



# International Conference on Transportation & Development

Pittsburgh, Pennsylvania | July 15–18, 2018

*ASCE's Flagship Conference in Transportation & Development*

2018

## *LRT, GRT, PRT Comparison*

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# Outline

- Background
- Methodology
- West Rail Line Light Rail Transit (LRT)
- Group Rapid Transit (GRT)
- Personal Rapid Transit (PRT)
- High Speed & Capacity PRT (HSCPRT)
- Comparison of Results
- Conclusions



# Background

- PRT & GRT
  - First and last mile applications 
  - Supplement to conventional transit 
  - Replace light rail transit (LRT) ?
  - Next generation of PRT ?

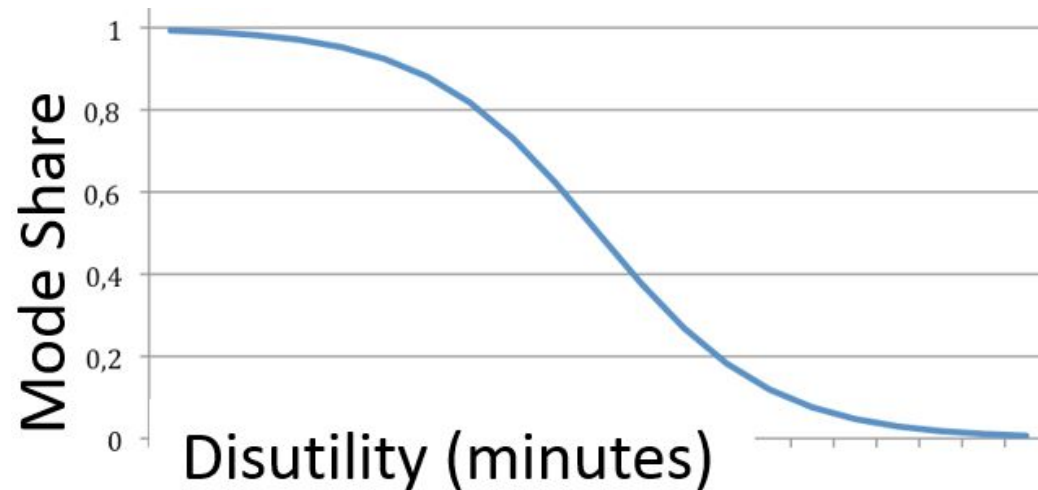
# Methodology

- West Rail Line LRT
  - Layout
  - Cost
  - Performance
- GRT
  - Matched LRT layout
- PRT
  - Adapted LRT layout to suit
- HSCPRT
  - Increased PRT speed & capacity
- Compared cost & performance

} Estimated cost, capacity & ridership

# Methodology

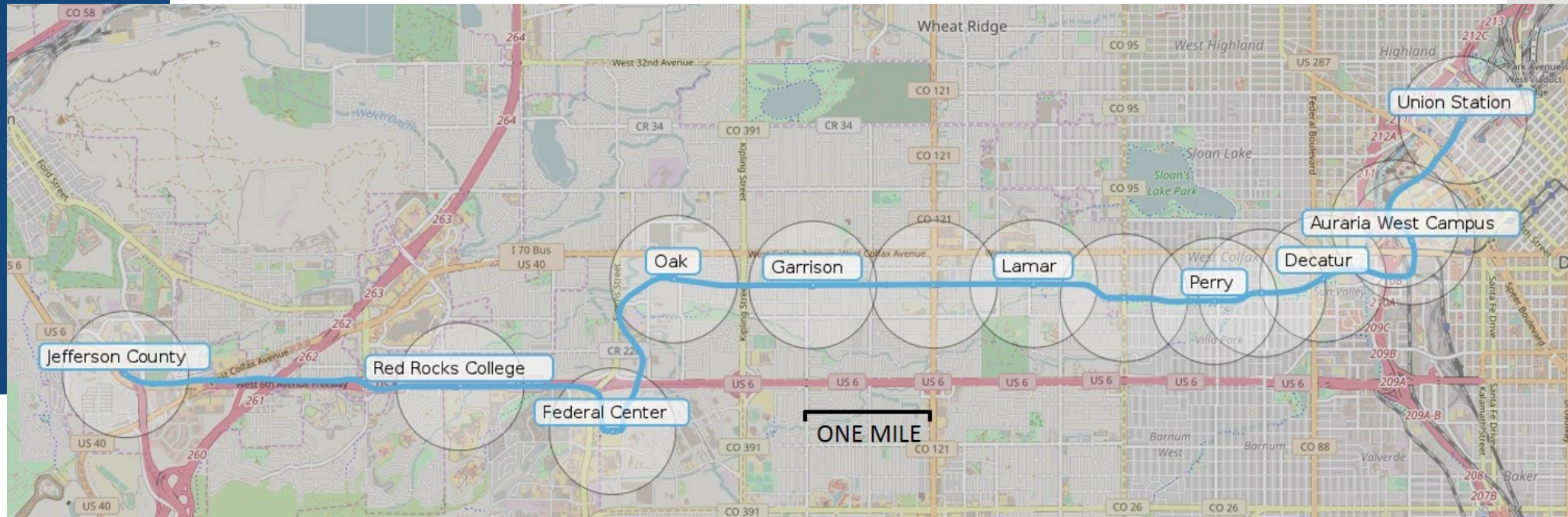
- Ridership
  - GRT, PRT & HSCPRT have shorter trip times
  - Increased ridership based on non-linear demand elasticity by a Logit choice model



Mode share decreases as weighted travel time increases

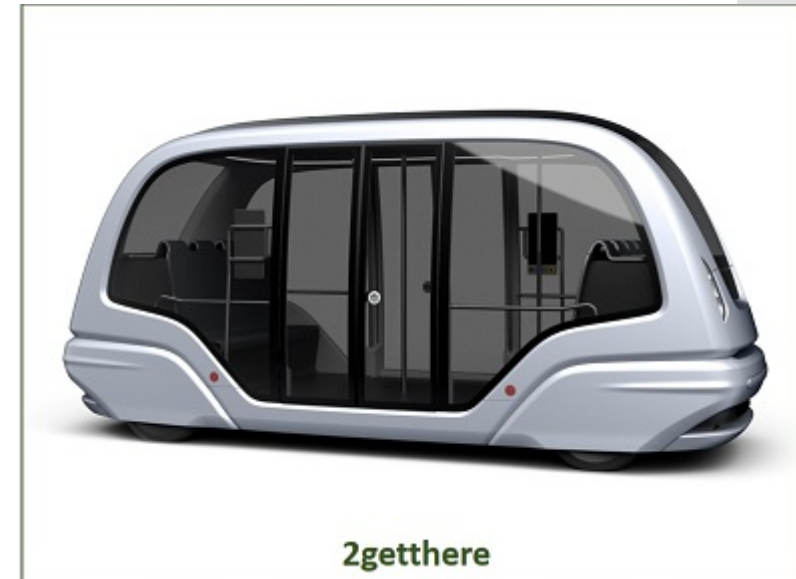
# West Rail Line

- Denver Union Station to Jefferson County Government Center
- 12.1 route miles (single track Jeffco to Federal)
- 14 stations
- 15 minute headway (7.5 minute avg. wait time)
- 55 mph top speed



# GRT

- Denver Union Station to Jefferson County Government Center
- 12.1 route miles (LRT layout)
  - 9.1 track miles at grade, 18.4 elevated
- 14 stations
- 2.5 minute avg. wait time
- 35 mph top speed



GRT

- Ridership increase due to:

- Reduced wait time
- Reduced trip time

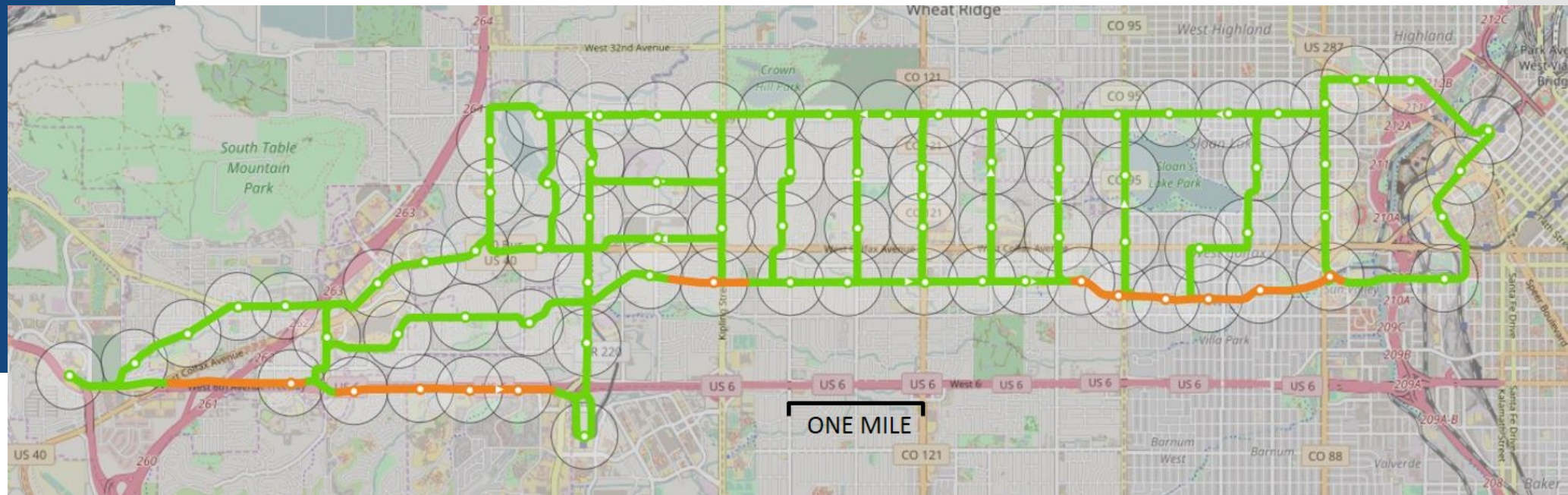


Logit model



# PRT

- Denver Union Station to Jefferson County Government Center
- 54 track miles
- 82 stations
- 1.0 minute avg. wait time
- 35 mph top speed



PRT

- Ridership increase due to:
    - Reduced wait time
    - Reduced trip time
    - Increased walking-area service population
    - 81 destinations per station (up from 13)
      - Assumed to double mode share
      - Accessibility factor = 2
- } Logit model

# HSCPRT

- Maximum speed = 70 mph
- Minimum headway = 1 second (vs. 4 seconds)
- Ridership increase due to:
  - Reduced trip time – Logit model

# Comparison of Results

Average Weighted Trip Times (minutes)				
	LRT	GRT	PRT	HSCPRT
Riders who park	43	29	24	19
Riders who walk (1/4 mile)	38	24	19	14
Riders who bus	53	39	34	29

Equivalent time by car = 31 minutes

# Comparison of Results

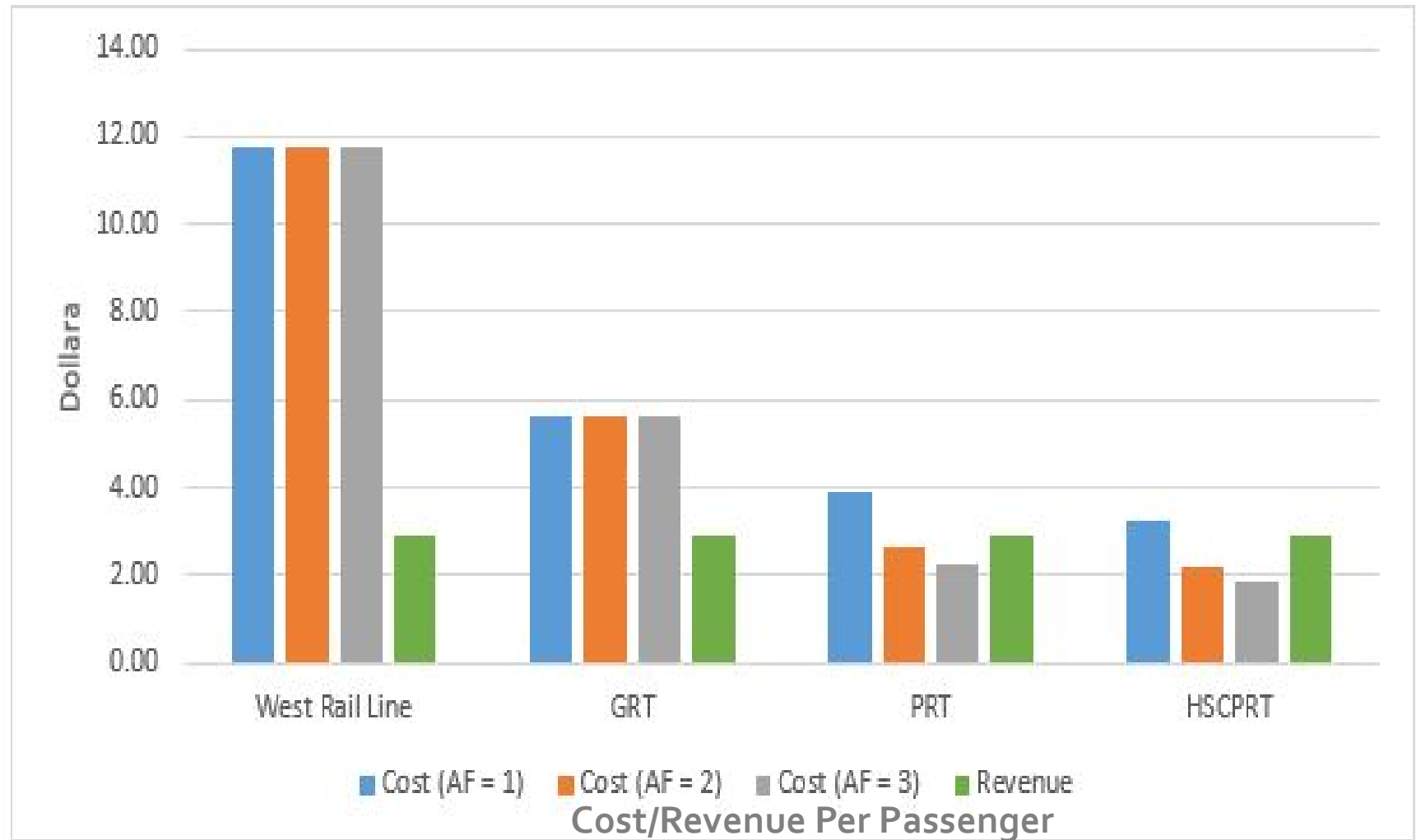
Average Weekday Ridership			
LRT	GRT	PRT	HSCPRT
12,500	20,370	104,123	125,213

# Comparison of Results

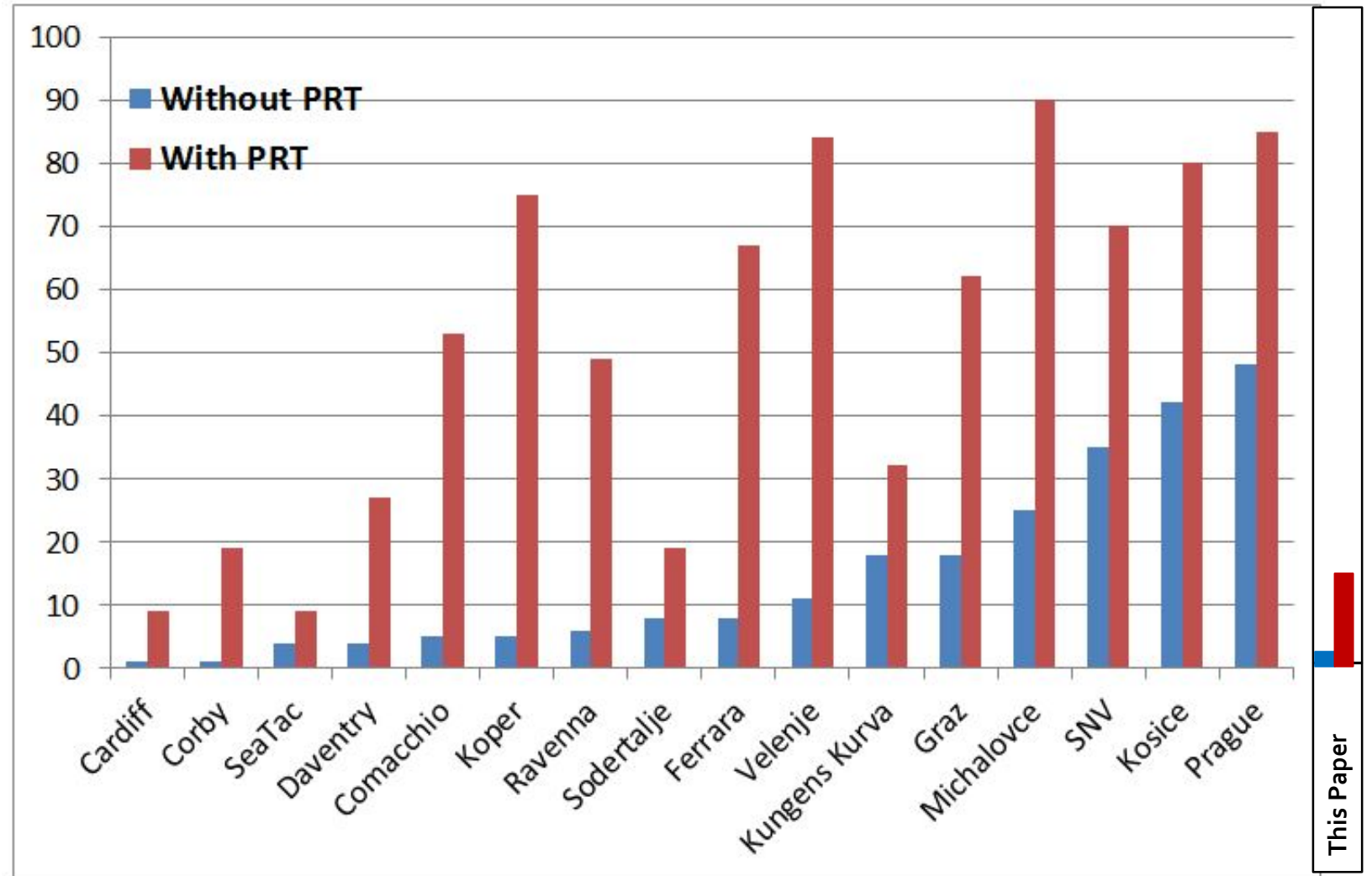
Business Case Analysis (\$ Millions)				
	LRT	GRT	PRT	HSCPRT
Capital Cost	677	565	1,203	1,226
Annual O&M Cost	11	6	23	23
Total Annual Cost <sup>1</sup>	47	37	88	88
Total Annual Revenue	12	19	97	117
Net Annual Revenue	(35)	(17)	9	29
Total Cost Per Passenger	\$11.77 <sup>2</sup>	\$5.60	\$2.65	\$2.21

1. Capital annualized at 4% over 25 years
2. Average fare is \$2.92

# Sensitivity to Accessibility Factor (AF)



# Mode Share Comparison



Transit Mode Share Percentage

Source: Studies in the named cities



## Property value impacts

- TCRP Report 102 indicates residential property premiums of 6.4% to 45% associated with being within 1/4 to 1/2 mile of a station
- PRT increases this area by 13 square miles resulting in a premium sufficient to cover the HSCPRT capital costs only requiring a 10% increase in value for properties within a 1/4 mile radius
- A 10% increase in property taxes covers about 1/3<sup>rd</sup> of the annual operating costs.

# Conclusions

- GRT, PRT and HSCPRT can all carry their respective projected ridership
- All three driverless modes attract more riders at a lower total cost per rider than LRT
- This is an example of transit that can pay for itself and turn entire neighborhoods into Transit Oriented Development