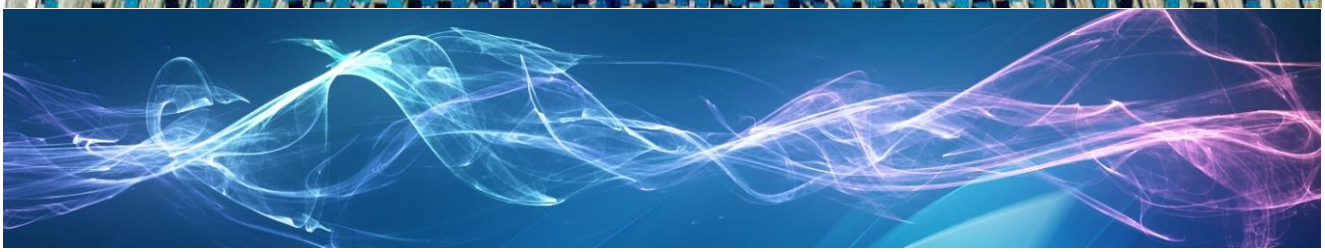


GENERATION SUSTAINABILITY INSIGHTS SERIES

TRANSITION IN THE POWER INDUSTRY

How a chain reaction set the industry and its investment landscape on a new course

JULY 2015

KEY INSIGHTS

> Over the past century, the power industry has operated under a model designed to maximise generating capacity in order to provide businesses and households with an abundant supply of electricity.

> In recent years, a chain reaction of events—involving the policy, technology, business and consumer arenas—has set the industry on a new course.

> We believe that the industry is headed towards a future model that seeks to optimise the provision of secure, sustainable and affordable power.

> While future models will differ by market, we expect them to include power generation primarily from renewable sources, transmission and distribution across digitalised smart grids and customer-centric retail sales.

> The transition to this new model is likely to be highly disruptive.

> Against this backdrop, we favour investments in companies that are developing solutions in the areas of digital energy, customer services and renewable energy.

> We also seek to avoid exposure to traditional electric utility companies given that they face significant stranded asset risk and are often less able to adapt to change relative to new entrants.

> Finally, we remain aware of the knock-on effects that changes in the power industry have on other areas, such as the technology, automobile, financial services and retail sectors.

[1] Top picture: Birdseye view of solar power array in Seville, Spain. Accessed on 30 July 2015. https://s-media-cache-ak0.pinimg.com/474x/a7/f2/1f/a7f21f70c0a8ebe848e587f37e68ae1d.jpg

[2] Bottom picture: Abstract multicolor with black background representing a current of electricity. Accessed on 30 July 2015. http://imgur.com/PbFjddP

ABOUT GENERATION

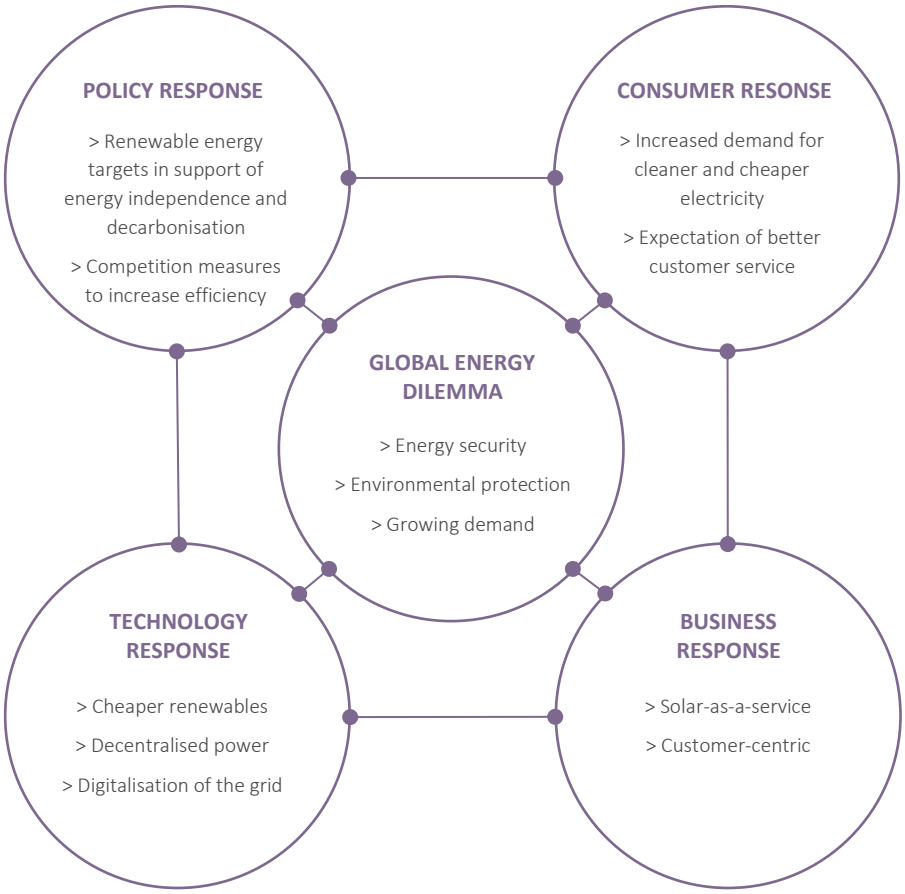
Founded in 2004, Generation is a boutique investment manager with four investment strategies: global equity, Asia equity, growth equity and direct lending. Generation seeks to deliver superior investment results[i] by consistently taking a long-term view and fully integrating sustainability research within a rigorous framework of traditional financial analysis.

I. INTRODUCTION

A chain reaction of events is reshaping the USD 2.2 trillion global power industry. The primary catalyst is the "Global Energy Dilemma", which refers to the challenge of providing a secure, sustainable and affordable supply of energy in a world where issues around energy security, environmental protection and growing energy demand are intensifying. Governments have responded to this dilemma by implementing a series of renewable energy targets and competition measures within the power industry. In turn, innovators have reacted to these policy incentives by developing renewable energy technologies that are much more cost effective, in addition to digital tools capable of significantly increasing the efficiency of the electric grid. Business leaders are executing new strategies to adapt to these rapidly changing circumstances. Consumers have also taken note and are shifting their demand in line with the new choices available to them. These changes are reinforcing one another, allowing and encouraging each group of actors to take even bolder steps forward.

Diagram 1

The chain reaction that is reshaping the global power industry



As a result of this chain reaction, the business environment within which electric utilities have operated for more than 100 years has fundamentally changed. The industry as a whole is now in the process of shifting towards an operating model that is better suited to the new environment. We expect this transition to be highly disruptive, as it requires a reconfiguration of the entire industry and simultaneously opens the door for new entrants to displace incumbent leaders.

In light of the magnitude of the changes underway, we have made the power industry an area of focus within our research. In this paper, we share some of our latest thinking, including our views on the future industry model and the innovations that are likely to shape it. We conclude with an overview of how we are navigating the rapidly changing investment landscape.

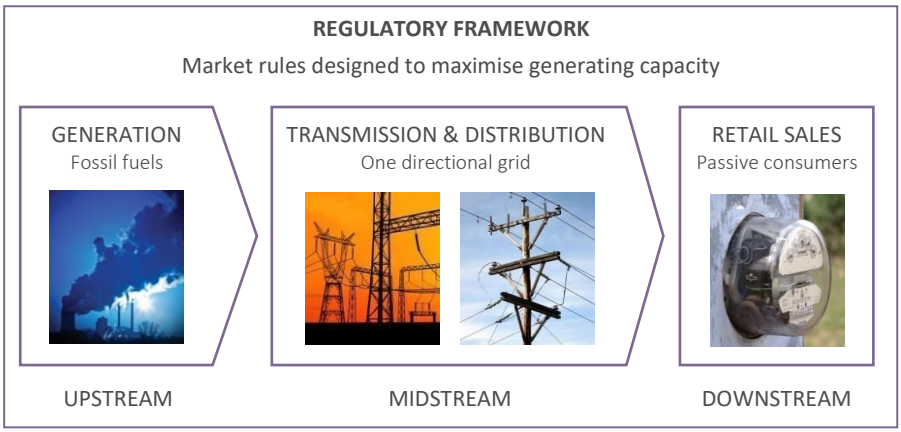
II. THE TRADITIONAL INDUSTRY MODEL

Ever since Thomas Edison established the first electric utility in New York City in the 1880s, most major electric utilities have operated under a centralised model comprised of three business segments: i) generation, ii) transmission and distribution and iii) retail sales. While each business segment varies by geographic market, they share many of the same characteristics.

Diagram 2

Traditional power industry model

Electricity generated primarily from fossil fuels is delivered over long distances through a basic transmission and distribution grid to passive consumers



Within the generation business, centralised fossil fuel plants produce the majority of electricity (67% of the global supply). This contributes to approximately 25% of the world's greenhouse gas emissions on an annual basis.[ii] Traditionally, regulators have incentivised electric utilities based on how much capacity they have to produce rather than how competitively they produce. While this structure has ensured that end users have access to a stable and readily available supply of power, it has also led to excess capacity and major inefficiencies in many markets.

With regard to transmission and distribution,[iii] this segment includes the extensive infrastructure network (typically referred to as the "grid") that sends electric power from generating plants to end users. Most grids were put in place over 50 years ago when the global population was less than half its current size and electricity needs were more basic. As a consequence, most grids are now in need of major upgrades.

Lastly, in the retail segment of the business, suppliers purchase electricity from the grid at a fluctuating wholesale price and sell it to end users at a flat retail price. Vertically integrated electric utilities have typically dominated this space with little competition from other providers. As they have had no immediate need to engage customers in retention efforts, retail providers' service offerings have focused primarily on monthly billing. Consumers, as a result, have long lacked the tools and incentives necessary to manage their electricity usage in line with daily fluctuations in wholesale costs (hence the term "passive consumer").

III. THE GLOBAL ENERGY DILEMMA

The traditional model described above works well under a certain set of conditions that were once considered "givens" in the industry. They include: a stable supply of natural resources within national borders or from trading partners, no perceived limitation on the capacity of the planet to absorb negative externalities and producers that are able to increase the supply of power in line with growing demand. However, in recent years, mounting concerns around energy security, environmental protection and the affordability of electricity have destabilised this foundation.

ENERGY SECURITY

Over the past 30-40 years energy security has become a serious concern for many governments. 1970 was the year that U.S. oil production peaked at 9.6 million barrels of oil a day, marking the moment when the country's dependency on foreign oil began its upward journey.[iv] Three years later, the world's major industrialised countries faced an oil crisis when the Arab members of OPEC proclaimed an embargo on sales of oil to certain Western nations. The Iranian Revolution soon followed in 1979, prompting further disruptions to the price of oil. These events pushed the global economy into recession for most of the decade. The return of relative oil price stability in the 1980s brought with it a temporary lull, but global sentiment shifted again in the 1990s when Russia began cutting off the supply of natural gas transported through Ukrainian pipelines to Europe.[v] This has since become a more frequent occurrence, with several disruptions occurring over the past ten years. Conflicts have simultaneously worsened in the oil rich Middle East, particularly in Iraq, Syria, Libya and Yemen, and also with the start of the "Arab Spring" in 2011.

Although oil is primarily used for fuel rather than power, these developments led governments to question more broadly whether they should continue to depend on other nations to meet their energy needs. Some countries responded by investing heavily in nuclear as an alternative power source. Others began looking for alternate options, given that not all had access to the technological know-how and capital needed to build nuclear plants; some also feared the low but nevertheless very serious risk of nuclear disaster.

ENVIRONMENTAL PROTECTION

Turning to environmental protection, the ability of the planet to absorb negative externalities has visibly declined. Air pollution in many cities has risen to dangerous levels, resulting in an increased incidence of asthma and other illness, in addition to the related issues of land and water pollution resulting from heavy metals released during coal combustion. Fast growing, fossil-fuel dependent emerging markets are experiencing the highest levels of air pollutants, giving rise to periods of so-called "airpocalypses" in countries such as China, India and Chile.[vi]

Diagram 3

Images of periods of "Airpocalypse" in India, China and Chile[vii]

The concentration of emissions in the atmosphere has also continued to rise. At current levels, we are likely to experience an average warming in global temperatures of 2-5 degrees Celsius by 2050. In order to limit the magnitude of this rise, the International Energy Agency estimates that emissions per unit of electricity would need to decrease by 90% versus current levels.[viii] Other carbon intensive industries, such as the transportation and industrial sectors, would also need to reduce their emissions levels.[ix]

GROWING DEMAND

Finally, in terms of meeting growing demand, governments are questioning how they are going to provide electricity to a global population that is projected to add two billion people over the next 35 years (with a high concentration of growth in South Asia and Africa). Moreover, as more people join the middle class and also move into cities, the demand for electricity on a per capita basis is also likely to rise.

Collectively, these concerns have converged into what has become known as the Global Energy Dilemma, which has subsequently set off a chain reaction of events in the policy, technology, business and consumer arenas.

Diagram 4

Global Energy Dilemma

Achieving the provision of secure, sustainable and affordable power in the face of issues around energy security, environmental protection and growing demand

ENERGY SECURITY	ENVIRONMENTAL PROTECTION	GROWING DEMAND
> Geopolitical tensions > Natural disasters > Price volatility	> Air pollution > Climate change	> Rapid population growth > Economic growth (expanding middle class and urbanisation)

IV. POLICY RESPONSE

In response to the Global Energy Dilemma, many governments have turned to renewable energy targets and competition measures in an effort to drive the industry towards the provision of more secure, sustainable and affordable power.

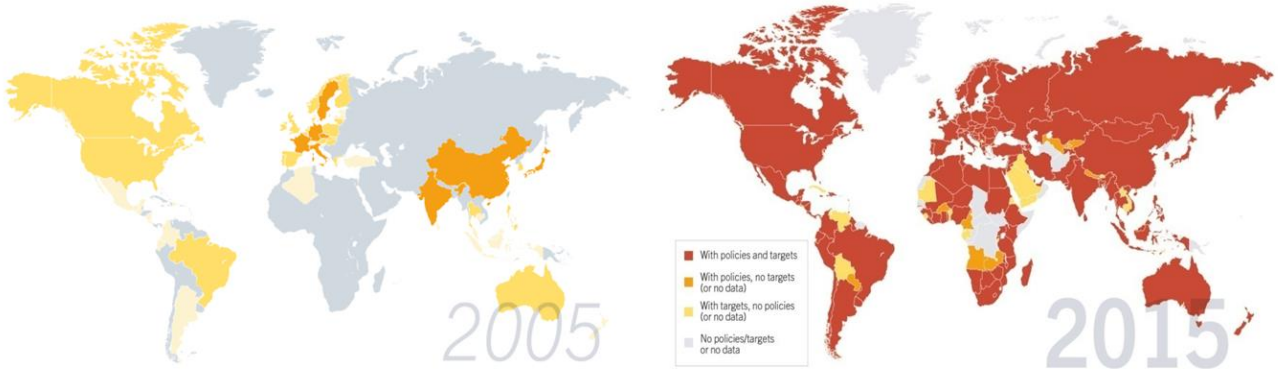
RENEWABLE ENERGY TARGETS

Renewable energy targets have been a favoured policy of many governments given that they address all three components of the Global Energy Dilemma: renewable energy is not only locally produced, but is also low in carbon emissions and increasingly affordable. It is therefore no surprise that over the past decade the number of countries with renewable energy policies has tripled from 48 to 164 (as illustrated in the graphic below).

Diagram 5

Countries with renewable energy policies[x]

2005 versus 2015



Many of the world's largest economies are leading the way in the adoption of these policies. For instance, in 2014 the Chinese government announced that by 2030 it intends to achieve its emissions peak and to raise the share of non-fossil fuels in primary energy consumption to 20%.[xi] In addition, in 2015 the leaders of the G7 countries (U.S., Germany, France, UK, Japan, Canada and Italy) collectively agreed to decarbonise the global economy over the course of this century. In alignment with this goal, they set a target of reducing emissions within a range of 40% to 70% by 2050 compared to 2010 levels.[xii]

COMPETITION MEASURES

The power industry, when left to its own devices, functions as a natural monopoly with single firms serving local markets.[xiii] This is due to the highly capital intensive nature of the transmission and distribution segment of the business, which gives rise to economies of scale. While the monopolistic structure has ensured a stable supply of power in many countries, it provides little incentive for producers to be energy and cost efficient. Furthermore, electric utilities have historically had little motivation to retain customers through lower prices, given that in most markets there has been no competition.

Liberalisation measures (sometimes referred to as deregulation) help to address inefficiencies in both the generation and retail segments of the business by opening up the market to competition. Although global markets are in different stages of the liberalisation journey, the industry as a whole is becoming more competitive. For example, the European Union began introducing measures in the 1990s. They included the removal of barriers that prevent alternative suppliers from importing or producing electricity and the lifting of restrictions that prohibited customers from

changing suppliers.[xiv] Around the same time, the Japanese government started taking steps to liberalise the country's regional monopolies. The Abe administration has since forged ahead, announcing plans to open the retail market to new entrants by 2016 and to spin off grid functions from power companies by 2020. While the majority of U.S. electricity markets remain regulated, many larger states have moved ahead with deregulation, including Texas, Illinois and New York.[xv] New York has been particularly ambitious in its move to unbundle the grid from the generation and retail segments and transform it into an open access platform, whereby many users—including new entrants—can offer products and services.

V. TECHNOLOGY RESPONSE

The policies described above are incentivising innovators to develop cheaper, cleaner and more efficient technologies, such as in the areas of renewable energy and the digitalisation of the grid.

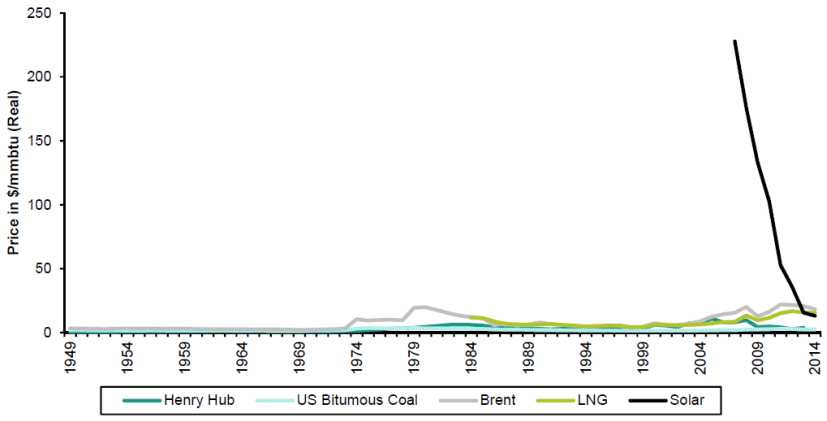
RENEWABLE ENERGY

The technological efficiency of renewables has increased greatly over the past decade. Onshore wind has reached parity with conventional energy in a growing number of markets, while solar has seen dramatic improvements, evidenced by the drop in the levelised cost of electricity[xvi] by 85% since 2007.[xvii]

Diagram 6

Price of fuel in USD per one million British Thermal Units[xviii]

Solar is rapidly becoming price competitive with fossil fuels



This significant cost-down curve has led to rapid adoption of both ground- and rooftop-mounted solar. Ground-mounted solar—or solar panels that are fixed to the ground using concrete bases or screws—is most typically used for large scale solar arrays. In contrast, rooftop-mounted systems are small in size with capacities in the 5-100 KW range. The electricity generated from these systems can either be used to power the underlying building or sold into the grid under an arrangement commonly referred to as "net metering". This development has led to the rise of "pro-sumers", or electricity users that both consume and produce power.

Diagram 7

Rooftop solar installation at a Wal-Mart store location[xix]

Commercial consumers of electricity have been amongst the first to embrace the title of "pro-sumer", as they have recognised the role that rooftop solar and other distributed energy resources can play in controlling costs and building their brands. For instance, in the retail sector, a growing number of large companies are optimising the space at their store locations by installing distributed energy resources to generate their own electricity. One example is the case of global retailer Wal-Mart. Wal-Mart promises its customers "everyday low prices", which require the company to aggressively control costs. Energy expense forms the second or third largest variable operating cost in each store location and also tends to be volatile. Wal-Mart has therefore been actively installing rooftop solar panels at its stores, as well as employing energy efficiency measures, towards a goal of meeting 100% of its future energy needs with renewables. Wal-Mart is now the largest rooftop solar operator in the U.S. with 105 MW in installed capacity.[xx] In the agriculture sector, some companies are taking this even further by going off the grid entirely. For example, a new entrant into the Australian horticultural market, Maria's Farm Veggies, is developing a potentially "carbon negative" 16 hectare high protected crop facility in New South Wales. The facility will employ off-grid rooftop solar to meet its heating and electricity needs and also sequester carbon to optimise indoor growing conditions. This structure is expected to give the company a significant advantage in a low margin business where energy spend would otherwise form a large portion of total variable cost. Today, we are also seeing the adoption of rooftop solar extend to the residential property market, particularly as the number of "solar-as-a-service" companies grows (as discussed in the next section).

While there are still many challenges ahead for the widespread adoption of renewable energy, technological developments have helped the industry to overcome many of them, paving the way for continued and accelerating advances.

DIGITALISATION OF THE GRID

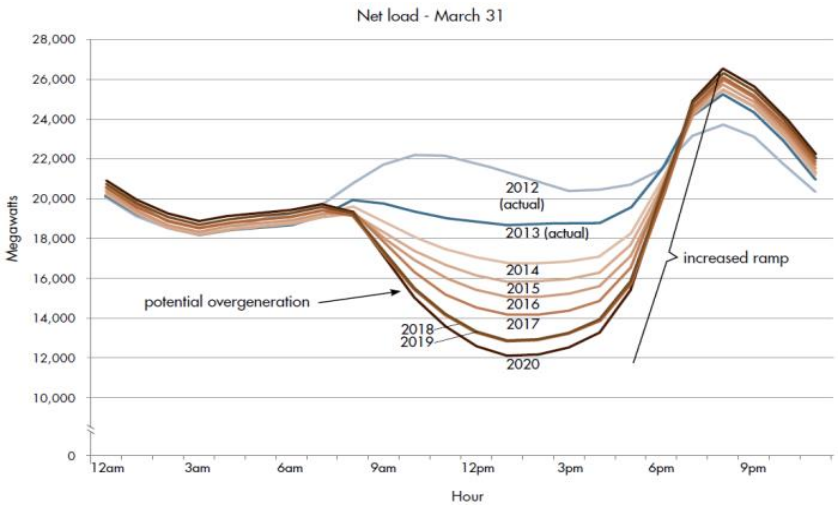
The Digital Revolution has given rise to the "Internet of Things" where everyday objects have network connectivity, enabling them to send and receive data. The power industry is rapidly becoming part of this transformation with the development of the "smart grid". This term refers to the integration of digital technologies (e.g. computers, sensors and automation tools) into the physical grid infrastructure (e.g. cables, substations and transformers) in order to produce real-time data and analytics on the flow of electricity. This in turn introduces intelligence into the management of energy demand.

Smart grids have many possible applications, such as speeding the integration of renewables into the grid and generating high frequency data on electricity usage. In terms of renewables, smart grids can help to manage the fluctuating supply of power from intermittent wind and solar sources. Specifically in the case of solar, supply is strongest during the day and then drops rapidly in the evening, precisely when the demand for electricity peaks. This creates a supply/demand mismatch, requiring production from other generating sources and/or storage to cover it. The below graph—commonly referred to as the "duck chart"—illustrates just how significant this mismatch can be. The "neck" of the duck is the period in which other generating sources must quickly come online. Smart grids allow grid operators to more effectively manage these risky ramp-up periods by reporting disturbances in real-time and facilitating the use of electrical energy storage capabilities.

Diagram 8

Load / generation mismatch in California[xxi]

The need for a ramp up of back-up capacity when solar output drops causes grid disturbances

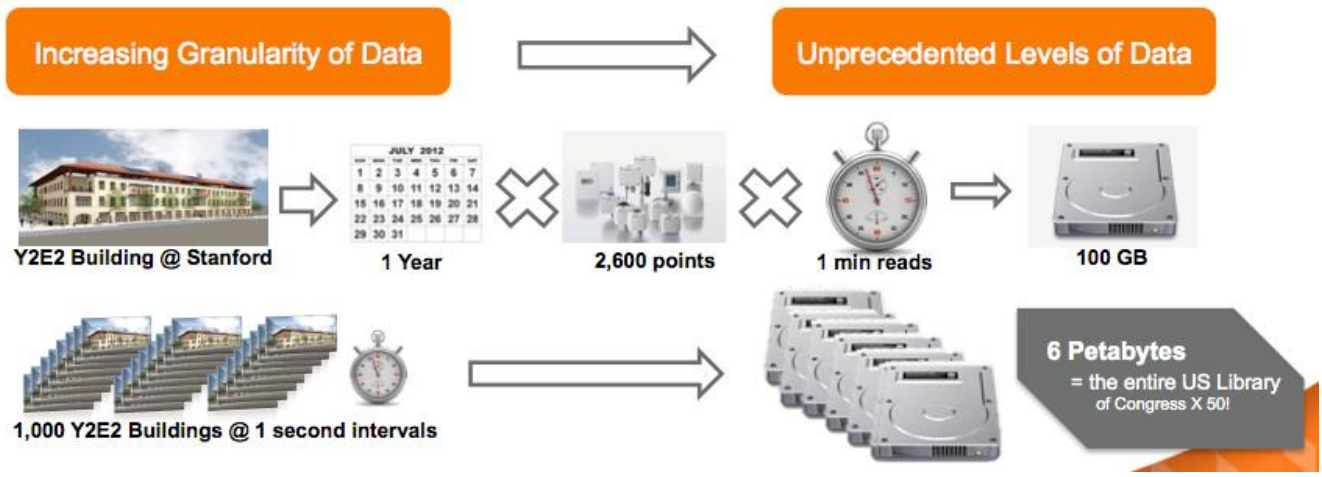


In addition, smart grids provide operators with more control over numerous and distributed points of generation. This is critical in the integration of power from variable renewables. Compared to conventional generating sources, wind farms and solar arrays have smaller capacity sizes and are located in more remote areas where wind and insolation conditions are most favourable. Smart grids allow operators to communicate in real time with these otherwise isolated locations.

Turning to data, smart grids are also capable of providing the industry with an unprecedented depth and breadth of information on electricity usage. A core component of smart grids are smart meters, which record electricity consumption in intervals of an hour or less and send that information back to the retail company for monitoring and billing. As smart meters are deployed in mass volume, the number of connections and the amount of data collected will multiply rapidly.

Diagram 9

Explosion of data in the smart grid[xxii]



The resulting two-way exchange of data between electricity providers and consumers could give rise to significant cost savings. Smart grids are able to send time-based prices to consumers' electric devices, such as smart home appliances and heating/cooling systems, which are connected to digital energy management

Diagram 10

In the future home owners will centrally control their electrical appliances in order to maximise energy and cost efficiency

systems. End-users with these systems in place can manage all of their electric devices through a centralised platform (typically by using an app on a smart phone) to maximise energy savings and cost efficiency. For instance, consumers could programme their heating/cooling units to turn off for 15 out of every 60 minutes when the price per hour goes beyond a certain threshold, or limit their use of washing machines to times of low demand, when the price of electricity is cheaper.

Overall, we view smart grids as having the potential to transform all segments of the power industry. Within generation, they are speeding the integration of renewables; in terms of the grid, they provide operators with greater precision and control; and lastly, in the retail segment, they are changing the way that consumers dynamically manage their electricity usage.

VI. BUSINESS AND CONSUMER RESPONSE

In order for the industry to fully capitalise on the enormous potential inherent in both the policy incentives and technological advances described above, it will require new retail strategies that provide businesses and consumers with a broader set of products and services.

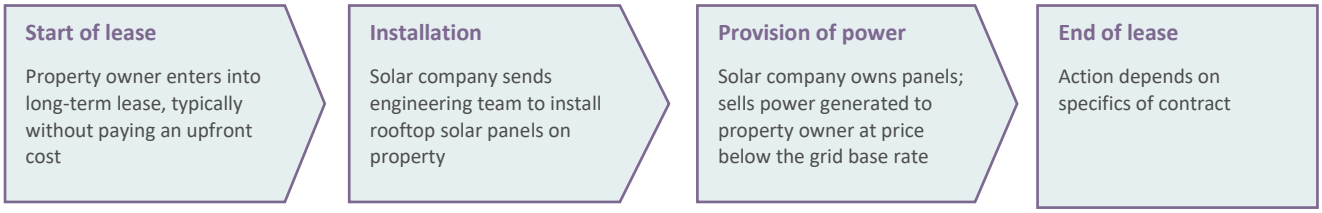
SOLAR-AS-A-SERVICE MODELS

As mentioned above, developments around rooftop solar (and other distributed energy resources) have enabled electricity users to become "pro-sumers". We are now seeing business model innovation, in the form of solar-as-a-service models, enabling the number of "pro-sumers" to reach meaningful scale in both developed and developing markets.

In developed markets, the solar-as-a-service model is based on fixed term lease agreements, as outlined in the diagram below. Companies that have pioneered this model include SolarCity, Sunrun, Sungevity and SunPower, among others.

Diagram 11

Solar-as-a-service business model for developed markets



In years to come, we expect the solar-as-a-service model to gain popularity as electric storage batteries become more widely available and as more consumers also become electric vehicle owners. The combined offering of electricity from rooftop solar panels, electrical vehicle ownership and battery storage may be considered a luxury today, but it is becoming increasingly affordable. For instance, Tesla Motors shortly aims to release a lower cost electric vehicle ("Model 3") and an economical home battery ("Powerwall") that is expected to work in conjunction with rooftop solar, which it offers through its partner SolarCity.[xxiii] SunPower, Ford and the Sierra Club have also teamed up to create a similar product offering.[xxiv]

Diagram 12

Rooftop solar, electric vehicle and battery service offerings[xxv]

Overall, we believe that the solar-as-a-service model presents a serious threat to traditional electric utility companies, as it allows new entrants to compete directly in the generation business (as off-grid means less demand for on-grid power) and the retail business (as every rooftop solar adopter is a customer lost from a service perspective). One provider, SolarCity, estimates that the size of its addressable market in the U.S. alone is USD 60 billion, with the potential to grow to up to USD 140 billion should its costs continue to fall as expected.[xxvi] In an attempt to discourage this growing trend, some electric utilities are fighting regulatory and legislative battles to impose taxes (or "fees") on rooftop solar panels and/or discriminatory low rates paid to "pro-sumers" for the electricity they sell back into the grid.

Diagram 13

Solar-as-a-service business model for developing markets

Start of pay-as-you-go contract

Customer enters into pay-as-you-go contract and make initial payment for "solar kit"

Provision of power

Customer uses mobile phone to pay for power when needed; receives code via SMS that unlocks a certain amount of time

End of lease

Customer typically becomes owner of the kit, gaining unlimited access to power

Diagram 14

Example of components of a basic "solar kit"

In the developing world, a variation on the solar-as-a-service model, known as "pay-as-you-go solar", is gaining significant traction, especially in areas where electric grids are weak or nonexistent. For instance, companies such as M-Kopa and Off-Grid Electric are implementing this model in parts of Sub-Saharan Africa and South Asia, including India.[xxvii] In these areas, households that are not connected to the electric grid rely primarily on kerosene lanterns for light. Although the purchase price of lanterns is low, they ultimately trap families into cycles of poverty due to the relatively high cost of kerosene over time.[xxviii] In addition, families are subject to toxic smoke inside their homes, the high risk of fires and poor quality of light. "Pay-as-you-go solar" goes a long way to address these challenges by providing a cheaper, cleaner and higher quality alternative.

This model is opening the door for a leapfrog moment potentially akin to the one that occurred in the early 2000s when millions of people started using mobile phones in areas lacking land-line telephone grids. In a similar way, solar kits could eliminate the market for electric grid extensions in underserved areas.

CUSTOMER-CENTRIC MODELS

In our view, electric utilities have traditionally undervalued customers as assets as a result of the monopolistic and regulated nature of the industry. However, with the

spread of renewable energy now taking revenue away from conventional generation assets and liberalisation policies opening the door for more competition, the perception of electric utilities is changing. Many are coming to realise that they must either reshape their retail businesses into customer-centric models or risk losing customers to new entrants. The "Big Six" electric utilities in the UK recently learned this lesson when independent provider Ovo Energy entered the market and began offering "cheaper, greener, simpler" energy in conjunction with a national marketing campaign in 2014. Ovo has subsequently captured over 450,000 electricity customers.[xxix]

In response to heightened competition, some incumbent players are bolstering their service offerings with the help of outside providers. For instance, 95 electric utilities across several major markets are now collaborating with software-as-a-service provider, OPower.[xxx] Companies that use OPower software are able to provide customers with tools that give them greater transparency into the efficiency of their usage—including more informative bills, access to online/mobile platforms and more engaging customer care. This in turn helps consumers to save on their electricity bills, which supports their retention.

On the whole, the rise of the "pro-sumer" and the digitalisation of electric devices is opening the door for electricity providers to offer customers a full suite of services. We believe that this is an area of enormous potential for value creation that both incumbents and new entrants will continue to tap into over the years to come.

VII. OUTLINE OF A FUTURE INDUSTRY MODEL

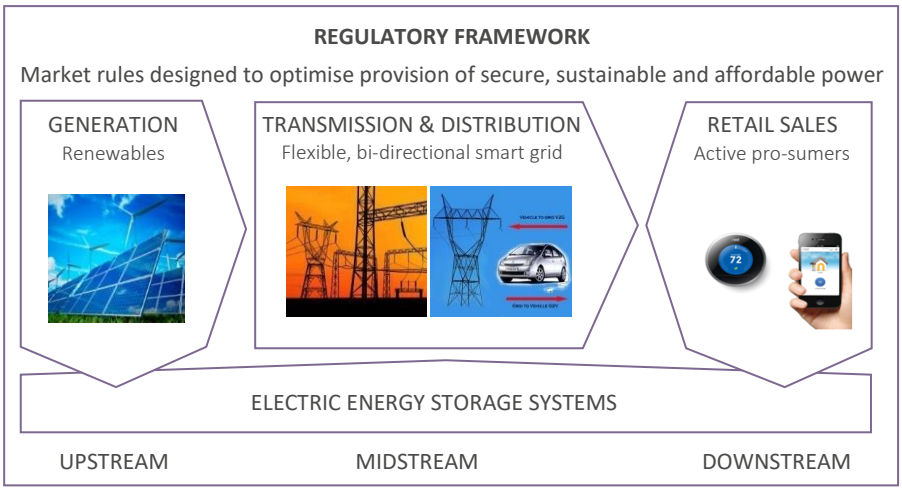
The chain reaction that is playing out in the power sector has led to the emergence of new industry models that seek to optimise the provision of secure, sustainable and affordable electricity. In doing so, these models reconcile the previously competing goals of reduced emissions, lower operational costs, greater system flexibility and increased customer satisfaction.

While future models will differ by market, we anticipate that most will share the following characteristics: new generation primarily from renewable sources, transmission and distribution along flexible, bi-directional smart grids, retail sales that cater to active "pro-sumers" and greater use of electric energy storage capabilities.

Diagram 15

Future industry model

Bi-directional smart grid designed to deliver electricity generated from renewable sources to active "pro-sumers"

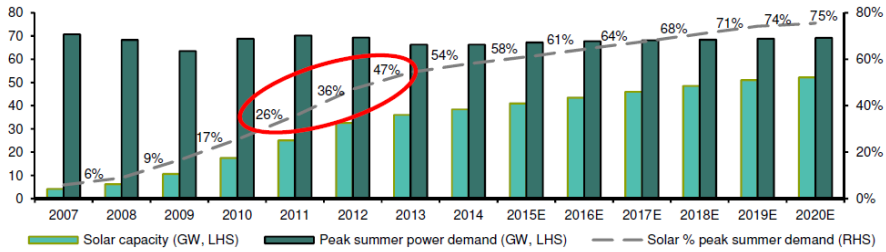


It is important to note that we do not expect the transition to this type of model to unfold in a uniform or smooth fashion across geographies or business segments. The case of Germany versus California in the integration of renewable energy into the power supply illustrates just how divergent the experiences of different markets can be.

In Germany, the desire for energy security and reduced emissions drove the government to enact the Renewable Energy Sources Act in 2000 (amended in 2004) based on the three principles of: i) investment protection through guaranteed feed-in tariffs and connection requirements, ii) no impact on the German public purse (i.e. the cost of the incentives is passed directly on to the consumer instead of paid for through tax subsidies) and iii) innovation through feed-in tariffs. This act set off the aggressive rollout of renewable technologies. The impact of these measures is evident in the chart below, which shows the growth of installed solar capacity relative to peak power demand in summer months. Over the last decade, capacity has increased from less than 5% to nearly 60% of peak demand.[xxxi]

Diagram 16

Solar capacity is shaving peak demand for traditional centralised power in Germany[xxxii]



While the transition to renewable power has taken place at an impressive speed, it has also inflicted considerable pain on German electric utilities with extensive fossil fuel generating assets. The reason for this is that in Germany, electricity is typically much cheaper from renewable energy sources than from fossil fuel and nuclear plants.[xxxiii] As a result, when the share of renewables in the generating mix increases, the average price per kilowatt hour decreases significantly. German electric utilities have therefore not only lost revenues from reduced fossil fuel production, but also from the overall lower average price of electricity. As a consequence, in 2014, the country's largest electric utility, E.ON, announced that it would spin off its entire

portfolio of fossil fuel plants and recognise billions of euros in impairment charges.[xxxiv]

In the case of California, although there has also been a strong move towards renewable energy (particularly solar), the experience of local electric utilities, such as PG&E, has been very different. This is due to the fact that they operate in a regulated market where they benefit from a "decoupling" scheme. Under decoupling, electric utilities are made whole for any gap in their actual revenue from production versus preset target revenues. Therefore, in spite of declining retail sales from conventional power, Californian electric utilities have been able to maintain a steady revenue stream.[xxxv] However, there is no guarantee that this measure will remain in place over the long-term. Should the steady adoption of solar continue, the state government may reach a point where it finds that it is no longer desirable or feasible to keep decoupling in place. It is therefore not out of the question that California's electric utilities could face similar challenges to their German counterparts.

In our view, this case illustrates that although markets are headed towards a similar future model, their experiences getting there are likely to vary widely, due to nuanced yet significant differences in market designs.

Although markets are headed towards a similar future model, their experiences getting there are likely to vary widely, due to nuanced yet significant differences in market design

VIII. INVESTMENT IMPLICATIONS

The power industry is fundamentally changing due to a chain reaction of events. In the face of the Global Energy Dilemma, government leaders have advanced policies that encourage the use of renewable energy and foster competition. Innovators have responded with cost-competitive renewable technologies and tools for digitalising the grid. New business strategies are coming into place, enabling the industry to capitalise on these advances. Consumers in response are changing their behaviour. Taken together, these forces are driving the industry towards a new model.

Although we believe that the direction of change is clear, other factors remain uncertain. For instance, we do not yet know the specific path and pace of change that each market will adopt. We also do not know whether traditional electric utility companies will successfully transition to this future model or whether a set of disruptive new entrants will rise to the top. In addition, it also remains to be seen what the knock-on effects will be on other industries.

Against this backdrop and from an investment perspective, we favour companies that are developing solutions in the following three areas:

Diagram 17

Three areas where companies are developing attractive solutions

DIGITAL ENERGY	CUSTOMER SERVICE	RENEWABLE ENERGY
Products and services that unlock the value inherent in the large amounts of data generated by connected devices and transmitted through smart grids	Tools that enable businesses to tap into the latent value of electricity consumers/"pro-sumers"	Solutions that aid in growth of generating assets or facilitate their integration into the grid, particularly by lessening reliance on fossil fuel back-up power, enhancing stability and/or reducing price signal distortion

We also seek to avoid investments in traditional electric utility companies, given that they are exposed to significant stranded asset risk.[xxxvi] The industry will need to steadily shed its fossil fuel assets over time, as producers continue to shift from fossil fuel to renewable energy generating sources. Should this transition take place at a faster pace than expected, numerous fossil fuel plants will not remain in operation through their "useful lives". Once these assets become "stranded", electric utilities will be forced to recognise impairment charges on their balance sheets, much like E.ON did in 2014.

Traditional players could find themselves subject to the "innovator's dilemma", wherein the very practices that have made them successful become responsible for their downfall

In addition, many traditional players could find themselves subject to the "innovator's dilemma" wherein the very practices that have made them successful become responsible for their downfall. Such practices include allocating capital to projects with known markets and accretive profit margins in the short-term, instead of allocating to disruptive ideas. They also include catering to the needs of customers (and investors) today, as opposed to anticipating their future needs.[xxxvii] Blockbuster, Kodak and Sears are three classic examples of industry leaders that succumbed to the innovator's dilemma. All were eventually overtaken by disruptive new entrants that were not subject to the same internal constraints. Although we do not expect this to be the fate of all electric utilities, those that resist adapting their businesses to the future model risk losing market share.

In line with this view, we would encourage investors to examine the exposure that they have to traditional electric utility companies in their portfolios, particularly those that are managed against broad equity and fixed income benchmarks. While the power industry has already absorbed some of the negative price impact of the transition, further adjustments are likely.

Finally, we seek to understand the ways in which transformational change in the power industry is impacting related industries. So far, we have seen notable secondary effects in the following areas:

Diagram 18

Secondary effects of changes in the power industry

TECHNOLOGY

- Adoption of renewables is shifting generation from infrastructure to technology sector
- Software providers are focusing on extracting value from digital energy

AUTOMOBILES

- Rapid spread of rooftop solar is paving way for adoption of electric vehicles, as they are increasingly able to run on cheaper and cleaner solar power

FINANCIAL SERVICES

- Energy services are being offered in conjunction with financial services, such as solar-as-a-service models; users are developing credit history as a result

RETAIL

- Retailers are increasingly turning to distributed energy resources to control costs while leveraging underutilised space

Overall, we believe that our broad sustainability lens remains key to understanding the deeply complex nature of these changes. We are enthusiastically investing in companies that we think will capitalise on the opportunities that arise from a global power industry in transition.

---

[i] Although Generation seeks to provide superior investment performance, this is an aspiration and there is no guarantee.

[ii] U.S. Energy Information Administration. "International Energy Statistics," 2012. www.eia.gov/cfapps/ipdbproject/IeDIndex3.cfm?tid=2&eyid=2012&syid=2012&reverseAxes=0&cid=&cid=ww&pid=alltypes&aid=12&unit=BKWH&updateB=UPDATE; Stern Review. "Stern review: the economics of climate change executive summary." Accessed on 29 July 2015. www.wwf.se/source.php/1169157/Stern%20Report_Exec%20Summary.pdf

[iii] Transmission refers to the higher voltage lines that connect power plants to distribution lines; distribution refers to the lower voltage lines that connect transmission lines to the points of end use

[iv] Even though the more recent revolution in shale oil and gas has caused production to rebound, it has not yet surpassed this peak level

[v] European Council of Foreign Relations. "The role of Russian gas in Ukraine". 16 April 2014. www.ecfr.eu/article/commentary_the_role_of_russian_gas_in_ukraine248

[vi] Financial Times. "A year in a word: Airpocalypse – China is getting airy ambitions." 30 December 2013. www.ft.com/cms/s/0/a5553e6a-671f-11e3-a5f9-00144feabdc0.html#axzz3hHBf0TkG

[vii] Image on left: India Gate monument in New Delhi, India, enveloped by a blanket of smog. India Get Green Blog. Accessed on 17 July 2015. http://indiagetgreenblog.com/2013/05/10/green-article-conserve-resources-please-do-it/the-india-gate-monument-in-new-delhi-india-enveloped-by-a-blanket-of-smog/; Image in middle: China's smog hits new highs (and lows). ZDNet. 14 January 2013. www.zdnet.com/article/chinas-smog-hits-new-highs-and-lows; Image on right: A general view of the Chilean capital Santiago under a heavy layer of smog during a fall day. REUTERS/Ivan Alvaradoon. 2 June 2011. www.trust.org/item/20140927000016-jx232

[viii] IEA, "Energy Technology Perspectives 2014: Executive Summary". Accessed on 23 July 2015. www.iea.org/Textbase/npsum/ETP2014SUM.pdf

[ix] U.S. Environmental Protection Agency. "Sources of Greenhouse Gas Emissions." Accessed on 17 July 2015. www.epa.gov/climatechange/ghgemissions/sources/industry.html

[x] Renewable Energy Policy Network for the 21st Century. "Renewables 2015 Global Status Report." Accessed on 17 July 2015. www.ren21.net/wp-content/uploads/2015/06/GSR2015_KeyFindings_lowres.pdf

[xi] The White House Office of the Press Secretary. "Fact Sheet: U.S.-China Joint Announcement on Climate Change and Clean Energy Cooperation." 11 November 2014. www.whitehouse.gov/the-press-office/2014/11/11/fact-sheet-us-china-joint-announcement-climate-change-and-clean-energy-c

[xii] Financial Times. "G7 leaders agree to phase out fossil fuels." 8 June 2015. www.ft.com/cms/s/0/ec2c365a-0ddf-11e5-aa7b-00144feabdc0.html#axzz3eBV3Rlj5

[xiii] Stanford University. "Benefits, exceptions and ethics: Natural monopolies." Accessed on 30 July 2015. http://cs.stanford.edu/people/eroberts/cs181/projects/corporate-monopolies/benefits_natural.html

[xiv] European Commission. "Energy and environment: overview." Accessed 17 July 2015. http://ec.europa.eu/competition/sectors/energy/overview_en.html; Energy Smart. "Regulated and Deregulated Energy Markets Explained." 27 June 2014. www.energysmart.enernoc.com/regulated-and-deregulated-energy-markets-explained/

[xv] U.S. Energy Information Administration. "Status of Electricity Restructuring by State." September 2010. www.eia.gov/electricity/policies/restructuring/restructure_elect.html

[xvi] The Levelised Cost of Electricity is a cost metric that takes into account the cost of a plant over its lifecycle including resource quality, equipment cost and performance, projects costs, fuels costs, operation and maintenance costs, the economic lifespan of the project and the cost of capital.

[xvii] Bernstein. "Asia Strategy: Shouldn't we all be dead by now?" May 2015.

[xviii] Idem

[xix] Solar City. "Wal-Mart raises the bar for businesses to 'Go Solar'" Accessed on 30 July 2015. www.solarcity.com/commercial/commercial-solar-projects/walmart

[xx] Wal-Mart. "Walmart Builds on Leadership of Commercial Solar Deployment and Expands On-Site Solar Energy Projects". 20 November 2014. http://news.walmart.com/news-archive/2014/11/20/walmart-builds-on-leadership-of-commercial-solar-deployment-and-expands-on-site-solar-energy-projects

[xxi] Greentech Media. "California's fowl problem: 10 ways to address the renewable duck curve." 14 May 2014. www.greentechmedia.com/articles/read/10-ways-to-solve-the-renewable-duck-curve

[xxii] Autogrid Systems. "Data deluge in the energy industry." Accessed on 17 July 2015. www.auto-grid.com/technology/the-energy-data-deluge/

[xxiii] Tesla. "Tesla Energy." Accessed on 17 July 2015. www.teslamotors.com/en_GB/presskit

[xxiv] Huffington Post. "Powering Cars with Sunshine." 19 November 2014. www.huffingtonpost.com/gina-coplonnewfield/powering-cars-with-sunshi_b_6187966.html

[xxv] Idem; Tesla. "Tesla Energy." Accessed on 17 July 2015. www.teslamotors.com/en_GB/presskit

[xxvi] Based on blended contract prices of USD 0.13 kWh (current) to USD 0.10 kWh (projected). SolarCity. "Investor Presentation." May 2015. http://files.shareholder.com/downloads/AMDA-14LQRE/454936036x0x830612/1A32ABBC-4024-44B9-8F81-1B5BD77DD00B/2015.05_SCTY_Investor_Presentation.pdf

[xxvii] Scientific American. "Pay-as-You-Go Solar Energy Finds Success in Africa." 22 November 2013. www.scientificamerican.com/article/pay-as-you-go-solar-energy

[xxviii] The Guardian. "Cheap coal is a lie – stand up to the industry's cynical fightback". 16 April 2015. www.genfound.org/media/pdf-Cheap-coal-is-a-lie-stand-up-to-the-industry-cynical-fightback-Guardian-OpEd-16-04-15.pdf

[xxix] Ovo Energy, "Now let's get competition working for UK energy customers". 12 May 2015. www.ovoenergy.com/press-releases/2015/05/get-competition-working-for-uk-energy-customers/

[xxx] OPower. "OPower expands platform to address customer care." 18 February 2015. http://opower.com/company/news-press/press_releases/117

[xxxi] Bernstein. "Solar, Storage and the Future of Power". 29 June 2015.

[xxxii] Idem

[xxxiii] Idem

[xxxiv] Financial Times. "Eon to spin off its fossil fuel assets as big losses loom." 30 November 2014. www.ft.com/cms/s/0/9c358caa-78cf-11e4-b518-00144feabdc0.html#axzz3hNMMRMPM

[xxxv] Center for Climate and Energy Solutions. "Decoupling in detail". Accessed on 30 July 2015. www.c2es.org/us-states-regions/policy-maps/decoupling/detail

[xxxvi] Generation Foundation. "Stranded carbon assets: Why and how carbon risks should be incorporated in investment analysis." 30 October 2013. https://www.genfound.org/media/pdf-generation-foundation-stranded-carbon-assets-v1.pdf

[xxxvii] Christensen, Clay. "The Innovator's Dilemma: When New Technologies Cause Great Firms to Fail," 1997, 2000; Boston, Massachusetts: Harvard Business Review Press.