Harmonization Management System

Bern Grush
UTTRI, June 28, 2018

Supported by:

RESIDENTIAL AND CIVIL CONSTRUCTION ALLIANCE OF ONTARIO
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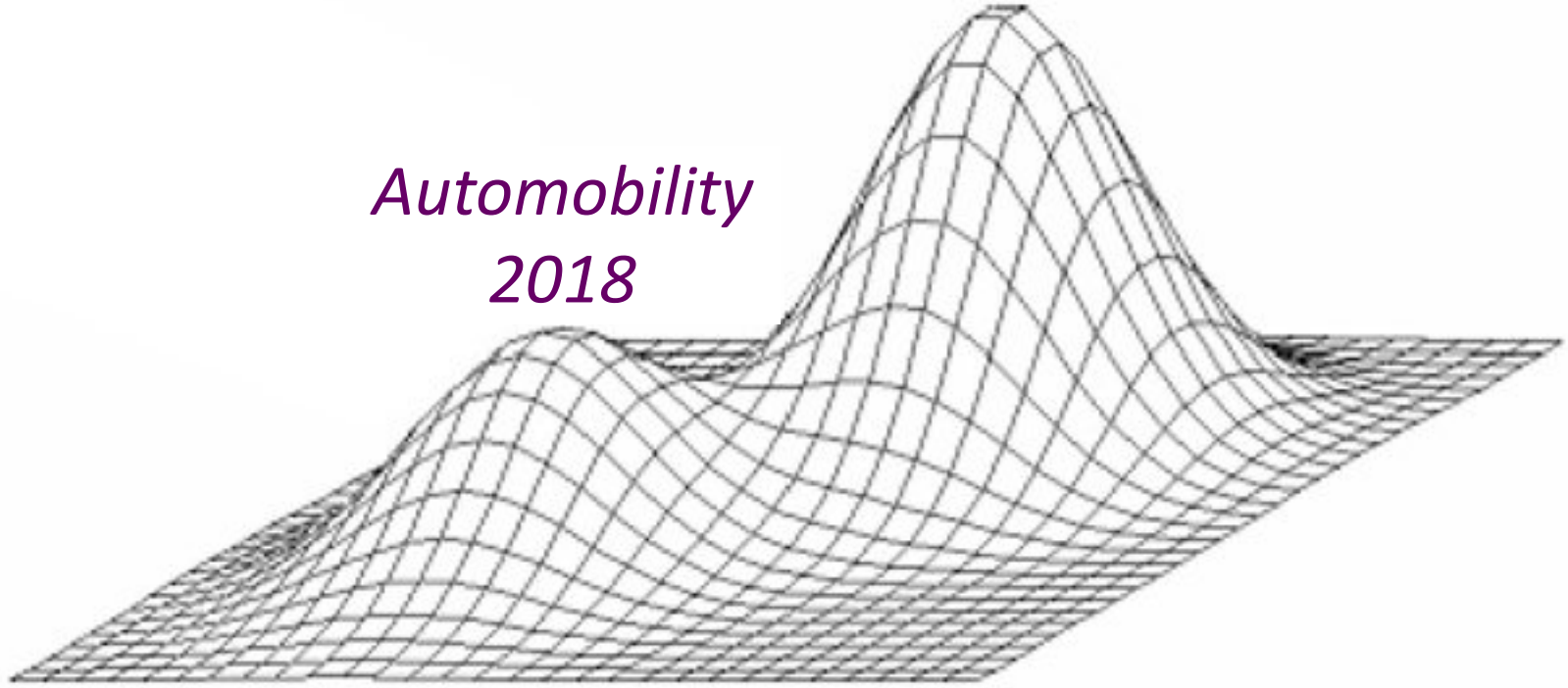
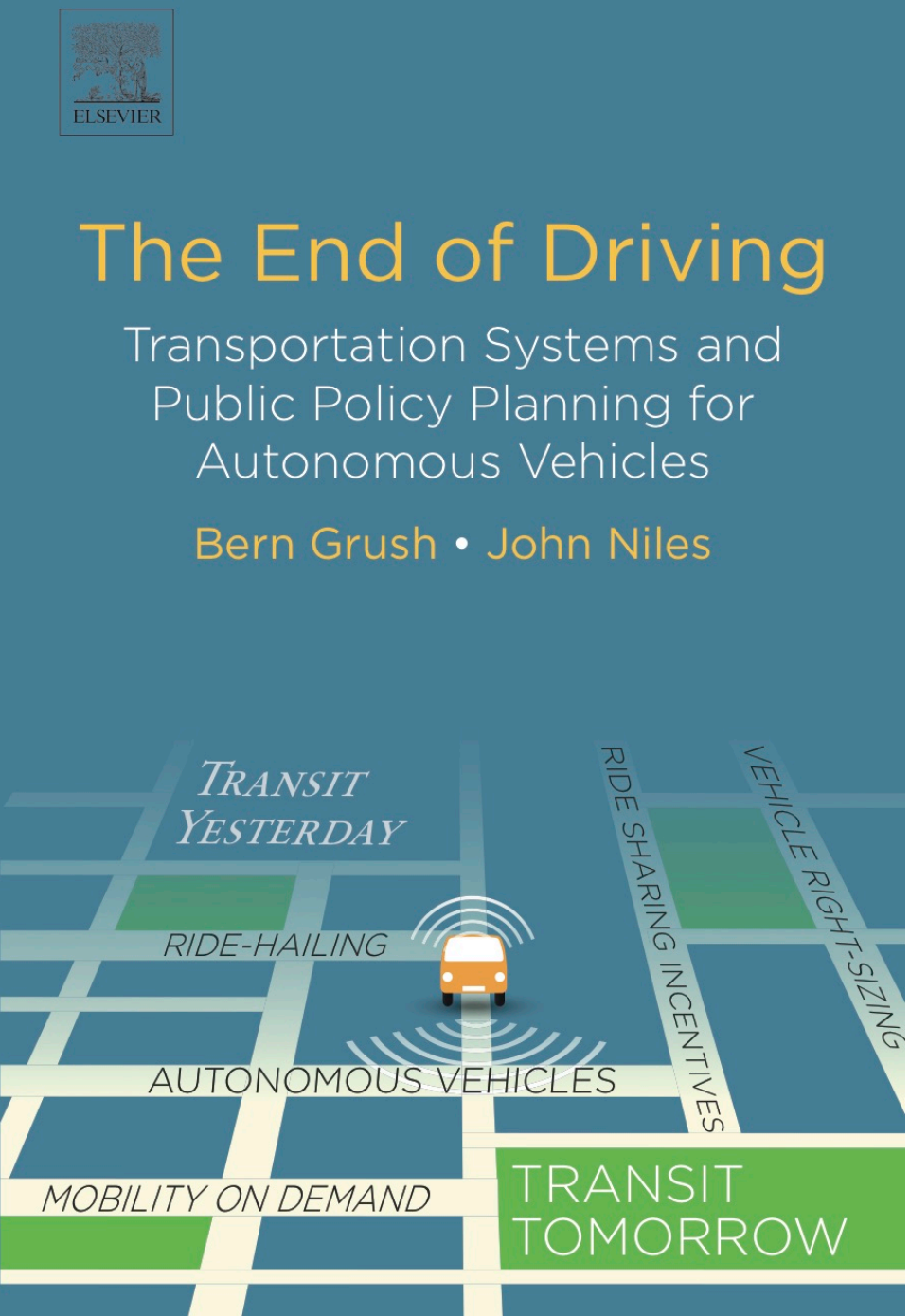
Constructing Ontario's Future

Automated and Shared mid-century

Automobility 2018





The End of Driving

1st Edition

Transportation Systems and Public Policy Planning for Autonomous Vehicles

☆☆☆☆☆ Write a review

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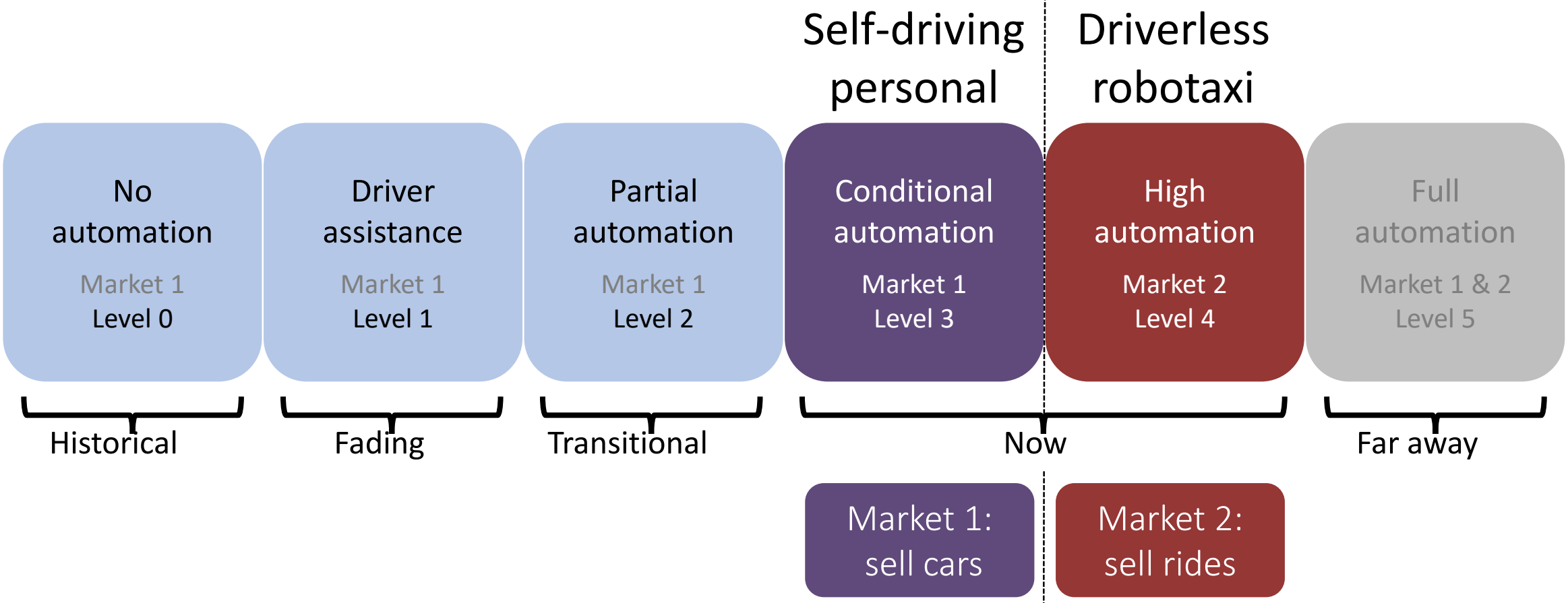
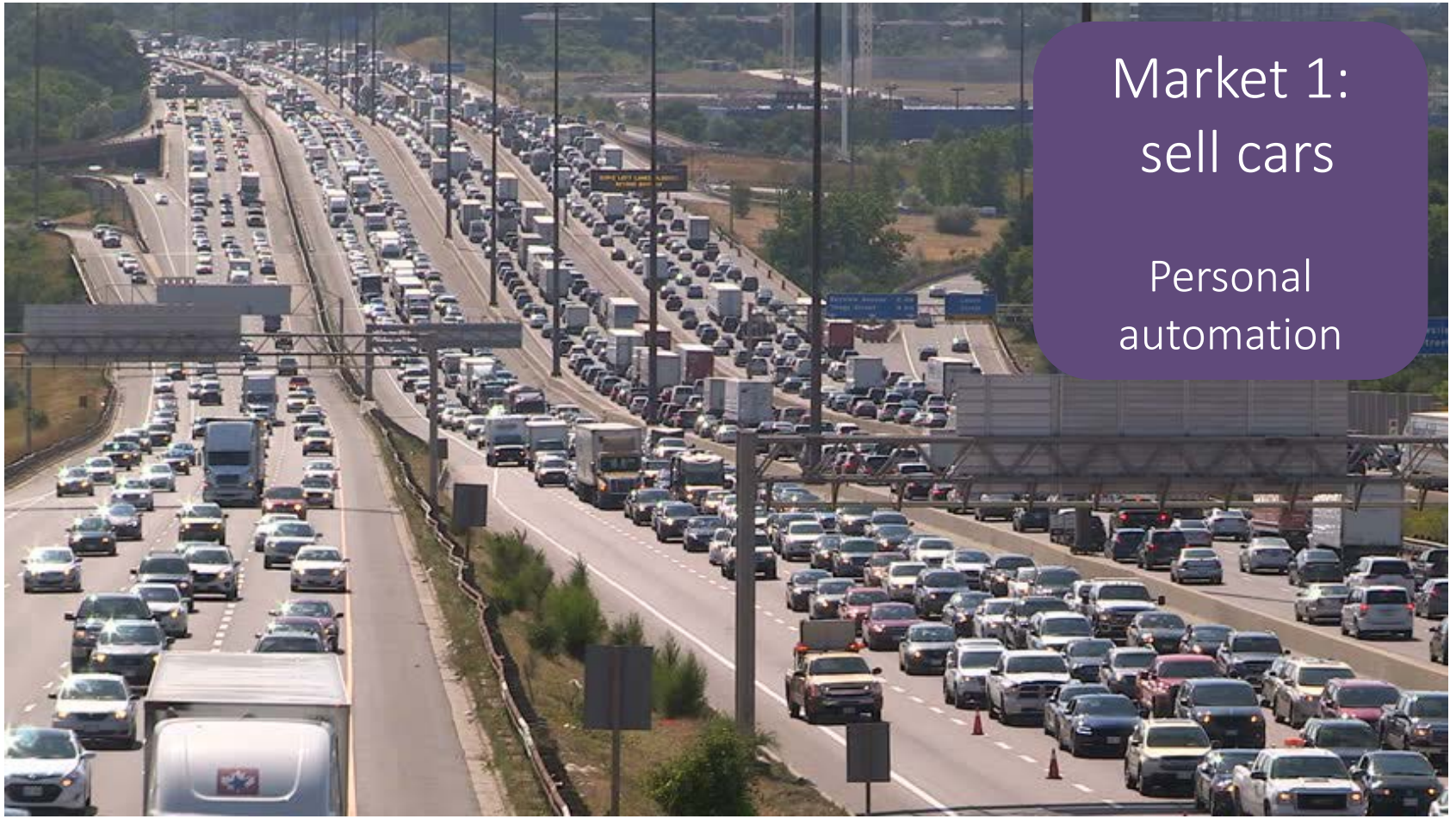
There are two markets for automation

(Only two SAE engineering levels really matter for now)



Social impact of Market 1 — Sprawl

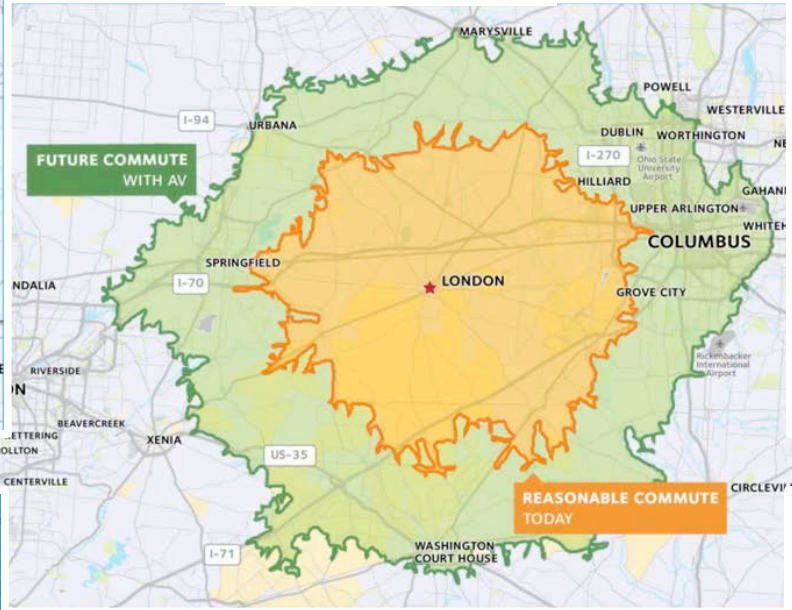
What happens to land-planning if AVs reduce the consumer pain of congestion?



Job reach (related to sprawl…)

Benton Harbor, Michigan

London, Ohio



Gary, Indiana

Elmira, New York

Market 1: Personal automation

Wilmington, Delaware

Images from 2018 America's Workforce and the Self-Driving Future (Securing America's Future Energy —SAFE)

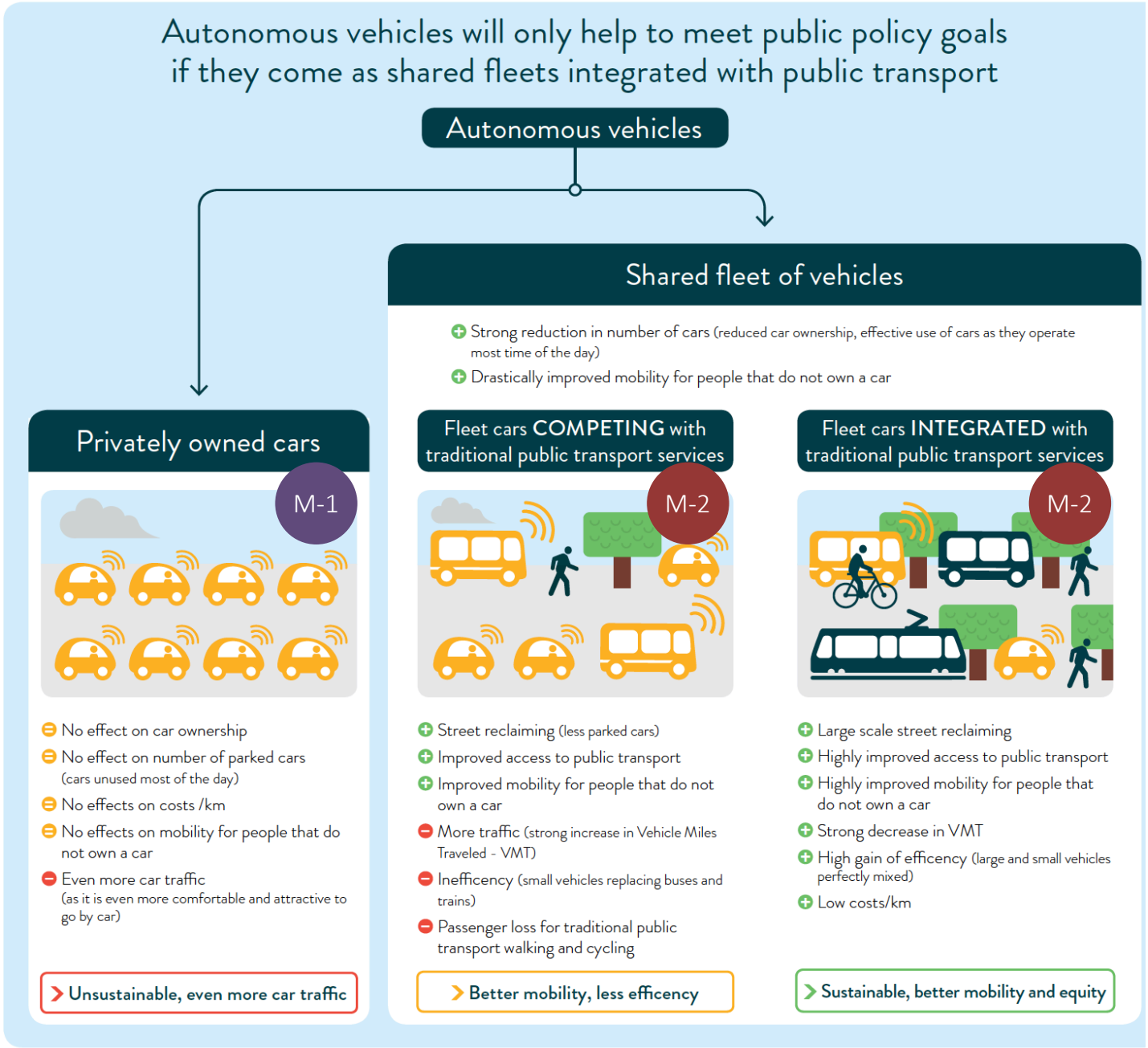
Social impact of Market 2 — Transit

What happens when robotaxis cost the same as the bus?

Market 2: sell rides

Public automation

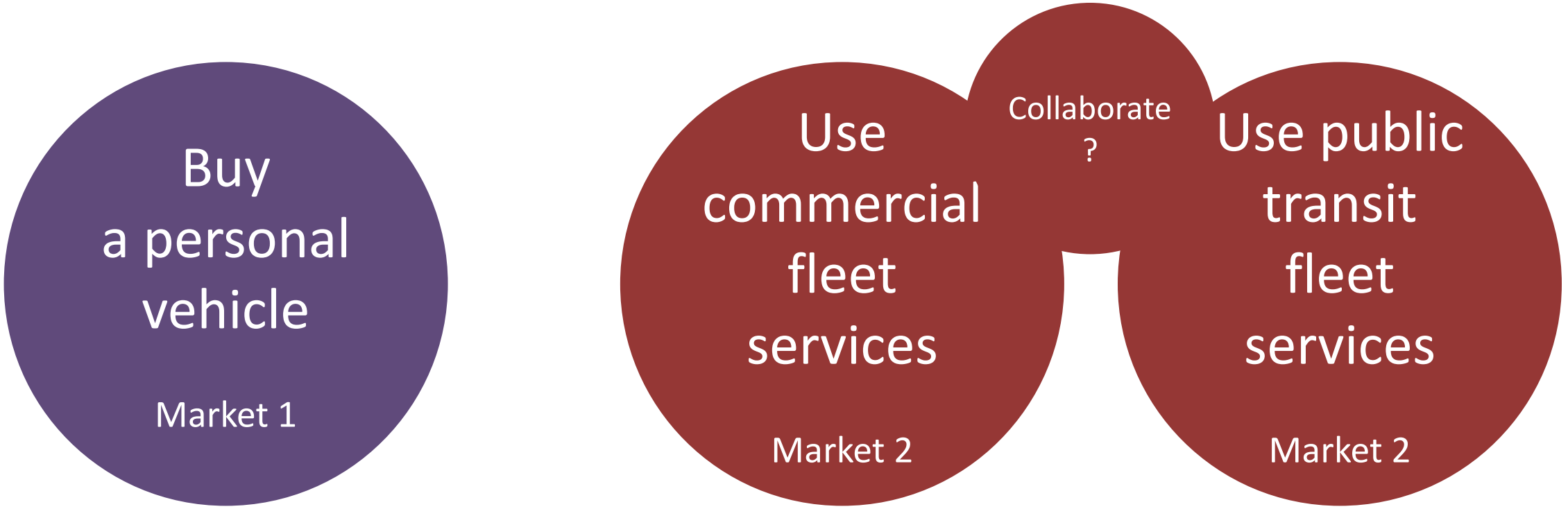
What happens when robotaxis cost less than the bus?



Market 2 has Two Outcomes

1. Commercial & competitive
   - Congested
   - Transit ridership falls
2. Harmonized & integrated
   - Optimizable
   - Heavy transit sustained

Future of motorized automobility

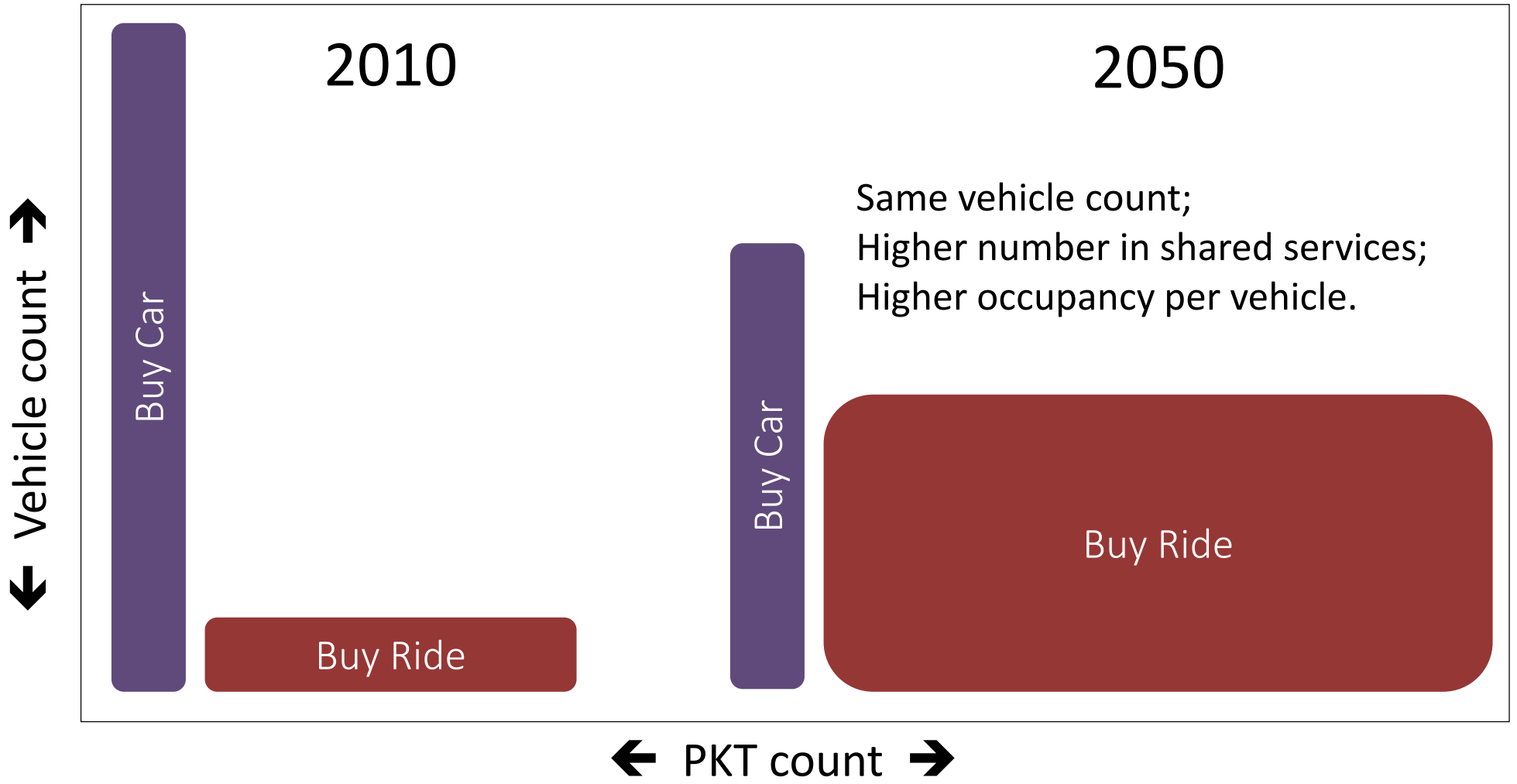


"…a war brewing …between the automotive sector and the transit sector" re who will deliver shared-mobility, autonomous, electrified services."

Josipa Petrunic, Canadian Urban Transit Research and Innovation Consortium (CUTRIC)

PKT expected to grow 3x 2010-2050

Can we serve this with the same fleet size?



Preparing for automated vehicle fleets

Acquire and operate?

Or Specify and regulate?

Risk

Tech obsolescence

Diffusion

Outcome

Timing

Acceptance

Costs

Funding

Mixed driving

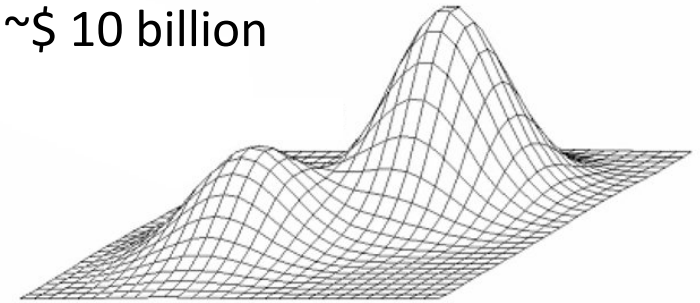
Resilience

Scale

Affordable?

150,000 vehicles to serve 25% of PKT demand in GTHA in 2030s

~$ 10 billion



Flexibility

Achievable?

Demanded by riders

Hard to achieve with current transit mindset and metrics

Competition

…for riders, roadspace, parking, funds

…among public transit, commercial services and private cars

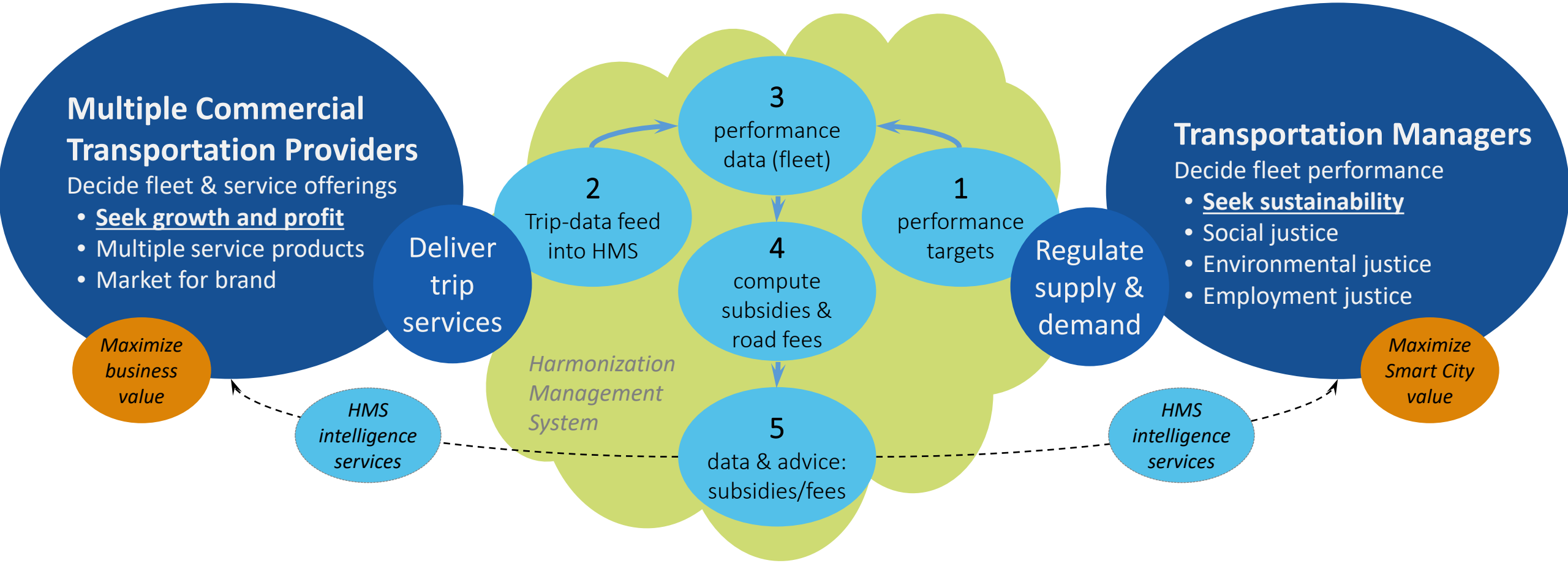
Why compete?

Harmonization Management System

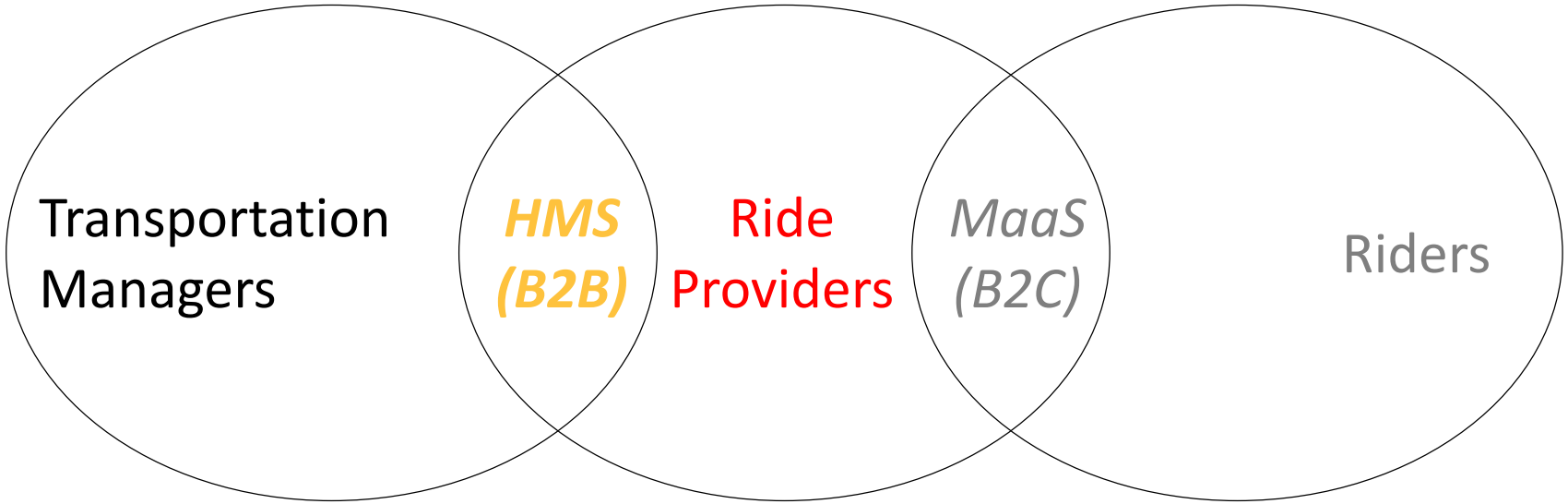
HMS is a software platform

Offers transportation demanders/mangers the ability to specify and regulate commercial transportation supply in the digital transportation era.

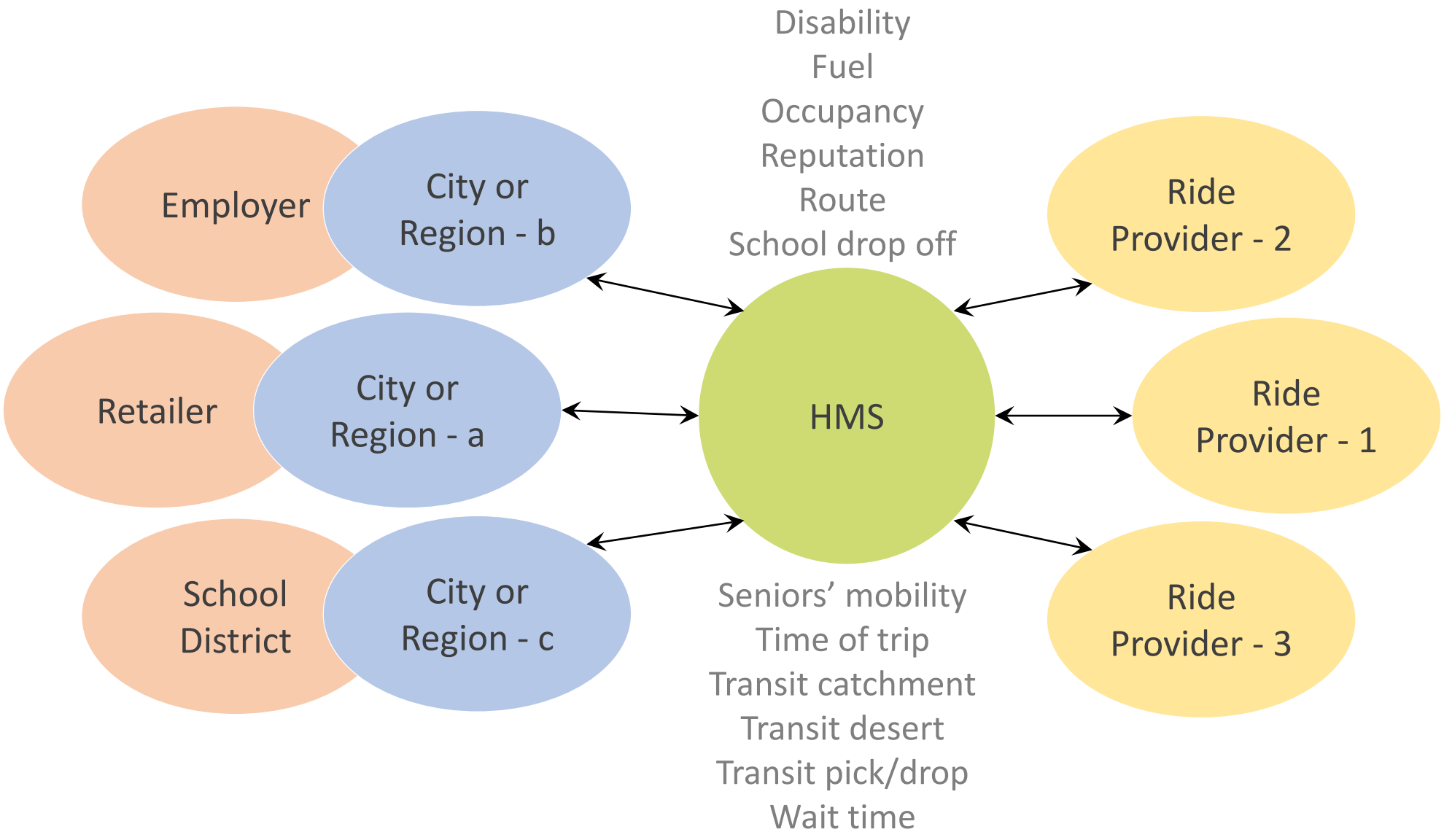
Harmonization Process Flow



HMS enables transportation managers to manage ride providers in the Platform Economy



Many to many to many.



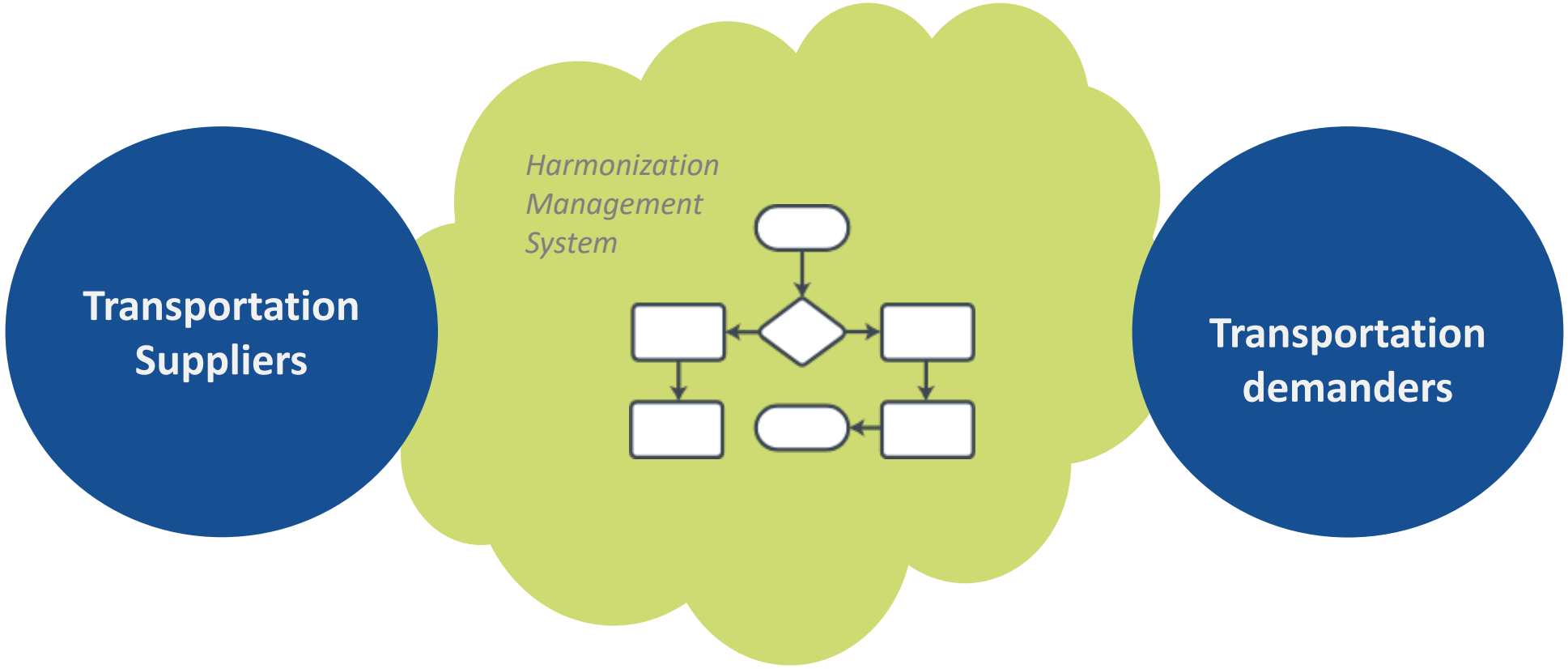
Purpose of HMS

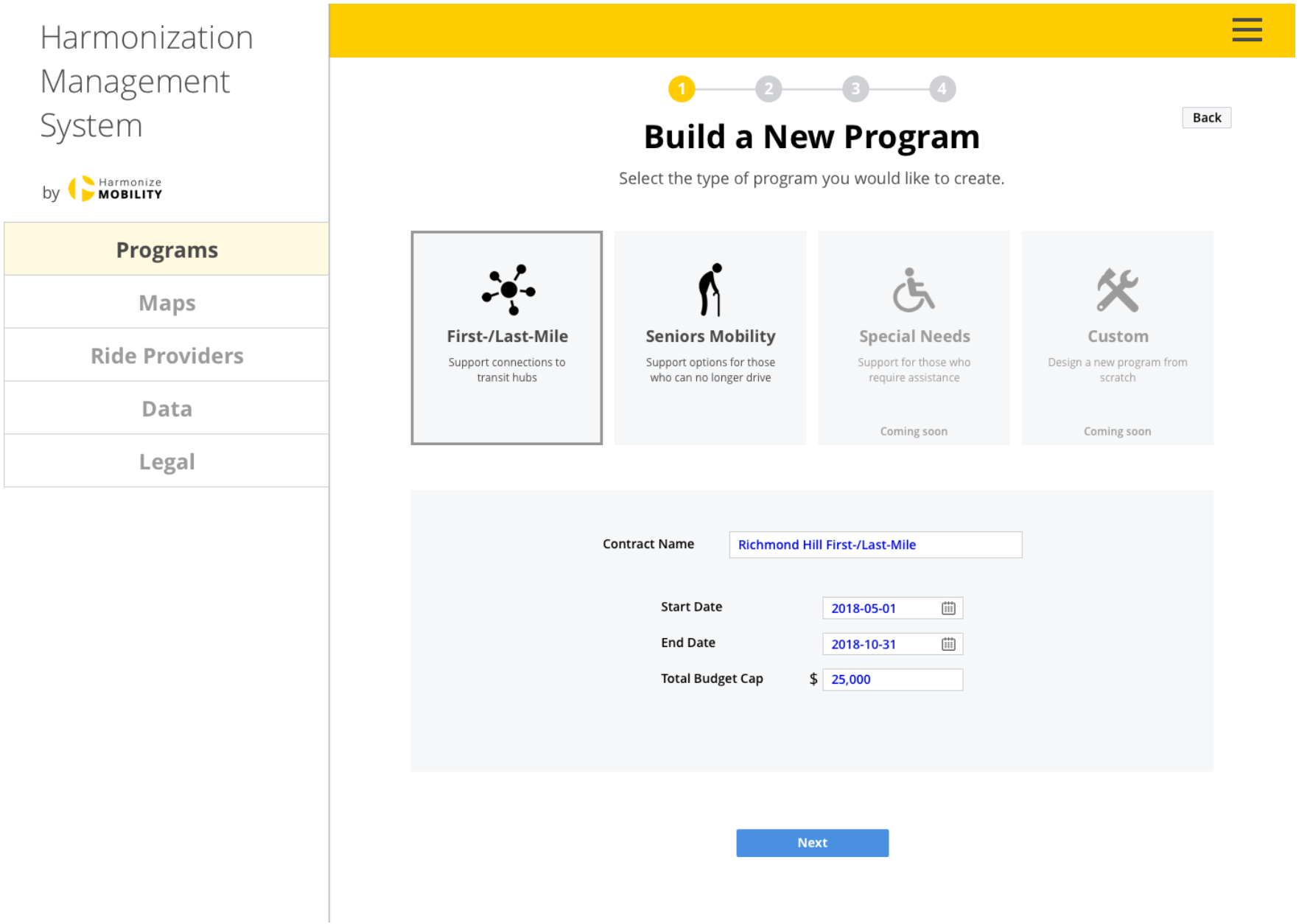
HMS: software platform

Offers transportation demanders/mangers the ability to specify and regulate commercial transportation supply in the digital transportation era.

1. Specify transit performance requirements
2. Regulated by transportation managers
3. Set and manage subsidy budget *(road-use fee?)*
4. Open to all ride providers and services
5. Simplify procurement process
6. Service resilience
7. Coverage for social equity
8. Uniform analytics
9. Data-learning from other cities
10. Increases business opportunities

Thank you!





Harmonization Management System

by Harmonize MOBILITY

- Programs
- Maps
- Ride Providers
- Data
- Legal

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Choose Location

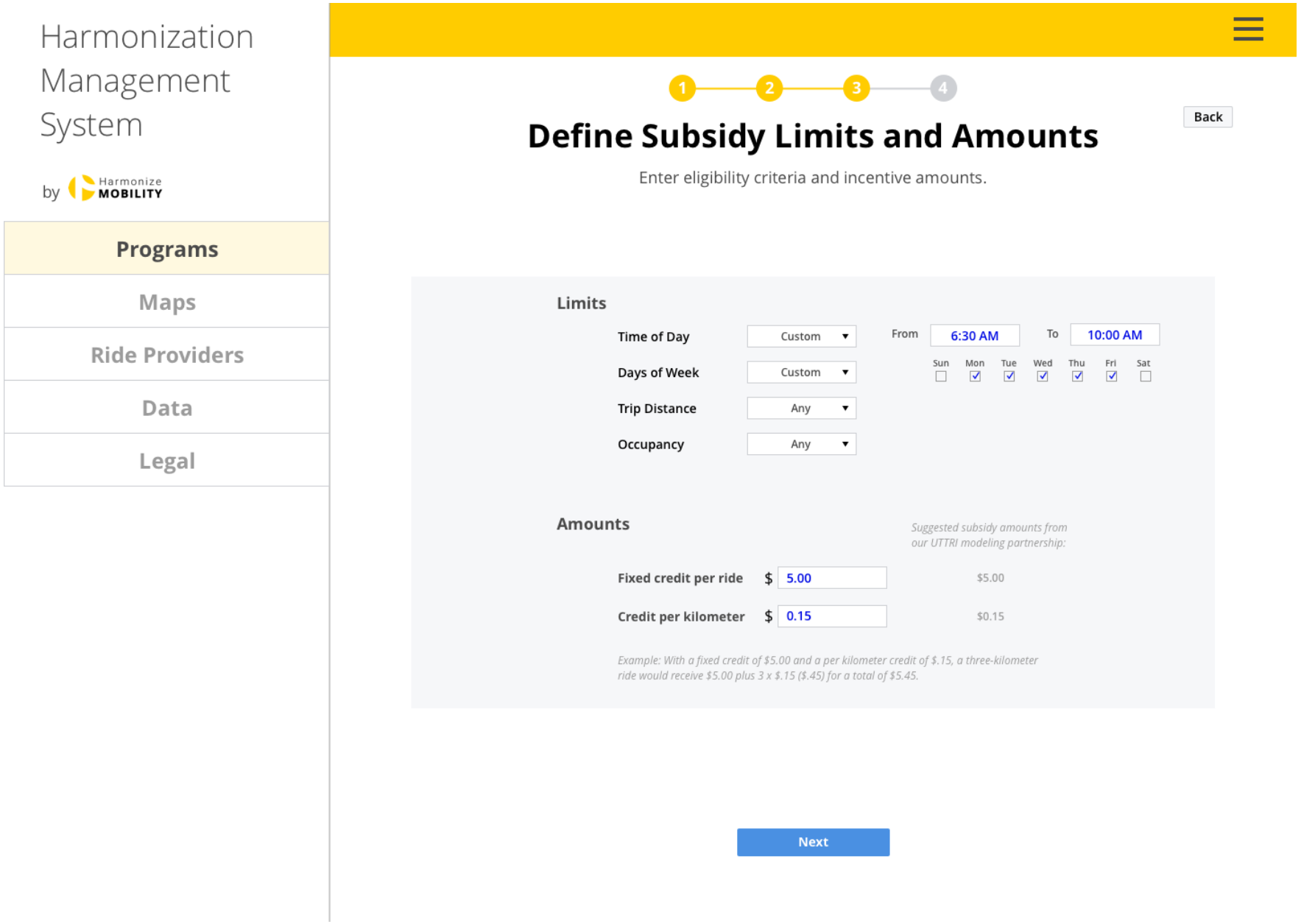
Select target and catchment areas to include.

Set Target Area | Set Catchment Area

Note: Increasing target area will improve use, decreasing will improve accuracy. Increasing catchment area will improve use but can increase costs exponentially.

Location Name: Richmond Hill Transit Station

Next



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Review Program

Verify program details and estimated outcome.

Program Name	Richmond Hill First-/Last-Mile	**Location**	Richmond Hill Transit Station
Total Budget Cap	$25,000	**Additional Limits**	None
Program Dates	May 1 2018 to Oct 31 2018	**Subsidy Amount**	$5.00 + $.15/km

Estimated Results

Estimations derived from our UTTRI modeling partnership

Total rides supported	Average TNC vehicle occupancy	Total subsidy expenditures:	Average catchment distance
3,000	1.7	$12,000	1.9 km

Estimated Impacts

Transit Ridership	Congestion	Parking
13% improvement	5% improvement	9% improvement

Submit Program

Harmonization Management System

by Harmonize MOBILITY

- Programs
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Program Outcome Report

Completed program.

Program Name	Oakville Seniors Pilot Project	**Location**	Oakville City Centre
Total Budget Cap	$150,000	**Additional Limits**	Age (65+), Licence (No Licence)
Program Dates	Aug 1 2018 to Jul 31 2019	**Subsidy Amount**	$5.00 + $.15/km

Program Results

	Total rides supported	Average TNC vehicle occupancy	Total subsidy expenditures:	Average catchment distance
	13,281	1.2	$114,089	2.2 km
Uber	5,765	1.6	$8,943	2.5 km
Lyft	3,988	1.6	$4,011	2.2 km
FaceDrive	902	1.1	$409	1.3 km
InstaRyde	1,254	1.2	$833	0.8 km
Taxify	1,172	1.5	$645	1.7 km

Program Impacts

Residents Served

+ 13%

		Estimate
Seniors with access	1651	*1576*
Unlicenced ratio	61%	*63%*

Accident Rate

- 5%

		Estimate
Road accidents / month	84	*1085*
Percent involving seniors	7	*14*

Parking

- 2%

		Estimate
Parking capacity filled	88%	*98%*
Curbside dropoff ratio	1:5	*1:3*

Table 1: A Rough Calculation of Expected Fleet Size, Estimated Costs to Service 25% of the GTHA PKT with Robo-Vehicles Circa 2030

GTHA population 2030 (projected)	8.5 M
25 percent of pop (Roland Berger suggested 27% of PKT in robo taxis)	2.125 M
Annual PKT per person (less than current U.S. 13,500 VKT to be conservative for ride-buyers, assume ride buyers purchase fewer km than car-owners travel)	12,000
Total annual PKT for 25%	25.5 B
Current per vehicle occupancy (in passenger vehicle (U.S.)	1.59
Total annual VKT for the 25% at this (current) occupancy	16 B
Target occupancy (mixture of 2-, 4-, 6-, and 12-person vehicles comprising 50, 25, 20 and five percent of the fleet respectively, and operating on average at 50% occupancy (including deadheading which means 55% occupancy when occupied if deadheading is at 10%)	2
Total annual VKT (by converting PKT to VKT at the target occupancy)	12.75 B
Daily duty hours of a vehicle (estimated: daily work cycle including deadheading and waiting for riders; excludes charging, parking when not in use)	16
Speed km/h, *estimated from current transit* ~2015 (top vehicle speed is the posted speed, but most actual travel is in-city, with traffic stops, pickups, waiting, heavy traffic, lights, etc);	24
Daily km potential: all in, stops, pickups, top speed, etc. (duty cycle x speed)	384
Annual km (daily km x 365) | (This may be high at first, so larger relative fleet may be needed at start ...)	140,160
NYC taxi annual (for comparison only; this indicates that 140,160 is only slightly high, since robo vehicles are more optimized than human-driven)	112,000

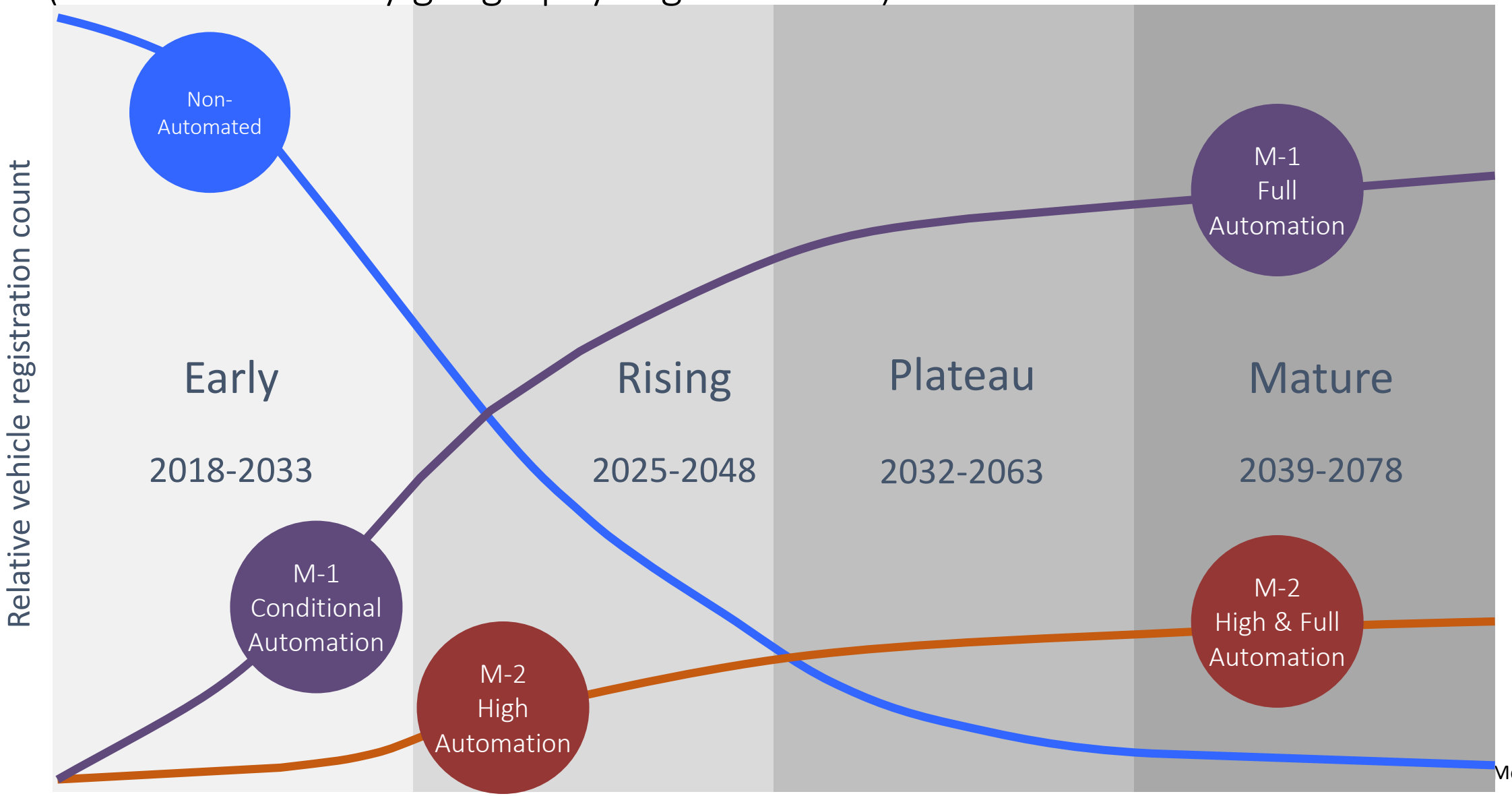
From: RCCAO.COM Ontario Must prepare for Vehicle Automation, Part 2

Annual km (daily km x 365) | (This may be high at first, so larger relative fleet may be needed at start ...)	140,160
NYC taxi annual (for comparison only; this indicates that 140,160 is only slightly high, since robo vehicles are more optimized than human-driven)	112,000
Floor estimate: Number vehicles to cover total VKT; assume perfect operation, average day	91,000
Ceiling estimate: assume 15% (of the ride-buying 25%) of the population is in a vehicle at the annual peak hour, the fleet would need to serve 3.75% of the population concurrently	159,000
Peak-to-Average estimate: use 1.6 x **floor** [Sweet] requires 146,000 vehicles. (The factor of 1.6 was taken from a traffic study of the Toronto area (this accounts for annual or weekly peaks, not the annual peak!)	146,000
Calculated estimate: the average between the **ceiling** and the **peak-to-average**. Such a fleet might incur slightly longer queues at some annual peaks (Christmas shopping, Halloween night) but would have spare capacity to meet short-wait promises, otherwise (**Note:** *there is no buffer for vehicle failures or scheduling and distributions shortcomings.*)	152,000
Average annual vehicle cost (capex+ opex+ 0.2FTE @ 80K) * * Assume Capex and Opex (excluding staff costs) for a vehicle is $50,000 per annum including support equipment. Assume fleet operations (fuel/energy, management, payment systems, security, police and emergency, maintenance (repairs and cleaning), oversight, stewards on the minibuses, map maintenance, roadway watchdogs) require 1 FTE per 5 vehicles. Average staff salary and overhead per FTE is $80,000 per annum, or $16,000 staff expense per vehicle (30,500 jobs for a fleet of 152,000).	$66,000
Total annual cost given above peak, but no buffer; implies occasional waiting times	$10.1 B
Cost per PKT (no contingency, no profit)	$0.39

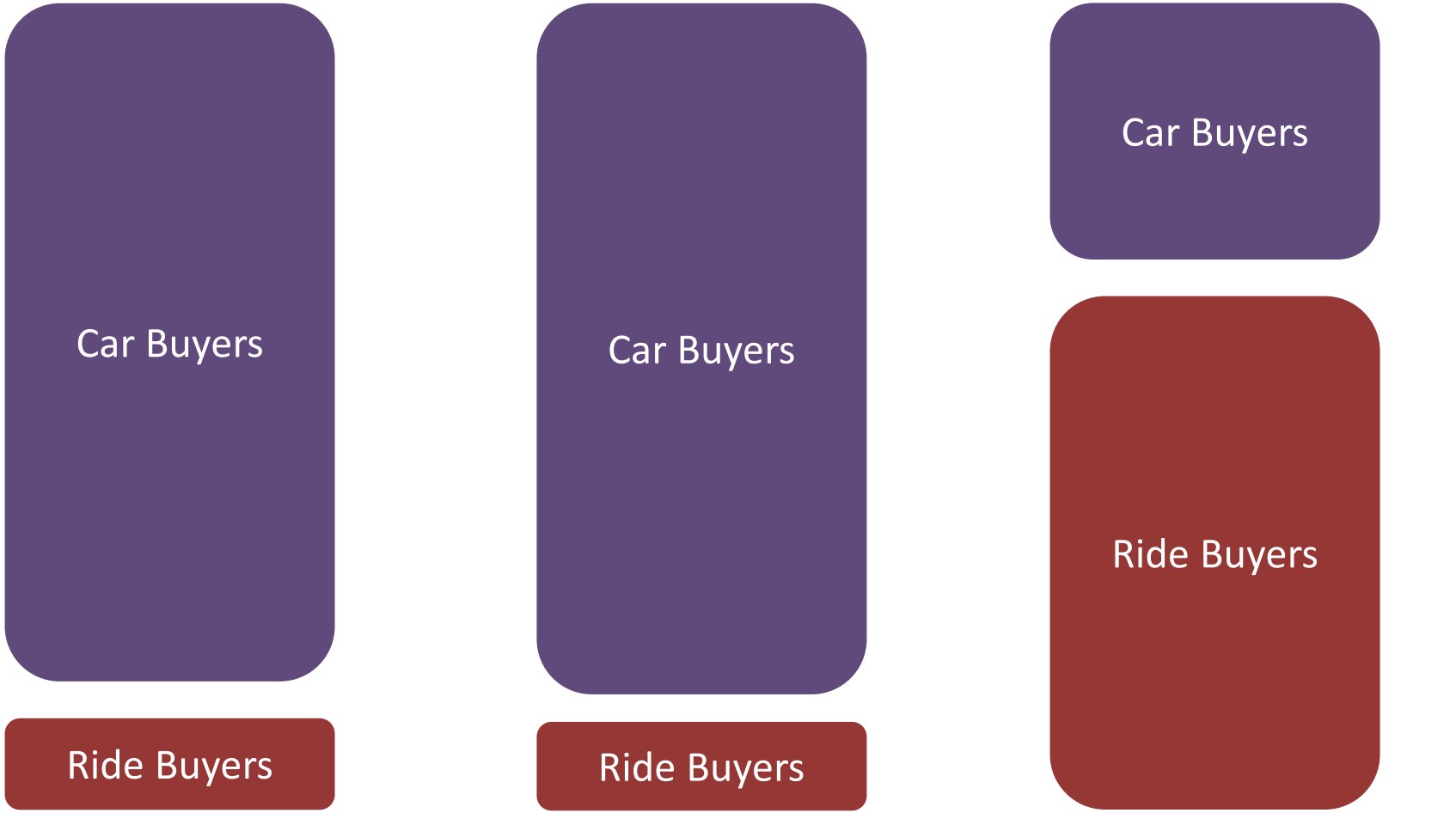
From: RCCAO.COM Ontario Must prepare for Vehicle Automation, Part 2

AV-Eras

(Diffusion varies by geography & governance)



Mobility



now

early automation
2020s
(evidence? “History”)

planner’s stated preference
2030s-2040
(evidence? “Hope”)