

Renewable energy risk and reward

Executive summary

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Based at Imperial College London, this centre provides an interface between technology and policy and produces analysis and policy advice for governments, industry, NGOs and other stakeholders worldwide.

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Executive summary

Energy systems across the world are experiencing fundamental shifts, driven by climate change policies and rapid technological changes, as the global community seeks to achieve climate targets.

Over the past 10 years or so, the renewable energy sector has expanded to such an extent it now makes up the majority of new power capacity in many countries.

The major types of renewable energy (in order of most use) are hydropower, wind, bioenergy, solar, geothermal and ocean/marine. For all technologies, apart from hydropower, the potential output far exceeds current levels of energy generation. The potential also far exceeds global energy consumption, for solar in particular, and also for wind and ocean technologies, implying that renewable energy supply is constrained by practical social and economic conditions, rather than resource availability.

Unquestionably, the rapid growth in the renewables industry, the changing nature of risks in the sector and the fact that insurance is often a pre-requisite for securing project finance means there is a growing need for insurance.

Lloyd's series of three reports on renewable energy, published in association with researchers from Imperial College, London, analyses the implications of the changes to the energy generation landscape for insurers, risk managers and brokers.

1. The [Key trends and territories](#) report is an overview of energy market developments in the renewables sector, which outlines the prospects for renewables in general and details national developments.
2. The [Risks and technologies](#) report outlines the risks associated with a range of established and emerging renewable energy technologies and explains how Lloyd's is responding to them.
3. The [Integrating renewables into grids and the role of energy storage](#) report provides a deep dive into renewables integration and the development of energy storage technology.

All reports showcase Lloyd's risk transfer solutions in the renewable energy space.

Key trends

The reports show that renewable energy technology development is driven by four major trends:

1. Costs
2. Policy
3. Investments
4. Decentralisation

Costs

Between 2010 and 2017, some renewable energy technologies (notably solar and wind) have become cheaper. Average costs of solar PV have come down by about a factor of four while wind has seen a reduction in the price of turbines, which are more standardised, and the cost of electricity it generates. Other technologies have stayed the same or gone up in cost (e.g. hydro, biomass and geothermal). The extent to which past cost trends will continue is uncertain, and the report addresses this by looking at a range of different scenarios.

Policy

Renewable energy's development is driven by government policies. It is estimated by the International Energy Agency (2019) that 95% of utility-scale renewable power is commissioned through public tenders (such as auctions) or administrative mechanisms (such as feed-in tariffs or other subsidies). Projects commissioned solely on the basis of wholesale market pricing are relatively rare, partly because the upfront capital costs reduce the rates of return. As noted by Gatzert (2016), this reliance on public contracting exposes projects to the risk of policy changes that could affect their financial viability. This is exacerbated by the fact that insurance coverage for these types of projects tends to be limited. Policymakers are seeking to reduce this risk by putting in place reliable policy frameworks and not changing them. The key trends and territories report in this series, analyses these policy trends in more depth and looks at how they are affecting the industry in terms of risks and development.

Investment

Global investment in renewables worldwide (excluding hydropower) amounted to £280bn in 2017, the bulk of which was asset finance for new projects.

In 2018 China, US, Europe and India invested more than £230bn in new renewable energy (excluding hydropower). Of this total, £216m was invested in large grid-scale projects (equally split between wind and solar, with less than £10m in other technologies), and £49bn in small distributed-generation capacity (mostly solar).

Since 2016, total investment in the power sector has outstripped investment in the oil and gas sector for the first time in decades. Consequentially, this has helped drive the rapid development of renewable technologies, through standardisation in wind and solar, and economies of scale. Renewables are maturing as an industry and are beginning to compete with fossil fuels in some major territories.

This is driving demand for insurance products, since insurance is one of the pre-requisites for project finance.

Decentralisation

The growth of renewables has led to both an expansion of smaller scale generation, closer to demand, and to the growth of wind farms and other developments in remote locations (including offshore wind). Decentralisation has not occurred in the way that was predicted at the beginning of the expansion of wind and solar energy because they are more cost-effective when deployed at scale. Nevertheless, adding more renewable energy to the grid requires both upgrades to local networks and longer distance transmission to access remote energy generators to help balance the output variations from renewable suppliers. The third report, integrating renewables into grids and the role of energy storage, explores how renewables are being integrated into national grids and looks at the insurance implications of decentralisation for the renewables industry.

Growth areas

Solar PV

Solar photovoltaics (PV) dominates renewable capacity growth with an estimated 575 Gigawatts (GW) to become operational in the next five years. The average costs of solar PV have reduced by a factor of four over the past decade. Building integrated photovoltaic technology (BIPV) – where panels are incorporated into materials used for construction – presents a sizeable opportunity to disrupt the energy sector. The global BIPV market is growing rapidly. With an expected CAGR of 23.4% from 2018 to 2024, the market value is predicted to expand from \$6.7bn to \$32.2bn in 2024 (Energias Market Research, 2019).

A bill in California is coming into effect during 2020 that will mandate all new housing to include solar power systems (California Legislature, 2019). Solar PV technology is expected to continue to develop and the price is further expected to drop as economies of scale are reached in the coming decade. As this technology matures it will require insurance products to ensure related risks and potential losses are protected against. For example, there is also an emerging risk relating to the decommissioning and recycling of solar PV panels, with only EU regulation relating to this.

Energy storage

As the proportion of renewable energy on the grid increases rises, the power system needs to become more flexible to cope with the variability of supply this brings. Flexibility can be provided by energy storage, conventional power stations, interconnection with neighbouring systems and by making demand more responsive to changes in supply. In the short-term, storage is not essential to renewables integration and it is currently not cheaper than open-cycle gas-fired power plants or old hydro schemes.

Most storage schemes currently installed internationally are pumped hydro, a large scale and traditional storage option that has been installed by power companies for many decades. Globally a total of just over 176 GW of storage capacity was connected to electricity networks at the end of 2017 (IEA, 2018). Of this, in excess of 170 GW was pumped hydro, the 'traditional' form of energy storage often constructed by monopoly utilities. Batteries, compressed air and other non-pumped-hydro capacity amounted to around 4.5 GW at the end of 2017 (IEA, 2017). However, the need for storage is expected to grow significantly. International markets for storage technologies have seen strong growth in grid-connected batteries and the emergence of 'behind the meter' storage in homes and businesses.

Global capital spending on grid-scale battery storage increased by 30% in 2018 compared with 2017, totalling more than 1.2 GW installed in 2018. Deployment in Europe (particularly the UK) and the US comprised half of this 2018 investment, supported by capacity mechanisms and contracts (IEA, 2019).

Lithium-ion batteries have become the most popular battery technology for storing energy in the past decade, with an 85% reduction in price (Economist, 2019).

Risks range from catastrophic failure, where fires or toxins create environmental damage, to supply constraints for raw materials such as cobalt, which are key components of batteries. It is important that appropriate planning and production measures are in place when commissioning or insuring lithium-ion batteries.

Key risks

The reports identify and analyse six risk categories that affect renewable energy projects, and that risk managers and underwriters should monitor and work together to create new insurance products for.

Quality and contractors' risks

Rapid growth in the renewables industry means that supply chains, contractors and subcontractors are also having to expand rapidly, leading to supply bottlenecks for equipment, and a shortage in some markets of necessary skills and construction experience. Insurers are starting to see construction and new quality standard risks in both emerging and established markets (previously it was mainly in the former) due to the rapid expansion of the sector. It is also experiencing contractors' negligence losses in mature markets such as the US, Australia -and Western Europe. Subcontractors are currently insured under a 'all risks policy', but if they are further down the supply chain (tier 3 or 4), insurers might not know about them. In the future, as losses grow, insurers might start limiting coverage to include/exclude sub-contractors.

Technology and innovation risks

New types of equipment are being used in the renewable sector as it expands, which may have little historical performance data, making it harder for insurers to assess their reliability. At the same time, companies need insurance to support new technology so they can operate. It is essential, therefore, that insurers work with customers to understand the design and test history of the new technologies, and that customers share this information. Insurers could use higher deductibles to facilitate risk sharing in this phase of development. In the long run, these pressures should reduce as increasing quality becomes priced into the market, and the technology matures and becomes more widely used.

(Extreme) weather events

Recent analysis (Aon, 2019) indicates that total global economic losses from weather-related natural disasters in 2018 were \$225bn, close to the total average loss rate for the previous 10 years. Insurers are reporting an increase in losses from less severe weather-related perils that are not sufficiently large to result in big losses but that lead to insurance claims. These include storms, hailstones, high winds and flooding. Risks are exacerbated for renewable energy projects such as wind and solar, which require large land areas (relative to traditional energy projects), making renewables more exposed to weather-related risk. Projects are often more remote, with performance more dependent on local weather conditions. Insurers should ensure that they obtain appropriate data when providing cover for weather events to renewable energy projects.

Cyber risks

Cyber-attacks currently pose a low risk to the renewable energy sector but that is likely to change in the future. Tensions between the US and Russia leave the North American power sector particularly at risk (GCube, 2018). In 2019, the renewable industry witnessed cyber-attacks on Utah-based company sPower and Finnish company Norsk Hydro, with the latter incurring £45m in damages. In 2015, attacks on Ukrainian energy companies resulted in days of blackouts. The business interruption costs and reputational damage from cyber-attacks could be significant for both businesses and insurers. Insurers will have to move coverage for cyber-related events affecting renewable energy projects to stand-alone cyber policies, and ensure cyber covers are included, subject to meaningful additional premium and exposure information. Non-affirmative cyber (unknown exposures from cyber perils) will remain a very important topic that requires further thought by clients, brokers and insurance.

In the meantime, exclusion clauses could be added to policies that unintentionally suggest protection for undefined cyber risks (IUA, 2019) to help underwriters manage cyber losses and to help customers understand their exposure. More detailed analysis and examples of products relating to renewables can be found in the key risks and technology report in this series.

Political, policy and regulatory risks

Revenue for renewable projects is often set through policy or regulatory mechanisms such as feed-in tariffs or PPAs, or government-mandated auction processes. This means that prices and/or the amount of renewable electricity sold can be subject to relatively high levels of intervention by policymakers and regulators compared to other types of power generation. Changes to government policy and regulation can, therefore, create policy risks that include the stopping of subsidies or changes to tax relief. Future renewable market developments could mean increases in curtailment risk with renewables projects not being fully compensated for changes to funding mechanisms. Policy risk may therefore increase in the future (Gatzert 2016). The [Key trends and territories](#) report delves further into the risks faced here and potential insurance implications.

Supply chain risks

Supply chains are subject to several risks going beyond physical damage of components/ materials to include unplanned IT or telecommunications outage, cyber-attacks and data breach events, loss of talent/skills and outsourcer failure, and transport network disruptions (BCI, 2018). Supply chain risks tend to be more significant for more specialist sectors, which includes large renewables projects such as offshore wind. Losses may be particularly severe if they involve knock-on effects (i.e. where loss or damage to one component or part of a structure indirectly damages other structures, parts of structures, machines or equipment of the same type causing secondary losses).

Insurance coverage tends to manage this risk by limiting the degree of coverage for such knock-on losses. There will certainly be a growing demand for insurance products that protect against such risks in the renewable supply chain.

Regional trends

Asia has the lowest average costs across all renewable technologies. This is due to a mixture of excellent access to natural resource and lower than average installed costs, notably for solar PV and onshore wind in China and India, which dominate both equipment manufacturing and deployment in the region. These large regional markets have also led to the development of a particularly competitive engineering procurement and construction (EPC) market in these countries.

China leads global deployment of renewables and has the highest capacity worldwide. It accounted for just over 45% of the global total in investments of renewables during 2017. China alone accounts for almost 45% of global solar PV expansion (IEA, 2018a). Furthermore, China currently has the most lithium-refining plants.

Recognising the importance and development of the Chinese market, in 2019 China Re launched a renewable energy consortium within Lloyd's to provide reinsurance for the construction and operation of offshore windfarms around China. The consortium covers construction all risks, erection all risks and third-party liability, and has capacity of up to \$225m per risk. China Re is supported by Canopus, Travelers, Axis, GCube and Chaucer syndicates at Lloyd's. China will require more insurance protection as its renewable market develops further and is, therefore a potential growth market for insurers.

Renewable energy products at Lloyd's

As an insurance market, Lloyd's can provide access to the combined scale, expertise and capacity of expert renewable energy insurers in one place. It is this ability to create relevant and tailored insurance solutions from the diversity of the market that sets Lloyd's apart. The [Risks and technologies](#) and [Integrating renewables into grids and the role of energy storage](#) reports include examples of products already available in the Lloyd's market that are either directly related or can be applied to the renewable energy industry. These risk transfer solutions target a number of renewable energy technologies including battery storage, wind and solar power and mitigate a range of risks from cyber threats to technology and weather underperformance.

Areas of improvement

Lloyd's sees the renewable energy sector as a substantial business opportunity due to the future growth and maturation of the sector. To take advantage of these opportunities, the reports identifies the following four areas that insurers and businesses need to focus on:

1. Provide uniform and consistent data

The lack of information about equipment failure and losses that have taken place under warranty (e.g. multiple low-level incidents), as well as a lack of operating data, prevent underwriters from having a full understanding of the risks and from developing bespoke pricing. Brokers and customers could work more closely with insurers to provide standardised uniform data to improve the information they supply, leading to more precise pricing of the risks.

2. Engage early and continuously

Renewable energy developers and manufacturers should involve insurers at an earlier stage of projects so they can have a greater influence on the design and the operational risks that may be insured in the future.

3. Ensure greater transparency and boundaries

It is important to establish the balance of responsibility between developers, insurers, financiers, site owners, suppliers and contractors. Each party must be comfortable with any additional or amended obligations, allow for associated costs, and price services accordingly. Insurers and project developers also need to have a clear understanding of the risk consequences when equipment passes out of warranty. Customers need to understand the implications of projects being out of warranty (e.g. higher deductibles).

Energy markets are still evolving so the balance of risks has not yet settled down to a stable long-term pattern. Energy markets are still evolving to accommodate the influx of renewable energy, and the balance of risks across the energy market has not yet settled down to a stable long-term pattern. In this context, it is likely that the role of insurance, and the demand for different products will increase and evolve as the market develops and matures.

4. Improve preparation and risk mitigation

As the sector matures, developers, contractors, financiers, suppliers and site owners will need to move beyond the current single-minded focus on cost reduction to include project quality and reliability. This includes a need for better strategies for the management and mitigation of project risks.

Anecdotal evidence suggests that vulnerability to weather- events risks is increasing due to new projects being sited in sub-optimal, more exposed locations (e.g. on flood plains) because prime sites have already been used, especially in more mature markets. This results in projects being exposed to more losses and insurers having to carefully consider underwriting and premiums. Recent events combined with regulators' focus on climate change will prompt insurers to analyse risk exposures more thoroughly, considering not only exposure to potential property damage, but also to issues that could impact sites' accessibility, slow reconnection to the grid and site security expenses. Better understanding of losses will also result in better preparation and risk mitigation.

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