

SMART INFRASTRUCTURE:

Technology Solutions for More Resilient Counties

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FEATURED COUNTIES:

- Alameda County, Calif.
- Bernalillo County, N.M.
- Johnson County, Iowa
- Los Alamos County, N.M.
- Oakland County, Mich.
- Miami-Dade County, Fla.
- Montgomery County, Md.
- Pinellas County, Fla.
- Sonoma County, Calif.

Introduction

Infrastructure provides the backbone for county operations. Without functioning transportation, water, energy and communications infrastructure, counties would not be able to provide the myriad of programs and services to the public that ensure health and safety and are critical for protecting a county’s economic health.

Recognizing the important role these lifelines play in preserving their communities’ way of life, counties invest more than \$100 billion annually in roads, bridges, transit, water systems and other public infrastructure.¹ Counties construct and maintain 45 percent of public roads and 40 percent of bridges, are involved in one-third of transit systems and airports across the U.S., support 960 hospitals throughout the U.S., and spend an annual \$23.3 billion on correctional facilities and \$18.6 billion on sewage and waste management.²

Inevitably, existing infrastructure succumbs to wear and tear through use and exposure to the elements. Decisions about how to repair or even replace infrastructure can have drastic effects that shape how counties grow, impacting not only the built environment but local economic conditions as well. With the rise in technological advancements over the last few decades, counties are exploring opportunities to incorporate technologies into new and existing transportation, energy and water infrastructure projects, along with other areas including jails, courthouses, hospital and healthcare facilities, libraries and solid waste and recycling facilities.

The result is so-called “smart infrastructure” that enables counties to manage traffic, monitor water usage in real-time, make adjustments to the electric grid based on consumption and more. These new and emerging technologies allow counties to run government services in a more efficient and cost-effective manner. This issue brief serves as a guide for county leaders to better understand the opportunities that smart infrastructure can provide to make their counties more resilient, efficient and safe.

WHY SMART INFRASTRUCTURE IS NEEDED

Efficiency

Smart infrastructure technologies enable counties to provide services to their constituents in a more efficient manner. Automated traffic monitoring can allow traffic signals to be timed, which reduces congestion and improves traffic flow. Sensors along water distribution networks can alert county public works departments and local utilities to leaks in the system, allowing them to expediently address the issue.

Cost Savings

By providing services in a more efficient manner, counties are also able to see significant operational savings from smart infrastructure. Miami-Dade County, Fla., for example, has used smart water technology to analyze water usage trends, conserve water and fix leaks in their system, saving them money to the tune of \$100,000 per year. Individuals can also reap the financial benefits from these improved services, such as lower utility bills and lower fuel consumption.

Job Creation

One of the biggest benefits to counties from the development of smart infrastructure is the creation of new jobs. Upgrading existing and developing new infrastructure requires skilled workers from the utility and manufacturing industry, both to construct and operate these new infrastructure technologies. As part of the American Recovery and Reinvestment Act of 2009, for example, \$100 million of the total \$4.5 billion was dedicated to workforce training, with some 30,000 individuals trained in smart grid technologies.³

New technologies enable counties to improve service to constituents and drive economic growth. Smart infrastructure allows for more efficient and cost-effective operations, and provides opportunities for job growth.

IMPROVING TRANSPORTATION

Resilient transportation infrastructure is critical to functioning counties and economies. Recognizing this, counties greatly invest in the nation's transportation infrastructure, building and maintaining 45 percent of public roads, 230,690 bridges and being involved in one-third of transit and airport systems in the U.S.⁴ County roads allow for efficient movement of people and goods, enabling people to carry out activities during their daily lives to various locations such as homes, places of employment and retail centers. Emergency personnel rely on efficient transportation to quickly respond and reach those in need. Businesses need capable transportation infrastructure to efficiently send and receive goods and other materials. Heavy traffic and congestion annually cause some \$101 billion in lost wages and productivity. Given the importance of transportation infrastructure, counties must actively address inefficiencies which can cost counties and the national economy billions of dollars each year.

Traffic Management

Pinellas County is located on Florida's Gulf Coast, and is home to 938,000 people.⁵ As in many other large urban areas, congestion and backups during daily commutes turn free-flowing roads into tangled messes. In 2004, Pinellas County surveyed residents on multiple transportation issues as part of the county's Comprehensive Plan Evaluation and Appraisal process. After reviewing the results, it became clear that the public had a strong desire to improve transportation efficiency using technological methods—nearly 70 percent of respondents indicated the need for coordinated signal timing and other methods to improve traffic congestion.⁶

Highway signage, like those seen here in King County, Wash., can alert drivers to unseen dangers. The red X here is letting drivers know that the lane is closed due to a stalled vehicle ahead.

Source: flickr user WSDOT



As a result of the survey, since 2007 the county has been using technology to improve transportation management in the county, making the local transportation system more efficient. The county's intelligent transportation system (ITS) is a collection of 15 technologies the county employs that allow it to address travel conditions in real time, improving public safety and traffic management.⁷ Using both wired and wireless devices throughout the county, the Public Works Department can monitor current traffic patterns, allowing them to manage traffic flows, minimize congestion, communicate with travelers and improve pedestrian and vehicular safety, all from its Traffic Control Center.

At major intersections throughout Pinellas County, closed circuit cameras mounted on poles record traffic flow, providing live video feed via fiber-optic networks to Control Center staff. If there is an accident or a major backup, staff can communicate to motorists through overhead message boards, displaying custom messages to alert drivers and provide alternative route options. As Deneta Jones, lead operator in the county's Public Works Traffic Engineering office explains, following an accident, the Control Center receives a note from 911. After they assess the accident site and severity of the accident, they warn drivers through the message boards to slow down or take alternative routes.

The county also uses an interconnected computerized signal system which can monitor variations in traffic flow and adjust signaling to respond. During rush hour and other peak travel times, the system can automatically synchronize signals at multiple intersections to keep lights along heavily traveled corridors green for longer times, thereby reducing congestion. If needed, staff at the Control Center can also manage traffic light synchronization.

The county and the public have seen a number of financial, safety and environmental benefits since the implementation of ITS. For every dollar it cost to build the system, drivers receive nearly \$7 in benefits through saved time and gas.⁸ Along U.S. Highway 19, one of the first corridors in which Pinellas County installed ITS technologies, traffic accidents have decreased significantly, with accidents resulting in injuries down 41 percent and rear-end collisions down 40 percent. In addition, keeping traffic flowing has reduced congestion and saved drivers an estimated \$600,000 in fuel costs. Along State Road 60, decreased traffic has resulted in \$750,000 in fuel savings. Reduced congestion also means that cars are releasing fewer emissions into the air, resulting in improved local air quality.

Pinellas County has prioritized when and where to install ITS technologies at intersections and along arterial roads, splitting installation into three phases; Phase 1 finished in 2009, with the third and final phase expected to be completed in 2018.¹⁰ To fund the ITS, Pinellas County implemented a one-cent increase on the gas tax in 2007, bringing in an estimated \$3.8 million in revenue. This revenue is solely dedicated towards installing, operating and maintaining the program.¹¹ The tax will expire on December 31, 2026.

Deneta Jones is proud of the county's use of technology to improve transportation, and the benefits it provides to travelers: "Pinellas County's Intelligent Transportation System allows the county to provide safe and efficient travel throughout the county. The moment we hear of an accident or a malfunctioning traffic light, we can use technology to take immediate action to keep traffic flowing and the public safe. As I like to say, you never realize how happy people can be until you fix a green light."

For every dollar it cost to build the system, drivers receive nearly \$7 in benefits through saved time and gas. In addition, keeping traffic flowing has reduced congestion and saved drivers an estimated \$600,000 in fuel costs.



Autonomous vehicles like the one shown here may lead to improved traffic flow and reduced traffic fatalities, and may one day be commonplace on county roads.

Source: Flickr user smoothgroover22

Self-driving Cars

One of the biggest technological advancements in transportation infrastructure is the advent of connected and autonomous vehicles. Connected vehicles are those that use technologies such as GPS and the Internet to communicate with other vehicles and infrastructure. Though the driver remains in control, he or she can be alerted to important information such as nearby accidents or heavy traffic ahead. Autonomous vehicles, on the other hand, can drive themselves. Using sensors such as cameras and radar, these vehicles can detect changes in their surrounding environment to control steering, accelerating and braking without the driver's assistance.¹²

Oakland County, Mich. is taking a lead in the development of new connected vehicle technologies. In February 2014, the county launched its Connected Car Task Force to explore the feasibility of a county-wide connected vehicle system.¹³ County Executive L. Brooks Patterson appointed three local business leaders to the task force to provide recommendations, based on research and interviews with connected vehicle stakeholders and industry leaders, on how to deploy such a system. If launched, the connected cars will be able to transmit information about the car and its location to other cars as well as transit infrastructure. Oakland County's goal is to demonstrate that connected vehicle technologies will reduce automotive collisions, as well as provide critical information to emergency responders should an accident occur.¹⁴



Autonomous vehicles are currently undergoing testing to demonstrate their ability in real-world situations.

Source: flickr user jurvetson

SMART GRID CONNECTIVITY

Autonomous vehicles are a potentially promising solution to a number of transportation issues that counties all across the country face. Widespread adoption of autonomous vehicles is predicted to improve public safety by reducing the number of vehicle collisions and fatalities, while more efficient travel would reduce emissions and fuel consumption. Depending on how much automated cars improve transit efficiency, it could even mean that counties would not have to expand roads by adding extra lanes.¹⁵

Currently, California, Florida, Michigan and Nevada are the only states that have laws allowing autonomous vehicle testing.¹⁶ As testing continues, Johnson County, Iowa, has become the first county in the nation to encourage autonomous vehicle testing. In 2014, the county passed a resolution that supported vehicle testing.¹⁷ Johnson County is an ideal place for testing the viability of autonomous vehicles—the county is home to 142,000 people, providing an urban, though not too densely populated, testing ground for the vehicles.¹⁸ The county is also home to the University of Iowa, which houses the National Advanced Driving Simulator, a tool that has been conducting research on automated highways for the U.S. Department of Transportation since the 1990s.

The county's Board of Supervisors unanimously approved the resolution to allow for autonomous vehicle testing in Johnson County, demonstrating their enthusiasm for a program they believe will not only improve public safety, but provide an opportunity for local economic development. As Supervisor Janelle Rettig noted, being at the forefront of innovation and technology will provide new jobs and other opportunities for county residents.

Much of the current energy grid that delivers electricity to residents and businesses is based on century-old technology and infrastructure. Often, this outdated infrastructure struggles to meet ever-increasing energy demands to power homes, offices, manufacturing facilities and more. In the last 60 years, residential energy use has increased by 37 percent, commercial use by 34 percent and industrial use by 26 percent.¹⁹ A number of utility companies and the counties they serve are exploring ways to upgrade their energy infrastructure through smart grid and smart meter technologies.

Smart grids allow for two-way communication between utilities and their customers, which can enable utilities to quickly address issues or abnormalities along the grid and adjust energy production based on real-time demand information. Customers can receive valuable information about their energy use and consumption, and can change their behavior, consuming more energy during off-peak hours when rates are lower, or cutting back on use to save money.

A key component of the smart grid is smart meters. These meters collect information about energy use and provide them to utilities, much like regular meters currently do. Smart meters differ, though, in that they can continually transmit data, eliminating the need to have utilities send out meter readers to collect usage data; they can also communicate with customers' appliances and programs, giving customers real-time information about how much energy is being used.

Though smart grid and smart meter adoption is still fairly new, counties are exploring ways in which they can adopt these technologies. In California, Alameda County's Santa Rita Jail has been saving tax payers more than \$260,000 per year through the jail's microgrid (a localized smart grid).²⁰ Los Alamos County, N.M. is participating in a demonstration project, fitting 1,600 homes with smart meters and appliances to better understand how the county's Department of Public Utilities can minimize demand during peak hours and translate the results on a larger scale. Montgomery County, Md. is currently exploring public-private partnerships to develop microgrids to enable the county's 410 facilities to remain operational during power outages and improve overall efficiency.²¹

Autonomous vehicles are a potentially promising solution to a number of transportation issues that counties all across the country face.



Water meters connected to the smart grid allow for counties and utilities to better analyze water use data, and can aid them in determining when and where abnormalities such as leaks occur.

Source: Shutterstock

RESILIENT WATER INFRASTRUCTURE

Smart Water Meters

In New Mexico, Bernalillo County is demonstrating how smart grid technologies can be used for more than just reducing energy use. The county's water and wastewater services are provided by the Albuquerque Bernalillo County Water Utility Authority, the largest water utility in the state. The Water Authority is governed by an eight member board, on which three county commissioners serve, and provides water to more than 600,000 users.²²

Following the installation of smart meters, the Bernalillo County Water Authority met its water reduction goal three years early, reduced costs, improved billing accuracy and fixed water leaks faster.

The county, like many in the west, is greatly concerned about the effects of drought on its ability to provide water to its customers. In 2001, Water Authority customers were using 205 gallons of water per day.²³ The Water Authority wanted to find ways to reduce water usage, but at the time it had to manually read 94 percent of its meters, making it difficult and time consuming to collect accurate data.

To address these issues, the Water Authority launched its smart grid program in 2010. The Water Authority established four goals it hoped to achieve through the development of a smart grid: meet the state-mandated target of 150 gallons per capita per day by 2014; further reduce residential and business usage; make Water Authority operations more efficient; and improve customer service.²⁴ To meet these goals, the Water Authority partnered with Harris Utilities to use their MeterSense and CustomerConnect tools.

During the first phase of the project, the Water Authority installed 900 meters in 2010, and another 40,000 in 2011.²⁵ With the smart meters in place, customers are now better prepared to understand their own water usage and how to reduce it. They can review their consumption data in near real-time, and compare their current usage with historical data. Customers are also able to create usage goals and receive email, text or phone updates about their progress.²⁶ The smart meters allow the water authority to see when and where there are system leaks, and data collected from the meters allow them to plan for additional ways in which the Water Authority can help conserve water.

Following the installation of the smart meters, the Water Authority saw nearly instantaneous results from the program. They met the state's mandated goal three years ahead of schedule, reduced the costs associated with data collection and meter reading, improved billing accuracy and were able to regularly identify and fix water leaks, which saved even more water in the process.

Maintaining water infrastructure is critical for counties to provide reliable water service. Not only is water used for everyday purposes including drinking, showering and cooking, it is also needed in a variety of activities including manufacturing, running industrial HVAC systems, fighting fires and treating wastewater.

Given the importance of maintaining water infrastructure, counties and water utility agencies face an ongoing threat of aging water infrastructure. The U.S. Environmental Protection Agency estimates that there are some 800,000 miles of water pipes in the U.S., with many in service for more than 100 years.²⁷ Over time, corrosion can develop holes in the piping or cause the pipes to collapse on itself. Earthquakes and other seismic activities can lead to massive breaks, or damage joints where pipes connect causing leaking. If a single faucet can leak 3,000 gallons per year, a leaky transmission pipe can leak exponentially more.²⁸

The Government Accountability Office estimates that one-third of all water agencies across the U.S. maintain and operate aging water infrastructure, with more than 20 percent of their pipelines nearing or beyond the end of their useful lives.²⁹ Replacing or repairing aging infrastructure and facilities will cost more than \$140 billion over the coming decades, not to mention the cost to counties and customers from water leaks. Given this threat, a number of counties are taking proactive steps using smart water infrastructure to ensure they can monitor and address any irregularities in the water supply, saving both water and costs to the county and the public.

Improving Water Distribution Resiliency

With California suffering from severe drought in the past few years, counties all across the state are making efforts to minimize water usage, and to make smart decisions about how most efficiently address the needs of residents and the business communities. Some counties are limiting water usage for watering lawns and washing cars, as well as collecting fines for those that break such restrictions. Other counties, like Sonoma County, are looking at innovative ways to use technology to create smart water management.

The Sonoma County Water Agency (SCWA) provides water to just over 600,000 residents in Sonoma and Marin counties, and is led by Sonoma County's Supervisors who make up SCWA's Board of Directors.³⁰ Located in the heart of the wine country, SCWA also provides water to businesses in the wine industry, the demands of which can stress water supply.

In order to address the water issues the region faced, SCWA partnered with IBM in 2011 to use smart technology to monitor water pressure at critical distribution points in real time and adjust pressure as needed. Managing a water distribution network's pressure system is a complex process that requires constant adjustment. Any drop in pressure in a single valve or pipe can have serious consequences across the system. For example, if a leak occurs in a pipe, engineers can reduce the pressure to that pipe to limit the amount of water lost, but it can also mean that there is not enough pressure to deliver water to customers.

Using IBM's water management system, SCWA can collect and analyze data on water usage, current weather and other environmental considerations to efficiently manage its water distribution system. The data collected by the system allows SCWA engineers to determine the optimal settings for valves based on information about the system as a whole. Water monitors can compare real-time information about water levels with expected and historic rates, giving SCWA staff valuable insight into when and where a leak in the distribution system may have occurred, and how to best adjust pressure for optimal service.

The public-private partnership between SCWA and IBM has proven to be successful for both SCWA and the public. Leaks in the water district have decreased by 30 percent since the system went online, meaning customers have more reliable water pressure and service. Additionally, SCWA estimates that the program saves them upwards of \$100,000 annually.³² Despite the myriad of benefits smart infrastructure can provide counties—improved public safety, reduced costs, water and energy conservation, among many others—there are a number of issues that counties must address when incorporating new technologies into their infrastructure programs.

Water monitors can compare real-time information about water levels with expected and historic rates, enabling counties to find leaks and optimize service.

A worker tests Sonoma County Water Agency's automated water pressure system. Counties will need new high-skilled workers to install and maintain technological upgrades in county infrastructure.

Source: IBM

COUNTY CONCERNS

Despite the myriad of benefits smart infrastructure can provide counties—improved public safety, reduced costs, water and energy conservation, among many others—there are a number of issues that counties may need to consider when incorporating new technologies into their infrastructure programs.

Costs

As previously noted, counties invest more than \$100 billion in various infrastructure programs and projects. Maintaining current infrastructure is expensive enough for counties, and upgrading or developing new infrastructure to carry out remote traffic monitoring or creating smart grids may be beyond what many counties can afford initially, even if the investment is poised to reduce county costs long-term. Additionally, as energy and water infrastructure becomes more efficient and produces less waste, it may paradoxically drive up the usage costs for counties and consumers alike, due mostly to fixed costs and debt associated with infrastructure development. Counties will need to seek new ways to fund smart infrastructure projects, through developing public-private partnerships, levying taxes, or seeking federal funding opportunities such as the Department of Transportation's Transportation Investment Generating Economic Recovery (TIGER) Discretionary Grants or from the U.S. Department of Agriculture for rural electric infrastructure projects.³³

Security

Connecting utilities to the smart grid provides counties the opportunity to provide services in a more efficient and cost-effective manner. Yet this advantage can be seen as a double-edged sword, as utilities are simultaneously potentially vulnerable to threats from outside groups. Cyberspies from foreign countries have previously penetrated the U.S. electrical grid through vulnerabilities, often unbeknownst to the utilities.³⁴ Were a group or individual able to take control of electrical facilities or water distribution systems, the results could be catastrophic. Counties and the utilities that serve them must take active measures to protect smart infrastructure from outside threats, including encrypting data communications sent to and from smart meters.

Privacy

One of the benefits smart infrastructure such as smart meters provide is the ability to collect and analyze large quantities of data, allowing utilities and consumers to better understand energy and water use and how to improve conservation efforts. Yet in the post-Snowden era, the public's perception on data collection has changed, and many may be wary about utilities or counties knowing their consumption habits. Data collected could provide insight into when people are at home, what kind of devices they use and for how long, and other daily habits and activities.³⁵ This data could potentially be sold to third-party groups such as manufacturers and retailers, or provided to law enforcement agencies looking to identify illegal activities. Counties and utility companies will need to ensure the public they serve that their data is secure and will not be used for any third-party purposes.

Future Job Market

As autonomous cars become more popular, counties will need to pay attention to the ways in which they might impact the local job market and economy. If they become widely adopted, autonomous vehicles may replace the need for bus, taxi or even heavy truck drivers—the most commonly held job in 29 states.³⁶ However, the market for high-skilled jobs may increase as programmers and engineers will be needed to design and manage the necessary technology for autonomous vehicles.

Aside from eliminating certain driving jobs, smart infrastructure may have broader impacts on the economy. For example, if autonomous vehicles lead to fewer human drivers, the need for roadside rest stops and hotels may subsequently decrease. If cars are programmed to obey speed limits, stop lights and other traffic rules, revenue from traffic tickets may decrease.³⁷ If utility companies switch to smart meters, their workforce needs may shift from occupations like meter readers to tech-based roles. The full economic impacts of smart infrastructure will be difficult to understand until these technologies become more common and widely adopted.

CONCLUSION

Counties rely on their transportation, water and energy infrastructure systems to provide critical services to constituents that drive economic growth and ensure public health and safety. Investing over \$100 billion annually in infrastructure programs, counties work tirelessly to maintain existing and develop new infrastructure that have significant effects on local economic and environmental conditions. As new technologies such as smart grids and remote traffic monitoring have come available in recent years, counties are integrating these technologies to develop smart infrastructure that enable them to provide services in a more efficient and cost effective manner.

It is inevitable that infrastructure will suffer from wear and tear through use and exposure to the elements, but with the rise in technological advancements over the last few decades, counties are exploring opportunities to incorporate technologies into new and existing infrastructure projects. Each year, more and more counties are beginning to see the benefits that smart infrastructure can bring to their communities to make them more resilient, efficient and safe.

ADDITIONAL RESOURCES

Alameda County, Calif.

- Alameda County: www.acgov.org
- Alameda County Microgrid: www.acgov.org/smartgrid.htm

Bernalillo County, N.M.

- Bernalillo County: www.bernco.gov
- Albuquerque Bernalillo County Water Utility Authority: www.abcwua.org

Los Alamos County, N.M.

- Los Alamos County: www.losalamosnm.us
- Los Alamos Smart Grid: www.losalamosnm.us/utilities/Pages/LosAlamosSmartGrid.aspx

Miami-Dade County, Fla.

- Miami-Dade County: www.miamidade.gov
- Intelligent Water: www-01.ibm.com/software/city-operations/miami-dade-water

Pinellas County, Fla.

- Pinellas County: www.pinellascounty.org/
- Intelligent Transportation System: www.pinellascounty.org/publicworks/ITS.htm

Sonoma County, Calif.

- Sonoma County: www.sonomacounty.ca.gov
- Sonoma County Water Authority: www.scwa.ca.gov

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ABOUT THE NATIONAL ASSOCIATION OF COUNTIES

The National Association of Counties (NACo) unites America's 3,069 county governments. Founded in 1935, NACo brings county officials together to advocate with a collective voice on national policy, exchange ideas and build new leadership skills, pursue transformational county solutions, enrich the public's understanding of county government, and exercise exemplary leadership in public service.

ABOUT THE RESILIENT COUNTIES INITIATIVE

NACo's Resilient Counties initiative serves as a catalyst between local governments and the private sector to strengthen the resilience of the nation's 3,069 counties, and create solutions for sustainable places.

In order to remain healthy, vibrant, safe and economically competitive, America's counties must be able to anticipate and adapt to all types of change. Through the Resilient Counties initiative, NACo works with counties and their stakeholders to bolster their ability to thrive amid changing physical, environmental, social and economic conditions.

Hurricanes, wildfires, economic collapse, and other disasters can be natural or man-made, acute or long-term, foreseeable or unpredictable. Preparation for and recovery from such events requires both long-term planning and immediate action. NACo works to strengthen county resiliency by building leadership capacity to identify and manage risk, and allow counties to become more flexible and responsive. Through the use of sustainable practices and infrastructure, counties will be better prepared to address these issues in a manner that can minimize the impact on local residents and businesses, while helping counties save money.

Through the initiative, NACo:

- Develops strategies to foster economic growth and competitiveness,
- Educates counties on techniques for implementing resiliency and sustainability strategies,
- Provides tools for counties to educate their communities on resiliency initiatives,
- Identifies ways to leverage changing conditions and take advantage of new technologies and innovation, and
- Facilitates an open exchange with the private sector.

For more information, visit www.naco.org/resilientcounties.

ABOUT NACo'S TRANSPORTATION AND INFRASTRUCTURE INITIATIVE

Under the leadership of NACo President Riki Hokama (Council Member, Maui County, Hawaii), NACo is strengthening the capacity of county leaders to deliver transportation and infrastructure services to their communities. The Transportation and Infrastructure Initiative addresses the county role in promoting investments that support economic competitiveness, improve passenger travel, foster creative partnerships, ensure safety and enhance community quality of life. This initiative focuses on the fundamentals of today's county transportation and infrastructure needs and explores the future of America's infrastructure advancements, including broadband expansion and technology innovations. For more information about this initiative, visit www.naco.org/transportation.

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