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BITRE Colloquium
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Research perspectives on the merits of Light Rail vs Bus

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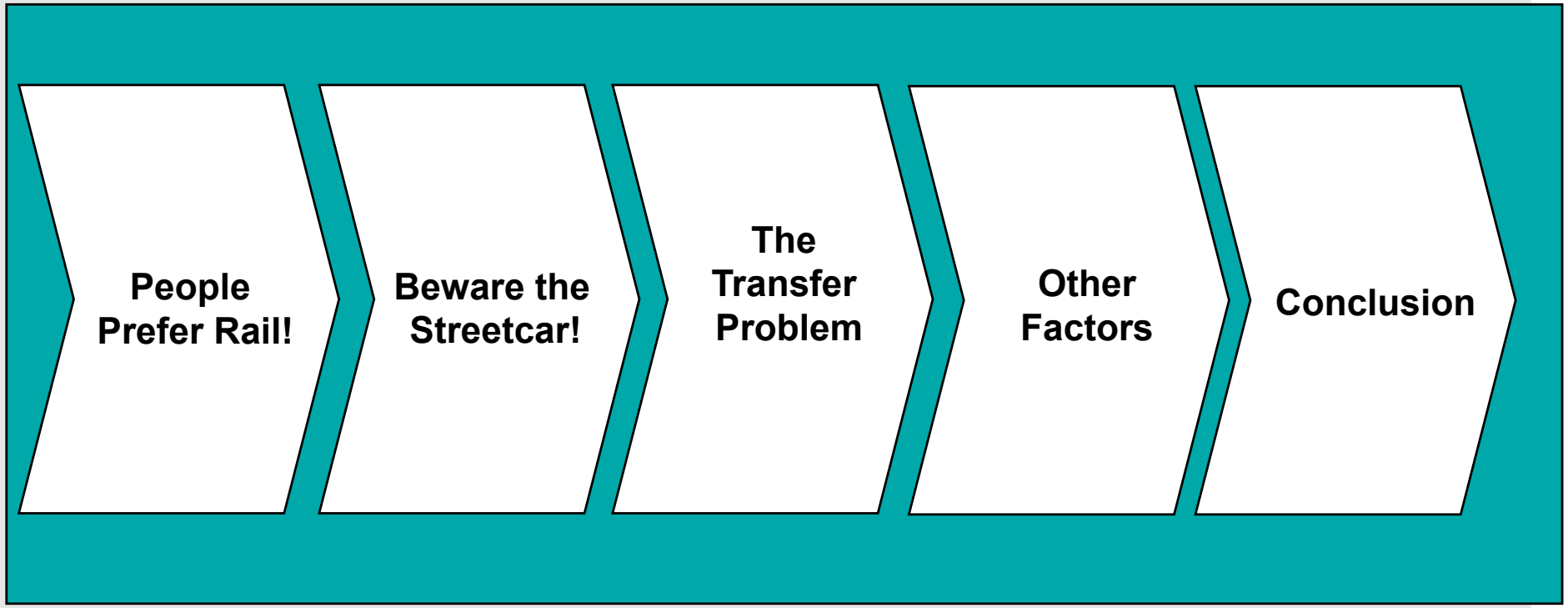
Agenda

1. Introduction
2. People Prefer Rail!
3. Beware the Streetcar!
4. The Transfer Problem
5. Other Factors
6. Conclusions

This paper examines trade offs in Light Rail vs Bus investment for urban Australia

- **Authorities face difficult decisions in using limited funds**
- **Much debate is polarised within industry divides – we need 'facts' not 'faith' upon which to base decisions**
- **Includes results from 3 research papers to inform the debate:**
  - Currie G (2005) 'The Demand Performance of Bus Rapid Transit' Journal of Public Transportation Vol 8 No 1
  - Currie G (2006) 'Do Melbourne Trams Have a Future?' ARRB Conf Oct-Nov 2006
  - Currie G (2006) 'Bus Transit Oriented Development – Strengths and Challenges Relative to Rail' Journal of Public Transportation Vol. 9, No. 4, 2006

It is structured as follows:



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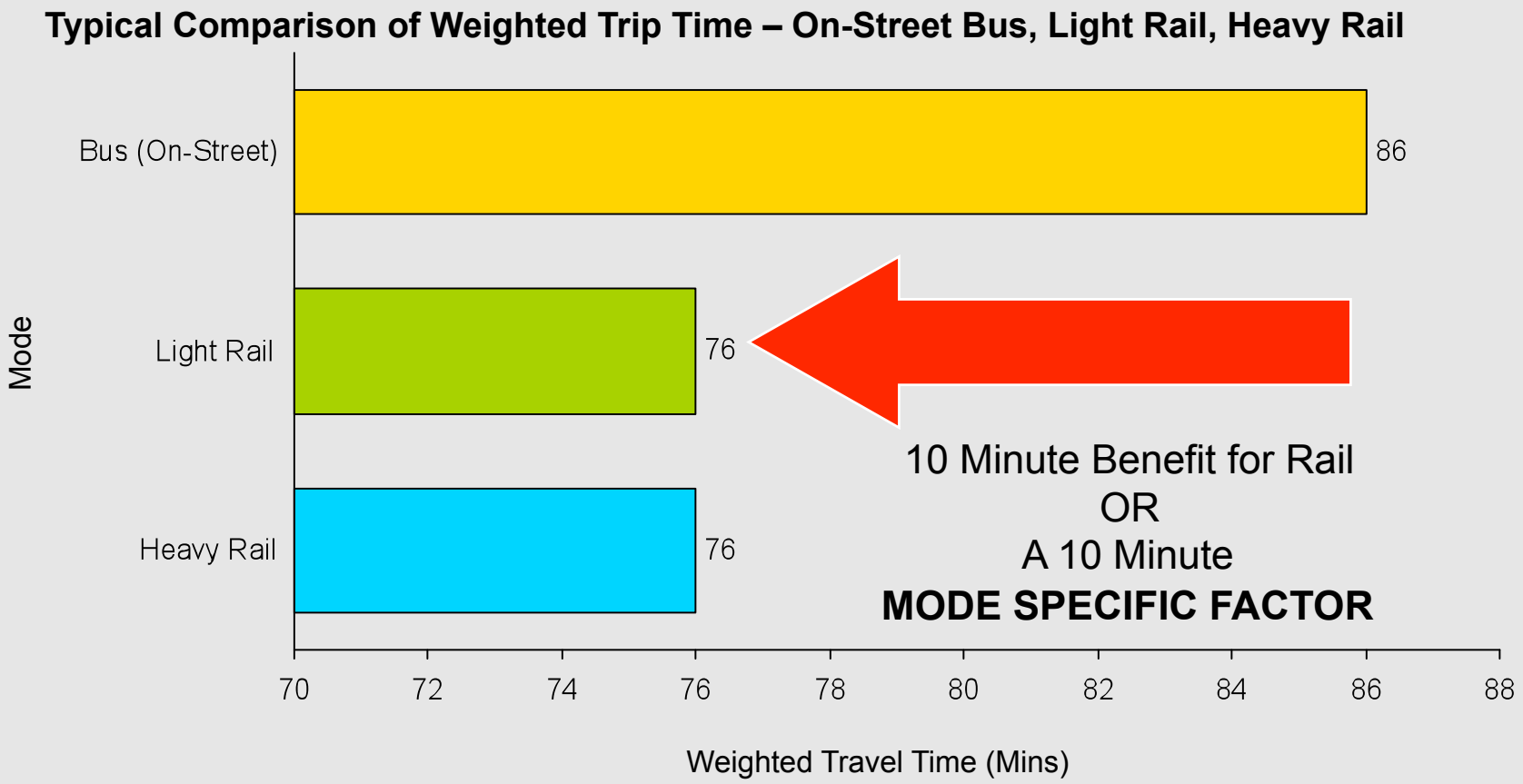
Behavioural research can be used to explore passenger preference for transit modes

How many will use on-street Bus vs Light Rail?

Same:

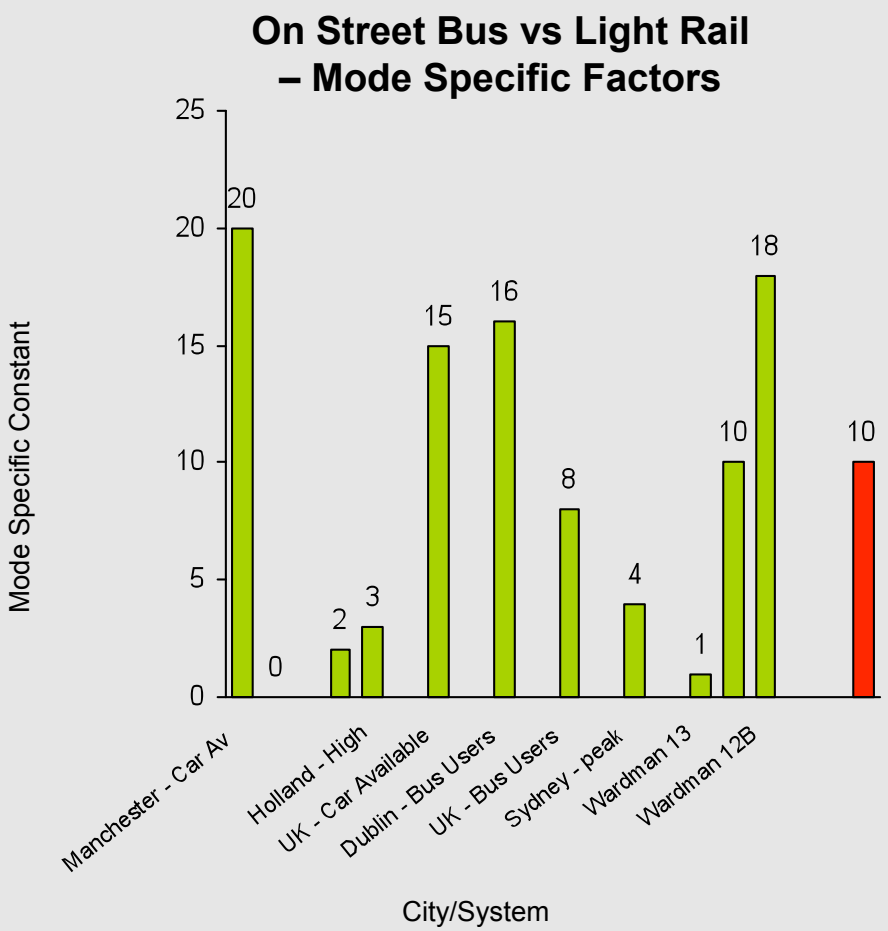
- Walk Access Time
- Wait Time (Frequency)
- Fare
- Reliability
- In-Vehicle Travel Time
- Walk Egress
- Reliability

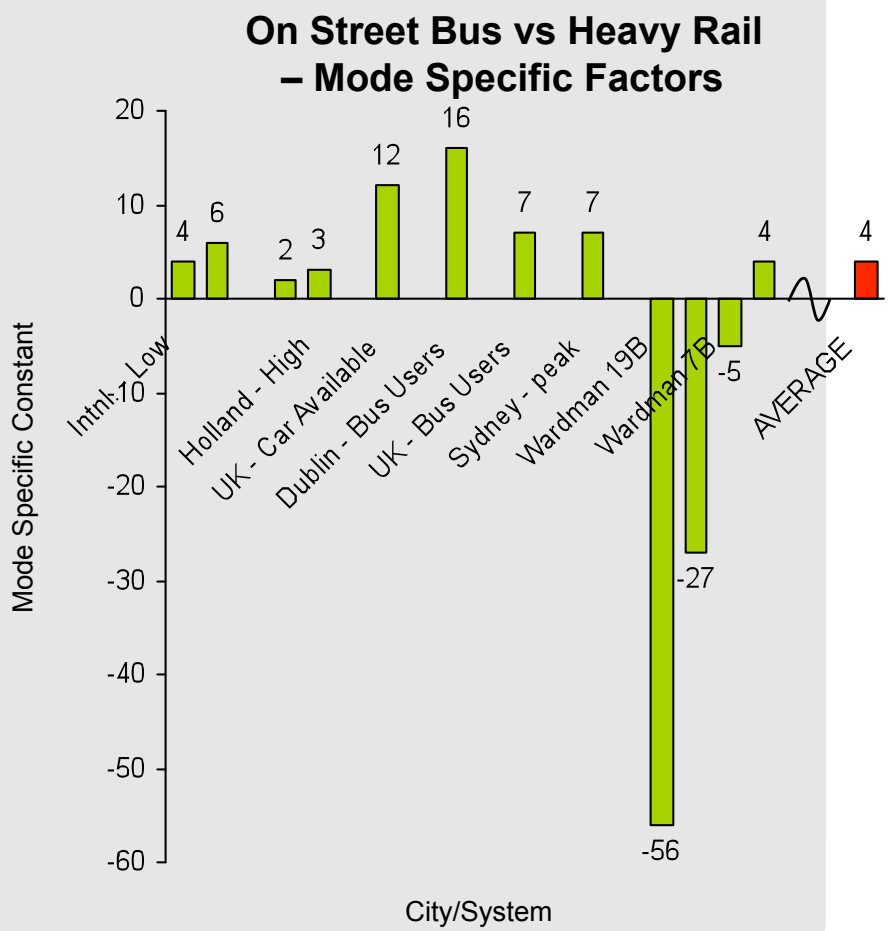
When measured for on-street bus, light rail and heavy rail interesting results emerge



Source: Based on Currie G (2005) 'The Demand Performance of Bus Rapid Transit' Journal of Public Transportation Vol 8 No 1

The evidence shows much variation by mode but a general trend to preference for rail





Source: Currie G (2005) 'The Demand Performance of Bus Rapid Transit' Journal of Public Transportation Vol 8 No 1

Why does rail have a perceived benefit over Bus?

- **The cause of the mode specific factor benefit of rail is related to comparative quality of bus vs rail in relation to:**
  - Stops/Stations
  - Network Knowledge
  - Ride Quality
  - Expectations of Reliability
  - Expectations of Priority
  - Expectations of Speed

Stations have more amenities and are easy to locate than bus stops

- **The cause of the mode specific factor benefit of rail is related to comparative quality of bus vs rail in relation to:**
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Rail lines are easy to understand – bus routes are spaghetti

- **The cause of the mode specific factor benefit of rail is related to comparative quality of bus vs rail in relation to:**
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A rail ride is comfortable, buses require a hand hold

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  - Expectations of Speed

Traffic makes buses more unreliable than rail

- **The cause of the mode specific factor benefit of rail is related to comparative quality of bus vs rail in relation to:**
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  - Expectations of Speed

Rail never waits at traffic signals – bus does

- **The cause of the mode specific factor benefit of rail is related to comparative quality of bus vs rail in relation to:**
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  - Network Knowledge
  - Ride Quality
  - Expectations of Reliability
  - Expectations of Priority
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Rail is perceived as faster – bus in traffic with on-vehicle fare collection is slow

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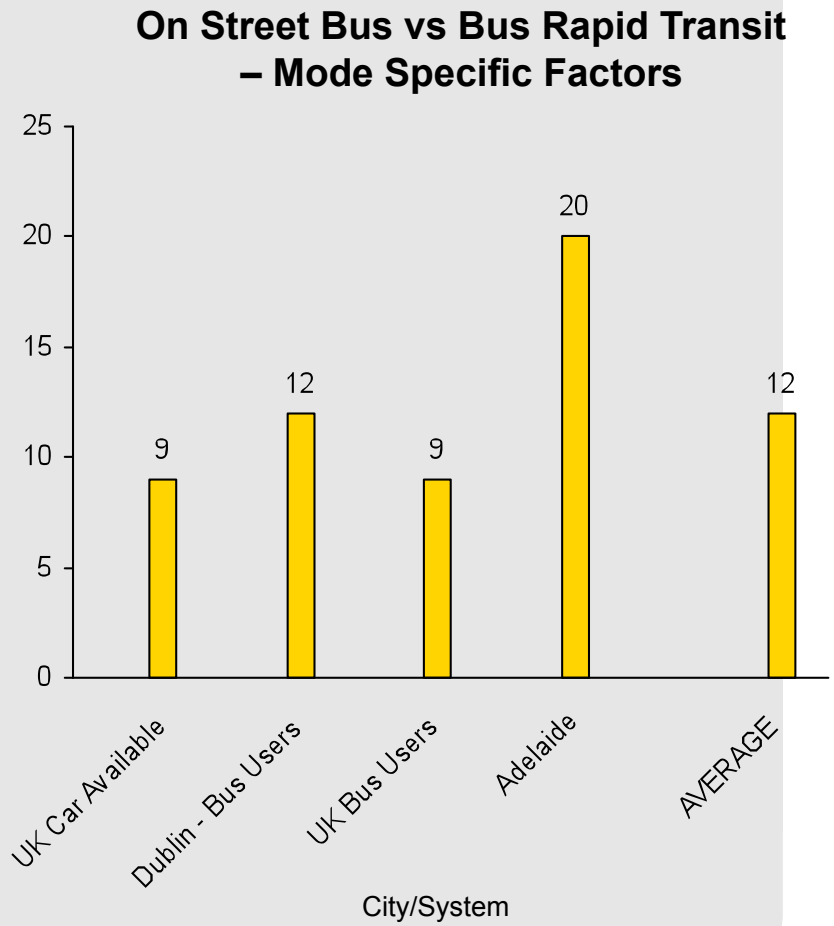
  - Expectations of Priority
  - Expectations of Speed

However (limited) evidence also suggests well designed bus systems can have similar MSC's



Source: Currie G (2005) 'The Demand Performance of Bus Rapid Transit' Journal of Public Transportation Vol 8 No 1

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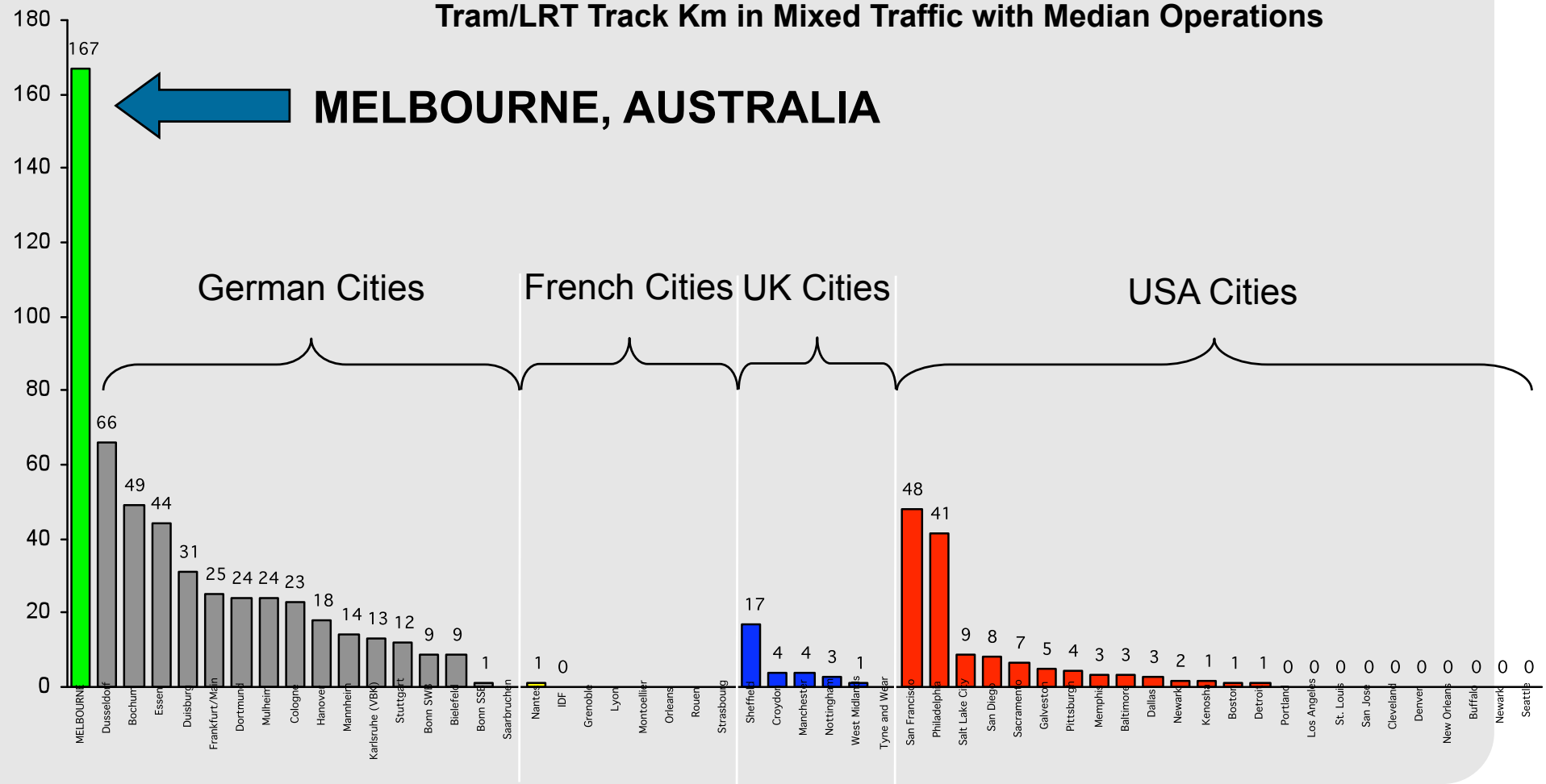
Melbourne has one of the worlds largest light rail systems

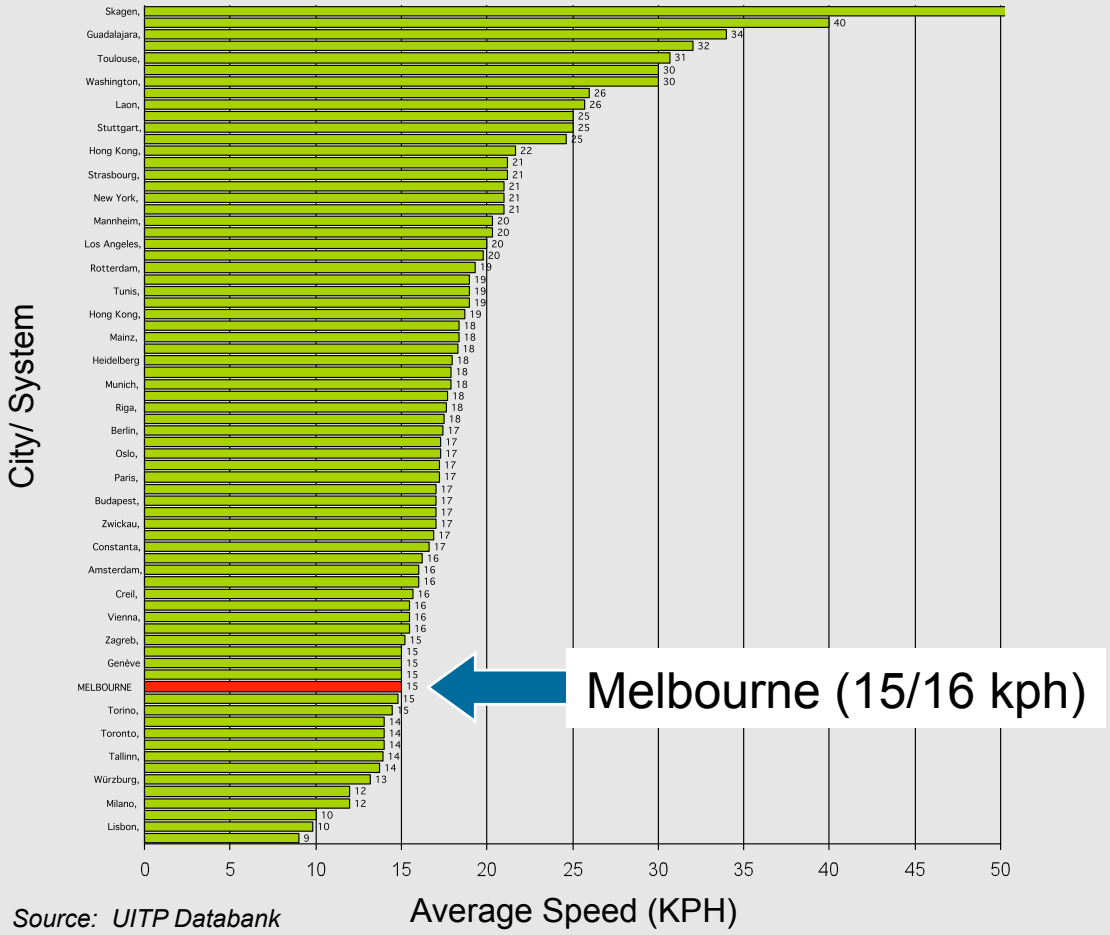
Unfortunately it's a "streetcar" system

Indeed its probably THE biggest (western) city streetcar system



Mixed Traffic service impedes performance

Average Operating Speeds – World Tram/Light Rail Systems



Melbourne (15/16 kph)

Source: UITP Databank

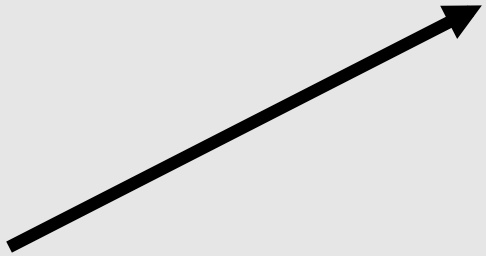
Melbourne Tram Reliability

- **33% of services are considered to be NOT running on time**
- **On time defined as arriving more than 1 min early of more than 6 mins late**

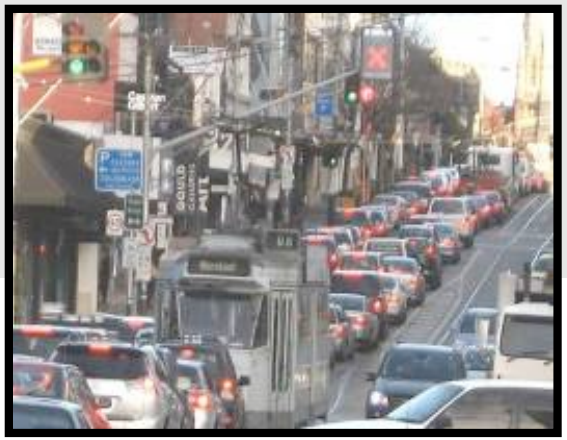
Source: Track Record

As traffic is growing, trams are getting slower and more unreliable

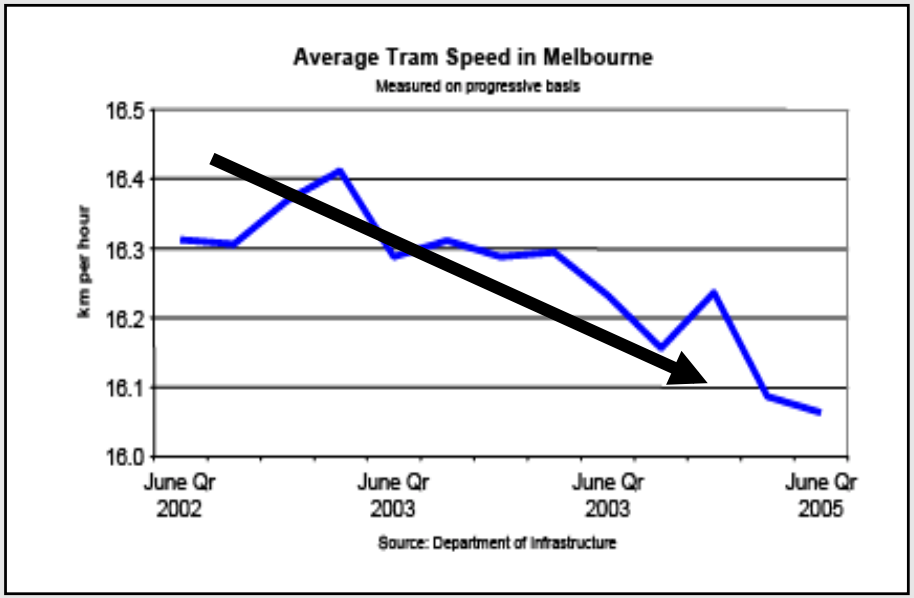
Share of Services NOT ON Time



Source: ITS analysis of 'Track Record' Data



Average Operating Speed (Kph)



Source: Department of Infrastructure

In addition its not DDA Accessible and needs to be by 2032

A good solution are ‘super stops’ – but these are feasible in few locations

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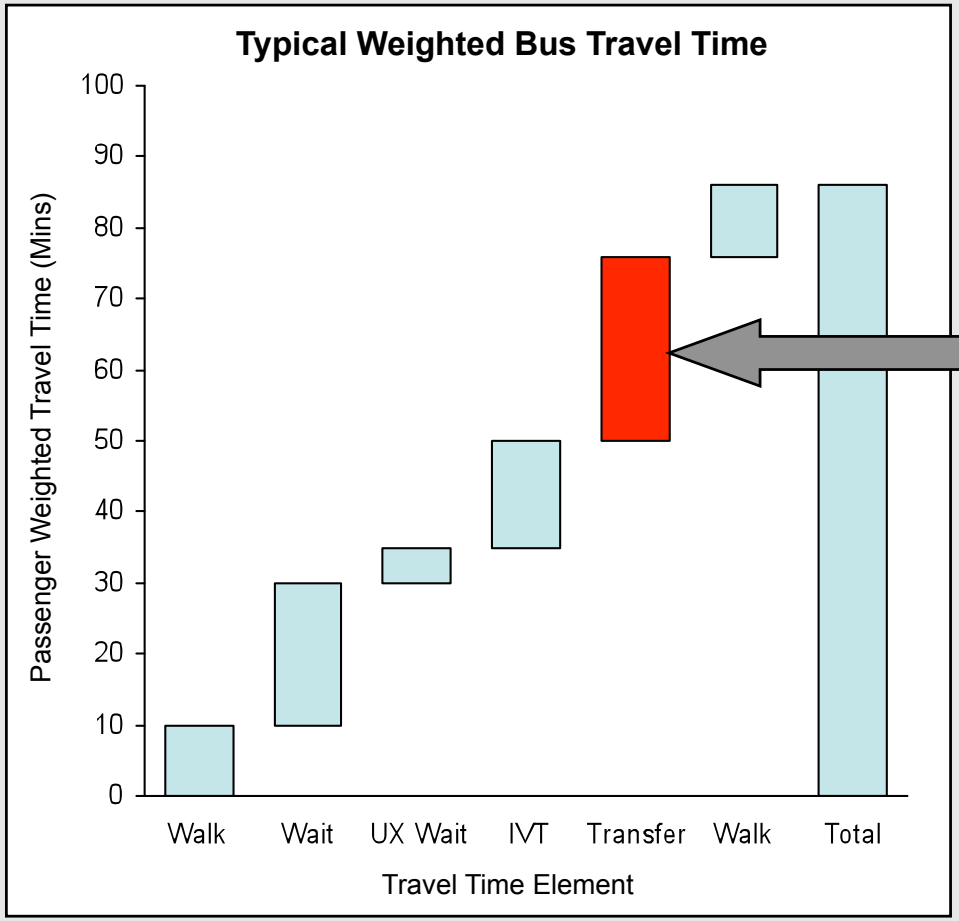
Passengers don't like transferring between transit modes to complete journeys



Transfer Issue

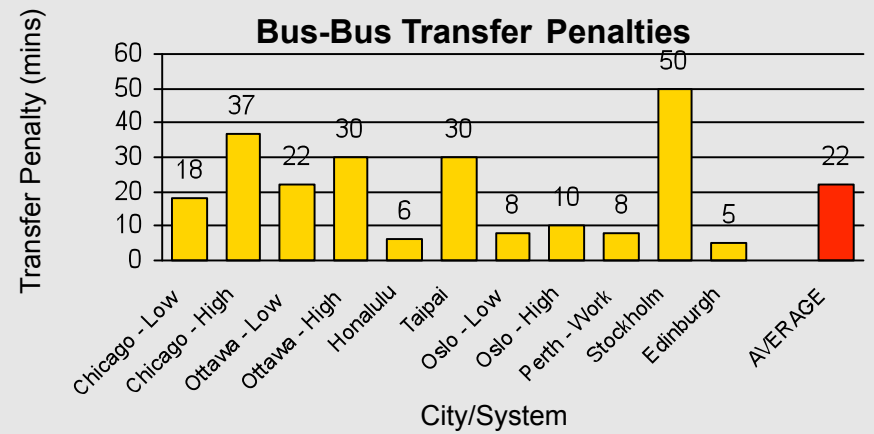
- **Represents over 30% of total perceived travel time**
- **Evidence shows transfer penalties can vary considerably with quality of the transfer location :**

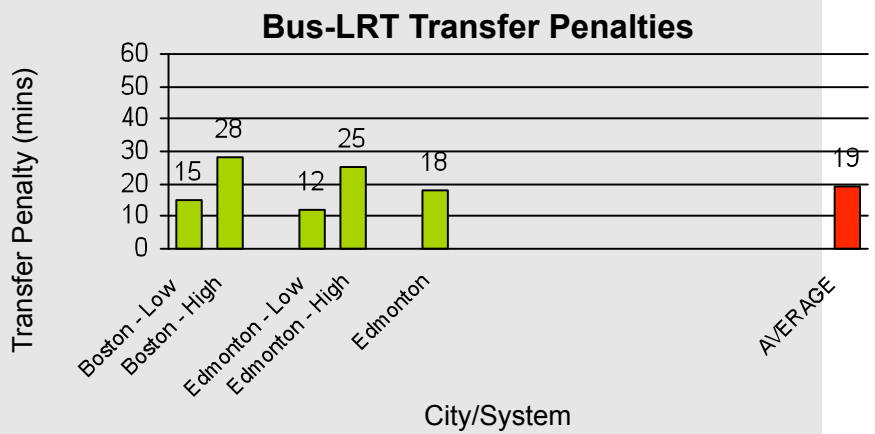
Unprotected Area, Open Air, Uncoordinated Transfer, Low Frequency	Protected Area, Covered, Coordinated Transfer, High Frequency
32 Minutes	4 Minutes

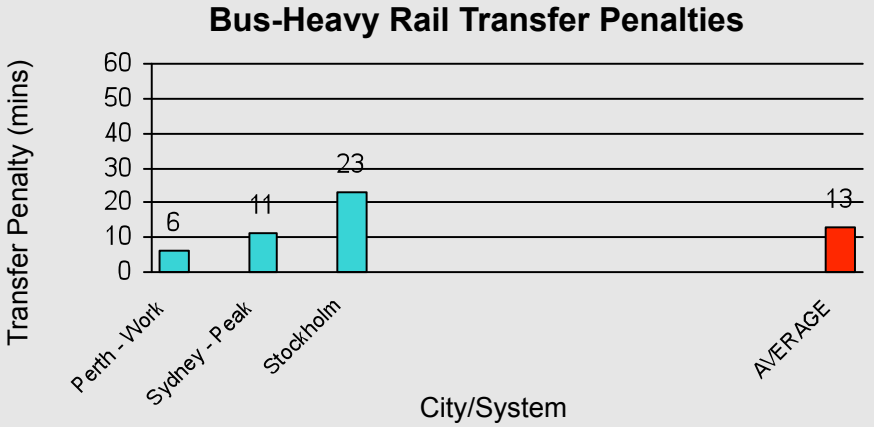
- **Utility of Transfer Includes:**
  - Walk transfer time (weighted)
  - Wait transfer time (weighted)
  - PLUS a fixed transfer penalty

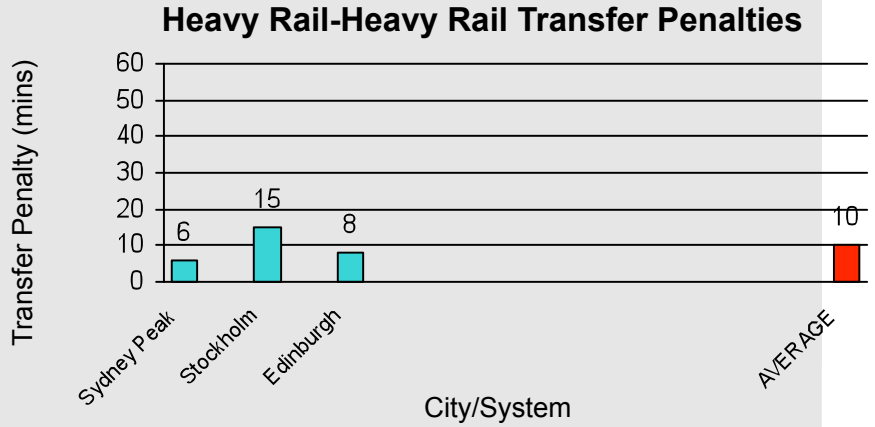
Source: Currie and Willis (98) Australasian Transport Research Forum

Evidence shows transfer ‘penalties’ vary but are generally significant in size



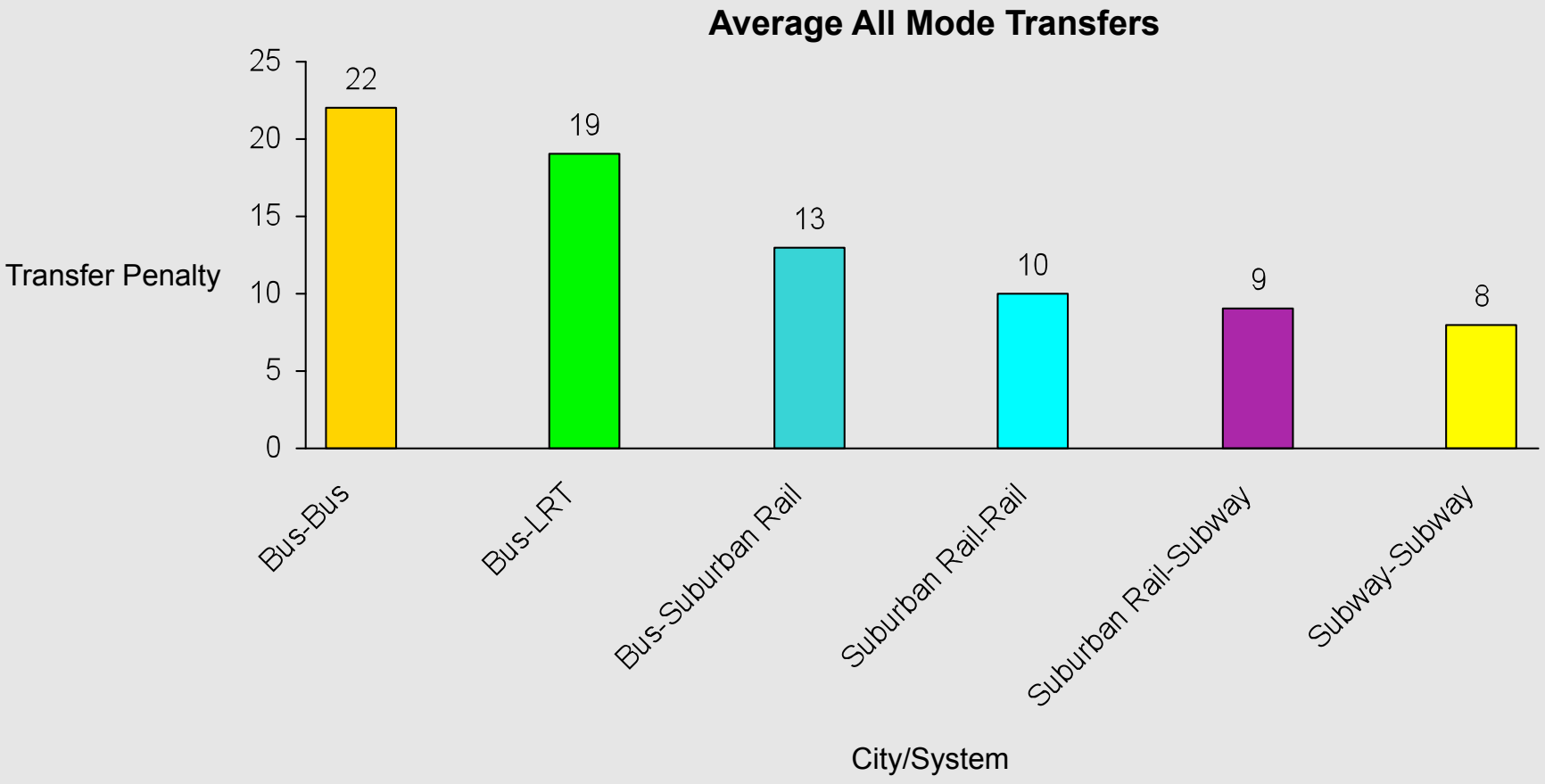






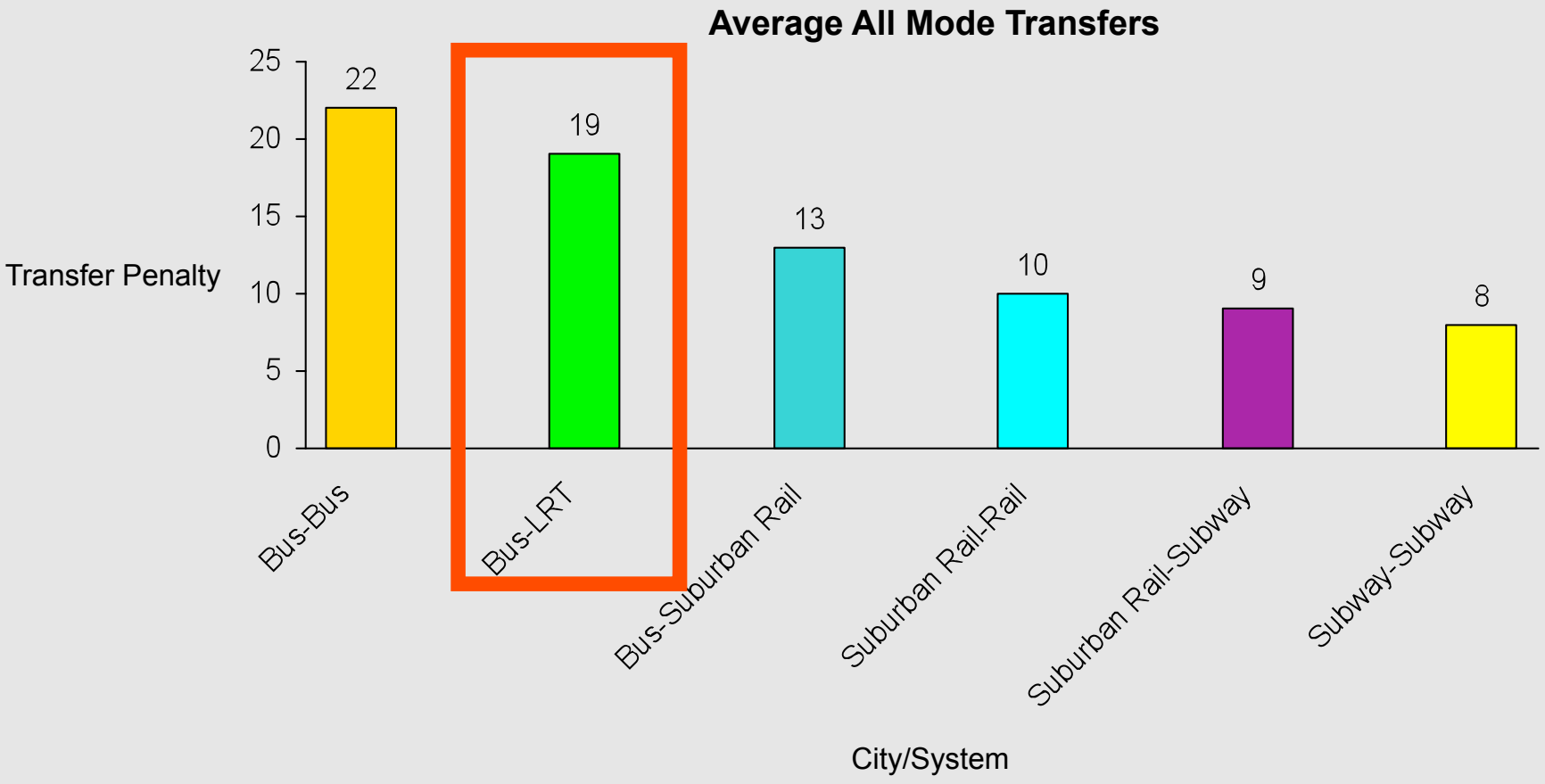
Source: Currie G (2005) ‘The Demand Performance of Bus Rapid Transit’ Journal of Public Transportation Vol 8 No 1

They also vary by mode – quality of the transfer environment is again the determining factor



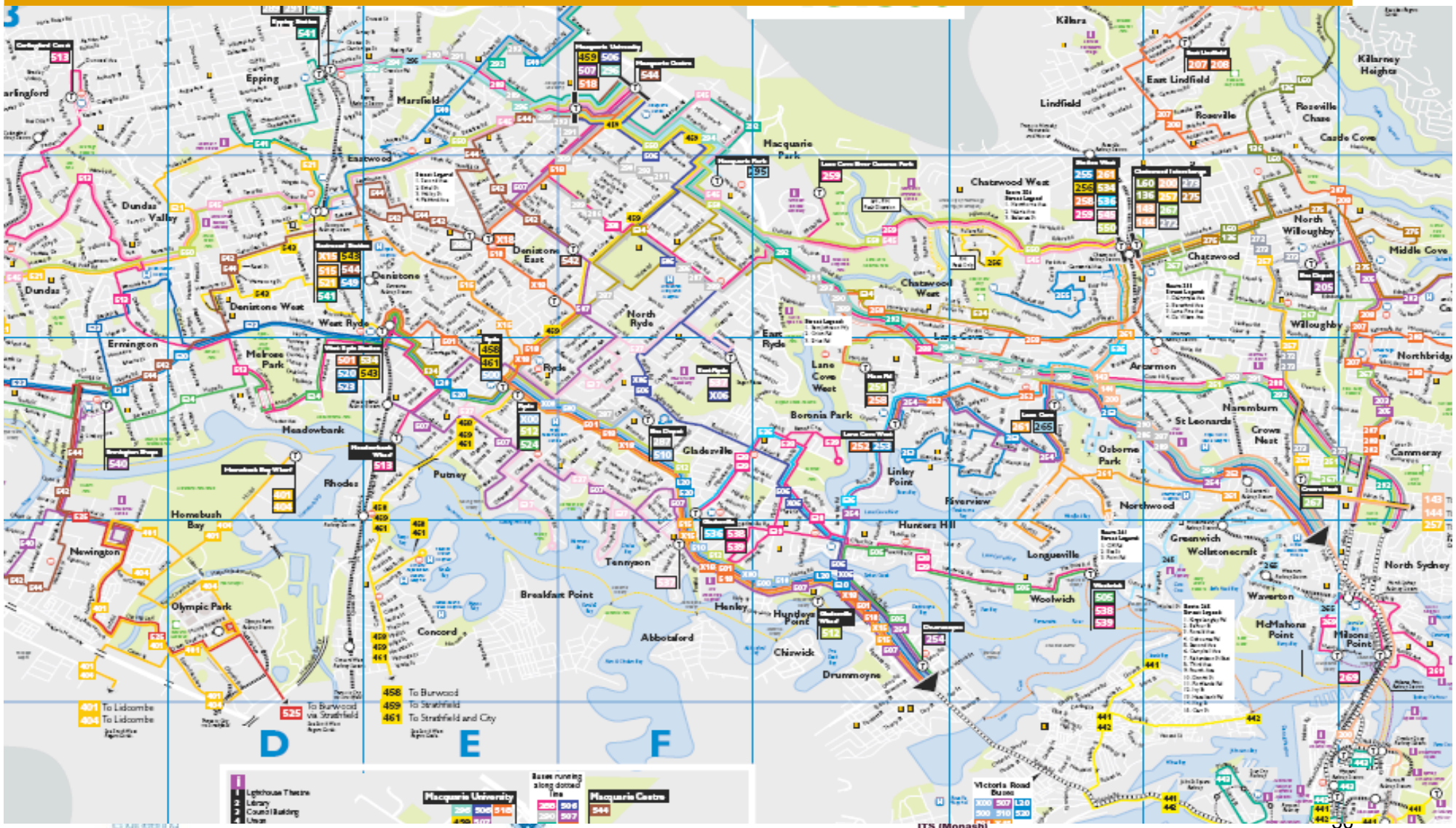
Source: Currie G (2005) 'The Demand Performance of Bus Rapid Transit' Journal of Public Transportation Vol 8 No 1

The average transfer penalty for LRT is 19 minutes – a significant deterent

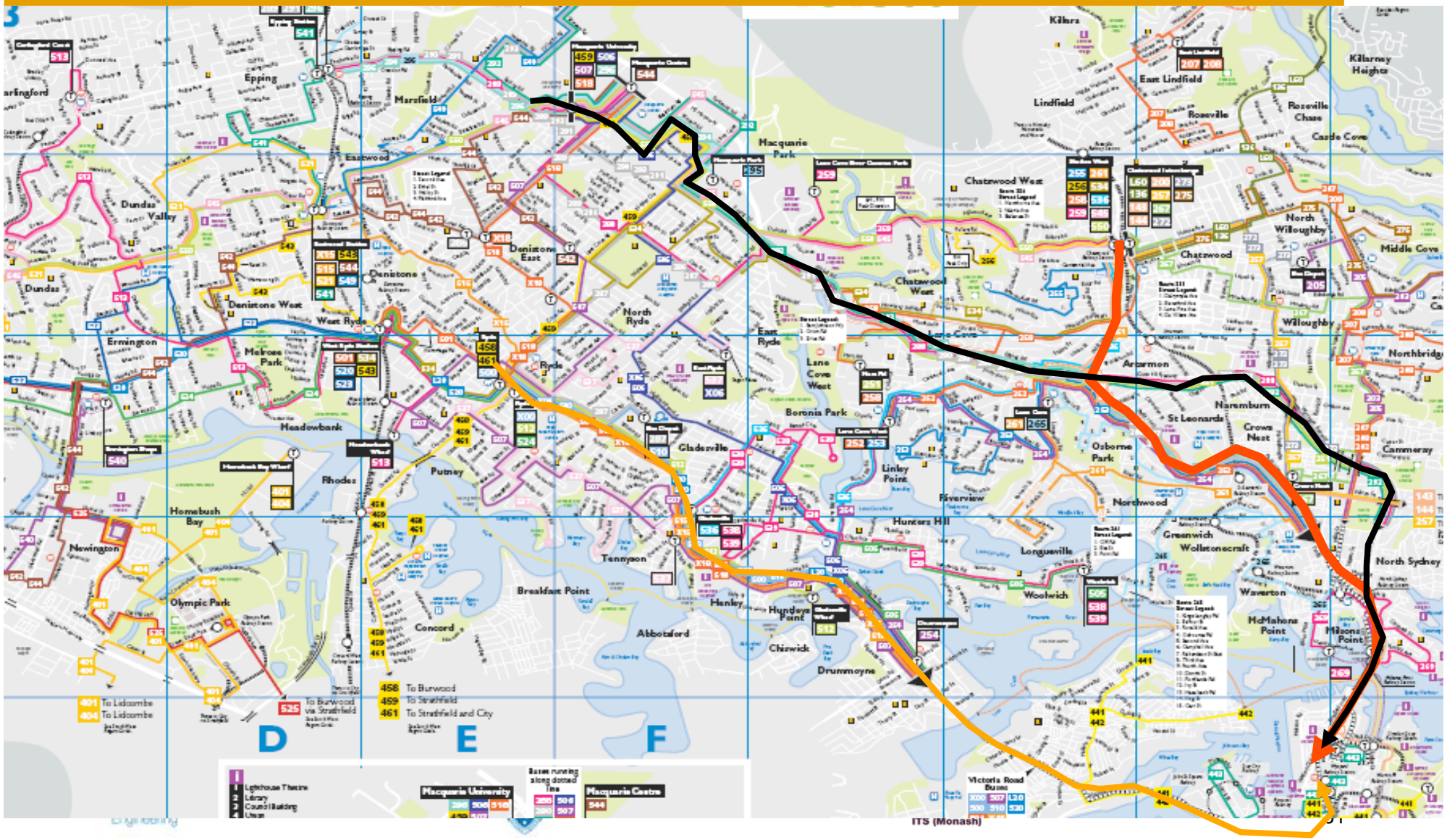


Source: Currie G (2005) 'The Demand Performance of Bus Rapid Transit' Journal of Public Transportation Vol 8 No 1

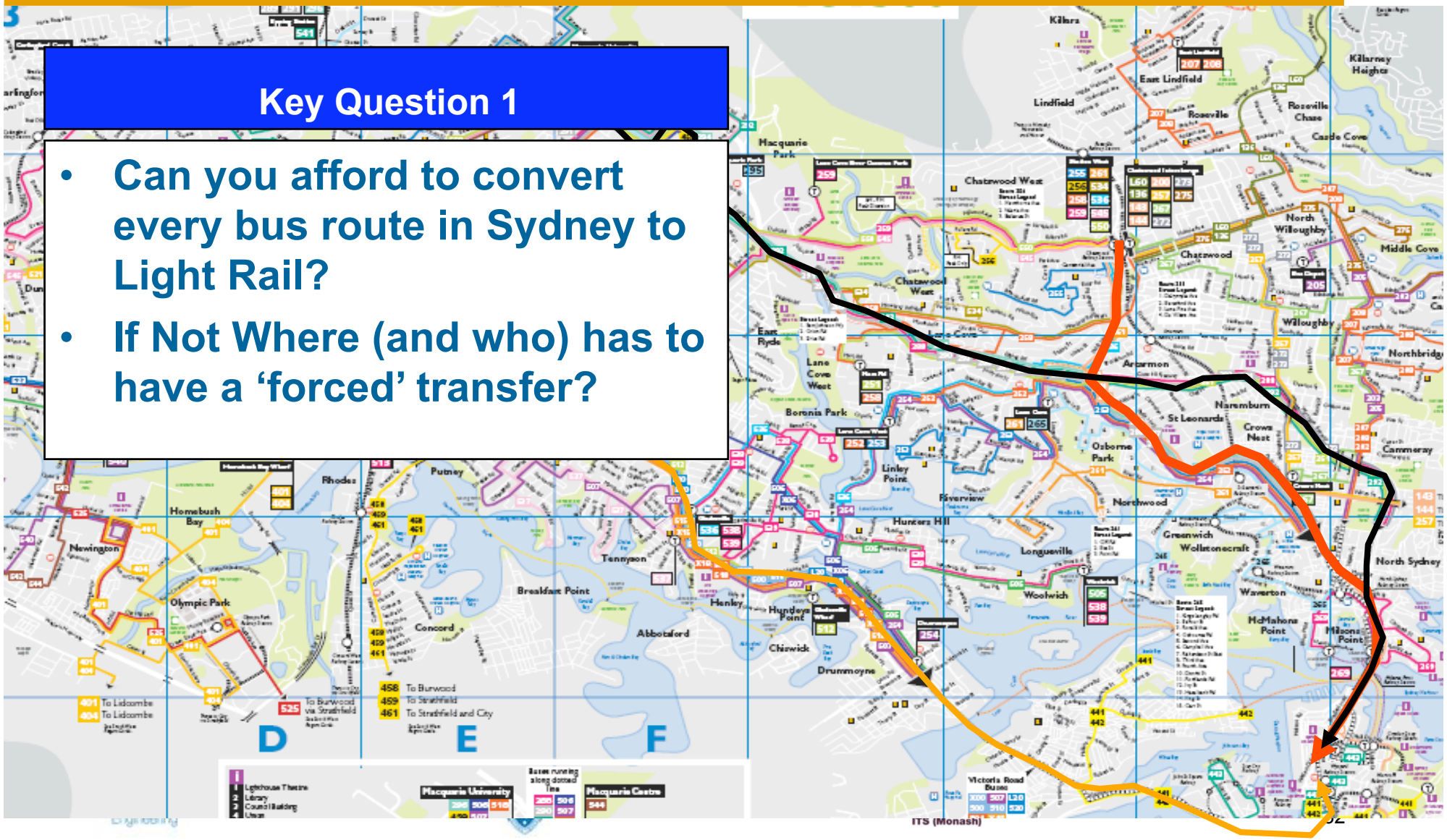
A major LRT design issue is how to avoid ‘forcing’ transfers from bus networks



Bus services run DIRECTLY (No transfer) into the CBD

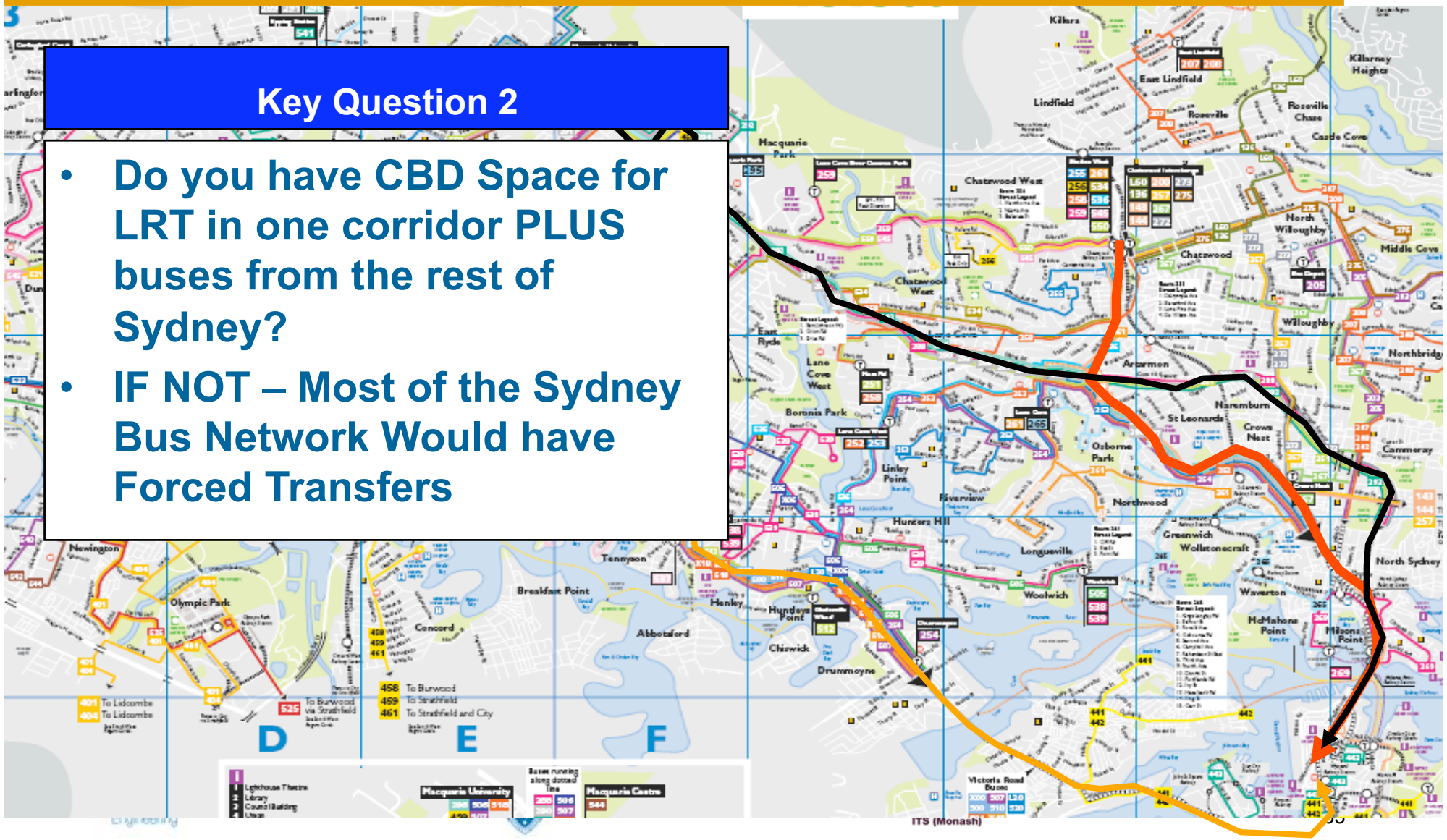


Only Light Rail Running the Full Length of the Route Would Avoid a 'Forced' Transfer



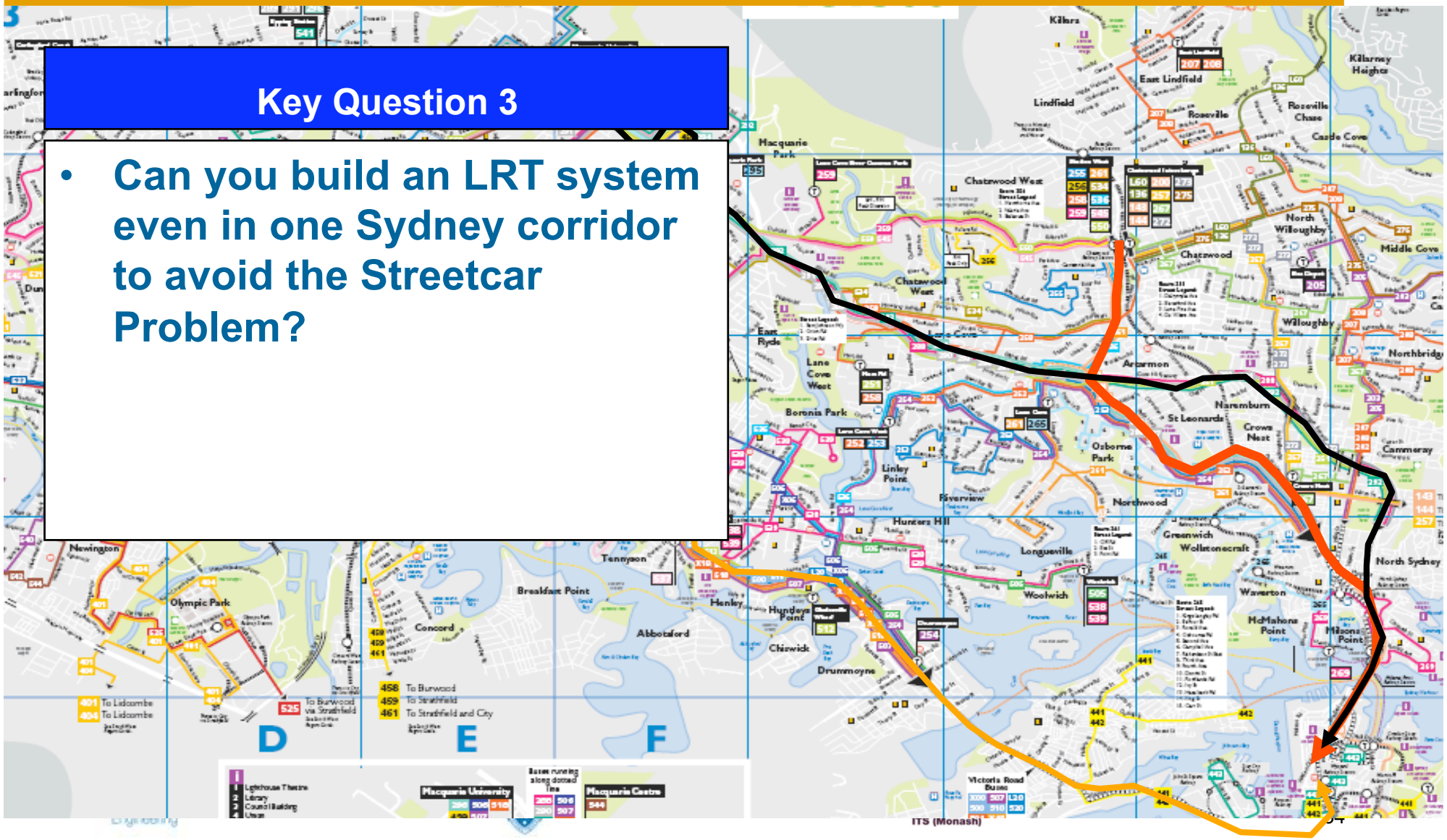
Key Question 2

- Do you have CBD Space for LRT in one corridor PLUS buses from the rest of Sydney?
- IF NOT – Most of the Sydney Bus Network Would have Forced Transfers



Key Question 3

- Can you build an LRT system even in one Sydney corridor to avoid the Streetcar Problem?



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5. Other Factors

a) Cost

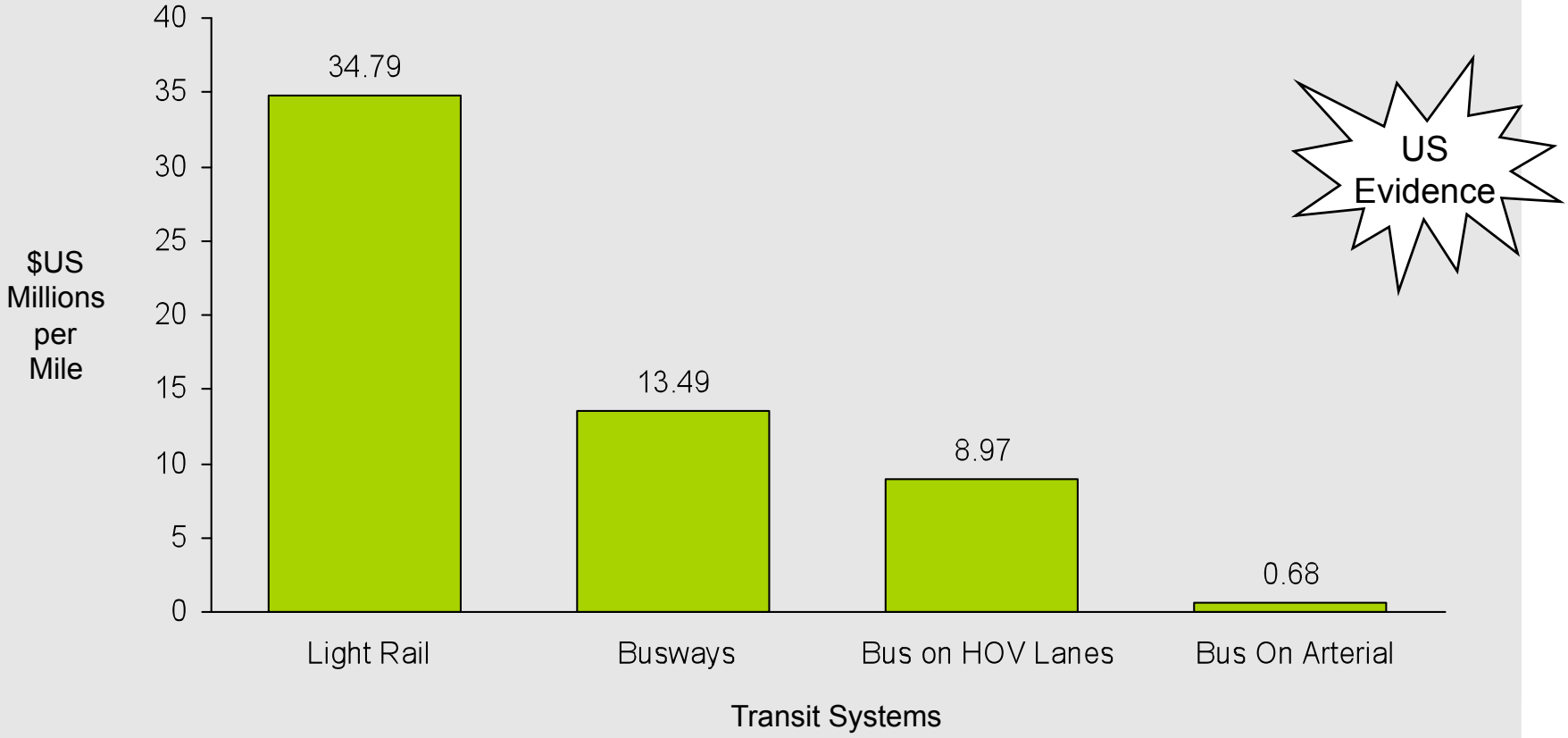
b) Capacity and Performance

c) Environment

d) Development Impacts

BRT is cheaper to build than Light Rail…

Figure 2 : Capital Costs per Mile – Light Rail and BRT Systems



Source: US General Accounting Office "Mass Transit – Bus Rapid Transit Shows Promise" Report to Congressional Requesters September 2001

BRT is cheaper to build than Light Rail…

UK Evidence

Table 8: Examples of systems operating costs

	UK light rail[32]	UK bus[33]
£ per vehicle km	£3.79	£0.94
£ per passenger km	£0.14	£0.08[34]

Table 10: Examples of out-turn capital costs (2002 prices)[40]

	Light rail	Bus lanes	Busways	Conventional guided bus
Infrastructure cost (£m/km, 2-way)	5-25[41]	0.006-0.3	2.7-15	2.7-4.3
Vehicle cost (£'000)	850-2,150	120-200	120-200	120-200[42]
Expected lifetime (yrs)	25-50	8-14	8-14	8-14

Commission for Integrated Transport

..so you can build more mass transit for the dollar available

- **Curitiba's BRT investment was 300 times less costly than an equivalent subway system (Hensher, 1999)**
- **Bogota – TransMilenio busway 100% city wide transit system for the same cost as one railway line covering a small share of the city (16%) (Cain et al, 2006)**

How much of Australian cities can you cover for the cost of LRT?

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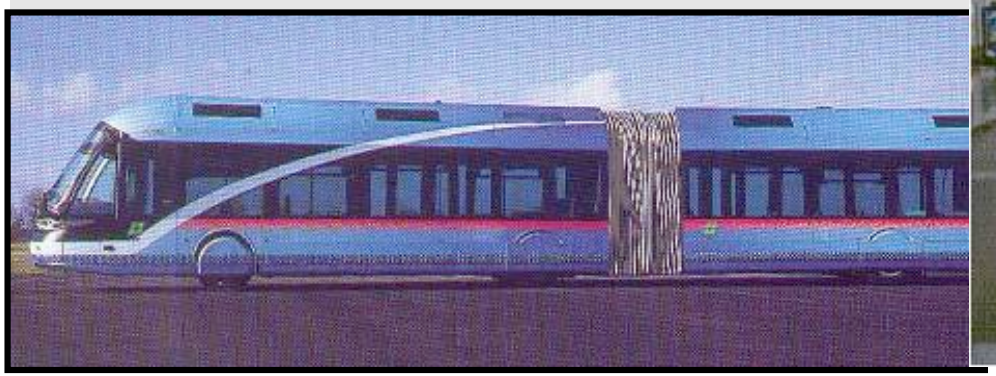
Rouen (France) changed from LRT to BRT investment for sound financial reasons

- **Transit investment:**
  - 1994 – 2 light rail lines
  - 2001 – 3 BRT lines
- **Why BRT?**
  - Construction costs divided by 5
  - Operating costs divided by 1.4
  - Total construction period halved
  - Flexibility of buses vs LRT



5. Other Factors

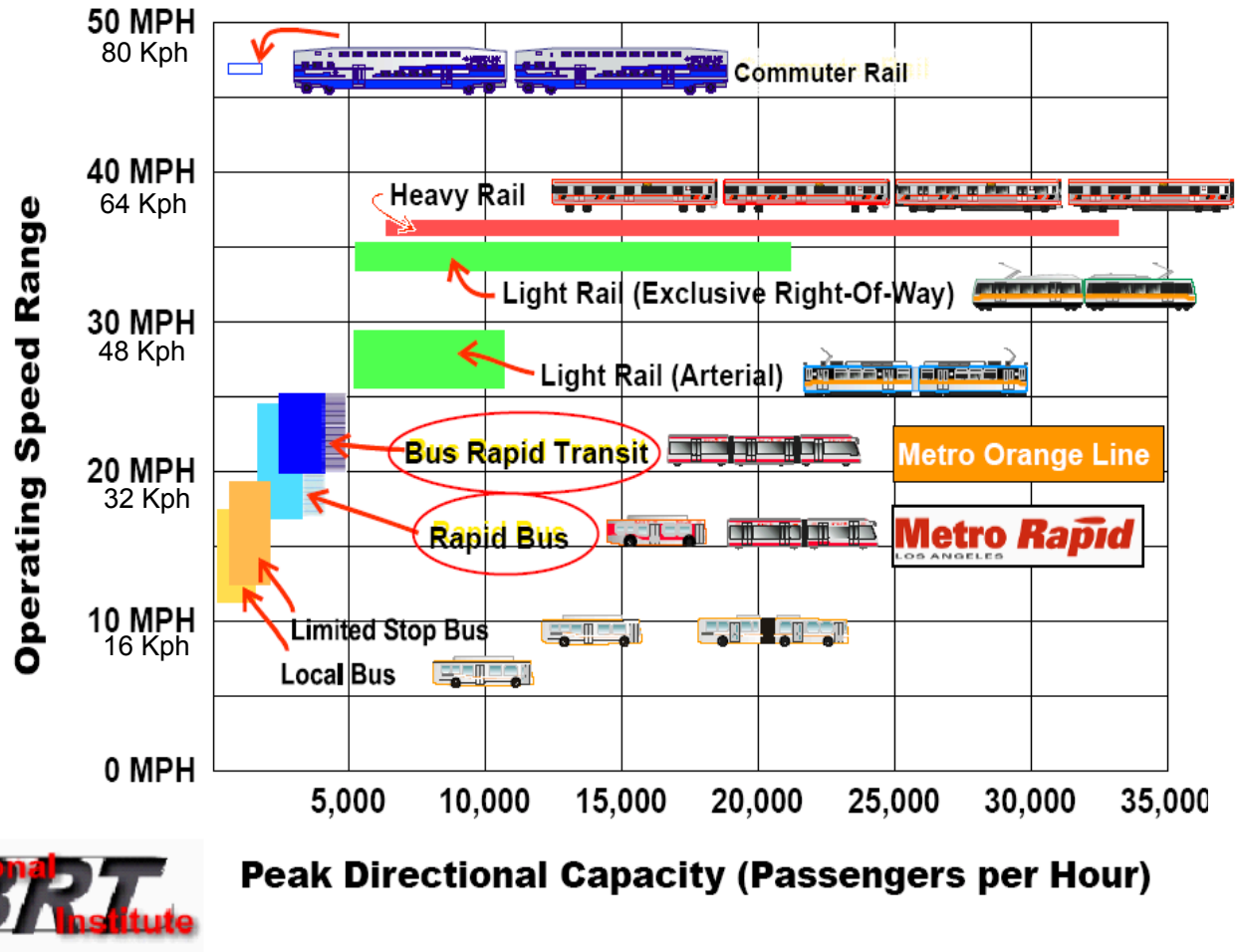
a) Cost

b) Capacity and Performance

c) Environment

d) Development Impacts

LRT claims speed and capacity advantages...



National BRT Institute

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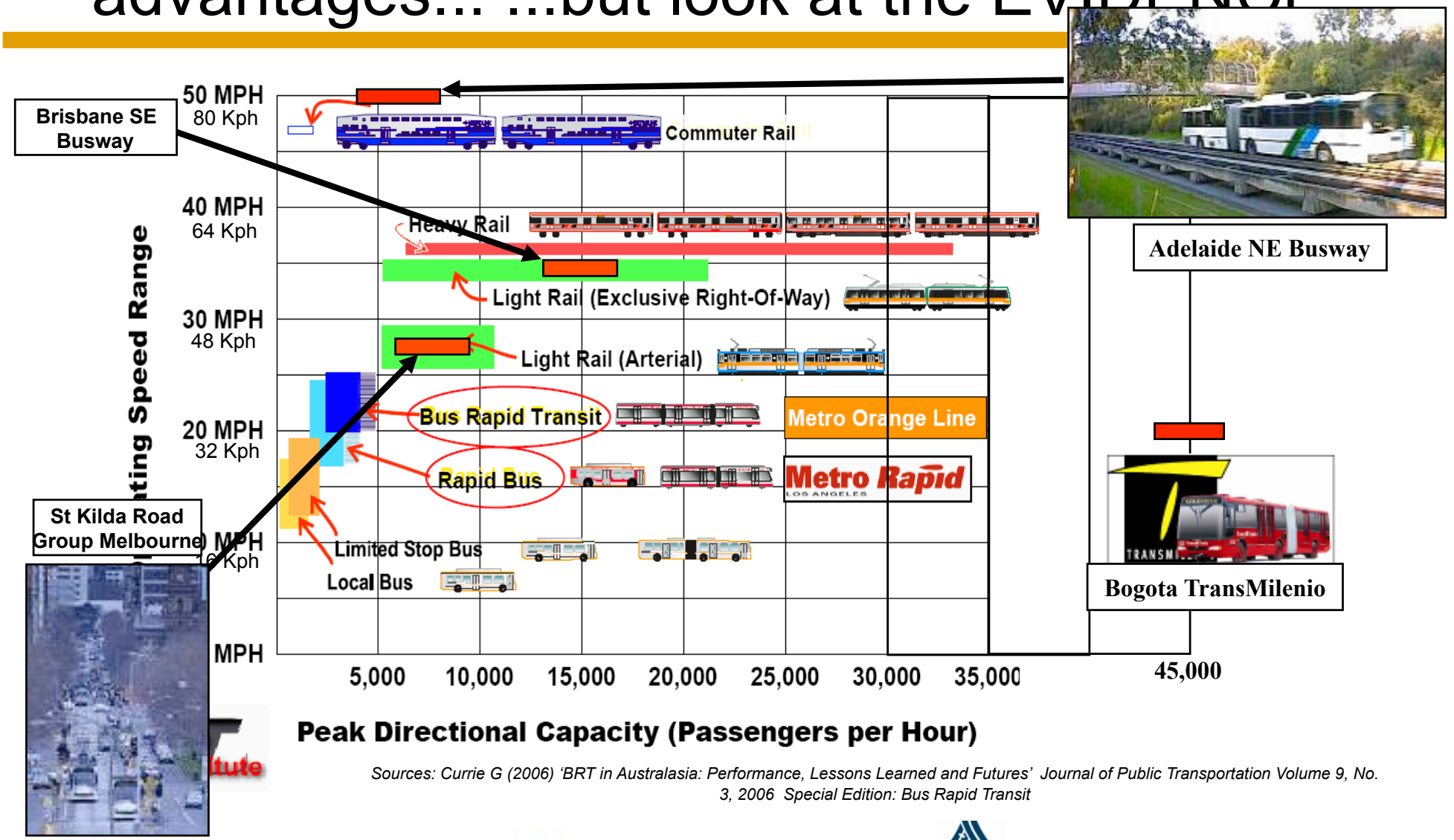
LRT claims speed and capacity advantages... ...but look at the EVIDENCE



Sources: Currie G (2006) 'BRT in Australasia: Performance, Lessons Learned and Futures' Journal of Public Transportation Volume 9, No. 3, 2006 Special Edition: Bus Rapid Transit

5. Other Factors

a) Cost

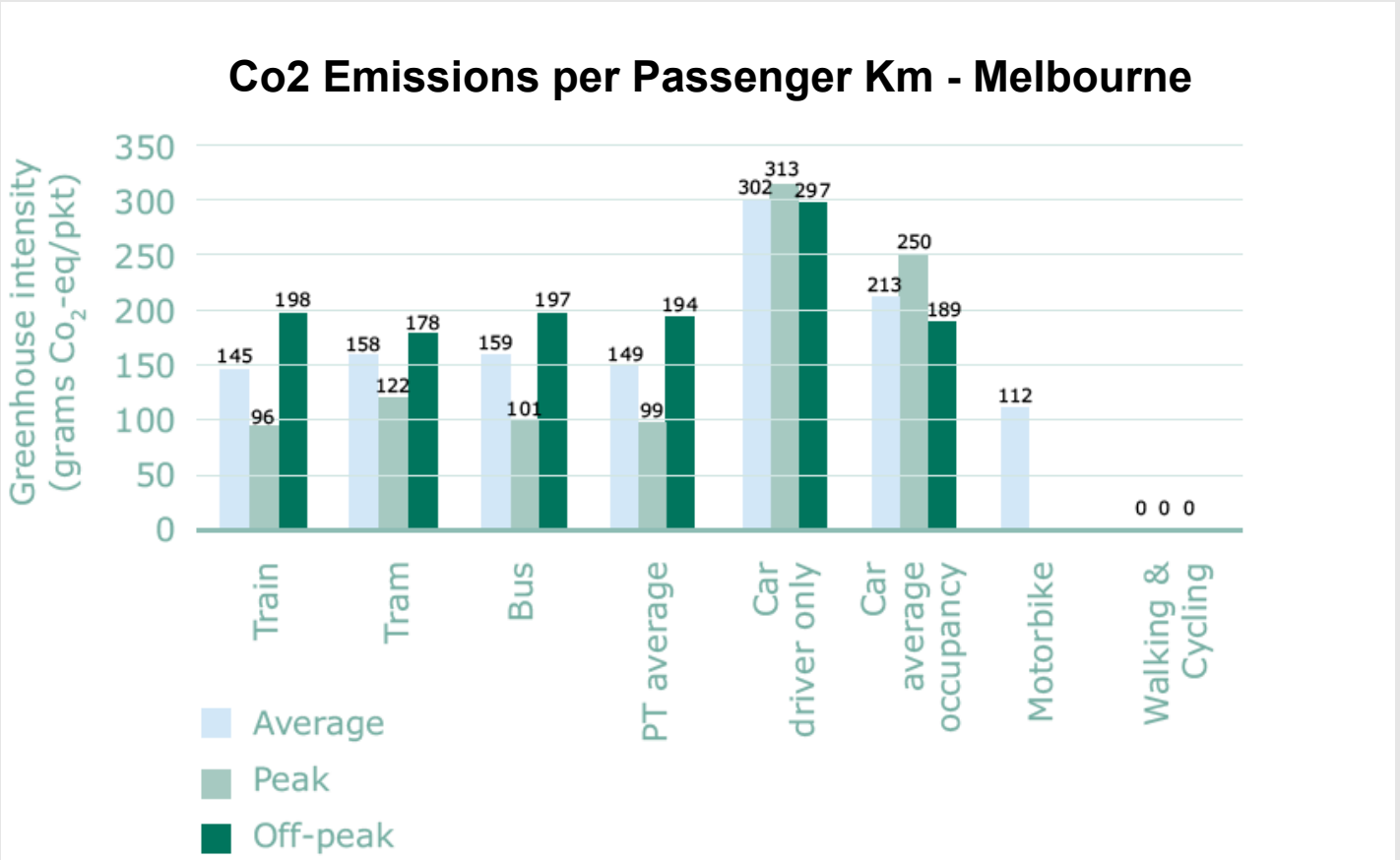
b) Capacity and Performance

c) Environment

d) Development Impacts

Light Rail runs on “clean” electricity while bus runs on “dirty” diesal

But in Melbourne, there isnt much difference



Source: 'Public transport's role in reducing greenhouse emissions' Position Paper July 2008 Commissioner for Environmental Sustainability, Melbourne Australia

5. Other Factors

a) Cost

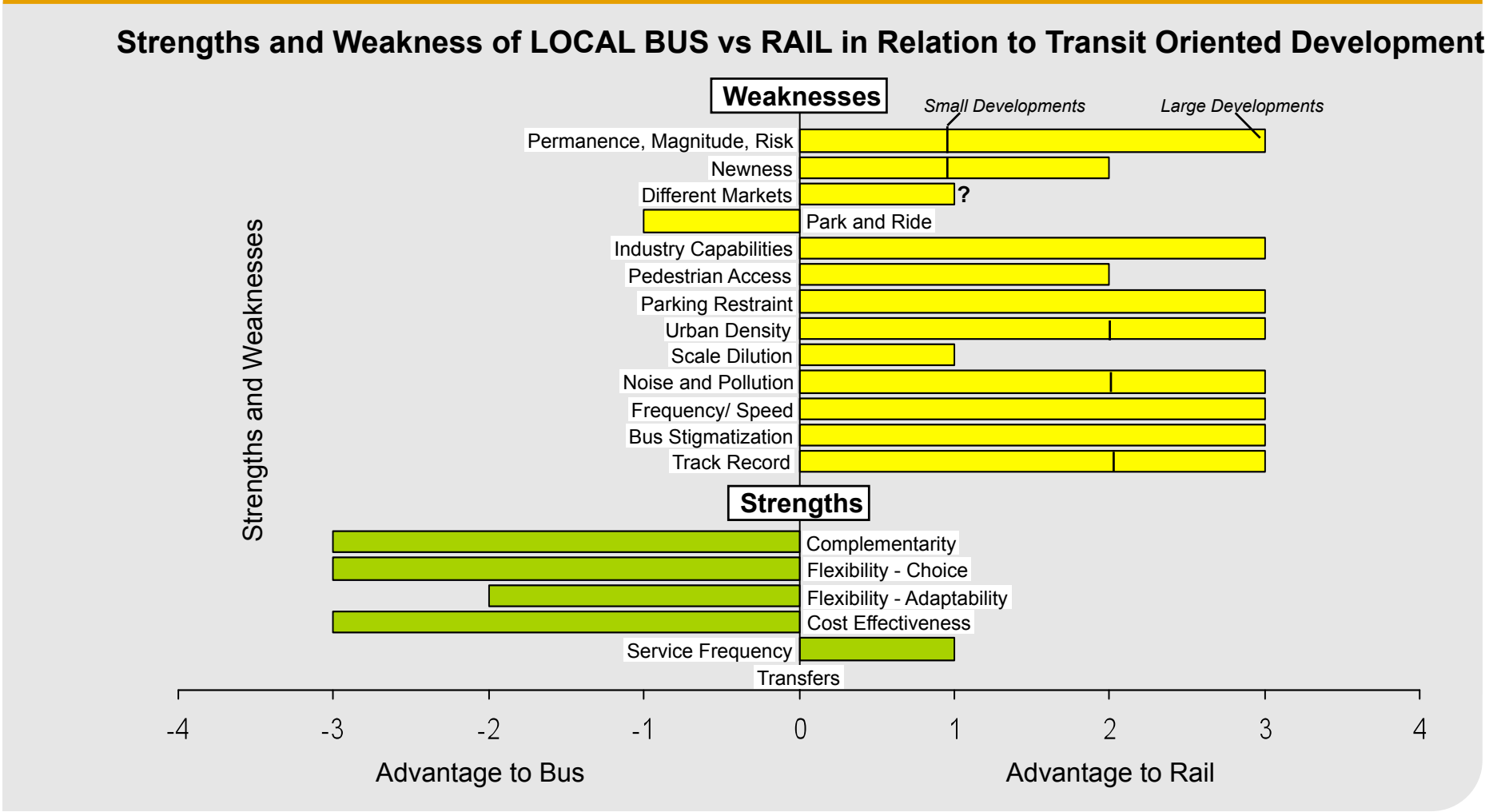
b) Capacity and Performance

c) Environment

d) Development Impacts

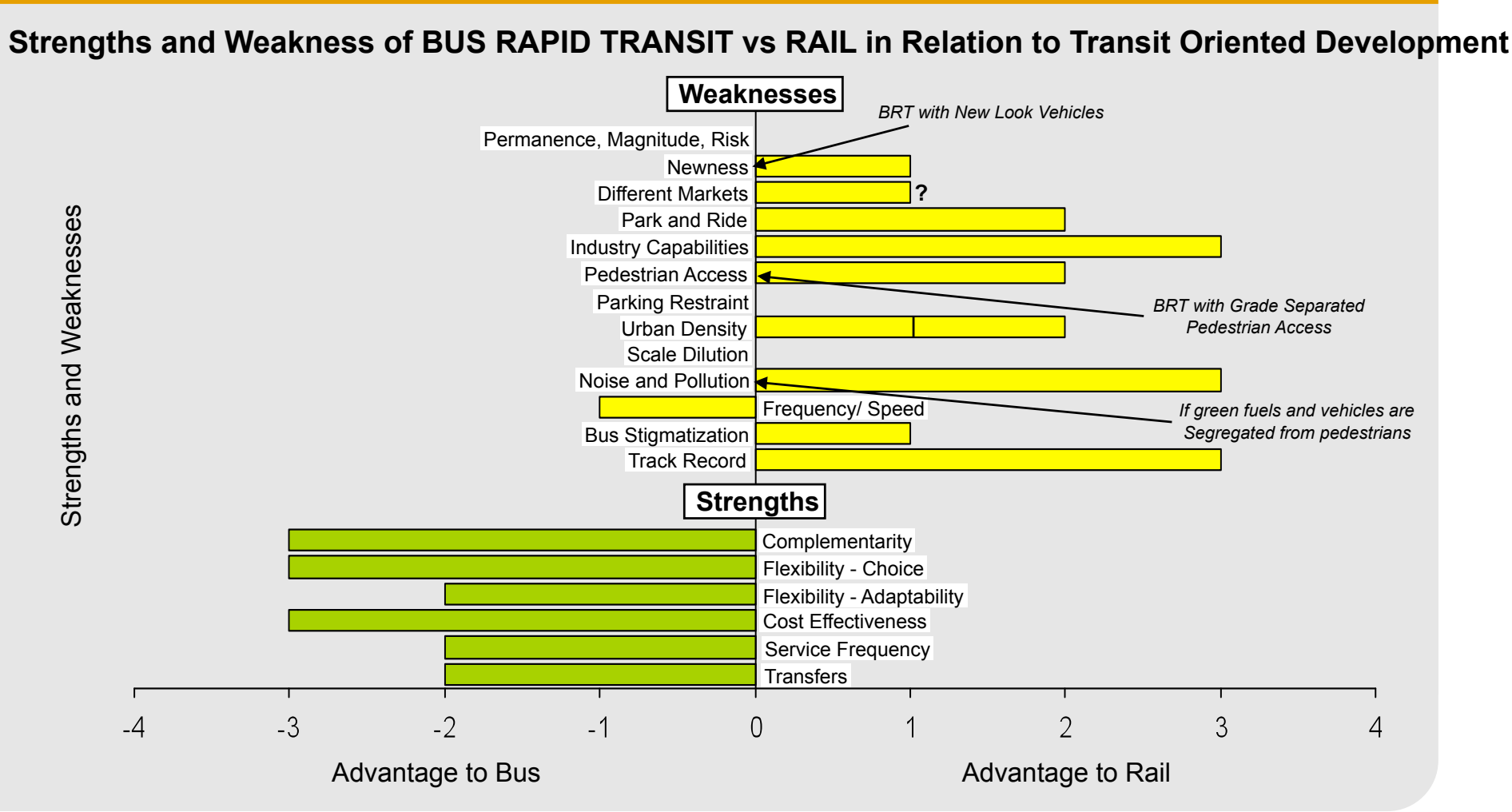
The positive impact of LRT/rail on transit oriented development (TID) are well documented

Research aimed to identify TOD pros (and cons) of bus relative to rail – rail is a clear winner



Source: Currie G (2005) "Bus Transit Oriented Development – Strengths and Challenges Relative to Rail' Journal of Public Transportation Vol. 9, No. 4, 2006

The same research indicated well designed bus systems can (almost) match rail performance



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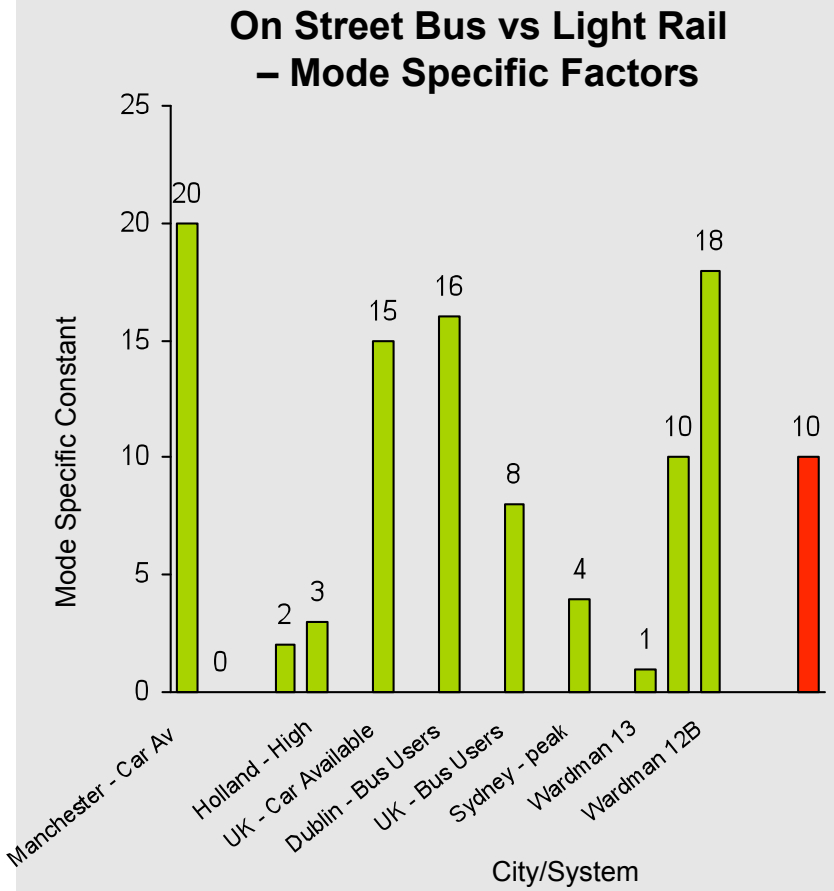
It is a ‘no brainer’ that Australian cities need quality public transport solutions

Transit with rail like qualities is preferred by users and has urban development benefits



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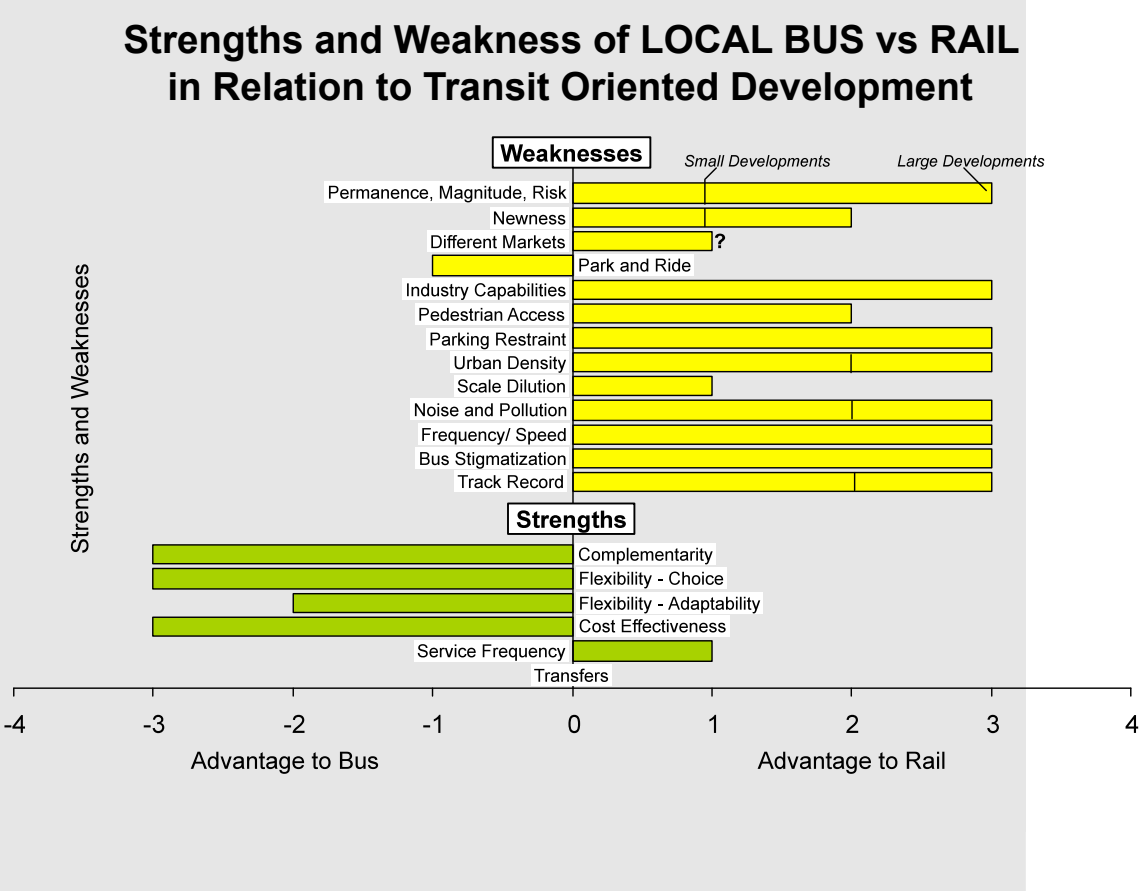
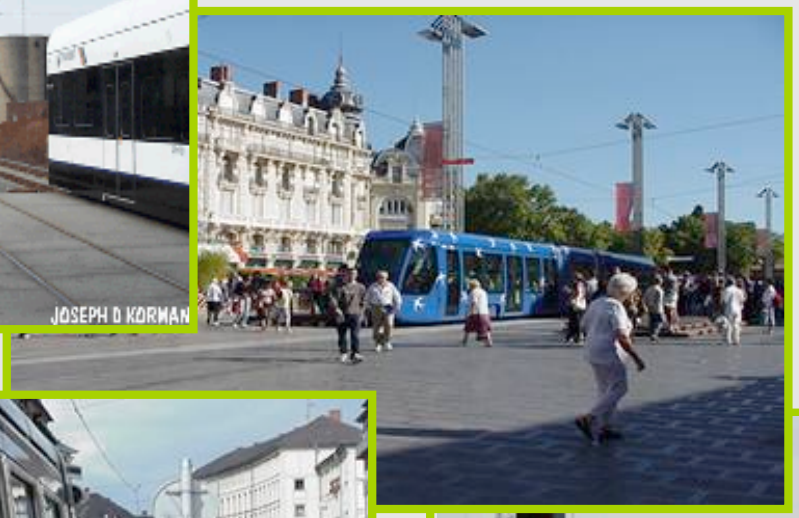


Source: Currie G (2005) "Bus Transit Oriented Development – Strengths and Challenges Relative to Rail' Journal of Public Transportation Vol 8 No 1

However streetcars should be rejected

Segregated ‘traffic free’ rights of way are needed



Research indicates the user priorities for an optimum transit upgrade whatever the mode

- Quality Stops/Stations
- Simple Networks
- Good Ride Quality
- High Reliability
- Priority Over Traffic
- High Speed
- Direct Transfer Free Trip

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