

White Paper #1 – The Future of Tolling

Tolling Technologies for a Brighter Future

Compiled by: [A-to-Be®](#) | [Mobility-Beyond](#)

Introduction

In 2020, A-to-Be launched a White Paper series concerning the Future of Transportation Funding in the United States, recognizing that roads and bridges are the lifeblood of the American economy. Crumbling transportation infrastructure, however, presents a debilitating roadblock to future productivity. Chronic underfunding and deferred maintenance put the U.S. in a position today requiring an estimated \$1 trillion in improvements. (1) Industry and government may disagree on the best approach, but one thing is certain – the United States must embrace sustainable sources of transportation funding.

For over a century, **America's road network has been primarily paid for through state and federal fuel taxes.** As we concluded in last year's white paper series, **the sale of gasoline will continue to decrease as demand for cheaper, more fuel-efficient cars, and electric vehicles increases.** Concurrently, **the pandemic has reshaped the way people commute in metropolitan areas.** A survey conducted by PricewaterhouseCoopers (PwC) showed that fewer than 20% of corporate executives believe employees need to return to the office five days a week. (2) As long as employees continue to work from home, the already struggling transportation financing will continue to feel the negative budget effects of the lack of traditional communities.

The purpose of Road Usage Charging (RUC) or a Vehicle Mile Tax (VMT) is to find a potential way to replace the gas tax by creating an equitable arrangement for drivers to pay for the time they spend on the road and recover the costs of damaged infrastructure. However, **RUC initiatives are being launched mostly in the form of pilots, suggesting that it will take some years to come to the final design and the full implementation** of the future taxing model for transportation infrastructure.

In any case, the current form of RUC will mostly aim, as the fuel tax does, at the maintenance and updating of the current road network, either managed at a Federal, State, or local level. Due to the expected economic growth in the United States and the increasing mobility needs of its citizens, **governments must not only play catch up with the backlog of maintenance of our current infrastructures but also work to alleviate the worsening congestion on key highways.** New infrastructure or major upgrades to existing bridges, tunnels, and roads, including the creation of HOV (High Occupancy Vehicles) or Express Lanes, are urgently required.

Even with the recent passage of the American Recovery Act, states and local governments struggle with already-strained budgets, and governments need to find alternative forms of funding to be able to cope with their constituents growing demands in the public transportation domain. For these investments, the different forms of tolling should be considered as an efficient funding alternative. Specifically, **state and federal governments should consider the following solutions:**

- 1 **Traditional Tolling** – Either through All-Electronic Tolling (AET) or traditional plaza-based tolling, an increasing number of states such as Connecticut, Michigan, and Wyoming are working to pass tolling legislation to shore up transportation funding. Recently, new toll roads opened in Texas, California, Virginia, Florida, North Carolina, and Oregon, and other state agencies are looking to expand their current network of tolled roads, bridges, and tunnels.
- 2 **Managed Lanes** – HOV or Express Lanes operate according to demand. Operational strategies for managed lanes enable a high degree of flexibility so that they may be actively managed to respond to changing conditions. These include access control lanes (express and reversible lanes), vehicle eligibility lanes (HOV and truck lane restrictions), pricing lanes (value-priced and toll), and comingled lanes (toll express lanes that also double as Bus Rapid Transit (BRT) lanes). Examples of these types of managed lanes are found across the United States. The managed lanes described above generate the funding necessary to respond to growing demand and congestion in an equitable way.
- 3 **Congestion Pricing** – Commonly cited as one of the most effective tolling tools, congestion pricing has a profound capacity to reduce traffic in and out of major cities. The usage fee works by shifting rush hour highway travel to other modes of transportation or to off-peak hours. New York is the first U.S. city to establish a congestion pricing toll system. Motorists traveling in and out of Manhattan will be charged a flat or variable rate to drive within specific areas of the city during peak times. The toll is projected to generate between \$1- \$2 billion annually. (3) Congestion pricing benefits drivers and businesses by reducing delays and increasing predictability in trip planning. Further, congestion pricing allows transit authorities to increase speed, reliability, and ridership while lowering overhead costs. State and local governments benefit by improving the quality of transportation services without increasing taxes or large capital expenditures, and by shortening incident response times for emergency personnel, thus saving lives. (4)

Any of these tolling alternatives can also apply to Public-Private Partnerships (P3), often used to deliver public services with the resources, efficiency, and innovation afforded by private companies. Under this model, private sector partners take on the design, build, financing, and long-term operation and maintenance responsibilities of the project to guarantee on-time delivery, cost-savings, and access to new sources of private capital. The user pays a “toll” to the private company selected by the public entity contracted to operate and maintain the tolled asset (road, bridge, tunnel). The Indiana Toll Road is an example of the P3 model in action: in 2006, Indiana agreed to lease a 157-mile toll road to private investors for an upfront payment of \$3.8 billion. In exchange for the \$3.8 billion, the private investors would keep all toll road revenue for 75 years. (5)

This year A-to-Be will author a new White Paper series concerning the most innovative tolling technologies that will ensure an efficient and effective toll collection in the long-term, enabling the sustainability of these infrastructure financing alternatives as a solution to deliver economic opportunity, ease of use, and peace of mind. We will also focus on the recent trends given the challenging times the world is facing and how A-to-Be learned and evolved accordingly.

“ This year A-to-Be will author a new White Paper series concerning the most innovative tolling technologies that will ensure an efficient and effective toll collection in the long-term ”

The Future of Tolling

Tolled infrastructures in the United States include roads, bridges, and tunnels. More recently, road tolling has evolved to include concepts like managed lanes and congestion pricing, as mentioned before. According to the most recent report by the Federal Highway Administration, **the United States has almost 6,000 miles of toll roads across 35 states. A large majority of these 6,000 miles of road are operated by public agencies.**

Almost 81 years have passed since the first modern-day tollbooth was installed just outside of Pittsburgh, Pennsylvania. Since then, innovation has continually brought advances to the tolling industry. **The tolling industry is now at an inflection point shifting away from 20th-century solutions to a future where technology will drive the industry's success.** The tolling industry is replacing the traditional toll booths and moving towards AET. **Electronic tolling uses Radio Frequency Identification (RFID) technology** that connects with the transponder on the car's windshield, which exchanges a signal with antennas located in the toll zone, and then charges the driver's account.

“ The tolling industry is now at an inflection point shifting away from 20th-century solutions to a future where technology will drive the industry's success. ”

“ Technologies are emerging to promote efficient and convenient toll collection, both for operators and end-users. ”

Apart from RFID, other technologies are emerging to promote efficient and convenient toll collection, both for operators and end-users. A-to-Be is on the cutting edge of technology in the mobility field, also promoting touchless and digital forms of tolling due to the current pandemic. **Image-based, GPS, or Bluetooth** are only a few examples of advanced technologies to charge for tolls offering time, convenience, and safety. Additionally, **blockchain-based solutions** can make toll collection easier and more efficient, providing a secure and transparent mechanism to make, record, and verify any type of transaction.

Machine learning is an application of artificial intelligence that develops robust algorithms that can support and enhance the business process in toll operations. For example, A-to-Be's solution for Automatic Vehicle Type Detection automatically analyzes each vehicle using the video engine, which determines not only the vehicle type but also its volume, dimensions, speed, and lane used. **Technology also allows us to eliminate traffic congestion** through apps, GPS, and other tools, that track traffic and set prices in real-time,

charging tolls using the location. Through **big data and analytics**, agencies today can analyze complex systems for the mobility environment and provide customized solutions. **Connected vehicles and 5G** are crucial steps to increase the safety of automated vehicles and their full integration in the overall transportation network, including tolling.

In addition, **modern back office systems, like A-to-Be's MoveBeyond, provides for a seamless user experience aligned with AET.** This secure system configures roadside data and license plate imaging to address dynamic pricing and RUC in real-time. Agencies who use new generation back offices will experience increased revenue streams and reduced leakage. Customers benefit from a simple account management interface on their smart device, multi-modal payment options, singular invoicing, and dedicated customer support.

More than half the world's population now lives in cities, and as congestion in urban areas becomes worse, new solutions such as congestion pricing need to be examined. (6) Congestion pricing works by shifting rush hour highway travel to other modes of transportation or off-peak hours. **Congestion pricing benefits drivers by reducing delays and increasing predictability in trip planning.** The technologies to enable Congestion Pricing and Managed Lanes already exist or are being developed. **Traditional gantries complemented with video analytics and dynamic pricing algorithms, supported by traffic management solutions and an integrated back office, allow agencies to provide superior service.** For instance, A-to-Be has developed an algorithm that automatically detects the number of occupants in a vehicle, which can be used for enforcement in HOV lanes.

From the first toll booth to the present day, tolling has evolved and will continue to move to new frontiers. There are no magic bullets to every problem the tolling industry faces, but **a variety of solutions ranging from traditional tolling practices, to highly optimized systems capable of regulating traffic in and out of our most congested cities, to high tech back office systems, will give us a look into the future of tolling.**

The Future of Mobility

The future of mobility depends on **updating our aging infrastructure**. Nationwide, **21.8% of roads are in poor condition and 7.6% of bridges need replacement or repair**. (7) More than two of every five miles across America's urban interstates are overcrowded and present congestion delays that cost American drivers a reported \$160 billion per year. (8) Infrastructure spending is commonly brought up in Washington D.C. but deciding how to pay for such a large package typically causes friction. **To finance an infrastructure bill, the federal government will likely consider a multitude of solutions that look into the future, including increasing the prevalence of tolling**, the subject of this year's series. These solutions may include congestion pricing or RUC, in this case as a replacement for the current fuel tax.

Transportation Secretary Pete Buttigieg has recently described for how mobility is evolving and is more than just the traditional model. For instance, Secretary of Transportation Buttigieg acknowledged that the **technology coming will be fascinating and will transform the traditional transportation model**. Other elected leaders, such as Congressman Sam Graves, the top Republican on the House Transportation and Infrastructure Committee, are also looking to the future and how the government can begin to use agencies such as the United States Postal Service to pilot projects. As the public and private sectors begin to plan for the future, **new technology that will improve our infrastructure is an exciting possibility**.

“ The technology coming will be fascinating and will transform the traditional transportation model. ”

As we peer into the future, car manufacturers such as Ford have said they plan to spend **\$22 billion on electric vehicles and \$7 billion on autonomous vehicles** through 2025. (9) General Motors wants to end production of all diesel and gasoline-powered cars, trucks, and SUVs by 2035 and shift its entire new fleet to electric vehicles as part of a broader plan to become carbon neutral by 2040. (10)

As electric vehicles become the norm, the Highway Trust Fund which supports the construction and maintenance of our nation's highways and transit systems is heading towards insolvency. The Highway Trust Fund is in financial peril due to Congress's decision not to raise the gas tax because the issue is seen as the third rail in government. **The federal gas tax, nevertheless, has not increased since 1993 and is worth 40% less than it was twenty-five years ago**. (11) If Congress continues to sit on the sidelines while the private sector moves away from gasoline-powered vehicles, our infrastructure will only continue to get worse. **RUC seems to be the right solution** as a gas tax replacement. **But it will be insufficient for the increasing mobility needs** of the U.S. citizens and businesses; **new infrastructure investments will also have to rely on tolling to cope with these needs**, implementing efficient and effective operations through the full set of **innovative technology** which is now available.

“ New infrastructure investments will also have to rely on tolling ”

A-to-Be's new series of White Papers

The tolling industry is shifting away from traditional cash payment at toll booths and is quickly being replaced by AET, which was first introduced in the late 1980s. **AET is popular because it allows cars to travel through lanes at highway speeds by simply passing under a gantry**. As a car passes the tolling gantry, electronic tolling collects and sends transaction records to a back office system for processing at a moment's notice. **A-to-Be will explore AET more deeply in the second white paper of this series, through the examination of a recently delivered project**.

The third paper in this series will focus on video tolling. Video tolling is a form of electronic toll collection, which uses still images of a vehicle's license plate to identify a vehicle, whose owner is then responsible to pay the toll. The image is captured as the vehicle drives under the gantry or through a toll plaza at a toll-collection facility. Video Tolling allows drivers without a transponder to use the toll road and pay after receiving a mailed invoice. In a foreseeable future, it may also replace the transponder, in connection to a driver's account.

Our fourth white paper will examine mobile tolling. Motorists today are accustomed to using a transponder to pay tolls, but now the technology exists to make a smartphone as reliable as a traditional transponder. By downloading a smartphone app, motorists can drive through an electronic tolling facility and pay their toll just like they would with a

transponder. One of the benefits of mobile tolling is that it allows drivers to travel through any electronic toll facility without cash or a vehicle-based transponder.

Our last white paper will discuss the need for multi-modality in tolling. Multi-modality is important from an agency perspective because it can lead to new revenue streams. By leveraging the same platform already in use, agencies and customers can benefit from patrons using tolling technology to pay for consumers' goods via their transponders. The potential for multi-modality is high and the U.S. has the technology to expand multi-modality uses.

Summary

As government leaders in states wrestle with limited dollars, **the tolling community must not be forgotten because of the direct benefits that the industry returns to the government.** Many states are updating operating budgets and are realizing the **dramatic effects COVID-19** has had on transportation revenues. (12) For example, at least 44 states, transportation authorities, and local governments have publicly projected declining revenues. When examining California, the state saw a \$556 million reduction in gas tax revenues compared to previous estimates. (13)

As the United States slowly begins to reopen following Covid-19, **toll revenues will begin to climb back towards normal, but the revenue may never be the same** following the work from home trends we are seeing. To continue to save money, state governments can begin to implement cost-saving structures through AET and Automatic Toll Payment Machines (ATPMs). Through this investment, state governments can see **significant savings** and reinvest those savings in aging infrastructure. **New technologies will certainly help, as concepts like Machine Learning, Blockchain, Connected Vehicles and 5G arise** in the tolling industry and agencies look at viable sources for success.

It's exciting to be part of the future of tolling. As the cost of tolling continues to decrease, governments will be able to leverage tolling as a way to deliver critical infrastructure projects. In our next white paper of this series, we will examine a combination approach of AET. The future of tolling is not one size fits all and will include a combination of new technologies that will help government deliver a modern infrastructure to its citizens.

“ The tolling community must not be forgotten because of the direct benefits that the industry returns to the government ”

“ Toll revenues will begin to climb back towards normal, but the revenue may never be the same ”

“ New technologies will certainly help, as concepts like Machine Learning, Blockchain, Connected Vehicles and 5G arise ”

“ The future of tolling is an exciting industry to be a part of. ”



Contact information
**Henrique Cordeiro, Vice
President Sales US**
Henrique.Cordeiro@a-to-be.com
A-to-Be, Powered by Brisa
a-to-be.com

Enjoyed the read and learned something?
Stay tuned for the second White Paper of
this series, where **A-to-Be** will explore the
concept of All-Electronic Tolling in more
depth.



More interesting
industry content can
be found at
A-to-Be's open library.

Works Cited

1. Zhirong Zhao , Jerry, et al. "America's Trillion-Dollar Repair Bill." The Volcker Alliance, Nov. 2019, www.volckeralliance.org/. [Online] <https://www.gsa.europa.eu/>.
2. PricewaterhouseCoopers. "Business Needs a Tighter Strategy for Remote Work." PwC, 12 Jan. 2021, www.pwc.com/us/en/library/covid-19/us-remote-work-survey.html. [Online]
3. Rivoli, Dan. "Biden Administration Could Green Light Traffic Fee." New York's Congestion Pricing Plan Could Start Under Biden, 7 Nov. 2020. www.ny1.com/nyc/all-boroughs/transit/2020/11/07/biden-administration-could-green-light-new-york-s-congestion-pricing-plan. [Online]
4. "Congestion Pricing - A Primer: Overview." Congestion Pricing - A Primer: Overview - Benefits of Congestion Pricing - FHWA Operations, Federal Highway Administration , ops.fhwa.dot.gov/publications/fhwahop08039/cp_prim1_04.htm. . [Online]
5. Trenkner, Tina. "The Indiana Toll Road: A Model for Privatization?" Governing, Oct. 2011, www.governing.com/archive/indiana-toll-road-model-privatization.html. . [Online]
6. "World's Population Increasingly Urban with More than Half Living in Urban Areas | UN DESA Department of Economic and Social Affairs." United Nations. www.un.org/development/desa/en/news/population/world-urbanization-prospects.html#:~:text=World's%20population%20increasingly%20urban%20with%20more%20than%20half%20living%20in%20urban%20areas,-. . [Online]
7. Trenkner, Tina. "The Indiana Toll Road: A Model for Privatization?" Governing, Oct. 2011, www.governing.com/archive/indiana-toll-road-model-privatization.html. . [Online]
8. "Road Infrastructure: ASCE's 2021 Infrastructure Report Card." ASCE's 2021 Infrastructure Report Card |, 7 Mar. 2021, infrastructurereportcard.org/cat-item/roads/. . [Online]
9. Klayman, Ben, and Paul Lienert. "Ford Boosts Investment Plan for EVs and Self Driving Vehicles, Reports Loss." Reuters, Thomson Reuters, 4 Feb. 2021. www.reuters.com/article/us-ford-motor-results/ford-boosts-investment-plan-for-evs-and-self-driving-vehicles-reports-loss-idUSKBN2A42VN. . [Online]
10. Wayland, Michael. "General Motors Plans to Exclusively Offer Electric Vehicles by 2035." CNBC, CNBC, 28 Jan. 2021, www.cnbc.com/2021/01/28/general-motors-plans-to-exclusively-offer-electric-vehicles-by-2035.html. . [Online]
11. "It's Been 28 Years Since We Last Raised the Gas Tax, and Its Purchasing Power Has Eroded." Peter G. Peterson Foundation, 16 Mar. 2021, www.pgpf.org/blog/2018/12/its-been-25-years-since-we-last-raised-the-gas-tax-and-its-purchasing-power-has-eroded. . [Online]
12. Premo Black, Allison. IMPACTS OF COVID-19 ON STATE & LOCAL TRANSPORTATION REVENUES & CONSTRUCTION PROGRAMS. American Road & Transportation Builder Association , 28 July 2020. www.artba.org/wp-content/uploads/2020/08/2020.07.28_ARTBA_COVID19RevImpact_v18_Public.pdf. . [Online]
13. Impact of COVID-19 on State Transportation Revenues, Legislative Analyst's Office | The California Legislature's Nonpartisan Fiscal and Policy Advisor, 17 Sept. 2020, lao.ca.gov/Publications/Report/4268. [Online]