Connect Smart Workshop

01 The Future of Mobility (30 minutes)
Shared mobility, electric vehicles, autonomous vehicles & mobility as a service

02 Objective: Where Do We Go Now?
What does it mean for urban planners, designers, policy makers, engineers and the public?

03 Session #1: Group Discussion (30 minutes)
How can we prepare for future mobility?

04 Session #2: Group Discussion (35 minutes)
Planning and Research Agenda

"The mobility of the future is emission-free, seamlessly networked and – if desired – will also be capable of making completely autonomous driving possible".
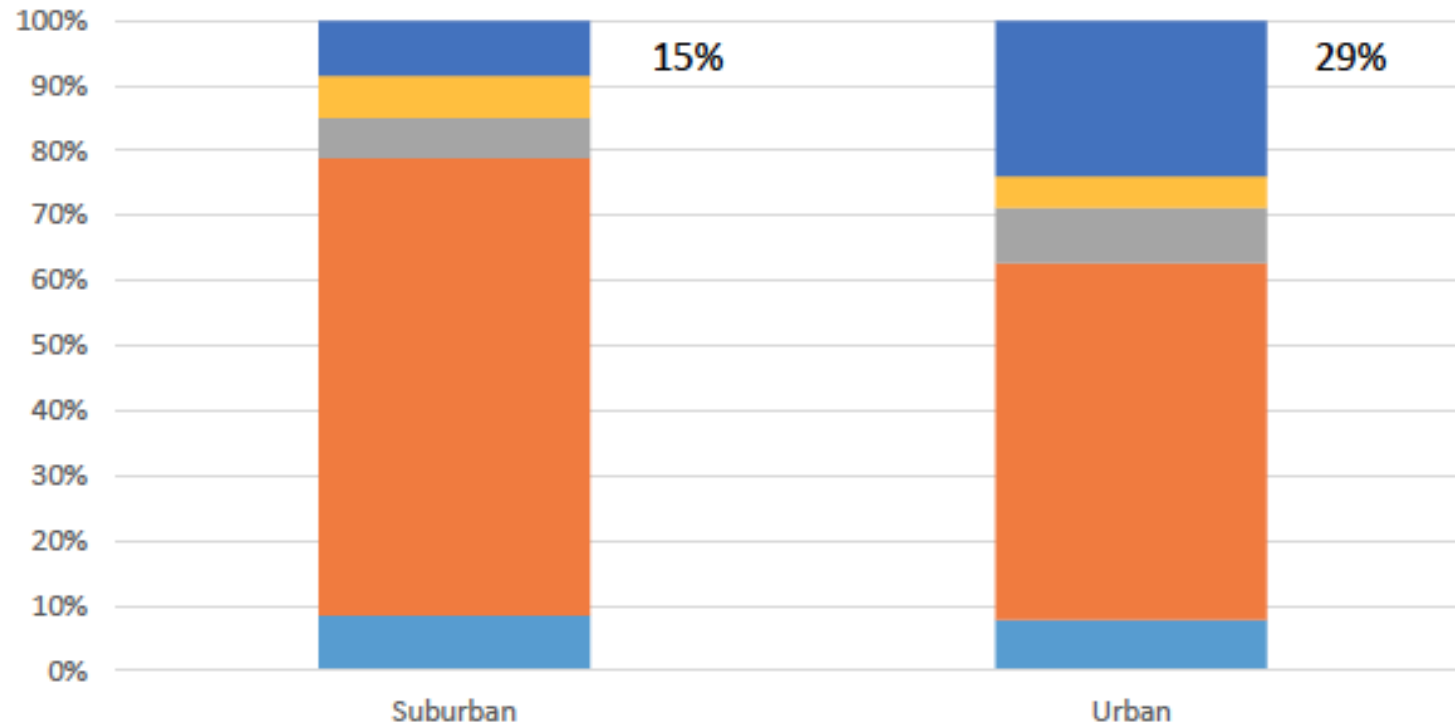
BACK

SHARE

ROGERS LTE 8:10 PM 86%

SHARE UBER

Share your promo code uberYOURCODEHERE with your friends, and they get $10 off their first Uber ride. Once they ride, you get $10 in Uber credits.

Shared Mobility

Adoption of Shared-Mobility Services

Study by UCDAVIS (Clewlow, Mishra, Jenn, Laberteaux, 2017)

Locations:
- Boston, MA
- Chicago, IL
- Los Angeles, CA
- New York, CA
- Seattle, WA
- San Francisco, CA
- Washington, D.C.

Shared Mobility Benefits

- Reduces the number of vehicles on the road by X 3

- 95% of demand can be covered by 2,000 vehicles instead of 14,000 taxies (New York)

Shared Mobility Benefits

In this example, taking public transit in Toronto costs $3.25 and takes double the time to get to the same destination with a car. UberPool costs $7-11, you would share the ride with other people, and get to your destination faster.

Impact of Shared Mobility

Ride hailing services have demonstrated car ownership can decline when travellers' needs are satisfied.
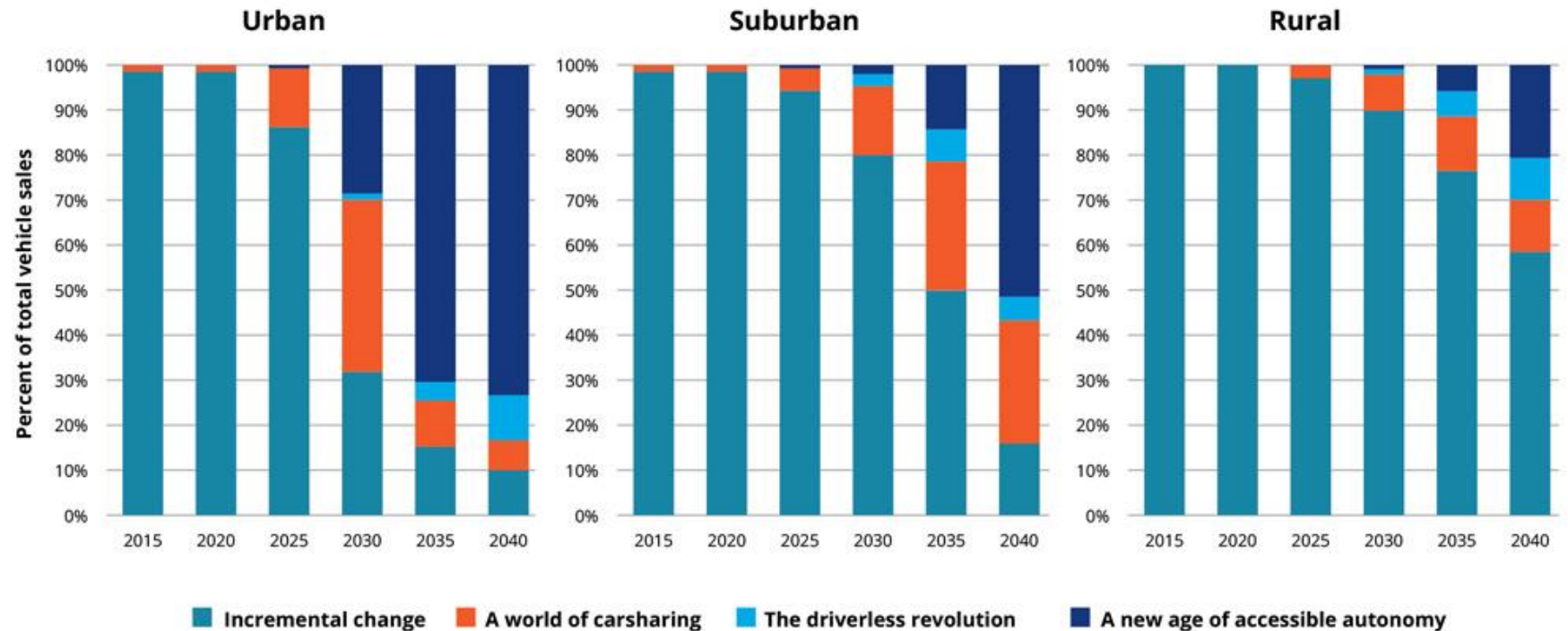
Access vs. Ownership? (U.S. Example)

Deloitte University Study (Jameson, Giffi, Vitale, 2016)

Projected adoption of shared and autonomous mobility across different geographies

Legend: ■ Incremental change ■ A world of carsharing ■ The driverless revolution ■ A new age of accessible autonomy

By 2030, shared vehicles could overtake personally owned vehicles in **urban areas**. Shared driver-driven vehicles will likely grow quickly until 2030 but then lose market share to shared autonomous vehicles.

Suburban areas will likely be slower to shift to shared and autonomous mobility, but by 2040, personally owned vehicles might be only a small portion of sales.

The benefits of shared and autonomous mobility are less pronounced in **rural areas**, and adoption will likely be slow.

Ridesharing in Canada – Smart Commute

Program of METROLINX and Municipalities in the Greater Toronto and Hamilton Area
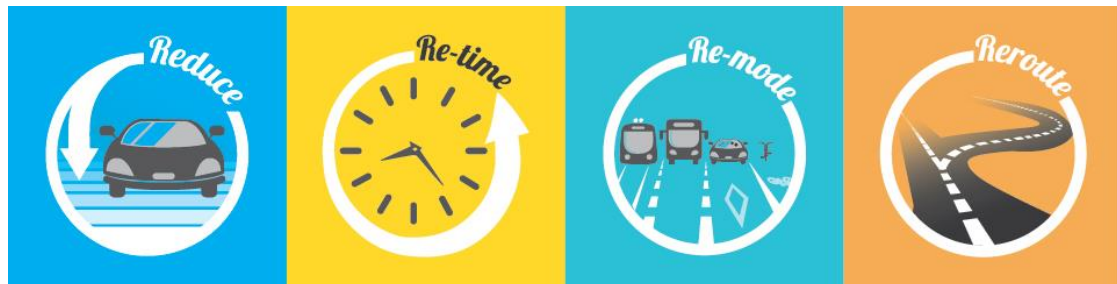
- **Save Money** – Share your commuting costs; calculate your potential savings.

- **Carpool Parking at GO** – Find your carpool partner and take advantage of designated carpool parking spaces at your local GO station

- **Free Carpool Parking** – The Ministry of Transportation of Ontario provides free carpool parking lots across the GTHA that are easy to access

- **Have Fun** – Our Commuter Attitudes survey showed that 81% of the carpoolers reported that they are satisfied with their commute.

- **Reduce Stress** – Sit back and let someone else do the driving for a change.

- **Bypass Traffic** – Take advantage of the high-occupancy vehicle (HOV) lanes.

- **Reduce Pollution** – Reduce greenhouse gas emissions by taking a vehicle off the road

Long-Distance Ridesharing in Canada

POPARIDE

Ottawa to Toronto for $35

Toronto to Montreal for $34

Regulatory Frameworks Study

Technology-Enabled Ride Sourcing : An Examination of Regulatory Frameworks and Public Discourse in Canadian Cities (Ashraf & Habib, 2017)

Established

- Toronto
- Ottawa
- London
- Niagara Region
- Waterloo Region
- Hamilton
- Calgary
- Edmonton

Emerging

- Red Deer
- Lethbridge
- Windsor
- Barrie
- Kingston
- **Quebec**
- **B.C.**
- **Manitoba**

Technology-Enabled Ride Sourcing

An Examination of Regulatory Frameworks and Public Discourse in Canadian Cities (Ashraf & Habib, 2017)

"It's a fair, level playing field... the only one that doesn't seem to like it is Uber. They don't believe in regulation, they don't believe in proper insurance, paying their taxes" (Calgary Cab Associations President)

"In a city where accessibility can often be lackluster at best, Uber Assist and accessible taxis provide two new ways to explore-and that alone should be celebrated"(Geboers)

"We look forward to the city (Toronto) screening and licensing Uber drivers as soon as possible to ensure that all options are safe for Torontonian"(Gary & Moore, The Globe and Mail)

"Uber argues cameras are unnecessary because it already has safety measures in place, including background checks and the fact that users are provided with drivers' names, photos, license plate numbers and vehicle information (Gary & Moore)

"The decision means the city will begin screening UberX drivers for criminal backgrounds, driving record and insurance" (Dehaas)

"This is a matter of fairness for all market partners and for the safety users... I also intend to work with our partners to develop innovative solutions to provide Quebec users with a modern industry that meets their needs" Gary & Moore)

"Places that failed to move carefully when they brought in ride-sharing have seen safety issues, unpredictable prices and unstable access to services"(Duran & Yuzda)

Technology-Enabled Ride Sourcing

An Examination of Regulatory Frameworks and Public Discourse in Canadian Cities (Ashraf & Habib, 2017)

X = Discourse theme represented in regulation
O = Discourse theme not represented in regulation

City	Tracking/Rating	Licensing	Safety Checks	Insurance	Accessibility	Social
Toronto		X	X	X	X	X
Hamilton	X	X	X			
London	X	X	X		O	
Ottawa		X	X			
Kitchener-Waterloo		X	X	X		
Niagara Region	O	X	X	X		
Calgary		X	X			
Edmonton	X	X	X	X		

Shared Mobility

New services and providers are emerging

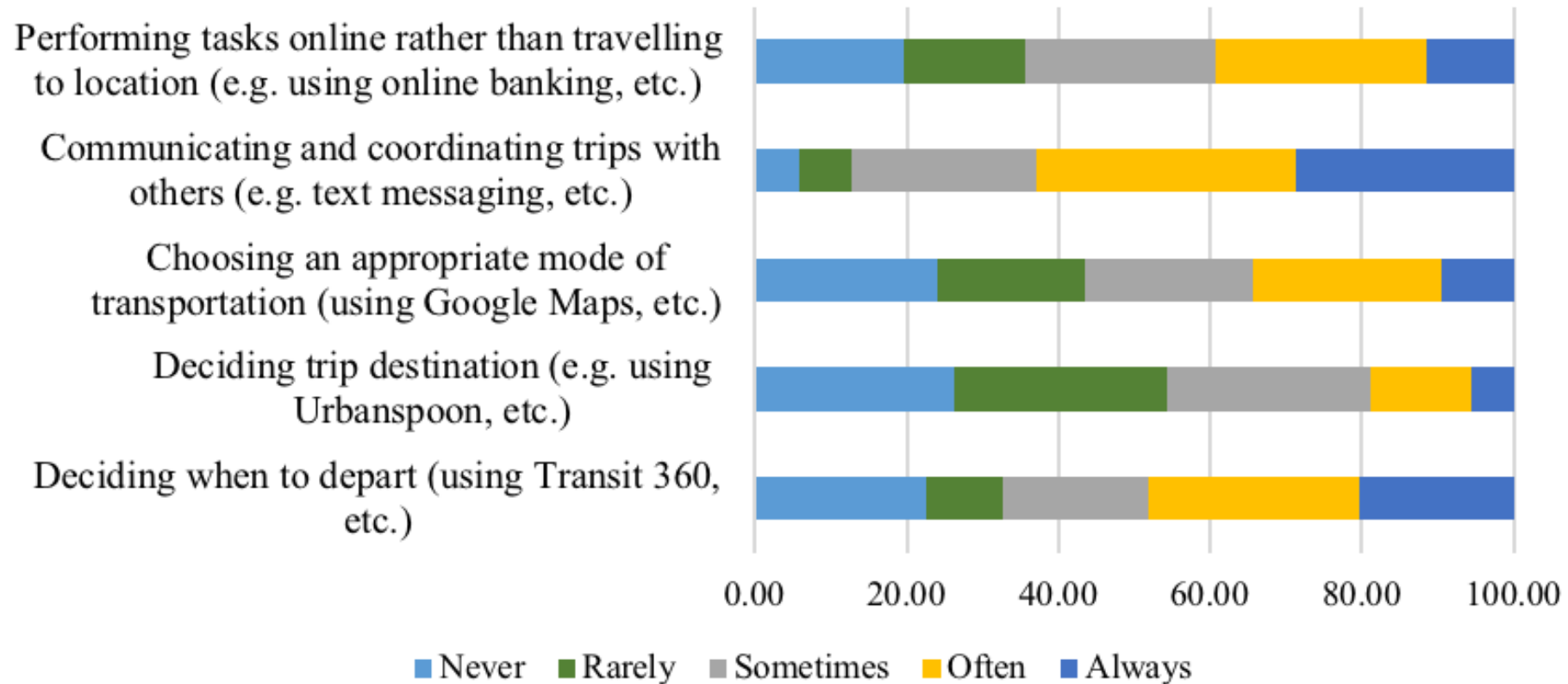Bike Sharing   Car Sharing   Ride Sharing   Taxi Apps

Smartphone and Travel Behaviour
Halifax Smartphone Use & Travel Survey (Jamal, Khan & Habib, 2017)

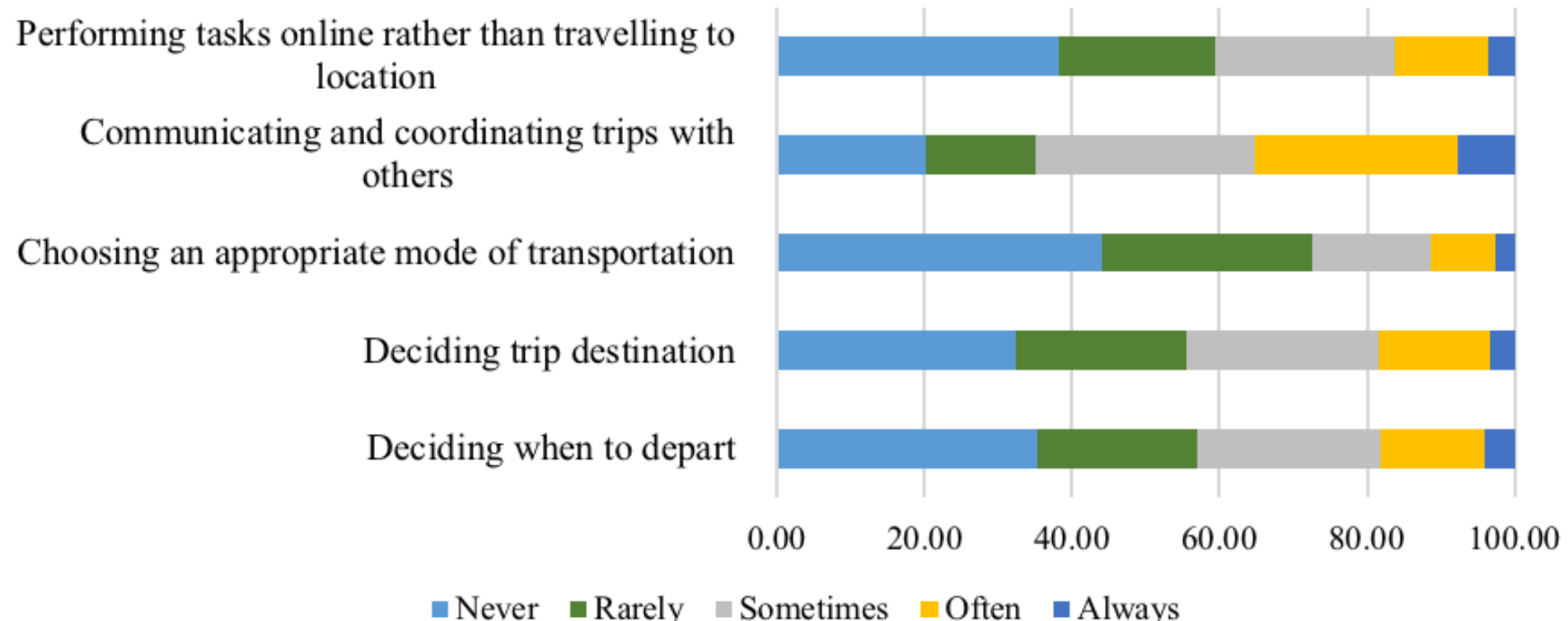Use of smartphone applications for trip planning activities

Social Networking and Travel Behaviour
Halifax Smartphone Use & Travel Survey (Jamal, Khan & Habib, 2017)
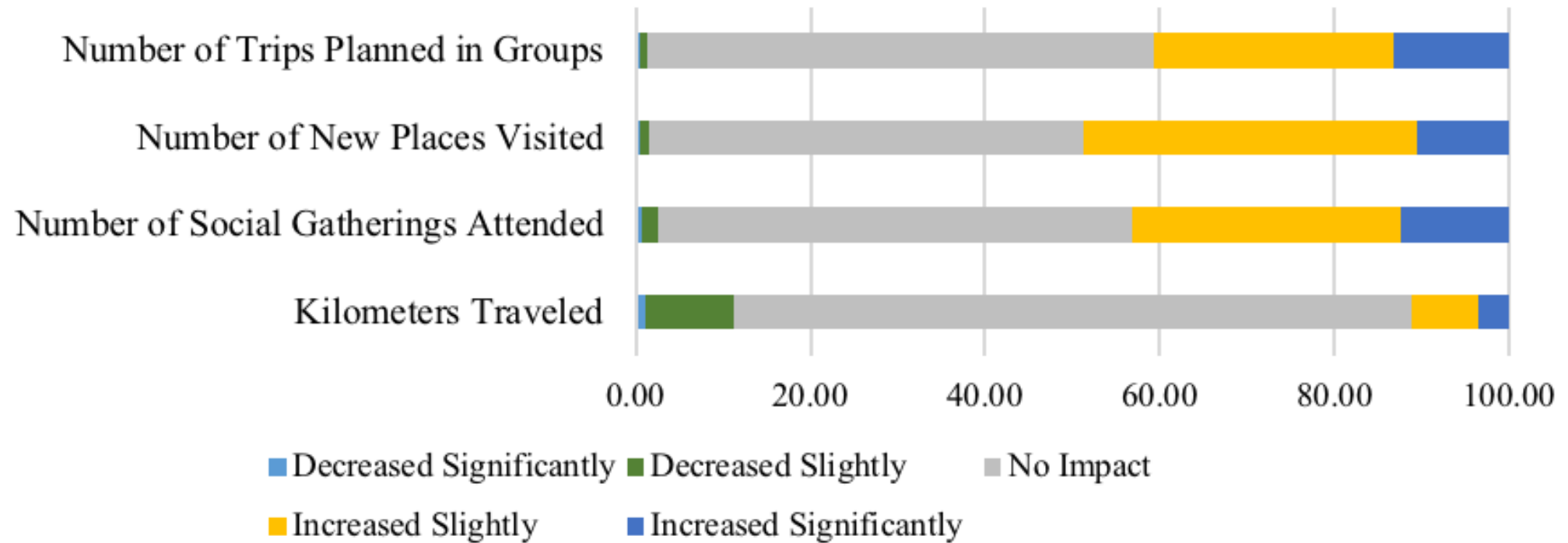

Use of social networking applications

Impact on Travel Outcome
Halifax Smartphone Use & Travel Survey (Jamal, Khan & Habib, 2017)

Impact of smartphone use on travel outcomes

electric drive
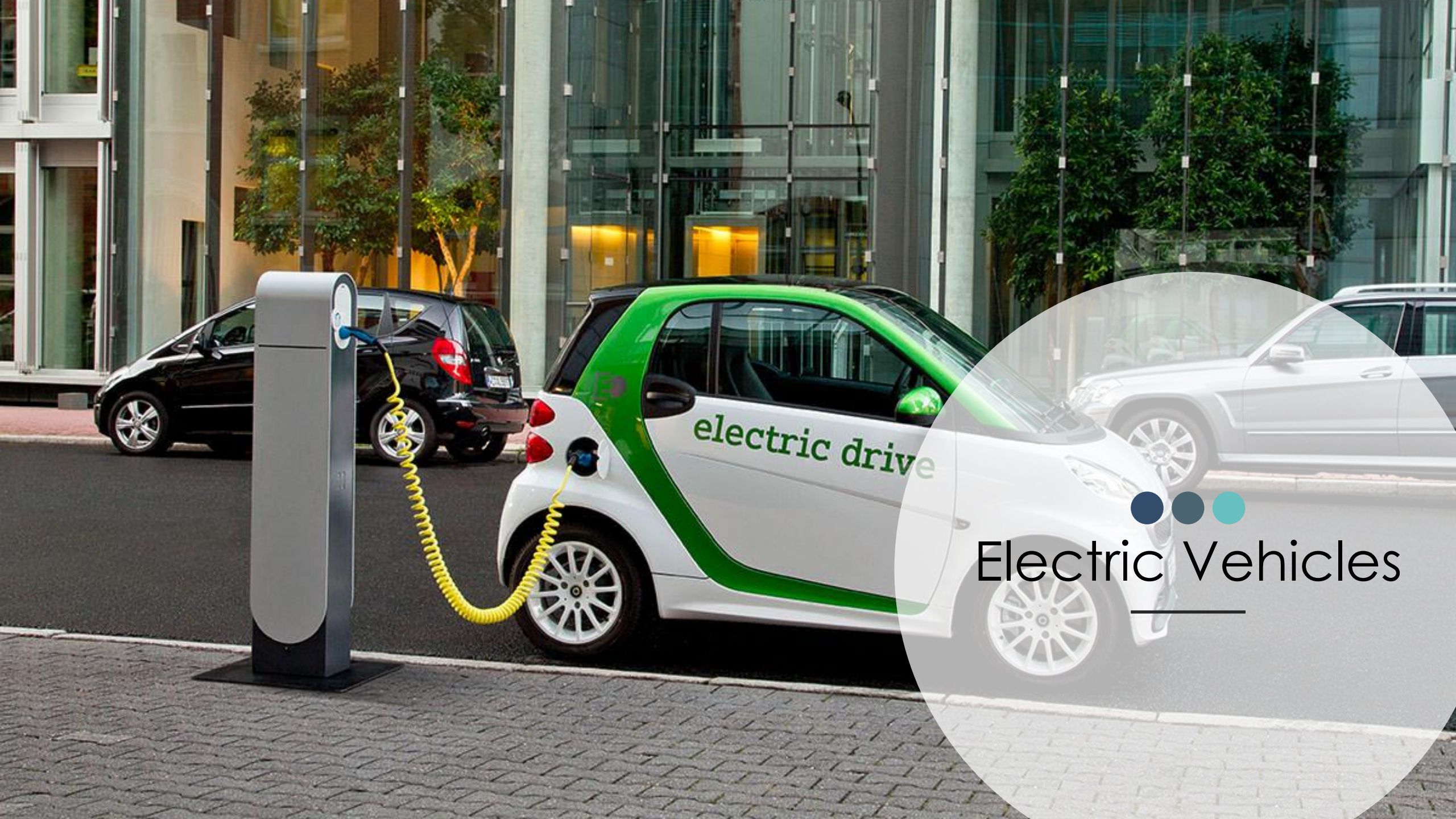
Electric Vehicles

Electric Vehicles Benefits

European Environment Agency Report, 2016

- Reduced emissions during the electric vehicle's lifetime outweigh the environmental effects of the production and end-of-life phases

- Electric vehicles can reduce the environmental effects of conventional vehicles, as long as the electricity is from renewable sources.

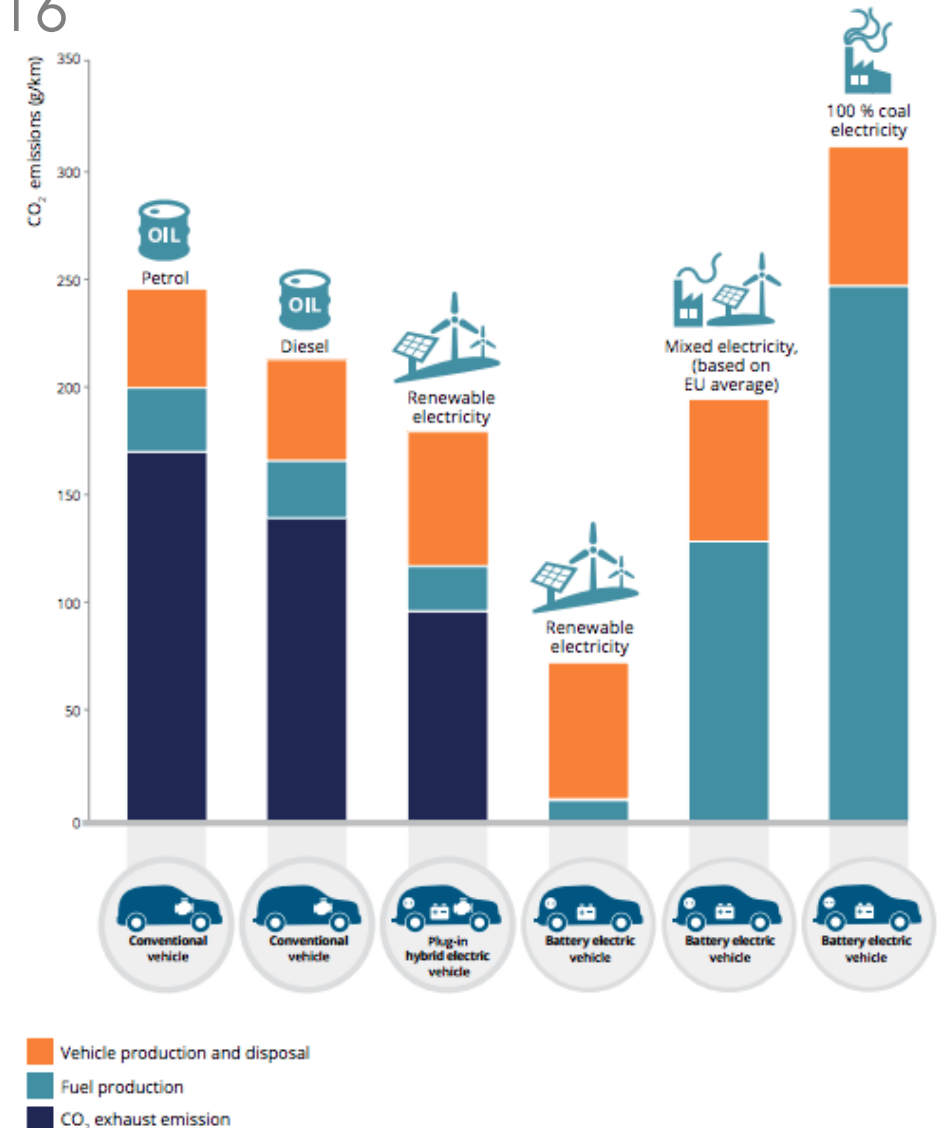# Adoption Trends of Electric Vehicles

European Environment Agency Report, 2016

The largest numbers of BEV sales:
- France (+17,650)
- Germany (+ 12,350)
- United Kingdom (+ 9,900)

The largest numbers of PHEV sales:
- Netherlands (+ 41,000)
- United Kingdom (+ 18,800)
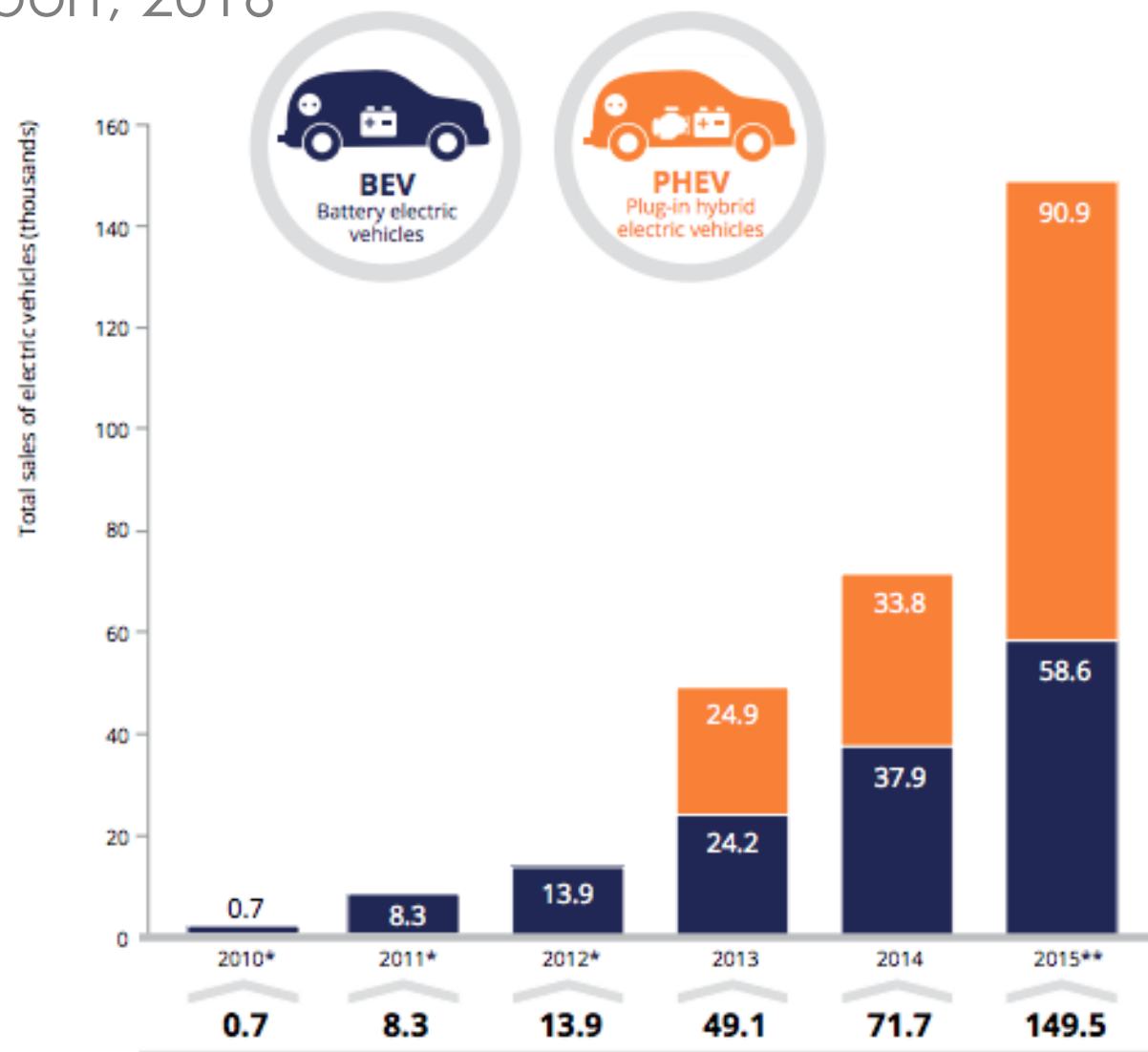
Adoption of Electric Vehicles in Canada

Study by McMaster University (Mohamed, Higgins, Ferguson, Kanaroglou, 2016)

Fig. 3. Prominence of each latent class by Census Metropolitan area.

Electric Vehicles Planning Considerations

Connected,
Autonomous
Vehicles

Cities Piloting CAVs

Cities that are hosting CAV tests, or have committed to doing it soon

West Midlands
Tampere
Stavanger Oslo Ban Birnbach
Milton Keynes Gothenburg
Oxford Cambridge
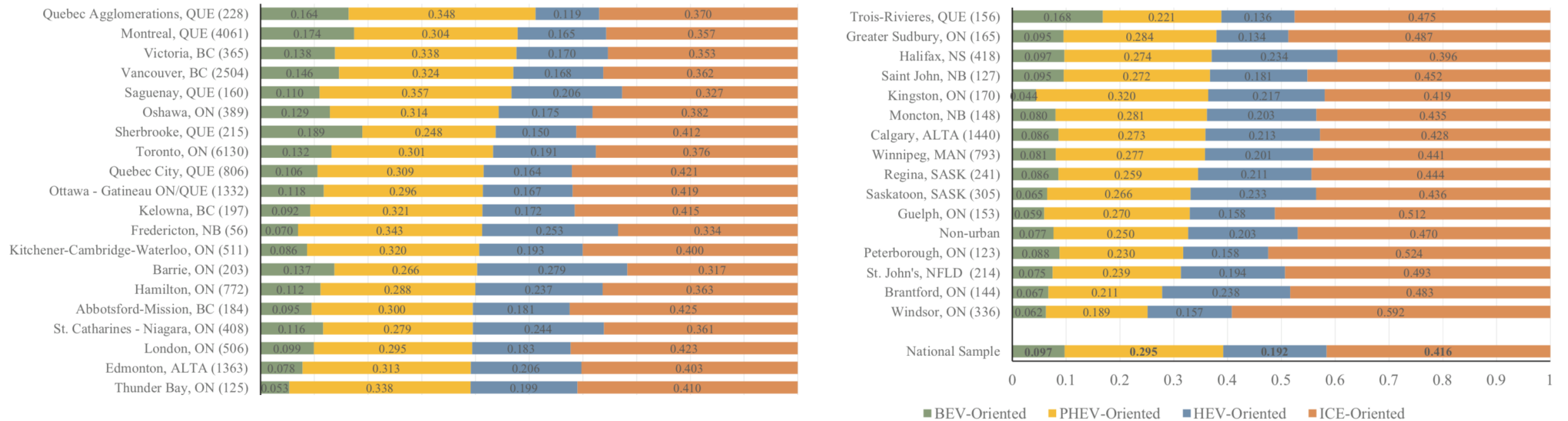Bristol London Helsinki Tallinn
Copenhagen Rotterdam
Haarlem Amsterdam Fribourg Wageningen
Eindhoven Sion Stockholm
Paris Lyon Cossonay
Rouen Trikala

Calgary Ottawa
Edmonton

Pittsburgh Denver Detroit
San Antonio Chandler Boston
Las Vegas Reno Arlington
Austin Greenville Washington
San Francisco San Jose Tampa
Gainesville

Seongnam
Wuhu Chiba City
Wuhan

Dubai Shenzhen Kaohsiung
Taipei

Singapore

Sydney
Adelaide
Canberra
Darwin
South Perth

~ 60 Cities

Cities Preparing for CAVs
Surveying the regulatory, planning and governance issues raised by CAVs but did not start piloting
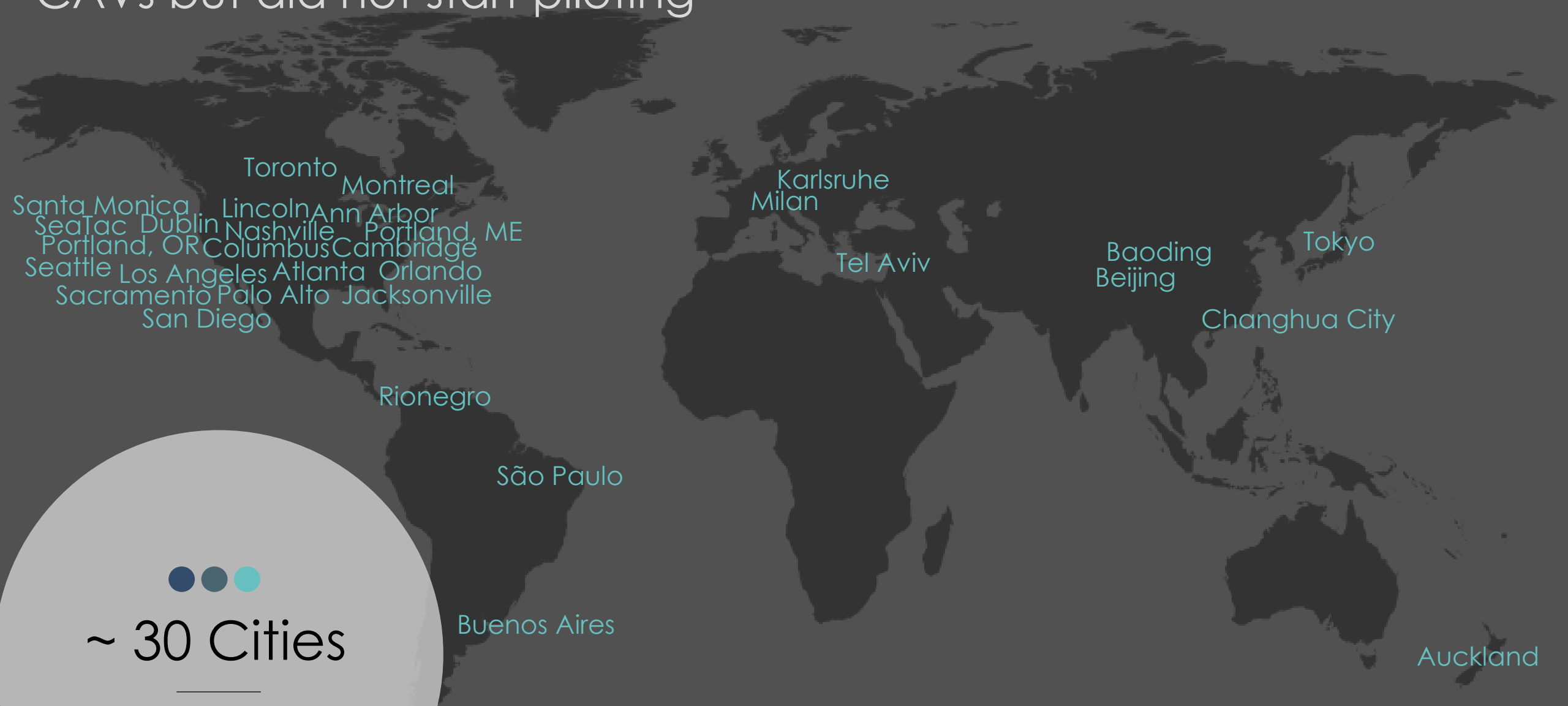
Toronto
Montreal
Karlsruhe
Milan
Santa Monica   Lincoln Ann Arbor
SeaTac Dublin   Nashville   Portland, ME
Portland, OR Columbus Cambridge   Baoding   Tokyo
Seattle   Los Angeles   Atlanta Orlando   Beijing
Sacramento Palo Alto Jacksonville   Changhua City
San Diego

Tel Aviv

Rionegro

São Paulo

● ● ●

~ 30 Cities

Buenos Aires

Auckland

Autonomous Vehicles Levels

Level 0	Level 1	Level 2	Level 3	Level 4	Level 5
No Automation	**Driver Assistance**	**Hands Off**	**Eyes Off**	**Mind Off**	**Steering Wheel Option**
System issues warnings only	Assisted parking Adaptive cruise control	System takes over steering & accelerate-on	Automated highway driving System recognizes limits	Automated city driving Driverless Parking	Full automation Driver not needed

Autonomous Vehicles Levels

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Benefits of Autonomous Vehicles

Study by Virginia Tech (Doerzaph, 2017)

- Vehicle to vehicle communication may address up to 81% of crashes involving unimpaired drivers (24k fatalities, 1.8M injuries, 7.3M property damage)

- Vehicle to individual communication may address up to 18% of crashes involving unimpaired drivers

- Improved traffic flow and reduce delays (27%)

- Increased awareness of and access to multi-modal choices

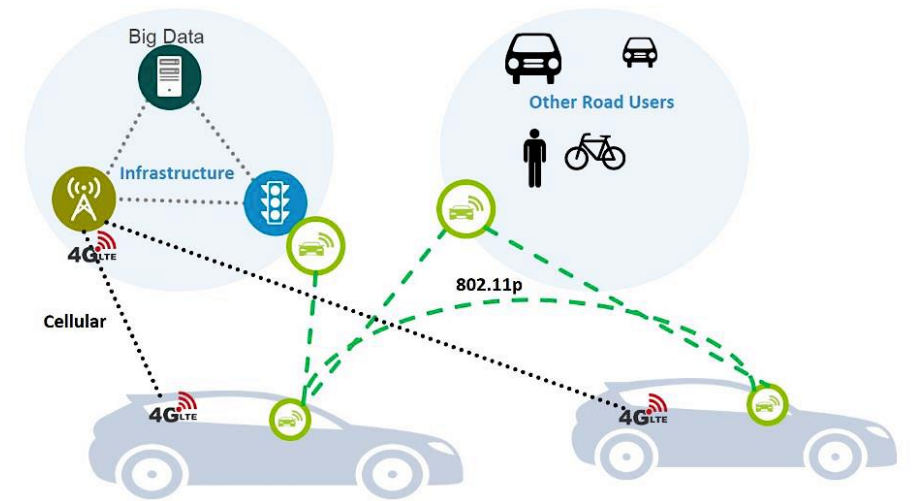- More direct, actionable information for drivers (re-routing, incidents, weather, etc.)

- Combined Eco-Signal apps may reduce CO_2 & fuel consumption (11%)

- Signal and freeway lane management combined reduce fuel consumption (22%)

Autonomous Vehicles
Methods of Connecting
Study by Virginia Tech (Doerzaph, 2017)

1) Dedicated Short Range Communications:

- Low latency
- High reliability
- High security and privacy
- Trusted connection
- Relatively short range
- Transportation agency ownership

2) 3G/4G Cellular:

- Nearly ubiquitous coverage
- Less reliable communications
- Higher latency
- Telecomm owned

3) 5G Cellular (Future):

- Still in draft technical specs but promising
- Works from much of the existing cellular infrastructure
- Performance TBD
- V2V capability TBD
- Telecom owned
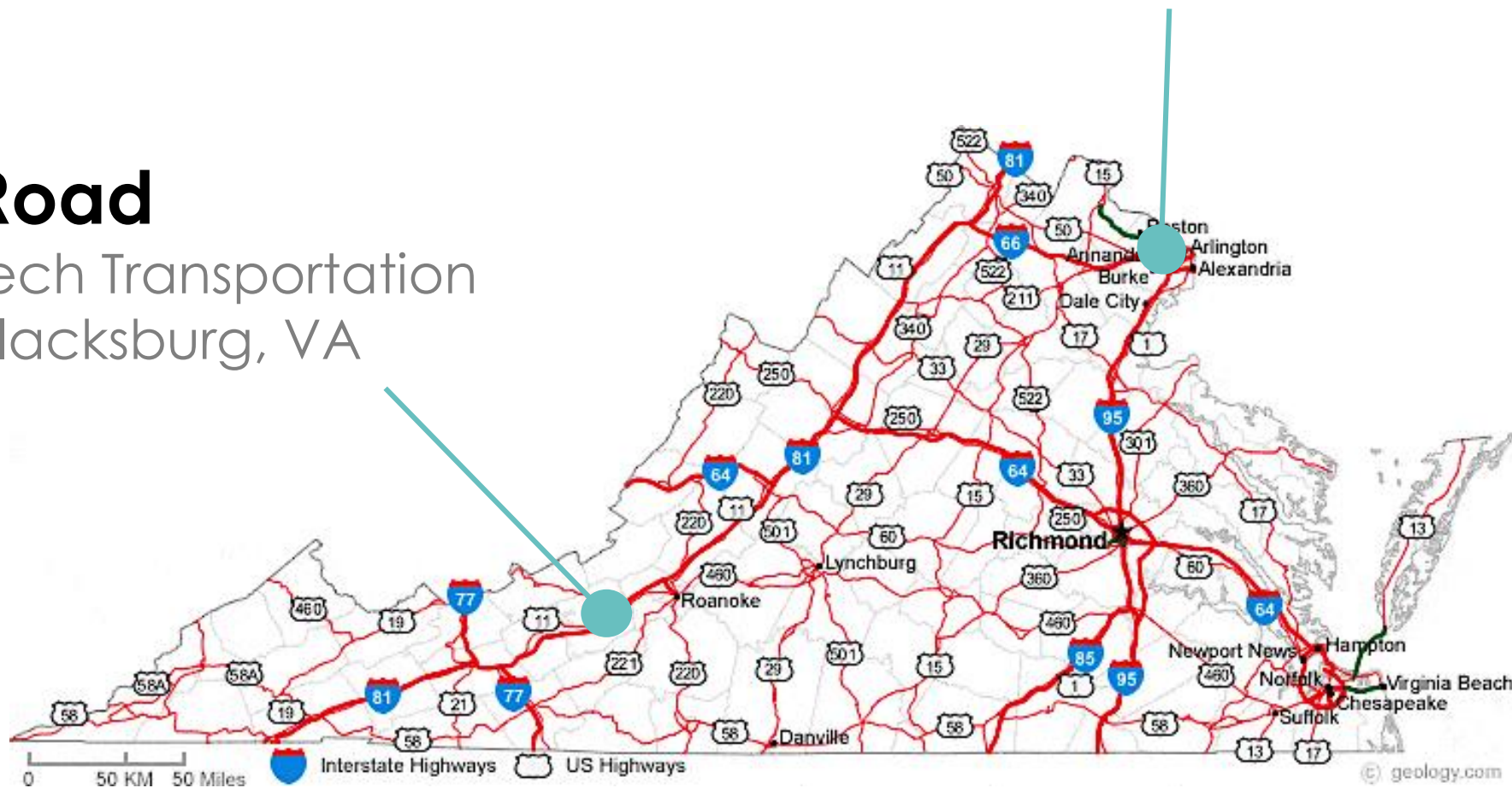
Planning Implications of Autonomous Vehicles

Study by Virginia Tech (Doerzaph, 2017)

1) Infrastructure 5-10 year Lifespan
- Comms equipment, connectivity, data management & storage
- Updates to legacy equipment, such as signal controllers may be necessary

2) Mobility Implications
- Models often show benefits, but still many assumptions under such estimates
- Mixed fleet is considered a key challenge for automated systems
- Huge potential gains once operational environment is refined (~2x capacity increases)

3) Increased needs for monitoring & contingency planning
- System outage or failures become more significant
- System security becomes critical
- Privacy becomes critical

4) Capacity Building
- More capacity required
- Initial needs for broader knowledge and ability to bridge technical gaps
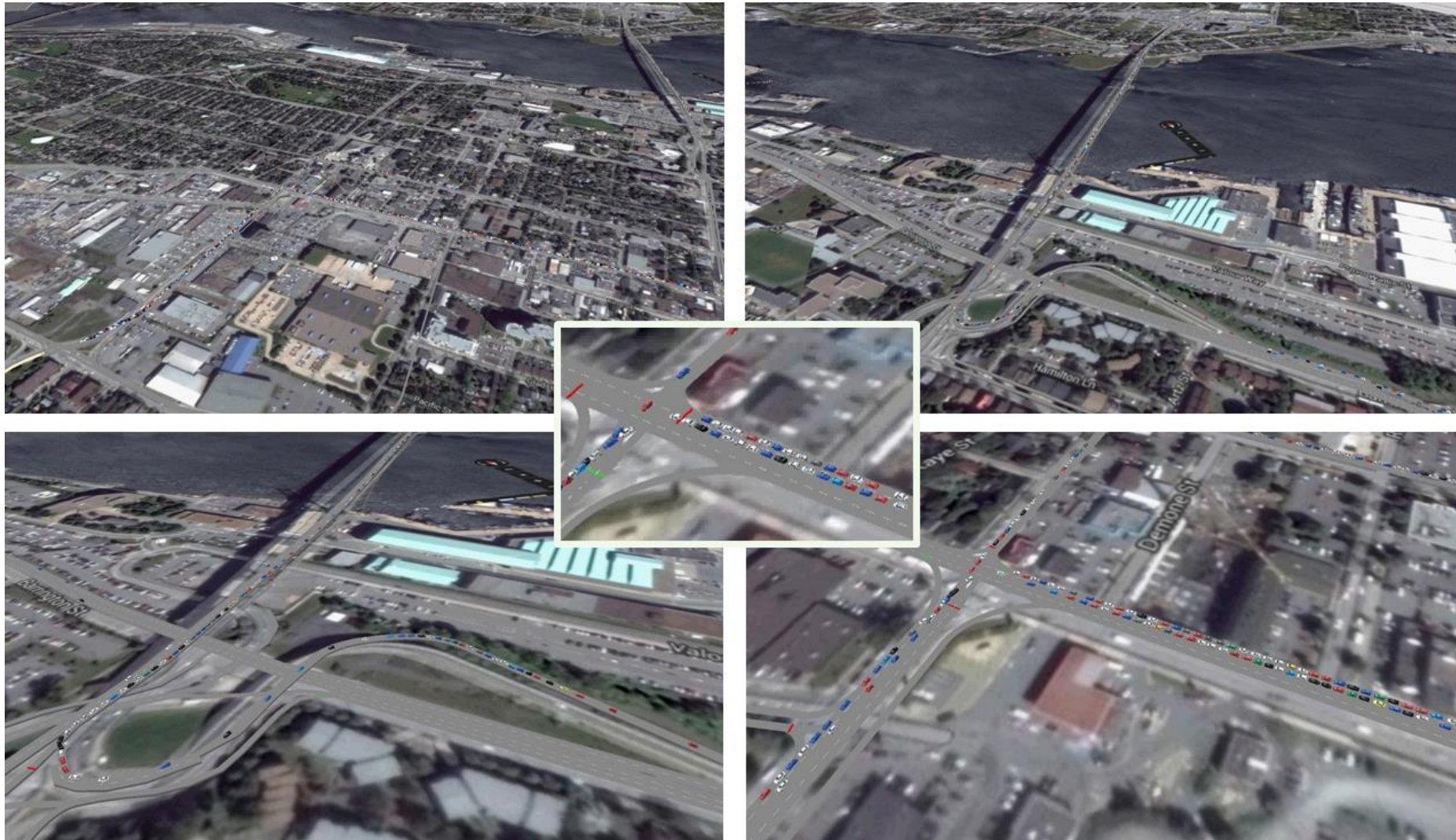- Competitive hiring environment

5) Lots of Data
- Robustness of data you publish and applications it supports, what to do with the data?
- Means, desire & authority to monetize?
- Privacy concerns, public acceptance
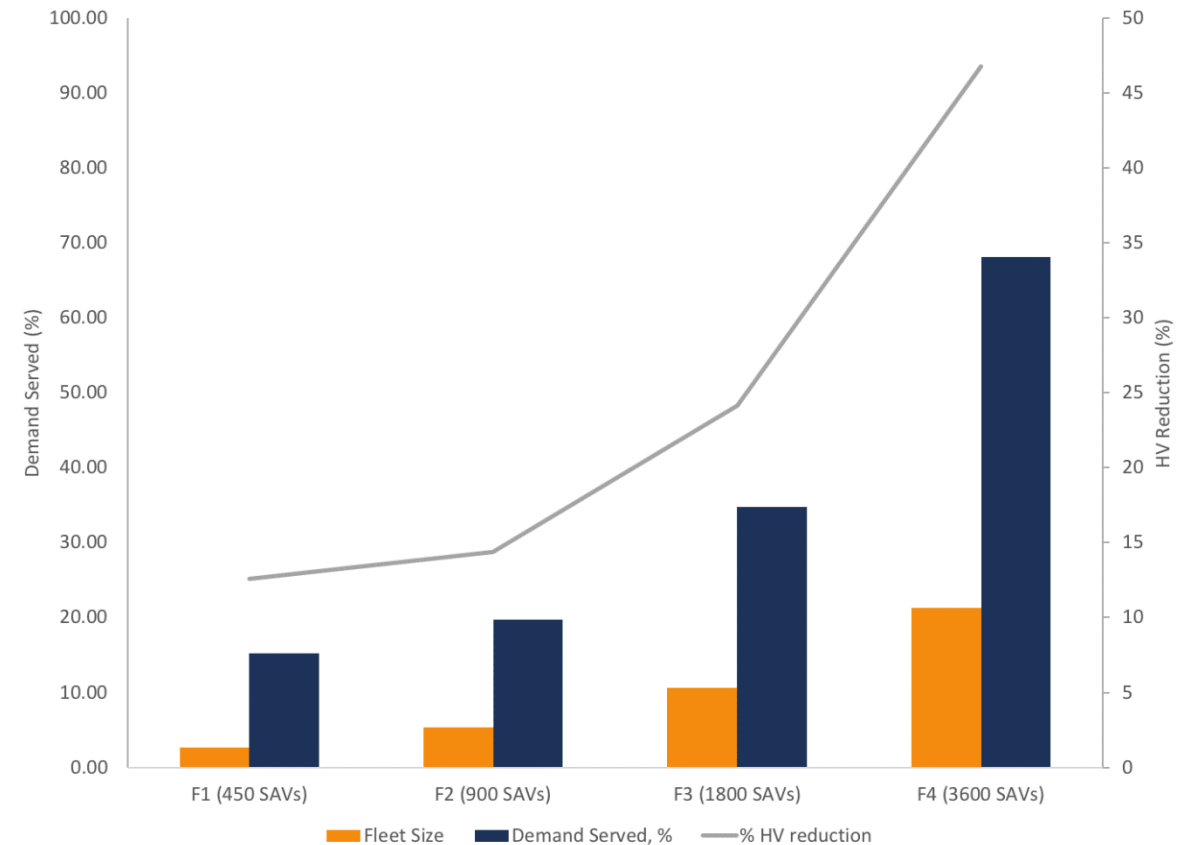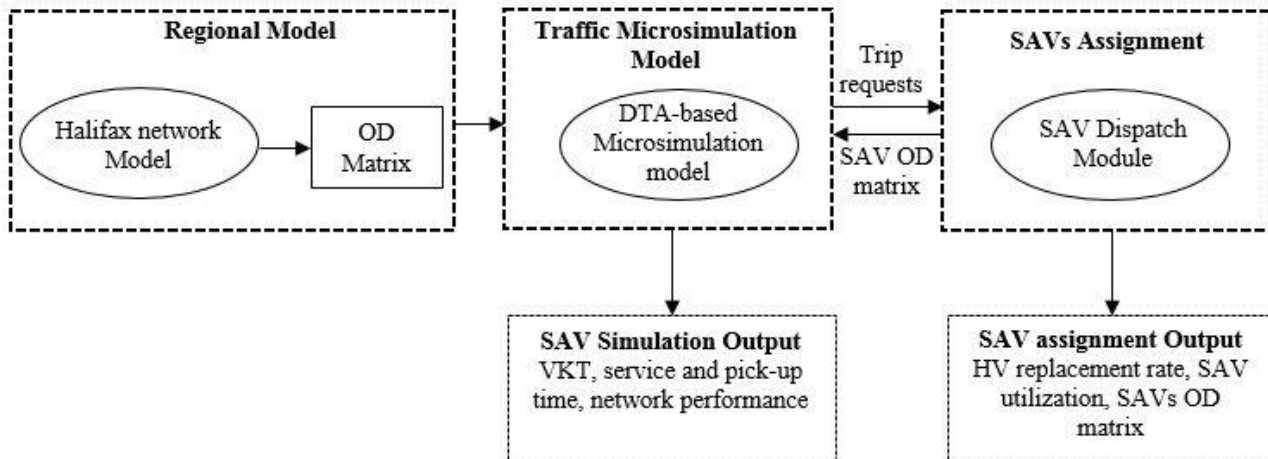
Halifax Peninsula AV Impact Study

By Alam & Habib, 2018
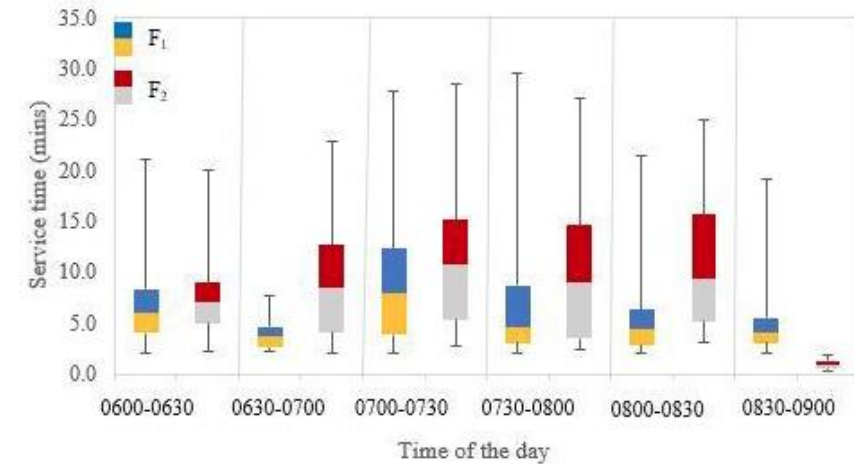
Halifax Peninsula AV Impact Study

By Alam & Habib, 2018

Halifax Peninsula AV Impact Study

By Alam & Habib, 2018

| Scenarios | Hours | Hourly network performance evaluation | | % Changes in VKT for peak periods | |
		% change in avg. speed	% change in total travel time	% change in total network VKT	% change in total Peninsula VKT
85% HV and 15% SAV trips	1st hour	9.64	-4.7	+1.73	+4.8
	2nd hour	-12.1	15.4		
	3rd hour	-25.3	33.4		
80% HV and 20% SAV trips	1st hour	7.5	-3.0	+3.63	+14
	2nd hour	-2.4	8.5		
	3rd hour	-15.2	18.7		

"The car is growing beyond its role as a mere mean of transport and will ultimately become a mobile living space"

Dr. Dieter Zetsche, 2017

Autonomous Vehicles
Planning for People Not Cars?
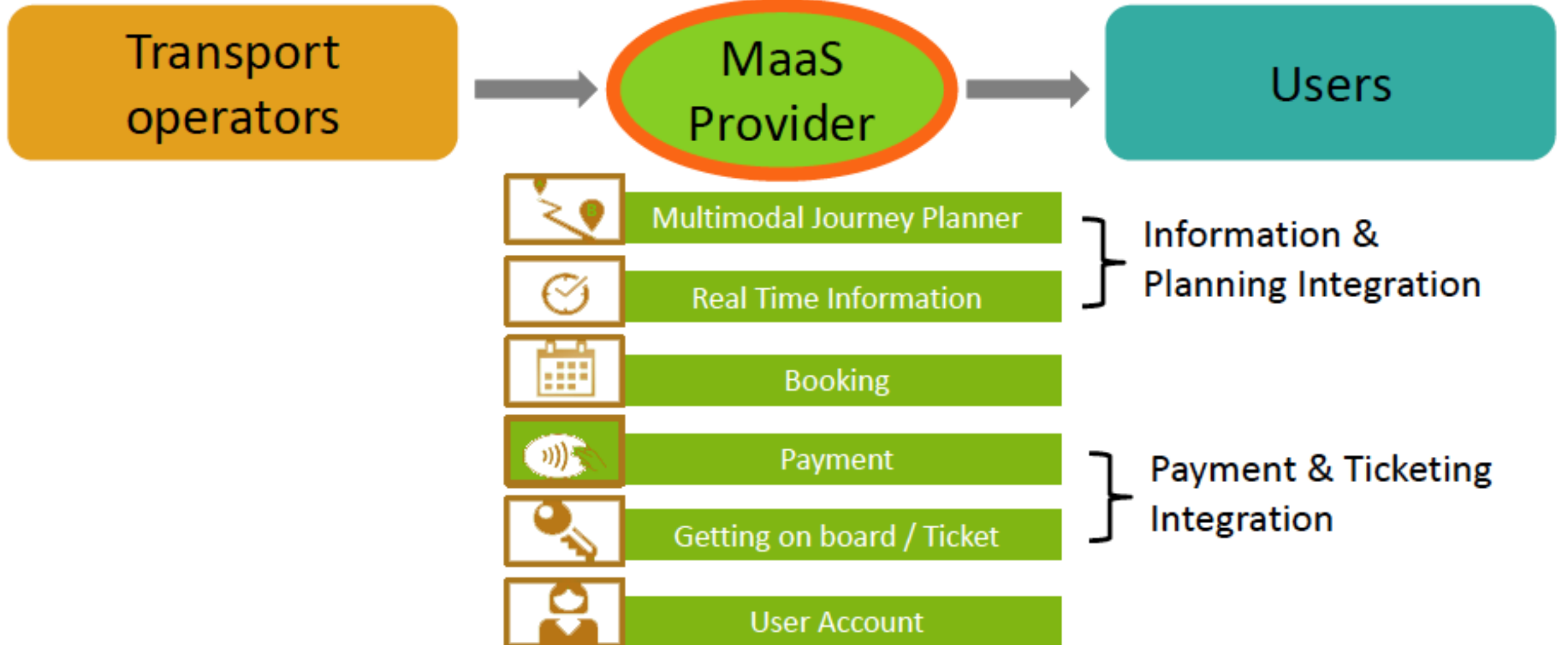
Autonomous Vehicles

The City of Tomorrow?

Mobility as a
Service

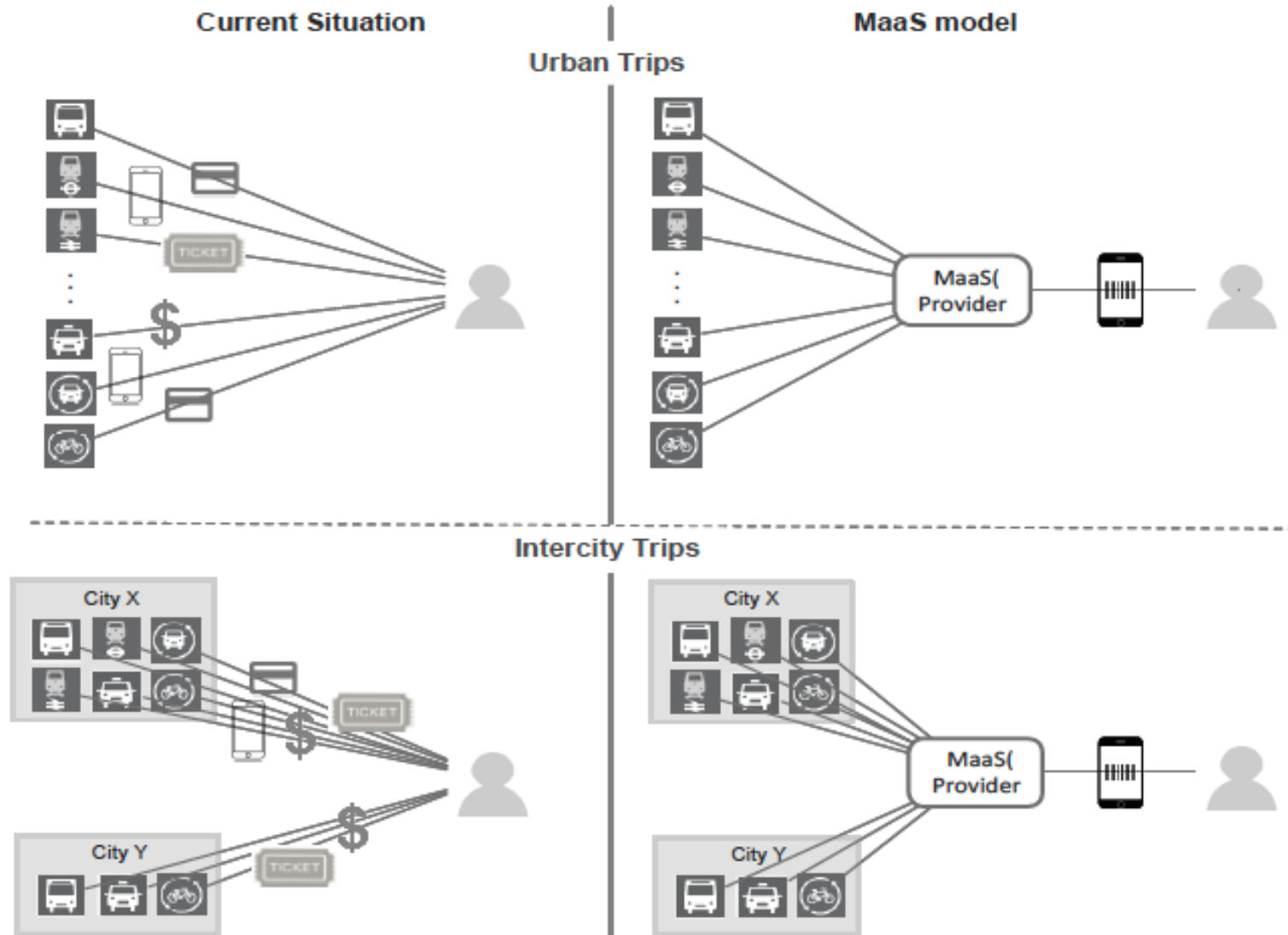# Mobility as a Service (MaaS) Concept

Research by UCL (Kamargianni, Matyas, 2017)

Mobility as a Service (MaaS) Concept

Research by UCL (Kamargianni, Matyas, 2017)

MaaS Products

Research by UCL (Kamargianni, & Matyas, 2017) (Whimapp: Helsinki, West Midlands, Amsterdam & Anterwerp)

Light

89 €
/month

Unlimited HSL Helsinki public transport + **1.000** Whim points

Use your Whim points as you like, for example:

2 taxi trips (~10 km/trip) daytime + ∞ unlimited local public transport

Medium

249 €
/month

Unlimited HSL Helsinki public transport + **5.500** Whim points

Use your Whim points as you like, for example:

8 taxi trips (~10 km/trip) daytime + ∞ unlimited local public transport + **2** days of car rental

Premium

317 €
/month

Unlimited HSL Helsinki public transport + **8.000** Whim points

Use your Whim points as you like, for example:

8 taxi trips (~10 km/trip) daytime + ∞ unlimited local public transport + **5** days of car rental

Pay-as-you-go

Try Whim without commitment and upgrade whenever you like.
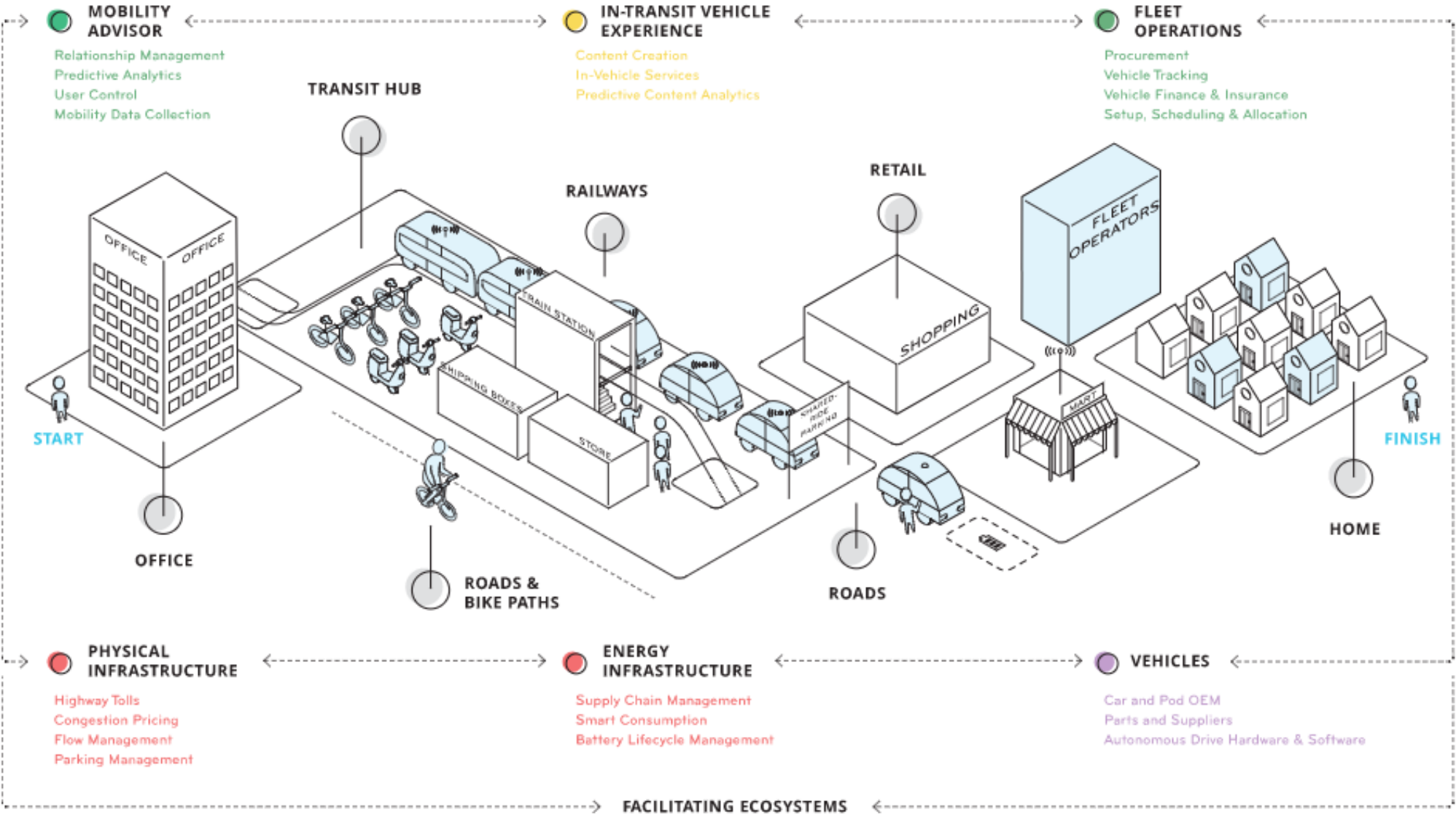
Transport providers:

HSL HRT   TAXI   SIXT   VEHO

We get you to your destination using your preferred mode of transport, letting you pay as you go – all in one app!

DIGITAL INFRASTRUCTURE

Security & Risk
Connectivity
Horizontal OS

MOBILITY ADVISOR

Relationship Management
Predictive Analytics
User Control
Mobility Data Collection

IN-TRANSIT VEHICLE EXPERIENCE

Content Creation
In-Vehicle Services
Predictive Content Analytics

FLEET OPERATIONS

Procurement
Vehicle Tracking
Vehicle Finance & Insurance
Setup, Scheduling & Allocation

TRANSIT HUB

RAILWAYS

RETAIL

OFFICE

SHOPPING

FLEET OPERATORS

START

FINISH

HOME

OFFICE

ROADS & BIKE PATHS

ROADS

PHYSICAL INFRASTRUCTURE

Highway Tolls
Congestion Pricing
Flow Management
Parking Management

ENERGY INFRASTRUCTURE

Supply Chain Management
Smart Consumption
Battery Lifecycle Management

VEHICLES

Car and Pod OEM
Parts and Suppliers
Autonomous Drive Hardware & Software

FACILITATING ECOSYSTEMS

POLICY

PRICING, PAYMENTS, AND INSURANCE

MaaS Planning Implications

Research by UCL (Kamargianni, Matyas, 2017)

1) Regulatory Framework
2) Integration issues and Pilot Projects:

- Greater Manchester (city and national trips – PTA)
- Luxembourg – Germany (intercity, international trips – TO)
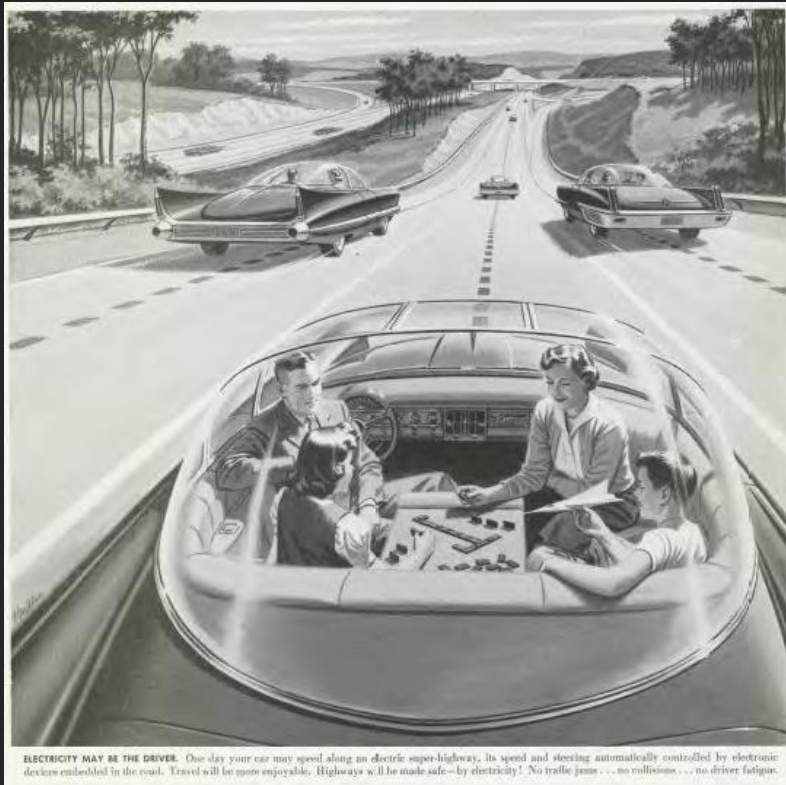- Budapest (city, national and international trips - MaaS trailblazer)

3) Partnership
- Multi-trillion dollar market (TSC, 2016)

4) Research and Development
- Market research for Maas demand (supported by Tfl and Dft)

We are far from realizing an automated transportation system.

Vision

Reality