Every 4 years, the American Society of Civil Engineers releases a Report Card for America's Infrastructure that depicts the condition and performance of the nation's infrastructure in the familiar form of a school report card by assigning letter grades to each type of infrastructure.

Source: ASCE's America's Infrastructure Report Card 2013
http://www.infrastructurereportcard.org/
America's Infrastructure Scores a D+
What Makes a Grade?

- **Capacity**: Does the infrastructure’s capacity meet current and future demands?
- **Condition**: What is the infrastructure’s existing and near-future physical condition?
- **Funding**: What is the current level of funding from all levels of government for the infrastructure category as compared to the estimated funding need?
- **Future Need**: What is the cost to improve the infrastructure? Will future funding prospects address the need?
- **Operation and Maintenance**: What is the owners’ ability to operate and maintain the infrastructure properly? Is the infrastructure in compliance with government regulations?
- **Public Safety**: To what extent is the public’s safety jeopardized by the condition of the infrastructure and what could be the consequences of failure?
- **Resilience**: What is the infrastructure system’s capability to prevent or protect against significant multi-hazard threats and incidents? How able is it to quickly recover and reconstitute critical services with minimum consequences for public safety and health, the economy, and national security?
- **Innovation**: What new and innovative techniques, materials, technologies, and delivery methods are being implemented to improve the infrastructure?
EXCEPTIONAL, FIT FOR THE FUTURE

The infrastructure in the system or network is generally in excellent condition, typically new or recently rehabilitated, and meets capacity needs for the future. A few elements show signs of general deterioration that require attention. Facilities meet modern standards for functionality and are resilient to withstand most disasters and severe weather events.

GOOD, ADEQUATE FOR NOW

The infrastructure in the system or network is in good to excellent condition; some elements show signs of general deterioration that require attention. A few elements exhibit significant deficiencies. Safe and reliable, with minimal capacity issues and minimal risk.
C

MEDIocre, Requires Attention

The infrastructure in the system or network is in fair to good condition; it shows general signs of deterioration and requires attention. Some elements exhibit significant deficiencies in conditions and functionality, with increasing vulnerability to risk.

D

POOR, At Risk

The infrastructure is in poor to fair condition and mostly below standard, with many elements approaching the end of their service life. A large portion of the system exhibits significant deterioration. Condition and capacity are of serious concern with strong risk of failure.
FAILING/CRITICAL, UNFIT FOR PURPOSE

The infrastructure in the system is in unacceptable condition with widespread advanced signs of deterioration. Many of the components of the system exhibit signs of imminent failure.
Hazardous Waste

Inland Waterways
Levees

Ports

Public Parks

Rail

Roads

Schools
C+ Solid Waste
D- Transit
D+ Wastewater
We can no longer afford to defer investment in our nation’s infrastructure. To close the $2.0 trillion 10-year investment gap, meet future need, and restore our global competitive advantage, we must increase investment from all levels of government and the private sector from 2.5% to 3.5% of U.S. Gross Domestic Product (GDP) by 2025.
THE CENTER FOR INFRASTRUCTURE RENEWAL

Dr. Bjorn Birgisson
Director, Center for Infrastructure Renewal
TEES Distinguished Research Professor

CREATING MODERN SOLUTIONS FOR INFRASTRUCTURE RENEWAL
Smart Communities Aspects

- Renewable Energy
- Smart, Zero Energy Buildings
- Intelligent Transportation
- Smart Water
- Internet of Things
- Sustainability
- Cyber Security
Center for Infrastructure Renewal:
Resilience and Critical Infrastructure Systems
Knowledge and Innovation Community
Research Thrusts

- Resilient Critical Infrastructure
- System-of-Systems Approach
- Complex Networks Modeling
- Public Policy
- Visualization/Decision Theater
- System Analytics
- Data Mining
- Resilient Critical Infrastructure

Theater
Resilience of Coupled Socio-Physical Networks Embedded in Critical Infrastructure

Transitions
Technological
Public Planning
Management
Policy

Social Networks

Physical Networks

Service

Adaptive Behaviors

Stressors

Population Growth
Loss of Critical Resources
Aging Infrastructure
Climate Change
Extreme Events / Hazards

Present
Future
Sea-Level Rise (SLR): A Major Climate Change Impact

Sea Level Rise Projection (NOAA, 2013)

Top 25 Most Dense Counties in United States (CCSP, 2009)
System of Systems (SoS) Approach for Analysis of SLR Impacts and Adaptation Pathways

Model Dynamic Transformation of Hazards under Climate Change

Model Stakeholders’ Adaptation Decision-Making

Identify Robust Adaptation Strategies

Model Infrastructure Vulnerability

Source: [30]

Model Dynamic Transformation of Hazards under Climate Change

Hazard Scenarios

Vulnerability/Impacts

Adaptation Decisions

Identify Robust Adaptation Strategies

Model Infrastructure Vulnerability

Retrofit and Rehabilitation

Civil Infrastructure Performance

Deterioration

Demand

Source: [30]

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Demand

Source: [30]
Study 1: Exploratory Modeling of Sea-level Rise Impacts on Road Networks in Miami
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Network performance was examined under to sea-level rise projections: slow, moderate, and fast

Over time, chronic SLR impacts can cost more than extreme, infrequent events
Study 2: Water Supply System Resilience under Sea-level Rise Impacts

80% of water supply networks in the Atlantic coast in the US extract their raw fresh water from underground coastal aquifers (ICCP, 2011)

South Florida extract 100% of their fresh water from coastal aquifers (Berry, 2012)
Study 2: Water Supply System Resilience under Sea-level Rise Impacts

Simulation of long-term saltwater intrusion to South Florida Well Fields and subsequent resilience impacts
Study 2: Water Supply System Resilience under Sea-level Rise Impacts

Exploratory Analysis of Resilient Adaptation Pathways through the use of Simulated Scenario Data
The CIR Model for Accelerating Research into the Marketplace

CIR Knowledge and Innovation Communities (KICs)
A Multidisciplinary, Multi-Stakeholder Systems Approach to Research, Innovation and Workforce Training
Multidisciplinary Focus

**BIG**
Large-scale infrastructure testing

**SMART**
Grid / Sensors
Vehicles / Water

**ADVANCED**
Advanced simulation and visualization laboratory
Materials and corrosion research
Aggregate, asphalt, cement and soil research
Where? At the RELLIS Campus

RELLIS is envisioned to be a 2,000 acre research and education campus containing:

- High-tech high-impact research facilities,
- A collaborative education complex, and
- Serving as a “Living Lab” for “Smart” technologies

That support world-class workforce development programs, applied research, and technology transfer.