

Smart Communities: Regional Issues Statements, Goals and Potential Strategies

*Economic Vitality Advisory Committee
Smart Communities Task Force*

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Introduction

This document explores how smart community initiatives, driven by regional collaboration, may take advantage of rapid progress in technological innovation and data analytics to improve mobility, economic vitality, quality of life and environmental quality in the region.

The strategies detailed here are tethered to a process that helps to ensure smart community actions will benefit the community and make prudent use of limited resources. This process involves three steps:

1. Identify regional needs or issues.
2. Identify strategies for how data and technology potentially can address that need or issue.
3. Develop action-oriented initiatives tied to regional plans that use data and technology to address the identified need.

The first two items are addressed in this paper. Identifying regional needs was chosen as the initial step in this process to guard against the pitfalls of pursuing exciting, but unproven and potentially costly technologies that may not represent the best use of regional resources. This first step also recognizes the breadth of urban problems that may be addressed through smart community actions. The process

used ensures smart community actions address regional needs and are consistent with voter-approved comprehensive plans.

The region already has multiple stakeholder groups progressing on smart community initiatives, even if not labeled as such. Pima Association of Governments (PAG), through its role as a regional planning organization, has become a participant in regional smart community efforts to facilitate regional coordination and decision making on these and other initiatives through convening diverse stakeholders and strengthening existing networks. The Arizona Center for Innovation provides assistance, mentorship and facilities for local technology startups; Pima Community College's Centers of Excellence are building a technical workforce to fill open positions in high-demand fields; and regional leaders are working to facilitate the building of an urban data center and other critical smart community infrastructure. **PAG's end goal for this smart community effort is to identify three to five actions embracing regional collaboration and create an implementation plan for these selected actions.**

To begin the process of identifying how smart community strategies can address regional needs and priorities, PAG, through its Economic Vitality Advisory Committee, assembled a Smart Communities Task Force. The task force consists of a group of leaders representing local government, the business community, economic development and technology organizations. The task force met three times from November 2017 through January 2018, with additional communication between meetings. This document is the product of task force workshops and round table discussions.

Future actions pursued may not address all the strategies identified by the task force, but the strategies will live on in this document for future consideration. The nascent stage of smart communities' policies, programs and technologies, and the realization that regional needs and priorities will shift over time, suggests that actions assessed as infeasible today may become more viable as technologies and regional conditions change. As these shifts occur, policymakers will continue to refer to this document as a guiding resource.

In addition to selecting potential strategies based on regional needs and approved comprehensive plans, the task force adhered to a set of guiding principles that included: ensuring future actions will necessitate collaboration among regional stakeholders; identifying actions that would have a strong potential return on investment; selecting actions affected stakeholders could commit time and resources to; and finally, that the actions should spark interest from the community and key stakeholders, both within and outside the region, while showcasing the region as a smart communities' innovation leader.

This process identified six regional issues: **data and communications infrastructure, modernization of the roadway network, water security, common regional vision and branding, workforce alignment and resiliency of infrastructure.** For each issue, a brief statement describes how the issue impacts the region specifically. The issue statement is followed by a regional aspirational goal that states where the region would like to eventually move with respect to the identified issue. Next, a list of potential strategies that would move the region toward achieving this goal are included, followed by a sample of supporting regional policies from adopted plans.

Potential Strategies proposed in the document are based on efforts currently underway in the region, specific regional needs and demonstrated best practices or state of the art efforts from other U.S. communities. While most of the actions in this document are proposed as standalone initiatives, many could be combined with one or more other actions proposed in this document.

About Pima Association of Governments (PAG) and the Economic Vitality Advisory Committee

Pima Association of Governments' programs and services support regional planning efforts to enhance mobility, sustainability and livability in all our communities. PAG's mission is to address regional issues through cooperative efforts and pooled resources, and to provide accurate, relevant data that leads to effective regional planning decisions. The PAG Economic Vitality Advisory Committee, established in early 2014, explores various topics of regional significance that affect the region's economic vitality. These topics include transportation, trade, technology, workforce and others. Composed of 30 organizations, committee members are representatives of PAG member jurisdictions, including city and town managers, as well as representatives of higher education institutions and economic development-focused organizations.

I. Data and Communications Infrastructure

Issue Statement

Connectivity through advanced communications technologies has become a ubiquitous and nearly essential part of our everyday lives. As communication capabilities become faster and more advanced, data and communications infrastructure will play an essential role in smart community initiatives to improve quality of life and accelerate economic development in the region. While data and communications infrastructure is included as a stand-alone issue here, such infrastructure will likely form the basis for potential strategies in most, if not all, other smart community issues addressed throughout this document.

In 2016, 89.2 percent of Tucsonans lived in a household with broadband. This number is an 8.2 percent increase from 2014 and is higher than both the state and national percentages of 85.7 percent and 85.2 percent, respectively. Cox Communications provides the option of ultra-fast, one gigabit per second download speeds to a smaller but significant portion of the region for prices starting at \$120 per month.

Tucson ranked fifth out of 12 [MAP Dashboard](#) comparison cities in accessibility to broadband at home in 2016.¹ While the ranking on this regional indicator website may not seem a cause for alarm, the region's ability to incorporate and expand new communication technologies is critical for its future prosperity.

¹ AZ MAP Dashboard, using American Community Survey 1-year survey data. The Making Action Possible (MAP) Dashboard project, operated by the University of Arizona Eller College of Management, in partnership with PAG, Community Foundation for Southern Arizona and Southern Arizona Leadership Council, seeks to improve Southern Arizona through data drive collective civic action and education.

Advancing our digital infrastructure will be fundamental to progress in every area of regional prosperity, including education, healthcare, research, business, government, public safety, agriculture, energy and the environment. For instance, libraries can become centers of excellence in job searching for the unemployed; advanced research and development in healthcare, biology, aerospace engineering, science and national security will be enabled by the capability to transmit massive amounts of data through interconnecting high-performance computer networks; and government operations will become more accessible and effective for all the region's residents.²

Several actions have been taken at the state level in recent years to accelerate development of data and communication infrastructure. Governor Ducey signed HB 2365 into law on March 31, 2017. This legislation prohibits cities, counties and other political subdivisions of the state from entering into exclusive agreements with wireless service providers for locating wireless facilities on existing rights-of-way. The legislation also limits the fees and rates local governments may charge wireless providers for use of the right-of-way so that local governments do not charge wireless providers more than other users. Finally, the legislation limits the amount of the fee or rate to the actual and direct cost of maintaining the right-of-way. In siting new utility poles or adjusting existing poles, wireless service providers are exempt from local zoning review procedures unless poles exceed a specified height.

Arizona's new wireless facilities law is consistent with proposed Federal Communication Commission regulations limiting a local jurisdiction's ability to impose barriers on wireless facilities in the right-of-way.³ These rules are intended to remove regulatory barriers to infrastructure investment and speed the transition to next-generation communication networks and services.

The Governor's Office has partnered with the Arizona Department of Education, the Corporation Commission and the non-profit "EducationSuperHighway" to provide high-speed internet access to every public K-12 instructional building in the state.⁴ Pima County and the state are engaged in efforts to increase connectivity and responsiveness among emergency responders through Pima County's Wireless Integrated Network Plan and Arizona's participation in the First Responder Network Authority.

Implementation of advanced communications and data infrastructure connecting critical regional districts and corridors will be key to future development of the intelligent transportation system, the Internet of Things network and urban data centers that form the core of well-functioning smart communities.

Regional Aspirational Goal

Become a national leader in the use of data and communications infrastructure for economic development and improved regional services.

² Digital Arizona Council (2012) Arizona's Strategic Plan for Digital Capacity: Expanded & Reference Version (Draft). Note: The Digital Arizona Council no longer exists.

³ 82 FR 22453, available at <https://www.federalregister.gov/documents/2017/05/16/2017-09689/accelerating-wireline-broadband-deployment-by-removing-barriers-to-infrastructure-investment>

⁴ <http://www.azed.gov/erate/2017/02/01/what-is-the-arizona-broadband-for-education-initiative/>

Potential Strategies

1. Engage in Partnerships to Establish Ultra-Fast Internet Infrastructure

Local governments have heavily invested in and depend on high-speed communications infrastructure in efforts to move forward with smart community actions and initiatives. At the same time, the prospect of local governments building their own networks presents significant hurdles, including large capital and operating costs and a lack of expertise. Engaging in partnerships with private industry to encourage the build out of high-speed infrastructure, therefore, presents an attractive option. By adhering to the following best practices, the region should become an attractive site for private companies capable of bringing state-of-the-art high speed communications infrastructure to the region with minimal expenditure of public funds.⁵ Regional partners should consider these policies as critical for encouraging private development of both next generation wireless and fiber optic cable communications infrastructure.

Best practices fit into three steps. The first step involves mapping the location and ownership of existing utility infrastructure. The second step is to work with regional stakeholders to ensure access to existing infrastructure, such as utility poles and conduit, for future communication infrastructure. This step also includes reviewing all state laws, local ordinances and existing commercial agreements and providing this information to potential installers. Finally, the region should have a process in place to streamline permitting and construction processes for large projects.

Cities of varying sizes across the United States have benefited from partnerships with private industry to build out communications infrastructure in their region. The Kansas City region, for example, became the first location selected for Google Fiber gigabit internet service in 2013 in part by creating a plan for how the region would facilitate and use the service through its [Digital Playbook](#). Other regions have implemented steps and policies that have facilitated private investment such as the creation of local leadership coalitions and policies of installing advanced fiber optic cable during already planned street digging or redevelopment. The federal government has implemented a policy of siting by right of wireless service antenna structures and equipment on federal properties, a policy that local jurisdictions could also apply.

2. Establish a regional innovation center that deploys state-of-the-art data and communication infrastructure

An innovation center would implement advanced infrastructure, including data and communications infrastructure, in one district or neighborhood targeted for economic development. This approach allows the region to create a test bed for smart community technologies without the risk and expense of regional or citywide implementation.

⁵ For further reading on best practices for encouraging advanced communications and data infrastructure investment see Google (2014) Google Fiber City Checklist; Levin, B. and E. Satterwhite, (2013) A gigabit garden begins to grow: lessons from the first planting, *Gig.U*; Hovis, J. and A. Afflerbach, (2013) Gigabit communities: technical strategies for facilitating public or private broadband construction in your community. *CTC Technology and Industry*.

Other comparison cities have current initiatives to implement innovation centers. Denver's "Pena Station NEXT" will be a smart city district on previously undeveloped land near the airport, centered around a new light rail station and Panasonic's new headquarters. Albuquerque's "Innovate ABQ" will be set in downtown Albuquerque and is a \$100 million partnership between the city and the University of New Mexico. The center plans to combine research and commercial labs, science and technology companies, and commercial and retail business. Both innovation centers are planned as live-work-play communities.

Innovation centers provide an opportunity for regional partnerships that encourage research and development on smart city technologies using the region as a "living laboratory." Partnerships also allow for sharing of risks and capital expenses.

3. Deploy free Wi-Fi/smart kiosks

Smart kiosks that also provide free Wi-Fi hotspots were a favorite proposal among the U.S. Department of Transportation's Smart City Challenge cities selected as finalists in 2016, and several peer cities have introduced or plan to introduce smart kiosks (Austin, Denver, San Diego). The Port of San Diego plans to use its smart kiosks as Internet of Things devices to collect data on areas such as traffic volume and use of the port, and in New York City, thousands of smart kiosks are now available on city sidewalks at the location of former telephone booths. In addition to providing Wi-Fi access, the kiosks can provide easier access to information on regional services such as transit, local libraries, parks and even provide access to job applications.⁶ Regional partnerships could provide a one-stop access to resources and services. The kiosks may be available without expenditure of public dollars, as they would receive revenue from advertisements displayed, in addition to public service announcements, when the kiosks are not in active use.⁷

4. Implement a public high-speed communications network

Public internet service providers (ISPs) increase competition for customers among ISPs in the region, incentivizing private ISPs to reduce prices and/or increase services. A public ISP would also provide local startups greater assurance that they can provide content to customers in the region without Internet speeds being throttled considering newly repealed Federal Communications Commission rules on "net neutrality."

Providing a public ISP, however, involves substantial capital costs and expertise. For this reason, nearly all public ISPs servicing whole communities in the United States have been existing public electric utilities. These utilities already have much of the infrastructure, maintenance and repair equipment and personnel needed to install and operate an ISP.

⁶ US DOT (2017) Smart Cities Challenge: Lessons Learned.

⁷ Clean Tech San Diego (2017), "Port of San Diego Initiates Smart City Interactive Kiosk Program to Enhance Waterfront Experience," available at <http://cleantechsandiego.org/port-san-diego-initiates-smart-city-interactive-kiosk-program-enhance-waterfront-experience/>

Jurisdictions without public electric utilities have, however, committed to smaller scale ultra-high-speed networks that target a high priority district or corridor. These more targeted infrastructure investments provide the communication capabilities for implementing intelligent transportation systems and modernizing emergency services communications. Cincinnati, for example, has unveiled plans to install a new fiber ring around its central business district.⁸ The primary purpose of the Cincinnati project is to replace the district's conventional traffic signal phasing system and enhance the city's existing municipal fiber grid, which facilitates communications for all city departments, including emergency services. The fiber ring also will give the district greater capabilities to adopt future smart community actions, including leasing connections to third parties.

Sample of Supporting Policies from Adopted Plans

- Pima Association of Governments (2045 RMAP):
 - Include evaluation of applicable telecommunications equipment and infrastructure (fiber optic cable) for all projects during the project scoping and early design process. [System Performance S.3]
- Pima County (Pima Prospers):
 - Implement the Pima County Wireless Integrated Network Plan [§4.6.G1.P1]
 - Improve County Wireless Integrated Network [§4.6.G1.P2].
 - Co-locate fiber optic lines with other utilities [§4.6.G1.P3].
 - Develop facilities that provide access to regional and community programs through wireless and broadband networks [§4.6.G2.P1].
 - Extend wireless and broadband communication networks [§4.6.G2.P2].
 - Promote and support new communications technologies to encourage business and investment [§4.6.G2.P3].
 - Enhance the County's human-infrastructure connectivity through emerging, advanced communication networks [§4.6.G3.P1].
 - Promote and support new communications technologies to encourage business and investment [§4.6.G2.P3].
 - Promote utilization of new communications technologies such as wireless and fiber networks to encourage business and investment [§6.3.G1.P1(h)].
- Tucson (Plan Tucson):
 - Assist and incentivize technological innovations that lead to local business development and expansion [BC4].
 - Expand technologies for public infrastructure and facilities [PI3].
 - Promote City as an internationally recognized center for innovation and creativity in science, technology, and the arts [RG6].
- Sahuarita (Aspire 2035):
 - Promote the provision of state-of-the-art communication technologies [PFS-7.3].
 - Provide, and encourage private investment in, high-speed internet, fiber optics, town-wide wireless and WIFI capabilities, and other unknown future technologies [SECAP-12.1].

⁸ Black, H. (2017) Smart Cincy update: downtown "fiber ring," Dec. 21, 2017, available at <https://www.cincinnati-oh.gov/cityofcincinnati/assets/File/4113.pdf>

- Locate all major fiber routes passing by and within Town [SECAP-12.3].
- Explore emerging energy technologies and promote their use [ENG-2.2].
- Marana (General Plan)
 - Build partnerships with regional and state infrastructure entities [§7.3.9.G5.P(b)].

II. Modernization of the Roadway Network

Issue Statement

The Tucson metropolitan area is in the middle of the pack in terms of average commute times among peer Western cities, experiencing less roadway network congestion than larger Western metropolitan areas such as Phoenix, San Diego and Denver. Two key congestion indicators, average travel time to work and the travel time index (a ratio of travel time during peak and non-peak hours), however, increased in the Tucson metropolitan area from 2010 to 2015.⁹

Pedestrian and bicyclists safety is also a key issue for the region's roadway network. In 2015, the Federal Highway Administration (FHWA) continued to identify Tucson as a pedestrian-bicycle focus city because of its high number of pedestrian-bicyclist accidents and deaths.

These two critical issues facing the region's transportation system may, in large part, be attributed to the region's heavy reliance on its arterial roadway network due to the lack of separated freeways and expressways, limiting accessibility of many areas of the region. The network's reliance on arterials means increased interruptions to cross-town flow from traffic signals, stopped buses and local traffic ingress and egress. A higher percentage of traffic volume on arterials also translates to more conflict opportunities between vehicles and pedestrians and bicycles. Out of all U.S. metropolitan areas with populations greater than 500,000 as of the 2010 Census--a total of 79 metro areas--only Cape Corral and Sarasota-Bradenton, Florida, had lower percentages of daily vehicle miles traveled on freeways and expressways in 2015.¹⁰

The region's reliance on arterial roadways underscores the need to modernize the region's transportation system as the region's population and, consequently, its traffic volume grows. Modernization may also prove the most efficient and cost-effective means for accommodating increased roadway demands. Businesses and residents tend to cluster along arterials resulting in costly, protracted and controversial processes when jurisdictions decide to expand arterial roadways.

Smart community actions to address regional roadway issues may involve solutions other than implementation of emerging and often expensive technologies. Solutions may also include low-tech actions such as alternative street designs or traffic management policies. These actions fall within the smart community universe because they are data-driven, using enhanced measures now available to

⁹ 2015 American Community Survey 5-year Estimate, table S0802; Texas Transportation Institute 2015 Urban Mobility Scorecard

¹⁰ US FHWA (2016) Highway Statistics 2015, table HM-71.

transportation planners and engineers to more effectively and efficiently target issues affecting the transportation system.

Regional Aspirational Goal

Foster economic vitality while improving environmental quality, public safety and quality of life in the region through efficient and cost-effective implementation of roadway modernization improvements.

Potential Strategies

1. Prepare for the introduction of autonomous vehicles (AVs)

The impending penetration of AVs into the U.S. vehicle fleet has the potential to radically disrupt all aspects of the current transportation system, as well as dramatically affect land use and employment.¹¹ AV technology could all but eliminate serious traffic accidents, reduce fuel consumption and congestion, revolutionize car ownership and make parking lots obsolete.

Statewide policies implemented by Governor Doug Ducey have resulted in Arizona becoming a national leader in AV testing. The testing, however, so far, has been confined to the Phoenix metropolitan region. Waymo, an Alphabet (Google) company, currently operates AVs with no human in the driver seat on public streets in Chandler, and it plans to begin a driverless ride hail service in the area in 2018.¹² The ride-hailing company Uber tests its self-driving fleet on Mesa streets. Several other auto or mobility companies have a presence in the metro region.

Experts attribute the state's business-friendly practices and the metropolitan area's good weather and straight, flat roads for its attractiveness as an AV test bed. Local leaders have secured final commitments from AV companies by providing assurance that jurisdictions would not impose additional regulations on AV testing.

The Tucson metropolitan area possesses the same attributes that have attracted AV test projects to Phoenix. Regional collaborations should continue efforts to expand the presence of AV technology in the region and brand the region as an attractive location for operations.

2. Commit to a "Vision Zero" goal using data-driven safety analysis

Vision Zero is an innovative approach to traffic safety that focuses on system improvements, as opposed to individual behaviors, toward a goal of eliminating traffic fatalities. A key element of Vision Zero is its reliance on data-driven safety analysis (DDSA) to predict the safety impacts of transportation projects. DDSA uses data-driven approaches to identify high-risk roadway features and target the most beneficial projects for expenditure of limited resources.¹³ Applied

¹¹ Guerra, E. (2016). Planning for cars that drive themselves: Metropolitan Planning Organizations, regional transportation plans, and autonomous vehicles. *Journal of Planning Education and Research*, 36(2), 210-224.

¹² Davies, A. (2017) Waymo has taken the human out of its self-driving cars, *Wired*, Nov. 7, 2017, available at <https://www.wired.com/story/waymo-google-arizona-phoenix-driverless-self-driving-cars/>.

¹³

https://www.fhwa.dot.gov/innovation/everydaycounts/edc_4/ddsa.cfm?utm_content=&utm_medium=email&utm_source=govdelivery

to Vision Zero, this process involves collecting data on where and how crashes happen, as well as factors such as the demographics of impacted communities, enforcement citations and hospital admissions. A regional Vision Zero initiative would focus on issues that uniquely affect transportation safety in the region, such as the transportation system's heavy reliance on arterial roadways and the impacts of the region's dark sky policy.

Open data also comprise an important part of Vision Zero. For example, New York City has an [interactive online map](#) with spatial data on crashes, street design, speed limits and outreach. Boston introduced its [safest driver competition](#) in 2016 as part of its Vision Zero policy. The competition relied on a mobile application that scores drivers on safe driving factors. Participants showed a 47 percent drop in phone distraction and a 35 percent drop in speeding. Current practices impacting regional data collection may need adjustment or reevaluation to move forward with a robust open data and vision zero policy.

The Tucson Department of Transportation (TDOT) is currently gathering information consistent with a Vision Zero strategy through its monitoring of pedestrian-vehicle interaction at the Speedway Boulevard and Campbell Avenue intersection with lidar technology. State and local bicycle and public safety non-government organizations also have generated publicly available [crash data maps](#) that could inform official Vision Zero efforts, possibly combined with PAG's existing [interactive maps](#).

3. **Implement adaptive signal control and prioritization technology along key corridors**
Conventional signal phasing technology uses pre-programmed, daily signal timing schedules. This inability to adapt to changing traffic conditions results in transportation system-wide inefficiencies. Adaptive signal control technology (ASCT) automatically gathers data on traffic conditions from remote sensors that it uses to continually update signal timing/phasing to adapt to current traffic conditions. On average, installation of ASCT improves travel time by between 10 percent and 50 percent, depending on the state of a region's current signal phasing, while providing a smoother traffic flow.¹⁴

The City of Tucson is currently exploring participation in the SPaT (signal phasing and timing) Challenge along the [Sun Tran 105X bus route](#). The SPaT challenge is an initiative by the National Operations Center of Excellence, a partnership of the American Association of State Highway and Transportation Officials, the Institute of Transportation Engineers and the Intelligent Transportation Society of America with support from the Federal Highway Administration. The initiative challenges state and local public-sector transportation infrastructure owners and operators to cooperate toward achieving deployment of dedicated short-range communication (DSRC) V2I infrastructure with SPaT broadcasts in at least one corridor or network in each of the 50 states by January 2020.¹⁵

¹⁴ US FHWA (2017) "Adaptive Signal Control Technology" available at <https://www.fhwa.dot.gov/innovation/everydaycounts/edc-1/asct.cfm> last visited December 14, 2017.

¹⁵ <https://transportationops.org/spatchallenge>

The City of Tucson also works with the city's intelligent traffic signal provider, Econolite, to develop intersection accident detection along the Speedway Boulevard Living Lab. In the event of a traffic accident, this system detects the collision, then automatically sends the 15 seconds before and the 15 seconds after the collision occurred to 911 dispatch. The dispatcher is thereby alerted to the incident, allowing the dispatcher to determine the severity of the accident and place the right equipment at the scene in a timely manner, improving emergency response and mitigating traffic disruptions.

Pima County is also undertaking efforts to expand and enhance its ASCT system through its switch to Miovision traffic operation technologies and through making system upgrades along key corridors managed by Pima County DOT.

The region will need to ensure a robust, reliable and redundant communications network to effectively use ASCT, as latency in the system has deleterious effects on its functionality due to its dependence on real-time connectivity. A fiber ring around key districts, fiber cable located along key corridors, advanced wireless communication infrastructure or some combination of these options could form the backbone of a regional ASCT system.¹⁶

Regional efforts on ASCT may benefit from coordination mechanisms, such as an intergovernmental agreement (IGA) between jurisdictions for the operation and maintenance of the system and to establish a cooperative fund and a regional traffic operation center.

Coordination by technical staff across agencies and departments also will be an important consideration for a successful ASCT system. Regional resources could be committed toward development of a real-time travel delay model that provides a picture of how the arterial network performs for regionally significant commuter routes. Focus routes would likely be linkages from residential areas to downtown, the University of Arizona and the Tucson International Airport.

4. Maintain a Regional Transportation Data Center for better interagency coordination and/or to create open data platforms

Advances in information sharing technologies and processes allow separate but symbiotic government agencies or departments to better coordinate decision making through data sharing. One method to facilitate data sharing is through an intergovernmental agreement between regional jurisdictions to develop and maintain a regional transportation data collection effort and plan. Increased data sharing and coordination can be used to address regional transportation issues often considered outside the smart community realm, such as creating cooperative efforts, policies and plans to address investments in roadway preservation, maintenance and operations.

¹⁶ See Data and Communications Infrastructure Proposed Action: "Establish Publicly Owned High-Speed Internet Infrastructure" *supra*.

5. Plan for and implement transportation electrification through increasing the electric vehicle fleet and expanding charging infrastructure

Electric vehicles (EVs), depending on their power source, significantly reduce or eliminate localized air pollution and greenhouse gas emissions while shielding drivers from volatile oil price fluctuations. Electric vehicle sales have grown substantially since the introduction of the first affordable, mass-produced personal all-electric vehicles in late 2010. EVs, however, still compose less than 1 percent of total U.S. new vehicle sales. Accelerated adoption will depend on expansion of EV infrastructure, namely charging stations, and reduction in cost through increased sales volume.

Denver, Colorado, is creating a charging plan to address where EV charging stations should be located and how the city should facilitate implementation. Aspects of the plan include locating super-fast charging stations and creating charging corridors that ensure access to all communities within the city. The city has also committed to expanding the electric fleet of city-owned vehicles.

In our region, multiple regional stakeholders, including PAG, Tucson Electric Power and Pima County have entered partnerships to expand EV capabilities in the region. These efforts include Pima County's recent resolution to add 20 EVs to its fleet per year for the next six years.

6. Encourage multimodal travel through “mobility on demand”

Mobility on demand (MOD) is a broad-based solution emphasizing the integration of different transportation modes to move people quickly and efficiently using enhanced data capabilities and mobile applications.¹⁷ Other regions in the United States have used solutions such as universal mobility payment cards and one-stop mobile applications to allow more seamless use of multiple transportation modes.

PAG plans to facilitate pilot projects to promote shared mobility solutions and encourage multimodal trip chaining to address first/last-mile challenges. For PAG, this could include: expansion of incentive-based travel demand management (TDM) strategies as featured in the Metropia service; multimodal traveler information and trip planning through expansion of TransView and Metropia to better service mobility shifting and last-mile service; shared use transportation through public and private provided services including RTA elder mobility service, PAG Rideshare, and PAG Pima Commuter School Pool; and integrated or single fare payment services to allow seamless transition among modes. ADOT has partnered with scientists at the University of Arizona toward developing a transportation performance measures dashboard to “tell the story” of the region's transportation system and better inform a future mobility on demand framework.

Developers of the demand management Smartphone application, Metropia, are working with PAG to use Metropia origin-destination data to enhance the region's congestion management

¹⁷ <https://www.transit.dot.gov/research-innovation/mobility-demand-mod-sandbox-program.html>

process. The University of Arizona and Metropia are also working with the RTA on a mobility on demand project for the Rita Ranch area. This project, known as AMORE, will improve the operation of mobility-as-a-service for residents of the community.

7. Plan and implement an AV transit pilot project

Most deployments of AVs on public streets, such as Waymo's service in Chandler and Uber's service in Pittsburgh, have been privately implemented and led projects. Other regions around the country, however, are planning to incorporate short-distance autonomous transit vehicles. Regional partners could acquire, potentially through purchase or lease, a pilot fleet of autonomous transit vehicles to provide services in a high-demand area such as the University of Arizona campus or a potential innovation center.

Sample of Supporting Policies from Adopted Plans

- PAG (RMAP 2045)
 - Upgrade traffic control equipment and technology on arterial roadways [Advanced Tech. S.1].
 - Pilot new technologies to improve system safety and performance [Advanced Tech. S.2].
 - Support expansion of alternative fuel vehicles [Env'tl Stewardship S. 15].
 - Evaluate and incorporate applicable Intelligent Transportation System features for all transportation projects during project scoping or early design process [System Performance S. 2].
 - Include evaluation of applicable telecommunications equipment and infrastructure for all projects during the project scoping and early design process. [System Performance S. 3].
- Pima County (Pima Prospers)
 - Support expansion of alternative fuel vehicles [Env'tl Stewardship S. 15]
 - Support electric vehicle recharging stations [§3.2.G5.P1(i)].
- Tucson (Plan Tucson):
 - Assist and incentivize technological innovations that lead to local business development and expansion [BC4].
 - Expand technologies for public infrastructure and facilities [PI3].
 - Promote City as an internationally recognized center for innovation and creativity in science, technology, and the arts [RG6].
- Sahuarita (Aspire 2035)
 - Include infrastructure for future technology needs (fiber-based communications) in all circulation projects [PFS-7.4, SECAP-12.2].
 - Explore emerging energy technologies and promote their use [ENG-2.2].
 - Seek technological innovations to reduce capital, operations and maintenance costs [CD-3.5].
- Marana (General Plan)
 - Build partnerships with regional and state infrastructure entities [§7.3.9.G5.P(b)].
 - Reduce transportation-related energy consumption through alternative or renewable energy sources [8.4.9.G2.P(a)].

- Oro Valley (Our Future, Your Voice)
 - Lead by example in energy efficiency, alternative fuel and solar projects in municipal facilities and operations [CE.1].

III. Water Security

Issue Statement

Tucson has the reputation as an urban water conservation leader. The City of Tucson reduced its residential water usage from 121 gallons per capita per day in 1996 to 80 in 2015; the University of Arizona has over 300 faculty and staff working on water-related issues; and government, academic, non-profit and business interests are coordinating on development of the Southwest Water Technology Cluster in Tucson.¹⁸

In recent years, water levels in Lake Mead, which supplies much of the region's drinking water through the Central Arizona Project (CAP), have dropped dramatically, with some CAP water deliveries likely being reduced after 2019. Lake Mead levels would have to drop significantly lower than current levels to trigger a reduction in urban water allocations, but the current trends in Lake Mead water levels combined with projected population growth throughout the Sun Corridor underscore the importance of water conservation to the region's long-term future.

Efforts in the region to increase water security include replenishing groundwater levels with excess CAP allocations and exploring the expanded use of effluent to augment the region's water supply. Regional water security also depends on the regional water systems' ability to consistently deliver clean, high quality water. The region's commitment to green infrastructure addresses both water quality and quantity by reducing urban runoff while replenishing groundwater.

Smart community solutions offer several new avenues to further water security efforts in the region through greater access to information and a more efficient water delivery system.

Regional Aspirational Goal

Encourage investment and innovation through global leadership in water conservation and technology to encourage the region's future vitality.

Potential Strategies

1. Implement a smart water management system using Internet of Things devices

This solution uses sensors in water system pipes to monitor flow and manage an entire water system. Such a system primarily benefits regional water management through earlier detection of leaks and other system malfunctions with superior accuracy. Some smart water management

¹⁸ Rothschild, J. (2014) "Tucson's new Southwest water technology cluster: supporting business while solving our problems," *Inside Tucson Business*, June 27, 2014, available at http://www.insidetucsonbusiness.com/opinion/columnists/guest_opinion/tucson-s-new-southwest-water-technology-cluster-supporting-business-while/article_b2a82450-fc8a-11e3-81c5-0019bb2963f4.html

systems offer more advanced capabilities such as the use of statistical algorithms to detect anomalies in the water network and machine learning to enhance leak and malfunction detection.

Tucson Water is incorporating next generation pipe monitoring equipment into its infrastructure. Currently, most of Tucson Water's leaks are identified when they become apparent at the surface level. Early detection via monitoring equipment placed on pipes can help reduce property damage and even identify an issue before the pipe breaks. The same monitoring equipment can provide feedback on pump operations for energy savings.

A smart water system can be further enhanced if combined with advanced water metering technology. Smart water meters and the connected sensors/devices that create the smart water management system can communicate throughout the network, allowing integration of metering, efficiency and system integrity tasks.

2. Expand the use of smart meters

Tucson Electric Power (TEP) is currently coordinating with Tucson Water on using the two organizations' compatible advanced metering infrastructure to more efficiently perform remote meter readings. Another advantage of advanced/smart meters is their ability to provide real-time data to utility providers and customers. This would allow customers to identify leaks faster and take proactive steps to reduce water usage. TEP already allows customers to access real time information on their energy use, as well as report power outages and view energy efficiency tips through its mobile application. Similar information could be offered by Tucson Water through its advanced metering infrastructure capabilities.

Sample of Supporting Policies from Adopted Plans

- Tucson (Plan Tucson):
 - Assist and incentivize technological innovations that lead to local business development and expansion [BC4].
 - Expand technologies for public infrastructure and facilities [PI3].
 - Promote City as an internationally recognized center for innovation and creativity in science, technology, and the arts [RG6].
 - Reduce energy costs and improve environmental performance through technological changes [EQ7].
 - Promote environmentally sensitive industry and technology [JW3].
- Marana (General Plan)
 - Build partnerships with regional and state infrastructure entities [\$7.3.9.G5.P(b)].
- Sahuarita (Aspire 2035)
 - Explore emerging energy technologies and promote their use [ENG-2.2].
 - Seek technological innovations to reduce capital, operations and maintenance costs [CD-3.5].

IV. Common Regional Vision and Branding

Issue Statement

PAG uses the term “smart community” in place of the widely used term “smart city” to convey the regional scale of the metropolitan area’s efforts and acknowledge that the daily activity of the region’s residents and businesses reach beyond jurisdictional boundaries. PAG member jurisdictions, as well as business leaders, academic institutions and community groups, are exploring and implementing smart community technologies and systems in innovative ways. These efforts, however, can be accelerated and synergies can be created by increasing coordination among disparate groups to connect talent and ideas across the region.

Regional projects/initiatives have a higher likelihood of succeeding where they address regional needs but also spark interest from the public and key stakeholders both within and outside the region. Stated another way, the central goal of the Task Force, and a critical component of smart community initiatives moving forward, is to showcase the region as a smart communities innovation leader while also improving the lives of the region’s residents.

Regional Aspirational Goal

Showcase the region as a smart communities innovation leader while also improving the lives of the region’s residents through collaboration and knowledge sharing.

Potential Strategies

1. Join the [MetroLab Network](#)

The MetroLab Network encompasses 35 regional city-university partnerships across the United States. Through these partnerships, universities act as local jurisdictions’ research and development departments for smart community solutions that address regional needs. Each local jurisdiction contributes to the partnership by acting as living laboratories for the university to deploy its research and development projects. This partnership helps to drive smart community innovation and accelerate implementation of smart community actions that benefit the region. The national network of university-community partnerships intends “to scale effective solutions, accelerate best practices, and advance the understanding of urban science.”

The University of Arizona already partners with local jurisdictions to deploy smart community technologies developed through its many laboratories and centers. Joining the MetroLab Network may allow the region to advance its reputation as a smart communities innovator while gaining exposure to state-of-the-art smart community practices.

2. Engage the public and key stakeholders through open data platforms

Open data platforms that allow access and contribution to key datasets would increase residents’ engagement and allow key stakeholders to better address critical regional issues.

The City of Pittsburgh has been an innovator in using open data portals to address regional issues. The city partnered with Allegheny County, the University of Pittsburgh and local non-

profits to create the Western Pennsylvania Regional Data Center (WPRDC).¹⁹ The project involved creation of a mobile web application that provides a single source for anyone to access a broad range of regional, city and neighborhood data. The WPRDC has assisted regional efforts to address a multitude of issues including the opioid epidemic, public safety and blight.

Locally, the Town of Sahuarita recently partnered with technology company [Cartegraph](#) to implement its [YourGov](#) web and mobile application. The application allows users to report park and roadway issues directly to the responsible town department. Users may take a picture with their mobile devices and fill out a description of the issue. When they submit the issue on the application, it automatically notifies the appropriate town department of the situation in real time. Users can also report an incident remotely by moving a ping over the issue location on the in-application map.

Efforts such as Sahuarita's could be combined at a regional level to provide more robust and open data to area residents and stakeholders, allowing government to more efficiently partner with business, institutions and NGOs to address important issues affecting the region.

3. Create a central smart community resource/organization for the region

A central smart community resource or organization would assist in identifying and leveraging the preferences of different stakeholders throughout the region as a means of selecting the most beneficial and cost-effective projects and issues to move forward on and for making the best use of the region's resources and knowledge base.

The [Regional Smart Cities Initiative](#) (RSCI) used the greater Cincinnati Metropolitan Area as the pilot project in its nonprofit effort to "give local and regional leaders the tools to research, plan, fund, and build smart cities and connected communities."²⁰ The [Smart Cincy](#) working group covers the greater Cincinnati tri-state region that builds collaboration among communities to assess how regional resources can be used and opportunities addressed through smart community technologies. The group has hosted monthly roundtable discussions, quarterly leadership summits, and RSCI held a conference in Cincinnati. These ongoing efforts have resulted in, among other accomplishments, a regional transit mobile application and a regional bicycle-sharing program.

This PAG EVAC Smart Communities Task Force represents a first step toward creating a central smart community resource or organization. Efforts could be expanded to create a more permanent regional group either through PAG or as a stand-alone entity.

Sample of Supporting Policies from Adopted Plans

- Tucson (Plan Tucson):
 - Promote City as an internationally recognized center for innovation and creativity in science, technology, and the arts [RG6].

¹⁹ <http://pittsburghpa.gov/open-data/index.html>

²⁰ <https://www.smartregions.org/>

- Connect arts with science and technology [AC9].
- Sahuarita (Aspire 2035)
 - Explore emerging energy technologies and promote their use [ENG-2.2].

V. Workforce Alignment

Issue Statement

Addressing a shortage of high-skilled workers in emerging technology fields is essential to deploying smart community projects and initiatives. Workforce development programs offer the potential to strategically align workforce training and industry needs. Careers requiring technical and skills training, better known as Career and Technical Education (CTE), can yield above-average wages and increased employment opportunity for workers. Of the 55 million U.S. job openings estimated to become available between 2010 and 2020, 64 percent are projected to require some post-secondary education, but only 35 percent are projected to require a bachelor's degree or higher.²¹ While workforce development will continue to be an important issue for supplying the future skillsets needed to develop and operate smart community technologies, the smart community technologies and initiatives currently available may also help the region to better align workforce skills with in demand jobs.

Pima Community College (PCC) has established itself as the regional leader in workforce development and alignment issues. Its planned \$40 million investment in community Centers of Excellence target high demand professions in the areas of applied technology, healthcare and public safety. All potential strategies described here could be implemented through or in coordination with PCC's Centers of Excellence.

Regional Aspirational Goal

Cultivate a workforce with the skills necessary to create and advance the region's smart community efforts through targeted educational programs and partnerships with the region's employers and institutions.

Potential Strategies

1. Establish regional innovation center that connects smart community innovators with workforce development programs

A regional innovation center (described above) creates an economic development district designed to showcase smart community technologies and create living laboratories based on partnerships between government, businesses and institutions.

Workforce development could become a component of such a center. For example, technology industry offices and laboratories could locate in the same building or complex as technical education classrooms. Here, education institutions partner with industry to create a technology

²¹ Carnevale, A.P., Smith, N., & Strohl, J. (2013). Recovery: Projections of jobs and education requirements through 2020. *Georgetown University: Center on Education and the Workforce*. <https://georgetown.app.box.com/s/tll0zkxt0puz45hu21g6> (accessed February 19, 2014).

workforce that meets the needs of industry. PCC is currently engaging in compatible efforts through its Centers of Excellence. Housing, retail and other services and amenities located within the district would create a live-work-play setting that allows partners to showcase smart community technologies.

2. Create a workforce dashboard to match workforce skills to employer needs

Informational dashboards are a smart communities solution to consolidate diffuse information into a centralized and easily understandable format. Dashboards have been used to help address a variety of civic issues, including the opioid epidemic,²² hunger²³ and homelessness.²⁴

Constructing a regional workforce dashboard could serve as a resource for employers and job market candidates. The dashboard would display data on industry needs and workforce characteristics on a central, intuitive online format. Job market candidates could use the dashboard to access the most current information about high-demand job skills in the region and available education and training programs for those jobs, while employers could learn how many potential employees are about to graduate from a workforce program matching their needs. A dashboard could develop from existing workforce development agencies and programs, such as Arizona@Work-Pima County One-Stop and PCC's Centers of Excellence.

3. Establish technical education partnerships to match workforce skills to employer needs

Partnerships between the technology companies with a regional presence and educational institutions could take multiple forms that involve increased coordination.

For example, the technology company, Oracle Corp., has created a partnership with a Silicon Valley school district by opening a charter school at its Redwood City, California, headquarters in January 2018.²⁵ The design- and technology-focused school maintains independent decision making from Oracle, but benefits from the partnership and proximity with the company. Oracle employees will volunteer at the high school for workshops and mini classes. If a student develops a marketable idea through an Oracle-led workshop, the student will retain intellectual property rights.

This general concept of industry benefiting by having input on the skills developed in the region's education/workforce programs and students and job seekers benefitting from direct interaction with high-skill, high-wage employers could be applied as a smart communities' initiative in the region.

Pima Community College (PCC) has or is in the process of pursuing partnerships fitting the above description through its Centers of Excellence. Examples of PCC efforts include:

²² <https://smartcitiescouncil.com/article/how-dashboards-analytics-and-e-prescribing-battle-opioid-addiction>

²³ <https://smartcitiescouncil.com/article/intriguing-ways-technology-helping-farmers-and-future-food>

²⁴ <https://smartcitiescouncil.com/article/bridging-human-services-silos-impede-progress-homelessness>

²⁵ Singer, N. (2017) "A Public High School on a Tech Giant's Campus" NY Times, Dec. 4, 2017. p. B1

- Working with multiple aerospace and defense and manufacturing employers to develop and hone advanced manufacturing curricula in the areas of prototyping/design, automation, instrumentation and process control, and quality assurance.
- As a charter member of the Talent Solutions Coalition (TSC), working with partner colleges and major airline carriers to customize maintenance and quality assurance curricula to meet the needs to specific companies.
- Partnering with area utilities (TEP, Southwest Gas, Tucson Water, and their contractors) to develop a core pathway for energy/utility technicians that is premised on transferable skills across multiple technology platforms.
- TuSimple, the autonomous truck company with offices in Tucson, has identified the PCC Truck Driving Training Program as its premier source of interns and potential employees.

Sample of Supporting Policies from Adopted Plans

- Tucson (Plan Tucson):
 - Promote City as an internationally recognized center for innovation and creativity in science, technology, and the arts [RG6].
- Sahuarita (Aspire 2035)
 - Explore emerging energy technologies and promote their use [ENG-2.2].

VI. Resiliency of Infrastructure

Note: This section excludes infrastructure issues and action specifically pertaining to data and communications, transportation, and water. Please see the appropriate section above for a summary and explanation of potential strategies pertaining to those areas.

Issue Statement

The region, like most areas of the United States, has a critical need to repair or replace its aging infrastructure. Some estimates project as much as three quarters of the country's infrastructure will need to be renovated or replaced by 2030. As infrastructure is renovated and replaced over the next two decades, the region has an opportunity to incorporate technologies that make this new and improved infrastructure more resilient, connected and technologically advanced.

Regional Aspirational Goal

Modernize the region's infrastructure to meet future demands and growth while improving resiliency and efficiency using smart community technologies.

Potential Strategies

1. Convert public buildings to smart buildings using Internet of Things technology and encourage private owners to do the same
Internet of Things (IoT) technology involves the use of sensors or other internet-connected devices that communicate data about surrounding conditions or interactions. For example, motion sensors can control lighting, thermostats or security cameras. Application of IoT devices

to buildings and surrounding property may result in significant efficiencies and improvements in areas such as energy efficiency, comfort and security.

The City of Tucson is interested in the potential application of virtual fence technologies at City parks. These systems incorporate IoT devices such as webcams and motions sensors. Virtual fence systems could allow the city to monitor unauthorized access to facilities. Intruders after hours and vehicles in prohibited areas are two of the major areas where this technology could assist. PAG also supports collaboration on integrated security and surveillance technology applications.

Many of IoT/smart building technologies may already be in use in the region. Coordination and expansion of these systems may, therefore, prove the most beneficial use of project time and resources. Potential IoT/smart building projects could include increased adoption in public buildings and/or incentivizing adoption by private building owners.

2. Improve regional flood readiness and response through spatial modeling

The University of Arizona College of Civil Engineering is working with the Pima County Flood Control District on a model called CHRE2D that enables basin-wide-real-time flood forecasting. They are also working to get the entire City of Tucson real-time flood forecasting system online. This capability can help public officials make more informed decisions regarding effective flood control and for post-event flood recovery systems.

3. Implement a smart grid

The smart grid refers to a set of technologies and system improvements that increase the responsiveness and level of automation in the electric grid.²⁶ A smart grid automatically adjusts power generation to meet demand. It is also more responsive during outages, isolating disrupted portions of the grid to prevent larger blackouts. The smart grid offers the potential to better use distributed power generation, such as rooftop solar. For example, during an outage, the smart grid could use distributed sources to power key infrastructure such as traffic lights, hospitals, and police and fire stations.

Sample of Supporting Policies from Adopted Plans

- Pima County (Pima Prospers)
 - Encourage reduction in energy consumption through application of technology [§4.3.G1.P1].
 - Strengthen partnerships to establish energy and renewable energy system innovations [§4.3.G4.P1].¹²
 - Develop renewable energy micro-grids through PPPs [§4.3.G4.P2].
 - Consider new technologies to improve sewer system cost and efficiency [§4.4.G1.P8].
 - Incorporate emerging technologies into wastewater system [§4.4.G1.P9].
- Tucson (Plan Tucson):
 - Assist and incentivize technological innovations that lead to local business development and expansion [BC4].

²⁶ https://www.smartgrid.gov/the_smart_grid/smart_grid.html

- Expand technologies for public infrastructure and facilities [PI3].
- Promote City as an internationally recognized center for innovation and creativity in science, technology, and the arts [RG6].
- Encourage new and existing City infrastructure, facilities, and operations to use best energy efficiency technologies [EC1].
- Reduce energy costs and improve environmental performance through technological changes [EQ7].
- Promote environmentally sensitive industry and technology [JW3].
- Marana (General Plan)
 - Build partnerships with regional and state infrastructure entities [\$7.3.9.G5.P(b)].
 - Create financial mechanisms and incentives to promote Town energy demand reduction, energy efficiency, and renewable energy programs [\$8.4.9.G1.P(d)].
 - Reduce transportation-related energy consumption through alternative or renewable energy sources [8.4.9.G2.P(a)].
- Oro Valley (Our Future, Your Voice)
 - Lead by example in energy efficiency, alternative fuel and solar projects in municipal facilities and operations [CE.1].
- Sahuarita (Aspire 2035)
 - Explore emerging energy technologies and promote their use [ENG-2.2].
 - Seek technological innovations to reduce capital, operations and maintenance costs [CD-3.5].