



**University
of Victoria**

Estimating on-road vehicle emissions and their impact on population exposure to traffic-related air pollution

Dr. Laura Minet
Assistant Professor - Civil Engineering
University of Victoria

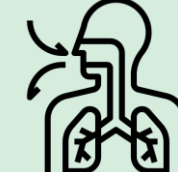
Ambient Air Pollution: a Threat for Human Health

Health risks

Acute:
stroke, hypertension,...



Long-term:
cancer, diabetes, asthma,...



Annual premature
deaths due to
ambient air pollution

4.2 million¹



15,300

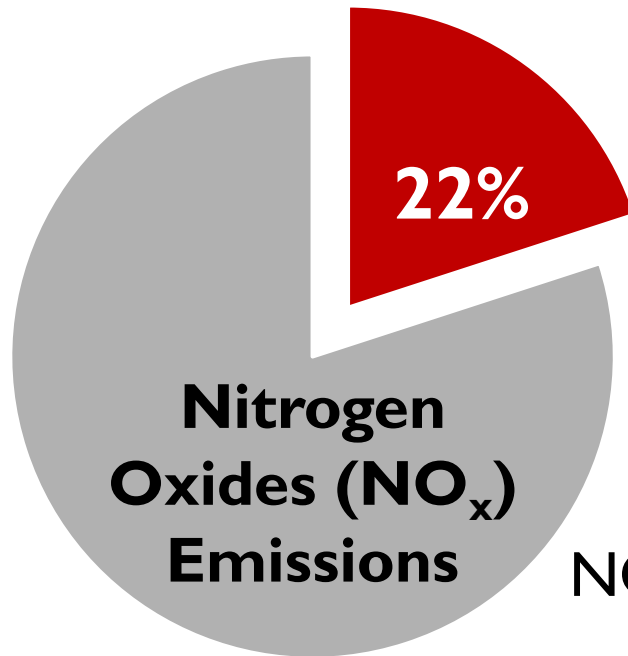
**\$114 billion of
health expenses**



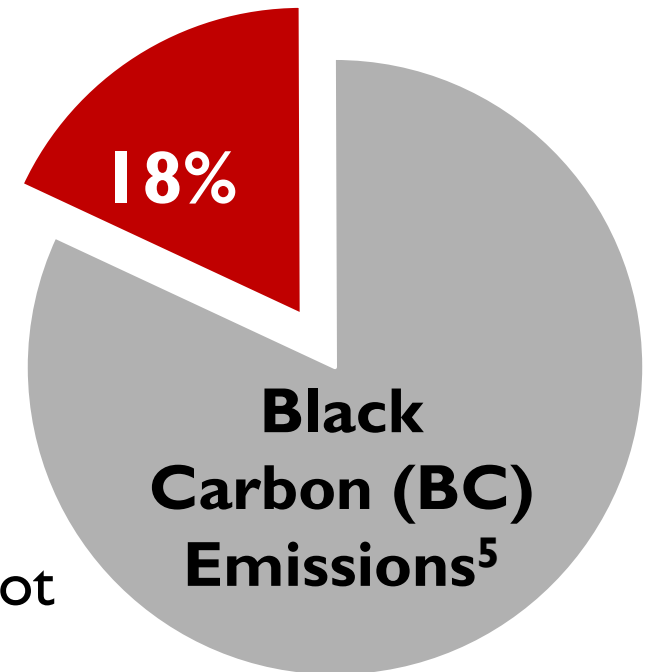
1,600
33 per 100,000
capita

On-Road Transportation: the Main Source of Emissions in Cities

On-road transportation



BC = Soot



Markers of traffic-related air pollution

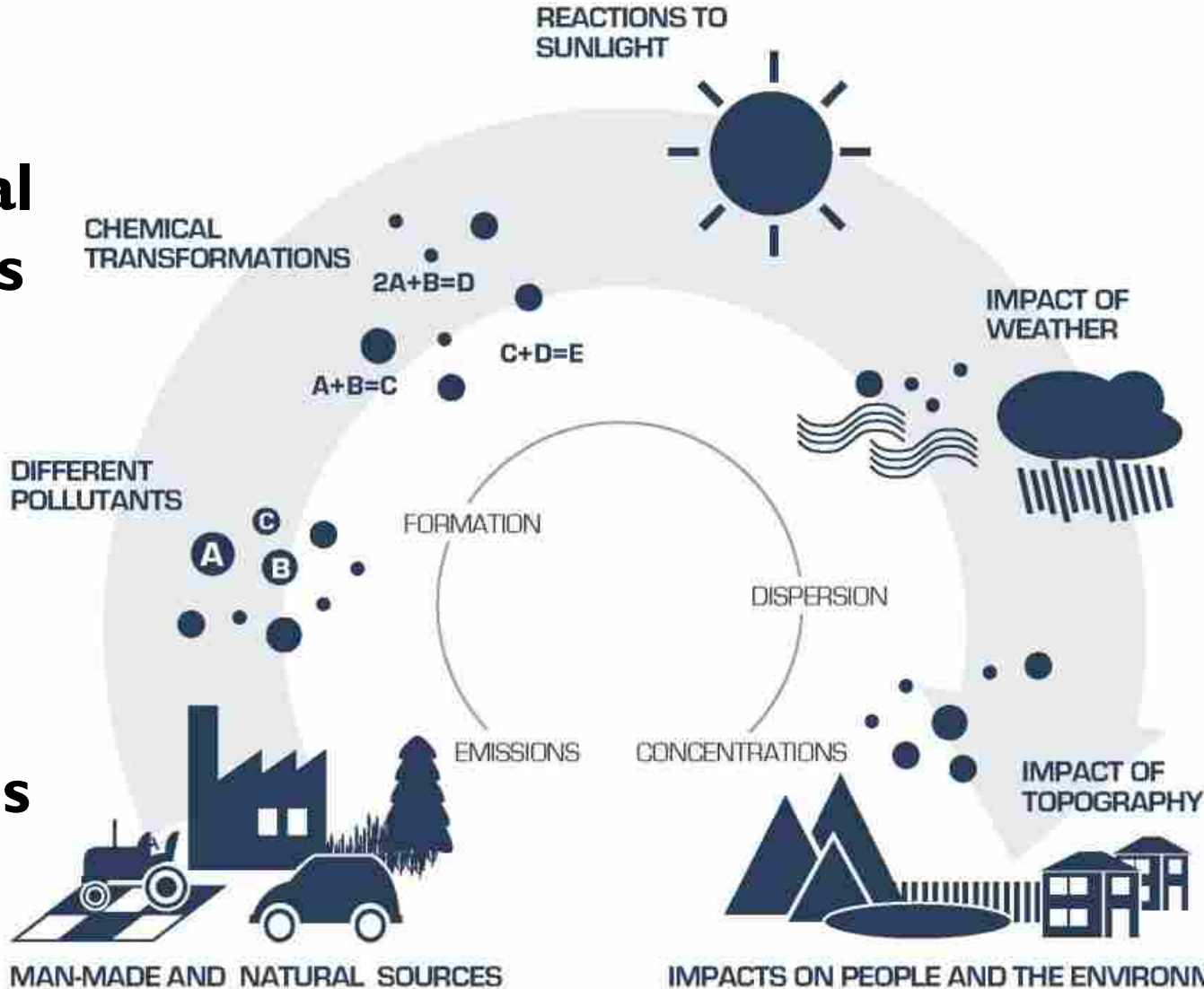
Understanding Population Exposure Requires More than Quantifying Air Pollutant Emissions

2) Chemical reactions

3) Meteorology

1) Emissions

4) Urban design



How Can We Minimize Population Exposure to Air Pollution ?

EMISSIONS:



- How can we reduce air pollutant emissions?
- What are the benefits of tackling air pollution?
- How do emission reductions impact population exposure?



URBAN DESIGN:

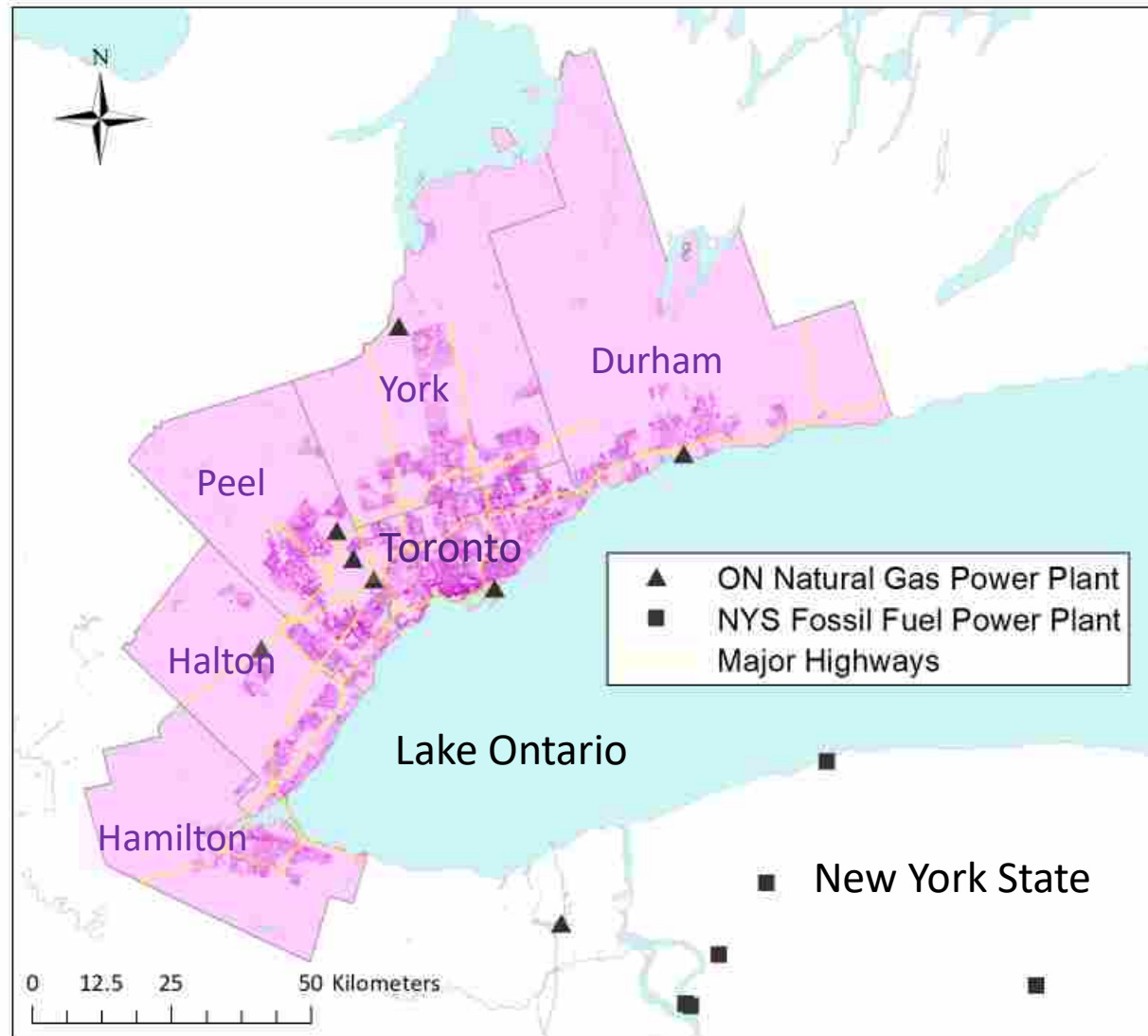
- How can we best design cities to minimize population exposure?





PART I: TRANSPORTATION POLICIES AND AIR QUALITY

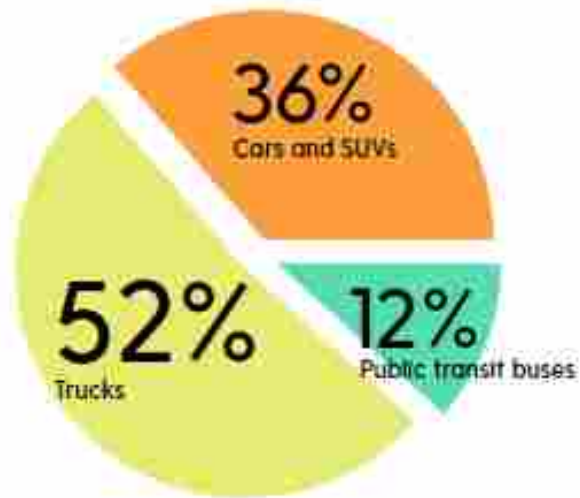
Study Area - The Greater Toronto and Hamilton Area (GTHA)



Trucks are the Largest Emitters of Traffic-Related NO_x and BC Emissions

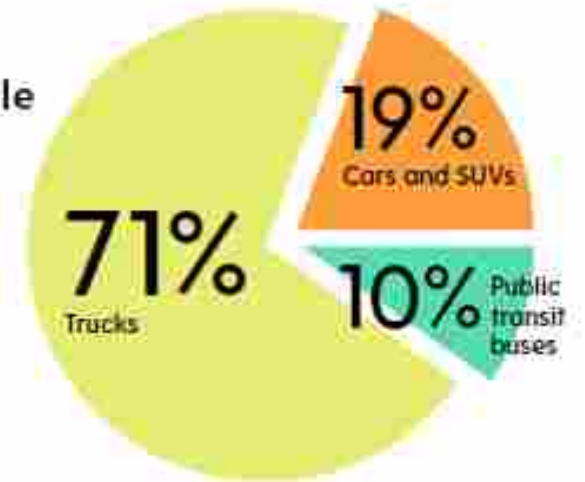
Traffic-related nitrogen oxides (NO_x) emissions by vehicle type in the GTHA

30 tonnes NO_x/day



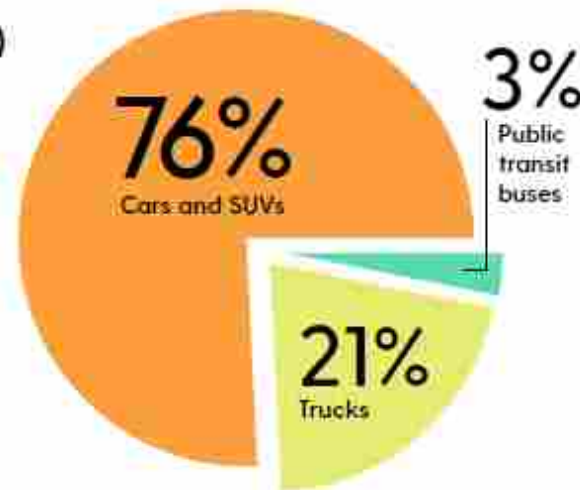
Traffic-related black carbon (BC) emissions by vehicle type in the GTHA

0.54 tonnes BC/day



Traffic-related greenhouse gas (GHG) emissions by vehicle type in the GTHA

34,340 tonnes CO₂ eq./day





WHAT ARE THE CLIMATE AND HEALTH BENEFITS OF GETTING CLEANER VEHICLES ON THE ROADS?

Scenarios

Base Case



Scenario 1 : cars and SUVs are
100% electric



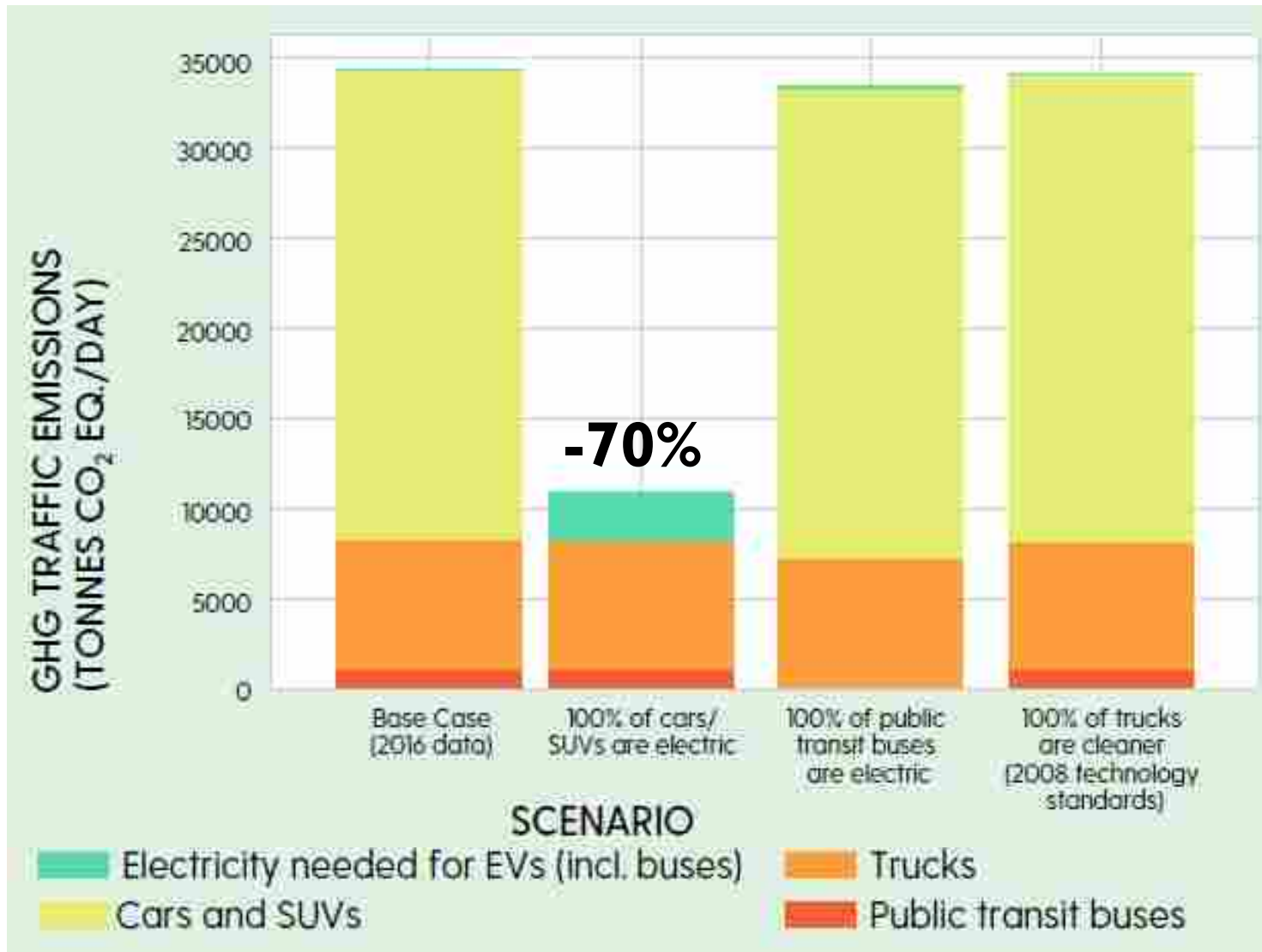
Scenario 2 : transit buses are
100% electric



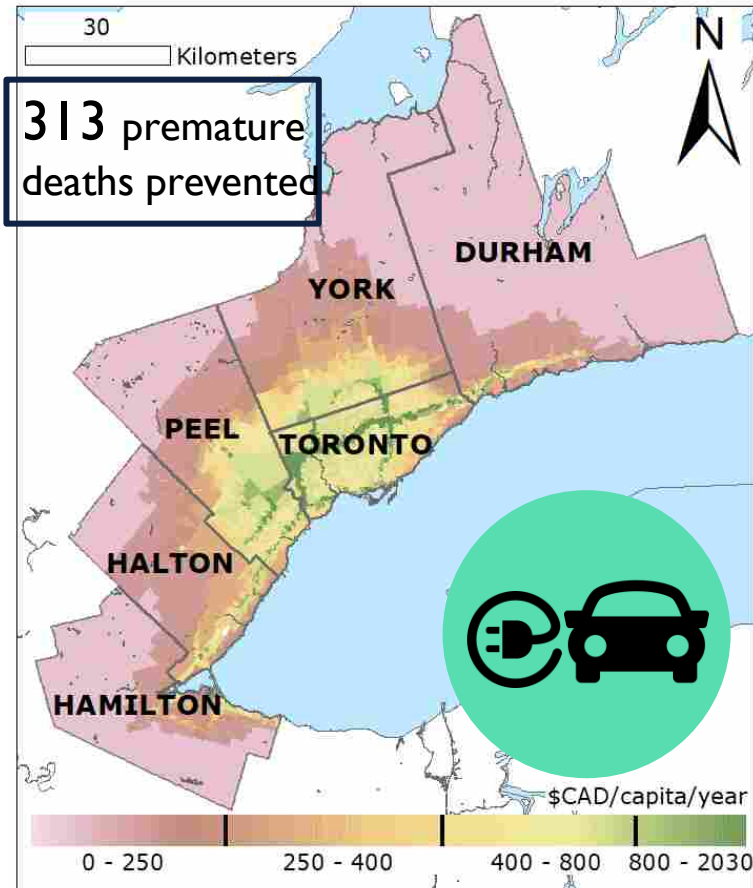
Scenario 3 : cleaner trucks
(2008 technology standards)



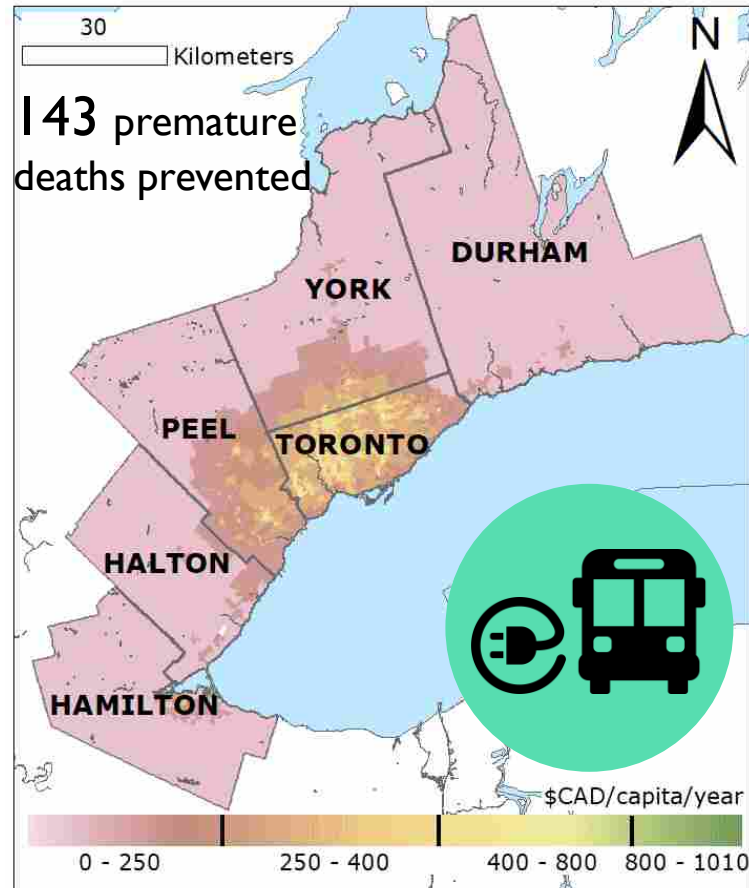
Electrifying all Private Passenger Vehicles Would Reduce GHG Emissions by 70%



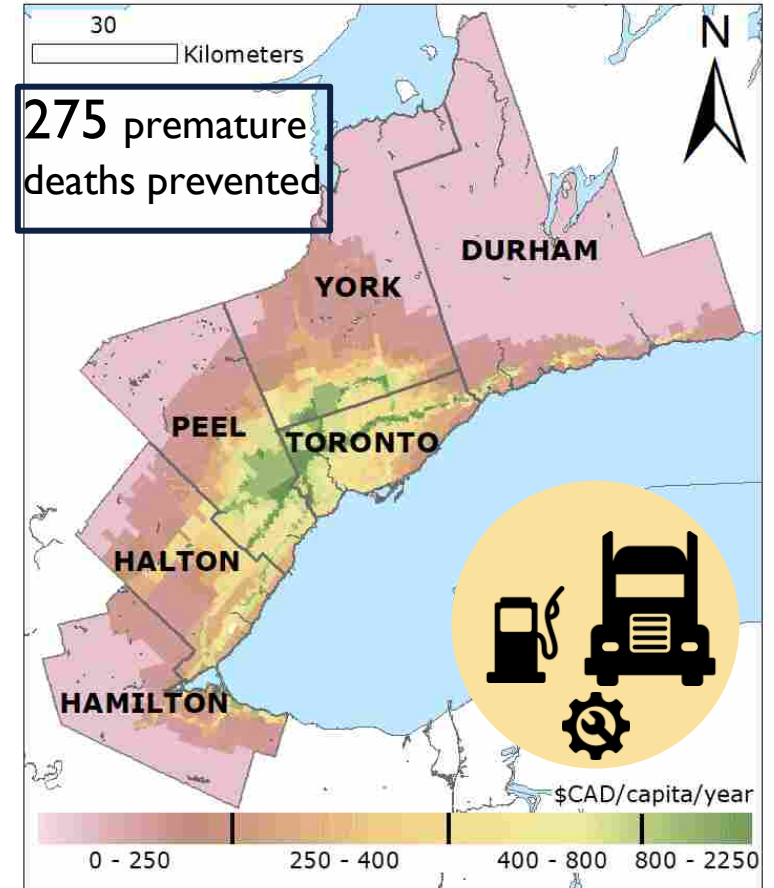
Cleaner Vehicles Prevent Premature Deaths and Reduce GHG Emissions



23,640



970



185

GHG emissions saved (tonnes CO₂ eq./day)



PART 2: URBAN DESIGN AND AIR QUALITY

What is the Exposure Along Different Bike Facilities?

Bike lanes



Cycle tracks



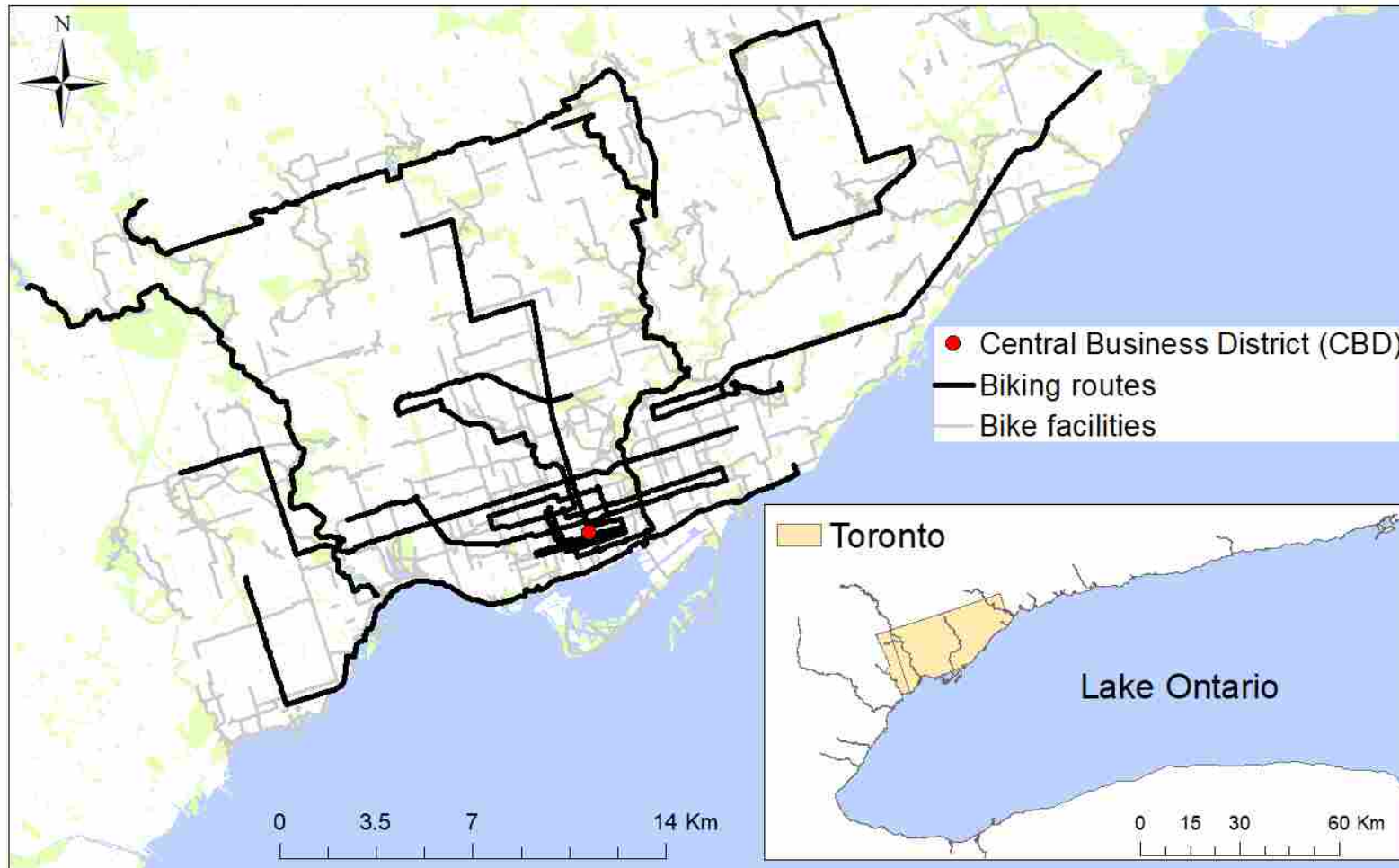
Multi-use
pathways and
laneways



Trails



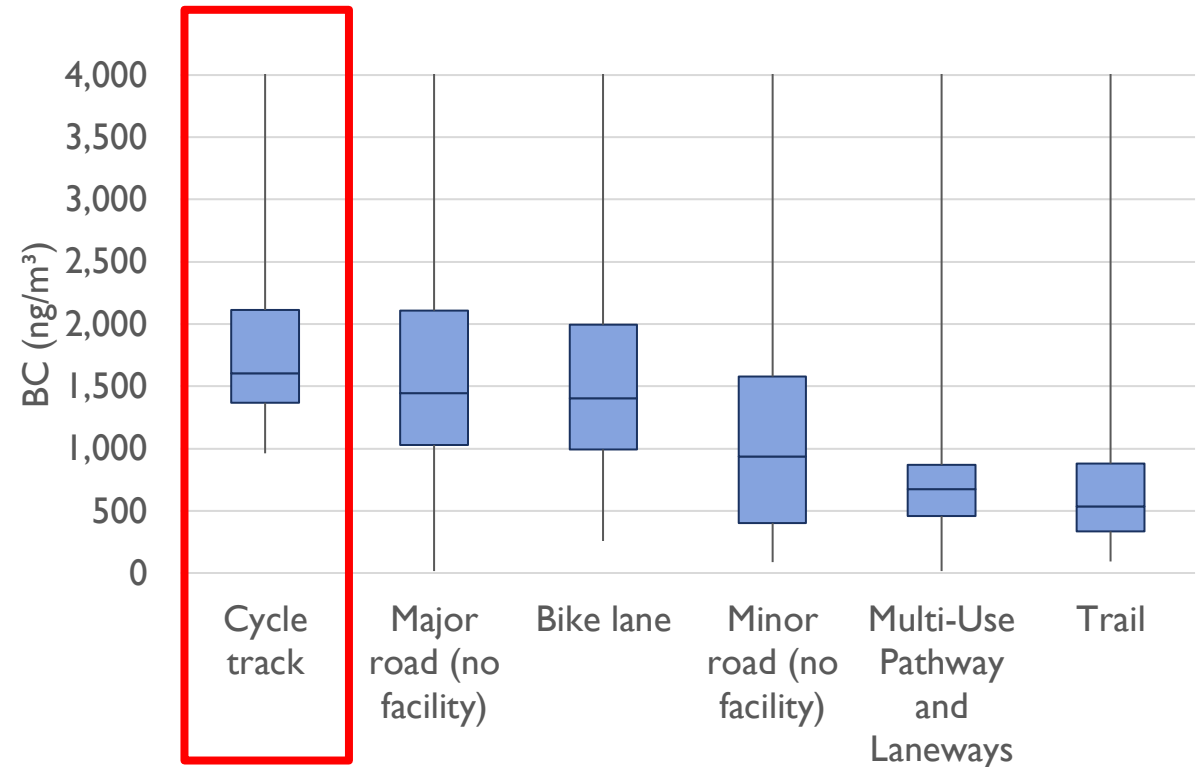
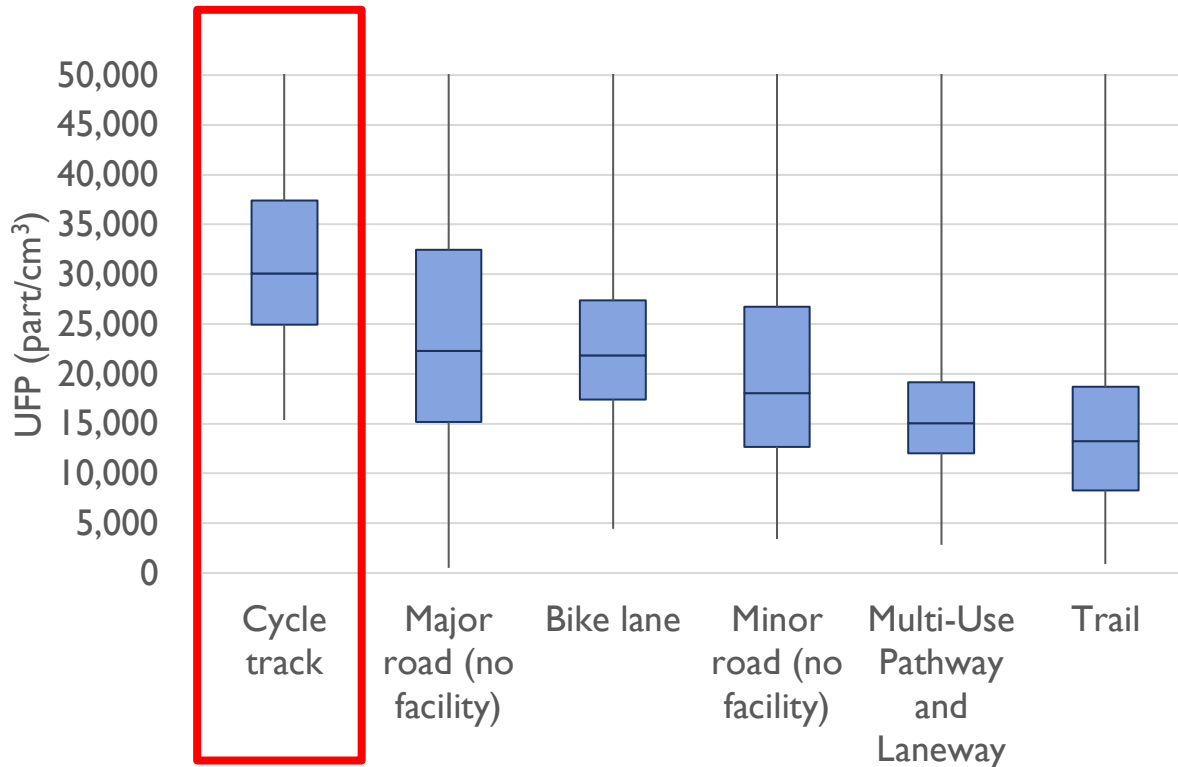
Method: Mobile Data Collection in Toronto



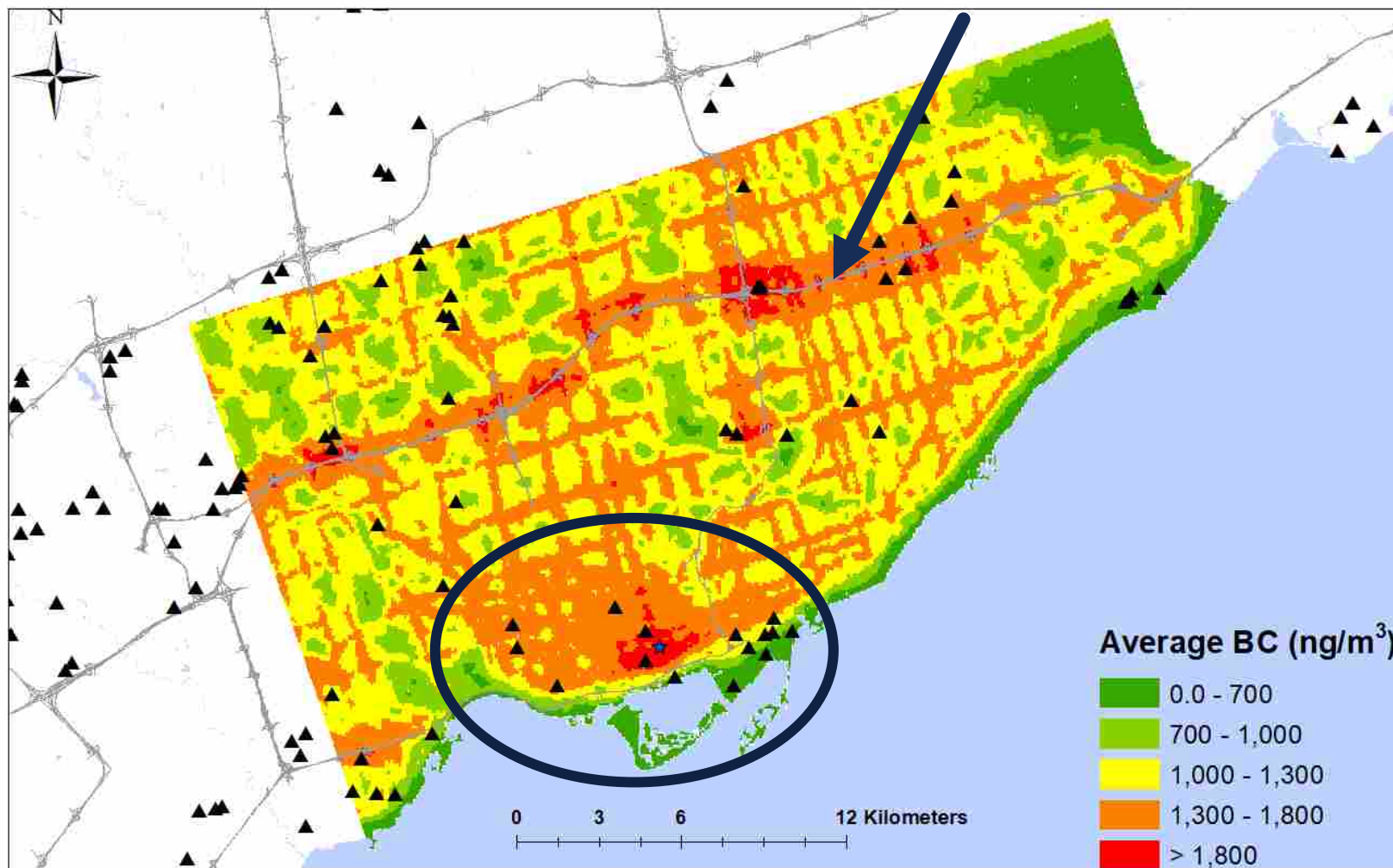
Ultrafine Particles (UFP):
diameter $< 0.1 \mu\text{m}$
Black Carbon (BC):
carbonaceous particulate
matter

270 km of cycling routes – Summer 2016

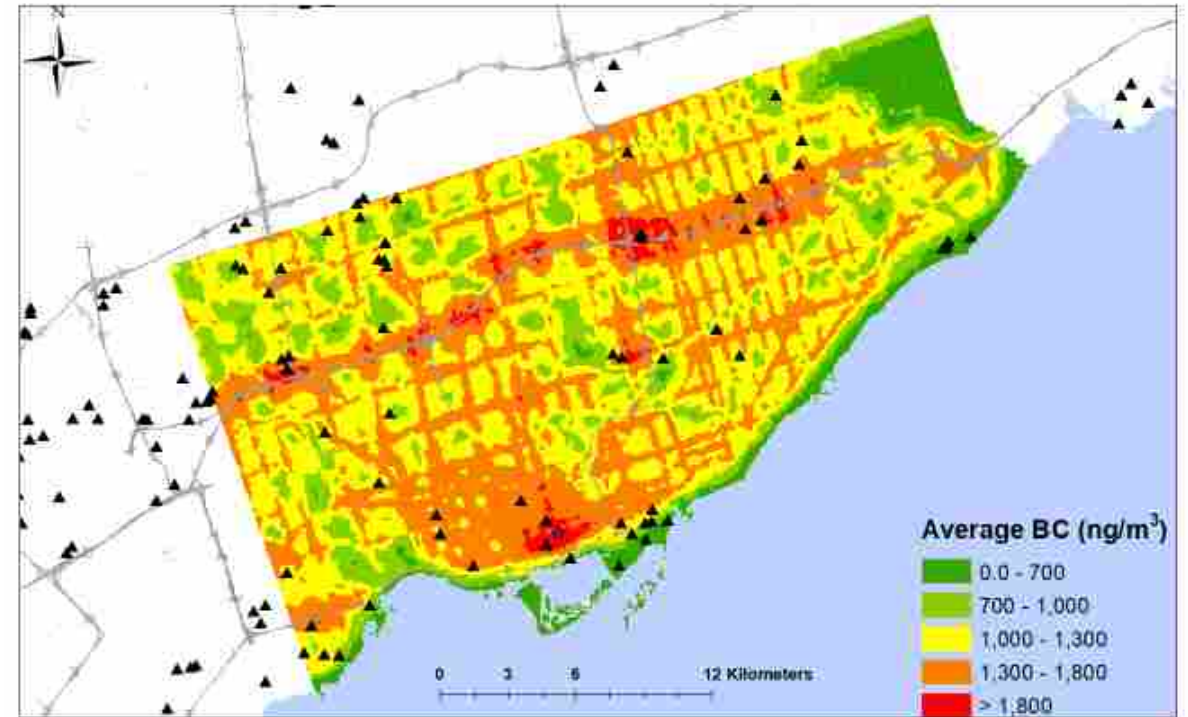
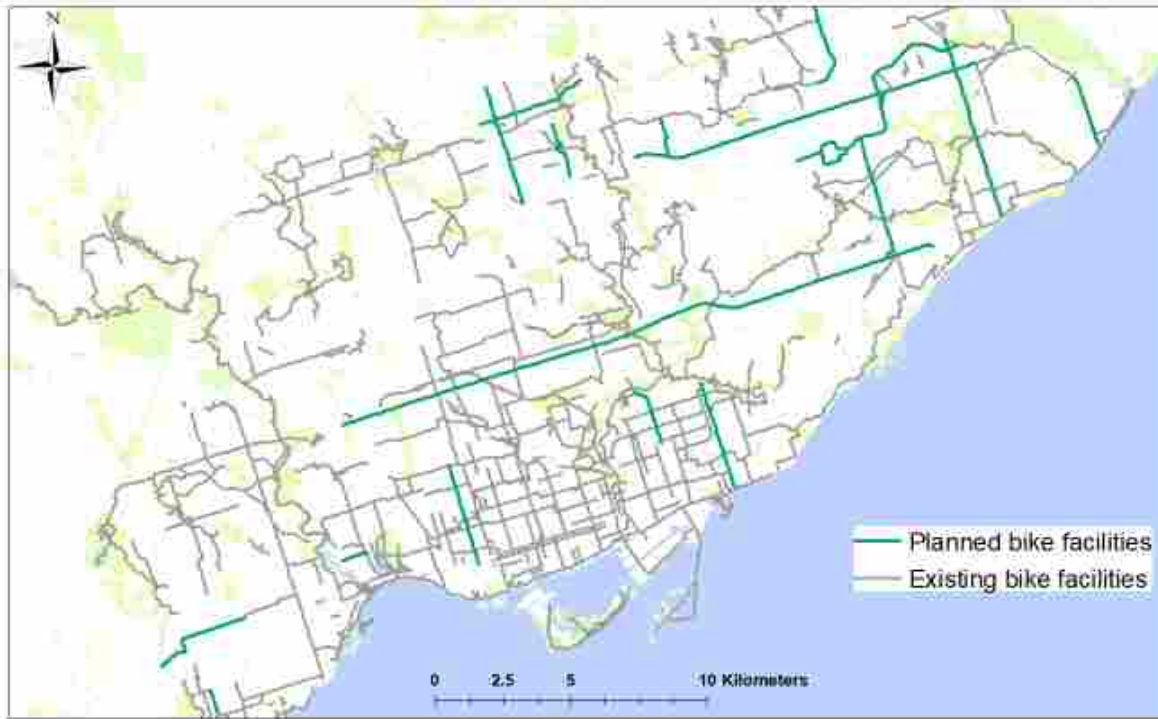
The Highest Concentrations are Experienced on Cycle Tracks



BC Concentrations are High Downtown and Along Major Traffic Axes



Intersection of Cycling Plan with Exposure Surface



Air Quality Should be Included in the Design of Bike Facilities



BC concentrations on the planned facilities will be **higher** than on the existing facilities



PART 3: WHAT ABOUT JAMES BAY?

Some Ideas

- Quantify changes in traffic flows/speeds/composition during the cruise ship season, the associated emissions, and their impact on air quality and population exposure
- Measurements of air quality before/after and during the cruise ship season, and associate changes with cruise ships and traffic

How?

- Install traffic counters and air quality monitors before the cruise ship season at strategic locations to get a baseline
- Conduct additional measurements during the traffic season

We Need Your Input !

- How many entry/exits points exist for the James Bay neighborhood?
- Are there any locations that attract taxis/buses/shuttles or cluster of taxis/buses/shuttles?
- Are there any locations with increased # of cars parked during the cruise ship season?
- Are there any temporary attractions (related to cruise ship industry) that may attract seasonal traffic?
- What are the most probable routes to reach the identified traffic gathering clusters/temporary attractions?
- What are the routes taken by taxis and buses ?

Contact



University
of Victoria

Laura Minet, PhD

Assistant Professor, Civil Engineering

lauraminet@uvic.ca; 250-721-8987

<https://cleanairlab.ca/>

