

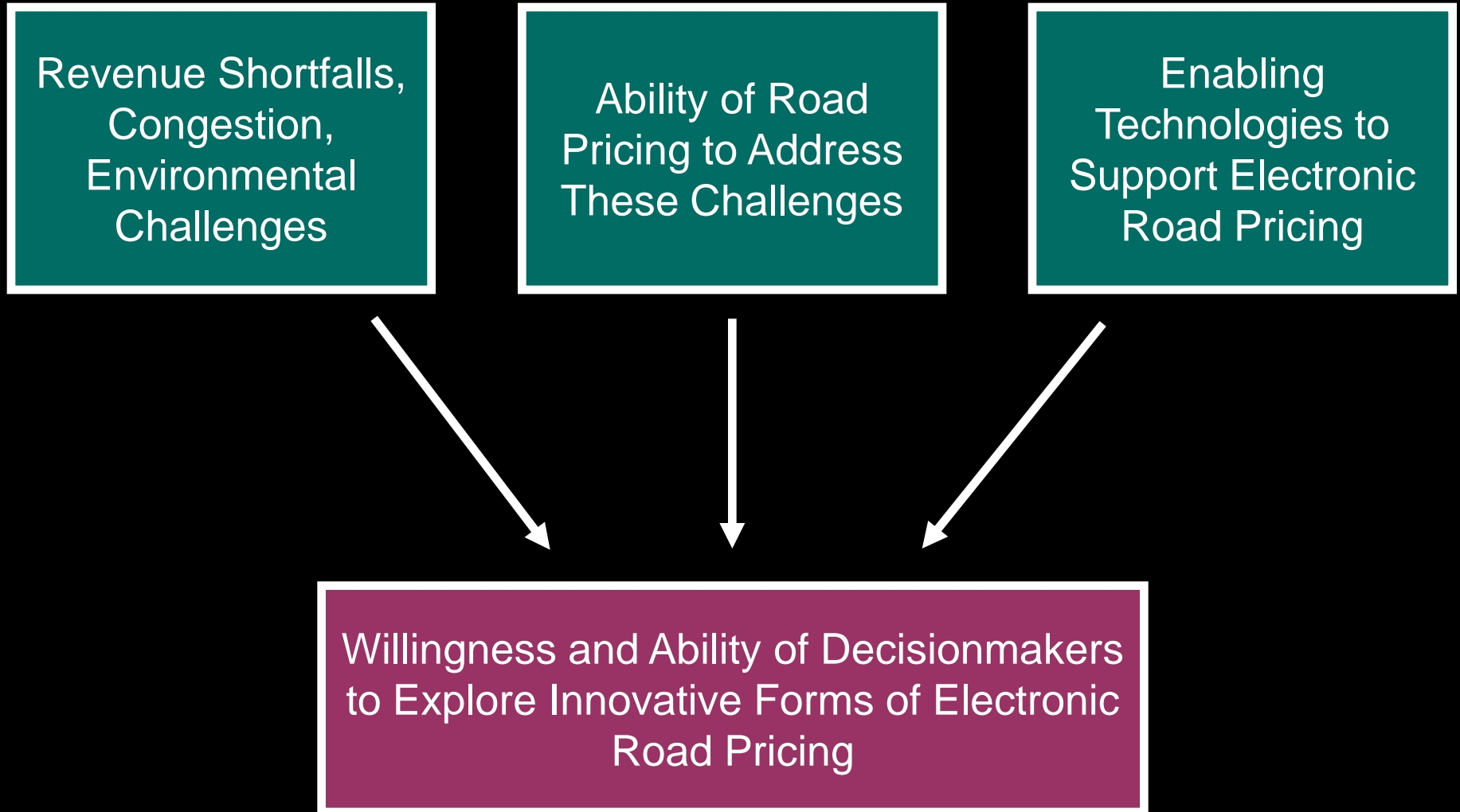


INFRASTRUCTURE, SAFETY,  
AND ENVIRONMENT

***Paying for What We Get:  
Progress in Pricing Transportation Externalities to  
Increase Economic Efficiency and Environmental Quality***

**Paul Sorensen, RAND Corporation  
UCLA Arrowhead Symposium  
October 21, 2008**

# *Challenges and Opportunities Are Driving a Rise in Innovative Road Pricing Programs*



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Revenue Shortfalls,  
Congestion,  
Environmental  
Challenges

Ability of Road  
Pricing to Address  
These Challenges

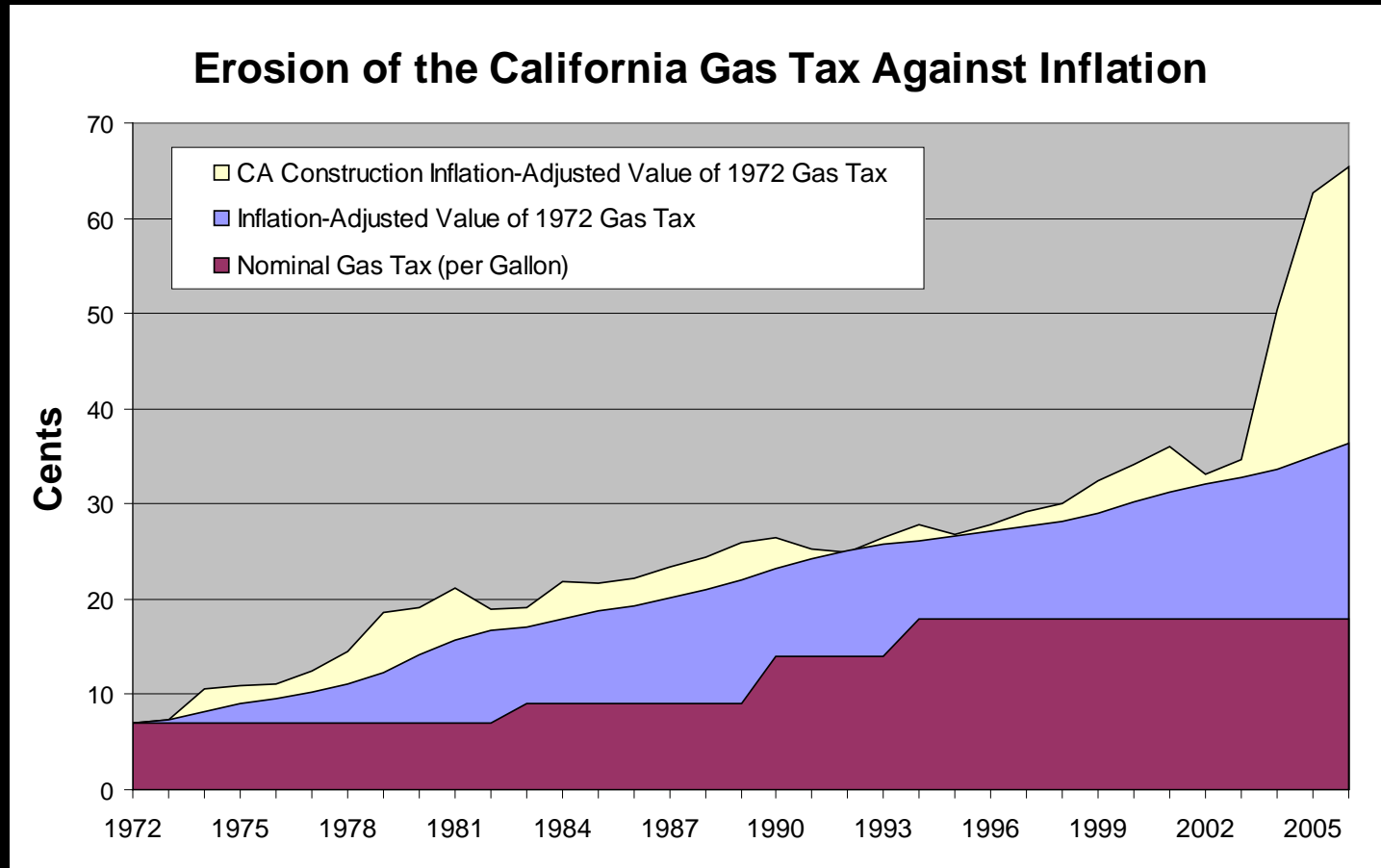
Enabling  
Technologies to  
Support Electronic  
Road Pricing

Willingness and Ability of Decisionmakers  
to Explore Innovative Forms of Electronic  
Road Pricing

# ***Failure to Raise Fuel Taxes Has Led to Transportation Revenue Shortfalls***

- **State and federal excise fuel taxes provide a significant share of highway and, more recently, transit funding**
- **Excise fuel taxes are levied in cents per gallon, and thus need to be raised to keep pace with inflation and improved fuel economy**
- **Elected officials have grown increasingly wary of any type of tax increases**
- **Recent decades have witnessed significant decline in real revenue per mile of travel**

# California Serves as an Example of the Erosion of Fuel Tax Revenues



# *Traffic Congestion Is Also Worsening*

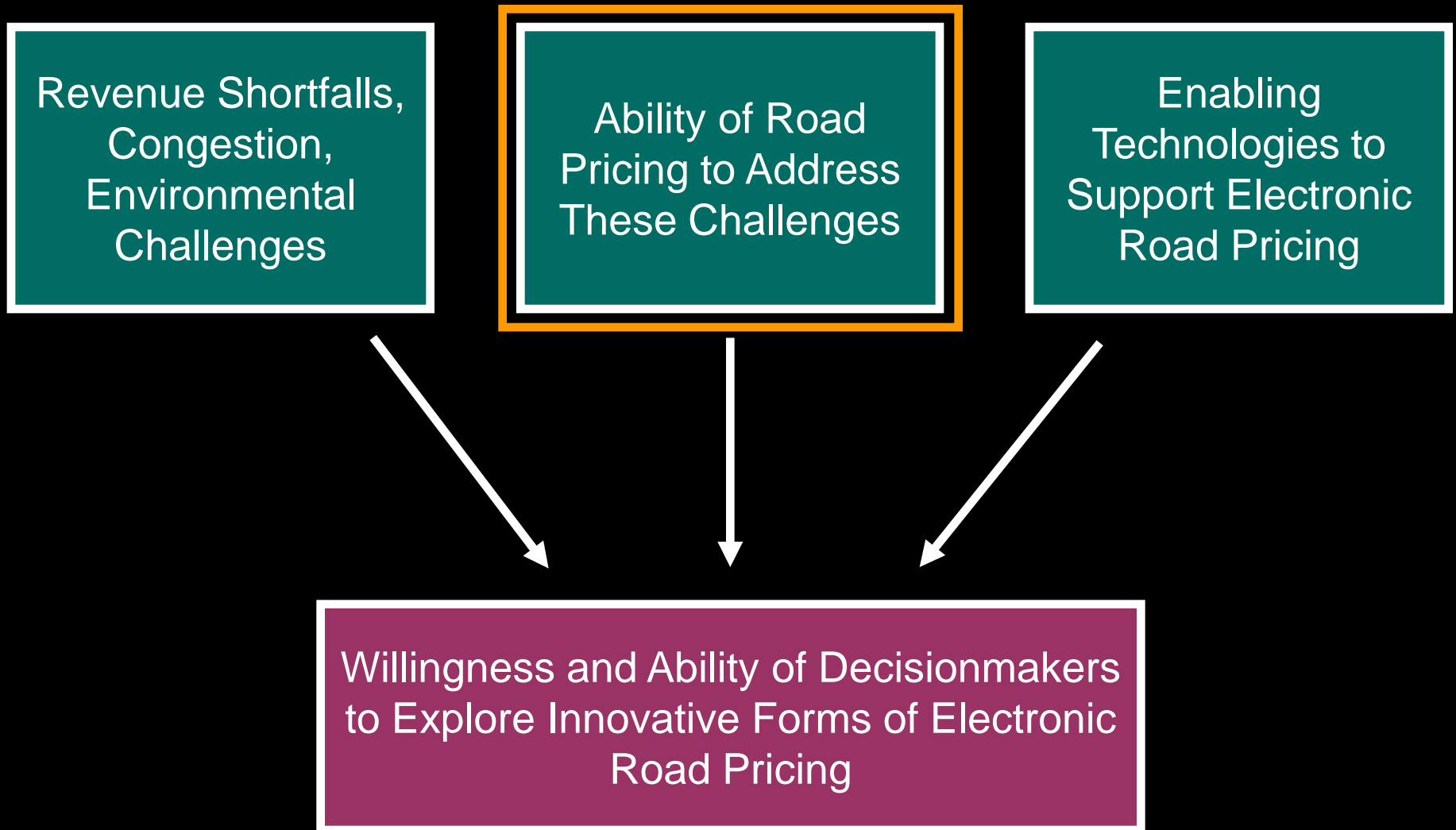


TTI has estimated that traffic congestion costs the Los Angeles region \$9.2 billion in wasted time and fuel each year (up from less than \$2 billion in 1982)

# ***Pressing Environmental Concerns Are Receiving Increased Attention***

- **Numerous urban regions have not yet achieved one or more of EPA's criteria pollutant standards**
- **Increasing evidence of adverse health effects stemming from concentration of harmful emissions around major transportation hubs and corridors**
- **Growing recognition of the severity of climate change and the key role of fossil fuel consumption in the generation of greenhouse gases**

# *Challenges and Opportunities Are Driving a Rise in Innovative Road Pricing Programs*





# *Driving Is Currently Underpriced*

- We do not generally pay for the congestion delays that our travel decisions impose on others
- We do not generally pay for environmental damage resulting from the emissions of criteria pollutants and greenhouse gases when we drive
- With failure to raise fuel taxes, we pay increasingly less for road wear-and-tear

Economists describe these social costs as “externalities”

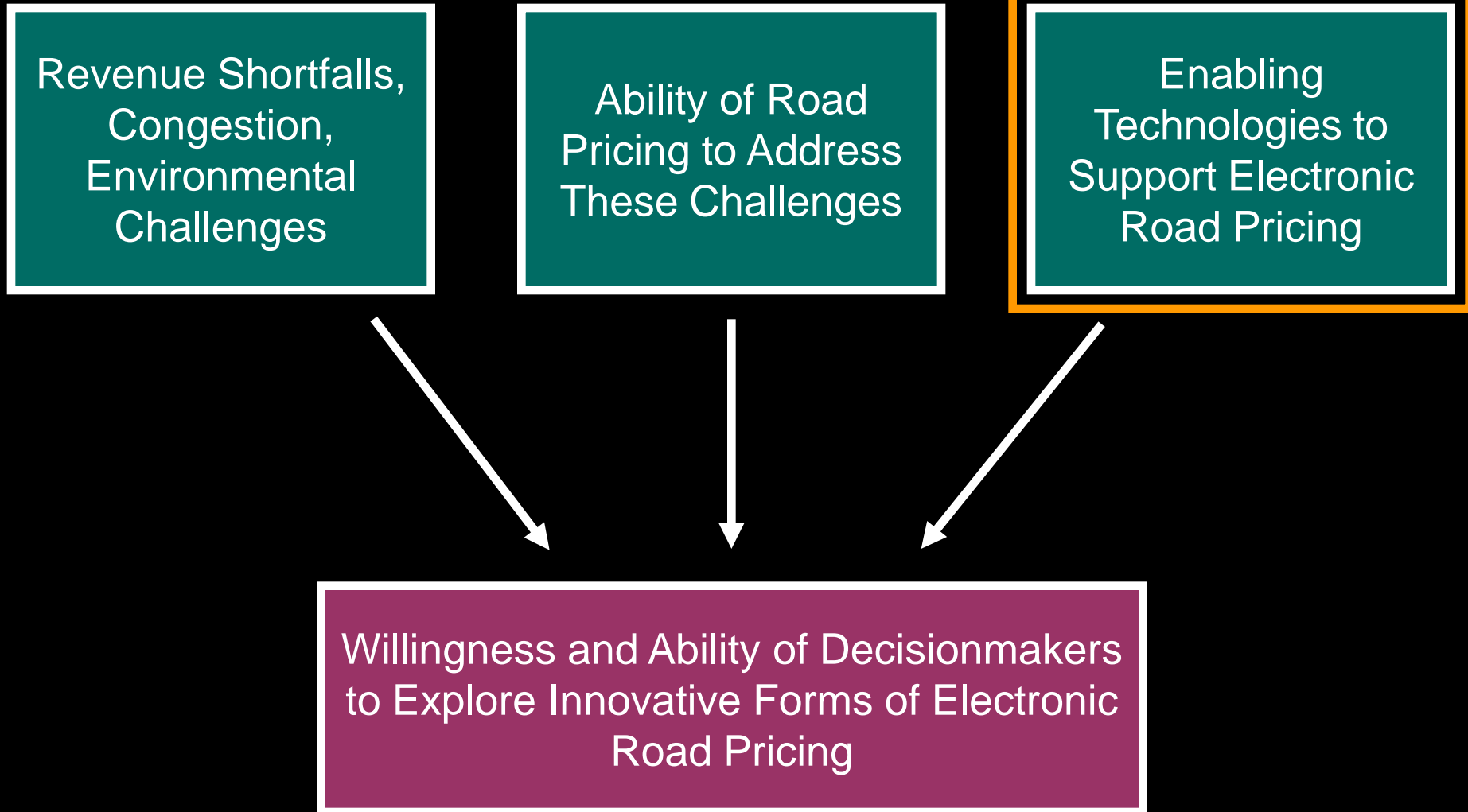
# ***Pricing Externalities Will Foster Greater Efficiency in Our Transportation System***

- **When externalities are unpriced, drivers will tend to “over-consume” road space – they will make trips for which the total costs (including costs to society) outweigh the total benefits (largely private)**
- **Pricing (internalizing) externalities creates an incentive for drivers to forego such trips**
- **Theoretically, this enhances economic efficiency, or net “social welfare”**
- **Practically, this leads to reductions in congestion and harmful emissions while generating needed transportation revenue**

# ***Road Pricing Makes It Possible to Include Externalities in the Cost of Driving***

- **Road pricing, broadly, can involve levying charges (user fees) that vary with:**
  - **Distance traveled**
  - **Time and location of travel**
  - **Vehicle characteristics, including type, weight, and emissions characteristics**
- **These features make it possible for road pricing to incorporate the externalities of:**
  - **Congestion (distance, time, and location of travel)**
  - **Emissions (distance, vehicle type, emissions class)**
  - **Road maintenance (distance, types of roads traveled, vehicle type and weight)**

# *Challenges and Opportunities Are Driving a Rise in Innovative Road Pricing Programs*



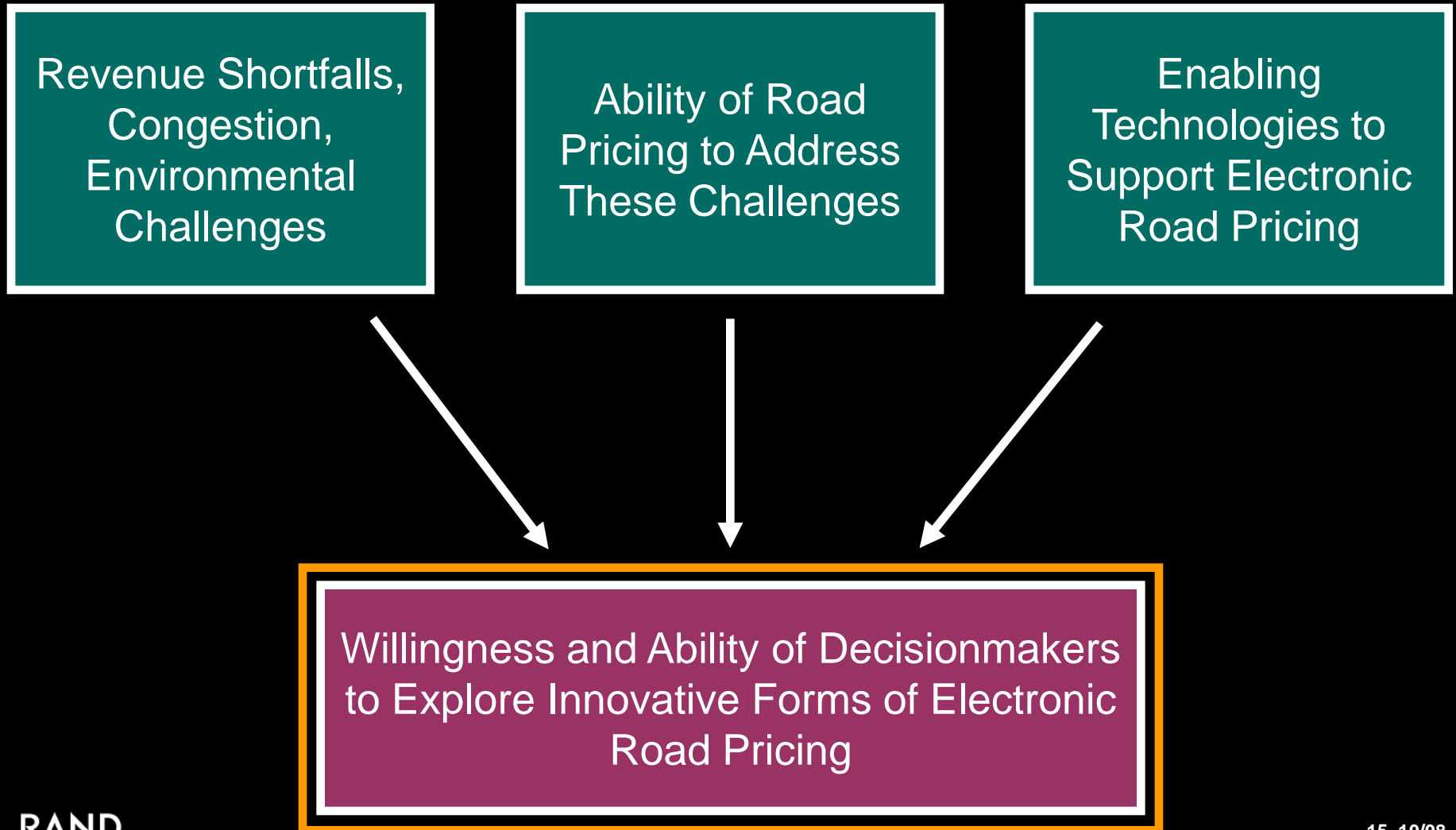
# ***Recent Technical Developments Make Sophisticated Road Pricing Schemes Possible***

- **Researchers and economists have long extolled the theoretical virtues of road pricing (e.g., congestion tolls)**
- **Practical implementation has only become possible with recent technical advances**
  - **ANPR (license plate recognition)**
  - **DSRC (in-vehicle transponders)**
  - **Cellular communications**
  - **GPS / GIS**
  - **On-board computers**

# ***Three Common Technical Configurations Have Been Applied in Metering Road Use***

- **Electronic transponders (DSRC):**
  - In-vehicle transponders communicate with roadside receivers to meter usage
- **License plate recognition (ANPR):**
  - Digital cameras and license plate recognition software are used to record vehicles that have used a facility or traveled within an area
- **GPS-based:**
  - Vehicles are equipped with onboard computers featuring GPS receivers and digital maps that determine the number of miles traveled in different jurisdictions, on different roads, and at different times of day

# *Challenges and Opportunities Are Driving a Rise in Innovative Road Pricing Programs*



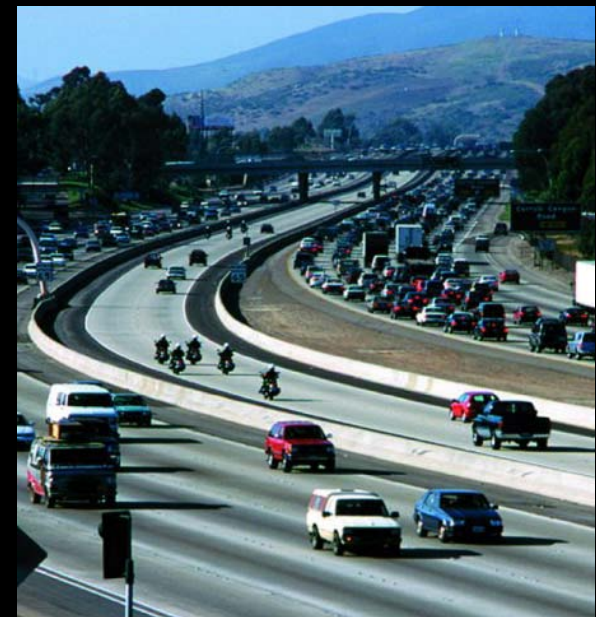
# ***We Are Witnessing a Rise in Innovative Pricing Applications in the U.S. and Abroad***

- **Partial facility congestion tolls**
- **Full facility congestion tolls**
- **Cordon (area) congestion tolls**
- **Weight-distance truck tolls**
- **VMT-based tolls**
- **Parking-related (variable curb parking charges, parking cash-out, etc.)**



# Partial Facility Congestion Tolls

- **Concept:**
  - Apply tolls on a subset of lanes
  - Vary tolls to prevent congestion
  - “HOT” or “express” lanes
- **Goals:**
  - Make use of excess HOV capacity
  - Provide option of faster travel
  - Fund new lane construction
  - Subsidize transit in corridor
- **Examples (mainly U.S.):**
  - San Diego, Orange County, Houston, Denver, Minneapolis, Miami
  - We have not yet converted general purpose free lanes to toll lanes



# *Full Facility Congestion Tolls*

- **Concept:**
  - Apply variable tolls on all lanes in a facility
  - Typically applied on existing or new toll facilities
- **Goals:**
  - Maintain free-flowing conditions
  - Use capacity as efficiently as possible
  - Fund new facility construction
- **Examples (U.S. and international):**
  - NY/NJ toll facilities
  - Toronto (407 ETR), Singapore



# Cordon Congestion Tolls

- **Concept:**
  - Set up cordon around congested area
  - Charge drivers for peak-period entry
- **Goals:**
  - Reduce traffic congestion in area
  - Raise significant revenue
  - Reduce emissions (optional)
- **Examples (mainly international)**
  - London, Stockholm, Singapore
  - Milan (emissions based)
  - Pier Pass program (Ports of LA/LB)



# *Weight-Distance Truck Tolls*

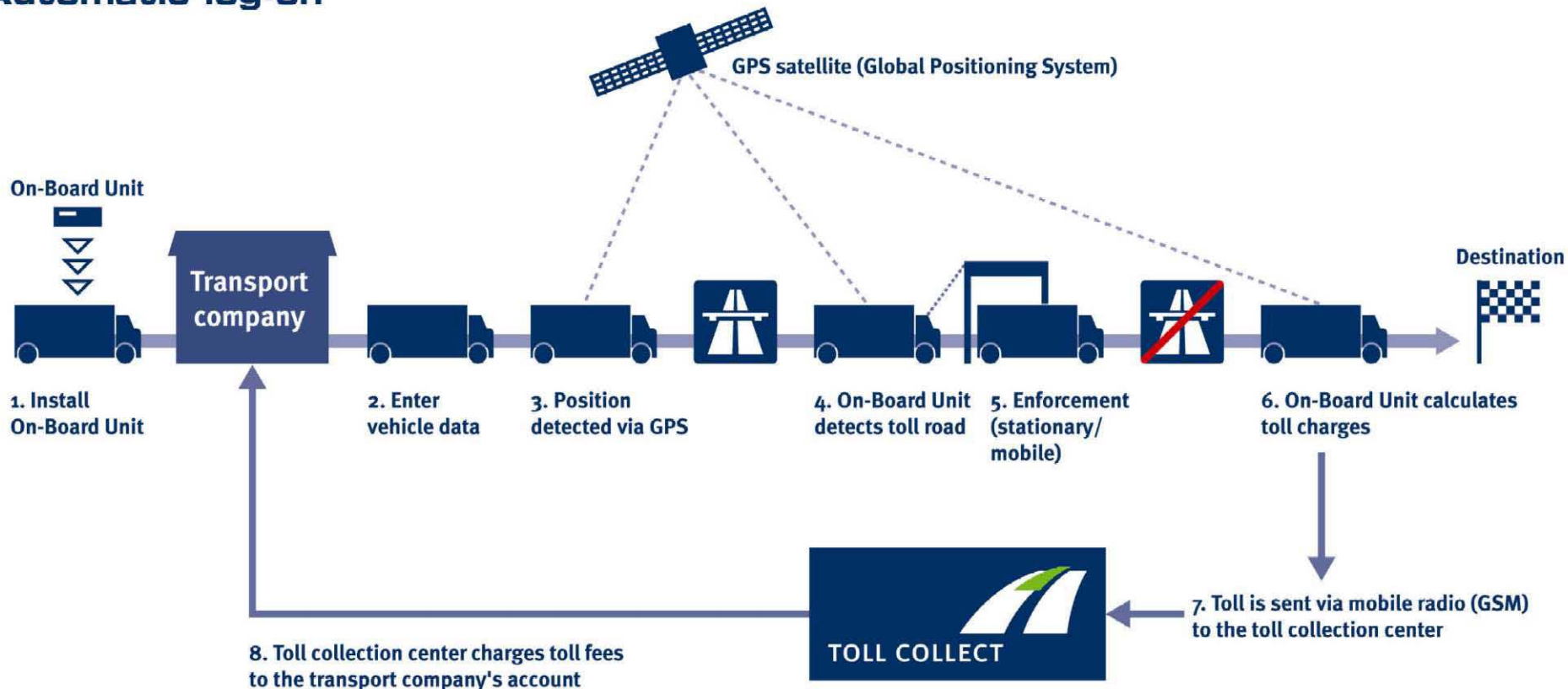
- **Concept:**
  - System of road-use fees for trucks
  - Charge based on (axle) weight, distance traveled
  - May apply on highways or all roads
- **Goals:**
  - Recoup maintenance costs for truck travel
  - Capture costs for “external” users (optional)
  - Encourage lower-emissions vehicles (optional)
- **Examples (international):**
  - Switzerland
  - Austria
  - Germany



# The German "Toll Collect" Program Is the Most Technically Advanced

## Truck toll collection in Germany

### Automatic log-on



# *VMT-Based Tolls*



- **Concept:**
  - Road-use charges for all vehicles
  - Based on distance traveled across network
  - May divide revenue across jurisdictions
- **Goals:**
  - Long-term replacement for fuel taxes
  - Platform for network-wide congestion tolls (optional)
  - Platform for network-wide emissions fees (optional)
- **Examples (no implementation to date):**
  - Netherlands
  - Oregon and University of Iowa studies
  - Puget Sound network-wide congestion tolls



# *Type of Pricing Has Implications for Technology and Level of Implementation*

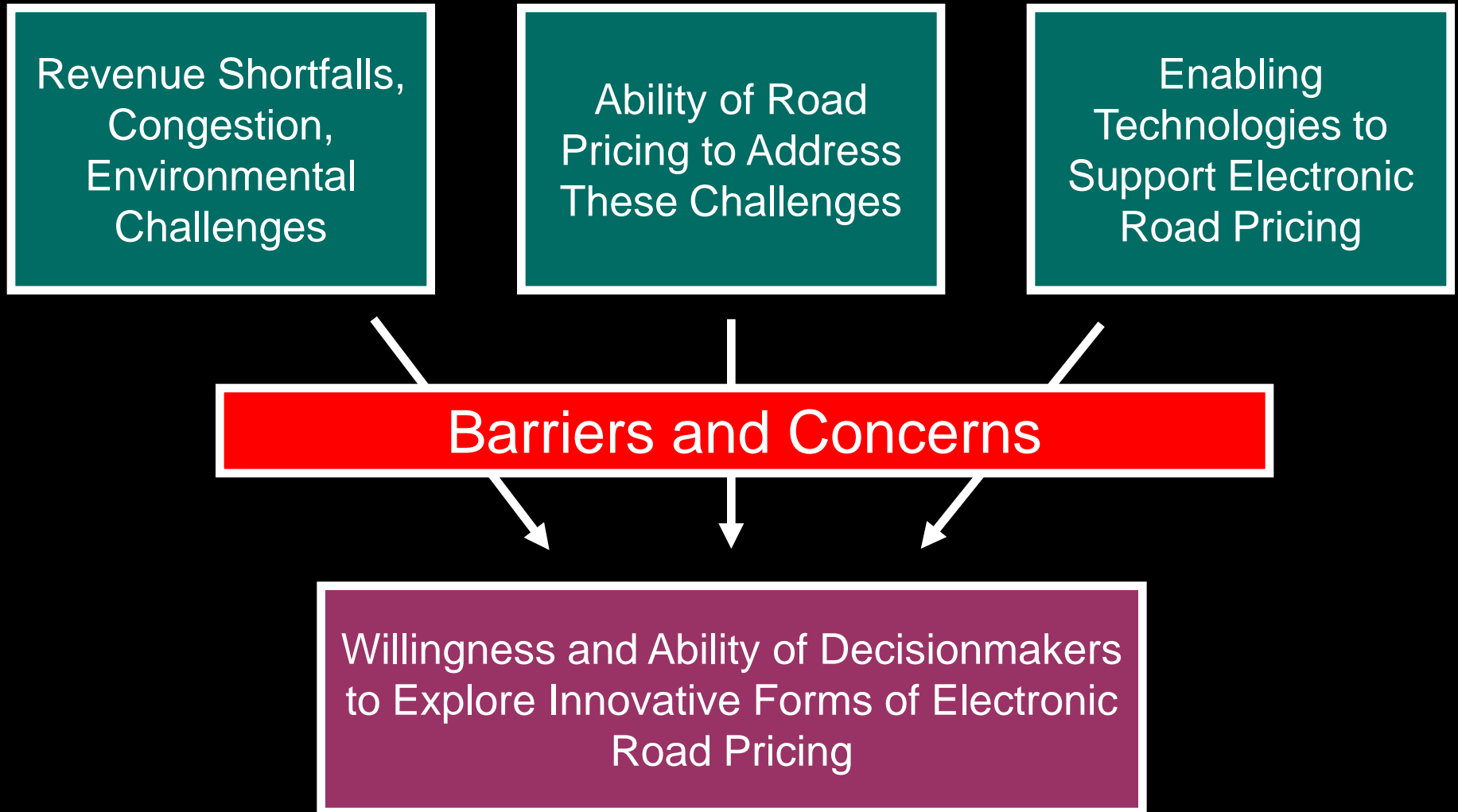
Application	Technology Platform			Level of Government		
	DSRC	ANPR	GPS	Local	State	Federal
Partial Facility Congestion Tolls	●	○	○	●	○	○
Full Facility Congestion Tolls	●	○	○	●	○	○
Cordon Tolls	●	●	○	●	○	○
Weight-Distance Truck Tolls	○	○	●		●	●
VMT Tolls			●		●	●

# ***Pricing Applications to Date Have Proven Very Successful in Meeting Aims***

- **Revenue:**
  - SR-91X: lanes self funding
  - London congestion toll: €275 M / year gross revenue
  - German truck toll: €2.9 B / year gross revenue
- **Congestion reductions:**
  - SR-91X lanes: 2x vehicles / lane / hour at 3x travel speed
  - Singapore cordon toll: traffic volume down 15%, expressway travel speed up almost 50%, CBD travel speed up almost 100%
  - PSRC network wide congestion tolling trial: participant trips down 7%, participant VMT down 13%
- **Emissions reductions:**
  - German truck toll: percent of trucks with most modern exhaust technology (Euro 5) increased from < 1% in 2005 to 37% in 2008, while percent of highest emissions trucks (Euro 2) decreased from 30% to < 10% over same period
  - London cordon toll: ambient levels of NOx and PM10 down 12%, GHG emissions down 19%



# *Is Widespread Adoption of Pricing a Foregone Conclusion?*



# ***Pricing Raises Many Concerns, Some Legitimate, Others Less So***

- Pricing is double taxation
- Pricing won't be effective
- Pricing will harm my business interests
- Pricing will harm the environment
- Pricing will violate my privacy
- Pricing will be difficult to enforce
- Pricing will benefit mainly the wealthy
- Pricing will hurt the poor
- Pricing is politically infeasible

# ***The Concerns Surrounding Pricing Merit Thoughtful Debate***

- **The relevance and degree of pricing concerns varies considerably with different types of pricing**
- **Some forms of pricing will create real winners and real losers; often the latter group includes those who benefitted most from unpriced externalities**
- **When evaluating a new program we seldom hold the status quo to a similar level of scrutiny; when looking at pros and cons, we need to ask: compared to what?**
- **Pricing programs can raise considerable revenue; thoughtful allocation of that revenue can help to mitigate legitimate concerns as well as help to enhance political feasibility**

# *The Devil Is In the Details*

- **German truck toll**
  - 2-year delay and lost revenue
  - Potential for route diversion
- **London cordon toll**
  - License plate theft
  - Western area expansion
  - Proposed emissions element

# ***A More Rational Transportation Finance Paradigm?***

- **Sales taxes, if used at all, to subsidize transit**
- **Fuel taxes to capture GHG externalities**
- **GPS-enabled VMT charges as principal user-fee revenue source**
  - **Offset by weight (axle-weight) and road class to capture maintenance costs**
  - **Offset by time and location to capture congestion costs**
  - **Offset by emissions class to capture local air pollutant damages**



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