Express Lanes

A National Perspective on Practice, Experiences, and Outcomes

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15 December 2016

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WHY LISTEN TO ME?

- Researcher, Practitioner, and Consultant in Priced Express Lanes since 1994
  - 21 states
  - 3 countries
  - 118 projects
  - 16 publications

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TODAY'S DISCUSSION

- Freeway Tolling to Manage Congestion
- Where / How Has the Concept Been Used
- Policy, Design, and Operations Options
- When Things Don't Go Right
- Lessons and Trends

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WHAT'S THE POINT OF FREEWAY TOLLING?

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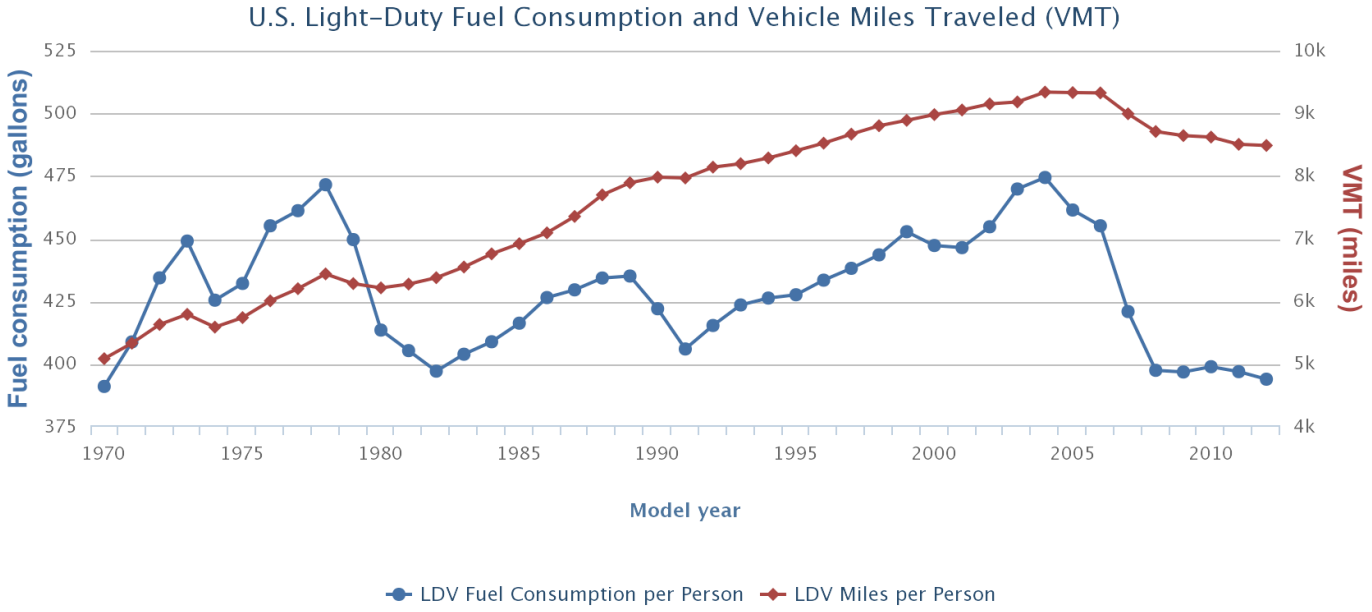
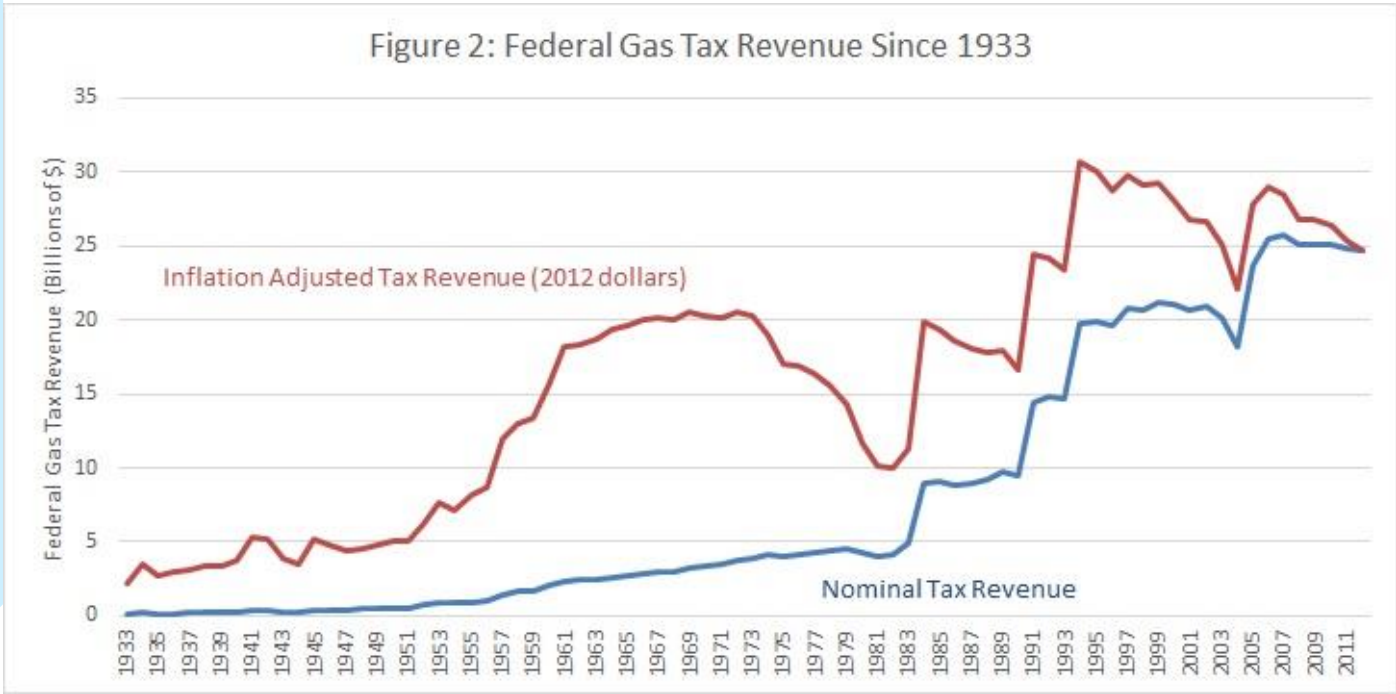
#1 RAISE REVENUE

- Drive More, Use Less Gas
- Net Decline in Gas Tax Revenue Corresponds with Fuel Efficiency Increase Since 2005

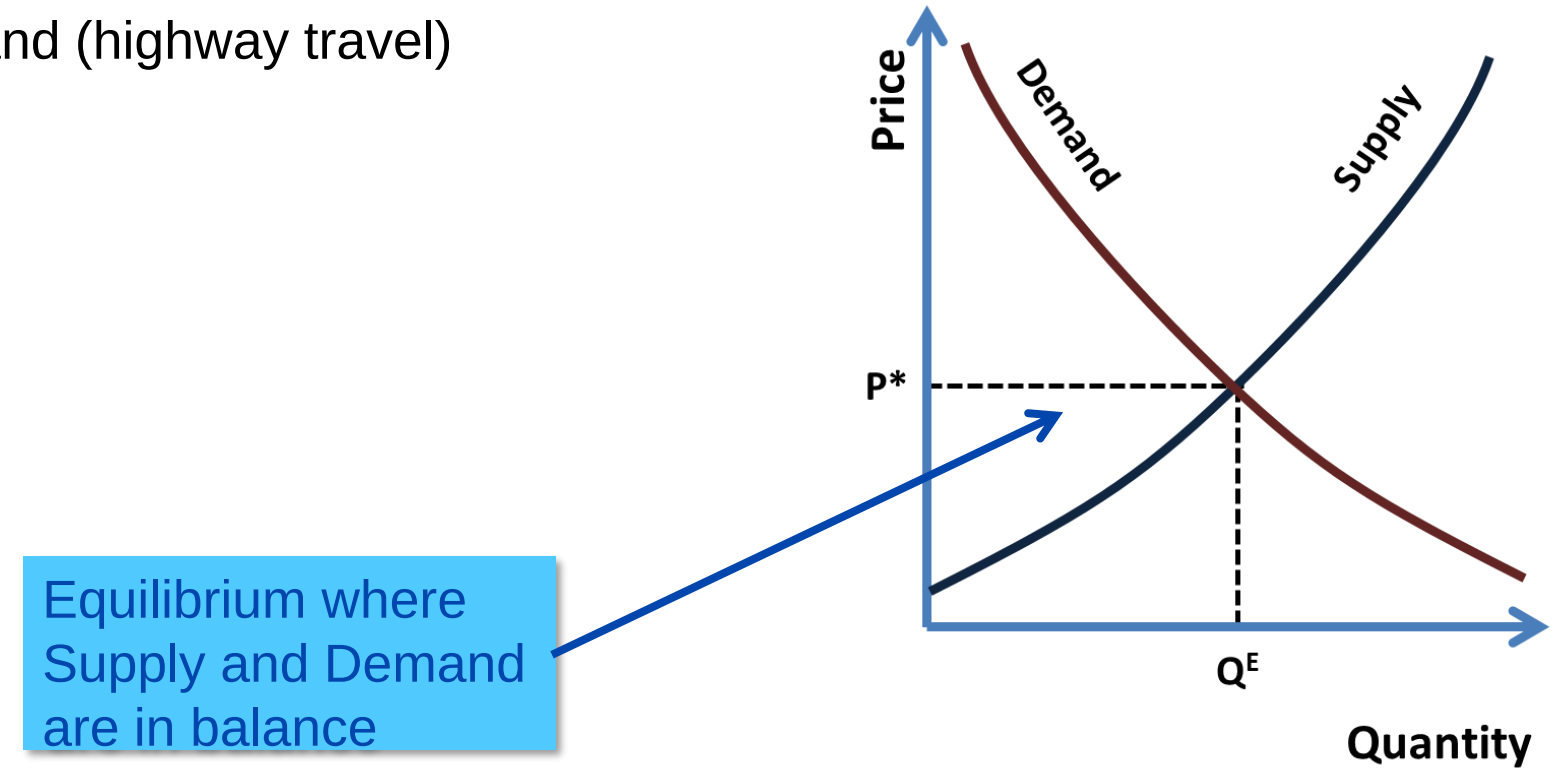




#2 SOLVE THE ECONOMICS OF CONGESTION

Congestion is an imbalance between:

- Supply (highway lanes)
- Demand (highway travel)



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ECONOMICS OF CONGESTION

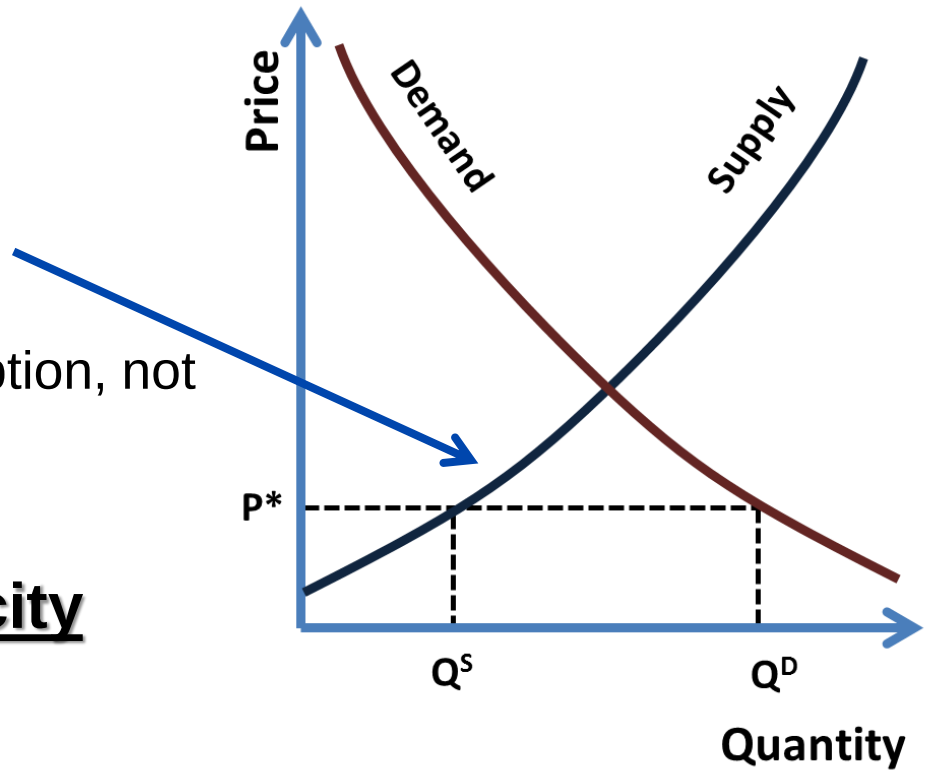
Congestion is an imbalance between:

- → Supply (highway lanes)
- → Demand (highway travel)

Unlimited demand yields overconsumption of supply

- → Demand limited by fuel consumption, not location and time of use

Outcome is <u>economic scarcity</u>



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DEALING WITH SCARCITY

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DEALING WITH SCARCITY

Build More Lanes

- Congestion relief is temporary
- Does not fix the fundamental imbalance
- Widening costs are expensive

Reduce Demand

- Yields rationing and trip avoidance
- Requires viable alternatives
- Impedes economic productivity

Control Access

- Does nothing for growth
- Shifts more trips to arterials

AVOIDING CONGESTION

- Requires a fundamental commitment to manage roadway capacity to avoid traffic flow breakdowns.

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CONGESTION IS THE RESULT OF FLOW BREAKDOWN

→ Predictable conditions

- Bottlenecks at known locations
  - Ramp merges, grades, weaving points, lane constrictions, bridges, etc.
- Speed differentials between vehicles

→ Unpredictable conditions

- Driver behavior that slows traffic, such as rubber necking or sudden braking
- Spikes in traffic that yield short periods of high density flow

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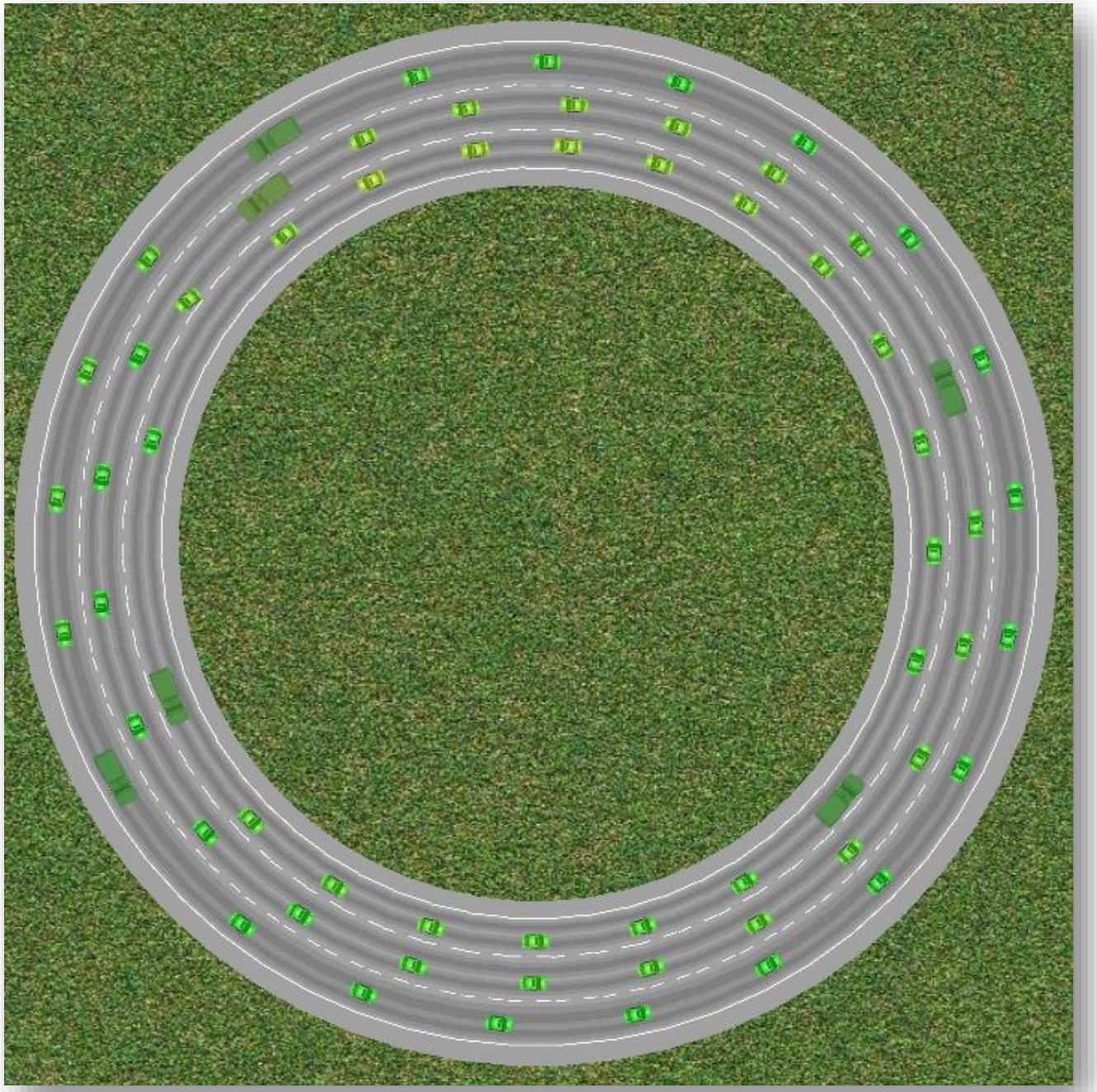
THE PHYSICS OF CONGESTION

Flow breaks down at 1800 – 2000 vehicles per hour per lane



EXAMPLE OF FLOW BREAKDOWN

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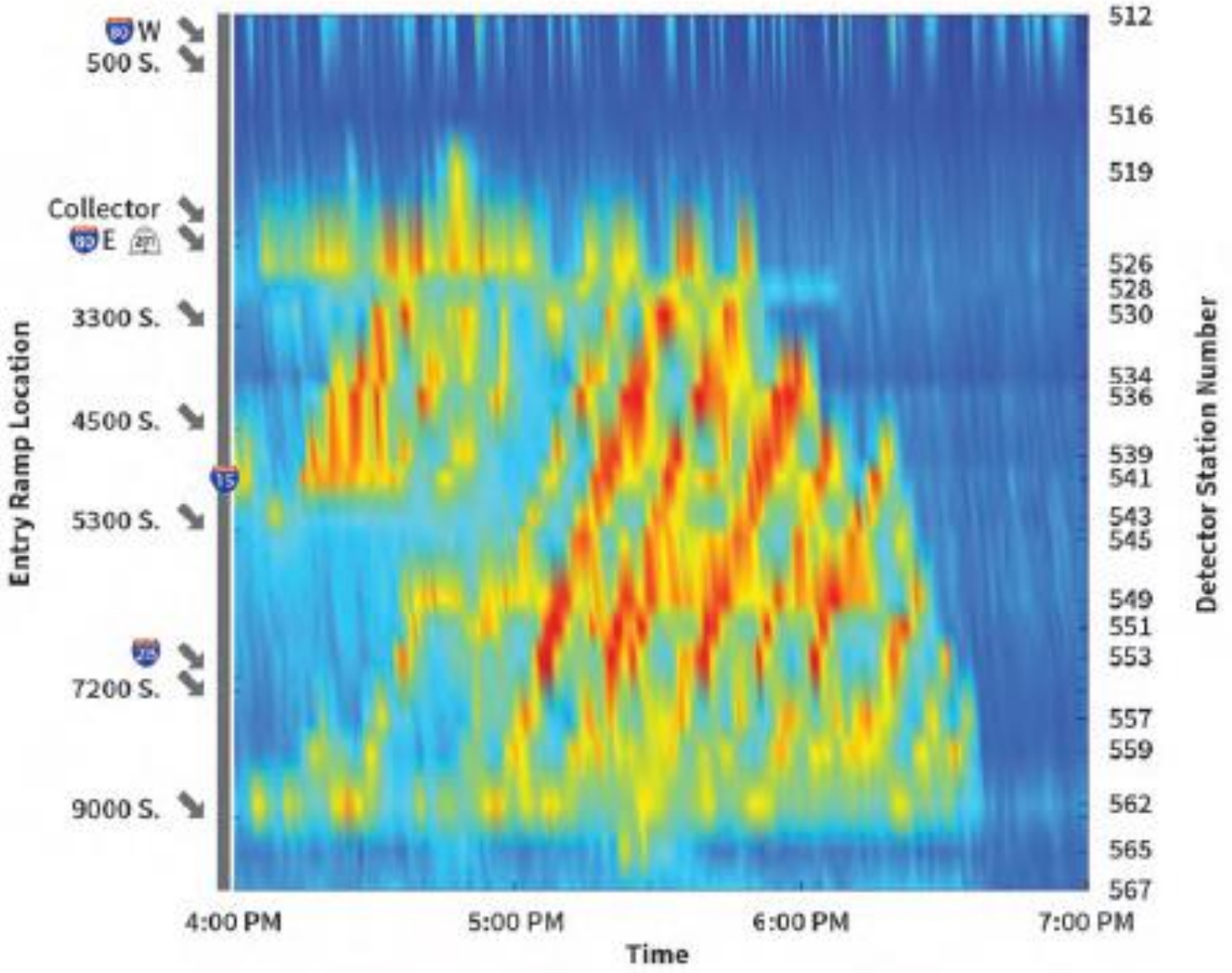


WHY SHOULD WE USE TOLLING?

→ Generates Revenue

- Afford more than we could otherwise build and maintain

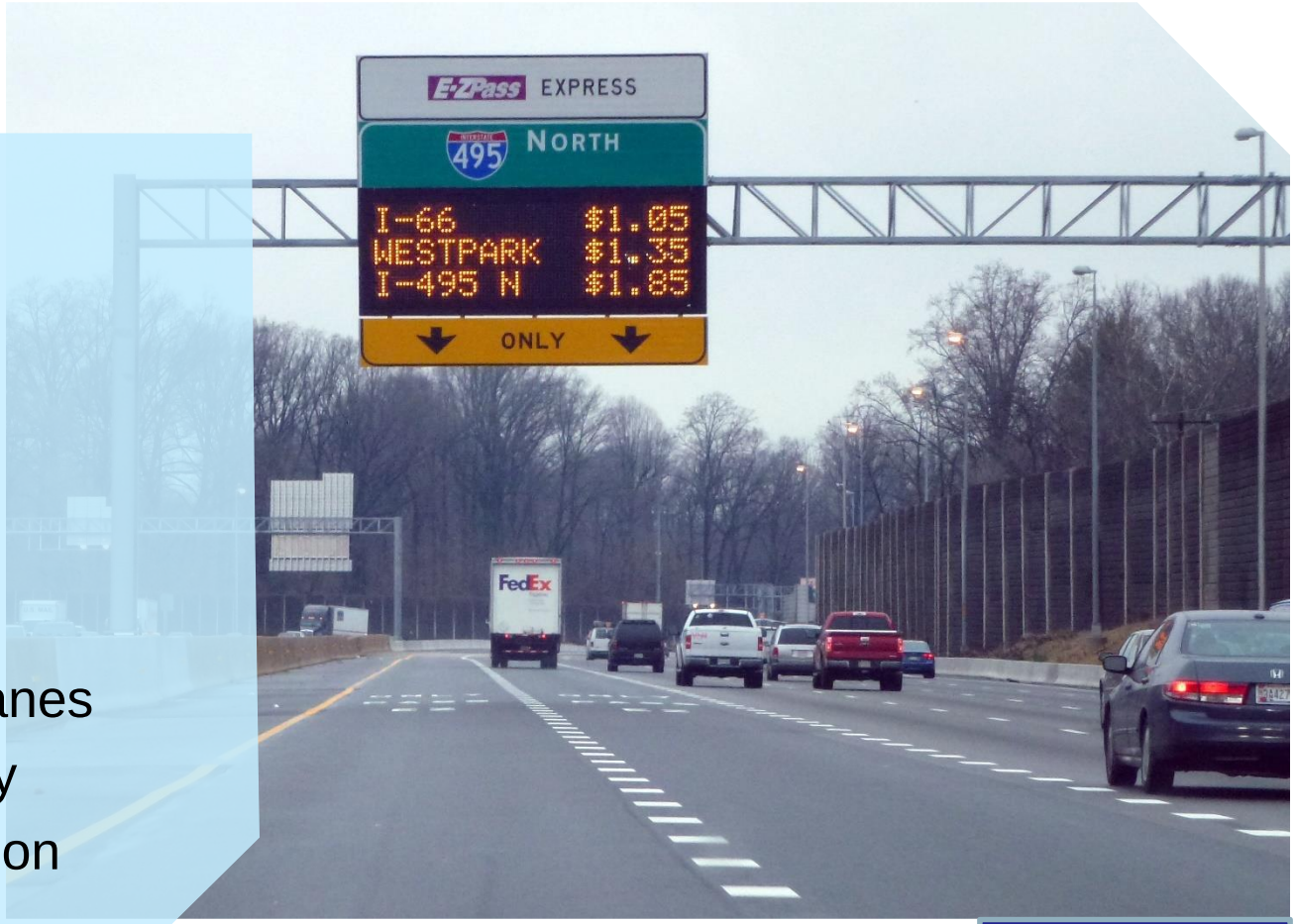
→ Meters Traffic

- Higher travel speeds accrue in medium and (especially) long term
- Pricing more efficient than signalization or rationing

You Don't Need a Toll to Meter
I-70 (Colorado) meters traffic through mainline traffic signals.

FREEWAY TOLLING COMBINES ALL THREE

- Application
  - Expands capacity
  - Shifts demand
  - Uses Pricing
- Outcome
  - Congestion-free lanes
  - Safety & Reliability
  - Long term Return on Investment



I-495, Virginia

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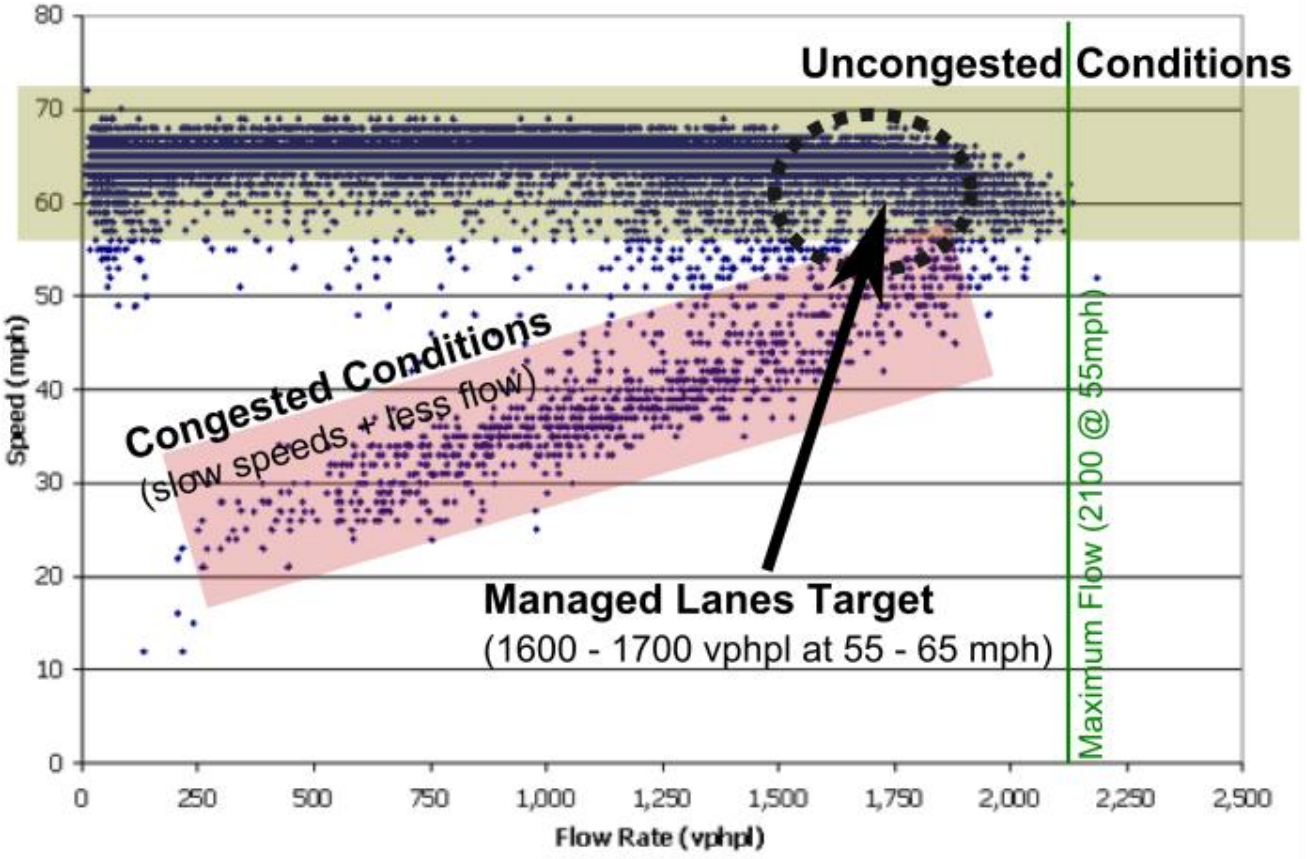
FREEWAY TOLLING MORE EFFICIENT

- Use of pricing meters traffic in order to prevent breakdown into congested conditions



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FREEWAY TOLLING IN PRACTICE

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TOLLED EXPRESS LANES: **2003**

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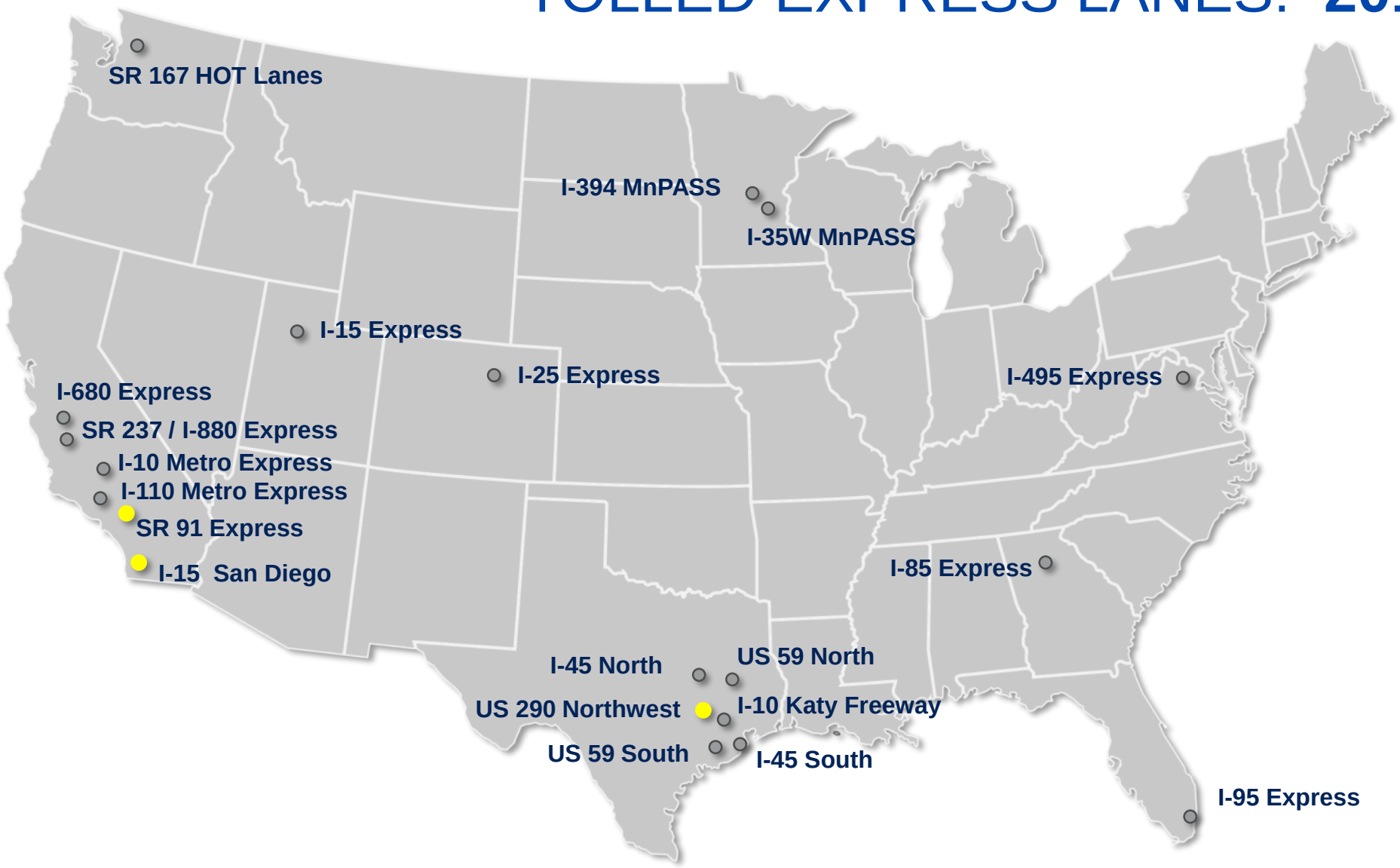
TOLLED EXPRESS LANES: **2013**



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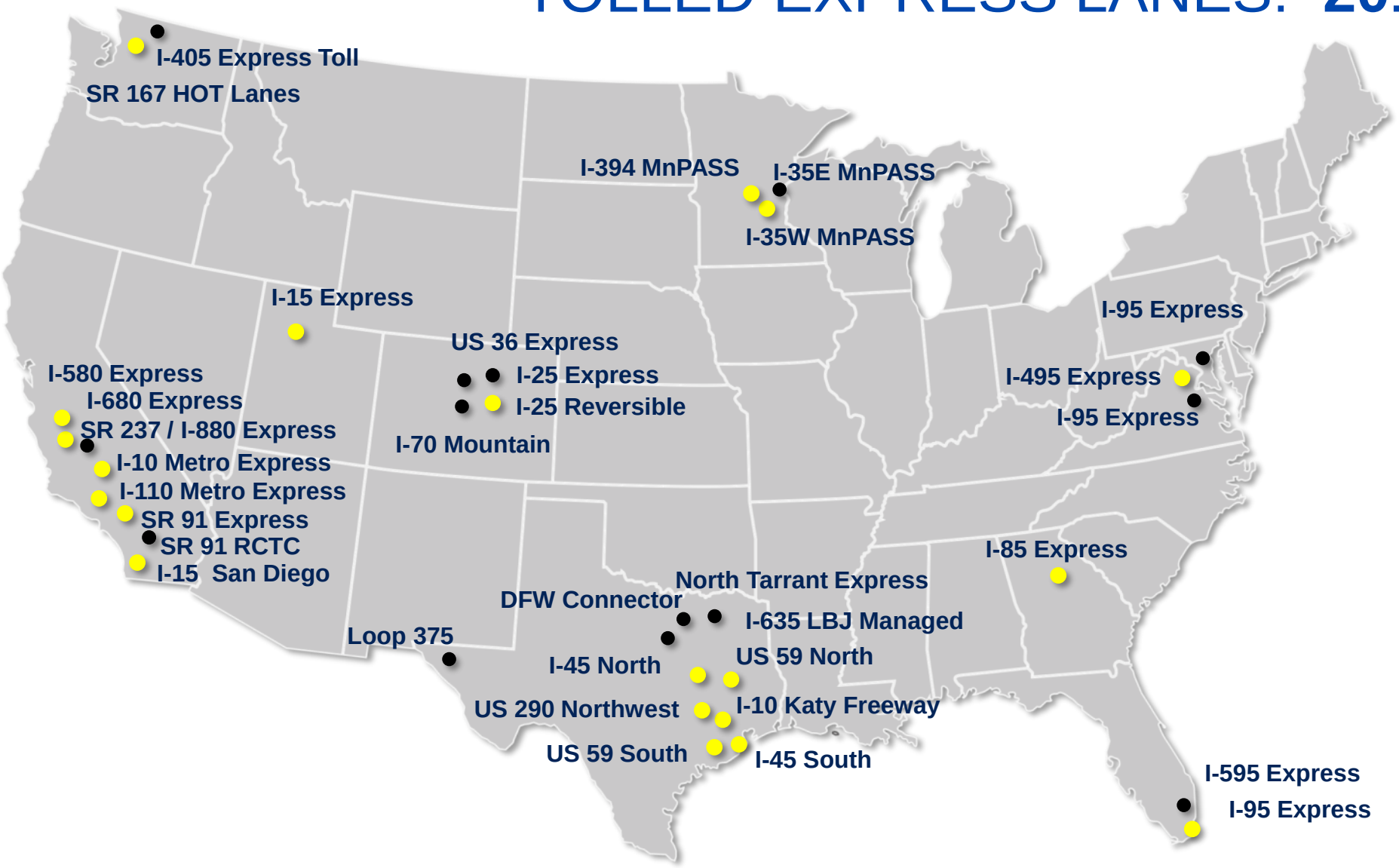
TOLLED EXPRESS LANES: **2016**



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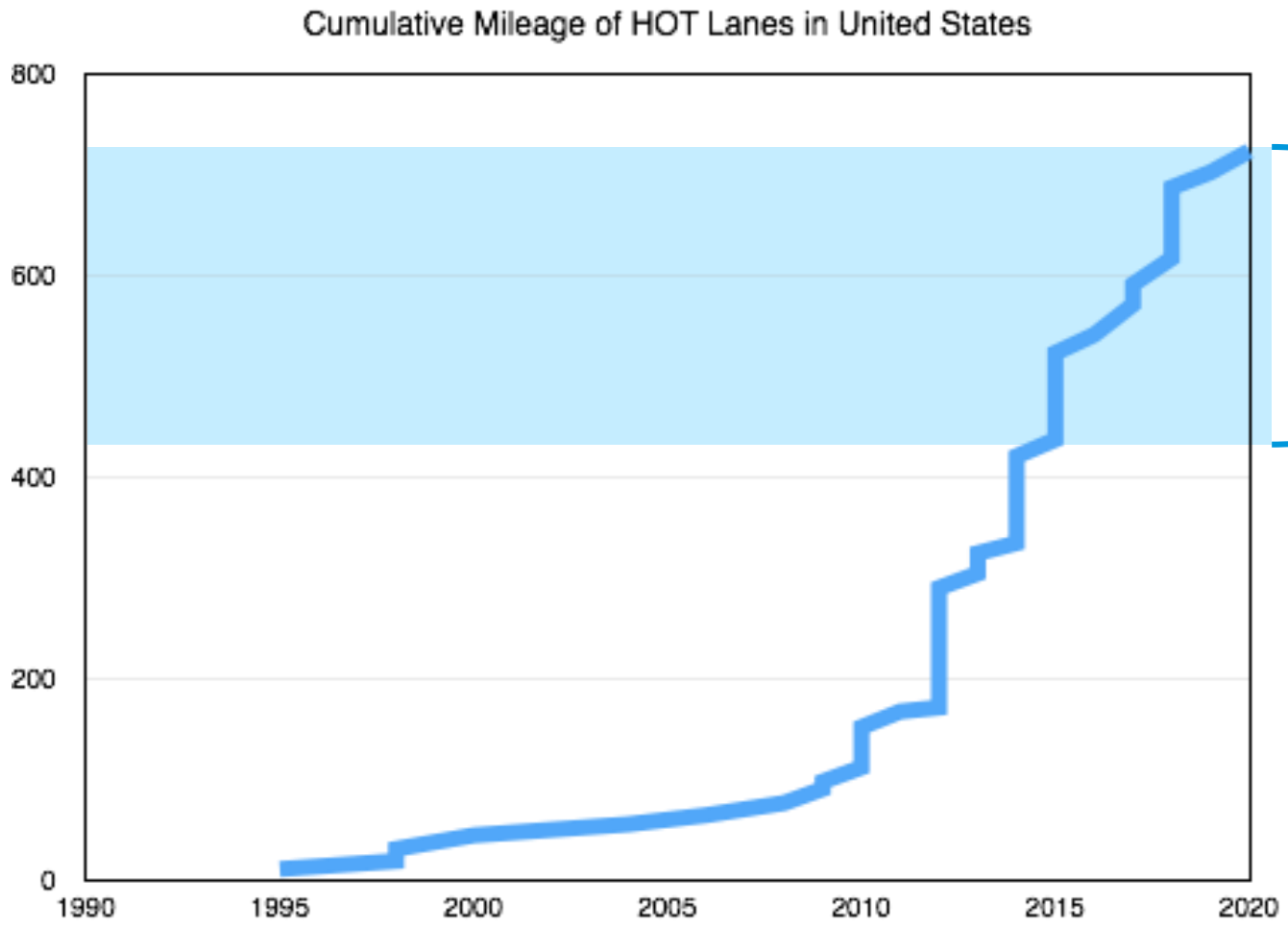
RAPID GROWTH IN TOLLED EXPRESS LANES



Almost doubling the total lane miles in the next five years

Graphic Source:
Prof. David Levinson, University of Minnesota, June 15, 2015.

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ALREADY IN SECOND GENERATION

I-15 San Diego, 2003

I-15 San Diego, 2013

I-10 Houston, 1999

I-10 Houston, 2013

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POLICY, DESIGN, AND OPERATIONS

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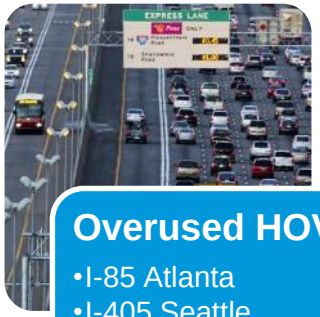
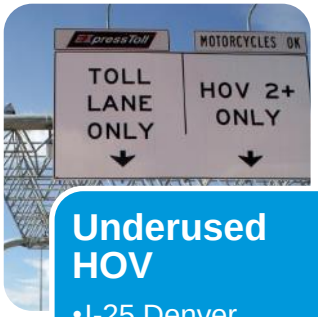
NOT ALL FACILITIES ARE THE SAME

Convert HOV Lanes



Overused HOV
- I-85 Atlanta
- I-405 Seattle

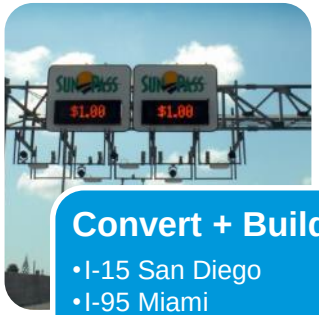


Underused HOV
- I-25 Denver
- I-15 Salt Lake City
- SR-167 Seattle
- I-394 Minneapolis

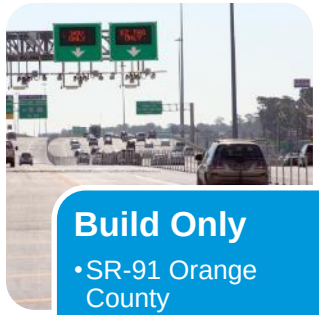
Anticipate Less Benefits

Anticipate More Benefits

Build New Lanes



Convert + Build
- I-15 San Diego
- I-95 Miami
- I-495 Virginia
- I-35W Minneapolis
- I-10 Houston
- I-635 Dallas



Build Only
- SR-91 Orange County
- I-595 Ft. Lauderdale
- North Tarrant Express Dallas
- DFW Connector Dallas

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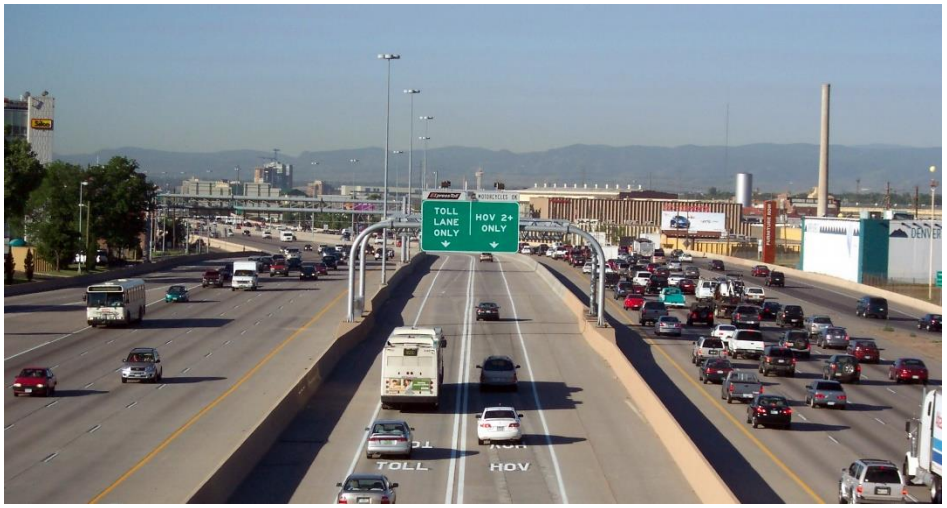
INITIAL LANES WERE PHYSICALLY SEPARATED



CONTEMPORARY LANES ALSO SIDE-BY-SIDE WITH GENERAL PURPOSE LANES

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PRICING OF HOV'S

HOV-2+ free at all times

I-15 (CA)
I-25
SR 167
I-35W
I-394
I-680
SR-237 / I-880
I-15 (UT)

HOV-2+ free peak only

I-10 (TX)
I-45

HOV-3+ free with limits

I-95 (FL)
I-85
I-495
SR-91*

HOV-3+ discount

SR-91*
I-635
I-35E (TX)

No HOV benefits

Loop 375
Loop 1
I-595
I-95 (MD)

I-635, Dallas

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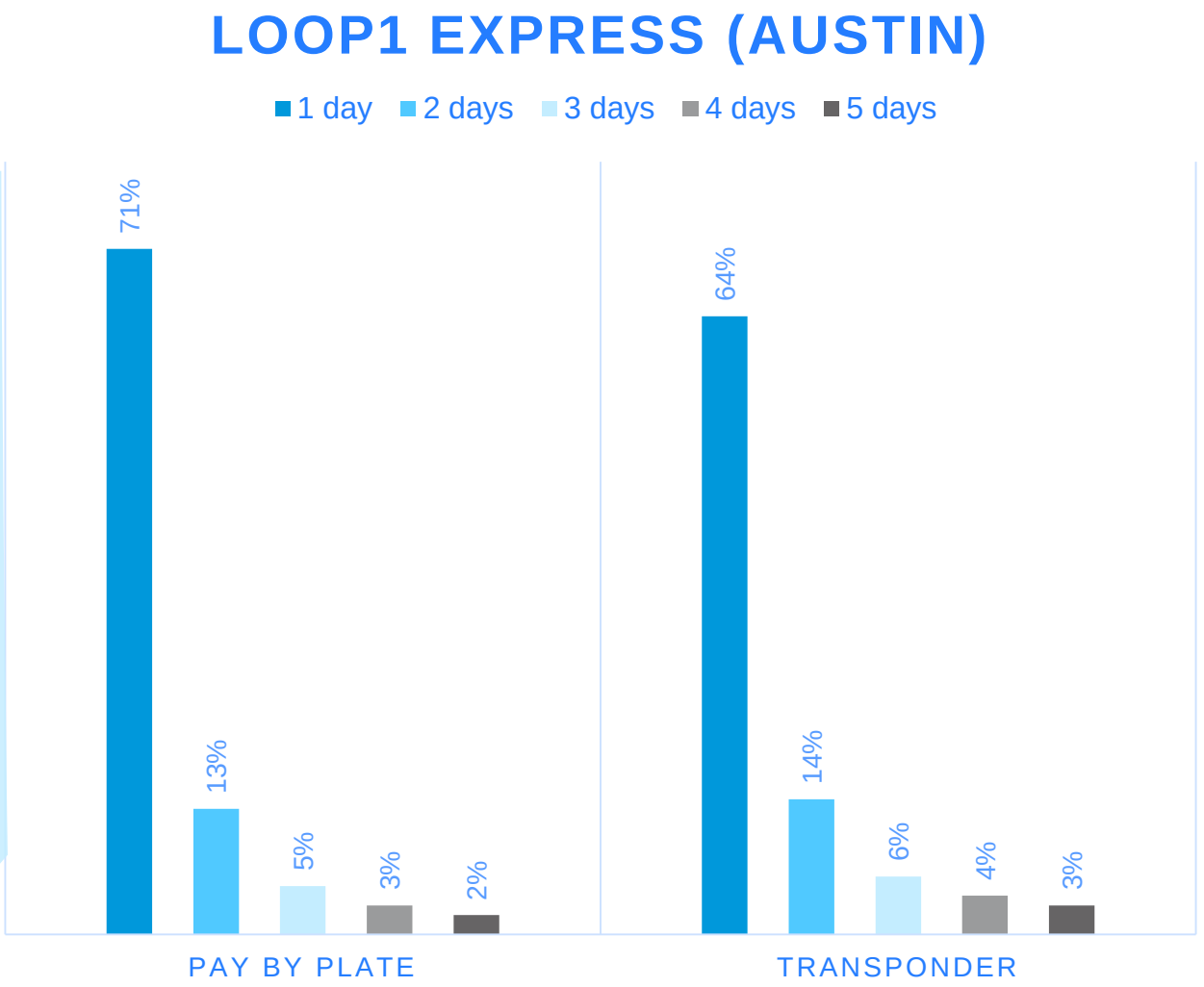
FREQUENCY OF USE

- Most customers are infrequent users
  - Industry average = 3 trips per month
- Very frequent users are often immune from being managed
  - Price insensitive users
  - Free users



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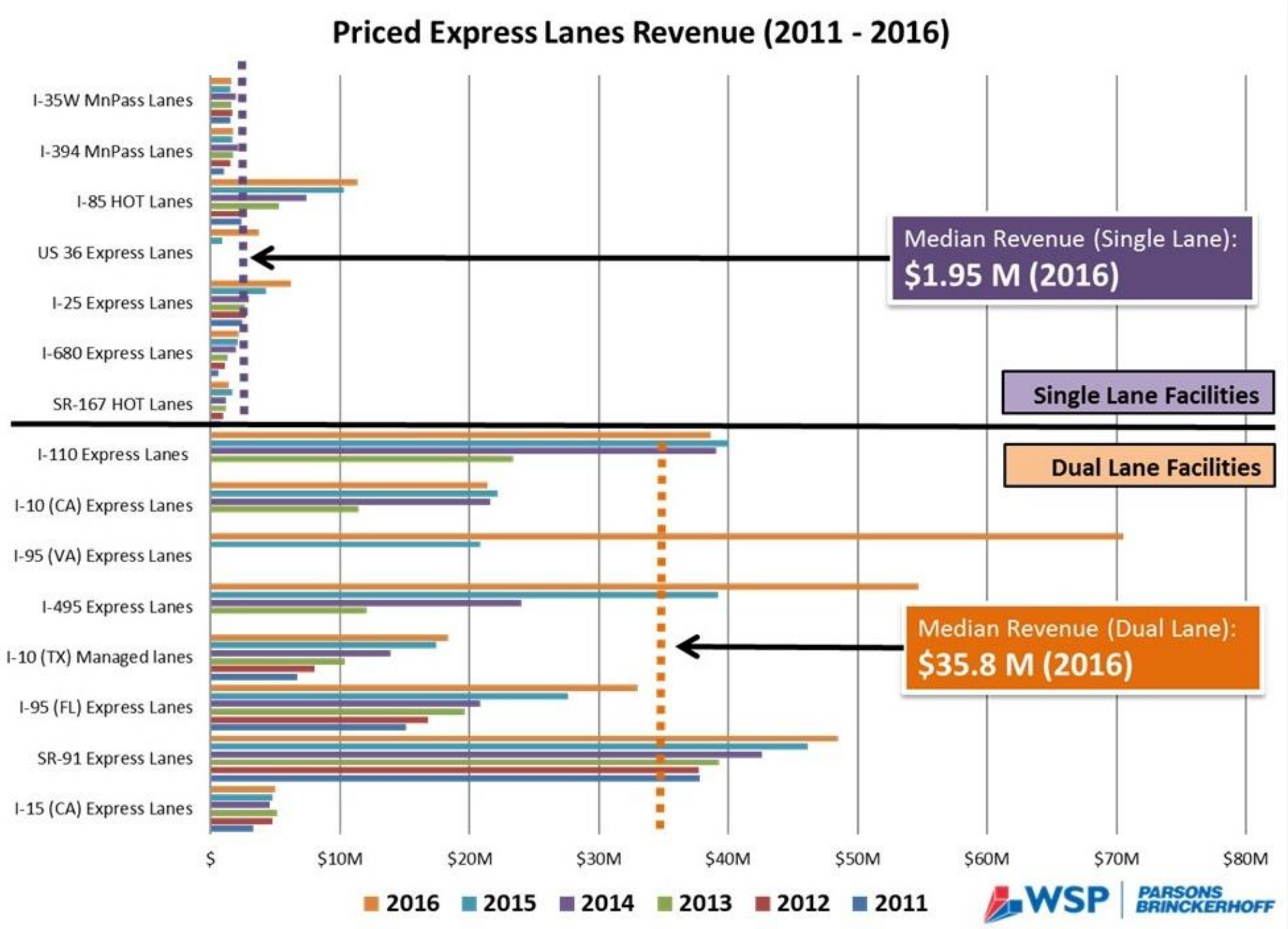
REVENUE EXPECTATIONS



WHEN THINGS DON'T GO RIGHT

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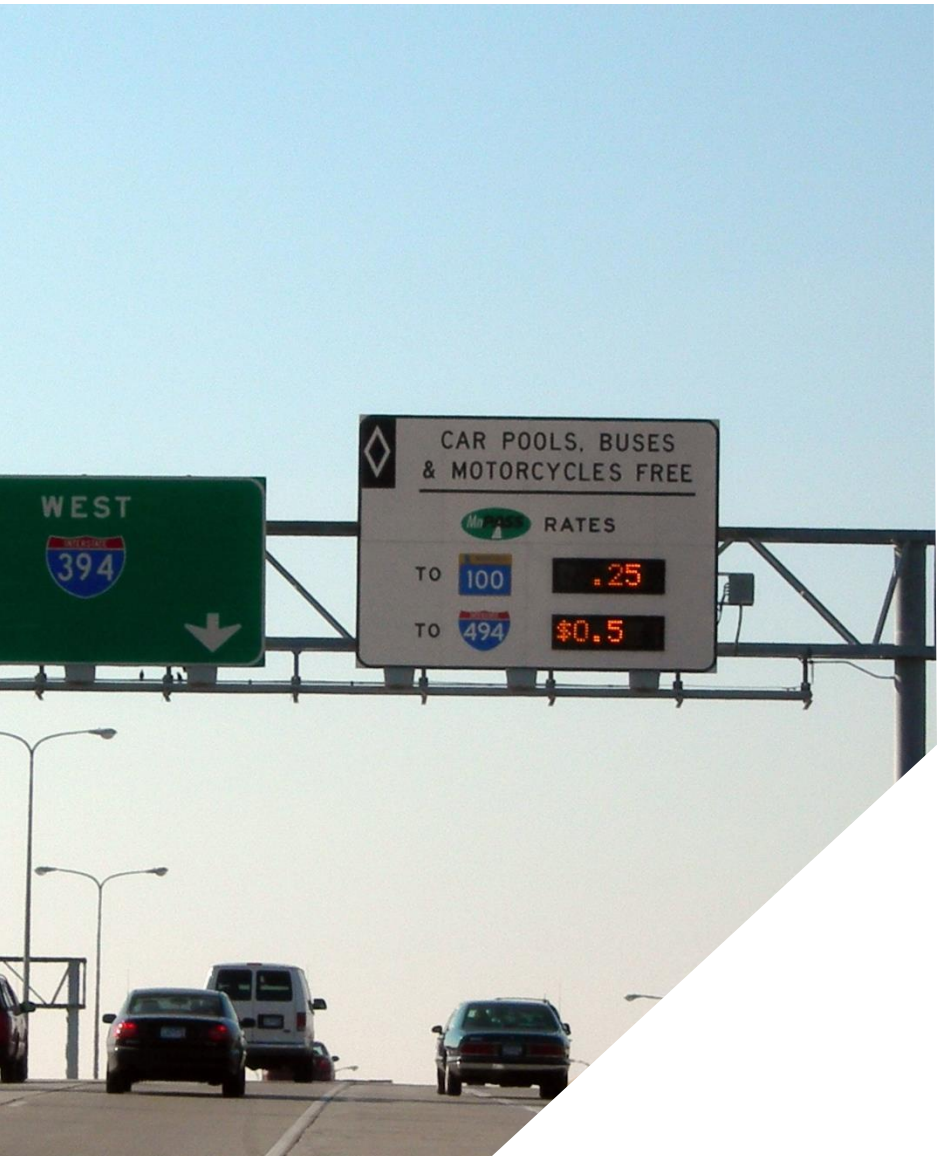
I-394 MINNEAPOLIS



Year Opened	2005
Length	11 miles
Directional lanes	1 lane each direction / 2 lane reversible
Access Type	5 Access Points
Separation Type	Painted Buffer
Transit	Moderate Bus Frequency
Capital Cost	$10M
Innovations	First use of buffer separation; mobile enforcement; static signage with DMS

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I-394 MINNEAPOLIS

What Went Wrong

- **Opened with 24 hours operation**
- **Increase in general purpose lane congestion**
  - Observed in off-peak direction
  - Unanticipated outcome
- **Increase due to a reduction in GP lane capacity**
  - Prior HOV configuration permitted GP traffic in off-peak times / directions
- **Legislature began considering a bill to reverse the I-394 Express Lanes**
  - Within first three weeks of operation

What Was Changed

- **MnDOT changes operations in response to legislature and public**
  - Instituted peak hour / peak direction policy
  - 6 am – 10 am inbound
  - 2 pm – 7 pm outbound

Outcome

- **Concerns alleviated**
  - Continuously operated since 2005
  - Support for new lanes on I-35W and I-35E
- **Mitigation depressed revenue**
- **Created precedent for all facilities**

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I-85 ATLANTA

Year Opened	2011
Length	15.5 miles
Directional lanes	1 lane each direction
Access Type	7 Weave Lanes
Separation Type	Painted Buffer
Transit	Adjacent to corridor
Capital Cost	$60M
Innovations	Registered carpool accounts, Mobile toll app, Mobile enforcement, Virtual barrier system

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I-85 ATLANTA

What Went Wrong

- **Restored flow to overused HOV lanes**
  - Converted congested HOV-2+ lane to priced managed lane with HOV-3+ toll-free with registration
- **Substantial increase in general purpose lane congestion**
  - By design, removing vehicles from express lanes
- **Dynamic pricing algorithm imposed very high toll rates**
  - Algorithm overly considered conditions in general purpose lanes when setting tolls

Measureable Impacts

- **Vehicular Throughput**
  - AM Peak: 6.6% decline
  - PM Peak: 2.9% decline
- **Person Throughput**
  - AM Peak: 9.9% decline
  - PM Peak: 6.3% decline
- **Vehicle Occupancy**
  - HOV-2: 30% (AM) decline
  - AVO: 2.0 → 1.2 person/vehicle

Source: Georgia Tech, College of Engineering
http://transportation.ce.gatech.edu/hov2hot

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I-85 ATLANTA

What Was Changed

- **Governor Deal intervened in the first five days to implement changes**
  - Placed cap on tolls
  - Required across-the-board reduction in toll rate
  - Opened additional access points to / from facility with restriping
- **Implemented a "human factor" in toll rate setting**
  - Replaced algorithm with human setting of toll rates
  - Algorithm "shadowed" changes and helped inform human operators
- **Changed algorithm**
  - No longer over-represented GP congestion in calculations

Outcomes

- **Public, legislative, and media concerns alleviated**
  - Changes were institutionalized
  - Express Lanes operate at / near maximum flow rates
- **Expansion of express lanes concept (under same Governor)**
  - Extension of I-85 Express Lanes
  - I-75 / I-575 (Northwest) under construction
  - I-75 (South) also under construction
  - Managed lanes key component of Governor's 10 year strategic plan

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I-110 LOS ANGELES

Year Opened	2012
Length	10.8 miles
Directional lanes	1 (4.3 miles); 2 (6.5 miles)
Access Type	7 intermediate with weave lanes
Separation Type	Painted Buffer
Transit	In-line stations (5)
Capital Cost	Appx. $35M
Innovations	Switchable transponders, transit incentives for use of express lanes

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I-110 LOS ANGELES

What Went Wrong

- **Northern end congestion**
  - Terminus in downtown Los Angeles involves critical bottleneck
  - Although lane split, demand does not follow split
  - Backups occur in both express lanes and general purpose lanes
- **Congestion at access points**
  - HOV only facilities on I-105 feed into I-110 Managed Lanes
  - High weaving volumes at junctions

What Went Wrong

- **HOV violations increased substantially**
  - Change to switchable transponders yielded more willful violators
  - 24 – 29% estimated violation rates in 2013 / 2014 operations

I-110 LOS ANGELES

What Was Changed

- **Reduce demand at bottlenecks**
  - $16M revenue reinvested for resolving traffic at bottlenecks
  - Changes in dynamic pricing algorithm to adjust to growing traffic volumes
- **Increased enforcement to reduce "unmetered" violators**
  - Violation rates declined to 10 – 12% when CHP actively patrolling
  - Exploring additional changes
    - Application of automated vehicle occupancy enforcement to aid CHP
    - HOV-2+ to HOV-3+ change

Outcomes

- **Public support for continuing Express Lanes**
  - Built-in sunset into project
  - Extensive public outreach / hearings yielded 58% support; 25% oppose
- **Legislative removal of sunset date**
  - Both I-110 and I-10 Express Lanes
  - Indefinite continuation (2015)
- **L.A. County Metro is developing additional Express Lanes**
  - I-110 Extension (pre-design)
  - I-105 (pre-design)
  - I-405 (pre-design)

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I-15 SALT LAKE CITY

Year Opened	2010
Length	40 miles
Directional lanes	1 each direction
Access Type	Near Continuous
Separation Type	Skip / Painted Buffer
Transit	None
Capital Cost	Appx. $150M

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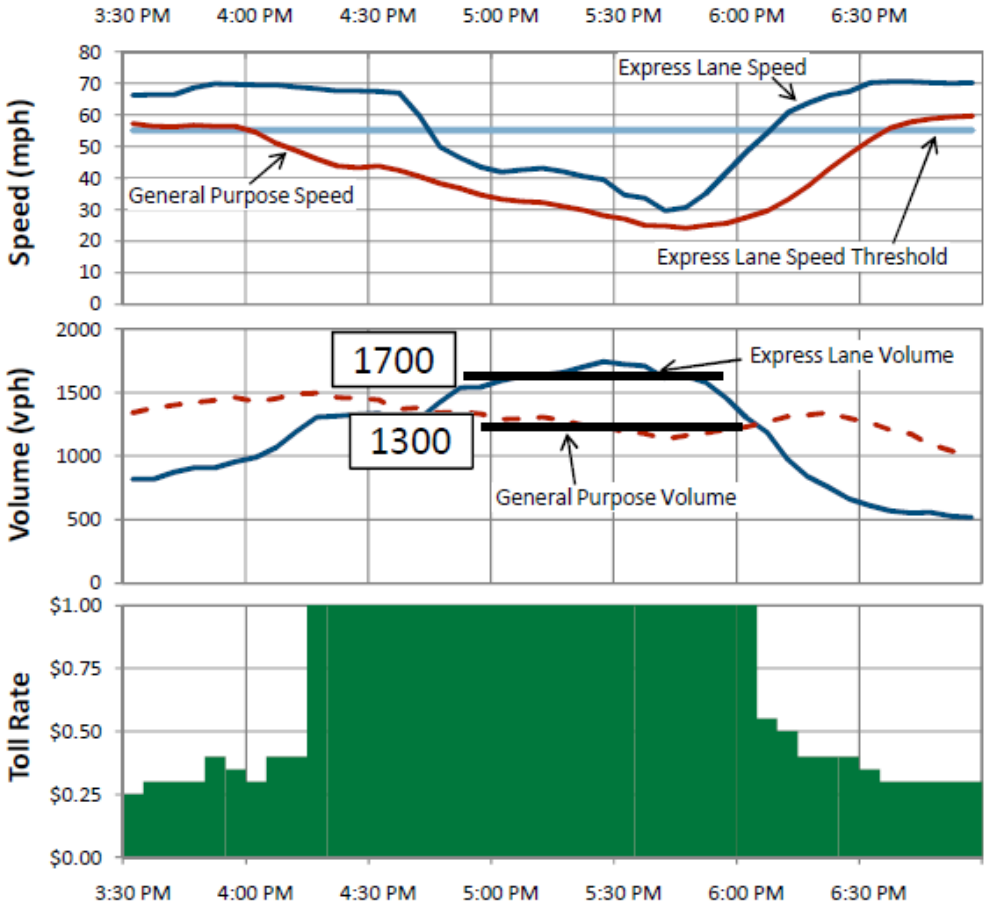
I-15 SALT LAKE CITY

What Went Wrong

- **Facility divided into 4 pricing segments**
  - Reduces ability to target benefit of pricing changes
- **Toll rate ceiling of $1.00 per segment**
  - Causes significant reduction in speeds in express lanes during peak hours

Impacts



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LESSONS AND TRENDS

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LESSONS AND TRENDS

- **Freeway Tolling is an increasingly mainstream mobility option**
  - Adopted express lanes policies in multiple states
    - Mandate preference for express lanes as new capacity
    - Shift to express lane *networks*
  - Limited general purpose lane widening in urban areas
  - Preservation of options
- **Still recognize that express lanes are a fundamental change in how we use highway capacity**
  - Evolution from “build and forget” to “every day operation”

I-70 Mountains, Colorado

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LESSONS AND TRENDS

- **Big Projects Require Big Revenue**
  - $1B+ reconstruction projects increasingly funded with revenue from express lanes
  - Leverages multiple funding sources
  - Alternative delivery / concession agreements
  - Provides O&M and limited capital coverage
- **Tolling for revenue involves different fundamental decisions than tolling for traffic management**
  - Mechanisms still the same

North Tarrant Express, Ft. Worth

I-495, Virginia

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LESSONS AND TRENDS

- **Success driven by planning and policy**
  - Invest early in education and outreach
- **Technical, institutional, public acceptance issues can be overcome**
  - Don’t oversell the project
  - Create “win” scenarios
  - Listen to constituents
  - Adapt policies to public desires
- **Establish performance measures and key policies early**
  - Agreement on what will constitute success or failure

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