CHAPTER 2

Energy Transitions

Brampton's Urban & Energy Evolution

KEY TAKEAWAYS

- Climate change is one of many reasons to develop a Community Energy and Emissions Reduction Plan. Another reason is ensuring Brampton is well positioned to manage the opportunities and risks associated with the modern energy transition underway.
- Energy transitions are not new - Ontario has already experienced two energy transition since European settlement: 1) the wide use of coal and steam power, and 2) the move to centralized energy systems and use of fossil fuels. Both brought on significant economic growth and quality of life improvements.
- Brampton's reliance on a centralized energy system results in the loss of significant local economic opportunities. Today, Brampton spends over $1.8 billion on its energy as a community, and almost 80% of those energy dollars leave the city to support the economic development of other communities that house power plants and refineries.
- The growing reliance on fossil fuels in these centralized systems is also contributing to the current global climate emergency. Today, Ontario relies on fossil fuels to meet 75% of its energy needs associated with electricity, natural gas, and gasoline and diesel.
- The latest global energy transition is being driven by two main factors: decarbonization and the localized distribution of energy.
- Urbanization has been a driving force of shaping Ontario's and Brampton's energy systems and use.
- Seen through an energy lens, the Brampton 2040 Vision is a community energy plan. The CEERP supports the Vision, providing a roadmap that takes us steps closer to achieving it.
- Community energy planning involves establishing local priorities for reducing energy use and energy-related emissions through approaches such as distributed energy systems, decarbonization of energy sources, energy technologies, green infrastructure, sustainable transportation options, well-designed complete communities, and local jobs.
- A full glossary of terms is available at the beginning of this report. Some of the key terms used in this chapter include: Energy Transition, Latest Energy Transition, Centralized Energy Systems, Decentralized/Distributed Energy Systems, and Urbanization.

Looking east on Queen St. at Main St. [1]

2.0 Energy Transitions

Climate change is one of many reasons to undertake a community energy plan. Another reason is ensuring Brampton is positioned to manage the risks and opportunities associated with the latest energy transition.

The last two centuries have seen several energy transformations in Ontario and Brampton. Each time, the resulting impact on the life of citizens and businesses has been immense. Evidence of these transformations can be seen in Brampton's urban and natural environment.

2.0.1 History of Energy Transitions in Ontario

Energy transitions are not new, and Ontario has experienced two major energy transitions since European settlement.[2]

Indigenous Peoples Relationship with Energy[3,4]

The relationship the Indigenous peoples in Ontario had with energy before European settlement varied greatly between tribes, however, relationships were closely tied to the land and its practical application to survival. In its many sources and applications, energy use often had deeply ingrained cultural and spiritual significance.

In its application for livelihood, fire was often utilized for heat to stay warm, cooking, and the preservation of food through smoking. The type of sources of fuel used for each application was shaped by generations of knowledge and observations, and was often guided by spiritual traditions and teachings.

Fire also greatly impacted the landscape, significantly affecting the location and type of resources available. Indeed, there are indications that certain tribes may have used fire intentionally to modify or manage their landscapes and resources. Other sources of energy came through the use of existing resources and systems already naturally present, such as using rivers for transportation, or dogs to help carry loads.

The area known as Brampton today is the traditional territories of the Anishinabek, Huron-Wendat, Haudenosaunee, and Ojibway/Chippewa.

Pre-industrial Energy System

Early European settlers in Upper Canada relied on a pre-industrial system for their energy comprised primarily of burning wood for heat, using work animals, and harnessing the movement of water to grind grain and saw logs.

The reliance on wood for fuel and building material was one of the causes behind Brampton losing almost 90% of its woodland cover by the early 1900s. Today, some of the traditional territories of remnants of this pre-European landscape are found in Brampton's valleys and woodlands.

Reliance on animal and human power also resulted in walkable hamlets that formed the basis of economic and social centres for local residents.

First Energy Transition: Coal and Steam Power

The first energy transition in Ontario and Brampton was fueled by the introduction of coal-fired steam engines in the mid-1800s. By the end of the 1800s, U.S. coal and local steam engines powered most of Ontario's industrial growth.

The introduction of steam engines and railroads offered economic and social opportunities and challenges to Brampton's hamlets. Goods, once produced for local markets, could now be imported from large urban centres and the world. Brampton's cut-flower industry was quick to seize this opportunity to become the Common Wealth's largest producer of cut roses, leading Brampton to be known as the Flower Town.

However, by the turn of the century rising coal prices and coal shortages were threatening local prosperity. Municipal politicians and boards of trade began to turn their attention towards the promise of a new energy technology - electricity.

Second Energy Transition: Centralized Electricity and Fossil Fuels

The first time the movement of water was used to produce electricity in Canada was at Chaudière Falls in 1881, which powered streetlights and local mills in Ottawa. Subsequently, electricity companies sprung up across Ontario. By the early 1900s, most of Ontario's electrical systems were owned by municipal governments eager to expand service to more homes and businesses. Demand for electricity increased and to meet that need, 14 Ontario towns formed the "Power for the People" movement. These local leaders were instrumental in the formation of the Hydro-Electric Power Commission of Ontario. Sir Adam Beck, the commission's first chairman, was an early champion of centralized power as the Mayor of London, Ontario. Abundant and cheap hydroelectric power from Niagara arrived in Ontario homes for the first time in 1910.


MrMurchy Mill

Brampton received electricity for the first time in 1886 when a 2,200 volt electrical line was built to connect downtown Brampton to the McMurchy woolen mill and generating station along the Credit River in Huttonville, lighting the first electrical street lamp in Brampton.

The centralization of electricity came to Brampton in February 1912, when Brampton taxpayers voted to allow the Hydro-Electric Power Commission to purchase Mr. McMurchy's rights to the electricity supply in Brampton "to prevent needless competition". This move led to the creation of the Brampton Hydro-Electric Power Commission.

Another key aspect of this second energy transition was the availability of fossil fuels. In the late 1800s, Brampton used natural gas to light its streets and coal to heat homes. It wasn't until the late 1950s that engineering breakthroughs facilitated the widespread use of natural gas for home heating and industry. Today, the majority of homes in Brampton use natural gas as their primary source of heating.

The widespread availability of fossil fuels also supported the monumental growth in the use of personal automobiles in the 20th century. The introduction of the personal automobile led to a significant transformation of the built environment, creating communities focused around the use of a car.

District Heating Powers Flower Town[5]

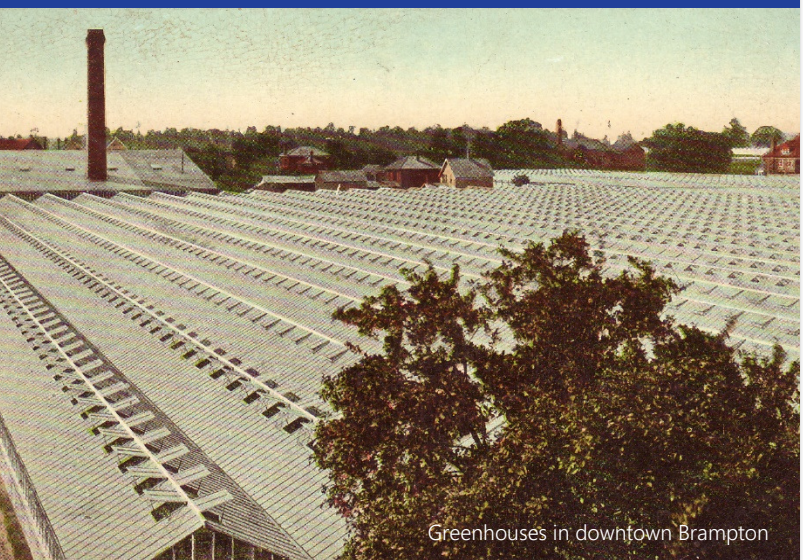
From 1915 to 1960, Brampton was known internationally as "The Flower Town of Canada". During this time there were over 48 nurseries in Downtown Brampton devoted to growing hothouse flowers. The Dale Estate was known as having the third largest number of greenhouses in the world.

To heat these greenhouses, the growers joined forces to build Brampton's first district heating system, which relied on a network of underground pipes and shafts to deliver heat to the greenhouses.

At its peak, the district heating system required approximately 6,000 to 19,000 tons of coal annually. Some estimates suggest there were over 100 miles of steam pipes under Brampton.

A 300-foot chimney, once a local landmark, was constructed for this heating plant to push the coal fumes high into the air.

In addition, several homes were added to the system including the Dale homes. Altogether, a total of 15 homes were heated by the district heat system.
In the years after WWII, the company converted the boilers to oil. This transition was more efficient and improved Brampton's air quality. At this time seven boilers were installed, burning 15,000 gallons of oil daily, or approximately three million gallons a year, with a capacity of 7000 HP.



Greenhouses in downtown Brampton

With each energy transition, communities have become less involved and less aware of where their energy comes from and how it is produced. Each energy transition resulted in changes to the urban landscape as increased energy inputs allowed cities to grow, gave people more freedom to travel more frequently and farther, and provided businesses the ability to trade over wider distances.

Ontario's Current Energy System

The result of the last energy transition has been a complete centralization of Ontario's current energy system. In Brampton, electricity, home heating, and gasoline are produced elsewhere in a centralized power station or refinery and distributed to the city through a network of wires and pipelines.

This centralization of power has powered both Ontario's and Brampton's economic and urban growth, but reliance on fossil fuels is also contributing to the current global climate emergency. Today, Ontario relies on fossil fuels to meet 75% of its energy needs associated with electricity, natural gas (home heating) and gasoline and diesel (cars and trucks).

In addition, Brampton's reliance on this centralized system results in the loss of significant local economic opportunities. In the past, energy production required local businesses and workers, which fed the local economy. Today, almost 80% of Brampton's energy dollars leave the city to support the economic development of other communities that house power plants and refineries.

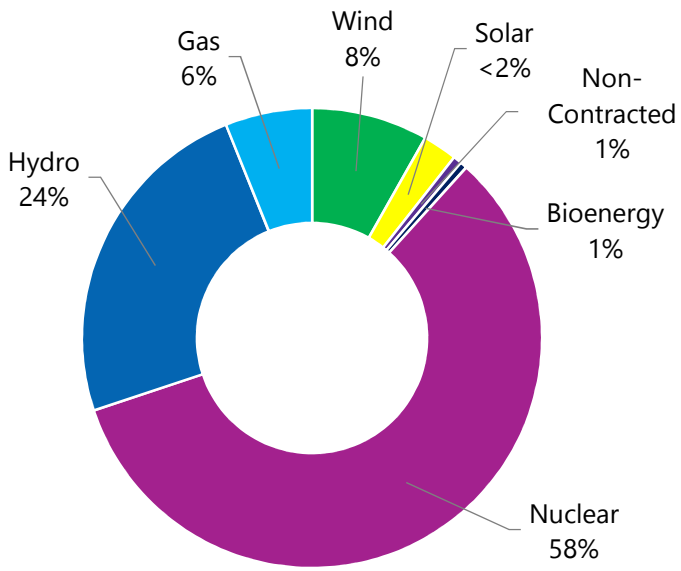
Electricity

Approximately 90% of Ontario's electricity comes from non-GHG emitting sources. In 2019 Ontario's electricity generation mix was 58.2% nuclear, 24% hydro, 6.1% natural gas, 8.2% wind, 2.5% solar, <1% biofuel and <1% non-contracted (uncategorizable). However, up until the 1950s, Ontario's electricity system was almost 100 percent renewable hydroelectric power.[6,7]

The centralization of the electricity system and the introduction of non-renewable energy sources (i.e. fossil fuel and nuclear) to meet the demands of increasing population, industrialization and urbanization has had two consequences:

1. the creation of waste by-products, including GHG emissions and nuclear waste; and
2. increased system losses from conversion and transmission.

2019 Ontario's Electricity Generation by Fuel Type [8] [9]



Nuclear	90.4 TWh
Hydro	37.2 TWh
Wind	12.7 TWh
Natural Gas	9.5 TWh
Solar PV	3.7 TWh
Bioenergy	0.8 TWh
Non-Contracted	0.9 TWh

In 2014, Ontario completed the closure or conversion of all coal-fired power plants to natural gas, which resulted in several environmental and health benefits, including a significant reduction of GHG emissions.[10] It also resulted in cleaner air. For example, in 2005, there were 53 smog days recorded in Toronto, but ten years later, in 2015 with comparable temperatures, there were none recorded.[11]

Natural gas

Natural gas is a non-renewable energy source that is used primarily to heat homes and domestic water. It is also a primary energy source for industrial steam and process heat. As noted above, about 29% of Ontario's electricity generation currently comes from natural gas.

Most of Ontario's natural gas comes from outside the province, mainly from western Canada, and has been delivered by interprovincial pipelines since 1958. Natural gas used for home heating and industrial processes is a major contributor to GHG emissions in the Greater Toronto Area (GTA).

Gasoline and diesel

Gasoline and diesel are nonrenewable sources of energy that are primarily used as engine fuel for various types of transportation vehicles. In Brampton, automobiles are used for over 80% of trips in the city, including commuting to work and to the grocery store.

Gasoline and diesel used in the transportation sectors are mostly sourced from crude oil, almost all of which come from outside Ontario, exported from western Canada, the Atlantic offshore, and the United States. Gasoline and diesel use in cars and trucks is a significant contributor to GHG emissions in Brampton and the GTA.

Brampton's Energy Milestones

1873

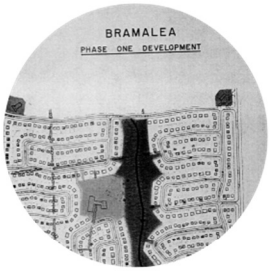
Brampton is incorporated as a town. Most homes are heated by local wood or coal imported from the United States. Streetlights were powered by natural gas. Transportation was mostly by foot, but richer residents might use a horse or bike.

1886

Electricity arrives in Brampton when a 2,200 volt electrical line was built to connect downtown Brampton to the McMurchy woolen mill and generating station along the Credit River in Huttonville.

Early 1900s

Brampton sees its first district heating system to heat the ever-growing greenhouses in the town. By 1929, the district heating system had approximately 160 km of steam pipes, six furnaces, and used 18,000 tons of coal each year.



Early 1960s

Bramalea, one of Canada's first master planned communities, is developed. Marketed as a "new town", Bramalea was built with a mix of residential areas, commercial and industrial uses and green space, but most residents still had to primarily rely on their cars to commute to work.

1945

After World War II, urban sprawl begins in Brampton. New neighbourhoods are built to be car dependent and rely on large roads and highways. This was aided by the second energy transition that provided centralized energy systems and the wide availability of fossil fuels. Sprawl continues into the 21st century.

1912

Although electricity first came to Brampton in 1886, Brampton voted to become part of the Ontario Hydro-Electric Power Commission power grid. Can you spot Brampton on this old power grid map?

2019

Between 2015 and 2019, Brampton Transit ridership increases by 50% from 1.6 million to 2.4 million rides per month. Despite this, 80% of trips are taken by car.

2041

Brampton's population is projected to grow by 300,000 for a total of 900,000 by 2041. If the current suburban form is replicated to accommodate this growth, Brampton will face significant economic, social, and environmental issues.

2.1 The Latest Energy Transition

The latest energy transition is being driven by two main factors: decarbonization and localized distribution of energy. In some regions of the world, notably in Nordic countries, this energy transition has been going on since the 1970s. In other regions, such as North America, the transition commenced only in the last decade. According to the 2019 Global Trends in Renewable Energy Investment report, renewable energy capacity quadrupled across the planet over the last ten years.[12]

To take advantage of this latest energy transition, Canadian communities are beginning to assert themselves in energy planning. By being proactive, these communities are trying to get ahead of the energy transition to reap the associated economic, social, and environmental benefits.

2.1.1 Decarbonized Energy System

The primary driver of the latest energy transition is the changing social values that are increasingly demanding more efforts to reduce global GHG emissions. In 2019, Brampton Council joined almost 1,468 jurisdictions in 28 countries in declaring a climate emergency and recognizing the need to dramatically reduce GHG emissions in the next 10 to 20 years to keep global warming below 1.5°C. To meet this goal, the energy transition needs to include a deep decarbonization of the energy system, which involves shifting away from the use of GHG-emitting fuels (e.g. gasoline, natural gas, coal) and towards the consumption of carbon neutral fuels (e.g. wind, solar, nuclear, hydro).

Global energy demand has doubled since 1980 as populations grow, nations develop, and fuels become more accessible and tradable. Global carbon emissions have increased by 52% in the past 25 years. Canada's emissions have increased by 33% over the same period.[13]

While Canada only generates 1.7% of global GHG emissions, the Organization for Economic Co-operation and Development (OECD) notes Canada's status as one of the most GHG emission-intensive economies in the world, and the fourth largest emitter of GHGs in the group of OECD nations. The Conference Board of Canada ranks Canada in last place compared to 17 peer countries for energy intensity, and assigns Canada a "D" grade for its energy intensity and GHG emissions.[14]

The Conference Board of Canada gives Ontario a grade of "B" with 12.6 tonnes of GHG emission per capita compared to the Canadian average of 20.7 tonnes of GHG emissions per capita. Since 2005, Ontario has reduced its GHG emissions by 22%, while the rest of Canada's emissions rose by 6%. Most of Ontario's GHG reductions can be attributed to the closing of coal plants.

However, being a leader in Canada does not mean that much, since Canada's energy use per Gross Domestic Product (GDP) is higher than the USA, European Union, and Japan. If Brampton wants to be a global leader in energy efficiency and reducing GHG emissions, it needs to adopt global best practices in energy production and efficiency. This will help the city realize significant competitive economic advantages, including competitive energy costs, energy reliability, and an increase in quality of life.

Carbon Dioxide Emissions per Capital[15]

Region	CO_2/Capita
USA	100
Canada	124
European Union	69
Japan	57
China	243
India	270
World	140

2.1.2 Distributed Energy Systems

The latest energy transition calls for more localized and renewable non-GHG energy sources. Distributed Energy Systems (DES) involve the local generation and operation of energy (e.g. solar panels on buildings, micro generators, heat waste power, district energy systems, etc.) often close or next to its point of use.

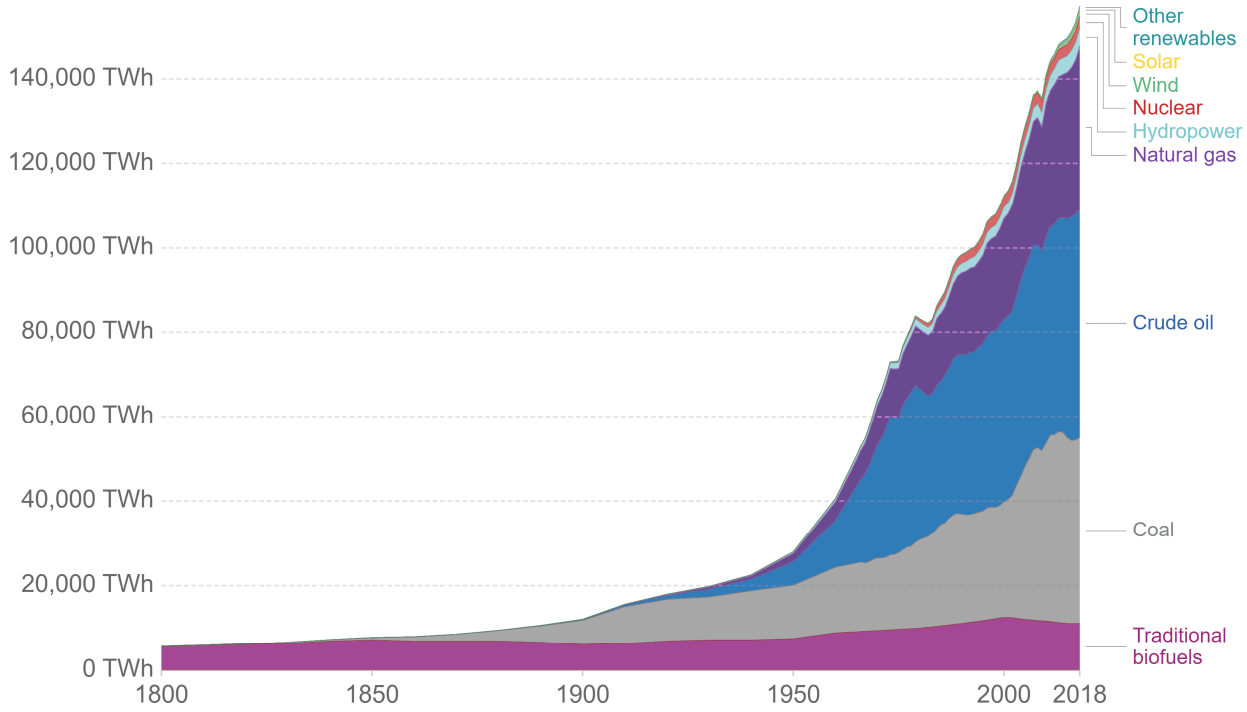
According to Ontario's Independent Electricity System Operation (IESO), "one of the most significant changes to electricity systems around the world has been the rapid expansion of distributed energy resources (DERs)".[16] DERs can include solar panels, combined heat and power plants, electricity storage, small natural gas-fueled generators, electric vehicles, and controllable loads, such as HVAC systems and electric water heaters.

IESO defines DERs as electricity-producing resources or controllable loads that are connected to a local distribution system or connected to a host facility within the local distribution system. These resources are typically smaller in scale than the traditional generation facilities that serve most of Ontario's demand.[17]

While the rise of Distributed Energy Systems is being driven by climate change concerns, a confluence of other developments are making the transition more feasible, such as:

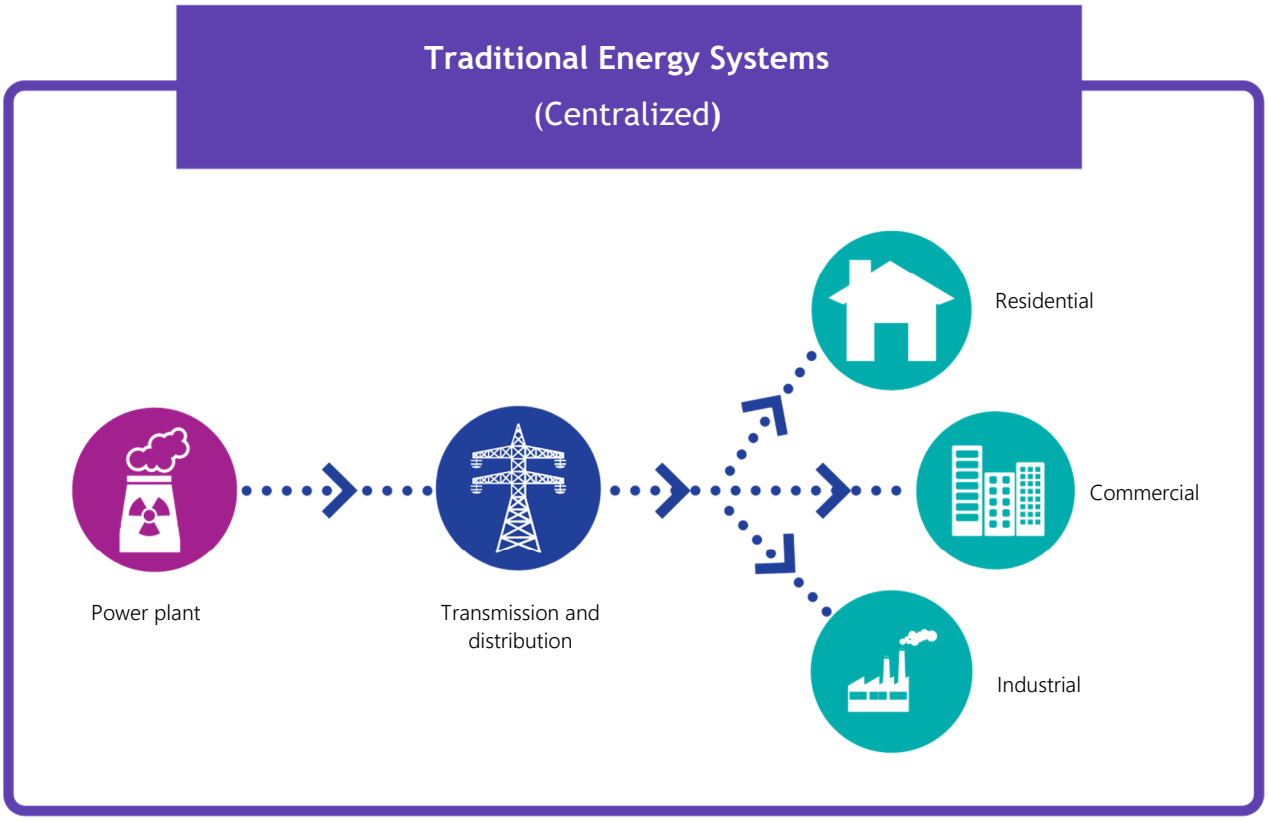
- a rise in cost-effective technologies for generating and distributing energy locally;
- the convergence of communication and energy technologies;
- systemic inefficiencies that have grown over time in our current centralized energy system; and
- growing concerns about energy security, which includes consumer issues of affordability, accessibility and reliability.

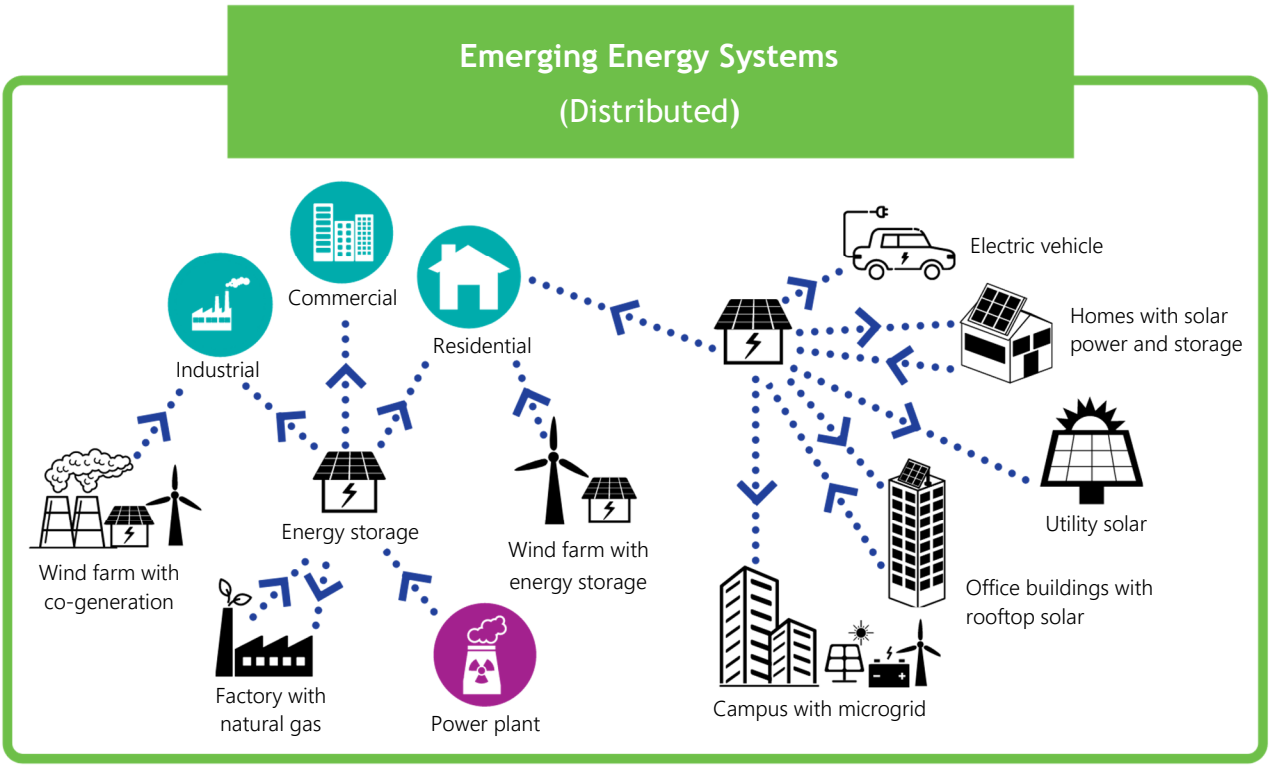
Growth in Global Primary Energy Consumption from 1800 to 2017 (Terawatt Hours per Year)[18]



Source: Vaclav Smil (2017) and BP Statistical Review of World Energy

Traditional Versus Emerging Energy Systems





2.1.3 Community Energy Planning

In some regions of the world, this next energy transition has been going on for 50 years, as the oil crises of the 1970s revealed how vulnerable world economies were to fluctuations in global oil supply. In Canada, this transition is just starting. In the last decade, over 400 Canadian communities have developed community energy plans that establish local priorities for reducing energy use and energy-related emissions.

Copenhagen, Denmark is one region that is considered a global leader in community energy planning. In 1973, Copenhagen exclusively relied on fossil fuels to heat its homes and drive its cars. Overnight, in October 1973, when the Organization for Arab Petroleum Exporter Countries declared an oil embargo, Copenhagen residents faced a substantial increase in home heating and transportation costs.

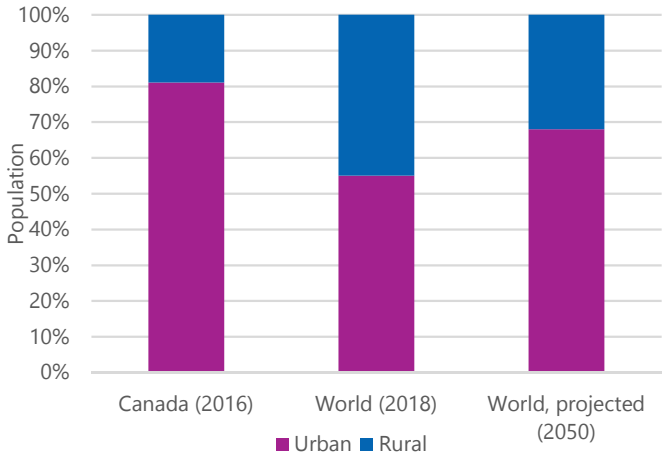
In response, Copenhagen focused its energy planning efforts on establishing a comprehensive district energy strategy and home insulation program. In addition, Copenhagen began to transform its transportation system, placing greater emphasis on sustainable modes of transportation like cycling and transit. Today, Copenhagen has set the goal of becoming the world's first carbon-neutral city by 2025.

Denmark and other Nordic countries are leaders in the latest energy transition, and are exporting their energy technologies and expertise around the world. In 2019, the City of Brampton hosted Nordic City Solutions to help inform the future development of Bramalea and Uptown Brampton urban centres. Nordic City Solutions is a public-private platform facilitated by the five Nordic governments of Denmark, Finland, Iceland, Norway, and Sweden.

The Nordic workshops, which looked at pursuing a path towards lower GHG emissions and a more energy conscious and resilient city, were part of a strategic partnership with the City of Brampton based on the Nordic strengths around sustainability and the Brampton 2040 Vision. Two key lessons for Brampton emerged from the workshops:

1. municipal governments have a key role in creating the conditions to accelerate the next energy transition; and
2. it is vitally important to engage businesses and citizens in planning, building, and operating the energy transition.

Proportion of Population Living in Urban Areas



2.2 Urbanization

Global urbanization is proceeding at an unprecedented rate. More than half of the world's population lives in urban centres. By 2050, it is expected to reach two thirds, and more urban areas and infrastructure will be built than currently exists.

Nationally, more than 8 out of 10 Canadians live in urban or suburban areas, and this ratio is expected to increase. By contrast, in 1851, nearly 9 out of 10 Canadians lived in rural areas. At that time, the Canadian economy was based more on the primary sector, led by agriculture and the exploitation of natural resources, such as wood or coal.[19]

Early Canadian communities were limited in size and wealth by their local energy resources. Typical communities relied on the surrounding forest for home heating and hydroelectric power from dammed rivers for industrial power.

To overcome these growth limits, communities began to search for alternatives, which usually meant importing external energy inputs. This search resulted in the first and second energy transitions described earlier. With a cheap infusion of imported coal, then centralized electricity and imported natural gas and gasoline, Canada experienced a dramatic increase in the size and shape of its communities.

In southern Ontario, hamlets, towns, and cities grew to become the sprawling modern Greater Toronto Area, with millions of citizens and jobs. The modern city is planned, designed, and constructed around a vast network of roads and highways to facilitate the movement of vehicles running on imported gasoline.

Eventually, all of this sprawling growth led to significant economic, social, and environmental impacts, including but not limited to congestion, intensive energy demands, loss of energy dollars, and a significant rise in GHG emissions.

2.2.1 Brampton's Urban History

Brampton was incorporated as a town in 1873. At the time, it mostly served as a service and retail area for the surrounding agricultural communities. Most homes were heated by local wood sources or coal imported from the United States. During this period, towns and cities were dirty places due to the burning of coal and wood to fuel local power plants and factories, and the use of wood stoves theat buildings.

To escape Toronto's foul air, wealthy residents fled to the outskirts and established Toronto's first suburbs, such as the Annex and Yorkville. This flight from Toronto's core was facilitated by new electric streetcars and bicycles.

The area known as Brampton today contained a bustling downtown and a dozen or so small hamlets that served local agricultural communities. Water was sourced locally, either from the ground or from a nearby river. If the river was large enough, it was dammed to produce energy for the local industry.

Almost all jobs at this time were locally accessible by foot, horse, or bicycle. Transportation between towns and cities was slow and uncomfortable.

After the Second World War, there was a drastic change in Brampton's hamlets and towns. The personal automobile gave residents the ability to live and work in separate, distant places. Single-family homes on large "green" lots were constructed to accommodate the post-war baby boom.

As it became widely adopted, and as the costs and infrastructure improved, the personal automobile offered city dwellers the opportunity to move away from their local job and the associated city smog for new "greener" suburbs.

In the early 1960s, the development of Bramalea commenced, Canada's first satellite city and one of the earliest master-planned communities. It was planned as an innovative "new town", a self-sustaining community outside the city. It was a community planned, designed, and constructed around widespread automobile use.

The automobile focused model of development expanded across Brampton and the Greater Toronto Area and was aided by the second energy transition that provided a

Edenridge Dr. in Bramalea, 1969.

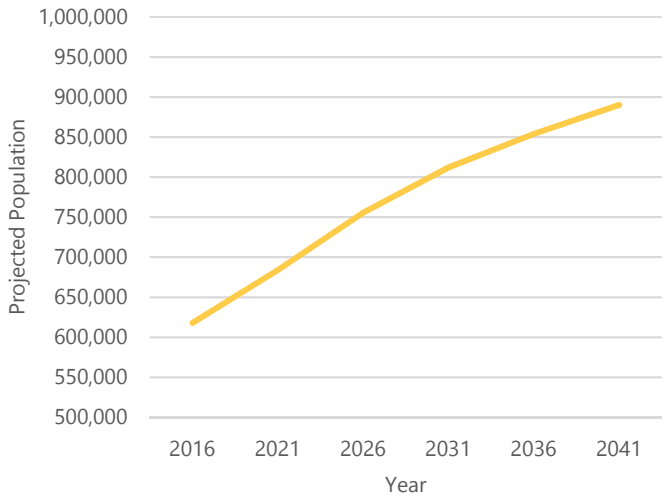
centralized electricity system and imported fossil fuels. The GTA transformed into a vast region containing sprawling communities connected by an immense network of roads with each city blending into each other.

Today, the GTA sprawls across 7000 km^2 and has a population of about 6 million. Within this vast region, Brampton is now 260 km^2 with a population of 600,000, and considered a modern suburban city characterized by the widespread use of the automobile, segregated land uses, low densities, and single-detached homes.

This postwar modern urban form is resulting in several economic, social, and environmental issues that threaten the future prosperity of this region and the globe. It is energy inefficient, costing each Brampton resident an average of $3000 in gasoline, electricity, and heating costs, annually. It is also responsible for 60% of Brampton's GHG emissions. According to a 2009 study by the OECD, the annual economic cost of congestion in the GTA is $3.3 billion. The financial impacts on the region ballooned by an additional $7.8 billion when productivity and health care costs were considered.[20]

By 2041, Brampton's population is projected to grow by 300,000 for a total population of 900,000. If the current urban form is continued to accommodate this growth, Brampton will be faced with significantly more economic, social, and environmental issues.

Brampton Population Forecast, 2016-2041[21]



Brampton 2040 Vision: Living the Mosaic

In 2017, Brampton's Council directed staff to look at the city in a more holistic approach to envision a future Brampton in 2040 and beyond. The City sought the expertise of Larry Beasley, a world renowned planner and global urban visionary, to develop a Vision for what Brampton will become in the next 20 years.

Developing the Brampton 2040 Vision involved the City's largest engagement campaign to date, which included over 90 engagement events such as an interactive website, targeted workshops/focus groups, participation at community events, a children's drawing contest, and two intensive public workshops.

Feedback from the community was foundational for transforming ideas into a vision. The Brampton 2040 Vision is a conceptual document that reflects the principles of the community and the objectives of what Brampton needs to achieve in order to become an innovative and forward thinking suburb.

Unanimously approved in 2018, the "Brampton 2040 Vision: Living the Mosaic" consolidates the aspirations of more than 13,000 members of the community who devoted their days, nights and weekends to participate in envisioning a future Brampton. This is a vision for the people, by the people.

Brampton 2040 Vision: Vision Statements

Notes

[1] Archival images sourced from the Peel Art Gallery, Museum & Archives, and the Toronto Public Library.

[2] Content for the section on Energy Transitions is largely drawn from the curriculum of the Energy Conscious Community: A Professional Development Course for Planners.

[3] Source: Miller, A.M and Davidson-Hunt, I. (2010). Fire, Agency and Scale in the Creation of Aboriginal Cultural Landscapes. Human Ecology 38:401-414. https://www.lakeheadu.ca/sites/default/files/uploads/53/outlines/2014-15/NECU5311/MillerDavidsonHunt_2010_HE_FireAgencyScale.pdf

[4] Source: Sayles, J. S., and Mulrennan M. E. (2010). Securing a future: Cree hunters' resistance and flexibility to environmental changes, Wemindji, James Bay. Ecology and Society 15(4): 22. https://www.ecologyandsociety.org/vol15/iss4/art22/

[5] Source: O'Hara, D. (2007). Acres of Glass: the Story of the Dale Estate and How Brampton Become "The Flower Town of Canada". Toronto: Eastendbooks.

[6] Source: The Conference Board of Canada. (2019). Powering Down Emissions: Case Studies of Electricity Generation in Three Provinces Report. https://www.conferenceboard.ca/e-library/abstract.aspx?did=10308

[7] Source: OEB. (June, 2020). Ontario's system-Wide Electricity Supply Mix: 2019 Data. Ontario Electricity Board. https://www.oeb.ca/sites/default/files/2019-supply-mix-data-update.pdf

[8] Source: OEB. (June, 2020). Ontario's system-Wide Electricity Supply Mix: 2019 Data. Ontario Electricity Board. https://www.oeb.ca/sites/default/files/2019-supply-mix-data-update.pdf

[9] Source: (OEB, 2020) Table and figure shows Ontario's 2019 system-wide generation in terawatt-hour – TWh.
Natural gas data: Includes Lennox and dual fuel (natural gas/bioenergy) consistent with IESO.
Bioenergy data: IESO's embedded generation data set combines biomass and gas.
Non-Contracted represents a variety of fuel types that the IESO is unable to categorize due to a lack of information from Local Distribution Companies (LDCs).
Note: Figure may not add to 100% due to rounding.

[10] Source: CAPE. (2017). "Ontario's Coal Plant Phase-out Produced Many Health and Environmental Benefits". CAPE. https://cape.ca/ontarios-coal-plant-phase-out-produced-many-health-and-environmental-benefits/

[11] Source: CBC News. (June 8th, 2017). "Smog study shows 'significant decreases' in pollutants in Ontario". CBC. Retrieved from: https://www.cbc.ca/news/canada/windsor/smog-study-shows-significant-decreases-in-pollutants-in-ontario-1.4151183

[12] Source: Frankfurt School – UNEP Collaborating Centre for Climate & Sustainable Energy Finance. (2019). Global Trends in Renewable Energy Investment 2019. https://www.fs-unep-centre.org/wp-content/uploads/2019/11/GTR_2019.pdf

[13] Source: National Energy Board. (2019). Historical and Future Changes to Energy Systems update. Federal Government of Canada. https://www.cer-rec.gc.ca/nrg/ntgrtd/mrkt/cndsnrgtrnstn/cndsnrgtrnstn-eng.pdf

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