APPENDIX B: METHODS AND CALCULATIONS

B.1 Methodological Standards

This Fairfax County Community GHG inventory consolidates two component research activities, the first for Fairfax County local government operations and the second for the broader non-governmental community (i.e., residential, commercial, industrial and transportation sectors).

Fairfax County created the government operations component using a set of standards evolved from the Greenhouse Gas Protocols (GGPs) for corporate and public sector organizations (8,16,17). In particular, the county closely followed direction of the Climate Registry (8) and its partners' GGP-compliant General Reporting Protocol (GRP) and its derivative Local Government Operations Protocol (LGOP), version 1.1 (2010).

The Community Greenhouse Gas Emissions Inventory Protocol (18) of the ICLEI was expected to provide a parallel framework for the second component of this project. However, at the time this report was completed, the protocol had not yet been finalized.[7] In the interim, ICLEI guided local governments to interpret and adapt its more general 2009 International Local Government GHG Emissions Analysis Protocol (IEAP) (7). Section 3.2.2, in particular, notes United Nations Framework Convention on Climate Change (UNFCCC) expectations that localities should report community emissions for the following sectors:

- Stationary Energy
- Transport
- Fugitive Emissions
- Industrial Processes
- Agriculture
- Land Use, Land Use Change and Forestry (LULUCF)
- Waste

Certain sources that represent less than 5% of total CO_2e emissions meet *de minimis* criteria and may be excluded from measurement and reporting (7). Beyond Fairfax County's own operations, all sectors beyond Stationary Energy and Transport were deemed to meet *de minimis* criteria for reporting exclusion on an annual basis. (LULUCF may be more prominent when examined over multi-year to decadal periods of

[7] The ICLEI Community Greenhouse Gas Emissions Inventory Protocol was scheduled for completion in Spring 2012. Early drafts were requested, but not made available to the research team before the Fairfax County GHG inventory was completed.

change.) Beyond transient mobile emissions, IEAP-optional Scope 3 emissions were also omitted.

Beyond the general terms of the IEAP, the development of Fairfax County's first community GHG Emissions inventory pre-dated any communitywide tool or data processing guidance from nationally or internationally-recognized authorities.

In order to be consistent with the IEAP's Global Reporting Standard for comparative purposes, neighboring Arlington County previously adapted ICLEI's LGOP-compliant Clean Air & Climate Protection software to generate its own community GHG inventory (19). Arlington incorporated locally generated (IEAP Tier 2 and Tier 3) data accessible to both counties wherever feasible, otherwise defaulting to national-scale Tier 1 specificity (e.g., regarding vehicular MPG estimates) (2). Arlington officials advised Fairfax that repeating its customization of proprietary ICLEI software might not be the most prudent course of action. As a result, the GHG inventory development team opted to develop its own calculation spreadsheets from scratch.

The community portion of this inventory – residential, commercial, industrial and transportation sectors – is derived from Arlington County's methods. Any known deviations from this approach are either noted above this section or else explicitly identified below.

B.2 Hierarchal Classification for Types of Emissions

Data were classified into sectors and sources, following standard and readily accessible categorization schema used by utilities and tracking agencies. Energy types include electricity, natural gas, diesel fuel and gasoline. Figure B-1 shows top-level classes of sources as stationary and mobile. One tier below, sectors include residential, commercial, transportation, local government and industrial. (For simplicity, transportation includes mobile sources related to any other sector.)

Figure B-1: High-level categories used for the Fairfax County GHG inventory

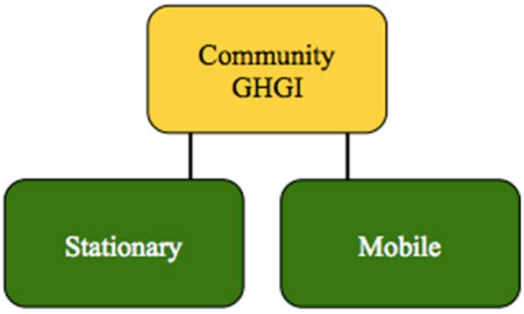
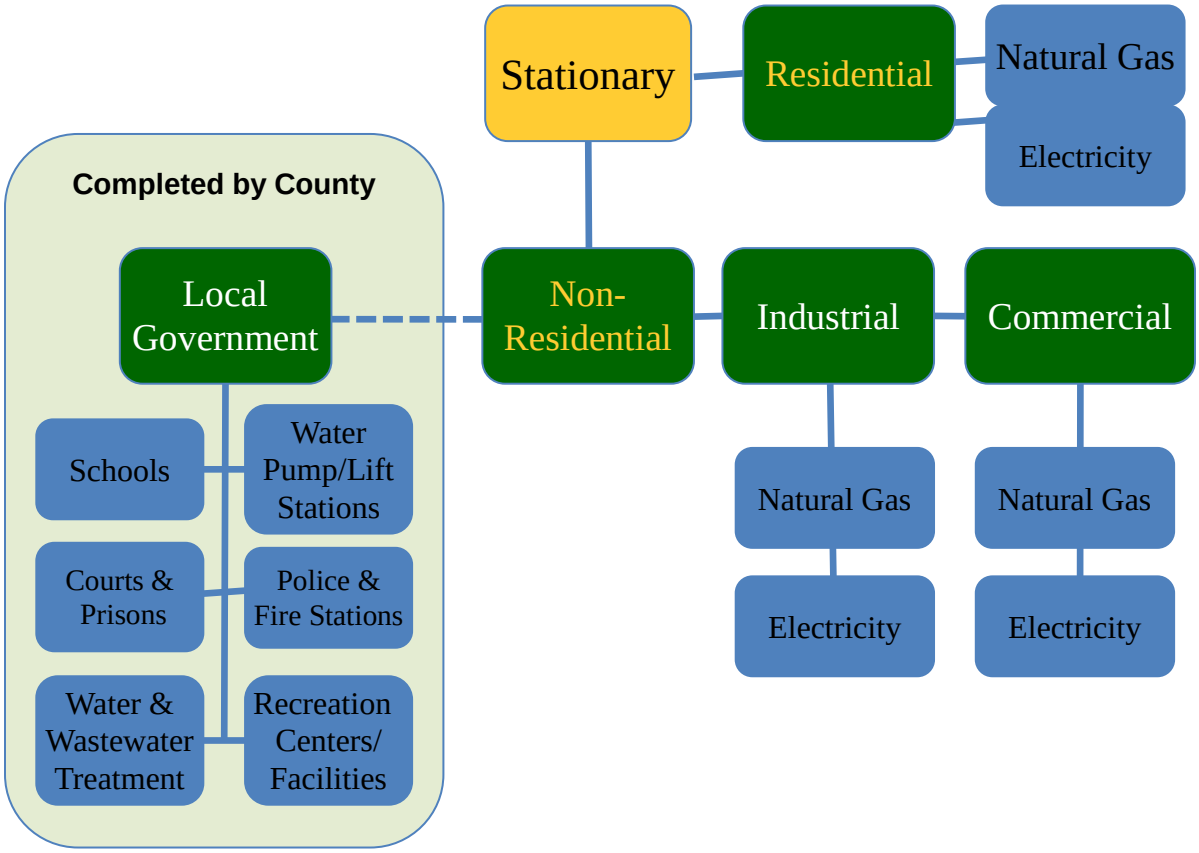


Figure B-2 presents primary categories for stationary emissions sources (residential and non-residential), along with sub-categories according to sector and energy type. Non-transportation fuel oil usage and livestock emissions were both deemed to be too small (<< 1%) to merit inclusion in the overall emissions for Fairfax County. Terms "Industrial," "Commercial" and "Residential" were defined per the Energy Information Agency (EIA) of the United States Department of Energy (10).

Figure B-2: Primary categories for stationary sources



As presented in Figure B-3, mobile emissions sub-categories include “local” vehicles that were registered in Fairfax County and “transient” vehicles that were not. Each includes a fleet of heavy duty trucks, light duty trucks and SUVs, and passenger vehicles and motorcycles. These vehicle classes reduced 13 federal functional classes to three (20), displayed in Table B-1. Note that local (registered in Fairfax County) vs. transient (registered elsewhere) could not be ascertained for off-road vehicles and are not applicable to Metrorail rapid transit and VRE commuter rail trains. County-owned passenger and transit fleets are implicitly included in this portion of the inventory, though explicitly listed under local government in Appendix C.

Figure B-3: Primary sub-categories for mobile category

While Fairfax County elected not to include pass-through transport via air or train tracks, emissions by county residents using Metrorail light rail and VRE commuter trains are included.

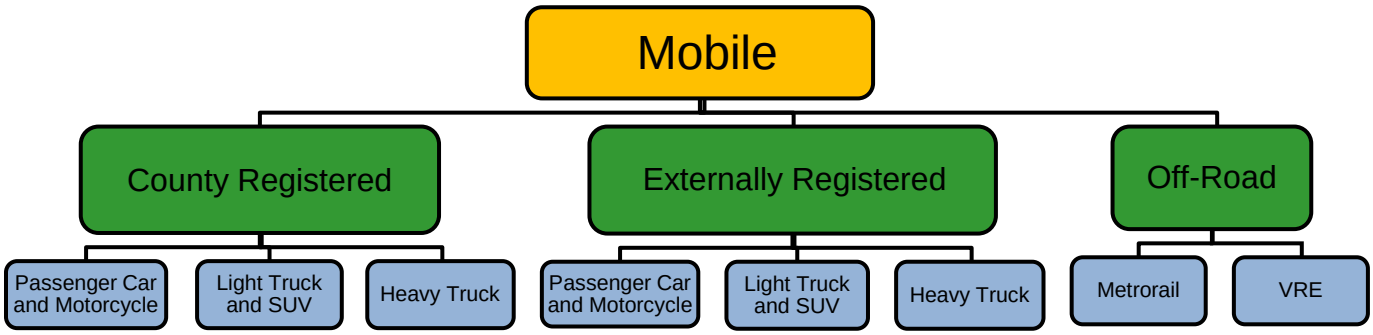


Table B-1: On-road vehicles by federal functional class, vehicle class and weight[8]

[8] County-registered vehicles of unknown make and model that weighed between 3,375 and 6,500 lbs. were assigned to vehicle classes of passenger or light duty truck using linear interpolation between these two values. Classes were based on EPA standards (http://www.fueleconomy;gov/feg/info/shtml). According to EPA's Test Car List Data Files (http://www.epa.gov/otaq/tcldata.html), Gross Vehicle Weight Rating (i.e., with passengers, called "ETW" by EPA) below 3,375 lbs. is always a passenger vehicle (class=0). Those above 6,500 and less than 10,000 are always [light] trucks (class=1). This was true for both 2006 and 2010 model years. For vehicles of intermediate weight (w), but unknown model type, we can linearly interpolate class (c) as follows: c = (w – 3,375) / (6,500 – 3,375), where c is in the

Federal Functional Class	Vehicle Classes	Weight of Vehicles
Motorcycles	Passenger	1 – 6,500 lbs.
Passenger Vehicles		
Two Axle, 4 Tire Single Unit Vehicles	Light duty truck	3,375 – 10,000 lbs.
Buses	Heavy duty truck	10,001+ lbs.
Two Axle, 6 Tire Single Unit Trucks		
Three Axle Single Unit Trucks		
Four or More Axle Single Unit Trucks		
Four Axle or Fewer Single Trailers		
Five Axle Single Trailers		
Six or More Axle Single Trailers		
Five Axle or Fewer Multi-Trailers		
Six Axle Multi-Trailers		
Seven or More Axle Multi-Trailers		

Off-road emissions classes – including off-road engines, equipment and vehicles – were estimated by EPA's NONROAD2008a model, the only readily available source for estimating off-road vehicular emissions for Fairfax County (14). This stand-alone tool does not provide estimates of quantity of (diesel or gasoline) fuel; hence it is not included in energy usage results (Appendix C.1 and C.2).

Table B-2 provides a list of off-road engines, vehicles and equipment for which emissions can be estimated at the county level using EPA's NONROAD2008a modeling tool

Table B-2: Off-road engines, vehicles and equipment with emissions estimated by EPA (14)

Off-Road Vehicles
Agricultural Equipment
Airport Support
Commercial Equipment
Construction Equipment

interval [0,1], representing the proportion of vehicles with known weight (w) that are expected to be passenger vehicles, and (1-c) the proportion expected to be light trucks. The known quantity (q) of all vehicles of a given weight under 6,500 lbs., but without make and model, that were classified as passenger vehicles was (q * c) and as light trucks (q * (1-c)).

Off-Road Vehicles
Industrial Equipment
Lawn & Garden Equipment
Logging Equipment
Oil Field Equipment
Railway Maintenance
Recreational Marine
Recreational Vehicle
Underground Mining

B.3 Data and Calculations

The basic model for determining GHG emissions for each usage type consists of first identifying their respective emission factors, i.e., how much GHG emissions – particularly metric tons (MT) of CO_2, CH_4 and N_2O – are produced per unit use of each resource (e.g., kWh of electricity, therms of natural gas, gallons of gasoline). This emission factor is then multiplied by a standard estimate of the Global Warming Potential (GWP) of that gas relative to CO_2, presented in units of metric tons CO_2 equivalent (MT CO_2e) in (1).

For instance, 1 therm of natural gas produces 5.31x10-3 MT of CO_2, 5.00x10-10 MT of CH_4 and $1.00x10^{-11}$ MT of N_2O. Multiplying each of these gas emissions by their respective GWP {1, 21, 310} results in {$5.31x10^{-3}$ $MTCO_2e$, $1.05x10^{-8}$ $MTCO_2e$, $3.10x10^{-9}$ $MTCO_2e$}, altogether slightly more than 0.00531 $MTCO_2e$ per therm of natural gas expended. This is the therm-to-CO_2e conversion factor for natural gas in this inventory.

Table B-7 provides some of the conversion factors for emissions considered in this inventory. (Upon request, the underlying spreadsheet is available for review.) Specific conversion factors used here include: therm to CO_2e, kWh to CO_2e, diesel to CO_2e, gasoline to CO_2e, ethanol to CO_2e, E10 gas to CO_2e, fuel oil to CO_2e and propane to CO_2e. (Due to variable fuel blends for electricity, kWh-to-CO_2e conversion factor is recalculated for each year.)

To determine the annual GHG emissions in $MTCO_2e$ for a given source and year, one calculates the product of the total quantity of that resource used (e.g., 73,547 therms used by Columbia Gas residential customers in 2006) and the conversion factor (0.00531 $MTCO_2e$/therm) to produce the results (e.g., 390 $MTCO_2e$ produced by those customers in 2006). These results divided by the county population for a given year provides the per capita GHG emissions.

B.4 Stationary Sources

Stationary emission sources include electricity and natural gas from residential, commercial and industrial sectors. The methodology to calculate emissions from these sources includes three steps:

B.4.1 Determine annual consumption of electricity and natural gas and, for local government operations only, stationary fuel oil.

B.4.2 Determine the appropriate CO_2, CH_4, and N_2O emission and conversion factors for electricity and natural gas.

B.4.3 Calculate emissions from electricity and natural gas.

The following sections (B.4.1-B.4.3) describe these steps in more detail.

B.4.1 Determine annual consumption of electricity and natural gas

Emissions resulting from electricity and natural gas were determined by using actual consumption data whenever possible. Annual consumption of residential, commercial and industrial electricity was provided by DVP, MWCOG and NOVEC. These data include gross consumption at point of meter, not inclusive of any transmission losses or Renewable Energy Credits (RECs, started by DVP in 2009). All data were received in MWh and kWh respectively. Table B-3 presents electricity consumption (in kWh) in Fairfax County from 2006 through 2010 by sector.

Table B-3: Total electricity usage (in kWh) by sector and year, 2006 – 2010

Type	2006	2007	2008	2009	2010
Commercial	5,925,905,138	6,153,587,240	6,096,775,760	5,919,452,368	5,976,199,142
Residential	4,957,128,372	5,234,984,703	4,985,215,444	4,985,809,019	5,366,142,672
Industrial	155,796,127	146,256,367	120,591,922	120,874,291	117,295,218
Local Government	557,301,768	565,734,851	568,933,533	559,968,145	580,165,555
Total	**11,596,131,405**	**12,100,563,161**	**11,771,516,659**	**11,586,103,823**	**12,039,802,587**

Annual consumption of residential, commercial and industrial natural gas was provided by Columbia Gas and Washington Gas. Natural gas includes gross in-county usage provided by Washington Gas and, for 2006, Columbia Gas.[9] Gross usage excludes any carbon offsets (started by Washington Gas in mid-2009) or transmission losses. All natural gas data were received in Mcf and therms respectively.[10]

Electricity and natural gas use by local government operations was provided directly by the county. Table B-4 presents natural gas consumption (in therms) in Fairfax County from 2006 through 2010 by sector.

Table B-4: Annual natural gas usage (in therms) by sector and year, 2006 – 2010

Sector	2006	2007	2008	2009	2010
Residential	163,279,747	177,504,347	178,656,732	181,608,585	185,393,179
Commercial	60,529,169	63,702,168	64,315,722	63,957,425	64,167,070
Industrial	28,496,373	26,588,025	24,024,929	26,225,554	25,749,351
Local Government	8,712,694	10,016,655	10,645,687	11,406,177	11,146,256
Total	**261,017,982**	**277,811,195**	**277,643,069**	**283,197,741**	**286,455,856**

The county also provided measures of its #2 fuel oil and propane usage, all of which were less than 4% of the county operations' total GHG emissions from stationary fuel usage (i.e., these fuel oils plus natural gas), per Table B-5. These emissions met the *de minimis* criterion (<5%) for exemption from reporting in a GHG inventory but were included in county operations for completeness. Since county use of these fuel oils met exemption requirements, extrapolating to other sectors would necessarily result in

[9] Natural gas consumption by Columbia Gas customers in 2007-2010 was estimated using the ratio of Columbia Gas-to-Washington Gas usage in 2006 multiplied by the usage by Washington Gas customers in subsequent years.

[10] Mcf was converted to therms by dividing by 10.27, per EIA estimates of average heat content per cf (13).

similar exemption. Thus, no further effort was made to estimate stationary fuel oil usage in other sectors, based on county operations values.

Table B-5: County operations' #2 fuel oil and propane usage (in gal.), 2006 - 2010.

Type	2006	2007	2008	2009	2010
#2 Fuel Oil	68,006	95,288	116,039	219,094	66,013
Propane	31,224	38,585	34,390	40,406	30,270
% of County stationary fuel GHG emissions	1.9%	2.2%	2.4%	3.9%	1.4%

B.4.2 Determine the appropriate CO_2, CH_4, and N_2O emission and conversion factors for electricity and natural gas

For electricity, the kWh-to-lb of CO_2 as well as kWh-to-lb of CH_4 and kWh-to-lb of N_2O emission factors vary year-to-year due to a transition to less GHG-polluting blend of energy sources, as shown in Table B-6. The county provided its standard emission factor, using the Inventory Emission Rate from 2006 eGRID using 2004 data, subregion SRVC, SERC Virginia/Carolina.

For natural gas, Mcf was converted to therms by multiplying by 0.09737 (13). The therm to CO_2e conversion factor (0.00530) is based on the LGOP (Version 1.1, May 2010).

Table B-6: Fairfax County CO_2, CH_4, and N_2O emission factors for stationary energy

Type	Units	2006	2007	2008	2009	2010
Electricity						
CO_2	MWh/lb	1,146.39	1,146.39	1,146.39	1,134.88	1,118.41
CH_4	MWh/lb	0.029	0.029	0.029	0.02377	0.02226
N_2O	MWh/lb	0.019	0.019	0.019	0.01979	0.01908
Natural Gas	Therm/CO_2e	0.0053	0.0053	0.0053	0.0053	0.0053

Note: Electricity factor from eGRID2010 Version 1.1, and natural gas factor from Climate Registry LGOP Version 1.1. The former decreased by approximately 1% in 2009 and 2010, due to the transition to less polluting energy sources for electricity (SAIC, personal communication).

Table B-7: Energy-to-MTCO_2e conversion factors used in this inventory

Energy Used	Units	Conversion Factor	Reference
Natural Gas	therms	0.005306	GWP in http://www.theclimateregistry.org/resources/protocols/general-reporting-protocol ; GHG per therm in http://www.theclimateregistry.org/downloads/2010/05/2010-05-06-LGO-1.1.pdf
Electricity	kWh in 2006	0.000522942	GHG per kWh provided by Fairfax County, based on EPA's eGRID
Electricity	kWh in 2007	0.000522942	GHG per kWh provided by Fairfax County, based on EPA's eGRID
Electricity	kWh in 2008	0.000522942	GHG per kWh from Calendar 2008 GHG Inventory Emission Rate from 2006 eGRID using 2004 data, subregion SRVC, SERC Virginia/Carolina (http://www.epa.gov/cleanenergy/documents/egridzips/eGRID2006V2_1_Summary_Tables.pdf)
Electricity	kWh in 2009	0.000517782	GHG per kWh from Calendar 2009 GHG Inventory Emission Rate from 2007 eGRID using 2005 data, subregion SRVC, SERC Virginia/Carolina; see http://www.epa.gov/cleanenergy/documents/egridzips/eGRID2007V1_1_year05_SummaryTables.pdf
Electricity	kWh in 2010	0.000510197	GHG per kWh from Calendar 2010 GHG Inventory Emission Rate from 2010 eGRID using 2007 data, subregion SRVC, SERC Virginia/Carolina; see http://www.epa.gov/cleanenergy/documents/egridzips/eGRID2010V1_1_year07_SummaryTables.pdf
Diesel	gallons	0.01030278	GHG per gallon, from http://www.theclimateregistry.org/resources/protocols/local-government-operations-protocol/
Gasoline	gallons	0.009242105	GHG per gallon, calculated as 100/95 of gasoline-to-CO_2 ratio, per http://www.epa.gov/oms/climate/420f05004.htm. I.e., assumes CO_2 comprises 95% of vehicular emissions, then multiplies accordingly by 100/95 per EPA to get CO_2e.
Ethanol	gallons	0.0058287	GHG per gal from http://www.theclimateregistry.org/resources/protocols/local-government-operations-protocol/
E10	gallons	0.008900765	calculated as 90% gasoline + 10% ethanol
Fuel Oil	gallons	0.010229236	GHG per gallon provided by Fairfax County.
Propane	gallons	0.00570462	GHG per gallon provided by Fairfax County.

B.4.3 Calculate emissions from electricity and natural gas

Using conversion factors as the sum across all GHGs of the product of emissions factors for that GHG times its GWP:

CO_2 Emissions (metric tons **CO_2**e) = **CO_2** Emissions (metric tons) x 1 (GWP)

CH_4 Emissions (metric tons **CO_2**e) = **CH_4** Emissions (metric tons) x 23 (GWP)

N_2O Emissions (metric tons **CO_2**e) = **N_2O** Emissions (metric tons) x *296 (GWP)*

With conversion factors in Table 7, the following equations were used to calculate total emissions:

Emissions (MT CO_2e) = kWh of electricity consumed × electricity conversion factor

Emissions (MT CO_2e) = therms of natural gas used × natural gas conversion factor

B.5 Mobile Sources

Mobile emissions incorporated local and transient on-road vehicles, off-road vehicles, rapid transit and commuter rail. Methods for determining the energy use and GHG emissions for each are presented below. The approach paralleled that for stationary sources:

B.5.1 Determine annual consumption of energy by on-road vehicles, rapid transit and commuter trains.

B.5.2 Determine the appropriate CO_2, CH_4, and N_2O emission and conversion factors for diesel and gasoline.

B.5.3 Calculate GHG emissions from vehicles and trains.

B.5.4 Estimate CO_2 from off-road vehicles and machines.

The following sections (B.5.1-B.5.4) describe these steps in more detail.

B.5.1 Determine annual consumption of energy by on-road vehicles, rapid transit and commuter trains

Distinct methods were used to determine energy consumption for each of on-road vehicles, Metrorail rapid transit and VRE commuter trains, as follows:

On-road vehicles

Fuel consumption (in gallons) by an on-road vehicle equals its distance traveled (in miles) divided by its fuel economy (MPG). That is:

Fuel consumption (in gal.) = AVMT (in miles) / fuel economy (as MPG)

Estimating fuel consumption across over a million vehicles – motorcycles, passenger vehicles and trucks registered in or traveling to Fairfax County – each year required counting and aggregating vehicles into vehicle classes, then determining MPG per vehicle class. Counts and MPG by vehicle class, in turn, served as inputs to calculate vehicle class-weighted, fleet-wide MPG (the denominator for fuel consumption). Finally, annual vehicle miles traveled (AVMT) was estimated for both county-registered and transient vehicles, their sum serving as the numerator for total fuel consumption.

Counting and classifying vehicles: Fairfax County provided aggregated registration data for over 940,000 vehicles residing in the county each year. Counts of vehicles by year, make and model for each registration year were categorized into three categories: passenger vehicle, light duty truck and heavy duty truck. Table B-1 presents how these vehicle classes consolidate federal functional classes.

Myriad registered vehicles were not recorded by year, make and model – from 137,000 in 2006 to over 330,000 by 2010. Instead, vehicle weights provided for all vehicles registered in 2010 were used to classify these unknown vehicles into vehicle classes (see footnote 9). The relative proportion of unknown vehicles in each vehicle class in 2010 was applied to similarly categorize unknown vehicles from prior years (for which vehicle weight was also unavailable) by vehicle class.

The result was a county-registered fleet comprised of about 69% passenger vehicles, 30% light duty trucks and 1% heavy duty trucks.

Determining vehicle class and fleet-wide MPG: Based on EPA's average MPG for both city and highway combined (http://www.fueleconomy.gov/feg/download.shtml), average MPG was estimated according to vehicles' model, year and class for each vehicle registration year.

Weighted MPG for each vehicle class for a particular production year was calculated as the product of the total number of vehicles for that model year and its corresponding average MPG. Summing weighted MPG across all model years provided an age-weighted MPG for each vehicle class, in each registration year. Average fuel economy for passenger vehicles (28.3 MPG) and heavy duty trucks (5.5 MPG) did not vary across 2006-2010 registration years; however, light trucks improved by 0.3 MPG (from 20.8 to 21.1). Weighting these MPG values by relative vehicle prevalence in the county, fleet-wide MPG rose from 25.7 to 26.1 during the five-year study period.

Estimating annual vehicle miles traveled: AVMT in Fairfax County was calculated using an annual road segment survey data from VDOT and interpolated from a 2005 and 2010 household survey data from MWCOG. The maximum of the two sources in a given year was used as the AVMT for this inventory.

VDOT – but not MWCOG – distinguished vehicle classes and Fairfax County from the jurisdictions it surrounds (Fairfax City and Falls Church). Hence MWCOG data were corrected for the proportion of VDOT miles across these three jurisdictions that was attributable to travel in the county alone. Furthermore, VDOT vehicle proportions were used to allocate AVMT by vehicle class. Meanwhile, MWCOG provided AVMT per household[11] which, when multiplied by the number of county households,[12] provided an estimate of AVMT by county-registered vehicles (vs. transient vehicles).

For each year, total AVMT within Fairfax County for the federal functional vehicle class was derived from daily means on the VDOT website (http://www.virginiadot.org/info/ct-TrafficCounts.asp). AVMT for Fairfax City and City of Falls Church was also obtained in order to determine their ratio of AMVT compared with Fairfax County. In addition, VDOT's AVMT data by federal functional class was consolidated into vehicle classes.

The following provides an example of this computation process. VDOT's 2006 daily vehicle miles traveled (VMT) for motorcycles in Fairfax County (59,630) was summed with passenger vehicles daily VMT (22,061,211) to determine the daily VMT attributable to passenger vehicles (85.9%) in 2006. Annualizing and summing with other vehicles' corresponding data determines the total VDOT estimate for 2006 AVMT (25,738,260 miles/day, 9,394 mega-miles/yr). MWCOG's estimated AVMT for all vehicle types[13] across the three jurisdictions (10,322 mega-miles/yr in 2006) was adjusted by the VDOT

[11] See http://www.mwcog.org/uploads/committee-documents/bF5cWV5Y20090415144559.ppt

[12] The Fairfax County website includes annual estimates of number of households and (for per capita calculations) residents at http://www.fairfaxcounty.gov/demogrph/gendemo.htm.

[13] MWCOG GHGI staff confirmed (July 2011) that MWCOG survey accounted for all vehicle classes.

proportion of AVMT attributable to trips within the county (10,061 mega-miles/yr). In 2006, county households' AVMT (4,869 mega-miles/yr for all county-registered vehicles) was calculated at 48.4% of total AVMT. This inventory's AVMT was the maximum of VDOT and MWCOG estimates, which for 2006 is 10,061 mega-miles/yr.

In all study years, MWCOG AVMT was greatest, while VDOT data helped to apportion AVMT by vehicle class. Thus, vehicle class and fleet-wide fuel consumption was determined as the MWCOG-derived county-wide AVMT divided by fleet-wide MPG for each study year.

Accounting for county-owned vehicles: Neither MWCOG nor VDOT estimates of countywide AVMT distinguished county-owned vehicles from those of the public-at-large. Nonetheless, the county directly calculated its vehicles' energy consumption. As a result, county vehicles were included in energy and emissions results for both the transportation sector and county operations, then subtracted from overall emissions calculations to prevent double counting.

Metrorail rapid transit and VRE commuter rail

Fairfax County's portion of electricity use for Metrorail rapid transit was estimated using the proportion of all Metrorail riders residing in the county multiplied by system-wide electricity use. WMATA provided total systemwide electricity use.

Similarly, commuter rail diesel fuel use was determined as a function of the proportion of all VRE riders residing in the county multiplied by systemwide diesel fuel use. Virginia Railroad Express (VRE) supplied its monthly systemwide diesel fuel usage.

The Fairfax County Department of Transportation (FCDOT) delivered ridership values on a fiscal year basis. (The fiscal year ended June 30 of the corresponding calendar year.) However, neither FCDOT nor WMATA nor VRE provided calendar year ridership. Thus, fiscal year was used as the best feasible proxy for calendar year.

B.5.2 Determine the appropriate CO_2, CH_4, and N_2O emission for diesel and gasoline

From LGOP version 1.1 (3), CO_2 emissions per gallon of diesel or gasoline fuel are presented as emission factors in Table B-8. The corresponding factors for diesel fuel CH_4 and N_2O are 6×10^{-7} and 3×10^{-7} kg/gallon, respectively – less than a millionth that of CO_2. Hence, even when factoring in the high GWP of these secondary byproducts, the diesel-to-CO_2e conversion factor is dominated by its CO_2 component.

EPA has recommended that CO_2 represent 95% of all GHG emissions for gasoline.[14] Using this multiplier, no additional emission factors needed to be calculated for CH_4 or N_2O.

Table B-8: Mobile CO_2 emission factor (in kg/gallon), by fuel type[15]

Fuel Type	Applicable Vehicles	CO_2 Emission Factor
Diesel	Heavy duty trucks, VRE commuter rail	10.084
Gasoline	Passenger vehicles, light duty trucks	8.788

B.5.3 Calculate GHG emissions from vehicles and trains

Metrorail electricity use in Fairfax County was converted to GHG emissions by multiplying the amount (in kWh) by the same annual conversion factors as for electricity as a whole, as shown in Table B-7). Emissions associated with passenger vehicles and light duty trucks similarly derived from the corresponding Table B-7 conversion factor for gasoline to CO_2e. GHG emissions from VRE commuter rail and heavy duty trucks were calculated by multiplying the amount (in gallons) of diesel fuel usage per year by the diesel-to-CO_2e conversion factor in the same table.

B.5.4 Estimate CO_2 from off-road vehicles and machines

Off-road emissions include CO_2 emissions from the sources listed in Table B-2: agricultural equipment; airport support; commercial equipment; construction equipment; industrial equipment; lawn & garden equipment; logging equipment; oil field equipment; railway maintenance; recreational marine; recreational vehicle; and underground mining.

These emissions were obtained from EPA NONROAD2008a model (with 2009-2010 based on 2008 model estimates, which is latest update) for Fairfax County (locality number 51059). This only provides CO_2 emissions, however, so other GHGs' magnitudes were not able to be directly estimated. Given the relatively tiny contribution of off-road CO_2, the contribution of other non-road GHGs was deemed inconsequential and thus exempt from reporting.

[14] Source: http://www.epa.gov/oms/climate/420f05004.htm

[15] Source: http://www.epa.gov/oms/climate/420f05001.htm