Transportation Asset Management Webinar Series

Webinar 38

Advanced Technologies and TAM

Sponsored by FHWA and AASHTO

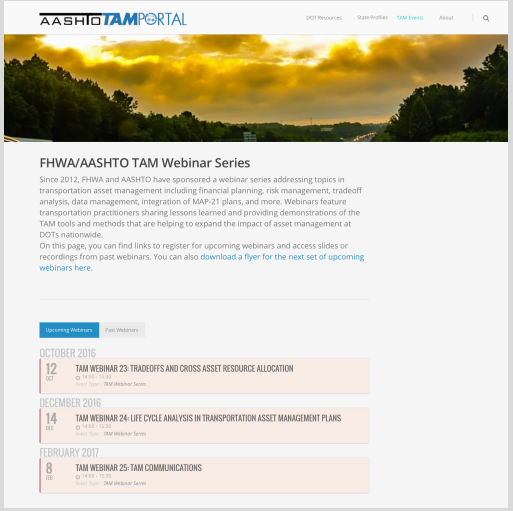
U.S. Department of Transportation
Federal Highway Administration

AASHTO
The Voice of Transportation

Webinar 38 – June 12, 2019

FHWA-AASHTO Asset Management Webinar Series

- This is the 38th in a webinar series that has been running since 2012
- Webinars are held every two months, on topics such as off-system assets, asset management plans, asset management and risk management, and more
- We welcome ideas for future webinar topics and presentations
- Submit your questions using the webinar's Q&A feature



Welcome

FHWA and the AASHTO Sub-Committee on Asset Management are pleased to sponsor this webinar series

- Sharing knowledge is a critical component of advancing asset management practice

Advanced Technologies and TAM

- FHWA is committed to helping agencies improve TAM practices
  - Requiring and supporting TAM plans
- New tools and technologies help states meet new challenges
  - This webinar provides examples and insights
- No matter the tools, the focus and purpose of asset management remains the same
  - *Asset management is a strategic and systematic process of operating, maintaining, and improving physical assets, with a focus on engineering and economic analysis based upon quality information, to identify a structured sequence of maintenance, preservation, repair, rehabilitation, and replacement actions that will achieve and sustain a desired state of good repair (SOGR) over the lifecycle of the assets at minimum practicable cost.*

    - FHWA

Learning Objectives

- Building working knowledge of key concepts and definitions relevant to tools and technologies and TAM
- Beginning to apply this knowledge in the context of new TAM technologies in order to answer the following questions:
  - What approaches are agencies taking to leverage advanced technologies in their TAM processes?
  - What benefits can my agency expect by better integrating these advanced technologies with existing TAM processes?
  - What are key lessons-learned for agencies as they move forward with new tools and technologies for TAM?
- **SHARE LESSONS LEARNED, IDEAS, KNOWLEDGE!!!**

Webinar Agenda

2:00 **Webinar Introduction and Overview**
Matt Hardy (AASHTO), Steve Gaj (FHWA), and
Hyun-A Park (Spy Pond Partners, LLC)

2:10 **Using Advanced Technologies with TAM Plans**
Peter Vanderzee (LifeSpan Technologies)

2:30 **Using Big Data to Rethink Mobility**
Fabio Duarte (MIT Senseable City Lab)

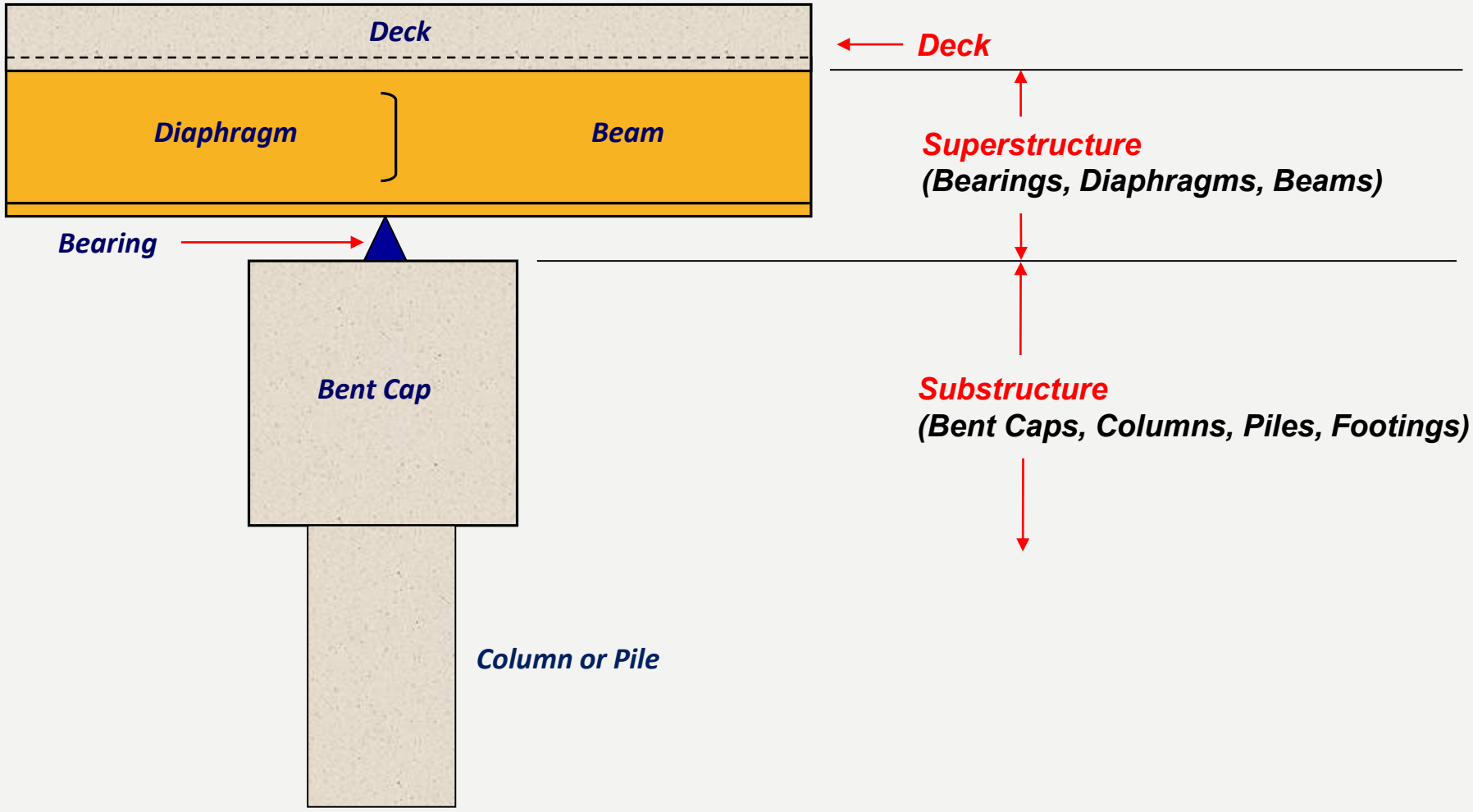
2:50 **Distance Based User Fees with Shared Mobility Car-Sharing**
Ken Buckeye (Minnesota DOT)

3:10 **Q&A and Wrap Up**

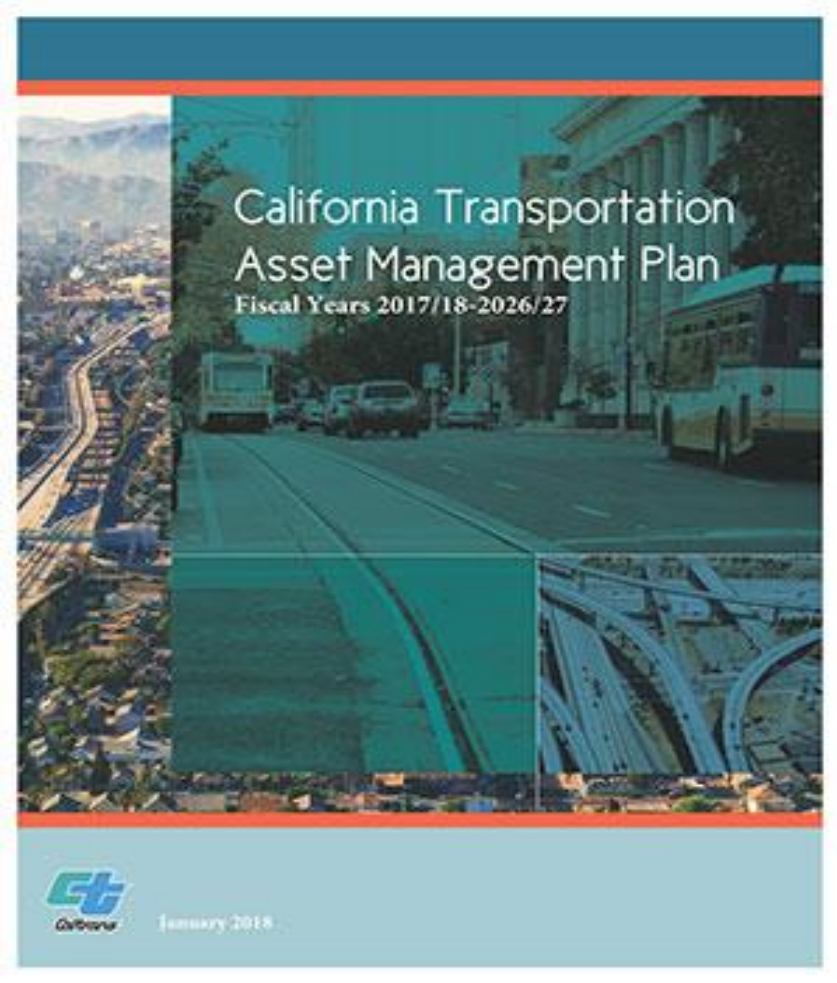
USING ADVANCED TECHNOLOGIES WITH TAM PLANS

WITH A FOCUS ON HIGHWAY BRIDGES

ANATOMY OF A TYPICAL BRIDGE



THE CHALLENGE OF TAM OPTIMIZATION

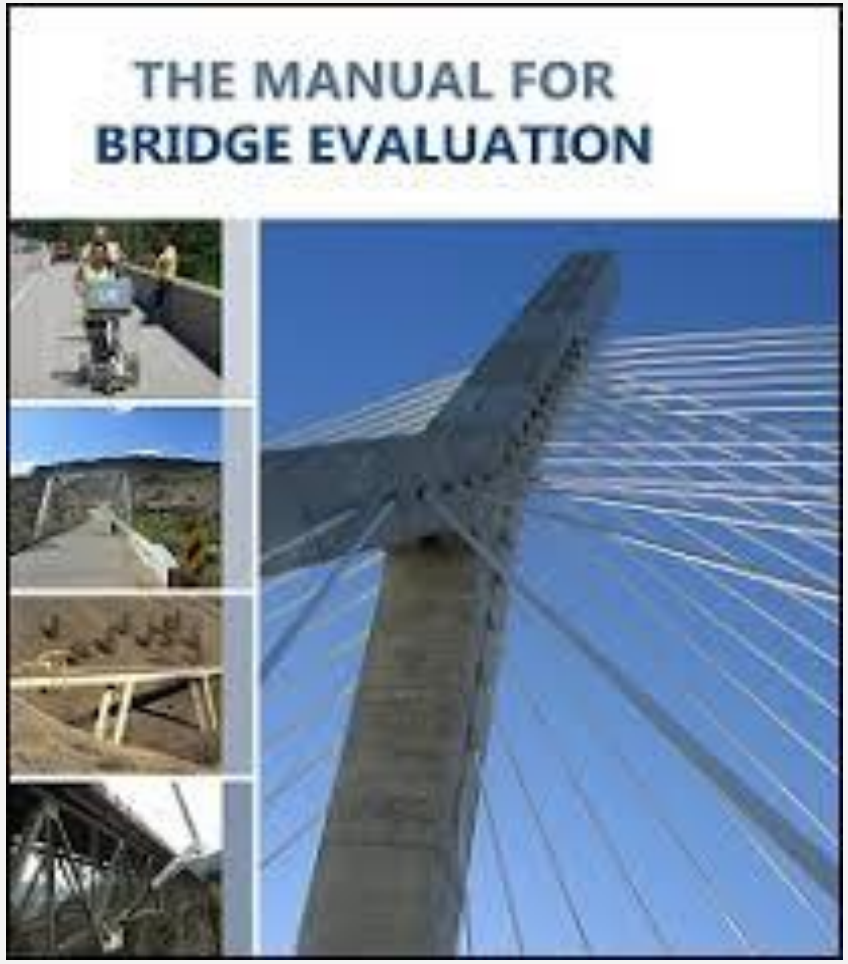


- TAM is an enhanced decision process for managing transportation assets, e.g. pavement and bridges.
- "Worst first" was often used to prioritize DOT spending; it didn't produce optimal system results.
- Congress, by requiring TAM plans, wanted DOTs to conduct more analysis; utilize system-wide thinking.
- MAP-21 and the FAST Act require DOTs to have "data-driven, risk-adjusted" TAM plans:
  - Why data-driven? > Congress wanted to maximize decision making based on objective data.
  - Why risk-adjusted? > Congress wanted system risks to be minimized to benefit user/taxpayers.
- **But the inherent subjectivity of condition assessment remained a problematic issue for optimization.**

VISUAL CONDITION ASSESSMENT OF BRIDGES HAS KNOWN ISSUES

- Circa 1971: The visual inspection process (NBIS) put into practice at State DOTs.
- 1972-ongoing: Visual inspection findings form the basis for making DOT spending decisions, e.g. bridge replacement.
- 1999: Fifty bridge inspectors from across US inspected 3 bridges in DC area for an FHWA study on NBIS efficacy.
- 2000: FHWA conducted statistical analysis of inspection data, then concluded:
  - **Visual inspection is "subjective" and "highly variable"; numerical scores can vary +/- 2 grades…**
- Circa 2005: Paper by Steve Chase, P.E. PhD at FHWA:
  - **NBIS produces "…highly subjective and variable" results; not sufficient to optimize future spending…**

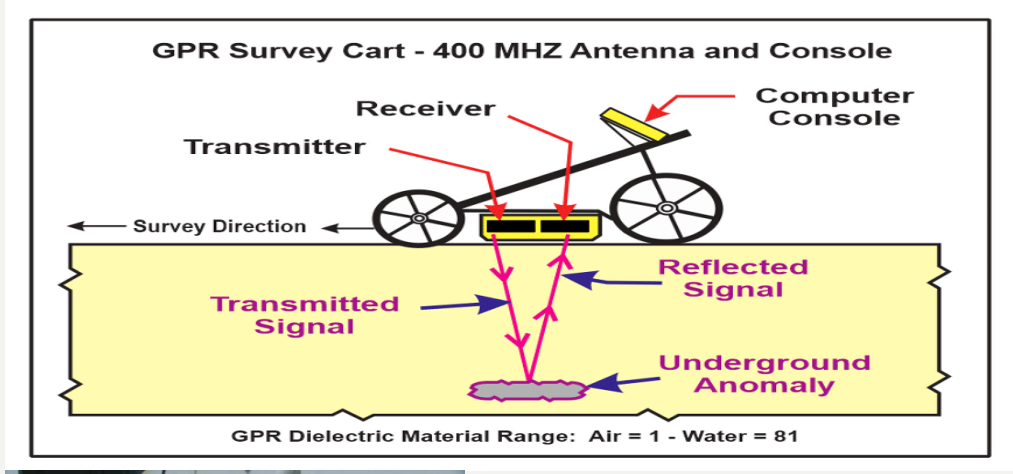
SUBJECTIVE VS. OBJECTIVE DATA

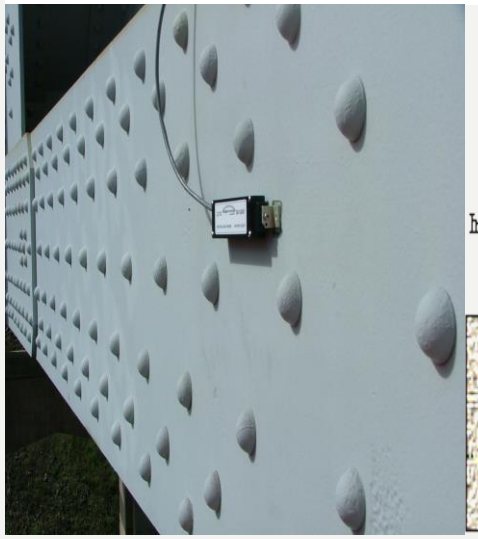


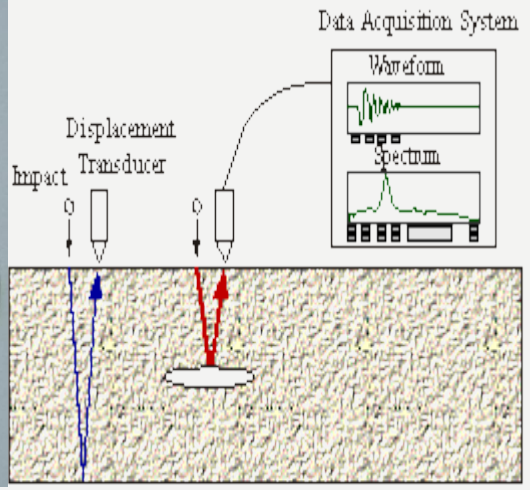
- BRIDGE CONDITION DATA can be subjective (visual inspection) or objectively precise (sensors).
- **We also know from experience that bridge visual inspection data is quite conservative – a good thing - yet the process tends to overstate negative condition assessments.**
- The power of objective condition data supports the use of a variety of advanced assessment technologies.
- Objective condition data also supports more objective, precise risk assessments.

TYPES OF ADVANCED TECHNOLOGIES

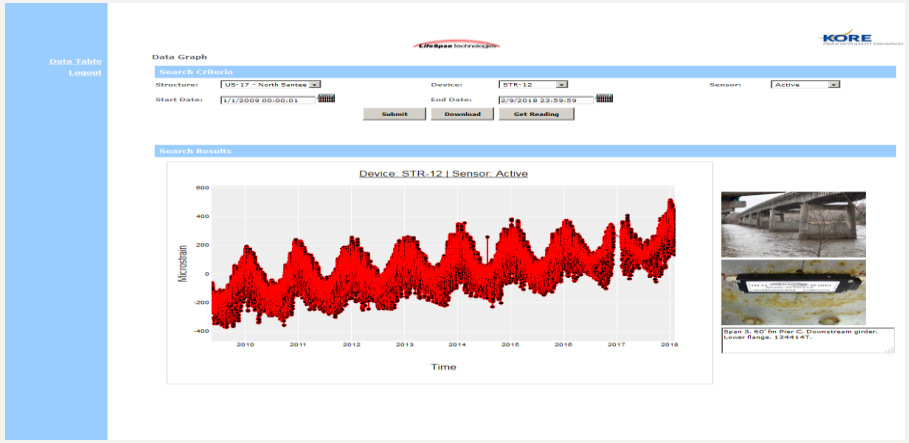
- Visual condition assessment has significant subjectivity, so to reduce subjectivity, use most appropriate advanced assessment technologies.
- **Non-Destructive Testing (NDT)** – over 10 different testing technologies commercially available for >20 years, e.g.:
  - Ground penetrating radar for bridge decks.
  - Impact Echo for concrete integrity.
  - Load testing using sensors.
- **Structural Monitoring (SM)** – commercially available for >15 years, e.g.:
  - Displacement (strain) data for members with section loss (corrosion) or crack propagation.
  - Inclinometers for substructure anomalies.







WHEN TO USE ADVANCED CONDITION ASSESSMENT TECHNOLOGIES



- **When a bridge is presumed deficient or in poor condition, consider technology use:**
  - Before a major repair/replacement action, seek to objectively determine actual condition and risk.
    - The most likely deficient component for structural monitoring success is the bridge superstructure.
    - Deck condition assessment uses NDT testing.
  - Carefully consider use for scour issues/alerting.
- **When a bridge is load restricted due to superstructure or substructure deterioration:**
  - Decide between manual or automatic data capture.
  - Conduct testing; run calculations; report to DOT.

HOW BEST TO USE THESE ADVANCED TECHNOLOGIES

- Visual inspection will always be the bridge owner's "first line of defense".
- Most NDT advanced technologies consist of tests that can be completed in a few days.
- Most structural monitoring technologies require a full year or more of data capture and analysis.
- Analytics can be done by the owner or consultants.
- Plan for a return on investment; it's not research.
- **40+ page "*Structural Monitoring Guidebook*" just published by TRB; 3 major Committees approved.**

EXAMPLE 1 – LOAD TESTING 3 SHORT SPAN BRIDGES

- Visual inspection and load calculations indicated load restrictions for 3 Midland County Michigan bridges.
- Owner did not have funds to replace bridges in order to remove detours and lower user risk.
- **MBE; Chapter 8; paragraph 8.2.1: "The actual performance of most bridges is more favorable than conventional theory dictates…load testing is an effective methodology to identify and benefit from the presence of certain load enhancing factors…."**
- Midland County bought sensors and allied equipment:
  - Owner "all-in" equipment/testing costs about $40,000.
  - Michigan DOT approved removal of all 3 postings.
  - **Users are saving about $100,000 per year.**
  - **County saved $2.3M by not replacing bridges.**
  - **County reusing the sensors and equipment.**

EXAMPLE 2 – MONITORING A LARGE, STRUCTURALLY DEFICIENT BRIDGE

- Southeastern DOT has two structurally deficient bridges on NHS and insufficient funds to replace.
- Decided to monitor in-service member stresses with objective of safely deferring replacements.
- Monitoring and analysis confirmed some stress levels high, but safe for users, even heavy trucks.
- DOT spends ~$300K for monitoring; analysis supports safe deferral of $50 million replacements.
- **Deferral value >$200,000 per month @ 5%; safe deferral now approaching 10 years.**

SHOULD YOU EXPECT AN ROI FROM USE OF ADVANCED TECHNOLOGIES?

- **ABSOLUTELY, BUT HERE ARE SEVERAL "NUGGETS OF WISDOM" TO CONSIDER:**
  - Use commercially available advanced technologies from reliable vendors.
  - Use experienced, insured contractors/installers when implementing solutions.
  - Use experienced consultants with proven track records for analysis and recommendations.
  - Limit number of sensors to start; allow for progressive diagnostics.
  - Limit monitoring period to capture essential information – not endless research.
  - Move the equipment to other bridges after finishing current project – drive per use cost lower.

EMBRACE ADVANCED TECHNOLOGIES; DON'T AVOID AN EASY VALUE-ADD

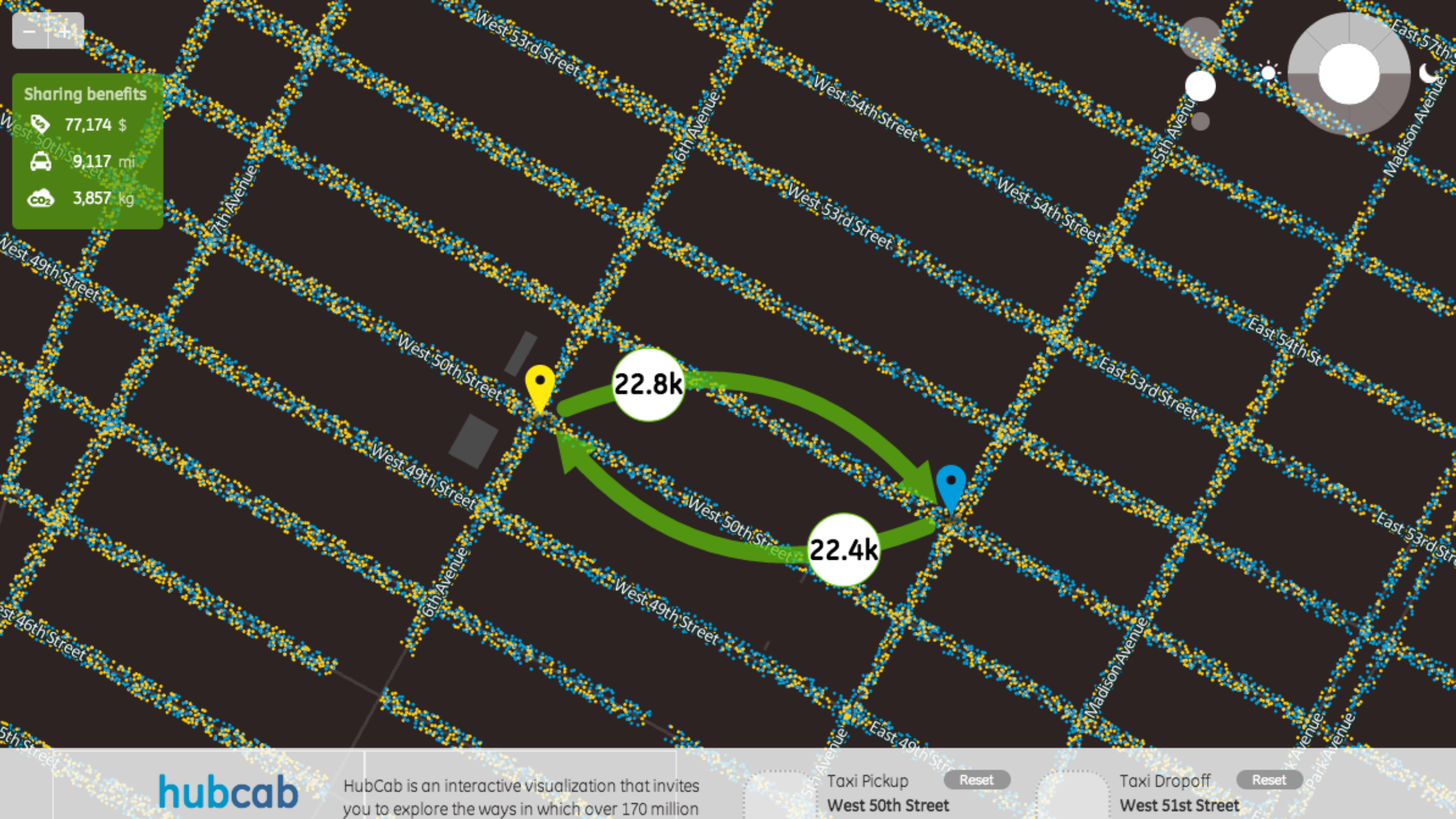
- Accept limitations of visual inspection and how that drives unnecessary spending.; **it's not a CRISIS**.
- Use appropriate, reliable advanced condition assessment technologies when ROI is likely.
- Use objective condition information to adjust risk and develop options for more effective spending.
- Benefits from routine use of advanced technologies:
  - Enhanced user safety.
  - Removal or relaxation of load restrictions.
  - Safe extension of bridge operating life.
  - Lower bridge life cycle costs.
  - Avoid tax increases; increase bond ratings.

senseable
city lab.


2
50
75
80

HubCab

MOBILITY, URBAN PATTERNS

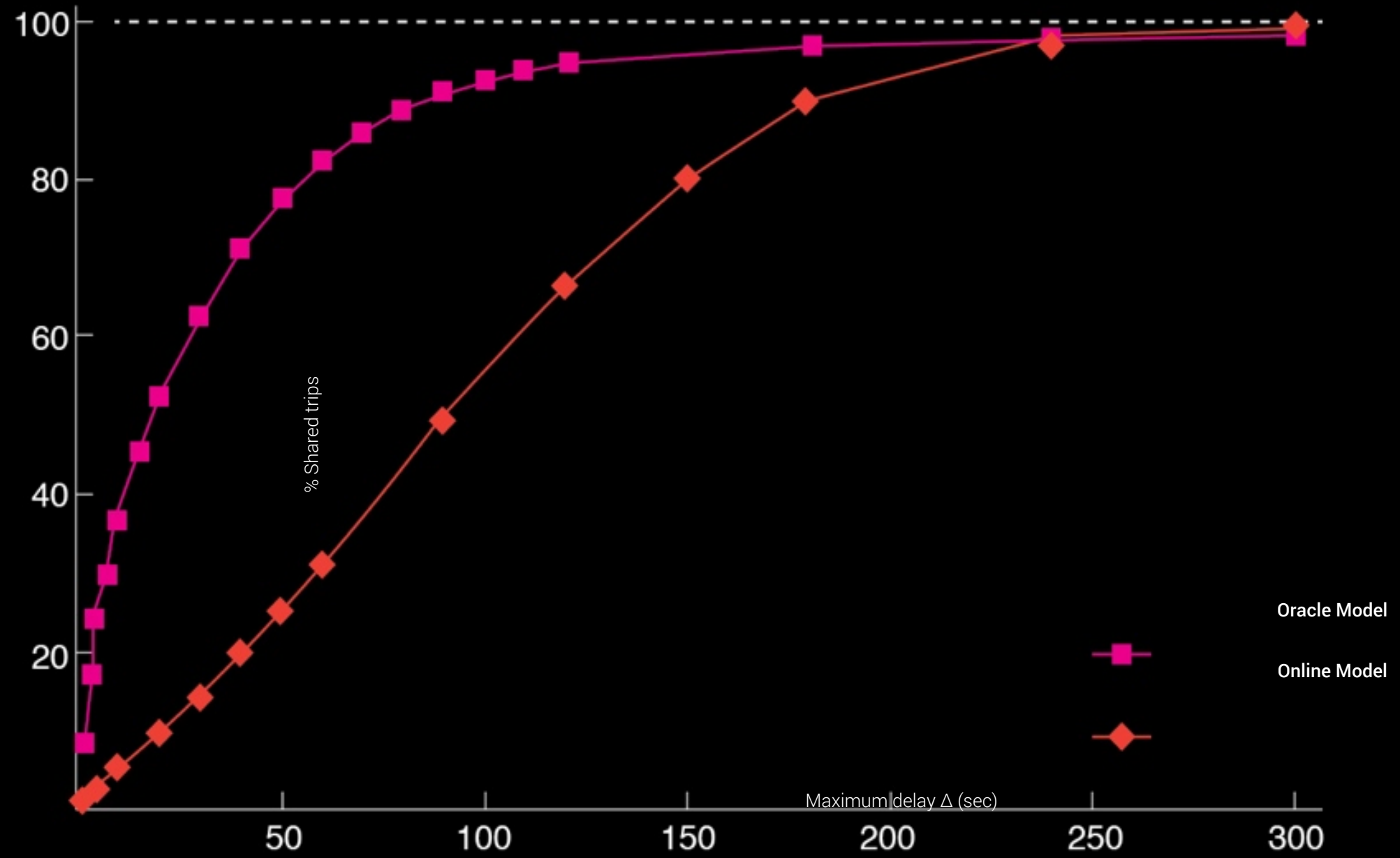


hubcab

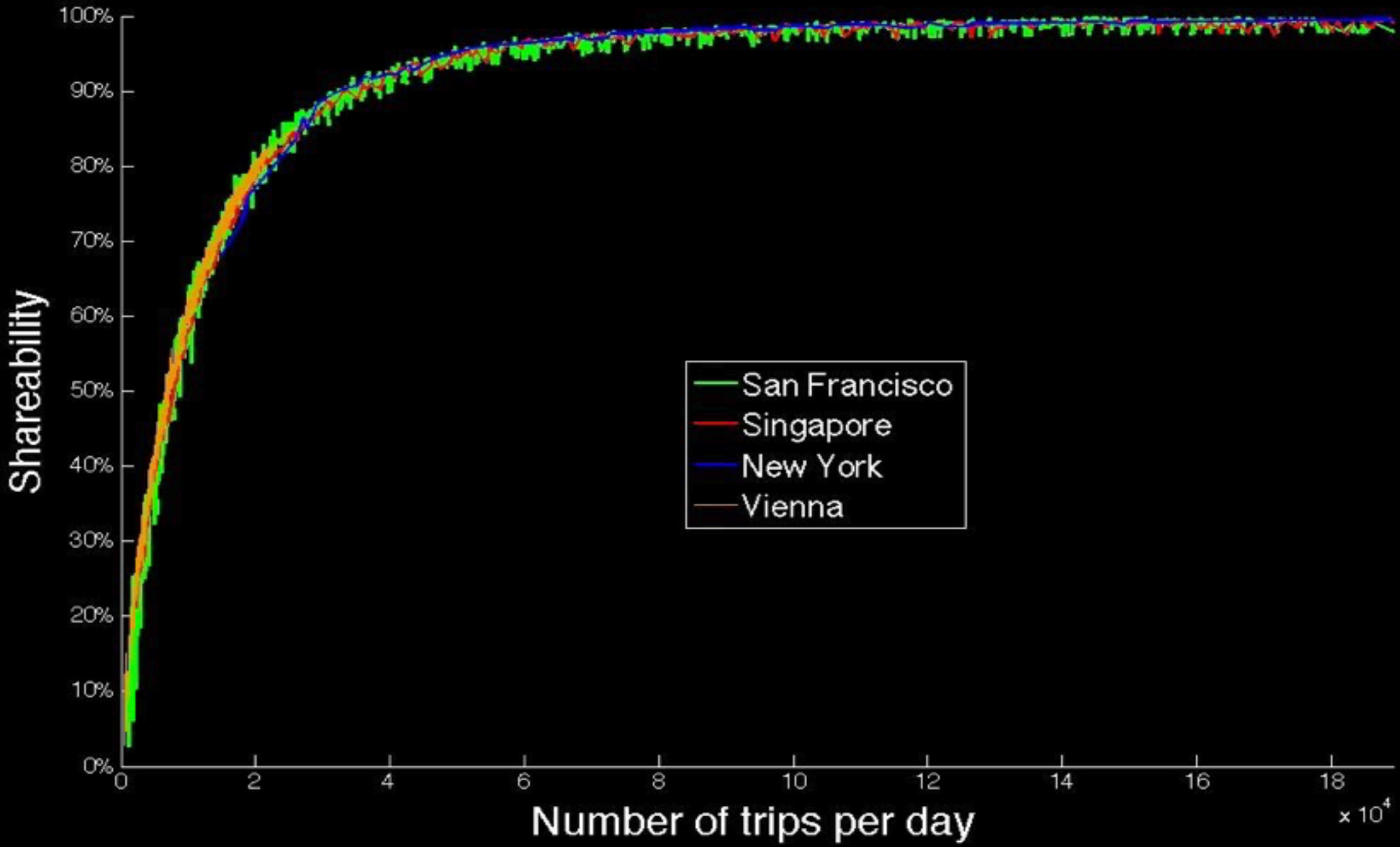
HubCab is an interactive visualization that invites you to explore the ways in which over 170 million

Taxi Pickup Reset
West 50th Street

Taxi Dropoff Reset
West 51st Street



P. Santi, G. Resta, M. Szell, S. Sobolevsky, S. H. Strogatz, C. Ratti,"Quantifying the Benefits of Vehicle Pooling with Shareability Networks",*Proc. National Academy of Science*, Vol. 111, n. 37, pp. 13290-13294, 2014

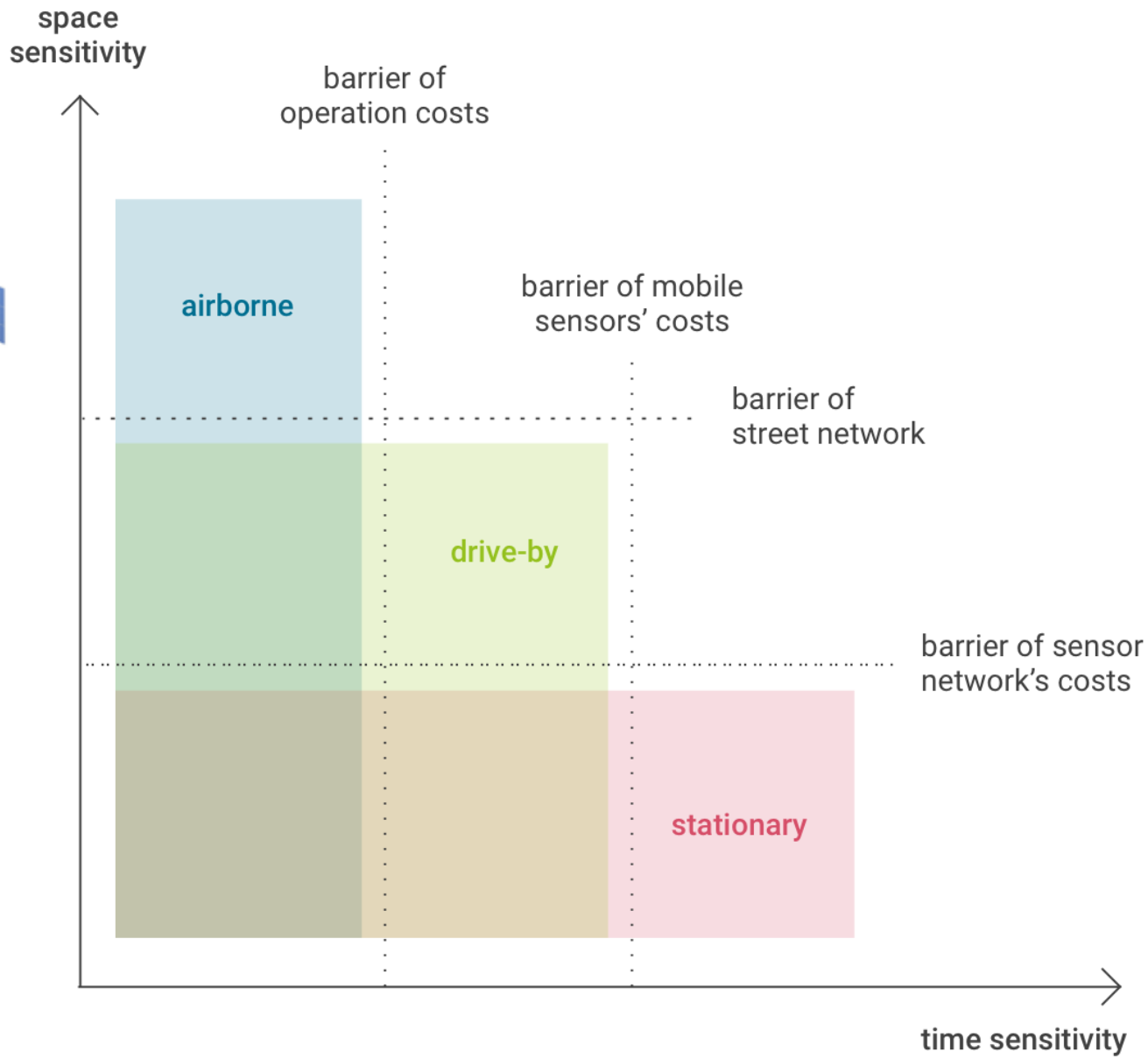

100%
90%
80%
70%
60%
50%
40%
30%
20%
10%
0%
Shareability
0
2
4
6
8
10
12
14
16
18
x 10^4
Number of trips per day
San Francisco
Singapore
New York
Vienna

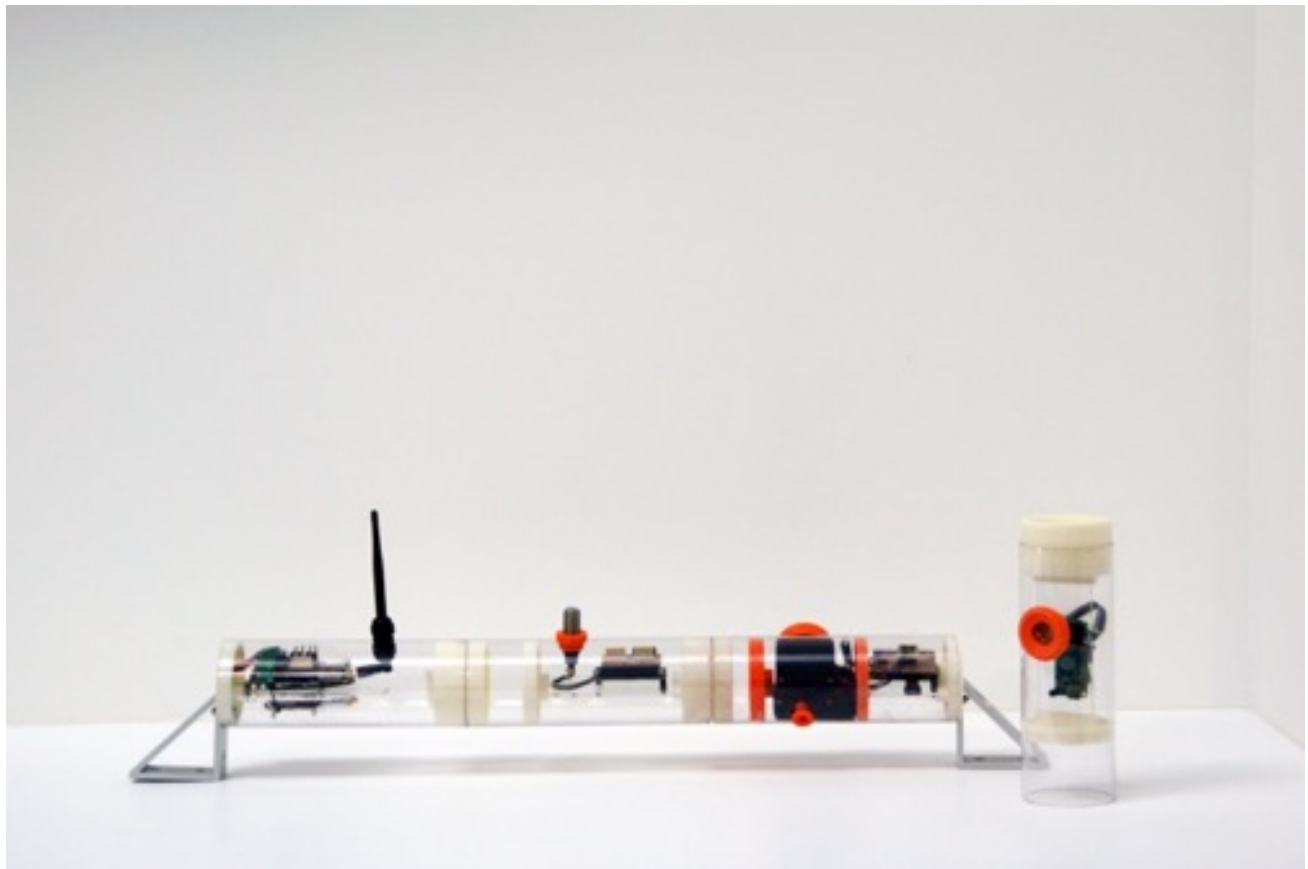
Minimum Mobility

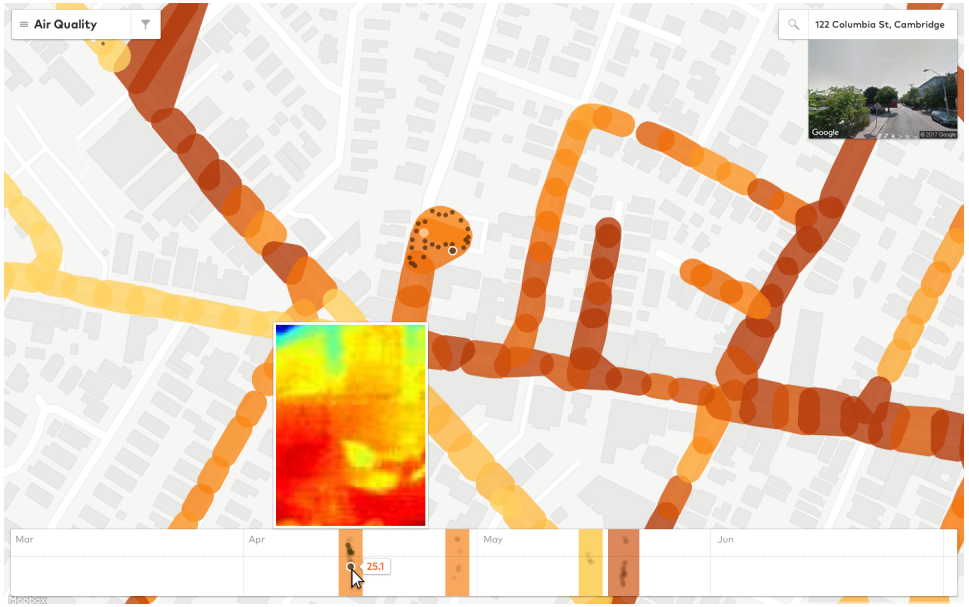
MOBILITY, URBAN PATTERNS

City Scanner

ENVIRONMENT, URBAN SENSING


space sensitivity
barrier of operation costs
airborne
barrier of mobile sensors' costs
barrier of street network
drive-by
barrier of sensor network's costs
stationary
time sensitivity





http://senseable.mit.edu/cityscanner/app/

senseable
city lab.

Fábio Duarte
fduarte@mit.edu

Demonstrating Road User Charges with Shared Mobility Car-Sharing

Ken Buckeye – Project Manager
Kenneth.buckeye@state.mn.us; **651-366-3737**
Office of Financial Management

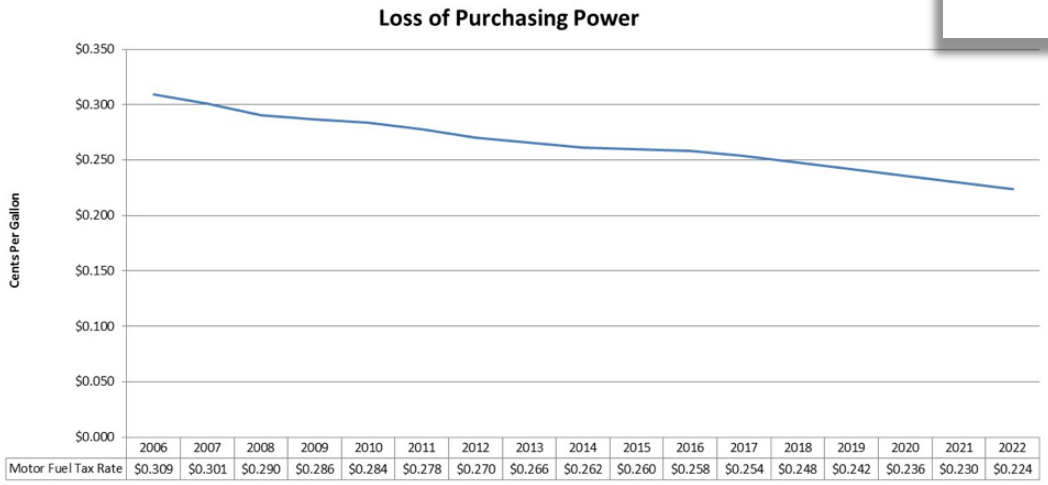
DEPARTMENT OF TRANSPORTATION

Overview

- Minnesota's experience with road user fees
- Why our partnership with FHWA is focused on Shared Mobility Car-sharing
- Leveraging emerging trends in transportation
- What our pilot seeks to demonstrate
- Retain the Motor Fuel Tax

Road User Charges: Why?

Price = Use



	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019	2020	2021	2022
Motor Fuel Tax Rate	$0.309	$0.301	$0.290	$0.286	$0.284	$0.278	$0.270	$0.266	$0.262	$0.260	$0.258	$0.254	$0.248	$0.242	$0.236	$0.230	$0.224

Source: USDOT FHWA

Road User Charges: the Challenges

Administrative expense

Privacy

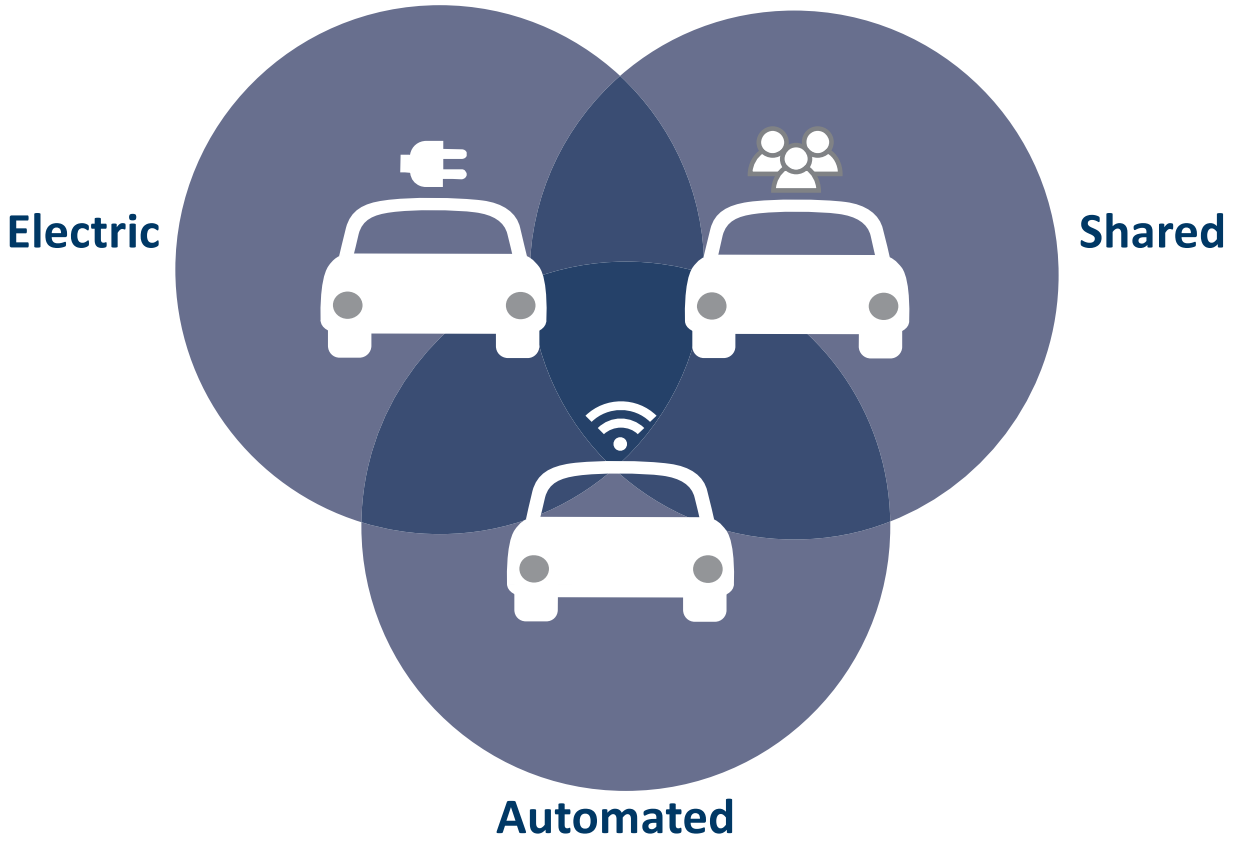
Scalability

Rate setting

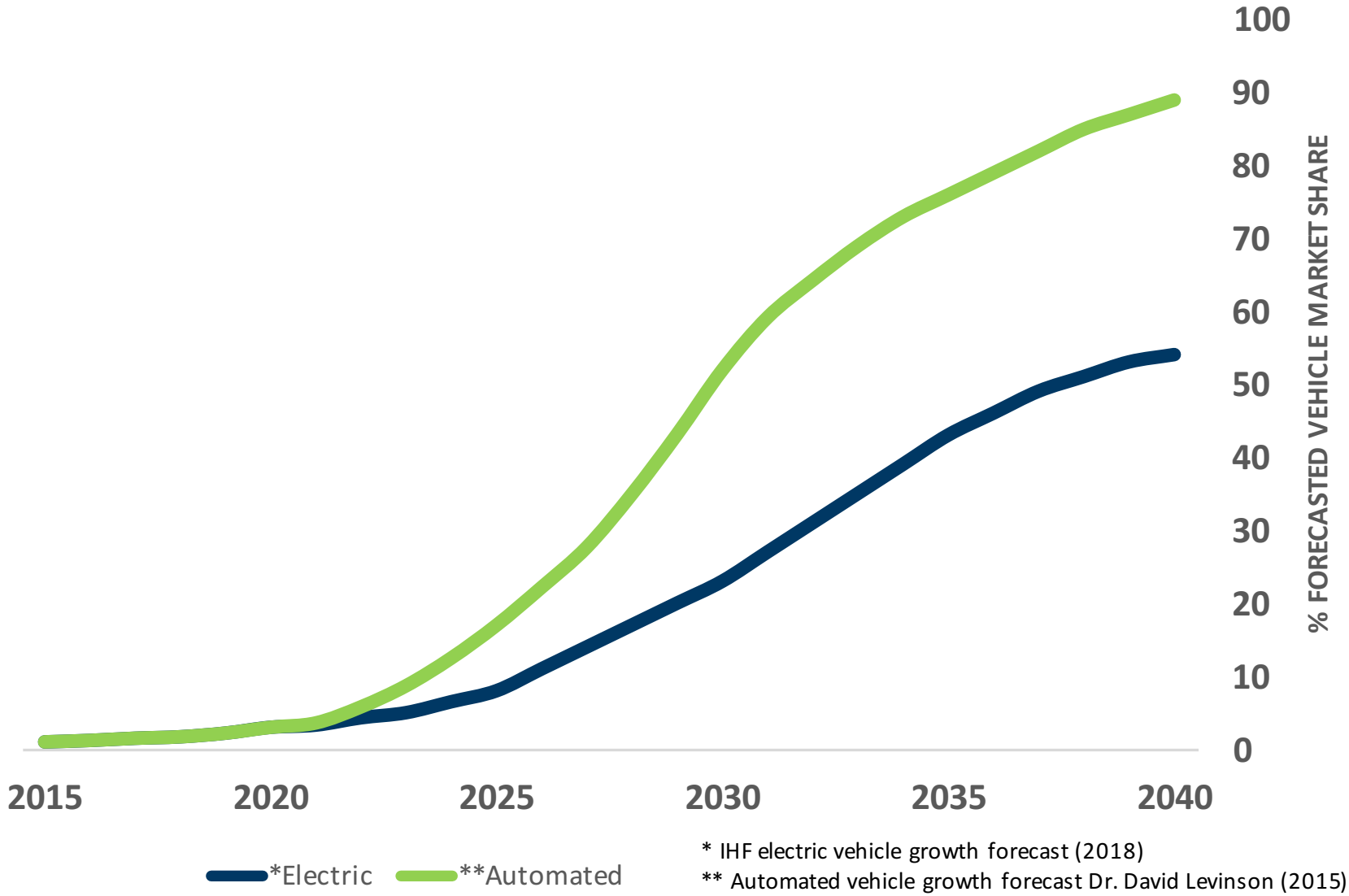
Evasion

Security

Convergence

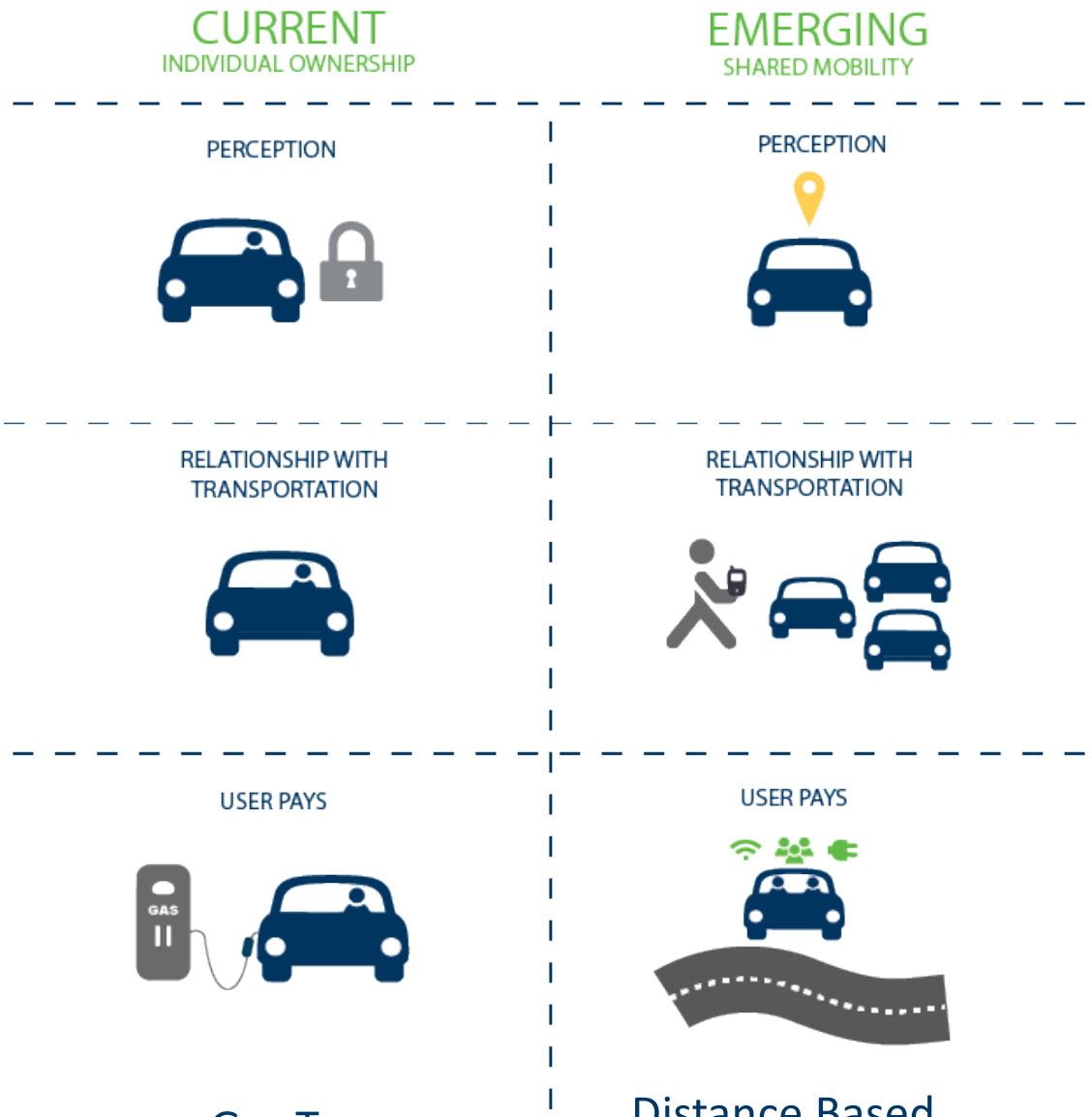


Convergence
Forecasted Automation & Electrification Growth



* IHF electric vehicle growth forecast (2018)
** Automated vehicle growth forecast Dr. David Levinson (2015)

Responding to shift in how we do transportation



Minnesota's Goals for the Road User Charge Demonstration

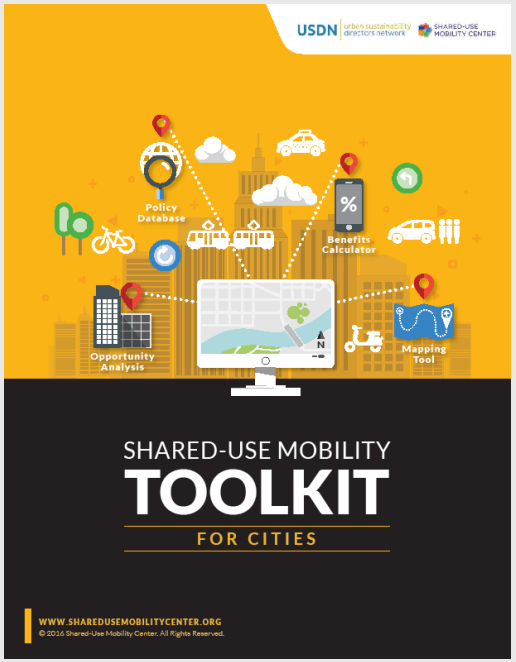
1. Develop a reliable and secure DBUF model that can be integrated with state revenue systems
2. Efficiency of administration
3. Chart path forward for wider implementation

Demonstration Objective

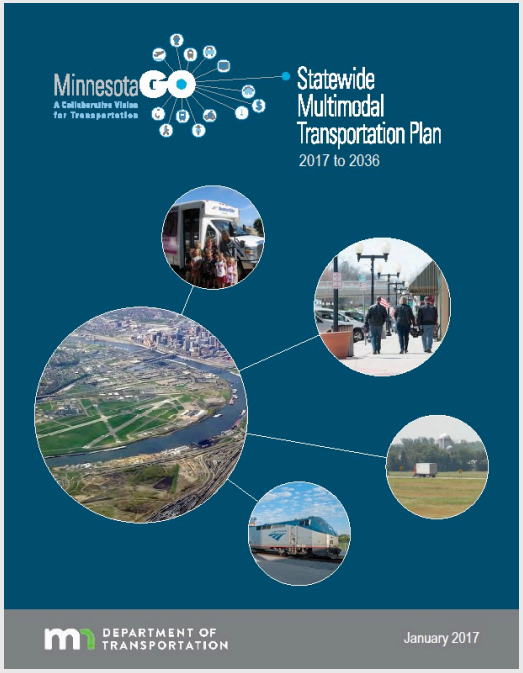
Prove that on-board embedded technology in Shared Mobility car-sharing vehicles can be used to efficiently and effectively collect distance based fees.

Shared Mobility

Benefits the system & aligns with our transportation Vision



Source: Shared Use Mobility Center



Opportunity to reduce VMT

Green house gas reduction

Provide multi modal options

Equitable access to mobility

Efficient and affordable

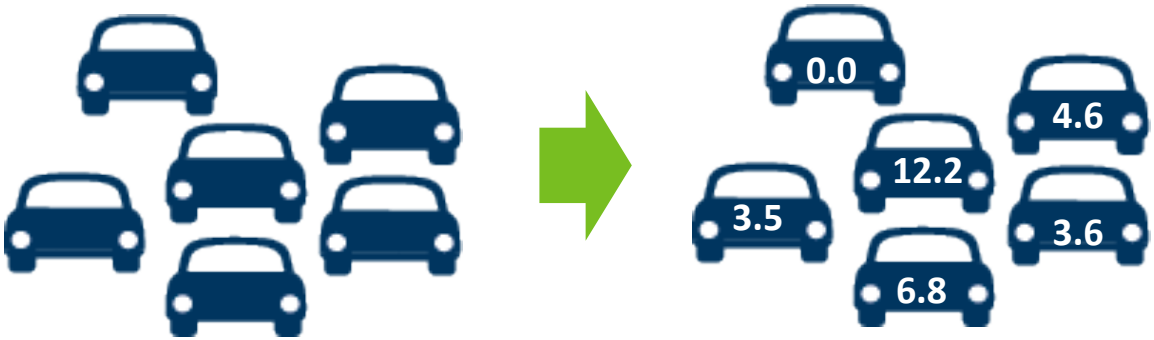
Demonstrating the Process

Car-share vehicles on Minnesota Roads

Demonstrating the Process

Form car-share partnerships

Car-share company calculates distance traveled of all vehicles

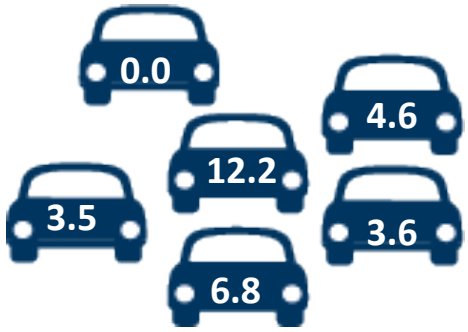


Demonstrating the Process

Calculate car-share vehicles on Minnesota Roads

Car-share company calculates distance traveled of all vehicles

Car-share sends summary of distance traveled to Department of Revenue



Invoice

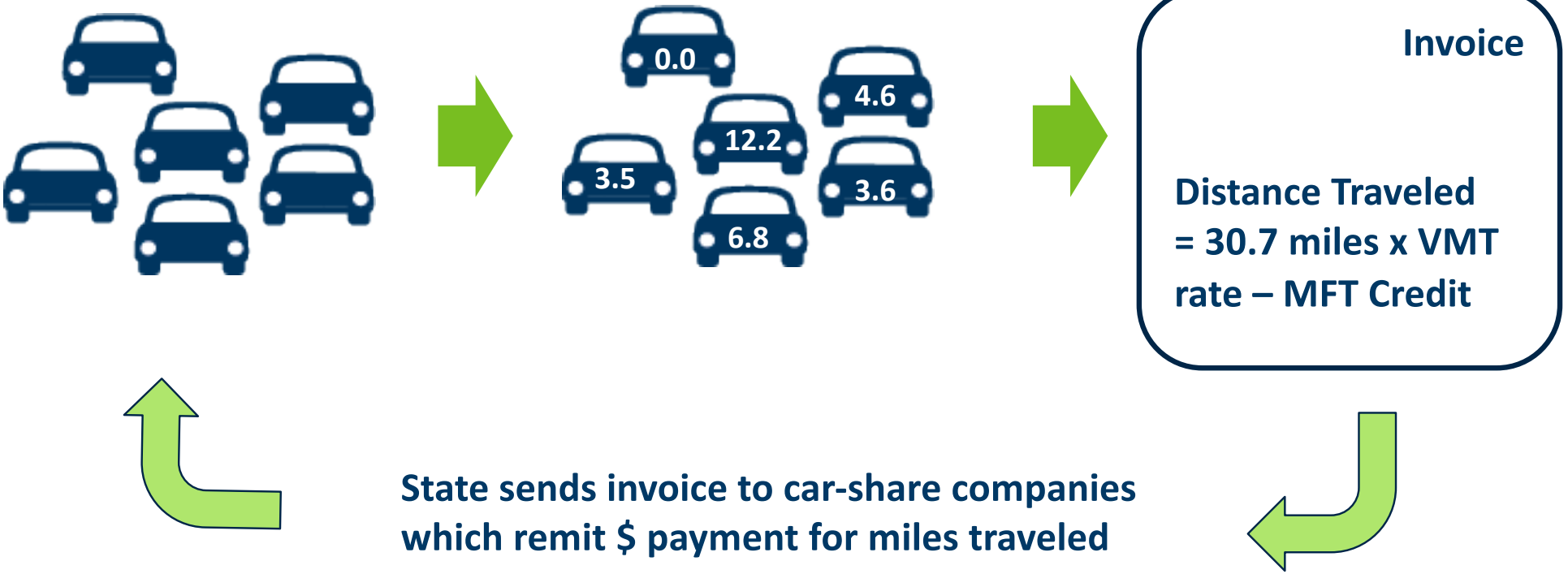
Distance Traveled = 30.7 miles x RUC rate – MFT Credit

Demonstrating the Process

Form Car-share partnerships

Car-share company calculates distance traveled of all vehicles

Car-share sends summary of distance traveled to Department of Revenue



Advantages to this Approach

- Incremental adoption (migration not a transformation)
- Leverages an emerging and dynamic modal opportunity that may open doors to wider adoption
- Data already available on shared use vehicles
- Avoids many – but not all – privacy concerns related to individual vehicle ownership
- Allows the motor fuel tax to continue to perform where appropriate

What's Ahead?

- Not an immediate and universal path to implementation
- Requires an added burden to shared mobility and /or other providers
- State and federal agencies are needed for implementation
- Some form of regulation in the long run
- Provides a means to stabilize revenue collection fairly, efficiently, and effectively

DEPARTMENT OF TRANSPORTATION

Thank you!

Ken Buckeye – Project Manager

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Office of Financial Management

Questions?

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TAMP Implementation

Wednesday, October 9, 2019 – 2:00 PM EST
Highlights: TRB Performance and Data in Transportation Decision Making Conference

Wednesday, December 11, 2019 – 2:00 PM EST
Consistency Review Process

More to follow!

Federal Highway Administration

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