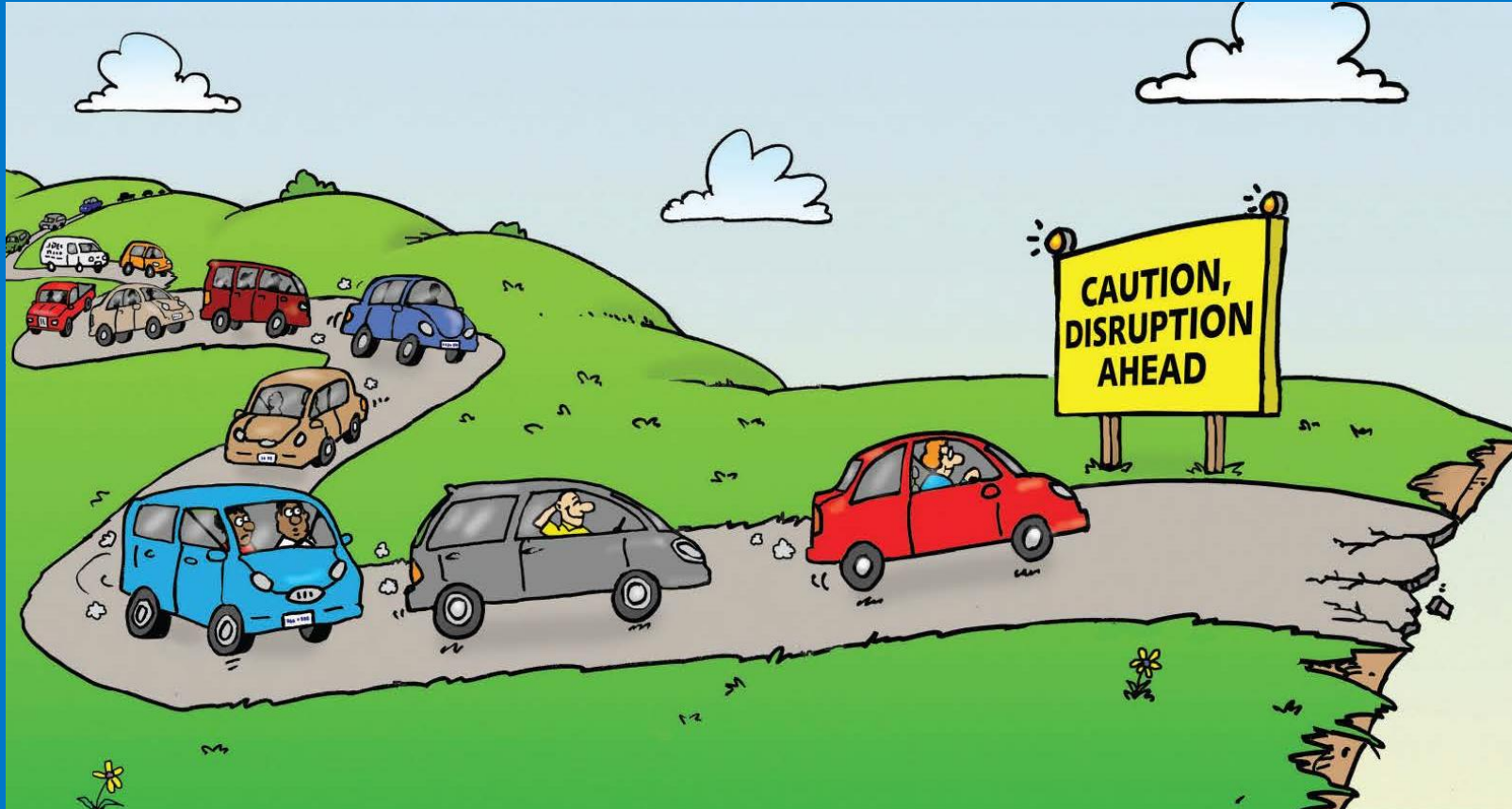


IMPROVED TRANSPORTATION IN THE TORONTO REGION



IMPROVED TRANSPORTATION IN ~~THE TORONTO~~ ONTARIO

A summary report¹ by the
University of Ontario Institute of Technology

2018

¹ This report summarizes 'Assessment of Electric Vehicles and Ridesharing in Ontario' prepared by the University of Ontario Institute of Technology (available at <https://sites.uoit.ca/sustainabilitytoday/>) supported through the Metcalf Foundation, Mitacs, Waterfront Toronto, and Veridian Connections and municipalities of Clarington and Pickering

IMPROVED TRANSPORTATION IN THE TORONTO REGION

Specifically, this report offers several system-based transportation initiatives:

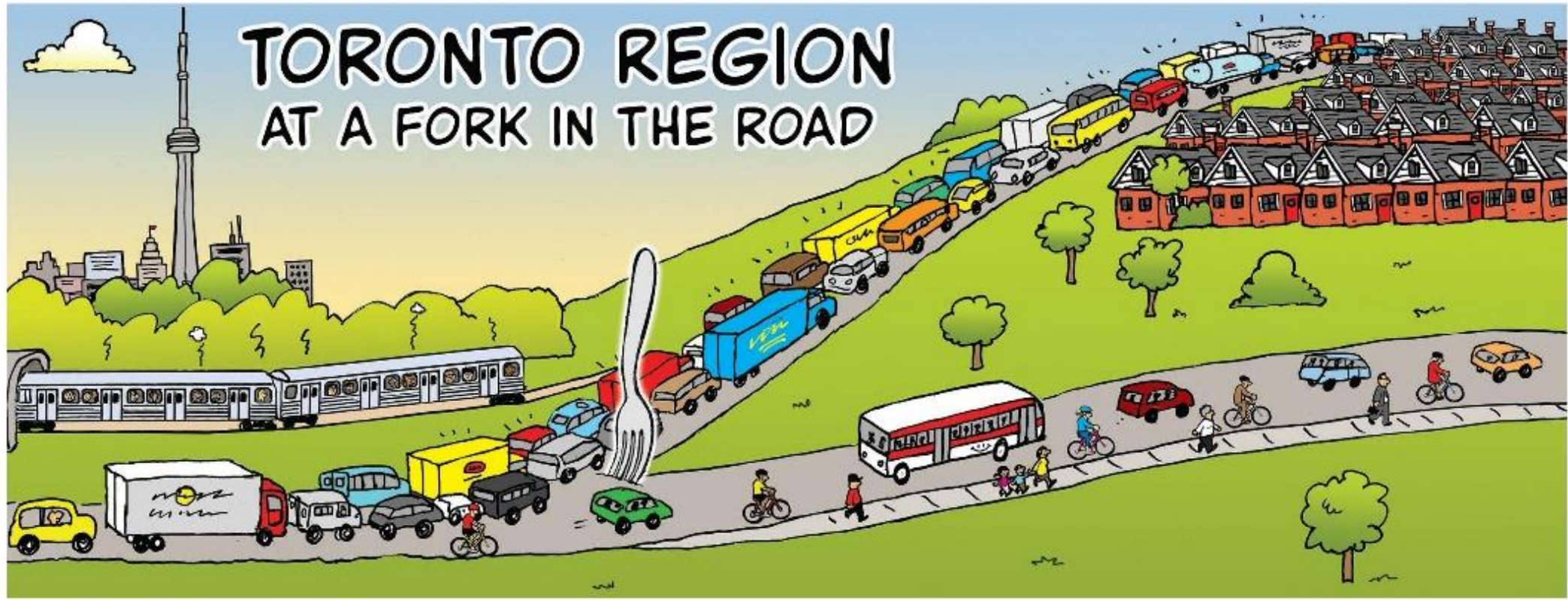
1. To seamlessly move more people, reduce the numbers of vehicles on highways, and better connect the inner and outer parts of the Toronto Region by efficiently linking transit nodes, such as college and university campuses (e.g., 'Learn on the GO').
2. To encourage ride-sharing. To enhance social mobility and community cohesion by making it easier, safer, and more common, to travel with others.
3. To show how the adoption of low-carbon (electric and fuel cell) vehicles could improve Ontario's overall transportation system, without expensive subsidies.
4. To establish a common community-based transportation platform combining transit and ride-sharing, ride-hailing services, e.g., expanded SmartCommute and BlancRide.
5. To strive for a minimum 50% reduction in carbon emissions associated with road transportation in Ontario (while increasing overall travel).
6. To ensure that transportation systems are fully and consistently aligned with local and regional land use plans.

IMPROVED TRANSPORTATION IN THE TORONTO REGION

The report also includes a transportation index and a dynamic compilation of information culled from hundreds of new studies. A detailed analysis accompanies this report and is available online.

Five key reports underpin the background of this review:

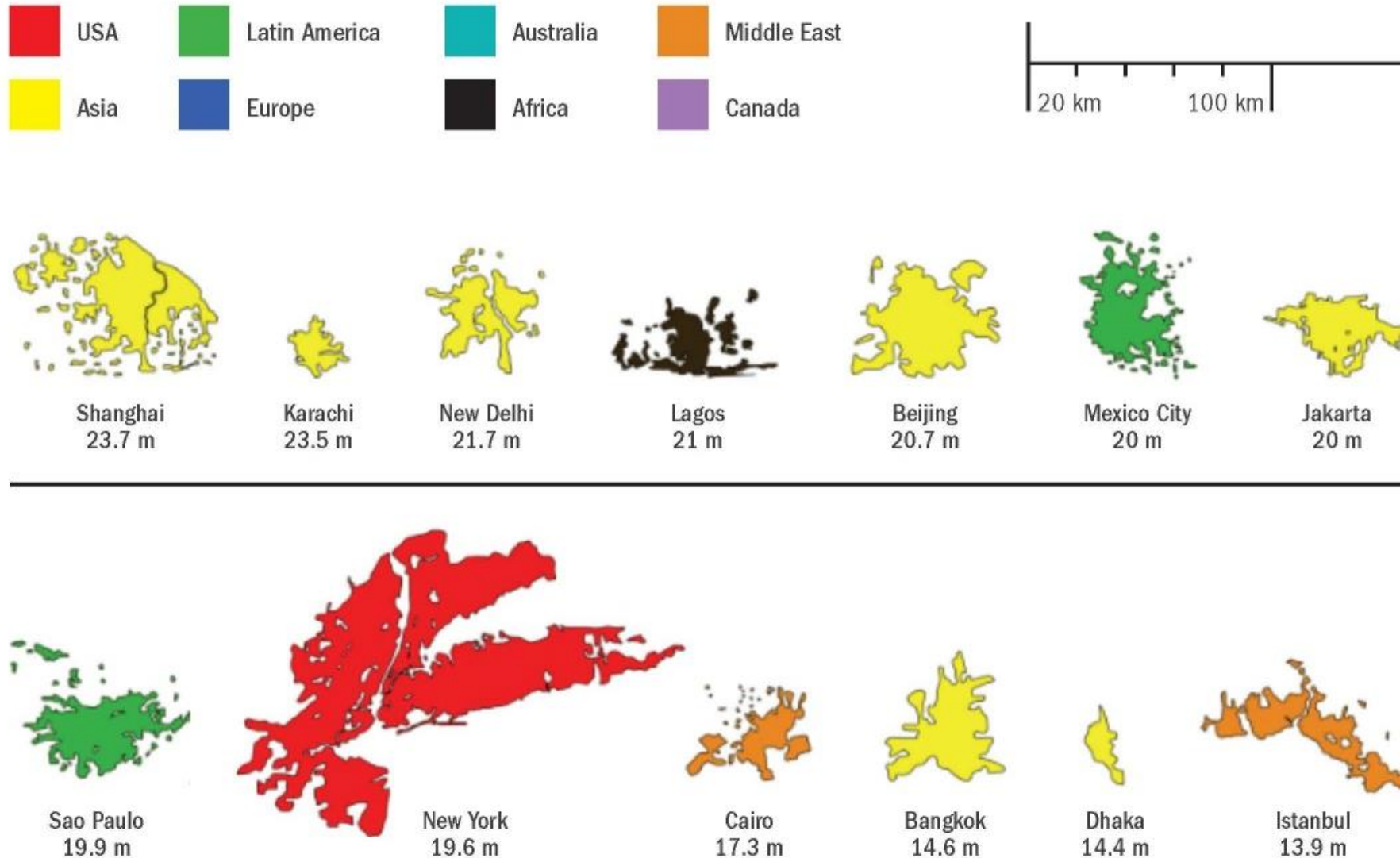
- (i) RethinkX “Rethinking Transportation 2020 - 2030”. 2017. Arbib and Seba;
- (ii) An Integrated Perspective on the Future of Mobility. 2016. McKinsey&Company and Bloomberg New Energy Finance;
- (iii) Draft 2041 Regional Transportation Plan. 2017. METROLINX;
- (iv) Making the Move: Choices and Consequences. 2013. Transit Panel report to the Government of Ontario;
- (v) Canada’s Electric Vehicle Policy Report Card. 2016. J. Axsen, S. Goldberg, N. Melton. Full referencing available in main report.

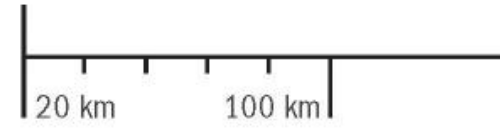


Toronto Region is at a crossroad. In one direction: congestion, health impacts, GHG emissions, and sprawl grow. The other direction represents the largest structural and social change the Region has ever undertaken. The transportation initiative outlined in this report aligns transportation with land use planning, and represents the Region's (and Ontario's, and probably Canada's) largest effort toward sustainable development.

Comparison of Global Urban Footprints

Cities arranged by population. Spatial extent of cities varies considerably across regions.





Tokyo
13.1 m



Buenos Aires
12.8 m



Los Angeles
12.8 m



London
11.9 m



Moscow
11.5 m



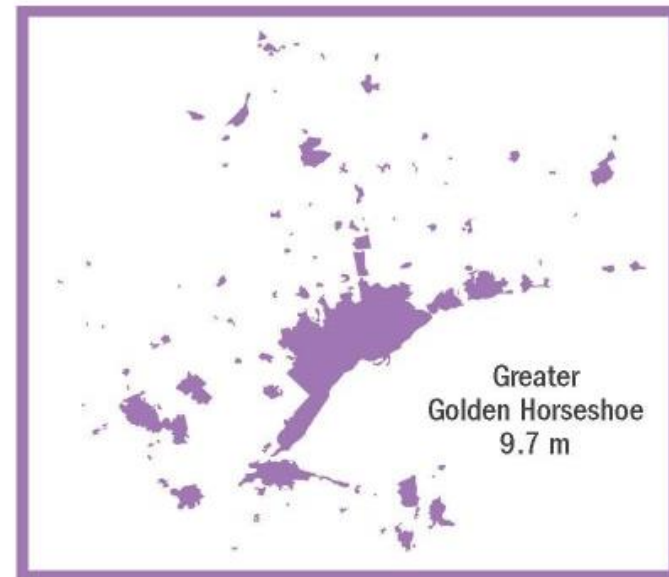
Guangzhou
11.1 m



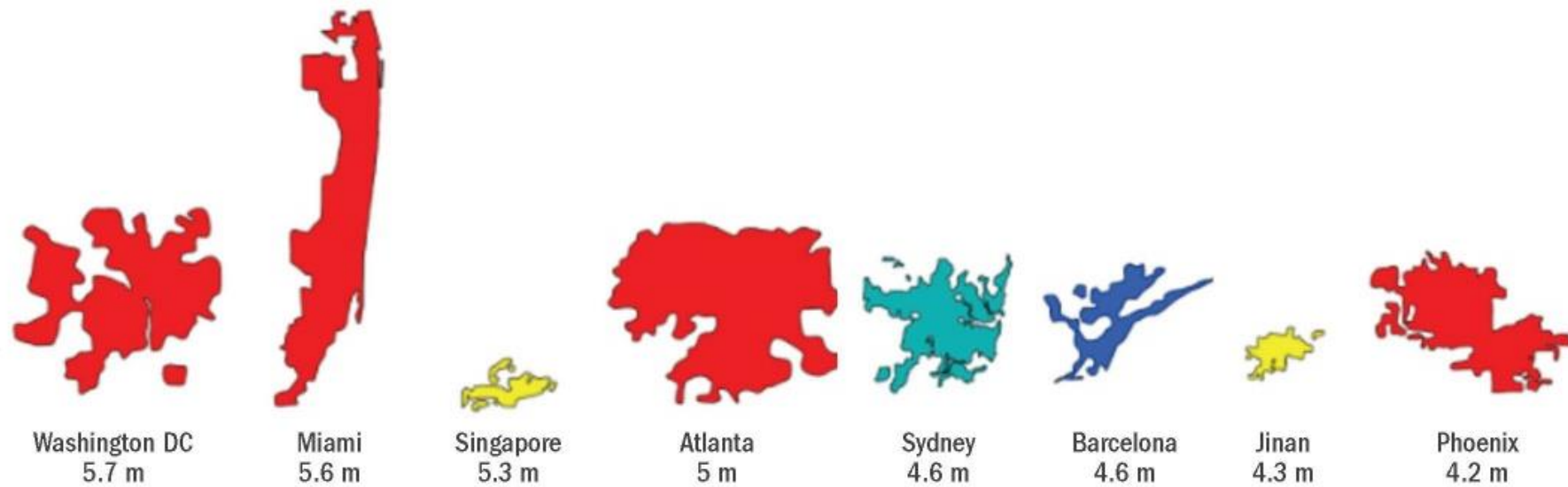
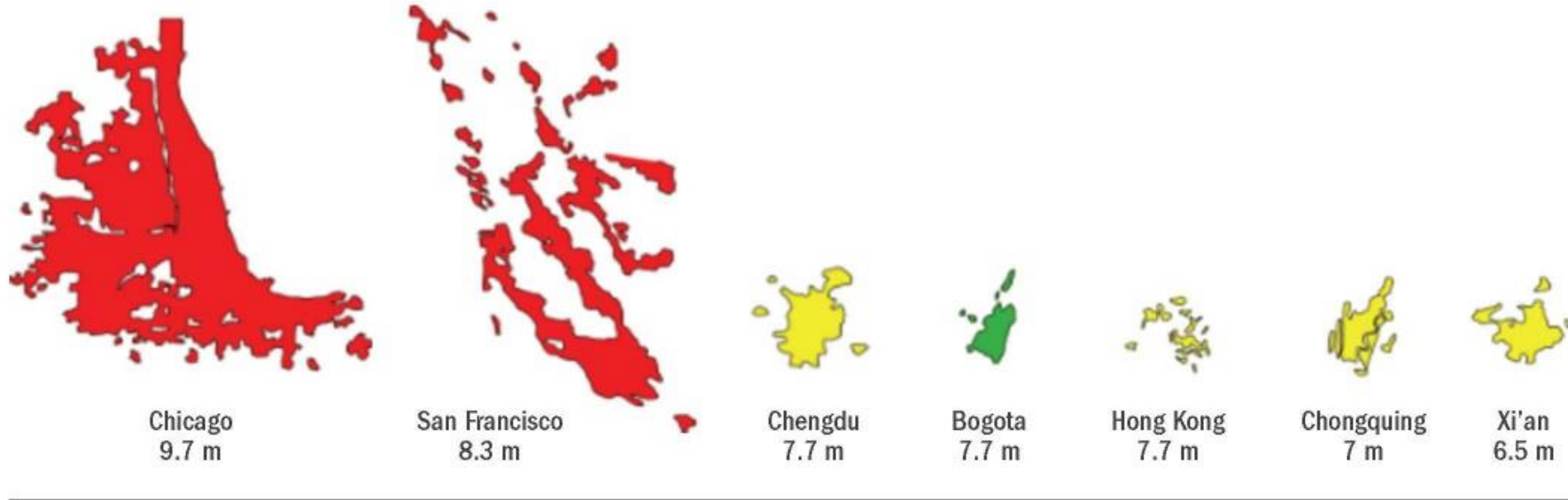
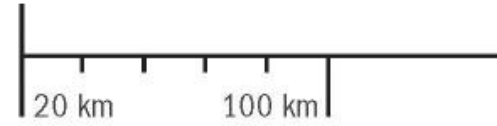
Paris
10.4 m

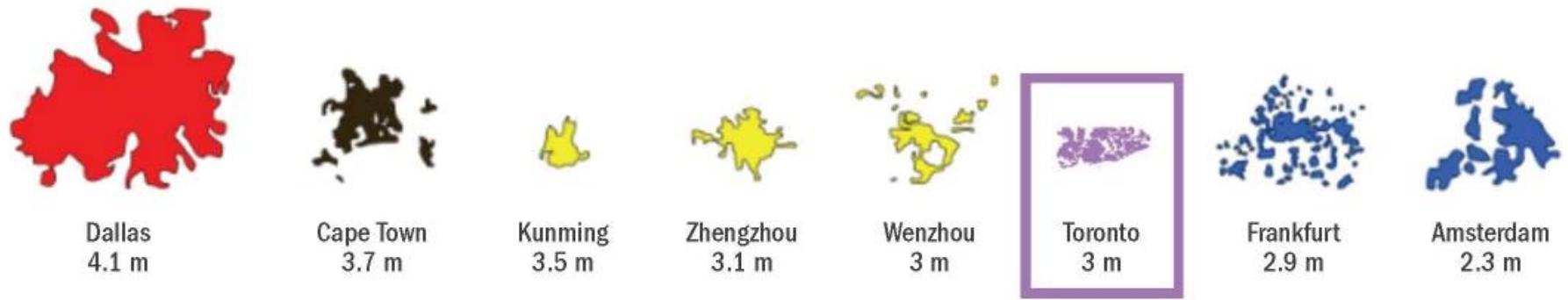


Seoul
10.4 m



Greater
Golden Horseshoe
9.7 m





Adapted From: M. Hartzell, 2013.

IMPROVED TRANSPORTATION IN THE TORONTO REGION

Catalysts for Change

EVs alone are not sufficient to bring about the enormous benefits that could accrue from changes to the Toronto Region transportation system, but this report suggests how EVs might catalyze this change and create widespread benefits in Ontario. This report suggests that efforts to encourage electric and autonomous vehicles in Southern Ontario will in turn provide broader improvements in personal mobility and freight delivery. To that end, the report analyzes the barriers to more widespread adoption of electric vehicles (EV) in the Toronto Region. The assessment focuses on three regional neighborhoods: The West Don Lands (WDL - a new neighbourhood east of downtown Toronto), Seaton (Pickering) and Clarington.

IMPROVED TRANSPORTATION IN THE TORONTO REGION

Catalysts for Change

A shift from internal-combustion engine (ICE) vehicles to EVs in the Toronto Region alone could eventually reduce carbon emissions by 25 Mt tonnes, about 2 tonnes per person. However, a shift from ICE to EVs alone will not address congestion in the Toronto Region. 'Transportation as a service' is likely the most important technical and social trend facing Ontario today. That is why this report emphasizes that Toronto needs an integrated approach that includes a 'one-two punch' of EVs plus ridesharing (along with improvements to arterial transit corridors).

This combined EV/ride-sharing with arterial transit approach would reduce carbon emissions and traffic congestion while also providing significant economic and social benefits. Specifically, the report suggests that new transportation systems could provide economic benefits of some \$45 billion and reductions in CO2 emissions by more than 25 Mt per year. This is a preliminary assessment, and detailed studies are still needed, however it is clear that opportunities of this scale are exceedingly rare.

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This report states that:

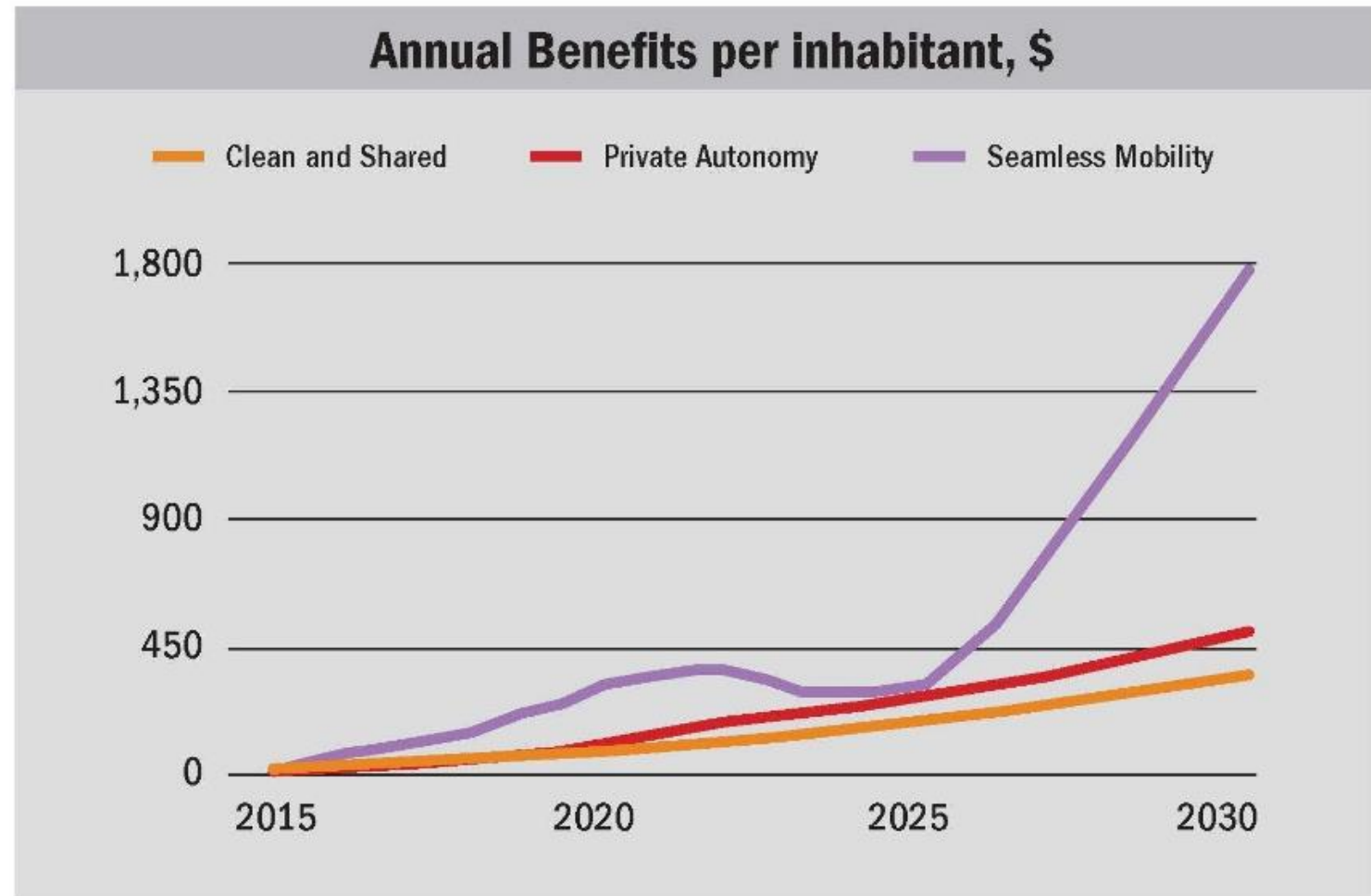
- Based on anecdotal discussions, residents in West Don Lands, Toronto (and presumably other dense urban centers) prefer lifestyles requiring low vehicle ownership (regardless of EV or ICE); integrated multi-modal systems are key.
- In Durham Region, new communities in Seaton and Newcastle prioritize near-by connectivity, i.e. 'first-mile, last-mile' links, particularly to existing and proposed GO stations.
- In typical southern Ontario communities preliminary work shows that a 10% EV penetration rate leads to overloading of about 12.5% of local electrical transformers. A 30% EV penetration rate will lead to significant overloading of transformers (grid revisions will be necessary).
- In dense cities, e.g. Changsha, China and likely the City of Toronto, ridesharing has the potential to reduce total kilometers driven by more than 20% and vehicle trips by 40% (assuming a maximum distance between trips less than 10 km, and schedule time less than 60 minutes).

IMPROVED TRANSPORTATION IN THE TORONTO REGION

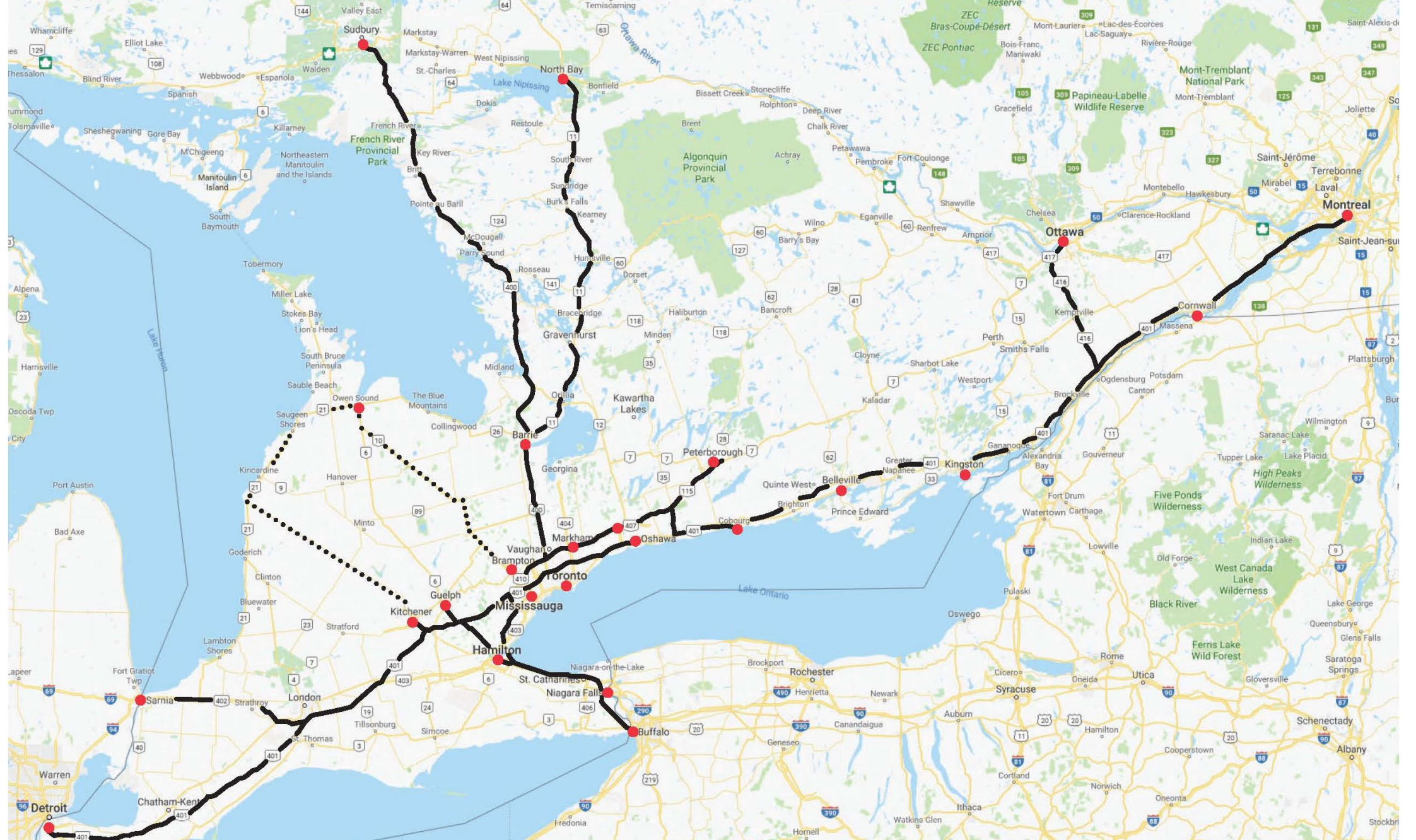
This report states that:

- In the Toronto Region (Greater Golden Horseshoe), ridesharing has the potential to reduce total kilometers driven by 11% and vehicle trips by 16% (assuming a maximum increased distance between trips 20% of total trip length, and schedule time less than 60 minutes).
- One of the most significant barriers to increased ridesharing in Toronto Region (and most other jurisdictions) is lack of social trust. Like most of the world, social trust is declining in Toronto Region, likely due to decreases in social capital, which is directly linked to the levels of civic engagement and social connectedness. Social trust (or lack of) is linked to income inequality. Immigrant populations in Canada have significantly lower social trust than other Canadians. Ridesharing may well have even greater benefits in increasing social capital than reducing congestion, accidents, and emissions.

IMPROVED TRANSPORTATION IN THE TORONTO REGION

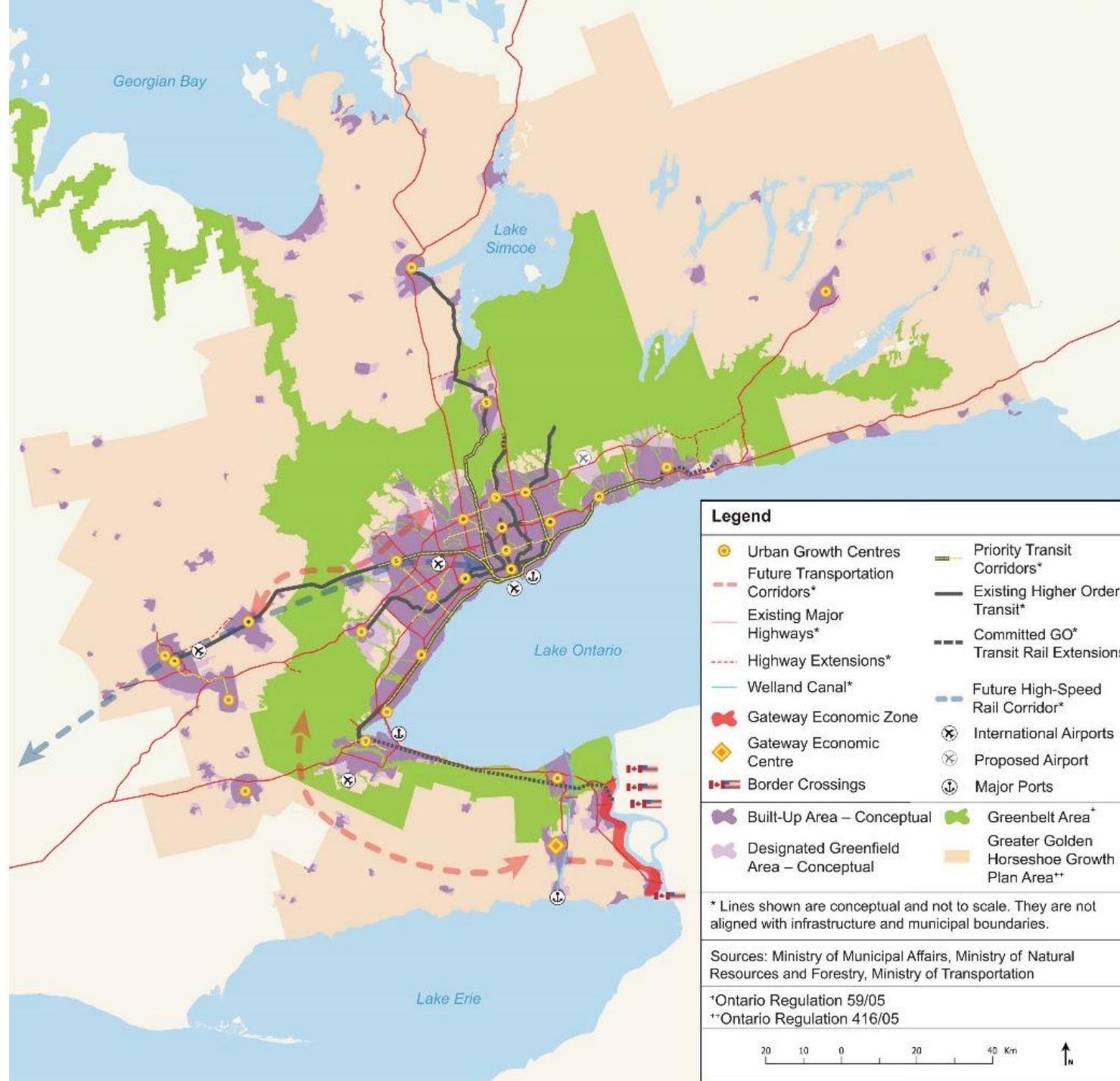


Right: Projected benefits under 'Seamless Mobility' (fully integrated), 'Private Autonomy' and 'Clean and Shared' (EVs and ride-sharing). From: S. Bouton, E. Hannon, S. Knupfer and S. Ramkumar, The future(s) of mobility: How cities can benefit, McKinsey&Company, 2017. [USD]



Strengthening Ontario's surface arterial routes; connecting transit nodes

Toronto Region 'Growth Nodes'



IMPROVED TRANSPORTATION IN THE TORONTO REGION

Summary Recommendations to Support the Transition to Transportation as a Service (Ontario)

NB: many of these recommendations are adopted from other studies, e.g., Metrolinx regional transportation plan.

Local Governments (municipalities)

- In new communities (in the Toronto Region), encourage new home design to facilitate easy conversion of garages and driveways to other uses (flexible building design and zoning).
- In new communities designate locations for parcel drop-off and commuter collection nodes.
- Identify and encourage establishment of work (transit) nodes; include designation in land-use plans.
- Work together to develop 'open source' mobility platform(s) for integrated travel across modes and contiguous communities.
- Serve as key interlocutor with residents on the need for transportation pricing to drive efficiencies, e.g. parking fees and tolls (advocate for municipal share of road revenues).

IMPROVED TRANSPORTATION IN THE TORONTO REGION

Local Governments (municipalities)

- Support the segregation of vehicle types, e.g. restricted hours for heavy-duty trucks, and identified zones for AVs, bike lanes, and pedestrian walkways.
- Encourage a fee for distance travelled for all autonomous vehicles (AVs) – differentiate the fee for single occupancy versus ride-sharing and ride-hailing.
- As part of land-use plans, publish population density goals by neighborhood – update progress annually. As AVs become widespread enact property tax policies that recognize deviations from density targets, i.e. act now to ensure that AVs do not bring about more urban sprawl.
- Differentiate parking fees by vehicle size, pollution levels, and typical occupancy levels.
- Lead on ‘first- and last-mile’ transportation service provision.

IMPROVED TRANSPORTATION IN THE TORONTO REGION

Local Governments (municipalities)

- Lead on data collection and security aspects of vehicles operating on local roads.
- As likely termini, the cities of Sudbury, North Bay, Kingston, Ottawa, Sarnia, London and Windsor have a unique role to play in supporting (and establishing) the proposed arterial transit system.
- Corporate influence will be intense, and the provincial and federal government are responsible for much of the funding and regulatory aspects of the system, however, municipalities need to lead in developing Ontario's new transportation system.
- Apply 'safety by design' in new TaaS infrastructure and services, e.g. licensing, training and vehicle monitoring.

IMPROVED TRANSPORTATION IN THE TORONTO REGION

Summary Recommendations to Support the Transition to Transportation as a Service (Ontario)

NB: many of these recommendations are adopted from other studies, e.g., Metrolinx regional transportation plan.

Government of Ontario

- Re-visit the long-term energy plan for a possible increase of 5,000 MW in electricity demand as the transportation fleet electrifies. Ensure that the carbon intensity of Ontario's grid-supplied electricity stays below 75 g CO₂/kWh.
- Prioritize arterial (surface) routes and transit servicing (signal likely routes, modes and timing).
- Fully integrate TTC and Metrolinx transit offerings (consistent with TTC long-range planning and 2018 Metrolinx Transportation Plan); include regional transit companies as well.
- Re-visit fees as a way to enhance efficiencies, e.g. parking fees and tolls.
- Signal that by a given date, say 2030, vehicles (especially AVs) will be levied a fee for distance travelled – differentiate the fee for single occupancy versus ride-sharing.

IMPROVED TRANSPORTATION IN THE TORONTO REGION

Government of Ontario

- Assess ways that 400-series highways can provide disaggregated travel lanes and times, e.g. separate lanes for vehicles below 1600 Kg (base curb weight); differentiated travel speeds (reduced for heavy-duty trucks, increased for rapid transit buses).
- Assess ways that heavy-duty trucks could by-pass Highway 401 through Hwy 407 ETR (with possible integrated bus rapid transit and heavy-duty truck lanes).
- Ensure that new transportation systems evolve with services for seniors, children, and persons with disabilities.
- Expand transportation services to link key system nodes such as post-secondary institutions, health care facilities, and tourist destinations.

IMPROVED TRANSPORTATION IN THE TORONTO REGION

Government of Ontario

- Prioritize the movement of people and goods (vis a vis manufacturing and local area development).
- Dictate a response time target for first-responders to return-to-service of roads after an accident, e.g. the USA FHWA 90 minute target for return-to-service after a major incident.
- Set a total annual upper-limit for the province's electricity sector, with individual CO₂e emissions below 2T per person (with an aspirational goal of 1T per person by 2050).
- Support launch of 'Learn on the GO' for Ontario's post-secondary institutions.

IMPROVED TRANSPORTATION IN THE TORONTO REGION

Government of Canada

- Establish a transportation transition program – with training and possibly financial support to key areas such as Alberta’s oil patch, automobile manufacturers, truck drivers, and auto servicing business operators.
- Provide an active website and regular publications on disruption of the transportation sector; benchmark Canada’s relative progress; designate several ‘pilot communities’ and service providers to develop aspects of the TaaS system.
- Ensure that oversight and regulation of Canada’s communication services is consistent with data systems requirements for transportation as a service objectives.

IMPROVED TRANSPORTATION IN THE TORONTO REGION

Boards of Education

- Encourage 'walk (or bike) to school' options for students and staff.
- Assess ways to open student bussing to local residents (security clearances and payment plans possible – provide real-time GPS of bus routes and stops).
- Encourage schools to locate next to, or support development of other key transportation nodes (pursue integrated use options for facilities).
- By 2025 provide draft policy for student transportation through AVs.

IMPROVED TRANSPORTATION IN THE TORONTO REGION

Local Distribution Companies (electricity utilities)

- Consider business opportunities to provide servicing to, or complete provision of, EV and AV fleets. For example, support battery-swap EV fleet servicing.
- Advise homebuilders and homeowners on ways to integrate vehicle charging with battery storage and increased resilience (off grid capacities).

IMPROVED TRANSPORTATION IN THE TORONTO REGION

Post-Secondary Institutions

- Work together to establish a Toronto Region arterial transit system to connect all institutions, i.e. develop 'Learn on the GO'.
- Work with partners to provide low cost transit options for students – with support for others to use the system.
- Collaborate with local governments to establish transit nodes near facilities (employment, freight & delivery, and logistical support).
- Assess practicality of making residences available on short-term basis to non-student occupants (possibly expanding facilities).

IMPROVED TRANSPORTATION IN THE TORONTO REGION

Private Sector

- All employers in the Toronto Region with more than 1000 employees (direct and/or contracted) should consider joining the smart commute program (as expanded with Learn on the GO).

TRANSPORTATION INDEX: ONTARIO AND CANADA

Annual motor vehicle license sales and renewal revenue in Ontario:	\$1.1 billion
Annual number of visits to drive-through establishments in Canada:	1.3 billion
Number of retail gas stations in Ontario:	3,601
Annual insurance premiums for Ontario drivers:	\$10 billion
Sales of diesel fuel in Ontario:	5,427,217,000 liters (14.7 million tonnes CO ₂) per year
Sales of gasoline in Ontario:	16,261,678,000 liters (37.4 million tonnes CO ₂) per year
Gasoline and motive fuel tax revenue in Ontario:	\$3.1 billion per year
Canada's annual vehicle export revenue:	\$84.3 billion (94% from Ontario)
Average monthly payment on new vehicles:	\$570 for loan and \$490 for lease
Value of vehicles and parts produced in Ontario:	\$201 million per day
Number of automotive manufacturing industry employees in Ontario:	101,000
Canada's retail sales in the automotive aftermarket:	\$19.3 billion per year
Number of employees and service technicians in Canada's aftermarket:	490,000
Annual revenue:	METROLINX, \$1.2 billion; Passenger rail (VIA), \$271 million

TRANSPORTATION INDEX: ONTARIO AND CANADA

Annual freight rail (CP, CN) revenues:	\$6.2 billion, \$12.8 billion respectively
Number of Canada's 20 worst highway bottlenecks located in Toronto:	10
Extra time behind the wheel, per year, that Canada's bottlenecks cost drivers:	11.5 million hours
Extra fuel used for the extended drive times at Canada's bottlenecks:	22 million liters
Minimum annual Highway 407 toll revenue:	\$373 million
Annual number of convictions through vehicle related incidences in Ontario:	1,323,774
Police officer's shift time spent in their vehicle:	49%
Annual motor vehicle related Emergency room visits in Ontario:	62,562
Minimum costs associated with injury from transportation incidences in Ontario:	\$1.23 billion
Average gross payment of automobile accident settlements:	\$120,000 per claimant
Number of taxi and limousine companies and self-employed drivers in Ontario:	17,276
Annual revenue for taxi and limousine services in Ontario:	\$807 million
Vehicles manufactured in Canada in 1999: 3 Mn.	Last year: 2.2 Mn
Ontario's imports of petroleum and natural gas:	\$11 billion per year

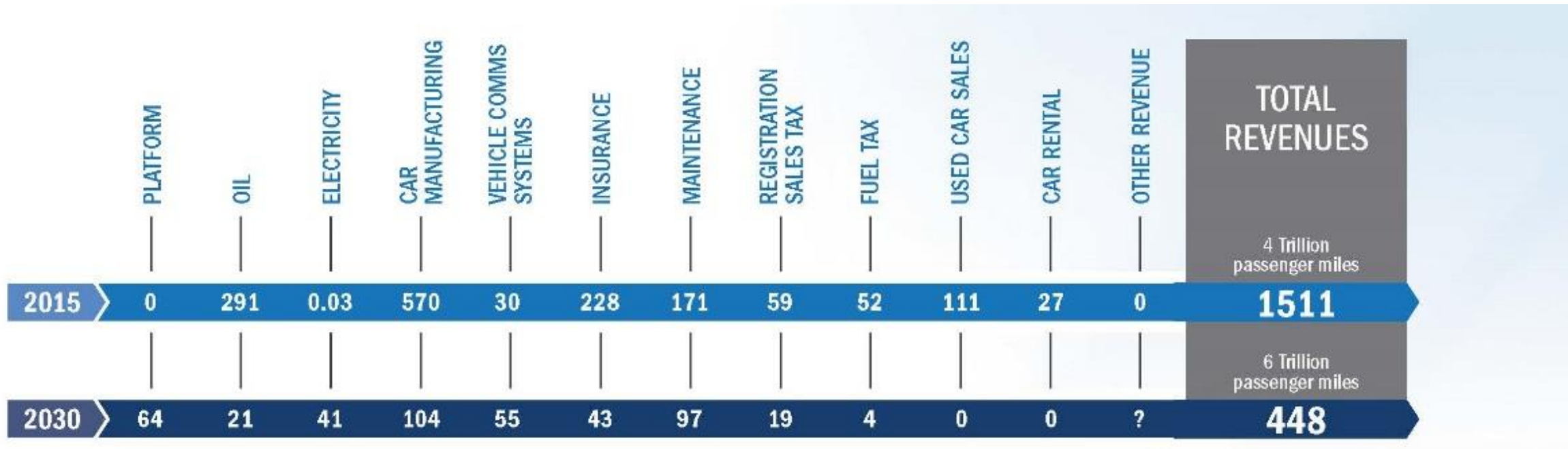
TRANSPORTATION INDEX: TORONTO

Number of vehicles registered:	6,123,926
Minimum annual operating cost of personal vehicles:	\$67 billion
Annual license plate renewal revenue:	\$734,871,120
Minimum number of parking spaces:	6,771,165
Number of drive through establishments:	1,142
GHG emissions from gasoline and diesel vehicles:	32 million tonnes CO ₂ per year
Number of trucks carrying goods travelling in the Region:	65,000 per day
Minimum value of goods coming into the Region by truck:	\$1.44 billion per day
Total transit operating budgets:	\$16 billion per year
Minimum annual car parking & ground transportation fees Pearson Airport:	\$160 million
Congestion costs to drivers on Hwy 401 between Hwy 427 and Yonge St:	3 million hours per year
Minimum number of vehicles on highways:	2 million per day
Trips per day at Highway 401 and Islington:	403,000 vehicles
Ratio of motor vehicles to pedestrian trips in Toronto:	10:1

TRANSPORTATION INDEX: TORONTO

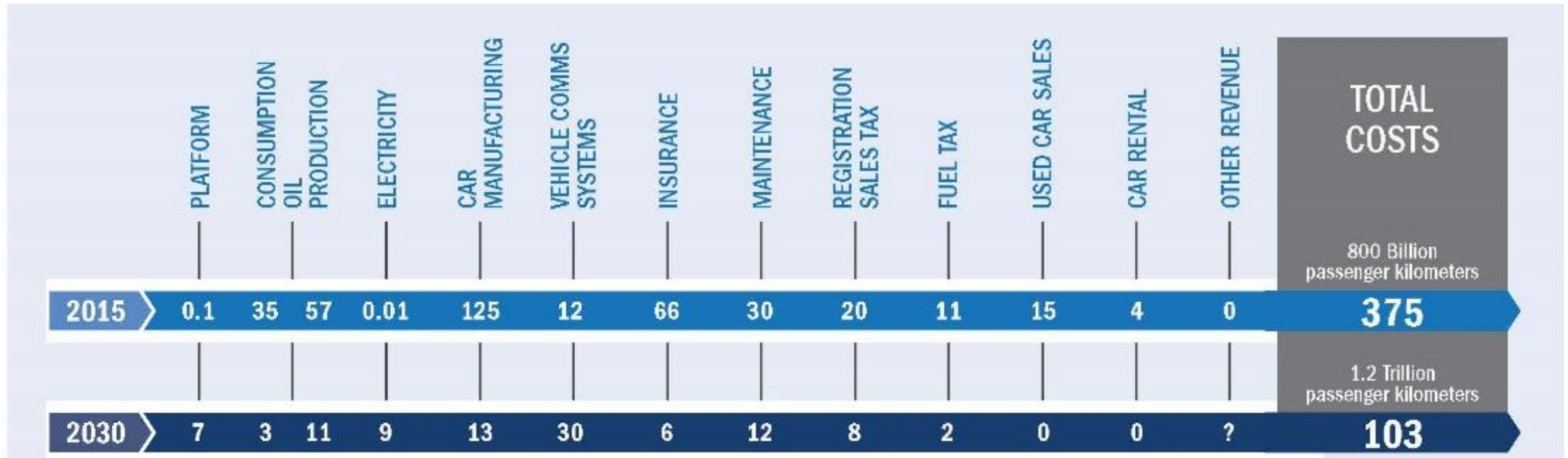
Number of police officers:	13,983
Vehicle ticket violations revenue:	\$252 million per year
People transported by ambulance after an automobile accident:	37,311 per year
Minimum cost for these transports:	\$30,706,953
Minimum annual hospital parking revenues:	\$60 million
Minimum annual firetruck dispatches to motor vehicle fire or accidents:	99,824
Minimum annual number of vehicle accidents resulting in injury or death:	45,216
Minimum number of pedestrians and cyclists killed in City of Toronto in 2017:	48
Number of driving schools:	604
Number of car wash stations:	1,260
Annual car wash revenues:	\$109,029,060
Estimated minimum number of City of Toronto police officers that live outside of Toronto:	80%

Annual Transportation Costs for USA in Billions Dollars, USD



Adapted from RethinkX 2017, 'Vehicle communication systems' estimated by authors; includes share of smart-phone and subscription fees.

Estimated Annual Transportation Costs for Canada in Billions of Dollars (\$CDN)



National projection based on Figure 1 (RethinkX 2017 – values applied to Canada).

Oil production based on 2015 oil production levels of 621,610 m³/day (3.9 Mbbbl/d@ \$40 net/bbl and an estimated 80% production decline).

Economic comparison based on Canada's \$US 45,032 per person GDP and USA \$US 59,532 per person (World Bank, 2017) and populations of Canada – 36.7 million and US – 326 million (Canadian worker productivity 82% of US counterpart).

'Car manufacturing' presented as fraction of economy rather than share of transportation cost (share of personal costs likely 50% less).

'Other revenues' likely to include road-usage charges and mobile data fees.

Estimated Transportation Costs for Ontario (Toronto Region) in Billions of Dollars (\$CDN)



Based on the two previous figures. Oil production negligible. Travel and economic values about 30% of Canada's overall. Other revenues' likely to include road-usage charges and mobile data fees. Values consistent with RethinkX, 2017. Suggested date of 2030 likely represents earliest possible transition.