Appendix I: Emerging Technology

GET THERE TOGETHER.

Kentucky's Long-Range Transportation Vision

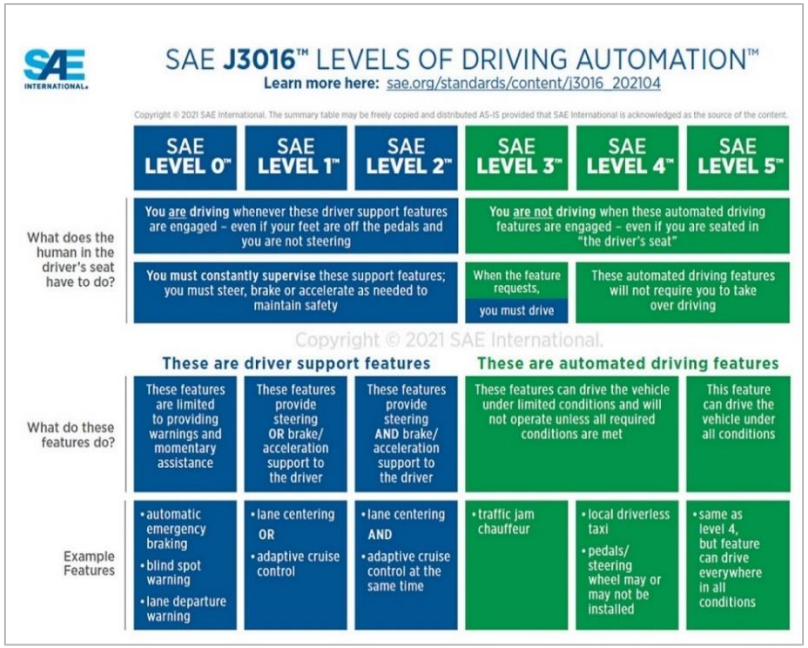
CONNECTED/AUTOMATED VEHICLES (C/AV)

C/AV Inventory

Connected vehicles (CVs) and autonomous vehicles (AVs) are a trending topic for the future of transportation and represent the next revolution in transportation. The C/AVs strive to improve safety by eliminating the human driver error, supporting a movement to zero deaths. Mobility is improved through connection and automation by providing access to transportation to all and improvement to traffic flow by eliminating human perception and decision time, limiting non-recurring congestion, and reducing headways.

The Society of Automotive Engineers (SAE) International has developed "the industry's most-cited source for driving automation. Commonly referenced as the SAE Levels of Driving Automation (Figure 1), the widely referenced publication provides an organized classification equipped with detailed definitions for six levels of driving automation, ranging from no driving automation (Level 0) to full driving automation (Level 5). In 2021, in collaboration with the International Organization for Standardization (ISO), SAE released the latest version of the standardization referred to as SAE J3016. The 2021 release provided, "more clear and concise terminology as well as clarity for an international audience" In addition to SAE, Federal agencies, such as the National Highway Traffic Safety Administration (NHTSA), have also issued connected and automated vehicle guidance for manufacturers and state and local governments. [1]

Figure 1: SAE J3016 Levels of Driving Automation Visual Chart



C/AV Summary

Rapid evolution of emerging technologies has increased the number of states looking to address the potential impacts of connected and automated vehicles on the transportation system. Common issues arising in C/AV-related legislation are safety, public acceptance, progression of automated technology, infrastructure needs and costs, licensing requirements, regulatory regimes for AVs, liability changes, and platooning. C/AVs have the potential to increase the safety of vehicle travel, reduce congestion and emissions, and make transportation more efficient. Prior to regulation, policymakers will have to look at the drawbacks C/AV technology brings, including an increase in Vehicle Miles Traveled (VMTs), job loss in the transportation industry, and costs that may initially be too high for many

[1] SAE International, 2021

consumers. CVs have a wide range of applications but there are privacy concerns over the collection and use of data as well as costs governments will have to bear as they build smart infrastructure. States have several options to prepare for the adoption of these technologies, including planning, monitoring, testing, preparing legislation/regulations, developing data standards, establishing partnerships with manufacturers, and educating the public.

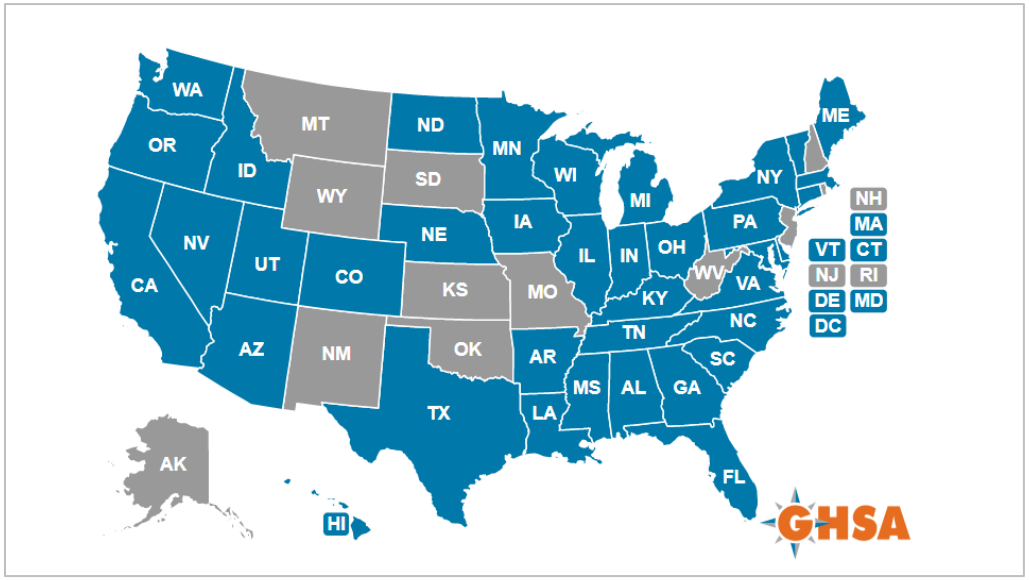
The United States Department of Transportation (USDOT) encourages states to develop clear regulations focused on testing, liability, AV identification via registration protocols, and crash procedures. The USDOT's Federal Automated Vehicles Policy, published in 2016, issues, "an ambitious approach to accelerate the highly automated vehicle evolution."[2]

The policy publication is divided into four sections:

1. Vehicle Performance Guidelines for Automated Vehicles
2. Model State Policy
3. NHTSA's Current Regulatory Rules
4. New Tools and Authorities

Following the policy publication in 2016, USDOT released the Automated Vehicles Comprehensive Plan (AVCP), laying out the Department's strategy to safely integrate Automated Driving Systems (ADS). "This comprehensive plan lays out a vision for the safe integration of automated vehicles into America's transportation system while ensuring that legitimate concerns about safety, security, and privacy are addressed," said Secretary Elaine L. Chao.[3] In parallel, numerous states have enacted or proposed legislation to deal with connected and autonomous vehicles (Figure 2). [4] The content of these statutes varies among states; however, shared areas of concern include defining what constitutes an autonomous vehicle, establishing basic protocols for testing connected autonomous

Figure 2: Map Showcasing States with Laws and Executive Orders Related to Autonomous Vehicles including Platooning



[2] https://www.transportation.gov/AV/federal-automated-vehicles-policy-september-2016
[3] https://www.transportation.gov/briefing-room/us-department-transportation-releases-automated-vehicles-comprehensive-plan
[4] Governors Highway Safety Association, 2022

vehicle technology on public roadways, specifying under what circumstances a manufacturer is liable for crashes, and setting guidelines for operating autonomous vehicles. [5]

In July of 2021 BuiltIn.com highlights 25 tech companies predicted to lead the way for autonomous vehicle technology over the next 30 years. The list includes companies such as Uber, Motional, AutoX, and Cruise who are forecasted to contribute to the estimated 33 million automated vehicles on our public roadways by 2040.[6]

In 2018 Kentucky passed SB No. 116 (Act No. 33), which allows vehicle platooning subject to specific requirements. For example, a platoon operator must provide notification and general plan to the Kentucky State Police prior to operation. Further, vehicles in a platoon are required to display warnings for other motorists and law enforcement. Platoon was defined in the Act as, "a group of two (2) individual commercial motor vehicles traveling in a unified manner at electronically coordinated speeds at following distances that are closer than would ordinarily be allowed under subsection (8)(b) of Section 3 of this Act".

Importance/Impact to KY's Economy

While Kentucky legislatures have discussed the issue of autonomous vehicles, there have not been many laws enacted to protect drivers in the event of an accident. In 2018, however, the state did enact a law to regulate truck platooning. Reviewing Kentucky Revised Statutes (KRS) and Kentucky Administrative statutes and Regulations (KAR), it is apparent there are areas in which future changes may be needed related to licensing, registration, cell phone usage (for AVs) and traffic enforcement. C/AVs, that can drive themselves and communicate with one another are likely to increase vehicle miles traveled and reduce people's willingness to use public transit, according to a new study from the University of California, Davis Three Revolutions Future Mobility Program, which researches shared, automated and electric vehicles.[7] Personally, owned CAVs could travel 40% more miles in 2050, the study found. Traffic congestion could also worsen.

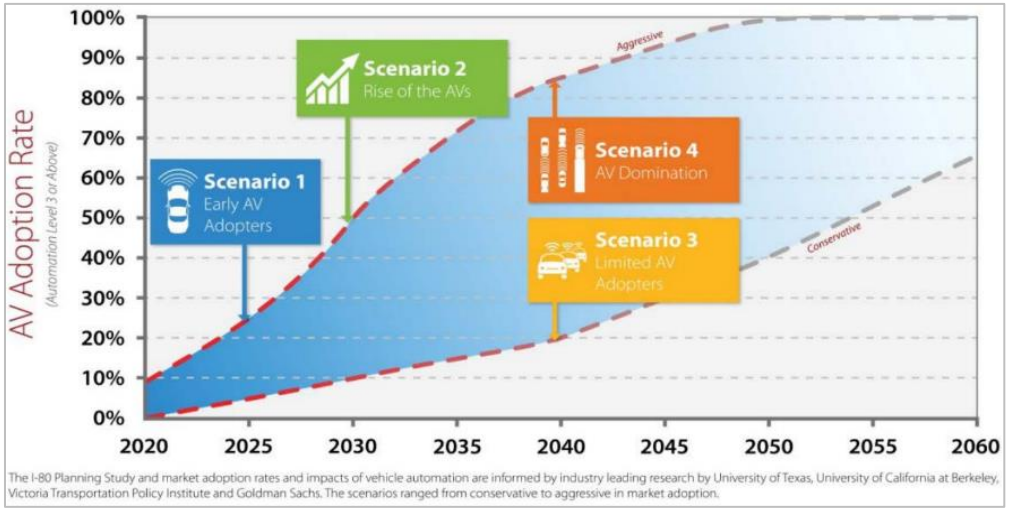
Strategies and Programs

I-80 AV Rates: A recent study in Iowa looked into the potential adoption rate of AV which are being used to estimate levels at in other states. The state of Iowa conducted a study on the I-80 corridor using four scenarios to represent different AV penetration rates.[8] The study concluded that AV technologies can lead to major improvements in safety, accessibility, and capacity. As a result, the level of AV technology adoption (Level 3 and above) was selected as a key factor in the scenario planning, along with 3 other key factors: millennial travel behavior, smart truck parking, and aging population. AV adoption rates, scenarios 1, 2, and 4 assumed "aggressive" adoption whereas scenario 3 was "conservative." The adoption

[5] Kentucky Transportation Center, 2017
[6] Built In, 2022
[7] Emissions Impact of Connected and Automated Vehicle Deployment in California, 2021
[8] Interstate 80 Planning Study, 2017

rate for scenario 1 assumed 20% adoption of AVs in 2025, scenario 2, 50% in 2030, scenario 3, 20% in 2040, and scenario 4, 85% in 2040. It should be noted that adjustments for the impacts of AVs were made in the analysis tools based on modeling results in the literature, specifically in number of trips, vehicle miles traveled, roadway capacity and crash frequency. Figure 3 highlights each scenario.

Figure 3: AV Adoption Rates



The I-80 Planning Study and market adoption rates and impacts of vehicle automation are informed by industry leading research by University of Texas, University of California at Berkeley, Victoria Transportation Policy Institute and Goldman Sachs. The scenarios ranged from conservative to aggressive in market adoption.

University of Louisville: Survey on AV Perceptions: Yearlong study designed to first introduce drivers to automated vehicle technologies and then record their levels of acceptance for use on roadways.

University of Kentucky: Analysis of Autonomous Vehicle Policies: The Report provides a review of all Kentucky laws and regulations relating to automobile and how they can apply to AVs. The report found an apparent need for future change of automobile laws in the following areas: licensing, registration, cell phone usage and traffic enforcement. Additionally, the report expresses a need for the legislature to develop a definition of operator, in the context of AVs. The report also explains that liability allocation is a major concern for manufacturers and the way in which liability is allocated could slow development and implementation of AVs in Kentucky.

Vision, Goals, Objectives, and Performance Measure

USDOT Recommends:

- Begin the planning process
- Begin updating regional ITS architecture
- Consider participating in the connected vehicle pooled fund
- Become involved in the V2I Deployment Coalition
- Monitor affiliated testbed activities and consider joining
- Purchase certified equipment to ensure interoperability
    - Participate in training
- New goals, objectives and performance measures based on knowledge of other states

- Review current legislation and policies for potential impacts
- Designate a responsible individual(s) to monitor and oversee CV and AV issues
- Participate in national discussion through various federal and interest groups
- Work within-state research organizations, such as universities and other labs
- Develop internal working group with members representing the different areas in which the impacts of CVs and AVs will be felt
- Establish external stakeholder groups to identify and address potential issues
- Conduct education outreach to state and local government officials
- Participate in federal deployment pilot projects
- Generate plan for workforce development
- Develop a strategy to manage financial issues that may arise from implementation

Modal/Area Critical Issues/Needs/Mitigation

- Defining what constitutes an autonomous vehicle
- Basic protocols for testing
- Liability
- Guideline for Operations
- Cyber Security/Data Analysis and Use

Modal/Area Trends, Challenges and Opportunities

Benefits:

- Crash Reductions
- Reduced headways
- Enabling real-time route planning
- Increasing capacity of current infrastructure through synchronized traffic flows
- Improved transportation access for the young, elderly, and disabled
- Reducing freight transportation costs
- Improving productivity by freeing up driving/commuting time

Challenges

- Costs
- Safety
- Privacy
- Legal and regulatory issues
- Cyber security

ELECTRIFICATION

Modal/Area Inventory

As of September 2021, there were a reported 5.6 million electric vehicles (EVs) worldwide.; Plug in America [9] reported 1,421 electric vehicles in Kentucky in 2017; however, the current amount is much higher as the industry witnessed a staggering 64% increase from 2018 where the total number of EVs reported was 3.4 million. See Figure 4. Government incentives to increase adoption of electric vehicle technology were first introduced in the late 2000s, leading to a growing market for the vehicles. Now, 20-years later we are continuing to see growth. With increasing public interest, awareness, and structural incentives, such as those structures being built into the green recovery from the COVID-19 pandemic, is expected to greatly increase the electric vehicle market. In Kentucky, there are 303 electric charging outlets available for electric vehicle users.

[9] "Plug In America." https://pluginamerica.org/.

Nationally, there are 2.9 alternative fueling stations and 9.7 electric charging outlets per 10K registered vehicles See Figure 5. Despite its smaller population, Vermont holds the highest rates of both alternative fueling stations and electric charging outlets, at 12.1 and 35.7 per 10K registered vehicles, respectively. Vermont, Hawaii, and Colorado have the most charging stations per 10K vehicles. Kentucky ranks 46th amongst the U.S. states in EV adoption, with a rate of 0.07%. The national rate of EV adoption in the U.S. is 0.49%. [10] However, the recent announcement of EV battery plants in Kentucky will like increase the Commonwealth's adoption rate.

General Overview

Hybrid electric vehicles (HEVs), plug-in hybrid electric vehicles (PHEVs), and all-electric vehicles (EVs) use electricity either as their primary fuel or to improve the efficiency of conventional vehicle designs. EVs have seen a resurgence in the 21st century as technological developments have broadened the accessibility and benefits of utilizing electric vehicles.

Importance/Impact of KY's Economy

With the recent economic downturn, vehicle manufacturers must choose where to invest their funding and they are choosing in favor of electrification. With the demand to drive down the cost of the vehicle, all components, including non-electrification parts, are under great pressure so there is a premium on innovative solutions that break existing cost structures. The massive investment in electrification has produced attractive vehicles that will achieve cost parity within the next five years and can be readily sold in all markets.

Highlights

- In 2018, the US saw one million registered electric cars on the road.
- The International Energy Agency reported in 2021 that governments should do more to meet climate goals, including policies for heavy electric vehicles. Electric vehicle sales may increase from 2% of global share in 2016 to 30% by 2030.[11] Much of this growth is expected in markets like North America, Europe, and China.

Figure 4: Electric Vehicles in Kentucky

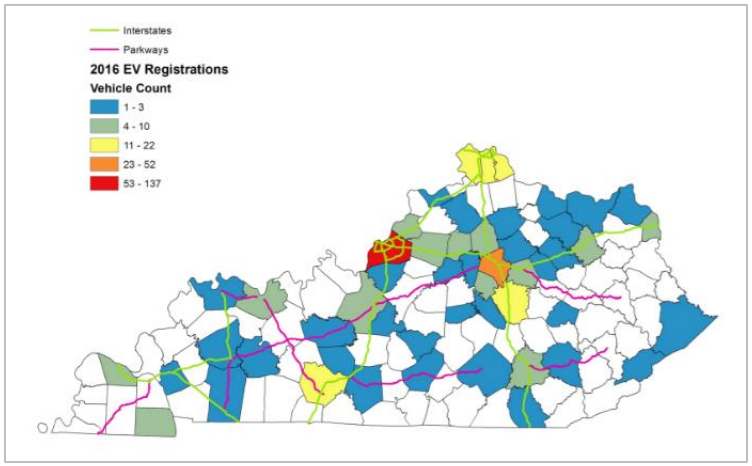


Figure 5: Alternative Fueling Stations in Kentucky

Biodiesel (B20 and above)	3
Electric (charging outlets)	303
Ethanol (E85)	71
Hydrogen	0
Natural Gas	10
Propane	19

[10] Quote Wizard, 2021
[11] Automotive World, 2021

Strategies and Programs

- The Kentucky Clean Cities Partnership works with vehicle fleets, fuel providers, community leaders, and other stakeholders to save energy and promote the use of domestic fuels and advanced vehicle technologies in transportation.
- Electrify America: Through the Volkswagen Settlement, $2 billion was allocated to promote the use of zero emissions vehicle technology across the country by creating Electrify America program.
- Kentucky Utilities/ Kentucky Clean Fuels Coalition (KCFC) Partnership: In 2012, Kentucky Utilities Company (KU) offered $250,000 in grant funding for acquisition of plug-in electric vehicles in fleets owned by governmental and quasi-governmental bodies.
- University of Louisville Vehicle Deployment and Research: In September 2011, the University of Louisville installed 6 Level II Electric Vehicle (EV) charging stations in the Floyd Street garage. The General Electric (GE) DuraStation charging stations were procured by the university to help promote electric vehicle research. In 2014, the University of Louisville (UofL) became the first U.S. Department of Energy (DOE) Workplace Charging Challenge (WCC) partner in the state of Kentucky. The Workplace Charging Challenge program aims to achieve a tenfold increase in the number of U.S. employers offering workplace charging in the next five years. (Press Release)
- Transit Authority of River City: TARC's new ZeroBus is a fast-charging, all-electric bus that produces zero emissions. It's a sleek, clean, and quiet way to get around. And with 10 new ZeroBus vehicles coming to Louisville, the city will have one of the largest fleets of this kind in the country.
- Hybrid Horsepower for Kentucky Schools: The KCFC and partners replaced 156 aging diesel school buses across Kentucky with new hybrid-electric school buses with an average of 35% greater fuel efficiency. Federal and state funding of approximately $28 million provided the incremental cost of the hybrid system to Kentucky school districts ordering new buses through the Hybrid Horsepower for Kentucky Schools project. The project has collectively saved almost 200,000 gallons of fuel and saved school districts over $700,000. These fuel savings are expected to continue over the fourteen-year life span of the vehicles.

National Electric Vehicle Infrastructure (NEVI) Program

KYTC submitted the state's s report EV report to NEVI in 2022. Highlights of the findings of that report are included below. "At the end of 2021, two million electric vehicles (EVs) were in the United States, making up 0.5% of all light-duty vehicles -- approximately double the number in 2018. At the same time, in Kentucky, about 6,000 EVs made up 0.2% of the registered light-duty vehicles -- nearly triple the number in 2018. Of the 6,000 EVs in Kentucky, 3,700 (62%) were battery electric vehicles (BEVs) and the remaining 2,300 (38%) were plug-in hybrid electric vehicles (PHEVs). Annual EV sales in Kentucky have increased substantially from 0.5% in 2018 to 1.6% in 2021. The 2022 first quarter EV sales increased even further to

2.4%."[12] It is expected the EV market share will continue to grow as barriers to EV adoption are addressed. For example, EV technology continues to improve, increasing vehicle range and reducing EV costs relative to comparable vehicle options. Customers are becoming more familiar with EVs and many more models are on the market than in prior years. Based on recent research, one 2022 projection showed EV sales in Kentucky exceeding 30% by 2030. Private companies and public agencies are also investing billions in new EV infrastructure. For example, the IIJA/BIL included $7.5 billion in new funding specifically to install charging infrastructure across the country. Much of this funding is designated to build DC fast-charging (DCFC) stations along designated Alternative Fuel Corridors (AFCs).

In Kentucky, the entire Interstate and Parkway system is part of the AFC network. Kentucky is also looking at other charging needs on other high priority EV corridors. Kentucky recently submitted a required EV Infrastructure Deployment Plan to FHWA, which will be updated in the future as infrastructure is installed and the industry matures. While most EV charging occurs at home or work, a major need still exists for long-distance and community based public charging in Kentucky. As of August 2022, nine public 24-hour DCFC stations with a total of 21 charging ports were present in Kentucky and approximately 142 public 24-hour Level 2 charging stations with 282 ports.[13] Private charging stations or those restricted by time or to customers were excluded. With current private and public investments, this network is expected to increase substantially in the next few years.

INTELLIGENT TRANSPORTATION SYSTEMS

ITS Inventory

The USDOT introduced Intelligent Transportation Systems (ITS) as technologies advance transportation safety and mobility and enhance American productivity by integrating advanced communications technologies into transportation infrastructure and into vehicles. ITS encompasses a broad range of wireless and traditional communications-based information and electronic technologies.

Modal/Area Summary

Some of the most prominent ITS technologies already deployed across the country are:

- Electronic Toll Collection (ETC) - ETC supports the collection of payment at toll plazas using automated systems that increase the operational efficiency and convenience of toll collection. Systems typically consist of vehicle-mounted transponders identified by electronic readers located in dedicated or mixed-use lanes at toll plazas. ETC has the potential to significantly increase mobility on the Nation's

[12] **US Department of Energy, Alternative Fuels Data Center, 2022.
[13] International Energy Agency, 2022 and Alliance for Automotive Innovation, 2022.

transportation system. High estimates for ETC's nationwide mobility benefits were over $1 billion per year, at 2007 deployment levels (2009 dollars).

- Ramp Meter (RM) - Traffic signals on freeway ramp meters alternate between red and green signals to control the flow of vehicles entering the freeway. Metering rates can be altered based on freeway traffic conditions. RM technologies had annual mobility estimates of over $287 million).
- Red Light Camera (RLC) - According to the U.S. DOT Federal Highway Administration's Priority, Market-Ready Technologies and Innovations, RLCs detect a motor vehicle that passes over sensors in the pavement after a traffic signal has turned red. The sensors connect to computers in high-speed cameras, which take two photographs of the violation.
- Traffic Signal Coordination (TSC) - According to the U.S. DOT's Traffic Signal Timing Manual, TSC provides the ability to synchronize multiple intersections to enhance the operation of one or more directional movements in a system.
- Transit Signal Priority (TSP) - TSP gives special treatment to transit vehicles at signalized intersections. TSP systems use sensors to detect approaching transit vehicles and alter signal timings to improve transit performance.
- Traveler Information Systems (TIS) - According to the U.S. DOT ITS Joint Program Office's Developing Traveler Information Systems Using the National ITS Architecture, effective TIS are multimodal and support many categories of drivers and travelers. Traveler information applications use a variety of technologies, including Internet websites, telephone hotlines, and television and radio, to allow users to make informed decisions regarding trip departures, routes, and mode of travel.[14]

Importance/Impact of KY's Economy

Highlights

- The ultimate benefits of a transformed transportation system—one that is fully connected; information-rich; and able to address safety, mobility, and environmental impacts—are wide-ranging and powerful. They will be felt by every one of us, delivering greater livability to our communities and to our daily lives.
- ITS improves transportation safety and mobility and enhances American productivity through the integration of advanced communications technologies into the transportation infrastructure and in vehicles.
- The process of developing and maintaining a regional ITS architecture can help to enhance the linkage between operations and planning through closer involvement of a wider array of stakeholders from both of these areas of transportation.

[14] https://www.its.dot.gov/factsheets/benefits_factsheet.htm

Strategies and Programs

- Kentucky Transportation Cabinet, Various ITS Research Initiatives – These include applications for environment, human factors, and mode-specific research.
- Commonwealth of Kentucky, Kentucky Transportation Cabinet, ITS Data Project - The Commonwealth's ITS project was a high impact, quick hitting effort that addressed some of the thorniest problems in data integration and analytics. Google has used this project to showcase Waze and the power of analytics.
- University of Kentucky, ITS Program - The program has enjoyed national prominence for more than 20 years and began with a substantial role in Commercial Vehicle Operations (CVO) projects, particularly the Advantage I-75 Mainline Automated Clearance System. In addition to CVO projects, we have conducted a variety of research projects for the Kentucky Transportation Cabinet and various state and federal transportation agencies as well as private companies. Research areas range from studies of virtual weigh station technology to traffic control procedures for emergency responders.
- Kentucky Regional Planning and Development Agency (KIPDA), ITS Architecture Report - The ITS Architecture Report summarizes the coordination efforts between agencies who operate the ITS systems in the Louisville/Jefferson County KY-IN Metropolitan Planning Area (MPA). Visit KIPDA's Regional ITS Architecture page for more information on ITS coordination for the region.[15]

Identify New Goals, Objectives, and Performance Measures Based on Knowledge of Other States

- Involve ITS strategies and education within the goal setting process
- Continuous investment in research that collects data
- Foster relationships with stakeholders
- Identify events or a timetable that determines when you will re-access existing ITS, some reports suggest every 3-4 years

[15] https://www.kipda.org/transportation/major-functions/its-architecture/

BROADBAND OVERVIEW

Broadband Inventory

As of July 2021, the average global internet connectivity speed is 58.27 Mbps, while average mobile upload speed was recorded at 12.35 Mbps. Amongst the US states, Kentucky (KY) ranks 33rd with a median download speed of 33.66 Mbps. Kentucky Governor Andy Beshear (see text box below) aims to expand internet access to unserved communities across the state, as part of his Better Kentucky Plan. The bills passed at the end of the 2021 legislative session, will direct American Rescue Plan Act of 2021, or ARPA, funds to boost the state's economy by building new schools, delivering clean drinking water and expanding access to broadband. The Finance and Administration Cabinet issued a Request for Proposals, or RFP, for $50 million in federal ARPA funds allocated to bring internet access to those who need it most through the Kentucky Broadband Deployment Fund. The state of Kentucky has a total of 74 internet providers available. It is the 46th most connected state, with 82% of the population having access to broadband speeds of 25 Mbps or more.

Broadband Summary

The superior technology to deliver Internet and network services is optical fiber that carries a communications signal from an operator's equipment all the way to a home, business or enterprise. This technology has been found to be more robust and reliable than older technologies. Though relatively new, running fiber to homes (fiber-to-the-home) is a fast-growing method of providing much greater bandwidth and speeds to consumers and businesses, for more robust video, internet and voice services. Connecting homes, business, and any endpoints -- including cellular towers or sites -- directly to fiber optic cable enables enormous improvements in what bandwidth devices are capable of delivering. Current fiber optic technology can provide two-way transmission speeds – upload and download -- of over a gigabit per second.

The COVID-19 pandemic accentuated the need for all Kentucky citizens to have access to high-speed, reliable internet access to stay informed and connected to school, work, family, church, health care and other critical services. As more jobs transitioned to telework and classrooms moved to online learning, households across Kentucky became increasingly reliant on enhanced internet capacity dependent technology to not only download data, but also to upload and share information, particularly when two or more platforms were simultaneously online.

Under House Bill 320 and House Bill 382, a bipartisan agreement signed into law by Gov. Beshear, Kentucky's Broadband Deployment Fund includes $300 million in state funds earmarked to address the connectivity needs of unserved and underserved communities across the Commonwealth. Combined with at least 50

"...RELIABLE INTERNET ACCESS IS FOR ALL OF US TO STAY INFORMED, SAFE AND CONNECTED TO WORK, SCHOOL, HEALTH CARE, FRIENDS AND FAMILY. AND NOW, WE LOOK TO OUR BROADBAND COMMUNITY TO TELL US HOW THEY WOULD USE THE FUNDS AVAILABLE TO SUPPORT THE CONSTRUCTION, DEVELOPMENT, OR IMPROVEMENT OF BROADBAND ACCESS ACROSS THE COMMONWEALTH, WITH OUR UNSERVED COMMUNITIES RECEIVING FIRST PRIORITY."

– GOVERNOR ANDY BESHEAR

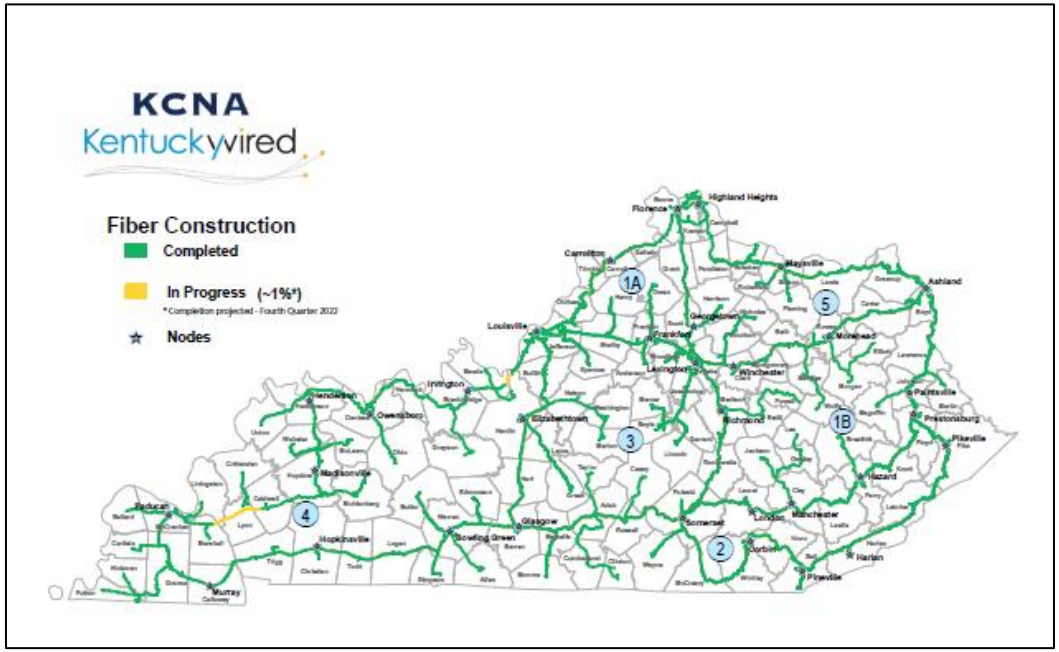
percent required matching federal investments, a minimum of $600 million will support broadband expansion in Kentucky, creating more than 10,000 direct and indirect jobs.

As older technologies stretch the limits of their performance or speed, constant improvements in fiber optic technology and equipment can improve how much bandwidth is available without having to deploy a new network. State broadband programs take different forms. Some states, including Minnesota and Colorado, have broadband offices established by statute or executive order. Others, including Tennessee, have staff within an agency dedicated to supporting broadband. Where these programs are located also differs and may include coordination across multiple departments or agencies. Minnesota's Office of Broadband Development is within the Department of Employment and Economic Development, while the Wisconsin Broadband Office is housed in the Public Service Commission of Wisconsin. And Colorado's Broadband Office is part of the Governor's Office of Information Technology and coordinates closely with the Department of Regulatory Agencies and the Department of Local Affairs, which administer broadband grant programs. States can use multiple policy levers to expand broadband access, and these do not have to be dependent on available funding. Supporting broadband planning on the regional level helps facilitate middle-mile projects that meet each region's needs and opportunities.

Strategies and Programs

- **Kentucky Communications Network Authority (KCNA) KentuckyWired**: KentuckyWired is a state-run project constructing over 3,000 miles of high-speed, high-capacity fiber optic cable in every county in Kentucky. The KentuckyWired network is a "middle mile" project connecting government offices, universities, community colleges, state police posts, state parks, and other government institutions to the global internet. Anywhere along its path, Internet Service Providers will be able to connect to the network and bring faster, more reliable internet to every corner of the Commonwealth. Cellular providers will also be able to connect to KentuckyWired and build more cell phone towers throughout the state.

Figure 6: KentuckyWired



Its 288-strand fiber optic cable will serve the needs of government agencies, universities, businesses, and citizens for decades to come.

- **Kentucky Infrastructure Authority Broadband Loan/Grant Program**: The program is administered by the Kentucky Infrastructure Authority with input from Connect Kentucky, the area development districts, and other interested businesses and government entities. Public or private providers can apply for funding for broadband applications to cover areas currently unserved by a broadband provider.
- **Connect Kentucky**: Under the direction of the Governor and funding of Connected Nation, Connect Kentucky seeks to accelerate the growth of technology in support of community and economic development, improved healthcare, enhanced education, and more effective government.
- **Coal to Broadband**: A collaborative effort to provide high-speed Internet access (broadband) to people living in rural areas of Breathitt, Estill, Lee and Powell counties in Eastern Kentucky. The program formed a non-profit called the Breathitt, Estill, Lee, Powell Regional Technology Authority, Inc. (RTA). The non-profit, RTA, will work to create and execute high speed Internet service to the four counties.
- **Kentucky Broadband Mapping Initiative**: A multi-year, multi-agency effort to map areas in the state that are currently served by the state's approximately 100 broadband providers. The results from this will be integrated into a national broadband availability map and will provide a solid foundation for future broadband.
- **Office of Broadband Outreach and Development**: Established by the governor in 2010, identify areas un-served and underserved, by affordable broadband, throughout the state, and to facilitate greater understanding and partnerships which work toward providing all Kentuckians with these critical capabilities.
- **University of Kentucky Gig U Partnership**: Along with 28 other universities, UK will participate in the national Next-Gen Network-Based Innovation project with Gig U. Through an open request for information process, Gig U will gather data with an intent to inform high-speed service providers of new implementation approaches, and to enable competition to bring high-speed networks to research communities. Gig U plans to demonstrate to commercial providers that there is sufficient demand for these services in college communities.
- **Dial Up Rocks**: Builds grassroots power in our community by speaking up for Internet needs.

Identify New Goals, Objectives, and Performance Measures Based on Knowledge of Other States

- Engage stakeholders at both the state and local levels
- Set well-defined goals and a clear policy direction in legislation and tasking agencies or setting up separate offices to lead statewide broadband programs
- Connect broadband to other policy priorities, including economic development, transportation, health care, and agriculture, to build partnerships and leverage more funding for expansion efforts
- Define goals and objectives that provide a baseline against which to measure progress

KEY TRENDS, THREATS, AND OPPORTUNITIES

Trends

Connected/Autonomous Vehicles

KYTC plans to test Dedicated Short-Range Communication (DSRC) technology enabling two-way communications between vehicles and infrastructure (V2I). This investment has enormous potential of returning safety and economic benefit to all users of Kentucky's transportation system. Below are potential DSRC Transportation Applications for Public Safety and Traffic Management that USDOT has identified.

- Traffic and travel condition data to improve traveler information and maintenance services
- Intersection collision avoidance and movement assistance
- Commercial vehicle clearance and safety inspections
- Transit or emergency vehicle signal priority
- Approaching emergency vehicle warning
- Electronic parking and toll payments
- Vehicle safety inspection
- In-vehicle signing
- Rollover warning

Electrification

As Kentucky's EV battery industry takes off with the addition of a new plant in Elizabethtown and support industries elsewhere, it is expected that EV adoption rate will accelerate.

ITS

Transportation is following the path of connectivity. In addition to integrating wireless connectivity into existing, broader Intelligent Transportation Systems (ITS), exciting next-generation ITS includes advancements such as connected and automated vehicle environments based on real-time data exchange between vehicles (vehicle-to-vehicle, or V2V), vehicles and infrastructure (vehicle-to-infrastructure, or V2I), vehicles and portable devices such as smartphones and tablets, aftermarket devices, and other sensors (vehicle-to-everything, or V2X). These advancements make travel safer, cleaner, and more efficient.[16]

14 https://www.sae.org/standards/content/j3016_202104/
https://www.ghsa.org/state-laws/issues/autonomous%20vehicles
https://uknowledge.uky.edu/cgi/viewcontent.cgi?article=2577&context=ktc_researchreports
https://builtin.com/transportation-tech/self-driving-car-companies
https://www.sae.org/blog/sae-j3016-update
https://its.dot.gov/research_areas/cybersecurity/about.htm

Threats

Autonomous Vehicles

Prepare for a potential reduction in parking, based on different levels of AV adoption, and how that will affect revenues and operations over the next 20 years. Another barrier to automated vehicles exists in many Kentucky statutes where passages reference a person operating a vehicle. KYTC is also supporting ongoing research through the Kentucky Transportation Center at the University of Kentucky intended to review existing Statute, Regulation, and Policy for barriers to Automated and/or Connected Vehicles. A notable barrier to allowing truck platooning exists in KRS 189.340.

Electrification

Although the number of chargers has grown rapidly, a gap between predicted EV adoption and planned charging stations still exists. The size of the gap is not certain, as projections for EV adoption and charging station buildout vary. One study by the International Council on Clean Transportation estimates that only one-fourth of the public and workplace charging infrastructure that will be needed by 2025 has been built as of 2017.

Because EVs require electricity to charge, they necessarily interact with the electric system and utility infrastructure within each Commission's purview. Two primary questions have been frequently raised to PUCs:

1. Who may own EV charging infrastructure?
2. What rate designs and other load management strategies are appropriate to mitigate EVs' potential negative grid impacts and maximize potential grid benefits?

Consumers are more likely to purchase EVs when they know they will be able to charge as needed. In many places across the country, policymakers, EV manufacturers, utilities, some private sector charging companies, and some advocacy groups want utilities to install and/or own EV charging stations. On the other hand, other private sector charging companies, consumer advocates, and others, while they are often supportive of utility investments in make-ready infrastructure and rebate programs, typically do not think that utilities should have a large role in installing and owning charging infrastructure, especially when needs may be met by the competitive market.

EV charging could strain local distribution networks, which may be exacerbated by the advent and further adoption of fast-charging systems that can magnify spikes in electricity demand. Analysis has shown that a typical residential feeder circuit of 150 homes at just 25 percent EV penetration would increase local peak load by nearly 30 percent. However, EVs also represent an opportunity for grid management. Because EV load is flexible, if charging can be moved to times of low demand or abundant renewable generation, EVs represent a significant opportunity for increased grid flexibility.

Finally, physical charging interface interoperability concerns are essentially restricted to DC fast charging. Level 1 and Level 2 charging plug interfaces use a single standard plug type (J1772) with Tesla vehicles requiring an adapter. However, DC fast charging in the United States currently uses three different plug types that are not generally interoperable: CHAdeMO, CCS, and Tesla.

ITS

Cybersecurity is now necessary to protect vital ITS systems and the information they contain. Transportation system manufacturers, integrators, and operators must systematically assess risks at all levels so that the vulnerabilities, malfunctions, or opportunities for malfeasance associated with ITS deployments are mitigated. This assumes that resiliency plans exist and are used, and that the workforce is trained and has the necessary tools and resources to monitor, identify, protect, respond, and recover from cyberattacks and other challenges.

Opportunities

Autonomous Vehicles

AVs are an opportunity to improve mobility and the city's livability rather than just a technological advance, the rollout and deployment of AVs can help Louisville achieve many of its residents' stated goals by redefining the transportation system and their relationship to it. The parking industry faces a particularly uncertain future given the potential for wide-scale adoption of AVs. Estimates of how much parking demand will decrease vary, but studies indicate that demand will ultimately decline. This change will bring challenges and opportunities as substantial sections of our neighborhoods and commercial districts could be completely redefined.

AVs have the potential to completely transform how the public transit system operates. By redefining the size, frequency, and routes of busses, better integrating with Transportation Network Companies (TNC), and receiving priority road space thanks to the space efficiency benefits of AVs, transit has an important role to play in the new transportation paradigm. Investing in public transit will be critical to reducing VMT once AV technology is widely adopted as the ultimate impact of AVs on VMT is not certain.

Electrification

As the nation's leading producer of light vehicles per capita, Kentucky is a particularly great fit for automotive-related businesses. Kentucky is the premier location in the U.S. to manufacture electric vehicles and their parts. Everything that goes into electric vehicles; motors, batteries, brakes or tires - can all be made and shipped to anywhere in the country easily. Competitive energy pricing, ample land, knowledgeable workforce and the best shipping and supply system add up to winning combination that cannot fail.

- Kentucky is the #1 producer of cars, light trucks, and SUVs per capita
- Auto Alley

  - 525+ automotive-related facilities in Kentucky
  - Kentucky is home to four major assembly plants — Ford (two plants), General Motors and Toyota
- $10.8 billion announced investments by automotive-related facilities since 2014
- 1 out of every 16 workers in the US automotive industry work in Kentucky
- 100,000 individuals employed in automotive-related establishments located in Kentucky

Until recently, there were few and somewhat insignificant improvements in battery technology for EVs. The primary large pack battery technology continues to be lithium-ion, and until recently, their high costs posed significant challenges to automotive original equipment manufacturers (OEMs) to make EVs a value viable option for consumers. However, with EV economies of scale starting to be realized, lithium-ion battery prices have fallen by 85% from 2010-2018 and will continue to decrease to nearly a third of their current price by 2030.

ITS

Blockchain is an extremely dynamic technology in recent times. Regarding ITS, one of its main applications is in anonymous authentication solutions in Vehicular ad-hoc networks (VANET). The use of distributed storage can be very suitable for storing data of the legitimacy of nodes. The nodes decide whether to admit a new participant in the communication based on its reputation. In this way, malicious nodes are discouraged. Another option for applying a blockchain is upper architecture layers as a secure data warehouse.