Flip the Switch

A guidance note for those effecting change in energy utility companies

Purpose

This guidance note has been developed to support energy utility companies in developing transition plans to a clean energy power system, and for asset owners, asset managers and other stakeholders to understand those plans and the risks and opportunities they imply. The transition to a clean power system must occur by 2050; transition plans provide companies and their investors a shared basis of understanding for how the utility company will chart its path through the coming energy transition.

> ***'When the rate of change on the outside is greater than the rate of change on the inside, the end is near.'***
>
> ***Jack Welch, former CEO GE***

We suggest a rolling five-year business plan and a strategic transition plan with the following five goals:

- *A highly distributed clean energy power system (95% non-fossil fuel generation) by 2050.*
- *Emissions of 184g/kWh across all generation sources by 2035 (IEA target for the world consistent with achieving warming of no more than 2°C), or the locally relevant equivalent, whichever is lower.*
- *A high level of customer satisfaction as the business evolves.*
- *A CEO and executive succession plan requiring strategic leadership capacity to drive the clean energy power transformation, and a remuneration strategy consistent with the transition.*
- *Demonstrated ROIC>WACC over the plan period, taking account of the life cycle of each asset and all attributable costs over the life cycle.*

This note gives an overview of:

Change on the outside: The considerable structural changes facing energy utility companies, arising from technological change and associated new entrants, and climate-related regulation, with air pollution an increasingly strong driver of change.

Change on the inside: What energy utility companies should include in short-term business plans and strategic transition plans to reach the 2035 and 2050 goals. Profound internal changes will be needed to flourish in an operating environment that is very different from the stable, highly regulated utility of the past, which:

- depended mostly on fossil fuels
- centralized transmission and delivery

- enjoyed high barriers to entry
- produced electricity that was consumed immediately.

The guidance does not prescribe which fuel strategies or business models should be deployed to reach these goals. The targets will present very different challenges to different utility companies and each will need to find its own path.

About Preventable Surprises

Preventable Surprises (www.preventablesurprises.com) is a 'think/do' tank aiming to shift investors towards a more proactive role in anticipating crises in the global financial system and helping to prevent them. Our climate initiative focuses on the climate-related systemic risks that investors face across a diversified investment portfolio, which cannot be avoided by hedging or stock picking. We encourage investors to exercise forceful stewardship by voting for AGM resolutions requiring the companies they own to develop, disclose, and subsequently implement transition plans that reduce emissions in line with <2C° of global warming.

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None of them should be held responsible for, or deemed to agree with, this guidance note in its entirety. Organisations are listed for identification purposes only.

Introduction

Some time before 2035 the environment in which electric power utilities operate will change rather fast. Recent changes in political leadership in Washington in the USA may cause a short-term delay, but the science of climate change does not follow voter sentiment. The principal driver will be the much lower cost of energy storage, integrated with the falling costs of renewable energy, smart grid management, and other low GHG (greenhouse gas) power sources such as hydro and next generation nuclear power. This will have a quadruple effect of:

- enabling rapid growth of renewable power as the dominant part of the fuel strategy, and the smart grid for power transmission and delivery.
- enabling households, communities and businesses to become wholly or partially independent ('prosumers').
- substituting battery power for certain grid services such as cold start.
- accelerating the market penetration of electric vehicles.

At some point, alternative power supply opportunities for customers will become so attractive that incumbent power utilities' attempts to block them will fail. More progressive countries will have a knock-on effect in countries where corporate capture of regulators has slowed change.

In addition to the aforementioned fundamental changes, regulatory and consumer responses to climate change will upend BAU models. Regulators must ensure affordable and secure power while meeting their country's commitments agreed in Paris in 2015. As targets can only be made more, not less, stringent, due to the five-year ratcheting provision, we assume that targets will over time exceed Paris commitments (which would limit warming to only around 3°C) and converge on the IEA 2035 2°C target. The 2035 target entails energy utility GHG emissions not exceeding 184g/kWh, with the 2050 goal dropping to 40g/kWh.[1] National carbon pricing may drive change in some jurisdictions, and needs to be kept in view, but it cannot be relied on across the board. In addition the regulator's role will transform to regulating the market conditions for a larger number of suppliers (see below.)

Consumers, particularly millennials, may begin to take a close interest in the social and environmental impact of their electricity supplier. Air pollution is being recognised as a major public health challenge. Around 6.5 million deaths are attributed each year to poor air quality, making this the world's fourth-largest threat to human health, behind high blood pressure, dietary risks and smoking. Of these, about 3 million are attributed to oil and coal consumption in power utilities, industry and vehicles. Air quality is already driving a shift to clean power in China – India is likely to follow at some point. Governments are facing litigation from their failure to deal with air pollution, and health

1 Energy, Climate Change and Environment 2016 Insights IEA 2016

professionals are becoming actively involved, 'battle ready' from their experience of dealing with the tobacco lobby.

Concurrent changes sweeping through the sector include:

Technological developments: smart meters, smart grids, small modular nuclear reactors (SMRs technology), which is next-generation nuclear power.

New practices: Time-based tariffs, time-zone shifting.

New entrants: Pure-play solar, wind, wave, and storage technology companies; other utility providers, e.g. telecoms, cooling services for data farms, and automotive and data companies.

> 'The paradigm shift in the sector, with higher and more evenly spread value across the value chain, seems irreversible. The identified upside will be tough for incumbent utilities to capture, and it is rather unlikely that they will all be able to take part.'
>
> Beyond the storm—value growth in the EU power sector, McKinsey&Company, 2014

To protect the interests of all stakeholders, it is essential that utilities effect change on the inside—the transformation of the energy utility business model and strategy—that at least matches the pace of change on the outside. Whilst new U.S. leadership is likely to do what it can to slow the progress of clean energy, other nations, including China and Saudi Arabia have already said that this will not affect their commitments and plans.

This guidance note is intended to support companies in developing business model transformation strategies and transition plans to a <2°C warming world, and to assist institutional investors and other financial system stakeholders in effectively reviewing those strategies and plans, innovation opportunities, and risks in creating long-term economic value and shareholder wealth. The aim is to ensure that companies make the required transition, and investors fulfil their fiduciary responsibility to protect their diversified investment portfolios from the systemic risks associated with climate change and anticipated regulatory changes. *How companies make the transition is up to them.*

While some investors will wait for clear regulatory or pricing signals, we believe this is both irresponsible and short sighted, for the reasons given above. Through this guidance note, we highlight another way for investors to fulfil their fiduciary responsibilities.

Scenarios are not enough. Investors need to track progress against a clear strategy and related milestones. Given the level of uncertainty from so many factors, we suggest that investors ask companies to outline one or more scenarios for 2035 and 2050 under which they will be meeting the IEA targets, and then plan in detail on a rolling five-year basis as to how they will reach their 2035 and 2050 goals. Tools should be used to provide metrics and milestones to enable investors to assess progress, e.g. the Transition Pathway Initiative soon to be released by the Church of England Pension Boards and the Assessing Low Carbon Transition project http://actproject.net.

The rest of this note is structured as follows:

Change on the outside

Climate change regulations and emissions targets

Demand for electricity

- *Electric vehicles*
- *Energy efficiency*

Supply of electricity

- *'Prosumers'*
- *Grid level renewables*
- *Battery power for grid level services*

Regulatory environment and other external factors

Change on the inside

Developing a transition strategy

- *Business planning assumptions*
- *Competitive positioning, risks, capex*
- *Forecast end state(s) in 2035*

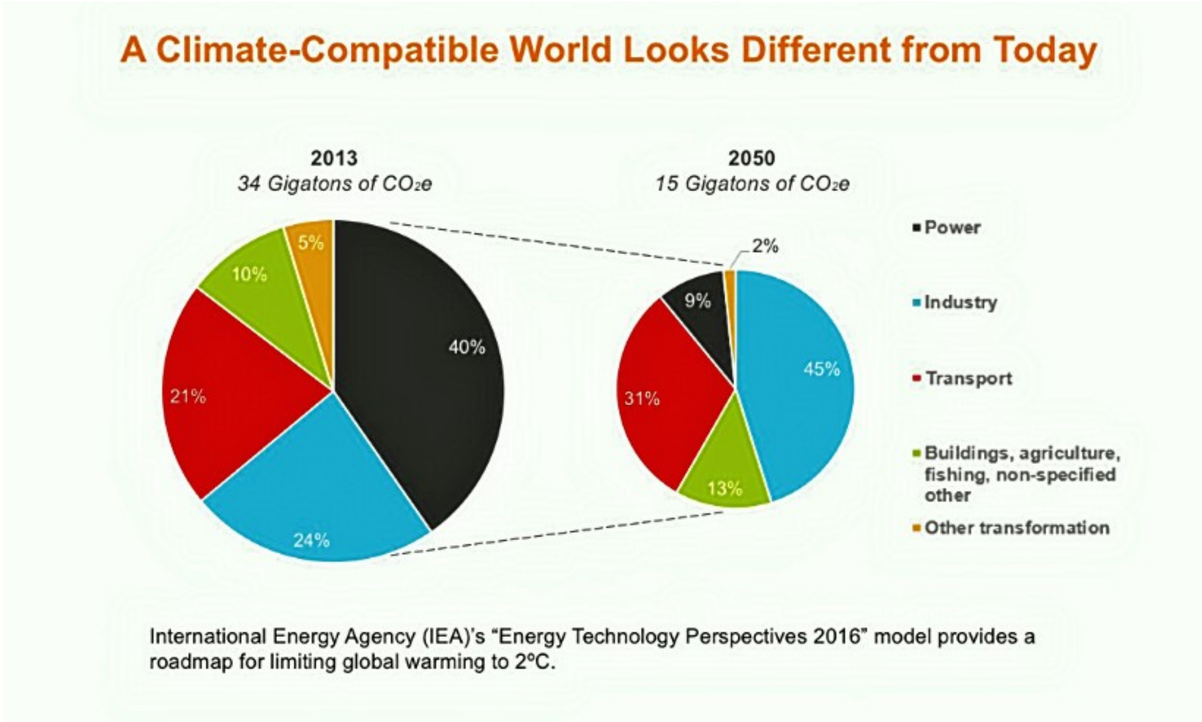
Implementing a transition strategy

- *Governance (including board & executive recruitment, performance metrics, remuneration design and lobbying)*
- *Risk*
- *Other metrics*

Change on the outside

Climate change regulation and emissions targets

Figure 1



Source: International Energy Agency

It is clear from this graphic that the power utility sector (black) needs to do the largest share of the 'heavy lifting' in order to limit global temperature rise to 2°C. Fortunately this is both possible, and if handled right, will have desirable consequences for users of electricity (most predictions are that prices will fall, as the power system will be more efficient) as well as offering opportunities for utility companies to reduce costs and provide more profitable added-value services. It is also good news for the workers in this sector because there are, in well-led companies, strong reasons for thinking a "just transition"[2] is possible.

However, making the transition will not be easy and the longer boards and senior executives delay, the less likely it will be that these companies will survive. Regulators will need to be nimble and make good judgements if incumbents are to be provided with a route to survival and profitability while allowing for new entrants to take advantage of new technological and market opportunities. Incumbent utilities will need to take calculated risks and to pilot new technologies, generation, and grid systems. Investor support will be important, as returns on capital in the near term will need to be sacrificed for investments to drive business model transformation for long-term survival and growth. Hence, investors need to be "tough friends and stewards of

[2] http://bteam.org/announcements/sharan-burrow-paris-agreement-promises-a-just-transition/

assets"—incrementalist 'asks' (e.g. 2°C stress tests) will turn out to be falsely supportive.

To meet the goal of an increase in global temperature of no more than 2°C, transition plans should be designed to achieve, by 2035, an overall emissions target across the whole of the utility's activities of not more than 184g carbon dioxide/kWh or the locally determined equivalent, whichever is lower. This is the IEA's global recommendation in order to achieve the Paris Agreement to limit the rise in overall global temperature to not more than 2°C. It covers Scope1 emissions only.

Beyond 2035 progress will need to accelerate to reach the IEA target of 40 g/kWh by 2050. For the purposes of this guidance note, we recommend plans focus on two major waves of innovation and business model transformation. Up to 2035, the transition strategy should rely only on proven fuel strategies and technologies. From 2035 to 2050 it is appropriate to outline key business strategies, new technologies, and investment assumptions to further transform to clean energy power systems, given the long lead time for transformation.

Since utilities are generally regulated by a national or state/provincial regulator, the targets set locally are also relevant. Recent announcements include[3]:

Table 1

United States	32% cut in electricity emissions by 2030 compared with 2005
Canada	30% cut in electricity emissions by 2030 compared with 2005
Germany	40% cut in emissions by 2020 compared with 1990
Japan	26% cut in emissions by 2030 compared with 2013
Australia	26-28% cut in emissions by 2030 compared with 2005

These targets do not necessarily meet the target of 2°C but are consistent with the commitment made by the countries in their NDC (Nationally Determined Contributions).

In the U.S., we can assume the new administration will seek to dismantle the Clean Power Plan (CPP) and limit the powers of the EPA. However, even in the U.S., it is likely that regional renewable energy portfolio standards (RPS) will continue to be moved up. Depending on the jurisdiction, the RPS will fall between 25% and 100 % by 2020 to 2045 (California, Hawaii, Colorado, Maine, Nevada, New York, Vermont, Illinois, Minnesota, and most of the Canadian provinces as part of the North American power system). Other countries have more ambitious targets—for example the UK is aiming for a 57% reduction by 2030 compared with 1990.[4]

[3] Low Carbon High Stakes Accenture Strategy with CDP 2015
[4]https://www.theguardian.com/environment/2016/jun/30/uk-sets-ambitious-new-2030s-carbon-target

Business and transition plans should assume that these goals will be met. PwC's latest Low Carbon Economy Index 2016 shows that across the world as a whole, the decarbonisation rate (i.e. the reduction in carbon use per unit of GDP growth) at 2.8% was only marginally below the NDC target for 2015 of 3.1%.

However, to limit the rise in temperature to 2°C, a rate of decarbonisation of 6.5% will be needed. There is an expectation that all targets will be subject to a five yearly upward-only ratchet in order to bring them into line, eventually, with the <2°C warming target. Thus, even though some jurisdictions do not currently require the IEA target, it is prudent to base strategies and long-term plans around it—recognising that some will reach it more easily than others, depending on the utility's power plant legacy.

Demand for electricity

Demand for electricity over the next 20 years will depend on growth in GDP plus additional demand from electric vehicles and, to a lesser extent, heating minus energy efficiency gains in the form of reduced energy input per unit of GDP output. How this equation will balance out is hard to predict. While the OECD predicts the use of electricity in developed countries will increase by 1.2% p.a. from 2012 to 2040[5], Deloitte's view is that demand may fall by 0.1% p.a. in Europe, while growing 0.2% in the US.[6]

Over the next 20 years, demand from electric vehicles is likely to dominate growth in demand. In the long term, domestic heating needs to shift from fossil fuels to electricity, including CHP (combined heat and power) and ground-source heat pumps. For example, the UK's Carbon Plan states that by 2050, carbon emissions from heating and cooling buildings need to be near zero. Space heating represents a much bigger challenge than displacing the internal combustion engine. While there are some pioneering local initiatives[7] (Sweden already provides 20% of domestic space and water heating from heat pumps), it is unlikely to have significant impact on demand in the developed world until the 2030s.[8] And non-carbon forms of space heating will probably require local government planning to optimise the efficiency of the system by maximising the density of customers.

However, the switch to use of electricity to heat water is more straightforward and could happen faster, particularly if half hourly tariffs are introduced on a wide scale, as the UK regulator is planning to do from 2017, so that water can be heated when demand is otherwise low.

Electric vehicles

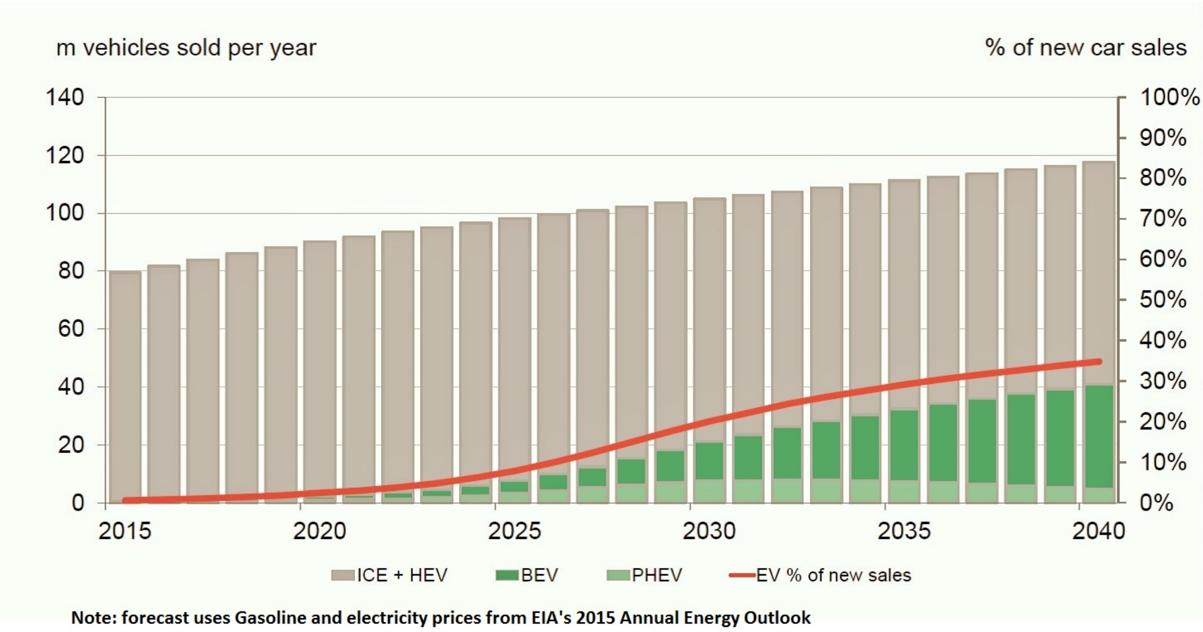
[5] IEA 2016 World Energy Outlook
[6] The Future of the Global Power Sector: Preparing for Emerging Opportunities and Threats. Deloitte 2015
[7] http://www.greentoscale.net/en/green2scale-ratkaisut/residential-heat-pumps
[8] The Future of Heating: Meeting the Challenge DECC 2013 p 11.

There is no consensus on the speed of up take of electric vehicles. At one extreme Exxon believes that as late as 2040, less than 10% of new registrations will be electric. Contrast this with VW's prediction that 25% of its sales will be electric vehicles by 2025. Adoption will vary by country, with high fuel prices encouraging the switch, and low prices, as in the U.S. inhibiting it. UBS forecasts cost parity in Europe in 2021 and China in 2025, with the U.S. further out. Although the largest installed bases are in China and the U.S., the most aggressive policies supporting adoption are in Norway (18% penetration already and the possibility of a ban on new sales of internal combustion engines as early as 2025), and the Netherlands (just under 10% penetration and considering a similar ban). California is on a similar track, aiming for electric vehicles to make up 30% of new sales by 2030.

A conservative assumption might be the UBS forecast[9] of 10% of the installed base of cars world wide by 2025 being plug-in electric vehicles or hybrids, assuming a payback of only six to eight years from a combined domestic PV, storage and vehicle package. Making the assumption that the adoption rate for a high-cost capital good goes from 10% to 90% in 20 years, then in the timeframe of this guidance, there might be an installed base of around 35-40% of the world market.

Bloomberg New Energy Finance's New Energy Outlook 2016 shows light electric vehicles would add 8% to global electricity demand by 2040if they reach 35% of new vehicles sales (c.40mn of 118mn). This is roughly consistent with Toyota's goal of an end to production of fossil fuel driven cars by 2050.

Figure 2



Note: forecast uses Gasoline and electricity prices from EIA's 2015 Annual Energy Outlook 'Low Oil Price' scenario (ranging from \$50 to \$65 per barrel between 2015 and 2025). High scenario assumes greater vehicle utilisation. Low scenario assumes \$20 per barrel oil price

Source: Bloomberg New Energy Finance

[9] Global Utilities, Autos & Chemicals: Will solar, batteries and electric cars re-shape the electricity system? UBS 2014

While this will require additional generation of electricity, and additional revenue if energy companies can capture a share of it, it may not however require commensurate additional generation capacity if cars are generally charged at night, when other demand for power is low.

EVs will also contribute a growing share of the storage capacity in the system—an 8% penetration of electric vehicles could represent 25% of the total storage capacity in the grid.[10] They will contribute to stabilising the grid and permitting a higher share of variable renewable power, but will potentially disrupt the merit order of plant, and could lead to the stranding of large high variable generation capacity, depending on the regulatory regime at the time.

Energy efficiency

Improvements in energy efficiency, the 'fifth fuel', are reflected in the declining carbon intensity of economic activity. Most experts believe that considerably greater improvements in energy efficiency are both needed and possible. The ACEEE (American Council for an Energy-Efficient Economy) suggests that compound energy efficiency savings of 1.0–1.4% per year appear to be feasible, and savings of 2.0–2.6% per year might be possible, but have been infrequently demonstrated in practice.[11] European experience lines up with this assessment—the greatest gains in energy efficiency have been in private sector industries finalising a 17.6% cut in consumption over 14 years (in part through recession-related reductions in heavy emitting sectors). Over the same period, consumption fell by a little under 10% in the residential sector, while transport and services actually increased emissions by 2.2% and 16.5% respectively.[12]

To achieve higher rates of energy efficiency would require either more assertive government policies, including extending renewable subsidy schemes to energy efficiency projects[13], or more imaginative commercial offerings by organisations whose revenues are not solely drawn from supplying energy. With these conditions in place, ACEEE[14] reckons that energy efficiency opportunities could reduce electricity sales by 40-60% from current 2030 forecasts.

An example of what can be achieved is the Japanese response to the Fukushima nuclear disaster, where electricity supply was curtailed.[15] In a short timeframe, demand in one

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[10] European Utilities: Fast Forward to the 21st Century Macquarie Research 2016
[11] http://aceee.org/blog/2016/09/studies-suggest-past-rates-energy
[12] http://www.edie.net/news/6/UK-plays-leading-role-as-European-Union-hits-energy-efficiency-target-six-years-early/
[13] http://aceee.org/regulatory-filing/ceip-letter-091516
[14] http://aceee.org/research-report/e1502 quoted in Ceres 2015
[15] Reset or Restart? The Impact of Fukushima on the Japanese and German Energy Sectors Chatham House 2012

of the affected regions was reduced by 18% (small businesses), 17% (households) and 15% (heavy industry). In another region, peak demand was cut by 20%.

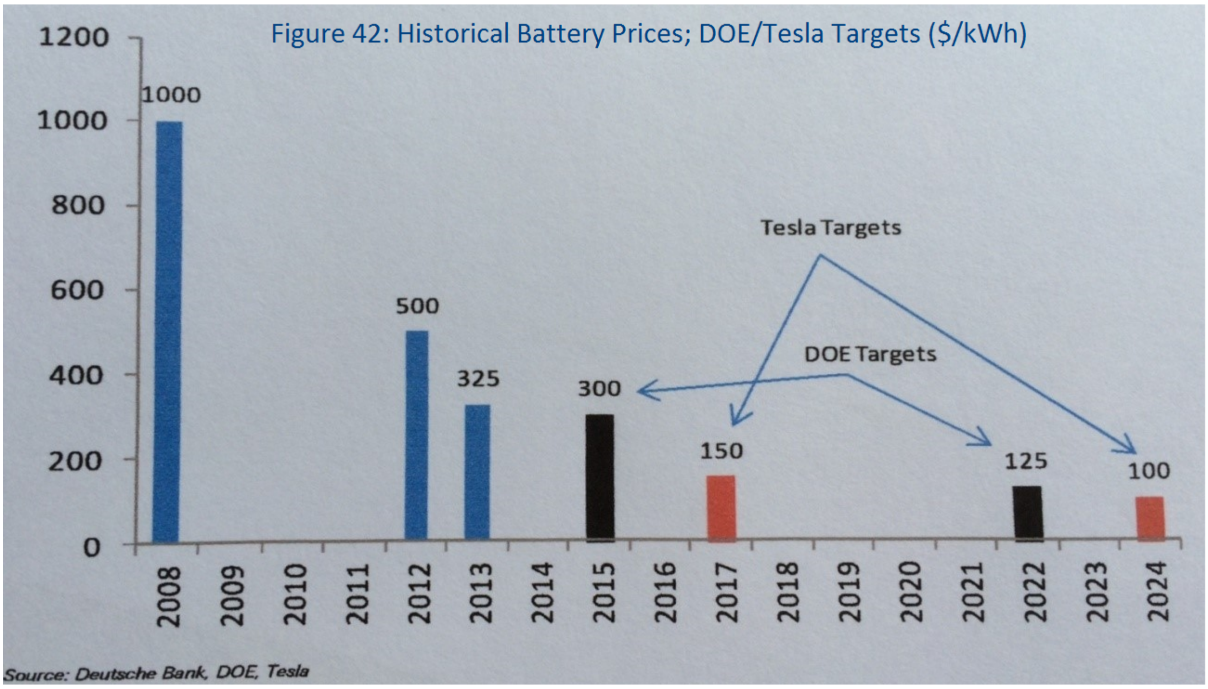
Looking to the future, the City of Zurich set a goal of reducing by 2050 the per capita energy consumed by 50% and GHG emissions by 80%. After a positive citywide vote, the city developed a comprehensive strategy involving non-fossil fuel supplies, transport and building initiatives, and the assessment of projects and procurement against environmental impact.

Supply of electricity

Storage

The battery storage market has developed rapidly as costs have fallen, with accelerating cost reductions forecast in the future.

Figure 3



As well as affecting demand for electricity, particularly in the electric vehicle market, cheaper storage will transform the way electricity is supplied in at least three different ways.

- *The emergence of 'prosumers'*

Price competitive storage will accelerate the trend for individuals, communities and companies to generate their own electricity from renewable sources. At one level this could be seen as inefficient, compared with the economies of scale available at the utility level. However, there are multiple motivations driving this trend:

For individuals:

- the desire to 'be green'
- the ability to manage their own demand in line with when supply is greatest
- the enjoyment of cost advantages when renewables and storage combined approach the wholesale, not the retail, price of electricity.

While there are limits to the proportion of households that can ever become 'prosumers', due to financial constraints, location, type of dwelling, etc, (possibly as low as 20% in the U.S.[16]), market research shows strong consumer interest in a number of countries, with South Africa and Brazil in the lead[17] with 88% and 81% interest respectively.

For communities, including local government-led solutions:

- the opportunity to capture more value through the use of community assets (e.g. land and rooftops for wind and solar) and tapping community capital
- the potential for more flexibility on fees, e.g. subsidising low income households and time-slot charging
- the desire to fund projects for community benefit using the margin between retail and wholesale pricing.

For companies:

- to demonstrate green credentials to customers by buying green energy directly or generating it, as Google and others are doing
- to capture value from the electricity supply chain by using assets such as rooftops
- to invest in generation solutions that fit their particular pattern of demand.

Major companies such as Ikea, Philips, BT and Unilever have pledged to use 100% renewable energy by 2020.

Table 2

Top 5 direct purchasers of renewable energy installed MW capacity[18]

Google	1,638
Amazon	538
Facebook	338
Equinix	330
Walmart	309

Utility companies can respond to the 'prosumer' opportunity by:

[16] Pathway to a 21st Century Utility Ceres 2015
[17] Low Carbon, High Stakes Accenture Strategy with CDP 2015
[18] Rocky Mountains Institute Business Renewables Centre

- Offering a 'green only' energy option
- Providing added value services, including sale, installation and maintenance of renewable and storage systems
- Providing energy management services
- Reducing the cost disadvantage of grid-based electricity by ironing out peaks (see below) and offering time-based charging (subject to regulation, system change, etc.)
- Providing energy efficiency audits for customers (residential and commercial).

In quantitative terms, the growth of 'prosumers' may be the largest impact of low-cost storage—indicated by the fact that Southern California Edison, one of the most forward-looking U.S. utilities, has recently procured 100MW of storage for front-of-meter applications but 135MW for back-of-meter applications. Other data, however, suggest that grid-level solar will provide the majority of generation capacity.

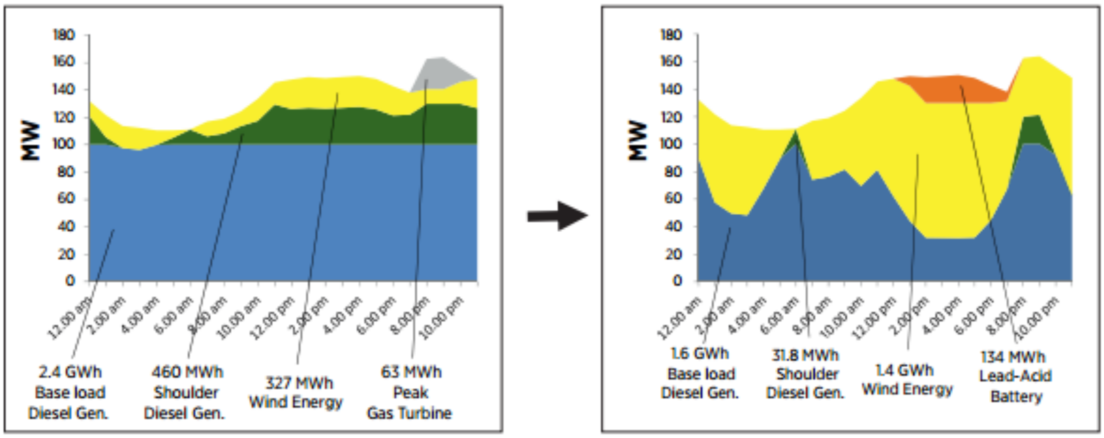
- *Enabling renewable power to increasingly dominate the grid*

Without energy storage, there is a limit on the amount of variable renewable power that the grid can effectively manage. The availability of grid-level storage can remove this cap. Particular applications of grid-level energy storage include:

- Smoothing of supply and demand, where batteries potentially offer both price and efficiency savings compared with peak-use-only fossil fuel plants;
- Compensating for sudden drops in renewable power, for example a cloud passing over a solar array;
- Complementing renewables for islands and off-grid scenarios, e.g. cellphone masts;[19]
- Providing more reliable power supply to businesses in areas with sub standard grid services, e.g. India.

[19] Battery storage for renewable: Market Status and Technology Outlook Irena 2015

Figure 4[20] : Island renewable energy production, impact of battery storage



Source: Potential for Energy Storage in Combination with Renewable Energy in Latin America and the Caribbean, Inter-American Development Bank, Washington DC, USA. Balza, L. et al. (2014)

The above graphic shows how the introduction of storage can reduce the use of fossil fuels, increase the use of renewables, and take out the need for a peak-load gas turbine. While the effects are particularly dramatic in a setting where inter-connection is not an option, similar principles will apply in many other situations.

- *Substituting integrated battery power and renewable energy system for fossil fuels for certain grid services.*

Battery power similarly offers a more efficient way to smooth supply and demand, while also providing voltage/reactive power support, frequency regulation, and black start capabilities. This should enable reductions in cost and increased reliability of the transmission and distribution system.

Overall, integration of additional renewables is forecast to be the most significant use for storage, followed by peak shaving.

Table 3

Grid-level battery use by application (% of total) [20]		
	2014	**2023**
Integration of renewables	29	40
Peak shaving	20	15
Load shifting	18	37
Ancillary services	17	3
Other applications	16	5

[20] Battery storage for renewable: Market Status and Technology Outlook Irena 2015

New entrants

The overall impact of renewable power will be to make fossil fuel plants less profitable, with particular impact on peak-only plants. This will only increase as storage complements renewables and as demand-side management is introduced.[21]

The most significant new entrants are 'prosumers' as described above. In addition there will be new commercial entrants, including:

- Specialist renewable companies: In wind (DONG, Vestas, GE, Suzlon); solar (Sunpower, First Solar, Sharp Solar, Yingli Green Energy); and, possibly further out, wave energy.
- Storage companies: Not just batteries (e.g. Tesla) but pumped storage and other traditional solutions, driven by carbon regulation rather than technology.
- Smart grid solutions providers: Both utility scale and domestic (e.g. Active Network Management, Silver Springs Networks).
- Niche players: Specialising in large data storage sites in cold climates (e.g. Hydro66); systems integration (e.g. IBM); telecommunications (e.g. Telstra).

Significant new generation capacity is being created by some unlikely competitors. In Utah, Virint, a home security company, has installed 274 MW of solar power over the last five years, equivalent to a utility-sized plant. Waste Management has created 500MW of capacity using methane from its 130 landfill sites.[22]

Regulatory environment

It seems inevitable, therefore, that the generation mix and power grid in 2035 and 2050 will look very different from today. It will be more distributed, more intelligent, and incrementally will transform to clean energy power systems. The need for fossil fuel burning plants will not have gone away by 2035 as gas-fired power generation (gas turbines) will act as a bridge replacing coal, but increasingly the functions such plants fulfil will be provided in other ways as power systems transform to close to 100% clean energy by 2050. Such a change has already taken place in Ontario, the first jurisdiction of North America to go virtually fossil free. Its generation mix is 95.6% net zero GHG emissions (nuclear, hydro, wind, solar). Gas-fired power electricity is less than 4.2% of the fuel mix. A number of other countries with big hydro or nuclear installations are also at or above 65% non-fossil fuels.

This will also require conceptualizing new economic models that work for consumers ('prosumers') and shareholders (return on capital exceeding the cost of capital) at the same time. Thus utilities' strategic leaders and their boards will be accountable for creating customer value, shareholder value, and societal value all at the same time as part of the utility business model transformation.

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[21] http://projects.exeter.ac.uk/igov/paper-governance-and-disruptive-energy-system-change/
[22] A Strategist's Guide to Power Industry Transformation PwC 2015

> *'We expect a new business model to emerge with (i) upstream focus on renewables and decentralized energy with conventional generation only as a back-up, (ii) midstream focus towards the creation of local distribution networks feeding into a smart and Pan-European transmission grid and (iii) downstream focus on services and facilities maintenance instead of supply. The pace of change will vary by country and plenty of stumbling blocks exist, the biggest of which is the lack of innovation track record in the utilities sector. However, the trajectory of change in our view is set and although the pace will be evolutionary (two plus decades), the outcome will be revolutionary '.*

Pan-European Utilities - The Lost Decade: Where Next, London
Citi Research (2013)

In all jurisdictions, the utilities transformation will have profound implications for regulation, including but not limited to the following:

- As consumers continue to rely on the grid, but for a smaller proportion of their electricity consumption and in some cases for feeding in, how can the costs of maintaining the grid be covered? Will a fixed charge, similar to a broadband charge, be the preferred way forward?
- How can the role of storage be recognised in legislation?
- What is the equitable way for third party generation organisations to connect to the grid?
- How will the carrying capacity of the grid for variable power be assessed and policed?
- How is responsibility for resilience and service levels shared between different generation providers?
- Will grid operators make consumers liable for any damage their battery storage systems cause to the grid?

Regulation will be just as much a driver/constraint on company strategy as before. Hence in shaping a transition strategy and plans to 2035 and 2050 utility companies cannot avoid conclusions about what form regulation should take in order to support the transition. Different utility companies will inevitably choose different paths, putting different pressures on the regulator. So although the big binary bets on which low carbon technologies get subsidies will fade away, the regulatory environment is likely to continue to be dynamic. Creating and managing constructive stakeholder relationships with regulators (regional and national) and helping regulators to recognize the risks in transition will be a key success factor for utility executive teams.

And finally . . .

One last aspect of change on the outside is the potential impact of physical risk from climate change on capital plant in areas subject to storms, hurricanes, or rising water levels. Within the 20-year horizon of the transition plan, sea levels are expected to be 6-10 inches above 1992 levels. Combined with a doubling of the likelihood of severe storms[23], high winds and floods, this could put generation assets at risk, increasing the attractiveness of more-distributed clean energy power systems.

Nuclear plants may suffer from shortage of water or increases in water temperature, and water shortages are already seriously affecting hydro power, e.g. in Brazil. Italy's *increase* in carbon intensity in 2015 was due to a forced substitution of gas for hydro power as a result of water shortages.

Geo-political tensions may also make energy security a much bigger issue in some markets, in particular Western Europe.

[23]http://sealevel.climatecentral.org/ http://sealevel.climatecentral.org/

Change on the inside

In this part of the guidance we lay out the questions we would expect a company to cover in some way in both a near term five-year business plan and a 20- to 35-year strategic transition plan. These questions align with those suggested by the Task Force on Climate Related Financial Disclosure, but with an additional emphasis on transition planning rather than merely scenario building or stress testing. The combination of a rolling five-year business plan and longer-term strategy should focus on five high level goals:

- *Enabling the company to make the transition to a highly distributed clean energy power system (95% non-fossil fuel generation) by 2050*
- *Meeting relevant emissions standards along the way by 2035 with a goal of either 184g/kWh across all generation plants (IEA target for the world consistent with achieving warming of no more than 2°C) or the locally relevant equivalent, whichever is lower*
- *Maintaining a high level of customer satisfaction as the business evolves*
- *Developing a CEO and executive succession plan that focuses on the skills needed to drive the clean energy power transformation to 2050, with remuneration schemes that align with transition plan targets*
- *Showing how ROIC>WACC over the plan period, taking account of the life cycle of each asset and all attributable costs over the life cycle.*

Internal scenario creation and evaluation processes can enable a longer-term transition plan that adapts to new information and remains relevant as facts and assumptions change. Risk factors will change over time, so companies may wish to envisage a number of different paths to meeting the 2035 and 2050 targets, which can be firmed up over time. We offer very general guidelines and focus on the questions that every company will need to address.

Strategy

Business strategies need to navigate a complicated transition over 20 years and beyond to achieve the goals above. After the first five-year business plan, many of the variables (e.g. rate to reach grid parity of different renewables, take-off of electric vehicles, storage costs) are likely to be clearer and this can inform a more detailed path to the 2035 and 2050 destinations.

The strategy needs to show how the company will improve the performance of existing assets, while also making calculated investments in new areas of business. These may be in generation (e.g. addition of non-fossil fuel plant including storage), transmission (e.g. improving the intelligence of the grid) or distribution and retail marketing (e.g. distributed energy integration, micro-grids, distribution system operators, long-term power purchase agreements.) The transition is likely to require an increase in R&D and a reconfiguration of senior staff and board roles—see governance section.

For suggestions on possible strategic directions, see *Low Carbon, High Stakes*[24] and *Beyond the Storm – value growth in the EU power sector.*[25] The former posits a potential value opportunity of €135 bb - €225 bb in saved and avoided costs, and €110 bb - €155 bb in new revenue per year worldwide in 2030.

In aiming for effective transition plans, utilities—and their investors—need to answer many questions. A selection follows. Note: "near term" refers to a five-year business plan and "transition term" to the period up to 2050.

Questions

Overall strategy – climate and regulatory risk

What assumptions about climate policy and regulatory changes, including fossil fuel subsidies and carbon pricing, locally, nationally and internationally, inform the business plan and transition plan?

Overall strategy - innovation

What proportion of revenue is expected to come from new clean energy products and services (including new markets but excluding new generating plant output) at the end of the five-year business plan cycle?

What is the R&D/acquisition strategy to support innovation?

Overall strategy – capital expenditure

What parameters guide the allocation of capital expenditure between current business and new initiatives? How is the risk of path dependency—i.e. long-term commitment to assets that will impede the transition to a clean energy end state—factored into planning?

What is the forecast balance sheet and invested capital at the end of the business term?

What is the requirement for investment, and the target return on capital, through the transition term?

What opportunities are there to raise capital from new sources, e.g. green bonds?

What are the expectations for dividend policy through the transition?

[24] 'Low Carbon, High Stakes' Accenture Strategy with CDP 2015
[25] Beyond the storm – value growth in the EU power sector McKinsey & Company 2015

Generation strategy and fuel mix

What generation mix is targeted for 2035 and 2050? What contribution to meeting the emissions target will come from energy efficiency at plant level and what contribution from changing the fuel and generation mix?

What assumptions is the company making about the price of fuel inputs over the next five years?

How is the generation mix expected to change in the near term? What is the expected emissions/kWh target for the end of the business plan?

What assumptions have been made about the role of energy/battery storage in complementing low carbon power generation systems, near term and transition term?

What is the timeline for phasing out and retirement of coal-fired plants (near term) and oil and gas-fired plants (transition term)?

How is the company revaluing assets to avoid large, sudden write-downs as projected closure dates approach?

How is the company managing capital provisioning for site remediation?

Transmission

What is the company's planned contribution to a smarter and cleaner power transmission eco-system that will generate emissions savings in the near and transition term?

How will a smarter transmission system generate cost savings and increased margins in the near and transition term?

What are the company's plans near and transition term to incorporate grid storage into the transmission system? How is this likely to affect operating costs?

Distribution and marketing

What is the vision for the relationship with customers in 2035? What changes are expected in the size and makeup of the customer base?

What assumptions are made about locally or nationally sponsored plans to increase energy efficiency over the period of the transition plan?

What value added services (e.g. demand response, energy efficiency) does the company plan to offer customers in the near term?

What is the company's digital strategy and plan to support the clean energy transformation?

What will be the company's strategy near and transition term in relation to retail, community, or business 'prosumers'? What products and services will be offered to support 'prosumers'? How will value be captured from third-party generators?

Governance

In order to survive and prosper through the transition, companies will need radical transformation of their strategic planning processes, accountability and managerial structure, performance metrics and CEO and executive succession planning processes, as well as their skills and knowledge base at four levels:

- Board of directors ('strategic duty' and oversight related to the power industry ecosystem and utility business model transformation)
- C-suite leaders (direct accountability for strategy for power industry eco-system transformation and utility business model transformation)
- Other staff complement (development of new clean energy products and solutions, energy efficiency and GHG reduction process innovations).

Board structure

Boards will need to include at least a significant minority of members with a good understanding of climate change drivers, risks and timeframes. The board as a whole should have a demonstrated level of conceptual capacity and systems thinking in relation to the transformation of both the industry eco-system and the company's own strategy, in order to support management in the transition, while maintaining close contacts and sharing of risks and opportunities with lead investors. In particular the chairs of audit/risk and remuneration committees should be fully up to speed with transition objectives and targets so these can be fully integrated into the work of these committees (see risk section below).

Designing and approving processes for CEO and executive succession planning, selection, and development for the next four generations of executive management will be critical to ensure a management structure and executive talent pipeline capable of leading both utility business model transformation and utility industry eco-system transformation to a 95 % clean energy power system in 2050.

Senior executives

In the past, senior executives will have been selected for their ability to manage a complex, integrated, stable, capital-intensive business in an environment that is heavily regulated, with high barriers to entry. Key skills needed were in-depth knowledge of the energy utility sector, operational experience, financial management and capital planning, and safety assurance. These skills will continue to be relevant for the continued operational oversight of existing generation and T&D assets, focusing on the need for positive returns and cash flows to internally fund the transition to a clean energy system, as well as emissions reductions through increased efficiency.

But a completely different and arguably higher order skill set will be needed to plan and execute the transition, focusing on strategic thinking, intellectual curiosity, risk taking, and rapid decision making, as well as a sound understanding of drivers of change in technology and climate regulation. The CEO and senior executives must be able to conceptualise and assess different pathways to the end goal of a clean energy power system, including drivers of change and ways in which new and undiscovered technologies may play a role. They will need to understand how new business models for generation, transmission and distribution interact and be explicit about the strategic milestones, and timescales for key decisions to be made. There is a limited pool of people with the capacity to plan at the level of complexity required (perhaps no more than 5% of the population) and the search will probably need to go wider than the energy utility sector.

Below senior management, new skills will be needed in R&D, strategic planning, technology forecasting and consumer marketing, including market research. Critical roles will include innovation for new clean energy products and solutions across the company's entire value chain, and the translation of the innovations associated with the long-term transition strategy into operational processes. Performance metrics and decision making structures will need to be redesigned to reflect the new business environment. Remuneration policies will need to reflect the demands of simultaneously generating returns from existing assets while making well-timed and considered moves into new territories and being on course to achieve the target reduction in emissions. Remuneration must be competitive to promote the recruitment and retention of skilled people with the conceptual thinking capacity to operate at all four levels of innovation (i.e. power industry ecosystem, utility business model transformation, new clean energy products and solutions, energy efficiency and GHG reduction processes)

Public policy

A company that is serious about making the clean energy transition will—at the very minimum—be transparent about its public policy positions and trade association memberships, and both will be selected to support governments and regulators adapting to the transformation of markets and technologies.

Questions

Board

How is the board ensuring that climate competency is central to new appointments?

What are the processes and frequency whereby board and/or board committees are informed about climate-related risks?

How does the board monitor and oversee progress against goals and targets for addressing climate-related issues in both the near- and the transition-term plans?

How is the board addressing the needs to enhance the organisational structure and talent development of senior management to encompass additional skills needed for a successful transition?

How are performance measures, remuneration and long-term incentives adjusted to reward long-term progress towards the end state of the transition plan, as well as meeting short-term operational and financial goals?

Is there a broad-based CEO and executive succession plan to 2050, including tools to assess the cognitive capacity of C-suite staff?

Organisational design and staffing

What is the organisational model and staffing strategy to identify and attract staff with the competencies and experience to support the transition, including the five-year business plan?

How is responsibility for climate-related issues assigned to senior staff? How do the relevant staff ensure they are informed about climate-related issues and the impact on business strategies and risk management?

How do staff and board interact on climate related issues?

Public policy

a) Policy positions[26]

What is the company's position on specific matters of climate and energy policy (e.g. capacity payments, renewables subsidies, energy-efficiency targets, carbon price, carbon tax, reform to local carbon markets)?

How are these policies made public?

Is the company playing a leadership role to help ensure policy makers determine sustainable policies that will serve the long-term interests of investors?

b) Activity

How much is spent on lobbying activity, and how is this divided between lobbying related to the traditional business model and lobbying for the clean energy transition?

Describe engagement with policy makers and regulators on matters affecting the 20-year transition to a low carbon economy

c) Alignment

What industry associations does the company have links with?

[26] With acknowledgement to 'IIGCC Investor Expectations of Electric Utility Companies 2016'

What is the governance process for managing these relationships?

How does the company ensure consistency between the policies needed to support the company's transition strategy and those articulated by your trade associations?

Risk management

The performance of the company in managing risks and identifying and exploiting new opportunities through the transition will be critical to its survival and growth. Risk management will need to encompass both physical adaptation risks associated with climate change (for example rising sea levels, water scarcity, increased storms) and transition risks arising from changes in technology, markets, and regulation that will affect the achievement of its business and transition strategies. Litigation risk may also emerge as an issue.

Questions

What are the arrangements for monitoring, and shaping responses to, the following risks?

- Acute physical risks from increased extreme weather, such as cyclones, floods and droughts
- Chronic risks, such as secular changes in rainfall, temperature, sea levels, and extreme variability in weather patterns
- Increased pricing of GHG emissions
- Enhanced emissions-reporting requirements
- Mandates on and regulation of existing products and services
- Exposure to litigation
- Substitution of existing products and services with lower emissions options
- Unsuccessful investments in new technologies/products/services
- Upfront costs to transition to lower emissions technology
- Changing consumer behaviour
- Uncertainty in market signals/regulatory environment
- Increased fuel and other input costs
- Shifts in consumer preferences
- Stigmatisation of sector
- Increased activism

Metrics

The most important metrics for companies and investors to review progress against will be actual emissions against targets, the efficiency of operating existing plant, the return on capital versus the weighted average cost of capital, and the percentage of revenue derived from new products and services (excluding new generation capacity). This last is important because it is virtually certain that the share of generation revenue for incumbent utilities will fall (even if the overall quantum remains buoyant as electric vehicles come on stream), and the profitability of generation may also decline in the face of competition. Other value-added services will need to be brought on stream to maintain profitability in the medium- to long-term.

% revenue derived from new products and services excluding generation

New products and services could encompass:

- Services to 'prosumers': energy efficiency monitoring, supply and installation of equipment including community-level grids, CHP, purchases of electricity
- Enhanced services to other customers, e.g. half hourly monitoring and time-based tariffs, smart home devices
- Provision of services for electric vehicles, e.g. public recharging points

Generation has been excluded, since replacing generation plant with cleaner substitutes will be picked up in the relative efficiency metrics discussed below.

Emissions against target

Both the business plan and the transition plan should incorporate the envisaged year-by-year reductions in GHGs required to meet the 2035 target and be on a trajectory to reduce emissions further to 2050. Science-based targets may help to map out the reduction path in more detail (www.sciencebasedtargets.org). Progress against these targets should be reported annually. If the IEA target of 184g/kWh (Scope 1 only) is not selected, the company should explain why ('comply or explain').

Efficiency of operating existing plant

Thermal efficiency ratios of existing plant

Customer satisfaction

Trends in customer satisfaction

% of customers taking up energy efficiency products and services

Human capital transformation

Progress in defining new capacities needed in board and senior management roles and recruitment against them

Return on investment

Clear statement of depreciation status of assets to enable like-to-like comparisons of the return on investment.

Overall return on capital versus weighted average cost of capital