National Transportation Operations Coalition

National Traffic Signal Report Card

Executive Summary

U.S. Department of Transportation
Federal Highway Administration

Institute of Transportation Engineers

Traffic Signals Affect Our Everyday Lives

Everyday we encounter traffic signals—on our way to and from work, running errands and picking up the kids from soccer practice. Traffic signals can either help us along our way or increase the time we spend traveling, making an already busy day more hectic and unpredictable.

It is estimated that poor traffic signal timing accounts for 5–10% of all traffic delay, or about 300 million vehicle-hours of delay, on major roadways alone.[1]

This affects us in the following ways:

- No one appreciates getting a green light at one intersection only to get a red light at the next intersection. No one should have that experience simply because the intersections are not coordinated or the timing has not been reviewed in 10 years.
- No one should stop at an intersection when there are no cars on the cross street because the sensor in the roadway is broken and the jurisdiction either doesn't know it is broken or can't afford to fix it quickly.
- No one should sit through more than one green signal at an intersection because the signal timing isn't efficient or wasn't adjusted to accommodate a detour from a crash, work zone, or to accommodate a special event.

Travelers recognize the problems and understand that something can be done to make traffic signal operations better.

Recognition of the problem and the knowledge that signals can operate better creates stress for many travelers as they sit in congestion. Stress can lead to motorists running a red signal, and other forms of unsafe driving behavior.

Fact:

In a February 2005 ABC/Time/Post poll, 55% of respondents said that "improving lights," meaning traffic signals, was a "very effective" remedy. In an earlier survey by the U.S. Department of Transportation, 50% of travelers said that signal timing should be improved and 36% said that signals should be checked more often. 47% of travelers surveyed believe that delays caused by congestion are the top community concern, and air pollution from vehicles is a concern for 31%[2], both of which can be improved through better signal operation.

1 "Temporary Losses of Highway Capacity and Impacts on Performance: Phase 2," Oakridge National Laboratory, November 2004, ORNL/TM-2004/209.
2 *Managing Our Congested Streets and Highways*, Publication No. FHWA-OP-01-018, U.S. Department of Transportation, Federal Highway Administration, 2001.

How Well is the Nation Supporting its Traffic Signal Systems?

Findings indicate that, overall, traffic signal operation in the United States scores a D-.

There are more than 260,000 traffic signals in the United States. Traffic signals are owned, operated and maintained by state and local governments and are paid for by taxpayers. Taxpayers deserve to know that a modest investment is needed to raise the D- grade. To gauge traffic signal operations, a national assessment was conducted to develop the first-ever National Traffic Signal Report Card. The Traffic Signal Operation Self Assessment was administered in August 2004, and voluntarily completed by 378 agencies in 49 states, representing about one-third of traffic signals in the United States.

A D- means that traffic signals are not operating as efficiently as they could be. This results in unnecessary delay to travelers, with valuable time wasted sitting at an intersection. It also means that our air is being unnecessarily polluted by vehicles that start and stop inefficiently and that we're using more fuel than necessary.

The National Traffic Signal Report Card Consists of Five Sections and an Overall Score.

It's Not Just About Green, Yellow and Red

An overall national grade of D- doesn't mean that our traffic signals fail to turn green, yellow, or red. Our traffic signals do indeed function. However, they do not operate as an efficient, well-integrated system that meets the traveling public's needs. The table below highlights key components of a signal system that operates with an A grade versus a D-.

Subject	Grade A: Where agencies strive to be	Grade D-: Where many agencies find themselves
Proactive Management	Agencies have a documented management approach for traffic signal operations that is shared with employees. Agencies meet with law enforcement and emergency service providers, remove unnecessary signals and conduct annual field measurements of major roadways to track performance.	A philosophy for how the agency operates signals is neither documented nor shared with employees. In addition, regular meetings with law enforcement and emergency service providers, and annual reviews of major roadways are rarely conducted.
Coordinated Signal Systems	Traffic signal timing is reviewed every 3 to 5 years and more often if changes in traffic volumes or roadway conditions suggest.	Traffic signal timing is rarely reviewed, resulting in outdated signal timings that do not reflect current traffic and pedestrian needs.
	Traffic signals are coordinated across jurisdictional boundaries.	As travelers cross jurisdictional boundaries, they experience stops and delays due to lack of coordination between systems.
	There is knowledgeable and consistent use of signal optimization software.	Signal technicians are not current on the use of modern software, or resource constraints prevent them from using current software, resulting in signal timings that are not up to date.
	There are signal timing plans for emergencies and special events.	Without timing plans for emergencies and special events, the traveling public suffers through severe congestion.
Individualized Intersections	The agency maintains documentation and an inventory of traffic signals and their timing settings.	Signals and timing inventories are maintained ad hoc, and field changes are rarely updated in the central office inventory, meaning that no one really knows how the signals are supposed to be operating.

Detection Systems	There are established programs for checking the quality of data gathered by roadway detectors against historical data or field observations, as well as physical checks to make sure they are operating correctly.	There are few, if any, quality checks of the detectors. This leads to using bad data for signal operations, and the potential for broken equipment in the field. As a result, signals may not operate based on actual traffic conditions.
Maintenance	There are adequately staffed maintenance offices to ensure the continued sound operation of traffic signals.	There are not enough staff members, therefore agencies are constantly fighting fires, rather than proactively maintaining the signal system.

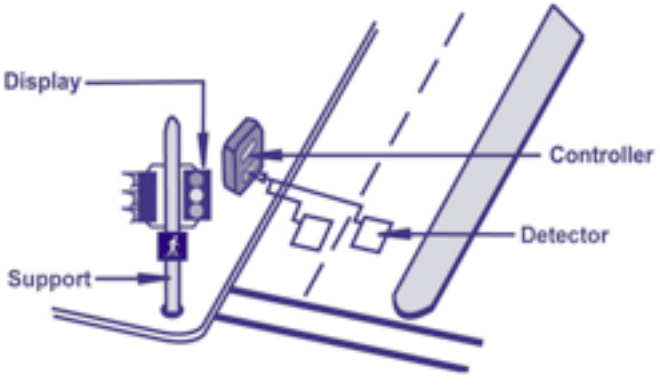
Traffic Signals Are a Bargain

Transportation dollars are stretched thin. In a time of competing needs, it is more important than ever to make wise investments. Studies have shown that the benefits of investing in signal timing outweigh the costs by 40:1 or more.[3]

To achieve an A level of traffic signal performance, more sustained resources must be devoted to signals and the professionals who design, operate and maintain them.

Excellence in traffic signal operation involves three components:
1. Reasonably current traffic signal hardware
2. Routine timing updates
3. Sound maintenance practices

Signal Hardware: Traffic signal hardware consists of the signal display that shows the green, yellow and red (and WALK/DON'T WALK) indicators, sensors to detect vehicles and a signal controller. The controller is a computer installed at the intersection that controls the signal operation and adjusts it for traffic conditions. The controller is similar to a personal computer except that it must function continuously in an outdoor environment through all types of weather. Like a personal computer, signal controller technology becomes outdated over time. To keep from having outdated equipment operating the signal system, signal controllers should be upgraded at least every ten years and possibly more frequently in high growth areas requiring more advanced control. On a national scale, if signal controllers were upgraded every 10 years at an approximate cost of $10,000 each, $265 million per year would ensure current equipment.[4]

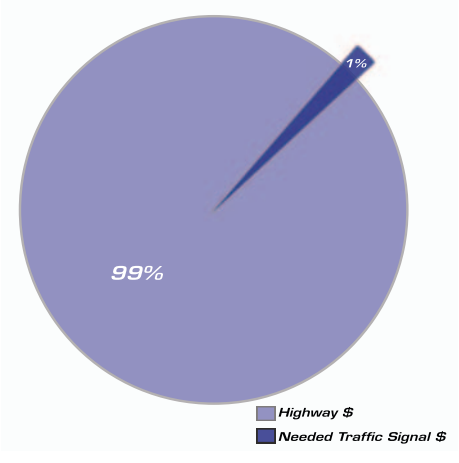


3 *Improving Traffic Signal Operations*. Institute of Transportation Engineers, 1995, page 7.
4 *Improving Traffic Signal Operations*. Institute of Transportation Engineers, 1995; and *ITS Benefits and Costs Database*, USDOT ITS Joint Program Office, www.benefit cost.its.dot.gov/.

Timing Updates: Recent estimates show that updating signal timing costs less than $3,000 per intersection.[5] To keep up with changing travel patterns, traffic signal timing should be updated at least every 3 to 5 years and possibly sooner depending upon growth and changes in traffic patterns. To support this level of signal timing nationally, an annual investment ranging from $159 million to $265 million would be needed. For the purposes of this report $200 million is assumed.

Maintenance Practices: Well-trained traffic signal technicians are needed to properly maintain traffic signals in good order and preserve the investment in the hardware and timing updates. It is estimated that one signal technician is needed for every 30-40 traffic signals.[6] With approximately 265,000 signals across the country and given current salaries, benefits, vehicles, parts/supplies, and other items necessary to run the maintenance program, the annual maintenance personnel investment should be about $500 million per year.

To get an A, investment must be made in current signal hardware, timing updates and maintenance resources, resulting in a total investment of $965 million per year. This is less than $4 per registered vehicle in the United States.



Nationally in 2000, $104 billion of federal, state and local funds were spent on highway transportation.[7] Spending less than one percent of this amount in traffic signal operation would result in an A.

As an example, a city with a population of 200,000 with approximately 200 signals would need:

- A staff of 4 to 7 traffic signal technicians for maintenance, plus one signal engineer devoted solely to signal timing, OR
- A budget of $500,000 per year, of which approximately $100,000 is for timing updates and $400,000 is for signal maintenance.

5 Philip J. Tarnoff and Javier Ordonez. *Signal Timing Practices and Procedures: State of the Practice*. Washington, DC: Institute of Transportation Engineers, 2004.
6 *Traffic Control Systems Operations*. Washington, DC: ITE, 2000.
7 Bureau of Transportation Statistics www.bts.gov/publications/national_transportation_statistics/2004/html/table_03_29a.html.

Benefits of an A

If the nation supported its signals at an A level, we would see:

- Reductions in traffic delay ranging from 15–40%[8]; reductions in travel time up to 25%; and reductions in stops ranging from 10–40%.[9] For example, if you spent 2 hours in your car commuting to and from work and running errands, you'd save 50 hours per year (or more than a work week) because of improved signal timing.

- Reduction in fuel consumption of up to 10%. Nationwide this would amount to a savings of almost 17 billion gallons of motor fuels per year.[10]

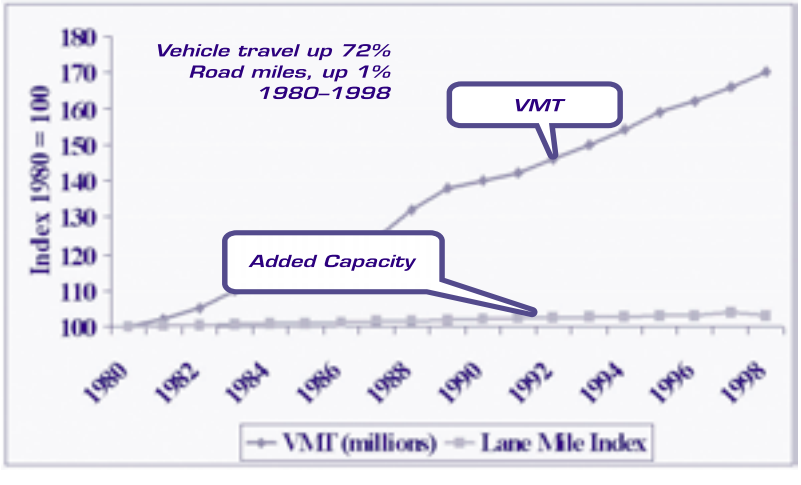
- Reduction in harmful emissions (carbon monoxide, nitrogen oxides, volatile organic compounds) up to 22%.[11] According to the Surface Transportation Policy Project, motor vehicles are the largest source of urban air pollution.[12] In addition, the EPA estimates that vehicles generate 3 billion pounds of cancer-causing air pollutants yearly.[13]

Conclusions

Never before has the need for good traffic signal operation been greater. Today, congestion is a major issue, particularly for cities. In fact, growth in roadway capacity increased a mere 1% per year between 1980 and 1998.[14] During that same time, the amount of travel grew by 72%.[15]

For many cities, the ability to build new roads or widen existing roads is limited or not possible at all, due to lack of available land, environmental issues and the costs associated with building or widening roads. To handle the growing traffic demand, we must make the best use of the transportation network that we have. That includes ensuring that our traffic signals provide for the best operation possible. And yet, the results of the National Traffic Signal Operation Report Card show that, nationally, our signals score a D-. We can do better.

Taxpayers deserve wise investments and, in the case of traffic signal timing, it is an investment that will reap benefits immediately. No right-of-way needs to be acquired. No impact to the environment results. Improvements can be made quickly and for the benefit of all. This can all be accomplished for a modest investment.



VMT=Vehicle miles traveled

8 "Temporary Losses of Highway Capacity and Impacts on Performance: Phase 2." Oakridge National Laboratory, November 2004, ORNL/TM-2004/209 and *Benefits of Retiming Traffic Signals*. Washington, DC: ITE, 2005.
9 *Benefits of Retiming Traffic Signals*. Washington, DC: ITE, 2005.
10 Bureau of Transportation Statistics. www.bts.gov/publications/national_transportation_statistics/2004/html/table_04_05.html
11 ITS Benefits and Costs Database, USDOT ITS Joint Program Office, www.benefit cost.its.dot.gov/
12 Surface Transportation Policy Project www.transact.org/library/factsheets/environment.asp.
13 National Toxics Inventory, 1996. www.epa.gov/otaq/regs/toxics/d00003.pdf
14 *Managing Our Congested Streets and Highways*. Publication No. FHWA-OP-01-018. Washington, DC: U.S. Department of Transportation, Federal Highway Administration, 2001.
15 Ibid.