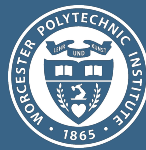


Recommending Improvements to the Efficiency, Equity, and Sustainability of the Bus System in Melbourne, Australia



WPI

Ryan Astor (he/him), Caroline Jaeger (she/her), Jenny Lewitzky (she/her),
Anthony LoPresti (he/him)

March 16, 2021

Melbourne's Transportation System



The Importance of the Bus System in Melbourne



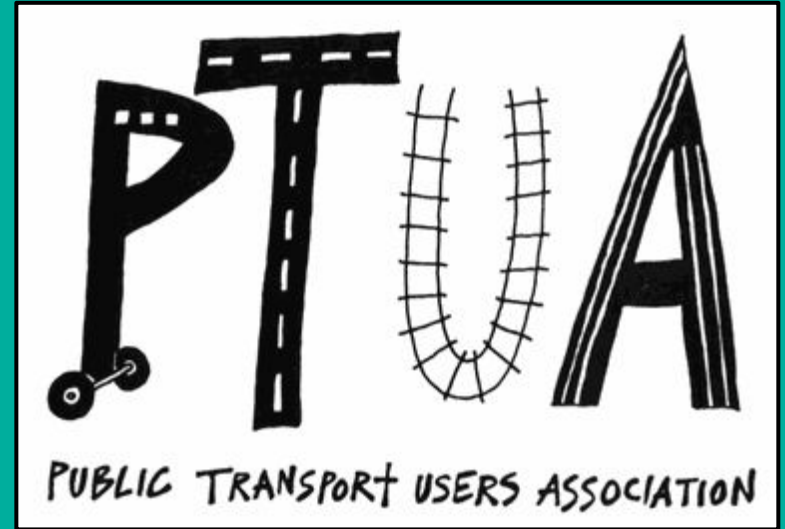
Melbourne bus by [Simon sees](#) is licensed under [CC BY 2.0](#)

Sustainable Cities Campaign

Friends of the Earth Melbourne



Public Transport Users Association



Melbourne's current bus system is

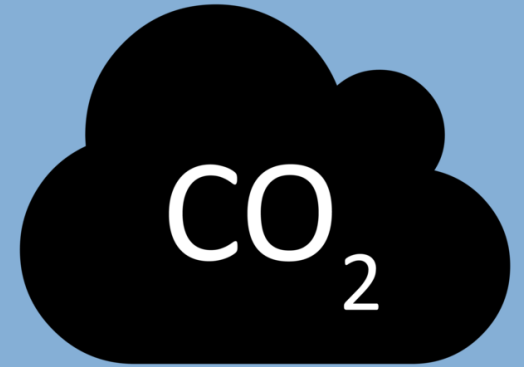
Inefficient



Inequitable



Unsustainable



Melbourne's buses have unnecessarily long wait times.

Weekdays:

**20 - 30
minutes**

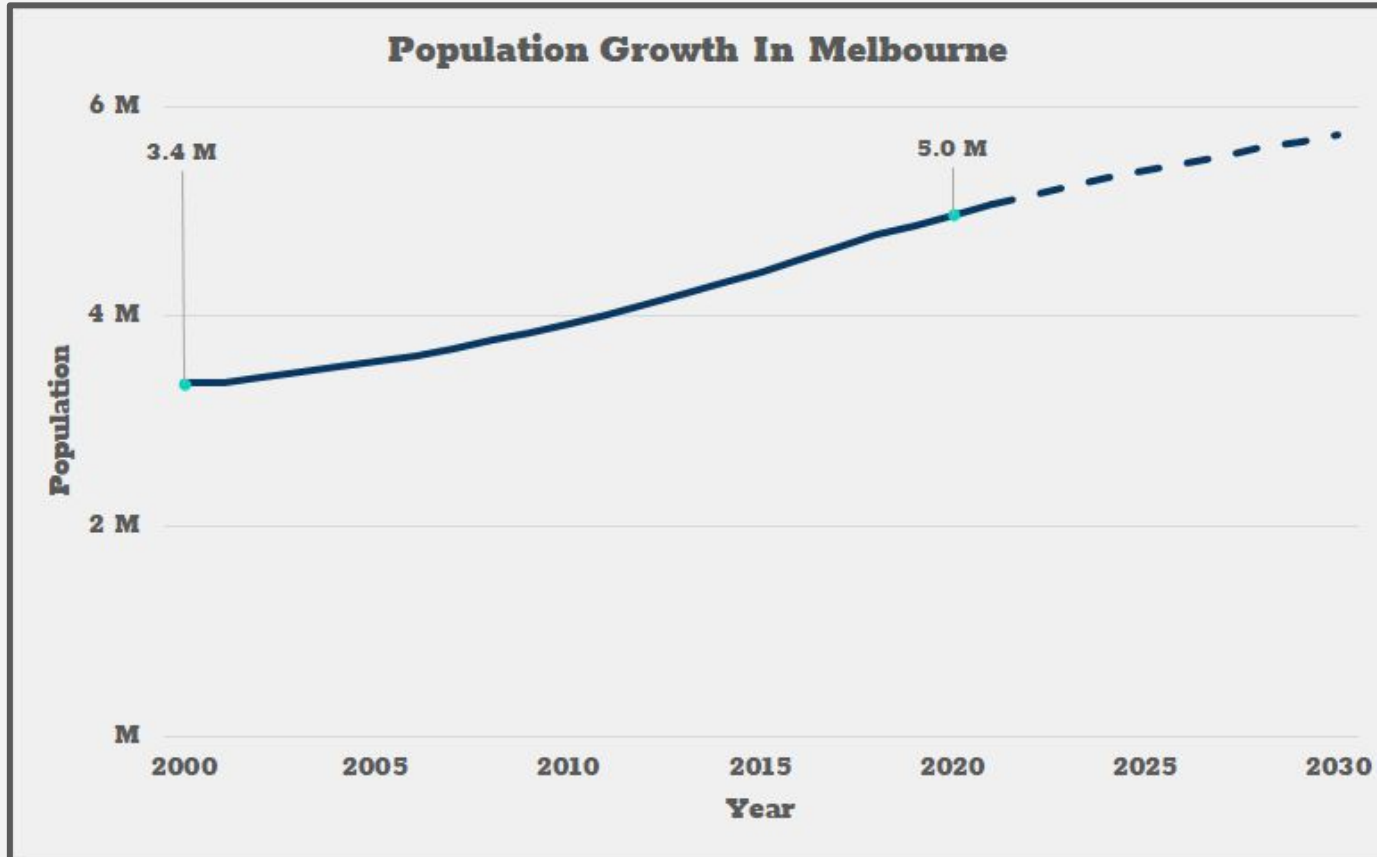
Weekends:

**30 - 60
minutes**



Santillan. (2021). *Passengers Waiting for Melbourne Bus*. Melbourne, Victoria, Australia

The Melbourne population has grown 48% in the past 20 years.



The spatial distribution of public services in Melbourne is less equitable than in other Australian cities.

Melbourne

Gini
Coefficient:

0.68

Sydney

Gini
Coefficient:

0.62

Perth

Gini
Coefficient:

0.52

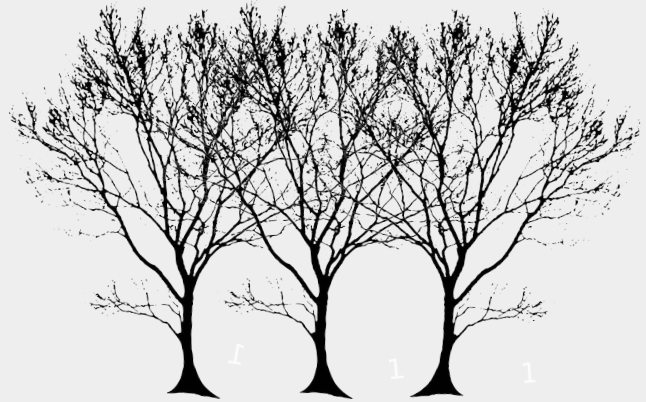
Just from tailpipe emissions, Melbourne's buses emit:

78,300

tonnes CO₂ each year

This is equivalent to cutting down

3,195
trees
every year



Provide recommendations for increasing the efficiency, equity, and sustainability of the bus system throughout Greater Melbourne.

Project Goal

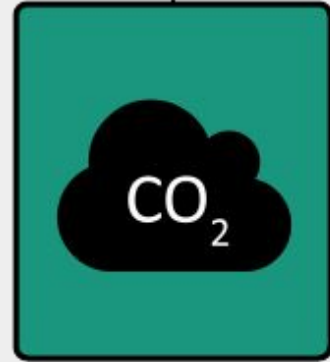
Project Approach



**Case Studies of
Various Bus
Systems**



**Investigation of
Equity in Bus
Accessibility**



**Implications of
Electric Bus
Implementation**

Findings and Analysis



[Co2 carbon dioxide icon](#) by [Tommaso.sansone91](#) is licensed under [CC0](#)

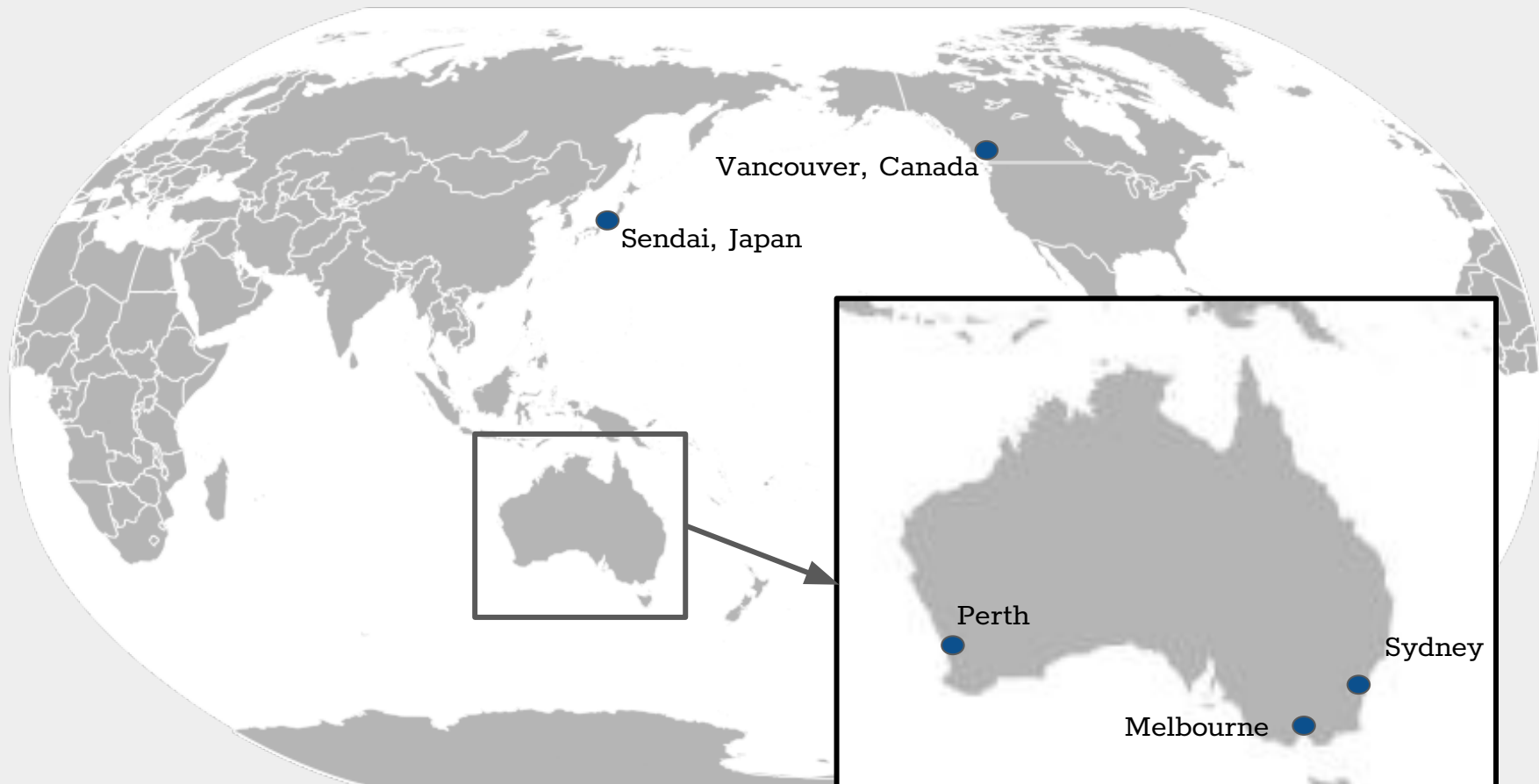
Case Studies of Various Bus Systems



[West Vancouver Municipal Transit 1603](#) by [Blue Bus Fan](#) is licensed under [CC BY-SA 4.0](#)



[Transport NSW liveried \(2514 ST\)](#) by [Bidjee](#) is licensed under [CC BY-SA 3.0](#)



Vancouver, Canada

Sendai, Japan

Perth

Sydney

Melbourne

Australia

Meet Our Interviewees

**John
Storrie**

Melbourne, Australia

**Dr. John
Stone**

Melbourne, Australia

**Private Bus
Operator**

Sydney, Australia

**Dr. Peter
Newman**

Perth, Australia

**Gordon
Price**

Vancouver, Canada

**Dr. Gregory
Trencher**

Sendai, Japan

Efficiency is the Most Important Aspect of Public Transportation

- High frequency leads to efficiency
- Melbourne continues to struggle with effective routing
- Traffic congestion is a big problem hurting efficiency in Melbourne
- Electric buses improve efficiency

An Equitable and Accessible Bus System Will Satisfy More Users

- Cities should use public transportation stations as a center for urban growth
- Rapid population growth in Melbourne has resulted in a disparity in equal access and a non-service
- While electric vehicles lead to equity problems, electric bus implementation can promote equity

Other Systems Vary in Approach on Public & Private Relationships

- Melbourne has always been run by private operators
 - Government regulation - who controls the bus routes?
- Hard to implement reform due to contracts
 - Operators are paid per km, not per passenger
- Perth smartly privatized its bus system
- Vancouver is run by the city, not the province

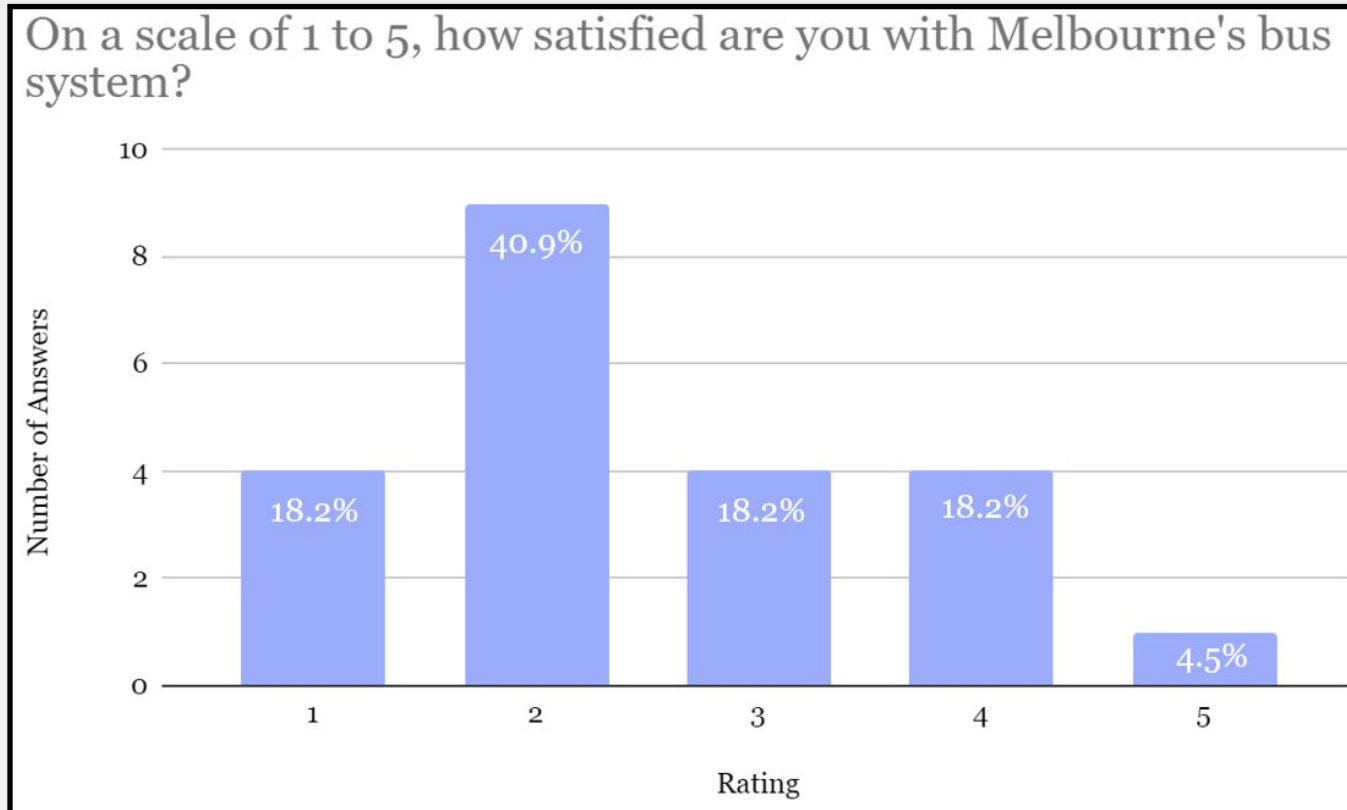
There are a number of barriers to electric bus implementation.

- Phasing out diesel buses should be given as much thought as introducing electric buses
- Melbourne's electricity grid will need to be upgraded
 - There is also a land scarcity concern
- Electric buses are expensive for small family operators in Melbourne to adopt

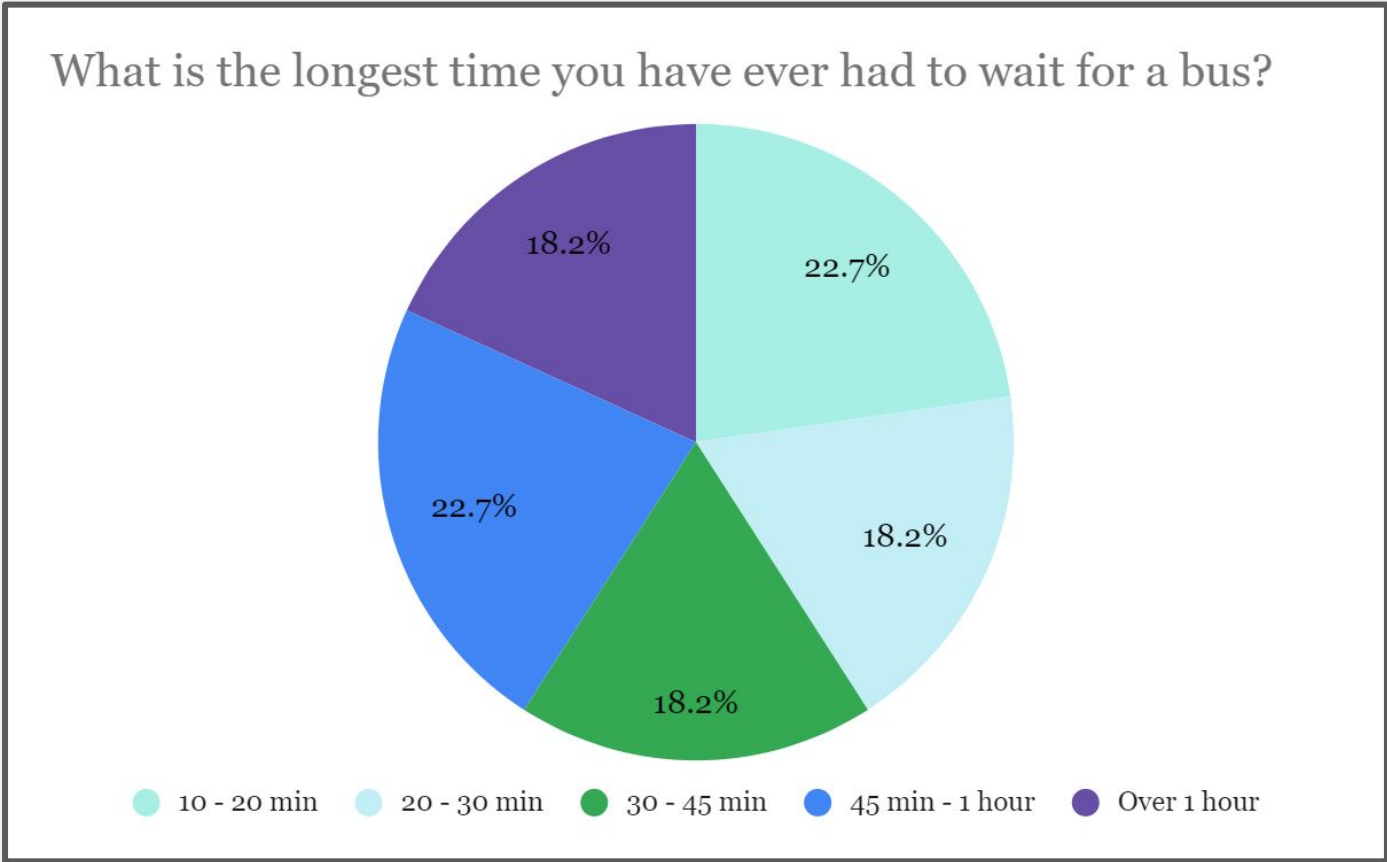
Investigation of Equity in Bus Accessibility



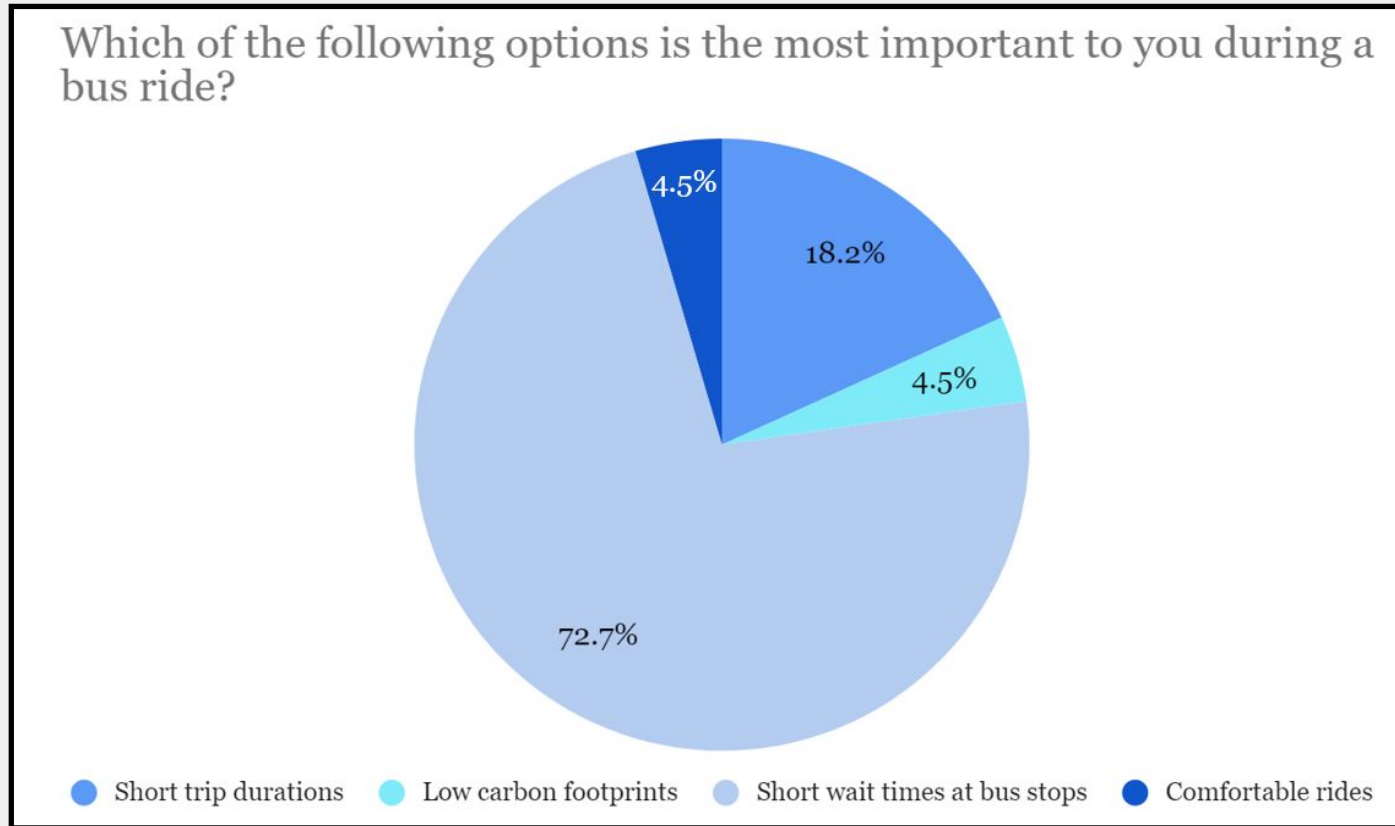
Most passengers are dissatisfied with Melbourne's bus system.



Many passengers have waited over half an hour for the bus.

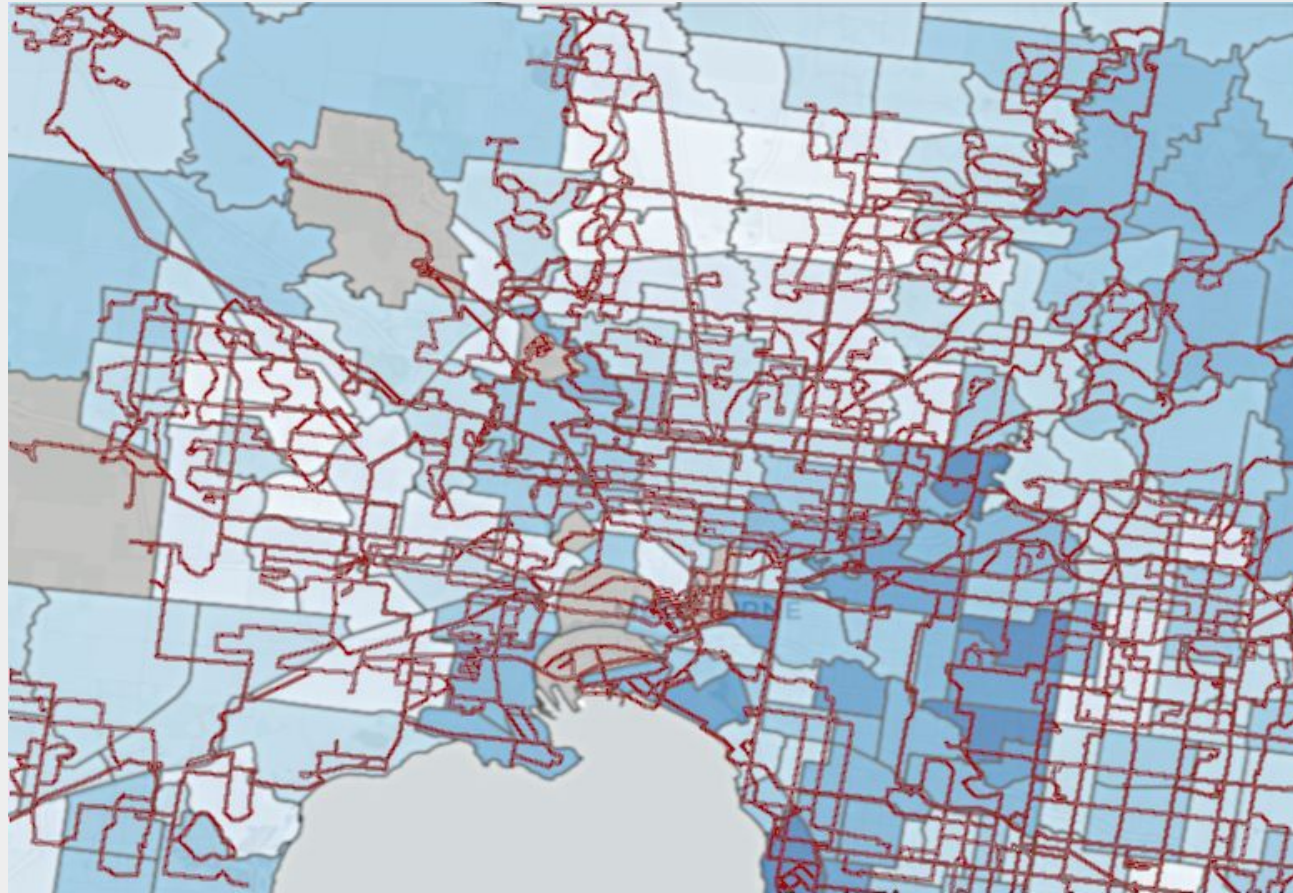


An overwhelming number of passengers value short wait times.

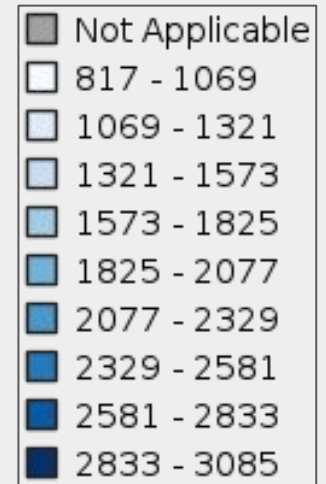


“The growth has been faster than the state has been able to keep up with . . . the wealthy suburbs have got bus, train and tram services . . . the gap for those lower income areas continue to widen.” - John Storrie

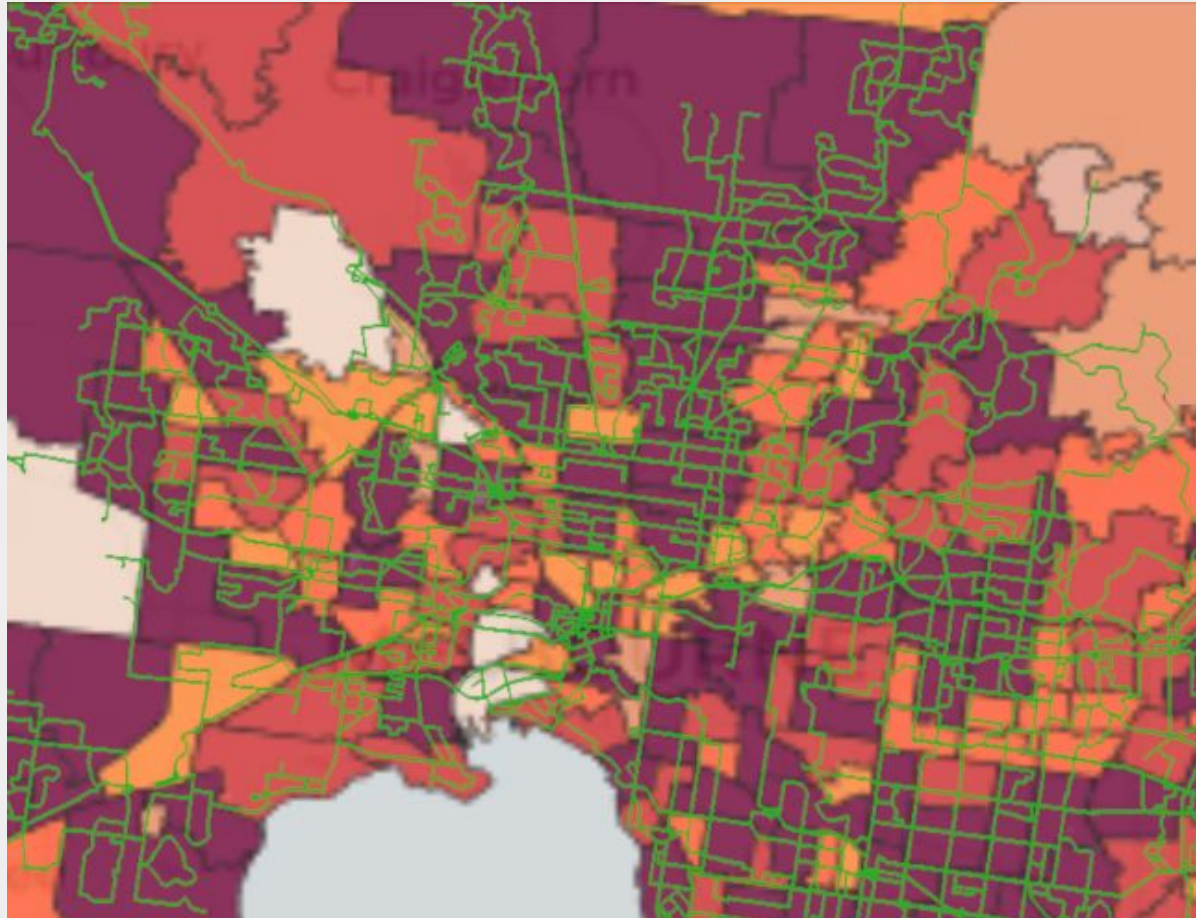
Routes seem to cater more towards higher income localities.



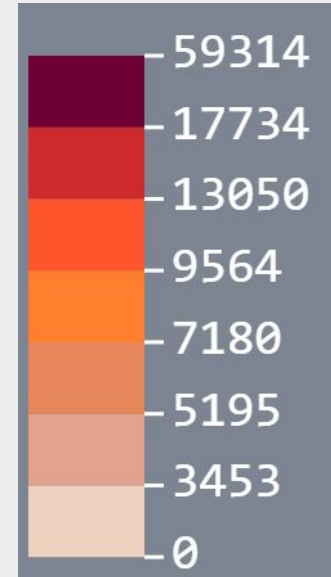
**Average Weekly
Incomes**



Bus routes seem to cater to highly populated areas.



Populations of Localities



“As it grows, there are more and more areas without service, or you've got to dilute the service offering . . . people get what is essentially a non-service - an hourly service or worse.” - John Storrie



Implications of Electric Bus Implementation

[BYD K9 en Petransrio 2014](#) by [Galeria de Fan Bus](#), difusión y prensa is licensed under [CC BY 2.0](#)

Assessment Assumptions

- Only comparing diesel fuel and electric bus batteries
- Australia manufactures lithium-ion batteries
- Crude oil imported from Middle East
- Diesel Fuel refined in Singapore, China, and South Korea
- Excluded truck emissions
- Bus fleet emissions may be very variable
 - Number of oil rigs used
 - Number of transportation/distribution trips

Fuel and batteries go through similar production processes.



Diesel Bus Fuel



Electric Bus Battery

*Assuming a 12 year lifetime for each bus

Fuel produces many more CO₂ emissions than batteries.

Diesel Fuel

45,819

tonnes CO₂e per bus

Li-Ion Batteries

153

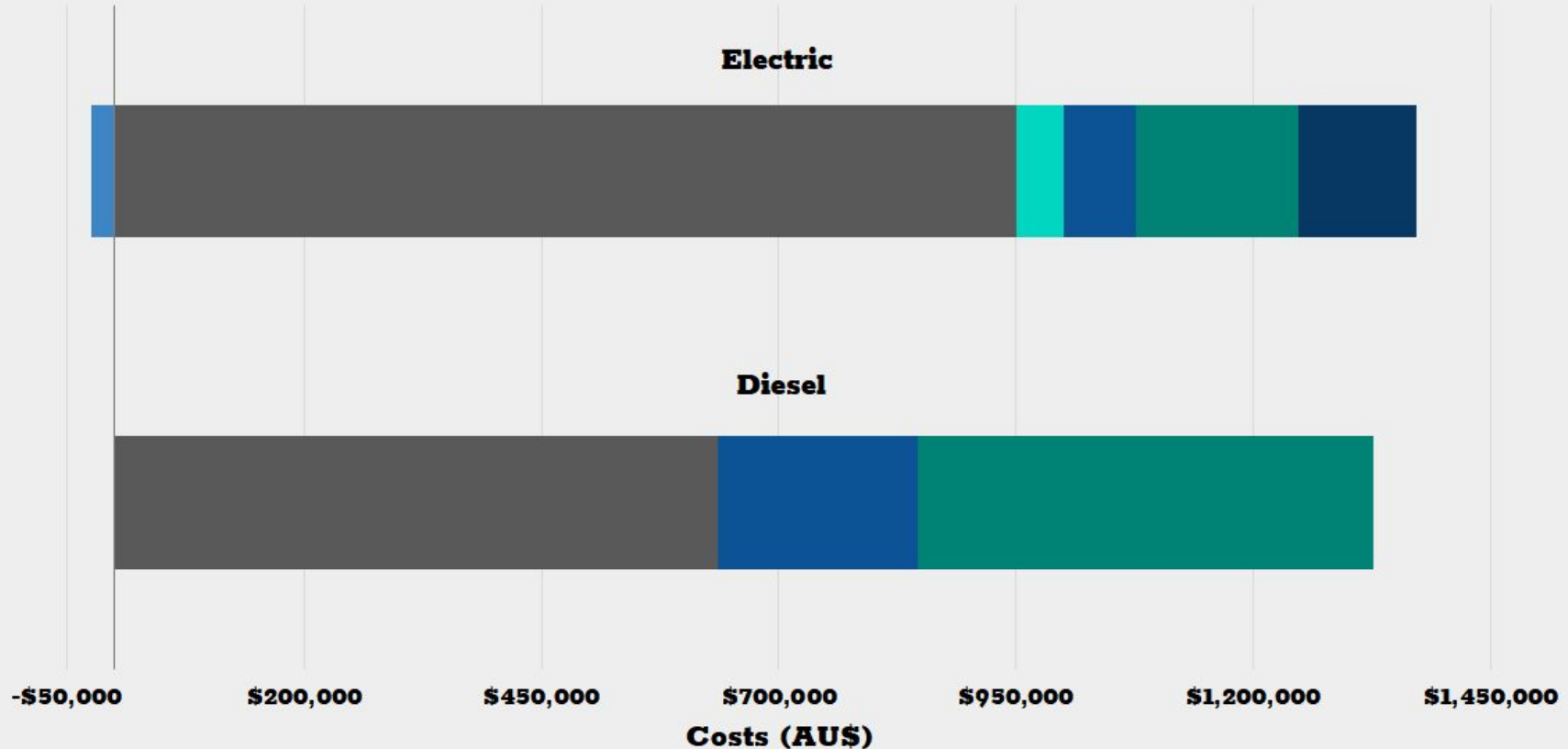
tonnes CO₂e per bus

*Assuming a 12 year lifetime for each bus

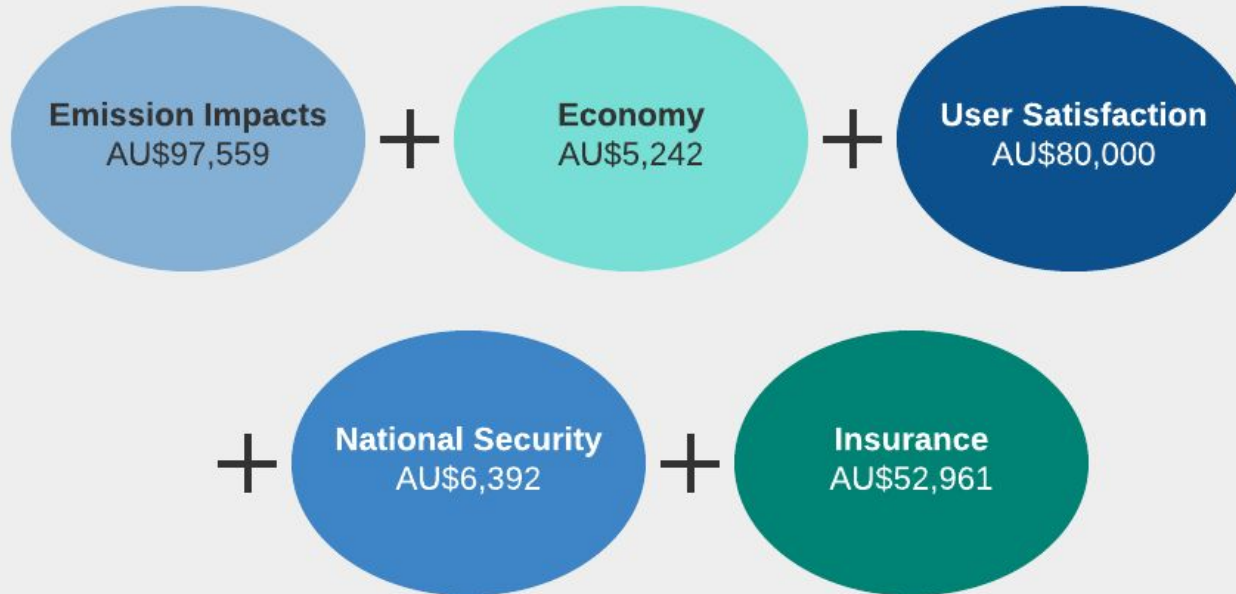
Electric and Diesel Buses have similar long-term direct costs.

Electric vs Diesel Costs Comparison

- V2G Savings
- Bus
- Charging Station
- Fuel
- Maintenance
- Battery Replacement



Electric Buses have big savings for the public.



*Assuming a 12 year lifetime for each bus

Savings from Electric Buses are significant.

Per Bus

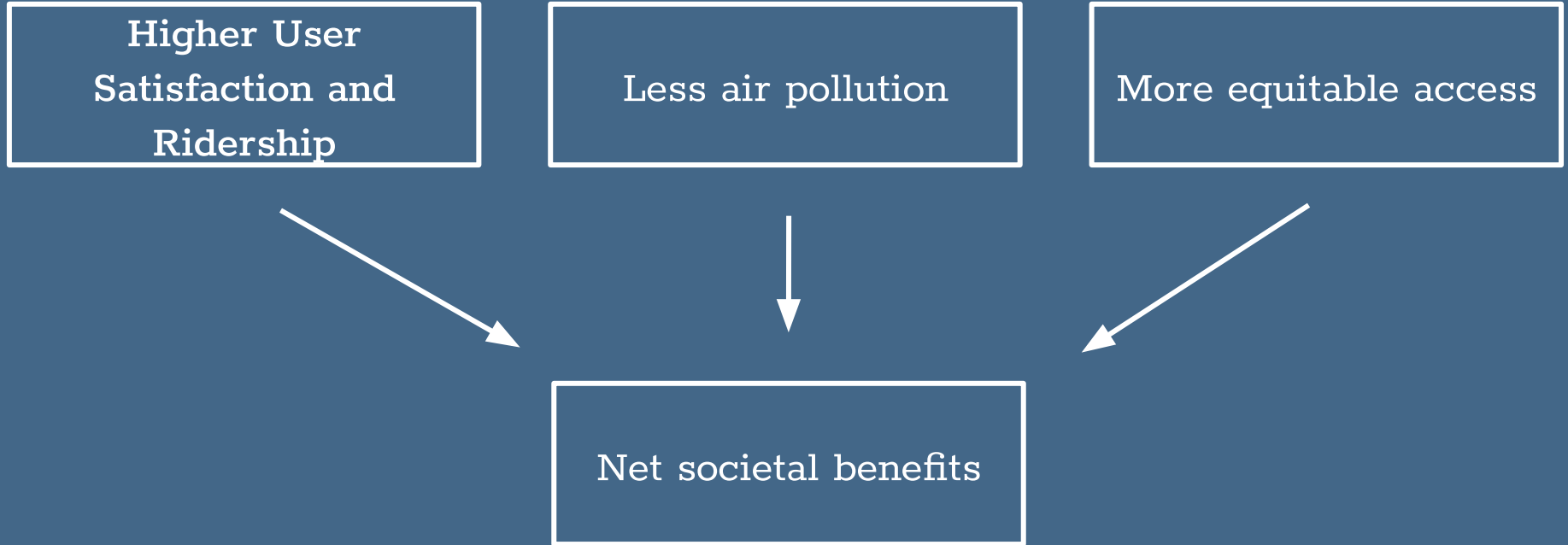
AU\$222,572

Whole Fleet

AU\$600,944,400

Moving Forward

Why should Melbourne convert their bus fleet to electric?

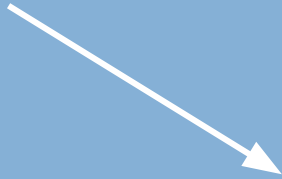


How should this change be facilitated?

Charging stations at existing depots

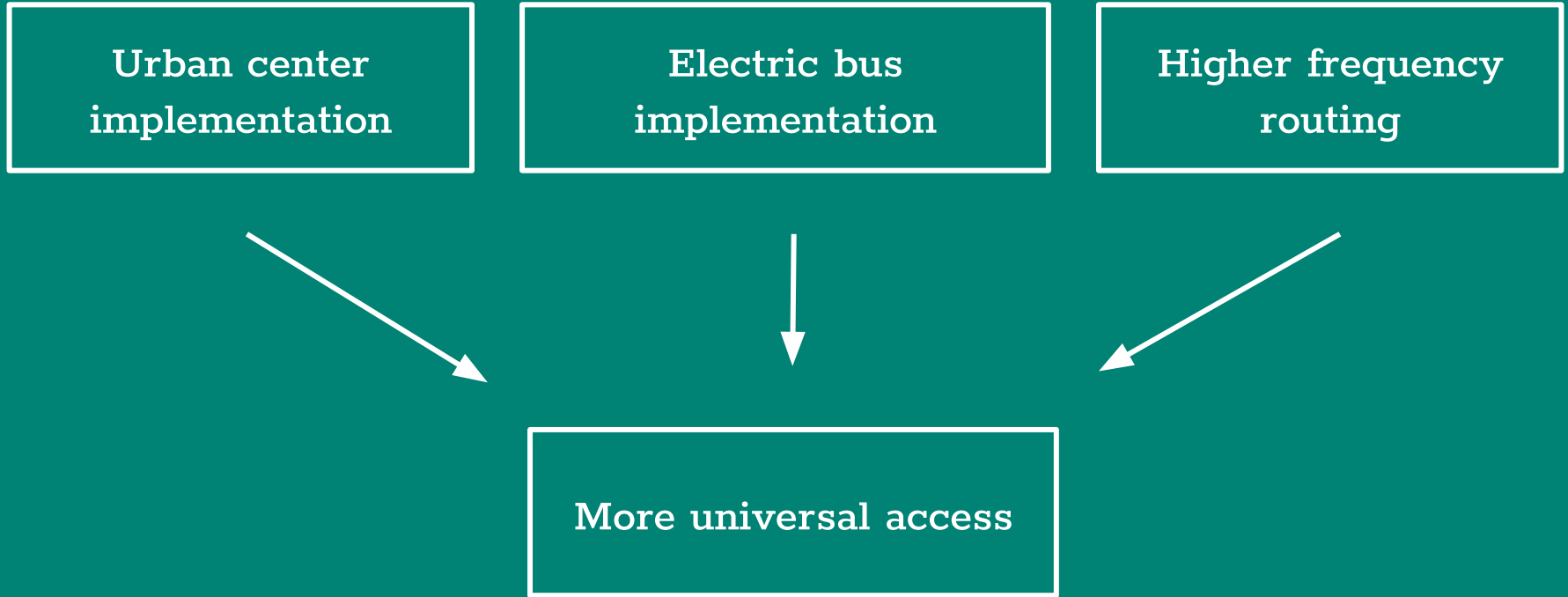
Small numbers of buses implemented at once

Incentivize adoption in contract renewal

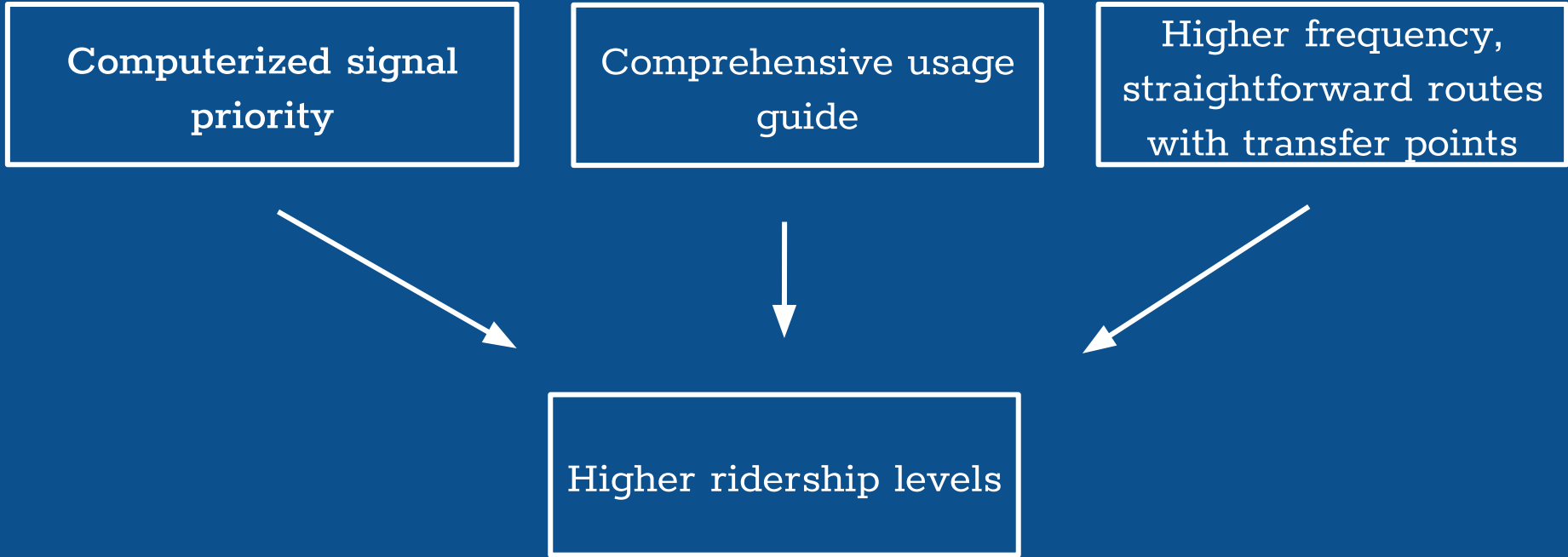


Smoother Transition

How can Melbourne's bus system become more equitable?



What would make Melbourne's current bus system more efficient?



Future Outlook

- Renewable energy generation
- Electric bus battery recycling
- Development of Electric Bus Technology
- Reassess current routing and timetabling
- Revisit contracts with bus operators

Acknowledgements

Partners

- Claudia Gallois, Friends of the Earth Melbourne
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Advisors

- Professor Stephen McCauley
- Professor Esther Boucher-Yip



Discussion