Connecting Cities: Achieving Sustainability Through Innovation

An Overview of the Connected Urban Development Program

Written specifically for
Connected Urban Development Global Conference 2008

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In the 21st century, *sustainable development*—defined by the United Nations as the "interdependent and mutually reinforcing pillars of economic development, social development, and environmental protection"[1]—has emerged as a major strategy and policy priority among government and enterprise organizations globally. To secure sustainable development, the world faces a number of prominent challenges. Preeminent among these are energy use and climate change—and the associated risks of massive environmental degradation that would heavily impact people around the globe.

In recent years, world temperatures have reached record highs, oil prices have climbed to new peaks, and the market for clean energy technologies has grown dramatically. Issues such as the "carbon intensity" of current economic growth patterns, the need to make available resources more productive, and the huge demand for energy are becoming paramount.

Sustainable Cities

Cities are the largest contributor to energy consumption and climate change. The world's 20 megacities alone, each with a population exceeding 10 million, are responsible for 75 percent of the planet's energy use. With their populations on the rise—according to the United Nations, 60 percent of the world will live in cities by 2030—cities are experiencing considerable increases in energy consumption. It is expected that by 2010, global electricity use will grow by more than 35 percent—and by more than 75 percent by 2020.[2]

Cities are also centers of innovation, economic growth, social transformation, healthcare, and education—and most are taking a proactive approach to address the urban sustainability challenge. The unprecedented development of new cities around the globe, however, and the need to renew outdated 20th century infrastructures in mature cities, require the creation of new urban design, metropolitan governance, and infrastructure investment models.

Most attention in sustainable urban development has been directed to three sectors: buildings, energy, and mobility. Today, however, it is becoming evident that a fourth, equally important element must be addressed: information and communications technology (ICT).

When it comes to urban sustainability, ICT is part of the problem (based on its contribution to overall energy consumption), but an even bigger element of the solution. A recent study,[3] for example, 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.

Sustainability and ICT are emerging at the commencement of the 21st century as two sides of the same coin: both are innovations for cities seeking to improve their environmental effectiveness in the context of connected societies, global competitiveness, economic development, climate change, and demographic shifts.

The Role of ICT in Sustainable Urban Development

Historically, urban development made communications and human interaction easier through concentrated physical development. Before ICT, all communications needed physical movement. Cities developed as spatially fixed places supported by a massive fabric of land parcels, buildings, streets, neighborhoods, and the material transportation and infrastructure networks required to support the physical flow of goods, people, and resources. Sustainable urban development is no longer viewed in such narrow terms.

Today's cities are linked by a global information and communications infrastructure that facilitates communications, human interaction, collaboration, and mobility. Information is coming to people, rather than the reverse. As a result, cities are evolving into places where overlapping networks of companies, institutions, civil societies, and citizens are supported by ICT-enabled flows of people, materials, information, capital, services, and media.

We believe that the transformational influences of 21st century ICT networks, and the resulting knowledge-based economy, are as significant as the two major waves of "network" innovation that characterized 20th century urban development. The first happened at the beginning of the last century, triggered by the age of steel, electricity, and heavy engineering, resulting in electrical networks. The second took place at midcentury, with the automobile and other forms of transportation spurring suburbanization and sprawl through networks of roads, highways, ports, and airports.

Today, worldwide digital communications and the Internet are becoming the fourth utility in cities (in addition to roads, water, and electricity). Similar to the beginning of last century, when newly built electrical networks were the focus, today's citizens, governments, and enterprise organizations are taking advantage of digital services delivered over the Internet.

Global Internet penetration has reached 20 percent,[4] while the quality and speed of access have increased dramatically as well. High broadband growth rates are no longer restricted just to developed northern European and northeast Asian countries and cities.

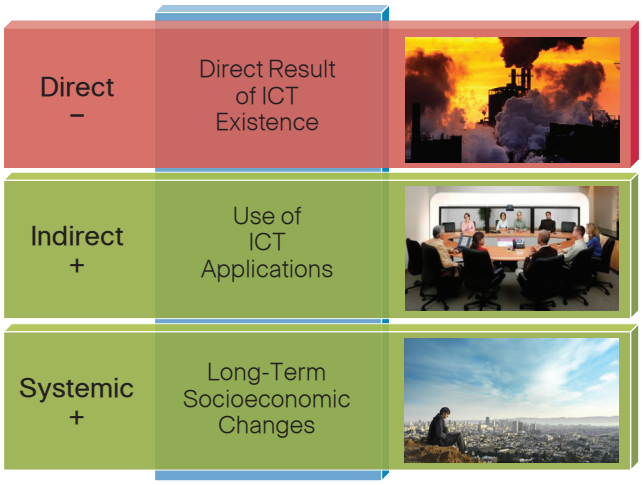
In the last two years, for example, Paris moved from being a broadband laggard to becoming the most fiber-enabled city in the world, thanks to forward-thinking public policy. Thailand, the Philippines, Indonesia, and Greece have witnessed

spectacular growth in national broadband penetration and speed. While Japan's fiber-to-the-home penetration increased to 16 percent[5] of total homes, and Seoul's Internet penetration reached 95 percent[6] of the population, countries such as South Africa and Australia launched aggressive broadband development programs. Broadband-based Internet access is becoming a reality for the Himalayan villagers of Dharamsala, thanks to an initiative by local entrepreneurs called AirJaldi.

3 Effects of ICT-enabled Sustainable Urban Development

Virtually all proposed solutions to energy consumption and climate change—such as Sir Nicholas Stern's "Stern Review: Report on the Economics of Climate Change," as well as the two "Climate Change" reports published by the European Union's Intergovernmental Panel on Climate Change (IPCC)—acknowledge the role ICT plays as a key enabler of environmental effectiveness in large metropolitan areas. But virtually no report or study has addressed exactly *how* urban ICT and broadband connectivity can help, and what the carbon-reduction impact of innovative urban ICT policy for energy efficiency can be.

Figure 1. 3 Ways ICT Impacts Sustainable Development of Cities



Source: Cisco IBSG, 2008

Any discussion of sustainable urban development must acknowledge that ICT is part of the problem facing cities today, based on its ever-increasing levels of energy consumption. This downside, however, is more than mitigated by ICT's valuable contributions to energy efficiency, its ability to reduce energy demand in other activities (e.g., using teleworking to reduce trips to the office), and the existence of ICT applications that increase the efficiency of energy used in these activities (e.g., car routing that cuts traffic congestion).

We believe that urban ICT impacts sustainable development of cities in three ways: directly, indirectly, and systemically.

- **Direct effects** are caused by the physical existence of urban ICT infrastructures. They are resource-intensive in manufacturing and distribution, consuming ever-greater amounts of energy and creating escalating volumes of solid and toxic waste. Mature cities already estimate that the direct ICT contribution to their energy consumption ranges between 5 percent and 15 percent.[7] More energy-efficient ICT solutions and architectures are being rapidly developed at the industry level, where businesses are starting to collaborate on the creation of consortia, such as the Green Grid initiative.
- **Indirect effects** stem from the use of broadband and ICT applications. They are the essential driver for productivity improvements and innovation (for instance, the virtualization of government and business services), as well as for more efficient management, control, and visualization of urban networks (buildings, energy production and use, mobility, water and sewage, open spaces, public health, and safety). For example, one U.S. study[8] projects that use of broadband could save 1 billion tons of greenhouse gases over 10 years—representing 11 percent of annual oil imports—through transportation substitution and "dematerialization."[9]
- **Systemic effects** link the network impact of ICT to society and urban planning at large. ICT innovations are catalysts of structural change for personal, work, and community life that will result in the development of more distributed, compact, and mixed-use urban forms. Green real estate development in densely populated locations could have the most significant impact on sustainable urban development, reducing energy consumption from the average suburban U.S. household by 75 percent, according to a paper published by Harvard Business School.[10]
    - Access to global networks and ICT resources is a requirement for individual and community success in the "Information Age"—and for driving the kind of continuous innovation that will be essential to competing successfully in the global economy. With proper focus, planning, and policies, cities can be centers of ICT-enabled innovation for sustainable growth.

Although these three ICT-enabled effects will have the most significant impact on urban sustainability, they are not yet well understood. Our fundamental belief is that today's flow of people, goods, energy, information, media, and services in cities can be as efficient as the traffic of digital packets on the Internet.

The Connected Urban Development Program

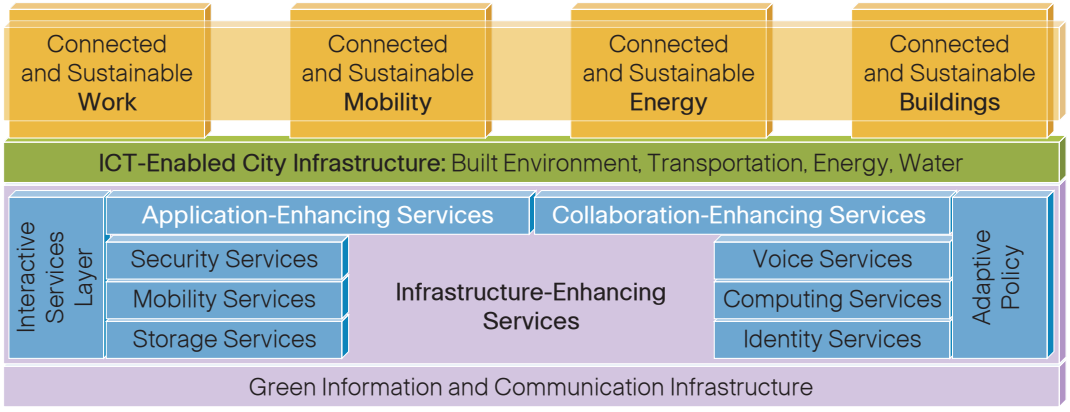
Attempts to reduce carbon emissions by cutting consumption of greenhouse gas-producing fuels have been largely unsuccessful. Reduction of energy consumption is viewed by many as counterproductive to economic growth, and such measures have been difficult to implement and impossible to enforce. Developing a new way of approaching the problem is critical, given the urgency posed by rapid climate change.

Connected Urban Development (CUD) was born from Cisco's participation in the Clinton Global Initiative—launched by the William J. Clinton Foundation in 2005 to solve global problems that affect the quality of human life—to help reduce carbon emissions and improve energy efficiency.

The CUD program initially involves three pilot cities: San Francisco, California; Amsterdam, the Netherlands; and Seoul, South Korea. These cities were selected because each had implemented or planned to execute a next-generation broadband (fiber and/or wireless) infrastructure; each suffers from significant traffic congestion issues; and each is led by a visionary mayor already involved in green initiatives. CUD relies heavily on the leadership of city mayors—and their commitment to ICT-enabled sustainability.

In its first phase, the CUD team is building partnerships with these cities to promote innovative practices using ICT to reduce CO2. Each of these cities will focus on excelling in one or two key areas. The result will be a blueprint of best practices and methodologies that other cities can reference in the second phase of the program, which will focus on scaling CUD's benefits to other cities around the globe. Areas addressed are Green ICT, Connected and Sustainable Built Environment, Connected and Sustainable Mobility, Connected and Sustainable Work, and Connected and Sustainable Energy.

Figure 2. Connected Urban Development Solution Framework



Source: Cisco IBSG, 2008

The 4 Principles of CUD

CUD is based on four principles:

1. **ICT directly contributes both to energy usage and CO2 reduction.** Industry efforts aimed at developing energy-efficient technology solutions can contribute to a sensible reduction of the environmental footprint in cities. But collaboration between government and industry, along with development of effective policy, are essential to a successful greening of ICT.
2. **Deploying broadband-based applications and services improves energy efficiencies.** These can be clustered in four major areas: Connected and Sustainable Built Environment, Connected and Sustainable Mobility, Connected and Sustainable Work, and Connected and Sustainable Energy.
3. **Urban pervasive broadband infrastructure and continuous development of application and services clusters can enable radically innovative practices** in the areas of urban form and planning, energy policy, new working practices, and new lifestyles. ICT pervasiveness and the emergence of Web 2.0 are having dramatic implications on the socioeconomic tissue of a city, as well as on its energy-efficiency policy.
4. **ICT and broadband connectivity have become enablers of combined, citywide urban policy, and of previously disconnected operational programs.** Integration of data and processes across siloed government initiatives is becoming a reality. Mobility, Built Environment, and Energy-related efficiency initiatives can now be successfully combined into integrated urban development programs.

Cisco relies on its networking expertise to provide a viable and sustainable solution for helping cities reduce carbon emissions. CUD draws on expertise from the Cisco Internet Business Solutions Group (IBSG)—Cisco's global strategic consulting arm—and researchers from the Massachusetts Institute of Technology (MIT). The program demonstrates how to reduce carbon emissions by introducing fundamental improvements in the efficiency of urban infrastructure through ICT. The CUD approach is different because it changes the way cities work and how they utilize resources.

The scope of the program will transcend the environmental dimension, delivering innovative, sustainable models for urban planning and economic development. Cisco's Corporate Development organization will invest US$15 million in the program over the next five years, including people, research, and equipment. Initially, Cisco IBSG will manage the project and support each city's strategic planning process by creating or acquiring research and providing analysis.

Connecting Within and Among Cities

CUD's vision is to create a global community of cities committed to sustainability. This focus is reflected in CUD's theme, "Connecting Cities: Achieving Sustainability Through Innovation," which refers both to the need to connect *within* cities (which, by inference, includes technology) and to the importance of connecting *among* cities. It is the start of a dialogue about how cities can develop coherent, long-term policies and plans to manage the environmental impacts of ICT, and to utilize ICT strategically for creating sustainable 21st century cities.

About Cisco and the Clinton Global Initiative

The William J. Clinton Foundation launched the Clinton Global Initiative in 2005 to solve global problems that affect the quality of human life. The initiative brings a community of global leaders together to devise and implement innovative solutions that address some of the world's most pressing challenges. It aligns with Cisco's strategy to reduce dependency on physical travel by investing in collaboration technologies that help reduce carbon emissions.

Recognizing Cisco for its role in addressing climate change, President Bill Clinton, in his book *Giving: How Each of Us Can Change the World*, wrote: "Cisco, the global information technology giant, has committed to reduce its CO2 emissions by 10 percent, primarily through a 20 percent company-wide travel reduction. It has also made a pledge with potentially far greater impact. The company will invest $15 million over the next three to five years to develop plans to reduce traffic congestion in cities, beginning with San Francisco, Seoul, and Amsterdam. Based on the projects, Cisco will develop a Connected Urban Development program, which can be used to improve sustainability in other urban areas, lowering CO2 emissions and saving both citizens and local governments time and money."

End Notes

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3. "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
4. Internet World Stats, December 2007 http://www.internetworldstats.com/stats.htm
5. FTTH Council, July 2007 http://www.ftthcouncil.org/?t=231
6. City of Seoul, Department of Information Technology
7. "Electricity Used by Office Equipment and Network Equipment in the U.S.: Detailed Report and Appendices," Energy Analysis Department, Environmental Energy Technologies Division, Lawrence Berkeley National Laboratory, University of California, Berkeley, February 2001 (http://enduse.lbl.gov/Projects/InfoTech.html); "Energy Consumption of Information and Communication Technology in Germany up to 2010, Project Number 28/01, Summary of the Final Report to the German Federal Ministry for Economics and Labour," Fraunhofer Institute for Systems and Innovation Research ISI, Centre for Energy Policy and Economics (CEPE), Karlsruhe/Zurich, January 2003; "An Inefficient Truth," Global Action Plan, London, United Kingdom, December 2007; "ICTs and Climate Change," ITU-T Technology Watch Briefing Report No. 3, November 2007 (see "The Impact of ICT on Global Emissions" report prepared by McKinsey & Company for the UN Environment Group, October 24, 2007)
8. "Broadband Services: Economic and Environmental Benefits," American Consumer Institute, Joseph P. Fuhr Jr. and Stephen B. Pociask, October 31, 2007
9. Other examples include installation of a smart grid by Pacific Northwest National Laboratory to control energy consumption in homes, cutting the average household electric bill by 10 percent annually. This could avoid the need to build 30 large coal power plants over the next 20 years in the United States alone—saving $70 billion in new plant investments (source: Pacific Northwest National Laboratory, January 2008). In addition, the State of Missouri reduced energy consumption by 20 percent across 100 buildings by networking climate-control systems to ensure they operate effectively (source: Dave Mosby, director of facilities, State of Missouri, December 2007).
10. "The New Real Estate," Working Knowledge for Business Leaders, Harvard Business School, Arthur I. Segel, March 12, 2007 (http://hbswk.hbs.edu/item/5620.html)

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