Wyoming

Overall Rank in 2007 - 6

Overall Rank in 2006 - 4

Overall Rank in 2005 - 7

Overall Rank in 2000 - 1

Performance by Category in 2007	**Rank**
State-Controlled Highway Miles	35
Bridges, Deficient or Obsolete	15
Fatality Rate Per 100 Million Miles Driven	36
Urban Interstate Congested	1
Urban Interstate in Poor Condition	32
Rural Interstate in Poor Condition	33
Percent of Narrow Lanes, Rural	12
Total Disbursements	10
Disbursements – Capital, Bridges	11
Disbursements – Maintenance	16
Disbursements – Administration	19

Technical Notes

This brief technical appendix summarizes the definitions and sources of the data used in this assessment. The discussion is based on the assumption that comparative cost-effectiveness requires not just data on system condition or performance, but also on what it costs to operate and improve the system.

A. Mileage By Ownership

Since it is generally easier to achieve high performance with a larger budget than with a smaller one, measures of resources should account for the different 'sizes' of the state-owned systems. In this study, the mileage of state-owned roads is used as the basic metric for bringing the states to a common basis.

In each state, the 'state-owned' highway systems consist of the State Highway System and other systems such as toll roads or similar, state-owned smaller systems in state parks, universities, prisons, medical facilities, etc. Each state's responsibility for roads varies. In some, for instance North Carolina, the state is responsible for almost all roads outside of municipalities, while in others, such as New Jersey, the state is responsible for primarily the major multiple-lane roads. In addition, other features such as bridges also vary, with some states having many and others few. Since several agencies are included, this report should *not* be viewed as a cost-effectiveness study of the state highway departments. Instead, it should be viewed as an assessment of how the state, as a whole, is managing the state-owned roads.

The source of this data is statistics on State Highway Agency mileage (rural and urban), and other rural state-owned mileage, as reported by each state to the Federal Highway Administration (FHWA), in Highway Statistics, 2007, Table HM-10 (http://www.fhwa.dot.gov/policy/ohim/hs07/xls/hm10.xls).

B. Population, Travel, Vehicles and Federal Allocations

In Table 17, we also consider whether other definitions of 'size' (population, travel, vehicle registrations or federal allocations) might yield similar or different findings. Statistics for state population, travel and vehicle registrations are from Highway Statistics, Tables PS1 and MV1, for 2007. Data for federal allocations to the states and each state's contribution to the Highway Trust

Fund come from Highway Statistics, Table FE221. This table also shows information for donor (contribute more than receive) and 'donee'(contribute less than receive) contributions from 1956 to 2007.

C. Receipts For State-Controlled Highways

Receipts for state-controlled highways include all revenues from a variety of sources, including highway user revenues, general fund appropriations, other state fees, bond issuance and debt service, federal funds and funds from local governments. The source of the data is statistics on revenues used for state-controlled highways, as reported by the states in Highway Statistics, 2007, Table SF-3 (http://www.fhwa.dot.gov/policy/ohim/hs07/finance.htm). Revenues include those of all state-controlled roads, not just the state highway system.

To bring each state to a common base, total receipts are divided by total mileage under state control. This produces "receipts per mile of responsibility," a close measure of the *relative* resources each state has to work with per mile of responsibility. All other things being equal, states with higher resources state-controlled mile should have a better performing system. Since large per-mile revenues are also a burden on taxpayers, the states are ranked inversely by this measure, with the highest per-mile receipts being rated lowest.

Unfortunately, due to a staffing problem at the Federal Highway Administration (FHWA), the 'receipts' data were not available for 2007, and therefore are dropped from the assessment. The use of this data in future years is under review.

D. Capital and Bridge Disbursements

Disbursements for state-controlled highways are of several types: capital and bridge work, maintenance and highway services, administration, research and planning, law enforcement and safety, interest (on bond payments) and bond retirement. 'Capital' actions are those intended to reconstruct or improve the system, whereas 'maintenance' actions are those intended to preserve or repair the system, but not improve it. However, the definitions of these categories vary somewhat between the states, particularly on 'capital' and 'maintenance' actions. Most states use contracts with the private sector to build and reconstruct the system, although in some cases they may also use their own workforces for some major jobs. Most states also conduct maintenance largely with agency forces and the work is generally light in character, but some also conduct major repairs such as thick overlays using contracted forces from the private sector.

The source of data for disbursements for 'capital and bridges' is Highway Statistics, 2007, FHWA, Table SF-4 (http://www.fhwa.dot.gov/policy/ohim/hs07/finance.htm). These disbursements are divided by 'mileage under state control' to arrive at a relative measure of capital expenditure per unit of responsibility. Since large per-mile capital and bridge expenditures are also a burden on

taxpayers, the states are ranked inversely by this measure, with the highest per-mile expenditures being rated lowest.

E. Maintenance Disbursements

The source for maintenance disbursements is also Table SF-4, Highway Statistics 2007, FHWA (http://www.fhwa.dot.gov/policy/ohim/hs07/finance.htm). These maintenance disbursements are divided by 'mileage under state control' to arrive at a relative measure of maintenance activity per unit of responsibility. Since large per-mile maintenance expenditures are also a burden on taxpayers, the states are ranked inversely by this measure, with the highest per-mile expenditures being rated lowest.

F. Administrative Disbursements

Administrative disbursements are intended to reflect all non-project-specific disbursements, and typically include most main-office and regional-office costs, research, planning and similar activities. Sometimes this category also includes bond restructurings and other non-project-specific financial actions. As a result, administrative disbursement can sometimes vary widely from year to year.

The source for administrative disbursements is again Table SF-4, Highway Statistics 2007, FHWA (http://www.fhwa.dot.gov/policy/ohim/hs07/finance.htm). These disbursements are divided by 'mileage under state control' to arrive at a relative measure of administrative costs per unit of responsibility. Since large per-mile administrative expenditures are also a burden on taxpayers, the states are ranked inversely by this measure, with the highest per-mile expenditures being rated lowest.

G. Total Disbursements

Total disbursements represent total state outlays for state-controlled roads and include several categories not detailed above. Usually, states disburse about 2-3 percent less funds than they take in, the difference being due to timing differences and delays in getting projects completed. However, states sometimes bring in revenues that are not immediately expended, such as major bond sales, which show up as major increases in 'receipts' without a similar increase in disbursements. And sometimes, later-year disbursements can be higher than 'receipts' as states move money into projects without increasing revenues.

The source for total disbursements is also Table SF-4, Highway Statistics 2007, FHWA (http://www.fhwa.dot.gov/policy/ohim/hs07/finance.htm). These disbursements are divided by 'mileage under state control' to arrive at a relative measure of administrative costs per unit of

responsibility. Since large per-mile total expenditures are also a burden on taxpayers, the states are ranked inversely by this measure, with the highest per-mile expenditures being rated lowest.

H. Rural Interstate Condition

Perhaps no measure is more fundamental to road performance than a measure of road condition. There are numerous ways of defining road condition, but the one used for the U.S. higher-road system is the International Roughness Index (IRI), essentially a measure of surface 'bumpiness' in inches of vertical deviation per mile of length. The states use a variety of procedures in gathering this data, but most use mechanical or laser equipment driven over the road system. They often supplement this data with detailed information on road distress features, but this information is not generally used in federal reporting. A few states, however, still use visual ratings as the basis of their reports.

Higher 'roughness index' scores mean a worse condition. By convention, interstate sections with roughness of greater than 170 inches per mile of roughness (about three inches of vertical variation per 100 feet of road) are classified as 'poor' in most reports. Roads classified as poor typically have visible bumps and create noticeable annoying bumpiness in vehicles. By comparison, sections with less than 60 inches of roughness per mile (about 1 inch per 100 feet) would be classified as 'excellent'. These measures also vary by section length: long smooth sections (greater than 1 mile in length) tend to dampen out short rough ones, so if a state has long sections in its database it can report very little 'rough mileage' as a percent of the system, even though it has some.

The source of road roughness data is Highway Statistics 2007, FHWA, Table HM-64 (http://www.fhwa.dot.gov/policy/ohim/hs07/xls/hm64.xls). This table shows miles by roughness, for several functional classes, for each state. We measure roughness by subjecting mileage to the International Roughness Index (IRI). We use the mileage at IRI greater than 170 inches per mile. This mileage is then converted into a percent, to account for different sizes of rural interstate systems in each state. (Note: Delaware has no rural interstate and is not rated on this measure.)

I. Rural Arterial Condition

Rural other principal arterials are the major inter-city connectors, off the interstate system, connecting regions of states. They can be US-numbered and state-numbered roads, and sometimes toll roads or parkways. This system would generally be a top priority of most state highway agencies because of its importance to the economic well-being of the state.

The roughness measure used for rural other principal arterials is also the International Roughness Index (IRI). By convention, however, road sections with greater than 220 inches per mile of roughness are classified as 'poor' in most reports. The cutoff is higher than for interstate since speeds on these roads are typically lower and roughness not as noticeable.

The source of this road roughness data is also Highway Statistics 2007, FHWA, Table HM-64 (http://www.fhwa.dot.gov/policy/ohim/hs07/xls/hm64.xls). We use the mileage at IRI greater than 220 inches per mile. This mileage is then converted into a percent, to account for different sizes of rural other principal arterial systems in each state.

J. Urban Interstate Condition

The measure used for urban interstate road condition is again the International Roughness Index (IRI), and the same cutoff as for rural interstates, 170 inches per mile or higher, for 'poor' mileage.

The source of road roughness data is also Highway Statistics 2007, FHWA, Table HM-64 (http://www.fhwa.dot.gov/policy/ohim/hs07/xls/hm64.xls). This table shows miles by roughness, for several functional classes, for each state. We use the mileage at IRI greater than 170 inches per mile. This mileage is then converted into a percent, to account for different sizes of urban interstate systems in each state.

K. Urban Interstate Congestion

Urban interstate congestion is measured as the ratio of traffic volume to the maximum carrying capacity of each road section. Road capacity is limited by driver skill, traffic and geometric characteristics. For most modern interstates, carrying capacity is about 2,400 vehicles per lane per hour, or one vehicle each 1.5 seconds passing by a roadside observer. Congestion (the delay caused by the presence of other vehicles) builds up incrementally as vehicles compete for road space and have to slow to avoid each other and drive safely. Maximum flow (and maximum delay) at capacity of 2,400 vehicles per lane per hour occurs not at high speeds but at about 40-45 mph. However, even at lower flow rates, some congestion occurs.

The source of urban interstate congestion data is Highway Statistics 2007, FHWA, Table HM 61 (http://www.fhwa.dot.gov/policy/ohim/hs07/xls/hm61.xls). Data are shown as miles of road, in each state, with various volume/capacity ratios. We use 0.70 as the cutoff for 'congested' although other studies sometimes use 0.80 and 0.95 as cutoffs, the use of these higher cutoffs would result in modest congestion not being counted, a distinct advantage for rural states.

Two states, South Carolina and Wisconsin, reported zero congested urban interstate mileage for 2007, which was inconsistent with their reported congested mileage for 2006 (118 miles or 50 percent and 115 miles or 44 percent of their total urban interstate mileage, respectively). We used the 2006 data for these two states.

Of course, traffic volumes have generally been rising over time, increasing congestion. But since driver skills and road geometrics have also been improving over time, road capacity is also rising,

although not as rapidly as traffic. The definition of maximum flow was 2,000 vehicles per lane per hour until 1994, then 2,200 until 2000, and now is 2,400 vehicles per lane per hour. For this reason, comparisons of congestion trends before about 2001 should be cautious.

L. Fatality Rates

Road safety is an undisputed important measure of system performance, and fatality rates are a key measure of safety. The overall state fatality rate has long been seen as a measure of state performance in road safety.

The source of the data for fatality rates is from two tables in Highway Statistics 2007, FHWA. Table FI-20 (http://www.fhwa.dot.gov/policy/ohim/hs07/xls/fi20.xls) provides a count of fatalities by state and functional class for 2007, and Table HM-81 (http://www.fhwa.dot.gov/policy/ohim/hs07/xls/hm81.xls) provides an estimate of daily vehicle-miles of travel for the state highway system, by state.

M. Deficient Bridges

As a result of several major bridge disasters in the 1960s and 1970s, states are required to inspect bridges biennially (every year if rated structurally deficient) and maintain uniform records of inspections. This data source, called the National Bridge Inventory, categorizes bridges according to these inspections. Bridges are classified as 'deficient' if their structural elements score poorly, or if they are no longer functionally adequate for the road system.

Historically we have used an annual summary of bridge deficiencies prepared by *Better Roads*, a trade publication, to assess bridge conditions. However, beginning in 2007 we used summaries prepared by the federal Bureau of Transportation Statistics, called the National Bridge Inventory, rather than data from *Better Roads*, since that is in a more convenient form. Since the National Bridge Inventory contains a mixture of inspections, some as old as two years, the 'average' inspection is about one-year old. So, a 'December 2008' summary from the Inventory would represent, on average, bridge condition as of 2007, consistent with our other data.

N. Rural Narrow Lanes

Narrow lanes on rural roads are a surrogate measure for system quality, since no data on other (perhaps more accurate) features such as sight distance, shoulder width or pavement edge drop-offs are readily available nationwide. The standard lane width for most major rural roads is 12 feet, and it is unlikely that a major rural road would be upgraded without widening its lanes to that standard.

The data source for our measure is also Highway Statistics 2007, FHWA, Table HM-52 (http://www.fhwa.dot.gov/policy/ohim/hs07/xls/hm53.xls). This table shows the mileage of roads, by functional class, in various lane-width categories, by state. For our purpose, we use the percentage of mileage on the rural other principal arterial system with less than 12-ft lanes, to adjust for different system lengths in different states.

O. Methodology of Overall Ratings

The 2007 overall ratings for each state are developed in several steps.

- First, the relative performance of each state on each of 11 performance measures is determined, by computing each state's 'performance ratio'. This is defined as the ratio of each state's measure to the weighted U.S. mean for the measure. The mathematical structure is as follows:

  M_{is} = Measure 'i' for state 's' (e.g., percent of rural interstates in poor condition)

  N = Number of measures (11 for 49 states, 10 for Delaware which has no rural interstate)

  R_{is} = Performance Ratio for State 's', measure 'i'.
  = M_{is} / **M,** where **M** is the aggregate (weighted) mean of M_{is} over the 50 states.

  L = Average number of lanes per mile, US.

  L_s = Average number of lanes per mile, state s.

- For the four financial measures, these ratios are adjusted for the 'average width' of each state's system, on the assumption that states with 'wider' roads should be given some credit for their extra per-mile costs.

  $$R'_{is} = R_{is}(L/\mathbf{L_s})$$

  Then, all 11 ratios (10 ratios for Delaware) are averaged:

  $$\text{Grand Performance Ratio}_{state} = \left(\sum_{\text{mod}\,e}^{N} R'_{is}\right)/11$$

  This method essentially treats each of the 11 measures as equally important.

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Related Reason Foundation Studies

David T. Hartgen and M. Gregory Fields, *Gridlock and Growth: The Effect of Traffic Congestion on Regional Economic Performance*, Reason Foundation Policy Study No. 371, June 2009.

David T. Hartgen and Ravi K. Karanam, *17th Annual Report on the Performance of State Highway Systems* (1984–2006), Reason Foundation Policy Study No.369, July 2008, http://www.reason.org/news/show/1003049.html

David T. Hartgen and Ravi K. Karanam, *16th Annual Report on the Performance of State Highway Systems* (1984–2005), Reason Foundation Policy Study No.360, June 2007, http://www.reason.org/news/show/1002859.html.

Peter Samuel, *Leasing State Toll Roads: Frequently Asked Questions*, Reason Foundation Policy Brief No.60, March 2007, http://www.reason.org/pb60_leasing_state_toll_roads.pdf.

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