#SMARTer2030

ICT Solutions for 21st Century Challenges

GeSI
GLOBAL e-SUSTAINABILITY INITIATIVE

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3.6 Energy – Integrating renewables into the grid

Smart Energy – The Context

The energy sector is currently undergoing fundamental changes that are driven by a variety of trends. Firstly, conventional energy sources are contributing significantly to climate change through emissions. As a result, companies are under pressure to find more efficient and alternative ways to generate reliable energy and to bring down associated emissions.

The energy sector needs to realign its business model from being production-centric to service-oriented. Forward looking utility companies are focusing on innovation.

Secondly, new energy sources are disrupting the business models of conventional utilities. Micro grids and energy storage solutions are gradually reducing the need for transmission and distribution. Although, these solutions are yet not commercially viable in *all* markets and locations, they are forcing utility companies to rethink and realign their business models. What is more, conventional *Transmission and Distribution* (T&D) networks are plagued with ageing or insufficient infrastructure and disparity between supply and demand.

Lastly, the traditional T&D based approach has not always proven to be sufficient in providing reliable energy, especially in developing countries. In fact, 1.3 billion people across the globe still do not have access to electricity at all[1], keeping the issue of energy access, security and reliability high on the agenda of developing as well as developed countries.

The good news is that ICT-enabled technologies can help to create a global energy system that is resilient, reliable and secure. ICT is a key driver behind improving energy efficiency in grids and accelerating the decarbonization of the energy sector. In fact, 92% of utilities executives believe that advanced data analytics will have the greatest impact on their business up to 2019[2].

What is the Smart Energy?

Smart Grids are able to establish a better balance between energy demand and energy supply. In the future, Smart Grids will be able to run themselves by collecting data with smart metering devices, conducting advanced data analytics, and acting on a continuous stream of data and information from all assets in the grid connected to each other via the cloud.

Making grids smarter means balancing energy supply to existing demand, integrating renewables and enhancing grid efficiency.

Besides managing demand dynamically and allowing for improved load management, ICT-enabled solutions can better integrate renewables into the grid. Smart Grids are much better at coping with intermittent and distributed energy than current grid networks which often waste excess electricity on the system or fail to balance demand to meet supply shocks – leading to brownouts.

On top of all of this, Smart Grids can help to enhance grid efficiency through streamlined operations and the constant monitoring of assets resulting in fewer losses during transmission, storage and distribution.

While there are numerous benefits to be derived from Smart Grids, they will come online gradually. Technologies like meter data management, intelligent electronic devices (like fridges and other white goods), advanced metering infrastructure will become scalable in about five years. Technologies like advanced

[1] World Energy Outlook 2014, http://www.worldenergyoutlook.org/resources/energydevelopment/energyaccessdatabase/.

[2] Accenture's Digitally Enabled Grid Program, 2014 http://www.accenture.com/us-en/Pages/insight-trends-toward-digital-grid-value-analytics-infographic.aspx

distribution management, demand response management, energy storage, micro grids and home energy management are likely to become commercially scalable in about a decade.[3]

It will take between 5 to 10 years for smarter grids to become fully integrated at scale.

Future of Smart Energy

Smart Grid technologies have the potential to create a global energy system that is resilient, reliable and secure. With demand response technologies able to reduce peak loads and exponential improvements in energy storage technologies, ICT is a key driver behind improving energy efficiency in the grid and accelerating the decarbonization of the energy sector.

Advanced analytics and big data solutions play an important role in interpreting data and create real-time system insights to support decision-making.

The future of Smart Energy for providers

From a provider's perspective, features of Smart Grid solutions include:

1. **Distributed and variable power generation**
   - Distribution grid management and sensor technologies allow for variable and renewable energy generation and distribution by improving asset management and optimizing distribution control
   - Automated information on and control over supply (generation) and demand facilitates distributed generation
   - Quickly developing battery technologies and uptake of electric vehicles could facilitate variable generation and distribution through energy storage
2. **Real-time response to demand changes, predictive analytics and forecasting**
   - Advanced analytic tools including descriptive analytics and visualization, predictive analytics, optimization, simulation, and application-specific solutions, contribute to better matching of supply and demand and optimizing load management
   - Smart metering and intelligent substations allow for the collection of vast amounts of data as input for improving grid operations
   - The *Internet of Things* and *Machine-to-Machine* technology through the deployment of intelligent sensors and energy management technologies are key enablers for utilities' transformation to information-centric digital businesses
   - Demand response technologies allow for real-time system response to changes in demand, and help flatten out the demand curve and reduce system load
3. **Reliable infrastructure resilient to changes**
   - *Asset Performance Management* helps utilities better predict equipment failure
   - IT/OT convergence improves reliability, renewable integration and environmental stewardship
   - Interconnection with other operating systems allows for direct trading between regions, enhancing resiliency to peak loads or shortages across borders
   - Advanced analytics used to predict demand, renewable generation, weather, wind etc. allows for a more reliable and resilient energy system

The future of Smart Energy for "prosumers"

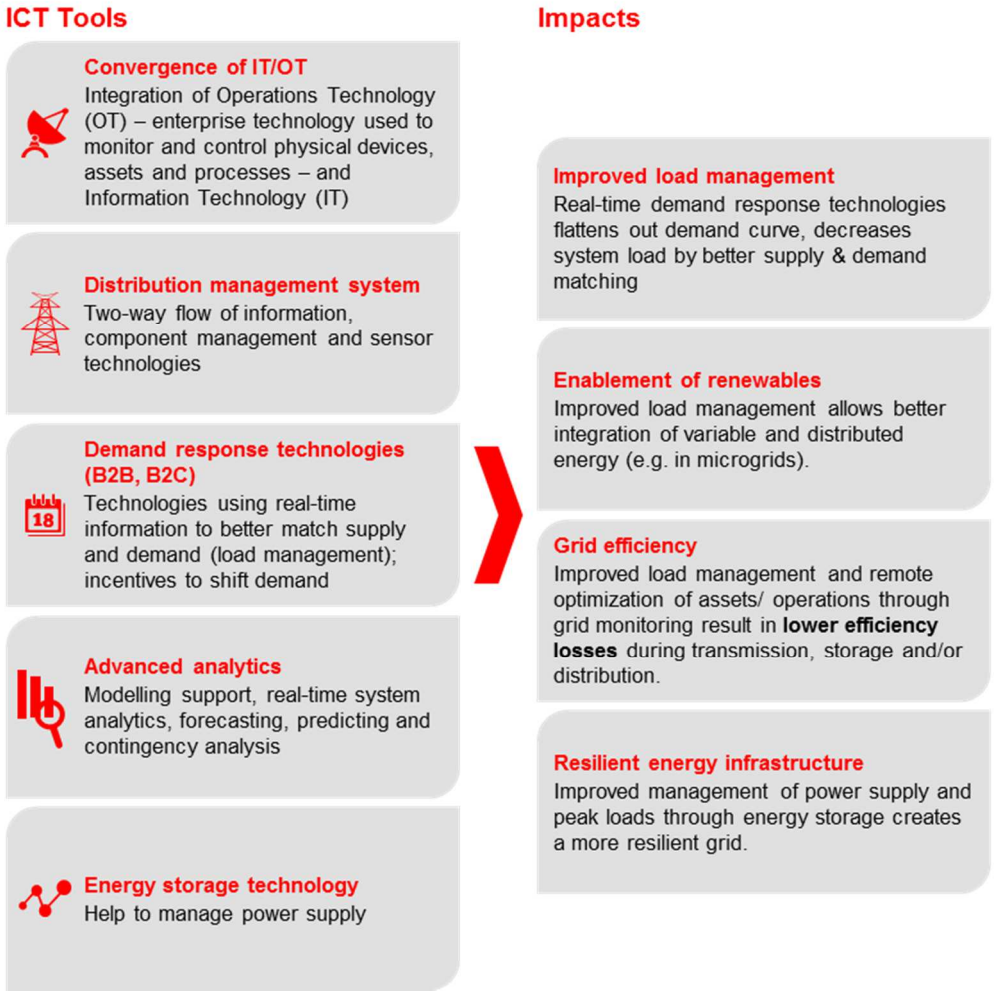
[3] Gartner Hype Cycle for Smart Grid , Accenture Digital

The conventional energy model has operated since its inception with consumers at one end and energy generators at the other. By 2030 we estimate that this model will change and that “prosumers”, i.e. consumers who are also producers of electricity, will become common features of the new, smart, energy landscape. The key will be to ensure that all these micro-generators have proper access to the grid.

Mobile technologies allow prosumers “Access and Insight” into locally generated energy, thereby enabling them to make informed decisions about energy production and consumption. ICT-enabled micro-grids allow households, neighborhoods, and even towns and cities to share energy production and consumption capacity, generate local energy and become self-sufficient. *Machine-to-machine* communication and general connectivity in the system creates a two-way flow of information, connecting all components, assets and other hardware in the system. This allows for the development of an efficient, decentralized grid - a Smart Grid.

However, the success of Smart Grids depends on the development of well-defined ICT solutions, such as the capabilities of advanced analytics and big data solutions to interpret data and create real-time system insights to support decision making. Furthermore, technologies that allow for variable and decentralized energy generation, storage and distribution need to be further advanced.

Figure 1: Energy - Future of Smart Energy: Technology Vision for 2030



Sustainability Impacts of Smart Energy

Our analysis shows that global emissions abatement from Smart Energy represents 1.8Gt CO_{2e} or 15% of the total abatement potential contributed by the eight sectors in this report. Additionally, 1.6Gt CO_{2e} can be cut from the energy sector due to decrease in energy production. However, this potential has been considered in those sectors that realize the reduce energy through improved demand and supply matching (75% Smart Building and 25% Smart Manufacturing)

The US and China represent almost three quarters of the total abatement potential, mainly due to their size and the size of their current energy footprint.

From a sustainability perspective, an ICT-enabled Smart Energy can bring huge environmental benefits, saving up to 6.3 billion MWh of energy.

If rolled out comprehensively, Smart Grids could *significantly* heighten the sustainability of our electricity networks, cutting costs and creating new revenues. As outlined below:

6.3 billion MWh of energy savings: According to our modeling, energy production could be reduced by 20% - a saving of 6.3 billion MWh - as a result simply of better demand management and the integration of renewables into a more flexible system. The energy lost during distribution could be reduced by 5% owing to improved grid efficiency.

700,000 km saved grid: ICT-enabled Smart Grids are expected to make energy generation and distribution more cost-effective, avoiding the need to lay over 700,000 km worth of grid.

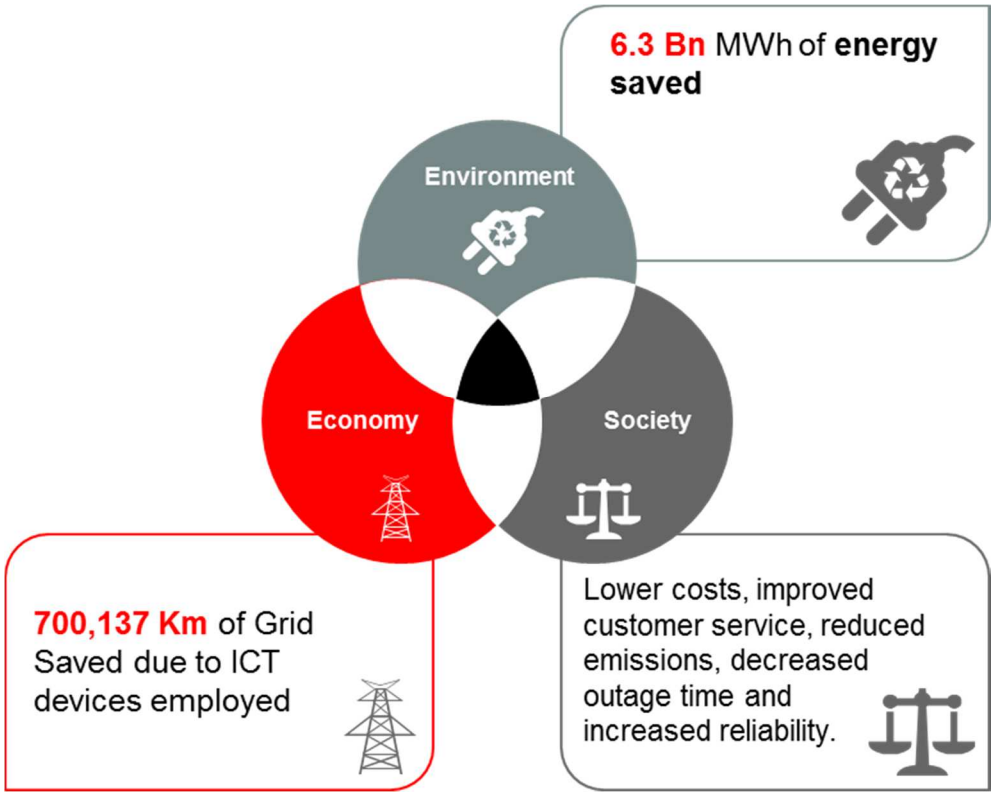
$810 billion of additional revenues: The evolution of Smart Grids could create $2.1 billion in additional revenues for the ICT sector and $811.3 billion in revenues for renewable energy companies.

Universal access to energy: There are numerous social benefits associated with the smart grid, especially in developing countries. These include, for instance, universal affordable access to energy as well as heightened energy security. It is also likely that Smart Grids could lead to higher levels of social cohesion as communities cooperate on new energy solutions.

As with so many of the solutions we have outlined in this report, ICT also has the power to vastly empower the consumer by placing him or her at the center of their own energy system, rather than the end of it, as a distant end-user in a clunking machine. We also foresee huge cost savings to individual households from transparency and from greater and more obvious incentives to become energy efficient.

The diagram below depicts the types of benefits that Smart Grids can help accrue across environment, economy and society.

Figure 2: Energy - Benefits from Smart Grid



eSmart Systems – Making cloud technologies the brain of the modern smart grid

Microsoft eSmart Systems is a cloud-based automated energy management system that employs sensors, Smart Meters and software to forecast consumption, reduce outages, and monitor assets to improve energy efficiency. There is a wealth of data available to utility companies on the energy grid, but the challenge is to make sense of this data and turn it into actionable information. eSmart Systems provides a central way of bringing this information together and enables energy companies to deal with complex challenges such as balancing peak loads and supply and demand, as well integrating renewable energy sources and technologies into the grid.

Managing data and information and upgrading the grid to better balance peak loads is highly costly. eSmart Systems provides a cloud-based and cost effective way of using data to optimize existing grids for energy efficiency, allow for predictive maintenance to reduce outage and continuous monitoring of all assets. This solutions helps energy companies save time, money, and energy and reduces CO2 emissions associated with these energy savings.

eSmart Systems is aimed at utility companies looking to improve efficiency. All that is needed to start running the brains of the smart grid is an internet connection.

Smart grid - An electricity grid that thinks for itself

Improving the efficiency of existing electricity grids is essential in providing reliable power to a growing population, especially in countries like China with a rapidly growing middle class. As a quickly developing economy, China has started to prioritize clean energy and CO_2 emissions reduction by developing an energy system that is efficient, reliable and environmentally responsible. To address the challenges of our time, next-generation power networks need to facilitate distributed and renewable energy sources, be highly automated and exploit the Internet of Things.

In line of this aim, China Southern Power Grid, providing electricity to 230 million people, has partnered with Huawei in piloting a smart grid empowered by wireless broadband. As the first 4G TD-LTE enabled smart distribution network, it features automatic distribution and measurement, as well as video surveillance of the distribution network and emergency communication. This ICT-enabled smart grid does not only enable energy savings and reduced emissions, but also saved China Southern Power Grid around 5% in costs compared to their previous solution. Moreover, this next-generation grid solution increases power supply reliability and lays the foundation for smart homes.





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About GeSI

The Global e-Sustainability Initiative (GeSI) is a strategic partnership of Information and Communication Technology (ICT) companies and organizations committed to creating and promoting technologies and practices to foster economic, environmental and social sustainability. Formed in 2001, GeSI's vision is a sustainable world through responsible, ICT-enabled transformation. GeSI fosters global and open cooperation, informs the public of its members' activities to improve their sustainability performance, and promotes innovative technologies for sustainable development. GeSI's membership includes over 30 of the world's leading ICT companies; the organization also collaborates with a range of international stakeholders committed to ICT sustainability objectives. These partnerships include the United Nations Environment Program (UNEP), the United Nations Framework Convention on Climate Change (UNFCCC), the International Telecommunications Union (ITU), and the World Business Council for Sustainable Development (WBCSD). Such collaborations help shape GeSI's global vision on evolution of the ICT sector, and how it can best meet the challenges of sustainable development. For more information, see www.gesi.org.

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