TA18.4
Appendix 2

Greenhouse Gas Emissions Inventory for the Greater Toronto and Hamilton Area

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Please direct questions or comments to:

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Introduction

The Greater Toronto and Hamilton Area (GTHA) is an interconnected metropolis of seven million residents representing 51 percent of Ontario's population. It is also a region of significant economic activity accounting for 57 percent of Ontario's GDP (Statistics Canada, 2013). The greenhouse gas (GHG) emissions of the region are considerable, forming approximately 29 percent of Ontario's overall GHG emissions. Major sources across the region include buildings, transportation, industry, and waste management, although their relative importance varies substantially among the numerous municipalities within the GTHA.

In order to understand and create strategies to reduce emissions throughout the region, TAF has created an emissions inventory that captures the climate impacts of the region as a whole, while comparing and contrasting contributions of different cities. We believe that creating and sustaining a collective understanding of the GTHA's emissions landscape will accelerate the identification, prioritization and deployment of the solutions needed to meet our climate change goals. This report will describe the methodology, data sources, and findings of the 2015 Greater Toronto and Hamilton Area Greenhouse Gas Emissions Inventory. TAF intends to update this inventory on a regular basis, creating a dynamic picture of regional emissions over time.

Methodology

The GHG inventory for the GTHA presented in this report is for the year 2015 and separates the emissions into five sectors: buildings, transportation, waste, agriculture, and industrial. The inventory is further separated into six geographical areas; two municipalities (Toronto and Hamilton) and four regional municipalities (Peel, York, Durham, and Halton).

In general, TAF has followed the guidelines in the Global Protocol for Community-Scale Greenhouse Gas Emissions Inventories and attempted to use as many primary sources of data as possible (ICLEI, WRI, C40, 2014). The inventory includes scope 1 and 2 emissions. In cases where specific municipal level data was not available TAF has interpolated values from provincial or federal data or extrapolated data from other local municipalities. This document will briefly describe the methodology used to create this inventory and each section will list the potential sources which were missed due to inadequate data. A more detailed methodology will be made available with the final version of this report.

Buildings

The two main sources of emissions from buildings in the GTHA are natural gas and electricity consumption. These sources are typically referred to as "Stationary Energy" but we refer to them as "Buildings" to make the concept more relatable. Natural gas consumption data was obtained from Enbridge, Union Gas, and the Region of Durham's emissions inventory. Electricity data was obtained from the Ontario Energy Board's (OEB) Reporting and Record Keeping Requirements (RRR), and local distribution companies (LDC). The RRR reports electricity distribution by LDC with some LDCs providing electricity to more than one region. The electricity consumption for some small municipalities in some regions were interpolated based on a strong correlation between historic population and consumption values for the GTHA. Electricity consumption could include sources which aren't associated with buildings such as EV

charging, street lighting, or transit operations. Those sources were not disaggregated because information is not consistently available across all regions.

Transportation

Transportation emissions are calculated from fuel sales data from Kent Group Limited. Both gasoline and diesel fuel sales were provided. Kent Group Limited's coverage is about 99% of public gas stations in the GTHA. Because Ontario's renewable fuel standard requires at least 5% of fuel sold to be from a renewable source it was assumed 5% of fuel sales were ethanol and the appropriate emissions factor was applied. Fuel sales occurring in each municipality were allocated to that municipality's emissions inventory. TAF took this approach for simplicity despite it being reasonable to attribute the emissions to the municipality in which the fuel is consumed.

The fuel sales data may not account for railway, marine, or local aviation emissions. Freight emissions where trailers fuel up at unsupervised stations are also not accounted for.

Waste

The methane commitment approach was used to calculate emissions from waste, meaning that the estimated lifetime emissions of waste disposed in a given year is attributed entirely to that year even though the emissions will occur over many years (ICLEI, WRI, C40, 2014).

Residential waste tonnage data was obtained from Resource Productivity and Recovery Ontario. Residential waste composition data was obtained from the City of Toronto and assumed to represent the GTHA.

Non-residential waste tonnage was assumed to be proportional to the residential tonnage based on the ratio between residential and non-residential waste disposed of as reported for Ontario by Statistics Canada (Statistics Canada, 2014). The non-residential waste composition was provided by Torrie Smith Associates and Kelleher Environmental as supplemental data to their report on Greenhouse Gas Emissions and the Ontario Waste Management Industry (Kelleher, Christina, & Torrie, 2015).

Wastewater emissions are assumed to be zero since the methane in digester gas is biogenic and either used to offset natural gas required by the plant for heating or processes or is flared. A credit is not calculated for the digester gas used to offset natural gas use because the avoided natural gas use is already excluded from the natural gas consumption values.

Agriculture

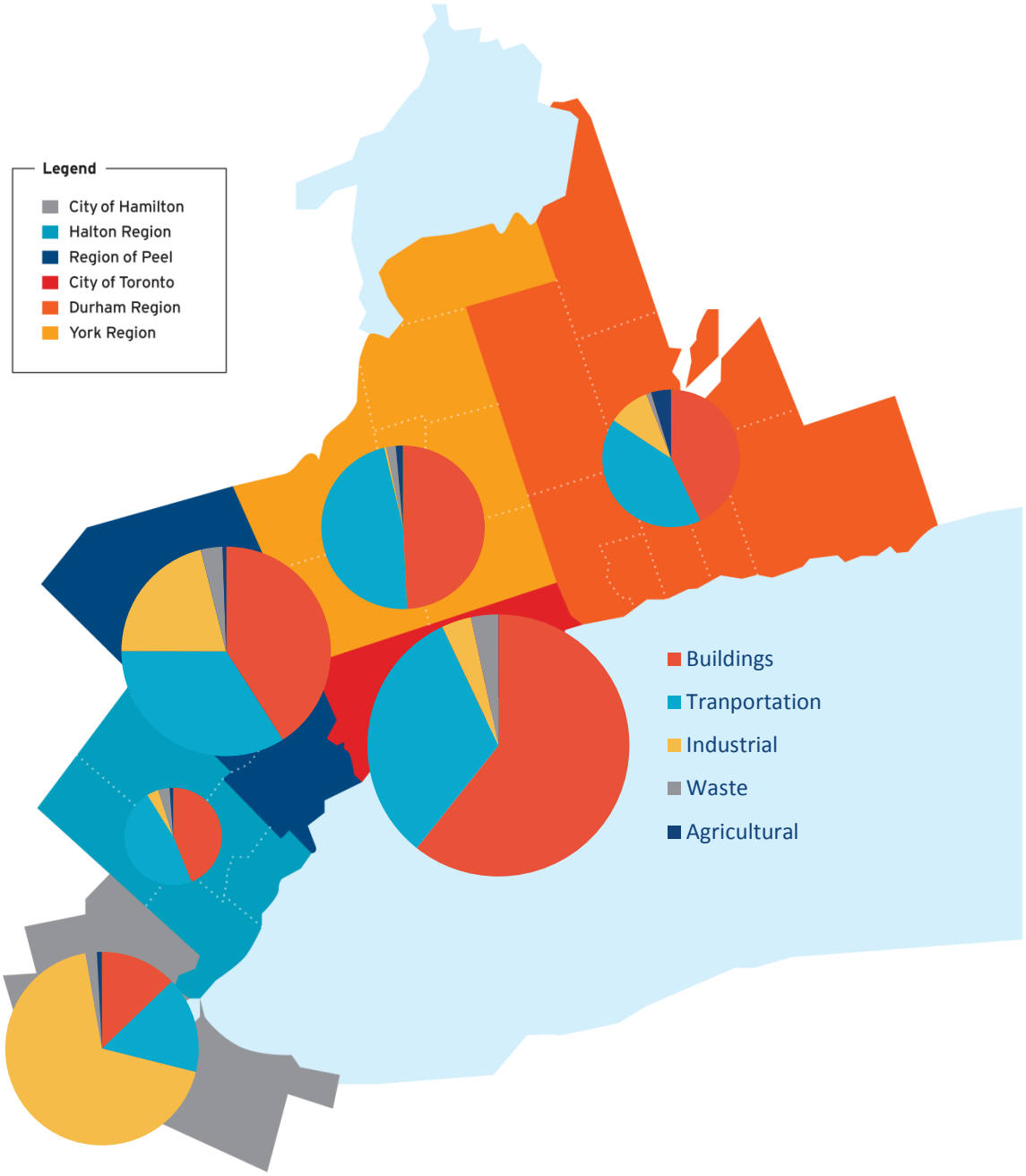
Agricultural emissions were estimated by proportioning Ontario's agricultural emissions in Canada's NIR based on StatsCan's agricultural census. Livestock emissions were proportioned based on the head count of cattle and emissions from manure management and agriculture soils were proportioned based on area of farm land.

Emissions from land use change or forestry activities were not calculated due to lack of data.

Industrial

Industrial emissions were taken from Ontario's 2015 GHG emissions reporting by large emitters (>25,000 tCO2eq/year). It was assumed the emissions from power generating facilities were already included in the electricity grid emissions and combined heat and power (CHP) plants' emissions were captured by the natural gas consumption data so those two sources were excluded. By excluding these two sectors most of the remaining emissions should be from industrial processes however, some electricity and natural gas emissions may be double counted as the large emitter's data reporting does not disaggregate the sources of emissions.

Results


Legend
City of Hamilton
Halton Region
Region of Peel
City of Toronto
Durham Region
York Region
Buildings
Tranportation
Industrial
Waste
Agricultural

Regional Inventory Findings and Observations

Emissions by Sector.

Overall, the GTHA's emissions come primarily from buildings (44%), and transportation (34%). The third largest emissions source is from industrial processes (19%). Waste and agricultural emissions are relatively minor at 3% and 1%, respectively (figure 1). The results reinforce the importance of the buildings and transportation sectors' emissions. Industrial process emissions are also significant, although their prominence is highly variable across different municipalities.

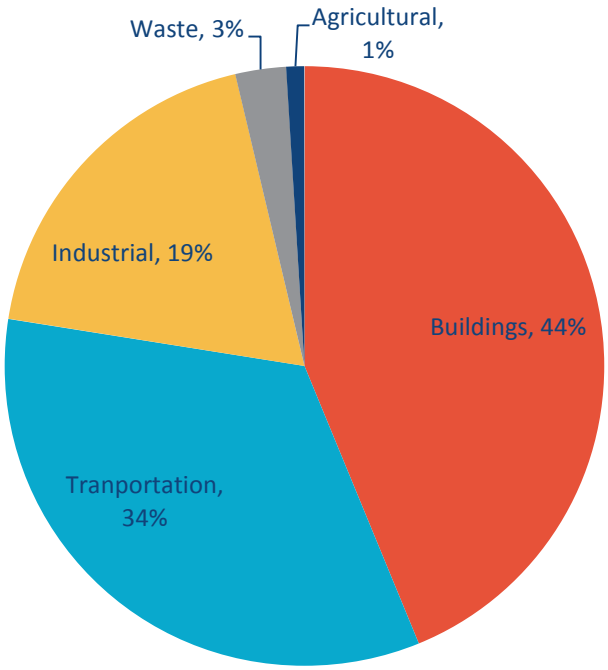


Figure 1 – Proportion of GTHA GHG Emissions by Sector

Emissions by Municipality

Figure 2 shows Toronto contributes the largest portion of the GTHA's emissions (31%) as the largest city. Peel Region is the second largest emissions contributor (23%) and Hamilton is the GTHA's third largest source (17%). York, Durham, and Halton Regions contribute 14%, 9%, and 6% of the GTHA's emissions, respectively.

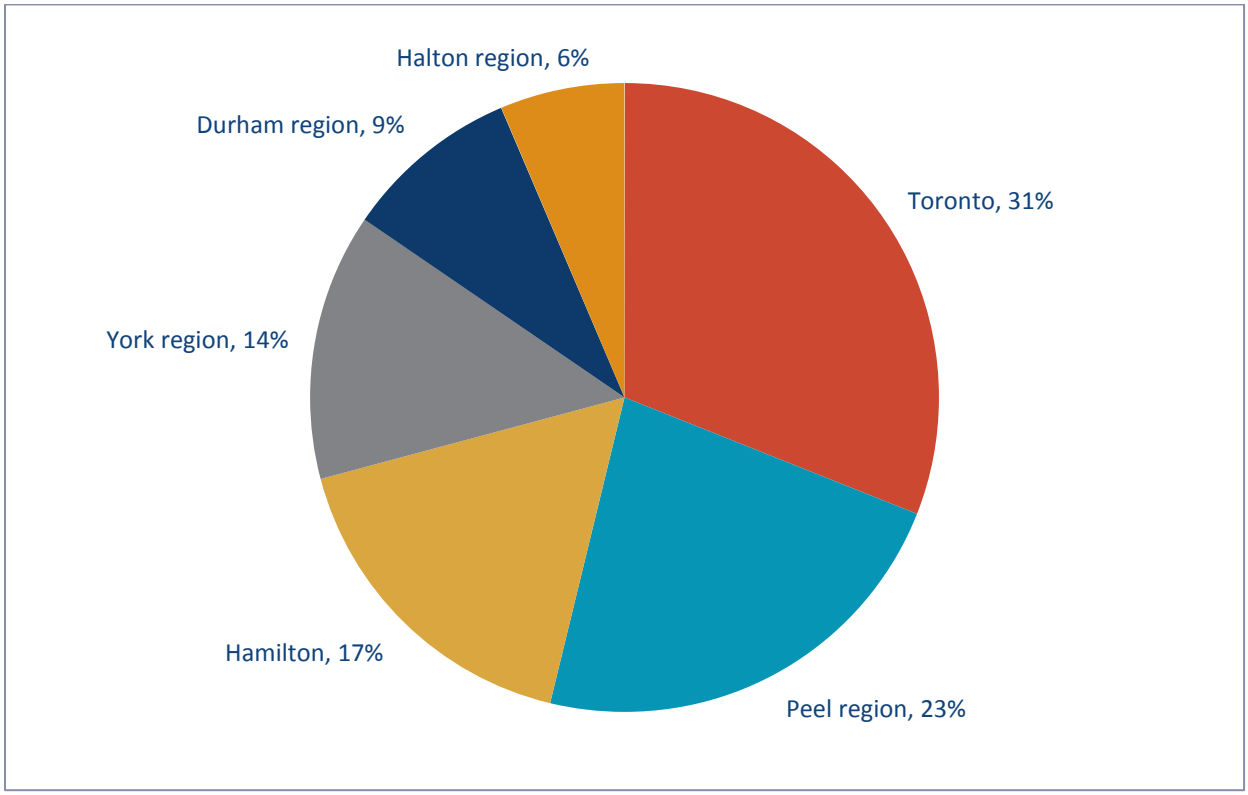


Figure 2 - Proportion of GTHA Emissions by Municipality

Municipal Emissions by Sector

While the major sources of emissions are consistent across all of the city-regions, the relative importance of the sources varies considerably. For example, Toronto's emissions are notably dominated by the buildings sector (60%), whereas Hamilton's emissions are dominated by industrial activity (68%) (figure 3). Peel Region has the second highest emissions from industrial activity after Hamilton. The Regions of York and Halton have the highest proportion of their emissions from transportation at 47%. Durham Region has a markedly higher share of agricultural emissions (5%) than the rest of the GTHA (1%).

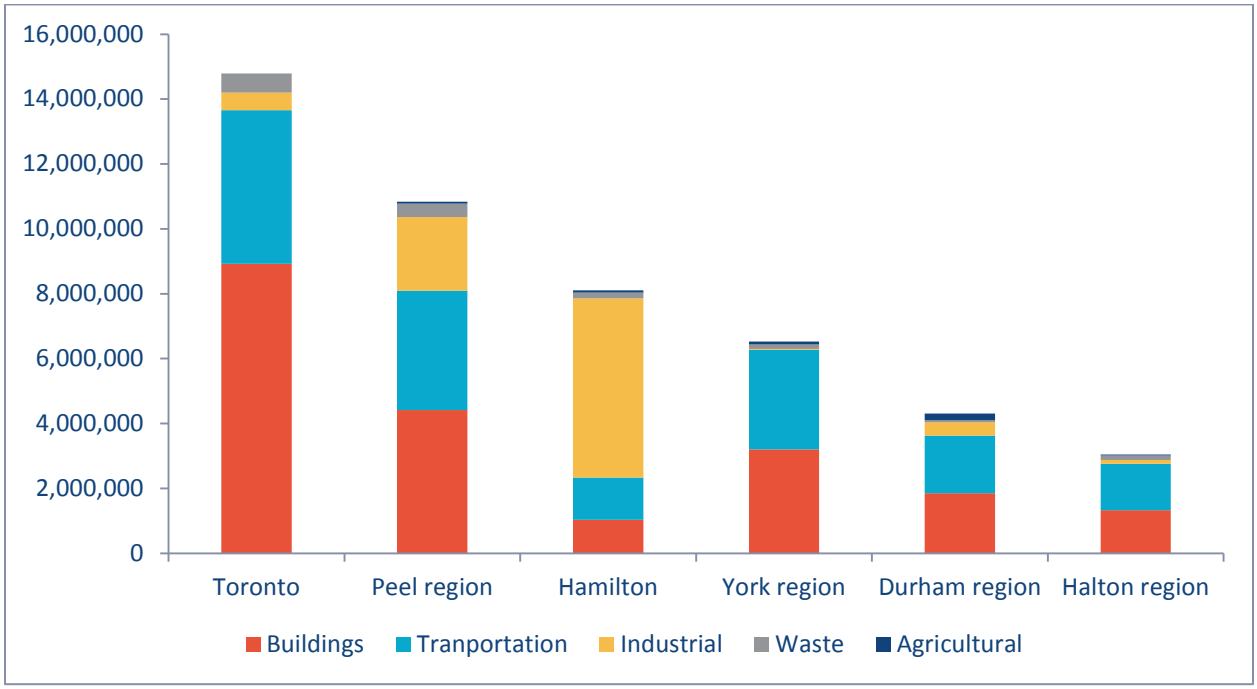


Figure 3 - GHG Emissions by Sector and Municipality

Municipal Emissions per Capita

Hamilton has the highest per capita emissions in the GTHA due to significant industrial sector emissions. Toronto, Halton Region, and York Region have noticeably lower than average emissions per capita.

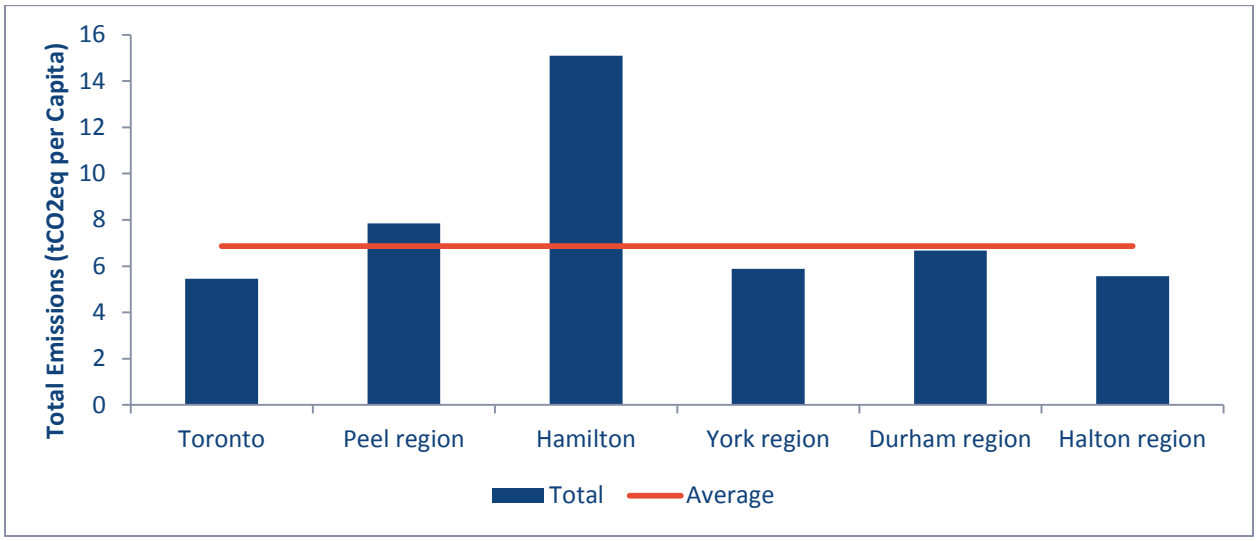


Figure 4 - Municipal Emissions per Capita

If the industrial emissions are excluded then Hamilton has the lowest emissions per capita, with Toronto and Halton also having lower emissions per capita than the regional average (figure 5). The emissions per capita (excluding the industrial sector) range from 4.8 to 6.2 tCO2eq, a 29% difference between the lowest and highest municipalities.

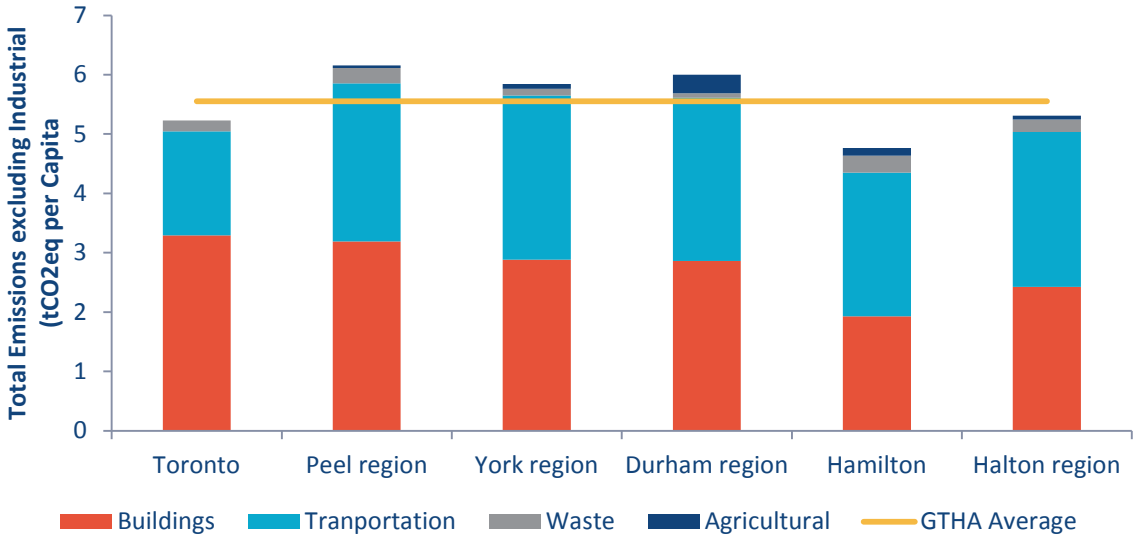


Figure 5 - GHG Emissions per Capita by Sector excluding Industrial Sector by Municipality

Buildings

It can be seen in figure 6 that buildings emissions in the GTHA are predominantly from natural gas (87%), which is mainly used for space and water heating. Electricity emissions have seen a decline since the phase out of coal-fired power generation in Ontario.

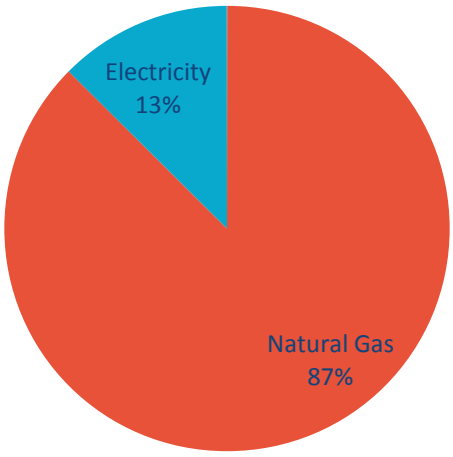


Figure 6 – Proportion of GTHA Building Emissions by Energy Type

Hamilton and Halton Region have lower than GTHA average per capita emissions from natural gas which factors into their overall lower than average per capita emissions (figure 7). Hamilton's natural gas emissions per capita is almost half of that of Toronto's.

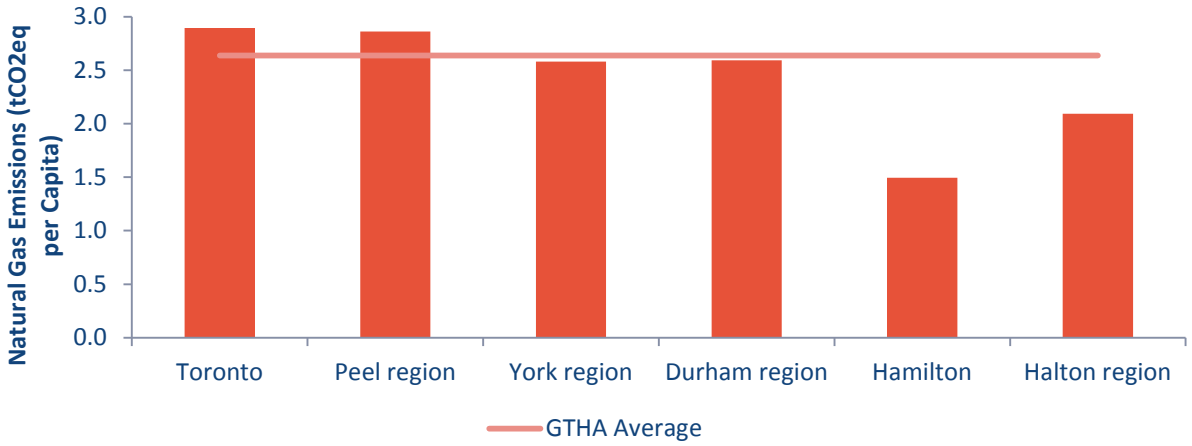


Figure 7 - Natural Gas Emissions per Capita by Municipality

Toronto has lower transportation emissions per capita than the GTHA average, while the regional municipalities have higher than average transportation emissions per capita.

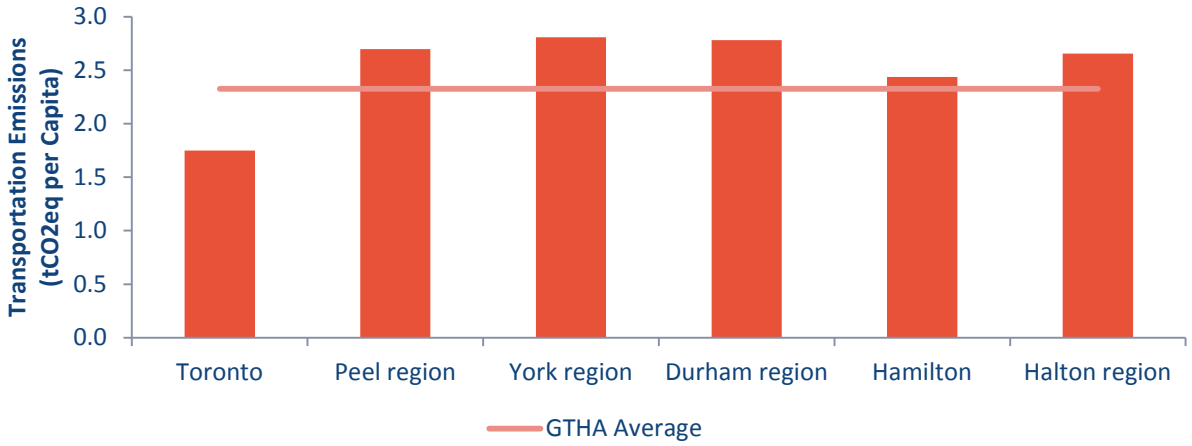


Figure 8 - Transportation Emissions per Capita by Municipality

Transportation emissions per capita in the GTHA have a strong negative correlation with population density (the higher the density, the lower the emissions) (Statistics Canada, 2016) (figure 9). While it is important to consider the role of confounding factors such as urban form, transportation infrastructure, and local income levels that may also affect transportation emissions, given the current analysis, the relationship between population density and transportation emissions per capita is quite clear.

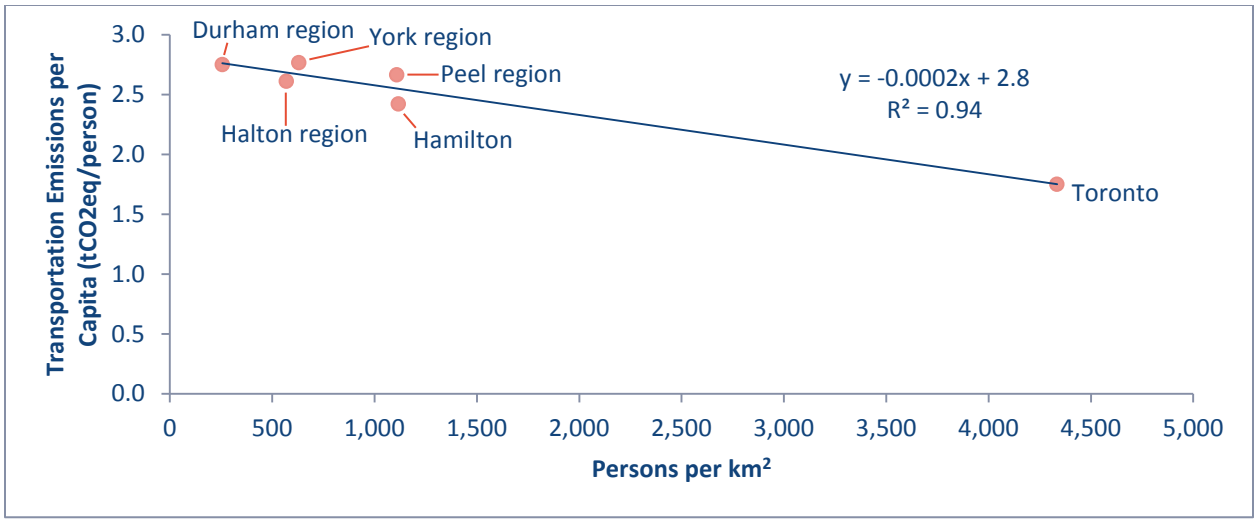


Figure 9 - Population Density and Transportation Emissions per Capita

Durham region has the highest agricultural emissions and agricultural emissions per capita in the GTHA although this sector is still a relatively low quantity of emissions.

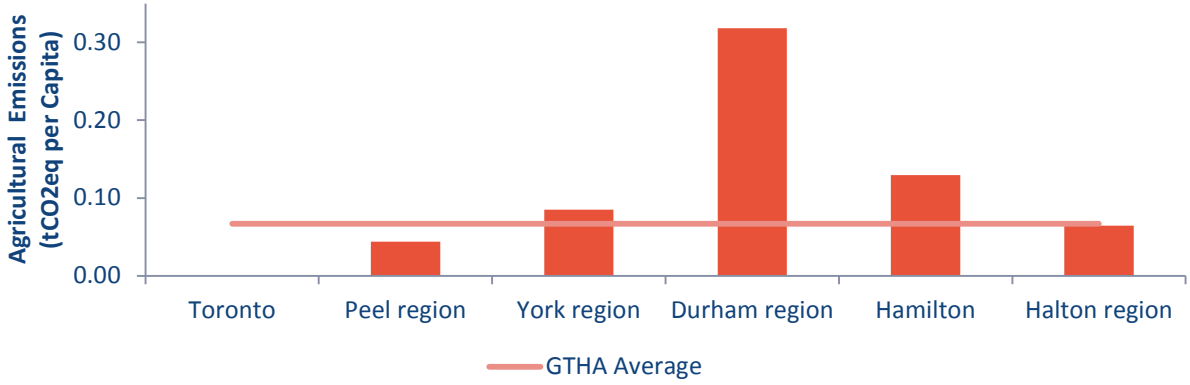


Figure 10 - Agricultural Emissions per Capita by Municipality

Provincial and National Comparisons

The GTHA comprises 51% of Ontario's population, generating 29% of Ontario's total emissions and 37.6% of Ontario's emissions in the sectors examined in this GHG Inventory (Environment and Climate Change Canada, 2017). The GTHA generates 6.6% of Canada's total emissions despite being 19% of the population and generating 21% of the GDP. However, a significant amount of Canada's GHG emissions are generated by sectors not included in municipal emissions inventories, such as aviation, and thus municipal inventories aren't fully comparable in the Canadian context.

In comparison to other large municipalities across Canada, the GTHA is the largest emitter by far. However, on a per capita basis the GTHA fares reasonably well. Comparisons are difficult

since many cities do not have updated emissions inventories and also use different methodologies.

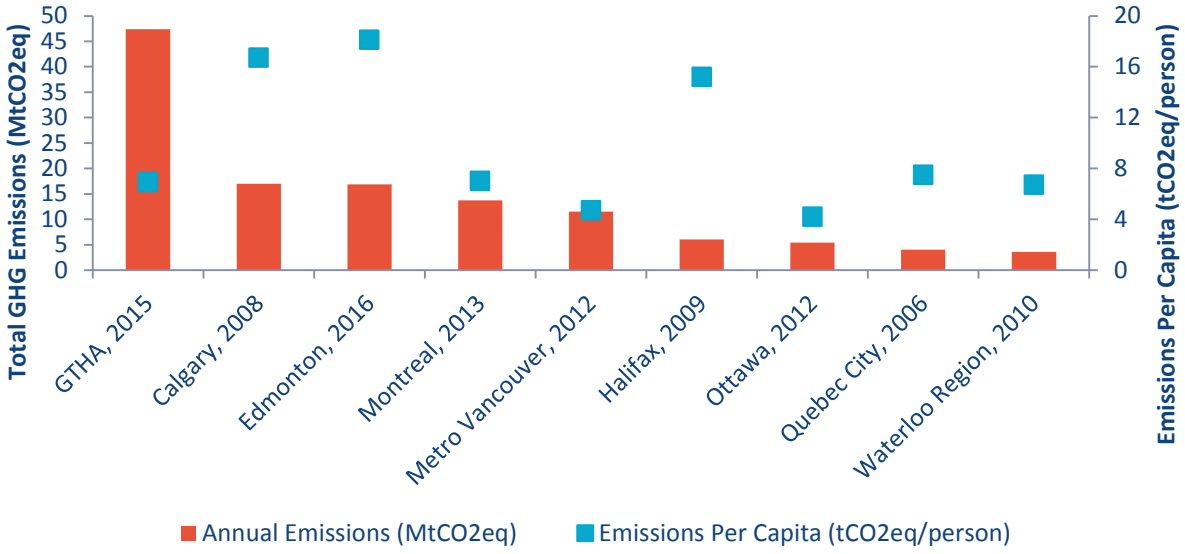


Figure 11 - Total Emissions and Emissions per Capita by Canadian Municipality

Future Projections

The GTHA's population is projected to increase by just over 3 million people (41.3%) between 2016 and 2041, creating significant impacts on the emissions of the region (Ministry of Finance, 2017). By using Ontario population projections, potential future emissions scenarios can be broadly estimated. If we multiply emissions per capita by population projections in all sectors except agricultural and industrial (which were assumed to remain constant for simplicity) we could estimate the future proportion of emissions from each region. This would not be the expected scenario but does demonstrate what might happen given no progress. Figure 12 demonstrates that Toronto's emissions would grow by about 5 MtCO2eq by 2041 based on estimated population growth. In figure 13, Peel, York, and Halton's proportions of GTHA emissions are estimated to grow while Hamilton's shrinks and Toronto and Durham Regions remain constant. Figure 14 shows the reduction of per capita emissions required to achieve a 50%[1] reduction in total emissions by 2041. GTHA-wide per capita emissions need to be reduced from 6.9 tCO2 per capita to 2.3 tCO2eq per capita by 2041 in order to see a 50% reduction in total emissions.

[1] This value was chosen based on the typical target of 80% reductions by 2050 compared to a 1990 baseline.

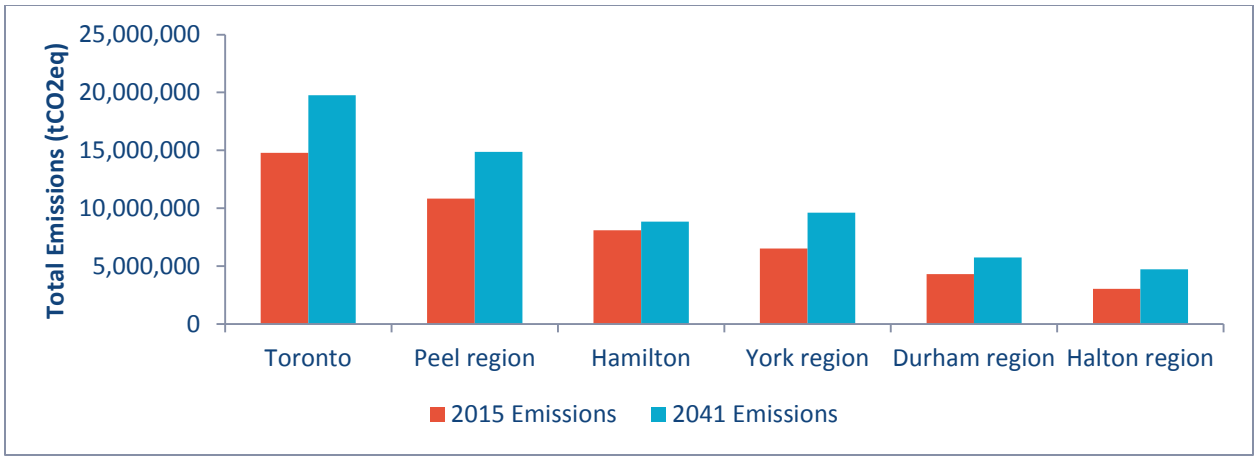


Figure 12 - Projected Total Emissions based on 2015 Per Capita Emissions by Municipality

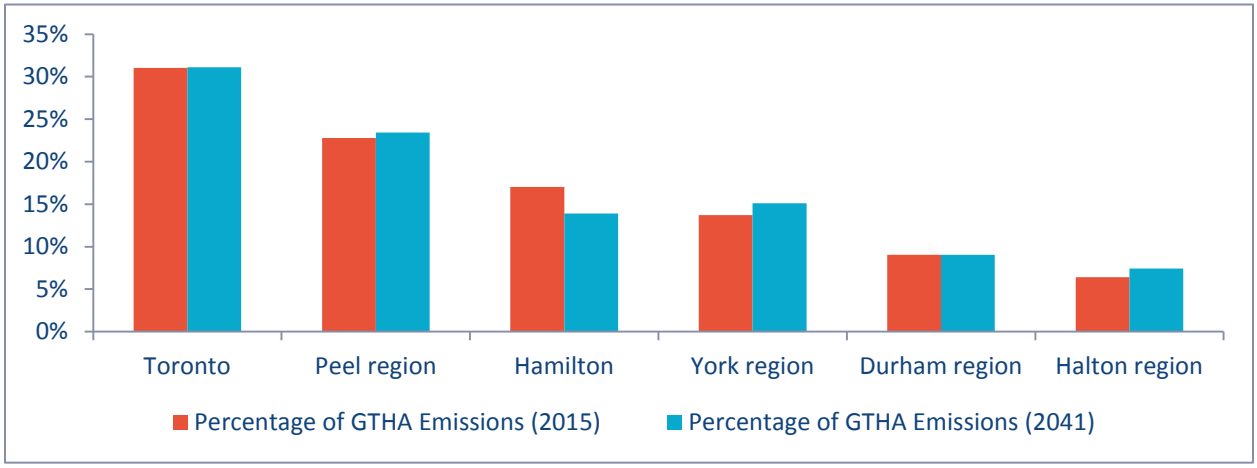


Figure 13 - Percentage of GTHA Emissions in the Years 2015 and 2041

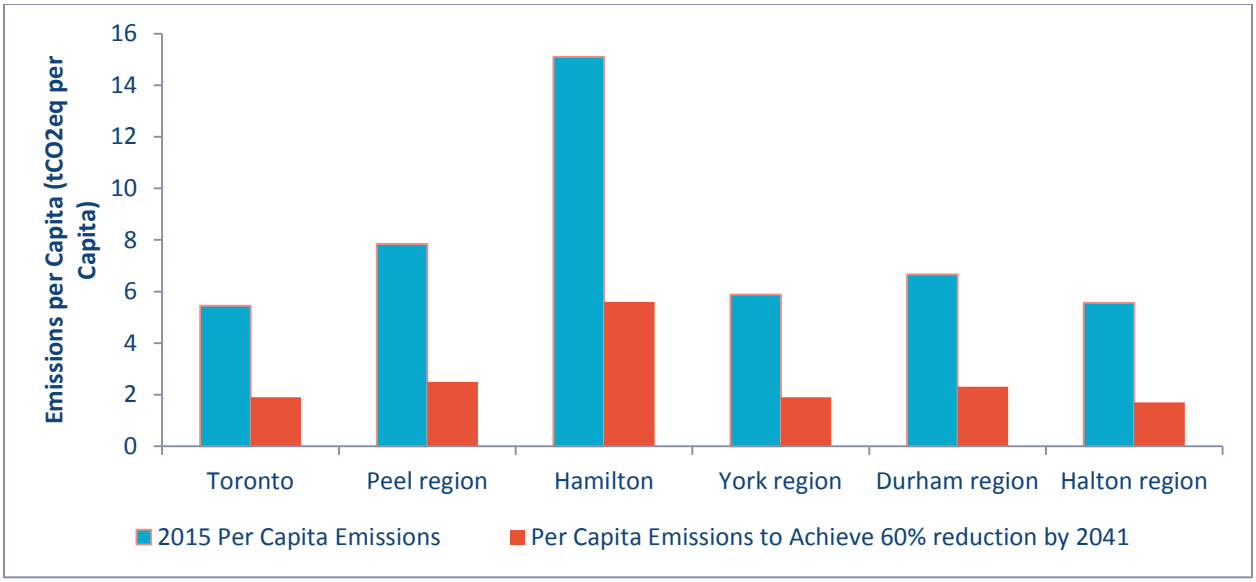


Figure 14 - 2015 Emissions per Capita Compared to 2041 Emissions per Capita with a 50% Reduction in Total Emissions

Implications

The results from the regional inventory reinforce both existing knowledge as well as provide new information to guide tactics for emissions reductions.

Buildings and transportation have long been known to be the two most significant sources of emissions and this remains true. Significant thought, resources, and focus should remain dedicated towards emissions reductions in these two areas.

Building emissions mainly come from the use of natural gas which is a much cheaper fuel per unit of energy than electricity in Ontario. If deep reductions in the buildings sector are to be realized they either need to focus on significantly reducing energy use for heating and hot water and/or converting to cleaner fuels such as electricity or renewable natural gas.

Regarding opportunities for reducing transportation related GHG emissions, it is much cheaper and lower emissions to power vehicles by electricity than gasoline (Plug 'N Drive, 2017). Electrification of transportation is therefore a key priority for emission reductions across the region. However, when considering electrification of both the buildings and transportation sectors, careful planning is required to ensure the additional loads do not result in a significantly higher electricity emissions factor. Based on the correlation between residential density and transportation emissions, increasing density, building complete communities and improving transit infrastructure can also lead to transportation emissions reduction at least on a per capita basis. The provincial Greenbelt Plan and Growth Plan support this notion of increased density, complete communities and building transit infrastructure (Government of Ontario, 2017; Government of Ontario, 2017).

Industrial emissions are the third largest sector of emissions in the GTHA and are highly concentrated in a few facilities. Therefore, targeted reduction strategies could be an effective approach. Notably, Hamilton and Peel house industrial facilities which generate 88% of the GTHA's industrial emissions. The provincial cap and trade program should provide a growing incentive for these industrial emitters to reduce emissions; however, there may also be potential for targeted programs and partnerships with all levels of government to accelerate reductions in industrial emissions.

Durham Region has the most agricultural emissions in the GTHA but agricultural emissions remain a relatively small portion of total emissions. Harnessing the methane from agricultural sources and using it to offset natural gas use may have significant potential to reduce emissions. While the local emissions are relatively insignificant, a more in depth look at the consumption emissions[2] may provide data on how to reduce emissions associated with food production and consumption.

When excluding the industrial sector, Hamilton and Toronto have the lowest emissions per capita out of the municipalities in the GTHA. This seems to be the case since Hamilton has the lowest building emissions per capita in the region and Toronto has the lowest transportation emissions per capita. Further investigation into the contributing factors needs to be undertaken so their applicability across the region and beyond can be assessed.

When comparing emissions per capita across major cities in Canada it can be seen that cities in provinces with coal fired power plants (Calgary, Edmonton, Halifax) have significantly higher GHG emissions than those without. Some cities do not break down their emissions into sectors or consistent sectors so further comparison on different metrics is difficult without access to this type of data.

Conclusion

By using a consistent methodology and by having the same year of data the 2015 GHG Inventory for the GTHA has provided numerous insights into the region's GHG emissions previously not possible. The key takeaways are:

- Buildings and transportation are the largest sources of emissions across the GTHA
- Outside the City of Toronto, increasing population density, combined with sound urban planning and investment in transit infrastructure, is critical to reducing transportation emissions.
- The entire region is growing very quickly, and achieving deep decarbonization in the context of rapid growth will require major reductions in per capita emissions.
- The industrial sector is a promising area to explore targeted emissions reduction strategies;

[2] The inventory undertaken by TAF is production-based. A consumption-based inventory is more complex and considers the emissions from products and services used or expended within the jurisdiction (such as food consumed locally, but not necessarily produced locally).

- While the GTHA is a significant contributor to provincial and national GHG emissions, it has below average emissions per capita compared to other major Canadian cities;
- The benefits of the inventory can be increased by annual maintenance, increasing data granularity, and applying temporal analysis lens in future research projects.

Overall, the analysis in this report helps provide a defined picture of the GTHA's emissions which are significant, varied, and poised for additional reductions.

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