

Methods used to Quantify Reductions in Electricity Consumption

Estimating Ozone Season Electricity Reductions

The calculation of energy reductions proceeds in two steps: calculation of annual electricity reductions and calculation of ozone season electricity reductions.

Annual Electricity Reductions

The annual reductions in electricity use are described below in the notes on each jurisdiction's approach.

Ozone Season Electricity Reductions

The annual kWh savings are then used to estimate ozone season kWh savings.

First, the kWh savings for each measure are classified into the following categories: air conditioning reductions, lighting reductions, and reductions from other measures. In the following notation, the subscripts a, l, and o are used to refer to these categories, respectively. The total annual reductions in each category are given by ΔkWh_a , ΔkWh_l , and ΔkWh_o .

As described below in more detail, the annual ΔkWh estimates are generally developed using engineering methods. The resulting estimates are taken to represent the performance of the energy efficiency measures when they are newly installed. The resulting ΔkWh estimates are assumed to decrease over time. A simple discounting formula serves as a proxy for a variety of complex factors that will decrease the performance of energy efficiency measures over time: It is assumed that the performance will decrease by 15% per year.¹

Using a building simulation model and data from the Commercial Buildings Energy Consumption Survey of the U.S. Energy Information Administration, model time-profiles were developed for each of these three categories of efficiency measures.² This procedure yields a set of three factors f_a , f_l , and f_o that represent the fraction of the annual savings that occur in the ozone season, for each category.

From these values, the hourly ozone-season kWh reductions for each category, $O_3\Delta kWh_a$, $O_3\Delta kWh_l$, and $O_3\Delta kWh_o$ are given straightforwardly by

¹ This approach follows the use of discounting described in: Jacobson, D; P. O'Connor; C. High; J. Brown. "Final Report on the Clean Energy/ Air Quality Integration Initiative Project of the U.S. Department of Energy's Mid-Atlantic Regional." DOE/GO-102006-2354. August 2006.

² B. Griffith. "Composite Hourly Electrical Savings Profiles for Government Buildings in the Washington, DC, area" Deliverable # 1, MWCOG TAP request, National Renewable Energy Laboratory, December 15, 2006 DRAFT.

$$O_3\Delta kWh_a = \Delta kWh_a \cdot f_a \quad [1]$$

$$O_3\Delta kWh_l = \Delta kWh_l \cdot f_l \quad [2]$$

$$O_3\Delta kWh_o = \Delta kWh_o \cdot f_o \quad [3]$$

The ozone season kWh reductions given by equations [1]-[3] are then multiplied by the ozone season displaced emissions factor calculator used to estimate the ozone season NO_x reductions.

Notes on the Energy Savings Estimates for Each Jurisdiction

Arlington County, VA

Arlington County has been investing in energy upgrades for its government facilities for some time. Data is available on the impacts of the investments for the period from 2002 to 2005. Initial estimates were developed using energy savings data and cost data for the energy retrofits from the program history. NREL developed estimates of future savings were developed from detailed descriptions of measures planned for future program investments. Each of the specific measures described falls into one of the three categories described above. The Δ kWh estimates for each measure were developed using engineering data from manufacturer's specifications and other sources.

Baseline. Arlington County used the existing performance of the building as the baseline figure. The estimation of Δ kWh assumes that the existing performance of the buildings would have persisted in the absence of Arlington's energy conservation program, and that the SIP baseline did not incorporate the impacts of the program. The county has provided a budget line-item for that program to make energy efficiency investments that would not have been made in the absence of the program.

Performance with Efficiency Measures in Place. For measures put in service between 2002 and 2005, *ex post* performance is based on measured data. The energy performance estimates for future measures were developed using engineering estimates, e.g. from manufacturer specifications.

Conservative assumptions for savings are used, and the buildings targeted here will not be mothballed, replaced, or substantively changed in intensity of occupancy or use. The use of the Arlington building inventory is somewhat fluid, but the buildings targeted by the included measures will remain in use for the foreseeable future.

Measures included in Arlington County kWh Savings

Table I-1 provides a list of the measures included in the Arlington County conservation program, for the purposes of this submission.

Table I-1: Arlington County Energy Efficiency Measures

Arlington County Energy Efficiency Measures (EEMs) and Projects, 2002 - 2010			
Building Names	Measure(s)	Annual Elec. Use before EEMs (kWh)	Annual Savings from EEMs (kWh)
Completed Projects (2002-2006)			
Central Library	Building automation improvement	2,800,000	600,000
Courthouse	Lighting (partial)	5,800,000	340,000
Madison Senior/Rec Center	Lighting (partial), HVAC ctrls	280,000	58,000
Court Square West	Lighting (partial), HVAC ctrls	1,450,000	80,000
Argus House (*)	Lighting (entire)	245,000	55,000
Lubber Run Rec Center	Lighting (entire)	280,000	36,000
Woodmont Center (*)	Lighting (partial)	440,000	20,000
Solid Waste/Traffic Admin Bldg	Lighting (partial), water heater	350,000	12,000
Prospective Projects – 2007			
Court Square West	Lighting (complete)	1,370,000	110,000
Court Square West	VFD on cooling tower	1,270,000	20,000
W/S/S Admin	Lighting (entire); HVAC ctrls	350,000	80,000
Central Library	Lighting (complete)	2,200,000	80,000
Drewry Center	Lighting (entire)	440,000	70,000
Courthouse	Lighting (complete)	5,460,000	50,000
Barcroft Sports Center	Bldg automation improvement	620,000	50,000
Vehicle Repair Shop	Lighting (entire)	620,000	40,000
Prospective Projects – 2008			
Detention Center	Lighting (partial)	5,900,000	120,000
Fire Station # 4	Lighting (entire)	400,000	65,000
Vehicle Repair Shop	Compressed air upgrade/repair	570,000	30,000
Drewry Center	Bldg automation improvement	380,000	50,000
Cherrydale Library (*)	Lighting (entire) & heat pumps	110,000	40,000
Dawson Terrace (*)	Lighting (entire) & heat pumps	110,000	40,000
Solid Waste/Traffic Admin Bldg	Lighting (complete)	338,000	30,000
Madison Senior/Rec Center	Lighting (complete)	222,000	25,000
Fire Stations # 8 and # 10 (total)	Lighting (complete)	200,000	25,000
Glen Carlin Library (*)	Lighting (entire)	90,000	15,000
Clarendon House (*)	Replace heat pump(s)	160,000	20,000
Residential Program Center	Replace chiller with new	400,000	20,000
Nature Centers (two)	Lighting (entire)	200,000	20,000
Prospective Projects - 2009			
Detention Center	Broad scope of EEMs (performance contract?)	5,780,000	600,000
Prospective Projects - 2010			
Human Svcs HQ, 3033 Wilson (*)	Broad scope of EEMs	4,800,000	500,000

Source: Excerpted from supplemental data provided by John Morill, Arlington County, November 2006.

Note: Because we are not certain of the dates, we discounted the measures undertaken before 2006. We have assumed that measures undertaken before January 1, 2003 are included in the SIP baseline and therefore not eligible. For Arlington, assuming that the measures are undertaken evenly over time, 20 percent would have been in service before 2003. To be conservative, we have excluded 30% of the total in each category.

Fairfax County Virginia

Measures included in Fairfax County kWh Savings

Table I-2: Fairfax County Energy Efficiency Measures

Agency/ Department	Program Description/Impact (Numbers of Building Sq Ft., Lighting, Units)	Total Projected Annual Energy Savings (kWh)	Year of Implementation	Comments on Implementation
FMD	Variable Speed Drives and Lighting Upgrades to the Government Center complex (Buildings B-1, B-2, B-3)	2,261,709	2006	Annual dollar savings \$111,000
FMD	HVAC and Lighting Upgrades to the Adult Detention Center	2,462,253	2005	Annual dollar savings \$184,000, in addition to KWH shown also reduced natural gas consumption by 111,440 therms per year
FMD	Lighting upgrades to multiple buildings	136,327	2006	Annual dollar savings \$9,700
FMD	HVAC and Lighting Upgrades to the Juvenile Detention Center and Springfield Warehouse	1,770,386	2005	Annual dollar savings \$86,887
NOTE: The projects listed above represent the major energy savings projects over the last two years for FMD.				

Montgomery County, Maryland

Measures included in Montgomery County kWh Savings

Table I-3 lists the efficiency measures from Montgomery County that are included for the purpose of this submission.

Table I-3: Montgomery County Energy Efficiency Measures

Agency/Department	Program Description/Impact (Numbers of Building Sq Ft., Lighting, Units)	Total Projected Annual Energy Savings (kWh)	Year of Implementati on
Montgomery Co. Schools	Lighting, Clopper Mill ES	330,000	12/15/2004
Montgomery Co. Schools	Auto Computer shutdown	3,000,000	7/15/2004
Montgomery Co. Schools	Wheaton/Edison HS retro-commission	420,000	9/15/2004
Montgomery Co. Schools	Lighting	3,000,000	1/15/1998
Montgomery Co. Schools	Lighting	2,200,000	1/15/1999
Montgomery Co. Schools	Lighting	1,100,000	1/15/2000
Montgomery Co. Schools	Lighting	900,000	1/15/2001
Montgomery Co. Schools	Lighting	7,100,000	1/15/2002
Montgomery Co. Schools	Lighting	640,000	1/15/2003
Montgomery Co. Schools	EMS upgrades	440,000	1/15/2003
Montgomery Co. Schools	EMS upgrades	240,000	3/15/2007
Montgomery Co. Schools	Lighting	850,000	3/15/2007
Montgomery Co. Schools	Re-lamping to T-8	10,700,000	1/15/2007
MNC Park Planning	Heat pump and HVAC	60,000	12/31/2005
MNC Park Planning	Programmable Thermostats	10,000	12/31/2005
MNC Park Planning	Lighting controls	10,000	12/31/2005
MNC Park Planning	Lighting upgrades	75,000	12/31/2005
MNC Park Planning	Unoccupied cycle controls prog.	60,000	12/31/2005
MNC Park Planning	Equipment replacement	64,000	7/15/2006
MNC Park Planning	Control improvements	42,000	7/15/2006
MNC Park Planning	Lighting projects	9,500	5/15/2007
Wash. Suburb. Sanitary	ESPC (Phase II)	5,555,000	10/15/2008
Montgomery College	Lighting	125,000	12/31/2006
Montgomery College	HVAC	50,000	12/31/2006
Montgomery College	Controls	25,000	12/31/2006
Public Works and Trans.	HVAC and other retrofits	100,000	6/15/2005
Public Works and Trans.	Elevator modernization	30,000	12/31/2002
Public Works and Trans.	Elevator modernization	30,000	12/31/2003
Public Works and Trans.	Elevator modernization	30,000	12/31/2004

Agency/Department	Program Description/Impact (Numbers of Building Sq Ft., Lighting, Units)	Total Projected Annual Energy Savings (kWh)	Year of Implementati on
Public Works and Trans.	Elevator modernization	30,000	12/31/2005
Public Works and Trans.	HVAC	2,550,400	12/31/2000
Public Works and Trans.	HVAC	1,728,833	12/31/2001
Public Works and Trans.	HVAC	3,056,117	12/31/2001
Public Works and Trans.	HVAC	2,250,158	12/31/2002
Public Works and Trans.	HVAC	1,344,083	12/31/2002
Public Works and Trans.	HVAC	1,344,083	12/31/2004
Public Works and Trans.	EMS Upper Co. Community Ctr	222,212	12/31/2005
Public Works and Trans.	Elevator modernization	12,500	12/31/2007
Public Works and Trans.	HVAC and other retrofits	75,000	12/31/2007