DIGITALIZATION OF THE ENERGY SECTOR TO ENHANCE ENERGY PRODUCTIVITY & RENEWABLE INTEGRATION

THE IMPORTANCE OF POLICIES TO SUPPORT ISSUES SUCH AS SECURITY, SOVEREIGNTY & INTEROPERABILITY

Pre-Read for Public-Private Roundtable

Eighth Clean Energy Ministerial (CEM8)
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Beijing, China
RISE OF THE INNOVATION CLUSTER


DIGITALIZATION AND THE ENERGY SECTOR

Smart Grids

Information and Communication Technologies (ICT) enabling predictive supply and demand management

Big Data

Mobile Internet and Cloud Technology enabling energy access

Artificial Intelligence

Blockchain

Mobile Internet

Blockchains leading to intelligent savings, smart contracts, and direct low-cost transactions

Cloud Technology

Internet of Things

Internet of Things (IoT) networked devices enabling smart buildings and industries

Smart Grids enhancing VRE integration and productivity

Internet of Things
Roundtable Scope and Objectives

1. Roundtable Scope and Objectives
2. Common Definitions and Current Landscape
3. Barriers
4. Potential Solutions
5. Existing Efforts
6. Opportunities for Progress
The roundtable is focused on the digitalization of the energy sector, in particular the phenomenon of devices becoming “network connected” and the associated energy-related issues and opportunities.

Associated with this are topics such as the internet of things, smart appliances, cloud computing, big data, machine learning, intelligent efficiency, demand response and blockchain.

The key cross-cutting issues are:

• The “openness” and “inter-operability” of devices, operating platforms and protocols, which is seen as key to the realisation of the full potential of connected devices
• Sovereignty, privacy, and cyber security concerns.
• The “energy cost” of devices becoming network-connected – remaining on a communications network 24/7.
• Policy and regulatory implications.
ROUNDTABLE OBJECTIVES

• Set out the opportunities presented by the digitalization of the energy sector.
• Define different digitalization categories that currently exist in the energy sector to clearly understand the commonalities and emerging opportunities within the digital landscape.
• Discuss exiting platforms that enable some of these emerging solutions to help connected devices achieve their full energy savings potential without additional burden on existing infrastructure.
• Outline the potential challenges, including system security, customer sovereignty and inter-operability.
• Discuss the policy and regulatory solutions for energy ministers to recognize when considering digitalization of the energy-sector.
EXPECTED ROUND TABLE OUTCOMES

• Increased high-level recognition of the digitalization of the energy sector and connected device issues with a focus on energy productivity.

• Identification of potential government/industry initiatives to address the issues – including an initial scoping and show of country support for a future CEM campaign or other activities.
**Questions to Guide Roundtable Discussion**

- What is the potential for connected devices to improve energy productivity and renewable integration?
- What political, regulatory, market and technological barriers inhibit this potential?
- Are there existing platform solutions that address issues such as the interoperability of devices, network security and consumer privacy concerns and should these be open?
- What's the role of governments in a commercial marketplace where there are multiple competing communications technologies?
- What industry and policy levers should be used to minimise the “energy cost” of device connectivity?
OUTLINE

1. Roundtable Scope and Objectives

2. **Common Definitions and Current Landscape**

3. Barriers

4. Potential Solutions

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6. Opportunities for Progress
Opportunity to enhance resilience of electricity networks, improve operational efficiency and system reliability, improve electricity market function, reduce losses, integrate energy supply and end-use technologies through advanced information, sensing, communications, control, and energy management.
**Information and Communication Technologies (ICT)**

ICT includes leveraging big data, machine learning, and artificial intelligence to enable transformation of the energy sector.

**Global e-Sustainability Initiative (GeSI)**

**What is GeSI?**
Leading source of impartial information, resources and best practices for achieving integrated social and environmental sustainability through ICT.

**Who is a part of GeSI?**
Represents 40 of the world’s leading ICT companies and partners with over 12 global businesses and international organizations.

- Climate Change
- Energy Efficiency
- E-waste management
- Supply-Chain

**Current Landscape**
**Blockchain**

Blockchain is the technology behind Bitcoin, however, it is not solely for finance...

Blockchain is a distributed, open source database. It can be a long record of transactions in a database made secure with state of the art cryptography. It is a system that works for collaborative initiatives within communities where peer-to-peer (P2P) exchanges can take place.
Challenging the Regulated Utility Model:

In Brooklyn, NY, USA, LO3 Energy has created a P2P transaction system for a solar energy microgrid. The microgrid allows users to sell locally generated, clean energy to their neighbors. This requires a reliable, secure platform for payments and blockchain can provide this high-level of security creating new models of power production and distribution.

LO3’s TransActive Grid (TAG) Platform:
- Combines blockchain-based software
- Supports “smart” applications
- Enables producers to sell directly to consumers
- Allows for grid balancing, demand response, and emergency management
"In the next 15 years, digital banking will give the poor more control over their assets and help them transform their lives. By 2030, 2 billion people who don’t have a bank account today will be storing money and making payments with their phones."

Bill Gates

M-KOPA in Kenya

- Company offers low-cost solar panels
- Customers must pay a small down-payment and the remainder of the payments over the course of a year
- Customers can use a secure mobile application to make payments
INTERNET OF THINGS (IoT)

Sensors and actuators connected by networks to computing systems monitoring and/or managing actions of connected objects and machines.

Source: Unlocking the potential of the Internet of Things, McKinsey & Company, 2015:
Per capita IP and Internet traffic growth has followed a similarly steep growth curve over the past decade. Globally, monthly IP traffic will reach 25 GB per capita by 2020, up from 10 GB per capita in 2015, and Internet traffic will reach 21 GB per capita by 2020, up from 7 GB per capita in 2015. Not long ago, in 2008, per capita Internet traffic was 1 GB per month. In 2000, per capita Internet traffic was 10 megabytes (MB) per month.

The sections that follow explore the trends contributing to the continued growth of global IP traffic.

**Trend 1: Continued Shifts in Mix of Devices and Connections**

Figure 2 shows that globally, devices and connections (10 percent CAGR) are growing faster than both the population (1.1 percent CAGR) and Internet users (6.5 percent CAGR). This trend is accelerating the increase in the average number of devices and connections per household and per Internet user. Each year, various new devices in different form factors with increased capabilities and intelligence are introduced and adopted in the market. A growing number of M2M applications, such as smart meters, video surveillance, healthcare monitoring, transportation, and package or asset tracking, are contributing in a major way to the growth of devices and connections. By 2020, M2M connections will be 46 percent of the total devices and connections.

Figure 2. Global Devices and Connections Growth

Figures (n) refer to 2015, 2020 device share.

Source: Cisco VNI Global IP Traffic Forecast, 2015–2020

M2M connections will be the fastest-growing category, growing nearly 2.5-fold during the forecast period, at 20 percent CAGR, to 12.2 billion connections by 2020. Smartphones will grow the second fastest, at 13 percent CAGR (increasing by a factor of 1.8). Connected TVs (which include flat-panel TVs, set-top boxes, digital media adapters [DMAs], Blu-ray disc players, and gaming consoles) will grow nearly next fastest at 12 percent CAGR, to 3.1 billion by 2020. PCs will continue to decline (about a 2 percent decline) over the forecast period. However, there will more PCs than tablets by the end of 2020 (1.35 billion PCs vs. 785 million tablets).

By 2020 the consumer share of the total devices, including both fixed and mobile devices, will be 74 percent, with business claiming the remaining 26 percent. Consumer share will grow at a slightly slower rate, at 9.5 percent CAGR relative to the business segment, which will grow at 12 percent CAGR. For more details about the growth in devices and connections in residential, consumer mobile, and business segments, refer to the Cisco VNI Service Adoption Forecast Highlights tool.

Numbers of connected devices are growing rapidly, and have already surpassed the number of humans on the planet


The “energy cost” of connectivity is also growing at a rapid rate

ICT electricity demand by segment

- Edge devices and user-premise network equipment: 42%
- Networks: 18%
- Data centres: 21%
- Other: 19%

Energy savings are a significant part of this potential.
**SHORT SYNOPSIS**

Connected devices offer the opportunity for a step-change in the way that energy is used in all sectors. Taking full advantage requires substantial action among policy makers and the private sector.

Connectivity brings opportunities for:

- Remote control of devices to save energy
- Communication of information about device energy usage
- System-wide optimization, including demand response

This kind of “intelligent efficiency” is the new forefront of energy conservation. Digitalization of the supply sector has commenced, but a fundamental change of the energy system could be unlocked by digitalization of the demand side.

At the same time, the “energy cost” associated with hundreds of billions of devices being connected to the internet - 24/7 - is a significant issue.

And the benefits of connectivity are not yet being fully realised.

Focused action among policy makers and the private sector is required to overcome political, market and technological challenges.

The path forward would benefit from further analysis and innovative thinking.
EXPLANATORY CASE STUDY – RESIDENTIAL LIGHTING

This is a simple case study to illustrate the issue. There are increasing numbers of LED light bulbs that can be connected to a home communications network.

This offers significant potential to save energy – lights can be programmed to switch on and off at various times, and intelligently anticipate the best times to turn on and off, in order to minimise energy consumption.

In a fully integrated system, connected lights would be able to communicate effectively with other related systems within the house – such as heating and cooling, the security system, window shading systems, and the like.

To achieve full energy savings potential, these diverse systems need to inter-operate, using a single, high-level communications protocol which is accessible by all the networked devices in the home.

Also, if the lights use significant energy to communicate (24/7), this can significantly erode the energy savings gained from intelligent control.

This is a simple example, which can be extrapolated to many other products, more complex systems, and other sectors of the economy.
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**Market Barriers**

- Key players are competing for a majority share of consumers without much concern for interoperability outside of their own “suite” of devices.
- Many consumers distrust new technologies and are hesitant about the security of their data, or how it may be used by third parties.
- Consumers are reluctant to take up new technologies until these are “proven” in the market place and demonstrable benefits can be seen.

Policy Barriers

- Lack of overall policy co-ordination - many economies have written high level strategies for the internet of things, however implementation of these strategies is still in its infancy, and detail is lacking.
- Lack of standardisation - while several manufacturers have joined together in various alliances and initiatives, the communication standards used for connected devices are still highly fragmented. Devices are entering the market without a consistent, proven communication platform, leading to market confusion and fragmentation.
- Lack of measurement capability for intelligent efficiency - the difficulty in assessing quantified and verifiable energy savings from intelligent efficiency may inhibit its advancement.
Inter-operability: How do we unlock the full potential of connected devices which requires addressing complex networks of different devices?

Security: How do we prevent connected devices from becoming weak entry points for hackers intending to disrupt energy services or expose personal user information?

Sovereignty: Who governs and sets boundaries for the networks and related data created by connected devices? How is sovereignty maintained?
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Connected Devices Alliance (CDA) Principles for Energy Efficient Connected Devices

The CDA Voluntary Principles for Energy Efficient Connected Devices were developed by the G20 Networked Devices Task Group to:

- Provide guidance on the key features of energy efficient connected devices, networks and communications protocols - for use by designers, manufacturers and protocols authors
- Encourage a common global framework for the development of government policies and measures - for use by policy makers.

The principles contain key recommendations for inter-operability and are currently supported by 15 major manufacturers, associations and governments.
TECHNICAL SOLUTIONS

CDA DESIGN PRINCIPLES FOR ENERGY EFFICIENT CONNECTED DEVICES

1. Networked device design should follow standards-based communication and power management protocols to ensure compatibility and interoperability, and should take advantage of standards and protocols that actively support energy efficiency.

2. Networked devices should not impede the efficient operation of a network (for example by injecting bottlenecks or faults, or impeding power management activities in other devices).

3. Network-wide energy efficiency optimization should be a key development consideration. Network power management should coordinate with individual device power management techniques to achieve this.

4. Connection to a network should not impede a device from implementing its internal power management activities.

5. Networks should be designed such that legacy or incompatible devices do not prevent other networked devices on the network from effective power management activities.

6. Networks and networked devices should have the ability to scale power levels in response to the amount of the service (level of functionality) required by the system.
CDA DESIGN PRINCIPLES FOR ENERGY EFFICIENT CONNECTED DEVICES (cont)

7. Edge devices without networking functionality should enter network standby, if not inappropriate\(^a\), after a reasonable period of time when not being used. Edge devices with networking functionality should provide power management capabilities for each function consistent with that function’s role in the network\(^b\).

8. Networking and networked infrastructure devices should, when work load allows, autonomously minimise power consumption.

9. Consumers should be informed about, and have control over, device power management, including any impacts on the energy consumption of the devise and of any dependent devices, and changes to the user experience.

10. The design and operation of networked devices should be compatible with, and promote the positive effects of, using consumer electronics and information and communication technology (ICT) to enable energy to be used more efficiently, often referred to as “Intelligent Efficiency.”
TECHNOLOGICAL SOLUTIONS

“Energy Aware” Devices

Energy aware devices are connected devices which can measure or estimate their own energy consumption and report it to the user.

Making devices energy aware is inexpensive, much like the fuel economy reporting which is now ubiquitous in modern passenger vehicles.

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Connected Devices Alliance (CDA)

Conceived in 2015 by G20 Networked Devices Initiative, the CDA is an informal alliance between 19 governments and more than 350 industry representatives. It has developed a number of initiatives including:

- Design & policy principles for connected devices
- Centre of excellence for related policy papers
- Policy guidance to encourage devices to become “energy aware”
- Awards for energy efficient communications protocols
- Recommendations for development of measurement methods for intelligent efficiency
- Policy guidance for intelligent efficiency
IEA-4E ELECTRONIC DEVICES AND NETWORKS ANNEX (EDNA)

The IEA EDNA Annex is a collection of 12 governments that have come together to help align government policies in the area of connected devices.
**The CEM’s Super-efficient Equipment and Appliance Deployment (SEAD) Initiative**

New SEAD Global Efficiency Medal Competition - recognition award for communications protocols (to be launched at CEM8)
GLOBAL E-SUSTAINABILITY INITIATIVE (GeSI)

GeSI’s vision is of a sustainable world through responsible, ICT-enabled transformation.

It aims to facilitate real world solutions to real world issues both within the ICT industry and the greater sustainability community.

It represents around 40 of the world's leading service providers and vendors from the Information and Communication Technology (ICT) sector.
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The output desired from the roundtable may be a group statement:

• An introductory paragraph aimed at increasing high-level recognition of the digitalization of the energy sector and in particular of the **energy savings potential and associated issues related to networked devices**.

• Identification of the **key features** that future digital energy solutions for networked devices should incorporate.

• A call to governments and industry to **support the CDA Principles** for Energy Efficient Connected Devices.

• A request to take forward a **future CEM campaign**
APPENDIX
BACKGROUND

Explanatory video: https://www.youtube.com/watch?v=H9grCy3bltc
Unlocking potential means addressing complex issues such as “inter-operability” of devices and systems.

There is a proliferation of communications protocols for connected devices, which limits interoperability.
CDA Policy Principles

CDA Policy Principles for Energy Efficient Connected Devices

1. Government and industry should seek harmonized policy approaches that benefit the global marketplace for consumer and commercial technology products and services, and that enhance the productivity and efficiencies achieved via networks.

2. Policy, including government procurement and best-practice sharing, should support continued device, network and intelligent efficiency innovation.

3. Energy efficiency requirements should be technology neutral. Policy should account for the different capabilities and performance of networked devices.

4. Policy should neither impede the functionality of networked devices or efficiency of the network nor impair device or network security.