High Occupancy Vehicle (HOV)/High Occupancy Toll (HOT)/Managed Lane Workshop #1

August 21, 2007
Program Agenda

- Welcome
- Introduction to Managed Lanes
- Technical Feasibility
- Institutional Feasibility
- Financial Feasibility
- Wrap Up and Next Steps
Regional High Occupancy Vehicle (HOV) / High Occupancy Toll (HOT) / Managed Lane Analysis

Agenda

◊ Welcome
◊ Introduction to Managed Lanes
◊ Technical Feasibility
◊ Institutional Feasibility
◊ Financial Feasibility
◊ Wrap Up and Next Steps
National Experience with HOV, HOT & Managed Lanes

- History of HOV, HOT and Managed Lanes
- Purpose and Benefits of Each
- Types of Lane Treatments
- Elements of a System
- Lessons Learned
- Concluding Thoughts
Traffic congestion costs us time. It costs us our peace of mind and quality of life. We don’t travel when we want to. We don’t go as far as we’d like. We don’t use the most direct route. We limit where we choose to live and where we’re willing to work.
...AND LIMITATIONS ON MEETING RISING DEMAND.

Lack of Space  
Environmental Constraints  
Inadequate Funding  
Explosive Growth
The First HOV Lanes were Demonstrations.

- Shirley Highway
- Blue Streak Express Bus Lanes
- El Monte Busway
- XBL Lane, NJ
Role of HOV Lanes: Move More People

Benefits of HOV Lanes
- Travel time savings
- Travel reliability
Mode Shifts

Example HOV Growth On I-45N

Houston, Texas

HOV Systems Planning, Design, and Operation Seminar
HOV Lanes Became Popular

Route-Miles

- Busways
- Radial Corridors
- Non-Radial Corridors

Regional High Occupancy Vehicle (HOV) / High Occupancy Toll (HOT) / Managed Lane Analysis
1990s: HOT Lanes were Tested

- Early demonstrations on SR 91 (Orange County, CA) and I-15 in San Diego
- One new facility, one converted facility
- HOVs free, SOVs pay
- Electronic toll collection made demonstrations possible
- Tested congestion pricing
What Are HOT Lanes?

- Managed priced lanes giving preference to HOVs.
- Highest HOVs are typically free.
- Offers unimpeded travel and reliability benefits during peak periods.
HOT Lane Benefits

**User Benefits**
- Reliable travel time
- Reduced delay
- More choices

**System Benefits**
- Greater throughput
- Improve mainlane capacity
- Preserves future capacity
- Improved air quality
- Revenue generation

I-15 San Diego

SR 91, Orange County, CA
Why Now?

Elected Officials see the Benefits
WHERE HOV AND HOT LANES ARE OPERATING

Legend: HOV Lanes: 🟡 HOT Lanes: ⬤
What Are Managed Lanes?

- Dedicated lanes serving different users over time.
- Real-time strategies used to preserve roadway operating capacity.
- Unimpeded travel offered during periods of peak demand.
Forms of Lane Management

- Eligibility/Occupancy
- Access Restrictions
- Pricing
Types of Lane Treatments

Concurrent-flow Lanes

I-495 Long Island Expressway, New York
Types of Lane Treatments

Reversible Lanes

I-10, Katy Freeway, Houston
Types of Lane Treatments

Contraflow Lanes

Dallas, I-30
Elements of an HOV or HOT System

- Support Facilities
- Intermodal Integration
- Funding
- HOV Lanes
- Implementation Coordination
- Marketing
- Bus Services

Strategic Plan
Park & Ride Facilities

US 290, Houston
Closing Thoughts

◊ Three feasibilities critical for any managed lane strategy: Technical, Institutional, Financial

◊ Managed lanes fit a unique role and are only part of a congestion management program that includes all other approaches to addressing demand.
Charlotte’s Experience with HOV Lanes
I-77 HOV Lanes

- State’s First HOV Facility
- Opened December 2004, 3 years from development of conceptual design
- Added to design-build contract
- Restricted to vehicles with 2+ occupants
- Restricted to HOVs at all times
- Some access restrictions
I-77 HOV Lanes

◊ Multi-agency team met during project.
◊ Extensive public outreach/education effort (logo, website, brochures, speakers bureau, traffic court flyers).
◊ Conducted 2 HOV enforcement workshops (SHP, CMPD, DA’s office).
### HOV Demand After 7 Weeks of Operation

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<tr>
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<th>General Purpose Per Lane</th>
<th>HOV Lane</th>
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## HOV Demand After One Year of Operation

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</table>
I-77 HOV - After First Year

- Travel time savings around 5 minutes
- 1232 bus passengers using HOV lane daily, up 53% from fall 2004
- 77% of respondents in fall 2005 poll were familiar with HOV lanes, up from 45% in 2004
- 17% used HOV lanes regularly based on poll responses
- 56% of poll respondents thought I-77 HOV lanes were good idea
**Design Challenges**

- Southbound HOV Lane Terminus
- Northbound HOV Lane Terminus
- Beginning of Northbound HOV Lane
- Ingress/Egress along HOV Facility
Southbound HOV Lane Terminus

- Extends south of I-277 Exit Ramp
- I-77 traffic volumes are lower, improving safety for merge
Southbound HOV Lane Terminus

- Design includes HOV-only bridge over I-85
- This feature dictated 24/7 operation to prevent driver confusion.
- Allows HOVs to by-pass I-85 ramp traffic
- Southbound HOV Lane is 10 miles
Northbound HOV Lane Terminus

- 3 GP lanes + HOV lane drops to 2 GP at end of current widening
- Merge creates 1-mile PM Peak queue
- Design has lane drops from right
- HOVs bypass queue because HOV lane becomes 1 of 2 GP lanes going north
NORTHBOUND HOV LANE TERMINUS

NOTE: Stationing is in meters; distances measured in feet
Beginning of Northbound HOV Lane

- Begins ½-mile north of I-85 interchange
- Allows trucks from I-85 to merge safely into left I-77 GP Lane
- Northbound HOV Lane is 5 miles
Ingress/Egress along I-77 HOV Lanes

- Maximum HOV Facility Access
- Safety Access Restrictions
Ingress/Egress along I-77 HOV Lanes

- Double white solid lines for prohibited HOV lane access
- 6-inch lines
Ingress/Egress along I-77 HOV Lanes

- Single white skip line for permitted HOV lane access
- 10-inch line
I-77 Enforcement

- Fine is only $10 because of interpretation of State statutes
- Violators still have to pay court costs of $100
- Violators also get 2 points on license
- NCSHP is primary enforcement agency
Elements of Study Feasibility

T = Technical
I = Institutional
F = Financial
Determining Feasibility of Managed Lanes

- **Technical**: Determine measurable benefits of HOV/HOT/MLs
- **Institutional**: Evaluate & shape stakeholder/public attitudes
- **Financial**: Look at costs, revenues and other impacts
Technical Feasibility

- Utilize tools developed by PB – rules of thumb – lessons learned to minimize delay in reaching decisions
- Employ revenue optimization model to quickly screen toll options (HOT Lanes)
- Factor in local conditions and standards – capitalize on previous work in the region
Institutional Feasibility

- Workshop, outreach, stakeholder interviews - measure perceptions of how locals would react to managed lanes being added to the freeway system
- Get pulse of the stakeholders early
- Identify and bring the right people to the table – and listen / identify what buzz is out there
Financial Feasibility

Define financing goals and objectives

◊ **HOT Lanes:**
  - Congesting pricing vs. revenue maximization
  - Self supporting system vs. contributions to O&M and/or capital expenditures

◊ **HOV Lanes:**
  - Identifying funding/revenue sources
  - Appropriately sizing the project to match availability of funding (Phasing)
Brainstorm Discussion: What Issues Could Affect Managed Lanes in Charlotte?
Agenda

- Welcome
- Introduction to Managed Lanes
- Technical Feasibility
- Institutional Feasibility
- Financial Feasibility
- Wrap Up and Next Steps
Overview of Technical Guidelines & Thresholds

- Lane Management Basics
- Critical Thresholds
- Typical Criteria
- Conditions for Each Strategy to Work
- Typical Output from Screening
**Lane Management Basics**

- **Throughput**: volume of vehicles carried
- **Demand**: volumes of vehicles passing a location
- **Capacity (LOS E-F)**: 2000-2200 vph/lane
- **Operation Threshold (LOS C)**: 1600 vph/lane

**Congestion!**

**Congested Lanes**
What does LOS “C” Look Like?
Critical Thresholds

◊ Travel Time Savings
  ▪ 0.5 minutes/mile or 5-7 minutes/trip

◊ Adequate Use
  ▪ Initial (opening year)
  ▪ Forecast (planning horizon)

◊ Ability to Add a Lane
  ▪ May borrow off-peak direction lane or shoulder
**Adequate Use**

◊ **Vehicles**
  - Perception based, varies by lane treatment
  - Typically 400-600 vph initially

◊ **Persons**
  - Parity or better compared to GP lanes by planning horizon (5-20 years after opening)
  - 2000 persons per hour =
    - 500 2+ carpools, 15-18 loaded buses
    - 800 2+ carpools, no buses
Typical Screening Criteria

- Presence of Congestion
- Demand-HOV vehicles
- Demand-Persons (HOV and transit)
- Demand-Toll paying commuters
- Demand-Commercial vehicles
- Travel Patterns
- Roadway Characteristics
For an HOV Lane to Work

◊ Vehicles
  ▪ Perception based, varies by type of treatment
  ▪ Typically 400-600 vph initially

◊ Persons
  ▪ Parity or better compared to GP lanes by planning horizon (5-20 years after opening)

◊ Ability to add a lane
◊ Transit and rideshare potential
◊ Ability to enforce
For a HOT Lane to Work

◊ Vehicles
  ▪ Typically 1000-1200 vph initially
  ▪ Maximum of 1600-1650 vph (LOS C)

◊ Ability to add a lane or convert an HOV lane

◊ Project champion and willing stakeholders

◊ Revenue Impact on Adequate Use
  ▪ 2+: May not cover pricing O&M costs
  ▪ 3+: Maximizes revenue at sacrifice to 85% of eligible HOVs
For a Truck Toll Lane to Work

- Requires 2 directional lanes
- Vehicles: 800 trucks/hour
- Common origins and destinations
- Mandatory tolling for financial feasibility
- Willing stakeholders
- None built yet, studied in Atlanta, Los Angeles, Bay Area
For an Express/Toll Lane to Work

- Minimum of 1 and preferably 2 additional directional lanes
- Vehicles demand of 1500 per lane/hour
- Common origins and destinations
- Willing stakeholders
- Ability to largely cover all costs from revenue
Typical Screening Output

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<th>Segment</th>
<th>Presence of Congestion</th>
<th>Bottlenecks</th>
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Notes: * = included in no-build
Example of HOV Demand Threshold

Existing and Funded Network: Corridors at the HOV Capacity Threshold

- Threshold Year:
  - 2011 - 2016
  - 2016 - 2020
  - 2021 - 2026
  - 2026 - 2030
  - 2031 - 2035

- HOV segments not exceeding the threshold by 2035.
Other Evaluation Criteria

- Connectivity
- Safety-design attributes
- Public attitudes/support
- Enforceability
- Cost/cost effectiveness
- Impacts on others
- Revenue generation potential
Potential Screening Criteria for Charlotte Region

- Presence of Congestion
- HOV Demand
- HOT Demand
- Physical Attributes
Presence of Congestion

- Line-haul congestion on freeways: V/C > 1.0 & speeds < 30 mph in peak period
- Line-haul congestion on arterials: V/C > 1.0 & speeds < 20 mph in peak period
- Bottlenecks (<0.5 mi.): V/C > 1.0 & speeds < 20 mph in peak period
HOV Demand

- Adequate transit ridership where carpools < thresholds
- Trip distances > 5 mi. for freeways & 3 mi. for arterials
- More persons per lane than GP lanes (using 2000 persons/GP lane)
- 600 PCEs/hour (min.) for freeways; 200 PCEs/hour (min.) for arterials
**HOT Demand**

- Trip distances > 5 mi. on freeways & 3 mi. on arterials for commuters or large trucks
- 1000 PCEs/hour (min.) for freeways; 400 PCEs/hour (min.) for arterials
- Commercial vehicles
  - 400 large trucks directionally/hour
  - Common O&Ds > 5 mi. using corridor
- Forecasted gross revenues
Physical Attributes

- Space for commuter demand > 16 ft. by direction
- Space for truck demand > 34 ft. by direction
- Assess feasibility of borrowing needed managed lane capacity based on above dimensions
Discussion:
What Technical Issues Should be Addressed?
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- Wrap Up and Next Steps
Institutional Feasibility

Market Characteristics and Elements for Success

- Product
- Placement
- Pricing
- Promotion
Market Characteristics & Elements for Success

- **Product**
  - Is it a product that people want to buy?
    - Is there a demand for moving more swiftly (that matches financing requirements)?
    - Is it more reliable?
    - Is it safe?
  - Is a product that has broad-based support*?
    - Project “champion” necessary regardless of managed lane strategy
    - Trusted agency sponsor (DOT, transit agency, city) and willing partners (FHWA, police, courts)
    - *unique to projects that use public $$ or other public resources*
Market Characteristics & Elements for Success

- **Product**: Is it a product that people want to buy?

- **Placement**
  - Can you provide the facility in the correct location?
    - Can you provide a safe, reliable facility at strategic locations where there is congestion?
    - Can the facility be easily and safely accessed at those locations?
      - Transit access
      - Entrances/exits/merges
Market Characteristics & Elements for Success

◊ **Product:** Is it a product that people want to buy?
◊ **Placement:** Can you provide it in the correct location?

**Pricing**

- Will consumers be willing to “pay” the product price?
  - Can you price it so that people are willing to pay (in money or behavior) to make it beneficial to use?
    » Carpooling/vanpooling easy to form and meet?
    » Toll attractively priced and easily understandable?
Market Characteristics & Elements for Success

- **Product**: Is it a product that people want to buy?
- **Placement**: Can you provide it in the correct location?
- **Pricing**: Will consumers be willing to “pay” the price?

**Promotion**
- Can you deliver the facility so that people know about and can easily purchase it?
  - Enforce Requirements
    - Occupancy
    - Toll
  - User “Amenities”
    - Transit Service
    - Park & Ride Lots
  - Toll Collection and “$ for Service”
    - Transponder Distribution and Servicing
    - “Money-Back” Guarantee
What Have We Learned?

No Negative Impact to General Purpose Traffic

- Converting existing lane to a HOV/HOT/managed lane
- Shoulder use requires additional incident management commitment
- Merging into and out of the managed facility can create new congestion or crashes in the GP lane
- “Non-Compete Terms” for HOT/managed vs. GP Lanes
Facility Perceived as Effective

- Ensure that project has adequate usage day of opening for public acceptance and users safety
  - Meets minimum thresholds for use
  - Low level of violations
  - No perception of negative impacts on adjacent users
  - Access to/exit from tolled lanes do not impede GP lanes
What Have We Learned?

Facility Perceived as Customer Friendly

- Easy to obtain and “reload” transponder
  - Easy to obtain in person, on phone or through internet
  - Rewards for account management via internet or frequency of use
- Policies and procedures for “money back” guarantee (HOT)
  - Users are “paying for level of service.” What happens when the level of service isn’t delivered?
What Have We Learned?

Facility “Honest & Acceptable”

to General Public

- Operator(s) of facility have a positive standing in the community
  - Denver and Texas examples
- Enforcement preparation and implementation
  - Troopers are trained and assigned
  - Judges educated regarding their enforcement role
- Fines are appropriate and legislatively enabled
  - Fines
  - Court Costs
  - Insurance Points
Current Project Challenges

• Competition for Lane Space -- What Trumps What?
  – People Moving vs. Vehicle Moving
  – Air Quality
  – Revenue Generation
Current Project Challenges

• Hybrid Usage
  – Can clog HOV lane
  – Hybrids use their gas engines (vs. energy efficient electric) when they are operating at 45+ mph 90% of the time, but are not “super energy efficient” when operating at freeway speeds -- conversely they offer more air quality benefits when operating in slow-speed traffic.

  “Speed is your enemy. The ideal routes have long stretches without stops, and speed limits of 30 - 35 mph. The maximum all-electric speed is 40 mph. The “sweet spot” for most hybrids, in "steady state" testing, is between 40 and 45 mph.”

Stakeholders Interview
Findings to Date
## Stakeholders Interviewed

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<th>Status</th>
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<td>Sue Myrick</td>
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<td>John Lassiter</td>
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<td>Lisa Renstrom</td>
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Discussion:
What Institutional Issues Should be Addressed?
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- Introduction to Managed Lanes
- Technical Feasibility
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- Financial Feasibility
- Wrap Up and Next Steps
Financing
Pricing
Examples
# Financing

## Federal Demonstration Funds
- TEA-21 – USDOT’s FHWA and State and or Local agencies
- Value Pricing projects
- Project - The HOT Lane program in Houston

## State Funds
- E.g. State Infrastructure Bank – like private banks
- Projects - Pocahontas Parkway, VA and Butler Regional Highway in Ohio

## Local Sales Tax Initiatives
- E.g. sales tax, motor fuel taxes, motor vehicle registration taxes, commuter taxes, tax increment financing, and other forms of special assessment

## Bonds/Private Financing
- Taxable toll-revenue bonds – private financing
- Tax-exempt toll revenue bonds – public financing
- Project – SR-91, Orange County, CA

## Innovative Financing Programs
- Section 129 Loans – allows Federal participation
- Transportation Infrastructure Finance and Innovation Act
- Project - President George Bush Turnpike, Dallas, first highway facility to be financed with Section 129 loans.
<table>
<thead>
<tr>
<th>Pricing Category</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>Variable Tolls</td>
<td>◇ Toll roads, bridges, existing toll-free facilities</td>
</tr>
<tr>
<td>Cordon Charges</td>
<td>◇ Charges within an area</td>
</tr>
<tr>
<td>Area-wide Charges</td>
<td>◇ Per-mile charge in an area</td>
</tr>
<tr>
<td>Variable Priced Lanes</td>
<td>◇ Express Tolls</td>
</tr>
<tr>
<td></td>
<td>◇ High Occupancy Toll lanes</td>
</tr>
</tbody>
</table>
Pricing Examples

- Currently over 130 managed lanes projects in US and Canada
- 7 projects currently use pricing
SR-91 Express Lane, Orange County

- Privately financed
- Variable rate bank loans, long term loans, private equity, subordinated debt.
- **FasTrak** transponder
- HOV 3+ gets 50% discounts
- Toll $1.10 - $7.75
- Time of day
I-15 HOT Lanes, San Diego

- Value Pricing Pilot Program grant
  - $1.99 million local matching funds
  - $230,000 FTA
- 1996 - $50 per month
- 1998 – FasTrak Dynamic Tolling
  - $0.50 - $4.00 ($0.25 increment), maximum $8.00
- HOV 2+ free
I-10 & US-290 HOT Lanes, TX

- 1998 – QuickRide on existing I-10 HOV
- 2000 – started on US-290
- No SOVs, 3+ is free
- Limited 2+ pay $3.00 toll during peak
- 2+ free during off-peak
- Revenue pays all operational costs
I-394 HOT Lanes, MN

- **MnPass** - converted HOV to HOT
- Dynamically priced
- Free to HOV and motorcycles
- No toll during off-peak
- Average $1.16 toll per trip
I-15 Express Lane, UT

◦ Free to 2+, buses, motorcycles & clean fuel vehicles
◦ $50 per month decal, renews monthly
◦ Longest HOT lanes in operation in the USA (38 miles)
◦ Fines are $82 Salt Lake County and $92 in Utah County
I-25 HOT Lanes, Denver

- **EXpressToll** transponders
- Time-of-day (TOD) toll levels
- Free to HOV, buses, motorcycles
- Purpose – cover M&O expenses not revenue maximization
- Actual Revenue
  - 3x estimated
<table>
<thead>
<tr>
<th>HOT</th>
<th>Annual Gross Revenue</th>
<th>Mi.</th>
<th>HOT lanes</th>
<th>Operation</th>
<th>Toll Range</th>
<th>Who Pays</th>
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</thead>
<tbody>
<tr>
<td>SR-91, CA</td>
<td>$39.5M</td>
<td>10</td>
<td>4</td>
<td>All-day</td>
<td>$0.75 – $9.50</td>
<td>SOV toll, HOV3+ free off-peak</td>
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<td></td>
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<td></td>
<td>TOD toll</td>
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<tr>
<td>I-15, CA</td>
<td>$2.0M</td>
<td>8</td>
<td>2</td>
<td>Reversible</td>
<td>$0.50 – $4.00</td>
<td>SOV toll, HOV2+ free</td>
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<td></td>
<td></td>
<td></td>
<td></td>
<td>Peak periods</td>
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<td></td>
<td>Dynamic tolling</td>
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<tr>
<td>I-10, TX</td>
<td>$0.16M QuickRide</td>
<td>13</td>
<td>1</td>
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<td>$3.00</td>
<td>NO SOV</td>
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<td>Peak periods</td>
<td></td>
<td>HOV2 toll/free off-peak, HOV3+ free</td>
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<td>Fixed toll</td>
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<tr>
<td>US-290, TX</td>
<td>See above</td>
<td>15.5</td>
<td>1</td>
<td>See above</td>
<td>See above</td>
<td>See above</td>
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<tr>
<td>I-394, MN</td>
<td>$1.3M</td>
<td>9.8</td>
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<td>Reversible &amp; Concurrent</td>
<td>$1.00 – $4.00</td>
<td>SOV toll, HOV2+ free</td>
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<td>Concurrent</td>
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<td>Peak periods</td>
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<td>Dynamic tolling</td>
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<tr>
<td>I-15, UT</td>
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<td>38</td>
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<td>All-day</td>
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<td>SOV toll, HOV2+/clean-fuel free</td>
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<td>Both directions</td>
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<td>Monthly decal</td>
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<td>I-25, CO</td>
<td>$1.6M</td>
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<td>$0.50 – $3.25</td>
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<td>Peak periods</td>
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<td>TOD toll</td>
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</table>
Discussion: What Financial Issues Should Be Addressed?
Agenda

- Welcome
- Introduction to Managed Lanes
- Technical Feasibility
- Institutional Feasibility
- Financial Feasibility
- Wrap Up and Next Steps