DNV·GL

ENERGY

SMART CITIES VENDOR ENGAGEMENT FRAMEWORK

In partnership with:

USDN urban sustainability directors network

NUTTER CONSULTING

CONTENTS

INTRODUCTION

Cities across the globe are challenged by resource constraints and rapidly changing technologies for maintaining and replacing aging infrastructure, managing maintenance costs, and ensuring proper data security and performance management.

> "Technology is the answer. But what is the question?"
>
> *Cedric Price (1933-2003)*

Urbanization and climate change are intensifying these challenges, as increasing populations and risks from climate-related events impact already overburdened city planning efforts and budgets. In exploring smart city technology opportunities, cities are asking:

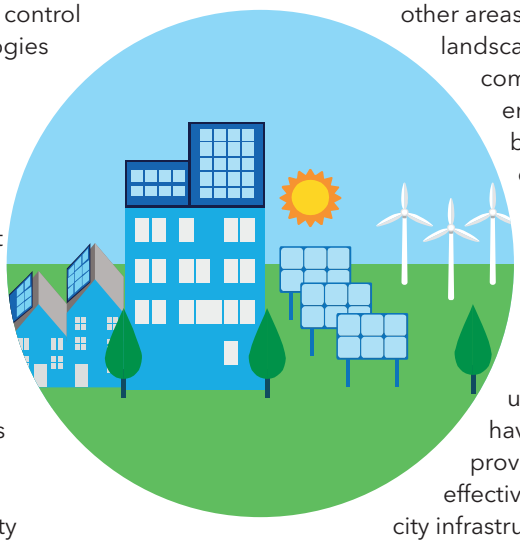
- How can cities overcome these constraints and benefit from the implementation of smart technologies?
- What processes work and what new innovative models are needed to engage smart technology vendors, review options, evaluate bids, and secure services?

These questions have emerged from previous research conducted by the Urban Sustainability Directors Network (USDN) and Nutter Consulting. In this report, DNV GL, Nutter Consulting, and USDN partner to investigate these issues and identify best practice solutions, with a focus on the buildings and energy sectors of smart sustainable cities. The results are the subject of this white paper.

Through a series of more than twenty stakeholder interviews that included more than ten USDN cities, two utilities, two Community Choice Aggregators, more than ten smart technology vendors, and extensive research on existing smart city activities, we developed the USDN Smart City Vendor Engagement Framework and twelve case studies that demonstrate the various ways of engaging with vendors. The goal of this framework is to help cities and vendors identify the most productive ways to engage each other to successfully meet our communities' smart infrastructure and sustainability needs.

The Potential of Smart and Sustainable Cities

Cities across the United States are making significant investments in new, smart technologies and data management systems that can vastly improve city services. These technologies, such as electronic building sensors, traffic sensors, and waste bin sensors, rely on digital platforms that enable cities to provide services faster and more efficiently, allow for remote control and measurement, and enable the technologies to communicate with each other. Smart, sustainable cities find innovative ways to use these types of internet communication technology (ICT) to improve quality of life through increased efficiency in urban operations and services, while ensuring that the city is meeting the economic, social, and environmental needs of present and future generations.



The rapid advancement of technology over several decades has provided opportunities for better service delivery to city residents and businesses through improvements in efficiency, speed, and functionality. Electricity meter-reading equipment that once relied solely on a service person checking sets of dials on individual buildings can now be managed remotely through computer systems.

This new generation of digital technologies offers a range of previously unforeseen capabilities for cities to serve their citizens in more innovative and sustainable ways by improving resource efficiency and operations performance. Developments in urban transportation, building energy efficiency, public safety, and other areas of city service are rapidly changing the landscape both inside city departments and in the communities they serve. In dozens of cities, energy saving lighting systems are reducing both lighting costs and greenhouse gas emissions. Remote sensors, cameras, and locking mechanisms are discouraging crime when city facilities are closed.

While the inclusion of new technologies and uses of data are beginning to support sustainable cities and to address pressing urban challenges, municipalities often have difficulty choosing the right technology providers. Cities also struggle with finding effective ways to engage vendors to help build city infrastructure that aligns with their multiple goals and ensure an understanding of the connectivity issues between products and services. To help navigate the complexities of technology innovation, related service offerings, and specific urban needs, cities need a new framework for engaging with smart city technology vendors.

The Smart Cities Vendor Engagement Framework

The USDN Vendor Engagement Framework (Framework) is designed to help cities understand different approaches to working with technology vendors to leverage the benefits of emerging smart technologies and achieve smart sustainable city goals. The Framework is also intended to help vendors effectively engage with cities on complex, long-term planning efforts. Sustainability directors can use this with Chief Procurement Officers (CPO's) to encourage more innovative procurement.

Figure 1 provides an overview of the USDN Vendor Engagement Framework that outlines three high-level categories for vendor engagement approaches: traditional procurement, partnerships and new innovative procurement. These approaches are aimed at supporting cities in the testing, refinement, trust-building, and scaling of smart city solutions to meet smart sustainable city goals.

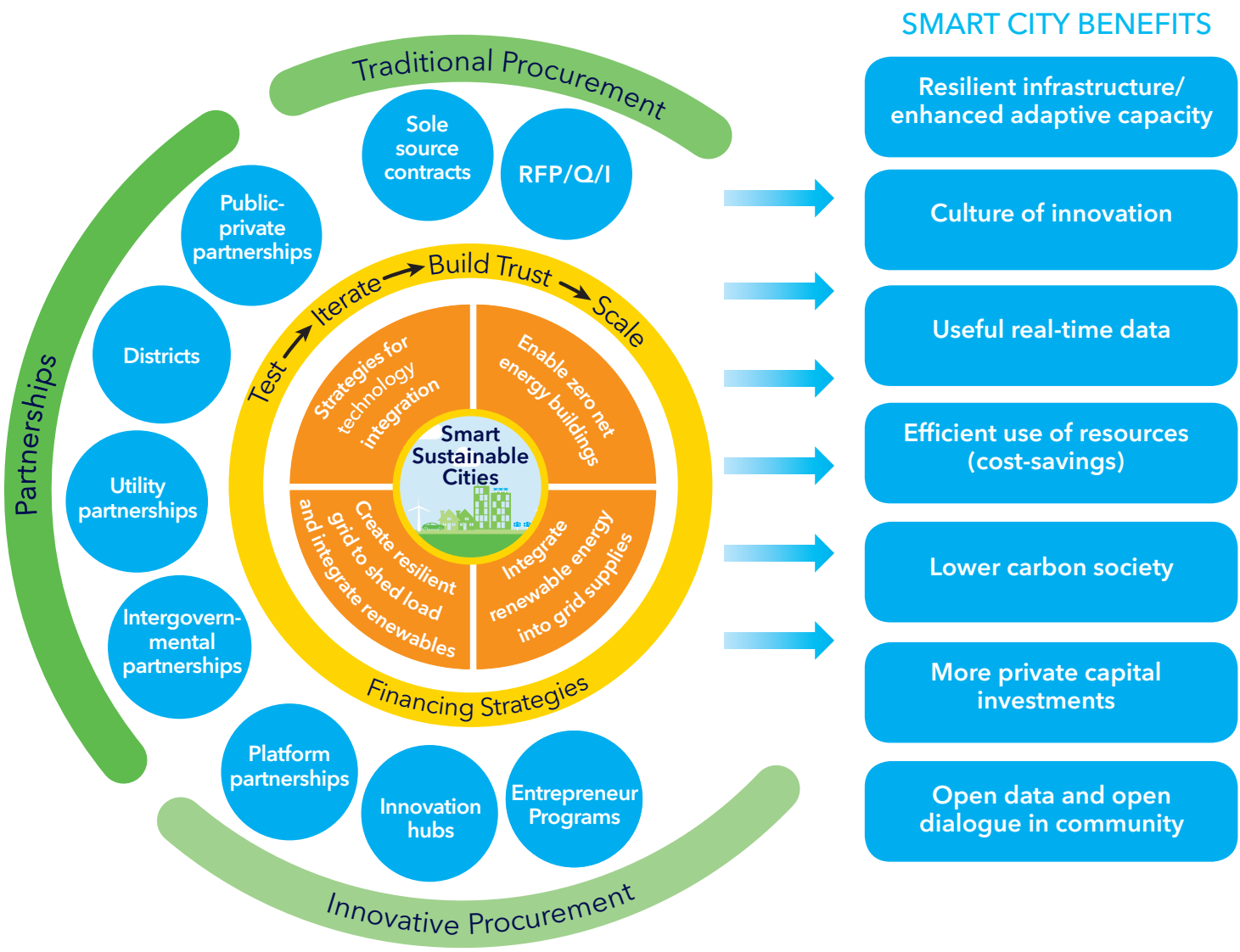


Table 1 provides initial guidance and comparison of different vendor engagement approaches. Note that the different approaches are not necessarily mutually exclusive and that many cities have leveraged a combination of vendor engagement strategies. A number of case study examples are provided in this report and the cities are listed in the table.

	TRADITIONAL PROCUREMENT	PARTNERSHIPS	INNOVATIVE PROCUREMENT
Applicability	■ Addresses specific challenges ■ Clear approach to take in solving the problem ■ Uses designated funding sources	■ Address broader community or infrastructure issues ■ Engage specific entities (e.g., higher education, national labs, etc.) ■ Leverage partnership for technical or financial support	■ Uses time and resources from an established city department or agency ■ Works with wider set of vendors on finding solution ■ Has the capacity for continual feedback and assessment of vendor partners
Advantages	■ Uses a known, familiar process ■ Ability to solve specific municipal challenges and objectives ■ Potentially easier to implement within traditional procurement processes	■ Ability to leverage existing expertise from within the community ■ Deeper engagement with fewer entities may be simpler to implement	■ Allows for testing and piloting new technologies, often with vendors willing to deploy their technologies at low or no cost ■ Cities generally not locked into long-term contract ■ Can be done with no money exchanged
Challenges	■ Requires more up-front work by cities to scope specific requirements ■ May disqualify vendors with innovative solutions outside scope of RFI or RFP	■ Requires high-level of public engagement ■ Requires synthesis of many perspectives presented by diverse stakeholders	■ Requires process of feedback with chosen vendors ■ Requires high-level of engagement by cities
Featured case studies	■ Chula Vista, CA ■ Columbus, OH	■ Pittsburgh, PA ■ Seattle, WA ■ Burlington, VT ■ Nashville, TN	■ San Francisco, CA ■ Berkeley, CA ■ Somerville, MA ■ Washington, DC

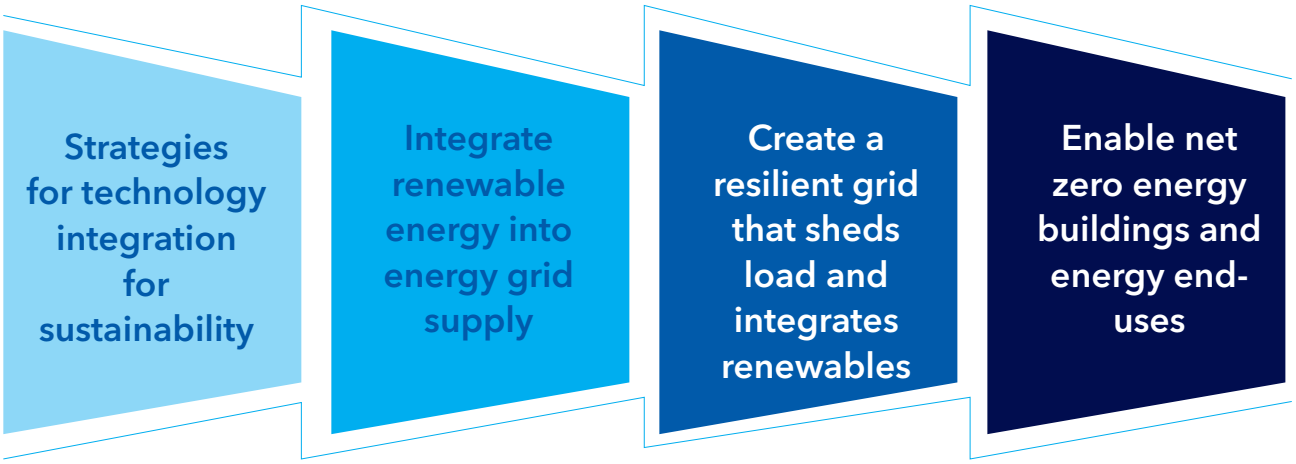
Recognizing the importance of identifying funding for smart city initiatives, the Framework also incorporates financing mechanisms that cities are using.

Financing for sustainable and smart city technologies can be both a barrier and an opportunity. Traditional funding does not always support the uncertainty and new ownership models of large or complex smart city projects, e.g., ownership of different microgrid components and associated revenue streams. Financing emerging sustainable and smart technologies is a rapidly evolving industry, presenting new opportunities to investors in sustainability and to municipalities that are forging ahead with smart city development. For instance, smart cities services, data, and infrastructure often result in lowered costs through improved resource efficiency and lowered maintenance costs through automation or digitalization. The inherent cost-effectiveness and cost savings of a smart city need to be properly captured to attract investments.

City agency directors and managers are becoming increasingly aware of opportunities they can act on to transform their cities into the digitally smart sustainable communities of the future. This report highlights best practices for vendor engagement to help facilitate this transformation.

Connecting to the Buildings and Energy Framework in the "Smart Cities for Sustainability" toolkit (2016)[2]

Building on the creation of the Getting Smart About Smart Cities Resource Guide and the Collective Voice of Cities (USDN Innovation Fund, 2014), this toolkit and framework is intended specifically for use by sustainability directors to delve more deeply into specific smart city approaches, technologies, and uses of data to advance their local sustainability goals.



Smart City Transformation Principles

The case studies detailed in this framework reveal key themes that characterize the challenges cities face in achieving the full capabilities of smart digital technologies. Based on the research conducted for this report as well as on the prior smart cities work conducted for the USDN, the following infographic provides the key principles related to enabling smart city transformation.

Raise up smart city champions and provide technical training to staff

Incorporate cross-silo smart city planning for integrated platforms and cost/resource efficiencies

Setup cross-sector smart city working groups to co-create integrated, nimble solutions

Identify goals, smart city priorities, a pipeline of projects, and new forms of investments

Pilot, iterate, build trust, share risk and innovate traditional procurement

Create forums for innovation and collaboration: use private sector and academia to fill knowledge gaps and resources

Ensure open data policies, processes, and standards

Integrate community dialogue streamlined with whole city (across departments)

Create an innovation office to address digitalization opportunities, as well as organize data layers and platforms

Redesign city processes with innovation focus

2 http://usdn.org/uploads/cms/documents/1._smart_cities_for_sustainability_final.zip

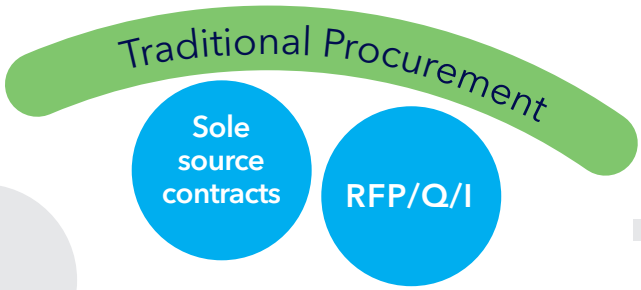
ACHIEVING THE SMART CITY VISION

The imperative for smart city technology emerges at the intersection of climate change, urbanization, aging infrastructure, internet connectivity (Internet of Things), renewable distributed energy, and open data.[2] To become a smart city is an opportunity to operationalize innovation; it allows for a process-partnership model that reaches across internal government departments, across both sides of the meter, and to all sectors of society.

In this section, we explore each component of the Framework and different approaches to engaging technology vendors.

Traditional Procurement

Traditional procurement effectively vets vendor qualifications but it does not always result in the most fitting technology due to rapid technological advances and the inherent blockage toward nimble solutions. Emerging digital and smart technologies can be embedded in municipal infrastructure, adding a layer of complexity to existing planning processes and a new requirement for technological upgrades or planning for technological obsolescence.



Below, we explore how the traditional procurement process can best be leveraged to build long-lasting partnerships across public and private sector divides to create more sustainable, livable cities.

[2]Open data is the idea that some data should be freely available to everyone to use and republish as they wish

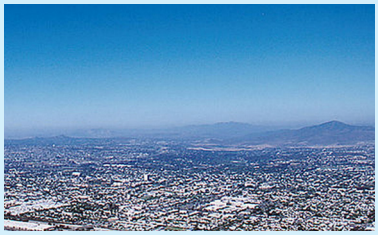
BEST PRACTICES FOR CITIES	BEST PRACTICES FOR VENDORS
■ Invest time in substantive pre-bid work allowing vendors to help scope problems and solutions/approaches. ■ Create working groups, and allow the private sector to inform technology solutions and have ongoing strategy/ implementation vetting. ■ Build technology upgrades and future risk mitigation into the request for proposal (RFP) process; include planned obsolescence or required upgrades as part of the life of the engagement with the vendor. ■ Identify mutual benefits including cost-saving potential and match with an appropriate financing solution. ■ If finance is a barrier, seek partnerships or innovative procurement processes that can transform the financing into an attractive investment opportunity.	■ Be willing to work with a city in a process of continuous improvement; a small contract can be a good way to create opportunities for further work with the city. ■ Respond specifically to the city RFP; present a technology solutions that fits the needs of the specific problem. ■ Listen and offer feedback during the RFP process; engage in a dialogue with the city to create more clarity on their needs and your offering. ■ Do not oversell your technology solution.

Request for Proposal -Traditional Procurement (RFP, RFQ, RFI)

Most cities are familiar with the standard procurement process that can be slow. It is helpful to be transparent with vendors about the process and how long it takes from the outset of any procurement process. Procuring smart city technologies creates added stress on all sides as the city might need to first go through a Request for Information (RFI) or Request for Qualifications (RFQ) to become aware of potential technology applications. Subsequently, many cities have rules that then disqualify vendors who have contributed their ideas in the RFI round from competing in the actual RFP solicitation. Cities and vendors can both benefit from an RFP that is scoped to procure the most innovative, effective, and adaptable technology possible.

Many cities have begun or plan to begin a smart city working group to develop a comprehensive smart city strategy. Such working groups are excellent avenues to map out smart city opportunities and what criteria should be included in an RFP.

Some cities such as Nashville, TN have taken stakeholder engagement another step by setting up a technical standard committee to develop appropriate criteria to be applied to technology solutions and identify emerging technologies to address their planning challenges. Pre-RFP work can include critical community engagement that ultimately creates a more fruitful procurement process and product for all.



Case Study:
Chula Vista Street Lights' Adaptive Controls

The City of Chula Vista, CA laid the groundwork of technology assessment by working with University of California, Davis, California Lighting Technology Center to incorporate adaptive controls for street lights. The objectives for the procurement were to:

- Understand the connection between dimming energy reduction and photometric performance,
- Validate and verify the accuracy and security of the automation of utility-grade metering, and
- Develop a metered time-of-use rate for street lights.

The city utilized a traditional RFP process for procurement. The project includes retrofitting the city's aged lighting system with LED luminaires combined with an adaptive control system that supports real-time monitoring and metering. Utility-grade metering allows the city to save energy by dimming streetlights in off-peak hours.

Key Action Steps Taken:

1. Involved other city departments to streamline communication and outreach
2. Engaged the vendor community early in order to assist in scope development
3. Utilized template language if available (for example, http://cesa.org/resource-library/resource/energy-storage-procurement-guidance-documents-for-municipalities)

Funding:

The City of Chula Vista utilized a combination of city funds, on-bill financing, Qualified Energy Conservation Bonds (QECB) and third-party financing.

Key project partners:

- Sensity Systems (owned by Verizon)
- CleanTech San Diego

Lessons learned:

- Ensure vendors are knowledgeable about the procurement procedures.
- Prioritize transparency with partners and vendors on the process.

Sole Source Contracts

Sole source contracts help cities interact with vendors around discrete and manageable pieces of smart city planning. Sole source contracts are a way of engaging with private companies that have a technology or service they can implement to help advance progress for a specific city need under a given cost threshold.

Sole source procurement occurs when a contract is entered into without going through the competitive bidding process. Cities benefit from this type of engagement when they can work and make progress on a specific outcome with a trusted vendor.

A sole source contract is an inroad to developing a trusted relationship between a city and vendor. City Departments all have budget thresholds (generally ranging from $5,000–$50,000) that often vary by department, which allow for a contract to be established without a formal RFP process. The next section, Partnerships, and the Section on Innovative Procurement, provide more innovative ways to test technologies before going to citywide RFP procurement.

Case Study: Sole Source Contract with the City of Columbus, OH

The City of Columbus, OH launched the GreenSpot program to engage the community on making homes, businesses, and community groups part of a cleaner, healthier, and more sustainable city. Energy management and sustainability software-provider JadeTrack took this program as an opportunity to engage with the city in hopes of improving the use and impact of GreenSpot. The company focused on listening to what the city wanted from the program and presented leaders with a technology that would track the impact of actions. The personal dashboard/app technology converts various behaviors into energy/natural resource and carbon savings, allowing people to measure impacts at the individual and community-wide level.

Other software providers that offer such technology include coolblock.org and goco2free.org.

Key Action Steps Taken:

1. Build trust and explore how technology solutions address city specific needs/goals.
2. Establish a scope of work and budget.
3. Obtain clearance from procurement.
4. Treat the project as a pilot.
5. If technology or vendor becomes scalable, consider an RFP.

Funding:

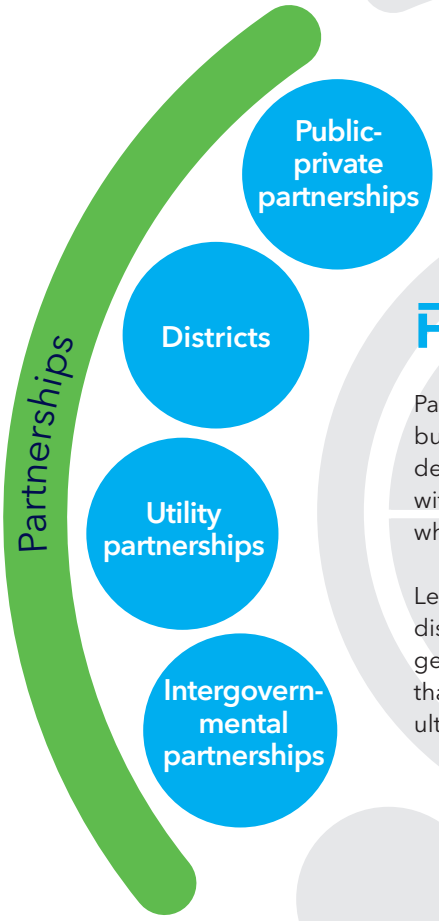
The city funded the project out of the Sustainability Department's budget.

Key project partner:

JadeTrack provides energy management and community engagement dashboards for municipal and private sector.

Lessons learned:

- Work with local vendors who are willing to develop specific solutions for your needs and goals and understand your challenges.
- Technology vendors can benefit from starting with a small contract and learning to adapt their technology and services to a specific city environment.
- Make sure data is available via an open application interface and is presented in a meaningful way.
- Engage with sole source service providers in a more collaborative way and clearly educate them about objectives and challenges; this is much different from the traditional seller-buyer engagement.



PARTNERSHIPS

Partnerships between cities and vendors come in many forms, and all are essential to building smart, sustainable cities of the future. Partnerships can be internal among city departments, or bridge public and private sectors, include academia, or facilitate work with the community. These diverse arrangements allow cities to leverage existing expertise when seeking innovative solutions to municipal challenges.

Leading cities such as Pittsburgh, PA, Seattle, WA, and Washington DC have created districts that focus on specific local challenges and are useful in engaging the public in a geographical area of the city. Cities are also building partnerships with utility providers that make data and information sharing more accessible, while building a relationship that ultimately improves service efficiency to city residents.

BEST PRACTICES FOR CITIES	BEST PRACTICES FOR VENDORS
■ Create a strong ICT backbone in your city; create systems for data collection and obtain a baseline of current data. ■ Create a clear roadmap for technology deployment, built on the baseline data and data collection system. ■ Be clear about purpose, partner roles, and timeframe of the partnership as well as its overall administration, management, and governance (e.g., frequency of meetings or communication among partners, if and how new partners are accepted). ■ Choose partners with diverse and complementary skills, assets, or resources. ■ Ensure partners' aims are in alignment with project.	■ Be completely open and honest and avoid overselling or over-promising. ■ Make sure the city knows about your platform and specific-use cases for it. ■ Provide some type of incentive for the city to try your product as an option.

Public-Private Partnerships

Traditionally public-private partnerships can take many forms. They are typically commercial transactions between a public and a private entity by which the private party performs a function previously performed by the public sector for a contracted period and assumes related construction, commercial, and/or operational risks. The public entity may pay for the services from its budget, user fees, or a combination of both.

Such partnerships benefit both public and private parties in several ways: by enabling faster delivery of services to the public, providing a guarantee of continuity to suppliers, and providing the public with a guarantee of quality and reliable services. There are many types of public-private partnerships that allow cities to engage with vendors in multiple ways. Three partnership structures that are often used for infrastructure projects like roads and water lines are concessions, DBO (design-build-operate), and BOT (build-operate-transfer) projects.[3]

As cities focus more on technology and innovation, new public-private models are emerging. For instance, Pittsburgh, PA is employing several new models and aggregating them around their smart city goals as described in the case study below. To prioritize smart city initiatives, cities should look at projects that can be implemented quickly, reach the broadest and neediest populations, and have a low start-up or total investment cost, or invest in a smart city planning process.

3 http://ppp.worldbank.org/public-private-partnership/agreements/concessions-bots-dbos

Case Study:
EcoInnovation District Pittsburgh and Inclusive Innovation Platform

Pittsburgh, PA has created an EcoInnovation District program and identified three focus areas for change and advancement within the district: buildings and energy, microgrid technologies, and fleet management and fuel conservation. To advance progress in these focus areas, the city created a framework for engaging with private companies that have the technology it needs to be successful.

Prior to program launch, Pittsburgh engaged deeply with community organizations and city government personnel to identify geographical areas of the city, as well as critical areas of the city's economy and infrastructure to prioritize for smart city implementation. City leaders chose the Uptown/Oakland district based on several criteria, including that the area had attracted some initial private investment, had issues of transportation access and water infrastructure, is centrally located, and is a historically lower-income neighborhood. Pittsburgh also obtained baseline data and developed a system of benchmarking to identify focus areas for the overall EcoInnovation Districts program.

To identify potential commercial partners, the city worked with PGH Lab to review applications from beta-stage technologies and allowed chosen companies to test their concept by deploying in Pittsburgh for a certain amount of time. No money is exchanged, and both parties benefit in a process of collaborative innovation. [4]

Pittsburgh also uses a framework called the Inclusive Innovation Platform to spur engagement with key stakeholders in the clean technology, start-up, entrepreneur, venture capital, and bioenergy sectors. By targeting key areas for improvement in the city, the Inclusive Innovation Platform elicits a long list of project ideas from target stakeholders. Pittsburgh scores ideas based on affordability, need for partners, speed of implementation, inclusivity, city capacity, and innovation. [5]

Key action steps:

1. Benchmark focus areas, develop baseline data, and conduct a strengths-weaknesses-opportunities-threats (SWOT) analysis.
2. Create an RFI for project ideas.
3. Identify geographic focus areas.
4. Engage with project vendors.
5. Assess progress.

Funding:

Pittsburgh approved $1.5 million in general fund dollars to create a planning and design team for the EcoInnovation District. For private companies, the city will not pay vendors to implement their technologies, but they are offering a way for these vendors to use it as a test bed for their products and services.

Key project partners:

- BOSS Controls LLC offers smart plug-load management and analytics which was tested in PGIT labs.
- Optimus Technologies offers biodiesel conversion systems for medium and heavy-duty truck fleets.

Lessons learned:

- Create a strong foundation of current baseline and data collection.
- Cities should ensure they first have a strong ICT backbone.
- Develop a robust baseline assessment and a clear roadmap for deployment.
- Have a smart city champion to push various innovation methods and districts forward.

4 http://pittsburghpa.gov/innovation-performance/pghlab/index.html
5 http://pittsburghpa.gov/innovation-performance/innovationroadmap/index.html

Districts

Districts provide a scale that is more manageable for a city to test new smart technologies, policies or process that will improve buildings/energy performance. Identifying the challenges in a discrete area allows cities to focus resources on finding unique and scalable solutions to problems that likely exist elsewhere. Community engagement, deploying smart technologies, and tracking progress against chosen indicators can all be managed more closely and efficiently within a defined boundary. Once workable solutions are identified, they can often be translated and scaled to other parts of the city.

The two following case studies represent examples of how partnerships and procurement are operationalized through the formation of a district.

Case Study: Seattle 2030 District

The Seattle 2030 District is an initiative that grew out of local efforts to develop an energy-use disclosure ordinance for commercial buildings. During this process, building owners and operators were engaged and inspired to come together to develop a program that would enable them to utilize the data and leverage a common platform to dramatically reduce energy and costs.

Five years since its launch, the Seattle 2030 District has 250 participating buildings with 54 million sq. ft. in downtown Seattle, WA. One of its key initiatives is related to smart buildings and the pilot of technologies that supports advanced building performance data analytics.

Currently, one of the Seattle 2030 District's pilot program leverages an Accenture/Microsoft smart buildings technology as a "plug in" to the building management system and to inform the building owner/operator if something is likely to go wrong before it does. The technology is similar to a car engine light that illuminates if a fan belt is close to breaking. The system utilizes millions of data points.

To launch the pilot, the Seattle 2030 District assessed the range of buildings within its membership that this technology might be appropriate for. They hosted a number of meetings with building owners to present the technology and see how they might use it.

Initial challenges included helping building owners to understand building systems and how monitoring the data points was going to achieve operational savings. At that point, the 2030 District realized it needed different levels of IT platforms ranging from basic energy management to more sophisticated high-performance building management to meet the diverse needs of their membership.

Key Action Steps:

1. Nurture district idea to get initial grant to provide seed funding.
2. Form preliminary district membership and then reach out and engage local building owners and operators.
3. Utilize a digital tracking platform to provide building performance comparative analysis reports.
4. Develop and release RFP for building analytics tool.
5. Pilot program with a small number of buildings.

Funding:

The Seattle 2030 District is a non-profit supported by foundation grants and private sector funding through sponsorships.

Key Partners:

- Accenture PLC and Microsoft Corp. offer advanced building performance data analytics.
- Urban Land Institute (ULI) Greenprint Center for Building Performance offers building energy-use comparative data reports.

Lessons Learned:

- To help create a district initiative, be sure to engage building owners, not just building operators.
- Match the site to the technology application (e.g., in this case the technology was best suited for newer buildings that had the infrastructure and building management system to best interface with the smart building technology).
- Use ENERGY STAR® Portfolio Manager to begin gathering energy and water-use data.
- Find a platform to manage and optimize large data sets.

Image source: the Office of Innovation in DC.

Case Study: Washington, DC Pennsylvania Avenue 2040 District

The Pennsylvania Avenue 2040 (PA 2040) district initiative seeks to implement innovative and stimulating Internet of Things technologies to "America's Main Street" comprising Pennsylvania Avenue west of the White House to New Hampshire Avenue.

PA 2040 serves as the foundation for a citywide smart cities infrastructure strategy, beginning with two distinct phases:

Phase one was initiated in 2015 with the installation of city-installed Wi-Fi and 71 smart streetlights along the "beta-block" of Pennsylvania Avenue. The smart streetlights feature sensors that turn on the lights when the area gets too dark or when a pedestrian enters the vicinity. Early program successes include power use reduction by 50% in the pilot area, from approximately 34,200 to 18,000 watts of energy.

Phase two will extend the technology throughout the district by eventually replacing all the city's 70,000 streetlights. Phase two will also include smart parking, public safety applications, environmental sensing, water management, and interactive kiosks, partially informed by the data collected by the smart sensors utilized in phase one. City services will utilize the collected data to improve efficiency. For example, sensors in trash cans will notify DC Public Works when they are near capacity and need to be emptied. This information can be used to design more efficient trash routes and schedules.

Other smart city initiatives include environmental sensing, such as measuring pollutants, emissions, particulate matter, via park benches outfitted with sensors and solar panels. Water sensors and soil monitors to reduce unnecessary water usage in landscaping and maintenance are also being implemented.

Key Action Steps:

1. Create and release RFI describing business needs and district goals.
2. Assess vendor responses.
3. Pilot new technology options in district
4. Engage partners to scale out best practices.

Funding:

Funded by Office of the Chief Technology Office (OCTO)

Key Project Partners:

Partnered with the District of Columbia government, Golden Triangle Business Improvement District (BID), the National Capital Planning Commission (NCPC), and technology vendors Cisco Systems, Inc. and Sensity Systems.

Lessons Learned:

- Consider setting up "Industry Days" to meet with and dialogue with vendors.
- Leverage benefits of a request for information (RFI) solicitation.
- Use pilot projects to test solutions for capabilities, data architecture, connectivity, and security.

Utility or Energy Provider Partnership

Cities setting progressive climate and smart city goals will benefit from productive partnerships with local utilities and energy providers. Utilities, energy providers, and cities share a need to find ways to maintain revenue streams while rethinking the ways they interact with their constituents and customers in a rapidly expanding technology marketplace.

Cities have an opportunity today to work with their utility counterparts to tackle some of the most difficult issues in energy—greater efficiency, increased reliability and security, and integrating renewable energy systems. Conversely, utilities are looking to further enhance relationships with their customers and local communities so they can better tailor solutions to satisfy customer and community needs and maintain a strong customer base. Utilities and local governments need to forge partnerships that allow for a better understanding of how both are working to measure and manage energy use and the unique problems they face. Such partnerships will require utility and city departments, with seemingly disparate responsibilities, to work together and overcome the confines created by working in siloes.

Figure 1 illustrates how a shift in focus is needed by both cities and utilities to advance smart green community goals.

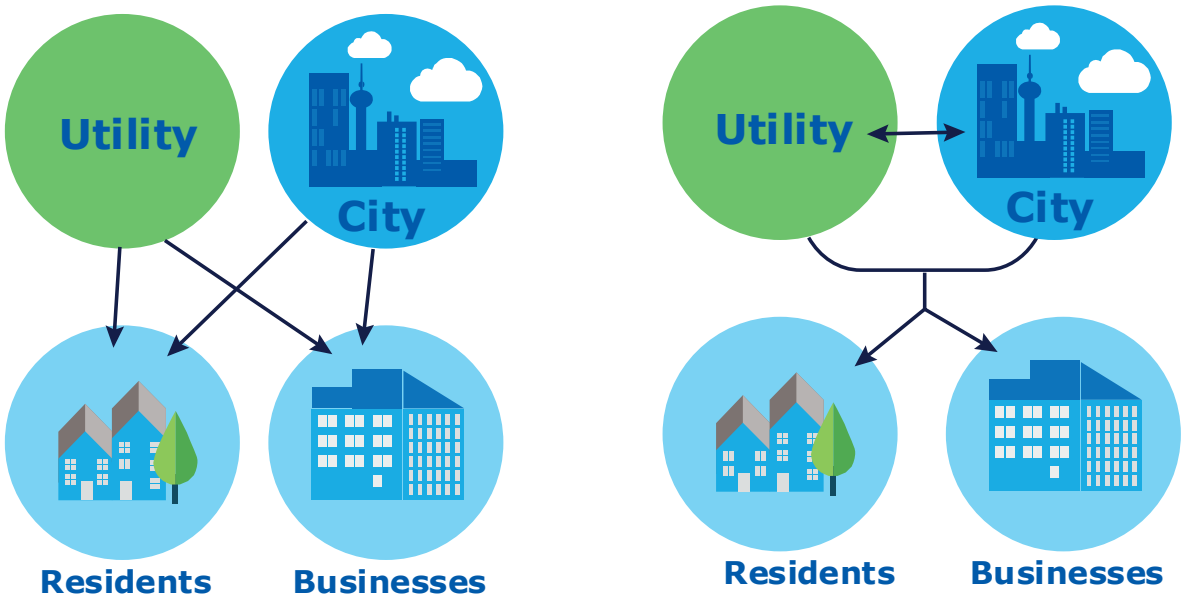


Figure 1: City-Utility Shift in Relationship

The energy sector today and in the near future is characterized by significant potential for disruption and growth. Regulatory, technological, and community-driven changes are opening the market for innovative products and services at the city level. Even cities with municipal utility departments must find ways to collaborate more closely to align sustainability and utility priorities.

Case Study:
City of Burlington, VT

Burlington, VT is in the early phases of exploring how to best leverage smart city technology opportunities. The Innovation Office, Sustainability Office and Electric Utility are taking the first steps to bring together cross-departmental leaders who will become a smart city visioning or working group. The Chief Innovation Officer has been focused on the ICT infrastructure, data security, proper hardware with integrated architecture to support analytics and open data (currently housed on Socrata). The Innovation Office strives for data-driven governance, specifically measuring data and using it to make decisions. The latest project toward that goal is the "City stat project" to develop a comprehensive city performance dashboard.

Currently the electric utility, Burlington Electric Department (BED), has separate energy platforms as it operates independently as a utility, but as the smart city conversation and strategy develops, integration of platforms may be explored. Having a city-owned utility is an opportunity to work together, and synchronize efforts across telecom, water, electric, and public works street departments.

Burlington Electric has a 90% adoption rate of smart meters so they are grappling with the volume of data and what to do with it. They use meters from Itron, Inc. that provide 15-minute interval data three times per day. The city is exploring a smart city vision where the ICT and electric fibers can run directly to homes, for real-time energy performance, eliminating the need for the meters as a potential future strategy.

Currently, the data is manually analyzed and utilized for research on specific user segments, but the city would like to leverage the data at a larger scale. Smart city strategies will help inform which data points need to be captured and make them easier to use, including those publicly available to the community, resulting in data that is more readily accessible and useful for everyone. The idea of energy democracy is being explored at BED; they are inspired by a vision of owning the energy footprint of the municipality, not giving away the data, but using it to accomplish a broader vision.

Key Action Steps:

1. Implement smart meters across the city to improve energy consumption data.
2. Identify questions or problems to be solved by data analytics.
3. Explore different models and approaches for data aggregation and access.
4. Form city and utility partnership.

Key project partners:

- City Innovation Office, Sustainability Office and Electric Utility
- Itron, Inc.

Lessons Learned:

Installing smart meters is the easy part; the hard part is figuring out what to do with the data and how to make it useful.

Intergovernmental Partnerships for Contracting

General service agreements with states allow municipalities to contract with certain vendors without going through an RFP process. The US General Services Administration (GSA), a department of the federal government, handles procurement of goods and services for government agencies through its Federal Acquisition Service (FAS). The GSA negotiates procurement contracts with vendors; these contracts, along with the GSA Schedules, can be viewed by government agencies who wish to purchase from the vendors. GSA Schedules are essentially a way for government agencies to opt-in to the pre-negotiated contracts with vendors. By using this type of engagement, state and city government agencies can save time, knowing that all legal issues with the contracts have addressed by the GSA.

Case Study: Metro Nashville and Davidson County – Community Relationship Management (CRM)

The Metropolitan Government of Nashville, TN (Metro) provides an example of how local governments can leverage an existing federal General Services Agreement contract to save time and money in procurement to achieve smart city goals. Instead of going through a traditional RFP process to design and implement a combined 311/community relationship management (CRM) system for its residents and visitors, Metro used an established GSA contract to implement and integrate its CRM solution. With a BPA (blanket purchase agreement) from Salesforce, a nationally recognized CRM provider, Metro was able to engage the vendor and an implementation partner to pursue directed goals for greater citizen engagement.

The CRM is a crucial part of Metro's integrated Smart City strategy. In 2016, Nashville's Mayor authorized Connected Nashville, a community-based working group led by Metro Government's Chief Information Officer, to investigate, prepare and present a strategic plan for Smart City Metro in Spring 2017. The basis for the Connected Nashville Strategy is to address critical community needs as identified in other published, vetted Metro Government and community planning documents. Plans reviewed include those for transportation, connectivity, city planning, affordable housing, education, and sustainability.

Members of the community at large were integral elements of the working group, joining many Metro department heads in order to consider and to understand how smart city technologies will influence and shape Metro service provision and citizens service demands. Additional input will be solicited through a community review, engagement and communications campaign led by the Mayor's office.

Leveraging available community resources during the Connected Nashville process, Metro also signed a memorandum of understanding (MOU) with Vanderbilt University for the Vanderbilt Initiative for Smart City Operations Research (VISOR). VISOR is a collaborative university/city effort with the intent to apply for membership in the Metro Lab Network. Metro will work with VISOR to perform proof of concept for potential use cases and solutions, and to collaborate on engaging vendors and grantors and meet Connected Nashville's goals.

Key Action Steps:

- Don't reinvent the wheel… Use important and established community planning documents that have been vetted, presented, and reviewed as the basis for comprehensive strategy.
- Form a smart city working group to help investigate, develop, and evaluate elements of smart city strategies.
- Use a process that brings together departments and sectors across the city that can provide a needed overarching framework for smart cities and sustainability work.

Key project partners:

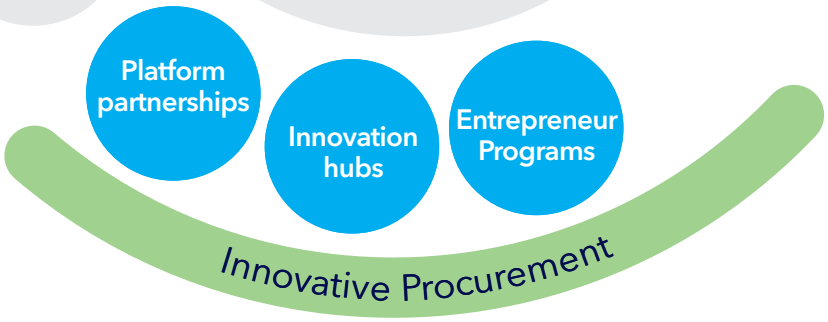
Metro Government of Nashville and Davidson County, Vanderbilt University, Salesforce

Lessons Learned:

- Allow existing community plans to drive development of smart city strategies
- Leverage the enthusiasm and technical expertise of community stakeholders
- Use collaborative working groups to drive and prioritize smart city strategy and implementation

Innovative Procurement

Cities across the country are finding innovative ways to procure public resources and engage with the vendors offering applicable technologies to urban systems. These new innovative procurement systems and platforms offer vendors and cities opportunities to learn about city sustainability needs and the range of solutions in the changing environment of urban sustainability and smart cities technology development. Learning on both sides leads to iterative processes, pilot projects, and smart technologies deployed in more cities.



City-Facilitated Entrepreneur Programs

Cities are often in the best position to spur innovation around challenges to their operations and city programs. Cities can best identify and articulate the areas needing change or improvement, drawing on years and often decades of combined experience within city departments and agencies. City-facilitated entrepreneur programs leverage this experience and create an exchange between city departments, which can identify a challenge, and the start-up or business community, which can bring new perspective and innovative ideas to the solutions.

BEST PRACTICES FOR CITIES	BEST PRACTICES FOR VENDORS
■ Be prepared for handling and vetting multiple sales pitches in response to RFIs. ■ Create an intentional innovation hub or district with a focus on piloting smart technologies (no money exchanges hands, but emerging smart technologies are tested, data is shared, and everyone learns). ■ Test, iterate, and build trust; then scale.	■ Relationships are built around trust. Focus less on the sales pitch and more on helping the city with the task at hand. ■ Work with cities that have a sustainability director or strong climate goals. These cities are already thinking about sustainability and innovation. ■ Be patient, as municipal processes are time-consuming and time between presenting an idea and deployment will take longer than expected. ■ Getting the backing of the Mayor or the right stakeholders helps to streamline the process.

Case Study: Start-up in Residence Program, San Francisco Office of Innovation

The Start-up in Residence Program (STiR) started in 2014 as an initiative of the San Francisco Mayor's Office of Innovation to spur collaboration and innovation between city government and civic-minded startups. STiR is a 16-week program during which startups work with city partners to build, refine, or co-develop products that can enhance municipal processes. To date, STiR has expanded to address city challenges in four jurisdictions—San Francisco, Oakland, San Leandro, and West Sacramento—across a diverse set of issues such as streamlining the foster care adoption process, reducing recovery time after an earthquake, and giving homeless individuals the services they need in real time.

STiR programs begin with outreach to city departments and agency staff who know the challenges and opportunities for innovation in their city. Once departments and agencies have submitted their challenges and created a clearly stated scoping document, STiR opens the applications for startups. Using scoping documents, templates, and in-person workshops helps city departments and startups communicate clearly and align throughout the process and ensures that progress is made and completed in the 16-week period of collaboration. By explicitly defining problems at the outset of a procurement process, STiR RFPs are more well defined and inviting for a wider range of contractors to respond with their best solutions.

Following the successful 2014 pilot initiative, the US Department of Commerce Economic Development Administration awarded the City and County of San Francisco a three-year grant to grow and scale the STiR program to Oakland, San Leandro, and West Sacramento. Now, in partnership with San Francisco's Nasdaq Entrepreneurial Center, STiR is scaling up to create a global network of 100 cities in the next five years.

Key Action Steps:

- STiR partners with city government.
- Startups submit applications.
- Startups selected and government teams formed for program launch.
- Startups participate in 3 to 4-month residency and coaching.
- Residency ends with product pitch and presentations.
- One month of training for startups, followed by demonstration days (Demo Days).

Funding:

Startups are not offered monetary assistance, nor a government contract for their work. However, the Demo Days provide startups the opportunity to share their work and the close relationships with city government give them the option to enter a paid work contract with the city.

Key Partners:

San Francisco, Oakland, San Leandro, and West Sacramento participated in 2016.

Lessons Learned:

- Be open to out-of -the-box ideas
- Be prepared to work with entrepreneurs to design viable online, digital, and application solutions for specific city needs.
- The San Francisco Office of Innovationrecommends that interested cities join the network cohort to design and implement the STiR program with others. This prevents duplicated efforts and can leverage best practices and lessons learned.

Platform Partnerships

Platform partnerships seek to engage with a wide number of vendors, who are open to providing some level of service or technology use at little to no cost, related to specific issues or problems. These partnerships allow cities to test various vendors/tools without going through an official procurement process. Platform partners are like other piloting efforts where the vendors get to understand the true needs/challenges that a city faces, while the city learns about how they can effectively use a tool. The vendor is also able to build trust.

The process is simple. A reputable organization or network with which a city has engaged would set up the platform partnership model to engage smart city vendors/consultants to offer services at a discount or free to cities.

Case Study: City of Berkeley and 100 Resilient Cities Platform

Through the Rockefeller Foundation's 100 Resilient Cities (100RC) Platform, the City of Berkeley was able to tap into a curated suite of resilience-building tools and services provided by partners from the private, public, academic, and nonprofit sectors. The Platform Partnership program is maintained by 100RC staff who review vendor applications and proposals and enter into a MOU that allows platform partners to work with participating cities.

The Chief Resilience Officer with City of Berkeley has worked with several partners on the 100RC platform, including with vendors such as Microsoft and Cisco. Microsoft is assisting the city to develop a framework for advancing cyber security. Cisco is assisting the city to identify opportunities and tools to advance work on their Internet of Things strategy.

The City of Berkeley utilizes the 100RC platform to connect outside expertise with staff throughout the city government to address key challenges and priorities. The 100RC platform is easy to access for cities in the 100RC network and adds significant value to the city's resilience work.

Key Action Steps:

1. Join networks/platforms that can support your city in achieving the city's smart city/sustainability goals.
2. Review platform partners.
3. Match needs/goals to available partners.
4. Conduct interviews, brief RFI or informal write-ups of tool/technology to understand capabilities.
5. Deploy tool and measure results.

Funding:

Usually there is no payment needed by the city other than paying membership dues to the organization/platform. Vendors usually pay for platform partnership memberships out of their business development/marketing budgets.

Featured Platforms:

- 100 Resilient Cities
- C40 Cities
- Carbon Disclosure Project (CDP)
- USDN (coming soon)
- Smart Cities Council Advisors

Lessons Learned:

Platform partnership programs are useful to get to know possible tools and solutions, as well as build relationships with the private sector.

Innovation Hubs

Innovation hubs are built on collaboration, bringing together entrepreneurs, researchers, city officials, and academics to bring innovative solutions to cities. These hubs foster creativity and sharing of perspectives and ideas. Innovation hubs in cities across the country and around the world hold hackathons and "pitch nights" to address challenges through social entrepreneurship. When cities are connected to and receptive to the ideas coming from these hubs, innovative technologies may be applied to long-standing challenges. Setting up a framework to pilot technologies has proven to be valuable both for cities and for innovation hub members.

For cities and vendors alike, deploying new smart city technology is forging new ground associated with procurement processes. Not only because of new technical features, but also because of potentially complex ownership models, possible new financial flows and models, and risks associated with the reliability and performance of emerging technologies. A national smart street light vendor, for example, initially wanted the City of Milwaukee to commit to a full conversion of all 68,000 streetlights to smart streetlights. However, city officials preferred a smaller, district-scale pilot of the technology to test its capabilities and align with local budget constraints. Similarly, Washington DC's PA 2040 District emphasizes innovation by developing specific goals on a 'beta block' of the district, and partnering with expert technology partners like Cisco and Sensity.

A pilot program is an effective outreach strategy to technology vendors, enabling them to respond more quickly to a small-scale, discrete opportunity. Similarly, piloting a technology allows cities to familiarize themselves with different potential technology solutions and explore a technology's value to city operations, and gather input from the community prior to committing to a large investment.

Image source: Wright Grid .

Case Study: Somerville Greentown Labs

Somerville wanted to focus on innovation and harness the benefits coming out of their Clean Tech start-up community. To accomplish this, the city created Greentown Labs to engage local clean-tech entrepreneurs in energy transformations that the city needs to meet its goal of an 80% reduction in greenhouse gas emissions by 2050.

Greentown Labs is a physical space, 33,000 square feet ofprototyping lab and co-located office space, a shared machine shop and electronics shop. The space offers immersion in a growing community of energy and clean technology entrepreneurs, as well as on-site events and programs designed to enable start-ups to rapidly grow their networks and their companies. The city asked companies to fill out a simple two page RFI and have a brief meeting to understand the potential benefits and outputs of the technology to be piloted.

One example of a useful technology that was developed from Greentown is Wright Grid. Wright Grid piloted their solar powered cell phone and personal device charging stations in Somerville for a 60-day period in late 2015. Wright Grid stations were free for public use, and are equipped with a battery that lasts up to a week with no sun and universal charging cables.

For Somerville's pilot, the stations were provided at no cost to the city, and advertisements on the stations covered the $1,500 per year data plan for each station. Starting with the pilot allowed Wright Grid to quickly deploy stations and gather data on their use and usefulness to Somerville and its residents.

Key Action Steps:

1. Develop a simple request for information (RFI) for interested participants.
2. Screen and select participants (e.g., proposal and interviews with city staff).
3. Sign MOU with the city.

Funding:

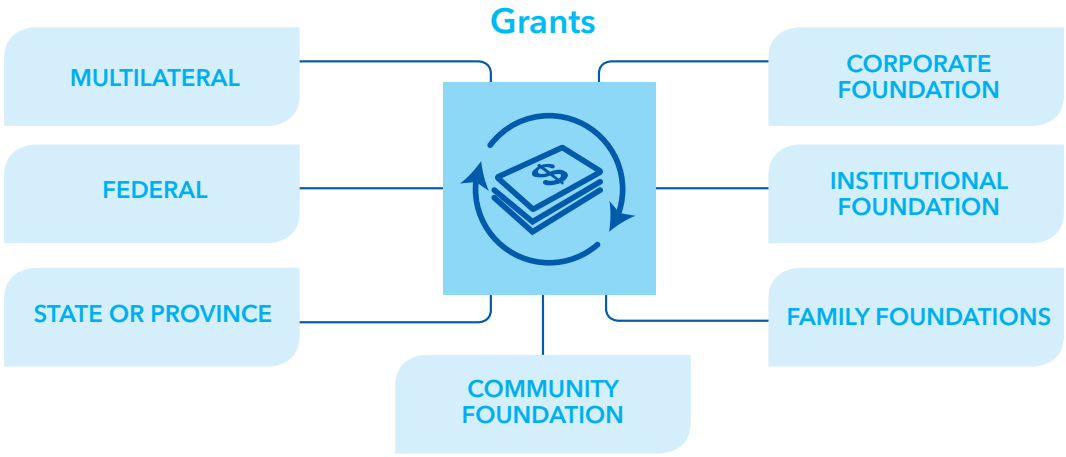
No funds are generally exchanged until/if the city decides to issue an RFP and procure technology at scale. In the case of Wright Grids, the stations are paid for by the advertisements on the units.

Featured Vendor:
Wright Grid provides independent solar panel stations that power a battery system to provide charging for phones and small hand-held devices as well as various smart sensors.

Lessons Learned:
- The Innovation Hub process was an effective approach for the City of Somerville to understand the capabilities of many smart, clean tech companies.
- The process can be initiated through a simple RFI to allow technology vendors to participate in testing and piloting.
- Based on the demonstration activities, the city is advancing their smart city goals and strategies through fostering local entrepreneurs.

FINANCING OPPORTUNITIES

Financing for sustainable and smart city technologies can be both a barrier and an opportunity. Financing of emerging sustainable and smart technologies is a rapidly evolving field, presenting new opportunities to the investors in sustainability and to the municipalities forging ahead with smart city development. Smart cities are delivering services, data and infrastructure, which often results in lowered costs through improved resource efficiency and lowered maintenance costs through automation and digitalization. The business case for a smart city is what needs to be captured and articulated to attract investments.



Cities are looking to attract private capital now more than ever, whether through bonds, explicit debt or equity investments, leases, financing, grants, or loans. Smart cities are finding ways to share risk across the public and private sectors, and share co-benefits with the entire community.

In this section, we highlight special considerations for engaging with vendors related to specific funding and financing approaches.

Grants

Interest in sustainability and climate action at the local level is greater than ever. This is reflected in the increasing number of organizations, agencies and funders issuing grants through city networks such as USDN, federal agencies such as the US Departments of Energy or Housing and Urban Development (HUD), and state and local grant-making players.

While grant applications and tracking can be time-consuming for cities, there are many vendors and solution providers who can perform most of the legwork. However, vendors must be prepared for lengthy review and approval processes by cities. Furthermore, cities must clarify at the outset any issues associated with sole source limitations and how competitive solicitation requirements would apply to partners on grant applications. One strategy utilized by cities such as San Francisco and Berkeley is to issue an RFQ to pre-qualify smart city contractors. This avoids a time-consuming and potentially frustrating RFP process after a successful grant application, although one downside is that the process limits the pool of partners from the outset.

Case Study: City of Fremont Microgrid Grants

The City of Fremont, CA was approached by a local clean-tech company, Gridscape Solutions, to pursue a $1.8 million grant from the California Energy Commission that would explore municipal applications for microgrid software optimization. With a commitment to fostering local public-private partnerships, Fremont worked with Gridscape Solutions to identify three fire station locations that would serve as appropriate test sites and support investment in Fremont's local infrastructure.

Once the project was funded, however, the city spent significant time working out contractual issues related to the grant requirements, and also ownership and operational issues beyond the three-year grant period. The city was able to utilize California Government code 4217.10 allowing for the project to be singly sourced as an energy saving project.

The project pilots the Gridscape Solutions microgrid controller and energy management system software. Overall, the project is capable of operating in islanded mode for a minimum of three hours, and automatically disconnects and operates independently from the grid, by identifying, isolating and serving critical loads.

One key question the City of Fremont grappled with was whether to purchase the system outright versus utilizing a power purchase agreement when grant funding for the demonstration project ended and assuming the city wanted to keep the system. The City of Fremont worked with Gridscape Solutions to develop a model that allows for system installation and allows the city to realize the energy savings with no out-of-pocket expenses. The city was able to utilize a previous power purchase agreement (PPA) template for solar to incorporate the battery storage technology. The final agreement was that energy generated during the CEC grant funded demonstration would be donated to the city, and after that, the project would operate as a PPA.

Key Action Steps:

1. Obtain commitment from local businesses to invest in some of the city's local infrastructure and encourage public-private partnership.
2. Support your vendor, who can lead development of the grant application with input from the city.
3. Once the grant is awarded to the vendor and city, the city can move forward with contracting based on a California state law that allows municipalities to procure energy project so long as they result in net savings.
4. Finalize terms of contract and financial model with vendor.

Funding:

Funding was provided by a $2.4 million California Energy Commission grant, with in-kind matching funds of city staff time estimated at $80,000

Key Partner:

Gridscape Solutions is a software and service company that specializes in designing and developing a broad range of smart energy solutions.

Lessons Learned:

- Solar is simple to understand. Solar plus storage is still relatively easy to understand. However, microgrid at a community or district level starts to be confusing, involving many entities (e.g., owners/renters and multiple meters). This requires city staff to have a good understanding of both the infrastructure and policy perspectives.
- Anyone working with a city needs to be prepared for the process to take longer than expected. Therefore, vendors need to accelerate their own deadlines and be flexible to address city procurement processes.

Performance Contracts

Energy performance contracts allow building owners to improve energy performance by partnering with an energy services company (ESCO) to enhance building operations and save energy. The ESCO identifies energy improvements, can provide the up-front project capital, installs improvements, and provides a performance guarantee in the contract.

Performance contracts are a good way to engage vendors and technology companies to leverage their expertise in smart building technologies. It is important that the building manager and the ESCO also participate when writing the contract to ensure that all parties will use the same reporting platform. In addition, expectations related to the requirements for building operations and maintenance must be clearly spelled out, in addition to measurement and verification protocols.

Case Study: Milwaukee, WI Performance Contracts

Milwaukee has a set a goal of reducing its energy intensity 20% by the year 2020. The city is moving forward by focusing on municipal buildings and pursuing energy performance contracts with private energy services companies to implement the upgrades and retrofits to building systems. About 80% of energy performance contracting currently takes place in the MUSH market, which include municipal, university, school and hospital buildings. Milwaukee plans to focus performance contracts on this market to achieve a 20% energy efficiency improvement. [6]

The city is utilizing a public RFP process that will lead to writing terms of a performance contract that aligns the energy savings requirements of the Better Buildings Challenge with a performance guarantee from the chosen company. Once in place, the energy contractor will implement energy efficiency measures on a small number of trial buildings in Milwaukee. If the trial is successful and performance guarantees are met, the city hopes to expand the implementation of the contract to more municipal buildings.

Energy performance contracts generally include a performance guarantee and includes financing of the energy upgrades. These contracts most often create a revenue stream of energy savings that pays for the cost of the project. However, when developing the contract, a city should align the measurement and verification of energy savings in the performance contract with the municipalities' public reporting of energy or carbon savings. For example, since Milwaukee's uses EPA's Portfolio Manager to monitor energy use intensity (EUI) in its buildings, it is looking at how its performance contracts can be structured to verify ESCO performance according to this same standard. In addition, if the performance contract has standards on how the building will be operated that affect the savings guarantee, it is critical to have the building maintenance and operations staff agree to these terms as well.

Key Action Steps:
1. Conduct a traditional RFP process.
2. Negotiate terms of performance contract.
3. Implement in trial buildings.
4. Assess based on performance guarantee.
5. City can opt-in to implement contract on wider scale.
6. Assess performance.

Funding:
Not yet financed

Lessons Learned:
While Milwaukee is supportive of using energy performance contracts to reduce energy use across several systems within a building, the Sustainability Director urges cities to consider the reporting and building management terms that are in the contract.

Several competitive solicitations for smart cities have emerged in the past several years. This type of engagement uses a competition model where individual cities compete with each other to earn resources, partnerships or technical support. The urgency created by the deadline and the financial award helps to quickly catalyze both ideation as well as action at the local level.

6 https://www.greenbiz.com/article/how-milwaukee-brewing-energy-efficiency-financial-innovation

Smart City Competitions

The process for setting up third party competitions differs based on the resources that will be awarded to the winner. In recent competitions involving smart cities, the prize has been a combination of grant funding and industry/expert advice or partnerships.

The **US Department of Transportation's (DOT) Smart City Challenge** is one recent example of using third party competition to drive innovation. DOT received some of the funds for the challenge from Vulcan Inc./the Paul Allen Family Foundation. DOT offered the Smart City Challenge to mid-sized US cities, inviting them to create a plan for incorporating new technologies into the transportation system. The contest was intentionally broad, encouraging cities to address transportation problems they saw as most pressing in the near future. The challenge produced applications from 78 cities, from which seven finalists were chosen to receive a $100,000 grant to build out their proposals, and one winner was ultimately chosen to receive a $40 million grant for implementation.

The **Global Cities Team Challenge (GCTC)** also uses third party competition to engage members of the public, private, and nonprofit sectors, along with academia and industry experts to deploy solutions to targeted problems the city needs to solve. GCTC is run by the National Institute of Standards and Technology (NIST) through their US Ignite program which aims to integrate Internet of Things technologies into cities. With Internet of Things framing the solutions, cities put out a challenge in areas like transportation, health, education, and utilities that spurs quick collaboration from cross-sectoral teams.

For example, in November of 2015, the County of Montgomery, Maryland put out a call for teams to "re-imagine public transit infrastructure as a platform for sensing and service delivery across domains." Phase one of a sensor network pilot program was rolled out in September 2016 by a diverse project team that collaborated with the county's Department of Transportation and industry experts to identify opportunities for Internet of Things integration.

Envision America[7] is another example of a contest between cities to produce a plan for innovation that can be acted on and implemented in a short period of time. Third party competition also invites cities to be bold in their plans submitted as applications, since they are competing with other innovative and change-making efforts.

Envision America grew out of Envision Charlotte (founded in 2011) which aimed to make downtown Charlotte a living laboratory for 'public-private-plus' collaborations. Through implementing smart cities technologies, their goal is to advance their economic, environmental sustainability, and positive community impacts, along with reducing energy consumption by 20% by the end of October 2016. Envision America launched in January 2016 with an initial cohort of ten cities, each of which is was partnered with academic teams, industry experts, and corporate allies in reaching smart cities goals.

The first cohort of cities included: Cambridge, MA; Dallas, TX; Greenville, SC; Los Angeles, CA; Milwaukee, WI; New York City, NY; Pittsburgh, PA; Portland, OR; San Diego, CA; Spokane, WA. Each of the ten cities identified their unique needs and reasons for participating in Envision America 2016. For instance, Greenville focused on building out full service public transit options. Spokane is working to implement a smart street lights pilot program in one district of the city. Pittsburgh's goal is to align infrastructure investments with policy and smart city project deployments.

Ten cities will launch at Envision America, beginning 2017. Envision America operates at no cost to participating cities.

7 http://www.envisionamerica.org/

OPERATIONALIZING INNOVATION IN SMART CITIES

The imperative for Smart City technology emerges at the intersection of climate change, urbanization, aging infrastructure, Internet connectivity (Internet of Things), renewable distributed energy, and open data. To become a Smart City is an invitation to operationalize innovation; it allows for a process/partnership model that reaches across internal government departments, across both sides of the meter, and to all sectors of society.

Sensor-based smart technologies have limited value on their own. Systems for processing, managing, and applying the data towards a desired end are necessary to access the full benefit of such technologies. How can cities sift through the endless options of smart city technologies, understand the connectivity issues and best interact with vendors of these products and services to get to a Smart Sustainable City future? Cities need a clear framework to better understand the options for engaging with smart city technologies vendors, and how to more effectively partner across sectors to enable smart, sustainable city innovations for the betterment of communities.

Advances in ICT (information and communications technology), sensor, smart meter, smart grid, and microgrid technologies are happening at a rapid pace. Smart technology, innovation and data are inextricably linked. Thus, the pathway towards creating more innovation and data-driven decisions in cities is interchangeable with the pathway towards creating a smart, sustainable city.

Many communities are already doing smart city projects, although they may not necessarily be categorizing them as such.

The Role of Chief Innovation Officer and the Organization of the Data Layer

In recognizing the importance of innovation, improved data analytics and data platforms, cities are increasingly hiring Chief Innovation Officers and Chief Data or Technology Officers. Cities can look to these Officers to coordinate smart technology and improved ICT infrastructure that can help transform cities. Smart innovation requires policies around sharing and storing data to be upgraded to enable collaboration across the various sectors of society and government to facilitate the full potential of an integrated smart city. Chief Innovation Officers are bringing together city operations data, energy/performance data, and other sensor-based data streams to track the performance of the city as a whole and portray the data in a meaningful way. Chief technology offices are leveraging machine learning as well, which connects across data sectors, allowing for more coordinated data-driven decisions.

Data as a Service and The Internet of Energy

Open data platforms and providing "data as a service" allow for more collaboration with the private sector. Data as a Service (DaaS) is an information provision and distribution model in which data files (including text, images, sounds, and videos) are made available to customers or the community over the Internet. [8]

In the energy and buildings sectors, smart technology and data management allow for a more integrated, intelligent, and resilient grid which can support more distributed, renewable energy resources. Zero net energy buildings produce as much energy as they consume. As our cities and buildings are increasingly connected to ICT, buildings can self-report on energy use, and the distributed energy resources on buildings become active participants in what's called the Internet of Energy.

Internet of Energy is the dynamic network infrastructure based on standard and interoperable communication protocols that interconnect the energy network with the Internet allowing units of energy (locally generated, stored, and forwarded) to be dispatched when and where it is needed. The related data follows the energy flows, thus implementing the necessary information exchange together with the energy transfer. [9]

PowerMatching city in Groningen, Netherlands, is the first deployed example of a working smart microgrid, developed by DNV GL. A total of 40 households are connected to an automated smart grid that matches the demand for power to fluctuating supply, and uses connections to smart appliances and electric vehicles in the system to deliver power as efficiently as possible. Houses in the system are outfitted with solar panels and wind turbines, and all power resources are shared within the system.

The advancement of the Internet of Energy enables the automation of demand response and sharing of distributed energy in a community. In this way, energy data and other sensors keep a finger on the real-time pulse of our cities. The collective vision for future smart cities' buildings and energy is showing up as an automated local energy market that can exchange energy, along with information on the energy source and cost, as well as enable trust between the participating members, thereby maximizing utilization of local energy assets.

8 http://searchcloudapplications.techtarget.com/definition/data-as-a-service
9 http://www.artemis-ioe.eu

CONCLUSION

Creating smart, sustainable infrastructure requires cities to partner and work with the private sector (as well as academia and the community) and to have systems and processes in place internally that will facilitate the most seamless interactions possible. Through experimenting with different types of arrangements as described in this vendor engagement framework, more cities will be able to create, test, and iterate new technologies and uses of data to advance sustainability and innovation.

Although cities do not typically have the internal capacity or technical expertise to develop cutting edge technology services, they are tasked with identifying innovative ways to use ICT to improve quality of life and efficiency in urban operations and services, while ensuring that the city is meeting the economic, social, and environmental needs of present and future generations. Partnerships with the private sector, along with innovative engagement and financing mechanisms, can maintain steady progress towards a smart, sustainable future.

To best facilitate progress, cities need to ensure that open and frequent communication exists across city departments and agencies so that challenges and solutions can be shared and built upon. As evident in many of the highlighted case studies, the urban challenges that need to be solved are more clearly identified and solutions are easier to design when multiple perspectives join together.

Creating a smart, sustainable city requires fostering a culture that is open to innovative solutions and new processes. Establishing cross-sectoral working groups of local experts in the public and private sector and academia can lead to tangible and meaningful implementation of city sustainability plans. Smart, sustainable cities will ultimately be advanced through solutions oriented partnerships and data driven solutions.

APPENDIX

APPENDIX A: Technical Criteria

The foundation of smart cities is based on new data platforms. Below are recommendations for questions to explore with new vendors.

CRITERIA	DESCRIPTION
Interoperability	■ Will new technology successfully integrate with existing systems/ technology? ■ How will multiple technologies be bundled to limit barriers to successful communication across devices? ■ How seamlessly will procured technology integrate with future technologies + planned projects? ■ Can the technology be scaled up to either accommodate increased demand for its current task or to handle additional tasks?
Support services	■ Is ongoing IT support bundled into the contract for the technology? ■ In what format and at what frequency will vendor support be delivered? ■ Will our internal workforce be adequately trained by the vendor to operate/manage the technology?
City governance	■ What internal departments/individuals within a city are typically responsible for ongoing management of this technology? ■ Does the current city governance structure align well with the governance structure needed to successfully manage this technology? ■ What support services does the vendor provide to assist the city in ongoing management of the technology?
User trust and adoption	■ How heavily does this technology rely on user trust and adoption among internal stakeholders? ■ Can elements of this technology be fully automated to limit the amount of user adoption required? ■ How will network stability and data privacy

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SAFER, SMARTER, GREENER

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