Agenda
City Council Workshop
The Corporation of the City of Brampton

Friday, March 5, 2021

9:30 a.m.

Council Chambers - 4th Floor, City Hall - Microsoft Teams Meeting

Members:

Mayor Patrick Brown	
Regional Councillor R. Santos	Wards 1 and 5
Regional Councillor P. Vicente	Wards 1 and 5
City Councillor D. Whillans	Wards 2 and 6
Regional Councillor M. Palleschi	Wards 2 and 6
City Councillor J. Bowman	Wards 3 and 4
Regional Councillor M. Medeiros	Wards 3 and 4
City Councillor C. Williams	Wards 7 and 8
Regional Councillor P. Fortini	Wards 7 and 8
City Councillor H. Singh	Wards 9 and 10
Regional Councillor G. Dhillon	Wards 9 and 10

For inquiries about this agenda, or to make arrangements for accessibility accommodations (some advance notice may be required), please contact:
Peter Fay, City Clerk, Telephone 905.874.2172, TTY 905.874.2130
cityclerksoffice@brampton.ca

1. Roll Call

2. Workshop Session

Purpose:

To provide City Council with an update on:

(i) the electrification of the Brampton Transit Service and the status of the Hurontario LRT Extension Study, and

(ii) ongoing work to advance the City's 5G Hyper-Connectivity Options.

9:30 a.m. **Welcome and Introductory Remarks**

Alex Milojevic, General Manager, Brampton Transit

9:35 a.m. **Electrification of Brampton Transit**

Brampton Transit staff

Hurontario LRT Extension Study - Project Update

Brampton Transit staff

Q&A and Discussion

12:00 p.m. Recess

1:00 p.m. **Introductory Remarks**

Kumanan Gopalasamy, Chief Information Officer

1:05 p.m. **5G Hyper-Connectivity**

KPMG representatives

Q&A and Discussion

3:00 p.m. **Wrap-up and Adjournment**

Session and break times may vary depending on Council discussion.
This virtual Council Workshop will be livestreamed
and archived on the City's website for future public access.

3. Adjournment

GREENING THE TRANSIT FLEET

TOWARDS ELECTRIFICATION

Council Workshop

March 5, 2021

Brampton Transit

BRAMPTON

Brampton Transit

Brampton züm

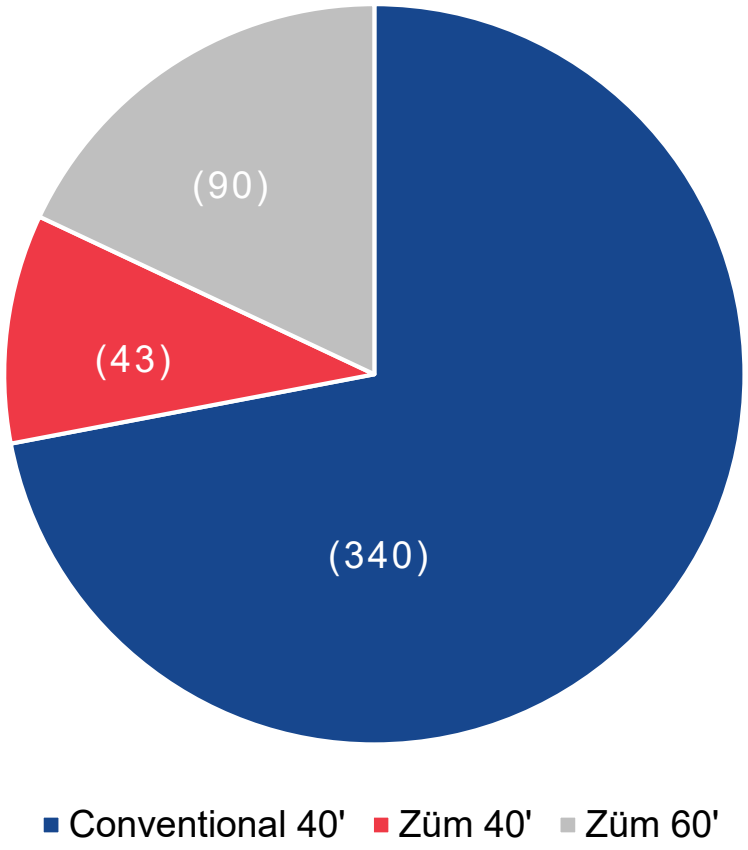
AGENDA

GREENING THE TRANSIT FLEET TOWARDS ELECTRIFICATION

01. Current & projected fleet
02. Bus deliveries (2020)
03. Pan-Canadian eBus trial
04. Federal policy landscape
05. Canada Infrastructure Bank (CIB)
06. Technology for Brampton
07. Analysis & roll out
08. New transit facility – electrification
09. Continuous Learning
10. Next Steps

Q&A

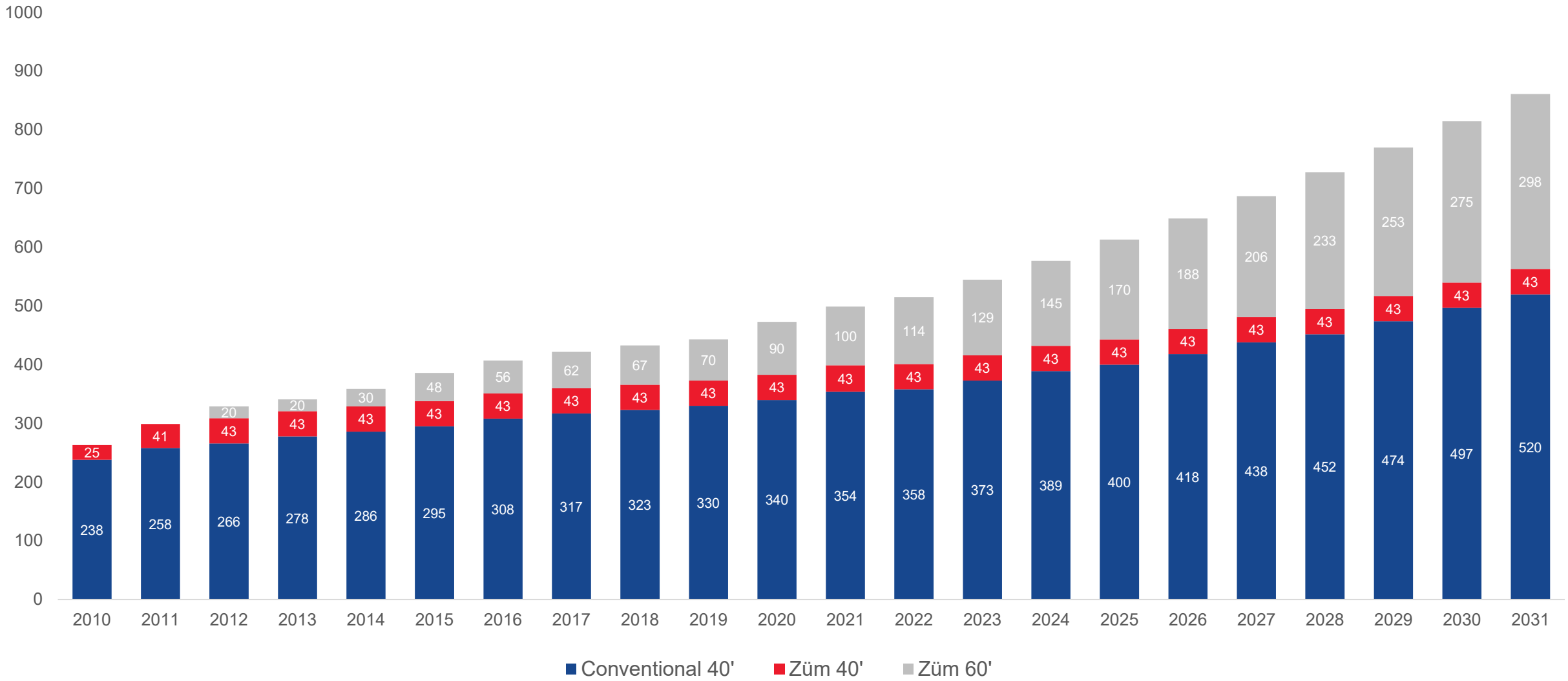
TRANSIT FLEET TODAY



HYBRID ELECTRIC: Züm	2010 = 133 Diesel-Electric Hybrid Buses
BATTERY ELECTRIC: CUTRIC Trial – Phase I	2021 = First 8 Battery-Electric eBuses

TRANSIT FLEET

(HISTORICAL & PROJECTED GROWTH)



BUS DELIVERIES

To maintain our replacement schedule and address growth related service expansion, in 2020 Brampton Transit received:

- 23 growth buses
- 13 replacement buses

City recently signed onto the City of Toronto's cooperative fuel procurement for supply and delivery of bio-diesel.

PHASE I

PAN-CANADIAN ELECTRIC BUS TRIAL

Brock University
York University
University of Windsor
University of Ontario Institute of Technology
UQTR Université du Québec à Trois-Rivières
St. Clair College
Centennial College
Red River College of Applied Arts, Science and Technology
Sheridan
Lambton College
Conestoga Connect Life and Learning

CUTRIC CRITUC
FASTER • SMARTER • GREENER
RAPIDE • INTELLIGENT • VERT

Natural Resources Canada / Ressources naturelles Canada
Canada

Brampton Transit
York Region Transit / VIVA
TransLink

Newmarket Hydro
Newmarket-Tay Power Distribution Ltd.

BC Hydro
Power smart

Support from: alectra
Discover the possibilities

New Flyer
Nova Bus
Driven by your city

ABB
SIEMENS

PHASE I

PAN-CANADIAN ELECTRIC BUS TRIAL

- Four (4) Battery Electric Buses
- Two (2) High-powered overhead chargers

- Eight (8) Battery Electric Buses
- Four (4) High-powered overhead chargers

- Six (6) Battery Electric Buses
- One (1) high-powered overhead charger

FEDERAL POLICY LANDSCAPE

- Federal ministerial mandate letters (December 2019)
  - ***Starting in 2023, ensure that new federal investments in public transit are used to support zero-emission buses*** *and rail systems and work with municipalities to address any exceptional circumstances.*
  - *Commit to working with provinces and territories to help school boards and municipalities purchase* ***5,000 zero-emission school and transit buses in the next five years.***
- Staff have participated in Clean Energy Canada consultations of industry experts for federal policy considerations, and OPTA/CIB consultation sessions.
- Government of Canada / Canada Infrastructure Bank announcement of $10B (October 1, 2020).

CANADA INFRASTRUCTURE BANK

GROWTH PLAN

$10 Billion

- Zero Emission Buses (ZEBs)
- Clean Power
- Energy Efficient Building Retrofits
- Large-scale Broadband Projects
- Agriculture-related Infrastructure

Supports Federal Mandate

- Growth electrification
- Purchase 5,000 zero-emission buses (2020-2024);
- Starting in 2023, new federal investments in public transit are used to support zero-emission buses.

Brampton-CIB MOU

- Non-binding Memorandum of Understanding
- Financing Agreement – Council/CIB approval

BRAMPTON DISCUSSIONS

Financing/Loan

- Differential cost between diesel bus and electric bus

Risk Mitigation

- Loan Repayment
- Other Funding

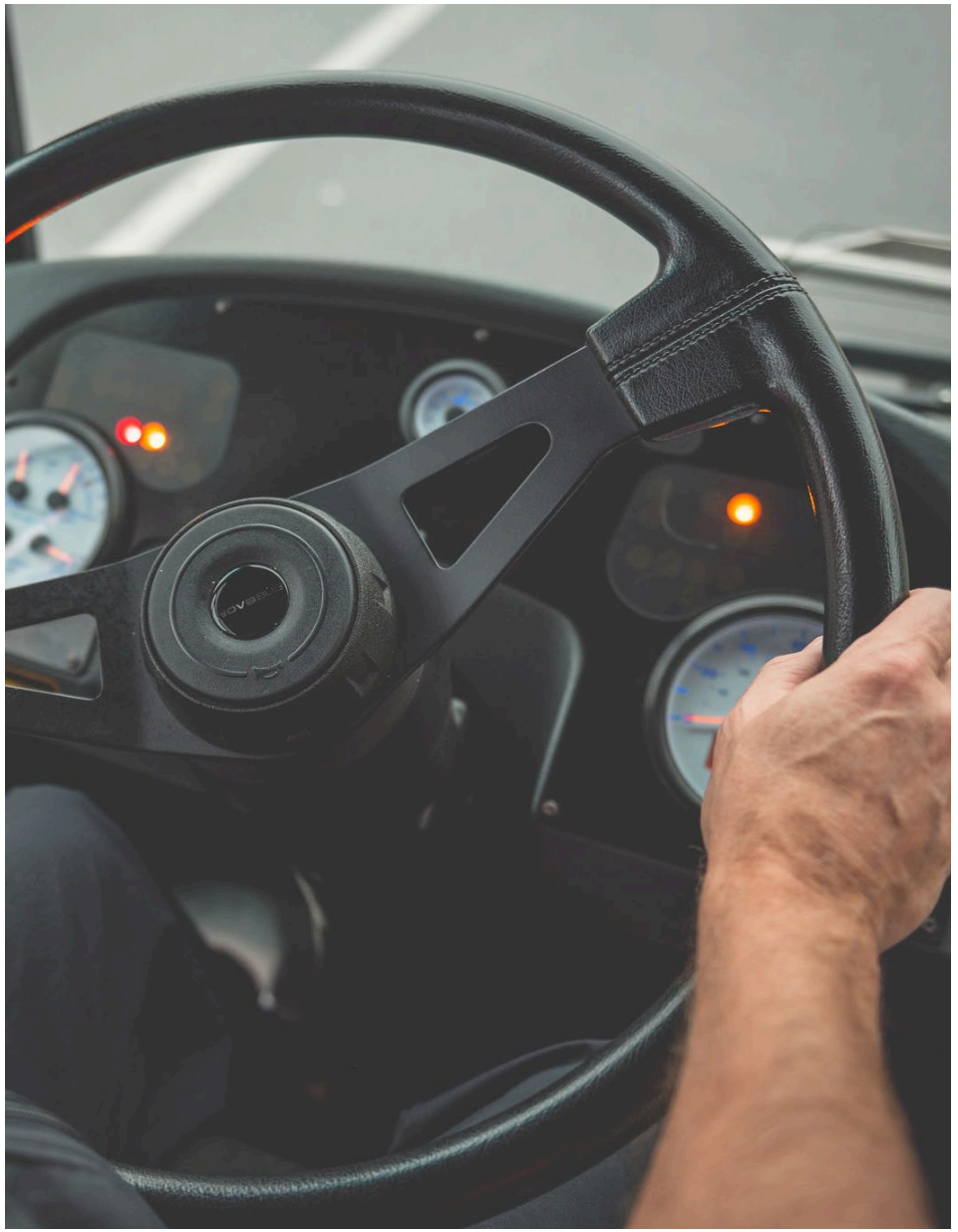
ZERO EMISSIONS BUSES

(ZEBs)

Q | Which ZEB technology is right for Brampton?

A | Based on what we know today, more than likely both BEB and FCEB (to be determined based on each route)

- BEBs, most proven technology in North America currently
- Two key studies to be completed to help determine our hybrid



ELECTRIC BUS TECHNOLOGY

	A	B	C	D
		Battery Electric Bus (BEB)		
	Diesel-Electric Hybrid	Opportunity (On-Street) Charging	Plug-In (In-Depot) Charging	Fuel Cell Electric Bus (FCEB)
				
Zero Tailpipe Emission	☒	☑		☑
Infrastructure (plus electricity costs)	N/A	8:1 	2:1 	50:1 
Interoperability Standards	N/A	☑		☑

ANALYSIS & ROLL OUT

Transit Network Fleet Electrification Feasibility Analysis*

- Where (routes) and What (ZEB technology: BEB & FCEB)
- Very detailed assessment: route by route/block by block

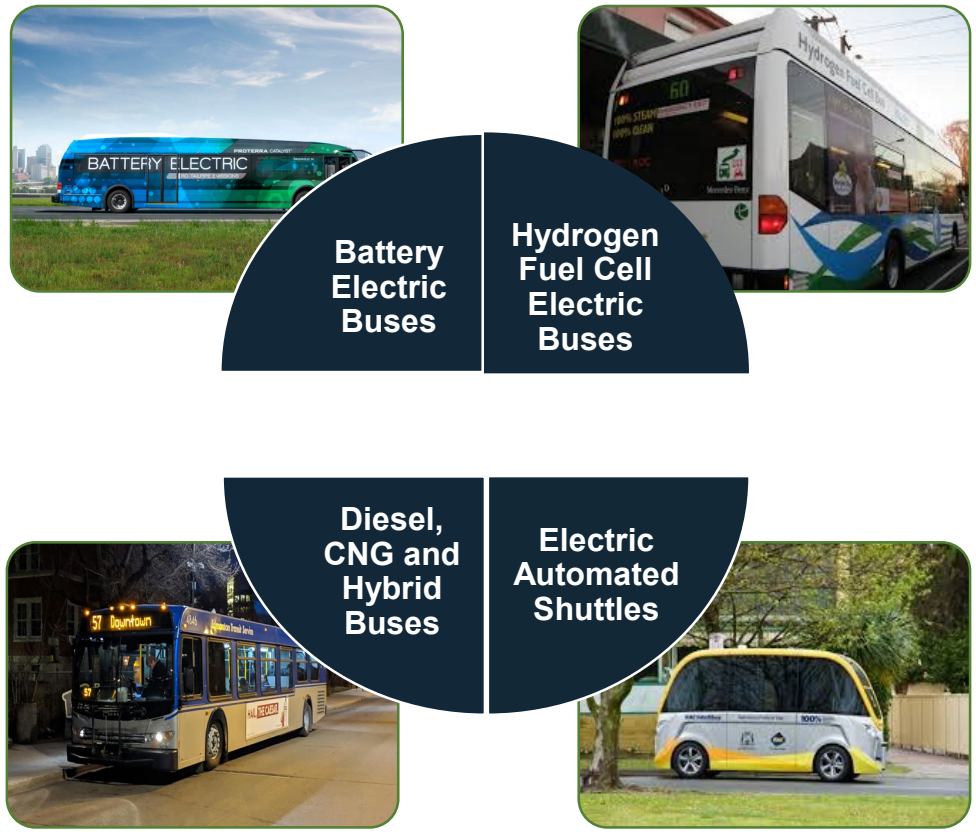
Transit Sustainable Fleet Strategy & Rollout Plan*

- When (fleet year-by-year) and How (funding/procurement plan)
- Costing Analysis and Budget Forecasting

* Approved by Brampton City Council on September 30, 2020.

CUTRIC's ROUT∑.i™ MODELLING FUNCTIONALITY

- Calculate actual electricity costs in local jurisdictions
- Predict state-of-charge (SOC) of battery onboard bus
- Predictively assess ZEB or AV shuttle energy consumption
- Predict performance success rates for ZEBs considering revenue and non-revenue operations
- Conduct downtime assessments for BEB charging (on route and depot) and FCEB fuelling



- Assess suitability of route/block/vehicles for electrification
- Make recommendations for BEB, FCEB, e-LSAs selection
- Locate optimal locations for opportunity chargers and fuelling stations
- Calculate actual GHG reduction from ZEBs, compared with fossil-fuel sources
- Assess the ease of electrification

THIRD TRANSIT FACILITY

PHASE I	250 bus capacity $204M
PHASE II	Additional 190 buses (total 440) $TBD
ELECTRIFICATION OF FACILITY	$150M*

*A rough order of magnitude costing estimate, subject to further feasibility review and detailed design.

THIRD TRANSIT FACILITY

(CONTINUED)

Key considerations required to electrify facility in support of a fully electric bus fleet operating from the new facility:

- Power requirements
- Charging equipment
- On-site energy storage

CONTINUOUS LEARNING

CUTRIC Pan-Canadian Trial:

Opportunity charging,
8 eBuses, 4 eChargers

Opportunity charging,
4 eBuses, 2 eChargers

Opportunity charging,
6 eBuses, 1 eCharger

Other Canadian Agencies:

Depot-charging, 3 garages, 30 buses
(10 each: New Flyer, Proterra, BYD)

Depot-charging using overhead chargers,
40 buses (2020; Proterra)

Depot-charging using overhead chargers,
60 buses (2020; 30 long-range, 30 quick-charge)

North American Peer-2-Peer (Quarterly):

Canada

USA

OVERVIEW – NEXT STEPS

- Transit Network Fleet Electrification Feasibility Analysis
- Transit Sustainable Fleet Strategy & Rollout Plan
- Financial Options
- Report back to Council

THANK YOU!

City of Brampton: LRT Extension Study Council Workshop

2021/03/05

Agenda

	Item	Presenter	Time Allotted
1	Introduction	Alex Milojevic	5 min
2	Hurontario LRT Update	Doug Rieger	5 min
3	LRT Extension Update	Compton Bobb/Nico Malfara	30 min
4	Questions		20 min

Hurontario LRT Update

Key Brampton Features

- Three LRT stops, including Ray Lawson, County Court and Brampton Gateway Terminal.

- The Operations, Maintenance and Storage Facility will be located within Brampton, on Kennedy Rd. south of Highway 407 ETR.

Background

The Hurontario LRT will bring 18 kilometres of fast, reliable, rapid transit between the Brampton Gateway Terminal and the Port Credit GO Station in Mississauga.

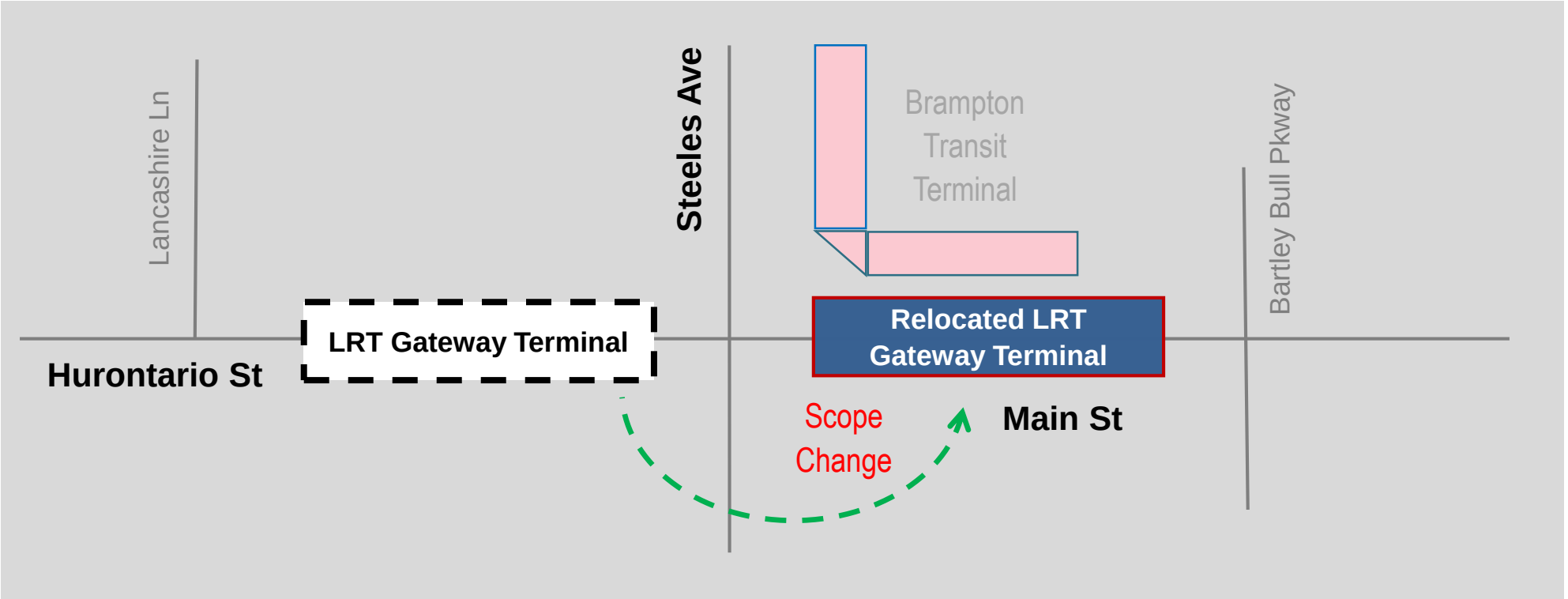
Current Status

- The design is in progress at various stages and some early works construction activities, such as utility relocations are in progress within the City.

- A tentative completion and commissioning of the system by fall of 2024.

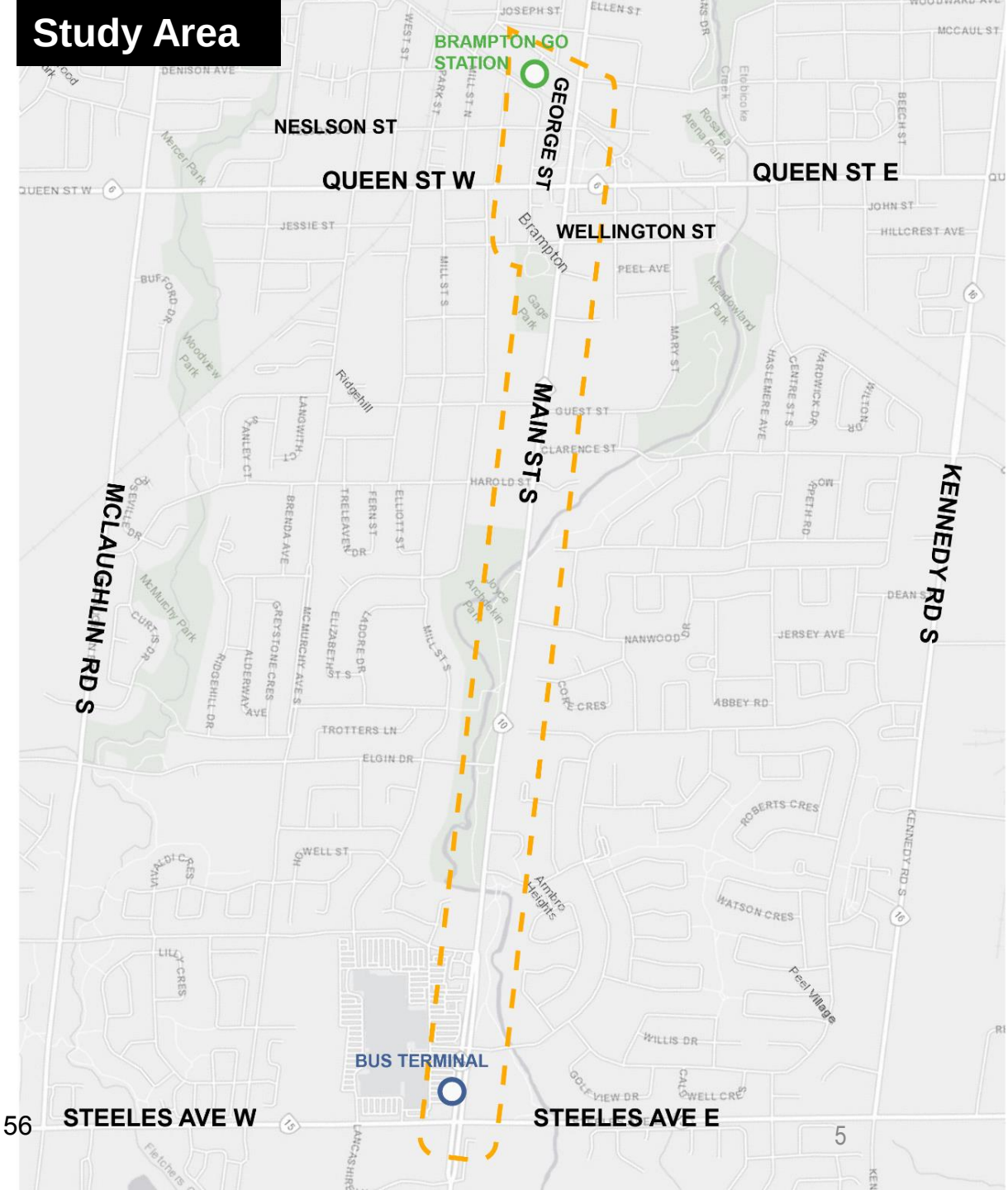
Hurontario LRT Update

- Brampton Gateway Hurontario LRT Stop Advocacy



LRT Extension Project Overview

Extending the planned Hurontario LRT from the Brampton Gateway Terminal at Steeles Avenue to the Brampton GO station is a key transit priority and city-building project for the City of Brampton.



Vision and Goals

Vision Statement

The LRT Extension will contribute to a safer and more integrated transportation system to serve the City of Brampton, encouraging civic sustainability, emphasizing transit use and other modes of transportation over traditional automobiles, and supporting the revitalization of Downtown Brampton into an aesthetically beautiful, place-making destination. The vision for the LRT Extension reflects the transportation vision and actions set out in the Brampton 2040 Vision (2018).

Goals

Strong Connections

Complete Travel Experiences

Sustainable and Healthy Communities

Problem Statement

The extension of the Hurontario LRT from Steeles Avenue to Brampton GO is intended to address the growth-related transportation needs in the study area and the City of Brampton.

In the Study Area…

Population is expected to increase by over **26,000** by 2041

Employment is expected to increase by over **13,000** by 2041

To meet the City's growing transportation needs, transit service along Main Street would need to increase by **40%**

If no improvements are made, average trip times will increase by **5%**

What We Heard from the Public and Stakeholders

- Expedite the project
- Minimize impacts to Main Street South and Downtown
- Provide expess service with fewer stops
- Create a transit hub at Brampton GO Station
- Support businesses and revitalize Downtown
- Retain heritage character and mature tree canopy on Main Street South
- Provide a pedestrian friendly environment and ease of transfer between travel modes
- Calm traffic along surrounding residential streets
- Protect for future northward extension
- Secure Provincial funding for the project

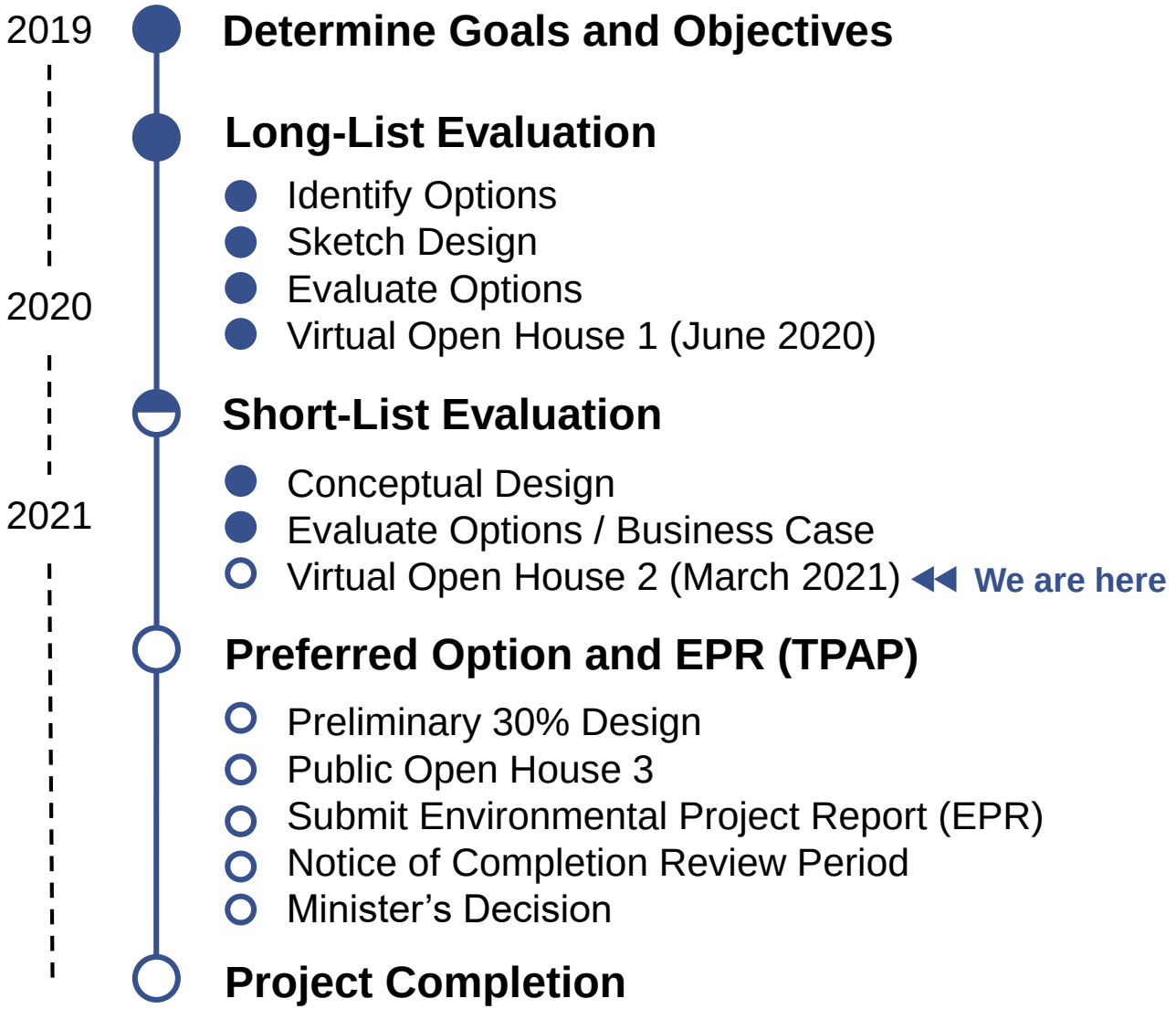
Study Process

The evaluation of options is a multi-level process that has occurred over the course of the study.

Through the three-level process, the long list of LRT options was evaluated and narrowed down to a short list. The short list was evaluated and is being presented at Virtual Open House 2.

The Transit Project Assessment Process (TPAP) is a provincial environmental assessment process developed specifically for the approval of public transit projects.

Proponents must complete the prescribed steps of the process within specified time frames.



Preliminary Design Business Case

The City of Brampton evaluated the short list options using the Metrolinx Business Case framework. A preliminary design business case (PDBC) was used to assess the short-listed options.

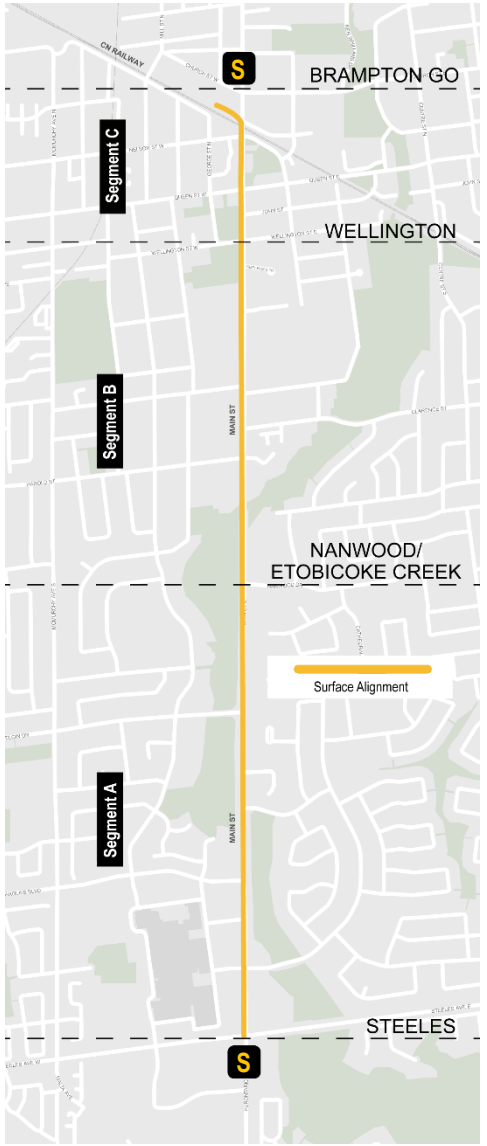
The analysis included four (4) business cases: Strategic, Economic, Financial, and Deliverability and Operations.

Short List of Options

Since the last virtual open house in Summer 2020, we've evaluated the short list options (four surface and two underground).

Note: The loop options presented in the previous open house were not advanced to the short list for further assessment due to physical constraints (i.e. issues accommodating longer LRVs / impacts to property).

4 Surface Options



2 Underground Options

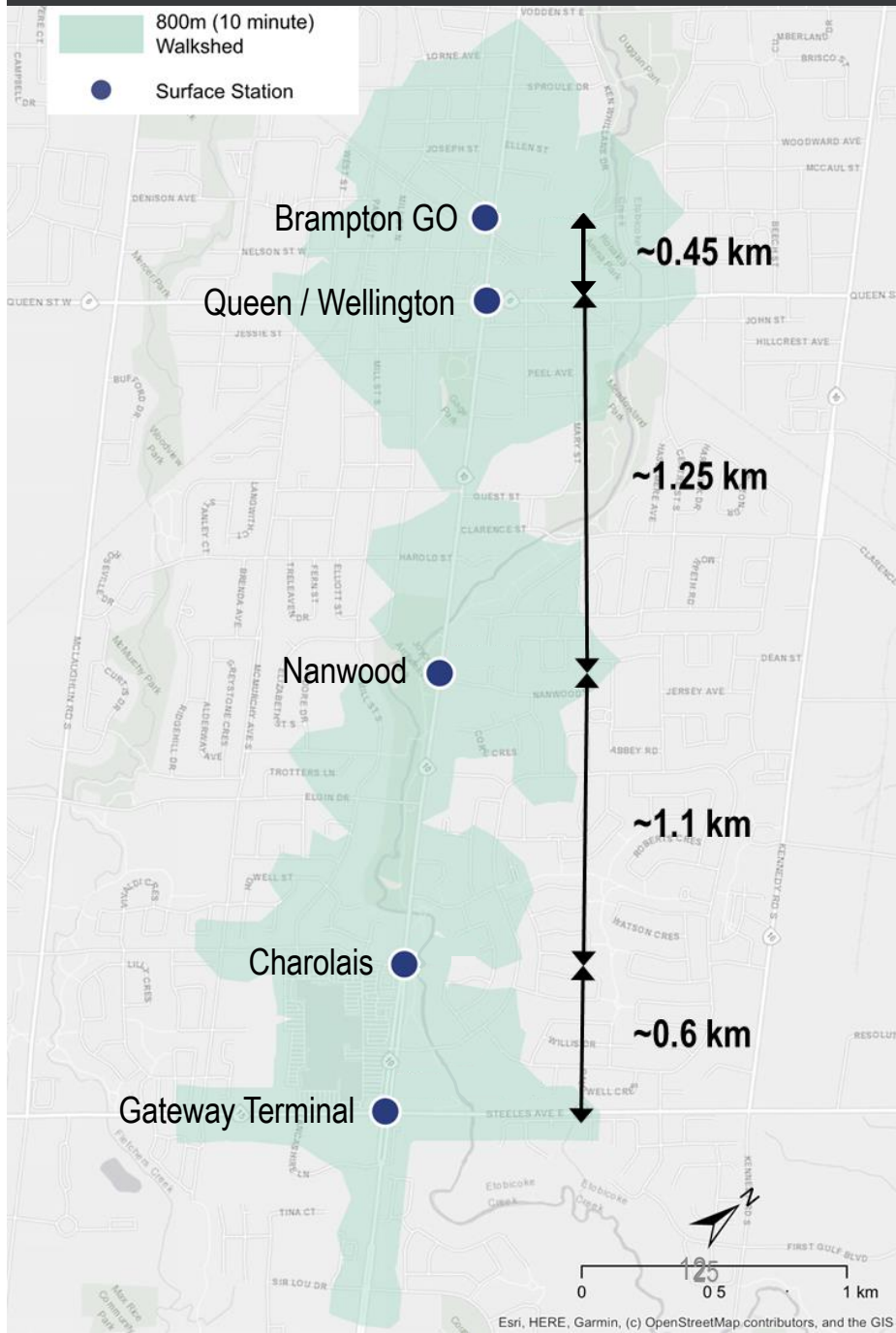
Proposed Station Locations

For surface options, stations are proposed at:

- Brampton GO
- Downtown (split platform)
  - Queen (Northbound)
  - Wellington (Southbound)
- Nanwood
- Charolais
- Gateway Terminal

Note: Station locations for surface options are consistent with 2014 TPAP recommendations.

Surface Options: Stations



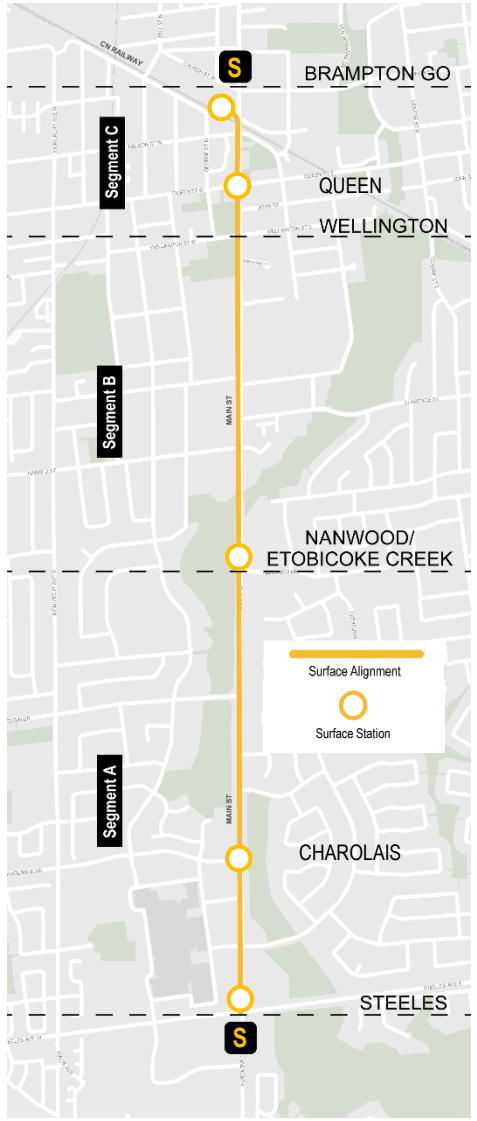
Proposed Station Locations

For underground options, stations are proposed at:

- Brampton GO
- Nanwood
- Charolais (surface stop)
- Gateway Terminal (surface stop)

Note: A station at Wellington Street was screened out during short list phase due its proximity to Brampton GO Station and high cost.

Short List: Surface Options



	Option S1	Option S2	Option S3	Option S4
Segment C	**LRT in Dedicated Curbside Lanes** (4 lanes, cycling in mixed traffic)		**LRT in Mixed Traffic** (2 lanes, cycle tracks)	
Segment B	**LRT in Dedicated Lanes** (4 lanes, cycling in mixed traffic)	**LRT in Mixed Traffic** (4 lanes, cycling in mixed traffic)	**LRT in Dedicated Lanes** (4 lanes, cycling in mixed traffic)	**LRT in Mixed Traffic** (4 lanes, cycling in mixed traffic)
Segment A	**LRT in Dedicated Lanes** (6 lanes, cycle tracks)			

All boulevard configurations shown are subject to change.

Surface Options: Evaluation Summary

Comparison of how each option performs relative to the rest.

Worst	Comparable	Best

The evaluation summarizes key performance measures to help compare the surface options.

		Option S1	Option S2	Option S3	Option S4
Strategic Case How and why should the investment be pursued; based on regional goals, plans and policies?	**Transit Travel Time***	8 minutes	11 minutes	9 minutes	12 minutes
	Auto Travel Time*	6 minutes	6 minutes	7 minutes	6 minutes
	Cycling Conditions	Cycle Tracks in Segment A, Discontinuous network on Main St	Cycle Tracks in Segment A, Discontinuous network on Main St	Cycle Tracks in Segment A and C, Discontinuous network on Main St	Cycle Tracks in Segment A and C, Discontinuous network on Main St
Economic Case What is the investment value to society?	**Value for Money**	Highest	Lowest	Higher	Lower
Financial Case What are the financial implications of delivering the investment?	**Total Costs**	Comparable Total Costs			
Deliverability and Operations Case What are the risks and requirement to consider to deliver and operate the investment?	**Driveway Access Impacts**	77 driveways converted to right-in, right-out	19 driveways converted to right-in, right-out	73 driveways converted to right-in, right-out	15 driveways converted to right-in, right-out
	Utility Conflicts	24 utility conflicts to be relocated			
	Property Requirements	Up to 5,100 m^2 of property required			

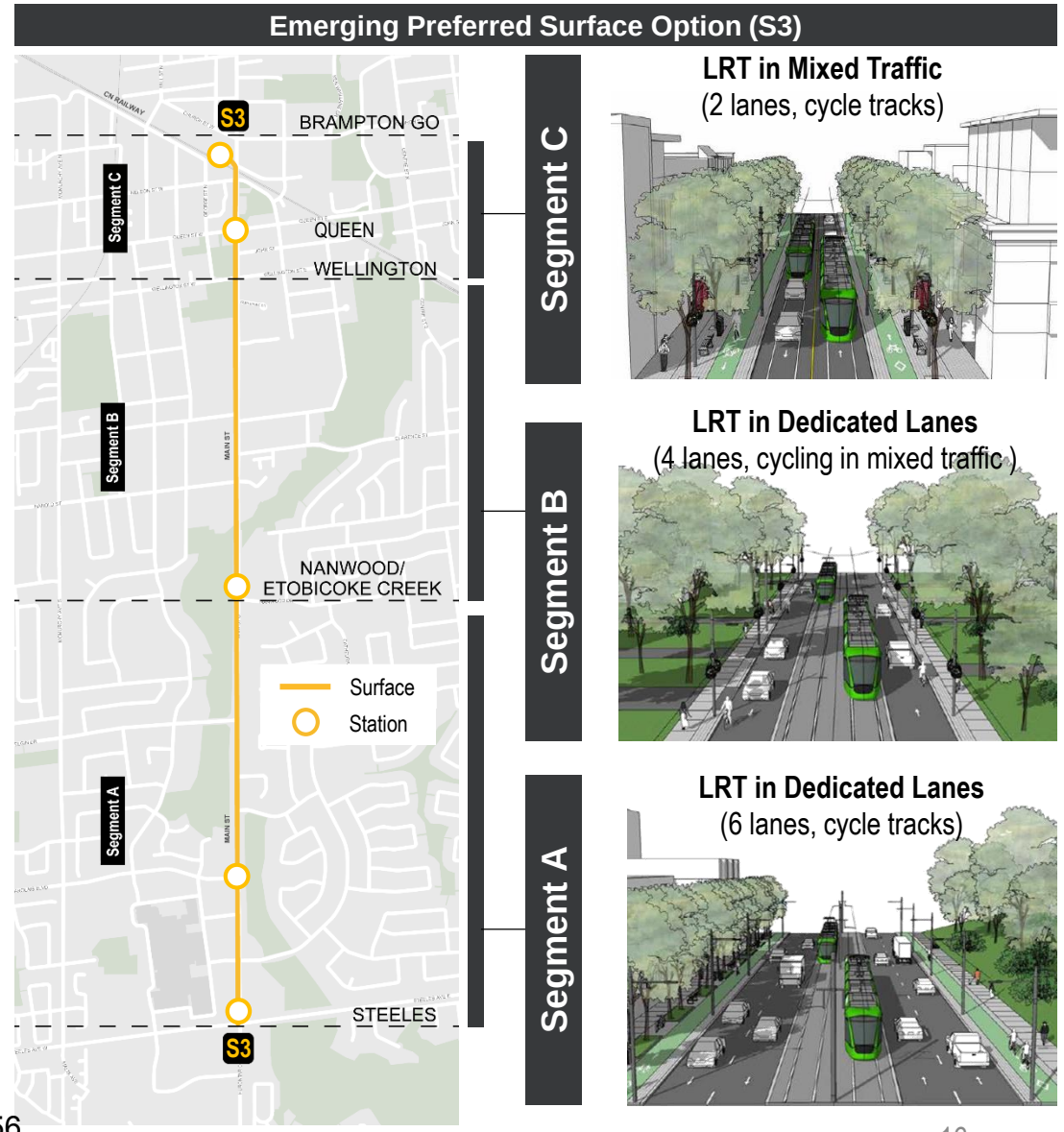
* Travel time between Steeles Avenue and Church Street

Surface Options: Evaluation Summary

All surface options perform relatively similar; however, Option S3 provides the opportunity to revitalize Downtown Brampton into an aesthetically beautiful, place-making destination with wider sidewalks, streetscaping, and cycle tracks (consistent with Downtown Reimagined Vision) while minimizing overall transit travel time.

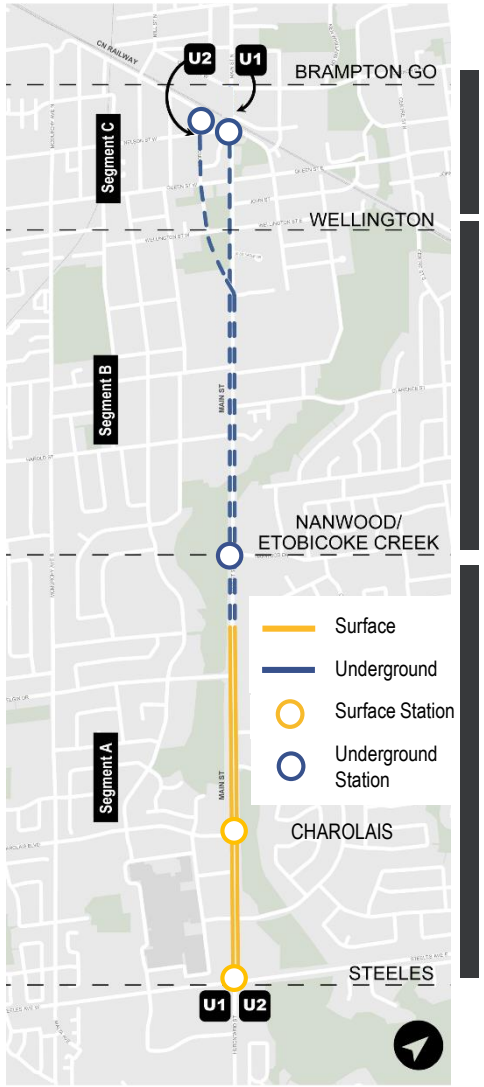
Driveway accesses will be modified as a result of the dedicated LRT right-of-way, but this will ensure safe and efficient travel for all users of the street.

Therefore, Option S3 is the emerging preferred surface option.



All boulevard configurations shown are subject to change.

Short List: Underground Options 1 (Main St) & 2 (George St)



Segment C

LRT Underground
(2 lanes, cycle tracks)

Note: Cross section is consistent with Downtown Reimagined Vision

Segment B

LRT Underground
(3 lanes, cycle tracks)

Segment A

LRT in Dedicated Median Lanes
(6 lanes, cycle tracks)

All boulevard configurations shown are subject to change.

Underground Options: Evaluation Summary

Comparison of how each option performs relative to the rest.

Worst		Comparable		Best

The evaluation summarizes key performance measures to help compare the underground options.

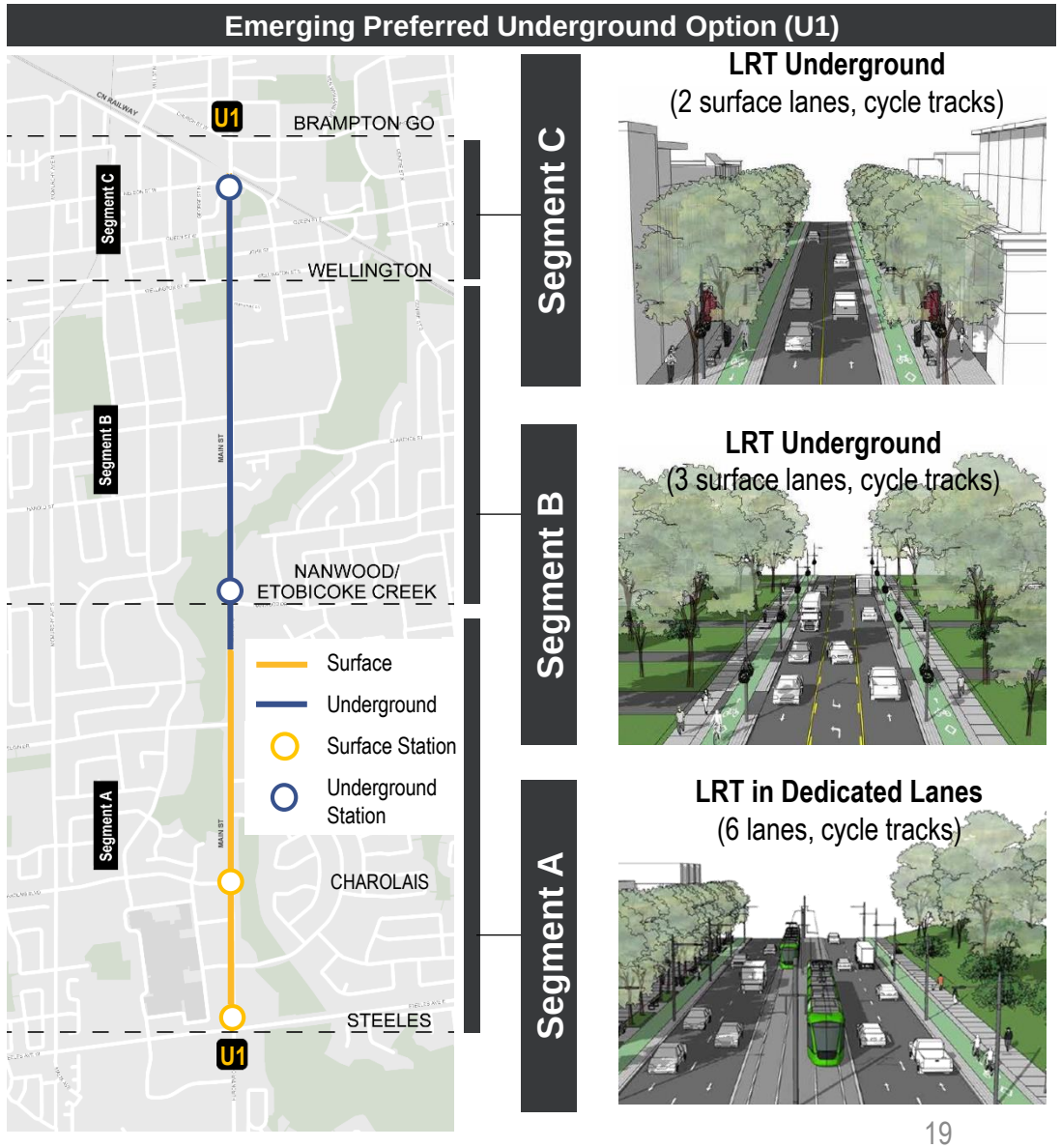
		Option U1 (via Main St)	Option U2 (via George St)
Strategic Case How and why should the investment be pursued; based on regional goals, plans and policies?	**Transit Travel Time***	7 minutes	8 minutes
	Auto Travel Time*	6 minutes	
	Cycling Conditions	Cycle Tracks in all Segments. Continuous Cycling Network.	
Economic Case What is the investment value to society?	**Value for Money**	Comparable Value for Money	
Financial Case What are the financial implications of delivering the investment?	**Total Costs**	Lower	Higher
Deliverability and Operations Case What are the risks and requirement to consider to deliver and operate the investment?	**Driveway Access Impacts**	All driveways in Segment A converted to right-in, right-out access (9 driveways)	
	Utility Conflicts	Minor utility conflicts	Minor utility conflicts at Brampton GO station
	Property Requirements	Up to 2,700 m^2 of property required	Up to 5,300 m^2 of property required
	Potential to Extend	Able to extend north in the future along Main Street	More difficult to extend north in the future from George Street

* Travel time between Steeles Avenue and Church Street

Underground Options: Evaluation Summary

Option U1 (via Main Street) and U2 (via George Street) perform similarly from a strategic perspective. However, Option U1 is more preferred than U2 as it is less costly, located closer to the heart of Downtown Brampton, requires less property takings and is more easily extended north in the future.

Therefore, Option U1 is the emerging preferred underground option.

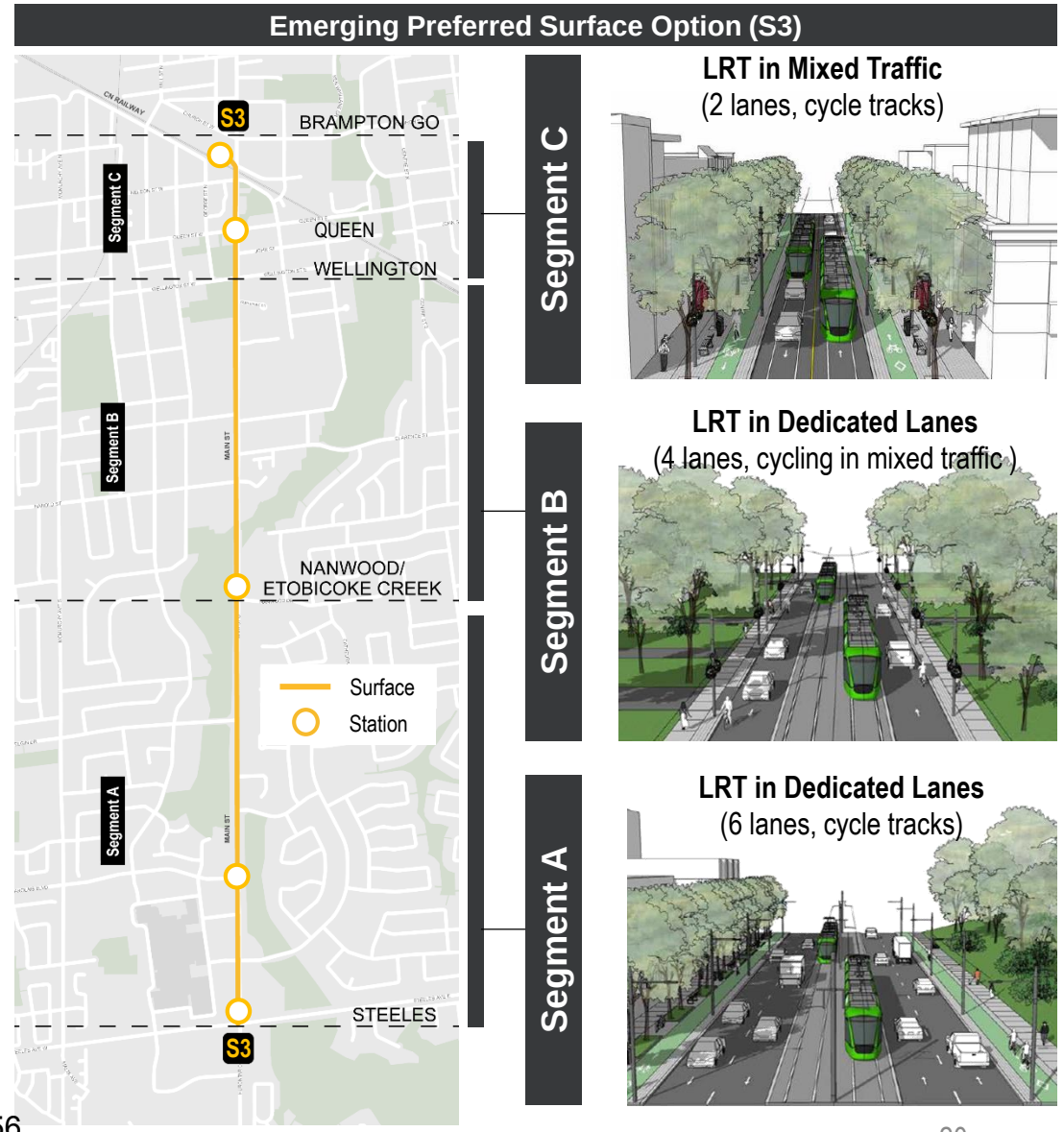


All boulevard configurations shown are subject to change.

Emerging Preferred Options

Surface Option S3

- The LRT will run in dedicated lanes between Steeles Avenue and Wellington Street and in shared lanes from Wellington Street to the Brampton GO Station.
- Option S3 allows for an enhanced streetscape in Segments A and C, including: cycle tracks, widened sidewalks, and a planting and furnishing zone. Cyclists must ride in mixed traffic in Segment B or use parallel routes.
- Driveways in Segment B will be modified to right-in, right out access.
- Overhead catenary systems and traction power substations (TPSS) will be located above ground in the study area.

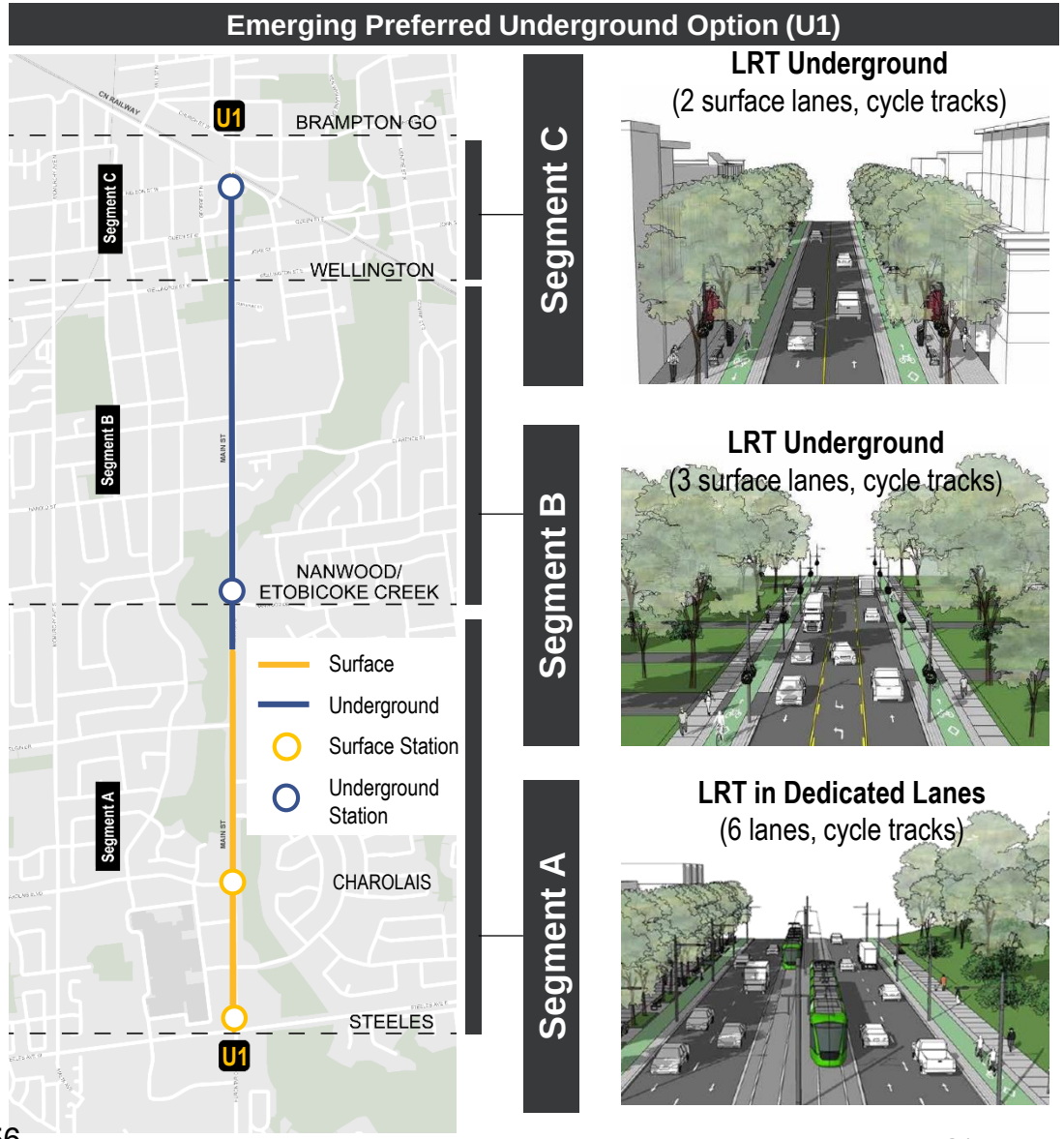


All boulevard configurations shown are subject to change.

Emerging Preferred Options

Underground Option U1

- The LRT will run in dedicated lanes north of Steeles Avenue to Elgin Drive then run underground from just south of Nanwood Drive to the Brampton GO Station along Main Street.
- Option U1 allows for an enhanced streetscape in Segments A, B, and C, including: cycle tracks, widened sidewalks, and a planting and furnishing zone. Option U1 allows for a continuous cycling network along Main Street.
- No access modifications are required in Segment B. Traction Power Substations (TPSS) will be located within underground stations.
- The portal and the two underground stations are located in the floodplain. Potential impacts to be mitigated.



All boulevard configurations shown are subject to change.

PDBC SUMMARY

Comparison of how each option performs relative to the rest.

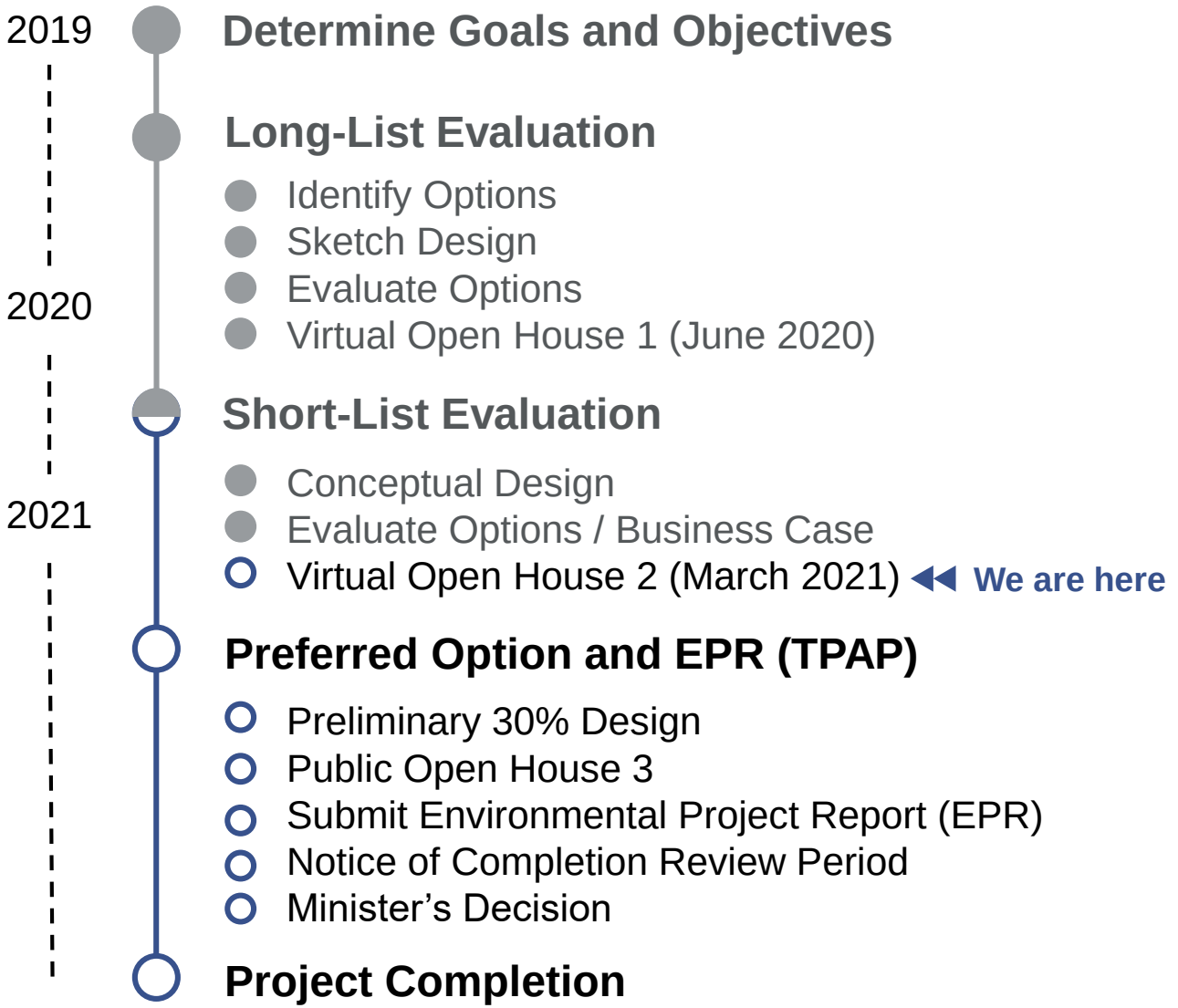
Worst		Comparable		Best

		Option S3	Option U1 (via Main St)
Strategic Case	Transit Travel Time	9 minutes from Steeles Ave to Church St	7 minutes from Steeles Ave to Church St
	Auto Travel Time	7 minutes from Steeles Ave to Church St	6 minutes from Steeles Ave to Church St
	Cycling Conditions	Discontinuous Cycling Network along Main Street Cycle tracks in Segments A and C and cycling in mixed traffic in Segment B	Continuous Cycling Network along Main Street Cycle tracks in all Segments
	Pedestrian Conditions	Enhanced Streetscape Features in Segments A and C, including: widened sidewalks and furnishing zones.	Enhanced Streetscape Features in Segments A,B and C, including: widened sidewalks and furnishing zones.
	Civic Events	Limits Opportunity to Close Downtown Streets for Civic Events	Provides Opportunity to Close Downtown Streets for Civic Events
	Cultural & Natural Heritage impacts	Greater Impacts	Lower Impacts
Economic Case	Value for Money	Higher	Lower
Financial Case	Total Costs	Lower	Higher
Deliverability and Operations Case	Access Impacts	73 driveways converted to right-in, right-out access Potential for impact to emergency / service vehicle operations	9 driveways converted to right-in, right-out access Minimal impact to emergency / service vehicle operations
	Utility Conflicts	24 utility conflicts to be relocated	Minor utility conflicts to be relocated
	Property Requirements	Up to 5,100 m^2 of property required	Up to 2,700 m^2 of property required

Next Steps

Following virtual Open House 2 (March 25th to April 15th), the project team will review and summarize feedback provided by the public and stakeholders.

Staff will prepare a Council Report to update Council on the Public Feedback Report and recommendation for next steps.



City of Brampton 5G Hyper-Connectivity Options Report

Council Workshop

March 2021

01. Background & Approach | Original Mandate

Municipal connectivity is emerging as the key component to unlocking the commercial and social benefits of smarter cities. The development of hyper connectivity (5G) is expected to have an exponential impact on cities across the following four areas:

ECONOMIC GROWTH	SERVICE INNOVATION	DIGITAL DIVIDE	PANDEMIC RESPONSE
A more attractive Brampton	A smarter Brampton	A more inclusive Brampton	A more resilient Brampton
▪ Stimulate economic growth sectors ▪ Create knowledge worker jobs and develop local talent	▪ A better Bramptonian experience ▪ More efficient and effective delivery of city services	▪ Support bridging the digital divide ▪ Enable greater and more diverse participation	▪ Support accelerated post-COVID recovery ▪ Build back a better and more resilient Brampton

01. Background & Approach | Review Approach

The 5G and connectivity review requested by Council ran from Nov 2019 to March 2020, at which point the report to Council was put 'on hold' as the City focused on its response to the pandemic. A COVID update to the report was provided in January of this year

ACTIONS | November 2019 – March 2020

- **ANALYZE** the global and Canadian telecoms market re municipal approaches to 5G roll out
- **ENGAGE** the 5G ecosystem (telcos, OEMs, infra providers, Brampton citizens) for commentary
- **ENGAGE** city stakeholders (incl. residents, Smart City program, transport, PSN, Reg. of Peel) for input
- **IDENTIFY** relevant global and national case studies
- **DEVELOP** municipal connectivity profile to help define the City's role on 5G & connectivity
- **RECOMMEND** a city approach and governance to help accelerate 5G adoption in Brampton

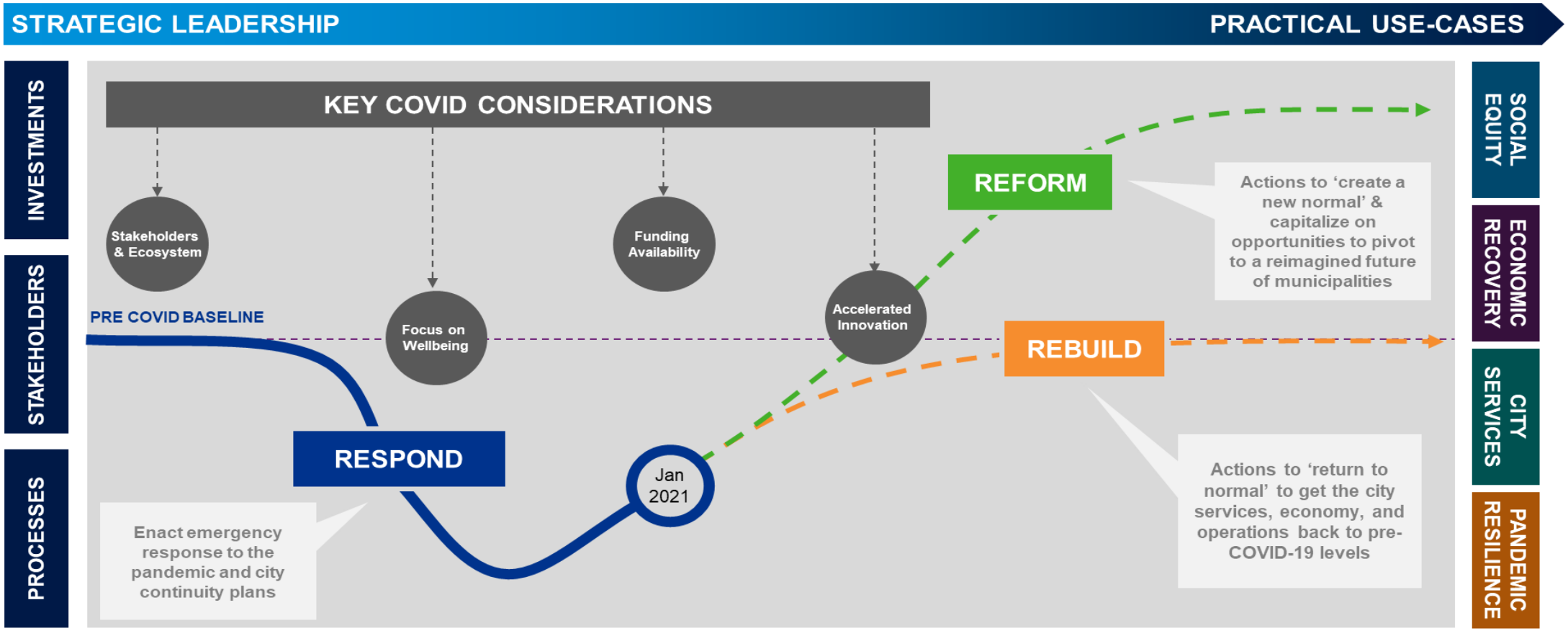
OUTPUTS

March 2020
Brampton 5G CONNECTIVITY REPORT

January 2021
Brampton 5G REPORT (COVID UPDATE)

01. Background & Approach | Building Back Better: COVID-19

Whilst COVID19 has had a dramatic and immediate impact on our communities but, cities are now at a critical juncture in pandemic recovery journey and connectivity could be a key driver for municipal reform, community resilience and economic recovery.



02. Report Recommendation | Strategy & Tactical Activity

Whilst there are multiple options and opportunities for Brampton's connectivity strategy and development journey, the primary recommendation of the report is to mandate a proactive stance to strategic engagement and practical use case to accelerate to connectivity leadership

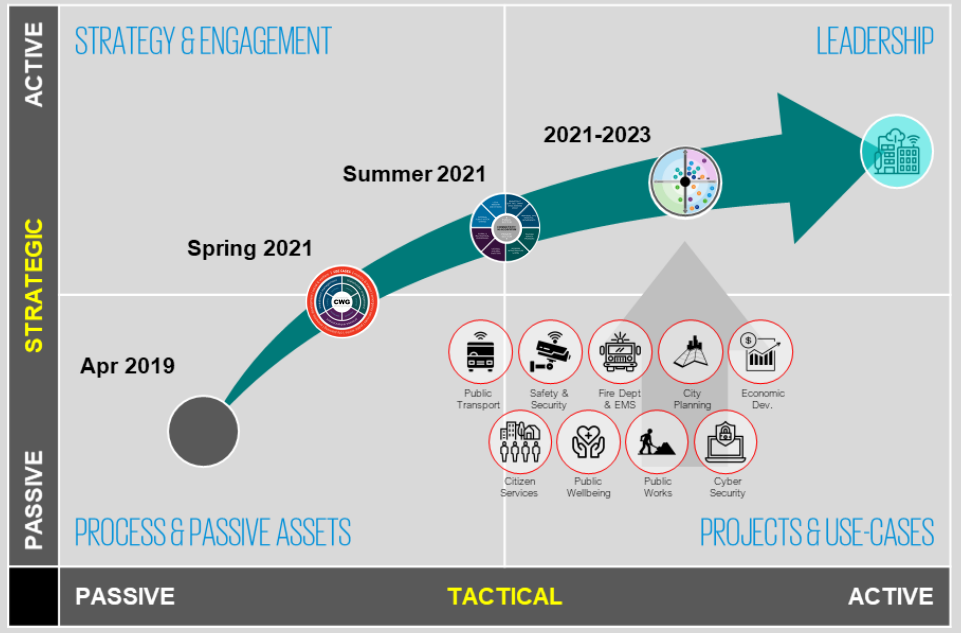
To drive the value of future connectivity, the City will need to play an active role in developing connectivity and 5G from a strategic and tactical perspective.

Strategic Role

Actively engage the broader connectivity ecosystem on the City's strategic approach to 5G and hyper connectivity whilst proactively managing the portfolio of associated funding and third party investments.

Tactical Role.

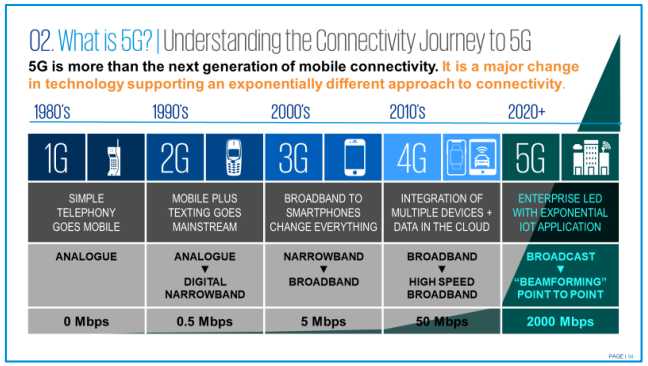
Actively support the development of pilots and use-cases, to be delivered by specific City departments or through collaborative industry working groups, to accelerate deployment and adoption hyper connectivity.



02. What is 5G? | Three provocations for 5G technology

Critical to understanding and valuing the hyper connectivity revolution that is fast approaching is recognizing that 5G is not simply an upgrade to the network but a fundamental change in technology, services and customer to the current approach to connectivity.

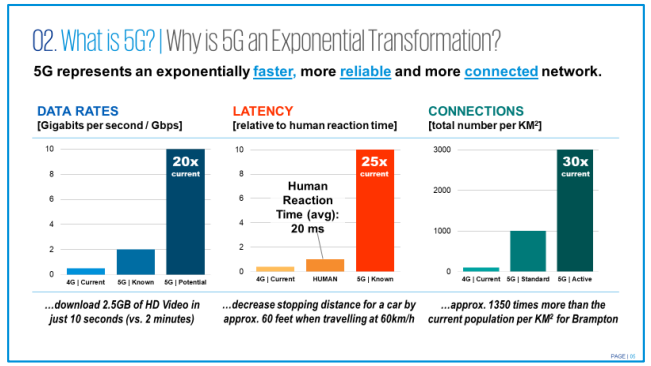
(01) 5G isn't simply 4G+1



5G & hyper-connectivity will unlock enhanced and/or next generation application of smart city technology

- Advanced Gunshot Detection,
- Enhanced Emergence Services,
- Traffic Optimization using HD tech

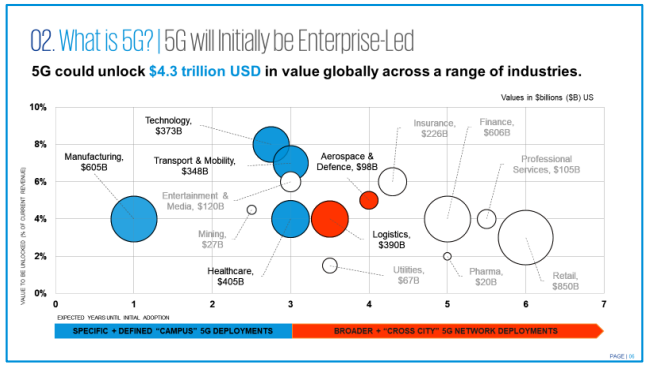
(02) 5G will be exponential



Furthermore, 5G technology will enable massive machine to machine connectivity delivering IoT potential

- Autonomous vehicles,
- Connected healthcare,
- Secure open campus networks

(03) 5G will be enterprise-led

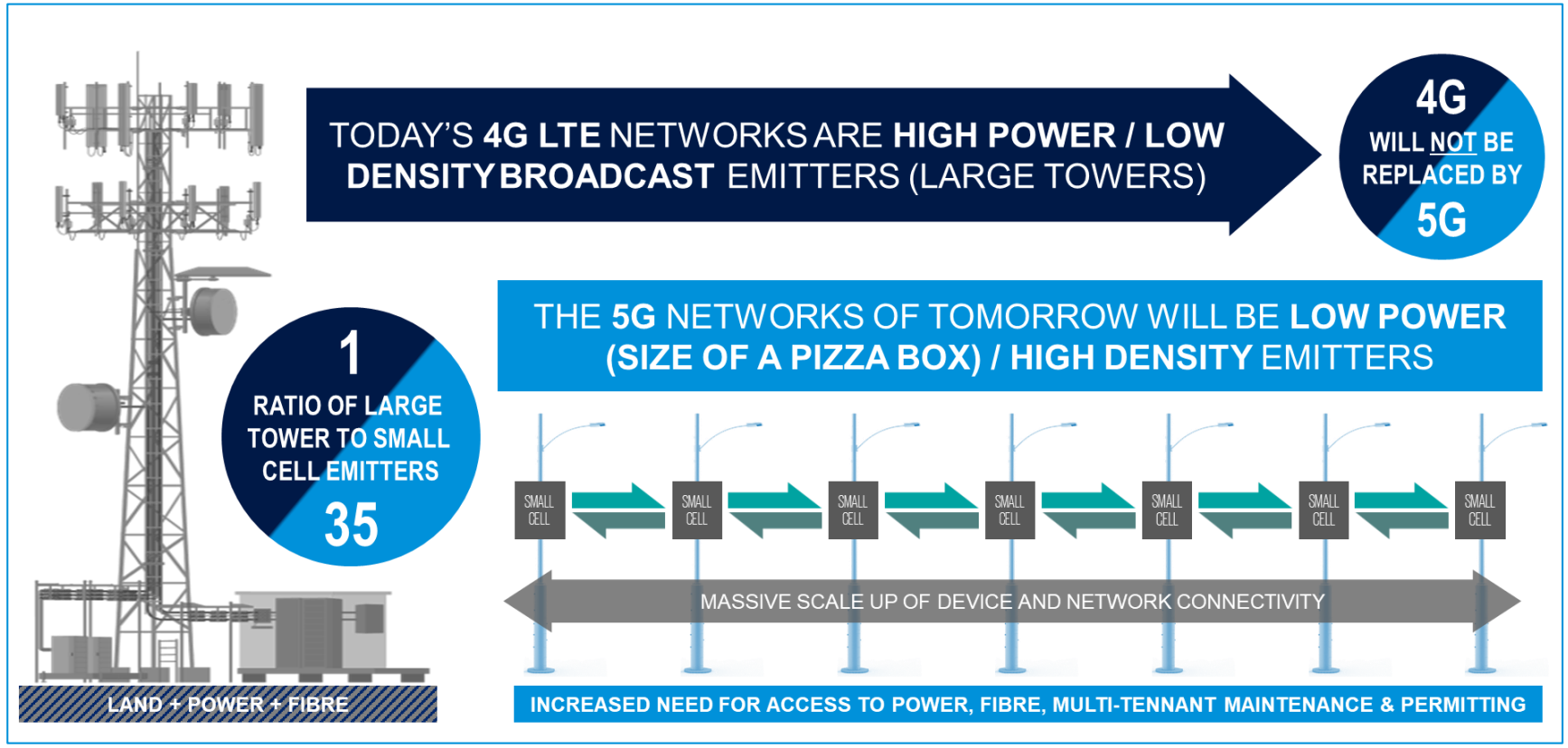


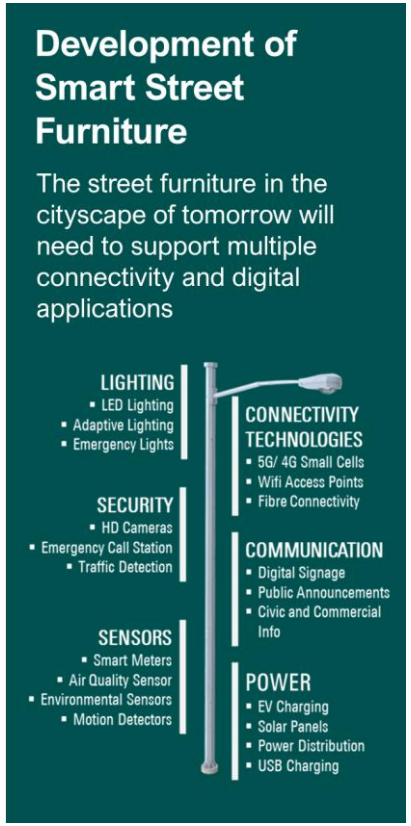
Finally, 5G & hyper-connectivity will be driven by the enterprise not the retail customer – in distinct phases

- Connected factories,
- Innovation & logistics corridors,
- High tech industrial estates

02. What is 5G? | The impact on the City's passive assets

The increasing demand to place an order of magnitude larger number of small cell emitters, the foundation of 5G technology, will also have a material impact on the use and value of the City's public sector network, passive infrastructure assets and street furniture.





03. Key Considerations | Critical Success Factors

To be a leader in the forthcoming 5G revolution and leverage the value from early adoption, Brampton needs to clearly define its role in the rollout. The following are five international examples of municipal connectivity leadership.

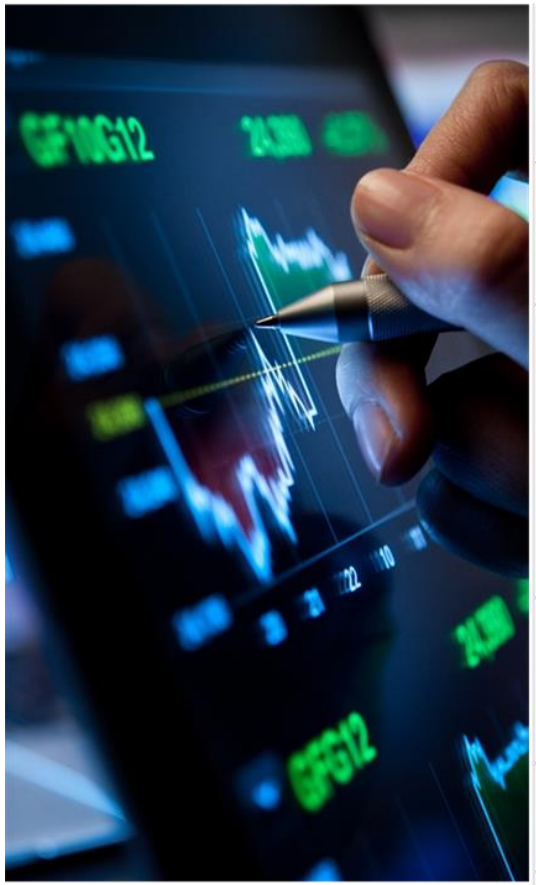
INDUSTRY FOCUS ← **ROLE RATIONALE** → **CITIZEN FOCUS**

INNOVATION LEADERSHIP Barcelona, Spain	FACILITATING COLLABORATION Calgary, Canada	ATTRACTING INVESTMENTS San Diego, USA	MONETIZING CITY ASSETS Sacramento, USA	USING A CITIZEN-CENTRIC MINDSET Wakayama, Japan
				
Driven by **economic development** and helping to transform Barcelona into a **world class digital innovation hub**	Accelerating 5G **innovation** and **adoption** through industry collaboration of **cross-sector working groups**	**Streamlining city processes** to become materially more attractive to **infrastructure investments**	Using a **commercial-led approach** to managing the City's passive assets in support of the network expansion and 5G roll out	**Acceleration** of 5G roll out by leveraging pre-existing City investments on **service improvement**

City of Brampton	Transport (Queen St Expansion)	EMS / Fire (Fire Dept)	EC.DEV. (Enterprise Zones)	Welfare (Social Housing)	City Planning (Activity Modelling)	Public Works (Flood Defenses)	Region of Peel (PSN)

03. Key Considerations | Deployment & Adoption

The 5G ecosystem continues to evolve at pace and 2021 will be a convergence of technology maturity, customer expectation and available funding.



CANADIAN MARKET 5G TIMELINES		RESPONDING TO COVID **INITIAL "5G" ROLLOUT** EVOLUTIONARY AND WILL LOOK LIKE 4G NETWORKS		**SMALL CELL / HYPER-CONNECTED 4G+ & 5G DENSITY EXPANSION** EXPONENTIAL NETWORKS ENABLING ENHANCED USE-CASES	
TELECOM OPERATOR 5G ROLLOUTS & BRAMPTON SERVICE	**APRIL 2019 |** INITIAL TELCO 5G SITE-VISIT		**Telco operators begin rollout of live 5G services**		
POTENTIAL 5G DEVICE ECOSYSTEM EVOLUTION		**EARLY GEN 5G HANDSETS** 5G FUNCTIONALITY HANDSETS	**GENERATIONAL HANDSET UPGRADES** COMMERCIALLY AFFORDABLE HANDSETS		
		5G DRIVEN DEVICE EVOLUTION 5G CHIPSETS IN LAPTOPS, TABLETS		**WEARABLES & SENSOR NET OF THINGS** 5G ENABLED WEARABLE DEVICES AND SENSORS	
5G CITY PILOTS & COLLABORATIONS	■ **L5 Ottawa** – 5G test-bed for autonomous vehicles ■ **University of Waterloo** – 5G collaboration and test-bed	■ Kelowna, BC: **Rogers** - 5G Smart City Pilot Transportation Focus ■ London, ON: **Bell** - Collaboration with Western Univ. for a 5G campus testbed ■ Windsor, ON: **Telus** – Partnership with Univ. of Windsor for a 5G connected campus ■ British Columbia: **Shaw** – Deployment of a 5G ready private LTE network for the mining industry			
REGULATORY CONSIDERATIONS	■ Key **spectrum auction** allowing for initial rollouts (600 MHz) – Apr 2019	■ External **panel review** on legislations related to communications	■ Key auctions (**3500 MHz**) – required for dense networks	■ Decision and potential auction of **ultra high frequencies** – enabling further densification and major network roll outs	
TIMELINE	2019	2020	2021	2022	2023

03. Key Considerations | Deployment & Adoption

The evolution of hyper connectivity is inevitable and its need to use a City's passive assets means there is no "do nothing" option. But the combination of population density and PSN means Brampton is uniquely positioned to benefit from playing an integral role in the roll out

ENABLING AND ACCELERATING 5G DEPLOYMENTS

INCREASING THE VALUE OF PSN

How does the City **collaborate** with the other PSN **stakeholders** (Peel, Mississauga, Caledon) to **increase value** from the PSN?

LEVERAGING PSN CAPACITY

How does the City utilize **available PSN capacity** to support the City's **increased future connectivity footprint** and requirements?

MANAGING THE PASSIVE ASSETS

How does the City **protect the inherent value** of its passive asset base whilst actively supporting a **high density** 5G deployment?

ENHANCING 5G ADOPTION

ENTERPRISE ATTRACTIVENESS

How does the City use connectivity to **accelerate adoption** and thereby increase the **economic impact** and **city attractiveness**?

ENHANCING CITIZEN SERVICES

How can the City work **collectively** to **leverage** the internal connectivity ecosystem to support the **modernization of service delivery**?

TELCO INFRASTRUCTURE CENTRIC

CUSTOMER CENTRIC

KEY RISKS

Legislation & Policy	Market Mechanics	Value Leakage	Decision delay	Technology Disruption	Stakeholder Engagement	Communications & Adoption

03. Key Considerations | Aligning with Brampton's bigger picture

5G and hyper connectivity is not the destination but rather the enabler to unlocking significant value for Brampton. By developing practical use cases that align to Brampton's "bigger vision", hyper connectivity can be a multiplier for current initiatives and future proofing investments

TERM OF COUNCIL PRIORITIES

- Innovation ecosystem in downtown
- Develop and implement the Brampton Connected City

VALUE | Build an inclusive city that is safe, sustainable, and successful

BRAMPTON 2040 VISION

- A diverse new urban core
- Update and revitalize Bramalea
- Integrated transportation choices

VALUE | Transform jobs, connect people, and revitalize living

ECONOMIC DEVELOPMENT

- Cyber-security focus
- Skilling via academic partnerships
- Focus on start-up hubs and attracting entrepreneurs

VALUE | Competitive advantage over other municipalities

URBAN DESIGN

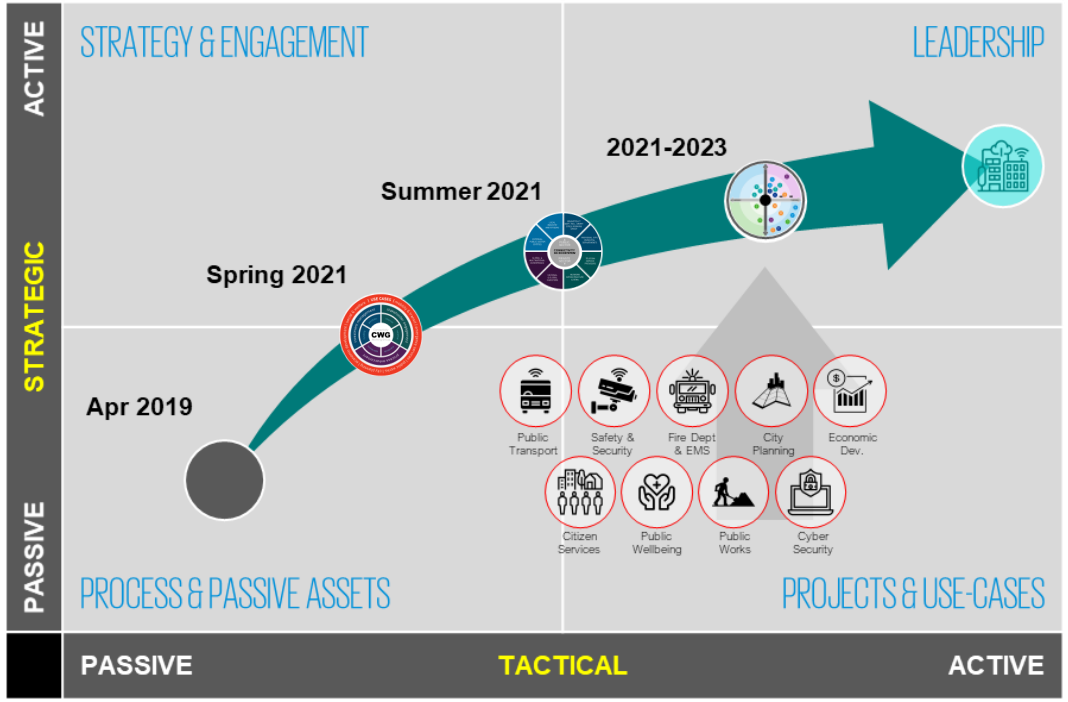
- Precinct Plan for Downtown Brampton
- Queen Street Precinct Plan
- Pilot zones & innovation corridors

VALUE | Evolve to a connected, inclusive, and innovative city

02. Report Recommendation | Strategy & Tactical Activity

To drive the value of future connectivity, the City will need to play an active role in developing connectivity and 5G from a strategic and tactical perspective. The diagram below shows a potential trajectory and key milestones the City could take to increase ecosystem collaboration, enhance adoption and practical roll out, and accelerate the public benefits of connectivity

PROPOSED DEVELOPMENT PATH & KEY MILESTONES



Connectivity Working Group (CWC) | The corporation sets up a CWC to drive stakeholder engagement, investment planning and process enhancements

Connectivity Ecosystem Development | The CWC develops stakeholder platforms for innovation, use case application and broader commercial discussions

City Use Cases for Connectivity | Individual departments identify, articulate and develop specific service use cases for funding and roll out.

Connectivity Roll Out Plan | The CWC manages an integrated 5G / hyper-connectivity roll out plan to enable accelerated delivery for best value ideas

Connectivity Leader | Brampton leverages its connectivity leadership position to drive further economic activity and social enhancements