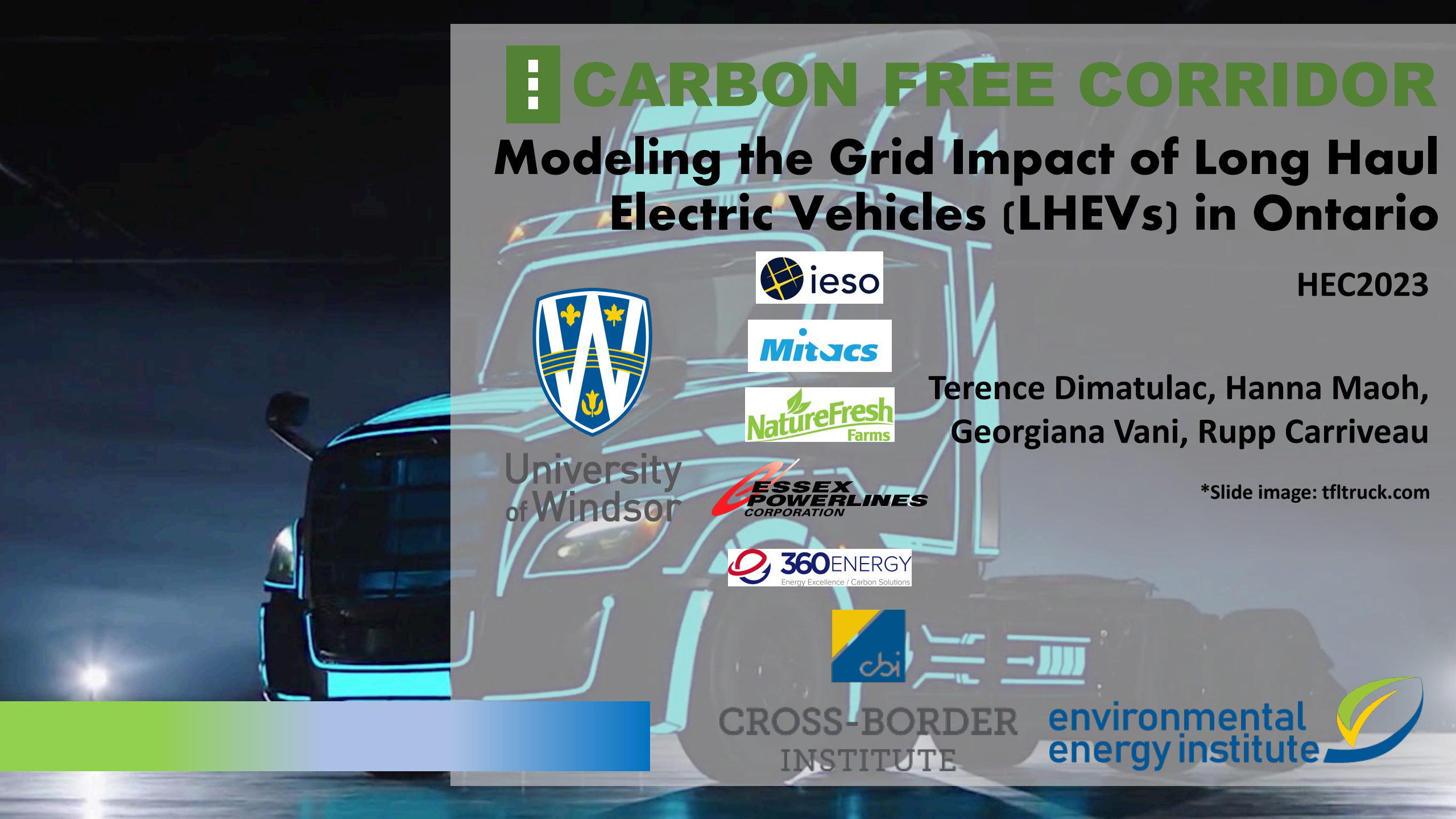


CARBON FREE CORRIDOR

Modeling the Grid Impact of Long Haul Electric Vehicles (LHEVs) in Ontario

HEC2023

Terence Dimatulac, Hanna Maoh, Georgiana Vani, Rupp Carriveau

*Slide image: tfltruck.com

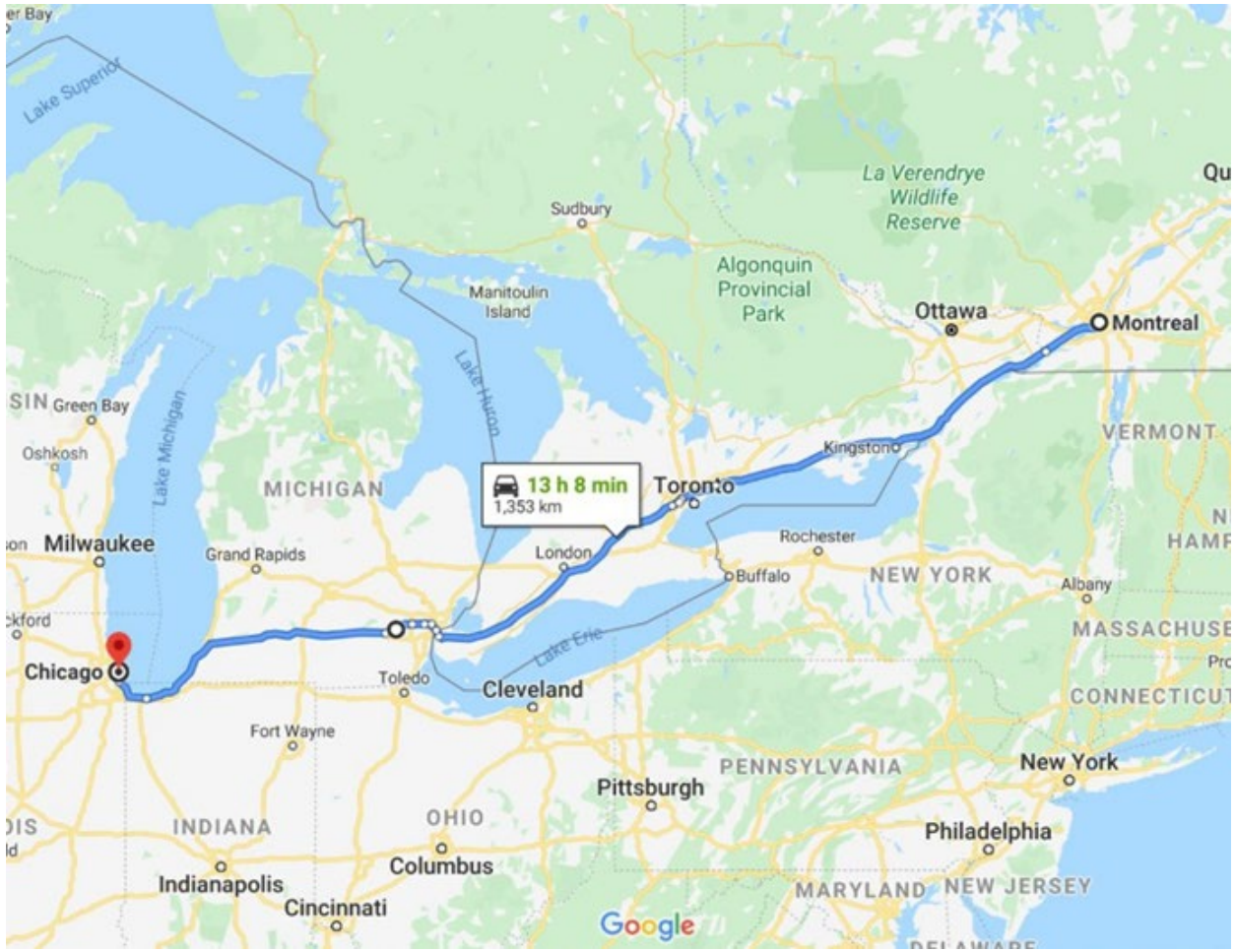
CFC Backgrounder

WHAT IS THE CARBON FREE CORRIDOR?

- An Information Movement Bent on Research and Business Case Construction to Decarbonize Transport Between Montreal and Chicago.
- Why Montreal to Chicago?

RECAP OF CFC ACTIVITIES (CFC Events)

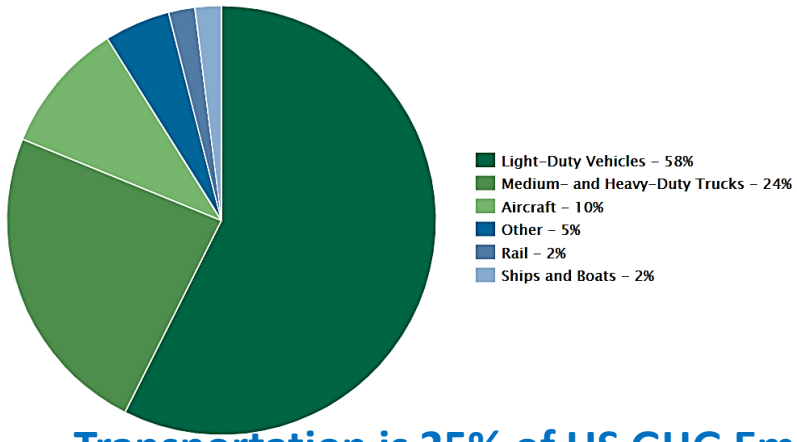
- CFC1 – Introduction & Scoping
- CFC2 – Trucking Transition
- CFC3 – EV Charging Challenges and Opportunities
- CFC4 – Bi-Directional Charging Infrastructure
- CFC5 – Decarbonizing Air Transport



environmental energy institute

Choosing Long Haul Trucks

2019 U.S. Transportation Sector GHG Emissions by Source



GOAL OF THE STUDY:

To develop models that help improve the understanding of the challenges and opportunities for Ontario grid operators on the pathway to long haul transport truck decarbonization

OBJECTIVE 1

Establish a Representative Archetypal Routing Network (ARN) to assess long haul transport loading of support infrastructure

OVERLAY TRANSPORT AND ENERGY GRIDS

OBJECTIVE 2

Develop a Parameterized Charging/Fueling Load Model to characterize energy grid loads

TRUCKS AS BOTH FREIGHT AND ENERGY CARRIERS

OBJECTIVE 3

Build out Industry-Specific Case Study to examine detailed economics and distributed energy resource/ancillary opportunities

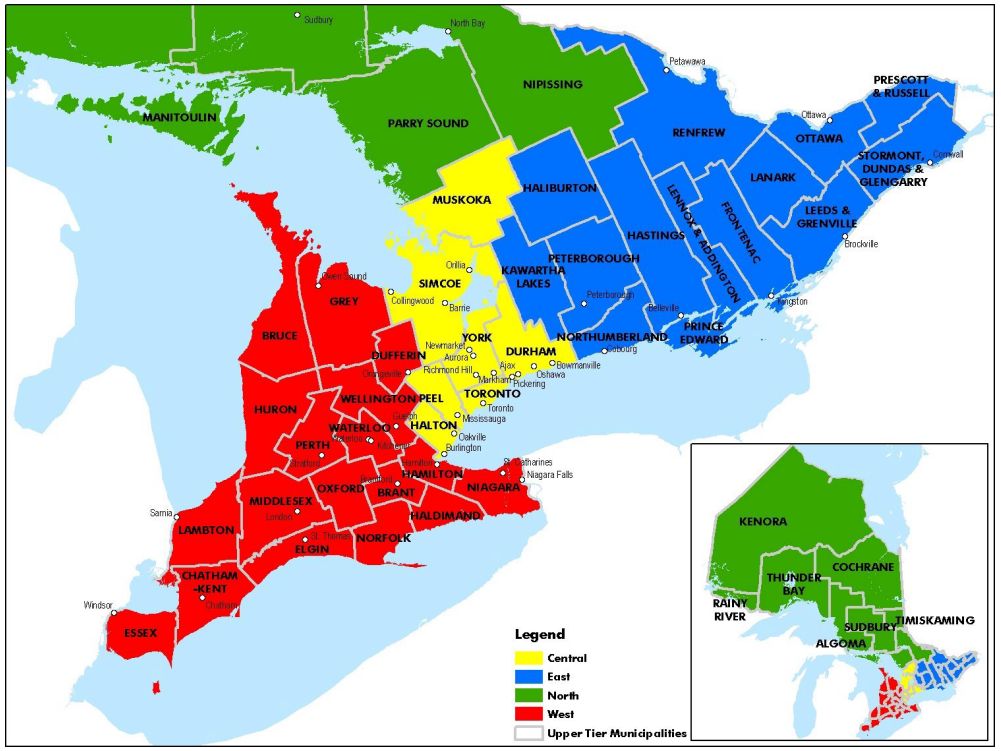
Transportation is 25% of US GHG Emissions per year. Medium and Heavy Trucks are 24% of that

https://www.epa.gov/greenvehicles/fast-facts-transportation-greenhouse-gas-emissions

cbi

environmental energy institute

Construction of an Archetypal Routing Network (ARN)



DATA OVERVIEW

- 60,000 GPS Tracked Long Haul Trucks used in dataset
- GPS data is for the entire month of March 2016

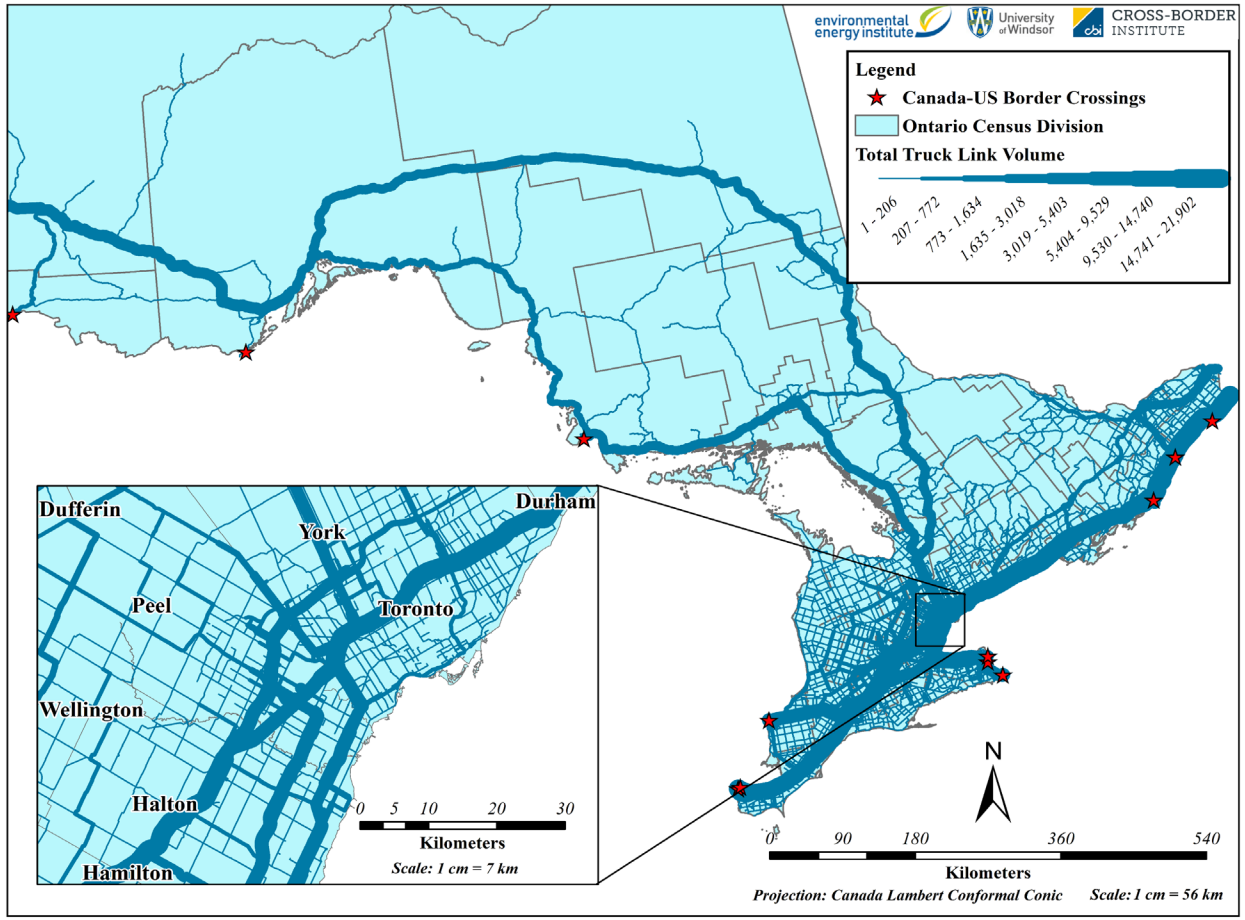
PRIMARY STOPS

- Primary Stops are generally Trip Origins and Destinations
- These will be critically important as they may also soon represent rest/fueling locations – longer stays

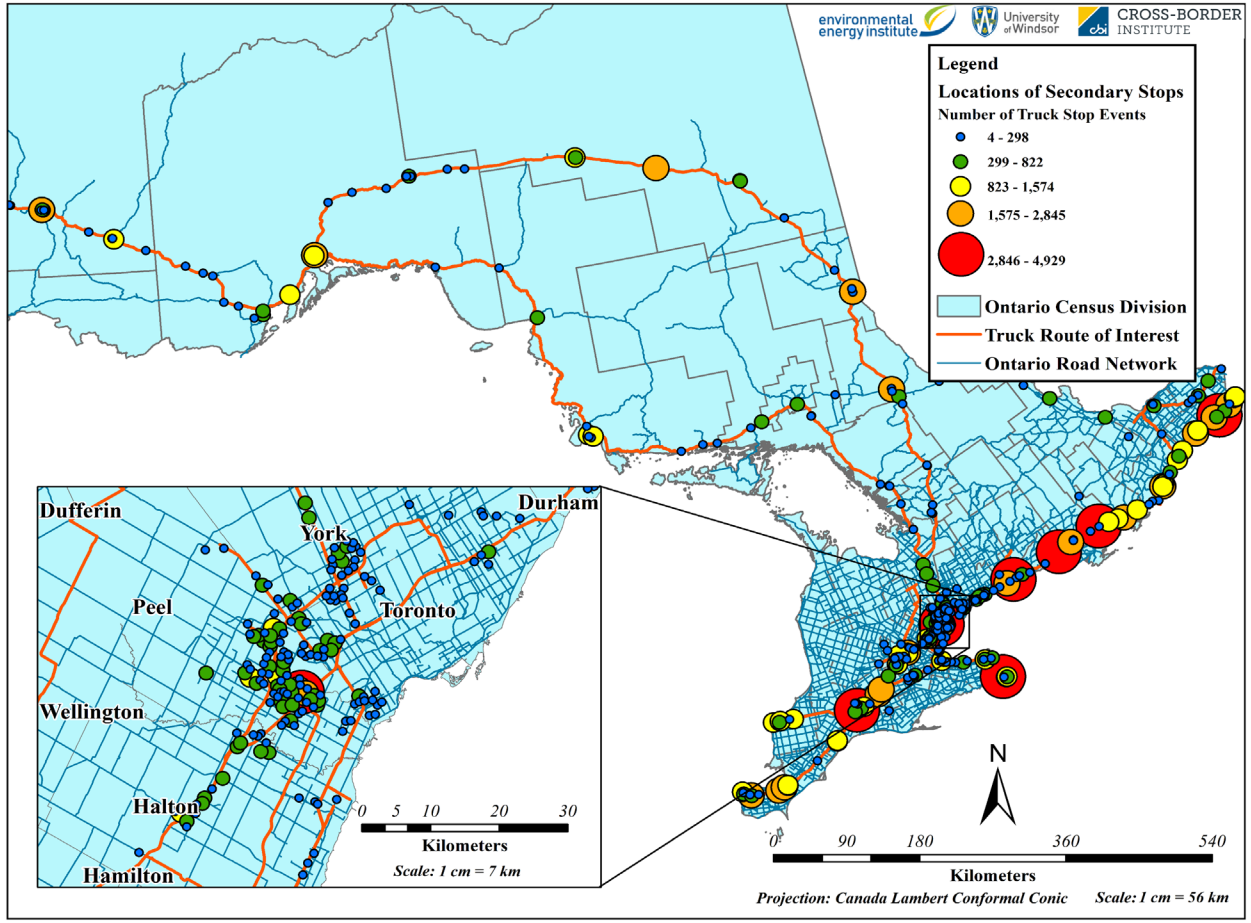
SECONDARY STOPS

- Shannon Entropy methods were applied to distinguish Secondary Stops from Primary Stops
- Secondary Stops are for purposes such as driver breaks and fuel refills
- Secondary Stops typically require a duration between 15 minutes and 45 minutes

Construction of an Archetypal Routing Network (ARN)



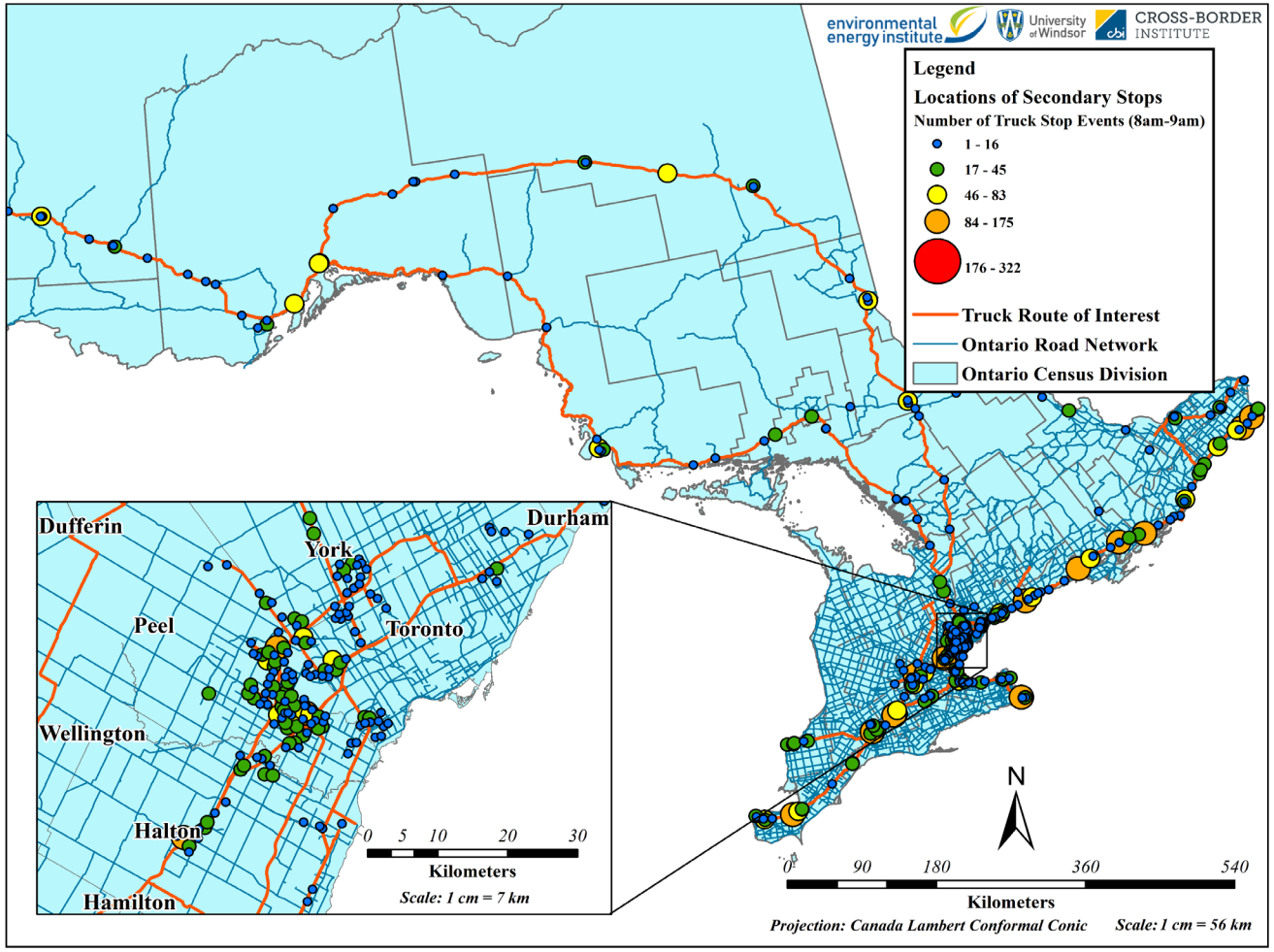
TRUCK FLOWS ACROSS THE NETWORK



TOTAL TRUCK COUNTS AT SECONDARY STOPS

environmental energy institute

Construction of an Archetypal Routing Network (ARN)



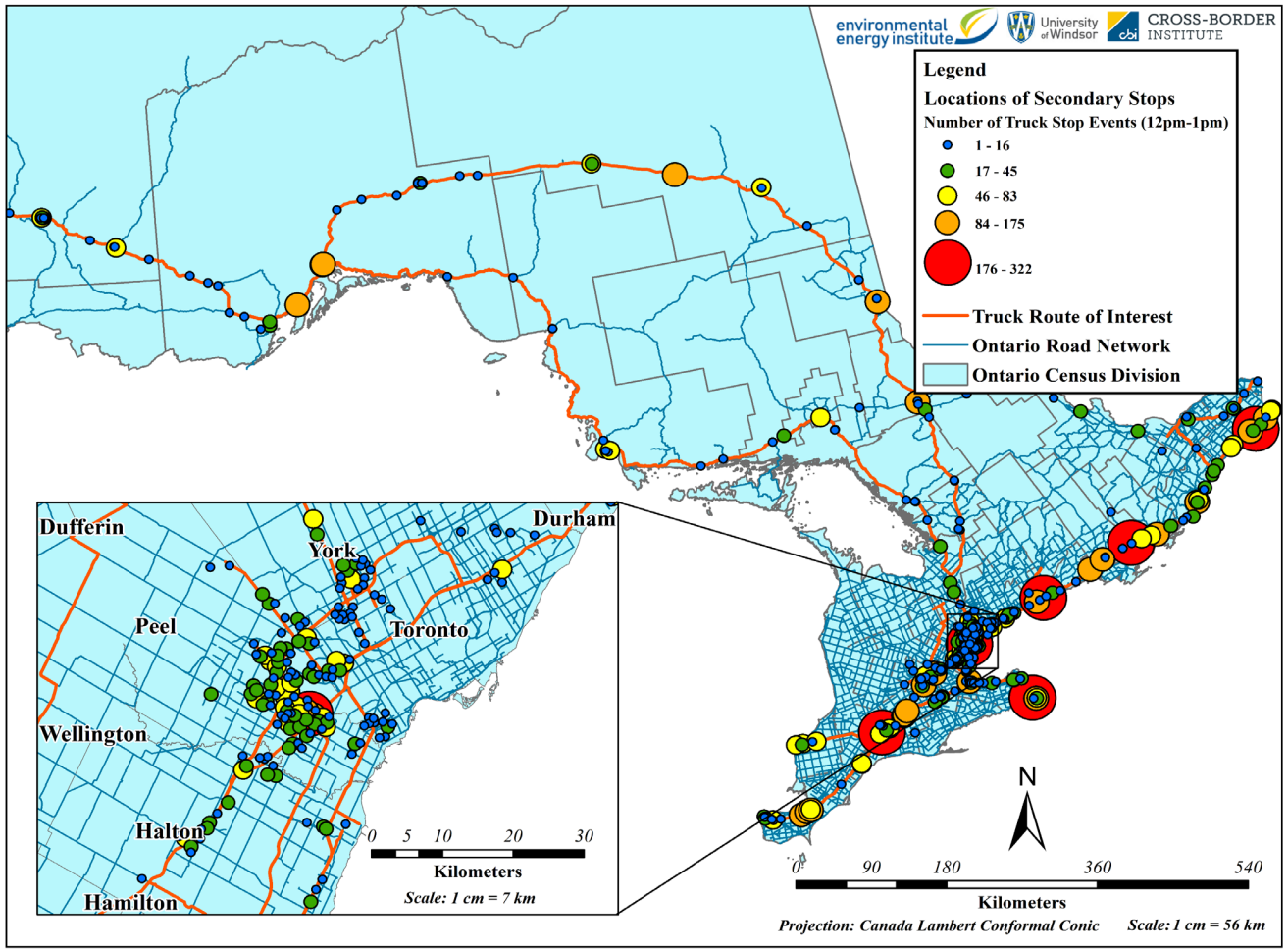
TRUCK COUNT AT SECONDARY STOPS BETWEEN 0800 – 0900 HRS

TRUCK COUNT 0800 HRS - 0900 HRS

- Volumes relatively low
- 400 Series Highways not surprisingly dominate the Figure
- However, there are notable critical nodes in the West-North-West

environmental energy institute

Construction of an Archetypal Routing Network (ARN)

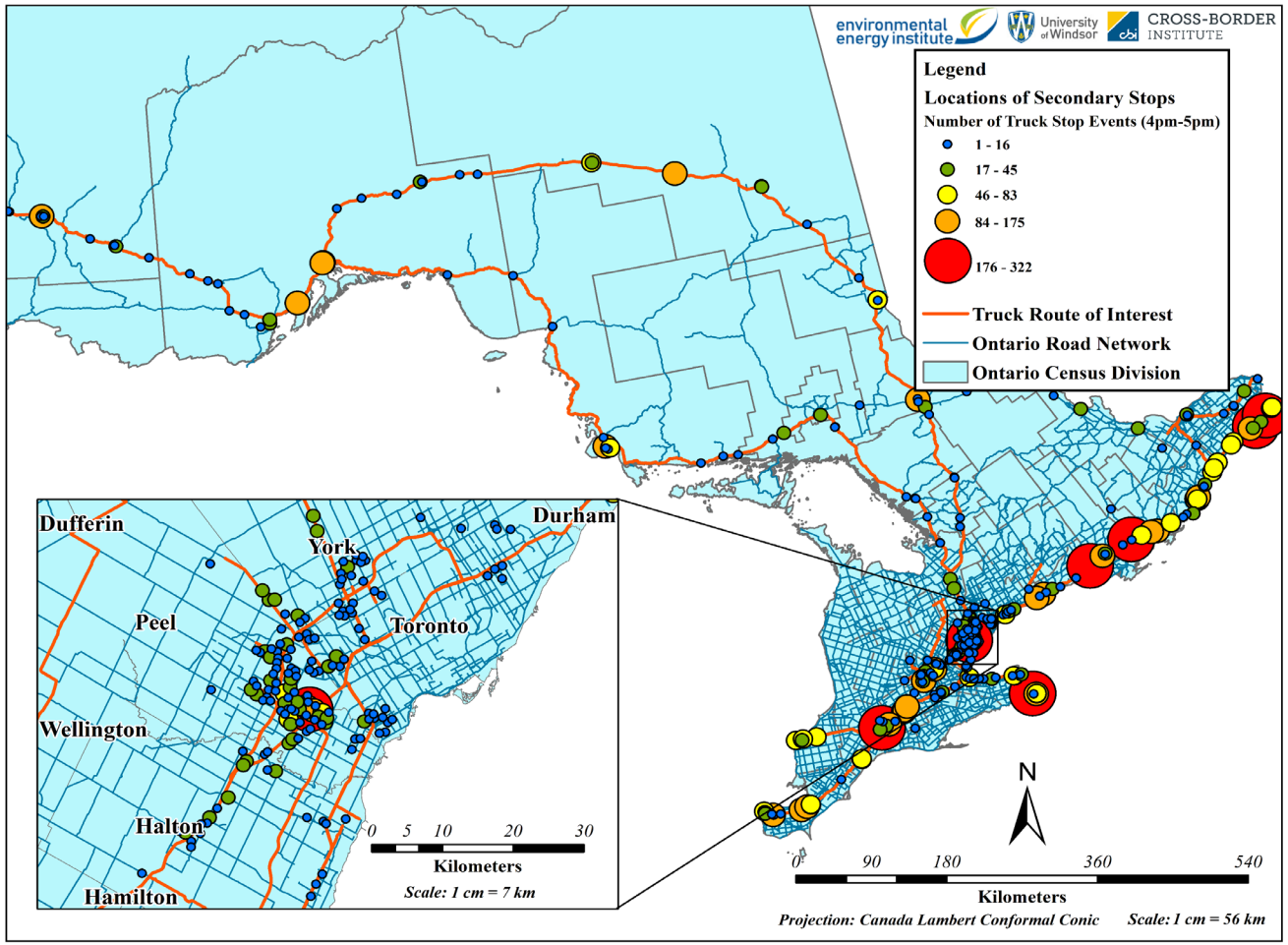


TRUCK COUNT AT SECONDARY STOPS BETWEEN 1200 – 1300 HRS

TRUCK COUNT 1200 HRS - 1300 HRS

- Volumes picking up
- Large number of Secondary Stops still being made the GTA at this time

Construction of an Archetypal Routing Network (ARN)

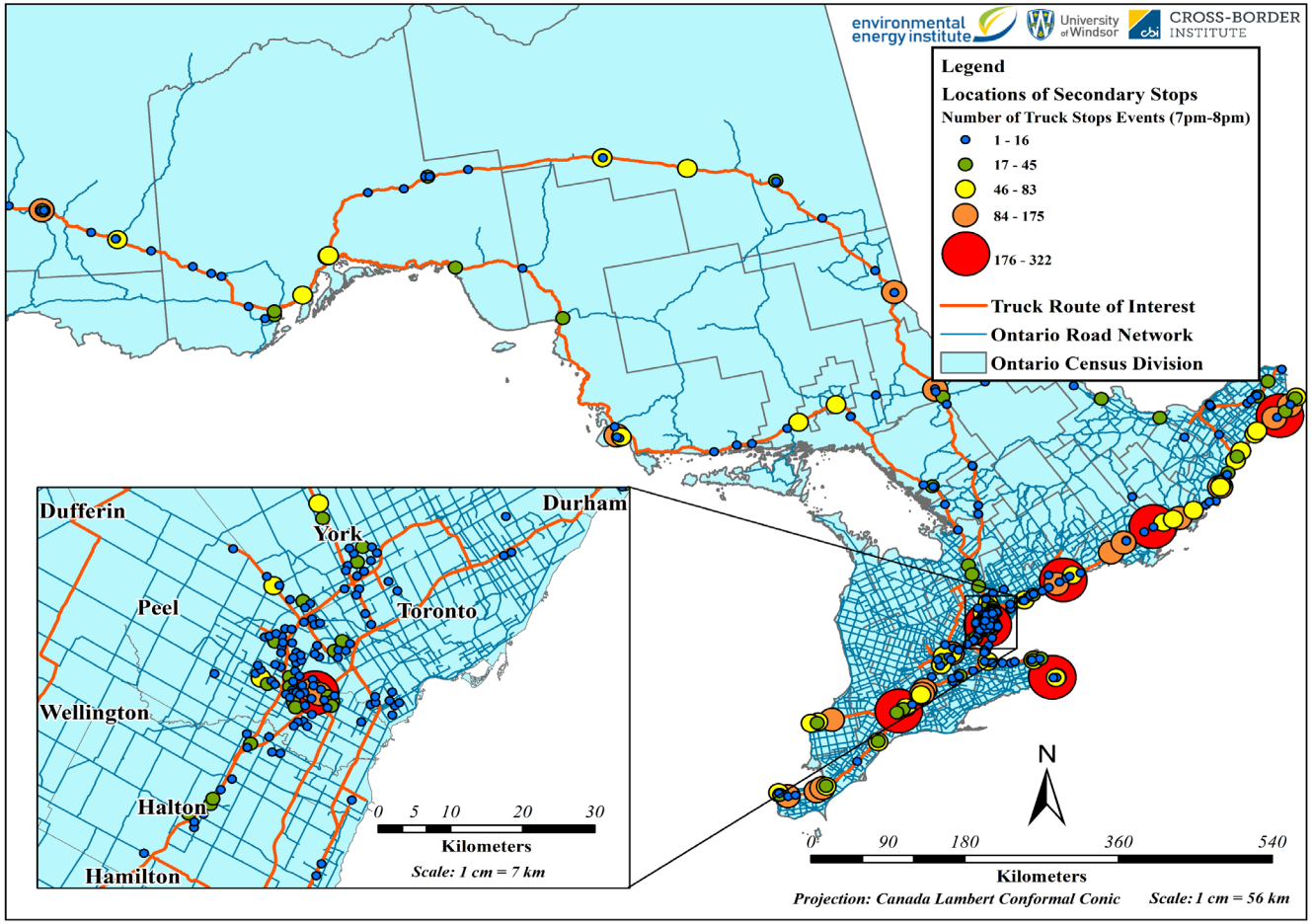


TRUCK COUNT AT SECONDARY STOPS BETWEEN 1600 – 1700 HRS

TRUCK COUNT 1600 HRS - 1700 HRS

- Volumes continue to pick up
- Large number of Secondary Stops still being made the GTA at this time

Construction of an Archetypal Routing Network (ARN)

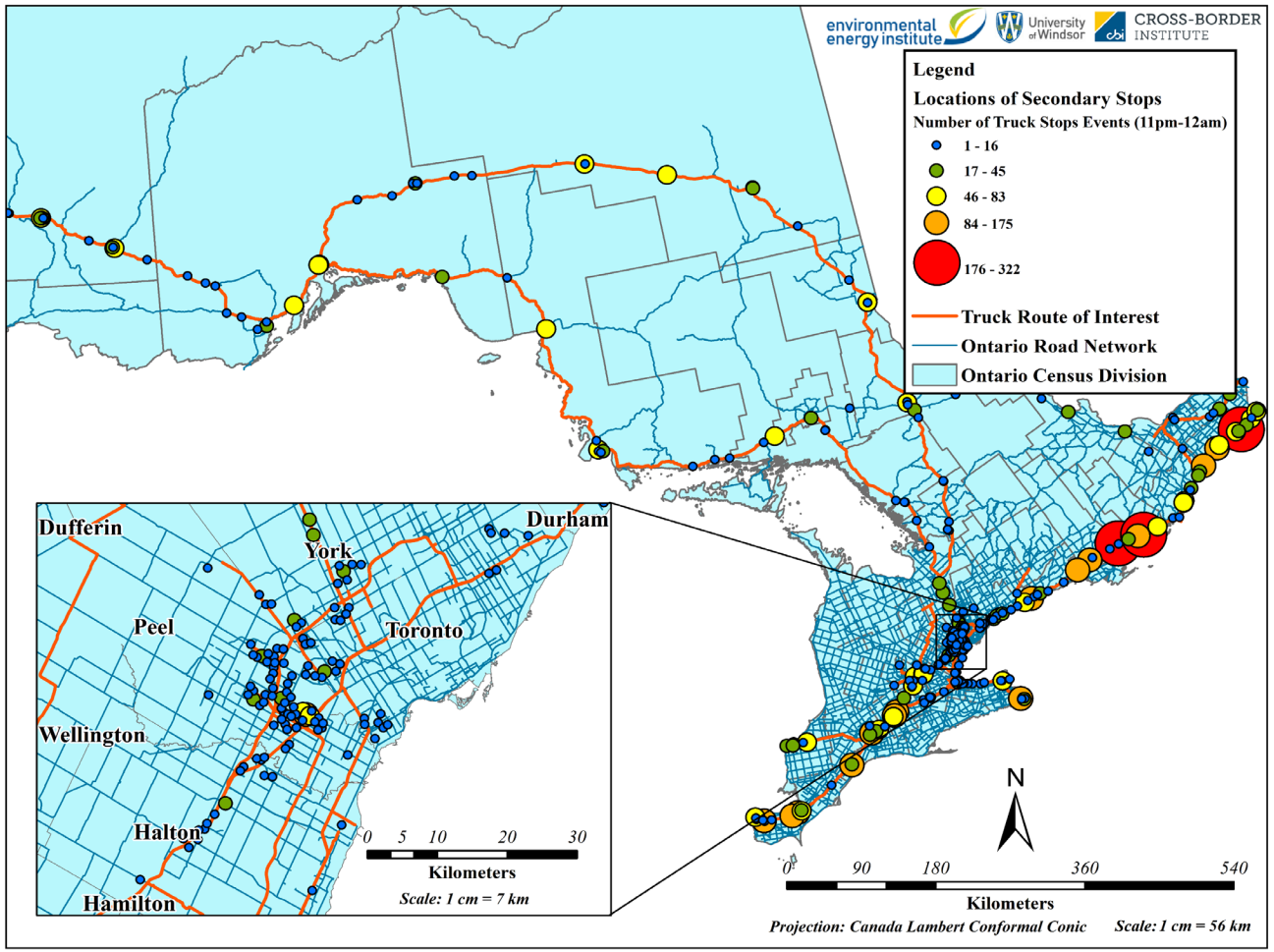


TRUCK COUNT AT SECONDARY STOPS BETWEEN 1900 – 2000 HRS

TRUCK COUNT 1900 HRS - 2000 HRS

- Volumes are consistent
- Secondary Stops in the GTA start to come down
- Peel, Niagara, and Kingston remain Secondary Stop favourites through most times

Construction of an Archetypal Routing Network (ARN)

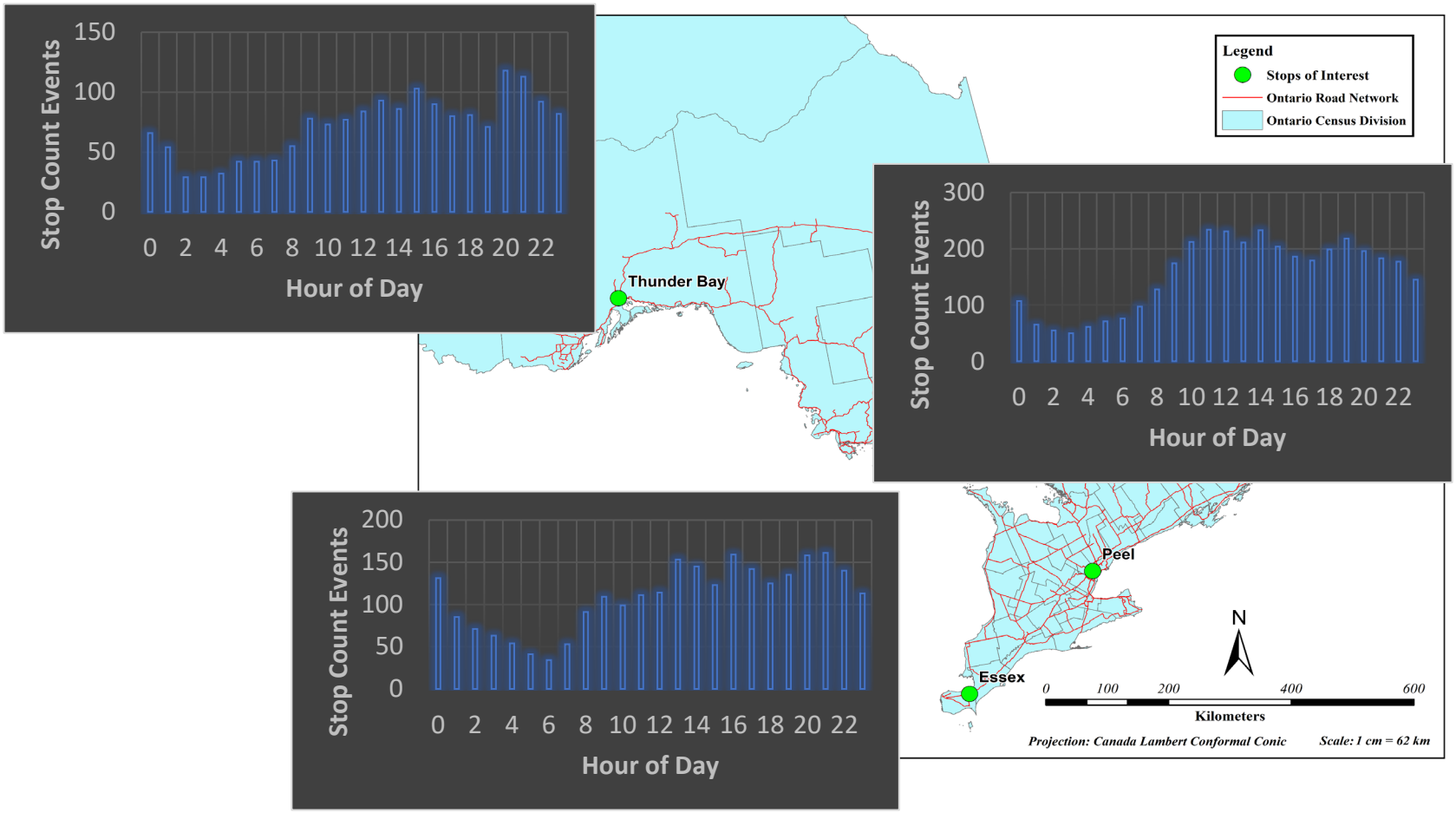


TRUCK COUNT AT SECONDARY STOPS BETWEEN 2300 – 0000 HRS

TRUCK COUNT 2300 HRS - 0000 HRS

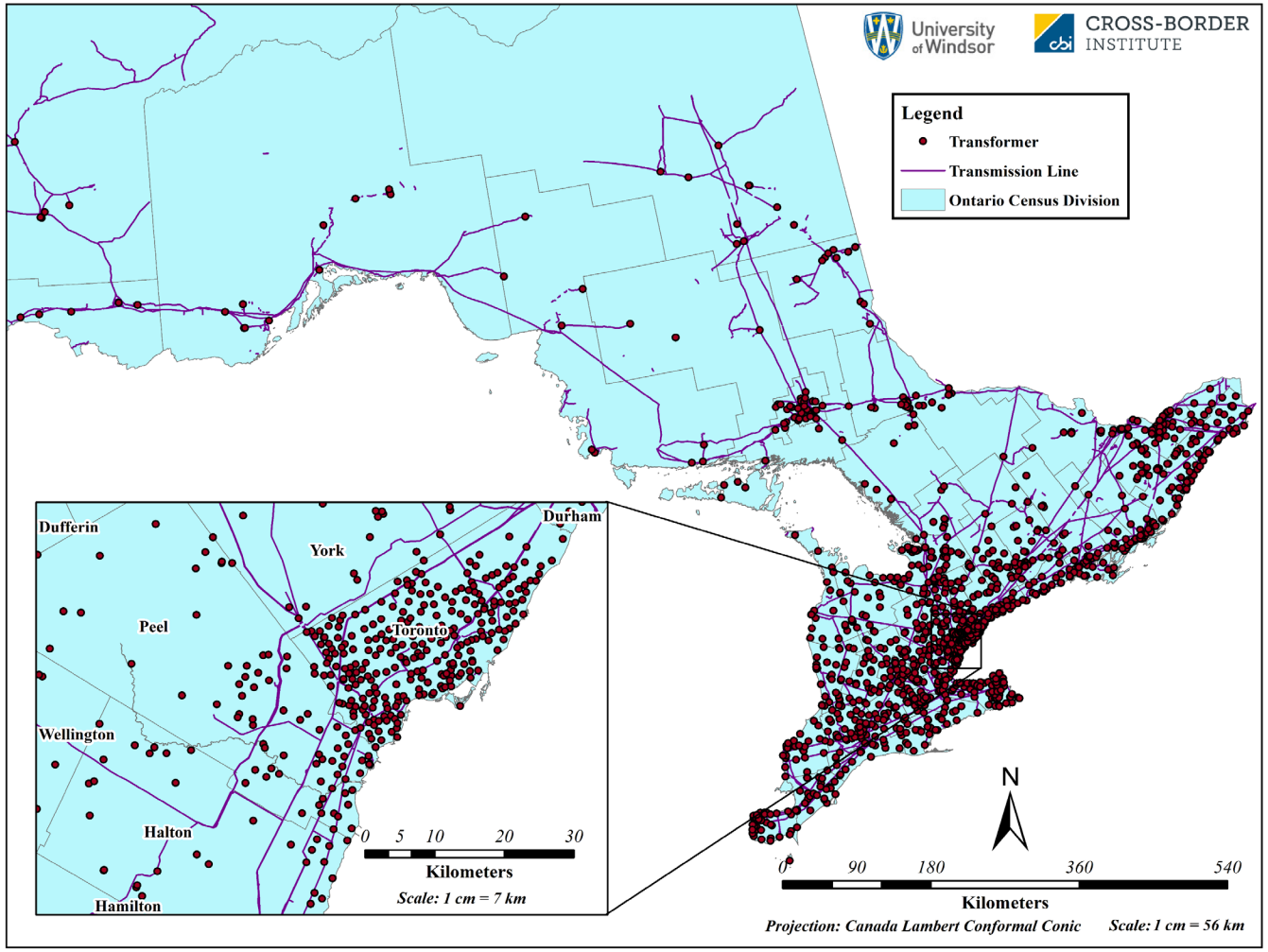
- Volumes nearing breakfast levels
- Kingston area remains dominant as a Secondary Stop across most time slots

Construction of an Archetypal Routing Network (ARN)



- Next Steps consider mapping the spatial and temporal transport loading functions to energy loading considerations
- Temporal shapes at 3 key locations are similar here

Construction of an Archetypal Routing Network (ARN)



ELECTRIC GRID OVERLAY

- GIS Technology enables us to overlay the electric grid on top of the ARN
- Strategically identify the potential locations where charging stations should be located
- Matching trucking activities with charging activities to ensure supply can meet the demand

Mapping Transport Load to Energy Demand: The Trucks

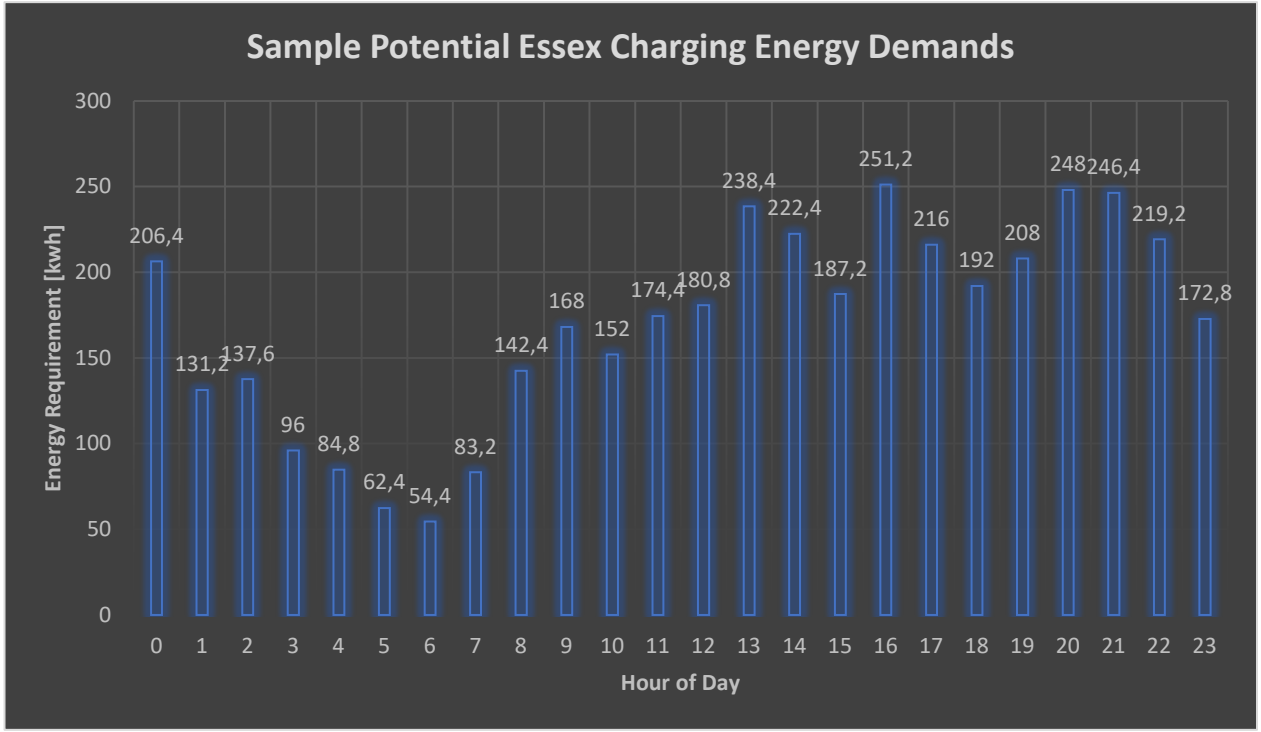
- Tesla, Freightliner, BYD, Lion, Volvo are all developing EV trucks
- Studies and specs for new trucks show a range typically between 400 and 800 km
- Typical battery is between 400 and 600 kWh, with extremes like Tesla up to 1000 kWh
- Previous studies on charging plus data on current infrastructure point to 4–8-hour charge times
- Despite this, companies like Tesla and Volvo say their trucks will be able to charge 80% in 30-70 minutes

tesla.com

Mapping Transport Load to Energy Demand: The Trucks

ASSUMPTIONS

- The full fleet are electric Tesla trucks
- Stop count data is based off a typical semi-truck
- Mid range Tesla is set to have range of only 800 km, so it will need to stop twice for every truck stop in the given data
- Tesla charges 80% of 1000 kWh battery at stations, so it is assumed that 800 kWh is charged for each truck



Ongoing Work

- Working closely with our strategic utility partners (EnWin, HydroOne) to marry Transport Loading Functions to Grid

- Continue Data Meetings with NatureFresh Partners to drive the process of energy and logistics profiling Case Studies

- Continue developing high level business cases and dynamic electricity pricing strategies to attract border region charging commerce

electrive.com