

# Strategic Priorities and Policy Committee

## Report

10th Meeting of the Strategic Priorities and Policy Committee  
September 17, 2018

**PRESENT:** Mayor M. Brown, Councillors M. van Holst, B. Armstrong, M. Salih, J. Helmer, M. Cassidy, P. Squire, J. Morgan, P. Hubert, A. Hopkins, V. Ridley, S. Turner, H. Usher, T. Park, J. Zaifman

**ALSO PRESENT:** M. Hayward, A. Barbon, B. Card, B. Coxhead, H. Chapman, S. Datars Bere, M. Feldberg, J. Fleming, O. Katolyk, G. Kotsifas, L. Livingstone, P. Mckague, D. O'Brien, A. Rammeloo, J. Ramsay, C. Saunders, S. Spring, S. Stafford, M. Tomazincic, B. Westlake-Power and J. Yanchula.

### 1. Disclosures of Pecuniary Interest

That it BE NOTED that Councillor J. Morgan disclosed a pecuniary interest in parts of clause 3.2 of this report, having to do with a presentation related to Bus Rapid Transit, by indicating that his employer, Western University, has previously stated preferences related to this matter in terms of desired vehicle requirements.

### 2. Consent

#### 2.1 London Community Grants Program Innovation and Capital Funding Allocations (2019)

Moved by: S. Turner  
Seconded by: A. Hopkins

That, on the recommendation of the Managing Director of Neighbourhood, Children and Fire Services, the following actions be taken with respect to the staff report dated September 17, 2018 providing an update on the London Community Grants Program:

- a) the above-noted report BE RECEIVED;
- b) the Mayor BE REQUESTED to forward a letter of thanks to the Community Review Panel members who supported the London Community Grants Program from 2016 to 2019, for their work in reviewing and approving applications under the program.

Yeas: (15): Mayor M. Brown, M. van Holst, B. Armstrong, M. Salih, J. Helmer, M. Cassidy, P. Squire, J. Morgan, P. Hubert, A. Hopkins, V. Ridley, S. Turner, H. Usher, T. Park, and J. Zaifman

**Motion Passed (15 to 0)**

Voting Record

Moved by: T. Park  
Seconded by: H. Usher

Motion to direct the Mayor to communicate Council's thanks to each of the panel members.

Yeas: (15): Mayor M. Brown, M. van Holst, B. Armstrong, M. Salih, J. Helmer, M. Cassidy, P. Squire, J. Morgan, P. Hubert, A. Hopkins, V. Ridley, S. Turner, H. Usher, T. Park, and J. Zaifman

**Motion Passed (15 to 0)**

2.2 Service Review Initiatives 2018 Update

Moved by: M. van Holst  
Seconded by: H. Usher

That, on the recommendation of the City Manager and the Managing Director, Corporate Services and City Treasurer, Chief Financial Officer, the staff report dated September 17, 2018 regarding an update on 2018 service review initiatives BE RECEIVED for information.

Yeas: (15): Mayor M. Brown, M. van Holst, B. Armstrong, M. Salih, J. Helmer, M. Cassidy, P. Squire, J. Morgan, P. Hubert, A. Hopkins, V. Ridley, S. Turner, H. Usher, T. Park, and J. Zaifman

**Motion Passed (15 to 0)**

**3. Scheduled Items**

3.1 Amendments to Consolidated Fees and Charges By-law

Moved by: P. Hubert  
Seconded by: H. Usher

That, on the recommendation of the City Clerk, with the concurrence of the Managing Director, Corporate Services and City Treasurer, Chief Financial Officer, the proposed by-law appended to the staff report dated September 17, 2018 as Appendix "A" BE INTRODUCED at the Municipal Council meeting on September 18, 2018 for the purpose of repealing By-law No. A-52, as amended, being "A by-law to provide for Various Fees and Charges" and replacing it with a new Fees and Charges By-law that adds and adjusts certain fees and charges for services or activities provided by the City of London;

it being noted that the Strategic Priorities and Policy Committee received a communication dated September 13, 2018 from B. Veitch, President, London Development Institute with respect to this matter;

it being pointed out that at the public participation meeting associated with this matter the individual indicated on the attached public participation meeting record, made an oral submission regarding this matter.

Yeas: (14): Mayor M. Brown, M. van Holst, B. Armstrong, J. Helmer, M. Cassidy, P. Squire, J. Morgan, P. Hubert, A. Hopkins, V. Ridley, S. Turner, H. Usher, T. Park, and J. Zaifman

Nays: (1): M. Salih

**Motion Passed (14 to 1)**

Voting Record

Moved by: A. Hopkins  
Seconded by: J. Zaifman

Motion to open the Public Participation Meeting.

Yeas: (14): Mayor M. Brown, B. Armstrong, M. Salih, J. Helmer, M. Cassidy, P. Squire, J. Morgan, P. Hubert, A. Hopkins, V. Ridley, S. Turner, H. Usher, T. Park, and J. Zaifman

Absent: (0): M. van Holst

**Motion Passed (14 to 0)**

Moved by: S. Turner  
Seconded by: J. Zaifman

Motion to close the Public Participation Meeting.

Yeas: (14): Mayor M. Brown, B. Armstrong, M. Salih, J. Helmer, M. Cassidy, P. Squire, J. Morgan, P. Hubert, A. Hopkins, V. Ridley, S. Turner, H. Usher, T. Park, and J. Zaifman

Absent: (0): M. van Holst

**Motion Passed (14 to 0)**

3.2 Dr. Josipa Petronic, Executive Director and Chief Executive Officer, Canadian Urban Transit Research and Innovation Consortium - Rapid Transit

That the following actions be taken with respect to the presentation of J. Petronic, Canadian Urban Transit Research and Innovation Consortium (CUTRIC), related to the potential electrification of the rapid transit project:

- a) the attached presentation from Dr. J. Petronic, Executive Director and Chief Executive Officer, Canadian Urban Transit Research and Innovation Consortium with respect to Rapid Transit BE RECEIVED;
- b) based on the financial and environmental benefits shown by the modelling done by CUTRIC, electrification of London's Bus Rapid Transit system BE ENDORSED-IN-PRINCIPLE;
- c) the Civic Administration BE DIRECTED to continue working with the London Transit Commission and Canadian Urban Transit Research & Innovation Consortium (CUTRIC) on economic modelling for electrification, including maintenance; and,
- d) the Civic Administration BE DIRECTED to work with the London Transit Commission and the Canadian Urban Transit Research & Innovation Consortium (CUTRIC) on securing funding and partnerships that would allow London to implement electric buses as part of London's Bus Rapid Transit.

**Motion Passed**

Voting Record

Moved by: B. Armstrong  
Seconded by: H. Usher

That the following actions be taken with respect to the presentation of J. Petronic, Canadian Urban Transit Research and Innovation Consortium (CUTRIC), related to the potential electrification of the rapid transit project:

- a) the attached presentation from Dr. J. Petronic, Executive Director and Chief Executive Officer, Canadian Urban Transit Research and Innovation Consortium with respect to Rapid Transit BE RECEIVED;

Yeas: (15): Mayor M. Brown, M. van Holst, B. Armstrong, M. Salih, J. Helmer, M. Cassidy, P. Squire, J. Morgan, P. Hubert, A. Hopkins, V. Ridley, S. Turner, H. Usher, T. Park, and J. Zaifman

**Motion Passed (15 to 0)**

Moved by: J. Helmer  
Seconded by: T. Park

b) based on the financial and environmental benefits shown by the modelling done by CUTRIC, electrification of London's Bus Rapid Transit system BE ENDORSED-IN-PRINCIPLE;

Yeas: (9): Mayor M. Brown, B. Armstrong, J. Helmer, M. Cassidy, P. Hubert, A. Hopkins, V. Ridley, S. Turner, and T. Park

Nays: (5): M. van Holst, M. Salih, P. Squire, H. Usher, and J. Zaifman

Recuse: (1): J. Morgan

**Motion Passed (9 to 5)**

Moved by: J. Helmer  
Seconded by: T. Park

c) the Civic Administration BE DIRECTED to continue working with the London Transit Commission and Canadian Urban Transit Research & Innovation Consortium (CUTRIC) on economic modelling for electrification, including maintenance; and,

Yeas: (15): Mayor M. Brown, M. van Holst, B. Armstrong, M. Salih, J. Helmer, M. Cassidy, P. Squire, J. Morgan, P. Hubert, A. Hopkins, V. Ridley, S. Turner, H. Usher, T. Park, and J. Zaifman

**Motion Passed (15 to 0)**

Moved by: J. Helmer  
Seconded by: T. Park

d) the Civic Administration BE DIRECTED to work with the London Transit Commission and the Canadian Urban Transit Research & Innovation Consortium (CUTRIC) on securing funding and partnerships that would allow London to implement electric buses as part of London's Bus Rapid Transit.

Yeas: (13): Mayor M. Brown, B. Armstrong, M. Salih, J. Helmer, M. Cassidy, P. Squire, P. Hubert, A. Hopkins, V. Ridley, S. Turner, H. Usher, T. Park, and J. Zaifman

Nays: (1): M. van Holst

Recuse: (1): J. Morgan

**Motion Passed (13 to 1)**

#### **4. Items for Direction**

##### **4.1 London Convention Centre Board Appointments**

Moved by: J. Zaifman  
Seconded by: B. Armstrong

That the City Clerk BE DIRECTED to bring forward to a future meeting of Municipal Council a by-law to incorporate the changes to the London Convention Centre Corporation By-law as requested in the communication dated September 5, 2018 from L. Da Silva.

Yeas: (15): Mayor M. Brown, M. van Holst, B. Armstrong, M. Salih, J. Helmer, M. Cassidy, P. Squire, J. Morgan, P. Hubert, A. Hopkins, V. Ridley, S. Turner, H. Usher, T. Park, and J. Zaifman

**Motion Passed (15 to 0)**

**5. Deferred Matters/Additional Business**

5.1 ADDED - Core Area Informed Response

Moved by: H. Usher

Seconded by: M. van Holst

The attached presentation by the City Manager regarding Core Area Informed Response BE RECEIVED.

Yeas: (12): Mayor M. Brown, M. van Holst, B. Armstrong, J. Helmer, M. Cassidy, P. Squire, J. Morgan, A. Hopkins, V. Ridley, S. Turner, H. Usher, and T. Park

Absent: (0): M. Salih, P. Hubert, and J. Zaifman

**Motion Passed (12 to 0)**

5.2 ADDED - 12th Report of the Governance Working Group

Moved by: V. Ridley

Seconded by: T. Park

That the following actions be taken with respect to the 12th Report of the Governance Working Group from its meeting held on September 17, 2018:

a) the following actions be taken with respect to updating the terms of reference and mandate of the Striking Committee:

i) the attached, revised, proposed by-law BE INTRODUCED at a future meeting of the Municipal Council, to amend By-law No. CPOL.-59(a)-401, Council Policy, "General Policy for Advisory Committees" by deleting section 4.3 Resignations and Appointments, and section 4.4 Eligibility for Appointment and replacing them with new sections 4.3 and 4.4 to incorporate the following amendments:

- three additional Members-at-large to the membership composition;
- requirement that Striking Committee members not be applicants for any of the Committees whose membership is recommended for appointment by the Striking Committee, or for the city Agencies, Boards or Commissions; and,
- remove a former member of municipal council from the membership composition;

ii) subject to the approval of part a), above, the City Clerk BE DIRECTED to take the necessary actions, including a public participation meeting before the Corporate Services Committee, to amend the Council Procedure By-law to reflect the proposed changes; and

b) clause 1.1 BE RECEIVED.

Yeas: (15): Mayor M. Brown, M. van Holst, B. Armstrong, M. Salih, J. Helmer, M. Cassidy, P. Squire, J. Morgan, P. Hubert, A. Hopkins, V. Ridley, S. Turner, H. Usher, T. Park, and J. Zaifman

**6. Confidential (enclosed for Members only.)**

That the Strategic Priorities and Policy Committee convene in closed session for the purpose of considering the following matter:

**1. Land Disposition/Solicitor-Client Privileged Advice**

A matter pertaining to instructions and directions to officers and employees of the Corporation pertaining to a proposed disposition of land; advice that is subject to solicitor-client privilege, including communications necessary for that purpose; reports or advice or recommendations of officers and employees of the Corporation pertaining to a proposed disposition of land; commercial and financial information supplied in confidence pertaining to the proposed disposition the disclosure of which could reasonably be expected to prejudice significantly the competitive position or interfere significantly with the contractual or other negotiations of the Corporation, result in similar information no longer being supplied to the Corporation where it is in the public interest that similar information continue to be so supplied, and result in undue loss or gain to any person, group, committee or financial institution or agency; commercial, information relating to the proposed disposition that belongs to the Corporation that has monetary value or potential monetary value; information concerning the proposed disposition whose disclosure could reasonably be expected to prejudice the economic interests of the Corporation or its competitive position; information concerning the proposed disposition whose disclosure could reasonably be expected to be injurious to the financial interests of the Corporation; information relating to a position, plan, procedure, criteria and instructions to be applied to any negotiations carried on or to be carried on by or on behalf of the Corporation concerning the proposed disposition.

The Strategic Priorities and Policy Committee convened in closed session from 9:14 PM to 9:42 PM.

**7. Adjournment**

The meeting adjourned at 9:42 PM.

## PUBLIC PARTICIPATION MEETING COMMENTS

### 3.1 PUBLIC PARTICIPATION MEETING – Amendments to the Consolidated Fees and Charges By-law

- B. Veitch – London Development Institute – noting his submission, as included on the Added Agenda; noting concern with the lack of transparency in the calculating of some fees; noting a better way for the calculation is an indexing method; advising that LDI has offered some alternative rates for consideration, stating that a revised calculation should be based on a better demonstration of the actual costs; advising that there is no understanding of why fees are increasing based on the information provided; and stating that it makes sense from an indexing standpoint and the LDI submission is a compromise.

## Techno-economic modelling of an electric bus demonstration project in London Ontario Fast Transit Route "7" & "L"

Anaïssia Franca

Dr. Yutian Zhao

Dr. Garret Duffy

Dr. Anahita Jami

Dr. Josipa Petrunic

Canadian Urban Transit Research and Innovation Consortium (CUTRIC)  
Consortium de recherche et d'innovation en transport urbain au Canada (CRITUC)

September 17<sup>th</sup>, 2018

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## Outline

- Routes and duty cycles
- E-bus energy consumption and SOC calculations
- Charging infrastructure simulation
- Comparative simulation of diesel bus fuel consumption
- Electricity costs estimations, simulation results and emissions calculation for each route
- GHG emission savings

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## Routes and duty cycles

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## Route "7" map (28.6 km RT)



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## Route "L" map (29.2 km RT)



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## Route statistics

Name of route	Length of the route round trip (km)	Estimated time to complete the route round trip (min)
London route "7"	28.6	~ 70
London route "L"	29.2	~ 70

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3.2

## Model the route elevation profile & topography

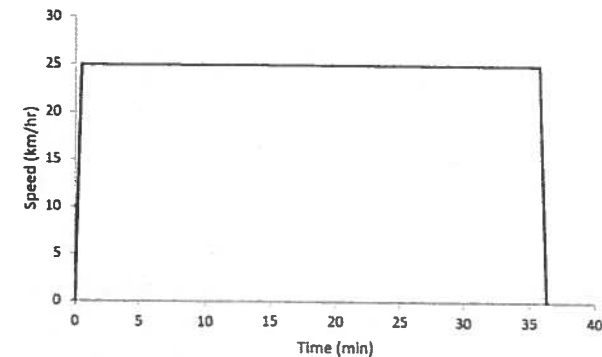
- Used Google Earth to define the path (.kml files)
- Calculated the distances between the nodes
- Used a DEM (Digital Elevation Model) database to obtain the raw data for elevations
- Used filtration/smoothing to obtain realistic road grades (multiple steps of Savitzky-Golay filter)

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## Route L (29.2 km RT) - Duty cycles development

- **Light duty cycle (1 driver, no auxiliary load)**
  - Constant velocity, no stop



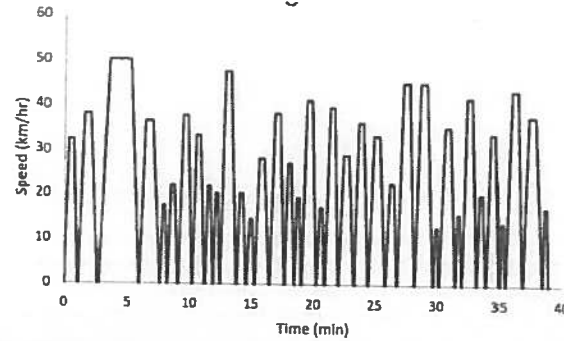
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## Route L (29.2 km RT) - Duty cycles development

### • Medium duty cycle (half full passenger load, half auxiliary load)

- Stop for all bus stops
- Additional stops at 50 % of other stops: randomly selected from all the traffic lights, passenger walks etc...



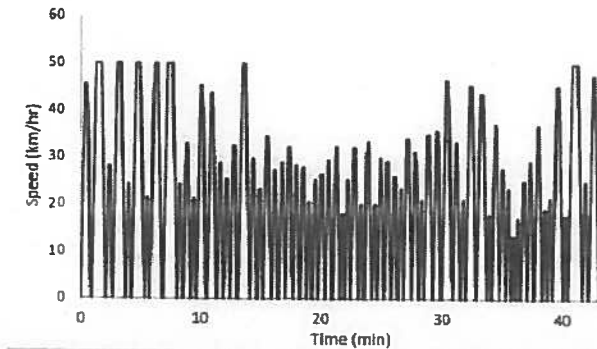
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## Route L (29.2 km RT) - Duty cycles development

### • Heavy duty cycle (full passenger load, full auxiliary load)

- Stop for all bus stops, traffic lights, stop signs and additional stopping for pedestrians



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## E-bus energy consumption and SOC calculations

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## Key variables affecting the energy consumption

- Weight of the vehicle: a 60 ft is roughly 30 ~ 40 % heavier than a 40 ft
- Auxiliary load
- Tire rolling coefficient
- Regenerative braking usage
- Gear ratio

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## Ebus energy consumption and charging power calculations

- Used in-house Matlab and Python code
- Physical characteristics of fully electric 60ft New Flyer (2019) and a 60 ft Proterra (2020)
- Accounted for variation in topography
- Regenerative braking power split: 35%
- Constant accessory draw
  - Heavy duty cycle: 26,000 W
  - Medium duty cycle: 13,000 W
  - Light duty cycle: 0 W
- Maximum passenger number : 160 (~ 60 seats and ~ 60 standees)

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## State of Charge (SOC): Route "7" (28.6 km RT) Proterra (660 kWh)

	South to West				West to South			
	kWh per km	Total kWh used	SOC at route end		kWh per km	Total kWh used	SOC at route end	
			5 % buffer	10% buffer			5 % buffer	10 % buffer
Light duty	0.6	8.62	93.6%	88.6%	0.57	8.24	93.7%	88.7%
Medium duty	1.79	25.67	90.9%	85.9%	1.79	25.78	90.9%	85.9%
Heavy duty	3.3	47.44	87.4%	82.4%	3.26	46.93	87.5%	82.5%

Note: Ideal battery initial SOC = 100%, 5 % buffer initial SOC = 95%, 10 % buffer initial SOC = 90 %

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## State of Charge (SOC): Route "7" (28.6 km RT) New Flyer (640 kWh)

	South to West				West to South			
	kWh per km	Total kWh used	SOC at route end		kWh per km	Total kWh used	SOC at route end	
			5 % buffer	10% buffer			5 % buffer	10 % buffer
Light duty	0.58	8.39	93.6%	88.6%	0.56	8.03	93.7%	88.7%
Medium duty	1.76	25.28	90.8%	85.8%	1.77	25.47	90.8%	85.8%
Heavy duty	3.28	47.17	87.2%	82.2%	3.22	46.24	87.4%	82.4%

Note: Ideal battery initial SOC = 100%, 5 % buffer initial SOC = 95%, 10 % buffer initial SOC = 90 %

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## State of Charge (SOC): Route "L" (29.2 km RT) Proterra (660 kWh)

	East to North direction				North to Easts direction			
	kWh per km	Total kWh used	SOC at route end		kWh per km	Total kWh used	SOC at route end	
			5 % buffer	10% buffer			5 % buffer	10 % buffer
Light duty	0.53	7.79	93.8%	88.8%	0.63	9.14	93.5%	88.5%
Medium duty	1.75	25.55	90.9%	85.9%	1.81	26.42	90.8%	85.8%
Heavy duty	3.4	49.64	87.1%	82.1%	3.49	50.91	86.9%	81.9%

Note: Ideal battery initial SOC = 100%, 5 % buffer initial SOC = 95%, 10 % buffer initial SOC = 90 %

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## State of Charge (SOC): Route "L" (29.2 km RT) New Flyer (640 kWh)

	East to North direction				North to Easts direction			
	kWh per km	Total kWh used	SOC at route end		kWh per km	Total kWh used	SOC at route end	
			5 % buffer	10% buffer			5 % buffer	10 % buffer
Light duty	0.52	7.59	93.8%	88.8%	0.61	8.9	93.5%	88.5%
Medium duty	1.73	25.19	90.9%	85.9%	1.78	26.04	90.7%	85.7%
Heavy duty	3.35	48.91	87.0%	82.0%	3.47	50.61	86.7%	81.7%

Note: Ideal battery initial SOC = 100%, 5 % buffer initial SOC = 95%, 10 % buffer initial SOC = 90 %

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## Charging infrastructure simulation

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## State of the art of the technology

- Today, the technology requires slow charging (~150 kW) and can have partial fast charging.
- By 2020 however, the technology will accommodate fast charging (450 – 600 kW) solutions at least partially (e.g if the SOC is within a certain range).

We modeled both solutions.

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## Slow charging (150kW)

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## Electricity demand: Route "7" (28.6 km RT)

- Battery buffer of 10%. SOC cannot be below 10%.
- Slow charge at garage. 150 kW, 90% efficient, final SOC 90%.

	Proterra			New Flyer		
	Number of runs (roundtrips) without charging	Overnight charging time (hours)	Energy from the grid (kWh)	Number of runs (roundtrips) without charging	Overnight charging time (hours)	Energy from the grid (kWh)
Light duty	31	4.3	580.7	31	4.2	565.6
Medium duty	10	4.2	571.7	10	4.2	563.9
Heavy duty	6	4.7	629.1	5	3.8	518.9

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## Electricity demand: Route "L" (29.2 km RT)

- Battery buffer of 10%. SOC cannot be below 10%.
- Slow charge at garage. 150 kW, 90% efficient, final SOC 90%.

	Proterra			New Flyer		
	Number of runs (roundtrips) without charging	Overnight/at-garage charging time (hours)	Energy from the grid (kWh)	Number of runs (roundtrips) without charging	Overnight/at-garage charging time (hours)	Energy from the grid (kWh)
Light duty	31	4.3	583.1	31	4.2	568.0
Medium duty	10	4.3	577.4	10	4.2	569.2
Heavy duty	5	4.1	558.6	5	4.1	552.9

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## Fast charging

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## Electricity demand: Route "7" (28.6 km RT) Proterra (660 kWh) 600 kW charger

### Notes:

**Ideal charging:** the energy from the grid goes straight to the battery

**Typical efficiency:** 86% of the energy from the grid goes to the battery (91% charger efficiency, 95% battery management system efficiency).

**Range of operation:** SOC 10%-90%

	East to North direction				North to East direction			
	Ideal charging 100 %		Typical efficiency 86 %		Ideal charging 100 %		Typical efficiency 86 %	
	Charging time (min)	Energy from the grid (kWh)	Charging time (min)	Energy from the grid (kWh)	Endpoint charging time (min)	Energy from the grid (kWh)	Charging time (min)	Energy from the grid (kWh)
Light duty	0.86	8.63	1.0	7.48	0.82	8.25	0.95	7.16
Medium duty	2.57	25.69	2.97	22.29	2.58	25.8	2.98	22.39
Heavy duty	4.74	47.42	5.49	41.14	4.69	46.88	5.42	40.67

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## Electricity demand: Route "7" (28.6 km RT) New Flyer (640 kWh) 600 kW charger

### Notes:

**Ideal charging:** the energy from the grid goes straight to the battery

**Typical efficiency:** 86% of the energy from the grid goes to the battery (91% charger efficiency, 95 % battery management system efficiency).

**Range of operation:** SOC 10%-90%

	East to North direction				North to East direction			
	Ideal charging 100 %		Typical efficiency 86 %		Ideal charging 100 %		Typical efficiency 86 %	
	Charging time (min)	Energy from the grid (kWh)	Charging time (min)	Energy from the grid (kWh)	Endpoint charging time (min)	Energy from the grid (kWh)	Charging time (min)	Energy from the grid (kWh)
Light duty	0.84	8.4	0.97	7.29	0.8	8.04	0.93	6.97
Medium duty	2.53	25.31	2.93	21.96	2.55	25.49	2.95	22.12
Heavy duty	4.72	47.21	5.46	40.96	4.62	46.22	5.35	40.1

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## Electricity demand: Route "L" (29.2 km RT) Proterra (660 kWh) 600 kW charger

### Notes:

**Ideal charging:** the energy from the grid goes straight to the battery

**Typical efficiency:** 86% of the energy from the grid goes to the battery (91% charger efficiency, 95 % battery management system efficiency).

**Range of operation:** SOC 10%-90%

	East to North direction				North to East direction			
	Ideal charging 100 %		Typical efficiency 86 %		Ideal charging 100 %		Typical efficiency 86 %	
	Charging time (min)	Energy from the grid (kWh)	Charging time (min)	Energy from the grid (kWh)	Endpoint charging time (min)	Energy from the grid (kWh)	Charging time (min)	Energy from the grid (kWh)
Light duty	0.78	7.8	0.9	6.77	0.91	9.15	1.06	7.94
Medium duty	2.56	25.58	2.96	22.19	2.64	26.44	3.06	22.94
Heavy duty	4.96	49.61	5.74	43.04	5.09	50.92	5.89	44.17

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## Electricity demand: Route "L" (29.2 km RT) New Flyer (640 kWh) 600 kW charger

### Notes:

**Ideal charging:** the energy from the grid goes straight to the battery

**Typical efficiency:** 86% of the energy from the grid goes to the battery (91% charger efficiency, 95 % battery management system efficiency).

**Range of operation:** SOC 10%-90%

	East to North direction				North to East direction			
	Ideal charging 100 %		Typical efficiency 86 %		Ideal charging 100 %		Typical efficiency 86 %	
	Charging time (min)	Energy from the grid (kWh)	Charging time (min)	Energy from the grid (kWh)	Endpoint charging time (min)	Energy from the grid (kWh)	Charging time (min)	Energy from the grid (kWh)
Light duty	0.76	7.6	0.88	6.59	0.89	8.91	1.03	7.73
Medium duty	2.52	25.22	2.92	21.88	2.61	26.07	3.02	22.62
Heavy duty	4.89	48.9	5.66	42.42	5.07	50.67	5.86	43.96

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# Comparative simulation of diesel bus fuel consumption

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## Fuel consumption simulation: New Flyer 2013 XD60s

- Used Python code developed in-house, based on work from [1]

Vehicle parameters	Value	Unit	Fuel parameters	Value	Unit
Vehicle curb weight	19,409	kg	LHV of low sulfur diesel	42.6	MJ/kg
Mean passenger weight	75	kg	Diesel density	850	kg/m <sup>3</sup>
Maximum passengers	128	-	CO <sub>2</sub> content of fuel *	2.630	kg CO <sub>2e</sub> /L fuel
Engine maximum power	246	kW			
Drivetrain efficiency	95	%			
Rolling coefficient	Provided by OEM	-			

\*Note: emission factors for mobile fuel combustion of diesel in heavy-duty vehicles, see [2]

- [1] W. Edwardes and H. Rakha "Modeling Diesel and Hybrid Bus Fuel Consumption with Virginia Tech Comprehensive Power-Based Fuel Consumption: Model Enhancements and Calibration Issues Model". Transportation Research Record: Journal of the Transportation Research Board, No. 2533
- [2] BC Ministry of Environment "2016/17 B.C. Best practices Methodology for quantifying greenhouse gas emissions" Victoria, May 2016

## Fuel consumption: Route "7" (28.6 km RT)

Runs (round trips) per week to compare with e-buses based on the schedule: 744

	Light-Duty	Medium-Duty	Heavy-Duty
Fuel used per run (round trip) per bus (L)	6.6	12.2	19.4
Fuel efficiency of diesel equivalent (L/100km)	23.1	42.4	67.7
Emitted CO <sub>2e</sub> per year (kg)	678,756	1,245,184	1,986,515
Cost of diesel per year @\$0.9116/L (\$) *	\$235,268	\$431,601	\$ 688,558

\* Note: \$0.9116/L based on London Transit's average fuel price over the last 10 years

## Fuel consumption: Route "L" (29.2 km RT)

Runs (round trips) per week to compare with e-buses based on the schedule: 1488

	Light-Duty	Medium-Duty	Heavy-Duty
Fuel used per run (round trip) per bus (L)	6.7	12.2	20.3
Fuel efficiency of diesel equivalent (L/100km)	23	41.7	69.7
Emitted CO <sub>2e</sub> per year (kg)	1,371,652	2,486,126	4,156,430
Cost of diesel per year @\$0.9116/L (\$) *	\$475,436	\$861,731	\$1,440,685

\* Note: \$0.9116/L based on London Transit's average fuel price over the last 10 years

## Electricity costs estimations, emission reduction and simulation results for each route

## Assumptions on the schedule (revised)

### Rapid Transit Operating Schedule Information

The "7" Corridor will operate on a 10-minute frequency during the following periods  
 Monday – Saturday from 6am to midnight (18 hours of operation)  
 Sunday & Stat Holidays from 7am to 11pm (16 hours of operation)

The "L" Corridor will operate on a 5-minute frequency during the following periods  
 Monday – Saturday from 6am to midnight (18 hours of operation)  
 Sunday & Stat Holidays from 7am to 11pm (16 hours of operation)

Stop at the terminal station: 5 min

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## Sample route "7" weekday schedule

Total # round trips/day: Weekday: 108,  
 Saturday: 108, Sunday: 96

West to South			South to West		
Wonderland & Oxford (starts)	White Oaks (arrive)	STOP time (min)	White Oaks (starts)	Wonderland & Oxford (arrive)	STOP time (min)
6:00	6:35	5	6:00	6:35	5
6:10	6:45	5	6:10	6:45	5
6:20	6:55	5	6:20	6:55	5
6:30	7:05	5	6:30	7:05	5
6:40	7:15	5	6:40	7:15	5
6:50	7:25	5	6:50	7:25	5
7:00	7:35	5	7:00	7:35	5
7:10	7:45	5	7:10	7:45	5
....			...		

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## Sample route "L" weekday schedule

Total # round trips/day: Weekday: 216,  
 Saturday: 216, Sunday: 192

West to South			South to West		
Wonderland & Oxford (starts)	White Oaks (arrive)	STOP time (min)	White Oaks (starts)	Wonderland & Oxford (arrive)	STOP time (min)
6:00	6:35	5	6:00	6:35	5
6:05	6:40	5	6:05	6:40	5
6:10	6:45	5	6:10	6:45	5
6:40	7:15	5	6:40	7:15	5
6:45	7:20	5	6:45	7:20	5
6:50	7:25	5	6:50	7:25	5
....			...		

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## Required number of buses if slow charging is used: Routes "7" & "L"

Minimum required for the schedule, 1  
 to 1 diesel replacement

Route 7 – less frequent	Number of 60ft required to fully electrify the route	
	Proterra	New Flyer
Light duty	8 [vs. 8]	8
Medium duty	11	11
Heavy duty	20	20

Minimum required for the schedule, 1  
 to 1 diesel replacement

Route L – more frequent	Number of 60ft required to fully electrify the route	
	Proterra	New Flyer
Light duty	16 [vs. 16]	16
Medium duty	22	22
Heavy duty	42	42

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## Required number of buses if fast charging (600 kW) is used: Routes "7" & "L"

Minimum required for the schedule, 1 to 1 diesel replacement

Route 7 – less frequent	Number of 60ft required to fully electrify the route	
	Proterra	New Flyer
Light duty	8 [vs. 8]	8
Medium duty	8	8
Heavy duty	12	12

Minimum required for the schedule, 1 to 1 diesel replacement

Route L – more frequent	Number of 60ft required to fully electrify the route	
	Proterra	New Flyer
Light duty	16 [vs. 16]	16
Medium duty	16	16
Heavy duty	27	27

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## Fully electrifying the route is possible with rapid chargers is possible

- Note, routes will not operate continuously on a heavy duty cycle mode.
- Four chargers are required, one at each North, East, West and South terminal
- **Route "7"**
  - Two buses charge in a 15min interval (used for demand charges calculations)
- **Route "L"**
  - Three buses charge in a 15min interval (used for demand charges calculations)
- There is a possibility to refine the model to include longer stops and charging at the Central Transit Hub if this is a preferred strategy to utilize fewer e-buses in total.

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## Slow charging

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## Overnight charging costs

- Assumed a constant overnight electricity cost of \$0.0936 /kWh (average 2016 night market price and added global adjustment rate that changes monthly )
- Remaining electricity price is calculated as per previous modelling, expecting the charging power is 150kW

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## Charging costs: Route "7" (28.6 km RT) Proterra (660 kWh)

Notes:

Used London Hydro Rates: General Service, Greater Than 50 kW with no interval meter rates

Assumed 1 slow charger per bus

Total cost per route (inclusive of all buses)

	Light	Medium	Heavy
Yearly MWh estimated	727	2,220	4,072
Electricity cost (CAD \$)	\$ 68,098	\$ 207,808	\$ 381,163
Delivery cost (CAD \$)	\$ 96,005	\$ 132,007	\$ 240,012
Regulatory cost (CAD \$)	\$ 7,933	\$ 24,203	\$ 44,391
<b>Total charging cost for a year (CAD \$)</b>	<b>\$ 172,036</b>	<b>\$ 364,017</b>	<b>\$ 665,566</b>
Diesel cost for a year (CAD \$)	\$ 235,268	\$ 431,601	\$ 688,558
<b>Benefits (CAD \$)</b>	<b>\$ 63,232</b>	<b>\$ 67,583</b>	<b>\$ 22,992</b>
Carbon price electricity (CAD \$) with \$50/TCO <sub>2e</sub>	\$ 1,601	\$ 4,884	\$ 8,959
Carbon price diesel (CAD \$) with \$50/TCO <sub>2e</sub>	\$ 12,927	\$ 23,714	\$ 37,833
<b>Benefits with Carbon price (CAD \$)</b>	<b>\$ 74,558</b>	<b>\$ 86,413</b>	<b>\$ 51,866</b>

\* at \$0.9116/L based on London Transit's average fuel price over the last 10 years

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## Charging costs: Route "7" (28.6 km RT) New Flyer (640 kWh)

Notes:

Used London Hydro Rates: General Service, Greater Than 50 kW with no interval meter rates

Assumed 1 slow charger per bus

Total cost per route (inclusive of all buses)

	Light	Medium	Heavy
Yearly MWh estimated	708	2,189	4,030
Electricity cost (CAD \$)	\$ 66,321	\$ 204,981	\$ 377,286
Delivery cost (CAD \$)	\$ 96,005	\$ 132,007	\$ 240,012
Regulatory cost (CAD \$)	\$ 7,726	\$ 23,874	\$ 43,939
<b>Total charging cost for a year (CAD \$)</b>	<b>\$ 170,052</b>	<b>\$ 360,861</b>	<b>\$ 661,237</b>
Diesel cost for a year (CAD \$)	\$ 235,268	\$ 431,601	\$ 688,558
<b>Benefits (CAD \$)</b>	<b>\$ 65,216</b>	<b>\$ 70,740</b>	<b>\$ 27,321</b>
Carbon price electricity (CAD \$) with \$50/TCO <sub>2e</sub>	\$ 1,559	\$ 4,818	\$ 8,868
Carbon price diesel (CAD \$) with \$50/TCO <sub>2e</sub>	\$ 12,927	\$ 23,714	\$ 37,833
<b>Benefits with Carbon price (CAD \$)</b>	<b>\$ 76,584</b>	<b>\$ 89,636</b>	<b>\$ 56,286</b>

\* at \$0.9116/L based on London Transit's average fuel price over the last 10 years

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## Charging costs: Route "L" (29.2 km RT) Proterra (660 kWh)

Notes:

Used London Hydro Rates: General Service, Greater Than 50 kW with no interval meter rates

Assumed 1 slow charger per bus

Total cost per route (inclusive of all buses)

	Light	Medium	Heavy
Yearly MWh estimated	1,461	4,485	8,677
Electricity cost (CAD \$)	\$ 136,761	\$ 419,816	\$ 812,248
Delivery cost (CAD \$)	\$ 192,010	\$ 264,013	\$ 504,025
Regulatory cost (CAD \$)	\$ 15,929	\$ 48,892	\$ 94,592
<b>Total charging cost for a year (CAD \$)</b>	<b>\$ 344,700</b>	<b>\$ 732,722</b>	<b>\$ 1,410,865</b>
Diesel cost for a year (CAD \$)	\$ 475,436	\$ 861,731	\$ 1,440,685
<b>Benefits (CAD \$)</b>	<b>\$ 130,736</b>	<b>\$ 129,009</b>	<b>\$ 29,820</b>
Carbon price electricity (CAD \$) with \$50/TCO <sub>2e</sub>	\$ 3,214	\$ 9,867	\$ 19,091
Carbon price diesel (CAD \$) with \$50/TCO <sub>2e</sub>	\$ 26,123	\$ 47,348	\$ 79,159
<b>Benefits with Carbon price (CAD \$)</b>	<b>\$ 153,645</b>	<b>\$ 166,490</b>	<b>\$ 89,887</b>

\* at \$0.9116/L based on London Transit's average fuel price over the last 10 years

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## Charging costs: Route "L" (29.2 km RT) New Flyer (640 kWh)

Notes:

Used London Hydro Rates: General Service, Greater Than 50 kW with no interval meter rates

Assumed 1 slow charger per bus

Total cost per route (inclusive of all buses)

	Light	Medium	Heavy
Yearly MWh estimated	1,423	4,421	8,588
Electricity cost (CAD \$)	\$ 133,207	\$ 413,839	\$ 803,928
Delivery cost (CAD \$)	\$ 192,010	\$ 264,013	\$ 504,025
Regulatory cost (CAD \$)	\$ 15,515	\$ 48,196	\$ 93,623
<b>Total charging cost for a year (CAD \$)</b>	<b>\$ 340,732</b>	<b>\$ 726,048</b>	<b>\$ 1,401,576</b>
Diesel cost for a year (CAD \$)	\$ 475,436	\$ 861,731	\$ 1,440,685
<b>Benefits (CAD \$)</b>	<b>\$ 134,704</b>	<b>\$ 135,683</b>	<b>\$ 39,109</b>
Carbon price electricity (CAD \$) with \$50/TCO <sub>2e</sub>	\$ 3,131	\$ 9,727	\$ 18,896
Carbon price diesel (CAD \$) with \$50/TCO <sub>2e</sub>	\$ 26,123	\$ 47,348	\$ 79,159
<b>Benefits with Carbon price (CAD \$)</b>	<b>\$ 157,696</b>	<b>\$ 173,304</b>	<b>\$ 99,372</b>

\* at \$0.9116/L based on London Transit's average fuel price over the last 10 years

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# Fast charging

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## Charging costs: Route "7" (28.6 km RT) Proterra (660 kWh)

Note:

Used London Hydro Rates: General Service, Greater Than 50 KW with no interval meter rates

Diesel at \$0.9116/L based on London Transit's average fuel price over the last 10 years

Total cost per route (inclusive of all buses)

	Light	Medium	Heavy
Yearly MWh estimated	761	2,321	3,900
Electricity cost (CAD \$)	\$ 88,882	\$271,178	\$455,661
Regulatory cost (CAD \$)	\$ 8,295	\$ 25,302	\$ 42,513
Delivery cost (CAD \$)	\$ 14,572	\$ 35,880	\$ 57,541
<b>Total charging cost for a year (CAD \$)</b>	<b>\$111,749</b>	<b>\$332,360</b>	<b>\$555,715</b>
Diesel cost for a year (CAD \$)	\$235,268	\$431,601	\$688,558
<b>Benefits (CAD \$)</b>	<b>\$123,519</b>	<b>\$ 99,241</b>	<b>\$132,843</b>
Carbon price electricity (CAD \$) with \$50/TCO2e	\$ 1,674	\$ 5,106	\$ 8,580
Carbon price diesel (CAD \$) with \$50/TCO2e	\$ 33,938	\$ 62,259	\$ 99,326
<b>Benefits with Carbon price (CAD \$)</b>	<b>\$ 155,782</b>	<b>\$ 156,394</b>	<b>\$ 223,588</b>

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## Charging costs – Route "7" (28.6 km RT) New Flyer (640 kWh)

Note:

Used London Hydro Rates: General Service, Greater Than 50 KW with no interval meter rates

Diesel at \$0.9116/L based on London Transit's average fuel price over the last 10 years

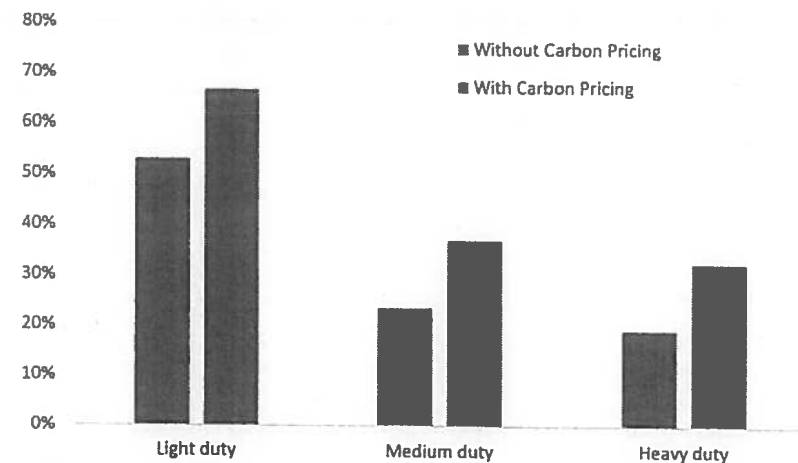
Total cost per route (inclusive of all buses)

	Light	Medium	Heavy
Yearly MWh estimated	741	2,289	3,900
Electricity cost (CAD \$)	\$ 86,562	\$267,485	\$455,661
Regulatory cost (CAD \$)	\$ 8,079	\$ 24,958	\$ 42,513
Delivery cost (CAD \$)	\$ 14,287	\$ 35,495	\$ 57,541
<b>Total charging cost for a year (CAD \$)</b>	<b>\$108,927</b>	<b>\$327,937</b>	<b>\$555,715</b>
Diesel cost for a year (CAD \$)	\$235,268	\$431,601	\$688,558
<b>Benefits (CAD \$)</b>	<b>\$126,341</b>	<b>\$103,664</b>	<b>\$132,843</b>
Carbon price electricity (CAD \$) with \$50/TCO2e	\$ 1,630	\$ 5,036	\$ 8,580
Carbon price diesel (CAD \$) with \$50/TCO2e	\$ 33,938	\$ 62,259	\$ 99,326
<b>Benefits with Carbon price (CAD \$)</b>	<b>\$ 158,648</b>	<b>\$ 160,887</b>	<b>\$ 223,588</b>

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## Average yearly benefits: Fast charging Route "7" (28.6 km RT)



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## Charging costs: Route "L" (29.2 km RT) Proterra (660 kWh)

Note:

Used London Hydro Rates: General Service, Greater Than 50 KW with no interval meter rates

Diesel at \$0.9116/L based on London Transit's average fuel price over the last 10 years

Total cost per route (inclusive of all buses)

	Light	Medium	Heavy
Yearly MWh estimated	1,515	4,652	7,737
Electricity cost (CAD \$)	\$177,208	\$544,009	\$ 904,952
Regulatory cost (CAD \$)	\$ 16,520	\$ 50,704	\$ 84,343
Delivery cost (CAD \$)	\$ 20,892	\$ 53,077	\$ 84,377
<b>Total charging cost for a year (CAD \$)</b>	<b>\$214,620</b>	<b>\$647,790</b>	<b>\$1,073,671</b>
Diesel cost for a year (CAD \$)	\$475,436	\$861,731	\$1,440,685
<b>Benefits (CAD \$)</b>	<b>\$260,816</b>	<b>\$213,941</b>	<b>\$ 367,014</b>
Carbon price electricity (CAD \$) with \$50/TCO2e	\$ 3,333	\$ 10,234	\$ 17,021
Carbon price diesel (CAD \$) with \$50/TCO2e	\$ 68,583	\$124,306	\$ 207,821
<b>Benefits with Carbon price (CAD \$)</b>	<b>\$326,066</b>	<b>\$328,013</b>	<b>\$ 557,814</b>

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## Charging costs: Route "L" (29.2 km RT) New Flyer (640 kWh)

Note:

Used London Hydro Rates: General Service, Greater Than 50 KW with no interval meter rates

Diesel at \$0.9116/L based on London Transit's average fuel price over the last 10 years

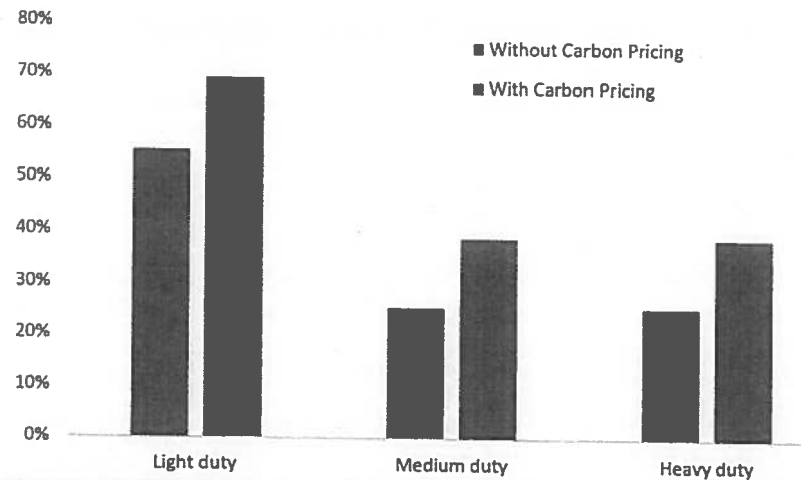
Total cost per route (inclusive of all buses)

	Light	Medium	Heavy
Yearly MWh estimated	1,476	4,585	7,737
Electricity cost (CAD \$)	\$172,602	\$536,263	\$ 904,952
Regulatory cost (CAD \$)	\$ 16,090	\$ 49,983	\$ 84,343
Delivery cost (CAD \$)	\$ 20,445	\$ 52,369	\$ 84,377
<b>Total charging cost for a year (CAD \$)</b>	<b>\$209,138</b>	<b>\$638,614</b>	<b>\$1,073,671</b>
Diesel cost for a year (CAD \$)	\$475,436	\$861,731	\$1,440,685
<b>Benefits (CAD \$)</b>	<b>\$266,298</b>	<b>\$223,117</b>	<b>\$ 367,014</b>
Carbon price electricity (CAD \$) with \$50/TCO2e	\$ 3,247	\$ 10,087	\$ 17,021
Carbon price diesel (CAD \$) with \$50/TCO2e	\$ 68,583	\$124,306	\$ 207,821
<b>Benefits with Carbon price (CAD \$)</b>	<b>\$331,634</b>	<b>\$337,336</b>	<b>\$ 557,814</b>

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## Average yearly benefits: Fast charging Route "L" (29.2 km RT)



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## Ontario 2015 Grid Emissions [2]

	Solar / Wind / Bioenergy	Natural Gas	Nuclear	Coal	Waterpower
Electricity production (TWh)	14.2	15.9	92.3	0	37.3
Percentage of the grid use (%)	8.89	9.96	57.80	0.00	23.36

- Total electricity production (2015): 159.7 TWh
- Total emission (2015): 7.1 MT CO2e
- The emission is calculated as 0.044 Tonne CO2e/MWh

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# Fast charging

## Emissions reduction: Route "7" (28.6 km RT) Proterra (660 kWh)

	Light	Medium	Heavy
Yearly electricity estimated (MWh)	761	2,321	3,900
Yearly diesel use (L)	258,082	473,454	755,329
CO2e from electricity (Tonne)	33	102	172
CO2e from diesel (Tonne)*	679	1245	1987
CO2e reduction for a year (Tonne)	645	1143	1815

\* : Mobile emissions factor for mobile fuel combustion of diesel in heavy-duty vehicles is 2.63 kg CO2e/L

## Emissions reduction: Route "7" (28.6 km RT) New Flyer (640 kWh)

	Light	Medium	Heavy
Yearly electricity estimated (MWh)	741	2,289	3,900
Yearly diesel use (L)	258,082	473,454	755,329
CO2e from electricity (Tonne)	33	101	172
CO2e from diesel (Tonne)*	679	1245	1987
CO2e reduction for a year (Tonne)	646	1144	1815

\* : Mobile emissions factor for mobile fuel combustion of diesel in heavy-duty vehicles is 2.63 kg CO2e/L

## Emissions reduction: Route "L" (29.2 km RT) Proterra (660 kWh)

	Light	Medium	Heavy
Yearly electricity estimated (MWh)	1,515	4,652	7,737
Yearly diesel use (L)	521,541	945,295	1,580,392
CO2e from electricity (Tonne)	67	205	340
CO2e from diesel (Tonne)*	1372	2486	4156
CO2e reduction for a year (Tonne)	1305	2281	3816

\* : Mobile emissions factor for mobile fuel combustion of diesel in heavy-duty vehicles is 2.63 kg CO2e/L

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## Emissions reduction: Route "L" (29.2 km RT) New Flyer (640 kWh)

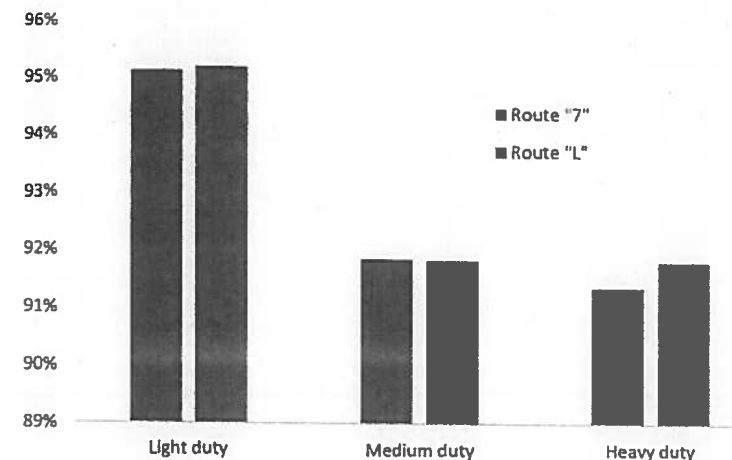
	Light	Medium	Heavy
Yearly electricity estimated (MWh)	1,476	4,585	7,737
Yearly diesel use (L)	521,541	945,295	1,580,392
CO2e from electricity (Tonne)	65	202	340
CO2e from diesel (Tonne)*	1372	2486	4156
CO2e reduction for a year (Tonne)	1307	2284	3816

\* : Mobile emissions factor for mobile fuel combustion of diesel in heavy-duty vehicles is 2.63 kg CO2e/L

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## Average yearly emission reductions: Route "7" and route "L"



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## Recall: 40 ft scenario

Electricity costs estimations, emission reduction and simulation results for each route

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## Assumptions on the schedule (revised)

### Rapid Transit Operating Schedule Information

The "7" Corridor will operate on a 10 minute frequency during the following periods

Monday – Saturday from 6am to midnight (18 hours of operation)

Sunday & Stat Holidays from 7am to 11pm (16 hours of operation)

The "L" Corridor will operate on a 5 minute frequency during the following periods

Monday – Saturday from 6am to midnight (18 hours of operation)

Sunday & Stat Holidays from 7am to 11pm (16 hours of operation)

**Stop at the terminal station: 5 min (maximum charging time is less than 4 min)**

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### Sample route "7" weekday schedule

Total # round trips/day: Weekday: 108,  
Saturday: 108, Sunday: 96

West to South			South to West		
Wonderland & Oxford (starts)	White Oaks (arrive)	STOP time (min)	White Oaks (starts)	Wonderland & Oxford (arrive)	STOP time (min)
6:00	6:35	5	6:00	6:35	5
6:10	6:45	5	6:10	6:45	5
6:20	6:55	5	6:20	6:55	5
6:30	7:05	5	6:30	7:05	5
6:40	7:15	5	6:40	7:15	5
6:50	7:25	5	6:50	7:25	5
7:00	7:35	5	7:00	7:35	5
7:10	7:45	5	7:10	7:45	5
...	...	...	...	...	...

*eBus B - 10 min frequency*  
*eBus A - 10 min frequency*

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### Sample route "L" weekday schedule

Total # round trips/day: Weekday: 216,  
Saturday: 216, Sunday: 192

West to South			South to West		
Wonderland & Oxford (starts)	White Oaks (arrive)	STOP time (min)	White Oaks (starts)	Wonderland & Oxford (arrive)	STOP time (min)
6:00	6:35	5	6:00	6:35	5
6:05	6:40	5	6:05	6:40	5
6:10	6:45	5	6:10	6:45	5
6:40	7:15	5	6:40	7:15	5
6:45	7:20	5	6:45	7:20	5
6:50	7:25	5	6:50	7:25	5
...	...	...	...	...	...

*eBus B - 5 min frequency*  
*eBus A - 5 min frequency*

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### State of Charge (SOC) - Route "7" (28.6 km RT) with Nova Bus (76 kWh)

	South to West			West to South				
	kWh per km	Total kWh used	SOC at route end		kWh per km	Total kWh used	SOC at route end	
			5 % buffer	10 % buffer			5 % buffer	10 % buffer
Light duty	0.4	5.79	87.0%	82.0%	0.38	5.45	87.5%	82.5%
Medium duty	0.99	14.29	75.2%	70.2%	1.0	14.3	75.2%	70.2%
Heavy duty	1.6	23.04	63.1%	58.1%	1.6	23.0	63.1%	58.1%

Note: Ideal battery initial SOC = 100%, 5 % buffer initial SOC = 95%, 10 % buffer initial SOC = 90 %

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### State of Charge (SOC) - Route "7" (28.6 km RT) with New Flyer (200 kWh)

	South to West				West to South			
	kWh per km	Total kWh used	SOC at route end		kWh per km	Total kWh used	SOC at route end	
			5 % buffer	10 % buffer			5 % buffer	10 % buffer
Light duty	0.43	6.12	91.8%	86.8%	0.4	5.73	92.0%	87.0%
Medium duty	1.03	14.82	87.2%	82.2%	1.03	14.76	87.2%	82.2%
Heavy duty	1.64	23.63	82.6%	77.6%	1.64	23.58	82.6%	77.6%

Note: Ideal battery initial SOC = 100%, 5 % buffer initial SOC = 95%, 10 % buffer initial SOC = 90 %

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# Recall: 40 ft Charging infrastructure simulation

## Electricity demand – Route "7" (28.6 km RT) Nova Bus (76 kWh) 450 kW charger

	South to West direction						West to South direction					
	Ideal charging 100 %		Typical efficiency 86 %		Worst case efficiency 71%		Ideal charging 100 %		Typical efficiency 86 %		Worst case efficiency 71%	
	Charging time (min)	Energy from the grid (kWh)	Charging time (min)	Energy from the grid (kWh)	Charging time (min)	Energy from the grid (kWh)	Endpoint charging time (min)	Energy from the grid (kWh)	Charging time (min)	Energy from the grid (kWh)	Charging time (min)	Energy from the grid (kWh)
Light duty	0.77	5.79	<b>0.89</b>	6.7	1.09	8.16	0.73	5.45	<b>0.84</b>	6.31	1.02	7.68
Medium duty	1.91	14.31	<b>2.21</b>	16.55	2.69	20.15	1.91	14.32	<b>2.21</b>	16.56	2.69	20.16
Heavy duty	3.08	23.07	<b>3.56</b>	26.68	4.33	32.49	3.07	23.02	<b>3.55</b>	26.63	4.32	32.43

Note: Ideal charging: the energy from the grid goes straight to the battery  
 Typical efficiency: 86% of the energy from the grid goes to the battery (91% charger efficiency, 95 % battery management system efficiency)  
 Worst case efficiency: 71% of the energy from the grid goes to the battery

## Electricity demand – Route "7" (28.6 km RT) New Flyer (200 kWh) 450 kW charger

	South to West direction						West to South direction					
	Ideal charging 100 %		Typical efficiency 86 %		Worst case efficiency 71%		Ideal charging 100 %		Typical efficiency 86 %		Worst case efficiency 71%	
	Charging time (min)	Energy from the grid (kWh)	Charging time (min)	Energy from the grid (kWh)	Charging time (min)	Energy from the grid (kWh)	Endpoint charging time (min)	Energy from the grid (kWh)	Charging time (min)	Energy from the grid (kWh)	Charging time (min)	Energy from the grid (kWh)
Light duty	0.82	6.12	<b>0.94</b>	7.08	1.15	8.63	0.77	5.74	<b>0.89</b>	6.64	1.08	8.08
Medium duty	1.98	14.84	<b>2.29</b>	17.16	2.79	20.9	1.97	14.77	<b>2.28</b>	17.08	2.77	20.8
Heavy duty	3.15	23.65	<b>3.65</b>	27.36	4.44	33.31	3.15	23.61	<b>3.64</b>	27.31	4.43	33.25

Note: Ideal charging: the energy from the grid goes straight to the battery  
 Typical efficiency: 86% of the energy from the grid goes to the battery (91% charger efficiency, 95 % battery management system efficiency)  
 Worst case efficiency: 71% of the energy from the grid goes to the battery

## Electricity demand – Route "L" (29.2 km RT) Nova Bus (76 kWh) 450 kW charger

	East to North direction						North to East direction					
	Ideal charging 100 %		Typical efficiency 86 %		Worst case efficiency 71%		Ideal charging 100 %		Typical efficiency 86 %		Worst case efficiency 71%	
	Charging time (min)	Energy from the grid (kWh)	Charging time (min)	Energy from the grid (kWh)	Charging time (min)	Energy from the grid (kWh)	Endpoint charging time (min)	Energy from the grid (kWh)	Charging time (min)	Energy from the grid (kWh)	Charging time (min)	Energy from the grid (kWh)
Light duty	0.69	5.17	<b>0.8</b>	5.98	0.97	7.28	0.81	6.11	<b>0.94</b>	7.06	1.15	8.6
Medium duty	1.86	13.96	<b>2.15</b>	16.15	2.62	19.66	1.97	14.8	<b>2.28</b>	17.13	2.78	20.85
Heavy duty	3.23	24.21	<b>3.73</b>	28.0	4.55	34.1	3.3	24.76	<b>3.82</b>	28.64	4.65	34.88

Note: Ideal charging: the energy from the grid goes straight to the battery  
 Typical efficiency: 86% of the energy from the grid goes to the battery (91% charger efficiency, 95 % battery management system efficiency)  
 Worst case efficiency: 71% of the energy from the grid goes to the battery

32



## Electricity demand – Route “L” (29.2 km RT) New Flyer (200 kWh) 450 kW charger

	East to North direction						North to East direction					
	Ideal charging 100 %		Typical efficiency 86 %		Worst case efficiency 71%		Ideal charging 100 %		Typical efficiency 86 %		Worst case efficiency 71%	
	Charging time (min)	Energy from the grid (kWh)	Charging time (min)	Energy from the grid (kWh)	Charging time (min)	Energy from the grid (kWh)	Endpoint charging time (min)	Energy from the grid (kWh)	Charging time (min)	Energy from the grid (kWh)	Charging time (min)	Energy from the grid (kWh)
Light duty	0.73	5.46	<b>0.84</b>	6.31	1.03	7.69	0.86	6.46	<b>1.0</b>	7.47	1.21	9.09
Medium duty	1.92	14.43	<b>2.23</b>	16.69	2.71	20.32	2.04	15.28	<b>2.36</b>	17.68	2.87	21.53
Heavy duty	3.32	24.93	<b>3.85</b>	28.84	4.68	35.12	3.4	25.47	<b>3.93</b>	29.46	4.78	35.87

Note: Ideal charging: the energy from the grid goes straight to the battery  
 Typical efficiency: 86% of the energy from the grid goes to the battery (91% charger efficiency, 95 % battery management system efficiency)  
 Worst case efficiency: 71% of the energy from the grid goes to the battery

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## Fully electrifying the route is possible today with 40fts

- According to the developed schedule, **8 buses** are required for route “7”, **16 buses** are required for route “L”, therefore **24 electric buses** are needed
- Four chargers are required, at each North, East, West and South terminals
  - Route “7” : Two buses charge in a 15min interval (used for demand charges calculations)
  - Route “L”: Three buses charge in a 15min interval (used for demand charges calculations)
- There is a possibility to refine the model to include longer stops and charging at the Central Transit Hub if this is a preferred strategy

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## Charging costs – Route “7” (28.6 km RT) Nova Bus (76 kWh)

	Light	Medium	Heavy
Yearly MWh estimated	507	1,290	2,077
Electricity cost (CAD \$)	\$59,258	\$150,692	\$242,669
Regulatory cost (CAD \$)	\$5,531	\$14,062	\$22,642
Delivery cost (CAD \$)	\$11,058	\$21,625	\$32,477
<b>Total charging cost for a year (CAD \$)</b>	<b>\$75,848</b>	<b>\$186,378</b>	<b>\$297,789</b>
Diesel cost for a year (CAD \$)*	\$227,459	\$386,218	\$570,636
Diesel cost for a year with cap & trade (\$CAD)	\$239,271	\$406,275	\$600,270
Benefits (CAD \$)	\$151,611	\$199,840	\$272,847
Benefits (CAD \$) if cap & trade	\$163,423	\$219,897	\$302,481

Note:

Used London Hydro Rates: General Service, Greater Than 50 KW with no interval meter rates

\* at \$0.9116/L based on London Transit's average fuel price over the last 10 years  
 \*\* with a current carbon price of \$18/TCO2e

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## Charging costs – Route “7” (28.6 km RT) New Flyer (200 kWh)

	Light	Medium	Heavy
Yearly MWh estimated	535	1,334	2,130
Electricity cost (CAD \$)	\$62,475	\$155,913	\$248,837
Regulatory cost (CAD \$)	\$5,832	\$14,549	\$23,218
Delivery cost (CAD \$)	\$11,468	\$22,271	\$33,210
<b>Total charging cost for a year (CAD \$)</b>	<b>\$79,775</b>	<b>\$192,732</b>	<b>\$305,264</b>
Diesel cost for a year (CAD \$)*	\$227,459	\$386,218	\$570,636
Diesel cost for a year with cap & trade (\$CAD)	\$239,271	\$406,275	\$600,270
Benefits (CAD \$)	\$147,684	\$193,486	\$265,372
Benefits (CAD \$) if cap & trade	\$159,496	\$213,543	\$295,006

Note:

Used London Hydro Rates: General Service, Greater Than 50 KW with no interval meter rates

\* at \$0.9116/L based on London Transit's average fuel price over the last 10 years  
 \*\* with a current carbon price of \$18/TCO2e

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## Charging costs – Route “L” (29.2 km RT) Nova Bus (76 kWh)

	Light	Medium	Heavy
Yearly MWh estimated	1,008	2,571	4,379
Electricity cost (CAD \$)	\$117,964	\$300,735	\$512,190
Regulatory cost (CAD \$)	\$10,998	\$28,032	\$47,739
Delivery cost (CAD \$)	\$15,230	\$31,416	\$49,948
<b>Total charging cost for a year (CAD \$)</b>	<b>\$144,192</b>	<b>\$360,182</b>	<b>\$609,876</b>
Diesel cost for a year (CAD \$)*	\$459,686	\$773,446	\$1,199,593
Diesel cost for a year with cap & trade (\$CAD)	\$483,557	\$813,611	\$1,261,889
Benefits (CAD \$)	\$315,494	\$413,264	\$589,717
Benefits (CAD \$) if cap & trade	\$339,365	\$453,429	\$652,013

Note:

Used London Hydro Rates:  
General Service, Greater  
Than 50 KW with no  
interval meter rates

\* at \$0.9116/L based on London Transit's average fuel price over the last 10 years  
\*\* with a current carbon price of \$18/TCO2e

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## Charging costs – Route “L” (29.2 km RT) New Flyer (200 kWh)

	Light	Medium	Heavy
Yearly MWh estimated	1,065	2,656	4,507
Electricity cost (CAD \$)	\$124,558	\$310,679	\$527,054
Regulatory cost (CAD \$)	\$11,613	\$28,959	\$49,124
Delivery cost (CAD \$)	\$15,882	\$32,310	\$51,252
<b>Total charging cost for a year (CAD \$)</b>	<b>\$152,053</b>	<b>\$371,947</b>	<b>\$627,430</b>
Diesel cost for a year (CAD \$)*	\$459,686	\$773,446	\$1,199,593
Diesel cost for a year with cap & trade (\$CAD)	\$483,557	\$813,611	\$1,261,889
Benefits (CAD \$)	\$307,633	\$401,499	\$572,163
Benefits (CAD \$) if cap & trade	\$331,504	\$441,664	\$634,459

Note:

Used London Hydro Rates:  
General Service, Greater  
Than 50 KW with no  
interval meter rates

\* at \$0.9116/L based on London Transit's average fuel price over the last 10 years  
\*\* with a current carbon price of \$18/TCO2e

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## Questions?

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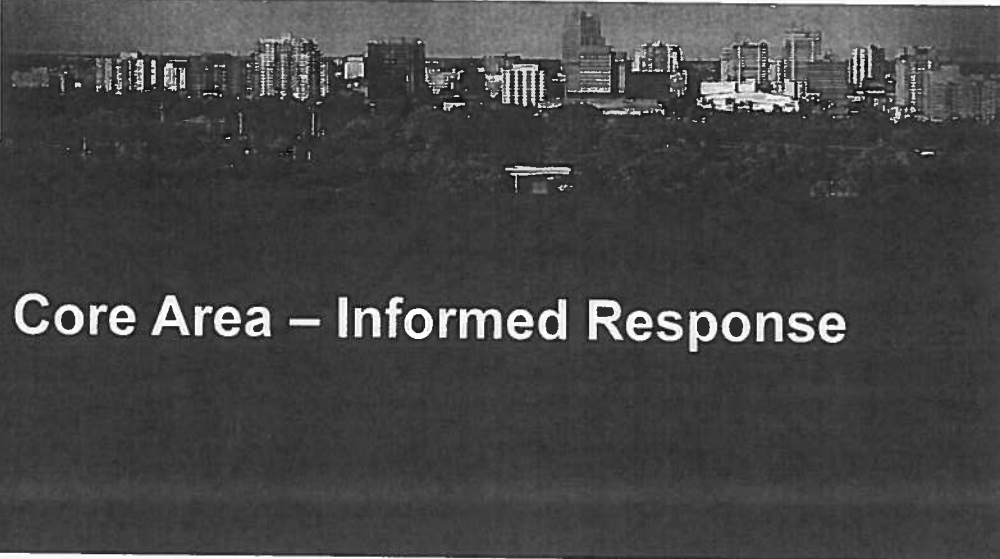
## Additional Q & A

- **SOC buffer :**
  - Slow charging: operates between 10-90 % SOC (current state of the technology)
  - Fast charging: operates between 5-95% SOC (assume technology improvements and future development)
- 150kW charger is assuming "at garage"
  - Note: we do not model the energy consumption of the bus between the terminal station and the depot (dead heading)
- The costs shown in the tables are operating costs for the route (including every buses in the fleet), but not inclusive of maintenance savings (which is a separate economic model)

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# Core Area – Informed Response

September 2018

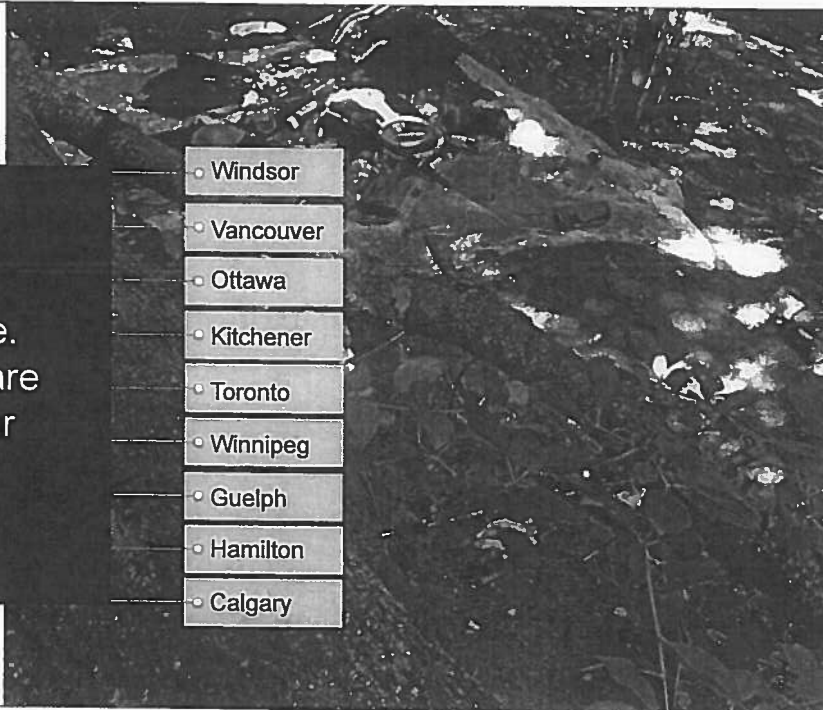


# What's Happening?



We are seeing an increase in street-involved activity and the City is concerned for the well-being and safety of all.

5.1



London is not alone. Other communities are experiencing similar challenges.

- Windsor
- Vancouver
- Ottawa
- Kitchener
- Toronto
- Winnipeg
- Guelph
- Hamilton
- Calgary



# Across Canada



FCM NEWS | September 10, 2018



Mayors press for opioid treatment to help end crisis



## In London

- Increased risks from drug use
- Untreated mental illness
- Homelessness
- Pressures on the supports and treatment options available

5



## Challenges

- Drug induced, unpredictable and disruptive behaviours
- Vandalism and excessive garbage
- Disruption to and trespassing in businesses
- Urban camping

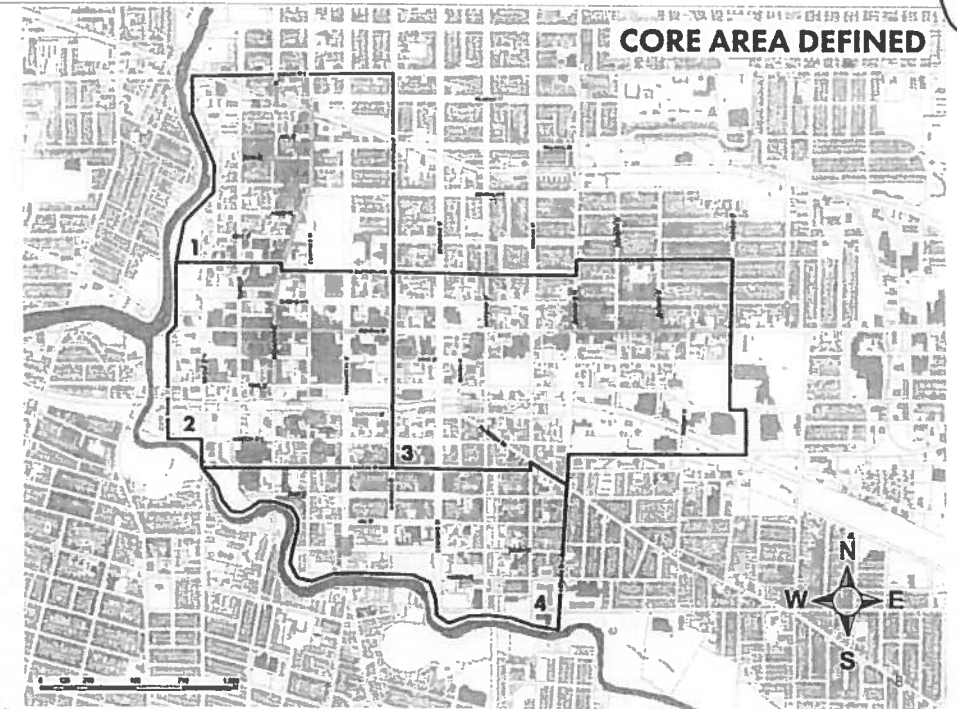
6



## Where Is This Happening In London?



7



london.ca

5.1



## What is London Already Doing?



## Collaboration

- Proactive relationships with the BIAs
- Collaboration among city service areas and community organizations
- Centralized call centre for complaints
- Strong response to all issues by staff
- Strategic plan and other plans in place that have resulted from community consultation



## Safety and Outreach

- Downtown London Police Service foot patrol is in place
- London Cares provides 24/7 outreach
- Community Oriented Response Unit operating within London Police Service
- UN Safe Cities Initiative



## Cleaning and Maintenance

- Strong attempt to keep London's streets clean
- Municipal property is kept clean
- Stationary needle bins are in place
- Our system identifies street cleaning or other issues that need to be addressed, beyond regular maintenance

5.1



## Homeless Prevention

- Five Housing First programs focused on rapidly housing individuals and families experiencing chronic homelessness
- London Cares street outreach operating 24/7
- Emergency shelters/crash beds operating at full capacity

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## Our Response



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## Principles

- 1 We will work collaboratively across all services areas and with other groups.
- 2 We will learn from other communities and employ focused solutions.
- 3 We will assess the effectiveness of our actions and use the results to make evidence-informed decisions.
- 4 We will embed harm reduction pillars in our work.
- 5 We will be a caring and compassionate community.
- 6 We will build on infrastructure and services that currently exist.

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## Pillars

- 1 **Prevention** – Strategies that help prevent the issues being experienced.
- 2 **Treatment** – Strategies that improve the lives of individuals.
- 3 **Harm Reduction** – Strategies that reduce harm to individuals and the community.
- 4 **Enforcement** – Strategies that enforce public order and safety.

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(5.1)



# Strategies

- Provide caring and compassionate response and enhance services available.
- Work collaboratively to solve homelessness through a housing first approach.
- Maintain the safety and cleanliness of private and public spaces.
- Protect and promote the well being and safety of all Londoners.
- Invest in collaborative work practices and infrastructure.



# Our Response

- Is part of an informed response
  - Is focused on an immediate response
  - Addresses the issues causing public concern
  - Focuses on enforcement and prevention in the short-term
- Is not a comprehensive community plan
  - Does not focus on long-term solutions
  - Does not solve the issues causing public concern
  - Does not focus on harm reduction and treatment in the short-term

# Informed Response

## SHORT-TERM

## MEDIUM-TERM

## LONG-TERM

### STRATEGIES

- Work collaboratively to solve homelessness through a Housing First approach.
- Maintain the safety and cleanliness of private and public spaces.
- Protect and promote the safety of Londoners.
- Provide caring and compassionate response and enhance services available.
- Invest in collaborative work practices to support the effective implementation of this informed response.

- Increase street outreach by London Cares.
- Continue to collaborate with Bylaw, London Police Service, London Cares.
- Implement the urban camping plan.
- Increase frequency of cleaning - laneways, streets, parks and parking lots.
- Advance the drug use equipment recovery strategy.
- Increase private security monitoring.
- Increase pro-active Bylaw enforcement.
- Increase police patrol.
- Collect data and manage the Informed Response Team in a focused way.

- Engage community organizations to determine immediate interventions such as additional crash beds, drop-ins, etc.
- Increase public education about drug use equipment recovery on private and public property.
- Increase the capacity to recover drug use equipment on private property.
- Continue to focus on improved coordination with the Southwest LHIN, Mobile Mental Health Crisis Response Unit, Middlesex London Health Unit Outreach Team and London Cares.
- Improve shared practice, data collection and reporting.

- Increase LPS presence in the core.
- Invest in new equipment to improve video surveillance.
- Develop and implement a coordinated plan to respond to the disruptive and violent behaviours of street-involved people.



# Why Now?



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## Why now?

- There is a continued increase in street-involved activities.
- There is a cost if we don't enhance our responses – social and economic.
- We have an opportunity to learn more through the data we collect and build informed responses that will help us into the future.

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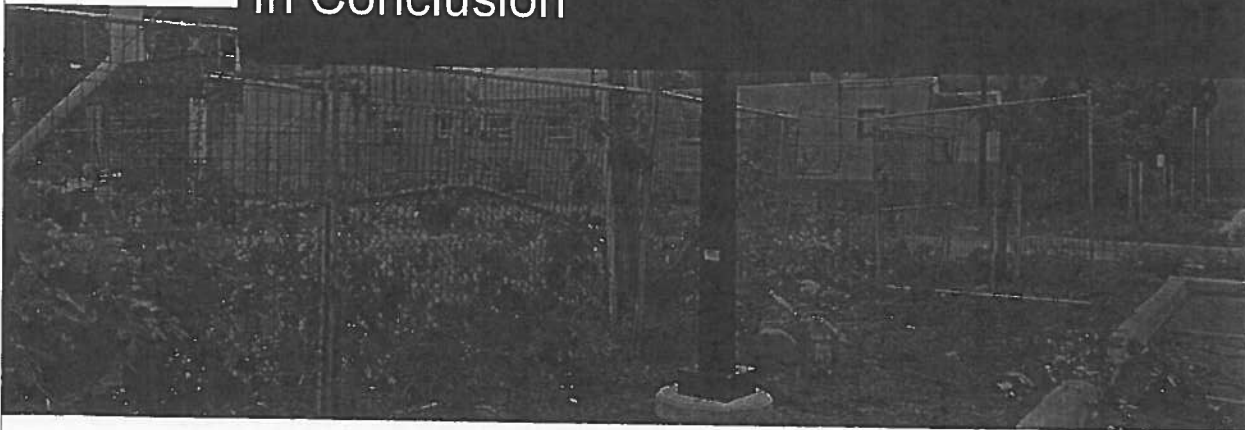
## Expected Short-Term Results

- Reduced health risks
- Increased feeling of safety
- Decreased unpredictable and disruptive behaviour
- Increased response to urban campsites
- Decreased destruction and vandalism
- Decreased criminal or nuisance activity
- Increased cleanliness of public and private property
- Improved appearance of London's core
- Improved data

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## In Conclusion



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(5)



**12TH REPORT OF THE**  
**GOVERNANCE WORKING GROUP**

Meeting held on September 17, 2018, commencing at 1:30 PM, in Committee Room #3, Second Floor, London City Hall.

**PRESENT:** Councillors V. Ridley (Chair), Mayor M. Brown; and Councillors J. Helmer, J. Morgan and M. van Holst; and B. Westlake-Power (Acting Secretary).

**ABSENT:** Councillors M. Cassidy and P. Squire.

---

**1. CALL TO ORDER**

1.1 Disclosures of Pecuniary Interest

That it BE NOTED that no pecuniary interests were disclosed.

**2. CONSENT ITEMS**

None.

**3. ITEMS FOR DISCUSSION**

3.1 Striking Committee Update

That the following actions be taken with respect to updating the terms of reference and mandate of the Striking Committee:

a) the attached, revised, proposed by-law BE INTRODUCED at a future meeting of the Municipal Council, to amend By-law No. CPOL.-59(a)-401, Council Policy, "General Policy for Advisory Committees" by deleting section 4.3 Resignations and Appointments, and section 4.4 Eligibility for Appointment and replacing them with new sections 4.3 and 4.4 to incorporate the following amendments:

- three additional Members-at-large to the membership composition;
- requirement that Striking Committee members not be applicants for any of the Committees whose membership is recommended for appointment by the Striking Committee, or for the city Agencies, Boards or Commissions; and,
- remove a former member of municipal council from the membership composition;

b) subject to the approval of part a), above, the City Clerk BE DIRECTED to take the necessary actions, including a public participation meeting before the Corporate Services Committee, to amend the Council Procedure By-law to reflect the proposed changes.

**4. DEFERRED MATTER/ADDITIONAL BUSINESS**

None.

(52)

**5. ADJOURNMENT**

The meeting adjourned at 1:38 PM.

Next Meeting: Monday, October 15, 2018, 1:30 p.m., Committee Room #3

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Bill No.

2018

By-law No. CPOL.-

A by-law to amend By-Law No. CPOL.-59(a)-401 being "General Policy for Advisory Committees".

WHEREAS section 5(3) of the *Municipal Act, 2001*, S.O. 2001, C.25, as amended, provides that a municipal power shall be exercised by by-law;

AND WHEREAS section 9 of the *Municipal Act, 2001*, S.O. 2001, C.25, as amended, provides a municipality with the capacity, rights, powers and privileges of a natural person for the purpose of exercising its authority;

AND WHEREAS the Municipal Council of The Corporation of the City of London wishes to amend By-law No. CPOL.-59(a)-401 being "General Policy for Advisory Committees" for the purpose of updating the Striking Committee references;

NOW THEREFORE the Municipal Council of The Corporation of the City of London enacts as follows:

1. By-law No. CPOL.-59(a)-401 being "General Policy for Advisory Committees" is hereby amended by deleting section 4.3 Resignations and Appointments, and section 4.4 Eligibility for Appointment and replacing with the following new sections 4.3 and 4.4:

"4.3 Resignations and Appointments

Advisory Committee members wishing to resign their appointment mid-term shall submit their resignation in writing to the City Clerk. When the resignation is accepted by the City Clerk, the City Clerk shall also consider the need to replace the Advisory Committee member, having regard to the remaining composition of the Advisory Committee, the current workload of the advisory committee and the length of time remaining in the Council term. If the City Clerk deems it advisable to replace the Advisory Committee member, then vacancies for citizen-at-large or sectoral Advisory Committee members shall be publicly advertised and residents of the Municipality shall be invited to apply to fill the vacancy. Vacancies for Advisory Committee members who represent a particular organization/agency shall be nominated by that organization/agency and the City Clerk shall have the delegated authority to confirm those appointments on behalf of the Municipal Council. All Advisory Committee appointments occurring mid-term shall be recommended by the committee mandated with that task by the Municipal Council, for consideration by the Municipal Council, with the exception of those appointments otherwise delegated to the City Clerk. Individuals who are unsuccessful in being appointed to an Advisory Committee at the beginning of a Council term shall be notified by the City Clerk of any vacancies that arise on the Advisory Committee to which they applied during that term, and be given an opportunity to re-apply for the vacancy.

The City Clerk shall, in the month of September immediately preceding a new Council term, invite applications for a Striking Committee being established by the Municipal Council to nominate appointments to Advisory Committees at the beginning of each new Council term.

The Striking Committee shall be comprised of the following voting members and will be provided secretariat support by a Committee Secretary designated by the City Clerk:

- 1 Past Member of the Diversity, Inclusion and Anti-  
Oppression Advisory Committee
- 1 Representative of Pillar Non-Profit Network

(5.2)

- 1 Representative of the Urban League of London
- 1 Representative of the London and District Labour Council
- 1 Representative of the London Chamber of Commerce
- 5 Citizens-at-Large selected by the outgoing Municipal Council

The Strategic Priorities and Policy Committee shall meet in advance of the last Council meeting of a Council term to review the applications for Striking Committee and nominate appointees for the Municipal Council's consideration by no later than the last regular Council meeting of the Council term.

Vacancies for citizen-at-large and sectoral Advisory Committee members shall be publicly advertised. All Advisory Committee appointments to be made at the commencement of a Council term shall be recommended by the Striking Committee for consideration by the Strategic Priorities and Policy Committee and recommendation to the Municipal Council, with the exception of Advisory Committee members who represent a particular organization/agency. Advisory Committee members who represent a particular organization/agency shall be confirmed by the City Clerk, on behalf of the Municipal Council. The Striking Committee may, at its discretion, liaise with the outgoing Advisory Committee chairs with respect to the qualifications of any returning citizen-at-large and sectoral applicants. The City Clerk shall advise the Striking Committee of any considerations with respect to the attendance history of applicants, and any other relevant information that may assist the Striking Committee in its review of the applicants. All applications shall be sought and handled in keeping with the Council Policy established to set the guidelines for same and where a Provincial Statute prescribes the type of appointments to be made by the City to an Advisory Committee, the Statute shall be complied with.

#### 4.4 Eligibility for Appointment

Council Members and individuals from the Civic Administration shall not be appointed as voting members to Advisory Committees, nor shall any residents who are not of legal voting age in the Province of Ontario. Advisory Committee members who represent a particular organization or agency shall be nominated by the organization or agency of which they are a member. No member of the Striking Committee noted in part 4.3 shall be eligible for appointment to an Advisory Committee or City Agency, Board or Commission, for the term for which that Striking Committee is recommending appointments."

2. This by-law shall come into force and effect on the date it is passed.

PASSED in Open Council on , 2018.

Matt Brown

Mayor

Catharine Saunders

City Clerk

First Reading – , 2018

Second Reading – , 2018

Third Reading – , 2018