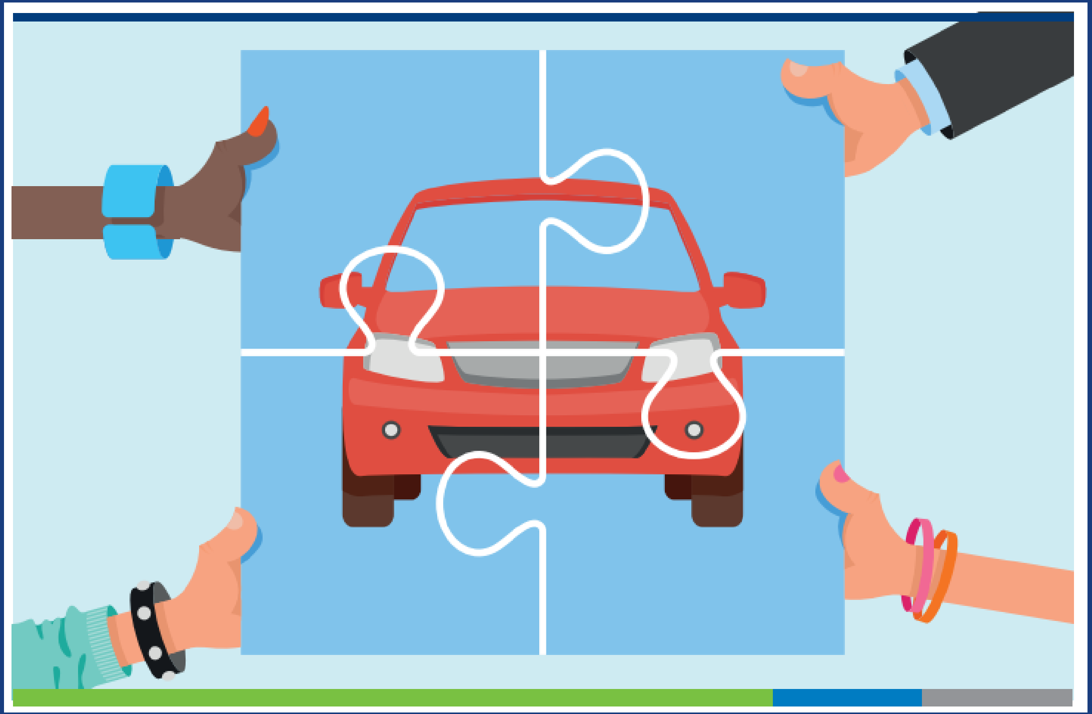
International Transport Forum

Shared Mobility

How it can cut emissions, decrease congestion and free public space – Integrated with mass transit



Francisco Furtado
(with Luis Martinez*, Olga Petrik and Jari Kauppila)

Door-to-door solutions: New business- opportunities for urban mobility

OECD

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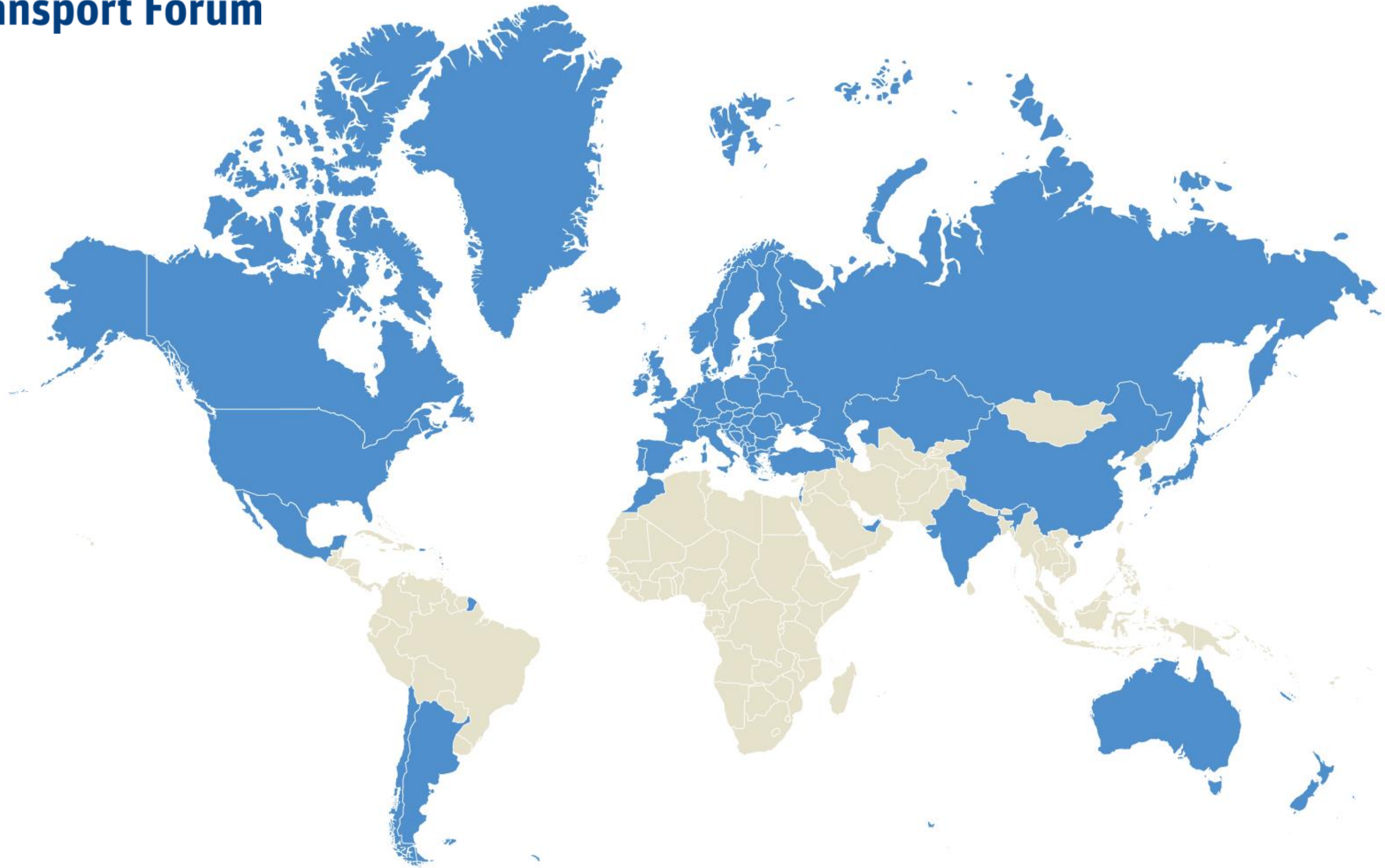

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JAGUAR
RENAULT
GM
TOYOTA
NISSAN
VOLVO
Mercedes-Benz
Google
TESLA
BMW
Audi
Ford

City of Stockholm

10% of 18 year olds

have a driver's licence

Aretun & Nordbakke, 2014

24hrs.


SOMPASAARI
PASILA
KESKUSTA
CENTRUM
70
STOCKMANN


Signal d'alarme


50 min.
per day
1.2

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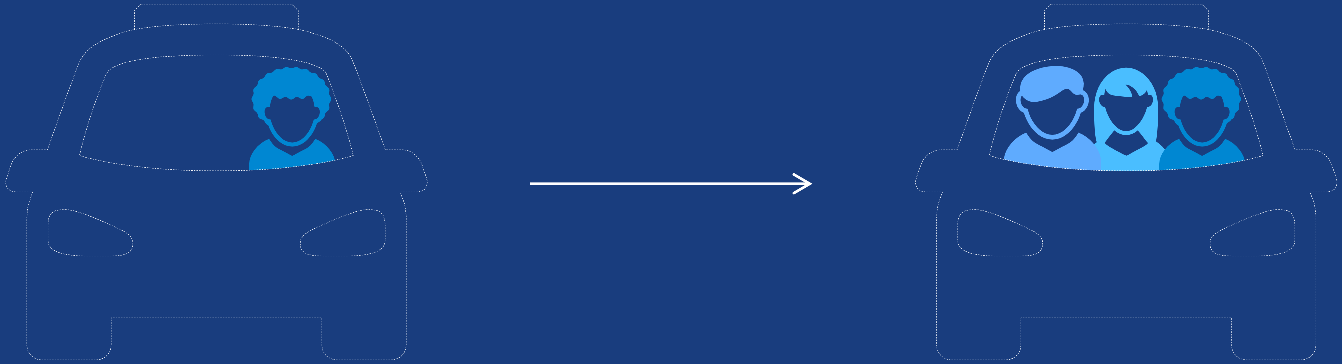
what if?

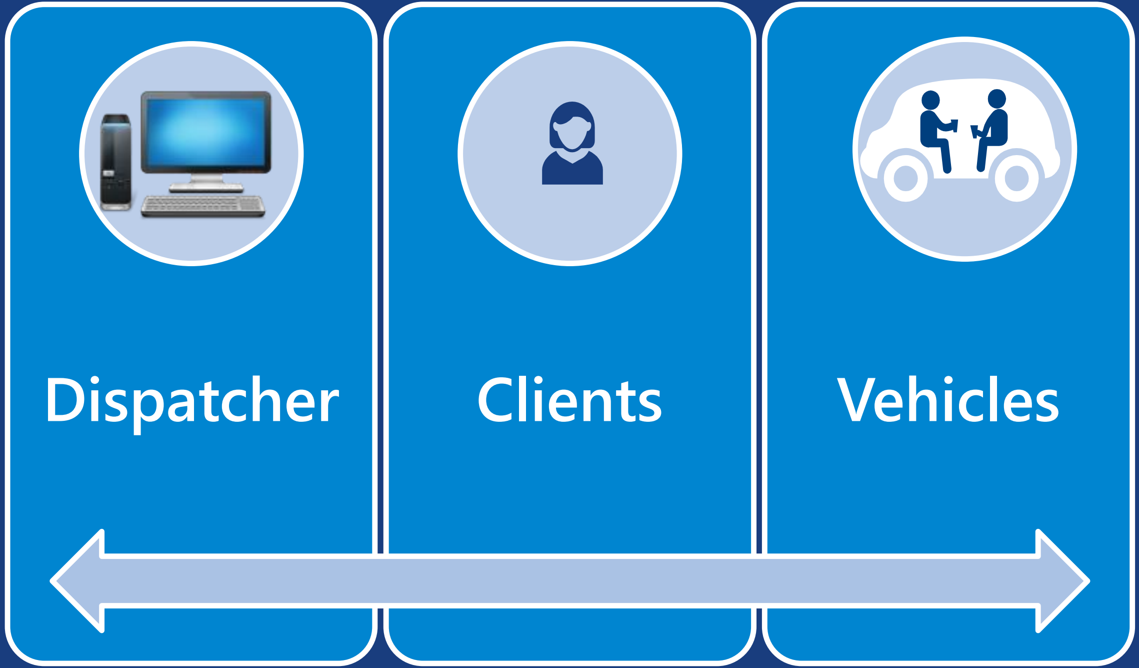



real city


real* trips


real routes

Agent-based Simulation framework



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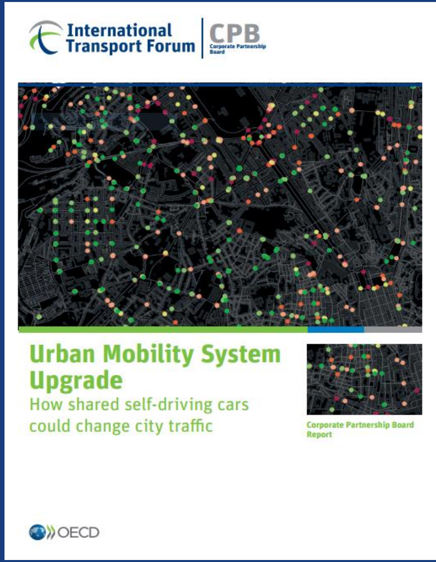
2015 Report

Urban Mobility System Upgrade: How Shared Self-Driving Cars Could Change City Traffic (Lisbon city)



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Impacts

	Scenario	Fleet size	Parking spots	Car-kms (million)	Peak hour flow
	Baseline (% of baseline fleet)	203,000	203,000*	3.8	60,000
Ride-sharing	No high capacity public transport (commuter rail, subway, BRT, LRT)	25,917 **12.8%**	11,563 **7.2%**	3.75 **98.7%**	25,867 **43.1%**
Ride-sharing	High capacity transport (commuter rail, subway, BRT, LRT)	21,120 **10.4%**	8,901 **5.7%**	3.55 **93.4%**	21,105 **35.2%**
Car-sharing	No high capacity public transport (commuter rail, subway, BRT, LRT)	46,249 **22.8%**	25,621 **16.0%**	5.45 **143.4%**	46,011 **76.7%**
Car-sharing	High capacity transport (commuter rail, subway, BRT, LRT)	34,082 **16.8%**	17,110 **10.7%**	4.83 **127.1%**	33,975 **56.6%**

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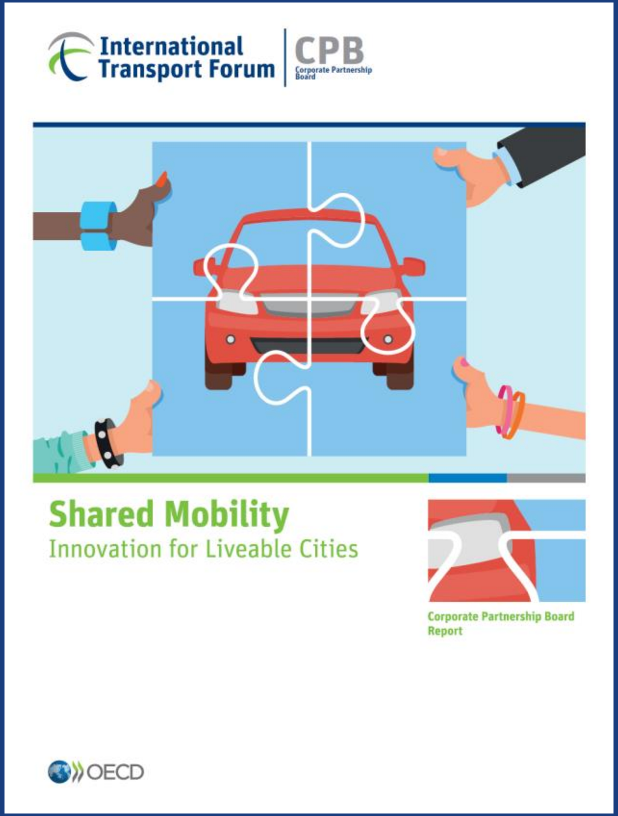
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CPB
Corporate Partnership Board
Shared Mobility
Innovation for Liveable Cities
Corporate Partnership Board Report
OECD

2016 Report

Shared Mobility: Innovation for Liveable Cities

(Lisbon city)

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Shared Taxis

simultaneous ride-sharing

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Taxi-Bus

optimised on-demand bus

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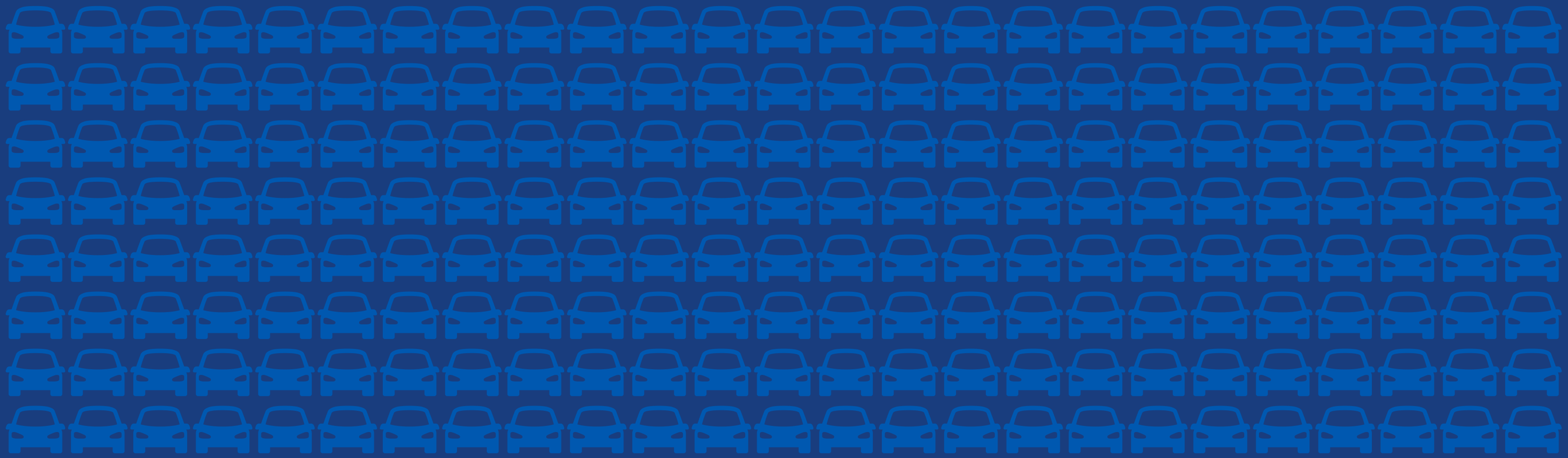
Lisbon

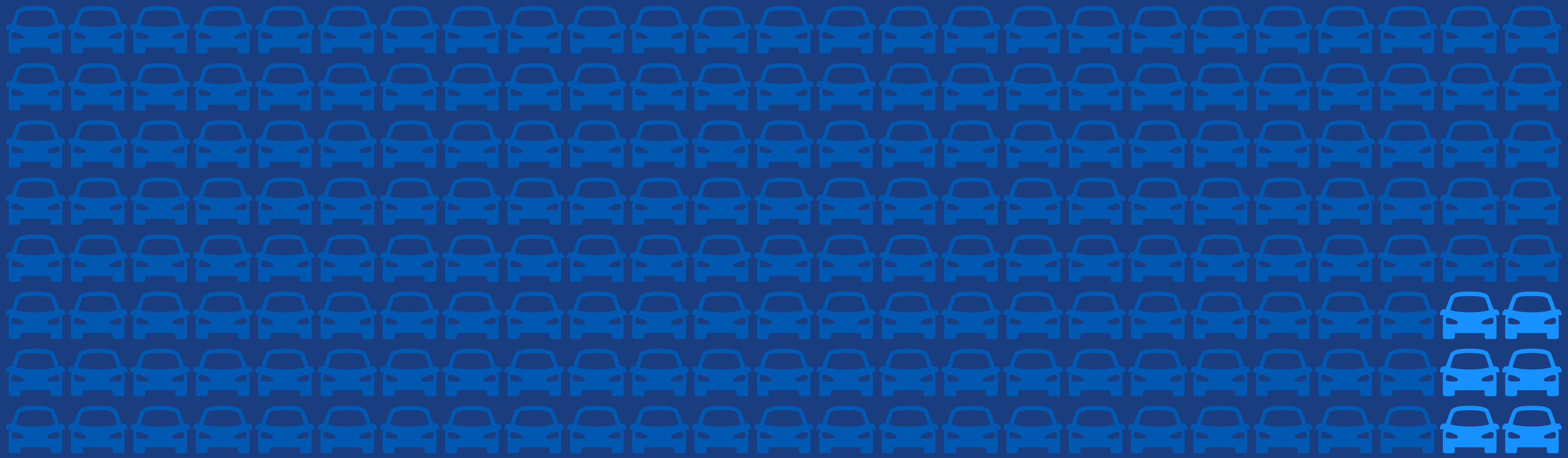


Scenario: 24 hours

Shared "taxis"
simultaneous ride-sharing
+
TaxiBus
optimised on-demand bus
+
high-capacity public transport

number of cars required to provide the same trips as before:

Lisbon



Scenario: 24 hours

Shared "taxis"
simultaneous ride-sharing

\+

TaxiBus
optimised on-demand bus

\+

high-capacity public transport

number of cars required to provide the same trips as before:

3%

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CO_2 emissions

-34%

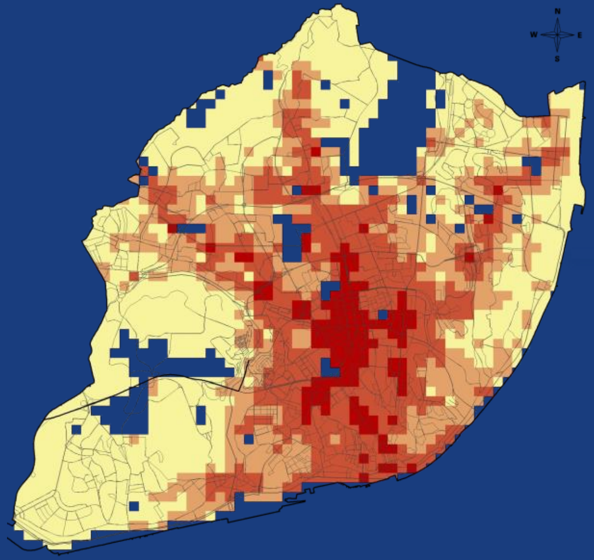
(Lisbon city)

OECD

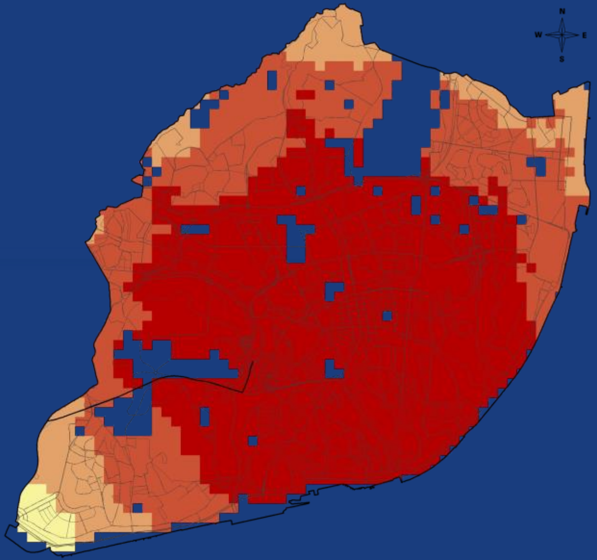
24hrs.

Impacts on Accessibility - Jobs

Current public transport + walking



Taxibus + Metro + walking



Inequity Indicator	Current PT + Walk	Taxibus + Metro + Walk
P90/P10	17.3	1.8
Gini coeff.	0.27	0.11

Legend

Classes of access by percentage of total jobs

- 0% to 25%
- 25% to 50%
- 50% to 75%
- 75% to 100%

For each cell as origin, % of total jobs in the city accessed in 30 minutes

24hrs.


eliminate
all street parking


-80%
off-street parking


PARKING


PARKING

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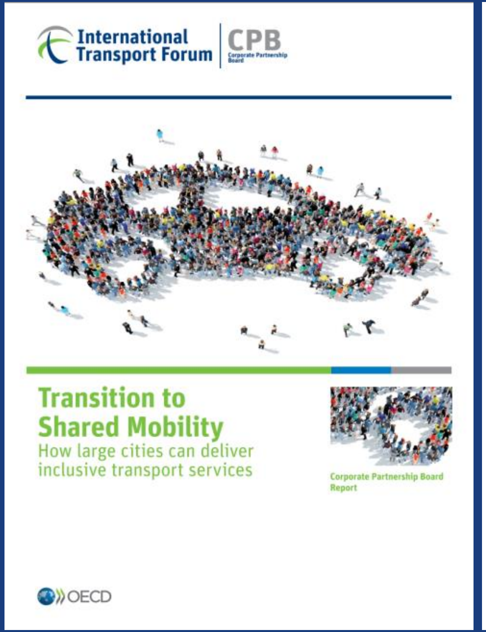

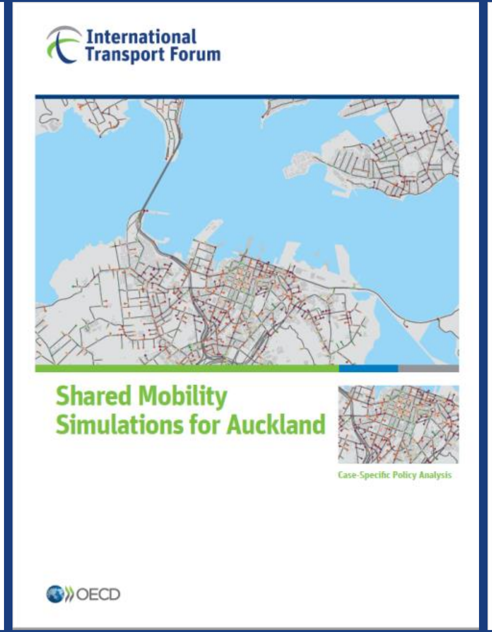

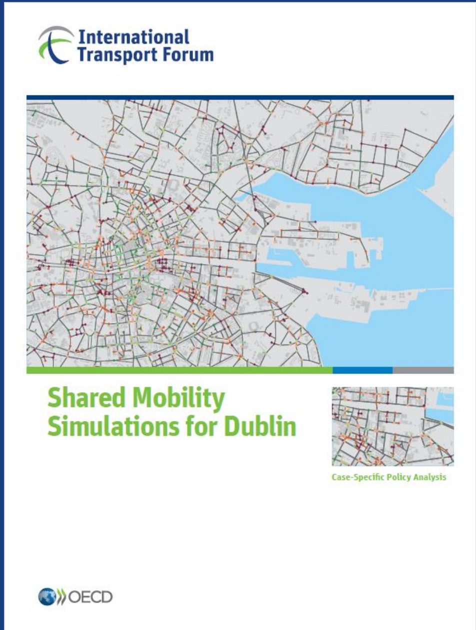

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Feeder services to mass transit

Booking rules of Taxi-Bus

PT station walking distance from origin or destination

One transfer

Travel time up to +15 min than car

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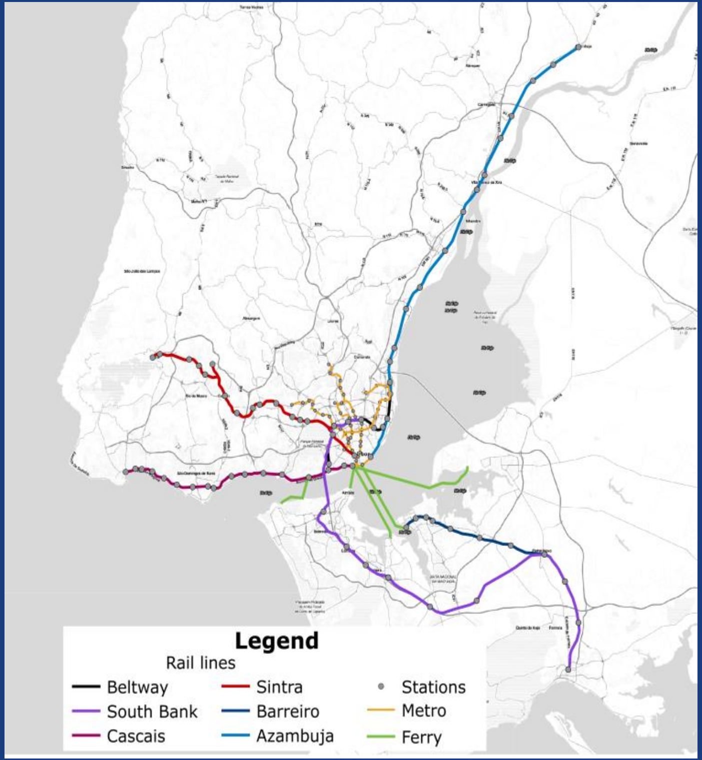
Increase in metro and rail ridership (Lisbon)

47%

(passengers per day)



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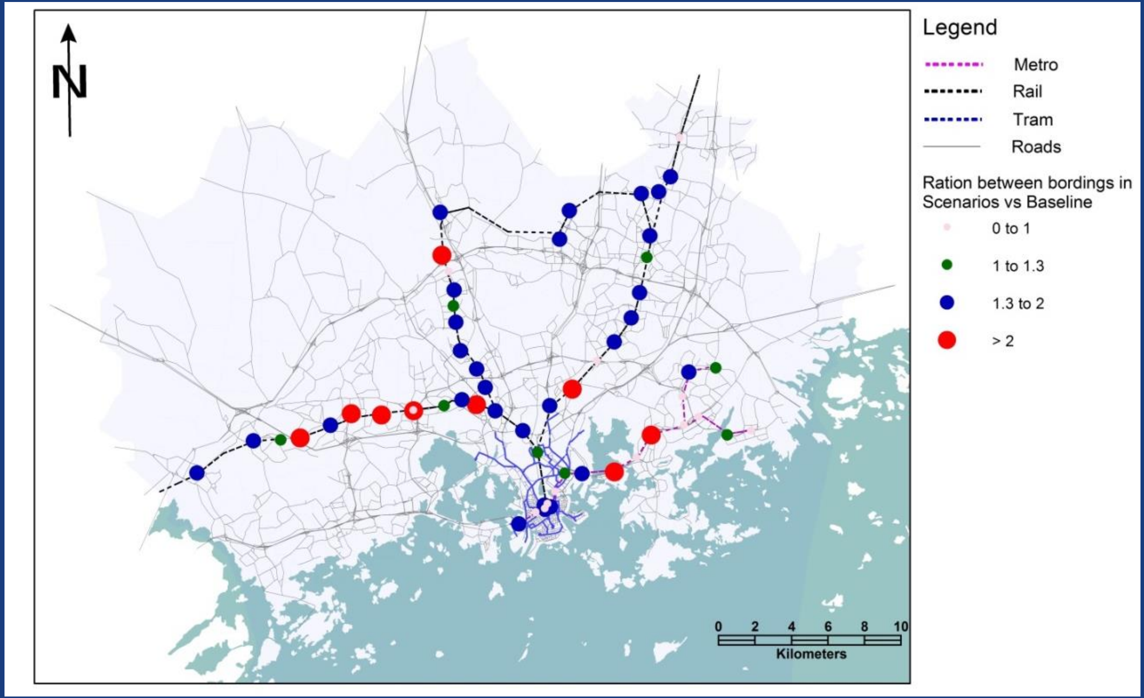
Increase in metro and rail ridership (Helsinki)

30%

(passengers per day)



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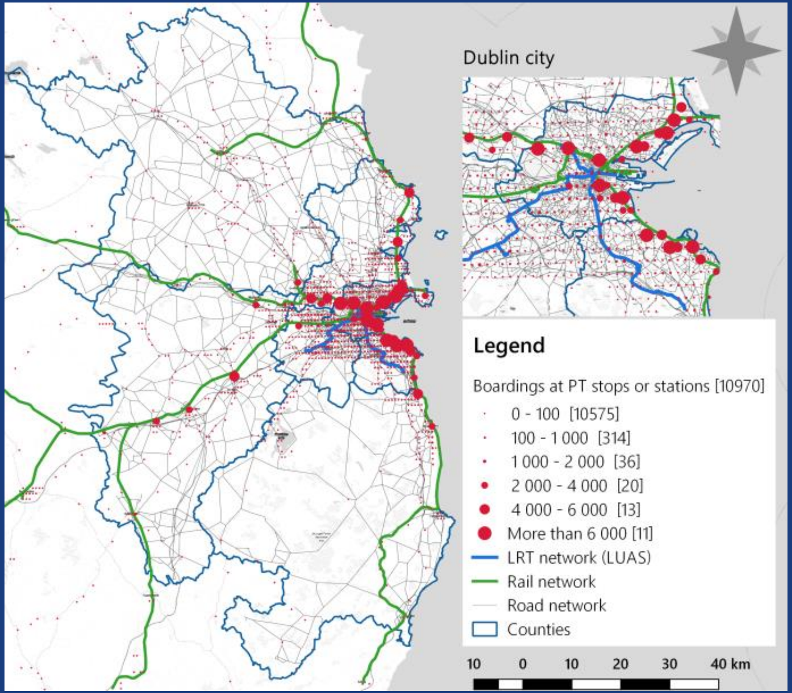
Increase in lrt and rail ridership (Dublin)

54%

(passengers per day)



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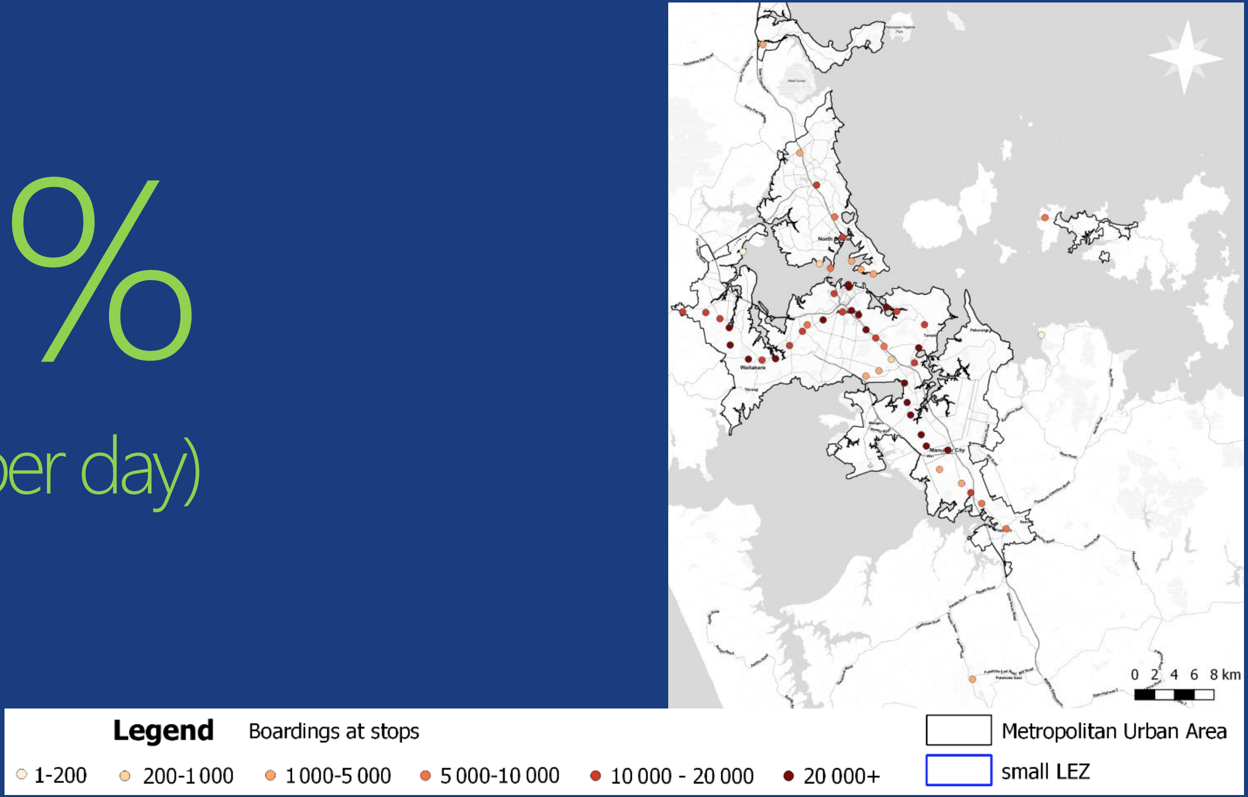
Increase in brt and rail ridership (Auckland)

681%

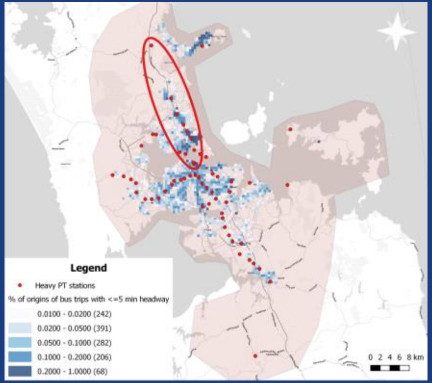
(passengers per day)



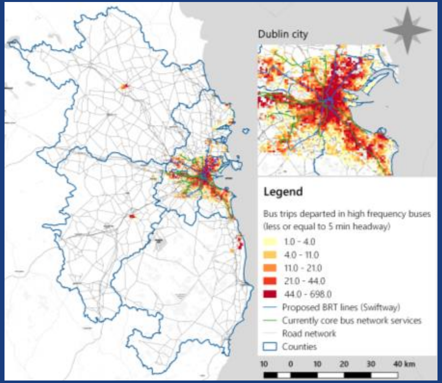
Testing targeted policies

Interaction with current bus operation

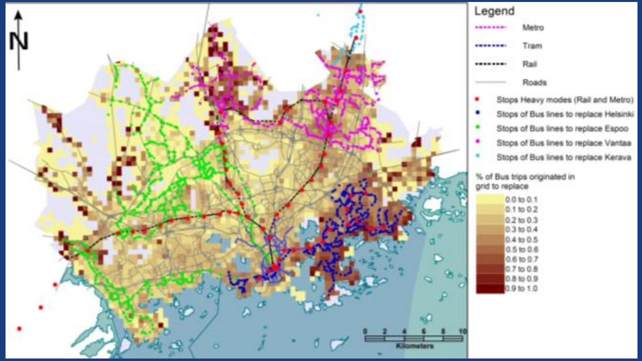
(Auckland)



(Dublin)



(Helsinki)



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Testing targeted policies

Interaction with current bus operation

(Auckland)

- BRT corridors preservation demonstrated better performance
- Low frequency services showed worse performance than SM
- Services should be adapted and be more flexible
- Cost provision reduction and greater connectivity and access

(Dublin)

- Core bus network and new BRT corridors seem to be well fitted to current demand (recent design) and perform better than flexible low capacity SM services
- SM outperforms other bus services specially regional services in the wider GDA
- Cost provision reduction and greater connectivity and access

(Helsinki)

- Replacing all buses worse from emissions perspective than keeping them
- Potential gains if lower frequency buses in remote areas are replaced
- Keep the other services or adapt
- Cost provision reduction and greater connectivity and access

Impacts (Full adoption scenario)

-54% (Auckland)

-31% (Dublin)

-34% (Helsinki)

-62% (Lisboa)

CO_2 emissions

24hrs.

Impacts (Full adoption scenario)

-93%	-97%	-96%	-96%
(Auckland)	(Dublin)	(Helsinki)	(Lisboa)

Motorised Fleet size

24hrs.

Impacts (Full adoption scenario)

+254% (Auckland)

+183% (Dublin)

+111% (Helsinki)

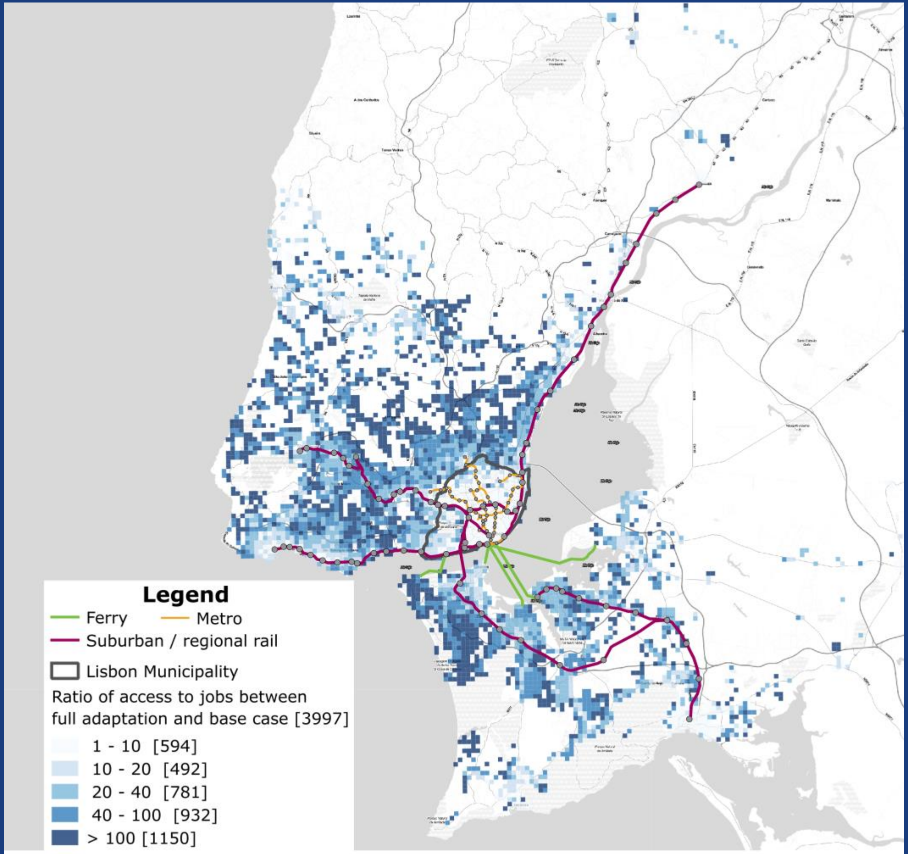
+589% (Lisboa)

PT + SM accessibility

24hrs.

Impacts on Accessibility - Jobs

Improvement in access especially for more remote regions less well-serviced by public transport.



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Carbon intensity model

Carbon intensity elasticity

Explanatory variable	Elasticity
Share of remaining car users (%)	0.39
Share of users of conventional bus (%)	0.04
Share of users of high performance bus (%)	-0.05
Highways network density (km/sqkm)	-0.07
Service provision (seat-km heavy PT per 1 million inhabitants)	-0.15
Population density (inhab. / sqkm)	-0.16
Non-motorised transport (%)	-0.14
Average trip distance (km)	0.08
Case study area size (skm)	-0.09
Car ownership	0.15

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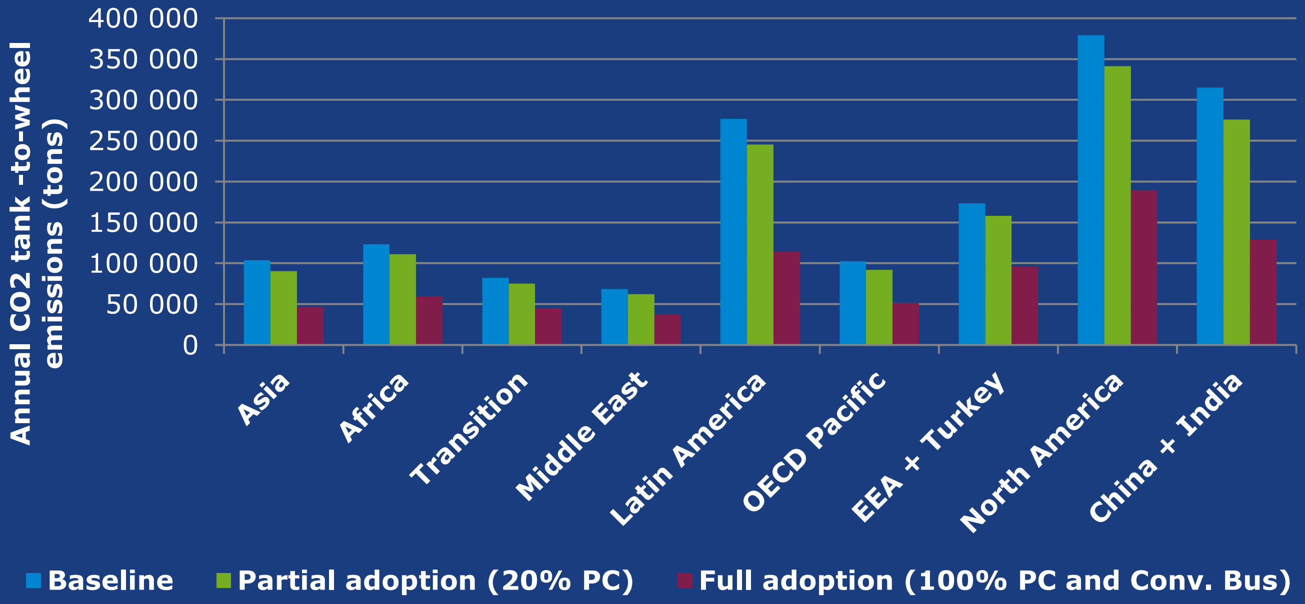
Carbon intensity model

Model testing – Results



Conclusions

Rail and mass transit are key for sustainable cities

Feed to mass transit – Quality of service PT

Ensure line and station capacity – Pick/Drop areas

Introduce at a sufficient scale

Target potential early adopters particularly car users

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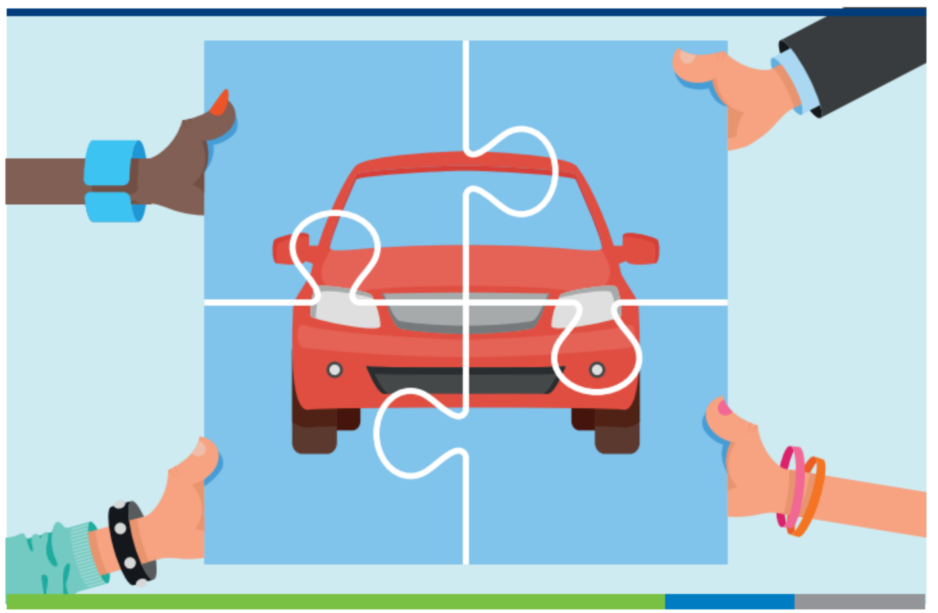

Thank you!

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Reports available at
https://www.itf-oecd.org/itf-work-shared-mobility

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Testing targeted policies

Interaction with current bus operation

(Auckland)

- BRT corridors preservation demonstrated better performance
- Low frequency services showed worse performance than SM
- Services should be adapted and flexibilising
- Cost provision reduction and greater connectivity and access

(Dublin)

- Core bus network and new BRT corridors seem to be well fitted to current demand (recent design) and perform better than flexible low capacity SM services
- SM outperforms other bus services specially regional services in the wider GDA
- Cost provision reduction and greater connectivity and access

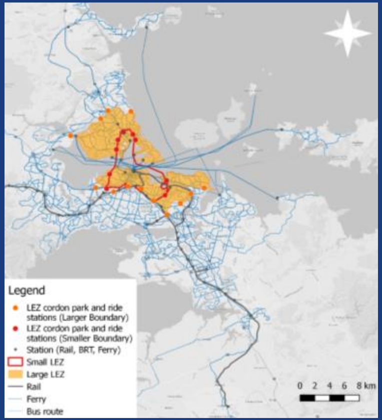
(Helsinki)

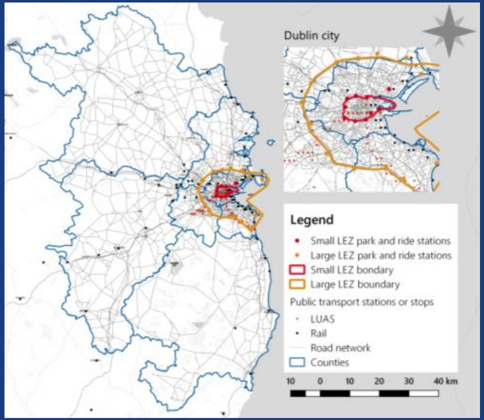
- Tested replacement of bus feeder services to Heavy PT or low frequency services
- Both approached of update these services provided now by SM give very positive outcomes, specially replacing feeder services
- Keep the other services or adapt
- Cost provision reduction and greater connectivity and access

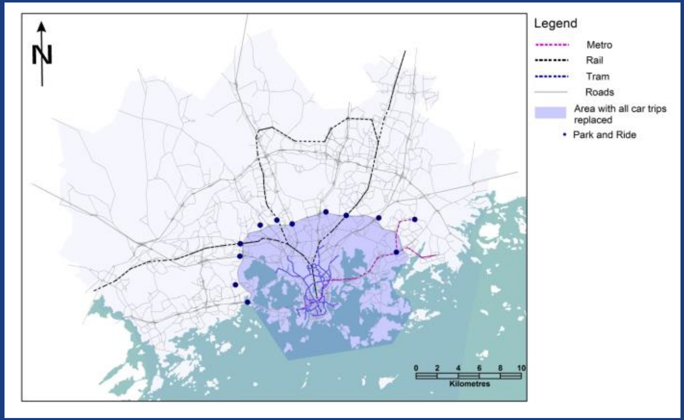
Testing targeted policies

Car use restrictions (Low Emission Zones)

(Auckland) **(Dublin)** **(Helsinki)**







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Shared modes specification

Mode	Booking	Access time	Max. waiting time (depending on distance)	Max. total time loss (depending on distance)	Vehicle type
Shared Taxi	Real time	Door-to-door	5 minutes (≤ 3 km), up to 10 minutes (≥ 12 km)	Detour time + waiting time, from 7 minutes (≤3 km), up to 15 minutes (≥12 km)	Minivan of 8 seats rearranged for 6 seats, with easy entry/exit
Taxi-Bus	30 minutes in advance	Boarding and alighting up to 400 m away from door, at points designated in real time	Tolerance of 10 minutes from preferred boarding time	Minimum linear speed from origin to destination (15 km/h)	Minibuses with 8 and 16 seats. No standing places

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Testing targeted policies

Car use restrictions (Low Emission Zones)

(Auckland)

- Spatially narrow LEZ with small interaction with Heavy PT may led to greater congestion near the LEZ parking lots
- Peak period focus can almost achieve similar CO2 performance as the whole day restrictions
- Feeding SM services outside Limited cost efficiency

(Dublin)

- Both tested LEZ systems where successful, yet again the narrow configuration has local congestion effects
- Traffic inside the LEZ is strongly reduced
- Services outside key in reducing the congestion at transfer points between car and SM / PT

(Helsinki)

- Significant reduction in congestion in tested scenario, showing comparable results with higher degrees of SM adoption in the whole study area
- Good integration with PT system allows reducing the local congestion effects
- Very efficient SM system (mainly Taxi-Buses)

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Testing targeted policies

Electrification

(Auckland)

- Reduce significantly costs
  1. The increase in fleet due to requirements of range and charging time are largely compensated by reduction on energy costs
  2. These savings became negligible if small market size and may even increase costs

(Dublin)

- Small reduction in costs
  1. The nature of a regional shared mobility services with greater distances leads to cars range be very frequently activated as a constraint, requirement significantly larger fleets for operation
  2. This problem intensifies for small adoption rates

(Helsinki)

- Reduce significantly costs
  1. Large potential due to small required fleet increases with rare range constraint activation
  2. These savings became less significant in smaller fleets to recoup the additional investment costs

Testing targeted policies

Self-driving technology

- The model estimates for self-driving operation result in reductions of approximately 50% on the prices for Shared Taxi and Taxi-Buses per kilometre. This reduction would lead to Shared Taxis being cheaper than current public transport in some cases

- The estimated values are aligned with recent studies that assessed the cost of shared self-driving vehicles

- Stephens, T. S., J. Gonder, Y. Chen, Z. Lin, C. Liu and D. Gohlke (2016), Estimated Bounds and Important Factors for Fuel Use and Consumer Costs of Connected and Automated Vehicles, National Renewable Energy Laboratory, NREL/TP-5400-67216

Testing targeted policies

Market structure of SM provision

- 15 %

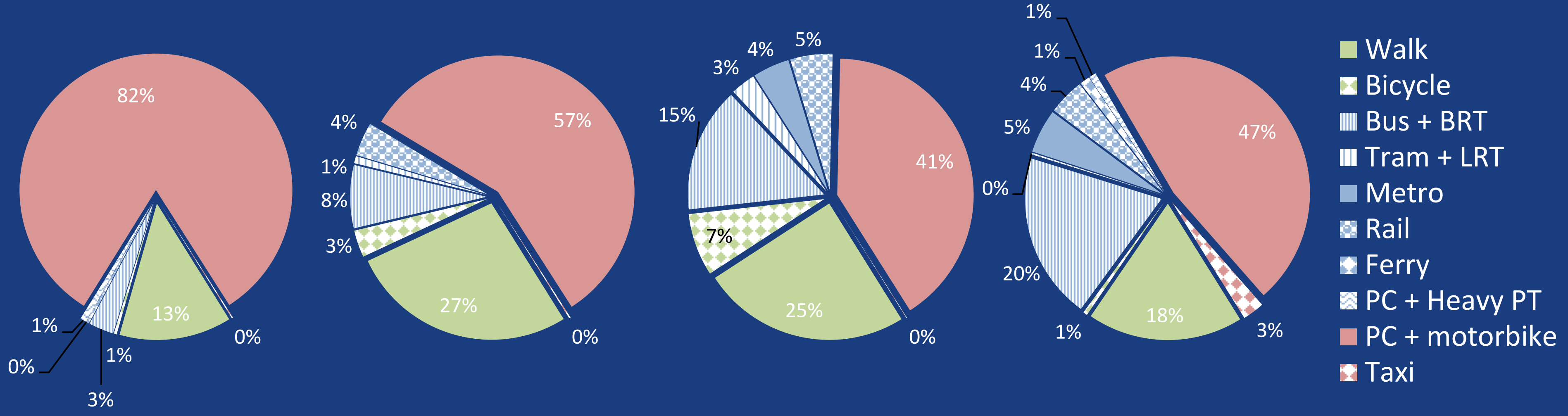
CO_2 savings with several dispatchers and non integrated operators

Understanding user preferences

Focus group for each city

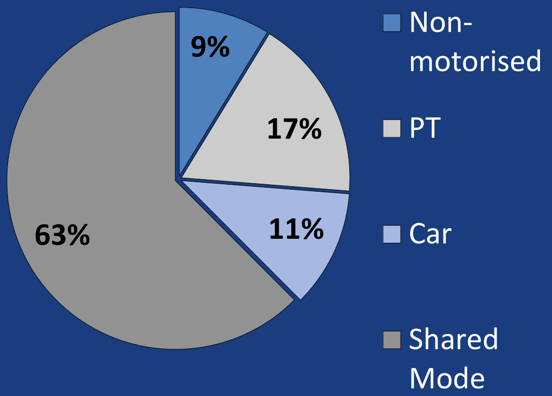
Stated preference survey

Mode shares

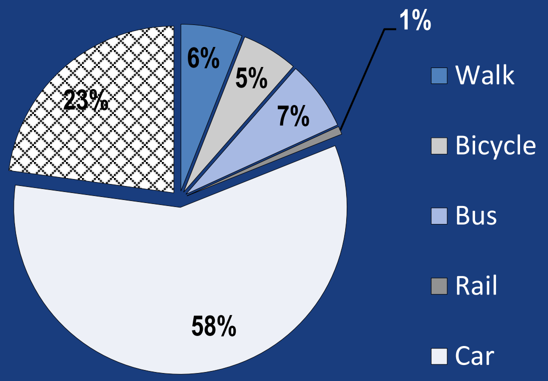


(Auckland) (Dublin) (Helsinki) (Lisbon)

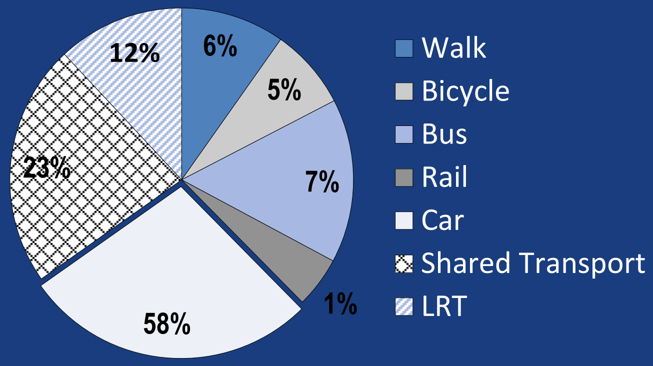
Shared mode in stated preference survey



Helsinki

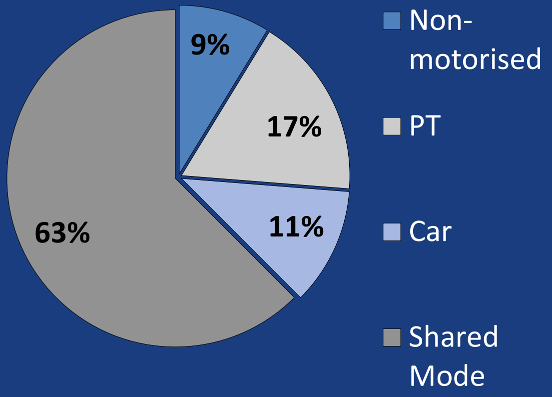


Auckland

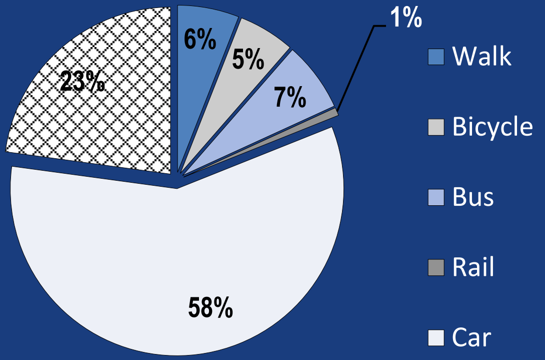


Dublin

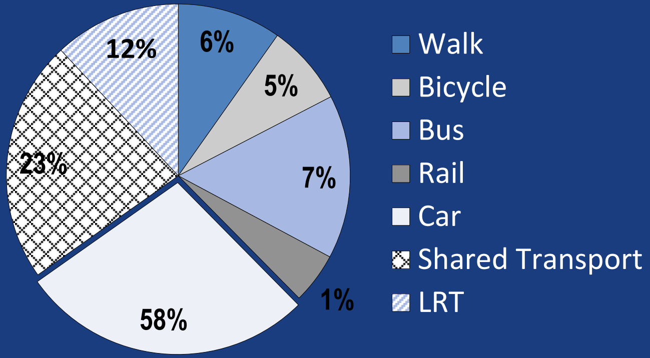
Car mode in stated preference survey



Helsinki (41%)



Auckland (87%)

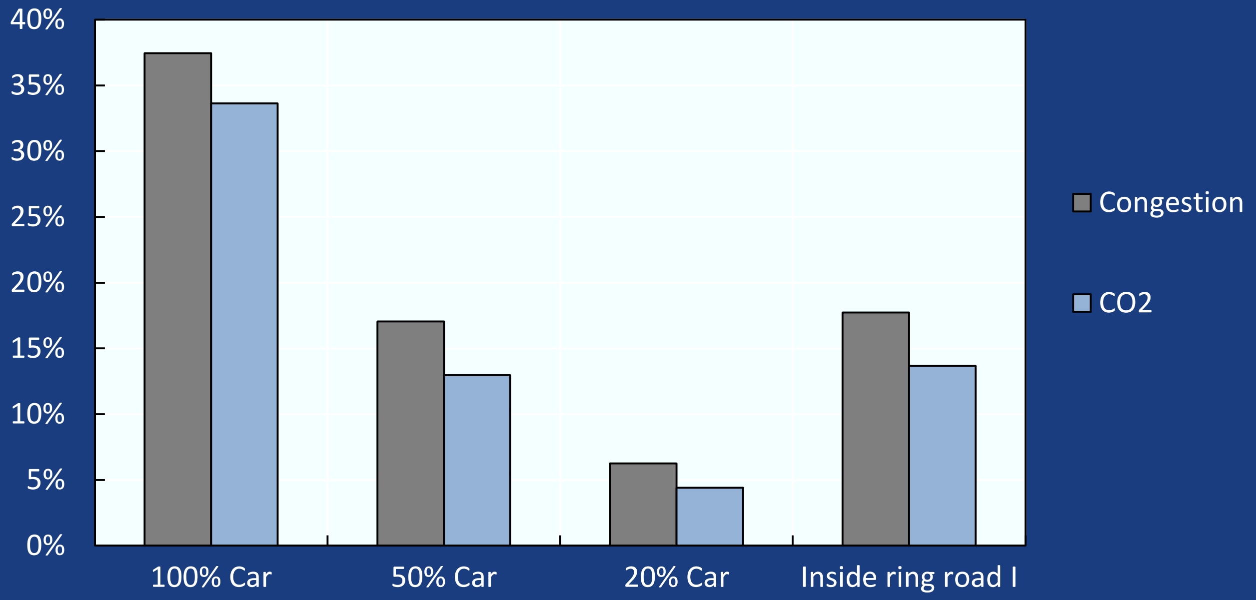


Dublin (65%)

Other observations

- Importance of having services across the entire area – and feeder service to mass transit
- Willing to share vehicles with more rather than fewer travellers
- Early adopters: residents living far from the city centre, regular PT users young and people above 55 years
- Price important factor for all respondents
  - Waiting, access and travel time, number of transfers and comfort
- One third of respondents that own a car stated they would sell one of more cars if shared mobility services were available

Impacts on Helsinki MA



Factors affecting outcome

Current modal share

Public transport quality

Density of the area

Trip patterns

Transition

Land use policies

Economic instruments

Infrastructure/service measures

Regulatory policies

Modelling Framework

Characterisation of the study area

Transport infrastructure and services
- Road network
- PT GTFS model

Spatial definition and resolution
- Study area boundaries
- Grid system definition

Mobility seed and transport mode preferences
- Travel survey
- Mode choice model

Transport performance by OD pair and mode
- Travel times by mode

Probability of trip production / attraction
Land use data (Grid)
- Population
- Employment
- Ameneties (POIs)
- Building footprint

Focus group and stated preference analysis
- Willingness to shift to SM

SM mode selection
Shared-Taxi, Taxi-Bus
Feeder service to rail, ferry or BRT

Synthetic mobility dataset
Household characterisation
(Residential location, family profile)

Individual data
(age, education level)

Mobility data
(trip sequence, each trip (origin, destination, schedule, purpose, transport mode))

Transport demand & supply scenarios
Demand (Scenario specification)
Private car trips, (% modal shift to SM),
Bus trips (% modal shift to SM)

Supply (Scenario specification)
Private car (allowed: Yes/No)
Bus (preserved: Yes/No)
BRT (preserved: Yes/No)
Walking & biking (preserved: Yes)
Rail and Ferry (preserved: Yes)
Low Emission Zone (active: Yes/No)

Simulation (Outputs)
Service quality
- Waiting time
- Detour time

Operational Performance
- Average vehicle occupancy
- Fleet requirements
- Costs

Society (Sustainability)
- Emissions
- Congestion
- Accessibility indicators
- Parking requirements