

# Mobility & Transport in Singapore

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Sharjah Learning Event  
October 2018

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# Mobility & Transport in Singapore

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Michael VAN EGGEMOND

Future Cities Laboratory | Singapore ETH Centre

Sharjah Learning Event | **Mobility & Transport in Singapore**

# Part 1: **Background**

# Background Singapore

Singapore's great strength in urban policy making:  
Unusual willingness to face up the need for difficult trade-offs.

## Goals

Moving people and goods space efficiently

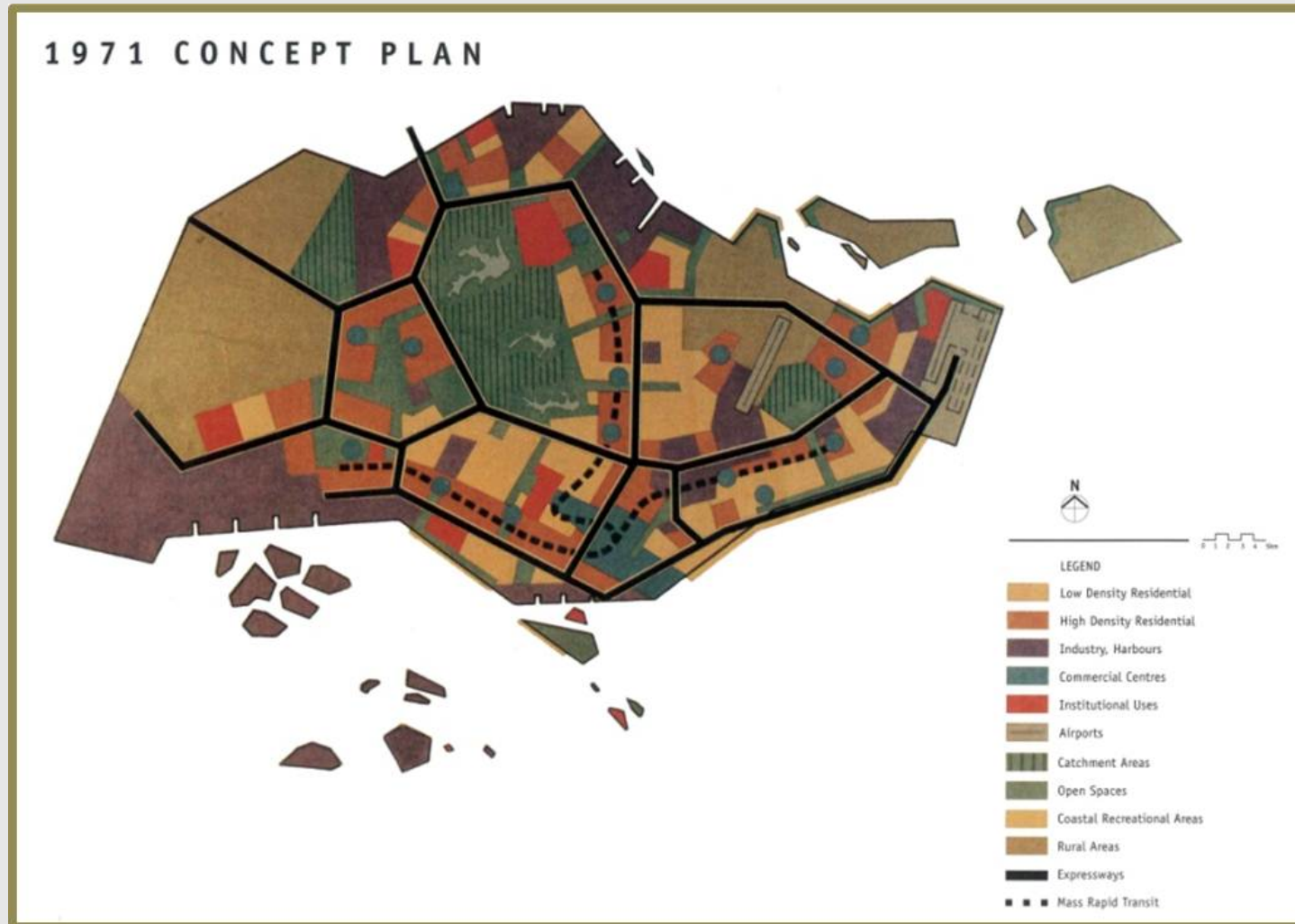
Reduce the need for travel, especially car travel through public transport oriented planning

Strategic concept plan, 1971, called for:

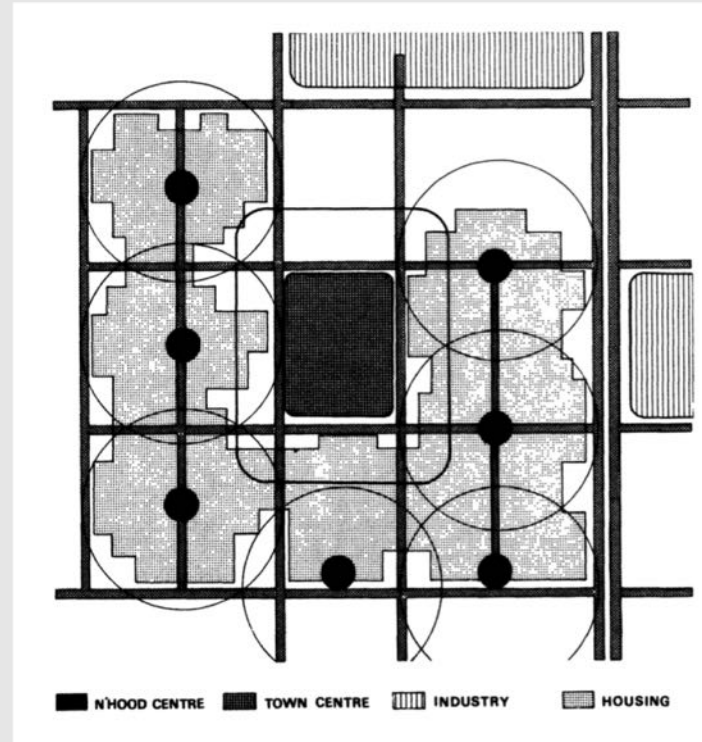
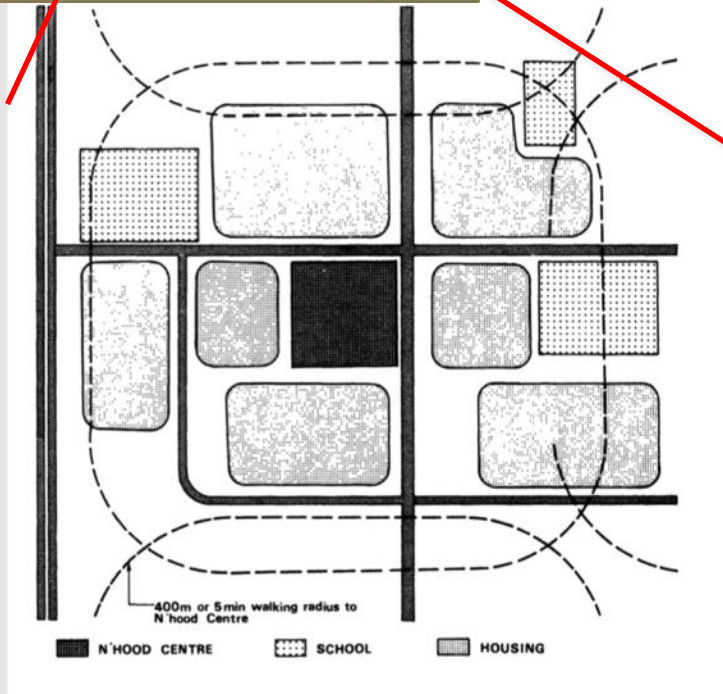
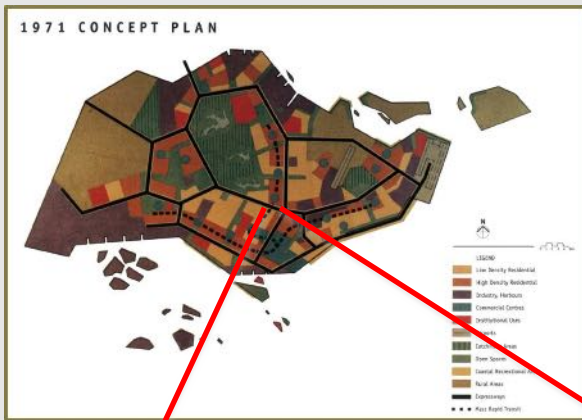
Urban structure with strong center

Clear corridors of high density new towns served by mass transit

Only 15% of land pass allocated for residential housing -> mass to live in high density dwellings.

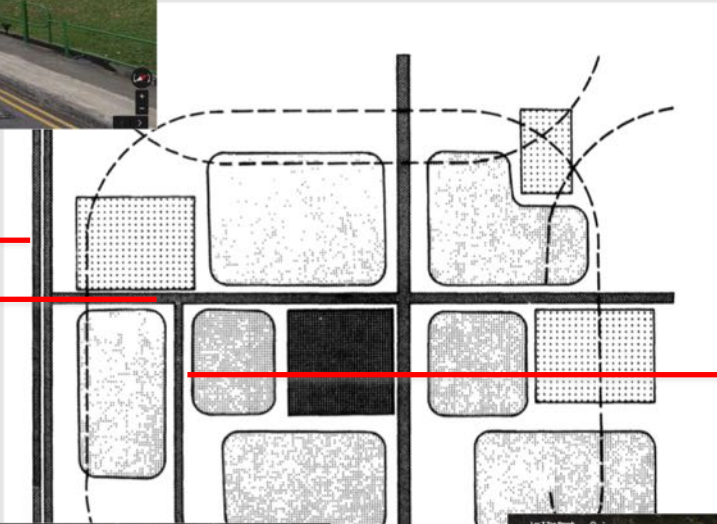


# Background Town design



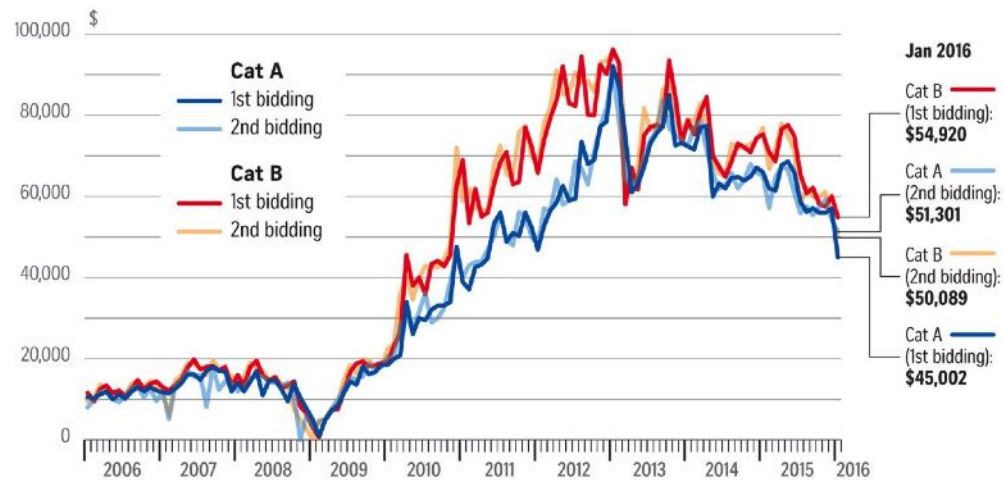


# Background Town design



# Background Vehicle management

## COE premiums over the years



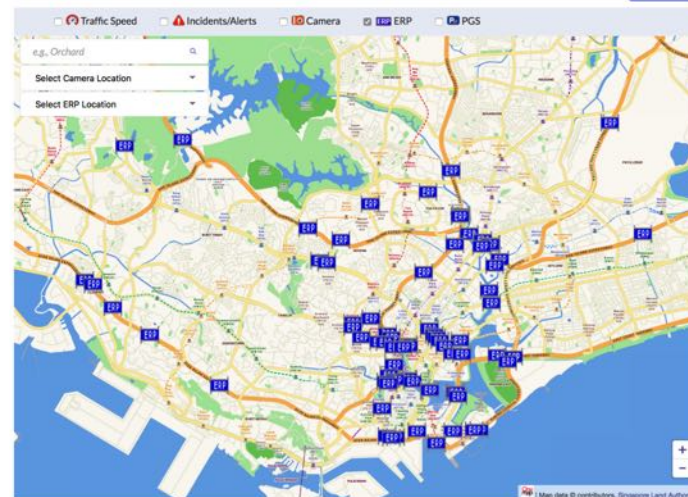
Source: LTA ST GRAPHICS



# Policy

## Road pricing

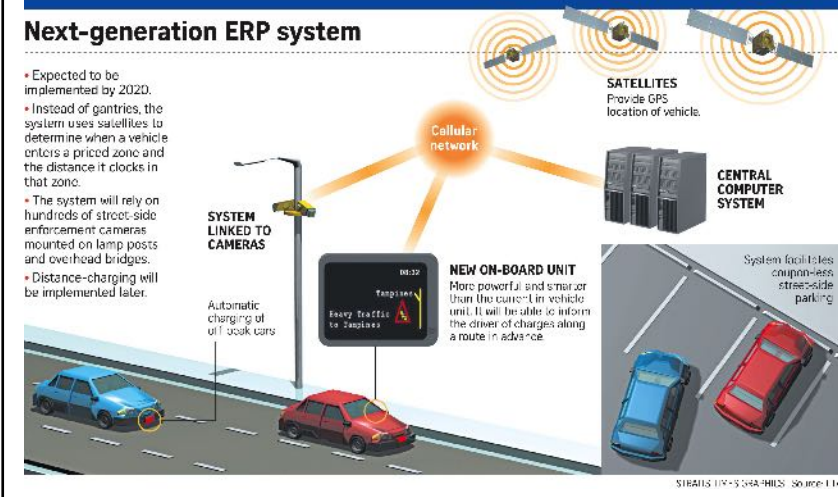
### Now



### 2020 onwards

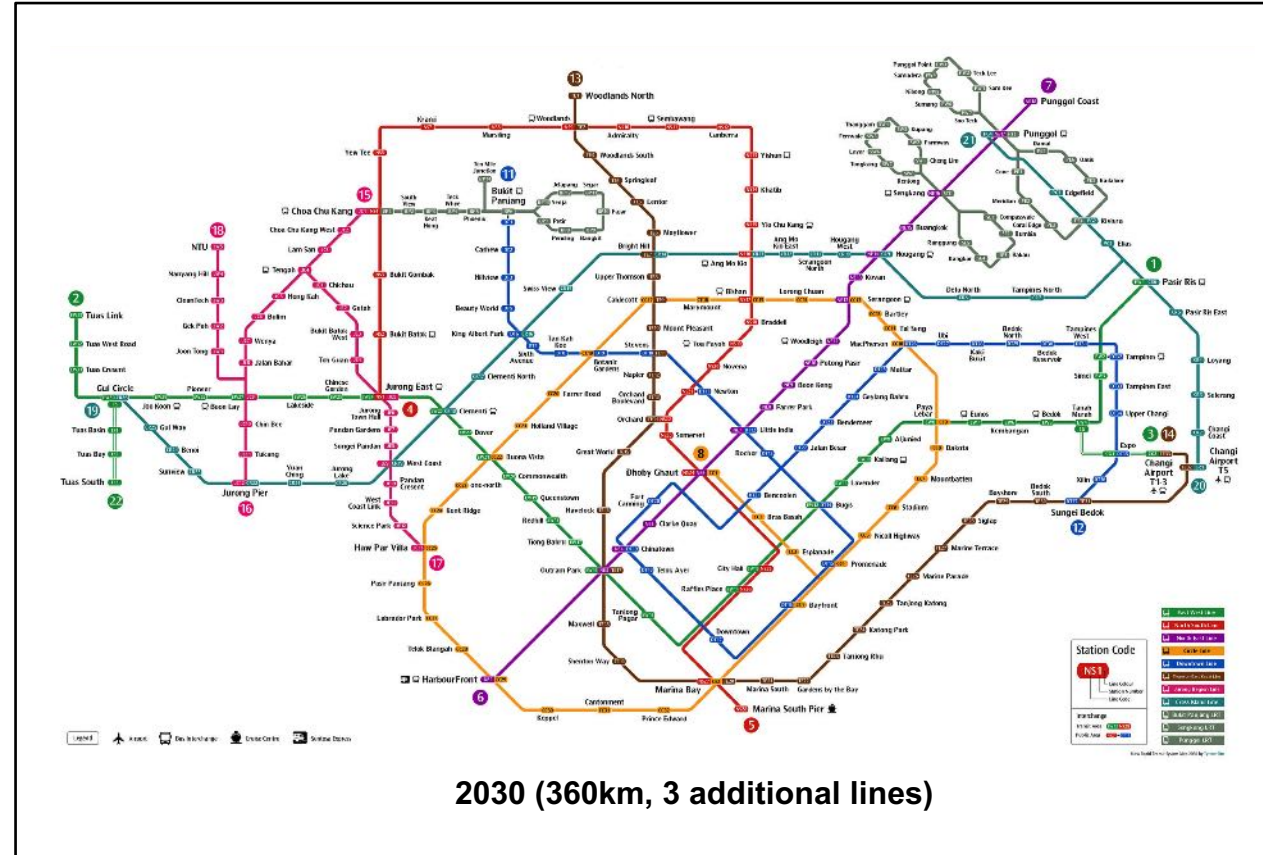
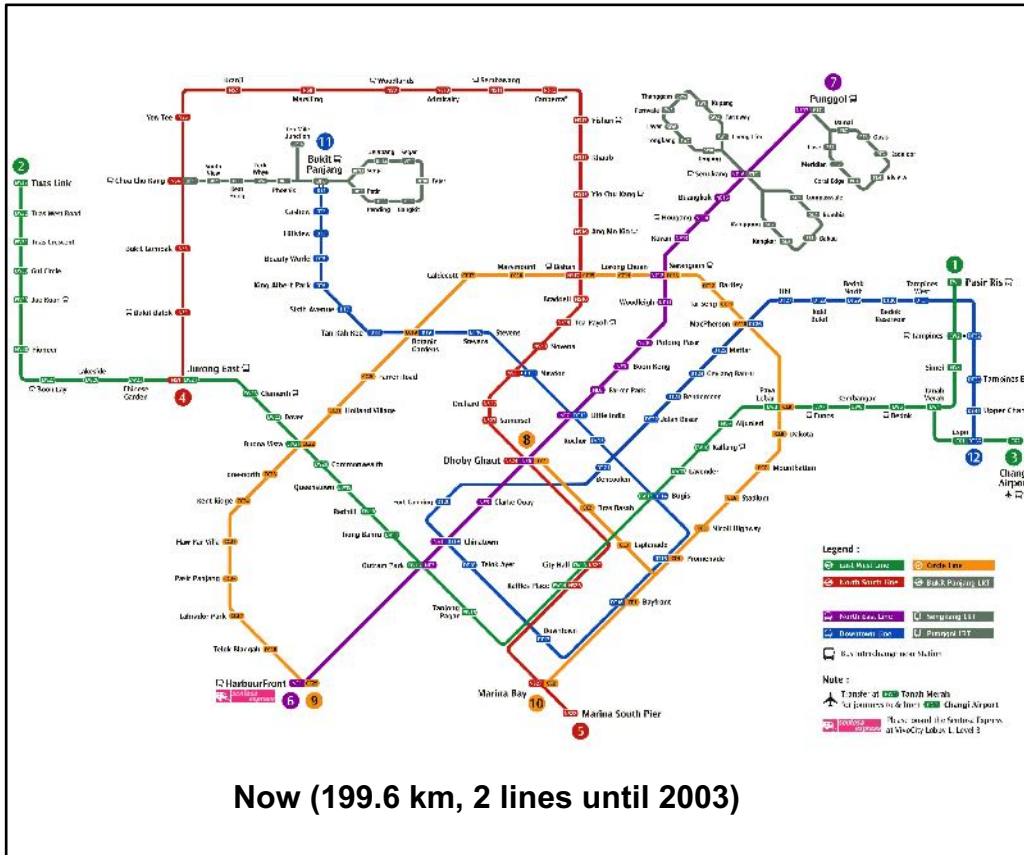
#### Next-generation ERP system

- Expected to be implemented by 2020.
- Instead of gantries, the system uses satellites to determine when a vehicle enters a priced zone and the distance it clocks in that zone.
- The system will rely on hundreds of street-side enforcement cameras mounted on lamp posts and overhead bridges.
- Distance-charging will be implemented later.





# Public transport MRT / LRT



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# Part 2: **Active Mobility**

## Walking



100 meters or 2 minutes?



30 meters or 4 minutes?

## Walking



**Decrease perceived travel time:**

Shops,

Greenery,

Cover

**Increase perceived travel time:**

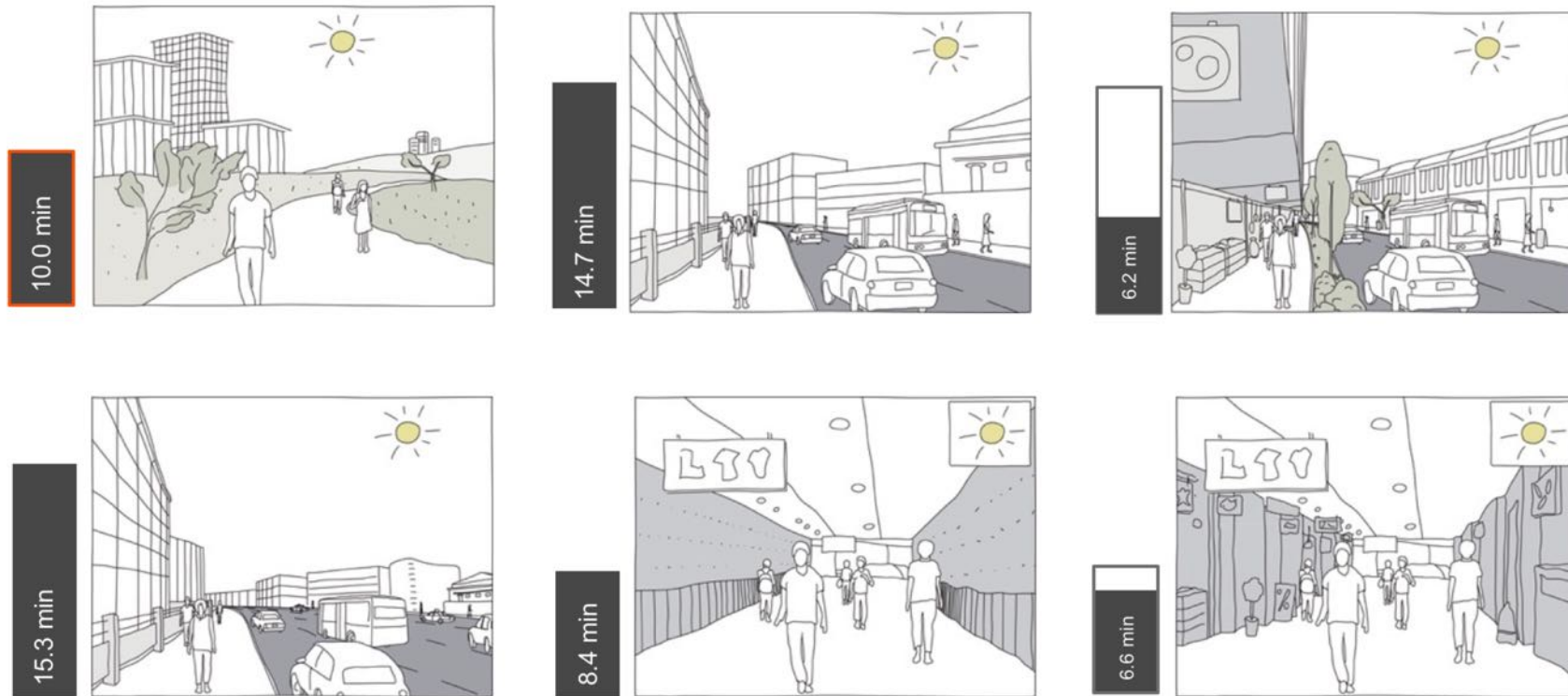
Crossings,

Bridges



# Walkability in Singapore Findings

## Reference



Six out of 42 images shown to respondents in the stated preference survey. Attributes depicted in the images include greenery, road type, cover, weather and the presence of shops. The travel time shown depicts the perceived walking time; walking time through a park is taken as a reference case. For instance, walking along a minor road is perceived as 47% longer than a park, whereas the presence of cover, greenery and shops can reduce the perceived walking time by 35%.

Approx. 35% of the pedestrians participated in an online follow-up stated preference survey in which participants were shown different routes and streetscapes. We found that:

- **Pedestrians prefer** routes with **cover** in sunny and rainy weather, and tend to **avoid crossings**.
- **Covered walkways** and an **active frontage** can **reduce** the perceived **walking time** by up to **30%**.
- **Crossing an overhead bridge** was perceived as **5 minutes** of walking (similar to previous findings in Singapore).



# Cycling

## Cycling in Singapore

Current mode share of cycling is low (1%) for trip stages and trips;  
However, certain residential new towns have mode shares up to 4% (HITS 2012, by authors)

Ambitious plans to make cycling a viable mode of transport

Up to 700 kilometres cycling lanes by 2030

Up to 360 km rail by 2030

## Challenges for cycling in Singapore

Typical residential developments in Singapore are influenced by 20<sup>th</sup> century town planning:

Segregated land-uses,  
Hierarchical road network

Large distances  
between crossings

Mainly footways with  
only pedestrians in  
mind

## Challenges for cycling in Singapore

Main arterials are designed for high speeds and function as barriers

Lane widths are generous;  
Long wait times for  
pedestrians at traffic lights

Tropical weather (rain /  
humidity)



VR

Audio

Questionnaire



Physiological  
sensor

Cycling simulator  
developed at FCL  
Pedalling, braking, steering



## Bike to the Future

Environment  
Audio  
Immersive VR  
Cycling simulator

Survey duration is approx.  
45 minutes.

Measurements:  
Questionnaire  
Cycling simulator  
Physiological sensor



See the video [here](#)





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# Part 3: **Future**

## The making of Jurong Lake District



### What could be up next

#### A VIBRANT, LIVELY CBD

100,000 new jobs  
20,000 new homes  
Land parcels can be sold in varying sizes and zoned "white", or mixed-use, for flexibility in planning

#### CAR-LITE DISTRICT

Dedicated roads for public transport only  
Consolidated carparks to encourage  
Logistics hub situated on JLD to cut down the number of trucks in the area by at least 50 per cent

#### SUSTAINABLE SYSTEMS

Integrating urban systems like district cooling, pneumatic waste and urban logistics management for more cost-effective design

All new buildings required to reduce energy consumption by up to 30 per cent



To make Singapore a great city to live, work and play

Home > Planning > Property > Guidelines > Car Parks > Land Sales > Get Involved > Resources

Home > Media Room > Media Releases > Getting Kampong Bugis ready to be a people-centric, car-lite residential precinct

## Getting Kampong Bugis ready to be a people-centric, car-lite residential precinct

Published: 19 April 2018

### Plans for Kampong Bugis residential precinct

The Kampong Bugis precinct will be comprehensively developed into a new people-centric, car-lite waterfront residential precinct in a lush park setting.

Kampong Bugis will be an open and inclusive neighbourhood with new community facilities, to foster more interaction among residents. The existing Kallang Riverside Park will be transformed into a lush vibrant waterfront park. To provide a pedestrian-friendly environment and promote active mobility, precinct will include a comprehensive network of pedestrian and cycling paths that will connect seamlessly to key public transport nodes.

The precinct will also include features that support environmental sustainability such as a precinct-wide pneumatic waste conveyance system for more efficient waste collection, and storm water treatment system.

Singapore

## 'Forest Town' Tengah's first batch of HDB flats to be launched in November



The first batch of flats in Tengah will be launched from in November in the plantation district. (Photo: HDB)

SINGAPORE: Around 1,500 HDB flats will be the first to be launched in November this year at Tengah, the first new town in more than 20 years.

## Future Car-lite

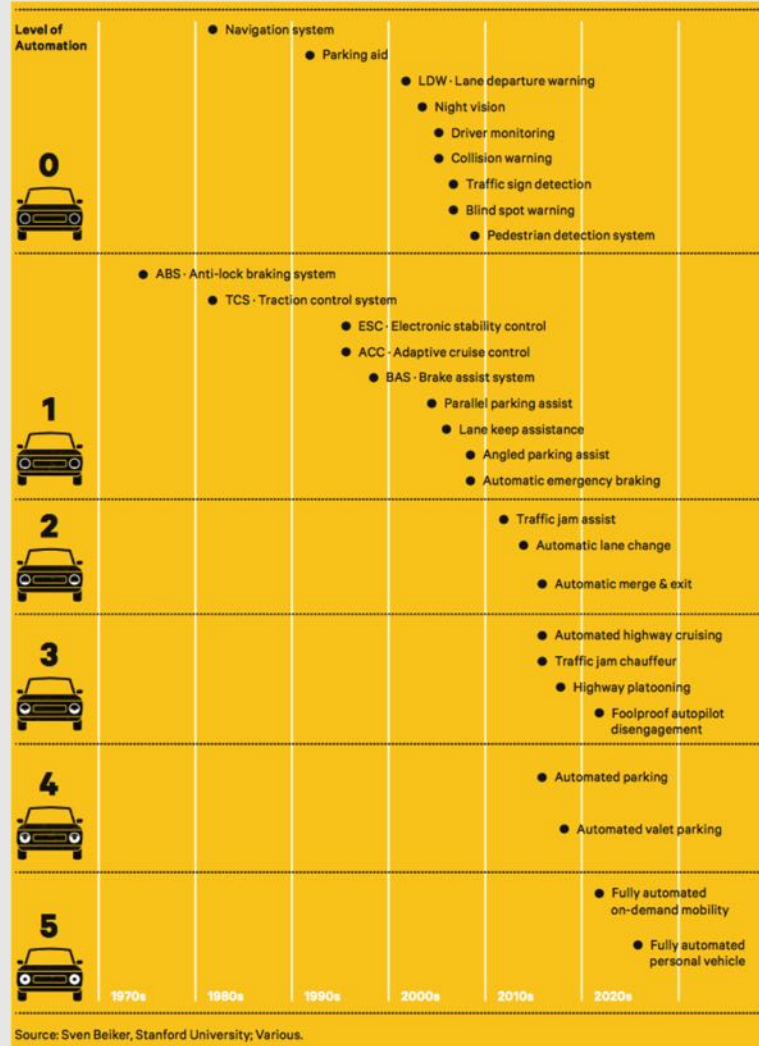
[https://www.straitstimes.com/sites/default/files/attachments/2017/08/26/ST\\_20170826\\_LAKEDISTRIC T26\\_3376573.pdf](https://www.straitstimes.com/sites/default/files/attachments/2017/08/26/ST_20170826_LAKEDISTRIC T26_3376573.pdf)

<https://www.ura.gov.sg/Corporate/Media-Room/Media-Releases/pr18-23>

<https://www.channelnewsasia.com/news/singapore/forest-town-tengah-s-first-batch-of-hdb-flats-to-be-launched-in-10229232>

# AV

## Levels of automation



**Level 0**  
Driver controls the car

**Level 1**  
Driver-assistance; specific functions can be done by the car

**Level 2**  
One driver assistance system of both steering and accelerating using environment information is automated

**Level 3**  
Drivers are still in the car, but can shift safety-critical features to the vehicle

**Level 4**  
Fully autonomous under certain driving conditions

**Level 5**  
Fully autonomous under all driving conditions

# AV

## Types of vehicles

- ⚙️ Uber, GM/Lyft, nuTonomy
- 📍 4
- 🚗 4,000–6,000 lbs
- 👤 4–6 passengers
- 🏎️ 25–35 mph
- 📍 Pittsburgh, San Francisco, Singapore

### Autovot / Taxibot



- ⚙️ Navya, Local Motors, Easymile, Auro Robotics
- 📍 4
- 🚗 6,000–8,000 lbs
- 👤 10–12 passengers
- 🏎️ 25–35 mph
- 📍 Lyons, Helsinki, Washington D.C.

### Driverless Shuttle



- ⚙️ Starship Technologies
- 📍 6
- 🚗 40–55 lbs
- 👤 0 passengers
- 🏎️ 4 mph
- 📍 Tallinn, London, Bern, Redwood City, CA, Washington D.C.

### Deliverybot



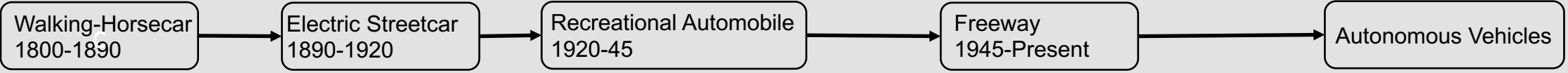
- ⚙️ Otto (Volvo), Scania
- 📍 18
- 🚗 33,000 lbs
- 👤 44,000 lbs cargo
- 🏎️ 55 mph
- 📍 Colorado, Rotterdam, EU (various)

### Software Train





# HOW WILL ADVENT OF AUTONOMOUS VEHICLES INFLUENCE URBAN FORM



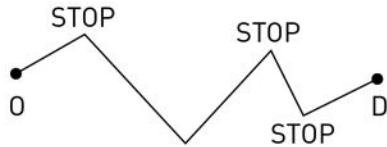
AVs will set the stage for the next major technology driven urban transformation.

Pictures:  
<http://s.picture-russia.ru/wpic//9/b/9bc4c2405b56fcc00df114add273aaa5.jpg>  
<https://www.6sqft.com/worlds-first-streetcar-began-operation-in-lower-manhattan-on-november-14-1832/>  
Diagram adapted from Peter O. Muller's Transportation and Urban Form

# Automation & transport

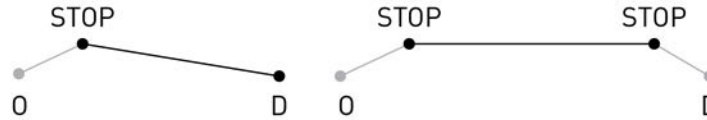
## TAXI AND RIDESHARING MODEL

Vehicle Size = 4-6 Persons



## GOVERNMENT REGULATED FLEET MODEL

Vehicle Size = 20 - 50 Persons



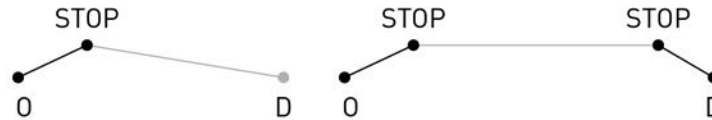
## PERSONAL OWNERSHIP MODEL

Vehicle Size = 4-6 Persons



## RESTRICTED USE MODEL

Vehicle Size = 2-4 Persons



What are the parameters?

Shared or Private?

Size of Vehicles?

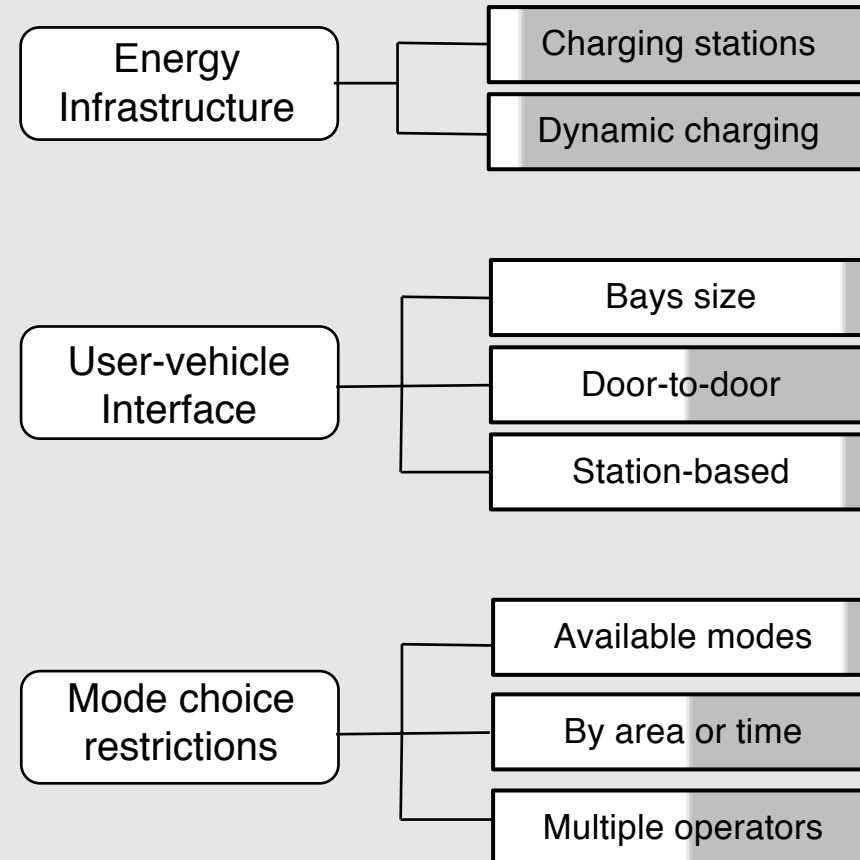
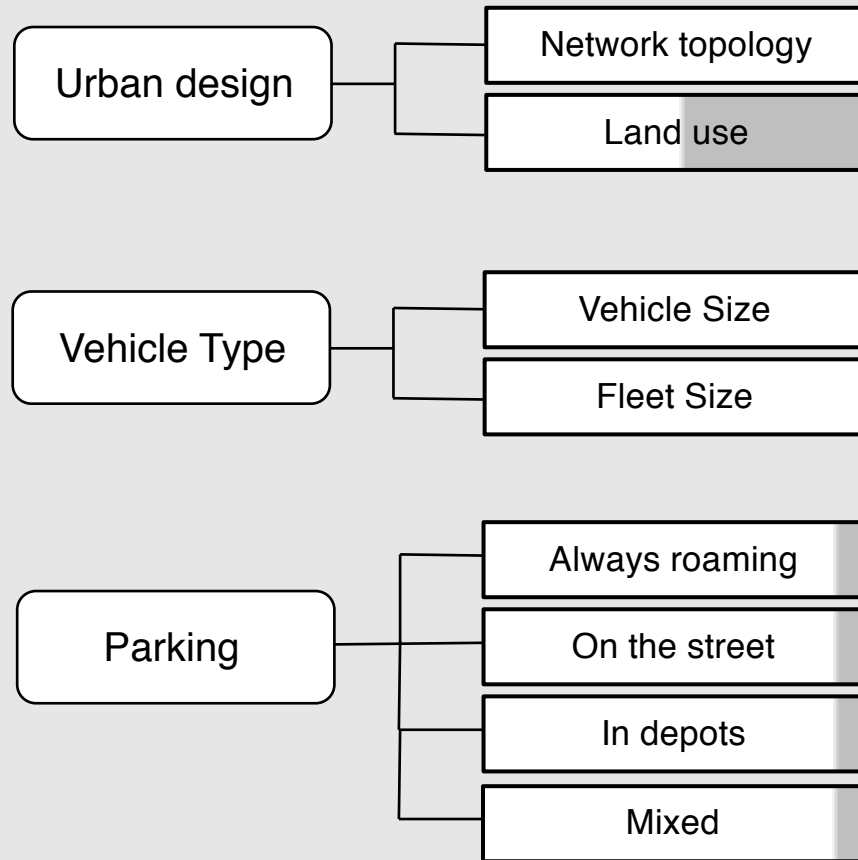
Size of Fleet?

Parking Strategy?

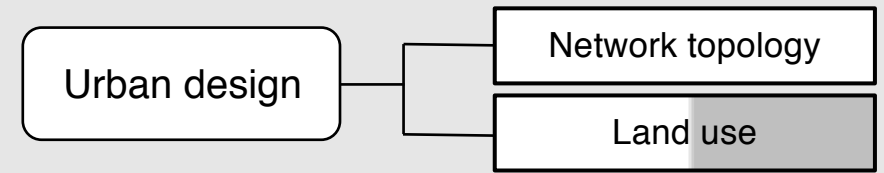
# Which performance indicators

Land surface allocated to roads	Space
Land surface allocated to parking	
Land surface allocated to green, or public space	
Population density accommodated	Comfort and Efficiency
Level of crowding at key destinations	
Congestion and delays for commuters	
Car ownership ratio	Environmental Sustainability
Vehicle occupancy rates	
Emissions	
Vehicle Kilometres Travelled (VKT)	Accessibility
VKT for Empty trips	
Waiting times for transit	
Travel Time	Active Mobility Social Cohesion
Mode share by trips	
Network Accessibility	
Walkability score	
Bikeability score	
Social interaction and Inclusiveness	

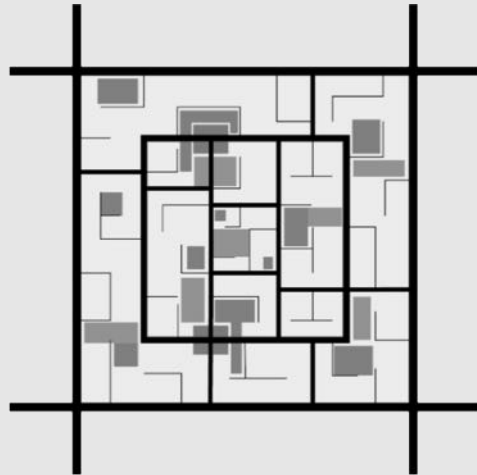
# Design & simulation





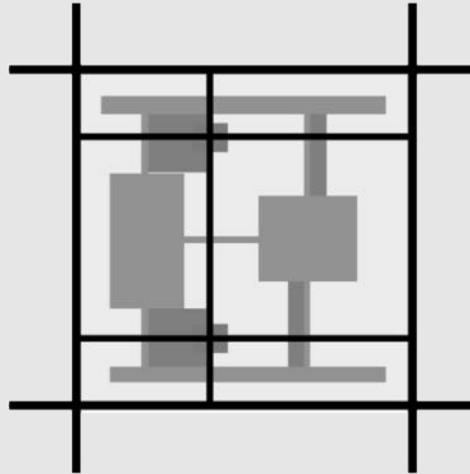


**Type I  
Existing cul-de-sac  
and loop model**



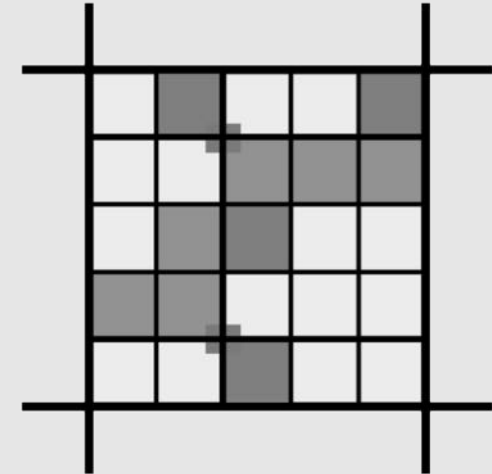
Typical HDB structure retrofitted to accommodate door-to-door AV service, maximising the use of existing Culs-de-sac and fixed route AV service through loops and X-junctions

**Type II  
Superblock Model**



Typical HDB cell modified to remove several links and create superblocks, with no door to door service, but high speed fixed route transit and low speed micro transit in shared spaces.

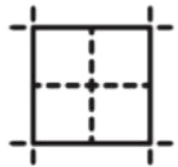
**Type III  
Permeable Grid**



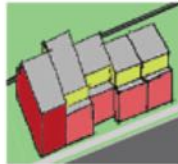
Re-imagining HDB cell, as a high density grid model, to facilitate shared rides with dynamic routing.

# What Aspects of **Urban Form** Impact Transport Flows

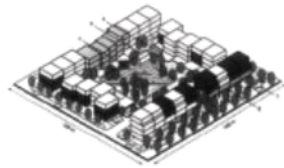
## What are the parameters?



Network Grid



Land Use Distribution



Development Intensity



Parking

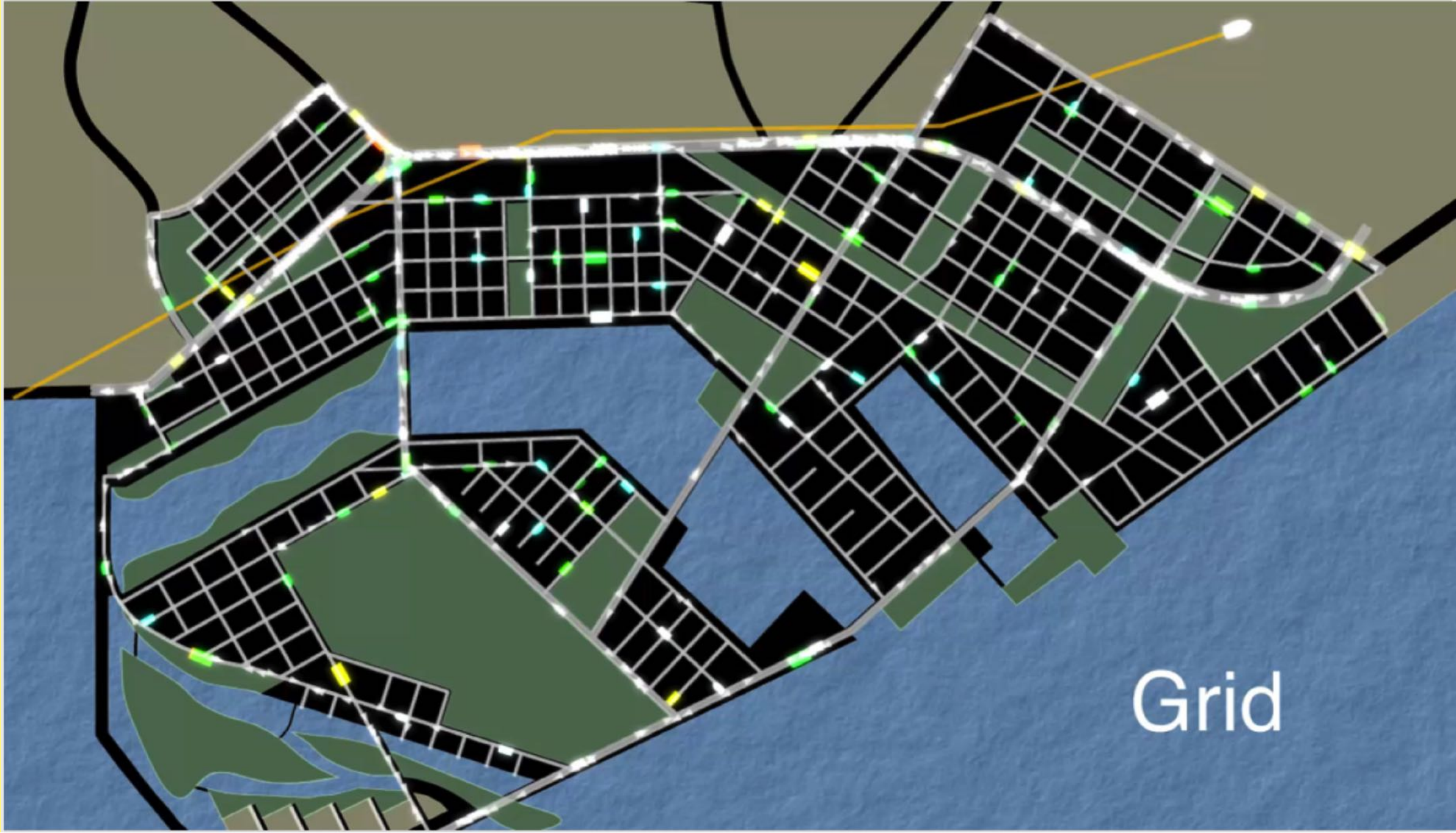


Interface



Street profile

- a. **First order impact** - Street sections, street capacities, public transit interface, parking,
- b. **Second order impact** - Reimagining the neighbourhood unit – network design, land use distribution
- c. **Third order impact** - Shape of the city - residential/job location choice, density, urban footprint



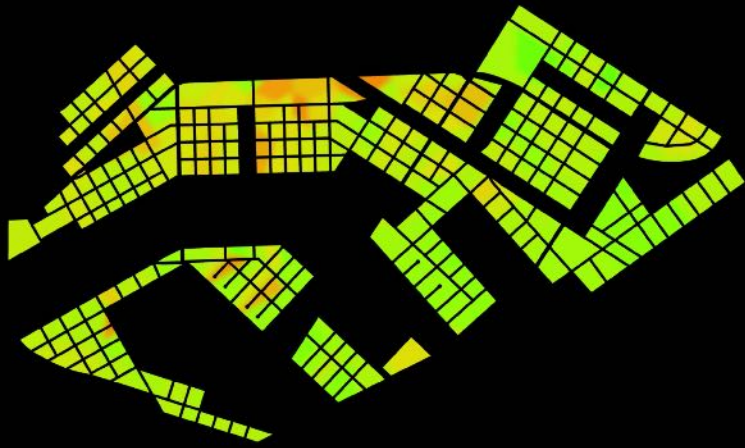
Grid



Urban design

Network topology

Land use



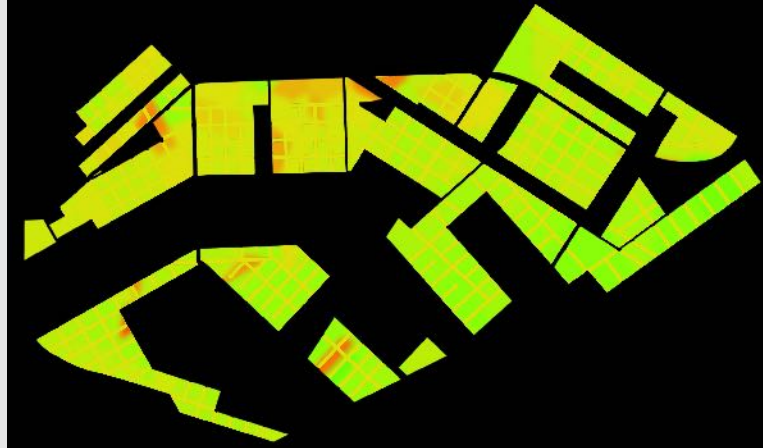
## Grid

223 lane km road, 91,419 AMOD veh km  
460 AVs for < 20 min travel time svc level



## Loops

176 lane km road, 105,817 AMOD veh km  
505 AVs for < 20 min travel time svc level



## Superblock

223 lane km road, 94,673 AMOD veh km  
450 AVs for < 20 min travel time svc level



AV  
Flying cars







## Flying taxis

[Uber.com/elevate](https://www.uber.com/elevate)

It's closer than you think

Low noise, safe, autonomous (after FAA approval), electric

Starting in 2020 in Dubai

Cheap retrofitting of existing parking structures

Typical expectation is reducing travel time by > 50%, door-to-door, of 60%+ of trips over 15km (depending on the city – see white paper)

# Flying taxis

Attracting serious money ([here](#))

Big industry support ([here](#))

Uber is not alone ([here](#))

See, e.g., PM of MOT's vision of future SG ([here](#))

THE BUSINESS TIMES TRANSPORT

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## Airbus to run parcel-delivery drone trial, and maybe one for flying taxis in S'pore

Friday, March 24, 2017 - 05:50

by SOON WEILUN soonwl@sph.com.sg @SoonWeilunBT



Airbus Helicopters signed a contract with the Civil Aviation Authority of Singapore last year to test a drone parcel-delivery service on the campus of the National University of Singapore in mid-2017. PHOTO: ISTOCKPHOTO

Singapore

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HOME TRANSPORT


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## Singapore in talks with firms to try out 'flying taxis'

Transport Ministry looks at aerial taxis and on-demand dynamic-routing bus services for the future

Thursday, March 23, 2017 - 05:50

by SOON WEILUN soonwl@sph.com.sg @SoonWeilunBT



The Hoversurf Scorpion, a human-carrying drone developed by a Russian startup, has already been prototyped and could be an urban-mobility option for Singapore.

Singapore

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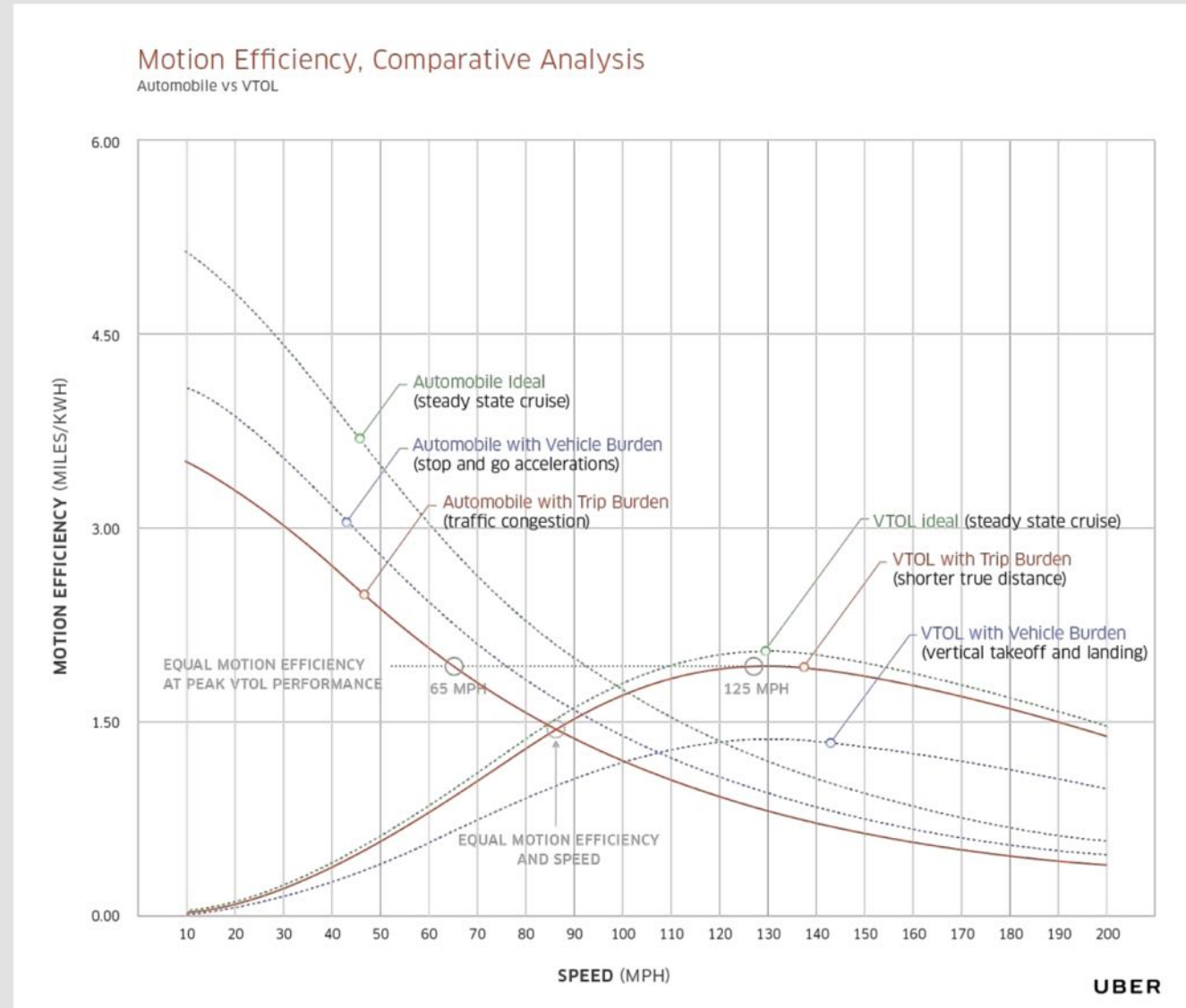
Martin Modern: A condominium with a botanic heritage BRANDED CONTENT

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# IMPLICATIONS

- / Longer distance trips due to dynamics and efficiency
- / (Implication on share of those trips..?)
- / SG implication (high speed rail)
- / The comparison is about speed, but does not highlight the implication on trip distance
- / Transport equity





# Implications

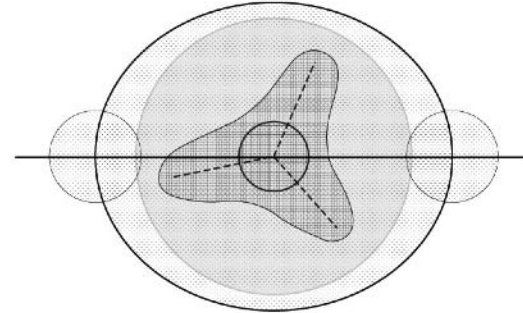
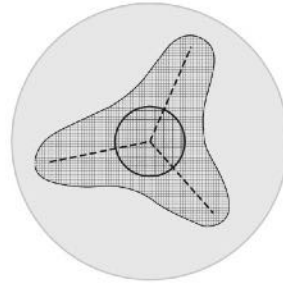
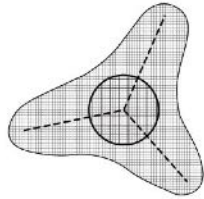
Walking-Horsecar  
1800-1890

Electric Streetcar  
1890-1920

Recreational Automobile  
1920-45

Freeway  
1945-Present

Future



Pictures:

<http://s.picture-russia.ru/wpic//9/b/9bc4c2405b56fcc00df114add273aaa5.jpg>

<https://www.6sqft.com/worlds-first-streetcar-began-operation-in-lower-manhattan-on-november-14-1832/>

Diagram adapted from Peter O. Muller's Transportation and Urban Form







What transport policy and design decisions can foster more liveable and sustainable cities in the future?

