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The Danger of Measuring Roadway Congestion Wrong

By Kevin DeGood May 4, 2016

As the old management principle goes: You don't get what you want; you get what you measure. In short, measurement is a powerful tool to effect change because it presents clear, quantifiable, and actionable information. Recently, the U.S. Department of Transportation, or USDOT, released a draft rulemaking to implement the performance measure requirement for roadway congestion and mobile-source emissions.

Unfortunately, USDOT's proposed rule is highly problematic because it would penalize metropolitan regions that make investments in public transportation—especially bus service that operates on principal arterial roadways. The problem comes down to a narrow focus on vehicle speed that fails to account for the positive performance benefits that result from the presence of public transportation service. In short, public transportation delivers benefits to drivers in the form of avoided delay that the draft rule fails to capture.

How did we get here?

Historically, federal surface transportation programs have lacked accountability beyond a few procedural and design requirements. The vast majority of funds flow to states and metropolitan regions based on formulas set in law that reflect political power rather than measures of need or the social, environmental, or economic value of a particular project. In many respects, federal funds function as an unrestricted block grant.

In 2012, Congress passed the transportation authorization bill Moving Ahead for Progress in the 21st Century, or MAP-21, which included new performance measurement mandates. For the first time, the federal government will require states and metropolitan regions to collect and report data on their progress toward meeting national transportation policy goals, including reducing roadway congestion, harmful transportation emissions, among others.[1] These measures represent the first step toward accountability in the federal program.

Shortcomings of the proposed USDOT rule

To understand how the proposed rule to measure congestion and mobile-source emissions is harmful, it helps to step back and look at roadway congestion. Congestion results from an excess of demand over capacity. Principally, this demand comes from light-duty vehicles—cars, light-duty trucks, and sport utility vehicles—within urban areas. In 2015, Americans drove 3.1 trillion miles.[3] Of this total, light-duty vehicles accounted for 90 percent of travel miles, with long-haul commercial trucks and local delivery trucks accounting for 6 percent and 4 percent, respectively.[4]

Investing in public transportation is a very effective strategy for reducing both congestion and harmful mobile-source emissions. Moreover, improving public transportation lowers household transportation costs and expands access to educational and economic opportunity—particularly for populations lacking other transportation options.[5] These benefits stem from the fact that a single standard 40-foot city bus takes up roughly the same amount of roadway space as two cars yet can carry as many as 75 passengers.[6] On average, buses and light-duty vehicles carry 47 and 1.3 passengers, respectively.[7] Another way to think of this is that one standard bus can carry the same number of people as 36 cars. Directing limited transportation funding to public transportation can improve overall service quality, leading to increased ridership and a significant reduction in the number of vehicles on the road.

A central reason that public transportation is so effective at reducing congestion stems from the fact that traffic congestion is nonlinear. That is to say, there is not a one-to-one correlation between the reduction in the number of vehicles on a roadway and the resulting improvement in roadway performance. For example, a reduction of just 5 percent in the overall traffic volume on a congested roadway can produce an increase in average vehicle speeds of as much as 30 percent.[8] For a roadway carrying 2,500 vehicles per hour, this would translate to reduction of just 125 cars.

However, this important benefit comes with a modest downside: Buses often travel at an average speed that is slower than the other vehicles on the road. For instance, the Los Angeles County Metropolitan Transportation Authority, or LA Metro, estimates that the average speed of a bus in the region is just 11.5 miles per hour.[9] Why is this the case? While public transportation service quality depends on many factors, in the simplest terms, buses have lower average travel speeds because they make frequent stops and must wait while passengers board and offload.[10]

The proposed USDOT draft rule would deem a roadway segment as congested when vehicle speeds fall below a specific threshold.[11] In effect, the rule would penalize regions for the slower average speed of buses without accounting for their ability to reduce overall congestion and increase person throughput—the number of people able to move through a corridor per hour.

National transportation policy goals

Safety: Reduce serious injuries and fatalities

Condition: Maintain assets in a state of good repair

Congestion: Reduce congestion on the National Highway System

Reliability: Improve the efficiency of the system

Freight: Improve the national freight network

Delivery: Reduce project permitting delays[2]

Specifically, the rule relies on the concept of "excessive delay," which is defined as occurring when vehicle speeds dip below 35 miles per hour on interstates, expressways, and freeways and below 15 miles per hour on other principal arterial roadways.[12] The measure would only apply to roadways that are part of the National Highway System, or NHS, in metropolitan regions with more than 1 million people that are designated as nonattainment or maintenance areas for air quality by the Environmental Protection Agency, or EPA.[13] In other words, the proposed rule would apply only to a limited set of metropolitan regions and a limited set of major highways and roadways within those regions.

The issue of applicability is not trivial, as transit providers operate their bus routes predominantly on the NHS. Prior to the passage of MAP-21, the NHS included fewer roadway miles: essentially the interstate system and a limited number of other freeways and expressways. For the most part, these facilities were not used to provide transit service. MAP-21 expanded the NHS to include virtually all principal arterial highways and roadways. In urban areas, the NHS now includes major avenues and boulevards. As a result, the expanded NHS now applies to roadways that form the backbone of bus transit service. In fact, signalized principal arterial roadways account for 70 percent of the expanded NHS.[14]

Because principal arterials other than interstates, freeways, and expressways make up such a large share of the NHS, the operations of public transportation providers will have an impact on the overall congestion score for their respective metropolitan regions. This will lead to a perverse outcome: Investing in improved transit service may actually lead to a worse congestion score.

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In short, the approach proposed by USDOT overlooks the fact that public transportation delivers benefits to drivers in the form of avoided delay. In other words, if bus service were removed from the roadway, a substantial number of the riders would resort to traveling by car. And the initial gain in corridor speeds from the removal of buses would be overwhelmed by the negative effect of many additional cars. Thus, a more accurate and comprehensive measure of metropolitan congestion must account for the positive effects that transit delivers, including a standard measure of avoided delay based on transit ridership.

Origins of the performance management program

Each performance measure established by MAP-21 is tied to a specific federal-aid highway program. In the case of congestion and emissions, the measures are tied to the Congestion Mitigation and Air Quality Improvement, or CMAQ, program. The CMAQ program, established in 1991, is part of the authorization bill known as the Intermodal Surface Transportation Efficiency Act, or ISTEA.[15] The act represented a significant pivot for Congress, moving away from a federal program focused predominantly on interstate construction and toward system preservation and management, as well as providing people with safe, affordable alternatives to driving.

CMAQ came the year after Congress enacted amendments to strengthen the Clean Air Act[16] and is intended to help states and metropolitan regions meet their National Ambient Air Quality Standards, or NAAQS, for ozone, carbon monoxide, and particulate matter.[17] Importantly, under federal law "projects that add new capacity for SOVs [single-occupant vehicles] are ineligible for CMAQ funding."[18] This restriction rests on the foundational principle that in order to truly affect congestion and emissions, states and regions must prioritize projects that manage overall transportation demand and provide alternatives to driving.

The proposed USDOT rule runs counter to the core intent of the CMAQ program by penalizing the very investments that have the greatest efficacy at reducing congestion and mobile-source emissions.

Wilshire Boulevard bus rapid transit

The Wilshire Boulevard rapid bus service is a perfect case study for understanding the negative implications of the proposed rule. The Los Angeles metropolitan region has more than 1 million people and is currently designated as a nonattainment community for particulate matter, ozone, and lead.[19] The Wilshire rapid line represents a concerted effort on the part of the City of Los Angeles, Los Angeles County, and LA Metro to increase ridership and improve overall transportation system performance through investments in high-quality public transportation. Yet, projects such as the Wilshire rapid line could ultimately hurt the region's overall congestion score.

Wilshire Boulevard is an iconic corridor that runs east to west, extending 16 miles from downtown Los Angeles to Santa Monica along the Pacific coast with three travel lanes in each direction for the majority of its length and parking in the curb lane—except during peak morning and evening periods.[20] Wilshire Boulevard is a critical arterial roadway, carrying more than 100,000 vehicles per day on some sections.[21]

The Wilshire Boulevard rapid line is known more broadly as bus rapid transit, or BRT. Compared to traditional local buses, high-quality BRT includes a number of service characteristics that provide significantly improved overall performance. The most important improvements are intersection signal prioritization—a systematic process for altering light cycles to reduce bus wait times by holding green lights longer or shortening red lights—and a dedicated travel lane, typically extending for all or a majority of the corridor. The dedicated lane is especially important because it allows a rapid bus to avoid the delays that occur when operating in mixed-flow traffic, especially during the morning and evening peak periods.

In the summer of 2000, LA Metro began pilot testing BRT service.[22] The Wilshire Boulevard line was one of the original pilot routes. The success of the initial routes provided the impetus for LA Metro to expand the program. In fact, LA Metro evaluated the performance of the Wilshire line, finding that total ridership increased along the corridor by 42 percent, with approximately one-third of the increase coming from new riders.[23] Overall daily corridor ridership at the time was 90,000.[24] Moreover, bus travel speeds increased by 29 percent.[25] Importantly, this first phase of pilot testing did not include dedicated travel lanes, however, signal prioritization, fewer stops, and frequent service resulted in substantial increases in ridership. For example, local buses in Los Angeles stop every 0.2 miles on average, while LA Metro rapid buses stop every 0.7 miles.[26]

The second phase of improvements for the Wilshire Boulevard line involved converting the curb lane in each direction from a mixed-traffic flow to a bus-only lane during the morning and evening peak periods: 7:00 a.m. to 9:00 a.m. and 4:00 p.m. to 7:00 p.m.[27] LA Metro outlined seven goals for the second phase upgrades:

- Improve bus travel times
- Improve service reliability
- Improve traffic flow on Wilshire Boulevard
- Repave curb lanes
- Encourage a shift from automobile travel to bus
- Improve regional air quality
- Minimize impacts on existing parking[28]

When LA Metro modeled the addition of the dedicated bus-only lanes, the agency expected bus travel times to improve by an average of 24 percent over and above the initial speed improvements from 2000.[29] Furthermore, the enhanced Wilshire Boulevard rapid bus service was expected to increase transit ridership by 20 percent, with a full 10 percent of the increase coming from riders leaving their cars.[30]

Finally, the improved rapid line would boost the overall throughput of the curb lane. The maximum capacity of a travel lane on a principal arterial roadway such as Wilshire Boulevard is 800 vehicles per hour.[31] In Los Angeles, the average occupancy level for a light-duty vehicle is 1.3 passengers.[32] As a result, the curb lane had a total person throughput maximum of approximately 1,056 people per hour.[33] By comparison, the average occupancy for the rapid and local buses that service Wilshire Boulevard is 50 passengers.[34] Under LA Metro's service plan, 30 buses per hour would run through the dedicated bus-only curb lane.[35] Even before factoring in increased ridership, LA Metro buses would push up the person throughput to 1,500 people per hour.[36]

These are impressive results that demonstrate why the Wilshire Boulevard BRT line is the type of project that regions should advance with limited transportation funding resources. Yet, LA Metro's decision to convert the curb lanes in each direction came at a price. A comprehensive traffic study found that the conversion would result in a significant increase in the average delay that drivers face at 21 intersections along the corridor.[37]

Iteris, a traffic engineering and consulting firm, found that increased intersection delay would result from the redistribution of traffic from the curb lanes to the remaining through lanes. In other words, cars that previously traveled in the curb lanes would be forced into the remaining through lanes, increasing the number of cars waiting to move through each intersection. To address the intersection delays, LA Metro and the City of Los Angeles worked on a series of mitigation projects, including selective street widening and the removal of extended curbs intended to reduce pedestrian crossing distances, as well as increasing the length of signal prioritization, among other actions. Taken together, these mitigation efforts were able to reduce delay at many of the affected intersections—but not at all of them.

In the end, LA Metro was not able to address the increased delays at 9 of the 21 intersections.[38] Under the proposed USDOT draft rule, the increased delay caused by the rapid line would show up in the congestion score, while the avoided delay from transit ridership would not. After all, using a conservative estimate, LA Metro determined that the rapid line would likely increase the person throughput of the curb lanes by 50 percent.[39] These scores will serve as a benchmark for ranking and comparing different metropolitan regions and the efficacy of their investment decisions. Moreover, in future years, performance scores will likely inform federal grantmaking decisions. Because of the poor design of the congestion measure, Los Angeles and other regions that make critical investments in public transportation may be less competitive for future federal funds.

Mobility Plan 2035

The implications of USDOT's draft rule extend beyond just the Wilshire Boulevard rapid line. In May 2015, the City of Los Angeles approved its long-range transportation plan known as Mobility Plan 2035. The plan represents a bold vision for the future in which limited transportation funds are used to promote a more equitable, healthy, and sustainable city.

Specifically, the plan calls for building a network of complete streets capable of serving all users regardless of age or ability level. In addition, the plan targets greenhouse gas reductions and the use of data to prioritize transportation projects that improve safety, public health, equity, access, social benefits, and economic development.[40] In many ways, Mobility Plan 2035 is a model for urban areas around the country.

At its core, the City of Los Angeles's plan recognizes that the historical approach of prioritizing investments to facilitate automobile use above all else leaves out many residents. The plan states that, "A fair and equitable system must be accessible to all, and must pay particularly close attention to accommodating the most vulnerable users."[41] The plan lays out eight specific, quantifiable transportation accessibility and affordability goals:

- Ensure that 90 percent of households are located within one mile of the Transit-Enhanced Network
- Ensure that 90 percent of all households have access within one-half mile to high-quality bicycling facilities such as protected bicycle lanes, paths, and neighborhood enhanced streets
- Increase the percentage of households with zero or one car from 50 percent to 75 percent
- Reduce the average share of annual household income spent on transportation costs to 10 percent through the provision of more transportation options
- Provide a shared-use vehicle within a half-mile of 75 percent of households
- Provide access to bicycle sharing within one-quarter mile of 50 percent of households
- Install pedestrian access curb ramps at all intersections
- Increase the combined mode split of persons who travel by walking, bicycling, or transit to 50 percent[42]

The investments envisioned by the Mobility Plan 2035 will be extensive. The city's transit and bicycle network maps show the ambitious scale of change envisioned by Los Angeles. The social, environmental, and economic benefits of Mobility Plan 2035 will be enormous. Once implemented, Los Angeles residents will have a far safer, affordable, sustainable and efficient transportation system.

In light of the many benefits, the plan's trade-off is very modest: slower average vehicle speeds. A comprehensive review of the plan as required by the California Environmental Quality Act reveals that drivers will experience reduced travel speeds and, by extension, increased delay. Taken together, the plan will reduce roadway level of service—a qualitative assessment of the ease of traffic flow that is often pared with measures of delay—within Los Angeles from a grade of C to D.[43]

The report also estimated that the average volume to capacity ratio throughout the city would increase. This measure looks at the volume of cars on the road compared to the total capacity of the roadway network. The closer the ratio is to one, the more congested the roadway network. Implementation of the plan will increase the volume to capacity ratio from 0.76 percent to 0.89 percent. In other words, the volume of cars will increase by 17 percent relative to the capacity of the network. [44] This result stems from the fact that slower moving cars take longer to reach their destination, leaving more vehicles on the roadway at any given time.

Under the proposed rule, the Los Angeles metropolitan region would be penalized for the city's decision to make the very kinds of investments that will reduce congestion and mobile-source emissions while also increasing the person throughput and overall productivity of the roadway network.

A question of priority

A fundamental question facing all cities, metropolitan regions, and transit providers is: Who is the focus of your planning and investment efforts? Los Angeles, like many larger regions, has complex traffic patterns, as both jobs and housing are spread throughout the region. As a result, some commuters must travel great distances. For this small segment of drivers, slower principal arterial roadway speeds and increased travel times are especially vexing. Even in the Los Angeles region, which consistently ranks as having some of the worst congestion in the nation, only 11 percent of commuters have a journey to work that is greater than 60 minutes.[45]

When planners and traffic engineers design roadways to maximize vehicle speeds above all else, they are in fact making a deeply political decision to value the needs of a few drivers that travel the farthest distance over the needs of local residents. Because all design and engineering decisions come with tradeoffs, improvements such as better transit service and amenities for nonmotorized users must remain on the shelf.

Conversely, when cities and transit authorities invest in public transportation such as the Wilshire Boulevard rapid line, they are choosing to prioritize the needs of local residents. After all, if someone rides the LA Metro rapid on Wilshire Boulevard in order to commute to work downtown, this trip is inherently local as compared to someone commuting from Orange, Riverside, or San Bernardino counties, for example. This raises other questions: Shouldn't roadways in Los Angeles prioritize serving the needs of city residents? And, shouldn't roadways in Irvine, or Anaheim, or Corona prioritize the needs of their residents over someone coming from Los Angeles?

Conclusion

The proposed USDOT congestion and mobile-source emissions measure as currently drafted would penalize metropolitan regions that make investments to expand and improve their transit systems, especially bus transit operating on arterial roadways. By narrowly focusing on vehicle speed, the proposed rule misses the important contribution that transit makes to reducing congestion and mobile-source emissions. The final rule should include a provision for calculating avoided delay and avoided emissions. Under this approach, metropolitan regions would report a final congestion statistic that includes a downward adjustment factor—essentially a coefficient less than one—determined by transit ridership. This more comprehensive approach would effectively capture the congestion-reducing benefits of high-quality public transportation.

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Endnotes

1 *Moving Ahead for Progress in the 21st Century Act,* Public Law 112-141, 112th Cong., 2d sess. (July 6, 2012), available at http://www.gpo.gov/fdsys/pkg/PLAW-112publ141/pdf/PLAW-112publ141.pdf.

2 Cornell University Legal Information Institute, "National goals and performance management measures," available at https://www.law.cornell.edu/uscode/text/23/150 (last accessed April 2016).

3 U.S. Department of Transportation, "U.S. Driving Tops 3.1 Trillion Miles In 2015, New Federal Data Show," Press release, February 22, 2016, available at https://www.fhwa.dot.gov/pressroom/fhwa1607.cfm.

4 U.S. Department of Transportation, "Freight Facts and Figures 2015," available at http://www.rita.dot.gov/bts/sites/rita.dot.gov.bts/files/FF%26F_complete.pdf (last accessed April 2016).

5 Linda Bailey, "Public Transportation and Petroleum Savings in the U.S.: Reducing Dependence on Oil" (Fairfax, VA: ICF International, 2007), available at http://www.apta.com/resources/reportsandpublications/Documents/apta_public_transportation_fuel_savings_final_010807.pdf.

6 Washington Metropolitan Area Transit Authority, "Metro Facts 2016, "available at http://www.wmata.com/about_metro/docs/Metro%20Facts%202016.pdf (last accessed April 2016).

7 Transportation Research Board, "Transit Capacity and Quality of Service Manual," available at http://onlinepubs.trb.org/onlinepubs/tcrp/tcrp_webdoc_6-b.pdf (last accessed April 2016).

8 Hofstra University, "The Geography of Transport Systems: Highway Speed, Flow, and Density," available at http://people.hofstra.edu/geotrans/eng/methods/highwaysfd.html (last accessed April 2016).

9 Los Angeles Metro, "Bus Lanes," available at https://www.metro.net/about/metro-service-changes/bus-lanes/ (last accessed April 2016).

10 Transportation Research Board, "Transit Capacity and Quality of Service Manual."

11 Federal Highway Administration, *National Performance Management Measures; Assessing Performance of the National Highway System, Freight Movement on the Interstate System, and Congestion Mitigation and Air Quality Improvement Program* (U.S. Department of Transportation, 2016), available at http://www.fhwa.dot.gov/tpm/rule/pm3_nprm.pdf.

12 Ibid.

13 Ibid.

14 Result based on author's calculation from U.S. Department of Transportation, "Public Road and Street Length, 1980-2013, Miles by Functional system National Summary," available at http://www.fhwa.dot.gov/policyinformation/statistics/2013/hm220.cfm (last accessed April 2016).

15 U.S. Department of Transportation, "Intermodal Surface Transportation Efficiency Act of 1991 – Summary," available at http://ntl.bts.gov/DOCS/ste.html (last accessed April 2016).

16 U.S. Department of Transportation, "Congestion Mitigation and Air Quality (CMAQ) Program Interim Guidance," available at https://www.fhwa.dot.gov/map21/guidance/guidecmaq.cfm (last accessed April 2016).

17 U.S. Department of Transportation, "Interim Program Guidance under MAP-21," available at http://www.fhwa.dot.gov/environment/air_quality/cmaq/policy_and_guidance/2013_guidance/index.cfm (last accessed April 2016).

18 U.S. Department of Transportation, "Interim Program Guidance under MAP-21."

19 Environmental Protection Agency, "Current Nonattainment Counties for All Criteria Pollutants," available at http://www3.epa.gov/airquality/greenbk/ancl.html (last accessed April 2016).

20 Los Angeles Metro, "Draft Environmental Impact Report/Environmental Assessment (DEIR/EA)-4.1 Traffic" (2010), available at http://media.metro.net/projects_studies/wilshire/images/deir/4.1_Traffic.pdf.

21 City of Los Angeles, "Palazzo Westwood Project Revised Draft EIR" (2003), available at http://planning.lacity.org/eir/Palazzo/text/traffic.pdf.

22 Los Angeles Metropolitan Transportation Authority, "Los Angeles Metro Rapid," available at http://www.nbrti.org/docs/ppt/Broward%20County%20BRT%20Workshop/Metro_Rapid_Presentation.pdf (last accessed April 2016).

23 Los Angeles Metropolitan Transportation Authority, "Final Report: Los Angeles Metro Rapid Demonstration Program" (2002), available at http://media.metro.net/projects_studies/rapid/images/demonstration_program_report.pdf.

24 Ibid.

25 Ibid.

26 Los Angeles Metropolitan Transportation Authority, "Los Angeles Metro Rapid."

27 Los Angeles Metropolitan Transportation Authority, "Revised Wilshire BRT Final EIR/EA" (2011), available at https://www.metro.net/projects/wilshire/revised-wilshire-brt-final-eirea/.

28 Ibid.

29 Los Angeles Metropolitan Transportation Authority, "Executive Summary - Wilshire BRT Final EIR/EA" (2011), available at http://media.metro.net/projects_studies/wilshire/images/EIR-EA_rev/Ch_0.0_Executive_Summary_041911.pdf.

30 Ibid.

31 Los Angeles Metropolitan Transportation Authority, "Revised Wilshire BRT Final EIR/EA."

32 Ibid.

33 Ibid.

34 Ibid.

35 Ibid.

36 Ibid.

37 Los Angeles Metropolitan Transportation Authority, "Wilshire Boulevard Bus Rapid Transit Project Traffic Impact Analysis Administrative Draft" (2011), available at http://media.metro.net/projects_studies/wilshire/images/EIR-EA_rev/Appendices/2_AppdxB_Traffic_Impact_Analysis_040111-Part_1.pdf.

38 Ibid.

39 Personal communication from Michael Meyer, Iteris, October 6, 2015.

40 Los Angeles Department of City Planning, "Mobility Plan 2035: An Element of the General Plan" (2015), available at http://planning.lacity.org/documents/policy/mobilityplnmemo.pdf.

41 Ibid.

42 Ibid.

43 City of Los Angeles, "Final Environmental Impact Report: City of Los Angeles Mobility Plan 2035" (2015), available at http://planning.lacity.org/eir/MobilityPlan/FEIR/feirmay12.pdf.

44 Ibid.

45 Author's calculation based on U.S. Bureau of the Census, "2009-2013 American Community Survey 5-Year Estimates: Table B08012."