Concepts, Trends, and Ideas for Innovative Technology in Communities

D R A F T – April 29, 2009

Research and analysis from DIT (the Department of Information Technology) to the Fairfax County Planning Commissioners considering future development plans and Comprehensive Plan text for Tyson's Corner

The information in this document is in a draft format and is not final. It documents some initial research and analysis about the myriad of planning aspects that Fairfax County may want to encourage developers and building owners to consider when renovating existing buildings or constructing new buildings. Most of these aspects would involve the use of technology in one or more capacities. This listing is intended to stimulate discussion about what some of the possibilities are regarding innovative use of technology in a new or revitalized community.

The following contains some "best practice" case studies, some innovative and visionary uses of technology, some upcoming technology trends, as well as some examples about what other localities are doing. Most descriptions have been kept brief – more context or explanation can be found in the numerous reference links that have been provided.

To provide context and facilitate discussion, this document highlights the various capabilities of certain vendors. However, the information is being presented for learning and idea generation and there is no intention or implication of any type of endorsement.

This information has not been previous reviewed by either the Fairfax County Planning Commission or the Board of Supervisors and is to be considered a draft working paper.

(A) Case Study – Masdar City -- Planning for a new United Arab Emirates City which incorporates many strategies and ideas relevant to Tyson's – from building energy conservation to carbon neutrality to restricted personal automobiles to technology planning that will enrich the lifestyles of its future constituents:
http://www.masdaruae.com/en/Menu/index.aspx?MenuID=69&CatID=34&mnu=Cat)

Masdar City is planned to be the world's first carbon-neutral, zero-waste city. Currently under construction in Abu Dhabi, the capital of the United Arab Emirates (UAE), Masdar City will feature all of the modern conveniences, services and benefits of living in one of the great cities of the world, but in a carbon-neutral environment. It will become home to 40,000 residents and 50,000 daily commuters, and is being built around pedestrians, where open public squares intersect with narrow shaded walkways and connect to homes, schools, restaurants, theatres and shops. The City is a free zone clean-tech cluster. Academics, researchers, students, entrepreneurs and financers and more than 1,500 visionary companies will have offices, research centers and operations within city walls, benefiting from 100% foreign ownership, zero taxes, zero import tariffs, zero restrictions on capital movement and among the strongest intellectual property protection in the region.

ICT (Information & Communication Technologies) initiatives will require collaboration between Masdar officials and partners:

- Sustainability Management
- City Management Applications
- Electronic Wallet
- Smart home/Smart office and facility management solutions
- Computer Equipment Utility computing
- ICT Infrastructure Services, Telecommunications (voice, video & data) & Data centers

To achieve sustainability and carbon neutrality objectives, Masdar requires modern and reliable modes of transport that promote limited use of personal cars by commuters and visitors to Masdar City. The idea is to develop:

1. An LRT (Light Rail Transit) system passing through the city as part of the main planned Abu Dhabi LRT system to transport almost all commuters and visitors.
2. A PRT (Personal Rapid Transit) system that will guarantee passenger privacy in a way similar to a car by ensuring that, once boarded, no other passengers will board a vehicle along the route.
3. Special parking spaces that would be dedicated to external commuters and visitors as well as to internal residents.

4. Logistics network composed of discrete logistic components that are required to ensure availability of goods and materials in the city (desire to excellent delivery logistics services within Masdar city while balancing quality of services delivered).

Masdar has Energy & Utilities initiatives that will also require collaboration with its partners:

- **Photovoltaic Power Generation**
- **Concentrated Solar Power**
- **Parabolic Dish Water Desalination / Potable water network** (potential solutions include reverse osmosis desalination)
- **District Cooling Network/ Reticulation** (potential solutions include three ring cooling solution using cold water, medium-temperature hot water and liquid desiccants).
- **Geothermal**
- **Grid Power Management (**near real-time solutions that enable customer decisions to reduce demand and/or provide utility providers with the necessary information to operate at peak efficiency levels; potentially an intake grid substation to serve a dynamic bi-directional 22 kV interconnected network).
- **Grey Water & Sewage Treatment, and Wet Utility Distribution (special handling for Grey, Black and Recycled Water)**
- Special **Waste Collection, Waste Handling & Recycling; also Waste to Energy (p**otential solutions include advanced thermal treatment (Gasification/ Pyrolysis – decomposition of a condensed substance by heating).

(B) Case Study – Buck Institute -- A recent LEED-certified building that also received the nation's first Innovation in Design Credit for Information Technology Infrastructure. GreenIT helped the Buck Institute reduce the use of copper data cable from an estimated 22,000 linear feet of 4-pair cable to slightly more than 10,000 feet by designing a converged Ethernet network in an Active Zone topology, where Ethernet switches that provide connectivity for both voice and data are located in ceiling boxes and are connected using fiber optic cable instead of copper cables. This eliminated the need for approximately 174 pounds of virgin-mined copper. The 22,000 feet of data cabling used in a traditional design would use approximately 319 pounds of PVC plastic, including six to 25 pounds of lead used as a stabilizer for the plastic compounds in the cable jacket. The PVC plastic jacket of ordinary data cables has no recovery value and there is no completely safe method of recycling it. Buy using FEP-jacketed Limited Combustible (LC) cable for this project, all PVCs and lead for data cables were eliminated. Instead, the cables are jacketed in an FEP plastic that can be completely recovered and re-used by the manufacturer in a cradle-to-cradle closed loop.
http://www.buckinstitute.org/theInstitute/news.asp?id=3

(C) Innovative Vendor Capability – Panduit Corporation specializes in a unified approach to enterprise infrastructure architecture across one to many buildings. The capability can offer the following advantages to business enterprises:

- Multi-technology architecture that extends the reach of cabling infrastructures to all end point devices, creating seamless integration of building systems with new services like IP telephony, wireless connectivity, digital media and unified communications.
- Flexibility to accommodate changing user needs, from mobility services to environmental controls that optimize worker comfort.
- Greater visibility and control of critical systems that identify, monitor and resolve problems before they affect tenants, enhancing overall security and safety.
- New levels of technology convenience that ultimately work to differentiate an owner's building, and attract tenants who require robust network applications.
- Minimized installation of disparate systems wiring, which reduces initial deployment and maintenance costs throughout the lifecycle of the building.
- Converged networks that enable enhanced commissioning and help meet energy performance requirements for a LEED rating.

Panduit has developed the industry's most comprehensive and holistic approach to a Unified Physical Infrastructure and can help enterprises align, converge, and optimize critical systems
– communication, computing, control, power and security – to build a smarter, unified business foundation.
This approach enables the use of an open standards-based, service-oriented architecture framework and is designed to deliver tangible infrastructure and business process improvements for increased functionality, interoperability and manageability of mission critical operations across the enterprise.

Panduit, in collaboration with other technology partners, combines best practice methodologies, physical and logical architectures, and a comprehensive portfolio of solutions to deliver robust, scalable physical infrastructure enabling the integration of a broad range of applications from security and lighting to HVAC and IP networks which facilitates the deployment of technologies to meet current and future requirements:
Security: Multiple systems notification when an employee or tenant accesses a facility, prompting environmental changes (lighting/HVAC), elevator access, network and PoE port enabling, and video security measures, all with the swipe of an ID card.
Safety: If a fire alarm is activated, automatic responses are simultaneous: building doors unlock, automated announcements begin and emergency shutdown or containment of specific sites is triggered.
Efficiency: When energy demands spike, lighting systems should self-adjust to reduce output, HVAC systems should regulate to conserve power, while informational announcements are made automatically by e-mail or IP phone.
Comfort: When temperatures surge outside, area sensors enable HVAC systems to accommodate tenant comfort, while maximizing energy efficiency and enabling cost savings.
http://www.panduit.com/index.htm

(D) Innovative Technologies that could be considered and/or implemented in Tyson's Corner:

- Converged communication networks (voice/video/data) to deliver high-speed and high-quality Internet (and Intranet) services, video & audio conferencing, satellite communication, distant learning, remote access to building systems, etc.

- Integrate existing and new systems, design & deploy a real-time communications infrastructure, and provide superior management decision making capabilities (portals, dashboards, analytics, and utility control technology).

- Shared platforms and architectures to allow different subsystems to communicate with one another and exchange data and make intelligent decisions.

- Open systems architecture

- Standards in building communication protocols (LonWorks or BACnet as examples).

- High capacity cabling infrastructure that is reliable, interoperable, and scalable. Wiring and building infrastructure to facilitate and support all types of future technology needs – including Cat6 or Cat7 cabling (Cabling standards with their respective capacity and performance are explained at: http://www.siemon.com/us/white_papers/07-03-01-demystifying.asp)

- FTTP (fiber to the premises)

- Broadband (high speed communications)

- Prepare for new and evolving Internet Protocols. The current standard for 99% of the Internet is IPv4. This allowed for approximately 4 billion unique IP addresses; however, the world is running out of these 32-bit addresses. The next standard will be IPv6 which is a 128-bit address platform and will alleviate concerns about a shortage of unique addresses. It is likely that IPv4 and IPv6 data packet protocols will co-exist for some period of time: http://en.wikipedia.org/wiki/IPv6

- RFID (radio-frequency identification tags/cards) -- RFID can be used in a variety of applications such as:

  - Employee identification and access management
  - Tracking of products and RFID in retail/inventory

- Asset management
- Tracking arrival and departure of persons
- Toll collection and contact-less payment
- Machine-readable travel documents
- Location-based services
- http://en.wikipedia.org/wiki/RFID

- Provide public access PCs with Internet connectivity (offer multiple channels to help bridge the digital divide for citizens and constituents that do not have the latest wireless technology)

- Enable wireless signals for cell and PDA/Blackberry services (may require external antennae)

- Enable Wireless signals for public safety radio communications (may require an external antennae;

  [Note – wireless signal penetration is affected many factors including building materials, land topography, distance to the nearest large antennae, signal strength, and capability of the hand held PDA/Blackberry/Cell Phone or public safety radio]

- Provide telework space and configurations

- Implement enhanced monitoring of all building facilities to reduce consumption

- Implement local building solar energy for electricity and hot water; also ability to sell any surplus back to the grid

- Recover heat generated from buildings and offices and repurpose it for hot water or other building heating needs

- Implement power management for PCs and electronic devices (hibernate, or turn off at night)

- Implement points and rewards schemes for walking, cycling, using public transportation, and carpooling

- Provide pervasive and visible recycling locations throughout buildings

- Regularly communicate enterprise environmental goals and footprint and progress through multiple channels

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- Consume fewer servers by virtualization strategies and techniques
- Improve capacity planning to reduce over-provisioning of computer resources
- Print less, and use recycled paper
- Recycle all e-waste; purchase more recyclable products
- Implement thin client (web-browser based) systems and applications (reducing the need for a high capacity PC or notebook computer)
- Consolidate printers
- Design & implement robust systems that are expected to be highly available yet not need 24 x 7 technical support. Where appropriate, implement employee self-service systems
- Implement effective and efficient data storage and backup/recovery capabilities
- Implement effective workforce collaboration tools and systems
- Implement technologies to support a more mobile workforce. Expect future employees to have a "virtual office" accessed via a portable computing device which will support telework initiatives
- Provide secure yet robust access to Web 2.0 "Social Media" utilities: http://en.wikipedia.org/wiki/Web_2.0
- Investigate future trends and strategies such as cloud computing – scalable and virtual IT resources that are provided as a service over the Internet: http://en.wikipedia.org/wiki/Cloud_computing
- Provide secure virtual presence connections for seniors having remote medical appointments with healthcare providers
- Provide seamless connections with schools and libraries

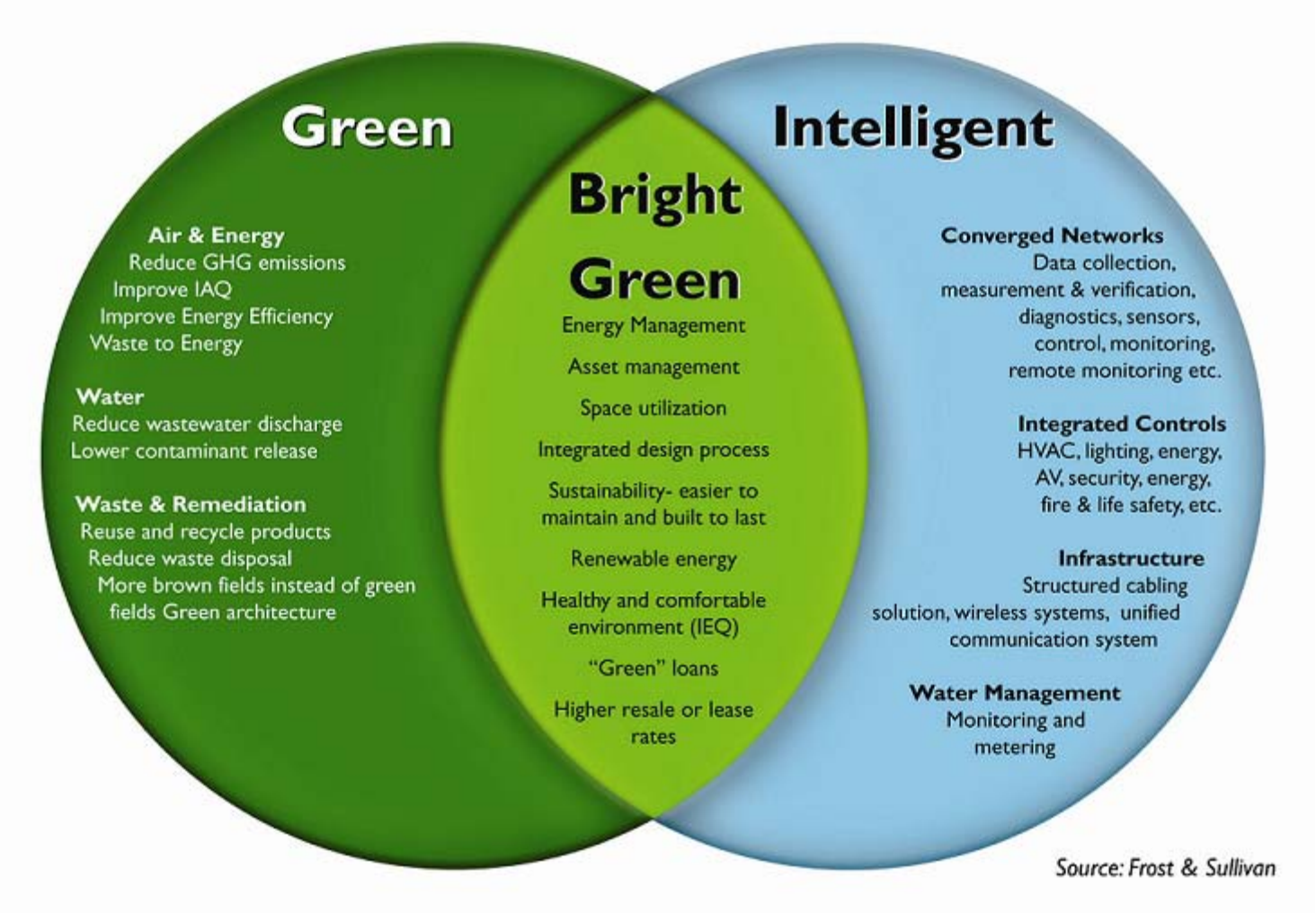
- Consider intangible values – such as providing relevant and accurate information to citizens; enhancing entertainment; and keeping citizens informed about the environmental progress agenda.

- Consider the needs of all constituents -- employers, retailers, residents, visitors, partners, and by government.

(E) Several Innovative Transportation-related ideas:

- Intelligent transportation (dynamic reconfiguration of lane changes)
- Smart traffic signals
- Proximity incident response (optimal pre-deployment and location of public safety services like Police, Fire & Rescue, towing, courtesy driver/vehicle assistance etc.).
- Real-time Transportation information to constituents (status and estimated next arrival for the internal Tyson's connector, bus & rail; also highway conditions)
- Demand-managed scheduling of PRTs – Personal Rapid Transit systems (http://en.wikipedia.org/wiki/Personal_rapid_transit; London Heathrow Airport and Masdar City plus other examples).
- Intelligent transport solutions -- smart systems to reduce traffic and air pollution using predictive tools, smart cards, and congestion charging systems. A new smart toll system has been implemented to reduce traffic congestion and carbon emissions in Stockholm. In London, a sophisticated congestion management system has lowered traffic volumes significantly. A traffic system developed in Singapore can predict traffic speeds with an accuracy of nearly 90%, and future developments will enable it not only to monitor but to predict other traffic conditions as well.
- Replace the light bulbs in all traffic lights with LEDs
- Implement solar powered traffic lights
- Smart parking – RFID transmits vehicle parking needs (size; handicapped, etc.) and intelligent guidance to an available parking space is provided.
- RFID can sense parking lot entrance or exit and power on and off lights, PCs, and temperature in the assigned building workspace.
- Require all future taxicabs to be hybrid vehicles

(F) One of the latest concepts has been called "**Bright Green Buildings**" with takes the best features of Green Buildings and Intelligent buildings and 'merges' them together. The chart below is from the CABA (Continental Automated Buildings Association) report entitled **Bright Green Buildings – Convergence of Green & Intelligent Buildings**: http://www.caba.org/brightgreen



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Extracted from CABA:

Conventional buildings suffer from the inability to communicate and intelligently manage the large amount of data that they possess and generate. A converged network solution allows a higher level of connectivity for a variety of products from multiple manufacturers. This results in benefits such as cost effectiveness, process improvements in facility automation, monitoring and management, and more efficient real estate portfolio management. Streaming building control and utility data into a shared network enables optimum management of facilities by connecting various silo systems and applications. Networking solutions can allow divergent technologies to converge and improve responsiveness, efficiency, and performance.

Bright green buildings can converge data, voice, and video with security, HVAC, lighting, fire & life safety, elevators, water management, AV technologies, and other electronic controls on a single network platform. Known as building automation systems (BAS) and building energy management system (BEMS), these solutions typically aim at optimizing the performance, start-up, and maintenance of building systems and greatly increase the interaction of mechanical subsystems in the building. This leads to improved occupant comfort, optimum energy consumption, and cost-effective building operation. All these can be done remotely or from a centralized system with a minimum human-in-loop factor.

Based on the Telecommunications and Electronic Industry Association 568 Standard, a structured cabling solution (SCS) can significantly increase the lifespan of cabling infrastructure in a building, obviating extensive changes or expensive upgrades. An SCS is an open system architecture that integrates voice, data, video and other buildings systems. It can reduce construction costs for the cabling infrastructure by as much as 30% and 25-60% for cabling related changes. Minimized upfront costs due to labor and material savings, increased lifespan and durability, and minimal maintenance costs are various direct/monetary benefits that can be realized.

Network infrastructure is more critical than ever. The cost to business for installation and maintenance is a large investment. Users seeking data communications architectures that support a wide range of network applications can use a Telecommunication Industry Association (TIA) standards based solution: Fiber-to-the-Telecom-Enclosure (FTTE) or Zone cabling. The FTTE architecture extends the fiber optic backbone to telecom enclosure closer to workstations throughout a building. The telecom enclosure can then distribute a flexible topology of mixed media and power to the devices using copper category cable, fiber optics, coaxial cable, and A/V cable. As a result, buildings can benefit from more useable real estate due to the removal or consolidation of the telecommunications room on each floor. Also, there is a 20-30% cost reduction on cabling due to consolidation and removal of proprietary networks, improved network performance, single contractor/integrator vs. several specialists for disparate systems, and a substantial reduction in cost and disruption to staff when making changes within work areas…

(G) Guiding Principles for ICT (Information and Communications Technologies) projects -- some extracted and adapted from a World Bank Study:

- Determine target groups that would benefit from ICT to help achieve project success
- Project objectives need to be clear and accepted by the majority of stakeholders
- Do not introduce technology for its own sake or for the sake of the project. Introduce technology to meet the information and communication needs of the target group.
- A "champion" with a vision of success is needed to be behind the project and keep it on track.
- Government ICT policies and partnerships can affect the day-to-day operation of ICT projects.
- Project success and sustainability requires a clear link between the target group and the institutional arrangements made with partners for the project.
- Project Success and Sustainability is affected by human capital and technical and organizational capacity. The capacity does not need to be present at the start of a project, but it must be either developed or found (by linking with other organizations or groups).
- When designing an ICT program, consider the different ways in which people learn, communicate, and use information.
- Create partnerships with public and private institutional infrastructures. Build on existing formal and informal local organizations and communication networks.
- ICT projects can address:
    - Infrastructure: providing suitable computer hardware, operating systems, software, and sustainable connectivity to the Internet.
    - Digital content and services, such as e-services, e-learning, e-health, e-business/e-commerce, and e-government.

(H) What are other localities, states, the federal government, and other nations doing?

Super-Green Buildings – 200 page December 2008 report from the Continental Automated Buildings Association about smart buildings that are combined with sophisticated controls systems and high-performance environmentally efficient structures. Building owners report a positive ROI: (http://www.greenerbuildings.com/news/2008/12/04/reports-affirm-green-benefits)

First facility of its kind to receive the U.S. Green Building Council's LEED Platinum rating for a combined office building plus IT data center – April 2009 in Frankfurt Germany with energy- and resource-efficient designs and close cooperation between both the Real Estate and Technology groups. Among the notable achievements: 72 percent of the roof is a vegetative "green" roof which keeps the building cooler in summer and warmer in winter, as well as absorbing rainwater and reducing summer "heat island" effect; the building will use free outside-air cooling 63 percent of the time; 27 percent of the materials were recycled; 40 percent of the materials were locally sourced; by virtualizing a large number of computer servers in the data center, the company used 250 kilometers (155 miles) less cabling to wire the facility; the data center uses just 30 percent of the power that a similarly sized data center would require. http://www.greenerbuildings.com/news/2009/04/23/citi-data-center-first-leed-platinum

Local governments are embedding carbon emissions controls and environmental impact standards within their 'green' building codes (Boston, L.A., San Francisco, D.C.):
http://www.usgbc.org/News/USGBCInTheNewsDetails.aspx?ID=3965
http://www.usgbc.org/News/USGBCInTheNewsDetails.aspx?ID=3945

The U.S. Green Building Council has just completed a pilot of its **LEED for Neighborhood Development** rating system. It integrates the principles of smart growth, urbanism, and green building technology into the first national system for neighborhood design. This program is a collaboration between the USGBC, the Congress for New Urbanism, and the Natural Resources Defense Council. http://www.usgbc.org/DisplayPage.aspx?CMSPageID=148

Austin, Texas is adopting a series of code amendments that by 2015 will make all new single-family homes in Austin zero energy capable. A zero-energy home is one capable of producing as much energy as it consumes over the course of a year.
http://www.ci.austin.tx.us/council/zech_release.htm

IBM has a SmarterCities Initiative that is helping a dozen cities with resource and transportation efficiencies combined with IT. One example – citizens will be able to interact with the locality as if there were a municipal official in front of them, delivering and receiving documents and checks, filling in and signing forms, and requesting support:

http://www-935.ibm.com/services/us/index.wss/summary/imc/a1031141?cntxt=a1000055

The Clean Tech Open is a west coast non-profit organization that serves as a catalyst for clean tech innovation. It provides today's clean tech innovators with the tools, training and connections they need to become tomorrow's viable clean tech businesses, uniting the public and private sectors in a shared vision for making America's clean tech sector a thriving economic engine.
http://www.cleantechopen.com/about.php?page=home

California passed a 2008 state law limiting CO2 emissions by curbing suburban sprawl and increasing transit-based development through incentives. Community plans with walkable, mixed-use, transit-oriented growth which reduce auto use and curb greenhouse gas emissions get "moved to the front of the line" for state & federal transportation funds.
http://www.usgbc.org/News/USGBCInTheNewsDetails.aspx?ID=3846

In 2008, Grand Rapids, Michigan, became the greenest city in the U.S. with the largest number of LEED-certified buildings per capita.
http://www.fastcompany.com/magazine/129/new-urban-eco-nomics.html
Green Grand Rapids Master Plan:
http://www.grand-rapids.mi.us/index.pl?page_id=2661
http://www.ci.grand-rapids.mi.us/index.pl?page_id=8688 (includes links to public meeting green choices and prioritization)

In Malta, IBM is helping to create and implement a new smart grid utilities system to enable more efficient consumption of energy and water. The system will detect leakages, allow for variable pricing and offer greater control to consumers of utilities.

In 2008, at least 8 states and 22 localities adopted Green policies or green building codes:
http://www.usatoday.com/news/nation/environment/2008-08-06-Buildgreen_N.htm

John Hartke, Director of Public Policy (formerly State & Local Advocacy) USGBC, presents an overview of green building efforts by several dozen state & local governments: http://www.mwcog.org/uploads/committee-documents/vVZfWVw20070802143605.pdf

Comprehensive list through February 2009 of all LEED projects and initiatives collected by the USGBC, including 34 counties, 122 cities, 30 towns, 31 state governments, 12 federal departments, 15 local public schools, and 39 institutions of higher learning:
https://www.usgbc.org/ShowFile.aspx?DocumentID=691

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Lots of practical strategies, tips, and tools for local governments to address climate change by this public/private partnership group; topics divided up by Green Buildings, Green Neighborhoods, and Sustainable Infrastructure (Arlington Co. is one of a dozen local governments involved): http://www.greenplaybook.org/
Commercial partners and consultants: http://www.greenplaybook.org/whoweare/team.htm

Government Building Codes Networking Community hosted by USGBC:
http://www.usgbc.org/DisplayPage.aspx?CMSPageID=1909

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