Current State of Smart Cities Programs

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PSC | **PUBLIC SECTOR CONSULTANTS**

Prepared by

Public Sector Consultants
publicsectorconsultants.com

Prepared for

NextEnergy/MiNextCities Program
nextenergy.org

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Executive Summary

Smart city technologies can be the answer to municipal challenges beyond mobility and transportation. Smart city solutions can take the form of energy-efficient street lighting, electrified buildings, flood monitoring, community-wide broadband, renewable energy installations, and numerous other innovative applications of technology for community benefit. An overarching goal of smart city technology deployments is transformation that uses new methods of innovation and sources of information to enhance experiences, improve environmental sustainability and resilience, and boost financial and operational performance of community services.

While the number of smart city technology deployments has been increasing in larger cities, successful deployment in small to mid-sized cities and communities can also be impinged by the many challenging processes that technology deployments can pose. These small to mid-sized cities will need to consider how to use change management strategies for adaptation in responding to changing work processes, training staff, and measuring new key performance indicators.

To assist communities with potentially limited resources and capacity, Public Sector Consultants (PSC) conducted an extensive study of past, current, and potential smart city projects within the United States. This exploration focused on the identification of successful and less effective deployments to identify both best practices and challenges. The purpose of this report is twofold: to provide examples of best practices and actions to overcome barriers and to inspire new smart city projects to be adaptive and creative in their own unique community context.

The investigation was conducted as a literature review as well as through interviews, process comparisons, and benchmarking. A more complete description of the research process is in Appendix B. After analyzing the findings, PSC categorized the data into seven foundational concepts to assist with future deployments of smart city solutions in small to mid-sized cities:

- Robust stakeholder engagement and communications strategy
- Clear short- and long-term goals
- Strong and visible support from organizational leadership
- Adequate funding for implementation and sustainable funding for maintenance
- Consistent performance metrics to measure impact
- Capacity for managing change
- Adaptive policymaking and governance

While the study uncovered many interesting project deployments and best practices, findings were community specific and often not outside general best practices for community engagement, goals and metrics, organizational leadership, change management, sustainable and adequate funding, and effective governance. The research team encountered several obstacles, including the lack of information about smart city projects in the smaller to mid-sized cities. Although almost a third of smart city projects are implemented in these cities, the availability of data specific to them is almost nonexistent. Therefore, much of the content in this report reflects the larger cities and their deployments.

The following report will introduce the purpose and value of smart cities, summarize the current state of smart city technology in municipal contexts, introduce the MiNextCities (MNC) program, and highlight the most effective best practices along with some of the most common barriers encountered by existing smart city deployments. The content of this report is a comprehensive and collective assembly of best practices employed to overcome barriers to successful deployments. Through the numerous program reviews, these best practices rose to the top as the most vital to consider when planning a smart city project. However, this is not meant to be an exhaustive list of practices. Across the many cities, communities, and projects, the highlighted practices included in this report reflect the most successful, significant,

and effective practices. While many practices may seem mundane, they are effective at overcoming the consistent speed bumps in deploying technology in a community setting.

In addition to best practices, the report highlights unique challenges encountered by communities and cities adopting smart city solutions. This is not a comprehensive list of challenges, as there are countless obstacles to a successful project implementation that can vary from city to city. These examples describe distinctive challenges encountered by specific projects or communities along with highlights of how a community addressed the issues.

Following the highlighted best practices and actions for overcoming challenges, the report will bring forward exemplary instances of best practices and solutions in action. Detailed information about all case studies, research, and literature review can be found in the report's appendices along with the research methodology.

Introduction

As awareness of smart city technologies grows, more cities in the state and regions within are adopting and deploying these recent technologies to assist with the progress of their municipal strategic goals and positively impact their residents' lives. As defined by the Smart Cities Council, a smart city features three key elements:

Livability

Defined as "cities that provide clean, healthy living conditions without pollution and congestion. With a technological and digital infrastructure for providing city services."

Workability

Defined as "cities that provide the enabling infrastructure – clean energy, connectivity, and other essential services that allow the city to develop economically."

Sustainability

Defined as "cities that provide services without compromising future generations."

While mobility- and transportation-related technologies are often the most familiar municipal deployments, a variety of solutions are available to interconnect, engage, and inspire cities to embrace technological advancements such as flood detection, street lighting, emergency response, wastewater management, telecommunications, waste management, digital services, public safety, etc.

Most often, larger cities and metropolitan areas have been leveraging smart city technologies to advance and promote their top priorities. But small to midsized municipalities and suburban areas can be overlooked for recent state and federal infrastructure funding opportunities or potentially lack the internal capacity to manage smart city technology deployment projects. As government leaders start to transform their organizations through the application of technology to significant business challenges, they are also looking for a roadmap to shape their community's thinking about the future and to provide a path toward transforming into a smart city.

In support of NextEnergy's management of the MiNextCities program, Public Sector Consultants investigated existing smart city programs and best practices, with a focus on those actions that can be incorporated into the development of emerging MNC programs. This included exploring metrics used to assess program impacts and crafting a methodology to rate existing programs for strengths and potential challenges. The research findings will assist with the ongoing implementation of MiNextCities, particularly the findings related to best practices for community engagement and technology deployment. This current-state assessment will also provide context for the MiNextCities Readiness and Deployment Guide in future phases of the project.

The following "current state," or best practice guide, provides the following information:

- Background on model smart city programs
- Best practices to be incorporated into MiNextCities
- Metrics and reporting to assess program progress and impact
- Synthesis of all findings, with recommendations to inform project implementation

But small to midsized municipalities and suburban areas can be overlooked for recent state and federal infrastructure funding opportunities or potentially lack the internal capacity to manage smart city technology deployment projects.

MiNextCities Program Overview

MiNextCities is a three-year initiative, funded by the Michigan Department of Environment, Great Lakes, and Energy (EGLE), to engage communities and develop strategies to address climate change, promote resiliency, and improve mobility, safety, and quality of life for Michigan residents of all backgrounds. MiNextCities will develop innovative place-based technology and engagement solutions that cities can use to address their communities' unique challenges and priorities. The lessons learned during these three years will help create a roadmap for deploying smart city solutions that can be replicated in cities of all sizes throughout Michigan.

The goal of the MNC program is for communities to recognize and pursue the value of smart city solutions. MNC will achieve its outcomes through community engagement, roadmap development, innovative technology solutions, and knowledge and capacity building. The deployment guidelines and roadmap will provide a framework that can be replicated across the state, not only for program participants, but also for communities seeking to achieve outcomes such as:

- Reducing greenhouse gas emissions
- Improving quality of life for residents and visitors
- Increasing attraction and retention of talent and businesses
- Increasing private-sector and community investment
- Enhancing community safety
- Improving mobility

MiNextCities deployments will focus on solving specific, community-defined challenges, including, but not limited to:

- Electric vehicle charging
- Pedestrian and vehicle safety technology
- Shared mobility options
- Electrification of city-owned fleet vehicles
- Building and infrastructure electrification
- Connected and automated lighting
- Smart building technologies
- Internet of Things
- Battery and other energy storage technologies
- Distributed energy resources
- Secure high-speed data networks

Deployments will be co-funded by the program and participating cities and partners. Program partners will work with communities to reduce project costs by identifying and accessing financial assistance tools such as federal and state grants, utility rebates, and public-private financing arrangements. All technology deployments will be designed with the communities' needs and budgetary constraints in mind, and program partners will help cities ensure that these deployments are well positioned for technical and financial success.

Participating cities will be instrumental in creating a replicable roadmap for similar communities across the state—further positioning Michigan as a leader in the clean energy and smart mobility space.

The MiNextCities team will leverage its depth of technical and program management expertise to implement community-backed solutions and assist cities in reducing project costs, ensuring that each deployment is set up for success. Participating cities will be instrumental in creating a replicable roadmap for similar communities across the state—further positioning Michigan as a leader in the clean energy and smart mobility space.

Current State of Smart Cities

MiNextCities was developed on the foundation and principles of smart city technology deployments in small to mid-sized cities. Cursory research indicated that most current smart city technology projects in the United States occur in large metropolitan cities. In a 2017 report by the U.S. Conference of Mayors, a survey indicated that one third of all smart city projects have taken place in these smaller to medium-sized cities (U.S. Conference of Mayors).

The 2017 survey concluded that new technologies can be easier to implement on a smaller scale and that small cities may be more motivated to become test beds for these technologies to spark economic growth and attract investment. However, they may require assistance obtaining funding to get the projects off the ground. To obtain this assistance, small cities can partner with nearby municipalities to share both resources and costs (U.S. Conference of Mayors 2017).

In addition, the 2017 study revealed that most U.S. municipalities with an interest in deploying smart city technology solutions encountered similar priorities and project objectives, including:

- Increasing residents' satisfaction with various elements of direct city interactions
- Improving responsiveness of municipality
- Increasing collaboration across city departments and community stakeholders
- Reducing operational costs
- Adapting to changing city populations and demographics
- Improving energy efficiency while reducing carbon emissions
- Attracting private investment in the city's business districts

Smart City Best Practices and Challenges

PSC conducted an extensive literature review as well other qualitative research methods, including interviews, process comparisons, and benchmarking, to identify smart city best practices and challenges. The goal of this research was to determine the core elements that lead to successful implementation projects, with the expectation of finding new and creative approaches to these projects. Through conducting over 20 interviews; researching more than 30 cities, programs, and pilots; and analyzing over 15 reports, surveys, and white papers, PSC identified common foundations for success, all of which were consistent with implementation best practices in other municipal initiatives. Successful deployments of smart city technologies have typically used standard models of technology deployment, community engagement, and governance. While the technologies themselves may include cutting-edge solutions, the deployment processes—from inception to execution—tended to be more focused on proven models and approaches. In other words, communities relied on what they knew worked while applying that knowledge to the emerging frontier of smart city technologies to ensure successful deployments.

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Foundational Elements

PSC's research on smart city best practices identified seven foundational elements that set the stage for successful smart city technology deployments. PSC's research revealed that these seven foundational elements were consistent across almost every deployment:

- Robust stakeholder engagement and communications strategy
- Clear short- and long-term goals
- Strong and visible support from organizational leadership
- Adequate funding for implementation and sustainable funding for maintenance
- Consistent performance metrics to measure impact
- Capacity for managing change
- Adaptive policymaking and governance

Specific best practices were also identified within each of the foundational elements. These tactical approaches ensured foundational elements were successful. However, smart city deployments were not without challenges. The research also identified the most shared challenges faced by communities undertaking smart city projects.
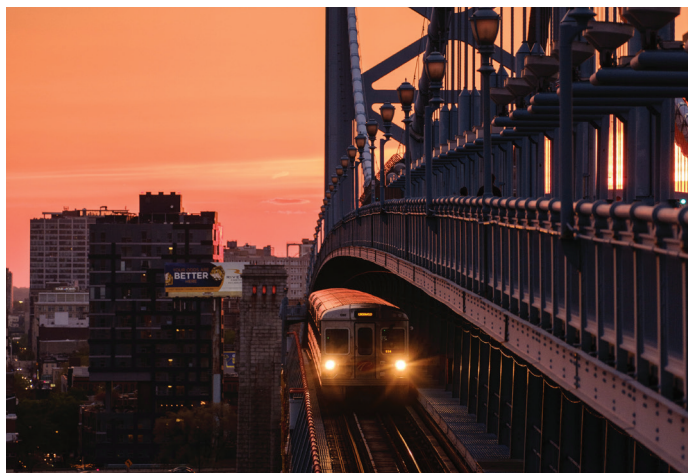
Robust Stakeholder Engagement and Communications Strategy

Robust stakeholder engagement and communications strategies were critical to successful smart city deployments. Community engagement was used to educate stakeholders–residents, businesses, and community partners–on the benefits of smart city technology, but more importantly to get their feedback on program design and deployment. By engaging stakeholders, communities ensured their project goals aligned with the communities' needs and that deployments were effective in solving pressing community challenges.

Communities' engagement tools included in-person town halls and similar engagement meetings where residents could voice opinions and provide direct feedback. Similarly, communities used electronic surveys to gather broad feedback and provide a convenient method for input when in-person meetings were not possible. Engagement also occurred through existing organizational structures, including city

councils, boards, and commissions. Communities also leveraged input from an advisory council or task force specifically chartered with guiding the smart city process.

In lock step with a robust engagement process was a clear communications strategy that focuses on public awareness and education. Garnering broad and effective input required informing stakeholders how to engage, what smart city deployments meant, and how a community would manage the process from start to finish. Successful communications were consistent throughout the duration of a project, from inception to postdeployment, so stakeholders could see the beneficial impacts. Communications tools included websites, email, social media, press toolkits, and newsletters. In disadvantaged communities, there was also an emphasis on word of mouth and more grassroots approaches to communication, as well as neighborhood-level engagement. These approaches helped address limitations like lower rates of internet access.

PROFILE
Philadelphia, Pennsylvania

City of Philadelphia proposed establishing an External Advisory Committee, made up of members of the Philadelphia community representing universities and colleges and private-sector and community-based organizations. The committee would serve as advisors to the city's leadership, providing support on project ideas and project implementation.

Best Practices in Action

Communities achieved robust stakeholder engagement and successful communications strategies through a variety of methods. This study has identified several best practices to ensure success at this stage:

- **Define a clear purpose for the program by communicating the problems/issues that the city is trying to solve and why—frame the initiative around solving those problems.** All community stakeholders must understand the purpose and value of smart city solutions in addressing the community's problems. Stakeholders should identify with local leadership the most pressing community challenges that can be solved by smart city technology.

- **Provide education to public officials and city staff at the right time in the process of deployment.** Effective public engagement is almost always preceded by educating stakeholders on smart city solutions. Everyone needs to understand the who, what, when, where, and why of the initiative. However, understanding and knowledge sharing should be structured appropriately for each stage of the process.

Everyone needs to understand the who, what, when, where, and why of the initiative.

- **Establish a well-structured engagement plan, crafted for each community's unique circumstances.** The best engagement plans are well planned with a clear purpose and structure. Plans should include stakeholder engagement from early in the process to after deployment. Stakeholders should have input in identifying the most pressing community challenges, guiding the selection of viable solutions and being informed of outcomes after deployment. Designing a plan that is tailored to reflect each community's respective assets and capacity challenges is equally critical. While plans should be thorough, they should also retain flexibility as not every contingency can be planned for or anticipated.

- **Ensure all communications are transparent and accessible to all stakeholders.** Communicating in today's fractured media is a challenge. It is important to leverage as many channels as possible to reach the maximum number of people. Communications should be consistent and access to information easily obtainable. This will typically require using multiple communication channels to reach all stakeholder groups.

- **Create a community advisory committee or assign to an existing board or commission.** Advisory committees play a significant role as a sounding board for staff and elected leadership. They provide helpful feedback on all aspects of deployment from engagement planning to technology implementation. An advisory committee representative of the community at large helps convey broader community sentiment in a constructive manner.

- **Develop robust partnerships to facilitate community engagement and collaboration.** The best engagement is the result of communities engaging a broad array of stakeholders. City boards and commissions, nonprofits, and community groups often show interest in smart city deployments that align with their missions. Leveraging these groups can help build credibility and share the burden of engagement, while resulting in collaboration that advances project goals.

- **Thinking in systems and regionally for greater impact.** Smart city deployments may well reach beyond a particular jurisdiction depending on the technology. In cases where solutions have regional impact, it may make sense to closely work with adjacent communities, counties, regional councils, and/or state government. There may be economies of scale and funding opportunities that can be leveraged using a more regional approach.

- **Develop a shared vocabulary with stakeholders, especially around equity, sustainability, and environmental justice.** Equity, sustainability, and environmental justice mean different things to different people. Developing smart city solutions that incorporate these concepts is important—but can only succeed when everyone shares a similar understanding of those elements. Using the engagement process to understand stakeholders' perspectives on these topics will help establish a common vocabulary and increase the likelihood that equity, sustainability, and environmental justice will be incorporated.

- **Implement user testing early.** All smart city technologies will require users to engage in those technologies. The power of pilot projects enables them to be deployed in a flexible, iterative way, which enables A-B testing for users so that direct user feedback can inform the development of user interfaces, thereby increasing the accessibility of the implemented technologies.

Overcoming Challenges

Every program faces challenges; it is crucial to address those challenges when they arise. PSC identified some common engagement and communications challenges. While many of these recommendations are common to most community engagement programs, the application by each city is reflective of their unique context.

- **Getting sustained support from city leadership, residents, and other key community stakeholders.** For any program to go beyond the conceptual stage, there must be wide-ranging support. This support may organically evolve but often requires intentional nurturing with a thoughtful and pragmatic strategy. In addition, initial enthusiasm is often high but wanes over time. This challenge can be offset by incremental progress and celebrating milestones.

- **Getting support from regional and national programs.** Some programs have relied upon momentum from regional and national efforts. For example, the U.S. Department of Energy has provided rebates for EV charging infrastructure that communities have leveraged to advance their goals.

- **Overcoming resident and business concerns.** Residents and businesses may have particular needs around a myriad of public services, from safe neighborhoods to improved parks. There is always a danger that smart city solutions will be seen as a lower priority than those other priorities if there is not a clear linkage. Stakeholders also have a cynical view around the cost of projects and the value to their own needs.

It is critical to put people first, ensuring that deployments benefit everyone and do not exclude Black, Indigenous, and People of Color and/or residents in disadvantaged neighborhoods.

- **Considering environmental justice and equitable investment in the community.** Smart city deployments can fall into the trap of technology first, people second. It is critical to put people first, ensuring that deployments benefit everyone and do not exclude Black, Indigenous, and People of Color and/or residents in disadvantaged neighborhoods. It is also important to work with the municipality to build trust—not erode the relationship between communities and the city.

- **Managing capacity constraints.** Many municipalities continue to face capacity constraints. A smart city project requires the engagement and participation of multiple staff, depending on the scope of the project. A lack of capacity can hamper efforts, from concept development to implementation. Setting clear expectations and accountability can help, as can leaning on partnerships and external partners.

Exemplary Cities

The exploration engagement and communications in smart city projects revealed many exemplary case studies, including the City of Philadelphia and the City of Long Beach. While each project was designed for a specific context and the technology solutions were different, the approaches to overcoming the many challenges of community engagement demonstrated creativity to support a successful implementation.

- The City of Philadelphia, Pennsylvania, proposed establishing an external advisory committee, made up of members of the Philadelphia community representing universities and colleges and private-sector and community-based organizations. The committee would serve as advisors to the city's

leadership, providing support on project ideas and project implementation. More information is within the **SmartCityPHL Plan** (City of Philadelphia. n.d.).

- The City of Long Beach, California, surveyed community members. One of the questions they asked was "have you heard of the term smart cities before?". After learning that more than half of respondents had never heard of the term before, the Smart City Initiative team put together a list of relevant terms (such as Internet of Things and machine learning) and shared it with residents to ensure people had some familiarity with smart city topics before diving into more community engagement. More information about this solution is in the **Long Beach Smart City Plan**.

Clear Short- and Long-term Goals

Identifying clear short- and long-term goals is an integral part of all smart city program development. Nearly all the program plans the MNC team reviewed included clearly articulated project goals that were established prior to the actual deployment of the selected solutions. In addition, the goals were often categorized as short-, mid-, and long-range strategic goals supported by tactical objectives. As with other foundational elements, goal setting and defining timeline were project and/or community specific.

Best Practices in Action

Specific goals and outcomes varied widely across smart city deployments. Despite these variations, PSC has identified several best practices to ensure success at the goal development stage:

- **First identify desired outcomes, then consider solutions to help achieve those outcomes.** Identifying desired program outcomes is an important early step in smart city program development. By working with community residents, city officials, and other important stakeholders to determine what they want to achieve through program deployment, municipalities can translate those desires into clearly defined program goals and objectives.

- **Create a detailed roadmap with achievable steppingstones for each deployment.** After desired program outcomes have been identified, create a roadmap with clearly articulated short- and long-term goals and objectives. These goals and objectives should be clearly defined, realistic, and

- **Facilitate alignment of smart city strategies with the complex web of policy agendas operating at other levels.** Smart city goals should align with community development goals and policies at the local, state, and federal levels. Such alignment is especially beneficial in preventing potential conflicts surrounding city planning objectives and gaining buy-in from a range of governmental stakeholders.
- **Continually evaluate goal completion throughout the project and adjust as needed.** As discussed in a forthcoming section of this report, measurable performance metrics should accompany each goal. These metrics should be used to continually evaluate goal completion throughout the lifespan of a project and adjust the project expectations as needed.

Convening a diverse group community partners may engender greater support and collaboration in the community and foster a sense of ownership over goal completion while also building or supporting trust between the city and community.

Overcoming Challenges

- **Be realistic about what is achievable.** Setting realistic expectations for goals and outcomes may be particularly challenging when it comes to deploying new technologies. If a particular smart city technology has not been widely deployed or tested, it may be difficult to know whether specific goals are realistically achievable within the constraints of a particular city or community. Communities may help mitigate this challenge by setting goals and identifying outcomes that are easily assessed and being willing to adjust expectations if needed.

PROFILE
Henderson, Nevada

The City of Henderson mapped out a set of three overarching goals, each with key focus areas and initiatives, for its Smart City Strategy. This strategy will guide the city's approach towards becoming a smart city in the years to come.

achievable in the specified time frame. Many smart city program plans include diagrams or lists of the program goals and objectives.

- **Include community partners when discussing and identifying goals, objectives, and outcomes.** Convening a diverse group community partners may engender greater support and collaboration in the community and foster a sense of ownership over goal completion while also building or supporting trust between the city and community.
- **Integrate smart city implementation goals into broader city planning documents.** Though broader plans may not specifically be focused on smart cities, integrating smart city goals into plans such as master plans, climate action plans, parks and recreation plans, land-use plans, etc. demonstrates high-level commitment to smart city initiatives and may also make it easier to obtain funding for smart city projects.

Exemplary Cities

Establishing goals for any project is important to positive outcomes. The following cities exhibited processes to identify and measure clear goals for their individual smart city programs.

- The City of Henderson, Nevada, mapped out a set of three overarching goals, each with key focus areas and initiatives, for its **Smart City Strategy**. This strategy will continue to guide the city's approach toward becoming a smart city in the years to come (City of Henderson 2018).

- The City of Coral Gables, Florida, developed a **Smart City Strategic Management Framework Architecture**, which provides a robust plan that the city is following to transition toward becoming a smarter city in the years to come. Among other provisions, the framework includes clearly defined goals and objectives as well as proposed timelines for completing various projects (Rudolfo 2022).

- The **City of Chicago (Illinois) Technology Plan** outlines five broad strategies that will enable the city to "realize its vision of becoming the city where technology fuels opportunity, inclusion, engagement, and innovation." One of the five strategies is to "make every community a smart community" (City of Chicago 2012).

Strong and Visible Support from Organizational Leadership

Successful projects, programs, initiatives, technology deployments, and other such efforts rely upon support from leadership. Projects that do not have strong and visible support from leadership will ultimately lose momentum and potentially encounter barriers that derail outcomes. Not only do these efforts require support from leadership, but that support also needs to be visible to people within the organization as well as stakeholders and the community at large. The project implementation plan should be developed with the clear understanding that achieving outlined goals will require leadership to support ongoing investment in the project. A few identified best practices include the following:

Best Practices in Action

- **Create a smart city working group composed of city leadership and key stakeholders to help guide smart city strategy development and implementation.** A working group demonstrates

PROFILE
Portland, Oregon

The Portland City Council adopted Resolution No. 37371 on June 21, 2018. The resolution established a priorities framework for the City of Portland's Smart City PDX Initiative, thereby demonstrating strong and visible support from city leadership.

commitment but also serves as a valuable sounding board and accountability mechanism for the implementers doing the work on the ground.

- **Public statements/documents of intent supporting smart city implementation (e.g., resolutions, press releases, etc.).** Consider the value of transparency not only in the potential positive outcomes of a project but also the demonstration of leadership supporting the efforts.

- **Create a city innovation hub (sometimes call a lab) to test and promote the adoption of smart technologies.** Given a city's capacity and interest in deploying multiple smart city solutions, the dedication of staff and other resources to an innovation hub is valuable.

- **Partner with industry leaders to deploy and manage smart city technology.** Partnerships with private industry, higher education, and other entities can enable cities to do more with less resources, align strategic goals, and continuously generate improvements based on the experiences of others.

- **Require or incentivize the integration of smart city elements into design and development of buildings and infrastructure.** Ensuring that all new and redesigned buildings, vehicles, and infrastructure must integrate this technology, which will help further drive adoption, ensure broader benefits from the technology, and enable standardization into procurement practices.

Overcoming Challenges

Garnering high-level support from organizational leadership can be difficult. PSC's exploration of existing smart city programs identified several challenges that technology deployment efforts might encounter when seeking buy-in from mayors, commissions, councils, and other municipal decision makers.

- **Ensuring a wide range of citizens receive communications regarding smart city deployments and opportunities.** Using multiple channels of communication (e.g., government websites, email, social media, surveys, etc.) can help with this.

- **Ensuring adequate staff capacity is available to manage smart city programs and projects.** Without dedicated staff or other personnel resources such as contractors, projects are highly likely to not be successful or sustained

- **Create decision-making criteria, processes, and analysis tools to incorporate smart city technology deployments in future relevant technology investments.** Developing and maintaining future smart city solutions requires that a city consider impacts and alternatives when investing in infrastructure and community development. Formalized systems of decision making that integrate and assert the contribution of smart city solutions, sustainability, and carbon reductions will effectively integrate the value into policy and process.

Exemplary Cities

Strong, clear, and visible support of smart city projects by city and community leaders is a key pillar of successful planning and sustaining positive outcomes from the project. Projects are likely to see a greater level of success when leaders and decision makers reflect the values of the program at all stage of implementation.

- The Portland City Council adopted Resolution No. 37371 on June 21, 2018. The resolution established a priorities framework for the **City of Portland's Smart City PDX Initiative**, thereby demonstrating strong and visible support from city leadership (Smart City PDX n.d.).

- The **San Diego (California) Smart Cities Regional Initiative** is a multiyear collaboration composed of government, business, education, and nonprofit organizations. Together, the organizations are working advance the San Diego region's goals to become a leader in the smart city movement.

Adequate Funding for Implementation and Sustainable Funding for Maintenance

Even if every other foundational element is in place for a successful smart city program, without adequate funding, deployments and long-term sustainability are not possible. Most smart city programs plan to leverage federal and state resources to ensure sustainability, sometimes combining those with local resources. Public funding is commonly connected to transportation upgrades and expansion where large funding amounts are often available.

Since smart city solutions are not limited to mobility-related technologies, some communities have developed more creative ways to fund projects. Beyond public funding, municipalities have leveraged public-private partnerships and private funding sources, although fully privatized funding is significantly less prevalent. Existing research continues to support that government-based funding is not a sustainable strategy for propagating smart city projects.

The IIJA's focus on mobility and the IRA's focus on energy and climate will infuse significant funding into these areas of the smart city marketplace.

Despite the need to identify nongovernmental sources of funding, the Bipartisan Infrastructure Bill (BIL), also known as the Infrastructure Investment and Jobs Act

(IIJA), and the more recent Inflation Reduction Act (IRA) offer significant potential in the near term to leverage additional federal funds for smart city deployments. The IIJA's focus on mobility and the IRA's focus on energy and climate will infuse significant funding into these areas of the smart city marketplace. While this funding will be beneficial for launching some projects and leveraging funds, they may further delay the transition to sustainable local funding but do offer good potential in the short term.

Best Practices in Action

Developing adequate and sustained funding requires consideration of multiple options. Best practices for funding include:

- **Pursue federal and state grant programs.** Federal and state grant programs can be an excellent resource for launching initial programs or enhancing existing ones. While these funding sources do not typically provide long-term revenue for ongoing maintenance and later replacement, many communities would not have pursued such projects without federal or state funding.

- **Create coalitions with nonprofits and other partners to collaboratively seek grants, sponsorships, and other financial sources.** Most grant programs favor applications that are submitted by robust coalitions. Competitive funding awards from both governmental and philanthropic sources favor initiatives that have a broader reach and a greater potential to be sustained. Multiple partners also improve the likelihood of sustainability should a project partner change course and no longer support an initiative.

- **Integration of project costs into long-term financing.** Transportation infrastructure projects are often financed with longer-term bonds and other mechanisms. The integration of associated mobility solutions into other transportation projects offers another opportunity to finance projects. While debt financing is not appropriate for ongoing maintenance, it can be a useful source for initial project development and balance out the reliance on grant funding. Recent increases in interest rates may make this option less favorable compared to the past decade.

To minimize the cost to construct the cycle track, the City of Huntsville coordinated the work to coincide with a resurfacing project for Spragins Street and upgrades to traffic signals.

- **Incubate entrepreneurs developing smart city solutions.** A sustainable long-term approach to generating investment in smart city technologies is through the development of businesses with profitable revenue models. More business development will lead to direct and indirect outputs of investment and job growth. While not every community is a candidate for supporting this type of business growth, regional business incubators and similar programs often have a good understanding of the existing marketplace.

- **Include funding in annual municipal budget allocations.** Local funds are the most likely sources for ongoing maintenance and program sustainability. Communities will need to allocate operational and capital improvement resources to smart city initiatives. Using cost savings or new revenue opportunities from the deployed technologies can provide the economic justification for ongoing funding. It is critical to understand the return on investment and have the language to clearly communicate the investment opportunities to decision makers.

- **Develop strong public-private partnerships to secure sustainable funding and capital investment sources.** Since many smart city solutions are integral to municipal operations and services, there is a tendency to undertake the planning, implementation, operation, and maintenance solely with municipal resources. Communities should thoroughly explore the potential for public-private partnerships. The private sector may be able to lead components of a project or an entire project with greater efficiency

and cost effectiveness, including developing creative financing options. Carefully evaluating the pros and cons of private-sector participation and a transparent procurement process can yield benefits.

- **Leverage existing and planned infrastructure improvements to incorporate smart city deployments.** Road, utility, and public facility improvements present opportunities to incorporate smart city project components. Rather than trying to shoehorn a project after the fact, being proactive about integrating projects to achieve cost savings and minimize disruption is an effective approach for saving money and time.

- **Undertaking projects that offer efficiency of scale and have a larger impact on municipal goals.** Communities are often hesitant to undertake large-scale smart city projects until the technology solution is proven to work in their community. However, certain technology deployments may be most cost effective at a larger scale and merit thorough consideration over smaller pilot projects. These types of projects should be ones that have been demonstrated to be successful in other communities and have a high likelihood of success.

Overcoming Challenges

- **Securing sufficient funding to start the project and build capacity.** One of the top barriers to all smart city projects is the initial funding hurdle, alongside sufficient staff capacity. Communities will often flinch at initial cost estimates for projects that are not always deemed a high priority relative to more pressing needs such as maintaining roads or covering underfunded infrastructure liabilities. Even with project funding for initial deployments, there needs to be adequate staff time to undertake the work. Pursuing a combination of federal, state, and municipal resources along with public-private partnerships in deployment and maintenance can help overcome these challenges.

- **Ensuring the community understands the financial resources required to sustain the project deployment over time.** A significant threat to smart city projects after deployment is the lack of ongoing resources for maintenance. Communities often fail to thoroughly assess the long-term needs or simply choose to ignore this facet for fear that a deployment will not be approved. This problem is

inherent to many public-sector capital improvement projects and should be addressed from the start. By not side stepping this issue, proponents can build credibility and improve the chances for longer-term funding commitments from their own municipality.

A significant threat to smart city projects after deployment is the lack of ongoing resources for maintenance.

- **Relying solely on publicly funded projects.** While federal and state resources are an excellent source of funding, and leveraging municipal resources is ideal, relying solely on public sources may exclude some potential projects. Creative approaches involving the private sector and the potential to generate new revenue streams, as well as the support of philanthropy, are two viable ways to expand beyond public funding.

- **Build awareness to smaller cities' priorities with national and local funders.** Numerous coalition organizations (Urban Sustainability Directors Network, National League of Cities, etc.) have internal advocacy groups focusing on small-city issues. These coalitions can identify and work with funders eager to fund small-city interventions. In addition, many smaller local foundations (family based, community foundations, etc.), are more likely to fund locally driven initiatives, especially if they will have positive local impacts.

Exemplary Cities

Without adequate and sustained funding, a project will likely fail before it gets started. Every smart city project explored identified sources of initial funding but also emphasized the development of sustaining the funding through deployment and into longer-term maintenance. Some of the communities developed creative approaches to funding their projects. While these instances are compelling, they are also very specific to the community, government structure, and local/regional partners. However, it does demonstrate that funding can be acquired and sustained through resourceful planning and partnerships.

- The City of Louisville, Kentucky, developed **AIR Louisville**, a public-private partnership aimed at improving air quality and related public health outcomes in the city. The initiative was funded by private grants in its early phases. Since then, the program has expanded through the collaboration of a variety of public and private partners.

- The City of Atlanta, Georgia, and the **Atlanta Police Foundation** (APF) partnered to launch Operation Shield, a smart policing initiative consisting of about 3,000 cameras deployed throughout the city. Videos stream to the Atlanta Police Department's Video Integration Center, where police officers can access real-time video footage from across the city. APF and private-sector companies have provided the funding for 80 percent of the system, freeing municipal resources for other urgent law enforcement needs (Atlanta Police Foundation n.d.).

Consistent Performance Metrics to Measure Impact

Measuring the success of smart city projects is perhaps the most challenging component of deployment. All programs identified the use of performance metrics that were directly related to the goals and objectives of their program. The degrees of specification varied—some programs had very specific performance measurement frameworks while others were more high level. The most detailed plans included goals, objectives, measures, baseline information, and data sources. Measuring the outcomes of smart city technology deployment can vary widely depending upon the type of technology and the goals established for programmatic success.

Performance metrics, much like engagement programs, were created to be adaptive to the individual cities' unique character in many case studies. For instance, pilot projects/programs were designed to be implemented and evaluated with a specified set of hypotheses and evaluation criteria, including indices for successes and failures. Performance measures were monitored with respect to four outcomes: improving safety, enhancing mobility, enhancing ladders of opportunity, and addressing climate change. The plan also included questions that were used as the overall basis for the performance measure approach (e.g., can the metrics be reliably measured, are there targets that can be identified, what data will be needed and from what sources, etc.).

Best practices in smart city performance metrics included developing performance processes that consider the unique outcomes of each project. Project outcomes should be aligned with the municipal plans and goals, such as a master plan, land use, sustainability, etc., and demonstrate unique outcomes to the technology.

Like many of the foundational best practices encountered, the adaptive nature and elevated level of variation between projects, specific technologies, and cities' overall performance metrics allowed the value of smart city solutions to resonate. Some examples of more general but popular key metrics included:

- Public safety and human health (quality of life)

- Energy efficiency (electricity, natural gas, etc.)

- Greenhouse gas emission reduction (vehicle fuel consumption/mobility, building energy use, waste reduction, etc.)

- Air and water quality measurements

- Cost savings, direct and indirect

- Continuous commissioning processes to monitor expected performance and ensure performance met specifications and settings

- Land use and conservation of green space, reforestation, or replacing lost natural environments

- Deployment of change management principles (ease of use, accessibility, speed of adoption, long-term utilization, learning barriers, etc.)

- Overall alignment with environmental justice and underserved populations

- Community/resident survey to determine resident priorities, resident needs, residents' ability to access resources and benefit from the value created by the deployment, etc., and then conducting a subsequent survey after deployment

Best Practices in Action
Best practices identified in developing metrics focus on both specific and variable metrics in addition to metrics that reflect the short-, mid-, and long-term performance of the project or deployment. Best practices also consider the connection of developing project metrics with setting goals. Both elements work together but should be indicative of the type of project, technology, or solution being deployed. Both metrics and goals should align with the organization's current planning efforts, including a master plan, utility

PROFILE
Columbus, Ohio

The Smart Columbus Program Data Privacy Plan provides a framework for the ways in which Smart Columbus will protect the privacy of users and the flow of data that is involved in the city's smart city technologies.

plans, land-use plans, economic development, and others. Following are several other best practices for identifying and using metrics:

- **Establish baseline metrics at the outset to measure impact more effectively over time.** Baseline metrics, understanding the status before deployment, will help to understand the change (positive or negative) from the business-as-usual scenario. Baseline metrics should be specific to the type of technology, such as water savings, energy use reduction, etc., and align with other plans and goals within the municipal system.

- **Monitor identified metrics on an ongoing basis.** Determine from project inception the appropriate interval for metric reporting, which should align with the ease and availability of acquiring data.

Baseline metrics should be specific to the type of technology, such as water savings, energy use reduction, etc., and align with other plans and goals within the municipal system.

- **Establish expectations for data structure, formatting, and standardizing from the outset.** Develop standard operating procedures across organizations and departments that outline requirements around data structure, ownership, privacy, security, formatting, etc.

- **Maintain transparent and open sharing of data (while still maintaining privacy).** Use open data portals, online dashboards, and/or email newsletters to ensure that all stakeholders have access to the reported data.

- **Identify and use common smart city metrics where possible.** Facilitates standardization of smart city deployments and better assessment across locations.

- **Recognize that the "best fit" metrics are a point-in-time decision.** Metrics that are relevant today may not be suitable in the future, and as communities progress and technologies improve, selected metrics may need to be revised and updated.

- **Example metrics (specific metrics used will vary depending on deployment)**
  - Health outcomes
  - Energy efficiency
  - Traffic congestion
  - Pollution (air, water, land)
  - Walkability/pedestrian traffic flow
  - Security/safety
  - Parking occupancy
  - Economic development

Overcoming Challenges

Data collection, consistency, and interpretation of measured outcomes is a major challenge for any performance metrics program. Smart city technology projects are no exception.

- **Establishing/identifying accurate ways to measure impacts.** This can be particularly challenging for innovative technologies that have not been widely deployed and/or in locations where smart city technologies are unfamiliar. Communities may help overcome this barrier by learning how project impacts were measured for other similar deployments, if applicable.

- **Solving for existing data gaps to establish baseline metrics more easily.** Where needed, use placeholder or proxy data that can provide insight in the place of the desired data, which may not be available or accessible in a timely or cost-effective manner.

- **Integrating public and confidential data in a way that provides security and value to all parties.** Use appropriate levels of aggregation and anonymization to protect individual privacy while still measuring the impacts of the technology on the relevant populations

Exemplary Cities

Setting achievable goals is only one part of the process. Project planning should then include metrics or key performance indicators to measure progress. Most projects examined included goals and aligned metrics but what the research also revealed was the adaptive nature of metrics to each project. While standard metrics were established, smart city projects also included additional metrics specific to the technology, solution, community, city, and correlating or overarching plans.

- Cities in the Greater Phoenix, Arizona, region launched **The Connective**, a consortium of public and private partners seeking to make the Greater Phoenix region the largest smart city region in the United States. One of the consortium's first goals is to work with its partners to define and standardize performance metrics that will help them track and measure progress over time (The Connective n.d.).

- The **City of Chula Vista's Police Department** (CVPD) launched its Drone Program in 2017. The program uses unmanned aerial systems to provide airborne support to police operations. CVPD uses

software to track drone flights launched by the department. As part of its commitment to public transparency, the department provides information about every CVPD drone flight on its website (City of Chula Vista. n.d.).

Capacity for Managing Change

The MiNextCities research team confirmed that foundational change management principles were applied in many smart city technology deployment projects. While the cities themselves did not call out these practices or challenges as change management, the conscripted actions clearly fall within the critical elements of managing change.

In general, change management is an important and often overlooked aspect of successful implementation. Change management considers that, for any change to be successful, project leaders must equip and support individuals who are moving through a potentially disruptive process that impacts their jobs, daily lives, and other social contexts. This supportive effort will help those individuals adapt to the change as well as adopt the core behavioral or perception changes necessary for progress. Without allotting time for change management or the necessary adoption/ adaptation process, changes are much less likely to succeed and therefore fall short of delivering the desired outcomes.

Measuring change is another aspect of deploying smart city technologies, especially as it relates to adoption of a changing process. Project managers can measure speed of adoption, rate of change, and growing competencies to understand whether the project implementation was successful. Measuring change can also provide project managers with insights into processes or technology deployments that are struggling to move forward. Being able to measure change and have the awareness to slow a deployment or re-engineer the implementation is indeed challenging but vital to achieving desired outcomes of any project.

Managing change throughout the process will aid the success rate of the project by ensuring social acceptance of the technology but also the change to an individual's or group's "normal" routine. An outcome of managing change can slow the implementation of a project if the rate of adoption is not meeting deadlines and deliverables, however, an adaptive organization can utilize the data to augment engagement efforts,

which eventually will improve the likelihood of long-term project success.

Best Practices in Action

Change management is a unique approach to any type of project or initiative, but this study has identified several best practices that were utilized in smart city technology projects in other communities.

- **Implement change management metrics to understand the adoption rate of change within the organization or community.** While measuring change is difficult and often overlooked, it is very much quantifiable. Examples of measuring change include assessing the rate of adoption, capacity for learning, effectiveness of the change on both individual and organizational levels, speed of execution, adherence to project plan and timeline, utilization of new technologies and effectiveness of use, observation of behavioral change if dependent upon staff or community members, level of understanding of change and purpose, engagement levels, etc.

- **Consider both intended and unintended consequences and how to manage them.** Change management is a systems-thinking

PROFILE
Boston, Massachusetts

In 2017, the City of Boston launched its Performance Parking Pilot in the Back Bay and Seaport neighborhoods. The city tested a different approach in each pilot site, then adapted and refined the plan for better managing the city's parking strategy in other locations based on the results.

approach to projects. Understanding how change is or potentially will be impacting individuals and environments supports a robust project implementation.

Understanding how change is or potentially will be impacting individuals and environments supports a robust project implementation.

- **Harness socioeconomic diversity as a source of innovation.** Diverse socioeconomic viewpoints can lead to new and innovative ideas. Embracing diversity, equity, and inclusion (DEI) in all aspects of a project is important, but project managers must ensure that DEI is a primary focus of managing change as not everyone affected learns or interacts with projects/programs in the same way. Project implementations should make intentional and visible efforts to assess audiences for change management and create implementation and change plans that prioritize the audiences impacted by the project.

- **Launch small-scale pilot projects for new and unfamiliar technologies, then adapt and refine in an iterative process.** The value of piloting projects cannot be overstated. The concept of piloting projects can be applied to many of the foundational elements within this report. Having the ability to measure change and pivot deployment approaches in the moment can assist with a successful solution launch.

- **Create multisectoral economies of scale based on the unique conditions of the region/city.** This will make cities more resilient to economic downturns.

Exemplary Cities

Managing change comes in many forms, often overlooked or potentially buried in the planning process. During the analysis of smart city program research, the team only identified a few programs that included clear examples of change management.

However, most successful projects do include elements of change management because successfully managing transformation requires a hyperfocused lens on moving people and project elements through a gambit of roadblocks. Cities that were willing and able to stop a process that wasn't working to reshape that process before proceeding demonstrate a high level of change management prowess, often without knowing.

- In 2017, the City of Boston launched its **Performance Parking Pilot** in the Back Bay and Seaport neighborhoods. The city tested a different approach in each pilot site, then adapted and refined the plan for better managing the city's parking strategy in other locations based on the results (City of Boston n.d.).

Adaptive Policymaking and Governance

Most proposed programs are housed and managed within the city government structure, either in an existing department or an established dedicated office. Staffing models to support the design and implementation of the program components vary, including the use of existing city employees or contracting with third-party entities, especially for the more technical aspects of design and implementation around technology deployment. Most programs also include the development of some sort of advisory council comprised of representatives from local and regional government entities, community residents, and nearby universities and businesses to provide strategic guidance, support, and funding to the program.

Ultimately, the governance approaches a community chooses to take will be shaped by the unique components of the community itself.

It is important to note that the most fitting governance structure of any given smart city program will vary depending on a range of factors. Further, as time moves on and political and social environments evolve, governance structures will need to be evaluated and perhaps changed. The following best practices provide broad guidance regarding how a community may go about structuring and managing a smart city program. Ultimately, the governance approaches a community chooses to take will be shaped by the unique components of the community itself.

Best Practices in Action

PSC has identified several best practices that will help guide successful governance and management of smart city initiatives:

- **Vertical and horizontal integration in municipal planning and operations.** Smart city programming should be integrated into multiple government levels and departments. Such integration may help make the program more resilient to staffing and operational changes and make it easier to access diverse funding sources.
- **Developing systems with equitable access through inclusive planning.** Inclusive stakeholder engagement and metrics development can help ensure that equity is integrated into project outcomes.

PROFILE
Kansas City, Missouri

The Kansas City (KS) Smart City program will be managed by a newly created position—the KCMO Program Manager—that will be located with the Department of Public Works. The program manager will be supported by the program advisory board, which consists of city officials, representatives from transportation organizations, public utilities, universities, and other nonprofit organizations.

- **Strong relationships with local/regional utilities (energy and water).** Most smart city initiatives require extensive interaction with utilities; therefore, developing a strong relationship is key to success.
- **Establishing necessary policies (e.g., open data, privacy, etc.) and administrative capacity (e.g., office of technology, hire additional staff, etc.) prior to implementing changes.** This provides the groundwork for successful smart city implementations.

Communities should explore the pros and cons of a range of governance models utilized in other smart city deployments and use that information to identify a governance structure that will work for them.

- **Looking to other cities for frameworks, best practices, and lessons learned.** Other cities that have piloted or deployed smart city technologies can provide valuable guidance about smart city program governance. Such guidance may include information about varying governance frameworks, best practices, lessons learned, what to expect, and more. Communities should explore the pros and cons of a range of governance models utilized in other smart city deployments and use that information to identify a governance structure that will work for them.
- **Employing both internal and external staff to operate smart city programs, as opposed to relying only on internal or external staff.** Many programs utilize both internal and external staff for program operation and management. Contracting with third-party entities may be particularly fitting for the more technical aspects of design and implementation around technology deployment.

Overcoming Challenges

- **Identifying and addressing the policies, ordinances, and other requirements that are potential roadblocks.** Employing a process to identify underlying contradictions or competing priorities before full deployment can dissolve potential delays and conflicts later in the process.
- **Considering how to align government regulation with adjacent communities, locally and regionally.** Policy coherence, while a challenge, is a key to successful engagement with broader community networks.
- **Developing flexible governance models.** Combining top-down policies with bottom-up initiatives (e.g., formal and informal governance models) is an adaptive process of developing a sound governance structure during the project planning process.
- **Adapting to socioeconomic and political changes.** The socioeconomic and political landscape is constantly changing. Adapting to these changes as they arise can be challenging, but communities that successfully navigate and adjust to this landscape may encounter fewer barriers to smart city project completion. Additionally, overcoming political gridlock may pose challenges to completing smart city goals.

Exemplary Cities

The quality of being adaptive was identified as key theme throughout the research. Smart city programs, by and large, have found paths to adapting the process of technology deployment to their specific needs, priorities, and contexts. Adaptation of policy and governance structures to move and bend with transformational change, such as smart city solutions, has been demonstrated in the following noteworthy case studies.

- Columbus and Portland both proposed the creation of a separate, nonprofit organization that is representative of the program. The proposed organization would be created to manage ongoing implementation and growth, support the community engagement, and leverage funding opportunities that can be exclusive to 501(c) designated entities (Smart City PDX n.d.). *(Referenced in USDOT Smart City Project Profiles in Appendix A)*
- The **Kansas City (KS) Smart City program** will be managed by a newly created position—the KCMO

Program Manager—that will be located with the Department of Public Works. The program manager will be supported by the program advisory board, which consists of city officials, representatives from transportation organizations, public utilities, universities, and other nonprofit organizations.

Conclusion

Although broad deployment of smart city technologies is still at a relatively early stage, it is growing quickly as many cities are currently planning and implementing projects. These projects will not be limited to large cities and will overwhelmingly continue to take place in small and mid-sized cities as well. However, funding remains one of the biggest challenges. For smart city technology deployments and projects to develop beyond pilot and demonstration projects, sustainable funding must be addressed. Although government initiatives are helping encourage growth in the smart city sector, they are not a sustainable source of funding for long-term projects. Many of the cities researched estimated a cumulative investment of between $1 million and $5 million in smart city technologies—this is quite a modest sum and indicates that, for the near future, many U.S. smart city projects will remain small in scale. However, once some of the funding challenges are met, hopes are that larger projects will become more common. The U.S. smart cities program is at an interesting stage of growth, where there is a lot of activity and many planned projects across the country, including MiNextCities, focusing on a much wider range of city challenges. Cities around the world will be closely watching the progress of projects in the United States for ways to meet similar challenges abroad.

Appendix A. Models of Smart City Projects

USDOT Smart City Project Profiles

In 2017, the U.S. Department of Transportation (USDOT) named seven finalists in a smart city/transportation-focused grant competition. Those finalists were Austin, Texas; Columbus, Ohio; Denver, Colorado; Kansas City, Missouri; Pittsburgh, Pennsylvania; Portland, Oregon; and San Francisco, California. The seven finalists dreamed big: they planned to implement autonomous shuttles to move city residents, to electrify city fleets, and to collectively equip over thirteen thousand buses, taxis, and cars with vehicle-to-vehicle communications technology. Over a three-month period, these finalists worked closely with the USDOT, their residents, and each other to develop detailed plans to put their Smart City visions into action. https://www.transportation.gov/smartcity/7-finalists-cities

Following are brief narratives of each project, serving as examples of challenges and successes when planning for smart city technology deployments.

Austin, Texas

> **Governance:** The City of Austin led the implementation of the program in partnership with the Smart City Team, which is comprised of various agencies, partners, and companies with the necessary experience and expertise to support the successful implementation of the program. In addition, the Austin Smart City Consortium was established with a joint executive team and dedicated full-time staff to provide stability, continuity and expanded capacity for program management and activities.

Members of the Smart City Consortium include:

- Joint Executive Team: City manager (leader), City of Austin, Capital Metro, Texas Department of Transportation, Central Texas Regional Mobility Authority, Travis County, Capital Area Metropolitan Planning Organization, University of Texas, Team Trail Outdoors, Southwest Research Institute, and other regional organizations.
- Advisory board: Department executives from the core team
- Consortium director: In this case, was the director of the Austin Transportation Department. This person and the overall program are supported by a program management firm and data management firm.
  - **Community Engagement:** Community engagement is seen as a requirement of Austin's Smart City project. Different engagement tools used included in-person and electronic surveys, communications through web, email, social media, and press releases, among others. Additional stakeholder engagement included various councils, boards, commissions, and the users of any transportation project—the residents, visitors, and businesses of Austin.
  - **Performance Metrics:** Each pilot project and program were designed to be implemented and evaluated with a specified set of hypotheses and evaluation criteria, including indices for

successes and failures. Performance measures were monitored with respect to four outcomes: improving safety, enhancing mobility, enhancing ladders of opportunity, and addressing climate change. The plan also included questions that were used as the overall basis for the performance measure approach (e.g., can the metrics be reliably measured, are there targets that can be identified, what data will be needed and from what sources, etc.).

- **Technology:** Austin's Smart City program includes implementing a variety of pilots and programs such as:
  - Smart Stations, or transit access hubs, which bring together an array of mobility services and serve as deployment centers for autonomous and connected vehicles, urban freight logistics, and electric fleets.
  - Connected Corridors, meant to link the Smart Stations with new transit services such as electric bus rapid transit and dedicated transit lanes.
  - Mobility Marketplace, which connects travelers to their best mobility options, provides integrated payment options, and provides real-time travel information.
  - An automated vehicle program.
  - A large-scale fleet electrification program.

Source: https://www.transportation.gov/sites/dot.gov/files/docs/Austin-SCC-Technical-Application.pdf

Columbus, Ohio

Governance: The Smart Columbus Program is led by the mayor and has assembled a team from the City's Department of Public Service to manage the Smart Columbus Program Office. The Program Office will also include personnel from the USDOT, other city departments, regional implementation partners, communications officials, and technical consultants. The Department of Public Service, through the Program Office, is responsible for managing and coordinating all activities related to the grant, including planning, execution, monitoring, and sustainment.

Community Engagement: The Smart Columbus Program Office works with key stakeholders from regional businesses and public entities for the implementation of program activities. This list includes (but is not limited to):

- The Columbus Partnership (nonprofit, membership-based organization of businesses and institutions)
- Columbus 2020 (regional economic development organization initiative)
- Rev1 Ventures (venture development organization)
- Mid-Ohio Regional Planning Commission
- Experience Columbus (membership-based coalition that invests in tourism)
- Central Ohio Transit Authority (regional public transit provider)
- Ohio Department of Transportation
- Ohio State University
- Clean Fuels Ohio

In addition, the Smart Columbus Board of Trustees supports the Program Office, is chaired by the mayor, and is responsible for partnership management, providing resources and guidance on project initiatives and identifying resources to fund and implement the program (through the acceleration fund).

Performance Metrics: The Smart Columbus program has established five overall goals related to providing safe and reliable transportation, providing access to jobs, connecting visitors, smart logistics, and implementing environmentally sustainable practices. Each of these goals has an associated objective, a technology solution, a specific performance measure, and a data source. A few examples of the performance measures are:

- The number of commuters using electric, autonomous vehicles for job commutes
- A reduction in the number of truck accidents due to truck height, weight, width, and roadway limitations
- Number of missed prenatal and pediatric visits scheduled with the Enhanced Human Services Model
- Amount of food received per family per targeted residential district
- The number of charging stations
- The number of smart meters installed

Funding and Sustainability: The Smart Columbus program plans to leverage federal funding opportunities, grant opportunities from key implementation partners, the creation of a nonprofit, and an acceleration fund to ensure ongoing financial support and sustainability of the program long after the USDOT grant period ends.

Technology: To achieve its vision and goals, the program utilizes four technologies:

- The Connected Columbus Transportation Network, which includes updates such as traffic signals equipped with traffic detection and sensors, pedestrian detection, kiosks with transit service information, parking availability, and Wi-Fi hotspots.
- The Integrated Data Exchange, which is an open data environment that generates performance metrics.
- Enhanced Human Services, which is a suite of applications, including multimodal trip planning, a common payment system, and assistance for people with disabilities.
- Electric Vehicle Infrastructure, including expanding the current Smart Grid program, providing support and analysis to fleet operators, creating customer education programs, etc.

Source: https://www.transportation.gov/sites/dot.gov/files/docs/Columbus-SCC-Technical-Application.pdf

Denver, Colorado

Governance: Denver's Smart City program uses city-led organizational structure to manage the program. The Smart City program is co-chaired by two city executives—the director of transportation and mobility and the mayor's deputy chief of staff—who also head the Executive Leadership Committee, which is made up of several key city officials and representatives from the Colorado Department of Transportation and the Regional Transportation District (RTD). The role of the Executive Leadership Committee is to provide strategic guidance and support to project leads throughout the duration of the grant. Each component of the Smart City program will be managed by a component lead and support by a component team, consisting primarily of city employees.

Community Engagement: The Smart City program collaborated with several public and private local and regional entities to guide the design and implementation of the different program activities, including the Colorado Energy Office, Colorado School of Mines, Colorado State University, Jacobs Engineering, and Excel Energy, among others. In addition, the program has used a comprehensive community engagement and awareness plan to ensure that community voices are included in all components of the program. Plan components include:

- Created a communications and community engagement workgroup to develop the plan and promote projects.
- Collected and shared data to better understand the effectiveness of the program's projects.
- Created engagement and education strategies and support materials (e.g., websites, social media presence, brochures, press kits, etc.).
- Gathered feedback from each project on an ongoing basis.
- Shared information regularly (e.g., set regular meetings, establish web-based engagement tools, etc.).

Performance Metrics: Working from existing citywide performance measurement frameworks and processes, the Smart City program established performance metrics for each program component. This process will include developing a logic model for each component, establishing baselines, identifying research questions and objectives, and establishing data collection methods.

Funding and Sustainability: The Smart City program leverages existing state and federal transportation resources to increase sustainability, such as grants from the Denver Regional Council of Governments, Colorado Department of Transportation, and the Regional Transportation District. Existing legislation and infrastructure investments also provide funding opportunities, such Colorado Senate Bill 09-108 or the Funding Advancements for Surface Transportation and Economic Recovery (FASTER) Act and the FasTracks program.

Technology: The Smart City program has three primary components that are supported by the Enterprise Data Management Ecosystem. The main components are summarized as:

- Mobility on Demand Enterprise, which aims to reduce access barriers and use data to provide mobility connections to all users through comprehensive information and payment systems and interactive kiosks.
- Transportation Electrification, which focuses on electrifying City of Denver transit and other commercial fleets and providing incentives for greater deployment of electric vehicles for personal use.
- Intelligent Vehicles, which uses transformational technologies to ensure greater mobility safety, efficiency, and reliability to the transportation network.

Source: https://www.transportation.gov/sites/dot.gov/files/docs/Denver-SCC-Technical-Application.pdf

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Kansas City, Missouri

Governance: The Kansas City Smart City program is managed by a newly created position—the KCMO program manager—located within the Department of Public Works. The program manager is supported by the program advisory board, which consists of city officials, representatives from transportation organizations, public utilities, universities, and other nonprofit organizations. The communications and outreach team is led by the City's director of communications. The program will also rely on third-party consultants and contractors to assist with the design, implementation, coordination, and management of program activities.

Community Engagement: The Kansas City Smart City program developed a communications and outreach plan to engage in local outreach efforts early in the program timeline, overcome misperceptions, and build a collective understanding of the goals and objectives of the program. The plan components include developing a web and social media presence, trade show strategy and budgets, local outreach strategy, initiatives to increase community awareness, and a crisis communications plan. In addition, the plan includes a stakeholder outreach component during the preliminary stages of the program to develop long-term relationships and provide a space to conduct listening and feedback sessions to understand the needs and interests of the community.

Performance Metrics: Kansas City currently collects data on existing Smart City performance measures related to the environment, mobility, government, society, and quality of life. In addition to these topics, Kansas City proposes collecting data on performance metrics tied directly to the Smart City Challenge grant goals, which include safety improvement, mobility enhancement, ladders of opportunity enhancement, and addressing climate change.

Technology: Technology advancement and deployment are centered around the three pillars of the program, including:

- Ladders of Opportunity: Technologies in this area will focus on revitalizing certain areas of the city to improve the economic and social environment of those communities. Programs include implementation of connected vehicle technologies for mass transit, access to wireless and other

digital technologies (e.g., interactive kiosks, real-time transit information, and Wi-Fi availability), and the introduction of mobility hubs, which offer several modes of transportation at a unique location.

- Advancing Safety, Mobility, Accessibility, and Clean Transportation: Technologies in this area include the deployment of automated vehicles, connected vehicles, and electric vehicles. Autonomous and connected vehicles will be introduced at the airport, downtown, and the Prospect Corridor. In addition, an autonomous shuttle system will be added to the certain streets. Finally, the program will leverage the existing electric vehicle charging infrastructure to transition fleet vehicles, buses, and terminal truck fleets to electric vehicles while installing new charging locations throughout the city.
- Connected and Empowered Communities: This pillar builds upon the existing Smart + Connected City initiative by expanding connectivity for Kansas City residents. The program will expand public Wi-Fi access, add more digital information kiosks throughout the city, and install more smart lighting in several parts of the city to better connect certain areas.

Source: https://www.transportation.gov/sites/dot.gov/files/docs/Kansas-City-SCC-Technical-Application.pdf

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Pittsburgh, Pennsylvania

Governance: The SmartPGH program is housed within the mayor's office and is led by the SmartPGH manager and the Smart PGH coordinator. The manager and support staff serve as the central hub for the deployment of the SmartPGH program and work with the relevant city departments (e.g., the mayor's office, Department of Public Works, Department of City Planning, Department of Innovation and Performance, and the Office of Management and Budget) to coordinate the program's implementation and communication. They are also responsible for managing the SmartPGH Consortium and other noncity partners.

The technical management of the program, including the systems engineering effort, will be managed through a Systems Engineering Management Plan (SEMP) and a Systems Engineering Management Team (SEMT), which will work directly with the SmartPGH manager on the deployment and implementation of program components.

Finally, SmartPGH created the SmartPGH Consortium, which is comprised of representatives from government, public authorities, utilities, universities, community-based organizations, foundations, and private-sector businesses to provide opportunities for collaborative planning and decision making and is responsible for infrastructure planning and capital coordination.

Community Engagement: SmartPGH developed a communications strategy, including a brand, to ensure that all outreach efforts were accurate and consistent, builds credibility with internal and external audiences, engages internal and external stakeholders, and ensures local and national media have an authoritative source of information related to the program. Dissemination tools include press releases, website, newsletter, and social media.

Performance Metrics: Performance measures were identified by the program and relate directly to the categories of overall goals of the program, including mobility, safety, air quality, and ladders of opportunity. A sampling of identified performance metrics include:

- Fifty percent reduction in transportation-related emissions by 2030
- Increase in available matching funds for transportation improvements
- Decrease in unlit or poorly lit roadways and intersections
- Reduction in crashes involving all modes
- Number of installed EV charging stations
- Increase in Minority, Women, and Disadvantaged Business Enterprise (MWDBE) contracts
- Reduction in regional unemployment rate

Technology: Technology deployment includes the following:

- Deploying the use of real-time adaptive traffic signals, pedestrian detection, vehicle-to-vehicle communication (V2V) and vehicle-to-infrastructure (V2I) technology, to improve mobility and safety for all users in Smart Corridors. In addition, the expanded use of Surtrac technology, an intelligent traffic signal control system, will help to manage the demands of multiple transit modes and improve air quality by reducing idle time.
- Converting approximately 36,000 streetlights to LED technology with integrated control systems and supplemental sensor technology to include pedestrian detection and monitor air quality. Wireless sensors will also be added to many streetlights to serve as Wi-Fi hotspots, increasing access in those areas.
- Implementing autonomous electric vehicle shuttle network.
- Creating the SmartPGH data utility, which is an open data ecosystem that can be used to make decisions, recognize economies of scale, and create standards for the transmission of data.
- Developing "Electric Avenue," which is a clean energy transportation corridor that includes the use of an electric vehicle fleet with a grid-to-vehicle charging mechanism.
- Implementing three "micro-pilot" projects that increase mobility outcomes for the vulnerable community, individuals experiencing homelessness, and those seeking preventative healthcare.
- Partnering with higher education institutions to ensure alignment of jobs in new industries through workforce training, employer engagement, developing certification programs, and leveraging and expanding existing programs.
- Working with a third party to gather quantitative and qualitative data to measure the impact of SmartPGH on residents.

Source: https://www.transportation.gov/sites/dot.gov/files/docs/Pittsburgh-SCC-Technical-Application.pdf

Portland, Oregon

Governance: The City of Portland created a nonprofit organization to serve as the implementation arm of the UB Mobile PDX, or Ubiquitous Mobility for Portland program, based on a similar management/partnership model that is used for Portland's streetcar system. UB Mobile PDX is responsible for designing the initiative, managing the implementation and operations of the program, coordinating public outreach and involvement, and assuring security of the data cloud. The UB Mobile PDX Board of Directors is comprised of representatives from the city, regional organizations, community-based organizations, and private businesses.

The UB Mobile PDX program manager is responsible for the day-to-day staffing and oversight of the implementation process. The city project manager is an appointed city employee who serves as the connection between the program manager and the city. Finally, the Community Advisory Committee, which is appointed by the Portland City Council, is comprised of representatives of residents and businesses within the affected neighborhoods and corridors of the program. They are responsible for advising on program design and implementation, with attention to the dissemination of technology throughout the community.

Community Engagement: UB Mobile PDX has identified a list of industry and transportation partners and community-based partners to engage throughout the program and described roles for each. In addition, the program developed a communications and outreach plan that includes a public education campaign, innovative citywide outreach, and partnering with community-based organizations to engage community members and gather feedback.

Portland has also formed formal Smart Cities partnerships with Seattle, Washington; Richmond, Virginia; New Orleans, Louisiana; and Los Angeles, California, to support the design and implementation of their start-up phases and share lessons learned.

Performance Metrics: UB Mobile PDX developed key performance indicators that align with the overall goals of the program, including safety, mobility, efficiency, sustainability, and climate change. Goals and objectives are established, coinciding measures identified, and they described the monitoring approaches for each measure.

Funding and Sustainability: Over the course of the grant program, UB Mobile PDX works to develop sustainable funding mechanisms to ensure successful projects can continue beyond the current funding cycle. The program will leverage existing funding models for the City of Portland, including working with private-sector partners, using regional transportation funding, sponsorships, grants, and support from the local business community. For example, mobility hubs or kiosks may be maintained through sponsorships from local businesses or other entities.

Technology: UB Mobile PDX will deploy citywide elements and implement demonstration corridors for specific projects, all of which will be supported by an open data cloud and urban analytics to integrate real-time data from a variety of sources to support management and research. Citywide elements include:

- A mobility marketplace app
- A multimodal payment system

- Vehicle electrification and infrastructure
- Connected fleets and vehicles
- Demonstration corridors will implement:
- Community-based organization engagement
- Equitable access to the mobility marketplace
- Sensor-based infrastructure for safety, lighting, and air quality
- One or more EV shuttles linking to transit in areas with poor pedestrian connectivity
- Air quality monitoring
- Connected freight fleet pilot

Source: https://www.transportation.gov/sites/dot.gov/files/docs/Portland-SCC-Technical-Application.pdf

San Francisco, California

Governance: The Smart City Challenge program was implemented through an organization administered by the San Francisco Municipal Transportation Agency (SFMTA) in partnership with University of California, Berkeley (UCB) and headed by a program manager from a third-party firm. The SFMTA and UCB will be responsible for completion of project tasks and delivery of all required reports and documentation. Implementation and project activities will be supported by dedicated city employees, while research and evaluation support will be provided by UCB staff. Finally, a Policy Advisory Board will be established and meet throughout the duration of the program to provide support and recommendations related to policy and regulations. The Policy Advisory Board is comprised of representatives from the mayor's office, UCB, and SFTMA.

Community Engagement: San Francisco proposed a communications plan that achieves four goals: grow awareness and understanding, build engagement, improve operations, and share lessons learned. The communications plan will target the public, including monolingual, non-English speaking communities, advocates, local businesses, media, and other companies. UCB is expected to implement communications plan activities, including public outreach and opinion, climate and equity stakeholder engagement, and knowledge transfer.

Performance Metrics: SFMTA has identified key hypotheses along with metrics and identified data sources to measure the program's impact against their main goals on mobility, safety, ladders of opportunity, sustainability, and climate change. Examples of identified metrics include:

- Increased public transit ridership
- Number of users on the mobility platform
- Observed safe driving behavior
- Reduced collisions
- Increased number of vehicles in high-occupancy vehicle(HOV) lanes
- Increased quality of life
- Increased equity for vulnerable users

Funding and Sustainability: SFMTA plans will leverage a portfolio of bond and grants revenue to sustain the program and the expansion of the transportation network.

Technology: SFMTA plans to implement demonstration projects at the regional, city, and neighborhood levels. Demonstration proposals and components include:

- Transport as a Service Platform, which includes a suite of apps such as a multimodal information and payment app, safe driving feature app, delivery service feature app, and smart parking feature app
- Connected High Occupancy Lanes, which include designated pick-up curbs, instant matching with smartphone apps, and a carpool pickup plaza mobility hub.
- Municipal Mesh Network, which includes collision avoidance and Wi-Fi for public vehicles and connected vehicles corridors.
- Shared Van Shuttle Service, for late night workers and after school pick-up.
- Shared Mobility Hubs, which include electric vehicle charging, Wi-Fi, transit, and active transport.
- Automated Vehicle Pilot, which includes the delivery and or municipal service of automated vehicles, and transit connection services.

Source: https://www.transportation.gov/sites/dot.gov/files/docs/San-Francisco-SCC-Technical-Application.pdf

Appendix B. Research and Assessment Methodology

Drawing on the expertise of solution partners, utilities, nonprofit organizations, associations, community development organizations, municipalities, and state and federal agencies, PSC conducted a current-state assessment of smart-city initiatives. Research conducted for the MiNextCities (MNC) project focused on smart city programs and other state, national, and international examples to provide leading benchmarks and best-practice analysis. The research process included internet research, interviews (virtual and phone), and other exploratory techniques.

Research and evaluation focused on—but was not limited to—the following elements within communities, cities, and regions with similar characteristics as the MNC program scope:

- Location, type of program, intended outcomes, scope, etc.
    - General demographic and geographic context
    - Primary contact information
- Program administration
- Types of technology deployed
- Evaluation, metrics, and reporting processes
- Organizational attributes and decision-making models
- Funding models and sources
- Types of collaborations and partnerships
- Stakeholder roles
- Policy and regulation analysis
- Engagement best practices and community response
- Risk management elements
- Environmental justice and DEI

Research Criteria

The following information has been gathered for each of the recommended programs and cities as part of the first phase of research:

- Name of program
- Managing organization
- Type of organization
- Primary contact
- Geographic location
- City population
- Brief description of the program
- Funding sources

Research Categories

1. Cities, municipalities, or other government entities
2. Coalitions, alliances, collaboratives, and other partnerships working within a state or region

3. Existing best-practice guides, reports, and other relevant resources

- Ann Arbor, Michigan
- Austin, Texas
- Birmingham, Alabama
- Boulder, Colorado
- Columbus, Ohio
- Denver, Colorado
- Ferndale, Michigan
- Huntsville, Alabama
- Kansas City, Missouri
- Ketchum, Idaho
- Madison, Wisconsin
- Pittsburgh, Pennsylvania
- Portland, Oregon
- Oberlin, Ohio
- San Francisco, California

*Research also included other select states and regions, including Louisiana, Kentucky, and Tennessee.

Coalitions and Collaboratives

- Climate Mayors Electric Vehicle Purchasing Collaborative
- Colorado Smart Cities Alliance
- ICLEI USA Sustainability Mobility, EcoMobility, EcoLogistics and Cities SHIFT program
- Illinois Smarter State Initiative
- Michigan Clean Cities Coalition
- National Governors Association
- New Urban Mobility Alliance
- Smart Cities Lab
- Smart Communities Virginia
- U.S. Department of Energy Clean Cities Coalition Network
- U.S. Department of Transportation

Municipal and Stakeholder Interviews

List of Interviewees

- Eric McDonald, Director of Infrastructure Development, Next Energy
- Jim Saber, President and CEO, Next Energy
- Maggie Calnin, Coalition Coordinator, Greater Lansing Area Clean Cities
- Erin Quetell, Environmental Sustainability Officer, Oakland County, Michigan (formerly of City of Ferndale, Michigan)
- Melissa Stults, Sustainability and Innovations Director, City of Ann Arbor, Michigan
- MNC Advisory Group

- James Clift, Deputy Director, Michigan Department of Environment, Great Lakes, and Energy (Chair of MiNextCities Advisory Group)
- Brandon Hofmeister, Senior Vice President of Governmental, Regulatory, and Public Affairs, Consumers Energy
- Jason Byrd, Manager of Customer Marketing, DTE Energy
- Jean Ruestman, Administrator, Office of Passenger Transportation, Michigan Department of Transportation
- Shanna Draheim, Policy Director, Michigan Municipal League
- Kate Abraham, Executive Director, Michigan Municipal Electric Association
- Grace Michienzi, Director of Research and Policy, Michigan Energy Innovation Business Council

Interview Questions

1. Name of the program:
2. Name of the organization(s) managing the program:
3. Please describe the program, including the scope, goals, and intended outcomes.
4. What are/were primary sources of funding for the program including multiple sources if existent?
   a. Include any additional funding models or plan(s) for sustaining funding for future growth.
   b. Identify amount of initial funding provided to launch the program (if available):
5. How is the program being managed? For example, via a partnership, a third party, a municipal government, etc.?
6. Are there advisory groups, citizen/community groups, sector advisors, subject matter experts, etc. that are involved in the implementation or management of the program?
7. What decision-making structures, tools, or criteria were used during the design and implementation phase of the program?
8. What types and extent of community and/or municipal employee engagement were used in the design and implementation of the program?
   a. What have been identified as best practices for engagement?
   b. What were major "wins" and major "barriers" to successful engagement?
9. What are the specific metrics identified for the program?
   a. How are the metrics being used to measure progress/success?
10. How is progress being reported to the public and/or grantor?
11. Please describe the types of "smart city" or "mobility" technology that has been or will be deployed in the community.
12. How have you determined the program's level of success, either qualitatively or quantitatively?
13. Please provide any information on the policy/regulation landscape of the program's location (city, state, federal implications).
14. Was a policy/regulation analysis conducted for program?
15. Please provide any information on the risk landscape of the program's location (city, state, federal implications).
   a. Was a risk analysis conducted for program?
16. Please provide any information on the environmental justice landscape of the program's location (city, state, federal implications).
17. Was an environmental justice analysis conducted for program?
18. Does the city have a climate action or sustainability plan? If so, how does smart city/clean city/ mobility incorporate and/or support that planning?

References

Alabama Power. n.d. "Smart Neighborhood." *Alabama Power*. Accessed October 14, 2022.
https://apcsmartneighborhood.com/

Angelidou, Margarita. July 2014. "Smart City Policies: A Spatial Approach." *ScienceDirect*. Accessed
October 21, 2022. https://www.researchgate.net/profile/Margarita-
Angelidou/publication/274166044_Smart_city_policies_A_spatial_approach/links/5b9bb5eb29
9bf13e602f88fe/Smart-city-policies-A-spatial-approach.pdf

Atlanta Police Foundation. n.d. "Operation Shield." *Atlanta Police Foundation*. Accessed October 26,
2022. https://atlantapolicefoundation.org/programs/operationshield/

Buffalo Niagara Medical Campus, Inc. and WSP USA Inc. August 2020. *Buffalo Main Street: Smart
Corridor Plan*. Accessed October 21, 2022.
https://www.dot.ny.gov/divisions/engineering/technical-services/trans-r-and-d-repository/C-
17-55.pdf

Canellakis, Krista, Paul Chasan, and Cassie Hoeprich. March 2017. *Living Innovation Zones*. Accessed
October 21, 2022. http://groundplaysf.org/wp-content/uploads/LIZ_Manual_v4.pdf

City of Ann Arbor. n.d. "Smart City Strategic Planning." *City Administrators Office*. Accessed October 16,
2022. https://www.a2gov.org/departments/city-administrator/IT/Smart-City-Strategic-
Planning/Pages/default.aspx

City of Austin. n.d. "Smart Mobility." *Austintexas.gov*. Accessed October 14, 2022.
https://www.austintexas.gov/department/smart-mobility

City of Birmingham. n.d. "Transforming Birmingham into a Smart City." *Birminghamal.gov*. Accessed
October 16, 2022. https://www.birminghamal.gov/smartcities

City of Boston. n.d. *Performance Parking Final Report*. Accessed October 21, 2022.
https://www.boston.gov/sites/default/files/embed/p/performance_parking_final_report_-
_web_1.pdf

City of Chicago. n.d. *The City of Chicago Technology Plan*. Chicago: City of Chicago. Accessed October 26,
2022. https://en.unesco.org/icted/sites/default/files/2019-
04/21_city_of_chicago_technology_plan_0.pdf

City of Chula Vista. n.d. "Drone Program." *City of Chula Vista*. Accessed October 26, 2022.
https://www.chulavistaca.gov/departments/police-department/programs/uas-drone-program

City of Henderson. February 5, 2018. *City of Henderson: Smart City Strategy*. Accessed October 21,
2022.
https://www.cityofhenderson.com/home/showpublisheddocument/2040/63738738386560000
0

City of Philadelphia. n.d. *SmartCityPHL Roadmap*. Accessed October 21, 2022.
https://www.phila.gov/media/20190204121858/SmartCityPHL-Roadmap.pdf

City of Pittsburgh. n.d. "Smart Cities and Emerging Mobility." *Department of Mobility & Infrastructure*. Accessed October 17, 2022. https://pittsburghpa.gov/domi/smart-cities

City of San Diego. n.d. "Clean Tech San Diego" Smart City Program, Accessed October 26, 2022. https://cleantechsandiego.org/smart-city-san-diego/

City of Schenectady. n.d. "Schenectady Smart City Projects." *Schenectady New York*. Accessed October 17, 2022. https://www.cityofschenectady.com/505/Smart-City-Project

City Tech Collaborative. October 2021. "Drone Uses for Rail Infrastructure Monitoring & Maintenance." Presentation. https://irp.cdn-website.com/9614ecbe/files/uploaded/CityTech_CTA_Drone_Demonstration_20211103.pdf

Climate Mayors. n.d. "EV Purchasing Collaborative." *Climate Mayors*. Accessed October 16, 2022. https://climatemayors.org/ev-purchasing-collaborative/

Colorado Smart Cities Alliance. n.d. "Welcome to the Colorado Smart Cities Alliance." *Colorado Smart Cities Alliance*. Accessed October 16, 2022. https://coloradosmart.city/

Connective, The. n.d. "About Us." *The Connective: A Smart Region Consortium*. Accessed October 25, 2022. https://www.greaterphxconnective.com/

Dallas Innovation Alliance. 2022. *Smart Cities Living Lab Case Study*. Dallas: Dallas Innovation Alliance. Accessed October 24, 2022. https://static1.squarespace.com/static/55e72848e4b07d5e3db159f8/t/5be1eb816d2a73056cd37c9f/1541532574863/DIA+Living+Lab+Case+Study.pdf

Eggers, William D., and John Skowron. March 22, 2018. "Forces of Change: Smart Cities." *Deloitte Insights*. Accessed October 25, 2022. https://www2.deloitte.com/us/en/insights/focus/smart-city/overview.html

European Commission. November 12, 2017. *The Making of a Smart City: Best Practices Across Europe*. Accessed October 24, 2022. https://smart-cities-marketplace.ec.europa.eu/insights/publications/making-smart-city-best-practices-across-europe

Fishman, Tiffany Dovey and Michael Flynn. 2018. *Using Public-private Partnerships to Advance Smart Cities Part Two: Funding and Financing Smart Cities Series*. n.p.: Deloitte Center for Government Insights. Accessed October 26, 2022. https://www2.deloitte.com/content/dam/Deloitte/global/Documents/Public-Sector/gx-ps-public-private-partnerships-smart-cities-funding-finance.pdf ICLEI. n.d. "Sustainable Mobility at ICLEI." *Sustainable Mobility*. Accessed October 16, 2022. https://sustainablemobility.iclei.org/

———. 2020. *Cities SHIFT: Capacity Building and Networking for Climate- and People-friendly Mobility Report*. Accessed October 24, 2022. https://sustainablemobility.iclei.org/wpdm-package/cities-shift-capacity-building-and-networking-for-climate-and-people-friendly-mobility-report/

Jagadish, Kamya. March 7, 2022. "Community Engagement in Smart City Development." *Data-Smart City Solutions*. Accessed October 25, 2022. https://datasmart.ash.harvard.edu/community-engagement-smart-city-development

Ketchum Urban Renewal Agency. n.d. "4th Street Heritage Corridor Project." *Capital Projects*. Accessed October 17, 2022. https://www.ketchumura.org/kura/page/capital-projects

Loftis, Jon Derek, David Forrest, Sridhar Katragadda, Kyle Spencer, Tammie Oranski, Cuong Nguyen, and Sokwoo Rhee. March/April 2018. "StormSense: A New Integrated Network of IoT Water Level Sensors in the Smart Cities of Hampton Roads, VA." *Marine Technology Society Journal* 54 (2): 56–67. Accessed October 24, 2022. https://www.ingentaconnect.com/content/mts/mtsj/2018/00000052/00000002/art00008;jsessionid=7hhrfa72h1fbm.x-ic-live-02

Michigan Clean Cities Coalition. n.d. "Michigan Clean Cities." *Michigan Clean Cities*. Accessed October 16, 2022. https://www.michigancleancities.org/#

Monzon, Andres. n.d. *Smart Cities Concept and Challenges: Bases for the Assessment of Smart City Projects*. Madrid: Transport Research Center, Universidad Politecnica of Madrid. Accessed October 24, 2022. https://ieeexplore.ieee.org/stamp/stamp.jsp?arnumber=7297938

National Conference of State Legislators. October 2020. *Creating Smart Communities: A Guide for State Policymakers*. Accessed October 24, 2022. https://www.ncsl.org/Portals/1/Documents/energy/Smart_Communities_v03_11_20_35545.pdf

National Governors Association. n.d. "The Latest." *National Governors Association*. Accessed October 16, 2022. https://www.nga.org/

National League of Cities. 2016. *Trends in Smart City Development*. Accessed October 24, 2022. https://www.nlc.org/wp-content/uploads/2017/01/Trends-in-Smart-City-Development.pdf

New Urban Mobility Alliance. n.d. "Home." *NUMO: New Urban Mobility Alliance*. Accessed October 16, 2022. https://www.numo.global/

Oberlin Project. n.d. *The Oberlin Project*. Accessed October 17, 2022. https://oberlinproject.org/

Rudolfo, Raimundo. 2022. "Smart City Initiatives and Digital Transformation: Sustainability, Resilience, Workability, Livability." City of Coral Gables Department of Innovation and Technology. Presentation. https://drive.google.com/file/d/1N0B60ZXzMBNRM1G2yq4OepkcXZ6l8sfV/view?usp=sharing

Serrano, Martin, Edward Griffor, David Wollman, Michael Dunaway, Martin Burns, Sokwoo Rhee, and Christopher Greer. February 24, 2022. "Smart Cities and Communities: A Key Performance Indicators Framework." *National Institute of Standards and Technology*. Accessed October 24, 2022. https://nvlpubs.nist.gov/nistpubs/SpecialPublications/NIST.SP.1900-206.pdf

Smart Cities Council. n.d. "The Smart Cities Council Story." *Smart Cities Council*. Accessed October 20, 2022. https://www.smartcitiescouncil.com/about-us

Smart Cities Lab. n.d. "Home." *Smart Cities Lab*. Accessed October 16, 2022. https://www.smartcitieslab.org/

Smart City PDX. n.d. "About Smart City PDX." *Smart City PDX*. Accessed October 17, 2022.
https://www.smartcitypdx.com/about

Stantec. November 18, 2019. "Smart Cities Research: Building a Hyperconnected City." *Stantec*. Accessed
October 24, 2022. https://www.stantec.com/en/ideas/content/presentation/2019/smart-cities-
research-building-a-hyperconnected-city

State of Illinois. n.d. "Smarter State." *Illinois Department of Innovation and Technology*. Accessed
October 16, 2022. https://www2.illinois.gov/sites/doit/Strategy/Pages/SmarterIllinois.aspx

Svitak, Tyler, and Matthew McAllister. n.d. "Smart Transportation." Presentation. Accessed October 24,
2022.
https://www.ncsl.org/Portals/1/Documents/energy/Smart_Comms_M_McAllister_%26_T_Svit
ak_present_32335.pdf

Tao, Yang. May 5, 2017. "Collaborating Towards a Smart Future." Presentation. Accessed October 24,
2022. https://wiscav.org/wp-content/uploads/2017/03/Madison-Smart-City-AV-Summit.pdf

United States Conference of Mayors. January 2017. *Cities of the 21st Century: 2016 Smart Cities Survey*.
Accessed October 24, 2022. https://www.usmayors.org/wp-
content/uploads/2017/02/2016SmartCitiesSurvey.pdf

University of Chicago. n.d. "Array of Things Technology." *Array of Things*. Accessed October 14, 2022.
http://arrayofthings.github.io/index.html

University of Texas at Austin. n.d. "NSF Civic Project Summary." *The University of Texas at Austin*.
Accessed October 14, 2022. https://sites.utexas.edu/nsf-civic/

US Ignite. n.d.a. *Lessons Learned from the AV Shuttle Pilot at Fort Carson*. Accessed October 24, 2022.
https://www.us-ignite.org/wp-content/uploads/2022/07/US-Ignite-AV-Playbook-Final.pdf

———. n.d.b. *Community CBRS Networks: What You Need to Know*. Accessed October 24, 2022.
https://www.us-ignite.org/wp-content/uploads/2022/04/Community_CBRS_Networks-3.pdf

U.S. Department of Energy. n.d. "Clean Cities Coalition Network." *U.S. Department of Energy: Energy
Efficiency and Renewable Energy*. Accessed October 16, 2022. https://cleancities.energy.gov/

U.S. Department of Transportation. n.d. "Smart City Challenge." *U.S. Department of Transportation*.
Accessed October 16, 2022. https://www.transportation.gov/smartcity

Virginia IT Agency. n.d. "Smart Communities." *The VITA Innovation Program*. Accessed October 16,
2022. https://www.vip.virginia.gov/innovation/smart-communities/

Wheeler, Kenya. n.d. "SFpark Pilot Program." *San Francisco Municipal Transportation Agency*. Accessed
October 14, 2022. https://www.sfmta.com/projects/sfpark-pilot-program

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