



CLEARING THE AIR

How Electric Vehicles And Cleaner Trucks Can
Reduce Pollution, Improve Health And Save Lives
In The Greater Toronto And Hamilton Area



environmental
defence

OPHA
Ontario Public Health Association

JUNE 2020

TABLE OF CONTENTS

Introduction	3
What does a shift to cleaner vehicles look like?	4
How does traffic impact our health now?	5-6
Comparing Clean Vehicle Scenarios	7-11
Achieving Clean Vehicle Scenarios	12
Getting to 100 per cent electric passenger vehicles in the GTHA	13
Getting to 100 per cent electric transit buses on the road	14
Getting newer, more efficient trucks on the road quickly	15
Conclusion	16
References	17

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environmental
defence



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Introduction

People in the Greater Toronto Hamilton Area (GTHA) use vehicles every day to travel to work, go to school, move goods, and do many other tasks. These vehicles emit air pollution and greenhouse gas emissions, and this pollution makes people sick.

In the GTHA, air pollution causes more than 3000 premature deaths every year. This estimate is based on exposure to 3 pollutants - fine particulate matter ($PM_{2.5}$), nitrogen dioxide (NO_2) and O_3 .¹ One of the biggest sources of this air pollution is vehicle traffic. Air pollution is linked to lung cancer, respiratory conditions like asthma, allergies and chronic obstructive pulmonary diseases, and cardiovascular conditions like angina, heart attack, hypertension and stroke.

The impacts of air pollution are worse for older adults, young children, people with existing heart or lung conditions or with diabetes, those who are active outdoors and people who live near industrial pollution or high traffic corridors.² Canadian research has shown that marginalized socio-economic groups are disproportionately exposed to traffic-related air pollution. Residents who face socio-economic barriers are also likely to be more vulnerable to the impacts of this pollution, as they face other health inequities correlated with socio-economic status.³ The impacts are also worse for those who contribute the least to traffic-related air pollution, with public transit riders, cyclists, and pedestrians exposed to higher levels of air pollution than drivers.⁴

This report shows that switching to electric vehicles - cars, SUVs and public transit buses - and to cleaner trucks will drastically reduce air pollution from traffic. Modelling done by researchers at the University of Toronto Transportation and Air Quality Group quantified the health, social and climate change benefits of switching to cleaner vehicles in the GTHA. The results show that a shift to electric cars and SUVs, electric public transit buses, and more efficient trucks in the GTHA would lead to cleaner air, save lives by improving respiratory and cardiovascular

health, and provide billions in social benefits every year. Our modelling shows that a shift to electric cars and SUVs (EVs) will mean 313 fewer premature deaths per year while newer, cleaner trucks will mean 275 fewer premature deaths annually. Shifting to 100 per cent electric cars and SUVs would provide up to \$2.4 billion per year in social benefits, electrifying all public transit buses would provide up to \$1.1 billion per year, and shifting to more efficient trucks would provide up to \$2.1 billion per year.

These health and social benefits are on top of the climate change benefits that come with reducing 8 mega tonnes of greenhouse gas (GHG) emissions per year if cars, SUVs, and public transit buses were electric, equivalent to the output of two coal plants;⁵ or about half of the reductions needed to meet Ontario's 2030 carbon emissions reduction targets. To achieve all these benefits, governments need to implement stronger policies to reduce air pollution and carbon emissions from vehicles. For example, in a scenario where all cars and SUVs are electric, a single EV replacing a gas-powered car brings \$9,850 in social benefits, justifying significant spending to get more EVs on the road quickly.

As governments take unprecedented action to address the COVID-19 pandemic, improving air quality may minimize the risk of experiencing severe consequences of infectious diseases such as COVID-19 that disproportionately impact those with underlying medical conditions like heart disease, respiratory diseases and cancer. Recent studies on this issue suggest that long-term exposure to air pollution increases the likelihood of experiencing the most severe COVID-19 outcomes.^{6,7}

What does a shift to cleaner vehicles look like?

We've modelled five scenarios (plus a base case of current conditions) to compare the benefits of reducing traffic pollution from cars and SUVs, trucks, and transit buses. Each scenario explores what the GTHA can look like with a specific mix of cleaner vehicles, and how this shift impacts air pollution, health, and greenhouse gas emissions in the region.

The scenarios we modelled are as follows:

- Base Case - current emissions (calculated with 2016 data)
- 20 per cent of cars and SUVs are fully electric (EVs)
- 50 per cent of cars and SUVs are fully electric (EVs)
- 100 per cent of cars and SUVs are fully electric (EVs)
- 100 per cent of public transit buses in the GTHA are fully electric
- All trucks including so that it is (including delivery vehicles) are replaced with newer, more efficient models meeting at least 2008 technology standards

We've assessed the impact of each scenario in reducing some of the most common and harmful traffic-related air pollutants, including NO₂ (nitrogen dioxide), PM_{2.5} (fine particulate matter), BC (black carbon, a significant portion of PM_{2.5} and mostly generated by diesel exhaust), as well as reducing greenhouse gases (GHGs). We also incorporated the impact of each scenario on O₃ (ozone) as it is a secondary pollutant closely linked to vehicle emissions.

HOW DID WE CALCULATE SOCIAL BENEFITS?

We calculated social benefits using a measure known as the Value of Statistical Life (VSL). This represents how much people are willing to pay to reduce their risk of death. For instance, it can include the wage premium required to attract employees to do dangerous work, or the willingness to pay for improved vehicle safety features. VSL captures the value of reduced risk of premature death, but does not include health care costs. As vehicle electrification will lead to both health and social benefits, the economic valuation of electrification is even greater than the social benefit amounts calculated for this report.

WHAT WE DIDN'T MODEL

We set out to answer a specific question: How can a switch to cleaner vehicles improve health and climate outcomes in the GTHA? Another critical question - outside the scope of this report - is exploring the impacts of reducing the number of vehicles on the road, and how far they drive.

Solutions like expanding work-from-home options, improving transit, supporting active transportation like walking and cycling, and improved urban planning are critical to cutting vehicle pollution and greenhouse gas emissions. Similar to the principle of "Reduce, Reuse, Recycle," the first and most effective solution is always to reduce. We recommend that policymakers consider these options in addition to those explored in our work.

How does traffic impact our health now?

Our base case modelling of air pollution accounts for all anthropogenic and natural sources. For GHGs, we modelled only traffic-related operating and fuel-cycle emissions, which include emissions from nearby power plants to account for the production of electricity fueling electric vehicles.

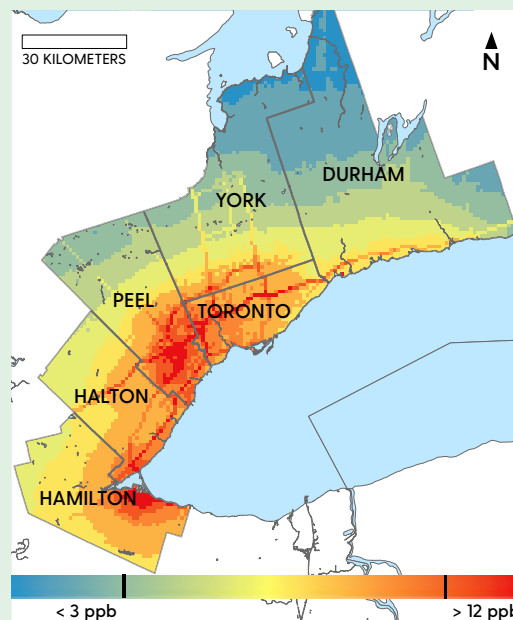
The modelling is based on a thorough study of the exposure to air pollution by GTHA residents based on where they live.

Measuring power plant pollution allows us to consider the power source used to charge vehicles and its impact on air pollution and GHG emissions. Results are based on the current emissions profile of electricity in Ontario - a relatively low-carbon grid. However, Ontario's plan to ramp up natural gas use could mean that electricity use pollutes more in the future.⁸

The base case scenario results reveal some important facts:

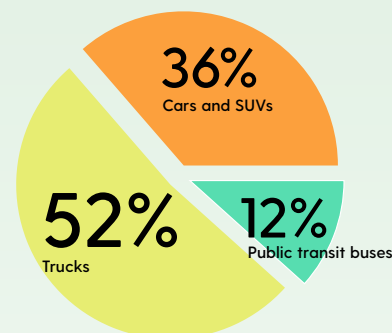
- Traffic-related air pollution from trucks, cars, SUVs and buses is responsible for 872 deaths in the GTHA every year
- Exposure to harmful air pollutants is concentrated close to busy roads, highways and hubs of freight movement, such as Toronto Pearson airport
- Trucks emit a disproportionate amount of nitrogen oxides (NO_x) and black carbon compared to cars and buses, and are responsible for almost 50 per cent of all traffic pollution related mortalities
- Private passenger vehicles (cars and SUVs) emit 76 per cent of the GHG emissions, but proportionately less NO_x and black carbon than trucks
- Public transit buses have a much smaller proportional impact on GHG emissions than other vehicles

Nitrogen Dioxide (NO₂) concentrations in the GTHA on an average weekday in parts per billion (ppb)



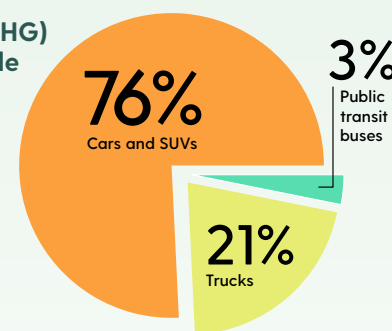
Traffic-related nitrogen oxides (NO_x) emissions by vehicle type in the GTHA

30 tonnes
NO_x/day



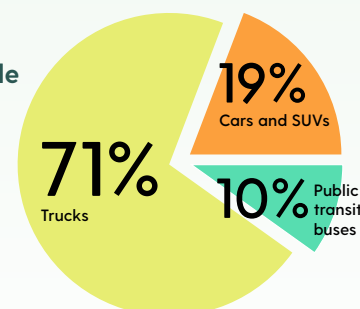
Traffic-related greenhouse gas (GHG) emissions by vehicle type in the GTHA

34,340 tonnes
CO₂ eq./day



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

0.54 tonnes
BC/day



Comparing Cleaner Vehicle Scenarios

The modelling done by researchers at the University of Toronto Transportation and Air Quality Group shows the health and social benefits and the air pollution and GHG reductions that can be achieved with different mixes of cleaner vehicles on roads and highways in the GTHA. To determine premature deaths avoided, years of life saved, and social benefits we've combined exposure data from all air pollutants measured except CO₂, which has longer-term health impacts from climate change, such as the impact from heat waves, extreme weather events, and vector-borne diseases.

The maps, tables and key findings from the modelling illustrate the greater health and social benefits resulting from the 100 percent EV and cleaner truck scenarios.

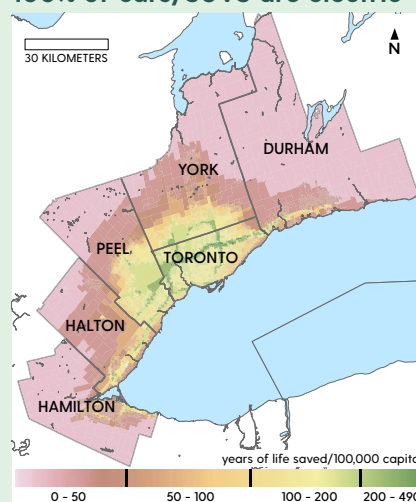
20% of cars/SUVs are electric



50% of cars/SUVs are electric



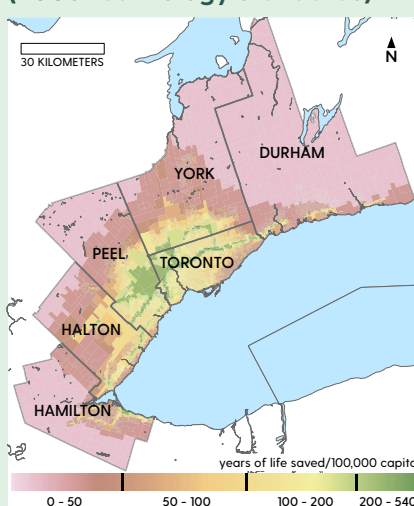
100% of cars/SUVs are electric



100% of public transit buses are electric



100% of trucks are cleaner (2008 technology standards)



**YEARS OF LIFE SAVED
IN THE GTHA EACH
YEAR PER 100,000
INHABITANTS BY
MODELLED SCENARIO**

TRAFFIC-RELATED GREENHOUSE GAS (GHG) EMISSIONS IN THE GTHA UNDER EACH MODELLED SCENARIO

AN AVERAGE WEEKDAY
IN THE GTHA

TOTAL GHG EMISSIONS:

34,340

tonnes of CO₂e

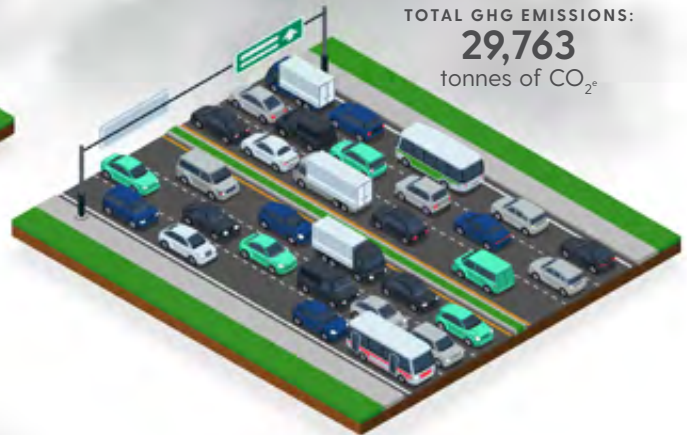


20% of cars/SUVs are electric

TOTAL GHG EMISSIONS:

29,763

tonnes of CO₂e



50% of cars/
SUVs are electric

TOTAL GHG EMISSIONS:

22,600

tonnes of CO₂ eq.

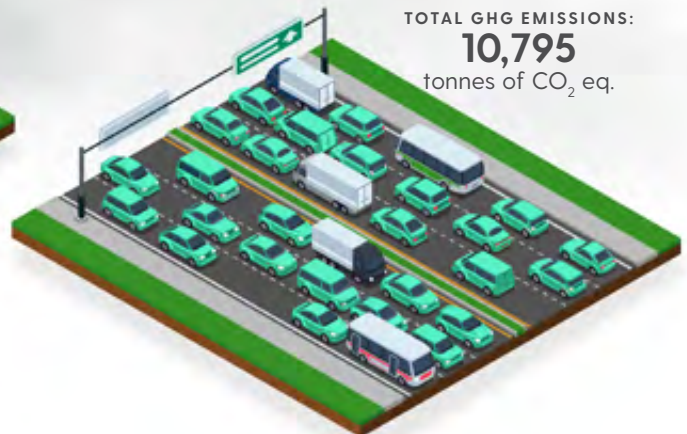


100% of cars/
SUVs are electric

TOTAL GHG EMISSIONS:

10,795

tonnes of CO₂ eq.



100% of public transit
buses are electric

TOTAL GHG EMISSIONS:

33,370

tonnes of CO₂ eq.



100% of trucks are cleaner
(2008 technology standards)

TOTAL GHG EMISSIONS:

34,150

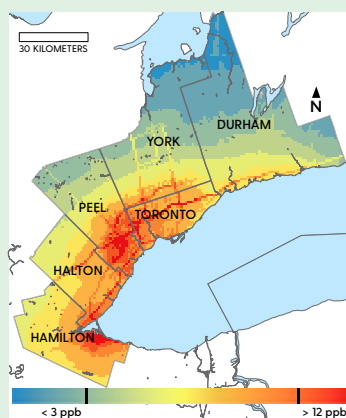
tonnes of CO₂ eq.



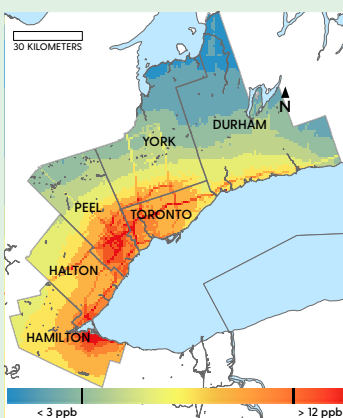
COMPARING THESE SCENARIOS LEADS TO SOME IMPORTANT CONCLUSIONS:

1. Of all scenarios modelled, 100 per cent car and SUV electrification achieves the greatest immediate health benefits and air quality improvements overall in the GTHA and the greatest GHG emission reductions (reducing GHG emissions from transportation in the region by 68.5 per cent). The broad benefits from this scenario justify the higher level of government investment and policy intervention. More ambition yields big results across the region.
2. Replacing older diesel trucks with newer, more efficient trucks brings strong immediate health benefits and air quality improvements to many communities in the GTHA, particularly those along 400-series highways where truck traffic is concentrated. This scenario ranked second in overall health benefits in the GTHA, but last in GHG emission reductions. Once heavy-duty truck electrification technologies become more feasible to implement at scale, renewing trucks with electrification rather than more efficient diesel technologies could further improve air quality as well as reduce GHG emissions.

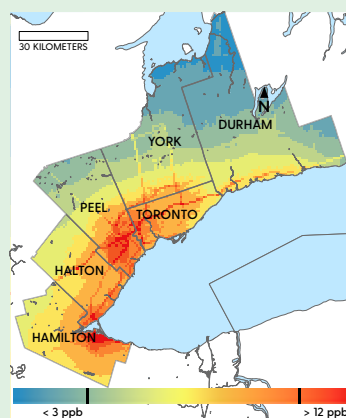
NITROGEN DIOXIDE (NO₂) CONCENTRATIONS IN THE GTHA ON AN AVERAGE WEEKDAY IN PARTS PER BILLION (PPB) FOR EACH MODELLED SCENARIO



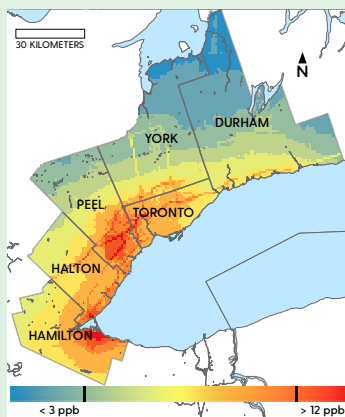
An average day
(2016 data)



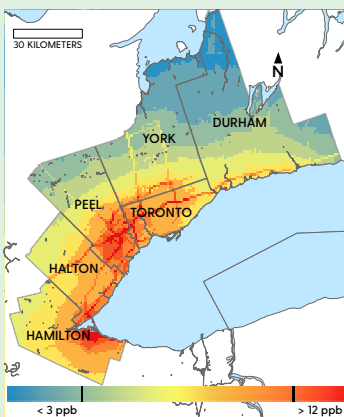
20% of cars/SUVS
are electric



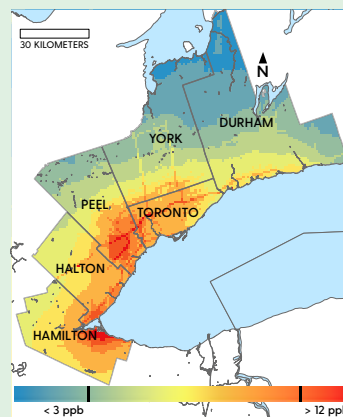
50% of cars/SUVS
are electric



100% of cars/SUVS
are electric

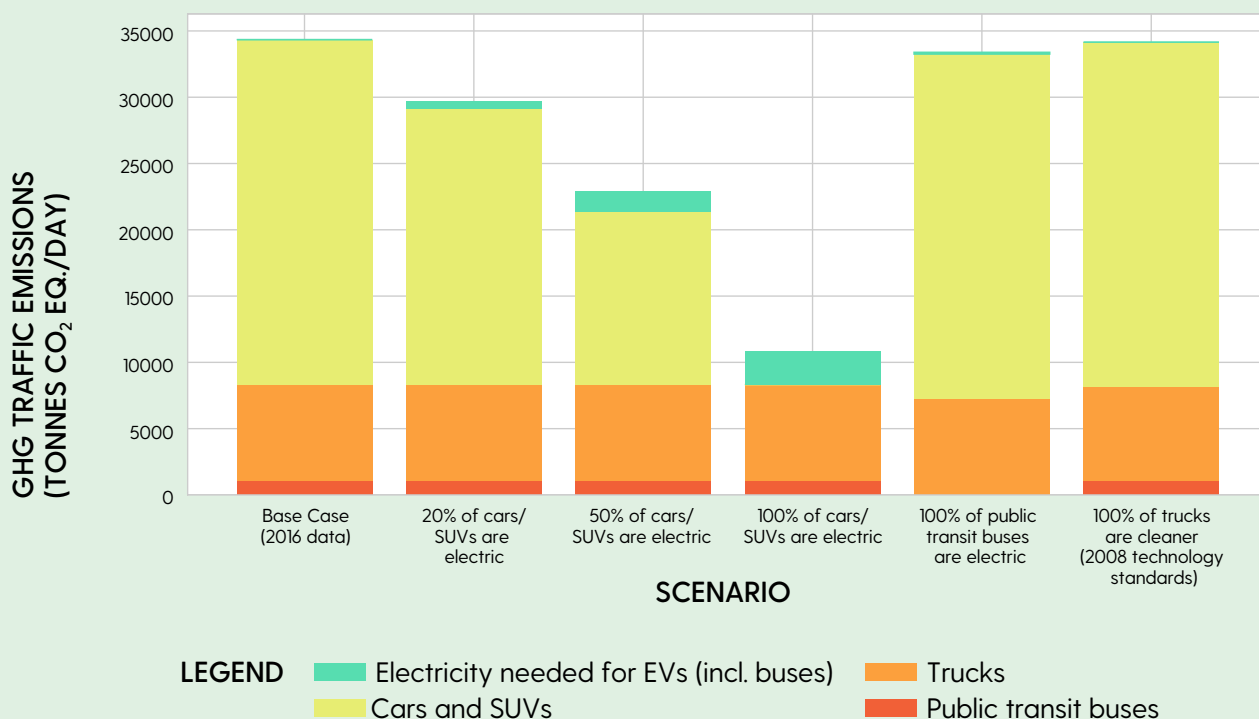


100% of public transit
buses are electric



100% of trucks are cleaner
(2008 technology standards)

DAILY TRAFFIC-RELATED GREENHOUSE GAS (GHG) EMISSIONS BY VEHICLE TYPE AND MODELLED SCENARIO



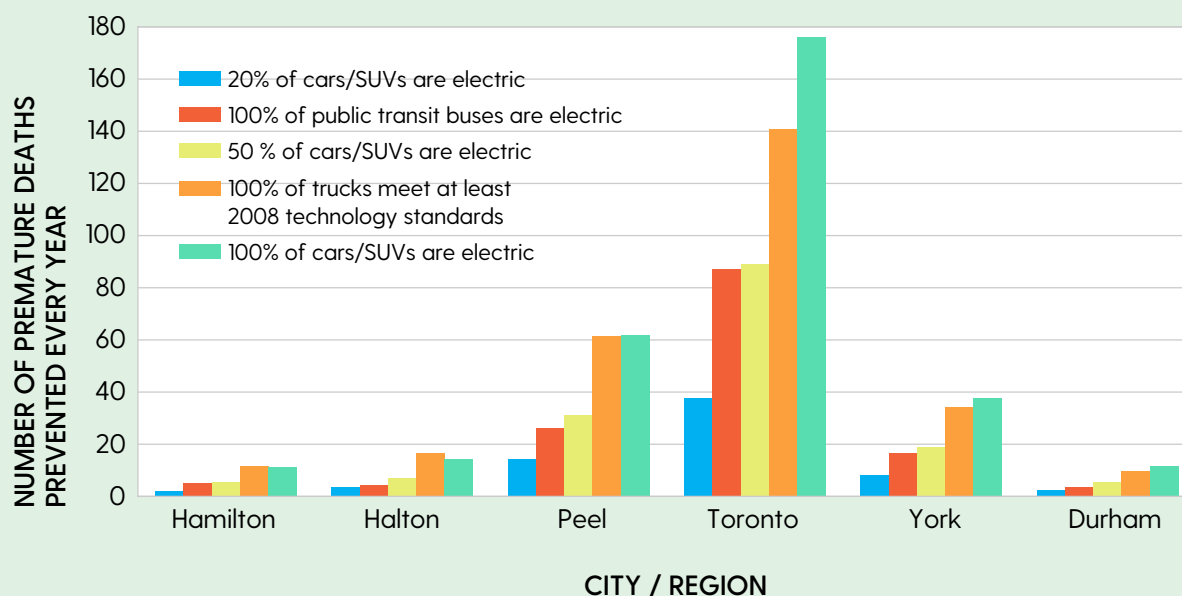
3. Electrifying 100 per cent of public transit buses in the GTHA (including GO and regional public transit) can reduce exposure to air pollution in urban centres like Toronto. Although the overall health, air quality and GHG reduction benefits are relatively small compared to other scenarios, the fact that buses are concentrated on major roads in dense population centres means that reducing their pollution levels helps more people. There are far fewer buses in the GTHA compared to cars and trucks, so their impact per vehicle is much greater.

4. Scenarios differ in their relative impacts on reducing air pollution versus reducing GHG emissions. Broadening policy action to make multiple vehicle types cleaner is the best way to balance immediate health benefits from better air quality with the long-term benefits of reduced GHG emissions.

5. Existing research in Toronto has revealed that people who are contributing little or no air pollution by walking, cycling or taking public transit, are exposed to more air pollution than those who are causing the pollution by driving gas and diesel vehicles.⁹ Vehicle electrification and cleaner trucks, along with reducing the number of vehicles on the road, will help address these unjust inequalities in air pollution exposure.

6. Broad policy action to improve multiple vehicle types (trucks, cars, SUVs, and transit buses) can improve health across the entire GTHA. Reducing emissions from certain vehicle types benefits some regions in the GTHA more than others. For example, regions with higher truck traffic, such as Peel Region, would benefit proportionally more from cleaner trucks, while Toronto residents would benefit proportionally more than other regions from electrifying buses. Reducing emissions from multiple vehicle types would help distribute health benefits across the regions of the GTHA.

PREMATURE DEATHS PREVENTED IN THE GTHA BY MODELLED SCENARIO AND REGIONAL MUNICIPALITY



7. Reducing air pollution through the modelled scenarios showed that populations currently exposed to higher air pollution levels would generally experience slightly greater health benefits. Since the biggest reductions in air pollution happen near major roads, people who live closest to major roads benefit most from the cleaner vehicles on these roads. Moreover, Canadian research has shown that marginalized socio-economic groups are disproportionately exposed to air pollution,¹⁰ and would benefit more from reducing that pollution.

8. Government funding to help get cleaner cars and trucks on the road will more than pay for itself in social benefits to GTHA residents. If all cars and SUVs on the road were electric in the GTHA, each electric vehicle that replaces a gas-powered car would bring \$9,850 in social benefits. This amount is far higher than the \$5,000 purchase incentive per vehicle currently offered by the federal government.

Comparing Vehicle Pollution Scenarios in the GTHA

SOLUTION & HOW WE GET THERE



Cars and SUVs: 100% electric

ZEV Sales Mandate @ 100%: supported by incentives and standards

Health impact: Mortalities prevented/yr



313

Cost impact: Social benefits/yr



2.4 billion

GHG Impact: MTs reduced/yr



7.6

Health Rank

1

GHG Rank

1

Cleaner Trucks

Truck scrappage program, green vehicle incentive program, truck fleet efficiency requirements, Low Emission Zones



275

2.1 billion

0.06

2

5



Cars and SUVs: 50% electric

ZEV Sales Mandate @ 50%: supported by incentives and standards

157

1.2 billion

3.7

3

2

Public Transit Buses: 100% electric

All GTHA public transit providers with buses commit to 100% bus electrification, supported by funding from province/federal government



143

1.1 billion

0.3

4

4



Cars and SUVs: 20% electric

Current planned passenger vehicle policies from federal, municipal government plans

63

0.5 billion

1.4

5

3

Achieving Clean Vehicle Scenarios

Policies to get cleaner vehicles on our roads are already being implemented by federal, provincial, and municipal governments in Canada. For example, the federal government now offers electric vehicle purchase incentives of \$5,000 to help increase affordability and uptake.

But current plans do not go far or fast enough. Strengthening and accelerating policies to electrify cars, SUVs and public transit buses, along with updating truck fleets will lead to major health benefits for GTHA residents, significant monetized social benefits, and major reductions in air pollution and GHGs.

To accelerate clean vehicle uptake and achieve the health benefits demonstrated in our research, we recommend the following policies that all levels of government can implement to achieve each scenario's outcomes. These recommendations are based on current evidence and show one potential pathway to this outcome, not an exhaustive list of policy options. They also do not include policies to reduce the overall number of vehicles on the road or the number of kilometres driven.



POLICY SUGGESTIONS

Getting to 100 per cent electric passenger vehicles in the GTHA:



Zero-emission vehicle (ZEV) sales mandates for cars and SUVs (passenger vehicles)

A ZEV sales mandate requires that automakers ensure a rising percentage of their car sales are electric by specific dates. British Columbia currently has a ZEV sales mandate requiring that automakers meet ZEV sales targets of 10 per cent of passenger vehicle sales by 2025, 30 per cent by 2030, and 100 per cent by 2040. This places the onus on automakers to ensure that ZEVs are widely available to consumers, and that promotional dollars are behind them.

Zero-emission vehicle (ZEV) purchase incentives (until price parity is achieved with gas-powered vehicles)

Although ZEVs are often more affordable over their lifespan due to savings on maintenance and gasoline, the up-front price can be a barrier. We recommend complementing a ZEV sales mandate with temporary ZEV purchase incentives to help address this barrier. A 2017 report¹¹ shows a combination of incentives, charging infrastructure, and a ZEV mandate could lead to higher ZEV sales. Our modelling found social benefits of up to \$9,850 per EV in a 100 per cent EV scenario, meaning government spending up to this amount will be offset by benefits to GTHA residents.

Investments in EV charging infrastructure

The City of Toronto's Electric Vehicle Strategy calls for investment in EV charging infrastructure to encourage drivers to switch to electric.¹² Ensuring proper infrastructure is in place is key to accommodating electric vehicle growth and addressing "range anxiety" from drivers.

Strengthened fuel efficiency regulations for cars

Current federal rules mean that automakers must achieve progressively more stringent annual fleet average GHG emission standards. This encourages them to produce and sell cleaner cars like EVs. Canada's standards are now tied to the U.S., but the U.S. plans to roll back their standards. Canada must maintain our stringent standards to incent increased ZEV deployment and help meet our climate targets.



POLICY SUGGESTIONS

Getting to 100 per cent electric public transit buses on the road in the GTHA:

Commitments from public transit providers to purchase exclusively electric buses and retire diesel-powered buses

This would involve a commitment from municipal and regional transit authorities (for example, the Toronto Transit Commission or Hamilton Street Railway) to purchase exclusively electric buses, retiring diesel buses at the end of their lifespan or sooner. Some transit authorities in the GTHA have already committed to bus electrification, and most have begun integrating electric buses.

Federal and provincial funding programs to support a transition to fully electric public transit buses

The cost of electric buses means that transit providers would need funding support from federal and provincial governments to achieve full bus electrification. This also presents an opportunity to create new jobs and support Canadian electric bus manufacturers like New Flyer Industries, who have sold electric buses to many Canadian cities, including Toronto.



POLICY SUGGESTIONS

Getting newer, more efficient trucks on the road quickly:

Truck scrappage programs

This program would allow fleet or vehicle owners to “cash in” older, more polluting trucks and get financial help buying newer, more efficient (or electric) trucks which cost more.

Maintain stringent fuel efficiency regulations for trucks

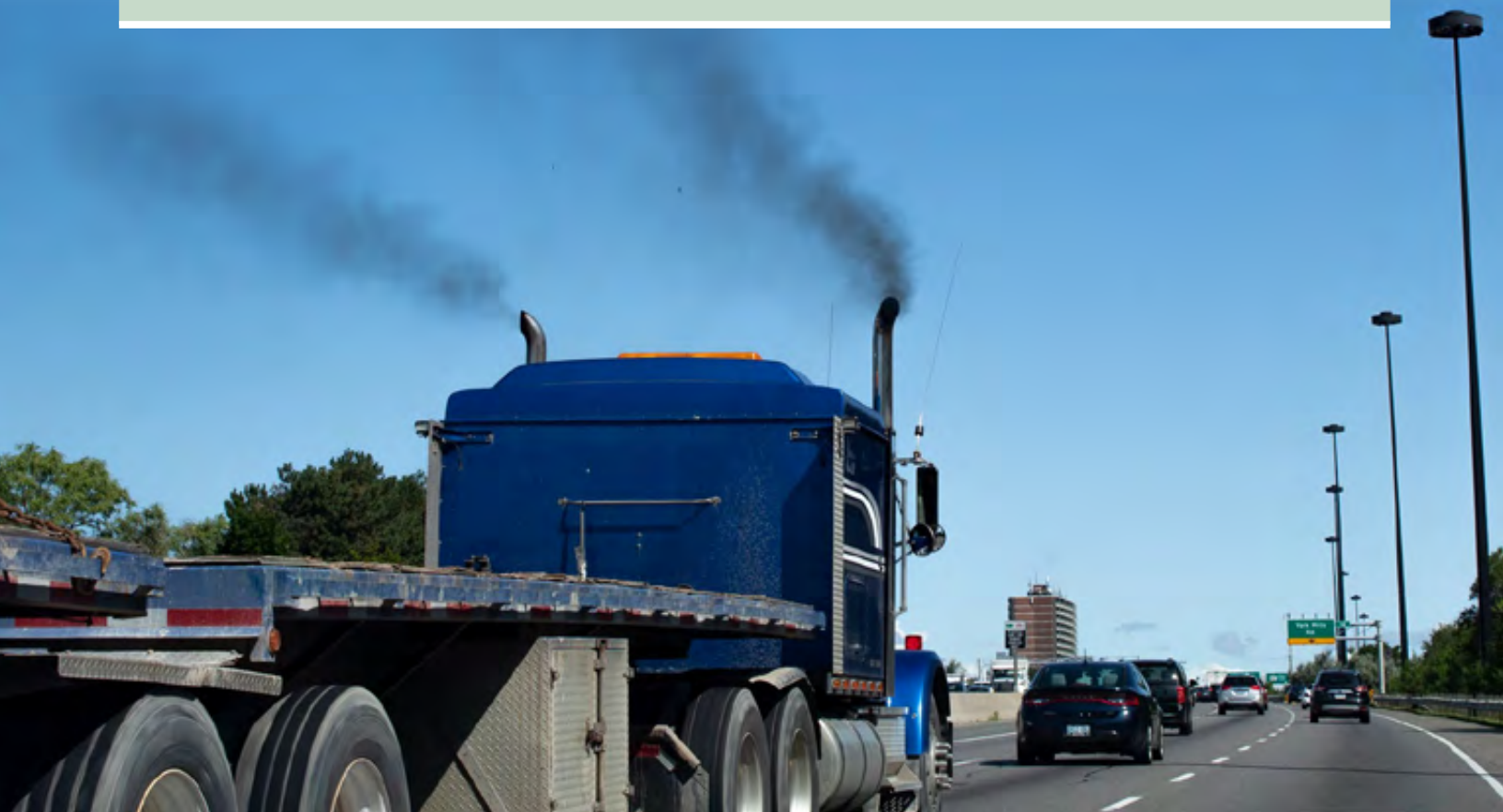
Like efficiency rules for cars, current federal regulations for heavy trucks require increasingly stringent GHG emission standards for new trucks. The more stringent regulations for trucks are still in play in the U.S., but Canada needs to separate our standards to avoid a similar weakening process to regulations for cars.

Green commercial vehicle incentive programs

Rebates would be available to companies who adopt electric or other trucks powered by clean technologies, and devices to retrofit existing trucks.

Low Emission Zones where stricter vehicle emission standards are in place

In high-pollution areas with dense populations, cities or regions could restrict the most polluting vehicles from entering certain areas. More than 250 cities in the European Union have already adopted such measures, with strong results. Madrid has seen a 32 per cent decrease in NO₂ emissions for their Low Emission Zone.¹³



Conclusion

Our modelling paints a picture of a healthier and more resilient population in the Greater Toronto-Hamilton area. There are fewer deaths and significant social benefits every year because our air is cleaner. Ontario's climate change targets are within reach because carbon pollution levels have dropped.

Governments have the tools at hand to create this world. By accelerating policies to electrify cars, SUVs, and buses, and get newer, cleaner trucks on the road, they can save hundreds of lives per year, bring billions in social benefits, and slow the devastating impacts of climate change.

Taking these steps forward will make all of our lives healthier here in the GTHA, both now and in the future.

[You can find more information on each scenario modelled, methodology, and recommended policies in our stakeholder report which can be found at \[www.clearingtheair.ca\]\(http://www.clearingtheair.ca\)](http://www.clearingtheair.ca)



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