America's Infrastructure Report Card:

Causes, Costs and Solutions

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When any one of us turns on the water, drives on a road, goes to a park or lake, takes out the trash or turns on a light, we are benefitting from the vast complex network of systems that comprise America's infrastructure. Infrastructure is silent, invisible and rarely thought of unless something goes wrong and it fails to perform. Unfortunately, due to its age, poor maintenance, and higher than predicted demands, much of America's infrastructure is in danger of failing and it is critical that it be brought up to current standards. In 1988, a Congressionally chartered commission, the National Council on Public Works Improvement, completed a study on the state of America's infrastructure entitled "Fragile Foundations: A Report on America's Public Works". Using a report card format to guide their analysis and publish their results, the commission gave the United States an overall infrastructure grade of 'C', stating that an annual increase in investment of up to 100% was required to improve our infrastructure (ASCE, 2009, p.9). Since then the American Society of Civil Engineers (ASCE) has issued four report cards on the nation's infrastructure. The most recent was issued this past March in which, the nation's infrastructure was given an overall grade of 'D' (Table 1) (ASCE, 2009, p. 2). ASCE estimates that infrastructure spending in the next five years will need to be $2.2 trillion in order to improve the condition of our infrastructure to 'good' (ASCE, 2009, p.6). This represents a $500 billion investment more than estimated in ASCE's 2005 report card and is approximately $1.1 trillion more than the U.S. currently invests in infrastructure (Table 2) (ASCE, 2009, p. 7).

Table 1
2009 Report Card for
America's Infrastructure

Aviation	D
Bridges	C
Dams	D
Drinking Water	D-
Energy	D+
Hazardous Waste	D
Inland Waterways	D-
Levees	D-
Public Parks and Recreation	C-
Rail	C-
Roads	D-
Schools	D
Solid Waste	C+
Transit	D
Wastewater	D-
AMERICA'S INFRASTRUCTURE G.P.A.	**D**

Note. From *2009 Report Card for America's Infrastructure*, American Society of Civil Engineers, p. 2. Copyright 2009 by the American Society of Civil Engineers. Adapted with permission.

Table 2
Estimated 5-Year Investment Needs in Billions of Dollars

CATEGORY	5-YEAR NEED (BILLIONS)	ESTIMATED ACTUAL SPENDING*	AMERICAN RECOVERY AND RESINVESTMENT ACT (P.L. III-005)	FIVE-YEAR INVESTMENT SHORTFALL
Aviation	87	45	1.3	(40.7)
Dams	12.5	5	0.05	(7.45)
Drinking Water and Wastewater	255	140	6.4	(108.6)
Energy	75	34.5	11	(29.5)
Hazardous Waste and Solid Waste	77	32.5	1.1	(43.4)
Inland Waterways	50	25	4.475	(20.5)
Levees	50	1.13	0	(1.13)
Public Parks and Recreation	85	36	0.835	(48.17)
Rail	63	42	9.3	(11.7)
Roads and Bridges	930	351.5	27.5	(549.5)
Discretionary grants for surface transportation			1.5	
Schools	160	125	0**	(35)
Transit	265	66.5	8.4	(190.1)
	2.122 trillion***	903 billion	71.76 billion	(1.176 trillion)

Total Need** **$2.2 trillion**

* 5 year spending estimate based on the most recent available spending at all levels of government and not indexed for inflation
** The American Recovery and Reinvestment Act included $53.6 billion for a State Fiscal Stabilization Fund for education, as of press time, it was not known how much would be spent on school infrastructure.
*** Not adjusted for inflation
**** Assumes 3% annual inflation

Note. From *2009 Report Card for America's Infrastructure*, American Society of Civil Engineers, p. 7. Copyright 2009 by the American Society of Civil Engineers. Adapted with permission.

The report card evaluated the condition of infrastructure as determined by its ability to meet current and projected needs and its resiliency and estimated the costs to improve the quality from its current grade to a 'B'. While long term maintenance and capital improvement funding can prolong the life of infrastructure systems, effectively improving the nation's infrastructure will require prioritization of spending and an understanding the underlying causes of failure. ASCE found infrastructure systems across the nation that were either approaching or were beyond their overall design life; serving demands that exceeded their design capacity; lacking redundancy; interdependent on other failing systems; and facing technological obsolescence. By recognizing that the overall decline in the condition of the nation's infrastructure is due to more than one contributing factor, engineers can take a broader approach to understanding the problems and developing solutions.

Drinking water systems touch all Americans and the continued performance of these systems is critical to our overall health and lives. At a time when much of the United States is deep into a multi-year drought, it is vital that these systems function continuously, correctly, and efficiently, utilizing the best technology to optimize consumption. ASCE gave the nation's drinking water systems a 'D-'. Despite significant funding investments at federal and local levels, ASCE reports that there remains a projected $11 billion shortfall in funding needed to replace facilities that are nearing the end of their useful lives (ASCE, 2009, p. 26). In 2000, the United States population consumed an estimated 43 billion gallons of water per day. An additional 7 billion gallons of clean drinking water is lost every day in leaking pipes (ASCE, 2009, p. 24). Drinking water systems face resiliency challenges with most systems lacking the redundancy required to maintain service in the event of a disruption. Further, their dependence

on a reliable power source to provide continuous service provides yet another resiliency challenge, given the 'D+' rating of energy infrastructure, for drinking water systems to address.

The nation's wastewater systems face similar challenges to the drinking water systems and also received a 'D-'. The facilities in many of these systems have reached the end of their useful lives resulting "in the release of as much as 10 billion gallons of raw sewage yearly (ASCE, 2009, p. 58)." In addition, many of these systems are combined storm water/sanitary sewer systems which are incapable of conveying flows generated by major storm events or runoff from heavy snowfalls. At a minimum separate sanitary sewer lines need to be provided in these locations to prevent uncontrolled discharge of raw sewage. There is a projected annual funding shortfall of $6 billion for wastewater treatment (ASCE, 2009, p. 58).

In order to meet increasing demands, maintain critical systems, replace aging facilities and create necessary redundancies to enhance resiliency, it is estimated that, overall, there is a five-year funding need of $255 billion for water and wastewater systems. In January 2009, the estimated spending for the next five years was only $146.4 billion, representing a $108.6 billion shortfall. While there are currently long term federal funding programs for national defense, and the interstate highway and aviation systems, no such program exists for drinking water and wastewater systems (ASCE, 2009, p. 60). A long term funding solution is critical to maintaining and improving public health and should work in conjunction with a variety of other funding mechanisms at the local and state levels. In addition to funding solutions, water and wastewater utilities will need to work together to identify ways to provide additional supply to meet growing water needs as water becomes increasingly scarce. Solutions may include developing reclaimed water systems, enhancing capture of storm water, and using treated wastewater to replenish groundwater supplies.

The nation's transportation system faces similar funding and aging challenges. Although the nation's bridges received the highest grade on the report card, 'C', more than one in four bridges is either structurally deficient or functionally obsolete (ASCE, 2009, p. 74). With a typical design life of 50 years "the average bridge … is now 43 years old (ASCE, 2009, p. 76)." A structurally deficient or functionally obsolete bridge is not necessarily unsafe but "cannot accommodate current traffic volumes, vehicle sizes, and weights (ASCE, 2009, p. 76)." The resulting restrictions on these bridges create congestion, delays, and reductions in service for emergency vehicles. The limitations of these bridges are compounded by increasing traffic demands. In the past 20 years truck traffic has more than doubled and trucks are hauling increasingly larger loads. The condition of the nation's bridges is only one contributing factor to the congestion on the roadways. ASCE gave roads a grade of 'D-'. Congestion on the roadways leads to wasted time and fuel costs of $710 per motorist annually (ASCE, 2009, p. 100). In addition to wasted resources, the poor quality of roadways, 84.9% of which are rated as only adequate, leads to safety issues. In 2007 alone there were 41,059 fatalities from motor vehicle crashes and 2.5 million injuries (ASCE, 2009, p. 100). Similar to their impact on bridges, trucks are a significant factor in issues facing the roadway network. In the ten years ending 2004, "freight traffic moved by truck grew 33% (ASCE, 2009, p. 100)." This increase is significant as an indicator of "the increased dependency of commerce on the efficiency of the roadways and the added wear and tear [on the roads] caused by trucks (ASCE, 2009, p. 100)." Resiliency of the roadway and bridge networks is critical. When a bridge or roadway fails, there is often an immediate loss of life and, until the system is restored, increased delays to roadway users. ASCE estimates a total of $930 billion is required over the next five years to improve the nation's roadways to a grade of 'B.' Of that amount, they anticipate that there will be a funding

shortfall of $549.5 billion. In addition to providing adequate funding at all levels for maintenance and capital improvements, it is important that national goals be set to not only improve the condition of the nation's roads and bridges, but to also increase funding for research on ways to enhance safety, reduce lost time due to construction, and improve overall movement on the nation's roadways.

The above provides only a brief summary of the challenges faced by four of the systems included in the ASCE *2009 Report Card for America's Infrastructure*. The report card serves to provide an understanding of the current state of America's infrastructure, the reasons it is decaying and provide specific recommendations to address the challenges faced by each infrastructure category. Additionally, ASCE provide five key solutions applicable to improving the state of infrastructure overall: 1) increase federal leadership in infrastructure, 2) promote sustainability and resilience, 3) develop federal, regional and state infrastructure plans, 4) address life cycle costs and ongoing maintenance, and 5) increase and improve infrastructure investment from all stakeholders (ASCE, 2009, p. 11). Implementing these solutions will result, over time, in improved infrastructure for the nation and will provide health, safety and economic security of its citizens.

Reference

American Society of Civil Engineers (ASCE). (2009, March). *2009 Report Card for America's Infrastructure*. Retrieved July 2009, from http://www.infrastructurereportcard.org