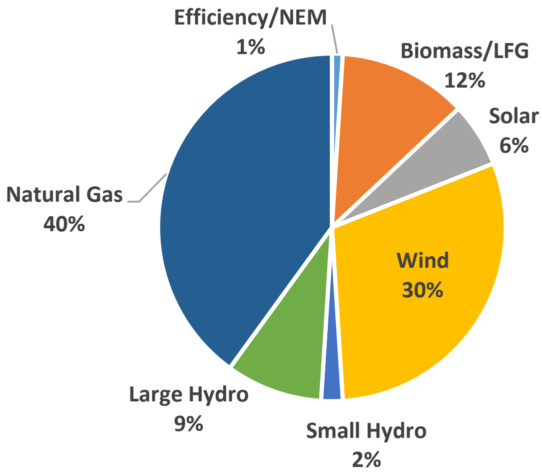
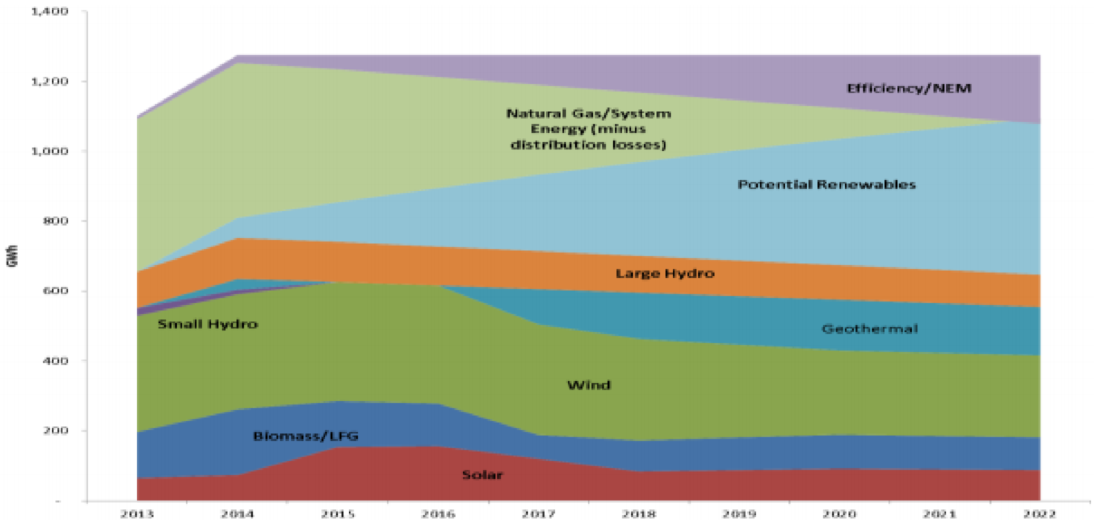


Figure 2.11 MCE Fuel Mix, 2013-2022



Source: Integrated Resource Plan Annual Update (MEA, 2013)

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Policy Option 9 - Encourage City Employees to Work More from Home

Automobiles are the main source of GHG emissions in College Park and a significant part of the automotive traffic is generated by commuters. One way to reduce this traffic would be to encourage greater working from home. Although it is not feasible for City government employees who perform on-site services, it might be feasible for some. If 20 City employees worked one day a week from home, GHG emissions could be reduced by about 400 tons of CO_2 per year.

Besides the GHG benefits, working from home might improve the overall work environment for some City employees such as mothers with young children. This could prove helpful in future hiring. Encouraging greater working from home by the City would also create a good example for the private sector of College Park.

Some Maryland counties have adopted telework as a way to reduce pollution and traffic congestion, and to increase productivity. TeleworkBaltimore.com serves employers in Baltimore City and Anne Arundel, Baltimore, Carroll, Harford, and Howard Counties interested in establishing telework programs for their employees.

Montgomery County offers a Telework Tax Credit to incentivize County employers to create work from home programs. The annual tax credit against the personal property tax is up to 50 percent of the cost of new computer purchases to set up a new offsite employee workstation.[4] Besides the Telework Tax Credit, green business certification is another incentive for telework.

Some question the benefits of working from home, arguing that it creates a poorly controlled work environment in which it is difficult to measure employee performance. Daniel A. Green, deputy associate director of the Office of Personnel Management (OPM), however, expressed an opposite opinion. “Effective performance management is the same whether or not an employee teleworks. Managers should measure employee performance by results, not physical presence.”

According to a 2013 OPM report, management resistance was the most frequently reported barrier to telework (32), followed by information technology (20), budget concerns (11) and security (11). [3] To address these issues, many agencies focus on training leadership in how to best use work from home as an effective management tool.

For the City of College Park, management resistance might be the major barrier to telework implementation. Moreover, there is no program in Prince George’s County designed to promote work from home.

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Chapter 3

Greenhouse Gas Sustainability Lessons and Strategies across the United States

Many U.S. municipalities and local governments have adopted sustainability plans that are now being implemented. California has been particularly active. Reducing GHG emissions is often an important part of local sustainability plans. Actions by other localities offer many examples of GHG strategies that College Park could study and profit from. Chapter 2's nine policy options are a beginning, but there are many more GHG reduction possibilities that might be explored in greater depth by College Park.

Prior to researching and writing this report, a similar University of Maryland study team developed an inventory of GHG emissions for Frederick, Maryland, which also suggested ways to reduce GHG emissions in Frederick. A study team based at the University of Wisconsin, prepared a GHG report on Madison, Wisconsin. The results of these reports are briefly summarized below. In addition, a list of sustainability actions with GHG implications is presented for a number of U.S. localities in the United States.

Frederick, Maryland

The PALS program at the University of Maryland recently helped the City of Frederick, MD complete a footprint and energy profile based on 2013 data. This was the first GHG inventory the City had performed, although the report stresses the importance of regularly monitoring the City's carbon footprint. The project's scope focused entirely on government financed operations—no private community operations were included, though is the report suggests that community data should be included in future inventories. The analysis indicated that Frederick has a footprint similar to peer communities in the metropolitan Washington, D.C. area, consuming about 2.5 MMBTU per resident per year.

While municipalities typically use the ICLEI Carbon Calculator, the students were able to use a beta version of the U.S. EPA's Local Government Greenhouse Inventory Tool (LGGIT), which is not normally publically accessible. Some internal and external data tracking issues caused data gaps and uncertainties, which in the end prevented a higher quality of analysis. In the future, more comprehensive data tracking will contribute to more sophisticated analyses.

Table 3.1 presents the results of the City's government-scale only inventory.

Table 3.1 Summary Activity Data and GHG Emissions for the City of Frederick, 2013

Scope and Sector	Activity in 2013	$MTCO_2e$	% of Gross *
Scope 1: Building Fuel Consumption *(Buildings Workgroup)*	13,874.3 MMBTU	740	3.65
Scope 1: Transportation Fuel Consumption *(Transportation Workgroup)*	336,313 Gallons of Gas Equiv.; 41,617 MMBTU	2,991	14.77
Scope 1: Non-combustion wastewater *(Non-combustion Workgroup)*	Multiple data pieces; emissions from CH_4 and N_2O	220	1.08
Scope 2:Purchased Electricity *(Buildings Workgroup)*	23,915.9 Megawatt Hours; 81,604 MMBTU	10,924	53.95
Scope 3: Fertilizer Application *(Non-combustion Workgroup)*	24,400 Pounds; 4.08 Short Tons of N	34	.17
Scope 3: Employee Commuting *(Transportation Workgroup)*	4.7 million miles traveled; 28,637 MMBTU	1,934	9.55
Scope 3: Solid Waste *(Non-combustion Workgroup)*	19,318 Short Tons; 422 MMBTU*	3,406	16.82
Gross Total	166,155 MMBTU	20,249	N/A
Sequestration: Composted Yard Waste *(Non-combustion Workgroup)*	535 Short Tons	-66	.33
Sequestration: Urban Tree Canopy *(Non-combustion Workgroup)*	1,804 acres of urban tree canopy	-5,969	29.48
Net Total	166,155 MMBTU	14,215	N/A

* The solid waste estimate includes fuel combusted to transport solid waste; ** The values in the "% of Gross Column" sum across all emissions sources (do not include sinks).

There were seven main categories of emissions and sinks: building fuel consumption, transportation fuel consumption, non-combustion wastewater, purchased electricity, solid waste, employee commuting, and sequestration from composted yard waste and urban tree canopy. The report indicates where improvements in data could be made, specifically regarding transportation and solid waste. All categories could have improved data, and in the future, more thorough data collection will result in more accurate and nuanced findings.

The beta version of the EPA's LGGIT tool was tested in the duration of the Frederick PALS project, and as with any test, there were software issues. Some of the calculator's assumptions create weaknesses in the report. For example, there is a single estimate for carbon sequestered from the tree canopy instead of providing a range of uncertainty. One lesson learned by the City of Frederick's report is that thorough data collection is absolutely key to any accurate analysis.

The Frederick team also developed recommendations in three specific areas. A Buildings Workgroup developed the analysis,*"Creating a Pathway to Sustainability for Harry Grove Stadium,"* that includes a package of carbon-mitigating projects focused on a high-profile City facility, a minor league baseball stadium. The Transportation Workgroup developed an analysis of *"A Smart Fleet Program for the City of Frederick,"* a work plan for advancing the City's fleet tracking and long-term planning. Finally, a Non-Combustion Workgroup developed an analysis of *"Growing Green: Tree Planting on Residential Property,"* a rebate program for encouraging City residents to plant trees on their properties.

Madison, Wisconsin

Working with faculty oversight, students at the University of Wisconsin-Madison School of Public Affairs researched and wrote a report detailing the community and governmental GHG inventory for the City of Madison, and also provided three policy recommendations based on the city's strategic plan. The City of Madison has the goal of reducing its GHGs by 80% by 2050, based on a 2010 baseline. In order to accomplish this, the City must employ an unknown, but clearly very large, number of programs to reach this target. The government completes a GHG inventory on a regular basis, making this the fifth government level GHG inventory completed for the City. The report provides the second community-wide inventory, as these inventories are much more time intensive and are therefore completed less frequently. The sectors accounting for the highest emissions were commercial energy, transportation, and residential energy. The policy recommendations provide one policy per carbon-intensive sector.

This analysis used ClearPath software created by ICLEI. Between 2010 and 2012, the City experienced a 12 percent increase in reported GHG emissions. This significant increase comes from including new emissions sources and uncertainty about geographic boundary comparisons. The 2010 report did not specify the boundaries within which data were collected, making duplication of those boundaries impossible for future reporting.

Commercial energy made up 46 percent of emissions, residential made up18 percent, and transportation 19 percent. In 2012, electricity accounted for over 55 percent of total yearly GHG emissions, even though it only accounted for 27 percent of the total energy created by source. Natural gas comprised 51 percent of the total energy created in 2012, even though it contributed only 22 percent of the total GHGs for the year. These findings are similar to those presented above for College Park.

This report presents one policy recommendation per highest consuming sector—commercial, residential, and transportation. The report stresses that these policies were chosen from the

City's sustainability plan, which has a list of 77 potential policies, and the recommended policies have some of the most promising political potential and highest potential GHG reductions. Table 3.1 explains each policy and the sector it targets for reduction.

Table 3.1 GHG Mitigation Policy Types and Description

Category: Policy Title	Policy Description	Expected Results
Commercial: **Commercial Building Energy Efficiency Benchmarking**	Requires all commercial building owners to publically report energy consumption. Uses Energy Star Portfolio Manager to categorize consumption into percentiles, which is the only data published publically. Incentivizes building owners to increase efficiency, since renters will want spaces that are more energy efficient. Must be mandatory to be effective, enforced with fines.	Building's efficiencies improve 2.4% per year over a 3-year period. If all buildings, regardless of size, are included in the ordinance, there should be ~5,859 $MTCO_2e$/year, and cumulative savings of $724,043/year.
Transportation: **Bus Rapid Transit**	Identify highly traveled transit corridors and create routes with 10-minute, peak-hour bus headways. Create dedicated bus lanes, sixty-foot articulated busses, transit signal priority, bike storage onboard, and WIFI. Projections assume increased ridership as service improves, and assumes a diesel electric hybrid, providing a 30-48% reduction of emissions.	Using lower end of 30% efficiency, emissions reductions are about 2126 $MTCO_2e$/year for the entire bus system.
Residential: **Solar Electricity Generation**	Bulk purchase solar panels, with the goal of 200 kW capacity installed per year, which comes to 1 MW by 2020. Assumes $5/W installation cost at $0.118/kWh.	Through 2020, emissions reduced by 2,355 $MTCO_2e$ through 2020. Cost savings could be $370,000 by 2020.

The Madison report makes GHG emissions projections through 2030 with both conservative and optimistic impacts of the three analyzed strategies. All projections lead to a future where the City of Madison has not reduced its net carbon footprint, but point to a future where the net will be lower than it would have been without the programs.

Several recommendations will improve Madison's inventory process in the future. First, they must identify a consistent timeline for a community baseline year as well as systematically document emissions to make comparisons between years. Also, creating a staff position will help with the uniform and consistent tracking of data. This will ensure that data is complete and usable when it comes time to create an inventory, streamlining the process to make it more efficient and accurate.

Key Lessons

These reports offer three takeaways for the City of College Park:

(1) To make significant GHG emissions reductions, many different programs need to be initiated at the same time, which may call for additional City staff focused on these programs.

(2) Data gathering and tracking that is uniform over time will produce better reports for any community to work with.

(3) College Park is not alone in seeking to reduce its carbon footprint, and the City of Madison is setting a high bar among Big 10 universities.

Nationwide List of GHG-Related Sustainability Activities, by Locality

As part of this report, the GHG reducing actions of localities across the U.S. were surveyed as possible examples for future College Park study and implementation. Table 3.3 summarizes the names and activities. The items listed fall into the following categories: community development and land use; electricity reduction; transportation and infrastructure; waste minimization, reuse, and recycling; water quality and conservation; and education and engagement.

Table 3.3 GHG-Related Sustainability Actions in U. S. Localities

Program/Activity	Description	Locality
	Community Development and Land Use	
Development Policies to Encourage Sustainable Growth	Planning and zoning policies that promote sustainability, including revising existing policies and removing regulatory barriers to promote sustainability	Aurora, IL
Planting of Native Vegetation	Removing regulatory barriers and requiring installation and proper maintenance of local vegetation to minimize impact of rain events, flooding pollution, and run-off	Aurora, IL
Sustainable Local Economy and Green Collar Workforce	Training local workforce for emerging technology jobs and incentives to attract businesses providing green jobs	Aurora, IL
Strategic Planning for City Sustainability	Strategic planning process that considers larger goals and uniting individual programs under specific themes that cross all parts of the government to go beyond incremental sustainability progress; it includes creating a tools for measuring ongoing success.	Mountlake Terrace, WA *This is in the CP strategic plan
Engage Community Groups	Adding existing local groups to City's communication network, cultivating leadership in individuals, and supporting volunteer efforts in environmental mapping, environmental stewardship and sustainability events. Celebrating and publicizing involved volunteer groups	Mountlake Terrace, WA
Mixed-Use Commercial Center	Areas where housing is strongly encouraged above the first floor commercial establishments in projects that include design details and pedestrian-friendly development. Focus on design, mixed use, street orientation, and mitigating traffic impacts	Northampton, MA *Not major part of CP's redevelopment plan, but should be
Local Gardening	Community gardening that engages citizens and supports healthy eating	South Lake Tahoe, CA *This is in the CP strategic plan

Increasing Green Spaces	Increase green areas and promote urban forestry as well as building features such as green roofs	Atascadero, CA
Making Buildings Solar-Ready	Encourage builders to make buildings solar-ready during new construction, even if solar panels are not planned to reduce the price of future installation	Goleta, CA
	Electricity Reduction	
Automatic Lighting/Lights and Computers off at night	Movement sensors in city-operated buildings reduce hours with lights on. All employee lights and computers shut off at night with some penalty when devices left on	Bell, CA San Pablo, CA
"Save Power Days" Program	Up to $100 in credits by reducing energy use on specific days and times (known in advance). The more energy saved, the more money earned. This program is run through the Southern California Edison (SCE) the power company.	Adelanto, CA
Solar Co-Op for Residents	Neighborhood solar co-ops use collective buying power and a competitive bidding process to select a single company that will install systems on participating homes. The average savings per household is 30%. College Park engaged with a solar co-op one year ago and could be done on a regular basis led by the city.	College Park, MD University Park, MD
Plug load sensors	Controls at workstations in city buildings help reduce energy consumed by computers, printers, and other electronic devices by shutting down systems after 30 minutes of inactivity.	San Pablo, CA
Residential Rebate Program for Energy Efficiency Improvements	Menlo Park financed up to $4,000 in rebates for citizens through the Energy Upgrade California Program. Similar programs for Maryland are listed on here: http://energy.maryland.gov/allincentives.html	Menlo Park, CA

Transportation and Infrastructure		
Encourage Alternative/Public Transportation	Increasing available bike paths and better management and coordination of public transportation.	Aurora, IL South Lake Tahoe, CA Atascadero, CA Bell, CA
Green Fleets Program	Working through grants and outside funding agencies to introduce green vehicles, such as electric/hybrid/fuel cell vehicles, to the city fleet.	Aurora, IL
Sustainable Roadways	Modifications to standard specifications for traffic signals, street lights and pavement types, while still ensuring public safety.	Aurora, IL
Technical Assistance and Incentives for Residential/Commercial Green Properties	To overcome public resistance to incorporating energy efficiency, green buildings, or adaptive re-use due to costs and lack of experience, projects that offer technical assistance and incentives to encourage early adopters among residential and commercial property owners.	Aurora, IL
Increase Sustainability of City-Owned Buildings	The City encourages the adoption of emerging technologies by example in its own operations and construction projects, e.g., LEED. The projects set and implement new standards to improve energy efficiency for new buildings, and in retrofitting existing buildings to maximize energy efficiency.	Aurora, IL
Promote Commute Trip Reduction (CRT) Programs	Financial incentives like bus passes and preferred treatment for carpoolers, shower and locker facilities for bicyclists, flexible work schedules (four 10-hr days), telecommuting, reduced parking availability to encourage transit use, mandatory reductions in single-occupancy vehicle commuting for organizations with 100+ on-site employees.	Mountlake Terrace, WA Aurora, IL Atascadero, CA Bell, CA
Waste Minimization, Reuse, and Recycling		
Sustainable Procurement Policies	A city’s purchasing power can create a market for sustainable products. Expanded demand will encourage vendors to offer more sustainable choices, which then become available for the larger consumer market.	Aurora, IL

	Projects include developing a sustainable products procurement policy and creating sustainable internal office policies and practices.	
Expand Reuse and Recycling Option	Increase availability of a wider range of recycling services, attract new businesses related to adaptive reuses and/or recycling, and use the city's contract to encourage waste minimization. Added a recycling bin to every trash receptacle available.	Aurora, IL Los Gatos, CA
Plastic Bag Ban	Ordinance banning the use of plastic bags by all grocery stores and food vendors as well as single-use carryout bags and paper bags with <40% recycled materials. Noncompliance results in a warning citation for the first violation, and fines thereafter.	South Lake Tahoe, CA
Zero Waste	Goals and tips for a zero-waste lifestyle published online along with recycling directions for apartments and businesses.	South Lake Tahoe, CA
City-Wide Garage Sale	A large-scale re-use project that helps households part with unneeded goods that may be useful to others. Proceeds could be donated to the city and could be incorporated into a larger community green event.	West Linn, OR
Public Salvage of Materials before Demolishing Buildings	Encourage the use of salvaged and recycled-content materials and other materials that have low production energy costs for building materials, hard surfaces, and non-plant landscaping. Require sourcing construction materials locally, as feasible.	Los Gatos, CA
	Water Quality and Conservation	
Incorporate Low Stormwater Impact (LSID) Strategies	Manage stormwater at its source using six strategies: • Conservation design that preserves open space (cluster development, reduced pavement width and setbacks) • Infiltration practices that capture and infiltrate runoff (porous pavement, rain gardens, infiltration basins and trenches) • Storage (rain barrels and cisterns, green roofs, storage in landscape islands, and tree/shrub/turf depressions) • Conveyance to slow flow velocities and delay peak flows (eliminating	Mountlake Terrace, WA

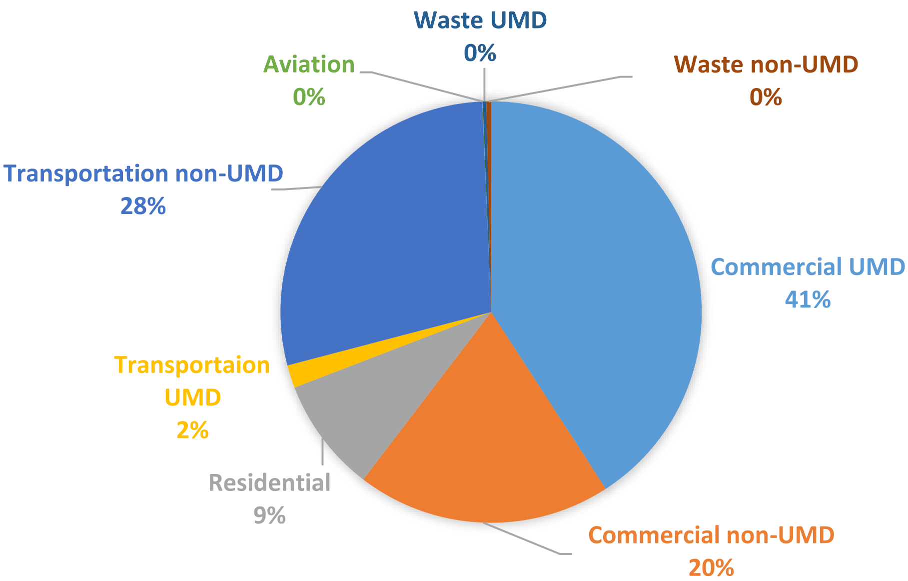
	curbs and gutters, roughening surfaces, and creating grassed swales and grass-lined channels) • Filtering to treat and capture pollutants (bioretention or rain gardens, vegetated swales, vegetated filter strips and buffers) • Low impact landscaping considering long term maintenance (planting native plants, reforestation, converting turf to shrubs and trees)	
	Education and Engagement	
Create Public Relations Sustainability Campaign	Education and engagement on sustainable policies and programs using websites, direct mail, public events, and customer service interaction to communicate with constituents to connect people with resources including information on sustainability programs and incentives	Aurora, IL Los Gatos, CA Bell, CA Menlo Park, CA
City Staff and Elected Officials Lead by Example	Training, outreach, coordination and research will help increase awareness and arm City staff and elected officials with the tools to make educated decisions based on resource conservation and life cycle cost.	Aurora, IL
Outreach through Schools, Libraries, Churches, Clubs and Sports Leagues	Programs such as school fundraisers with LED lights, or the Kill-A-Watt Electricity Usage Monitor program where residents check out a device from the library to see electricity use of household electronics	University Park, MD Los Gatos, CA

Appendix A - College Park Community-Scale Greenhouse Gas Emissions Inventory (2010 and 2013)

Introduction

The following report presents a GHG inventory for 2010 and 2013 for the City of College Park. It estimates that the total emissions for College Park in 2010 and 2013 are 410,747 metric tons of carbon dioxide equivalents ($MTCO_2e$) and 438,824 $MTCO_2e$[10], respectively. The report also compares results with the earlier 2007 inventory. At 464,705 $MTCO_2e$ total emissions in 2010 and 2013 were about 6 percent lower than in 2007. College Park GHG emissions total 14.8 and 14.5 $MTCO_2e$ per capita, which is lower than the national level of 17.6 $MTCO_2e$ per capita.[11]

Figure A.1 Percentage of GHG Emissions ($MTCO_2e$) by Sector, 2013



[10] $MTCO_2e$: Carbon Dioxide Equivalent (CO_2e), is a quantity (in Metric Ton that describes, for a given mixture and amount of greenhouse gas, the amount of CO_2 that would have the same global warming potential, when measured over a specified timeframe (generally 100 years).

[11] World Bank, 2010. Available online: http://data.worldbank.org/indicator/EN.ATM.CO2E.PC

Figure A.1 shows total emissions by proportion from different sectors and broken down by the non-UMD College Park community and the University of Maryland in 2013. The commercial sector[12] accounted for the largest proportion of total emissions (61 percent), including UMD (41 percent) and non-UMD (20 percent) sources. The second largest emission sector is transportation (30 percent), in which non-UMD sources account for about 28 percent. Aviation emissions are very small, only 0.03 percent of total emissions. About 9 percent of emissions came from residential and the remainder (~1 percent) is from waste.

The following detailed report on College Park's community-scale GHG inventory is divided into six sections. The second section provides definitions about basic terms, the geographic boundary of College Park, data sources, and the methodology followed to estimate GHG emissions. The third section provides an overview of the inventory and reviews trends from 2007 to 2013 by different sectors. The fourth section compares the results of College Park with the City of Madison, Wisconsin, the City of State College, Pennsylvania, and U.S. level data. The fifth section presents further analysis for electricity, natural gas consumption, and transportation emissions, which are the major sources of GHGs in College Park. The sixth section provides recommendations for continuing and improving the inventory in the future and introduces policy recommendations for GHG emission reduction for College Park.

Methodology

The College Park community-scale GHG emissions inventory employs the ICLEI Clear Path GHG Calculator Tool and follows the U.S. Community Protocol. Methodologies consistent with national standards are used to generate a high-quality GHG inventory, which will allow for year-over-year comparisons and replication.

The inventory is bounded by GHG-generating activities occurring within the City of College Park boundary (e.g., electricity consumption) and by calendar years 2010 and 2013. Process highlights include:

- GHGs from energy consumed within the City's jurisdictional boundary including electricity, natural gas, propane, and diesel fuel for backup generation, as well as non-energy related sources such as solid waste. Energy data were collected from Pepco, Metropolitan Washington Council of Governments (MWCOG), the College Park city government, and the University of Maryland's GHG emissions report. Demographic data, such as population and

[12] Community GHG emission consists of commercial sector, residential Sector, and transportation sector. Commercial sector includes all commercial activities within boundary of City of College Park, and all the emission from University of Maryland, College Park.

income, were found at the Census Bureau website. Energy data were made available by zip code and sector (i.e., commercial, residential, and government). ZIP codes included 20742, 20741, and part of 20740 (some of 20740 belongs to town of Berwyn Heights).

- Mobile source includes emissions from community transportation, UMD student/staff commuting using UMD fleet, and air travel. Most transportation related data were provided by WMCOG and the UMD carbon emission report.

One special category included in the inventory is renewable energy certificates (RECs) purchased by the University of Maryland, which negate a large portion of emissions from electricity otherwise generated with fossil fuels. The amount of RECs purchased by the University each year varies and it's important to understand gross emissions patterns (excluding RECs). Therefore, results are presented as two scenarios: excluding RECs and including RECs.

This inventory also references the 2007 College Park community inventory, which is the first report about College Park community GHG emission. After correcting for some methodological differences between 2007 and 2010/2013, data from 2007 report offers a good opportunity to compare the GHG emission trend over years.

GHG Emission Result

Table A.1 shows College Park GHG emissions by sectors in 2007, 2010, and 2013. Total GHG emissions in 2010 were 410,747 $MTCO_2e$, which is the lowest among three years (464,705 $MTCO_2e$ in 2007 and 438,824 $MTCO_2e$ in 2013), whether including or excluding RECs. After excluding carbon offset, the 2010 and 2013 emissions (452,105 $MTCO_2e$ and 453,403 $MTCO_2e$, respectively) were very similar, only with a 0.3 percent increase. This growth rate is very different when including RECs—a 7 percent increase from 2010 to 2013.

Although total GHGs are similar in 2010 and 2013, emissions trends across scope and sector show some interesting patterns.[13] Scope 1 and scope 3 emissions increased by 6 percent and 2 percent respectively while the emissions from scope 2 fell by 7 percent between 2010 and 2013. Compared to 2010, the 2013 emissions are characterized by less electricity and more natural gas consumption. This trend was very similar among residential, UMD, and non-UMD commercial categories. UMD transportation emissions in scope 1 also had a significant change—diesel fuel

[13] The GHG protocol categorizes GHG emissions into three scopes. Scope 1: All direct GHG emissions; Scope 2: Indirect GHG emissions from consumption of purchased electricity, heat or steam; Scope 3: Other indirect emissions, such as the extraction and production of purchased materials and fuels, transport-related activities in vehicles not owned or controlled by the reporting entity, electricity-related activities (e.g. T&D losses) not covered in Scope 2, outsourced activities, waste disposal, etc.

consumption at UMD increased tenfold as they shifted away from B5 fuel in 2013. The emission from solid waste decreased by 16 percent but the contribution was rather small as well because it made up only a small proportion of the total emission (less than 1 percent).

Table A.1 GHG Emissions ($MTCO_2e$) by Sector and Scope, 2007-2013

	2007	2010	2013	*07-13%*	*10-13%*
Residential Buildings					
Electricity	27,633	25,656	23,408	*-15.3%*	*-8.8%*
Natural Gas	22,531	16,115	16,400	*-27.2%*	*1.8%*
Comm. Buildings – *UMD*					
Electricity	53,945	52,019	51,613	*-4.3%*	*-0.8%*
Natural Gas	135,184	125,827	132,931	*-1.7%*	*5.6%*
Propane	416	323	587	*41.1%*	*81.7%*
Diesel fuel	78	144	37	*-52.6%*	*-74.3%*
Comm. Buildings – Community *(Non-UMD)*					
Electricity	85,698	79,725	71,172	*-17.0%*	*-10.7%*
Natural Gas	12,867	15,809	17,447	*35.6%*	*10.4%*
Transportation – *UMD*					
Gasoline	3,863	3,871	3,862	*0.0%*	*-0.22%*
Diesel	633	370	3,873	*511.8%*	*946.8%*
Natural Gas	2	1	0	*-100.0%*	*-100.0%*
E85	20	228	234	*1070.0%*	*2.6%*
B5	2,144	2,659	0	*-100.0%*	*-100.0%*
Transportation – Community (Non-UMD)					
Gasoline	114,878	121,371	124,279	*8.2%*	*2.4%*
Diesel	4,161	4,396	4,501	*8.2%*	*2.4%*
Aviation	453	150	157	*-65.3%*	*4.7%*
Solid Waste	2,471	3,441	2,902	*17.4%*	*-15.7%*
Scope 1*	177,728	165,347	175,371	*-1.3%*	*6.1%*
Scope 2	167,276	157,400	146,193	*-12.6%*	*-7.1%*
Scope 3	121,963	129,358	131,839	*8.1%*	*1.9%*
REC offsets	-2,262	-41,358	-14,579	*544.5%*	*-64.7%*
Total (include offsets)	**464,705**	**410,747**	**438,824**	***-5.6%***	***6.8%***
Total (exclude offsets)	466,967	452,105	453,403	*-2.9%*	*0.3%*
Population of College Park**	27,225	30,463	31,274	*11.9%*	*14.9%*
Emissions per person ($MTCO_2e$/person)	17.15	14.84	14.50	*-13.5%*	*-15.5%*

Similar to the change from 2010 to 2013, the reduction in electricity emissions was the major reason for lower emissions in 2013 compared to 2007 (reduced by 13 percent). However, the change was attributed to scope 3 (increased by 8 percent) instead of scope 1 (reduced by 1 percent). For UMD transportation in scope 1, diesel emissions in 2013 were five times the emissions of 2007 while the gasoline emission did not change much. Emissions from E85 also increased by ten times but again, the share was rather small. For the non-UMD transportation in scope 3, the additional emissions mainly came from gasoline emission (increase by 8 percent).

Comparative Analysis

The first three columns of Table A.2 give a general idea about total emission from different sectors by UMD/non-UMD. From 2010 to 2013, emissions from UMD (including RECs) increased from 145,877 $MTCO_2e$ to 179,812 $MTCO_2e$ (23 percent) while non-UMD emissions reduced from 264,870 $MTCO_2e$ to 259,012 $MTCO_2e$ (2 percent). Compared to the 2007 emission levels, UMD and non-UMD emissions in 2013 fell by 7 percent and 4 percent, respectively. Per capita emissions total 14.84 $MTCO_2e$ and 14.50 $MTCO_2e$ in 2010 and 2013, respectively.

The last two columns of Table A.2 show the GHG emissions of Madison County, Wisconsin. Madison County is a much larger than College Park with a larger population and industries. Although the demographic and economic characters are rather different, Madison is still comparable due to a detailed GHG emission inventory for 2012 and a similar methodology used in the inventory. To make the numbers more meaningful, the comparison is based on the per capita and scenarios excluding offsets and/or industrial activities.

Table A.2 also considers the income difference between years and locations. Income per capita is used instead of GDP per capita since there is no reliable data source for GDP. For College Park, emissions per dollar earned was slightly higher in 2013 (0.84 MTCO2e/1,000$) than 2010 (0.75 $MTCO_2e$/1,000$). Although Madison has a higher emission on per person basis, the emission on income base is much smaller than College Park. In other words, for every thousand dollars of income earned by residents, the GHG emission was 0.75 $MTCO_2e$ in College Park and 0.57 $MTCO_2e$ in Madison in 2010.

Table A.2 - GHG Emission ($MTCO_2e$) Comparison, City of College Park and Madison County by Sector, 2007-2013

	College Park, MD			Madison, WI	
	2007	**2010**	**2013**	**2010**	**2012**
Commercial	288,188	273,847	273,787	1,574,096	2,157,848
UMD	189,623	178,313	185,168	-	-
non-UMD	98,565	95,534	88,619	-	-
Residential	50,154	41,771	39,808	859,582	823,390
Industrial	-	-	-	373,254	623,245
Transportation	126,154	133,046	136,906	1,073,720	822,705
UMD	6,662	7,129	7,969	-	-
non-UMD	119,039	125,767	128,780	-	-
Aviation	453	150	157		
Waste	2,471	3,441	2,902	73,641	81,290

UMD	-	1,793	1,254	-	-
non-UMD	-	1,648	1,648	-	-
REC Offsets	-2,262	-41,358	-14,579	0	0
Total	464,705	410,747	439,824	3,954,293	4,508,478
UMD	194,023	145,877	179,812	-	-
non-UMD	268,211	264,870	259,012	-	-
UMD (exclude offset)	196,285	187,235	194,391	-	-
Population	27,225	30,463	31,274	233,209	233,209
Per capita	17.15	14.84	14.5	16.96	19.33
Income per capita (k$)	17.08	18.12	17.07	29.93	30.39
Emission/income ($MTCO_2e$/1000$)	0.95	0.75	0.84	0.57	0.63

According to the World Bank, the average CO_2 emission per capita in the U.S. was 17.6 $MTCO_2e$ in 2010. The U.S. national average is so much greater than College Park because it includes heavy industry and other sources not included in the College Park inventory.

State College, the home of Pennsylvania State University, also has a GHG emission for CY 2006. The population estimated for State College is 33,604 in 2006 and the population in College Park is 30,463 in 2010. According to Table A.3, total GHG emissions per capita in College Park are slightly higher than State College, which can be attributed to more electricity and on-site fuel (natural gas and stationary combustion) emissions, and a smaller population. The two cities had a very similar emission per capita in transportation sector and College Park's solid waste emission was slightly lower than State College.

Table A.3 Comparison of GHG Emissions ($MTCO_2e$) per capita, College Park and State College by Sector, 2007-2013

	College Park			**State College**
	2007	**2010**	**2013**	**2006**
Electricity	6.15	5.18	4.67	3.76
On-site fuel	6.29	5.20	5.35	3.75
Transportation	4.62	4.37	4.37	4.42
Solid Waste	0.09	0.08	0.11	0.17
Total	17.15	14.84	14.5	12.1

Contextual Trends and Detailed Sector Level Analysis

GHG Emission, Energy, and Carbon Intensity

As shown in Table A.4, the total energy consumed for 2013 totaled 6.1 million MMBtu compared to 5.9 million MMBtu in 2010. Natural gas use was significantly lower in 2010, which resulted in a smaller amount of total energy consumed in that year compared to 2007 and 2013. By comparing energy content vertically (see Table A.4), it is clear that most of the energy used is from electricity, natural gas, and gasoline consumption. Among them, the sum of energy created by natural gas and gasoline was less than gas, which shows that the primary energy provider in College Park is natural gas. However, although natural gas generates the most energy, the GHG emission from natural gas was very similar to electricity, indicating that electricity used in College Park was more carbon intensive than natural gas.

Because electricity and natural gas consumption is closely related to the weather, the inventory analysis has introduced the definition of Degree Days.[14] The baseline temperature is set at 65 °F. Heating Degree Days (HDD) used in this analysis measures how many days in a year when outside air temperature was lower than the base temperature. A higher HDD may lead to higher natural gas consumption since more natural gas has to be burnt in this year. Cooling Degree Days (CDD) measures how many days in a year when outside air temperature was higher than the base temperature. A higher CDD refers to a hotter year and the air conditioner may run for a longer time, affecting electricity consumption.

The electricity energy per CDD and natural gas energy per HDD varied in different years and thus temperature change alone cannot explain the energy change. According to Table A.4, the CDD in 2010 was higher than 2007 and 2013, which matched with higher energy created by electricity in 2010. However, the HDD cannot explain natural gas consumption. While HDD in 2007 was the lowest among three years, the natural gas energy in that year was the highest. The reasons might be complex (e.g. a variant price, the economic recession, etc.) and it would be difficult to explain with current data.

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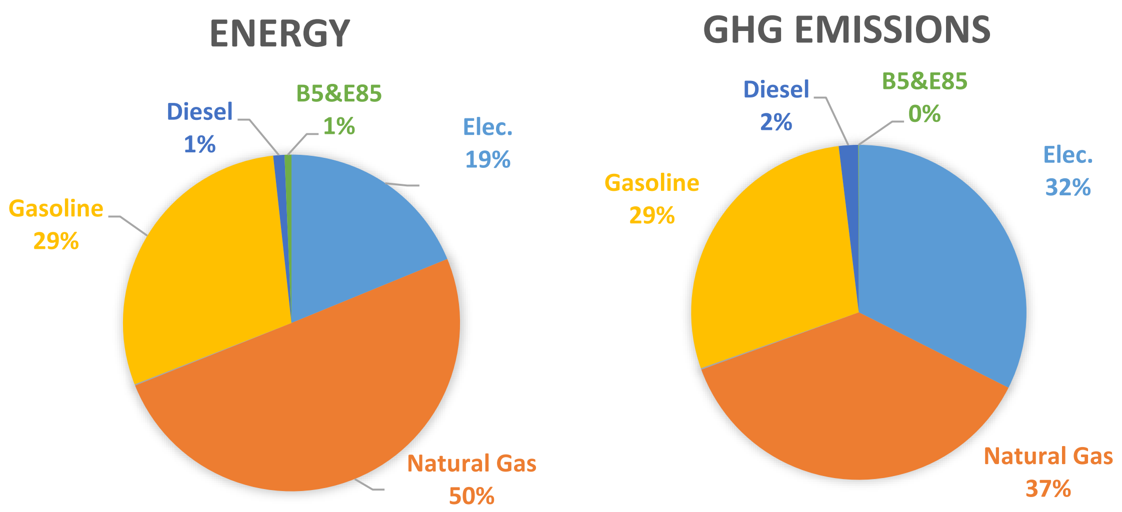
[14] Degree Day is a measurement designed to reflect the demand for energy needed to heat/cool a building. It is derived from measurements of outside air temperature. The heating/cooling requirements for a given structure at a specific location are considered to be directly proportional to the number of Heating Degree Days/Cooling Degree Days at that location

Table A.4 Energy (MMBtu), GHG Emission ($MTCO_2e$), and Carbon Intensity by Source, 2007-2013

	2007		2010		2013	
	Energy	GHG	Energy	GHG	Energy	GHG
Electricity	1,098,757	167,276	1,111,958	157,400	1,092,396	146,193
Carbon Intensity	0.152		0.142		0.134	
Natural Gas	3,206,699	170,584	2,966,672	157,752	3,136,397	166,778
Carbon Intensity	0.053		0.053		0.053	
Stationary Combustion	7,610	494	7,134	467	9,955	624
Carbon Intensity	0.065		0.065		0.063	
Gasoline	1,636,585	118,741	1,728,088	125,242	1,767,849	128,141
Carbon Intensity	0.073		0.073		0.073	
Diesel	64,572	4,794	63,750	4,766	112,536	8,474
Carbon Intensity	0.074		0.075		0.074	
B5&E85	29,276	2,164	39,047	2,887	3,160	234
Carbon Intensity	0.074		0.074		0.074	
Total energy	6,043,499		5,916,649		6,120,293	
CDD (°F)	1,447		1,604		1,295	
Elect. Energy/CDD	759		693		692	
HDD (°F)	4,363		4,519		4,533	
NG energy/HDD	735		656		844	

Figure A.2 presents the energy and GHG emissions from each source, which shows more clearly the relative carbon intensity of each source. While the percentage of gasoline, diesel, B5&E85 were almost the same in energy and GHG emission pie charts, the electricity and natural gas were very different. Although 50 percent of the energy was from natural gas in 2013, it only provided 37 percent of total GHG emission. Additionally, electricity made up 32 percent of total GHG emissions but only provided 19 percent of total energy. Among all six analyzed energy sources, natural gas was the least carbon intensive in these years.

Figure A.2 Percentage of Energy (MMBtu) and GHG Emissions ($MTCO_2e$) by Source, 2013

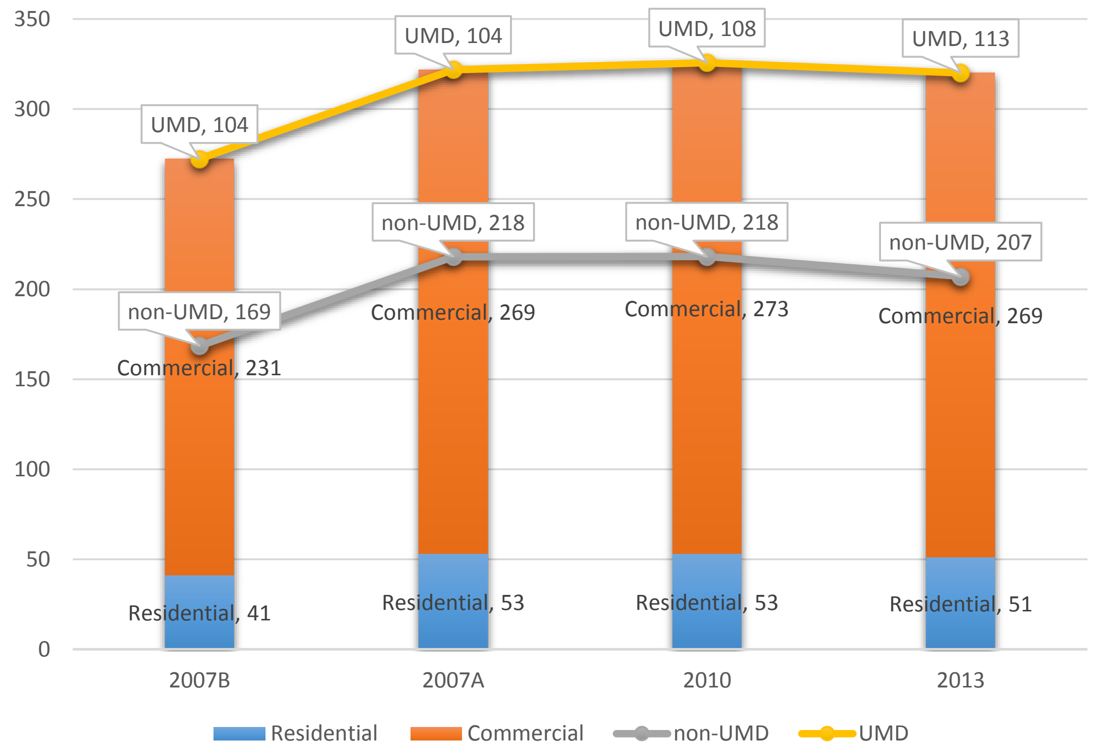


Electricity Sector

Figure A.3 gives more details about electricity consumption from 2007 to 2013. The first two stacks represent the electricity consumption in 2007 from different data sources. For 2007B, the data comes from the 2007 inventory report. And 2007A was based on 2007B but recalculated some numbers with the methodology for 2010 and 2013. Thus, the 2007A is more comparable than 2007B. Figure A.3 shows the total electricity consumption, the proportion of each sector, and their changes over years. Commercial electricity accounts for up to 80 percent of total consumption, most of which belonged to non-UMD. However, the actual electricity consumption would be higher than what Pepco has provided. The 27.5 MW combined heat and power plant at UMD generates about half of electricity used in the campus. The UMD plant burns natural gas to produce electricity with higher efficiency but a lower GHG emission. It also produces chilled water for air conditioning using steam in summer, which further reduced electricity consumption.

Total electricity consumption has been very similar among the three years, with a slightly higher level in 2010. UMD electricity consumption increased steadily (from 104 million kWh in 2007 to 108 million kWh in 2008 and 113 million kWh in 2013) while non-UMD stayed the same (218 MkWh for 2007 and 2010) or even decreased (218 MkWh in 2010 to 207 MkWh in 2013). Residential electricity consumption did not change over time but commercial consumption was slightly higher in 2010 (273 million kWh) than 2007 and 2013 (both 269 million kWh).

Figure A.3 Electricity Consumption (million kWh) by Sector, 2007-2013

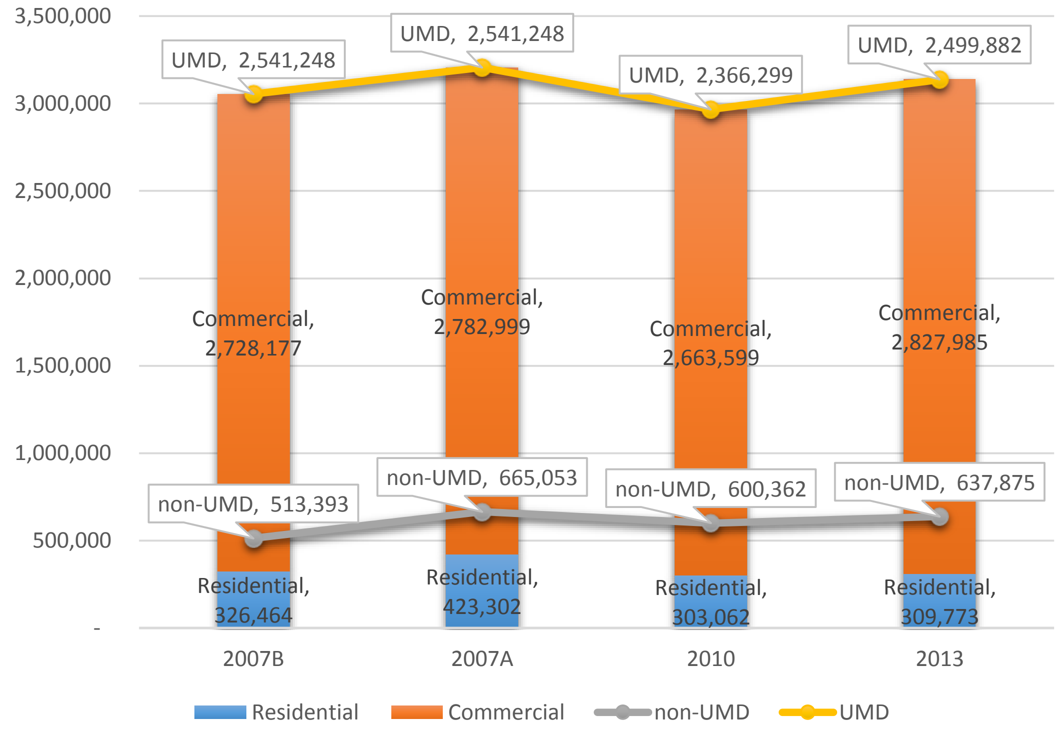


What's more, the actual emission from electricity consumption in UMD should be even less than what has been presented in Figure A.3. Each year, UMD purchased RECs in varying amounts depending on the year's carbon emission target. For example, the University purchased 66,000 RECs in 2010, which resulted a significant reduction in the total GHG emission according to the result estimated in this inventory. One of the reasons is that the Climate Action Plan targets set by UMD for 2012, when UMD need to reduce 15 percent of carbon emission based on 2005 emissions.

Natural Gas Sector

Natural gas consumption in Figure A.4 shares characteristics with electricity consumption. Commercial used about 90 percent of natural gas consumed in College Park and the 2010 natural gas consumption was the lowest among the three years. Since the Combined Heat and Power plant burns natural gas to generate electricity, UMD used about 80 percent of natural gas consumed in College Park. This is a large percentage compared to a 30 percent use of total electricity by UMD. Annual CO_2 saving from the CHP plant has reached 53,000 tons (equals to 48,081 $MTCO_2e$) because of a doubled steam efficiency and a cleaner source for electricity generation. Compared to 100 percent natural gas, the energy mix for PJM electricity consists coal (44 percent), natural gas (17 percent), nuclear (35 percent), and renewable (1 percent).

Figure A.4 - Natural Gas Consumption (MMBtu) by Sector, 2007-2013

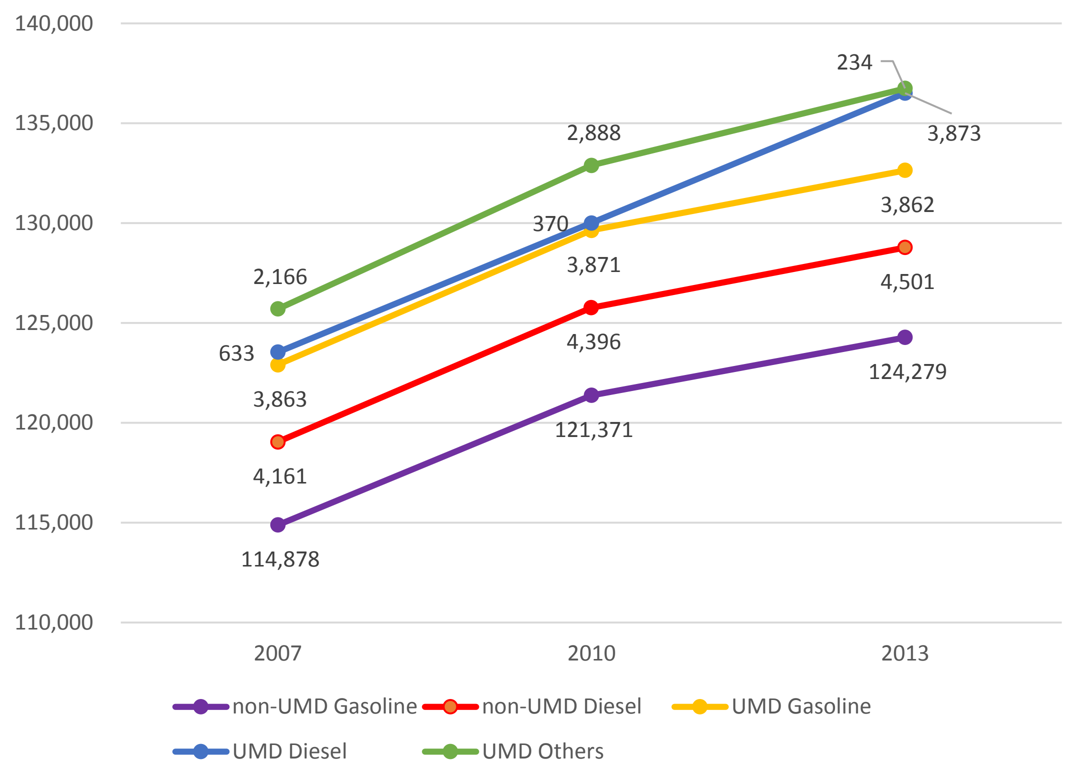


Another difference is that all natural gas consumption reached the lowest level in 2010, including Commercial, Residential, UMD, and non-UMD. One possible reason is the 2008 economic recession affected the natural gas consumption. In 2013, the consumption increased a little, indicating a slow economic recovery after six years. The pattern of natural gas consumption may be most obvious and sensitive to economic conditions because 50 percent of the energy has been provided by natural gas instead of electricity and other energy sources.

Transportation Sector

Figure A.5 shows emissions from different transportation fuel in UMD and non-UMD. From emissions the trends, it is clear that non-UMD gasoline consumption has increased meanwhile the diesel consumption has changed little over past six years. And non-UMD gasoline consumption alone could account for over 90 percent of total emissions from transportation. Fuel used in UMD is for the UMD fleet only and does not include personal vehicle traveling from students or faculties. The gasoline consumption was stable but there is a sharp increase in diesel consumption from 2010 (370 $MTCO_2e$) to 2013 (3,873 $MTCO_2e$). Also emission from other fuels, mainly E85 and B5, has fallen from 2,888 $MTCO_2e$ to 234 $MTCO_2e$. The rise in diesel consumption other than gasoline or other fuels would not have contributed much to the GHG emissions since all these fuels have a similar carbon intensity.

Figure A.5 Transportation GHG Emissions ($MTCO_2e$) by Sector, 2007-2013



Recommendations

<u>Inventory and Data</u>

The College Park Community inventory collects data on carbon emission activities in the City boundary and analyzes the data by different scopes and years. Also, the inventory includes data from 2007 report, recalculated using current methodology to make it comparable. Although the information is rather comprehensive, some improvements are still needed. The most important is to ensure the data is complete. Missing from the inventory is emission data on wastewater processing in all three years.

Also, data has to be accurate. Data from City government and MWCOG are not recorded for each year. For example, transportation data from MWCOG did not include year 2010 and 2013. Thus, estimates based on other years can hardly reflect the real emission. Moreover, the different methodology used in 2007 has made comparison difficult and thus increased uncertainty.

Another issue is that the data always includes emissions from areas outside the boundary of College Park. For example, the electricity and natural gas data provided by Pepco was sorted by zip code. However, zip code 20740 has includes both part of the City of College Park and the entire town of Berwyn Heights. The inventory analysis adjusts the data by using a population percentage to make a rough estimate of electricity and natural gas consumption in College Park.

Finally, the demographic data comes from the Census Bureau, which only conducts a population census every ten years. The most recent one was in 2010 and 2013 population data came from the American Community Survey 2013 five-year estimate. However, there is no similar estimate data for 2007 or the data provided by various ACS were not complete. For example they include only the City of College Park but not zip code 20742 or the town of Berwyn Heights. This has increased the difficulty of data analysis on a per person basis.

It is important to keep a continuous inventory to effectively track College Park's GHG emissions over time. The City should try to record different carbon emission sources, especially in the years of inventory. Also, each inventory should use similar methodology to make results comparable, which will make a long-term carbon inventory possible.

Projections

Among College Park's GHG emissions, commercial are the largest share. As shown earlier, more than 60 percent of emissions came from commercial uses and two-thirds of the commercial emissions were from UMD in each year. The share of commercial UMD may rise for the next few years since student enrollment may rise during the economic recession. This may further reduce electricity and natural gas GHG emissions since the electricity generated by UMD is cleaner than the electricity purchased from Pepco, because the University uses the CHP plant and owns a 630kW solar array that powers one of the campus buildings.

UMD's Sustainability Council has achieved significant targets in creating a greener campus. Not only have they used the student sustainability funds to purchase RECs to lower total emissions in College Park, they also monitored the GHG emissions of every carbon related activity, such as the transportation emissions, through a system capturing vehicle flow inside the campus. Another big improvement from 2007 to 2013 is the gradually strengthened recycling system, which reduces carbon emission from solid waste.

However, the methodology of the UMD GHG inventory is different from the current inventory, which makes it difficult to combine or compare. Further cooperation between UMD and College Park will share experiences and establish a better system to track the carbon activity for both UMD and College Park community.

Additionally, electricity has been the most carbon intensive energy source in College Park from 2007 to 2013 due to the high proportion (40 percent) of coal in the fuel mix that provides electricity in the PJM market. According to the EPA's eGRID report, the average output emission rate from electricity generation in Maryland is 1,007.04 lb/MWh in 2010. As a reference, the emission rate in California is 613.28 lb/MWh. Encouraging residents to use cleaner energy will lower the electricity emissions in College Park.

Appendix B - City of College Park Government Operations Greenhouse Gas Emissions Inventory (2013 and 2014)

Introduction

This report tracks the greenhouse gas emissions from the government operations of the City of College Park in 2013 and 2014. Along with the two-year comparison, this inventory also looks at trends since 2007, completed by the College Park Committee for a Better Environment. The report also compares College Park's emission with those the City of Frederick government.

Methodology

This inventory uses the ICLEI Clear Path GHG Calculator Tool and follows the standard ICLEI Local Government Operations Protocol for two years of data, 2013 and 2014. This report covers the following sectors:

- Solid Waste Facilities
- Buildings and Facilities
- Street Lights and Traffic Signals
- Vehicle Fleet
- Employee Commutes

Three scopes are evaluated in this inventory. Scope 1 includes natural gas consumption in government-operated buildings and in vehicle fleets using diesel and gasoline. Scope 2 contains the indirect emissions from electricity purchased by the City, which consists of streetlights and electricity consumed by government buildings. Scope 3 is composed of three parts: solid waste facilities, commuting of government employees, and air travel by employees.

The data used to compile the inventory came primarily from the City's Pepco invoices and other records (e.g., solid waste reports, etc). The City offered fleet fuel consumption records, employee zip code information, City-owned streetlight information, and solid waste recycling data. The City's electricity bills were provided by Pepco, and gas bills came from Washington Gas. It should be noted that we used the 2014 employee commuting data as a proxy for the 2014 missing data. Further, the darkness hours for estimating the 2013 and 2014 streetlight operating duration used 2015 data from U. S. Naval Observatory.

The City also purchased renewable energy credits (RECs) and while records verify that RECs were purchased in 2014, a comparable amount of RECs were also purchased in 2013. The general findings will compare emissions with and without RECs.

GHG Emission Results

Government operations are not the major contributor to College Park's greenhouse gas emissions (see the community-scale emissions), representing only 0.6 percent of the total emissions (sum of community and government) in 2013. The City of College Park government operations consumed 20,433 MMBtu in 2013 and 20,712 MMBtu in 2014 and were responsible for the emission of approximately 3,477 $MTCO_2e$ in 2013 and 3,457 $MTCO_2e$ in 2014.

Table B.1 College Park Government Operations GHG Emissions, 2007, 2013, and 2014

	2007	**2013**	**2014**	***07-14%***	***13-14%***
Building Gas	96	83	94	*-2.1%*	*13.3%*
City Fleet - Gasoline	511	122	126	*-75.3%*	*3.3%*
City Fleet - Diesel	19	379	376	*1878.9%*	*-0.8%*
Building Electricity	373	384	380	*1.9%*	*-1.0%*
PEPCO-owned Streetlights - Electricity	442	416	416	*-5.9%*	*0.0%*
City-owned Streetlights - Electricity	19	24	26	*36.8%*	*8.3%*
Air Travel	39	11	13	*-66.7%*	*18.2%*
Reimbursed Personal Vehicle*	11	N/A	N/A	*N/A*	*N/A*
Employee Commuting	541	410	410	*-24.2%*	*0.0%*
Solid Waste	N/A	1,648	1,616	*N/A*	*-1.9%*
Waste Water*	1	N/A	N/A	*N/A*	*N/A*
Scope 1	626	584	596	*-4.8%*	*2.1%*
Scope 2	834	824	822	*-1.4%*	*-0.2%*
Scope 3	593	2,069	2,039	*244.1%*	*-1.4%*
REC offsets	-6	-824	-822	*13600.0%*	*-0.2%*
Total (include offsets)	**2,047**	**2,653**	**2,635**	***28.8%***	***-0.7%***
Total (exclude offsets)	2,053	3,477	3,457	*68.4%*	*-0.6%*

Accounting for the RECs purchased to offset the emissions from electricity consumed in Buildings and Facilities and in Streetlights, the City's net emissions are 2,653 $MTCO_2e$ in 2013 and 2,634 in 2014. The purchase of RECs helped the City reduce emissions by about 823.5 $MTCO_2e$ per year. Based on 2014 data the leading sources of emissions from government operations are solid waste (61 percent), vehicle fleet (19 percent), and employee commutes (16 percent).

There was little change between 2013 and 2014 (see Table B.1). The general reduction resulted from solid waste, which is the largest source of government emissions. Solid waste is also the only sector that experienced an emissions decrease between 2013 and 2014 at a rate of -2 percent, or 32 $MTCO_2e$.

There is no difference between the two-year emissions of employee commutes and streetlights since commuting data are assumed to be the same in the two years, and the streetlight emissions are offset by RECs.

The remaining sectors, buildings and vehicle fleet, show slight growth of 12 and 3 $MTCO_2e$ of GHG emissions. Compared to the data from 2007, the total emissions increased 28 percent from 2,053 to 2,635 $MTCO_2e$. Despite the reduction in four sectors, the increase in total emissions is attributed to the significant emissions in solid waste, which equaled zero in 2007. Figure B.3 indicates that all the purchased electricity by the city's government is offset by RECs, so there are no emissions from scope 2.

Figure B.1 City of College Park Emissions by Sector, 2007

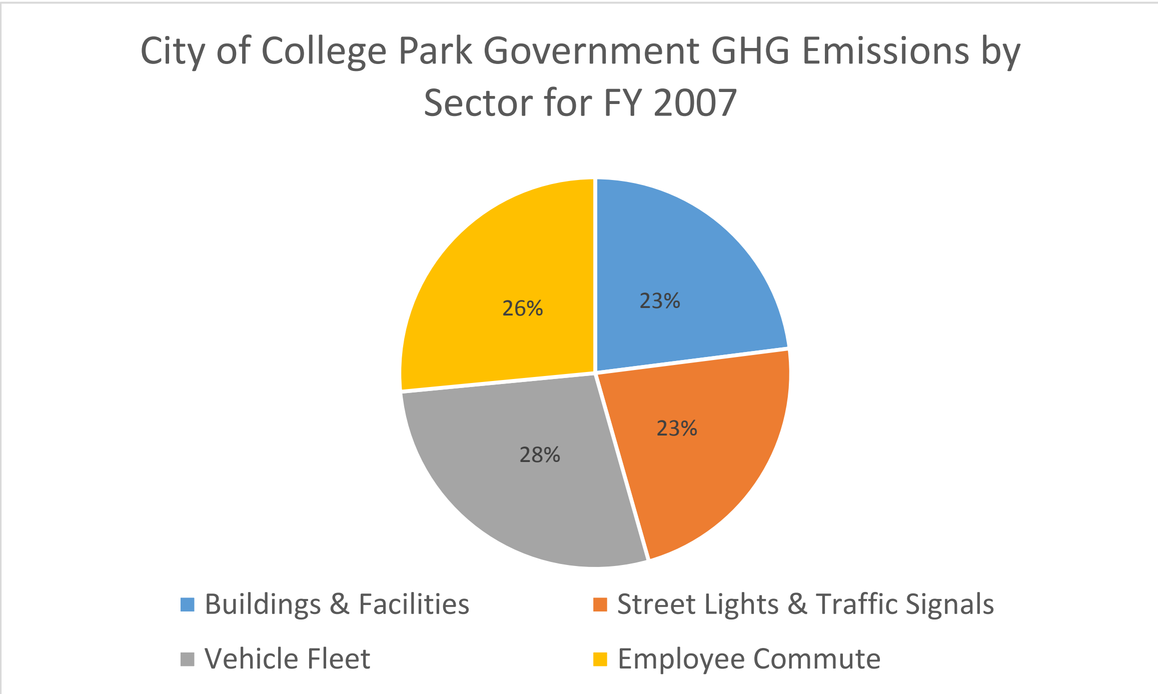


Figure B.2 City of College Park Emissions by Sector, 2014

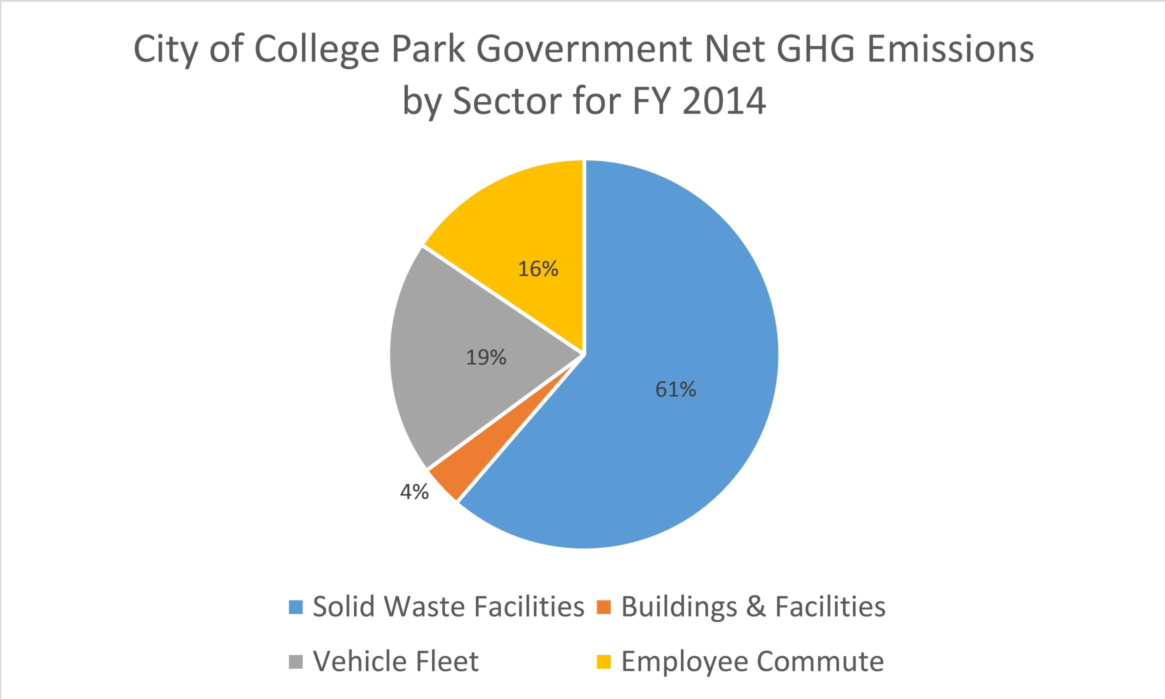


Figure B.3 City of College Park Government Net GHG Emissions by Scope

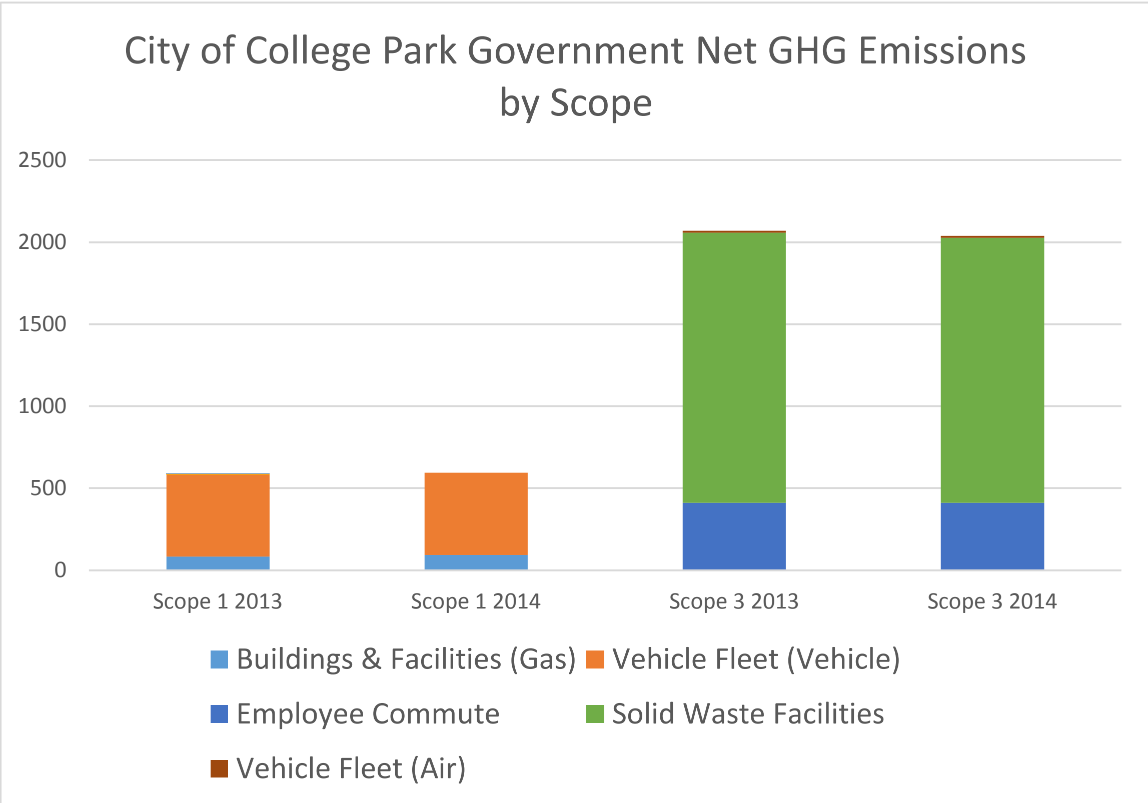


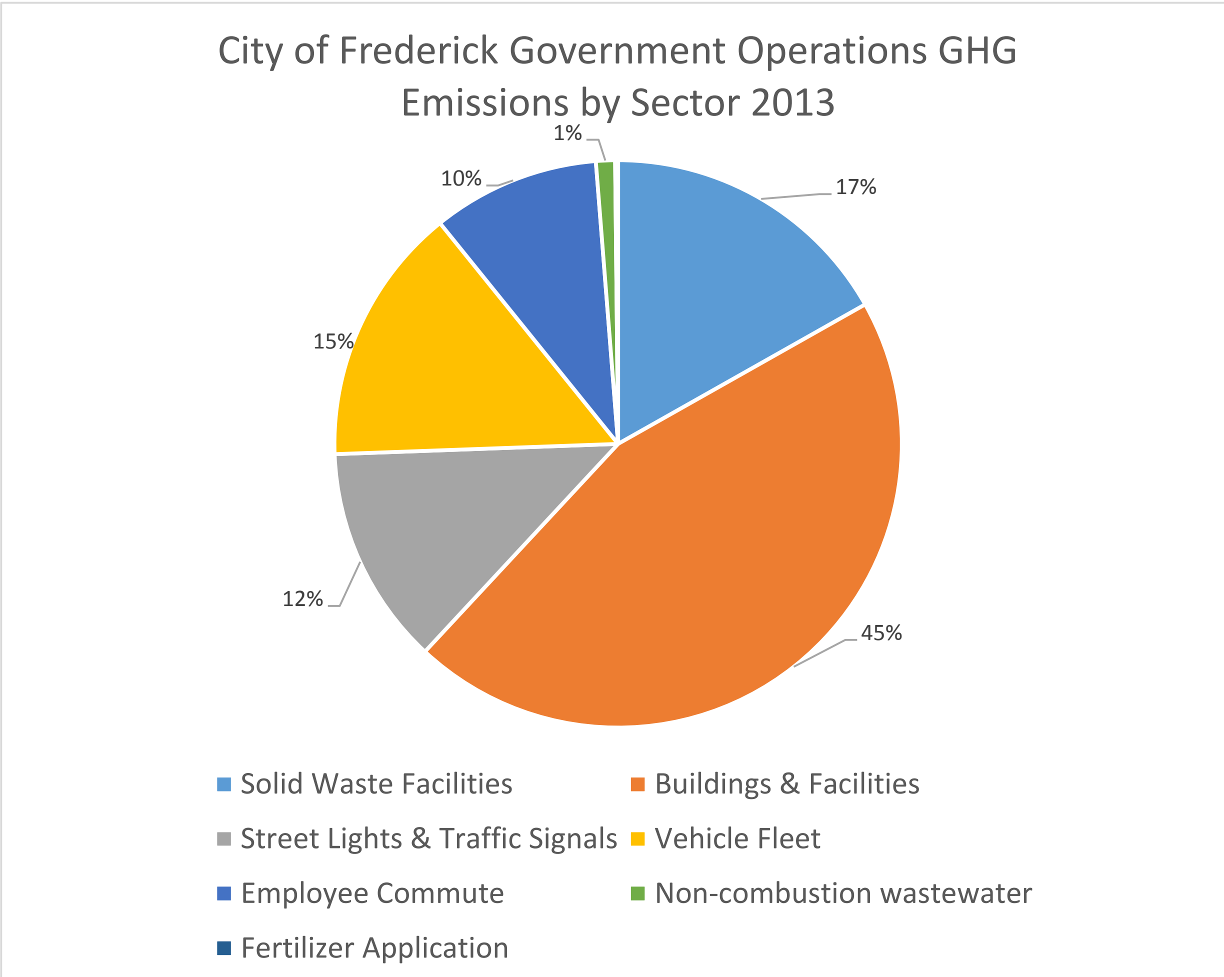
Table B.2 Comparative Study of College Park and Frederick

Sectors \ City and Year	College Park						Frederick	
	2007 GHG Emissions	2007 Energy Equivalent	2013 GHG Emissions	2013 Energy Equivalent	2014 GHG Emissions	2014 Energy Equivalent	2013 GHG Emissions	2013 Energy Equivalent
Solid Waste Facilities	-	-	1,648	-	1,616	-	3,406	-
Buildings & Facilities	469	4,264	467	4,405	475	4,634	9,133	75,077
Street Lights & Traffic Signals	461	3,149	440	3,289	442	3,300	2,531	20,401
Vehicle Fleet	581	6,884	512	7,031	515	7,060	2,991	41,617
Employee Commute	541	6,976	410	5,718	410	5,718	1,934	28,037
Total	2,053	21,282	3,477	20,443	3,458	20,712	14,215	166,155
Per Resident	**0.07**	0.75	**0.11**	0.66	**0.11**	0.67	**0.21**	2.48

As shown in Table B.2, the City of Frederick's emissions are more than four times that of College Park. The difference is mainly attributed to the cities' different sizes. Frederick is one of Maryland's largest cities with a population of 66,893 in 2013. The GHG emissions and energy equivalent per resident are calculated to control the effect of the sizes. It appears that the energy consumption by College Park's government is more efficient than that of Frederick's. Another contributor to the difference is that UMD accounts for a large portion of College Park's gross emissions, making the share of the government operations even smaller.

Buildings and facilities generated only 4 percent of the overall GHG in College Park (Figure B.2) while in Frederick emissions from buildings were the primary GHG source. The results are based on two factors: solid waste accounts for large percent of College Park's emissions, and Frederick has a larger government than College Park.

Figure B.4. City of Frederick Government Operations, 2013



Further Analysis

Solid Waste

The significant increase in College Park's total emissions from 2007 to 2014 is caused by solid waste. In 2007, the GHG emissions from solid waste equal less than 0.1 percent of the total emissions output while GHGs from solid waste in 2013 and 2014 total around 1,600 $MTCO_2e$.

The difference is based not on a fundamental change in managing solid waste, but in the methods employed to estimate GHG emissions. The 2007 inventory did not capture solid waste, but the 2013 and 2014 inventories sought to account for the solid waste collected by the City government. Although solid waste management occurs outside the City at a County landfill, the conservative approach is to attribute the solid waste to the City because the City collects it and has some responsibility over solid waste creation. The primary GHG created from solid waste is methane from decomposition, which has a far greater global warming potential than carbon dioxide from the combustion of fossil fuels.

Buildings

Ten City buildings were in operation in 2013 and 2014, compared to nine in 2007. Their GHGs decreased by 4.25 percent between 2007 and 2014, indicating the buildings are operating more efficiently. With the same gross size of government buildings of 178,473 square feet, the GHG output increased by 1.28 percent between 2013 to 2014. In total, 4,600 MMBtu equivalent energy was consumed in 2014. The energy intensity of the City's buildings is fairly low at 25.8 kBtu/square foot (Table B.3 compared to data from large cities.

Table B.3 Energy Equivalent Consumption by Government Buildings

Building	Building Size (Gross SF)	2013 Energy Equivalent (MMBtu)	2014 Energy Equivalent (MMBtu)	2013 Energy Intensity (kBtu/SF)	2014 Energy Intensity (kBtu/SF)
4500 Knox Rd (City Hall)	12,000	1021	1028	85.1	85.7
4601-A Calvert Rd (Public Services)	2,000	192	206	96.0	103.0
4711 Knox Rd (Old Parish House)	2,732	117	138	42.8	50.5
4912 Nantucket Rd (Youth & Family Services)	6,000	453	531	75.5	88.5
9217 51st Ave (Public Works)	1,600	221	228	138.1	142.5
9219 51st Ave (Public Works, Fleet Garage)	5,544	1088	1130	196.2	203.8
9219-B 51st Ave (Public Works, Supply)	8,200	259	264	31.6	32.2
Calvert Rd School (vacant)	20,000	51	52	2.6	2.6
7310 Yale Ave (Public Parking Garage)	115,735	737	737	6.4	6.4
9217 51st Ave (Davis Hall)	4,664	266	286	57.0	61.3
Total	178,475	4,405	4,600	24.7	25.8

Emissions from buildings and facilities consist of natural gas and electricity consumption. The annual electricity consumed in 2014 is 836,475 kWh. More electricity was consumed in winter (December to

March) because of longer darkness duration and more power usage for streetlights. City Hall and the Public Parking Garage had the most significant utility usage (Table B.4) resulting from their large floor areas and frequent use.

In terms of natural gas, 1,553 MMBtu was consumed in 2013 and 1,751 MMBtu in 2014. 96 percent of the consumption of natural gas happened from November to April, most likely for space heating. The decrease in natural gas consumption resulted in reduced emissions of 31.4 percent in 2014.

Table B.4 Building Emissions: 2007, 2013 and 2014

Building	Sector	2007	2013	2014	2007-2014 Rate	2013-2014 Rate
4500 Knox Rd (City Hall)	Electricity	118	102	93	-21.19%	-8.82%
	Natural Gas	13	14	18	38.46%	28.57%
Subtotal		131	116	111	-15.27%	-4.31%
4601-A Calvert Rd (Public Services)	Electricity	25	26	28	12.00%	7.69%
	Natural Gas	25	0	0	-	-
Subtotal		50	26	28	-44.00%	7.69%
4711 Knox Rd (Old Parish House)	Electricity	2	1	1	-50.00%	0.00%
	Natural Gas	6	6	7	16.67%	16.67%
Subtotal		8	7	8	0.00%	14.29%
4912 Nantucket Rd (Youth & Family Services)	Electricity	36	35	36	0.00%	2.86%
	Natural Gas	12	10	14	16.67%	40.00%
Subtotal		48	45	50	4.17%	11.11%
9061 Rhode Island Ave (Duvall Field, Lights)	Electricity	8	0	0	-	-
Subtotal		8	0	0	-	-
9061-A Rhode Island Ave (Duvall Field, Block House)	Electricity	15	0	0	-	-
Subtotal		15	0	0	-	-
9217 51st Ave (Public Works)	Electricity	65	30	30	-53.85%	0
	Natural Gas	8	0	0	-	-
Subtotal		73	30	30	-58.90%	0
9219 51st Ave (Public Works, Fleet Garage)	Electricity	56	28	29	-48.21%	3.57%
	Natural Gas	57	47	48	-15.79%	2.13%
Subtotal		113	75	77	-31.86%	2.67%
9219-B 51st Ave (Public Works, Supply)	Electricity	48	35	35	-27.08%	0
Subtotal		48	35	35	-27.08%	0
Calvert Rd School (vacant)	Electricity	0	7	7	-	0
Subtotal		0	7	7	-	0
7310 Yale Ave (Public Parking Garage)	Electricity	0	99	99	-	0
Subtotal		0	99	100	-	1.01%
9217 51st Ave (Davis Hall)	Electricity	0	21	22	-	4.76%
	Natural Gas	0	6	6	-	0
Subtotal		0	27	28	-	3.70%
Electricity Subtotal		373	384	380	2.95%	-1.04%
Natural Gas Subtotal		121	83	93	-31.40%	12.05%
Total		**494**	**467**	**473**	**-4.25%**	**1.28%**

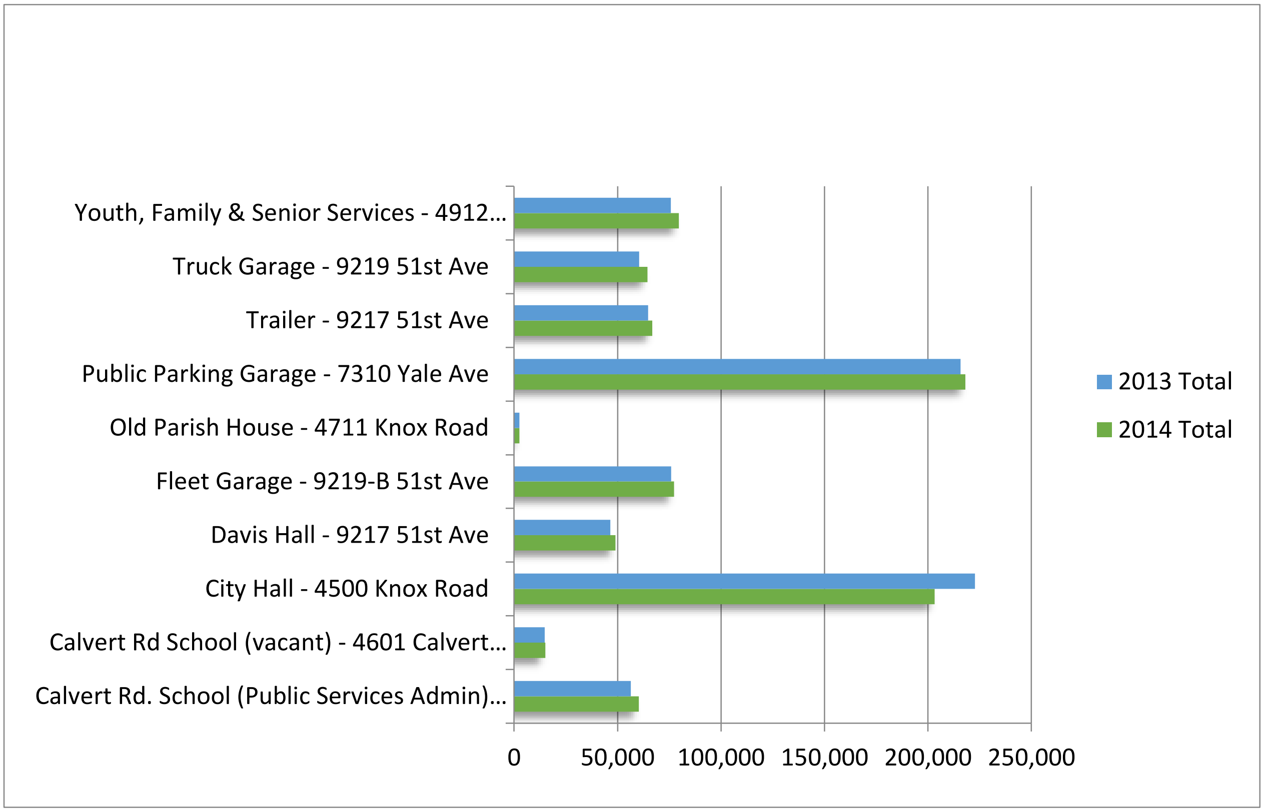


Figure B.5 Electricity Use (kwh) by College Park Buildings

Streetlights

In 2014, College Park had 1,666 streetlights in operation, 92 percent of which belong to Pepco and the rest owned by the City (Table B.5). 442 $MTCO_2e$ was emitted by streetlights in 2014. The annual electricity usage in 2014 was 966,877 kWh, a slight increase from 2013 due to nine new induction streetlights installed by the City.

Induction streetlights are the most energy and economic efficient among all the City streetlights currently in use, 90 percent of which are high-pressure sodium. The two-year streetlight emissions of 882 $MTCO_2e$ were offset by the purchase of RECs, so the emissions for the category were calculated as 0, compared to 461 $MTCO_2e$ in 2007.

Table B.5 Streetlight Information, 2013 and 2014

Year	Ownership	Type of Light	Count	Bulb Wattage	Lamp Wattage	Annual Energy Usage (kWh)
2013/2014	PEPCO	100 Watt - HPS OH	1,095	100	120	566,012
2013/2014	PEPCO	150 Watt - HPS OH	215	150	175	162,072
2013/2014	PEPCO	250 Watt - HPS OH	67	250	295	85,139
2013/2014	PEPCO	400 Watt - HPS OH	3	400	470	6,074
2013/2014	PEPCO	70 Watt - HPS OH	73	70	85	26,728
2013/2014	PEPCO	1000 Watt - Lumen	3	1,000	92	1,189
2013/2014	PEPCO	100 Watt - MV	9	100	130	5,040
2013/2014	PEPCO	175 Watt - MV	38	175	210	34,374
2013/2014	PEPCO	100 Watt - HPS UG	13	100	120	6,720
2013/2014	PEPCO	150 Watt - HPS UG	3	150	175	2,261
2013/2014	PEPCO	250 Watt - HPS UG	12	250	295	15,249
Total			1,531			910,857
2013	City	induction	21	85	85	7,689
2013	City	induction	3	85	85	1,098
2013	City	high pressure sodium	13	100	100	5,600
2013	City	metal halide	89	100	100	38,337
Total			126			52,724
2014	City	induction	21	85	85	7,689
2014	City	induction	12	85	85	4,394
2014	City	high pressure sodium	13	100	100	5,600
2014	City	metal halide	89	100	100	38,337
Total			135			56,020
2013 Total			**1,657**			**963,582**
2014 Total			**1,666**			**966,877**

Vehicle Fleet

Fuel economy factors from national transportation statistics were used to calculate the GHG emissions from the City's vehicle fleet, the diesel heavy truck fuel economy is 18.9 MPG and gas heavy truck fuel economy is 17.1 MPG. In general, 515 $MTCO_2e$ was emitted, and 7,060 MMBtu was consumed in 2014.

Under this category, there are four kinds of fleet travel: diesel-powered, gasoline-powered, air travel and gasoline-powered patrol. Diesel and gasoline vehicles contributed 98 percent of emissions. The diesel-powered vehicles were driven for 777,510 miles in 2014 and gasoline-powered vehicles were driven for 149,298 miles. The emissions from diesel-powered vehicles increased significantly from 19 to 376 between 2007 and 2014, while the output of gasoline and air travel decreased separately by 75 percent and 67 percent, respectively.

Employee Commute

Due to data limitations, 2013 emissions from employee commuting are assumed to be the same as 2014. The City has 112 employees, 92 full-time and 20 part-time. Assuming the part-time employees worked half the time of full-time employees, part-time employees drove an estimated 41,289 miles, and full-time employees drove 680,812 miles per year. Assuming that employees' cars are fueled by gasoline, employees commuting emitted 278 $MTCO_2e$ in both 2013 and 2014.

A similar methodology was used to calculate the emissions from police officer commuting. The only difference is that all officers work for the City part-time, and can be assumed to work four days a week, driving 549,827 miles, and emitting132 $MTCO_2e$ in their commutes.

Compared to 2007, 8 less staff were employed by the government in 2014 and meanwhile 131 $MTCO_2e$ less GHG was emitted.

Recommendations

Despite the small portion of the government operations that account for gross emissions, several recommendations can improve energy efficiency and reduce GHG emissions.

Although all the purchased electricity has been offset by RECs, retrofitting the high-pressure sodium streetlights with LED streetlights will make a large difference in emissions. Most of the City's streetlights are high energy consuming and have a short lifespan; an LED retrofit will generate both energy and cost savings.

The second recommendation is to change employee commuting. If they are allowed to work from home, the total vehicle miles traveled can be reduced along with emissions from vehicle driving. Further, if public transit is improved to serve more government staff and police officers, fewer private vehicles will be used for government commuting.