



2014 Saskatoon Greenhouse Gas Emissions Inventory



Executive Summary

The 2014 Saskatoon Greenhouse Gas Emissions Inventory supports federal and international reporting standards. The inventory is meant to provide a representation of Saskatoon's total emissions as well as emissions by sector to support the exploration of emissions abatement strategies in the community, and efficiencies within City of Saskatoon operations.

Saskatoon joined the Compact of Mayors in 2015 to demonstrate a commitment to respond to climate change and acknowledge that local action can have significant global impact. As a result, the City is required to engage in mitigation and adaptation reporting, target setting and implementation of a climate change plan, to be completed and maintained in 2018. This coincides with the timing of the federal government announcement to implement a price on carbon in 2018. The carbon price comes as a result of the Canadian government commitment by way of the Paris Climate Agreement to reduce emissions and engage in activities to keep global temperatures within 2 degrees Celsius above pre-industrial levels.

Saskatoon conducted an emissions inventory in 2003, and has produced estimates for 2006 and 2013. During this time, an emissions reductions target for the City of Saskatoon Corporation was set to 30% below 2006 levels by 2023.

Overall, the Saskatoon community emissions have increased 12% since the 2003 inventory. Additional sectors were analyzed for the 2014 inventory to report a more comprehensive emissions inventory. Eliminating these additional sectors continues to produce an 8% increase since the 2003 emissions inventory. Industrial, commercial and institutional energy consumption in buildings is the highest emitter, but has realized a 38% decline in emissions since the 2003 inventory, whereas emissions associated with residential buildings increased by 54%.

The City of Saskatoon corporate emissions increased 39% since the 2003 inventory. The highest emitting sector is realized in building energy, with administrative and operational buildings consuming a greater share than recreational facilities and emergency services.

Contents

.....	1
2014 Saskatoon Greenhouse Gas Emissions Inventory	1
Introduction	9
1 Introduction	10
1.1 The Greenhouse Gas Effect	10
1.2 Saskatoon Memberships and Commitments	11
Methodology	14
2 Inventory Methodology	15
2.1 Protocol	15
2.2 GPC Methodology	16
2.2.1 Global Warming Potential	16
2.2.2 Scope	16
2.2.3 Sectors	17
2.3 Data Sources	19
2.3.1 Community Inventory	19
2.3.2 Corporate Inventory	20
2.4 Adjustments and Estimates	21
2.5 Verification	21
Results	22
3 Results	23
3.1 Saskatoon Community Emissions Inventory	23
3.1.1 Community Buildings	27
3.1.2 Community Transportation	30
3.1.3 Community Solid Waste	32
3.1.4 Community Agriculture and Land Use	34
3.1.5 Industrial Processes	36
3.2 Saskatoon Corporate Emissions Inventory	39
3.2.1 Corporate Buildings	40
3.2.2 Water and Wastewater Treatment	42
3.2.3 Streetlights	42
3.2.4 Transportation and Equipment	43
3.2.5 Solid Waste	45
3.2.6 Other Operations	45

3.2.7 Zoo and Land Use	45
Context	48
4 Context	49
4.1 Climate Change Impacts	49
4.1.1 Climate Change on the Prairies	50
4.1.2 Socio-Economic Impacts of Climate Change.....	51
4.2 Response to Climate Change	52
4.3 Saskatoon Response to Climate Change	53
4.4 The Role of Cities and Government in Climate Change	53
Appendices	56
Appendix A – Compact of Mayors	57
Appendix B – GPC Sectors.....	59
Appendix C – Summary of Saskatoon Community Emissions	60
Appendix D – Summary of Saskatoon Corporate Emissions	61
Appendix E – Global Warming Potential and Emission Factors	62
Appendix F – Emissions and Demographics by Neighbourhood.....	64

List of Tables

Table 1 - Emissions Contributors	11
Table 2- Global Warming Potential of Greenhouse Gases.....	16
Table 3 - Saskatoon Community Emissions - 2003 & 2014	25
Table 4 - Saskatoon Community Transportation Emissions Summary - 2014	30
Table 5 - Saskatoon Waste Production & Emissions 2003 & 2014	33
Table 6 - Reported Emissions by Province and Territory - 2014	38
Table 7 - Corporate Inventory Data Summary - 2003 & 2014	39
Table 8 - Energy Consumption and Emissions in Corporate Buildings - 2014	41
Table 9 - Emissions Produced by Wastewater and Water Treatment - 2003 & 2014	42
Table 10 – Streetlight Energy Use and Emissions - 2003 & 2014.....	43
Table 11 - Traffic signal energy Use and Emissions - 2003 & 2014.....	43
Table 12 - Vehicle Use at the City of Saskatoon Corporation - 2014	44
Table 13 - Fuel Consumption for Saskatoon Fleet and Emergency Services - 2003 & 2014	44
Table 14 - Corporate Waste Produced in Tonnes - 2003 & 2014.....	45

List of Figures

Figure 1 - The Greenhouse Gas Effect.....	10
Figure 2- Compact of Mayors Commitments Phases	12
Figure 3 - Compact of Mayors Commitments Timeline	12
Figure 4 - GPC - the Protocol used to complete the 2014 Saskatoon Greenhouse Gas Emissions Inventory.....	15
Figure 5 - Scope of Analysis for the Inventory	17
Figure 6 - Sectors of Analysis for the GPC Protocol.....	18
Figure 7- Saskatoon Age Distribution – 2014	23
Figure 8 - Saskatoon Community Emissions - 2014.....	24
Figure 9 - Emissions per Capita for Select Canadian Cities – 2014.....	25
Figure 10 - Emissions by Province - 2014	26
Figure 11 - Emissions by Building Type 2003 & 2014	27
Figure 12 - Primary Age of Dwelling in Saskatoon by Neighborhood.....	28
Figure 13 - Density by Number of Dwellings per Acre	29
Figure 14 - Average Household Income by Neighbourhood.....	29
Figure 15 - Total Emissions by Neighbourhood.....	30
Figure 16 - Saskatoon Community Transportation Emissions by Sector - 2014	31
Figure 17 - Mode of Travel to Work for Saskatoon Municipality - 2011.....	32
Figure 18 - Provincial Waste Data – 2014 & 2012.....	33
Figure 19- Content of Residential Waste in Canada – 2012	34
Figure 20 - Residential Garbage Collection per Capita for Select Cities - 2013.....	34
Figure 21 - Annexation Dates for the City of Saskatoon.....	35
Figure 22 - Facilities Reporting to NPRI by Sector – 2014	36
Figure 23 - Emissions by Source for Industrial Processes in Canada – 2014.....	37
Figure 24- Corporate Emissions by Sector - 2014.....	40
Figure 25 - Energy Consumption by Building Type	41
Figure 26 - Global Temperature Trends - 1981 to 2010	49
Figure 27 - Global Temperature Variation	50
Figure 28 - Projected Increase in Annual Temperature for the Canadian Prairies.....	51
Figure 29 - Provincial Exports Percentage Share of Nominal GDP – 2014	52
Figure 30 - The Expected Increase of Global Emissions to 2050.....	54

List of Acronyms

Acronym		Definition
AFOLU	Agriculture, Forestry and Other Land Use	A sector that reports emissions produced as a result of affecting the natural environment
C40		A climate leadership group of international municipalities
CO ₂ e	Carbon dioxide equivalent	A unit of measurement to emissions by using carbon dioxide as a benchmark
CPI	Consumer Price Index	A unit of measurement to report the cost of consumer goods; it is often used as an indicator of the health of an economy
FCM	Federation of Canadian Municipalities	A member organization that provides municipal government the opportunity to communicate at the federal level
FTE	Full-time Employee	A council approved employment measurement that constitutes full time hours
GDP	Gross Domestic Product	A value of all the goods and services produced in a designated area such as a country or province
GHG	Greenhouse Gases	
GJ	Gigajoules	A unit of measurement for energy
GPC	The Global Protocol for Community-Scale Greenhouse Gas Emission Inventories: An Accounting and Reporting Standard for Cities	The protocol used to produce the 2014 Saskatoon Greenhouse Gas Emissions Inventory
GWP	Global Warming Potential	A unit of measure to report how much heat a gas will absorb in the atmosphere
ICI	Institutional, Commercial and Industrial	
ICLEI		
IPPU	Industrial Process and Product Use	A sector that reports emissions produced as a result of industry
kWh	Kilowatt hours	A unit of measurement for electricity
NPRI	National Pollution Release Inventory	A report produced by the Canadian federal government that corporations must report to annually; the inventory reports emissions by geographical area and sector
PCP	Partners for Climate Protection	A network of Canadian municipalities that have committed to reducing GHG emissions
PSAB	Public Sector Accounting Board	The body that establishes accounting standards for the public sector
t	Tonnes	Unit of measurement; commonly used to report emissions



Introduction



1 Introduction

The 2014 Saskatoon Greenhouse Gas Emissions Inventory Report summarizes annual emissions in Saskatoon which includes emissions resulting from corporate and community activities within city limits. The report identifies benchmarks and material sources of emissions in Saskatoon, and relates those to targets set by the City in the Strategic Plan. As part of this commitment, the City of Saskatoon's intention to reduce Greenhouse Gas (GHG) emissions is outlined in the Saskatoon 2013-2023 Strategic Plan.

1.1 The Greenhouse Gas Effect

Global warming occurs when gases in the air absorb thermal radiation that would otherwise be reflected outside Earth's atmosphere (Figure 1). One effect of increasing emissions levels is a steadily increasing temperature on Earth's surface. Naturally occurring absorbents include trace gases and water vapour; which are augmented by gases in the air from pollution.

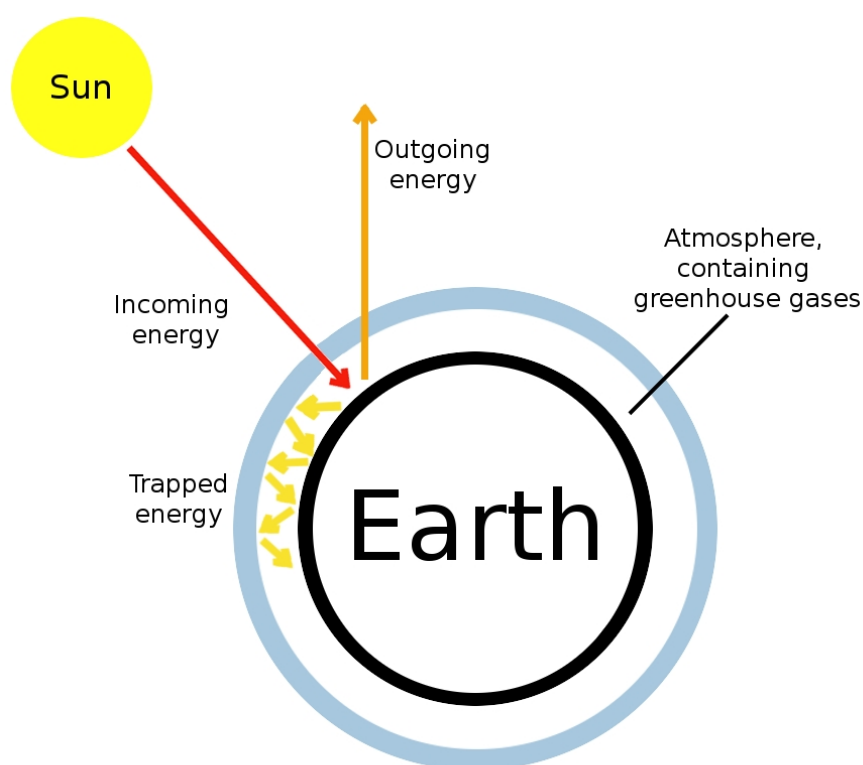


Figure 1 - The Greenhouse Gas Effect (Extance, 2010)

As shown in Table 1, some emissions are generated during the typical course of nature's life cycle, while other emissions are a result of human activity.¹ The increase in global temperatures over the last half century can be partially attributed to the increased emissions following the Industrial Revolution. The Industrial Revolution prompted the increased burning of fossil fuels (such as those used for heating buildings and transportation), as well as increased deforestation and industrial processes. The quantity and type of gases produced during these activities have higher heat absorbing qualities, reported as Global Warming Potential, and discussed further in the Methodology section of this report.

Table 1 - Emissions Contributors

Natural emissions	Emissions as a result of human activity
Decomposition	Deforestation
Plant respiration	Burning of fossil fuels
Air-sea gas exchange	Industrial process emissions
Photosynthesis	Electricity generation

Globally, the activities that produce the highest emissions are energy, agriculture and land use, industrial processes and transportation.² These activities form the main categories for the 2014 Saskatoon Greenhouse Gas Emissions Inventory Report.

1.2 Saskatoon Memberships and Commitments

As a member of the 'Big City Mayors Caucus' of the Federation of Canadian Municipalities, the City of Saskatoon was invited to sign on to the Compact of Mayors, a joint voluntary agreement launched at the 2014 United Nations Summit on Climate Action and initiated by C40 and ICLEI – Local Governments for Sustainability, and the United Cities and Local Governments. The United Nations acted as facilitator between countries to encourage binding agreements on climate change commitments, and the Compact of Mayors created a platform to initiate real reduction of emissions and address climate adaptation. The primary methodology to achieve this is to report climate action data at the municipal level in a consistent and transparent way.

In 2016, the Compact of Mayors united with the EU Covenant of Mayors to produce the Global Covenant of Mayors for Climate and Energy. The mission remains the same,

¹ Bio-Equip (2013) Exeter Analytical: Elemental Analyser Assists Monitoring of the Carbon Cycle. Consulted February 2016. Accessed at: <http://www.bio-equip.cn/ensrc.asp?ID=2771>

² IPCC (2014) Intergovernmental Panel on Climate Change Assessment Report. Consulted May 2016. Accessed at: https://www.ipcc.ch/pdf/assessment-report/ar5/wg3/ipcc_wg3_ar5_chapter1.pdf

with more resources and a larger city membership base (7,100 strong)³ to institute climate change at a municipal level.

In addition to reporting climate change data, the City of Saskatoon's commitment to the Compact of Mayors agreement, summarized in Figure 2 and 3, requires adopting mitigation efforts to reduce or prevent emissions, and adaptation, a response plan to reduce the vulnerability to climate change impacts. Detail on how to participate in the Compact of Mayors commitment is outlined in Appendix A; it is a four-phase process of:



Figure 2- Compact of Mayors Commitments Phases (Compact of Mayors Full Guide, 2015)

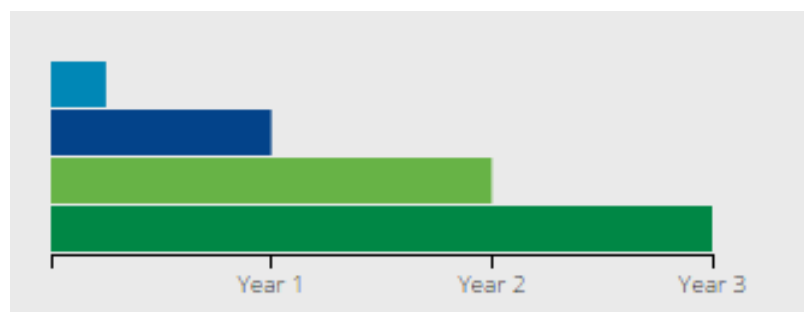


Figure 3 - Compact of Mayors Commitments Timeline (Compact of Mayors Full Guide, 2015)

Year 1 (2015):	Commitment
Year 2 (2016):	Inventory
Year 3 (2017):	Target-setting
Year 4 (ongoing):	Planning

Compact of Mayors issues a Compliance rating issued on an annual basis, based on the members' reported commitments within the required timeline. The commitment addresses both adaptation and mitigation, and compliments Saskatoon's ongoing

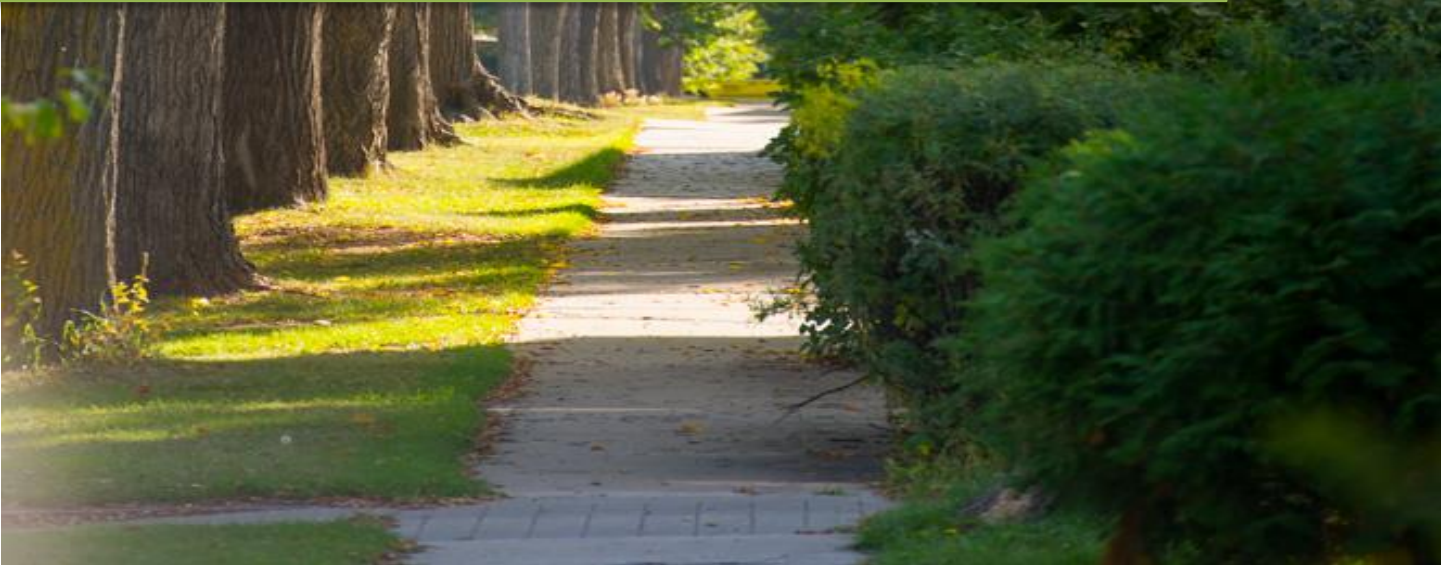
³ Compact of Mayors (2016) Global Covenant of Mayors for Climate and Energy. Consulted September 2016. Accessed at: <https://www.compactofmayors.org/globalcovenantofmayors/>

commitment to the Partners for Climate Protection (PCP) program initiated by the Federation of Canadian Municipalities (FCM). The PCP program is based on a five milestone framework used to guide municipalities to reduce greenhouse gas emissions, including creating an emissions inventory and forecast, setting a reduction target, developing a local action plan, implementing the plan and ongoing monitoring and reporting.

ICLEI – Local Government for Sustainability has been a significant resource for the City of Saskatoon by providing resources and guidelines. ICLEI is also a contributing partner that produced the protocol used to complete the Saskatoon emissions inventory.



Methodology



2 Inventory Methodology

A Greenhouse Gas Emissions inventory is required to follow the same relevant accounting principles utilized in the production of financial statements and recognized by the Public Sector Accounting Board (PSAB). To produce this, protocols have been developed by key members of the global climate change community.

2.1 Protocol

The Global Protocol for Community-Scale Greenhouse Gas Emission Inventories: An Accounting and Reporting Standard for Cities (GPC) was developed by the World Resources Institute, C40 Cities and ICLEI in 2014. Approximately 70% of the world's emissions are released from cities,⁴ and the organizations felt that the GPC was a critical tool to address climate change where it was most effective. The protocol corresponds with other global protocols and accounting principles.

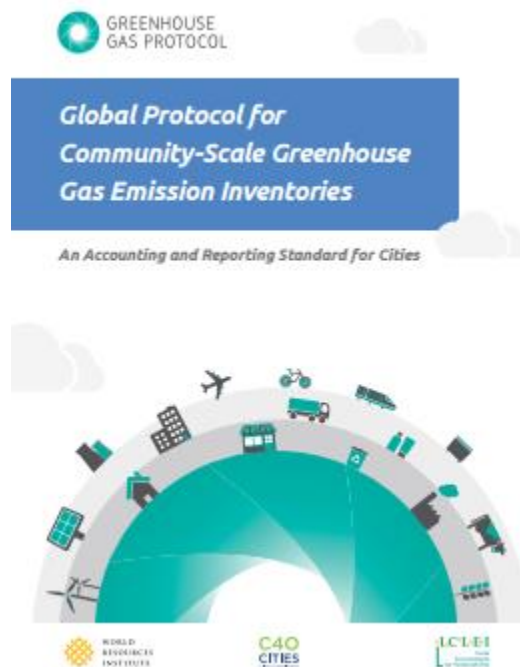


Figure 4 - GPC - the Protocol used to complete the 2014 Saskatoon Greenhouse Gas Emissions Inventory

⁴ C40 (2016) Global Protocol for Community-Scale Greenhouse Gas Emission Inventories: An Accounting and Reporting Standard for Cities. Consulted February 2016. Accessed at: http://c40-production-images.s3.amazonaws.com/other_uploads/images/143_GHGP_GPC_1.0.original.pdf?1426866613

2.2 GPC Methodology

The GPC requires cities to report their emissions by gas, scope, sector, and subsector. This makes the cause of emissions more transparent and results in a comprehensive report. It also enables an entity to report emission reductions that relate to specific initiatives.

2.2.1 Global Warming Potential

In order to report emissions using a common denominator, all gases are reported by way of Global Warming Potential (GWP). GWP is a method of quantifying the heating quality of pollutants to determine their effect on the warming potential of the atmosphere, and is expressed in units of carbon dioxide equivalent or CO₂e for reporting consistency. The seven leading emissions categories and the GWP applied in the 2014 City of Saskatoon Corporate and Community Greenhouse Gas Emissions Inventory are listed in Table 2 and illustrates how much stronger each pollutant is when compared to carbon dioxide (i.e., methane is 25 times more potent as greenhouse gas). GWP is discussed in more detail in the 2.4 Adjustments and Estimates section of this report.

Table 2- Global Warming Potential of Greenhouse Gases

Greenhouse gas		GWP Values
Formula	Name	
CO ₂	Carbon Dioxide	1
CH ₄	Methane	25
N ₂ O	Nitrous Oxide	298
SF ₆	Sulphur hexafluoride	22,800
CF ₄	Carbon tetrafluoride	7,390
C ₂ F ₆	Hexafluoroethane	12,200
NF ₃	Nitrogen trifluoride	17,200

2.2.2 Scope

Figure 5 summarizes the scope of analysis for the Saskatoon Emissions Inventory. Scope 1 reports emissions from sources located within the city boundary (e.g., curbside garbage that is collected from residential dwellings and taken to the landfill), Scope 2 reports emissions occurring as a consequence of the use of grid-supplied energy within the city boundary (e.g., power usage by a household), and Scope 3 reports all other emissions that occur outside of the city boundary as a result of activities that take place within the city boundary (e.g., family vacation where the air travel begins in Saskatoon but the destination is another city).

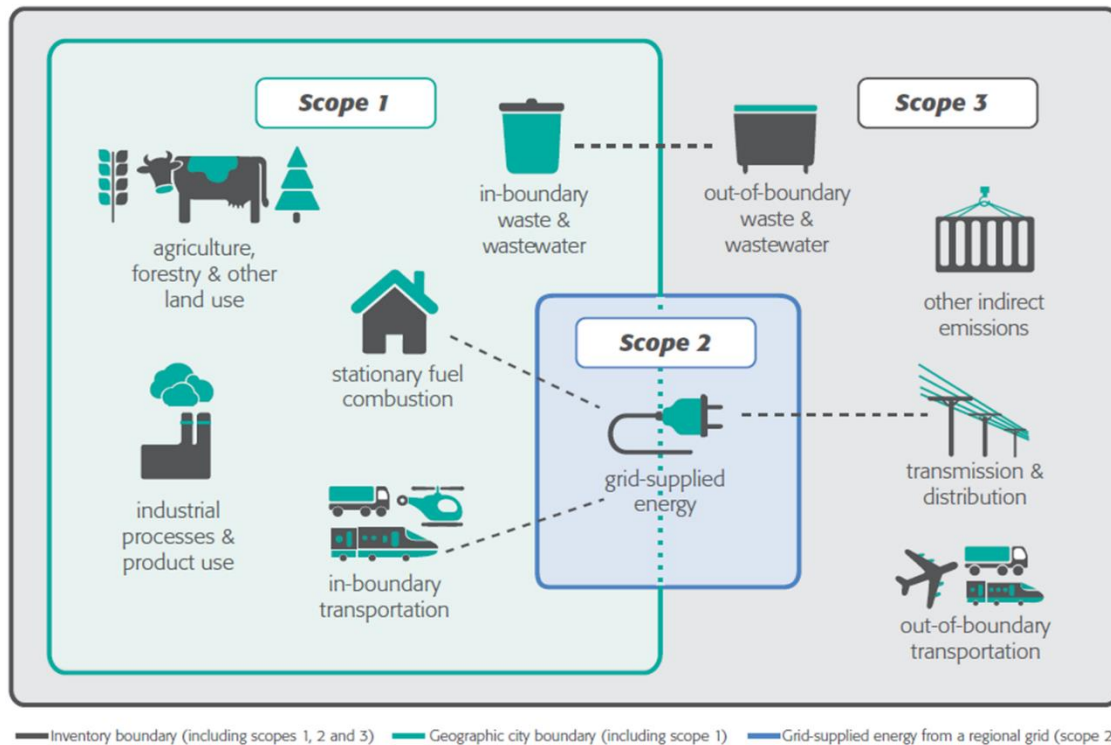


Figure 5 - Scope of Analysis for the Inventory (Global Protocol for Community Scale Greenhouse Gas Emissions Inventories, 2014)

2.2.3 Sectors

The primary sectors of the GPC are Stationary Energy, Transportation, Waste, Industrial Processes and Product Use (IPPU), and Agriculture, Forestry and Other Land Use (AFOLU). The subsectors are the drivers that contribute to the primary sector. For example, the emissions recognized by residential buildings are a subsector of Stationary Energy. See Figure 6 and Appendix B for more detail.

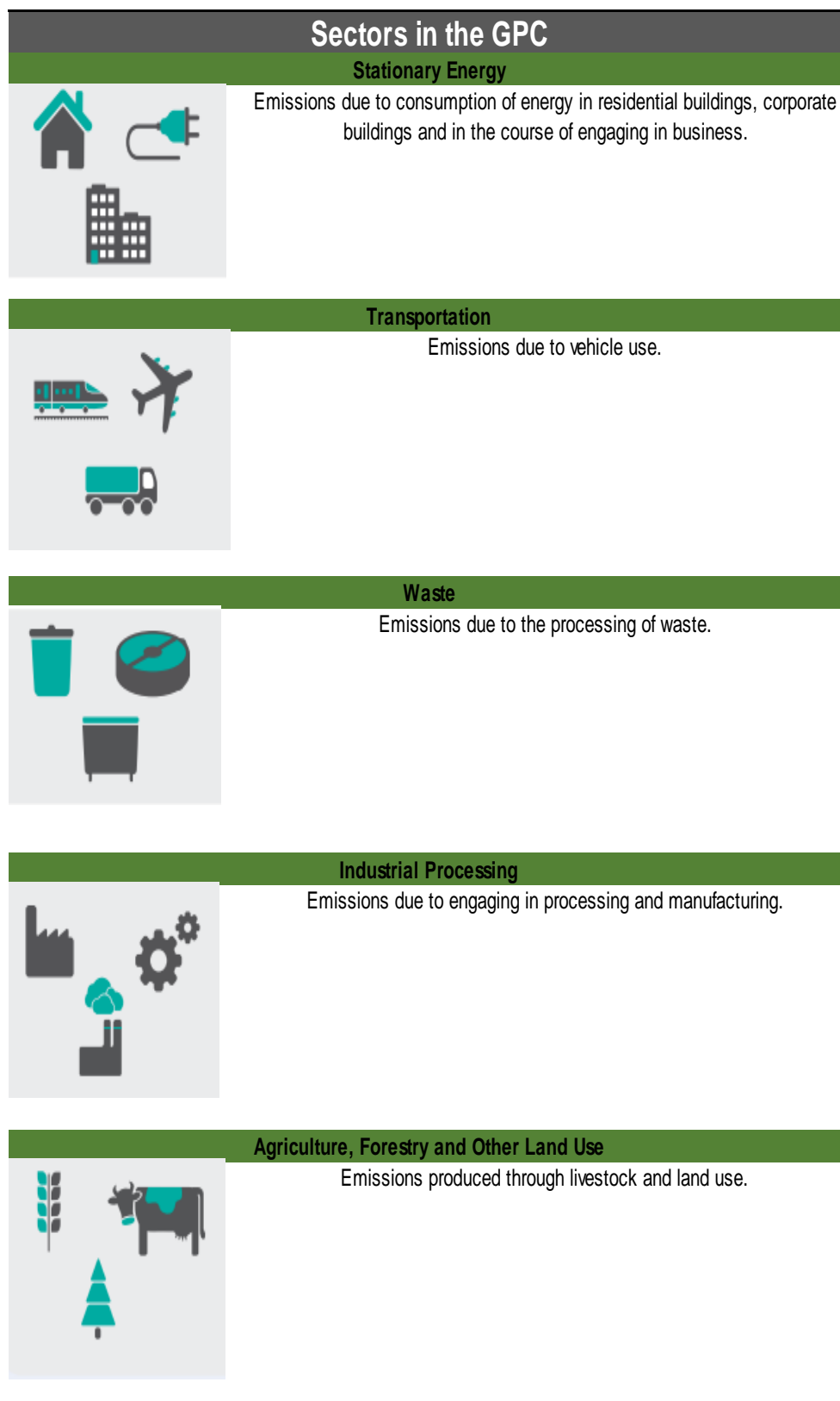


Figure 6 - Sectors of Analysis for the GPC Protocol (Global Protocol for Community Scale Greenhouse Gas Emissions Inventories, 2014)

The framework provided by the GPC allows for cities to report emissions using a BASIC and BASIC+ guideline. The most significant difference between these two standards is that BASIC+ requires an accounting of Agriculture and Land Use (AFOLU), and Industrial Processing (IPPU), two categories that are poignant in the economy of Saskatoon and relevant in the province of Saskatchewan. In the interest of providing the most useful emissions reporting, this emissions report includes AFOLU and IPPU estimates.

2.3 Data Sources

Where possible, all data was requested from the source. Data received from internal and external sources for the inventory was verified to eliminate double counting, incomplete data and incorrect reporting units.

2.3.1 Community Inventory

The Community inventory was led by Environment and Corporate Initiatives, and included contacting various external data sources. The data includes:

$$\text{Total } E_{\text{Community}} = E_{\text{Energy}} + E_{\text{Transportation}} + E_{\text{Waste}} + E_{\text{AFOLU}} + E_{\text{IPPU}}$$

Where:

E	is emissions produced for a specified activity
E_{Energy}	is emissions generated by heat and electricity usage by residential, industrial, commercial and institutional buildings in the community
$E_{\text{Transportation}}$	is emissions generated by movement of goods and people
E_{Waste}	is emissions generated through the processing of liquid and solid waste produced in the community
E_{AFOLU}	is the emissions generated from the University and community land use
E_{IPPU}	is the emissions generated through industrial processing

Emissions produced through energy consumption may be affected by a number of factors, such as number of residents living in a household, and installation of 200 Amp circuits on new buildings. The consumption for energy was obtained from power and energy providers in Saskatchewan, and reported by neighborhood for residents and as a total for commercial businesses and institutions.

The transportation sector is based on the fuel consumption for all vehicles in Saskatoon. Some fuel purchases within the city limits are possibly emitted outside city limits, and

could be considered Scope 3 emissions, rather than Scope 1, but all emissions on fuel bought in the city are reported in the inventory to be conservative.

Waste produced by the community will be affected by waste diversion initiatives such as Curbside Recycling and the Green Cart program. In 2014, Saskatoon had one commercial landfill located in the RM of Corman Park. The Saskatoon municipal landfill and the commercial landfill processes materials produced within city limits.

Agriculture emissions are produced through livestock within city limits. It does not report emissions produced by household pets.

The Industrial Processing sector emissions are different than the energy sector in that the emissions are generated by processing rather than building heating and electricity usage. This sector is based on estimate; the industrial sector was not contacted for emissions data due to the volume of engagement required to do so. Rather, the industrial sector is required to report their processes to the federal government. Estimates were produced based on this publicly shared material. More details are provided in Appendix C. Where appropriate, all assumptions have been recorded with explanations.

2.3.2 Corporate Inventory

The corporate inventory was led by Environment and Corporate Initiatives and calculated utilizing data from internal sources and external sources. The data utilized included:

$$\text{Total } E_{\text{Corporate}} = E_{\text{Energy}} + E_{\text{Transportation}} + E_{\text{Waste}} + E_{\text{AFOLU}}$$

Where:

E	is emissions produced for a specified activity
E_{Energy}	is emissions generated by heat and electricity usage by the City of Saskatoon corporation
$E_{\text{Transportation}}$	is emissions generated by movement of goods and people for City of Saskatoon corporate operations
E_{Waste}	is emissions generated through the processing of liquid and solid waste produced during the course of doing business at the City of Saskatoon corporation
E_{AFOLU}	is the emissions generated from the zoo and corporate land use

Emissions produced by energy consumption in the Saskatoon Corporation include buildings, streetlights, traffic lights, and other operations such as irrigation for parks.

The transportation sector for the corporation includes fleet emissions such as those produced during curbside garbage collection and street sweeping. It also includes equipment usage at the landfill and maintenance of park space.

Solid waste produced at the corporation includes products used in administrative buildings and other operational activities such as processing tailings from street sweeping.

A section for Industrial Processing is not required, as the corporation does not engage in industrial processing. All processes (such as road repair) is externally contracted and included in the community inventory. Appendix D summarizes the emissions produced by the City of Saskatoon Corporation.

2.4 Adjustments and Estimates

The GWP and emissions factors between 2003 and 2014 have changed in some instances. The standards used in the 2003 inventory and 2014 inventory are summarized in Appendix E. The data tables reported in the results section of this report have recalculated the 2003 data, using 2014 emissions factors and GWP where possible to provide a comparative analysis. A note is present where insufficient data was present to calculate the data using 2014 emissions factors and GWP.

2.5 Verification

Internal verification and external verification from a qualified third party was performed on the inventory to assure data used was both reliable and reasonable.

Results



3 Results

3.1 Saskatoon Community Emissions Inventory

The Saskatoon Community emissions are affected by a number of variables, including population, the health of the economy, developed land and annexation. The increase in consumption by a growing municipality is offset by efficiencies and environmental sustainability programs such as the city recycling program, energy efficient buildings, and efforts to decrease fuel consumption.

The City of Saskatoon population in 2014 was reported as 254,569, with the age distribution summarized in Figure 7. The population increased by 26% from 2003 to 2014. The acres of land developed in suburban areas increased by the same amount (27%) in only four years (i.e. between 2010 and 2014) reaching 883.12 acres. Growth in housing units since 2010 was 18%.

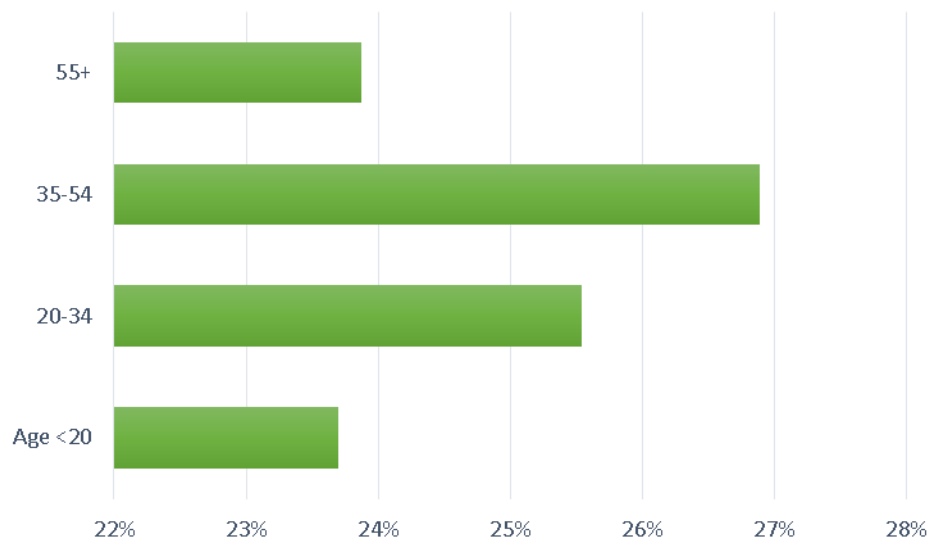


Figure 7- Saskatoon Age Distribution – 2014

The Saskatoon Community Emissions includes emissions that are created inside the municipal boundary or as a result of activities that occurred within the municipal boundary. Services provided that are used by residents (e.g., transit services, waste from curbside garbage collection), and activities that residents and businesses engage in that produce emissions (e.g., vehicle transportation, household electricity consumption) are included in the community emissions inventory.

Figure 8 summarizes the Saskatoon Community emissions by sector, accounting for Agriculture and Industrial estimates. Table 3 shows the change in emissions from 2003 to 2014. Overall emissions have increased 12.6% since 2003. Additional sectors were reported from the 2003 inventory. If these sectors are eliminated, the increase to emissions is slightly less than 8%.

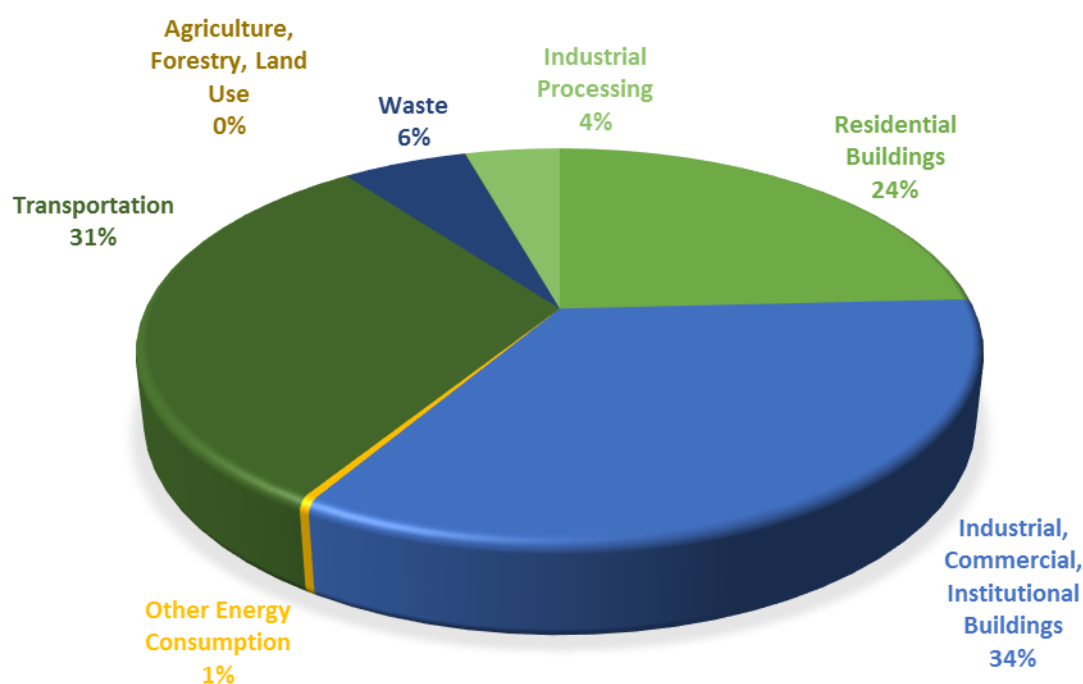


Figure 8 - Saskatoon Community Emissions - 2014

Table 3 - Saskatoon Community Emissions - 2003 & 2014

Sector	GHG (tonnes of CO ₂ e)			
	2003	2003 new standards	2014	% Increase 2014
Residential Buildings	659,433	604,686	932,215	54.2%
Industrial, Commercial, Institutional Buildings	2,312,564	2,135,152	1,321,768	-38.1%
Other Energy Consumption	NR	NR	14,129	
Transportation	562,285	632,414	1,194,014	88.8%
Waste	49,057	49,057	221,984	352.5%
Agriculture, Forestry, Land Use	NR	NR	511	
Industrial Processing	NR	NR	167,550	
Total	3,583,339	3,421,309	3,852,171	12.6%

* NR = Not Reported

The largest increase in tonnes of emissions was realized in transportation, an 89% increase from the 2003 inventory. The largest proportional increase in emissions is in the waste category.

The Saskatoon community has a relatively high emissions rating per capita compared to other municipal communities in the country, as reported in Figure 9. This is an increase from 14.62 t of CO₂e emissions per capita from 2003, an increase of approximately 3%.

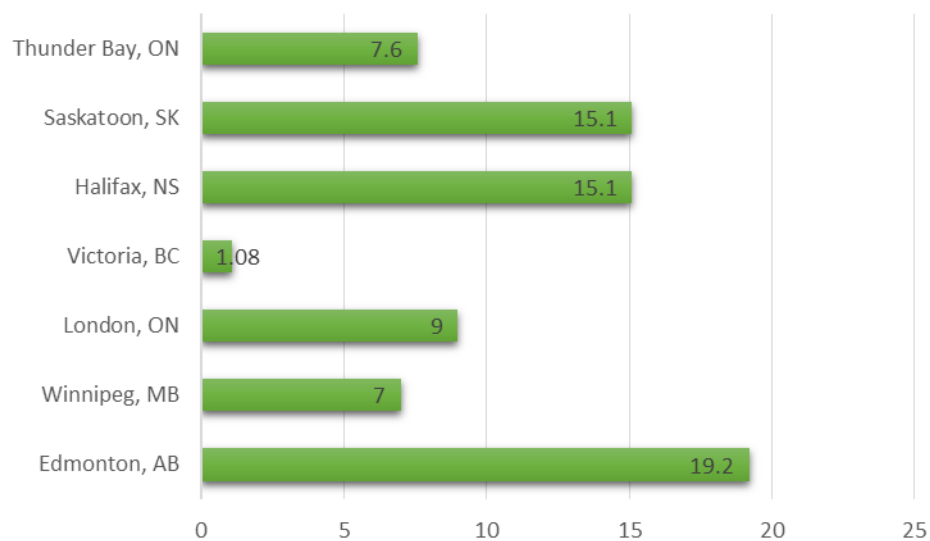


Figure 9 - Emissions per Capita for Select Canadian Cities – 2014 (Stats Canada, 2016)

Saskatchewan's emissions constitute 10% of the total emissions released by the country of Canada, and are summarized in Figure 10⁵ with GDP and population making up 3.7%⁶ and 3.1%⁷, respectively. Saskatchewan is an agriculture and energy-based economy, and the emissions from those sectors account for approximately 50% of emissions in the Province. As 8% of provincial emissions can be sourced to Saskatoon, and with Saskatoon being the largest city in the province, it stands to make a significant impact on emissions based on municipal emission reduction initiatives.

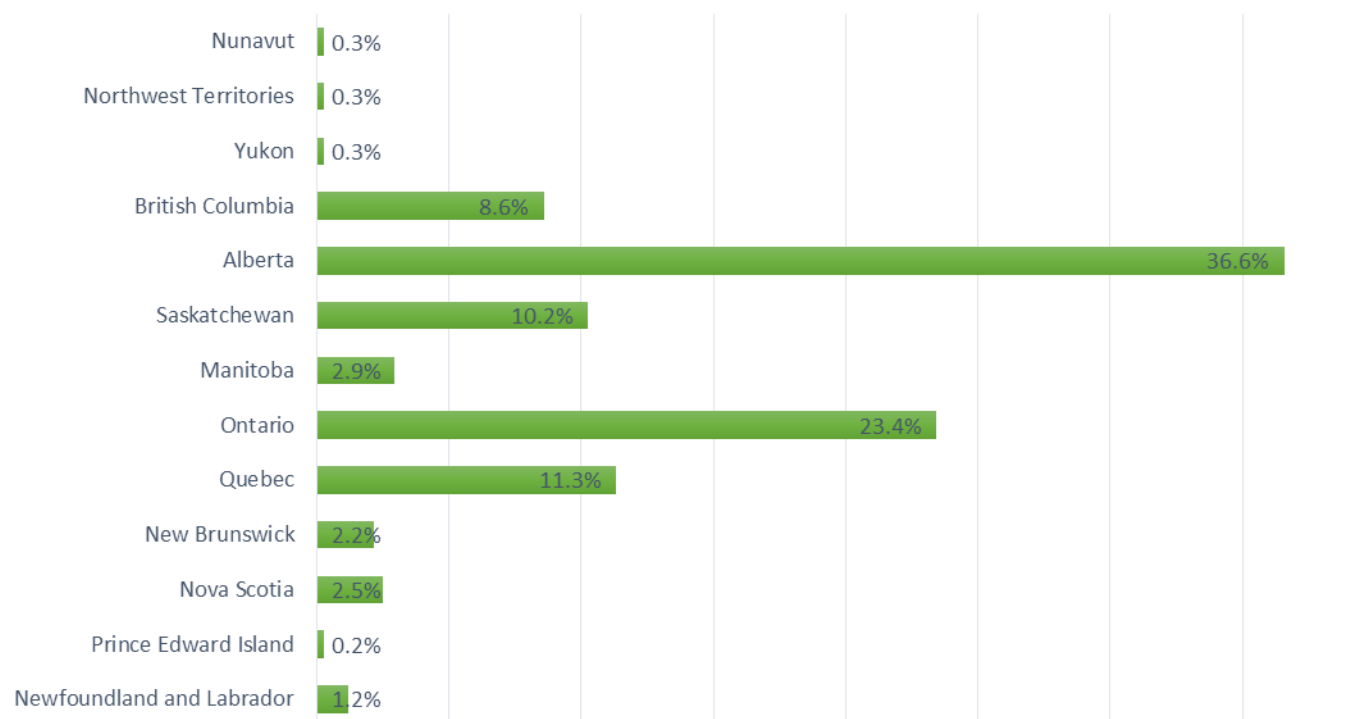


Figure 10 - Emissions by Province - 2014

⁵ Environment and Climate Change Canada (2016) Canadian Environmental Sustainability Indicators: Greenhouse Gas Emissions. Consulted on 15/02/2016. Available at: www.ec.gc.ca/indicateurs-indicators/default.asp?lang=en&n=FBF8455E-1

⁶ Statistics Canada (2016) Gross domestic product, expenditure-based, by province and territory. Consulted 15/02/2016. Available at: <http://www.statcan.gc.ca/tables-tableaux/sum-som/l01/cst01/econ15-eng.htm>

⁷ Statistics Canada (2016) Population by year, by province and territory. Consulted 15/02/2016. Accessed at: <http://www.statcan.gc.ca/tables-tableaux/sum-som/l01/cst01/demo02a-eng.htm>

3.1.1 Community Buildings

As Figure 11 illustrates, residential household consumption of energy increased by 54% from the 2003 inventory, while the Industrial, Commercial and Institutional sector decreased by 38%.

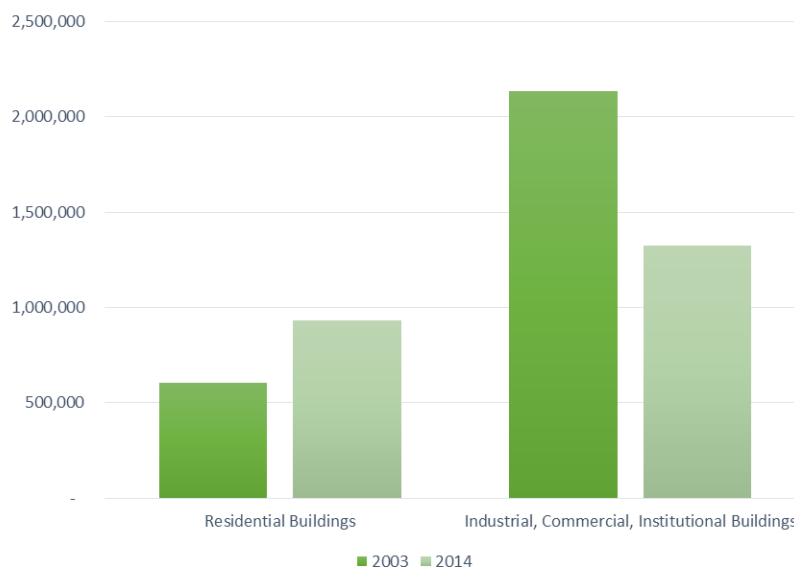


Figure 11 - Emissions by Building Type 2003 & 2014

Industrial, Commercial and Institutional Energy Consumption (Buildings)

While emissions from Industrial, Commercial and Institutional buildings was decreasing, business licenses grew 8.4% from 2011-2014, with an average of 1,258 new businesses annually. The largest sector among business licenses in the city were in Construction and Trade (wholesale and retail), comprising a total of 38% of the total business licenses granted in 2014. In addition to the commercial and industrial sector, the City of Saskatoon hosts large Institutional organizations such as the Saskatoon Health Region and the University of Saskatchewan.

The Landfill Gas Facility at the municipal landfill produced approximately 10,615 t of CO_{2e} to produce electricity. These emissions are included in the Industrial, Commercial and Institutional Buildings and are new for 2014.

Residential Energy Consumption (Buildings)

A number of trends and factors influence residential energy consumption. City maps by neighborhood show primary age of dwelling, densities in neighborhoods, average income per household, and emissions by neighborhood as a result of energy consumption in residential households, in Figures 12, 13, 14 and 15, respectively. Appendix F provides a summary of household consumption of electricity and natural

gas as compared to key indicators such as size of household and age of homes in the area. The table summarizes energy consumption and key profiles of each neighborhood.

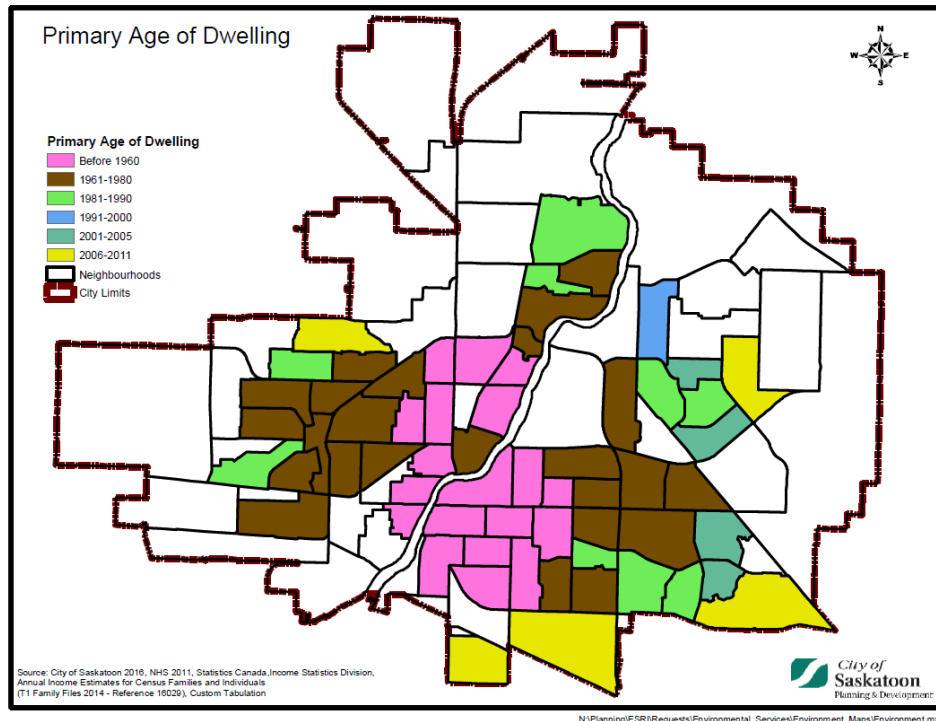


Figure 12 - Primary Age of Dwelling in Saskatoon by Neighborhood

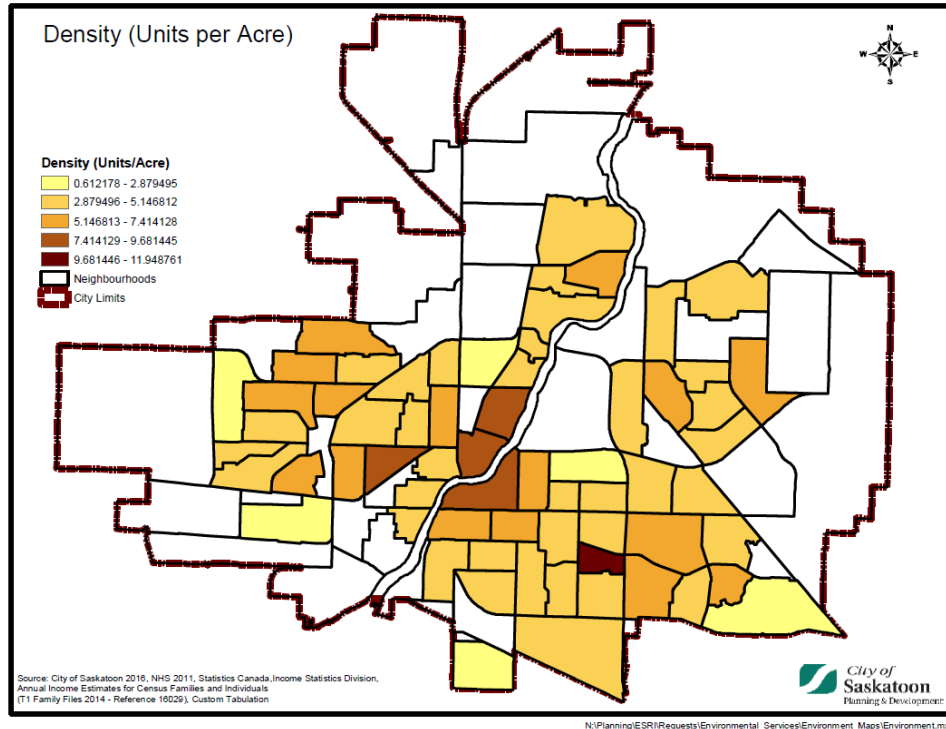


Figure 13 - Density by Number of Dwellings per Acre

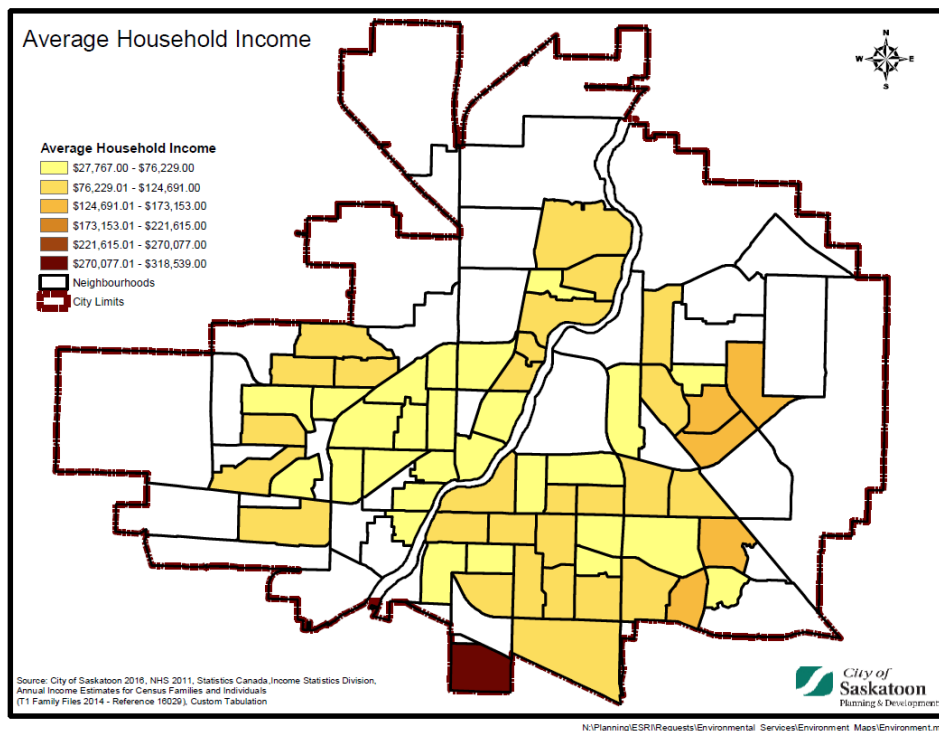


Figure 14 - Average Household Income by Neighbourhood

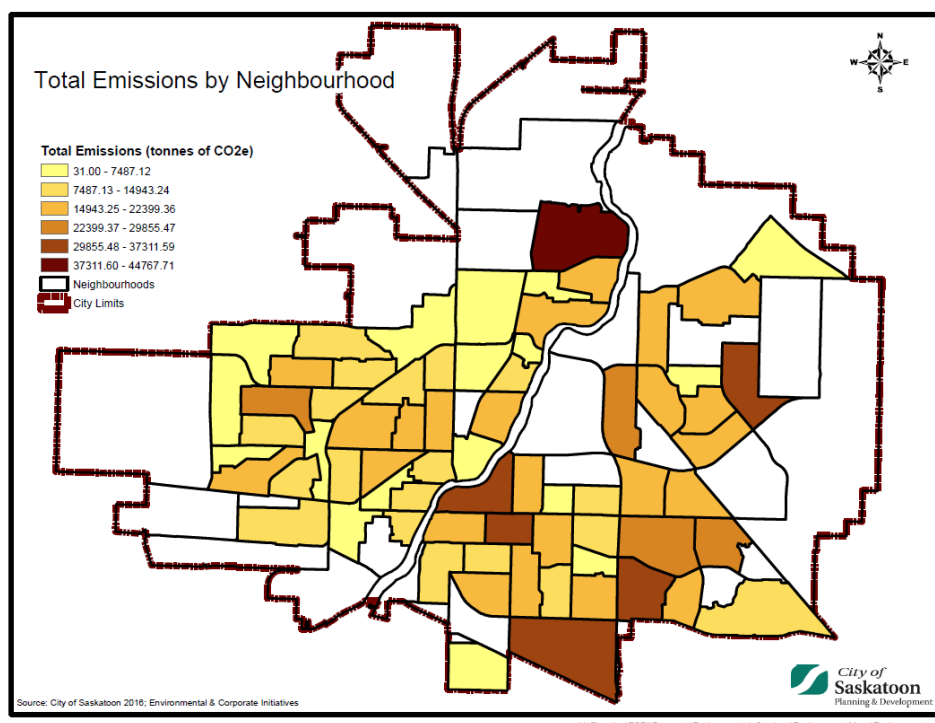


Figure 15 - Total Emissions by Neighbourhood

3.1.2 Community Transportation

Saskatoon Community transportation emissions are reported in Table 4, and Figure 16 illustrates the emissions produced based on user type. Private transportation is the highest emitter, and includes residential vehicles and traffic from the commercial and industrial sector. The emissions are based on fuel consumption, so the margin of error occurs with emissions produced when vehicles that have purchased fuel at other locations drive into city limits, and vehicles that purchase fuel in Saskatoon but then drive outside the municipal boundary.

Table 4 - Saskatoon Community Transportation Emissions Summary - 2014

Vehicle Type	Fuel consumption (L)	GHG (t CO ₂ e)	Number of vehicles
Saskatoon transit	4,002,352	10,957	156
Public service	3,649,242	9,306	1,073
Private transportation	426,705,786	1,029,710	255,508
Rail transportation	NR	8,953	NR
Waterborne transportation	5,423	15	NR
Aviation transportation	434,397,053	135,073	NR
Total	868,759,856	1,194,014	256,737

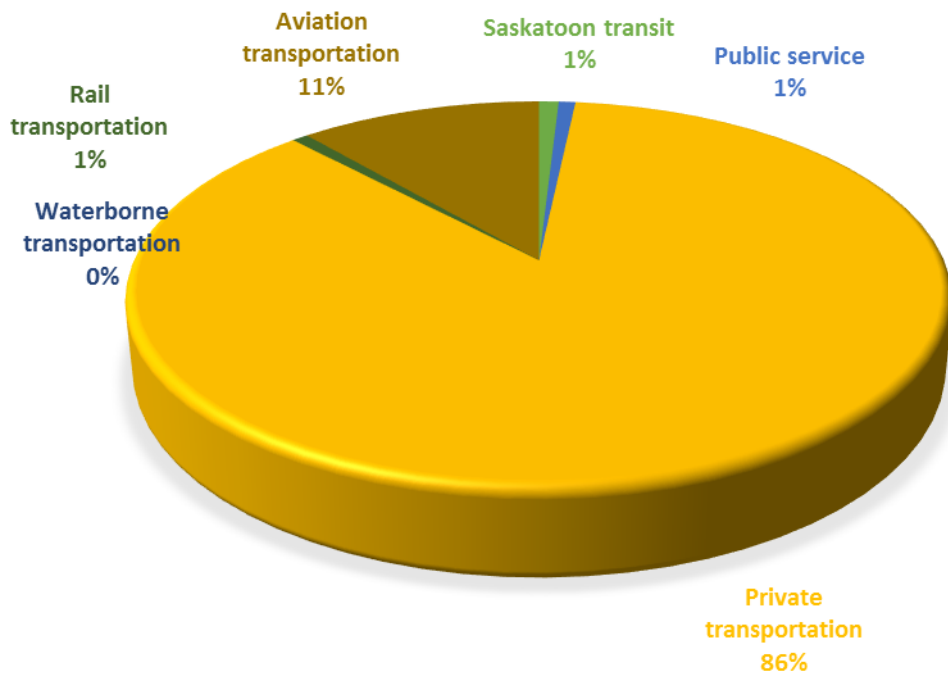


Figure 16 - Saskatoon Community Transportation Emissions by Sector - 2014

Emissions due to private vehicle use have increased over 85% in the 2014 inventory as compared to the 2003 inventory. The methodology used to produce the emissions for 2014 is based on consumption data from fuel purchases within the City of Saskatoon. There is a percentage of the consumed fuel that would be emitted outside city limits. In comparison, the methodology utilized in the 2003 inventory was based on kilometres traveled, through an estimation report provided by an external party that is no longer able to produce the data.

Figure 17, reported in the City of Saskatoon Neighborhood Profiles report, illustrates mode of travel to work from the 2011 Census. There is a high reliance on single occupant vehicles within Saskatoon.

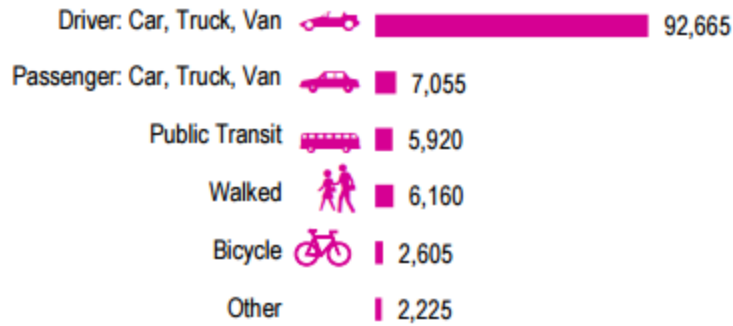


Figure 17 - Mode of Travel to Work for Saskatoon Municipality - 2011

Emissions produced through Saskatoon Transit have increased 31%. The methodology for this sector is much more precise than Transportation as a whole, since the fuel usage for Saskatoon Transit is specific to that sector and within the City of Saskatoon limits.

Emissions produced by the Aviation sector are estimated by fuel consumption from the Saskatoon International Airport. It includes fuel consumption by commercial and private aircraft from all sectors such as business travel, pleasure travel and emergency services. Total passengers enplaned and deplaned in 2014 at the Saskatoon International Airport was 1,460,613.⁸ Approximately 2% of fuel is delivered to local aircraft, with the other 98% delivered to aircraft flying internationally and domestically outside the Saskatoon area.

3.1.3 Community Solid Waste

Two commercial landfills currently lie close to the City of Saskatoon boundary; the 1990 and 2003 Emissions Inventories did not report the waste received at either of the commercial landfills in the area. It is reasonable to expect that a portion of materials received at the commercial landfills would be waste produced within the City of Saskatoon boundary. As a result, it is appropriate to report the waste taken to those landfills on the community emissions inventory. Table 5 reports a significant increase in material and emissions from 2003 to 2014. A large percentage of this increase is due to inclusion of tonnes of waste materials produced within City of Saskatoon limits but processed outside the city boundary at a commercial landfill.

⁸ Statistics Canada (2015) Air Carrier Traffic at Canadian Airports. Consulted 2016. Accessed at: <http://www.statcan.gc.ca/pub/51-203-x/51-203-x2015000-eng.pdf>

Table 5 - Saskatoon Waste Production & Emissions 2003 & 2014

Year	Waste (t)	GHG (t of CO ₂ e)	% Increase 2014
2003	101,842	49,057	
2014	264,638	221,984	353%

Saskatchewan as a province has one of the highest disposal rates in Canada (Figure 18).⁹

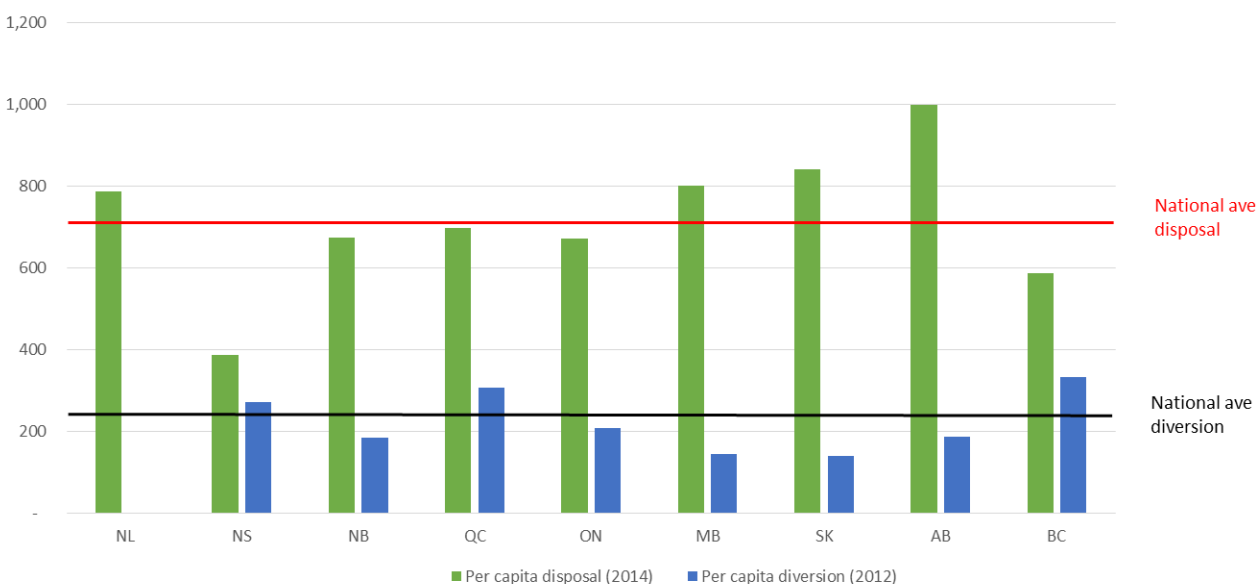


Figure 18 - Provincial Waste Data – 2014 & 2012

The City of Saskatoon 2014 Waste Management Annual Report shows curbside residential garbage has been decreasing since 2007. Figure 19 summarizes the materials typically produced in Canadian household, and suggests that options for residents to mitigate the emissions from waste include reducing organic materials and recyclable materials from waste bins. The City of Saskatoon is expecting to release a Waste Characterization study and develop strategies to increase waste diversion in 2017 that should provide more insight into what our waste consists of and how to reduce waste and the corresponding emissions.

⁹ Statistics Canada (2016) Disposal and Diversion of Waste, by Province and Territory. Consulted 2016. Accessed at: <http://www.statcan.gc.ca/tables-tableaux/sum-som/l01/cst01/envir32b-eng.htm>

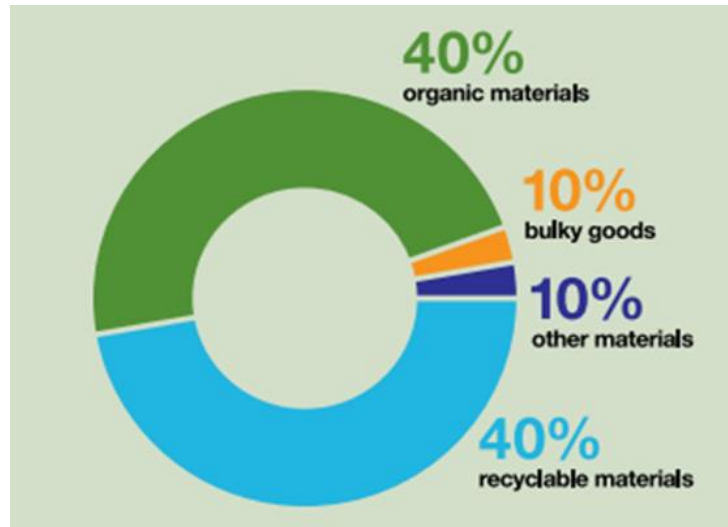


Figure 19- Content of Residential Waste in Canada – 2012 (Federation of Canadian Municipalities, 2016)

The 2014 Integrated Waste Management Annual Report publicised that Saskatoon residents produce approximately 250kg of residential garbage per capita. This is similar to other Western municipalities, but higher than Eastern municipalities (Figure 20).

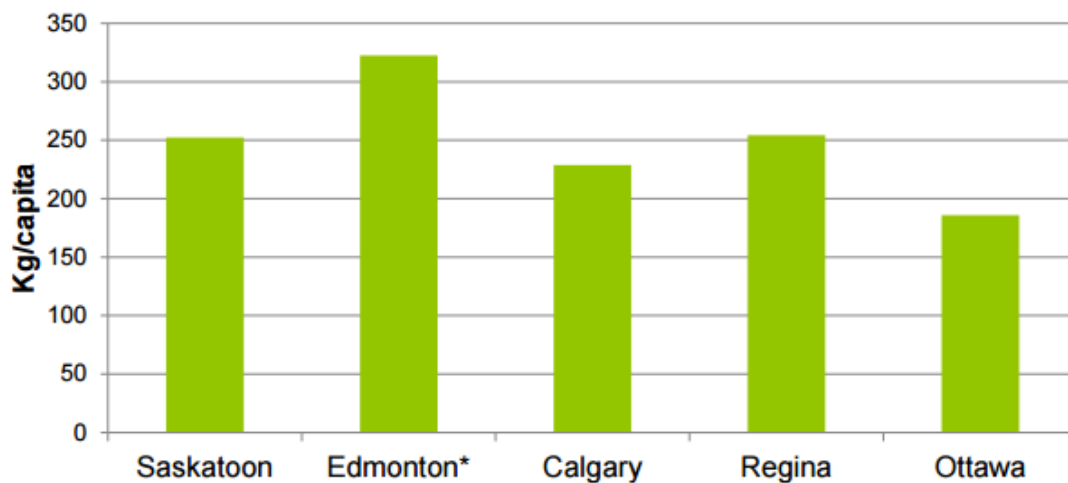


Figure 20 - Residential Garbage Collection per Capita for Select Cities - 2013

3.1.4 Community Agriculture and Land Use

The emissions produced by agricultural activities within city limits amounts to approximately 511 tonnes of CO₂e. This includes the emissions produced by all livestock within the City of Saskatoon boundary, namely, the University of Saskatchewan and the Saskatoon Zoo.

The city has undergone a number of annexations to bring RM land into city limits for further development (Figure 21). As the city expands, land use adds emissions to the City of Saskatoon emissions inventory which would previously have fallen under the RM of Corman Park.

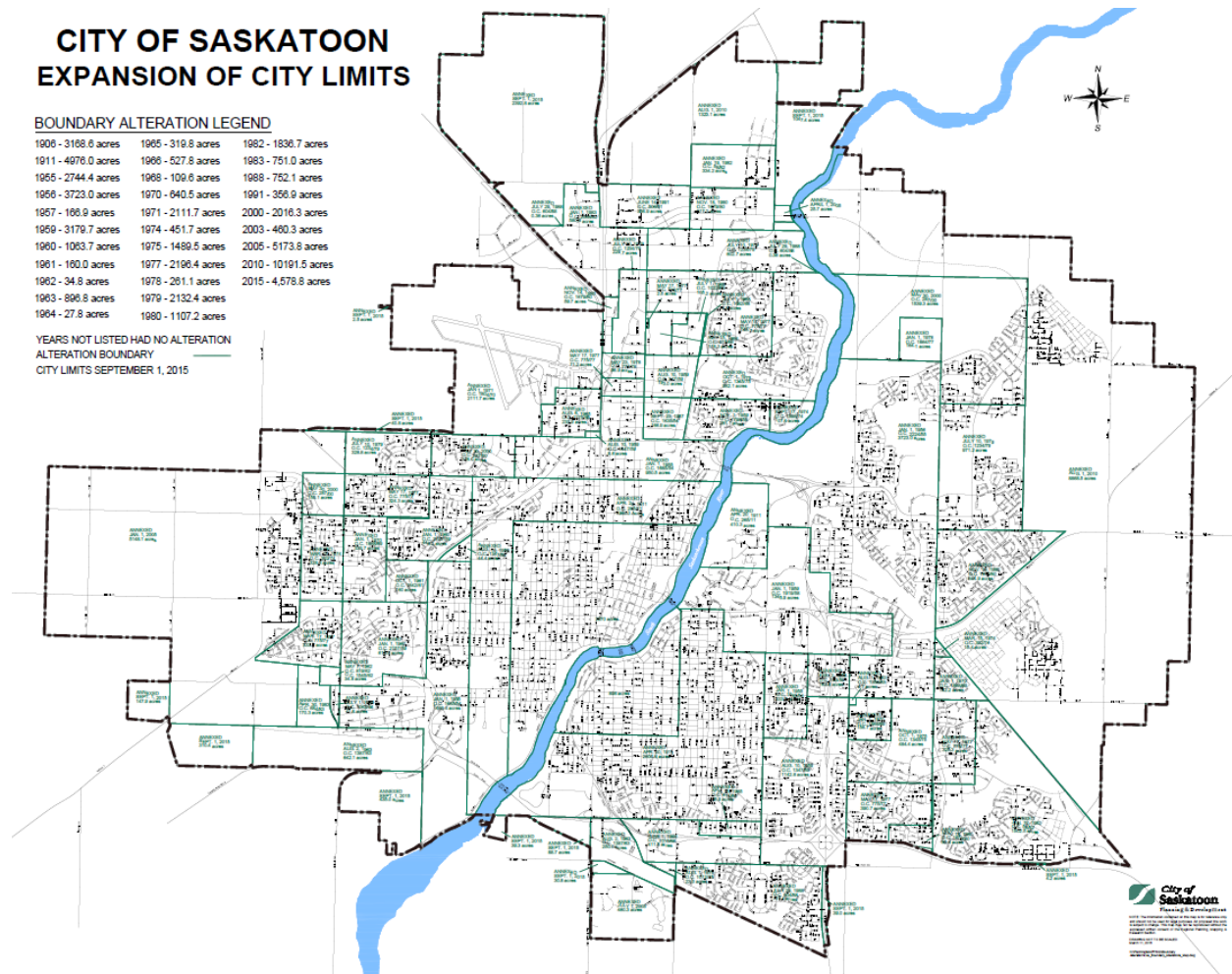


Figure 21 - Annexation Dates for the City of Saskatoon

Emissions produced through land use are reported by categorizing the land use type and then the emissions associated with the land use. Land use types are urban forest, grasslands, wetlands, cropland, developed land and other. As the city changes its use of land, the emissions produced will also change. For example, if trees from forest land are removed and a new neighborhood is developed, the emission sink of the trees must be acknowledged, and the emissions produced by the development process recorded.

The city contains 7,157 acres of development, 2,975 acres of park space, and 1,581 acres of wetlands. The more green space an urban centre is able to produce that combines an appropriate level of vegetation type, age and diversity, the higher level of emission sinks will be produced, thus reducing the emissions reported in by the municipality. The City of Saskatoon is currently undergoing a process to create an inventory of land types and uses across multiple divisions. This will allow future emission inventories to report the emissions from land use and changes in land use.

3.1.5 Industrial Processes

Each year, most companies engaging in industrial processing activities are required to report to the National Pollutant Release Inventory (NPRI) with the Government of Canada. This enables the federal government to identify pollution risks, prioritize initiatives and improve public understanding. Figure 22 illustrates the geographical location of facilities reporting to NPRI (excluding pipeline transportation systems), and Figure 23 reports the overall source of emissions for these facilities.

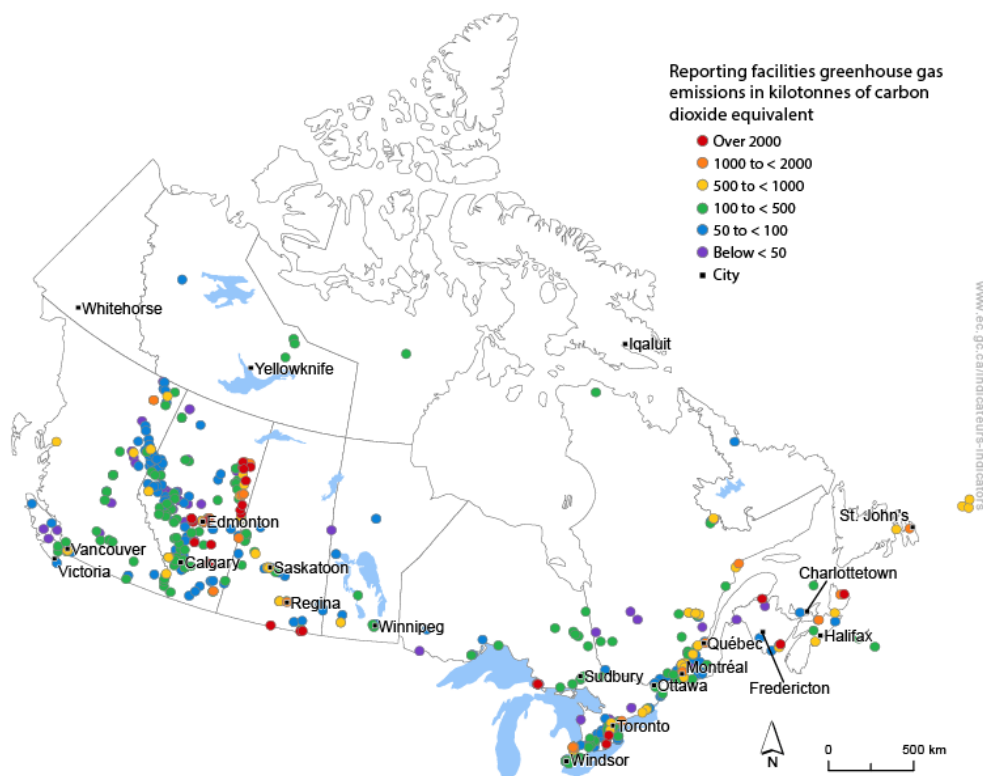


Figure 22 - Facilities Reporting to NPRI by Sector – 2014 (Environment and Climate Change Canada, 2016)

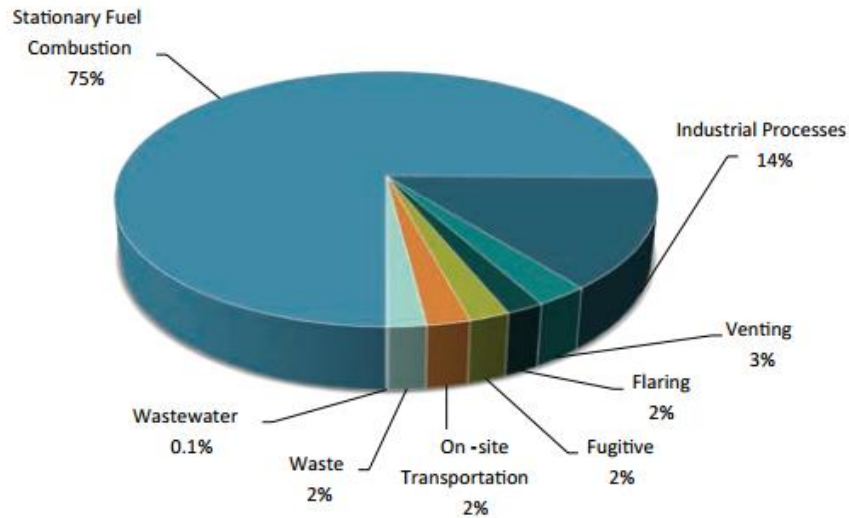


Figure 23 - Emissions by Source for Industrial Processes in Canada – 2014 (Environment and Climate Change Canada, 2016)

A portion of waste is counted in both the Industrial Processing sector and the Waste sector. Detailed data reported to produce the NPRI results is not available, so calculations are not possible to segregate landfilled waste from other waste. For example, hazardous waste that requires special processing would typically produce more emissions than landfilled waste. In the interest of producing a conservative report, all waste produced in Industrial Processing is included in this sector, which would include landfilled waste that is also reported in the Waste sector of the community emissions.

Approximately 42 Saskatchewan facilities report emissions to NPRI, which account for 9% of the total number of facilities (Environment and Climate Change Canada, 2016). The reported emissions by Province and Territory for 2014 are listed in Table 6.

Table 6 - Reported Emissions by Province and Territory - 2014

Province	Number of Facilities	Total Emissions (kt CO ₂ e)	Percentage of Total Emissions*
Newfoundland and Labrador	8	4,806	2.00%
Prince Edward Island	1	55	0.02%
Nova Scotia	10	7,829	3.00%
New Brunswick	12	7,544	3.00%
Quebec	84	20,008	8.00%
Ontario	139	43,017	16.00%
Manitoba	12	1,961	1.00%
Saskatchewan	42	23,933	9.00%
Alberta	182	139,266	53.00%
British Columbia	79	14,758	6.00%
Northwest Territories	4	576	0.20%
Nunavut	1	180	0.10%
Total	574	263,936	

Note: No facilities from the Yukon reported

Based on the North American Industry Classification System (NAICS), the Industrial processes within City of Saskatoon limits estimate is approximately 5% of Saskatchewan as a whole.¹⁰ Based on this, the emissions for the city of Saskatoon is estimated at 167,550 tonnes of CO₂e for 2014. This includes activities for manufacturing, oil and gas and minerals.

¹⁰ Environment and Climate Change Canada (2016) Facility Greenhouse Gas Emissions Reporting Program: Overview of 2014 Reported Emissions. Consulted October 2016 to provide the federal and provincial emissions by sector. Accessed at: <https://www.ec.gc.ca/ges-ghg/default.asp?Lang=En&n=82BA1E22-1>

3.2 Saskatoon Corporate Emissions Inventory

The Saskatoon corporation emissions are approximately 2% of the total Saskatoon community emissions, similar to the 2003 results. Corporate emissions, however, have increased 38.7% from the 2003 results. Table 7 summarizes the results for the 2003 and 2014 inventories. The 2003 inventory results have been recalculated for comparison purposes, to account for adjusting emissions standards. The exception is solid waste; a recalculation using 2014 emissions standards was not possible because the material type of waste in 2003 is not known.

Table 7 - Corporate Inventory Data Summary - 2003 & 2014

Sector	GHG (t of CO ₂ e)			
	2003	2003 new standards	2014	% Increase 2014
Buildings	36,270	31,246	45,022	44.1%
Water & wastewater	30,437	24,608	32,702	32.9%
Streetlights	16,925	13,311	14,129	6.1%
Fleet	6,047	6,022	9,391	55.9%
Solid waste	1,619	1,619	4,576	182.6%
Other operational	NR	NR	656	
Land use	NR	NR	NR	
Zoo	NR	NR	21	
TOTAL	91,298	76,806	106,497	38.7%

* NR = Not Reported

The distribution of emissions by source is illustrated in Figure 24. The 2014 emissions inventory analyzed additional sources than those reported in the 2003 inventory. If the additional sectors are eliminated, the emissions per sector are very similar between 2003 and 2014.

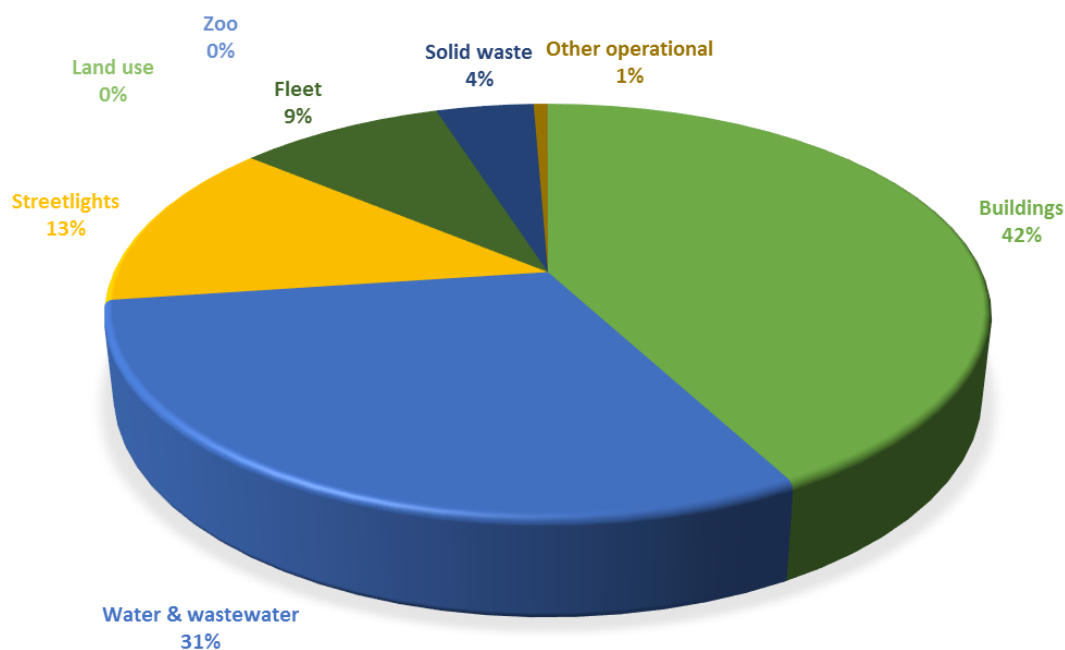


Figure 24- Corporate Emissions by Sector - 2014

The type and volume of fuel for the corporation has changed from the 2003 inventory. An increase of 23% was realized in gasoline and an increase of 45% was realized in natural gas. Diesel consumption increased by 124%. Emission factors differ by fuel type, as summarized in Appendix E, which suggests that fuel usage choices will affect the overall emissions produced by the corporation.

3.2.1 Corporate Buildings

The 2003 emission inventory used a cost-estimate basis for calculating consumption. The 2014 emissions inventory utilized a direct approach by using actual metre reads for power consumption where possible, and consultation with SaskPower and SaskEnergy to report actual consumption where metre reads were not possible. This results in a

comprehensive consumption report for all corporate facilities. The energy use for the corporation has increased approximately 4% since 2003.

The size and number of corporate buildings has increased, site improvements including the Saskatoon Police building, and additional offices in Civic Square East has changed the energy consumption at the City of Saskatoon. The consumption of electricity on Table 8 shows a material increase of emissions that may also be partially due to estimates calculated in the 2003 inventory, where reliable consumption data could not be obtained. Lack of data for several facilities as reported in the 2003 Emissions Inventory summary required estimates that may have been lower than actual consumption.

Table 8 - Energy Consumption and Emissions in Corporate Buildings - 2014

	2003	2014	Increase (Decrease)
Electricity (kWh)	30,178,713	43,916,913	45.5%
Natural Gas (m3)	6,450,022	9,150,385	41.9%
GHG (t of CO2e)	31,246	45,022	44.1%

Administration and operations facilities reported the highest energy consumption of three categories of Corporate Offices: Recreational facilities, Emergency facilities utilized by Saskatoon Fire and Saskatoon Police services, and Operational facilities (Figure 25). Programs such as the Combined Heat and Power installations completed in the Shaw and Lakewood Civic Centres in 2016 should result in decreased consumption at select locations.

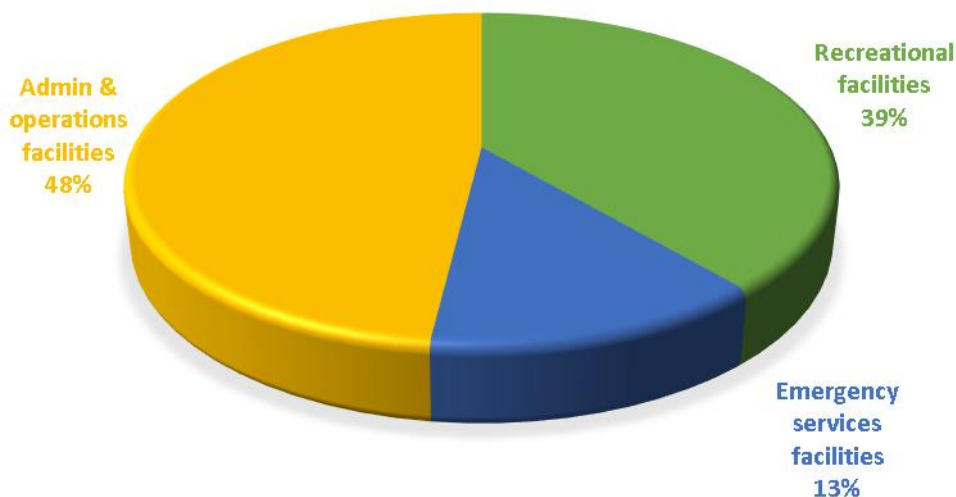


Figure 25 - Energy Consumption by Building Type

3.2.2 Water and Wastewater Treatment

Energy consumption for water and wastewater includes the energy used to treat drinking water and wastewater in the city. Relative to the 2003 inventory, the electricity consumption for water treatment increased over 38% and natural gas consumption for wastewater treatment increased over 210%. Increased energy consumption can be linked to expanding operations; efficiencies in controls and instrumentation has kept consumption increase in electricity lower than natural gas consumption. The result is an overall emissions increase of 28% for wastewater treatment, and over 37% for water treatment. Table 9 summarizes the emissions for providing water and wastewater treatment to the City of Saskatoon, but does not include 1,300 t of CO_{2e} emissions due to transmission and distribution loss from grid-supplied energy.

Table 9 - Emissions Produced by Wastewater and Water Treatment - 2003 & 2014

	GHG (t of CO _{2e})		
	2003	2014	Increase (Decrease)
Wastewater treatment plant	11,252	11,673	3.7%
Lift stations/ Biosolids operations	577	2,885	400.0%
Transmission & distribution loss	NR	602	
Total wastewater treatment	11,829	15,160	28.2%
Water treatment plant	9,526	12,151	27.6%
Water operations	3,254	4,695	44.3%
Transmission & distribution loss	NR	696	
Total water treatment	12,780	17,542	37.3%
Total wastewater and water treatment	24,609	32,702	32.9%

3.2.3 Streetlights

The Streetlights sector for the 2014 City of Saskatoon Corporate Emissions Inventory includes street lighting at night, traffic signals and festive lighting. The electricity used for streetlights is provided by SaskPower or Saskatoon Light and Power, depending on the area of the city.

Table 10 is a summary of energy consumption and emissions for streetlights. Consumption through SaskPower decreased negligibly and electricity usage through Saskatoon Light and Power has increased approximately 50%. Transmission and distribution loss from grid-supplied energy was included in the streetlights emissions because consumption in streetlights is approximately 97% of the total emissions from streetlights and traffic signals as a total.

Table 10 – Streetlight Energy Use and Emissions - 2003 & 2014

Year	Electricity (kWh)	GHG (t CO ₂ e)	Number of Units	Increase to GHG
2014	20,822,121	13,694	29,628	39.6%
2003	15,591,991	9,810	6,996	

In 2013, a pilot project to install LED lighting for roadway and park pathway in the Evergreen development was approved. Energy usage has reduced 55% for the LED bulbs installed in the development as compared to standard fixtures for roadway. This is expected to reduce emissions by 300 tonnes CO₂e annually when the Evergreen development is complete.

In 2007, the City of Saskatoon engaged in an LED replacement program to reduce emissions from traffic lights. The program forecasted a reduction of emissions of approximately 1,300 tonnes CO₂e. Currently, 250 signaled intersections in the city use LED bulbs, which should result in consumption savings of approximately 2,940,000 kWh, or emissions of approximately 1,849 tonnes CO₂e. The consumption results in Table 11 report a reduction in electricity consumption of 75% as compared to the 2003 Emissions Inventory report.

Table 11 - Traffic signal energy Use and Emissions - 2003 & 2014

Year	Electricity (kWh)	Energy (GJ)	Cost (\$)	GHG (tonnes CO ₂ e)	% Increase (Decrease) 2014
2014	672,330	2,420	78,948	423	-75.7%
2003	2,766,932	9,961	232,347	1,741	

Holiday lighting accounted for only 18,570 KWh of consumption, which results in emissions of 12 tonnes CO₂e. This is 0.08% of the total electricity consumed for the streetlights sector in 2014.

3.2.4 Transportation and Equipment

Saskatoon Vehicle and Equipment Fleet services provides the motorized vehicles and equipment required for operations, including trucks for parks, dozers for the landfill, police vehicles, fire trucks, sweepers, and garbage trucks (Table 12). Transit is not included in the corporation emissions inventory, but are included in the Saskatoon Community Emissions Inventory.

The number of vehicles required to provide services increases as the city limits expands and population grows. For example, the number of street sweepers required to clean streets increases with the growth of paved roads, and the number of garbage trucks required for curbside garbage collection increases with an increase to single unit residences.

Table 12 - Vehicle Use at the City of Saskatoon Corporation - 2014

Vehicles	2003			2014		% Increase (Decrease) of GHG Emissions
	# of units	GHG (tonnes CO ₂ e)		# of units	GHG (tonnes CO ₂ e)	
Fire Fleet	57	351		76	318	-9.4%
Police Fleet	150	1,220		184	1,342	10.0%
Operations Fleet						
mini-vans	33	137		63	200	46.0%
full-size vans	83	442		98	453	2.5%
1/4 ton trucks	59	186		87	309	66.1%
1/2 ton trucks	72	298		82	476	59.7%
3/4 ton trucks	53	320		62	380	18.8%
1 ton trucks	108	651		104	838	28.7%
Other	133	2,252		317	4,989	121.5%
Total Operations Fleet	541	4,286		813	7,645	78.4%
Total City Vehicles	748	5,857		1,073	9,305	58.9%

The number of vehicles operated by the City of Saskatoon to provide service to Saskatoon residents has grown 43.4% between 2003 and 2014, with a corresponding increase in fuel consumption for Saskatoon Police and the operations fleet (Table 13). Saskatoon Fire realized a decrease in fuel consumption of 7.8%, which is a result of increased efficiencies in operations.

Table 13 - Fuel Consumption for Saskatoon Fleet and Emergency Services - 2003 & 2014

Vehicles	2003					2014			
	# of units	Gasoline (L)	Diesel (L)	GHG (tonnes CO ₂ e)		# of units	Gasoline (L)	Diesel (L)	GHG (tonnes CO ₂ e)
Fire Fleet	57	33,277	99,832	351		76	44,277	78,457	318
Police Fleet	150	516,710	-	1,220		184	575,998	894	1,342
Total Operations Fleet	541	791,619	885,259	4,286		813	1,128,082	1,821,535	7,645
Total City Vehicles	748	1,341,606	985,091	5,857		1,073	1,748,357	1,900,886	9,305

Additional emissions produced in the Corporate Transportation sector are a result of aviation support for emergency operations, such as Saskatoon Police Service and

Saskatoon Fire. The aviation support is shared among other emergency services within Saskatoon such as the Royal Canadian Mounted Police, Saskatoon Search and Rescue and others. This results in approximately 85 tonnes of CO₂e and amounts to less than 1% of total Corporate Transportation emissions.

3.2.5 Solid Waste

Corporate waste includes the waste that is produced by the corporation to provide services. All waste produced by the corporation is collected and processed as recycling through a contractor, or collected as garbage and delivered to the Municipal Landfill. Waste collected through curbside services are included in the Saskatoon Community Emissions Inventory. Waste diversion initiatives such as the Corporate Recycling initiative and decreased paper consumption through printing and digital documents can reduce the amount of waste produced in the corporation. The waste generated by the corporation includes that produced by services such as street sweeping and the removal of waste from public areas. The tonnes of waste estimated to be produced by the corporation has increased by over 78%, and the rate of waste production by each full-time employee (FTE) has increased by 34% since 2003 (Table 14).

Table 14 - Corporate Waste Produced in Tonnes - 2003 & 2014

Year	Full-Time Employees	Waste Generated (tonnes)	Waste Generated per FTE (tonnes)	GHG (tonnes CO ₂ e)	GHG per FTE (tonnes CO ₂ e)	% Increase 2014
2014	3,297	6,005	1.82	4,576	1.39	78.7%
2003	2,481	3,361	1.35	1,619	0.65	

3.2.6 Other Operations

Other operational consumption is energy consumed in providing service such as irrigation for parks. The consumption of 1,042,055 kWh of electricity used to provide these services resulted in 656 tonnes of CO₂e emissions to be produced, which amounts to 0.6% of total Saskatoon corporate emissions.

3.2.7 Zoo and Land Use

The Saskatoon Forestry Farm Park and Zoo is home to over 200 animals, reptiles and birds, and an expansive park and retired nursery. The emissions produced by the zoo animals and the manure processing for zoo poo and fertilizer is an insignificant source of emissions to the corporation. The emissions produced by the zoo is estimated at approximately 21 tonnes of CO₂e, which is .002% of the total emission from the City of Saskatoon Corporation.

The emissions produced by corporate land use is realized through corporate development of green space and site preparation for urban development. Future emissions inventories will provide insight into land use at the City of Saskatoon Corporation.



Context

4 Context

Why does it matter?

The effects of climate change

“... is projected to lead to both changes in average conditions and in extreme weather events. Increases in droughts, heavy rains, floods, and severe storms, where these occur, can be very disruptive for society and are among the potential impacts of most concern... Changes in temperature and precipitation will affect natural habitats and managed ones, with impacts on agriculture and food supplies of particular concern to a growing human population.”

(Environment Canada, 2016)

4.1 Climate Change Impacts

Naturally occurring variations in global temperature may be realized year over year, but the impact due to increased levels of greenhouse gas emissions is more visible when evaluated over a long-term period. An increase of 0.85 °C globally has been estimated between 1880 and 2012, shown in Figure 26 and 27, which has been linked to human activities such as the burning of fossil fuels and deforestation.

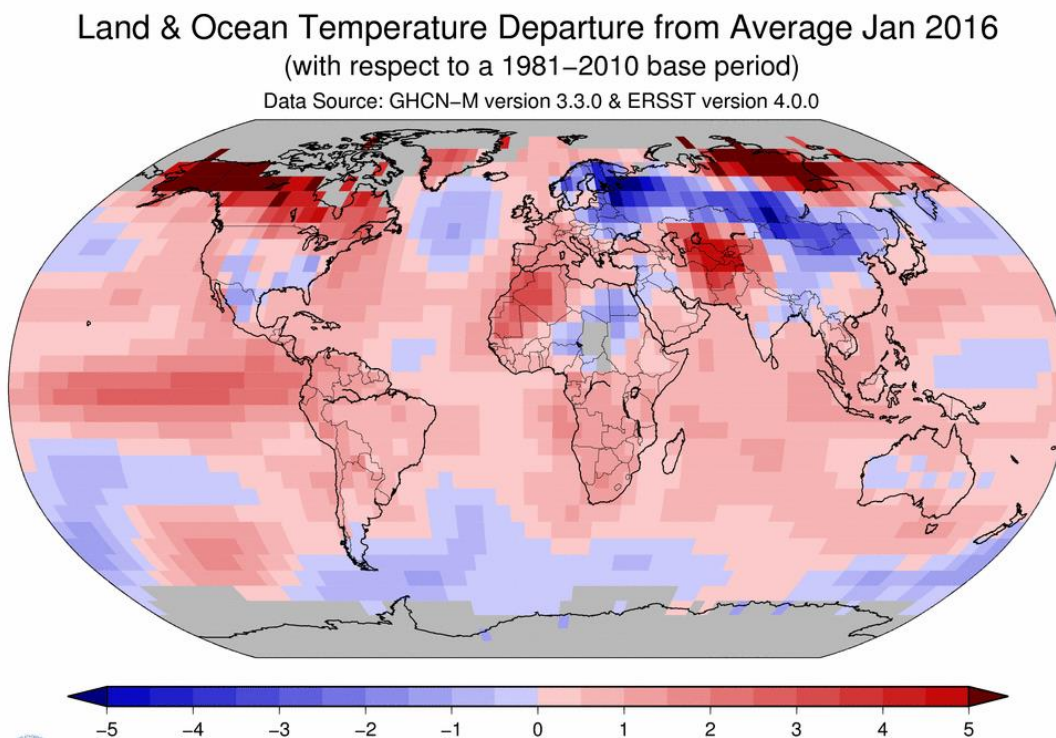


Figure 26 - Global Temperature Trends - 1981 to 2010 (NOAA, 2016)

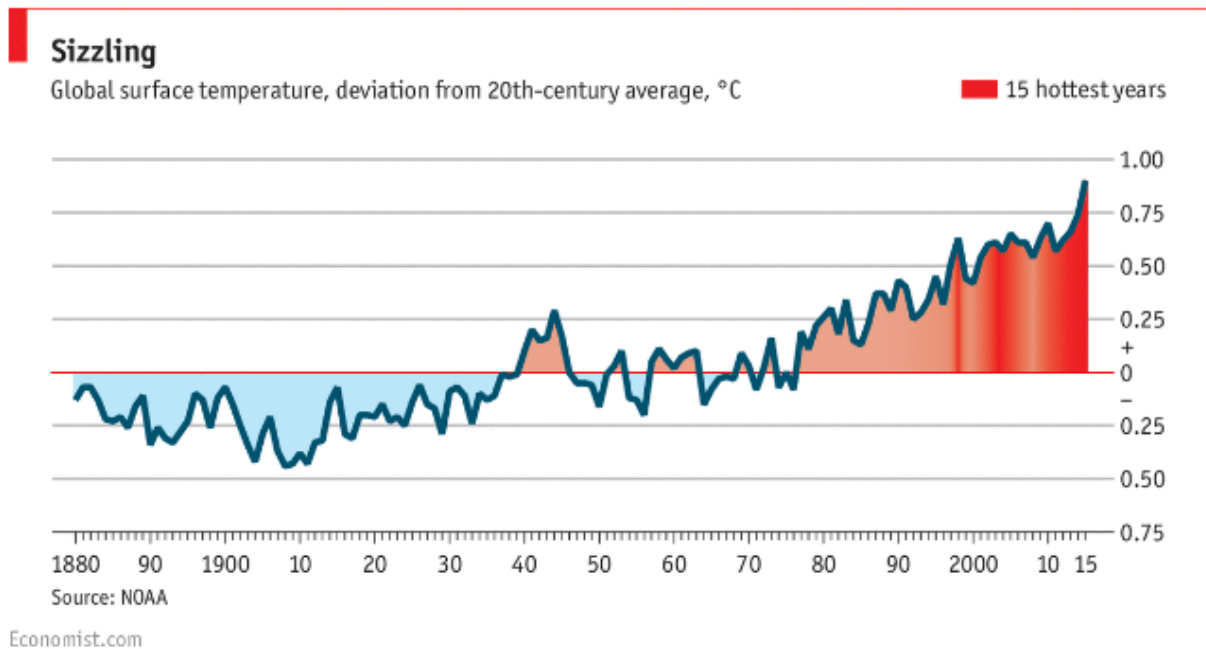


Figure 27 - Global Temperature Variation (Team, 2016)

4.1.1 Climate Change on the Prairies

Research conducted through the Prairie Climate Centre, a partnership of the University of Winnipeg and the International Institute for Sustainable Development, shows that a 1.0 °C global increase in temperature is expected to result in a 2.0-3.0 °C increase in prairie regions.¹¹ This will likely result in more severe weather and drought on the prairies than will be experienced through the average global effect. Figure 28 shows how the temperature on the Canadian Prairies might expect to increase as the average global temperature increases.

¹¹ Prairie Climate Centre (2016) Projected Increase in Annual Temperature for the Prairies. Consulted May 2016. Accessed at: <http://www.climateatlas.ca/home.html>

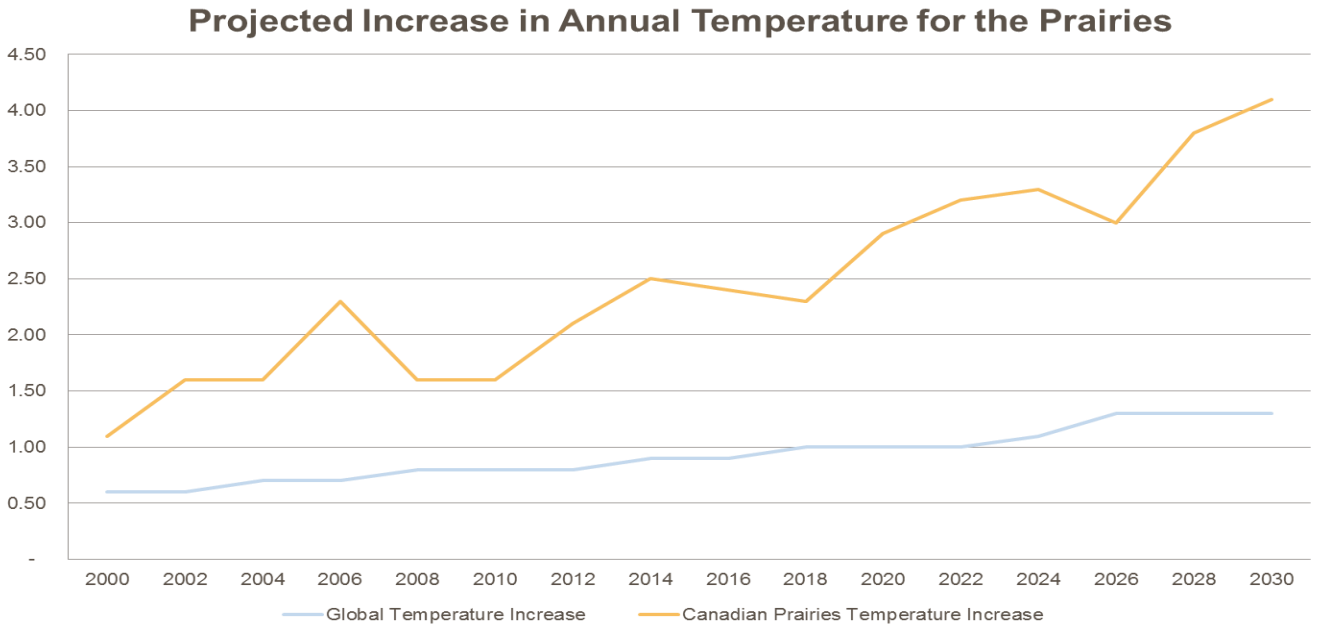


Figure 28 - Projected Increase in Annual Temperature for the Canadian Prairies

Additional effects experienced in the Prairies may include drought, flash floods, weather pattern changes, additional extreme weather events (e.g., tornadoes, plow winds) and unprecedented wildfires.

4.1.2 Socio-Economic Impacts of Climate Change

Indicators in Saskatoon between 2003 and 2014 indicate a growing economy. The unemployment rate in 2014 was 4.1%, down 34% from 2003. Consumer Price Index (CPI), is an indicator of the cost of consumer goods experience by residents, and taken with cost of housing increase and unemployment rate decrease suggests an increasingly healthy municipal economy.

The Saskatoon Neighborhood Profiles, Edition 14, reported that 59% of GDP is associated with goods and transportation/ trade in the Saskatoon metropolitan area. The Saskatchewan economy shows the highest exports as a percentage of GDP in Canada, as depicted in Figure 29¹², with potash, oil and wheat as the top three exports.¹³ As provinces and countries implement their environmental programs, they will demand that imports are produced with minimal emissions in order to meet their own emissions targets and avoid carbon cost. Saskatchewan may find that they are required

¹² Statistics Canada (2016) Gross Domestic Product, Expenditure-Based, Provincial and Territorial. Consulted 2016. Accessed at: <http://www5.statcan.gc.ca/cansim/a26?lang=eng&id=3840038>

¹³ Government of Saskatchewan (2016) 2015 Export Diversity. Consulted August 2016. Accessed at: <https://www.saskatchewan.ca/business/invest-and-economic-development/exporting-and-trade>

to engage in emissions reductions for processing if the Province wants to continue exporting to other provinces in Canada.

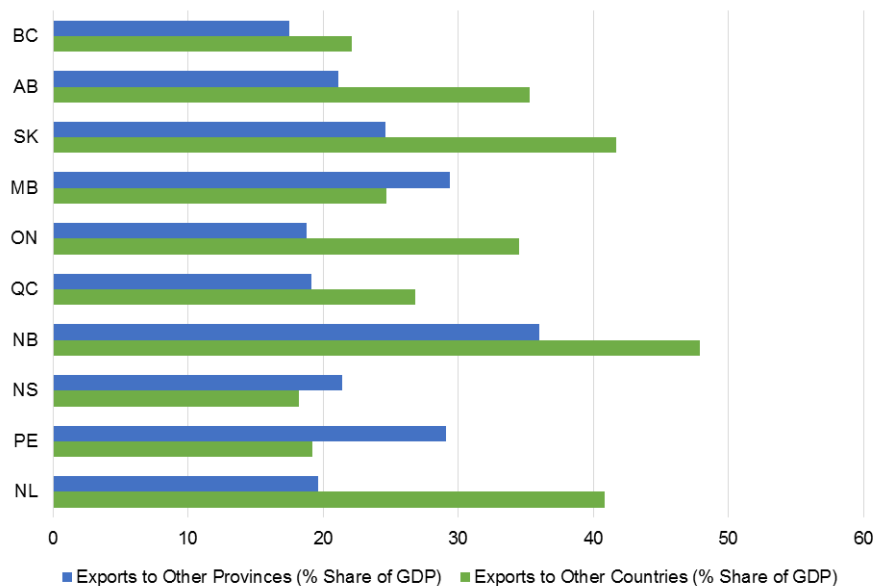


Figure 29 - Provincial Exports Percentage Share of Nominal GDP – 2014

The Canadian federal government announced the intention to implement a carbon price for the 2018 fiscal year that would affect provincial and municipal governments and business.¹⁴ Details on the carbon price, such as type and guidelines remain pending. The need to create efficiencies that reduce emissions is more urgent to reduce operational and tax expense at the municipal, institutional and corporate level. Emissions reductions through efficiencies can decrease operational expenses through consumption (e.g., through fuel consumption of vehicles and equipment), and through tax expense (e.g., carbon tax obligations decrease by reducing emissions).

4.2 Response to Climate Change

To address climate change, the United Nations created a Conference of Parties which had its 21st meeting in November 2015. At this meeting 195 countries, including Canada, signed an agreement to:

- Keep the rise of global temperatures below 2 °C above pre-industrial levels;
- Cut emissions by 30 per cent from 2005 levels by 2030;

¹⁴ CBC News (2016) Justin Trudeau gives provinces until 2018 to adopt carbon price plan. Consulted October 4, 2016. Accessed at: <http://www.cbc.ca/news/politics/canada-trudeau-climate-change-1.3788825>

- Engage in transparent reporting, create adaptation plans and provide support for developing countries.¹⁵

Saskatchewan has made a commitment to reduce emissions 20% below 2006 levels by 2020.¹⁶ Electricity results in the second highest emissions in the province, second to the oil and gas sector. SaskPower, the primary electricity provider in the province, has committed to doubling the percentage of renewable energy produced in Saskatchewan by 2030. The result of the SaskPower target would result in a 40% reduction in emissions from power consumption below 2005 levels.¹⁷

4.3 Saskatoon Response to Climate Change

The City of Saskatoon has outlined a commitment to reduce emissions tied to civic operations in the 2013-2023 Strategic Plan. Other commitments in the strategic plan such as the city-wide compost and recycling program help to reduce emissions. A corporate waste reduction target of 70% by 2023 is outlined in the Strategic Plan, which will directly impact the emissions of the City of Saskatoon. The target for the Saskatoon corporation is a 30% reduction from 2006 levels by 2023. A reduction target has not yet been set for community emissions.

4.4 The Role of Cities and Government in Climate Change

As much as 70% of emissions occur in urban centres.¹⁸ Consequently, municipalities will be integral in the effort of reducing emissions. Policies and regulations regarding climate change will fall to government bodies and be implemented in the Institutional, Commercial and Industrial (ICI) sector. Municipal governments are often more able to take immediate action than provincial or federal governments, which allows for more immediate and responsive impacts on climate change.¹⁹ Figure 30 shows the critical role that municipalities will play in helping the global emissions decrease to the global target.²⁰

¹⁵ UNFCCC (2016) Canada's INDC Submission to the UNFCCC. Consulted March 2016. Accessed at: <http://www4.unfccc.int/submissions/INDC/Published%20Documents/Canada/1/INDC%20-%20Canada%20-%20English.pdf>

¹⁶ Government of Saskatchewan (2016) Climate Change. Consulted March 2016. Accessed at: <http://www.environment.gov.sk.ca/climatechange>

¹⁷ SaskPower (2015) SaskPower to develop wind, solar, and geothermal power to meet up to 50% renewable target. Consulted August 2016. Accessed at: <http://www.saskpower.com/about-us/media-information/saskpower-targets-up-to-50-renewable-power-by-2030/>

¹⁸ The World Bank (2016) Urban Development Overview. Consulted October 2016. Accessed at: <http://www.worldbank.org/en/topic/urbandevelopment/overview>

¹⁹ C40 Cities (2012) Why Cities? Ending Climate Change Begins in the City. Consulted October 2016. Accessed at: <http://www.c40.org/ending-climate-change-begins-in-the-city>

²⁰ C40?

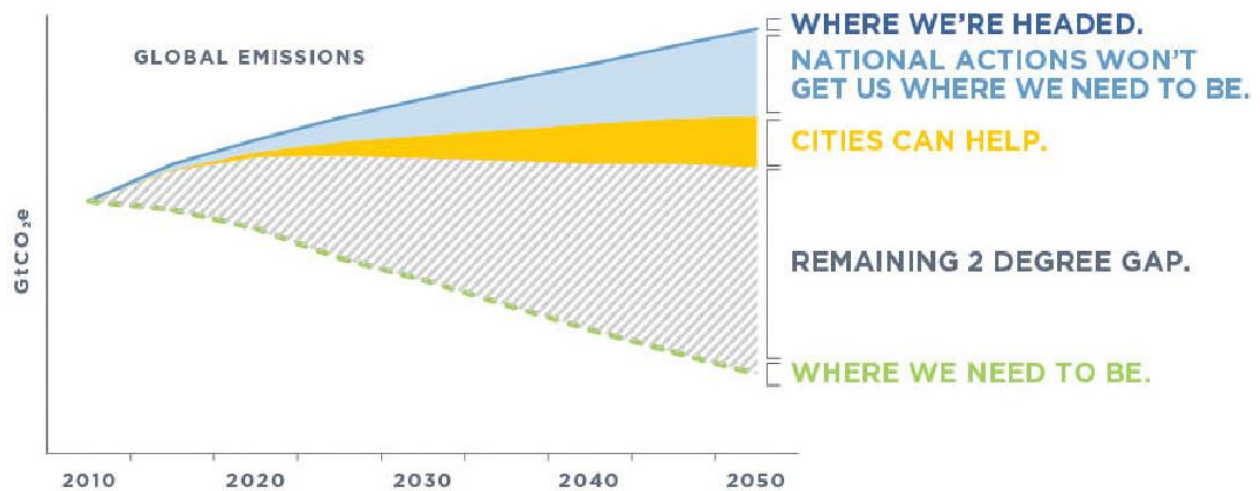


Figure 30 - The Expected Increase of Global Emissions to 2050 (C40, 2016)

Environmentally sustainable business models are a fundamental shift in strategy for many organizations and requires a common reporting and valuation methodology. Each municipality is ideally situated to understand the economy and geography of its region and the optimal actions that will protect both. For example, Saskatchewan's climate change approach considers an agricultural and energy sector economy balanced with climate change impacts, including drought, flooding and fossil fuel mining.

With the institution of a National target and a Federally mandated price on carbon, each Province will be responsible for creating the regulatory requirements of the taxing system, and the municipal governments would be responsible for providing the policy and bylaws to provide the community with guidance.

Bibliography

- C40. (2016). *Advancing Climate Ambition: Cities as Partners in Global Climate Action*. Retrieved from C40.org:
<http://www.c40.org/researches/advancing-climate-ambition-infographic>
- Compact of Mayors Full Guide*. (2015, July). Retrieved from Compact of Mayors:
https://data.bloomberglp.com/mayors/sites/14/2015/07/Compact-of-Mayors-Full-Guide_July2015.pdf
- Environment and Climate Change Canada. (2016, April). *Facilities Greenhouse Gas Emissions Reporting Program: Overview of 2014 Reported Emissions*. Retrieved from Environment and Climate Change Canada:
http://www.ec.gc.ca/ges-ghg/82BA1E22-9653-45F1-8EC2-9BF8A2151555/Overview%20Report%202016_en.pdf
- Extance, A. (2010, December 22). *A Picture of Climate Change is Worth 1,000 Words*. Retrieved from Simple Climate: <https://simpleclimate.wordpress.com/2010/12/22/a-picture-of-climate-change-is-worth-1000-words/>
- Federation of Canadian Municipalities. (2016). *Getting to 50% and Beyond: Waste Diversion Success Stories from Canadian Municipalities*. Retrieved from Federation of Canadian Municipalities:
https://www.fcm.ca/Documents/tools/GMF/Getting_to_50_percent_en.pdf
- Global Protocol for Community Scale Greenhouse Gas Emissions Inventories*. (2014). Retrieved from GHG Protocol:
<http://www.ghgprotocol.org/city-accounting>
- NOAA. (2016, March). *State of the Climate*. Retrieved from National Centres for Environmental Information - National Oceanic and Atmospheric Administration: <http://www.ncdc.noaa.gov/sotc/global/201604>
- Stats Canada. (2016, February 10). *Population of Census Metropolitan Areas*. Retrieved from Statistics Canada:
<http://www.statcan.gc.ca/tables-tableaux/sum-som/l01/cst01/demo05a-eng.htm>
- Team, M. a. (2016, January 21). *The Hottest Year on Record: 2015*. Retrieved from The Economist:
<http://www.economist.com/blogs/graphicdetail/2016/01/climate-change>
- The Economist. (2016, July 23). *The great provincial obstacle course*. Retrieved from The Economist:
<http://www.economist.com/news/americas/21702495-country-far-being-single-market-may-be-about-change-great-provincial>



Appendices

Appendix A – Compact of Mayors

All graphics and summary documentation on Compact of Mayors and the commitment on the part of the City of Saskatoon are taken from the Compact of Mayors website. Further information on the organization and cities that have committed to Compact of Mayors is available on the Compact of Mayors website at <https://www.compactofmayors.org/#>.



Establish An Action Plan

Within three years, a city's strategic action plan must show how it will deliver on its commitment to reduce greenhouse gas emissions and adapt to climate change.

At each phase, the committed city is required to report the results to the Compact of Mayors through an approved method in order to receive acknowledgement and verification of the phase.


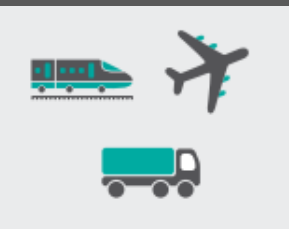



Phase	Mitigation	Adaptation
1 – Commitment November 2015	Cities commit to: <ul style="list-style-type: none"> • Reduce local GHG's • Measure community emissions using GPC • Set data-based targets for the future • Develop climate action plan 	Cities commit to: <ul style="list-style-type: none"> • Address impacts of climate change • Identify climate hazards • Assess vulnerabilities • Develop climate adaptation plan
2 – Inventory December 2016	Complete a community-wide emissions inventory using the GPC standard	Identify climate hazards
3 – Target December 2017	Update emissions inventory & set emissions reduction target	Assess climate change vulnerability
4 – Plan December 2018	Develop climate action plan demonstrating how the city will deliver on its commitment to reduce greenhouse gas emissions	Develop a climate change adaptation plan demonstrating how the city will adjust to actual or expected climate change impacts

Once the Compliance phase has been reached, the city is required to report their inventories, targets, updates, reductions on an annual basis in order to maintain the Compliance rating.

Appendix B – GPC Sectors

The GPC protocol is available online, and sectors are described in detail here:

<http://www.ghgprotocol.org/city-accounting>

Sectors in the GPC	
Stationary Energy	
	<p>Stationary energy sources are one of the largest contributors to a city's GHG emissions. These emissions come from:</p> <ul style="list-style-type: none">-combustion of fuel in residential, commercial and institutional buildings and facilities-combustion of fuel in manufacturing industries, construction-power plants to general grid-supplied energy-fugitive emissions from extraction, transformation and transportation of primary fossil fuels
Transportation	
	<p>Transportation includes all travel by air, rail, road and water, including inter-city and international travel. GHG emissions are produced directly by the combustion of fuel.</p>
Waste	
	<p>Waste disposal and treatment produces GHG emissions through aerobic or anaerobic decomposition, or incineration. GHG emissions from solid waste is calculated by landfill data, biological treatment and incineration, and open burning.</p>
Industrial Processes and Product Use	
	<p>The main emission sources from industrial activities are released from industrial processes that chemically or physically transform materials. Additionally, certain products used by industry and end-consumers, such as refrigerants, foams or aerosol cans also contain GHG's which can be released during use and disposal.</p>
Agriculture, Forestry and Other Land Use	
	<p>Emissions are produced through:</p> <ul style="list-style-type: none">-livestock - enteric fermentation and manure management-land use and land use change such as development of green space and deforestation'-aggregate sources and non-CO2 emission sources on land such as fertilizer application

Appendix C – Summary of Saskatoon Community Emissions

GPC ref No.	Scope	GHG Emissions Source (By Sector and Sub-sector)	Notation keys	GHGs (metric tonnes CO ₂ e)			
				CO ₂	CH ₄	N ₂ O	Total tCO ₂ e
I		STATIONARY ENERGY					
I.1		Residential buildings					
I.1.1	1	Emissions from fuel combustion within the city boundary		431,375	211	2,412	433,998
I.1.2	2	Emissions from grid-supplied energy consumed within the city boundary		470,965	668	3,261	474,894
I.1.3	3	Transmission and distribution losses from grid-supplied energy		23,131	33	160	23,324
I.2		Commercial and institutional buildings and facilities					
I.2.1	1	Emissions from fuel combustion within the city boundary		483,100	236	2,715	486,051
I.2.2	2	Emissions from grid-supplied energy consumed within the city boundary		731,330	1,037	5,064	737,432
I.2.3	3	Transmission and distribution losses from grid-supplied energy		34,331	49	238	34,617
I.3		Manufacturing industries and construction					
I.3.1	1	Emissions from fuel combustion within the city boundary		63,053	29	586	63,669
I.3.2	2	Emissions from grid-supplied energy consumed within the city boundary	IE				
I.3.3	3	Transmission and distribution losses from grid-supplied energy	IE				
I.4		Energy industries					
I.4.1	1	Emissions from energy production used in power plant auxiliary operations within the city					
I.4.2	2	Emissions from grid-supplied energy consumed by energy industries					
I.4.3	3	Emissions from transmission and distribution losses from grid-supplied energy used in power plant auxiliary operation	NO				
I.4.4	1	Emissions from energy generation supplied to the grid					10,615
I.5		Agriculture, forestry and fishing activities					
I.5.1	1	Emissions from fuel combustion within the city boundary					
I.5.2	2	Emissions from grid-supplied energy consumed within the city boundary	NO				
I.5.3	3	Transmission and distribution losses from grid-supplied energy consumption	NO				
I.6		Non-specified sources					
I.6.1	1	Emissions from fuel combustion within the city boundary	NO				
I.6.2	2	Emissions from grid-supplied energy consumed within the city boundary		13,424	19	93	13,536
I.6.3	3	Emissions from transmission and distribution losses from grid-supplied energy consumption		588	1	4	593
I.7		Fugitive emissions from mining, processing, storage, and transportation of coal					
I.7.1	1	Fugitive emissions from mining, processing, storage, and transportation of coal within the city boundary	NO				
I.8		Fugitive emissions from oil and natural gas systems					
I.8.1	1	Fugitive emissions from oil and natural gas systems within the city boundary	NO				
II		TRANSPORTATION					
II.1		On-road transportation					
II.1.1	1	Emissions from fuel combustion on-road transportation occurring in the city		1,040,930	1,390	7,571	1,049,892
II.1.2	2	Emissions from grid-supplied energy consumed in the city for on-road transportation	NO				
II.1.3	3	Emissions from transboundary journeys occurring outside the city, and T and D losses from grid-supplied energy use		80	0	1	82
II.2		Railways					
II.2.1	1	Emissions from fuel combustion for railway transportation occurring in the city					8,953
II.2.2	2	Emissions from grid-supplied energy consumed in the city for railways	IE				
II.2.3	3	Emissions from transboundary journeys occurring outside the city, and T and D losses from grid-supplied energy use	NE				
II.3		Waterborne navigation					
II.3.1	1	Emissions from fuel combustion for waterborne navigation occurring in the city		15	0	0	15
II.3.2	2	Emissions from grid-supplied energy consumed in the city for waterborne navigation	IE				
II.3.3	3	Emissions from transboundary journeys occurring outside the city, and T and D losses from grid-supplied energy use	NE				
II.4		Aviation					
II.4.1	1	Emissions from fuel combustion for aviation occurring in the city		2,882	67	84	3,033
II.4.2	2	Emissions from grid-supplied energy consumed in the city for aviation	IE				
II.4.3	3	Emissions from transboundary journeys occurring outside the city, and T and D losses from grid-supplied energy use		130,921	37	1,082	132,040
II.5		Off-road transportation					
II.5.1	1	Emissions from fuel combustion for off-road transportation occurring in the city	IE				
II.5.2	2	Emissions from grid-supplied energy consumed in the city for off-road transportation	NE				
II.5.3	3	Emissions from transboundary journeys occurring outside the city, and T and D losses from grid-supplied energy use	NE				
III		WASTE					
III.1		Solid waste disposal					
III.1.1	1	Emissions from solid waste generated in the city and disposed in landfills or open dumps within the city			91,512		91,512
III.1.2	3	Emissions from solid waste generated in the city but disposed in landfills or open dumps outside the city			109,845		109,845
III.1.3	1	Emissions from waste generated outside the city and disposed in landfills or open dumps within the city	IE				
III.2		Biological treatment of waste					
III.2.1	1	Emissions from solid waste generated in the city that is treated biologically in the city					6,132
III.2.2	3	Emissions from solid waste generated in the city but treated biologically outside of the city	NO				
III.2.3	1	Emissions from waste generated outside the city boundary but treated in the city	NO				
III.3		Incineration and open burning					
III.3.1	1	Emissions from waste generated and treated within the city	NO				
III.3.2	3	Emissions from waste generated within but treated outside of the city	NO				
III.3.3	1	Emissions from waste generated outside the city boundary but treated within the city	NO				
III.4		Wastewater treatment and discharge					
III.4.1	1	Emissions from wastewater generated and treated within the city		4,150	10,345		14,495
III.4.2	3	Emissions from wastewater generated within but treated outside of the city	NO				
III.4.3	1	Emissions from wastewater generated outside the city boundary but treated within the city	NE				
IV		INDUSTRIAL PROCESSES and PRODUCT USES (IPPU)					
IV.1	1	Emissions from industrial processes occurring in the city boundary		167,550			167,550
IV.2	1	Emissions from product use occurring within the city boundary	NE				
V		AGRICULTURE, FORESTRY and OTHER LAND USE (AFOLU)					
V.1	1	Emissions from livestock			425	86	511
V.2	1	Emissions from land					
V.3	1	Emissions from aggregate sources and non-CO2 emission sources on land	NE				
VI		OTHER SCOPE 3					
VI.1	3	Other Scope 3	NE				

Appendix D – Summary of Saskatoon Corporate Emissions

GPC ref No.	Scope	GHG Emissions Source (By Sector and Sub-sector)	Notation keys	GHGs (metric tonnes CO ₂ e)			
				CO ₂	CH ₄	N ₂ O	Total tCO ₂ e
I		STATIONARY ENERGY					
I.1		Residential buildings					
I.1.1	1	Emissions from fuel combustion within the city boundary		17,285	8	95	17,389
I.1.2	2	Emissions from grid-supplied energy consumed within the city boundary		26,225	37	182	26,444
I.1.3	3	Transmission and distribution losses from grid-supplied energy		1,179	2	8	1,189
I.2		Commercial and institutional buildings and facilities					
I.2.1	1	Emissions from fuel combustion within the city boundary		4,879	3	28	4,910
I.2.2	2	Emissions from grid-supplied energy consumed within the city boundary		26,274	37	182	26,493
I.2.3	3	Transmission and distribution losses from grid-supplied energy		1,289	2	9	1,300
I.3		Manufacturing industries and construction					
I.3.1	1	Emissions from fuel combustion within the city boundary	NO				
I.3.2	2	Emissions from grid-supplied energy consumed within the city boundary		13,424	19	93	13,536
I.3.3	3	Transmission and distribution losses from grid-supplied energy		588	1	4	593
I.4		Energy industries					
I.4.1	1	Emissions from energy production used in power plant auxiliary operations within the city					
I.4.2	2	Emissions from grid-supplied energy consumed by energy industries		621	1	4	626
I.4.3	3	Emissions from transmission and distribution losses from grid-supplied energy used in power plant auxiliary operations		29	0	0	29
I.4.4	1	Emissions from energy generation supplied to the grid					
I.5		Agriculture, forestry and fishing activities					
I.5.1	1	Emissions from fuel combustion within the city boundary	NO				
I.5.2	2	Emissions from grid-supplied energy consumed within the city boundary	NO				
I.5.3	3	Transmission and distribution losses from grid-supplied energy consumption	NO				
I.6		Non-specified sources					
I.6.1	1	Emissions from fuel combustion within the city boundary	NO				
I.6.2	2	Emissions from grid-supplied energy consumed within the city boundary	NO				
I.6.3	3	Emissions from transmission and distribution losses from grid-supplied energy consumption	NO				
I.7		Fugitive emissions from mining, processing, storage, and transportation of coal					
I.7.1	1	Fugitive emissions from mining, processing, storage, and transportation of coal within the city boundary	NO				
I.8		Fugitive emissions from oil and natural gas systems					
I.8.1	1	Fugitive emissions from oil and natural gas systems within the city boundary	NO				
II		TRANSPORTATION					
II.1		On-road transportation					
II.1.1	1	Emissions from fuel combustion on-road transportation occurring in the city		9,163	9	134	9,306
II.1.2	2	Emissions from grid-supplied energy consumed in the city for on-road transportation	NO				
II.1.3	3	Emissions from transboundary journeys occurring outside the city, and T and D losses from grid-supplied energy use	NO				
II.2		Railways					
II.2.1	1	Emissions from fuel combustion for railway transportation occurring in the city	NO				
II.2.2	2	Emissions from grid-supplied energy consumed in the city for railways	NO				
II.2.3	3	Emissions from transboundary journeys occurring outside the city, and T and D losses from grid-supplied energy use	NO				
II.3		Waterborne navigation					
II.3.1	1	Emissions from fuel combustion for waterborne navigation occurring in the city	IE				
II.3.2	2	Emissions from grid-supplied energy consumed in the city for waterborne navigation	NO				
II.3.3	3	Emissions from transboundary journeys occurring outside the city, and T and D losses from grid-supplied energy use	NO				
II.4		Aviation					
II.4.1	1	Emissions from fuel combustion for aviation occurring in the city		81	2	2	85
II.4.2	2	Emissions from grid-supplied energy consumed in the city for aviation	NO				
II.4.3	3	Emissions from transboundary journeys occurring outside the city, and T and D losses from grid-supplied energy use	NO				
II.5		Off-road transportation					
II.5.1	1	Emissions from fuel combustion for off-road transportation occurring in the city	IE				
II.5.2	2	Emissions from grid-supplied energy consumed in the city for off-road transportation	NO				
II.5.3	3	Emissions from transboundary journeys occurring outside the city, and T and D losses from grid-supplied energy use	NO				
III		WASTE					
III.1		Solid waste disposal					
III.1.1	1	Emissions from solid waste generated in the city and disposed in landfills or open dumps within the city			4,576		4,576
III.1.2	3	Emissions from solid waste generated in the city but disposed in landfills or open dumps outside the city	NO				
III.1.3	1	Emissions from waste generated outside the city and disposed in landfills or open dumps within the city	NO				
III.2		Biological treatment of waste					
III.2.1	1	Emissions from solid waste generated in the city that is treated biologically in the city	NO				
III.2.2	3	Emissions from solid waste generated in the city but treated biologically outside of the city	NO				
III.2.3	1	Emissions from waste generated outside the city boundary but treated in the city	NO				
III.3		Incineration and open burning					
III.3.1	1	Emissions from waste generated and treated within the city	NO				
III.3.2	3	Emissions from waste generated within but treated outside of the city	NO				
III.3.3	1	Emissions from waste generated outside the city boundary but treated within the city	NO				
III.4		Wastewater treatment and discharge					
III.4.1	1	Emissions from wastewater generated and treated within the city					
III.4.2	3	Emissions from wastewater generated within but treated outside of the city					
III.4.3	1	Emissions from wastewater generated outside the city boundary but treated within the city					
IV		INDUSTRIAL PROCESSES and PRODUCT USES (IPPU)					
IV.1	1	Emissions from industrial processes occurring in the city boundary	NE				
IV.2	1	Emissions from product use occurring within the city boundary	NE				
V		AGRICULTURE, FORESTRY and OTHER LAND USE (AFOLU)					
V.1	1	Emissions from livestock			20	1	21
V.2	1	Emissions from land	NE				
V.3	1	Emissions from aggregate sources and non-CO ₂ emission sources on land	NE				
VI		OTHER SCOPE 3					
VI.1	3	Other Scope 3	NE				

Appendix E – Global Warming Potential and Emission Factors

Emission Factors

Energy/Fuel Source	Unit	Emission Factor			
		CO ₂	CH ₄	N ₂ O	CO ₂ e
Electricity	kg/kWh				
2003		0.794	0.000176	0.00585	0.800
2014		0.624	0.0000354	0.0000145	0.629
Natural Gas	kg/m ³				
2003		1.880	0.00002	0.000043	1.880
2014		1.889	0.000037	0.000035	1.900
Propane	kg/L				
2003		1.53	0	0.00003	1.530
2014		1.515	0.000024	0.000108	1.548
Diesel (mobile)	kg/L				
2003		2.73	0.0004	0.0002	2.731
2014 (average)		2.690	0.0000933	0.000165	2.742
Gasoline (mobile)	kg/L				
2003		2.36	0.00165	0.00024	2.362
2014 (average)		2.316	0.000315	0.000246	2.397

Note: emission factors for 2014 mobile fuel sources represent averaged values for light- and heavy-duty vehicles, as published in the 1990-2013 National Inventory Report (Table A6-11).

Appendix E – continued

Global Warming Potential

Greenhouse Gas		Global Warming Potential	
Formula	Name	2003	2014
CO ₂	Carbon Dioxide	1	1
CH ₄	Methane	21	25
N ₂ O	Nitrous Oxide	310	298
SF ₆	Sulphur hexafluoride	23,900	22,800
CF ₄	Carbon tetrafluoride	6,500	7,390
C ₂ F ₆	Hexafluoroethane	9,200	12,200
CHF ₃	HFC-23	11,700	14,800
CH ₂ F ₂	HFC-32	650	675
CH ₃ F	HFC-41	150	92
C ₂ HF ₅	HFC-125	2,800	3,500
C ₂ H ₂ F ₄	HFC-134	1,000	1,100
CH ₂ FCF	HFC-134a	1,300	1,430
C ₂ H ₃ F ₃	HFC-143	300	353
C ₂ H ₄ F ₃	HFC-143a	3,800	4,470
C ₂ H ₄ F ₂	HFC-152a	140	124
C ₃ HF ₇	HFC-227ea	2,900	3,220
C ₃ H ₂ F ₆	HFC-236fa	6,300	9,810
C ₃ H ₃ F ₅	HFC-245ca	560	1,030
NF ₃	Nitrogen trifluoride	n/a	17,200

Note: Global Warming Potentials for 2003 and 2014 taken from IPCC Second and Fourth Assessment Reports, respectively. Information also included in the 'Reference Tables' worksheet of the GPC Reporting Tool.

Appendix F – Emissions and Demographics by Neighbourhood

Sources for energy consumption were obtained by data supplied by SaskPower, SaskEnergy and Saskatoon Light and Power. Sources for neighborhood data were obtained by the City of Saskatoon Neighborhood profiles, Edition 14.

Neighborhood	Natural Gas (m3)	Electricity (kWh)	GJ	Predominant age of dwelling	Ave household size	2014 Neighborhood population	Total Households	Consumption per neighborhood	Consumption per household (GJ)
Adelaide/Churchill	4,163,662	11,358,660	201,192	Before 1960	2.6	3,683	1300	55	77,382
Airport Business Area	94,150	181,601	4,279	NR	NR	NR	NR	NA	NA
Arbor Creek	6,471,868	11,574,682	290,836	2001-2005	3.1	5,147	1605	57	93,818
Aspen Ridge	31,252	NR	NA	NR	NR	NR	NR	NA	NA
Avalon	4,638,510	10,800,124	217,463	Before 1960	2.4	3,379	1,380	64	90,610
Blairmore Suburban Centre	NR	2,808,133	NA	NR	NR	918	700	NA	NA
Brevort Park	4,482,381	9,281,142	205,984	1961-1980	2.4	3,761	1425	55	85,827
Brianwood	7,277,010	17,716,174	343,943	2001-2005	2.9	5,356	1725	64	118,601
Buena Vista	6,808,068	9,907,396	297,777	1961-1980	2.1	3,211	1405	93	141,799
Caswell Hill	6,823,465	10,613,448	300,912	Before 1960	2.2	3,667	1555	82	136,778
Central Business District	1,076,435	7,175,116	67,273	1961-1980	1.4	3,261	1970	21	48,052
City Park	5,747,873	10,987,013	260,846	Before 1960	1.6	4,277	2765	61	163,029
College Park	6,066,924	15,054,315	287,772	1961-1980	2.5	5,813	2065	50	115,109
College Park East	5,560,971	14,053,271	264,689	1961-1980	2.6	4,679	1755	57	101,804
Confederation Park	6,180,664	17,706,608	301,699	1961-1980	2.9	7,447	2305	41	104,034
Confederation Suburban Centre	230,736	1,423,944	14,010	1961-1980	2.5	1,046	600	13	5,604
Dundonald	5,892,101	15,786,903	283,679	1981-1990	2.9	5,871	1750	48	97,820
Eastview	4,993,678	11,045,206	232,019	1961-1980	2.5	3,909	1455	59	92,808
Elk Point	9,557	103,565	741	NR	NR	NR	NR	NA	NA
Erindale	4,993,223	13,066,211	239,277	1981-1990	3.0	4,464	1410	54	79,759
Evergreen	4,408,311	11,666,954	211,721	NR	NR	3,283	NR	64	NA
Exhibition	3,245,479	7,920,866	153,466	Before 1960	2.0	2,571	1240	60	76,733
Fairhaven	3,717,660	11,894,447	185,950	1961-1980	2.6	4,970	1650	37	71,519
Forest Grove	6,046,546	16,785,852	293,221	1981-1990	2.6	5,575	2130	53	112,777
Greystone Heights	3,008,951	7,197,291	141,755	1961-1980	2.5	2,650	970	53	56,702
Grosvenor Park	2,340,033	4,577,424	106,570	Before 1960	2.1	1,596	735	67	50,748
Hampton Village	7,275,285	NR	NA	2006-2011	3.0	7,236	950	NA	NA
Haultain	5,917,748	30,216,932	336,614	Before 1960	2.1	2,797	1410	120	160,293
Holiday Park	2,431,869	4,981,148	111,559	Before 1960	2.1	1,745	750	64	53,123
Holliston	4,793,648	10,515,667	222,412	Before 1960	2.2	3,571	1515	62	101,096
Hudson Bay Park	3,266,777	5,861,148	146,871	1961-1980	2.1	2,150	890	68	69,939
Kelsey - Woodlawn	1,365,594	2,681,680	62,229	Before 1960	2.2	961	380	65	28,286
Kensington	384,674	227,997	15,631	NR	NR	NR	NR	NA	NA
King George	3,986,014	5,861,859	174,564	Before 1960	2.3	2,147	780	81	75,897

Neighborhood	Natural Gas (m3)	Electricity (kWh)	GJ	Predominant age of dwelling	Ave household size	2014 Neighborhood population	Total Households	Consumption per neighborhood	Consumption per household (GJ)
Lakeridge	4,569,946	11,995,848	219,128	1981-1990	3.2	4,078	1205	54	68,477
Lakeview	7,646,352	26,031,157	388,097	1981-1990	2.6	7,519	2820	52	149,268
Lakewood Suburban Centre	NR	NR	NA	2001-2005	2.0	1,901	960	NA	NA
Lawson Heights	5,207,054	15,169,915	255,083	1961-1980	2.5	5,146	1850	50	102,033
Lawson Heights Suburban Centre	870,306	2,940,165	44,091	1991-2000	1.5	1,421	975	31	29,394
Massey Place	3,537,808	8,797,387	167,876	1961-1980	2.6	3,680	1290	46	64,568
Mayfair	4,419,337	8,495,185	200,727	Before 1960	2.3	2,857	1080	70	87,273
Meadowgreen	4,124,684	10,353,995	196,075	1961-1980	2.6	4,656	1595	42	75,413
Montgomery	3,950,274	8,593,700	183,023	1961-1980	2.8	2,936	900	62	65,365
Mount Royal	6,653,827	12,469,924	301,064	1961-1980	2.2	4,946	1910	61	136,847
North Industrial	10,973	16,133	481	NR	NR	NR	NR	NA	NA
North Park	2,917,599	6,628,479	136,190	Before 1960	2.2	2,028	965	67	61,905
Nutana	10,119,944	19,178,677	458,661	Before 1960	1.9	6,056	3300	76	241,401
Nutana Park	4,430,964	9,020,085	203,064	1961-1980	2.6	2,940	1045	69	78,102
Nutana Suburban Centre	1,613,975	5,875,602	83,290	1981-1990	1.3	3,065	2040	27	64,069
Pacific Heights	3,933,443	11,393,446	192,454	1961-1980	3.0	4,481	1325	43	64,151
Parkridge	5,153,204	13,877,598	248,358	1981-1990	3.0	5,343	1590	46	82,786
Pleasant Hill	6,472,686	12,184,398	293,062	1960 & 1961-1980	2.3	5,471	1815	54	127,418
Queen Elizabeth	3,756,401	8,054,286	173,617	Before 1960	2.4	2,703	1060	64	72,340
Richmond Heights	1,451,531	3,002,735	66,694	1961-1980	2.4	1,004	330	66	27,789
River Heights	5,483,671	14,612,517	263,726	1961-1980	2.5	4,602	1680	57	105,491
Riversdale	4,135,889	5,920,838	180,547	Before 1960	2.4	2,669	860	68	75,228
Rosewood	2,915,067	7,439,724	139,013	2006-2011	3.3	2,207	35	63	42,125
Silverspring	5,551,743	15,171,644	268,360	1991-2000	3.2	5,244	1595	51	83,863
Silverwood Heights	12,653,097	32,934,098	605,707	1981-1990	2.8	10,909	3600	56	216,324
South West Industrial	44,049	74,272	1,963	NR	NR	NR	NR	NA	NA
Stonebridge	10,156,120	26,817,369	487,553	2006-2011	2.6	8,907	1550	55	187,520
Sutherland	7,430,356	15,685,068	342,535	1961-1980	2.3	5,362	2480	64	148,928
The Willows	1,100,736	3,175,802	53,811	2006-2011	2.3	642	180	84	23,396
University Heights Suburban Centre	1,748,090	4,473,862	83,407	2001-2005	1.7	1,541	885	54	49,063
Varsity View	7,717,080	11,044,054	336,866	Before 1960	2.0	3,291	1850	102	168,433
West Industrial	233,500	155,260	9,549	NR	NR	NR	NR	NA	NA
Westmount	4,047,438	13,824,162	205,593	Before 1960	2.5	2,805	960	73	82,237
Westview	4,814,147	4,442,411	201,337	1961-1980	2.9	4,128	1220	49	69,427
Wildwood	7,182,757	21,449,242	353,753	1961-1980	2.0	7,455	3650	47	176,877
Willowgrove	9,767,324	22,895,352	458,465	2006-2011	3.0	7,212	1725	64	152,822
Consumption not associated by neighborhood		52,094,224	187,539	NA	NA	NA	NA	NA	NA

