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# Tennessee's Growth is Outpacing its Infrastructure:

## Addressing the state's Increasing Traffic Congestion

February 2023

# EXECUTIVE SUMMARY

Tennessee is growing rapidly. With this growth come benefits in the form of rising economic opportunity for its residents and more secure public finances. However, it also creates challenges. The state's infrastructure is feeling the strain of this burgeoning growth, which is nowhere more apparent than on Tennessee's clogged and congested roadways.

**US Top 100 Freight Traffic Bottlenecks Within Tennessee**

| | |
|---|---|
| #10 | Chattanooga, TN: I-75 at I-24 |
| #11 | Nashville, TN: I-24/I-40 at I-440 (East) |
| #29 | Chattanooga, TN: I-24 at US 27 |
| #42 | Memphis, TN: I-55 at I-40 |
| #49 | Nashville, TN: I-40 at I-65 (East) |
| #57 | Nashville, TN: I-65 at I-24 |
| #64 | Knoxville, TN: I-40/I-75 at I-140 |
| #88 | Knoxville, TN: I-40 at I-275 |
| #95 | Nashville, TN: I-65 at SR 386 |

With more than 95,000 miles of roadway, Tennessee is uniquely positioned to be within a day's drive of more than two-thirds of the United States. However, research shows that in 2022 **nine of the country's top 100 freight traffic bottlenecks are located within Tennessee's state borders**, including two of the top 20 in the nation. These bottlenecks, or traffic congestions, negatively impact quality of life for Tennessee residents, the operating environment for businesses, and the transport of goods through the state. Estimates suggest that Tennessee **congestion costs Tennessee road users $800 million in lost productivity** each year.

As a source of revenue, per-gallon gasoline taxes are under pressure from rising fuel efficiency and the adoption of electric vehicles.

Reducing congestion in Tennessee requires taking a fresh look at the public policies that govern transportation infrastructure decisions. Traditionally the state addressed transportation infrastructure needs through the state's gas and diesel tax, effectively assessing a tax on Tennessee residents and out-of-state gasoline buyers in proportion to the gallons of gasoline they use. As a source of revenue, per-gallon gasoline taxes are under pressure from rising fuel efficiency and the adoption of electric vehicles.

**Traffic congestion threatens to derail the economic momentum the state is currently enjoying if policymakers don't seize the opportunity** to address and resolve this challenge.

These steps include considering a broader set of policy tools, many of which would require legislative action, as well as funding mechanisms that would generate revenue from users and other sources to fund projects to address the problem.

### Legislative changes could include:

- A broader set of user fees for managed lanes, congestion pricing, etc.
- Public-private partnerships for a wider range of projects beyond transit.
- Addressing design-build constraints to speed up project delivery.
- Enhancing regional transit authority power at the sub-state level.

These legislative changes would allow the state and local governments to **adopt next-generation congestion mitigation strategies** increasingly employed in other states.

### Potential mitigation strategies could include:

- Investments in road capacity expansions (e.g., designated truck and HOV lanes).
- Advanced technology solutions like real-time, automated traffic management, and route redesignation.
- Utilizing the state's waterways and railways to provide additional capacity – strategic freight diversions to rail and water would free up road capacity for commuters and freight that needs to remain on Tennessee's roads.
- Long-term land use planning between public and private stakeholders to develop freight clusters could increase productivity and growth while reducing traffic congestion outside that immediate area.

Tennessee is in a solid fiscal position and has excellent economic momentum. Mitigating congestion on the state's roadways will improve the quality of life for Tennessee residents and reduce their cost of living. It will also make Tennessee businesses more competitive and improve the state's attractiveness for startups and relocations.

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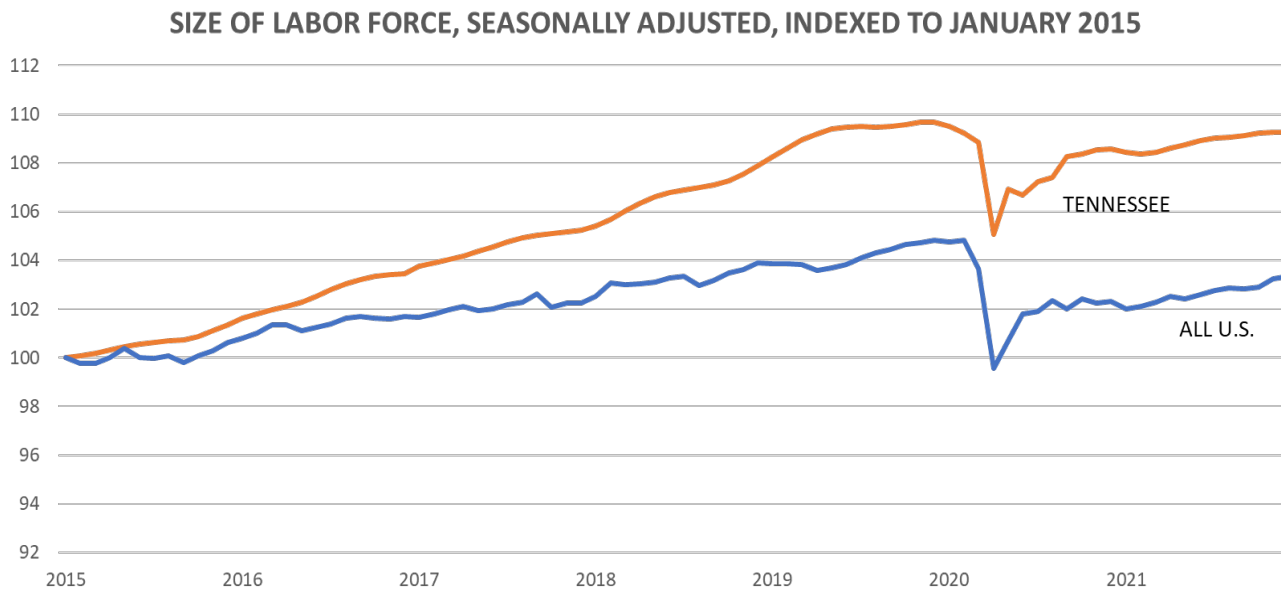
The congestion challenge in Tennessee can be met, but it will require thinking differently about the set of policy tools available. If implemented now, **policy changes to facilitate better long-term traffic planning and management can help the state get ahead of the growing congestion challenge** and maintain its position as a destination of choice for US workers and businesses.

# 1. INTRODUCTION

Tennessee continues to grow rapidly. Measures of output, population growth, and labor force size all indicate a strong, positive trajectory for Tennessee's economy. One of the first states to recover output after the COVID-19 pandemic, the state is expected to experience gross domestic product (GDP) growth of 4.2 percent in 2022. Between 2010 and 2020, Tennessee's population grew at an average rate of 0.86 percent per year, the 17th fastest rate in the country.[1] Labor force growth has been even more impressive. Between January 2015 and 2021, the state's labor force grew by nearly 10 percent while the country's labor force overall grew by less than 4 percent. (See Figure 1.) Amid an acute, nationwide labor shortage, states like Tennessee with a growing labor force are an attractive place for employers to expand operations.

**FIGURE 1: LABOR FORCE GROWTH IN TENNESSEE**




*SOURCE: FRED; BUREAU OF LABOR STATISTICS*

But our future trajectory is not guaranteed. To support continued economic vitality in the State, Tennessee must address one of its most prominent and growing challenges: congestion. This road congestion is expected to double by 2045, affecting the competitiveness of Tennessee businesses and the quality of life of Tennessee residents.[2] The Tennessee Department of Transportation's (TDOT) budget is almost fully devoted to maintaining existing infrastructure, despite the fact that road mileage is not growing. While essential, these maintenance investments are not laying the foundation for future economic growth. Congestion threatens to derail the state's economic growth agenda in several ways.

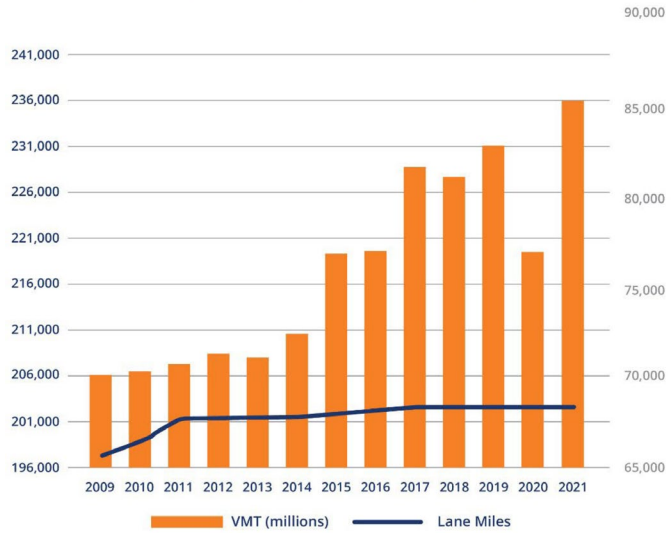
[1] https://www.pewtrusts.org/en/research-and-analysis/articles/2021/07/27/population-growth-sputters-in-midwestern-eastern-states

[2] Source: Tennessee Department of Transportation

***Congestion represents an impediment to work for Tennessee residents***

Tennessee has one of the lowest labor force participation rates in the country. 60.5 percent of Tennessee adult residents were working or looking for work in September 2022, the 11th lowest rate out of 50 US states.[3] The State of Tennessee is investing in workforce training to drive higher participation rates. But labor force participation is also affected by the physical accessibility of work, and by the costs of engaging in work. Urban congestion reduces the accessibility of jobs in urban locations and increases the cost of work for Tennesseans living in both urban *and* rural locations by increasing the travel time and costs required. Commuters in rural Tennessee locations already spend more time commuting to work than urban residents: an average of 27.7 and 24.2 minutes per day, respectively.[4] Much like enhanced internet quality may open up additional work opportunities for rural residents, quicker access to jobs in urban locations may facilitate work as well.

**FIGURE 2: GROWTH OF VMT VS. LANE MILES**




*SOURCE: TN Department of Transportation*

***Congestion reduces the competitiveness of Tennessee businesses***

Congestion limits the competitiveness of Tennessee businesses and makes the state less desirable than it could be for business establishment and expansion. In addition to reducing labor force availability, congestion increases costs to Tennessee businesses associated with bringing inputs into their facilities and sending outputs to market. Among business-friendly Southern states, Tennessee is relatively far from export-enabling ports. Congestion amplifies this disadvantage and makes other states more attractive for exporting firms. Congestion also raises the cost of doing business in Tennessee's metro areas. For example, firms seeking to serve customers throughout the Nashville metro area may find it necessary to establish multiple offices as a result of congestion, lowering their competitiveness and reducing economic opportunity.

***Congestion reduces the attractiveness of Tennessee as a migration destination***

Congestion threatens Tennessee's ability to maintain population growth, a key competitive advantage in the effort to recruit businesses to the state and increase the quality of jobs available to Tennesseans. Nationwide, population growth is at an all-time low.[5] The US population grew at a rate of 0.12 percent between 2020 and 2021, the result of both the COVID-19 pandemic and longer-term demographic patterns. Tennessee is not immune to these forces. In both 2020 and 2021, the number of deaths of Tennessee residents exceeded births to Tennessee residents. Excess deaths from COVID-19

[3] https://www.bls.gov/web/laus/lalfprderr.xlsx

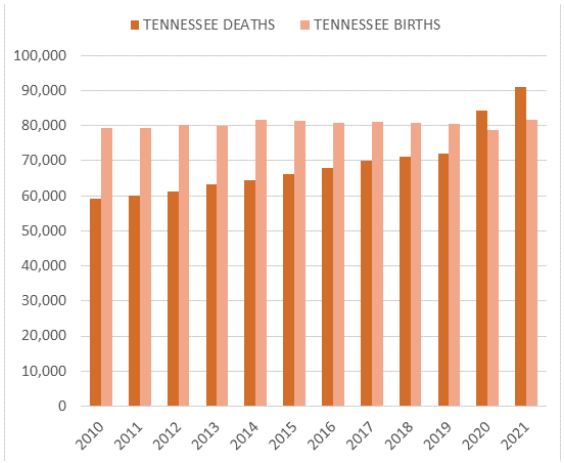
[4] Source: 2016-2020 5-Year American Community Survey, US Census Bureau; Tennessee Department of Economic and Community Development. The question is: "How many minutes did it usually take this person to get from home to work last week?"

[5] https://www.brookings.edu/research/u-s-population-growth-has-nearly-flatlined-new-census-data-shows/

contributed to this pattern, but the state was on a path to deaths exceeding births even without the pandemic's impact.

While the rate of natural population growth in the state is negative, domestic in-migration is strong, pushing Tennessee population growth into positive territory. (See Figures 3 and 4.) Tennessee has become one of the most popular destinations in the country for relocating families, in large part a reflection of strong economic opportunities in the state. In 2021, the Volunteer State welcomed 63,141 residents from elsewhere in the country, exceeding the peak numbers from previous in-migration waves and driving high rates of population growth in Tennessee's urban counties.

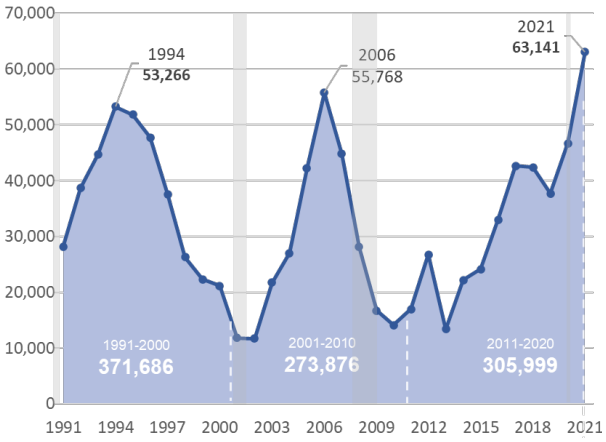
**FIGURE 3 - TENNESSEE'S NATURAL POPULATION GROWTH**




*SOURCE: Tennessee State Date Center*

As Figure 4 makes clear, however, continued in-migration is not guaranteed. Tennessee welcomed in-migrants from other states at elevated rates in 1994 and 2006 only to see migration volumes decline in the years following. In-migration rates are somewhat cyclical, although the peaks and troughs of the two previous waves do not line up perfectly with the business cycle (shown as gray bars in Figure 4). In short, the future of migration to the State of Tennessee is not guaranteed. Higher transportation costs and deteriorating quality of life in Tennessee as a result of rising congestion would disadvantage the state in recruiting migrants, with associated impacts on workforce growth and business expansion.

**FIGURE 4 - TENNESSEE'S DOMESTIC NET MIGRATION**

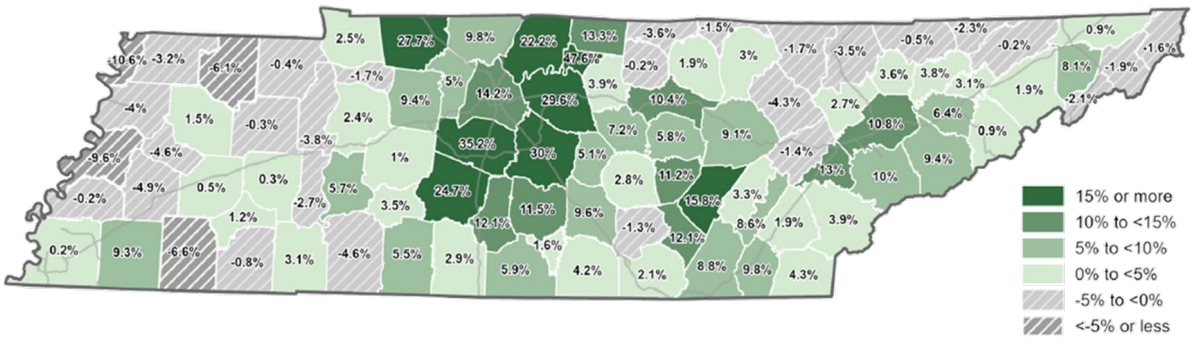



*SOURCE: Tennessee State Data Center*

***Congestion raises housing costs for Tennessee residents***

Congestion also raises housing costs for Tennessee residents by inducing a more limited set of residence options for a given employment choice. At a time when 20 out of 95 counties are losing population (see Figure 5) and housing costs are growing rapidly in Tennessee's urban centers, reducing congestion and opening up a broader radius of residence locations for a given employment choice may be part of a broader housing affordability policy agenda.

**FIGURE 5: POPULATION CHANGE BY COUNTY IN TENNESSEE**




*SOURCE: 2022 Economic Report of the Governor; UT Boyd Center for Business and Economic Research*

***What can be done?***

Reducing congestion in the State of Tennessee requires taking a fresh look at the public policies that govern transportation and infrastructure decisions in the state. Tennessee has traditionally addressed transportation and infrastructure needs through the state's gas and diesel tax, effectively assessing a tax on Tennessee residents and out-of-state gasoline buyers in proportion to the gallons of gasoline they use. Importantly, since the taxes are levied on a per-gallon basis, revenues do not rise with the price of gasoline or fuel. As a source of revenue, per-gallon gasoline taxes are under pressure from rising fuel efficiency and the adoption of electric vehicles. The State of Tennessee has enacted public policy changes to address these issues and could do more to shore up gasoline tax revenues.

But no matter the implementation strategy, gasoline taxes are ill-suited for supporting congestion-inspired infrastructure expenditures since such taxes are not directly related to the congestion induced by travelers on Tennessee roads. A gallon of gasoline purchased in rural Tennessee counties for consumption on rural roads with no congestion carries the same tax as a gallon purchased and consumed in urban Davidson County. Consequently, the benefits of congestion mitigation are concentrated while the tax impact from a higher gasoline tax would be nearly universal across Tennessee gas consumers.

Moreover, an increase in gasoline or diesel taxes has limited ability to drive targeted demand reduction during peak congestion hours.

New ways of funding congestion management expenses will be needed for Tennessee to resolve its congestion challenge. A new set of policy levers would enable the state to deploy a wider variety of congestion mitigation technologies and expenditures, technologies that other states have deployed successfully in their own congestion fights. We review the potential policy levers and congestion mitigation technologies in the remainder of this white paper and lay out potential metrics for success.

## 2. DEFINING THE POLICY PROBLEM

Congestion in Tennessee is bad and likely to get worse. Population growth is highly uneven across the state, and the state's metropolitan areas, in particular, are experiencing congested transportation networks. The increased number of vehicles in urban locations, along with modest investments in the network, have created a problem that will not resolve on its own.

With more than 95,000 miles of roadway, the state of TN is uniquely positioned to be within a day's drive of more than two-thirds of the United States. As a result, a lot of traffic comes through Tennessee, and with that comes a demand for an improved transportation system - with better highways and infrastructure utilization. Trucks and freight make up a substantial share of the traffic on the Interstate System. As an example, the Interstate occupies about one percent of all the road mileage in the state, yet carries over 30 percent of the daily miles driving traffic in the state, and almost all the trucks. In the rural areas of the state, truck traffic makes up almost 30 percent of overall road traffic but as you get into more urbanized areas, commuter traffic volumes increase, bringing down the overall percentages of truck and freight traffic. In Nashville for example, truck traffic makes up about 15 percent of over-the-road traffic.[6]

Recent TDOT planning efforts aimed at identifying and prioritizing congestion reduction investments in the four largest cities in the state (Chattanooga, Knoxville, Memphis, and Nashville) highlights data-driven methodologies to quantify urban congestion in each of these areas. Following this tradition, our research team employed a variety of data sources to determine the extent of congestion across the state - not only the four major urban metropolitan areas. A primary resource for our congestion data analyses was the University of Maryland's Regional Integrated Transportation Information System (RITIS) platform. Made available through TDOT, this dataset collects real-time information on traffic flow conditions using anonymized data from GPS-enabled devices in vehicles, thus providing access to current and historical vehicular speed data.

**TABLE 1: Summary of congestion performance metrics for all clockwise segments of all roads in Tennessee (a total of 16,285 TMC segments) in a sample month (August 2022)**

| | Buffer time (minutes) | Buffer index | Planning time (minutes) | Planning time index | Travel time (minutes) |
|---|---|---|---|---|---|
| | 12:00 AM - 12:00 AM | 12:00 AM - 12:00 AM | 12:00 AM - 12:00 AM | 12:00 AM - 12:00 AM | 12:00 AM - 12:00 AM |
| Mon | 9.23 | 0.20 | 56.02 | 1.23 | 45.62 |
| Tue | 11.21 | 0.24 | 58.44 | 1.29 | 46.28 |
| Wed | 12.38 | 0.26 | 60.01 | 1.32 | 46.40 |
| Thu | 12.98 | 0.27 | 60.39 | 1.33 | 46.37 |
| Fri | 7.58 | 0.16 | 55.29 | 1.22 | 45.59 |
| **Weekdays** | **10.06** | **0.21** | **57.39** | **1.26** | **46.06** |
| Sat | 4.67 | 0.10 | 50.90 | 1.12 | 44.00 |
| Sun | 4.99 | 0.11 | 50.80 | 1.12 | 43.82 |
| **Weekends** | **4.80** | **0.10** | **50.83** | **1.12** | **43.91** |
| All Days | 8.77 | 0.19 | 55.77 | 1.23 | 45.50 |

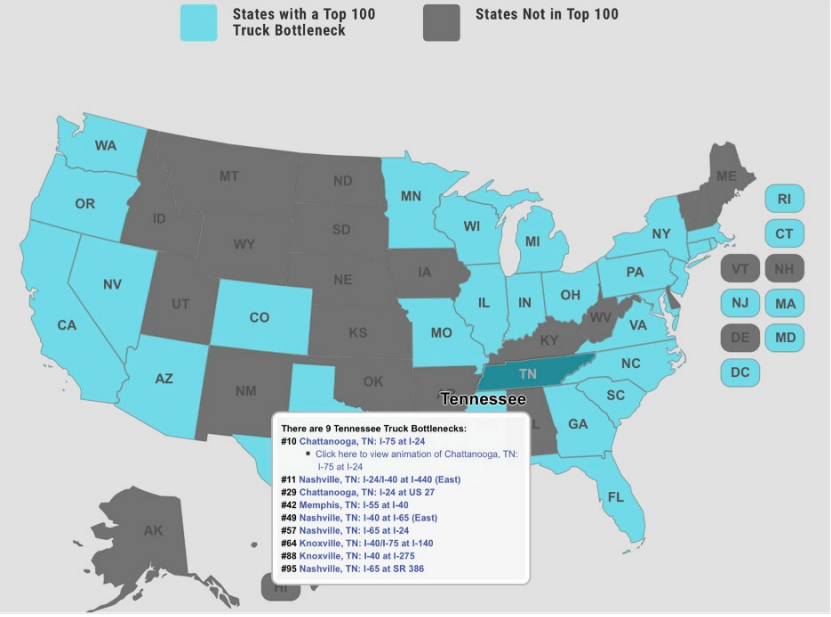
[6] https://www.highwaysee.com/episodes/the-history-of-tennessees-road-system

Across the state's most significant arteries, the buffer index[7] doubles from a range of 10-11 minutes during the weekends to a range of 20-26 minutes during the weekdays, suggesting that the travel conditions during peak periods compared to free-flow conditions are enough to require road users to double the amount of extra "buffer" time needed to be on-time for their activities. In a sample month (August 2022), Table 1 provides a summary of congestion performance metrics for all clockwise segments[8] of all roads in Tennessee (a total of 16,285 TMC segments) using INRIX data from the RITIS database.[9]

As one might expect, congestion is not evenly spread across the state - neither are the effects evenly felt across the state's infrastructure. Policy and solutions must thus be tailored to address the most significant of these. Freight GPS data from the American Transportation Research Institute (ATRI) shows that Tennessee arteries occupy 9 of the top 100 freight bottlenecks in the country (Figure 6) and two of the top 20[10]. Congestion in the state creates more than 31 million vehicle hours of delay (Figure 7) each year with estimated annual costs of over $800M attributed to user delays (representing 1.8% of the US total).[11]

There are two separate policy issues to be considered. The first is the mechanism for reducing congestion, including traffic diversion, express lanes, congestion tolling, managed lanes with congestion tolling (including High Occupancy Toll or HOT lanes) and mass transit. An additional set of related initiatives are referred to as micromobility and micro transit; micromobility solutions are not designed to address interstate highway

**FIGURE 6: CONGESTION ANALYSIS – FREIGHT BOTTLENECKS IN THE STATE OF TN COMPARED TO THE UNITED STATES**




*SOURCE: https://truckingresearch.org/2022/02/08/top-100-truck-bottlenecks-2022/*

[7] Also commonly referred to as the Buffer time index (BTI) is a widely used operator-side performance indicator) that defines the extra time needed so that one is on time most of the time. This index relates to the reliability of an individual vehicle trip and determines the impact of congestion on one vehicle traveling on a segment of a roadway during a specific period. It is computed as the difference between 95th percentile travel time and average travel time, divided by average travel time.

[8] Defines the direction of travel: From North and South; East and West; or - for certain roads like ring roads and beltways - Clockwise and Counterclockwise.

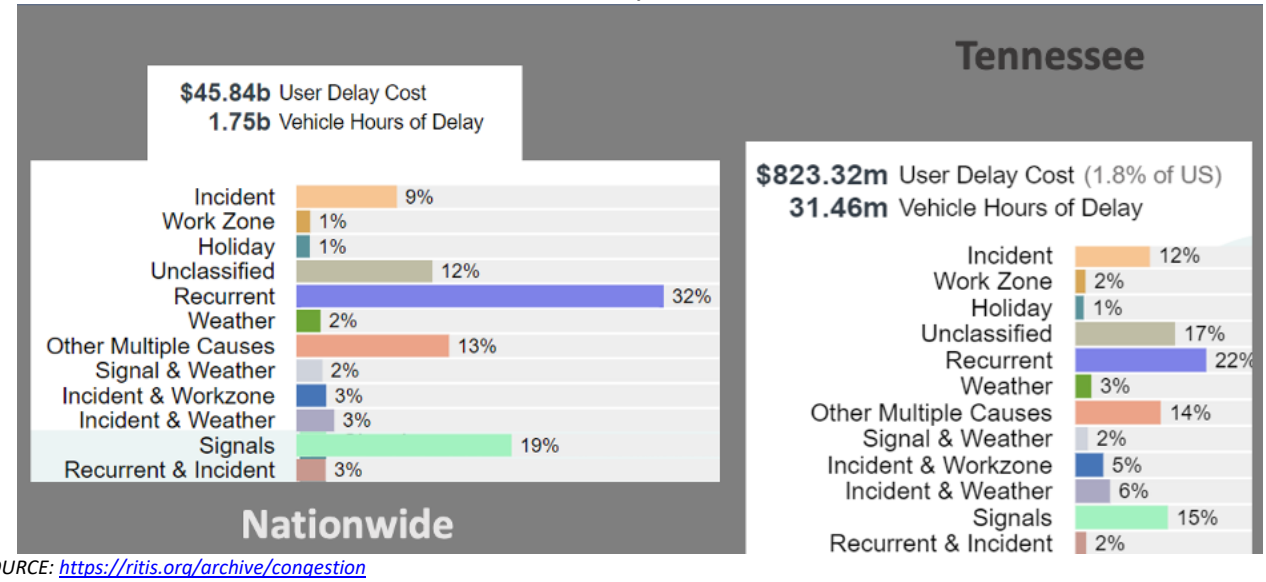
[9] Traffic Message Channel

[10] https://truckingresearch.org/2022/02/08/top-100-truck-bottlenecks-2022/

[11] Source: RITIS.

congestion and are therefore not the focus of this report.[12] We address the mechanisms question in Section 4.

**FIGURE 7: CONGESTION ANALYSIS – USER DELAYS, TENNESSEE COMPARED TO U.S.**




*SOURCE: https://ritis.org/archive/congestion*
*Data obtained from Transportation Disruption and Disaster Statistics (TDADS) dashboard - archive of operational-related transportation system disruption, resilience and disaster statistics nationally.*

The second policy issue is the funding mechanism and how revenue will be generated from users or other sources (including private investors, the state, and the federal Department of Transportation) to fund projects. The State of Tennessee's financial model for transportation funding is not designed to meet the congestion challenge. Traditionally, the congestion mitigation strategy and funding have been jointly addressed by state transportation agencies that identify project needs and then fund capital investment and maintenance services through dedicated revenue streams like gas and diesel taxes. This strategy is appropriate for funding *broad and routine* transportation infrastructure needs statewide.[13] Dedicated user fees (gas and diesel taxes) are modest by national standards, but when roads need to be repaved across the state, current gas and diesel revenues are sufficient.

Congestion problems concentrated around the state's metropolitan areas and other transportation choke points across the state are related to *congestion* rather than simply the need for more capital investment in roadways. This suggests that the problem should be addressed by focusing on the

[12] The former includes traditional mechanisms like traditional pedestrian walkways and bike trails, and more modern options like scooter sharing; micro transit has a more specific connotation that includes ride sharing coupled with new technology and information systems, for example, an Uber driver that charges real-time fares based on traffic congestion and best-available routing. One definition refers to micro transit as "simply tech-enabled shared transportation that lives in the space between traditional fixed route transit and ride hailing technology. Its routes are nimble; its 'schedules' aren't really schedules at all, as they shift constantly based on rider demand; and its vehicles range in size from vans, shuttles, or buses." For more information, see https://ridewithvia.com/resources/articles/what-is-microtransit/. While both micromobility and micro transit can play a role in moving traffic off roadways, they tend to have localized applications with minimal impact on interstate and major transportation network traffic flows. They can be especially attractive for last-mile transit for both work and leisure.

[13] For background on transportation finance in Tennessee, see Mark Burton, Matthew N. Murray and Donald Bruce, "Sustaining Mobility in Tennessee: Fuels, Roadway Use and User-Funded Alternatives, the University of Tennessee, July, 2013. For a broad discussion of revenue options, see Mark Burton, Matthew N. Murray, Emily Pratt and Jilleah G. Welch, "Tax Policies and Alternative Revenue Sources: State Responses to Declining Purchasing Power of Roadway Funding," The University of Tennessee, November 30, 2016. https://bakercenter.utk.edu/wp-content/uploads/2022/08/Taxes.Policies.Alternative.Revenue.Sources.pdf

congestion problem itself and the sources of this congestion, including localized users of the network and trucks and automobiles from other regions and states that contribute to congestion in local areas.

Traditional levies, from the gas tax to the sales tax, are inappropriate to mitigate the congestion problem because they are not properly linked to the localized sources of congestion, instead falling on all users of the network. A gas tax or state sales tax solution to the congestion challenge would imply levying higher rates on all Tennessee residents to ameliorate congestion problems in specific metropolitan locations. The use of these same levies at the local level (a higher local sales tax, for example) to address congestion is also problematic since the levies could easily be avoided by simply making purchases in other regional communities where rates are lower. Motor vehicle registration and license fees, including the relatively higher fees the state imposes on EVs, have only a loose connection to localized congestion and cannot address out-of-community users of the network, including both non-resident automobiles and trucks.[14] A new model is required.

## 3. PRINCIPLES OF SOUND TAX POLICY

The following principles should guide state tax policy to fund congestion amelioration.

**Revenues should be adequate to fund needs.** This would include any private funding that is used to fund new investments, coupled with state and local dollars. Current road funding revenue is simply inadequate to address the unique challenges posed by regional congestion problems.

**Revenues should be responsive over time to potentially rising needs and costs.** Need and cost may rise together through growing local populations and increased cross-community use by nonresident individuals and truckers; costs may also increase because of rising costs of inputs to road construction, including concrete and asphalt. All of this has taken place in Tennessee, putting additional pressure on traditional funding mechanisms. The traditional gas tax is problematic because of slow growth in VMT and improved vehicle fuel economy which means slow growth (or even contraction) in the base (gallons sold). Slow growth in the base is a primary reason for ongoing increases in tax rates. This challenge will not go away.

**The stability of revenues over the ups and downs of the business cycle is important to ensuring the ability to smoothly fund roadway capital projects.** No revenue source is completely stable, including traditional user fees like the gas and diesel taxes. For example, gas tax revenues were hit hard by COVID which sharply reduced VMT; recent spikes in gasoline prices also adversely affected revenue because they reduced gasoline consumption. Revenue stability should be considered for any new funding options to address congestion to ensure investment stability.

**Taxes and user fees should entail low costs of administration and compliance, including compliance costs borne by those who directly or indirectly pay the levies.** Existing levies have a natural advantage here over any new levies because the apparatus of tax payment and collection is already in place and

[14] For background on the treatment of electric vehicles in Tennessee, see Rebecca J. Davis, Matthew N. Murray and Jilleah G Welch. "How Much Should Hybrids and Electric Vehicles Contribute to Roadway Funding?" Policy Brief 1.17, Howard H. Baker Jr. Center for Public Policy, the University of Tennessee, January 3, 2017. https://bakercenter.utk.edu/wp-content/uploads/2022/08/How.Much_.Should.Hybrids.Electric.Vehicles.Contribute.Roadway.Funding.pdf

familiar to those who pay the tax and remit revenue. For example, individual buyers of gasoline face no gas tax compliance costs whatsoever because the tax is administered at the wholesale level; wholesale collection of the tax greatly reduces the costs to the state as well as to consumers and businesses compared to a retail levy. Diesel taxes for interstate shippers are allocated based on miles driven in each state (as well as Canadian province), with administration managed by the International Fuel Tax Accord. This system is somewhat more complicated and thus more costly but has been in place for many years and works very well by aligning revenues with burdens imposed by truckers. Potential administrative and compliance costs should be taken into account when designing systems to address localized congestion.

**Revenue instruments should in most cases seek to be neutral and not distort decisions made by individuals and businesses.** Neutrality is especially important for various business taxes like the corporate income and franchise taxes since high taxes may distort where businesses choose to locate, make investments and hire workers. Note that neutrality is a foundational principle behind the way that the diesel tax is structured–high versus low diesel tax rates across jurisdictions should have a limited impact on where fuel purchases are made since revenue is allocated based on miles driven per jurisdiction rather than the point of purchase. When addressing the roadway congestion problem, the issue of neutrality may be reversed–distortions may in fact be desirable to help adjust driving patterns in order to mitigate crowding problems. For example, it may be desirable to divert drivers to less congested routes, induce changes in work hours away from peak travel time and encourage drivers to substitute toward mass transit. Note that these changes in behavior impose costs and therefore need to be balanced against the benefits of reduced congestion costs.

**Taxpayer equity is the final tax policy criteria, especially horizontal equity which requires that equally-situated taxpayers pay similar amounts of tax.** Gas and diesel taxes are intended in part to achieve this form of equity by taxing units of fuel consumed that roughly correspond to burdens and benefits from the transportation network. However, congestion breaks this linkage since users bear additional costs from queueing in traffic, a higher incidence of accidents and greater wear and tear on vehicles. As a result, overall driving costs can differ significantly for those in similar vehicles who drive the same number of miles. (A separate notion of fairness is vertical equity which addresses fairness for those with differential ability to pay, typically measured by income. Vertical equity cannot easily be addressed through traditional user fees like the gas tax since its collection has no bearing on individual circumstances.) Solutions to the congestion problem should be focused on those who contribute to the problem to the extent possible.

# 4. FISCAL POLICY OPTIONS

To fund congestion mitigation investments, the state should consider enabling a broader set of policy tools, guided by the Principles of Sound Policy discussed above. Four options for legislative action are proposed below.

### *1. Legislatively enable a broader set of user fees for managed lanes, congestion pricing, etc.*

The practical inability of traditional transportation-related levies to address congestion requires a look at alternatives, many of which fall under the umbrella of congestion pricing.[15] Congestion pricing is especially attractive since it jointly combines the mechanism for traffic mitigation with a significant revenue stream derived from network users. Tolling revenues can be used to defray all or a portion of project investment and maintenance costs. New technologies (e.g., electronic dashboard devices) enable the implementation of congestion pricing without causing traffic to stop at classic payment kiosks.

Congestion tolling can be implemented in a variety of settings, including complete roadway segments and managed lanes that give drivers the option to choose a toll versus a non-toll route. HOT lanes can also be supported as a variant of the managed lane model.

In principle, congestion pricing seeks to charge drivers a price that reflects the congestion costs imposed on other users of the transportation network. By facing the true price of driving, behavior is adjusted accordingly. As discussed in the narrative above, gas and diesel taxes, as well as vehicle registration fees, are poorly suited to addressing congestion since they cannot be tailored to specific driving situations. Congestion pricing is conceptually attractive since any differential levies are intended to mimic market prices and appropriately affect behavior.

Congestion pricing and other strategies do not eliminate congestion, but instead mitigate it by diminishing negative impacts on users of the transportation network — mitigation strategies entail costs, and these should be balanced against the benefits of reduced congestion. An important strength of congestion-pricing strategies is that they can yield important revenues to fund transportation investments and maintenance. Building more highway lanes may reduce congestion, but at a high budget cost to the state, no dedicated revenue yield from the investment, and no targeted costs imposed on the generators of congestion. Toll lanes, on the other hand, can link revenue yield to use, with higher tolls being imposed on network users when congestion costs are present. In this example, the toll can provide base funding for underlying infrastructure costs while at the same time addressing the congestion problem. Using tolls in this way is a classic application of congestion pricing.

The approach to tolling has evolved over time, benefiting from the emergence of new information technologies that can monitor traffic flows (including accidents) to improve system operability. These

[15] The Federal Highway Administration provides an introduction of congestion pricing at https://ops.fhwa.dot.gov/congestionpricing/cp_about.htm. For a recent review, see Alan Jenn, "Implementing Pricing Schemes to Meet a Variety of Transportation Goals," September 26, 2019, https://dot.ca.gov/-/media/dot-media/programs/research-innovation-system-information/documents/final-reports/ca19-3399-finalreport-a11y.pdf

technologies enable *smart* systems that allow for dynamic congestion pricing based on traffic flows and congestion.

***2. Legislatively enable public-private partnerships for a broader range of projects beyond transit.***

The state has low levels of debt and a high credit rating, which means low costs of debt finance. But TDOT generally does not use debt finance for capital projects, despite the fact that the beneficiaries of current investments include future generations and users of the network. Debt finance is generally attractive when the costs of debt, linked to the flow of benefits from the capital investment, are paid by users of the capital.[16] The state's commitment to pay-as-you go financing has popular appeal, but severely limits the state's ability to invest in projects that have high upfront costs and long-term benefits.

The private sector does not share the state's commitment to pay-as-you-go financing, and relying on the private sector to take on short-run debt for long-term benefit may help the state out of its infrastructure funding conundrum. Public-private partnerships (P3s) are financing systems that in principle can be used to fund virtually any transportation investment, including those designed to mitigate traffic congestion.[17] Private investments are typically supported in conjunction with public dollars with strong planning support and oversight from State and/or local governmental bodies. Private engagement may include any or all of the components along the design-build-finance-operate-maintain (DBFOM) continuum. Tolls are a primary mechanism for providing a return to private sector investors, providing the desirable feature of funding transportation upgrades with revenue from users.

## P-3 EXAMPLE: TEXAS NORTH TARRANT EXPRESS

An example of a complete private-sector engaged DBFOM project is the Texas North Tarrant Express I-35W (Segments 3A, 3B and 3C).[1] The three phases of this $1.64 billion investment together represent 17.3 miles of *managed toll lanes* on I-35 that operate in both directions, along with general purpose lanes and access roads. Phase 3A and 3B have been completed and the third phase is scheduled for completion in 2030. This is a partnership between TxDOT and private contractor NTE Mobility Partners. Notably NTE Mobility Partners designed the project and holds a 52 year *concession* contract with the state to manage and operate the facility. The concession contract entails ongoing payments to the private operator for the life of the facility, effectively replicating a debt financing arrangement.

Dynamic tolling will be used to help control congestion along the managed lanes, building on a new information technology and management system that will create a *smart* transportation corridor. A goal of the smart corridor is to maintain traffic flows at 50 mph while enhancing emergency response times.

Funding for the project comes from a combination of private activity bonds, a federal Transportation Infrastructure Finance and Innovation Act (TIFIA) loan (to be repaid with project revenues, including toll revenue), funding from federal and state governments, equity and funding from the North Central Texas Council of Governments (NCTCG).[1] The NCTCG is a voluntary association representing local governments engaged in regional planning, including transportation planning.

[16] Examples include a business that incurs debt to purchase equipment or a household that acquires an appliance that provides a flow of service benefits over time.

[17] For an introduction to alternative financing schemes including P3s, see the Federal Highway Administration's Center for Innovative Finance Support, available at https://www.fhwa.dot.gov/ipd/finance/

P3s have been in existence for many years, but there is still a lack of familiarity on the part of many state-level transportation planners because of the lack of direct experience and the novelty of having private partners. Especially challenging is the long-term horizon for transportation projects, as well as the inherent uncertainty over future use and the capacity for revenue generation from tolls and any other sources tied to use. An important issue is maintenance of the roadway infrastructure. Contracting should have incentives and penalties to ensure that the integrity and operability of the system is sustained for future generations.

Importantly, in the State of Tennessee, P3s have been legislatively authorized solely for transit projects and projects related to transit. The Public-Private Transportation Act of 2016 authorized public-private initiatives that build public transit or facilitate the build of public transit, including related parking facilities or utilities.[18] But the Act does not authorize P3s for projects unrelated to transit, including roadways or other infrastructure improvements.

### LOCAL GOVERNMENT TAX CAPACITY

A separate problem for local funding relates to local government tax capacity and tax effort. Tax capacity refers to the ability to generate revenue from local government revenue sources. Williamson County is an example of a community with high capacity by virtue of relatively large property and sales tax bases, as well as high income. Hancock County, on the other hand, has a much more constrained capacity to generate revenue from own-sources; expanding the number of tax instruments available to the community would do nothing to change this since the county is relatively poor. The practical implication is that communities with relatively low tax capacity may not be able to fund local transportation infrastructure needs.

Tax effort refers to the actual collection of revenue, given a community's capacity. The important distinction between capacity and effort is that the former reflects the generally fixed economic characteristics of a community while the latter reflects choices made by the community. Note that even a low capacity community can demonstrate high tax effort if they choose to do so.

Any revenue-raising requirements from local governments must recognize the fact that communities can have widely divergent tax capacity. The key is to define a system that formally addresses this, and potentially to include additional aid from the state to low-capacity places.

3. ***Legislatively grant enhanced regional transit authority power at the sub-state level.***

Congestion mitigation strategies could rely in part or in whole on local government revenue sources, though the state would presumably continue to play a primary role in identifying project needs and coordinating the statewide transportation network. Local governments would face the same challenges as the state in identifying revenue instruments to fund any locally-administered programs, and the state may have to grant local governments additional revenue-raising authority. General revenue instruments such as the sales and property taxes cannot serve as congestion pricing tools since they do not affect driving behavior. They could be used to fund other efforts to mitigate congestion, but tax burdens would not align with the sources of congestion and community-wide taxpayers end up bearing the burden. Special local option levies could be enabled, like a surcharge on

[18] https://www.stites.com/resources/client-alerts/tennessee-enacts-public-private-partnership-statute-in-its-quest-to-solve-g

the gas tax or a dedicated sales tax. However, there would continue to be a disconnect between taxpayers and the sources of the congestion problem, and tax avoidance remains an issue.

An alternative would be to rely on local governments through a dedicated regional transportation authority to administer state-funded transportation grants, potentially in partnership with the private sector. Using state grants avoids the issue of local revenue generation and can ensure adequate funding streams for chosen projects. Properly structured grants that require some form of matching can be complementary, but once again, these need to recognize the differential ability to generate funding across communities with differential revenue capacity.

***4. Legislatively address design-build constraints to speed up project delivery.***

Whatever strategy the state uses to advance infrastructure development will more immediately impact Tennessee businesses and residents if it is accompanied by legislation to accelerate project delivery. Current design-build constraints affect not only the State's ability to construct needed infrastructure quickly, but also the ability of Tennessee municipalities to construct needed infrastructure.

Tennessee law imposes as set of requirements over what public purchases must be authorized through a competitive bidding process, and provides for limited exceptions to these requirements. Work authorized under the Tennessee Department of Transportation typically happens under a Design-Bid-Build model where the State separately contracts with a designer and a builder, sequentially, to complete needed work, and competitive bidding governs builder selection. The process adds time delays to a project because the design must be fully set before the builder selection process can begin. Under a Design-Build model, contracts are awarded to a single contractor with responsibility for both designing and building the project in question. The time advantage comes from eliminating the bid time, and from construction commencing prior to design being finalized. Design-build projects are may be somewhat less cost efficient, however, because they do not allow the buyer to separately contract over the two stages of the process, and competitive bidding does not enter into the build stage separately.

To move infrastructure projects in the State most quickly, the State might consider granting additional exceptions to the design-bid-build rule, pushing higher priority projects into the design-build structure.

## 5. CONGESTION MITIGATION POLICY OPTIONS

With the fiscal policy solutions identified in the previous section, the State of Tennessee could then turn to increased investments in congestion mitigation.

Traffic congestion tends to be characterized by a self-limiting equilibrium state: when congestion increases, it may discourage some people from commuting, but it also discourages them from participating in efficient transportation options such as rideshare and transit[19]. As a result, congested road networks have a consistent element of "latent" demand such that traditional solutions like roadway expansions seldom provide long-term congestion relief/reductions because much of the additional capacity fills up with latent demand. Long-term congestion reductions require changing this equilibrium, shifting demand in more lasting ways — a process we refer to as "demand management."[20]

We classify demand management strategies into four groups based on the timeline of relief delivery as well as the potential to deliver lasting congestion relief effects.

**CATEGORY 1: Providing immediate relief for over-the-road congestion**

The State of Tennessee has an opportunity to quickly provide relief for road congestion. With new legislative authority to implement managed lanes and congestion pricing on the most clogged arteries, the state could implement truck acceleration and deceleration lanes, allowing freight traffic to enter and exit interstate routes more efficiently and safely. The city of Dallas/Fort Worth uses TEXpress lanes, where drivers pay congestion fees that do not exceed $0.93 per mile to move at an average speed of 71 miles per hour in these express lanes. Analysts project the economic impact on the Dallas area to be an increase of $7.5 billion in revenue for infrastructure investment while adding 4,500 new jobs during the construction phase.

A second managed lane option is active lane diversion. Figure 8 shows two examples of the actual slowdown that occurs on major TN arteries (I-75 and I-24) during a 24-hour period, with evidence of the potential relief that managed lane diversions (from northbound to southbound, eastbound to westbound, and vice versa) during peak periods has to offer. In each case, diverting some I-75 northbound lanes to a southbound direction and some I-24 eastbound lanes to a westbound direction during peak periods would offer significant relief without the need for heavy capital intensive investments.

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[19] Curiel Rafael Prieto, Humberto González Ramírez, Mauricio Quiñones Domínguez and Juan Pablo Orjuela Mendoza (2021), "A Paradox of Traffic and Extra Cars in a City as a Collective Behaviour," Royal Society Open Science (https://royalsocietypublishing.org); at https://royalsocietypublishing.org/doi/10.1098/rsos.201808#d1e284.

[20] Prior research also supports this notion that roadway expansions - if they work - usually provide only modest and short-term congestion reductions on major urban corridors where congestion is most intense. For background information on this relationship see Susan Handy and Marlon Boarnet (2014), Impact of Highway Capacity and Induced Travel on Passenger Vehicle Use and Greenhouse Gas Emissions, policy brief and technical background memo prepared for the California Air Resources Board at http://arb.ca.gov/cc/sb375/policies/policies.htm. and Susan Handy (2015), Increasing Highway Capacity Unlikely to Relieve Traffic Congestion, National Center for Sustainable Transportation (http://ncst.ucdavis.edu), available at https://cal.streetsblog.org/wp-content/uploads/sites/13/2015/11/10-12-2015-NCST_Brief_InducedTravel_CS6_v3.pdf

**Figure 8: I-75 and I-24 samples**

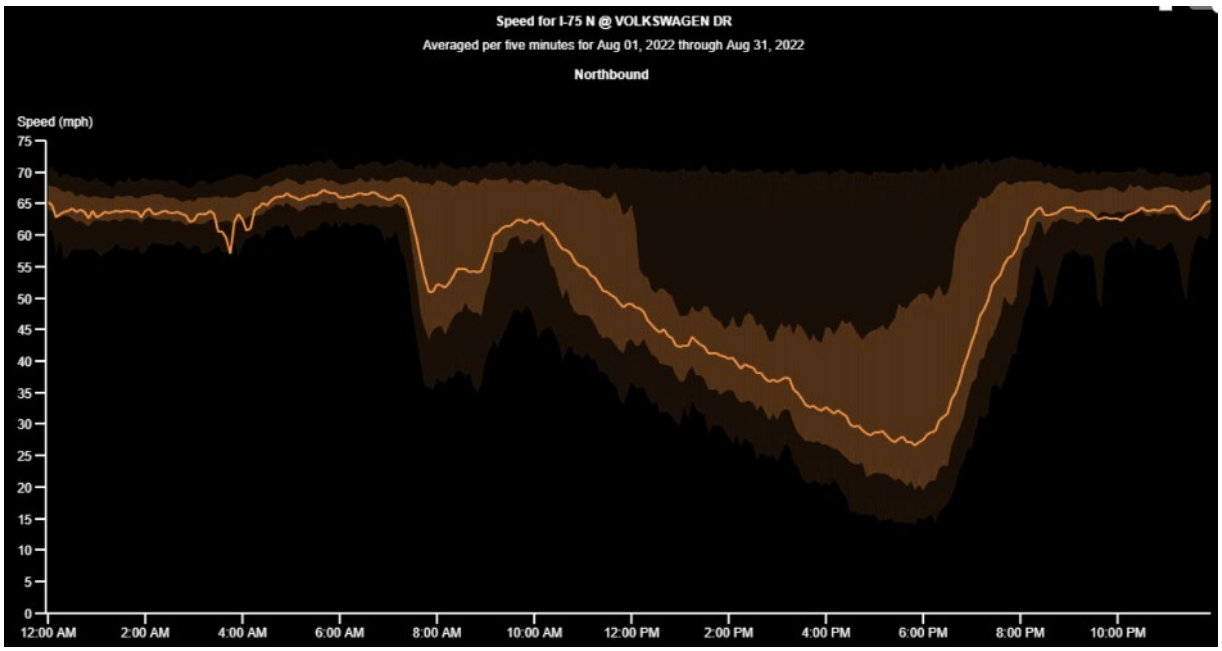


Figure 8A: Speed Metric for August 1 – August 31 (12AM-12PM): I-75N

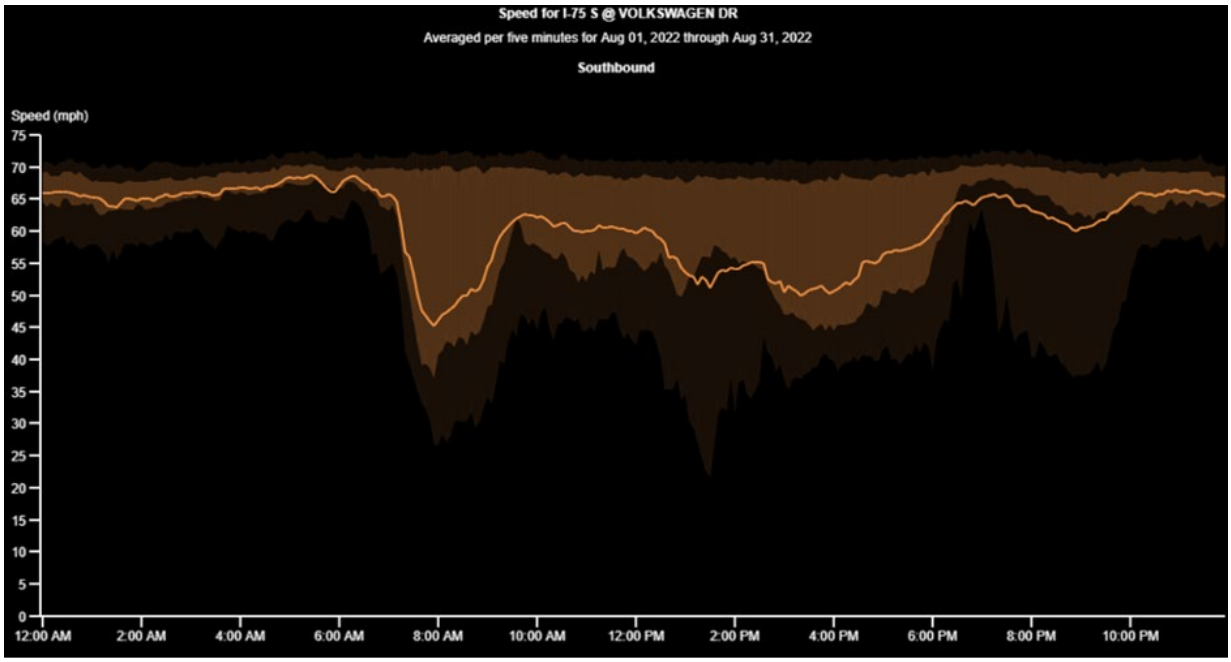


Figure 8B: Speed Metric for August 1 – August 31 (12AM-12PM): I-75S

Author-generated from data obtained from RITIS

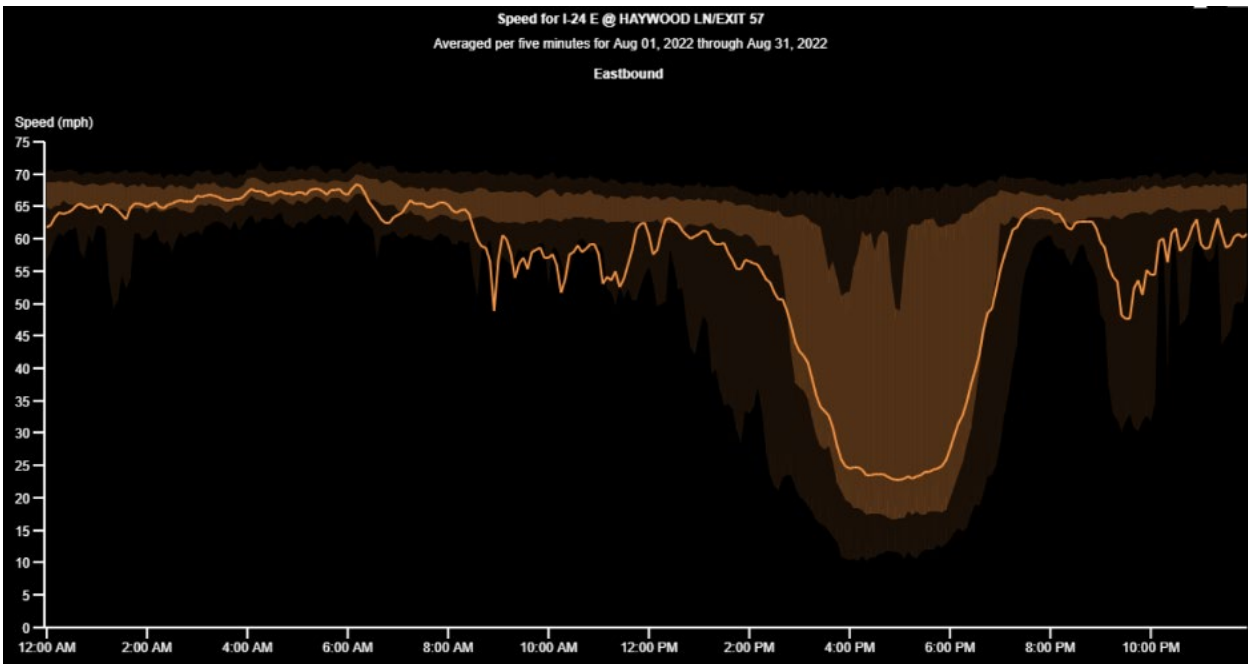


Figure 8C: Speed Metric for August 1 – August 31 (12AM-12PM): I-24E

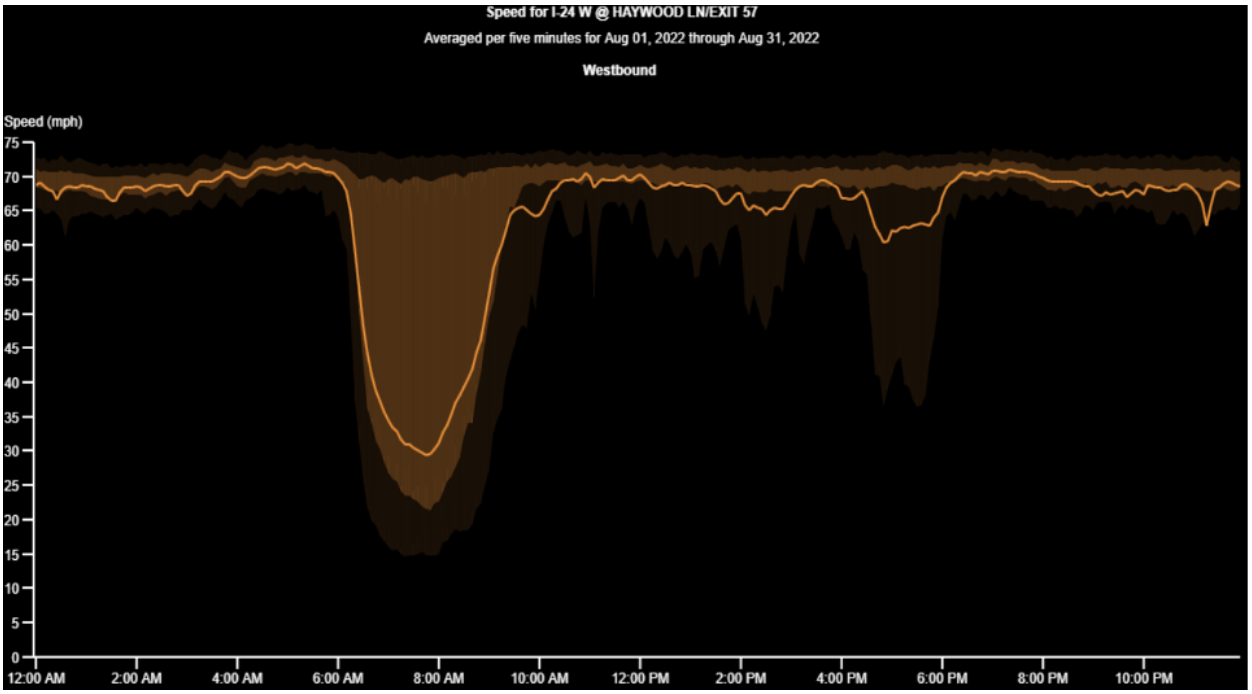


Figure 8D: Speed Metric for August 1 – August 31 (12AM-12PM): I-24W

Author-generated from data obtained from RITIS

Another example of a managed lane solution is the implementation of HOV or truck only lanes. The I-75 Commercial Vehicle Lanes project involves the construction of two barrier-separated, northbound truck-only lanes beginning at the I- 75/I-475 Interchange in Monroe County along the I-75 corridor for approximately 41 miles, ending near the SR 20 Interchange in Henry County. Managed lanes are

designed to maximize the use of available lanes by encouraging travelers to use high occupancy vehicles. Managed lanes strategies include the designation of lanes for use by only high occupancy vehicles to increase the total passenger carrying capacity of a roadway. The result is a reduction in

overall vehicle demand and an increase in travel speed. Secondary benefits of these approaches may also include the opportunity to increase transit use by offering transit-only lanes, providing alternative fast speed choices to the traveler, while generating state revenue through layered congestion pricing solutions.

Congestion pricing is another option for generating immediate relief on Tennessee's roadways by pushing traffic demand away from peak hours while staying within the carrying capacity of the roadway. This effectively reduces backups and delays that result when traffic flows exceed the carrying capacity of the roadway. The implementation of congestion pricing, particularly if layered with proactive lane diversions/redesignations, can increase average traffic speed during peak hours and increase the utilization of available roadway capacity outside peak hours.

**CATEGORY 2: Advanced Technology Solutions**

The use of advanced transportation technologies offers significant potential for congestion relief. Example opportunities include the use of TDOT funds to invest in more transportation technology as a means to proactively divert freight traffic off major commuter arteries and onto alternative modes. For example, installing Variable Message Signs (VMS) on freeways and arterials can inform drivers about diversion routes to avoid periodic lane blockages that occur due to traffic incidents. Analysis of the carrying capacity of alternative routes will reveal the carrying capability of alternative routes and identify the improvements required to expand capacity to meet forecasted demand. Improvements can range from upgrading traffic control such as traffic signals to expansion of roadway capacity through spot lane expansions.

Traffic relief through signal timing and prioritization are a proven tool for successful integrated corridor management, as evidenced in the following examples.

In the state of TN, the multiphase, 28-mile-long I-24 Smart Corridor project uses artificial intelligence to advance a comprehensive Integrated Corridor Management system along that interstate and connecting highways and state routes.

The city of Dallas has achieved substantial gains from their integrated corridor management program along US-75 - a freeway with continuous frontage roads. Dallas implemented managed high occupancy vehicle (HOV) lanes combined with the use of approximately 900 traffic signals. Using real-time traffic control systems, sensors and smart cameras are employed to improve traffic flow and have cars and trucks wait shorter times at lights.

In the same way, the city of Chicago has done substantial work using traffic signal timing and prioritization to improve its safety and congestion issues. Chicago's Transit Signal Priority (TSP) program leverages existing transportation and transit infrastructure to modify communication and software systems. This prioritizes transit buses at every traffic signal, thus eliminating the need for

separate field equipment to detect buses. TSP is deployed along 13 priority corridors to help citizens travel along 100 miles of roadway and through over 500 intersections operated by the Illinois Department of Transportation.

**CATEGORY 3: Modal Diversions - Incident and Non-Incident Induced**

The third category of mitigation techniques involves diversion of traffic flow from one mode of transportation to another and/or from one means of transportation to another in real time.

***Incident-Induced Diversion***

Incident-induced Rerouting Solutions involve the implementation of diversion routes to provide alternatives to primary routes in the event of a significant or total roadway capacity reduction. Events may include a traffic incident, natural disaster, or emergency rendering a roadway facility impassable. This solution category requires the ability to actively (and in real-time) divert traffic to parallel roadways in a carefully planned alternate route implementation. This option provides an effective, albeit temporary, response to facilitating increased mobility and improved travel time reliability in the corridor. Because safety is key, the deployment of Advanced Traffic Management System (TMS) traffic network monitoring systems is helpful to navigate this solution and improves the management capabilities of TMC operations staff and incident responders in the field. Solution ideas that enable the safe execution of this category of congestion relief include enablers of operational control of field devices such as dynamic message signs, traffic signal controllers, pedestrian/transit systems along these parallel routes, etc.

***Non-Incident Induced, Semi-Permanent Modal Diversion***

Because the congestion issues experienced on over-the-road modes of transportation are not the same as with other modes in the State of Tennessee, another sub-category of modal diversion solutions include the ability to facilitate non-incident induced, semi-permanent diversion of freight from over-the-road options to alternative modes. For example, congestion does not exist on the state's inland waterways and rivers; there is plenty of capacity on these water systems. Congestion is also not measured in inland waterways in the same manner as over the road highways. On the inland river system, congestion can be re-defined as 'delays' and many of the delays on the inland river system are caused by the lock system. For example, a tug (push-boat) can move upwards of 12-15 barges yet in most locks, generally only 4-6 barges can be moved at any one time. The barges are then moved through the lock, held temporarily on the other side until all the barges can then be repositioned together as one unit. To solve this queueing bottleneck problem, there is growing interest by inland ports (including the city of Memphis) to develop an alternative way of getting ocean containers into the US market more efficiently using the container on-barge service. This concept involves moving ocean containers up inland waterways to new and established container ports inland. Proponents suggest this alternative way of getting ocean containers into the Midwest by moving ocean containers up the Mississippi River via barges or similar vessels. River travel is already established in the US and the Tennessee Valley Authority (TVA) estimates that barges can move one ton of cargo 647 miles per gallon of fuel.[21] While limited information was found in our research regarding similar interest (outside of Memphis), say in Nashville, Chattanooga, or the Knoxville area, overall, the inland river system has capacity to move more freight. A critical step in this direction requires connecting barge owners with freight owners (shippers) that are willing to move freight via the inland river system.

[21] https://www.tva.com/environment/managing-the-river/economic-significance

Key recommendations therefore include the utilization of legislative and economic incentives to encourage targeted Beneficial Cargo Owners that currently reside in Tennessee, and that are medium to high users of the interstate system, to utilize the inland river system to lessen the congestion impact. The Inland Rivers Port & Terminal Association, in conjunction with *OpenTug*, have created a digitized platform that allows shippers to have crowdsourcing capabilities that may help increase containers-on-barge. Shippers along and near the inland river system oftentimes may not have a minimum container volume to cost effectively justify the route. Using solutions and systems like *OpenTug*, shippers will have the ability to coordinate and combine shipments in order to utilize container-on-barge modes more efficiently and more cost effectively. In 2018, New York City launched a $100 million plan to improve maritime transport by exploiting the river barges that run throughout the city. The ultimate goal was to try and get 30,000 trucks off of the roads each year by routing some of that freight traffic over the Hudson and East Rivers. To compare that to the entire State of Tennessee, we have the Mississippi River running by Memphis, the Cumberland River running through Nashville, and the Tennessee River running through Chattanooga and Knoxville. As one key example of the state's move towards this particular mode diversion opportunity, TDOT was recently awarded grant funding to study the inland river system. The project, titled "Effective Use of Tennessee Inland Waterways" has three objectives: develop a knowledge bank on best practices on inland waterway programs; develop a web-based and desktop data analytics and decision support tool that will help synthesize and analyze available data on Tennessee's inland waterway system, and associated assets; and develop a set of key performance indices to monitor stressors and performance.

Rail is also an option for freight mode diversion. Nationwide, rail system capacity has diminished within the past 18 months. The Union Pacific (UP) announced in July 2021 that they were not accepting container trains from the west coast ports to the Midwest for 10 days. The BNSF accepted freight from the west coast ports to the Midwest yet placed the trains along sidings in the Plains States. Since then, operations are near normal with the greatest concern over the imbalance of empty containers. This creates an opportunity in states like Tennessee where four of the Class I railroads operate in the Memphis area, with Norfolk-Southern (NS) and CSX being primary operators across the rest of the state. More recent port congestion is also creating further opportunities, enabling container shipping companies and rail operators to enter into new trade relationships. As the Ports of Los Angeles and Long Beach continued to struggle with rail and truck productivity last year, some operators like Norfolk Southern started cutting down on container congestion by offering truck drivers incentives to drop off and pick up containers on the same trip. The rail operator has also opened two lots which can handle as many as 2,000 ocean containers in an effort to relieve the gridlock at its main terminal in Memphis, TN[22]. Key recommendations therefore include investing in targeted rail infrastructure improvements to upgrade the connectivity and condition of existing rail lines in the state. This opportunity offers the potential for expanded rail use through the improvement of existing rail lines and long-term expansion of rail infrastructure.

## INLAND PORT OPPORTUNITY

Inland port solutions are another modal diversion opportunity to offer long-term relief. Inland ports divert international freight from and through international port locations to an inland location for further processing and distribution via water, rail, or road.

Several cities in the United States have already started on this approach, with the typical go-to exemplar being the inland port of Joliet, Illinois, which has become one of the front runners in its ability to facilitate movement of goods and commuter traffic. Will County, where Joliet is located, has created a strategic focus on the supply chain to capitalize on its current infrastructure, pushing $75 billion worth of goods through its inland port. The port combines the use of three navigable waterways with five Class 1 railroads and four interstate highways to move goods throughout the region. Joliet also boasts a privately-owned and operated freight-only bridge over Des Plaines River currently underway to divert freight traffic from I-80, I-55, and local roads directly into intermodal yards.

Another example model of a successful inland port is at Fort Worth Alliance Airport. Multimodal in nature, the Alliance, Texas intermodal hub is ranked 20th in the nation for US cargo operations with a capability to handle large cargo aircraft and intermodal exchanges. This enabled the inland port to accommodate private sector clients such as the BNSF Alliance Intermodal Facility, Amazon's regional air hub, and FedEx and UPS's southwest regional ground sort hub. Other benefits to the private sector include direct access to west coast ports and the opportunity to utilize the foreign trade zone (FTZ) inventory tax exemption that covers the entire port.

Two other major cities, Kansas City and New York, have either started or already completed projects where similar inland ports are used to increase traffic mobility through towns. Kansas City has an economic development organization referred to as Kansas City SmartPort. The KC SmartPort is a nonprofit, investor-based organization that tries to "determine the feasibility and national benefits of establishing the Kansas City region as a place where international trade processing activities can be carried out." Touting their "2 days or less" accessibility to 85% of the rest of the US, KC SmartPort has access to three major interstate systems and 20,000 miles of railroad to move products nationally and internationally. To further this goal, recent infrastructure improvement projects include the signed MOU between Kansas City SmartPort and the St. Louis Regional Freightway to support upgrade projects on Missouri's I-70 corridor due to its strategic importance as a key industrial freight route.

**CATEGORY 4: Long-term Land Use Approach - Freight Clusters and Permanent Modal Diversions**

Finally, we highlight a broader and more structured regional solution for significant pass-through traffic and future growth: a land-use approach to creating freight clusters. The Atlanta Regional Commission defines freight clusters as plans "that focus on facilitating the efficient movement of freight, improving access to jobs, reducing traffic congestion, changes in the freight industry, and improving safety, mobility, and access for all roadway users."[23]

[23] https://atlantaregional.org/transportation-mobility/freight/transportation-mobility-freight-freight-cluster-plans/

Freight clusters represent a more proactive, long-term effort to mitigate over-the-road congestion by consolidating common types of activities into a single area in order to reduce the activity's negative impact on a broader area. Typically requiring coordinated efforts across multiple public and private sector stakeholders, freight clusters concentrate freight users (such as distribution centers, manufacturers, truck terminals, intermodal facilities, etc.) into a single geospatial area.

Concentrating freight users in a single location enables the support of increased productivity and growth within the defined area while controlling the typical spillover effects that such growth brings. By congregating like-minded entities close to a "base" origin or source of high-volume freight (such as ports, production facilities, distribution centers, free trade zones etc.), this approach lends itself to innovative land use solutions for mitigating congestion while enabling economic growth. While there could be significant potential for increased traffic in the immediate surrounding area of the freight cluster region, innovative land-use approaches effectively reduce freight traffic outside the immediate area by consolidating all freight users within close proximity to the freight origin.

BMW's recently expanded Spartanburg, SC plant is a perfect example of how innovative land use for freight planning works. With the facility billed to be over a million square feet in size, addressing the impact of truck traffic in the area was critical to success. BMW planned for two private bridges over I-85, to connect the logistics center to the BMW campus, allowing the company to essentially implement measures for a more sustainable land-use approach to expanding its logistics operation.

The Ford Company investment plan for Stanton, TN just outside of Memphis is an opportunity to learn from this land use model. The planned 6-square mile manufacturing complex, dubbed BlueOval City, is a perfect example of a project that will require innovative land-use approaches to proactively manage congestion.[24] Because these solutions require land acquisition, construction, and facilities operations, this approach requires extensive cooperation between multiple stakeholders in the public and private sectors and surrounding communities. Extensive stakeholder involvement and legislative support of public-private partnerships will be necessary, as will be an assessment of potential impacts of such planned land use for all economic agents and stakeholders involved.

The Inland Port in Greer, SC to the South Carolina Port is another prominent example of how freight clusters mitigate congestion within and around an origin high freight volume source. As a rail-served inland port facility located in the upper part of South Carolina, Greer extends the Port of Charleston's reach 212 miles further inland through rail transportation to ensure the fast and efficient movement of goods into the market area. With an estimated 150,000 rail moves via Norfolk-Southern Railway in 2022, the presence of this inland port eliminates that equivalent amount of truck moves to/from Charleston. With an expanded FTZ capability offering significant tariff reductions, the inland port at Greer, SC also supports next-day availability of containers through its 24/7 gate availability. Import loads discharged in Charleston in the morning can be taken to the local Norfolk Southern Intermodal ramp and made available in Greer, SC by 8:00 AM the following day. This offers freight users unprecedented flexibility and control, supporting manufacturers' abilities to run tight production schedules and retailers' abilities to offer faster inventory velocity and reliability in their supply chains. In its location close to population centers and the state's key import/export clients, the inland port at

[24] https://www.commercialappeal.com/story/money/business/development/2022/07/21/memphis-ford-plant-latest-developments-blue-oval-city/10116675002

Greer, SC shifts freight off the roads without jeopardizing effective supply chain operations at the port - again enabling growth without the associated congestion spillover effects.

For an example of innovative land-use solutions closer to home, we highlight the permanent diversion project at the I-55 interchange at Crump Boulevard in Memphis, TN. With its heavy pass-through traffic heading to and from Arkansas, this interchange represents a crucial aspect of congestion relief for the state as high volumes of commercial trucks use this interchange. From a permanent diversion perspective, the proposed project will replace the existing cloverleaf configuration with one that improves driver safety, reduces crashes and links to a continuation of I-55. These improvements will consist of constructing new travel lanes for the mainline traffic on the interstate to eliminate the current requirement for interstate traffic to use single-lane, low-speed ramps to continue on I-55. With that, a new multi-lane roundabout intersection will be constructed to replace the existing cloverleaf interchange[25]. Potential heavy investment areas stand the chance of benefiting from such a land-use approach to rethinking freight movement and potential congestion mitigations strategies.

**MEASURING SUCCESS**

While a few states (Florida, Texas, and Georgia) provide great examples of what is possible, the Volunteer State could also identify key performance measures that can be used to measure progress in reducing congestion and its related costs.

In order to ensure that we are making progress in meeting the needs of Tennessee residents and businesses, useful measures include:

- Incremental number of new businesses that relocate to TN
- Incremental number of businesses that relocate to a specific region, or cluster area within zones where congestion relief solutions have been implemented
- Number of incidents involving trucks pre-post project implementation

From a congestion perspective, tracking tried and true congestion metrics is critical. These measures include two critical ones:

- Measure of Total Travel Time- Travel Time Index (TTI): Defined as the ratio of actual travel time to free-flow travel time, measures the intensity of congestion.
- Measure of Travel Time Reliability - Planning Time Index (PTI), defined as the ratio of 95th percentile travel time to free flow travel time, measures travel time reliability.

[25] https://www.memphistn.gov/news/lane-closures-and-traffic-shifts-for-i-55-and-crump-boulevard/

## CONCLUSION

The State of Tennessee has an opportunity to accelerate its recent successes in workforce growth and business relocation. The Volunteer State offers low taxes and a low cost of living to residents and businesses, along with natural beauty in each of the three grand divisions. The state's education systems are strong, including a highly ranked community college system with a funding model that provides two years of post-high school education free to Tennessee residents. Tennessee's unemployment rate is low, and job availability high. Tennessee sits within a day's drive of two-thirds of the country's population, an advantageous location for residents and Tennessee businesses alike.

Mitigating congestion on the state's roadways will improve quality of life for Tennessee residents and reduce their cost of living, while also making Tennessee businesses more competitive and improve the attractiveness of the state for new startups and for business relocations.

The congestion challenge in Tennessee can be met, but it will require thinking differently about the set of policy tools available to do so. At current transportation funding levels and with current legislative authorizations, the state cannot take on the capital expenditures required to meet congestion challenges, nor can it enable next-generation technologies in congestion management. And the state is not currently enabled to take advantage of the private sector's capital and know-how in this area. A set of legislative actions to open new funding avenues would then allow the state to make the sorts of investments and engage in the sorts of partnerships currently underway in other Southern states.