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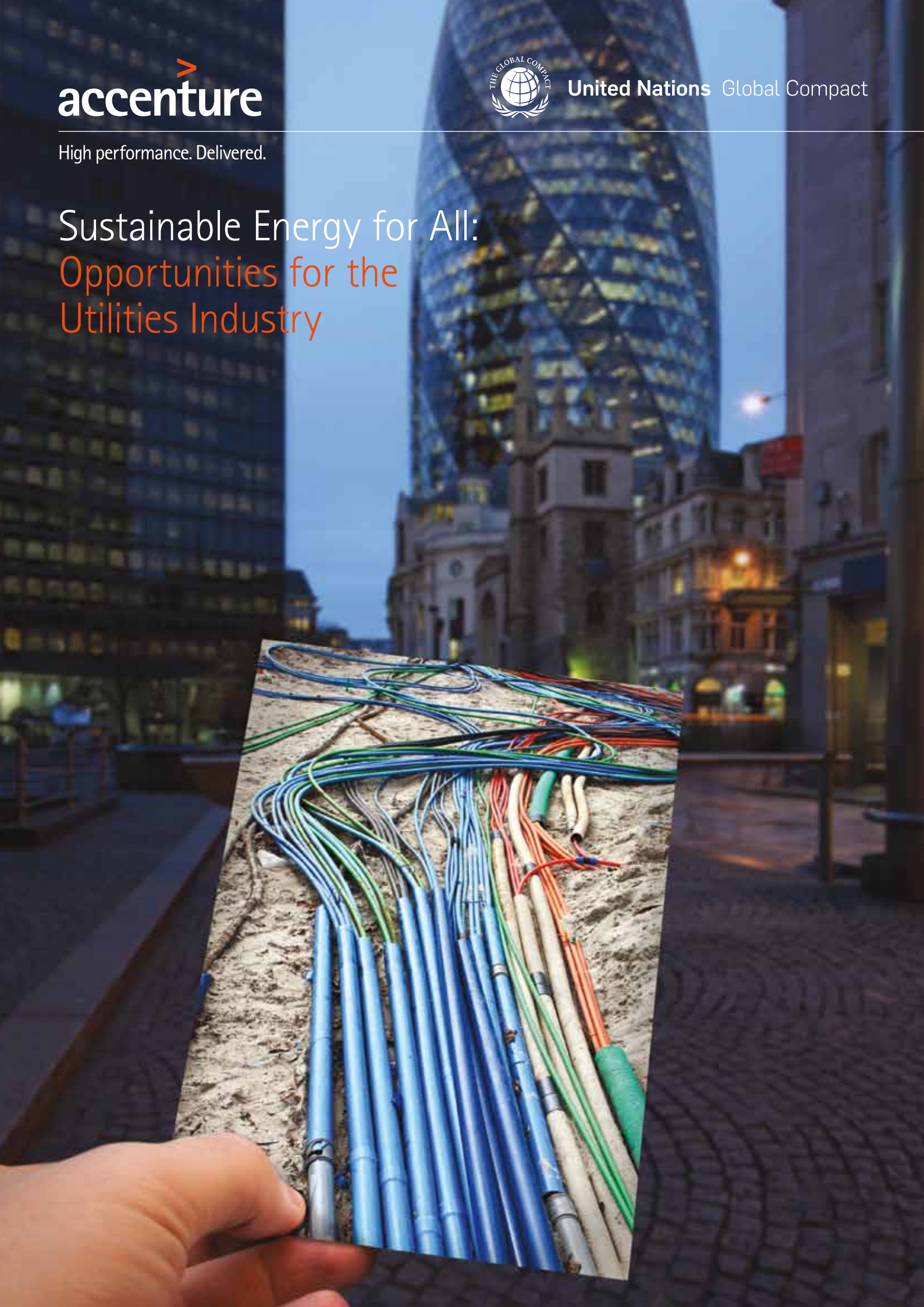
Sustainable Energy for All: Opportunities for the Utilities Industry



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Preface

In support of the United Nations Secretary General's *Sustainable Energy for All* initiative, the United Nations Global Compact and Accenture have partnered to identify the most important actions the private sector can take across nineteen different industries to advance the primary objectives of the initiative while simultaneously driving business value.

This body of work includes an introductory report that discusses the relationship between the initiative and the private sector in a broad sense, as well as 19 individual "Industry Opportunity" documents. In total, the objective is to provide guidance and to inspire companies across all industries to take action in pursuit of sustainable energy and benefits for their own companies.

This document provides an analysis of the opportunities *Sustainable Energy for All* presents to the utilities industry. It identifies specific priority actions utility companies can take to advance the three objectives of the initiative—energy access, energy efficiency, and renewable energy—while also driving increased business value.

The priority actions identified for each industry are aligned to the vision and objectives of the *Sustainable Energy for All* initiative. They span multiple modes of engagement—operations, products & services, social investment and philanthropy, and advocacy and public policy engagement—and represent four different ways that businesses can create value: revenue growth, cost reduction, brand enhancement, and risk management.

As United Nations Secretary General Ban Ki-Moon wrote prior to the 2012 World Future Energy Summit, "Energy transforms lives, businesses and economies.... To succeed, we need everyone at the table—governments, the private sector, and civil society—all working together to accomplish what none can do alone.... The obstacles are not so much technical as human. We need to raise sustainable energy to the top of the global agenda and focus our attention, ingenuity, resources, and investments to make it a reality."

Addressing the world's energy needs is a way to advance society and also to advance sustainable value creation for the utilities industry – while balancing positive economic, environmental, and social gains across the globe.

About the Utilities Industry

The utilities industry powers a wide variety of customers from residential and commercial to larger industrial customers, generating a total of 20,261 Terawatt hours (TWh) of electricity and 1,313 million tons of oil equivalent (Mtoe) of gas worldwide.[1] Utilities can provide services such as electricity or heat as well as water, which is not covered in this report. Although they provide an undifferentiated end-product, utilities differ by functional classification, mix of generation assets and ownership structure. The utility value chain can be divided by function into generation, transmission and distribution, and retail. The utility asset generation mix can include coal, gas, nuclear, hydro, and renewable energy inputs.

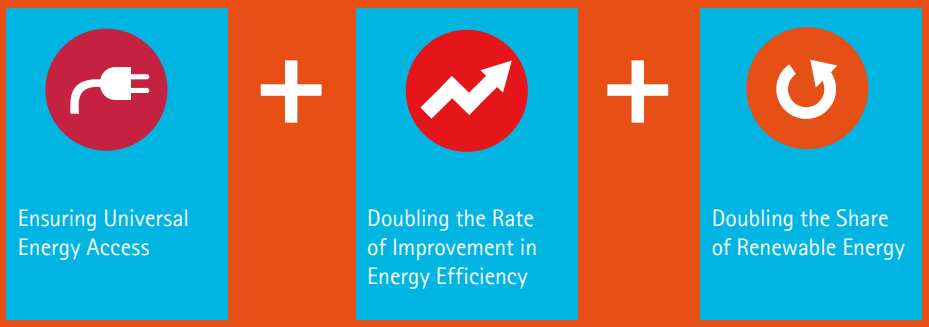
Summary

The ambitious objectives of the United Nations *Sustainable Energy for All* initiative will require commitment and vigorous action from the private sector to drive investment, increase innovation in products and services, and increase operational efficiencies. The utilities industry has opportunities both to contribute to the broader social goals of the initiative and to realize enhanced business value in the areas of revenue growth, cost reduction, brand enhancement, and risk management.

The utilities industry can have a major impact on all three primary objectives of *Sustainable Energy for All*; energy access, energy efficiency, and renewable energy. With regard to energy access, utilities can expand service to developing urban areas as well as partner with governments and other organizations to expand access to rural areas, especially in developing countries. Improving energy efficiency in operations is also important; currently, a large percentage of the raw material inputs utilities use for power generation are not effectively converted to usable power. Finally, introducing renewable energy into the generation mix will become increasingly important to utilities' long-term strategies, especially as utilities face increased regulations for renewable energy. The utilities industry can take action to advance the three objectives of *Sustainable Energy for All* while simultaneously driving increased business value—in a number of different ways.

For utility companies to advance their business opportunities related to access to energy, energy efficiency, and renewable energy, the industry should focus on nine priority actions — mapped to the business value levers, objectives, and engagement modalities of *Sustainable Energy for All*:

Priority Industry Actions	Business Value Levers	Objectives	Engagement Modalities
Deploy distributed energy technologies (micro-or off-grids) to advance rural electrification efforts.	• Cost Reduction • Brand Enhancement	• Energy Access • Renewable Energy	• Core Business: Products and Services • Social Investment and Philanthropy
Use innovative business models and create new products and services to improve energy affordability among low-income populations.	• Revenue Growth • Risk Management	• Energy Access • Renewable Energy	• Core Business: Operations • Core Business: Products and Services • Social Investment and Philanthropy
Increase adoption of smart grid technologies to modernize the grid.	• Cost Reduction • Risk Management	• Energy Efficiency • Renewable Energy	• Core Business: Products and Services • Advocacy and Public Policy Engagement
Leverage existing infrastructure to advance urban and semi-urban electrification efforts.	• Revenue Growth	• Energy Access	• Core Business: Products and Services
Integrate a higher percentage of renewable energy into the electrical grid.	• Brand Enhancement • Risk Management	• Renewable Energy	• Core Business: Products and Services
Improve energy efficiency in operations.	• Cost Reduction	• Energy Efficiency	• Core Business: Operations
Increase adoption of an alternative energy vehicle infrastructure and a low carbon grid.	• Cost Reduction • Risk Management	• Renewable Energy	• Core Business: Products and Services
Educate consumers on how to improve energy efficiency.	• Brand Enhancement	• Energy Efficiency	• Core Business: Products and Services
Create new products and services to increase sustainable consumption by end-customers.	• Revenue Growth • Risk Management	• Energy Access • Energy Efficiency • Renewable Energy	• Core Business: Products and Services



What Is *Sustainable Energy for All*?

Under the leadership of Secretary-General Ban Ki-moon, the United Nations is mobilizing key constituencies from the private sector, public sector, and civil society in a major global initiative, *Sustainable Energy for All*. The goal of the initiative is to catalyze action around three clear objectives to be achieved by 2030:

- Energy access: Ensuring universal access to modern energy services.
- Energy efficiency: Doubling the global rate of improvement in energy efficiency.
- Renewable Energy: Doubling the share of renewable energy in the global energy mix.

The *Sustainable Energy for All* initiative strives to mobilize bold actions and large-scale investments by fostering the enabling conditions for success, supporting cooperation and coordination across sectors, and tapping into a broad array of businesses and financiers. The initiative has the capacity to leverage a rapidly expanding knowledge network, disseminate ideas, and monitor progress toward the initiative's objectives. It can "change the terms of engagement" by introducing new public-private partnerships based on synergies across relevant sectors of the economy and engendering constructive dialogue on policy, investment, and market development by governments, businesses, and civil society.

Sustainable Energy for All provides a clearly articulated global vision for sustainable energy and brings together the unparalleled global convening power and reach of the United Nations, which will help build consensus, drive a common agenda, and coordinate the actions of multiple entities at both the global level and the national levels, helping all entities work toward shared and mutually beneficial goals. *Sustainable Energy for All* brings together all relevant stakeholders in the sustainable energy area—the public sector, private sector, and civil society—on a common and open platform for communication and collaboration.

For more comprehensive information about *Sustainable Energy for All*, please go to: http://www.sustainableenergyforall.org/

The Importance of Sustainable Energy for the Utilities Industry

Innovation in the Utilities Industry

The utilities industry is committed to investing in new technologies to meet energy demand and the challenges of sustainability.

There are several innovation trends taking shape in the utilities industry to address sustainable energy opportunities and market development:

- The Smart Grid will use technologies such as sensors and other telecommunications technologies to capture information about consumer use and the efficiency of operations, allow greater control over operations, increase reliability of operations and facilitate integration of new technologies such as renewable energy, electric vehicles and energy storage into the grid
- Innovative business and financing models will determine how a utility integrates new technologies into the system and how a utility expands access to sustainable energy in under-served areas

These innovations can be combined to expand access to sustainable energy and increase efficiencies and renewable energy generation in the industry.

Utilities are one of two industries (the other being oil and gas) that supply the majority of global energy demand. In the push toward achieving the objectives of *Sustainable Energy for All*, utilities have the opportunity to provide energy access through increased generation, both large scale and distributed generation. In addition, utilities can choose to generate this energy through renewable sources. This need for increased energy access and increased renewable energy is necessary in both the developing and developed world.

Beyond supplying more and cleaner energy, utilities also have the opportunity to apply new technologies and optimized processes across all of the different energy generation types, which can improve plant efficiency and resource productivity. Utilities can contribute their experience and knowledge to national energy plans and informed policy decisions, combined with financial support and choosing the best business models, utilities can greatly impact the objectives of this initiative. Finally, utilities have a direct customer relationship with energy consumers positioning the utility to become a trusted energy advisor and the opportunity to promote energy education and the scale adoption of electric vehicles, energy management solutions and distributed-sustainable generation.

Energy Access as a Tool for Economic Development

The lack of access to energy sources remains a major obstacle in fostering growth in the developing world. Approximately 1.3 billion people do not have access to reliable electricity sources, and the vast majority (84 percent) lives in rural areas.[2] Providing universal access to modern energy services—one of the three primary objectives of *Sustainable Energy for All*—would spur increases in economic development related to transportation, manufacturing, telecommunications, healthcare, and a number of other sectors. A WEO study indicates that serving the current population that is without electricity would demand 950 TWh by 2030, or 250 GW of generation capacity.[3] The additional 950 TWh only represents a small fraction (2.9 percent) of the 33,000 TWh of projected global generation in 2030.[4] In addition, utilities that extend the natural gas supply or provide small scale distributed generation for rural communities could provide "clean cooking" options to 2.7 billion people who use traditional biomass to cook. This represents a dire need in the developing world as premature deaths from the indoor use of biomass could increase to over 1.5 million by 2030 if no further actions are taken.

The Growth in Renewables

As stated earlier, generation can come from a range of sources, and varies by country. France, for example, receives over 75 percent of its energy from nuclear generation.[6] In the United States, the sources are more diversified. The most common ones include coal (44.9 percent), natural gas (23.9 percent), nuclear (19.6 percent), and hydroelectric and renewables (10.3 percent).[7] Globally, although coal, nuclear, and natural gas remain the most prevalent sources of electricity, renewable energy has seen continued growth due to steep drops in the cost of technologies along with financial support mechanisms. Currently, nearly 20 percent of global electricity generation comes from renewables, with about 16 percent of this coming from hydroelectric power.[8]

Solar photovoltaic prices have fallen dramatically, and the market more than doubled in 2010 adding an additional 17 GW of capacity worldwide. Wind generators added 38 GW to the grid, with wind power now totaling more than 198 GW worldwide.[9] In addition to advances in technology, many countries have enacted policies and made commitments to foster growth in the renewables space. 119 countries have committed to renewable energy policy targets, more than half of these in the developing world.[10] Although there have been great strides in renewable energy recently, there are still technology developments necessary to bring down prices and expand generation.

The Business Opportunity Presented by *Sustainable Energy for All*

In taking actions to advance the three objectives of *Sustainable Energy for All*, the extent of this unprecedented, rapid change will provide companies with new opportunities to drive sustainable business value in a manner that aligns to their core strategies. To seize these opportunities, there are four engagement modalities companies can address as they implement the identified priority actions:

1. Core Business - Operations: Businesses can transform their operations through increased energy efficiency and the use of renewable energy alternatives.

2. Core Business - Products and Services: Businesses can innovate and modify their core products and services to meet the new and developing market demands for more energy efficient products, sustainable energy, and the infrastructure needed to extend energy access around the world.

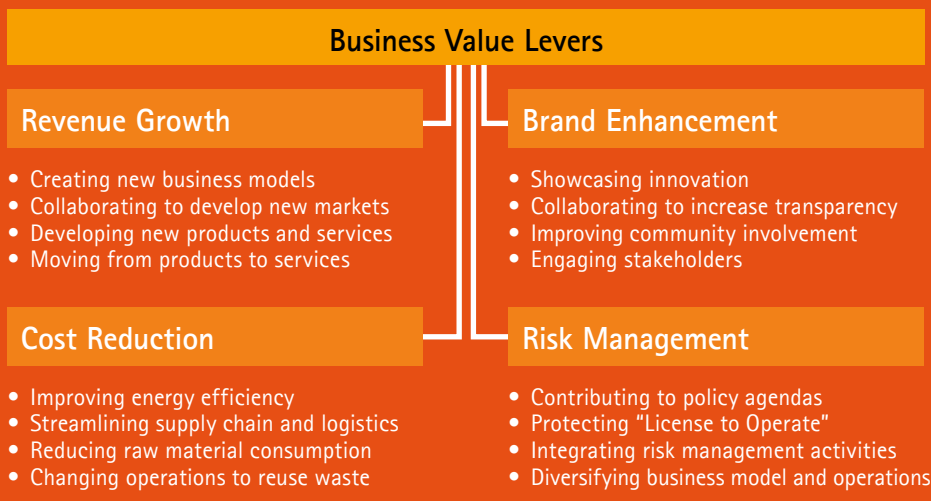
3. Social Investment and Philanthropy: Businesses can identify ways to establish a strategic link between social investments and their core strategies to increase the likelihood that such activities will be sustained and able to reach scale.

4. Advocacy and Public Policy Engagement: Businesses can seek to engage governments (national, regional, or local) on relevant issues that protect competitiveness and drive opportunities, while working toward the objectives of *Sustainable Energy for All*.

Sustainable Energy for All provides a platform to address global financial, social, and environmental concerns associated with energy. Ultimately, in working toward the achievement of the three objectives of the initiative—energy access, energy efficiency, and increased use of renewables—businesses also have significant opportunities to drive sustainable value. Especially important are four value levers related to revenue growth, cost reduction, brand enhancement, and risk management.

Which Actions Will Your Company Take to Drive Value?

The particular actions a company chooses to drive business value depend on a range of factors: its unique attributes and energy characteristics; its business model, corporate strategy and consumer base; and external factors such as level of regulation and economic context. Each of the priority actions in this document is aligned to one or more of the four business value levers described here.



Sustainable Energy as a Value Driver for the Utilities Industry

Untapped Markets – Electrification Opportunities in Urban and Rural Areas – Through Innovative Financing and Creative Business Models

Utility companies have the opportunity to drive revenue growth by entering new markets that responsibly serve customers who do not yet have access to energy and to expand services to growing urban areas.

Distributed and Off-grid Electricity – Solutions for Rural Populations

Consumer demand for energy, driven by emerging economies, is expected to increase by 35 percent by 2035 according to the International Energy Agency.[11] The potential market opportunity associated with this demand needs to be considered in terms of the location of the demand. Rural areas tend to have lower-income customers and less existing infrastructure. Yet, according to the World Business Council for Sustainable Development (WBCSD), the energy market for those at the "base of the [economic] pyramid" is approximately $500 billion per year.[12] To serve this market, utilities must rely on more distributed technologies requiring less infrastructure, innovative financing and public private partnerships to provide the incentive needed to invest and enter into the more challenging and capital-intensive rural marketplace.

Distributed energy systems such as off-grid and micro-grid solutions can address the problem of providing energy access to rural areas without infrastructure. Eighty-four percent of people without energy access live in rural areas. Of this rural population, 70 percent will require distributed solutions due to the high cost of extending the grid.[13] These solutions will be localized, involve the community from an operations and maintenance perspective, and provide energy from mostly renewable sources. This population presents utilities with a significant innovation opportunity: If utilities can develop suitable off-grid or micro-grid technology solutions and business models, they can gain access to a sizeable untapped market.

An example of community involvement and a utility using creative means to profitably provide accessible energy to more people is shown by LYDEC, a subsidiary of GDF Suez. LYDEC led a management contract for the provision of electricity in the Greater Casablanca, a region of Morocco.[14] (See Priority Industry Action #1 and the related case study for more information.) According to a study by Harvard University, projects (like the LYDEC example) that involve community members can also prevent theft, as social pressure from direct interaction with representatives can be an effective deterrent.[15] Business model innovation can be just as effective as technological innovation in expanding access to populations without service.

Developing Infrastructure for Urban Electrification

In some urban areas, the business case for expansion is clear. For example, large cities in China such as Beijing or Shanghai are expanding their electricity infrastructure as people rapidly move from rural to urban areas as the country's economy grows. Although these urban areas may be easier to reach, utilities will still be challenged to economically provide the necessary infrastructure.

Opportunities in the Developed World – the Benefits of Smart Grid

While utilities have significant opportunities to expand into developing countries, they also have an opportunity to become more efficient in developed ones. For those countries with an existing and comprehensive grid infrastructure, smart-grid implementations are an important way for utilities to reduce operational costs and increase efficiencies. This can be achieved through a number of different ways, including new ways of communication and improved access to data. According to figures from the Electric Power Research Institute (EPRI), smart grid development will yield direct financial benefits in nine areas: productivity ($1 billion), safety ($13 billion), environment ($102 billion), capacity ($299 billion), cost ($330 billion), quality ($42 billion), quality of life ($74 billion), security ($152 billion), and reliability ($281 billion).[16]

Regardless of the estimates, the most important direct economic benefits can be condensed into a few key areas. Smart grid helps to reduce operational costs by lowering labor costs required in traditional distributed grid maintenance and operations. It provides utilities with an abundance of energy information with which they can create more accurate pricing schemes and reduce consumer energy use, such as critical peak pricing (CPP) or peak-time rebates (PTR)—pricing that can benefit companies and consumers alike. For utilities, smart technology also introduces a range of new possibilities to help consumers better understand and control their energy usage. Utilities have the opportunity to introduce new products and services such as programmable thermostats, smart appliances or home improvement solutions that drive additional revenue while also helping consumers decrease their energy costs. The benefits of smart technology also apply to the grid where utilities are better able to monitor stress on the grid, identify line losses and adopt infrastructure for increasingly popular plug-in electric vehicles. For utilities, smart technology also introduces a range of new possibilities to help consumers better understand and control their energy usage. Utilities have the opportunity to introduce new products and services such as programmable thermostats, smart appliances or home improvement solutions that drive additional revenue while also helping consumers decrease their energy costs. Perhaps most important, it can foster further innovations in energy efficiency and renewable energy technologies.

Priority Actions for the Utilities Industry

The following section provides detail on nine priority actions the utilities industry can take to become more energy efficient and advance their business opportunities in the sustainable energy market:

1. Deploy distributed energy technologies (micro- or off-grids) to advance rural electrification efforts.
2. Use innovative business models and create new products and services to improve energy affordability among low-income populations.
3. Increase adoption of smart grid technologies to modernize the grid.
4. Leverage existing infrastructure to advance urban and semi-urban electrification efforts.
5. Integrate a higher percentage of renewable energy into the electrical grid.
6. Improve energy efficiency in operations.
7. Increase adoption of an alternative energy vehicle infrastructure and a low carbon grid.
8. Educate consumers on how to improve energy efficiency.
9. Create new products and services to increase sustainable consumption by end-customers.

1. Deploy Distributed Energy Technologies (Micro- or off-grids) to Advance Rural Electrification Efforts

Despite the large number of urban poor without electricity, they are significantly outnumbered by rural populations without energy access. In its "Access to Electricity" report, the International Energy Agency notes that, "to achieve universal access by 2030 only 30 percent of rural communities will be [directly] connected through the grid" and that decentralized solutions will "account for most of the investment over the projection period."[17] The remaining 70% will require mini-grids or off-grid energy systems.[18]

Rural populations can more effectively access electricity through mini-grid or off-grid energy solutions because of their distance from existing transmission and distribution networks. Although mini-grid and off-grid technologies already exist, current solutions can be improved to reduce their production and implementation costs. Projects can vary from electricity generated from decentralized sources such as small hydro power plants (using micro-turbines along mountain streams) and biomass gasifier systems, to off-grid solutions such as solar lighting devices or hybrid solar (to replace, for example, kerosene or diesel sources of light). In addition to increasing access to energy, these systems represent an opportunity to increase the share of renewable energy to power these systems in remote areas.

ABB, a power and automation technology firm, has created an Access to Electricity rural electrification program. One of their main projects is located in the deserts of an Indian town, Rajasthan. The firm installed solar panels on the roofs of 1,100 huts, providing electricity to over 7,000 people.[19] In another mini-grid project in Tanzania, they installed a small diesel generator to power a village. The costs have been spread between the villagers, ABB, and the non-governmental organization with whom ABB partnered. The electrification projects have provided innumerable economic benefits to the villages: the productivity of weavers and tailors has risen by 50 percent and 40 percent respectively because they can now work during the night. The village built a saw mill, as well as a sunflower and sesame press. Children can now study after dark, and school attendance has increased. Health and healthcare has improved as replacing kerosene with solar electricity has reduced the danger from cooking with traditional biomass, and health clinics can now operate at night.[20] GDF Suez has also taken the initiative to expand energy access to rural areas through these distributed energy technologies. "Rassembleurs d'Energies" is a partnership-based program that has created a joint venture fund that will increase to €100 million by 2013. The fund invests in mini-grid and off-grid technologies in small villages in India, Indonesia, South America, and France.[21]

Accompanying the installation of these products and services, a leading practice is the provision of capacity building or local training of people in order to guarantee the long-term maintenance of the installations. This training should also include the importance of empowering women. In many situations they have a critical role in the deployment of the solutions. For example, as part of the Enel Group's "Enabling Electricity" program, one goal is to develop and share professional know-how and skills in the energy sector ("capacity building"). One concrete example: Enel Green Power has signed an agreementfor the realization of a rural electrification project in Latin America with Barefoot College, a non-governmental Indian association. The model devised by Barefoot College, already successful in many countries in Asia and Africa, involves identifying young, often illiterate women (aged 35 to 50), to be put on a special training program to transform them into Barefoot Solar Engineers.[22]

Case Study: EDF's approach to rural electrification – the RESCO model[23]

EDF has 15 years of experience in rural electrification, principally in Africa. EDF's approach is based on providing initial funding, working with local partners, adopting the most appropriate technologies and ensuring the proposed services are affordable.

A specific example is Yéelen Kura ("New Light" in Bambara) in Mali which aims to improve the quality of life of villagers and develop rural economies while protecting the environment. EDF set up a renewable energy services company (RESCO) to bring electricity to these remote communities. Initially, photovoltaic panels were installed in households, schools, health centers and businesses. The second phase involved the electrification of some 20 parts of the region and connection of 6,000 customers, or 120,000 people. The RESCO continued to supply photovoltaic kits to remote households, but in more densely populated villages it used low-and medium voltage micro-grids connected to small diesel-fired generation plants. This helped develop the local economy and bring power for productive activities (crafts, pumping, etc.). In 2008, Yéelen Kura built a hybrid solar plant (72 Wp) in the village of Kimparana, with financing from AMADER (Malian Agency for Rural Electrification and Household Energy) and the Netherlands. In addition to enabling savings on fuel, this new plant was to help determine whether this solution was viable from a technical and economic standpoint.

Through its 15 years of operations, EDF has gained considerable experience in dealing with the challenges of energy access. What are the key factors for success?

- Institutional Framework: needs to be in place, clear and welcoming to investors
- Regulatory Framework: efficient, adaptable and flexible
- Local Stakeholders: analyze the local environment (population density, kind of families etc.) and select the most adequate technology to provide electricity
- Scale: minimum of several thousand customers
- Diversity: respond to a variety of needs with a variety of services and technologies
- Customer Relationships: affected more by local culture than the technology
- Partnerships: with organizations appropriate to the scale of the host country

Bringing electricity to rural areas is always more expensive and complicated than envisaged and delays are normal. In most cases, initially this is not a profit-driven line of business for a utility but over the medium- to long-term, it should become reasonably profitable or, at least, no-longer be a "not profit-driven" business.

Using the experience it gained in Mali up to 2008, EDF continues to reflect and experiment in providing energy access solutions and currently has four electricity companies in Botswana, Senegal and South Africa serving more than 100,000 people.

2. Use Innovative Business Models and Create New Products and Services to Improve Energy Affordability Among Low-income Populations

Providing access to low income populations may not always be just about technological or infrastructure solutions, but about adapting the business model to low income population needs in developed and developing economies. Access to energy means also giving economic access to services. Low income populations (living in both urban and rural areas) sometimes cannot afford the costs of energy consumption provided to their homes. This can create other problems related to the security of the service, and sometimes, for example, cases of energy theft, impacting a company's revenues. To face this dilemma, utilities should find innovative solutions to abate the energy costs for low income customers.

Abating the cost of the bills through creative financing is a way to help low income customers pay their consumption and at the same time guarantee them an effective service. Thus companies can protect revenue losses from theft in the short term and profit by extending power to these populations in the long term. Utilities have the opportunity to work with local governments to advocate for subsidies, tax incentives or other assistance that could be available. Utilities can also partner with other companies in related industries and local NGOs to advance financing.

One way Coelce, Endesa's distribution company in Brazil, a subsidiary of Enel Group, has been developing creative ways to abate customer's bills is the Ecoelce program in the state of Ceará. This program consists of exchanging recyclable urban waste for discounts on customers' energy bills. The project aims

to resolve two problems faced by the distribution company in this area: "the numerous defaults on payment in the underprivileged neighborhoods due to lack of economic resources and the serious environmental problems caused by the government's lack of recycling initiatives." As a result of the Ecoelce project, people are gaining access to electricity by being given incentives to recycle household waste in exchange for discounts on their electricity bills.[24] Thanks to the successful experience in the state of Ceará, this model has been implemented in the Ampla distribution area, the other Brazilian subsidiary of the Rio de Janeiro state, and in Chile with the Ecochilectra project.[25]

This issue of lack of economic resources to procure energy is equally challenging for "fuel poor" customers in developed economies. In addition to regulatory responses, often in the form of adapted tariffs, energy utilities can take voluntary measures to reduce costs for consumers to ensure they receive the support for which they are eligible. EDF Energy in the UK, part of EDF Group, has been working for 10 years with the London city authorities on the London Warm Zone program, which identifies the most vulnerable households and invests in energy efficiency improvements. The result: 57,000 housing units have been insulated since the beginning of the operation. In France, EDF has set up partnerships with nearly 200 outreach and contact points in France to support people in difficulty and explain to them how they can obtain the assistance for which they are eligible.[26]

Balancing affordability for the consumer with self-sustainability for the utility is a difficult task without policies in place that support both of these objectives. Government legislation of appropriate tariff policies can help define the balance between the two. According to the World Bank, the rural poor are willing to pay for electricity if the supply can be priced at long-run marginal cost. Given that long-run marginal cost price is charged, the World Bank estimates willingness to pay at $0.010-$0.40/kWh and long-run marginal cost at $0.05-$0.10/kWh.[27] This would create a more affordable price for the consumer and a more sustainable long-term revenue stream for the utility. Partnerships through local banks or microfinance organizations can also support the initial cost of gaining access to energy.

While investing in the extension of the grid in urban areas can be profitable, rural areas pose a greater challenge due to the high cost of infrastructure investment. As a result, government support for financing connection costs is a critical factor to expanding energy access. Long-run marginal cost pricing can help the poor afford electricity, but the initial short-term connection costs required may deter utilities from extending the grid and many times deter customers from choosing to purchase it. Innovative financing policies should support utilities in spreading connection costs over many years, or eliminate them via government funding initiatives.

Policies that target effectiveness in metering, billing, and collections will improve return on investment and mitigate risk associated with serving poor rural communities. In addition to improving the utility's financial stability, revenue certainty will attract more external investment. In China, utilities and governments have hired farmers in rural areas to act as part-time meter readers.[28] Creating closer ties to the community often lowers default rates through social pressure. South Africa and Brazilian utilities have adopted "pay-as-you-go" prepay programs, enabling low-income customers to manage their electricity use to remain within their means.[29] Prepay programs also provide utilities with revenue certainty as the consumer pays a fixed amount prior to consuming the electricity.

Case Study: LYDEC, a Subsidiary of GDF Suez, Successfully Provides Safe Electricity to the Urban Shantytowns of Morocco[30]

The LYDEC electrification program was able to provide safe electricity to 30,000 low-income households in the Greater Casablanca region in Morocco covering 75% of the city's poor neighborhoods. The key innovations and success drivers of the electrification program included:

- A community connection model, where LYDEC supplies electricity to one community representative who then sells this electricity to twenty households in the block, reducing the capital and operational costs of providing services
- Customer contributions to support connection costs spread over three years to improve affordability.
- Reduction of capital costs through the use of trained local electrical contractors and adaptation of equipment standards.
- A partnership model for project design and implementation to ensure buy-in of local communities, and ongoing dialogue between partners on performance, decisions and accomplishments.

Case Study: Enel Group – Applying Smart Grid Technologies to Build Sustainable Smart Cities: the Case of SmartCity Malaga[31]

Since 2009, companies like Enel Group have developed large scale Smart Grid demonstrations, called 'Smart cities', where customers and distribution companies work together to reach optimal integration of renewable sources and the latest technologies in distributed energy resources (demand response, efficient public lighting, e-mobility and smart buildings) in electric grids, including end users as active actors of the power system and encouraging a responsible energy use by customers. To shape a 'Smart City' synergies are created among different actors: energy companies, public institutions, universities, local governments and cutting-edge technology companies. Enel is playing a leading role in validating this new model. The first participating cities are: Genoa (Italy); Bari (Italy); Malaga (Spain); Buzios (Brazil); and Barcelona (Spain).

The most advanced demonstration, launched in 2009, is SmartCity Málaga, one of the larger energy efficiency projects in Europe involving investment in smart grids and sustainable urban development. In this area, Endesa (a subsidiary of the Enel Group) has pioneered the installation of 17,000 smart meters as of May 2012, with an overall target of 1 million in the region, delivered electric vehicles, installed charging points, deployed a PLC network to provide grid automation and monitoring services, and installed low consumption light-emitting diode street lighting. Endesa is leading a group of 11 multinational utilities, technology companies, universities, and research institutes to develop SmartCity Malaga. The project has a budget of €31 million, partly financed by the European Regional Development Fund. SmartCity Málaga, the first of its kind worldwide, will lead to energy savings of 20% and increase renewable generation.

3. Increase the Adoption of Smart Grid Technologies to Modernize the Grid.

Smart grid encompasses three major components: smart metering, grid automation and smart in-house technology. Each component differs in its return on investment, technological certainty and widespread acceptance. In many developed nations, transmission and distribution infrastructure is aging and not equipped for 21st century analytics. Smart grid technologies are an important aspect of this modernization, using sensors, digital communications, and embedded digital processing to automate all aspects of the grid and provide the utility with increased access to data on the operation of its assets and the use patterns of its customers. Two-way, instantaneous communication with consumers of electricity and gas can result in numerous benefits. For example, instead of requiring monthly usage readings, meters can take digital interval reads every 15 minutes or less, expanding the availability of demand response and critical peak pricing programs. Better information also gives consumers a better understanding of their energy usage, and integrates the data with smart in-house devices, which can learn to efficiently automate energy intensive items such as heating, ventilation, and air conditioning systems. Ultimately, this technology can help to create convenient set-and-forget solutions that help consumers bring sustainability and efficiency into their homes and businesses. In addition, smart grid technologies improve renewable energy connections and energy storage technologies and mitigate disruptions from electric vehicles plugged into the grid given the access to increased information on customer load and power distribution.

Smart meters benefit the utility as much as they benefit the customer. The meters can reduce operational costs by pinpointing outages, reduce the need for meter readers, and remotely connect and disconnect users from the grid. Furthermore, smart meters can protect revenues from electricity theft through tamper and tilt detection combined with analytics software. Meter data management systems can accurately estimate missed reads and forecast load data. Enel was a first mover in replacing old electromechanical old electromechanical meters with electronic ones, installing 32 million of them in only five years in Italy. Today this project, called Telegestore, represents the largest and most widespread remote management infrastructure in the world. In 2008 together with Endesa, Enel launched the Smart metering project to adapt the Telegestore solution to the regulatory and business needs of the Spanish market. Endesa is currently installing 13 million electronic meters for all of its customers.[32]

Smart grids that are fully integrated into the fabric of cities will enable the creation of "smart cities". Integrated management of a number of technologies will allow energy consumption connected with urban requirements to be optimized, such as building heating, ventilation, and air conditioning systems, public transportation, and street lighting. The use of emergent technologies (distributed generation, advanced grid automation) and demand management are key for smart grid management and creation of "smart cities". However, technology will only be a part of the solution. For example, Amsterdam Smart City combines innovative technology such as smart meters, a smart electric grid, electric vehicles, and smart building design to promote energy efficiency in the residential, commercial, public, and transportation economic sectors, but is also focusing on changing consumer behavior related to energy consumption. The early stages of the project have been successful due to a wide range of public-private partnerships involved with deploying this initiative including; government, utilities, grid operators, financiers and universities as well as technology and consulting companies.

Although Smart Grid technology exists and is not new; means to capture its benefits are not fully understood and the benefits are different for different stakeholders. Utilities must focus on articulating and demonstrating the benefits to its customers. In addition, utilities need to advocate for universal standards to lower costs and facilitate ease of deployment and operation. One particular area in need of standards is the capture, storage, and use of data from Smart Grid technology. Finding the right partners and business models to build trust with consumers will be important.

4. Leverage Existing Infrastructure to Advance Urban and Semi-Urban Electrification Efforts

On-grid electrification provides great opportunity to drive revenue growth while helping to achieve universal energy access. If utilities adopt the aforementioned financing models (such as pay-as-you go, appropriate tariffs, or reducing connection costs), they can capitalize on a burgeoning urban marketplace – by 2030, in Asia alone, 903 cities are projected to have a population that exceeds 1 million.[33] Although costs may be minimized due to the ability to serve denser populations and existing infrastructure in urban areas; many of these systems are aging and will need to be replaced in the coming years and expanded.

To ensure energy access for the entire population, on-grid electrification will require an $11 billion annual investment through 2030.[34] However, these initiatives will create a number of economic benefits by providing energy to approximately 20 million urban consumers every year[35] and will create new revenue streams for the utility. The traditional utility business model may also need to change to advance urban and semi-urban electrification efforts. For example, energy companies such as Eni (see case study) producing oil and gas may find ways to provide gas or electricity to provide access to energy for urban populations.

Case Study: Eni – Flaring to Power in the Republic of Congo[36]

Eni has a flaring down strategic plan that seeks to address the dual challenge of fighting energy poverty while tackling climate change. Between 2007 and 2011, Eni has reduced flaring by over 42%, and is investing in new energy infrastructure to bring this figure up to 80% by 2015. When fully implemented, the program will recover around 5 billion cubic meters of gas per year. Where the associated gas is used to supply the local market and produce electricity, the population gains access to a continuous supply of reliable and safe energy. This, in turn, acts as a catalyst for social and economic development. (These projects occur predominantly in Africa.)

In 2007 Eni signed an agreement with the Republic of Congo and presented a four-year plan to the Congolese authorities, setting out its commitment to produce electricity for the country from two electric power stations and phase out flaring. Gas flaring can be eliminated both by re-using the gas to produce electricity and re-injecting the gas into the hydrocarbon deposit.

The gas, which comes from the M'Boundi onshore field, is collected and transported along the 55-kilometer gas pipeline to the Djeno area, where it contributes to fuelling the 50 MW Centrale Electrique Djeno (CED) and the new 300MW Centrale Electrique du Congo (CEC). CEC is not operated directly by Eni, which holds a 20% stake in the power station, while the remaining 80% is held by the Congolese government. The two power stations currently account for 60% of the country's installed capacity, and it is distributed in the Pointe-Noire area, which has a population of approximately 700,000 people. While average electricity per capita consumption in Congo is around 157 Kwh per year, the average figure in the Pointe-Noire area in 2009 rose to 350 KWh and 462 KWh in 2010. Eni has also contributed to strengthening the national electricity network by revamping the high voltage line (220 kV) from Pointe-Noire to Brazzaville (550 km) as well as 8 electricity substations in 2011. This infrastructure will ensure that electricity will be supplied not just to the main Congolese cities, but also to numerous smaller towns. In addition, in 2010, Eni undertook the extension of Ponte-Noire's electricity distribution network: the work is planned to be completed by 2013.

Because local workforce capacity building is critical for supporting the success of access to energy initiatives, Enipower, Eni's power company, is offering technicians and engineers from the Congolese national power company the opportunity to work in Italy for two years to acquire skills to manage projects independently. Enipower is also advising the Congolese Government on enhancing the Network Code, which are the technical regulations governing the country's electricity infrastructure.

5. Integrate a Higher Percentage of Renewable Energy into the Generation Mix.

Alternative energy (solar, wind, biomass, geothermal, etc.) technologies are slowly providing a larger part of the global electricity supply. Renewable energy provides over 19 percent of global electricity, with the majority of that (16 percent) coming from hydroelectric power and most installation occurring in OECD countries as well as China, India and Brazil.[37] However, these technologies are still facing economic and non-economic barriers such as regulatory uncertainty or infrastructure integration limitations. It is becoming increasingly important that the energy generated from renewable sources be integrated seamlessly into the electric power grids. This integration will require new ways of thinking about how countries generate and distribute electricity to ensure renewable electricity can be fed into the grid simply, safely, and reliably.

For example, companies like GDF Suez have joined the Initiative Wood Pellets Buyers group (IWPB) to overcome some barriers surrounding biomass generation. The organization is a collaborative of major European utilities with large thermal power plants that want to foster a tradable market for wood pellets. Often times, biomass plants rely on long term procurement contracts, and cannot stop the inflow of wood pellets during plant shut downs. Storage costs of the pellets are typically high. As a result, the members created a uniform approach to procurement contracts, technical specifications, and sustainability principles of wood pellets. This set of uniform standards have enabled wood pellets to be traded amongst utilities, which has helped them drive down operational costs by shedding excess pellets during these plant shut downs and procuring additional pellets during peak times.[38]

Utilities can also establish financial incentives such as feed-in tariffs and support long-term power purchase agreements of renewable energy while trading or selling the associated tradable green certificate to increase cost-effective deployment of these technologies. Finally, to further incentivize utilities, governments need to establish long-term country and region renewable policy regulation to provide market stability. Utilities with a greater mix of renewable energy can minimize risk from renewable portfolio standards and other climate change legislation. The sooner grid parity is achieved, the easier the choice to invest in renewable energy will be. Technological advancements in integration, storage, and load balancing will all contribute to driving down the price of renewable energy solutions.

The utilities industry has an opportunity to make one of the greatest impacts on the *Sustainable Energy for All* renewable energy objective. At the core of their business, utilities can choose the amount of traditional fuel sources they use (such as coal and oil) as well as the share of renewable sources they adopt (such as wind, solar and geothermal). For example, Enel Green Power, in Latin America, applies diverse applies diverse technology facilities ranging from hydro, mini-hydro, wind and geothermal facilities, and has thus maintained a high profile throughout the Latin American market with over 660 MW of renewable capacity and minority interests in another 195 MW. Moreover, Enel Green Power has also established joint ventures for geothermal development, in Chile, Nicaragua and El Salvador.[39]

6. Improve Energy Efficiency in Operations.

Utilities require significant amounts of energy to generate end-use electricity. The efficiency of generation varies widely with the technology used. For example, coal-fired power plant efficiency averaged 35.1% in 2007, up only slightly from its 1971 level of 33.5 percent.[40] Hydroelectric power has about 90 percent efficiency,[41] nuclear about 40 percent,[42] and solar about 15 percent.[43] The amount of energy lost in the generation process represents a higher cost of production for the generator, as well as a substantial waste of resources. In addition, transmission and distribution systems average about 6 percent to 8 percent loss when transporting power.[44] These losses can be mitigated through a variety of means, such as high voltage direct current (HVDC) lines, flexible AC Transmission systems (FACTS), grid optimization and distribution automation, and also by using superconducting wires with near-zero resistance.[45] Improving the energy efficiency of generation, transmission and distribution can reduce costs by limiting the amount of inputs required to produce the same amount of power output.

The efficiency of a new power plant is largely a function of economic choice. The technology needed to produce a highly efficient plant is well understood. However, to reach higher efficiency levels, higher pressure and temperatures are required. This increases the cost of the plant because special alloy materials are needed. Technology innovations and improved manufacturing processes could lower the cost of these special materials. Developing countries have an opportunity to introduce higher efficiency units at the outset of construction. Power plants can have lifetimes greater than 40 years, so it is important to introduce the efficient units early in the development of the infrastructure.

Several actions are needed to improve power generation efficiencies:

- Technology research in advanced materials will be required to lower the capital costs of more efficient units that require exotic materials for construction.
- Increasing generation fleet turnover can yield greater energy efficiency improvements by replacing older, less efficient units with newer, more efficient ones (although such an action does not necessarily guarantee a lower carbon footprint). Construction of highly efficient plants is critical particularly in developing countries where the fleets have room to grow. With a 40+ year lifespan, it is important that new units be as efficient as possible.
- Utilities need to be accepting of on-site combined heat and power generation at their large customer's facilities. Combined heat and power captures heat that would be wasted in a conventional power plant, potentially reaching an efficiency of up to 80 percent.[46] These systems consume less fuel to produce the same amount of energy.

Enel's Torrevaldaliga Nord power plant, in Italy, provides an excellent example of how energy efficient power plants can benefit the utility. They converted the plant from oil to clean coal by taking several actions, including boiler replacement, steam turbine replacement, a new flue gas cleaning train, and upgraded coal absorber towers with corrosive resistant steel.[47] As a result, efficiency improved from 39% to 45%, while simultaneously reducing overall emissions 50% below limits set by EU legislation (SOx and particulate emissions down 88% and NOx down 61%).[48]

E.ON's recently developed plant in Maasvlakte, Rotterdam underscores the importance of incorporating energy efficiency into new construction. The hard coal fired plant will be equipped with an 1100 MW production capacity and generate with a thermal efficiency of 46%. The thermal efficiency far exceeds traditional coal plants, relies on cogeneration, supplies excess thermal heat to neighbors, and can also burn biomass as a substitute for coal.[49]

Case Study: CNTG developing distributed natural gas generation capacity[50]

One of the key initiatives driving China's energy policy was the decision to construct 1,000 distributed energy combined heat and power natural gas driven power plants as announced in the 12th Five Year Plan for the period 2011 – 2015. CNTG and its joint venture partner, Huadian New Energy Development Co Ltd (one of China's largest state-owned energy consortia) are constructing the first of a series of such power plants in Jiangxi Province that will be completed at the end of 2012. The use of distributed energy combined heat and power will be the most efficient use of natural gas in China and will be a significantly cleaner alternative to the higher greenhouse gases from coal-fired power plants. The design is projected to achieve 80 percent efficiency of natural gas input making it economically viable, along with various by-products such as steam and chilled water which is demanded by local industries. A secondary benefit is that these distributed natural gas power plants are located near the customer and can be switched on or off as energy consumption peaks or troughs. This makes such power plants essential for the reliable delivery of electricity for the grid and to minimize grid congestion.

7. Increase Adoption of an Alternative Energy Vehicle Infrastructure and a Low-Carbon Grid.

Developed economies are facing growing energy demand, global climate change and rising fuel costs. Advanced vehicle technologies such as plug-in hybrid electric vehicles, battery electric vehicles, and hydrogen fuel cell electric vehicles can be an important way that utilities can help meet these challenges. Plug-in electric vehicles and battery electric vehicles are commercially available and have a number of demonstrated financial and environmental benefits. Electric vehicles are twice as efficient as gasoline powered vehicles,[51] have lower operational and maintenance costs, can reduce CO2 emissions and have zero tailpipe emissions.[52] The adoption of this technology can decrease fueling costs and reduce dependence on oil for energy consumers.

Electric vehicles will be fueled by the generation mix provided by the utility. Thus, transitioning the grid to a more renewable mix through wind, solar and other renewable fuel types is critical to driving the *Sustainable Energy for All* objective of doubling the renewable energy generation mix. Government regulations such as renewable portfolio standards which mandate a percent of renewable power in the generation mix can help advance this objective.

This shift toward an electric vehicle friendly grid depends on providing, supporting, and augmenting the necessary infrastructure for advanced alternative energy electricity fueled vehicles. Utilities can advance the electrification of transport in several ways: 1) deploy pilot charging stations; 2) develop the enabling technologies that facilitate the integration of plug-in vehicles (e.g. ability to manage the charging of large numbers of vehicles, billing and payment customer processes, and communication technologies); 3) fund smart charging i.e. vehicle to grid research and 4) partner with automobile companies developing the vehicles. As the traditional utility value chain changes, electric vehicles can be a way for utilities to create new business models and generate new revenue streams through charging infrastructure.

NRG Energy is making a sizeable $100 million investment in charging stations throughout the state of California. They will install 200 charging stations and 10,000 wired parking spaces across a few major metropoltan areas. The firm will provide the proper infrastructure to support the growing number of electric vehicles, including those in low-income areas.[53]

8. Educate Consumers on How to Improve Energy Efficiency

A significant gap exists between consumer perceptions about energy efficiency and their actual knowledge of it. The level of awareness of their energy consumption is typically low, so their ability to reduce consumption is often limited. When investigating retrofits for their homes or offices, energy consumers often underestsimate the potential savings. Additionally, consumers may also move residences before receiving payback for the cost of an upgrade. Utilities have an opportunity to further engage with their customers on the topic of energy efficiency. Pacific Gas and Electric, for example, provides its customers with a free online home energy audit, resources for investing in renewable energy, and buyer guides for energy intensive purchases.[54] In addition, corporate demand response programs are gaining in popularity as companies learn they can save money by reducing energy use at peak times.

Utilities can build credibility with consumers and enhance their brand value by serving as a trusted source of information about energy efficiency. There are many ways to communicate with consumers and each of these points of contact should be examined and appropriate mechanisms should be designed and implemented. One of the most effective methods of communication is through new energy management dashboards enabled by smart meters. By collecting nearly real-time data, development companies have created web-portals that convert the massive amounts of information into relevant consumption statistics and recommendations. Increasingly popular channels of communication such as mobile and social media also offer opportunities to more actively engage consumers around energy efficiency by providing control of devices or "gamifying" the energy experience and encouraging conservation competition within a social network. However, a one-size-fits-all approach will not work as consumers have a diverse values and preferences. To effectively educate consumers and become a trusted energy advisor, utilities need to develop a deep understanding of their customers and create targeted messaging and solutions. Some utilities use behavioral psychology to engage the consumer by showing their energy consumption relative to others in their neighborhood. Consumer education in developed countries will be driven by the new inflow of energy usage data that smart meters and advanced IT infrastructure have produced. Utilities in developing countries have also taken measures to educate consumers on energy efficiency.

The EDF Group has committed to promoting education of energy issues and an understanding of sustainability to its consumers. For a number of years, Edison, an EDF subsidiary in Italy, has helped Legambiente develop projects in the field of environmental education and energy conservation and has reached over 2,500 schools. EDF Energy's Greener Schools program is designed to help schools make real and measurable changes in their energy and water efficiency and carbon footprint. It aims to engage 2.5 million youngsters by 2012. Its website offers teachers free lesson plans, ideas to promote "green" activities and the opportunity to share experiences.[55] So far 14,750 schools have signed up – around 45% of all UK schools.[56] Similar experiences have been carried out by Endesa with programs like Chispita in Chile (www.chispita.cl), which aims to engage kids to change their families' energy consumption and other initiatives like the internet tool twenergy (www.twenergy.com), a website creating a community of more than 33,000 users which trains consumers on sustainable energy moving them to action.[57]

9. Create New Products and Services to Increase Sustainable Consumption by End-Customers.

One step beyond educating and raising awareness on sustainable and efficient energy consumption, utilities have a prominent role to play on supplying end customers with products and services that enable them to achieve a more sustainable and efficient use of energy. Utilities have the relationships and expertise to develop, market or sell products and services that enable customers to use electricity in a sustainable and efficient manner. Depending on the type of customer (commercial, residential, or industrial), utilities can provide customers with energy efficiency assessments, micro-generation, installation of renewables and retrofits. This will be especially relevant for utilities with a regulated rate of return. For de-regulated utilities, new products and services to increase sustainable consumption is a potential new revenue source. As smart metering provides more detailed usage information, utilities will have the ability to offer targeted solutions to consumers and businesses to help them reduce energy usage. Leveraging their data and relationships with consumers, utilities can offer a range of revenue generating solutions either on their own or working with partners.

There are huge policy hurdles and the important thing is that policy creates a market for energy efficiency by facilitating finance (such as CDM mechanisms, incentives, rebates, etc.), taking away barriers, setting standards etc. This action area facilitates actions by other industries working toward achieving the *Sustainable Energy for All* objectives. One of the main roles of utilities is to offer products and services that ease and enable industry initiatives on achieving sustainable energy consumption. Accompanying the installation of these products and services, a best practice should be the provision of capacity building or local training of people and employees in order to guarantee the long-term maintenance of the solutions.

Conclusion

The priority actions identified in this document are meant to provide guidance and inspire utility companies to take action to advance the three objectives of the *Sustainable Energy for All* initiative while simultaneously maximizing their realized business value. It is vital that the private sector be fully engaged and committed to successfully achieve the initiative's ambitious objectives. With the right level of support, coordination, and action the power of industry can be unleashed to ensure universal energy access, dramatically improve the energy efficiency of business operations, increase the use of renewable energy, and develop more sustainable products and services. Actions focused on achieving the desired outcomes of *Sustainable Energy for All* will drive significant positive societal change in addition to economic growth and opportunity.

As one of the key providers of global energy, the utilities industry is in a unique position to expand access to energy in a sustainable manner. With combined political and financial support, the utility industry can provide the necessary infrastructure (new or upgraded), generation (large-scale or distributed) and consumer education to fulfill the needs of the 1.3 billion people without access to electricity and the 2.7 billion people without access to clean cooking solutions.[58]

For utilities companies to advance their business opportunities related to energy efficiency and renewable energy, the industry should focus on the nine priority actions detailed in this document. By focusing on these actions, the utility industry will be able to maximize its contribution to *Sustainable Energy for All*, increase business value, and ensure a sustainable future based on a balanced approach to improving social, environmental, and economic benefits for all.

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