CONNECTED URBAN DEVELOPMENT

White Paper

Connected and Sustainable ICT Infrastructure

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About Connected Urban Development

Connected Urban Development (CUD) is a public-private partnership program focused on innovative use of information and communications technology (ICT) to make knowledge, people, traffic, and energy flow more efficiently. This increased efficiency enhances how people experience urban life, streamlines the management of cities, and decreases the urban environmental footprint.

The program's main success elements are:

- Measuring CO2 emissions reduction resulting from operational implementation of CUD projects within cities
- Demonstrating the positive impact of ICT and broadband connectivity on climate change
- Developing relevant thought leadership and replicable methodologies allowing CUD partner cities to learn from each other and share their experiences and best practices with cities around the world

The initial scope of the program includes five primary areas of focus:

- Connected and Sustainable Work
- Connected and Sustainable Mobility
- Connected and Sustainable Energy
- Connected and Sustainable Buildings
- Connected and Sustainable ICT Infrastructure

Context

In the policies and plans for sustainability and eco-responsibility in cities, much attention has been directed to three sectors: the built environment, energy, and mobility. At the beginning of the 21st century, it became obvious that a fourth, equally important element must be addressed: ICT. When it comes to city sustainability, ICT is part of the problem (based on its contribution to the overall eco-footprint), but more important, ICT is an even bigger element of the solution. A recent study found that ICT is a significant contributor to energy efficiency: for every extra kilowatt-hour of electricity demanded by ICT, the U.S. economy increases its overall energy savings by a factor of 10.[1] To manage ICT effectively, cities need a common framework for data and performance, and a set of solutions for urban sustainability.

1. "Information and Communication Technologies: the Power of Productivity, How ICT Sectors Are Transforming the Economy While Driving Gains in Energy Productivity," American Council for an Energy-Efficient Economy, February 2008.

ICT Enablement of Sustainable Cities

ICT products, systems, and networks are the essential drivers of productivity improvements and innovation for the 21st century. They will enable sustainability solutions in all networks of urban life: buildings, energy production and use, mobility, water and sewage, open spaces, education, and public health and safety. ICT innovation is also a catalyst for changes in personal, work, and community life that create completely new urban environments. In addition, ICT will become a fundamental requirement for sustainable economic development.

ICT's Environmental Footprint in Cities

ICT products and systems are a significant and rapidly growing part of the environmental footprint of modern urban life. They are resource-intensive when it comes to manufacturing and distribution, consuming great amounts of energy while in use, and producing escalating volumes of solid and toxic waste. ICT products may also have negative effects on individual and societal health as they are produced, used, and discarded.

Connected and Sustainable ICT Master Planning

Until now, little attention has been given to measuring the eco-footprint of ICT in cities or to clearly understanding its role in enabling other sustainability initiatives. Because ICT systems and products are literally everywhere in modern life, it is difficult to see and understand that each device is part of a whole system—globally linked networks that create, manipulate, store, move, and provide information to humans and machines. To manage the ICT environmental footprint successfully and realize the benefits of enabling sustainability, a city must have a vision and strategy for ICT that encompasses all organizations and constituencies.

Key Principles

When considering Connected and Sustainable ICT strategies for cities, seven key points must be addressed, spanning both the mitigation of ICT's own environmental footprint and the positive impact ICT can have in promoting sustainable cities.

1. **ICT is a vital and necessary tool for sustainable social and economic development in 21st-century cities.**

Access to global networks and ICT resources is a requirement for individual and community success in the information age. Some governments see ICT-driven development programs as "a key enabler in addressing social exclusion," and envision creating "a replicable neighborhood model that uses ICT to deliver a step-change reduction in net emissions for all communities." ICT also is both a requirement for and driver of continuous innovation essential to competing successfully in the global economy. With proper focus, planning, and policies, cities can become centers of ICT-enabled innovation for sustainable growth.

2. ICT must be integrated into planning, designing, and developing urban land and buildings to increase use of space and reduce demand for travel.

Real-world experience demonstrates that new ICT-enabled workplace designs in the public and private sectors can intensify usage of building space by 40 percent to 60 percent.[2] For example, the U.K. government campaign Working Without Walls aims to create "better environments using new technology...to improve the delivery of public services"[3] and reduce impact from buildings. ICT-enabled developments of mixed-use, walkable, and sustainable neighborhoods can improve the environmental performance of cities significantly. Realizing these benefits on a broad scale, however, requires major changes in financing, creating, and managing the built environment.

3. ICT innovation shows great potential for energy efficiency and climate protection in cities.

Studies in various countries, generally supported by or associated with telecom companies, suggest broad potential for ICT to cut energy use and carbon emissions. One U.S. study projects that changes enabled by broadband networks could save the "equivalent of 11 percent of U.S. oil imports through transportation substitution and dematerialization."[4]

An Australian study on a high-bandwidth and low-carbon future describes seven opportunities that could reduce national carbon emissions by 5 percent.[5] A recent study supported by the United States Department of Energy demonstrates significant results from smart-grid technologies to monitor and adjust home energy consumption, reducing average household consumption by 10 percent. By consumers proactively managing home energy use in this way, peak loads on utility grids could be reduced by up to 15 percent annually.[6] The RAC Foundation in the United Kingdom estimates that "through the use of ICT, there is potential within 10 years for a 15 percent reduction in commuter travel, an 18 percent reduction in heavy freight, and a 10 percent reduction in shopping by car."[7] Many good ideas for how ICT can support innovation for sustainability have been suggested, but most benefits remain unrealized.

4. The creation and use of ICT affects the health of individuals and society.

The electronics industry is one of the world's largest manufacturing sectors, with social, economic, and ecological impacts across the planet. The manufacture of ICT components and products has been associated with land, water, and air pollution. While in use, ICT equipment has been shown to contribute to indoor air pollution. In both developed and developing societies, the gap between the rich and poor for access to ICT resources is perceived to be a significant social problem.

2. "Office Design Case Study: How Cisco Designed the Collaborative Connected Work Environment," Cisco (http://www.cisco.com/web/about/ciscoitatwork/case_studies/real_estate_dl2.html).
3. http://www.ogc.gov.uk/government_relocation_transforming_workspace
4. "Broadband Services: Economic and Environmental Benefits," Joseph P. Fuhr, Jr. and Stephen B. Pociask, The American Consumer Institute, October 31, 2007.
5. "Towards a High-bandwidth, Low-carbon Future: Telecommunications-based Opportunities to Reduce Greenhouse Gas Emissions," Climate Risk Pty Limited (Australia), 2007.
6. "Department of Energy Putting Power in the Hands of Consumers through Technology," Pacific Northwest National Laboratory, January 2008 (http://www.pnl.gov/topstory.asp?id=285).
7. "ICT as a Mode of Transport: A Review of Information and Communication Technology to Achieve Transport Policy Goals," Forum for the Future, September 2006.

5. ICT has significant environmental effects beyond direct energy use and greenhouse gas emissions.

Compared to cars and appliances, ICT components and products require relatively large amounts of materials and energy for their manufacture and distribution. Sixty-five percent to 80 percent of a PC's lifecycle carbon footprint and energy consumption occurs during manufacturing, according to estimates.[8] Product resources include substantial quantities of water, plastics, chemicals, gases, and metals. ICT products also have a short lifecycle compared to most other manufactured goods. Few ICT products are designed for upgrade, disassembly, or reuse; only a small percentage are recycled at end of life. In the United States, discarded electronic waste (e-waste) represents only 2 percent of total municipal waste by weight, but accounts for 70 percent of the heavy metals and 40 percent of the lead in landfills.[9] Although toxic e-waste is banned from ordinary solid-waste disposal systems in many places, most e-waste from developed countries ends up as unmanaged trash in developing countries. ICT products also drive demand for other products that have substantial eco-footprints, such as white paper, building cable and wire, and packaging.

6. Major cities must have a comprehensive and systematic analysis of energy consumption and greenhouse gas emissions attributable to ICT. ICT represents a significant portion of the total.

Global carbon emissions for ICT as an industry are estimated at 2 percent to 2.5 percent of world totals. This number would be as high as 14 percent if indirect energy use were included.[10] Estimates of total electricity consumption by ICT range from 3 percent to 10 percent in the United States and Europe;[11] consumption growth rates for ICT have been 10 percent to 20 percent per year since 2000.[12] Estimates of ICT-driven electricity usage in commercial office buildings are 20 percent to 40 percent of the total. ICT-based electricity consumption may be as high as 65 percent of total electricity used by buildings that have efficient lighting, heating, ventilation, and air-conditioning, along with a high density of ICT equipment.[13] Large cities with a high concentration of knowledge workers, office buildings, and ICT are likely to find that ICT energy use is significantly higher than national averages.

8. *Computers and the Environment: Understanding and Managing Their Impacts*, Ruediger Kuehr, Eric Williams, Springer Publishing, 2003.
9. *High-Tech Trash: Digital Devices, Hidden Toxics, and Human Health*, Elizabeth Grossman, Island Press, 2006.
10. "Gartner Estimates ICT Industry Accounts for 2 Percent of Global CO2 Emissions," Gartner, Inc., 2007.

    "ICTs and Climate Change," ITU-T Technology Watch Briefing Report, No. 3, November 2007.
11. "Electricity Used by Office Equipment and Network Equipment in the U.S.: Detailed Report and Appendices," Kaoru Kawamoto, Jonathan G. Koomey, et al., Energy Analysis Department, Environmental Energy Technologies Division, Ernest Orlando Lawrence Berkeley National Laboratory, University of California, Berkeley, February 2001.

    "Energy Consumption of Information and Communication Technology (ICT) in Germany up to 2010," Project Number 28/01, Summary of the Final Report to the German Federal Ministry of Economics and Labour, Fraunhofer Institute for Systems and Innovation Research ISI, Centre for Energy Policy and Economics, Karlsruhe/Zurich, January 2003.

    "An Inefficient Truth," Global Action Plan, London, United Kingdom, December 2007.
12. "EPA Report on Server and Data Center Energy Efficiency," United States Environmental Protection Agency, ENERGY STAR Program, August 2, 2007.

    "Tackling the IT Footprint," Bob Crooks, Department of Environment, Rural Affairs, and Fisheries, London, United Kingdom, November 27, 2007.
13. "California Commercial End-Use Survey," Itron, Inc., for the California Energy Commission, Consultant Report, CEC-400-2006-005, March 2006.

    "Managing Energy Use: Minimising Office Equipment and Air-conditioning Costs," United Kingdom Department of the Environment, Good Practice Guide 118, 1996.

    "Best Practice Guide for Commercial Office Buildings," Flex Your Power, California Energy Commission (http://www.fypower.org/bpg/index.html?b=offices).

7. ICT needs a common framework for data and performance metrics, and a set of solutions for urban sustainability.

Viewed systemically, ICT's environmental footprint is large and growing rapidly. ICT also has significant potential as an enabler of new solutions to environmental challenges related to mobility, energy, buildings, and land use, as well as driving sustainable economic development. No comprehensive system, however, exists for assessing, managing, and employing ICT to achieve sustainability goals.

Solutions

Awareness and leadership are necessary preconditions for creating an effective Connected and Sustainable ICT initiative. Political and technical leaders in local government must recognize and understand the critical role of ICT in creating sustainable 21st-century cities. Education among senior leaders is crucial for ICT to be viewed as a distinct and pervasive element of policy, planning, and management in every aspect of urban life. Once awareness is established, building an initiative based on the seven basic principles outlined above will require active, visible, and ongoing leadership from the top.

In considering and creating a Connected and Sustainable ICT initiative, cities should begin by reviewing the environmental and sustainability goals that have already been set—for example, reduction targets for greenhouse gas emissions, energy efficiency, and renewable-source supplies; reduction goals and requirements for waste; and existing procurement standards relevant to ICT. A review enables leaders to see how ICT can support or hinder the achievement of pre-established goals.

Managing the Eco-Footprint of Government ICT Operations

In keeping with the lead-by-example principle, creating a program for city operations is the first step cities must take toward reducing their ICT eco-footprint and realizing the benefits of ICT-enabled innovation. To start, cities must create a valid and comprehensive data set to assess impacts, set action priorities, and measure success.

Data Collection

Cities *are* making efforts to create programs to reduce greenhouse gas emissions. Going forward, a Connected and Sustainable ICT initiative must start with a baseline measurement to determine which ICT systems each city owns and uses in its operations and its eco-footprint. While the basic concept for taking inventory and collecting data is simple, executing the process is not. ICT equipment, unlike other government assets such as buildings or bridges, is hard to track because it is relatively small, mobile, and distributed. Therefore, it can be picked up and moved, thrown away, misplaced, or stolen.

Taking a physical inventory of the equipment is one approach to collecting data. This approach, however, is labor-intensive, slow, and intrusive, which means generally it is feasible only for a sampling exercise to collect a preliminary baseline. Even a modest sample can provide data to quickly evaluate the validity of a claim or calculation on data collected by other means, or as a way to create "order-of-magnitude" estimates.

A second approach is to rely on inventory or asset lists maintained by the government or vendors; in most municipal governments (and in most private enterprises for that matter), however, ICT inventory records are neither complete nor current. Record-keeping systems are frequently widely distributed across an organization. Many elements of ICT systems are small, and some systems are not highly valued. Because of the rapid spread of client-server computing over the last 25 years, few cities developed robust asset tracking systems for ICT equipment. Consequently, data from purchasing records or inventory lists generally is not easy to obtain and does not provide an accurate or complete picture of a city's ICT portfolio.

A third approach is to use automated tools to identify all of the equipment linked to city networks. Specialized software can be acquired for this purpose, or systems in place for other purposes (for example, network security) may have this capability. Generally, however, automated processes can identify only equipment on a certain type of system or subsystem (data network or telephone system, for instance), and many older ICT systems are not interconnected in a way that allows for automated data collection across platforms. Furthermore, some ICT equipment is not connected to a network at all. Even with a high level of automated data acquisition, some manual assembly of data from disparate systems is necessary.

Definitions and boundaries are major issues cities face in collecting data to measure ICT's eco-footprint. ICT is no longer divided neatly among telephones, computers, copiers, and audiovisual equipment. Today, visual communication is the fastest-growing part of ICT. "Computers" are embedded in many types of devices. Furthermore, we are seeing rapid convergence—new devices that merge, or meld, multiple and traditional information and communications functions to provide entirely new capabilities.

Most studies of ICT eco-footprints use definitions that are narrow, traditional, and do not adequately recognize the nature of today's wired world and the pervasiveness of ICT. They also frequently ignore the direct physical support infrastructures used by ICT such as cabling, power supplies, cooling, and fire suppression systems. Indirect effects, such as the consumption of space in buildings, are another area frequently overlooked in assessing the overall eco-footprint of ICT. For any green ICT project, a city must decide what will be included when measuring its ICT eco-footprint.

Environmentally Responsible ICT Management

Establishing a standard and expectation that environmental effects *will be* a consideration in every decision about ICT system design, procurement, and operations is the first, and most critical, step in developing the tools and processes necessary to manage ICT's eco-footprint. Until recently, in most places, no consideration was given to environmental effects or eco-efficiency in decisions about ICT.

For example, energy efficiency has not been a design criterion or management objective for data centers. System purchases do not include formal consideration of true lifecycle costs, use of toxic materials, carbon footprints, possible human health effects, or end-of-life responsibilities. With few exceptions, performance criteria for new

systems do not include measurements of work produced per unit of energy consumed or targets for efficiency improvements over time.

Instead, design and purchase decisions tend to be based on three factors: system performance, personal preferences of ICT practitioners, and lowest purchase price. Revising processes to ensure that environmental criteria are included, and actually considered, requires consistent and concerted effort over time. It also requires the cooperation of at least three groups—purchasing managers, environmental experts, and ICT technical managers—to create an integrated process that meets operational, financial, procedural, and environmental requirements.

ICT for City Operations

The notion that ICT is central to all functions of government is not recognized, accepted, or understood by many leaders and managers in local government. Other professional disciplines that contribute to the development of cities—such as lawyers, civil engineers, architects, educators, and urban planners—have a long history and clearly established roles in urban government. In a "sustainable information society," however, how well a city performs in developing and managing ICT will greatly affect economic and social development, as well as protection of the natural environment.

Developing knowledge and awareness of the role of ICT in urban life for all leaders and managers in local government must be an explicit goal of a Connected and Sustainable ICT initiative. A reasonable degree of technical literacy, as well as reliable data, is necessary for making intelligent decisions about transportation systems, energy generation and distribution, traffic management, healthcare policy, land use planning, building design, school system management, and a host of other basic city services. It is also important for cities to develop a cadre of technology managers who have specific "industry knowledge" about the needs and operating practices of specific government functions.

Building on a base of cross-functional knowledge, an initiative that realizes the sustainability benefits of ICT innovation must include the development of new linkages and processes across separate departments to enable new solutions. For example, a teleworking initiative aimed at reducing the amount of commuter traffic caused by government employees must have the proper technology in place to begin, but will need input and cooperation from the human resources, legal, and finance departments (at a minimum) to be launched. To be successful, supervisors, managers, and employees must support a teleworking program. If the program's aim is to reduce a city's use of office space, other groups such as architects and facilities managers will be key players.

While the technology is readily available to support teleworking programs that deliver financial, environmental, and quality-of-life benefits, few cities have the organizational capability to coordinate simultaneous changes in all the different areas that must be involved to be successful. ICT does not respect traditional organizational or geographic boundaries. In a wired world, developing new approaches to cross-functional cooperation and collaboration will be a major challenge for local government.

Impacts

Managing the eco-footprint and realizing the sustainability benefits of ICT require recognition of the central role of ICT in 21st-century urban life. ICT is the dominant force for social and economic transformation around the world. Although the role of ICT in driving and enabling change has been broadly recognized, it frequently has been viewed within city government as either a highly technical issue best left to the "experts" or a "utility" that is important but not "strategic." Until recently, linking ICT to the development of a sustainable information society also has been largely ignored.[14] As this becomes clear, cities must incorporate the reality of ICT and a global networked society into every policy and program.

There are many benefits of a systematic Connected and Sustainable ICT initiative to cities. The first is financial: a coherent program that manages a city's ICT systems efficiently will reduce both investment and operating costs for city operations. In many cities, ICT systems are purchased, owned, and managed by various internal government departments, with minimal central planning or control. Currently, many private sector enterprises around the world are creating consolidation, simplification, and ICT outsourcing programs and operations to reduce cost and improve performance. Similar initiatives in cities could pay big financial dividends. Changes to operations that reduce energy consumption, extend equipment life, decrease the quantity of equipment purchased, and reduce the amount of waste produced have direct environmental benefits as well, at no additional cost. Efficient acquisition and management of ICT systems clearly is a win-win situation—both financially and environmentally.

Integrating ICT into other aspects of city operations is also a clear winner for both city finances and the natural environment. In every urban area, local government is one of the largest employers. City workers take up a significant portion of nondomestic buildings and form a large part of daily commuter traffic. The role of commuter traffic and buildings in city eco-footprints is well documented. Adopting new work practices and workplace designs for city workers is an important step in reducing rising real estate costs and the environmental impacts of buildings and automobile traffic.

The next benefit of a green ICT initiative will come from influencing other major stakeholders outside city government: citizens and private enterprises. The adoption of new ICT-enabled strategies for efficiency and structural innovation across all parts of the urban community can produce not only substantial direct benefits for individuals and companies, but also greater benefits to the whole community through "network effects." Networked technologies can produce nonlinear benefits beyond the simple mathematics of growth in the number of connections.[15] Financial, environmental, and quality-of-life benefits, too, will grow exponentially for everyone when a broader spectrum of participants in the urban community adopts new behaviors.

14. *Progress in Industrial Ecology: An International Journal*, Dr. Auli Keskinen, guest editor, Vol. 2, Issues 3/4, 2005.

15. Metcalfe's Law (http://en.wikipedia.org/wiki/Metcalfe%27s_law).

While the potential benefits of a green ICT initiative are obvious, so are the outcomes of failing to develop a comprehensive and systematic program around "greening" ICT. Cities and other local government bodies that have made specific commitments to reduce greenhouse gas emissions rapidly are almost universally failing to meet those targets. The eco-footprint of ICT systems are significant enough that if cities expect to reach the goals they have set for achieving energy-efficient, carbon-neutral, zero-waste, and nontoxic places to live, they must have a specific agenda for addressing ICT for government operations and all other segments of the community. ICT also must be an explicit element of every policy and program if urban areas are to support two other pillars of sustainability—being socially inclusive and economically vibrant. Unless ICT becomes a visible and integral part of every forward-looking activity, cities have no hope of meeting their goals, much less becoming truly sustainable in the information age.

A city that can set an example by managing and using ICT effectively to demonstrate the power of innovation for urban sustainability can lead and inspire the rest of the community to follow. A successful city program will show why and what can be done. With experience and a proven track record, local government can also be more effective in creating legislative programs, mandates, or regulations that apply to private enterprises and citizens.

Making the connection between ICT and a truly sustainable future can help cities justify and build support for other projects such as redevelopment plans, educational programs, and municipal broadband or wireless networks. Successful development of ICT infrastructures, both physical and organizational, can in turn advance other important sustainability goals. A policy paper on work/life balance and the status of women in the workforce identified teleworking as one of the most important enablers of improved quality of life for women.[16] In this case, the right ICT infrastructure and a coordinated policy for change across many city government groups can improve the economic status of women and promote social inclusion and a healthier family life, while reducing the environmental effects of automobile travel and office buildings.

16. "Work-Life Policies and Practices Survey Report," Ann Lehman and Jennifer Mitchell, Department on the Status of Women, City and County of San Francisco, 2001 (http://www.sfgov.org/site/dosw_page.asp?id=66182).

Implementation

A Connected and Sustainable ICT initiative must build on three basic tenets:

1. Ensuring the development of fundamental, physical, and organizational infrastructures
2. Employing integrated planning techniques and creating systemic solutions
3. Leading by example in government operations

Physical and Organizational Infrastructure

Many cities have already recognized the need for ICT infrastructure to be competitive in a networked global economy. Businesses cannot effectively operate where reliable high-speed communications networks and associated technical support infrastructure are not available. Individual citizens are rapidly coming to the same conclusion. Cities have responded in some places with publicly financed wired and wireless broadband infrastructure projects. This paper does not debate the question of who should own and operate networks. It is clear based on our research that local governments have a legitimate interest in ensuring that basic services are generally available and reasonably affordable.

Where cities have generally been less active is in providing for the organizational infrastructures required for managing and coordinating ICT systems, both within city government and for the community at large. While many cities have powerful and visible transit authority boards and regional transit planning agencies, for example, few have equivalent organizations for ICT infrastructures. This reality became apparent during the attacks on the World Trade Center in New York City on September 11, 2001, when the lack of a common communications system hampered emergency first-response units. Since then, the United States has launched efforts to create standardized emergency-service communications networks in urban areas, but virtually nothing has been done to address the issue of standards for essential nonemergency ICT infrastructures and services.

Integrated Planning Techniques and Systemic Solutions

For at least half a century, most major cities have had a telecommunications department to manage voice communications. Data processing entered the picture in the 1960s, evolving into the information services (IS) or IT departments of today. Most large public and private organizations have now merged telecom and IT into a single organization (at least on paper), recognizing that ICT must be integrated. The technology developments of the last 20 years, however, continue to outpace most organizational structures. Cities now own and manage a long list of ICT systems that go far beyond telephone and computing devices. Today, there are radio and television stations, copper and fiber-optic networks, wireless networks and communications devices, building-management systems, security surveillance systems, traffic monitoring and management systems, utility control networks, electronic voting systems, and more—all of which are rapidly converging onto common technology platforms. We are evolving into a “network of things” in which virtually every electronic device will have the ability to communicate over a network. Cities must radically improve management systems to keep up.

Not only have the types of ICT systems proliferated, they also have become an integral part of everything that happens in a city. Buildings cannot operate and workers cannot perform their jobs if ICT systems do not work. Health and public safety personnel cannot deliver services and transit systems cannot operate without built-in ICT systems. The management and design of ICT systems is no longer something that can be viewed as a separate activity unrelated to traditional disciplines such as architects, urban and transportation planners, and healthcare professionals. To create planning and management processes that deliver eco-efficient and innovative solutions for sustainable cities, new, integrated processes must be created that look at things once considered to be separate (such as buildings and ICT systems) as complete systems.

Leading by Example

Cities have adopted many policies that affect citizens and organizations outside local government in their efforts to build for a sustainable future. The success of a Connected and Sustainable ICT initiative relies on city governments' ability to lead by example, adopting the techniques necessary for ecologically responsible ICT design and management. They also must adopt innovations that can produce benefits in other areas such as workplace design, transportation, and buildings.

A lead-by-example approach is necessary for two reasons:

The first is "credibility." There is relatively minimal knowledge and awareness of the role ICT plays in sustainable development. Furthermore, ICT systems are complex, distributed, and rapidly evolving, which makes effective regulation of any kind difficult to create and enforce. If cities cannot use their own experiences to demonstrate the importance of ICT for citizens and public sector organizations, there is little likelihood that other stakeholders will pay attention or take action except where they see a direct and short-term financial benefit.

The second reason is "goals." If cities do not create comprehensive and systematic green ICT initiatives, they will not achieve their public goals. If local governments that have been outspoken leaders on ecological responsibility and sustainability cannot meet their objectives, it is unlikely that other stakeholders will meet their goals.

Conclusion

Sustainability for cities, and the entire planet, is a concept without a precise, universally acknowledged definition. One of the most common definitions is the one created by the Brundtland Commission that says sustainable development "meets the needs of the present without compromising the ability of future generations to meet their own needs."[17] Most formulations for how sustainability can be achieved include the idea of three "interdependent and mutually reinforcing pillars" of sustainable development: economic development, social development, and environmental protection, according to the Commission.

17. "Report of the World Commission on Environment and Development: Our Common Future," Transmitted to the General Assembly as an Annex to document A/42/427 "Development and International Cooperation: Environment", NGO Committee on Education, August 2, 1987.

Many cities are supporting, and in some cases financing, municipally owned broadband and wireless networks and view these investments as analogous to investments in the other basic elements of shared, public urban infrastructure—roads, water supply, sewage, and waste removal systems—and essential to economic development. There is no question that reliable and ubiquitous high-speed communications networks are essential to the economic health of modern cities.

For leading-edge cities, ICT is no longer just a tool for *promoting* social inclusion and economic development; it is the tool for social and economic development, as well as for environmental protection. They see ICT as "critical in tackling climate change, acting as a key enabler in addressing social exclusion," and a fundamental requirement for economic competitiveness.[18] In this role, ICT supports the three "pillars" and truly becomes the enabling technology for sustainable cities of the 21st century.

18. "Digital Innovation & Green Sustainability," Dave Carter, Manchester Digital Development Agency, 2008.

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