Perceptions of the infrastructure in the U.S.

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***Abstract* —** *In order to review the performance of the nation's infrastructure over the last decades the American Society of Civil Engineers (ASCE) prepared an infrastructure report card at the national level on March 1998, March 2001, September 2003, and March 2005. On Jan. 28, 2009, ASCE released the most recent grades from its Report Card for America's Infrastructure, assigning the nation's roads, bridges, water systems and other critical facilities a cumulative grade of "D" and noting a five-year investment need of $2.2 trillion. As an example, the Report Card reveals that more than 26% (more than one in four) of the nation's bridges are either structurally deficient or functionally obsolete. In addition, Americans spend 4.2 billion hours a year struck in traffic at a cost to the economy of $78.2 billion, or $710 per motorist. It is estimated that $15.8 billion is needed annually to maintain conditions and $21.6 billion to improve the system. Raising the grade on the infrastructure will require a wide range of solutions in every category, including technical advances, funding, and regulatory changes in public behavior and support. Thus this comprehensive Report Card provides a great deal of information on the impact of failing infrastructure, and also focuses on ways the nation can begin addressing these critical deficiencies. Most importantly, President Obama has utilized the ASCE Infrastructure Report Card to explain one of the reasons the economic stimulus bill should be enacted by Congress.*

***Index Terms* —** *Cost, infrastructure, jobs, report card for America's infrastructure, stimulus package*

INTRODUCTION

The American Society of Civil Engineers and its members are committed to protecting the health, safety, and welfare of the public, and as such, are equally committed to improving the nation's public infrastructure. To achieve that goal, the Infrastructure Report Card depicts the condition and performance of the nation's infrastructure in the familiar form of a school report card assigning letter grades that are based on physical condition and needed fiscal investments for improvements. Actually the concept for a report card to grade the nation's infrastructure originated in 1988 with a congressionally chartered commission, the National Council on public works improvement.

As a service to the public, and to develop the quadrennial Report Card for America's Infrastructure, ASCE assembles an advisory panel of the nation's leading civil engineers to determine the scope of the inquiry and establish a methodology for assigning grades. The grades issued for the last 3 report cards are listed in Table 1.

The Report card issued in 2001 showed a slight upturn to a D+ in the overall grade, but by 2005 it sank back to a D-. This shows that the discussion of the report must lead to greater understanding of current and future needs of the nation and provide necessary funding to address the Infrastructure needs, and supply information regarding better policy, planning and co-ordination systems.

"Over the next two years, according to a speech by President Obama, the Economic Stimulus Package (Fixing the US infrastructure plan) will save or create 3.5 million jobs. More than 90% of the jobs will, hopefully, be in the private sector including rebuilding roads and bridges, constructing wind turbines and solar panels, laying broadband and expanding mass transit".

DISCUSSION OF FUNDING

Hopefully, the reports discussed below will help motivate citizens, civil leaders, and elected officials to continue to work to secure consistent funding for urgent long term infrastructure needs.

Subject	2001 Grade	2005 Grade	2009 Grade
Aviation	D	D +	D
Bridges	C	C	C
Dams	D	D	D
Drinking Water	D	D -	D -
Energy	D +	D	D +

Hazardous Waste	D +	D	D
Inland Waterways	D +	D -	D -
Levees	-	-	D -
Public Parks	-	C -	C -
Rail	-	C -	C -
Roads	D +	D	D -
Schools	D -	D	D
Solid Waste	C +	C +	C +
Transit	C -	D +	D
Wastewater	D	D -	D -

TABLE 1
REPORT CARD

ROADS AND HIGHWAYS: D-

America spends 4.2 billion hours a year stuck in traffic at a cost of $78.2 billion a year - $710 per motorist. Poor road conditions cost U.S. motorist $67 billion a year in repairs and operating costs - $333 per motorist. In addition, 33% of America's major roads are in poor or mediocre condition and 36% of the nation's major urban highways are congested as shown in Table 2. The current spending level of $ 70.3 billion for highway capital improvements is well below the estimated $186 billion needed annually to substantially improve the nation's highways [8], [9].

Rank	**City**	**Hours of delay per traveler**
1	Los Angeles, CA	72
2	San Francisco – Oakland, CA	60
3	Washington, DC – VA - MD	60
4	Atlanta, GA	60
5	Dallas – Fort Worth – Arlington, TX	58
6	Houston, TX	56
7	Detroit, MI	54
8	Miami, FL	50
9	Phoenix, AZ	48
10	Chicago, IL - IN	46

TABLE 2
TOP 10 MOST CONGESTED HIGHWAY CITIES IN THE U.S.

BRIDGES: C

More than 26%, or one in four, of the nation's bridges are either structurally deficient or functionally obsolete. A $17 billion annual investment is needed to substantially improve current bridge conditions. Currently, only $10.5 billion is spent annually on the construction and maintenance of bridges. According to the American Association of State Highway and Transportation officials (AASHTO), a total of $10.5 billion was spent on bridge improvements by all levels of government in 2005. AASHTO estimated in 2008 that it would cost roughly $140 billion to repair every deficient bridge in the country – about $48 billion to repair structurally deficient bridges and $91 billion to improve functionally obsolete bridges [10]. If Congress works to address these problems in 2009, it should establish a goal that less than 15% of the nation's bridges be classified as structurally deficient by 2013 and should provide the funding needed to accomplish this action [5], [8].

TRANSIT: D

Nearly half of American households do not have access to bus or rail transit, and only 25% have what they consider to be a "good option". The Federal Transit Administration estimates $15.8 billion is needed annually to maintain conditions and $21.6 billion to improve to good conditions. In 2008, federal capital outlays for transit were only $9.8 billion [10]. Congress should implement a "mode-neutral" planning process that examines the specific needs of metropolitan areas and regions and implement the most effective transportation mode to meet the needs. Investments must focus on additional, system wide travel options, technological innovation, life cycle funding, modernization to support future growth, and improved design and construction standards to withstand both natural and man-made extreme conditions.

AVIATION: D

Despite surging oil prices, volatile credit markets, and a lagging economy, the Federal Aviation Administration predicts 3% annual growth in air travel. There are 510 U.S. airports with commercial service, accounting for 99.88% of the total passenger enplanements. Between 2000 and 2008, U.S. airlines domestic operations combined operating and net losses of $27.9 and $3.6 billion respectively. Most recent estimates from the Airport Council noted total U.S. airport capital development cost as $87.4 billion over five years, or $17.5 billion per year [4]. To remain successful, the nation's aviation systems need robust and flexible federal leadership, a strong commitment to airport infrastructure, and rapid deployment of NextGen.

SCHOOLS: D

Spending on the nation's schools grew from $17 billion in 1998 to a peak of $29 billion in 2004. However, by 2007 spending fell to $20.28 billion. No comprehensive, authoritative nationwide data on the condition of America's school buildings has been collected in a decade. The National Education Association's best estimate to bring the nation's schools into good repair is $ 322 billion [13]. For example, estimations include $9 billion needed for new construction and $3.5 billion needed for modernization of public school facilities in California and $ 9.7 billion needed statewide between 2008 and 2012 for school facilities in North Carolina.

DRINKING WATER: D-

America's drinking water systems face an annual shortfall of at least $11 billion to replace aging facilities that are near the end of their useful lives and to comply with existing and future federal water regulations. Leaking pipes lose an estimated 7 billion gallons of clean drinking water a day. In 2002, the U.S. Environmental Protection Agency (EPA) estimated a potential 20 - year funding gap for drinking water capital expenditures as well as operations and maintenance, ranging from $45 billion to $ 263 billion, depending on spending levels [7]. One of the solutions to improve the problem is to create a Water Infrastructure Trust Fund to finance the national shortfall in funding of infrastructure systems under the Clean Water Act and Safe Drinking Water Act, and other projects designed to improve the nation's water quality.

DAMS: D

U.S. currently lists 4,095 non-federal dams of which 1,743 are considered high hazard needing repair and 1,826 considered a significant hazard. In 2009, a report noted an additional investment of $12 billion over 10 years will be needed to eliminate the backlog of 4,095 deficient dams at an annual cost of $850 million a year [5]. Solutions include developing emergency action plans for every high hazard dam by 2011, and encouraging effective state dam safety programs that provide adequate funding, staff and statutory authorities.

SOLID WASTE: C+

Per capita solid waste generation in 2007 was 4.62 pounds per person per day, a slight decline from 4.65 pounds in 2000. In 2007, the U.S. produced 254 million tons of municipal solid waste of all types – an increase from 239 million tons in 2000 according to the EPA. Of the 254 million tons of solid waste generated in 2007, 85 million tons, or 33% were recycled compared to 30.1% in 2000; 32 millions were burned in waste-to-energy (WTE) plants; and 137 million tons or 54% went into landfills compared to 55.3% in 2000 [18]. Solutions refer to encourage greater use of landfill gas for energy conversation to reduce greenhouse gas emissions and create new energy resources to develop national standards to promote proper, effective, and efficient collection and recycling of waste electronics.

HAZARDOUS WASTE: D

Redevelopment of Brownfield's sites over the past five years generated an estimated 191,228 new jobs and $408 million annually in extra revenues for localities. In 2008, however, there were 188 U.S. cities with Brownfield sites awaiting cleanup and redevelopment. Additionally, federal funding for "superfund" cleanup of the nation's worst toxic waste sites has declined steadily, dropping to $1.08 billion, in 2008, its lowest level since 1986. Of the 188 cities with idle Brown fields, 148 reported that a total of 576,373 new jobs and as much as $1.9 billion annually could be generated if the sites were developed [20]. The main solution is to reauthorize federal Superfund taxes on chemicals, petroleum, and corporations or create another federal funding mechanism to revive the Hazardous Substance Superfund cleanup program.

INLAND WATERWAYS: D-

The average tow barge can carry the equivalent of 870 tractor trailer loads. Of the 257 locks still in use on the nation's inland waterways, 30 were built in the 1800's and another 92 are more than 60 years old. The average age of all federally owned or operated locks is nearly 60 years, well past their planned design life of 50 years. The cost to replace the present system of locks is estimated at more than $125 billion. The inland waterways system provides an average transportation savings of $10.67 per ton over the cost of shipping by alternative modes. This translates into more than $7 billion annually in transportation saving to the U.S. economy. Future investment should focus on life-cycle maintenance, system independencies, redundancy, security and recovery from natural and man-made hazards.

ENERGY: D+

There are more than 3,100 electric utilities in the U.S. among them are 213 stockholder-owned utilities that provide power to about 73% of customers; 2,000 public utilities run by state and local government agencies that provide power to about 15% of the customers; and 930 electric co-operatives providing power to about 12% of the customers [14]. Additionally, there are nearly 2,100 nonutility power producers, including both independent power companies and customer-owned distributed energy facilities. Progress has been made in grid reinforcement since 2005 and substantial investment in generation, transmission, and distribution is expected over the next two decades. The demand for electricity versus public opposition and difficulty in the permitting processes are restricting much needed modernization. Projected electric utility investment could be as much as $1.5 trillion by 2030. A long term generation research and development plan to extend current energy supplies through new and potential energy sources is needed.

LEVEES: D-

Rapid development of land behind levees built to save crops, not lives, has increased risk and left the nation with 100,000 miles of mostly locally owned levees of uncertain reliability. Estimates put the cost of repair and rehabilitation at more than $100 billion [9], [12].

PUBLIC PARKS: C-

Public parks and recreation contributed 6.5 million jobs and $730 billion annually to the economy. Significant investment is being made, but the National Park Service still faces a $7 billion maintenance backlog [9], [12].

RAIL: C-

Rail needs $200 billion invested through 2035 to meet expected growth in freight and passenger demand [9], [12].

WASTE WATER SYSTEMS: D-

Aging waste water systems face a $390 billion investment need over the next 20 years. The category gets a D- grade just a shade above failing [9], [12].

SUMMARY AND CONCLUSION

ASCE states that the release of the report card was advanced to January 28, 2009 to support plans to stimulate the economy through investment in the infrastructure. Only one category improved since 2005: the electrical power grid. It rose from D to D+ in the five-letter scheme of A to F. Grades fell for aviation, roads and transit. The report was developed by a council of 28 civil engineers from many disciplines. Categories were evaluated on capacity, condition, funding, future need, operation, maintenance, public safety and resilience.

The "poor" status reported in 2001 and 2005 shown in Table 1 is unchanged in 2009. Unfortunately, the five-year $2.2 trillion investment needed to correct the infrastructure has increased by half a trillion dollars since 2005. This is a severe problem that must be eventually addressed by the nation.

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