



# RUTGERS

Center for Advanced  
Infrastructure and  
Transportation

A U.S. Department of Transportation  
University Transportation Center

## **State of Good Repair: A proactive policy**

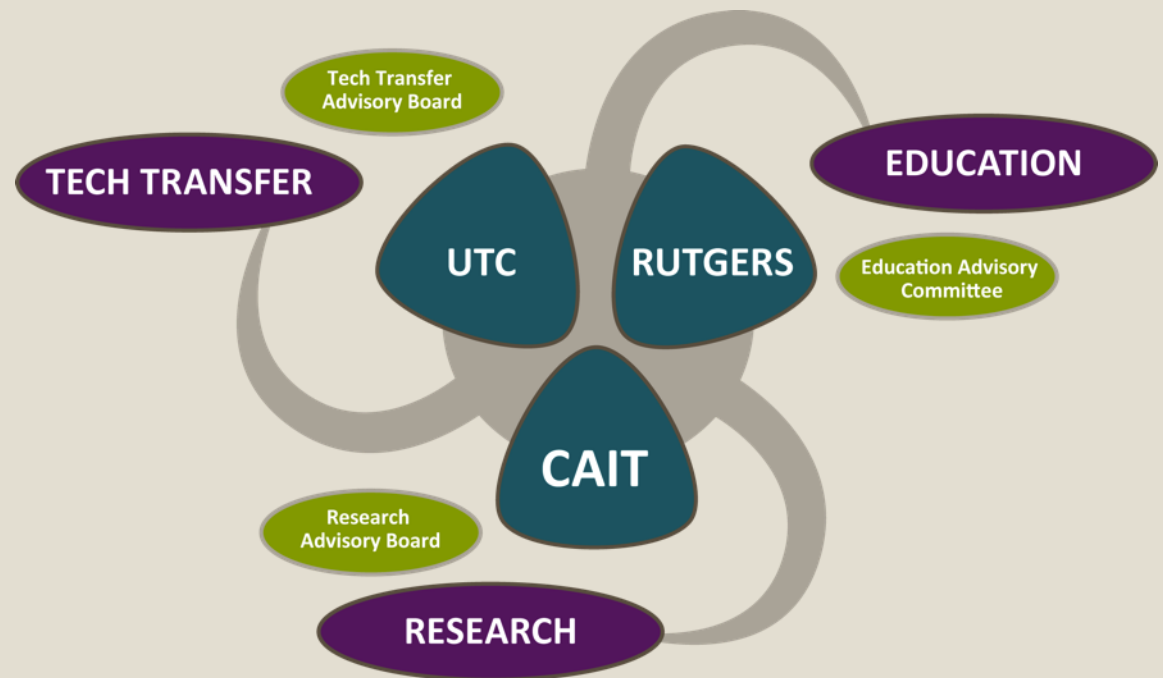
September 28, 2015

# CAIT at a Glance >>



## CAIT's Mission

Solving complex, interrelated transportation infrastructure problems, specifically in high-volume, multimodal corridor environments.



## Successful & Elite >>



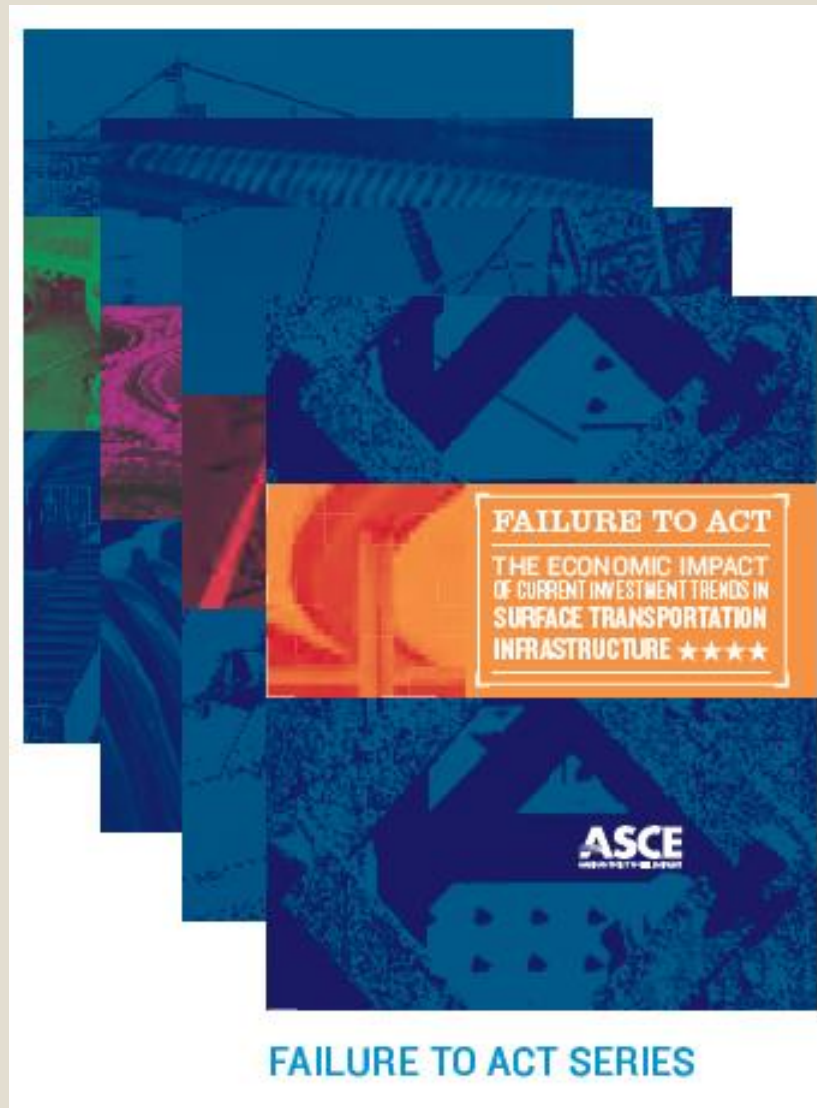
- >> CAIT was named one of five USDOT National University Transportation Centers in September 2013
- >> Successfully maintained UTC status through three transportation bills and four national competitions
- >> CAIT now leads a UTC consortium with eight top U.S. research universities



# ASCE Failure to Act Series>>

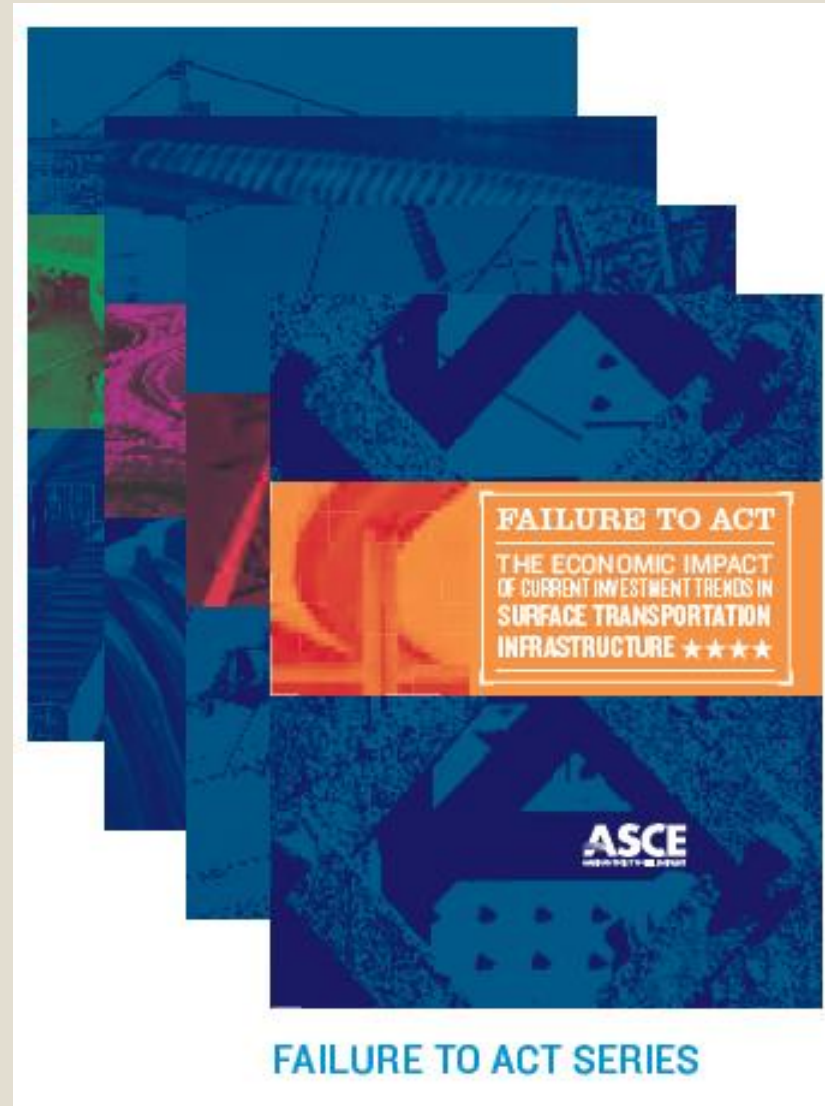
**How does a D for infrastructure affect America's economic future?**

“This Failure to act report answers the key questions of how the conditions of the U.S. infrastructure systems affect the nation's economic performance ...”



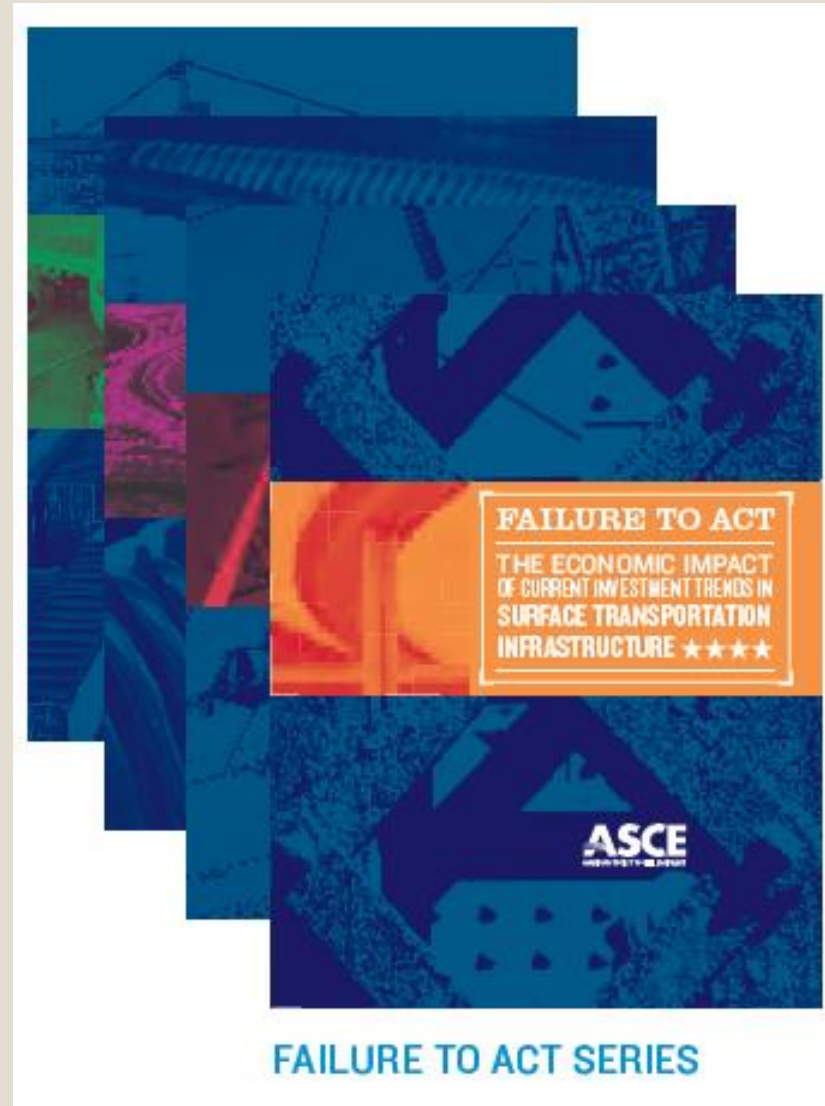
# ASCE Failure to Act Series>>

**“Deteriorating infrastructure has a cascading impact on the nation’s economy, negatively affecting business productivity, GDP, employment, personal income and international competitiveness.”**

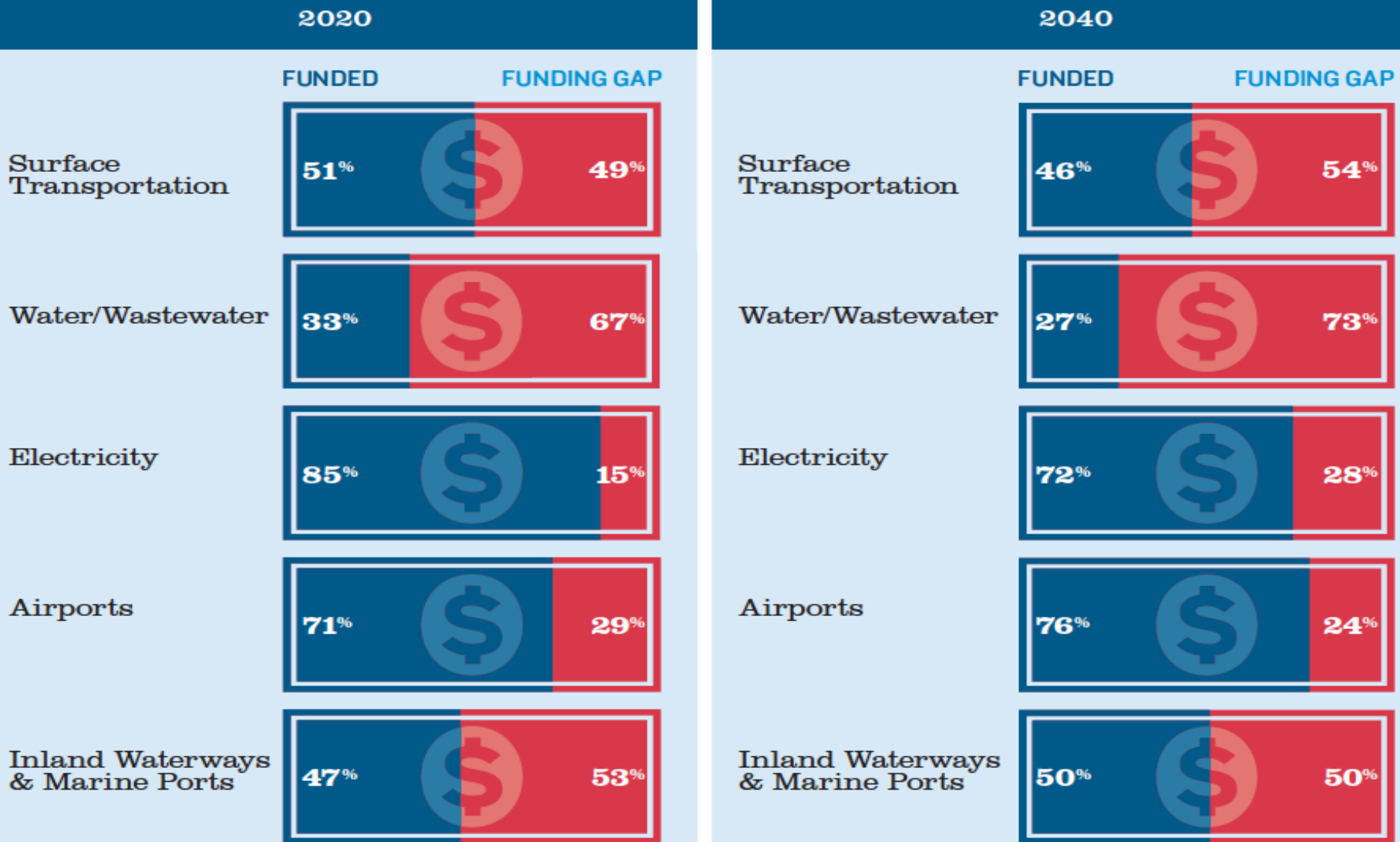


# ASCE Failure to Act Series>>

**“By 2020, America’s projected surface transportation infrastructure deficiencies are expected to cost the national economy cumulatively almost \$900 billion in GDP, rising to \$2.7 trillion through 2040.”**

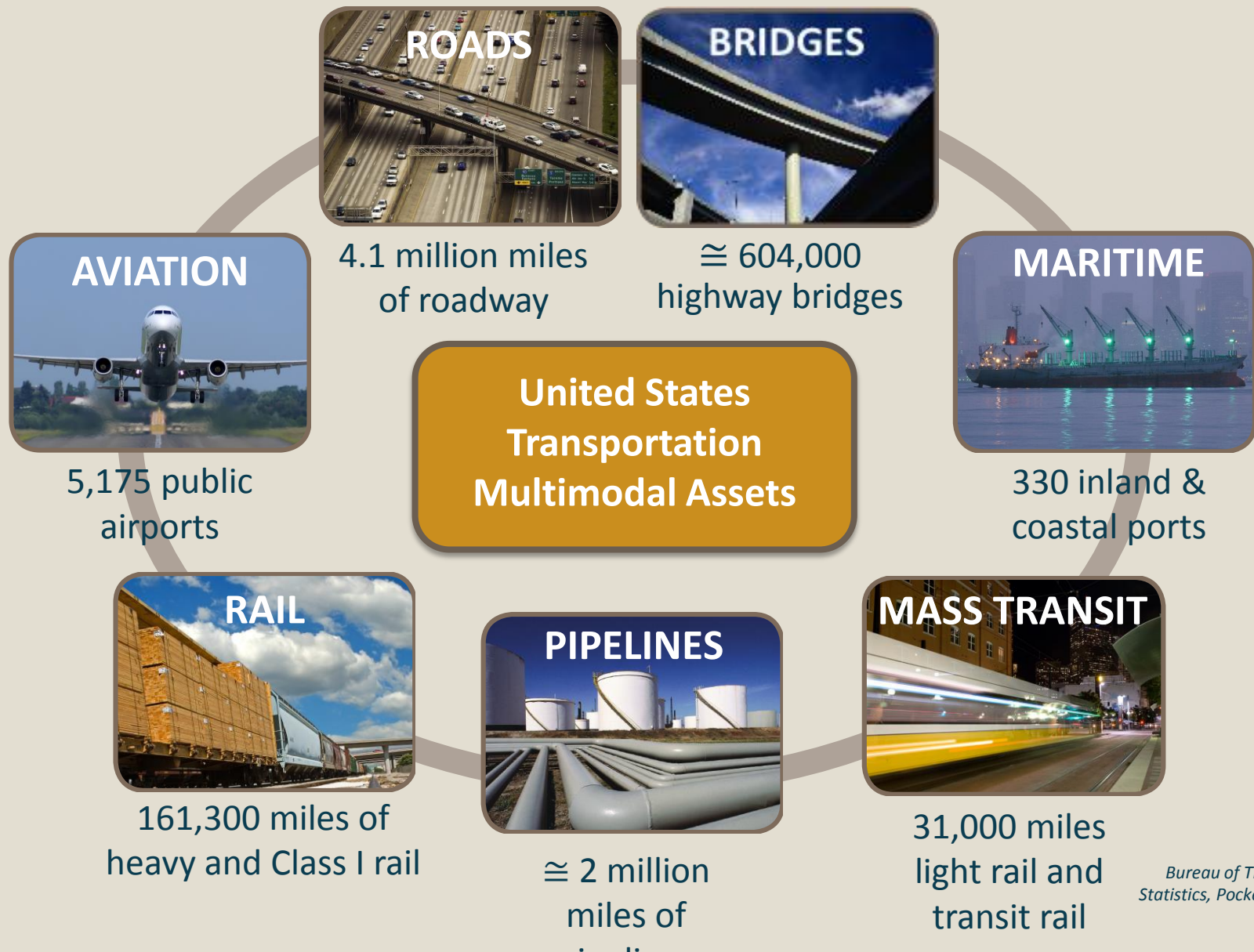


**FIGURE 1 ★ Investment Gap by Infrastructure Category as a Percentage of Total Needs in the Years 2020 and 2040**



**SOURCE** Data taken from previous *Failure to Act* studies.

# The Need for Infrastructure Research >>



Source:  
Bureau of Transportation  
Statistics, Pocket Guide 2012



Testing, engineering, and data management solutions—CAIT contributes to the health, durability, and performance of our nation's bridges.



Long-Term Bridge Performance



CAIT uses and develops cutting-edge nondestructive evaluation tools to accurately assess condition, detect deterioration, and monitor the health of critical infrastructure.



Infrastructure Condition Assessment & Monitoring



# Rapid Load Testing and Rating of Large Populations of Bridges

## Step 1

Rapid modal impact testing using a self-contained mobile device

## Step 2

Semi-Automated pre- and post-processing to obtain global frequencies and mode shapes

## Step 3

Automated FE modeling using NBI data and on-site assessment

## Step 4

Automated FE model calibration and load rating

## Step 5

Reporting





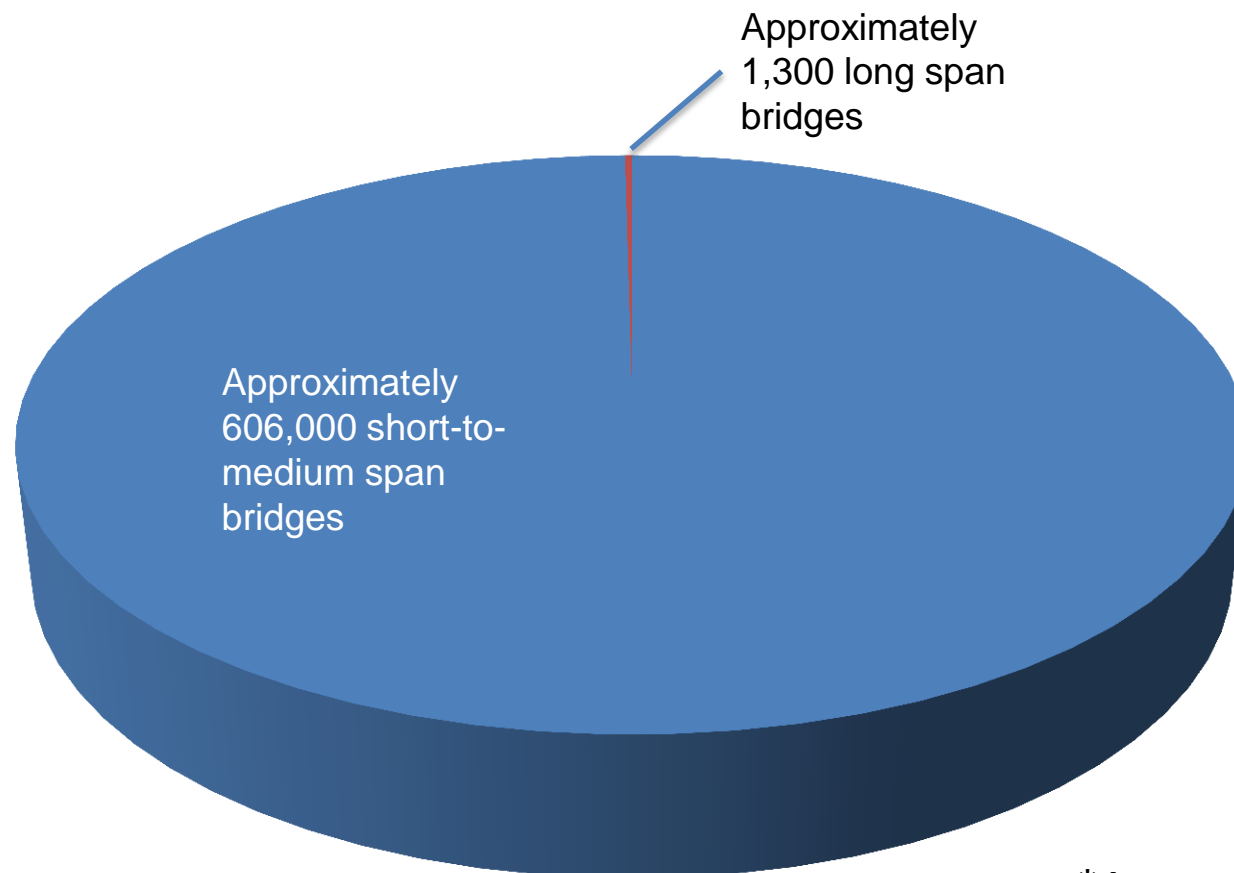


# Comparison with Current Structural Testing Approaches

	Technology/ Approach	Cost	Prep. Time	Testing Time	Report Time	Access Equip	Bridge Closure	Overall Quality
Quasi-Static	Ambient monitoring w/ displacement transducers	\$30-50K	5-10 days	2-5 day	3-5 days	Yes	Only under-side	Mod
	Load testing w/ displacement transducers	\$30-50K	5-10 days	1 day	3-5 days	Yes	Partial 2 hrs	High
Dynamic	Ambient vibration monitoring	\$20-30K	5-7 days	2-5 days	5-7 days	Yes	Only under-side	Mod
	MIMO Impact Testing	\$40-60K	5-7 days	1 day	5-7 days	Yes	Partial 2 hrs	High/Mod
	Rapid Load Testing System	\$3-5K	N.A.	1-3 hrs	1-2 hrs	No	Slow downs	Mod



# Breakdown of Bridges in the US...



The U.S. (inclusive of states, counties, and municipalities) spends approximately \$2.0 billion\* per year inspecting short-to-medium span bridges

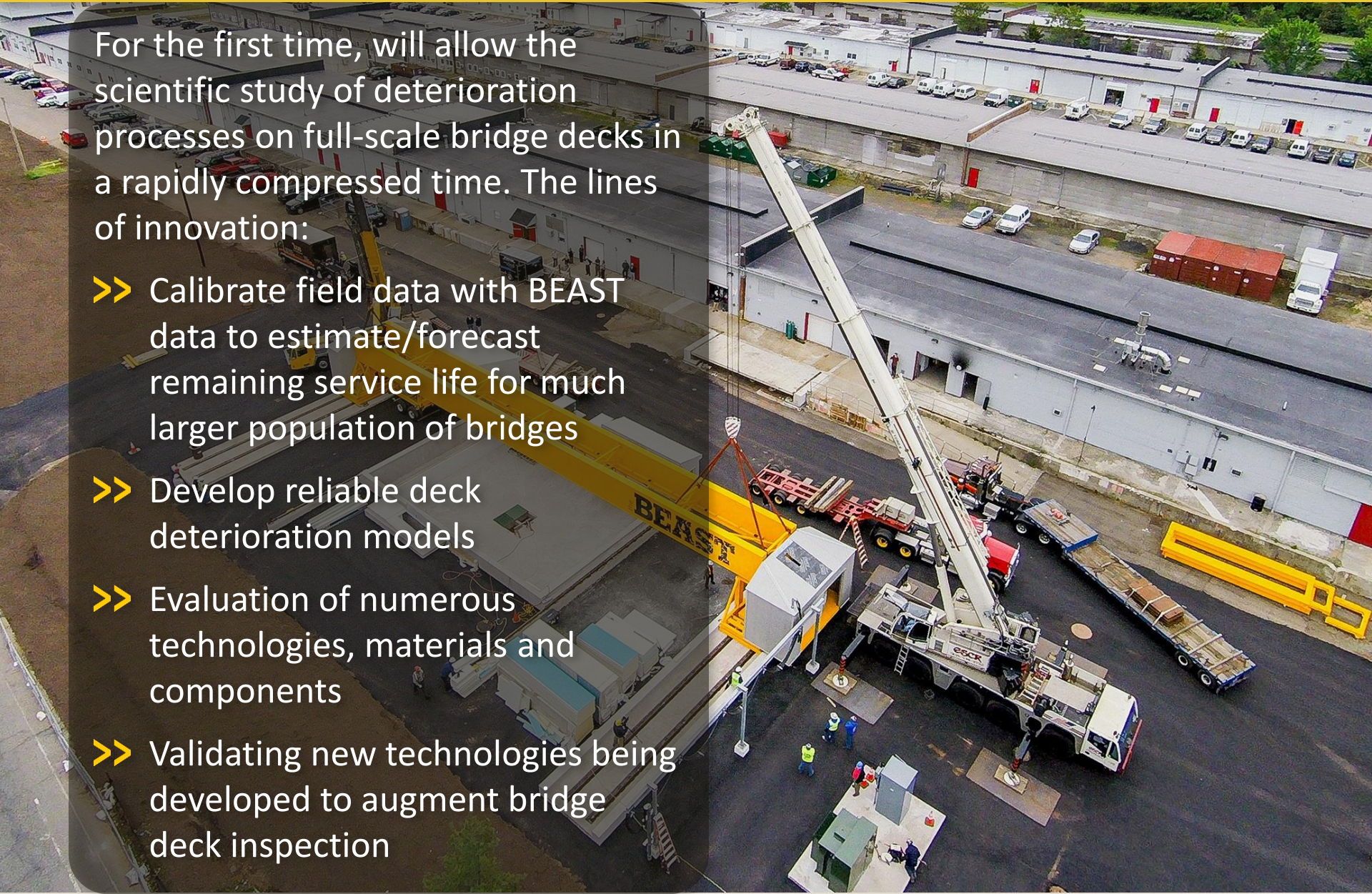
\*Assumes biennial inspections at an average rate of \$6,500/bridge



# BEAST: Mission >>

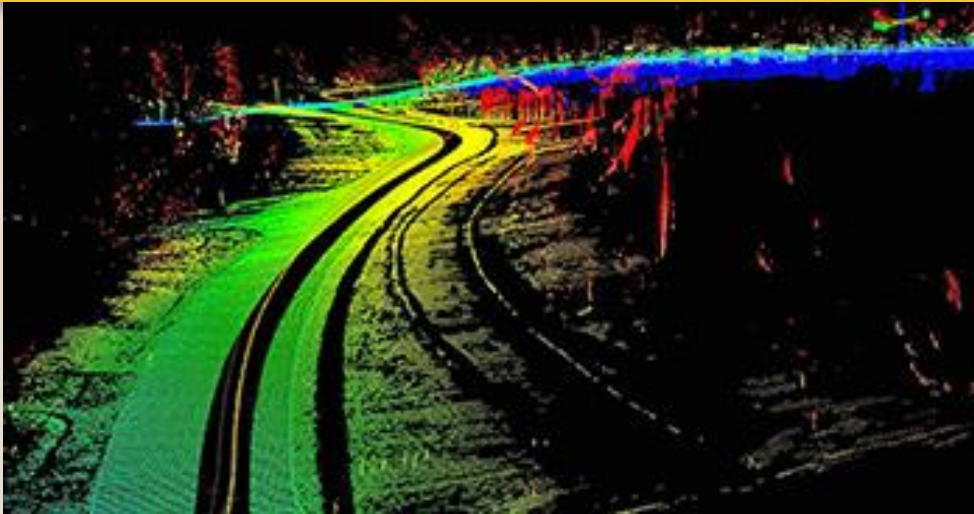
For the first time, will allow the scientific study of deterioration processes on full-scale bridge decks in a rapidly compressed time. The lines of innovation:

- >> Calibrate field data with BEAST data to estimate/forecast remaining service life for much larger population of bridges
- >> Develop reliable deck deterioration models
- >> Evaluation of numerous technologies, materials and components
- >> Validating new technologies being developed to augment bridge deck inspection





# Pipeline safety and security >>



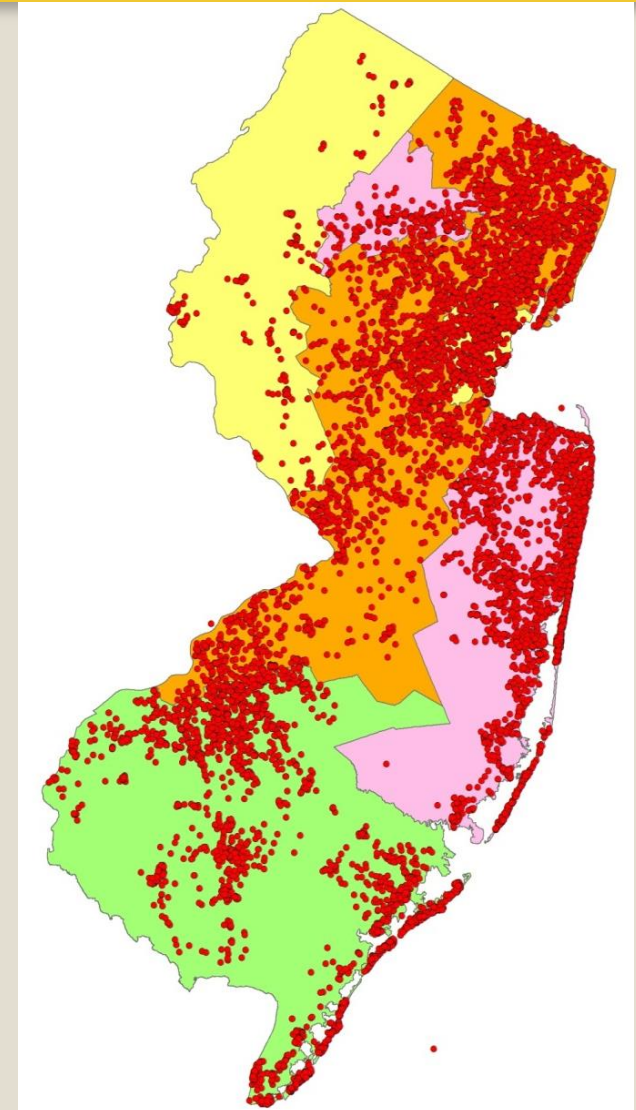
Lidar Output: post-damage assessments

## Issues:

- >> “no-call” and high-risk excavations
- >> Encroachments

## Opportunities (big data, internet of things):

- >> Automated assessments:
  - >> UAV, Lidar, thermography
  - >> Utility operator and commission data



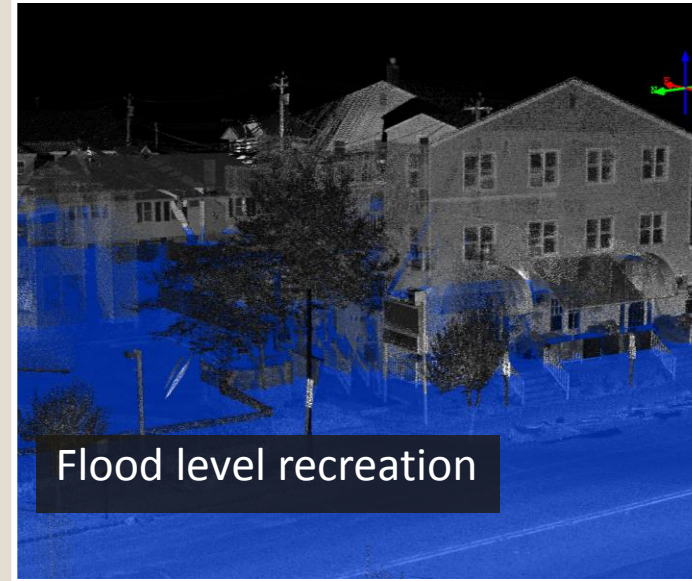
All Damage Locations 2009-2014  
Ref: 2014 Gas Line Damage Report



# Highlight: Mobile LiDAR Post-Sandy Study >>



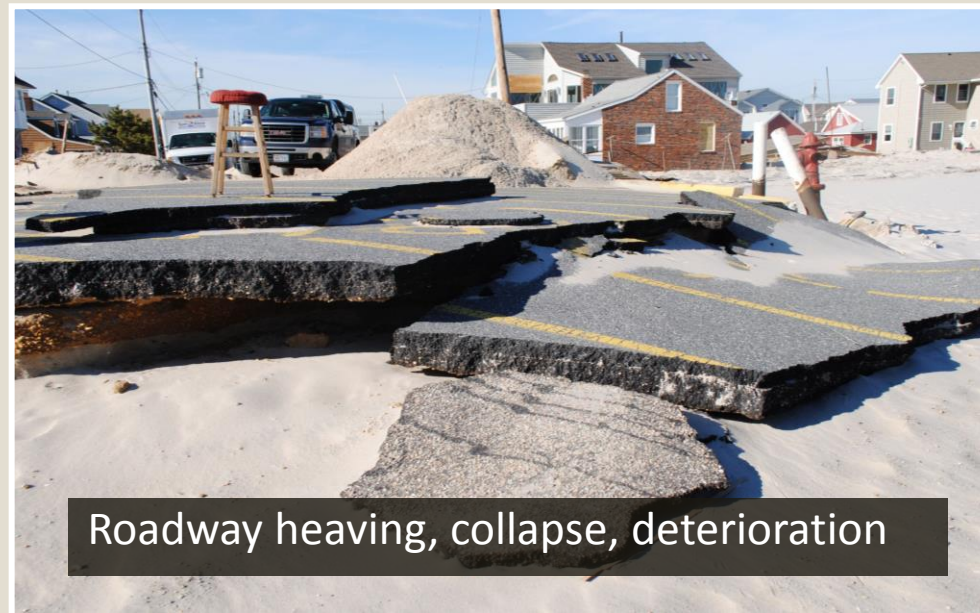
Structural damage, terrain change/displacement



Flood level recreation



Scour, soil erosion



Roadway heaving, collapse, deterioration



## Highlight: Mobile LiDAR Post-Sandy Study >>

- >> Mobile LiDAR collects extremely accurate surface condition data; paired with visual reference the data creates a virtual reality
- >> Can be used to record environment and structures before an event, and changes to them after disaster
- >> Data enables highly-accurate risk and predictive models that help planners, developers, and government agencies like FEMA assess future risk



Through research and training in pipeline technology and security, CAIT helps keep America's 2 million miles of underground infrastructure safe and flowing free.



Pipeline Safety & Security



# CAIT Workshop – Life Cycle Cost Reduction

- Identifying innovation
- Developing Roadmap

Piscataway, NJ

January 2016

Welcoming participants

Life Cycle Cost Reduction - 2016



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Thank you!

