Price Demand Elasticities and Usage of Houston's HOT Lanes

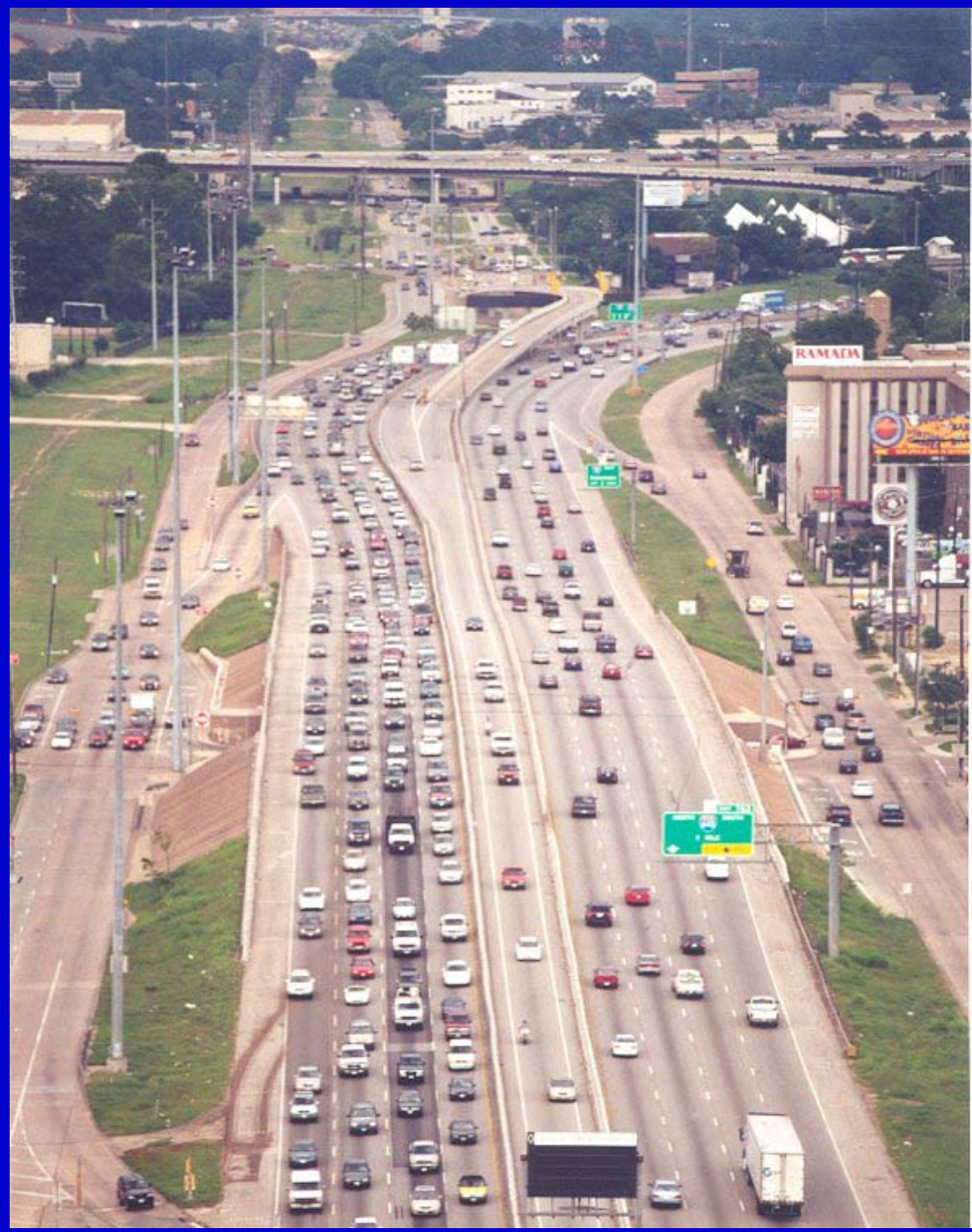
Mark Burris
Texas A & M University
Texas Transportation Institute

International Symposium on Road Pricing
Key Biscayne, Florida
November 2003

Texas Transportation Institute

Katy Freeway (I-10)

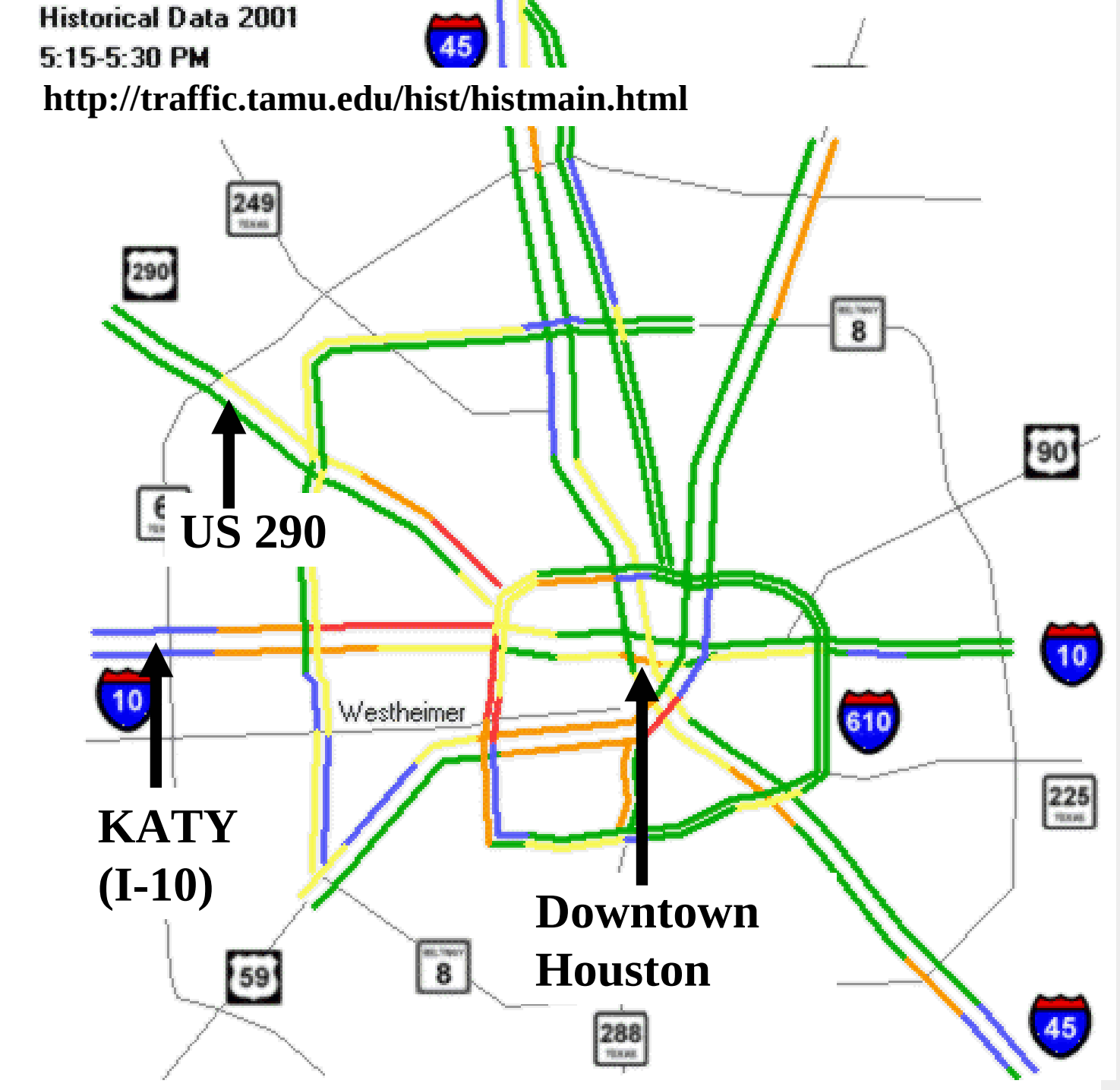
- 212,000 vpd
- 6 to 10 mainlanes
- 4 to 6 frontage road lanes
- 1 reversible, barrier separated, HOT lane



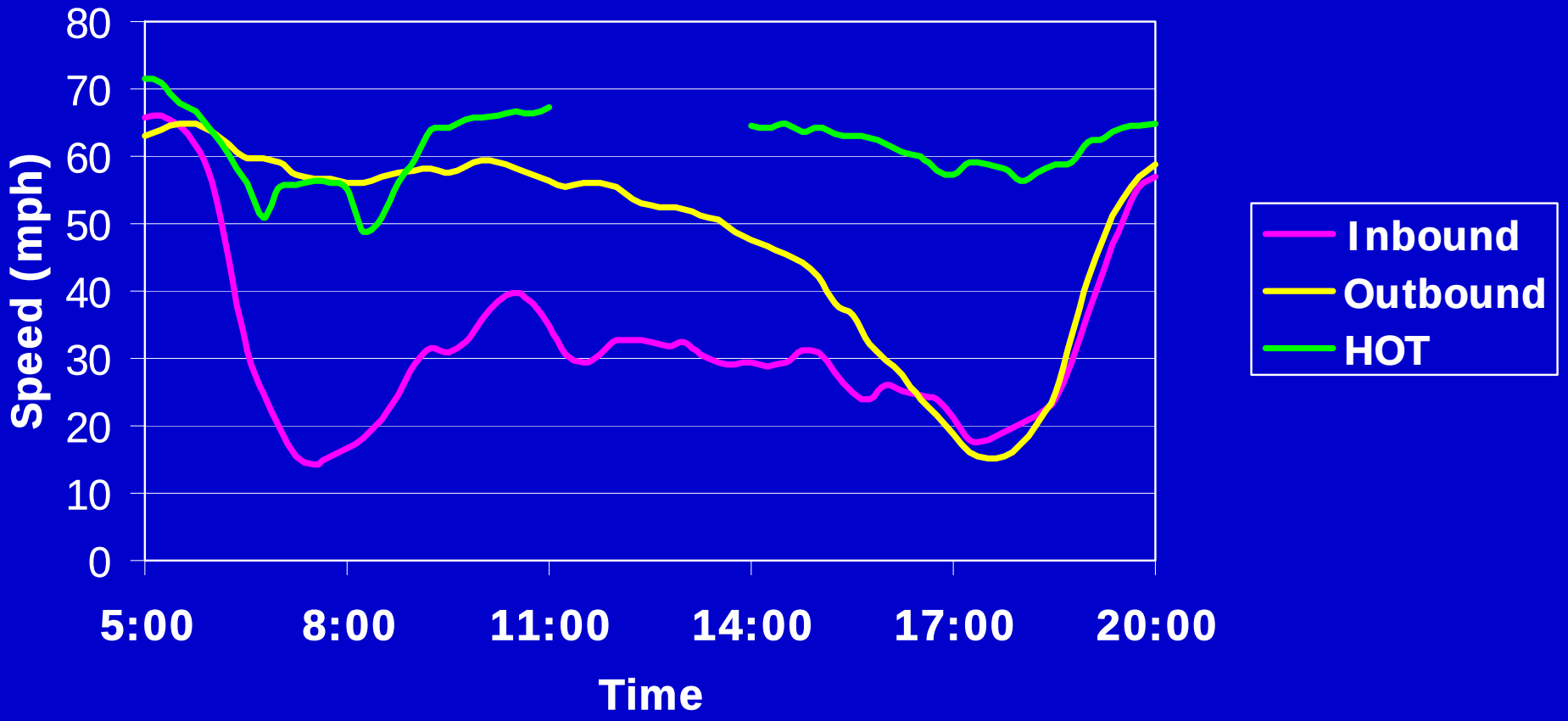
Northwest Freeway (US 290)

- 245,000vpd
- 6 to 10 mainlanes
- 4 to 6 frontage road lanes
- 1 reversible, barrier separated, HOT lane

Houston Real-Time Traffic Map

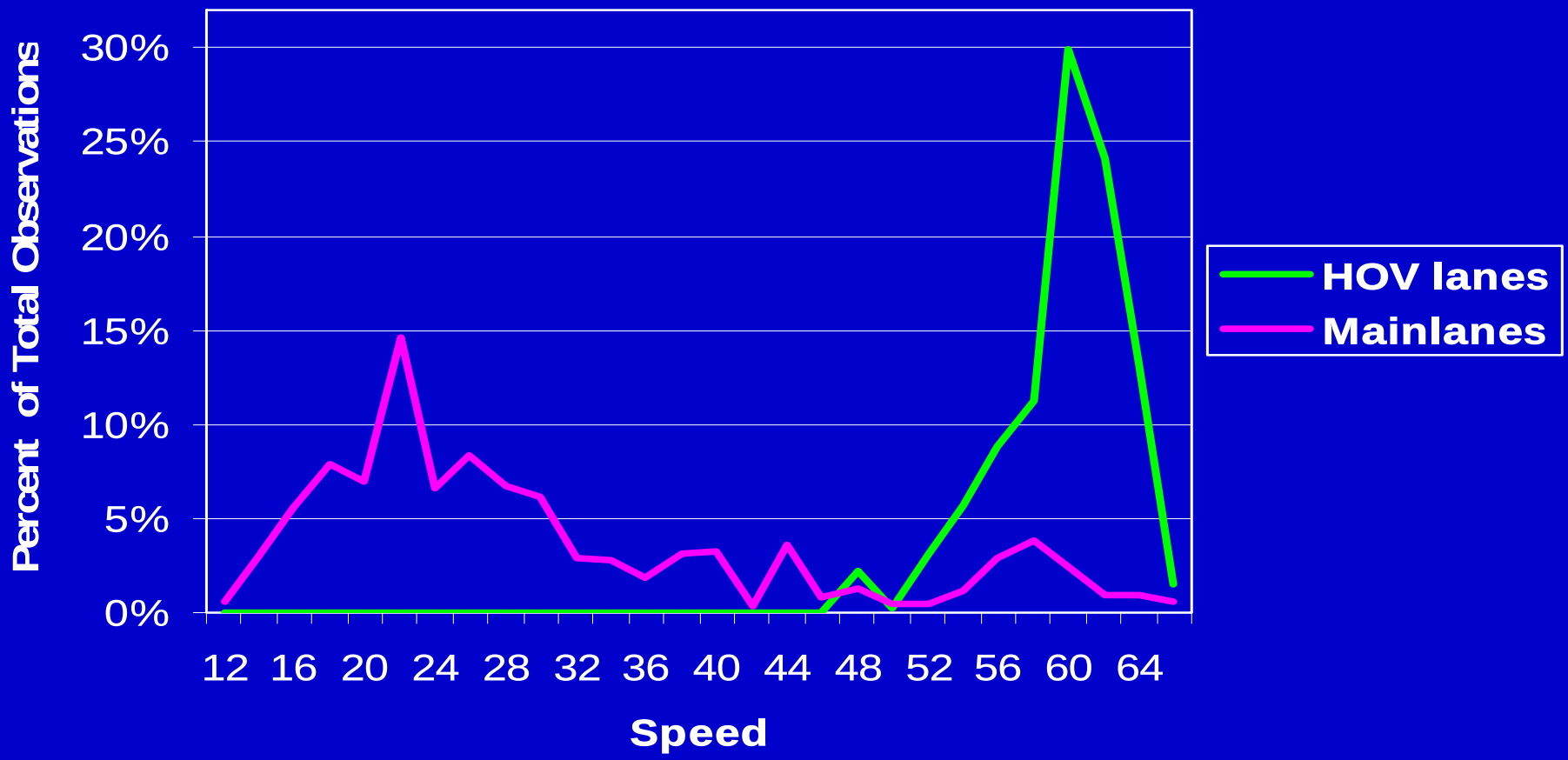


Katy Freeway: Sam Houston - Blalock
Travel Speeds for 2002



Variability of Travel Speeds

2002 Northwest Freeway (Pinemont to W34th)
7:30 to 7:45 AM (Jan 1 to Sept. 30)

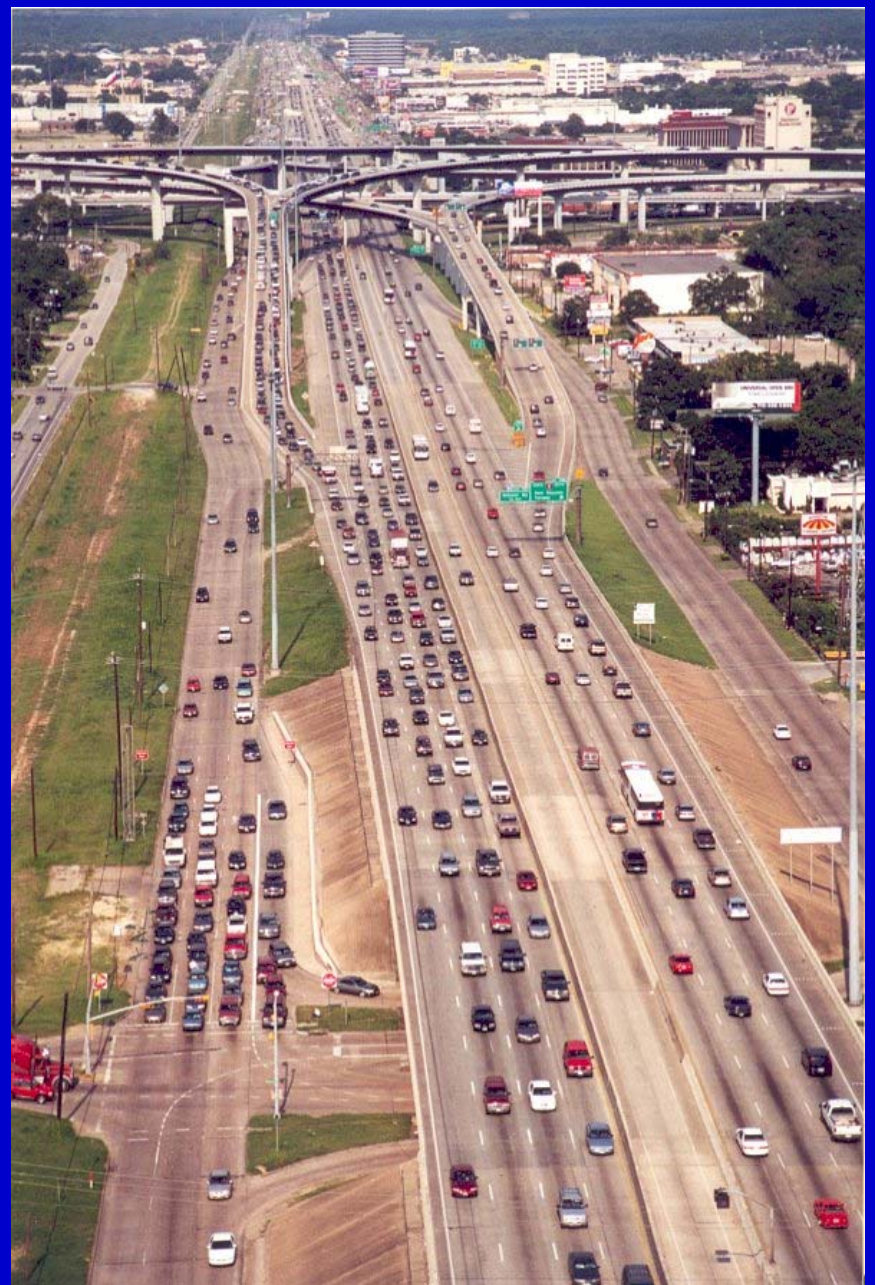


Houston HOV Lanes

- Katy Freeway (I-10) HOV lane opened in 1984
- Initially allowed buses and vanpools only
- By 1986 users expanded to HOV 2+
- Occupancy raised to 3+ in the morning peak (6:45 to 8:00 a.m.) in 1988 due to congestion
- Afternoon peak (5:00 to 6:00 p.m.) followed
- Then the morning period on Northwest Freeway (US 290) in July 1999

Houston HOV Lanes

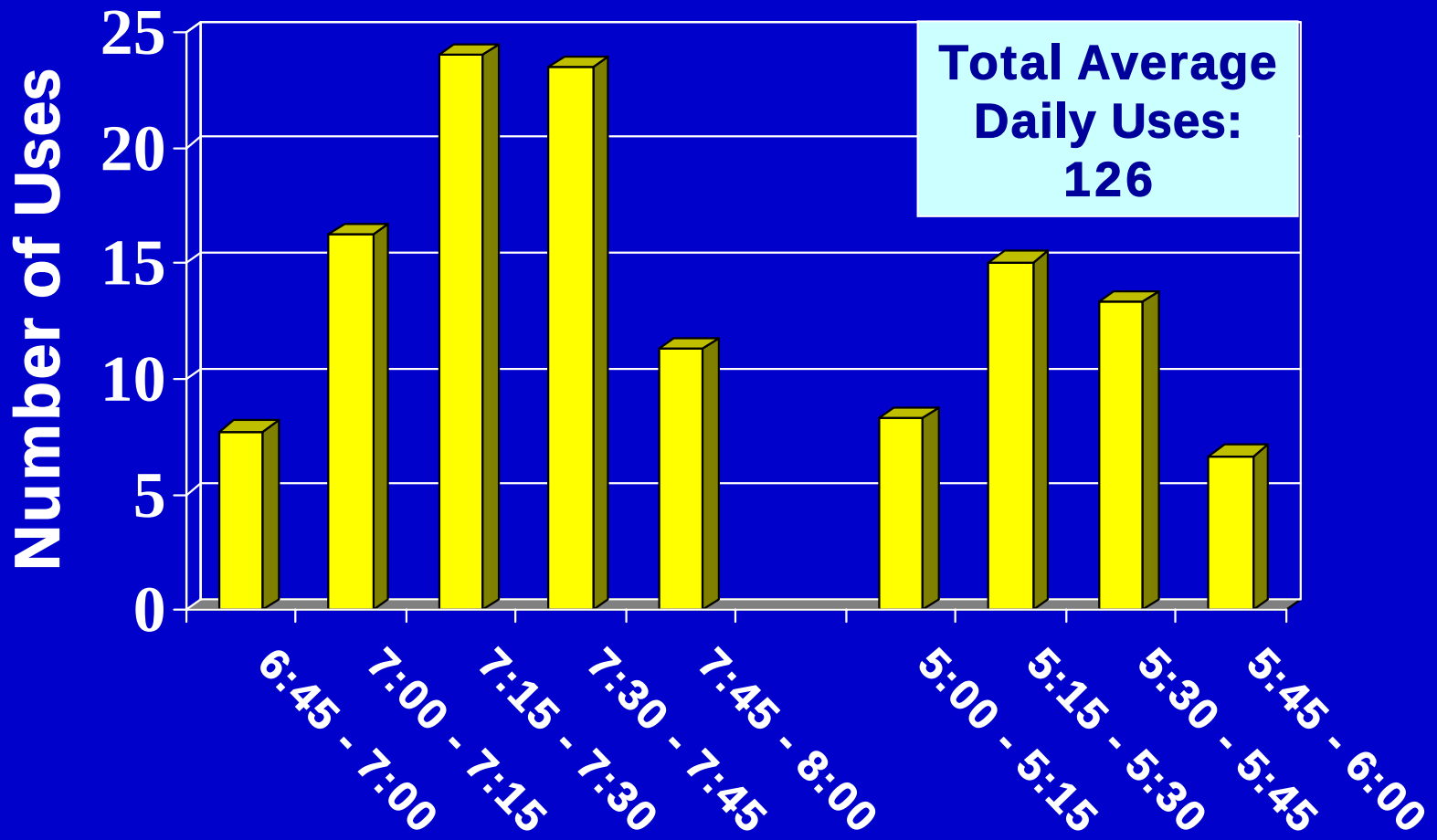
- The 3+ restriction lead to HOV lane being “underutilized” during peak hours
  - The empty lane syndrome



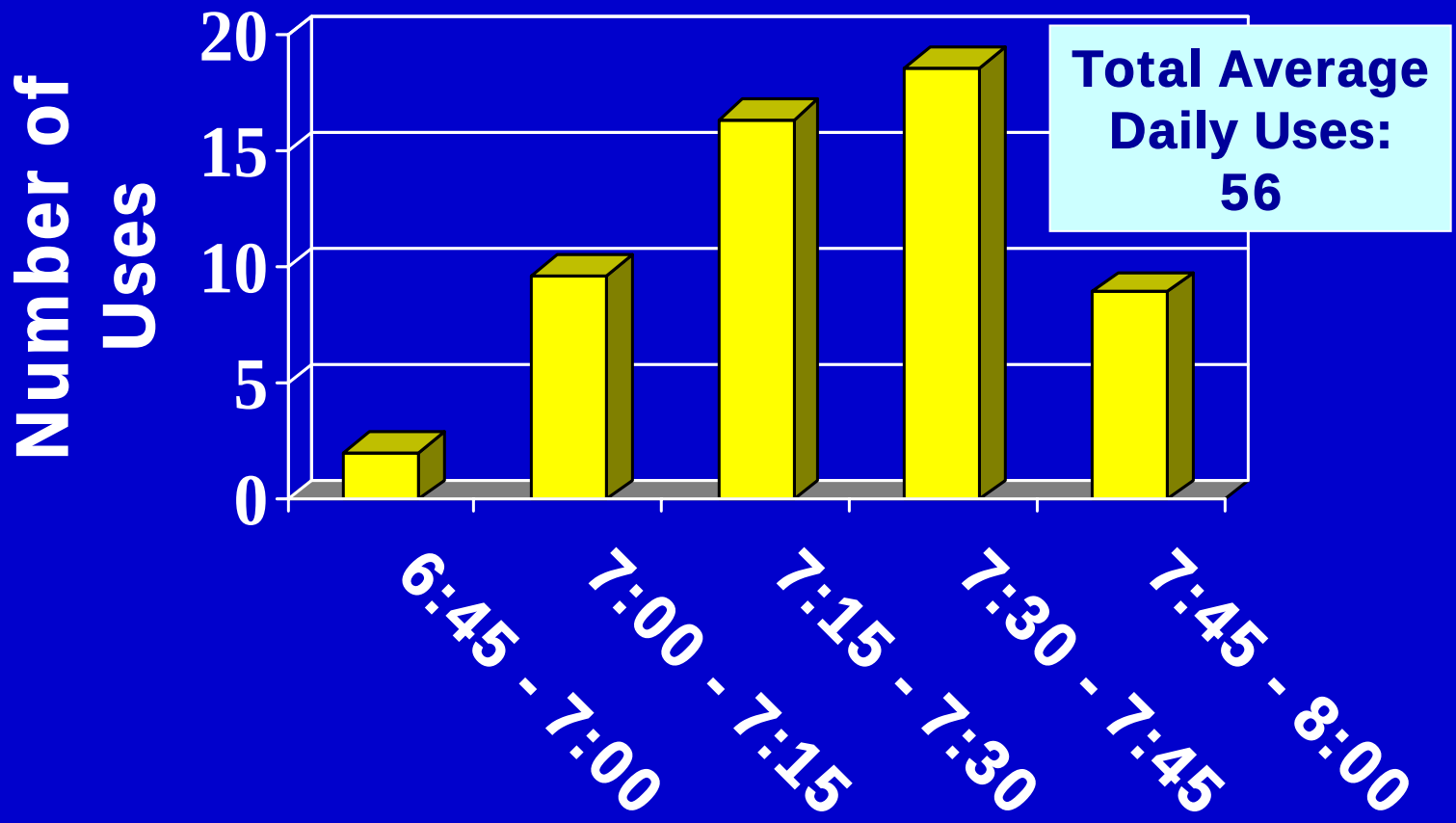
Houston QuickRide Program

- Allows 2-person carpools to use HOV lane during peak hours for a $2 toll
- Known as a High Occupancy/Toll lane or HOT lane
- January 1998 – Houston QuickRide Program implemented on Katy Freeway
- November 2000 – began on US 290

Average Daily QuickRide Usage
Katy Freeway - 2002



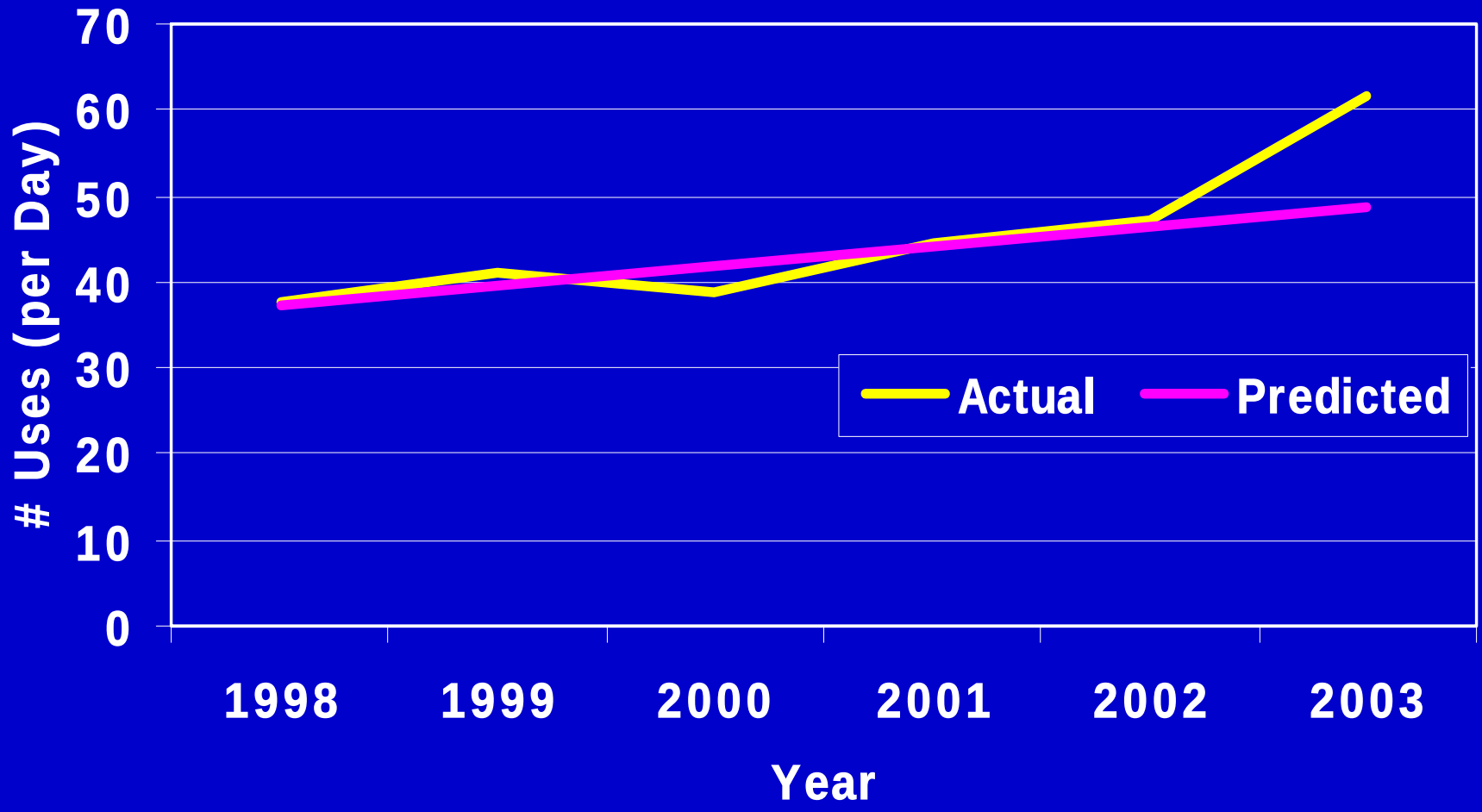
Average Daily QuickRide Usage
Northwest Freeway - 2002



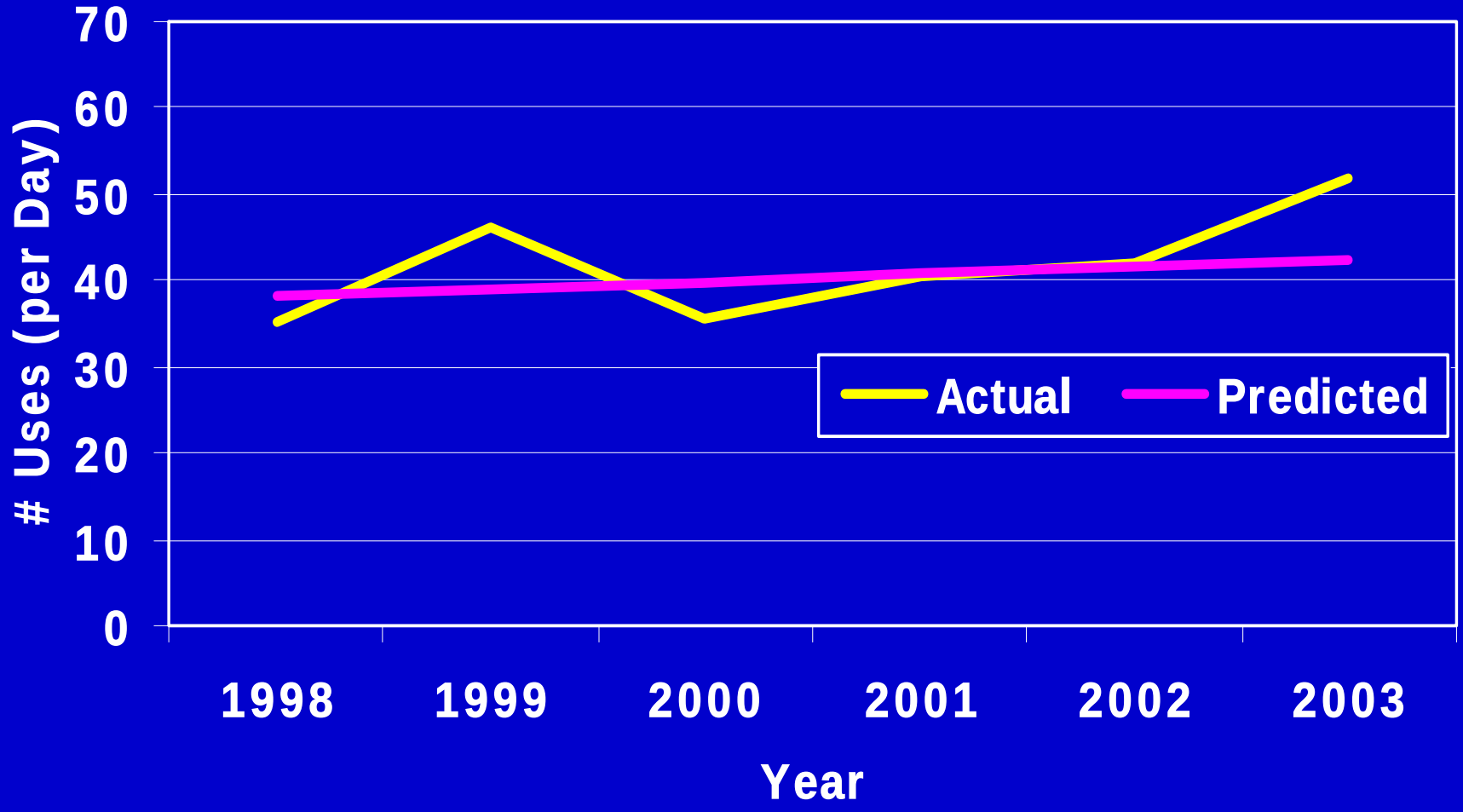
Elasticity of Demand for QuickRide

- Price elasticity of demand an important indicator/predictor of travel behavioral changes
- The QuickRide toll was reduced to $1 for all of April 2003
- Announced in a letter, which accompanied a survey
- Observed an increase in QuickRide usage

Katy PM QuickRide Uses (April)



Katy PM QuickRide Uses (March)



Impact of April 2003 Price Drop

- Linear regression to develop trends in usage over the years (predicted results)
- Increase due to price drop =

$$April_{Actual} - \left(April_{Predicted} \times \frac{March_{Actual}}{March_{Predicted}} \right)$$

Relative Impact of April 2003 Price Change

Movement	Predicted uses per day[1]	Actual uses per day	Difference	Elasticity[2]
Katy AM	89.4	97.6	+8.2	-0.18
Katy PM	58.4	61.7	+3.3	-0.11
US 290 AM	66.0	74.6	+8.6	-0.26
TOTAL	**213.8**	**233.9**	**+20.1**	**-0.19**

1. Predicted that April usage increased at a similar rate as March usage
2. E = $\dfrac{(q_2 - q_1)/q_2}{(p_2 - p_1)/p_2}$

Relative Impact of April 2003 Price Change

Movement	Predicted uses per day[1]	Actual uses per day	Difference	Elasticity[2]
Katy AM	89.4	97.6	+8.2	-0.13
Katy PM	58.4	61.7	+3.3	-0.08
US 290 AM	66.0	74.6	+8.6	-0.18
TOTAL	**213.8**	**233.9**	**+20.1**	**-0.13**

1. Predicted that April usage increased at a similar rate as March usage

2. $$E = \frac{\frac{(q_2 - q_1)}{(q_2 + q_1)/2}}{\frac{(p_2 - p_1)}{(p_2 + p_1)/2}}$$

Midpoint or arc elasticity

Relatively Inelastic Response

- SR-91 : -0.9 to -1.0
- I-15 : -0.34 to -0.42
- Singapore : -0.25
- Hardy Toll Road : -0.4 to -0.8
- France A1 : -0.16 to -0.28
- Lee County : -0.02 to -0.36
- Houston HOT Lanes : -0.11 to -0.26
- Typical Flat Tolls : -0.03 to -0.35

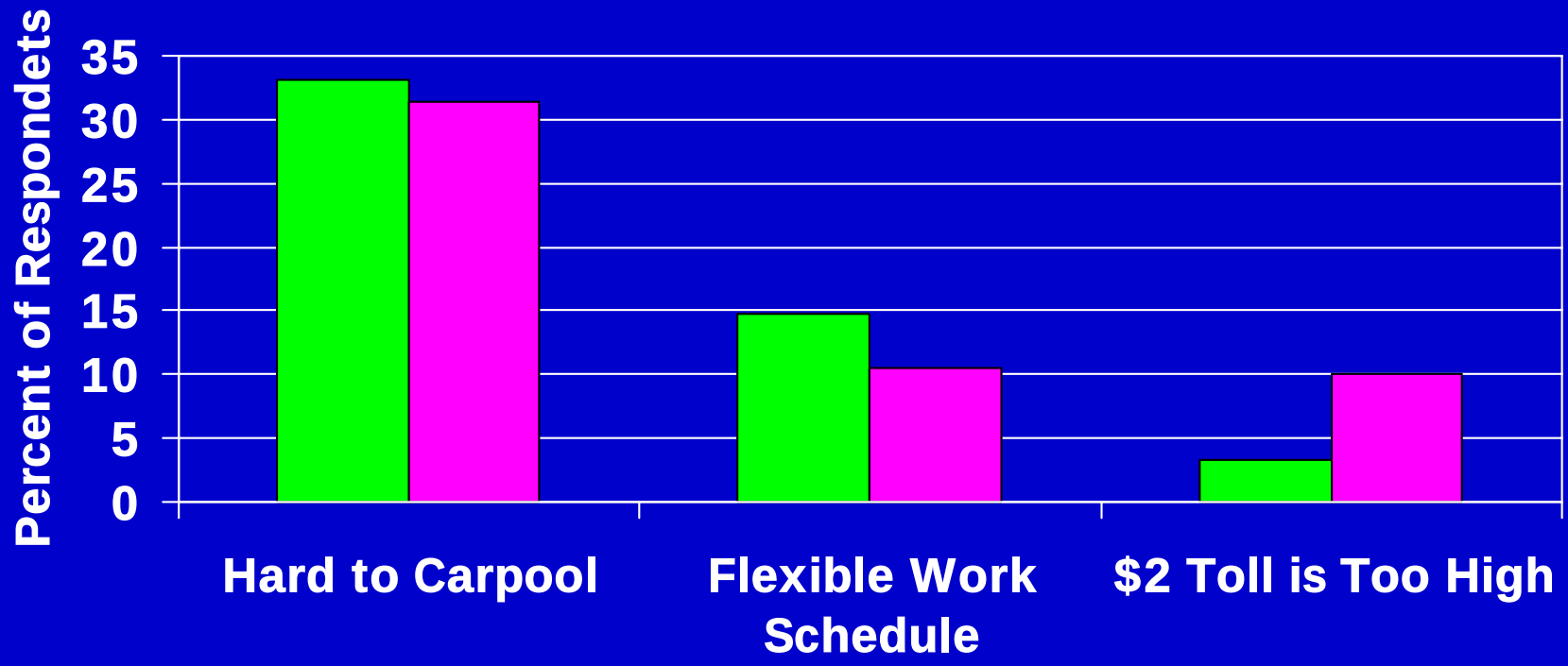
Relatively Inelastic Response

- Somewhat surprising due to options available:
  - Switch mode (transit, carpool, casual carpool)
  - Alter time of travel
  - Select alternative route (HOT lane versus main lanes)
  - Additional trips
- Examined Survey of QuickRide Enrollees and Former Enrollees

Survey Responses

- 73.3% indicated that the $2 toll had little to no impact on their decision to use QuickRide
- Similarly, 71.5% indicated that a reduced toll would not cause them to make more QuickRide trips

Main Reasons for Current Level of QuickRide Usage

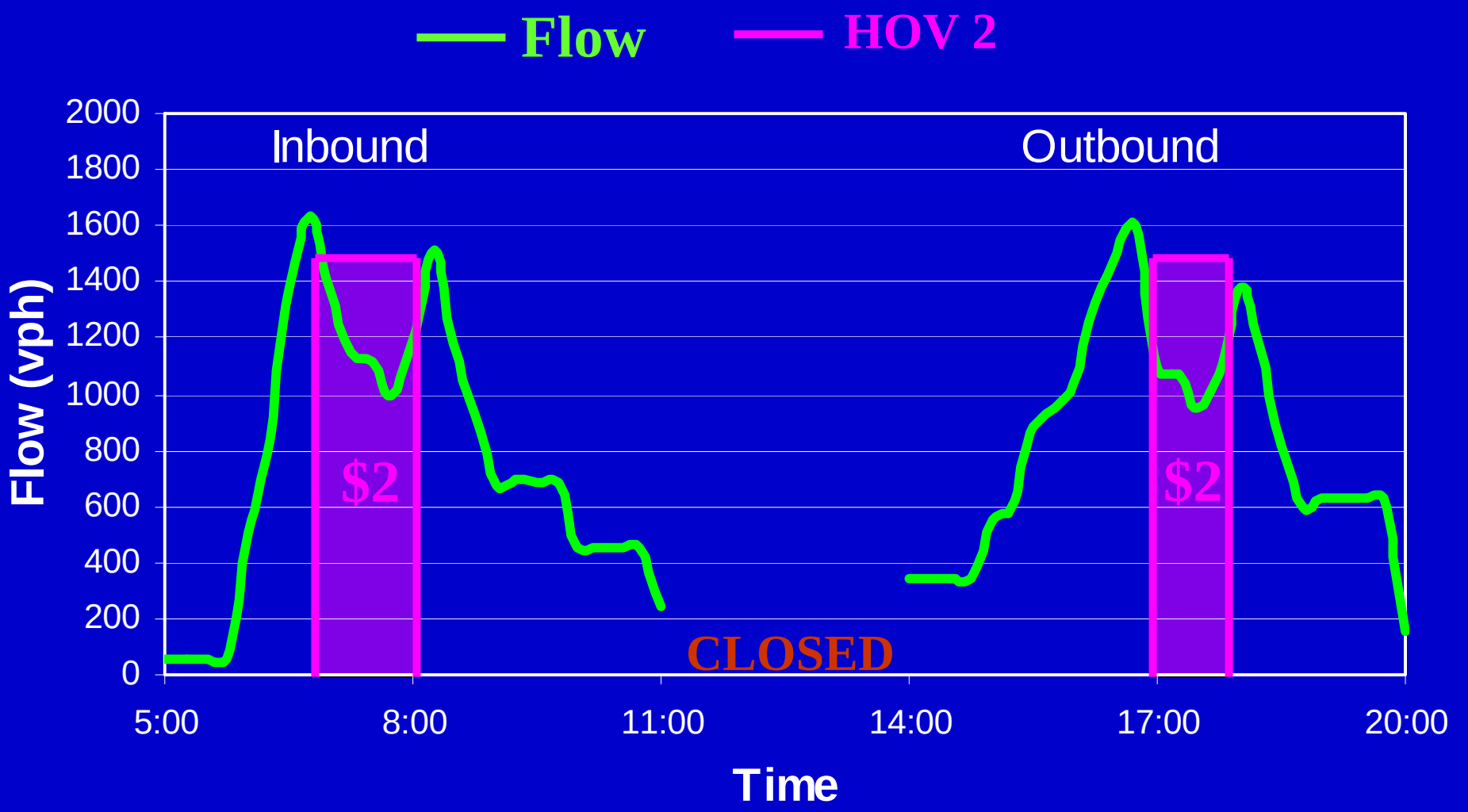


Note: percentages do not sum to 100 as many other categories, with small response rates, are not shown

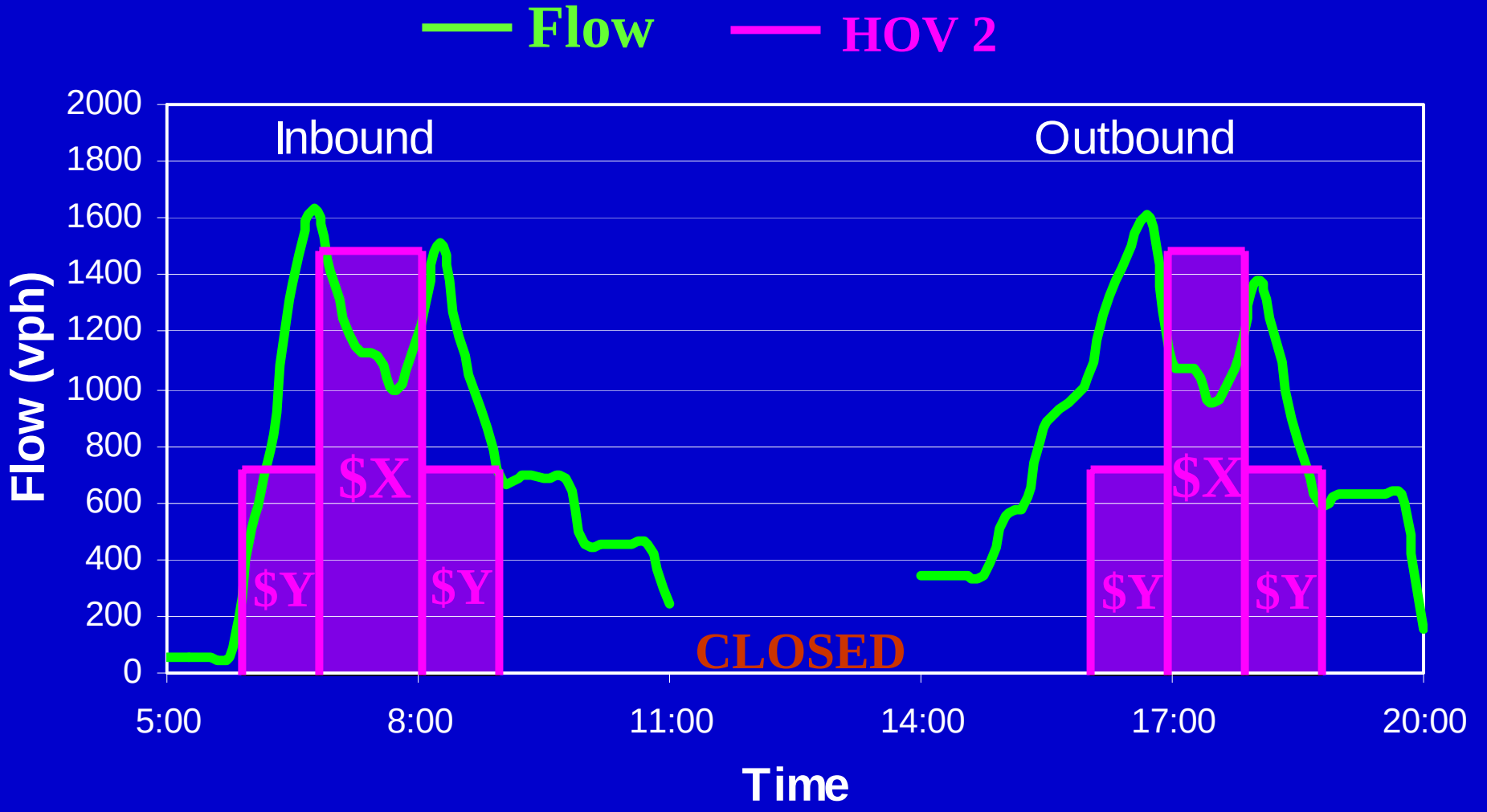
Next Steps

- Increase usage of the HOT lane:
  - Different pricing mechanisms?
    - Variable based on time of day (SR-91)
    - Dynamic based on congestion (I-15)
  - Allow SOVs off-peak?
- Stated preference survey currently underway to predict optimal solution
- ….further into the future are managed lanes

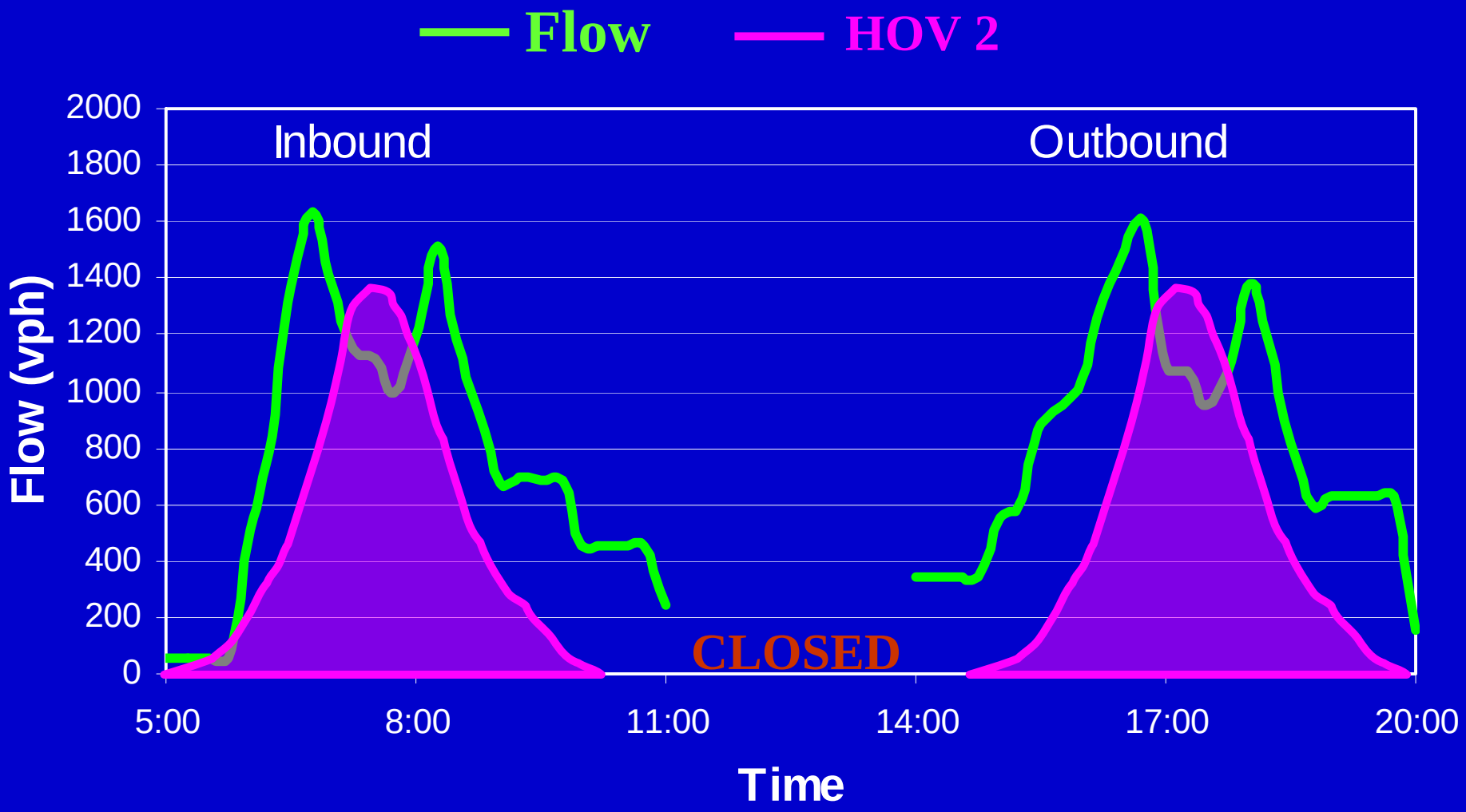
Pricing Options - Current



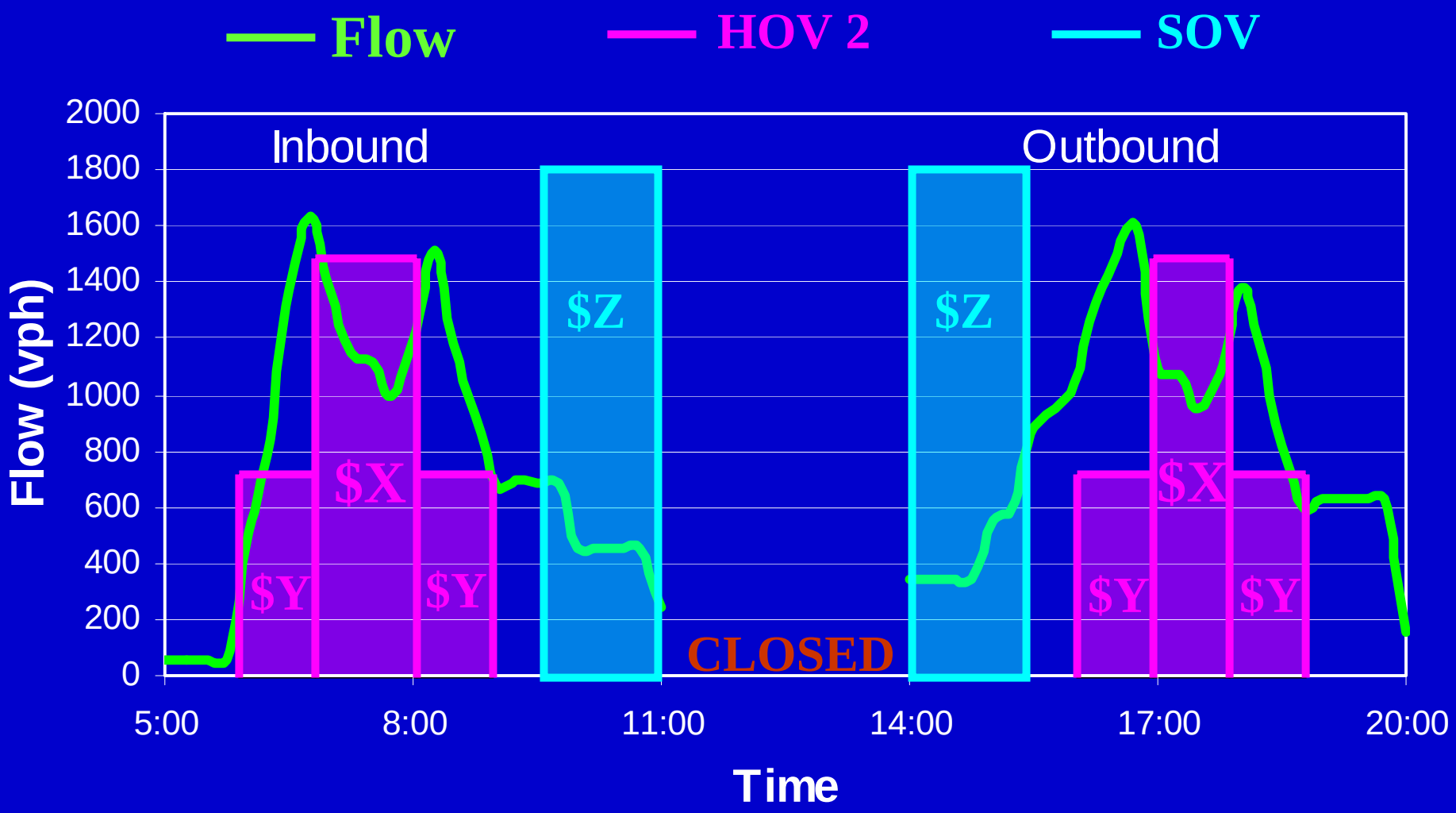
Pricing Options - Variable



Pricing Options - Dynamic



Pricing Options - SOV



Next Steps

- Increase usage of the HOT lane:
  - Different pricing mechanisms?
    - Variable based on time of day (SR-91)
    - Dynamic based on congestion (I-15)
  - Allow SOVs off-peak?
- Stated preference survey currently underway to predict optimal solution
- ….further into the future are managed lanes

Conclusions

- HOT lanes in Houston operational for 5 years
- Provides drivers an option
- Relatively low use, but steadily increasing
- Inelastic responses to price – usage more a function of carpool convenience

Texas Transportation Institute