2012 Community & Local Government Greenhouse Gas Emissions Inventory

CITY OF SHORELINE

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Credits and Acknowledgements

The City of Shoreline 2012 Community & Local Government Greenhouse Gas Emissions Inventory was conducted through the collaborative efforts of the following City of Shoreline staff, Cascadia Consulting Group, and other organizations, including considerable assistance from the International Council for Local Environmental Initiatives (ICLEI).

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Introduction

The City of Shoreline recognizes that greenhouse gas emissions from human activity are catalyzing profound changes in long range climate and short term weather, both of which pose substantial risks to the future health, well-being, and prosperity of our community. In response, the City took action to understand the sources of these emissions in Shoreline through the completion of a greenhouse gas (GHG) emissions inventory for the year 2009. This inventory established a baseline for comparison with future inventories, in order to evaluate the success of our climate protection efforts over time. Calculating GHG emissions depends upon numerous assumptions, and it is limited by the quantity and quality of available data. With this in mind, it is useful to think of any specific number in this report as an approximation of reality, rather than an exact value. The current inventory of GHG emissions in 2012, presented here, offers a profile of emission trends within Shoreline.

Enhancing Shoreline's natural environment, community, and ultimately the Puget Sound region, are of great importance to the City and its leadership. On April 24, 2006, the City Council authorized Mayor Ransom to sign the U.S. Mayors Climate Protection Agreement. One of the City Council's goals in 2007 was "to create an environmentally sustainable community." In 2008, the City's first Environmental Sustainability Strategy was developed to build on existing efforts toward sustainability, expand into new areas deemed critical to a viable community, provide leadership in the region, and create the Forevergreen website with indicators to track our success.

One of the City Council's goals for 2012-2014 was to improve Shoreline's utility, transportation, and environmental infrastructure, while continuing to implement the City's Environmental Sustainability Strategy and Tree City USA initiatives. In addition, the City recently developed a Climate Action Plan that established specific emission reduction targets and suggested actions to reach those goals. The City has multiple opportunities to reduce GHG emissions, both through local government operations and by inspiring action throughout the community. This and future inventories support the long-term efforts of Shoreline to protect our climate, by providing current data that can be used to evaluate and fine-tune our actions, in order to meet our goals here, at home.

ICLEI's Climate Mitigation Program

To assist jurisdictions in developing benchmarks that result in the implementation of an effective Climate Action Plan, ICLEI provides the following 5 Milestones (see Figure 1, right):

1: Conduct a baseline emissions inventory and forecast of local greenhouse gas emissions;
2: Develop a Climate Action Plan for reducing emissions;
3: Establish a greenhouse gas emissions reduction target;
4: Implement the Climate Action Plan; and,
5: Monitor and report on progress.

The City has completed Milestone One, through its 2009 baseline inventory, as well as a second emissions inventory in 2012 to measure trends over the intervening years. In addition, the City's Climate Action Plan will soon be adopted, thus accomplishing Milestones 2, 3, and 4 by the end of 2013. These steps provide a foundation for future work to reduce emissions in Shoreline.

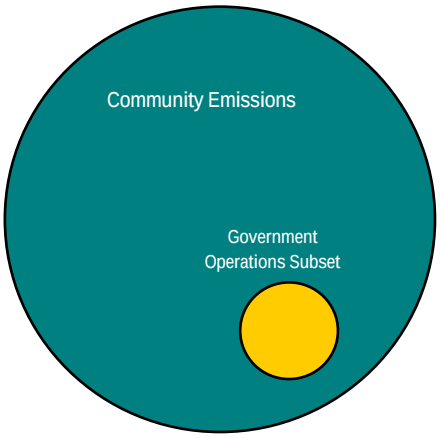
Understanding a Greenhouse Gas Emissions Inventory

The first step toward achieving tangible greenhouse gas emission reductions requires identifying baseline levels and sources of emissions in the community. Standard processes of accounting for emissions have been developed, to which this inventory adheres. For this portion of the inventory, the emissions from government operations are a subset of the community inventory, as illustrated by Figure 2 (right). For example, data on commercial energy used in the community includes energy consumed by municipal buildings, and estimates of community vehicle miles traveled include miles driven by municipal fleet vehicles. By analyzing emissions in this manner, the City of Shoreline can understand and reduce its own impact within the community and serve as a model to the community.

Figure 1: ICLEI's 5 Milestones

Source: Adapted from the City of Pittsburgh 2005 Greenhouse Gas Inventory

Figure 2: Community vs. Municipal Inventory



Source: ICLEI

Table 1: Greenhouse Gases

Greenhouse Gas	Chemical Formula	Global Warming Potential
Carbon Dioxide	CO_2	1
Methane	CH_4	21
Nitrous Oxide	N_2O	310
Hydrofluorocarbons	Various	43-11,700
Perfluorocarbons	Various	6,500-9,000
Sulfur Hexafluoride	SF_6	23,900

Greenhouse gas emissions are commonly aggregated and reported in terms of equivalent carbon dioxide units, or CO_2e. This standard is based on the Global Warming Potential (GWP) of each gas, which is a measure of the amount of warming a greenhouse gas may cause, measured against the amount of warming caused by carbon dioxide (see Table 1, previous page, for the GWPs of the commonly occurring GHGs). Converting all emissions to equivalent carbon dioxide units allows for the consideration of different GHGs in comparable terms. For example, since methane is twenty-one times more powerful than carbon dioxide on a per weight basis in its capacity to trap heat, one metric ton of methane emissions is equal to 21 metric tons of carbon dioxide. In this report, all figures are reported in metric tons of carbon dioxide equivalent greenhouse gases ($MTCO_2e$).

Evaluating Greenhouse Gas Emissions

In order to quantify these emissions, it is essential to identify emissions Sources, and in order to analyze this data, it is broken down into categories of both Scopes and Sectors, as described below.

Greenhouse Gas Emissions by Source

Emissions are created through activities, such as the burning of fossil fuels for transportation, which introduce large amounts of carbon dioxide and other greenhouse gases into the atmosphere. These emissions-producing activities, or fuels, are referred to as Sources.

Quantification Methods and Calculations

Data for a GHG inventory is gathered according to Source, and then emissions are calculated from that raw data. In this inventory, emissions were calculated by using activity data and emissions factors. To calculate emissions, this basic equation is used: *Activity Data x Emissions Factor = Emissions*

Activity data refer to the measurement of energy use or other greenhouse gas-generating processes, such as fuel consumption by fuel type, metered annual electricity consumption, and annual vehicle miles traveled.

Known emissions factors are used to calculate equivalent quantities of emissions. Emissions factors are usually expressed in terms of emissions per unit of activity data (e.g. pounds CO_2/kWh of electricity). Table 2, below, provides an example of common emissions calculations that use this formula.

Table 2: Basic Greenhouse Gas Emissions Calculations

Activity Data	Emissions Factor	Emissions
Electricity Consumption (kWh)	**CO_2 emitted/kWh**	**CO_2 emitted**
Natural Gas Consumption (therms)	**CO_2 emitted/therm**	**CO_2 emitted**
Gasoline/Diesel Consumption (gallons)	**CO_2 emitted /gallon**	**CO_2 emitted**
Vehicle Miles Traveled	**CH_4, N_2O emitted/mile**	**CH_4, N_20 emitted**

In order to convert all of the energy usage data to equivalent emissions for this inventory, the majority[1] of the data was entered into ICLEI's Clean Air and Climate Protection 2009 (CACP 2009) software, which determines emissions by combining activity data (energy consumption, waste generation, etc.) with verified emissions factors. Although the software provides governments with a sophisticated and useful tool, calculating emissions from energy use with precision is difficult. As stated previously, calculating GHG emissions depends upon

numerous assumptions, and it is limited by the quantity and quality of available data. With this in mind, it is useful to think of any specific number generated by the CACP 2009 software as an approximation of reality, rather than an exact value.

Greenhouse Gas Emissions by Scope

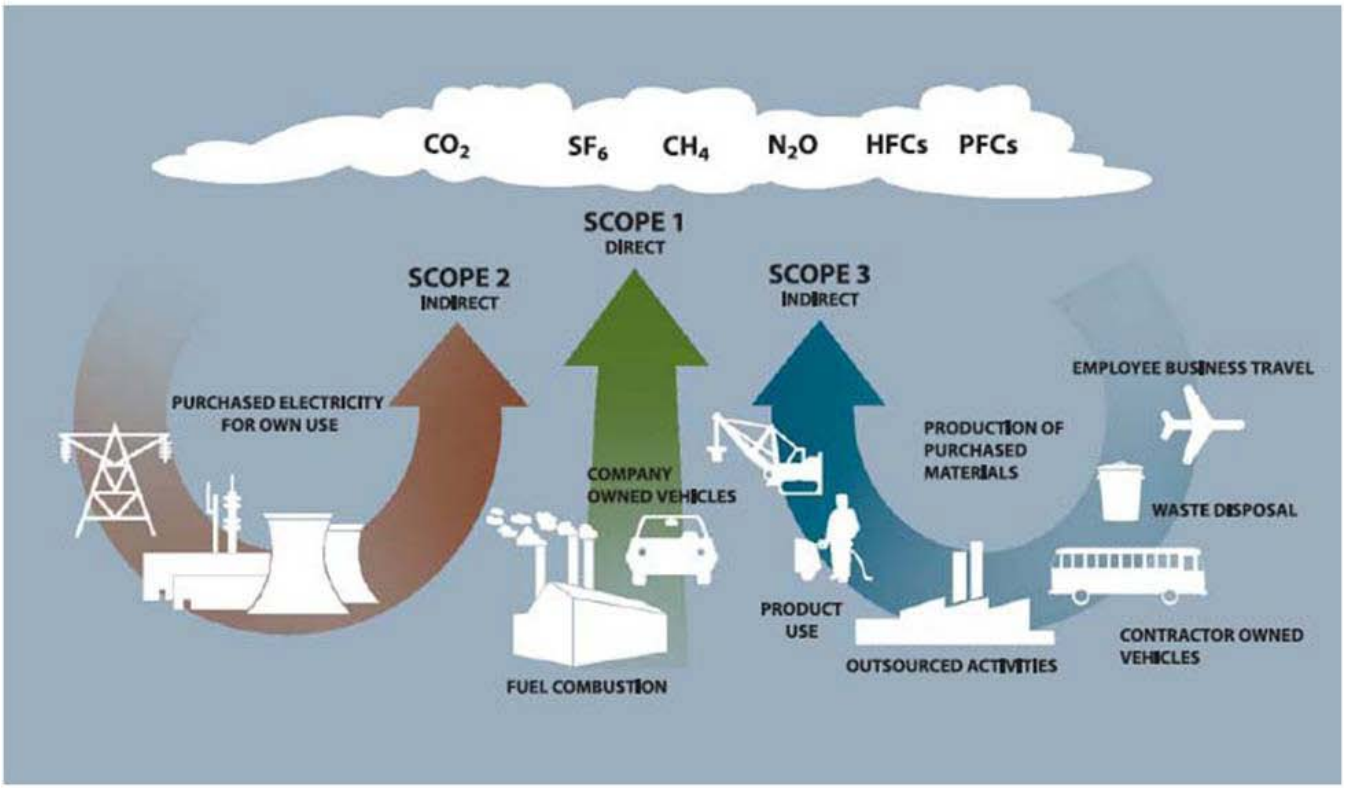
Emissions Sources are further categorized as direct or indirect emissions – Scope 1, Scope 2, or Scope 3. To prevent the double counting of emissions for various categories, such as electricity use and waste disposal, the Scopes framework is used to report GHG emissions at the local level. Three emission Scopes for both the community and municipal inventories are included in the framework:

Scope 1: All direct emissions from sources located within the boundary of the local government, such as vehicle fuel or natural gas combustion.

Scope 2: Indirect emissions associated with the consumption of purchased or acquired electricity, steam, heating, and cooling. Scope 2 emissions occur as a result of activities that take place within the boundary of the local government, but that rely upon emissions-producing processes located outside of the government's jurisdiction, which are owned or controlled by another entity.

Scope 3: All other indirect or embodied emissions not covered in Scope 2, such as emissions from up-stream and downstream activities that occur as a result of activity within the local government's boundary, emissions resulting from the extraction of and production of purchased materials and fuels, contracted services, and waste disposal. For example, municipal paper usage and employee commuting both qualify as Scope 3 emissions.

Figure 3: Scopes and Sources



Source: World Resources Institute (WRI) / World Business Council for Sustainable Development (WBCSD) Greenhouse Gas Protocol Corporate Standard, Chapter 4 (2004)

Scope 1 and Scope 2 sources are the most essential components of a GHG analysis, as these Sources are typically the most significant in scale, are directly under the control of local governments, and are the most easily affected by policy-making.

Local governments typically have indirect control over Scope 3 emissions. For example, Shoreline has very little control over the pulp mill that manufactures the paper that the City uses, yet the City still bears a level of responsibility for these emissions, as the demand for and use of paper affects the amount of emissions produced.

Greenhouse Gas Emissions by Sector

In addition to categorizing GHG emissions by Source and Scope, this inventory examines emissions by Sector. Many local governments find a Sector-based analysis more relevant to policy-making and project management, as it assists in formulating Sector-specific GHG reduction measures and Climate Action Plan components. This inventory evaluates community and government emissions by the Sectors listed in Table 3, below.

Table 3: Community and Government Sectors

Community	Government
Residential Energy	Buildings & Facilities
Commercial Energy	Vehicle Fleet
Industrial Energy	Streetlights & Signals
Transportation	Employee Commute
Solid Waste	Paper Use

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Community Greenhouse Gas Emissions Inventory Results

Community Greenhouse Gas Emissions by Scope

There are numerous items that can be included in a community-scale emissions inventory, as demonstrated in Table 4. This inventory includes scope 1 and 2 sources from the following **sectors**:

- Residential Energy
- Commercial Energy
- Industrial Energy
- Transportation
- Solid Waste*

Within these sectors, the following **energy and emission sources** are included:

- Electricity
- Natural Gas
- Heating Oil
- Gasoline
- Diesel

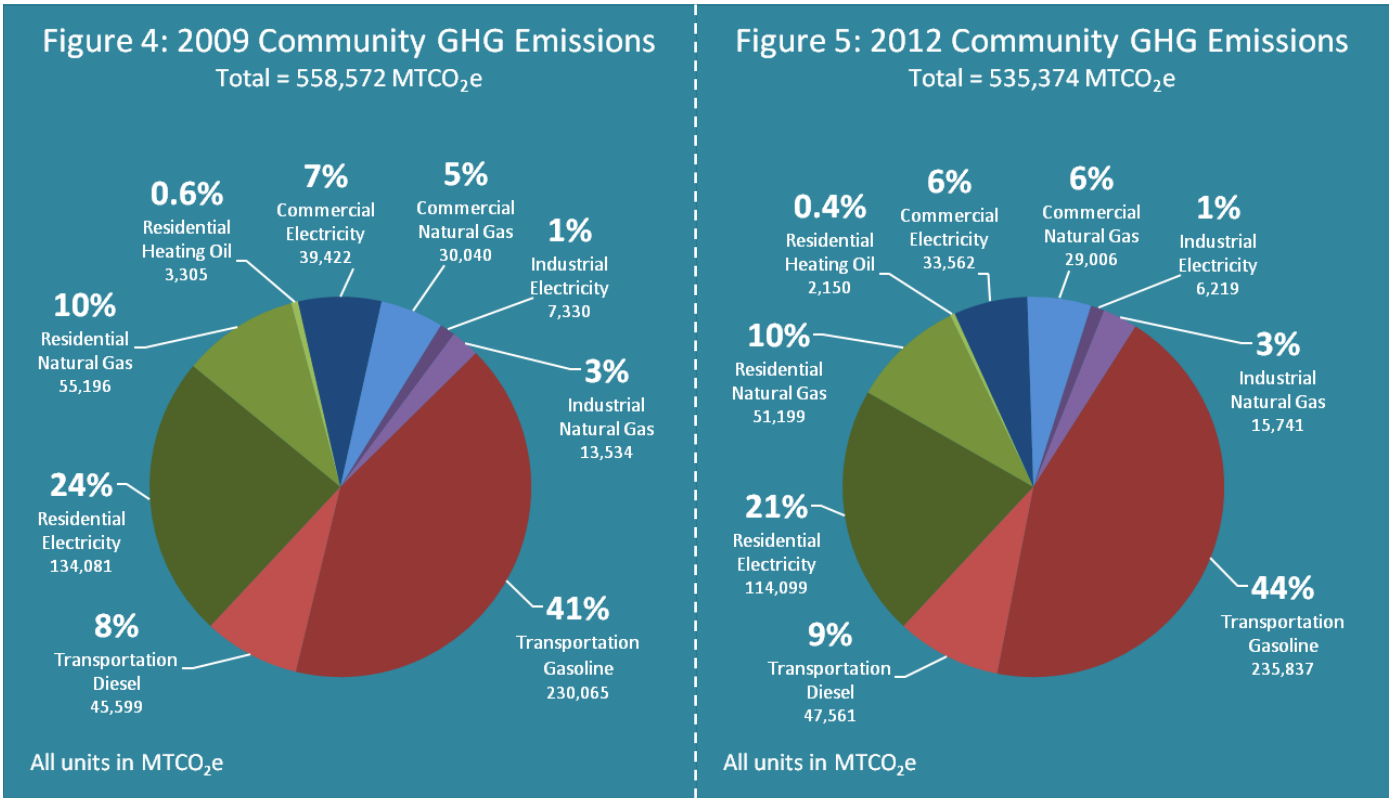
Table 4: Community Greenhouse Gas Emissions per Scope, Sector, and Source in 2012 ($MTCO_2e$)

Sector	Scope 1			Scope 2			TOTALS	
	Energy / Emissions Source	$MTCO_2e$	% of Scope 1 CO_2e	Energy / Emissions Source	$MTCO_2e$	% of Scope 2 CO_2e	Total $MTCO_2e$	% of Total CO_2e
Residential	Natural Gas & Heating Oil	53,349	14%	Electricity	114,099	74%	167,448	31%
Commercial	Natural Gas	29,006	8%	Electricity	33,562	22%	62,568	12%
Industrial	Natural Gas	15,741	4%	Electricity	6,219	4%	21,960	4%
Transportation	Gasoline & Diesel	283,398	74%				283,398	53%
Total $MTCO_2e$	**381,494**			**153,880**			**535,374**	
% of Total CO_2e	**71%**			**29%**				

*Solid Waste emissions are not included in this table or in the totals in the following sections, as their net emissions are in the negative, due to carbon sequestration and sinks. More information is provided in the Solid Waste section of the report (pages 17-18).

Total scope 1 and 2 GHG emissions for the community of Shoreline were approximately 535,374 metric tons of carbon dioxide equivalent greenhouse gases ($MTCO_2e$) in the year 2012. Emissions from scope 3 sources were not included in the community-level inventory. As shown in Table 4 and illustrated in Figure 5 below, scope 1 emissions are by far the largest share (71%) of Shoreline's community emissions, with scope 2 (29%) constituting the remainder.

Figure 4, below, illustrates the emissions composition measure in Shoreline's baseline inventory in 2009[2], while Figure 5 shows the 2012 emissions inventory composition.



As shown in Table 4 and Figure 5, above, the largest percentage of scope 1 emissions in 2012 came from the Transportation sector (74%). The Transportation Sector emissions are the result of diesel and gasoline use on local roads and on the State highways located within Shoreline city limits. The majority of the remainder of scope 1 emissions was caused by natural gas combustion in Shoreline homes, businesses, and industrial sites (19%), with just a small portion caused by heating oil consumption (0.4%).

Seventy-four percent of 2012 scope 2 emissions were generated through electricity consumption by the Residential sector (Table 4, previous page, and Figure 5, above). The remaining 26 percent of Shoreline's scope 2 emissions came from electricity consumption by both the Commercial and Industrial sectors within City boundaries. As noted in the general description of scope 2, the actual emissions from these activities were generated outside of the City, i.e. at the source of electricity generation.

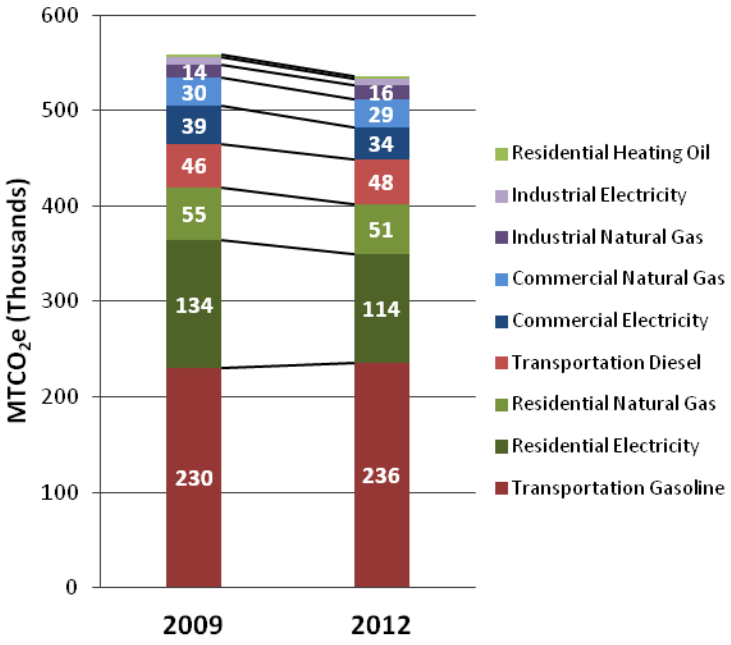
Emission Trends

The amount of overall community emissions has decreased by 4% (23,198 $MTCO_2e$) since the City conducted its baseline inventory in 2009, as seen in Figure 6 (right). Community emissions were dominated by transportation and electricity use, which collectively account for over 80 percent of community emissions.

Consequently, between 2009 and 2012, emissions decreased from 11 to 10 $MTCO_2e$ per capita.

As visible in Table 4 and Figure 2 (above), Figure 6 (right), and Figure 7 (below), emissions from almost every sector and source have decreased, with the most significant exception being from transportation gasoline and diesel use.

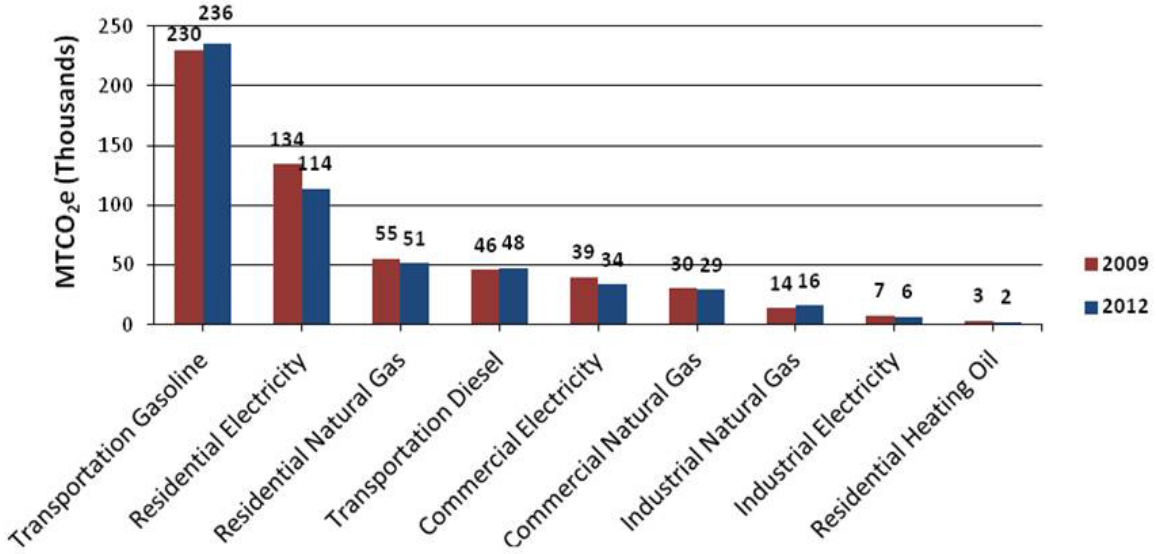
Figure 6: Community Emissions Trends



Community Greenhouse Gas Emissions by Sector and Source

The community of Shoreline, across scopes 1 and 2, emitted approximately 535,374 metric tons of CO_2e in the year 2012. In addition to considering emissions via scopes, we can also focus specifically on each sector, with scopes and sources aggregated by sector.

Figure 7: Community GHG Emissions

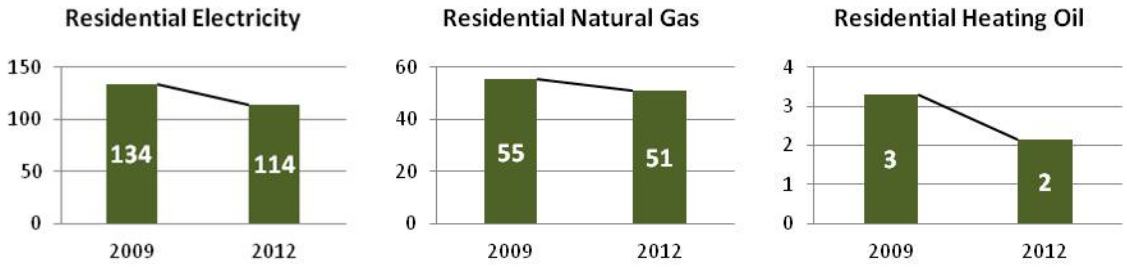


Residential Energy

The Residential sector constituted 31% of Shoreline's emissions in the year 2012. Overall emissions from the Residential sector have decreased by 13% since 2009, with emissions from electricity use decreasing by 15%, natural gas decreasing by 7%, and heating oil decreasing by an estimated[3] 35%.

Figure 8: Residential Emissions by Source

All units in thousands $MTCO_2e$

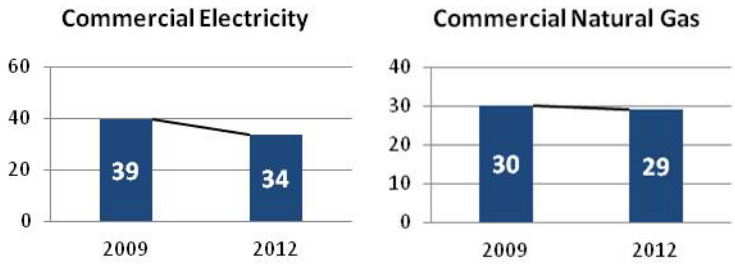


Commercial Energy

The Commercial sector made up 12% of Shoreline's total 2012 emissions; since 2009, that portion has decreased by 10%, with emissions from electricity decreasing by 15% and natural gas decreasing by 3%.

Figure 9: Commercial Emissions by Source

All units in thousands $MTCO_2e$

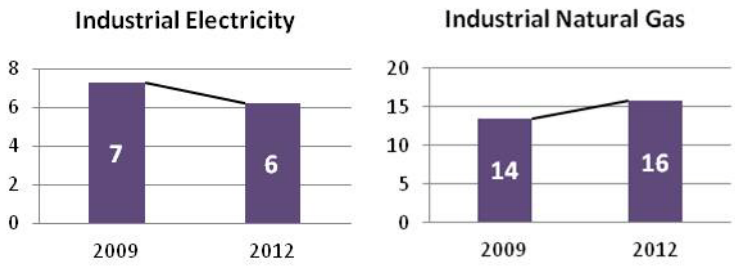


Industrial Energy

The Industrial sector represented just 4% of Shoreline's total emissions in 2012, and while emissions from industrial electricity use have decreased by 15% since 2009, overall emissions from the Industrial sector have increased by 5% since 2009, with natural gas emissions increasing by 14%. This may be due to decreasing natural gas rates, which could be driving a rise in natural gas usage over electricity.

Figure 10: Industrial Emissions by Source

All units in thousands $MTCO_2e$

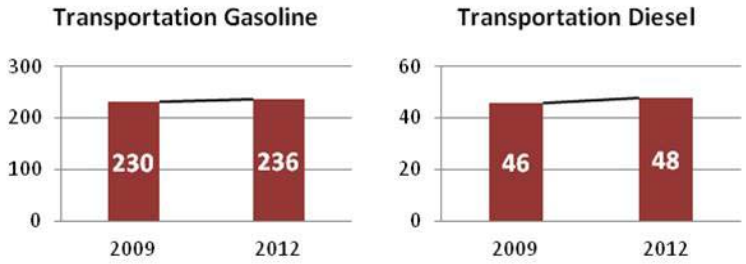


Transportation

The Transportation sector constituted 53% of Shoreline's emissions in the year 2012. In order to calculate emissions from transportation, the annual vehicle miles traveled (VMT) is measured, both for freeway and non-freeway roads. It is then converted into $MTCO_2e$, broken down by fuel type. Since 2009, overall emissions from the Transportation sector have increased by 2.7%, with emissions from gasoline increasing by 2.5% and diesel emissions increasing by 4%.

Figure 11: Transportation Emissions by Source

All units in thousands $MTCO_2e$

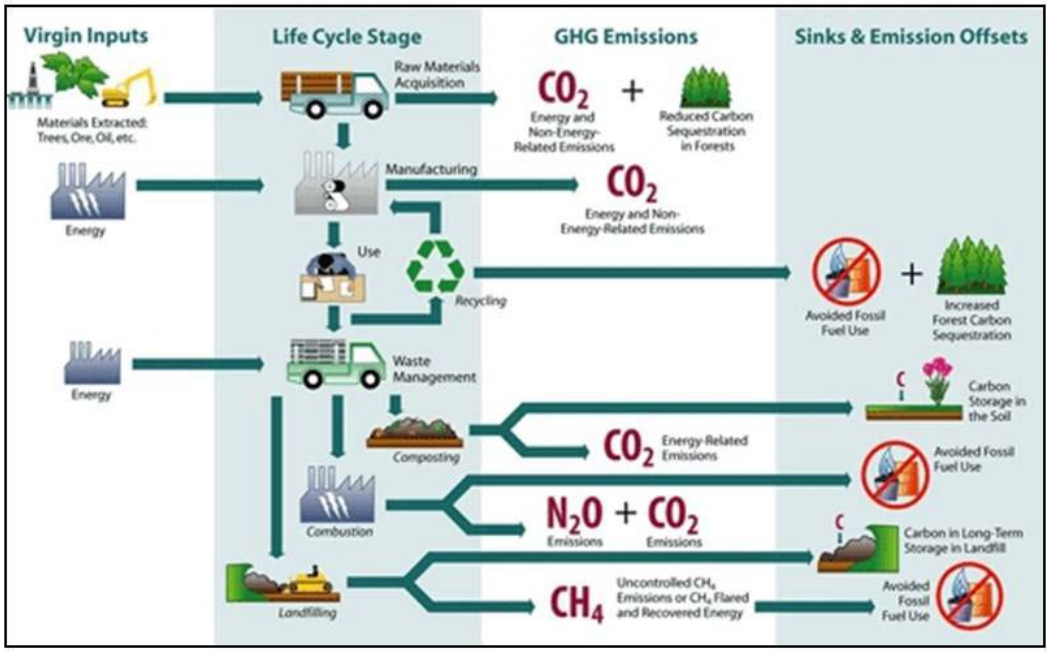


Defined by road type, non-freeway VMT have increased by 3.7%, while freeway VMT have increased by 4.5%.

Solid Waste

As stated above, emissions from solid waste were not factored into the totals for Shoreline's emissions inventories, as the net $MTCO_2e$ from solid waste was negative[4]. This is due to carbon sequestration, which is defined as the process of capture and long-term storage of atmospheric carbon dioxide (CO_2). This occurs through "carbon sinks", such as in soil, where carbon's potential escape as GHG emissions is averted. Carbon emissions are also avoided through recycling and reusing products. For details, see Figure 12.

Figure 12: Solid Waste Life Cycle



Source: United States Environmental Protection Agency

Although these carbon sinks exist, and Shoreline's solid waste emissions were calculated to be negative, the City would like to emphasize the continued importance of reducing waste, reusing or recycling items, and composting organics, as landfill space is not infinite. If the landfill reaches its maximum capacity, solid waste will need to be transferred elsewhere for disposal. This transport would likely be on a train, which would produce additional emissions and potentially higher rates for disposal.

Shoreline's community has been successful in the past few years on this front. Overall solid waste output has decreased by 3% since 2009; community garbage output decreased by 10%; community recycling increased by 2%; and community composting increased by 12.5%, as illustrated by Figures 13 and 14.

Figure 13: Total Solid Waste

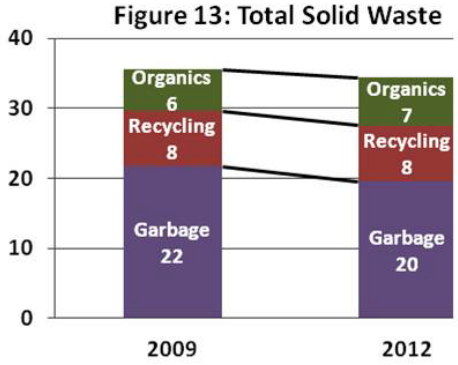
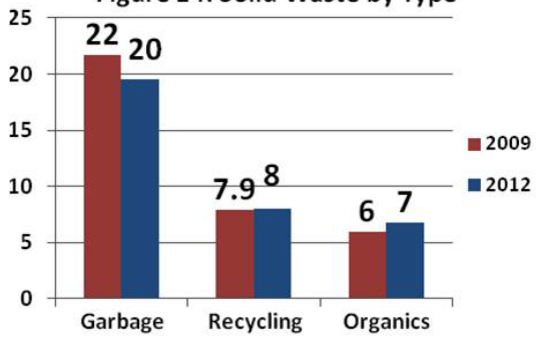


Figure 14: Solid Waste by Type



All units in thousands of tons

Water Consumption

In addition to sources of GHG emissions, the City of Shoreline has collected data on water consumption from 2010 through 2012. While water does not contribute to emissions, it is an important aspect of resource conservation, one of the categories emphasized in the Sustainability Strategy. Since 2010, water usage has increased by 3.3%, as seen in Figure 15, below.

Table 5: Seattle Area Rainfall (in inches)

As measured by the gauge at Sea-Tac Airport

Average	2010	2011	2012
37.49	46.99	36.40	48.26

When observing water usage, it is important to consider rainfall for the period of time being analyzed, as the need for irrigation increases during dry periods. For the years 2010-2012, 2011 displayed both the lowest precipitation and water use in Shoreline (see Table 5). Water usage in 2011 was 6% lower than in 2012, yet rainfall was nearly 25% lower in 2011 than 2012. Taking a closer look at the data, both 2010 and 2012 saw a much more dramatic drop in rainfall between the spring and summer than average, and a subsequent rise in the fall. This explains the increased water usage during these wetter years; with drier summers, residents are using more water for their lawns and gardens. As for the reason behind the unusual rainfall, climate change exaggerates weather patterns and causes extreme weather events, so it may be the cause behind these emerging patterns.

Figure 15: Water Usage Trends

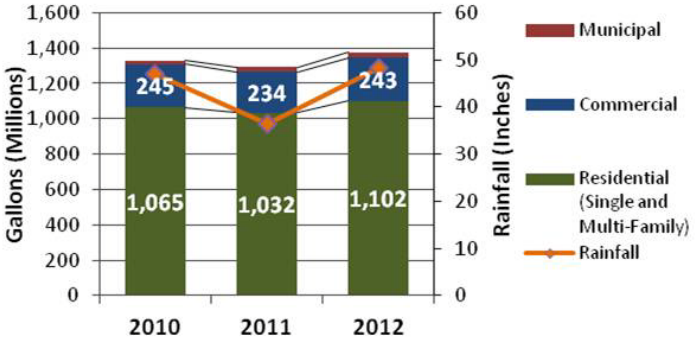
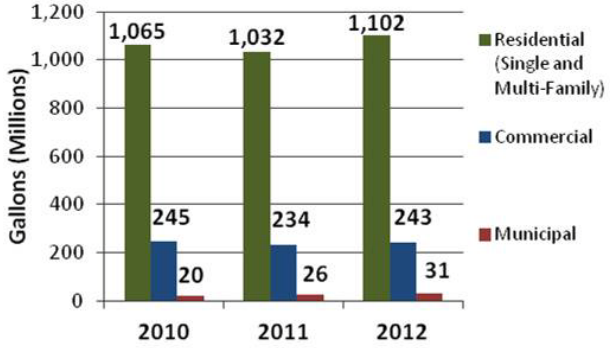


Figure 16: Water Usage by Sector



Recommendations

Electrical Usage:	Provide incentives and education on efficient practices that reduce energy consumption and promote installation and use of renewable energy.
Natural Gas and Heating Oil:	Encourage upgrading to newer, more efficient systems.
Transportation:	Expand the promotion and incentives for alternative forms of transportation.
Solid Waste:	Continue to provide opportunities, tools and education that facilitate a reduction in garbage, an increase in recycling and composting, and the purchase of products made from recycled materials.
Water Consumption:	Encourage the conservation of all our natural resources through the development of habits that support a sustainable environment and community.

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Government Operations Emissions Inventory Results

Municipal Greenhouse Gas Emissions by Scope

Greenhouse gas emissions from municipal operations are produced by a few key source types, which are categorized into sectors, as demonstrated in Table 6. This inventory includes scope 1 and 2 sources from the following **sectors**:

- Buildings and Facilities
- Vehicle Fleet
- Streetlights and Traffic Signals

Within these sectors, the following **energy and emissions sources** are included:

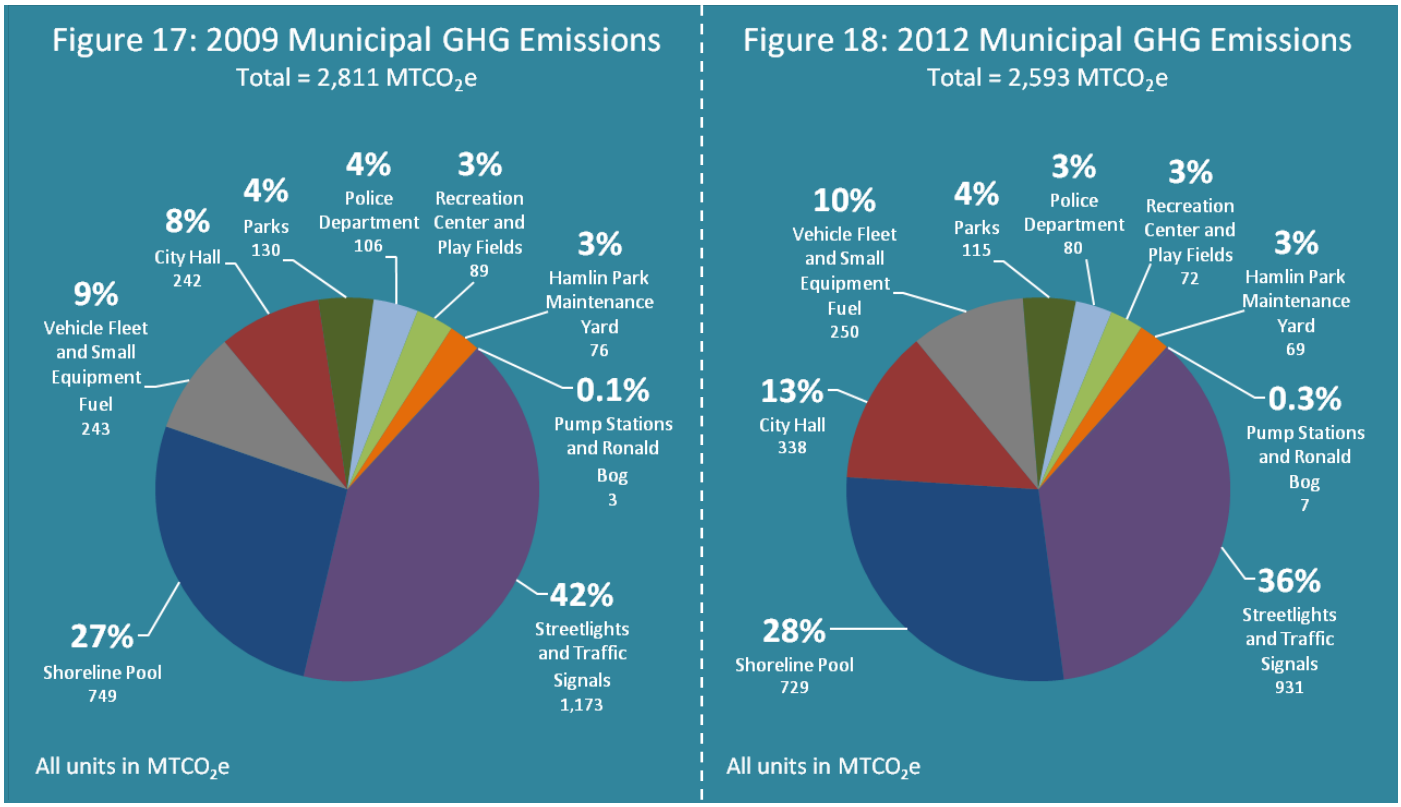
- Electricity
- Natural Gas
- Gasoline
- Diesel

Table 6: Municipal Greenhouse Gas Emissions per Scope, Sector, and Source in 2012 ($MTCO_2e$)

Sector	Scope 1			Scope 2			TOTALS	
	Energy / Emissions Source	$MTCO_2e$	% of Scope 1 CO_2e	Energy / Emissions Source	$MTCO_2e$	% of Scope 2 CO_2e	Total $MTCO_2e$	% of Total CO_2e
Buildings and Facilities	Natural Gas	588	70%	Electricity	823	47%	1,411	54%
Vehicle Fleet	Gasoline & Diesel	251	30%				251	10%
Streetlights and Traffic Signals				Electricity	931	53%	931	36%
Total $MTCO_2e$	**839**			**1,754**			**2,593**	
% of Total CO_2e	**32%**			**68%**				

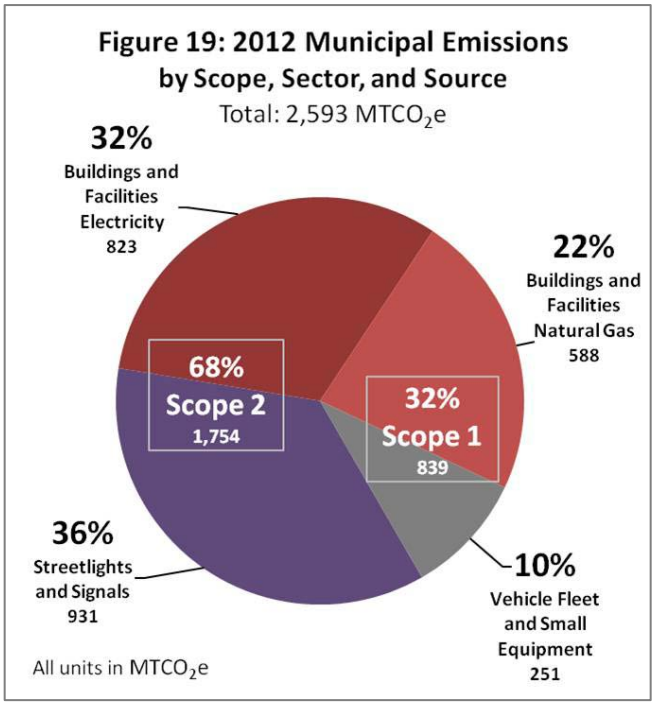
Including scopes 1 and 2, Shoreline's local government operations emitted approximately 2,593 metric tons of carbon dioxide equivalent greenhouse gases ($MTCO_2e$) in the year 2012. As shown in Table 6 and illustrated in Figure 18 below, scope 2 emissions are by far the largest share (68%) of Shoreline's municipal emissions, with scope 1 constituting the remaining 32% of emissions.

Figure 17 illustrates the emissions composition in Shoreline's baseline inventory in 2009[5], while Figure 18 shows the 2012 emissions inventory composition. Total municipal emissions have decreased by 8% since 2009. However, although emissions have decreased, total municipal costs have increased by 27% since 2009 due to rising energy rates.



As shown in Table 6 and Figure 18 (above), and Figure 19 (right), the largest percentage of scope 1 emissions in 2012 came from the Buildings and Facilities sector (70%). Scope 1 emissions from this sector are the result of natural gas combustion in facilities, such as the Shoreline pool and the Richmond Highlands Recreation Center. The Vehicle Fleet sector was the source of the remaining scope 1 emissions, from diesel and gasoline used by City-owned vehicles.

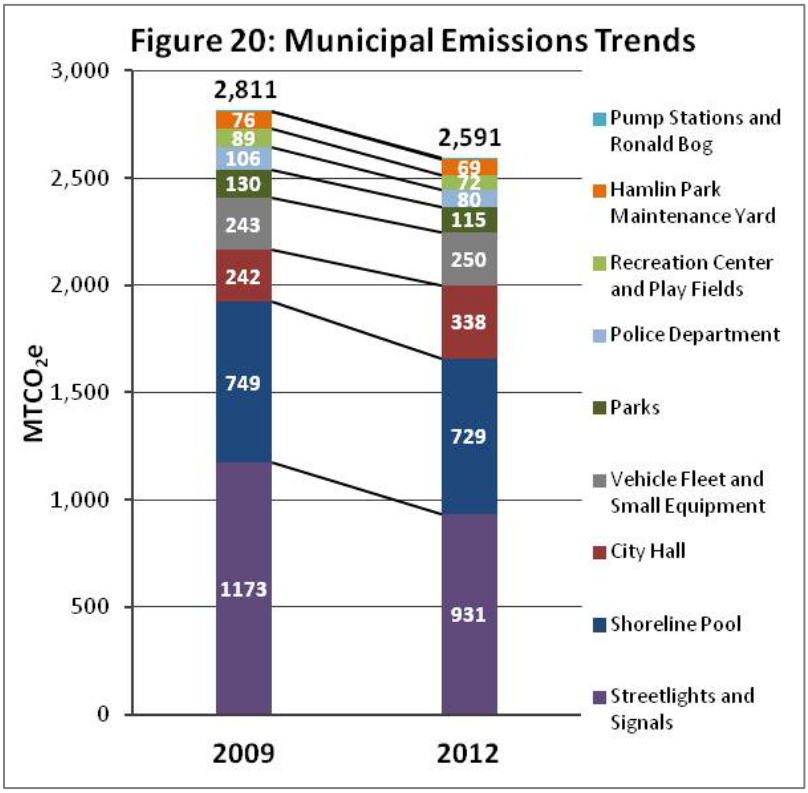
Fifty-three percent of 2012 scope 2 emissions were generated through electricity consumption by the Streetlights and Traffic Signals sector (see Table 6 and Figures 18 and 19). The remaining 47 percent of Shoreline's scope 2 emissions came from electricity consumption by municipal Buildings and Facilities. The actual emissions from these activities were, however, produced at the source of the generation of the electricity, as noted in the description of scope 2 emissions.



Emission Trends

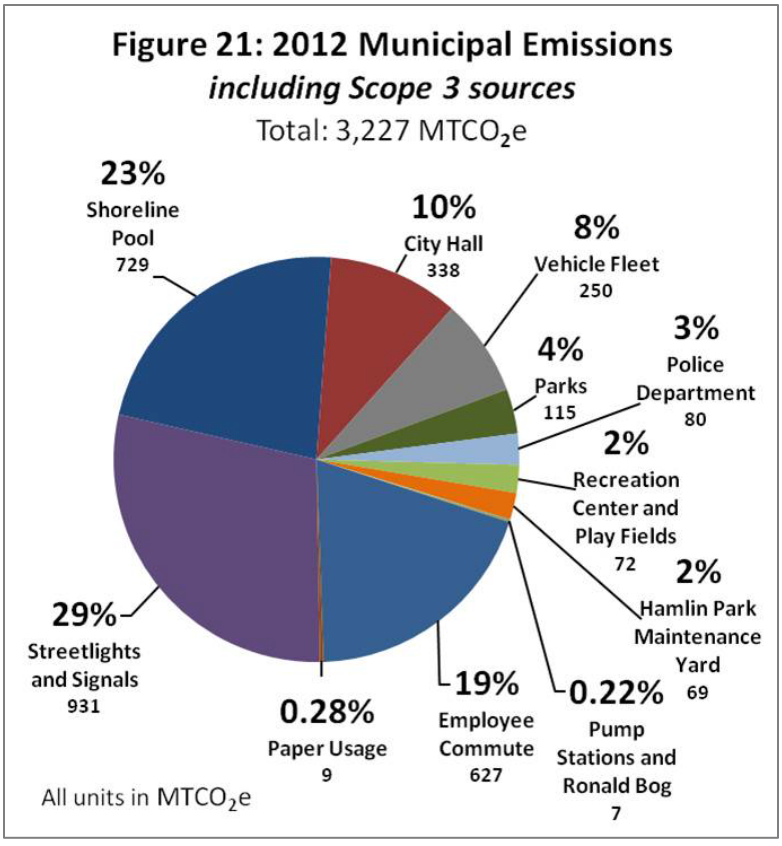
The overall municipal operations emissions amount has decreased by 8% (218 $MTCO_2e$) since the City conducted its baseline inventory in 2009, as seen in Figure 20 (right). Government emissions were largely comprised of electricity use by Streetlights and Traffic Signals, as well as Buildings and Facilities, which collectively account for over 70 percent of municipal emissions.

As seen in Table 6 and Figures 18 (previous page) and 20 (right), emissions from almost every sector and source have decreased, with the most significant exceptions being from City Hall and the Vehicle Fleet, the reasons for which will be described in later sections.



Expanded Sources – Scope 3 Emissions

This year, the City also took into account two more sources of GHGs produced in 2012 that were not measured in the 2009 baseline inventory. These categories are Employee Commute and Paper Usage, and they both qualify as scope 3 emissions. To reiterate, scope 3 emissions are indirect emissions from up-stream and downstream processes that occur as a result of activities within the operational boundaries of the local government, but outside the direct control of the municipality, i.e. emissions resulting from the production of purchased materials (such as paper) and fuels (such as those used in employee commuting).



Including these new sources raises the City's total emissions from 2,593 $MTCO_2e$ to 3,227 $MTCO_2e$ (see Figure 21, left), an increase of 20% (634 $MTCO_2e$). These categories constitute a significant portion of municipal emissions, and they are worth measuring in future inventories to observe trends in future years. They will not, however, be included in most of the totals of this report, as this would complicate comparison of trends with the 2009 inventory results.

Municipal Greenhouse Gas Emissions by Sector and Source

In addition to considering emissions via scopes, we can also focus specifically on each sector, with sources divided by sector.

Buildings and Facilities

Facility operations contribute to GHG emissions by consuming electricity and fuels such as natural gas. Emissions from the Buildings and Facilities sector have increased by 1% since 2009. While the overall amount has remained fairly consistent, the composition has changed slightly in the past three years, illustrated by Figure 22 (upper right). Emissions from almost all facilities decreased during the past three years, with the chief exception being City Hall.

City Hall

Built to high sustainability standards, Shoreline's City Hall has been awarded LEED® Gold, established by the U.S. Green Building Council and verified by the Green Building Certification Institute (GBCI). LEED is the nation's premier program for the design, construction and operation of high performance green buildings.

Although emissions from almost all City facilities have decreased, City Hall has produced more greenhouse gases over the past three years and represents the greatest increase in buildings and facilities emissions since 2009, as seen in Figures 23 and 24.

While this information may seem alarming, there are reasons behind this change. Since the City Hall has only been in operation since mid-2009, the baseline inventory covered only a few months of its initial operation.

In addition, as a Civic Center, the City Hall has provided a new location for citizens to meet, exchange ideas, and explore issues that support the community, and for the public to rent as a site for special occasions.

Comparing City Hall with the City's other buildings and facilities, as in Figures 23 and 24,

Figure 22: Municipal Facilities Emissions

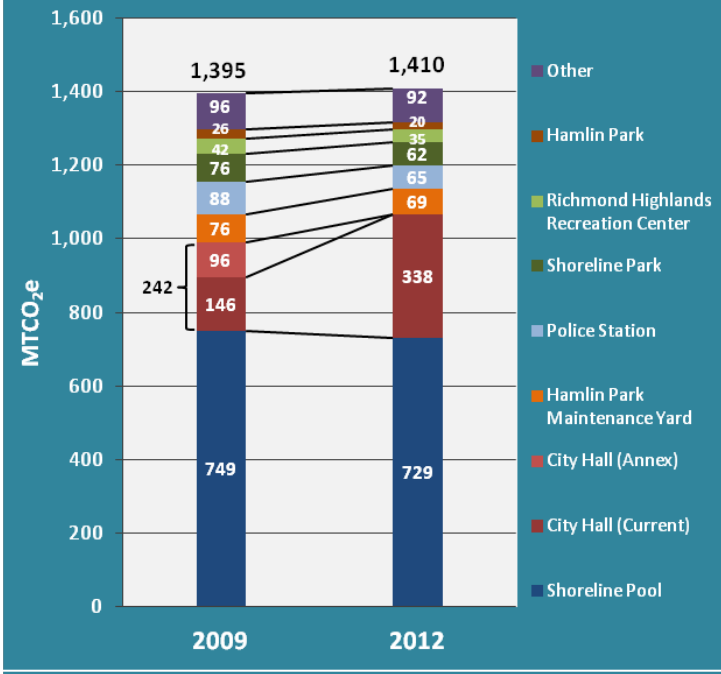


Figure 23: Total Facilities Emissions

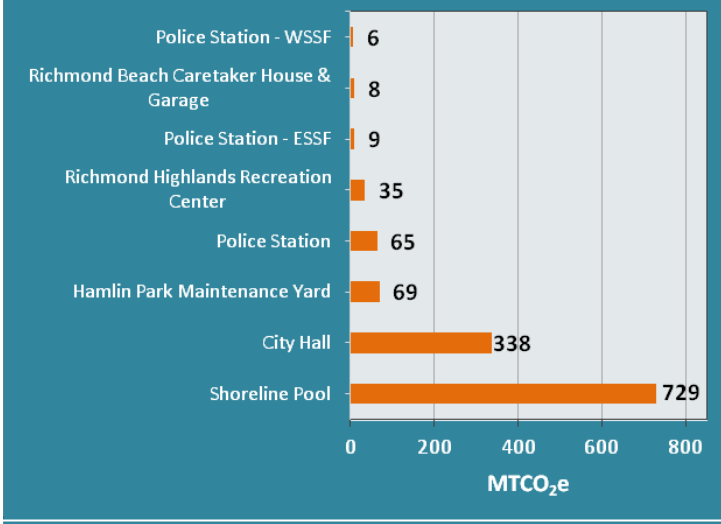
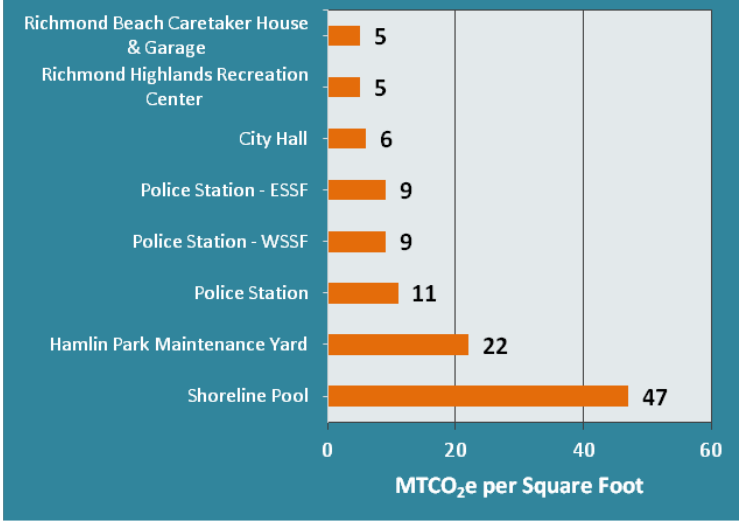
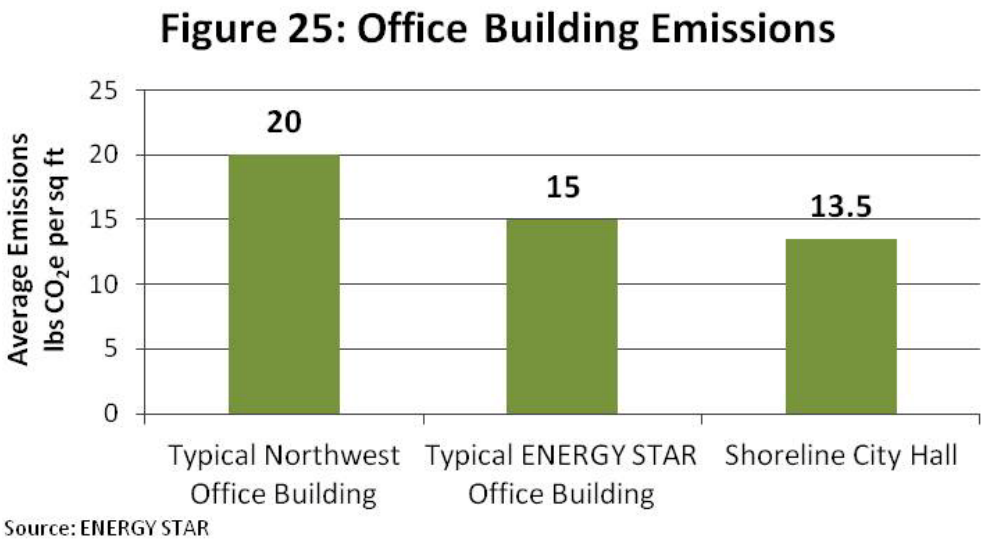


Figure 24: Normalized Facility Emissions



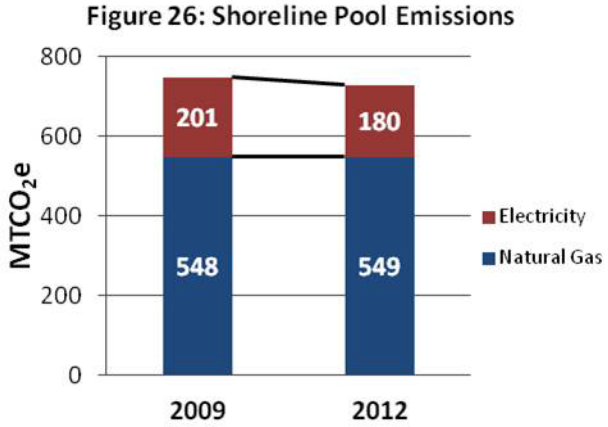


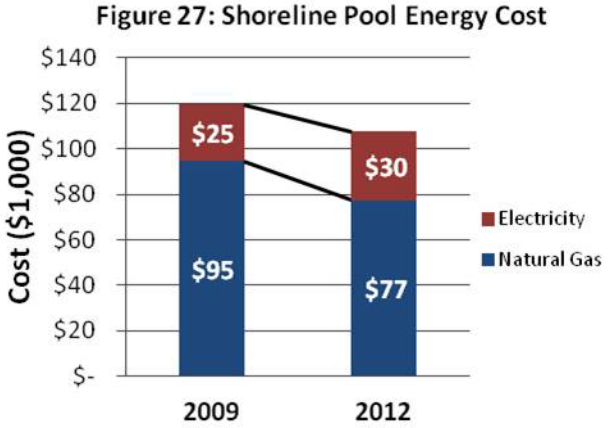
illustrates its energy efficiency, as it has one of the lowest emissions per square foot.

When comparing City Hall with other buildings of its size and usage, an even more impressive picture forms; Shoreline City Hall produces 33% less emissions than a typical Northwest office building, and 10% less emissions than a typical ENERGY STAR office building (see Figure 25). In addition, water consumption at City Hall has decreased by 5% since 2010.

Shoreline Pool

Since 2009, emissions produced by the Shoreline pool have decreased by 2.7%, while costs have decreased by 10.8%. Although these numbers might seem puzzling at first, energy rates have increased over time, while natural gas rates have decreased. Since the pool uses much more natural gas than electricity, as illustrated by Figure 26, its energy costs have decreased dramatically since 2009 (see Figure 27, below).





This also provides an example of why cost trends do not translate to emissions trends. Shoreline pool's 10 percent decrease in costs over a period of three years, while beneficial to the City, does not reflect its emissions or energy usage or its overall energy efficiency as a facility (see Figures 23 and 24, previous page).

When the pool's boiler required replacement in 2013, the City installed a new boiler with approximately 10% higher energy efficiency than the previous boiler. An analysis is being conducted to determine other potential measures to upgrade the aging pool facility, in order to decrease energy use.

Water Consumption

In addition to emissions, the City of Shoreline has tracked its water use from 2010 through 2012. Although water does not contribute to greenhouse gas emissions, it is an important aspect of conserving resources.

Surprisingly, municipal water usage has increased by 35% since 2010. One possible reason for this increase is the City's Aurora Corridor Project. With the redevelopment of the road, landscaping was planted on medians and along sidewalks in the right-of-way. This steadily increasing green space requires irrigation, such that 33% of municipal water use now contributes to watering the street trees, shrubs, and groundcover along Aurora, as shown in Figure 28, below.

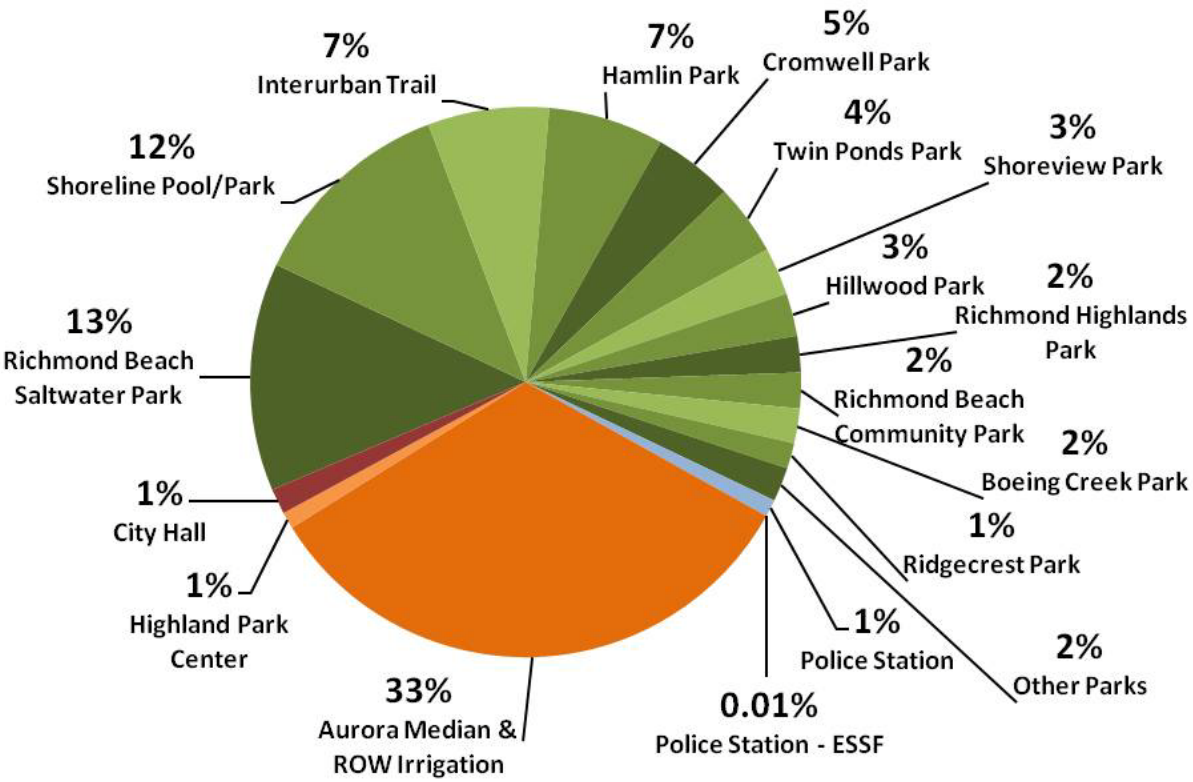
By contrast, the Shoreline pool only comprises 12% of municipal water consumption. Not including the pool, Shoreline's parks constitute about 52% of the City's water usage.

In addition to its energy efficiency, City Hall also operates sustainably in its water conservation, with low flow toilets and sensor activated toilets and faucets. City Hall's water usage has decreased by over 21% since 2011, and by 5% compared to 2010 (see Table 7, right). Unlike that of the community at large, City Hall's water consumption mirrors precipitation levels, in that its water usage was higher in 2011, the driest year of the three, and lower in 2010 and 2012, which were particularly rainy years.

Table 7: City Hall Yearly Water Consumption (in gallons)		
2010	**2011**	**2012**
494,428	598,400	468,802

Figure 28: 2012 Shoreline Municipal Water Consumption *by Department*

Total: 31,353,609 gallons



Vehicle Fleet

From maintenance trucks used for parks and recreation to tree trimmers and street sweepers, the vehicles and mobile equipment used in Shoreline's daily operations burn gasoline and diesel, resulting in greenhouse gas emissions. In 2012, Shoreline operated a vehicle fleet with 50 vehicles. Shoreline's vehicle fleet performed a number of essential services, including maintaining roads and right-of-ways, responding to customers' needs, and attending to park maintenance.

Vehicle fleet emissions have increased by 0.03% since 2009, yet emissions per vehicle have increased from 4.5 $MTCO_2e$ in 2009 to 5 $MTCO_2e$ in 2012 (as shown in Table 8, below).

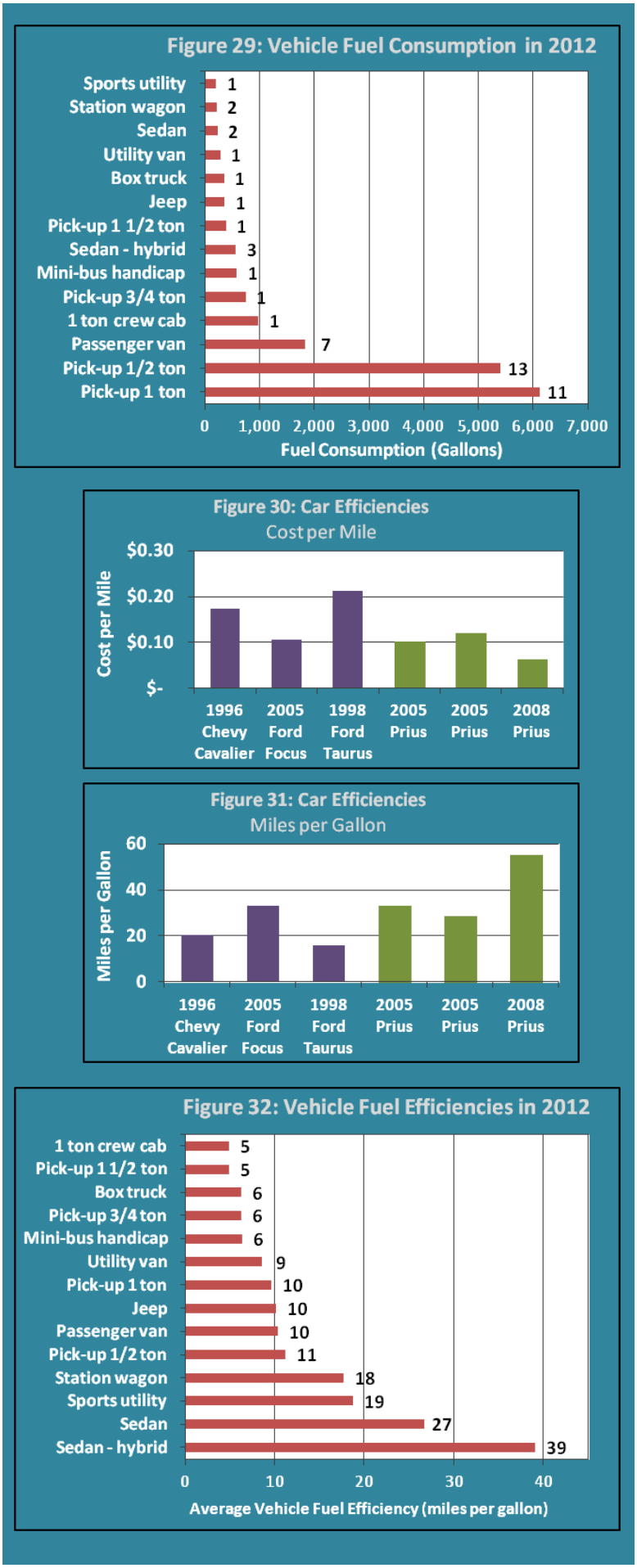
Table 8 – Vehicle Fleet Emissions		
	2009	2012
Number of vehicles	54	50
Total annual emissions ($MTCO_2e$)	243	250
Annual emissions per vehicle ($MTCO_2e$)	4.5	5

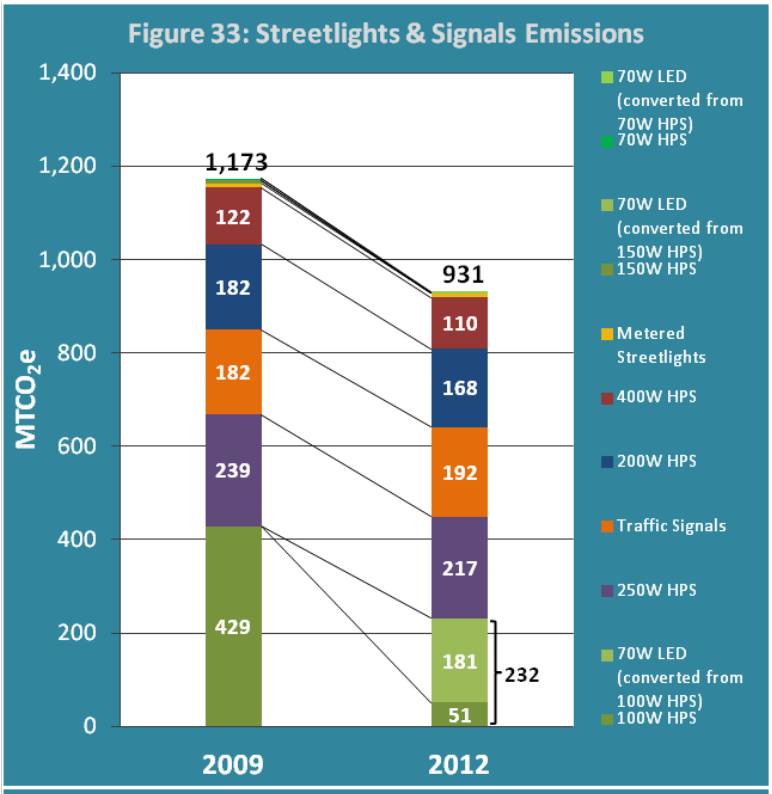
Additionally, as seen in Figure 29 (upper right), in 2012, ½ and 1-ton pickup trucks constituted 61% of fuel use, but only 52% of the fleet.

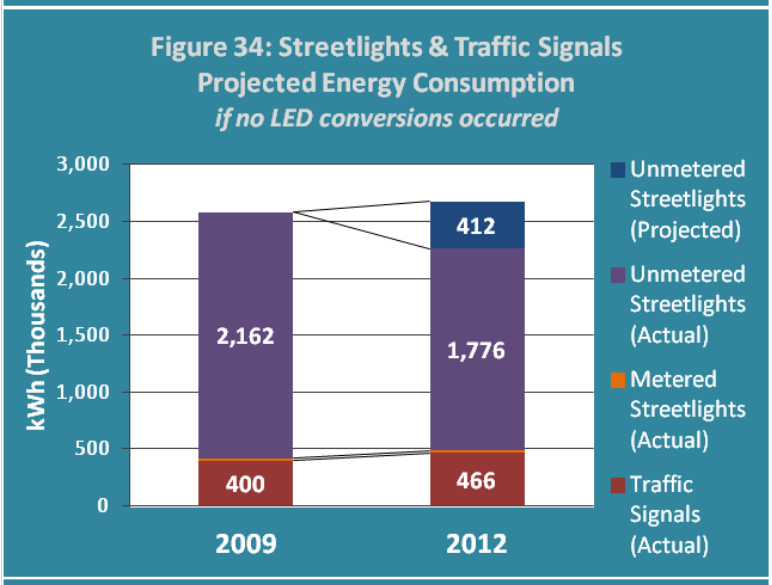
The City now owns three hybrid cars, which drive 41% more miles per gallon than the average passenger vehicle in the vehicle fleet, and incur 44% less in fuel costs (see Table 9, below, and Figure 31, right).

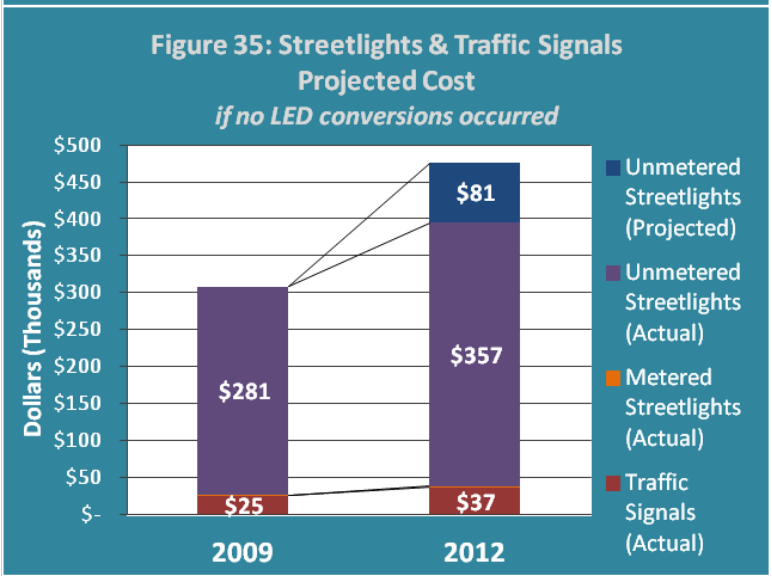
Table 9 – Sedan Fuel Efficiency and Cost		
	Miles per Gallon	*Cost per Mile*
Sedan	23	$0.16
Hybrid	39	$0.09

Overall, hybrids were 70% more fuel efficient and cost 42% less per mile than the average vehicles in the fleet (see Figure 32, right). Switching to hybrids reduces car fuel use by 32% and sports utility fuel use by 52%.









Streetlights and Traffic Signals

Like most local governments, Shoreline operates a range of public lighting, such as streetlights, traffic signals, and park lights. Emissions resulting from the operation of this infrastructure are the result of the generation of electricity.

Since 2009, Shoreline's streetlight and traffic signal emissions have decreased by 21% (see Figure 33, left). This sizeable reduction is due to ongoing system upgrades on residential streets. Over the past few years, Seattle City Light has been converting older High Pressure Sodium (HPS) streetlights to LED fixtures, which produce a more natural light, have a longer lifespan, and use less energy.

This reduction constitutes the majority of the overall decrease in Shoreline's municipal carbon footprint. Considering this, it is interesting to look at the potential effects had the conversion to LEDs not occurred.

If these LED replacements did not occur, rather than decreasing by 12%, streetlight and signal energy usage would have increased by an estimated 3.5% (see Figure 34, left). This increase would have resulted in an additional 170 $MTCO_2e$ emitted by streetlight and traffic signal use – 15% more than was actually produced in 2012.

Due to increasing electricity rates, energy costs for streetlights and traffic signals have increased by 22% since 2009. If the LED conversions had not occurred, costs would have increased by an estimated 35%, as shown in Figure 35, left.

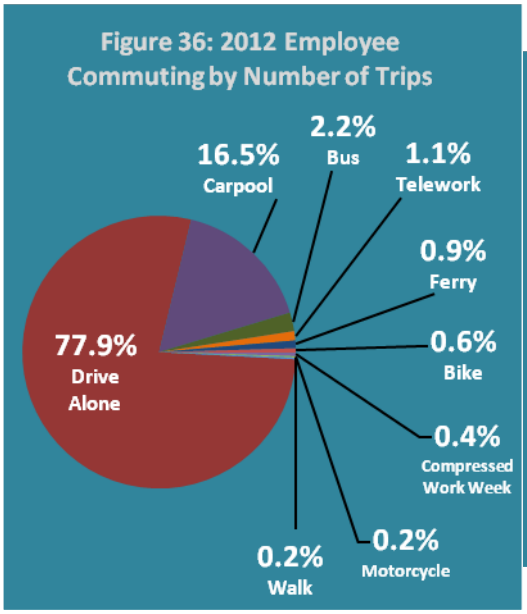
Overall, 56% of Shoreline's unmetered streetlight fixtures have been converted to LEDs, reducing kWh consumption by over 415,000 kWh, 20%, annually. If the remaining 1,135 HPS fixtures were upgraded, annual energy use could be reduced by a further 20% – over 325,000 kWh, or 134 $MTCO_2e$.

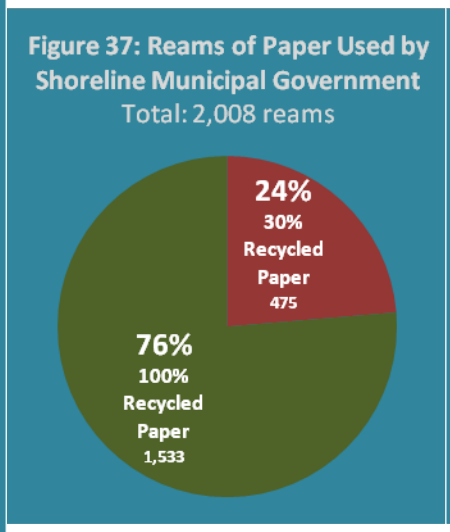
Employee Commute

Shoreline municipal employee commuting emitted an estimated[6] 627 $MTCO_2e$ in the year 2012, which constitutes 19% of municipal emissions when scope 3 sources are included.[7] Employee Commute is considered a scope 3 source, because while the City is the underlying reason for these emissions, the government does not have control over how far employees travel or what mode of transportation they use.

Although Employee Commute and the resulting emissions were not included in the 2009 baseline inventory, data from the Washington State Department of Transportation Commute Trip Reduction (CTR) Survey reports that the percentage of Shoreline employees who drove alone to work was 69.5% in 2007-2008; 71.9% in 2009-2010; and 77.9% in 2011-2012 (see Figure 36, below).

This is not a complete picture of commuting, as it reflects just one week, but it does provide a glimpse into staff habits and resulting impacts. Based on these results, it is important to find additional ways to incentivize carpooling, taking the bus, riding a bike, or walking. The City provides transit passes and a Guaranteed Ride Home program, but it would be beneficial to continue to raise awareness of the footprint of commuting.





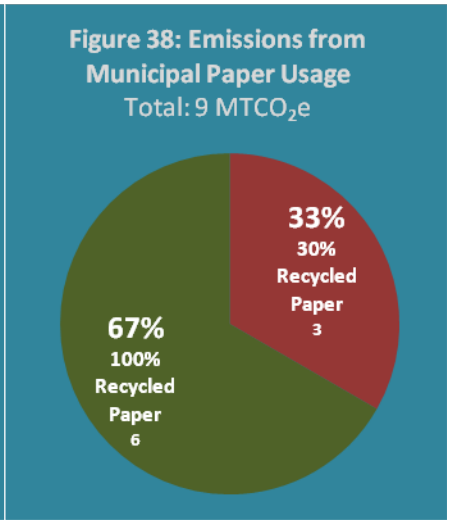


Figure 39: The Lifecycle of Paper

Paper Usage

In 2012, municipal paper usage produced 9 $MTCO_2e$ GHG emissions. Based on the up-stream and downstream activities, such as the manufacturing of paper, transporting it to a supplier, and its potential future incineration. This "lifecycle" of paper is illustrated in Figure 39, right.

Although the City of Shoreline typically uses 100% recycled paper, in 2012, 24% of the paper used by the Shoreline municipal government was only 30% recycled paper (see Figure 38, above), due to problems with older printing equipment. While 30% recycled paper only constitutes 24% of the paper used, it makes up 33% of the emissions from paper, as illustrated by Figure 39. If the City switched entirely to 100% recycled paper, emissions would decrease by 11%.

Source: The Official Wisdom Jobs

Recommendations

All facilities:	Continue to monitor facilities and operations for potential upgrades and opportunities to increase efficiency.
Shoreline Pool:	Given that the pool comprises 28% of municipal emissions, continue to consider possible upgrades to the pool facility.
Water Consumption:	Create residential and commercial incentives to conserve water and fix leaks, as part of drinking water service acquisition from Seattle Public Utilities.
Vehicle Fleet:	Continue to upgrade to more fuel efficient vehicles.
Streetlights and Traffic Signals:	Encourage Seattle City Light to continue upgrading to LED lighting in Shoreline.
Employee Commuting:	Further promote CTR program.
Paper Usage:	Work toward using only 100% recycled paper.

Footnotes

[1] Total CO_2e from municipal electricity, natural gas, gasoline, and diesel consumption, as well as community electricity, natural gas, and fuel oil consumption, was calculated by using the ICLEI CACP 2009 software, Version 3.0. Total CO_2e from municipal employee commuting was calculated by using a spreadsheet from the Seattle Climate Partnership Carbon Footprint Calculator 2010, as it produces much more regionally-specific data. Total CO_2e from municipal paper usage was calculated by using the Environmental Paper Network online Paper Calculator 3.2, which provides a very nuanced and accurate set of numbers. Total CO_2e from community solid waste production was calculated by using a spreadsheet with data from the EPA Warm Model; the King County Waste Characterization and Customer Survey Report data was used in conjunction with the EPA Warm Model to obtain results that draw on much more regionally-specific solid waste composition.

[2] While compiling and analyzing the data for the 2012 Community Greenhouse Gas Emissions Inventory, a significant error in the data from the Greenhouse Gas Baseline Municipal & Community 2009 Inventory was discovered. For the Transportation sector, instead of including the 2009 annual vehicle-miles-traveled (VMT) within the City of Shoreline, the number that was included was the 2009 daily VMT for all of King County; this was entirely due to human error. In the Greenhouse Gas Baseline Municipal & Community 2009 Inventory report, the total Transportation emissions were reported as 28,063 $MTCO_2e$, when in actuality, community transportation produced 275,664 $MTCO_2e$ in 2009; this constitutes a discrepancy of 247,601 $MTCO_2e$. As for how this affects the overall emissions totals from 2009, originally, community transportation was recorded as 9% of the total 2009 community emissions, which were reported as 311,023 $MTCO_2e$ (not including solid waste emissions – for more information on the reasoning behind this, read the Solid Waste section on pages 17-18, or endnote number 4); in actuality, community transportation constituted 49% of the total 2009 community emissions, which were in fact 558,572 $MTCO_2e$, as shown in this report. This represents a difference of 44% from the original erroneous data.

[3] While the data on community electricity and natural gas use is comprehensive, the community heating oil usage data is less exact. There are a number of heating oil companies that deliver to homes and businesses within the City of Shoreline, and many of them either did not respond to requests for data or were not able to obtain the data requested, as their records do not necessarily isolate data according to city boundaries. The two largest distributors of heating oil in Shoreline contributed data to the 2009 GHG inventory. For the 2012 GHG inventory, only one of the same companies supplied data, though three other companies that were not included in the 2009 GHG inventory contributed data. Overall, these are easily the least exact numbers included in this inventory, but given that heating oil produces such a small portion of the City's emissions (an estimated 0.4%), this should not be a great concern.

[4] For the 2012 Community Greenhouse Gas Emissions Inventory, CO_2e from the Solid Waste sector was calculated using a spreadsheet with data from the EPA Warm Model; the King County Waste Characterization and Customer Survey Report data was used in conjunction with the EPA Warm Model to obtain results that draw on much more regionally-specific solid waste composition. In the Greenhouse Gas Baseline Municipal & Community 2009 Inventory, however, CACP 2009 was used to calculate solid waste emissions, resulting in a positive number. While it is still possible to go back and read these numbers on the Greenhouse Gas Baseline Municipal & Community 2009 Inventory report, as seen in Appendix B, the totals from 2009 included in this report for 2012 are not those that were reported in the baseline report; rather, they were retroactively re-calculated using the same methods used for the 2012 data, to provide consistent data with which to compare between the two years.

[5] While compiling and analyzing the data for the 2012 Government Operations Emissions Inventory, three errors in the data from the Greenhouse Gas Baseline Municipal 2009 Inventory were discovered.

The first was relatively minor – while the fuel usage data for the City's vehicle fleet was entered into CACP 2009 and converted into $MTCO_2e$, the vehicle-miles-traveled (VMT) were not entered into CACP 2009. The fuel usage data produces the measurement of CO_2 emitted, but the VMT data produces the measurement of various other greenhouse gases, specifically, Nitrous Oxide (N_2O) and Methane (CH_4). When the missing data was entered into CACP 2009, it

accounted for approximately 2 $MTCO_2e$; therefore, the Vehicle Fleet emissions data in the Greenhouse Gas Baseline Municipal & Community 2009 Inventory report is slightly lower than actual levels.

The second error was also minor – the energy usage of the metered streetlights was not included in the totals for the 2009 inventory; the reason for this is unknown. The metered streetlights make up only a fraction of the overall streetlights in Shoreline, the vast majority of which are unmetered, so this error likely resulted in an insignificant difference in reported emissions.

However, the third error discovered in the 2009 data was of a greater significance. The Streetlights and Traffic Signals sector was reported as constituting 34% of 2009 municipal emissions, when in actuality, it constituted 42% of 2009 municipal emissions. Only a fraction of this difference is due to the aforementioned error; rather, this difference is almost entirely due to a couple of simple miscalculations made during the collection of the 2009 data. For two large groups of streetlights, a month's, rather than a year's, energy usage was included in the total energy usage of streetlights in 2009, as the monthly kWh consumption was never multiplied by 12 for those two groups. This error was large enough to account for a difference of approximately 335 $MTCO_2e$.

Between these three errors in the Greenhouse Gas Baseline Municipal 2009 Inventory, the total municipal emissions, which, in the Greenhouse Gas Baseline Municipal & Community 2009 Inventory report, were reported as 2,474 $MTCO_2e$, are raised to 2,811 $MTCO_2e$ in actuality, as shown in this report. This represents a difference of 12% from the original erroneous data.

[6] Employee Commute data was gathered from the results of the Washington State Department of Transportation Commute Trip Reduction (CTR) Employer Survey Report, in which City of Shoreline employees report their commute habits for the past week; this survey is conducted in accordance with the King County CTR Law, which requires that each city and county must reduce drive alone trips at major worksites, with specific reduction targets. Because the data is self-reported and only representative of a particular week of the year, the emissions from annual employee commuting are estimated and inexact.

[7] Previous sections (Buildings and Facilities, Vehicle Fleet, and Streetlights and Traffic Signals) on the municipal GHG emissions inventory did not include Scope 3 emissions sources (Employee Commute and Paper Usage) in their totals and percentages. Only the sections titled Expanded Sources – Scope 3 Emissions (page 23), Employee Commute, and Paper Usage (page 29), cite the emissions totals with Scope 3 sources included.

Appendices

Appendix A – Tables and Figures

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Appendix B – Greenhouse Gas Baseline Municipal & Community 2009 Inventory

Greenhouse Gas Baseline Municipal & Community 2009 Inventory

Local Governments for Sustainability

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Introduction to Climate Change

The Greenhouse Effect and Global Warming

The greenhouse effect is a natural warming process that is essential for life on Earth. When discussing the greenhouse effect it is important to identify the major chemical contributors; these gases (water vapor, carbon dioxide, methane, and nitrous oxide) are special because of their ability to absorb incoming (solar) and outgoing (infrared) radiation. The problem with the greenhouse effect lies within the quantities, absorption characteristics, and life-spans of these gases in the atmosphere.

Water vapor being the most abundant greenhouse gas (GHG) in the atmosphere is a strong absorber but also has the shortest life-span so its long term global warming effects are negligible.

Carbon dioxide, methane, and nitrous oxide on the other hand are much larger contributors to global warming, because of their strong absorption properties, long life-spans, and increasing concentrations since the dawn of the Industrial Revolution (1750).

As these gas concentrations continue to increase so does the amount of energy absorbed by the atmosphere. This increase in absorbed energy increases the average global temperature, I know what you are thinking warmer weather in Washington sounds like a great idea but there are consequences for even the slightest warming. Small changes in average temperature cause undesirable climate effects for the Northwest. (Source: IPCC AR4 synthesis report Sec. 2.2 Drivers of climate change)

Climate Change in the Pacific Northwest (PNW)

To prevent misconceptions when addressing climate change in the Pacific Northwest (PNW), it is important to acknowledge the impacts of both **natural** weather variability and **human-caused** climate change ('global warming') on PNW resources. The following summary of impacts was compiled by the University of Washington's Climate Impacts Group, based on extensive scientific research and modeling.

Natural Variable Climate Impacts

Weather changes from day to day, creating large and small impacts on our natural habitat. Changes, such as in precipitation and temperature, may be subtle or they may have noticeable impacts on the region's mountain snowpack, river flows and flooding, the likelihood of summer droughts, forest productivity, forest fire risk, salmon abundance, and quality of coastal and near-shore habitat.

Potential & Existing Human-caused Climate Change Impacts on PNW Resources

Water

- Decreased mountain snowpack
- Earlier snowmelt
- Higher winter stream flow in rivers that depend on snowmelt
- Higher winter stream flow in rain-fed river basins if winter precipitation increases in the future as projected
- Lower summer stream flow in rivers that depend on snowmelt (most rivers in the PNW)
- Earlier peak (spring) stream flow in rivers that depend on snowmelt (most rivers in the PNW)
- Decreased water for irrigation, fish, and summertime hydropower production
- Increased conflict over water
- Increased urban demand for water

Salmon

- Increasing winter floods that can wash-out egg clusters
- Decreased summer stream flow
- Increased water temperature
- Decreased available habitat and food supply

Forests

- Seedling regeneration may be altered by:
  - Increase in high snow forests
  - Decrease in dry forests
- Tree growth may be affected by:
  - Increase in high snow forests
  - Decrease in dry (east-side) forests
- Increases in forest fires
- Overall, the PNW is likely to see increased forest growth region-wide over the next few decades followed by decreased forest growth as temperatures increase and overwhelm the ability of trees to make use of higher winter precipitation and higher carbon dioxide.
- Potential for extinction of local populations and loss of biological diversity if environmental shifts outpace species migration and adaptation rates and interact negatively with population dynamics.

Coastline

- Increased coastal erosion and beach loss due to rising sea levels
- Increased landslides due to increased winter rainfall
- Permanent inundation, especially in south Puget Sound around Olympia
- Increased coastal flooding due to sea level rise and increased winter stream flow from interior and coastal watersheds

Shoreline's Commitment to Climate Protection

About Shoreline

The City of Shoreline stretches north from Seattle's city line to Snohomish County and from the east shore of Puget Sound to the City of Lake Forest Park. It has 3.4 miles of shoreline, with 330 acres of park land/open space inside its 12.3 square miles of area. With a population of 54,580, Shoreline is Washington's 15th largest city. It is primarily residential with more than 70 percent of the households being single-family residences. Over the years, the Shoreline community has been known for its numerous parks, strong neighborhoods, large backyards, trees and excellent schools.

US Mayor's Climate Protection Agreement

To help protect Shoreline's community and natural environment, the City Council authorized Mayor Robert Ransom to sign the U.S. Mayors Climate Protection Agreement, City Resolution No. 242, on April 24, 2006.

RESOLUTION NO. 242

A RESOLUTION OF THE CITY OF SHORELINE, WASHINGTON, AUTHORIZING SUPPORT FOR THE U.S. CONFERENCE OF MAYORS CLIMATE PROTECTION AGREEMENT

WHEREAS, the 73rd Annual U.S. Conference of Mayors amended and endorsed the U.S. Mayors Climate Protection Agreement which reads:

Mayors Climate Protection Agreement

A. We urge the federal government and state governments to enact policies and programs to meet or beat the target of reducing global warming pollution levels to 7 percent below 1990 levels by 2012, including efforts to reduce the United States' dependence on fossil fuels and accelerate the development of clean, economical energy resources and fuel-efficient technologies such as conservation, methane recovery for energy generation, waste to energy, wind and solar energy, fuel cells, efficient motor vehicles, and biofuels; and
B. We urge the U.S. Congress to pass bipartisan greenhouse gas reduction legislation that includes 1) clear timetables and emissions limits and 2) a flexible, market-based system of tradable allowances among emitting industries; and
C. We will strive to meet or exceed Kyoto Protocol targets for reducing global warming pollution by taking actions in our own operations and communities such as:
    1) Inventory global warming emissions in City operations and in the community, set reduction targets and create and action plan;
    2) Adopt and enforce land-use policies that reduce sprawl, preserve open space, and create compact, walkable urban communities;
    3) Promote transportation options such as bicycle trails, commute trip reduction programs;

4) Increase the use of clean, alternative energy by, for example investing in "green tags" advocating for the development of renewable energy resources, recovering land fill methane for energy production, and supporting the use of waste to energy technology;
5) Make energy efficiency a priority through building code improvements, retrofitting city facilities with energy efficient lighting and urging employees to conserve energy and save money;
6) Purchase only Energy Star equipment and appliances for City use;
7) Practice and promote sustainable building practices using the U.S. Green Building Council's LEED program or a similar system;
8) Increase the average fuel efficiency of municipal fleet vehicles; reduce the number of vehicles; launch an employee education program including anti-idling messages; convert diesel vehicles to bio-diesel;
9) Evaluate opportunities to increase pump efficiency in water and wastewater systems; recover wastewater treatment methane for energy production;
10) Increase recycling rates in City operation and in the community;
11) Maintain healthy urban forests; promote tree planting to increase shading and to absorb CO2; and
12) Help educate the public, schools, other jurisdictions, professional associations, business and industry and about reducing global warming pollution.

WHEREAS, the City Council supports the three proposals of the Mayors Protection Agreement including suggested local measures to promote energy efficiency and reduce harmful emissions that are feasible and cost effective for Shoreline; now therefore

> BE IT RESOLVED BY THE CITY COUNCIL OF THE CITY OF SHORELINE, WASHINGTON:
> That the Mayor is authorized to execute on behalf of the City Council a statement of support for the U.S. Mayors Climate Protection Agreement and the City Clerk shall file the statement with officials coordinating support on behalf of the U.S. Conference of Mayors.

City Council Goal

From 2007 through 2009, the City Council further supported climate protection initiatives through one of its own goals, i.e. to 'create a sustainable community.'

ICLEI Membership

To comply with the proposed reductions of the Mayors Climate Protection Agreement, the City of Shoreline partnered with ICLEI (International Council for Local Environmental Initiatives) since 2007.

ICLEI is an international membership association of local governments dedicated to climate protection and sustainable development. It is currently known as ICLEI-Local Governments for Sustainability. In the U.S., there are more than 600 cities, towns and counties working with ICEI to reduce GHGs and to create sustainable communities. Locally, more than 30 Washington

jurisdictions, such as: Edmonds, Kirkland, Seattle, Snohomish County and Shoreline belong to ICLEI.

ICLEI's 5 Milestones

To assist jurisdictions develop benchmarks that result in the implementation of an effective Climate Action Plan, the following 5 Milestones were developed:

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

Shoreline's Baseline Inventory

Municipal Inventory

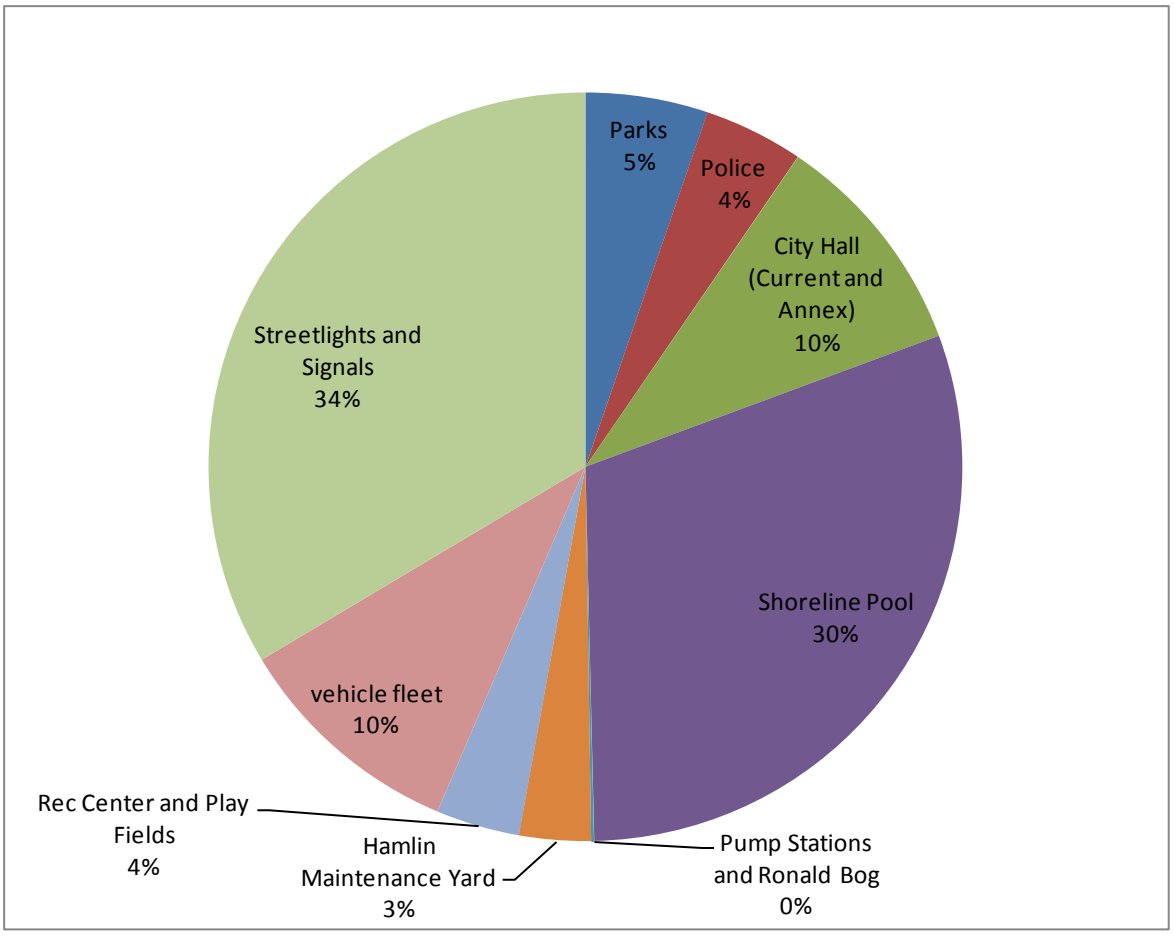
GHG emissions are created when the City performs operation and maintenance activities for the following nine sectors: the City Hall, Parks, Police, Shoreline Pool, Richmond Highlands Recreation Center/Recreational Fields, Hamlin Maintenance Yard, Municipal Vehicle Fleet, Streetlights/Signals, and Ronald Bog/Pump Stations.

Based on the data and calculations from 2009, each sector was ranked according to CO2e units (see table 2.1). CO2e describes the amount of CO2 that a GHG that would have to have, in order to create the same global warming potential as CO2. CO2e allows GHGs to be compared according to their global warming potential over a specified period of time, often 100 years.

Table 1. Municipal Usages and GHG Emissions (2009)

Government Operations	**Electricity** (kWh)	**Natural Gas** (therms)	**Fuel** (gal)	**Cost** ($)	**CO2e** (tons)
Streetlights and Signals	1,828,774	0	0	$308,229	831
Shoreline Pool	443,360	93,481	0	$119,527	750
Vehicle Fleet	0	0	20,182	$43,588	247
City Hall (Current and Annex)	534,216	0	0	$31,779	242
Parks	287,548	0	0	$18,992	130
Police	163,414	5,539	0	$17,860	106
Rec Center and Play Fields	140,369	4,192	0	$15,080	89
Hamlin Maintenance Yard	166,877	0	0	$10,626	76
Pump Stations/Ronald Bog	2,518	0	0	$778	3
Total	3,567,086	103,212	20,182	$566,459	2,474

Figure 1. Percentage Municipal CO2e Emissions (2009)



Recommendations

Streetlights & Signals:	Upgrade to LED lighting
Shoreline Pool:	Upgrade facilities or reduce hours of operation
Vehicle Fleet:	Upgrade to fuel efficient vehicles
City Hall:	New facility upgraded to LEED-Gold certified
All facilities:	Continue to monitor facilities and operations for efficiencies

Community Inventory

When reviewing the GHG emissions for the residential and commercial sectors in Shoreline's community, it is important to compare the size of each sector to the amount of emissions. The community is roughly comprised of 90% residential, single and multi-family homes; 10% commercial; and less than 1% industrial.

The residential sector, which also represents the largest proportion in the community, is responsible for 62% of the total CO2e emitted. The commercial sector is small, but responsible for 23% of the total CO2e. The industrial sector is minuscule in size, and contributes 6% of the CO2e. (See Tables 2, 3, and 4 and Figure 2.)

Table 2. Community Usages and CO2e Emissions (2009)

Community	Electricity (kWh)	Natural Gas (therms)	Fuel Oil (gal)	Waste (tons)	Total CO2e (tons)
Residential (Single and Multi-Family)	295,181,454	9,419,961	292,000	11,894	195,488
Commercial	86,788,275	5,126,690	0	11,401	72,292
Industrial	16,136,697	2,313,406	0	0	20,874
Total	398,106,426	16,860,057	292,000	23,295	288,654

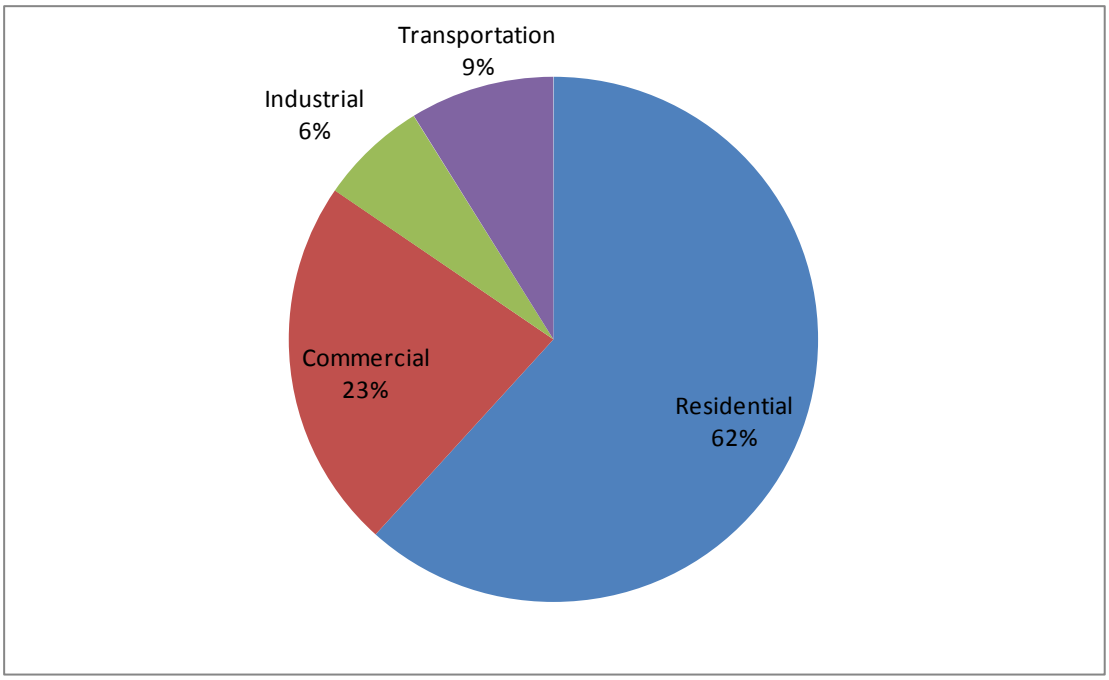
Table 3. Community CO2e Emissions (2009)

Community CO2e	Electricity CO2e (tons)	Natural Gas CO2e (tons)	Fuel Oil CO2e (tons)	Waste CO2e (tons)	Total CO2e (tons)
Residential (Single and Multi-Family)	134,081	55,237	3,284	2,885	195,487
Commercial	39,422	30,062	0	2,808	72,292
Industrial	7,330	13,544	0	0	20,874
Total	180,833	98,843	3,284	5,693	288,653

Table 4. Community Transportation and CO2e Emissions (2009)

Community	Vehicle Miles Traveled	Gasoline CO2e (tons)	Diesel CO2e (tons)	Total CO2e (tons)
Transportation	43,413,025	23,497	4,566	28,063

Figure 2. Community CO2e Emissions (2009)



Recommendations

Electrical Usage:	Provide incentives and education of more efficient practices, e.g. SustainableWorks 2011 audits and retrofit projects in the Shoreline community
Natural Gas:	Encourage upgrading to new, more efficient systems
Transportation:	Motivate use of bus use, carpools, biking and walking