

Smart Cities & Communities

*Dentons Global Smart Cities
& Communities Think Tank,
Fall 2019*

Note from the Editors

The Dentons Smart Cities & Communities Think Tank celebrated its second full-year of activity this summer with a Global Smart Cities & Communities Summit in Washington DC. More than 250 thought leaders from around the world convened for two and a half days to discuss trends and best practices as our communities grapple with tremendous shifts in population centers, politics and governance, with rapid changes in technology and disruptions impacting process and attitudes regarding change, leadership, risk, delivery of services, sustainability, lifestyle demands, and social justice.

The enormity of how to manage and adapt to all of the changes and disruptions is daunting. Massive urbanization is underway. The United Nations reports that there are 7.3 billion people living in cities and surrounding communities today, and that number is projected to rise to nearly 10 billion by 2050. This, along with climate and sustainability imperatives and ever increasing strain on limited resources means that communities need to scale up solutions across physical, digital and social infrastructure, devise creative approaches to the looming challenges, and convene community leaders to provide critical thought leadership on means to achieve those objectives.

Cities and communities are rising to the challenge as population centers for the regional exchange of ideas and innovation. Solutions will vary. There is no one-size-fits-all answer to the challenges presented by advances in technology and impacts from the implementation of innovation. Responses to the needs of cities and communities vary by region and must be tailored to solutions that are oftentimes community-specific based on factors unique to the communities seeking to adopt them. The best outcomes will be facilitated by technology, not driven by it. Cities and communities are first and foremost about people. The human and cultural aspect of modernization is vitally important. Social infrastructure must be given far more attention than it has been given if we are to address equity, access, and importantly, build the confidence and earn the social license at all levels essential to a “smarter” city or community. Privacy, engagement, accountability and follow-up are all inextricably linked.

With a global thought-leader membership of nearly 300, the Dentons Smart Cities and Communities Think Tank looks forward to grappling with the issues facing communities and their inhabitants. Over the past year, we have examined a broad range of issues, including development of a Smart Master Plan, deployment of 5G technologies, securing a smart future, smart healthcare and smart transportation options. We have learned about successes and challenges from representatives of cities and governmental authorities around the country, and around the globe. The coming year will include discussions of forging a path to modernize the grid, funding and financing infrastructure modernization, as well as issues touching on equity, access and affordability in our cities and communities. Managing adaptation and change will be key considerations in the adoption of these new technologies and realizing on the promise that implementing them can offer. This second collection of articles penned by our members includes reflections on topics we hope our readers will find timely and thought-provoking. We invite our readers to reach out to the Editorial Board with ideas for future topics for exploration and analysis.

Rudy Beese and Jennifer Morrissey

Co-Editors-in-Chief

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An aerial night photograph of a complex multi-level highway interchange. The scene is illuminated by the warm orange and red lights of the city and the cool blue lights of the streetlights. Overlaid on the image is a network of glowing blue lines that connect various points across the frame, symbolizing a digital or data network. The lines are thin and translucent, creating a web-like pattern that suggests connectivity and infrastructure.

Smart Cities and Communities: Infrastructure modernization facilitated by technology in an era of rapid urbanization

by Clint Vince and Jennifer Morrissey

Recently in the media there have been a number of articles decrying smart cities as a technology-for-technology's sake play. These observers appear to argue that the incorporation of technology into city systems is necessarily in conflict with priorities important to most city leaders and residents such as public spaces, parks, education and opportunity. We would urge a completely different perspective on smart cities, starting with a much broader definition of what a smart city and smart community could mean. The essential crux of a "smart" city or community is the modernization of digital, physical and social infrastructure by harnessing advanced technologies and integrating and connecting the delivery of all essential city services for the benefit of the entire community.

It is with this broader definition in mind that our law firm created a Global Smart Cities & Communities Think Tank, with participation by nearly 300 thought leaders from around the world all grappling with issues associated with the confluence of the ever-accelerating pace of technological development, rapid urbanization and an urgent need to modernize essential infrastructure and delivery of services in cities and communities across the planet.

With the extraordinary urban migration presently underway, cities and communities must scale up and modernize their infrastructure at an unprecedented pace. This includes not just the physical structures, but digital and, importantly, community social infrastructure as well. To accomplish this in a secure, fair and cost-effective manner, government officials, policy makers and city and community leaders need to create a new paradigm. It is not about the latest technological gadget, but rather about modernizing the electrical grid as the critical backbone system, and incorporating advanced telecommunications and transportation networks, modern water and waste systems, buildings, public safety solutions, and so forth – all in preparation for the unprecedented growth that is coming, and in many cases, already occurring.

All of this must be done in a secure manner, with protections against cyber and physical intrusions as well as turbulent weather and climate change impacts. One challenge will certainly be mitigating the risk of obsolescence associated with some technologies or initiatives. However, given the scope and magnitude of the changes that are coming, this is already high on the radar of many, if not most, of the leaders working on smart cities.

The greater challenges at the moment are a lack of comprehensive decision-making, obstacles to securing adequate funding, and disparate regulatory authority regarding issues that need to be dealt with in a unified manner. Focusing first on grid modernization and advanced telecommunications and transportation offers the advantage of familiar and proven financing models that will allow a city or community to jump-start its efforts, while other aspects of a smart cities plan will require creative thinking and cooperation among entities that traditionally have operated separately.

The notion of “interconnectedness” that is fundamental to any smart city or community is broad, going far beyond sensors and apps. To this end, we agree that the focus should not be solely on technology, but on modernization of all infrastructure. Smart cities and communities are about improving the lives of the people who reside, work and play in those cities and communities. Technology, properly used, can help cities to improve the enjoyment of all of the things that communities value – including the parks, neighborhoods, public spaces and economic opportunities. And leveraging advanced technologies does not necessarily mean that everything is new. Advanced analytics allows cities and communities to find ways to integrate and improve existing systems, such as by leveraging data that can be collected or that is already being collected for other purposes, thereby helping the city or community to become far more efficient and cost-effective in delivery of services, yielding tremendous benefit for residents and also for the cities themselves, which frequently operate under constrained budgets.

Debating nomenclature is less important than the need to scale up fast. Whether one uses “smart” or “dumb” or “connected” or some other term to describe a smart city approach is less important than making sure that cities and communities are creating forward-looking paradigms to deal with the challenge of extraordinary urban migration. Technology, the internet of things, artificial intelligence, sensors, and the like will all facilitate that development. But the scope of the challenge should be the foremost concern because at the end of the day, smart cities are not only about the technology. Technology is the tool that facilitates a smart city or community. It is not the end in itself, and it is not an either/or proposition.



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The Future of the 5.9GHz Spectrum

By Todd D. Daubert and Eric J. Tanenblatt



The dream behind autonomous vehicle systems is a world where people and goods are transported very quickly and efficiently, and without the accidents, pollution or visual clutter that are inevitable when humans control each vehicle individually. In this new world, each vehicle could be optimized for its intended use, allowing us to reclaim all of the time and money we currently waste sitting in traffic or waiting for goods to arrive. The technologies needed to support autonomous vehicles are improving so quickly that this dream could soon become a reality, which is beginning to force regulators and lawmakers to consider and confront the issue of digital roadway management.

One key to facilitating connected transportation and autonomous vehicles is efficient management of the spectrum upon which the vehicles will rely, which means that regulators around the world will have to adopt, implement and, on an ongoing basis, refine the rules for how this spectrum will be assigned, used and protected from interference.

In the United States, the Federal Communication Commission (FCC) in 1999 allocated the 5.9 GHz wireless spectrum band for transportation communication traffic using dedicated short-range communication (DSRC), which facilitates both vehicle-to-vehicle and vehicle-to-infrastructure communication. Since then, several automakers and a handful of state departments of transportation have outfitted vehicles and infrastructure with DSRC-based technologies. Not surprisingly, technology has improved significantly since then, leading to the development of various alternatives to DSRC, the most notable being cellular vehicle-to-everything (C-V2X) communication, a unified connectivity platform designed to offer vehicles low-latency vehicle-to-vehicle (V2V), vehicle-to-roadside infrastructure (V2I) and vehicle-to-pedestrian (V2P) communication.

C-V2X offers various advantages over DSRC. For example, C-V2X does not require a large-scale deployment of roadside units as it is designed to be compatible with forthcoming 5G mobile technology. Also, unlike DSRC, C-V2X uses two separate transmission modes: one for direct communications between vehicles, between vehicles and infrastructure and between vehicles and other road users, such as pedestrians, which ideally would leverage the dedicated 5.9 GHz wireless spectrum band; and the other for network communications, which would leverage traditional mobile service networks to enable vehicles to receive information about road conditions and traffic.



...a strong commitment
to DSRC from the
FCC would incentivize
near-term investment
by companies that
are currently hesitant
to invest in DSRC
technology...

Under current FCC regulations, C-V2X systems cannot use the 5.9 GHz wireless spectrum band. But the agency is considering amending its rules so that C-V2X or other technologies can be used as alternatives to DSRC. In coordination with the Departments of Commerce and Transportation, the FCC has launched a three-phase research plan to evaluate options for opening the 5.9 GHz wireless spectrum band for non-DSRC uses. Throughout the study period, stakeholders and the public will be able to express their opinion as to whether the 5.9 GHz wireless spectrum band should remain allocated solely for DSRC, be preserved solely for additional automotive technologies like C-V2X, or repurposed, in part or in full, to meet increasing demands for additional unlicensed spectrum that is unrelated to automotive technologies.

Phase I of the plan was completed in October 2018, and the FCC concluded that DSRC and non-licensed uses, such as Wi-Fi, are safely able to share the 5.9 GHz wireless spectrum band—a boon to C-V2X deployment, although its conclusion also opens up the possibility that the band's repurposing could include non-automotive industries. After reviewing public comments on Phase I, the Commission, in coordination with the Department of Transportation (DOT) and National

Telecommunications and Information Administration (NTIA), will move onto Phases II and III, described in the public notice as follows:

- Phase II: Basic field tests with a few vehicles at a DOT facility. The Phase II tests will determine whether the techniques to avoid interference that were evaluated in Phase I's lab tests are effective in the field.
- Phase III: Tests in "real-world" scenarios, with many vehicles, more test devices, and at a suitable facility.

The timetable for completion of Phases II and III has not yet been announced, but that is not stopping key stakeholders from making their preferences known.

To date, opinions on how the 5.9 GHz wireless spectrum band rules should be amended vary significantly. Several auto manufacturers, hardware developers and state departments of transportation that are heavily invested in DSRC are, not surprisingly, advocating for maintaining the status quo. They argue that DSRC technology is both immediately available and has been validated as a means of reducing congestion and traffic fatalities. They also point out that a strong commitment to DSRC from the FCC would incentivize near-term investment by companies that are currently hesitant to invest in DSRC technology due to fear that it may be rendered obsolete by changes to the FCC's regulations. The Alliance of Automobile Manufacturers is urging the FCC not to reallocate the 5.9 GHz wireless spectrum band, in full or part, to non-automotive uses, arguing that it could undermine transportation systems.



Once the US concludes its three-phase examination, a domestic spectrum solution will come into focus.

Not all auto manufacturers are on the same page. A coalition of automakers, device manufacturers and telecom operators that goes by the name “5GAA” vigorously support a fast rollout of C-V2X. Joining the 5GAA in its call for reallocating the band is Citizens Against Government Waste, a nonpartisan, nonprofit think tank on a mission to reduce government mismanagement. CAGW argues that the current restrictions on the 5.9 GHz wireless spectrum band are anticompetitive and stifle the growth and market viability of more effective 5G compatible technology. Although the positions of the various stakeholders are unlikely to change significantly throughout the next two phases of the research plan, the findings of record may end up supporting one of the positions.

Importantly, the US is not the only country debating C-V2X vs. DSRC. The EU and China are both mulling over their automotive communications policies. At present, Europe is leaning towards DSRC while China seems to prefer C-V2X. For auto manufacturers, international regulatory disunion is disconcerting. In an industry dependent on international trade, manufacturers desperately want to avoid varying legal requirements and government preferences that could render their vehicle’s technology, useless. Once the US concludes its three-phase examination, a domestic spectrum solution will come into focus. While international consensus is from inevitable, it’s a battle worth fighting because clear decisions from major markets could influence stakeholders’ decisions in other regions. And if not, the history of wireless mobile services has demonstrated that technology will adapt to accommodate conflicting preferences by different regions.

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IN FOCUS

Paramatta, Australia

Collaboration and accountable, representative governance is key to success

Paramatta, the oldest inland European settlement in Australia, is taking great strides toward becoming the continent's leading smart city. The city council adopted a smart masterplan nearly five years ago, an early example of this key element of a successful smart city. Recognizing that the city government cannot achieve its smart city objectives alone, has engaged in extensive community outreach since then to ensure that

the Smart City plan reflects what inhabitants need and want. An annual Smart City Smart People report is prepared to guide future planning and to keep a finger on the pulse of public perception of the city's progress and capacity to transform itself. The ultimate goals include good urban planning, transparent governance, open data and enabling technologies in order to create a city that is vibrant, people-centric, connected and economically prosperous. Smart City leaders recognize that there is a very broad and diverse range of needs, and a large number of infrastructures, technologies and approaches that may be used or required to

meet those needs. Any decisions will require a "holistic" analysis to evaluate the impacts of a proposed smart city project not only on the immediate goal but also of its interplay with other projects. Among some of the key tenets of Paramatta's Smart City Masterplan are open data, accountable, independent and representative Smart City governance, global standards for benchmarking progress, community wifi, digital wayfinding and online services, but the list also includes community learning centers, digital art and crowdfunding for some projects, giving the inhabitants a greater voice and stake in the smart infrastructure.



IN FOCUS

Smart City Challenge Grants in Canada—Smart, Outside-the-Box Applications

Both the US and Canada have offered Smart City Challenge Grants over the past few years to fund a handful of Smart City pilot projects. In the US, the program was sponsored by the Department of Transportation, and was open to mid-sized cities to develop ideas for an integrated, first-of-its-kind smart transportation system that would use data, applications, and technology to help people and goods move more quickly, cheaply, and efficiently. A separate program overseen by a private organization has provided “smart cities readiness” grants to a number of cities and regions to support projects focusing on video analytics, community Wi-Fi, and fiber-optic connectivity, among others, that will help to foster collaboration, coordination and cost-efficiencies within the winning cities and regions. The idea behind

all of these projects is to take the successes and best practices that are developed and to apply and adapt them to other communities throughout the country.

Canada has taken a different approach to its Smart Cities initiative. The winners of its Smart City Challenge Grants include large metropolitan areas, small towns and indigenous communities. Most of the winning projects are surprising at first glance, with only one traditional “smart city” proposal; but all of the winners highlight (1) the intersection between technology and the goal of improving the lives of the people who inhabit a city or community, and (2) the essential role of the community social component of infrastructure modernization. The City of Montreal put forth the most traditional project of the winners, with a proposal to improve mobility, but it also includes a focus on access to food as a goal of the project. Also focused on access to food, the City of Guelph and Wellington County, Ontario

will be funding implementation of a proposal to create a circular food economy, leveraging digital tools to increase the availability of nutritious food and reduce waste. The Town of Bridgewater, Nova Scotia will use its funds to create a program to reduce energy poverty. Advanced home energy monitoring systems will be installed in low-income homes, which make up nearly 40% of the community. Finally, the most outside-the-box winning proposal was the Nunavut Communities, with a proposal to use technology to develop a life promotion approach to suicide prevention and to foster interconnectedness to address the extreme isolation that communities in that region of the country experience. In addition to digital health and wellness, the funds will be used to create public gathering spaces including STEAM-based activities, arts, culture and languages and interactions with older community members.



The background of the entire page is a dark blue architectural wireframe of a tall skyscraper, likely the Key Tower in Youngstown, Ohio. The wireframe is composed of numerous thin, light blue lines that form the structural grid of the building, including floors, columns, and internal bracing. The building is shown from a low-angle perspective, making it appear to rise steeply towards the top of the frame. In the upper left corner, there are faint, light blue technical drawing elements, including a compass rose indicating a 30-degree angle and various dimension lines with numbers like 12, 13, 92.5, and 185. The overall aesthetic is technical and modern.

Youngstown, Ohio: Smart revitalization in an era of deindustrialization

By Barbara Altman

I saw through the eyes of a child the potential impact of technology on humanity, for better or for worse. One day I read the story of John Henry to a third-grade class. At the end of the story, the powerful, proud, and industrious “steel-driving” John Henry won his race against the steam-powered rock-drilling machine, but died from the stress of his effort. As I closed the book, one little boy burst into tears and remained inconsolable until I offered to help him re-write the ending.

We did so to his satisfaction. In his version of events, the advent of the newfangled machine didn’t kill John Henry or diminish his stature, but rather provided him a healthy challenge and some relief. The proud John Henry got to live and die on his own—human—terms.

The potential impact of smart technology and smart cities and communities, both positive and negative, is limited only by our imaginations. With thoughtful leadership, these advances can help protect the planet, improve human health and wellbeing, and help turnaround struggling cities and communities. And inclusive training opportunities can help provide access to jobs that are safer and more equitable and productive than those of the past.

Without thoughtful leadership and proper management, the very real fear exists that technology can get ahead of us and negatively impact our social fabric, livelihoods, and dignity. Taken to extreme, one only need see the latest dystopian sci-fi movie. On a more human scale, headlines, such as this one from the Boston Globe, illustrate these concerns: “Why robots, not trade, are behind so many factory job losses.”

<https://www.bostonglobe.com/business/2016/11/02/why-robots-not-trade-are-behind-many-factory-job-losses/bfg4Wo9hpr4A5Yc5c81GtM/story.html>

I’m from the former steel-producing town of Youngstown, Ohio, located in Mahoning Valley (“Steel Valley”), which has experienced the impact of industrialization almost since its inception, and deindustrialization since the 1970s. According to the Ohio Steel Council, the area’s “iron and steelmaking roots go back to 1802, the same year the state was admitted to the Union.” [sic] <http://www.ohiosteel.org/ohio-steel-industry/history/>

A once thriving region that attracted immigrants from all over the world to grueling jobs in the steel mills and a shot at the middle class, Youngstown was recently reported to have the highest unemployment rate of cities of its size in Ohio, a state that itself has unemployment rates above the national average. And that was before the devastating closures of the GM Lordstown plant, followed by Falcon Transport trucking company and other ancillary businesses. <http://www.wfmj.com/story/39516247/new-data-says-youngstown-has-worst-unemployment-rate-in-the-state>

Youngstown’s grand past and future potential survives, however, in its architecture, American art museum, playhouse, sports arenas and continuing sports prowess, symphony orchestra and performing arts venues, beautiful 2,658 acre park established in 1891, vibrant library system and popular university. It is centrally located between Cleveland and Pittsburgh, the east coast and Chicago, and sits on the Mahoning River, as well as Interstate 80. It continues to



The potential impact of smart technology and smart cities and communities, both positive and negative, is limited only by our imaginations.

attract the interest of entrepreneurs and venture capitalists, and houses the highly acclaimed Youngstown Business Incubator. Its size and tight urban core contributed to its being chosen last year to receive a \$10.85 million transportation grant from the federal government, potentially to include autonomous transit shuttles.

Youngstown's diverse workforce base, many of whom are highly skilled, experienced, and laid off, should add to opportunities for commerce and innovation. Missing, however, is the kind of training that allows eligible workers to fill the jobs of the future. In order for the Youngstown area's laid off, unemployed and underemployed workers to stay local and avoid falling prey to the area's grim statistics on poverty, depression, suicide, violence and addiction, they need in-demand skills training that will allow the offspring of those who spent their lives working in or around the mills to have living wage jobs and prospects for professional and socio-economic growth and satisfaction.

While so many are willing to take any job, and indeed may be working two and three minimum wage jobs to gain less than they once did, smart technology provides the opportunity for jobs that can and should be better and safer than those of the past.

When my brother started his summer job as a hotballer then a slagger at US Steel, the foreman told him "after you finish this job you won't be afraid of Hell, because it can't be any hotter down there."

Indeed, he performed his work wearing three layers of clothing and a helmet under an asbestos suit and hood on a walkway made of subway grating suspended 30' above a ladle of molten steel at over 2500 degrees. The only thing guarding him from the molten steel below was a thin handrail about 3 feet above the walkway on which he worked. He said his ears rang from the heat, he chewed on salt gummies throughout his shift to avoid heatstroke, and that at the end of the day his face and hands were covered in black soot. Another brother told me that for hours after he got home each day from his summer job at an aluminum factory he would cough up black stuff from his lungs.

With the advent of smart technology, workers should not have to choose between their health and employment. Industries using new technologies can deliver goods and services, decent jobs, and sustainability. Additive manufacturing is the kind of future-looking work that is a natural fit for an industrial town like Youngstown, and has already taken hold to some degree. Indeed, a March 7th CNN article refers to Youngstown as "the Silicon Valley of 3D printing," which should be promising, given that the industry market size has been estimated to grow from \$1.5 billion in 2019 to \$8.7 billion by 2027. <https://www.marketsandmarkets.com/PressReleases/3d-printing-materials.asp>



Having been a part of, and a witness to, the inspiring stories of program participants and graduates, I am motivated to create these opportunities in my hometown of Youngstown.

In addition to being an up and coming industry, additive manufacturing has the potential to help address one of our great national and global crises—that of recycling the millions of tons of plastic that are ending up in our oceans and ecosystem, even in the salt on our tables. This prospect is especially timely now that China is no longer accepting our waste for recycling.

The vital missing link between the residents in need of work, on the one hand, and future-oriented, promising job openings on the other, is similar to the one that caused a friend and me to come up with the idea of providing IT training for unemployed and underemployed DC area residents some twenty years ago. My friend, Glenn Stein, was a self-taught IT professional who found a lot of doors open to him. Short-term, high impact training could help employers find the employees they needed, and could provide access to those in need of living wage jobs.

We started with one class at a homeless shelter. Recently Glenn and I reunited with three of the six original students in the advanced cohort, all three of whom continue to work as IT professionals. These many years later that initiative, Byte Back, continues to help hundreds of students a year gain in-demand skills, obtain Microsoft and CompTIA certifications, and launch careers. After receiving a \$775K grant to scale, this year Byte Back has expanded to Baltimore. Having been a part of, and a witness to, the inspiring stories of program participants and graduates, I am motivated to create these opportunities in my hometown of Youngstown.

Good will and partnerships are at the ready. The Public Library of Youngstown and Mahoning County, with 15 area branches, has six employees ready to be trained to teach certification courses, and Glenn Stein is ready to train them. A wide array of leaders and community members in the Youngstown area, as well as the current Byte Back leadership, and former and current students, volunteers, employees, and board members have all made themselves available to support the effort.

The next step is to engage the smart city and community leadership and the business community in guiding the advanced training for eligible participants and employing our graduates. By teaming with the Youngstown workforce in need of new opportunities, the venture capitalists interested in connecting with the Midwest, and the businesses and entrepreneurs looking for trained and proven employees, we can do our part to help provide people with living wage jobs that don't endanger their health and help a once thriving area prosper again in the era of smart cities and smart communities.

Together we can re-write the ending.

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To learn more, see: <https://byteback.org/about/history-mission/>



Exploring Smart City & Community Opportunities in Ghana

By Ronke Luke



Recognizing the difficulty collecting on current debts or obtaining regulatory approval for a cost-reflective electric tariff, Ghana's electric transmission company, GRIDCo has pursued a strategy over the past two years to achieve financial stability while redefining its role as a provider of services.

GRIDCo is a private limited liability company with over 5000 circuit kilometers of high voltage transmission lines connecting generating plants to 60 bulk supply points across the country. With over 4000MW of installed capacity, Ghana has over capacity, an unusual situation for an African country. Yet, like many power sector companies in Africa, GRIDCo is financially unstable, plagued by late payments from customers and tariffs that are not cost-reflective.

GRIDCo also has 3,000 KM of fiber optical ground wire installed alongside its transmission wires. In early 2017, the company launched a wholly-owned subsidiary, GRIDTel. GRIDTel has obtained a license to operate a National Terrestrial Fibre Network to provide services to Ghana's telecommunications sector. GRIDTel is positioning itself as a "carrier of carriers" allowing telecom firms to lease its fiber network infrastructure to provide their services across the country.

The advantage for Ghana's current telecom companies is two-fold. Without significant upfront investment in infrastructure, they can: 1) extend their networks to currently underserved parts of the country, and 2) improve the quality of their spotty, unreliable service in parts of the country (including the capital and major cities) they already serve. Prospective telecom companies can enter the market without the burden of infrastructure costs and focus on services. GRIDCo believes that revenue from GRIDTel will be an important offset for the shortfalls realized from its transmission tariffs.

It is unusual in Africa to have a country with excess installed electric capacity and a transmission utility with a robust fiber optic network actively seeking to monetize this asset in a bid to stabilize its finances and shore up the power sector. This situation represents a tremendous opportunity for Ghana to propel itself into a leadership position for smart infrastructure on the continent. With the key backbone system already in place to support advanced networks, the Ghanaian government has come to realize that monetizing its fiber optic network would be beneficial to rather than a distraction from its core obligations in the energy sector, and the State Enterprises Commission (SEC) now seems to recognize the potential that GridCo is offering for Ghana's socio-economic development. Among other things, the SEC Executive Chairman has urged GRIDTel to support e-Learning. In Ghana, there is a disparity in education (access and services) between the north and wealthier south. Within this context, in Ghana, improving education across the country using GRIDTel's fiber optic network is an obvious immediate "smart city/smart community" initiative, but there are many other opportunities that would be mutually-beneficial to GRIDTel, businesses and Ghanaian consumers. Potential sectors worth examining include education, health, transportation, and computing. GRIDTel itself is unlikely to own or launch businesses in all these sectors, but it is ideally situated to play an active role in marketing, exploring, and socializing the digital infrastructure that exists and to help develop an information/communication technology-based economy.



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IN FOCUS

Warsaw, Poland

Warsaw is looking at many of the same initiatives and technologies that are being examined and deployed in cities across Europe to enhance sustainability and improve city services and quality of life. Looking at what is being done elsewhere allows the city to benefit from lessons learned across the region. One area where Warsaw is ahead of the curve, however, is in the area of community social engagement. According to Michal Olszewski, Deputy Mayor of Warsaw, the development of a city is smart when people come first: “The inhabitants come first in Warsaw, and each technical advancement is aimed at improving the quality and convenience of their lives. We are using technology to cooperate

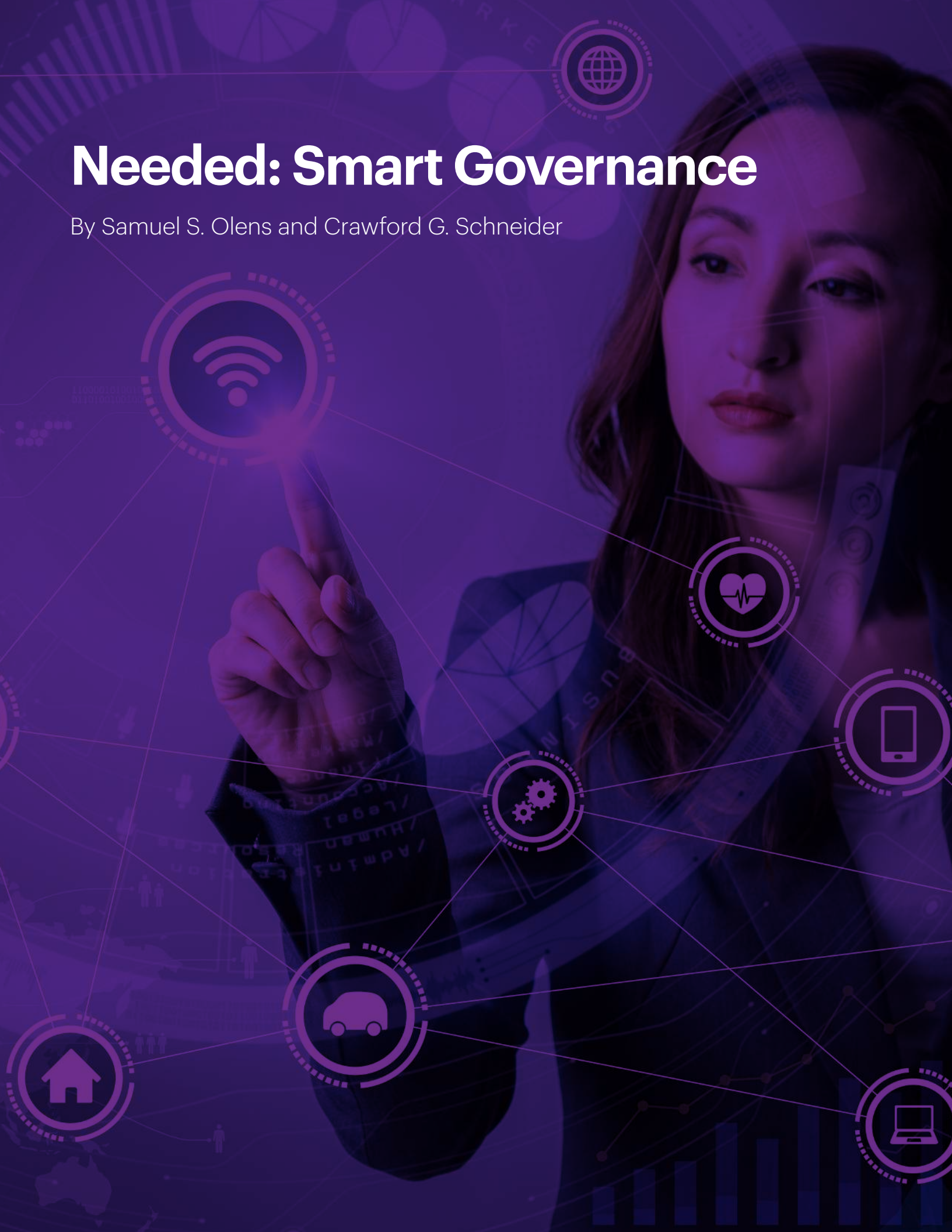
with inhabitants who might have an influence on such important issues as public transport, air quality, green spaces or the city budget. The city develops in a smart way when its residents are well-informed and can contribute to the city’s management, where they can live and have the opportunity to explore their ideas. In the last couple of years, Warsaw has been developing dynamically and a number of initiatives have been implemented in cooperation with the city’s residents. These include the participation budget and local projects to improve the quality of local infrastructure and respond to specific needs. It is also important to build trust between local government and residents, who feel like hosts for the place in which they live. The Smart City is not just a well-designed urban system; it is primarily about

satisfied city inhabitants.” Warsaw has been very entrepreneurial not only in communicating with inhabitants, but in giving them a clear stake in outcomes, and in so doing, earning their trust and support. The “participation budget” is one example. Approximately 1% of the city budget is set aside for projects that the inhabitants themselves propose and select. These projects might include green spaces and parks, cultural events, social and economic initiatives, and so forth. Not only does it lead to visible results; the process has helped to enhance voter participation overall; it has created a forum where citizens can engage with city leaders on issues of importance to them; and it has given inhabitants ownership of the development of their city.



Needed: Smart Governance

By Samuel S. Olens and Crawford G. Schneider



The minds of entrepreneurs, technologists and new wave urbanists are consumed with the future of “Smart Cities”. However, too often, visions of Smart Cities are disassociated from the citizens themselves. That said, it is indisputable that modernizing the digital, physical and social infrastructure of a community can result in widespread social benefits for citizens, and with the sophistication of emerging technologies it would be unwise not to explore new mechanisms for providing public services.

However, the pursuit of a Smart City should not conflict with Smart Governance. Before investing in the newest technology, local governments must first consider the tangible benefits to their residents. To do so, governments must distinguish between wants and needs. Governmental priorities, commonly referred to as needs, should not be altered. All citizens need quality education, mobility, access to health care, utilities and a sense of safety. These fundamental priorities are, in and of themselves, costly and complex and as such, robust examination of Smart City solutions is necessary to ensure they directly address a demonstrated need and work to solve governments’ core complexities. Wants, which may be a function of a limited number of highly motivated citizens, should optimally be satisfied by the private sector, whereas needs, the primary function of a responsible government, should be addressed by elected officials or their designees.

In addition to internal cost-benefit analyses, governments must explain the intended purpose of newly deployed technologies to the citizenry. Civic involvement is essential before any effort is undertaken that will, as technology often does, fundamentally alter citizens’ lives.

The best technology and communications systems are meaningless without the support and buy-in of residents and businesses. Without an all-encompassing focus on the community’s needs, solutions may be misguided. For example, investments in autonomous public transit will prove useless without consumer trust. At present, according to polls conducted in 2018, over 60 percent of Americans are wary of autonomous vehicles, yet the technology largely dominates public discourse on transportation. There is no doubt autonomy will have massive benefits. However, from a governance perspective, before investing public monies in a nascent technology, the use must be explained and demonstrated through pilots and public awareness programs.

Smart technologies are frequently dependent upon data sharing and insight into consumer behavior. This may be viewed as intrusive and unnecessary unless the government is able to identify and articulate (1) ways in which the technology benefits citizen lives, and (2) how sensitive data will be protected. Without adequate public discourse, even predictive crime technologies, gunshot sensors and policy trackers can be seen as intrusions by “big brother” rather than prudent public safety investments. Moreover, deployment of 5G infrastructure, which is the essential platform for many new smart technologies, may greatly increase



By engaging in productive conversations with all stakeholders, governments will make smarter investment decisions and products will enter the market with less the fear of regulatory or consumer backlash.

the efficiency of government services by providing predictive analytical capabilities, but the need, cost-benefit analysis and comparative applications must be considered and explained prior to government investment.

Adequate public discourse requires more than simply holding a town-hall where citizens are invited to voice their opinions for an hour or so. Listening to citizens, while of primary importance, is not in and of itself sufficient. Elected and appointed officials have a vital role serving as a convener. Smart solutions demand intra-government, inter-government and public-private collaboration. Cooperation between all three tiers is required to bring about success. Too often, private sector innovators assume that technological benefits are self-explanatory. They are deep in the weeds of the technologies they develop on a daily basis, and thus may forget to explain, in layman's terms, why and how their product improves lives. Similarly, governments are sometimes prone to "kneejerk" regulation when a new mode of transport or a novel health care service or other proposed change to city operations doesn't neatly fit into a 10- or 15-year strategic plan. By engaging in productive conversations with all stakeholders, governments will make smarter investment decisions and products will enter the market with less the fear of regulatory or consumer backlash.

There is an important balancing act that governments must strike in allocating financial resources and municipal assets to improve city operations for the benefit of its constituents. Inclusive, collaborative engagement with technologists, government agencies and departments, and stakeholders in the community who will be affected by proposed technologies will help keep people, governments and businesses moving in the same positive direction, and will ensure that scarce financial resources are allocated appropriately.

A smart city is the result and an end, not an effort or goal.

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IN FOCUS

Busan, Korea Smart City by 2021

The Presidential Committee on the Fourth Industrial Revolution and the Ministry of Land, Infrastructure and Transport in Korea has set in motion a plan to make Busan one of two initial smart cities in Korea -- and it is to be done by 2021! It will be a technology hub, with products and services paid for in a cryptocurrency secured by blockchain, goods delivered and traffic and public safety monitored by drones. The city is planned as environmentally friendly and

centered around water-based technology. Waterfront buildings will be constructed along the city canal. Smart water management technology will be introduced, with the entire water supply process managed through smart systems. There are a number of regulatory challenges, as many of the plans will require revisions to established laws. For example, at present, drones are permitted to fly only within sight of their pilots and autonomous vehicles are not allowed on roads. To address the many changes that will need to be implemented, the government is taking an approach it characterizes

as a "regulatory sandbox" to permit, temporarily, technology and services that are otherwise prohibited. The government will also have to overcome skepticism that impacts investment. Investors are unlikely to participate unless there is regulatory certainty that changes in the laws will be lasting. Market confidence may also need to be bolstered. In an era of rapid technological development, many entrepreneurs are unsure whether the government-led process, as opposed to a more collaborative process, is the right approach.



New Cities, New Opportunities

By Erick Brimen

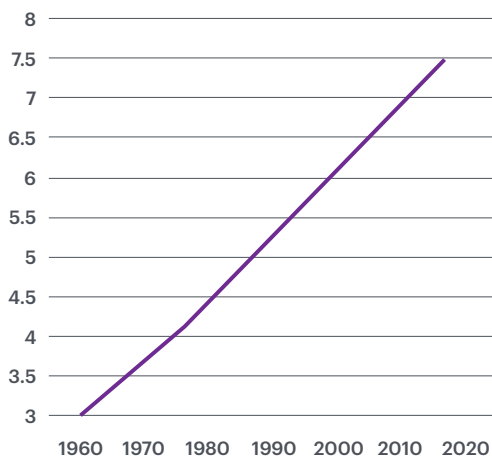


As the world's urban populations grow, demand for expanding urban centers and new cities grow with it. As existing cities struggle to meet the needs of swelling populations, new, emergent city centers have an unparalleled opportunity to flourish. Depending on location and structure, they can provide unparalleled opportunities for economic prosperity and growth, they can empower citizens and enhance daily municipal operations.

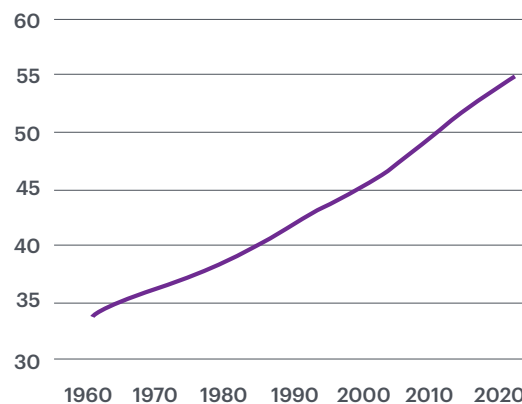
GROWING DEMAND FOR CITIES AND URBAN INNOVATION

Converging demographic trends are driving the demand for new cities: a rapidly growing world population and simultaneous urbanization of that increased population. Data from the World Bank indicates this trend will continue.¹

WORLD POPULATION



WORLD URBAN POPULATION
(% of total population)



Over the last five decades, the world population has more than doubled, while the percentage of people living in urban areas has increased by over 60%. As a result, many existing cities are straining to meet the needs of their residents, and new cities are being built to meet the excess demand.

¹ <https://data.worldbank.org/indicator/SP.POP.TOTL?page=1>



A smart city is the result and an end, not an effort or goal.

One reason populations are settling more and more in urban areas is the economic opportunity that they represent. Some economists estimate that the “urban wage premium”—that is, the higher earning potential individuals can gain from simply moving out of rural areas and into opportunity-rich urban centers—is as high as 19%.² This allure of economic opportunity and prosperity is creating a massive influx of urban dwellers.

At the same time, construction of new housing in many existing cities has slowed and the existing stock is increasingly constrained. For example, in San Francisco, for every eight new jobs that have been added to the economy, only one new housing unit is added. This has caused prices to skyrocket while pushing the urban sprawl of that city far outward from the city center. Similar stories are playing out around the world as urban populations swell faster than existing cities can keep up.

One solution is the development of greenfield city-scale projects. And as cities seek to modernize and become “smarter,” new cities have an opportunity that legacy cities do not: the ability to leverage a clean slate. Similarly, brownfield projects, where entire neighborhoods or segments of a city are razed and rebuilt almost from the ground up, offer tremendous opportunities to incorporate smart infrastructure. Starting from scratch can accelerate innovation and more rapidly modernize governance and operational models.³ This is especially true in the developing world, where populations are increasing exponentially faster than in more developed regions.

LEGACY CITIES: CHALLENGES TO IMPLEMENTING INNOVATION

Legacy cities face a host of structural and institutional challenges when seeking to modernize in order to adapt to the needs of increasing populations. Aging city infrastructure must be updated, but it can be complicated and expensive to integrate new smart city technologies with legacy systems. Established cities have cultural and political histories that must be considered along with the physical infrastructure in any modernization project. Between cost and the often powerful conscious and unconscious bias against change, whether from city leadership, residents or interest groups, it can be particularly challenging to introduce significant evolutionary change, let alone implementation of radical innovations. Beneficial technological improvements may also require changes in basic governance structures, which may be challenging both by a reluctance to increase taxes to pay for infrastructure as well as aggressive interest group participation in municipal development projects, often opposing changes even if they ultimately represent an improvement on the status quo.

² Yankow, Jeffrey, “Why do cities pay more? An empirical examination of some competing theories of the urban wage premium,” *Journal of Urban Economics*, Volume 60, Issue 2, September 2006, Pages 139-16, <https://www.sciencedirect.com/science/article/pii/S0094119006000246>

³ <https://sf.curbed.com/2017/7/26/16040938/san-francisco-jobs-housing-ratio-homes>

NEW CITIES: HUBS OF PROSPERITY

New or greenfield cities have the benefit of a “clean slate” from which to start, and can quickly become “hubs” of economic activity and prosperity for residents and businesses. Often, these new urban centers build upon the Special Economic Zone (“SEZ”) model. A SEZ is a development concept where special rules are established in order to encourage investment and job creation. These zones may enjoy tax treatment, trade rules, labor regulations, or financial policies that differ from the rest of the country or state where it is located. The model has been very successful in some parts of China (e.g., Shenzhen) and the Middle East (e.g., Dubai) and is catching on in other regions of the globe.

Taking the SEZ model further, a “Prosperity Hub” model can be applied to deliver a more holistic approach. Rather than tinkering on the edges of governance, modifying only a select few regulations or taxes, as traditional SEZs do, a Prosperity Hub builds a new urban center and its operational platform from the ground up. Prosperity Hubs pay particular attention to innovation and seek to implement intelligent infrastructure deployments and operational efficiencies that will directly improve the lives, activities and well-being of residents, workers and visitors alike. The Prosperity Hub model can be deployed when public and private sector players work hand-in-hand to create an environment where essential infrastructure—including governance structures—consistently meets or exceeds the needs of its citizens. In addition to the economic benefits, a Prosperity Hub can:

- Implement smart infrastructure to make the city safer, more efficient, and more environmentally responsible by empowering city leaders and citizens to make strategically informed decisions regarding critical operations
- Institute e-Governance to put the power of the government in the hands of the people by enabling direct, actionable citizen-to-government interaction
- Empower businesses and citizens alike by putting municipal administrative and operational functions online in a transparent e-Governance platform
- Create blockchain property and business registries to facilitate swift, manageable growth in an equitable, secure and scalable manner allowing both the citizen and business populations to grow more rapidly and efficiently
- Craft custom regulatory frameworks specifically designed to enable innovation in R&D, and operations, to attract the world’s best companies, create jobs and drive global competitiveness



Prosperity Hubs pay particular attention to innovation and seek to implement intelligent infrastructure deployments and operational efficiencies that will directly improve the lives, activities and well-being of residents, workers and visitors alike.

- Implement broad and equitable social impact programming to ensure all members of society benefit from the growth, stability and operational efficiency of the city

A Prosperity Hub provides a better, more productive and inclusive life for all, rapidly moving communities and citizens into lasting prosperity, and can avoid or overcome many of the obstacles that are present in an established city.

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A proven finance professional, team leader and serial entrepreneur, Erick is passionate about investing in life-enhancing opportunities that further human flourishing. Erick started his career in private banking, later moved to investment banking and consulting. He was the CFO of the Latin American operations for the Borealis Group. He later founded ComparaMejor.com and in 2013 started NeWay Capital LLC.

IN FOCUS

Tashkent, Uzbekistan

The Republic of Uzbekistan is taking a broad and aggressive approach to modernizing the nation's cities. This year, the Cabinet of Ministers adopted a framework for the implementation of "Smart City" technologies beginning immediately and proceeding through four phases. In the first phase, an assessment of existing infrastructure and assets in the cities will be conducted. Beginning in 2022, the government will explore financing strategies while defining a plan of action including assessment of risks and development of criteria to assess the success of the program as it is implemented. Then, in 2025,

much more detailed planning and efficiency forecasting will take place, as well as deployment of modernized information systems. Finally, from 2028 through 2030 the country plans to move forward with Implementing the technologies and evaluating overall effectiveness. The programs will cover transportation, education, healthcare, grid modernization, water & sewage systems, housing and utility systems.

One of the key focuses of the Uzbekistan government will be measures to ensure that information, communications technologies and infrastructure do not become obsolete, particularly given the rapid pace of change in the world today. The framework also envisages a significant role

for business in tackling social problems through public-private partnerships.

In the capitol city of Tashkent, a number of pilot projects are already underway to address safety, transport and healthcare. Additionally, there are efforts to introducing modern infrastructure, which has its own challenges when overlaid on a place rich with history and structures that date back thousands of years.



IN FOCUS

Parma, Italy

Under the umbrella of the European Union's Smart Cities initiative, Parma is working with five other cities under an initiative known as "Ruggedized" to combine ICT, e-mobility and energy solutions to create sustainable urban spaces. The city aims to improve the quality of life of the citizens by offering a clean, safe, attractive, inclusive and affordable living environment. Among other things, the projects involve managing energy needs and data platforms, CO2 emissions

reductions in energy production, buildings and transport, and increased renewable energy options.

Starting in November of 2017 and continuing today, Parma has convened a series of workshops with stakeholders to craft a Roadmap for a "Smart Future" for the city. Working groups within this process focus on one of four major themes: innovation and economy, people, energy-grid-environment, and transport and mobility. Parma faces challenges similar to many European cities -- an aging population, an influx of immigrants, traffic congestion, flooding and challenges associated with

modernizing infrastructure in locales that are hundreds if not thousands of years old. But it is also a center of innovation with an important engineering school (the self-driving car was conceived at the university there), and a center of culture and gastronomy attractive to residents and visitors alike. Through the roadmap development process, the working groups are presently prioritizing projects. Over the next year, they will seek to create partnerships with the community to craft a concrete plan for action and investment to achieve the smart city goals by 2030.



The background of the entire page is an abstract, high-speed photograph of water splashing. The water is captured in various stages of motion, creating dynamic, flowing shapes and droplets. The color palette is primarily shades of blue and white, with some darker blue areas where the water is deeper or in shadow. The overall effect is one of movement and fluidity.

Water Challenges in Smart Cities*

By Ann M. Bartuska and Casey Wichman,
Resources for the Future, and Matt Ries
and Tristen Townsend, DC Water

*Portions of this document were adapted from "Facing the Nation's Water Challenges: Results from Resources for the Future Roundtable Series" (RFF, March 2019).

Americans have come to expect clean, abundant fresh water for domestic consumption, irrigation, industrial needs, infrastructure and transportation systems, healthy ecosystem functions, and recreational opportunities and tourism on our rivers, streams, and lakes. As the proportion of the US population living in urban areas continues to grow, domestic and industrial demand for water will increase and compete with other uses of water. Irrigation for agriculture, for example, is one of the largest users of fresh water, both surface water and groundwater, in the United States. The availability of fresh water in the specific qualities and quantities needed by different, competing users is becoming increasingly problematic.

Concerns about water quality are urgent because agricultural and urban pollution affects water supplies for human populations and ecosystem functioning. The levels of nutrients in surface water and groundwater present a growing threat to public health and local economies, contributing to harmful algal blooms, contamination of drinking water sources, and damage to recreation, tourism, and fisheries. Emerging contaminants, including pharmaceuticals, additives in personal care products, and engineered nanoparticles, represent a largely unquantified danger to water quality. Many cities' water quality has declined because of infrastructure decay and vulnerability to severe weather and other stresses, imperiling public health for millions.

Affordability and access to safe drinking water are also a pressing equity issue. By some estimates, maintaining the current levels of service provided by water and sewer infrastructure will require more than \$1 trillion in investments over the next two decades. Most of the costs will be passed on to ratepayers, so it is imperative to understand the distributional consequences of water costs and to explore alternative policies that could alleviate financial burdens on low-income households.

The management of water resources has been complicated by droughts, floods, and other extreme weather events. Climate change and development activity are altering the quantity and availability of fresh water, affecting our water supply, and straining our aging infrastructure. Waterfront communities face threats of flooding from climate change-induced storms and unpredictable rain patterns. Communities must manage the risks to life and property by building resilience to flooding, and policies and programs must anticipate and prevent future damage.



Everyone deserves affordable access to clean and safe water, yet that is not the case in all parts of this nation.

MAJOR ISSUES FOR THE WATER SECTOR

In 2018, Resources for the Future invited stakeholders to identify the most pressing water issues facing government agencies, utilities, businesses, and nonprofits. Through informal interviews with water practitioners and five roundtables (held in Chicago, San Francisco, Denver, Houston, and Washington, DC), a short list of ideas was developed that can guide future research and management directions. Among the issues and ideas most relevant to Smart Cities are the following:

- **Fragmentation in governance, questions of scale, and benefits of utility consolidation**

Fragmentation of governance in the water sector was perhaps the most commonly cited issue. The fragmentation is both vertical, in terms of siloed approaches to management of wastewater, stormwater, and drinking water, and horizontal, in terms of geographic scale and funding that follows political rather than watershed boundaries. Stormwater runoff, for example, does not respect municipal boundaries, and the associated costs and risk management make it highly visible to local governments. According to participants, many small water agencies find it difficult to meet Safe Drinking Water Act requirements: they lack modern equipment and can't take advantage of economies of scale. Related to fragmentation is the disconnect between water and land-use development. Better long-term planning and policies that consider the relationship between urban spatial structure and landscape planning for hydrology, floodplain management, and water use are needed, as is a consideration of urban-rural connections.

- **Water access, affordability, and equity**

Everyone deserves affordable access to clean and safe water, yet that is not the case in all parts of this nation. Fragmentation of governance separates affluent users from poor communities, making it harder to set rates that are affordable and equitable. Policy analysts should assess what local governments can do to address the affordability of water while maintaining service, especially for disadvantaged communities. The financial health of water utilities—not to mention their public image—has been harmed by shutoffs, which can cost more than working with residents to keep current on water bills. It would be valuable to know the costs versus the benefits of providing a basic increment of water to everyone for free, as well as the cost to water agencies of direct installation programs (which install water-efficient pumping in homes and businesses) to reduce water loss in disadvantaged communities.

- **Benefits of distributed and green infrastructure**

More focus on green and distributed infrastructure, especially in urban environments, is needed to address water challenges at lower cost while dealing with affordability and accessibility. Distributed infrastructure (DI) refers to decentralized water management strategies and technologies—indoor water-efficient fixtures and appliances, graywater systems, and the like—deployed over many properties. Unlike conventional water infrastructure, DI is generally not owned or operated by water agencies, but it functions in concert with built infrastructure. Green infrastructure (GI) comprises strategies that protect, restore, or mimic the natural water cycle. Credible research is needed on the potential for DI and GI options to serve as effective and cost-effective water management strategies compared with more conventional approaches. Also of interest is how a shift to DI and GI can alter the economics of addressing the cost of water for disadvantaged communities. For GI, data are needed on barriers to adoption, such as undefined costs, uncertain financing mechanisms, and confidence in the long-term solution. Full consideration of the multiple benefits provided by DI and GI is also important.



- **Source watershed infrastructure (nature-based systems)**

Currently, five major municipalities have water sources of sufficiently high quality that they are not required to filter their water: New York City, Boston, Portland, Seattle, and San Francisco. Each city has recognized that it is more cost-effective to manage its source watersheds than to build downstream filtration plants. Protecting source watersheds and using natural infrastructure improve downstream water quality and quantity and provide stormwater management, flood control, and ecosystem services. Compared with traditional gray infrastructure, natural systems offer multiple benefits, including resilience to hazards like drought, flood, and wildfires. Such approaches can be a building block for smart growth and the integrated consideration of water and land uses in regional planning. Most municipalities, however, lack the data to evaluate source watershed management and assess the economic benefits of natural treatment versus engineered solutions. Articulating a business case for these investments, as well as a scenario-based model that shows costs and benefits to both the community and the watershed, could promote more widespread acceptance.

Protecting source
watersheds and using
natural infrastructure
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The American Water Works Association estimates that more than \$1 trillion must be invested in water delivery infrastructure over the next two decades to maintain current levels of operation...

BALANCING EQUITY AND CONSERVATION INCENTIVES IN WATER RATES

Across the United States, water utilities are raising water prices to meet environmental regulations and repair and invest in aging infrastructure. The American Water Works Association estimates that more than \$1 trillion must be invested in water delivery infrastructure over the next two decades to maintain current levels of operation, and that the cost of water and sewer infrastructure is rising three times faster than the rate of inflation. In the coming decades, costs of water and sewer service may exceed energy costs for the typical American household.

High water prices aren't all bad, however. Economists would emphasize the importance of covering both the costs of treating and distributing water and the costs of rising water scarcity. Consideration of scarcity suggests that the current price of water might be too low. If water cost more, individuals and business would be more likely to invest in water-saving technology and behaviors, lessening the strain on current water supplies. But according to ongoing RFF research, nearly one in seven US households already faces unaffordable water and sewer service. That creates a conundrum: how can we incentivize efficient water use without burdening lower-income Americans?

Many utilities and regulatory authorities are testing solutions to that problem. DC Water (see below) has "lifeline" rates that reduce the price of water to zero for low-income customers' first few units of consumption each month. The City of Philadelphia has adopted a rate structure in which eligible households pay a fixed proportion of their monthly income in lieu of a water bill. The California State Water Resources Control Board has proposed a statewide water rate assistance program that gives low-income households a rebate to defray the cost of water service. And many utilities across the country are adopting tiered rate structures to encourage conservation by large users while setting a low water price for low-income households. Despite the inventive ways utilities are dealing with affordability concerns, however, very little research has been done on the cost-effectiveness of the various policies.

From an economics perspective, it is extremely difficult to balance multiple objectives with a single policy instrument, in this case the water rate structure. If we want to achieve cost-effective conservation, we should price water at its long-run marginal social cost so that individuals and businesses will adjust their consumption toward the most valuable uses. If we want to address equity concerns, we should give households lump-sum rebates that do not distort their willingness to use water efficiently. If we want to raise revenue, we should account for the fact that people use less of something when its price rises. These are standard economic principles. Of course, the reality on the ground is much more complicated than textbook economics. Some state regulations dictate what municipal



Incorporating 21st-century technology into a 19th-century platform while meeting strict regulatory standards presents numerous challenges, with concomitant issues of financing and costs for users.

revenues can be used for. Small utilities in low-income areas do not have the economics of scale to cross-subsidize low-income customers. And water rates are rarely set in a way that prices scarcity.

Addressing the joint challenge of conservation and equity is a pressing issue for revenue-strapped utilities across the country. Economic theory suggests ways of designing water rates to achieve multiple objectives, and utilities' experiences with novel policies are beginning to show what might be feasible under current regulatory conditions. But the time is ripe for additional empirical analysis to quantify the effectiveness and distributional burden of utilities' policies and to develop an empirical basis for cost-effective affordability policies that do not distort conservation incentives or affect utilities' bottom line.

CASE STUDY: WASHINGTON, DC – BUILDING A SMART CITY ON OLD INFRASTRUCTURE

DC Water is the public water and wastewater utility that serves the District of Columbia and surrounding jurisdictions in Maryland and Virginia. Created in 1996 as an independent authority of the District government, it provides drinking water to the 700,000 residents of the District and 21 million annual visitors and workers. It also treats wastewater for 1.6 million people in the Washington metropolitan region.

DC Water's infrastructure was initially built by the federal government in the 1800s and 1900s. It comprises reservoirs, water tanks, pumping stations, 1,350 miles of potable water pipes, 1,900 miles of sewers, and the world's largest advanced wastewater treatment plant, Blue Plains. The legacy of the Federal system remains. The sewers built before 1900 are combined sewers: they convey both wastewater and stormwater, and during heavy storms, they can overflow, sending untreated effluent into the District's waterways. Additionally, the overall system is aging, with an average pipe in service for approximately 80 years.

Incorporating 21st-century technology into a 19th-century platform while meeting strict regulatory standards presents numerous challenges, with concomitant issues of financing and costs for users. DC Water is responding with a range of strategies.

Complying with Regulatory Requirements

The District's drinking water exceeds Safe Drinking Water Act standards, which are enforced by the US Environmental Protection Agency (EPA). Wastewater treatment and combined sewers and combined sewer overflows (CSOs) are regulated under the Clean Water Act. Blue Plains, the wastewater treatment plant, discharges treated water to the Potomac River, part of the Chesapeake Bay watershed. All discharges to the bay are regulated under the Chesapeake Bay's total maximum daily load (TMDL) framework—EPA's "pollution diet" for the bay. The TMDL allocates pollutant



DC Water's response is a massive, \$2.7 billion project called Clean Rivers, the largest infrastructure project in the District since the Metro subway system was built in the 1970s.

loads to each discharger, focusing on nutrients (nitrogen and phosphorus) and sediment. To meet TMDL requirements, DC Water has spent more than \$1 billion over the past decade in upgrading treatment processes and installing state-of-the-art processes to remove nutrients.

DC Water is also under a consent decree with the federal government to virtually eliminate CSOs to the Potomac and Anacostia rivers and to Rock Creek. DC Water's response is a massive, \$2.7 billion project called Clean Rivers, the largest infrastructure project in the District since the Metro subway system was built in the 1970s. Clean Rivers will capture the CSOs before they discharge to the rivers via a system of tunnels 100 feet below ground, and the water will then be pumped up to Blue Plains for treatment. Clean Rivers is also installing street-level bioretention ponds, permeable pavement, rain barrels, and other green infrastructure that reduces runoff by capturing, filtering, and in some cases reusing stormwater so that the sewer system is not overwhelmed.

Paying for New Infrastructure

The majority of DC Water's revenue comes from its residential, wholesale, and government customer bills; only a small amount comes from grants or other sources. The average monthly residential water and sewer bill, including Clean Rivers, is currently \$108 and is predicted to rise to \$184 by 2030. Bills will increase 5.6 percent in 2020 for the average household customer and are projected to continue increasing at similar rates. The increases are in line with water and sewer rates across the country, which are rising at twice the rate of the consumer price index.

To help pay for the Clean Rivers project, DC Water bills include an impervious area charge, assessed on property owners based on an "equivalent residential unit"; the rate varies depending on property size and imperviousness. The initial charge was about \$1 per unit in 2009 but has risen to \$23 as the project has progressed. This rate increase has proven burdensome for some of the District's nonprofits and lower-income ratepayers.

DC Water has taken some innovative financing approaches intended to minimize effects on ratepayers. It issues its own municipal bonds and maintains a AAA rating. It has issued a "century bond" with a 100-year maturity and a green certification to help pay for Clean Rivers. This bond's term matches the anticipated useful life of the project infrastructure and spreads the cost more affordably across all those who will benefit from it over the next century. DC Water has also issued an environmental impact bond to finance the green infrastructure portion of Clean Rivers. The performance risk of the green infrastructure is shared between DC Water and the investors, with varying payments based on the success of the green infrastructure approach.

Working with the Community

DC Water created a Stakeholder Alliance in 2018 to provide input on a range of issues—ratepayer equity in particular. Through the alliance, DC Water regularly and directly engages a diverse group of 21 stakeholders—city residents from every ward and representatives of the faith community, businesses, and other organizations. This has given the utility an opportunity to share information, receive feedback directly from the public, and collaboratively work on solutions to address concerns.

In December 2018, Stakeholder Alliance discussions led DC Water’s board of directors to revise its rate considerations and, in February 2019, proposed a budget incorporating the feedback. Suggested solutions were rolled out to the public through town hall meetings in spring 2019. The face-to-face meetings with DC Water and its ratepayers allowed for transparency with the public and a sharing of ideas and information about rates and proposed rate changes. Public comments in the town hall meetings were recorded for the DC Water board of directors, which approved the revised rate changes at a public hearing in June.

Addressing Ratepayer Affordability

DC Water is addressing affordability and ratepayer equity challenges with rate changes and customer assistance programs (CAPs). The new rate structure will recover a portion of the Clean Rivers costs based on sewer volumetric rates, with the charge tied to water usage. Ratepayers will now be able to reduce their water bills and Clean Rivers fees via water conservation.

Along with the rate changes, DC Water is expanding its CAPs to assist low-income households. The CAP in place since 2001 provides a lifeline rate: the first 400 cubic feet of water and sewer service is free, rates for higher volumes are discounted, the Clean Rivers impervious area charge is cut in half, and water service replacement fees are waived.

The original CAP program has already provided more than \$11 million in assistance to an average 4,577 customers per year. CAP2 and CAP3 programs extend benefits to additional residents with household incomes up to \$117,200 (based on the area median income). Furthermore, a nonprofit relief program has been created to provide impervious area credits to nonprofit organizations in the District. Finally, DC Water offers a “SPLASH” program: funded by contributions from DC Water employees, customers, and the community, it helps customers maintain critical water and sewer service in times of financial emergency.

Rate changes aren't the only way DC Water is empowering rate payers to take action and potentially lower their water bills. DC Water's Water Meter Replacement Project installed 90,000 new "smart meters" in the District over the past 12 years, replacing meters near the end of their useful life. New meters allow for more timely and accurate monthly bills, and, when combined with automated metering infrastructure, allows water usage for each household to be tracked on customer-set threshold: an hourly, daily, monthly, or yearly basis. If the system detects an abnormally high usage, customers enrolled in DC Water's High Usage Notification Application (HUNA) will be alerted automatically via text, phone, or email. This enables customers to check for broken pipes and leaks to avoid high water bills. HUNA generated over 37,000 notifications to DC Water customers in the past year alone.

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Matthew Ries serves DC Water as Director, Sustainability and Watershed Management. He is responsible for providing strategic direction, technical information, and stakeholder engagement to develop DC Water's sustainability program and catalyze related improvements to the watersheds serving the District of Columbia. He has a broad range of responsibilities from assurance of the performance of existing assets, water quality assessment, coordination of technical assistance, and the creation, implementation and coordination of work plans and strategies to enhance DC Water's sustainability efforts and restore and protect watersheds. A member of DC Water's Performance Management team, Dr. Ries is also working to develop, track, and report performance throughout the enterprise.



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A man in a dark suit is seen from the side, looking at a smartphone. The entire image has a teal overlay. Several circular icons are connected by lines, representing smart city concepts: a cloud, two people, a heart with an ECG line, a smartphone, and two power towers. A Wi-Fi symbol is also visible on the left.

Community Buy-In: Approaches for community engagement in smart city initiatives

By Casey DeMoss

Because of its history and geographic position, New Orleans, Louisiana, is often on the front lines of rebuilding and re-inventing itself. Following Hurricane Katrina, the city had to undertake a massive rebuild of the physical infrastructure that was destroyed during the storm and as a result of the levy failure; but it also had to rebuild much of its social infrastructure when so many of the city's residents did not return after the evacuations.

Now New Orleans has embarked on an effort to modernize its infrastructure, placing it on a path to become a leading "Smart and Sustainable City". As a roadmap for the development of a smart master plan is being vetted, there is an emphasis on community engagement in the process. Leaders of the Smart and Sustainable city initiative can learn much from the city's past initiatives, some highly successful and some less so. Engaging city and community dwellers can be challenging, but gaining their trust and buy-in is essential. The approach taken may vary depending on the problem to be solved or goal to be achieved and the technology and resources available to address it. Three possible approaches include:

- A "technology forward" approach, where a goal, problem or "pain point" is identified, a technology is available to address it, and the challenge is how to get that technology implemented.
- An "expert forward" approach, where a goal, problem or "pain point" is identified, the expertise and skills are available to address it, and the challenge is to connect the expertise with the community to achieve or address it.
- A "people forward" approach, where the community to be helped has been identified, the technology or experts are available, and the challenge is to identify the specific goals, "pain points" or problems to be solved and specific solutions to be created.

TECH FORWARD: THE SMART PHONE SCENARIO

When the iPhone was first introduced, it came with the promise that it would revolutionize telecommunications. What was unanticipated was how it would revolutionize lives. Smart phone technology has been adapted and used in ways the engineers who developed it could not have predicted—from the impact of videos taken by passers-by of transformative events that go viral and revolutionize conversations around societal issues, such as race, gun use, or teen suicide, to moments that unite the planet, such as World Cup soccer broadcasts through television apps to people on all seven continents, to surgeries being performed and guided remotely by physicians located thousands of miles from the patient. The smart phone was not designed for these purposes, but end-users have innovated to change lives.

Most conversations about Smart Cities intuitively begin with a Tech Forward bias, but technology often engenders fear and skepticism, and it often is viewed as available only to a few. In order for technology to become widely adopted, it must be easily accessible and affordable. As a practical matter, the Tech Forward approach is often driven by timing. For example, during Hurricane Katrina, the phone lines and power went down, making



The social fabric of that neighborhood was woven around people spending time sitting on their front porches and speaking to their neighbors who passed by.

phone calls impossible. But, text messaging still worked. Residents who already had cell phones before the hurricane made landfall were able to communicate during and after the storm. People who had never texted before Katrina now do so on a daily basis as a matter of course. This is not to say that it takes a natural disaster for people to buy in to new technology. But this example highlights the challenge involved in getting tech to the right people at the right time.

TECH FORWARD BEST PRACTICES:

1. Make emerging tech easily accessible and affordable. And, if you can make it fun and easy to interface, even better.
2. Communicate with end-users and research innovative applications.
3. Look for leap frogging opportunities, even where sunk costs are present.

EXPERT FORWARD: THE FRONT PORCH SCENARIO

Hurricane Katrina decimated New Orleans' housing stock, especially in neighborhoods near the levee breaches. In the aftermath, well-meaning architects and builders arrived in New Orleans to volunteer their expertise and resources to rebuild homes. The Holy Cross neighborhood in the lower ninth ward was one of the neighborhoods that attracted philanthropic attention. Generous and skilled architects pulled out all the stops in designing new, modern homes to replace what had been destroyed in the storm. They designed net-zero energy, modern homes with incredible features and landscaping. Yet, when people returned to the city, they refused to move in to these houses.

The architects and builders were confused and dismayed by the rejection of these beautiful houses. A series of meetings were scheduled with city residents to try to understand what the problem was. It turns out, the problem was that the homes had no front porches. The social fabric of that neighborhood was woven around people spending time sitting on their front porches and speaking to their neighbors who passed by. The absence of the front porch meant a collapse of what made the neighborhood special, and it eroded the desire to return to the neighborhood. The architects went back to work and designed homes with front porches.

Understanding communities and social systems before trying to solve their problems should be obvious but often this is overlooked.

In New Orleans, there are historic problems that Smart Cities proponents are trying to solve. Decades of structural racism like segregation, disinvestment, redlining, etc. still impact communities today, and it has a tremendous effect on many aspects of daily lives. Only by understanding the structural and cultural history of a city, can solutions be created that benefit people.

EXPERT FORWARD BEST PRACTICES

1. When trying to implement a solution, utilize the EPA definition of “meaningful involvement” to avoid expensive pitfalls:
 - People have an opportunity to participate in decisions about activities that may affect their environment and/or health;
 - The public’s contribution can influence the decision;
 - Community concerns will be considered in the decision making process; and
 - Decision makers will seek out and facilitate the involvement of those potentially affected.
2. Invest time in developing and understanding cultural competence, including traditional power dynamics and the role of the smart city leader or participant within that context.
3. Consider strategies to ensure that community residents derive concrete benefits from attending meetings with planners and developers.

PEOPLE FORWARD: THE CO-CREATION SCENARIO

From a community social infrastructure perspective, the gold standard for successful community engagement is “Co-Creation”—the People Forward approach. This approach is based on the age-old concept that the whole is greater than the sum of its parts, or, otherwise stated, the smartest person in the room is the room itself.[*]

In this scenario, leaders, technologists, experts and the people in the community collaborate, each bringing a different skill set and knowledge base to the conversation, all coming together to share ideas and create solutions. From this perspective, a single individual with specialized knowledge can only create the best of their unique imagination. However, many individuals with a wide range of experiences and expertise can create logarithmically more creative solutions.

A prime example of the Co-Creation approach is the “Louisiana Safe” program. It started as an effort in ‘collaborative resiliency planning’ and finished as the most extensive community visioning and input effort in Louisiana history. From its inception, the organizers understood the importance of community buy-in. The outreach and engagement campaign encompassed 71 separate public meetings across five rounds of events in six coastal Louisiana parishes. The projects that came out of this process span all six parishes and enjoy complete buy-in and local engagement. The buy-in came naturally because the community itself created it. Collective imagination is the magic of co-creation. Solutions develop organically, and the ownership of the ideas and results is shared.

CO-CREATION BEST PRACTICES:

1. “Honor boots on the ground” expertise. Think of the people living in the city as having experiential education that was difficult to attain. A lifetime spent in a place offers hard-won knowledge that is important to access.
2. Let the design process serve as coalition and capacity building.
3. Local participants should be partners in the implementation process.
4. Consider strategies to ensure that community residents derive concrete benefits from participation in the process.

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Public-Private Partnerships Driving the Integration of Renewables into Microgrids

Robin Cantor,¹ Gonçalo Mendes,² Noah Schlosser,¹
and Joanna Martin Ziegenfuss¹

¹ Berkeley Research Group LLC. The opinions expressed in this paper are those of the individual authors and do not represent the opinions, position, or policy of BRG or Lappeenranta University of Technology, or of their other employees or affiliates.

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The development of microgrids in the US is gaining momentum as a solution to smart city challenges. These challenges include the increase in power demand from urban communities insufficiently served by the grid, the need for stronger grid resiliency, and the delivery of cost-competitive renewable power generation to relieve dependence on fossil fuels. The ability to operate independently, as an integrated resource to the regional grid, or in both modes allows microgrids to deliver value-added technical and economic flexibilities. In addition, power autonomy from the grid and stronger resiliency to power outages, as well as the ability to trade power, can make the economics attractive to planners.

Microgrids are increasingly powered by solar and/or heat pumps (e.g., a solar and heat pump microgrid was recently integrated in a new residential community developed in a brownfield site in San Francisco),³ allowing end users to be self-sufficient and climate friendly. In other cases, fuel cells are used as an energy efficient means to generate power from natural gas and mitigate greenhouse gas emissions (e.g., a fuel cell microgrid was developed for the city of Hartford, Connecticut, to power critical infrastructure in the event of future grid outages).⁴

Public-private partnerships (P3s) have been critical in supporting the successful development of early microgrid projects in the US. P3s are legal entities created by public and private capital to develop large, capital-intensive projects for public purposes with multi-decade lifetimes, such as power plants, highways, and stadiums. Such projects require not only large amounts of funding, but also deep technical expertise and suitable risk mitigation measures. Private parties, typically project developers, engineering firms, and investors, provide the capital and expertise, and benefit from the close coordination of the public entity to navigate, troubleshoot, and expedite permitting and regulatory requirements. Public entities, namely local and state governments, benefit from the funding and technical expertise to develop projects they could not achieve on their own.

For energy infrastructure, P3s often use a build-own-operate-transfer (BOOT) structure, wherein the private party takes on the development and management risks for the asset's expected lifetime, and the public party provides land and fast-track permitting in the development phase.

3 HPS2 OCII Commission Presentation. Candlestick & Hunters Point Shipyard Project Update (March 20, 2018).

4 Connecticut's Latest Microgrid and Fuel Cell Project Goes Live in Hartford. Microgrid Knowledge (April 25, 2017).

The asset is typically transferred to the public party at a predetermined date and residual monetary value.

A growing number of cities are considering the implementation of microgrids powered by renewable energy to support their urban growth in a sustainable manner. This paper considers factors that challenge the planning and implementation progress of such projects and provides examples of pioneering P3 microgrid projects in the US.

PUBLIC PURPOSE

P3s serve two main public purposes: first, P3s help unlock the financing required for capital-intensive projects. Public entities are often financially constrained to undertake large public-purpose capital projects because of a lack of short-term funding. Private entities bring in the additional upfront funding. Further, because P3s are separate legal entities, their funding is insulated from government budgeting decisions, providing a degree of protection to investors worried about the repayment of long-term loans.

Second, P3s can create positive externalities: benefits to society that can't be financially captured as revenue, such as increased reliability of the power supply to address unplanned outages. If a project creates large positive externalities and therefore benefits the public's interest, but its cash flows are not sufficiently profitable to developers, it will not be privately developed. The P3 structure, by involving public entities, can reduce private development costs through subsidies, and reduce land costs and permitting timelines, rendering a microgrid project more profitable to developers.

The portfolio of distributed energy resources (DER) available for microgrid operations is wide ranging. Within that, renewable energy technologies, particularly photovoltaics (PV), offer value streams that align with microgrids' public purpose. The zero, or reduced, emissions associated with the renewable technologies are one clear benefit and help to guarantee the environmental suitability that many communities now demand. Less recognized are the continuous drop in installed costs and increase in performance of solar microgrid installations combined with storage technology. These innovations have led to efficient capital cost recovery via power purchase agreements and new business models, such as energy service company (ESCO) arrangements. Additional benefits from renewable microgrid projects include ease of installation and minimal maintenance. This compares favorably to sophisticated microgrids that include heat-and-power fossil-fueled generators. And while such generators currently offer the most robust and optimal economics for large microgrids, this reliance on fossil fuels raises concerns that without adequate policy in place, its ubiquitous adoption could be detrimental toward efforts to control and reduce greenhouse gases.⁵

⁵ Evaluating business models for microgrids: Interactions of technology and policy. Energy Policy 103 (April 2017), pp. 47-61.



In Pennsylvania and Maryland, for example, utilities have had to ask regulators for exceptions to develop microgrids to keep power flowing to essential community services during grid outages.

KEEP IT SIMPLE

The mixed-ownership aspects of P3 microgrids often involve complex financial agreements for which implementation remains challenging. These arrangements can generate considerable legal and regulatory issues, especially in states where the ownership of generation assets by electric utilities is a controversial issue. In Pennsylvania and Maryland, for example, utilities have had to ask regulators for exceptions to develop microgrids to keep power flowing to essential community services during grid outages. This reliability benefit is in addition to the value of public-purpose microgrids intended to reinforce and bolster normal utility operations and benefit all customers.

A related, ongoing debate addresses the rate-based nature of power purchase agreements, the most common business model for public-purpose microgrid projects. Under such arrangements, the project capital costs are recovered via fees added to customers' electricity bills. Commonwealth Edison Company (ComEd) used this model to recover capital costs of the Bronzeville Community Microgrid, which received approval by the Illinois Commerce Commission in February 2018 (see Table 1 below). The Commission recognized that the microgrid provided a benefit to local customers as well as to the entire grid.

In other US states, however, this approach has encountered criticism and resistance from regulators and communities due to the focused benefits but general cost recovery. For example, the Maryland Public Service Commission (PSC) rejected the Potomac Electric Power Company's (Pepco) broad cost-recovery approach for two microgrids it considered in 2018 (one of them being the Prince George microgrid listed in Table 1). These challenges suggest that some regulators might prefer an alternative model that recovers the capital costs exclusively from customers benefiting directly from the microgrid rather than socializing the costs across the utility's entire customer base.

The balance of microgrid ownership between private and public utility has also become a contentious point. Private entities have perceived P3 projects as a channel for public utilities to further delve into competitive market environments. This was one reason the Maryland PSC denied Baltimore Gas and Electric's plans to develop another public-purpose microgrid in 2016.

The range of revenue streams that public-purpose microgrids offer, such as local environmental improvements and community energy resiliency, are not purely financial. The intangible societal value they offer is difficult to monetize and translate to clear value propositions for project promoters and financiers. This can render the feasibility studies particularly challenging (e.g., Montclair Town Center Microgrid, in Table 1). Short of traditional profitability indicators, investors have relied on the financial stability and credit-worthiness of project promoters and their consortium partners before they opt in.



The regulatory frameworks for capturing microgrid revenue streams from DER-enabled service offerings, such as ancillary services, microgrid stand-by, and reliability support, are also either uncertain or prohibitive in many states.

The regulatory frameworks for capturing microgrid revenue streams from DER-enabled service offerings, such as ancillary services, microgrid stand-by, and reliability support, are also either uncertain or prohibitive in many states. The development of the Gaithersburg (Maryland) Public Safety Headquarters Microgrid (see Table 1), which seeks to add such value streams into its cost recovery plans, is facing administrative inertia from state regulators because of the inadequate regulatory framework.

Concurrently, certification and standardization organizations are using trailblazing projects as case studies to develop consolidated standards and processes to help accelerate project development. For example, the Port of Los Angeles Green Omni Terminal microgrid (see Table 1) has endured years of delay, largely over stringent city permitting processes and gaining third-party independent certifications for the system's different components.

In light of the above, a trend is emerging for P3 microgrid promoters to avoid complex, cumbersome microgrid setups, which may end up too costly, resource consuming, or plainly unfeasible. There is also an interest in maintaining the focus on the public purpose by pursuing community benefits such as energy savings and increased local reliability, rather than riskier, regulation-dependent value streams such as those from ancillary market participation. Another consideration is the type of P3 partners: Microgrid projects promoted by non-utility entities are not burdened with utility commission approvals and face less administrative inertia. Successful examples include the Gaithersburg and Montclair Town Centre microgrids (shown in Table 1).

TRAILBLAZERS

There are a number of pioneering P3 microgrid projects emerging across the U.S. which are facing some of the challenges discussed above and working to resolve them. These are listed in Table 1 along with summaries of their project information and their key challenges.

Name	Location	Employed solutions	Status	Key challenges	MORE INFO
Bronzeville Community Microgrid	Chicago, IL	<ul style="list-style-type: none"> - 750 kW solar PV - 2 MWh Lockheed Martin GridStar™ lithium-ion batteries - Future expansion to 7.7 MW DER - ComEd's microgrid controller 	Under development, close to completion	<ul style="list-style-type: none"> - At an early stage, the project faced opposition from various fronts: asset ownership, tariff implementation, its proposed cost recovery model, which remained a major point of contention until final approval by the commerce commission. 	Promoter: ComEd <ul style="list-style-type: none"> - Approved on February 28, 2018 - Service to 10 critical customers, including Chicago Police and Fire Department HQs - Co-paid by customers and US DOE - Generation assets owned by third-parties - Coupled with existing IIT microgrid facility
Prince George Public Purpose Microgrid	Prince George's County, MD	<ul style="list-style-type: none"> - 1.225 MW solar PV - 5.6 MW NG DG - 3.2 MWh battery energy storage 	Not Approved, Pending Further Review	<ul style="list-style-type: none"> - PEPCO's microgrid cost recovery model was rejected by the Maryland Public Service Commission. It has advocated for local government, businesses, and energy funds to support the project capital costs rather than burdening Maryland's electricity customers. 	Promoter: PEPCO <ul style="list-style-type: none"> - Service to 6 critical customers, including a gas station and a regional medical center - Net costs to be recovered from customers in the service territory via distribution rates - Competitive entities provide DG, PEPCO owns storage, controls, and delivers power - Customers keep retailer of their choosing
Gaithersburg Public Safety Headquarters Microgrid	Montgomery County, MD	<ul style="list-style-type: none"> - 2 MW solar PV - NG CHP reciprocating engine - NG generator bank - Absorption cooling units - Schneider microgrid controller 	In operation	<ul style="list-style-type: none"> - The County challenged the microgrid industry to develop innovative and creative solutions for the development of a P3 model that would allow the project to be financed as a Microgrid-as-a-Service. The County was successful in developing a contract structure that reached this objective with Schneider Electric and Duke Energy Renewables. 	BPromoter: Montgomery County <ul style="list-style-type: none"> - Entered operation on October 24, 2018 - P3 where Duke owns, operates assets with assistance from REC Solar and Schneider - Duke's Microgrid-as-a-Service business model eliminates up-front costs for county - 25-year PPA signed with customer - Further cost offset via capital improvements and cost recovery through operational efficiencies

Name	Location	Employed solutions	Status	Key challenges	MORE INFO
Montclair Town Center Microgrid	Essex County, NJ	<ul style="list-style-type: none"> - 50 kW + 75 kW + 20 kW solar PV - 2 MW + 100 kW NG CHP - Siemens SICAM or Johnson Control's Grid Connect microgrid controller 	Planned	<ul style="list-style-type: none"> - The feasibility study shows a funding gap of roughly \$4 million after considering expected funds from commercial debt and equity investments. - This is in line with similar projects in Connecticut and New York. 	<p>Promoter: Montclair Township</p> <ul style="list-style-type: none"> - Funding for feasibility study, approved in February 2019 by NJ BPU - Service to various critical facilities, which include a hospital, a middle school, and NJ Transit's Bay Street Station and Garage - Seeking public and private investors
Green Omni Terminal – Port of Los Angeles Microgrid	Los Angeles, CA	<ul style="list-style-type: none"> - 1MW solar PV and 2.6 MWh battery storage system, Siemens SICAM microgrid controller - High power EV charging 	In operation	<ul style="list-style-type: none"> - Lack of standards and processes - Long time to obtain city permits - No precedent for commercial manufacturer-independent system component UL certification for various microgrid components. 	<p>Promoter: Pasha Stevedoring</p> <ul style="list-style-type: none"> - Driven by emission and reliability goals - Burns & McDonnell built the microgrid - P3 composed of Pasha Stevedoring, CARB, BYD, Transpower, and the LA Department of Water and Power

Key: PV – Photovoltaics; DER – Distributed Energy Resources; ComEd – Commonwealth Edison; HQs – Headquarters; DOE – Department of Energy; IIT – Illinois Institute of Technology; NG – Natural gas; DG – Distributed generation; PEPCO – Potomac Electric Power Company; CHP – Combined heat and power; Duke – Duke Energy Renewables; Schneider – Schneider Electric; PPA – Power Purchase Agreement; DR – Demand Response; BPU – Board of Public Utilities; EV – Electric vehicle; UL - Underwriters Laboratories; LA – Los Angeles; CARB – California Air Resources Board.

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Modernizing and coordinating digital, physical and social infrastructure can make delivery and use of public, private and hybrid services more efficient, cost effective and socially beneficial. Dentons' Smart Cities & Communities Initiative and Think Tank helps cities and communities take advantage of technological developments that enable the integration of essential services. Bringing together the resources of the world's largest firm and leaders of municipal government, businesses, innovators and stakeholders, we help communities craft innovative legal, economic and policy solutions to societal challenges in an era of accelerating technological change.

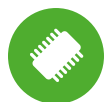
Pillars of a Successful Smart City:



Government Leadership & Public Policy: Dentons can develop engagement strategies at every level of government, including identifying and building relationships with decision-makers and people empowered to implement the necessary components of a Smart City. We tailor best practices utilized by leading political subdivisions across the United States and the world to meet the specific needs of the community and project.



Regulation: Dentons provides counsel on effective design of regulations so as to lower development costs, speed technology deployment, and achieve efficient and equitable outcomes for communities. This can be done both proactively, in the early stages of Smart City implementation, and reactively, if legal structures are discovered that will present challenges at a later phase.



Technology & Innovation: Dentons can assist communities in assessing infrastructure needs and creating feasible strategies to design and install the systems necessary to support smart technologies, while continuing to examine advances coming out of centers of innovation, such as the national laboratories, universities, and private enterprises.



Telecommunications: Advanced telecommunications systems are needed to support smart technologies. We work with stakeholders to evaluate and advocate policies that promote 5G deployment and the development of compatible firmware and hardware. Focus on facilitating multiple uses for smart infrastructure upgrades is essential so costs can be minimized and appropriately shared among a broad array of beneficiaries.



Cyber & Physical Security and Privacy: Dentons advises on the creation of systems to protect privacy while allowing for deployment of advanced digital technologies, including frameworks and protocols for data gathering and use. We also provide strategic advice on issues related to infrastructure security to address perennial and novel challenges faced by communities.



Consumer Engagement & Community Social Infrastructure: Social infrastructure is every bit as critical as physical and digital infrastructure in any modernization initiative, but it is often given far less attention. Dentons works with community leaders, interest groups, businesses, and residents to conduct outreach to ensure broad public participation, understanding and buy-in to the benefits that a Smart City can offer, and to adapt a Smart City program to the particular needs and desires of the community.



Finance, Investment & Economic Development: Because of the varied benefits that will flow from Smart Cities— including improved environmental health, social, and economic-related outcomes, modernization initiatives may exceed the scope of traditional municipal infrastructure projects. Dentons can help to identify optimum funding strategies and solutions from both existing and untapped sources of capital.



Transportation & Mobility: Mobility is key to quality of life. When infrastructure is powered by advanced technologies, cities will realize countless benefits from reduced emissions and congestion as clean vehicle and ride share use increases, to enhanced public safety, to economic development opportunities as underserved communities are connected with employers through efficient, data-driven mass transit. Dentons can provide counsel on appropriate physical infrastructure and policy options to support technological advancements in transportation and mobility, deployment of electric and autonomous vehicles, and updated traffic and transit systems for the modern economy.



Energy: Electric grid modernization is the touchstone of an effective and comprehensive smart city strategy. Without a modern, safe, reliable and resilient grid, implementation of smart technologies is limited. Dentons advises cities on modernizing their electric infrastructure — transitioning to a multi-directional grid with advanced clean technology solutions, including a broad array of distributed energy resources, integration of demand response and efficiency measures.



Water, Wastewater and Waste: Water is essential to the well-being and functioning of any city or community. Water availability and quality are two of the greatest challenges that cities and communities will face moving into the future. Similarly, wastewater and waste are issues faced by every city and community worldwide. Dentons can help bring together technical, legal, and policy experts from government, industry, academia, and NGOs who are at the forefront of water resources planning to develop new approaches to address water, wastewater and waste issues.



Buildings, Cities & Green Space Planning: Smart buildings are a foundational block of tomorrow's cleaner, healthier cities and communities. Dentons can help bring together municipalities, real estate developers, engineers, land use and other experts to create smart building and development strategies that encourage productivity and energy efficiency while promoting liveable and sustainable habitats for the future.



Environment, Health & Safety: Dentons works with cities and communities to ensure that environmental strategies support economic opportunity while sustaining natural resources and improving quality of life. We also work with communities to address smart delivery of health and safety services, and maximizing the opportunities offered by the "Internet of Things" to enhance security, safety and operational efficiencies related to healthcare and public safety.



NGOs & Universities: While developing smart cities plans, local governments should engage universities and NGOs to provide intellectual firepower and nurture public trust. At the same time, many universities are ideally scaled for utilization of smart infrastructure and can serve as models for communities in their regions for clean technology solutions. Dentons works with these entities, through the Think Tank and in work for clients, to take advantage of the wealth of resources they offer to cities and communities seeking to modernize infrastructure.



Global Best Practices: Smart Cities and Communities are constantly evolving worldwide. Because innovations developed in one country or region have international application, Dentons, with its unparalleled global reach, can play an important role in helping to integrate new developments and share best practices from across the globe.

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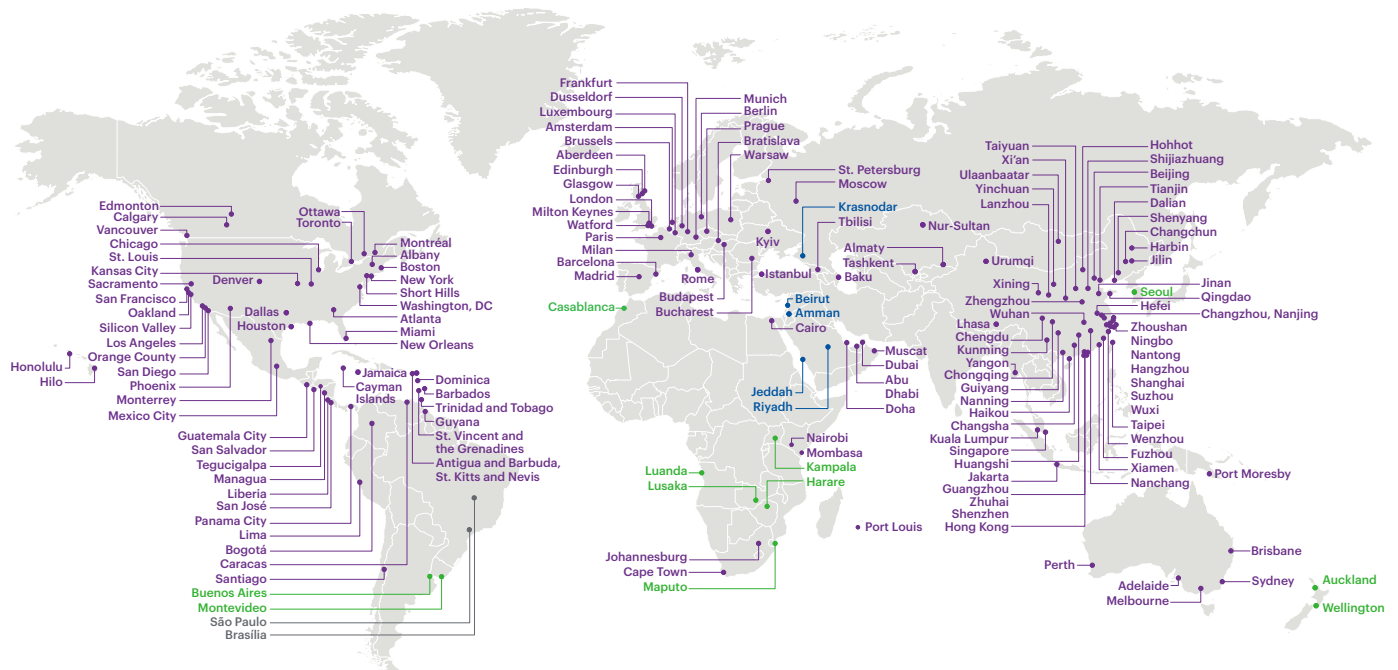


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Global presence



Locations in purple represent Dentons offices.

Locations in blue represent associate firms, offices and special alliances.

Locations in green represent proposed combinations that have not yet been formalized.

Locations in gray represent Brazil Strategic Alliance.



ABOUT DENTONS

Dentons is the world's largest law firm, delivering quality and value to clients around the globe. Dentons is a leader on the Acritas Global Elite Brand Index, a BTI Client Service 30 Award winner and recognized by prominent business and legal publications for its innovations in client service, including founding Nextlaw Labs and the Nextlaw Global Referral Network. Dentons' polycentric approach and world-class talent challenge the status quo to advance client interests in the communities in which we live and work.

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