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The Oslo Study
Measuring the impacts of shared mobility

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June 2019

1. Making waves
2. Bucking the trend
3. Avoiding the pain
4. The Oslo Study

   Simulating the solution

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Making waves

Now let me tell you this

Norway's coastline stretches further than Australia's !

Centuries of pounding…

Forecasting the future

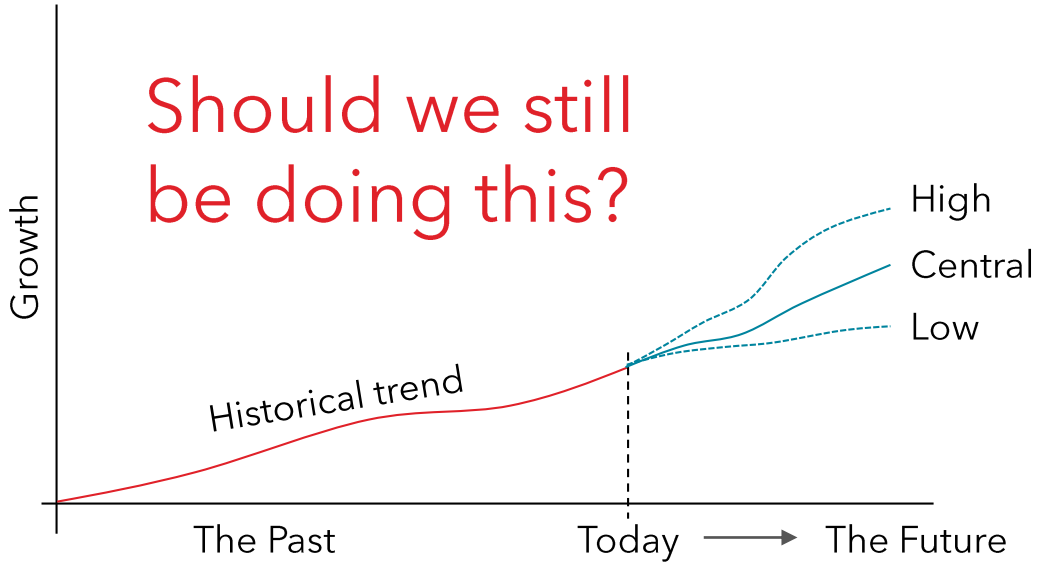
Traditionally….. We project forward based on historical trends. And then only a handful of futures

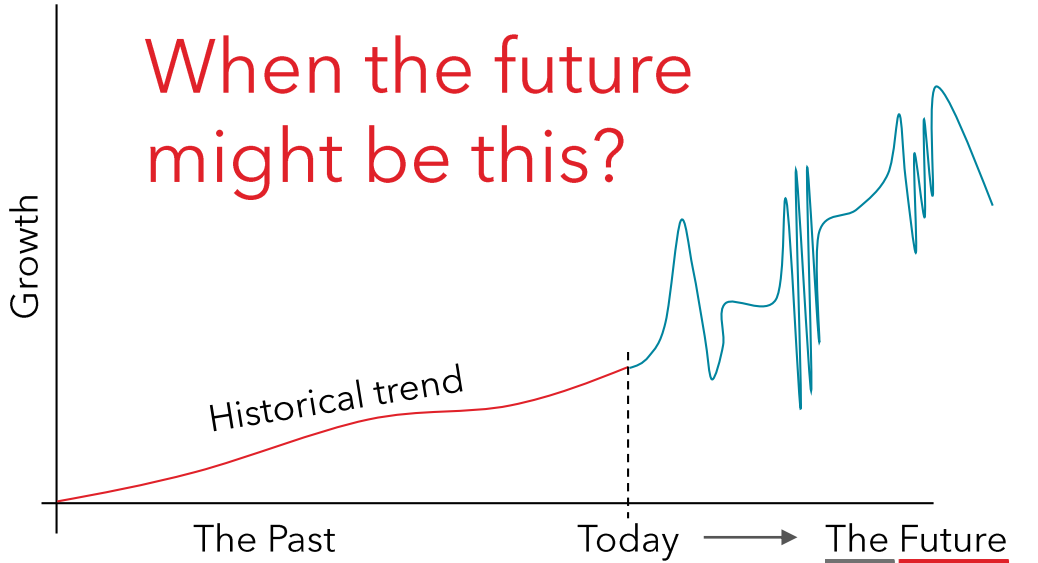
Traditionally….. We freeze…

- Household trip rates (propensity to travel)
- Value of Time (usually a disbenefit)
- Car availability levels (are these declining amongst younger people??)

…. But are we witnessing new trends with MaaS?

- Adoption rates (a change in mindset)
- Pay as you go (reduced car ownership)
- Increase in choices (value of time)
- Increased inclusivity (propensity to travel)





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Bucking the trend

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The four 'P's

Probable

- Business as usual

Plausible

- Hyperloop?

Painful

- Backing the wrong horse

Possible

- Choose your future

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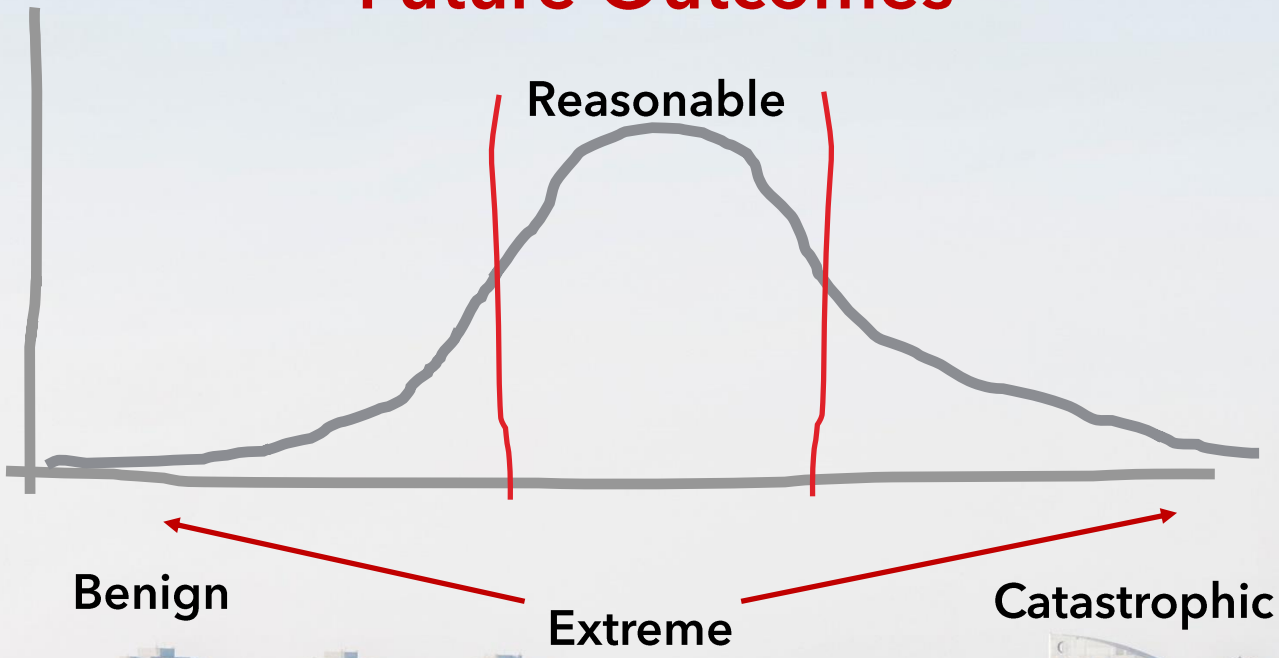
Future Outcomes



Avoiding the pain…

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Transport Model Solution.

Data & algorithms are the basis.

- **Data & algorithms**
- Model & simulate
- Plan & predict
- Optimise & control

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Transport Model Solution.

Reliable plans based on real-time information & prediction.

- Data & algorithms
- Model & simulate
- **Plan & predict**
- Optimise & control

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Transport Model Solution.

Real-time information in combination with network for solid traffic & fleet control.

- Data & algorithms
- Model & simulate
- Plan & predict
- **Optimise & control**

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The Oslo Study

in conjunction with COWI

for

Ruter#

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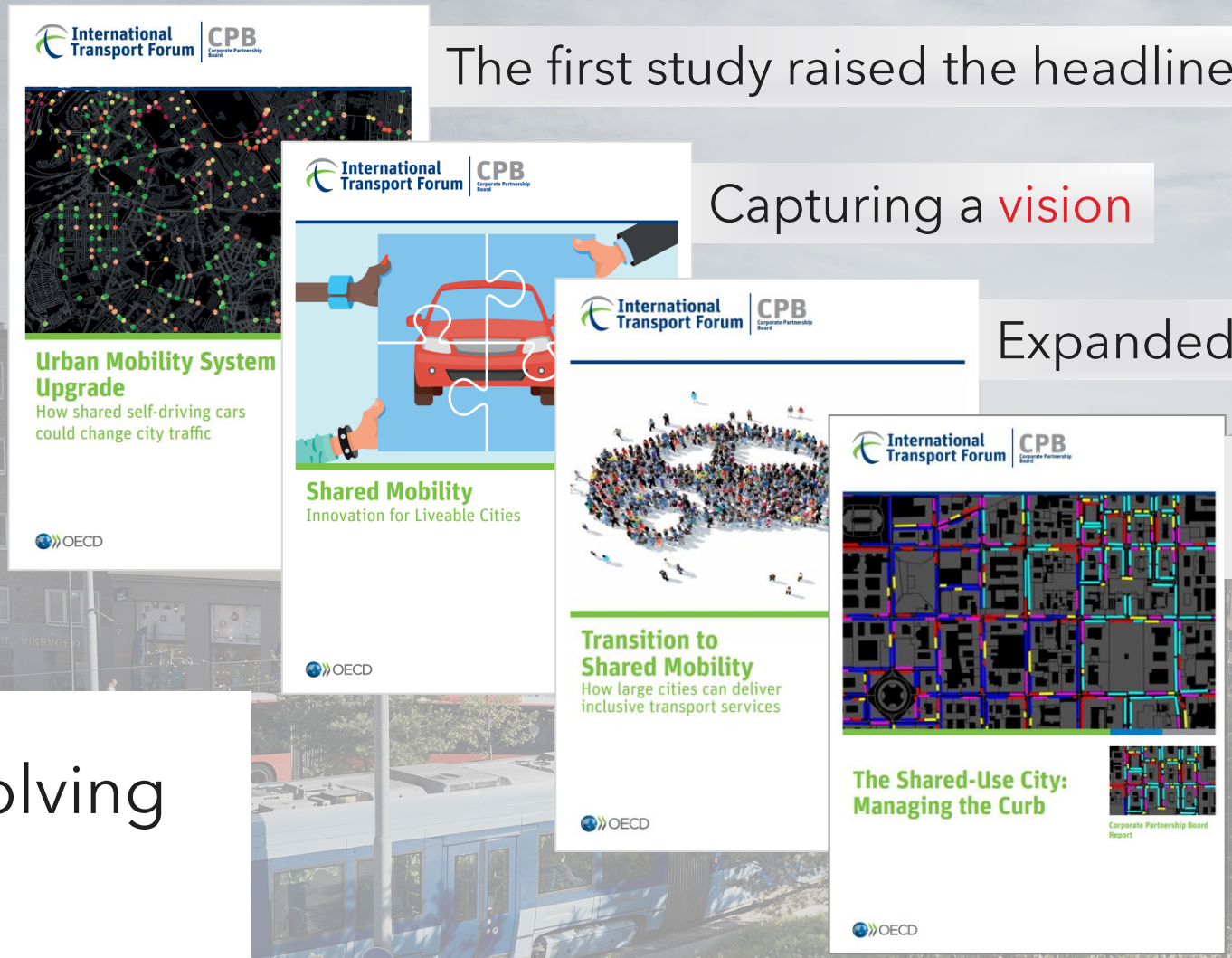

The first study raised the headlines

Capturing a vision

Expanded to a wider region

Identifying the curb as an asset to be managed

The evolving Lisbon Studies

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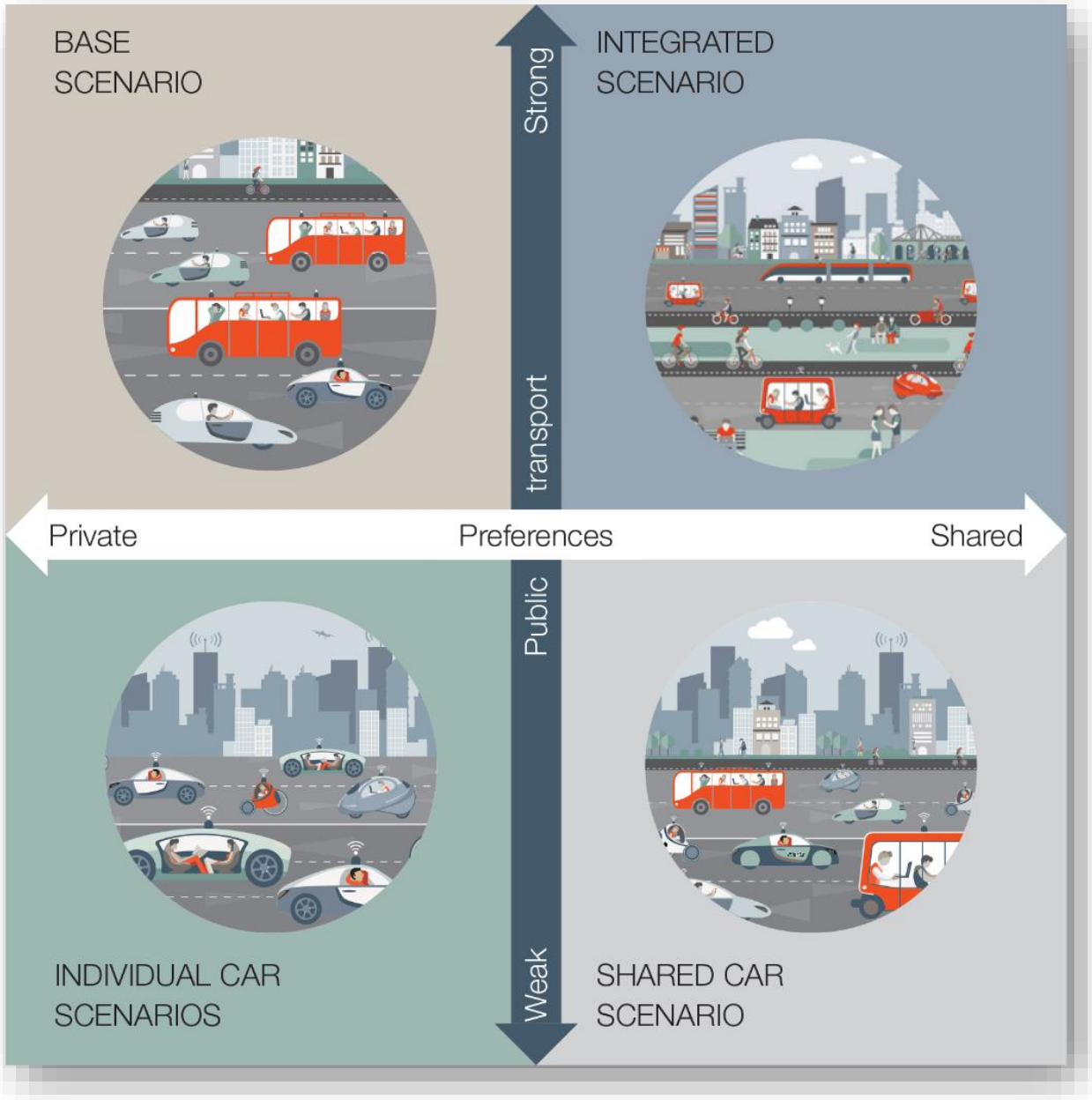
Technological trends

Megatrends set the framework for future mobility in all scenarios:

- Technological development
- Urbanisation
- Climate change

Critical uncertainty is a relationship one does not know how to develop. The assessed scenarios in The Oslo Study relate:

- Citizens' preferences
- The quality of public transport



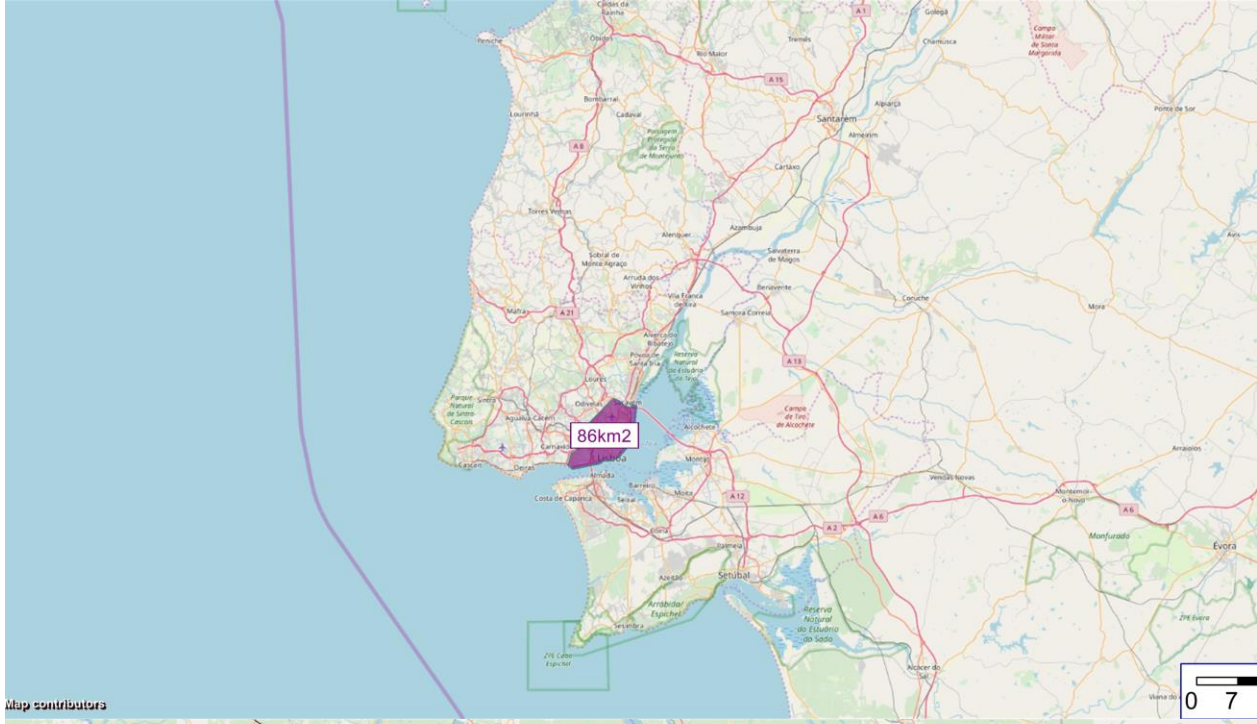
Study Area

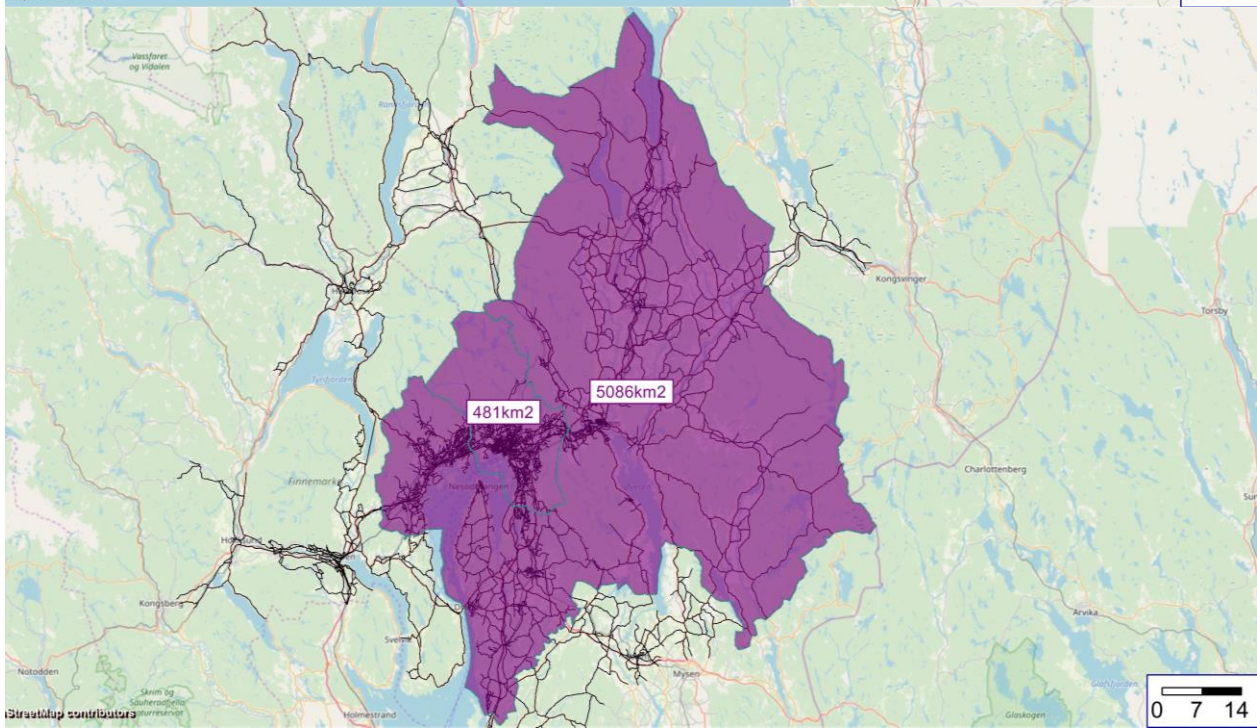
Covers Oslo & Akershus

AM peak 06:00-10:00 simulated.

The busiest Scenario includes existing car drivers, their passengers and public transport riders on tram and bus.

This equates to over 600,000 trip makers moving to shared mobility in the simulated time period.

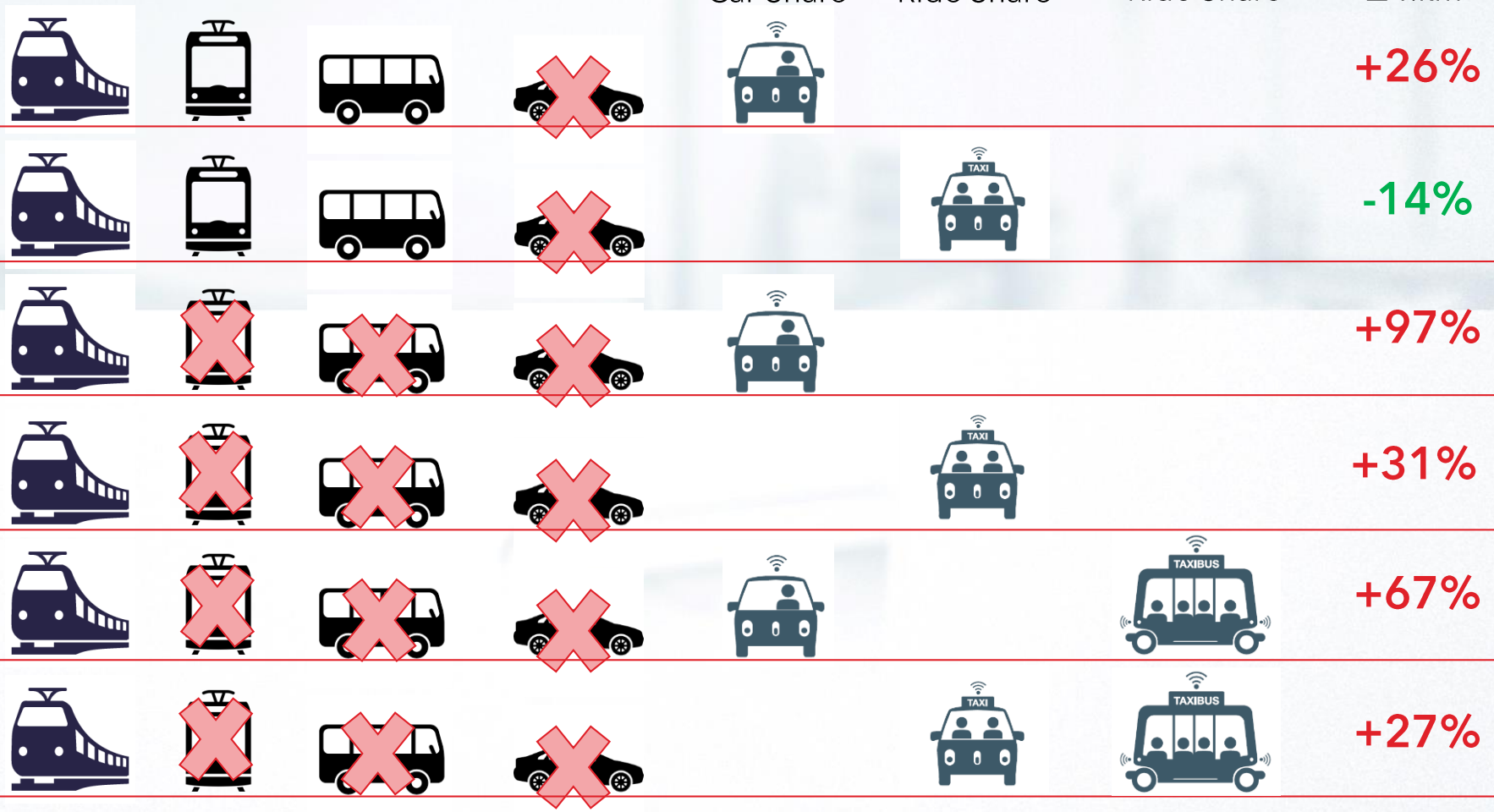




Oslo's PT provider: Ruter

Replacing private cars & PT with Shared Mobility

- Data as the basis
- Digital Twin
- **Scenario Management**
- **Results**



So how does Oslo compare ?

	OSLO	LISBON*	HELSINKI	DUBLIN	AUCKLAND	STUTTGART
Area (km^2)	5,400	3,000	800	7,000	2,200	3,700
Population (millions)	1.3	2.8	1.1	1.8	1.3	2.7
Population density (inhabitants versus area)	241	933	1,375	257	591	730

So how does Oslo compare?

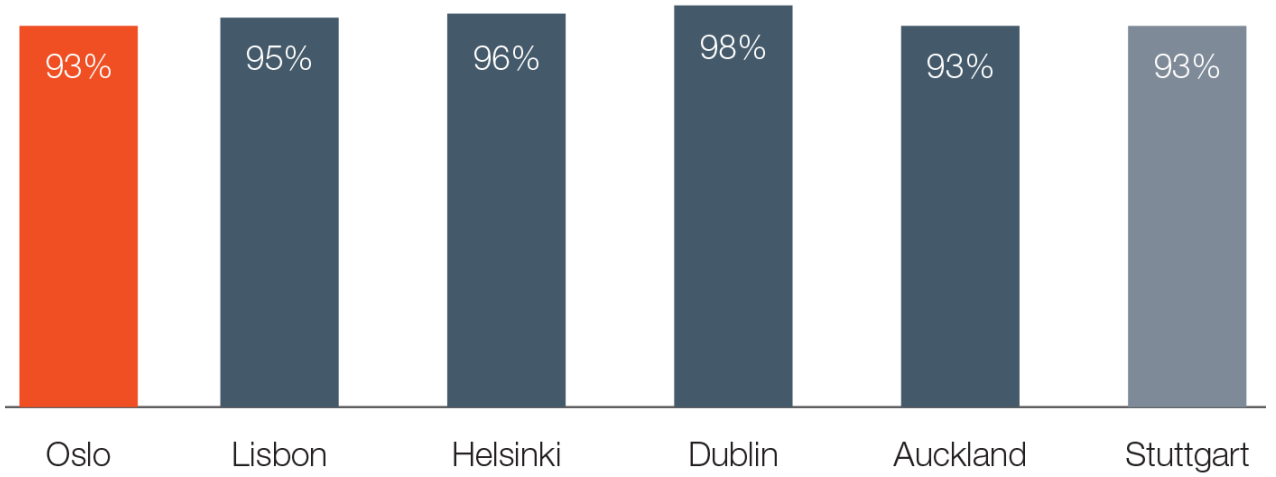
SCENARIO 1A
Car users change mode to shared car without ridesharing.
Public transport riders do not change mode and continue to ride public transport.

SCENARIO 1B
Car users change to shared taxi with ridesharing.
Public transport riders do not change mode and continue to ride public transport.

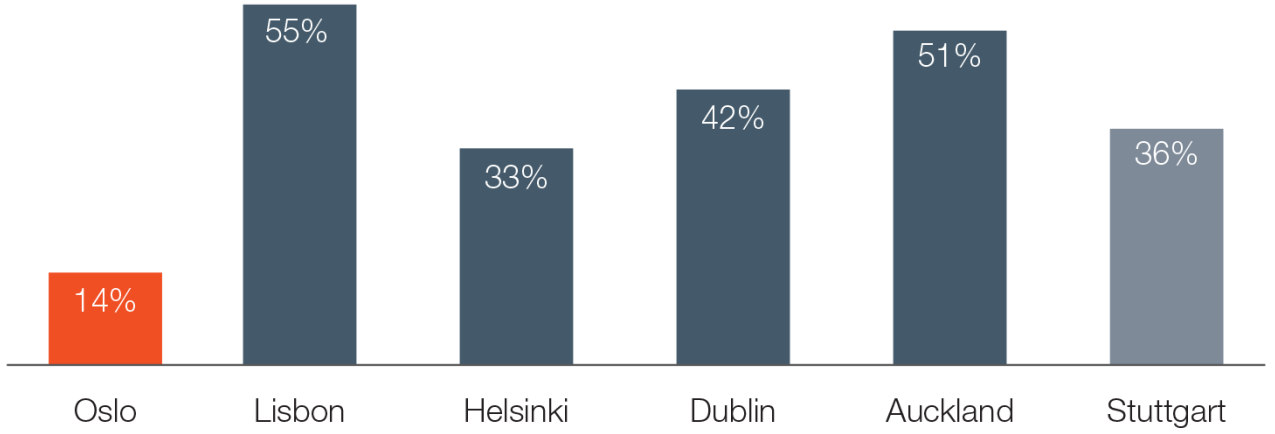
SCENARIO 2A
Car users change to shared cars, without ridesharing.
Public transport riders on buses and trams change to shared car, without ridesharing. Train and metro riders continue without changing.

SCENARIO 2B
Car users change to shared taxi with ridesharing.
Public transport riders on buses and trams change to shared taxi with ridesharing. Train and metro riders continue without changing.

REDUCTION IN NUMBER OF VEHICLES
In scenarios comparable with 1b



REDUCTION IN VEHICLE KILOMETERS
In scenarios comparable with 1b



Simulating the solution

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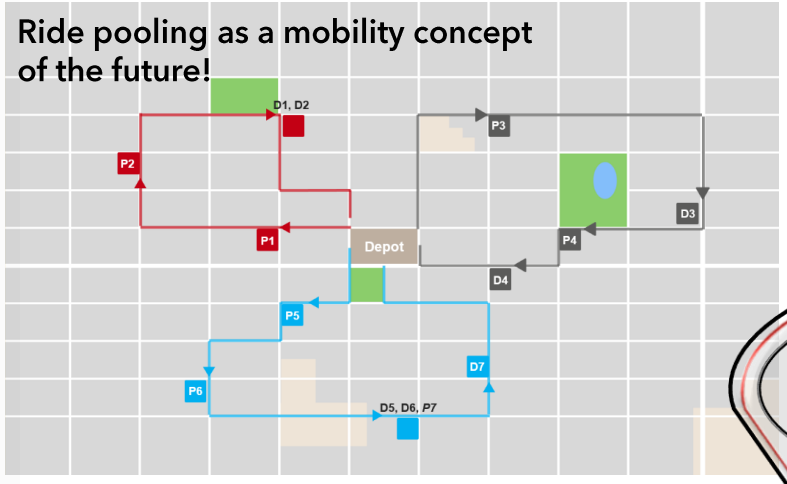
Simulating Shared Mobility

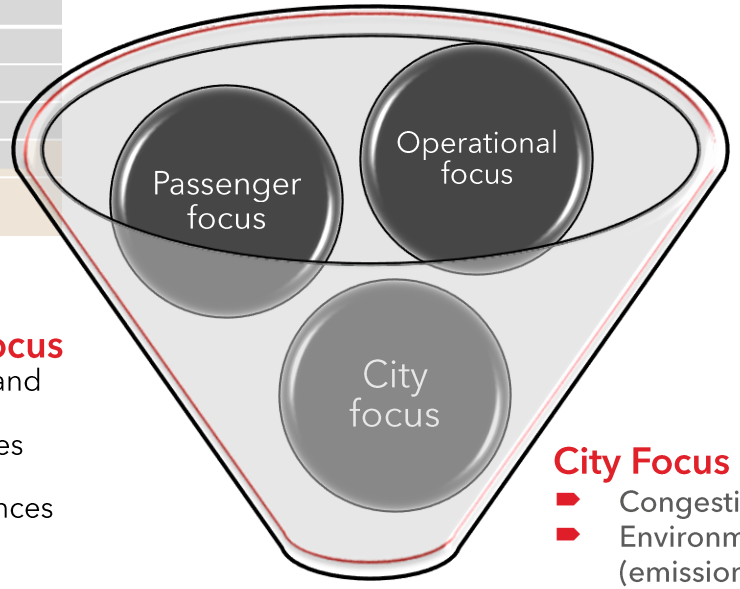
The shared mobility algorithm addresses three core conditions:

- Minimise unserved trip requests
- Minimise the fleet size required
- Minimise the objective function



Holistic overview

The Objective Function



Operational focus

- Required vehicle fleet
- Occupancy
- Duration of the trip
- Operating hours
- Operating performance
- Revenue

Passenger focus

- Travel demand served
- Waiting times
- Detours
- Travel distances
- Travel times
- Fare

City Focus

- Congestion relief / impacts
- Environmental factors (emissions)
- Safety
- Urban realm possibilities / challenges

Sustainable decisions

Service specification

Vehicle seating capcity: **6 seats**

Pre-Booking Time: **1 min**

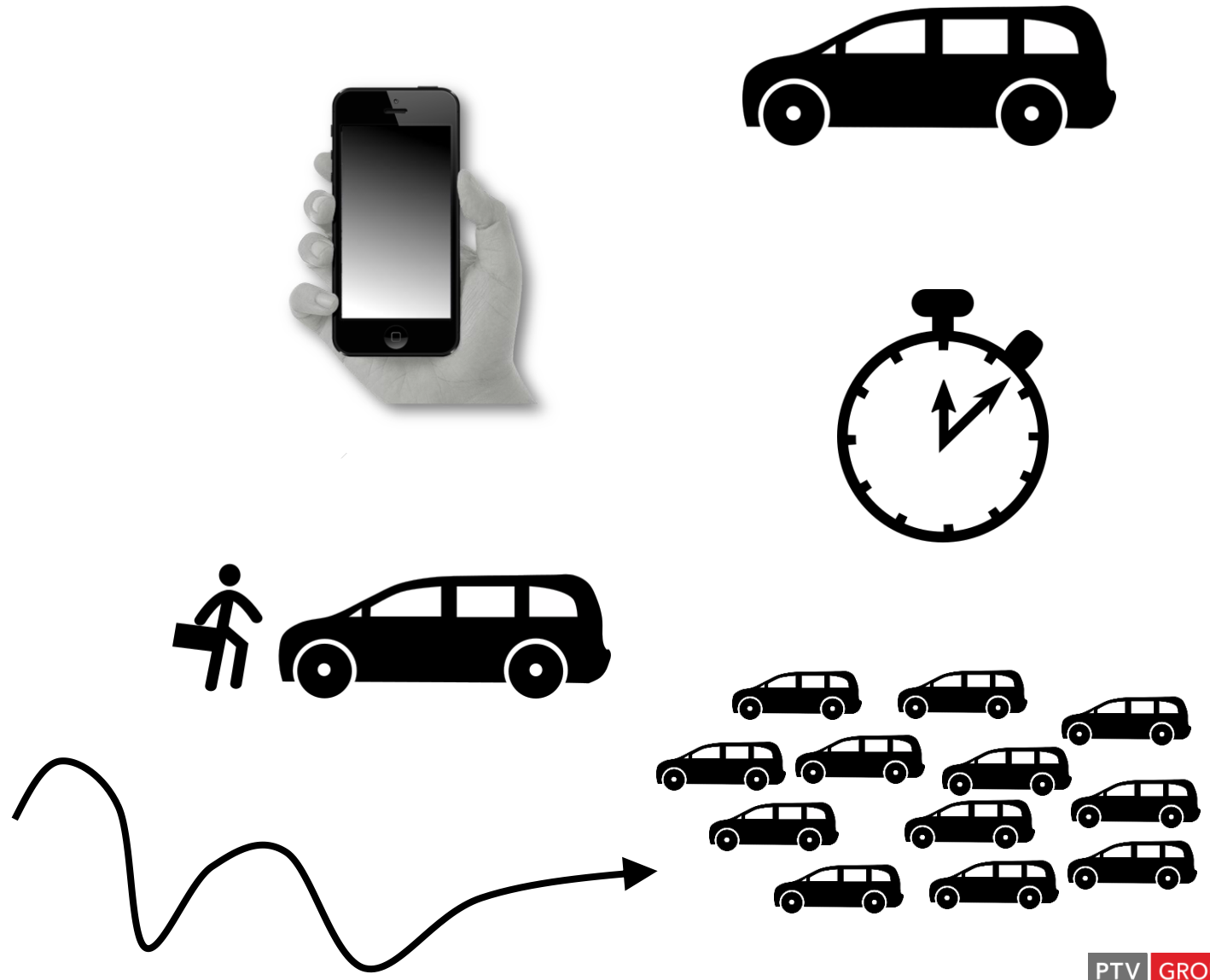
Maximum Wait Time: **15 min**

Pick up/Drop off-time: **60 s**

Fleet size: **300**

Detour

- Minimum accepted wait time: 20 min
- Maximum detour factor: 2



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Simulating Mobility as a Service

The shared mobility algorithm addresses three core conditions:

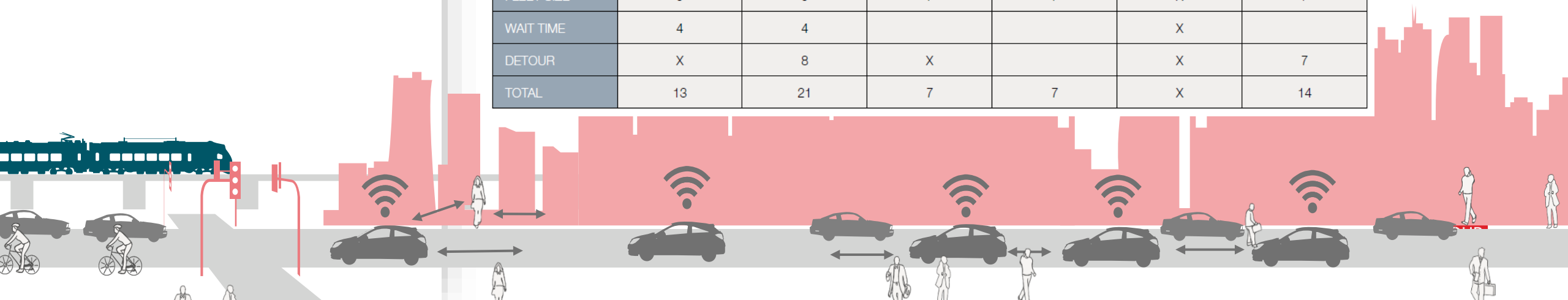
- Minimise unserved trip requests
- Minimise the fleet size required
- Minimise the objective function (cost)

TABLE 5-1 Scenario Specification

	DEMAND		SERVICE SPECIFICATION		SERVICE VEHICLE		
	CAR USER	PT USER	CAR SHARING	RIDE SHARING	SHARED CAR	SHARED TAXI	TAXIBUS
SCENARIO 1A	X		X		X		
SCENARIO 1B	X			X		X	
SCENARIO 2A	X	X	X		X		
SCENARIO 2B	X	X		X		X	
SCENARIO 3A	X	X	X	X	X		X
SCENARIO 3B	X	X		X		X	X

TABLE 5-2 MaaS Simulations by scenario

	SCENARIO 1A	SCENARIO 1B	SCENARIO 2A	SCENARIO 2B	SCENARIO 3A	SCENARIO 3B
CAR	CAR SHARE	RIDE SHARE	CAR SHARE	RIDE SHARE	CAR SHARE (AS 1A)	RIDE SHARE (AS 1B)
PT (BUS & TRAM)			CAR SHARE	RIDE SHARE	RIDE SHARE (AS 3)	RIDE SHARE (AS 3)
FLEET SIZE	9	9	7	7	X	7
WAIT TIME	4	4			X	
DETOUR	X	8	X		X	7
TOTAL	13	21	7	7	X	14



Best and worst case

	BASE	1A	1B	2A	2B	3A	3B
	PRIVATE CARS 2020	FROM PRIVATE CAR TO CAR SHARING	FROM PRIVATE CAR TO SHARED TAXI	FROM PRIVATE CAR, BUS AND TRAM TO CAR SHARING	FROM PRIVATE CAR, BUS AND TRAM TO SHARED TAXI	FROM BUS AND TRAM TO TAXIBUS	
						FROM PRIVATE CAR TO CAR SHARING	FROM PRIVATE CAR TO SHARED TAXI
PERSON TRIPS	401,000	401,000	401,000	611,000	611,000	611,000	611,000
FLEET SIZE	352,000	33,000	26,000	55,000	40,000	49,000	42,000
FLEET SIZE COMPARED TO BASE		[illegible]	7%	16%	11%	14%	12%
VEHICLE KM (MILLION)	4.4	5.5	3.7	8.6	5.7	7.3	5.5
PCT. CHANGES IN VEHICLE KM COMPARED TO BASE	-	+26%	-14%	+97%	+31%	+67%	+27%

Fleet size reduction - 93%

Vehicle kilometre reduction - 14%

Best case

Worst case

Vehicle kilometre increase +97%

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Empty vehicles

	BASE	1A	1B	2A	2B	3A	3B
	PRIVATE CARS 2020	FROM PRIVATE CAR TO CAR SHARING	FROM PRIVATE CAR TO SHARED TAXI	FROM PRIVATE CAR, BUS AND TRAM TO CAR SHARING	FROM PRIVATE CAR, BUS AND TRAM TO SHARED TAXI	FROM BUS AND TRAM TO TAXIBUS	
						FROM PRIVATE CAR TO CAR SHARING	FROM PRIVATE CAR TO SHARED TAXI
VEHICLE KILOMETERS – IN SERVICE (MILLION)	4.4	4.0	3.1	6.1	4.6	5.5	4.7
VEHICLE KILOMETERS – EMPTY VEHICLE (MILLION)	0	1.5	0.6	2.4	1.1	1.7	0.9
VEHICLE KM (MILLION)	4.4	5.5	3.7	8.6	5.7	7.3	5.5
VEHICLE KILOMETERS SHARE – IN SERVICE	100%	73%	83%	72%	81%	76%	84%
VEHICLE KILOMETERS SHARE – EMPTY VEHICLE	0%	27%	17%	28%	19%	24%	16%

28% of vehicle kilometres are empty vehicles

Fleet utilisation

	BASE	1A	1B	2A	2B	3A	3B
	PRIVATE CARS 2020	FROM PRIVATE CAR TO CAR SHARING	FROM PRIVATE CAR TO SHARED TAXI	FROM PRIVATE CAR, BUS AND TRAM TO CAR SHARING	FROM PRIVATE CAR, BUS AND TRAM TO SHARED TAXI	FROM BUS AND TRAM TO TAXIBUS	
						FROM PRIVATE CAR TO CAR SHARING	FROM PRIVATE CAR TO SHARED TAXI
MEAN OCCUPANCY – IN SERVICE	1.14	0.79	1.62	0.80	1.62	1.10	1.62
MEAN OCCUPANCY – IN OPERATION	1.14	1.14	1.86	1.14	1.89	1.40	1.89
MEAN OPERATION DISTANCE [KM]	12	166	144	153	143	148	133
MEAN OPERATION TIME [H]	0.2	3.2	3.0	2.9	3.0	2.9	2.8

Vehicle operation distance increase from 12 kilometres to about 150 kilometres

Vehicle operation time increase from 12 minutes to about 3 hours

Level of service

	BASIS	1A	1B	2A	2B	3A	3B	3	BASIS
	PRIVATE CARS 2020	FROM PRIVATE CAR TO CAR SHARING	FROM PRIVATE CAR TO SHARED TAXI	FROM PRIVATE CAR, BUS AND TRAM TO CAR SHARING	FROM PRIVATE CAR, BUS AND TRAM TO SHARED TAXI	FROM BUS AND TRAM TO TAXIBUS		FROM TRAM AND BUS TO TAXIBUS	PUBLIC PASSEN-GERS IN BUS/TRAM 2020
						FROM PRIVATE CAR TO CAR SHARING	FROM PRIVATE CAR TO SHARED TAXI		
AVERAGE TRIP DISTANCE [KM]	11.7	11.4	12.6	11.4	12.6	11.9	12.7	12.9	13.3
AVARAGE TRIP TIME – TOTAL	12.3	18.3	20.5	18.3	20.7	19.2	20.7	21.0	31.6
AVERAGE WAITTI[illegible]	0.0	4.1	2.9	4.0	2.8	3.6	2.8	2.6	5.7
[illegible]VERAGE TRIP DURATION [MIN]*	12.3	14.1	17.7	14.3	17.9	15.6	17.9	18.3	25.9
AVERAGE DETOUR TIME (RIDE) [MIN]	-	2.0	5.5	2.0	5.6	3.3	5.6	5.7	-

Without ride sharing, Car users' travel time extends by approx. 6 minutes

With ride sharing, Car users' travel time extends by approx. 8 minutes

Public passengers in bus/tram save 10-11 minutes

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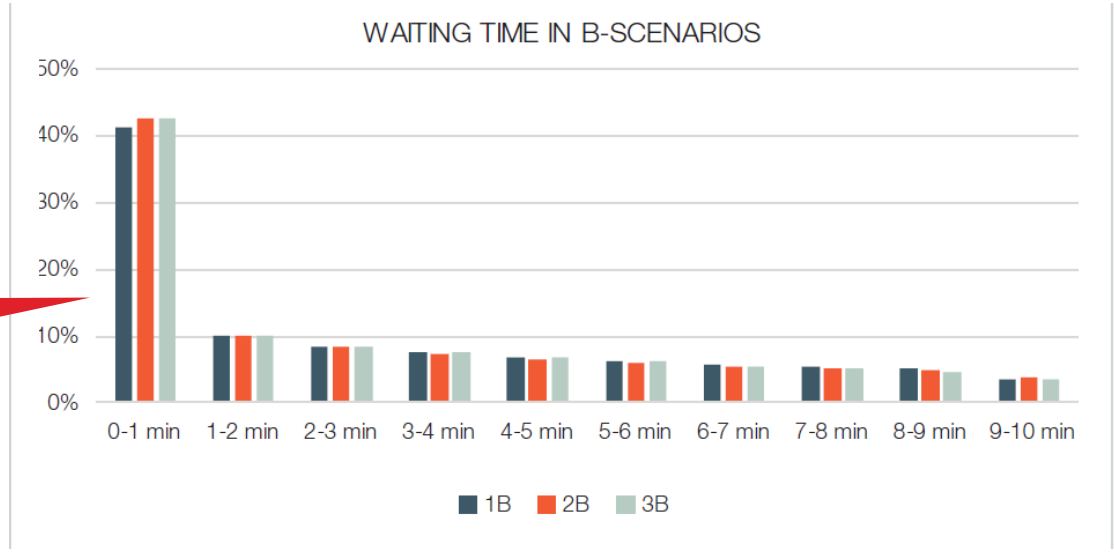
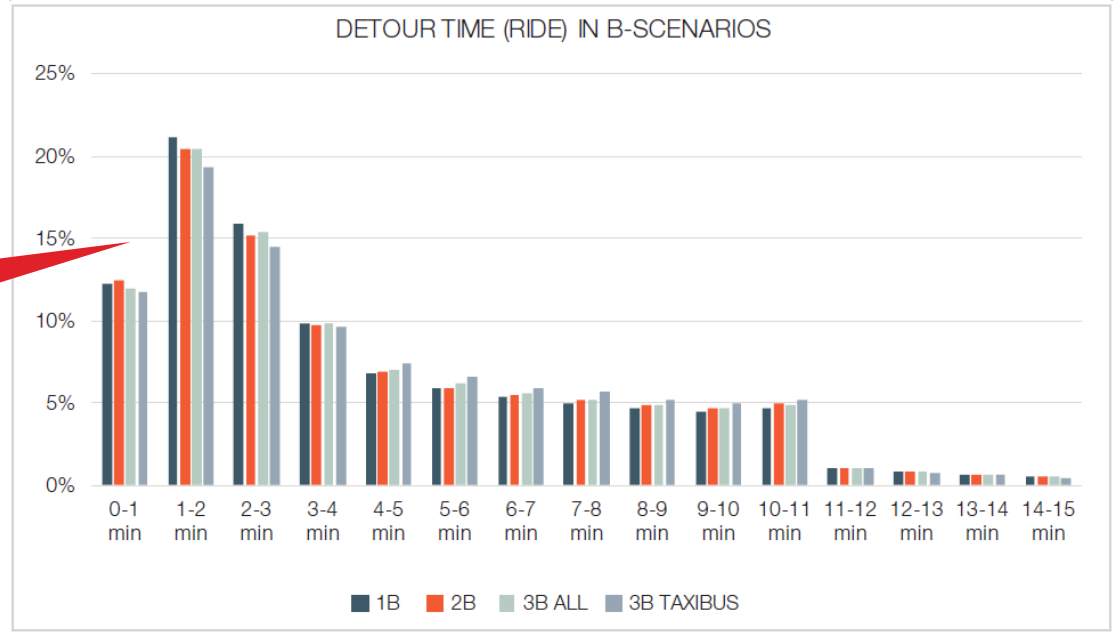
Customer
Level of Service

Most passengers have a short waiting time



Most passengers have a low detour ride time



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Sensitivity analysis

Level of service

- Detour factor and waiting time

	BASIS	1B	1B	1B
DIRECTION	PRIVATE CARS 2020	"FROM PRIVATE CAR TO SHARED TAXI	FROM PRIVATE CAR TO SHARED TAXI	FROM PRIVATE CAR TO CAR SHARING
ASSUMPTIONS				
DETOUR FACTOR	-	1.5	2.0	1.5
WAITING TIME MAXIMUM	-	10 MIN	10 MIN	20 MIN
RESULTS				
FLEET SIZE	352,000	26,000	20,000	26,000
FLEET SIZE PROPORTION OF BASIS		7%	6%	7%
VEHICLE KM (MILLION)	4.4	3.7	3.0	3.8
VEHICLE KM CHANGE COMPARED TO BASIS		-14%	-31%	-13%
MEAN OCCUPANCY – IN OPERATION	1.14	1.62	2.48	1.61
AVERAGE TRIP DISTANCE [KM]	11.7	12.6	14.8	12.6
AVARAGE TRIP TIME – TOTAL	12.3	20.5	25.8	20.6
AVERAGE WAITTIME [MIN]	0.0	2.9	3.5	3.0
AVERAGE TRIP DURATION [MIN]*	12.3	17.7	22.2	17.6
AVERAGE DETOUR TIME (RIDE) [MIN]	-	5.5	10.1	5.5

Larger reduction in vehicle kilometers and fleet size can be achieved, but…

….it costs at the service level.

10 or 20 minutes of accepted waiting time makes no difference

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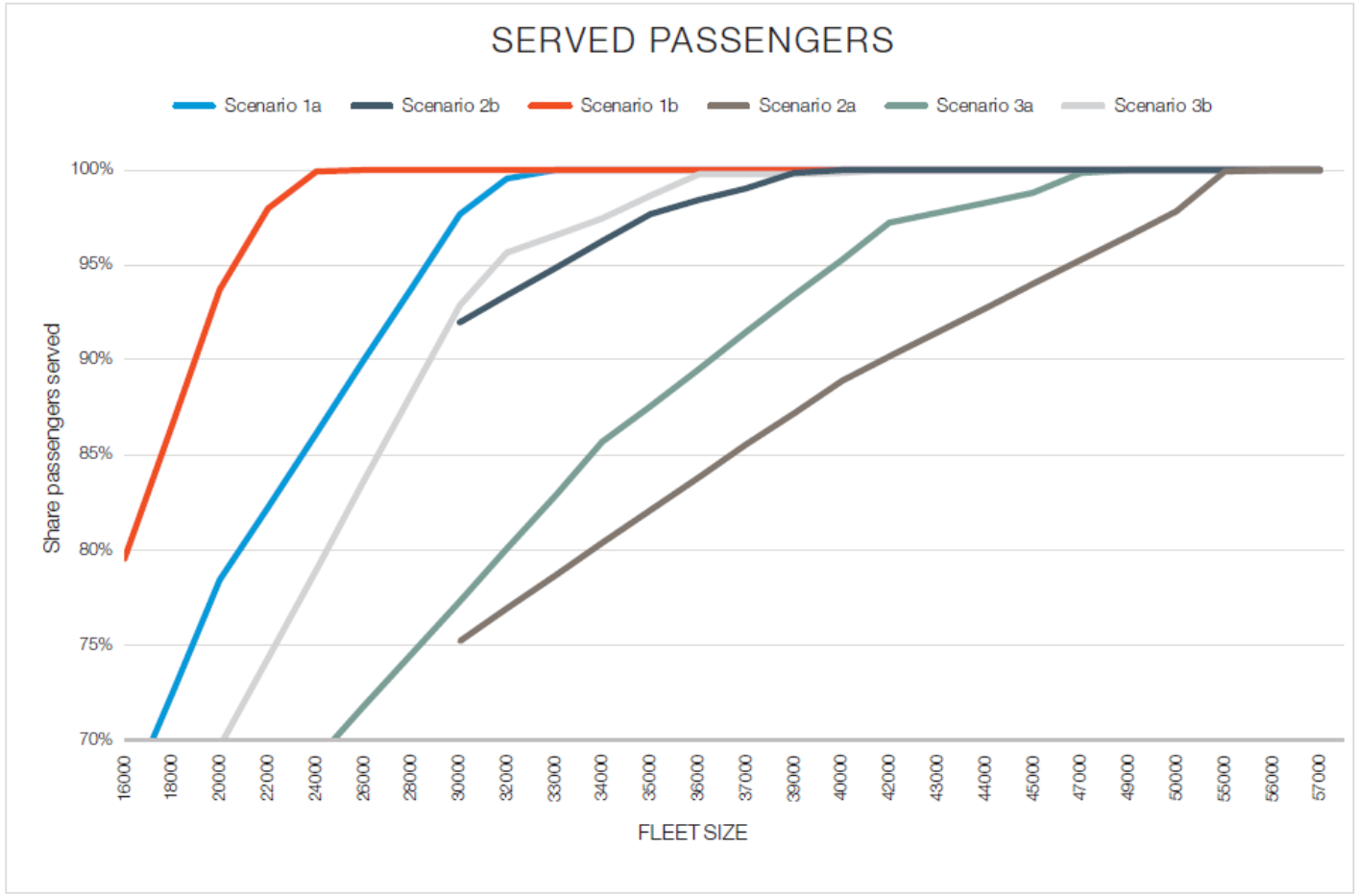
Sensitivity analysis

Level of service

- Served passengers

	1b	1b	1b
	From private car to shared taxi	From private car to shared taxi	From private car to shared taxi
Person trips	401,000	401,000	401,000
Share served passengers	100 %	98 %	94 %
Fleet size	26,000	22,000	20,000
Fleet size proportion of basis	7 %	6 %	6 %
Vehicle km (million)	3.7	3.7	3.5
Vehicle km change compared to basis	-14 %	-16 %	-20 %



Fleet size can be reduced considerably

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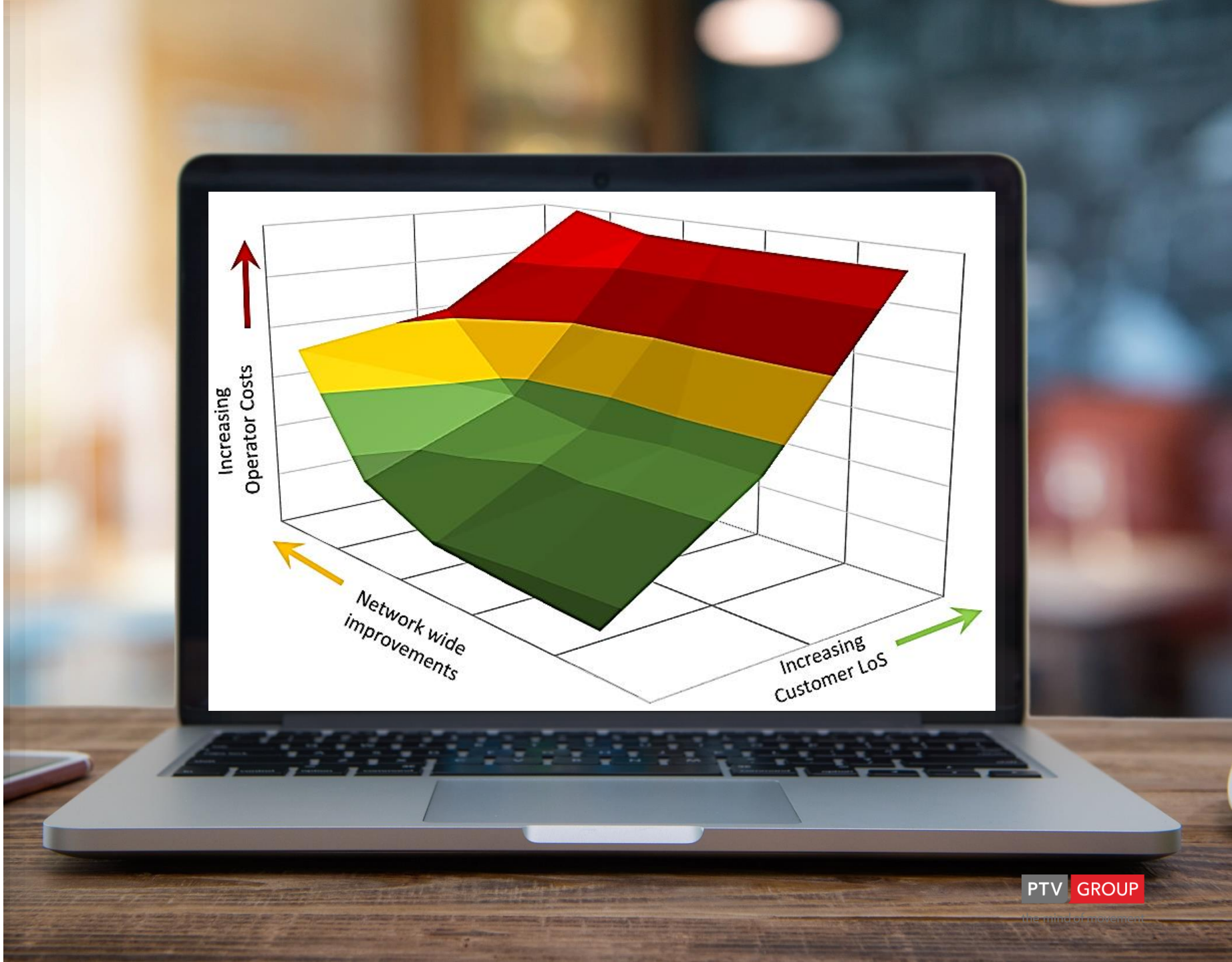
Measuring
Success / Risk

The volatility of assumptions & variable parameters increase with closeness to deployment.

Sensitivity testing reveals a range of results that can be better judged and benchmarked.

… which should lead to more confident and sound decision making.



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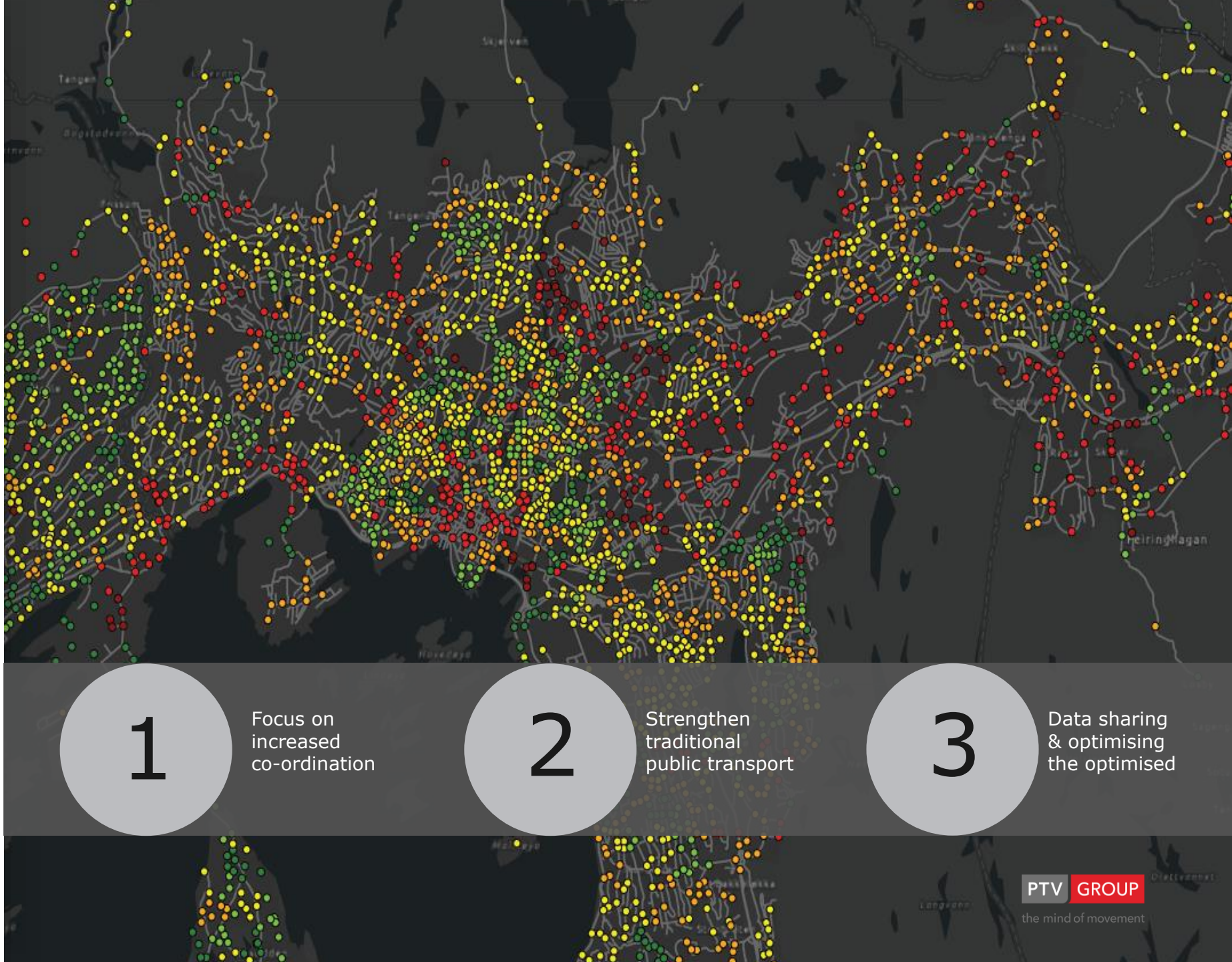
Take-aways & where next

Where will #RUTER turn their attention to next?

- Feeder Services / expanding transport hub catchment areas?
- Prioritise corridors?
- Service transport poverty?



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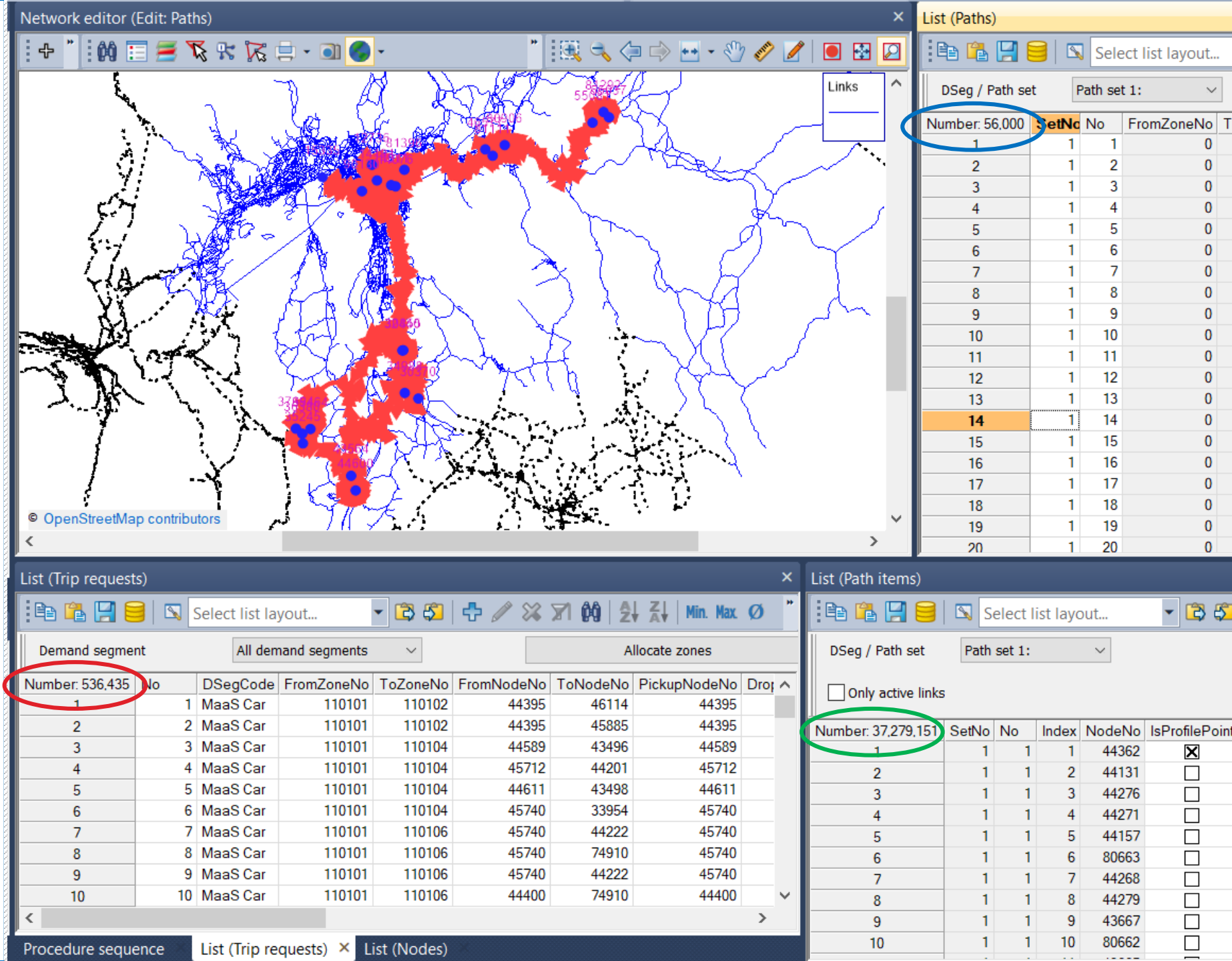
The MaaS Model

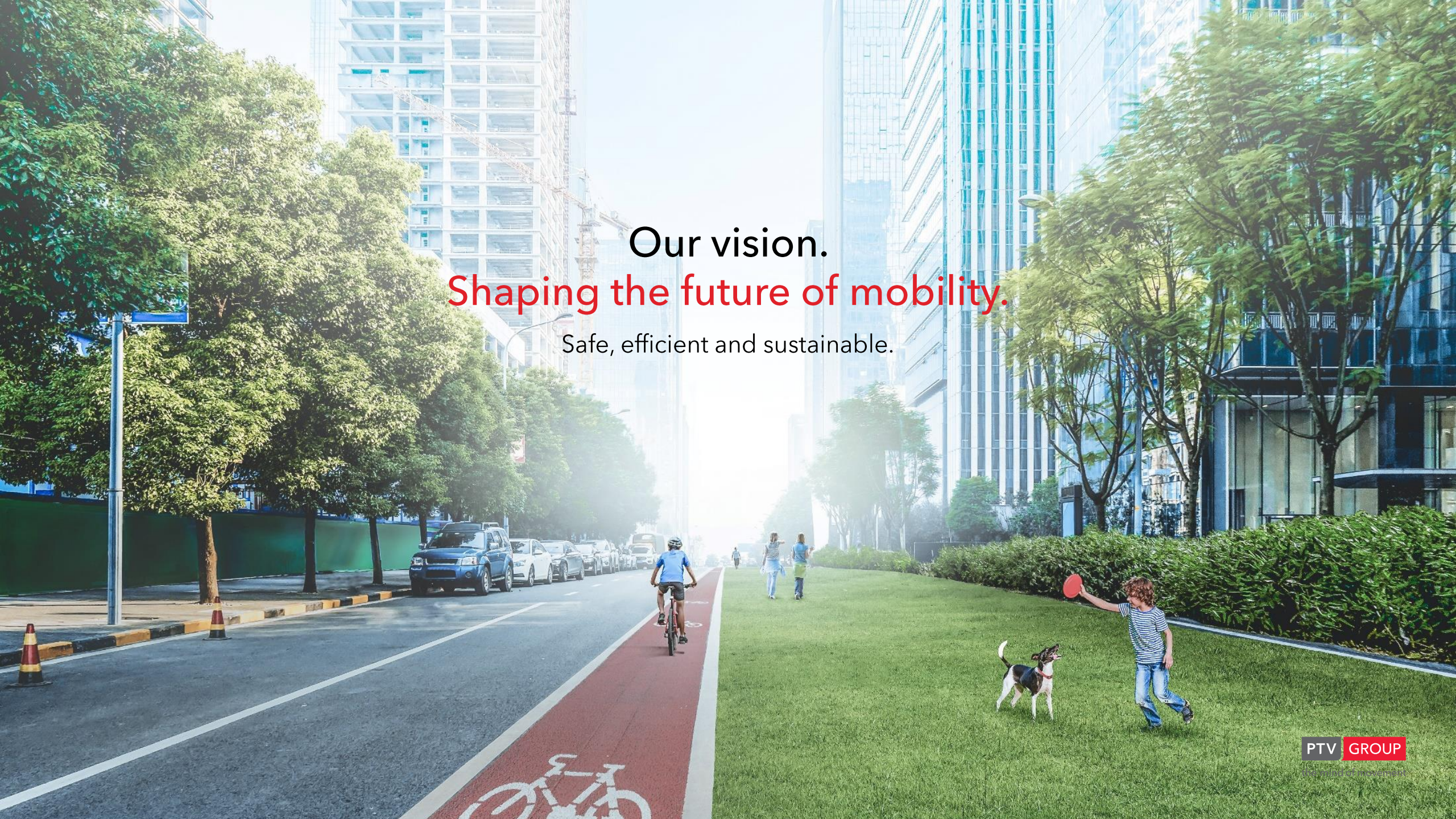
Key Statistics

- Scenario 2a
- 536,436 trip requests
- 56,000 vehicles
- 37,279,151 journey legs

#RUTER has all the answers!

Now… what was the question?




Our vision.
Shaping the future of mobility.
Safe, efficient and sustainable.
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