

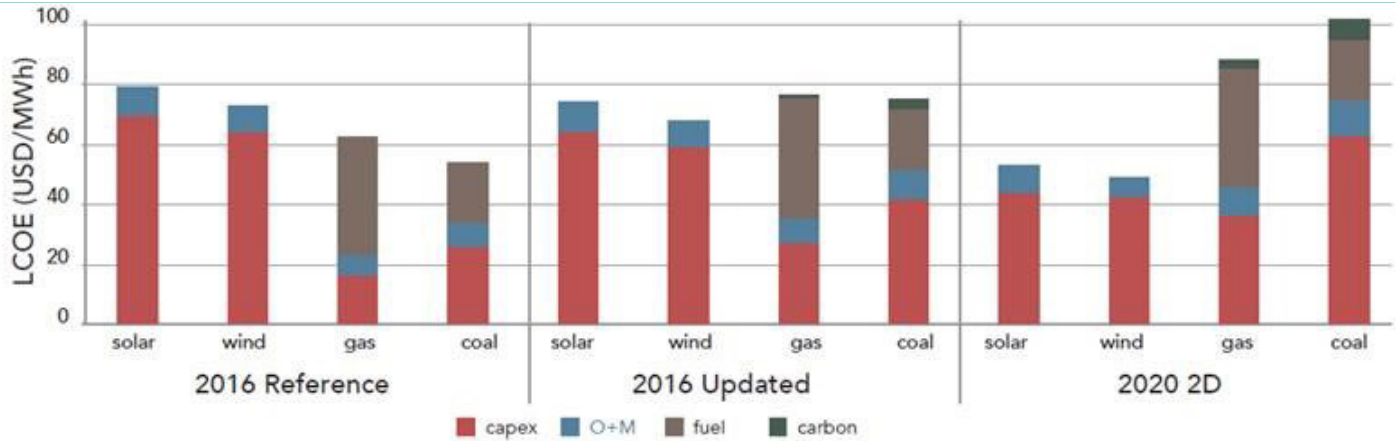
The Risks and Opportunities  
of Climate Change

# Case Study Disruption and Stranded Assets in the Energy Sector

The starting point for assessing the economic competitiveness of different utility-scale power generating and energy storage technologies is normally their levelised cost of energy (LCOE). LCOE reflects the life cycle costs of different technologies as some technologies have higher capital costs (e.g. solar and wind) while others have higher operating costs (including fuel) (e.g. coal and gas). However, LCOE only tells part of the story as this case study will explore.

Even when assessed narrowly through an LCOE lens, the energy sector provides a compelling case study for the risks and opportunities associated with low carbon transition. Particularly, since 2016 when Carbon Tracker found on average new build wind and solar PV were cheaper than new build coal and gas globally.

### Comparison of LCOE results across all scenarios

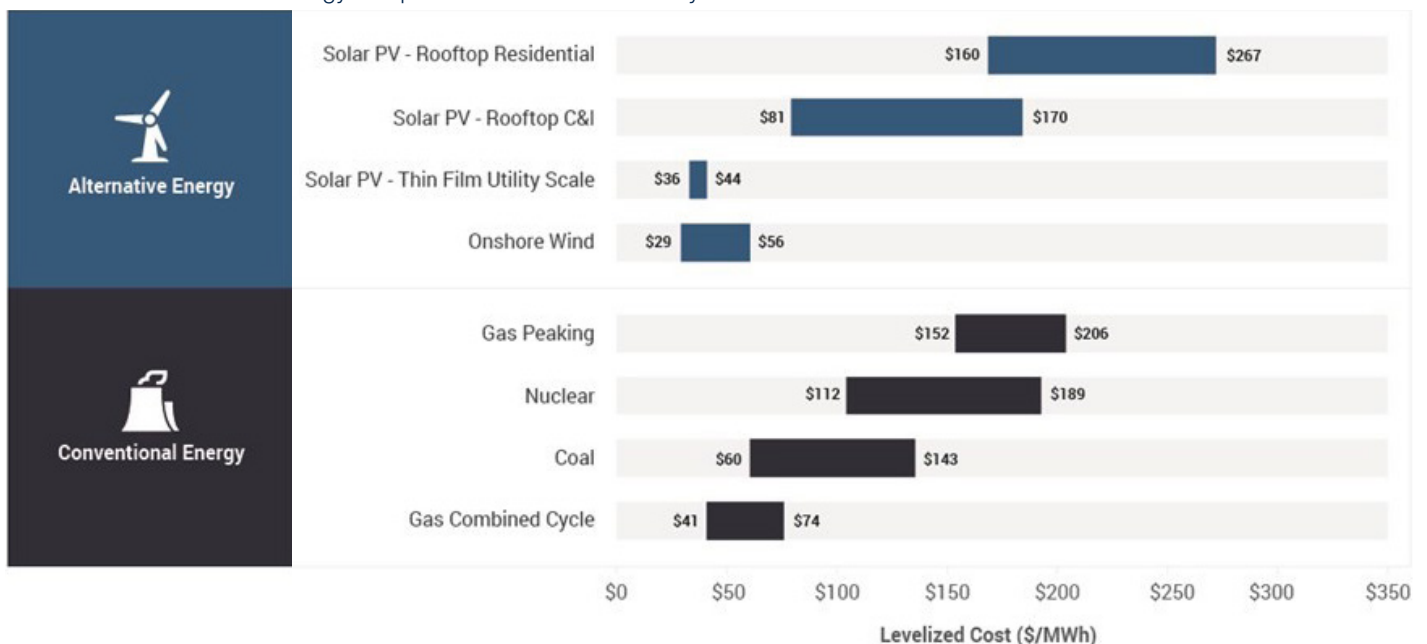


Source: Carbon Tracker: 2016 The end of the load for coal and gas.

As with all LCOE analysis, understanding assumptions is important. Carbon Tracker's analysis challenged conventional assumptions in a number of areas for both current and 2020 scenarios including utilisation rates, differentials in costs of capital and the introduction of carbon prices (albeit modest ones at US\$5 (2016 updated) and \$10 (2020 2oC) per tonne).

As a demonstration of how quickly these costs have moved, Lazard, in its 2018 annual LCOE review found that in some cases new utility scale solar and wind had become cheaper than existing coal and gas. The cost of storage, which allows for the intermittency of renewable sources to be managed, is also falling rapidly. These dramatic changes are without Carbon Tracker's assumptions of a carbon price and differentials in cost of capital and assumes no additional costs for site remediation for coal.

Chart 3: Levelised cost of energy comparison – unsubsidized analysis



Source: Lazard: Levelized Cost of Energy and Levelized Cost of Storage 2018

These trends are supported by cost declines in electric vehicles and batteries and more advanced energy efficiency technologies, which pose a threat to incumbent industries and demand for fossil fuels. Technological disruption driven by efforts to reduce carbon emissions is happening or forecasted across industries. For example:

- Increased use of light-emitting diodes (LEDs) will cut power consumption from lighting by 40% from 2013-2030, the U.S. Department of Energy forecasts.
- By 2050, wind and solar are expected to generate 48% of global energy supply, with hydro, nuclear and other renewables adding an additional 23%. Coal, oil and gas-based generation is expected to fall to 29% from 63% in 2018, according to BloombergNEF.
- Solar thermal and geothermal heating for district heating, residential water heating, residential and industrial space heating and industrial drying, is being used for 25% of heat demand in LATAM, 19% in Europe, 10% in the US, and growing at 25% yoy in Asia according to ren21. Coriance, the French District heating company owned by our Unlisted Infrastructure fund, uses geothermal and biomass-fired boilers as renewable energy sources (in addition to traditional gas-fired).
- The UN's International Maritime Organisation, representing the global shipping industry, have adopted a climate change strategy, with the goal of switching to biofuels or electrifying engines. Forsea, a passenger ferry business owned by our

Unlisted Infrastructure Fund, has electrified its fleet with plans underway for the related Scandlines ferry business to do likewise.

- IATA (the International Air Transport Association) has set three targets:
  - Improve average fuel efficiency by 1.5% from 2009 to 2020
  - Cap net aviation CO2 emissions from 2020 (carbon-neutral growth)
  - Reduction in net aviation CO2 emissions of 50% by 2050, relative to 2005 levels in 2017.
- Five countries have announced their intention to ban sales of new diesel and petrol cars – by 2030 (India, the Netherlands and Slovenia) and by 2040 (France and the United Kingdom).

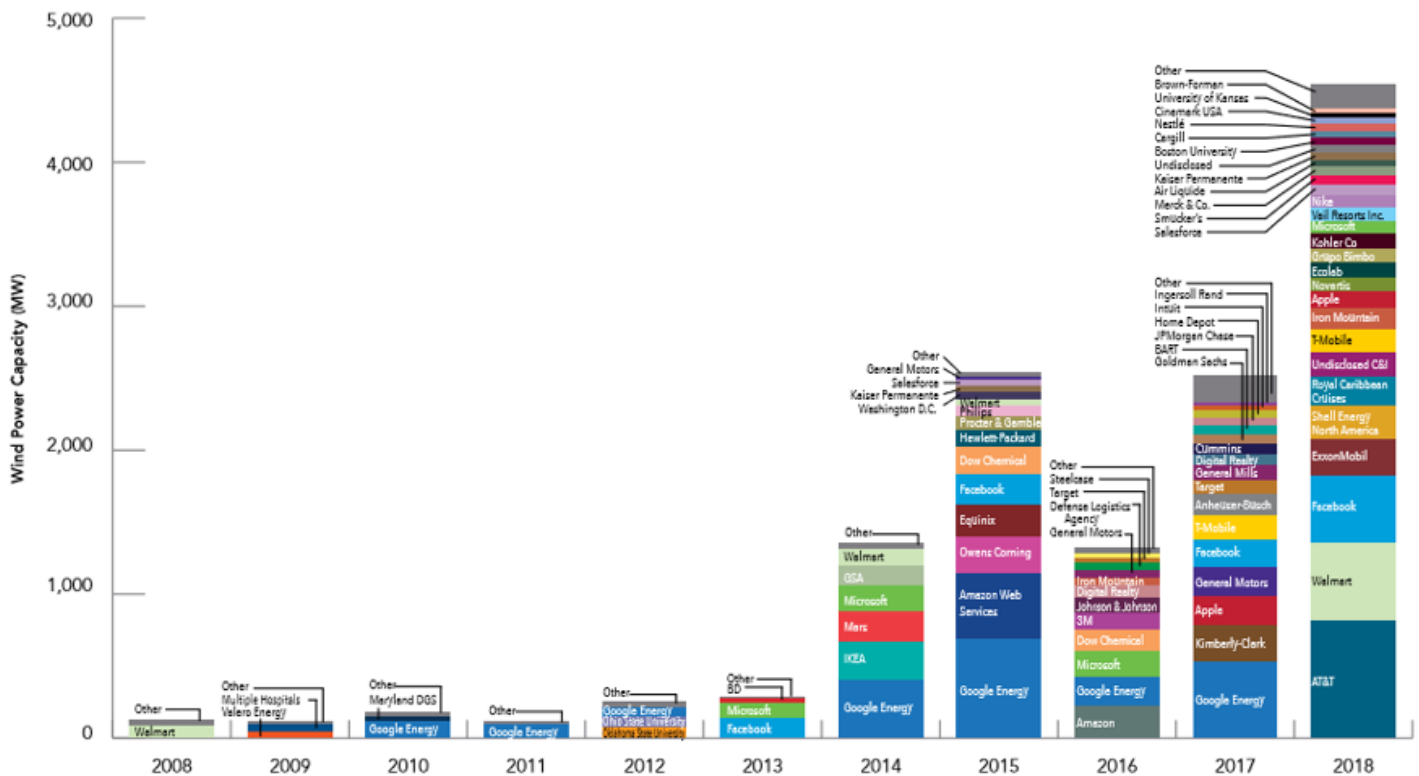
## Corporates step in – the rise of self-generation and direct purchasing

In addition to changing the dynamics of electricity markets, renewable energy has become increasingly attractive to companies wanting to buy electricity directly from sustainable sources.

Renewables sourced by long-term corporate PPAs (power purchase agreements) allow buyers to lock in cost competitive renewable energy prices for long periods without exposure to commodity price swings. In the US, The American Wind Energy Association tracks PPA purchases with growth in capacity and number of deals almost exponential since 2008.

This includes self-generation – for example, commercial and industrial rooftop solar, that has the added benefit of avoiding (to a degree) network / distribution costs.

## US Non-utility wind power purchases per year



Note: Data include publicly announced physical and virtual power purchase agreements (PPA), direct ownership of onsite or offsite wind projects, and large-scale REC purchases associated with specific wind projects. Data is recorded at the time of announcement and does not indicate when the associated wind project is placed into operation.

Source: AWEA, U.S. Wind Industry Annual Market Report

## Storage including batteries the next wave of the energy revolution

Advances in battery technology could help electric grids better match renewables supply with demand. The largest lithium-ion battery in the world, the 100MW Tesla-developed Hornsdale Power Reserve in South Australia began operating on 1 December 2017 and has been commended by the energy market regulator as providing “a range of valuable power system services, including rapid, accurate frequency response and control.”

In the USA a solicitation for new developments to replace closing coal plants by Xcel energy in 2017 received a record 850 bids with the median price for renewables including storage being lower than the operating costs of existing coal plants.

Notwithstanding this progress, batteries currently are not a viable back-up solution. They can help to bridge to other energy sources but do not have the storage capacity to be a firming option in their own right. However, batteries are not the only storage technology with growing interest in pumped hydro and other storage solutions supplemented by gas peaking plants.

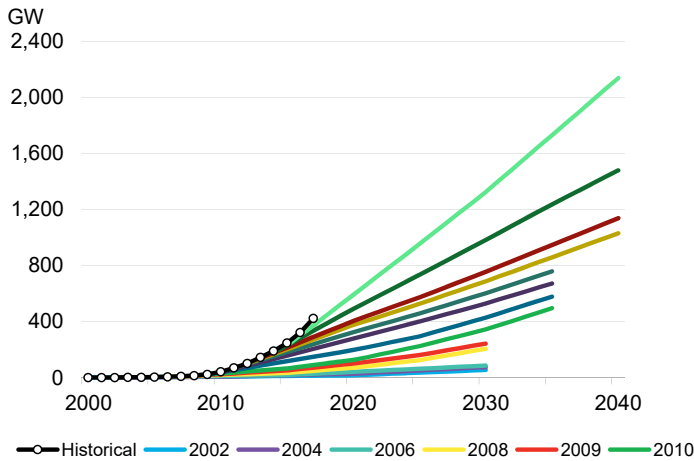
These rapid changes and the growing recognition of the unique and multiple benefits that battery and other firming technologies can provide is likely to further disrupt the energy sector.

## Asset stranding

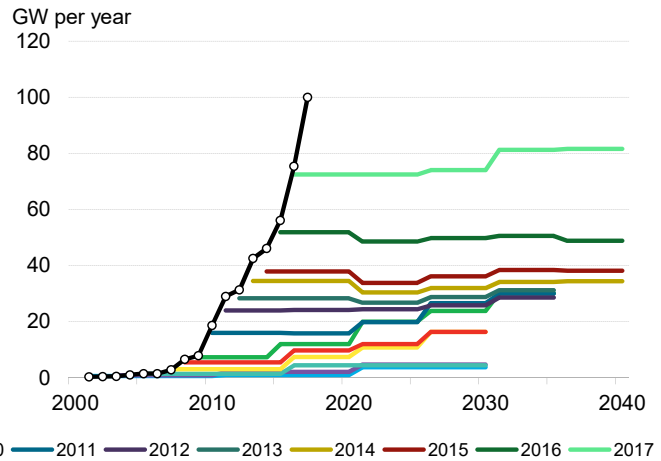
These rates of change are striking yet forecasts have continually underestimated the price declines and adoption rates for clean technology. For example, the IEA's World Energy Outlook forecasts have consistently underestimated actual renewable energy installations.

Chart 5: Difference between IEA scenarios and actual renewable energy growth

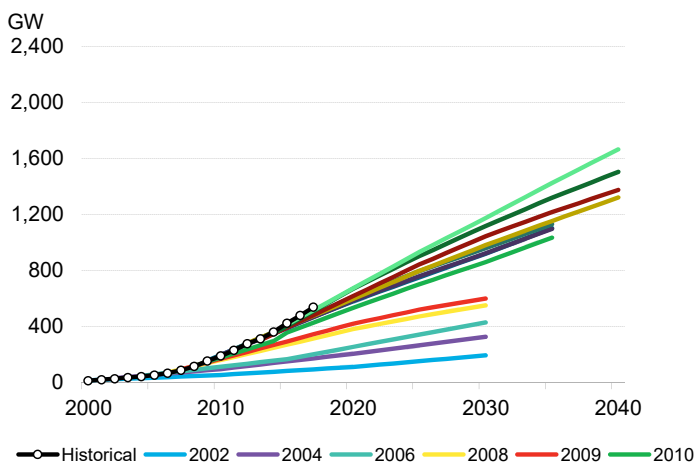
### Global cumulative solar installations



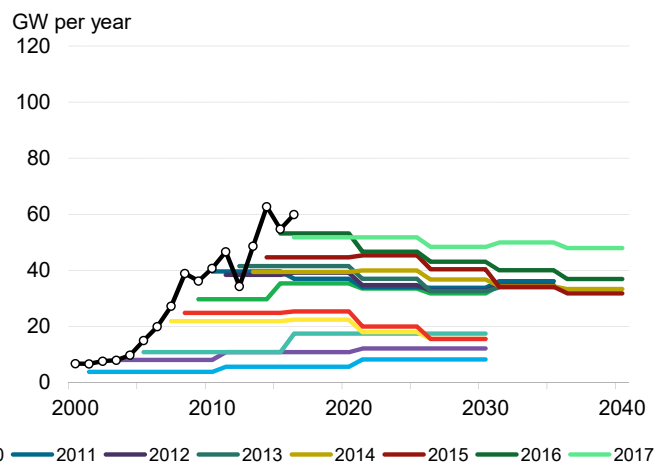
### Annual solar additions



### Global cumulative wind installations



### Annual wind additions



Source: Liebreich Associates, IEA World Energy Outlook

These technology related changes alone risk companies, governments and investors being caught between expectations and rapidly changing reality. However, technology is not the only factor driving these changes. In our 2015 Stranded Assets Tool Kit, we found a number of factors were changing the supply and demand dynamics for fossil based energy. These factors include the human health impacts of air pollution and related regulations to curb it, the increased costs of extracting lower quality fossil fuel reserves (as the best and lowest cost sources are depleted, and the related increased risks and costs of exploration for unconventional oil and gas.

**Table 1. Drivers of asset stranding for fossil fuel assets**

Increasing costs			Reducing demand		
Increased regulation (carbon pricing, emissions reduction, SOx and NOx and Mercury standards etc)	Reducing quality/energy intensity of source materials	Increasing exploration costs (Deep sea, Arctic, tar sands)	Increased regulation (carbon pricing, emissions reduction, SOx and NOx and Mercury standards etc)	Increasing effectiveness of renewable energy storage	Pollution and public health concerns driving activism

Source: CFSGAM Stranded Assets Toolkit 2015

In the toolkit we recommended nine tests across three areas which investment analysts can use to better understand the risks of asset stranding for fossil fuel companies.

**Table 2. Nine tests for assessing fossil fuel company's exposure to stranded assets**

Fossil Fuel Companies (Coal, Oil and Gas)		
Determine the company's baseline position	Test the company's resilience with scenario analysis	Assess the company's approach
Assess company against the cost curve	Using lower commodity prices or margins	Benchmark the company against good practice
Assess the supply chain and local regulatory environment	Using higher capital requirements and cost of capital	Assess incentives for potential misalignment
Assess capital plans and exploration activities	Using delayed starts to planned projects	Set engagement objectives with the company

Source: CFSGAM Stranded Assets Toolkit 2015

Similar tests can be applied to companies in other sectors as fossil fuel companies are not the only companies with transition and stranded assets risks.

As this case study shows, while LCOE is a useful tool and tells a compelling story about energy system transformation (and disruption), it does not address other significant drivers of change in supply and demand for high and low carbon energy technologies. This has caught out traditional forecasting methods and associated losses for investors and companies who rely on them to make decisions.

While the transition risks in the energy sector are unfolding the quickest and are the most obvious, energy is not the only area where these issues will unfold. The third paper in our series on climate change explores these issues and finds a number of other sectors equally exposed.

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