

Power and Renewable Energy Market Review 2018

The climate of change



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Introduction

Welcome to our Power and Renewable Energy Market Review for 2018. During the last 12 months, these industries continue to operate in a climate of change; as Selwyn Parker of Petroleum Economist notes in the leading article of the Review, the world has embarked on “an epochal transition” away from hydrocarbon-fuelled economic growth. A key driver of this transition is the imperative to meet the Paris Agreement goals of keeping global warming well below 2°C (relative to pre-industrial levels) and pursuing measures to keep the rise to 1.5°C.

One such measure, identified in the UN’s Emission Gap Report 2017, is “avoiding building new coal-fired power plants and phasing out existing ones”. It’s interesting that a potential game-changer in this objective has emerged from what some may consider a surprising source – the insurance sector. 2017 has seen a number of leading global insurers announcing that they will no longer invest in or offer insurance

to companies with significant coal generation or mining operations, and it appears that others will follow suit.

Without insurance, these companies can’t operate – yet despite the continuing growth of the renewables industry, analysts expect coal to remain the dominant component of the global power generation mix over the next decade. Watch this space as the picture develops.

Within our Review we also identify a number of issues which are impacting the risk management strategies of the power and renewable energy industries. These include subjects as diverse as the role of private equity and the future of work in these sectors, as well as a focus on geothermal wells, battery storage, floating offshore wind structures, solar farms and critical materials. We’ve also included a piece on de-risking the supply chain – surely a critical area of concern for many risk managers in both the power and renewable energy sectors.



Turning to the insurance market itself, in our last edition in December 2016 we described the ways in which the market had systematically strengthened its resilience since its *annus horribilis* of 1992, when Hurricane Andrew was one of a series of catastrophic natural and man-made losses that propelled 11 insurance companies into insolvency.

This enhanced market resilience was put to the test last year by the most active Atlantic hurricane season in recent years, which may yet make 2017 the worst year for overall insured losses in history. Although there is still huge uncertainty over both the total quantum of insurance and reinsurance claims arising from Hurricanes Harvey, Irma and Maria and the extent to which these claims will have a sustained impact on market capacity, rates and coverage, it appears that this impact will not take the form of the long-awaited return of a truly hard market. A US\$100bn+ loss year, it seems, is no longer enough to actually 'turn' the market.

As noted in the North American update contained in Part Three of the Review, two factors are currently mitigating against this: (1) the continued provision of ample market capacity; and (2) the fact that power generation risks weathered the hurricanes better than many other industries. In general terms this means that for well-managed power and renewable energy sector risks going into 2018, in the absence of other factors such as claims or significant natural catastrophe exposure, the effect of any market hardening will probably be modest. Be that as it may, in the light of these losses we thought it was important to include a special feature in this Review from our analytics team that highlights modern ways of managing natural catastrophe risk.

We are grateful to all the contributors to this Review, who as usual include both Willis Towers Watson specialists from around the world and external expert commentators. We hope that you enjoy reading it.

Graham Knight is Global Head of Power, Willis Towers Watson

"For well-managed power and renewable energy sector risks going into 2018, in the absence of other factors such as claims or significant natural catastrophe exposure, the effect of any market hardening will probably be modest."





Part One: special features





Welcome to the climate of change!

The new energy world

Ten, twenty or thirty years? Forecasts may vary as to exactly when the new world of energy is going to arrive, but the experts do agree on one thing: we're embarking on a steady but epochal transition from hydrocarbon-fuelled economic growth to one powered by a mix of the earth's resources. In short, there's a climate of change afoot.

Multiple factors underlie this historic change in the energy mix, including:

- fast-improving science
- governments that are in a hurry to reduce emissions, such as China
- powerful lobby groups
- a public increasingly concerned about the long-term damage to its health and environment
- a commercial sector that not only sees value in embracing environmental virtue but is attracted by the stable, long-term cashflows available in new projects such as wind farms

In a report released in September 2017 (Oil and Gas Outlook to 2050) the respected Norway-based classification society DNV GL, which is heavily involved in the maritime, oil & gas and renewables industries, predicts several game-changing events over the next three decades.

Game changer number one: slowing consumption

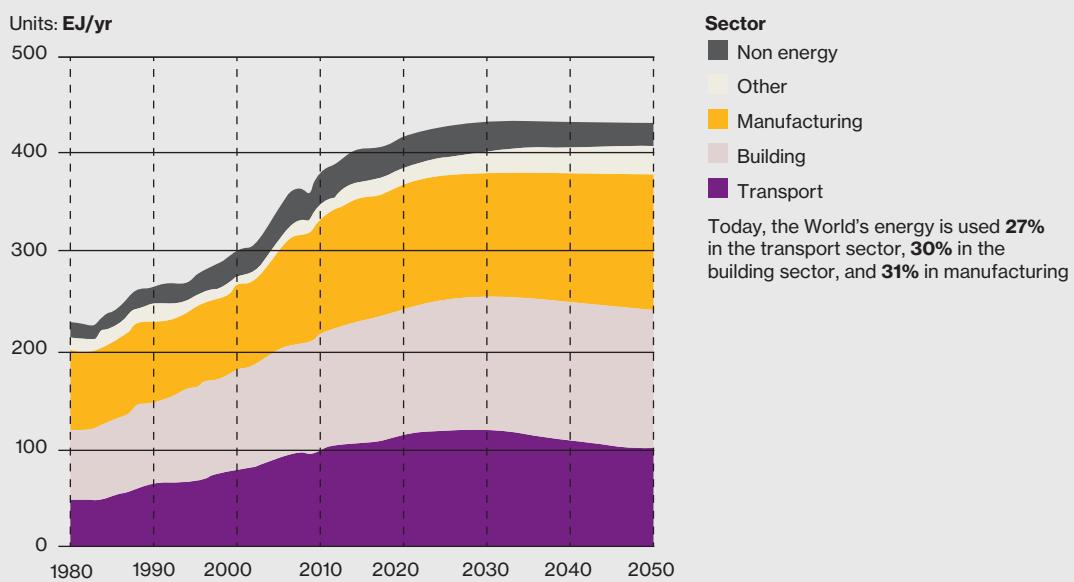
For the first time since the beginning of the industrial age, the world's appetite for energy will begin to slow. The DNV GL report concludes that final energy demand has risen 35% over the past 15 years, but is expected to increase by only 7% between 2015 and 2030 - thereafter it will become virtually flat.

The society attributes this turnaround to three determinant factors:

- reduced growth in production;
- continuous increases in energy efficiency and especially from renewables, in particular wind and solar; and
- a slowing increase in the global population.

Figure 1 - World Energy demand will peak in 2022, predicts DNV GL

World final energy demand by sector



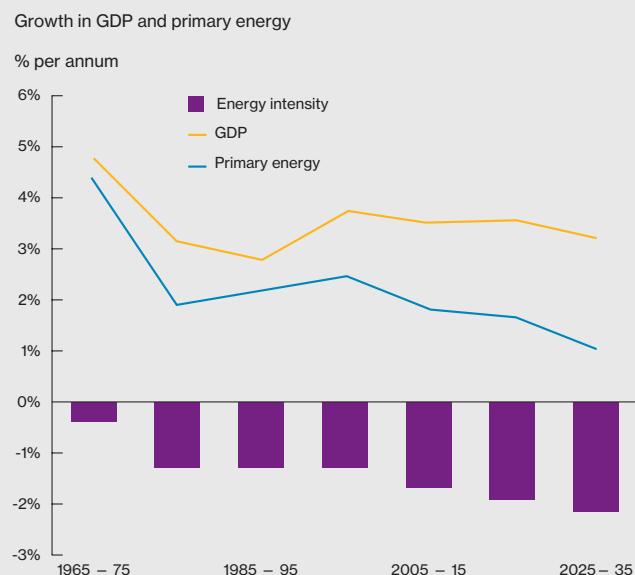
Source: DNV GL Oil and Gas Outlook to 2020, September 2017

This reduction in demand is forecast to happen as early as 2030 - just around the corner in terms of the 50-70 year timescales of the energy industry.

The society has dared to put a number on this pivotal moment. Noting that global final energy demand in 2015 was 400 exajoules (to use the International System of Units' main measure for global production) the DNV GL study assumes it will increase to only 430 exajoules by 2050.

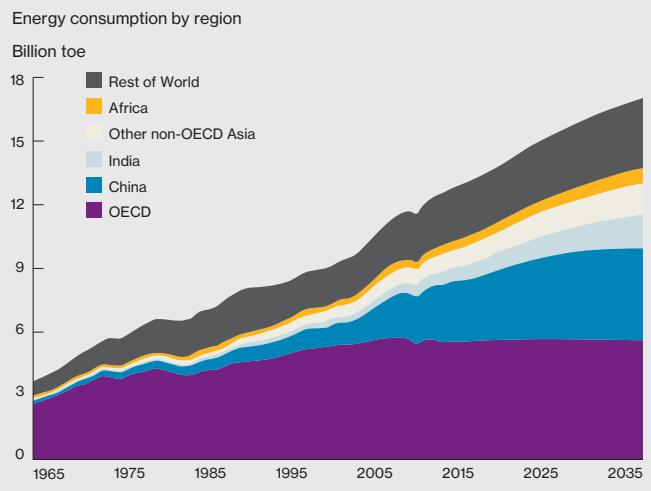
Even more bravely, DNV GL predicts that the demand for oil will peak as early as 2022, starting in the industry's historic stronghold of the western world (North America and Europe). This will spread to parts of the Pacific and eventually on to China, as that nation undertakes a monumental conversion of its entire transport industry to electric power (earlier this year India embarked on a similar route). The study assumes that hydrocarbons will power just half of the world's transport within 30 years, compared with 90% now (see Figure 1 above).

Figure 2 - BP charts the growth of GDP and primary energy between now and 2035



Source: BP Energy Outlook 2017

Figure 3 - Global energy demand will increase by only 30% by 2035 although world global GDP will double in that time, forecasts BP



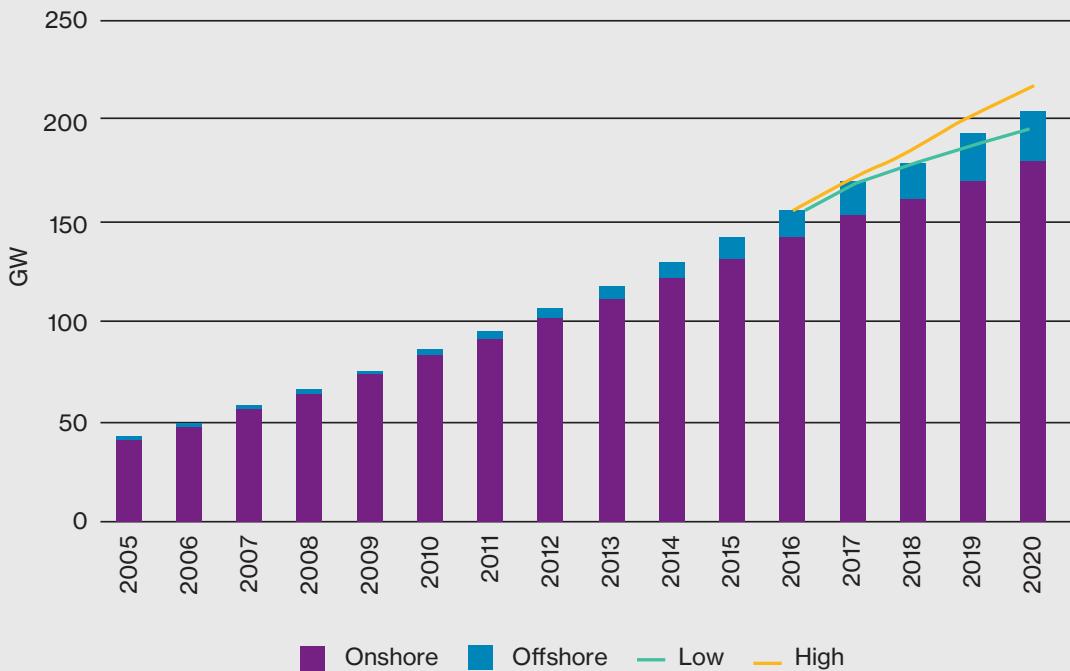
Source: BP Energy Outlook 2017

Is DNV GL out on a limb? According to a consensus of energy experts that include BP economists, Warwick Business School's professor Michael Bradshaw and most of the oil majors, these predictions could be premature by a few years - perhaps even by a decade or more - but few are in any doubt that a revolution in energy demand is fast approaching.

Although more conservative than DNV GL, in its Energy Outlook 2017 BP broadly agrees that consumption faces a turning point. The forecast

predicts that the growing world economy will require more energy, but consumption is expected to grow less quickly than in the past - at 1.3% per year over the period 2015-2035 compared with 2.2% a year in 1995-2015. This is because energy intensity – the amount of energy used for each unit of gross domestic product -- is expected to fall more rapidly. Global GDP should double between now and 2035 while energy demand will grow by only 30% (see Figure 3 above).

Figure 4 - Wind power capacity is on the rise



Source: WindEurope

Game changer number two – advances in technology

As mentioned earlier, scientific development in recent years has been exponential. Battery technology is advancing almost monthly, enabling 200 mile-plus trips by electrically powered vehicles (EVs) far sooner than anybody predicted even three years ago. Developing in tandem is the essential battery-charging infrastructure in Europe, North America and China which is leading the way for the rest of the region.

Estimates of EV sales, and hence their effect on oil demand, vary wildly. However BP - more conservatively than most - notes that an extra 100 million EVs on the world's roads by 2035 would lower oil demand by about 1.4m barrels a day.

Wind turbines now deliver more bang for their buck – in 2017, 8MW turbines are being installed in sites in Europe, the capital of wind power, for the first time. Simultaneously, the technology that enables highly productive floating offshore sites is being perfected – the first one starts up in late 2017 off Scotland (see Figure 4 above).

And even though there are considerable doubts about nuclear energy, it's regaining credibility, particularly in the United States, because of its low-emission virtues. Under development are small modular reactors that can be assembled in factories, transported on site as whole units and plugged in on arrival. Simultaneously, nuclear scientists are working on molten-salt reactors that are cooled by fluoride salts that liquefy and remain stable at high temperatures without having to be pressurised, as light-water reactors do. According to researchers, molten-salt reactors are much less prone to meltdowns.

Game changer number three – wind and solar take-ups defy original forecasts

Meantime there's no doubt that renewables lie at the heart of the energy revolution. In their report, DNV GL calculates that within a little over 30 years they will make up almost half of the energy mix, largely because of the steadily falling price of delivered power. For instance WindEurope, the voice of the EU wind power industry, points out in its 2017 half-year report that the average price of a wind turbine, as measured per megawatt produced, fell to €0.83m in 2016, down from €0.91m in 2015.

As value improves, investors are jumping aboard. Under WindEurope's middle-line scenario, wind power will account for more than half of new

renewable installations between 2017 and 2020 in the EU. And with 37% of new installations, Solar Photovoltaic Systems (solar PV) won't be far behind. Between them, solar PV and wind energy will represent almost 90% of new renewable capacity in Europe.

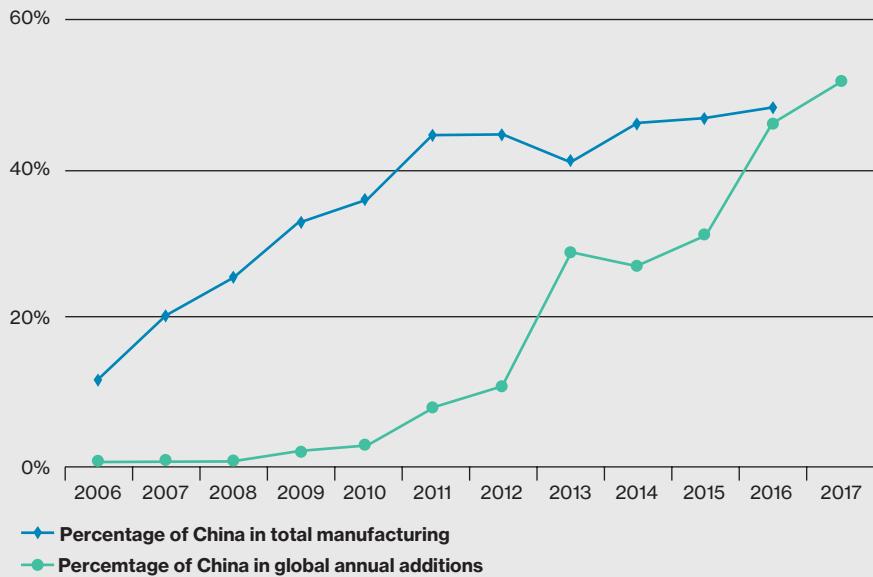
There's already 200 GW of installed wind energy capacity in Europe and by 2020, predicts WindEurope in the same report, the industry will meet 16.5 per cent of the EU's electricity needs, surpassing hydro power and becoming the largest source of renewable electricity. One of the first countries off the mark, Denmark should harvest more than half of electricity demand from wind energy by then, Germany almost 30% with Ireland (29%), Portugal (27%), Spain (24 %) and the UK (21%) not far behind.

Globally, there are variations in the take-up of renewables but the trend is similar. According to the International Energy Agency (IEA), it was solar PV that dominated the addition of 165 gigawatts in renewables globally in 2016. This was "largely because of booming [solar PV] deployment in China and around the world, driven by sharp cost reductions and policy support!" Last year, overall solar PV capacity jumped by 50 per cent to over 74 gigawatts.

Astonishingly, China accounted for almost half of this growth, as borne out in Figure 5 overleaf.

"The average price of a wind turbine, as measured per megawatt produced, fell to €0.83m in 2016, down from €0.91m in 2015."

Figure 5 – China's share in global solar PV manufacturing and demand



Source: Renewables 2017, IEA

For the IEA, the trend is unmistakeable, pointing out that for the first time, solar PV additions rose faster than any other fuel, surpassing the net growth in coal. A major factor is falling auction prices, with solar PV selling for as little as three cents per kilowatt hour. If this continues, the IEA predicts that solar PV will easily surpass wind and hydro in the increase of capacity in renewables. As a result, in its World Energy Outlook 2017 the agency has revised its latest forecast for solar PV upwards by over 30%.

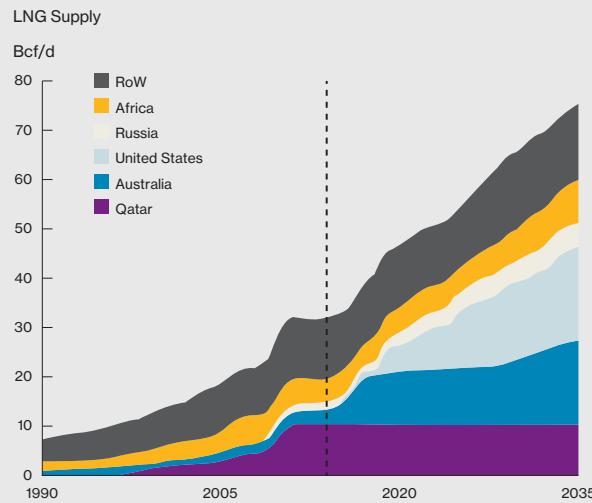
While China's breakneck dash for cleaner air has skewed all the forecasts, it's often forgotten that the United States, despite uncertainty about policies under the current presidency, is the second-largest growth market for renewables. In contradiction to the anti-climate change rhetoric from the White House, there are still many federal and

state tax incentives for renewables of all kinds and they are unlikely to be abolished any time soon.

India is on the same path – the IEA estimates it could match the United States in the rate of growth in renewables, primarily solar PV and wind, within five years.

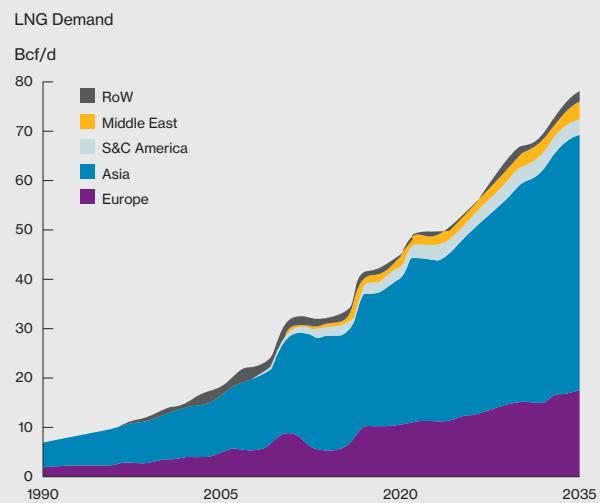
None of this spells the death of the oil and gas industry as we know it. BP's Outlook predicts global demand for oil will increase by about 30% between 2015 and 2035, thereby remaining a dominant source of energy. To the industry's credit, it has reacted with remarkable agility to the "lower for longer" – or perhaps lower for ever – commodity price environment. Many producers are now profitable at a price of US\$50-55 a barrel after slashing offshore development and production costs by 30-40% in the past three years.

Figure 6 - Measured by billions of cubic feet a day, growth in global LNG supply is led by the US, Australia and Africa



Source: BP Energy Outlook 2017

Figure 7 - forecast demand for LNG shows gas is the fastest-growing fossil fuel among Asian economies, measured by billions of cubic feet a day



Source: BP Energy Outlook 2017

Game changer number four – the rise of LNG

However, the industry's future will depend on gas, and particularly Liquefied Natural Gas (LNG). In its Energy Outlook 2017, BP predicts that by the middle of the century, gas will be the biggest single source of energy as the supply of oil flattens out. In terms of production, the United States will lead the LNG charge, with Australia close behind (see Figure 6 above).

But the dynamics of supply and demand will change dramatically, threatening the old game of pipeline politics played principally by Russia. As LNG-based trade grows, supplies can be redirected around the world by sea in response to regional fluctuations in supply and demand. The BP Outlook suggests that as a result, gas markets are likely to become increasingly integrated across the world.

It's just another example of an energy world in transition. Welcome to the climate of change!

Selwyn Parker is a freelance journalist and a regular contributor to Petroleum Economist magazine.

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China's One Belt, One Road: implications for wind power and solar energy

Overview of the wind power industry in China

Capacity doubled for four years in a row

The construction of wind farms in China began in 1980s and during the following 10 years, the country experienced the initial demonstration and industrialization establishment phases. Following this, wind farm installed capacity grew slowly and steadily. Since 2003, which saw the bidding for the first government wind power concession project, wind farm construction has entered the large-scale and localization stage and as a result installed capacity had increased rapidly. From 2006, installed capacity doubled for four consecutive years, an explosive level of growth².

The rapid development of Chinese wind power in recent years has benefitted from both from the specific plan and the upgrading development assistance from local government. Power companies and manufacturers have therefore developed wind power confidently in China.

Original objectives revised

The rapid development of wind power is forcing China's original long term objectives to be constantly revised; indeed, China has now become the largest and fastest growing wind power generation market in the world. According to the statistics of the Global Wind Energy Council, the global cumulative installed wind power capacity has increased from 23,900MW at December 31 2001 to 486,749MW at December 31 2016, with annual growth rate at 22.25%. During the same period, the annual growth rate of China's cumulative installed capacity of wind power was 49.53%, ranking first in the world. In 2016, the new installed wind power capacity of China was 23,328MW, being 42.7% of global new installed capacity, making China the world leader. By the end of 2016, total installed wind power capacity was 168,690MW, being 34.7% of the world's installed capacity and the highest for any country in the world.

² The source for all statistics for this article apart from where specifically cited is the Global Wind Energy Council gwec.net/publication/global-wind-report-2/



Development of offshore wind power projects in China

As at the end of August 2017, there are 19 offshore wind power projects in China, with a total installed capacity of 4,799.05MW. These projects are located in:

- 7 provinces in China (Jiangsu, Fujian, Zhejiang, Guangdong, Hebei, Liaoning and Tianjin)
- 8 in Jiangsu with a total capacity of 2,305.55MW
- 6 in Fujian with total capacity 1,428.4MW
- 1 in Zhejiang, Guangdong, Hebei, Liaoning and Tianjin respectively

In these 19 projects the capacity of wind turbines (installed or planned) made by:

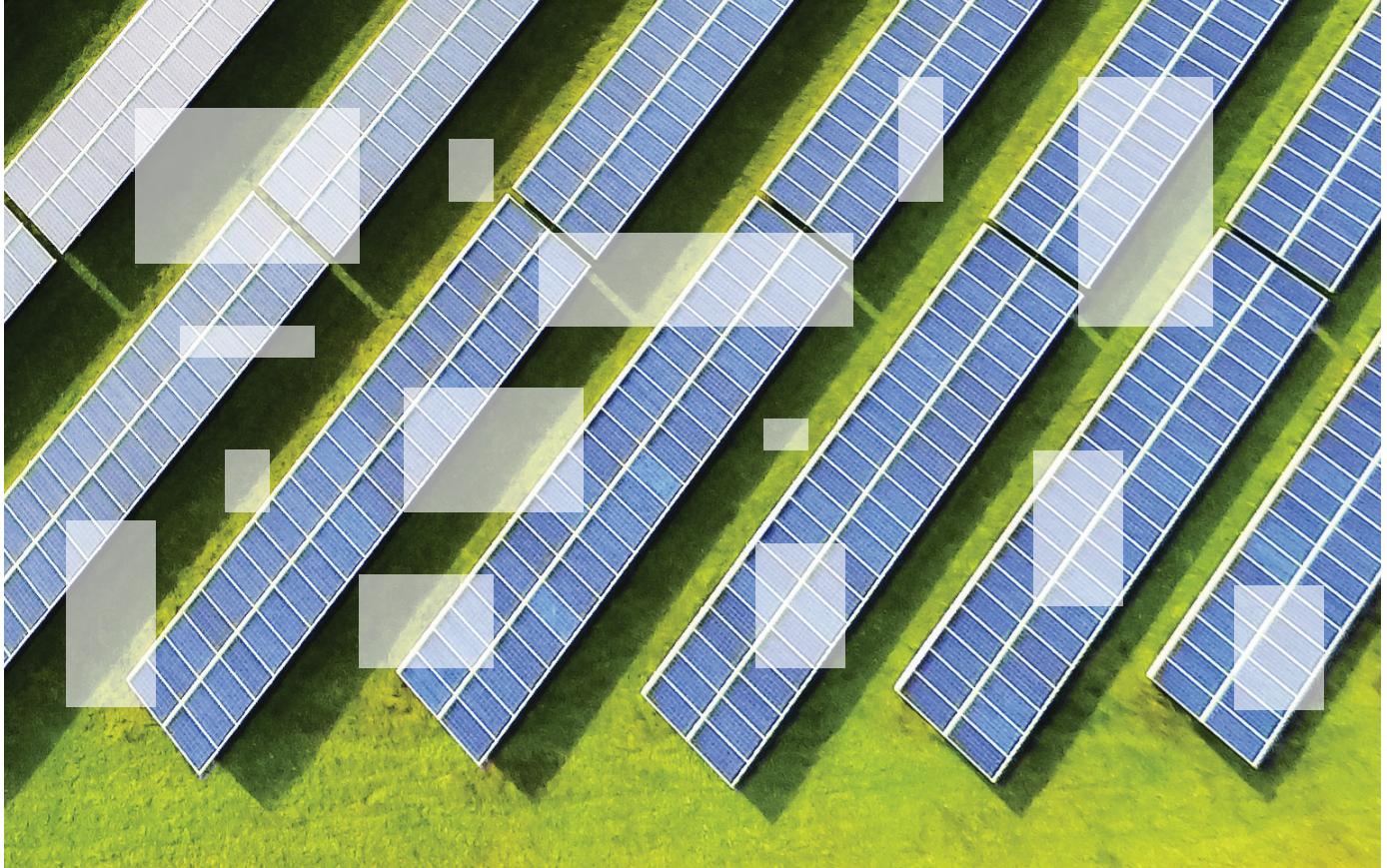
- Shanghai Electric (Siemens technology) is 2,232MW
- Goldwind is 964.15MW
- Ming Yang Energy is 567MW
- Envision Energy is 400.8MW
- China Haizhaung is 110MW

Huge potential resources

China has huge potential offshore wind power resources, especially in the eastern coastal areas around Shanghai. According to the Chinese government's renewable energy planning, offshore wind power projects will be located in coastal areas of Jiangsu, Shandong, Shanghai, Zhejiang, Fujian and Guangdong.

In 2016, more than 135 offshore wind turbine units were installed in China, with a capacity of nearly 600MW. The development areas of offshore wind power in the future are mainly concentrated in the economic developed eastern coastal areas. According to the Global Wind Energy Council recent report, the research shows that within 5 to 25 meters of water depth in coastal areas, at 50 meters above sea level, the capacity of wind power would be 200GW. The development of offshore wind power will not only meet the electricity demand of the eastern area with a combination of onshore and offshore wind power, but also accelerate the growth of China's renewable power generation."

"The development of offshore wind power will not only meet the electricity demand of the eastern area with a combination of onshore and offshore wind power, but also accelerate the growth of China's renewable power generation."



Reduced costs

With the investment and development of new technologies, the cost of offshore wind projects is being reduced. The offshore wind developers are facing more competition; according to the Chinese government development plan, the installed capacity of wind power will be 210GW by the end of 2020, including 5GW installed capacity of offshore wind power.

As the key part of China's "One Belt, One Road" national strategy for renewable energy, offshore wind power is an important factor which will promote the transformation of China's energy industry in these developed coastal regions. In May 2017, the government produced a proposal to speed up the research to develop the equipment and components of 5MW, 6MW offshore wind turbines.

Development of the solar industry in China

In 2016, the annual installed capacity of solar power in China was 34.54GW, with a total installed capacity of 77.42GW. New and total installed capacities are both world

leaders, which includes 30.3GW of ground solar farms and 4.24GW of distributed solar farms. The capacity of distributed solar farms has now grown by 200%.

As at the end of September 2017, newly installed solar power capacity in China is at about 42GW, having grown by 60%; this includes 15GW of distributed solar farms, representing a growth of more than 300%.

High efficiency, high quality

Under the Chinese government development plan, the Chinese solar industry is being developed with high efficiency and high quality in mind. Some poor quality solar farms will be eliminated; on the other hand, solar industries enterprises will further reduce the cost of solar power by the continuous innovation of technology. PV modules, systems, inverters, and electricity prices were reduced by 90%, 88.3%, 91.5% and 77.5% respectively in last 8 years. During 2016 -2017, the price of components decreased by nearly 21%.

Ray Zhang is Head of Power and Renewable Energy, Willis Towers Watson China

Managing risk through analytics: some fresh perspectives for the power industry

Introduction – a catastrophic hurricane season

This year's Atlantic hurricane season has brought a great deal of devastation to the Caribbean region and parts of the US. Puerto Rico faced three major hurricanes in a row, with the first Category 4 hurricane (Maria) to cross the country since 1932. With wind speeds reaching up to 160mph, Maria caused extensive damage to the island and its infrastructure including its power distribution network.

The hurricanes have prompted interest in ways of shifting island power grids toward greater reliance on renewable energy and greater power preservation techniques. Centralised power grids have showed deficiencies in resilience to storms and experts consider that smaller diversified grids could provide a solution and lower costs. Rebuilding the same type of power infrastructure could mean similar damage and destruction in the future and such reinvestment could prove unsustainable in the long run.

The impact of the recent hurricanes on the US power sector was also significant. Harvey caused outages to substations, power plants and transmission lines in Texas and along the US Gulf coast. Damage was caused by both the devastating wind forces and the widespread flooding, which some considered to be a '1 in 500 year' loss event (i.e. a 10% chance of this loss occurring within 50 years)³.

At its peak, over 10,000 MW were offline, fuel supplies were affected and personnel were not able to reach power generating facilities. Hundreds of high-voltage transmission lines, including several 345kV lines and more than two hundred smaller lines experienced storm-related outages. Outages were also reported for wind turbines which normally shut down at 55mph winds.

In the aftermath of such events companies often turn their attention to resilience. The best way to achieve this is through a holistic approach to risk - from analytics through insurance to managing the broader enterprise risks.

³Unless otherwise cited, sources for this article are from Willis Towers Watson, Washington Post, Reuters, Bloomberg, US Energy Information Administration and the US Department of Energy

The changing risk profile of the power industry

A more complicated energy mix

The changing power industry risk landscape is forcing power companies to radically re-think their business and operating models. We have seen players moving to a more 'retail' oriented mentality and investing in new technologies to reshape customers' experience. As the commercial viability of different renewables evolves, the energy mix is getting more complex. Companies are spreading their bets and this has significantly impacted their Capex and Research & Development (R&D) spending. There have also been increasing challenges to market position from several fronts: deep-pocketed oil and gas players seeking greater downstream presence and agile tech players and start-ups deploying technology to gain an edge.

Hard & Soft Risks

A power company's risk register will typically describe certain "harder" risks using financial measures and other, "softer" risks using qualitative measures.

Most companies employ analysts to measure particular "hard" risks such as commodity prices, bank loan interest rates, bond rates and currency fluctuations. Where financial instruments are available and cost effective, they will then decide the extent to which they wish to pay to hedge these risks.

These "hard" risks are characterised by an abundance of data and mature yet constantly developing risk

transfer markets. Analysts working in these areas look at historical experience, economic factors and exposure metrics to project how these risks are likely to develop over the coming months and years, and the range of volatility around these average expectations.

"Soft" risks tend to arise from many, volatile and opaque contributory factors, often including human behaviour such as financial crime, fraud, changing regulations and sanctions. Senior management, investors and local regulators want evidence that the company has a real understanding of both its upside and downside risks, with proper reference to the company's risk appetite.

Power companies are therefore increasingly asking the following questions along the transformation journey:

- Our company is a very different organisation now - how has this changed our risk profile? Is my insurance strategy still appropriate?
- As our reliance on technology deepens, what does this mean for our cyber risk? What does this mean for our reputational and operational risk?
- As our company evolves, what would happen if our employees' skills and capabilities do not realign to changing business needs?
- Are senior leaders fluent in the new realities of the business? How are the portfolio changes impacting the organisation's culture?

"The changing power industry risk landscape is forcing power companies to radically re-think their business and operating models. We have seen players moving to a more 'retail' oriented mentality and investing in new technologies to reshape customers' experience."

Quantifying Risks

"Our company doesn't need heavy-duty analytics - we're insured"

As illustrated in Figure 1 overleaf, insurance is just one means of risk management; while not addressing many of the key risks that power companies face, it can provide a financially efficient form of risk transfer for a range of risks from property to liability to D&O.

Today's processing power is sufficiently advanced and cheap to enable actuaries and catastrophe analysts to model more risks. The insurance industry is increasing its reliance on analytics to help them understand risks and to set pricing guidelines for their underwriters.

Fortunately, the power sector increasingly has access to the analytical

power and information to address this concern. Growing databases of client and industry loss and exposure information and sophisticated analytical and catastrophe modelling tools are enabling better risk models to be created, allowing companies to objectively answer the key insurable risk questions:

- What is the loss profile of the risks: how many losses are expected each year (frequency) and how large will they be (severity)?
- Are our assets and operations exposed to catastrophic hazards and climate risk and if yes, what could be the potential financial impact?
- How much risk should we retain, how much insurance should we buy and what should this insurance cost?
- How can I reduce my risk costs through alternative policy structures and risk mitigation?

Figure 2 – Indicative indication of what can be done (1) - loss forecasts and risk transfer analysis

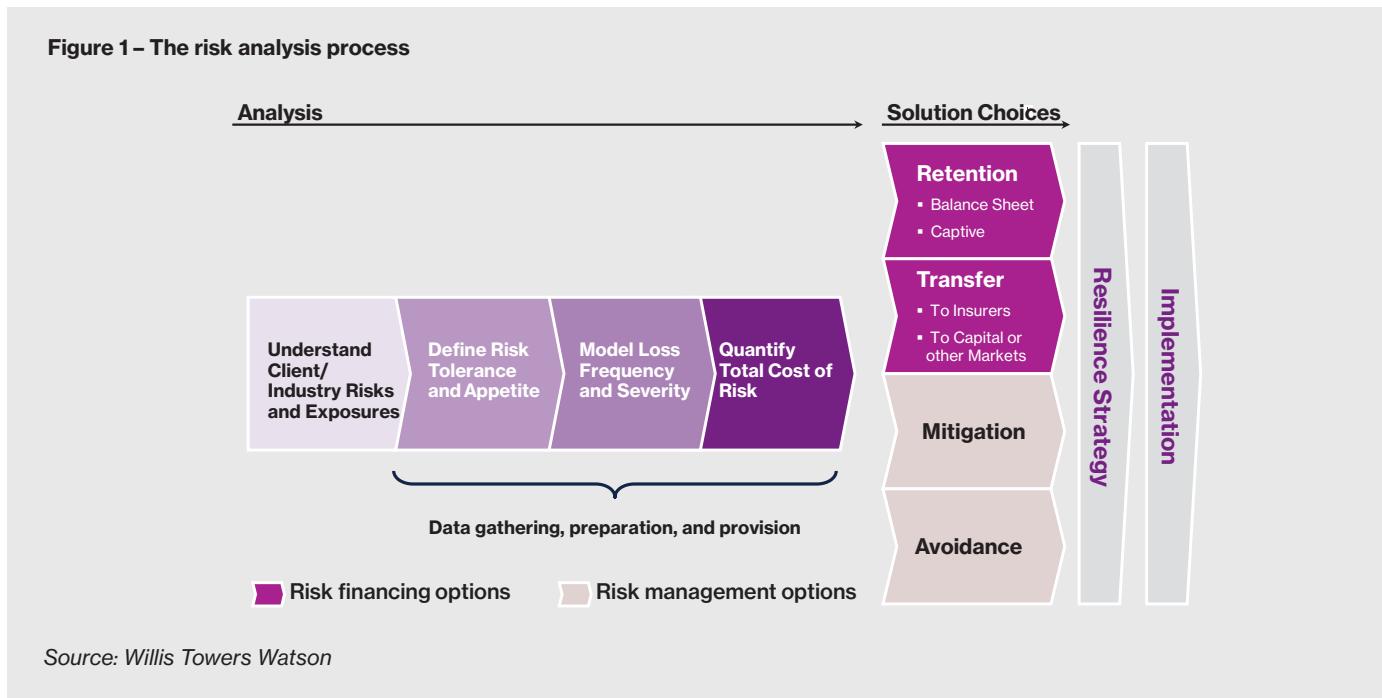
Return Period (Years)	Percentile	Gross Losses		Current Structure — BU \$0.5m, Captive \$5m/\$15m, Insurer \$800m				Reinsurers \$800m Limit
		Total Loss	Total Number	Retained by BU	Retained by Captive	Ceded to Insurers	Exceed Limit	
3 in 4	25.0%	14.79	16.00	3.74	8.05	0.22	0.00	
1 in 2	50.0%	28.96	19.00	4.91	12.99	10.54	0.00	
1 in 4	75.0%	57.39	24.00	6.19	15.00	37.94	0.00	
1 in 5	80.0%	68.27	25.00	6.54	15.00	48.47	0.00	
1 in 10	90.0%	111.88	28.00	7.54	15.00	90.74	0.00	
1 in 20	95.0%	167.61	31.00	8.46	15.00	148.69	0.00	
1 in 100	99.0%	411.34	37.00	9.96	15.00	389.97	0.00	
1 in 200	99.5%	566.76	39.00	10.65	15.00	545.04	0.00	
1 in 1000	99.9%	1,121.78	43.00	11.73	15.00	810.98	194.53	
Mean		53.14	19.95	5.06	11.25	36.12	0.72	
Std Dev		89.38	6.33	1.86	4.33	78.52	20.01	

The diagram illustrates the breakdown of aggregate losses across different retention layers. It shows a flow from total aggregate losses down to the insurance limit, with various retention points indicated by dashed lines and callouts.

- BU Deductible and Aggregate:** Could consider a \$7.5m stop loss aggregate, to be activated 1 year in 10.
- Captive Aggregate Retention Limit:** The annual aggregate retention of \$15m is expected to be fully exhausted once every 4 years. Potential dollar swapping with the insurers – claims are ceded every year. Could consider increasing its aggregate limit to \$40m.
- Insurance Limit:** Probability of the limit being breached is 1 in 1,000 years.
- Value for money of insurance:** Insurer's expected annual claims forecast as \$36.12m.

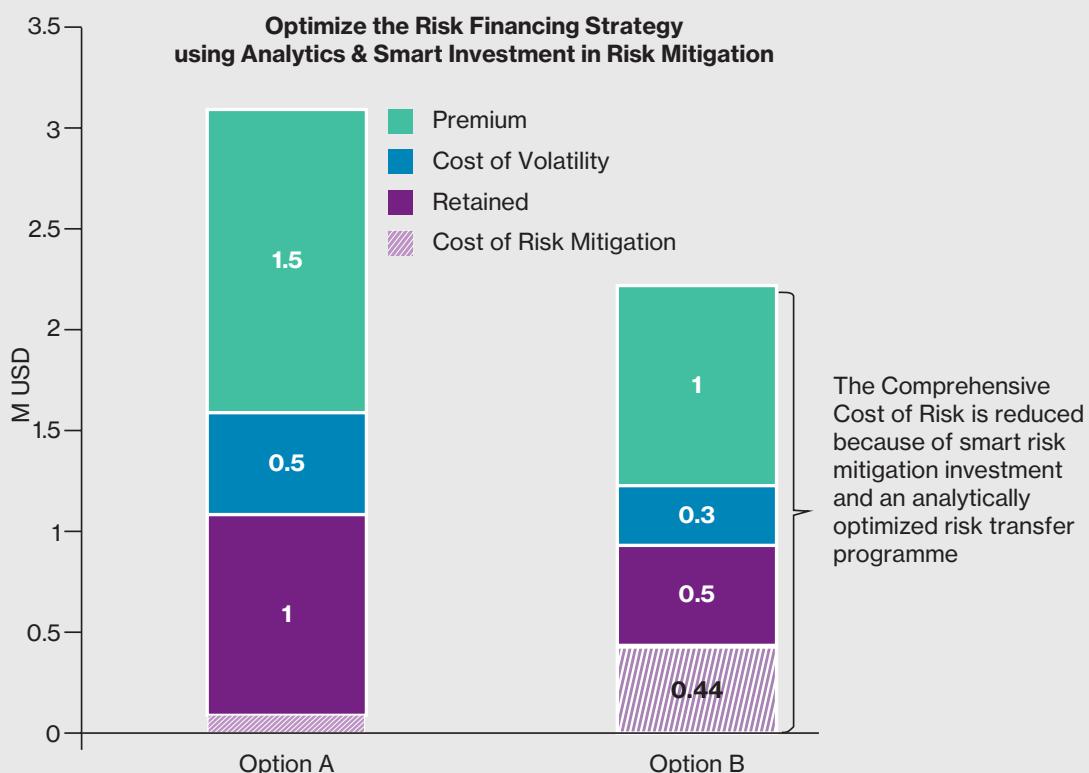
Source: Willis Towers Watson

Figure 1 – The risk analysis process



Source: Willis Towers Watson

Figure 3 – Indicative indication of what can be done (2) - Reducing the cost of risk through investments in resilience

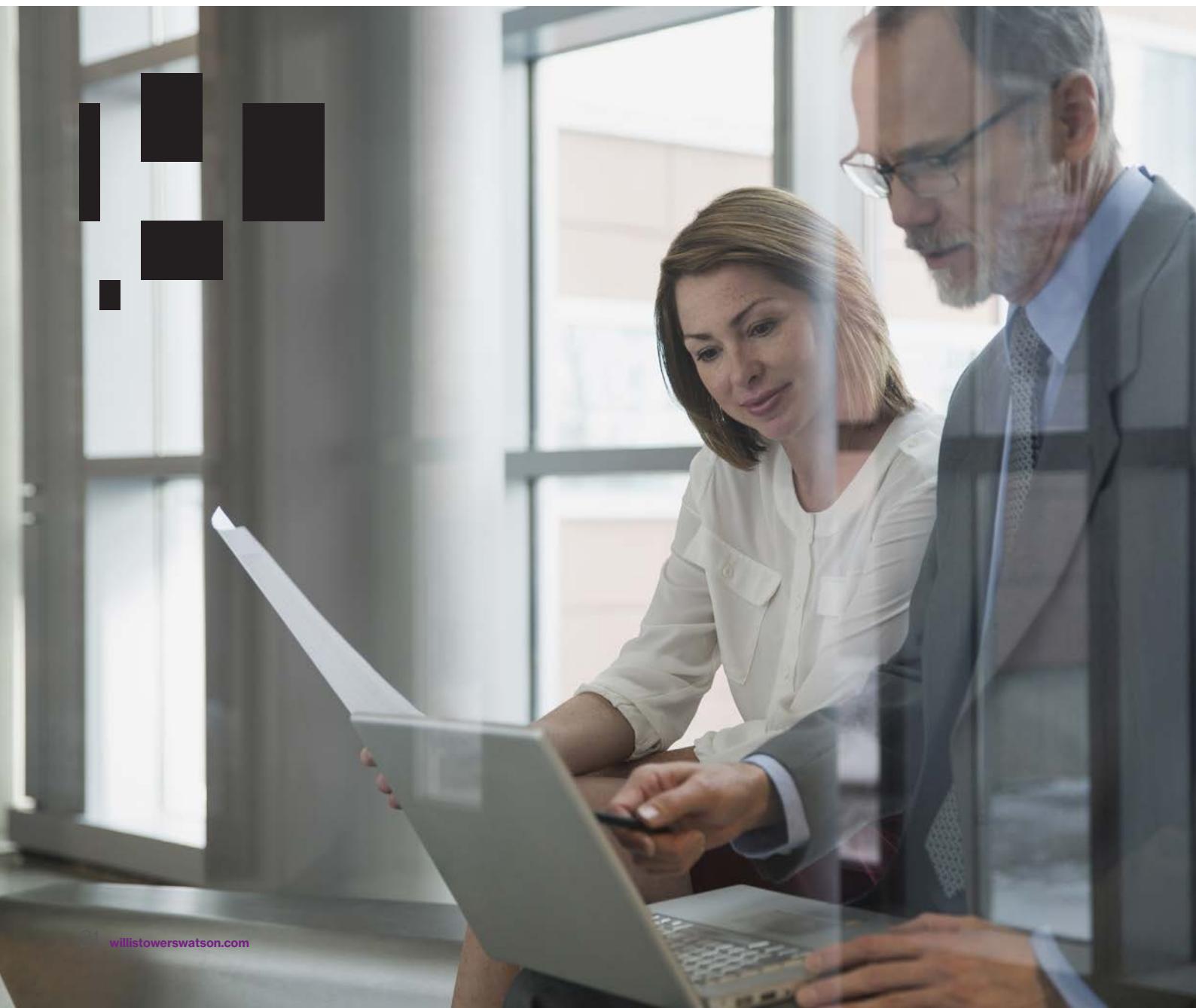


Source: Willis Towers Watson

Determining the most efficient risk financing strategy

An efficient risk financing strategy of a power company must align with the company's risk appetite and risk tolerances. Typically, there will be more than one strategy which satisfies these criteria, so the challenge is to identify the "optimal" strategy – i.e. the most efficient risk financing structure.

Considering all the insurable risks of a power company as a combined portfolio allows them to determine a credible selection of alternative risk retention and insurance strategies, each of which is on the "efficient frontier" for a given budget and level of residual retained risk.



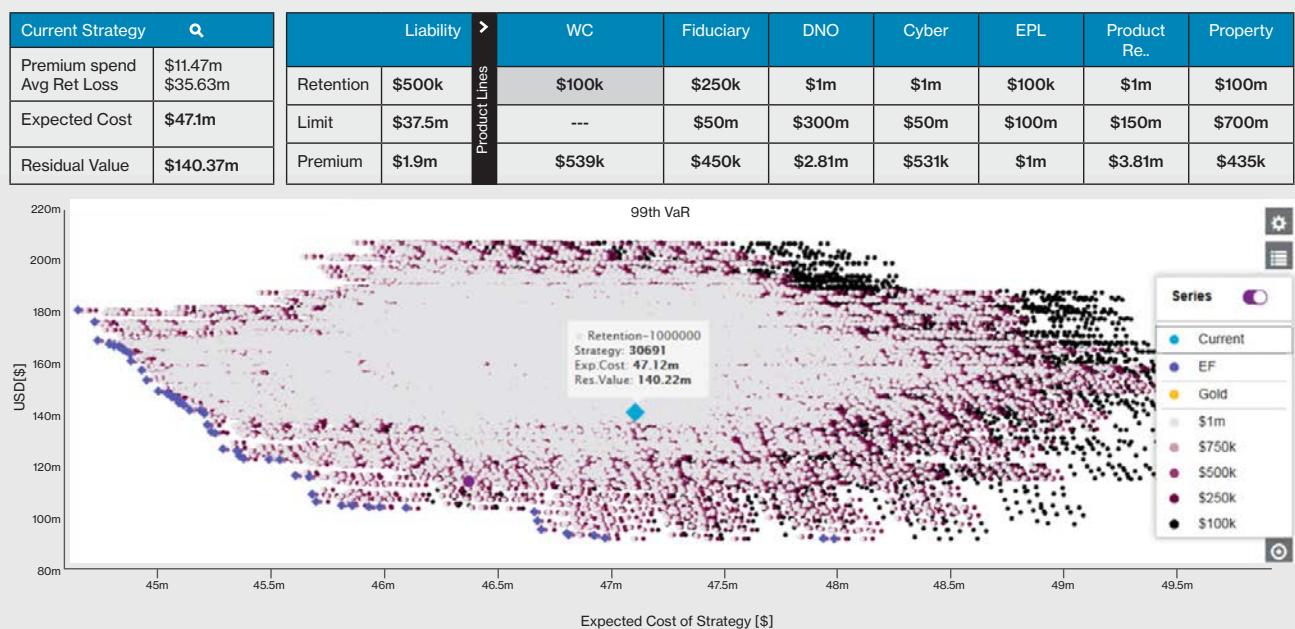
For large power companies, risk analytics is becoming an essential strategic resource and a corporate governance necessity. As more companies adopt this approach, so the body of risk data and quality of advice is developing and improving, to the benefit of the industry.

Managing enterprise risks

Analytics and insurance can help quantify and transfer risks; however, there is also a need to manage the broader non-insurable business risks.

Over the past year, we have seen several power companies trying to establish robust risk governance frameworks with clearly articulated organisational structures. This is necessary to enable organisations to improve the risk adjusted decision making and comply with general accepted risk management standards such as the updated COSO and the new ISO. Figure 5 is an example of a well-articulated Enterprise Risk Management (ERM) framework, and its elements, that power companies frequently use.

Figure 4 - Risk optimizer and the “efficient frontier”



Source: Willis Towers Watson

Figure 5 – Example framework for the power industry



Source: Willis Towers Watson

- 1** The organisation's ethics and expected behaviours are defined in the context of risk and regularly updated reports/ dashboards get communicated to the Board. Transparency and communication about risk is expected and monitored.
- 2** Quantitative and qualitative statements that clearly articulate Group's tolerance by fully reflecting its business strategy and financial goals (i.e. reframing risk in terms of performance). Group's tolerance should be cascaded and allocated to various business units, using metrics and language that are consistent with Group risk appetite. The BU's tolerances should be monitored and any breaches should be escalated, and where appropriate influence Group's strategy.
- 3** Stakeholders are identified, prioritised and documented and their focus/influence on the organisation is understood and incorporated in the risk appetite statement. The loss events and near misses are clearly communicated via well defined internal and external communication channels.
- 4** Group objectives and strategy are documented and communicated to employees. Risk is explicitly considered in the strategy and it covers, at least 2 dimensions; risk to strategy and risk of the strategy.
- 5** A well articulated corporate governance structure, that follows the 3 Level of Detail (LoD) model, detailing Terms of References (ToRs) and accountabilities, underpinned by a comprehensive risk management policy that explains the key elements of the organisations' risk management strategy.
- 6** Identification and quantification of the principal risks (both current and emerging) faced by the firm. Established processes and metrics in place to aggregate, prioritise and report risks on an individual and enterprise level.
- 7** The vulnerabilities, triggers, patterns and consequences of the risk drivers are defined and documented. Prioritisation of risks, based on residual impact, and action plans with clear ownership are in place and frequently reviewed.
- 8** Effective and efficient management reporting , enabling the timely monitoring of the key risks through early warning indicators.
- 9** Embedded and effective risk culture by having the right people in the right functions and incentivising them appropriately.
- 10** Appropriate infrastructure in place, to support the ERM and increase its efficiency.

Figure 6 – Achieving ERM objectives

Framework Element	Current Status				Improvement Planning		
	1 Basic	2 Average	3 Advanced	4 World Class	Priority	Timeframe (Months)	Resources
1 Culture, Commitment & Mandate					2 Medium	1 year+	1 Low
2 Stakeholder Definition				→	1 Low	1 year+	1 Low
3 Group Risk Appetite Definition					1 Low	6 to 12 months	1 Low
4 Clarity of Group Objectives and Strategy		→			1 Low	1 year+	3 High
5 BU Risk Tolerance Specification			→		3 High	0 to 6 months	2 Medium
6 Risk Policy			→		1 Low	1 year+	1 Low
7 Risk Governance	→				1 Low	1 year+	1 Low
8 Risk Identification					2 Medium	6 to 12 months	2 Medium
9 Risk Articulation					1 Low	1 year+	1 Low
10 Risk Quantification	→		→		1 Low	1 year+	1 Low
11 Risk Treatment & Improvement					2 Medium	1 year+	1 Low
12 Monitoring		→			1 Low	1 year+	1 Low
13 Communication			→		1 Low	1 year+	1 Low

The diagram consists of a grid of 13 rows and 8 columns. Rows 1 through 12 represent individual framework elements, and Row 13 represents a summary or final step. The first four columns represent the 'Current Status' (1 Basic, 2 Average, 3 Advanced, 4 World Class). The last four columns represent 'Improvement Planning' (Priority, Timeframe (Months), Resources). Arrows point from the 'Current Status' columns to the 'Improvement Planning' columns, indicating the direction of improvement. For example, for element 2 (Stakeholder Definition), there is an arrow from the '2 Average' column to the '1 Low' priority column. For element 4 (Clarity of Group Objectives and Strategy), there is an arrow from the '1 Basic' column to the '1 Low' priority column. For element 13 (Communication), there is an arrow from the '3 Advanced' column to the '1 Low' priority column.

Source: Willis Towers Watson

Establishing such a framework can be a challenging process and it requires a clear action plan with improvement points and defined timelines. To do that, an assessment of the current status of each ERM element against the desired - “fit for purpose” one and the global standards is required. A widely used framework from power companies that achieves the above objectives is demonstrated in Figure 6 above.

Power companies around the globe are trying to set appropriate risk appetites and tolerances that reflect their strategy, their business model and the environment in which they operate. In doing so, they are

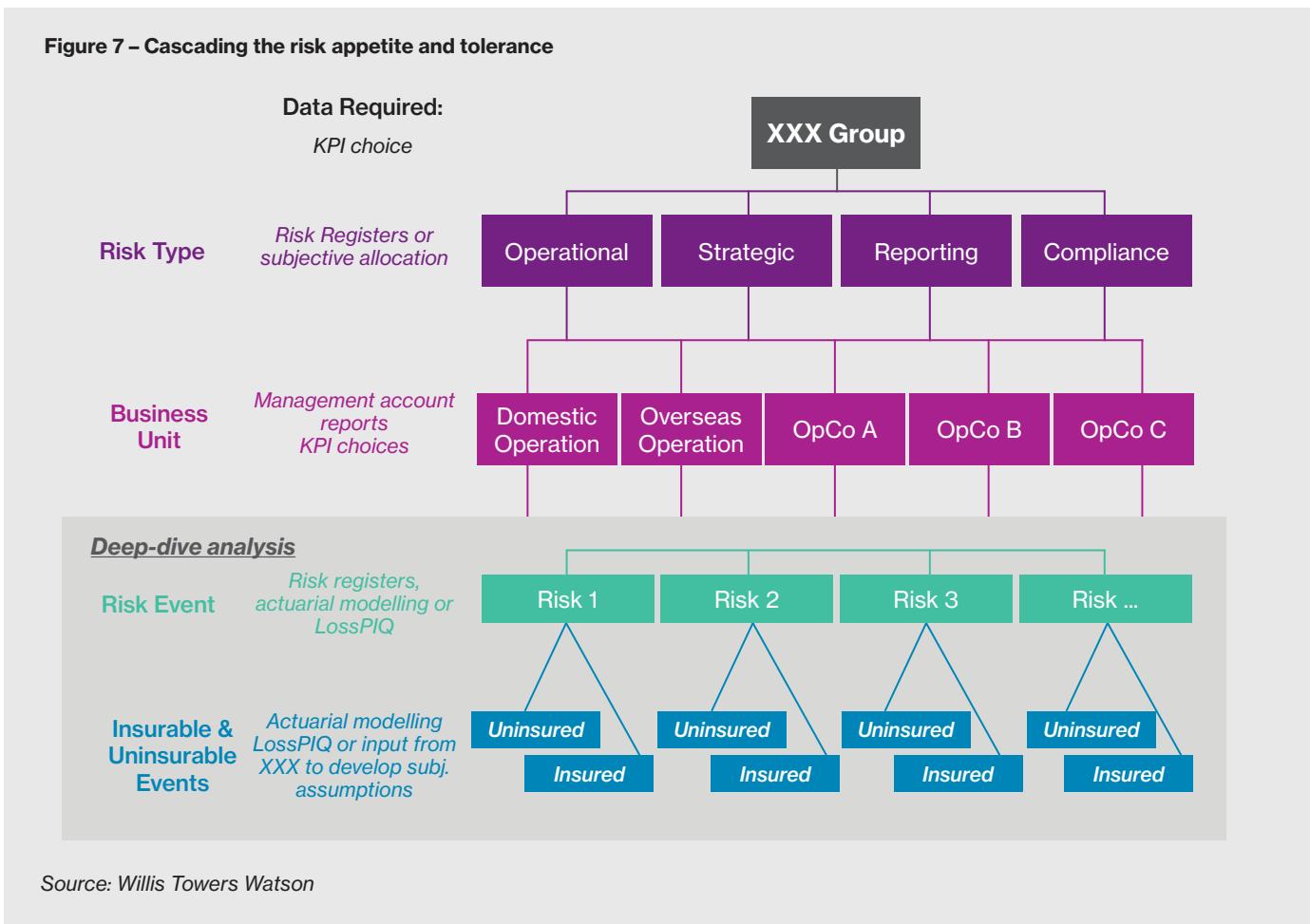
establishing financial and non-financial limits and tolerances against which their exposure to the major classes of risk can be controlled, measured and reported.

Cascading a high level risk appetite to more granular tolerances and allocating those to the different business units is a challenging process and the effort and time commitment that is required to complete this should not be underestimated. The outcome of this process however, enables organisations to link risk with their strategy and assess which business decisions are best aligned with their appetite and do not breach their tolerance.





Figure 7 – Cascading the risk appetite and tolerance



Source: Willis Towers Watson

Conclusion

It is becoming increasingly important to adapt to the new realities and manage change brought by adverse or favourable events. Analytics and risk management can help power companies to become knowledgeable risk takers, support the financially efficient transfer of risks where appropriate and forge bolder business visions and resilient organisations.

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Part Two: key industry issues

M&A and Private Equity (PE) investment in renewable energy: increasing the pace

M&A activity in renewables: market trends

2016 witnessed a record installation of renewable energy capacity across the globe of 138 gigawatts (GW) - nearly 11 GW more than in 2015. Growing capacity installation has been followed by increasing numbers of mergers and acquisitions (M&A) taking place in the renewable energy sector, with transaction volumes rising for a third consecutive year – reaching more than US\$110 bn in 2016, up by 17% compared to 2015¹.

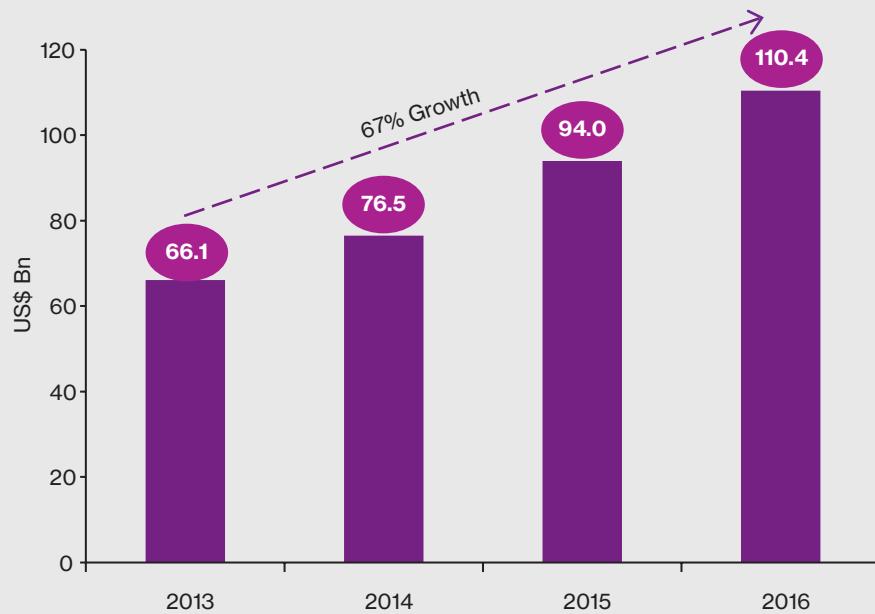
Confirming historical patterns, last year M&A growth in renewable energy was mainly driven by solar power, which increased by 43% to reach US\$44 bn. This was followed by a more moderate 12% growth in wind energy. Figure 2 shows us how historically wind and solar have dominated the renewable energy deal space, accounting for around 60% and 40% respectively of the total transaction values.

The Americas and Europe Middle-East Africa (EMEA) attracted the vast majority of M&A activity in the renewable energy sector in 2015 and 2016. However, the Asia Pacific (APAC) region has recently witnessed rapid growth in investments, registering an impressive growth rate of 27% in 2016 reaching a total of US\$15bn in new investments. According to forecasts made by Bloomberg New Energy Finance, it is expected that China and India will receive renewable energy investments of over US\$2tn and US\$800bn respectively up until 2040².



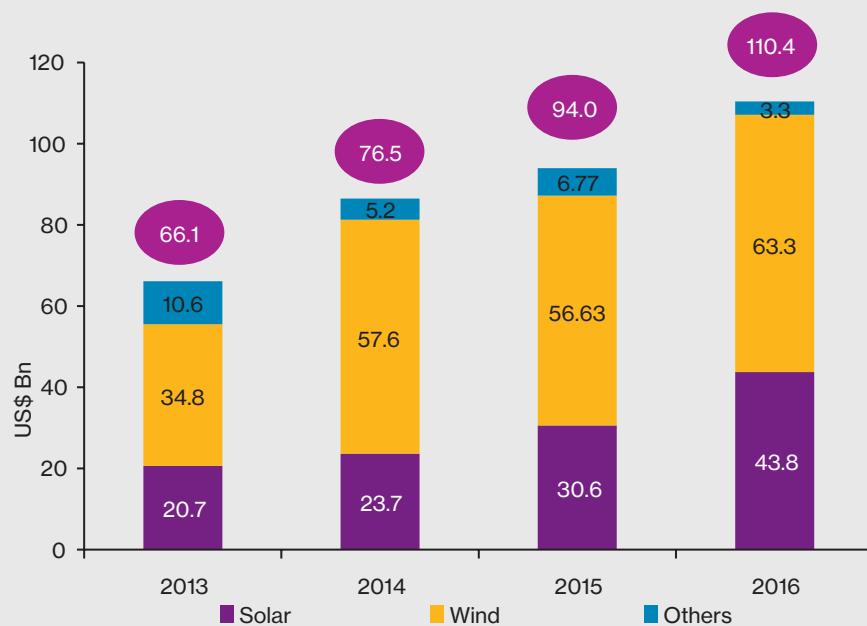
¹ Unless separately cited, all other sources for the statistics quoted in this article are from Bloomberg New Energy Finance New Energy Outlook 2017
² BNEF New Energy Outlook 2017

Figure 1 – Global M&A Transactions in Renewable Energy

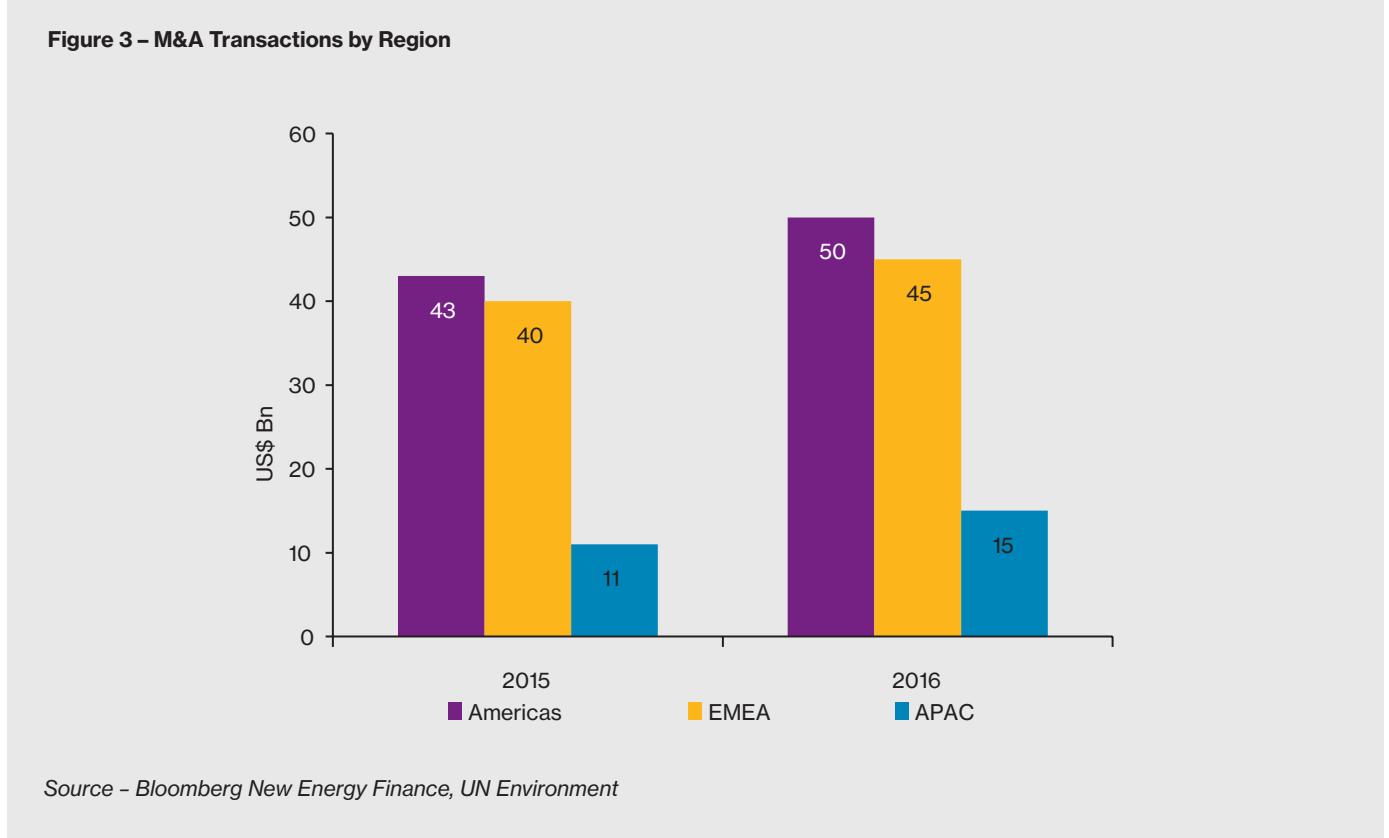


Source – Bloomberg New Energy Finance, UN Environment. Figures in circles are the total M&A transaction values

Figure 2 – Global M&A transactions in Renewable Energy by Sector



Source – Bloomberg New Energy Finance, UN Environment. Figures in circles are the total M&A transaction values

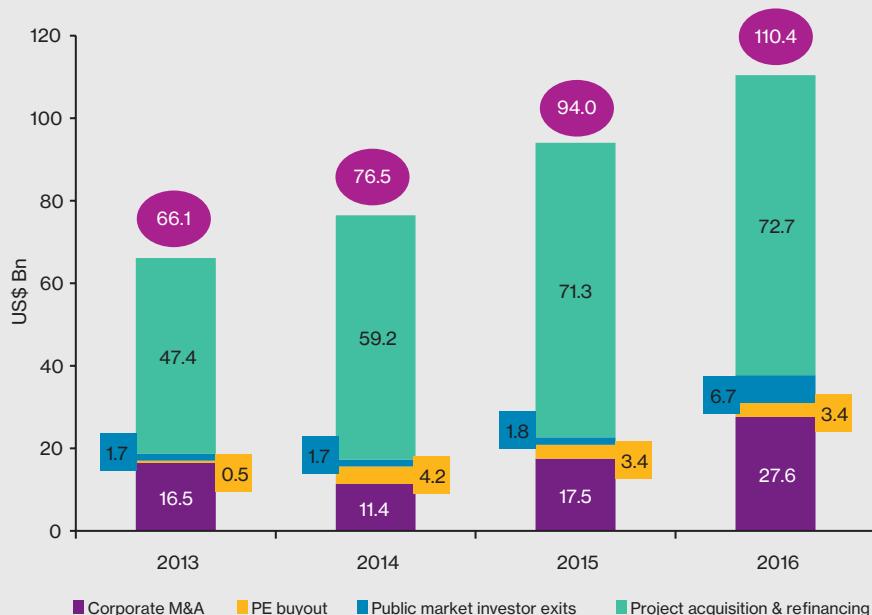


Corporates, alongside public market exits, were the main drivers behind growing M&A numbers during 2016, surging 58% to US\$28bn and tripling to US\$7bn respectively. However, at the same time project acquisition & refinancing and Private Equity (PE)/Venture Capital (VC) buyouts remained mainly unchanged compared to 2015. Despite this

somewhat muted development in 2016, data from Bloomberg New Energy Finance reveals that PE/VC activity has witnessed a surge so far in 2017, with investments already more than double those made in 2016. Conversely, other investor activity has either dropped or remained unchanged.



Figure 4 – Renewable M&A transactions by Investor type



Source - Bloomberg New Energy Finance, UN Environment. Figures in circles are the total M&A transaction values

Renewable energy and Private Equity: so far, not a story of true love

The story of Private Equity (PE) / Venture Capital (VC) investment in the renewable energy industry has so far not exactly been a story of true love. In 2016, total PE/VC

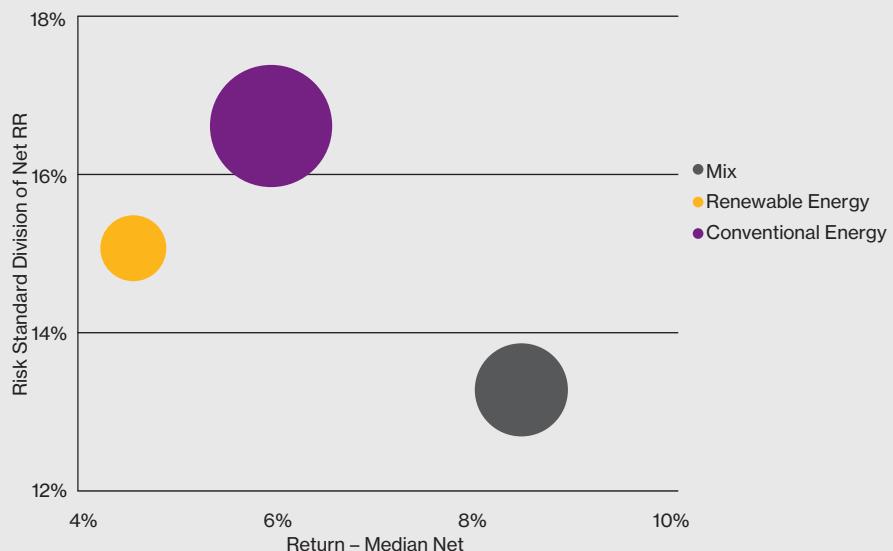
investment into renewable energy stood at US\$3.4bn – a mere 2%³ of total capital invested. Historically too, PE/VC investments has been quite low, amounting to around 3-5% of total M&A value. Instead, the majority of PE/VC investments in power have traditionally focused on fossil fuel-related assets⁴.

³ Global Trends in Renewable Energy Investment 2017 - Frankfurt School-UNEP Centre/BNEF (<http://fs-unep-centre.org/sites/default/files/publications/globaltrendsinrenewableenergyinvestment2017.pdf>)

⁴ Private Equity in Clean Energy Transformation – Imperial College (<https://www.imperial.ac.uk/business-school/intelligence/centre-for-climate-finance-investment/private-equity-in-the-clean-energy-transformation/>)



Figure 5 – risk/return of PE funds by type (vintage 2004-2014)



Source – Preqin

A number of reasons have been mentioned to date to explain the lukewarm relationship:

- **Low returns:** many renewables-focused PE funds have generated returns below median⁵ (see Figure 5 above). As an example, the recent performance of CalPERS Clean Energy and Technology Fund shows negative returns on 12 of its 14 investments⁶.
- **Long time horizons:** furthermore, renewables-focused PE funds have

achieved their target Internal Rate of Return (IRR) over investment periods of 14-16 years, which hasn't matched the traditional PE/VC sweet spot of 5-7 years.

- **Regulatory exposure:** over time, the investment case for renewable energy in most countries has been significantly affected by the granting and withdrawal of government tax credits or subsidies. For instance, feed-in tariffs prevalent in Europe and production tax credits in the US incentivize investments in renewable

⁵ Private equity retreats from renewables 'fad' (<https://www.ft.com/content/ef1b2248-94bb-11e3-9146-00144feab7de>)

⁶ <https://www.calpers.ca.gov/page/investments/asset-classes/private-equity/pep-fund-performance/fund&id=5>

energy. However, as investment periods are relatively long, the stability of policy and regulations is a risk that cannot be ignored⁷.

- **Output volatility:** renewable energy output greatly relies on the presence of wind, water flow, thermal heat and sunshine. Unpredictable weather has resulted in unwelcome output volatility, negatively affecting returns.
- **Uncertainty of operation and maintenance costs:** weather unpredictability has been further underlined by sometimes unreliable performance of the technology established to extract value from renewable energy assets, creating questions about operation and maintenance costs.

PE/VC investments in renewable energy going forward

However, the world of PE is changing. Record levels of raised yet un-invested capital (so-called “dry powder”) is pushing up asset prices globally while putting question marks next to the sustainability of current return levels. This effect is further exacerbated by the growing number of PE funds who are competing for the same available assets. As a consequence, it is highly likely that investment horizons will lengthen from the traditional 5-7 years to 10-12 years in order to allow fund managers enough time to make their hurdle rates.

Renewables investments to become more competitive

These overall developments of the PE industry might actually fuel PE/VC investment in renewable energy going

forward. Firstly, as expected PE returns may fall below the usual 20% mark from increasing competition, renewable energy investments are likely to become more competitive. Similarly, as longer investment periods materialize overall, renewable energy investments become comparably more attractive. Furthermore, institutional investors are also adapting their expectations – lengthening the time perspective of their investment portfolios.

Investments directed at wind and solar

At the same time, the renewable energy sector itself has undergone some significant developments. Moving on from biofuels, which were popular in 2006-2010 but generated significant losses, most PE/VC investments today are directed towards the solar and wind sectors which have proved more successful.

In parallel, there are risk management solutions available that could support further PE/VC investment into the renewable energy space:

- **Political risk insurance** can be used to mitigate the policy risk associated with the granting and withdrawal of government subsidies. For example, in the US, OPIC extends the coverage of its political risk insurance to offer protection against such risks for renewable energy investments⁸.
- **Parametric risk solutions** are an effective method to mitigate the potential weather volatility in power output. They limit the impact unpredictable weather could have on output, thus making expected cash-flows and returns more certain.

⁷ Private financing of renewable energy – A guide for policymakers (https://www.chathamhouse.org/sites/files/chathamhouse/public/Research/Energy,%20Environment%20and%20Development/1209_financeguide.pdf)

⁸ IRENA - Unlocking renewable energy investment (https://www.irena.org/DocumentDownloads/Publications/IRENA_Risk_Mitigation_and_Structured_Finance_2016.pdf)

- A number of insurers are now willing to take on the **technology performance risk** associated with renewable energy assets, thereby helping to facilitate investment. These solutions are discussed in further detail in the next article of this publication.

Overcapacity will lead to more M&A transactions

Global renewable energy capacity is expected to nearly quadruple from 2,082 Gigawatts (GW) in 2016 to 7,856 GW in 2040. Moreover, renewables are expected to surge from 31% of the energy mix in 2016 to 61% in 2040. With installed capacity rising, the sector is soon likely to face a challenge of overcapacity resulting in consolidation – leading to a rise in M&A transactions.

As the renewable energy industry matures, it will become increasingly attractive for PE investors, given their focus on financing more mature businesses that are seeking to grow and develop. Currently there is high demand from institutional investors such as pension funds to purchase operational projects. According to the latest figures from Bloomberg New Energy Finance, PE/VC investments have more than doubled from 2016 and stand at around US\$8bn by Q3 2017. With the renewable energy sector poised for growth, we expect private equity deals to surge even further.

Silvi Wompa Sinclair is responsible for Willis Towers Watson's Private Equity client development across the UK, EMEA and APAC.

"As the renewable energy industry matures, it will become increasingly attractive for PE investors, given their focus on financing more mature businesses that are seeking to grow and develop."





Private Equity investment in renewables: a role for insurance?

Introduction

In the previous article of this Review, we concluded that Private Equity (PE) and Venture Capital(VC) investment in the renewable energy industry has so far not exactly been a story of true love. A key factor constraining investment by PE/VC firms, as well as their own investors, is the perceived performance volatility of the industry. While the investment community is excited about generating more green energy, it is simultaneously concerned about the cash-flow volatility that such assets may experience. Investors are cautious as they evaluate projected cash-flows and worry about assuming the risk of potential underperformance. In this article, we discuss how innovative insurance solutions might help mitigate these concerns.

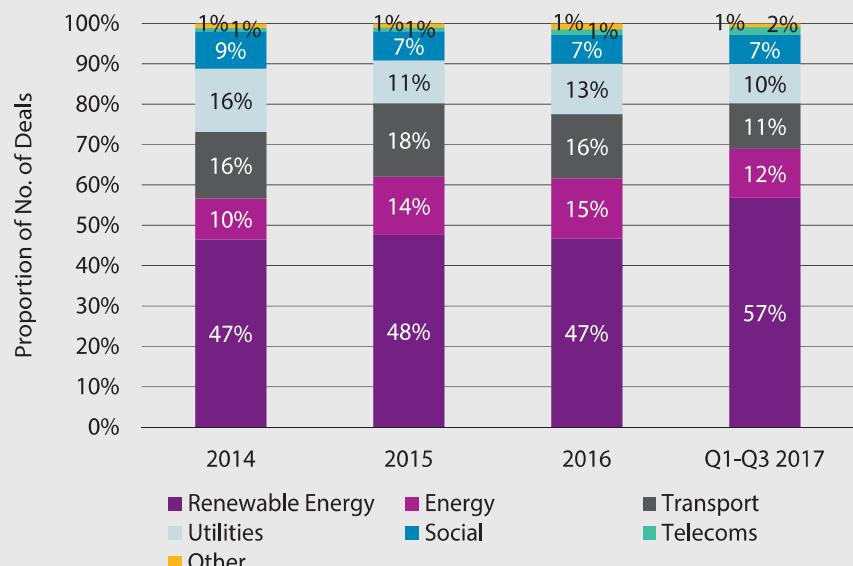
Two reasons for underperformance risk in renewable energy

For renewable energy assets, any potential underperformance emanates from two main factors:

- 1. Unpredictable weather.** More specifically, investors are concerned with the variability of power output which relies on the availability of wind, water, thermal and solar.
- 2. Variability in power output.** This can be due to the underperformance of new technologies that are put to use in these assets. Risks associated with technology performance can take many shapes. Will the technology perform as designed? Will it withstand the operating conditions where it is erected? What could impact the expected operating life of the asset? As long as such questions remain unanswered, they will keep a lid on potential investments.



Figure 1 – Infrastructure deals by primary industry, 2014 -2017 YTD



Source: Prequin Infrastructure Online

Answering questions related to expected performance

Owners and developers of renewable energy assets will provide prospective investors with in-depth studies that contain performance data (historic, from lab tests and field studies), third party engineering reports and detailed financial models that include extensive scenario analysis. PE investors are growing in sophistication in terms of evaluating these data sets and in judging project feasibility.

Recent transactions, such as the Global Infrastructure Partners and China

sovereign wealth fund's acquisition of a portfolio of Asian wind and solar energy projects from Singapore-based Equis Pte Ltd for US\$3.7bn, confirm that there is now a growing in-house expertise and comfort level to judge and evaluate the performance-related risks, which is enabling decisions to invest – indeed, data from Prequin Infrastructure Online confirms this trend. As a result, compared to the three previous years an increased number of investments in the renewable energy industry in 2017 can be observed, as shown in Figure 1 above.



How insurance can support renewable energy investors

Parametric solutions

Even with sophisticated ways to evaluate projected performance, there may still be risks that the investment community would rather not assume. In the 2016 Power Market Review⁹ the Alternative Risk Transfer team at Willis Towers Watson outlined how parametric solutions could be used to limit potential volatility in power output due to weather. This mitigates one of the concerns of the investment community by creating more certainty around output – thereby making related cash-flows more predictable.

However, the potential underperformance of new technology remains a significant concern for investors – a key short-term road block to more PE investment.

For example Gianluca Loria, Managing Director, Cenciarini & Co has recently commented:

“...the uncertainty generated by the potential impact of these events together with the small amount of data available on the actual performance of these emerging technologies, may explain why they constantly account for less than the 7% of the total number of Infrastructure deals and even less in terms of value.”

Insurance solutions

Addressing these concerns, a couple of large insurers have accelerated their offering in respect of technology-related risks. There is now a concentrated group of insurers that are willing to underwrite the technology performance risk for renewable assets and help facilitate the financing of such projects.

Leveraging insurer expertise to build comfort with technology performance risk

Insurers that are willing to take on technology performance risk in the renewable energy industry will leverage their internal expertise to contribute to the due diligence process. They will engage risk engineers who specialize in renewable energy technologies, underwriters with experience in the field and risk management consultants in order to evaluate the risk. Just like sophisticated investors, they will underwrite the technology risk based on historic performance data (including lab and field testing data), engineering reports, actuarial models and financial models.

So where PE and other investors may shy away, insurers are looking to participate in order to facilitate stable cash-flows and overall investment.

“So where PE and other investors may shy away, insurers are looking to participate in order to facilitate stable cash-flows and overall investment.”

Share risk with parties most comfortable to absorb it

Insurers can provide the crucial link between investors, owners and developers of new renewable energy technology. Owners and PE firms, as well as other investors, now have partners to help facilitate investment. These partners are willing and comfortable to evaluate the technology risk and lend their balance sheets to help absorb specific risks relating to technology-related underperformance.

Willis Towers Watson is excited to work with insurers as they move to fill this gap, remedying an inefficiency that is currently holding back investment in renewable energy. We strongly believe that this move can encourage more PE capital to enter the renewable energy industry. PE firms looking to acquire renewable assets, those who already own renewable assets and those looking to divest can all benefit.

An insurance solution can help facilitate deals by creating additional certainty for more risk-averse investors and consequently help drive the growth of renewable energy. We look forward to helping our partners structure these alternative risk transfer deals in the months and years ahead.

Silvi Wompa Sinclair is responsible for Willis Towers Watson's Private Equity and Corporate M&A client development across the UK, EMEA and Asia Pacific.

Jens Peters is a member of Willis Towers Watson Alternative Risk Solutions.

"Insurers can provide the crucial link between investors, owners and developers of new renewable energy technology. Owners and PE firms, as well as other investors, now have partners to help facilitate investment."

Battery storage: shaping the future of renewable energy

Introduction - the Lithium revolution

To increase reliance on renewable energy, we need to find ways to store it. Will the new range of battery energy storage systems provide what the world needs?

Jamestown, South Australia is a blip on the map; 200 kilometres from Adelaide and home to fewer than 2,000 people (as well as a lot of sheep). It's an unlikely place for a world first. But it is the site for the world's largest Lithium-Ion (Li-Ion) battery, built by US technology giant Tesla for French company Neoen's Jamestown wind farm. This 100 megawatt battery represents the evolution of a technology that will shape the future of renewable energy.

Promoted on a number of occasions by techpreneur Elon Musk, the battery represents a quantum leap forward for governments pushing greater uptake of renewable energy. This project is part of South Australia's ambitious A\$550 million push to solve the state's energy woes. Willis Towers Watson is proud to be the insurance advisor and broker to the Tesla project.

Renewables become economic

Power is being transformed: the energy and technology sectors are driving the transition from a carbon past into a green and clean future. Electrical energy from renewable sources provides great potential to meet today's and tomorrow's energy requirements in a sustainable manner.

In many jurisdictions around the world, prices for energy derived from the renewable sectors have started to decrease. In the UK for example, offshore wind energy has moved from being one of the most expensive forms of renewable energy to, in some cases, being cheaper than nuclear. Private investment is growing and government legislation is encouraging the move.

Wind and solar, as well as the longer established hydro, have been part of the renewable landscape in Australia and around the world for a significant period. The issue with wind and solar to date has been the inability to store the energy from these forms of generation, at a high enough level, to ensure stable supply.

BESS - the storage solution

The answer is Battery Energy Storage Systems, or BESS. Technology has come to the fore to develop such systems, but it has not been a linear progression; indeed there have been some spectacular failures that have blunted the risk appetite for some players in the insurance industry. Despite that, renewable energy insurance provider GCube estimates that, within the next five years, up to 4,000 MW of these systems are expected to be constructed¹⁰. There is clearly a growing market opportunity for insurers.

But Li-Ion technology appears to be developing at the fastest rate, driven by implementation costs that have been falling around 70% every 18 to 24 months¹¹. However, in future the cost saving is expected to slow.

¹⁰ http://www.gcube-insurance.com/en/news_en/understanding-the-practicalities-of-battery-energy-storage-systems/

¹¹ https://www.greentechmedia.com/articles/read/stem-cto-weve-seen-battery-prices-fall-70-in-the-last-18-months#gsl_3FQuY

Is BESS a bad risk?

The Kahuku legacy

Insurers have a long memory and the fire disaster at the Kahuku wind farm on the Hawaiian island of Oahu in 2012 led many to believe that battery technology is a bad risk.

That incident – the largest single loss recorded to date globally for a BESS – concerned a legacy-style lead battery rather than Li-Ion technology. Nevertheless, it has put risk management under intense scrutiny.

GCube research

GCube research shows the sector is now approached from two standpoints; ensuring that installations are designed and constructed with the best fire protection practices in mind and identifying factors that contribute to BESS failure, looking specifically at preventive measures.

Charlie Richardson, Senior Underwriter at GCube comments that “*whilst BESS is not new as a concept or indeed as a storage reality, it still presents a substantial risk for developers, investors and insurers alike. The unprecedented growth of renewable energy projects has more recently been coupled with an increased demand for grid stability, power on demand and energy storage capability in order to maximize grid availability, to address demand cycles and to prevent power outages.*

“This demand has driven a far greater interest in the sector from technology manufacturers and therefore of

increased production volume, the strive towards improved energy density and naturally a drive towards ever reducing costs per MWh of output. However, quality assurance concerns remain in what is still a fragmented and relatively immature market of suppliers and installers with varying levels of expertise, professionalism and financial standing.

“Moreover, BESS is increasingly prevalent in areas with weaker grids, notably remote locations or island based projects that present limited specialist labour pools, longer lead replacement times and, often, higher natural catastrophe risk. Ever since experiencing a very large BESS fire loss in 2012, GCube has been working closely with technology manufacturers and developers to deliver a well risk managed, suitably protected and ultimately an insurable BESS format for projects around the world.”

Recent advances

Michael Stuckings, operations vice president, group manager, field engineering for FM Global, one of the world's largest commercial and industrial property insurers, says there have been many advances in battery management systems that control the operation, safety and long-term reliability of the BESS.

“Lithium-ion battery energy storage systems have been leading the market in new installations of the past few years and continue to grow in market share,” Stuckings said. “Most systems we see now use this technology, and a lot of effort has been undertaken by the industry to understand the risks posed by BESS.”



Understanding the Li-Ion risk

FM Global has extensively researched Li-Ion technology, coming up with a property loss prevention data sheet for electrical energy storage systems. As with any new technology, it is critical for the insurance industry to understand the type of system being constructed and develop knowledge of the differences in failure modes associated with different types of batteries.

The Tesla battery is a giant, modularised Li-Ion battery. While Elon Musk, ever the showman, describes it as something 'sculptural' and likely to become 'a tourist attraction' for Jamestown, there's no surprise that the installation is in a largely remote

part of Australia with a low population base. In short, any battery system has a risk of fire, but understanding what may trigger a problem and designing to avoid catastrophic situations such as in Oahu are paramount.

There are many different types of energy storage systems. Electromechanical systems include Li-Ion batteries and the still developing technology of metal-air batteries (an electrochemical cell using an anode made from pure metal and an external cathode of ambient air). Thermal storage systems include the molten salt system seen in thermal power plants. A pumped hydro system is an example of mechanical storage.

Thermal runaway reactions and key variables

Without commenting on the design of the Tesla project specifically, Stuckings says the key difference with Li-Ion batteries from a risk perspective is that they are susceptible to “thermal runaway reactions”.

“These may be caused by mechanical damage of the cells, over voltage, over temperature but also under temperature,” Stuckings said. “During a thermal runaway event, the cell produces gas that builds up within the cell enclosure, and without prompt action, thermal runaway can cascade from cell to cell, causing much more damage.

“That said, regardless of the technology there are a number of key variables to consider when evaluating the risk profile of a BESS. Obviously the equipment protection or safety devices are a key element to ensure a safe shut down in the event of an upset condition, and there should be no single point of failure. For Li-Ion batteries the handling is much more critical to avoid any mechanical damage.”

Fire exposure dependent on technology

According to scientific research conducted by FM Global, the fire exposure is dependent on the technology and arrangement of the

cells – the cell and case material, the number in a module or rack, and the proximity of racks to each other. “The heat associated with a battery fire is intense, meaning if a large number of cells are close to each other a fire could destroy a large portion of the BESS,” Stuckings said. “That is why data sheet 5-33 ‘Electrical Energy Storage Systems’ recommends appropriate segregation between BESS enclosures, or groups of enclosures, and buildings or critical site utilities, provided by either a minimum space separation of six metres or thermal barriers such as concrete block walls.

“In any event, to assess a site’s risk quality we would have one of our specialist engineers visit and review factors such as construction, battery management systems and safety devices, fire protection, asset integrity management programs, contingency planning and natural hazard exposures.”

Making energy storage happen - and the risks involved

Battery storage systems can be either a standalone installation or a hybrid system connected with complementary technologies such as wind turbines or solar installations. Implementing an energy storage system has complex deployment considerations intertwined with its own unique risk characteristics.

Recent developments

Storing energy is still a missing link for most renewable power installations across the world, but there are rapid developments in the US and Europe as well as research and start-up companies who may fill that gap. FM Global's Andrew Stafford, vice president, client service manager, says it's important for the industry to understand the strengths and weaknesses of any type of BESS:

"An additional factor to be considered is the long-term reliability and availability of these systems, which, given the recent rapid developments, has obviously not been proven. I am confident that the market will adopt the appropriate technology to meet the end-users' needs in Australia."

Track record issues

The lack of a good track record is also an issue for insurers. While some insurers "got burned" with the Oahu disaster and part of the industry is still second guessing itself on this sector, Li-Ion technology has had sufficient growth over the last five years to give the industry some confidence that it will be able to perform in accordance with its specifications.

It should be remembered that renewable energy technology itself carries a significant level of risk; early

underwriters of solar and wind risk would have also been impacted by losses and there are insurers who have since opted out, only willing to put their capacity to traditional thermal or hydro-electric generation. Hydro may be considered a renewable but it is a mature technology.

Conclusion: working together

FM Global's Stafford believes it is important for insurers, brokers and clients to work together to understand the risk associated with this developing technology – enabling the end-users to ensure appropriate mitigation strategies are used in their projects:

"While we really can't speak for the insurance sector as a whole, we have a history of research and collaboration with key industrial organisations. When translated into sound loss prevention practices at a client's facilities, this knowledge should help prevent and mitigate loss and ultimately build a more resilient business - the end result being the ability to provide a tailored, cost-effective insurance and risk financing solution."

Martyn Thompson is Australasia Regional Industry Leader, Natural Resources, Willis Towers Watson

"Storing energy is still a missing link for most renewable power installations across the world, but there are rapid developments in the US and Europe as well as research and start-up companies who may fill that gap."



Hot rocks: the rise of geothermal energy

Introduction - the heat of the earth

The flow of heat from the earth's interior to the surfaces is immense; it is estimated to be around 47 terawatts (TW). Despite solid geothermal energy potential in 90 countries, obstacles such as policy uncertainty, licensing delays, high upfront costs of drilling and exploration risks has limited development to just 24 of those countries and a combined installed power generation capacity of just 13,270 MW¹².

If you have ever seen the geysers in Rotorua (New Zealand) and Yellowstone Park (USA), you will appreciate the immense power

and heat that the earth possesses. Geothermal power is witnessing a rapid growth worldwide - 14,165MW is currently in development and this number could more than double in the coming years.

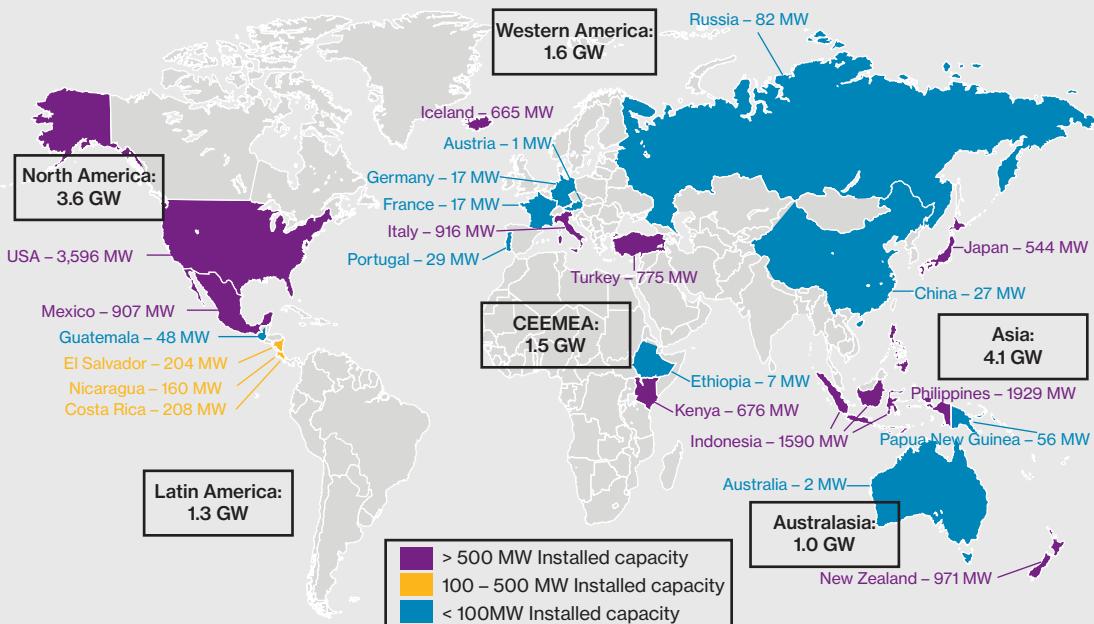
The nature of extracting heat from the ground is a complex and risky endeavour. One of the major hurdles that the industry faces is commonly seen in the oil and gas sector - exploration and drilling risks, searching for the resource and ultimately tapping into it. These activities are deemed below ground risks, an area for which the insurance sector has been hesitant to provide cover.

¹² Think Geoenergy , "Overview on installed geothermal power generation capacity worldwide," [Online]. Available: <http://www.thinkgeoenergy.com/overview-on-installed-geothermal-power-generation-capacity-worldwide/>. [Accessed 31 October 2017].

Figure 1 – 2016 Geothermal installed capacity in megawatts (MW) and Gigawatts (GW)

The US has the largest geothermal capacity followed by the Philippines Indonesia and New Zealand

2016 Geothermal Installed Capacity, in Megawatts (MW) and Gigawatts (GW)



Source: BP Statistical Review of World Energy 2017

The geothermal market

At 0.3%, the geothermal share of global power generation is very small, but in certain countries it plays a significant role in the power supply - for example Kenya (44% of power), Iceland (27%), El Salvador (26%) and New Zealand (18%). The United States is the single biggest geothermal power producer as a country, with just over 3,500 megawatts of installed capacity, although this only contributes around 0.3% percent of the nation's power - over 80% of this is installed in California. Asia has the largest number of projects in the pipeline by

both volume and value, with almost 60% of these projects in Indonesia. Both California and Indonesia lie on the Pacific "Ring of Fire".

The growth in new capacity will most likely come from Europe, East Africa, and the South Pacific. Overall capital expenditure on Geothermal in the next 13 years could range between US\$100bn and US\$300bn* (based on world energy council estimates & ~ USD 5,000 per KW). Opportunities primarily exist in developing economies such as Indonesia and Kenya, where energy demand is rising and geothermal resources are plentiful.



The Kenyan government aims to have 1,500MW of geothermal capacity by 2019 and 5,000MW by 2030. Indonesia's geothermal industry is set to grow rapidly over the coming decade, as the strong project pipeline of geothermal facilities is gradually commissioned. There is around 2GW of geothermal capacity in various stages of development in Indonesia, with over 30 developers. However, these markets are facing a number of difficulties in geothermal development due to lack of sufficient funding and insurance.

Clean sustainable energy

Geothermal energy is the energy stored in the form of heat beneath the earth's surface, so the intensity of this heat increases with depth, on average by 25-30°C/Km, the geothermal gradient. Therefore the deeper you drill, the greater the energy potential but also the greater potential for drilling complications.

This energy source is a carbon free, renewable and sustainable form of

energy. It can provide a continuous, uninterrupted supply of heat for a range of uses, including power generation and directly property heating, district heating, agriculture and laundries.

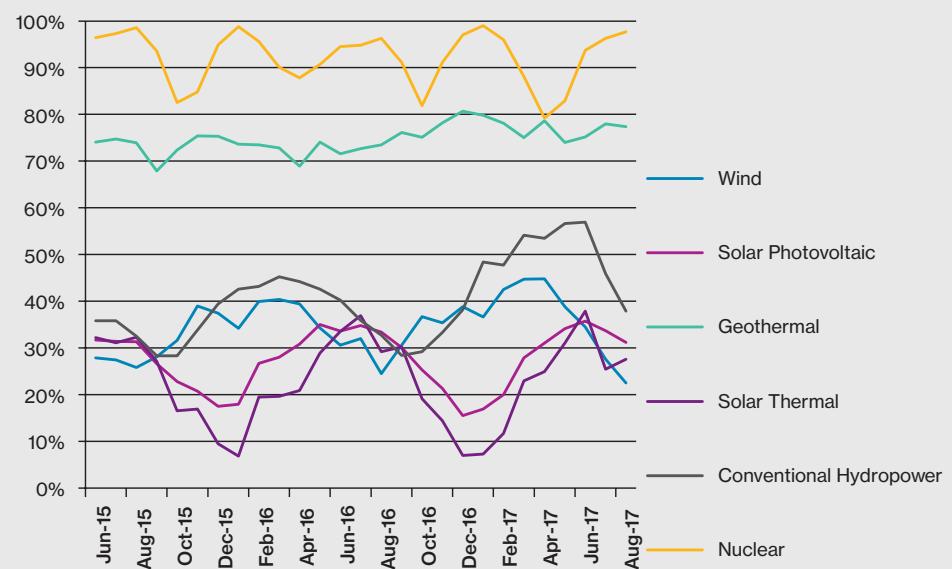
Geothermal energy is available at all times of the day, which means that a Geothermal plant has the ability to produce power at a much higher capacity factor than wind or solar. In other words, geothermal produces significantly more electricity per MW of capacity¹³. According to EIA data, the annual capacity factors for geothermal sites is around 74%; this is in contrast to Wind, which produces at around 34% of its theoretical maximum whilst solar PV comes in at around 26.5%¹⁴. This advantage can be useful for bulk power supply in similar way to a coal power plant. When operational, the running costs are generally low and predictable, which means when selling at a set price the plant can offer a guaranteed return on investment.

¹³ BP , "Geothermal power," [Online]. Available: <https://www.bp.com/en/global/corporate/energy-economics/statistical-review-of-world-energy/renewable-energy/geothermal-power.html>. [Accessed 31 October 2017].

¹⁴ U.S. Energy Information Administration , "Capacity Factors for Utility Scale Generators Not Primarily Using Fossil Fuels, January 2013-August 2017," [Online]. Available: https://www.eia.gov/electricity/monthly/epm_table_grapher.php?t=epmt_6_07_b. [Accessed 30 October 2017].



Figure 3 – Capacity factors for utility scale generators



Source: EIA data

Power from the earth - methodologies

The most common way of capturing energy from geothermal sources is to tap into naturally occurring hydrothermal convection systems. Cool water seeps into the earth's crust from the surface and rises back up as steam or heated water. When this reaches the surface, the heat is captured and used to drive a turbine connected to a generator, thereby producing electricity. This can be done with Flash Steam and Binary Cycle systems; however, when there is local heat but no natural fluid deposits, synthetic geothermal systems can be engineered. This is done by injecting pressurised water deep underground, known as Engineered Geothermal Systems (EGS).

Flash Steam

This system is generally associated with higher temperature geothermal sources (>180°C). As the pressure of the sub-surface environment is much greater than at the earth's surface, water can exist as a liquid at much higher temperatures. This high temperature, high pressure water can be drawn to the surface, and when it enters a low pressure chamber is 'flashed' into super-heated steam. This steam is passed through a turbine, which then spins to generate electrical power.

Binary Cycle

When temperatures are too low to 'flash' water into steam, the heat of water must be transferred to a different liquid (a 'working fluid' with a lower boiling temperature). The hot water is brought to the surface and passed through a heat exchanger; this transfers the heat from the geothermal water to the working fluid. The working fluid will vaporize into a gas to drive the turbine producing electricity.

Engineered Geothermal Systems (EGS)

For geothermal hotspots where there are limited or no underground reservoir fluid deposits, an engineered geothermal system (EGS) can be created. An EGS typically involves three key steps¹⁵.

1. A borehole is drilled into the fractured rock to a depth where high temperatures can be found (150-200°C).
2. Water is then injected at a high pressure to ensure fracturing, or to open existing fractures.
3. The original borehole now becomes the injection well whilst a second borehole is then drilled into the reservoir to act as the production well. The water is recovered as the surface as hot water/stream and used for electricity generation.

¹⁵ British Geological Survey , "Geothermal energy – what is it?," [Online]. Available: <http://www.bgs.ac.uk/research/energy/geothermal/>. [Accessed 31 October 2017].

Insurance Shortfalls

Finding a viable resource

The key area where the insurance industry currently falls short is geothermal exploration risk. Exploration risk is the risk of not finding a viable resource with firstly an output, and then secondly the desired output; this makes for a complex risk profile and volatile planning. If geothermal resources are not found and/or do not deliver a useable output, all investments in the project can be lost. External research has shown us that the approximately 1 out of 3 3MW wells fail, while about 25 % of wells below 1MW are dry - this presents a huge hurdle before construction even begins. Drilling costs represent around 30% of total investment and can be higher in ECG projects.

Financing challenges

The uncertainty surrounding the success and substantial costs of geothermal reservoirs has made many good-quality geothermal projects difficult to finance, with lenders being unwilling to lend and developers often having insufficient equity to finance the projects.

A lifecycle solution?

Munich Re has made an attempt to plug this hole in insurance provision by creating an exploration risk product; however, with limited insurers available to commit capacity we have seen this product under-utilised.

Willis Towers Watson is proactively looking to fix this; we are building a product to cover the lifecycle of a geothermal product, from the drilling to the construction, operation and decommissioning in the coming decades. This will mitigate both exploration and project lifecycle risk through a combined insurance solution. The product will reduce financial planning uncertainties thereby attracting the traditional capital markets, private and institutional investors to the geothermal market by improving risk-adjusted returns.

Steve Munday is Head of Renewable Energy, Willis Towers Watson Natural Resources

Anastasia Ioannou and Myles Milner are members of the Renewable Energy team at Willis Towers Watson Natural Resources

"We are building a product to cover the lifecycle of a geothermal product, from the drilling to the construction, operation and decommissioning in the coming decades."



Critical materials risk in the low carbon supply chain

Renewable energy and low carbon technologies address environmental and resource concerns when they produce electricity. They produce hardly any greenhouse gases, or radioactive waste compared to conventional power generation methods. They obtain “clean energy” from sustainable wind, sun or oceanic sources.

How green is green?

But how clean is it really? How green is green? Willis Towers Watson has been researching this sector to understand the critical raw materials in the supply chain for low carbon technologies. Our research has shown that our current generation of renewable energy technologies relies on a set of critical materials. We looked at these in depth to understand where they come from, how they are taken out of the ground

and how their price has changed over time. We have found that concerns have been raised about the supply of these critical materials; this supply vulnerability/risk primarily stems from a variety of political, economic and social factors. These are risks that our clients and the wider sector should be thinking about.

Increased demand

So what are the critical materials and why do they matter? These are a mix of rare-earth metals (REMs), other non-rare-earth metals and minerals. These have applications in permanent magnets of wind energy generators, photovoltaic cells in the solar industry and in both utility and electric vehicle battery energy storage systems. As the low carbon sector continues to grow, the demand for these is only expected to increase.



Figure 1 – Critical metals and associated carbon technology

Critical metal	Associated low carbon technology
Rare Earths: Neodymium (Nd), Dysprosium (Ds), Praseodymium (Pr), Cerium (Ce), Samarium (Sm), Lanthanum (La)	Wind turbines and electric vehicles
Gallium (Ga)	Thin-film solar panels
Tellurium (Te)	Thin-film solar panels
Indium (In)	Thin-film solar panels
Lithium (Li)	Lithium-ion batteries
Cobalt (Co)	Lithium-ion batteries
Germanium (Ge)	Thin-film solar panels
Selenium (Se)	Thin-film solar panels
Platinum group metals	Hydrogen fuel cells

Source: Willis Towers Watson

China - political intervention

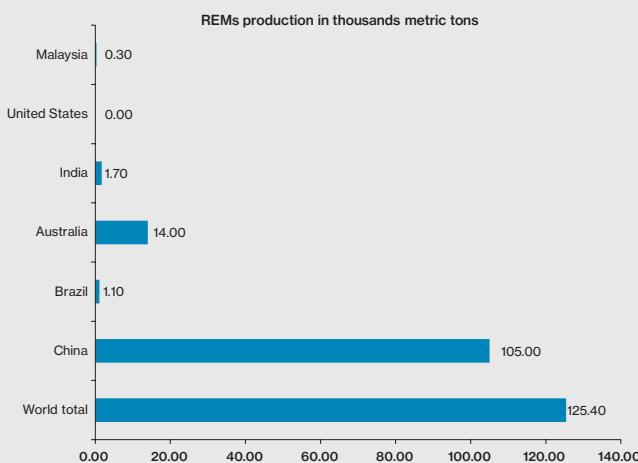
China has been the primary producer of REMs (84% of global production in 2016); however, political issues have posed a threat to their global supply over the past few decades. These were principally driven by concerns about reserves and future supplies, emerging environmental protection policies and measures against illegitimate rare earth metal mining. In the late 2000s, the sector's reliance on China as a supplier was brought the industry's sudden attention when prices began to rocket as a result of declining export quotas¹⁶; this change in approach has already caused shocks within the market. The price of Neodymium (which is used in magnets) rose nearly 400% between 2010 and 2011.

So if you are an industry reader of this Review, is your supply chain prepared for such a sudden rise in raw material costs if more restrictions are implemented?

Growth of the industry

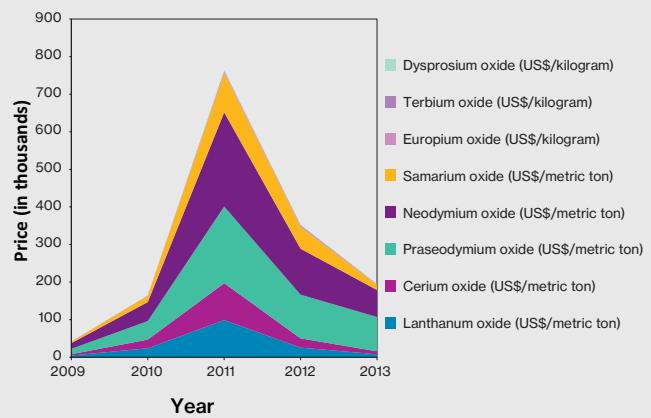
Among other factors, future demand for critical materials is expected to greatly depend on the deployment levels of low carbon energy technologies, as well as the material intensity of these technologies¹⁷. Demand for solar PV, wind energy and electric vehicles (EV) is expected to maintain an upward trajectory up to 2025.

Figure 2 - Rare earth production in 2016 per country



Source: Statista

Figure 3 - Global prices of rare earths from 2009 to 2013



Source: Statista

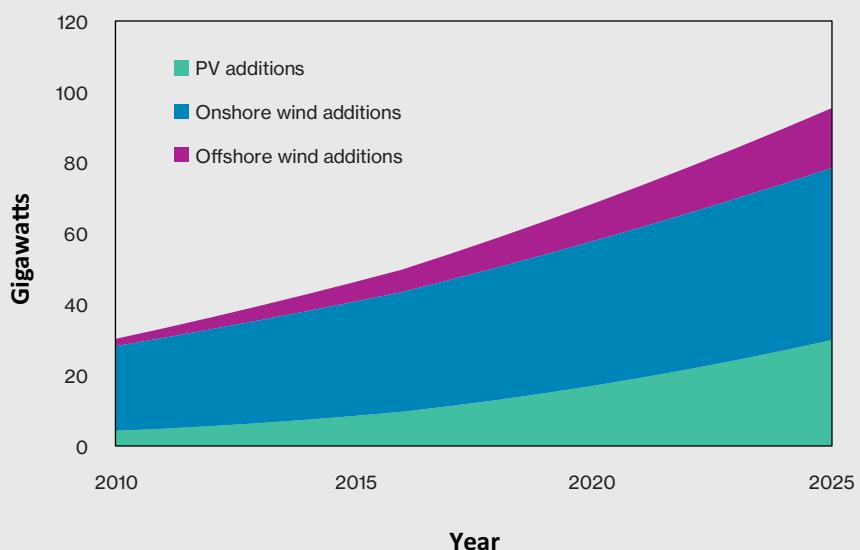
¹⁶ Karen Smith Stegen, 2015. Heavy rare earths, permanent magnets and renewable energies: An imminent crisis. Energy Policy 79 (2015) p.1-8

¹⁷ Sources:

1. UKERC, 2014. Materials availability for low-carbon technologies: An assessment of the evidence
2. IEA, 2011. Critical materials strategy



Figure 4 - Growth of solar PV and wind energy generation from 2010 to 2025



Source: Statista

Demand for neodymium and dysprosium is expected to sky-rocket in the next 15 years due to their application in generator magnets. These are key components in a type of wind turbine generators and electric vehicles¹⁸. Will Chinese export quotas inhibit this growth?

Supply chain bottleneck

The industry faces a supply chain bottleneck, with a lack of alternative sources for these elements, and demand is unlikely to lessen unless technological innovation supplies alternative solutions. The current low price levels are acting as a deterrent to exploration for further sources outside of China; a number of European energy firms are already looking at alternative suppliers to reduce their exposure to the supply risks. Long term risk management measures can involve diversification of the supply chain and investments in R&D to reduce the use of critical materials in low-carbon technologies where possible¹⁹.

Lithium demand increasing

Lithium demand is also expected to increase with the deployment of hybrid and electric vehicles, while in respect of smart grids expansion Li-Ion batteries will play a vital role towards the integration of renewable technologies to the grid²⁰. Indeed, capacity of Li-Ion batteries is projected to reach 3,130 MW by 2020; until now, no major supply bottlenecks

have been noted regarding the countries producing Lithium. There is a diverse portfolio of potential producers, but at present Australia (14,300 TN) and Chile (12,000 TN) are the largest producers²¹.

If you are from the industry: have your suppliers planned to increase output to account for this? If demand outstrips supply, the price will only rise.

Demand for tellurium, indium and gallium used in solar conversion technologies, such as thin-film photovoltaics (PV) is expected to peak around 2020 and start declining by 2030 onwards. The fall is expected to result from competitive technologies acquiring market share, as well as a move towards more efficient designs needing smaller quantities of the materials.

Society and our environment

If you are from the industry: does the country that you get your raw materials from matter? As long as it is good value is a common retort, but this may be short-sighted. Our culture and society as a whole is dictating that we should move towards cleaner energy sources; shifting demographics, the development of our communities, technology uptakes and population growth will undoubtedly push up our energy demands to ever greater heights. This is going to strain our critical material supply chain.

¹⁸ Wiebke Rabe, Genia Kostka, Karen Smith Stegen, 2017. China's supply of critical raw materials: Risks for Europe's solar and wind industries? Energy Policy 101 (2017) p. 692–699.

¹⁹ Massari and Ruberti, 2013. Rare earth elements as critical raw materials: Focus on international markets and future strategies. Resources Policy 38 (2013), p. 36–43.

²⁰ European Commission, Joint Research Centre (JRC), 2016. Substitution of critical raw materials in low-carbon technologies: lighting, wind turbines and electric vehicles

²¹ <https://investingnews.com/daily/resource-investing/energy-investing/lithium-investing/lithium-producing-countries/>



REM toxicity

Mining and extraction activities in general tend to be polluting for water supplies, and REMs are considerably toxic for soil and water when extracted and processed, which could potentially render water unsuitable for drinking and irrigation purposes.

Nowadays, more than 60% of cobalt comes from the Democratic Republic of Congo; cobalt's demand is expected to undergo a 30-fold increase by 2030 so as to supply the rapidly growing market for electric vehicles²². Extraction of minerals from the Congo has been notorious for being improperly regulated and causing serious social and environmental problems, especially

in the artisan and small scale mining operations. Digging of soil and mines can cause soil degradation and spread of harmful materials such as lead. As a result, excess chemicals often pollute adjacent waterways, thereby entering the food chain through the fauna of the rivers. Apart from the environmental downgrading, child labour and a large number of fatal accidents in artisanal mines are just two other outcomes of poorly regulated mining activities.

The rest of the product life cycle processes, from smelting to transportation, can involve a great deal of emissions²³. The energy production phase may not produce emissions, but any pollution to get there cannot be discounted.

²² <https://www.bloomberg.com/news/articles/2017-06-08/cobalt-upstarts-eye-glencore-s-turf-for-244-billion-ev-spoils>

²³ Jiabao, L., Jie, L., 2009. Rare Earth Industry Adjusts to Slow Market, ChinaDaily. China Daily, China.

Kanazawa, Y., Kamitani, M., 2006. Rare earth minerals and resources in the world. Journal of Alloys and Compounds 408, p. 1339–1343.

Paul, J., Campbell, G., 2011. Investigating Rare Earth Element Mine Development in EPA Region 8 and Potential Environmental Impacts. In: US Environmental Protection Agency (Ed.), EPA, USA, p. 35.

Do you understand your supply chain?

Manufacturers of low carbon energy technologies must be vigilant of the potential impact critical materials risks can have on their supply chain. Where do my raw materials come from? How reliable are my suppliers? Am I investing enough in ensuring the reliability of my supply chain? Looking into the future of low carbon technologies, will there be enough supply of critical materials to meet the future demand? How can technological innovation protect my supply chain? These are some of the questions manufacturers of such technologies should think about and act accordingly.

Choice of technology

If you are from the industry: consider the choice of technology and supplier of your renewable energy components. Changing wind turbine magnet type can reduce the amount of a critical material by 75%, thereby limiting your dependence.

Social and environmental implications

As corporate social responsibility becomes a strong communicator of the firm's commitment to sustainability, manufacturers should also think of the social and environmental implications of critical materials. Should you transact with suppliers who place limited environment and social consideration on their practices? All these factors will eventually affect the security of the supply chain either in the long or short run.

Our final questions to readers from the industry: do you fully understand your supply chain? Is it truly sustainable? A supplier may be good value but what about other risks?

These are all questions which you should be asking and are questions which Willis Towers Watson can help to answer.

Steve Munday is Head of Renewable Energy, Willis Towers Watson Natural Resources

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Floating offshore wind: challenges & innovation

Deeper water & greater reward

The offshore wind industry in Europe is following an upward trajectory; installed capacity has risen from 5GW at the end of 2012 to 12.6 GW in 2016²⁴ and is predicted to hit 40GW by 2020 and 150GW by 2030²⁵. 80% of the offshore wind resource in Europe is located in waters deeper than 60 meters and has a potential capacity of 4,000GW²⁶.

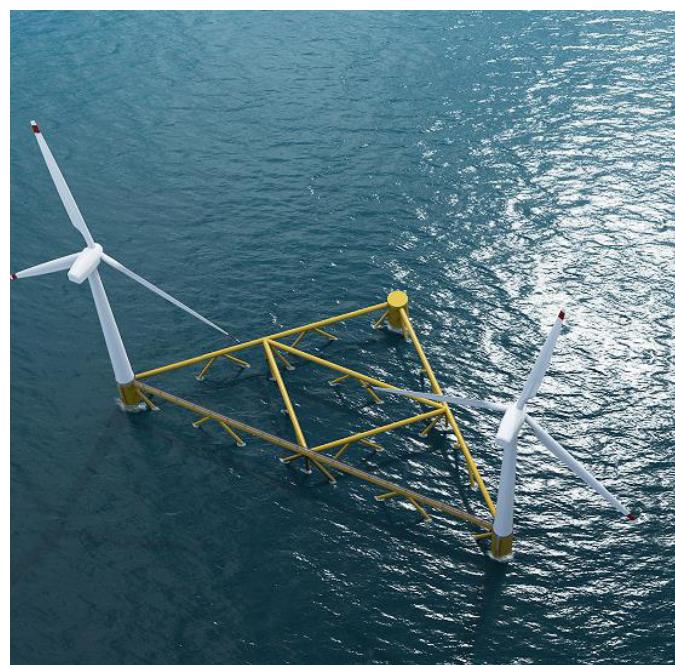
Previously these waters were considered too deep; monopile

technology is uneconomically attractive beyond depths of 30metres. To reach the industry's ambitious targets, it needs a means of deploying turbines into this deep-water resource and the increased ocean acreage that will be available.

So how can this deep-water resource be tapped into? The industry looked at proven technology from the oil and gas sector, and the current understanding from bottom fixed offshore wind. Floating offshore wind turned out to be the answer.



Credit: Fukushima Offshore wind Consortium



Hexicon Dounreay Tri Floating Wind turbines

²⁴ Wind Europe, 2017. The European offshore wind industry – key trends and statistics 2016. January 2017.

²⁵ Wind Europe Reports, Deep Water. The next step for offshore wind energy. July 2013

²⁶ Wind Europe News, 2017. A breakthrough for offshore wind: world's first floating wind farm opens in Scotland. Available at: <<https://windeurope.org/newsroom/news/a-breakthrough-for-offshore-wind-worlds-first-floating-wind-farm-opens-in-scotland/>>

Unlocking deepwater sites - 2 pilot farms

Floating wind technology can unlock deep water sites located close from shore; port-based installation and major O&M process can yield significant cost savings in relation to the bottom-fixed counterparts. Up until today, we have seen instances of individual floating wind projects with different floating foundation designs, mainly being built for demonstration purposes. However, we are only now beginning to see pilot multi-turbine wind farms appear.

- WindFloat, a pioneering 2MW floating prototype design, was deployed in 2011 off the coast of Portugal. The innovative features and design enabled wind turbines to be sited in previously inaccessible locations where water depth exceeds 40m and wind resources are superior.
- The Hywind project in the North Sea off the coast of Scotland has the principal objective to verify new scaled-up designs on a multiple wind turbine basis in order to demonstrate the viability of a future commercial scale farm. This development will have 5 turbines of 6 MW each, giving a total capacity of 30MW.

Both of these demonstration projects will provide important lessons in terms of design, fabrication, installation and operation. However, what happens when we scale up the turbine size? There are currently 8 MW

offshore wind turbines supported on grounded monopile foundations deployed in UK waters (e.g. Burbo Bank Extension), and the industry is moving forward. The challenge for the industry is not just proving both prototypically and commercially a 10MW (and greater) turbine, but proving this on a floating foundation.

10MW and beyond?

Floating offshore wind structures, combined with high capacity turbines, are the critical next steps in the industry's attempts to harness energy from the wind. Scale and competition have been the key drivers of falling energy prices from fixed monopile wind farms and the same is true for floating wind. EU-funded projects have been working on the design of 10-20 MW wind turbine concepts for some time; however, the challenge is to demonstrate and now construct a full scale turbine greater than 10MW and provide proof of a significant cost reduction potential.

But what happens when the industry pushes over 10MW? Are there other considerations that should be made? With smaller prototypical designs such as Hywind and Kincardine, the insurance industry has often adopted a cautious approach, and the same would be true for larger designs. The market normally dictates that they want to see proof of a design or product before they consider insurance options; however, the market is a place for innovation and Willis Towers Watson is ready to approach this challenge head on.



The risk transfer challenge

An apprehensive insurance market

Generally speaking, underwriters will not intend to provide cover where the developer is involved in a demonstrative project or a pilot park – that risk is the developer's to take. Underwriters require adequate commercial reference on which to base their opinions; however, this does not mean that the markets are averse to such developments. In the area of renewable energy, a host of specialist brokers and underwriters have developed products that focus on risks in the offshore wind industry. These underwriters can relish the challenge to be involved in such innovative and challenging projects, with the additional intention of being involved in the insurances of any future commercial rollout.

Bankability

The UK ORE Catapult in 2015 recognized a series of 10 technical challenges for floating wind technology, one of which was bankability. They identified a lack of innovative methods to improve bankability of floating wind projects through new risk management approaches and insurance. Risk mitigation and the survivability of the features unique to floating technology will eventually drive investors' appetites.

Transition to a commercial optimized model

From the industry's perspective, the challenge would be to lower the costs that have been invested so far on expensive demonstrators by making the transition to a commercial optimized model which will benefit from economies of scale.

Academic and research institutions can contribute to the acceleration of this transition by focusing their research on key priority areas which could yield significant savings in the cost of energy. Innovations in the electrical system should involve increasing the reliability of high voltage dynamic cables and ensuring the lifetime integrity of the cabling. This is a significant risk consideration area since cable-related incidences are currently responsible for most claims in offshore wind. Furthermore, the design of novel mooring designs and their installation procedures, along with the scaling to larger turbines, the integrated design and the logistics on the major repair and assembly operations, will be some of the key R&D priorities for this emerging technology.

"In the area of renewable energy, a host of specialist brokers and underwriters have developed products that focus on risks in the offshore wind industry."



The role of Certification Bodies

The role of Certification Bodies will also be pivotal. Design Standards of floating wind turbine structures are already in place (e.g. the DNV OS-J103 Offshore Standard); certification of the feasibility of a novel design can only increase market's confidence. Bespoke standards will support the assessment of the turbine design, manufacturing, installation and commissioning of floating wind structures, as well as the upscaling of wind turbines to higher than 10MW concepts (thereby enhancing the bankability of novel designs).

Step up in turbine size

The next challenge to address is the interaction between the floating sub-structure and the significant step-up in turbine size attached to the floating sub-structure. The development of large scale turbines of greater than 10MW will have intrinsically complex challenges regarding design, fabrication, handling (storage, loading and transport), installation, operation and maintenance and finally decommissioning.

These challenges are all interlinked and cannot be tackled alone. So the insurance market must be highly ingrained into the process early on to ensure that such projects get off the ground.

Figure 1 - a selection of Floating Offshore Wind risks

▪ New and bigger turbines	▪ Transportation	▪ Supply chain risk	▪ Delay risk
▪ Certification	▪ Site conditions	▪ Construction risks	▪ Defects in design
▪ Cable installation	▪ The interface been contractors	▪ Vessel capability	▪ The environment
▪ Weather risk	▪ Decommissioning	▪ Operation and maintenance	▪ Lack of Wind
▪ Mooring arrangement	▪ Anchor design		

Source: Willis Towers Watson



Figure 2 – Floating Offshore Wind Risk Packages



Cover	Stakeholders	Responsibility
Construction All Risks (CAR) including Marine Transit and Terrorism	Principal, all contractors technical advisors, lenders	Principal
Third Party Liability (inc. Marine Liability)	Principal, all contractors technical advisors, lenders	Principal/ Contractors
Deby in Start-up inc. Marine D&U and Terrorism	Principal, lenders	Principal

Cover	Stakeholders	Responsibility
Operating All Risks inc. Machinery breakdown	Principal, Maintenance contractor, lenders	Principal
Business Interruption (BI)	Principal, lenders	Principal
Third Party Liabilities	Principal, Maintenance contractor, lenders	Principal



Cover	Stakeholders	Responsibility
Charaters' Liability	Liability related to the chartering party	Chartering party
Contractor's plant & equipment	Own interests only	Contractor
Employers' liability/Workers compensation	Own interests only	Each party
Hull & Machinery	Vessel owners' property	Vessel Owner
Motor	Own interests only	Each party
Plant & Equipment	Own interests only	Contractors
Production & Indemnity	Vessel owners' liabilities	Vessel owner
Professional Indemnity	Own interests only	Designers
Vessel construction	Hull Constructor	Shipyard or Owner

Source: Willis Towers Watson

The solution

Marine renewable projects have often been reliant on engineering expertise developed in the offshore oil and gas industry; this is conventional technology used in a new way and has its own unique risk profile.

Early engagement with insurers critical

Offshore wind farms are highly sophisticated developments that require careful planning and thorough risk evaluation before they are implemented. We suggest the early engagement of the insurance market into the process, which will avoid cost and time overruns. Commercial banks remain risk averse and are hesitant to invest in an industry where there are few precedents and the banks may not have an established procedure for evaluating the risk reward profile of a potential investment. By addressing risk in a proactive manner, we are in a position to potentially improve the viability of a project.

Taking the risk to market

We can help a project team understand the full lifecycle risks that they will face and design solutions to address them. Prior experience has demonstrated that for a developmental project the developer would typically have to retain more of the risk than would it be a commercially implemented design. We will examine and discuss the impact of this across the project with all stakeholders.

A risk solution can be designed to offer the greatest protection to the project possible through proper risk management protocols and the transfer of risk where possible to the insurance market. Your broker will be fundamental in identifying areas of high risk/concern and addressing in a timely manner. This identification process will help give greater certainty to the underwriting process.

The recipe for success –thorough project design underpinned by competent project participants

A thorough project design with well-defined and continuous risk management, underpinned by competent and expert project participants is fundamental to the success of a project. We can learn lessons from the oil and gas sector but the interaction between deeper water, floating and larger wind turbines brings its own challenging and unique risk profile. Challenges will be faced and lessons learnt but by engaging the insurance market early in the project planning phase, we can see more projects get off the ground and ensure the ultimate growth of this exciting sector.

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Solar farm case study: Muhammed bin Rashid Al Maktoum Phase III goes frameless

Background

This project is part of Dubai's Integrated Energy Strategy 2030, the aim of which is to supply 7% of Dubai's electricity from renewable sources by 2020 - increasing this share to 25% by 2030 and 75% by 2050 under the Dubai Clean Energy Strategy 2050.

The project is structured as a standalone Independent Power Project (IPP) and is being developed on a Build Own Operate basis (BOO).

Willis Towers Watson's Global Renewable Energy team are privileged to be the appointed insurance advisor, broker and risk consultant to Shuaa Energy 2 as the Developer and Owner. We provided in-house expertise on risk engineering as well as advice on transformer management and emergency power solutions for the electrically driven trackers.

Evolution of frameless solar panels

While traditional solar panels have aluminium frames, frameless solar panels have evolved over time and are now considered a cost effective solution with superior qualities. When the DEWA 800MW solar park was designed, the concept of using frameless solar panels was an attractive option, and the Park became the largest solar project of its kind.



Source: Abu Dhabi Future Energy Company PJSC (Masdar)

Canadian Solar is the supplier of the panels, with solar photovoltaic cells arrayed between two layers of glass which are therefore called glass-on-glass panels. The glass on the rear of the panel has to be a little thicker to provide structural integrity to the panel.

Frameless solar panels advantages

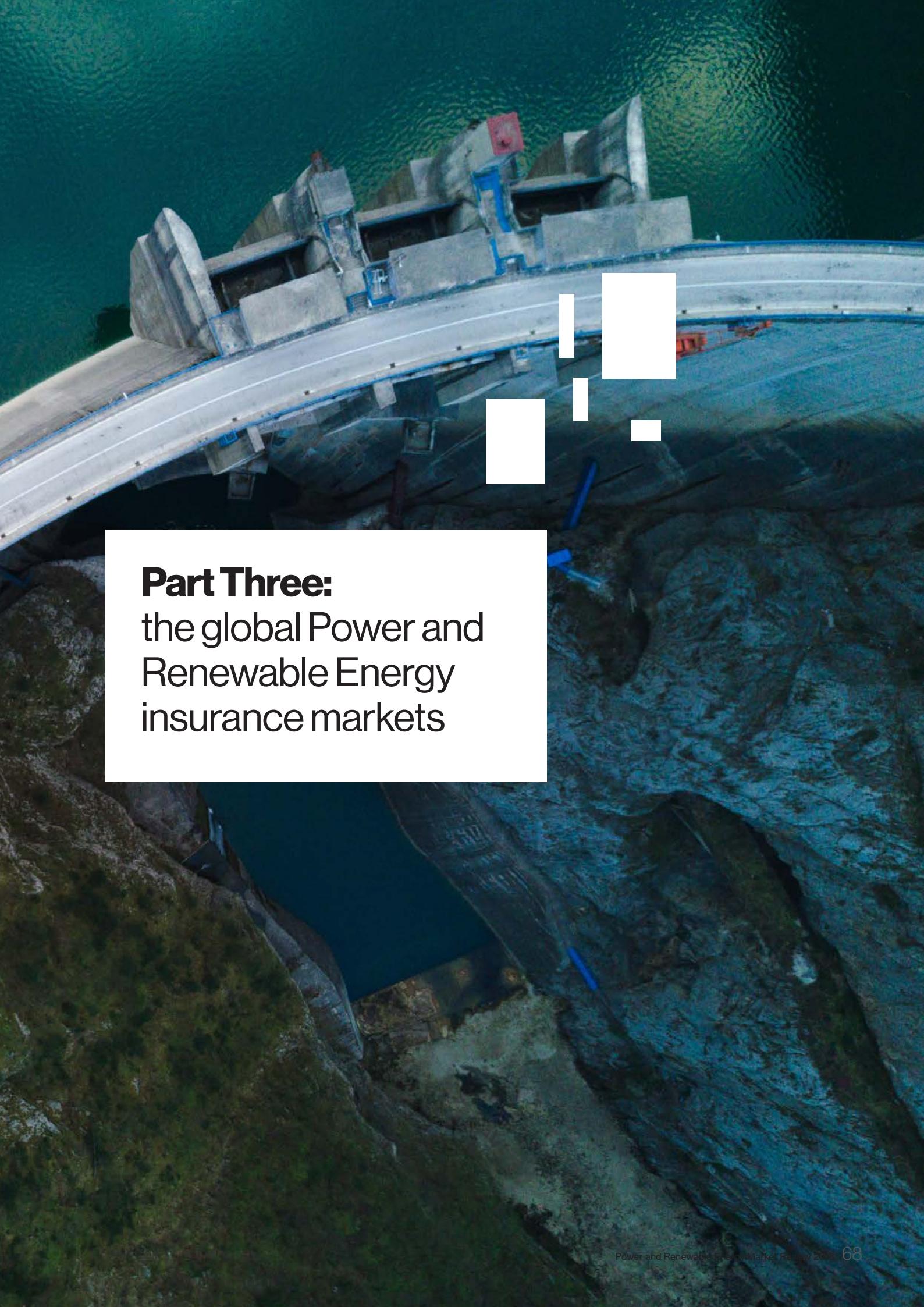
This frameless technology has the following advantages:

- The design reduces the impact of potential-induced degradation (PID)
 - enabling a longer lifespan
- Longer warranties with encapsulation
- Frameless solar panels do not suffer from problems with corrosion of the frames and are also more durable and easier to robot clean
- No need for grounding of the frame
- There is a fire safety rating improvement because there is no polymeric back sheet
- Modules achieve high voltage at 1500V DC, so less current
- One of the common concerns with a silicon module is micro-cracking
 - having a glass panel, front and back, gives better mechanical protection during transportation and installation

The solar park benefits from having a tracker system which allows the azimuth angle to alter in an east west axis. The safe mode is with the panels horizontal which provides a minimum profile during wind events.

Roger Hughes is an engineer specialising in renewable energy at Willis Towers Watson Natural Resources





Part Three:
the global Power and
Renewable Energy
insurance markets



Introduction: the risk management challenges facing the global power market

Despite the investment of time and resources in risk management and operational safety, the global power sector has continued to suffer machinery breakdown incidents, damage by natural perils and other losses, from an increasing variety of causes.

Technology

The technology involved in the industry is becoming more complex and highly interlinked; with environmental concerns in particular driving demand for different sources of power generation, plants designed for base load operation may have to be operated intermittently while others are often in continuous use - variants which impact the life cycle of the equipment.

Weather

The power sector is not immune to the weather. Floods can affect not only power plants themselves but also the equipment and premises of customers or supplier. Windstorms can affect a power station's operations by damaging transmission and distribution networks.

Apart from the 'traditional' natural perils, climate change is likely to impact production in the coming decades. Increasing instances of drought or water shortage will impact hydropower stations and thermoelectric plants, which are heavily water dependent. In many countries the summer months are periods of high power consumption and demand, but this is the season when droughts and higher water temperatures are most likely to occur, making it harder to operate power plants which rely on water for their cooling.

Changing weather has seen flash floods in the Middle East and extreme heatwaves in Europe (among many regions). These unpredictable weather patterns have compelled the affected power facilities to either reduce or suspend their generation, forcing those companies with contracted output to buy on the spot market and purchase additional power to meet their contractual obligations.



Dependence on unit cycling

With the varied power requirement imposed by the national power authorities, many in the generation market have increased their dependence on unit cycling and decreased their base loading generation. This has put additional stress on equipment, causing a number of effects such as:

1. **Generator failures** include overheating, cracks, engine failure due to lack of oil or coolants, and short circuits, which can occur from internal or external effects:
 - **Internal** effects include breakdown of equipment or transmission lines from deterioration of insulation in a generator. Such issues may be due to ageing of insulation, inadequate design or improper installation.
 - **External** effects include insulation failure due to lightning surges, or overloading of equipment causing excessive heating and resulting in mechanical damage.

2. **Turbines** are complex machines which operate under stress and as a result have, over the years, presented insurers with a large number of machinery breakdown claims. Corrosion, fatigue, rubbing and vibrations are a few examples of repeated occurrences. In addition, contaminants such as calcium and metal have resulted in a build-up of deposits within these machines.

3. **Compressors** are susceptible to changes in the atmosphere. For example, a saline or dusty industrial environment can result in corrosion, so it is important that compressors are adapted to the environment.

4. **Boiler failures** can be caused by corrosion, cracking and degradation. Adherence to the original equipment manufacturers' (OEM) operating and maintenance is often a condition of claim coverage or a warranty, but some claims have emanated from poor maintenance or operational practices.

Design Failures

With the continued stresses applied to generating equipment, and the commercial need to meet contractual supply obligations or demand from the local power authority, machinery may not always have been sufficiently tested in 'real life' operating conditions before entering operation in order to allow any design faults to be identified and corrected.

These days, insurers are very aware of the risks arising from equipment that has not been fully tested, and frequently apply a Testing and Commissioning ('T&C') clause to policies covering plants entering operation after their construction phase. These clauses make it a condition of the attachment of cover under the operational policy that a specified range of testing and commissioning activity has been successfully carried out. In some cases the generation company may not be able to completely satisfy the T&C clause, sometimes for perfectly legitimate engineering or other reasons; when these are explained to insurers, underwriters will often agree to accept the plant under the policy notwithstanding that the inability to fulfil all the terms of the T&C clause.

As in any industry, there is ongoing pressure for the newest and fastest models, such as the demand for faster start turbines to meet the growing energy consumption requirement. OEMs strive to deliver ever more efficient models; the pressure to supply this may result in other components being neglected or not upgraded.

Age

Many power generation machines are reaching the end of their life cycles, ensuring a continued focus on maintenance schedules and availability of spares.

Many of these facilities have utilized a LTSA (Long Term Service Agreement) which can be described as follows:

"LTAs typically commit the original equipment manufacturer (OEM) to providing, on a relatively "fixed-priced" basis, maintenance services for the very equipment that they manufacture (e.g., gas turbines, steam turbines, etc.). Commercially speaking, LTAs can offer many advantages to Owners, including the predictability of relatively fixed long-term maintenance costs and contractually guaranteed or incentivised OEM support. However, these very complex agreements can often contain pitfalls for the unwary equipment Owner – pitfalls that can cause an Owner to bear an inordinate amount of risk, or may result in costly and time-consuming disputes with the OEM."

Richard E. Thompson II and Jason B. Yost, Troutman Sanders LLP¹

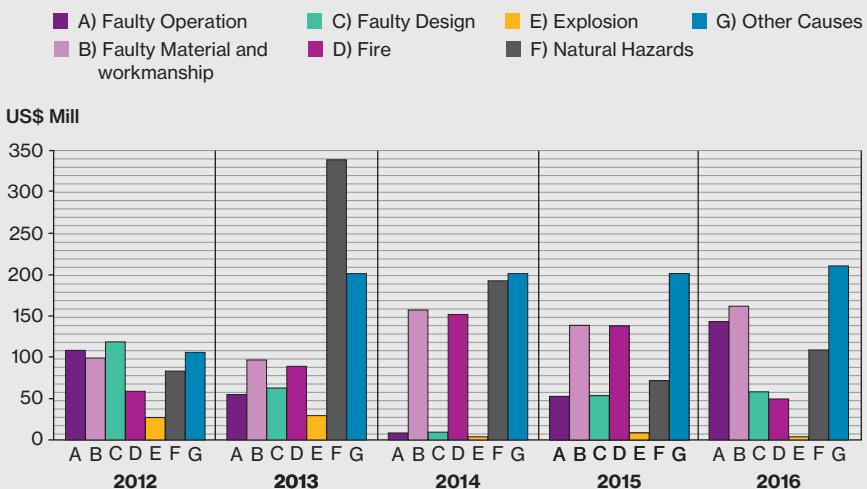
The benefits of these LTAs include:

1. Awareness of the maintenance cost
2. Information on new technologies introduced into the plant and training for equipment and its operation and maintenance
3. Proper maintenance reducing the possibility of failure occurring and identifying alternative sources to use as backup

¹<http://www.power-eng.com/articles/print/volume-107/issue-2/features/long-term-service-agreements-top-10-contractual-pitfalls-and-how-to-avoid-them-part-i.html>

Figure 1 – large claims and causes of loss

Large Claims - Cause of Loss:



All figures are based on information supplied to IMIA by its Member countries. It should be in mind that these figures may not always contain IBNR provisions, and that premium patterns may vary between reporting member countries.

Source: IMIA

Many machines have bespoke parts, which would otherwise result in long lead times before spares can be obtained and transported to site.

Facilities would be given the choice to have spares available at alternative sites and may sign an agreement with other owners in the same region, thereby decreasing the time to obtain a spare in an emergency.

Human Error

Despite the increased use of technology and machines to streamline and increase the automated process, losses attributed to human error or faulty operations still regularly occur.

It is often found after such incidents that correct procedures were not followed, which can be the result of poor training, lack of inspection or

supervision, or misunderstanding information provided. Figure 1 above shows a sample of large losses by cause over the last few years.

Although there is no clear pattern in these numbers, it is possible that the decrease in explosion-related losses is the result of better maintenance processes now adopted by many power generation firms.

New causes of loss in the power industry may result from increased automation and reliance on technological control, which may be targeted by increasingly sophisticated cyber-attackers aiming to disrupt operations.

Manvinder Phul is a Divisional Director, Claims Advocacy and Client Claims, Willis Towers Watson P&C



London: Property

Introduction – same old, same old?

In recent years it has been difficult to keep finding new ways to describe the insurance market environment, both for the Power sector and for the wider market in general, and across all the main classes of insurance. Since the last truly ‘hard’ global insurance market, which followed the 9/11 terrorist attack in the US in 2001 and lasted for a couple of years before starting to soften again, insurance buyers have enjoyed an extended period of soft global insurance market conditions – despite significant natural catastrophe ('cat') loss events such as Hurricanes Katrina, Rita and Wilma (2005) and Sandy (2012) in the US and Caribbean, the Japanese earthquake and tsunami (2011), and the Thai floods (2011).

Why had the market stayed soft?

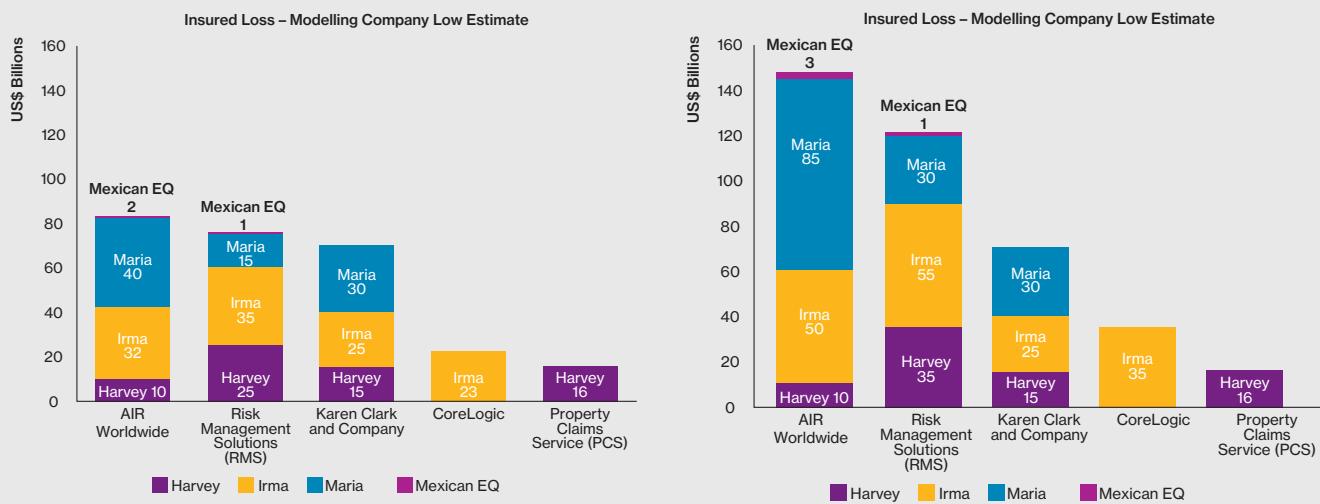
There have been a number of contributing factors to this prolonged soft market:

- Low interest rates spurred investors to seek opportunities outside traditional interest-bearing investments, which resulted in a

significant influx of new capital to the global insurance market, driving premiums down through the supply / demand dynamic.

- Despite the effect of low interest rates on their financial investments, insurers were still able to deliver positive underwriting results and acceptable combined ratios. This was largely been due to:
 - Low levels of cat losses in historic terms, which for property underwriters effectively subsidised the 'risk' or non-cat element of insurers' books of account
 - Insurers' ability to release old claims reserves to bolster profits
- Insurers were forced by market conditions to improve their underwriting discipline, becoming more selective about accepting risks with significant past losses and/or with an inferior risk management programme in place. At the same time, most large insurers have put advanced risk modelling programmes in place, and these programmes require that clients and brokers provide a significant amount of risk details to the insurers in order to secure optimal terms and conditions.

Figure 1 – insured loss estimates for various natural catastrophes, 2017



Source: Willis Re, October 2017

Q1-2 2017: market softening slows

By the first half of 2017 it was clear that the pace of market softening had begun to slow. One reason was that there were no longer any significant old reserves to release, leaving insurers solely dependent on positive pure underwriting results to deliver acceptable returns to shareholders. Some underwriters were commenting on the need for improved pricing, as their margins thinned in the soft market. This did not signify

an imminent hardening of the market environment, but rather that large rate or premium reductions for already competitively priced programmes were becoming more difficult to achieve.

However, there is no doubt that the particularly active 2017 Atlantic hurricane season, combined with other second-half events such as the earthquake in Mexico and Californian wildfires, has changed the market mood.

Although there remains huge uncertainty over the quantum of losses from hurricanes Harvey, Irma, Maria (collectively referred to as 'HIM'), there seems to be a growing consensus that insured losses will exceed US\$100bn and effectively wipe out a whole year's premium for many carriers.

Although these loss events are primarily a matter for insurers and reinsurers of Property and Business Interruption risks, their impact extends to other insurance classes, as discussed below.

Q4 2017: immediate post-hurricane response

Property and Business Interruption underwriters in the Power and Energy sectors reacted in the immediate aftermath of the 'HIM' events by refusing to countenance any rate reductions at Q3/Q4 renewals even for claims-free accounts. Reinsurers appear united on the need to drive through higher rates at the 1 January 2018 treaty renewals; on 13 October the ratings agency S&P predicted flat to 5% increases for global reinsurance at 1 January, with rates in regions and business lines directly affected by the cat losses expected to see double-digit increases.

Reinsurance rate rises to be passed on

Increases in reinsurance rates can be expected to feed through to the direct insurance market, as insurers will have to pass higher reinsurance costs on to their direct buyers. It was reported at the end of October that a number

of Lloyd's syndicates were looking to take advantage of the expected favourable pricing conditions in 2018 with significant planned increases in stamp capacity.

However, it is noteworthy that the scale of rate changes being mooted in response to what could yet turn out to be the worst year for insured cat losses in history, is relatively modest. This arises from the likelihood that the combined 'HIM' loss will be an earnings rather than a capital event for the insurance market. Readers may recall that our 2016 Power Market Review included an analysis by Rowan Douglas, CEO of Willis Towers Watson's Capital Science and Policy Practice, of the measures that the global insurance sector had taken to increase its resilience since 1992, when Hurricane Andrew propelled a number of insurance companies into insolvency. The proof of this greater resilience is that the 2017 'HIM' claims will be readily absorbed by the insurance industry, and will not constitute a true market-changing event.

A long term market hardening?

Whether underwriters will succeed in achieving a sustained hardening in market conditions is therefore uncertain. The last major hurricane-affected year (2005) triggered a spike in insurance rates for 2006, but prices started to come back down after a relatively short time. Global insurance and reinsurance markets remain heavily over-capitalised and ultimately market conditions will be driven by supply and demand.

"It is noteworthy that the scale of rate changes being mooted in response to what could yet turn out to be the worst year for insured cat losses in history, is relatively modest... whether underwriters will succeed in achieving a sustained hardening in market conditions is therefore uncertain."



Power insurance market dynamics

The insurance market arena for risks in the power and utilities sector is a specialist area of the wider insurance market, and has its own dynamics. In addition their liability for 'cat' claims, Power sector insurers continue to be hit by attritional machinery breakdown and other claims, as described in the previous article of this Review.

Environmental considerations are also having a direct impact on power insurance market capacity. As this Power Market Review was being finalised, Zurich Insurance Group announced that it intends to:

"stop providing insurance or risk management services for new thermal coal mines or for potential new clients that derive more than half their revenue from mining thermal coal, and also for utility companies that generate more than half of their energy from coal," as well as divesting from equity holdings in such companies. It will also apply "strong ESG [environmental, social and governance] risk management"

for utility companies that generate up to 30% of their energy from coal, and "enhanced risk screening" for those that generate between 30% and 50% from coal².

Zurich's stated motivation for this policy is that:

"Insurers can play a role in facilitating [the] generational transition towards cleaner energy by increasingly reflecting the climate-related risks inherent in thermal coal in their underwriting and investment policies."

In making this decision, they are following AXA and SCOR, which earlier this year became the first insurance companies to announce that they would no longer underwrite significant coal projects (although in SCOR's case this applies specifically to lignite plants³. In addition, Swiss Re and Lloyd's will reportedly announce new policies on coal in the coming months⁴.

This is therefore a developing picture, with potentially serious implications for major coal generators.

² <https://www.zurich.com/en/knowledge/articles/2017/11/insurers-can-facilitate-the-transition-to-a-low-carbon-future>

³ <https://www.scor.com/en/media/news-press-releases/scor-announces-further-environmental-sustainability-initiatives>).

⁴ <http://unfriendcoal.com/2017/11/15/leading-insurance-companies-divest-20b-from-coal-and-end-underwriting/>)

Early engagement essential!

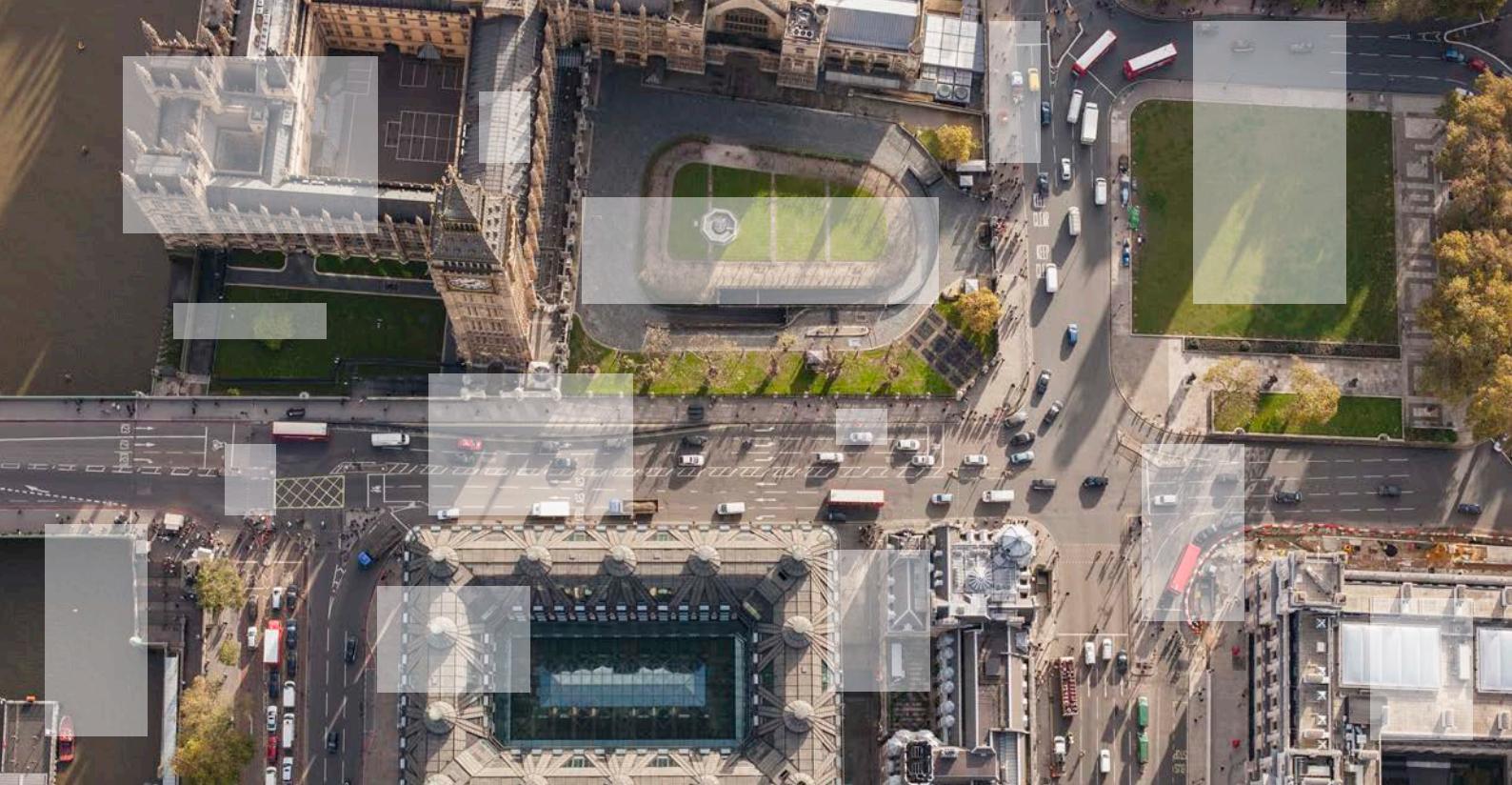
Regardless of whether it turns out to be short-lived or of longer duration, the change in insurance market mood comes at a bad time for those power companies that have presented their insurers with significant claims, whether through 'cats' or other types of loss – particularly if these companies have significant coal-fired power plants. Underwriters who will have previously been constrained by market dynamics from applying terms for such companies that they consider appropriate will be more able to carry rate increases and/or changes in deductibles and other terms and conditions in the current market environment.

It is therefore important for insurance buyers in this situation to engage with underwriters early in the renewal process to share the lessons learned from their claims, and work with their brokers and insurers to develop viable and sustainable options for their insurance programmes.

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Alex Findlay is a Divisional Director, Downstream Natural Resources, Willis Towers Watson





London: Terrorism and Political Violence

Flatter market conditions reflect overall Property landscape

Although not directly affected by the 2017 Atlantic hurricane season, most Terrorism and Political Violence underwriters have strong ties into their “All Risk” Property counterparts, often with either linked or shared treaty reinsurances. As a result, the second half of 2017 has seen much of the market renewing business at flat rates, albeit with small rate reductions still being available in some cases.

Recent terrorism and police violence activity

The last three years have seen steady increments in the number of terrorism and political violence events globally, with actual attacks against the power industry being mostly seen in the Middle East, Africa and Central Asia, where the legacies of ongoing conflict perpetuate themselves.

Attacks in Europe and North America have mostly been in city centres, targeting mass casualties rather than infrastructure, but a number

of terrorist plots against the power industry have been foiled; for example, the perpetrators of the Belgium airport and subway attacks in 2016 had plans to attack a power plant, while a self-described neo-Nazi from Florida, who was arrested in 2017, had plans to blow up power lines in the Everglades and launch explosives into a power plant.

Political violence risk escalates

Along with terrorist attacks and both global and localised conflicts, the threat of strikes, riots, civil commotion and protests remain as an ever-present risk to the power industry. For example, US President Donald Trump's pledge to revitalise the coal industry is likely to face opposition from environmental activist groups, while many new construction projects around the world will continue to face environmental activism and local opposition, including those where land disputes and population displacement may arise.



Insurance considerations – is your current programme still appropriate?

While the Terrorism and Political Violence market and the corresponding risk landscape continue to change, insurance buyers in the power industry should continue to consider whether their current purchase is appropriate. This could include whether buying through government pools provides sufficient coverage or if either a full standalone Terrorism and Political Violence policy or Difference in Conditions/Difference In Limits/Excess policy would provide more appropriate coverage for their needs.

This can also include altering limits and deductibles, compared with “All Risk” coverages, for example where recent losses and different risk factors may force higher retentions or lower limits in order to balance premium spend. However, this may not be quite so impactful upon rating and pricing within the Terrorism and Political Violence market.

Do you have the appropriate cover?

Insurance buyers should also continue to consider whether the risk transfer products they currently buy are appropriate for the changing risk environments they may operate in. For example, in recent years events in Egypt and Turkey have highlighted how quickly insurance needs and buying habits can change rapidly. Towards the end of 2016 and start of 2017, many buyers in Turkey, both inside and outside the power industry, were trying to renew their insurance policies, increasing their coverage from Terrorism only to include full Political Violence.

During this time the market faced a very challenging period of managing demand (for both current demand and to hold reserves for expected demand in the year ahead) against available capacity and basic economics states that this would also affect pricing.



Do you understand your exposures?

Our advice is that insurance buyers (as much is reasonably possible given what are often unforeseeable events) should continue to use everything available to them to try and foresee their potential exposures and ensure their insurance program is sufficiently designed around their findings, and not just wait until their traditional renewal period to review their position.

Have you considered other coverages that you currently don't purchase?

Finally, with the threat of strikes, riots, civil commotion and protests remain being an ever-present risk, it is important that insurance buyers review what coverage they may or may not have. While many buyers may have some form of coverage in their "All Risk" property policy or a standalone Terrorism and Political Violence policy, this will most likely not include any coverage for Business Interruption due to site access being prevented or hindered by strikers or protestors in the absence of physical damage.

Impairment of Access

In response to this, Willis Towers Watson and a leading Lloyd's Syndicate have recently collaborated to offer a new policy wording covering Impairment of Access. This Impairment of Access coverage uniquely responds:

- whether or not physical damage has occurred from an act of protestors, riot, strike, civil commotion, malicious damage, sabotage and/or terrorism; and
- whether or not the Impairment of Access was due to an act at the insured's site or within a pre-agreed radius or access route (whether or not the insured was the intended target of such act).

Lyall Horner is an Account Executive, Terrorism and Political Violence division, Willis Towers Watson

"With the threat of strikes, riots, civil commotion and protests remain being an ever-present risk, it is important that insurance buyers review what coverage they may or may not have."

London: Construction

Introduction – “As you were...”

Competitive market conditions continue to dominate the Power Construction insurance market. With no deterioration in available capacity, most, if not all, Construction markets consider the power industry as one of their primary focus areas. The leading reinsurers remain the major markets such as AIG, Allianz, Chubb, Munich Re, SCOR, Swiss Re and the Lloyd's Construction Consortium, but many of the others have gained another year of valuable experience and have cemented themselves as viable lead options.

More than enough capacity for any project

Furthermore with significant capacity being available from other local and regional markets, available capacity should be more than adequate for any project, other than nuclear and large hydroelectric projects being built in exposed natural catastrophe areas.

While rate reductions continue to be available, the pace of reduction has slowed somewhat during the course of 2017. 2017's natural catastrophe events are likely to further decelerate this decline and we even suspect that this may lead to some individual rate increases in exposed locations. However, it remains too soon to make a firm prediction of where rates will go in 2018.

Technology issues remain at the forefront of underwriters' minds. The continued advancement of gas turbine technology and developments in super and ultra-super critical boiler designs are constantly monitored by insurers.

Introduction of enhanced gas turbine power plants

The last couple of years have seen the introduction of a number of enhanced and large scale gas turbine models which have moved from comprehensive validation programs at numerous locations around the globe to being presented to the insurance market as the main component of a new risk.

There has been a continued development in the “H” class of units, with General Electric now moving to validate the latest version of its Higher Efficiency Air-cooled (“HA.02”) units in their fleet and Siemens continuing to enhance their own “H” class model, which has resulted in even larger units now being presented to insurers and their engineers. The testing and validation of the GT 36 unit by Ansaldo Energia across 2016 and 2017 signals their entrance in to the “H” class technology market whilst Mitsubishi Hitachi Power Systems continues to develop the “Enhanced Air Cooling” technologies of their large frame J class machines.

Rate of technological advancement increases

With virtually the full range of earlier and more established units such as the “F” class and “G” class also undergoing continued enhancement, the rate of technological advancement shows no sign of slowing down.

Regular updates by the main gas turbine manufacturers assist the power focused underwriters within the construction insurance market to monitor the development and progress of such enhanced and larger machines prior to their introduction as a risk to be evaluated.



Insurer conservative stance maintained

However, despite the continued dialogue between the insurance market and manufacturers, underwriters and their engineers still tend to take a conservative approach when evaluating a new gas turbine plant being presented to them - utilising a model that has not achieved the milestone of 8,000 Actual Operating Hours, regardless of the soft nature of the general construction insurance market over recent years.

Market holds firm on deductibles

With bigger machines potentially meaning a higher replacement value, insurers are keen to maintain a minimum threshold when it comes to the level of deductibles to be applied to large frame gas turbine and generator sets, while at the same time seeking reassurance on the robustness of the warranty from the Original Equipment Manufacturer that

they expect to be in place. Insurers do not see their role as covering the risk of design and manufacturing of such new and enhanced machines, and where possible continue to limit the scope of the cover they provide to what they perceive to be the "construction" risk when covering such projects.

Coal fired plants – newer and more exotic materials

Continued development in super and ultra-super critical boiler design using higher temperatures and pressures than earlier sub-critical designs has resulted in the need for newer and more exotic materials to be used in certain sections of the boiler.

The early experiences of such exotic steels (such as T-24) were a cause for concern for insurers. As a result, the design and composite make-up of the boiler is often the first question asked when a new risk is presented for consideration.



Coal fired plants – what insurers are looking for

It is therefore crucial that new coal fired Construction risks are presented to insurers in a way that enables the underwriter to gain confidence, not only in the way that the project has been designed but also how it will be managed through the construction and commissioning phases.

Insurers will want to see evidence of a robust and comprehensive QA/QC programme, including a focus on Positive Materials Identification (PMI). We would also expect that underwriters will want a detailed understanding of the planned inspection programme for the project, including details of the Owner Engineer's role in the QA/QC process.

Similarly, adherence to internationally recognised industry codes, standards and guidelines in relation to fire protection measures will also be at the top of the underwriter's list when first evaluating the risk. In addition to the final design to be incorporated into the plant once completed, Construction insurers will also pay close attention to measures in place during construction prior to the permanent system being set up, with a key focus on the availability of any temporary fire water supply and the detection and prevention measures around main the components of the plant. Again, this applies to codes to

comply with for a power plant under construction in addition to what the permanent system will be once commissioned.

Although such detail is often flushed out during the first or second risk inspection carried out by insurers' engineers, by this time the opportunity may have been missed to impress on the insurer the more positive aspects of the risk itself when negotiating the terms and conditions. As always with major construction projects, a well presented and detailed underwriting submission, supported by a proactive flow of information between insured and insurer (managed by the insurance broker) only enhances the chances of a more positive response when negotiating terms for major power plants under construction.

Nuclear – slowdown in the UK

The expected nuclear revival in the UK has slowed down somewhat following the Government's announcement to go ahead with Hinckley Point C early in 2017. This slowdown has been caused by a number of factors which include the failure of some major nuclear OEM suppliers, a difficulty in attracting the required levels of finance, concerns over Brexit and the rapid changes in nuclear technology that are currently taking place including the development of SMR's (Small Modular Reactors) and other forms

"Adherence to internationally recognised industry codes, standards and guidelines in relation to fire protection measures will also be at the top of the underwriter's list when first evaluating the risk."



of alternative power generation, ably assisted by the ongoing development of battery storage technology.

However, any possible nuclear revival will require the support of a growing insurance market capacity to help drive the need of an industry that has generally seen good experience in the western hemisphere.

Nuclear – new Exclusion Clause

A new Nuclear Exclusion Clause LMA5628 has been developed, the aim of which is to produce a “cold zone variant” of its model exclusion wording which should make it easier for underwriters to cover construction projects in the nuclear sector.

The London market’s standard exclusionary language largely dates back to the 1950s. Since that time we have seen a number of major technological developments in the nuclear industry, with major incidents recorded such as the Fukushima disaster in 2011 and the more recent fire at the Flamanville nuclear plant in February 2017.

It is anticipated that new nuclear projects will require insurance during the construction phase for the ancillary buildings, cold zones and the HRZ long before any radioactive material is actually introduced to the site. The addition of a new model nuclear wording therefore aims to

make it easier for the London market insurers to cover such projects whilst there are also plans to make the current market primary policy exclusions for nuclear risks more user-friendly.

LMA’s Wording Manager, Alison Colver was quoted as saying: *“Our intention is to future-proof the market’s nuclear exclusions and to give Lloyd’s underwriters more options to underwrite nuclear installations under construction. As a specialist market, we need to ensure that our model wordings allow underwriters to provide the cover needed with the expected increase in interest in nuclear over the coming years⁵”*

Conclusion – London market retains its flexibility

Technical changes advance at pace, capacity remains readily available (at the time of writing) and the London market continues to prove itself as a flexible thought leader for the most challenging of risks. Quality information and time for engineering reviews will continue to allow the broker to secure optimal coverage and perhaps with the technological advances a keen eye needs to remain with regards warranties and insurability.

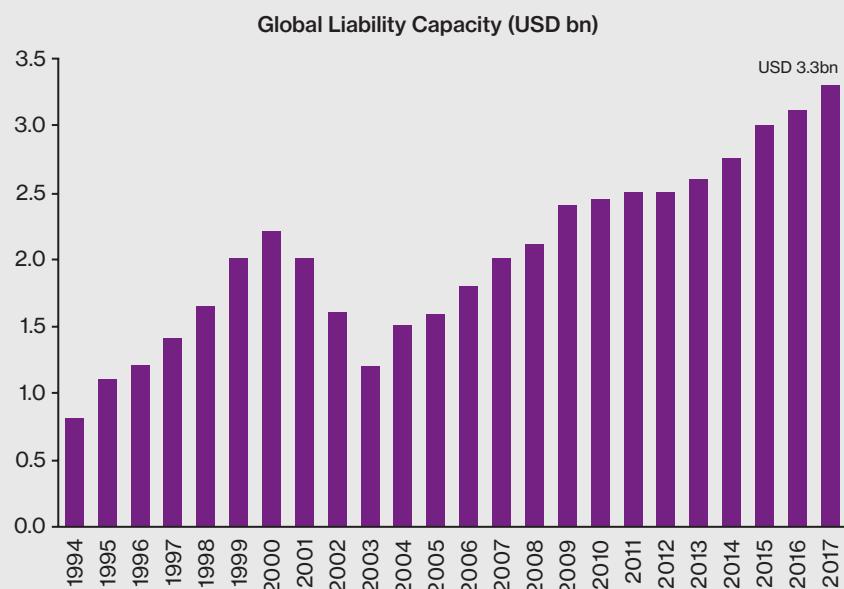
Phillip Callow is an Executive Director, Construction division, Willis Towers Watson

⁵ http://www.lmalloyds.com/LMA/News/Releases/PR_2017/Insuring_the_nuclear_future_14March2017.aspx

London: Liability

Capacity – up again in 2017

Figure 1 – Liability market capacity, 1994 - 2017



Source: Willis Towers Watson

Over the past twelve months the size of the global Liability market has continued to increase and has now reached a total of around US\$3.3 billion, although realistically for any one buyer the available capacity will be closer to half this amount.

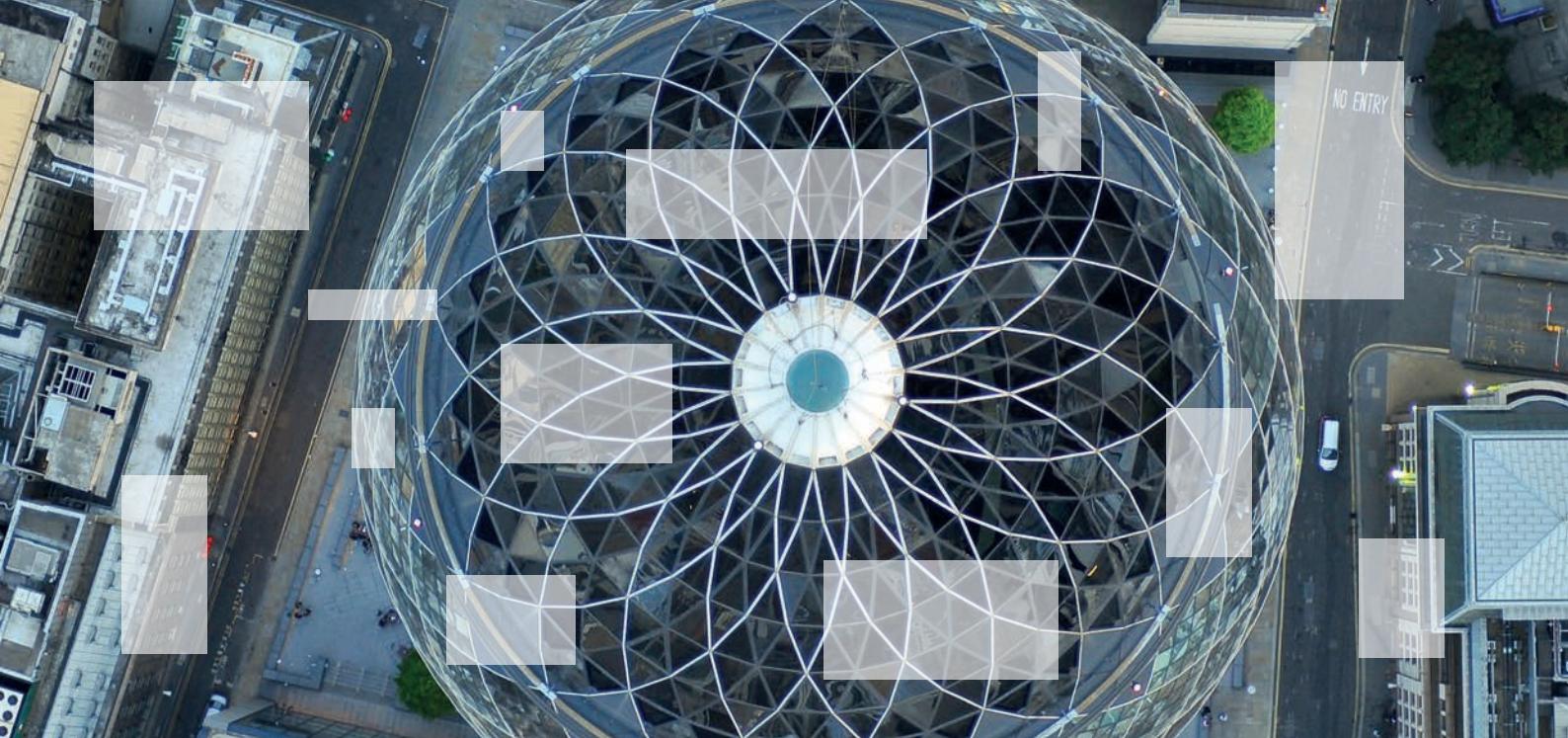
This is generally considered more than sufficient for liability programmes in the Power sector, which can vary considerably in size, from modest limits to limits that test the total capacity available in the market. This variance is driven by a number of aspects including the location of risk, type of plants being insured and the size of assets, with the most significant limits still purchased by European clients in the hydropower industry.

A whirlwind few months!

Despite a number of large events affecting liability insurers during 2015 and 2016, the liability market

remained constant in the face of adversity and the market continued to be described by commentators and participants alike as 'soft'. However, following a long period of relative stability the Liability market has begun to demonstrate a palpable hardening in underwriting conditions. There have been two significant triggers which have served as the catalyst for change, namely:

- The series of 2017 hurricane events, which affect the Liability market because Liability portfolios are often consolidated with Property portfolios from an underwriting management perspective.
- The adoption by the Lloyd's Franchise Board of a stricter approach to syndicates' business plans, only approving 2018 business plans that demonstrate profitable growth.



Significant increase in Reinsurance Treaty costs

As a consequence of the declining loss ratios, insurers are also facing the prospect of significant increases in their treaty reinsurance costs which will have a direct impact on their rating models for 2018, although to date upward rate pressure has been mitigated by new insurers entering the market and the 'sideways expansion' of existing capacity.

The International landscape

Over the past few years local insurance markets have added to the inter-market competitive pressure by offering alternative – and often cheaper – solutions to overseas buyers, particularly in the Middle East and Latin America. As the wave of change rises in London, brokers will be closely monitoring whether international markets are now the subject of a ripple effect. To date, overseas insurers have not reacted as discernibly to recent events as the London market which may result in an increase in policies being placed in the local insurance markets in the short term. That being said, it is hard to foresee a situation where local markets do not eventually harden their underwriting stance in line with the London market, although quite when this will happen is unclear at the moment.

Coverage developments – Failure to Supply

As we enter 2018, underwriters will not only be paying close attention to rates, but also to coverage. Failure to Supply coverage remains a key aspect for underwriters who continue to exclude the Pure Financial Loss aspect of such cover unless substantial information – and often premium – is proffered to enlist underwriters' agreement.

Markets are also prudent when it comes to transmission and distribution exposures, with pure generation risks tending to benefit from the most competitive rates. Separately, insurers are generally unwilling to remain silent on Electromagnetic Fields (EMF) exposures and the requirement for such cover to be positively written into the wording, albeit on a conditional and somewhat restricted basis, is now shared across the London and international markets.

Some underwriters are also pushing for cyber exposures to be picked up under a separate Cyber Liability policy rather than a General Liability policy.

Conclusion – can the market act in unison?

Despite the undercurrent of uncertainty that underpins the present state of the market, there are still some affirmations that can be made. Primarily, the liability market remains a two tier market, which effectively means that the position for an insured with a single-territory exposure requiring a modest limit of liability is quite different to that of an insured with a multi-territory complex exposure requiring higher limits and/or wider coverage. For the latter the capacity pool remains smaller and premium reductions harder to come by, especially as the market begins to turn. From an excess of loss perspective, insurers are also increasingly observing a cost of capacity threshold and refusing to breach minimum rates.

Overall therefore, there is an increased requirement from insurers when it comes to risk information as underwriters look to justify their position to a greater extent, both

internally and externally. That said, the abundance of capacity still available for most limits purchased by power companies means that whilst renewals may have become trickier for brokers, good deals are still available as some markets – particularly the relatively young syndicates with high gross written premium targets – may seize the opportunity to ‘steal’ business from competitors struggling to justify a rate reduction. The key question therefore is whether the market is capable of turning in unison or if it will be fragmented by the nature of its composition. Either way, the Liability market appears to be changing and the clients that will be dealt the best deals will be those who not only provide the highest quality risk information, but also engage the right broker capable of navigating the changing insurance landscape.

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Liability division, Willis Towers
Watson, Natural Resources*

“Whilst renewals may have become trickier for brokers, good deals are still available as some markets – particularly the relatively young syndicates with high gross written premium targets – may seize the opportunity to ‘steal’ business from competitors struggling to justify a rate reduction.”



North America

Introduction – the North American power market

The Trump Impact

Despite President Donald Trump's pledge to revive the struggling U.S. coal industry, aging coal plants continue to close, with no plans to build new ones. Trump's attempt to revive coal includes rolling back environmental initiatives implemented during the Obama administration, such as initiating plans to withdraw from the Paris climate accord and to repeal the Clean Power Plan. However, the US cannot fully withdraw from the Paris accord until 2020 (after the next election) at which time Trump may no longer be President.

Furthermore, some coal-killing programs are not easily unravelled. States continue to expand their renewables footprint, with 30 states pledging an increasing proportion of energy to renewables over time.

Leading the way are California, New York and Hawaii, all committing 50% of their power to clean energy by 2030. Additionally, major corporations are prioritizing renewable energy, implementing carbon, sustainability and renewable energy policies, with some signing long-term renewable Power Purchase Agreements (PPAs).

Nevertheless, Trump's steps may help more modern coal plants continue to operate, which would have been more challenging under Obama's environmental policies.

There are further steps the Trump administration could take to support coal-fired generation, but experts believe that these will have only minimal impact, if any. Coal's demise has more to do with economics than policy, with older coal plants no longer competitive with other technologies.



Growth Sectors

Overall, US power usage is down slightly, such that newly installed generation predominately replaces aging and inefficient nuclear and coal generation being shutdown. Regulators are taking steps to ensure that sufficient baseload capacity remains available to meet anticipated peak power needs, even if this baseload capacity is less efficient than other generating assets; otherwise, more coal and nuclear generation would likely be shut down as well. Interestingly, despite the fact that nuclear plants have become less competitive, states concerned over the impact of plant closures on their labor forces as well as the fact that nuclear power is a form of clean energy, may seek ways to keep these facilities on line.

Replacement generation consists of flexible combined cycle generation fired by natural gas (CCGTs), as well as utility-scale ground-mounted Photovoltaic (PV) systems and onshore wind. Renewables growth is aided both more competitive installation costs versus thermal plants than in past years and by state-driven mandates. Rooftop solar projects continue to grow as well, though utility-scale ground-mounted projects comprise most PV capacity. “Behind the meter” energy storage projects are growing and, as energy storage capabilities mature, PV solar

and wind will become even more competitive with thermal plants.

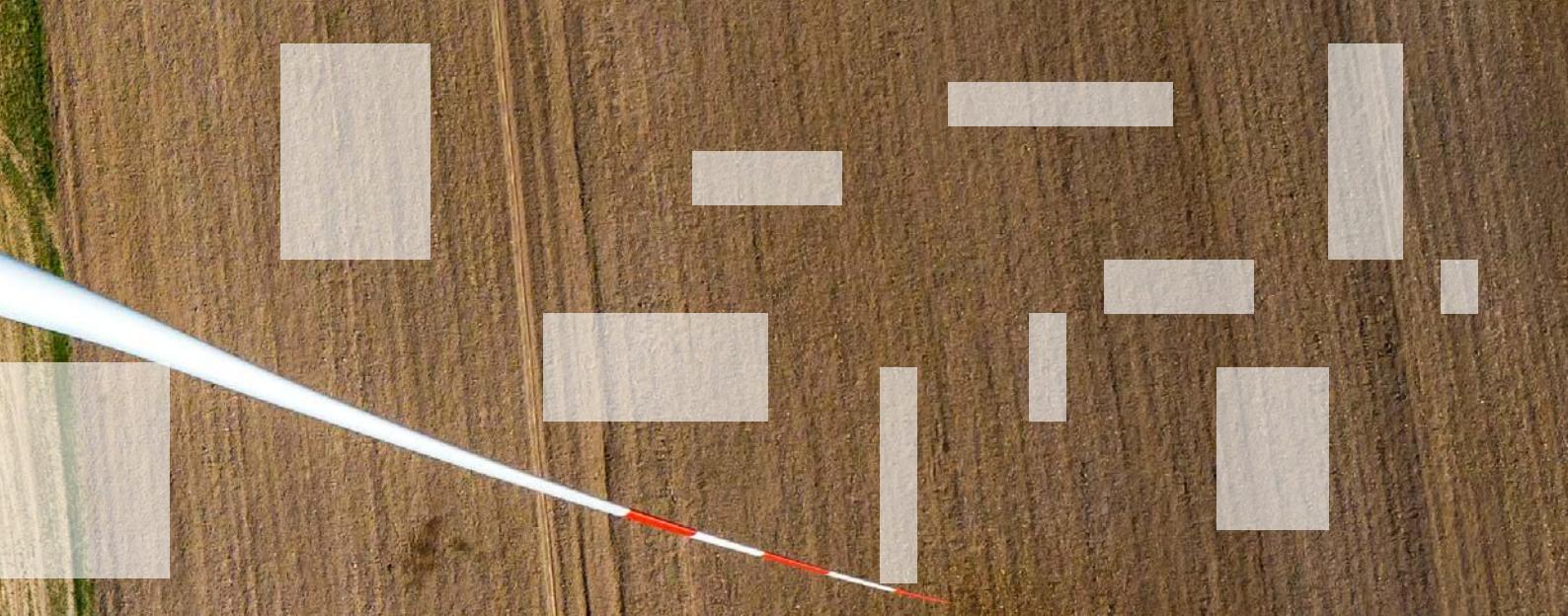
The first commercial US offshore wind project, Block Island Wind Farm, began operating in December 2016. Other projects have been proposed along the Northeast and Mid-Atlantic coast, though several of these projects are struggling with funding.

Prospects for growth of nuclear power generation dimmed after the V.C. Summer nuclear project in South Carolina was cancelled. The project was under construction but severely over budget such that it was cheaper to abandon the project and build gas generation instead.

Energy Storage key to US power market evolution

Energy storage is an important growth area for renewables, helping provide power when solar and wind are unavailable. Lithium Ion technology is expected to be the technology of choice for the next 10-15 years given its current momentum in this space. Battery storage costs will drop as China and India begin manufacturing and state renewable commitments push demand, akin to how PV technology cornered the solar market circa 2008.

As battery storage grows, the US power market will evolve. States are promoting increased use of



battery storage with defined MW goals (California 1.6 GW by 2024). The California energy market will significantly change as individuals arbitrage power by selling power during peak periods by discharging their electric car batteries to the grid, and recharging their cars overnight when power prices are less expensive. This will minimize profits to baseload plants that made money predominately during peak periods. Ultimately, California will need to alter grid economics as distributed energy becomes more and more common, potentially reducing needed baseload capacity. Individual customers will purchase more personal fuel cells for buildings for use during peak periods as well ("behind the meter" projects).

Insurance trends and implications

Thermal generation

The inflow of renewables, including energy storage, into the power system requires generation assets that were designed for baseload operation to cycle on and off more frequently, requiring more attention and maintenance for these facilities. Some newly installed, modest capacity, combined cycle generation is designed for flexible use to better handle the quicker shutdown and start-up environment of today. Insurers are wary of newer generation assets

still considered prototypical, as well as the impact of frequent cycling of older baseload generation assets, as these conditions potentially could result in higher frequencies of forced outages.

Renewables & Energy Storage

Insurers are wary about energy storage risks, given threat of fires involving Lithium Ion battery storage technology, the most widespread type used. There are potential supply chain mining challenges in the future as well, as there are potential challenges in securing enough magnesium, cobalt and lithium, though current supplies should be sufficient through the 2040s. However, some of these materials are mined in areas of high political risk, where supplies may not be accessible during times of political turmoil.

Loss control standards for PV Solar and Energy storage continue to evolve, and the NFPA plans to issue a standard in the near future for protection of utility scale battery storage installations. Protection schemes for Energy Storage projects are not agreed upon by all parties at this time. Lenders still have concerns with Lithium Ion technology, given the life / degradation issues and its bankability. Lenders will also be closely watching the performance of nascent projects such as NextEra's Arizona projects.

Onshore Wind – Warranty Expiration

G-Cube estimates that approximately 1/3rd of all wind turbines globally are reaching the end of original equipment manufacturer (OEM) service agreements and entering long-term operations and maintenance (O&M) contracts either with their OEMs, non-OEM operators or, in the case of large project owners, self-operation. These programs vary in length as well as scope - scheduled only to scheduled and non-scheduled contracts. Typically, insurers carry higher risk of loss once OEM warranties expire. Where the post warranty O&M contracts exclude unscheduled maintenance, insurers look to increased deductibles. Prudent project owners ensure that inspections are completed near the end of the warranty period detailing repairs needed, so that the OEM can make any necessary repairs before warranty expiration. Unfortunately, such inspections are often missed, such that project owners and their insurers become responsible for such repairs. Insurers see an uptick of losses once warranties expire, including issues with gearboxes, blades and other equipment.

Offshore Wind

US Offshore wind projects present a challenge to insurers as wind turbines are subject to damage from heavy winds commonly found along the east coast. These areas have favourable conditions for wind generation, but carriers are hesitant to provide coverage for these projects due to the hurricane exposure. The Block Island Wind Farm was designed to withstand

a Category 3 hurricane, the strongest hurricane strength to make landfall in New England in recorded history.

Design standards need to be addressed to ensure projects can withstand anticipated hurricane-force winds, as was done for this project. Insurers also want to see such projects successfully withstand hurricane-force winds, as designed. Additionally, insurers have concerns with potentially extended repair periods as the project locations are less accessible, and getting cranes to the locations to facilitate repairs can be challenging and expensive.

Wildfires

Insurers paid billions in 2017 for wildfires in California and the Pacific Northwest. Given the greater frequency, greater unpredictability and greater severity of such fires, insurers are hesitant to continue to provide wildfire coverage. Clients with this exposure will pay more to maintain the coverage they have, and some may struggle to secure coverage.

Cyber

Cyber threats in the US continue to grow, with several firms severely impacted by the Petya virus.

While Petya and other cyber events did not significantly impact the US Power industry, utilities and the electrical grid remain potential targets to hackers and cyber-criminals. Generators are spending more time focusing on this exposure, and many are purchasing cyber insurance.

"Prudent project owners ensure that inspections are completed near the end of the warranty period detailing repairs needed, so that the OEM can make any necessary repairs before warranty expiration. Unfortunately, such inspections are often missed, such that project owners and their insurers become responsible for such repairs."

Capacity performance/pay for performance- dynamic pricing

In the winter of 2014, approximately 22% of capacity committed to grid operator PJM's Regional Transmission Organization (RTO) was unavailable due to cold weather-related problems (interruption to gas supplies, etc.)⁶. Consequently, PJM and Independent System Operator ISO New England introduced Capacity Performance (CP) and "Pay for Performance" (P4P) requirements, respectively, for generators feeding their grids, to ensure that these organizations could meet peak load requirements under emergency conditions. Under the new rules, failure to generate in an emergency when called can result in significant non-performance penalties. These penalty payments are sent to generators that provide the energy that those called upon could not. This approach serves as an insurance policy for the grid operator, to prevent power outages.

Generators have few exceptions for not performing including pre-approved maintenance or planned outage, or the site has been dispatched down for economics, based on cost based offer or reliability reasons.

Emergency Conditions

Emergency conditions are rare. A "Performance Assessment Hour" (PAH) represents each whole or partial clock-hour for which an Emergency Action has been declared. From 2005 to 2017, only 164 distinct (PAH) events totalling approximately 755 hours have occurred within PJM, representing just 0.68% of all operating hours. On average, these

events lasted less than five hours. Most of these events occurred in periods of extreme temperatures, with 42% in temperatures above 90°F and 22% in temperatures below 20°F. No PAHs have occurred since the CP requirements were developed⁷.

Improved reliability

As a result of CP requirements and penalties, generators have taken steps to improve their reliability to minimize the likelihood of a Forced Outage event that might trigger these penalties, by modernizing their equipment, securing fuel supplies and adapting their facilities to use different fuels. In addition, to minimize their risk of penalties, many generators are altering how they bid into the grid-operators capacity markets, and by pooling with other generators. Generators can also purchase replacement power on the spot market, should they sustain an outage, to minimize their penalty risk.

Mandatory penalty structure

While the rules were written in 2015, the penalty structure becomes mandatory for these generators beginning in 2018. By June, 2020, CP will become the only capacity product in PJM. While there have been no emergency conditions triggering potential penalties since 2014, generators remain concerned that they could potentially lose millions in a few hours. While potentially solving the grid operators' problems, the penalties created significant uninsured risk to generators in the form of these heavy non-performance assessments, which property insurers view as penalties.

⁶ Tenaska presentation "PJM Capacity Performance", September 18 2017 (slide 4)

⁷ Michael Borgatti, Global Associates, "Longview Power Capacity Performance Insurance Product Discussion" - www.globalassociates.com



Special forced outage policies

Special insurance markets, including Swiss Re and Lloyds, developed special forced outage policies to insure this “penalty” risk. When these policies were introduced, pricing was steep and take-up low. In 2017, AEGIS and HSB began offer similar coverage for this exposure. With this new competition, and as these insurers have become more comfortable with the exposure, pricing has decreased. Additionally, limited coverage for this exposure has been creeping into property policies, subject to high monetary deductibles and modest sub-limits. However, most property policies exclude these penalties and any embedded coverage provided does not meet the needs of most clients. Separate forced outage policies still provide the most comprehensive coverage available, with a broader coverage trigger and without the day deductibles present in typical property policies. Still these stand-alone policies do not offer complete protection, as PJM can assess fees in the event of a grid outage (outside of the generator's control), and the forced outage policies only respond to events that occur within the generator's facility.

PJM proposed modest changes in 2017 to make up for the mismatch between fixed costs and marginal price-based energy markets. Essentially, baseload units never intended to work in a flexible configuration are being asked to do that now. This is because PJM's original plan favors nimble low variable cost, over high fixed cost baseload resources. Since it was important to PJM reliability to ensure that baseload operators, including coal and nuclear assets, are available in emergency conditions, PJM is providing them with more favourable pricing treatment than lower variable cost generators (CCGTs). Effectively, the most expensive generation dispatched by PJM will set pricing going forward. This change only impacts pricing and not dispatch, at this time.

While currently CP/P4P pricing is in place only in ISO New England and PJM, other US grid operators such as ERCOT (Texas) and MISO (Midwest US) are considering developing similar approaches for their RTOs/ISOs.



Insurance market update

2017 North American Power market starts soft

Throughout 2017, the US Power Generation Market, along with the Energy market overall, was softer than the general US Property marketplace. Key markets for the thermal power sector in North America remain Associated Electric & Gas Insurance Services (AEGIS), AIG, Liberty International, Munich American, Swiss Re, FM Global, and Zurich. Insurers writing thermal power generation also entertain renewable energy risks, along with HSB and AXIS, as well as MGA's GCube and PERse.

Cat losses stabilize the market - modest firming expected

Following the active hurricane season, both general Property and Energy markets firmed at the end of 2017. The 2017 hurricane season has been one of the most active and financially disruptive in history, with losses to the insurance industry expected to exceed US\$100bn⁸. Power generation risks weathered the storms better than other industries and ample market capacity remains to temper severe

market hardening, but we expect modest firming overall in the sector through 2018. This market correction could end by the end of 2018, given the abundance of available market capacity and the possibility that projections of insurer storm losses might be overstated. Results for each client will vary, depending on loss history, CAT exposure, and which insurers are involved.

Differing underwriting stances

Some insurers such as AIG and Swiss Re sustained heavier CAT losses in 2017 than the others. As such, these insurers began pushing for rate increases in September. Conversely, AEGIS and FM Global, who sustained smaller storm losses, continue to offer more competitive terms and push for growth in the sector. There is still significant domestic North American capacity available, estimated at over US\$3 billion for the right accounts, although this drops off significantly if the risk has extensive loss experience or catastrophe peril exposure.

Michael J. Perron is Northeast Region Property Placement Leader - Energy & Engineered Risk, Willis Towers Watson North America

International

Middle East

The Middle Eastern market, which has been a growing hub of reinsurance capacity in recent years, has matured at considerable pace to keep up with its international counterparts in order to become a key reinsurance market for complex Property, Downstream Energy and Heavy Industry risks (amongst others). This growth has been accompanied by substantial claims activity, with a number of complex property and machinery breakdown claims. This factor, combined with a much closer alignment with its international hubs, as well as global claims activity, has led underwriters in the Middle East to review their book of business, appetite for renewing business and the outlook for entertaining new business. While no issue is responsible in isolation for a less optimistic underwriting appetite, 2017 has seen a shift in the rhetoric emanating from reinsurers regarding what the reinsurance market may look like in the near future.

Guidelines from Head Office have influenced many underwriters to limit the “broad brush” reductions that have been witnessed in recent years, and it is relatively common for well-running business to be renewed at flat premium rating.

Growth of DIFC

The Dubai International Finance Centre (DIFC), as one of the major reinsurance hubs in the Middle East, continues to grow during 2017, with a series of MGAs being licensed in the last 12 months, as well as further international carriers becoming

licensed in the DIFC during 2017. The majority of this new capacity comes from reinsurers who wish to “follow” the terms of a technical lead reinsurer, rather than act as a leader.

Underwriting philosophies modified in light of recent losses

The power industry losses in the region during 2017 have acted as a catalyst for some reinsurers to modify their underwriting philosophy and approach in the region during Q4 2017. The Middle East market is not necessarily going through a stage of “hardening” with automatic rate increases, but instead is becoming a more “fussy” market. It is uncertain at this stage to what extent the reinsurance market will remain in this fluid state but, in line with global carriers headquartered in the UK and Europe, we can expect a more comprehensive underwriting approach for power risks in the region and a greater focus on risk engineering and individual claims activity.

Australasia

Whilst significant capacity continues to be available in the local markets in Australia and New Zealand, in our opinion premium rates have started to creep up by c.5% - 10% following the bottoming out of the soft market conditions of recent years. The market is now being driven by insurer results which, for many organisations, have been less than desirable. The larger power companies in Australia and New Zealand also engage with the global insurance markets, and so are affected by the global trends described above.

Insurers are becoming more selective regarding the quality of risks for which they will offer capacity and some are now willing to walk away from business that in their view is not adequately priced.

Lead insurers such as AIG, Chubb, QBE and FM Global offer significant capacity locally and remain committed to clients that continue to meet their engineering and risk control standards.

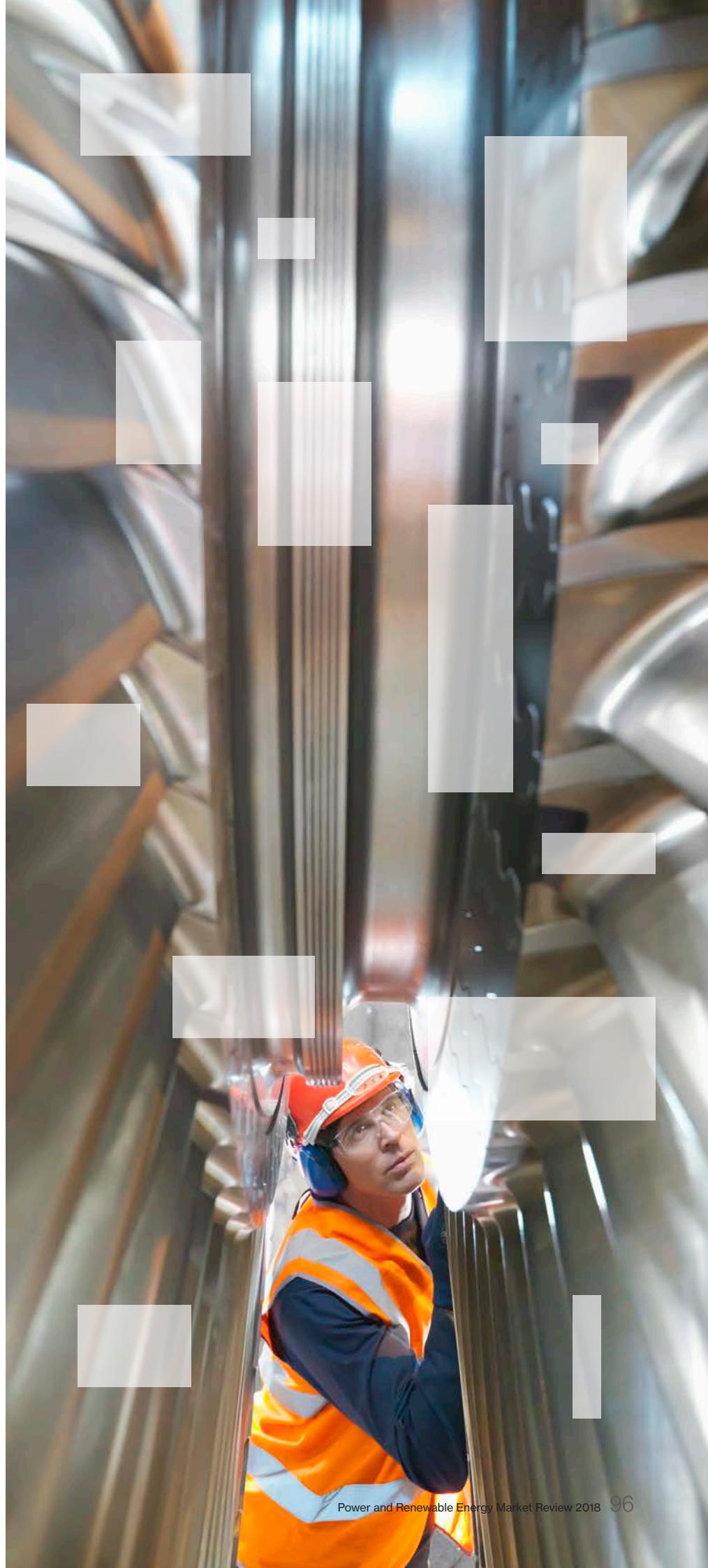
AXA Corporate Solutions, Allianz Global, Berkshire Hathaway, Liberty International, Swiss Re, XL Catlin, HDI and Zurich continue to support programmes in the power sector.

Asia

The Asia marketplace in 2018

Singapore continues to strengthen as an insurance and reinsurance hub for power business in Asia. International insurers with local subsidiaries operating across Asia have regional hubs in Singapore, with full underwriting authority and no requirement to refer to their home offices for approval. Likewise, international reinsurers all have regional offices in Singapore with the same degree of authority.

In recent years a number of European insurers, such as Allianz Global Corporate Solutions, Axa Corporate Solutions, Zurich Insurance and more recently HDI, have increased their penetration into the Asian power markets. In contrast, Lloyd's companies writing power business from Singapore have found themselves squeezed by the company markets' capacity and pricing; the Insurance Insider reported in November 2017 that Lloyd's Asia's top



line fell for the first time in five years in 2016 (by 5.9%), and that CV Starr had closed its Lloyd's Asia platform to new business.

Middle East markets with offices in Kuala Lumpur and Singapore have strengthened their offering in the power insurance sector. Korean insurers also offer significant capacity on domestic and regional business, and Chinese insurance companies can not only retain significant shares of most domestic power risks, but also offer significant capacity at attractive terms for power accounts in the region where the project has Chinese financial interest.

Market conditions in 2017

The first three quarters of 2017 saw continued market softening in Asia, as oversupply of capacity drove the market ever downwards. This was despite the sector as a whole remaining challenging for insurers, who continue to incur attritional losses in the face of declining premium rates.

Risk selection has remained a key strategy for insurers striving for profitability in this challenging sector, maintaining a high level of competition for those power companies who can demonstrate superior risk management and a good loss record – these companies will have enjoyed another round of respectable premium savings this year. Buyers with losses and/or a poorer risk profile have been judged on their own merits, but also have benefited from a certain degree of leverage in negotiating renewal terms in an oversupplied market.

Underwriters in the region have generally maintained a disciplined approach to coverage and deductible levels, a factor differentiating this longstanding soft market from previous soft markets, without which underwriting results would almost certainly have been significantly worse.

However, there is still some divergence between the requirements of international "specialist" or "technical" power markets for minimum deductibles and those of some local insurers in the region. Furthermore, a number of power projects entering their operational phase with "unproven" or even "prototypical" technology have been able to secure relatively low premium rates and deductibles, compared to international norms, as ultimate underwriting authority lies in the regional offices in Singapore.

To what extent will we see the end of the soft market in 2018...and for how long?

Insurance buyers in Asia are waiting to find out to what degree the hurricanes in the US will affect the Asian power market. There are certain factors to consider:

- The Power market in Asia is dominated by international insurers and reinsurers, all of whom have exposures to the losses in the US and are seeking rate increases across most lines of business and in most regions of the world as a result.
- Power business continues to present challenges to insurers' profitability, with continued attritional machinery breakdown losses documented year on year around the globe, including Asia.

- The performance of insurers' power portfolios has been masked to some extent by better performing general Property business. This mask has effectively been removed by the catastrophic property losses suffered this year, and therefore Power, like other specialist Property classes, will fall under even more scrutiny as insurers look to shore up underperforming business lines.

Messages from the international insurers and reinsurers being delivered in Asia in recent weeks range from the strongly expressed opinion that we have reached the end of the soft market and a market 'correction' in rates is now required, to what may be a more realistic view that the levels of rate reduction seen in recent years will no longer be achievable but rate increases will not be at the levels desired by the more hawkish underwriters.

Regional and local underwriters tasked with delivering these messages from their Home Office find themselves in a potentially difficult position, as carrying out these instructions will most likely result in a fall in existing revenue. Unless the market moves as one, attempts to increase rates on better quality business will present opportunities to other insurers to cherry-pick the most profitable accounts. With no sign of any reduction in capital available in the Asian market, the inevitable consequences of an excess of capacity over demand can only dampen underwriters' spirits further.

It will be interesting to see the extent to which regional power underwriters in Singapore have to refer to their

Home Office for authority to break with the corporate message in an effort to protect key accounts from being lost.

Much will depend on the impact that the January 2018 treaty renewal season will have on insurers' cost base, and to what extent they need to pass increases in treaty costs onto their own customers, the original Insureds. Reinsurance treaty commentators to date have noted that it is taking much longer this year for reinsurers to offer renewal terms, so at the time of writing the likely impact of international, regional or even local treaty renewals on the Asian insurance market is unclear. Whilst the general consensus is that power market conditions will change in Asia, the reality is that until early 2018 we won't know for sure to what extent and even then, for how long. Perhaps a degree of resilience is found in this regional marketplace, which will protect buyers from what others could be facing even outside of the US. The Asian power market, whilst very much a strain on insurer profitability, remains well capitalized and with a healthy blend of local and international insurers and reinsurers remaining committed to this sector.

Commentators have speculated that without a global retraction in capital to the insurance market, only a regional catastrophic event with significant resultant insurance claims would be sufficient to really turn the market in Asia. Whilst we have experienced numerous natural disasters in the region, causing economic loss and appalling human tragedies, insurers have not seen any major insured losses in recent years.

"Much will depend on the impact that the January 2018 treaty renewal season will have on insurers' cost base, and to what extent they need to pass increases in treaty costs onto their own customers, the original Insureds."

Latin America

The Latin American power industry remains on a path for growth, due to growing demand and commitment from governments to expanding generation, transmission and distribution sectors. However, in 2017 the weak economic outlook in Latin America has dampened somewhat the power investment growth, which is expected to rebound in 2018.

The power market outlook in this region can be summarised as follows:

- Other than hydro, renewables will be the outperforming generation type for new investments. Attractive government policies and falling investment cost/MW for renewables are important factors in that respect.
- Oil and coal fired are expected to lose share in the generation portfolio.
- Nuclear will retain a stable share of about 2% in Latin America as a consequence of planned investment in Argentina.
- Brazil, Mexico and Argentina will continue to be leaders in terms of percentage MW capacity in Latin America. Chile, Peru and Panama are expected to outperform for new power investments.

In respect of the insurance market, Latin America's insurance capacity for large power projects remains the international markets in Miami, London and Spain. The Brazilian insurance market remains strong for Brazilian power risks and is also expanding internationally (for example, IRB). Some important global insurers also have underwriting capacity from other countries in Latin America, being Mexico, Colombia, Chile and Argentina.

Latin America's Power market has suffered important claims, especially in Puerto Rico and the Caribbean due to the hurricanes. Finally, the emerging risk of cyber and the insurance protection which is available starts getting attraction in Latin America.

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Conclusion: is this the turn of the tide?

Although it may appear that the soft market conditions of recent years have come to an end, it is possible that they have only been put on hold. While conditions in Q4 of 2017 and Q1 of 2018 will be more testing for insurance buyers, especially those with a poor claims experience and/or located in cat-exposed regions, it is too early to tell whether the global insurance market for power and energy companies and other buyers has truly 'turned'.

We consider that there are three key factors:

1. Hurricane losses on their own may not be enough to turn the markets. It's clear that in the immediate aftermath of these storms, the insurance markets have become more challenging for brokers and buyers, but maintaining a hardening dynamic in the face of record levels of underwriting capacity will be just as challenging for insurers. Ironically, they may fall victim to the global insurance market's increased resilience (as discussed above) – while a US\$100bn loss event would almost certainly have turned the market a few years ago, it is difficult to see it doing so today. Insurers may find themselves in the worst of both worlds – liable for US\$100bn+ in claims, but unable to lift, and more importantly sustain, their pricing to the levels they perceive to be appropriate.

2. The impact of the reinsurance buying season on the direct energy market remains unclear. We will need to be several weeks into 2018 before we can determine whether what we're hearing now is the first sign of a genuine turnaround, or nothing more than wishful thinking.

3. Overall supply may remain stable in 2018. A number of Lloyd's syndicates, sensing a hardening market environment, are taking the opportunity to scale up their operations, and they may be followed by other insurers; this may balance out any potential withdrawals. And if the same amount of capacity continues to be available, simple economics suggest any market hardening will be difficult to sustain in the long term.

Even if insurers do succeed in reversing the soft market trend of recent years, any harder market environment may be relatively short-lived. In the Baden-Baden Reinsurance Symposium in October a representative observed that after the last hurricane-hit year of 2005 there were "three renewal periods when tariffs increased, but no more than that". Given that the market today is much better capitalized than in 2005, the timescales for a return to more benign market conditions could be much shorter.

David Reynolds is an Executive Director, Downstream Natural Resources, Willis Towers Watson



A photograph showing three business professionals in a meeting. On the left, a Black man wearing glasses and a white shirt with a grey tie is pointing with a pen. In the center, a white man with brown hair, wearing a blue striped shirt and a maroon tie, looks down at a document. On the right, a woman with long dark hair, seen from the side, also looks down at the document. They are all leaning over a table covered with papers and a laptop. The background shows a modern office interior with large windows and wooden paneling.

Part Four:

new perspectives on people and risk



De-risking supply chain disruption to wind energy projects

Background – the supply chain breakdown headache

A company's supply chain is a vital part of its operations and usually involves complex networks and relationships with multiple stakeholders. Businesses tend to ignore or underestimate their supply chain risks and therefore the potential consequences of supply chain disruptions.

Indeed, according to a survey conducted by Business Continuity Institute and Zurich insurance company in November 2017 regarding the uptake of supply chain resilience plans by organisations, 65% of companies have suffered supply chain disruptions. Yet over 7% of organisations do not identify their key suppliers at all and as many as 63% stated that they do not use any technology for analysing, monitoring or tracking their supply chain¹.

Causes often non-PD/BI correlated

Respondents came from different industry sectors, ranging from financial

and insurance to manufacturing companies. Interestingly, the majority of disruptions in the supply chain are not attributed to physical damage of components/materials. Rather, the main causes were reported to be the unplanned IT or telecommunications outage, the cyber-attack and data breach events, the loss of talent/skills and the outsourcer failure. Adverse weather and fire filled the sixth and seven positions respectively, following the transport network disruption.

Harsh consequences

The consequences for the company can be harsh; around 23% stated that the incurred cost from the disruption was above €1million. The most significant consequence according to the survey was loss of productivity, followed by the increased cost of working (see Figure 1 overleaf).

¹Business Continuity Institute - Zurich: "BCI Supply Chain Resilience Report 2017"
103 willistowerswatson.com

Figure 1 Consequences of disruption



Source: BSI, 2017

Wind Projects can be particularly vulnerable

Figure 2 Onshore wind turbine farm



Within the renewable energy sector, the challenges faced in securing resilience of supply chains differ according to the type of the energy technology and the size of the project. The supply chain network for wind energy has grown substantially over the last few years, with many tiers involved in the manufacturing of nacelles, blades, towers, cables and even raw materials.

Nevertheless, taking the supply chain risk out of wind projects remains of vital importance to financiers. Our own Willis Towers Watson supply chain experience with wind project developers has been established over the last three years and we are aware of developers' increasing concern regarding the potential for non-delivery to project sites, given the tight timeframes that are often involved.

Consequences of disruption

Should a wind energy project experience a supply chain disruption, the consequences can be severe and multifaceted. The wind energy project developer could suffer loss of government subsidies, liquidated damages, cost overruns and damage to reputation; lenders would be concerned about not getting compensated for their interests as a result of the project's loss of productivity. Finally, contractors may not be able to complete the EPC contract as a result of the project delay.

Typical insurance programs for construction and operation of wind turbines do not cover delays

Typical products covering risks during construction and operation stages of the wind turbines include policies such as Marine, Delay in Start Up, Business Interruption, Construction All Risks, Operational All Risks and Third Party Liability for each phase. However, these covers cannot cover a consequential loss from the delay in the supply chain, since they only trigger in the event of physical loss or damage to property. The key real risk of non-delivery therefore remains uninsured unless a separate risk transfer solution is implemented.

There is therefore a gap in cover which can be addressed through a tailored risk transfer solution - namely Willis Towers Watson's Renewable Energy Supply Chain insurance product.

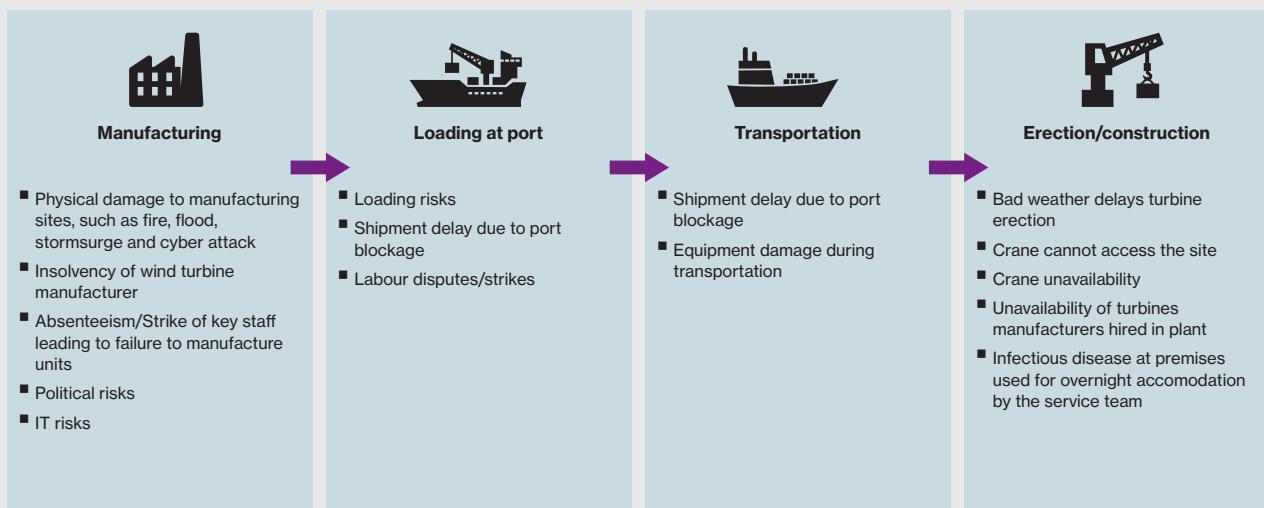
The Willis Towers Watson/Zurich supply chain solution

A broader solution across all supply chain stages

To meet developers' growing requests for risk coverage across all stages of the supply chain, Willis Towers Watson now works closely with Zurich insurance who have an extensive market experience in the design of insurance products that would include the coverage of supply chain risks, including the manufacturing of the wind turbine generators up to the commissioning stage.

This supply chain solution uniquely includes insolvency of wind turbine manufacturers and their Tier 2 and 3 suppliers as well as fire, storm surge and IT risks, to name but a few. In fact, there are numerous risks along the spectrum from the manufacturer to the project site (as shown in Figure 3 below):

Figure 3 wind turbine supply chain risks



Source: Willis Towers Watson

Supply chain risk coverage – all risks, inclusive of insolvency

Our combined supply chain solution offers an 'All-Risks' business interruption cover throughout the supply chain of the project, from manufacturing of the wind turbine generators to site delivery, including some unique coverages such as:

- insolvency
- targeted cyber-attack
- tax liability
- political risks

Although some exclusions apply to this package (quality recall, war, terrorism and regional pandemics) the product is designed to be an attractive solution for renewable energy developers and investors alike.

Willis Towers Watson has developed the risk solution with Zurich to offer developers a high value de-risking solution via a three-step process, including an indicative quote, a supply chain risk assessment and a firm quotation, as illustrated in Figure 4 below.

Figure 4 - a three step supply chain risk process



Source: Willis Towers Watson

1. Indicative quotation: This stage involves the collection of high level information on the company's part, by means of a short "Health Check" questionnaire, with the aim to determine appetite and criteria.

2. Supply Chain Risk assessment: During this stage, Willis Towers Watson and Zurich produce an extensive Supply Chain Risk Assessment report covering the whole supply chain of the project. The risk assessment will determine the full exposure to the project including the vulnerability of the supply chain. The sums insured are

calculated, including the Estimated Maximum Loss (EML) and the Probable Maximum Loss (PML) scenarios².

3. Firm quotation. Zurich will then calculate their premium based on the sums insured using the rating based on the scoring from the full risk assessment of the supply chain. It allows Zurich to score the supply chain against 26 key factors. The risk assessment document produced from this process forms the basis for the "Firm quotation" delivered by Zurich.

² The EML is the largest monetary loss suffered by the insured that maybe be expected to occur as even with specified contingency plans impaired. The PML scenario is the largest monetary loss suffered by the insured that maybe be expected to occur as even with contingency plans in place, such as a strike or port blockage.

Figure 5 - a typical supply chain health check three step supply chain risk process

Supply chain health check – How resilient is your project supply chain?		Yes	No
1.	Do you know who the critical suppliers of the wind farm components are, and how much their failure would impact your company's profits?		
2.	Have you fully mapped the critical supply chains of your wind energy project upstream to the raw material level and downstream to the customer level?		
3.	Do you have a risk management process in place for your supply chain?		
4.	Do you have routine, timely systems for measuring the financial stability of critical suppliers?		
5.	Do you understand your tier 1 production facilities and logistic hub exposures to natural catastrophes?		
6.	Is supply chain risk management integrated into your enterprise risk management approach?		
7.	Do you record the details of supply chain incidents and the actions you have put in place to avoid future incidents?		
8.	Do your tier 1 suppliers have business continuity plans that have been tested in terms of their viability?		
9.	Have you provided risk training to your supply chain management team?		
10.	Is risk on the agenda at performance meetings with your strategic suppliers?		

As developers become more aware of this innovative risk solution to de-risk their projects, there is a quick way to ‘sense check’ just how vulnerable the specific project might be as set out in figure 5 above.

If you would like to discuss your renewable energy project and understand the vulnerabilities of your supply chain, please contact us!

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The future of power and energy captives

Introduction – a renewed interest from the power and energy market?

Captives have historically been quite prevalent in the power and energy sector. The ability to build cash reserves through risk retention, access greater capacity and exert greater control over insurance programme design has traditionally appealed to the large and complex power and energy companies.

However, like everything, the relationship that the power and energy sector has with captives is subject to change. The extended period of macro-economic depression and then uncertainty from 2008 until relatively recently, negatively impacted captive utilisation across most industry sectors including the power and energy sector.

More recently, there has been an increase in interest in captive utilisation. The explanation for this renewed interest can be explained by the desire for the core risk financing benefits that a captive can provide, but also in some new developments in the captive industry.

How are captives being used for power and energy risks?

Power and energy companies have typically been enthusiastic adopters of captive strategies. Captives compliment the strong risk management emphasis of power and energy companies. Being typically large and complex organisations, power and energy companies benefit from captives' ability to centralise risk and insurance arrangements through a central 'hub', giving greater visibility of risk and collecting and consolidating risk management data which can be used to identify risk management improvement initiatives.

Many power and energy companies benefit from healthy balance sheets and risk bearing capacity and given the investment in risk control and risk management that is typically present in the sector, captives provide a perfect vehicle to take advantage of both the ability and the confidence to retain risk.

How are captives adapting to a new environment?

The emerging trends that provide an insight into the evolution that captives are currently experiencing is arguably more interesting and exciting.

In general, the two most notable evolutionary traits that captives have displayed in recent times have been:

- the utilisation of data to optimize risk financing arrangements; and
- the way in which they mirror the evolving risk profile of power and energy companies accommodating a far broader range of risks.

Data and captives

Data has become valuable currency in all facets of life in recent years and the capacity of captives to act as a repository for risk management data has grown exponentially as a result.

Through the correct usage of their own data, power companies now have a wealth of insight to inform what and how they retain risk and this has led to an emergence of captive owners who speak in terms of “optimal retention structures”, “portfolio benefit maximization” and “maximization of return on equity” – a genuine insurance mind set. This has led to the pursuit of more sophisticated structures such as multi-year, multi-line programmes, to refine and optimize how corporates finance their risk and provide additional cash flow benefits - something that most mine operators would welcome.

In a sector with complex and potentially high severity risks, with high degrees of interdependencies

between loss events, the ability to firstly model the operations risk profile, and then use these insights to make financially beneficial retention decisions is of paramount importance.

Broader risk profile associated with new ways of working

It is not a coincidence that the major trends and innovations of the captive industry in recent years have been in areas such as human capital benefits, political risk and cyber liability to name but a few – these represent the fastest growing risks of most major corporates.

Captives are rapidly adjusting to the new reality of a more interconnected global economy, where human capital is now, more than ever, seen as the greatest asset a company can have.

The emergence of captives as viable insurers of employee benefit risk is one of the most noteworthy developments in recent years and exemplifies the evolution of captives from vehicles for ‘traditional P&C’ risk to enterprise wide risk solution vehicles. The ability for power companies to have more flexibility in employee benefit design and execution could have profound impact of talent attraction and retention in a period of a well-documented ‘talent war’ within the sector.

This broadening of captives’ risk profiles has also improved the efficiency of captives through increasing diversification benefits but also ensured that they remain relevant to the key risks corporates face today.

“Captives are rapidly adjusting to the new reality of a more interconnected global economy, where human capital is now, more than ever, seen as the greatest asset a company can have.”

Increasing globalization of captives

Another trend which has become more evident in recent years is the increasing global spread of captive hubs or domiciles. Historically, captives congregated in a handful of captive strongholds such as Bermuda, Luxembourg and Guernsey. However there are now over 60 recognized captive domiciles with insurance legislation specific to captives.

This development underlines the growing demand for captive solutions outside Europe and the US, and is a reflection of the globalization of modern business environments.

Current challenges to the industry – Base Erosion and Profit Shifting ('BEPS')

One of the most significant challenges facing the captive industry is BEPS, which is an Organisation for Economic Co-Operation and Development (OECD) led taxation initiative, expected to become a global taxation standard. This initiative aims to renovate global taxation frameworks and 'close the loop' in tax legislation which allows multinational corporates to artificially shift profit to lower tax jurisdictions and reducing their overall tax bill. Although the measures introduced by BEPS are not specifically aimed at captives, as subsidiaries of large multinational companies they fall within its remit. It is likely that many companies in the natural resources sector will own captives in locations where the corporate tax rate is lower than that of the headquarter jurisdiction, and if this characteristic applies, so may BEPS.

However, it is important to stress that having a captive in a location where corporate tax rates are lower (relative to the organization average) does not imply wrongdoing, nor should captive owners be unduly concerned.

Positive preparation

What is important is positive preparation. Although the ultimate guise of BEPS in all jurisdictions is still to emerge, there is enough in the principles covered in the OECD guidance for captive owners to be preparing for. A sensible first step on the preparation project journey, and something we are recommending to captive owners through our proprietary proposition, RADAR, will be to review the captive's position in relation to the principle expectations of the BEPS package. Measuring the captive against key metrics, and documenting where positive compliance can be demonstrated, and where remedial action is required will allow captive owners to begin thinking about BEPS in specific terms that are actionable. This can lead to a BEPS preparation plan which ultimately puts the captive owner in control of the challenge and removes much of the uncertainty that currently exists for many captive owners.

Implications for the power sector

So what conclusions can the power sector draw from these developments?

Utilization of data to achieve a more analytical approach

A common theme ties the various developments observable in the captive industry of today – captives have continued to keep pace with economic and risk management developments. Big data, cyber risk, changing work places and practices, and challenges related to the governing of an interconnected global economy are all terms that will be encountered when reading any commentary of today's economy. Utilization of data to achieve a more analytical approach, accommodating risks such as employee benefits and cyber, and aligning to regulations designed for interconnected global economies through BEPS suggest that captives have more than kept pace and are displaying the ability to 'future proof' themselves.

Periodic review and realignment of captive deployment

However, none of these benefits will happen automatically. Captive owners who derive the best value, and maintain the greatest relevance from their captive strategy, employ a periodic review and realignment approach to their captive deployment. The rate of change in the risk profile of power companies, with changing work practices, regulations and commodity price volatility, together

with the numerous external forces impacting a captive approach, results in the "shelf life" of a given captive strategy becoming potentially shorter.

However, this should not be viewed as a negative development as the greatest benefit of a captive is its ability to adapt and transform to meet the demands of the group as and when they change. If reviewed regularly, the enhancements to strategy will take the form of incremental improvements as opposed to any fundamental change in the strategic direction of the captive.

Conclusion: a flexible and dynamic tool

To conclude: a captive remains a flexible and dynamic tool for the management and financing of the traditional risks associated with operating a power plant, but significantly it can also prove an effective tool for dealing with emerging risks associated with more sophisticated work practices. The benefits of a captive strategy also now span further than the risks typically under the remit of the risk manager and can be considered on a truly enterprise wide basis.

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Connected, automated, innovative – the future of work in the power industry

Introduction – the power industry is transforming!

Power is key to driving human progress. With digitalization and technology, that progress is accelerating in power generation, distribution and consumption.

- **New energy sources can be utilized.** Advances in generating and storing renewable energy mean that new market players and business models are emerging. Wind and solar are growing significantly, but also (for example) geothermal, biomass and ocean energy may potentially be bigger in the future.
- **Generation is happening on a more distributed basis and closer to the consumer.** Consequently, the consumer can control consumption through the use of smart-home devices, gaining more influence on energy related decisions.

- Networked energy management, in combination with predictive data analytics, brings more efficiency and network stability. Connected buildings, as well as smart homes and cities, allow for a range of improvements in energy management and everyday life. The “Internet of Everything” has emerged.
- **Customers will expect more individualized services.** As digital technology gives greater control over consumption choices, customers will expect higher and more individualized level of services than in the past.

At the same time, power companies are facing economic pressure to achieve greater cost competitiveness which puts pressure on business models. In other words, the challenge involves “closing the demand gap and providing value for customers profitably”³.

³ <https://www.strategyand.pwc.com/trend/2017-power-and-utilities-industry-trends>

Business models are evolving – so organisations and people need to adapt

Innovation trends, in combination with regulative legislation, are forcing the industry to adapt or even reinvent business models. For example, utilities are utilizing blockchain to create a decentralized, efficient and reliable energy system; it makes transactions between market participants easier and less cumbersome. Many organizations can collaborate on the same blockchain with minimal need for human interaction, resulting in flexibility and great efficiency benefits for grid operators and distributors. In the future, consumers may be able to switch power suppliers easily by using a blockchain platform.

Organizations therefore have to rethink and adapt operating models, organization designs and (eventually) the work itself and how it's done. We have identified four major recommendations for HR to help drive progress, which we outline below.

1 - Revisit organizational design and create an agile network organisation

Organizations are setting up their structures to adapt even faster to market changes. There are several trends in play to create more flexible, effective organizational set ups:

Alliances speed up energy innovations

In order to speed up innovations in energy transitions, industry players are collaborating and creating partnerships. Some examples:

- **GE Digital** has partnered with several other industry leaders, such as Apple, Intel and PwC, and innovators to join forces in advancing the new digital industrial era. Working together with Apple, they are bringing industrial apps to the market that provide predictive data and analytics from Predix, GE's industrial Internet of Things (IoT) platform⁴.
- **Fingrid** is using IBM IoT's solutions to build a centralized asset management and big data analytics platform⁵.
- **Energy Web Foundation (EWF)**⁶ is a global non-profit organization focused on accelerating block chain technology across the energy sector. Corporate affiliates, a set of key leaders across the energy sector, are the funders of EWF and in return reduce transaction costs for their processes, maintaining their current position.

⁴ <http://www.genewsroom.com/press-releases/apple-ge-partner-bring-predix-industrial-apps-iphone-ipad-284065>

⁵ <https://www-935.ibm.com/industries/energy/>

⁶ <http://energyweb.org/>

(Corporate) start-ups⁷ increase speed to market

Large players in the industry are investing in start-ups as a way to understand and test new concepts and adopting them into their processes.

Some of the start-ups to watch⁸:

- Sympower focuses on synchronizing household energy consumption with renewable resources.
- DAJIE is using blockchain to enable peer-to-peer energy sharing.
- Swuto allows you to track and compare one's energy bill and will automatically switch you to the cheaper energy supplier.

Corporates engage increasingly in funding or co-creating start-ups. Accelerators and Incubators facilitate founding of new enterprises. Enel's Innovation Hubs⁹, E.on's :agile accelerator¹⁰ and Engie's open innovation platform¹¹ are just some examples of corporate entrepreneurship.

Going agile and customer-centric

Agile team setups and flatter hierarchies with clear decision rights empower teams to act independently and take accountability for innovation in their respective area of responsibility. Small, empowered teams in a network with clear collaboration processes and routines are the right basis for fast progress and adaptability. The Haier

Corporation is a progressive example of such a dynamic network-based organization; they built a network of entrepreneurial ventures run by employees, whose compensation is based on the success of their products in the market¹².

Customer-centric organization design

Market leaders in innovation put the customer first and even involve them in the value creation. For example, Tesla is in the process of setting up a shared fleet program that allows Tesla owners to rent out their cars and make money doing so to pay off car loans and generate extra income¹³. Another example is ReGen Villages, planning to apply a model where residents will use technology to grow their own food and produce energy and water, allowing them to sell excess goods and generate extra income¹⁴. They are building the first village in the Netherlands, and plan to expand into Northern Europe.

In order to become that customer-centric, organisations have to be set up to design and deliver on the basis of rigid focus on the customer needs and the customer experience. A customer-centric company strategy, followed by translation into operating model and organization design, is key. Organizing teams around customer problems and setting up processes so that customers can be involved in product development are two examples of operationalization success.

⁷ <https://www.gepower.com/transform/article.transform.articles.2017.may.energy-industry-start-ups--how-are-they-changing-power-generatio>

⁸ <http://www.dexmatech.com/10-smart-energy-startups-follow-2017/>

⁹ <http://startup.enel.com/en/bulletin/innovation-hub-en>

¹⁰ <https://eon-agile.com/>

¹¹ <https://innovation.engie.com/en/>

¹² <https://sloanreview.mit.edu/article/leading-to-become-obsolete/>

¹³ <http://uk.businessinsider.com/elon-musk-reveals-tesla-shared-fleet-2016-7?r=US&IR=T>

¹⁴ <http://www.regenvillages.com/>

2- Reconsider the best way to get the work done

46% of study respondents in the World Economic Forum's Future of Jobs study see the changing nature of work as a top trend impacting business models in the energy industry, directly after new energy supplies/technologies and climate change/natural resources.

How work gets done in the future

Willis Towers Watson recently asked 909 HR professionals around the globe for their opinions on the future of work. Respondents expect that three years from now automation (artificial intelligences, robotic process automation, robotics, etc.) will on average account for 22% of work done in their organizations.

Of course not all jobs face the same probability of automation; for instance, there is a 9.7% probability for electrical power-line installers and repairers to be automated, whereas the power plant operator has an 85% automation probability¹⁵. Likewise, traditional full-time employees will still be the norm in many parts of the industry.

But even for employees work will change, with 25% of employers expecting to redesign work so that the tasks performed will require more skills and 27% of employers expect to redesign work so that tasks will require fewer skills, according to our global Future of Work survey. Many of these organizations are doing both simultaneously.

Identifying the tipping points

In our view, it is important to take a differentiated perspective and "deconstruct work". That means identifying what task of a job shall best be done by what resource:

- Is it best to hire someone for a longer term?
- Or should an external free agent be appointed on a project basis?
- Or does it make economic sense to automate that task, for example because it is of a repetitive and high volume nature? When this is done, what makes sense to be left in the job?
- And of what's left, does it require more or less skills?

¹⁵ https://www.oxfordmartin.ox.ac.uk/downloads/academic/The_Future_of_Employment.pdf



A “work scan” activity helps to identify the tipping points of this change in the workplace. That means identifying hard to fill roles, premier work and jobs that have skill obsolescence or over supply. Those are the first jobs to be rethought. What tasks can be automated? What type of worker is best suited to do particular tasks that are not automated? What are the costs and risks to be weighed?

There are already plenty examples of robotic process automation in the industry. From customer records management and billing, to former field technician work (measuring and metering), and quality or safety control jobs, often in high risk environments (e.g. power plants). In the field technician work example, if drones, robotics and AI take over the routine work associated with measuring and metering, the non-routine work in issue resolution may require new skills, performance and training requirements.

And there are also new jobs emerging. One example: with increasing data volumes, utilities are expected to invest more than US\$ 20 billion in analytics between 2012 and 2020, expecting a return of more than US\$ 120 billion¹⁶. New roles include Data Scientists, Data Visualization Experts and Data Analysts. Big Data Analytics was identified as the most wanted IT skill in

the next one to two years in a recent Willis Towers Watson IT skills survey¹⁷.

Redefining work strategy and work architecture

These trends show that organizations have to rethink how work gets done and adapt both their talent and work strategies and their job and work architectures accordingly. Talent and Work Strategy takes into account not just the supply and demand of talent and the needs of the future workforce, but also the supply and demand of work. It answers questions related to: how will work change with technology, and what are the future requirements for the work and workforce? Job and work architectures account for not just how jobs are organized in the organization, and their associated scope of work, but also addresses the emerging skills required for the work and recognizes where work may be addressed by technology, creating obsolescent skills. The World Economic Forum’s Future of Jobs report confirms: 80% of respondents believe that future workforce planning (the supply and demand for talent as well as the skills required) should be a leadership priority for the Energy industry; furthermore, 59% of respondents believe that strategies should involve investing in re-skilling of current employees¹⁸.

¹⁶ <http://www.pennenergy.com/articles/pennenergy/2014/05/market-research-big-data-analytics-for-utilities.html>

¹⁷ <https://cms.willistowerswatson.com/en/insights/2017/09/Attraction-retention-and-engagement-of-digital-talent>

¹⁸ <http://reports.weforum.org/future-of-jobs-2016/energy-2/>

3- Build a culture of learning and innovation

The best structures and job setups are worth nothing if employees do not accept them and live them. An open-minded, collaborative organisational culture with focus on innovation and learning is needed to really thrive in the future of work.

Continuous learning is especially important, as new ways of working require new skills or even different types of traits and attitudes. In Willis Towers Watson's recent Global Future of Work Survey 67% of organizations believe applying automation to work will have a positive impact on workers. But only 40% of organizations report that their approach to organizational design effectiveness and change currently accounts for the impact of work automation.

Adaptability, flexibility, willingness to learn

Most important will be for every worker to be adaptable, flexible, and willing to continuously learn, upskill or even reskill. Being able to use the potential of new technologies will be pivotal. Technical skills will be important if they cannot be done better by machines or if they are needed to creatively develop new solutions – as creativity

is a competency machines do not master that well - yet. But the Future of Jobs report identified that there will be an even bigger demand for social skills. Emotional intelligence, empathy, coordinating with others, relationship building and cross-cultural sensitivity are some of the most important competencies to navigate this new world of work. Leaders and managers play an important role in preparing and guiding their workforce through those changes. Leadership development needs to be adapted accordingly¹⁹.

Less than half of leaders actively planning

Respondents of our global Future of Work survey confirm that in the next three years leaders face major challenges: today, only 43% of respondents say senior leaders are actively planning for and developing ways to combine and automated work. That will have to change quickly as 65% expect that leaders will need to focus more on communicating and leading change around the new combinations of humans and automated workers in the next three years. 61% think that managers will need to educate workers on how automation changes work during this same span.

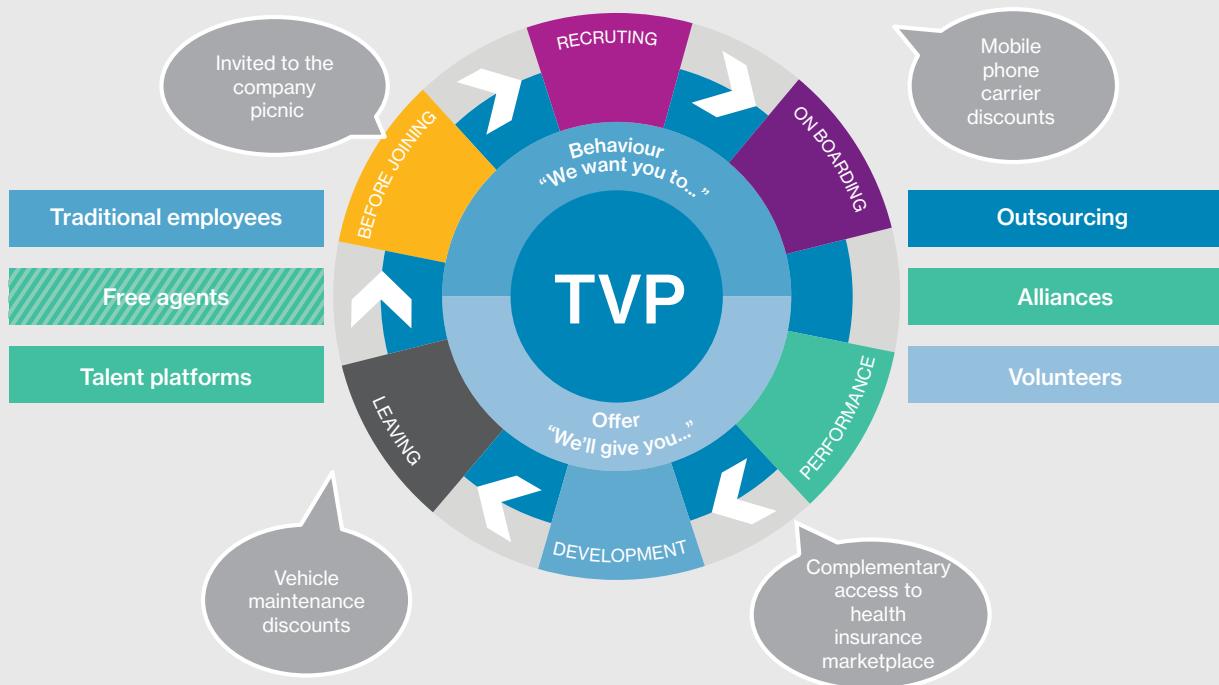
¹⁹ <https://hbr.org/2016/10/as-work-changes-leadership-development-has-to-keep-up>

4- Define your Talent Value Proposition – and adapt HR programs

In essence, the workplace is becoming more diverse; business as usual doesn't exist anymore. Your co-worker might be a start-up entrepreneur, a freelancer, might be from another company – or might be a robot. You have to collaborate and work towards a common goal – most likely involving continuous rethinking and adapting routines and work habits.

HR has a leading role to play in this endeavour. At the foundation is a common experience and shared practices for all workers; a Talent Value Proposition serves that purpose. The organization clearly states what it offers every employee and non-employee segment – and what it expects in return. Different talent groups and their specific needs are considered in every phase of the talent lifecycle.

Figure 1 - from Employee Value Proposition to Talent Value Proposition



Source: Willis Towers Watson



It starts with effective recruiting and a positive and consistent on-boarding experience. In our global Future of Work survey, only 2% agree that the HR function of their organization is fully prepared for identifying the emerging skills required for the business. Only 2% feel that HR is fully prepared to effectively match talent to the new work requirements. And 30% think that “breakthrough” approaches will be needed for employer branding and talent acquisition (60%) to adequately address the challenges ahead.

Only 3% think that HR is fully prepared for enabling careers based on a more agile and flattened structure. Hence, 60% of respondents think innovation is required in career management, as well as Performance

Management (69%). A career marketplace might be an adequate measure to match the right talent to the right opportunities²⁰.

Pay programs and Benefits should also be harmonized. 60% of respondents of our Future of Work survey agree that “breakthrough” approaches and innovation will be required in pay or benefit programs to ensure the challenges of automation and digitalization are adequately addressed. One possible solution is an online platform to provide contingent workers with access to benefits, as our partner Stride Health provides²¹. Modernizing Total Rewards programs should also be a priority²².

²⁰ <https://www.willistowerswatson.com/en-TH/insights/2017/04/the-career-marketplace-what-the-future-of-work-looks-like>

²¹ <https://www.stridehealth.com/>

²² <https://www.willistowerswatson.com/en-TH/insights/2017/06/10-practices-to-overcome-outdated-tr-programs>



Powering up – creating opportunities for the future

With all developments happening in the industry and in the broader business environment, the need for change and innovation is undeniable. It brings challenges that will often be a stretch for workers and organisations. Good communication and change management will be key here. If managed well, new technologies and the transformations both in the business and in work structures offer immense opportunities. On the one hand, our global Future of Work Survey respondents state that the next three years will bring:

- Work being deployed to other locations (67% of respondents)
- More pay for certain skills sets (62%)
- Less employees (49%)

But they also think the changes in workforce and workforce activities will bring:

- Increased work flexibility e.g. scheduled hours to get work done (68% of respondents)
- Improved collaboration and information sharing (63%)
- more use of non-employee talent (not directly employed with the company) (50%)

Ultimately, it is about seizing the opportunities and navigating one of the most complex transformations the industry has seen. As Peter Drucker put it: “The best way to predict the future is to create it”.

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Managing cyber risk in the power sector

No immunity, no boundary – the risk is systemic...

Cyber security represents a fundamental challenge for the power sector and a top priority for industry leaders. Malicious hacking, ransomware attacks, data leaks and electronic fraud are occurring on a global basis, where the motives vary from financial, political or merely to cause disruption. The recent global ransomware incidents WannaCry and Petya have shown us that:

- **No one is immune.** Attacks do not need to be targeted at a specific company or industry sector.
- **Cyber-attacks lack a geographical boundary.** They are easily able to bridge the geographical boundaries which exist in a physical context.
- The potential systemic risk which can arise from a cyber-attack is far from theoretical.

Power sector particularly vulnerable

The power sector plays a critical role in economic growth, national defense and personal safety and as such is an attractive target for attacks aimed at disrupting operations. A Business Blackout Report in 2015 by Lloyd's of London and Cambridge Centre for Risk Studies examined the economic and insurance implications of a major cyber-attack using the US power grid as an example²³. The report depicted a scenario where hackers destabilize parts of the US power grid plunging 15 US states into darkness and leaving 93m people without power. Experts predicted that this would result in a rise in mortality rates, a decline in trade, disruption to water supplies and chaos to transport networks as infrastructure collapses. In a worst

case scenario these attacks could result in infrastructure shut down, triggering economic and financial disruptions or even loss of life and massive environmental damage. The total impact to the US economy was estimated at US\$243m but economic losses could top US\$1 trillion in the most extreme version of the scenario.

The power sector remains vulnerable to cyber-attacks and breaches from many fronts and the convergence of IT and operational technology, the uptake of smart devices for real-time operations management and remote operations, and the adoption of cloud services are driving significant change. The sector must continue to refine and improve its security capabilities with an ongoing programme of investment and monitoring to ensure security and availability are maintained across the entire IT & OT estate and prevent business disruption.

Transformation of working practices

Technology has transformed working practices, leading to increasing productivity and driving operational efficiency and innovation. However, this increased adoption and reliance on technology does not come without increased risk and as systems become more increasingly interconnected and processes more digitised, energy companies will need to contend with an increased number of network born security threats. Systems that were previously isolated from other networks are now connected in both critical and non-critical systems. Never has industry been more susceptible to operational derailment and ultimate financial loss due to a cyber-attack.

²³ Lloyd's Emerging Risk Report – 2015. Business Blackout. Cambridge Centre for Risk Studies. University of Cambridge Judge Business School

It's not just a technology issue!

In our recent 2017 Cyber Risk Employer Survey²⁴ 76% of companies reported that they have improved their technology systems and infrastructure over the last three years. While this shows that companies around the world are focusing their time, resources and budget on technology solutions, most companies still perceive themselves vulnerable to cyber incidents.

While critical to protecting the enterprise, technology is only one piece of the solution. This is again evident from our survey, which shows almost 75% of organizations report that in the next three years, they intend to allocate more capital to human capital solutions (such as comprehensive training programmes for employees) and business processes.

Human Resources and CISO personnel now playing key roles

Although IT departments – and to some degree, risk managers – are seen as responsible for cyber risk management strategies, other functions such as Human Resources and Chief Information Security Officers (CISOs) are increasingly playing an integral role in protecting the enterprise and creating a cyber-savvy workforce.

The majority of cyber incidents are ultimately sparked by employee behavior (whether through

negligence, accidents or intentional acts). Our cyber insurance claims data shows two-thirds of incidents are the direct result of employee behavior – for example, negligence leading to lost devices and malicious and disgruntled insiders seeking to profit from corporate espionage. When analyzing the other 33% of incidents, a large portion can ultimately be traced back to additional human errors that can be linked to issues such as talent shortage, skill deficits and employee engagement.

Information has value

The theft of individuals' personal information and personal financial information has long been a motive behind a number of highly publicized cyber incidents. While this continues to be an area of focus, cyber criminals increasingly understand the value of a much wider range of sensitive data, whether in terms of an opportunity for direct monetary gain or in manipulating business dynamics.

For example, theft of intellectual property could be a potential motive; in a competitive market, the importance and value of this information cannot be overlooked. Having a robust information security programme should not be viewed as a cost but rather an essential investment and an opportunity to gain competitive advantage, generating increased confidence with customers and investors seeking to protect the value of their investment.

"Never has industry been more susceptible to operational derailment and ultimate financial loss due to a cyber-attack."

²⁴ <https://www.willistowerswatson.com/en/insights/2017/06/2017-cyber-risk-survey-report>



Regulation continues to tighten

Regulation relating to cyber and information security has historically been focused around data privacy and data protection issues; however, regulatory scope is expanding to encompass infrastructure and providers/operators of essential services. This is a trend which will continue, particularly with the increasingly connected nature of systems, data and services providers. As with any regulation, this will drive the behaviour of organisations to achieve compliance, as the potential financial and reputational consequences of not doing so can be significant.

Managing the consequences of an incident

The cascade of events and disruption following a cyber-incident can be far reaching; for example, the financial impact on some of the companies impacted by the Petya ransomware outbreak is in the hundreds of millions of dollars. The insurance market in this area has continued to evolve, particularly for those sectors where both IT & OT exposures exist.

Risk Transfer solutions

From a coverage perspective the insurance market draws a distinction between:

- Cyber-attacks leading to physical outcomes (e.g. property damage, bodily injury etc.). In this context, the insurance approach can vary from coverage being specifically excluded, specifically included or silent (i.e. neither specifically included or excluded).
- Cyber-attacks leading to non-physical outcomes (e.g. loss of data, network outages, extortion demands). The insurance market has developed broad stand-alone product offerings for these exposures some of which can include added access to added value services around incident response to support recovery post event.

Our 2017 Cyber Risk Employer Survey shows that nearly nine in ten companies have reviewed or will review their cyber insurance arrangements within the next two years, with a view to identifying gaps in existing insurance coverage. In addition 71% of respondents advised that they expect to enhance their insurance coverage within the next two years. The insurance market continues to develop its understanding of the cyber risk environment through the collection (and modelling) of more consistent data and this is driving a willingness to develop new products and services to keep pace with this evolving exposure.



What should organisations do?

To manage cyber risk effectively across the enterprise and ensure resilience, organizations need a fully integrated, comprehensive plan that emphasizes people, capital and technology protections. Understanding the risk exposure across both IT and OT and investing in the appropriate security is vital to remain ahead of the curve and prevent financial, reputational and intellectual property risk. In particular energy companies should remember:

- **Cyber security needs to be managed proactively** as a key part of overall operations; an organisation can't assume that its current cyber security policies and funding are adequate simply because they have not experienced a successful attack.
- **IT solutions can't be adopted and implemented in a vacuum.** People and technology need to have a symbiotic relationship to ensure cyber security is connected to the business and not simply a superficial wall surrounding an organization. Cyber risk is complicated; as such, the constantly evolving and dynamic environment demands agile solutions to combat new threats that many organizations may not be tracking.
- **People risks are the next frontier in cyber risk management.** Understanding that technology solutions are only as effective

as the people operating and managing those solutions is critical. Organisations need to engage with their IT department and uncover skills deficits and talent shortages in critical roles to ensure that talent strategies align with overall cyber-security objectives. By taking these steps, you can ultimately help improve your employees' "Cyber IQ", create a cyber-savvy workforce and ensure cyber resiliency across all levels of your organization.

- **Assume it's going to happen.** The notion that 'it won't happen to us' continues to be disproved, therefore preparation is key. When a cyber incident occurs, having a well-developed and well-rehearsed cyber incident response plan will be critical to ensuring a quick recovery, thereby mitigating the longer term financial, regulatory and reputational damage.
- **Transfer the risks you can't remove.** A robust cyber risk management programme will reduce the probability of an event occurring, but you can never fully eliminate the risk. Cyber insurance risk transfer solutions exist to mitigate the financial impact when things go wrong. As a starting point, check your existing insurance coverage; understand what cover you've got and what options are available.

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