THE UTILITY'S TRANSFORMATION TO A SMART CITY PLATFORM PROVIDER

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-EXECUTIVE SUMMARY-

The concept of *Smart Cities* is pervasive when contemplating emerging energy trends and opportunities. And increasingly, large cities and municipalities are moving forward with sustainability objectives which are decidedly concentrated on the premise of *smart* livability, workability, and environmental stewardship. Given this trend, coupled with an increasing percentage of the global population choosing to live in cities, *Smart City* methodologies offer plans and best practices to scale intelligently. To that end, The United Nations projects that by 2030, one in every three people will live in cities with at least half a million inhabitants.[1] With this accelerated pace toward urbanization, infrastructure will need to be addressed. In considering today's infrastructure needs, over 2.5 billion people in the developing world lack access to reliable electricity, approximately 2.5 billion people globally lack access to basic sanitation, almost 800 million people globally lack access to water, and 1-1.5 billion people globally do not have access to reliable phone services.[2] Urbanization combined with massive needed infrastructure upgrades lends itself well to comprehensive *Smart City* approaches in cities around the world.

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[1] The World's Cities in 2016. Report. Economic and Social Affairs, United Nation. Accessed December 15, 2017. http://www.un.org/en/development/desa/population/publications/pdf/urbanization/the_worlds_cities_in_2016_data_booklet.pdf

[2] "Infrastructure and Industrialization - United Nations Sustainable Development." United Nations. Accessed December 15, 2017. http://www.un.org/sustainabledevelopment/infrastructure-industrialization/

One significant and influential common public good in cities today is the electric utility. While *Smart City* ideas are being rolled out and discussed at every level, most utilities are strategizing on how to enable *Smart Community* development. The research provided in this report demonstrates how utilities are uniquely positioned to be a Smart City Platform Provider in their respective communities. Utilities understand their communities, possess core capabilities, are often price regulated, and are incumbent asset operators and owners. **This Capstone will impart that when utilities are empowered to become platform providers, they are best positioned to take leadership roles in Smart Community development.** The research concludes that the electric utility must pivot and self-disrupt to take advantage of this very present opportunity. Failure to do so could result in the eventual utility death spiral. The recommendations center on the utility becoming a *smart city* enabler and champion. Utilities accomplish this by:

- partnering with their stakeholders to understand a common vision;

- leveraging their assets and data to unleash new products and services;

- becoming customer-centric and embracing the rise of prosumers, and;

- transforming into integrated platform providers.

The research further demonstrates that the democratization of energy is critical to scaling *smart city* initiatives, and to do that responsibly, utilities must recognize and be willing to address climate change and sustainability priorities. The utility proposals on where to engage are fully discussed in the *Utility Course of Action + Recommendations* section of this report.

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-INTRODUCTION-

A confluence of factors is underway causing utilities and energy providers to transform how they operate and serve customers. Unsurprisingly, *utility-of-the-future* and *smart city* initiatives (using data and modern technologies to increase efficiency, share information, and increase the quality of services and customer engagement) are emerging at every discerning utility. And rightfully so; shrewd utilities realize that to remain relevant in a new digital economy, their traditional business model must be disrupted to make way for new value-added services. Unlike most utility capital investment programs of the past, in large part utilities are not driving the pace. Municipalities, residents, and corporations are prompting the demand for *smart city* technologies and services. Many utilities are concerned that ignoring the opportunity will accelerate the death spiral so many energy executives are trying to impede: a future of decreased demand, increased customer-owned distributed generation, and utility stranded assets. To sustain, to thrive, utilities must transform.

But why now? Many experienced utilities acknowledge the threats, but are enough acting in earnest? Unlike other areas of

utility investment which enjoy regulated rates of return, virtually risk-free cost recovery, and monopolistic franchise areas, the pressing nature of *smart city* technologies can be conceived, offered, and delivered by new market players. A force accelerating the opportunity is the growing influence and role which cities play. Cities are becoming more densely populated and progressive. There are resounding calls for smarter infrastructure, more efficient transportation, and reduced greenhouse gas emissions. President Trump's retreat from the Paris Agreement and lackadaisical state regulation have put cities in the driver's seat to act on the pressing calls for climate action from progressive urbanites. Beyond altruistic reasons, *Smart City* developments, when planned and executed correctly, can be economic catalysts which attract residents and businesses, and further act as a framework for infrastructure spending, optimization, and prioritization.

From the utility's perspective, the focus has been shifting from beyond rate base growth to the customer experience. Although the customers are varied: residential, commercial, industrial, institutional, neighborhoods, municipalities, etc.; their focus on receiving excellent services in their communities is unwavering.

With this comes an important designation, the idea of defining a *Smart City* vs. a *Smart Community*. While *Smart City* has many interpretations, and is becoming a universal buzz phrase for all things 'smart', the idea is premised on leveraging data collection and measurement as an essential resource to enhance citizens' lives. In more progressive cities, the lynchpin inclusion in these discussions is sustainability, but the list of issues to address is continually growing.

Some have painted the idea of *Smart City* development as a panacea to address poverty, education, equity, clean water initiatives, clean energy, economic growth, and climate action.[3] Obviously, when framed in this way, such an undertaking is not solely in the utility's purview; though, utilities are natural institutions to serve the needs of communities. If *Smart Cities* is premised on the idea of unleashing cutting edge technologies on increasingly dense metropolitans, the idea of *Smart Communities* seeks to "thrive in a context of broadband economy, its engine and reason for being."[4] **The utility has a role to be a leader in either context.**

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[3] Azahara. (2017, June 07). Smart Cities vs. Smart Communities | Blog Geographica. Retrieved April 01, 2018, from https://geographica.gs/en/blog/smart-community/
[4] *Id.*

Defining Smart Cities + Smart Communities

Wikipedia provides this definition of a *Smart City*: "an emerging conceptual view of a city that promotes the use of information and communication technologies (ICTs) to engage with citizens to develop social capital and intellectual capital, to make better use of hard infrastructure (physical capital), reduce usage of environmental capital and support smart growth (sustainable economic development)."[5] "Smart Cities - A $1.5 Trillion Market Opportunity," research from the consulting firm Frost and Sullivan, goes on to identify eight key aspects which they claim defines a *Smart City*. These include "smart governance, smart energy, smart building, smart mobility, smart infrastructure, smart technology, smart healthcare and smart citizen as follows."[6] With regard to *smart energy*, Frost and Sullivan elaborate that a *Smart City* "uses digital technology through Advanced Meter Infrastructure (AMI), distribution grid management, high voltage transmission systems and for demand response for the intelligent and integrated transmission and distribution of power."[7] This is a narrow view of the role the utility can play. In fact, most utilities have already been advancing smart grid initiatives through traditional rate proceedings and business-as-usual cycles. Digging deeper and

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[5] Wall, D. (2014). Smart Cities vs. Smart Communities: Empowering Citizens not Market Economics | Gurstein | The Journal of Community Informatics, 10(3), 2014th ser. Retrieved April 1, 2018.

[6] Singh, S. (2014, July 02). Smart Cities -- A $1.5 Trillion Market Opportunity. Retrieved April 01, 2018, from https://www.forbes.com/sites/sarwantsingh/2014/06/19/smart-cities-a-1-5-trillion-market-opportunity/#3323a6036053

[7] *Id.*

sampling multiple sources concedes a common consensus: there is no universally agreed definition, and the sector is still in the "*I know it when I see it*" phase. That stated, it is important to recognize that there are differences between *Smart Cities* & *Smart Communities*, even if the delineation only memorializes itself via the way it is communicated it stakeholders. *Smart Communities* presents a much broader opportunity for investor owned utilities, municipalities, and cooperative utilities. *Smart Communities* is premised on *Smart City* but is more focused on communities and neighborhoods. In fact, one could argue that *Smart Communities* make *Smart Cities*. *Smart Communities* are seen as empowering the citizen, whereas *Smart Cities* are often viewed as empowering governments and the private sector. The distinction is important, and to be successful, it is important for utilities to craft their messaging and strategy to optimize outcomes in the territories they serve. The solutions explored in this research are applicable to both *Smart Cities* and *Smart Communities* and focuses on how the utility can evolve by offering outcome-based solutions which involve "citizen engagement, hard infrastructure, social capital and digital technologies to make cities and communities more livable, resilient and better able to respond to challenges."[8] Unless otherwise delineated, for purposes of this research, the term *Smart City* will encompass both *smart cities* and *smart communities*.

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[8] Centre for Cities. (2014, May 29). Smart Cities Definitions. Retrieved April 07, 2018, from
http://www.centreforcities.org/reader/smart-cities/what-is-a-smart-city/1-smart-cities-definitions

Equity Considerations

Communities and the utilities that serve them are increasingly partnering to address issues related to modernizing infrastructure. These partnerships typically touch on focused goals including economic development, *smart* infrastructure, public safety, and mobility. While certain communities are experiencing positive outcomes due to wealth flooding into metropolitan regions, there is often unintentional negative impacts on "community members of varying income levels, particularly those at the bottom who face increased housing prices, greater need for social services, and growing concern for community safety."[9] Accordingly, ensuring equity is of incredible importance when innovating and deploying new *smart* technologies and services. The *smart city* equity theme is a significant consideration for utilities to understand and appreciate as they develop their plans. In consideration of the foregoing, utilities are uniquely positioned to help address *smart city* equity concerns.   This is due to their structure, understanding and commitment to their local communities, and even due to their regulations. This position is underpinned by the fact that utilities must serve all in their respective territories, treat all customers fairly, and charge everyone a just and reasonable rate. Utilities can thoughtfully address how to extend *smart* infrastructure in an equitable way by engaging and collaborating with their stakeholders and communities.

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[9] DuPuis, N., Stahl, E., & Rainwater, B. (2017). The Future of Equity in Cities (Rep.). Retrieved April 03, 2018, from https://www.nlc.org/resource/the-future-of-equity-in-cities

Utility Rationale for Involvement

Utilities as we know them today were built to provide public goods at just and reasonable rates efficiently. What served utilities and the public well in the 20th century is not in itself sufficient for the increasing customer demands of the 21st century. Although electric utilities have long enjoyed being the monopolistic provider, the current business model of vertically-integrated compacts is poised for disruption. Electric utilities should embrace the coming transformation, which includes the addition of *internet of things* ("IoT") enabled devices on the distribution system. Quite simply, ***Smart City* investments are something utilities can say *yes* to**. They are scalable, proactive, and enhances the utility/customer relationship. Further, the global smart cities market size is anticipated to reach over $2.5 trillion by 2025, according to a report by Grand View Research, Inc.[10] Accordingly, a number of companies, from established technology and software platform providers to overnight IoT outfits, are all going after this opportunity. While each of these market players may be able to provide real solutions to enable a *smarter* city, few of them are able to bring the comprehensive set of services inherent in the local utility. These services include "utility-grade communications infrastructure, (smart meters, SCADA systems, enhanced networks), wide geographic coverage of vital "nodes" such as

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[10] Smart Cities Market Size, Share & Trends Analysis Report By Application (Education, Governance, Buildings, Mobility, Healthcare, Utilities), By Component (Services, Solutions), And Segment Forecasts 2018 - 2025. (2018, February). Retrieved April 03, 2018, from https://www.grandviewresearch.com/industry-analysis/smart-cities-market?utm_source=pressrelease&utm_medium=referral&utm_campaign=PRN_Mar6_SmartCitiesrd1&utm_content=Content

streetlights, distribution poles and rights-of-way, plethora of valuable data including energy usage, electric vehicle charging, geospatial facilities and topography – and emerging analytics capabilities to draw unique insights, and a long history of working with municipalities to improve the quality of life for their citizens."[11] Approximately half of all U.S. electricity customers are being served by advanced smart meters. [12] With smart two-way meters, utilities are able to realize operational savings and capture valuable customer data.

Additionally, many utilities are investing to further leverage their smart investments by upgrading their communication platforms and offering *smart* streetlights and sensors. Now, utilities can leverage these investments to "become information-driven partners that use analytics to generate insights that will fundamentally change how smart cities are run."[13] Utilities must act quickly. In fact, many tech giants have already begun partnering with local municipalities and civic organizations to create public-private partnerships to provide upfront technological infrastructure in return for a share of *smart city* revenues or municipal savings. Absent robust and meaningful involvement, "utilities run the risk of being left out of these partnerships, or be relegated to limited role, which would blunt the potential impact utilities can have in this

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[11] Mazurek, J. (2017, June 30). Smart cities and a leadership role for utilities | Accenture. Retrieved April 15, 2018, from https://www.accenture.com/us-en/blogs/blogs-smart-cities-evolve-how-utilities-can-take-leadership-role

[12] At the end of 2016, U.S. electric utilities had installed about 71 million advanced metering infrastructure smart meters, according to EIA. U.S. Energy Information Administration - EIA - Independent Statistics and Analysis. (2017, December 6). Retrieved April 10, 2018, from https://www.eia.gov/todayinenergy/detail.php?id=34012

[13] Mazurek, J. (2017, June 30). Smart cities and a leadership role for utilities | Accenture. Retrieved April 15, 2018, from https://www.accenture.com/us-en/blogs/blogs-smart-cities-evolve-how-utilities-can-take-leadership-role

space."[14] Although the risks of inaction are great and damaging to sustainability of the long-term utility model, utility involvement should not be fear-based. Utilities must be flexible, innovative in their approach, and willing to play outside of their complacent sandbox. They must be seen as **innovative** *smart city* champions, rather than obstructionists or digital dinosaurs.   To begin, utilities must develop their *smart cities* vision. The vision should marry the utility's aspirations with its business model. It should also define the utility's leadership role in the community.[15] Utilities must also inventory their capabilities and infrastructure assets to understand how they can provide services to *smart city* ecosystem partners today and look forward to anticipating what they need to build out to meet the needs of tomorrow. Further, utilities need to quantify the cost/benefit analysis of potential investments and understand the optimal cost recovery mechanisms allowed in their states. Above all, there needs to be a clear understanding of how benefits flow to the customer.   Through these actions, utilities can define and prioritize the greatest potential to create value for the utility and "shared value" for *smart city* stakeholders and citizens. [16] Finally, utilities must view all traditional infrastructure replacement/upgrade decisions with an eye toward creating a *smart* infrastructure that can support future *smart city* programs.[17]

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[14] *Id.*
[15] *Id.*
[16] *Id.*
[17] *Id.*

Statement of Purpose & Objectives

This Capstone explores the compelling reasons which position utilities as the optimal platform provider to deploy *smart* technologies and services for cities and communities. The findings touch on areas of policy, technology, transportation, livability, environment and energy. Accordingly, through this research, key decision makers will be informed of *smart city* options and paths, cost and benefits, and key pitfalls to avoid. The research ultimately endeavors to articulate the utility's role and describe opportunities for the utility to thrive in a changing environment which is trending toward citizen empowerment via IoT ecosystems. The research supports the notion that when **electric utilities are empowered to become platform providers, they are best positioned to take leadership roles in *smart city* development.** This topic, which is trending nationally and globally, is of great interest to municipalities as they plan for growth and infrastructure in a sustainable manner. The Capstone will provide meaningful evidence showing how utilities can act as platform providers and become champions in this effort, ultimately enabling cities to become more workable, intelligent, livable, and sustainable.

-METHODS-

Various methods have been employed to support the
research findings of this Capstone. The primary method
includes the thorough analysis of various *smart city*
objectives and technologies, and the electric utility's role in
these efforts. These items are partially sampled in the
below table:

Sector	Energy	Transportation	Water and Waste	Buildings
Objectives	• Efficiency • Low cost • Low pollution • Low CO2 emissions • Synergies with water and transport • Resilience	• Time savings • Low cost • Efficient resource utilization • Universal access • Low emissions	• Integrated system: water, flood control, agriculture, and sanitation • Resilience	• Affordability • Healthy environments • Resilience • Comfort • Efficiency
Technologies	• Distributed renewables • Cogeneration • District heating and cooling • Efficient lighting • Smart grids • Microgrids and virtual power plants • Demand response • Energy efficiency • Energy storage	• Multi-modal integration via technology • On-demand digitally enabled transport • Electric vehicle infrastructure • Traffic and congestion management • Autonomous vehicles • Parking management • Technology-enabled transportation pricing	• Smart water meters • Sensor networks • District and building water re-use • Digital water distribution control and leak detection	• Energy efficient and adaptive construction designs, technologies, and standards • Sensors, actuators for real-time space management • Energy management systems • Smart equipment and appliances • Advanced HVAC • Building retrofits

Source: ScottMadden [ref: *https://www.scottmadden.com/insight/the-smart-city-opportunity-for-utilities*

Another primary method includes analyzing key *smart city*
pilots globally, with a focus on the United States, and further
evaluates the utility's role in their successes or failure. A
critical method also includes thoroughly analyzing and
researching available trade organizations focused on *smart*
city advancement. These trade organizations conference

regularly, are inclusive to utilities, municipalities, and technology providers, and often provide thought leadership in this area.   Sample data was selected from available research and white papers on the following topics:

- demonstration of how utilities contribute toward *smart city* development in the above listed areas;

- demonstration of the impact of deploying these technologies;

- *smart city* financing considerations;

- *smart city* environmental impact and quality of life evaluations; and

- *smart city* technology roadmaps.

Methodologies yield mostly qualitative results. Other trade groups, including the Smart Cities Council, were referenced. Data collected from The Edison Electric Institute, research from ScottMadden, Accenture, and Black & Veatch were leveraged obtain information regarding utility-specific involvement. The methods concluded results in the following areas:

- [Smart City Pilots](#)
- [Smart City Technologies + Services](#)
- [Smart City Policies + Consortiums](#)
- [Utility Involvement](#)

The sampled research yielded results in the areas of *smart city*: pilots, policies, technologies, and utility involvement. While not totally encompassing of the universe of *smart city¸* these subject matter areas are important considerations for utilities to review and strategize as they progress through their *smart city* journeys.

Smart City Pilots + Utility Involvement

In many cities throughout the world, smart city pilot projects are being implemented to test innovative technologies. These efforts are meant to help address sustainability concerns, improve municipal services, and above all, to enhance the quality of life for those in the affected communities. These projects have been typically supported by municipalities, funded by subsidies, and run in partnerships.[18] Of the countries doubling down on *smart cities¸* it appears that no one is doing more than China. China has approximately 500 smart city pilot projects, making it the highest in the world.[19] In fact, China makes up half of the reported 1,000 *smart city* pilots operating or under construction worldwide,

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[18] Van Winden, W., & Van den Buuse, D. (2017, September 5). Smart City Pilot Projects: Exploring the Dimensions and Conditions of Scaling Up. Retrieved April 08, 2018, from https://www.tandfonline.com/doi/abs/10.1080/10630732.2017.1348884?journalCode=cjut20

[19] P. (2018, February 20). China has highest number of smart city pilot projects: Report. Retrieved April 11, 2018, from https://economictimes.indiatimes.com/news/international/world-news/china-has-highest-number-of-smart-city-pilot-projects-report/articleshow/62998738.cms

covering big and small cities.[20] Helped by its governmental structure (particularly its ability to leverage state-run agencies), China began piloting developments in 2012. These pilots encouraged the use of latest technologies, such as artificial intelligence and IoT devices, to help traffic flow, improve law enforcement, and make buildings more efficient.[21] Deloitte reported that China aims to "nurture 100 new smart cities from 2016 to 2020 to lead the country's urban planning and development."[22] Stateside, there is also much activity surrounding *Smart Cities.* Thorough partnership with their utilities, communities throughout the country have been piloting *smart city* technologies. Edison Electric Institute ("EEI"), the association which represents all U.S. investor-owned electric companies, has partnered with their member utilities to compile a listing of *smart community* pilots in the United States.[23] In their whitepaper, EEI coves *smart community* pilots in cities ranging from Albuquerque to Washington D.C. Included projects in the technical report fall into the following categories: *smart* street lighting, *smart* transportation, *smart* buildings, distributed energy resources, and

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[20] *Id.*

[21] *Id.*

[22] *Id.*

[23] *Examples of Smart Communities in Action | Electric Companies Play a Leading* Role (Vol. 2018, Tech.). (n.d.). Washington, D.C.: Edison Electric Institute.

data analytics and intelligent Services.[24] While each project is nuanced and different, a common theme persists: utilities are working with their communities to deploy *smart* energy infrastructure. Utilities are leveraging their data and technology to promote sustainability, spur economic development, and help drive efficiencies. Highlighted pilots focus on opportunities where utilities can collaborate to make communities smarter.   A selection of U.S. cities, their *smart city* journeys, and associated utility involvement are included below. Additional information related to *smart city* pilots, along with stated objectives, utility involvement, and piloted technologies, is included in the Appendix.

SAN FRANCISCO

Not surprisingly, in California, *smart city* initiatives are tilted toward sustainability and equity issues. Particularly, in San Francisco there is an effort underway to pilot *smart city* programs which will make streets safer, as well as reduce greenhouse gas emissions and improve rider satisfaction.[25] To think globally, San Francisco joined a consortium of other cities, including Paris, Barcelona, Spain to share *smart city* best practices; these shared learnings have

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[24] *Id.*

[25] Rosencrance, L. (2017, November 20). San Francisco smart city pilots aim to make streets safer. Retrieved April 11, 2018, from https://internetofthingsagenda.techtarget.com/feature/San-Francisco-smart-city-pilots-aim-to-make-streets-safer

helped San Francisco move forward with initiatives related
to reducing energy use, streamlining waste management, and
expanding its transportation systems to make mobility
easier.[26] While a number of agencies and partners have
played a role in directing San Francisco's *smart city*
objectives, the San Francisco Municipal Transportation
Agency ("SFTMA") has been the key municipal player. The
SFTMA has a stated goal to improve transit and pursue
environmental goals, specifically zero carbon emissions.[27] In
recent years, San Francisco received $11 million in funding
from the U.S. Department of Transportation for six projects
explicitly aimed at reducing traffic congestion and creating a
safer and more efficient transportation system.[28] An
additional highlight of San Francisco's progress includes the
use of sensors to detect parking-space occupancy in meter
spaces. Through the use of sensors and associated programs,
San Francisco was able to realize a 30% reduction in
greenhouse gas emissions and vehicle miles traveled in
neighborhoods where the program was implemented.[29] With

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[26] *Id.*
[27] *Id.*
[28] I*d.*
[29] I*d.*

its utility, Pacific Gas and Electric Company, San Francisco is investing in wind, solar, *smart* appliances, and battery storage.[30] These new developments create choice and engage citizens by allowing them to send energy back to the grid and thus become *prosumers*.[31]

DALLAS

The city of Dallas, Texas is embarking on new smart city programs which are designed to improve mobility, increase conversation, bridge the digital divide and help residents and visitors better navigate through the city.[32] The progress in Dallas capitalizes on a growing trend in smart city projects, the use non-profit public/private partnerships. The Dallas Innovation Alliance brings the public and private sector together to design and execute Dallas' smart city strategies. In a March 2018 press release, the Dallas Innovation Alliance announced a breadth of projects, including: *smart* irrigation, *smart* water management, and *smart* parking. A partnership with AT&T to launch CityIQ, public Wi-Fi, and various mobility initiatives was also

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[30] Where Smart Cities and Utilities Overlap. (2017, September 21). Retrieved April 25, 2018, from http://meetingoftheminds.org/smart-cities-utilities-overlap-22922

[31] *Id.*

[32] S. (Ed.). (2018, January 24). Dallas pilots more smart city solutions. Retrieved April 11, 2018, from https://www.smartcitiesworld.net/news/news/dallas-pilots-more-smart-city-solutions-2537

announced. CityIQ offers applications including "TrafficPulse," "ParkingView" and "CitySight". These *smart city* investments follow a 2009 request from Oncor (Dallas' regulated transmission and distribution utility) for more than $300 million in smart grid stimulus funds.

NEW YORK

New York has made quite the splash with their smart city objectives and progress. Their smart city goals across the five Burroughs are centered around innovative approaches to building a smarter, more equitable and responsive city, with the ultimate goal to make New York City the most innovative and tech-friendly city in the world.[33] Their efforts yielded them the "2016 Best Smart City" by the Smart City Expo World Congress. The award specifically recognized the *smart city* initiatives as being a catalyst to resolve urban challenges.[34] New York is recognized globally for their *smart city* adoption. This reputation is due to their massive investments *smart city* pilots and their general culture and openness to adapt supportive policies. Specific projects of note include *The Lowline*, an underground park powered by solar,

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[33] Rosencrance, L. (2017, November). NYC smart city projects focus on user experience, transportation. Retrieved April 11, 2018, from https://internetofthingsagenda.techtarget.com/feature/NYC-smart-city-projects-focus-on-user-experience-transportation
[34] I*d.*

LinkNYC, which offers free public Wi-Fi, and NYC *Connected Communities,* which provides open access computer centers. With their electric provider Con Edison, New York continues to look for ways to innovate streetlights, the steam system, rail, and roadways. The shared objectives between New York City and Con Edison include modernizing and integrating the electric infrastructure, making the grid more environmentally friendly, increasing access to *smart* infrastructure for lower-income citizens, and to improve public safety and convenience with newer technologies.[35] Lighting initiatives include retrofitting over 250,000 streetlights with LED bulbs, and partnering with GE to pilot intelligent lamp posts.[36] Additional highlights from Con Edison include: investing $1.3 billion to install nearly 5 million smart meters by 2022, demand management programs to allow 52 MW of demand reductions and 17 MW of DERs, and $40 million to spur microgrid development.[37] New York City is also investing $10 million to develop fast charging hubs in every borough by the end of 2018 and 50 fast charging hubs citywide by 2020 (with each hub hosting 20 chargers).[38]

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[35] *Examples of Smart Communities in Action | Electric Companies Play a Leading* Role (Vol. 2018, Tech.). (n.d.). Washington, D.C.: Edison Electric Institute.
[36] *Id.*
[37] *Id.*
[38] *Id.*

Smart City Technologies + Services

Anything categorized as *smart* connects to the internet or a network and employs two-way communication. While its common to associate most IoT technologies and sensors as *smart city* assets, the *smart city* technologies most prevalent today are generally grouped into the following categories: energy, transportation, mobility, data analytic services, infrastructure, and distributed IoT devices.

These *smart* assets not only provide operational insights and generate massive amounts of actionable intelligence, they also provide tangible benefits. The benefits of *smart* lighting include efficiency, improvements in safety and congestion. *Smart* transportation improves safety, mobility, and reduces environmental impacts. Regarding *smart* energy, the use of distributed energy resources ("DERs") improves sustainability, efficiency, reliability, and resiliency. A promising endeavor for utilities, the use of data analytics and intelligent services can increase efficiency, improve city services, and enhance citizen quality of life.[39]

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[39] *Examples of Smart Communities in Action | Electric Companies Play a Leading Role* (Vol. 2018, Tech.). (n.d.). Washington, D.C.: Edison Electric Institute.

SMART ENERGY

An easy win to begin employing *smart* technologies includes investing in *smart* energy. *Smart* energy technologies and services can include providing services to retrofit residential and commercial buildings so that they are more efficient, use less energy, and generate energy data which can be analyzed. *Smart* grid initiatives, including the deployment of *smart* meters and *smart* streetlights, are also common and can help achieve city goals. With a *smarter* grid, utilities can improve outage detection, field service operations, speed up data capture, and provide for a more resilient grid.[40] Other *smart* energy programs can include the easy adoption of DERs and microgrids.

SMART TRANSPORTATION + MOBILITY

Smart cities include multi-modal transportation, including *smart* traffic lights and *smart* parking.[41] These technologies include EV charging and fast charging infrastructure, *smart* mass transit, and the use of data to improve congestion. Regarding mobility, services improvements are related to the mechanisms in which data travels across technologies. That

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[40] Maddox, T. (2016, August 1). Smart cities: 6 essential technologies. Retrieved April 13, 2018, from https://www.techrepublic.com/article/smart-cities-6-essential-technologies
[41] *Id.*

is, "the ability to seamlessly move in and out of many different municipal and private systems" as an essential service to realize "the promise of smart cities."[42]

SMART DATA

With the proliferation of IoT sensors and *smart* assets, comes tremendous amounts of data. For *smart* cities to realize their potential, they must be able to quickly analyze these disparate sources of information and be able to rapidly deploy actions. Open access data portals are one option that some cities have chosen to publish city data online. Using this data, utilities and other agencies can build predictive analytics to assess future patterns.[43] John Gordon, chief digital officer at Current, powered by GE, describes the potential of leveraging this data:

> *"The pervasiveness of technology and the expansion of open data policies is about to unleash an economic growth engine for urban innovation that we have never seen. We are moving from analyzing data that exists within city hall, to generating new data from sensors that are deployed all across cities for use by multiple departments and people for multiple uses." - John Gordon*

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[42] *Id.*
[43] *Id.*

SMART INFRASTRUCTURE + IOT DEVICES

Smart cities have *smart* infrastructure which leverages data from multiple sources. Leveraging data from infrastructure allows pro-active maintenance and better planning for future demand.[44] Being able to obtain *smart* infrastructure data is reliant on networked IoT sensors and devices. And really, IoT in and of itself, is the key and necessary component that ties everything together in *smart* cities. The ability to extract intelligence out of IoT data and rapidly employing predictive analytics is a key component of *smart* cities. Tom Blewitt, director of principal engineers at UL describes the use of IoT:

> " *In a smart city, information will increasingly be obtained directly from purposefully deployed sensors or indirectly from sensors deployed for another purpose but which gather and share useful information. With this information, freely exchanged, complex city systems can be managed in real-time and, with sufficient integration, to minimize unintended consequences. As dependence on sensors grows, so too will the need that they be reliable and that the systems to which they are connected will be able to tolerate the inevitable failures.*" – Tom Blewitt

Along with the good and insights that accompany IoT sensors and increasingly smart infrastructure, the technologies also present serious privacy and security challenges.[45]

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[44] *Id.*
[45] *Id.*

Smart City Policies + Consortiums

There are a number of *smart* city policies enacted in various jurisdictions throughout the United States. The transformation to become a *smart city* represents not only innovation in technology, but innovation in policy as well. To that end, there are several smart city consortiums and trade allies which promote specific policies in this arena. Notably, the Smart Cities Council, which envisions "a world where digital technology and intelligent design have been harnessed to create smart, sustainable cities with high-quality living and high-quality jobs,"[46] advocates policy in several areas. Common themes include working to implement policies that "encourage and foster innovation, interoperability, industry-led standards development and best practices, transparency, inclusion, privacy and security."[47] Beyond trade groups, specific municipalities and states are moving forward with their own policies to promote *smart city* objectives. Perhaps most notable amongst them, New York's *Reforming the Energy Vision* (NYREV) endeavors to move toward a clean and resilient grid with a focus on reduced emissions and increase distributed generation.

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[46] SmartCitiesCouncil | About Us. (n.d.). Retrieved April 13, 2018, from https://smartcitiescouncil.com/article/about-us-global

[47] Smart Cities Policy Task Force. (n.d.). Retrieved April 13, 2018, from https://smartcitiescouncil.com/task-force/smart-cities-policy-task-force

-DISCUSSION-

As demonstrated in many states, utilities have the opportunity to capture additional value by embarking on *smart city* objectives. The discussion focuses on three imperatives: utility implications and considerations, *smart city* frameworks, and potential utility courses of action.

Utility Implications + Considerations

As evidenced in the Results, there are many facets to the *smart city* concept, and even more when ideating implementation channels. Digitally connected cities can serve to spur economic growth, sustainability efforts, and can aid in the efficient delivery of core services. However, *smart city* objectives cannot be solely realized on the shoulder of utilities. **In many successful pilots, there are partnerships.** The utility being a catalyst to drive public private partnerships, which bring together sometimes opposing stakeholders who share common goals, can benefit *smart city* build-out. These partnerships, which are generally non-political and outlast mayoral administrations, can bring together sources of funding and ensure community support.

Utilities can do their part to spur *smart city* projects by working on the implementation of *smart* grid initiatives, including the rollout of public charging infrastructure, smart meters, and other value-added services. A *smart* grid relies on intelligent infrastructure and big data analytics. The deployment of public charging infrastructure can facilitate EV proliferation in the utility's service area. This proliferation benefits not only the utility, but also the community through cleaner and quieter streets. The utility is also able to leverage their existing infrastructure to roll out new services, such as public Wi-Fi, sensors, distributed energy resources, and energy storage. Offering these solutions in a 'energy-as-a-service' suite can help communities tackle with issues relating to sustainability, energy redundancy and resiliency, and public safety. Utilities need to work collaboratively with their communities to understand their goals, and to share data and leverage other sources of data, where appropriate. These emphasis on data is an important one for utilities to understand to get right; with increased decentralization and blockchain-based approaches to *smart city*, the utility needs to manage and extract value from its data securely.

Smart City Frameworks

Utilities should leverage their regulatory constructs, knowledge of community, and assets to push *smart city* frameworks forward. In many states, utilities can timely recover investments in grid modernization. These investments should be made with *smart city* objectives in mind. Such investments should enable *smart city* programs and services. **The framework for *smart city* from a utility's perspective, should match utility strengths and assets to community needs and objectives.**

The framework should identify and map stakeholders, and clearly identify the utility's value proposition, which includes: financial support/scale and access to capital, planning expertise, and commitment to community. Utilities are trusted integrators with proven expertise on delivering technical solutions in their communities. The transformation to becoming *smart city* enablers is an evolution. The utility cannot approach this opportunity solely utilizing yesterday's tools, policies, or regulations. They, too, must evolve into offering services and monetizing the data insights they have at their disposal.

Utility Course of Action + Recommendations

For utilities to thrive in a changing industry with increased customer needs, environmental and economic pressures, and an evolving business model, *smart cities* presents a very present and relevant opportunity. Furthermore, it's something utilities can say *yes* to!   Utilities can no longer rely on selling one product on a demand and volumetric basis. **Electric utilities must pivot and leverage their platform to provide smart energy solutions.**   This conclusive section outlines eight-core "musts" or recommendations utilities should consider as they embark on their *smart city* journey.

1) **UTILITIES MUST TRANSFORM TO SMART CITY ENABLERS + CHAMPIONS**

Utilities should begin their journey by partnering with their communities and municipalities to understand the common vision. In the successful *smart city* pilots noted in the Results and Appendix, utilities partnered with their stakeholders to coalesce around shared goals.   If these discussions have not commenced, the utility has the opportunity, and perhaps even the obligation, to spur collaboration in this area. The underlying goals will be varied, but emergent themes will arise, and these themes will determine the priorities. The utility must remain flexible,

transparent, and open, but should be active in driving the process forward. Utilities must take a leadership role and engage their customers and stakeholders. **To fully grasp these opportunities, utilities must embrace the disruption.** Delivering the technical aspects of *smart cities* is not a giant leap for technically strong utility professionals. However, to be a *smart city* champion, the requirements extend well beyond technical and engineering acumen. Utilities must begin transforming their external personas and create new revenue streams and business models. This potentially means standing up to municipalities and regulators who have long viewed utilities with a very different set of core infrastructure skills.[48] Such transition also requires the utility to polish their branding, marking, and selling expertise as they go head-to-head with large technology companies including Amazon, IBM, Google, and Tesla, in part.[49] Utilities must lead and foster collaboration by creating alignment among communities and private and public stakeholders. By championing *smart cities*, utilities have the opportunity to remain essential to their communities in a positive, value-additive, forward thinking and collaborative way.

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[48] Socha, D. (2017, March 09). Utilities at the heart of smart cities? Retrieved April 11, 2018, from
https://www.metering.com/magazine-article/utilities-heart-smart-cities
[49] I*d.*

2) **UTILITIES MUST LEVERAGE THEIR CONSTRUCTS TO SECURE FINANCING OPTIONS**

One of the paramount challenges to initiating *smart city* projects is the lack of funding. Similar in New York, where Con Edison leveraged its NYREV construct, utilities should leverage their framework, regulation, and access to capital to help initiate pilots. Utilities should partner with their stakeholders to obtain workable funding mechanisms, including municipal borrowing, public-private partnerships, and integration with federal programs. Utilities must understand how returns on these investments will be realized and measured. Most importantly, utilities must account for who enjoys the benefits of the cost reductions and savings generated from *smart city* investments.

3) **UTILITIES SHOULD TAKE A PHASED APPROACH**

For utilities to be successful, a phased, yet expeditious, approach is prudent. It's important to first begin with the priorities, and not start with technology solution recommendations. Once the priorities are understood, utilities can begin by extracting incremental value out of their energy networks. This includes analyzing data generated by existing assets (smart meters, etc.) to

identify opportunities to add new services or automation.[50]

Additional opportunities in this phase include retrofitting streetlights with smart LED fixtures. Streetlights represent a substantial portion of energy budgets for municipalities and communities. Investing in new *smart* lighting can save cities' money by: dimming lights when activity is low, providing energy savings, and by providing information about outages or other issues. *Smart* lighting can be a platform to build out future *smart* assets, such as data gathering and communications platforms.[51] Other solutions in this phase include the rollout of fast chargers and expanding into *smart* building advising (energy efficiency retrofits, etc.). Demonstrating wins in these areas improve services while minimizing risks and costs in early state initiatives.[52] The next phase includes leveraging utility assets to provide solutions which aren't necessarily energy-based. This could include the utilization of utility data resources to augment municipality and community services.[53] Utilities can also leverage their employees, expertise, and assets to provide new services. Another phase

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[50] *The Smart City Opportunity for Utilities* (Tech.). (2017, May). Retrieved April 12, 2018, from ScottMadden, Inc. website: http://www.scottmadden.com/wp-content/uploads/2017/05/ScottMadden_The_Smart_City_Opportunity_for_Utilities_2017_0524.pdf
[51] I*d.*
[52] I*d.*
[53] I*d.*

should be the consideration of expanding beyond the jurisdictional franchise and into new businesses areas, such as citizen engagement and transportation.[54] Taking a phased approach allows utilities the optionality to extract the most value out of their systems, while offering new consumer choice.

4) **UTILITIES MUST BECOME DATA EXPERTS**

For far too long, too many utilities have been data rich and analytic poor. With the advent of smart meters, IoT assets, supervisory control and data acquisition ("SCADA") systems, geographic information system ("GIS"), and customer relationship management ("CRM") systems, utilities must now invest in analytic platforms to derive the collective value of the disparate systems. Furthermore, utilities should onboard data scientists and complementary roles. Leveraging data in the new energy future empowers the utility in its partnerships for *smart city* advancement. Additionally, understanding the information allows the utility to realize operational improvements to make better business decisions and improve customer satisfaction. With these data insights, utilities must also be prepared to address privacy and security concerns; data governance policies must be enacted.

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[54] I*d.*

5) **UTILITIES SHOULD <u>NOT</u> TAKE ON EVERY SMART CITY OBJECTIVE**

   Although the utility should champion *smart city* initiatives, they should not, nor try to be, the responsible party to implement every objective. There are several initiatives which naturally align to the utility's strengths, and those should be under consideration for utility action.

6) **UTILITIES MUST DEMOCRATIZE ENERGY ABUNDANCE BY EMBRACING A CLEANER, GREENER, ENERGY FUTURE**

   Climate change is one of the most cited challenges of our time. Yet, reliance on energy-based solutions is an underlying tenet of *smart city* proliferation. As evidenced in the discussed pilots, more cities and communities are demanding a decarbonized society and a prompt transition to a cleaner renewable fleet of resources. Common *smart city* goals include cleaner transit, the advancement of energy efficiency and addressment of climate change, and the fostering of sustainability. Therefore, utilities have an imperative to diversify their generation fleets toward renewable sources; this includes embracing customer-owned DERs and energy storage. If the utility views sustainability as a goal and acts on it, they are better able to promote *smart city* programs in authentically and engage stakeholders.

7) **UTILITIES MUST BE CUSTOMER-CENTRIC + EMBRACE THE RISE OF PROSUMERS**

For utilities to thrive in their *smart* city journeys, they must focus on the customer above all else. While many utilities do have a deliberate focus on the customer experience, they need to contemplate whether it is of value to reset the customer experience.[55] Customers are demanding more from their utilities, especially in traditionally regulated states where there has been little choice. Expectations include more services, transparent and competitive pricing, and the power to control their interactions with the utility.[56] To put the customer first, utilities should focus on the customer experience by advancing early wins, including: simplifying transactions, anticipating the customer and developing self-service mechanisms, collaborating with customers and encouraging feedback, and analyzing customer data.[57] As utilities prepare their *smart city* investments, they need to align their spend to customer values, in a very intentional manner. Ideally, this will connect *smart city* investments borne by the utility to customer acceptance and excitement.

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[55] Accenture. Creating a customer-centric utility. Retrieved April 14, 2018, from
http://www.ey.com/gl/en/industries/power---utilities/creating-a-customer-centric-utility#
[56] I*d.*
[57] I*d.*

8) UTILITIES MUST ADAPT TO BECOME INTEGRATED PLATFORM PROVIDERS

The culmination of the efforts described in this report result in the utility adaption to an integrated platform provider. The building of a smart city will never end; there will always be newer technologies, services, and policies. Therefore, the utility needs to reorient and position itself as a platform provider that can thrive in a decentralized environment. As discussed, this transition includes championing and monetizing data, opening platforms, and continuously innovating. With the approaching advances in autonomous vehicles, EV proliferation, the electrification of things, and continual pressure to address climate change, utilities are best positioned to take a leadership role in providing solutions and guiding the narrative in their communities. The utility must also leverage its distribution system to allow for easy and economic onboarding of DERs and intelligent devices. In some communities, highly efficient use of the distribution system, coupled with DERs, could render the transmission system obsolete. **Ultimately, utilities must be transparent, engage their customers, and leverage their assets to create a data and services driven platform.**

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-APPENDEX | SMART CITY PILOTS-

SMART COMMUNITY SPOTLIGHT CITIES [source: EEI]

Public Service Company of New Mexico, Contact: Jon Hawkins
Community: Albuquerque, NM
- <u>Goals</u>: create new jobs, improve citizen well-being, introduce more efficient technology, develop new ways to cut costs
- <u>Lighting</u>: 19,000 auto-dimming LED w/ smart controls + IoT sensors
- <u>Transportation</u>: DC fast chargers and electric buses for rapid transit
- <u>DER</u>: 500 KW storage + solar facility
- <u>Data Analytics + Intelligent Services</u>: 550 solar powered smart parking meters, free Wi-Fi, and a city portal with access to municipal applications

Commonwealth Edison, Contact: Shay Bharamirad
Community: Chicago, IL
- <u>Goals</u>: support economic development and job creation; advance energy efficiency and clean energy; develop clean transit options; address climate change
- <u>Lighting</u>: 270,000 street lights with LED fixtures with dimming capability; off-grid streetlights powered by wind turbines, solar panels, and batteries
- <u>Transportation</u>: screening tool developed by ComEd to site EV charging infrastructure; electric buses; community mobility
- <u>DER</u>: proposing Microgrids and researching smart invertors; smart buildings via *Retrofit Chicago*
- <u>Data Analytics + Intelligent Services</u>: data from smart streetlights to identify systemic failures; 500 sensor nodes around the city; networked public kiosks that provide free Wi-Fi

AEP Ohio, Contact: Scott Osterholt
Community: Columbus, OH
- <u>Goals</u>: drive economic growth; improve quality of life; foster sustainability; improve safety
- <u>Lighting</u>: AEP will upgrade 1,000 street lights to networked LED fixtures, with plans to network another 201,000 street lights pending regulatory approval
- <u>Transportation</u>: AEP investing to install 1,275 EV chargers and 25 fast chargers
- <u>DER</u>: AEP investing $52 million to build 8–10 solar-powered microgrids
- <u>Data Analytics + Intelligent Services</u>: plan to aggregate travel time and route data to provide information to citizens; AEP's smart lighting system will populate a data exchange; web-based applications related to EV charging facilities; 132,000 smart meters, with plan to replace an additional 542,000

Xcel Energy, Contact: Andre Gouin

Community: Denver, CO

- <u>Goals</u>: advance renewable energy and energy grid resiliency; improve air quality and mobility; demonstrate new technologies
- <u>Lighting</u>: upgrading 15,000 streetlights to LEDs across
- <u>Transportation</u>: electrified light rail and DC fast chargers
- <u>DER</u>: Xcel Energy leads two battery storage demonstrations
- <u>Data Analytics + Intelligent Services</u>: deploy technology that will address traffic congestion and safety; installing dedicated short-range communications in 1,500 city fleet vehicles; dedicated short-range communications-enabled freight signal priority program

Kansas City Power & Light, Contact: Kim Winslow

Community: Kansas City, MO

- <u>Goals</u>: improve delivery of city services; improve transportation and connectivity; support connected and autonomous vehicles; increase info sharing, mobility, and accessibility
- <u>Lighting</u>: piloting 125 dimmable LED streetlights by Sensity and installed 122 video sensors, along with Shotspotter technology
- <u>Transportation</u>: installed approximately 900 electric vehicle charging stations, with plans to incorporate automatic billing and optimal time/rate charging control
- <u>DER</u>: KCP&L matched $23M of federal funding to demonstrate a microgrid
- <u>Data Analytics + Intelligent Services</u>: developed an open-access portal with live maps provided by Xaqt; Sprint partnership to develop free public Wi-Fi across 50 downtown blocks, and will extend it to 180,000 more residents; Cisco partnership to develop 25 interactive kiosks

Florida Power & Light Co., Contact: Brian Hanrahan

Community: Miami, FL

- <u>Goals</u>: improve efficiency and promote sustainability; make transit faster, easier, and safer; expand EV access; encourage renewable energy adoption; high reliable, low cost energy
- <u>Lighting</u>: partnership with Silver Spring Networks to install wireless mesh network with efforts to deploy 480,000 smart street lights across the state of Florida
- <u>Transportation</u>: deployed more than 700 EV charging stations and County requested funding to purchase 75 all-electric buses
- <u>DER</u>: FPL installed distributed solar projects and launched energy storage pilot
- <u>Data Analytics + Intelligent Services</u>: partnership with CIVIQ Smartscapes to install up to 300 "WayPoint" digital interactive kiosks; installed smart traffic signal technology; invested over $3B on storm-resilient energy grid"

Pacific Power, Portland General Electric, Contact: Cory Scott

Community: Portland, OR

- Goals: transition to a carbon-free economy; collaborate to become a zero-emissions vehicle city; integrate smart grid technologies with renewable energy; leverage private sector partnerships and autonomous, connected vehicle technologies to reduce congestion
- Lighting: issued $18.5-million bond for LED streetlight upgrade project, which is 85% complete. City is saving $300,000 per month in energy costs
  Transportation: Portland ranks fourth among U.S. cities in electric vehicle (EV) charging stations; PGE owns 10 DC fast chargers and 27 Level 2 chargers and has 100% renewable charging stations; piloting EV car sharing program for low-income
- DER: identifying potential public sites for solar and storage projects that provide resiliency and emergency preparedness benefits.
- Data Analytics + Intelligent Services: partnering with CIVIQ Smartscapes to deploy interactive kiosks around the city with information for wayfinding, multi-modal transit, free Wi-Fi, capability for emergency alerts, and 311 applications; deploying and test nine air quality sensors at three intersections; Portland will install 200 pedestrian and vehicle traffic monitoring sensors; Pacific Power developed a software solution with Schneider Electric that allows commercial building owners to easily upload energy benchmarking data, as required by the city, into the Energy Star portfolio manager

San Diego Gas & Electric, Contact: April Bolduc

Community: San Diego, CA

- Goals: improve the region's energy independence; empower citizens to use electric vehicles; reduce greenhouse gas emissions; encourage economic growth
- Lighting: replacing 14,000 (of 60,000) streetlights with LED lamps, which is a $30 million upgrade effort that includes sensors, monitoring, and adaptive controls that provide the ability to dim the lights on fixtures remotely; installing cameras, microphones, and sensors on 3,000–6,000 street lights in downtown San Diego
- Transportation: SDG&E is installing 3,500 EV charging stations; Free Ride Everywhere Downtown (FRED), a free, electric-powered, smart-phone ride hailing service, began operating in downtown San Diego in 2016; San Diego Metropolitan Transit Authority is investing $2 billion in the electric-powered San Diego Trolley system
- DER: 45-megawatt microgrid provides UC San Diego with 85–90 percent of its power needs. SDG&E operates a 30-megawatt lithium-ion battery storage facility in Escondido that supports the electricity needs of San Diego.
- Data Analytics + Intelligent Services: free Wi-Fi at all public libraries and the convention center; 30 interactive kiosks which will be funded via advertising

Pepco, Contact: Dana Small
Community: Washington, D.C.
- Goals: improved quality of life, comprehensive infrastructure solutions, citizen inclusion through digitally enhanced services, enhanced energy reliability and resiliency
- Lighting: evaluating the potential to upgrade 76,000 streetlights to LEDs with integrated remote monitoring and control systems enabled through gigabit speed Wi-Fi that also provide internet access for District citizens
- Transportation: Pepco is seeking regulatory approval for a project designed to manage EV charging demand on its grid and reduce charging costs for EV owners; Washington, DC's Office of For-Hire Vehicles established an EV taxicab service with 150 taxis in use
- DER: building an advanced microgrid for the Walter Reed Army Medical Center; integrating a series of combined cooling, heating, and power energy centers with solar photovoltaic, district heating and cooling, and energy efficiency assets; Pepco provides state-of-the-art hosting capacity maps and soon-to-be-released heat maps that support renewable energy and partner with customers.
- Data Analytics + Intelligent Services: Washington, D.C. is planning to use data from smart sensors in key economic development corridors to enable digitally enhanced services, drive more efficient city operations, and enhance economic planning efforts; pilot to evaluate managing Washington, DC's curbside and parking assets through demand-based pricing to influence parking space availability, which would have a positive effect on traffic congestion; Pepco piloting "Smart & Connected Corridor" project by installing high-capacity Wi-Fi on Pepco-owned street light poles along a one-mile corridor in the city

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