White Paper

Utilities in 2050: Hypotheses for the Future of the Industry

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Summary

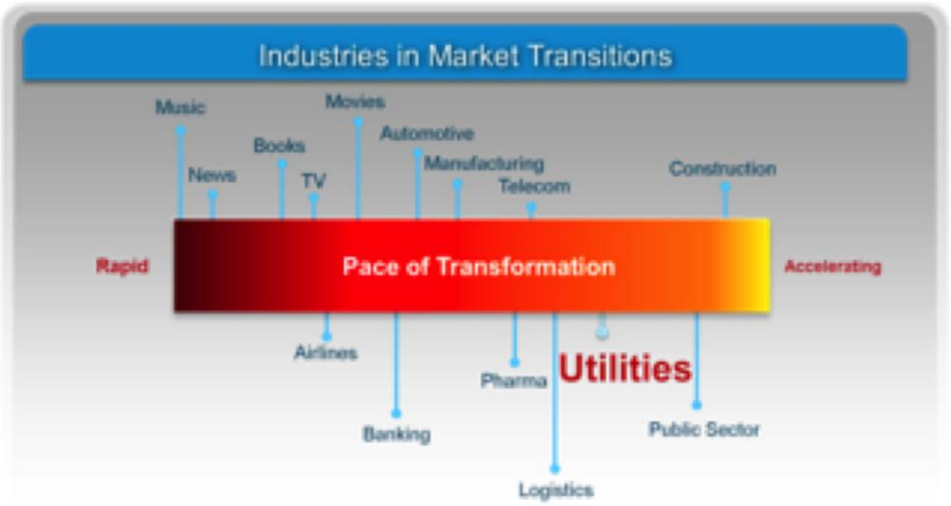
The Utility industry is an industry in transition. Transition means change, and change is often perceived as a smooth evolution of the current situation. We believe the Utility industry transition is by far more substantial than most industry players are ready to acknowledge. As a consequence, strategic moves need to be more fundamental than simply adapting the business and operating model of today. Considering the example of a (distribution) grid operator, we provide examples for new value-creation opportunities and survival strategies for Utilities open to bolder moves in the market.

Point of Departure

Our energy system is and has been a system of change and transition (Figure 1). The barnstorming years of this industry date back to the years following the first International Exposition of Electricity in Paris in 1881. In the following years, the industry saw great technological and commercial battles, such as Westinghouse promoting Tesla's AC technology versus Edison promoting DC technology. Nicholas Carr discusses in his book "The Big Switch" how Edison convinced legislators in New York to use Westinghouse's AC system for the first electrification of a death-row prisoner in New York in 1890 to sway public opinion toward DC distribution technology.[1] In the early years of electrification, the electricity system did change from insular industrial systems to local networks with larger-scale generation facilities. They have been replaced with even larger and more intensely meshed networks. At the same time, utilities' business models have changed multiple times—from building onsite generation to leasing energy-consuming household goods to selling electric power by the kWh.

[1] Carr, N. (2009), The Big Witch, page 38f

Figure 1. Industries in Transformation



After the fundamental technological arguments were settled—wars and their horrible devastation of Europe aside—power utilities led a very prosperous life at the edge of complacency until the late 1990s. After almost half a century of undisturbed growth, the demise of the golden age of power utilities has started with the Directive 96/92/EC[2] concerning common rules for the internal market in electricity, and has been accelerated by the Kyoto Protocol beginning in 2005. The former tried to introduce a more market-based system through value-chain unbundling (and we do not intend to contemplate its success or failure in this article), and the latter started the race for a renewables-based electric power system. In general, one has to wonder how leading Utilities and local electricity companies alike could miss the move toward a decentralized renewables energy system at such a scale. While all over Europe private investors started to build onshore wind and small-scale solar plants, established industry players were still overpaying on large-scale generation projects at the time.

They had not realized the paradigm shift in the system, having lived such prosperous and comfortable lives. And although most of the industry is dealing with the aftermath of the energy transition (Energiewende), we see a sustained reluctance to acknowledge the continuance of the system transition. As we write this article, Google has just acquired nest for more than US$3.2B and EnerNOC has acquired Entelios for an undisclosed amount as its new hub for European expansion. Although EnerNOC's acquisition of Entelios happened for an obvious reason, most industry players are not aware of the value behind nest. Admittedly, the big data component of selling thermostats to private customers must appeal to Google. More generally, the acquisition is a renewed effort by Google to enter the residential electricity market, because nest is already offering home energy-management services to power utilities in seven U.S. states, serving 20 million customers. So it's time to start thinking about what the next wave of industry transformation and innovation will bring.

[2] http://eur-lex.europa.eu/LexUriServ/LexUriServ.do?uri=CELEX:31996L0092:EN:HTML (Feb. 24, 2014)

Hypotheses and Opportunities for the Next Wave of Transformation

We believe the next wave of transformation will be affected by the disruptive potential Information and Communication Technology (ICT) together with other enabling technologies in the same ways that advanced robotics and three-dimensional (3D) printing have affected the electricity industry.

Figure 2. New Business Opportunities for Grid Operators

A common characteristic of all of those technologies is that they are on an exponential learning curve. Consider 3D printing, for example. The broader theme of Additive Layer Manufacturing (ALM) dates back to the 1970s when German engineers made their initial experiments in this space. Since then, ALM has gone through numerous hype cycles because the technology did advance but in the past never really left the rapid prototyping environment because of the cost and quality of the output. Now, thought leaders in the industry believe this technology has crossed the chasm between experimental and the early mass adoption stage and will find rapid adoption, particularly in the field of Operations and Maintenance (O&M)[3]. To cite a quote attributed to Bill Gates, “Most people overestimate what is achievable in two years but underestimate what is in ten”.

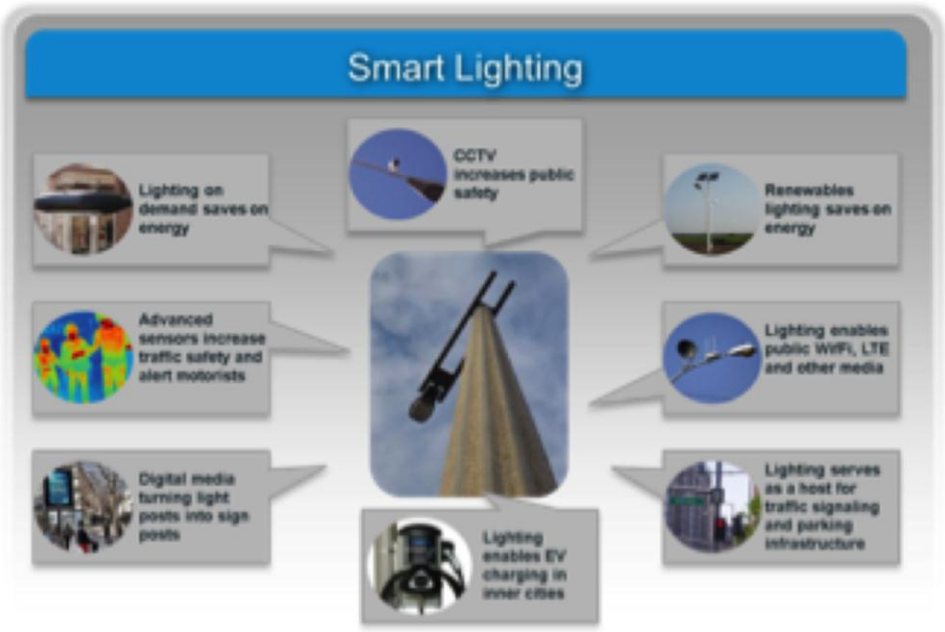
The changes will be accelerated by our understanding of what parts of the business really need to be regulated and potentially transitioning large portions of today’s regulated business into a commercial market design as disruptive technologies and business models herald the further breaking up of monopolistic industry design. We have developed five hypotheses for the next wave of transformations (Figure 2) and will sketch five corresponding and potentially disruptive business opportunities in the following sections.

[3] McKinsey &Company (2014), McKinsey Quarterly 2014/1: Shaping the future of manufacturing, p. 40ff

Convergence of Business Models

Utilities specialize in building and operating a single-purpose infrastructure. Power plants generate electricity, power grids transport and distribute electricity, and so forth. This model works well for the electricity system as long as we remain in the traditional setup (that is, no disturbances such as distributed energy resources) and costs relative to profitability do not matter. Going forward, we believe Utilities will need to discover the potential to converge business models and opportunities to create multipurpose infrastructures and business models (Figure 3).

Figure 3. Smart Lighting



Specifically, Utilities will need to find ways to share costs of an infrastructure across different use cases and/or use existing infrastructure for multiple use cases. In this case, the expression “infrastructure” refers to the broader term including all forms of public infrastructure reaching beyond the power system (for example, lighting, water, etc.). One example in this space is the public lighting infrastructure. Many of these networks today are operated by power Utilities for the obvious reason: It is a DS0 type of power network with a high number of nodes that happen to be single-purpose consumers, namely light bulbs. It is an electricity grid that was built in parallel to the electricity network in a DS0 user’s service area. Although we all appreciate the benefits public lighting provides—increased safety at night, for example—Utilities tend to operate this infrastructure not because it is a lucrative business (in reality, it tends to be a neither-profit-nor-loss situation at best) but rather because it helps them secure good will and a lucrative power grid concession with local stakeholders.

One could take a different perspective on public lighting. Public lighting is a network of prime commercial real-estate locations across a metropolitan area and it is underused, being dedicated to only one product line (lighting). So why not put this prime real estate to more productive use by taking advantage of its already-existing state of connectivity. Use cases could range from providing closed-circuit television (CCTV) for traffic and crime monitoring, road-side electric vehicle charging stations (consider the Berlin startup Ubitricity, which enables a light pole–based charging station at little over 100 EUR) to digital media streaming and public Wi-Fi. The latter might actually prove to be the most valuable arrangement. Although rural areas are at risk to be left behind in the digital divide, DS0 could help promote broadband access in those areas by offering lamp post–based Wi-Fi connectivity (typically, even isolated communities tend to have some sort of fiber to the municipality infrastructure, but do struggle with the infrastructure required to cover the last mile).

In this example, a Utility offering those services moves from an electric lighting infrastructure provider to becoming a Smart City platform operator.

The Postunbundling Era

Traditionally, Utilities have been excellent at managing and operating single-product businesses, that is, the disparate elements of the value chain. A trained power-plant operator stayed in the power plant. Why would anyone want to change that model in an environment that thrives on system stability? Over the past decade, governments and their regulators have even incentivized utilities' "siloed" thinking because unbundling created hard-to-cross legal boundaries around value chains. As a side note, Germany is taking this thinking to the extreme, for example, by creating an increasing number of market roles around the end-customer meter and corresponding services, and I am certain this trend will continue along the entire power utility value chain.

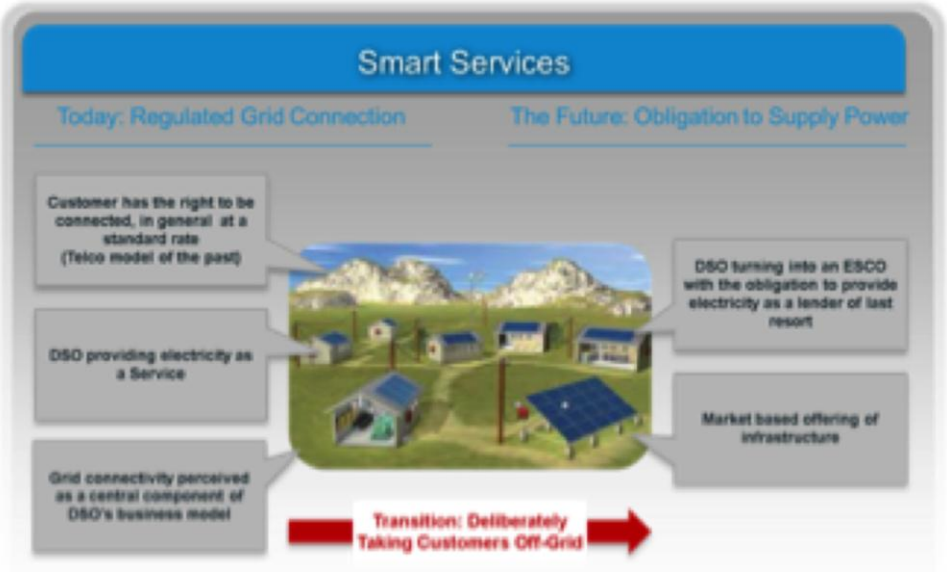
Rethinking the mechanisms of regulation and unbundling is long past due. The concept may have had its merits in the 1990s when it was developed by European regulators. At that time, all elements of the value chain were operated in a more or less monopolistic way. Unbundling was seen as a means to create competition by allowing new players to enter the market with free access to infrastructure. As a consequence, we did see numerous new players entering the market in large-scale generation as well as in trading and electricity retailing. Power transmission and distribution have seen many changes of ownership, but fundamentally they are still being operated and protected as natural monopolies.

One truly wonders why regulators do not take a more entrepreneurial approach to this part of the electricity system. As Because off-shore wind-grid connection seems to be a major impediment to the build-out of more renewables generation, why would we not want to revert to a new way of tendering smaller parts of the system and leave the overall management thereof to a separate entity? We do privatize even small elements such as toll bridges and tunnels of our road infrastructure. Why not in the transmission business?

The argument of natural monopolies is even weaker for distribution networks. Private investors now own the majority of distributed generation assets—definitely in numbers if not also in scale. Because the distribution network is the intermediary between generation and consumers, boundaries between the elements of the value chain of power Utilities are blurring. This situation is true on the commercial side and even more so for commercial and industrial customers because they are eagerly investing in onsite generation.

Grid-based storage is one of the new frontiers of regulatory challenges as legislation struggles with the ability to trade on storage capacity embedded in the monopolistic power grid. The evolution of our power-distribution grid will depend on a vision where those two technologies—distributed generation and distributed storage—and their market adoption will be heading. As a consequence, we believe the grid business model and its regulation will change.

Figure 4. Smart Services

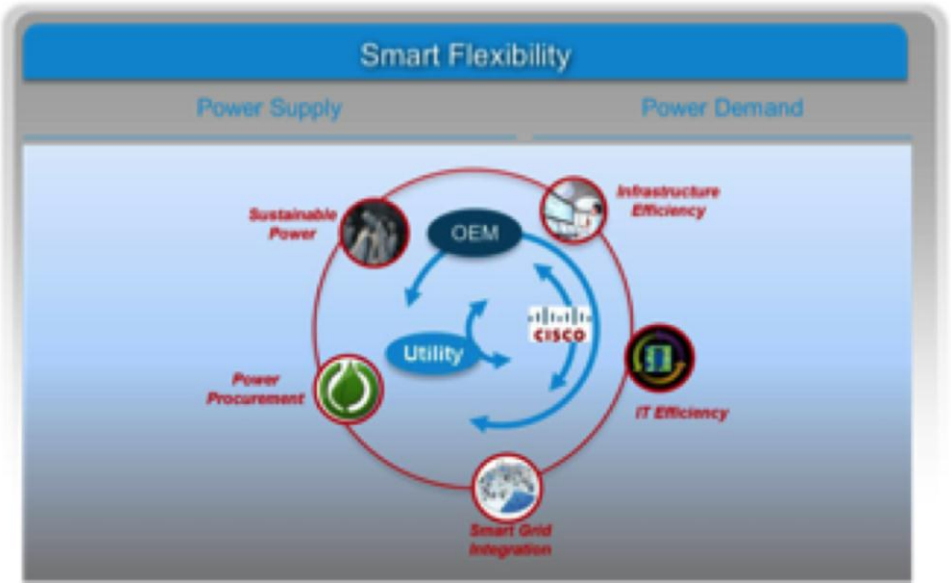


Should an electricity grid be governed as a regulated asset in a world where customers can choose between either power-grid or gas-grid connectivity—or remain on both grids? As more and more customers take parts of their electricity supply in their own hands and DSO are moving into the role of backup system providers, shouldn't DSO be allowed to decline servicing certain geographies as the costs per kWh continue to explode at a consumption-based grid connection and pricing model (Figure 4)? Especially in rural areas they should be allowed to take a more market-based approach, offering electricity supply as pure off-grid solutions. The market for decentralized and insular power supply would substitute monopolistic and regulated distribution grid–based power supply. And DSO would have a choice where they want to offer services. Clearly, this concept does have its limitations when it comes to metropolitan areas. Albeit even there we are limited only by the true inner city centers, and the suburban quarters may well be included in this concept.

Leaving the Commodity Zone

In the early days of electrification when Utilities expanded from industrial to residential use of electricity, one of their key challenges was dealing with the concern of affordability. Electricity may have been cheap in relative terms, but households simply could not afford electricity-consuming devices beyond light bulbs at scale. As a consequence, utilities did adapt their business model, moving from selling electricity by the kWh to leasing electricity-consuming household goods.

Figure 5. Smart Flexibility



We are not suggesting this business model should be revived in the residential market, although aspects of it may be deemed relevant in the area of home automation. Rather we want to urge utilities to consider this model as they contemplate strategies for the industrial and commercial segments (Figure 5). The current investigation by the EU Commission into the German practice of excluding industrial customers from the renewables compensation scheme highlights the increased relevance of the costs of power to industrial customers.

And we are talking not only about the absolute costs of power but also the need to consider the inherent external costs such as the CO2 footprint. As a consequence, industrial customers will be looking to Utilities to help them mitigate the increasingly negative effect of the surging power costs on their business. Utilities will need to have mitigating strategies in place that range from new energy-supply concepts to integrated consumption models. The former is quite straightforward because Utilities have a long history of optimizing power supply by adding onsite generation and procurement optimization to customer contracts. Procurement is more challenging because it requires a new approach to sharing the pain with customers. For one, this challenge will give a new push to Demand Response (DR) schemes.

In the short history of DR offerings in Europe, Utilities have played their relevance down, referring to the long history of load shedding. We believe they did take the easy way because DR cannot be compared to load shedding. Load shedding is the act of taking large consumers offline. DR is the art of minimizing the impact of surges in costs of power while maximizing operational flexibility of a customer's operation, and conversely. DR requires a much deeper understanding of a customer's operation and potentially also risk sharing. Creating that

financial optimum and the required flexibility may even cause Utilities to think about some sort of model where they take responsibility for not only providing power but also optimizing the underlying infrastructure of drives, motors, heating and cooling, or any other sort of electricity-intense equipment.

Smart Operators Creating “Over-the-Top” Plays

Over-the-top (OTT) plays are a key concern to public telecommunication system operators. Originally, their business model was based on selling capacity by the minute (that is, minutes of voice conversation). Over time, telecommunication networks have migrated from voice to data networks and voice has also migrated from analogue voice transmission to data transmission. As a consequence, they are now operating large data networks. The evolution of the Internet has seen the advent of a broad number of business models that do hinge on the underlying high-performance data networks but are not necessarily attached to them; again, think Google, iTunes, and YouTube.

Figure 6. Smart Operator

We do not suggest that Utilities revisit their business plans of the early 2000s to try to establish broadband over power lines (BPL)-based data plays for competition with fiber-optic networks. Rather we want to encourage Utilities to consider the logical separation of the operation of the physical infrastructure and the capabilities required to manage an intelligent power system. Maintaining cables and transformers requires a different skillset than balancing a power grid with a high number of distributed medium and low voltage–based “prosumers”. The maintenance of the physical infrastructure requires predominantly geographic proximity and the ability to manage strong technical field force. Operating the Smart Grid requires developing an intelligent data model and operating the intelligent infrastructure. The high number of small and often municipal Utilities across Europe may not find themselves prepared for the demands of creating the intelligent logic and operating it going forward. Why not come to a model where the basic infrastructure could be operated through local entities while the intelligent network component would be centrally provided by a few players focusing on the logical infrastructure (Figure 6).

E.ON and RWE have both stated they want to grow their business in an asset light model developing new competences and deploying them globally. In our opinion, they will be looking to become such a smart operator in service areas where the incumbent may not have the skills required to manage the smart infrastructure.

This approach does not necessarily need to turn into a thread for smaller players in the market. It merely means they will need to focus on their skills of operating basic infrastructure.

On the other hand, this approach might enable a coherent investment strategy in the Smart Grid at last. The current regulatory regime and unbundling preclude Utilities from investing into a converged infrastructure today. Distribution-grid operators find it difficult to invest in assets enabling Smart Metering at a future point in time and conversely as cross-charging proves to be difficult in an unbundled system. An OTT player in the utilities space may find it easier to create that coherent intelligent infrastructure layer.

Digital Technologies in Operations

The digitalization of utilities' operations has one key influencer: aging workforce. EDF performed an analysis of its workforce in 2010 and discovered it would lose approximately half of its field force in the coming 5 years because of retirement.[4] This situation is critical. Although professional services firms may successfully operate a business model that hinges on a high turnover rate, the complex infrastructure of a Utility today does not lend itself to a model of high workforce turnover. Utilities depend upon highly skilled employees with a broad and deep knowledge of the asset base they have been entrusted with. Solid technical training combined with a long history of servicing the assets makes them the experts of **their** infrastructure.

Facing the departure of about half of all their skilled and experienced workers, Utilities need to find ways to capture their knowledge and experience and preserve it for the future. They also need to find ways of making this information accessible to their new employees. And finally, they need to find ways to better support the workforce in the field to take advantage of the latest technology. In this context, digitization means much more than simply introducing yet another system—be it software or hardware. Utilities will have to take a fresh approach to system support. Today, many find themselves using a large number of software tools in the field, often reaching medium-level double digits. Systems are overloaded because they are being manhandled into completing tasks they were never designed to fulfill (for example, geographic information systems [GISs] being tuned in fully developed asset-management databases).

Utilities are not using all the information in their systems to full advantage because systems are being operated as siloed elements. And finally, we often see one key component missing—transparent access to the corporate network. Going forward, Utilities should rethink how they can use technology to full advantage to make operation of their assets safer (reaching from physical to cyber security), how they can better ascertain the state and availability of assets (simple tracking to predictive analytics) and also create portal-like platforms for their staff for easy and coherent access to relevant information on any asset, for example (Figure 7).

[4] EDF (Hg.) EDF Sustainability Report 2010, S. 70, London 2011: http://www.edfenergy.com/sustainability/performance-report/2010/report/#/1/, Date: August 12, 2013

Figure 7. Smart Working

All of these goals can be achieved with technology available today. Much like the enterprise systems consolidation most large utilities had to go through following their national and international expansion, they now need to restructure and provide a state-of-the-art operating environment in the field.

Digitization should not end here. So far, we have covered only basic technologies available today. Utilities should start looking into new areas such as robotics for the maintenance of hazardous or remote areas (already in use, for example, in the Oil & Gas industry), 3D printing (Additive Layer Manufacturing) to optimize spares handling and reduce downtime (particularly in a world where assets may stay in operation for several decades), and prognostic maintenance to take advantage of new and abundant sensor networks (taking predictive maintenance to the next level by understanding the probability that a given part will not fail within a given time). We see Utilities falling short particularly in areas previously described, underestimating the speed of the development of these technologies.

Change Agents or the End of Incest

Will Utilities successfully master the necessary transformation, and will they be nimble and adapt their business and operating models? Judging from their histories most Utilities have when it comes to dealing with the Energiewende, one might question that ability.

The necessary transformation will push Utilities well out of their comfort zone. It will require new skills and a different set of experiences. The archetype of the employee of any given utility today is a life spent with a single employer or a small number of Utilities as employers. Having worked for yet another asset-heavy industry such as oOil & and gGas or alternatively for one of the major Original Equipment Manufacturers (OEMs) is already considered exotic. And yes, there is still the political placement happening in this industry offering safe retirement options for the failed politician going private. We believe this industry needs to open up and aggressively bring in fresh talent from other industries. Why not attract staff from Fast Moving Consumer Goods (FMCG) companies such as Procter & Gamble to promote retail innovation, someone from the service provider or ICT industry to run Smart Grid programs, and so forth. This industry has been governed by the mantra of stability promoting a “more-of-the-same” attitude rather than a willingness to change. We believe the utility industry will be able to master the necessary transformation only if it opens up to new ways of doing business as well as different skills to improve business.

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