Halton Region

Integrated Growth Management Strategy: Growth Concepts – Comparative Greenhouse Gas Emissions Assessment

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Introduction

As part of Halton Region's Official Plan Review, 4 Growth Concepts and a Preferred Growth Concept are being explored to help determine the next 30 years of land use development that will accommodate 1.1 million people and 500,000 jobs by 2051. To complement other assessments, greenhouse gas (GHG) emissions estimates for the four different Growth Concepts were calculated to determine expected emissions differences between them. Each Growth Concept is composed of different assumptions regarding new residential building types and location. In order to estimate the potential impact of these differing growth concepts on GHG emissions, data from detailed modelling work done for the Town of Halton Hills was used as representative data for Halton Region. Growth Concept 3B was not included in this quantitative assessment but is addressed qualitatively in this document.

Methodology

Growth Concepts

This analysis is based on four Growth Concepts developed by Halton Region with varying levels of densification and locations of new housing units.

Concept 1: 60% densification, moderate greenfield expansion.

Concept 2: 70% densification, limited greenfield expansion.

Concept 3A: 80% densification, employment area only greenfield expansion.

Concept 4: 50% intensification, greatest greenfield expansion.

The different distribution and types of homes between the Growth Concepts results in varying building and transportation emission estimates due to different building energy efficiencies and implied driving habits.

Data and Estimates

Overview

Using Halton Hills emissions data as a proxy for Halton Region, expected emissions in 2051 from new buildings (commercial, apartment, ground-related) and personal vehicle transportation were estimated for each Growth Concept. Per capita emissions intensities for the region (tonnes per year per person) were used to scale emissions for waste, wastewater, industrial, and commercial transportation emissions. These emissions are the same across concepts as they are only related to population growth, not housing geographic distribution. Emissions associated with land use conversion are excluded and considered negligible.

Results were compared to Halton Hills data and Toronto Atmospheric Fund data for Halton Region for consistency. It is important to note that these calculations are high-level estimates and are not to be considered the result of rigorous modelling, which would provide greater precision.

GHG emissions are expressed in tCO2e: tonnes carbon dioxide equivalent of greenhouse gas emissions. GHGs like methane (primarily from burning natural gas) and nitrous oxide (primarily from burning gas and diesel) are converted to tCO2e for ease of calculations and comparisons.

Residential buildings emissions intensities

Each of the four Growth Concepts has a different mix of ground-related housing and apartment units. Halton Hills' average emissions intensity per unit type was used as a proxy to determine emissions from new residential buildings for the four Growth Concepts. An emissions intensity of 4.11 tCO2e/unit/year is used for apartments and 5.00 tCO2e/unit/year for ground-related units.

For each scenario, the number of apartment units was multiplied by the apartment emissions intensity per unit and the number of new ground-related units by the ground-related emissions intensity in order to obtain an estimate of emissions.

Transportation emissions intensities

The location of growth will influence driving habits and therefore emissions from personal use vehicles. An average personal vehicle emissions intensity per dwelling unit per year by area type was used to determine how new units would influence transportation emissions (Table 1).

The emissions intensity for transportation came from three representative zones from the Town of Halton Hills model. The emissions per unit intensity for the Built-Up Area (The existing built up urban area identified by the Province as the area for which a minimum intensification target must be met.) is an average from a zone in the Built-Up Area of Georgetown. The emissions per unit intensity for the additional high density in the existing Designated Greenfield Area (generally undeveloped areas within the urban area but outside the Built-Up Area) was from a subdivision in the South of Georgetown. It was assumed that the existing Designated Greenfield Area and the new Designated Greenfield Area would have a similar emissions intensity. The emissions intensity used for this zone also came from a residential area in Georgetown.

Table 1. Transportation emissions intensities. (DGA = Designated Greenfield Area)

Area	**Transportation emissions per unit per year (tCO2e/unit/year)**
Built-Up Area	3.8
Existing DGA	7.9
Additional high density in existing DGA	6.3
New DGA	7.9

Commercial emissions intensities and total emissions estimate

New emissions from commercial buildings were estimated using an average intensity of emissions/job/year, calculated from Halton Hills detailed modelling. Each of the four Growth Concepts has the same job estimate for new job creation by 2051, which leads to emissions from commercial buildings being the same across concepts. While the concepts differ in where employment is directed, we assume that this would not significantly impact the emissions from commercial buildings for the purposes of this calculation.

Average emissions intensity per job per year = 1.55 tCO2e

Total cumulative new jobs in Halton Region by 2051 = 222,000 jobs

Total emissions related to new commercial buildings in the year 2051 = 344,100 tCO2e

Other sector emission estimates

Emissions from a range of other sources were estimated, including waste, wastewater, and others. These sources were estimated using new population projections and per capita emissions data. Because the population is the same across the four concepts, the estimated emissions are also the same. Other transportation emissions and industry data is from the Toronto Atmospheric Fund. Waste and wastewater per capita estimates were taken from the Halton Hills model.

Results

New residential buildings emissions estimate

Table 2 shows the different emissions estimates for new residential buildings by Growth Concept for the year 2051. Concept 3A has the lowest emissions from new residential buildings at just under 765 ktCO2e, while Concept 4 has the highest new building emissions: 797 ktCO2e. This is a difference of 32 ktCO2e (4.1%) between the concepts with the highest and lowest emissions estimates.

The difference in emissions stems from the differing amounts of apartments versus ground-related new residential units projected in each concept. Ground-related units use more energy per unit than apartment units, and, assuming a relatively similar distribution of energy using equipment for each building type, this translates to higher emissions per unit for ground-related units versus apartment units. Concept 3A has the highest ratio of projected apartments to ground-related units which leads to it having the lowest emissions estimates. On the other hand, Concept 4 has the lowest ratio of projected apartments to ground-related units which results in the highest emissions of the four Growth Concepts.

Table 2. Residential buildings emissions estimate for 2051. Emissions intensities are 5.00 tCO2e/unit/year for ground-related homes and 4.11 tCO2e/unit/year for apartments. (DGA = Designated Greenfield Area)

			Concept 1	Concept 2	Concept 3A	Concept 4
New units	Built-Up Area	Ground-related	11,550	8,680	8,830	11,550
		Apartment	76,390	82,240	85,040	76,390
	Existing DGA	Ground-related	44,990	46,900	47,040	44,850
		Apartment	5,010	5,210	5,230	3,780
	Additional high density in existing DGA	Ground-related	0	0	0	0
		Apartment	11,950	17,960	27,880	2,990
	New DGA	Ground-related	21,760	11,760	0	32,780
		Apartment	2,310	1,300	0	2,300
Emissions (tCO2e)	**New Residential Emissions**		**784,663**	**775,278**	**764,947**	**797,141**
	Difference from Concept 3A		**+2.5%**	**+1.3%**	**-**	**+4.1%**

Personal use vehicles emissions estimate

Table 3 shows the estimated additional emissions from personal use vehicles for each growth concept. The driver behind the different emission estimate results is the level of new residential units which are planned to be constructed in the Built-Up Area versus Designated Greenfield Area for each of the four Growth Concepts.

New residential units in Built-Up Areas will generally benefit from more accessible transit options and an increased proximity to amenities which contrasts with higher personal automobile mode share and kilometres travelled for homes developed in green field developments. Since Concept 3A has the highest ratio of new residential units in the Built-Up Area versus new Designated Greenfield Area, it has the lowest transportation emissions estimate for 2051 (944 ktCO2e). Concept 4 has the lowest ratio of new residential units in Built-Up Areas versus new Designated Greenfield Area and thus has the highest projected transportation emissions linked to new residential building units (1011 ktCO2e). The difference between the lowest and highest emissions estimate for additional vehicle emissions is 6.9%.

Table 3. Personal use vehicle emissions estimate for 2051. (DGA = Designated Greenfield Area)

		Transportation emissions per unit per year	Concept 1	Concept 2	Concept 3A	Concept 4
New units	Built-Up Area	3.8	87,940	90,920	93,870	87,940
	Existing DGA	7.86	50,000	52,110	52,270	48,630
	Additional high density in existing DGA	6.32	11,950	17,960	27,880	2,990
	New DGA	7.86	24,070	13,060	0	35,080
Emissions (tCO2e)	**Additional Vehicle Emissions**		**991,886**	**971,239**	**943,750**	**1,011,029**
	Difference from Concept 3A		**+5.0%**	**+5.0%**	**-**	**+6.9%**

Summary of Results

Combining all the emissions calculations, Growth Concept 3A has the lowest emissions impact of the four concepts in 2051 (2,933 ktCO2e). It has the lowest emissions from residential buildings because there are comparatively fewer ground-related units, and has lower transportation emissions because comparatively more growth is located in the Built-Up Area or strategic growth areas. Concept 4 has the highest 2051 emissions (3,032 ktCO2e). The difference between Concept 3A and 4 is around 100 ktCO2e (3.3%). Estimated per capita emissions are 6.08 tCO2e/person for Concept 3A and 6.29 tCO2e/person for Concept 4.

Table 4. Summary of estimated 2051 emissions (tCO2e).

	Changes with population distribution		Scales by per job emissions intensity	Scales with population			Equivalent across scenarios			
Concepts, ranked lowest to highest emissions	New residential building emissions	New personal vehicle emissions	New commercial building emissions	New other transpor-tation emissions	New waste emissions	New water emissions	New industrial emissions	**Total new emissions**	Difference	Emissions per capita for new population (tCO2e/ person)
Concept 3A	764,947	944,240	343,526	555,016	138,753	6,335	179,716	**2,932,532**	-	6.08
Concept 2	775,278	971,809						**2,970,433**	+1.3%	6.16
Concept 1	784,663	992,505						**3,000,513**	+2.3%	6.23
Concept 4	797,141	1,011,721						**3,032,208**	+3.3%	6.29

Growth Concept 3B Greenhouse Gas Emissions

A variation on Concept 3A, 3B differs only in how employment growth is assumed. 3B assumes that employment will be intensified either in existing employment lands or shifted from employment lands to new office and mixed-use developments. There is no new total settlement area expansion.

GHG emissions in this Growth Concept would be similar to those of Growth Concept 3A for most activities, with transportation associated emissions from employment commuting a notable exception. If all employment development occurs through employment lands intensification or accompanies new mixed-use or infill developments, transportation-related GHG emissions will likely be less than Growth Concept 3A. Instead of commuting longer distances to jobs in newly developed employment lands or outside the region further from homes, commuting would be more localized, thus reducing personal transportation GHG emissions. Commercial transportation GHG emissions would also be reduced as freight and deliveries would have less distances to travel.

Conclusions

The Growth Concept GHG emissions calculations demonstrate that development choices result in differing GHG emissions from buildings and transportation. The outcome is what one would intuitively expect: complete, compact communities have buildings that use less energy and require less transportation using personal vehicles which results in fewer emissions. The quantification of the emissions differences between the Growth Concepts demonstrates that the variation is significant. The 3.3% difference between Growth Concepts 3 and 4 may not sound like much, but at 100 ktCO2e in 2051, it is equivalent to the total annual building emissions of a small town of 23,000 homes, every year.[1]

Land use development is an important tool in a region's efforts to reduce GHG emissions - an imperative in the current climate emergency. The building, infrastructure, transportation, and energy systems decisions made with current and future developments lock in energy use and behavioural patterns for decades, if not centuries. Changing developments and infrastructure is much more costly and disruptive than planning development well in the first place. Knowing the probable GHG emissions effects of these decisions helps regional governments make informed development decisions that will provide high quality of life, lower costs, and a safe climate for residents.

Next Steps

The Preferred Growth Concept will be assessed in more detail, with comprehensive land use, energy, and emissions modelling enabling comparison between a business as usual outlook for the region and the Preferred Growth Concept. This assessment will provide increased accuracy and more detailed considerations of energy use and emissions production in the region's expected future versus the potential future offered by the Preferred Growth Concept.

[1] NRCAN Greenhouse Gas Equivalencies Calculator: https://oee.nrcan.gc.ca/corporate/statistics/neud/dpa/calculator/ghg-calculator.cfm