Feasibility Analysis of a Voluntary Greenhouse Gas Offset Program in Washington, D.C.

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Executive Summary

According to generally accepted greenhouse gas (GHG) inventory accounting methods, as the District of Columbia (the District) implements programs to achieve the District-wide GHG emissions reduction target previously set, the city cannot sell the reductions achieved by these programs as offsets to external customers such as visitors to the District. "Offsets" are the rights to particular emissions reductions, and only one entity can take credit for those reductions. Reductions can either be counted toward a target, or sold to offset another entity's emissions, but not both.

CA-CP and MJB&A recommend that the city delay implementation of a voluntary offset program for visitors until after it completes its Climate Action Plan (CAP). Once the plan is completed, it will be clear which programs are helping the city meet its reduction commitment and which programs are additional to that commitment. Carbon reductions from the additional programs could be bundled and marketed as part of an offset program. Since the District is early in the development of its CAP, it has an opportunity to look for these types of programs and separate them from the voluntary commitment early in the process. This will set the stage for a future offset program.

CA-CP and MJB&A recommend that the District develop a "Greenhouse Gas Reduction Fund" as a first step toward developing a carbon offset program. Such a fund could be designed to complement and extend existing programs and all emissions reductions resulting from the fund could be directed toward meeting the voluntary commitment. The city may want to change this name to one that reflects the fact that the programs are all located in the District and will count toward the voluntary emissions reduction target agreed to by the mayor.

As a next step, the District should identify an initial portfolio of GHG emission reduction strategies and develop a recommended donation for visitors to the city. Since the District will not be selling offsets, the city needs to make clear that contributing to the Greenhouse Gas Reduction Fund is not a way to offset emissions resulting from travel to the District. That is, visitors are not reducing their own emissions; rather, they are helping the District reduce its emissions. One way of making this distinction is to base the contribution amount on average visitor emissions instead of calculating the emissions associated with a specific visitor (i.e., using a carbon footprint calculator). Over two million visitors generate 1.7 million tons of CO_2 (about 1.5 million metric tons) traveling to and staying in the District. That is about 0.65 metric tons per visitor.

The report reviews nine potential sources of emissions reductions from seven categories:

- Urban forestry,
- Distributed renewable energy,
- Home energy efficiency,
- Street light energy efficiency,
- City vehicle fleet management,
- Transportation modal shifts, and
- Waste management.

CA-CP and MJB&A found a wide range of costs per metric ton of reduction as summarized in Table E1. Quality and Visibility are both subjective assessments based on the opinion of experts at CA-CP and MJB&A. Quality refers to the quality of the emission reduction for potential long-term inclusion in a verified offset program. Visibility refers to the potential for the public to see and learn from the project. To solicit donations, the District could package some of the lower-cost options in Table E1 and provide a suggested donation based on the average cost of emissions reductions in the Greenhouse Gas Reduction Fund portfolio.

Table E1. Potential Emission Reduction Projects and Estimated Costs

Project	Estimated Reduction Price ($/metric ton)	Quality[a]	Visibility[b]	Notes
Accelerated Fuel Efficient Vehicle Purchases	$14	Medium	Medium	Assumes accelerated replacement of end-of-life vehicles (not full cost of vehicle)
Street light energy efficiency	$20-$61	High	High	Assumes entire system is replaced, accelerated payback period of 10-year lifetime
Bike Lanes	$24	Low	High	Assumes existing methodology is applicable to GHGs, 20-year lifetime
Bike Racks	$76	Low	High	Assumes existing methodology is applicable to GHGs, 20-year lifetime
Refrigerator Change-Out	$86-$270	High	Medium	Assumes program focuses on oldest refrigerators, 10-year lifetime
Solar Installations	$228-$422	High	Medium	Based on estimated costs from pilot program, 20-year lifetime
Tree Planting	$4,183	High	High	Assumes 15-year tree life
Tree Maintenance	$35,532	Medium	High	Assumes tree life is extended to 30 years with maintenance
Methane Capture at Blue Plains	NA	High	Low	WASA is currently reviewing technologies

a. Quality is a subjective assessment of the quality of the project for the inclusion in a verified offset program.
b. Visibility is a subjective assessment of the public visibly of the project for purposes of public education.

Considerations for Developing a Washington, D.C.-Based Voluntary Greenhouse Gas Reduction Fund

The District's Department of the Environment (DDOE) asked Clean Air-Cool Planet (CA-CP), which contracted with M. J. Bradley & Associates (MJB&A) with support from the District of Columbia Office of Planning (OP), to review the potential for a Washington, D.C.-based voluntary greenhouse gas (GHG) offset program. As DDOE and OP envisioned the program, visitors to Washington, D.C. would be given the opportunity to purchase GHG offsets from emission reduction projects in greater Washington, D.C. area. The program would take advantage of visitors' desire to reduce their GHG footprint and benefit emissions reductions programs within the District. As CA-CP and MJB&A reviewed the potential for such a project, it became clear that a scaled-down program that offered visitors the opportunity to support existing emissions reductions programs was more appropriate. This scaled-down vision does not preclude the development of voluntary GHG offset program in the long run; rather, it is intended to develop the infrastructure and procedures for a high quality and more robust offset program in the future.

As described in more detail below, CA-CP and MJB&A believe a scaled-back approach is appropriate for four main reasons:

1. It avoids concerns about additionality and double counting;
2. It can help the District meet its existing commitments;
3. It builds on existing initiatives; and
4. It creates a framework for a future offset program.

Voluntary carbon offset programs are currently a hot topic, with at least 65 million metric tons of CO2 equivalents traded in the voluntary carbon market in 2007, in both the over-the-counter (OTC) markets and the Chicago Climate Exchange (CCX). Volumes traded in 2007, compared to 2006, tripled in the OTC markets and doubled in the CCX. The CCX was valued at $72.4 million in 2007, and the OTC market was worth $258 million in 2007, for a combined value of $331 million. This value is more than triple that of 2006.[1] The sale of voluntary offsets is projected to grow more than tenfold by 2010.[2]

Carbon offsets are gaining in popularity as climate change emerges as a priority issue in the U.S. High-quality carbon offsets could play a role in providing cost-effective GHG emission reductions in the near to medium term. However, with the increased attention comes increased scrutiny. Concern about the quality of the voluntary carbon offsets in the market is eroding support for their use as voluntary and regulatory GHG emission reduction mechanisms. This makes quality one of the most important issues associated with offsets, potentially more important than price. The issues that determine the quality of offsets include: additionality, permanence, third-party certification and verification standards, and avoidance of double-counting.

[1] Ecosystem Marketplace & New Carbon Finance, "Forging a Frontier: State of the Voluntary Carbon Markets 2008", May 2008.

[2] Michael Gillenwater, Derik Broekhoff, Mark Trexler, Jasmine Hyman & Rob Fowler. "Policing the voluntary carbon market", *Nature Reports Climate Change* (2007) Published online: 11 October 2007. doi:10.1038/climate.2007.58

Currently, there is no regulation of offset programs. This has drawn the attention of members of Congress, the Federal Trade Commission, and the State of California, who are beginning to investigate the market. CA-CP, in its 2006 *Consumers' Guide to Retail Carbon Offset Providers*, developed the following lists of questions that consumers should ask when purchasing offsets, which address some of the most common concerns[3]:

- Do your offsets result from specific projects?
- Do you use an objective standard to ensure the additionality and quality of the offsets you sell?
- How do you demonstrate that the projects in your portfolio would not have happened without the GHG offset market?
- Have your offsets been validated against a third-party standard by a credible source?
- Do you sell offsets that will actually accrue in the future? If so, how long into the future, and can you explain why you need to 'forward sell' the offsets?
- Can you demonstrate that your offsets are not sold to multiple buyers?
- What are you doing to educate your buyers about climate change and the need for climate change policy?

CA-CP and MJB&A believe that the District will have a high burden of proof to show that a voluntary offset program using District-based projects is additional to its existing voluntary reduction commitment, and will lose the ability to count reductions toward its voluntary commitment if it sells the reductions as offsets. In January 2007, Mayor Adrian Fenty signed onto the U.S. Conference of Mayors Climate Protection Agreement to reduce GHG emissions. As part of this agreement, Washington, D.C. set a voluntary target of reducing District-wide GHG emissions by seven percent from 1990 levels by 2012. According to the preliminary GHG inventory prepared by the District of Columbia Air Quality Division in October 2005, the District is projected to be 2.402 million metric tons of CO_2 equivalents short of the voluntary goal in 2012.[4]

As part of the planning process in the context of the Mayors Climate Protection Agreement, the District is undertaking the development of a Climate Change Action Plan – a critical implementation document for the District to reduce its GHG emissions – which will include a final GHG inventory and specific recommendations for energy-saving projects from which the necessary GHG reductions will be generated. Once the District establishes a Climate Action Plan enumerating reductions to meet the goals of the Mayors' Agreement, offsets could be defined from any verifiable emissions reduction beyond those specified in the Climate Action Plan. These emissions reductions could be in the form of additional work on an existing program or the result of a new program. For example, if the District met its voluntary commitment but identified an additional 500,000 tons of emissions reductions that could be gained through energy efficiency, it could package those verifiable reductions and sell them to anyone who wanted to purchase GHG offsets, provided they meet the qualifications as additional and permanent.

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[3] Clean Air-Cool Planet, *A Consumer's Guide to Retail Carbon Offset Providers*, December 2006. http://www.cleanair-coolplanet.org/ConsumersGuidetoCarbonOffsets.pdf

[4] The shortfall is 1.112 million metric tons when GHG emissions associated with imported electricity are not included.

According to generally accepted GHG inventory accounting methods, as the District implements programs to achieve the District-wide GHG emissions reduction target previously set, the city cannot sell the reductions achieved by these programs as offsets to external customers such as visitors to the District. "Offsets" are the rights to particular emissions reductions, and only one entity can take credit for those reductions. Reductions can either be counted toward a target, or sold to offset another entity's emissions, but not both.

For example, if the District counts the carbon sequestration benefits of its urban forestry programs towards its voluntary 2012 GHG emissions reduction target, it cannot then sell any of that sequestered carbon to convention-goers to offset their travel, because two entities would then be taking credit for the same sequestered carbon. This is known as "double counting."

CA-CP and MJB&A recommend that the city delay implementation of a voluntary offset program for visitors until the Climate Action Plan (CAP) is completed. Once the plan is completed, it will be clear which programs are helping the city meet its reduction commitment and which programs are additional to that commitment. The additional programs could then be bundled and marketed as part of an offset program. Since the District is early in the development of its CAP, it has an opportunity to look for such programs and separate them from the voluntary commitment early in the process. This will set the stage for a future offset program. CA-CP and MJB&A have reviewed GHG reduction opportunities in the District, and determined that initiatives at the Blue Plains Wastewater Treatment facility might be particularly well suited to an offset program.

As an aid to the District's consideration of a voluntary offset program, Ecosystems Marketplace surveyed existing city- or state-based voluntary offset programs and provided the city with examples to consider. One such example was the Aspen, Colorado Canary Tags program.[5] This program sells carbon offsets at $20 per ton of CO_2 but also allows interested parties to donate to local energy efficiency and renewable projects. The donation option does not include the transfer of offsets; rather, it is an opportunity to support projects in the city that reduce GHG emissions. As the program website states:

> When you make a donation your money goes into renewable energy and energy efficiency projects here in the Roaring Fork Valley. These investments actively work to lessen our environmental impact and improve the lives of residents, but do not meet the verification required to be part of our carbon offset portfolio.

CA-CP and MJB&A recommend that the District develop a similar fund as a first step toward a carbon offset program. Such a fund could be designed to complement and extend existing programs and all emissions reductions resulting from the fund could be directed toward meeting the voluntary commitment. For discussion purposes, we call this fund the "Greenhouse Gas Reduction Fund" to make it clear that it is not an offset fund. The District may want to change this name to one that reflects the fact that the programs are all located in the District and will count toward the voluntary emissions reduction target agreed to by the mayor.

[5] For additional information see the Ecosystems Marketplace report delivered to the D.C. Office of Planning in December 2007 (Ecosystem Marketplace, *Cap and Trade & Carbon Offsets in the District of Columbia*, December 20, 2007) or visit the City of Aspen Canary Tags website at http://www.aspenzgreen.com/offsets.cfm.

It is worth noting that, as part of the marketing for such a program, the District can promote its commitment to the Mayors Agreement, involvement with the ICLEI program, and development of its Climate Action Plan. Participants in the program would be "helping the Nation's Capitol reach its goal of becoming an international leader on climate change."

There are a number of different ways that the District could set up the Greenhouse Gas Reduction Fund. It could identify and allow visitors to contribute to specific projects (e.g., a specific tree could be sponsored by a visiting school group) or it could advertise the portfolio of projects and encourage visitors to donate to a general fund that would be used to support all of the projects in the portfolio.

While the development of a Greenhouse Gas Reduction Fund avoids the concerns about additionality and double counting, it will still be important for the District to show specific results from the use of funds. Visitors will likely want to see that their contributions are having a real and measurable impact on District CO_2 emissions. As a result, the District should clearly account for the use of funds and estimate the emissions reductions annually.

The remainder of this report explores the potential supply of emissions reductions and the potential demand for those emissions reductions.

Range of Potential Voluntary Greenhouse Gas Emissions Reduction Supply

CA-CP and MJB&A researched the potential for District-based emissions reductions projects in the following areas:

- Urban forestry,
- Distributed renewable energy,
- Home energy efficiency,
- Street light energy efficiency,
- City vehicle fleet management,
- Transportation modal shifts, and
- Waste management.

MJB&A conducted web-based research of ongoing initiatives in the District and contacted city officials as well as members of outside organizations working on initiatives in the District. We found that many of the city's agencies and departments have initiated programs associated with these categories but either do not calculate potential emissions reductions or do not have a robust system for tracking emissions reductions. Obviously, this will change as the need to complete an inventory and identify emissions and reductions, pursuant to both the Mayors Agreement and the work with ICLEI, comes in to play.

Urban forestry

Maintaining and expanding the tree canopy in the District has a number of benefits. According to the non-profit Casey Trees[6]:

- Trees absorb storm-water runoff, reducing the flow of pollutants into rivers and streams;
- Trees filter harmful air pollutants;
- Trees cool the city in the summer;
- Trees increase property values; and
- Research suggests that tree-lined neighborhoods have lower crime rates and stronger communities.

Trees also absorb CO_2, and tree planting or tree maintenance could be supported through the Greenhouse Gas Reduction Fund. Tree planting in the District is currently funded through the city and supported by the non-profit group Casey Trees. As a result of these existing funding mechanisms, it will be important from a marketing perspective to show the emissions reductions resulting from the use of the Greenhouse Gas Reduction Fund as separate from the reductions from existing programs.

Tree maintenance is currently a part of the city's Urban Forestry Administration budget. However, according to the Associate Director, Mr. John Thomas, the department's maintenance funding is primarily devoted to tree trimming and removal. Mr. Thomas suggested that through a more robust tree maintenance program, the Urban Forestry Administration could double the expected life of trees from 15 to 30 years. Older trees provide a number of environmental and community benefits including sequestering CO_2.

Greenhouse Gas Reduction Potential

To assist in calculating the GHG benefits of a tree planting and tree maintenance program, Mr. Thomas provided the following District-specific data:

- Average cost of planting a tree: $502 per tree under the current contract
- Average annual maintenance cost of a tree: $358.64

To estimate the CO_2 reduction potential of planting a tree, MJB&A used a spreadsheet calculator developed to estimate the CO_2 benefits of urban tree plantings for the U.S. Energy Information Administration (EIA) Voluntary Reporting of Greenhouse Gas Emissions program.[7] Based on CO_2 uptake estimates provided by Mr. Thomas, MJB&A determined that trees planted in the District were best represented in the spreadsheet calculator as "Medium Hardwood" trees. The calculator uses a tree life of 15 years, which matched Mr. Thomas' estimate of average tree life.

Over 15 years, a medium hardwood tree stores 0.12 metric tons of CO_2. Ignoring the annual maintenance costs, the cost of CO_2 reductions are $4,183 per metric ton of CO_2. Including annual maintenance costs will significantly increase the per metric ton cost.

[6] Casey Trees, http://www.caseytrees.org/programs/WhyCT.html

[7] The spreadsheet is available for download from http://www.eia.doe.gov/oiaf/1605/techassist.html. It can be found under "Sequestration Projects" on the right-hand side of the page.

Considering a maintenance program that extends tree life, Mr. Thomas said that tree life could be extended by 15 years to a total lifetime of 30 years. Using the EIA spreadsheet calculator, MJB&A assumed the annual CO_2 uptake increased annually at the same rate during the second 15 years as it was during the first 15 years (the rate of increase was non-linear so doubling the 15-year estimate was not appropriate). The lifetime CO_2 uptake of a tree with an extended life is 0.42 metric tons (an additional 0.30 metric tons from business as usual). If annual maintenance is required from planting to get those additional 0.3 tons and we treat the annual costs as nominal, that is $358.64*30 years=$10,759 or $35,532 per metric ton of CO_2.

Opportunity for Greenhouse Gas Reduction Fund

The cost estimates per ton of CO_2 are a potential barrier to the use of trees as an emissions reduction strategy in the Greenhouse Gas Reduction Fund. However, the calculations assume the entire cost of the tree is loaded onto the Greenhouse Gas Reduction Fund. Since trees have benefits beyond GHG reduction, it may be possible to provide a percentage of funding to a tree planting or maintenance program and still take credit for some of the emissions reductions. On its website, Casey Trees estimates the value of each tree in the District and estimates the pollution reduction value of the tree. The District could work with Casey Trees to develop a methodology for calculating the benefit of incremental funds towards increasing CO_2 reductions.

The District could make a tree-planting or tree-maintenance CO_2 reduction initiative highly visible to the public by identifying clusters of trees planted or maintained by the fund. For example, the District could install signage indicating that the trees were provided by the Greenhouse Gas Reduction Fund.

Distributed Renewable Energy

The District has ongoing initiatives to encourage the installation of renewable energy systems in the city. The Renewable Energy Demonstration Project (REDP) educates the public about renewable electricity generation and provides incentives for installing grid-connected generation systems. The city initiated the REDP as a pilot program from 2005 through 2007. During that time, the goals of the program were to:

- Award renewable energy grants, a $3 per watt incentive to property owners, up to 50% of the cost of installing a renewable generation system.
- Educate the public about renewable technologies by providing access to demonstrations of implemented systems, as well as coordinating efforts with the Zero Energy Home and other projects.
- Provide information regarding program partners (manufacturers, distributors, and installers).

During the pilot period, District applicants could apply for funding to implement a project that produces electricity using a renewable source of fuel (i.e., solar, photovoltaic, biomass, wind or hydropower). Projects could include but were not limited to installing photovoltaic systems in houses, commercial or institutional buildings.

DDOE is currently working to restructure the REDP based on the success of the pilot program. The restructured program will likely have an incentive cap of $3 per watt and is requesting funds of $450,000.

In addition to the REDP, the District has a renewable portfolio standard (RPS) that it adopted in 2007. The RPS requires offices in the District to obtain an increasing percentage of electricity from solar, wind, and biomass sources. It requires that 11% of electricity sold in the District come from renewable sources by 2022. The standard includes two tiers. Tier one renewable resources include solar, wind, biomass, landfill gas, geothermal, ocean (mechanical and thermal) and fuel cells fueled by tier one resources. Tier two renewable resources include hydropower (other than pumped-storage generation) and municipal solid waste. The standard calls for an additional 0.386% of the city's renewable energy to come from solar energy by 2022. The most recent draft of the Clean and Affordable Energy Act of 2008 increases the renewable energy portfolio standard to 20% by 2020 with 0.4% to come from solar.

Greenhouse Gas Reduction Potential

During the 2005 to 2007 pilot phase of the REDP, DDOE collected data on the size of the installations and the size of the grant award to the installation. Mr. Emil King at DDOE provided data for 45 installations funded by DDOE during the pilot program (additional installations were funded but either included educational components that increased the cost or refunded the money to the District after being awarded the funds). Using the assumptions in Table 1 and assuming that the grants accounted for half of the installation costs associated with a project (the maximum allowed under the program); CA-CP and MJB&A estimated the cost of the emissions reductions as shown in Table 2. Note that all the installations included in the calculations were photovoltaic installations even though funding was available for all the categories described above.

Table 1. Assumption for Solar Installations Awarded under REDP

Electricity Cost[a]	$0.11	per kWh
Generation[a]	1,232	kWh per kW per year
Avoided CO_2[b]	1,252	lbs/MWh
Lifetime of PV System[a]	25	years
Discount Rate	6	percent

a. Based on assumptions provided by Emil King
b. Based on PJM as reported in Pepco's disclosure to the District of Columbia Public Service Commission.

Table 2. Benefits of District Solar Installations based on 2005-2007 REDP Installation Data

Installations	45
Average Output (kW)	4
Average Generation (kWh/yr)	4,765
Average Annual Electricity Savings ($/yr)	$524
Average Lifetime Electricity Savings @ 6% DR	$6,701
Average Award	$14,262
Average Installation Cost ($)	$28,523

Net Lifetime Cost	$21,822
Average Annual CO2 Avoided (metric tons/yr)	2.71
Average Lifetime CO2 Avoided (metric tons)	68
Average Cost of Avoiding CO2 ($/metric ton)	$323

The estimate in Table 2 ($323 per metric ton of CO_2) discounts the electricity savings using a rate of six percent and assumes that the grid emissions remain constant. If the electricity savings are not included in the calculation, the avoidance cost is $422 per metric ton of CO_2. If the electricity savings are calculated in nominal terms (i.e., the savings were calculated for one year using $0.11 cents per kWh and multiplying by the expected 25 year life of the installation), the avoidance cost is $228 per metric ton of CO_2.

Opportunity for Greenhouse Gas Reduction Fund

The Greenhouse Gas Reduction Fund could work with the restructured REDP to identify high-profile, distinct renewable energy installations in the District that could be funded by the Greenhouse Gas Reduction Fund. For maximum visibility, the Greenhouse Gas Reduction Fund would likely want to be the primary funder of an installation, however, given the cost per ton, the District could mirror the approach of the REDP and provide a percentage of the funding to an installation and then claim a percentage of the reductions.

Note that any attempt to transition renewable energy installations into a certified offset program will need to review the impact of the District's RPS on encouraging installations. Technically, reductions in GHGs from projects initiated in order to meet the RPS will not be classified as offsets, since the projects were undertaken in order to meet the standard.

Home Energy Efficiency

The District currently has programs focused on improving energy efficiency funded by the RETF. For example, the Home Energy Rating System (HERS) sponsors energy efficiency assessments for single family homes in the District. Based on a HERS audit, auditors suggest specific cost-effective, energy-efficient improvements to reduce a home's operational costs and improve comfort.

Beyond the existing programs, the District could sponsor an appliance change-out program where qualifying residents exchange older, inefficient appliances for newer, more efficient appliances.

Greenhouse Gas Reduction Potential

Energy efficiency programs have the potential to indirectly reduce GHG emissions. By improving the electrical or heating efficiency, they reduce total electricity or natural gas consumption. We can estimate the potential for reductions from electricity savings by

calculating the annual expected electricity savings and multiplying by the average grid emissions per unit of electricity generated. We can estimate the potential for reductions from reduced natural gas use by calculating the annual expected savings and multiplying by an emissions factor.

For example, if the District sponsored a refrigerator change-out program to replace older, less efficient refrigerators for low-income residents with new, EnergyStar rated refrigerators, it would calculate the potential reductions using the electricity savings and the average emissions of the grid. According to the 2005 *Residential Energy Consumption Survey* published by the Energy Information Administration (EIA) in April of 2008, about a quarter of refrigerators in homes eligible for federal assistance[8] have refrigerators that were purchased between 1996 and 2000 (8 to 12 years old). Another 23 percent have refrigerators purchased between 1986 and 1995 (13 to 22 years old).[9]

In the EIA survey, almost 60 percent of homes eligible for federal assistance had refrigerators between 15 and 18 cubic feet and the majority used refrigerators with a freezer on top.[10] According to data published by EnergyStar, 16.5 to 18.9 cubic foot refrigerators with a freezer on top had the average efficiencies shown in Table 3.

Table 3. Average Annual Efficiency of 16.5 to 18.9 Cubic Foot Refrigerators with a Freezer on Top

Year Built	Average Efficiency (kWh/year)
1980 to 1989	1,556
1990 to 1992	1,182
1993 to 2000	790
2001 to 2006	506

Source: Energy Star, *Refrigerator Retirement Calculator*, http://www.energystar.gov/index.cfm?fuseaction=refrig.calculator

The top-rated top-freezer EnergyStar refrigerators sized between 18 and 22 cubic feet in a recent product report by *Green Guide*, a green products magazine published by *The National Geographic Society*, range in price and efficiency from $549 for a 432 kWh per year Frigidaire FRT21HC5D to $2,807 for a 254 kWh per year Sun-Frost R-16.[11]

Table 4 uses the two refrigerators from the *Green* Guide and estimates the benefits and costs of replacing existing refrigerators. The average efficiencies of the existing refrigerators are taken from Table 3. Table 4 shows that the cost per metric ton is most attractive when the oldest, least efficient refrigerators are replaced. The cost of the new refrigerator is also an important variable.

[8] Eligible for Federal Assistance: Households are categorized as eligible for Federal energy assistance if their income is below the Federal standard. The Federal standard is 150 percent of the poverty line or 60 percent of statewide median income, whichever is the higher income. Individual States can set the standard at a lower level than the Federal one.

[9] Energy Information Administration, "Table HC7.9 Home Appliances Characteristics by Household Income, 2005", *Residential Energy Consumption Survey 2005*, April 2008. Available at: http://www.eia.doe.gov/emeu/recs/recs2005/hc2005_tables/detailed_tables2005.html

[10] Ibid.

[11] *Green Guide*, Refrigerators, Accessed June 11, 2008. Available at: http://www.thegreenguide.com/products/Appliances/Refrigerators/3.

Table 4. Example Estimates of Greenhouse Gas Benefits and Costs of Replace Refrigerators

Average Efficiency of Existing Refrigerator (kWh/year)	Efficiency of New Refrigerator (kWh/year)	Cost of New Refrigerator	Electricity Savings (kWh/year)	Estimated Avoided Emissions (metric tons CO2/year)	10-Year Benefit (metric tons CO2)	Cost per Metric Ton of CO2
1,556	432	$549	1,124	0.64	6.4	$86
1,182	432	$549	750	0.43	4.3	$129
790	432	$549	358	0.20	2.0	$270
506	432	$549	74	0.04	0.4	$1,306
1,556	254	$2,807	1,302	0.74	7.4	$380
1,182	254	$2,807	928	0.53	5.3	$533
790	254	$2,807	536	0.30	3.0	$922
506	254	$2,807	252	0.14	1.4	$1,961

While the refrigerator example focuses on one householder appliance, the District currently collects information on the efficiency of home systems through the HERS program. HERS assesses and gives recommendations to homeowners on how to improve efficiency and lower home natural gas and electric bills. While HERS identifies actions homeowners can take, it does not provide funding for the implementation of suggested measures.

According to draft numbers provided by Mr. Willie Vazquez, the coordinator of the HERS program in DDOE, which he based on an analysis of reports from 25 homes; the average annual savings identified at a home evaluated by HERS is $1,451.[12] Measures included in those savings are:

- Ceiling, wall, and attic hatch insulation,
- Air leakage reduction (infiltration),
- Heating and cooling system replacement,
- Window, skylight, and door replacement,
- Hot water tank replacement, and
- Thermostat replacement.

According to Jim Conlin, president of Elysian Energy, the company that audits homes under the District's HERS program, the majority of these measures save on heating. In the District, most heating is natural gas-based. Any measure that improves the heating efficiency of the house would reduce natural gas usage and reduce GHG emissions. The District could review the results of the HERS audits and identify energy efficiency projects that the city could sponsor as part of the Greenhouse Gas Reduction Fund. Mr. Conlin suggested that home insulation is relatively inexpensive but can dramatically improve home energy efficiency. Using the approach outlined in the refrigerator example above, the District could determine the baseline efficiency of a home and use the information in the HERS audit to calculate GHG savings. Mr. Conlin said he is in the process of adding such a component to the Elysian Energy audit. Once

[12] Mr. Vazquez stressed that these are draft numbers and should only be used as a rough estimate of the potential for savings. Actual savings will vary considerably from house to house.

the GHG savings are calculated, the District could estimate the cost of insulating the house and develop a cost of avoided emissions per metric ton of CO_2. Given the house-by-house differences in size and specific recommended measures, MJB&A did not estimate the potential per house contribution to a greenhouse gas reduction plan. MJB&A believes that the District has most of the information it needs to make such an estimate on a per house basis.

Opportunity for Greenhouse Gas Reduction Fund

The refrigerator change-out program is attractive because it can be broken into discrete pieces and the benefits are easy to measure. As part of the existing home auditing program, the District could identify the oldest, least efficient refrigerators and replace them with modern EnergyStar units. While the example here focuses on refrigerators, the District could do a similar analysis for any home appliances such as air conditioners, hot water heaters, and washing machines or dishwashers.

The HERS program provides an opportunity for the District to evaluate a number of different home energy efficiency-based initiatives as part of the Greenhouse Gas Reduction Fund. Since the existing program identifies efficiency projects but does not fund the installation of those projects, the Greenhouse Gas Reduction Fund could take the next step and fund the installation of energy efficiency measures in households. The GHG benefits of these measures could be calculated as described above. It will be important, however, to develop a system to ensure that equipment is appropriately installed and maintained and to track the success of the projects.

Since it is possible that these savings will not be calculated for use in the reductions for the Mayors' Agreement, and will be in many cases made possible by grants under the GHG Reduction Fund, permanent reductions they could potentially be counted as offsets. The value of the initiative for offset credits will likely depend on the number of homes and the size of the potential aggregated emissions.

Street Light Energy Efficiency

A recent analysis by the American Chamber of Commerce Executives (ACCE) suggests that the District could realize significant energy efficiency and GHG reduction benefits through the deployment of a managed streetlight network.[13] The report says:

> Washington, DC has a total of 62,394 streetlights and uses 60.7 million kWh annually. A 50 percent reduction in electricity will save 30.4 million kWh annually translating into a dollar savings of $1,824,000 and a reduction in carbon footprint of 23,596 metric tons of CO_2.

To calculate these savings, ACCE obtained an inventory of streetlights from the District's Department of Transportation and assumed that electricity costs $0.06 per kWh.[14]

[13] Grow, Robert T. *Energy Efficiency Streetlights: Potentials for Reducing Greater Washington's Carbon Footprint*. March 2008. Available at: http://green.dc.gov/green/lib/green/pdfs/Energy_Efficient_Street_Lights.pdf

[14] For the solar installation example, we used $0.11 per kWh based on information from DDOE. For the street light installation example, we kept the $0.06 to reflect wholesale prices the city receives.

ACCE based the 50 percent reduction in electricity consumption on the implementation of a managed streetlight network in Oslo, Norway. A managed streetlight network would include:

- Installation of "smart" electronic ballasts in each streetlight,
- Installation of High Intensity Discharge (HID) lamps,
- Installation of segment controllers to manage the streetlights' schedules, track failures, collect data, and ensure communications, and
- Management of the network from a central command post.

ACCE estimates the project implementation costs to be $232 per streetlight. The capital cost of replacing all 62,394 District street lights is $14,475,408. However, the cost of implementation will be counter balanced, to some extent, by annual energy savings and by reduced maintenance costs from changing out light blubs.

Greenhouse Gas Reduction Potential

As described above, the CO_2 reduction potential of changing out all the street lamps in the District is 23,596 metric tons of CO_2 annually. That is approximately 0.38 metric tons of CO_2 per streetlight per year. If we assume a lifetime of 10 years, the total emissions savings for changing out all the light bulbs are 235,960 metric tons of CO_2. At that rate, the cost per ton is $14,475,408 divided by 235,960 metric tons of CO_2 or $61 per metric ton of CO_2.

This calculation, however, ignores the annual energy savings benefits. Unlike the renewable energy example, which has a payback period of more than 20 years with the electricity savings, the street lamp change out has a payback period of about 11 years. Another way to consider the value of selling the emissions reductions is the impact on the payback period of the project. If we assume a discount rate (DR) of six percent and that the annual operation and maintenance costs are not different from the existing streetlight network, the annual electric savings will cover the capital costs of the project in just over 11 years. However, if the District raises money for the project at a rate of $20 per ton of emissions reduction, the payback period is closer to eight years, assuming that the price of electricity and the emissions profile of the grid stay constant. The Greenhouse Gas Reduction Fund could be used to make the project more attractive.

Opportunity for Greenhouse Gas Reduction Fund

This could be an effective and highly visible program to include in the portfolio of projects for the Greenhouse Gas Reduction Fund. However, installation of one light at a time will likely not results in the benefits described by ACCE. The reductions described in the ACCE paper assume deployment of an entire network.

It may be possible for the District to deploy the project by neighborhood as a way to divide the deployment. If the District is not currently contemplating such a program because of the cost, it could structure this program outside of the Mayors Agreement and potentially use it as a source of offsets in the longer term.

CA-CP and MJB&A understand that the District has started replacing some existing streetlights with LED bulbs and has received negative feedback from residents. It will be important for the city to keep citizen concerns in mind if it decides to move ahead with a street lamp program as part of the Greenhouse Gas Reduction Fund.

City Vehicle Fleet Management

The District's Department of Public Works (DPW) maintains a fleet of approximately 2,000 light-duty vehicles along with a number of heavy-duty vehicles. DPW is currently engaged in two initiatives that impact the use of vehicle change-out as a carbon reduction opportunity. Under the Energy Policy Act of 1992 (EPAct), all states (for the purposes of EPAct, DC is considered a state) must reduce reliance on petroleum by purchasing alternative-fuel vehicles (AFVs) for their light-duty vehicle fleet (75 percent of purchases have to be AFVs). AFVs that qualify include E85 vehicles, natural gas vehicles, electric vehicles, and hydrogen vehicles. If the state is not able to meet the 75 percent target with E85 vehicles, it can use hybrid vehicles as an alternative compliance mechanism.

As the District works to comply with EPAct, it is also engaged with a consultant to develop and initiate a fleet optimization plan. Under the fleet optimization plan, DPW will likely restructure the current distribution of vehicles and identify vehicles to retire or replace. This process is ongoing, with a final report expected in the next six months.

Greenhouse Gas Reduction Potential

Ms. Hallie Clemm from DPW suggested that any carbon reduction initiative that included the light-duty vehicle fleet would be best implemented after the fleet optimization report was completed and approved. She suggested that during the reorganization that will likely result from the fleet optimization, there may be opportunities to identify older vehicles that could be replaced as part of a strategy to improve the carbon footprint of the fleet.

In addition to being coordinated with the fleet optimization, a vehicle change-out program centered on DPW's light-duty fleet would require coordination with the requirements of EPAct. EPAct's focus is on reducing petroleum consumption and not necessarily on reducing GHG emissions.

As an example of the potential for reductions, a 2000 Ford Taurus currently in the fleet could be replaced with a 2008 Prius. Table 5 compares the annual CO_2 emissions savings using EPA data.

Table 5. Annual CO2 Emissions and Fuel Cost Savings for Light-Duty Vehicles in a Vehicle Change-out Program

	2000 Ford Taurus	2008 Toyota Prius
Fuel Economy (miles/gal)[a]	20	46
Annual Tons of CO_2 Emitted[b] (Annual Savings versus Taurus)	9.2	4.0 (5.2)
Annual Fuel Cost[b] (Annual Savings versus Taurus)	$2,708	$1,175 ($1,533)

a. Based on EPA's estimates available at http://www.fueleconomy.gov
b. Based on EPA's estimates assuming Based on 45% highway driving, 55% city driving, 15000 miles/year and Reg.: $3.61 per gallon

According to Kelley Blue Book, the MSRP is $21,760 for a 2008 Toyota Prius.[15] If we assume that the alternative to replacing the 2000 Taurus is to continue to use it until 2010 at which time it is replaced by a Prius, we can compare the cost of accelerating the replacement of the Taurus to the opportunity cost of using the money elsewhere. Assuming an IRR of six percent, the opportunity cost of spending the money on the Prius is $2,690. The fuel savings over those two years (using the data in Table 1) is $3,066. That means that at today's gas prices and assuming an IRR of six percent, it makes economic sense for the District to buy the Prius today instead of waiting two years. However, this calculation is heavily dependent on the assumptions. If the fuel cost is $3 per gallon instead of the $3.61 assumed in Table 5, the annual fuel savings are $2,543 over the two year period. Using this alternative scenario, the city would need an additional $147 to make purchasing the Prius two years early the preferred options. If we divide the $147 by the 10.4 tons of CO_2 reduced, the cost of reducing CO_2 by accelerating the deployment of a Prius is $14 per ton of CO_2.

There are a number of other variables that could enter into the decision-making process for including a vehicle change-out program as part of the Greenhouse Gas Reduction Fund. For example, there may be elevated operation and maintenance costs associated with the older vehicles. If the District is going to include vehicle change-out as part of the Greenhouse Gas Reduction Fund, it should conduct a more rigorous economic analysis using its own IRR and estimates of vehicle life, miles traveled, and fuel efficiency.

Opportunity for Greenhouse Gas Reduction Fund

Paying to accelerate the change out of the District's light-duty vehicle fleet could potentially fit into the Greenhouse Gas Reduction Fund portfolio. However, it will be important to identify specific vehicles that need to be replaced and determine how the money from the fund could be best applied. Above, we assume that the best use of the fund is to accelerate the turnover of the oldest vehicles in the fleet. It may be more appropriate to consider the change out of the least efficient vehicles in the fleet.

There are other methodologies the District could consider for this calculation. For example, the city could identify an inefficient vehicle, sell the vehicle, and buy a new vehicle using the Greenhouse Gas Reduction Fund to cover the difference. This might be particularly effective if the District considered buying smaller, lower priced vehicles like the Smart Fortwo. These tradeoffs should be easier to evaluate after the fleet optimization is completed and DPW has an idea of its needs going forward.

It is also important that the District coordinate the AFV requirements from EPAct with any use of the Greenhouse Gas Reduction Fund to accelerate vehicle turnover. Since the AFV requirement is focused on petroleum reduction and not GHG reduction, the two programs may, at times, be at cross purposes.

[15] Kelley Blue Book is available at http://www.kbb.com

Transportation Modal Shifts

The Transportation Policy and Planning Administration in the District's Department of Transportation (DDOT) manages a number of initiatives designed to increase bike use in the District. These initiatives include the installation of bike racks and bike lanes. Washington, D.C. already calculates emissions benefits (although not CO_2 emissions benefits) of installing measures to increase bike usage. Adding bike racks or bike lanes in the District has the potential to be a highly visible way for the District to use the emission reduction funds.

Another bike-related program recently initiated in the District is called SmartBike. SmartBike consists of kiosks throughout the city where subscribers can rent bikes for three-hour increments. There may be a potential to involve SmartBike in a program in the long term but Mr. Jim Sebastian at the DDOT said that he would like the program to get off the ground before expanding it and considering involvement from the Greenhouse Gas Reduction Fund.

DDOT also runs non-bike related programs geared toward increasing walking. One such program is called Safe Routes to Schools. The Safe Routes to Schools program is designed to encourage children to walk to school instead of being dropped off or riding the bus. According to Mr. Sebastian, the Safe Routes to Schools program is currently well funded and, while additional funds may be needed in the future, it is unlikely additional funds from the Greenhouse Gas Reduction Fund will provide clear emissions reductions benefits in the near term.

Greenhouse Gas Reduction Potential

DDOT currently estimates the air quality benefits of adding bike racks and bike lanes using guidance from the Congestion Mitigation and Air Quality (CMAQ) Improvement Program. DDOT estimates reductions in volatile organic compounds (VOCs) and nitrogen oxides (NOx) but not reductions in CO_2 or other greenhouse gases.

Mr. Sebastian provided examples of the department's estimates for reducing VOCs and NOx through the installation of bike racks and bike lanes. Below, we use the same assumptions to develop an estimate of the CO_2 benefits of installing bike racks and bike lanes.

Bike Racks Estimate

Assumptions for the installation of one bike rack:

- Racks are used by one bike per day,
- Trips are two miles each, round trip, and
- The cost to site, supply and install one rack is $350.

Based on these assumptions, each bike rack eliminates one two-mile vehicle trip per day. Using the 2005 U.S. light-duty fleet average of 22.9 miles per gallon[16] and 8,482 grams of CO_2 per gallon of gasoline, there are 370.4 grams of CO_2 emitted per mile traveled.

The savings per bike rack are 740.8 grams of CO_2 per day. Assuming a 20-year lifetime and 312 days of use per year (DDOT assumptions), the total CO_2 benefits are:

[16] USDOE Transportation Energy Data Book, Edition 26, 2007, Table 4.1.

740.8 g CO_2/day * 1 metric ton/1,000,000 grams * 312 days of use/year * 20 years
= 4.6 metric tons CO_2/bike rack (0.23 metric tons of CO_2 per year)

At $350 per bike rack, the CO_2 emissions reductions cost about $76 per metric ton.

Bike Lanes Estimate

Assumptions for bike lane installations:

- Each mile of bike lane in DC will generate 100 new bike trips per day, replacing 72 single occupancy vehicle trips. DDOT based these assumptions on the Comsys model (based on work trips from the US Census) and the before and after counts from new DC bike lanes, and
- New bike trips using bike lanes average five miles roundtrip (DDOT used this estimate even though it is less that the regional bike work trips of nine miles).

Using the emissions assumptions described for bike racks, we assume 370.4 grams of CO_2 are emitted per mile traveled. Seventy-two trips at five miles round trip per trip is equivalent to 360 vehicle miles traveled (VMT) (to incentivize a five-mile roundtrip bike trip, we assume the bike lane either extends an existing lane or has a total length of more than 2.5 miles).

360 VMT * 370.4 g CO_2/mile * 1 metric ton/1,000,000 grams * 312 days of use/year * 20 years
=832 metric tons CO_2/additional mile of bike lane

At $20,000 per mile, the CO_2 emissions reductions cost about $24 per metric ton.

Opportunity for Greenhouse Gas Reduction Fund

Either bike racks or bike lanes provide the District with distinct projects that have the potential to be highly visible parts of a Greenhouse Gas Reduction Fund. As with the other projects, it will be important for the marketing of the fund to make sure the racks or lanes funded are separate from existing or already budgeted projects. The estimates calculated above should be considered rough order-of-magnitude estimates. Some areas of the city may have more bike traffic than others, it is important that a bike rack or bike lane is placed in an area were it will be utilized. It would be beneficial to monitor the projects after they are completed to see if they meet expectations. This will be important for defending its inclusion in the Greenhouse Gas Reduction Fund as well as for refining estimates for future Fund projects. It will be important, and likely difficult, to develop robust, defendable estimates of emissions reductions if the District is going to consider bike lanes or bike racks as part of a verified offset program.

While we did not consider the benefits of the SmartBikes program or the Safe Routes to School program, the city should review each of these programs in the future for potential inclusion in the Greenhouse Gas Reduction Fund portfolio.

There are likely additional transportation-related projects the District could develop as part of the Greenhouse Gas Reduction Fund portfolio. Ideally, a project would reduce specific point-to-point trips to make the emissions reduction calculation more robust (and make it more likely to qualify as an offset). For example, if the District could reduce the number of waste hauling trips

to the landfill through waste reduction (e.g., increased recycling) or through modal shifts (e.g., switching from diesel trucks to rail), it could calculate the emissions savings using the number of trips eliminated.

Wastewater Treatment

One of the most promising large-scale opportunities for reducing emissions is at the Blue Plains Advanced Wastewater Treatment Plant (AWTP). Blue Plains is the largest advanced wastewater treatment plant in the world; it covers 150 acres with a capacity of 370 million gallons per day (mgd) and a peak capacity of 1.076 billion gallons per day. Wastewater is collected by the District of Columbia sewer system and from the Maryland and Virginia suburbs and is delivered to the Blue Plains AWTP.

The DC Water and Sewer Authority (DCWASA) manages the Blue Plains AWTP. DCWASA has been evaluating the addition of anaerobic digestion facilities at the Blue Plains AWTP since 2002. Three different anaerobic digestion technology options were provided to the DCWASA Board at its March 13, 2008 meeting. The Board asked for further refinement of the options which DCWASA staff is scheduled to provide at the Board's June (2008) meeting.

DCWASA has approximately $350 million budgeted for this project while the three options presented to the Board are in the $500 million range. DCWASA has not evaluated any potential renewable energy credit value (either for compliance or voluntary markets) or potential carbon offset value in the economic review of the options. However, they have evaluated (at a basic level) the CO_2 emissions baseline and CO_2 emission reduction potential associated with the three different anaerobic digester technologies.

Greenhouse Gas Reduction Potential

If DCWASA utilizes anaerobic digesters to process the wastewater, it will produce biogas (methane gas) which could be used to generate electricity and thermal energy. All of the options being considered will produce about 170,000 standard cubic feet per hour (scfh) of biogas, with the potential to produce about 10 MW power or about a third of the Blue Plains AWTP energy needs.

Anaerobic digesters and the use of biogas to produce electric and thermal energy have the potential to:

- Reduce onsite CO_2 emissions associated with the displacement of natural gas use;
- Reduce onsite CO_2 emissions associated with lime stabilization utilized in the current wastewater treatment process, and
- Reduce indirect CO_2 emissions associated with the use of electricity from the grid (i.e., electricity provided by PEPCO and Hess).

DCWASA has not begun specific evaluation of the generating technology options to use the biogas. As a placeholder, DCWASA has assumed they would use a gas turbine with some form of heat recovery steam generator. A combined heat and power (CHP) facility – which not only

would supply electricity but also heat to the facility – would maximize the cost savings and environmental benefits. The electricity and heat can be used for a variety of purposes including:

- To sell back to the grid as green power and obtain financial value for the green power through the sale of renewable energy credits into compliance or voluntary markets;
- To operate pumps and blowers used throughout the treatment process.
- To maintain optimal digester temperatures, dry the biosolids, and provide space heating for the Blue Plains AWTP.

EPA has identified municipal wastewater treatment facilities as a strategic sector in its CHP Partnership Program. According to EPA, more than 500 large waste water treatment facilities (with influent flow rates greater than 5 mgd) around the country use anaerobic digesters to process their waste and produce biogas. If all of these facilities used their biogas to fuel CHP, they would generate an additional 340 MW of clean electricity each year. This increase in CHP use would eliminate approximately 2.3 million metric tons of carbon dioxide annually—equivalent to removing the emissions of almost 430,000 cars.[17]

The baseline emissions at the Blue Plains AWTP include the CO_2 emissions associated with lime stabilization, CO_2 emissions associated with electricity consumption sourced from the electric grid, and the CO_2 emissions associated with fossil fuel combustion in the process and plant heating equipment. Approximate baseline emissions are shown in Table 6.

Table 6. Estimated CO_2 Emissions Baseline for Blue Plains AWTP

Segment	Quantity Consumed Annually	Emission Factors	CO_2e Emissions (Tons Per Year)	Annual Cost (2008 estimate)
Lime Stabilization	18,000 tons	1.43 tons CO_2 per ton CaO	~30,000	TBD
Grid Sourced Electricity Consumption	272,000 MWh	1,240 lbs CO_2/MWh	~169,000	$25 million
Natural Gas Consumption	341 MMscf	120,953 lbs CO_2/MMscf	~20,500	~$500,000
Total			**~219,500**	

If DCWASA implemented an anaerobic digester project, it could eliminate the lime stabilization, decrease the quantity of electricity purchased from the grid, and reduce the quantity of onsite combustion of natural gas. Estimated emissions from such a project are show in Table 7.

[17] See http://www.epa.gov/chp/markets/wastewater.html

Table 7. Estimated CO_2 Emissions for Blue Plains AWTP

Segment	Quantity Consumed Annually	Emission Factors	CO_2e Emissions (Tons Per Year)
Lime Stabilization	0 tons	1.43 tons CO2 per ton CaO	0
Grid Sourced Electricity Consumption	~189,000 MWh	1,240 lbs CO2/MWh	~117,000
Onsite Electricity Generation	~83,000 MWh	0 lbs CO2/MWh	0
Natural Gas Consumption*	341 MMscf	120,953 lbs CO2/MMscf	~20,500
Total			**~137,662**

*The degree which natural gas consumption on site can be displaced by the direct use of biogas or use of thermal energy needs to be explored.

Approximate annual CO_2 emission reductions are shown in the Table 8.

Table 8. Estimated CO_2 Emission Reductions for Blue Plains AWTP

Segment	CO2e Emissions Reduced (Tons Per Year)
Lime Stabilization*	~30,000
Grid Sourced Electricity Consumption	~51,600
Natural Gas Consumption	TBD
Total	**>81,600**

In 2008, DCWASA anticipates electricity cost of over $25 million for the operation of the Blue Plains AWTP. However, DC WASA is planning on implementing energy efficiency measures to reduce electricity consumption over the next ten years. Based on the estimates outlined in the tables above, DCWASA could realize an annual reduction in electricity costs of over $7 million annually if the anaerobic digester project is implemented. Furthermore, natural gas costs may also be displaced if the technology of choice is CHP, therefore the annual energy costs savings would be greater.

Opportunity for Greenhouse Gas Reduction Fund

The scale and cost of reducing emissions at the Blue Plains AWTP are significant impediments to including the project in an initial version of the Greenhouse Gas Reduction Fund. It would also not be a particularly visible project and it would be difficult for the District to break the project into smaller pieces. However, this project represents one of the District's best opportunities for creating real, high-quality offsets. As the city moves forward with its CAP it should consider actions at Blue Plains as either a part of the emissions reductions plan or as a separate offset-generating project.

Range of Possible Voluntary Carbon Offset Demand

Based on conversations with OP and CA-CP, MJB&A reviewed the demand for emissions reductions from people traveling to Washington, D.C. to attend conferences. Under the Greenhouse Gas Reduction Fund, the District would ask visitors to donate money to the fund and suggest a price based on the average CO_2 emissions for a visitor traveling to the District. As we discuss in the *Recommendations* section, it will be important that the District is clear that the emissions reductions are not offsets and the reductions will count toward the city's voluntary goal. In the future, under an offset program, the District could offer reduction credits to this group of visitors to offset the carbon dioxide (CO_2) emissions associated with travel to a conference and the emissions associated with staying in the District for a conference.

To estimate the CO_2 emissions associated with conference travel, MJB&A obtained data from the Washington, D.C. Convention and Tourism Corporation on the number of people who traveled to the District for conferences in 2007 (2.3 million) along with data on mode of transportation and state or country of origin.

Table 9 shows a breakdown of the various modes of transportation for people traveling to conferences in the District Table 10 shows the states of origin for people traveling to conferences in Washington, D.C. in 2007. Ten percent of conference-goers traveled to the District from other countries.

Table 9. Transportation Mode for Washington, D.C. Conference Visitors in 2007

Mode of Transportation	Percentage of Conference Visitors
Airplane	58%
Car	28%
Van/Small Truck	4%
Train	3%
Bus	5%
Other	1%

Table 10. States of Origin for Washington, D.C. Conference Visitors in 2007

International	10%
Alabama	1%
California	5%
Connecticut	2%
Delaware	2%
Florida	3%
Georgia	2%
Illinois	2%
Indiana	3%
Kansas	5%
Kentucky	1%
Louisiana	2%
Maryland	6%
Massachusetts	3%

Missouri	1%
New Jersey	6%
New York	8%
North Carolina	5%
Ohio	5%
Oklahoma	1%
Oregon	1%
Pennsylvania	5%
Rhode Island	1%
South Carolina	1%
Tennessee	1%
Texas	7%
Utah	1%
Virginia	6%

Michigan	4%	Washington	1%
Minnesota	1%	Wisconsin	1%

MJB&A used online mapping programs to estimate the distances from the major cities in each of the states to Washington, D.C.[18] MJB&A estimated the distance for international travelers using data on country of origin provided by the Convention and Tourism Corporation. Table 11 shows MJB&A's estimates for the passenger miles for each type of transportation along with emissions factors and the estimated CO_2 emissions for each mode of transportation.

Table 11. Estimated CO2 Emissions for Travel to Conferences in Washington, D.C. in 2007

Mode of Transportation	Total Passenger Miles[a]	Emissions Factor (lb/mile)[b]	CO_2 Emissions (tons)
Airplane (Long Distance)[c]	1,725,000,000	0.39	483,483
Airplane (Short Distance)	2,554,028,100	0.64	817,289
Car	280,441,530	0.73	102,361
Van/Small Truck	46,007,613	1.1	25,304
Train	58,363,857	0.21	6,128
Bus	6,373,323	3.66	11,663
Total			**1,446,229**

a. Calculated using data provided by the Washington, D.C. Convention and Tourism Corporation on the number of people who attended conferences in 2007, their state of origin, and their mode of transportation.
b. Emissions factors based on the Greenhouse Gas Protocol.
c. Long distance flights were assumed to be greater than 5,000 miles roundtrip.

While travel is the largest portion of emissions associated with conferences, there are also emissions from facility use (electricity and heating and cooling) and hotel use. The most accurate way to calculate the emissions associated with hotel stays and conferences would be to review the specific hotels where visitors stay and the energy usage at the specific conferences that visitors attend. This sort of calculation would be possible using spreadsheets or calculators available through a number of offset providers. If the District initiates an offset program and targets this group of customers, it could collect this information at the point of sale using information provided by the purchaser.

To develop a rough estimate of the emissions associated with hotel and conference center use, MJB&A looked at publically available materials from conferences that invested in offsets. MJB&A found an estimate that about 85 percent of emissions associated with conferences are associated with travel to the conference.[19] Using this estimate, the total emissions generated by the 2.3 million annual conference attendees are about 1,700,000 tons of CO_2.

[18] Distances for states within driving distance were estimated using Google Maps. Distances for states further away were estimated using a GPS calculator available at www.zenithair.com/misc/distance.html.
[19] Make the 2008 ACA Meeting Climate Neutral, http://neutrons.ornl.gov/conf/aca2008/climate_neutral.shtml

To check this estimate, MJB&A used data from the the District's Convention and Tourism Corporation on the average length of stay for a conference visitor. The average length of stay is 3.4 days. TravelGreen, a program from Sustainable Travel International that provides offsets to hotels, estimates that use of an average 300 square foot hotel room generates 33.6 pounds of GHG emissions per night.[20] Based on this estimate, the 2.3 million annual visitors to Washington, D.C. generate about 130,000 tons of CO_2 emissions from their use of hotels. That means that the remaining 128,000 tons of CO_2 emissions from our estimate come from convention center use, a number that seems appropriate.

Without a market survey, it is difficult to estimate the level of interest in a District-based offset or emissions reduction program. It is important to remember that there are a number of commercial providers who engage with conferences and conference centers to sell offsets and create "carbon neutral" events. The District will face competition from these providers and may be at a disadvantage because it is offering travelers not carbon offsets for their own emissions, but the opportunity to reduce the city's emissions. Other cities, most notably Denver, have assumed a 10 percent participation rate for travelers voluntarily offsetting emissions.[21] This estimate may be high considering that the District will not initially be offering verifiable offsets. If the District had 10 percent participation, the demand for emissions reductions would be about 170,000 tons or 154,000 metric tons per year. At $20 per metric ton, that *could* result in over $3 million in donations per year.

Recommendations for the Greenhouse Gas Reduction Fund

As a next step, the District should identify an initial portfolio of GHG emission reduction strategies and develop a recommended donation for visitors to the city. Since the District will not be selling offsets, the city needs to make clear that contributing to the Greenhouse Gas Reduction Fund is not a way to offset emissions resulting from travel to the District. That is, visitors are not reducing their own emissions; rather, they are helping the District reduce its emissions. This is a very important distinction given the attention currently focused on the voluntary offset market. One way of making this distinction is to base the contribution amount on average visitor emissions instead of calculating the emissions associated with a specific visitor (i.e., using a carbon footprint calculator). Using the data in the demand section, 2.3 million visitors generate 1.7 million tons of CO_2 (about 1.5 million metric tons) traveling to and staying in the District. That is about 0.65 metric tons per visitor.

To solicit donations, the District could provide a suggested donation based on the average cost of emissions reductions in the Greenhouse Gas Reduction Fund portfolio. Table 12 lists the projects reviewed in the supply section. The column title "Suggested Donation" is the estimated reduction price multiplied by the 0.65 metric ton average-visitor CO_2 emissions. The District could select a number of the lower-price options in Table 12 and bundle them as part of the Greenhouse Gas Reduction Fund.

[20] TravelGreen-Carbon Neutral Accommodations, *The Calculation*, http://www.travel-green.org/carbonneutralhotel.html#thecalculation.
[21] Denver Climate Action Plan, *Section 3. Recommendations*, p. 25. http://www.greenprintdenver.org/docs/DenverClimateActionPlan_P3.pdf.

To make the higher donation projects more attractive, the city could package a specific project, such as the planting of a tree or the installation of a solar panel, and offer visiting conferences the opportunity to sponsor the project. The city could recognize sponsorship through the use of signage such as that used in areas where groups sponsor highways.

The city will also want to be mindful of the cost of purchasing voluntary offsets on the open market. A 2006 CA-CP report on the voluntary offset market listed offset prices ranging from $8 per ton to $35 per ton ($8.80 to $38.60 per metric ton).[22]

Table 12. Potential Emission Reduction Projects and Estimated Costs

Project	Estimated Reduction Price ($/metric ton)	Suggested Donation[a]	Quality[b]	Visibility[c]	Notes
Accelerated Fuel Efficient Vehicle Purchases	$14	$9	Medium	Medium	Assumes accelerated replacement of end-of-life vehicles (not full cost of vehicle)
Street light energy efficiency	$20-$61	$13-$40	High	High	Assumes entire system is replaced, accelerated payback period of 10-year lifetime
Bike Lanes	$24	$16	Low	High	Assumes existing methodology is applicable to GHGs, 20-year lifetime
Bike Racks	$76	$49	Low	High	Assumes existing methodology is applicable to GHGs, 20-year lifetime
Refrigerator Change-Out	$86-$270	$56-$175	High	Medium	Assumes program focuses on oldest refrigerators, 10-year lifetime
Solar Installations	$228-$422	$148-$274	High	Medium	Based on estimated costs from pilot program, 20-year lifetime
Tree Planting	$4,183	$2,719	High	High	Assumes 15-year tree life
Tree Maintenance	$35,532	$23,096	Medium	High	Assumes tree life is extended to 30 years with maintenance
Methane Capture at Blue Plains	NA	NA	High	Low	WASA is currently reviewing technologies

a. Suggested donation based on a 0.65 metric ton purchase which is equivalent to the average emissions associated with attending a conference in Washington, D.C.
b. Quality is a subjective assessment of the quality of the project for the inclusion in a verified offset program.
c. Visibility is a subjective assessment of the public visibly of the project for purposes of public education.

Price is not the only factor the District should consider in the development of the portfolio; Table 12 includes subjective rankings for *quality* and *visibility*. These rankings are based on the opinion of experts at CA-CP and MJB&A. Quality refers to the quality of the emission reduction for potential long-term inclusion in a verified offset program. Visibility refers to the potential for the public to see and learn from the project. Projects that are highly visible, such as bike lanes and bike racks, may not be as easy to roll into a verified offset program in the future. However, these projects may be important for the District as an educational tool.

[22] Clean Air-Cool Planet, *A Consumer's Guide to Retail Carbon Offset Providers*, December 2006. http://www.cleanair-coolplanet.org/ConsumersGuidetoCarbonOffsets.pdf

Once it establishes a set of programs and a recommended donation, the city should develop educational and marketing materials that are consistent with the city's ongoing green initiatives, including a District Greenhouse Gas Reduction Fund web page on the Green DC website. It should also develop strategic partnerships with local environmental advocates, NGOs, universities and city businesses. These partnerships could lead to future emissions reduction projects or to additional funding opportunities.

CA-CP and MJB&A believe that the Greenhouse Gas Reduction Fund must be transparent in its use of donations and accurately account for the projects that are funded and the emissions reductions associated with each project. This exercise will lay the groundwork for a future offset program and will provide the program with feedback as it moves forward and potentially grows in size and scope. There are a number of ways the District could provide this transparency. For example, it could document every project on the Greenhouse Gas Reduction Fund web page, including support from the Fund as well as estimated CO_2 reductions. The District should also publicize a methodology for choosing projects and for distributing the funds.

Recommendations for a Future Offset Program

CA-CP and MJB&A recommend that Washington, D.C. refine the supply of the emissions reductions projects and potential for future offset projects through its evaluation and development of its Climate Action Plan. As the District develops its Climate Action Plan, the possibility of developing a voluntary carbon offset program should be an integral part of the planning process.

If and when the District pursues an offset program, there are additional implementation considerations including:

- Choosing an existing online carbon footprint calculator or developing one that is District specific;
- Identifying a voluntary carbon offset registry (such as Environmental Resources Trust) where District projects can be registered and the voluntary carbon offsets retired;
- Developing a simplified contract and voluntary carbon offset certificate for transmittal to voluntary carbon offset buyers; and
- Identifying the issues and considerations for pricing the voluntary carbon offsets including, at minimum, the administration of the voluntary offset program (including monitoring and verification) and implementation of the emission reduction strategies.

We suggest that the District consider investigating the local market demand for offsets. Marketing an initiative to local organizations, businesses, and individuals, especially when the program is getting off the ground, would avoid some of the double-counting issues and would engage local stakeholders in the task of reducing the city's emissions. For example, D.C. could install solar panels on the roof of the Verizon Center. Installing the solar panels would reduce the emissions from electricity generation within the inventory by a measurable amount. D.C. could then sell those emissions reductions as offsets for electricity use at National's Park. National's Park could then list in its advertising materials that it was offsetting emissions from

its operations by purchasing solar energy from D.C.[23] Since all the reductions are within the boundaries of D.C.'s emissions inventory and emissions are going down, the city would still be meeting its voluntary climate target and there would be no doubling counting.

Under this option, the offset supply would not necessarily need to be clearly separate from the District's Climate Action Plan strategies but could be utilized to achieve the voluntary GHG emissions reduction targets. This option could be tied to a District-specific outreach and educational campaign to enlist the participation of D.C citizens, businesses, university, hospitals and other institutions to reduce GHG emissions. This option may be a good first step for the District to build its offset program prior to expanding it to target visitors to Washington, D.C.

The biggest opportunities for offsets are most likely in sewage treatment and in solid waste. Even if it does not fit within the Greenhouse Gas Reduction Fund, the city should find a way to coordinate the creation of a combined heat and power (CHP) application for Blue Plains using biogas to generate electricity and the waste heat to generate steam for more electricity. If the biogas is not regulated, the city could claim offsets from methane and the grid; if it is regulated, it is possible that the electricity savings could pay for the project.

Outside the boundaries of the city, the District should investigate the existing solid waste handling facilities. The facilities should be capturing methane to generate power. The District could also investigate how waste is hauled and if there are less fuel-intensive ways (rail, for instance) of hauling it.

[23] Note that the Verizon Center could not claim to be reducing its emissions since National's Park bought the rights to the emissions reductions