City of Edmonds, Washington

Greenhouse Gas Emissions Inventory
Community Analysis
June 2009

ICLEI
Local Governments for Sustainability

Acknowledgements

This work would not have been possible without the assistance of many people. The author would like to thank the following people for their contributions to these efforts:

City of Edmonds Staff:

Santos Cardenas, Computer Support Tech
Robert Chave, Planning Manger
Bertrand Hauss, Transportation Engineer
Steve Koho, Wastewater Treatment Plant Manager
Jen Machuga, Planner
Noel Miller, Director of Public Works
Carl Nelson, CIO
David Sittauer, Fleet Maintenance Manager
Jim Stevens, Facilities Maintenance Manager

ICLEI Staff:

Amy Shatzkin, Eli Yewdall, Xico Manrolla

As well as:

Dominador Amor, PSE Local Government and Community Relations Manager
Art Arneson, PUD Executive Account Manager
Sadie Bronk, PSE
Ray Burton, PUD *(now retired)*
Jonelle Garcia, PSE Associate Account Representative
Sego Jackson, Principal Planner for Snohomish County Solid Waste Management
Marla Kempf, Deputy Director for the Port of Edmonds
Kris Overby, Puget Sound Regional Council
Suzanne Oversees, PUD Utility Analyst
Stephen Toy, Principal Demographer for Snohomish County Planning and Development Services
Robert Yetter, PSE Market Research

Special thanks to:

Steve Fisher, Recycling Coordinator who conducted an earlier City Operations inventory for 1999 and 2006, providing an invaluable contribution to this report.

Principal Author:

Nicole Sanders

Table of Contents

Executive Summary 4

I. An Introduction to Climate Change
- A. How Global Warming Works 6
- B. Edmonds and Climate Change 8
- C. ICLEI and the cities for Climate Protection Campaign 9

II. Emissions Inventory
- D. The Uses of an Inventory 10
- E. Inventory Overview: Software and Methodology 11
- F. Community Analysis: Sources and Fitting the Data to the Model 12
- G. Community Analysis: Exceptions 21
- H. City operations Analysis: History 22
- I. City operations Analysis: Comparing Municipal Inventories Between Cities 23
- J. City operations Analysis: Description and Sources 24
- K. City operations Analysis: Exceptions 25
- L. City Operations Analysis: City Operation Emissions Modification for 2000 26

III. Community Inventory Results
- M. Base Year Emissions Inventory 27
- N. Interim Year Emissions Inventory 28
- O. Comparison Between Base and Interim Year Inventories 30

IV. Forecasts and Back-casts
- P. Introduction 31
- Q. Sources and Fitting the Data to the Model 32
- R. Forecast Results 38
- S. Comparison Between Interim and Projected Year Inventories 39
- T. Back-cast Results 41
- U. Comparison Between the Back-cast and Inventories of Other Years 42
- V. Biogenic Emissions 47
- W. eGRID Emissions for Future Reporting 48
- X. Alternative Emission Predictions 49

V. Next Steps
- Y. Reflection 50
- Z. Conclusions 51

Appendix A - Greenhouse Gas Emissions 101 52

Appendix B - Common Acronyms Used in this Report 53

Addendum A – *(not yet available)*

Executive Summary

> "Environmental issues are best handled with participation of all concerned citizens, at the relevant level." - *Rio Declaration on Environment and Development*[1]

Scientific consensus is that human-induced climate change is a reality. The world is beginning to feel the impacts of climate change, impacts which are only predicted to increase over time. It is one of the most serious environmental threats not only facing us today, but it is one that could face our children and our children's children.

Climate change is already occurring. In the 20th Century the planet experienced a rate of warming that is unparalleled in the known geologic record. The past decade has been the warmest in recorded history, and the world's preeminent climate scientists have overwhelming evidence that human activity is the primary cause. It is likely that in the next 100 years, climate change and its associated disturbances will negatively impact ecosystems, food and water supply, one quarter of all plant and animal species, and marine species as a whole.[2] Sea levels are predicted to rise, and weather event frequency and intensity is expected to increase, including floods, heat waves, cyclones, and drought. The health of millions across the globe is expected to be affected through malnutrition, disease, and increased risk of injury, with the poor especially at risk.

Edmonds has chosen to do its part. The international community has long held that global environmental issues require the participation not only of the world's national governments, but also of its individual citizens. The City of Edmonds recognizes that climate change is an urgent matter, requiring that each community take responsibility for its local actions. Edmonds has been working steadily to address climate change over time:

- On September 18, 2006 the Edmonds City Council passed Resolution 1129, adopting the goals of the U.S. Mayor's Climate Agreement. Over 850 communities in all 50 states have also adopted the goals of the US Mayor's Climate Agreement, affirming the commitment to reduce greenhouse gas (**GHG**) emissions in a manner consistent with the international targets set by the Kyoto Protocol. This includes the goal of reducing GHG emissions to 7% below 1990 levels by 2012.
- In order to implement the resolution, the City of Edmonds joined more than 350 U.S. local governments and 700 local governments worldwide with **ICLEI** (International Council for Local Environmental Initiatives). Better known by its acronym (pronounced *ik-lee*) this organization offers members their Cities for Climate Protection® (CCP) Campaign. In partnering with ICLEI, Edmonds has committed to the ICLEI Five Milestone Process to address climate change:

  Milestone 1: Conduct a baseline emissions inventory and forecast;
  Milestone 2: Adopt an emissions reduction target;

[1] The UN Conference on Environment and Development, "Rio Declaration on Environment and Development", Principle 10, http://www.unep.org/Documents.Multilingual/Default.asp?DocumentID=78&ArticleID=1163 (accessed July 31, 2008)

[2] see Section A, page 9

Milestone 3: Develop a Climate Action Plan for reducing emissions;
Milestone 4: Implement policies and measures;
Milestone 5: Monitor and verify results.

The emissions inventory summarized in this report completes Milestone 1.

- The City of Edmonds has also already worked on energy savings in the government with actions such as: switching to B-20 biodiesel fuel in many City-owned vehicles; retrofitting plumbing in City-owned buildings for efficiency; installing energy-efficient LED lights in traffic signals; supporting rapid transit initiatives; and offering public education on solid waste reduction and recycling.
- The City of Edmonds Climate Protection committee formed by the Mayor, which includes city officials and local citizens is working on encouraging citizens to be a part of the solution, to conserve resources, and to reduce their environmental impact. The committee also assists the City Council with implementing ideas to effectively address the future of climate change.

Inventory results. An emissions inventory for the City of Edmonds was conducted for the years 2000 and 2005. The 2000 analysis represents the baseline year, against which emissions in all future years will be compared. The 2005 analysis represents an interim year that can be used to calculate the rate of emissions change from 2000 to the present. A separate report on emissions resulting from city government operations in 2001 and 2006 was submitted earlier in 2008. As city operations energy data is no longer available for 2000, and is generally a subset of larger community emissions as a whole, the city government inventory is assumed to be equivalent for use in 2000 and 2005 inventories.

In both years, the total Edmonds community emissions compiled showed the following:

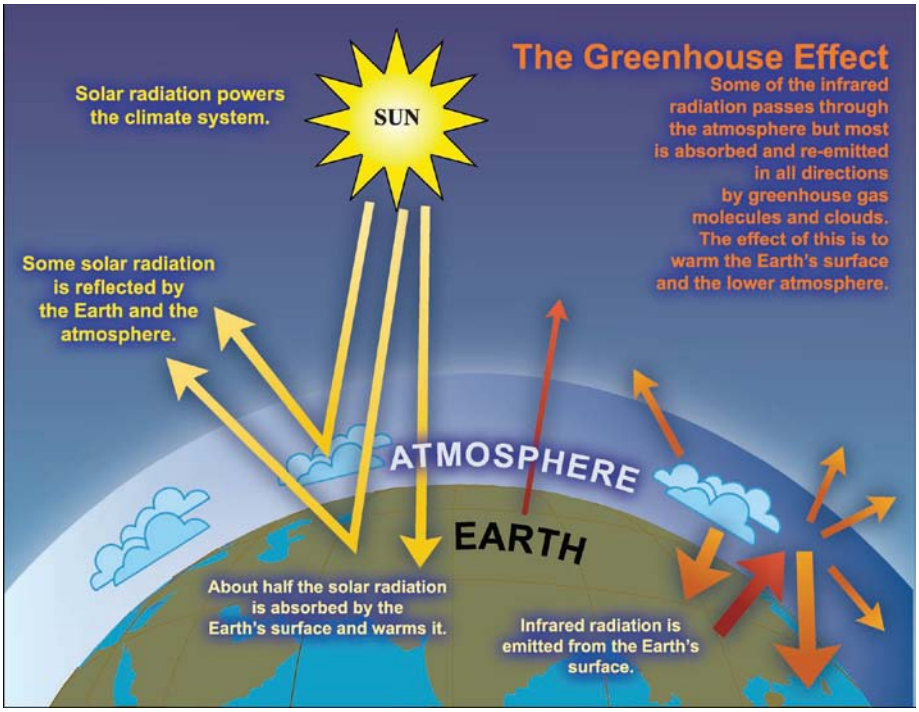
- The City of Edmonds released 174,955 metric tons of carbon dioxide equivalent (**CO_2e**) in 2000 and 168,700 metric tons in 2005. Based on a year 2000 population of 39,493 and 39,882 for 2005, that amounts to 4.43 metric tons per capita in 2000 and 4.23 metric tons per capita in 2005.
- If current overall population trends continue, the City of Edmonds is projected to emit 8.0% more greenhouse gasses than the 2005 interim year, by year 2012, a projection of 4.37 metric tons per capita.
- In order to meet the reduction goals that the city has set for the year 2012, according to forecasts of emissions growth and back-casts back to 1990, estimates find that the community of Edmonds would need to aim to reduce emissions by **25,286 metric tons** of CO_2e by 2012.

The data indicates that there is much work to be done. However, the City of Edmonds has already taken steps to reduce carbon emissions and is committed to continued action. Addressing greenhouse gas emissions in our community not only upholds our responsibility as a community, but benefits the city and its residents by saving money, decreasing dependence on volatile fossil fuel markets, increasing overall air quality, and augmenting the qualities of Edmonds that already make it a livable community.

Part I: An Introduction to Climate Change

A. How Global Warming Works

The earth's atmosphere naturally contains several gases, generally called greenhouse gases, which retain heat from the sun and maintain a stable average base temperature of 60ºF. Essentially, solar light and energy approach the earth with short wavelengths, but when they bounce off the planet, their wavelengths become longer. The majority of the atmosphere is made up of non-greenhouse gases that do not interact with the longer wavelengths, such as nitrogen and oxygen which respectively make up 78% and 21% of our dry atmosphere. More complex molecules, however, react to these longer wavelengths by absorbing and distributing heat for a longer period, with a net warming effect. Without this process, the planet would be too cold to sustain life.[3]



A simplified model of the greenhouse effect. Source: IPCC Fourth Assessment Report, Working Group 1, 98, FAQ 1.3, Figure 1

Water vapor is the most important greenhouse gas, with carbon-dioxide as the second-most important. However, water vapor stays in the atmosphere for only a matter of days, so increases in water vapor can be counterbalanced in a relatively short period. Other greenhouse gases stay in the atmosphere for decades, and sometimes centuries, making it more difficult to offset their effects. Each greenhouse gas provides varying warming effects at the molecular level. The other greenhouse gases which occur naturally in the

[3] IPCC, " 'Frequently Asked Questions', Climate Change 2007: The Physical Science Basis. Contribution of Working Group I to the Fourth Assessment Report of the Intergovernmental Panel on Climate Change" ed. S. Solomon et all. Cambridge University Press, Cambridge UK. 98 http://ipcc-wg1.ucar.edu/wg1/Report/AR4WG1_Print_FAQs.pdf (accessed July 16, 2008)

environment are nitrous oxide, ozone, and methane.[4] Many of these gases are present only in trace amounts – for instance, carbon dioxide composes only .035% of the air or 750 billion tons in the 1990s, yet it has a tremendous impact on thermal regulation.[5]

In the past 150 years since the industrial era, technology has largely been fueled by utilizing fossil fuels, releasing carbon and other greenhouse gases into the atmosphere at accelerated rates from natural cycles. It is estimated that our energy and agricultural demands have added 20 –30% more carbon dioxide (CO_2) into the atmosphere in the past century and a half, with a possibility of doubling CO_2 concentrations by 2050.[6] The current atmospheric concentration of carbon dioxide exceeds by far the natural range over the last 650,000 years (180 to 300 parts per million) as determined from ice core measurements.[7] Methane concentrations have more than doubled, going from 715 parts per billion (**ppb**), to 1774 ppb and nitrous oxide (N_2O) concentrations have increased by 270 ppb – from 49 ppb to 319 ppb.[8] In addition, man-made synthetic gasses are growing as well, such as hydrofluorocarbons (HFCs), perfluorocarbons (PFCs), and sulfur hexafluoride (SF_6). Though relatively low in concentration, these gasses are of particular concern because they have a heat trapping capacity between 1,500 and 22,000 times stronger than CO_2.[9]

The increased atmospheric presence of these gases could lead to a change in global temperature, with ultimate results as outlined by the Intergovernmental Panel on Climate Change (**IPCC**).

In the Fourth Assessment report (AR4), the IPCC states that the warming of Earth's climate is "unequivocal". Since 1961, the ocean has an average temperature increase to a depth of 1.8 miles; while on land, eleven of the twelve years from 1995 to 2006 were the warmest since instrumental measuring began in 1850. Arctic sea ice has shrunk an average of 2.7% a decade since the 1980s and the permafrost top-layer

What is the IPCC?

The Intergovernmental Panel on Climate Change (IPCC) was established in 1988 by the World Meteorological Organization (WMO) and the United Nations Environment Program (UNEP) to establish scientific consensus on the issue of global warming. The IPCC does not conduct research, but allows climate experts from the world's leading universities and government institutions to synthesize scientific findings on climate change. The IPCC has issued climate change assessments in 1990, 1996, 2001 and 2007.

The Fourth Assessment Report (AR4), released February 2007, is the most comprehensive synthesis of climate change science to date. Experts from more than 130 countries contributed to the assessment over a six year period. More than 500 lead authors received input from over 800 contributing authors, and an additional 2,500 experts peer-reviewed the draft documents.

Source: About the IPCC - http://www.ipcc.ch/about/index.htm

[4] Ibid.
[5] Schneider, Stephen. *Laboratory Earth: The Planetary Gamble We Can't Afford to Lose.* London: Weidenfeld & Nicholson, 1996, 39
[6] Ibid, 40.
[7] IPCC, ""Climate Change 2007: Synthesis Report" 2007. Contribution of Working Groups I, II and III to the Fourth Assessment Report of the Intergovernmental Panel on Climate Change" [Core Writing Team, Pachauri, R.K and Reisinger, A.(eds.)]. IPCC, Geneva, Switzerland, 2007, 15. http://ipcc-wg1.ucar.edu/wg1/Report/AR4WG1_Pub_Ch10.pdf (accessed July 16, 2008)
[8] Ibid.
[9] Ibid.

temperature has increased by 3 percent.[10]
Changes in temperature and climate will have a dramatic impact on plants and animals that are adapted to present climactic conditions. Surface temperatures are on course to increase by between 3.2 and 7.2º F by the year 2100, with temperatures in the Arctic expected to increase by twice the global average. In addition to causing average temperature increases, rising levels of greenhouse gases have a secondary destabilizing effect on a number of different microclimates, conditions, and systems.[11]

The IPCC has stated it is likely that in the next 100 years climate change and its associated disturbances will: exceed the resilience of many ecosystems, negatively impacting food and water supply; 20 – 30% of plant and animal species will face increased risk of extinction; and sea levels will likely rise. In addition, existing stresses on freshwater stores are expected to be further aggravated; ocean acidification will likely impact marine ecosystems including corals and their dependent species; and weather event frequency and intensity is expected to increase, including floods, heat waves, cyclones, and drought. The health of millions across the globe is expected to be affected through malnutrition, disease, and increased risk of injury, with the poor especially at risk.[12]

B. Edmonds and Climate Change

> "…Additional adaptation measures will be required at regional and local levels to reduce the adverse impacts of projected climate change and variability, regardless of the scale of mitigation undertaken over the next two to three decades." – *IPCC AR Report*[13]

Many cities have strong policies and programs in place to reduce greenhouse gas pollution, but more action is needed at the local, state, and federal levels to meet this growing challenge. On February 16, 2005 the Kyoto Protocol, the leading international agreement to address climate disruption, became law for the 141 countries that had ratified at that time. On the same day, Seattle Mayor Greg Nickels launched an initiative aimed at recruiting an equal number of 141 American cities to adopt the goals of the Kyoto Protocol, including the reduction of 7 percent below 1990 emission levels by the year 2012. The goals were formalized in the U.S. Mayors Climate Protection Agreement, passed unanimously by the U.S. Conference of Mayors on June 13, 2005. The goal of 141 cities has long been exceeded. There are currently over 850 mayors representing more than 72 million people across all 50 states, Washington DC, and Puerto Rico that have signed the agreement, included 32 mayors in the State of Washington.

Recognizing the importance of addressing climate change and its associated concerns, the City of Edmonds formally expressed support for the Kyoto Protocol in September 2006, adopting the U.S. Mayors Climate Protection Agreement by Resolution No. 1129, and

---

[10] Ibid, 30
[11] Ibid
[12] Ibid, 48-53
[13] IPCC, "Climate Change 2007: Synthesis Report" 2007, 56, http://www.ipcc.ch/pdf/assessment-report/ar4/syr/ar4_syr.pdf (accessed July 31, 2008)

joining the International Council for Local Environmental Initiatives (ICLEI) by Resolution No. 1130. The City of Edmonds Climate Protection Committee was formed earlier that year in July, including the Mayor, city officials, and local citizens. The committee has many goals, including the following: encouraging citizens to be a part of the solution; encouraging citizens and the city to conserve resources and reduce their environmental impact; and assisting the City Council to implement ideas that will effectively address the future effects of climate change.

As the Kyoto Protocol aims for a 7% reduction from 1990 levels by 2012, the city is undertaking measures to both understand and reduce its carbon footprint.

C. ICLEI and the Cities for Climate Protection Campaign

The Cities for Climate Protection® (CCP) Campaign is the flagship campaign of ICLEI (see inset). Designed to educate and empower local governments worldwide to take action on climate change, ICLEI provides software and technical assistance to local governments for measuring and reducing greenhouse gas emissions in their communities and their municipal operations.

The ICLEI CCP Campaign was launched in 1993 when municipal leaders, invited by ICLEI, met at the United Nations in New York. As a group, they adopted a declaration calling for a worldwide movement of local governments that reduced greenhouse gas emissions, improved air quality, and enhanced urban sustainability. The CCP Campaign links climate change mitigation with actions that improve local air quality, reduce local government operating costs, and improve the general quality of life.

What is ICLEI?

ICLEI—Local Governments for Sustainability has been a leader on both the international and national level since it was founded in 1990. Launched in the United States in 1993, ICLEI has grown to include over 1,000 cities in multiple counties providing national leadership on climate protection and sustainable development. Today in Washington State, ICLEI is working with over 20 cities and counties on local climate policies – and forging a strong network between these governments. In addition to providing personal assistance to member cities, ICLEI provides software for cities to use in tracking Greenhouse Gas emissions associated with individual municipalities.

ICLEI uses the performance-oriented framework of the CCP Campaign's Five Milestones to assist U.S. local governments in developing harmonized local approaches for reducing global warming and air pollution emissions, with the additional benefit of improving community livability. The milestone process consists of:

- Milestone 1: Conduct a baseline emissions inventory and forecast
- Milestone 2: Adopt an emissions reduction target
- Milestone 3: Develop a Climate Action Plan for reducing emissions
- Milestone 4: Implement policies and measures
- Milestone 5: Monitor and verify results

Part II: Emissions Inventory

D. The Uses of an Inventory

An emissions inventory serves several purposes. Guidance from ICLEI lists some of the different applications of an inventory, such as when businesses and citizens use them to track emission trends, when scientists use them to develop climate models, or when policymakers use them to develop appropriate emission reduction strategies.[14] The different anticipated end uses of an inventory, however, have the potential to inform how an inventory is conducted.

Many entities that are developing emission tracking systems are intent on applying uniform methods by which to assess emissions. Among other things, emission tracking is concerned with the consistency with which emissions profiles are developed and the comparability of emitters across regions. A consistent methodology is necessary to be able to compare city profiles fairly. If the state mandates emissions reporting in the future, it will likely operate in a uniform emission tracking system.

However, reporting for regional consistency and reporting for local policy sometimes require different approaches suited to their different goals. Sometimes a methodology developed for a wider region is not as suitable for the individual circumstances affecting a city's finer policy decisions.

A majority of the inventory decisions in this report are in line with the advised inventory methodology for the larger region. However, this report was generated with a strong orientation towards supporting relevant local policy development. As such, one notable exception from the regional methodology is how electricity emissions are inventoried. (The reasoning and methodology to this decision is discussed further in Section F, page 13. Also see Appendix A) One result of this decision is that Edmonds emissions may also appear lower than other cities in the region as the electric utility's coefficients are much lower than regional averages. This difference will be lessened with regional city comparisons, though, as Washington tends to have lower electricity emissions than other states from its abundant hydropower resources.

Realizing that a comparable inventory using the regional methodology might aid other cities, and that future state law may require using the regional methodology, alterative electricity emissions using the regional methods are provided in Section W, page 48.

In addition, it should be noted that this inventory is a snapshot of emissions using the sources and methods accepted currently. How emissions are added, what variables are considered, and the known science supporting these decisions are a product of present circumstance. Emissions inventory methods have already seen significant debate in international and national circles. As such, we can expect that the inventory methods used in the future will change. All attempts have been made to leave thorough and clear

[14] ICLEI, "Greenhouse Gas Emissions Inventory Guidance for the Puget Sound Region (*prepared for the Puget Sound Clean Air Agency)*", June 2008 DRAFT, 10

documentation in how this inventory was compiled so that future emissions accounting can respond to increasingly precise inventory methods. Although the changeability of methodology can initially be disheartening, these inventories provide more information than cities previously possessed, allowing for increasingly informed decisions by the populace and government.

Although the end uses of an inventory vary, and the way they are inventoried may change over time, the inventory itself is often the first step in achieving real reductions in emissions. This is the most important use that can come from its compilation.

E. Inventory Overview: Software and Methodology

Software: The City of Edmonds Greenhouse Gas Inventory was generated with the Clean Air and Climate Protection software (**CACP**). CACP was provided by ICLEI, the International Council for Local Environmental Initiatives and, STAPPA/ALAPCO, the State and Territorial Air Pollution Program Administrators and the Association of Local Air Pollution Control Officials, developed with Torrie Smith Associates. ICLEI advised the City of Edmonds in developing the greenhouse gas profile.

The CACP program is divided into four components or "modules", two of which are used in generating current and previous emissions inventories: Community Analysis and Government Analysis. (For clarity the Government Analysis will be referred to as **City Operations**) Not discussed in this report are the other modules, Community Measures and Government Measures, which are used to illustrate the greenhouse gas reductions achieved with different community or government actions. These measures will be the subject of future research by the city.

Inventory Method: The Inventory takes into account emissions generated from energy consumption, vehicular travel, and waste generation. Emissions resulting from City Operations are factored into the community, making City Operation emissions a subset of the community total. As such, the emission results of City Operations are not added to the emissions results of the Community Analysis, as that would count some emissions twice. Instead, the City Operations (discussed on page 22) is provided as a way for the government to understand its own contributions and take direct action to reduce its emissions in the future.

This report overviews the emissions for the base year of 2000 and the interim year of 2005. Base years are often set as far back as reliable data are available, while the interim year serves as a more recent update in carbon reporting, helping with additional data analysis, forecasting and decision-making. Information on the selection of forecast and back-cast years is discussed in Part IV, beginning on page 31. The community analysis has a base year of 2000, an interim year of 2005, a forecast of 2012 emissions, and a basic emissions reduction number from a 1990 back-cast. An earlier City Operations Analysis was conducted for the base year of 1999 and 2006. Due to time and data constraints, this report discusses this analysis as an approximation for City Operation emissions in 2000 and 2005.

Results are not included. However, the results can be found on the Climate Protection Committee's webpage, as a detailed document, with summary and addendum.[15]

Choices for the selected inventory years have been reviewed for consistency, methodology and accuracy by ICLEI.

F. Community Analysis: Sources and Fitting the Data to the Model

An emissions inventory requires a wide range of data from multiple sources that must be adapted to the inventory model in different ways. The Community Analysis module is itself partitioned into 6 different emissions groups: Residential, Commercial, Industrial, Transportation, Waste, and Other. The following section outlines the sources by sector, describes how the components fit into the model, outlines the exceptions of data not incorporated in the inventory, and provides the reasoning behind these decisions.

Sources

Residential, Commercial, and Industrial sectors essentially require the same types of data – natural gas use and energy use. This data was collected by the city's providers, Puget Sound Energy (**PSE**) for natural gas and the Snohomish County Public Utility District No.1 (hereto referred to as **the PUD**) for electricity consumption.

Transportation data is composed of Vehicle Miles Traveled (VMT) data from the Puget Sound Regional Council, and U.S. Census and Snohomish County population data.

Waste information includes all data available on solid waste collected and destined for landfill disposal. The city is serviced by three waste haulers, each of which provided some solid waste data: Allied Waste collects from the majority of the city; Sound Disposal collects from most of the downtown or "bowl" area; while Waste Management NW collects from a small portion of southeast Edmonds. Waste categories data are derived from the 1998 Snohomish County Waste Characterization study.

Other. This sector provides emissions information from gas sold by the Port of Edmonds Marina. Fuel sales and prices were provided by the Port of Edmonds, with fuel prices for 2000 partially informed by Energy Information Administration records.

Fitting the Data to the Model

Establishing emissions from **Residential, Commercial, and Industrial** electricity usage, the City of Edmonds had several decisions to make: whether to use default regional emissions numbers; how to report biogenic fuel emissions; and what to do for missing data sets for the years 1990 and 2000.

[15] The current web address for the Climate Protection Committee is http://www.ci.edmonds.wa.us/climate_prot.stm

Emissions are often calculated by using regional emission rates or by using emission rates specific to a utility, also known as coefficients. One of the systems reporting regional emissions is the Emissions & Generation Resource Integrated Database (**eGRID**) developed by the Environmental Protection Agency.[16] CACP software was programmed in with electricity grid defaults from a different database, based on the National Energy Modeling System (**NEMS**) model used by the U.S. Energy Information Agency. While the NEMS model is more accurate, it is not used as widely as the eGRID. In addition, several potential upcoming national emissions tracking systems such as the Climate Registry[17] require use of the eGRID figures. For these and other reasons discussed at the end of this document (Section W, page 48), ICLEI strongly advises its members to use regional eGRID Emission coefficients.

A "coefficient" in this case is a ratio of the amount of a greenhouse gas (**GHG**) emitted per unit of what is being measured in the software, such as GHG per ton of paper deposited in a landfill, or GHG per megawatt hour of electricity generated.

Edmonds opted not to use the eGRID coefficients for its main analysis*****. Edmonds' electric utility, the PUD, has a different mix of energy sources than the surrounding eGRID region, so that the PUD's actual emission coefficients are significantly lower than other parts of the region. As such, emissions rates specific to PUD were used for this report as they are closer to the true city emissions profile, and can more accurately guide local policy towards achieving real emission results. (****Please see Appendix A for an update on the ICLEI protocol. Also see applied use of eGRID coefficients in Section W, page 48***.)

Registering emissions inventories with an organization like the Climate Registry usually requires eGRID regional numbers. While Edmonds might voluntarily join the Climate Registry in the future, it does not plan on doing so at this time. However, as emissions reporting may be required by the state at a future date using default eGRID numbers, adjusted annual emissions per eGRID rates are supplied in Section W, page 48.

The 2005 coefficient used was provided by the PUD and reflects an average of emission records between 2004 and 2006. This figure is **.0833 short (American) tons per megawatt hour (MWh)**, or 166.67 pounds. This is not reporting the absolute amount of carbon being emitted, but the carbon-

The Climate Registry

The Climate Registry a non-profit organization that is developing a GHG emissions protocol and online reporting tool. Board members currently represent 40 U.S. and 6 Mexican states, several tribes, and all but one of the Canadian Provinces. It currently supports 263 government, non-profit, and corporate reporters. The Climate Registry will likely play an important role in future GHG reporting, but it is still relatively new. Founded in 2007, their emissions tracking tool CRIS was launched in 2008. Industry specific verification protocols are not yet developed, and its rigorous reporting requirements include annual GHG calculation with third party verification.

[16] for more information on how the EPA derived its regional emissions, please see Suzy Rothschild et al, "eGRID Emissions Estimation Methods", http://www.epa.gov/ttn/chief/conference/ei13/pointarea/rothschild.pdf (accessed August 12,2008)

[17] Visit *www.theclimateregistry.org* to learn more about the Climate Registry

equivalent pollution. As each greenhouse gas affects the atmosphere differently, each emission quantity is multiplied by its atmospheric impact to convey its effect when compared to carbon dioxide. This provides reporting of emissions for their Global Warming Potential, which is how different parties report emissions around the globe.[18]

The PUD coefficient provided above subtracts emissions associated with flared landfill gas and biomass, known generally as biogenic fuels. Per advice from ICLEI, these are reported separately from fossil fuel emissions, in alignment with international UN guidelines.[19] There is still controversy on how to conceptualize and report biogenic carbon sources. For municipal greenhouse gas inventories, ICLEI recommends tracking these separately until consensus has been reached. As such, figures of biogenic emissions are reported separately in Section V, page 47, based on the coefficient .06 short (American) carbon-equivalent tons per megawatt hour.[20]

Why Are Biogenic Fuels not Counted?

Plants naturally inhale and store carbon from the atmosphere, and plant-based fuels provide energy by releasing that carbon, such as when wood is burned in a fireplace. The theory behind why biogenic fuels, or biofuels, are not added to emission counting is that they use carbon that is already circulating in the biosphere, as opposed to the carbon stored in fossil fuels, which was interred there hundreds of millions of years ago. While this accounting method may follow current standards, it is still being debated internationally.

As a coefficient for 2000 and 1990 was not available, the 2005 coefficient was substituted for all years. The PUD noted that this probably was more appropriate than the actual emissions generated for 2000. The years 2000/2001 saw huge market price increases surrounding the deregulation of wholesale energy markets in California. A large PUD-energy supplier, the Bonneville Power Administration was forced to buy energy from a highly volatile market due to previous contracts, with less control over energy sources and source emissions.[21] The year 1990 was also atypical due to an unusually cold winter. The highest recorded peak demand for the PUD was in December 1990 when the "Arctic Express" hit and stayed in the Northwest for several days. Demand exceeded the PUD 2007 peak of 1,417 Megawatt Hours by almost 200 MWh.[22] Peak demand sometimes requires utilities to buy power from outside their normal sources, lessening their ability to carefully select energy sources. As 2000 and 1990 were both outlier years in the normal trajectory of the PUD, emissions coefficients would be artificially inflated. This would make subsequent annual emissions appear as if reductions had been achieved, when the truth is that emission peaks were just returning to normal. Emissions coefficients derived from more standard PUD operating

[18] IPCC, "National Greenhouse Gas Inventories Programme: Frequently Asked Questions" June 5, 2008, 4. PDF version can be downloaded at http://www.ipcc-nggip.iges.or.jp/faq/faq.html (accessed July 15, 2008)
[19] IPCC, "Reporting Instructions Volume 1: Common Reporting Framework," *Revised 1996 IPCC Guidelines for national Greenhouse Gas* Inventories, 1.3. http://www.ipcc-nggip.iges.or.jp/public/gl/guidelin/ch1ri.pdf (accessed July 15, 2008).
[20] The difference between the 2005-2006 Gross versus Net averaged coefficients, as provided by PUD.
[21] Snohomish County PUD, "2008 Draft Integrated Resource Plan", June 30, 2008, 36. www.snopud.com/content/external/documents/IRPDraftFinal063008.pdf (accessed July 15, 2008).
[22] Ibid, 126

years more accurately represent emissions reality, so this substitution was not seen as a complication in generating the inventory. Additional information on emissions in the 1990 year is included in the Back-cast Results starting on page 41.

ICLEI allows emissions tracking for six different greenhouse gases, which it converts to their carbon dioxide equivalents. Various criteria air pollutants were previously derived from the reported 2006 PUD fuel mix: Coal 6%, Hydroelectric 82%, Natural Gas 2%, Nuclear 9%, and Other Generation 1%.[23]

These numbers are provided below for future reference in case the data is needed for a future criteria air pollutant report; however, they were **not** entered into the software. This is because the main PUD coefficient was reported in carbon dioxide equivalent tons, so the PUD had already converted and integrated the impacts of the other air pollutants.

Table 1: CO_2e in pounds per megawatt hour (MWh) of electricity generated

Emissions Coefficient Used	
Equivalent CO_2	166.67
Criteria Air Pollutants *(not entered in software)*	
Nitrogen Dioxide (N_20)	.001
Methane (CH_4)	.015
Nitrous Oxide (NOx)	.447
Sulphur Oxide (SOx)	.669
Carbon Monoxide (CO)	.034
Volatile Organic Compounds (VOC)	.003
Particulate Matter 10	.317

Tonne (metric ton) vs. the Short(or American) Ton: Conventional reporting of greenhouse gases is done in metric tons, equaling 1,000 kilograms, or 2,204.6 pounds. The American ton or "short" ton is 2,000 pounds, about 10% less. Emissions provided from the PUD were in short tons, but final CO_2 emissions are reported in the international standard of metric tons (also written tonnes).

Figures for 2005 energy and natural gas use were reported directly from the PUD and PSE. PSE provided direct data for 2000 and 2005; 1990 levels were approximated. For the PUD data, the 2000 and 1990 energy levels were approximated based on Energy Information Administration data, general Snohomish County trends, population and housing levels, and discussions with utility representatives. This methodology is discussed more in the Forecasts and Back-casts section beginning on page 31.

[23] Published on the SnoPUD website at http://www.snopud.com/energy/pwrsource.ashx?p=1878#fuelmix (accessed July 7, 2008).

Transportation emissions result from many different inputs, such as the level of traffic on the road, what types of vehicles make up the traffic, how many miles people are driving, and if these averages vary with the season, time of the day and days of the week. The CACPS software has many built in defaults to assist cities with most of this information, as this level of data is far beyond what most cities have available. With defaults for the mix of vehicles on the road, and average emissions per vehicle type, cities usually have to either figure out how much fuel is being purchase per year within city limits or cities have to figure out how much driving is occurring within the city. The City of Edmonds chose the latter. Built-in transportation assistance in the CACPS software generates the miles driven within a city using Vehicle Miles Traveled (**VMT**) per type of road, and the length of roads within a city per road type. Another method, using counts for how many cars are recorded on each road class, was used for back-casting and forecasting.

The current VMT per capita for 2000 and 2006 were 11.13 and 11.05 respectively, as provided by the Puget Sound Regional Council (**PSRC**). As PSRC did not have VMT data for 2005, it advised the city to substitute the 2006 number. The VMT figure stated above represents that for every person in the city, an average of eleven miles are traveled within the city per day. This VMT data differs from the type used in transportation planning (please see the Note at the end of this Section). The PSRC VMT data was then multiplied by the Census and Snohomish County population totals for the City of Edmonds, providing how much daily traffic there was in the city on an average weekday. This weekday average was then translated into an annual average.

An annual total for VMT must balance with traffic differences on weekends. In Edmonds, traffic levels are usually smaller during the weekends in comparison to weekdays. However, the street markets and different festivals in the summertime generate a lot more traffic, making weekday traffic volumes roughly equivalent with weekend volumes for that period. [24] For cities with less weekend traffic than weekday traffic, ICLEI recommends multiplying the weekday average by 330 rather than 365 to balance out the volume difference. As city traffic is equal on weekends and weekdays for one quarter of the year, one quarter of the 365 total was combined with three quarters of the 330 total, resulting in a multiplier of 338.75 to account for Edmonds' unique traffic patterns. This number was used with the per capita VMT provided by PSRC for the years 2000 and 2005.

Table 2: Vehicle Miles Traveled calculations

Year	VMT/capita/day	Population	Day Multiplier	Annual VMT Total (*in millions*)
2000	11.13	39,515	338.75	**149.04**
2005	11.05	39,860	338.75	**149.25**

[24] From conversations with the City Transportation Staff.

Note before Using the PSRC Vehicle Miles Traveled Data

ICLEI specifically advised that when conducting an emissions inventory, the general VMT data for the City of Edmonds be used. This general VMT data includes trips not only made by Edmonds residents or those traveling to and from the city, *but also trips by people (non-residents) passing through the city to get somewhere else*.

While this total accurately captures emissions falling within city boundaries, the number is **not** suitable for those looking to create transportation policies for Edmonds. Other VMT data focused on counting trips that originate or end within the city are most appropriate for the development of transportation policy. The general VMT data used in this inventory would mislead those planners developing transportation policy. PSRC advises that the correct VMT data for addressing transportation policies, which focuses on motor vehicle trips that begin or end within city boundaries, be obtained when developing policies for the city.

For instance, in a data set provided by ICLEI of a 2006 PSRC study that was not as precise, the following values were provided as VMT data for cities. The first column is general VMT data. The second column represents VMT data of trips originating from or ending in the city. This is the figure used more for developing transportation policy, and while Edmonds' general VMT is quite low compared to other cities, it is the *only* city among those studied whose VMT increases in the second column, and it does so 25% of the original figure; it ties for second place as the highest VMT in this circumstance.

Table 3: PSRC VMT comparisons for policy*

City	VMT general	VMT home base
Bellevue	32.6	9.2
Tukwila	115.1	9.5
Shoreline	24.2	10.6
Mercer Island	25.7	13.1
Lynnwood	27.5	10.5
Everett	26.2	10.7
Edmonds	**9.8**	**12.3**
Lake Forest Park	15.3	12.3
Tacoma	19.4	10.7
Seattle	18.8	6.8

**These figures, while sourced from legitimate PSRC research, are for illustrative purposes only. Please contact the PSRC or another valid transportation analyst group for more current, appropriate numbers to apply in transportation modeling and policy development.*

Waste emissions estimates require information on how much waste is being disposed, the composition or character of the waste being disposed, and what operations are in place at the disposal site. Understanding why this information is necessary requires understanding the nature of what occurs with waste at a landfill.

Not all waste disposed in landfills emit the same amount and types of greenhouse gases. Organic matter, or waste that is derived from natural products such as yard waste, paper, and some types of clothing, will tend to have higher global warming impact due to increased output of methane. Most landfills in the U.S. cover waste with soil, tarps, or other materials daily, after it is deposited on-site, wherein oxygen is quickly depleted by aerobic bacteria. Subsequently, anaerobic decomposition occurs, or digestion by bacteria that thrive in non-oxygenated environments. Anaerobic bacteria break organic matter into intermediate substances such as cellulose, amino acids, and sugars, which further decompose via fermentation, producing gases that are roughly half carbon dioxide and half methane by volume.[25]

Methane production (CH_4) can last anywhere from 10 to 60 years after waste is deposited, which is a significant concern because of methane's impact on the atmosphere. The global warming potential of methane is 21 times that of carbon dioxide,[26] though it remains in the atmosphere for a shorter period of time – about 12 years on average, compared to carbon dioxide, which lasts in the atmosphere for 50 to 200 years.[27] Still, molecule for molecule, CH_4 has a greater impact than CO_2.

The main landfill for the City of Edmonds is the Roosevelt Regional Landfill found in Klickitat County, Washington. Roosevelt is lined with compacted clay and a high density plastic, and is covered with soil daily to prevent odors and animal scavengers..[28] In addition, the Roosevelt Landfill began employing a methane gas collection system in 2000, flaring (igniting) the gas for energy production, and converting methane gas back to carbon dioxide. As Roosevelt flares its methane, but uses soil and not plastic for a top cover, the ICLEI-advised 75% methane recovery rate was applied in calculating waste sector emissions. This level of methane recovery often leads to negative emissions per ton of waste disposed.

Why Landfilled Waste has "Negative" Emissions

CACP Software calculations are based on the Environmental Protection Agency's (EPA) Waste Reduction Model (WARM), which determines the GHG impacts of various waste management practices. Methane and carbon dioxide (CO_2) are naturally released as part of the decomposition of organic matter in landfills. Some CO_2 is buried and trapped in the landfill, while flaring the methane changes the gas to carbon dioxide that would have naturally circulated in the atmosphere under normal decomposition conditions. The end result is that, with adequate methane flaring, less CO_2e is released to the atmosphere than would have occurred had the waste been left to decompose on its own, resulting in negative emissions in the waste sector.

[25] EPA, "Inventory of U.S Greenhouse Gas Emissions and Sinks: 1990-2006," April 2008, 8-2. http://epa.gov/climatechange/emissions/downloads/08_CR.pdf (accessed July 15, 2008)
[26] Ibid. ES-3.
[27] Ibid. 1-7.
[28] by Snohomish County Solid Waste Management , "Where Does My Garbage Go?", webpage http://www1.co.snohomish.wa.us/Departments/Public_Works/Divisions/SolidWaste/Garbage/wheregarbagegoes.htm (accessed July 22, 2008).

Of course, this does not mean that creating additional garbage is part of the solution to global warming. Reducing the amount of waste we create is part of the solution for a variety of reasons. Among other benefits, reducing the amount of waste created can preserve natural resources and decrease emissions from transporting solid waste. In addition, manufacturing paper and other goods from recycled sources is less energy intensive than harvesting and processing new inputs.[29]

Information on the amount of organic matter being disposed in the landfill can be derived from waste composition studies. The percentages used for 2000 and 2005 were derived from the last waste characterization study for the Snohomish County Solid Waste Management Division in 1998. Another solid waste characterization is planned in 2008, so future emissions will need to be updated accordingly.

Nearby King County conducted a more recent waste characterization study in 2002, but King County also has a different set of programs in place that likely alter the nature of the waste disposed. For this reason, Snohomish County advised that their earlier, in-county waste study would be more appropriate for ICLEI measurements. Construction and demolition (**C&D**) debris is not included in the characterization as most of the landfills listed as receiving C&D have reported that it is mostly concrete and rubble, without a significant amount of lumber or other decomposable materials. In addition, staff at the Snohomish County Solid Waste Management Division stated that there is a high degree of inconsistency in how C&D materials in are listed in reporting forms. Although more information about this arena would be helpful in the future, a finer distinction is not possible at this time.

Table 4: Percentages for 2000 and 2005 waste characterization

Waste Type	Waste Stream Percent
Paper Products	21.9%
Food Waste	13.3 %
Plant Debris	2.5%
Wood & Textiles	13.8%
Includes Wood,	(11.3%)
Textiles,	(2.4%)
Leather,	(.1%)
Other	48.5%

Sound Disposal was able to provide complete data for 2000 and 2005. The other two haulers, Allied Waste and Waste Management NW, had only partial data for these years, requiring some estimation. Allied Waste had data for 2005, but data for year 2000 had to be averaged from partial data that was available from years 1999 and 2002. The reported annual customer number for both years was relatively equal at about 8,600 customers. 6,762 tons of solid waste was collected in 2000 and 6,811 tons was collected in 2005.

[29] U.S. Environmental Protection Agency. (2006). "Solid Waste Management and Greenhouse Gases: A Life-Cycle Assessment of Emissions and Sinks. http://epa.gov/climatechange/wycd/waste/SWMGHGreport.html

In 1999 there was no separate data reported for multifamily and commercial waste. As such, additional estimate amounts were added to the 1999 Allied Waste totals for the commercial and multifamily areas. The additional commercial and multifamily values were approximated using the percentiles from the average ratio of commercial/multi-family to residential waste from 2002 on 1999 waste tons. These amounts were added to the original 1999 total. The 1999 and 2002 waste tons were averaged by month, and these months added together, for the final total tons hauled by Allied in the year 2000.

Waste Management NW (**WMNW**), which serves a smaller portion of Edmonds, was only able to provide the average customer base of 87 units for the year of 2000. The average tonnage per customer for Sound Disposal and Allied Waste (from earlier approximations) was multiplied by 87 to get the tonnage for that year. For 2005, the WMNW customer base was estimated by multiplying its share of the customer base in 2000 by the predicted number of houses in 2005. As WMNW serves a very small population, the customer number ended up being the same for both years This number was then multiplied again by the average tonnage per customer for Sound Disposal and Allied Waste to get the total tonnage for 2005 as well.

Table 5: Edmonds Waste Tons by Hauler, 2000 and 2005

2000: Waste Hauler	Waste Tons	Customer Number	Waste Tons per Customer
Sound Disposal	3,546	1,906	1.86
Allied Waste	**12,584**	8,554	**1.47**
residential	*6,762*		
commercial	*3,581*	?	
multifamily	*2,239*	?	
Waste Mgmt. NW	**145**	87	**1.67**

2005: Waste Hauler	Waste Tons	Customer Number	Waste Tons per Customer
Sound Disposal	3,566	1,913	1.86
Allied Waste	17,927	8,806	2.04
residential	*6,811*	*8,497*	
commercial	*8,321*	*226*	
multifamily	*2,795*	*83*	
Waste Mgmt. NW	**170**	**87**	1.95

Please Note: Figures bolded in **red** *were approximated to some degree.*

Other. The City of Edmonds has a train station, ferry terminal, and marina/port within city limits. Although approximations of fuel use by the ferry and train services are not included in this inventory (see Community Analysis: Exceptions, page 21), an attempt was made at including emissions from fuel sales at the Port to recreational boaters.

The Marina, supporting the Port of Edmonds, provides multiple services to boaters in the area. Among them are fuel sales from the fuel dock, which accesses two 12,000-gallon tanks for unleaded gasoline and one 12,000-gallon tank for diesel. Total fuel sales are roughly equivalent with supply, with gasoline composing 2/3 of the sales and diesel

composing the remaining 1/3. ICLEI representatives informed the city that, for boats, the vehicle type does not matter. Burning a gallon of gasoline will produce almost exactly the same greenhouse gas emissions regardless of the vehicle type. As such, efforts were focused on attempting to approximate gallons of fuel sold by the Marina in various years. Port officials were able to supply quarterly totals of gallons sold and fuel prices on the last day of the quarter for 2003 through 2007, as well as the first two quarters of 2008.[30] While this provided data for 2005, some approximation was required for 2000; this process is detailed below.

The recorded gallons of fuel sold for 2003 and 2004 were very similar, with the number of gasoline gallons sold decreasing by 2.6% and the number of diesel fuel gallons sold actually increasing by 4.3%. As estimated prices for 2000, 2003, and 2004 were relatively stable, it was assumed that the number of gallons sold for 2000 would remain relatively stable as well, with price not influencing demand. As such, the gallons of gasoline and diesel gallons sold were averaged from the years of 2003 and 2004 to produce the total for 2000.

G. Community Analysis: Exceptions

There are some elements that were not incorporated into the emissions inventory because: they were considered to have minimal impact; the data was difficult to obtain, extrapolate, or approximate; they were the responsibility of another entity; and/or they would be claimed by another entity. The facets that are not being incorporated fall within the standards of ICLEI protocols.

The main exceptions are as follows:

- The Ferry: The Ferry is owned and operated by the state, so Edmonds has little influence over its emissions as the city does not control the fiscal or management operations of these facilities. However, ICLEI standards recommend incorporating ferry emissions to at least some degree. This can be done by either dividing emissions from fuel used along service routes among cities, or calculating emissions from fuel use by the ferry while the engine is idling in port. Due to data and time constraints, emissions from fuel used by the ferry were not included in this analysis. The emissions from energy consumption at the Ferry Dock service buildings fall within city limits, and thus, were included. A future study would preferably incorporate the additional fuel use along service routes, though at this time this inclusion is not possible.

- Off-road traffic emissions, such as from construction and off-road leisure vehicles are not included.

- There is a train station within city limits, servicing two Amtrak routes and several Sounder Commuter routes. While emissions resulting from the energy used to

[30] Port of Edmonds, "Port of Edmonds Fuel Sale History", provided by Marla Kempf, Deputy Director for the Port of Edmonds on July 30, 2008

power the station are included, the emissions from the diesel fuel used to power these routes are not. This is again due to data and time constraints. Neither these services, nor the station itself, are owned or operated by the city. Amtrak is a quasi-public corporation with presidentially-appointed board members,[31] receiving both national and Washington State subsidies. Sounder Commuter Rail is operated by the Central Puget Sound Regional Transit Authority (Sound Transit), an agency composed of King, Pierce and Snohomish Countries.[32] Edmonds was advised that, while other arenas were higher priority, a more complete study would get the total emissions from the train operator and multiply by the fraction of the total track length that runs through the jurisdiction (which the operator should be able to help with obtaining). This data search was not completed in time for the report. It is expected that inclusion of this element might be easier in the future, as more counties and businesses develop carbon inventories for cities to draw on.

H. City Operations Analysis: History

For the complete City Operations analysis with results, please see the City of Edmonds Analysis of City Operations and Activities Report Years 1999 and 2006.[33]

> "Local authorities construct, operate and maintain economic, social and environmental infrastructure, oversee planning processes, establish local environmental policies and regulations, and assist in implementing national and subnational environmental policies. As the level of governance closest to the people, they play a vital role in educating, mobilizing and responding to the public to promote sustainable development." – UN Conference on Environment and Development, Local Agenda 21, Article 28.1 *http://www.un.org/esa/sustdev/documents/agenda21/english/agenda21chapter28.htm*

Prior to this 2000-2005 community analysis, a City Operations emissions inventory for the years 1999 and 2006 was completed by City of Edmonds Recycling Coordinator Steve Fisher. The analysis was provided to the mayor and posted on the city website, under the Climate Protection Committee's page, as a detailed document, summary, and addendum with additional charts for clarity.[34] Collecting the data for the reports was an extensive process, calling on the assistance of many city staff and taking approximately 16 months to complete. The years of 1999 and 2006 were initially selected because 1999 was as far back as many reliable records went and 2006 was the most recent year for which data was available when the process began.

---

[31] Subcommittee on Railroads, "Hearing on Current Amtrak Issues" (*archives)*, 2003, 1, 2 http://web.archive.org/web/20061110231722/http://www.house.gov/transportation/rail/04-30-03/04-30-03memo.html (accessed July 7, 2008).

[32] Sound Transit Office of Corporate Communications, Operations, Projects and Corporate Services, "Sound Transit History and Chronology", October 2007, 2, 3 http://www.soundtransit.org/Documents/pdf/about/Chronology.pdf and Sound Transit's History, http://www.soundtransit.org/x1228.xml , (accessed July 7, 2008).

[33] City of Edmonds Analysis of City Operations and Activities Report Years 1999 and 2006, 2008 http://www.ci.edmonds.wa.us/climate_prot_ggi.stm

[34] The current web address for the Climate Protection Committee is http://www.ci.edmonds.wa.us/climate_prot.stm

When the Community Analysis was undertaken, the inventory years were changed from 1999 and 2006 to 2000 and 2005. This was done because census information is relatively important in developing community-wide data and emissions projections, and census data is released by decade. With census data developed on a decade-by-decade basis, an intermediate five-year estimate also made sense. Although this change in analysis years was considered necessary for the accuracy of the larger community analysis, it raised the question how to handle the previous City Operations analysis.

Initially, recreating the City Operations analysis for the 2000 and 2005 years was considered. One individual who aided in the original analysis was Ray Burton of the city's electricity provider, the PUD. Investigation revealed that the 1999 data he had provided for specific buildings was from records he kept in personal files for special needs, long after the larger PUD tracking system had disposed of them. When the city attempted to reconnect with the PUD to retrieve specific files on buildings we were informed that process was no longer an option; Ray Burton had since retired, and with him went the personal data that had informed the previous process. Current PUD records only go back as far as 2003.

With a large data source no longer available for 1999, the recreation of a city operations inventory was reconsidered. Additional analyses would take additional time, as back-casting is a more extensive, time-consuming and less accurate process than using the actual records. Also considered was the fact that city operations emissions are not added to the larger Community Analysis. Their greatest use is as a report considered separately, to inform policy decisions within government operations. When considering the purpose of city operation inventories, the additional time required, and the reduced accuracy of a recreated city operations inventory, analysts decided to keep the existing City operations Analysis intact as to more accurately portray the arenas where government action could be most effective.

The original data sources and exceptions in the 1999/2006 City operations Analysis are described here; for data results, please see the original report. It is advised that the City operations Analysis be updated, along with community emissions, when more current data is available following the 2010 census.

I. City Operations Analysis: Comparing Municipal Inventories Between Cities

There is one important difference between the City Operations and Community Analyses worth emphasizing: for tallying energy emissions, they use slightly different electricity coefficients for tons emitted per megawatt hour.

When Edmonds first corresponded with the PUD for the City Operations Analysis, they were working with several entities to generate the correct coefficients per ICLEI accounting methods. At the time, the coefficient they generated was 0.14 tons or 285 pounds of carbon dioxide-equivalent emissions per megawatt hour (MWh) as averaged for the 2004-2006 years. However, after the City Operations Analysis was complete, the PUD provided an alternative calculation that removed biogenic emissions, notably emissions

resulting from landfill gas and biomass energy generation. The PUD-calculated coefficients averaged out to .0833 tons, or 166.6 pounds of carbon dioxide-equivalent emissions per MWh.

The effect of this difference is significant. As the PUD uses very few fossil-fuel energy sources, both city operations and community emissions resulting from energy use will be far below that of many other cities throughout the country. To compare relative energy use and emissions levels, please refer to Section W, page 48, which provides some city emissions using regional electricity using eGRID emission figures. Additional information on eGRID, is provided in Section F, page 12.

For policy purposes, it is best to adjust for the different electricity coefficients used in the City Operations and Community Analyses. The electricity segment emissions of the city operation inventory amount to 58% of its emissions level. Emission totals can then be divided into the Community Analysis to provide a percentile of the contribution of city operations to overall city emissions, a percentage that could be compared against other cities. These calculations are shown in a chart denoting the base year of 2000 in Tables 6 and 7 on page 26.

J. City Operations Analysis: Description and Sources

The City operations Analysis portion of the CACPS software is similar to the Community Analysis, again taking into account the emissions from energy consumption, vehicular travel, and waste generation. However, because the number of buildings operated by the city is a smaller set than the city itself, it is possible to create a more specific profile of the government itself, helping to inform future policy decisions and allowing the city to model accountability for its own carbon emissions.

It should again be noted that the City Operations Analysis is a part of, not an addition to, the Community Analysis. Emissions resulting from the energy use, waste, and transportation choices of municipal employees and the operations of city buildings are not intended to be subtracted from the emissions of the community as a whole. This accounting is standard among community carbon profiles, and helps the Edmonds profile remain comparable to the efforts and accounting of other municipalities.

The City Operation Analysis module is partitioned into 7 different emissions groups: Buildings, Vehicle Fleet, Employee Commute, Streetlights, Water/Sewage, Waste, and Other. The following section outlines the sources by sector, and outlines the exceptions of data not incorporated in the inventory, as well as the reasoning behind these decisions.

Sources

Buildings data tracked the individual emissions from natural gas and energy use in city-owned structures and by city parks (for restroom lighting, irrigation, etc.). This data was provided by the city's utility providers, Puget Sound Energy (PSE) for natural gas usage and the PUD for electricity consumption.

Vehicle Fleet data came from the City of Edmonds Fleet Maintenance in the Public Works Department and the archives of old payables files, also in Public Works.

Employee Commute data was extrapolated from Commuter Trip Reduction surveys conducted every two years with city employees. The surveys were made available by the city's Traffic Engineer, Community Transit, and the Washington State Department of Transportation.

Streetlights data was derived from monthly PSE billings, provided by Accounting in the Administrative Services Department.

Water/Sewage electricity use data came from the PUD and PSE directly, with the assistance of the Wastewater Treatment Plant Manager

Waste data was provided by Allied Waste, Sound Disposal, Waste Management NW, archived city files, and the City of Edmonds Recycling Coordinator. Data about waste categories are derived from the 1998 Snohomish County Waste Characterization study.

K. City Operations Analysis: Exceptions

- Edmonds water services come from a variety of providers. The city receives its potable water from the Alderwood Water District and the Olympic View Water District. Most of the city's wastewater is treated by the city at the municipal Wastewater Treatment Plant. Some additional wastewater from the City of Mountlake Terrace and the Town of Woodway are also received by this facility. Additional sewer services are provided by the city of Lynnwood in the northern part of the city. In the course of the inventory, Edmonds city staff inquired with ICLEI whether a percentile of Edmonds water service emissions occurring outside the city should be integrated as a part of the inventory. City staff was advised that other cities would likely include the entire emissions associated with their potable and wastewater services in their inventories, and that for the city to integrate this emissions percentage would likely result in some double counting. In addition, the City of Edmonds has very limited ability to influence the emissions of these water plants with city policy, as the plants are outsides the city's operational jurisdiction. As such, the emissions from these utility providers are not included in the inventory.

L. City Operations Analysis: City Operationl Emissions Modification for 2000

To achieve an appropriate proportion of city operations emissions to community emissions, city operations emissions resulting from electricity use must be modified (see Section I, page 24). The electricity segment emissions would be reduced to 58% of its emissions level; an example of this reduction process is provided below.

Table 6: Modified City Operation Electricity Emissions from 1999

City Operation sectors	Original CO_2e metric tons	58% of Original
Buildings subtotal	328	190.24
Lights subtotal	182	105.56
Lift Stations subtotal	24	13.92
Wastewater & tanks subtotal	716	415.28
Total	**1,250**	**725.00**

Source: CACP Model Output

Table 7: City Operation Emissions from 1999 as a portion of 2000 Community Analysis

City Operation Inventory Calculations		Community Analysis
Total Reported City Operations Emissions	3,487	
Previous Electricity Emissions	1,250	
Modified Electricity Emissions	725	
Total with previous electricity emissions subtracted	2,237	
Add to 2,237 the modified electricity emissions	**2,962**	
Community Emissions for the year 2000 (in metric tons)		174,955
City Operation Emissions percentage of Community Total		**1.69%**

Source: CACP Model Output

City operation emissions for Edmonds in 2000 constituted 1.69% of the city's total community emissions. City operation emissions typically fall between two to five percent of overall community emissions. City operation emissions in Edmonds are likely lower than this average because the city's water and waste water treatment is partially aided from plants in other cities (see Section K, page 25). The wastewater treatment process produces greenhouse gas emissions through direct emissions from waste and intensive energy use for water remediation and pumping. Reduced emissions in this sector results in a lower proportion of city operation emissions compared to the total community inventory.

Part III: Community Inventory Results

The Community Emissions Inventory is an estimate of all greenhouse gas emissions occurring within Edmonds city limits or for which the city is otherwise responsible.

M. Base Year Emissions Inventory

In the base year of 2000 the City of Edmonds emitted approximately **174,955** metric tons of CO_2e.

- The transportation sector was the largest producer of greenhouse gas emissions, with gasoline and diesel fuel combustion producing 53.1% of the total community emissions.
- The residential sector was the second-largest, producing 34.7% of the total community emissions.
- The largest single source of emissions was from gasoline and diesel fuel, producing 54.9% of all emissions when road traffic and marina fuel sales are combined.
- Electricity use in all sectors accounted for 13.6% of emissions while natural gas combustion accounted for 32.9% of community emissions

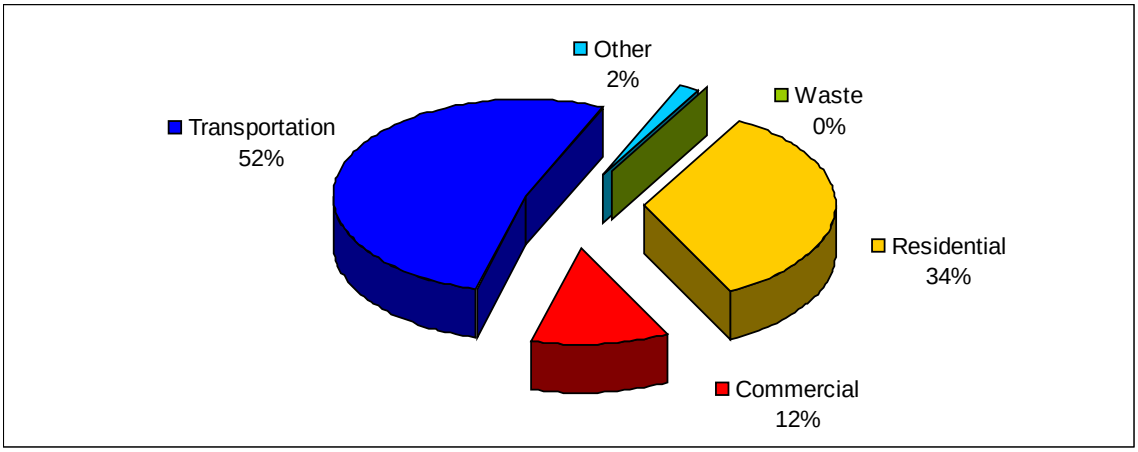
.

Table 8: Edmonds Community Greenhouse Gas Emissions by Sector, 2000

Sector	**Equivalent CO_2 (metric tons)**	**Percentage of Total**	**Energy Consumed (million Btu)**
Residential	60,611	34.7%	1,513,682
Commercial	20,630	11.8%	589,948
Industrial	49	0%	1,844
Transportation	92,937	53.1%	1,189,043
Waste	(-2,504)	(-1.4)	-
Other	3,232	1.8%	-
Total	174,955	100%	3,294,517

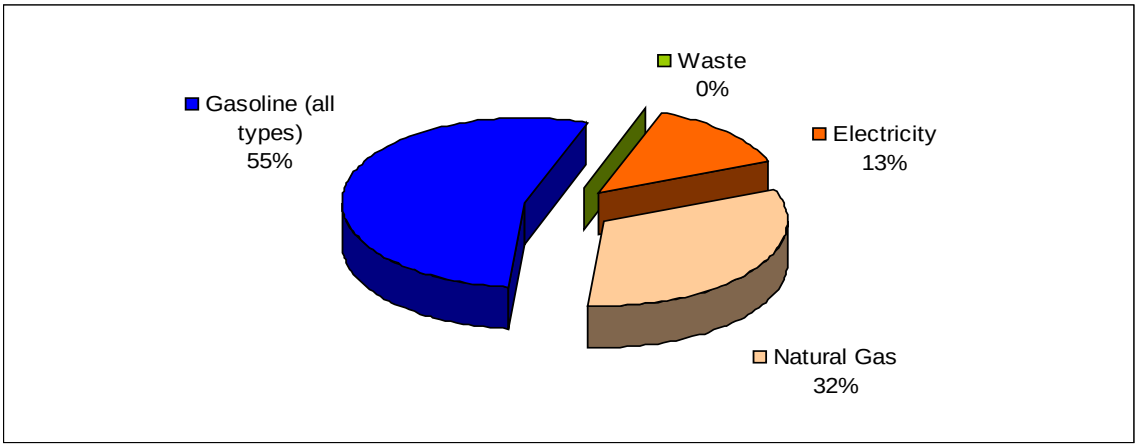
Source: CACP Model Output

Figure a: Edmonds Community Greenhouse Gas Emissions by Sector, 2000



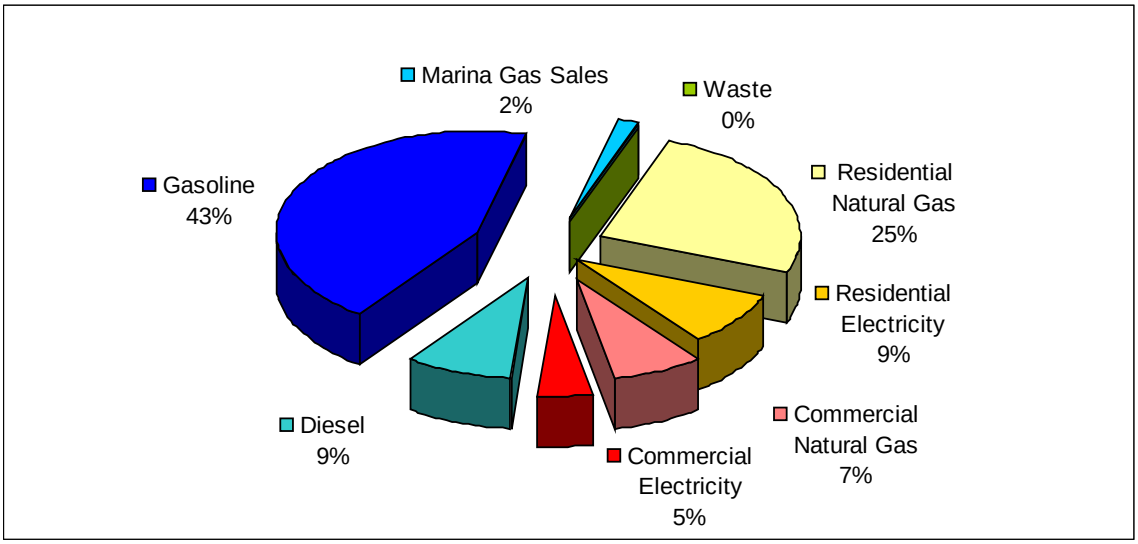
Source: CACP Model Output

Figure b: Edmonds Community Greenhouse Gas Emissions by Source, 2000



Source: CACP Model Output

Figure c: Edmonds Community GHG Emissions by Sector and Source, 2000



Source: CACP Model Output

N. Interim Year Emissions Inventory

In the interim year of 2005 the City of Edmonds emitted approximately **168,700** metric tons of CO_2e, a reduction of about 3% from the year 2000. This reduction is believed to be due mostly to the fact that actual values were used in 2005 and many estimated values were used in 2000.

- The proportion of emissions by sector and source remain relatively the same between 2000 and 2005
- The transportation sector was the largest producer of greenhouse gas emissions, with gasoline and diesel use producing 53.0% of the total community emissions.

- The residential sector was the second-largest, producing 34.7% of the total community emissions.
- The largest single source of emissions was from gasoline and diesel fuel, producing 54.5% of all emissions when road traffic and marina fuel sales are combined.
- Electricity use in all sectors accounted for 13.4% of emissions while natural gas combustion accounted for 34.2% of community emissions.

Table 9: Edmonds Community Greenhouse Gas Emissions by Sector, 2005

Sector	Equivalent CO_2 (metric tons)	Percentage of Total	Energy Consumed (million Btu)
Residential	58,404	34.7%	1,439,979
Commercial	21,602	12.9%	606,488
Industrial	74	0%	1,317
Transportation	89,012	53.0%	1,143,720
Waste	(-3,333)	(-2.0%)	-
Other	2,941	1.5%	-
Total	168,700	100%	3,191,504

Source: CACP Model Output

Figure d: Edmonds Community Greenhouse Gas Emissions by Sector, 2005

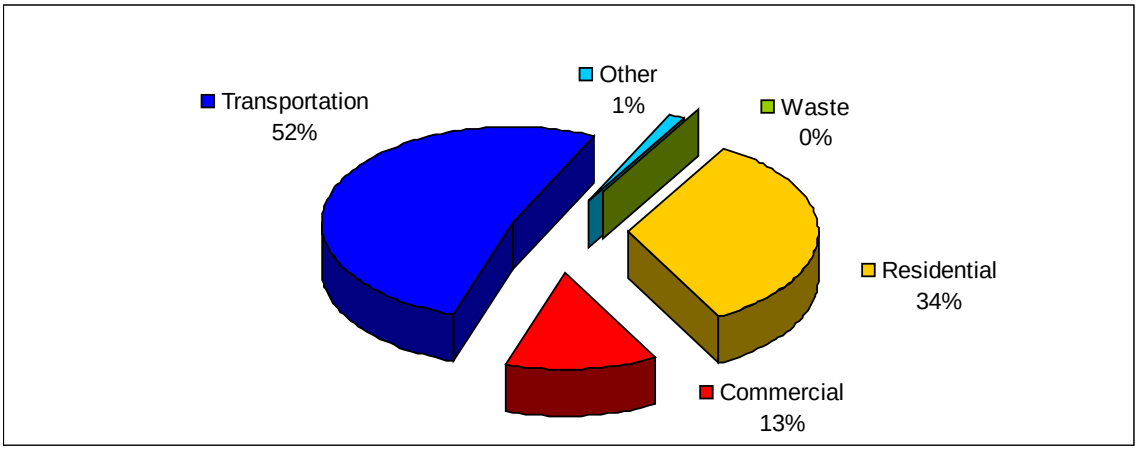
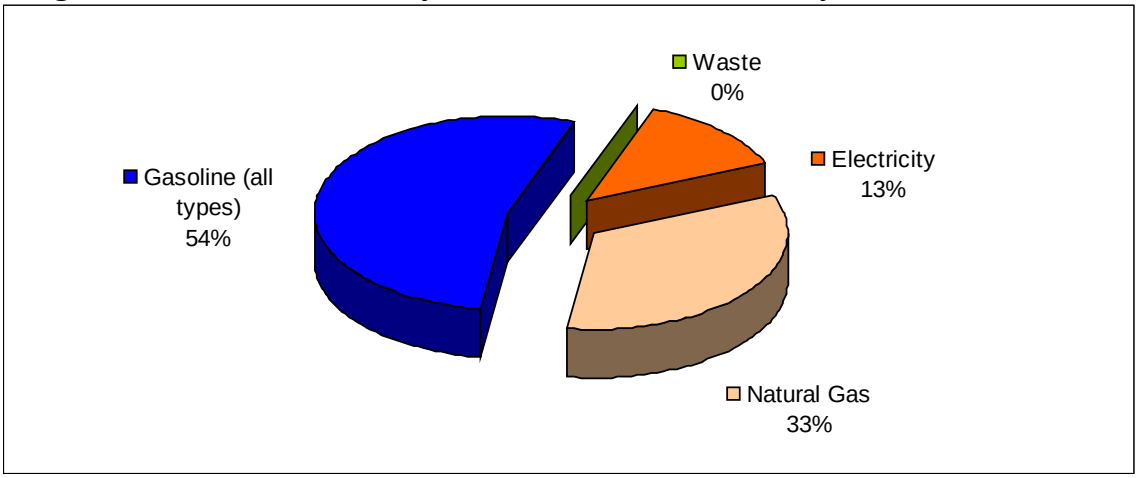
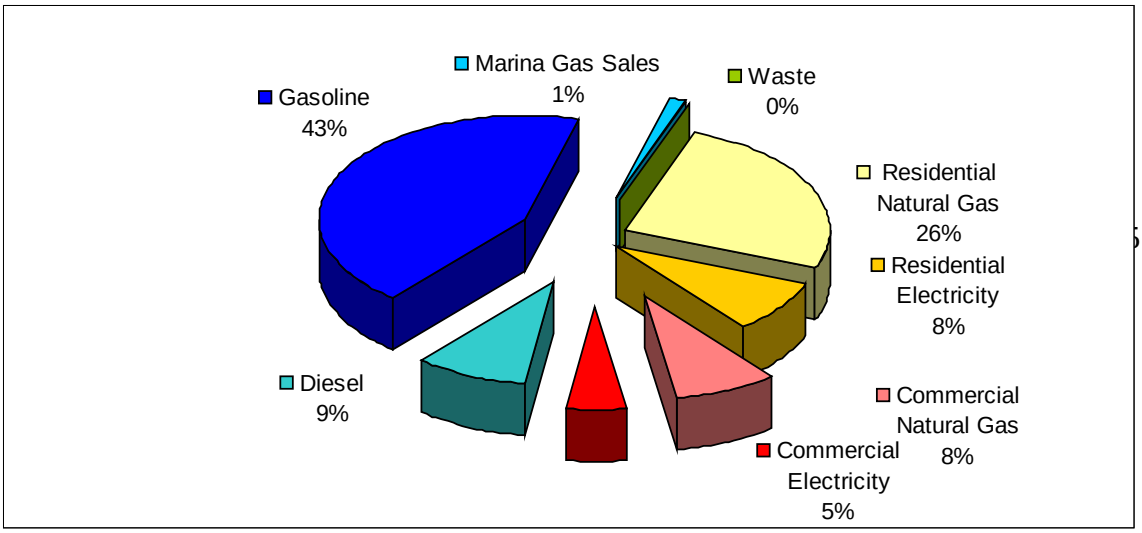


Figure e: Edmonds Community Greenhouse Gas Emissions by Source, 2005



Source: CACP Model Output

Figure f: Edmonds Community Greenhouse Gas Emissions by Sector and Source 2005



Source: CACP Model Output

O. Comparison Between Base and Interim Year Inventories

Between 2000 and 2005 total Edmonds emissions decreased by 3.6% (Table 10). However, the decrease is believed to be due to increases in vehicle fuel efficiency, natural variability in resource use between years, and the need to estimate electricity use in 2000. Changes in emissions are not consistent between sectors.

- The residential sector saw a mild decrease of 3.6% in emissions from electricity and natural gas use. Changes in natural gas emissions are from differences in actual figures, showing a slight decrease in the residential sector from natural annual variation. There is some uncertainty as to the accuracy of the residential sector as these figures had to be estimated from the City's proportionate energy share of Snohomish County. However, the emissions differences are relatively mild, and possible within the model.
- The commercial sector saw a slight increase in emissions of 4.7% between 2000 and 2005.
- The waste sector saw a 33.1% emissions decrease. Solid waste tonnage actually *increased* in this period, but because of methane gas burning and some carbon dioxide sequestration in landfills, this resulted in a net decrease of emissions. Please see Section F, page 17, for more information.
- Transportation also saw a decrease of 4.2% in emissions from 2000 to 2005 despite a slight increase in millionVehicle MilesTraveled during this time (from 149.04 in 2000 to 149.25 in 2005). This is likely due to imbedded data in the CACP software. The CACP software incorporates the average efficiency of all the cars on the road in a particular year as calculated by the EPA. As such, the decrease in emissions is attributed to an assumed increase in fuel efficiency for vehicles on the roadways.

Table 10: Comparison between 2000 and 2005 by Sector

Sector	2000 Equiv CO_2 (metric tons)	2005 Equiv CO_2 (metric tons)	Percentage Change
Total Residential	60,611	58,404	-3.6%
Total Commercial	20,630	21,602	+4.7%
Total Industrial	49	74	+51.0%
Total Transportation	92,937	89,012	-4.2%
Waste	(-2,504)	(-3,333)	-33.1%
Other	3,232	2,941	-9.0%
All Sectors	**174,955**	**168,700**	**-3.6%**

Source: CACP Model Output

Please note that the percentage change in the "All Sectors" category is not the sum of "Percentage Change" across all previous rows, but the percent increase of CO_2e between 2000 and 2005 in the "All Sectors" row.

Table 11: Comparison between 2000 and 2005 by Sector and Source

Sector & Source	2000 Equiv CO_2 (metric tons)	2005 Equiv CO_2 (metric tons)	Percentage Change
Residential – Electricity	15,727	14,478	-7.9%
Residential – Natural Gas	44,884	43,926	-2.1%
Commercial – Electricity	8,073	8,043	-0.4%
Commercial – Natural Gas	12,557	13,559	+8.0%
Industrial – Electricity	36	-	-100%
Industrial – Natural Gas	13	74	+469%
Gasoline	77,510	73,614	-5.0%
Diesel	15,427	15,398	-0.2%
Marina Fuel Sales	3,232	2,941	-9.0%
Waste	(-2,504)	(-3,333)	-33.0%
Total	**174,955**	**168,700**	**-3.6%**

Source: CACP Model Output

Please note that the percentage change in the "All Sectors" category is not the sum of "Percentage Change" across all previous rows, but the percent increase of CO_2e between 2000 and 2005 in the "All Sectors" row.

Part IV: Forecasts and Back-casts

P. Introduction

Both forecasts and back-casts provide valuable information in setting appropriate carbon reduction goals. The emissions of different activities are dynamic, rising and falling with the variables of population, technology, and different regional policies. As energy use and population are both expected to grow in the near future, it is likely that emissions will also grow unless mitigating steps are taken. The rise in emissions without mitigating steps is referred to as Business-As-Usual emissions. Both internationally and locally, emission reduction goals must account not only for the current greenhouse gas reductions desired,

but also incorporate the additional emissions that will result from business-as-usual trends in the future.

A back-cast inventory for the 1990 year was attempted and is provided in this report, but analysis results should be interpreted with care. While the year 1990 is cited as an important policy year for local and international carbon accounting, data for that year is too inconsistent and unreliable to provide a meaningful baseline for the city, especially when considering the changes in the city from 1990 to 2000. As a whole, Edmonds annexed over 1000 additional acres of land in this period, including a significant amount of the current city population – over 6,000 people, or one fifth of its 1990 census level. City governance also underwent significant operational changes, rebuilding of one of the three fire stations, constructing a new Public Works facility and changing the site of City Hall. Such changes add complexity to tracking down older records, and detract from the value of comparing inventories irrespective of these considerations for policy purposes.

Inventories are meant to track increases and decreases in the absolute or net amount of carbon being released into the atmosphere. A large portion of the "increases" from 1990 to 2000 are not a result of an increase in net carbon emissions, but rather the transfer of Snohomish county emissions to the City of Edmonds via annexation, with the increases in car travel, waste generation, and energy emissions due to the population addition.

However, with the limited data available, the 1990 "back-cast" was attempted to shed some illumination of what emissions were at a *per capita* level, or how much Edmonds was emitting on a per-person level, at that time. This per-person emission was then compared to 2000 per-person emission levels to derive the emission reduction goal of a 7% reduction from 1990 levels by 2012, as outlined by the U.S. Mayors Climate Protection Agreement. This also explains why the City of Edmonds selected the year 2012 as its forecast year, to measure its progress towards reaching that goal. However, another interim inventory in 2010 is advisable, as forecasts are influenced by population growth projections and updated census information will be released shortly afterward.

Forecasting and back-casting require both the original data used in 2005 as well as information about changes in energy use, transportation volumes, population, and households. The following section covers the new sources, describes how the data fits into the model, and outlines the exceptions of data not incorporated in the inventory, as well as the reasoning behind these decisions.

Q. Sources and Fitting the Data to the Model

Sources

Population and Household data was needed for four different years: 1990, 2000, 2005, and 2012. Population totals for Edmonds in 1990 and 2000 are derived from US Census counts for their respective years. The intercensal year of 2005 was derived from the

Washington Office of Financial Management (**OFM**).[35] The population of 2012 was drawn from estimates by Snohomish County predictions,[36] developed from Census and OFM data. To inform regional data, additional population forecasts of other states were drawn from the varied departments heading official population projections..

Energy use information was extracted from the PUD data and the PUD Integrated Draft Resource Plan, released to the public for comment in June, 2008.

Natural Gas projections were based on data from Energy Information Administration reports, projecting energy use by year and US region through 2030.[37]

Additional **Transportation** data on Average Daily Trips per road class, as well as the lengths of various road classes within the city, were provided by the City of Edmonds Public Works Department.

Additional **Waste** data was gathered from the Washington State Department of Ecology Solid Waste studies in addition to information provided by city waste haulers.

Fitting the Data to the Model

Residential, Commercial, and Industrial data provided by PSE and the PUD can accurately furnish the electricity and natural gas usage within city limits for current dates. However, predicting growth often means tracking changes in how much average electricity a customer will use, and how many additional customers will be added to the system later on. While the new data system installed by the PUD should be able to provide accurate customer numbers for a city in the future, Edmonds was informed that total customer numbers for an entire city system are more difficult to accurately extract from the older PUD database. In fact, customer numbers were considered highly variable. As the total customer base for the county as a whole has greater predicted accuracy, Edmonds was advised to take a percentage out of county predictions for future energy use. This still required that the city come up with a way to reasonably estimate its own customer number for past and future years.

Customers are not the population base of a city, but the buildings base. For instance, "Residential customers" is the number of residential buildings that are served by a PUD meter and charged the residential service rate. Multifamily housing buildings, such as those with apartments, are charged a meter rate on par with commercial buildings, so they

---

[35] Office of Financial Management, State of Washington. "Population of Cities, Towns and Counties Used for Allocation of Selected State Revenues", June 30, 2008. http://www.ofm.wa.gov/pop/april1/finalpop2008.xls (accessed July 8, 2008)

[36] Snohomish County Council, "CURRENT Countywide Planning Policies for Snohomish County", last updated June 3, 2008, 27. http://www.co.snohomish.wa.us/documents/Departments/Council/Agendas/CURRENTCountywidePlanningPolicies.pdf

[37] Energy Information Administration, "Consumption & Prices by Sector & Census Division," *Supplemental Tables to the Annual Energy Outlook 2008*, (Report #: DOE/EIA-0383(2008)), June 2008. http://www.eia.doe.gov/oiaf/aeo/supplement/index.html (accessed July 8, 2008)

are actually grouped with commercial buildings in PUD reports. Duplexes, however, would be charged a residential rate. As such, a consistently accurate data source for the number of single-family houses was considered the closest match for predicting a customer base. Of the different data sources tested as a ratio of total Snohomish County emissions, the Washington OFM's housing predictions for 1-unit housing came the closest to reported PUD levels for 2003, with a 3% difference from actual values. As such, this customer base model was applied to previous and future years. There were no single-unit housing data from OFM for 1990 or 2012, so missing values were approximated from the closest years. For 1990, this value was derived by applying the ratio of single-housing units to the total number of households reported by census data. For 2012 the same ratio application was used, save here the household number was also not provided. This was derived by dividing the 2012 population estimated by Snohomish County by the person per household number from 2005 intercensal predictions.

For **Commercial** data projection, it was observed that while the number of residential customers is much larger than the number of commercial customers, the commercial sector uses much more energy per customer. Overall, the commercial sector uses an average of half the energy of the residential sector (53.68%). Due to greater variability in commercial building size, character, length of business stay, etc., it was expected there would be greater variability in energy usage annually. For both back-casting and forecasting, this percentage was applied to projected residential energy use to estimate the energy use of this sector as well.

Industrial data has seen less change over the years. As Edmonds has not had a significant history of industrial presence during this time, the last recorded industrial energy use in 2003 was used for 2000, while 1990 industrial emissions were reduced by the population change percentage. In 2005, however, PUD records show only 386 kilowatt hours of consumption in the Industrial sector. As the 2007 records show no energy consumption by the Industrial sector; it is assumed for the 2012 projection that there would still be no industrial energy use in Edmonds. For gas records (PSE) this is slightly different, as PSE and the PUD definitions of what classifies for the Industrial rate varies. As PSE recorded some natural gas use by industry in 2005, projected PSE data was derived by applying Energy Information Administration predicted natural gas growth, modified to correct for predicted regional population growth. This methodology is explained more under the following sub-section, Natural Gas.

Natural Gas was forecasted based on an increase of 3.6% in natural gas use in the Pacific region from 2007 to 2012.[38] This number was modified based on the population gain of the Pacific region, composed of contributing individual state projections, namely Washington, Oregon, California, Alaska and Hawaii.[39] The increase number, when

[38] Energy Information Administration, "Consumption & Prices by Sector & Census Division," *Supplemental Tables to the Annual Energy Outlook 2008*, (Report #: DOE/EIA-0383(2008)), June 2008. http://www.eia.doe.gov/oiaf/aeo/supplement/index.html (accessed July 8, 2008)

[39] Offices providing these calculations are the Washington State Office of Financial Management, the Oregon Office of Economic Analysis, the California Department of Finance, the Alaska Department of Labor and Workforce Development and the Hawaiian Department of Business, Economic Development & Tourism. All estimates were current as of July 23, 2008

modified for population gain, was 2.72%, which was applied to the most recent (2006) reported PSE levels in the Commercial, Industrial, and Residential Sectors.

For back-casting, Energy Information Administration records show a substantial increase in natural gas use for the residential sector between the years of 1990 and 2000, with natural gas use increasing by 77.91%. For the state of Washington as a whole between 2000 and 2007, natural gas increased only 11.67%. Both rates were partially due to a 21.11% increase in population, as Washington grew from 4.86 million in 1990 to 5.89 million in 2000. As such, this 78% increase in natural gas in the residential sector was multiplied by the remaining, stable population percentage (88.89%), applied to the per capita natural gas use, which was then multiplied by the 1990 population level to get residential natural gas use. Lacking enough commercial data, Edmonds followed ICLEI advice by modifying commercial therm (heat measurement unit) totals by applying the percentile population change between 2000 and 1990. For the industrial therm total, recorded 1999 and 2000 year totals were averaged to help smooth out irregularities. This total was then reduced by the population change percentage of the previous decade to achieve the estimated 1990 value.

Transportation. The Puget Sound Regional Council (**PSRC**), which previously supplied Vehicle Miles Traveled (**VMT**) data for 2000 and 2005, did not do VMT analysis in 1990. As such, the city required a different method for back-casting and forecasting for other periods. An ICLEI-described method was selected where the software automatically generates a VMT estimate using Average Daily Trips per type of road class, combined with information on the road lengths per classes in the city.

Between the years of 1990 and 2000, the city annexed over 1000 additional acres of land, increasing overall road lengths within the city by 20%. As total lengths of road by street class are no longer available for 1990, each road class length was reduced 20% to approximate 1990 totals. Original street lengths were provided in the Street Inventory of the City of Edmonds Transportation Element, 2002 update.[40] Street classes were then divided into the street types provided in the software, namely Major Arterials and Collector/local streets. One ICLEI street class, "limited access highway", was subtracted from the Major Arterial total. Edmonds Way, or State Route 104 from Paradise Lane to Pine Street, can be fall into this category; its length is approximately half a mile. Its entire length was within city boundaries before 1990 and remained unchanged between the two periods.

[40] City of Edmonds, "Background and Inventory", *City of Edmonds Transportation Element – 200 Update* December 2002 (Table 5), 19, http://www.ci.edmonds.wa.us/CityDepartments/EngrDept/2002_Final_Transportation_Plan.pdf (accessed July 31, 2008)

Table 12: Road Lengths by ICLEI Classifications

Road Type	Miles in Edmonds	20% Reduction for 1990
Limited Access Highway	0.5	0.5 (unchanged)
Principal Arterials	22	17.6
Principal Arterials	(7.0)	
Minor Arterials	(15.0)	
Collectors and Local Streets	116.6	93.28
Collector Streets	(10.0)	
Local Streets	(106.6)	
Total	**139.1**	**110.88**

Average Daily Trips (**ADT**) data was gathered for various roads in Edmonds in 2001 and 2003. Data was first extrapolated up to 2005 and down to 2000 based on the assumption that the City of Edmonds increases in volume 1% every year.[41] This was completed so as to test how estimation methods would compare with PSRC-submitted VMT models. ADT were then generated by applying a 1% decrease in ADT to each year prior to 2000 back to 1990 (multiplying by 99% of the year prior each time), with a similar method moving forward (multiplying each year by 1.01%) to subsequent years until 2012.

When average ADT counts and road classes were entered into the CACP software, it provided a VMT of 99.2 million VMT for 1990 and 164 million VMT for 2012. These numbers were used for the transportation sector's emissions for the respective years.

Note: Although this method provided an accurate estimation of a 1% annual traffic increase until the year 2012, the method is imperfect for back-casting. The 1% decrease from year to year takes a mildly larger portion of the original sum going backward than it takes as 1% from the smaller sum going forward. However, when the 1990 totals were run forward again to the 2000 as a test, the difference to the original number never exceed .02%, a tolerable level of error.

Waste underwent a similar process in back-casting and forecasting to arrive at emissions levels. With the waste management method established, the inventory required both the character of the waste being disposed of in 1990, as well as the overall tonnage of waste being generated. One notable difference to the back-cast is the state of methane recovery at the Roosevelt Landfill in 1990. The methane recovery system currently in place was installed in June, 1999. As such, methane recovery for this year was 0% instead of latter year's recovery factor of 75%.

For a 1990 Waste characterization, there were no studies found that were particular to Snohomish County. The Washington State Department of Ecology's 1992 Waste

[41] From conversations with the lead Edmonds Transportation Engineer

Characterization Study was closest to the back-cast year, with data for the report collected from late 1990 through 1991. Part of the study was specifically partitioned out to represent the Central Puget Sound Area, whose summary was used for Edmonds' waste disposal characteristics.[42]

Table 13: Percentages for the 1990 waste characterization

Waste Type	Waste Stream Percent
Paper Products	21.1%
Food Waste	12.6 %
Plant Debris	7.0%
Wood & Textiles	15.4%
Includes Wood,	(10.51%)
& Other Organics	(4.85%)
Other	43.9%

Waste tonnage records for 1990 were incomplete, but haulers were able to supply enough data to reasonably estimate the waste tons previously generated within the city. Sound Disposal had 5 consecutive months of 1990 tonnage hauled available; records for other months were no longer available. The missing monthly data was filled in with the average rate from the supplied 5 months.

Tracking down records for Allied Waste was challenging. However, they were able to supply monthly customer numbers for 1990 but not tons of waste collected. As such, the 2000 waste tons per customer rate was used, as modified by the percentage change in waste per customer for Sound Disposal in the same period.

There was no data available for Waste Management NW at this time. First, the number of households they served was derived by applying their 2000 percentage share of houses to the 1990 number of residential housing units. This approximated customer number was then multiplied by the waste tons per customer, as averaged from Sound Disposal and Allied Waste disposal rates.

For the forecast, again a customer base and average disposal rate was needed for each hauler. The customer base was derived by applying each hauler's 2005 household share to the number of households estimated to exist in Edmonds by 2012. The estimated customer base per hauler was multiplied by the 2005 rate of waste tons per customer. Waste characterization percentiles from 2005 were carried over unchanged for 2012.

Other Emissions. In keeping with the current community inventory, back-casts and forecasts included emissions estimations from fuel sales in the Port of Edmonds Marina. It is difficult to say how future rises in fuel prices will impact fuel sales. While total fuel sale *incomes* continue to rise based on information provided by the marina, the number of *gallons sold* decreases annually. From 2003 to data provided thus far for 2008, the number

[42]Washington State Department of Ecology, "Central Puget Sound Waste Generation Summary," 1992 http://www.ecy.wa.gov/programs/swfa/solidwastedata/waste.asp (accessed July 31, 2008)

of gallons sold per years is decreasing an average of 4.97% for gasoline and 5.82% for diesel. To project the how much fuel gallons sold would decrease in the future if current decreasing rates continued, regular and diesel fuel sale totals from 2007 were multiplied by their respective decrease rates per year until the year 2012. As a whole, these figures are at 77.5% and 74.1% the total of 2007 recorded sales.[43]

Previous sales for 1990 are generated by taking the gallons sold for the year 2000 and reducing that total by the percentage of population change for Snohomish County between 1990 and 2000 as recorded by the U.S. Census. This form of estimation is advised by ICLEI when lacking alternative growth and decline rates. The Snohomish county rate is used because population gain specifically for the city would grossly exaggerate fuel changes due to 1990-2000 annexation patterns. As such, population change for overall the county is believed to be a better gauge for increasing Port use and related fuel purchases over time.

Exceptions are similar to those of the base and interim years, where the emissions from fuel use by the train and ferry are not incorporated, but some effort was made at estimating emissions resulting from fuel sales at the Port of Edmonds Marina.

R. Forecast Results

> "Continued greenhouse gas emissions at or above current rates would cause further warming and induce many changes in the global climate system during the 21st century that would *very likely* be larger than those observed during the 20th century."— *IPCC AR Report*[44]

In the year 2012, if emissions continue unmitigated, it is predicted that the City of Edmonds will be emitting approximately **182,161** metric tons of CO_2e, an increase of 8% from the year 2005 (see Table 15). The most significant gains would come from additional electricity use in the residential sector. If the city wishes to reach a 20% emissions drop below 1990 levels it will have to add these emissions to its abatement goals.

- The proportion of emissions by sector and source is predicted to be relatively the same between 2005 and 2012
- The transportation sector is predicted to still be the largest producer of greenhouse gas emissions, with gasoline and diesel fuel combustion producing 51.9% of the total community emissions.
- The residential sector is predicted to be the second-largest, producing 35.7% of the total community emissions.
- The largest single source of emissions is predicted to come from the use of gasoline and diesel fuel, producing 53.0% of all emissions when road traffic and marina fuel sales are combined.

---

[43] Port of Edmonds, "Port of Edmonds Fuel Sale History", provided by Marla Kempf, Deputy Director for the Port of Edmonds on July 30, 2008

[44] IPCC, ""Climate Change 2007: Synthesis Report" 2007, 45 http://www.ipcc.ch/pdf/assessment-report/ar4/syr/ar4_syr.pdf (accessed July 31, 2008)

- Electricity use in all sectors is expected to account for 15.9% of emissions while natural gas combustion accounted for 33.1% of community emissions.

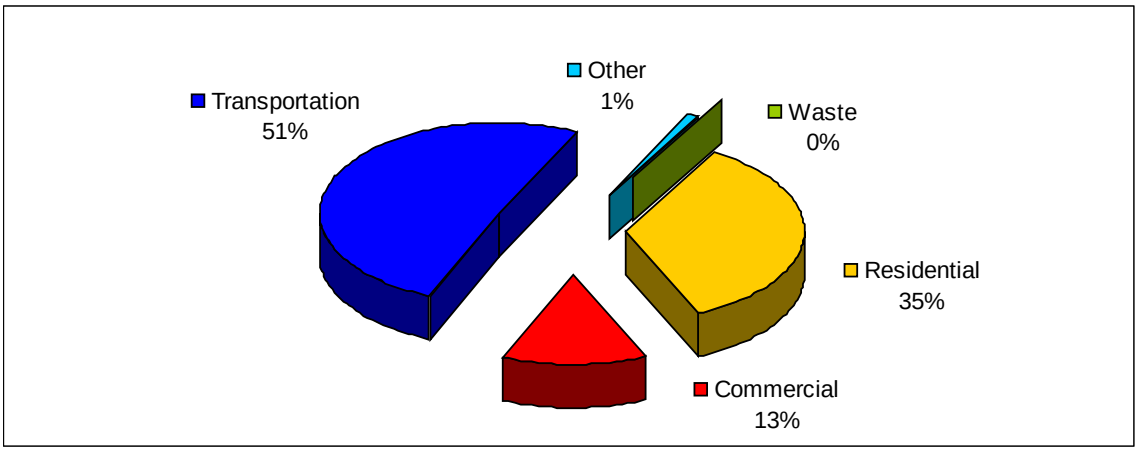
Table 14: Edmonds Estimated Community Greenhouse Gas Emissions by Sector, 2012 – Business As Usual*

Sector	Equivalent CO_2 (metric tons)	Percentage of Total	Energy Consumed (million Btu)
Residential	64,938	35.7%	1,672,869
Commercial	24,161	13.3%	710,836
Industrial	77	0%	1,366
Transportation	94,456	51.9%	1,215,694
Waste	(-3,494)	(-1.9%)	-
Other	2,023	1%	-
Total	**182,161**	**100%**	**3,600,765**

Source: CACP Model Output

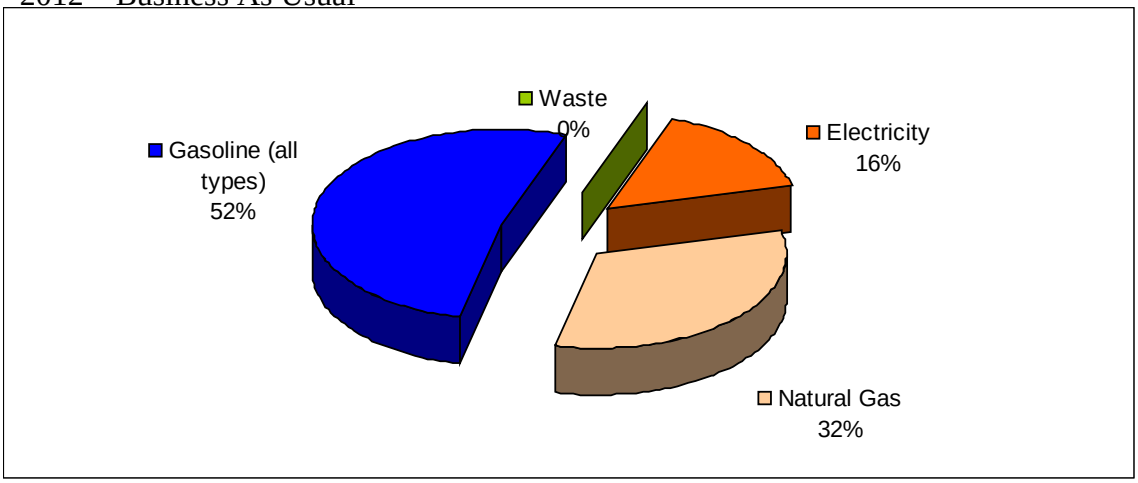
*Predicted values for the 2012 year.

Figure g: Projected Edmonds Community Greenhouse Gas Emissions by Sector, 2012 - Business As Usual



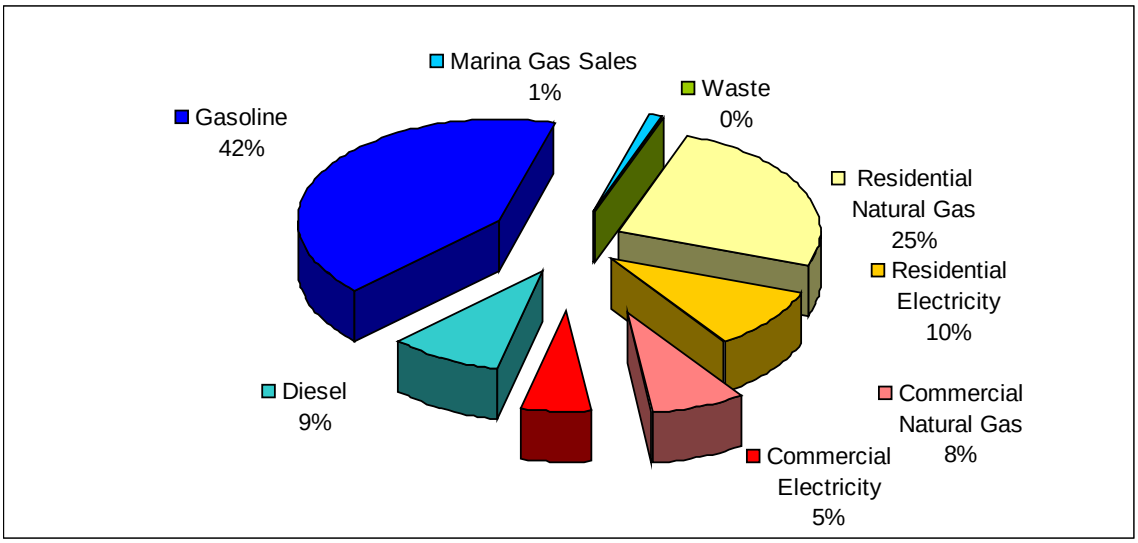
Source: CACP Model Output

Figure h: Projected Edmonds Community Greenhouse Gas Emissions by Source, 2012 – Business As Usual



Source: CACP Model Output

Figure i: Projected Edmonds Community Greenhouse Gas Emissions by Sector and Source, 2012 Business As Usual



Source: CACP Model Output

S. Comparison Between Interim and Projected Year Inventories

If current emissions continue to increase with population and other factors, it is predicted that total Edmonds emissions will increase by 8.0% during the seven year period between the interim and forecast year (see Table 15; this percentage is relatively the same for the base year as well). However, this percent change might be smaller if residential energy conservation is achieved, and increasing fuel prices lead to lower use of personal vehicles in the area.

- Residential energy emissions increased by 11.2%, at roughly the same increase rate predicted for Snohomish County as a whole. If Edmonds' electricity use grows at a slower rate than the county average, these emissions will be different than predicted.
- The commercial sector is predicted to increase emissions by 11.8% between 2005 and 2012 if Edmonds electricity use stays at the same rate as Snohomish County.
- The waste sector is predicted to have an additional decrease of 4.8% in emissions, despite predicted increases in solid waste collection, due to methane gas burning and some carbon dioxide sequestration in landfills. Please see Section F, page 17, for more information.
- Transportation emissions are expected to increase 6.1% between 2005 and 2012 due to increasing predicted traffic volumes. This does not account for changes in transportation decisions from increasing gas prices, an alternative explored further in the alternative emissions scenario discussed on page 49.

- Fuel sales of the Marina are expected to continue their trend of decreasing sales in coming year, leading to a 31.2% reduction in emissions.

Table 15: Comparison between 2005 and estimated 2012* emissions by Sector

Sector	2005 Equiv CO_2 (metric tons)	2012 Equiv CO_2 (metric tons)	Percentage Change
Total Residential	58,404	64,938	+11.2%
Total Commercial	21,602	24,161	+11.8%
Total Industrial	74	77	+4.1%
Total Transportation	89,012	94,456	+6.1%
Waste	(-3,333)	(-3,494)	-4.8%
Other	2,941	2,023	-31.2%
All Sectors	**168,700**	**182,161**	**+8.0%**

Source: CACP Model Output
*Predicted values for the 2012 year.

Please note that the percentage change in the "All Sectors" category is not the sum of "Percentage Change" across all previous rows, but the percent increase of CO_2e between 2005 and 2012 in the "All Sectors" row.

Table 16: Comparison between 2005 and estimated 2012 emissions by Sector and Source

Sector & Source	2005 Equiv CO_2 (metric tons)	2012 Equiv CO_2 (metric tons)*	Percentage Change
Residential – Electricity	14,478	46,229	+219.3%
Residential – Natural Gas	43,926	18,709	-57.4%
Commercial – Electricity	8,043	10,179	+26.6%
Commercial – Natural Gas	13,559	13,982	+3.1%
Industrial – Electricity	-	-	0.0%
Industrial – Natural Gas	74	77	+4.1%
Gasoline	73,614	77,574	+5.4%
Diesel	15,398	16,882	+9.6%
Marina Fuel Sales	2,941	2,023	-31.2%
Waste	(-3,333)	(-3,494)	-4.8%
Total	**168,700**	**182,161**	**+8.0%**

Source: CACP Model Output
*Predicted values for the 2012 year.

Please note that the percentage change in the "All Sectors" category is not the sum of "Percentage Change" across all previous rows, but the percent increase of CO_2e between 2005 and 2012 in the "All Sectors" row.

T. Back-cast Results

As stated before, the back-cast inventory for 1990 was attempted to derive a per capita emissions level, by which to estimate a greenhouse gas reduction goal for 2012. Given that Edmonds annexed over 1000 acres of land and 6,000 people between 1990 and 2000, a large portion of the overall emissions are not a net increase in carbon emissions, but the

transfer of emissions from Snohomish County to Edmonds due to additional population. However, completing the 1990 "back-cast" allowed the city to examine the per-person emissions for 1990 and 2000. A 7% reduction of 1990 per person reduction levels was then multiplied by the 2000 population to find a greenhouse gas reduction goal that balances out the effect of the annexed population. The back-cast also helped display changes in emissions concentrations, and the general increase of emissions in Edmonds over time.

In 1990 it is estimated that Edmonds was emitting about **131,167** metric tons of CO_2e.

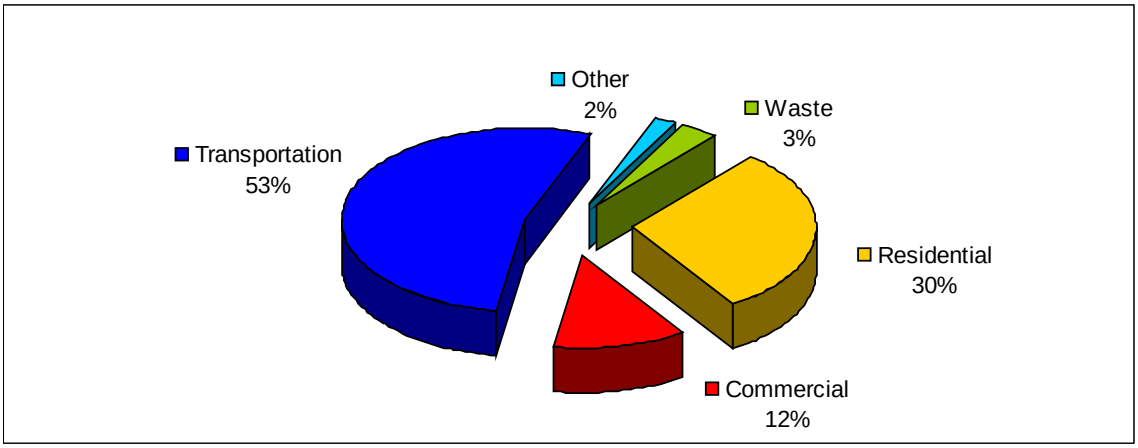
- Predictions indicate that emissions by sector and source have changed between 1990 and 2000.
- The transportation sector is estimated to have been the largest producer of greenhouse gas emissions, with gasoline and diesel fuel combustion producing 53.4% of the total community emissions.
- The residential sector is predicted have been the second-largest, producing 29.6% of the total community emissions.
- The largest single source of emissions is predicted have come from gasoline and diesel fuel, producing 55.3% of all emissions when road traffic and marina fuel sales are combined.
- Electricity use in all sectors is believed to have produced 12.1% of emissions while natural gas combustion accounted for 29.2% of community emissions.

Table 17: Estimated Edmonds Community Greenhouse Gas Emissions by Sector, 1990

Sector	Equivalent CO_2 (metric tons)	Percentage of Total	Energy Consumed (million Btu)
Residential	38,844	29.6	975,990
Commercial	15,371	11.7	428,167
Industrial	31	0%	839
Transportation	70,009	53.4	894,974
Waste	4,428	3.4%	-
Other	2,484	1.9%	-
Total	**131,167**	**100%**	**2,299,970**

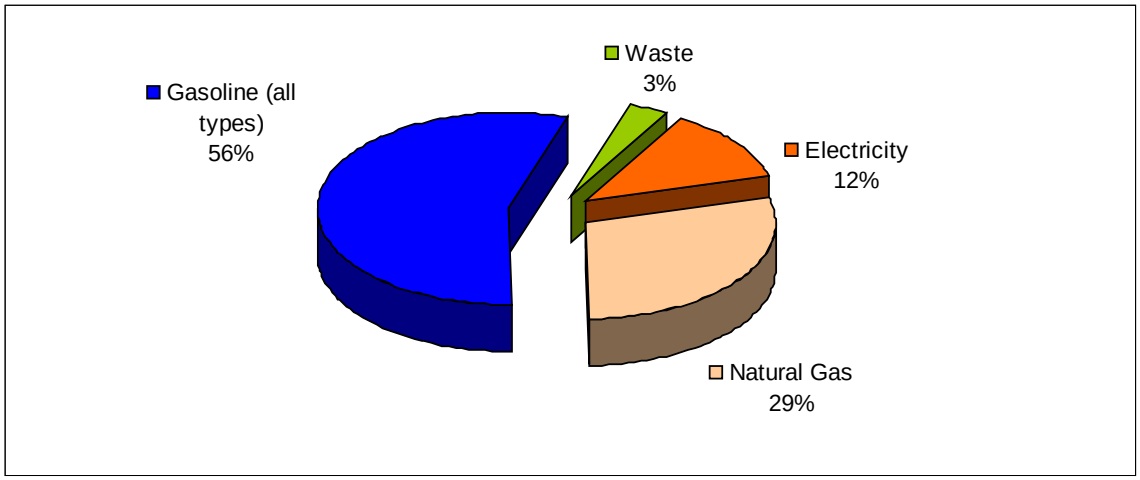
Source: CACP Model Output

Figure j: Estimated Edmonds Community Greenhouse Gas Emissions by Sector, 1990



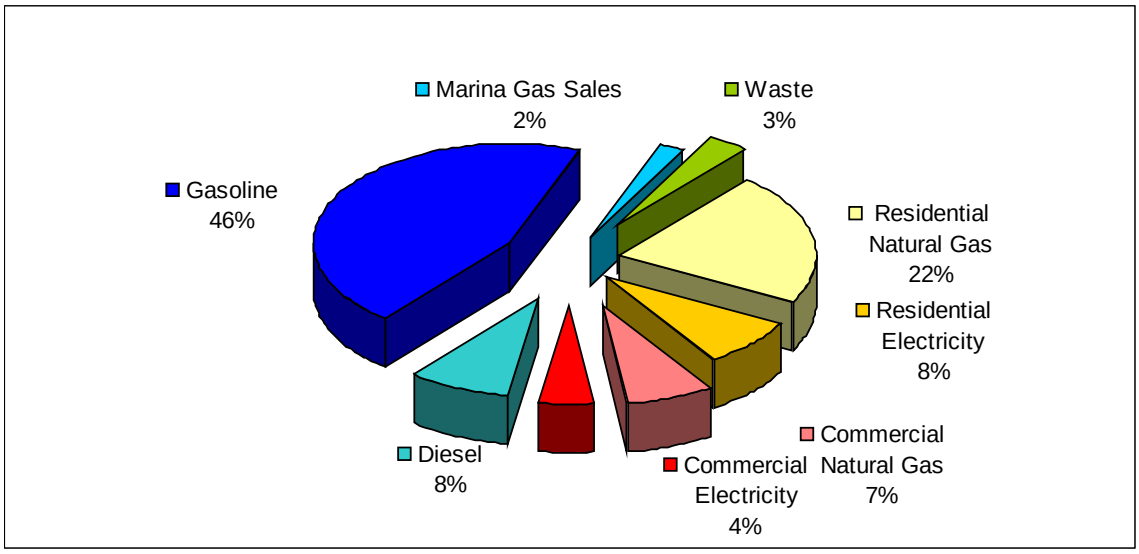
Source: CACP Model Output

Figure k: Estimated Edmonds Community Greenhouse Gas Emissions by Source, 1990



Source: CACP Model Output

Figure l: Estimated Edmonds Community Greenhouse Gas Emissions by Sector and Source, 1990



Source: CACP Model Output

U. Comparison Between the Back-cast and Inventories of Other Years

Between 1990 and 2000 total Edmonds emissions increased by 33.4% (Table 18). However, the increase is largely influenced by population gain (see Section P, page 31 for more information). As such, the annual comparisons look mostly at the changes in the shares of emissions held by various sectors. Changes in emissions between these sectors are not consistent.

- The most notable change between 1990 and 2000 is that in 1990 waste emissions were positive instead of negative, as methane flaring technology was not installed at the landfill until the late 90's. Emissions went from 3.4% to -1.4%.
- The residential sector increased 5.1% between 1990 and 2000. For 2005 and predicted 2012 levels this sector share does not show additional significant change.
- Most other sectors maintain similar percentage shares between the years overall. The commercial and transportation sectors do not show great change between 1990 and 2000, but between 1990 and 2012, the commercial sector gains a little less than 2% while the transportation decreases by about 1.5%.

Table 18: Comparison between 2000 and estimated 1990 emissions by Sector

Sector	1990 Equiv CO_2 (metric tons)	2000 Equiv CO_2 (metric tons)	Percentage Change*
Total Residential	38,844	60,611	+56.0%
Total Commercial	15,371	20,630	+34.2%
Total Industrial	31	49	+58.1%
Total Transportation	70,009	92,937	+32.8%
Waste	4,428	(-2,504)	-56.5%
Other	2,484	3,232	+30.1%
All Sectors	**131,167**	**174,955**	**+33.4%**

Source: CACP Model Output

*Percentage change inflation influenced significantly by annexed population gain between 1990 and 2000. Percentages cannot be considered the natural increase rate of resource use and emission rate per resident.

Please note that the percentage change in the "All Sectors" category is not the sum of "Percentage Change" across all previous rows, but the percent increase of CO_2e between 1990 and 2000 in the "All Sectors" row.

Table 19: Comparison of 2000 and estimated 1990 emissions by Sector and Source

Sector & Source	1990 Equiv CO_2 (metric tons)	2000 Equiv CO_2 (metric tons)	Percentage Change*
Residential – Electricity	10,294	15,727	+52.8%
Residential – Natural Gas	28,550	44,884	+57.2%
Commercial – Electricity	5,601	8,073	+44.1%
Commercial – Natural Gas	9,770	12,557	+28.5%
Industrial – Electricity	10	36	+260%
Industrial – Natural Gas	21	13	-38.1%
Gasoline	58,980	77,510	+31.4%
Diesel	11,029	15,427	+39.9%
Marina Fuel Sales	2,484	3,232	+30.1%
Waste	4,428	(-2,504)	-56.5%
Total	**131,167**	**174,955**	**+33.4%**

Source: CACP Model Output

*Percentage change inflation influenced significantly by annexed population gain between 1990 and 2000. Percentages cannot be considered the natural increase rate of resource use and emission rate per resident.

Please note that the percentage change in the "All Sectors" category is not the sum of "Percentage Change" across all previous rows, but the percent increase of CO_2e between 1990 and 2000 in the "All Sectors" row.

Table 20: Comparison between percentage share of emissions, 1990, 2000, 2012 by Sector

Sector	1990 Equiv CO_2 (percentage share)	2000 Equiv CO_2 (percentage share)	2012 Equiv CO_2 (percentage share)*
Total Residential	29.6%	34.7%	35.7%
Total Commercial	11.7%	11.8%	13.3%
Total Industrial	0%	0%	0%
Total Transportation	53.4%	53.1%	51.8%
Waste	3.4%	(-1.4%)	-1.9
Other	1.9%	1.8%	1.1
All Sectors	**100%**	**100%**	**100%**

Source: CACP Model Output
*Predicted values for the 2012 year.

Table 21: Comparison between percentage share of emissions, 1990, 2000, 2012 by Sector and Source

Sector & Source	1990 Equiv CO_2 (percentage share)	2000 Equiv CO_2 (percentage share)	2012 Equiv CO_2 (percentage share)*
Residential – Electricity	7.8%	9.0%	10.3%
Residential – Natural Gas	21.8%	25.7%	25.4%
Commercial – Electricity	4.3%	4.6%	5.6%
Commercial – Natural Gas	7.4%	7.2%	7.7%
Industrial – Electricity	0%	0%	0%
Industrial – Natural Gas	0%	0%	0%
Gasoline	45.0%	44.3%	42.6%
Diesel	8.4%	8.8%	9.2%
Marina Fuel Sales	1.9%	1.8%	1.1%
Waste	3.4%	-1.4%	-1.9%
Total	**100%**	**100%**	**100%**

Source: CACP Model Output
*Predicted values for the 2012 year.

After completing the 1990 "back-cast", per-person emission results between 1990 and 2000 are roughly equivalent, increasing from 4.27 to 4.43 in the year 2000. A 20% reduction of 1990 per-person reduction levels can then be multiplied by the 2000 population to find a greenhouse gas reduction goal that neutralizes the effect of the annexed population. Reducing the reported 1990 per capita emission level of 4.27 by 7% results in a per capita emissions reduction of 3.97 CO_2 equivalent metric tons per year. Multiplied by the city's 2000 population, and adding the additional emissions expected in Edmonds by 2012, means a reduction goal of 25,210 CO_2 equivalent metric tons, or a 2012 emissions goal of **156,875 CO_2e tons**, 13.88% below 2012's predicted emissions level, as shown in the next two tables and in the graph of Figure n on page 47.

Table 22: Reduction goal, before incorporating 2012 emissions

Emission Target Variables	**1990**	**2000**	**2012***	**Reduction goals**
Annual Emissions	131,167	174,955	182,161	
Population	30,744	39,493	41,711	
CO_2e tons per capita	4.27	4.43	4.37	
7% below per capita	3.97			3.97
Multiplied by 2000 pop		156,875		156,875
Difference between year target and actual value for 2000				**18,080**

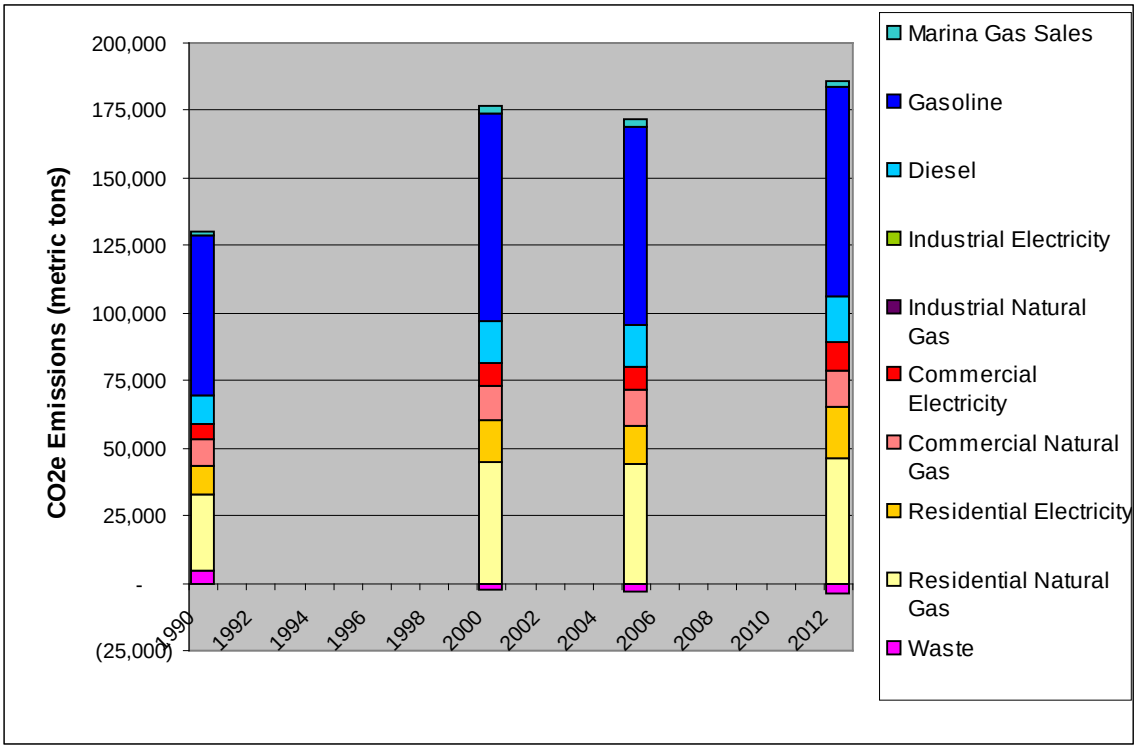
Source: CACP Model Output
*Predicted values for the 2012 year.

Table 23: Reduction goal incorporating additional 2012 emissions

	Annual	Total
CO_2e reduction goal for 2000		18,080
2000 emissions	174,955	
2012 emissions	182,161	
Difference between 2012*-- 2000		7,206
Total CO_2e reduction goal for 2012*		**25,286**

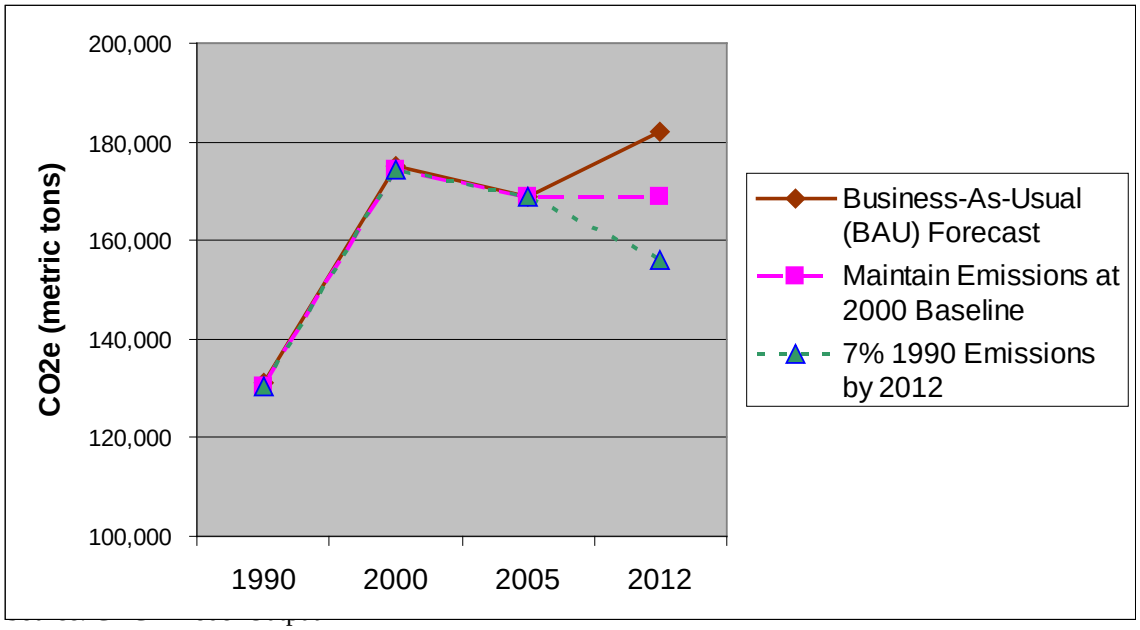
Source: CACP Model Output
*Predicted values for the 2012 year

Figure m: Edmonds Community Greenhouse Gas Emissions, 1990- 2012



Source: CACP Model Output

Figure n: Community Emissions Reductions Scenarios, 1990 - 2012



V. Biogenic Emissions

As advised by ICLEI, Edmonds accounted for its biogenic emissions separately for each of the inventory years, including forecasts and back-casts. This topic is addressed more fully on in Section F, page 14. The figures of biogenic emissions are based on the coefficient .06 short (American) carbon-equivalent tons per megawatt hour for each year as reported by the PUD.[45]

Table 24: Biogenic Emissions from Energy Consumption, all years

Year	Energy Use (KWH)	CO_2e Biogenic Emissions (tonnes) *additional to reported levels*
1990	211,233,054	11,498
2000	316,255,748	17,214
2005	299,101,126	16,280
2012	383,660,723*	20,883*

Source: CACP Model Output
*Predicted values for the 2012 year.

[45] The difference between the 2005-2006 Gross versus Net averaged coefficients, as provided by PUD.

W. eGRID Emissions for Future Reporting

As discussed in Section F, the City of Edmonds selected the utility-specific PUD coefficients to calculate electricity emissions rather than the coefficients of the surrounding eGRID region. This was done to generate an accurate city emissions profile, and to better guide local policy towards achieving real emission results. At the initiation of this inventory there was consensus among neighboring cities and ICLEI to proceed with using the utility-specific coefficients. (See Appendix A for an update on the ICLEI protocol.)

Despite Edmonds' decision, ICLEI preferred the use of eGRID coefficients for multiple reasons, among them:

1. It provides a more accurate picture of electricity consumption.

2. Average grid electricity reflects electricity sales within the grid, which sometimes activate different electricity generation plants according to seasonal and daily need.

3. It is impossible to obtain consistent, accurate, utility-specific carbon coefficients across the state or region. Utilities often only report fuel mix data, which does not accurately account for the impact of buying and selling electricity. In addition, for inventories to be comparable between cities, they require comparable sources and inputs – such as a uniform electricity database source.

4. It is not prudent to use utility-specific coefficients due to probable changes and requirements in inventory reporting that might soon be required by the state.[46]

To assist outside users in comparing emissions between cities, and to help future inventories should state or regional reporting become mandatory using eGRID figures, the following numbers were generated as an alternative set of emissions. Although this does not go into a full analysis, the numbers do provide insight both into how future emission reports might look in comparison to the current edition, and how emissions from the City of Edmonds might compare to other cities when analyzing net resource use.

Table 25: PUD versus eGRID Electricity Consumption, all years

Year	Current Electricity Emissions, PUD figures (shown as CO_2e)	Emissions when using eGRID figures (shown as CO_2e)
1990	15,905	64,295
2000	23,813	97,261
2005	22,521	124,952
2012	28,888*	160,278*

Source: CACP Model Output
*Predicted values for the 2012 year

[46] ICLEI, "Greenhouse Gas Emissions Inventory Guidance for the Puget Sound Region (*prepared for the Puget Sound Clean Air Agency)*", June 2008 DRAFT, 37

Table 26: PUD versus eGRID energy Consumption by Sector and Annual Total, all years

Year	Residential CO_2e	Commercial & Industrial CO_2e	Electricity Subtotal, CO_2e	Emissions of Other Sectors	Adjusted Total Emissions	Adjusted Per Capita
1990	*41,614*	*22,681*	**64,295**	*115,262*	**179,557**	5.84
2000	*63,575*	*33,686*	**97,261**	*151,119*	**248,380**	6.28
2005	*80,328*	*44,624*	**124,952**	*146,179*	**271,131**	6.80
2012	*103,804**	*56,474**	**153,273***	*153,273**	**313,551***	7.52*

Source: CACP Model Output

*Predicted values for the 2012 year

If eGRID numbers became mandated by the state, the appropriate emissions reduction goal, incorporating estimated increases in 2012 emissions, would rise 98,923 metric tons, or 32,775 metric tons below the 2000 year baseline.

X. Alternative Emission Predictions

Emissions predictions, by their nature, are not certain. Many inputs can disrupt previous trends and cause variables to veer in unexpected directions. A good example of this is fuel price.

Fuel prices have seen a national 50% increase in price over the last year, impacting consumer purchases in gasoline and leading more people to consider public transit. Although the current model follows a 1% increase in traffic volumes per year between 2005 and 2012, fuel prices may result in 0% growth, or even a decrease from 2005 levels. To estimate these potential alternative impacts, a 1% and 5% reduction from 2005 traffic volumes was considered to illustrate these potential divergent possibilities.

Table 27: Alternative Transportation Scenario, Modified Emissions

Scenarios	VMT	CO_2e from Transportation	Total Annual CO_2e Emissions	Reduction from 2012 Prediction	Remaining Reduction goal
Current 2012 Predictions	164	94,456	182,162	-	25,210
1% Traffic Volume reduction from 2005	151.4	86,881	174,510	7,575	17,635
5% Traffic Volume Reduction from 2005	145.3	83,392	171,021	11,064	14,146

While the percentages of 1% and 5% were selected arbitrarily, these numbers also help to show what degree of traffic reduction would be necessary to impact CO_2e reductions.

Part V: Next Steps

> "Delayed emission reductions significantly constrain the opportunities to achieve lower stabilization levels and increase the risk of more severe climate change impacts" – *IPCC AR Report*[47]

Y. Reflection

The City of Edmonds has a very low level of carbon emissions as a city. While the emissions level is logical when considering the variables of transportation and electricity, it is also evident that Edmonds' low emissions are the result of luck – of actions taken by entities outside the city's control.

As a whole, Edmonds compares favorably to other cities across the nation and even in the Puget Sound region due to the inputs of electricity and transportation. ICLEI staff noted that the city's per-capita emissions of 4.4 metric ton per person are about 1/4 of US overall per-capita emissions. Even an adjusted eGRID per capita of 6.8 metric tons in 2005 is still half of the average US emission level. This figure makes sense when Washington's regional electricity emission ratio of 671 pounds of CO_2e per megawatt hour of electricity is compared to the almost-doubled national average of 1,360 pounds of CO_2e per megawatt hour. In addition, the city has less energy consumption due to a notable lack of industrial energy use and a temperate climate requiring less air conditioning and heating services. The city's general Vehicle Miles Traveled (VMT) of 11 mi/person/day/ is also low, hovering at about 1/2 the national average. However, as stated in section F on page 17, this VMT is not how much people drive to or from the city but are driving within its boundary. Edmonds is not located in the path of major traffic corridors and has a more limited freeway exposure, which helps to explain the reduced transportation emissions.

When considering these factors, it becomes more apparent that Edmond's low emissions levels are very much the product of fortuitous circumstance more than choice. This does not mean that citizen and government actions have not contributed to lower emissions levels, or that Edmonds pays less attention than other cities to environmental concerns. However, the lower emissions of the city cannot be claimed as evidence of greater environmental concern or precaution, because the lower emissions largely result from situations beyond the city's control.

Low emissions in Edmonds are due partially to the type of VMT measurements advised by ICLEI and largely from the benefits of a utility that independently selected low-emission energy sources. Because of the advised VMT inputs, this report does not address emissions resulting from commuting beyond the Edmonds city limits, which are likely significant levels of emissions when compared to other areas, as outlined in section F. Instead, our commuter emissions are being claimed by other cities, who are counting the vehicle miles of *our* commuters passing *through* their cities. In addition, PUD uses green energy that other utilities can not then use; our emissions are not necessarily due to conservation, which would allow a larger populace to use more emissions free energy. In

[47] IPCC, "Climate Change 2007: Synthesis Report" 2007, 66, http://www.ipcc.ch/pdf/assessment-report/ar4/syr/ar4_syr.pdf (accessed July 31, 2008)

both transportation and energy concerns, the City of Edmonds' image benefits from the choices of others.

These facts provide perspective on how to interpret the results of this inventory. When compared to other cities, it appears that Edmonds is impacting the environment less or that it might be less important for the city to act on climate issues because its relative emissions are so low. Other entities, however, are potentially assuming an emissions burden that Edmonds would otherwise claim. In this light, the actions of Edmonds can be every bit as helpful as the actions of other cities, and its reduction goal can potentially carry just as much impact as the larger reduction goals of other cities.

Z. Conclusions

This study shows that a reduction goal of 25,286 metric tons for 2012 is appropriate for the City of Edmonds, with a target of 156,875 CO_2e tons emitted for 2012 or less.

By passing a resolution, setting reduction goals and completing a greenhouse gas inventory, the City of Edmonds has taken its first steps towards reducing its climate impact. In order to meet the reduction goals laid out in Resolution 1129, however, Edmonds must figure out what actions are necessary to reduce its GHG emissions to 7% below 1990 levels by 2012. This ambitious goal is reachable, but requires immediate, decisive action. First and foremost is the need to complete and implement a citywide Climate Action Plan. This could be done with the aid of additional assistance from ICLEI and the use of the CACPS software, which helps predict emissions reductions based on information on proposed city policies.

As a relatively small contributor to total emissions, actions to reduce municipal emissions may have a limited impact on Edmonds' overall community emissions levels. However, municipal action has strong symbolic value and demonstrates leadership that extends beyond the magnitude of emissions actually reduced. As such, it is prudent to investigate how to reduce emissions resulting from municipal operations parallel to reducing emissions from the city as a whole.

Given that overall energy use results in few emissions when compared to other sectors, initiatives that target transportation issues and residential natural gas use, such as increasing insulation to reduce heating and cooling costs, will likely have the largest probability of achieving the reduction targets. However, if mandates for future emission reductions require the use of electricity as calculated by the eGRID, emission reduction targets could be much larger, and electricity conservation could be of great importance. In addition, energy conservation will make more emissions-free energy available to others, and contribute towards reduction goals for the state. The various options for addressing emissions reductions through policy would best be addressed through future study and interaction with the City of Edmonds Climate Protection committee.

Appendix A

Community Greenhouse Gas Emissions Inventory Protocol

Coming soon from ICLEI:
A national standard for measuring greenhouse gas emissions across an entire city, county, town, or other jurisdiction.

Why a National Community Protocol is Needed

Local governments, supported by state and federal agencies, constituents and key stakeholders, are increasingly embarking on a path to create policies that will reduce emissions from the activities of their residents, businesses, and visitors. The emissions reduction process begins with identifying primary sources of emissions, and with quantifying the scale of emissions from these sources.

Establishing standards for community-scale inventories will ensure consistency and quality of inventories; allow for accurate monitoring of progress against emissions targets; and provide standard guidance as local governments pursue environmental review, inventory certification and other relevant processes in their day-to-day operations. In short, a national standard will be the basis for all future climate actions, and will help all actors address the challenge of climate change more effectively.

To that end, the Community Protocol will:

- Identify all major and relevant minor sources of emissions to be included in a community-scale greenhouse gas emissions inventory.
- Establish a standard emissions inventory boundary.
- Identify best practice and alternative methods for quantifying these emissions.
- Provide a standard reporting framework as well as additional guidance for reporting emissions to the media, policymakers, and other relevant parties (this may include guidance on participation in carbon markets).
- Provide best practice data sources for activity data and emission factors.
- Provide direction on conducting emissions inventories that responds directly to the opportunities and challenges faced by local governments. (Possibly as a separate document).
- Identify the context of emissions quantification (e.g. inventory purpose, regulatory framework for emissions inventories).

Timeline for Community Protocol Development Process

Kick-off: June 2010

Steering and technical committee meetings: July 2010 through January 2011

Public comment: January 2011 – April 2011

Expected final release: **April 2011**

Appendix B - Common Acronyms Used in this Report

ADT – average daily trip

C & D – construction and demolition

CACP – Clean Air and Climate Protection

CCP – Cities for Climate Protection

CO_2e – carbon dioxide equivalent

eGRID – Emissions & Generation Resource Integrated Database

EPA – Environmental Protection Agency

GHG – greenhouse gas

ICLEI – International Council for Local Environmental Initiatives

IPCC – Intergovernmental Panel on Climate Change

LED – light-emitting diode

MWh – megawatt hour

NEMS – National Energy Modeling System

OFM – Office of Financial Management

ppb – parts per billion

PSE – Puget Sound Energy

PSRC – Puget Sound Regional Council

PUD – Public Utility District

VMT – vehicle miles traveled