

Greetings transportation planners and policymakers,

Are you a fiscal conservative who wants to lower the overall cost of our infrastructure? Are you a liberal who cares deeply about climate change and environmental sustainability? Are you a libertarian who believes governments should work to maximize freedom? What if we told you there was a set of policy changes that could do all of those things?

If you live in the United States, there is a single performance metric that shapes your life in ways you probably never realized, shaping the places that you live, and deciding what mobility options you will have. This performance metric is called “level-of-service,” or LOS. LOS is a relatively straightforward metric that grades roadway facilities with letters A through F depending on the amount of peak period vehicle delay. A simple example is illustrated in the table below.

| | Traffic Light | Stop Sign | Freeway |
|------------------|-------------------------|-------------------------|---------------------------|
| Level of Service | Delay (seconds/vehicle) | Delay (seconds/vehicle) | Traffic Flow |
| A | 0-10 | 0-10 | Free flow |
| B | 11-20 | 11-15 | Reasonably free flow |
| C | 21-35 | 16-25 | Stable flow |
| D | 36-55 | 26-35 | Approaching unstable flow |
| E | 56-80 | 36-50 | Unstable Flow |
| F | >80 | >50 | Flow breakdown |

Traffic engineers often use LOS to understand where congestion is occurring on roadway networks to assist them in planning and prioritizing capacity expansion projects or other congestion mitigation plans. Urban planners often use LOS to understand the impacts of new development, changes to comprehensive city plans, new specific plan re-zonings, or other land use plans and regulations on the existing roadway network.

In many states, analyzing the environmental impact of a transportation project also includes looking at LOS impacts. This is due to the [U-shaped curve](#) for many emissions per mile as a relationship to travel speed. Generally, an increase in travel speed beyond very low speeds tends to decrease emissions per mile, which then begin to climb up again at higher speeds (with the specific relationship depending on the engine, vehicle, and roadway characteristics). Thus, many traffic engineers deduce that congestion is also the cause of added air quality problems and greenhouse gas emissions, and strive to ensure cars can move relatively quickly and unhindered. Though the federal government [does not require it](#), LOS has often been used to measure the environmental impact of transportation projects.

But there’s an underlying problem with LOS, or at least a problem with the common uses of and implicit messages sent by LOS. One of the major problems is on the economic side. The economic problem with LOS is that it generally fails to consider the concept of latent and [induced demand](#). You can understand this concept quite simply as “if something is made cheaper, people will do or consume more of it.” LOS is an intrinsically engineering-based approach that often leads traffic engineers to propose capacity expansion as the main method to cut down on congestion. Unfortunately, capacity expansion, particularly in the context of metropolitan freeways and arterials, unleashes latent demand (people make more trips) in the short term and causes induced demand in the long term (because the new roadway capacity causes [redistribution of metropolitan-area growth](#) from the core to the periphery).

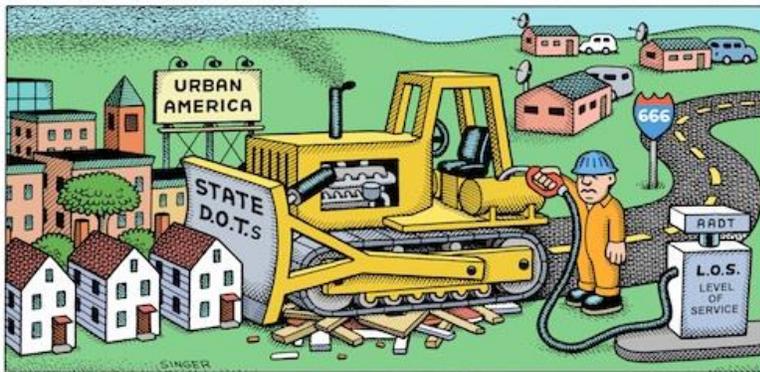
Now, not all “induced demand” is inherently bad, freeway capacity expansions *can* provide additional mobility and give people more choices on where to live, shop, and work (keyword, “can,” not necessarily will). However, it also means that the congestion-mitigation impacts of capacity expansion are likely to be vastly overstated, and that such capacity expansions are likely to increase overall vehicle-miles traveled, as well as any negative externalities associated with higher vehicle miles traveled such as air pollution and greenhouse gas emissions. Thus, while the traffic engineers correctly point out that increasing speeds from very low to mid-range will reduce emissions per mile, the analyses will often fail to account for the additional emissions from the higher vehicle miles traveled (VMT) induced by the capacity expansion project (sometimes referred to as “VMT-clawback”). In effect, roadway capacity expansion can fail to meaningfully reduce congestion in the long term while adding to regional air quality problems, increasing overall greenhouse gas emissions, and leaving behind ever increasing amounts of infrastructure and pavement that will ultimately need to be maintained with tax dollars (and we’ll take this opportunity to note that less than half of all roadway expenditures in the U.S. are paid for by user fees, as noted in [Exhibit 6-1 here](#)).

Capacity expansions on major freeways have other effects, as they put economic and political pressure on exurban jurisdictions to zone for additional fringe development. While some jurisdictions charge developers impact fees to build the new local roads and infrastructure for this new development, many do not, and oftentimes the financial responsibility for long-term O&M will still fall on public works departments even if there are impact fees for initial development. Furthermore, fringe development will often increase congestion on networks downstream and in other jurisdictions, causing the local jurisdiction or neighboring jurisdictions to expend additional resources to expand their own roadway capacity, with such costs not being internalized by the development creating the impact. Local jurisdictions may not always internalize these costs either, as transportation funding is often transferred to them from higher levels of government and taxpayers in other jurisdictions, meaning that said jurisdictions will likely allow fringe development beyond what is economically efficient because they don’t bear the full tax burden of the long-term infrastructure impacts of their decisions.

The other major issues with LOS are philosophical and practical. The implicit philosophical message sent by focusing on LOS alone is that the primary goal of a transportation network is to “*move more cars faster*.” While doing so can have benefits, it can also have [important drawbacks](#) that LOS often fails to capture. Additional urban freeways can separate communities and [destroy the urban fabric](#) that knits neighborhoods together, making local travel by walking more difficult and circuitous while lowering the quality of life in freeway-adjacent neighborhoods due to air and noise pollution. For commercial property owners whose businesses rely on foot traffic from local neighborhoods, or residential property owners whose tenants rely on walking for local goods, services, or to access jobs, it can end up harming local property values due to the [lowering of the accessibility](#) of said properties to their own walk shed. A heavier reliance on cars instead of walking can further [incentivize the erosion of the urban fabric](#) and the proliferation of surface parking lots or parking structures, or even incentivize local governments to [require parking minimums](#), all of which often create large “dead-zones” that hamper the quality of the walking environment. What’s more, the focus on automobile delay often comes at the expense of other modes, as anything that hinders the movement of automobiles is seen as a negative. Traffic engineers and planners, guided by LOS, often end up removing crosswalks or never installing them in the first place. Furthermore, guided by LOS, traffic impact “mitigations” charged to new developments often

involve roadway capacity expansions, intersection grade-separations, narrowing sidewalks for more travel or turn lanes, or other “improvements” that [degrade mobility for pedestrians](#).

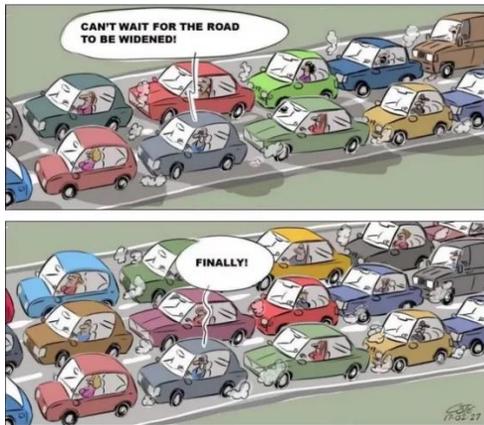
As such, we have [some of the major problems with LOS](#): (1) it makes infill development look bad because infill development loads traffic onto a congested network, even if infill loads substantially less VMT per capita onto the network; (2) it uses an analysis scale that is often too small and focused on local impacts to congestion instead of regional reduction in VMT; (3) it often includes mitigations that exacerbate the problem, such as pushing development to the metropolitan fringes and roadway widenings that induce more VMT; (4) it implicitly views pedestrian, biking, and transit improvements as a negative because they might obstruct cars even if such improvements can increase person-throughput in a corridor; and (5) it focuses on minimizing vehicle delay instead of maximizing access to destinations, and these might not always be equivalent. In response to these and other concerns about LOS, some states and local jurisdictions are taking a harder look at alternatives. California is [changing the long-standing practice](#) of estimating environmental impacts of transportation and zoning decisions from LOS



to another metric, VMT. The California Office of Planning and Research found that measuring VMT, instead of vehicle delay, more accurately captures the environmental impacts of different development, zoning, and transportation choices than LOS, while [providing other benefits as well](#).

Aside from aiding more informed decision-making when it comes to transportation planning, assessing VMT impacts can also lead to more efficient decision-making on zoning issues. Strict zoning regulations that explicitly, through height, FAR, density, and bulk restrictions, or implicitly, through other requirements such as parking minimums that can make infill development financially unviable, [have been blamed](#) for the [rapidly increasing housing crisis in major U.S. metropolitan areas](#). Zoning restrictions also often prevent increases in density, forcing more development and growth from existing urban neighborhoods (with existing infrastructure) to the exurban fringe. Sometimes zoning restrictions are defended using the framework of LOS, arguing that density should not be allowed to go beyond what the roadway network can support without peak period delays. However, this ultimately leads to higher infrastructure needs, vehicle miles traveled, and energy use per capita, and thus creates higher criteria pollutant emissions, [CO2 emissions](#), and tax burdens per capita. Additionally, the added [costs of parking](#) and maintaining additional infrastructure for telecommunications, water lines, and other utility lines are ultimately passed on to consumers by private companies and utilities as a hidden tax.

Strict zoning regulations are a limitation on [individual property rights](#), and prevent property owners from using their property for its highest and best use. When zoning restrictions are onerous, often the only “up-zonings,” or the acts of allowing additional development on a given parcel of land, are given to politically connected and large developers, effectively shutting smaller developers and businesses out of the market. Zoning restrictions prevent more supply from being created in areas with increasing demand, artificially driving down rental vacancy rates and for-sale housing supplies, which in turn drive up rents and house prices, leading to [increased](#) gentrification and displacement.



Additionally, the induced suburban sprawl created by freeway investments combined with forced suburban sprawl created by strict zoning regimes harms public transportation viability. First, for coverage-focused modes like buses, the modes must travel farther and through less dense areas, [sacrificing ridership and revenue while driving up operating costs](#). Second, for throughput-focused modes such as bus-rapid transit, light rail and heavy rail (notice streetcars are [not included](#)), zoning restrictions prevent residents and businesses (and the employees who would work at those businesses) from locating in the watershed of mass

transportation stops. This reduces transit agency ridership and revenue, decreasing farebox recovery ratios, and thus leaves additional subsidies to be borne by taxpayers while [devaluing](#) major public investments in mass transit. All of this also drives up costs for companies to hire workers due to increased commuting costs and increased housing prices, another hidden tax on businesses.

Given these and other issues with strict local land use regulation, local jurisdictions, state legislatures, and the federal government should consider whether zoning reform is needed, as [many states](#) are [in the process](#) of doing, such as [S.B. 50](#) in California. Other [countries](#) may also offer [additional lessons](#). While there may be no singular one-size fits all approach, every bit of work on this issue by states and other countries offer lessons and ideas for improving transportation, housing, environmental, and fiscal policy. Those who argue the current built environment is the [free market](#) at work should ask themselves some tough questions (and before you start bringing up Houston as proof that sprawl is the free market, here is something you should [read first](#)). It's difficult to argue that government-planned, financed, engineered, constructed, policed, plowed, salted and maintained roadways are truly the free market at work. Similarly, zoning regulations that require minimum amounts of parking or substantially restrict density are far from laissez-faire. This is not to say government intervention to construct and maintain roadways is a bad thing, or that all zoning regulations are inherently bad, it is just to say these things should [not disguise themselves](#) as the "free market," and represent market distortions that require justification for their existence and public conversations about what the appropriate level of intervention should be.

If you explored the links during this journey you've ended up hearing from academics, think tanks, government agencies, free market conservatives, environmentally- and socially-conscious liberals, anti-regulation libertarians, housing advocates, radical socialist video creators, bloggers, urban planners and engineers. They raise important questions about the policies that have shaped the places we live and the way in which we live in those places, often to an incalculable degree. Many of them ask whether those policies are actually leading to the creation of places we want to live in or the results we'd like to see, and beg the question of whether or not it is time to reexamine or alter those policies. The point of this was not to pretend we have all the answers, but to get people asking the right questions. We hope this small piece here goes on to become part of the broader change towards a more efficient, sustainable, and equitable society.

Thank you for your time, we hope you found this interesting and that you'll share this, or the ideas contained within it, with anyone that you think may find it a worthwhile read. Remember, each and every one of us, even doing something small, can make a big difference. That change begins with you.