

APPENDIX 1

TOWN OF WELLESLEY SUSTAINABLE ENERGY PLAN

EMISSIONS INVENTORY METHODOLOGY

The Emissions Inventory is guided by the idea stated so succinctly in the Falmouth, Maine Plan¹; “*what you can measure you can manage*”. This maxim captures the message shared with us by other area communities, which began working on reducing emissions without doing an inventory, but eventually returned to this step when they recognized how important a baseline inventory is to measure, monitor, and motivate change. So while the Green Ribbon Study committee (GRSC) has worked to encourage specific initiatives, we have also taken the time to compile the data for the energy inventory for both 2007 and 2008, to guide our development of the Sustainable Energy Plan with a baseline inventory and some initial trend analyses. The inventory enables us to:

- **Measure** the Town’s use of fuels and production of Greenhouse Gas² (GHG) emissions in the baseline year, and to
- **Motivate** change, and
- **Monitor** progress based on the goals we set.

Baseline Energy Inventory

We chose to develop the emissions inventory for the Town using the standard protocol developed by ICLEI³, Local Governments for Sustainability, which is also being used by other communities in Massachusetts, throughout the United States and internationally. The 2007 calendar year was chosen as the baseline year for the Emissions Inventory as the year for which the most accurate and reliable data was available. When specific data was not available, a model was developed to estimate the fuel consumption based on methods recommended by ICLEI, using specific information from Town departments as well as regional averages from other sources. Every effort was made to select data that would accurately describe our current emissions and also would be sensitive to changes in emissions over time.

Software

¹ Falmouth Energy and Climate Protection Plan 11-13-2009, Falmouth, ME

² GHGs are transparent to solar (short-wave) radiation, but opaque to long-wave (infrared) radiation, so they prevent long-wave radiant energy from leaving the Earth’s atmosphere, thereby ... trapping and absorbing the radiation and warming the planet’s surface. (CACP Glossary)

³ ICLEI (originally International Council for Local Environmental Initiatives ... they have kept the same acronym, but now call themselves ICLEI - Local Governments for Sustainability).

⁴When we began the Energy Inventory in 2008, we used the ICLEI-CACP 2003 version, but are currently converting the data to the 2009 version of the software. We considered two other software options: the EPA software and Green Communities software, but because they are designed only for municipal energy inventory, they could not be used for the more comprehensive Town-wide Inventory. ICLEI membership is \$600 annually for the use of the software and additional webinars and consults. Current ICLEI Contact: Allison Webster allison.webster@ICLEI.org
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The Emissions Inventory was developed using the ICLEI Clean Air and Climate Protection (CACP) Software⁴, which includes the coefficients necessary to convert fuel consumption and waste data into a standard measurement of GHG emissions, known as Carbon Dioxide-Equivalents (e-CO₂). E-CO₂ is a unit that measures the combined global warming potential of the GHGs and expresses it in terms of carbon dioxide. The CACP software calculates the e-CO₂ based on the three most common GHGs produced by humans: Carbon dioxide (CO₂), Methane (CH₄), and Nitrous Oxide (N₂O). Specifically, a ton of CO₂ is equivalent to a ton of e-CO₂, whereas a ton of CH₄ has a warming effect equivalent to 21 tons of e-CO₂, and a ton of N₂O has a warming effect equivalent to 310 tons of e-CO₂. The amount of CO₂ produced is in direct proportion to the energy (BTUs) of the fuel, and so does not change with improvements in technology. In contrast, CH₄ and N₂O are both bi-products of combustion that vary depending on the efficiency of the combustion technology.

Criteria Air Pollutants (CAPs) are other compounds released with combustion of fuels, which are not categorized as GHGs because they do not produce a global warming effect. CAPs produce smog and haze and are associated with health related problems, such as respiratory disease. The software also tracks emissions from the CAPs (NO_x, SO_x, VOCs, CO and PM₁₀)⁵, but at this time we are not using these results in our analysis.

Each of the primary fuels being monitored for the production of GHGs (electricity, natural gas, fuel oil, gasoline and diesel) has an emissions factor that can be modeled based on the efficiency of the combustion of the fuel, which may improve as the efficiency of furnaces and vehicle engines are improved. The GHG emissions associated with electricity are unique in that they also vary by region of the country depending on the combination of source fuels that are used to produce the electricity, including coal, natural gas, fuel oil, nuclear, hydro, bio-fuel, wind and solar. The software includes these emissions factors as sets of coefficients in the software to model the emissions for each fuel, by year, and in the case of electricity, by region of the country. The electricity coefficient set that we have used is based on the EPA data for New England. The actual fuel source profile for the Wellesley Municipal Light Plant may differ slightly. The software would allow us to modify the fuel source profile, to better reflect the WMLP fuel source profile, in the future. This may be an improvement in our model to consider, as the MLP continues to develop and purchase renewable electricity.

Scope of the Inventory

The software categorizes the emissions for the Town into two sectors: Government and Community. The software includes energy use within the geographical boundaries of the Town; therefore, two notable omissions are air travel and the production of goods consumed in Town, but manufactured elsewhere. Understandably, electricity used in Town is included, although it is produced outside of the Town. A more controversial part of the current ICLEI model is that transportation emissions are based on traffic within the Town, not on vehicles registered in Wellesley. In recognition of the limitations of the current transportation model, other transportation models that we have used for validation and may be able to use in the future for the inventory are discussed in the transportation section of this appendix.

The 2009 Software Local Government Operations Protocol (LGOP) is now the official standard method for local governments in the United States to develop a GHG inventory. The protocol was developed through collaboration between ICLEI, the [California Air Resources Board](#), the [California Climate Action Registry](#), and [The Climate Registry](#). The Local Community Protocol is still being developed.

⁵ Nitrogen Oxide (NO_x), Sulfur Oxides (SO_x), Carbon Monoxide (CO), Volatile Organic Compounds (VOCs), and coarse particulate matter less than 10 micrometers in diameter (PM₁₀).

The Government Sector Inventory Methodology

The Municipal Sector inventory was developed from actual records and billing receipts from the Town departments⁶ and schools. After much consideration, we decided to use Fiscal Year (FY) as our record for the entire municipal sector as all of the departments are accustomed to working with fiscal year and the records are readily available in this form. The software organizes the municipal data into five categories: Buildings; Vehicle Fleet; Streetlights; Water & Sewage; and Municipal waste.

- **Municipal Electric data** are based on actual consumption for the 84 municipal accounts for buildings and infrastructure, provided as monthly data, in kilowatt-hours (kWh), from the Wellesley Municipal Light Plant (WMLP)⁷.
- **Municipal Natural Gas data** were obtained from Town Hall and the School Department based on receipts which record 12-month usage for each building⁸.
- **Municipal Fuel Oil data** are based on actual total purchases and consumption, throughout the fiscal year for the only two municipal buildings (High School and Middle School) that use fuel oil for heat, in combination with natural gas.
- **Municipal Fleet Vehicles**⁹ data on gasoline and diesel use is based on actual records of fuel purchases from the Town pump operated by the Department of Public Works (DPW). The annual totals for gallons of gasoline and diesel consumed are recorded by specific vehicle, and have been categorized by vehicle category to fit the software.
- **Municipal Waste data** was obtained from the RDF, based on annual tonnage.

The Community Sector Inventory Methodology includes all fuels used throughout the Town. The software organizes the community data into five categories: Residential; Commercial; Industrial; Transportation; and Waste disposal. The Industrial category is not currently used for our Town data. The commercial sector includes all businesses and the three colleges in Town. . . , We As soon as we have completed the verification of the College data, we plan to separate the data for Wellesley College, Babson College, and Mass Bay Community College from the other commercial data, to be categorized as “Institutions” using the Industrial category, as the colleges play a unique role in our Town as major users of energy and innovators and leaders in energy conservation. **Electric** data are from actual aggregate monthly records, available from the WMLP, categorized by subsidized housing and regular housing for the residential sector and categorized by small, large, primary and partial primary accounts for the commercial sector. Institutional electric data are available from the three colleges, with data from Wellesley College detailing the natural gas used to fuel the cogeneration of electricity by their on-site facility.

Natural Gas¹⁰ data are from actual aggregate monthly records available from National Grid, with subcategories for heat and non-heat for residential accounts, and with subcategories for small and large accounts for the commercial sector. Natural gas use for the colleges was requested directly from the colleges.

⁶ Municipal Employee Commute data has not been collected for the baseline 2007 Emissions, but may be added in the future

⁷ MLP data through Debra Healey, MLP business manager, and Tom D’Orazio, Network Information Services, from Town computer records.

⁸ Municipal natural gas data was compiled by Tanyalee Williams, Town Hall.

⁹ Fleet data compiled by Robert Cooper of GRSC from electronic data provided by David Cohen, Department of Public Works.

¹⁰ National Grid natural gas data was obtained through email communications and excel spreadsheet (10/6/08) summarizing natural gas consumption by month for all active gas customers in Wellesley from April 2002 through August 2009.

- **Fuel oil** data is not available from the individual fuel oil companies, in any form, a common problem for all communities in developing an energy inventory. Therefore, models were developed for residential and commercial fuel oil consumption, based on estimates derived from natural gas use figures and regional fuel oil consumption averages.
 - Residential fuel oil consumption was estimated based on the total number of households minus the number of natural-gas-heating accounts, and the number of households that heat with electricity. This number was then multiplied by the Massachusetts average for residential fuel oil consumption¹¹, 924 gallons¹². We were also able to obtain an estimate of average fuel oil use from Ogilvie Fuel Oil in Weston, as 1,200 gallons¹³, which may better reflect the size and fuel consumption of the residences in Wellesley, based on the average therms for homes heated with natural gas, but should have further validation before it is used in the model.
 - Commercial fuel oil consumption estimates are particularly problematic, because of the wide range of the size of the buildings, and the lack of accurate records by building indicating source of heating fuel. This estimate needs to be improved, if possible, by obtaining data on actual buildings using fuel oil, as a baseline year that could be updated every few years. Currently, the base-line model is an estimate based on the regional percentage of commercial fuel oil heat and the square footprint of the commercial sector. The estimates for change are based on the number of new natural gas accounts converted from fuel oil, and the average number of therms per account type.
 - Institutional fuel oil records have been provided by Wellesley College, and have been requested from Babson College. Mass Bay Community College does not use fuel oil.

Gasoline and Diesel

Town-wide traffic is challenging to measure or model. ICLEI has established the use of geographical boundaries of the town to define the area of transportation emissions. Therefore, we have developed a model based on the ICLEI guidelines to quantify travel within Wellesley, with traffic counts measured as Vehicle Miles Traveled (VMT) on four¹⁴ classifications of roads:

1. Route 128
2. Route 9
3. Major arteries (10) such as Route 16 and Weston Road
4. Smaller neighborhood streets

Although our initial instinct was to exclude Route 128 from the model (as other communities have chosen to do), as a roadway that we have little influence over, on closer evaluation we determined that the traffic on Route 128 did not weight the model disproportionately. In fact, transportation emissions are more consistent with an alternative model based on actual vehicles registered in Wellesley and the national average for annual miles travelled per vehicle, when Route 128 is included in the model. The estimated annual mileage per vehicle registered in Wellesley, based on the emissions calculated for the model which includes Route 128, is 12,121, almost exactly the national average of 12,000 miles per year. In contrast, using the emissions calculated without Route 128 in the model, the annual mileage estimate falls to 9,222 miles per year. Moreover,

¹¹ Recommended by ICLEI as the most recent data available.

¹² Fuel Oil average for Massachusetts (2004), from the Average Household Energy Consumption by state for fuel oil, U.S. Census Bureau.

¹³ Ogilvie & Sons Fuel Oil, Weston MA, estimate for average residential Fuel Oil consumption in 2007.

¹⁴ CACP software allows for 3 categories of roads, but we have chosen to describe four different types, to more accurately model the traffic.

recent data received from the RMV¹⁵ for a sample of 233 vehicles registered in Town, show average mileage of 12,304 annual miles, confirming that the annual mileage of vehicles in Town is consistent with the national average and the transportation model that includes Route 128. Our ongoing work with the RMV and ICLEI, to develop a more sensitive transportation model, may enable us to transition to a transportation model based on actual annual mileage and registered vehicles. This may provide a more sensitive model to measure change, but would not appear to affect the estimated transportation emissions significantly.

We also validated the model by comparing the profile of vehicles used in the model to estimate fuel efficiency to the categorization of vehicles registered in Wellesley provided by the RMV. We found them to be very similar, with about 60% autos and 35% light trucks and SUVs, for each method.

The commuter trains have not yet been entered into the transportation model.

WASTE:

Emissions from waste are based on the annual tonnage of waste¹⁶ (Municipal, Residential and Commercial) transported to landfill and an estimate of the approximate composition of that waste. Wellesley RDF has very precise records regarding recyclables, compost, and waste taken to landfill. These annual fiscal year statistics were used to calculate emissions from waste.

Methane is the primary green house gas produced by the anaerobic decomposition of waste in landfills. The standard estimation for Methane recovery at the landfill is estimated to be 75% in the software.

The current waste data underestimate total Town waste, as most commercial waste is collected by private hauling companies who do not have permits with the RDF. It is estimated that 15% of residents also use private hauling companies, only one of which has a permit with the RDF. We do not currently have an accurate record of the number of residences that use private hauling companies, or the tonnage of waste and recyclables that are collected at curbside. In order to improve the accuracy of the Town data on waste disposal, private haulers should be required to report monthly tonnage to the RDF, as is currently stated in the hauling permits issued by the Health Department. This would also provide valuable information about the effectiveness of curbside pick-up and single-stream recycling.

The ICLEI software does not currently allow for the detailed separation of recyclables at the RDF, but aggregates all plastics, all paper, etc. The calculation of e-CO₂ avoided by recycling includes not only an estimate of the methane emissions avoided from decomposition in the landfill, but also the emissions avoided in manufacturing new materials.

¹⁵ Data requested by Weston and Wellesley on High MPG vehicles registered in Town.

¹⁶ Information from discussion with Gordon Martin and annual reports (FY00 - FY09)