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Smart energy - the new landscape of the energy industry sector emerging

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Our current energy supply networks form a highly complex large scale network connecting cities and even countries together. This ecosystem of technology and various players is facing a major revolution.

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Energy conservation is a key concern for us all. Not only is it about preserving our planet's resources, but also about side effects such as global warming and pollution caused by excessive use of fossil fuels. At the same time, businesses and private persons alike feel the impact of energy costs. Our current energy supply networks are critical to us all, and form a highly complex large scale network connecting cities and even countries together. This ecosystem of technology and various players is facing a major revolution, partially driven by the expansion of the internet, wireless communication, low cost sensors and battery technology, but also due to new large scale technologies and sophisticated software and automation. No wonder then that smart energy is high on the agenda for nations and their governments, cities and regions, big and small business, universities and research centers, and ordinary citizens. Smart energy has big implications for us all.

Understanding smart energy

When internet, wireless communications and low cost sensors with communication capabilities (Internet of Things) are brought into mainstream energy supply networks, a lot things become simpler. Suddenly the consumer and provider can follow energy consumption in real time, choose how they source, provide and use that energy, and all this happens in real time. However, smart energy, and the concept of smart grid goes beyond this. Increasing

the capabilities of the energy supply network to handle data communication also helps to manage renewable sources such as wind power, the unpredictability of which has caused grey hairs for many utility managers. Combining real time data availability from a vast number of sources with high power analytics helps to predict power generation, which in turn directly reduces to keep reserve power on stand-by in case the wind dies out. Similarly, mixing in new battery technology and small scale distributed energy resources such as homeowner solar panels, suddenly becomes manageable as the network can help control when to feed in and when to source out energy from these micro-sources. Meter reading can be automated when smart meters can be connected through the latest LTE mobile networks directly to the utilities.



So in short, while smart energy and smart grids are much more than just internet of things and wireless communication, it is this capability of transferring information back-and-forth, and issuing commands to various parts in the network that creates a completely new type of flexibility in terms of what can be done. This flexibility in turn releases the full power of a whole range of technologies, from large scale renewable power generation facilities such as wind and solar farm, to energy storage either in the grid or at the home, and local energy production in small scale. The availability of information from all the devices in the network also unleashes new analytical possibilities, which can be captured by sophisticated analytical software that can optimize the performance of the network further.

Figure 1 summarizes the key elements and terminology of smart energy and smart grids.

Smart energy is a big market and it is growing fast

Given the breadth and diversity of components in smart energy and smart grids, it is surely no surprise that the overall market is expected to be huge. The worldwide overall smart grid market, for example, is expected to exceed 400 billion USD by 2020. It is, however, already several tens of billion USD. Exact figures vary based on which market research company you believe in, as do growth rates. However, the growth is expected to be significant over the next 5-10 years, ranging between 8-18% annually, depending on which year and period one looks at. The largest market, around 24% of the total, is expected to be China.

While this market is very fragmented, some of the segments are sizeable. One of the most significant categories are the smart meters, which are expected to become an 18 billion USD market by 2019. Obviously there are also many small segments which are highly specialized. Some specialized segments, such as smart grid data analytics, are expected to grow very fast, with 20% compound annual growth rate (CAGR) predicted.

There is not only growth in existing market segments. Venture capitalists and technology entrepreneurs are expecting also new opportunities to emerge. Investment into the smart grid space has been active for several years, and jumped up close to 200 million USD in Q1 2015, having been between 50-150 million USD in previous quarters. Mergers and acquisitions are also actively pursued. The “hot” areas currently seem to be energy storage/battery, and energy efficiency.

All this bodes well – both big and small companies, existing and new players, are briskly entering the arena. We can expect rapid innovation in the coming years. There are spill-over effects to multiple markets. Smart home being an obvious one (we discussed for example Google's acquisition of Nest in a previous blog), but also markets such as cyber security (also the topic of an earlier blog). So this change is not only about an isolated market changing and growing, it really is a network effect connecting multiple markets. While focused smaller players may find this a great opportunity, for larger players it does pose the challenge of what the optimal offering portfolio should be, and how it should evolve over time.

Software and hardware technologies driving the smart energy sector

The smart energy sector is not about a well-defined set of technologies, rather it is about combining a broad range of new and old technologies together in novel ways. Standard internet, wifi and wireless telecom technologies (including latest LTE technology) play a key role, but so does security technology. In many cases these technologies are adapted to the specific needs of the smart grid. In security protocols like Zigbee are playing a key role. Similarly, when applying LTE mobile technology for smart meter communications, Quality of Service features are used to handle the traffic in the most effective way.

Renewable energy plays a key role, as do battery technologies. However, for maximal usability software solutions are needed. An interesting feature is that electric cars and their batteries, when the car is parked, can be connected to the grid and serve as temporary energy storage. During the day or evening their batteries can feed energy to the building, and then be charged in the night when energy consumption goes down. So even the automotive industry has a role to play in the smart energy ecosystem. At the same time, the supply chains are interconnected – to achieve economies of scale electric car manufacturer Tesla for example now offers batteries both for grid and house energy storage.



A multitude of sensors and control technology play a key role in the smart grid. However, mobile apps also enter. New applications allow home owners to control energy usage remotely, and apparently one mobile phone application allows even checking the energy consumption of a device by placing the phone near the power cord! Software plays a big role also at the utilities, where massive analytical algorithms use big data to optimize grid operation and the asset utilization of the utilities.

In a survey of industry experts, the top five disruptive technologies listed were distributed energy generation, energy storage, internet of things, grid defection and big data. Of these, three are clearly related – distributed energy generation, energy storage and grid defection – indicating that we can expect autonomous units and micro or nanogrids (small region or even singular building grids) becoming more common place. This may change the entire economics of the energy industry, from central supply and distribute to a much more dispersed system. The smart grid makes this possible, but certainly a lot of regulative overhaul is also needed to make this reality.

The role of the government as a booster

In a market this big, and in a sector as strategically important as energy is, it is no surprise that governments play a massive role. For some it is about improving the nation's energy budget and overall energy efficiency while battling global warming and pollution by having a broad range of energy sources (in particular renewables). The key issue here is that nations need multiple energy sources, since replacing current fossil fuels is not possible with only one kind of energy source. At the same time this is about helping the domestic technology industry. US, Germany, Spain and Denmark all were leaders in wind energy adoption, for example, and helped to create strong domestic players in this sector. South Korea and China, with varying success, have since done the same. It is truly a race for glory and dominance. In 2014 China beat US in smart grid investment for the first time, and continues to invest heavily in renewable energy technologies. US is not about to slow down either, and President Obama pushed a 3.5 billion USD grid modernization investment into the 2016 budget. Both countries, as well as multiple other technology focused countries such as Germany, South Korea and Japan, are actively driving the development of this area, thereby seeking to help develop the competitiveness of their respective industrial players. Even large cities see this as a strategically important area. New York City Governor Cuomo recently announced a plan to create a world class research and development center to develop the next generation electric grid, covering topics such as electric system resiliency and advanced use of renewable resources.

New major players entering the arena of energy through smart grid

The competitive landscape is changing rapidly. Not only are utilities challenged by distributed energy generation and new micro utilities and virtual plants, in addition a range of completely new types of players are entering the arena with a potential of strategic upheaval. Recent announcement of Elon Musk and electric car manufacturer Tesla to enter the home (and grid) battery market is a case in point. Google has also entered the advanced energy management services market, and is doing massive investments both into energy generation and energy distribution. Power technology companies like ABB, Siemens, GE and Alstom are obvious combatants, and the large Korean industrial companies such as LG, GS, Posco, and Hanhwa are all active in the area with significant investments into multiple technology and application areas. IT service companies like LG CNS and Oracle are offering platforms for system integration, and Schneider Electric has built a software platform for customers' energy management and demand response.

Partnerships are also playing a key role. Witness Solar City's partnership with Google's Nest, and now also with Tesla, as well as Telefonica's, Ericsson's and E.ON Research Center's collaboration on smart meter reading using the LTE networks.

The end of centralized energy production – potential impact of smart renewable energy

The obvious question is where will all this lead? Clearly strong forces are pushing the power away from the once-invincible energy utilities, but they certainly are fighting back. At the

same time, large industrial conglomerates find themselves investing in a broad range of technologies and solutions, seeking to optimize their offering portfolio. Venture capitalists are actively pursuing new opportunities, hoping to finance the next big thing that can be listed or trade sold (like Nest) at multi-billion valuation.

Like in many other industries, software and access to data will play a key role. But it is not obvious which data is the most important one, nor what part of the grid will dominate. Will the large grids prevail, or will they lose out to microgrids and distributed power generation? What effect will adjacent industries, such as the automotive industry and their electric cars, have on all of this?

The good news is that this development is now happening, and the opportunities that this soup of various technologies offer are broad. Energy conservation and finding ways to handle effectively without damaging our environment are key issues. While the battle of the smart energy landscape continues with both governments and business tightly involved, it seems likely that this development of the energy sector will bring considerable benefits to us all.

Figures

Figure 1. Smart energy combines a range of technologies and features together for improved efficiency, service, and flexibility.



An interesting illustration of major players is available here: http://www.greentechmedia.com/images/wysiwyg/research-blogs/taxonomy-large.jpg



Further reading and references

Smart energy, smart-grid technology, and smart metering are an expansive subject with a wide range of information on different technologies and sub-industries. For an overview of the IT architecture behind smart energy, the “Architecture” part of the following article is useful: http://timreview.ca/article/702

This blog is based on a broad range of articles and reports. I list some of the more interesting here:

https://www.greenbiz.com/article/3-economic-technology-forces-will-shape-future-NRG-IDEO-energy
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