
Smart Cities, Energy Transformation

Opportunities and Challenges for Utilities

BY JAN VRINS, ERIC WOODS, AND MARCEL VOLKERTS

The development of smart cities and the transformation occurring in the energy industry have much in common. Both developments are rooted in changing customer demands and rapid technology innovation.

There are also shared drivers related to the advancement of the clean energy agenda, including responding to climate change and the transition to a low carbon economy, the possibilities offered by distributed energy resources and the digitization of energy products and services.

While cities represent only two percent of global land use, they are responsible for around eighty percent of global gross domestic product. They are also responsible for around seventy percent of the world's energy use, and roughly the same percentage of greenhouse gas emissions.

With urbanization accelerating, cities move to the forefront of global action on climate change, and the impact of urban innovation programs on the future of the energy sector cannot be ignored.

Today, a significant number of U.S. cities are promoting smart city initiatives. They are setting carbon reduction and renewable energy targets, while implementing clean energy programs supported by

initiatives like the Smart Cities Initiative, the Department of Transportation's forty-million-dollar Smart City Challenge, and the Envision America program, as well as other government and private-sector funds.

City leaders are recognizing that an integrated energy strategy is a crucial factor in delivering improved city services, increasing sustainability, and driving economic development. The mayor of Chicago recently announced that public buildings in the city would be powered by a hundred percent renewable energy by 2025. He also made it clear that he sees this bolstering the city's role as a leader in the clean energy industry and signifying its determination to build a twenty-first century economy.

The energy sector is, of course, also going through a series of profound changes. It is driven by new technologies (including smart grids, digitization, and the Internet of Things) and the shift to renewable and distributed energy sources. This transformation is creating a much more complex energy market that offers greater



JAN VRINS

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choice for how energy is generated, supplied, and consumed.

Navigant characterizes this transformation as the emergence of the Energy Cloud. This model represents the shift away from centralized energy generation and distribution toward a highly distributed, networked, and dynamic grid in which technology-rich platforms such as integrated DER, connected buildings, transportation-to-grid, smart cities, communications superhighway, IoT, and trans-active energy platforms are emerging.

As with smart cities, the energy transformation is entering an important new phase as technologies mature, competition intensifies, and traditional ways of

Jan Vrins is the leader of Navigant's global Energy practice. He advises energy and utility executive leaders on developing and operationalizing their strategy to achieve sustainable excellence. **Dr. Eric Woods** is a research director at Navigant, leading the firm's comprehensive smart cities research. **Dr. Marcel Volkerts** is an associate director at Ecofys, a Navigant company, focused on urban energy and smart energy systems.

doing business are disrupted. In parallel, new cross-sector technologies and market platforms are developing. They will create new businesses and value streams but also introduce even more radical disruption.

Utilities should not approach the emergence of smart cities with a business as usual attitude. New forms of urban energy production and consumption challenge traditional utility business models while at the same time they present a wide range of new opportunities.

In this article, we examine the interplay between these two waves of innovation – smart cities and the Energy Cloud – and suggest how utilities can put themselves at the heart of smart city programs.

Working with Cities to Shape the Energy Future

The changes associated with the energy transformation are creating a space for cities and communities to become more actively engaged in the energy ecosystem. Cities are seizing the opportunity to work with utilities and other stakeholders in the creation of new urban energy systems and solutions.

One of the most obvious ways that cities are influencing these developments is in the push toward a hundred percent renewable energy as part of ambitious plans to reduce carbon emissions. San Diego, San Francisco, Vancouver, and Portland, for example, are among a growing number of North American cities that have committed to a hundred percent renewable energy target.

These cities are setting targets for their utilities to shift to clean energy. Even more significantly, they are encouraging residential and commercial clean energy solutions through programs to support solar PV, storage, combined heat and power systems, and other community energy schemes. This push toward local clean energy will accelerate even more quickly as adoption of Energy

Cloud platforms supporting electrification of transportation, building-to-grid, and more increases.

This shift to distributed clean energy solutions threatens a large segment of traditional utility business. It also presents an opportunity for diversification, as there is a clear role for utilities that can support the expansion of local distributed energy programs.



ERIC WOODS

Support for renewables and new demand-side programs increase the pressure on utilities.

Notably, cities need to ensure that the benefits of innovation in the energy sector are made available to all, including the least advantaged. Community solar programs, for example, are now being developed by more utilities to meet this goal.

In addition, as distributed energy expands, so will the opportunity to implement community-based microgrids and virtual power plants. There may also be opportunities to offer white-label and back office energy services to small local sustainable energy companies that have ties with the community, but lack the resources or experience to act as a full supplier.

Cities are also actively working to transform demand-side energy consumption. These initiatives include building energy efficiency programs, encouraging the

development of heating and cooling networks, building energy management solutions, electric charging infrastructure, and the introduction of smart street lighting.

The drive to greater building energy efficiency in cities provides utilities the chance to offer additional services for energy optimization, energy retrofits, combined heating cooling and power, and advanced energy management services to both public sector and commercial building owners.

Collaboration between city departments and local energy utilities to improve energy efficiency also enables retrofit and rebate programs to be targeted at the most appropriate residents, businesses, and communities.

The city of Seattle, for example, has a goal of reducing energy consumption of public buildings by twenty percent by 2020, compared to 2008. Duke Energy has worked with other stakeholders in the Envision Charlotte programs to reduce the energy consumption in sixty-one of the city's commercial buildings by nineteen percent.

In the process, twenty-six million dollars in energy costs and fifty-seven thousand tons of carbon dioxide emissions were saved or prevented. Vancouver is targeting zero emissions from any new buildings by 2030.

Street lighting is another area where significant savings are being made. It can also be a beachhead into other smart city services. The introduction of LED street lighting can reduce electricity consumption by up to fifty percent, and the additional intelligent controls can provide another twenty to thirty percent in savings.

New York City expects six million dollars annually in energy savings from replacing its two hundred fifty thousand street lights with LEDs and a further eight million dollars in maintenance costs savings. San Diego's recently announced smart street lighting project is expected to save the city 2.4 million dollars annually in energy costs.

It is estimated that over fifty percent of street lights in the U.S. are owned by utilities. The need to increase the efficiency of those lights is a good example of the changing priorities for utilities as they work with cities to reduce their energy consumption.

Like city managers, utilities are also recognizing that lamp poles are valuable assets that can be a platform for a range of intelligent services including electric vehicle charging, mobile communications, and other smart city applications.

Cities with ambitious carbon reduction goals realize that transportation is one of the most difficult areas to address. The need to reduce emissions, as well as the need to improve urban air quality, is making cities strong proponents for the electrification of transportation.

Electrification is only one element in the transformation of urban transportation over the next decade and more. These vehicles (cars, trucks, taxis, bikes, and buses) will increasingly be autonomous, connected, and shared. They will also be part of new mobility as service platforms and innovative business models.

Many utilities are already active in urban electric vehicle programs, but this can be a first step to other service offerings and new partnerships. Working with local utility SDG&E, San Diego is positioning itself to be the electric vehicle capital of the U.S., and sees adoption of EVs as a vital element in its energy and carbon reduction strategy. Transport electrification is also a core element of the Columbus Smart City program supported through the Smart City Challenge grant.

Support for renewable generation by city authorities and new demand-side programs increase the pressure on utilities to deliver infrastructure that can integrate these new resources in a manageable way and accelerate other innovations.

Navigant Research expects the global market for smart energy solutions for smart cities to grow from nearly thirteen

billion dollars in annual revenue in 2016 to more than twenty-seven billion dollars by 2024, representing a cumulative investment of a hundred and ninety billion dollars.

Cities are already the focus of extensive smart grid pilots.

They are demonstrating the increased control, flexibility, and integration made possible by a digital infrastructure for grid monitoring and management.



MARCEL VOLKERTS

Cities are collaborating with utilities where possible, but are also willing to challenge them.

Chicago is working with ComEd and its partners to develop a Smart Grid for a Smart Chicago that will eventually see four million smart meters deployed.

In addition there will be smart grid upgrades to the city's electricity network.

Adaptation to the impacts of climate change is also important. For this reason, resilience is increasingly seen as a key attribute of a smart city. A resilient city needs to understand the complex web of interdependencies between its physical, informational, and social systems.

Electricity networks are at the heart of these interconnected infrastructure and institutional systems. After the experience

of Hurricane Sandy, New York is looking to increase the use of distributed generation alongside other grid and market innovations. That will provide an energy infrastructure better able to cope with future events on that scale.

Smart Cities and Energy Cloud 2.0

These diverse energy-focused programs are coming together with a more integrated and strategic view of urban energy requirements and provision. Consequently, cities are increasingly proactive in their approach to their future energy needs and willing to intercede in local energy markets.

They are collaborating with their local utilities where possible, but are also willing to challenge them and, if necessary, look to alternative providers and partners.

Utilities, of course, are already expanding their renewable portfolios, investing in smart grids, supporting energy efficiency programs, and developing new services and business models. The Navigant white paper, *Navigating the Energy Transformation*, examines these developments; they are creating a new ecosystem of platforms that will shape the Energy Cloud 2.0.

These platforms break down established silos and recombine technologies and services to offer industry players the opportunity to harness new value streams. Smart cities will be responsible for some of the most ambitious and challenging of these platforms, spanning energy, water, buildings, transportation, and diverse public services. Energy issues are woven through this complex fabric, and utilities should be in a prime position to meet emerging city requirements.

As cities reach a critical mass of DER and demand-side innovation, they will need partners who can provide advanced integration, aggregation, and orchestration services. They will also need help navigating the possibilities offered by further waves of innovation. Those are associated with transactive energy

systems, blockchain technologies, and the increasing use of machine learning and other advanced technologies for energy management.

The role of digital system orchestrator for the new urban energy ecosystems should be an obvious one for the local utility – but there will be strong competition from a host of new players eyeing this opportunity.

How Utilities Can Shape Smart City Development

To benefit from the development of smart cities and to play a leading role in their evolution, utilities need to ensure their strategies are aligned where possible with those of the city. In our assessment of smart city programs globally, Navigant has identified five common factors for successful smart cities. Each of these factors presents an opportunity for utilities to establish their own place in these new urban ecosystems.

Strong leadership: The leading cities have not only produced a guiding vision for a smart or future city, they are also embedding these ideas into their programs for service improvement and capital investment. Utilities need to be engaged in local smart city stakeholder groups and leadership teams and participate as active players in their development. Utilities bring unique capabilities and experience to support these programs.

A focus on local priorities and strengths: Each city has its own priorities in terms of social, environmental, and infrastructure challenges, as well as distinct strengths in terms of its history and resources.

Successful smart city programs build

on those assets to develop a unique smart city vision that is aligned with local needs and goals. Utilities need to work with cities to define a future energy roadmap embedded in local realities. They can help chart a viable program for a city to turn ambitious energy and emissions targets into reality.

They also need to demonstrate how energy-related services are connected to a wide range of city priorities such as social inclusivity, economic development, and environmental improvement.

There will be strong competition from a host of new players eyeing this opportunity.

Community engagement: One of the biggest challenges for the further development of smart cities is increasing the direct engagement with citizens. Cities need to work with local communities in all aspects of their smart city programs, from initial strategy to project design, deployment, and data collection.

A smart city strategy that does not engage with local communities has little chance of long-term success. Utilities have a unique connection to all city residents, which could provide a strong basis for furthering community goals as well as helping utilities improve and redefine their customer relationships. Utilities should also ensure that existing and new community energy projects are recognized as part of any smart city program.

Developing a new collaborative ecosystem: Smart city solutions can only be delivered through a network

of partnerships. The leading cities are notable for their ability to bring together public sector agencies, the private sector, and academia to address new challenges.

Utilities should be key players in these emerging smart city networks and can be catalysts for new types of collaboration in the energy sphere. These new networks are also a key element in developing new services and business opportunities in the city of the future.

A data-driven transformation: The rapid growth in the number of sensors and other intelligent devices deployed across the city landscape is creating an immense amount of new data that city departments need to manage and exploit to the benefit of all.

Smart cities are looking at how they can better use that data to improve services and boost innovation. Energy data is a valuable element in any city data platform, and utilities should be proactive players in shaping new data exchanges and markets.

The emerging vision is of a smart city that integrates large and small-scale energy initiatives and solutions, including major infrastructure investments, city-wide improvements in energy efficiency, and DER.

In the process, cities will become clusters of smart energy communities that can exploit the benefits of new energy systems. To achieve this, cities and communities will need partners to develop and manage this complex network of energy innovations, services, and resources.

These requirements offer immense opportunities to utilities as they help cities drive productivity improvement and economic development from energy, transportation, and technology innovation. ❖