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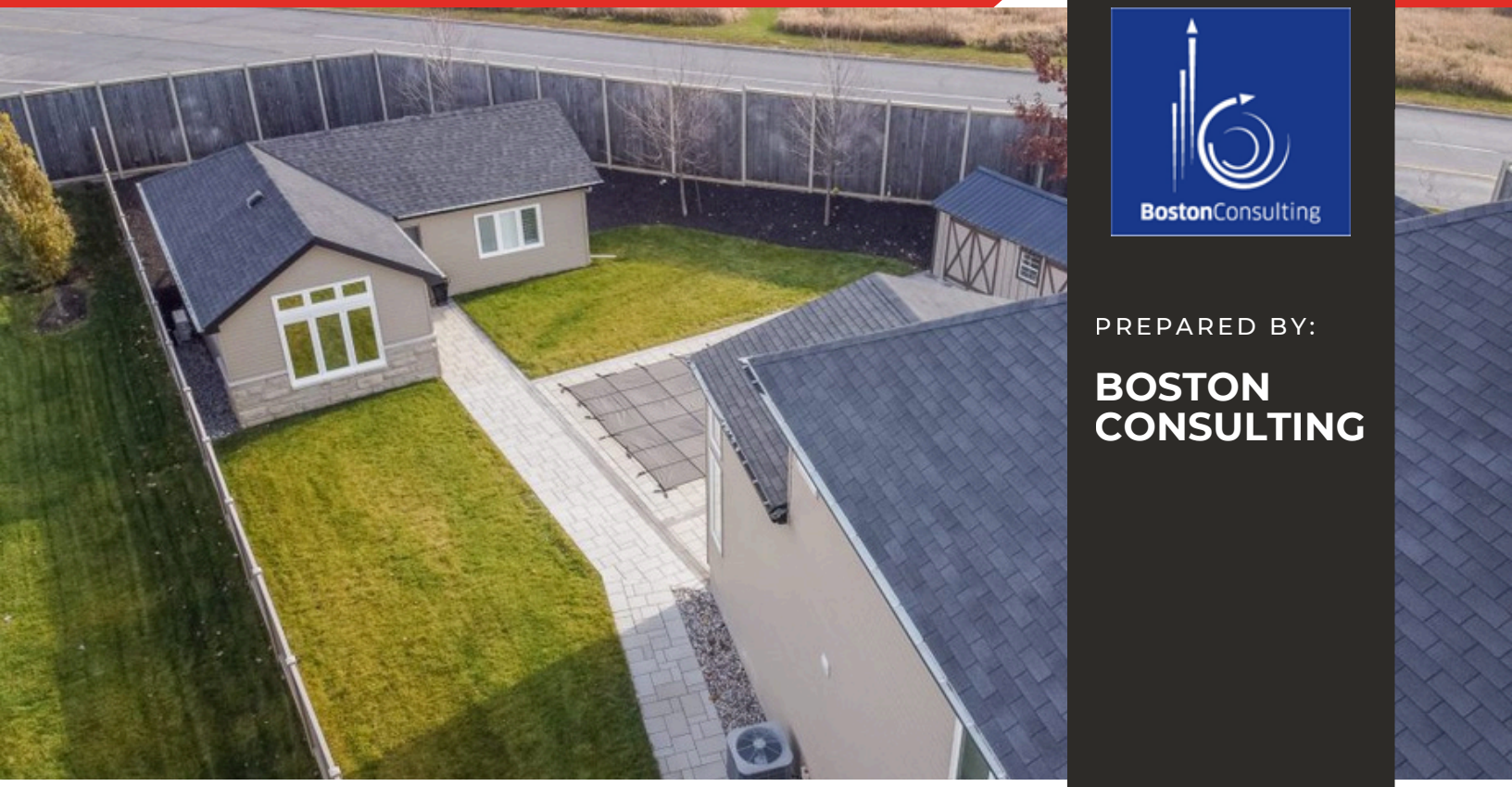

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ANALYSIS

CLIMATE AND HOUSING SUITE SPOT:

Options to Reduce Carbon from New Homes in Ottawa

Prepared for: Ottawa Climate Action Fund
www.ottclimatefund.ca

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Introduction

Ottawa has pledged to build 151,000 new homes by 2031. How and where these homes are built will determine whether growth makes life more affordable and climate-friendly, or locks in higher costs, congestion, and climate emissions.

The city faces a choice: continue its traditional pattern of greenfield development through sprawling expansion, or by adding gentle density in existing residential neighbourhoods closer to jobs, schools, transit and other amenities called "secondary suites". This provides Ottawa with immense untapped potential to rapidly grow affordable, low carbon, rental housing with negligible neighbourhood impact and income-generating potential for existing homeowners.

***Secondary Suites** are additional housing units that are added to an existing property. These can include coach houses in backyards, basement suites, or turning a single-family home into multiple units.*

This study explores four scenarios for housing growth in Ottawa evaluating the impact at both the household level and on the community level on carbon and congestion.

The potential role of secondary suites is robustly considered because of the composition of Ottawa's housing stock – the relative absence of secondary suites, the large and rising share of one- and two-person single detached homes, and the urgent need for new affordable housing units.

Methodology

Housing Type and Locations

The analysis compares carbon and traffic congestion impacts for four housing scenarios for housing growth in Ottawa, each adding 15,000 new units using different housing types and locations.

The scenarios are built on **three different housing types:**

- **Single Detached:** The largest share of Ottawa's housing stock, and until very recently the largest share of growth. The dominant single detached growth pattern is greenfield development on the urban periphery (Figure 1).
- **Apartments:** The second largest share of Ottawa's housing stock. Since 2018, apartments and condos have represented the largest share of growth, intensifying development predominantly in nodes and corridors.
- **Secondary Suites:** These units can be part of the original design, but most growth typically comes from adding units to existing single detached homes or yards. Secondary suites account for the smallest share of Ottawa's housing stock, representing approximately two percent of homes.[i]

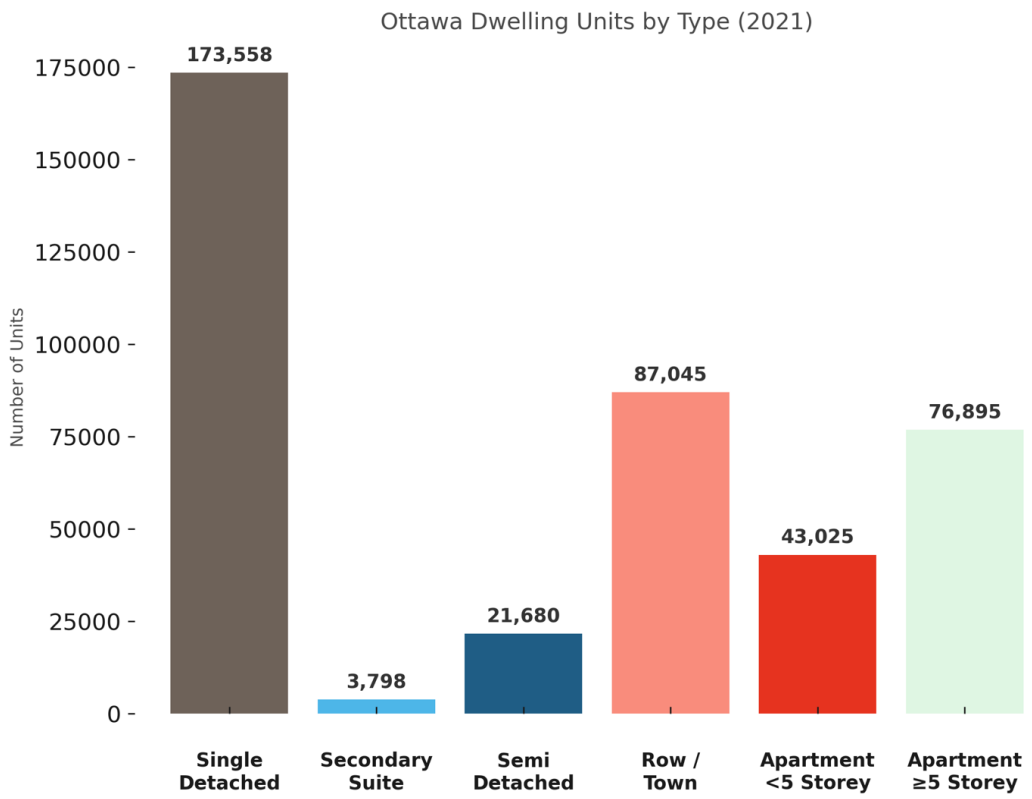
These housing types are built into growth scenarios in **three different locations**:

- **Central and suburban hubs**, areas in central Ottawa such as Westboro but also including slightly more suburban areas that are still close to amenities such as Alta Vista;

- **Existing single detached areas**, like neighbourhoods around Hunt Club and Innes;
- **Urban edge greenfield**, in areas such as Kanata-Stittsville, Barrhaven, Riverside South and Orleans.

While the growth of Ottawa's housing stock has recently accelerated due to increased emphasis on building houses, historical rate has averaged 5,500 new housing units per year. New housing in Ottawa has primarily been single-family greenfield development resulting in increased urban sprawl (Figure 2).

Figure 1: Ottawa Dwelling Split



Housing Scenarios Analyzed

The study evaluates three densification scenarios:

- **Hub suites:** Secondary suite units **in** single detached homes in and around major employment and post-secondary service hubs;
- **Distributed suites:** Secondary suite units distributed equally across all single detached geographies community-wide;
- **Hub apartments:** New rental apartments (mix of concrete and wood frame) in central and suburban employment/post-secondary service hubs.

A fourth reference scenario, is based on Ottawa's dominant growth pattern:

- **Traditional single detached:** Single detached homes, predominantly in greenfield developments at the urban edge, reflecting Ottawa's historical trend.

Figure 2 summarizes the characteristics of the four scenarios.

Figure 2: Ottawa Residential Build Out Options

	Intensification Scenarios			Reference Scenario
	Hub Suites	**Distributed Suites**	**Hub Apartments**	**Traditional Single Detached**
Planning Synopsis				
Type	Renovation in existing single detached home	Renovation in existing single detached home	New apartment	New single detached home
Proximity to services	Close to job & post secondary hubs and grocery stores. Transit service and walkability are excellent.	Varied	Close to job & post secondary hubs and grocery stores. Transit service and walkability are excellent.	Far from job & post secondary hubs and grocery stores. Poor transit service and walkability.
Neighbourhood	Inner suburbs and suburban hubs	Existing general urban	Urban and suburban hubs	Greenfield development

Study Findings

The study finds that hub suites in and around major employment and post-secondary service hubs, followed closely by distributed suites, deliver the highest GHG benefit (Figure 3).

- The two most carbon-efficient scenarios show identical results for tonnes of carbon for housing per household per year, with distributed suites producing slightly higher emissions from operational transportation compared to the overall winner, hub suites. Both hub suites and hub apartments deliver the lowest transportation emissions among the four scenarios due to their proximity to areas that inhabitants frequent.
- On all measures, traditional single detached housing produces the highest emissions per household — 50 percent more than hub suites, 35 percent more than hub apartments, and 41 percent more than distributed suites (Figure 3).
- For community-wide GHGs, annual driving and transit emissions in traditional single detached comes in 57.6 percent higher than hub suites, 55 percent higher than hub apartments and 29 percent higher than distributed suites. The analysis shows similar magnitudes of difference for embodied carbon for auto manufacturing and disposal.

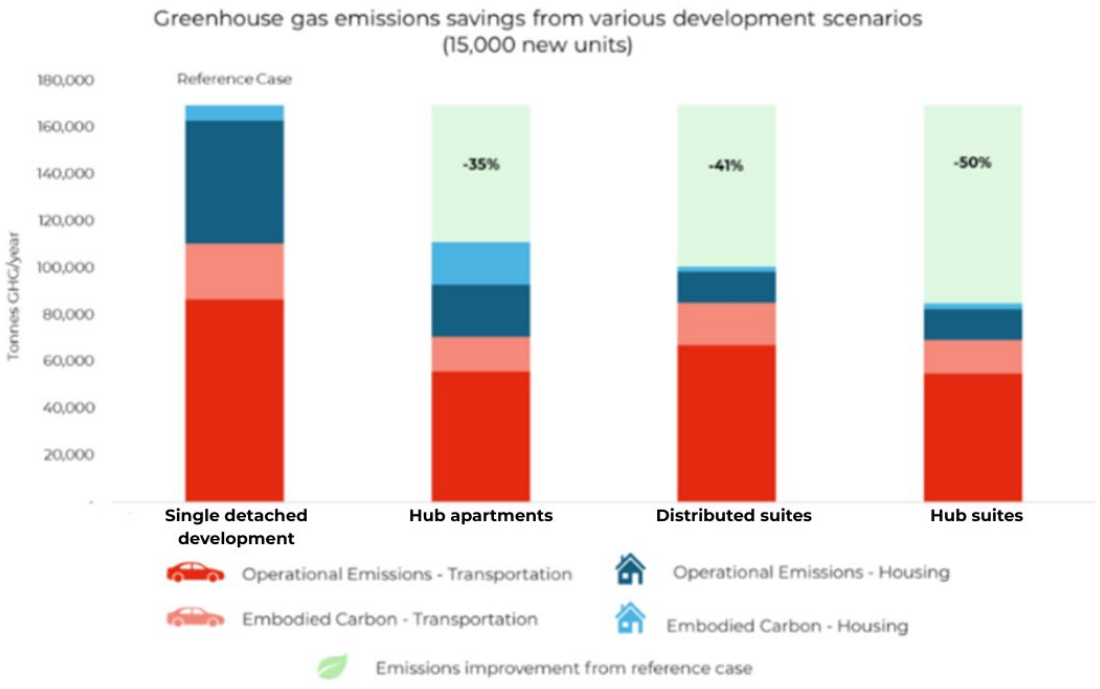


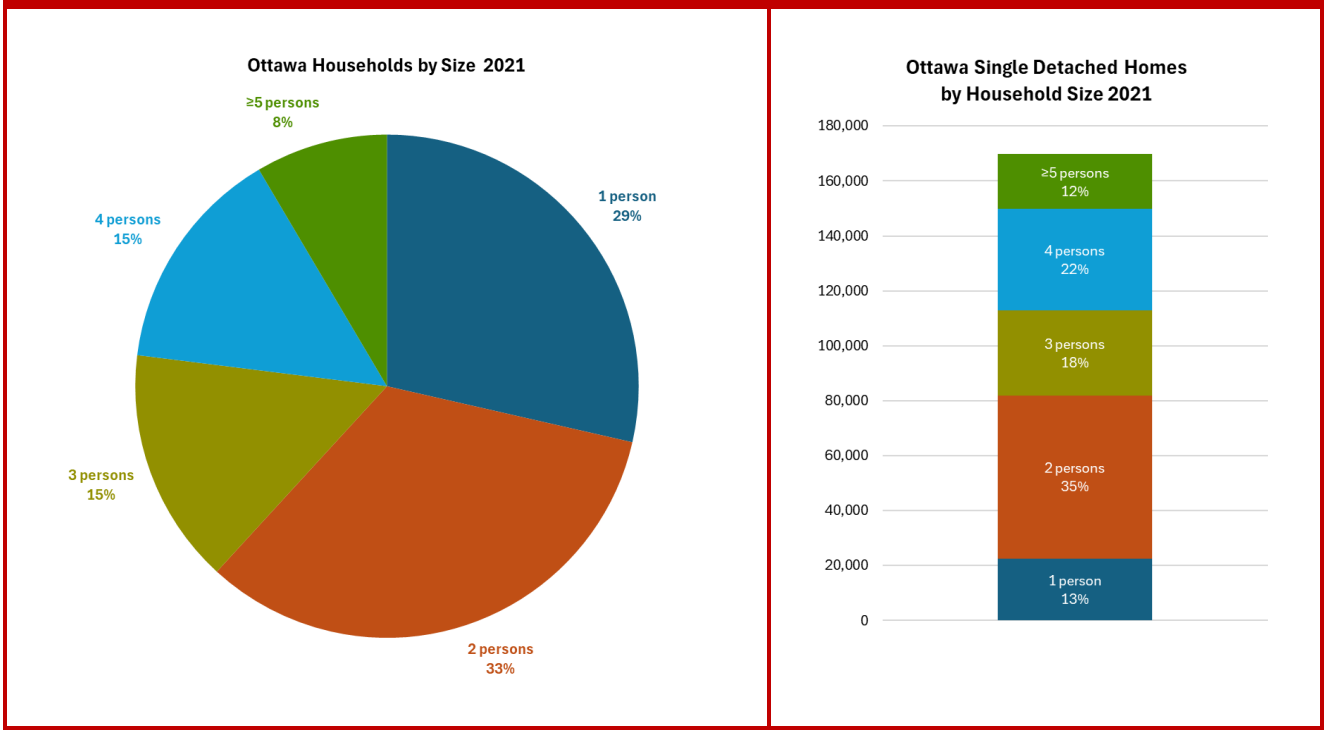
Figure 3: Emissions associated with the four growth pathways

Analysis

Key Demography & Housing Considerations

The fastest-growing households in Ottawa for more than a generation have been composed of one or two people. While once occupied predominantly by families of four, today half of Ottawa's single detached homes and two-thirds of *all* Ottawa homes are occupied by just one or two people (Figure 4). [ii]

Figure 4: Ottawa Household Size: All Homes and Single Detached, 2022



Source: Statistics Canada. Table 98-10-0041-01, Structural type of dwelling and household size: Canada, provinces and territories, census divisions and census subdivisions, https://www150.statcan.gc.ca/t1/tbl1/en/tv.action?pid=9810004101

Three-quarters of all homes and half of all single detached homes in Ottawa have three occupants or fewer. The fastest-growing household, including in single detached homes, is composed of just one person (Figure 5).

Ottawa's dominant growth pattern over the last several decades has been driven by single semi-detached urban edge greenfield development, followed by strong nodal and corridor intensification. Those trends are reflected in Ottawa's growth data for 2010-2019 (Figure 6), although the city is placing more emphasis on urban intensification housing strategies for the decade ahead (Figure 7 & 8).

Figure 5: Average Occupants Per Household by Housing Type, 2022

All housing types	2.5
Single detached	2.9
Semi/Row/Town	2.7
Secondary Suite	2.1
Apartment	1.7

Figure 6: Ottawa Growth 2010-2019								
Housing Type	**Total**		**Intensification**			**Greenfield**		
	Units	**Share**	**Units**	**Infill %**	**% of all Units**	**Units**	**Greenfield %**	**% of all Units**
Ground Oriented homes (single-family, townhomes, etc.)	36,200	67%	4,200	19%	12%	32,000	100%	88%
Apartment or condo	18,100	33%	18,100	81%	100%	0	0%	0%
Total	**54,300**		**22,300**		41%	**32,000**		59%

Source: City of Ottawa, 2020 (March), Residential Growth Management Strategy for the New Official Plan, https://documents.ottawa.ca/sites/documents/files/res_dwelling_pipeline_q1_2024_en.pdf

Figure 7: Projected Growth Allocation By 2031		
Intensification	87,900	64%
Greenfield - Urban	43,400	31%
Greenfield - Rural	6,800	5%
Total	138,100	100%

Source: City of Ottawa, 2023, City of Ottawa Housing Pledge, Report to Housing and Planning Committee and Council, March 2023, https://pub-ottawa.escribemeetings.com/filestream.ashx?DocumentId=113487

Figure 8: Units Under Construction, 2024		
Ground Oriented	2,851	18%
Apartment	13,051	82%
Total	15,902	

Source: City of Ottawa, 2024, Residential Dwelling Approval Pipeline

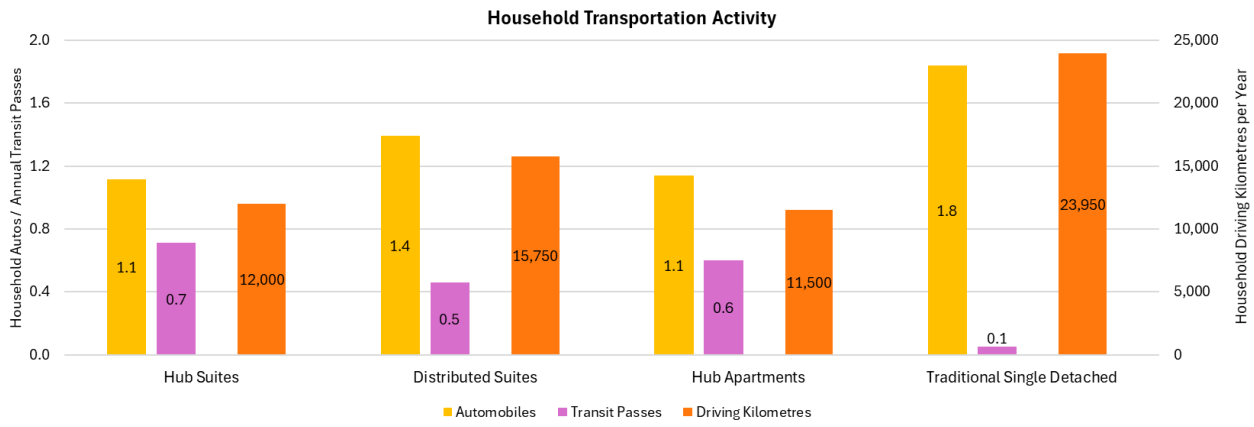
Transportation Activities

Household transportation activity is determined by car ownership and driving patterns, which are in turn shaped primarily by proximity to job hubs, and then services (Figure 9). A determining factor of household car ownership rates, driving distance and vehicle emissions is location, specifically proximity to an urban region's central business district, followed by secondary job hubs and services, notably grocery stores.[iii]

As discussed, hub suites and hub apartments were tied for lowest transportation activity, followed by distributed suites, since average vehicle travel demand was greater with the more distributed population. Urban edge, single detached households had extremely low transit usage and extremely high vehicle ownership and driving kilometres.

Across the four housing scenarios, hub suites and hub apartments result in lower contributions to traffic congestion, reflecting fewer additional vehicles, lower average auto ownership per household, and fewer kilometres driven annually. In contrast, distributed suites and particularly the reference scenario are associated with higher car ownership and substantially greater vehicle kilometres travelled, indicating increased pressure on the road network and higher congestion impacts.

Figure 9: Household Transportation Activity: Automobile Ownership, Transit Passes and Driving Activity



Climate Impacts Summary

This composite indicator considered operational GHGs for both housing and transportation, as well as the embodied carbon for building materials and vehicle manufacturing.

The suite scenarios were tied for first in housing GHGs. However, the operational GHGs for a hub suite were modest next to any other new standard housing unit, and the embodied carbon for materials and labour was modest.

Apartment GHGs were higher because the square footage is additional, so heating GHGs are measurable. Apartments have the highest embodied GHGs in construction and materials of any scenario due to the volume of concrete per unit. The embodied construction GHGs put apartments out of contention for second in this composite indicator because the category was tied for top place in transportation carbon. Operational GHGs were highest in single detached housing, largely due to the large floor area and natural gas heating.

Most household GHGs are concentrated in the transportation sector[iv], which is fueled overwhelmingly by fossil fuel. Similar to their performance on transportation congestion, hub suites and hub apartments had the lowest operational carbon performance due to better active travel and transit and less driving. Distributed suite households drove modestly more on average, and single detached occupants on the urban edge drove dramatically more.

Embodied carbon for vehicle materials and manufacturing is about 10 tonnes per vehicle[v], annualized to less than a tonne per vehicle over its operating life. Hub apartments and focussed suites had the lowest household vehicle ownership, largely because of proximity to job hubs and services, followed by distributed suites. With the greatest distance from job hubs and services, single detached homes had the highest automobile ownership, and therefore the highest embodied GHGs in transportation materials and manufacturing.

Figure 10: Household, Transportation & Land Use GHGs

	Hub Suites	Distributed Suites	Hub Apartments	Traditional Single Detached (Reference Scenario)
Household GHGs (tonnes per household)				
Annual Operational Housing	0.9	0.9	1.5	3.5
Annual Embodied Housing	0.2	0.2	1.2	0.4
Annual Operational Driving and Transit	3.7	4.5	3.7	5.8
Auto – Total Embodied Manufacturing/Disposal	10.0	12.5	10.3	16.6
Auto Annualized Embodied	1.0	1.2	1.0	1.6
TOTALS	**14.7**	**18.2**	**15.0**	**24.0**
Community-Wide (tonnes) – per 15,000 units				
Annual Home Operational Tonnes	68,199	80,375	78,355	139,171
Annualized Home Embodied Tonnes	16,643	20,179	32,657	30,349
Annual Operational Driving and Transit	55,012	67,188	55,919	86,671
Total Embodied Auto Manufacturing/Disposal	150,525	187,650	153,900	248,400
Auto Annualized Embodied (10.5-year average lifespan per vehicle)	14,336	17,871	14,657	23,657
TOTALS	**304,715**	**373,263**	**335,488**	**528,248**
Additional Autos	16,725	20,850	17,100	27,600
Additional Annual KMs	180,000,000	236,250,000	172,500,000	359,250,000
Average Auto Ownership per Household	1.1	1.4	1.1	1.8
Annual KMs Per Household	12,000.0	15,750.0	11,500.0	23,950.0
Avg Annual Transit Passes per Household	0.7	0.5	0.6	0.1

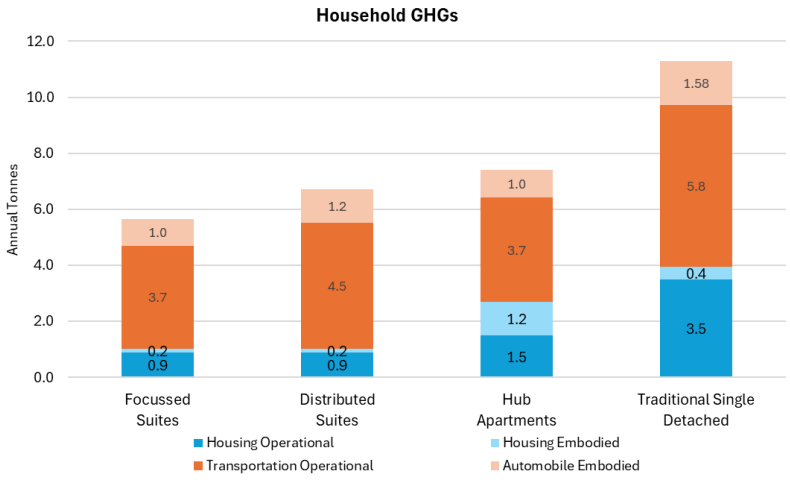
Household and Community-Wide Operational and Embodied GHGs

The study evaluated the GHG impact of each scenario for operating the 15,000 new housing units and their associated transportation activity, as well as the embodied carbon for building the homes and manufacturing the vehicles.

The two suite scenarios delivered the lowest housing GHGs (Figure 11). Their operational GHGs were modest compared to any other new housing unit of standard building performance. That's because most operational GHG emissions in housing trace back to natural gas space heating, and secondary suites require only modest additional space heating because there is no increase in total household floor area. The next biggest source of operational GHGs, hot water heating, increased 50%, while electrical loads like appliances and lighting increased by one third.

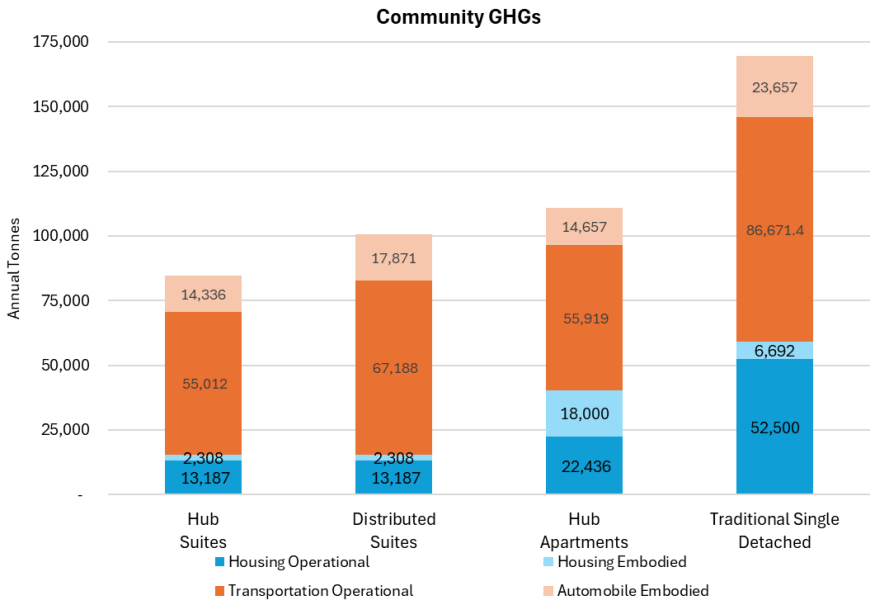
Embodied carbon for secondary suites is also very low, as the structures already exist and only modest materials and labour are required to adapt them. Operational GHGs emissions for apartments are higher, since the heating GHGs for the new square footage are measurable.

Figure 11: Household Operational and Embodied GHGs



Of all the housing types, apartments have the highest embodied GHGs for construction and materials, due to the volume of concrete being used (in these scenarios, apartments included a mix of low-rise wood frame and mid/high-rise concrete) (Figure 12). Apartments were also tied for top place in transportation carbon. Single detached homes had the highest operational GHGs, largely due to their large floor area and natural gas heating.

Figure 12: Community-Wide Operational and Embodied GHGs



Across all the scenarios, the greatest shares of GHGs were generated by operating vehicles, largely due to the transformative reductions that Ontario achieved when Ontario eliminated coal-fired electricity generation. Ontario has a relatively low-carbon grid, so lighting and plug in electrical loads produce only modest GHG emissions. Transportation, however, is still fueled overwhelmingly by fossil fuels. Hub suites and hub apartments had the lowest operational carbon performance due to better active travel and transit opportunities and less driving, leading to less gasoline and diesel combustion. There was modestly more driving on average for distributed suites, and dramatically more for single detached homes on the urban edge (Figure 9).

The embodied carbon from vehicle materials and manufacturing is about 10 tonnes per vehicle, annualized to less than a tonne per vehicle. Hub apartments and hub suites had the lowest household vehicle ownership, largely due to their proximity of job hubs and services, followed by distributed suites. Single detached homes were furthest from job hubs and services and had the highest automobile ownership, and therefore, the highest embodied GHGs in materials and manufacturing.

Supplementary Data

Build Out by Scenario (Distribution across urban geographies)	Urban Hub	Inner Suburban	Suburban Hub	Outer Suburban	Greenfield Exurban
Intensification Scenarios					
Distributed Suites	5%	25%	20%	50%	0%
existing general urban distributed	750	3,750	3,000	7,500	0
Hub Suites	5%	50%	45%	0%	0%
in/near urban hubs, in suburban hubs	750	7,500	6,750	0	0
Hub Apartments	30%	10%	60%	0%	0%
in hubs and inner suburbs	4,500	1,500	9,000	0	0
Reference Scenario					
Traditional Single Detached	1%	3%	2%	4%	90%
greenfield oriented	150	450	300	600	13,500

Key Housing Assumptions: Size & GHGs	Floor Area		Operational GHGs	New Construction Embodied GHGs
New Unit Types	**Square feet**	**Square meters**	**Tonnes / Year**	**One Time Tonnes**
Secondary Suite	700	65	1.0	5
Apartment	700	65	1.5	72
Single Detached	2500	232	3.5	29

Calculations and Assumptions for a New Secondary Suite Added to Existing Single Detached Home	Existing Single Detached Energy Intensity		Existing Single Detached* Energy and GHGs per year		New Secondary Suite** Additional Energy and GHGs per year		
End Use	**Energy/m2**	**Type and Unit**	**Energy Use**	**GHG tonnes**	**Use Factor**	**Energy Use**	**GHG tonnes**
Space Heating	11.8	Gas m3	2196	4.22	110%	220	0.42
Water Heating	3.1	Gas m3	568	1.09	150%	284	0.55
Appliances	22.4	Electricity kwh	4159	0.12	135%	1,456	0.04
Lighting	8.0	Electricity kwh	1481	0.04	135%	518	0.02
Cooling	10.4	Electricity kwh	1932	0.06	110%	193	0.01
			Total	5.54		Total	1.03

*Size 2000 sqft / 186 m2

**Size 35% of existing single detached. 700 sqft / 65 m2

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CMHC & IBI Group (2000). *Greenhouse Gas Emissions from Urban Travel: Tool for Evaluating Neighbourhood Sustainability*. Government of Canada. https://publications.gc.ca/collections/collection_2011/schl-cmhc/nh18-1-4/NH18-1-4-1-2000-eng.pdf

Ewing, R, Bartholomew, K, Winkelman, S, Walters, J, & Chen, D. (2007). *Growing Cooler: The evidence on urban development and climate change*. Washington, DC: Urban Land Institute. https://www.nrdc.org/sites/default/files/cit_07092401a.pdf

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[i] This is an order of magnitude estimate based on the best available data from Statistics Canada. Some suites are in semi-detached homes, and some single detached may have more than one suite.

[ii] Statistics Canada. Table 98-10-0041-01, Structural type of dwelling and household size: Canada, provinces and territories, census divisions and census subdivisions, https://www150.statcan.gc.ca/t1/tbl1/en/tv.action?pid=9810004101

[iii] CMHC & IBI Group, 2000; Ewing et al, 2007

[iv] Carolinian Canada. *Household energy use and greenhouse gas emissions*, https://caroliniancanada.ca/article/household-energy-use-and-greenhouse-gas-emissions-20201125

[v] Oğuz, Selin. Life Cycle Emissions: EVs vs. Combustion Engine Vehicles, Visual Capitalist, June 23, 2023, https://www.visualcapitalist.com/life-cycle-emissions-evs-vs-combustion-engine-vehicles/