

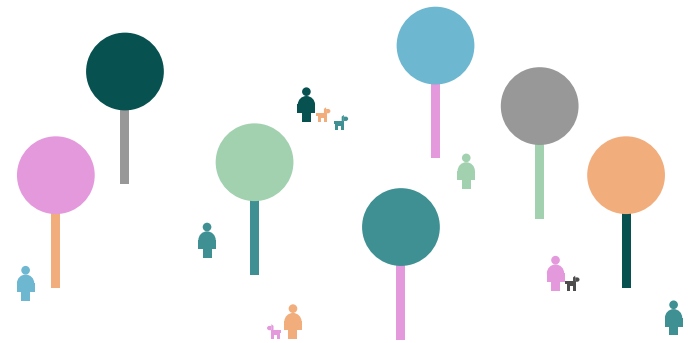
Density Done Right

How distributed urban density can support healthy, livable neighbourhoods, housing affordability and the environment



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Why We Need Distributed Urban Density

According to Ontario's Growth Plan, population in the Greater Golden Horseshoe (GGH) region is set to grow to 13.5 million people by 2041. This means we will welcome millions of new residents over the next two decades, and the population of towns and cities in the GGH will continue to grow.

The challenge is to disrupt our current pattern of development.

Historically, most municipalities in the GGH have grown via two primary approaches: new low-density subdivisions in greenfield areas further away from urban centres, and more recently, high-density developments built on small parcels of land in urban centres. This "tall and sprawl" development pattern has contributed to significant issues in the region, including mounting municipal infrastructure and service costs, increased commute times and associated greenhouse gas emissions, and housing unaffordability.

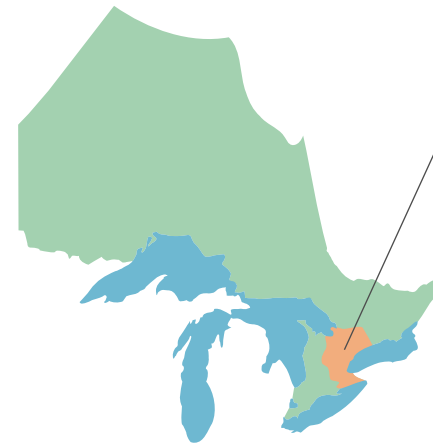
Urban sprawl in the GGH puts pressure on farmland, natural ecosystems and the region's drinking water headlands – and threatens the protection of the Greenbelt. Highly concentrated tall development strains infrastructure and services, and provides limited affordable family-friendly housing options.

Our current pattern of housing development has also contributed to a lack of suitable and affordable housing options within urban and suburban centres close to schools, transit, health and community services, amenities and jobs. Increased housing prices have already forced too many people to choose between squeezing into too-small condos and commuting to a home far outside the centre of the city.

But growth needs to go somewhere.

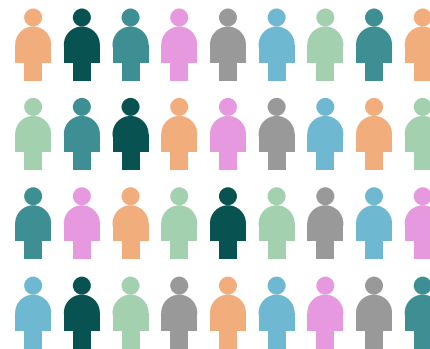
By optimizing our urban footprint, we can add density strategically throughout existing urban areas with a variety of building types and a range of densities.

Distributed density can make our communities and region more healthy, livable and affordable for residents, while saving energy, protecting our natural environment and agricultural land, and helping to mitigate climate change.



2041

Greater Golden Horseshoe (GGH)



13.5

Million People

The High Cost of Sprawl

For decades, population growth in the GGH has been characterized by low-density sprawl, which built over thousands of hectares of previously undeveloped agricultural and natural lands.¹ *The Greenbelt Act* was created by the Province of Ontario in 2005 to limit sprawl by placing permanent protections on an arc of important natural and agricultural lands around the region. The accompanying *Places to Grow Act* and the resulting *Growth Plan for the Greater Golden Horseshoe* designated lands for growth, set targets for intensification, and provided a framework to guide growth within the region.² Despite these policies, development in our region continues to sprawl.



Father Tobin Road in Springdale Neighbourhood, Brampton, Ontario.

Photo by SSTUDIO Samuel Bietenholz. CC BY-NC 2.0. Source: Flickr.



Toronto Region Suburbs,
Statistics Canada 2016 Census³

- Active Core
- Auto Suburbs
- Exurban
- Transit Suburbs

Image courtesy Professor David Gordon, Queen's University.



Markham, Ontario.

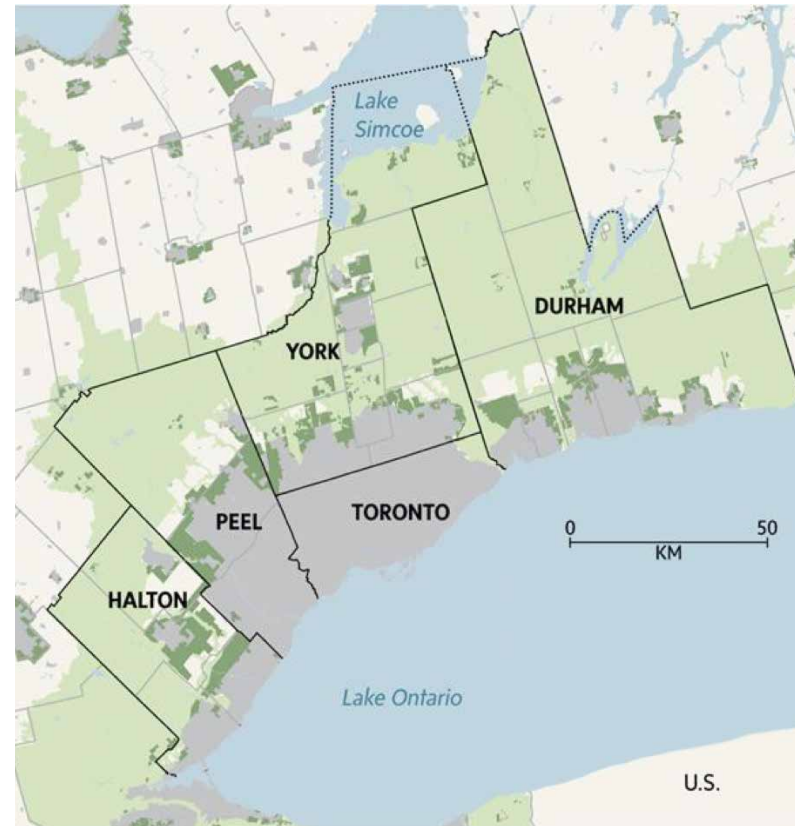
Photo by Antoine Belaieff. CC BY-NC-ND 2.0. Source: Flickr.

Paving Over Farmland

Between 2006 and 2016 (post-Greenbelt and Growth Plan), municipalities in the Greater Toronto and Hamilton Area consumed designated greenfield areas (previously undeveloped land, typically farmland located at the periphery of urban areas) at a rate of over 1,000 hectares per year to build new developments.⁴ Between 2001 and 2011, over 86% of net new residents added to the GTHA were housed in new subdivisions built on greenfield land.⁵ This sprawl has paved over Ontario's agricultural land – some of Canada's most valuable – and natural areas.⁶

The Growth Plan works with municipalities in the GGH to designate greenfield lands ("Designated Greenfield Areas") for subdivision development. In 2017, the Neptis Foundation found that 87,440 hectares of these lands in the region are unbuilt and available for future growth.⁷ In addition, between the protected Greenbelt and designated greenfield areas lies land currently undesignated for either development or protection, including 94,000 hectares of fields, forests and agricultural lands.⁸ (For perspective, the average sports field is one hectare in area.)

As sprawl marches outward towards the far reaches of designated greenfield areas, the future of undesignated agricultural lands and green spaces is threatened. Environmental groups have called for these areas to be protected like the Greenbelt, as they are critical to protecting biodiversity, wildlife habitat, economic prosperity in the agricultural sector and drinking water headlands. Plus, as climate change creates uncertainty regarding domestic and international food production, protecting more lands for Ontario's food security is critical.⁹



The Greenbelt, the GTA and the "Whitebelt" between the two areas. Ontario's *Places to Grow Act* (2005) and *Greenbelt Act* (2005) designated the Greenbelt as permanently protected lands and laid the framework for the Growth Plan for the Greater Golden Horseshoe.

- Greenbelt
- Designated Greenfield Areas (2006-2031)
- Built-up areas

Source: Neptis; Globe and Mail

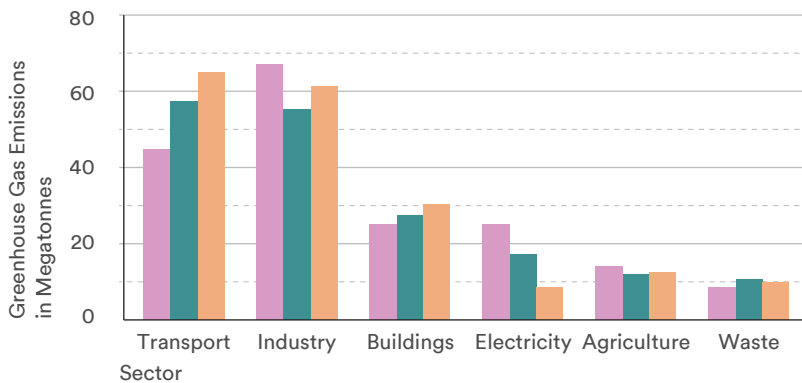
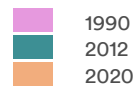
Sprawl and Climate Change

A 2019 report by the Environmental Commissioner of Ontario identified transportation as Ontario’s primary source of climate emissions and air pollution, and noted that planning policy has driven up these emissions by favouring costly and destructive sprawl.¹⁰ The continued expansion of low-density sprawl in the GHG has increased car dependency and commute times, and thus has become a major contributor to carbon emissions.

As new greenfield developments are built further from urban centres and employment areas, services and rapid transit, commutes by automobile get longer and longer. **Research found the GTA’s low-density suburban areas produce significantly more GHG emissions than areas in the central core, largely due to much higher private auto use.**¹¹ In this way, sprawl contributes directly to climate change – and must be curtailed if Ontario hopes to meet its climate targets.

Greenhouse gas emissions by source

From Ontario’s Five-Year Climate Change Action Plan 2016 – 2020, page 7.



Infrastructure and Service Costs of Sprawl

Sprawl carries with it significant public and private costs. It leads to lost farmland and natural areas, and negative impacts to health and the environment associated with auto-dependent development. In particular, sprawl in low-density areas is more costly in terms of municipal services and infrastructure,¹² which places financial burden on municipalities. For example, the City of London, Ontario, estimated that over 50 years, the municipal capital costs of a sprawling growth scenario would be an additional \$2.7 billion, or 180% higher, than a more compact growth scenario.¹³

The Regional Municipality of Halifax studied the estimated annual costs to service households in neighbourhoods of varying densities. The 2005 study found that households in low-density suburban areas of approximately 40 people per hectare cost \$3,462 to service annually, compared to \$2,170 for households in middle-density areas of approximately 89 people per hectare and just \$1,416 for households in high-density urban areas of approximately 228 people per hectare.¹⁴ Services studied included linear infrastructure such as roads, water and wastewater, as well as services such as libraries, and fire and police services. These costs clearly demonstrate the financial benefit of more concentrated development.¹⁵

To account for the real costs of sprawl and to ensure that new development pays for itself in areas that are more difficult to service, some municipalities differentiate development charges based on their ability to service growth. This practice, known as area-specific development charges, is used by some municipalities to direct development towards built up areas and away from greenfields. Markham,¹⁶ Richmond Hill,¹⁷ Oakville,¹⁸ Kitchener,¹⁹ Peterborough,²⁰ Hamilton²¹ and others have implemented area-specific development charges that are higher for new homes built in suburban areas than for those in central urban areas.²²

The Limits of Tall

While higher density development is optimal in locations close to major transit station areas, transit corridors, and employment centres, many municipalities in the region have relied too heavily on tall residential buildings to meet their intensification targets, squeezing the majority of their intensification efforts into small areas of land. For example, a 2017 report found that 84% of apartment/condo units in construction and pre-construction within the GTA were in buildings 12 storeys or higher.²³ Rising land values in the limited areas approved for growth precipitate an over-reliance on building “tall” in a small number of high-growth areas. This, in turn, has led to challenges in the GGH, including a lack of units suitable for larger households, overburdened infrastructure systems, and a mismatch between population density and the provision of services, such as transit, schools, health and community services, and parks and recreation.

Share of Units 2 Bedrooms or Larger by Construction Period and Location

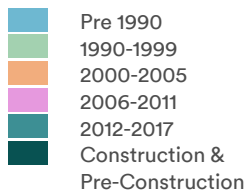
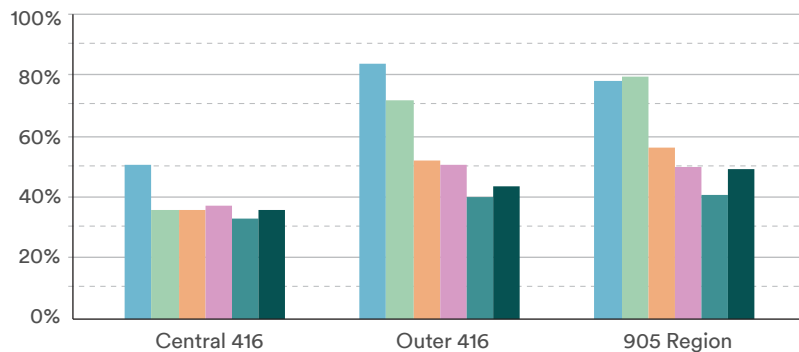


Chart originally published in Bedrooms in the Sky, a report by the Ryerson City Building Institute with Urbanation, 2017. Data source: Urbanation.



Small Units, High Prices

As the region grows, multi-unit residential buildings are necessary. However, most high-rise developments contain primarily small units, not suitable for larger or growing households. And where larger units exist, they can be expensive. Consider:

- **Units are getting smaller.** Statistics Canada analysis shows that in both Toronto and Ontario overall, while property values per square foot are increasing, condo apartment units are getting smaller. In Ontario, the median area of a condo built in 2016 or 2017 was 665 square feet, which is 35% smaller than the median of 1,030 square feet in the 1980s.²⁴ In the Toronto Census Metropolitan Area (CMA) specifically, the median area of a condo apartment built in 2016 or 2017 was 650 square feet, or 39% less than the median of 1,070 square feet in the 1980s.²⁵
- **There are fewer units with 2+ bedrooms.** The proportion of new condo units with two or more bedrooms is declining across the GTA. In the 1990s, 67% of completed condo units contained at least two bedrooms. But by 2017, only 41% of units in construction or pre-construction contained two or more bedrooms.²⁶

- **Multi-bedroom units, where available, are expensive.**
Due in part to construction costs in the GTA (approximately \$190 to \$280 per square foot for a high-rise condominium or apartment unit, not including parking)²⁷ and selling prices in downtown Toronto (pre-sale prices in downtown Toronto were \$1,279 per square foot in the first quarter of 2019),²⁸ multi-bedroom units in high-rise buildings can be expensive. Where multi-bedroom units are available – like the family-friendly units in larger developments now mandated by Toronto’s TOcore plan²⁹ – the high price tag could put these units out of reach for many households.

Rising Land Values, High Prices

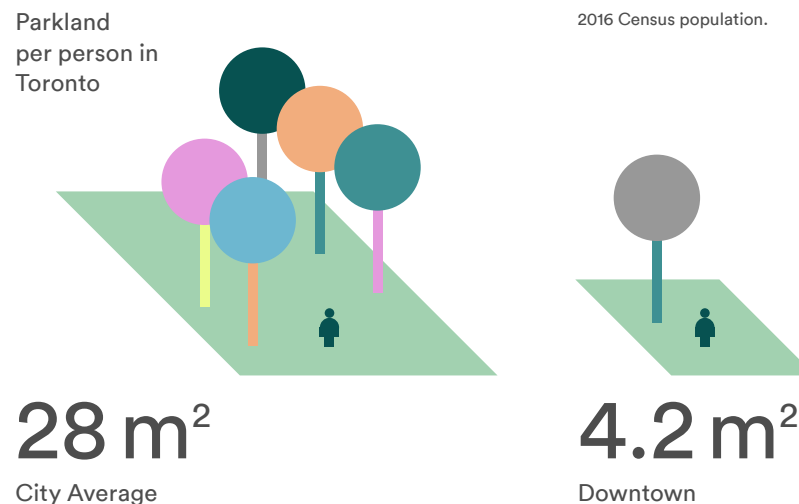
According to a Spring 2019 report by MCAP, a Canadian mortgage financing company, market value for high-rise residential land in Toronto’s downtown core ranges from \$265 to \$275 per buildable square foot – more than double what this land cost in 2015.³⁰ Because the cost of land paid by developers is ultimately passed down to purchasers, the increase in land value in the GTA has contributed to price escalation in the housing marketplace.

Overburdened Infrastructure

In general, denser forms of development make efficient and cost-effective use of infrastructure and services compared to the cost of servicing sprawl.

However, if governments cannot provide appropriate levels of service to match growth, intense concentrations of high-rise development can place significant pressure on hard and soft infrastructure systems, namely transit, water, waste water, parks, childcare and schools.³¹

Highly concentrated development placing strain on public services is a growing issue in our region. Take, for example, parkland in Toronto’s high-growth downtown core. Currently, area residents share an average 4.2 square metres of parkland per person: much less than the city-wide average of 28 square metres.³² And with downtown’s density expected to nearly double from 399 people and jobs per hectare to 729 people and jobs per hectare by 2041, this disparity is likely to grow more severe in the future unless significant new park space is added.³³



Distributed Density

One alternative to the predominant pattern of “tall and sprawl” development in the region is to plan for more distributed density throughout the urban footprint, utilizing a variety of building typologies and a range of densities. Far from wishful thinking, moving away from “tall and sprawl” in this way is attainable in the present, as we explore below.

Distributing low, medium and higher residential densities throughout urbanized areas in GGH municipalities, rather than in concentrated high growth nodes, could help address many of the challenges associated with hyper-concentrated development, provide more new “in-between” housing options for end users and minimize the reliance on unsustainable sprawl to deliver family homes. A distributed approach to density could:

- Improve the livability and economic vibrancy of neighbourhoods by adding new housing and households near existing health and community services, parks, transit, schools and amenities
- Address affordability issues in the region by reducing the scarcity of land designated for multi-unit development, and permitting gentle and medium density in more places
- Assist in sustainability efforts by mitigating carbon emissions, protecting valuable land, consuming less energy and encouraging healthy, walkable neighbourhoods
- Provide more housing options within neighbourhoods to meet the needs of individuals and families at all stages of life, allowing residents to grow and age in place

Distributed Density on the Ground

Distributed density can take many forms...for which research suggests there is latent demand amongst homebuyers.³⁴ While most survey respondents indicate a single-detached house as their preference, the lack of availability of this housing type within the GTA, plus the high price tag, puts this type of home out of reach for many. Research suggests that Missing Middle housing could fill this gap by offering more affordable options for ground-related housing without necessitating long commutes out of the core.³⁵

The following is a range of building typologies that can add medium densities throughout urban areas:

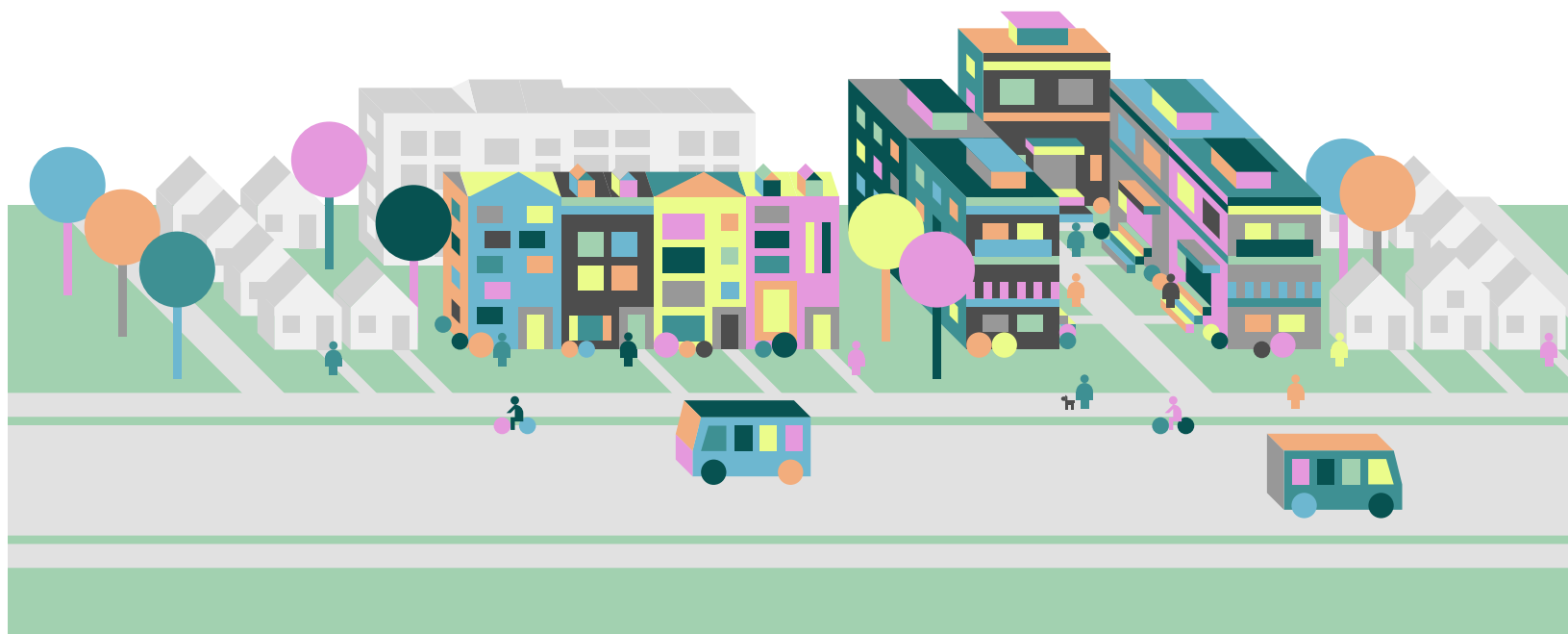


- **Mid-rise buildings at strategic urban centers, transit station areas, along transit corridors and neighbourhood avenues and main streets.** These buildings are typically five to 11 storeys, and lower scale along avenues and neighbourhood main streets, with heights based on the adjacent street width. If well designed, they can fit nicely into the character

of the neighbourhood main street, with retail at street level and higher storeys set back from the street wall, making for a more “human scale.” They can accommodate the densities required to support higher order transit such as light rail transit (LRT) and bus rapid transit (BRT). They can also be part of a mix of densities near transit station areas.

- **Walk-up apartment buildings and townhouses (stacked or back-to-back) in existing residential neighbourhoods.** At heights of up to four storeys, these buildings can add gentle density, increase walkability and support transit ridership, both in existing residential areas and along main streets in

lower-density suburban areas.³⁶ Walk-ups and townhouses can offer many of the same amenities as single-detached homes, including ground-level entry and access to front or rear yards, while allowing for more density than single-detached homes. Walk-up apartments offer much-needed purpose-built rental units, which, unlike accessory units in single-detached homes, may not carry the same risk of being reconfigured into a single unit or of being removed from the rental market entirely.³⁷ Townhouses fronting onto municipal streets can provide approximately double the amount of housing per hectare as single-detached dwellings.³⁸



- **Conversions of single-family homes into multi-family duplexes, triplexes or fourplexes.** Converting existing single-detached dwellings into multi-unit residences can add gentle density without significantly altering neighbourhood scale or built form, but may require changes to zoning. Conversion can be achieved in a variety of ways, from the simple (adding a single basement suite) to the complex (reconfiguring a single dwelling into four apartments, for example).

- **Accessory dwelling units like laneway suites or backyard (garden) suites.** Located at the rear of residential lots, detached secondary suites can introduce additional dwelling units while respecting neighbourhood look, feel and scale. Accessing existing servicing from the principal residence (water, sewer, electricity, gas, etc.), accessory dwelling units can provide rental income for homeowners while introducing smaller rental units and diversifying housing options in single-detached neighbourhoods.³⁹



The City of Toronto recently amended its Official Plan and Zoning By-Law to permit laneway suites in low-rise residential areas throughout the city,⁴⁰ and the City of Kitchener recently approved a new zoning bylaw that permits granny flats, tiny houses and carriage houses on residential lots.⁴¹

- **A range of scales at major transit station areas, large infill sites near transit and arterial nodes.** Adding a range of building scales in a number of distributed locations – instead of clustering towers only in the downtown core – can help cities achieve intensification targets, and support rapid transit investments and access to community services and amenities.



Missing Middle



The term “Missing Middle” has become a centrepiece of many conversations about housing, but it has been defined in different ways. American design firm Opticos first coined it to promote housing solutions that were compatible with single-detached typologies and walkable neighbourhoods but that were small in scale – two to three storeys in height, with setbacks on all sides.⁴² In 2015 and 2016, the Ontario Home Builders Association, Pembina Institute and Ryerson City Building Institute expanded the concept beyond typology to advance gentle- and medium-density multi-family options in the GTHA in proximity to transit, schools, services and

employment. (This was seen as an alternative to the predominant choices of small units in high-rise buildings or family-sized houses in car-dependent locations with long commutes.)⁴³

The term has also come to refer to housing affordable to middle-income families that falls between subsidized housing and current market-rate housing, as used in Mississauga’s housing strategy, *Making Room for the Middle*.⁴⁴

Taken together, the definitions of Missing Middle refer to housing that is appropriate and affordable for a range of household sizes and incomes.

Myth Buster: No Room for New Homes

A common perception is that we don't have room to add more housing to already developed urban areas, and that we must sprawl and build tall because our towns and cities are already full. This is a myth. Even densely populated cities in the GGH region have ample room to accommodate population growth in distributed forms of density.

Recent research demonstrates the potential of distributed density. In the study *Finding the Missing Middle in the GTHA*, the Ryerson City Building Institute demonstrated that Mississauga has room for over 174,000 new housing units delivered through low- and mid-rise buildings within the existing urban footprint, even without adding density to single-detached residential neighbourhoods.⁴⁵ This would provide enough new housing to accommodate all of Mississauga's projected population growth to 2041, and even 80% of Peel Region's projected growth. The exercise was academic; it did not suggest that all of Peel's growth be directed to Mississauga, but showed that "tall and sprawl" was not a necessary strategy for accommodating the region's housing needs. The findings of the report refuted the argument that Mississauga has no more room to grow, and demonstrated that it is possible to accommodate significant new growth within the city's built-up area while taking pressure off greenfields.

Subsequent research by the Centre for Urban Research and Land Development (CUR) at Ryerson University found that building Missing Middle housing in the form of townhouses along rapid transit corridors would sufficiently accommodate

all of the province's expected population growth over the following 24 years.⁴⁶ Further research by CUR showed that if Toronto had the same ratio of duplexes to single-detached homes as Vancouver, the city would boast 300,000 to 400,000 additional family-friendly housing units, and that even more housing would be possible if the entire GGH region had the same share of duplexes as cities like Vancouver or Montreal.⁴⁷

An award-winning concept by Toronto-based architecture firm Studio JCI also demonstrates the potential for additional density within Toronto's land zoned residential, the majority of which is zoned for only single-detached or semi-detached homes.⁴⁸ JCI's "Multi-Tach" proposal would see existing single-family homes in Toronto's Residential Detached (RD) zones transformed into multi-family dwellings. The proposal suggests that, with modest adjustments to zoning by-laws, single-family homes could be transformed into multi-family, detached buildings containing three to five units, thereby efficiently adding new housing to existing neighbourhoods while conforming to existing height and setback limits. Studio JCI estimates that transitioning just 1% of the city's existing 1.1 million households into "multi-tach" homes could create approximately 44,000 new housing units, and relatively quickly, as each triplex would take one to two years to deliver (compared to three to four years for a mid-rise, or five to seven years for a high-rise).⁴⁹

These studies, along with many others, demonstrate that there is significant room to grow within the GGH, without encroaching on greenfield lands.

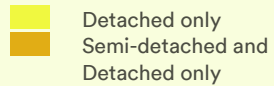
The Yellowbelt

In many municipalities, current zoning enshrines single-detached dwellings as the primary housing option and restricts new multi-unit housing development to a small area of the land base.

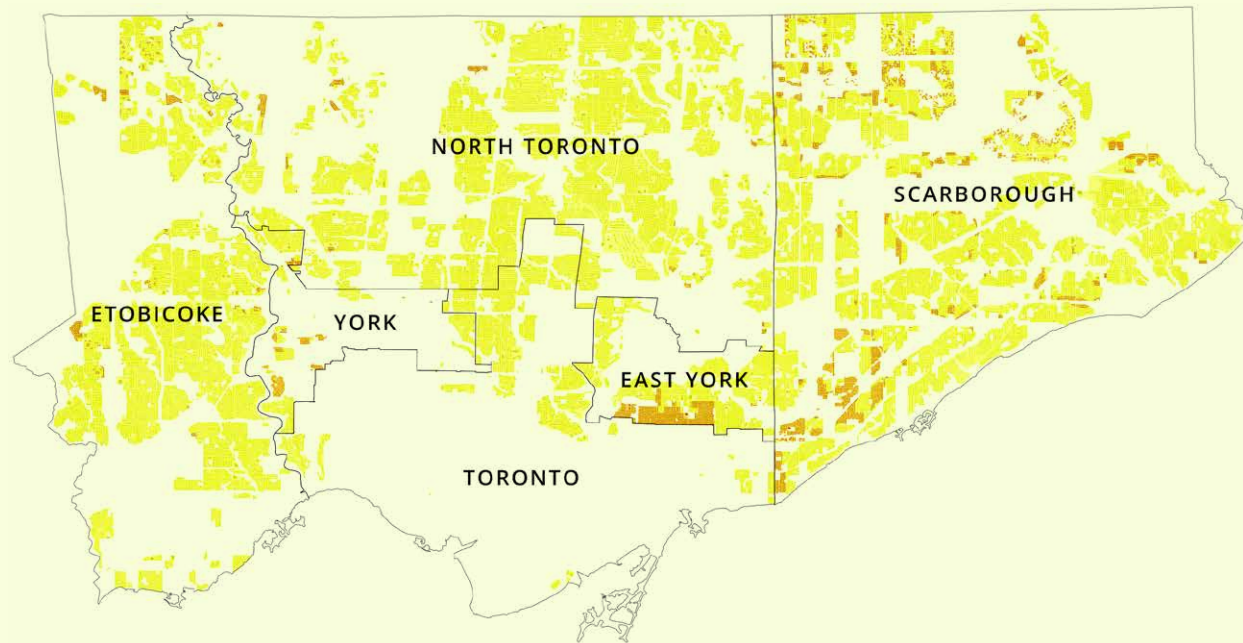
For example, in Toronto, a majority of recent and planned residential development is concentrated in a small portion of the city. The Downtown and Central Waterfront area accounts for 3.4% of the total City land mass, but contains 36.6% of all residential units in the development pipeline (i.e. built, active or under review) between 2014 and 2018. Another 10.5% of all

new residential units were proposed or built in Toronto's four Centres (Yonge-Eglinton, North York, Etobicoke and Scarborough), and 21.5% along designated Avenues.⁵⁰ By contrast, the majority of land zoned for residential use within Toronto is subject to restrictive zoning policies that allow only single-detached and semi-detached housing. These areas are commonly referred to as the "Yellowbelt," in reference to the assigned colour on municipal zoning maps and the accompanying restrictions placed on additional density in these zones.⁵¹

Map of Toronto's Yellowbelt by MapTO, 2017.



Data from the City of Toronto.



300 Units

2 Midrise (90 units each)
+ 2 Towns (45 units each)
+ 10 Triplexes (3 units each)

300 Units

1 Tower (35 storeys)



Opportunities for Distributed Density

Across the GGH, a number of innovative opportunities exist for intensification and good density, including the following examples.

Transit-Oriented Development Near Existing and Planned Transit Stations

Transit-oriented development (TOD) is “higher density, mixed-use development that is connected, next to or within a short walk of transit stations and stops, and is designed to encourage transit use.”⁵² Recognizing the potential of TOD, municipalities across the region are planning to encourage mixed-use development near existing or planned stations, along with social and physical infrastructure to support livability. Recent examples include Brampton’s Mount Pleasant Village, built around the new Mount Pleasant GO Transit station. Anchored by a new community centre, library, public square and school, the mixed-use Mount Pleasant Village forms the core of a larger transit-supportive community. The compact, walkable and transit-oriented centre aims to satisfy Growth Plan policies that encourage complete and compact communities.⁵³

Recently, Metrolinx and Infrastructure Ontario (IO) have partnered to support TOD at existing and new GO Transit, subway and LRT stations. Together, Metrolinx and IO will work with the development industry to produce development integrated with or adjacent to transit stations, with the goal to create new investment opportunities while supporting transit ridership and ultimately creating more complete communities in proximity to transit.⁵⁴

Metrolinx’s TOD plans are already taking shape. At the existing Mimico GO station, Metrolinx has partnered with a private real estate developer that will cover the costs of upgrades including a new station building, parking and landscaping,

acknowledging that development will support ridership.⁵⁵ At the planned new Woodbine GO station in Etobicoke, Metrolinx has partnered with Woodbine Entertainment Group, which will pay for the construction costs of the new station to coincide with a major redevelopment planned near the site.⁵⁶

Mount Pleasant Village development.

Images courtesy NAK Design Strategies. Urban Design and Landscape Architecture, NAK Design Strategies.



Redeveloping Large Mall and Plaza Sites

Another strategy for distributed density that has gained traction in recent years is the redevelopment of large single-use sites, such as malls and plazas, into mixed-use communities. Due to their low density, large scale and simple ownership patterns, plazas and malls at arterial nodes and close to transit offer good opportunities for redevelopment. Transforming big-box stores, strip malls and shopping centres into mixed-use communities with a range of housing typologies, densities and scales can add housing and employment in neighbourhoods with good access to transit and other services.

Many such projects are planned and underway in the region, including Etobicoke's Humbertown redevelopment, Port Credit West Village in Mississauga, the Shoppers World redevelopment in Brampton and a number of proposals along Scarborough's Golden Mile. The City of Mississauga is proactively planning for the repurposing of large retail centres with its recent Reimagining the Mall project, which introduces policies to direct the potential redevelopment and intensification of five indoor shopping mall sites and guide their long-term evolution into healthy, mixed-use communities.⁵⁷

Mall and plaza redevelopments can help to optimize existing infrastructure and support higher order transit investment in already developed areas, while tapping into local services and amenities without consuming undeveloped greenfield lands.



Etobicoke's Humbertown Shopping Centre site then and now.

Photo of Humbertown, built in 1956, from the City of Toronto Archives; rendering of Ednbridge development courtesy of Tridel.

Gentle Density in Residential Neighbourhoods

In many residential neighbourhoods throughout the GGH, development is restricted to single-detached – and in some cases semi-detached – dwellings, producing significant areas of low residential densities. However, many of these areas pose great potential for municipalities to add gentle density while preserving neighbourhoods' overall look and feel through secondary and laneway suites, triplex conversions, new low-rise walk-up apartments and other options. Adding gentle density to single-detached neighbourhoods can accommodate population growth and provide a range of housing options and tenures to meet the diverse needs of residents.

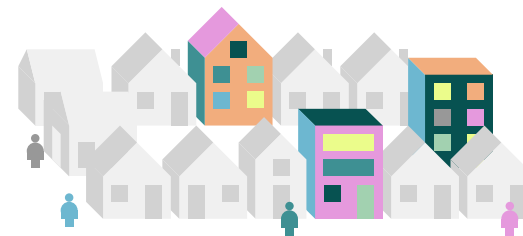
While there is a range of building typologies that could facilitate distributed density, current zoning can make it difficult to add new homes in some residential neighbourhoods dominated by single-detached homes. Achieving distributed density in these neighbourhoods requires updating zoning and Official Plan policies that have prevented residential detached neighbourhoods from welcoming additional multi-unit housing typologies.

Updating zoning to allow for Missing Middle housing typologies could add significant new housing to existing residential neighbourhoods. For example, in the approximately 200 square kilometers of Toronto that is zoned exclusively for single-detached dwellings, adding one duplex per hectare could create enough new housing to accommodate 45,000 residents.⁵⁸

It could also make these housing projects more attractive to developers. In most municipalities in the GGH, most low- and mid-rise projects must go through the same steps for approval by a municipality as those to build high-rise buildings, most often involving complex and time-consuming amendments to Official Plans and zoning by-laws. This current scenario encourages developers to favour high-rise buildings, as they provide a higher financial return for a similar effort and land cost.⁵⁹ **Zoning changes to make multi-family housing typologies permissible as-of-right could provide more certainty to developers and encourage uptake of low-rise residential development**, particularly among small-scale home builders and individual property owners.

Density Transition Zones

Density Transition Zones is a policy proposal developed by Toronto-based urban planners Sean Hertel and Blair Scorgie. The proposal aims to encourage distribution of density and diversification of the housing stock and to ease the transition between lower-density neighbourhoods and higher-density development along avenues, main streets and suburban arterials. These density transition zones would support medium-density, Missing Middle-type infill housing in close proximity to main streets, transit and services.⁶⁰ See transitionzones.com for more.



Case Study: Upzoning in Minneapolis

Minneapolis recently carried out an exercise that could serve as a model for how to promote more distributed density. In creating a new comprehensive city plan, “Minneapolis 2040,” and updating associated zoning by-laws, the City increased densities near its downtown and along transit corridors, as-of-right. The goal of the policy was to improve access to housing by increasing housing supply and diversity in location and typology. One of the first amendments to the zoning code will be to allow three dwelling units on each lot in areas currently zoned single-family. The plan’s other changes include allowing higher-density multi-family housing development on public transit routes, new housing within areas with an existing mix of housing types, and greater housing densities in and near the downtown.

The plan focuses on significant increases to densities in core areas near transit and jobs, as well as on incremental increases to densities in single-family neighbourhoods. By upzoning the city as a whole, Minneapolis expects to add housing to accommodate another 233,000 households by 2040.⁶¹

Case Study: Density Diversity in Hamilton’s Core

In 2018, Hamilton amended both its Official Plan and zoning by-law to permit more density in its downtown core. The updated plan permits heights of 11 metres to 151 metres throughout the downtown area, and developers wishing to exceed permitted building heights must follow specific conditions. The City has also established requirements for developers to replace pre-existing rental housing in their new developments, in some cases.⁶²

With this new plan, Hamilton has a clear framework that allows developers and landowners to understand how much development is possible on a given site, what community benefits and studies will be required to help support the development, and a transparent process for development approval. This provides increased certainty for all parties, and has the potential to reduce approval timelines.

Distributed Density Supports Livability

At the heart of every neighbourhood are neighbours. However, in some areas, population is declining along with housing density due in part to demographic change. Neighbourhoods experiencing stagnating or declining populations face challenges regarding the efficiency and productivity of land and infrastructure and the maintenance of services.

Adding gentle density can help ensure there are enough people in a neighbourhood to support local schools, health and community services, and keep shops and restaurants open. It can provide a range of housing types and tenures that support the needs of individuals and families throughout all stages of life and allow for aging in place. It can also support public transit service, providing residents with efficient and affordable transportation options without relying on private automobiles.



Empty Bedrooms

In areas with stagnating or declining populations, many people are over-housed. A study by the Canadian Centre for Economic Analysis (CCEA) found that **nearly two-thirds of Ontarians are over-housed**, resulting in an estimated **five million empty bedrooms in the province**.⁶³ The CCEA and the Canadian Urban Institute uncovered a similar pattern, finding that many Toronto neighbourhoods zoned primarily for single-detached dwellings experienced very little growth or, in some cases, population decline between 2011 and 2016. Since 2001, these **declining densities have prevented an estimated 220,000 people from accessing housing in established urban residential neighbourhoods**.⁶⁴

Schools for Families

One striking example of how population decline affects neighbourhoods is school closures. A 2017 study found that 48% of Toronto's neighbourhoods were threatened by school closures due to under-enrolment, while across Ontario, over 600 schools were facing possible closure.⁶⁵ Meanwhile, some schools in high-growth areas lack sufficient capacity for students.⁶⁶ This imbalance suggests that better distributed density within existing neighbourhoods could create more housing options for young families, ease the intensity of population growth and decline, and ensure that new and existing neighbourhoods have the population necessary to support schools, as well as other infrastructure and services.

Healthy Neighbourhoods

Complete communities with appropriate densities can support the health and wellbeing of residents by providing built-in sources of physical activity and social connection through

walkability and active transportation, and also by facilitating access to health services.

Active transportation and public transit use can lead to positive public health outcomes by increasing physical activity amongst residents, decreasing traffic-related air pollution, and supporting improved mental health and social connectivity. A recent report by four Medical Officers of Health in the GTHA outlined how good land use and transportation planning – including increased densities, proximity to transit and services, and mixed uses – is necessary to support complete communities, active transportation and associated positive health outcomes.⁶⁷

Furthermore, it can be more cost-effective and efficient for governments to deliver health care services in areas with higher population densities. Research has found that population density correlates with higher levels of health coverage.⁶⁸ Areas with more dispersed populations may face challenges in accessing health services, due to geographic distance as well as the centralization of some services in urban centres.⁶⁹

Local Transit Needs Density

High quality transit service can provide residents with affordable, convenient and efficient transportation options, and in turn reduce private automobile use and its associated GHG emissions. But more improved transit service requires sufficient population densities. Transit service with headways of 15 minutes typically requires a residential density of about 30 housing units per hectare (or about 75 people per hectare), while rapid transit requires at least 60 housing units per hectare (or about 150 people per hectare) to be viable.⁷⁰ Intensification can increase neighbourhood densities and help support improved levels of transit service – making transit a more appealing transportation alternative for residents.

Myth Buster: Parking and Traffic

With population on the rise in the region, it's important that our housing strategies reduce car dependency, reduce congestion and reverse the trend towards long commutes. But many worry that greater urban density entails greater traffic congestion. In fact, there is evidence that increased density need not contribute to worsened traffic congestion. According to a report by the Residential and Civil Construction Alliance of Ontario and the Ryerson Urban Analytics Institute, denser development comes with lower rates of car ownership than single-family homes.

The study found that more than half (53%) of all downtown Toronto households living in apartments do not own a car; this is almost double the car-free rate of other dwelling types. By comparison, only 27% of those living in townhouses and 26% of those living in single-family homes in Toronto do not own a car.⁷¹ This can also provide affordability benefits, as encouraging more location-efficient development over car-oriented sprawl can dramatically reduce auto-dependence, and also save households an estimated \$8,000 to \$15,000 per year by eliminating the need for car ownership.⁷²



Visualizing Density

In 2017, the Canadian Urban Institute released *Visualizing Density*, a report intended to help people “visualize what the built form looks like in relation to density targets set out in the Provincial Growth Plan.”⁷³ The examples on this page are drawn from the *Visualizing Density* report and show blocks with residential densities of over 150 people per hectare – enough to support rapid transit. To see more examples of density and explore the full report, visit visualizingdensity.ca.

Density generally refers to the ratio of human activity (residents, jobs, or built form) to the land area it occupies.⁷⁴ In Ontario’s Growth Plan, density is expressed in terms of people and jobs per hectare, and is a key measure of how communities are achieving the Plan’s targets.⁷⁵



A block in Oakville’s Uptown Core with a density of 220 people per hectare.



A block in Toronto’s Dundas and Carlaw neighbourhood with a density of 169 people per hectare.



A block in Downtown Burlington with a density of 571 people per hectare.

Images from the 2017 report of the Canadian Urban Institute (CUI), visualizingdensity.ca, courtesy CUI.

Distributed Density Supports Affordability

The issue of home (un)affordability – by now, widely reported, and a product of many factors – is a concern for many living in the GGH. Scarcity of attainably-priced housing has driven people further afield, and housing suitable for larger households is especially hard to find.

At a household level, this scenario is threatening finances, but at the local and regional levels, whole labour markets are at risk. The City of Mississauga noted that professionals like teachers, nurses and social workers struggle to afford housing in that city, and that addressing this challenge is vital to maintaining the city's social mix and economic wellbeing.⁷⁶



Harnessing Construction Cost Savings

Restricting development to a small percentage of the urban landscape contributes to high land costs and encourages the costliest form of residential development to build: high-rise. The Canadian Centre for Economic Analysis found that from a construction cost perspective, an 880-square foot condo unit is the same cost to build as a 1,400-square foot unit in a low-rise wood frame building, a 1,480-square foot single-detached home or a three-storey stacked townhouse.⁷⁷ Altus Group produces an annual cost guide that tracks construction costs in the GTA and across Canada; according to their 2019 publication, tall residential cost the most to build per square foot.⁷⁸

Permitting the construction of more low- and mid-rise housing types in existing neighbourhoods (i.e. through distributed density) could translate into lower costs for buyers and renters, if decreased construction costs were passed on to end users.

Residential construction cost per square foot in the GTA, 2019

Building Type	Construction Cost / sq.ft. (based on Gross Construction Area)
Buildings 60+ storeys	\$225-\$280
Buildings 13-39 storeys	\$190-\$255
Buildings <5 storeys (wood)	\$150-\$200
Stacked townhouses	\$135-\$180

Source: Altus Group 2019 Canadian Cost Guide

Beyond building smaller, a number of additional factors can bring down construction costs of infill development, as follows.

Modular Construction

The off-site, factory manufacturing of modular housing components can offer significant construction time and cost savings, cutting up to 20% of the cost of a three- or four-storey wood-frame multi-family apartment building, and reducing timelines by 40 to 50%.⁷⁹ Producing components in controlled factory settings enhances production efficiency, minimizes weather delays, reduces waste, improves worker safety and job stability, and allows site engineering and preparation to proceed concurrently.⁸⁰ Investment in and support for modular manufacturing is needed to allow for scale to achieve such benefits.

Wood Frame and Mass Timber Construction

Wood and mass timber structures are lighter weight, quieter and quicker to build than their concrete and steel counterparts, and can reduce construction timelines, thereby reducing costs.⁸¹ Before Ontario's Building Code was amended in 2014 to permit six-storey wood structures, the construction cost savings of wood frame construction was estimated at 10% to 15% over concrete, resulting in savings of \$20,000 to \$25,000 on a 1,000-square foot residential unit.⁸²

Reduced Parking Requirements

The cost to construct underground parking in new residential developments in the GGH can range from \$40,000 to \$60,000 per space in Toronto.⁸³ But in neighbourhoods that are walkable and well served by transit, car ownership – and therefore, parking space – is not necessary for many homeowners. When adding gentle forms of density in existing neighbourhoods, removing underground parking from the equation could achieve significant cost savings for developers and homebuyers.

Some GGH municipalities are already implementing policies to reduce parking requirements in higher-density areas that are well served by transit:

- Hamilton has reduced minimum parking requirements in its Transit Oriented Corridor Zones near the new LRT⁸⁴
- Markham has reduced its per-unit parking requirements for apartment dwellings in the Markham Town Centre area, and does not allow additional parking spaces (thereby serving as both a parking minimum and maximum)⁸⁵
- Vaughan has implemented parking minimums and maximums for multi-unit dwellings in the Vaughan Metropolitan Centre area (based on number of bedrooms)⁸⁶

These policies could be enhanced by providing dedicated car-share spaces and bicycle parking in new buildings.

Complementary Policies

While supply-side measures such as increasing zoning permissions may boost supply and offer more housing options, there is no guarantee that this will result in more affordable homes for end users. In fact, there is some evidence that, at least in the short term and at a local level, rezoning for additional density can lead to increased housing prices. For example, research in Chicago found that increasing allowable densities around transit stations by 33% (along with increasing the number of allowed dwelling units by 50% and building heights by 50%) increased property values by 15% to 23%.⁸⁷

Here in the GGH, some Missing Middle housing typologies – such as townhouses, stacked towns, and mid-rises – are already being developed in residential infill pockets and along designated avenues. However, this new supply alone may not offer significant affordability benefits over other housing options in neighbourhoods.

To address this, efforts to increase the supply and diversity of housing through distributed density should be complemented with policies specifically directed at enhancing the affordability of homes and rental units, including:

- **Accompanying zoning changes with value capture and inclusionary zoning tools:** Municipalities can supplement policies to encourage distributed density with policies to support the development of affordable housing. Since rezoning activities have the potential to increase land values – from a development potential standpoint, and from an outright value perspective – value-capture tools like more progressive land value or property taxes, or the use of inclusionary zoning, could support the creation of new affordable housing. For example, in Minneapolis, some advocates who called for expanding city-wide zoning permissions also successfully championed accompanying policy measures to address affordability. For example, YIMBY (Yes in My Backyard) group in Minneapolis “Neighbors for More Neighbors” was instrumental in advocating for more neighbourhood density. But they also pushed for greater protection for renters, more funding for affordable housing and taxes on land value.⁸⁸
- **Protecting public land:** Municipalities can also support the development of more affordable housing on public land by leveraging it for long-term leases to support the development of affordable housing while maintaining public ownership. For example, 14 of Metro Vancouver Housing’s sites are currently located on leased municipal lands. The agency’s 10-Year Plan highlights the opportunities to renew these leases to preserve existing affordable housing, and also to expand new long-term lease arrangements, making the development of new affordable housing

financially viable while also maintaining public land assets.⁸⁹ Implementing municipally-led or supporting non-profit-led shared equity programs could also make homeownership more accessible.

- **Protecting existing affordable housing:** Implementing policies to protect the existing supply of more affordable housing typologies and tenures, including rental apartments and rooming houses, is another option. To address the financialization of housing and its impacts on tenants, Ontario municipalities and the Province could introduce greater measures and regulations to protect tenants. At the provincial level, expanding rent control regulations to limit allowable annual rent increases for all units, including newly-built units, as well as enhancing tenant protections to protect against eviction and “renovictions,” could enhance the stability and security of existing rental housing. The City of Toronto’s recently approved licensing and registration system and accommodation tax for short-term rentals, like Airbnb, is an example of municipal regulations targeting specific challenges related to affordability in the rental housing market.⁹⁰
- **Prioritizing purpose-built rental housing:** Over the past 20 years, the number of renters in the region has increased, but very little purpose-built rental housing has come to market. As a result, renters have become increasingly reliant on condo units offered through the secondary market.⁹¹ These units do not offer the same level of housing stability as purpose-built rentals, as they can be converted to ownership housing, removing units from the rental system altogether.⁹² As homeownership costs continue to climb, so will pressure on our rental market. Targeting incentive programs and as-of-right approvals to encourage investment

in purpose-built rental developments with units at attainable (rather than luxury) rates, will be critical in ensuring the GGH remains affordable for renters.⁹³

- **Helping homeowners add attainable rental units:** Incentivizing and supporting existing homeowners to convert their properties into multi-unit dwellings can help address one of the most significant challenges to housing affordability: land cost. Municipal and/or provincial programs could provide support for homeowners seeking to convert single-detached homes into triplexes or multiplexes, ensuring the process is simple, efficient and cost-effective. Further policies would be required to ensure the resulting new rental units are made available to end users at affordable rates, rather than as expensive, luxury housing products. Similar incentive programs could apply to commercial landowners seeking to add rental units to their properties on main streets. For example, Toronto-based developer R-Hauz is working with commercial property owners along main streets to add modular rental suites to their buildings at a low scale (six stories). These innovations enable local landowners to expand the supply of rental housing, can help ensure that the new units are for end users (not investors), and can cut construction costs and offer greater affordability through factory production and modular assembly.



Distributed Density Supports Environmental Sustainability

Meeting our climate change mitigation commitments requires us to drive down the harmful emissions related to housing and transportation. The easiest way to do this is to ensure that all new development is as climate-friendly as possible.



Where We Build Matters

The Environmental Commissioner of Ontario's 2019 report, *A Healthy, Happy, Prosperous Ontario: Why we need more energy conservation*, cites Ontario's planning policy regime and the Growth Plan as key contributors to increasing urban sprawl and automobile dependency and destroying valuable agricultural lands, natural areas and wetlands. Removing barriers to medium-density housing is noted as a key action needed to reduce sprawl and associated carbon emissions in the province.⁹⁴

Housing built further from the core can result in higher transportation-related emissions. A study of the Toronto Census Metropolitan Area found that average household emissions differed significantly by census tract, from 3.1 to 13.1 tonnes of carbon dioxide equivalents per year. The highest emitting census tracts were in low-density suburban locations, while the lower emitting tracts were in the central core. This difference can be attributed primarily to emissions from auto use, which are much greater outside the core at 3.80 tonnes, compared with only 1.88 tonnes in the core.⁹⁵

By focusing more density in existing walkable, transit-connected neighbourhoods, we can reduce the transportation-related impacts of future development, and more ably meet our environmental commitments. This idea extends to existing suburban areas, where there is potential to retrofit existing, low-density communities into more walkable and transit-connected neighbourhoods, in part by introducing medium- and gentle-density development.⁹⁶

What We Build Matters

In addition to the well-established environmental benefits of location-efficient development, adding new homes within the existing urban footprint can also be an opportunity for municipalities to significantly reduce GHG emissions from new buildings. By creating building and zoning policies that support distributed density and also require that new construction meet ambitious energy efficiency targets, municipalities have a unique opportunity to achieve broader climate benefits through intensification.

Take, for example, Vancouver's 2016 Zero Emissions Building Plan, which establishes specific targets and implementation actions to achieve zero emissions from new buildings by 2030. The targets apply to all buildings – even low-rise – making gentle-density infill development a positive contributor to overall GHG reduction efforts (see more on next page).⁹⁷

Here in the GGH, many municipalities have already adopted climate change action strategies, including specific GHG reduction goals. For example, Toronto's climate change action strategy, TransformTO, requires that by 2030 all new homes and buildings produce near net-zero greenhouse gas emissions.⁹⁸ Ensuring that all new homes constructed, including gentle and middle densities added to existing neighbourhoods, meet high standards for energy efficiency could be a significant step towards reaching environmental goals.

Case Study: Vancouver's Zero Emissions Building Plan

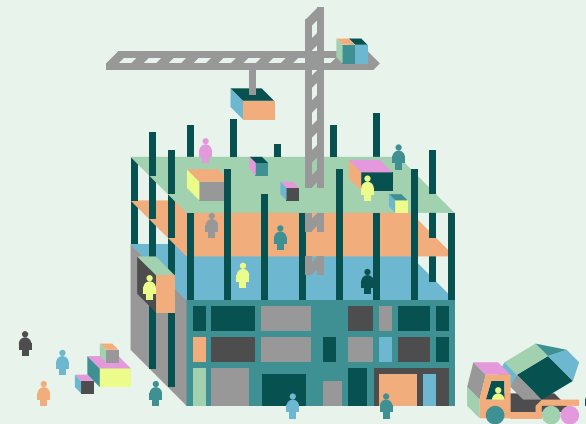
Established in 2016, Vancouver's Zero Emissions Building Plan sets out strategies to achieve zero emissions from new buildings by 2030. Rather than retrofitting existing buildings, the plan focuses on new construction, recognizing that "the sooner new buildings achieve zero emissions, the fewer buildings there will be that require costly and challenging deep energy retrofits to achieve the target [of only renewable energy by 2050]."⁹⁹

Vancouver's plan establishes energy limits by building type, along with capacity building strategies to encourage the private sector to demonstrate leadership in the development of zero emissions buildings.¹⁰⁰ The City itself has committed to meeting zero-emission standards in new City-owned buildings and in City-owned and managed Vancouver Affordable Housing Agency projects.¹⁰¹

Vancouver's plan is woven into a number of City-level policies, including the Building Bylaw and the rezoning process. The Building Bylaw includes tailored energy requirements for new

homes up to six storeys and large and commercial buildings, as well as energy efficiency upgrade requirements for single-detached home renovations and high-rise residential and commercial buildings.¹⁰² The Green Buildings Policy for Rezoning uses the rezoning process as an opportunity to expedite the transition, requiring that all new rezoning applications meet either Near-Zero Emissions Buildings or Low Emissions Green Buildings standards.¹⁰³ The Zero Emissions Building Catalyst equips Vancouver's planning department with new powers in the rezoning and development permit stages to facilitate the development of zero-emissions multi-unit residential and mixed-use buildings, including the discretion to vary policies and guidelines, relax regulations such as frontage or site coverage, and increase overall density/floor area ratio.¹⁰⁴

By setting ambitious emissions standards for new buildings as well as in rezoning processes, Vancouver's plan ensures that both large-scale development and the gradual introduction of new housing in existing neighbourhoods are steps in the right direction towards meeting broader city-wide climate goals.



How We Build Matters

Multi-unit (or multi-family) housing is generally more energy-efficient than single-detached housing. Research in the United States found that comparable households living in single-family detached units consumed 54% more energy for heating and 26% more energy for cooling than comparable households living in multi-family units.¹⁰⁵

When it comes to structure, wood-frame housing is more energy efficient than similar structures made from concrete or steel.¹⁰⁶ What's more, concrete and steel buildings embody more carbon than wood frame buildings. One lifecycle study found that home construction involving concrete or steel leads to 20% to 50% more carbon emissions than wood frame construction.¹⁰⁷ Another study found that construction of high-rise timber structures would have a climate change impact 34% to 84% lower than that of reinforced concrete structures.¹⁰⁸ Moving toward more sustainable and less carbon-intensive forms of construction is desirable, and it's already possible – examples of net-zero buildings exist here in the Greater Golden Horseshoe and elsewhere in Canada, achieving dramatic carbon savings through green construction materials and techniques.¹⁰⁹

Building for Climate Resilience

As weather events like heavy rainfall, heat waves and extreme cold continue, strong public policy will be important in avoiding costly impacts.¹¹⁰

New development provides many opportunities to start improving our climate resilience. For example, high-rise construction that includes multi-level underground parking structures can have adverse effects on municipal stormwater and sewage systems, thus building more multi-family housing that requires less parking could contribute to the resilience of our region.¹¹¹ We can also select building sites to avoid flood-prone areas, expand permeable surfaces to manage stormwater runoff and reduce the urban heat island effect, and ensure buildings are designed or retrofitted with efficient heating, ventilation and air conditioning (HVAC) to lessen energy usage overall and during severe weather. Such measures at the building level can be managed or supported through public policy.

Reducing Carbon Block by Block

The Sightline Institute, an American think tank, compared two hypothetical residential city blocks using 18 homes.

On the first block, they replaced three typical homes with new 3,400-square foot homes. On the second block, they replaced the same three homes with a duplex, triplex and fourplex. The multi-unit buildings together contained approximately the same square footage as the single-detached homes placed on the first block.

Using data from the Oregon Department of Environmental Quality, they found that the second block would produce average household carbon emissions per household approximately 20% lower than those of the first block.¹¹²

Imagine the potential emissions savings if a full block were redeveloped instead of only three sites.

Distributed Density: Conclusions

Over the next two decades, municipalities in the GGH will be called upon to accommodate millions of new residents and jobs, and this will be a challenge. But it's also an opportunity to get density right, and to disrupt the “tall and sprawl” development pattern that has put pressure on the Greenbelt, strained municipal services and left many without suitable and affordable housing options. Distributing residential density throughout urbanized areas in a range of building typologies could help curb sprawl and support vibrant communities. Distributed density has the potential to:

- Help municipalities prioritize intensification and optimize existing developed areas rather than consume greenfield lands, thereby preserving farmland and natural areas while reducing municipal infrastructure costs
- Support and sustain local health, community and transit services, infrastructure, schools and businesses, and reduce public costs associated with providing hard and soft services to low-density, suburban areas
- Diversify housing options within neighbourhoods, offering new housing options in a range of sizes and typologies that meet the needs of residents at all stages of life
- Help local home and property owners add rental units for end users
- Reduce car dependency and related carbon emissions by enhancing housing options that are “location-efficient,” i.e. walkable and close to transit, jobs, schools and services

- Harness the environmental benefits and cost savings associated with mid-rise development, modular and wood-frame construction
- Help address affordability by accompanying these new opportunities for housing with complementary policies and regulations to achieve and protect affordability

Achieving the benefits of density requires an integrated approach to ensure support for broader public policy objectives (such as climate action, housing affordability, complete communities and social equity) and to avoid unintended consequences such as fuelling housing market speculation.

We hope that this guide provides approaches and examples of how to build resilient and inclusive communities through distributed density, and support citizens and decision-makers as they engage in municipal planning and development processes.



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References

- 1 Neptis Foundation (2002). *Toronto-Related Region Futures Study*. https://www.neptis.org/sites/default/files/ibi_reports/neptis_bau_final_report.pdf
- 2 Province of Ontario (2019). *Ontario's Greenbelt*. Retrieved October 30, 2019 from <https://www.ontario.ca/page/ontarios-greenbelt>
- 3 David L.A. Gordon, Lyra Hindrichs and Chris Willms (2018). *Still Suburban? Growth in Canadian Suburbs, 2006-2016*. Toronto: Council for Canadian Urbanism, Working Paper #2. <http://www.canadianurbanism.ca/canu-working-paper-2-growth-in-canadian-suburbs-2006-2016/>
- 4 Neptis Foundation (2017). *An update on the total land supply: Even more land available for homes and jobs in the Greater Golden Horseshoe*. Retrieved February 20, 2020 from <https://www.neptis.org/publications/update-total-land-supply-even-more-land-available-homes-and-jobs-greater-golden>
- 5 Burchfield, Marcy and Anne Kramer (2015). *Growing Pains: Understanding the New Reality of Population and Dwelling Patterns in the Toronto and Vancouver Regions*. The Neptis Foundation. https://www.neptis.org/sites/default/files/growing_pains/growingpains_neptisreport_final.pdf
- 6 The Neptis Foundation (2003). *Agriculture in the Central Zone*. <https://www.neptis.org/publications/agriculture-central-zone>
Environmental Defence (2013). *The High Costs of Sprawl: Why Building More Sustainable Communities Will Save Us Time and Money*. <https://environmentaldefence.ca/report/report-the-high-costs-of-sprawl/>
- 7 Neptis Foundation (2016). *No shortage of land for homes in the Greater Toronto and Hamilton Area*. <https://www.neptis.org/publications/no-shortage-land-homes-greater-toronto-and-hamilton-area>
- 8 Wilson, Sara (2013). *Nature on the Edge: Natural capital and Ontario's growing Golden Horseshoe*. David Suzuki Foundation. <https://davidssuzuki.org/wp-content/uploads/2018/02/nature-edge-natural-capital-ontario-golden-horseshoe.pdf>
- 9 Wilson, Sara (2013). *Nature on the Edge: Natural capital and Ontario's growing Golden Horseshoe*. David Suzuki Foundation. <https://davidssuzuki.org/wp-content/uploads/2018/02/nature-edge-natural-capital-ontario-golden-horseshoe.pdf>
Swail, Susan Lloyd (2015). *Farming - an economic driver in the Greater Golden Horseshoe*. Environmental Defence online. <https://environmentaldefence.ca/2015/07/20/farming-an-economic-driver-in-the-greater-golden-horseshoe/>
- 10 Environmental Commissioner of Ontario (2019). *A Healthy, Happy, Prosperous Ontario: Why we need more energy conservation. 2019 Energy Conservation Progress Report*. <https://docs.assets.eco.on.ca/reports/energy/2019/why-energy-conservation.pdf>
- 11 VandeWeghe, Jared R. and Kennedy, Christopher (2007). A Spatial Analysis of Residential Greenhouse Gas Emissions in the Toronto Census Metropolitan Area. *Journal of Industrial Ecology*, Vol. 11, Issue 2, pp. 133-144, 2007. <https://ssrn.com/abstract=2236025>
- 12 Blais, Pamela (2010). *Perverse Cities*. UBC Press: Vancouver, BC.
- 13 City of London (2013). *Building a Mixed-Use, Compact City*. <https://www.london.ca/business/Planning-Development/Official-Plan/Documents/RethinkLondon/4%20Building%20a%20MixedUse%20Compact%20City.pdf>
Thompson, David (2013). *Suburban Sprawl: Exposing Hidden Costs, Identifying Innovations*. Sustainable Prosperity. http://thecostofsprawl.com/report/SP_SuburbanSprawl_Oct2013_opt.pdf
- 14 Regional Municipality of Halifax (2005). *Settlement Pattern and Form with Service Cost Analysis*. <http://usa.streetsblog.org/wp-content/uploads/sites/5/2015/03/Halifax-data.pdf>
Thompson, David (2013). *Suburban Sprawl: Exposing Hidden Costs, Identifying Innovations*. Sustainable Prosperity. https://institute.smartprosperity.ca/sites/default/files/sp_suburbansprawl_oct2013_opt.pdf
- 15 Regional Municipality of Halifax (2005). *Settlement Pattern and Form with Service Cost Analysis*. <http://usa.streetsblog.org/wp-content/uploads/sites/5/2015/03/Halifax-data.pdf>
- 16 Regional Municipality of Halifax (2013). *Quantifying the Costs and Benefits of Alternative Growth Scenarios*. <https://www.halifax.ca/sites/default/files/documents/about-the-city/regional-community-planning/HRMGrowthScenariosFinalReportJuly82013.pdf>
- 17 City of Markham (n.d.). *Development Charges*. Retrieved November 22, 2019 from <https://www.markham.ca/wps/portal/home/business/planning/development-charges/06-development-charges>
- 18 Richmond Hill (n.d.). *Development Charges*. Retrieved November 22, 2019 from <https://www.richmondhill.ca/en/invest-and-do-business/Development-Charges.aspx>
- 19 Town of Oakville (n.d.). *Development Charges*. Retrieved November 22, 2019 from <https://www.oakville.ca/townhall/fees-development-charges.html>
- 19 City of Kitchener (n.d.). *Development Charges*. Retrieved October 17, 2019 from <https://www.kitchener.ca/en/building-and-development/development-charges.aspx>
- 20 City of Peterborough online (n.d.). *Development Charges*. Retrieved October 17, 2019 from <https://www.peterborough.ca/en/doing-business/development-charges.aspx>
- 21 City of Hamilton (2019). *Development Charges Information - Pamphlet*. Retrieved October 17, 2019 from <https://d3fpllf1m7bbt3.cloudfront.net/sites/default/files/media/browser/2019-06-13/dc-pamphlet-june132019-july62019.pdf>
- 22 Environmental Defence (2013). *The High Costs of Sprawl: Why Building More Sustainable Communities Will Save Us Time and Money*. <https://environmentaldefence.ca/report/report-the-high-costs-of-sprawl/>
- 23 Burda, Cherise, Graham Haines and Shaun Hildebrand (2017). *Bedrooms in the Sky: Is Toronto building the right condo supply?* Ryerson City Building Institute and Urbanation. <https://www.citybuildinginstitute.ca/portfolio/bedrooms-in-the-sky/>
- 24 Statistics Canada (May 3, 2019). *New data on assessment value per square foot and above-grade living area*. Retrieved October 30, 2019. <https://www150.statcan.gc.ca/n1/daily-quotidien/190503/dq190503b-eng.htm>
- 25 Canada Mortgage and Housing Corporation (May 2019). *Housing Market Insight: Overview of residential property living areas in British Columbia, Nova Scotia, and Ontario*. Retrieved October 30, 2019 from <https://epdscrmssa01.blob.core.windows.net/cmhcprodcontainer/sf/project/cmhc/pubsandreports/housing-market-insight/2019/housing-market-insight-canada-68469-2019-m05-en.pdf?sv=2018-03-28&ss=b&srt=sco&sp=r&se=2021-05-07T03:55:04Z&st=2019-05-06T19:55:04Z&spr=https,http&sig=bFocHM6noLjK8rlhy11dy%2BkQJUBX%2BCDKzkjLHF-hUIU0%3D>
- 26 Burda, Cherise, Graham Haines and Shaun Hildebrand (2017). *Bedrooms in the Sky: Is Toronto building the right condo supply?* Ryerson City Building Institute and Urbanation. <https://www.citybuildinginstitute.ca/portfolio/bedrooms-in-the-sky/>
- 27 Altus Group (2019). *2019 Canadian Cost Guide*. <https://www.altusgroup.com/resources/reports/canadian-cost-guide-2019>
- 28 UrbanToronto (May 2, 2019). *GTA Condo Construction Hits Record High in Q1 2019*. <https://urbantoronto.ca/news/2019/05/gta-condo-construction-hits-record-high-q1-2019>

- 29 City of Toronto (2017). *Downtown Plan*. <https://www.toronto.ca/legdocs/mmis/2019/cc/bgrd/backgroundfile-135953.pdf>
- 30 MCAP (2019). *GTA and Southwestern Ontario Residential Land Value Market Report, Spring 2019*. <https://www.mcap.com/development-finance/land-value-report>
- MCAP (2015). *GTA and Southwestern Ontario Residential Land Value Market Report, Spring 2015*. <https://www.mcap.com/development-finance/land-value-report>
- 31 City of Toronto (2018). *Midtown in Focus: Final Report*. <https://www.toronto.ca/legdocs/mmis/2018/pg/bgrd/backgroundfile-115684.pdf>
- 32 Ryerson City Building Institute (2017). *The Opportunity of Rail Deck Park*. <https://www.citybuildinginstitute.ca/portfolio/rail-deck-park/>
- 33 City of Toronto (2016). *Staff Report: Rail Deck Park - Results of Feasibility Analysis and Next Steps for Implementation*. <http://app.toronto.ca/tmmis/viewAgendaItemHistory.do?item=2017.EX29.2>
- 34 Ryerson Centre for Urban Research (2019). *A Strategy for Significantly Increasing the Supply of "Missing Middle" Housing in the City of Toronto*. https://www.ryerson.ca/content/dam/cur/pdfs/TREB/CUR_Missing_Middle_Housing_Toronto.pdf
- 35 Ryerson Centre for Urban Research (2019). *A Strategy for Significantly Increasing the Supply of "Missing Middle" Housing in the City of Toronto*. https://www.ryerson.ca/content/dam/cur/pdfs/TREB/CUR_Missing_Middle_Housing_Toronto.pdf
- 36 City of Toronto (2017). *Townhouse and Low-rise Apartment Guidelines*. <https://www.toronto.ca/wp-content/uploads/2018/01/964c-townhouse-low-rise-guidelines-02-2017.pdf>
- 37 Evergreen and Ryerson City Building Institute (2017). *Getting to 8,000*. <https://www.citybuildinginstitute.ca/download/6419>
- 38 Clayton, Frank. A and Cameron J. Macdonald (2017). *Why Are There Not More Townhouses Being Built in the Greater Toronto Area and What is the Outlook?* Centre for Urban Research and Land Development. https://www.ryerson.ca/content/dam/cur/pdfs/Projects/Why%20are%20there%20not%20more%20townhouses%20being%20built%20in%20the%20GTA%20and%20what%20is%20the%20outlook_2017.05.30%20.pdf
- 39 Lanescape and Evergreen (2017). *Laneway Suites: A New Housing Typology for Toronto*. <https://www.toronto.ca/legdocs/mmis/2017/te/bgrd/backgroundfile-104581.pdf>
- 40 City of Toronto (2019). Staff Report PH7.1: *Changing Lanes: The City of Toronto's Review of Laneway Suites - City-wide Expansion of City-Initiated Official Plan Amendment and Zoning Amendment - Final Report*. <http://app.toronto.ca/tmmis/viewAgendaItemHistory.do?item=2019.PH7.1>
- 41 City of Kitchener (2019). *New Zoning By-law (Stage 2a) - Residential Base Zones Comprehensive Review of the Zoning By-law (CRoZBy) Project*. https://www.kitchener.ca/en/resourcesGeneral/Documents/DSD_PLAN_DSD-19-233-CRoZBy-2a-Report.pdf
- 42 Parolek, Daniel and Karen Parolek (2018). *Why Form and Scale Matter in the Missing Middle Conversation*. Opticos online. Retrieved December 11, 2019 from <https://opticosdesign.com/blog/economics-form-scale-matter-missing-middle-housing-conversation/>
- 43 Collins-Williams, Mike and Cherise Burda (2015). *Make Way for Mid-rise: How to build more homes in walkable, transit-connected neighbourhoods*. Pembina Institute and Ontario Home Builders Association. <https://www.pembina.org/pub/make-way-for-mid-rise>
- Vijayakumar, Nithya and Mike Collins-Williams (2015). *Make Way for Laneway: Providing more housing options for the Greater Toronto Area*. Pembina Institute and Ontario Home Builders Association. <https://www.pembina.org/pub/make-way-for-laneway>
- 44 City of Mississauga (2017). *Making Room for the Middle: A Housing Strategy for Mississauga*. https://www7.mississauga.ca/documents/pb/main/2017/DRAFT_AffordableHousingStrategy.pdf
- 45 Ryerson City Building Institute (2018). *Finding the Missing Middle in the GTHA*. <https://www.citybuildinginstitute.ca/portfolio/missing-middle/>
- 46 Ryerson Centre for Urban Research (2019). *Transit Nodes in Ontario have Untapped Development Potential*. https://www.ryerson.ca/content/dam/cur/CUR_Report_TransitOrientedDevelopments.pdf
- 47 Ryerson Centre for Urban Research (2019). *A Strategy for Significantly Increasing the Supply of "Missing Middle" Housing in the City of Toronto*. https://www.ryerson.ca/content/dam/cur/pdfs/TREB/CUR_Missing_Middle_Housing_Toronto.pdf
- 48 Studio JCI (n.d.). *Multi-Tach*. Multi-Tatch online. Retrieved August 15, 2019 from <https://www.multitach.com>
- 49 Studio JCI (n.d.). *Multi-Tach*. Multi-Tatch online. Retrieved August 15, 2019 from <https://www.multitach.com>
- 50 City of Toronto (2019). *How Does the City Grow? June 2019*. <https://www.toronto.ca/legdocs/mmis/2019/ph/bgrd/backgroundfile-135021.pdf>
- City of Toronto (2017). *How Does the City Grow? April 2017*. <https://www.toronto.ca/wp-content/uploads/2017/10/9773-How-Does-the-City-Grow-April-2017.pdf>
- 51 mapTO online (April 28, 2017). *The Yellowbelt*. Retrieved December 6, 2019 from <http://www.mapto.ca/maps/2017/3/4/the-yellow-belt>
- 52 Metrolinx (April 10, 2019). *Transit Oriented Development Implementation*. Retrieved November 1, 2019 from http://www.metrolinx.com/en/docs/pdf/board_agenda/20190410/20190410_BoardMtg_TOD_Implementation_EN.pdf
- 53 City of Brampton (2019). *Mount Pleasant Village*. Retrieved November 8, 2019 from <https://www.brampton.ca/EN/Business/planning-development/projects-studies/Pages/Mount-Pleasant-Village.aspx>
- City of Brampton (2019). *Mount Pleasant Village: A New Transit-Oriented Neighbourhood in Brampton*. Retrieved November 8, 2019 from https://www.brampton.ca/EN/Business/planning-development/projects-studies/Documents/MPV_article_illustrated_Jan_2012.pdf
- City of Brampton (2010). *Mount Pleasant Secondary Plan Area 51*. Retrieved January 28, 2020 from <https://www.brampton.ca/EN/Business/planning-development/projects-studies/Documents/SP%2051.pdf>
- 54 Metrolinx (April 10, 2019). *Transit Oriented Development Implementation*. Retrieved November 1, 2019 from http://www.metrolinx.com/en/docs/pdf/board_agenda/20190410/20190410_BoardMtg_TOD_Implementation_EN.pdf
- 55 Metrolinx (2019). *Mimico GO Station*. Retrieved November 8, 2019 from <http://www.metrolinx.com/en/greaterregion/projects/mimico-go.aspx>
- 56 Metrolinx (March 7, 2019). *Woodbine ponies up for new GO station near race track*. Retrieved November 8, 2019 from <https://blog.metrolinx.com/2019/03/07/woodbine-ponies-up-for-new-go-station-near-race-track/>
- 57 City of Mississauga (2019). *Reimagining the Mall*. Retrieved November 22, 2019 from <https://yoursay.mississauga.ca/reimagining-the-mall>
- 58 Scorgie, Blair (2019). "Dissecting Official Plan Amendment 320." *House Divided: How the Missing Middle will solve Toronto's affordability crisis*. Bozickovic, Alex, Cheryl Case, John Lorinc and Annabel Vaughan. Toronto: Coach House Books. Pp. 140.
- 59 Burda, Cherise and Mike Collins-Williams (2015). *Make Way for Mid-rise. Pembina Institute and Ontario Home Builders Association*. <https://www.pembina.org/reports/make-way-for-mid-rise.pdf>

- 60 Scorgie, Blair and Sean Hertel (n.d.). *Density Transition Zones: Solution: Introduction*. Density Transition Zones online. Retrieved Sept. 11, 2019 from <https://www.transition-zones.com/introduction.html>
- 61 City of Minneapolis (2018). *Minneapolis 2040: The City's Comprehensive Plan*. <https://minneapolis2040.com>
- 62 City of Hamilton (2018). *City of Hamilton By-Law No. 18-To Amend Zoning By-law No. 05-200 Respecting Downtown Zones & New Utility (U2) Zone*. <https://pub-hamilton.escribemeetings.com/filestream.ashx?DocumentId=152668>
- 63 Canadian Centre for Economic Analysis (2017). *Understanding the forces driving the shelter affordability issue: A linked-path assessment of housing market dynamics in Ontario and the GTHA*. <https://www.rccao.com/news/files/Affordability-Phase2-report.pdf>
- 64 Canadian Centre for Economic Analysis and Canadian Urban Institute (2019). *Toronto Housing Market Analysis: From Insight to Action*. <https://static1.squarespace.com/static/546bbd2ae4b077803c592197/t/5c5c92ae15fc0cc392edc40/1549570776033/CUIPublication.TorontoHousingMarketAnalysis.2019.pdf>
- 65 Bailey, Tetyana and Cheryl Case (2017). *Protecting the Vibrancy of Residential Neighbourhoods*. <https://cpplanning.ca/project-work>
- Micallef, Shawn (March 10, 2017). "In the shadow of the greenbelt it's all about sprawl: Micallef". *The Toronto Star*. <https://www.thestar.com/news/gta/2017/03/10/in-the-shadow-of-the-greenbelt-its-all-about-sprawl-micallef.html>
- 66 Bascaramurty, Dakshana and Caroline Alphonso (June 13, 2014). "Brampton's school system is experiencing growing pains". *The Globe and Mail*. <https://www.theglobeandmail.com/news/toronto/brampton-school-system-is-experiencing-growing-pains/article19160815/>
- 67 Mowat, D. et al. (2014). *Improving Health by Design in the Greater Toronto-Hamilton Area: A report of the Medical Officers of Health in the GTHA*. <https://www.peelregion.ca/health/resources/healthbydesign/pdf/moh-report.pdf>
- 68 Hanlon, M. et al. (2012). Exploring the relationship between population density and maternal health coverage. *BMC Health Services Research*, 12: 214.
- 69 Rechel, B. et al. (2016). Hospitals in rural or remote areas: An exploratory review of policies in 8 high-income countries. *Health Policy*, 120: 758-769.
- 70 Burda, Cherise, Alison Bailie and Graham Haines (2010). *Driving Down Carbon*. The Pembina Institute. <https://www.pembina.org/reports/driving-down-carbon-report.pdf>
- 71 Ryerson Urban Analytics Institute (2019). *How Parking Regulations Need to Evolve for high-rise Buildings: A new approach for emerging trends in transportation, housing, and the environment*. Residential and Civil Construction Alliance of Ontario. <http://www.rccao.com/research/files/RCCAO-Parking-Report-June2019.pdf>
- 72 Canadian Automobile Association (2017). *Driving Costs Calculator*. Retrieved October 17, 2019 from <https://carcosts.caa.ca/>
- 73 Canadian Urban Institute (2017). *Visualizing Density*. <https://static1.squarespace.com/static/58b48d3fd482e9ba70170d01/t/58d53742414fb51d9a4b9c85/1490368363238/Visualizing+Density-Screen.pdf>
- 74 Taylor, Zack (2008). *Shaping the Toronto Region, Past, Present, and Future*. Neptis Foundation. <https://www.neptis.org/publications/introduction/chapters/density-indicator-urban-form>
- 75 Canadian Urban Institute (2017). *Visualizing Density*. <https://static1.squarespace.com/static/58b48d3fd482e9ba70170d01/t/58d53742414fb51d9a4b9c85/1490368363238/Visualizing+Density-Screen.pdf>
- Province of Ontario (2017). *Growth Plan for the Greater Golden Horseshoe*. <http://placestogrow.ca/images/pdfs/ggh2017/en/growth%20plan%20%282017%29.pdf>
- 76 City of Mississauga (2017). *Making Room for the Middle: A Housing Strategy for Mississauga (Draft)*. https://www7.mississauga.ca/documents/pb/main/2017/DRAFT_AffordableHousingStrategy.pdf
- 77 Canadian Centre for Economic Analysis (2017). *Understand the forces driving the shelter affordability issue*. <https://www.cancea.ca/sites/economic-analysis.ca/files/Affordability%20Phase%20%20-%20final%20report.pdf>
- 78 Altus Group (2019). *2019 Canadian Cost Guide*. <https://www.altusgroup.com/resources/reports/canadian-cost-guide-2019>
- 79 Galante, Carol, Sara Draper-Zivetz and Allie Stein (2017). *Building Affordability by Building Affordably: Exploring the Benefits, Barriers, and Breakthroughs Needed to Scale Off-Site Multifamily Construction*. Turner Center for Housing Innovation. Retrieved August 30, 2019. http://turnercenter.berkeley.edu/uploads/off-site_construction.pdf
- 80 Burda, Cherise, Graham Haines and Claire Nelischer (2019). *Rethinking the Tower: Innovations for Housing Attainability in Toronto*. Ryerson City Building Institute. <https://www.citybuildinginstitute.ca/portfolio/rethinking-the-tower/>
- 81 Ontario Ministry of Natural Resources and Forestry, Ontario Ministry of Municipal Affairs (2017). *Ontario's Tall Wood Building Reference: A Technical Resource for Developing Alternative Solutions Under Ontario's Building Code*. https://files.ontario.ca/ontarios_tall_wood_building_reference.pdf
- 82 Bedford, Paul (2013). *Unlocking the Potential for mid-rise Buildings: Six Storey Wood Structures*. Building Industry and Land Development Association. <http://wood-works.ca/wp-content/uploads/Bedford-Report-Unlocking-the-Potential-for-mid-rise-Buildings-Six-Storey-Wood-Frame-2013-DRAFT.pdf>
- 83 Ryerson City Building Institute (2016). *Why parking is taking a back seat in many municipalities*. Ryerson City Building Institute online. Retrieved August 30, 2019 from <https://www.citybuildinginstitute.ca/2016/10/04/why-parking-is-taking-a-back-seat-in-many-municipalities/>
- Ryerson Urban Analytics Institute (2019). *How Parking Regulations Need to Evolve for high-rise Buildings: A new approach for emerging trends in transportation, housing, and the environment*. Residential and Civil Construction Alliance of Ontario. <http://www.rccao.com/research/files/RCCAO-Parking-Report-June2019.pdf>
- 84 City of Hamilton (2016). *Transit Oriented Corridor Zones - Wards 1-4*. Retrieved October 21, 2019 from <https://www.hamilton.ca/city-planning/official-plan-zoning-by-law/transit-oriented-corridor-zones-wards-1-4>
- 85 City of Markham (2016). *City of Markham Parking Standards By-law 28-97*. Retrieved October 21, 2019 from https://www.markham.ca/wps/wcm/connect/markham/866bcd3a-1a4a-4af3-b3c3-da8016a4856b/Bylaw-28-97.pdf?MOD=AJPERES&CONVERT_TO=url&CACHEID=ROOTWORKSPACE.Z18_2QD-4H901OGV160QC8BLCRJ1001-866bcd3a-1a4a-4af3-b3c3-da8016a4856b-mrL.TGS
- 86 City of Vaughan (2018). *Comprehensive Zoning By-law Number 1-88*. Retrieved October 21, 2019 from https://www.vaughan.ca/services/business/zoning_by-law_and_opas/188/bylaw1-88_2012_VOL_Dec.%203_2018.pdf
- 87 Freemark, Yonah (2019). Upzoning Chicago: Impacts of a Zoning Reform on Property Values and Housing Construction. *Urban Affairs Review*, 1-32.
- 88 Neighbors for More Neighbors (August 1, 2017). *How can Minneapolis improve its housing policy*. Retrieved October 21, 2019 from <https://medium.com/neighbors-for-more-neighbors/how-can-minneapolis-improve-its-housing-policy-ee142eae962a>

- 89 Metro Vancouver Housing (2019). *Metro Vancouver Housing 10-Year Plan*. Retrieved December 13, 2019 from http://www.metrovancouver.org/services/housing/HousingPublications/MV_Affordable_Housing_plan2019.pdf
- 90 City of Toronto online (2019). *Short-Term Rentals*. Retrieved December 13, 2019 from <https://www.toronto.ca/community-people/housing-shelter/rental-housing-standards/short-term-rentals/>
- 91 Evergreen and Ryerson City Building Institute (2017). *Getting to 8,000*. <https://www.citybuildinginstitute.ca/download/6419>
- 92 Canadian Centre for Economic Analysis and Canadian Urban Institute (2019). *Toronto Housing Market Analysis: From Insight to Action*. <https://www.toronto.ca/legdocs/mmis/2019/ph/bgrd/backgroundfile-124480.pdf>
- 93 Evergreen and Ryerson City Building Institute (2017). *Getting to 8,000*. <https://www.citybuildinginstitute.ca/download/6419>
- 94 Environmental Commissioner of Ontario (2019). *A Healthy, Happy, Prosperous Ontario: Why we need more energy conservation: 2019 Energy Conservation Progress Report*. <https://docs.assets.eco.on.ca/reports/energy/2019/why-energy-conservation.pdf>
- 95 VandeWeghe, Jared R. and Christopher Kennedy (2007). A Spatial Analysis of Residential Greenhouse Gas Emissions in the Toronto Census Metropolitan Area. *Journal of Industrial Ecology*, 11(2), 133-144. <https://ssrn.com/abstract=2236025>
- 96 Burda, Cherise, Mike Collins-Williams and Alicia Kingdon (2016). *Suburbs on Track: Building transit-friendly neighbourhoods outside the Toronto core*. Retrieved December 13, 2019. <https://www.citybuildinginstitute.ca/portfolio/suburbs-on-track/>
- 97 City of Vancouver (2016). *Zero Emissions Building Plan*. <https://vancouver.ca/files/cov/zero-emissions-building-plan.pdf>
- 98 City of Toronto (2019). *TransformTO Climate Action Strategy*. <https://www.toronto.ca/services-payments/water-environment/environmentally-friendly-city-initiatives/transformto/transformto-climate-action-strategy/>
- 99 City of Vancouver (2016). *Policy Report: Zero Emissions Building Plan*. Pp. 4. <https://council.vancouver.ca/20160712/documents/rr2.pdf>
- 100 City of Vancouver (2016). *Policy Report: Zero Emissions Building Plan*. <https://council.vancouver.ca/20160712/documents/rr2.pdf>
- 101 City of Vancouver (2016). *Policy Report: Zero Emissions Building Plan*. <https://council.vancouver.ca/20160712/documents/rr2.pdf>
- 102 City of Vancouver online (n.d.). *Zero Emissions Buildings*. Retrieved November 22, 2019 from <https://vancouver.ca/green-vancouver/zero-emissions-buildings.aspx#resources>
- 103 City of Vancouver (2018). *Green Buildings Policy for Rezonings*. <https://guidelines.vancouver.ca/G015.pdf>
- 104 City of Vancouver (2018). *Zero Emissions Buildings Catalyst Policy*. <https://guidelines.vancouver.ca/Z001.pdf>
- 105 Ewing, R. and F. Rong. (2008). The impact of urban form on U.S. residential energy use. *Housing Policy Debate*, 19(1), 1-30.
- 106 Upton, B., R. Miner, M. Spinney and L. S. Heath (2008). The greenhouse gas and energy impacts of using wood instead of alternatives in residential construction in the United States. *Biomass and Bioenergy*, 32(1), 1-10.
- 107 Upton, B., R. Miner, M. Spinney and L. S. Heath (2008). The greenhouse gas and energy impacts of using wood instead of alternatives in residential construction in the United States. *Biomass and Bioenergy*, 32(1), 1-10.
- 108 J.L. Skullestad, R.A. Bohne and J. Lohne (2016). High-rise timber buildings as a climate change mitigation measure – a comparative LCA of structural system alternatives. *Energy Procedia*, 96, 112-123.
- 109 Ryerson City Building Institute (May 13, 2019). *Net-Zero House Tackles Affordability And Sustainability: Cheryl Atkinson*. Retrieved February 20, 2019 from <https://www.citybuildinginstitute.ca/2019/05/13/net-zero-house-tackles-affordability-and-sustainability/>
- Dodge, David (March 23, 2015). “Welcome to Canada’s First Net-Zero Commercial Building”. *The Huffington Post*. https://www.huffingtonpost.ca/david-dodge/net-zero-building-canada_b_6921036.html
- 110 Urban Resilience Program (2018). *Ten Principles for Building Resilience*. Urban Land Institute. Retrieved November 22, 2019 from https://americas.uli.org/wp-content/uploads/sites/2/ULI-Documents/10P_BuildingResilience.pdf
- 111 Ryerson Urban Analytics Institute (2019). *How Parking Regulations Need to Evolve for high-rise Buildings: A new approach for emerging trends in transportation, housing, and the environment*. Residential and Civil Construction Alliance of Ontario. <http://www.rccao.com/research/files/RCCAO-Parking-Report-June2019.pdf>
- 112 Anderson, Michael (June 7, 2019). *A Duplex, a Triplex and a Fourplex Can Cut a Block’s Carbon Impact 20%*. Sightline Institute. Retrieved July 3, 2019 from <https://www.sightline.org/2019/06/07/a-duplex-a-triplex-and-a-fourplex-can-cut-a-blocks-carbon-impact-20/>

