

# SMART CITIES AND SUSTAINABILITY INITIATIVE

American Planning Association

April 2015



**American Planning Association**

*Making Great Communities Happen*

## ACKNOWLEDGEMENTS

### Co-Chairs

Robert M. Kerns, Jr., AICP  
Kathleen McMahon, AICP  
David Fields, AICP

### Coordinators/Contributors

Matthew T. Bucchin, AICP, *Project Manager*  
Brad Barnett  
Daniel G. Haake, AICP  
Jessica McVary, AICP  
Lisa Nisenson  
Karen Quinn Fung  
Mike Walsh  
Adrienne Zicklin-Kanter

### Innovation Portal Subcommittee

Michael Burton  
Thomas L. Coleman, AICP  
Robyn L. Eason, AICP  
Cristina A. Garmendia  
Colleen Hardwick  
Sarah McClain, AICP  
Marie Patane Curtis  
Kyla Williams

### APA Staff

Jennie Gordon, AICP  
David C. Rouse, AICP  
Mike Welch

## TABLE OF CONTENTS

<b>I. Introduction.....</b>	<b>1</b>
A. What is APA’s Smart Cities & Sustainability Initiative?.....	1
B. What is a Smart City?.....	3
C. Trends Leading to the Development of Smart Cities.....	4
D. Benefits of Smart Cities.....	6
E. Challenges for Planners.....	6
<b>II. Components of Smart Cities.....</b>	<b>8</b>
A. Supporting Infrastructure (e.g., broadband infrastructure/sensor deployment).....	8
B. Technology/Applications/Data.....	10
C. Sustainability/Resiliency/Energy.....	11
D. Equity/Digital Divide.....	13
E. Governance/Roles of Planners.....	14
<b>III. Findings: Planning Interest in Smart Cities.....</b>	<b>16</b>
A. Socio-Economic Disparity.....	16
B. Broadband Infrastructure.....	17
C. Climate Adaptation/Hazard Mitigation.....	19
D. Renewable Energy and Efficiency.....	20
E. Public Safety.....	21
F. Green Streets.....	21
G. Traveler Information/Decision Making.....	22
H. Freight Supply Chain.....	24
I. Civic Engagement and Local Services.....	25
J. Issues in Collecting and Using Big Data.....	27
<b>IV. Conclusions and Next Steps.....</b>	<b>30</b>
A. Initiative Summary.....	30
B. Recommendations.....	30
<b>Appendix:Smart Cities Initiatives Survey Results.....</b>	<b>a</b>

## INTRODUCTION

As an extension of APA's Sustaining Places Initiative launched in 2010, the Smart Cities and Sustainability Initiative continues the focus on sustainability by addressing recent advances in technology and innovation which lead to smarter, more sustainable, and resilient cities.

APA recognizes that the planning movement and its professional planners are uniquely qualified to provide leadership in defining, analyzing, and debating the issues of sustainability, and in integrating place-based strategies in the broader discussion of sustainability. To guide this initiative, the talents and resources of three APA divisions were utilized – the Sustainable Communities, Technology, and Transportation Planning Divisions. The following white paper overviews the results of APA's Smart Cities & Sustainability Initiative, including the process by which the planning community was involved, the basics and benefits of Smart Cities, and immediate challenges and future opportunities for planners' involvement.

### A. What is APA's Smart Cities & Sustainability Initiative?

#### 1. Initiative Objectives

As established early in the Initiative, the Task Force identified several objectives to frame the process, help identify needed outreach efforts, and to provide guidance regarding the outcome of the overall effort. The objectives included:

- Identify the critical technologies that planners need to stay on top of now and to be forward thinking over the next 20 years.
- Determine what aspects of Smart Cities planners are most interested in and conduct research to determine their level of interest in the topic as well as their interest to be involved in current or future initiatives
- Determine how the field of planning can utilize the information on these critical technologies to add value to their communities and to contribute to economic vibrancy, while being fiscally responsible with limited resources, and addressing issues of responsible use of data.
- Determine appropriate mechanisms of information transfer from the Task Force, to and from planners, and out to their communities so that these critical technologies can be better implemented as part of their daily work activities.
- Identify ways this initiative can go beyond just the written form to achieve a different end result (e.g., convening forums on best practices, roundtable webinars, blogs, discussions, etc.) and how could that be consolidated into this white paper.

#### 2. Listening Phase Framework

Outreach to APA membership was central to arriving at robust recommendations rooted in the experiences, aspirations, and observations of practicing planners. Additionally, outreach to practicing planners, with and without certification or membership, and those working in planning-related professions on sustainable development, was also important for rounding out our understanding of Smart City issues and ultimately identifying recommendations for future actions.

The following five objectives were identified for all the task force's outreach activities:

1. Gauge awareness: To gauge APA members' level of knowledge on various Smart City initiatives, programs, and developments.

2. Stay relevant to planning: To determine the extent to which APA members are interested in the implications of Smart City activities on planning practice, or believe it to be relevant to current or future work.
3. Identify leaders: To identify those who are interested in facilitating additional conversations on Smart City topics; to recruit them as volunteers or peripheral contributors in support of Task Force objectives to continue the efforts after the Task Force has concluded.
4. Be a resource: To connect APA members with resources (such as people, tools, and reports) to learn more about these topics and their connection to planning practice.
5. Sow seeds: To promote the APA's efforts to planners on this topic; to develop literacy for the techniques that communicate this; and to illustrate these processes into action in the course of pursuing the Task Force activities (Walk the Talk).

Several potential outreach methods were considered and shortlisted based on evaluation of how well they achieved each of these objectives, along with available resources and strengths within the Task Force. Out of this process emerged our work on the Survey, the Ideation Tool, and the Innovation Portal.

#### *a. Survey*

The Task Force designed an on-line survey of 14 topic areas to appeal to planners with a wide range of experience or understanding. Survey respondents had the option to read an overview of each topic area and how it related to Smart City developments affecting planning and sustainable communities.

Participants were encouraged to “choose their own adventure” by selecting the as few or as many topic areas to provide feedback. For each topic they selected they were directed to:

- indicate their understanding of the relevance of the topic area to their work (present and future);
- learn more about the topic via a series of curated resources; and
- provide their contact information if they were interested in further contributing their expertise in the topic to the Task Force.

The survey was subsequently promoted through the Smart Cities section of the Sustaining Place Initiative website, to members of the Divisions involved in the Task Force (Sustainable Communities, Technology, and Transportation Planning), through Division communication, as well as all APA members through the APA Interact e-mail sent in December 2014; and on social media through groups devoted to experienced and emerging professionals, touching on any of the 14 topics covered by the survey.

#### *b. Ideation Tool*

The Ideation Tool (<http://smartcities.mindmixer.com/topics/all>) will leverage the information collected in the survey to create an alternative and focused forum for engaging APA members in learning about and applying the principals of Smart Cities to their respective practices.

Ideation tools have emerged as a popular technique for getting geographically dispersed people who share a common interest to collaborate on the creation, refinement, and ranking of ideas. From a planning perspective, they are often used to engage public and non-expert audiences to develop ideas about civic issues.

Ideation tools are a subset of a growing number of online or digital public involvement tools that are enabling a much broader set of engagement activities to accompany public planning initiatives. It is hoped that Smart Cities Ideation Tool can:

- Stimulate interest in the Smart Cities and Sustainability Initiative amongst APA members;
- Provide content for inclusion in this report;
- Provide content and momentum for the Smart Cities and Sustainability Initiatives activities at the 2015 APA National Planning Conference in Seattle; and
- Provide content and focus for the Innovation Portal.

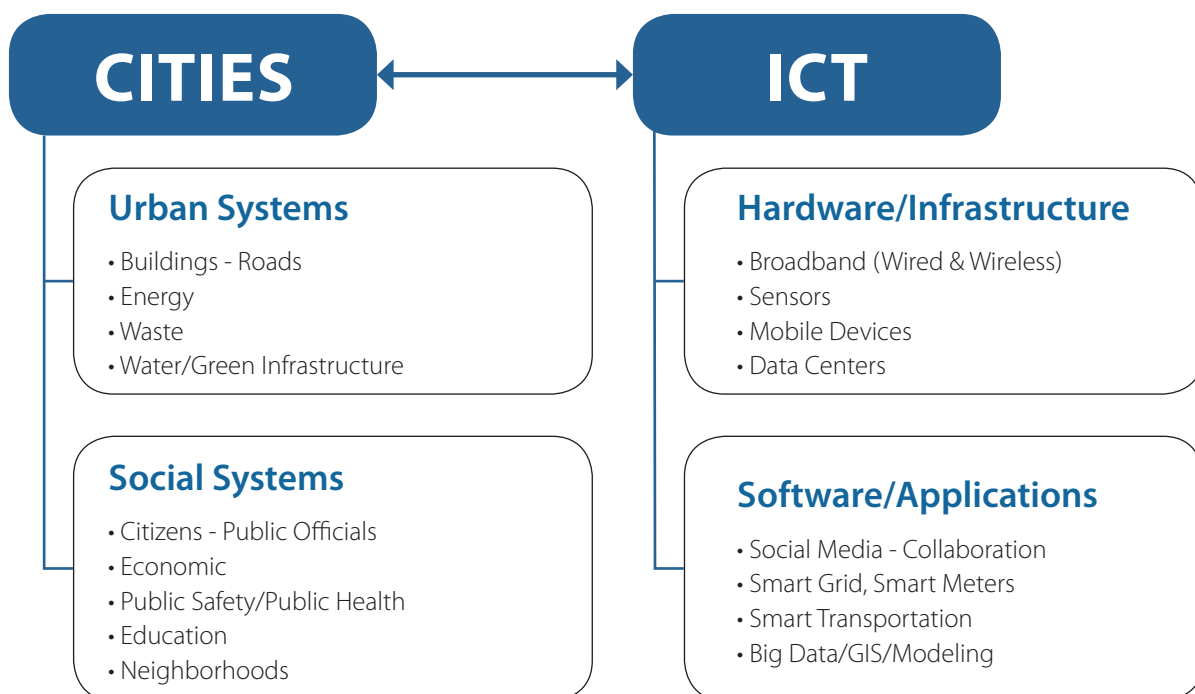
**c. Innovation Portal**

Like the Ideation tool, the Innovation Portal ([www.linkedin.com/groups?home=&gid=8241104&trk=my\\_groups-tile-grp](http://www.linkedin.com/groups?home=&gid=8241104&trk=my_groups-tile-grp)) leverages information collected in the survey as a source of content for the topic areas. The portal provides learning resources, links, background materials and connections to experts on the Smart Cities and Sustainability topics identified as most relevant to APA members.

The purpose of the Innovation Portal is to compile best practices in Smart City technologies. The portal is intended to provide a platform to share innovations that will continue beyond the initial taskforce presentation at the 2015 APA National Planning Conference. The impetus behind the Innovation Portal is to recognize that the applications and technology related to Smart Cities are constantly evolving and there is a need to have a resource that will include a benchmark of the latest technologies. The Innovation Portal will be structured to be searchable by topic or key words and will include links to additional resources as well as the ability for discussion and reviews of applications. APA members and Smart City innovators will be invited to contribute innovation portal content.

**B. What is a Smart City?**

The term “Smart City” has been around since the 1990’s and various definitions have emphasized different aspects of the term. Common elements among these definitions are that Smart Cities use information - communication technology (ICT) to engage citizens, to deliver city services, and to enhance urban systems. The use of Smart City technologies results in cost efficiencies, resilient infrastructure, and an improved urban experience. As opposed to



the term “intelligent cities”, which often refers to the knowledge network to advance economic development, the term “Smart City” emphasizes the integration of technological networks and the built environment. Recently, these two concepts have begun to merge and more current discussions of Smart Cities incorporate the social/human components with the technological realm.

Within this general concept of Smart Cities are the separate components of ICT and urban areas. Cities are defined by both urban systems and the human/social component while ICT is comprised of hardware and software components. The graphic below illustrates the relationship of these components in a Smart Cities framework.

These components alone, however, do not define a Smart City. It is equally important to consider the desired outcomes of investing in these technologies. Smart Cities should be dynamic and exhibit an ability to innovate, reorganize, and adapt to changing conditions. Smart Cities are places where the community is engaged with decision makers and empowered to problem solve in their neighborhoods. Smart Cities should result in healthier environments, safer neighborhoods, and more efficient operations. It is these features that will ultimately be the defining characteristic of a Smart City.

### C. Trends leading to the development of Smart Cities

There are many trends that have led to the rise of Smart Cities – one of which begins with the rapid urbanization of the world’s population. While starting with the onset of the agricultural and industrial revolution in the late 18th century, the rapid transition from rural to urban continues today – with over 50 percent of the population now living in cities. By 2050, it is predicted that nearly 70 percent of the world’s population, which equates to more than six billion people, will live in urban areas.<sup>1</sup> It is this critical mass of people which has provided the foundation for the rise of Smart Cities, and despite only representing two percent of the world’s surface area, they are the economic drivers of the world’s economy accounting for over 80 percent of the world’s gross domestic product (GDP).<sup>2</sup>

Within these cities, dramatic shifts in the way people live, work, and play have contributed to the proliferation and use of many of the ICT applications discussed throughout this white paper. According to a recent study by Microsoft, profound and widespread changes in our political system and improvements in technology will facilitate equally profound shifts in our social, environmental, and financial lives.<sup>3</sup> The following summarizes many of the trends impacting Smart Cities and how it relates to our daily lives.<sup>4</sup>

- *Political Trends.* Socially empowered consumers demand more transparency and accountability from city governments, corporations, and non-governmental organizations.
- *Technological Trends.* The rapid decrease in costs of computing and communication technology has led to the rise of the Internet, “Big Data,” and cloud-based computing. As a result, millions of software- and hardware-based sensors are beginning to be deployed, installed, and connected across our communities – in buildings (e.g., solar power and integrated control systems) and in our infrastructure networks (e.g., water, wastewater, smart-grid energy transmission networks), in our transportation systems (e.g., automated toll tags, signal timing, real-time route data for public transport) and our businesses and workplaces (e.g., virtualization of data and interconnected networks), and even on our personal bodies (e.g., smart phones, watches, and eyeglasses; social software; location-based services; touch and voice interfaces; etc.). In addition, all of these technologies are generating lots and lots of data – data which will be provide the bedrock of many Smart City technologies still to come.

- *Social Trends.* Both the political and technical shifts have led to equally prolific changes in our daily social lives. One of these trends is the blurring of the work/life balance that has been a part of the work environment since industrialization. An increasingly interconnected world (through mobile Smart phones, cloud-based computing, etc.), combined with a more mobile workforce (through telework, flexwork, etc.) has allowed service-industry work to be done almost anywhere, anytime. In addition, societal expectations have also demanded real-time response, which means more people are still conducting work-related tasks long after the traditional workday has ended. “Big Data” and the availability of data have also provided massive amounts of “information” that can be used for and in real-time, Smart City applications. This availability and need for “real-time” response has put consumers in the driver’s seat, oftentimes requiring access to this data and its services, for free. Concurrently, and alternately, these trends have also led to an increase in concerns over privacy, security, and integrity of data.
- *Financial Trends.* Globalization, the flattening of the world’s economy, and the rapid increase of “standard of living” in developing countries has also been an influencing trend regarding the rise of Smart Cities. While developed countries constantly pushing the limits of innovation, they are oftentimes hampered or constrained by outdated infrastructure systems, higher wages, and more expansive social systems (e.g., insurance rates, retirement costs, etc.). Developing countries, however, are sometimes faced with a clean slate. Consequently, while cities in the U.S. are retrofitting Smart City technologies (like signal timing on existing streets or developing individual greet streets), some cities in the developing nations are building complete Smart Cities from the ground up. When combined with increases or decreases in oil/gas prices, recessions, and political turmoil, all of which affect the movement of goods, people, and money across the world, these trends will continue to influence the rise of Smart Cities in both developed and developing countries.
- *Environmental Trends.* Finally, each of the other trends has also influenced the world’s understanding of the “social responsibility” that we have for each other and our natural environment. This has led to an increasing demand for transitioning to a carbon-neutral energy supply system (i.e., replacing fossil fuels with more environmentally sustainable wind, solar, and geothermal energy solutions), greater efficiency in both our built environment (e.g., automated climate control systems, life-cycle materials) and work environment (e.g., virtual meetings, telecommuting, etc.), the rise of the sharing economy.

## D. Benefits of Smart Cities

A Smart City is at heart, a city; the reason for a city to exist is to provide a place for people to live, work, and play with others who want to do the same. A Smart City helps people to live, work, and play while requiring fewer resources. A Smart City is therefore an extension of a sustainable city: creating the most benefit for the most people while minimizing the impacts.

In simple terms, a Smart City offers these benefits by making life easier for members of the community. That ease is provided by operating the community’s systems efficiently, including physical systems (such as transport and power) as well as administration (such as applications for assistance). The benefits accrue to the entire community by reducing energy consumption, reducing costs, and simplifying the time and energy an individual needs to expend to live, work, and play. Cost savings are also realized by community services being able to increase the pace by which they adapt to changing condition; the more one department learns how to better serve the community, the faster all departments can learn the same lesson.



**“When you get to a critical mass, the data on the benefits [of a Smart City] is so compelling: a 50 percent reduction over a decade in energy consumption, a 20 percent decrease in traffic, an 80 percent improvement in water usage, a 20 percent reduction in crime rates.”**

— *The smart-city solution, McKinsey & Company, October 2012*

Reducing the cost (in terms of dollars, time, and energy), offers two additional beneficial spinoffs: individuals with more time and money have more time and money to spend on their individual pursuits. More freedom for personal choice of time and money offer an improved quality of life. At the same time, reduced time and money also spur economic growth, with businesses requiring fewer resources to be financially successful.

Smart Cities also offer the members of the community more venues to participate in their community. By providing connections, Smart Cities allow people to provide input on the direction of their community; learn about goods, services, or volunteer activities; and connect to other people with similar interests, all on their own time and in manners that encourage connection.

The primary benefit of Smart Cities, therefore, is to create a more connected community.

## E. Challenges for planners

Planners occupy a critical place in the advancement of Smart Cities. Planners use a spectrum of data to derive benchmarks that measure outcomes and indicate how plans are improving our cities. Planning, however, is not simply a field of measurement. Data provides the information, from which planners apply critical thinking and community input to identify opportunities for the future. Smart Cities offer so many tools and provide so much data that the challenge for the planner is to know what is useful, what is extra, and what could actually be harmful.

- *Frame the Plan:* A planner's responsibility is to clearly articulate a community's vision with goals and objectives. Once a planner knows what the community is trying to achieve, they can identify when that vision has been achieved through specific performance measures. These measures can be collected and analyzed through the components of a Smart City, with data to indicate what parts of the plan are working, what needs more time, or what needs to be amended. The challenge for the planner is to help the community agree to a vision, so that everyone can see how tools of a Smart City support that vision.
- *Avoid Distraction:* Smart Cities include infrastructure and technology, each of which can make our places more sustainable and more connected. Everyone in the community will have a pet project or recommended measurement tool, but every component comes with the time and expense to implement and manage it. The challenge for the planner is to stay current with the quickly evolving elements of a Smart City, learning how to apply them locally, and not be overwhelmed by intriguing options that do not advance their community's plan. A secondary challenge is to recognize when an existing element is no longer providing value (or a new tool can provide an increased value) so that a change is appropriate.
- *Maintain the Public Trust:* Big Data tells us so many things, but at what point does the community fear what it is telling the government about us? A planner has an ethical challenge to make sure all data is used in the best interest of a free community. Maintaining the public trust also requires a planner to ensure that all community members have equitable access to the information and benefits of their Smart City.

## II. COMPONENTS OF SMART CITIES

The following chapter identifies the basic components of Smart Cities as seen from the public's view. These elements frame the universe of the physical, operational, and programmatic elements of Smart Cities, and include a discussion of the role of planners in each of those components.

### A. Supporting infrastructure (e.g., broadband infrastructure/sensor deployment)

#### 1. Smart Cities Rely on Broadband

All Smart City technologies require a robust and reliable broadband network to operate. Today, high-speed broadband networks are as critical as roads, water, sewer, and electricity. News headlines routinely describe how health care, education, public safety, and government institutions are being transformed by new information technologies that rely on high-speed communication networks. People stay connected to the community through social network applications. Video streaming and gaming over the Internet is replacing broadcast television as the main form of home entertainment. Businesses must have access to broadband networks to be competitive. As noted by the Smart City Council, "To build a proper foundation for a Smart City, you must have high-speed broadband and citywide communications."<sup>5</sup>

In 2010, the Federal Communications Commission (FCC) National Broadband Plan noted that, "Broadband is the great infrastructure challenge of the early 21st century."<sup>6</sup> The plan detailed how investment in broadband infrastructure promotes economic growth, increases civic participation, improves public safety and results in more efficient use of resources. The plan calls for every American and every institution to have access to broadband capability. Such networks must be able to meet today's needs as well as the growing demand for bandwidth.

#### 2. Broadband Trends

In 2010, when the FCC adopted the National Broadband Plan, the definition of broadband was 4mbps download speed.<sup>7</sup> In the FCC "2015 -Broadband Progress Report", the FCC adopted a new standard for broadband of 25mbps download speed. This new standard reflects the increasing demand for bandwidth.

The following trends are some of the major drivers of this demand.

- *Video* – Video includes video streaming services such as Netflix, video on demand, Internet TV, peer-to-peer file sharing, tele-conferencing and video-monitoring. Cisco predicts that video in all forms is expected to represent 80-90% of Internet traffic in 2017.<sup>8</sup>
- *Cloud Computing* – Cloud computing requires centralized data processing and storing. Large data centers must have access to multiple broadband networks for redundancy and a reliable electric grid. Data centers are an essential component of Smart Cities.
- *Multiple Devices* – Most households now have multiple devices connecting to the Internet at any time, including PC's, laptops, television, and tablets. Family members simultaneously streaming high-definition video streams on separate devices will require ultra-fast bandwidth speeds.
- *Machine to Machine (M2M)* – Over time, more devices are becoming connected to the Internet. These not only include laptops and smartphones, but also power meters, washing machines, thermostats, refrigerators, and light bulbs. Many Smart City applications are based on sensors used for smart grid, smart home, smart transportation, smart water, and other applications. M2M applications are used for monitoring, telemedicine, and wearable technology. It is projected that M2M traffic over the Internet will grow by 84% by 2018.<sup>9</sup>
- *Telecommuting* – More people are working part or full time from homes. Even full-time office employees need to access work networks during off-hours. Home occupations that rely on

information technology are more common. This is creating a need for reliable, affordable, and high speed networks to the home.

To accommodate this growing demand, the FCC National Broadband Plan established a goal for the year 2020 of 100 mbps download speeds for homes and one gigabit speeds for anchor institutions such as schools, hospitals, libraries, and government centers. Already communities such as Chattanooga, TN and Lafayette, LA have deployed fiber-to-the-home gigabit networks. Google is investing in gigabit networks in Kansas City and Austin and is planning for more. Cities are recognizing that upgrading networks to ultra-fast speeds of 100 mbps or more has significant economic and social benefits.

### 3. Wired vs. Wireless

Another major trend is the growth in wireless networks such as WiFi and cellular services. In 2013, it was estimated that 22% of the world population owned a smartphone. According to the data from the International Data Corporation (IDC), 87% of connected devices sales by 2017 will be tablets and smartphones.<sup>10</sup> Growing use of wireless networks will require upgrades to existing network access points and construction of new access points such as cell towers. Even with such investments, however, there are concerns that the existing wireless spectrum will become overcrowded and new spectrum auctions will be required.

Although the growth in wireless traffic is impressive, wireless broadband networks still carry far less traffic than fixed wireline networks. One reason is that the growth of mobile data actually increases demand for fixed networks. Mobile connections only travel over the air for a short distance to an access point where Internet traffic is aggregated and carried on high capacity wired connections such as fiber. Additionally, wired networks have more capacity and are more reliable than wireless technologies.

A Smart City will need both robust wireless networks to provide the mobility and convenience that consumers desire and fiber networks to provide the high capacity, security, and reliability advantages that are desired by businesses, health care and telecommuters.

## B. Technology/Applications/Data

The backbone underlying technological infrastructure described in the previous section serves as the platform for a whole host of applications. These applications have the promise and potential to radically alter existing relationships with natural and built environments and systems; with each other and ourselves, and with the organizations and institutions that support, serve, and affect us, from individual moments through to major life stages and entire lifespans.

The new capabilities enabled by technologies open up both quantitative and qualitative differences compared to our everyday experiences. The firms engaged in developing and refining these technologies have varied interests and goals in seeing their solutions or methods adopted and incorporated into projects in the built environment. Most discussions of Smart Cities understandably emphasize the interests of multinational companies seeking to replicate projects in cities around the world, either independently or as part of collaborations with the public sector or higher education. These efforts are often directed at bringing major enhancements to market with the goal of wide adoption, serving as platforms for new applications.

Working simultaneously in parallel as well as in tension with this top-down activity are many others crafting solutions from the bottom-up, combining distributed or alternate funding models with an ultimate open source ethos to build tools that can be made available at low-cost or even free, and broadly available to others for enhancement and adaptation. These projects, which may start from individuals or which sometimes spin out of previously commercial

ventures, utilize models of online collaboration and decision-making to develop tools, and often become the locus of ecosystems involving both individuals and new businesses. These are sometimes known as community technology or civic technology projects<sup>11</sup>, and will exist as an additional or alternative to formal solutions in areas or serving groups that lack financial resources and/or formal organization, or cities in developing countries.

The discussion of the history and philosophy of how a tool, application, or technique came to be may seem to have minimal impact on the outcomes we want to achieve as planners concerned with specific outcomes for our cities and communities. However, in the same way that plans matter as much, if not less, than the process of planning and the conversations spurred by the development of a plan, the story of the development of a tool or technique will play a significant role as people continue to trust their everyday lives to technologies that may diverge from or impinge upon our interests as individuals. The irritations associated with technology now are symptomatic of differences in how problems are framed, how individuals' autonomy, participation, and involvement as citizens or workers are considered and incorporated, and the struck between short-term or task-oriented needs with the broader public interest. Ensuring solutions providers are engaged in early and close collaboration with a wide range of stakeholders and potential users is one way to mitigate this; putting in robust processes for feedback is another.

The core of the proposition for the Smart City is an altered relationship with data — scaling it up, then incorporating its scale into our decision-making algorithmically, to allow for more responsiveness by requiring different or less intensive human intervention. The Smart Cities Council<sup>12</sup> breaks this down as the 3 “C’s” and the 3 “P’s”:

- *Collecting data* – deploying sensors in infrastructure and objects: much of this might be considered transactional data, while others may be voluntarily shared by individuals.
- *Communicating data* — creating networks for working with collected data in real-time.
- *Crunching data* — capabilities for making sense of what’s available.
- *Presenting information* — making it understandable for people with a role in the system or domain.
- *Perfecting systems* — automating the process of adjusting or optimizing systems (typically envisioned as a remote manipulation of a system setting or mechanism).
- *Predicting phenomena* — using the large volumes of historical data to attempt to anticipate events such as inefficiencies, crises or system failures, and to make decisions and take action on them in real-time.

Planners working in organizations participating in the vetting and deployment of such systems will need to be critical and open-minded. Effective collaboration with technical experts, elected representatives, and members of the public will be key to navigating the benefits, tradeoffs, and limitations associated with putting each component of these systems in place.

It is also worth noting that each of these 3 “C’s” and 3 “P’s” can have relational value, as the tasks can be performed in ways that contribute to an ecosystem through data-sharing, or provide opportunities for collaboration or participation across organizational or sectoral boundaries. For example, the use of crowdsourcing for data collection or in presenting information opens new avenues for partnering with members of the public to assist in building broad support and buy-in for sustainable development initiatives. These might variously seen as the extension of existing initiatives such as Citizen Science (open government), built into the model of a product-service sharing systems<sup>13</sup> or as part of alternative models moving away from commoditization<sup>14</sup> for the purposes of sustainable development.

## C. Sustainability/Resiliency/Energy

One of the core tenets that all Smart Cities should embody, is to utilize Smart City technologies to improve the quality of life of today's generation without compromising the ability of future generations to do the same. In today's context, and with particular regard to the intensification of climate change, Smart City technologies will need to help solve some of the most important problems facing the world today – issues which get increasingly more challenging each year.

One of the first issues is addressing short-term increases in population. By 2051, the U.S. is predicted to surpass 400 million persons, which equates to an estimated increase of 81 million people over the next 36 years.<sup>15</sup> The second issue involves a continued migration towards urban areas, where it is estimated that at least two thirds of the buildings needed by 2050 are yet to be built and as much as 80 percent of development is projected to be located on the “edge” of metropolitan areas.<sup>16</sup> In some instances, this growth is occurring in greenfield areas that require costly new infrastructure systems (e.g., roads, mass transit, water and wastewater, parks, etc.). In other instances, this growth is occurring in older metropolitan areas which are already facing the physical and financial challenges of replacing aging infrastructure systems. With a full understanding of the predicted growth in population, combined with the scale of built environment (including both buildings and supporting infrastructure) needed to support this growth, the adaptiveness of our cities will have a profound impact on the U.S.'s ability to address climate change and mitigate its associated impacts.

Many are pinning their hopes on Smart City projects to address our country's long-term ability to address these issues. These projects can and will be used to address long-term sustainability, resiliency, and will help further our transition to a renewable energy future. Some of these include using Smart City technologies to develop smart grids and increase the use of renewable energy, and to design, construct, and manage green buildings, streets, and transit. On a national infrastructure scale, Smart City technologies are being used to make progress on several fronts. One of the first involves the development of a “Smart Grid,” which generally refers to a class of technology being used to adapt the energy supply delivery system based on actual demand. Using computer-based controls and automation, these “smart grids” offer both energy suppliers and end-users improvements in energy efficiency while being more reliable and affordable. At its core, the automation technology integrated into a “smart grid” allows the utility to “adjust and control each individual device or millions of devices from a central location.”<sup>17</sup>

Smart City technologies are also playing an important role in America's clean energy efforts by providing real-world solutions for reducing emissions that result in climate change. Contributing to this “revolution,” dramatic improvements in wind energy technology and operations have lowered costs and tripled wind supply in the U.S since 2008.<sup>18</sup> In fact, from 2009-2013, wind represented approximately 30 percent of all new electrical generation in the U.S.<sup>19</sup> A decrease in cost has also spurred a dramatic shift in the use of photovoltaic technologies (i.e., solar power), not only to reduce the demand for end-users, but to add utility-scale supply as well. Although this shift started with five government financed projects totaling 1,500 megawatts (MW) of capacity, the private sector (through 17 privately financed projects) has either built or is constructing an additional 3,800 MW of capacity.<sup>20</sup>

Smart City technologies are also being used to design, build, and construct green buildings, streets, and transit. Beyond just the “technical” construction of the building or street itself, Smart City technologies can be used to influence where they should be built. At its core, however, the built environment is an essential piece of the Smart City framework. Since buildings are the single biggest source of carbon emissions in the world and account for over 50 percent of all energy consumed, the true change to energy utilization can be significantly improved through Smart City technology.

A planner plays a unique role in promoting Smart City technologies to improve sustainability, resiliency, and to improve our energy future. Planners are advocates in the national and regional conversations, staff members who prepare reports and studies, and enablers of Smart City projects. It is at the local level, however, where a planner really has an

influence on controlling and shaping the built environment. Through the use of regulatory codes and ordinances, a planner can either help implement Smart City solutions, or create barriers to them. At the local level, a planner oftentimes also plays a role in developing long-term goals and plan for their community. As one of the few professions that is tasked with taking both a citywide and long-term perspective, a planner needs to have a holistic understanding about how all components of the built environment – whether it is housing and land use, streets and infrastructure, parks and public health, finances or economic development – work together. It is this understanding that allows the planner to be a facilitator and leader at the table. Consequently, each planner needs to better understand Smart City technologies, analyze their existing regulatory framework to remove barriers, educate elected and appointed officials on the benefits, and otherwise promote the use of Smart City solutions in all aspects of their work.

## D. Equity/Digital Divide

Smart Cities have the potential to transform city planning as well as the fields of health care, economic development, government, and education. New applications are being developed every day that create cost efficiencies, improve job productivity, result in innovation and improve the quality of life for citizens in urban areas. The advantages of living in a Smart City, however, will not be available for those who cannot access on-line services or for those who lack the skills to use the technology.

This gap between the technology “haves” and “have nots” is called the digital divide. While this white paper describes the many benefits of Smart Cities, it is equally important to address the social equity issues that arise when some groups do not have access to broadband technologies. Data from the National Telecommunications and Information Administration (NTIA), indicates that almost one-third of homes lack Internet connections.<sup>21</sup> Seniors, low-income households, and individuals without a college education are less likely to have access to high speed Internet access in the home. While minority neighborhoods and rural areas have made gains over the last few years, there are still pockets where digital adoption is significantly less than other areas.<sup>22</sup>

Reaching these areas is important because cities, and planners, are becoming more dependent on web sites and mobile apps as avenues for public involvement. For example, government forms and planning documents are now mostly on-line. City council meetings are streamed live over the Internet using high speed connections. More often households need high speed Internet for telework, telemedicine, and distance learning applications. Given the growing reliance on Internet technologies, planners must address the different reasons why people are not on-line including issues regarding lack of broadband access, lack of broadband adoption, and lack of technology skills. Although there has been much news coverage about the Google fiber initiative in Kansas City and Austin, Google uses a “fiberhood” model. In this model, a certain percentage of residents in a neighborhood must agree to sign up for Google service, before the fiber will be deployed in their neighborhood. It is likely that these “fiberhoods” will be in more affluent neighborhoods. Planners should ensure that every neighborhood has access to and benefits from the deployment of Smart City technologies.<sup>23</sup>

Affordability of broadband services is another key reason why many households fail to subscribe to broadband services. Senior citizens on fixed incomes simply can't afford high speed service that cost \$60 to \$80 a month. .... The NTIA notes, “. . .the continued persistence of financial and other barriers to Internet use is an urgent problem for policymakers because the ‘Internet has become integral to daily life in the United States’.”<sup>24</sup>

Lack of technology skills is another contributing factor that hinders broadband adoption. Additionally, some people are reluctant to go on-line because they don't think the Internet is relevant or they mistrust the technology. Plans to adopt Smart City technologies, must contain strategies to address all of the reasons households are on the wrong side of the digital divide.

## E. Governance/Roles of Planners

Smart Cities have the direct potential to increase the quality of governance by utilizing applications and data to provide most cost efficient services and receive more direct input, allowing responses to adapt more immediately to citizenry needs.

Smart Cities allow government to better serve the population by improving the feedback loop from which the public can voice their opinions; the clearer the voice of the people, the better the support government can provide. This is especially true of community members who are frequently less connected and even disenfranchised. Offering more and easier ways for these populations to participate in the public process, should provide both a greater quantity and quality of that input. Input can be converted into actionable items and the effectiveness of those actionable items can be measured in real time, allowing government to evolve with more efficient responses.

Smart Cities also help the government share information about the services provided, hopefully reaching more members of the community and connecting them with the wealth of offerings. The last component of the improved public-government feedback loop is a direct channel for suggestions for improvements and complaints which will require response and improvement.

Planners are one of the key agents in the municipal feedback loop: promoting public participation with an inclusive and transparent process, overcoming barriers and historic deficiencies in the involvement process for underserved populations or regarding underperforming programs, identifying options for improving the community's quality of life, reducing costs, and responding to public input on current and proposed projects.

The planner's role also extends to ensuring that the expanded capabilities of a Smarter City are used to support the community and its vision without overstepping. Private businesses may collect and analyze data to provide goods and services that can be sold at a greater profit, the government's role is to collect and analyze data to provide goods and services to maximize the benefit to the community. The planner's role is to ensure the ability to collect digital information on a massive scale is always pointed at supporting the community's vision and goals and avoid the potential for these tools to be abused and used for power for power's sake. There is a second nuance in this distinction: not only is the planner's role to ensure the components of a Smart City are used for the public good, but the planner is also responsible for communicating the rationale so that even well intentioned efforts are not misperceived as overreaching.



### III. FINDINGS: PLANNING INTEREST IN SMART CITIES

The following chapter identifies the key elements that planners need to know about Smart Cities, how planners are currently using these elements (based on input received during from the Smart Cities Taskforce process), and how planners can start using these elements to create great places. Each component also includes a highlight of the recurring themes identified in the input and the topics planners are interested in learning more about.

#### A. Socio-economic Disparity

##### 1. Overview

Socio-economic disparity was ranked as the second most important topic by planners who took the Smart City and Sustainability Task Force survey. One survey respondent commented, "Socio-economic disparities are the main obstacle for building smart cities in a sustainable way." A report from the Benton Foundation identifies vulnerable populations that are at risk of being excluded from the benefits of a digital economy, or Smart City technologies. These populations include children, people with disabilities, low-income families, communities of color, rural residents, and senior citizens.<sup>25</sup> To address these social equity issues, communities must address the cause of the digital divide disparities.

##### 2. Access

Communities must have access to reliable, high-speed broadband networks. At the federal level, the USDA Rural Utilities Service and the NTIA Broadband Technology Opportunity Program have provided funds for the development of fiber networks. Some states have invested in broadband networks and have provided funding to localities. The majority of the federal and state funds, however, have gone to incumbent telephone companies to upgrade their networks while offering little support for locally implemented networks. More frequently, municipalities are now taking the lead in building out fiber infrastructure.<sup>26</sup> A recent report by the White House recommends removing state prohibitions against such municipal broadband networks.

Whether a community is working with the private sector, or investigating the feasibility of building a local network, planners should identify broadband as critical and should establish broadband priorities in their comprehensive plans. A survey of planners in 2013<sup>27</sup> indicated only 15% of comprehensive plans addressed broadband issues. Of those that did have policies for broadband the most common approaches included:

- Offer incentives to broadband providers to upgrade broadband networks;
- Identify co-location sites for wireless facilities;
- Develop a broadband plan for the community;
- Place conduit or fiber in the right-of-way during road construction activities; and
- Build public computing centers to provide access to technology.

##### 3. Affordability

As noted by the National League of Cities, "A variety of costs are associated with home broadband adoption, including purchase of a computer and equipment to enable broadband, startup service costs, and recurring monthly subscription fees."<sup>28</sup> At the local level, cities often partner with non-profits and schools to provide free laptops or tablets to low-income households. FCC programs such as the universal service fund and e-rate are intended to address the affordability issues. Still, the cost of broadband is out of reach for many households. Some communities have constructed free Wi-Fi networks or have included public hot spots at libraries, schools, and government buildings. Encouraging competition among broadband providers has also been a successful strategy to attain more cost effective Internet services.



## 4. Adoption

Lack of broadband adoption can also be the result of lack of technology skills or lack of awareness about the benefits of broadband technologies. Libraries have been leaders in establishing public computing centers that offer training, as well as access to Internet technologies. Many non-profit organizations are also providing assistance to communities to improve digital literacy among vulnerable populations, including the Gates Foundation, Blandin Foundation, and the foundation arms of technology companies and telephone providers. Improving workforce skills or promoting telework opportunities through training and technical assistance is sometimes included as part of a local economic development strategy. Another aspect of broadband adoption is to design technology applications that are accessible to people with disabilities. E-government applications should comply with the Americans for Disability Act standards for web sites.<sup>29</sup>

As noted previously, the benefits of Smart Cities will not be realized unless all citizens have access to these technologies.

## B. Broadband Infrastructure

### 1. Broadband Issues

For planners to take an active role in planning for broadband infrastructure they must understand the issues related to broadband demand and broadband networks. The PAS Report #569, Planning and Broadband: Infrastructure, Policy and Sustainability, is a good broadband primer for planners. Among the issues the report discusses are:

- *Connectivity* – As noted previously, the current definition for broadband is 25mbps. For businesses and institutions a minimum of 100 mbps or even a gigabit is required for these organizations to be able to compete in the global economy. According to the statistics from the national broadband map, 83.8% of the population has access to at least 25 mbps advertised broadband speeds while 59.8% have access to 100 mbps advertised speeds. (<http://www.broadbandmap.gov/>) This figure varies widely among states, however, and it is important for planners to identify underserved areas and develop strategies to upgrade broadband services in these neighborhoods.
- *Costs* – Communities with higher broadband costs are at a competitive disadvantage. It is important to examine not just the availability of service but to determine if the cost of service is comparable to peer communities. Additional broadband services are typically more expensive in rural states due to issues related to population density and lack of competition. Even urban areas are concluding that where choice of providers is limited, broadband service is more expensive. Some municipalities are building their own open access networks to attract additional providers and introduce more competition in the market place.
- *Redundancy* – Redundancy in a broadband network means having a back-up system in case of a service outage in the network. While a business can subscribe to a back-up service to guard against service outages, if both providers use the same “middle mile” network to connect to the Internet backbone this solution does not offer complete redundancy if there is a network failure. Path redundancy offers two paths to the Internet backbone. If the fiber is cut, data traffic can be re-routed to another path elsewhere on the network. Many Smart City applications are being used to manage critical infrastructure such as electric grid, water plants, and wastewater treatment facilities. A redundant broadband network is essential to avoid disruption of these services, especially during severe weather events when public safety is a primary concern.

## 2. Incorporating Strategies into Comprehensive Plans

Some communities are taking a pro-active approach to planning and deploying broadband infrastructure. The Institute for Local Self Reliance maintains a map of community owned broadband network (<http://www.muninetworks.org/communitymap>). In February, 2015 the FCC took action to preempt state laws that would prohibit community broadband systems (<http://www.fcc.gov/document/fcc-preempts-laws-restricting-community-broadband-nctn>).

While there is growing momentum for municipal broadband networks, the vast majority of broadband services are still being provided by the private sector. Whether the network is a public or private network, every community should be incorporating policies into their comprehensive plans that will facilitate the deployment of these networks. Such policies may include:

1. Create a broadband task force & develop a broadband plan.
2. Work with providers to improve broadband networks – especially in underserved areas.
3. Amend subdivision regulations to require placement of conduit or dark fiber in the right-of-ways during road constructions.
4. Adopt right-of-way policies to coordinate with providers on management and construction issues for fiber deployment.
5. Amend zoning regulations to address wireless facilities.
6. Inventory community assets and identify co-location sites for data centers and wireless facilities.
7. Investigate investment in an open-access middle-mile fiber network.
8. Address issues regarding redundancy.
9. Identify broadband facilities as essential infrastructure for downtown plans, tax increment finance districts, industrial parks, and other plans.
10. Deploy a fiber network to connect public buildings and anchor institutions.
11. Aggregate demand to attract broadband investment.

## 3. Guidebooks and Models

As part of the input that was received from planners in the drafting of this whitepaper, there were many comments suggesting that model ordinances or guidebooks would be useful tools for planners. Below are some links to such resources.

Model Codes & Policies	Broadband Planning Toolkits
<ul style="list-style-type: none"> <li>• University of Wisconsin – Extension, “Collected Broadband Regulations”, <a href="http://broadband.uwex.edu">http://broadband.uwex.edu</a></li> <li>• CTC Net, “Broadband Strategies Checklist”, <a href="http://www.ctcnet.us/library/">http://www.ctcnet.us/library/</a></li> <li>• California Emerging Technology Fund, “Model Policies and Ordinances”, <a href="http://www.cetfund.org/resources/information/model-policies-and-ordinances">http://www.cetfund.org/resources/information/model-policies-and-ordinances</a></li> </ul>	<ul style="list-style-type: none"> <li>• National Telecommunication and Information Administration, “Broadband Adoption Toolkit”, <a href="http://www2.ntia.doc.gov/BTOP-Reports">http://www2.ntia.doc.gov/BTOP-Reports</a></li> <li>• Fiber to the Home Council, “Community Toolkit”, <a href="http://toolkit.ftthcouncil.org/">http://toolkit.ftthcouncil.org/</a></li> </ul>

## C. Climate Adaptation/Hazard Mitigation

The increasing frequency and intensity of natural and man-made disasters, including extreme drought, wildfires, hurricanes, and tornadoes, has resulted in the need to better prepare for these events to reduce the loss of life and

property, as well as identify policies and strategies to reduce risks associated with these events in the future. The following paragraphs identify Smart Cities-based strategies, which planners have employed for successful climate adaptation and hazard mitigation.

- *Planning Information Exchange:* Web-based meetings and seminars provide an opportunity to engage planners in dialogue to share ideas and strategies for addressing climate adaptation and hazard mitigation within communities. For example, the Natural Floodplain Functions Alliance facilitates monthly conference calls and webinars to provide information on strategies related to the protection and management of natural floodplains in an effort to minimize hazards associated with flooding. The American Planning Association, in partnership with the Federal Emergency Management Agency and the Association of State Floodplain Managers, plans to implement a similar information exchange in the near future.
 

Similarly, the Climate Adaptation Knowledge Exchange is dedicated to establishing a shared knowledge for effectively managing natural and built systems in the midst of climate change by providing resources, facilitating an online platform dedicated to information exchange, maintaining a directory of relevant professionals, and identifying additional resources.
- *Geographic Information Systems:* Successful climate adaptation and hazard mitigation strategies are largely related to the location and type of development present within sensitive zones. The use of geographic information systems (GIS) and associated data provide a foundation for planners to evaluate the risks associated with natural disasters, as well as develop strategies for mitigating future risks.

Throughout the listening phase of the Initiative, respondents identified Climate Adaptation and Hazard Mitigation as important topics which are relevant now, as well as in the future. While respondents recognized the importance of these topics, Climate Adaptation and Hazard Mitigation were not identified as primary topics for additional learning. However, one respondent referenced the work of the National Renewable Energy Laboratory, an organization dedicated to the use of technology to address energy challenges.

Resources:

<https://www.planning.org/nationalcenters/hazards/planninginformationexchange>

<http://aswm.org/watersheds/natural-floodplain-function-alliance>

<http://www.cakex.org/>

<http://www.oas.org/cdmp/document/papers/gisconf.pdf>

[http://www.nrel.gov/tech\\_deployment/disaster\\_recovery.html](http://www.nrel.gov/tech_deployment/disaster_recovery.html)

## D. Renewable Energy and Efficiency

Renewable energy and efficiency are fundamentally linked to climate adaptation and hazard mitigation, due to their relationship to climate change. Planners are increasingly proactive in helping to advance the use of renewable energy sources such as solar, wind, and geothermal power, as well as encouraging efficiency through smart growth, transit-oriented development, site selection, building design, and xeriscaping. The following paragraphs identify strategies, which planners have identified for improving the use of renewable energy and efficiency in their communities.

- *Smart Meters and Knowledge Exchange:* A significant portion of energy is used within homes and businesses, and the use of smart meters, devices that record and report the consumption of energy, has provided an opportunity to communicate energy consumption to individual consumers and provide options for reducing consumption levels. Mission Data is a national coalition of innovative technology companies, which provide consumers with access to their

energy consumption to improve efficiency. (Resource: <http://www.missiondata.org>.)

Similarly, the Rocky Mountain Institute, an organization devoted to the efficient and restorative use of resources, provides a knowledge center to share information on renewable energy and efficiency. For example, the Rocky Mountain Institute features publications of local governments, which have employed the use of solar energy and efficiency strategies through their traditional utility systems to encourage renewable energy use, as well as improved efficiency. (<http://www.rmi.org>.) Other organizations focused on energy efficiency include Southface (<http://www.southface.org>), Advanced Energy (<http://advancedenergy.org>) and the Southeast Energy Efficiency Alliance (<http://www.seealliance.org>).

- *Transportation:* Single Occupancy Vehicle miles traveled significantly contributes to greenhouse gas emissions and energy consumption. The United States Department of Energy established the Clean Cities Program to reduce petroleum use in transportation. The Clean Cities Program establishes partnerships between private companies, local governments, fuel suppliers, vehicle manufacturers, laboratories, and government agencies to implement alternative transportation projects. The Clean Cities Program offers an online toolbox to participants to provide information, resources, and relevant data, such as maps, which identify alternative fueling locations, types of alternative fuel vehicles, and petroleum reduction planning tools (<http://www1.eere.energy.gov/cleancities>).

In the listening phase of the Initiative, respondents identified renewable energy and efficiency as an extremely important topic, now and in the future, second only to green building and site design. While the topic was identified as very relevant, less than half of the respondents expressed a desire to learn more about the topic. In addition to the above referenced resources, a respondent also noted the relevance of Greentech Media, a source of news and research on green technology and renewable energy ([www.greentechmedia.com](http://www.greentechmedia.com)).

## E. Public Safety

Technological solutions continue to make our nation safer. From a homeland security standpoint, technology has allowed critical infrastructure and facilities to become more secure, while maintaining reasonable public access. Despite the benefits, some technologies like license plate readers and facial recognition cameras have been controversial for some applications.

More locally, law enforcement and analysts have partnered to use GIS and other tools to develop analytical, evidence-based approaches to track and fight crime. While the use of these technologies started in the 1990's, many smaller agencies has begun to realize the real power and availability of this analysis to make a difference in their communities. Many have even banded together to track regional crime patterns.

Neighborhoods have embraced technology to harden and make public spaces more defensible, while still open to the public. Many have used technology to apply lighting where and when it is most appropriate while managing light pollution and energy usage. In addition, great strides have been made to secure transit facilities across the nation. Depending on the system and facility, technologies protect users from a broad spectrum of threats, from everyday crime to terrorism.

As part of the Smart Cities Initiative, survey respondents ranked public safety as a topic that was important to planners, however overall knowledge on the subject was very low. Survey respondents showed an overwhelming (80%) demand to learn more about the topic.

## F. Green Streets<sup>30</sup>

Streets serve an important role in the livability of neighborhoods. For many years, streets were viewed as a means to efficiently move vehicles through a neighborhood. Today, through initiatives like Complete Streets, they have begun to serve their real purpose as a common space that ties a neighborhood together, instead of separating it. Another aspect of Complete Streets is to include broadband infrastructure in the streets as they are being constructed.

As communities recognize the power of this collective space, efforts are underway to create Green Streets, where the street becomes a means to improve the collective environmental sustainability of a neighborhood. Streets by their nature create and collect stormwater run-off. Through the use of technology and innovative design techniques, Green Streets can minimize the amount of polluted grey water run-off from the neighborhood and into our rivers and water sources. To create a Green Street, planners balance the amount of run-off created and the streetscape's ability to retain and treat run-off, especially applying the following techniques.

- *Permeable Surfaces* – While permeable pavement has been available for over 20 years, it has recently become an acceptable pavement surface in many communities. Even in communities which do not approve of the use of permeable pavement for vehicular travel lanes, it can serve as a mitigation technique for parking areas, bike, and pedestrian facilities. Similarly, pavers can be spaced to maximize the ability of rainwater to pass through the road and be absorbed by the ground. While these pavers are effective, care must be taken to account for the type of traffic on the street, in particular its effect on bicyclists.
- *Pavement Width* – Reducing the overall space that is taken up by impervious surface can be the most effective means of limiting the amount of stormwater run-off created by a street. Widths can be reduced by narrowing or reducing travel lanes, or by creating fully multiuse facilities. It is important for planners to consider the full use of the street when designing Green Streets, and to find the appropriate balance for the neighborhood.
- *Streetscape Treatment* – Designing the streetscape to retain and treat the diminished amount of stormwater is the other critical piece to creating a Green Street. Using landscaping techniques like rain gardens, bioswales, plantings, and trees that thrive in the street environment will allow neighborhoods become more sustainable and a responsible member of the larger community.

As part of the Smart Cities Initiative, survey respondents ranked the importance of green streets very high. In particular, they were interested in the inter-relationship between Green Streets and freight. Smart Cities technologies, such as modeling the water cycle and sensors to monitor water quality, should be included as part of the planning for green streets.

## G. Traveler information/Decision Making

The emergence of the Smart City offers many ways in which the role of transportation – both public and private – can allow travelers to make more informed decisions and thereby enhance the vitality of cities large and small. Informed decisions help achieve many cities' highest priorities, including economic development and competitiveness, employment opportunities, environmental sustainability, public health, quality of life, safety and security, as well as issues surrounding equity.

The definition of the Smart City with regard to transportation varies, but generally refers to the employment of information, communication, and technology to allow for real-time decisions that maximize efficiency and conservation.<sup>31</sup> The use of sensors on vehicles, in roadbeds, and in other infrastructure, as well as video monitoring, GPS data, mobile phone signals, satellite images, air traffic control data, reservation systems, smart fare cards, and yet other types of information, all contribute to a more effective use of time and resources.<sup>32</sup>

There are a variety of ways in which one can see the manifestation of Smart City transportation:

- The optimization of freight movement through the maximization of capacity and unobstructed routes.
- Improving traffic management by giving drivers and users of public transit information about congestion and other phenomena that cause delays as well as alternatives to avoid these issues.
- Reduction of time for drivers to find parking spaces.
- Reduced emissions by allowing cars and trucks to arrive at their destinations more effectively.
- Providing public transit users with information so that they can choose the quickest option for getting to school, the office or other appointments.
- More informed road and transit planning so that investments can be made with maximum effectiveness.
- Faster assistance for motorists through the use of automated emergency response systems.
- Road congestion pricing as a replacement for a fuel tax offers a worthwhile opportunity to reduce traffic and raise money.<sup>33</sup>
- While European cities are much more frequently cited for their employment of Smart City transportation strategies, there are ample examples of U.S. cities' embrace of these tools.
- Intelligent Transportation Systems incorporate a wide variety of technological and communications tools to offer drivers current information on highway congestion as well as other reliability and safety issues. As of 2015, the U.S. Department of Transportation announced \$2.6 million in grants to expand real-time travel information in 13 cities. This will allow for a more coordinated and effective transportation system, both by alerting drivers of congestion and inform them about alternate routes. These are referred to as Integrated Corridor Management Grants because they coordinate information from different regional sources and allow travelers to make real-time decisions.<sup>34</sup>
- Real-time parking information has diminished a variety of urban challenges. For example, San Francisco's Municipal Transportation Authority recently completed a pilot evaluation of real-time parking information that made parking easier for drivers. By reducing the time drivers spent circling in search of a parking spot, the introduction of this resource reduced fuel consumption and traffic, which also improved vehicle flow for buses and private vehicles, and made it safer for pedestrians and bicyclists through the diminished number of distracted drivers and double-parked cars.<sup>35</sup>
- Through the use of automatic vehicle locations systems which rely on satellite technology, public transit systems, like New York City Transit Authority, are more efficiently and cost-effectively deploying a network of fixed-route buses as well as paratransit vehicles. By tracking the location of buses throughout the system, dispatchers can modify schedules to keep service even and predictable, a great benefit to customers. The information also reduces the need for redundancy since buses can be relocated with far greater ease, thus reducing costs to the operator.
- Through the use of "Connected Vehicle", which relies on wireless communications, vehicle sensors and global positioning system navigation, transportation departments can convey information about roadway hazards. This enhances safety and reduces roadway congestion.<sup>36</sup>
- The introduction of car-sharing programs which rely on the use of smart phone apps or online access in United States cities has reduced the need for car ownership. In fact, one rental car has been cited as taking the place of 15 independently owned vehicles. With substitution of this shared resource, there is a lower demand for parking and costs to individuals.
- Bicycle-sharing programs which rely on smart technology improve quality of life by offering a healthier option that reduces traffic and fuel reliance. Capital Bikeshare (Washington DC) was the first such program in the United States. It has expanded to surrounding counties, but bike share systems now exist in cities of all sizes and climates throughout the United States. With the swipe of a

membership card, bike share programs allow users to pick up a bicycle at any bike station and return it to any other station. Providing information about where bikes are available for sharing plus where bike routes offer access, creates an additional dimension for a city's transportation system.

## H. Freight Supply Chain

Livable neighborhoods are often defined as those where residents can travel to work, school, and to the store without requiring a car trip. However, how useful is walking to the store if there is nothing there to purchase? While major livability policy shifts have improved neighborhoods for residents, many have forgotten to account for delivery traffic to neighborhood shops, restaurants, and grocery stores. This has accounted for increased cost within the supply chain but more importantly to less effective transportation networks for local residents as trucks clog narrow streets as they make deliveries to local businesses. To address these issues, planners have worked with the private sector to improve policy and to implement the following Smarter Cities solutions.

- *Off-Hours Delivery* – Significant work has been completed by planners in New York City and Atlanta to evaluate the feasibility of shifting neighborhood deliveries overnight to alleviate the congestion caused by improperly parked delivery vehicles during the day. However, significant challenges remain to implement these policies, mainly noise mitigation and changes required within the supply chain to serve customers that demand both day-time and others who are willing to take night-time deliveries.
- *Parking Appointments* – Local planners will work with neighborhood business leaders to coordinate delivery schedules in such a manner that the number of delivery trucks at any given time in the neighborhood match the number of designated truck parking spaces. Success under this scenario will rely on the strict enforcement of vehicles that do not belong or have exceeded their designated time. Similarly, trucks can use an electronic system to book parking appointments in dense neighborhoods.
- *Improved Agility* – As the nation becomes more urban, major carriers (FedEx, UPS) have begun using smaller delivery vehicles to improve flexibility and agility within the urban core. Similarly, entrepreneurs have begun to develop demand-response systems for urban freight deliveries.
- *Supply Chain Optimization* – The urban roadway system has continuously become more congested and less reliable. To account for the increased operating costs of an urban environment many logistics providers have fully integrated real-time traffic data into their routing software. This addition has allowed truck drivers and dispatchers to make more appropriate operating decisions which ultimately result in savings to the customer and to other drivers on the network. Application of demand-response pricing at curbside meters and roadway, bridges, and tunnels that varies based on the amount of network traffic and incentivizing freight delivery at less crowded times also helps optimize the supply chain.

As part of the Smart Cities Initiative, survey respondents ranked freight as among the least popular, but least understood aspects of the initiative. Given its importance to the livability of our neighborhoods it will be important to expand the overall understanding of how deliveries impact the urban environment. The Federal Highway Administration publication, "The Freight Technology Story: Intelligent Freight Technology and Their Benefits" provides an overview of how technology can address this issue. (<http://www.ops.fhwa.dot.gov/freight/>)

## I. Civic Engagement and Local Services

The concept of Civic Engagement is certainly not new. What is new, and changing daily, are the tools and techniques that planners have at their disposal to undertake Civic Engagement, both online and in new, innovative ways at in-



person events. A key component of Smart Cities is the ability to effectively include the community in the process of moving towards healthier, more sustainable cities. Engagement tools are an important component of the process in a new planning paradigm including:

- In person events are changing – hostility, confrontation and poor attendance are increasingly common.
- Online and Digital tools – there are a myriad of online tools and digital now being used, which can help make the Civic Engagement process more successful (depending on the definition of success), but getting the right tool at the right time can be a challenge.
- Tool creation and ownership – Many groups (agencies, NGOs, technical evangelists) are developing their own tools, so what role can open source tools and community developed tools (often created via hackathons and similar events) play?

### *1. The Evolution of the Town Hall Meeting*

Planners have long been called on to play a role in face-to-face events to engage community members. In many instances and jurisdictions, these events are mandated, either by statute, expectations based on previous practice, political will or public pressure.

No matter the impetus, the fact remains that historically in-person events have been the common engagement tool. Yet, for all our collective experience at designing and running these events, even when public participation professionals and facilitators are employed, effectiveness is inconsistent.

In the public participation profession, stories abound about events with more planners and consultants in attendance than community members. It is now common practice to have members of the local law enforcement on hand, as the subject of public planning is seen by some as conflicting with the right to own and control private land. Not all events are hostile, and many are working to improve the situation (see <http://www.planetizen.com/node/63734>), but the fact remains that many people are not attending in person events, particularly a key segment of the community, the silent supporters. These folks are either too busy, not interested enough, or fed up with unpleasant in-person events, so that their voices are often not heard. Without them, the squeaky wheel often gets the grease.

### *2. Online and Digital Tools*

Over the past 20 or so years, a wide range of endeavors, some from academia, some from public agencies themselves and some from the private sector, have been undertaken with the general intention of improving community engagement. Twenty years ago this was about using information technology, or digital tools, to improve the in-person event, including using better visual information tools such as PowerPoint, to deploying modeling and scenario tools, and other techniques. These tools generally try to make the complexity associated with many planning initiatives more understandable by the community.

The Internet has profoundly changed the relationship between the community and the agency, as websites, e-governance and other innovations have created a more open, accessible version of the public sector. The Internet has also given rise to a large number of tools that are all intended to help with the community engagement process (See this recent blog post for 50 of them <http://www.communitymatters.org/blog/let%E2%80%99s-get-digital-50-tools-online-public-engagement>). It is now very common for a community engagement process to utilize a mix of tools and techniques, including some in-person events, many that employ digital tools, as well as some form of online tool or tools.



The online engagement tools industry is really a mix of online survey tools and planning-specific tools. Together, this industry can be characterized as having a few large players from the online survey industry, (Survey Monkey is the largest, but it derives a very small percentage of its revenues from community engagement; the bulk come from private sector market research uses), combined with firms developing engagement specific tools. The engagement tools sector includes a few mid-size firms, such as MindMixer and a rapidly evolving group of small private firms that collectively offer a wide range of tools. This does not include tools developed by other types of organizations. The challenge for the planning professional is determining which tools are best suited to the particular requirements of their community engagement process. Since many planning projects span months or even years, they often need to engage the community at different stages. This means that the tools used in one phase may be different in the next one. Selecting the correct tool requires careful consideration of:

- the objectives of the engagement stage;
- the information that is to be collected and what it will actually be used for;
- the true cost of the tool, including set up, usage, and analyzing the results;
- agency resources required to make the tool work;
- technology limitations, implications, and consequences; and
- how well the tool integrates into the larger engagement process, which can include other tools.

In short, using online and digital tools is becoming increasingly common, yet selecting the correct tool(s) can be a challenge. Getting assistance from a trusted and experienced resource before utilizing online and digital engagement tools is strongly recommended. (Note: See Planning Advisory Service Report #564 – “E-Government”, for further discussion.)

### ***3. Tool Creation, Ownership, and Open Source***

Using online and digital tools, particularly those developed and supplied by for-profit enterprises, can pose challenges ranging from cost to creating a reliance on a particular vendor, technology, or proprietary means of accessing and/or interpreting the data that is collected. As the cost of developing software has decreased dramatically over the past decade, efforts to create tools that are less costly or are not proprietary have been common. Hackathons are a popular way to crowd-source tools to solve a specific problem. They draw on the resources of skilled, passionate software developers and other technical folks who collaborate to create tools for some public good.

In general, the cost of acquiring open source or community developed tools is lower than those developed by the private sector. Similarly, open source and agency- or academic-developed tools strive to use open standards for the data they require and produce. The US Government’s Open Data efforts are a case in point (<http://www.data.gov/>). Increasingly the developers of proprietary tools are also embracing open data as a way to remain competitive and reduce costs.

The issue that needs to be considered in contemplating the use of open source or free tools is the cost of implementation, including staff time for training, configuring the tools, and extracting the results. It can also be the case that support for these tools does not exist, or comes at a cost that makes the project more expensive than originally anticipated.

## **J. Issues in Collecting and Using Big Data**

According to Wikipedia ([http://en.wikipedia.org/wiki/Big\\_data](http://en.wikipedia.org/wiki/Big_data)), Big Data is “a broad term for data sets so large or complex that traditional data processing applications are inadequate”. In layman’s terms, this means too big to fit in an excel spreadsheet. Put more simply, Big Data refers to a large collection of information, increasingly collected and

stored automatically by computers and other technology, the analysis of which is deemed to provide some value to some audience.

For planners, there are some important issues with respect to big data that need consideration, mostly to do with the public benefit of using the data versus privacy concerns about how it is collected and stored. Looking beyond the ethical questions about collection, arguably the more pragmatic and interesting consideration is what big data sets exist that are relevant to Smart Cities and how are they being used. Big Data can be viewed as two primary sets of issues:

- *Collection and Storage* – How big data is collected, who holds it, and in what cases might public good outweigh strict privacy requirements?; and
- *Use* – Given that Big Data exists, what can be done with it to contribute to the evolution of Smart Cities?

### 1. Big Data Collection

There are a myriad of examples of how big data is contributing to the evolution of the Smart City. Think about your commute to work, 10 years ago compared to today. In the past, any information you received about congestion likely came from the radio. Today, for many people, their in-vehicle GPS system is accessing real-time traffic data, likely collected and published by Google, helping them to make informed decisions about which route to take. Fast forward 10 years and you may not even be part of the decision making process; your self-driving car may use big data to choose the best route.

Helping improve and make more efficient the transportation system and creating better, more efficient buildings are potential possible uses of big data. However, before this all becomes ‘standard practice’, there is serious debate raging over the public good of collecting and using the data versus the potential privacy rights that are being violated. It is one thing for public sector agencies and governments to be the collectors and holders of this information (although many would argue this is still an issue), but for most the bigger concern is the fact that much of this information is being collected and stored by the private sector. Google is an obvious example, but there are many others. These are complex issues that need further consideration. For planners, wading in to this ethical discussion can be daunting. (See for example <http://senseable.mit.edu/engagingdata>, for materials from an event organized by MIT to discuss issues of big data collection and privacy.)

### 2. Using Big Data

With all of the big data sets that exist, and with more coming all the time, where are the opportunities for planning professionals to harness or even improve big data? Transportation data provides some current examples: Google collects and makes available information about routing options, not only for cars, but also for transit users, cyclists, and pedestrians. One opportunity to use and even improve this information is for cycling and walking. The Google route planning tools need to know where people travel. Google has a reasonable appreciation of road and transit systems, but would benefit from better information about cycling networks. Google will incorporate data from agencies into their system, to help improve the effectiveness of their platform.

An interesting future possibility for transportation planners trying to create travel demand models will be to harness the data collected by mobile devices from vehicles (there are several private companies working to create this data; See <https://www.moj.io/> for instance; it is very likely that the auto manufacturers will also be players with ‘connected cars’), plus the data from fitness devices such as FitBit (<http://www.fitbit.com/>). Together, the data collected by devices like these could be combined to create a very robust, easily accessible travel survey for a city or region.

On the building front, smart meter data (the data collected by utilities from household smart meters) is an excellent example. Making smart meters available and encouraging firms, agencies and others to turn it into real, positive action is the mandate of the Green Button initiative (<http://www.greenbuttondata.org/>). This data can be used to help communities design and build smarter buildings and cities by providing much more effective feedback about energy use, building management, and building design. There are a variety of private companies working to turn smart meter data into value-adding tools for individuals and businesses (see Opower for instance <http://opower.com/>).

## IV. CONCLUSIONS AND NEXT STEPS

### A. Initiative Summary

The Smart Cities and Sustainability Task Force was initiated by APA to address recent advances in technology and innovation to cultivate cities that are smarter, more resilient, and sustainable. The collaborative initiative between the Sustainable Communities, Technology, and Transportation Planning Divisions of APA has sought to research how technology advances are creating new opportunities and challenges for the communities we serve, and demonstrate how planners can lead on these important changes.

There were three major goals this initiative set out to achieve over the past year. The first goal was to identify the aspects of Smart Cities that would be most relevant for planners in their professional practice. This white paper is the product of those efforts. The second major goal was to survey the planning community regarding their level of knowledge and/or interest in Smart City topics. The results of this survey are included in the Appendix. The third goal was to create a growing online library of Smart City projects and practices, so planners could both add their best ideas to help build the library and use others' ideas and apply them in their communities. These ideas are collected in the Innovation Portal ([www.linkedin.com/groups?home=&gid=8241104&trk=my\\_groups-tile-grp](http://www.linkedin.com/groups?home=&gid=8241104&trk=my_groups-tile-grp)) and a Smart City Ideation Tool (<http://smartcities.mindmixer.com/topics/all>). It was also created as a way to harness smart city technologies and help planners interact with these topics in a direct way.

As the task force progressed on its work on these three goals it was impressed with the high interest and passion planners have for this topic. The blending of technology and sustainability is a powerful combination that has the potential for new levels of efficiency, reshaping our communities, and improving the quality of people's lives. This passion and the continually evolving technological advances related to Smart Cities convinced the task force that our work was to create a starting point for planners wanting to apply Smart Cities technologies and practices in their communities. The task force is delivering a set of information and communications tools for APA to build on in the coming years to take full advantage of the promise of Smart Cities and provide further leadership in their development.

### B. Recommendations

The Smart Cities and Sustainability Task Force has listened to the planning community, has reviewed the information related to Smart Cities, and has condensed this information into components relevant to planners. This work has set the foundation for APA to strategically focus on specific initiatives that will be of the highest value for its members. The task force recommends several actions be taken by APA over the next year. They are as follows:

To add value to members' planning practice it is recommended APA:

1. *Invest in developing the Smart Cities Innovation Portal* to create a robust catalogue of great ideas and applications of technology to improve cities' efficiency and/or quality of life. Planners implementing these powerful applications could add significant value to their role in communities.
2. *Develop Comprehensive Plan Smart City Guidelines for Land Use, Transportation, & Economic Development.* To make a community "smarter" and get the most value out of technology, prioritizing technology investments based on established and overarching community goals is very important. Many comprehensive plans in communities focus on making sure technology and infrastructure is adequate, but what should also be addressed are how the key investments in technology better position a community to achieve their long-term goals, such as improving quality of life and competing in the global economy.

3. *Partner with Universities, Businesses, & Other Groups to Research Reports on Key Technologies.* Individuals and communities can sometimes be enticed by the latest gadget or tool as part of competitive planning efforts. APA and research partners could provide objective information on what technologies will stand the test of time for smart investment.

Priorities for Study:

- Communications infrastructure and processes needed for communities to compete in the global economy.
- Using technology to enhance performance of buildings and streets for energy savings, green infrastructure/water management, and infrastructure maintenance.
- The role/impacts of new spaces where people work in a mobile society.
- Optimizing new transportation choices for communities and its impacts for street operations, design, and parking.

To educate planners regarding smart cities it is recommended that APA:

4. *Offer Expanded Technology Updates at the National Planning Conference.* APA does regularly feature technology presentations and trainings at the annual conference. This recommendation is focused on expanding how technology is presented. The Seattle conference will include a Technology Zone. Features that are more demonstration-based and hands-on could create a new educational experience for planners at the conference. Examples of technologies to feature could include automated cars (such as the Google car) or smart home exhibits.
5. *Work with AICP on integrating technology systems training into broader planning education.* If planners are to help lead smart city initiatives in their communities, they will need to apply the lessons within this white paper and understand the basic core technologies and systems driving change as part of their basic planning degree and continuing education.

To provide leadership regarding smart cities it is recommended that APA:

6. *Create a new Divisions Council Initiative for Smart Cities.* Three APA divisions have collaborated on this task force to begin these planning efforts. At the 2014 Fall Leadership Conference other divisions expressed interest in joining the Smart Cities Initiative. The task force recommends further leadership for the Smart Cities work should continue and be led by a cross-pollinating team of the organization's subject matter efforts in the Divisions Council as a recognized new Divisions Council Initiative.
7. *Offer ethics training related to big data.* Ethics training is a fundamental part of AICP's continuing education requirements as planners. Ethics concerns related to big data would be a timely topic to consider for targeted ethics training by APA.
8. *Advocate for policies that bridge the digital divide.* Part of our role as planners is to not only serve our elected officials or clients but to advocate for the common good and broader public. The digital divide contributes substantially to inequity in our communities and creates an uneven playing field for citizens striving to better their lives and contribute to their communities. APA should have strong advocacy positions on correcting these inequities.

## APPENDIX: SMART CITIES INITIATIVES SURVEY RESULTS

	Survey Order	Q2 Count	Importance Rank (Q2)	Relevant Now	Relevant Future	Importance Rank (Future Relevance)	Want to Learn More	Learn More %	Rank Learn More	Composite Rank Calculation (Lowest Best)	Composite Rank
Socio-Economic Disparity	1	20	2	28	28	6	18	64%	6	14	3
Broadband Infrastructure	2	8	7	22	22	7	14	64%	7	21	7
Applications of Big Data	3	3	11	11	12	11	8	67%	3	25	10
Climate Adaptation/Hazard Mitigation	4	14	3	37	36	4	16	44%	12	19	6
Renewable Energy and Efficiency	5	14	3	40	40	2	18	45%	11	16	4
Green Building and Site Design	6	22	1	43	43	1	21	49%	10	12	1
Public Health	7	3	11	17	17	9	0	0%	14	34	13
Public Safety	8	2	13	10	10	13	8	80%	1	27	11
Green Streets	9	13	5	37	37	3	24	65%	5	13	2
Traveler Information/Decision Making	10	4	9	12	12	11	8	67%	3	23	8
Freight Supply Chain	11	1	14	9	9	14	5	56%	9	37	14
Civic Engagement & Local Services	12	11	6	31	31	5	12	39%	13	24	9
Issues in Collecting and Using Big Data	13	4	9	13	13	10	8	62%	8	27	11
Sharing Economy	14	6	8	18	19	8	14	74%	2	18	5

## ENDNOTES

1. United Nations, Department of Economic and Social Affairs, Population Division, World Urbanization Prospects: The 2011 Revision. <http://esa.un.org/unpd/wup/CD-ROM/Urban-Rural-Population.htm>.
2. United Nations, Rio+20, Sustainable Cities. <http://www.un.org/en/sustainablefuture/cities.shtml>.
3. Harald Becker, "Office Labs Envisioning Research: Shifts & Trends 2.0" Microsoft Corporation, November 8, 2010
4. A well-organized and concise table summary of trends influencing the rise of Smart Cities is contained in Microsoft's Smart City 2020, Technology and Society in the Modern City, by Jan Hedlund, Architect, Microsoft Services, March 2012.
5. Smart City Council, Smart City Readiness Guide, <http://smartcitiescouncil.com/>
6. Federal Communications Commission, National Broadband Plan, 2010, <http://www.fcc.gov/national-broadband-plan>
7. Federal Communications Commission, "2015 Broadband Progress Report and Notice of Inquiry on Immediate Action to Accelerate Deployment", <http://www.fcc.gov/reports/2015-broadband-progress-report>
8. Organization for Economic and Community Development, <http://www.oecd.org/Internet/broadband/>
9. Federal Communications Commission, "2015 Broadband Progress Report and Notice of Inquiry on Immediate Action to Accelerate Deployment", <http://www.fcc.gov/reports/2015-broadband-progress-report>
10. Polytechnic Institute of New York University, "Future Internet Bandwidth Trends: An Investigation of Current and Future Disruptive Technologies", Technical Report TR-CSE-2013-04, November 1, 2013
11. Townsend, Anthony. Smart Cities.
12. Smart Cities Council Readiness Guide, <http://smartcitiescouncil.com/resources/smart-cities-readiness-guide>
13. Botsman, Rachel, and Roo Rogers. What's Mine is Yours, 2010.
14. Manno, Jack. Privileged Goods: Commoditization and Its Impact on Environment and Society. 1999.
15. U.S. Census Bureau Population Estimates and Projections (P25-1143). Projections of the Size and Composition of the U.S. Population: 2014 – 2060, by Sandra L. Colby and Jennifer M. Ortman. Issued March 2015.
16. Architecture 2030: The 2030 Blueprint, Solving Climate Saves Billions. April 7, 2008. <http://architecture2030.org/files/2030Blueprint.pdf>.
17. U.S. Department of Energy. Smart Grids. <http://energy.gov/oe/services/technology-development/smart-grid>. Retrieved on 03-23-15.
18. U.S. Department of Energy. Revolution Now – The Future Arrives for Four Clean Energy Technologies – 2014 Update. October 2014. [http://energy.gov/sites/prod/files/2014/10/f18/revolution\\_now\\_updated\\_charts\\_and\\_text\\_october\\_2014\\_1.pdf](http://energy.gov/sites/prod/files/2014/10/f18/revolution_now_updated_charts_and_text_october_2014_1.pdf). Retrieved 03-23-15.
19. U.S. Federal Energy Regulatory Commission (FERC) Office of Energy Projects Energy Infrastructure Updates.
20. Ibid. U.S. Department of Energy. Revolution Now.
21. National Telecommunications and Information Agency. (2012). "Exploring the Digital Nation: America's Emerging Online Experience" [http://www.ntia.doc.gov/files/ntia/publications/exploring\\_the\\_digital\\_nation\\_-\\_americas\\_emerging\\_online\\_experience.pdf](http://www.ntia.doc.gov/files/ntia/publications/exploring_the_digital_nation_-_americas_emerging_online_experience.pdf).
22. <http://www.pewInternet.org/2013/08/26/home-broadband-2013/>
23. <http://google.about.com/od/blogs/g/What-Is-A-Fiberhood.htm>
24. National Telecommunications and Information Agency, "Exploring the Digital Nation: Embracing the Mobile Internet", Oct. 2014, [http://www.ntia.doc.gov/files/ntia/publications/exploring\\_the\\_digital\\_nation\\_embracing\\_the\\_mobile\\_internet\\_10162014.pdf](http://www.ntia.doc.gov/files/ntia/publications/exploring_the_digital_nation_embracing_the_mobile_internet_10162014.pdf)
25. Benton Foundation, "The New Network Compact: Making the IP Transition Work for Vulnerable Communities", 2014, <https://www.benton.org/ip-transition>
26. "Community-based broadband solutions: The benefits of competition and choice for community development and highspeed Internet access," January, 2015 [www.whitehouse.gov](http://www.whitehouse.gov)
27. McMahon, Kathleen, "Broadband: Survey of Planners and Best Practices", Practicing Planner, <https://www.planning.org/practicingplanner/2013/fall/>
28. National League of Cities, "Closing the Digital Divide: Promoting Broadband Adoption Among Underserved Populations", <http://www.nlc.org/find-city-solutions/center-for-research-and-innovation/infrastructure/technology-and-communications/broadband-access-and-adoption>
29. <http://www.ada.gov/pcatoolkit/chap5toolkit.htm>
30. <http://www.smartgrowthamerica.org/complete-streets/implementation/factsheets/green-streets/>

31. [http://www.business-standard.com/article/opinion/vinayak-chatterjee-what-is-a-smart-city-114121501181\\_1.html](http://www.business-standard.com/article/opinion/vinayak-chatterjee-what-is-a-smart-city-114121501181_1.html)
32. [http://www-01.ibm.com/common/ssi/cgi-bin/ssialias?infotype=PM&subtype=XB&appname=SNDE\\_TT\\_TT\\_USEN&htmlfid=TTE03001USEN&attachment=TTE03001USEN.PDF](http://www-01.ibm.com/common/ssi/cgi-bin/ssialias?infotype=PM&subtype=XB&appname=SNDE_TT_TT_USEN&htmlfid=TTE03001USEN&attachment=TTE03001USEN.PDF)
33. [http://www-01.ibm.com/common/ssi/cgi-bin/ssialias?infotype=PM&subtype=XB&appname=SNDE\\_TT\\_TT\\_USEN&htmlfid=TTE03001USEN&attachment=TTE03001USEN.PDF](http://www-01.ibm.com/common/ssi/cgi-bin/ssialias?infotype=PM&subtype=XB&appname=SNDE_TT_TT_USEN&htmlfid=TTE03001USEN&attachment=TTE03001USEN.PDF)
34. <http://www.fhwa.dot.gov/pressroom/fhwa1504.cfm>
35. <http://sfpark.org/about-the-project/benefits/>
36. <http://www.macro.com/transit-its/transit-it-projects/mta-new-york/>
37. <http://www.economist.com/node/16945232>
38. [http://www.pedbikeinfo.org/programs/promote\\_bikeshare.cfm?/bikeshare](http://www.pedbikeinfo.org/programs/promote_bikeshare.cfm?/bikeshare)



