

# **COMMUNITY GREENHOUSE GAS INVENTORY**

**PCP MILESTONE 1**

**Baseline Year 2002**



**May 2014**

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## **1.0 INTRODUCTION**

Various global efforts have been initiated to fight climate change and reduce greenhouse gas emissions. Climate change refers to the long-term change in average weather including temperature, precipitation and wind patterns. A rise in the global temperature, referred to as global warming, is a measure of climate change and is partly attributed to the greenhouse gas effect. Like the glass of a greenhouse, gases in our atmosphere, including carbon dioxide (CO<sub>2</sub>), trap the sun's heat and prevent it from escaping. Human activities such as the burning of fossil fuels increase the amount of greenhouse gases (GHG) in our atmosphere and therefore intensify the natural greenhouse gas effect.

The Partners for Climate Protection Program (PCP), managed by the Federation of Canadian Municipalities (FCM) and the International Council for Local Environmental Initiatives (ICLEI), was designed to guide municipal governments in reducing their GHG emissions. There are now 247 municipal governments, including 17 municipalities in New Brunswick, which are members of the PCP program. The program is based on a five-milestone framework to be completed for both the corporation and the community. The five milestones include:

- Creating a GHG emissions inventory
- Setting an emissions reduction target
- Developing a local action plan (LAP)
- Implementing the local action plan
- Monitoring progress

It is recommended that municipalities first develop a GHG inventory and action plan for their operations before developing the community inventory and action plan. To this effect, the Corporate GHG inventory was completed in 2009. A baseline year of 2002 was selected for the inventory as accurate data was not available for earlier years.

## **2.0 COMMUNITY PROFILE**

According to Statistics Canada census data, the 2011 population of Moncton was 69,074, while in 2001 it was 61,046. This represents an increase of 12.7% over ten years, or on average 1.27% per year since 2001.

In the city of Moncton, there are two hospitals, two universities, multiple parks and many four-season entertainment opportunities. Moncton residents take advantage of one of the lowest cost of living environments in the country and commute-to-work times are among the shortest in Canada.

Additionally, Moncton's central location within the Maritime Provinces gives it a natural advantage as a transportation, communications and manufacturing centre for New Brunswick and the region. Today, Moncton is a major transportation and distribution centre supported by

a diverse economic base that includes national “back-office” centres, customer service centres, head and regional offices, medical services, education, and retail along with a growing and dynamic manufacturing base.

In recent years, the labour force in the Greater Moncton Area has experienced a steady rate of growth in most sectors, with particular emphasis in the financial, administrative, and service sectors.

Above all, Moncton is a city whose residents believe in sustainability, creativity, and leadership. A city where innovative decisions are made that takes our environment, our economics, and our community into consideration.

### **3.0 METHODOLOGY**

The Community GHG emissions inventory was developed by the City’s Environmental Technologist. A baseline year of 2002 was selected to match the baseline year of the Corporate GHG inventory.

The community GHG emissions inventory includes an assessment of GHG emissions in the following categories:

- Residential
- Commercial
- Industrial
- Transportation
- Waste

Population data was obtained from Statistics Canada, using 2001, the year closest to the year of the baseline inventory. As previously mentioned, the population of Moncton has grown 12.7% between 2001 and 2011, or 1.27% annually. Therefore, 1.27% was added to the 2001 population to obtain a population estimate for 2002.

Electrical energy consumption data was obtained from NB Power. Fuel oil, diesel, and propane energy use estimates were calculated using the consumption patterns in Atlantic Canada and New Brunswick as published in the Comprehensive Energy Use Database obtained from Statistics Canada and Natural Resources Canada (NRCan) (2013). The estimated values for fuel oil, diesel, and propane were first calculated in kilowatt hours and then converted to litres using conversion rates provided by NRCan (2012) for each fuel type, as shown in Appendix B.

Transportation emissions were calculated using the recommended Vehicle Kilometers Travelled (VKT) method. Option 1 for this method was employed, which uses the number of households in the community to estimate the annual VKT.

Community waste statistics were obtained from the Westmorland Albert Solid Waste Corporation. The statistics only include residential waste and the spring clean-up, as commercial and industrial waste statistics are not tracked.

The emissions were calculated using the PCP Inventory Quantification Spreadsheet supported by the PCP Secretariat and available on the FCM’s website.

## 4.0 COMMUNITY GHG EMISSIONS INVENTORY – 2002

### 4.1 Residential Energy Emissions

Residential fuel consumption estimates were made using Natural Resources Canada’s Comprehensive Energy Use Database – Secondary Energy Use by Energy Source for 2002. In New Brunswick, according to the database, energy demands of residences would be met by electricity (57.5%), heating oil (24%), propane (1.4%), and wood (17%). In 2002, residential natural gas service was not available.

The actual amount of electricity consumed by residential customers in 2002 was provided by NB Power, therefore the amount of fuel oil and propane expended were both estimated using the percentages provided by NRCan (2013), assuming that the electricity amounts given represented 57.5% of the total amount. The estimated values for fuel oil and propane were calculated in kilowatt hours and then converted to litres using conversion rates provided by NRCan (2012) for each fuel type, as shown in detail in table 1.

**Table 1: Residential Energy Use and CO<sub>2</sub> Emissions**

Fuel Type	KWh	Energy Use %	NRCan Conversion Factor	Total Use	Total eCO <sub>2</sub> (t)
Electricity	426,909,246	57.5	-	426,909,246 KWh	226,262
Fuel Oil	178,188,207	24	11.25 KWh/L	15,838,952 L	43,322
Propane	10,394,312	1.4	7.38 KWh/L	1,408,443 L	2,175
<b>Total</b>					<b>271,759</b>

Based on the results, the total tonnes of CO<sub>2</sub> emissions generated by the residential community in 2002 were 271,759 with electricity contributing to 83% of emissions produced.

### 4.2 Commercial and Institutional Energy Emissions

Commercial and institutional fuel consumption estimates were made using Natural Resources Canada’s Comprehensive Energy Use Database – Secondary Energy Use by Energy Source for

2002. This data is broken down by region, as opposed to by province. According to the database, in Atlantic Canada, in 2002, energy demands of the commercial and institutional sectors were met by electricity (54%), fuel oil (8.5%), diesel (28.5%), and propane (8.9%).

The actual amount of electricity consumed by commercial and institutional customers in 2002 was provided by NB Power, therefore the amount of fuel oil, diesel, and propane expended were all estimated using the percentages provided by NRCan (2013), assuming that the electricity amounts given represented 54% of the total. The estimated values for fuel oil, diesel, and propane were calculated in kilowatt hours and then converted to litres using conversion rates provided by NRCan (2012) for each fuel type, as shown in detail in table 2.

**Table 2: Commercial Energy Use and CO<sub>2</sub> Emissions**

Fuel Type	KWh	Energy Use %	NRCan Conversion Factor	Total Use	Total eCO <sub>2</sub> (t)
Electricity	414,812,860	54	-	414,812,860 KWh	219,851
Fuel Oil	65,294,617	8.5	11.25 KWh/L	5,803,966 L	15,875
Diesel	218,929,009	28.5	10.66 KWh/L	20,537,430 L	57,295
Propane	68,367,305	8.9	7.38 KWh/L	9,263,892 L	14,304
<b>Total</b>					<b>307,325</b>

Based on the results, the total tonnes of CO<sub>2</sub> emissions generated by commercial and institutional buildings in the community in 2002 were 307,325 with electricity contributing 72% of GHG emissions in the commercial sector.

### 4.3 Industrial Energy Emissions

Industrial fuel consumption estimates were made using Natural Resources Canada's Comprehensive Energy Use Database – Secondary Energy Use by Energy Source. Similar to the commercial sector, data is provided by region instead of province. According to the database, in Atlantic Canada in 2002, energy demands of the industrial sector would be met by electricity (23.5%), fuel oil (18.3%), diesel (6.6%), and propane (3.2%).

The actual amount of electricity consumed by industrial customers in 2002 was provided by NB Power, therefore the amount of fuel oil, diesel, and propane expended were all estimated using the percentages provided by NRCan (2013), assuming that the electricity amounts given represented 23.5 % of the total. The estimated values for fuel oil, diesel, and propane were calculated in kilowatt hours and then converted to litres using conversion rates provided by NRCan (2012) for each fuel type, as shown in detail in table 3.

**Table 3: Industrial Energy Use and CO<sub>2</sub> Emissions**

Fuel Type	KWh	Energy Use %	NRCan Conversion Factor	Total Use	Total eCO <sub>2</sub> (t)
Electricity	56,453,358	23.5	-	54,453,358 KWh	29,920
Fuel Oil	43,961,551	18.3	11.25 KWh/L	3,907,693 L	10,688
Diesel	15,854,986	6.6	10.66 KWh/L	1,487,335 L	4,149
Propane	7,687,266	3.2	7.38 KWh/L	1,041,635 L	1,608
<b>Total</b>					<b>46,366</b>

Based on the results, the total tonnes of CO<sub>2</sub> emissions generated by industrial buildings in the community in 2002 were 46,366 with electricity contributing to 65% of GHG emissions in the industrial sector.

#### 4.4 Transportation Emissions

Providing an accurate estimate of transportation emissions can be difficult given the nature of the traffic in a community. Due to Moncton's central location, there are many people who commute to Moncton from surrounding areas for employment, medical, education, and retail purposes.

To calculate the emissions for transportation, the estimated annual vehicle kilometers travelled (VKT) method was used. The number of households in Moncton was obtained from Statistics Canada 2001 Census data and the PCP spreadsheet provided an average of 1.55 vehicles per household. The estimated annual VKT was then determined to be 677,686,145 km which yielded an emissions total of 233,269 tonnes of CO<sub>2</sub>.

Table 4 provides a breakdown of the source of the estimated transportation-related eCO<sub>2</sub> emissions, in tonnes, along with the estimated fuel consumption, in litres.

**Table 4: Transportation Emissions (tonnes) and Fuel Consumption (litres)**

Fuel Type	Tonnes (CO <sub>2</sub> )					Total Fuel Used (L)
	Autos	Light Truck	Heavy Truck	Bus	Total	
Gasoline	77,945	78,225	6,157	0	<b>162,327</b>	66,540,199
Diesel	211	2,121	66,652	58	<b>69,042</b>	25,268,916
Propane	1,900	0	0	0	<b>1,900</b>	1,230,679
CNG	0	0	0	0	0	0
Ethanol Blend (10%)	0	0	0	0	0	0
<b>Total</b>	<b>80,056</b>	<b>80,346</b>	<b>72,809</b>	<b>58</b>	<b>233,269</b>	<b>93,039,794</b>

It should be noted that these results do not reflect emissions related to public transportation (city buses), as they were already included in the corporate greenhouse gas inventory.

#### 4.5 Community Waste Emissions

Solid waste production information for the residential sector was available directly from the Westmorland Albert Solid Waste Commission. The waste category includes emissions produced from waste generated from the residential sector only. Industrial waste, construction waste and demolition waste, including concrete, wood, tires and contaminated soil, are not included in the community emissions inventory. Recyclables have also been excluded from the total, as they are not landfilled.

As depicted in table 5 below, in 2002, 15,857 tonnes of waste was sent to landfill, which attributed to 7,638 tonnes of eCO<sub>2</sub>.

**Table 5: Community Waste Emissions**

Waste to landfill (tonnes):	<b>15,857</b>
eCO <sub>2</sub> Emissions (t):	<b>7,638</b>

#### 5.0 TOTAL COMMUNITY GHG EMISSIONS SUMMARY

As indicated in table 6 and figure 1, based upon the calculated residential, commercial and institutional, and industrial emissions, the total CO<sub>2</sub> emissions for the 2002 baseline year is equivalent to 866,369 tonnes. The largest source of emissions was the commercial sector which contributed to 36% of emissions, followed closely by the residential sector with 31% and the transportation sector with 27%.

**Table 6: Community GHG Emissions Inventory Summary by Sector - 2002**

Sector	Total eCO <sub>2</sub> (t)
Residential	271,760
Commercial	307,337
Industrial	46,366
Transportation	233,269
Community Waste	7,638
<b>Total</b>	<b>866,369</b>



**Figure 1: Community eCO<sub>2</sub> Emissions Breakdown by Sector**

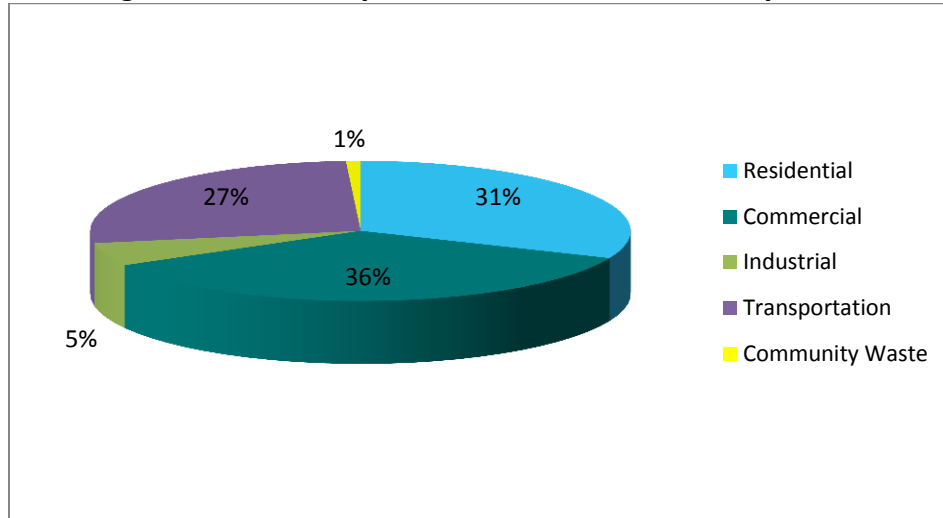
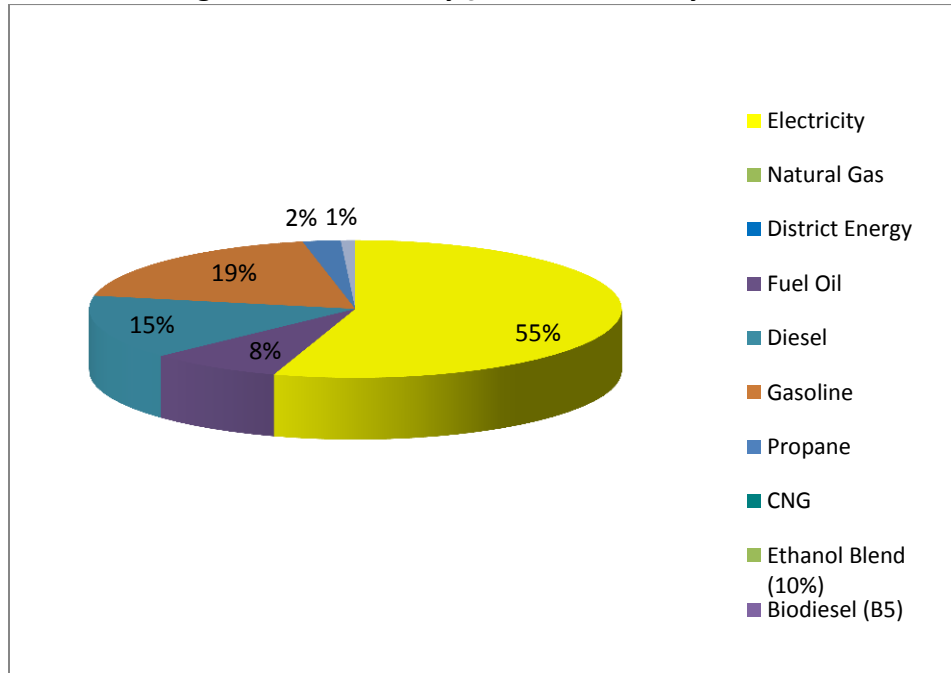


Table 7 and figure 2 show the emissions according to source. In this instance, electricity is the largest contributor of greenhouse gas emissions in the community, with 55% of the emissions.

**Table 7: Community GHG Emissions Inventory Summary by Source – 2002**

Energy Type	Total eCO <sub>2</sub> (t)
Electricity	476,033
Natural Gas	0
District Energy	0
Fuel Oil	69,885
Diesel	130,486
Gasoline	162,327
Propane	19,987
CNG	0
Ethanol Blend (10%)	0
Biodiesel (B5)	0
Biodiesel (B10)	0
Biodiesel (B20)	0
Waste	7,638
<b>Total</b>	<b>866,356</b>

**Figure 2: Community eCO<sub>2</sub> Emissions by Source**



This baseline community inventory will provide a departure point in which the City of Moncton can use for setting an emissions reduction target.

## 6.0 EMISSIONS FORECAST

### 6.1 POPULATION GROWTH FORECAST

As mentioned in the community profile of Section 2.0, according to Statistics Canada census data, the 2011 population of Moncton was 69,074, while in 2001 it was 61,046. This represents an increase of 12.7% over ten years, or approximately 1.27% per year. The city of Moncton’s population, both actual and estimated, is summarized in table 8 below.

**Table 8: Population Estimates for Moncton from 2001 to 2012**

Year	Population
2001	61,046*
2002	61,821**
2011	69,074*
2012	69,951**

\*Actual population, based on Statistics Canada Census Data for that year

\*\*Estimated population

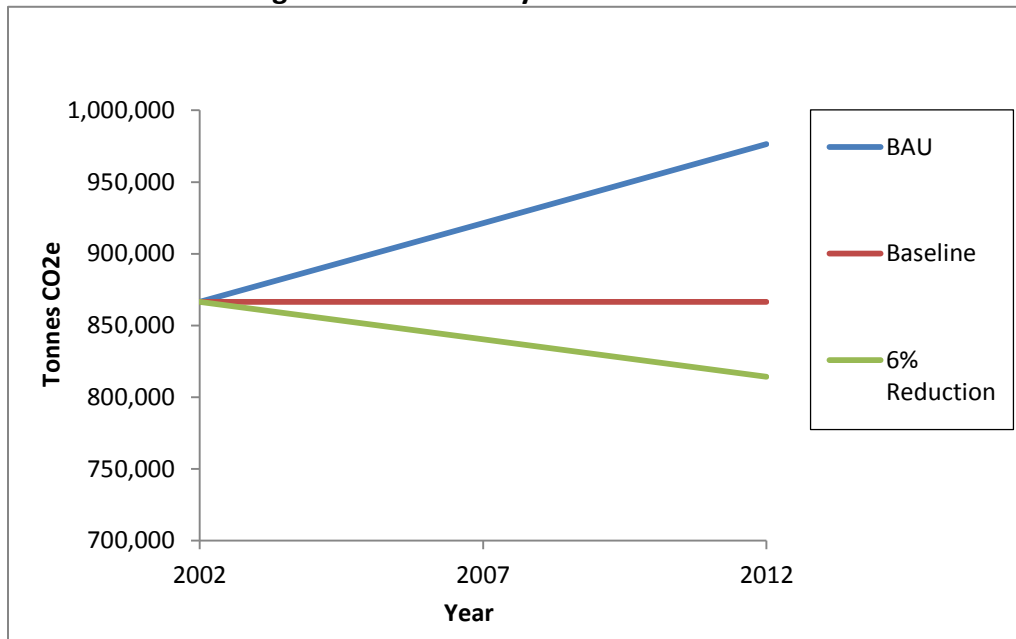
## 6.2 COMMUNITY EMISSIONS FORECAST – BUSINESS AS USUAL (BAU)

Based on the population growth, a 1.27% per year increase was used to forecast GHG emissions from the baseline year of 2002 to the target year of 2012. This forecast, shown in Table 9 and Figure 3, represents the business as usual (BAU) scenario.

**Table 9: BAU Forecasted Emissions for 2012**

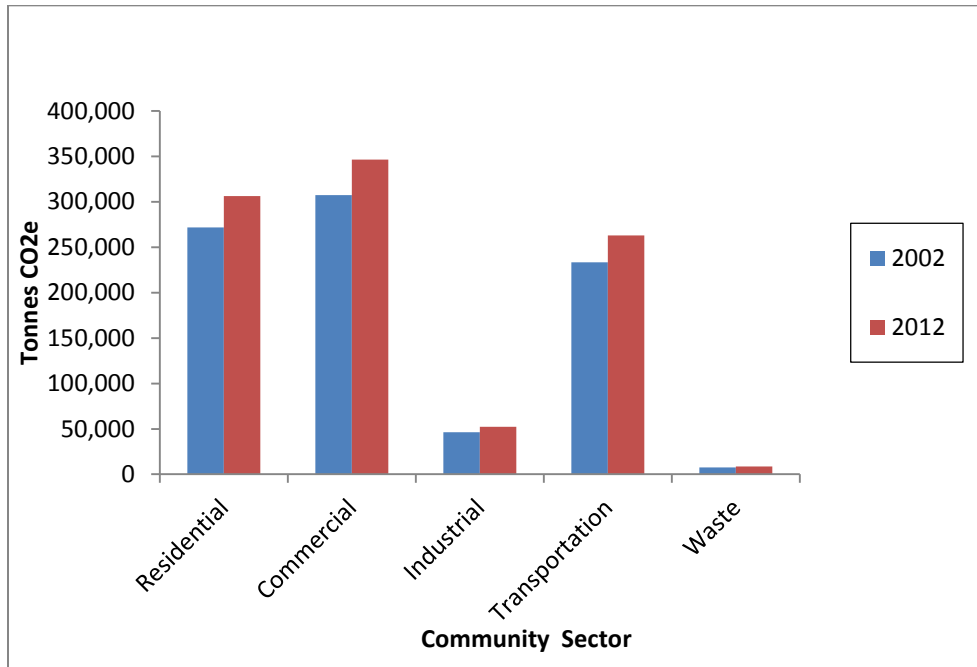
	Current emissions	Emissions in Forecast year
Residential	271,759	306,272
Commercial	307,325	346,355
Industrial	46,366	52,255
Transportation	233,269	262,894
Waste	7,638	8,608
<b>Total Emissions (t CO<sub>2</sub>e)</b>	<b>866,356</b>	<b>976,383</b>

**Figure 3: Community Emissions Forecast**



When the BAU scenario is analyzed by sector, as shown in Figure 4, the commercial sector emissions are predicted to be the highest, followed closely by the residential sector and thirdly by transportation sector.

**Figure 4: Community Emissions Forecast by Sector**



## 6.0 RECOMMENDATIONS AND NEXT STEPS

This inventory presents a reference point for Moncton’s community GHG emissions trend. The baseline inventory will become an important tool when assessing the community’s progress in reducing GHG emissions and achieving the selected reduction target.

The City of Moncton has already identified several energy reduction targets for the community in its Integrated Community Sustainability Plan. These goals include decreasing the percentage of community energy use from non-renewable resources, along with achieving the FCM recommended target of a 6% reduction in emissions within 10 years.

It is recommended that the City continues to move forward with the PCP program and undertakes the following steps:

- Establish a realistic and achievable community emissions reduction target (Milestone 2 of the PCP) and;
- Develop a comprehensive local action plan for reducing emissions and achieving the established target (Milestone 3 of the PCP)

## REFERENCES

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## **APPENDIX A**

### **Community GHG Emissions Inventory Data Baseline Year – 2002**

## General Information

Name of Municipal Government:	City of Moncton
Province/Territory:	New Brunswick
Community Inventory Year (btw 1990 and 2012):	2002

## Residential

### Community Inventory

Electricity stats provided by NB Power for 2002. Others calculated using NRCan Comprehensive Energy Use Database table. 1.27% was added to the 2001 Stats Canada population to produce an estimate for 2002.

Description: Number of households provided by Statistics Canada, Population and Dwelling Counts 2001 Census

Fuel Type	Units	Total Use	Total eCO <sub>2</sub> (t)
Electricity	kWh	426,909,246	226,262
Natural Gas	m <sup>3</sup>		0
District Energy	GJ		0
Fuel Oil	L	15,838,952	43,322
Diesel	L		0
Propane	L	1,408,443	2,175
<b>Total</b>		<b>444,156,641</b>	<b>271,759</b>

Indicators	Indicator Values	Total eCO <sub>2</sub> /Indicator
Population:	61,821	4.395894715
Households:	27126	10.01838115

## Commercial

### Community Inventory

Electricity stats provided by NB Power for 2002. Others calculated using NRCan Comprehensive Energy Use Database table. The # of establishments based on the number of customers for the category provided by NB Power

Description: based on the number of customers for the category provided by NB Power

Fuel Type	Units	Total Use	Total eCO <sub>2</sub> (t)
Electricity	kWh	414,812,860	219,851
Natural Gas	m <sup>3</sup>		0
District Energy	GJ		0
Fuel Oil	L	5,803,966	15,875
Diesel	L	20,537,430	57,295
Propane	L	9,263,862	14,304
<b>Total</b>		<b>-</b>	<b>307,325</b>

<b>Indicators</b>	<b>Indicator Values</b>	<b>Total eCO<sub>2</sub>/Indicator</b>
Floor Area (1000 m <sup>2</sup> ):		#DIV/0!
Employees:		0.00
Establishments:	3284	0.01

## ● Industrial

### Community Inventory

Electricity stats provided by NB Power for 2002. Others calculated using NRCAN Comprehensive Energy Use Database table. The # of establishments based on the

Description: number of customers for the category provided by NB Power.

<b>Fuel Type</b>	<b>Units</b>	<b>Total Use</b>	<b>Total eCO<sub>2</sub> (t)</b>
Electricity	kWh	56,453,358	29,920
Natural Gas	m <sup>3</sup>		0
District Energy	GJ		0
Fuel Oil	L	3,907,693	10,688
Diesel	L	1,487,335	4,149
Propane	L	1,041,635	1,608
<b>Total</b>			<b>46,366</b>

<b>Indicators</b>	<b>Indicator Values</b>	<b>Total eCO<sub>2</sub>/Indicator</b>
Floor Area (1000 m <sup>2</sup> ):		#DIV/0!
Employees:		370.93
Establishments:	125	370.93



## ● Transportation

### Community Inventory

Description: Number of households based on Statistics Canada 2001 Census Data for the city of Moncton, NB

### Option 1: Vehicle Kilometers Travelled (Recommended)

Total Annual Vehicle Kilometres Travelled (VKT): 667,686,145

#### eCO<sub>2</sub> Emissions (t)

	Autos	Light Truck	Heavy Truck	Bus	Total	Total Fuel Used (L)
Gasoline	77,945	78,225	6,157	0	162,327	66,540,199
Diesel	211	2,121	66,652	58	69,042	25,268,916
Propane	1,900	0	0	0	1,900	1,230,679
CNG	0	0	0	0	0	0
Ethanol Blend (10%)	0	0	0	0	0	0
<b>Total</b>	<b>80,056</b>	<b>80,346</b>	<b>72,809</b>	<b>58</b>	<b>233,269</b>	-

If modeled VKT data is not available for your community, consider the following option to estimate this total. VKT can be estimated by looking at the number of households in your community

Number of households	27,126
Average vehicles per household	1.55
Average distance per vehicle	16,118
Estimated annual VKT	677,686,145

## ● Community Waste

### Community Inventory

Description: Provided by WASWC, Region 7, only includes residential waste and spring clean up  
Waste to landfill (tonnes): 15856.67

eCO<sub>2</sub> Emissions (t): 7,638

## ● Business-as-Usual

### Community Inventory

Community info

Base Year	2002
Forecast Year*	2012
Reduction Target by Forecast Year* (%)	6%

\* PCP recommends calculating a BAU estimate for approximately 10 years after the baseline year

	Current emissions	% Change Expected**	Emissions in Forecast year	Explanation for % change expected
Residential	271,759	12.7%	306,272	Increase in population by 12.7%
Commercial	307,325	12.7%	346,355	
Industrial	46,366	12.7%	52,255	
Transportation	233,269	12.7%	262,894	
Waste	7,638	12.7%	8,608	
<b>Total Emissions (t CO<sub>2</sub>e)</b>	<b>866,356</b>		<b>976,383</b>	

\*\* For expected decreases, enter a minus symbol before the number

#### Data for Line Graph

BAU	2002	866,356
	2007	921,370
	2012	976,383
Baseline	2002	866,356
	2007	866,356
	2012	866,356
6% Reduction	2002	866,356
	2007	840,365
	2012	814,375

#### Data for Bar Graph

	Baseline	BAU
Residential	271758.6	306,272
Commercial	307324.6	346,355
Industrial	46366.1	52,255
Transportation	233268.6	262,894
Waste	7638.2	8,608

## APPENDIX B

### Assorted Heating Values

RETScreen

<b>Fuel</b>	<b>Unit</b>	<b>Higher heating value (kWh/unit)</b>
Biomass	t	5,489
Coal	t	9,356
Diesel (#2 oil) - gal	gal	40.36
Diesel (#2 oil) - L	L	10.66
Electricity	MWh	1,000.00
Gasoline - gal	gal	35.43
Gasoline - L	L	9.36
Kerosene - gal	gal	38.49
Kerosene - L	L	10.17
Natural gas - 100 ft <sup>3</sup>	100 ft <sup>3</sup>	29.49
Natural gas - GJ	GJ	277.78
Natural gas - m <sup>3</sup>	m <sup>3</sup>	10.41
Natural gas - mmBtu	mmBtu	293.07
Oil (#6) - gal	gal	42.6
Oil (#6) - L	L	11.25
Propane - gal	gal	27.94
Propane - kg	kg	14.47
Propane - L	L	7.38

[www.retscreen.net](http://www.retscreen.net)

Source: Natural Resources Canada, 2012