Reducing Energy Consumption and Emissions Through Congestion Management

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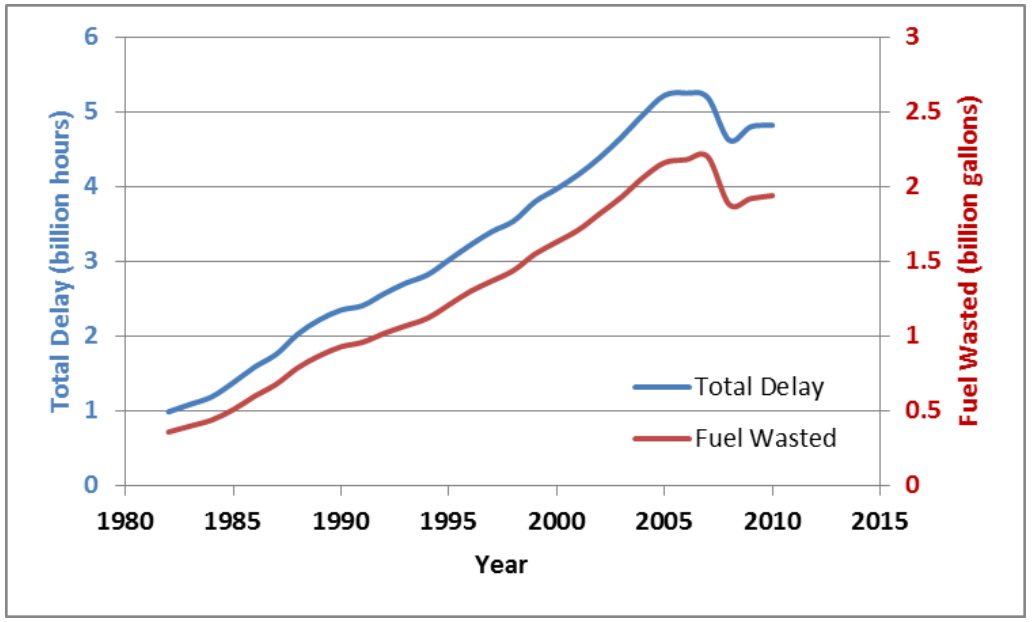
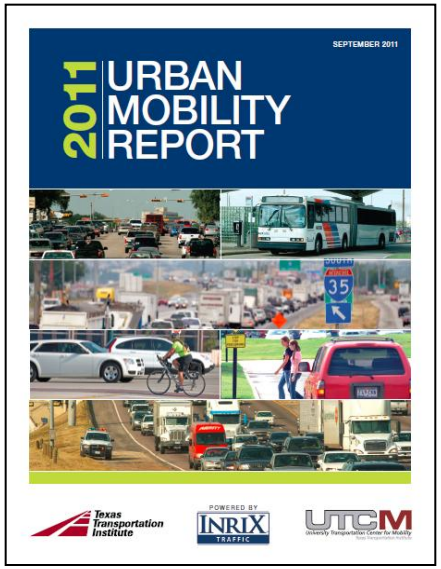
Trends of Traffic Congestion in U.S.

- Traffic congestion in urban areas has been growing.
- The costs of congestion in 2010*
  - 4.8 billion hours of travel delay
  - 1.9 billion gallons of wasted fuel
  - $101 billion of associated costs





*http://mobility.tamu.edu/ums/

Top 10 Urban Areas in 2010*

Areas with most travel delay	Areas with most wasted fuel
1. Washington DC	1. Washington DC
2. Chicago	2. Chicago
3. Los Angeles	3. Los Angeles
4. Houston	4. Houston
5. New York	5. Denver
6. Baltimore	6. Seattle
7. San Francisco	7. New York
8. Denver	7. Baltimore
9. Boston	7. San Francisco
10. Dallas	7. Dallas

*http://mobility.tamu.edu/ums/

Reducing Energy and Emissions Impacts from Surface Transportation

- Build cleaner, more efficient vehicles
  - Make vehicles lighter (and smaller)
  - Improve engine efficiency
  - Develop advanced powertrain technologies
- Develop and use alternative fuels
  - Biofuels
  - Synthetic fuels
- Decrease the amount of driving
  - Better land use/transportation planning
  - Travel demand management
- Improve transportation system efficiency

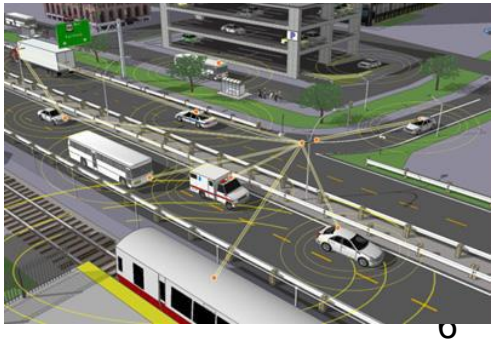
Improving Transportation System Efficiency

Through the implementation of *transportation systems management and operational (TSMO) strategies* and the supporting *intelligent transportation system (ITS) technologies*

- Regional collaboration and coordination
- Incident & emergency management
- Integrated corridor management (ICM)
- Active traffic management (e.g., lane/speed control)
- Managed lanes (HOV, HOT)
- Coordinated traffic signal timing and adaptive control
- Traveler information
- Commercial vehicle operations
- Transit enhancements (e.g., bus rapid transit and transit signal priority)
- Ramp management
- Road weather management

ITS Targeted Benefits

- Improving safety
  - Reducing number of accidents
  - Making accidents less severe
- Improving mobility
  - Increasing throughput
  - Maximizing economic opportunities
- Reducing energy and environmental impacts
  - Reducing vehicle energy consumption
  - Reducing vehicle emissions
    - Criteria pollutants
    - Greenhouse gases

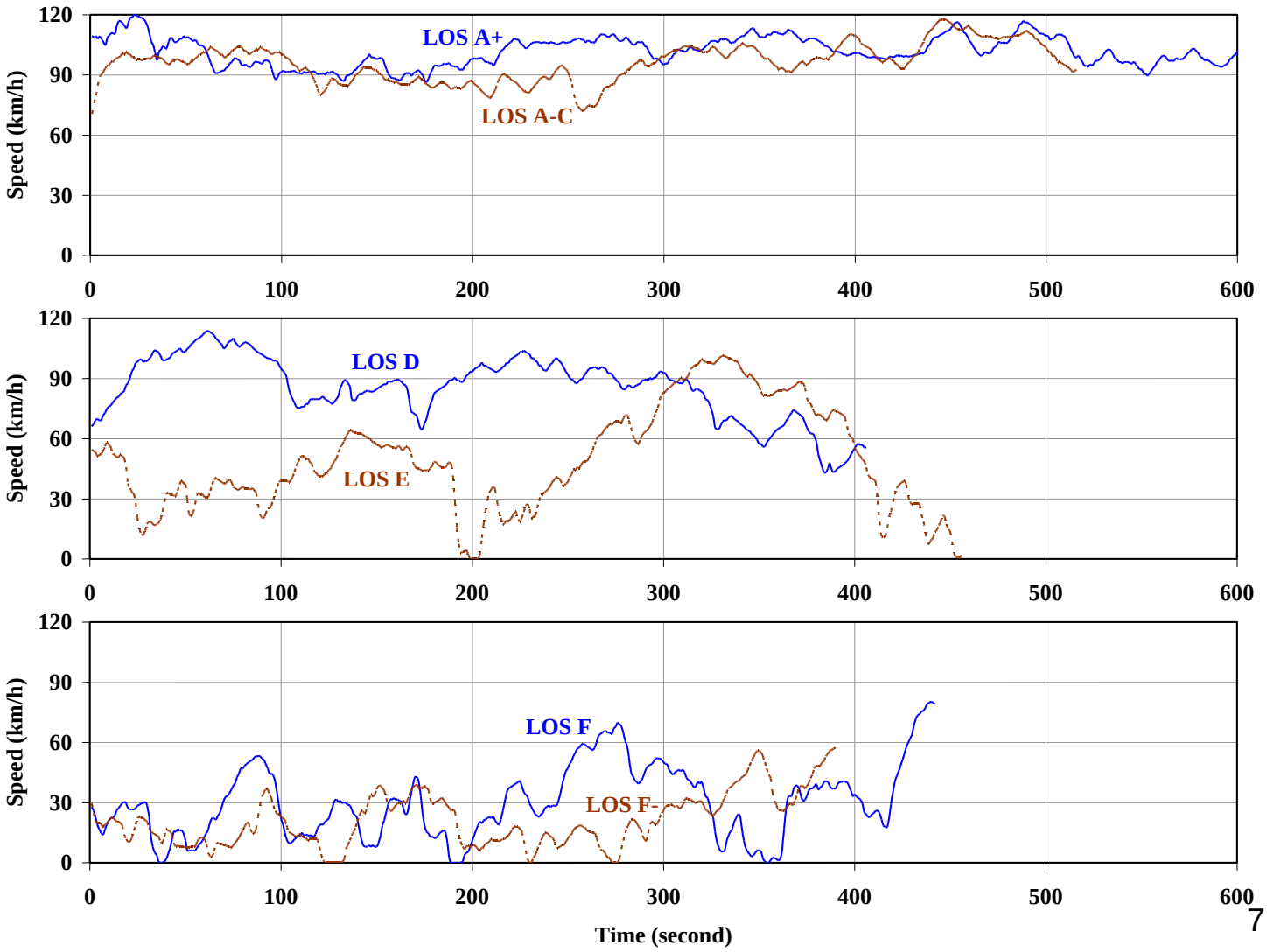


Real-World Driving Speed Profiles

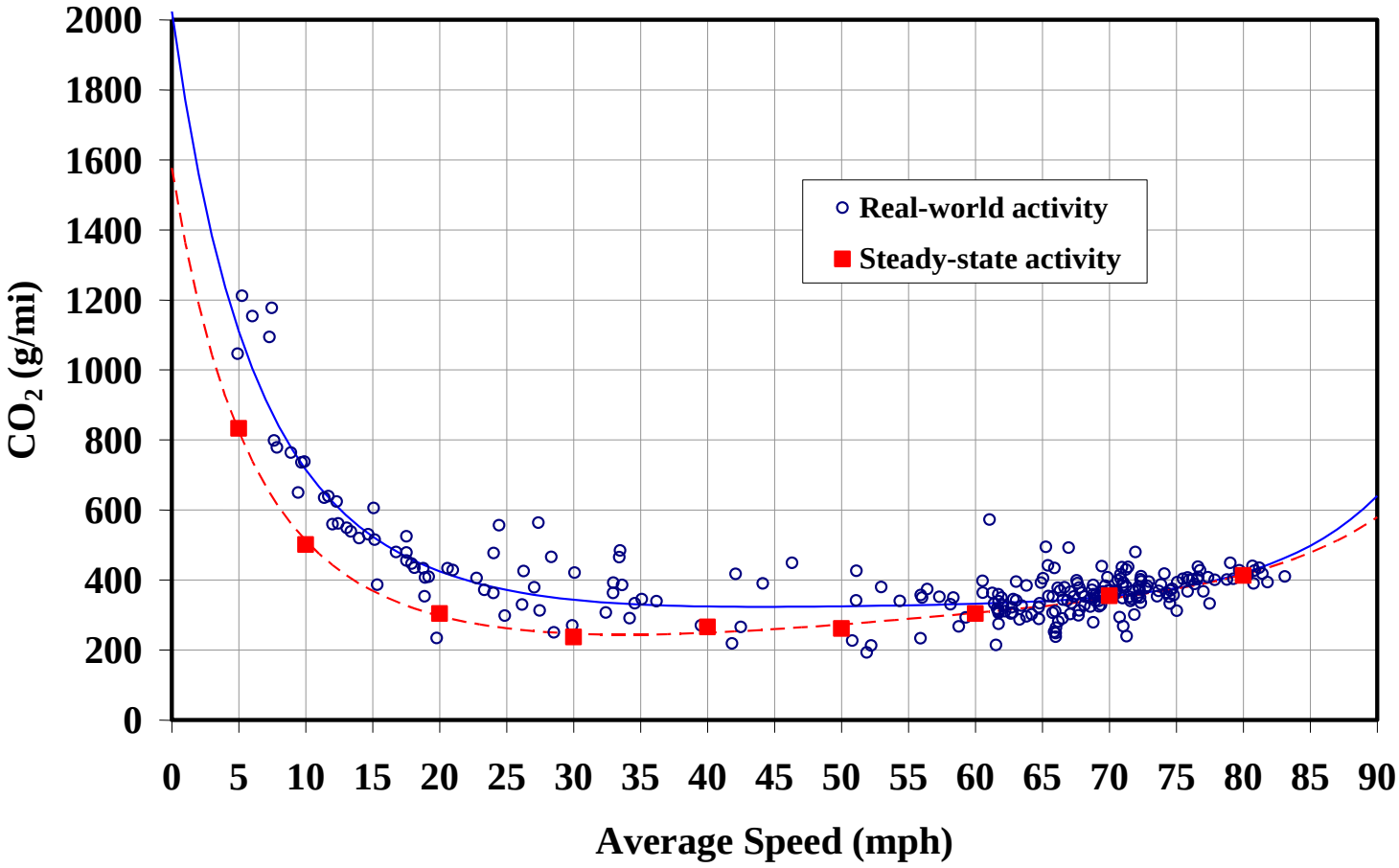
No congestion

Mild congestion

Heavy congestion

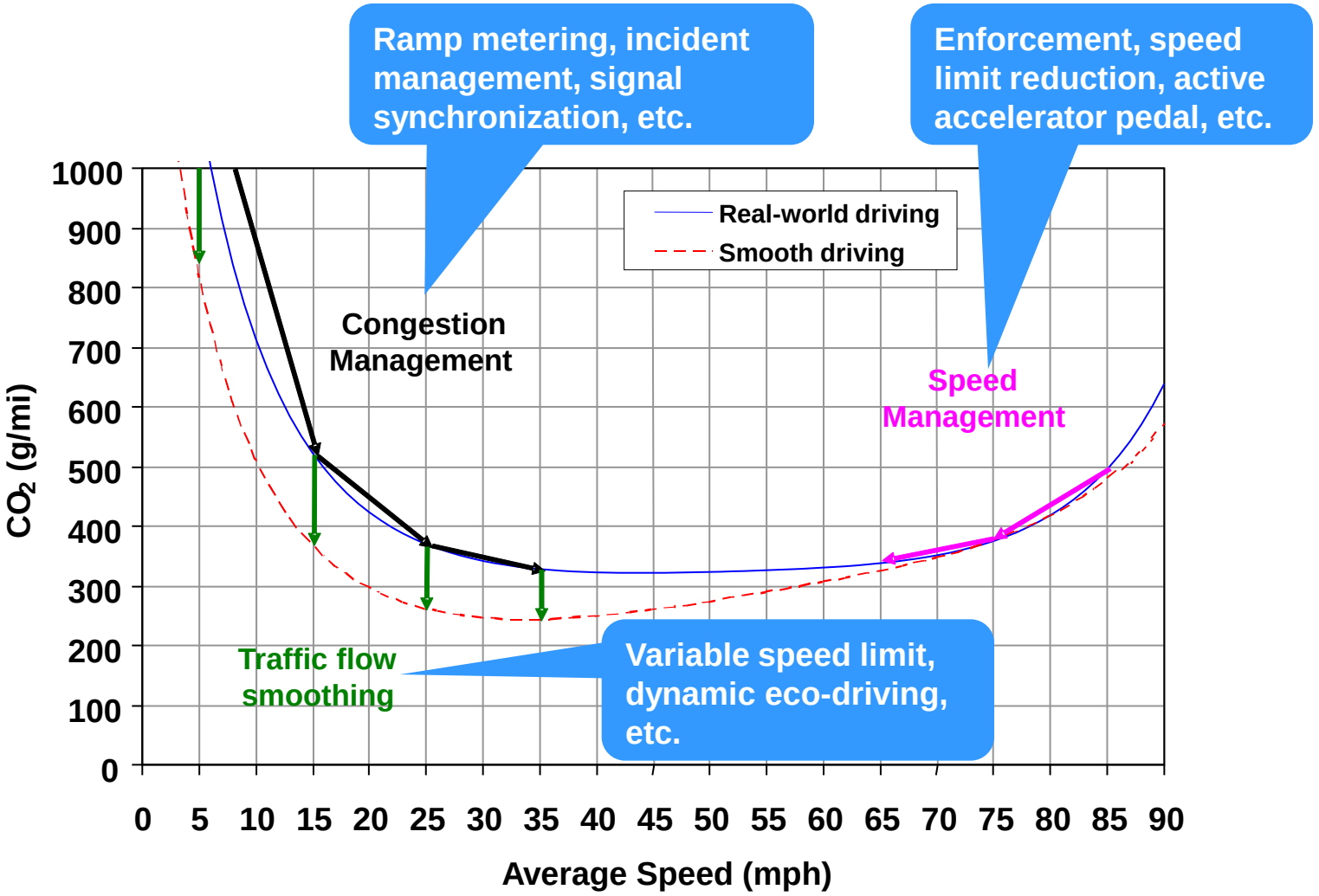


Energy/Emissions as a Function of Average Traffic Speed



From Barth and Boriboonsomsin, 2008

Strategies for Reducing Energy/Emissions



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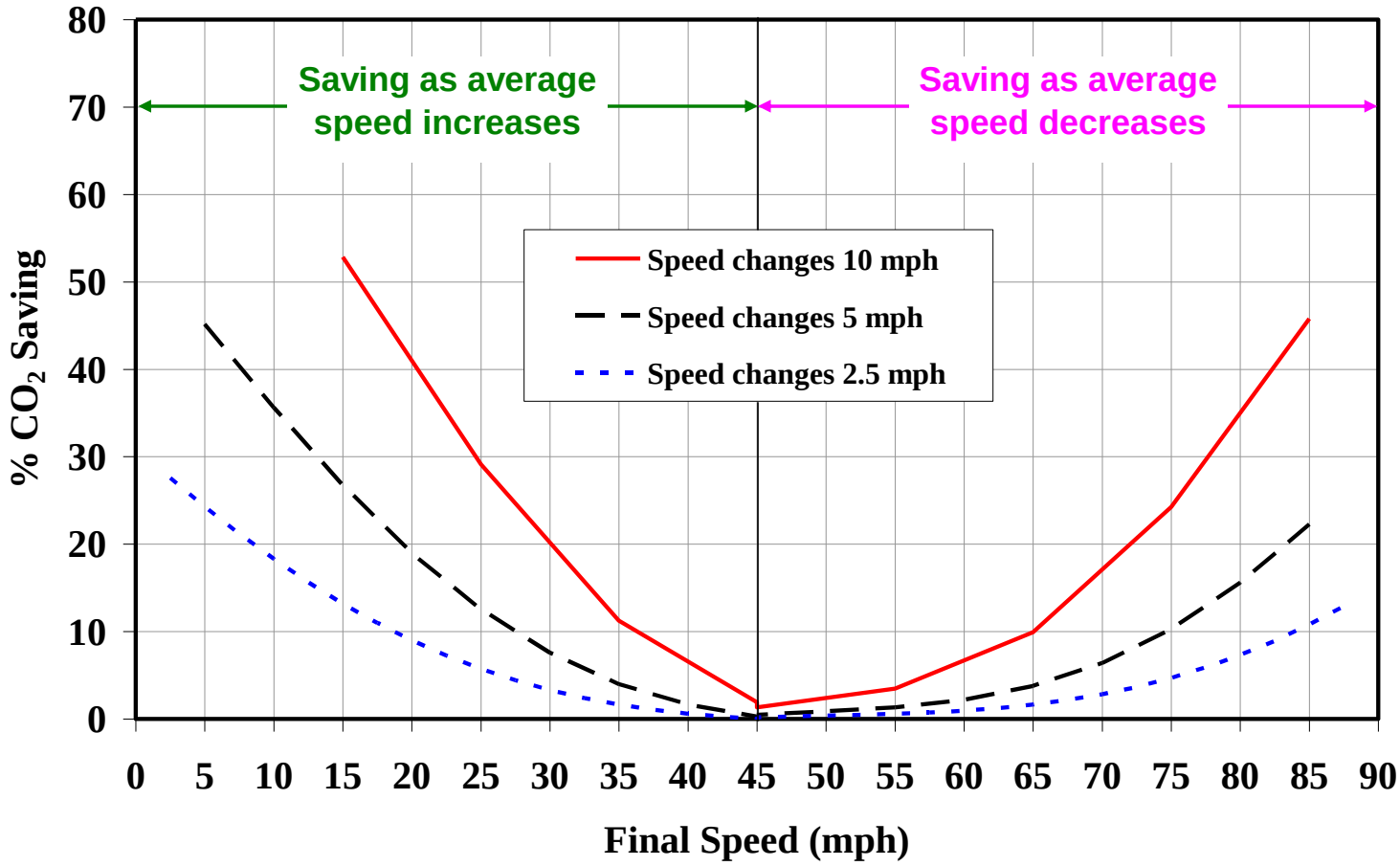
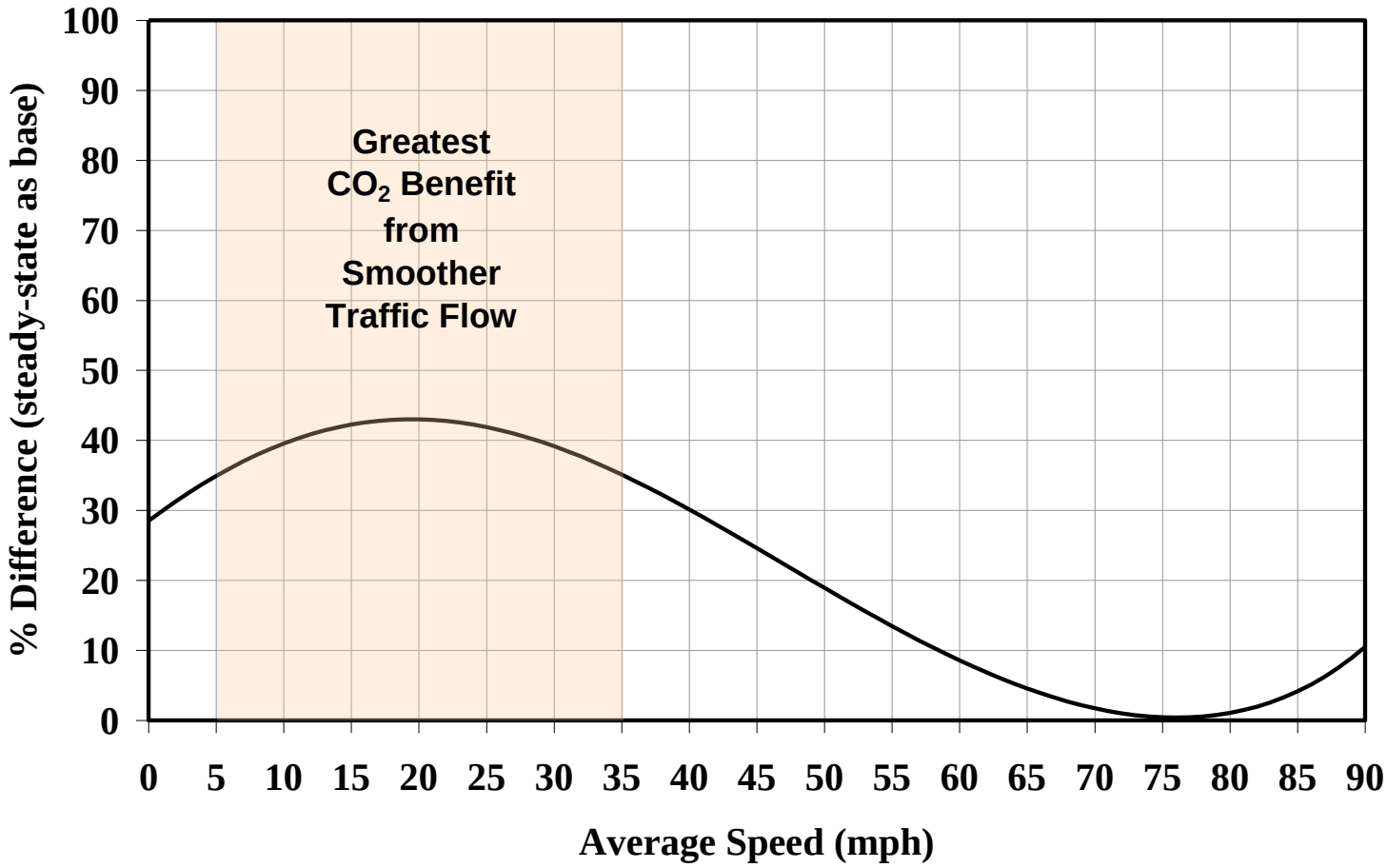
Potential Savings from Congestion and Speed Management



From Barth and Boriboonsomsin, 2008

Potential Savings from Traffic Flow Smoothing



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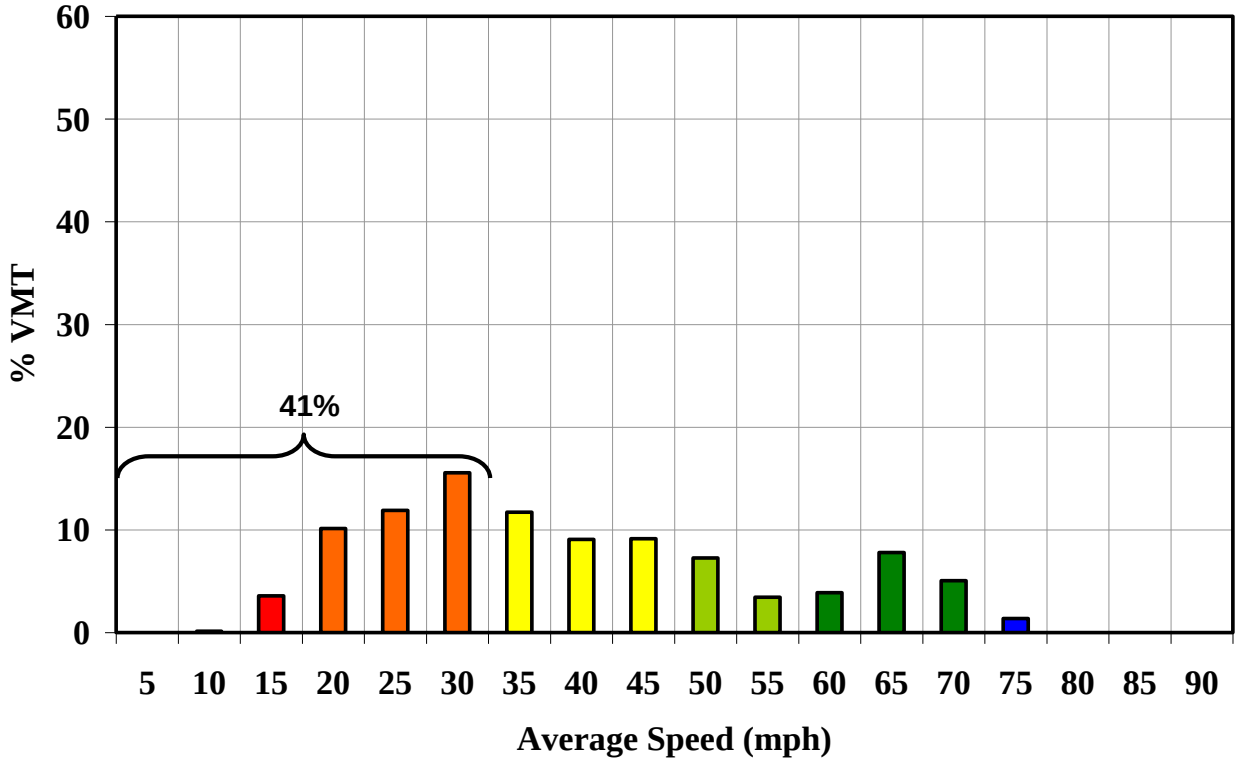
Example – Congestion Management

- VMT by speed on SR-60 E in CA, 5-6 p.m., June 2007

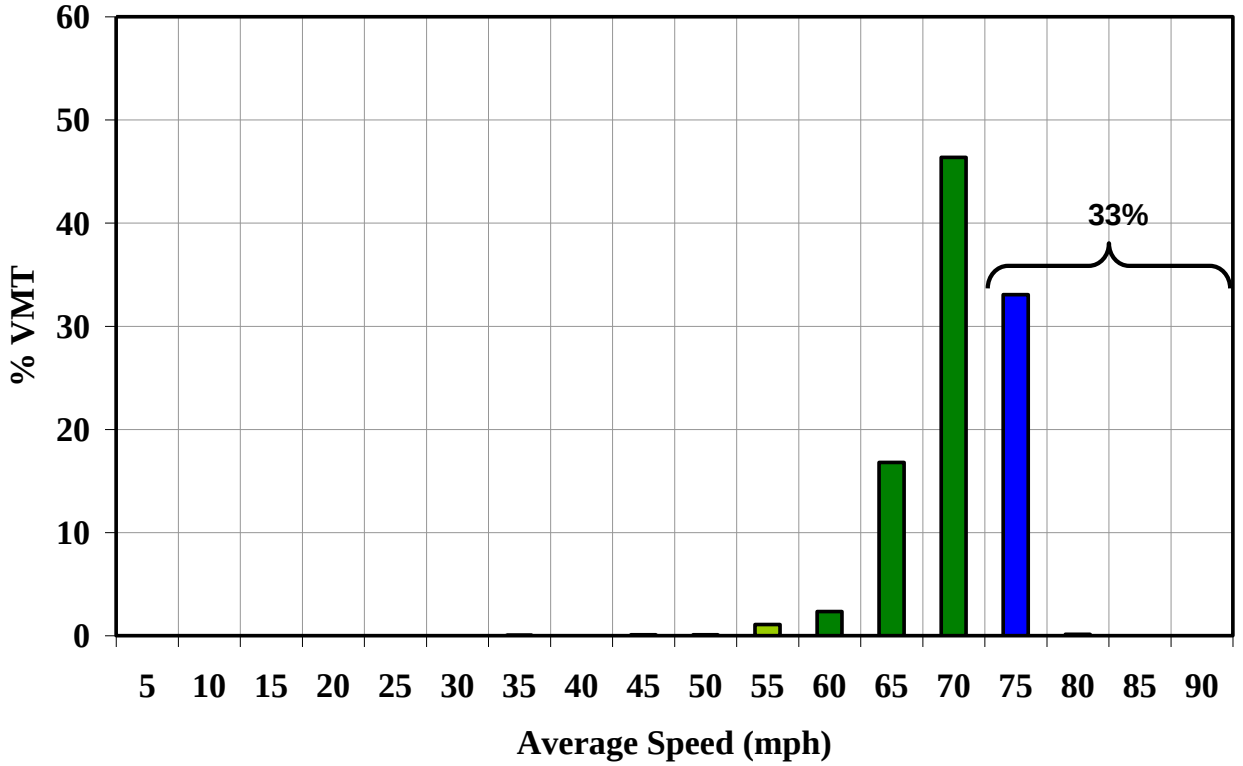


*Data from http://pems.eecs.berkeley.edu/

- Eliminating congestion so that all VMT were at 60 mph would reduce energy/emissions by 7%.

Example – Speed Management

- VMT by speed on SR-60 E in CA, 5-6 p.m., June 2007



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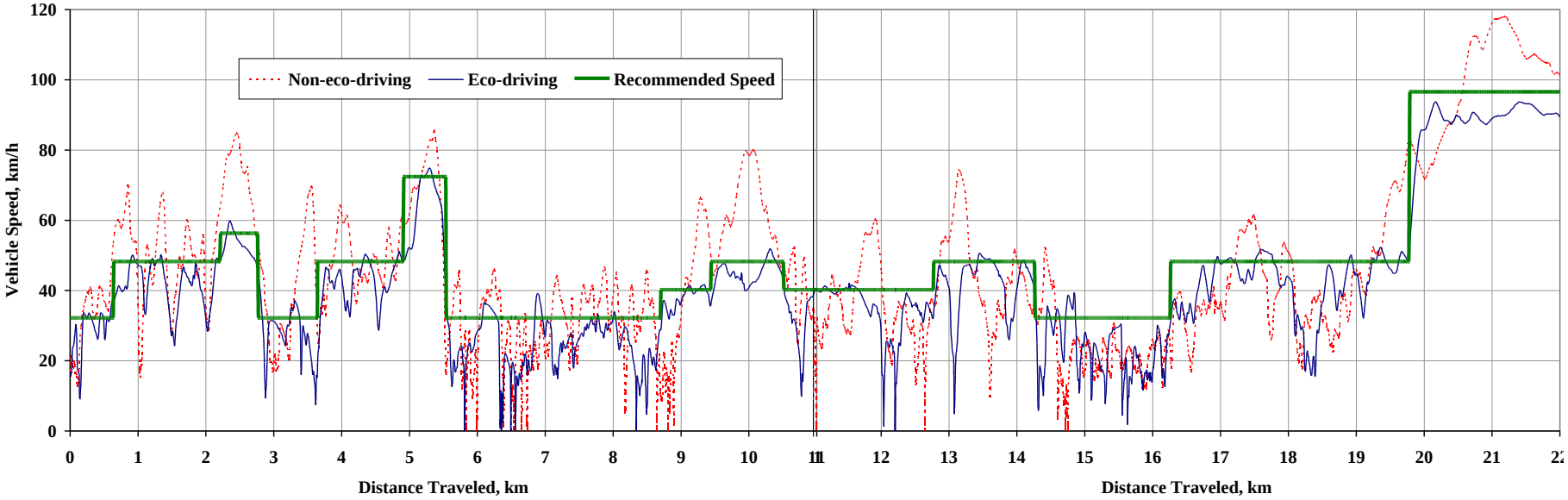
- Eliminating speeding so that all VMT were at 60 mph would reduce energy/emissions by 8%.

Example – Traffic Flow Smoothing

- Dynamic eco-driving technique that provides suggested driving speed to drivers while in congestion.



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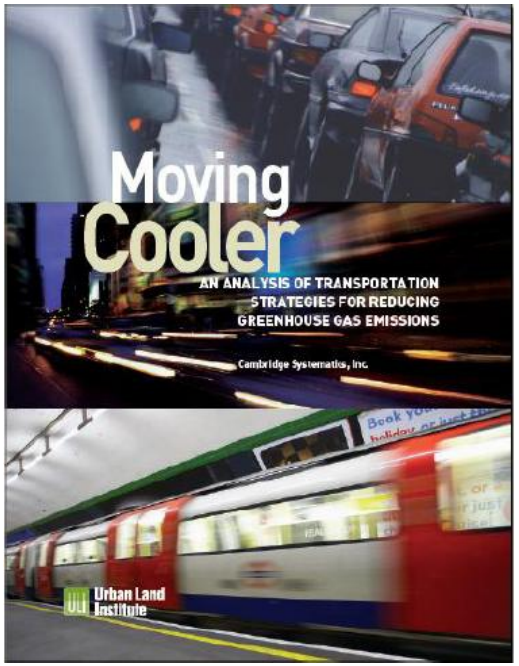
- Real-world experiment on SR-91 in Southern California shows fuel savings of 13% for the eco-driving vehicle.

Near-Term vs. Long-Term Benefits

- TSMO and ITS strategies could be implemented relatively quickly (within a few years).
- Their potential energy/emission benefits in near term are significant and immediate.
- According to the *Moving Cooler* study, these benefits in long term could be compromised by "induced demand"
  - additional travel induced by the reduced cost of travel due to the added capacity of roadway.



http://movingcooler.info/

Findings from *Moving Cooler*

Cumulative Reductions in GHG Emissions from Baseline: 2010 – 2050	Min	Max
PAYD Insurance + VMT Fees	1.2 %	7.1 %
Regional Congestion Pricing	0.8 %	1.8 %
Combined Land Use Strategies	0.3 %	2.1 %
Combined pedestrian / bicycling strategies	0.2 %	0.5 %
Transit Capital Improvements	0.4 %	1.1 %
Employer-Based Commute Strategies	NA	1.7 %
Lower / Enforced Speed Limits	2.0 %	3.6 %
Eco-Driving	1.1 %	2.7 %
ITS / Operations	**0.3 %**	**0.6 %**
Freight (Truck APUs / Rail Capacity)	NA	0.4 %
Highway Expansion / Bottleneck Improvements	Increase in GHG emissions	

Discussions around Induced Demand

- Is the induced demand effect due to added capacity from new roadways the same as increased capacity on existing roadways? (Neudorff, 2010)
- Latent vs. induced demand (Shladover, 2011)
  - Latent demand is a short-term phenomenon that derives from the fact that people are often deterred from making trips that they would like to take because of the cost of those trips.
  - Induced demand is a long-term phenomenon associated with the interaction between transportation and land use.
- Can we manage induced demand?
  - Increase the cost of travel (e.g., road pricing, higher parking fees, higher fuel tax)
  - Use a combination of operational, pricing, public transit, and land use strategies

Closing Summary

- Strategies that improve transportation system efficiency can play a significant role in reducing energy/emissions from surface transportation.
- In addition to congestion management strategies, speed management and traffic flow smoothing strategies should also be considered.
- The potential energy/emission benefits in near term are significant and immediate.
- The long-term benefits in the context of possible induced demand effects need further research.
- Finally, traffic congestion is a problem that deserves serious attention even without the associated energy/emission issues.

References

- Barth, M. and Boriboonsomsin, K. (2008). Real-world carbon dioxide impacts of traffic congestion. *Transportation Research Record*, 2058, 163-171.
- Barth, M. and Boriboonsomsin, K. (2009). Energy and emissions impacts of a freeway-based dynamic eco-driving system. *Transportation Research Part D*, 14, 400-410.
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- Shladover, S. E. (2011). Challenges to evaluation of CO2 impacts of intelligent transportation systems. Proceedings of the 1st IEEE Forum on Integrated and Sustainable Transportation Systems, Vienna, Austria, June 29 – July 1.

Thank You.

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