The Internet of Things and Energy & Environment Policy Principles

Background

Historically, governments and the public have focused on the *negative* environmental and energy impacts, or "footprint", of information and communications technology (ICT). More recently, energy and environmental impact assessments of the ICT industry have emphasized the *positive* effects, or "handprint", of these technologies. For example, the most significant recent assessment of ICT's beneficial *net* environmental impact focused on climate emissions. The Boston Consulting Group concluded that a comprehensive portfolio of ICT-enabled climate mitigation strategies could reduce global climate change emissions by 16.5 percent in the year 2020 compared to a "business as usual" baseline, saving $1.9 trillion in fuel savings in the process. This potential contribution is larger than virtually any other alternative climate mitigation strategy, and seven times larger than the ICT sector's own climate emissions.[1] ICT's climate handprint vastly outweighs its footprint, meaning the sector is a significant net solution.

The underlying reason that ICT applications can have this significant positive impact is because ICT enables a significant number of end-use energy efficiency improvements that can reduce the need for electricity and, thus, reduce the carbon and other pollution associated with that foregone electricity. These improvements can be found in such technologies as home and building energy management systems, smart grid devices, global positioning system (GPS) technologies for smart logistics, and smart industrial motors employing variable speed motors. But the most important point is that this positive energy and environmental story is not about individual devices or technologies, but rather about the network that connects these devices.

And that is where the Internet of Things (IoT) is relevant. The IoT in effect extends and multiplies the reach and impact of the positive ICT network impacts described above. The American Council for an Energy-Efficient Economy (ACEEE) has labelled the IoT-enabled energy efficiency phenomenon as "intelligent efficiency" (IE), which they say is "…a systems-based, holistic approach to energy savings, enabled by ICT and user access to real-time information." They distinguish IE from component energy efficiency, with the former being "…adaptive, anticipatory, and networked." Within IE, they distinguish between "people-centered efficiency" (which provides consumers with greater access to information about their energy

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[1] *GeSI SMARTer 2020: The Role of ICT in Driving a Sustainable Future*, The Boston Consulting Group (2013), http://gesi.org/assets/js/lib/tinymce/jscripts/tiny_mce/plugins/ajaxfilemanager/uploaded/SMARTer%202020%20-%20The%20Role%20of%20ICT%20in%20Driving%20a%20Sustainable%20Future%20-%20December%202012._2.pdf.

use and the tools to reduce it) and "technology-centered efficiency" (which utilize various types of connected and automated systems to enable optimization of energy systems in buildings, industry, and transportation systems).[2]

Intel is already demonstrating IoT-based energy efficiency gains in a project with Daikin Applied, employing an Intel-based intelligent gateway solution to enable Daikin to connect numerous rooftop heating, ventilation and air conditioning (HVAC) units and remotely monitor and manage them, including providing advanced energy management.[3] Beyond Intel, other examples of energy applications include:

- Building energy management systems (BEMS) and home energy management systems (HEMS) that involve extensive deployment of sensors to allow fine-grained energy management across single or multiple buildings.

- Integration of BEMS and smart meters to enable demand-side management (DSM).

- IoT-enabled home appliances that communicate with the grid and the consumer to permit optimal scheduling of service cycles.

The potential for IoT-driven advances extend into the broader environmental market. Intel Labs is demonstrating some of these benefits in three "smart cities" projects in Dublin, London, and San Jose. In Dublin, we have deployed gateways and sensors to monitor air quality and noise levels.[4] The London project focuses on both air quality monitoring and transit system improvements that can yield environmental improvements. Other examples of existing and potential environmental IoT applications include:

- Deployment of low-cost air and water quality monitors that enable crowd-sourcing of real time ambient data via wireless systems.

- Low-cost water quality monitors that can enable point/non-point source "nutrient" trading to reduce the cost of cleaning up water resources like the Chesapeake Bay.

- "Smart water grid" technologies that can pinpoint distribution system leaks and enable predictive maintenance, reducing water withdrawals from lakes and streams.

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[2] *A Defining Framework for Intelligent Efficiency*, American Council for an Energy-Efficient Economy (June 2012), http://aceee.org/research-report/e125.

[3] http://www.intel.com/content/www/us/en/intelligent-systems/iot/daikin-applied-transforms-hvac-with-iot.html?wapkw=daikin.

[4] http://www.irishtimes.com/business/sectors/technology/smart-dublin-high-tech-sensors-to-monitor-life-in-the-capital-1.1745721

- Vehicle and highway technologies that can reduce congestion and engine idling, thereby reducing air pollution.

- "Precision agriculture" systems that employ GPS systems and in-soil sensors to enable application of water, pesticides and fertilizer at just the right time in just the right amounts, reducing polluting runoff.

- Deployment of ambient sensors that permit better weather prediction and preparedness for extreme weather events.

Policy Principles

Lead by Example

- The Federal and state governments collectively are the country's largest employers, fleet operators, ICT purchasers, and landlords. They can help jumpstart the use of IoT systems for energy and environmental purposes via government procurement.

- Although governments and private companies have different missions, they share similar operational functions. By documenting and spotlighting the benefits of IoT systems deployment in government buildings, fleets, etc., governments can help the private sector understand the business case for specific IoT applications.

Give Consumers Access to Data

- In the energy and water markets, governments can ensure that consumers are given ready access to their real-time consumption data. This has been shown to spur the development of IoT devices and applications that enable closer control over their own consumption, driving significant efficiency savings.

- In the environmental quality market, making government air quality data sets available will spur the development of new "apps" to make practical use of the data.

Encourage the Integration of Crowd-Sourced Environmental Data with "Official" Data

- The increasing availability of inexpensive, IoT-based environmental monitoring devices may enable a virtual explosion in crowd-sourced environmental data. Those data in most cases will not be of the same quality as required of data generated for government environmental regulatory programs. But assuming IoT-based monitors exceed a minimum quality threshold, the data they generate will have value for understanding real-time air and water quality conditions. Moreover, because IoT-based devices are likely to be much less expensive than “official” regulatory monitors, they can be deployed much more pervasively and thus potentially create a more comprehensive picture of local environmental conditions. Governments should find ways to take advantage of these new information resources.

Emphasize Overall System Efficiency Rather than Device-Level Networked Standby Efficiency

- Governments have made a priority of reducing so-called “phantom” energy loads, including the standby power consumption of devices that, by design and function, must always be “on”. The growing proliferation of Internet-connected home appliances, industrial process optimization sensors, and other energy efficiency-focused manifestations of IoT potentially will drive growth in standby loads.

- Governments rightly want to limit such growth but need to do so in a way that does not miss the proverbial forest for the trees. IoT-enabled efficiency promises to drive energy savings that dwarf the cumulative phantom load they will create. Poorly-designed networked standby requirements will undermine this potential.